Maryia Rusak

FACTORY-MADE:
The Everyday Architecture of Moelven Brug, 1955-1973

While architectural histories of post-war Norway tend to focus on the work of select signature architects, the role of construction companies and industrial producers in shaping the built environment has remained largely overlooked. This PhD project aims to fill this gap by studying the prolific building output of Moelven Brug—a Norwegian timber prefabrication company that, between 1955 and 1973, built schools, large housing developments and public buildings across the country. Through the lens of a single company, the thesis explores the tripartite convergence between architectural discourse, pragmatic concerns of industrial production and bureaucratic institutions of the Norwegian welfare state. In doing so, the thesis ventures into the socio-economic "hinterlands," offering an architectural history of a different post-war Norwegian modernity created by construction companies, managers, engineers, contractors, state regulators, politicians, local planners and architects. Testing the limits of the discipline, this PhD proposes a new methodology to study architecture beyond the accepted canon, bringing forward names and projects that have hitherto been overlooked.

Maryia Rusak (1992) holds a BA in Architecture from Princeton University, USA and a MSc in Sustainable Urban Planning and Design from the KTH Royal Institute of Technology, Sweden. Prior to joining the AHO PhD program in 2018, she worked at SWECO Architects on large infrastructural and urban design projects in Sweden and abroad. During her doctoral research, she has been a research fellow at the Bauhaus Global Modernism Lab in Dessau (2020) and co-taught a Master's studio course on urban densification strategies through timber constructions (2021).

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Maryia Rusak

FACTORY-MADE:
The Everyday Architecture of Moelven Brug, 1955-1973

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LIST OF ABBREVIATIONS

AAB	Arbeiderbevegelsens Arkiv
AHO	Arkitektur- og designhøgskolen
AP	Arbeiderpartiet
CEN	The European Committee for Standardization
ECA	Economic Cooperation Administration
EEC	The European Economic Community
EDB	Elektronisk databehandling
EFTA	European Free Trade Association
EPA	European Productivity Agency
FPL	Forest Products Laboratory
FRS	Forsøksrådet for Skoleverket
HRTB	Arkitektkontoret Hultberg, Resen, Throne-Holst og Boguslawski
IRAS	Industriforbundets Rasjonaliseringskontor
ISO	International Standards Organisation
KUB	Komitéen for Undervisningsbygg
KUD	Kirke- og Undervisningsdepartementet
LO	Landsorganisasjonen
MSA	Mutual Security Organisation
NAF	Norsk Arbeidsgiverforening
NAL	Norske Arkitekters Landsforbund
NB	Nasjonalbiblioteket
NBBL	Norske Boligbyggelags Landsforbund
NBI	Norsk Byggforskningsinstitutt
NBR	Norsk Byggstandardiseringsrådet
NI	Norges Industriforbund
NLH	Norges landbrukshøyskole (contemporary NMBU)
NORAD	The Norwegian Agency for Development Cooperation
NPI	Norsk Produktivitets Institutt
NSF	Norsk Standardiseringsforbund
NTI	Norsk Treteknisk Institutt
NTH	Norges tekniske høgskole (contemporary NTNU)
NVE	Norges Vassdrags- og Energidirektorat

OBOS	Oslo Bolig og Sparelag
OECD	The Organisation for Economic Co-operation and Development
OEEC	Organisasjonen for europeisk økonomisk samarbeid (Norwegian for OECD)
PAGON	Progressive Architects Group Oslo Norway
RA	Ringsaker Almenning
RA	Riksarkivet
RH	Ringsakerhus
SAH	Statsarkivet i Hamar
SINTEF	Stiftelsen for Industriell og Teknisk Forskning
SHKS	Statens Håndverks- og Kunstindustriskole (contemporary AHO and KHiO)
STI	Statens Teknologiske Institutt
STUI	Statens ungdoms- og idrettskontor
USBL	Ungdommens Selvbyggerlag

“HOUSES MUST GO UP ALL OF A PIECE, MADE BY MACHINE TOOLS IN A FACTORY, ASSEMBLED AS FORD ASSEMBLES CARS, ON MOVING CONVEYOR BELTS.”[1]

1 Le Corbusier, quoted in Reyner Banham, *Theory and Design in the First Machine Age* (London: Architectural Press, 1960), 221.

INTRODUCTION

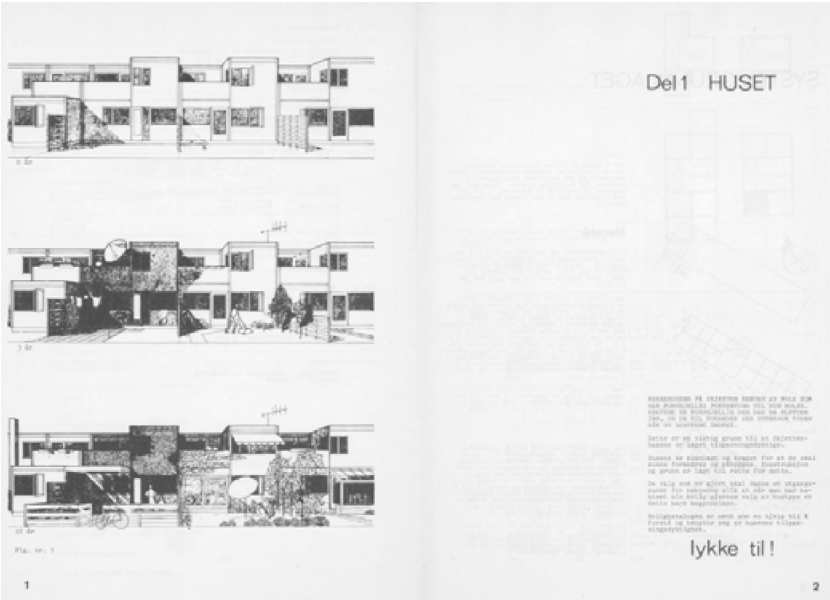

Fig. 1. Different spatial potentialities of Skjetten building system. The first spread from Skjetten house-manual, *Håndbok 2 etg rekkehus og hage: til og for folk i Skjettenbyen*.

“Where there’s a will there’s a detective story”—noted Carolyn Wells, a prolific American writer of hundreds of mystery novels. Indeed, what started out as a conventional PhD project quickly turned into a detective story. As I was working on my application for AHO PhD Fellowship on type and spatial form in 20th-century Scandinavian architecture, I stumbled upon a description of Skjetten housing project, completed in 1971-72 some 20 kilometres north-east of Oslo. Built with a system of prefabricated timber panels, the project offered not one but 3400 type variations and spatial forms for future dwellers to choose from.[2] Guided by a comprehensive user manual that included step-by-step instructions and even pre-filled building permit forms, Skjetten dwellers could adjust and modify their homes as their needs changed over time.[3] This late-1960s *tour de force* of flexibility and user participation, with factory-made houses accompanied by a neat set of IKEA-like instructions, gave a new direction to my search for reproduceable Scandinavian building types.

My interest in typological solutions was not new. Growing up in Minsk in a prefabricated apartment building (the “1-464” type-series, designed in 1958 by the Giprostroyindustriya Institute), I was fascinated with the grand project of industrially-produced housing built to the same standard across thousands of kilometres and climate zones. This interest found fertile academic ground during my studies at Princeton University, leading to an undergraduate thesis that explored how spatial constraints of standardised housing presupposed an ideal political subject, and the ways in which dwellers managed to appropriate or subvert this regulatory framework. Skjetten’s system of light timber panels was particularly fascinating to me, since it was so radically different from the rigid concrete prefabrication systems common in continental Europe and Eastern Bloc countries that left little to no space for individual expression and user participation. Instead, Skjetten seemed to offer a glimpse of hope, a specifically Norwegian reconciliation between the individual and the collective, pragmatism of construction and good architecture accessible to all. This accessibility—or so it seemed to me—was not only conditioned by the project’s design in itself, but indebted to the constructive system of light timber panels that made adjustments and modifications easy.[4] However, to my surprise, and despite the fact that the project is well-known in Norwegian architectural

2 Erik Hultberg, “Systemgrunnlaget for rekkehusene i Skjettenbyen,” *Byggekunst* 52, no.4 (1970): 147.
3 Margrethe Dobloug, “Håndbok 2 etg rekkehus og hage: til og for folk i Skjettenbyen” (I/S Skjettenprosjektering, 1972), 2.
4 Karl Otto Ellefsen discusses this quality of light prefabrication elements in “Homely Structures,” *Nordic Journal of Architecture* 2, no.1 (2012): 42-49.

historiography, nobody seemed to know exactly how it came about: references to its industrial origins were obscure at best and misleading at worst.[5] Thus, my detective work started: who produced and delivered the buildings that came with IKEA-like assembly instructions?

After searching through many volumes on Norwegian architectural history and theory, I emerged with a very loose thread: a note in the margins of Anne-Kristine Kronborg's book on the largest Oslo housing cooperative, OBOS, that briefly mentioned Skjetten in connection with another housing project in Furuset.[6] Both were built with prefabricated elements produced at the same factory: Ringsakerhus A/S, a joint industrial enterprise between OBOS and Moelven Brug. And so I went on in my search for other projects by Ringsakerhus and Moelven. To my surprise, I stumbled upon an unearthed wealth of buildings and even greater array of people connected with the industrial enterprise of Moelven Brug. A former sawmill some one hundred kilometres north of Oslo, in the post-war period Moelven turned to prefabrication, and developed a comprehensive building system suited for mass-production based on modular timber components. Skjetten was just one of the many projects by the company, that not only built housing, but delivered a wide range of typologies for everyday life across the country: from barns, industrial, storage and office buildings, to schools, sports halls, churches, swimming pools, hospitals and community buildings. The company fostered close relations with the institutions and decision-makers of the Norwegian welfare state, while its structures resulted from a collective effort of architects, engineers, managers, building researchers, productivity managers and state legislators. Moelven's system of modular prefabricated elements allowed it to reconcile variation and order, individual choice and rationality of technology, personalised object and the type. Moelven Brug was in that sense my perfect object of study: driven by pragmatism and technological processes, their prefabricated building system allowed their clients to customise and adapt standardised designs according to their needs.

While Moelven remains a household name in Norwegian homes—much like IKEA, Nokia and Siemens in other places—its built products have left nearly no mark in Norwegian architectural history.[7] Although I was surprised at first, I soon discovered that this was less of an exception but rather a common fate of industrially-produced buildings around

5 See, for example, an entire issue of *Nordic Journal of Architecture* 2, no.1 (2012) dedicated to Skjetten.
6 Anne-Kristine Kronborg, *OBOS: 100 borettslag 1929-2013* (Oslo: Press, 2014), 234–35.
7 Oddvar Hemsøe, *Moelven 1899-1999* (Moelv: Moelven industrier, 1999), 76. By the 1980s at least 85% of Norwegians could recall Moelven and had some knowledge about the company's products.

Fig. 2. “Shall the dwellers decide everything?” A cover of *Bonytt* article on Skjetten project and its development. From *Nye Bonytt* 31, no.7 (1971).

Fig. 3. Moelven St. Hanshaugen development in Haugerud, 1970s. From *Moelven Brug i forvandling og vekst: en jubileumskavalkade 1899-1974*.

the world. Over the course of the 20th century, architecture professionals have maintained a complicated relationship with prefabrication. On the one hand, several generations of architects—from Walter Gropius, Marcel Breuer, Konrad Wachsmann and Buckminster Fuller to Alvar Aalto, Jean Prouvé and Jørn Utzon—have been enchanted by the egalitarian promise of prefabrication, striving to reconcile rationality of means and architectural expression. On the other hand, faced with rigid production frameworks, concerns of profitability and cost, sophisticated architect-designed building systems have often been stripped bare of any aspirations of flexibility and change. As prefabrication became more common in the post-war period, according to architectural historian Gilbert Herbert, it lost its heroic appeal, as architects "soon discovered that there were greater satisfactions at the drawing board than in the market place."[8] Industrial building was left as a pragmatic instrument in the hands of cost-conscious developers and construction companies, while design decisions were relegated to production specialists, engineers, managers and accountants.[9] In this way, mass-produced post-war buildings, often considered anonymous "architecture without architects," rarely made it to the pages of architectural history books beyond surveys of social housing. Industrial producers, in turn, never quite managed to ignite the imagination of architectural historians. It is not surprising then that Moelven Brug, an industrial company that produced prefabricated buildings, did not make it to the pages of Norwegian architectural history books.

However, where else, if not in Norway, would an architectural history of a company that built for the "common people" find its home?[10] Post-war Norwegian architectural history is abundant with surveys of social housing, studies on cooperative construction and critical reports concerning the anthropology of the dwelling.[11] Many studies—like Tore Brantenberg's *Sosial boligbygging i Norge* or Jon Guttu's *Den gode boligen*—contextualise housing construction within a broader set of post-war social, political and economic developments.[12] At the same

8 Gilbert Herbert, *The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsmann* (Cambridge, Mass: MIT Press, 1984), 5–6.
9 Thomas Schmid and Carlo Testa, *Systems Building: An International Survey of Methods*, First Edition (London: Pall Mall Press, 1969), 39.
10 See a reference to "common" Moelven customers in *Hamar Arbeiderblad*, June 12, 1970, 14.
11 Ketil Moe and Johan-Ditlef Martens, *Hva er en god bolig: boligens utvikling i Norge fra 1650 til 2017*, *NFFO* (Oslo: Universitetsforl., 2018). Kurt Jørgensen, *Debatten om boligkvalitet og arbeidet med typetegninger* (Oslo: Husbanken, 1996). Johan-Ditlef Martens, *Norske boliger* (Oslo: Norsk arkitekturforl., 1993). Mette Sjølie et al., "Boliger for folk flest" (Oslo: Museet, 1996). Øystein Kock Johansen, *Å bo: II : Tradisjon og nyskapning*, vol. II (Oslo: Kagge, 2012). John Greve and Norges byggforskningsinstitutt, *Housing, Planning and Change in Norway*, Rapport 52 (Oslo: NBI, 1969).
12 Jon Guttu, "'Den gode boligen': fagfolks oppfatning av boligkvalitet gjennom 50 år" (PhD diss., Arkitekthøgskolen i Oslo, 2003).

Stovnerskogen STOVNER

FAKTA

Laget består av ni rekkehus med 80 leiligheter.

80 fireroms (94/103,6 m²)

Adresse:	Hagaveien
Grunnareal:	32.574,2 m²
Bebygd grunn:	4242 m²
Brutto gulvareal:	8960 m²
Boareal:	7386,4 m²
Byggekostnader	
pr. m² brutto gulvareal:	Kr. 1336,-
pr. m² boareal:	Kr. 1528,-
Leie pr. mnd. pr. m²	
v/innflytting:	Kr. 78,-
Innskudd:	Kr. 45.000,-/49.000,-
Innflytting:	Nov. 1973 - mai 1974
Arkitekt:	Abrahamsen, Grinde og Philip
Entreprenør:	Moderne Bygg A/S og A/S Ringsakerhus

Fig. 4. Ringsakerhus Stovnerskogen project literally on the margins of large housing survey books. From *OBOS: hus og hjem i 75 år*.

time, few, if any works look closely at the techniques and technologies of construction or investigate the building output of a single industrial producer. To me, this seemed like a missed opportunity, given that it was particularly in the post-war period that, as architectural historian Nicholas Bullock argues, private construction companies not only grew increasingly close with state actors as they delivered non-speculative building schemes, but were also forced to experiment with new building methods in order to keep the costs of these commissions low.[13] These new industrial building methods profoundly altered the roles of the major participants in a construction process—the client, the architect, the materials and components producer, the contractor and building labour, but these changes are little recorded in post-war Norwegian architectural history.[14] In other words, the history of post-war industrial construction in Norway remains to be written.

British historian Brian Finnimore argues that system building is a remarkable study object, since it amalgamates social theories, technological advancements and policy-making.[15] I want to extend this argument further, suggesting that construction companies—a definition that can include material producers, general contractors and real estate developers—also pose as remarkable study objects for a new type of architectural history, interested not just in products, but systems and processes. Approaching the company in its entirety allows me to enlarge the field of research, as called for by scholars like Timothy Hyde and the Aggregate Architectural History Collaborative engaged with investigations of "assemblages of thoughts and things."[16] And while a study of such scale required a merger between the methodological toolkits of architectural and construction histories, this merger allowed me to fill in the gaps left by narrow disciplinary approaches and examine a broad set of projects and actors that never made it into the canon. This thesis is not just the story of the company, then, but an architectural history of another post-war Norwegian modernity, as created by construction companies, local planners and architects, engineers, managers, contractors, researchers, material producers, state regulators, politicians and entrepreneurs.

13 Nicholas Bullock, *Building the Post-War World: Modern Architecture and Reconstruction in Britain* (London: Routledge, 2002), introduction, xi.
14 Brian Finnimore, *Houses from the Factory: System Building and the Welfare State 1942-74* (London: Rivers Oram Press, 1989), 2.
15 Finnimore, 1.
16 Timothy Hyde, "Is Architectural History Getting Any Bigger?," *Architectural Research Quarterly* 21, no. 4 (December 2017): 347–50, https://doi.org/10.1017/S1359135518000106. See a description of the Aggregate Collective and its umbrella of "systems" in http://www.we-aggregate.org/umbrella/systems, accessed March 1, 2022.

HISTORICAL CONTEXT

The story of this thesis unfolds in Norway in the middle of what is known as the thirty "golden" post-war years of the nearly-monolithic reign of the Norwegian Labour Party (AP).[17] The strict economic rationing and material shortage of the reconstruction period were largely over, and the social-democratic order was being gradually cemented: obligatory health insurance for all workers, pensions and child benefit, measures to ensure workers' safety, unemployment insurance and disability benefits were introduced in the late 1950s-early 1960s.[18] As the Norwegian state was heading for a large project of modernisation of all aspects of everyday life, this period, according to historian Thorvald Gran, brought a significant change from political organisation towards the institutionalisation of a new bureaucracy and led to an expansion of state apparatus and administrative instruments to all spheres of life.[19] These extended administrative networks relied on an unwavering belief in new technology, rationalisation, mechanisation, quantifiable variables, numeric models and scientific experiments. A new culture of expertise was emerging in which research institutions played a key role in supplying policy makers with hard evidence, and where engineers, architects and social scientists were introduced into the political realm. By the 1960s, the constitutional corporatism of the inter-war period was supplanted by what Norwegian historian Trond Bergh called a "network of more informal and hidden contacts."[20] No doubt, this spirit of modernisation, rationalisation and regulation with its new business models and scientific expertise, made its way into the building sector. With growing prosperity towards the 1960s, the country experienced rapid urbanisation, as numbers of urban and suburban dwellers rose three-fold in the post-war decades.[21] As the Norwegian state needed rational solutions to house its expanding functions and institutions, it turned to informal networks within the building sector. It was in this context that the industrial company Moelven Brug ventured into prefabrication as a solution for a wide range of building typologies.

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17 Although usually defined as a period between 1945 and 1980, the Labour party had an absolute parliament majority from the first post-war elections in 1945 to 1961, coming back with minority governments between 1963-1965 and 1972-1981. See, among others Knut Halvorsen and Steinar Stjernø, *Work, Oil and Welfare: The Welfare State in Norway* (Oslo: Universitetsforl., 2008), 20.

18 Berge Furre, *Norsk historie 1914-2000: industrisamfunnet - frå vokstervisse til framtidstvil* (Oslo: Samlaget, 2000), 162.

19 Thorvald Gran, *The State in the Modernization Process: The Case of Norway 1850-1970* (Oslo: Ad notam Gyldendal, 1994), 370.

20 Trond Bergh, *Storhetstid (1945-1965)* (Oslo: Tiden, 1987), 256.

21 Even Lange, *Samling om felles mål: 1935-1970*, *Aschehougs norgeshistorie* (Oslo: Aschehoug, 2005), 261.

Fig. 5. Moelven early sales catalogue featuring a timber wheel, 1912. From the National Library Archives.

Fig. 6. Moelven's "golden egg"—the first "house-on-wheels" produced by the company, 1950. Hedmark photo archive.

While Moelven's production closely followed the Norwegian urbanisation of the 1960s, its early history also paralleled Norway's modernisation. Located in Moelv some hundred kilometres north of Oslo in the first half of the 20th century Moelven Brug—literally the "sawmill of Moelv"—specialised in timber products: wooden barrels, furniture, carriages, sledges, equipment for agriculture and timber wheels.[22] Wheels were a Ringsaker regional speciality based on craft passed down through generations of carpenters, while materials came from nearby forests around Lake Mjøsa. In the early 1900s, Moelven briefly ventured into prefabricated houses built with a pre-cut method, an experiment that caused significant resistance from local carpenters, leaving the company to concentrate its efforts on furniture and equipment for agriculture.[23] In the post-WWII period with increased mechanisation of Norwegian agriculture, the company's timber products grew increasingly obsolete. Moelven's managing board was forced to reconsider the company's future, enlisting a rationalisation consultancy to modernise its production. In 1949 the board hired a new general manager Johannes Mageli, one of the first graduates of the new business school in Bergen, who became a crucial driver of Moelven's transformation. It was under his ardent initiative, extended business ties in the region, and prior experience with prefabrication that Moelven turned to structural elements made out of timber. From a modest commission for "houses-on-wheels" for Oslo municipality in 1951—*de facto* temporary barracks for construction and forestry workers—the company developed an entire eco-system of prefabricated flat timber elements, laminated beams, chipboard panels and other wooden products.

In the mid-1950s, Moelven Brug started to build storage and office buildings based on a system of prefabricated timber panels. Flat-packaged, cheap to produce and easy to assemble, these structures could be delivered to inaccessible places, closely following Norwegian industrialisation of the 1950s. Moelven's buildings housed workers at large infrastructural projects, new electric power stations, airports, weather stations as far as Svalbard, South Georgia and Queen Maud's Land.[24] In 1958, as new educational reform ushered an acute lack of

22 For an early history of the company see Trygve Dalseg, *Med Moelven-hjul på vei gjennom tiden: historien om Aktieselskabet Moelven Brug i de første 50 år, 1899-1949* (Moelv: Moelven Brug, 1966). More on Moelven Brug products see catalogues at the Nasjonalbiblioteket archive, Oslo, Norway.

23 Dalseg, *Med Moelven-hjul,* 48–54. Among the first prefabricated structures, Moelven built "Doktorgården"—a house for Dr. E. Wergeland, a house for sisters Hjelt that came from the US, as well as a pharmacy at Tynset, an Augedal Bros hotel at Brandbu and houses in Hamar. For a similar developmental arc of a sawmill that successfully engaged with early pre-cut prefabrication see Kari Amundsen, *Complet færdige Huse: Strømmen trævarefabrik - ferdighusproduksjon 1884-1929* (Oslo: Bonytt, 2002).

24 Trygve Dalseg, *Moelven Brug i forvandling og vekst: en jubileumskavalkade 1899-1974* (Moelv: Moelven Brug, 1974), 41–44.

Fig. 7. Moelven's "houses-on-wheels" were used for temporary worker's housing in remote places, for example in forestry works or construction sites. To the right, a brochure suggesting these houses could be used as winter cabins. Moelven marketing catalogues, the National Library Archives.

Fig. 8. With time,"houses-on-wheels" were adapted as summer cabins. Moelven catalogue, 1955, the National Library Archives.

classroom space, Moelven adapted its system of prefabricated elements for schools and kindergartens, producing more than 12.000 m2 of built schools space per year. By the mid-1960s, as housing provision became a kernel of political competition, Moelven developed two technologically sophisticated house-building factories. Ringsakerhus A/S established together with OBOS—the largest Oslo housing cooperative—delivered large timber panels, primarily used in large low-rise high-density housing developments. The second “section-house” factory, Mobruk, produced more conventional single-family house units with a prefabrication grade of up to 95%, sold to individual consumers. In its operations, the company managed to realise the modernist dream of a factory-built house assembled on a conveyor line.[25] In parallel, the company developed technologies of lamination, building large representative buildings—churches, swimming pools, sports halls, assembly places—in structural timber all across the country. Although this study does not encompass all of Moelven’s production—the factory maintained a significant mechanical department that produced heavy machinery that only marginally figures in this thesis—the three main typologies of schools, housing and public buildings provide the backbone structure and material for this inquiry.

MAIN LINES OF INQUIRY

This thesis investigates the products and processes of a single industrial producer—Moelven Brug. In order to grapple with diverse aspects of its operations, the thesis is structured around three main lines of inquiry: first, the techniques and technologies of Moelven's production; second, the company’s relationship with state officials and decision-makers; and third, the way the company’s products fit within a broader professional architectural discourse and were incorporated by different architects into their work. Each of the thesis’ chapters addresses all three of these questions.

First and foremost, the thesis is interested in the industrial and technological part of the story: what happens when the process of building is transferred entirely to a factory, approximating that of a car assembly? In what way did new techniques and technologies, often imported from abroad, change and challenge the process of construction? In its production, Moelven managed to realise what generations of architects

25 Le Corbusier quote on houses produced at the factory in Reyner Banham, *Theory and Design in the First Machine Age* (London: Architectural Press, 1960), 221.

“suffering from the bouts of the Henry Ford syndrome,” as Gilbert Herbert puts it, had dreamed of: a mass-produced, standardised, low-cost single family house.[26] Flat-roofed, with simple rectangular shapes, Moelven houses reflected both the technological conditions of their production and still-prevalent modernist aesthetics. While Moelven was not the only company that engaged with timber prefabrication at the time—or, for that matter, prefabrication in Norway— its elaborate production apparatus distinguished the company from its competitors—for example, Block Watne or Systemhus.[27] Moelven's vertically integrated in-house production cycle that accounted for all aspects—from material sourcing to on-site delivery—had no analogues either in the Norwegian or the European context. A variety of actors, from engineers to managers, calculators and production specialists, influenced Moelven products beyond the architects’ drawing board, while the company’s pursuit of mechanisation was quantified and communicated in percentages of prefabrication. Moelven engineers went abroad to study new techniques and technologies and developed close partnerships with similar industrial actors in other countries, while local research institutes provided the company with the most recent know-how and local adaptations of foreign expertise. Thus, studying Moelven processes and products allows a new insight into how the process of construction changed when buildings were conceived of as technologically-driven industrial products.

Second, the thesis is interested in networks of political actors, state decision-makers, regulatory bodies and research institutions that conditioned both the appearance and performance of Moelven’s buildings. The company’s production responded to the rapid urbanisation and sub-urbanisation of Norwegian towns that needed new schools, affordable housing and sports facilities.[28] If these buildings could be delivered with reasonable quality and within a set time-framework and budgets, both local politicians, building committees and private contractors earned extra points.[29] With new industrial methods, Moelven could meet these constraints of cost and time and grew firmly embedded within this intricate network of state contracts for non-commercial

26 Gilbert Herbert, *The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsmann* (Cambridge, Mass: MIT Press, 1984), 3–4. Also see David Gartman, *From Autos to Architecture: Fordism and Architectural Aesthetics in the Twentieth Century* (New York: Princeton Architectural Press, 2009).

27 On Moelven competitors see Hild Sørby, *Klar - ferdig - hus: norske ferdighus gjennom tidene* (Oslo: Ad Notam Gyldendal, 1992), 84–102.

28 For a discussion on the “pillars” of the welfare state see Ulf Torgersen, “Housing: The Wobbly Pillar under the Welfare State,” *Scandinavian Housing and Planning Research* 4, no. 1 (January 1987): 116-126.

29 Andrew Saint talks about similar processes in *Towards a Social Architecture: The Role of School-building in Post-war England* (Yale University Press, 1987). Also see C. G. Powell, *An Economic History of the British Building Industry 1815-1979* (London: The Architectural Press, 1980), 152–54.

construction. To maintain this position, Moelven's entire production apparatus and product planning had to be adapted to the fluctuations of state policies and regulations, while its structural designs were subjugated to the spatial prescriptions of a plethora of regulatory bodies that measured, limited and supervised the construction of everyday spaces. Thus, similar to the way architectural historians Erik Stenberg and Erik Sigge argue that post-war Swedish housing programmes cannot not be understood without tapping into the depth of *Harpsundsdemokratin*—an informal corporatist structure between state and business actors—Moelven's projects cannot be fully understood without tapping into vast networks of state and regulatory actors engaged in their production.[30] One of the goals of this research is to unearth this wealth of business, social and political connections that allowed a Hedmark-based business to significantly shape the built environment across the country. Neither a history of the architecture of the welfare state, nor a history of capitalism under a social-democratic regime, this is an investigation into the way larger entities, research institutions, regulatory bodies and political actors affect the way we build.

Lastly, although Moelven Brug was an industrial company whose legacy remains largely unrecorded in architectural history, its works and processes were closely intertwined with architectural discourse. The company collaborated with a number of architects, including Paul Cappelen and Torbjørn Rodahl and Hultberg, Resen, Throne-Holst and Bogulsawski (HRTB) partnership, and employed the architectural office of Hans Grinde, Helge Abrahamsen and René Philipp to carry out most of the in-house design tasks. The Ringsakerhus factory was behind the construction of the most famous Norwegian low-rise high-density flexible housing project—Skjettenbyen—and offered a peculiarly-Norwegian alternative to the heavy prefabrication of mass-housing developments of post-war Europe. In addition, Moelven brought back the technology of laminated timber to Norway (non-existent since Guttorm Brekke's factory in Mysen burned down in 1924), which allowed the use of exposed load-bearing timber in numerous architectural projects.[31] Not least, Moelven's laminated beams have been used by Sverre Fehn in the Domkirkeodden museum and later for Oslo Gardermoen Airport,

30 Harpsund refers to a private mansion, where the Swedish government held meetings with different representatives of trade and industry. See note 10 in Helena Mattsson, "Where the motorways meet: architecture and corporatism in Sweden 1968," in *Architecture and the Welfare State*, ed. Swenarton, Avermaete, and Heuvel, 173.

31 More on the early history of glued laminated timber in Norway see Chapter 5; briefly in Nils Ivar Bovim and Haumann Sund, *Limtreboken*, 2. utg. (Moelv: Moelven limtre, 1977), 8.

heralding an updated Norwegian tradition for building with timber. Moelven's prefabricated timber schools, in turn, provided a Norwegian counterpart to the better-known European experiments with modular school construction in the post-war period. And while the Moelven Brug industrial buildings have long escaped the pages of architectural history books, situating Moelven's production within a broader architectural discourse allows me to reconsider the value of its industrial architecture and enrich Norwegian architectural history of the 1960s. This study hopes to complicate the narrative of imposed separation between "good" architecture and "bad" prefabrication, and show that in fact, many architects were interested in industrial production and successfully collaborated with industrial producers across the aisle.

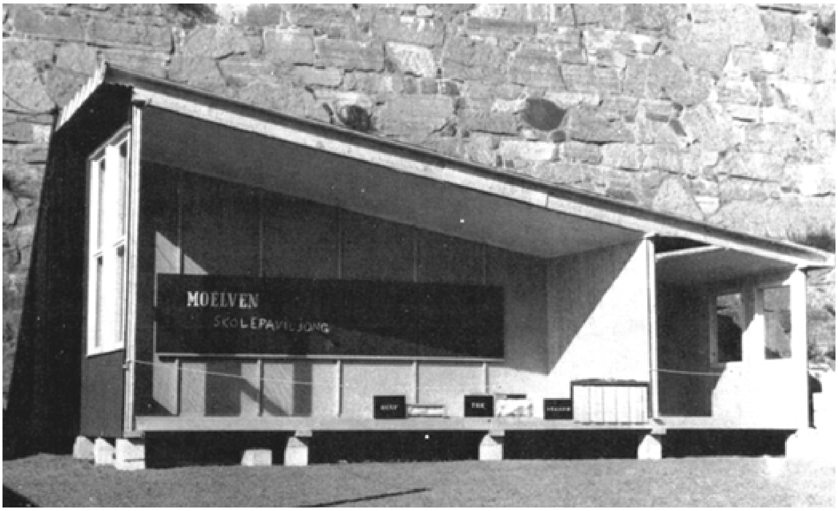
Overall, this thesis belongs to a genealogy of works that are less interested in what the architecture wishes to be (i.e. its semantics), and more in the economic and political realities that conditioned its production and appearance.[32] As Manfredo Tafuri explained, "to discover the secret of a magician's tricks, it is far better to observe him from backstage than to continue to stare at him from a seat in the orchestra," urging architectural scholars to consider the entire production cycle of architecture.[33] In order to do so, the thesis draws on a framework of construction history that has long been looking at architecture from the backstage. In 2006, architectural historian Antoine Picon argued that construction history is situated at a strategic mid-point between cultural history and the history of technology.[34] Few scholars have actually utilised this advantage, however, and most works in construction history tend to focus on select technical aspects of structural design.[35] This thesis strives to correct this shortcoming by venturing into both cultural and building history, all through the investigation of the building output

32 For works that operate among similar lines see Patrick Dunleavy, *The politics of mass housing in Britain, 1945-1975: a study of corporate power and professional influence in the welfare state* (Oxford: Clarendon Press, 1981). Barry Russell, *Building Systems, Industrialization, and Architecture* (London: Wiley, 1981). Herbert, *The Dream of the Factory-Made House*. Christine Wall, *An Architecture of Parts: Architects, Building Workers and Industrialization in Britain 1940-1970* (London: Routledge, Taylor & Francis Group, 2013).

33 Tafuri in *Architecture Theory Since 1968*, 165.

34 Antoine Picon, "Construction History: Between Technological and Cultural History," *Construction History* 21 (2005-6): 11-23.

35 See, for example a full list of publications in *Construction History* journal https://www.constructionhistory.co.uk/wp-content/uploads/2014/09/CHS-Journal-contents-list.pdf, accessed February 16, 2022. Quite surprisingly, studies of individual building firms appeared in the early issues of *Construction History*, an interest that soon died down. See T.F.M. Hinchcliffe, "In Pursuit of Construction History: Historical Material Held by Building Firms," *Construction History* 1 (1985): 6–12. Brian Finnimore, "The A.I.R.O.H. House: Industrial Diversification and State Building Policy," *Construction History* 1 (1985): 60–71. Iain Russell, "Researching a Company History: The McAlpine Project," *Construction History* 2 (1986): 68–75. Joseph Abram, "An Unusual Organisation of Production: The Building Firm of the Perret Brothers, 1897-1954," *Construction History* 3 (1987): 75–93.



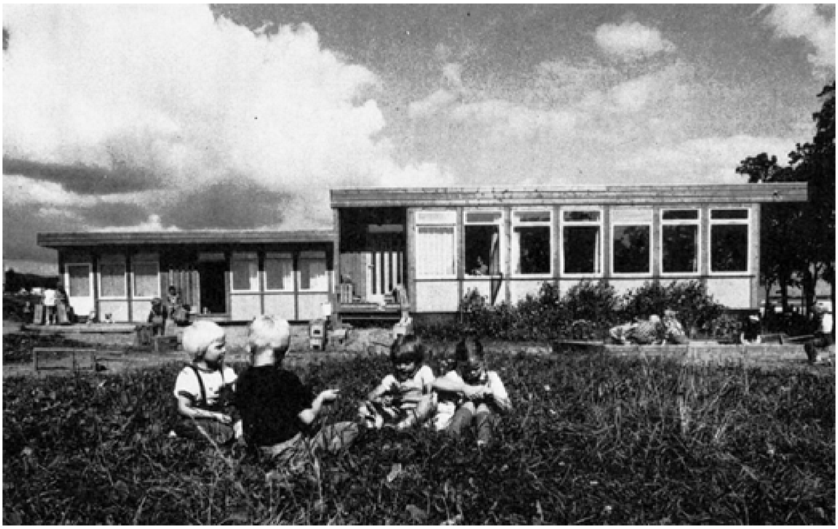


Fig. 9. The production of prefabricated elements was adapted for schools and kindergardens, built with a flat roof to simplify the construction. Above, a cross-section of the prefabricated school pavilion at *Bygg reis deg* exhibition in Oslo, 1958. Below, a kindergarden at Blindern, Oslo, 1958. From *Moelven Brug i forvandling og vekst*.

of a single industrial company.[36] In so doing, the thesis concentrates its inquiry on what John Summerson called the "lost tribe"— building firms and contractors.[37] The history of a single firm allows the researcher to examine the total process of getting a building up on site, including the recruitment of labour, selection of materials and equipment, aspects of production and transport, relations with contractors, methods of payment, and so on.[38] Thus, this thesis ventures into what Summerson referred to as the "the social, economic and industrial hinterland," constructing a "backstage" architectural history of post-war Norwegian modernity, concerned with industrial processes, products and technologies.

Two additional threads run through the entire study. Firstly, an interest in interconnected webs of actors and ideas, revealed when zooming in on a particular "everyday" building project. This approach is similar to the one taken in the book *Neoliberalism on the Ground* that, as the volume editors Kenny Cupers, Cathatrina Gabrielsson and Helena Mattsson argue, aims to demonstrate "the many ways in which the concrete everyday is connected to some abstract economic theories and policies that have reshaped the world."[39] Although "everyday" is a complex term that has been thoroughly scrutinised by philosophers and architects alike, in this study it denotes ordinary building typologies—housing, schools, barns, churches and sports halls—that upon a closer inquiry reveal a wealth of often interrelated theories, people and ideas.[40] The second thread is the transfer of ideas across geographical and social contexts. Although Norway borrowed many organisational and technological models from abroad in the post-war period, initiating what economic historians Amdam and Yttri called "Americanisation by invitation," these models were not applied directly.[41] Instead, as Norwegian scholars that study knowledge-transfer emphasise, new

36 John Summerson, "What is the history of construction?", *Construction History* 1 (1985): 1-2.

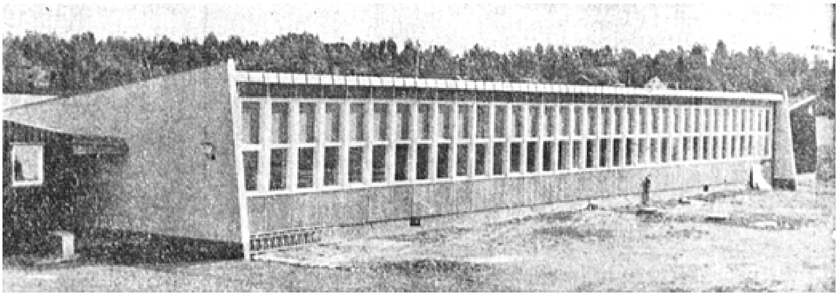
37 C. G. Powell, "Case Studies and Lost Tribes: The Bristol Firm of James Diment and Stephens, Bastow & Co," *Construction History* 1 (1985): 25–35. John Summerson, *The London Building World of the Eighteen-Sixties*, vol. 5, Walter Neurath Memorial Lectures (London: Thames and Hudson, 1973), 11.

38 Summerson, "What is the history of construction?", 1-2.

39 Kenny Cupers, Helena Mattsson, and Catharina Gabrielsson, *Neoliberalism on the Ground: Architecture and Transformation from the 1960s to the Present*, Culture, Politics, and the Built Environment (Pittsburgh, Pa: University of Pittsburgh Press, 2020), 5.

40 See, for example, Deborah Berke and Steven Harris, *Architecture of the Everyday* (New York: Princeton Architectural Press, 1997), http://ebookcentral.proquest.com/lib/ahono/detail.action?docID=3387372. Sarah Wigglesworth and Jeremy Till, *The Everyday and Architecture* 134, Architectural Design Profile (London: Academy Editions, 1998). Mary McLeod, "Everyday and 'Other' Spaces," in *Architecture and Feminism,* ed. Debra Coleman, Elizabeth Danze and Carol Henderson (New York: Princeton Architectural Press, 1996.) Michel de Certeau, *The Practice of Everyday Life* (University of California Press, 1984).

41 Rolv Petter Amdam and Gunnar Yttri, "The European Productivity Agency, the Norwegian Productivity Institute and the Management Education," in *Missionaries and Managers: American Influences on European Management Education, 1945-60,* ed. Terry Gourvish and Nick Tiratsoo (Manchester: Manchester University Press, 1998), 9.



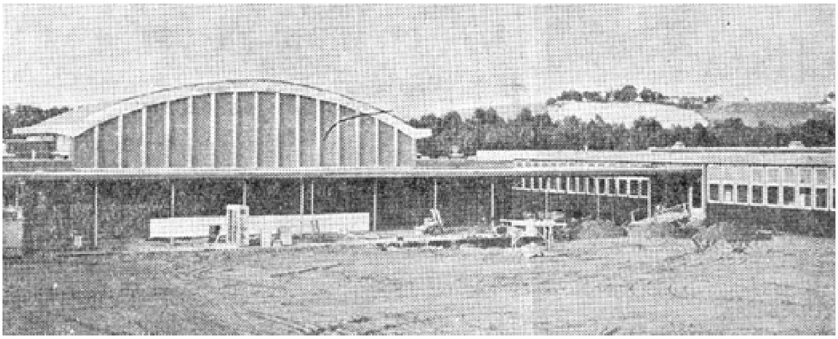


Fig. 10. Prefabricated schools soon became one of the company's main products. Above, Fredheim school built in 1959. Below, Kjellervolla school built in 1964. Newspaper clippings.

ideas were often adapted to already-existing local practices, producing curious hybrids.[42] It is in this process of "accretion," as social scientist Kerstin Sahlin-Andersson argues that specific cultural values crystallise.[43] By studying how Moelven adapted techniques and technologies from abroad, it is possible to distinguish the existing social institutions and values that modified these technologies into unique socio-technological hybrids. Equipped with this multi-lateral theoretical framework, the thesis aims to show that the business of producing architecture is far more complex than what it may seem on the pages of architectural magazines.

42 See, for example Rolv Petter Amdam and Knut Sogner, "The Diffusion of American Organisational Models to Norwegian Industries, 1945-1970," in *Americanisation in 20th Century Europe: Business, Culture, Politics. Volume 2,* ed. Matthias Kipping and Nick Tiratsoo (Lille: Publications de l'Institut de recherches historiques du Septentrion, 2018), 204.

43 Kerstin Sahlin-Andersson in *Translating Organizational Change*, eds. Barbara Czarniawska-Joerges and Guje Sevón (Walter de Gruyter, 1996), 83.

LITERATURE REVIEW

MOELVEN BRUG

Despite a prominent building output, Moelven Brug remains largely overlooked in both historical and architectural literature. In addition to three hagiographic publications commemorating Moelven anniversaries—50, 75 and 100 years—and a transcript of Mageli's lecture as a part of the NTH Kristofer Lehmkuhl lecture series in 1977, the only academic work on Moelven Brug by social geographer Asbjørn Karlsen deals with the company's economic restructuring processes.[44] In the study, Karlsen relied mainly on secondary sources without studying the company's archives, a suit followed by a short economic inquiry into Moelven's business with Russia in the 1990s.[45] Largely absent in academic works, Moelven makes a brief appearance in local history books, for example, *Moelvboka: modalshistorie i tekst og bilder, Storkommunen: Ringsaker,* or *Moelv—fra ødemark til by*.[46] In fact, it is in these regional ethnographic works written by historical societies and local enthusiasts that the importance of the company for regional development shines through.[47] Some of them—for example, Magne Antonsen's *75 år med Moelven-klubben i medgang og motgang: 1913-1988*—cut across different disciplines and venture into other domains, for example industrial or labour history.[48] The majority of these works are rather descriptive in nature, however, offering little to no critical insight and deal with Moelven only as a single thread within the larger story of regional development.

In architectural history, on the other hand, the history of Moelven and its role in post-war development are virtually non-existent. In *Byggekunst*—the main architectural magazine in Norway—the company

44 Three company's publications in chronological order: Dalseg, *Med Moelven-hjul på vei gjennom tiden*. Dalseg, *Moelven Brug i forvandling og vekst*. Moelven industrier et al., *Moelven 1899-1999*, *Norbok* (Moelv: Moelven industrier, 1999). For Mageli's lecture see Johs Mageli, *A/S Moelven brug: karakteristika og synspunkter*, Kristofer Lehmkuhl forelesning 1977 (Bergen: Norges handelshøyskole, 1977). NF-report no.14/94 see Asbjørn Karlsen, "Fra håndverk til masseproduksjon: en studie av omstillinger ved Moelven Brug" (Report, Nordlandsforskning, 1994). Asbjørn Karlsen, *Institusjonelle perspektiver på næringsomstilling*, *Norbok* (Trondheim: Norges teknisk-naturvitenskapelige universitet, Fakultet for samfunnsvitenskap og teknologiledelse, Geografisk institutt, 1999). Asbjørn Karlsen, *En utlegning om institusjonelle perspektiver: sammendrag fra dr. polit. avhandling* (Bodø: Nordlandsforskning, 1999).

45 Tore Karlsen, "Inward-Outward Connections in the Internationalization Process of the Firm: A Case Study of Moelven Industrier in Russia" (MSc. thesis, Handelshøyskolen BI, 1999).

46 See for example, Ove Johansen, *Moelvboka: modalshistorie i tekst og bilder*, *Norbok* (Moelv: Moelvboka v/styret, 1986). Ola Alsvik and Jan Haug, *Storkommunen: Ringsaker* (Brumunddal: Brøttum historielag, 2006). Ola Alsvik et al., *I krig og fred*, *Ringsakboka* (Brumunddal: Brøttum historielag, 2001), among others.

47 The role of local historical collectives in preserving the history of the company becomes apparent when comparing a local wiki page dedicated to Moelven (far more detailed) against a general Wikipedia entry. See https://lokalhistoriewiki.no/wiki/Moelven_Brug; https://no.wikipedia.org/wiki/Moelven_Industrier. Accessed April 10, 2022.

48 Magne Antonsen, *75 år med Moelven-klubben i medgang og motgang: 1913-1988* (Moelv: Bedriftsklubben Moelven, 1988).

appears only in episodic advertisements of laminated timber and occasional mentions in the lists of contractors and material producers.[49] The only *Byggekunst* article that featured Moelven buildings dates to an issue from 1973, dedicated to industrial housing.[50] In a more interior-design oriented magazine *Nye Bonytt* Moelven appears once in a volume from 1969 that presented different types of ready-made houses.[51] The only two works that come close to offering an architectural analysis of Moelven buildings are a 2007 master's thesis that briefly discusses Moelven's prefabricated "Senior"-type house exhibited in Maihaugen open-air museum in Lillehammer, and a book on Norwegian timber prefabricated houses *Klar- ferdig- Hus,* by art historian Hild Sørby.[52] In both works, Moelven figures only marginally. Sørby is mostly preoccupied with a comparative reading of ready-made houses' aesthetics and its evolution over time, while the company and its prefabricated buildings are discussed only briefly among products of multiple other entrepreneurs. Architectural historians writing about Moelven projects—for example, Skjettenbyen, the only project that made it to the "high" architectural canon—often don't discuss its industrial origin, elusively referring to it as a generic "wood-based prefabrication system."[53] Symptomatically, in the "blue" 2012 issue of the *Nordic Journal of Architecture* dedicated to the Skjetten project, the only author that mentions Ringsakerhus—the Moelven timber-panels factory—is Gunnulv Eiesland, a civil engineer who worked on the project.[54] Overall, Moelven features, quite literally, only on the margins of already-niche histories of everyday architecture, for example Anne-Kristine Kronborg's studies of OBOS housing projects.[55] In survey books on 20th-century architectural history in Norway, the company does not even make it to footnotes.[56]

49 Ads for Moelven laminated products were featured in nearly every issue of *Byggekunst* between 1963-1968.
50 See "Seksjonshus fra A/S Moelven Brug," *Byggekunst* 55, no.2 (1973): 48-49.
51 *Nye bonytt:norsk spesialblad for hus, hjem og boliginnredning* 29, no. 2 (1969): 3–9. In fact, Moelven also appears in a book by *Bonytt* which serves more as an annotated listing of different prefabricated house types. See Willy Sveen and Bonytt, *Bonytt typehus og ferdighus 1: råd om valg, økonomi, huskritikk* (Bonytt, 1971).
52 See Stine Hoel, "Samtidens bolig på museum: en studie av Norsk Folkemuseums utstilling 'Bonytthjemmet 1979', og Maihaugens utstilling '1974 Moelven Senior'" (Master thesis, UiO, 2007). Sørby, *Klar - ferdig - hus*.
53 See Karl Otto Ellefsen, "Homely Structures," 44-48.
54 Gunnulv Eiesland, "New Forms of Collaborations. The Skjetten Experience," *Nordic Journal of Architecture* 2, no.1 (2012): 39.
55 Literally see text on the margins in Kronborg, *OBOS*, 182–85. Also 204-207; 232-235.
56 Moelven is absent in books like Arne Gunnarsjaa, *Norges arkitekturhistorie* (Oslo: Abstrakt, 2006). Nils Georg Brekke, Per Jonas Nordhagen, and Siri Skjold Lexau, *Norsk arkitekturhistorie: frå steinalder og bronsealder til det 21. hundreåret*, Samlagets bøker for høgare utdanning (Oslo: Samlaget, 2003). Odd Brochmann and Odd Brochmann, *Bygget i Norge: en arkitekturhistorisk beretning. B. 2*, *Bygget i Norge* (Oslo: Gyldendal, 1981).

Fig. 11. Over time, prefabrication technology was expanded to deliver different types of public buildings. Above, an photo of a post-office built from Moelven prefabricated elements. Below, a pavilion for a hospital in Lillehammer. Newspaper clippings, 1960.

This historiographical absence of a company that claimed to build for the "ordinary people" is surprising, considering the abundance of studies on everyday building typologies. From the 1930s PLAN magazine discussions on housing provision and post-war debates on the economy of construction, to new urbanisation models of the 1960s and critical reports on the anthropology of the dwelling that emerged towards the 1970s, housing, its standards, spatial qualities and provision, have been at the centre of Norwegian architectural discourse.[57] However, the role of industrial actors in shaping these everyday environments still remains overlooked. This amnesia testifies to two aspects: first, it shows how little architectural historians still engage with the realities of the architectural production, industrial companies, people, materials and machines behind projects' materialisation. Second, specific to a Norwegian context, this absence can be explained by the fact that industrial, mass-produced architecture never quite came in vogue in Norway. Although the post-war generation of Norwegian modernists like the PAGON group was fascinated by mass production and modular systems, the Norwegian building industry lacked the capacity and technology to enact these lofty visions.[58] By the time technological development caught up, prefabrication and modular coordination had lost the heroic appeal of the post-war years, and were increasingly associated with standardised high-rise flats and growing urban monotony. If Norwegian architects were to engage with prefabrication, it was to break the mindless mediocrity bred by industrial producers and harness prefabrication for individual expression. Industrial producers—like Moelven Brug—were more often than not associated with the former. By the 1980s, according to Hild Sørby, for Norwegian architects to work with prefabricated firms "became nearly compromising."[59]

Although the fashion to castigate mass-produced timber houses might have come in later, "good" Norwegian architecture had always been associated with the tailor-made, site-specific and material-con-

57 For a sample selection see Johan-Ditlef Martens and Ketil Moe, *Plan 1933-36: tidsskrift for bolig- og byggespørsmål* (Oslo: Universitetsforlaget, 1983). Anne Sæterdal and Thorbjørn Hansen, *Ammerud 1: planlegging av en ny bydel*, *Norbok*, Rapport (Norges byggforskningsinstitutt : trykt utg.) 58 (Oslo: Norges byggforskningsinstitutt, 1969). Iver Tore Svenning and OBOS, *Hvordan vi bor i Oslo og OBOS: OBOS-undersøkelsen 1971 : resultater og kommentarer*, *Norbok* (Oslo: Tiden, 1972). Odd Brochmann and Odd Brochmann, *Bygget i Norge: en arkitekturhistorisk beretning. B. 2*, *Bygget i Norge* (Oslo: Gyldendal, 1979-1981, 1981). Karl Otto Ellefsen, Tarald Lundevall, and Vesterålen interkommunale plankontor, *Generalplanlegging: spredt boligbygging* (Oslo: Miljverndepartementet, 1983). Mette Sjølie and Norsk arkitekturmuseum, "Sosial boligbygging i Norge 1945-1980: forskning om bygningsvern og utviklingsplanlegging" (Norsk arkitekturmuseum, 1989). Tore Brantenberg and Husbanken, *Sosial boligbygging i Norge 1740-1990: fra arbeiderbolig til husbankhus*, *Norbok* (Oslo: Ad notam Gyldendal, 1996).

58 *Byggekunst* 32, no.6/7 (1953) dedicated specifically to CIAM and PAGON. In particular, see Arne Korsmo's "Hjemmets Mekano," 110-113.

59 Sørby, *Klar - ferdig - hus*, 142.

scious.[60] Prefabricated houses—if not exactly "soulless," "scandalous" and "degenerative," as described later—were most definitely reproduceable and not site-specific.[61] As Mageli, Moelven's general manager, bitterly noted in a 1960 interview: "we have been often met with a very negative attitude and resistance to everything that is built at the factory [...] it is common to believe that everything that is made by hand would be much better."[62] The Norwegian architectural establishment, by and large, did not consider Moelven buildings "architecture," as the company's products were associated with workers' housing, temporary barracks, cheap catalogue homes and overall poor construction quality.[63] The roots of this uneasy relationship between cultural establishment and mass-production can be traced back to the immediate post-war period when, as Norwegian design historian Kjetil Fallan argues: "more often than not, industrial mass-production had been portrayed as an evil force vulgarizing material culture."[64] It is not surprising, then, that industrial architecture produced at a factory with machinic tools had not quite made it to the Norwegian architectural canon.

This thesis proposes to fill what I consider to be a significant gap in existing post-war Norwegian architectural historiography, or, more precisely, to correct a blind spot regarding industrial, mass-produced architecture. This work aims to go beyond the dichotomy between "good" and "bad" architecture, writing an architectural history of Moelven's industrial production (an undertaking controversial in its premise for any Norwegian architect familiar with the unspoken place of Moelven in the popular cultural imaginary). In this ambition, the thesis is inspired by the recent disciplinary establishment of design history in Norway and abroad that has managed to expand the subject-matter of conven-

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60 See, for example, a chapter "The Mutable and the Eternal" in Nils-Ole Lund and James Manley, *Nordic Architecture* (Copenhagen: Arkitektens Forlag, The Danish Architectural Press, 2008); as well as a description of Knut Knutsen's architecture in Nils Georg Brekke, Per Jonas Nordhagen, and Siri Skjold Lexau, *Norsk arkitekturhistorie: frå steinalder og bronsealder til det 21. hundreåret*, *Norbok*, Samlagets bøker for høgare utdanning (Oslo: Samlaget, 2003), 347.

61 Terje Forseth "Arkitekten og boligen," interview with civil architects Bagstevold, Benum, Vardun in *Nye Bonytt* no. 8 (1979): 6; Terje Forseth "Byggeskikk i Norge" in *Nye Bonytt* no. 3 (1978): 76. Hoel, "Samtidens bolig på museum," 26.

62 *Lillehammer Tilskuer*, February 20, 1960, 7.

63 See, for example, Christian Norberg-Schulz referring to prefabricated houses as "degenerative" in introduction to Yukio Futagawa, *Wooden Houses in Europe* (Tokyo: Edita, 1978). In the reader's reply to the first version of the manuscript, prof. Karl Otto Ellefsen wrote: "Most outputs of Moelven Brug would not be considered as architecture but as buildings, given a traditional (AHO) definition of the concept. [...] Correctly architectural history as told in *Byggekunst* and *Arkitektur N* mostly (not entirely) deals with architecture of high quality and the same goes for the few comprehensive narratives and canons of Norwegian architecture"—assuming that Moelven's architecture was *not* of high quality. Karl Otto Ellefsen, Oslo 12.2.2022 in "Readers report to PhD Dissertation."

64 Kjetil Fallan, *Modern Transformed: The Domestication of Industrial Design Culture in Norway, ca. 1940-1970* (Fakultet for arkitektur og billedkunst, 2007), 268.

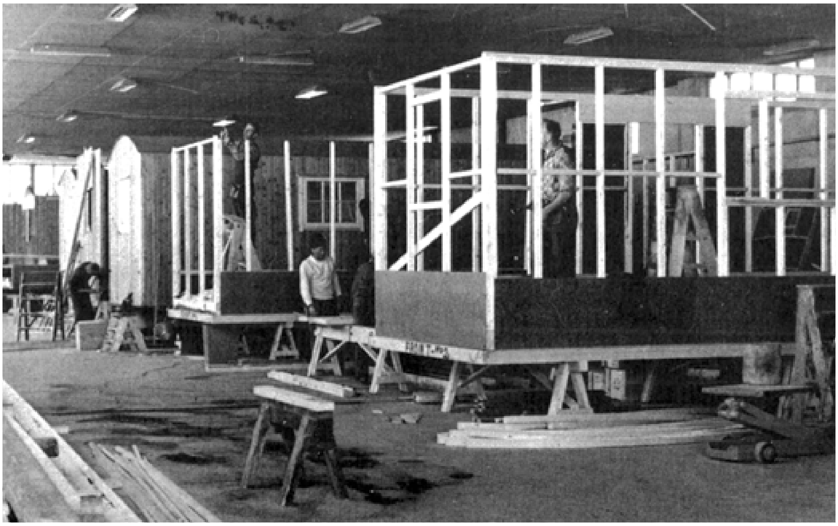


Fig. 12. Moelven production process based on a line assembly. Newspaper clippings, 1963.

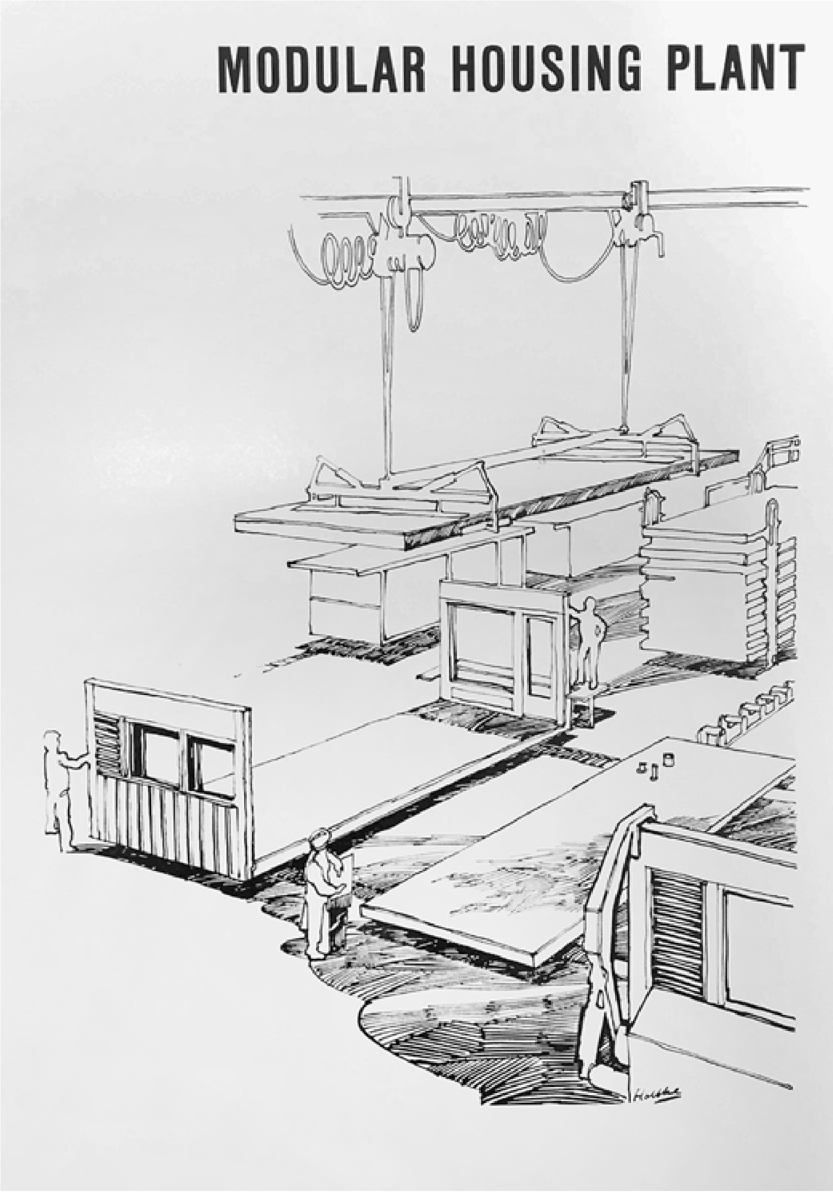
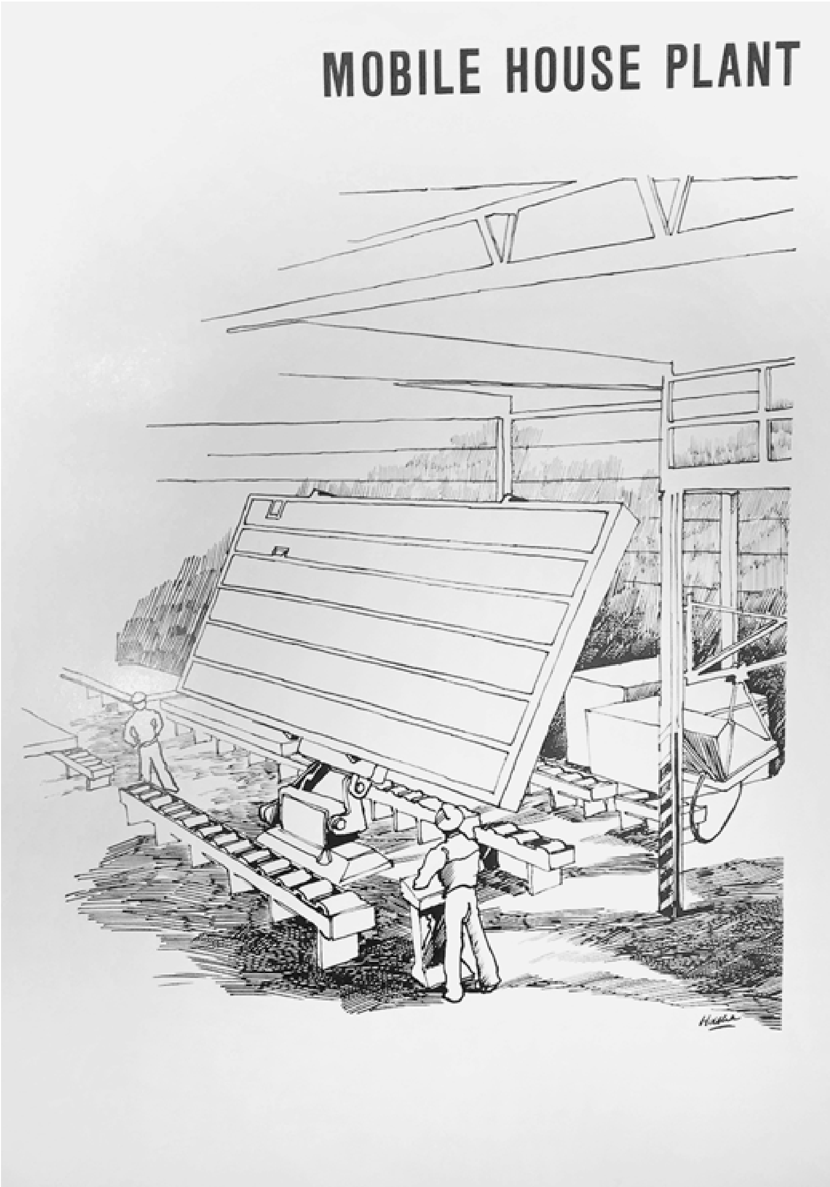


Fig. 13. By 1965, Moelven opened two prefabricated housing factories: one based on modular timber elements, and another one based on “sections” that had a 95% prefabrication grade. Drawings from “Moelven Housing System” marketing booklet, in “Produktspekter M-S,” SAH/ARK-287-01/J/Je/L0003, State Archive in Hamar.


MOBILE HOUSE PLANT

tional "good" art history to include expressions of mass-culture.[65] While I do not aim to convince the reader that Moelven architecture exhibited exceptional spatial qualities, I want to challenge the assumption that mass-produced, prefabricated buildings and typological solutions are not worth the attention of architectural practitioners and historians. I argue that everyday mass-produced buildings can serve as no-less appropriate, and perhaps more fruitful study objects, that upon close investigation reveal not only a wealth of social, political and material connections, but also implicit values with which we endow our built environment. This is just one of the many stories of the ordinary built environment that remain to be written and can be written anywhere across the world.

COMPANIES AND THE STATE

While industrial producers have received more attention in international than Norwegian architectural history, this dissertation is interested in an even more narrow strand of this inquiry—specifically, in the relationship between building systems producers and state actors in non-commercial building projects.[66] A substantial part of such scholarship emerges from the United Kingdom, which in the post-war period had come far in implementing prefabrication for a range of typologies—hospitals, schools, municipal housing estates, local and central governmental offices. In *Houses From the Factory: System Building and the Welfare State*, Brian Finnimore explores the ways in which British post-war prefabrication industry developed in a close relationship with social and economic policies and was closely attuned to the changing aspirations of politicians and housing experts.[67] The state became the single largest investor into new systems of construction and the main customer of the building industry. Unlike Finnimore, Roger White argues that the main role of the state in developing new building methods was to assure continuity both in terms of production and demand, while actual new products were often developed not by governmental

65 Kjetil Fallan, "A Matter of Design," 5th STS Italia Conference "Making Society through Science and Technology" (keynote presentation, Politecnico di Milano, Italy, Plenary Session II June 13, 2014). https://www.youtube.com/watch?v=7pEDzWJ3N14&ab_channel=FondazioneGianninoBassetti, accessed August 13, 2021.

66 For more general works on prefabrication see Alfred Bruce and Harold Sandbank, *History of Prefabrication* (New York: Ayer Co Pub, 1972). Bullock, *Building the Post-War World*. Gilbert Herbert, *Pioneers of Prefabrication: The British Contribution in the Nineteenth Century*, vol. 19, The Johns Hopkins Studies in Nineteenth-Century Architecture (Baltimore and London: The Johns Hopkins University Press, 1978).

67 Finnimore, *Houses from the Factory*, 8.

departments, but by adaptive individuals and entrepreneurs.[68] In turn, in his exhaustive 800-page book, *Building Systems, Industrialization and Architecture,* Barry Russell traces the genealogy of British prefabrication, underlining the importance of a conjuncture between popular social concerns, welfare state policies, available philosophies of industrialisation and practical tools.[69] Finally, Patrick Dunleavy's *The Politics of Mass Housing in Britain, 1945-1975* provides a unique account of corporate relations between private construction firms, professional interest groups and state actors in post-war British social housing schemes.[70]

Although these inquiries are indeed situated at the crossroads between technological and social histories, most of them deal with the history of post-war prefabrication in general terms, mapping networks of actors, politicians, material and system-producers in very broad strokes. Few studies take on the challenge to explore the development and application of individual construction systems in depth. Among these exceptions are Brenda Vale's study of Arco, Uni-Seco, Tarran and Aluminium house systems, Gilbert Herbert's intricate documentation of the General Panel Corporation production, or Andrew Saint's exploration of CLASP and SCUOLA prefabrication systems for post-war British school building.[71] Similar to these works, this thesis sees an opportunity to address the relationship between private construction companies and state actors through the lens of a single building system, which in the case of Moelven, was applied not just to housing, but also other everyday typologies. This approach allows the researcher to uncover new, previously undiscovered sets of local actors, architects, policymakers and regulations that might have been overlooked in more general accounts.

Studies of industrial building systems at the service of the state are not limited to the British context: similar research has taken place across Europe and the United States. The modes of cooperation varied across economic models and geographic contexts. For example, the American "Operation Breakthrough" was based on discrete case-by-case partnerships between the US Department of Housing and private

68 Roger B. White, and Building Research Station, *Prefabrication: A History of Its Development in Great Britain* (H.M. Stationery Office, 1965).
69 Russell, *Building Systems, Industrialization, and Architecture*, 305–15.
70 Dunleavy, *The politics of mass housing in Britain, 1945-1975*, 15–23.
71 See Brenda Vale, *Prefabs: The History of the UK Temporary Housing Programme* (Routledge, 2003). Herbert, *The Dream of the Factory-Made House*. Andrew Saint, *Towards a Social Architecture: The Role of School-Building in Post-War England* (New Haven: Yale University Press, 1987).

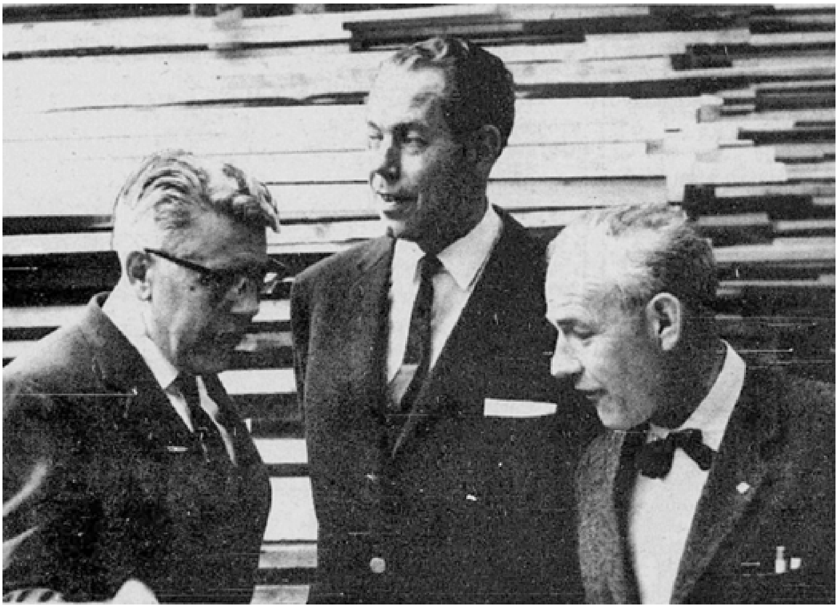


Fig. 14. Delivering public projects, Moelven maintained a close relationship with state actors. On the photograph, Moelven's Mageli to the left is pictured talking to OBOS director Odvar B. Solberg in the middle, and the Minister of Local Affairs Odvar Hedlund on the right. Newspaper clipping, 1965.

firms.[72] Experiments with prefabrication in other contexts—like the Soviet Bloc or Allende's Chile—were administered through state-controlled enterprises and planned production.[73] The closest to the context of this research are the French and Swedish cases of private construction conglomerates building large mass-housing projects.[74] For example, in *The Social Project: Housing Postwar France,* Kenny Cupers investigates publicly-funded housing projects, based on the application of heavy concrete prefabrication. However, despite bringing architecture, bureaucrats and industrialists into a single study, the intricacies of industrial

72 U.S. Department of Housing and Urban Development, "Operation Breakthrough," *Phase II: Prototype Construction and Demonstration,* vol. 4 (Washington D.C: 1974). Michael Abrahamson, "Decent and suitable modules: the politics of construction research in HUD's Operation Breakthrough," *Proceedings from the 5th international Congress on Construction History*, Chicago, June 3rd-7th, 2015. Also Abrahamson, chapter "Rocket Science or Representation?" in Pedro Ignacio Alonso and Hugo Palmarola, *Flying Panels: How Concrete Panels Changed the World* (DOM Publishers, 2020), 137–49.

73 Pedro Ignacio Alonso, Hugo Palmarola "A Panel's Tale: The Soviet KPD System and the Politics of Assemblage," *AA Files*, no.59 (2009): 38. For proliferation of panels of the same "prefabrication family" across the globe and different relationships between state actors and industrial producers see Alonso and Palmarola, *Flying Panels*.

74 Nicholas Bullock, "You assemble a Lorry, but you build a House': Noisy-le-Sec and the French Debate on Industrialised Building 1944-49." *Construction History* 22 (2007): 75-95.

production still slip through the storylines.[75] Edited volumes like *Architecture and the Welfare State* explore a wide range of state-sponsored schemes that utilised prefabrication methods, but rarely pick up on the specific role of industrial producers.[76] Helena Mattsson's research into the complex corporatist relationship between the building industry, capital and commercial groups during the heyday of Swedish state-financed housing projects and, in particular, the role of Svenska Bostäder in shaping Skärholmen, is a refreshing exception in this regard.[77] In Sweden, despite a growing body of work on *Miljonprogrammet*—an ambitious state housing programme of the late 1960s—few works address cooperation between decisionmakers and private producers.[78] In this context, Erik Stenberg and Erik Sigge's background research for the 2019 *Flying Panels* exhibition stands out. They delve into the "well-oiled machinery" of public and private building actors, and uncover an intricate network of corporatist relations that allowed for successful construction of more than one million apartments.[79] This thesis works along similar lines, unearthing networks of relations that empowered private construction companies to complete large state-financed commissions.

In Norway, monographic histories of industrial companies—such as Selvaagbygg A/S by Jon Skeie and Fredrik Selmer A/S by Øyvind Steen, or building cooperatives—for example, USBL by Terje Kili and Jon Skeie, or OBOS by Bjørn Bjørnsen and Anne-Kristine Kronborg, come the closest to examining the interwoven relationship between industrial producers and state actors.[80] Written largely from the perspective of a business venture or sponsored by a cooperative, these

75 See, for example, a chapter "Bureaucratic Epistemology" in Kenny Cupers, *The Social Project: Housing Postwar France* (U of Minnesota Press, 2014).

76 Swenarton, Avermaete, and Heuvel, *Architecture and the Welfare State* (London: Routledge, 2015).

77 Helena Mattsson, "Where the motorways meet: architecture and corporatism in Sweden 1968," in *Architecture and the Welfare State*, 160-168.

78 See, for example projects listed as a part of Architecture and Welfare Network, https://www.architectureandwelfare.net/about-the-network.html. Or Helena Mattsson and Sven-Olov Wallenstein, *Swedish Modernism: Architecture, Consumption and the Welfare State* (London: Black Dog, 2010). Although not focused on a "social" building typology, the work of Frida Rosenberg is an exception: in her 2018 dissertation she closely follows negotiations between politicians, businessman and material producers during the construction of Wenner-Gren Center. Frida Rosenberg, "The Construction of Construction: The Wenner-Gren Center and the Possibility of Steel Building in Postwar Sweden" (PhD diss., KTH, 2018), http://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-233818.

79 Erik Stenberg and Erik Sigge, an unpublished manuscript with background research for "Svensk flygande betong," a prototype for the "Flying Panels" exhibition, private correspondence. Among published sources, see Erik Stenberg's chapter "D4-gruppen 1955-1961" in Alonso and Palmarola, *Flying Panels*, 211–39.

80 Jon Skeie, *Bolig for folk flest: Selvaagbygg 1920-1998* (Oslo: Tano Aschehoug, 1998). Øyvind Steen and Ingeniør F. Selmer A/S, *I første rekke: Ingeniør F. Selmer A/S 1906-1981*, *Norbok* (Oslo: Ingeniør F. Selmer A/S, 1981). Terje Kili, Jon Skeie, and Ungdommens selvbyggerlag, *Pionér i 50 år: USBL fra selvbygging til økologi: 1948-1998*, *Norbok* (Oslo: Boligbyggelaget USBL, 1998). Bjørn Bjørnsen and OBOS, *Hele folket i hus: OBOS 1929-1970*, *Norbok* (Oslo: Boksenteret, 2007). Bjørn Bjørnsen, Anne-Kristine Kronborg, and OBOS, *Hele folket i hus: OBOS 1970-2009*, *Norbok* (Oslo: Gaidaros, 2009). Jo Sellæg and Drammen boligbyggelag, *Hus for folk flest: sosial boligbygging i Drammen: Drammen boligbyggelag 1946-1996*, *Norbok* (Drammen: DBBL, 1996).

works are less interested in a critical viewpoint and often result in a hagiographic historical narrative mostly concerned with housing provision. Nevertheless, they refreshingly cut across different historical disciplines and bring up aspects of business history and organisation, new technologies and techniques, questions of labour and popular reception. In Norwegian historiography, these works serve as the first stepping stones towards multi-disciplinary histories of construction companies. Inspired by these works, this thesis is not just a monograph on a company. Rather, it strives to write a different history of post-war Norwegian architecture from the perspective of an industrial producer.

Although this research could potentially fall into the category of "architecture of the welfare state," it aims to steer clear from the implicit ethical and aesthetic constructs associated with it. Discussions of the political workings of the Norwegian welfare state and critiques of universal social provisions remain outside the scope of this study. However, similar to the way Helena Mattsson proposes to reconsider the over-simplified narrative of the "welfare" period by bringing into discussion the role of capital and commercial groups in shaping the Swedish construction at the time, this thesis argues that a close investigation of the interdependent relationship fostered between business interests and political actors can offer a different perspective on the architecture of the period.[81] Such an approach yields particularly fruitful results when applied to post-war Norway where, according to Gran, "social democracy took the responsibility for the expansion of the capitalist economy as a basis for building a welfare state."[82] A close corporatist alliance between large business interests and political decision-makers persisted until the mid-1970s, when it was quickly dismantled with the new politics of deregulation—marking the end date of this inquiry.[83] Through the case of Moelven Brug, this dissertation thus sets on to investigate the ways in which industrial building actors adjusted their production to the legislative framework, centralised spatial regulations and building programmes of the post-war Welfare State.

81 Mattsson, "Where the motorways meet," 160-164.
82 Gran, *The State in the Modernization Process*, 299–313.
83 See, for example a discussion in Barbara Elisabeth Ascher, "The Hallagerbakken Housing Project in Holmlia, Norway: When Welfare Became Business," *The Journal of Architecture* 21, no. 3 (April 2, 2016): 442–44, https://doi.org/10.1080/13602365.2016.1181912.

Fig. 15. Among Moelven main products were prefabricated row-houses in timber. Above, a housing development in Øvre Høybråten Borettslag. Below, a project in Stovner. From *OBOS: hus og hjem i 75 år*.

INDUSTRIAL HISTORIES

While aspects of production continue to evade architectural history, there is a growing body of literature that begins to grapple with these questions. From studies on material histories, labour behind architectural production and bureaucracies of architectures, a new type of scholarship is interested in the previously side-lined industrial, technical and socio-economic "hinterlands." Among these works venturing beyond the common perception of materials are an edited volume *Material Matters* by Katie Lloyd Thomas and her most recent study on material theory and architectural specifications, along with Michal Osman's inquiry into the managerial aesthetics of concrete.[84] This thesis draws upon their close reading of material histories and attention to networks of sourcing and supply.[85] Although the labour behind architectural production has often remained invisible, this process has been gradually reversed in the works of Christine Wall, Linda Clarke, and Peggy Deamer that have inspired this thesis's approach.[86] Overall, this investigation follows the lead of a 2016 edited volume, *Industries of Architecture,* that considered "industry" as a polyvalent term, interested not just in the organisation of machinery but also the dynamic processes and relations, issues of labour, and the technical and social organisation of production.[87] The investigations of the Aggregate Architectural History collaborative, which delineates "matter, plots, systems" as its primary focus areas, best exemplify simultaneous zooming-in and zooming-out on matters previously invisible in architectural history, an approach largely adopted in this thesis.[88]

The interest in the production of architecture heralds a merger between industrial and architectural histories, most visible, for example, in a study of how industrial companies have shaped the built environment in an edited volume by Anja Kervanto Nevalinna or investigations of architecture offices specialised in industrial architecture or those with an

84 Katie Lloyd Thomas, *Material Matters: Architecture and Material Practice* (Routledge, 2006). Katie Lloyd Thomas, *Building Materials: Material Theory and the Architectural Specification* (Bloomsbury Academic, 2021). Michael Osman, "The Managerial Aesthetics of Concrete," *Perspecta* 45 (2012): 67–76.

85 In this lineage of investigations in relation to the building site see Timothy Hyde, "The Building Site, Redux," *Journal of Architectural Education* 75, no. 1 (January 2, 2021): 84–93, https://doi.org/10.1080/10464883.2021.1859890.

86 Linda Clarke, *Building Capitalism (Routledge Revivals): Historical Change and the Labour Process in the Production of Built Environment* (Routledge, 2012). Christine Wall, *An Architecture of Parts: Architects, Building Workers and Industrialization in Britain 1940-1970*, Routledge Research in Architecture (London, New York: Routledge, Taylor & Francis Group, 2013). Peggy Deamer, *Architecture and Capitalism: 1845 to the Present* (Routledge, 2013). Douglas Spencer, *The Architecture of Neoliberalism: How Contemporary Architecture Became an Instrument of Control and Compliance* (London: Bloomsbury Academic, 2016).

87 2014 workshop series Industries of Architecture (https://industriesofarchitecture.org/) led to a publication by Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech, *Industries of Architecture*, vol. 11, Critiques: Critical Studies in Architectural Humanities; (London: Routledge, Taylor & Francis Group, 2016).

88 More on the works of Aggregate Collective see http://we-aggregate.org/, accessed March 1, 2022.

industrial scale of production.[89] Claire Zimmerman's study of Albert Kahn Associates of Detroit belongs to the latter category: it examines not just the company's prolific built output, but also office organisation, new work relations and changing labour of an architect within an environment closer to an industrial factory.[90] Similarly, Michael Abrahamson's recent PhD thesis on the office and work at Gunnar Birkerts largely aligns with the growing interest in bureaucracies of architecture.[91] Although architecture has always been deeply entangled in systems of regulation and thus bureaucratic structures, this entanglement has remained largely invisible. Michael Osman fleshes out this oft-obscured relationship in his meticulous investigation, *Modernism's Visible Hand: Architecture and Regulation in America*.[92] Osman describes how systems of regulation—an assemblage of mechanical, legal, administrative and scientific techniques—transformed the physical structures of buildings, processes of production and ways of representation. These new interests—in part inspired by historical studies that cut across a wide range of disciplines, for example Alfred D. Chandler's *The Visible Hand*—show that the field of architectural history is gradually expanding to include business and organisational history, labour and technology studies, material theory, studies of new tools, and representational techniques. The object of research has shifted from a single architect and select projects—what John Summerson referred to as "the sophisticated peaks"—towards "the gross national product of building": collectives, offices, companies, systems and regulations that affect architectural production. Studying the construction output of one single industrial producer inserts this thesis into the same genealogy of works, and allows me to address architectural production as a result of both white- and blue-collar work, new managerial order and planning visualisation, bureaucratic regulation, scientific research and administrative techniques. It is within this enlarged field that zooms in on small, previously invisible details that this research finds its home.

89 Anja Kervanto Nevanlinna, ed., *Industry and Modernism: Companies, Architecture, and Identity in the Nordic and Baltic Countries during High-Industrial Period* (Helsinki: Finnish Literature Society, 2007).

90 Claire Zimmerman, "Building the World Capitalist System: The 'Invisible Architecture' of Albert Kahn Associates of Detroit, 1900–1961," *Fabrications* 29, no. 2 (May 4, 2019): 231–56, https://doi.org/10.1080/10331867.2019.1603134. Also Claire Zimmerman, "Albert Kahn's Territories [Office US Catalogue 2014]," *Office US: Catalogue*, accessed May 4, 2021.

91 Michael Abrahamson, "Testing the Establishment: Authorial Signature and Professional Method in the Architecture of Gunnar Birkerts, 1958-81," PhD Thesis, University of Michigan, 2019. Accessed May 4, 2021, https://deepblue.lib.umich.edu/handle/2027.42/150014. For this new type of inquiries see conference *Architecture and Bureaucracy: Entangled Sites of Knowledge Production and Exchange*, Brussels, 30–31 October 2019. http://www.architectureandbureaucracy.be/

92 Michael Osman, *Modernism's Visible Hand: Architecture and Regulation in America* (Minneapolis: University of Minnesota Press, 2018).

METHODS

"What is the size of the IBM or the Red Army or the French Ministry of Education or the world market?", asks Bruno Latour in *We Have Never Been Modern*. In this key passage, what the French philosopher is really calling for is a new methodology to study not just an object or a person but a network of heterogeneous actors, a "system."[93] The main protagonist of this story—the industrial company Moelven Brug—belongs to the same analytical category. It consists of a large network of heterogenous actors, a discourse full of people, technological objects and concepts. How does one approach something so vast and yet so concrete? Thomas Hughes and Wiebe Bijker argue that "system builders are no respecters of knowledge categories or professional boundaries."[94] This, in turn, requires system historians to forego disciplinary limitations and mobilise a wide range of theoretical frameworks. In order to produce a multi-scalar study of an industrial company that ventures beyond disciplinary categorisation, this thesis adapts a methodology inspired by the field of science, technology and society studies (STS): it proposes to consider Moelven Brug as a socio-technological system. Derived from Bruno Latour's actor-network theory (ANT) and Thomas Hughes and Michel Callon's studies of large technological systems, this approach allows this investigation to venture into a broader range of disciplinary fields and ask questions that the history of technology does not allow the researcher to access.[95] However, while this study is inspired by STS concepts and the new paths of inquiry that open with it, it steers away from a direct application of its prescriptive methodologies and vocabulary. For example, although not writing the history of Moelven from the point of view of technological artefacts, non-human actors, the thesis does consider them as an essential and equal element within this horizontal socio-technological system.

Conceiving of Moelven Brug as a socio-technological system that consists of both human and non-human actors in interlocking roles allows this research to engage with questions of technological change, study the social impact of new technology, and explore the ways in which technological artefacts were challenged and negotiated by actors within the system. Overall, this dissertation adapts a constructivist view on technology that considers technological choices to be both

93 Bruno Latour, *We Have Never Been Modern* (Harvard University Press, 1993), 120.

94 Wiebe E. Bijker, Thomas Parke Hughes, and Trevor Pinch, *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, Mass: MIT Press, 1987). Introduction.

95 See Latour, *We Have Never Been Modern*. Essays in Bijker, Hughes, and Pinch, *The Social Construction of Technological Systems*. Thomas Parke Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: Johns Hopkins University Press, 1983).

Fig. 16. Skjetten housing project built with prefabricated Moelven components is perhaps one of the best-known Norwegian flexible housing projects of the late 1960s. It is also the only of Moelven projects that made it to the "high" architectural canon. Photo from *Norske boliger*.

socially constructed and socially shaping.[96] As Moelven was an industrial company continuously concerned with advancing mechanisation, its technological choices were socially shaped but, in return, they also affected and structured humans within and outside that technological system. Even more importantly, this systemic approach allows me to mobilise other theoretical frameworks, studying both managerial and business organisation, questions of labour and technology, processes of production, technological adaptations, and the actual built structures produced by the company. Considering Moelven Brug as a socio-technological system also allows me to map the broad set of heterogenous actors and power brokers with which the company engaged: from workers, engineers, managers, economists, and architects to clients, policy-makers, researchers, advertisement professionals and state politicians. In a way, the company is a methodology in itself: Moelven works as a sandbox of tools, from where particular modules of themes can be selected and developed outwards, connecting with larger social processes, policies and cultural narratives, and in turn populated with built objects and technological artefacts. Thus, a methodological framework of system and network studies enriches the conventional methodologies of architectural history, making it possible to detect and analyse more complex processes and interactions within and outside the system that would have escaped the traditional approach of architecture history.

96 Thomas P. Hughes, "The Evolution of Large Technological Systems" in Bijker, Hughes, and Pinch, *The Social Construction of Technological Systems*, 51.

The second methodological thread this work relies on is a different approach to the sources mobilised in the study of everyday objects, an architecture of "the near." Sigfried Giedion was among the first pioneers of this new history, interested in "anonymous and unpretentious things."[97] In order to study these objects, Giedion turned to the seemingly-pedestrian primary sources, previously ignored by architectural and art historians: patent registrations, original pamphlets and product catalogues, scientific journals, lay press, advertisements and technical drawings.[98] In the last decade, more works in architectural history have followed suit. As the editors of *Industries of Architecture* argue, it is particularly in interdisciplinary studies that the researcher is often forced to look at sources beyond the conventional drawings, texts and publications considered "proper" sources of architectural history and theory.[99] New technical knowledge is required to look at a wider range of objects and technical specifications, but it is particularly by zooming in on details of specific practices and techniques that, according to Tilo Amhoff, Nick Beech and Katie Lloyd Thomas, broader material and social relations become visible.[100] Sharing the conviction, this research relies on a close reading of a wide range of unconventional sources: business correspondence, meeting notes, procurement contracts, payment negotiations, managerial documents, sales catalogues and brochures, technical drawings and scientific reports. These sources are technological artefacts in themselves that prove that documents shape us inasmuch as our technological choices do. Moelven products, then, become not only what Bijker et al. call "strategic research sites" from which the "seamless web of technology and society can be rewoven," but also convenient entry points to the study of a post-war Norwegian society animated by the pursuit of rationalisation and technological innovation.[101]

Danish architect Nils Ole-Lund argued that one can write the history of Nordic architecture through the history of housing and vice versa. It is in the "evenness" of the everyday and not in flashy projects that the Nordic "functional tradition" finds its expression.[102] This thesis

97 Sigfried Giedion, *Space, Time, and Architecture; the Growth of a New Tradition* (Cambridge, Harvard University Press, 1954), 28, http://archive.org/details/spacetimearchite00gied.
98 Sigfried Giedion, *Mechanization Takes Command: A Contribution to Anonymous History* (Minneapolis: University of Minnesota Press, 1948, 2013), vi.
99 Thomas, Amhoff, and Beech, *Industries of Architecture*, 3. In particular, see Tilo Amhoff "The electrification of the factory or the flexible layout of work(s)," in Thomas, Amhoff, and Beech, 259–69. Thomas, *Building Materials*.
100 Thomas, Amhoff, and Beech, *Industries of Architecture*, 9.
101 See, for example, part III: 'Strategic research sites", with case studies varying from guided missiles and drugs to ultrasound and cooking stoves, in Bijker, Hughes, and Pinch, eds., *The Social Construction of Technological Systems*, 185–86.
102 Nils-Ole Lund, *Nordic Architecture* (Copenhagen: The Danish Architectural Press, 2008), 252.

argues that it not just through the study of housing, but rather through the study of the *production* of ordinary architecture, that new insights about the Norwegian building tradition and architecture of the period might be gained. Thus, by applying two main methodological frameworks—one, borrowed from network studies, the second, equipped with a different set of sources related to the production of everyday buildings—this thesis obtains its multi-scalar and multi-disciplinary approach.

THESIS STRUCTURE

According to Manfredo Tafuri, no single methodology can be applied to access the "totality" of architectural work. Instead, he advises to introduce a "disintegration, a fragmentation, a dissemination of its constructive units." [103] Aspects such as "client reactions, symbolic horizons, avant-garde hypotheses, linguistic structures, methods of reorganizing production, technological inventions" all become stepping stones to study the entire process of architectural production.[104] This dissertation follows Tafuri's advice: in order to understand the scale of Moelven's tentacular reach, the company's operations had to be disintegrated into separate constructive units, each subject to a different analytical framework.

With an ambition to study both the *processes* and *products* of Moelven Brug, this thesis is structured in two main parts. The first part is dedicated to people and technology, setting out the context of production within white- and blue-collar work, while the second part deals with the company's built products. Primarily interested in Moelven's immersion into the structures and infrastructures of the state, the thesis selects three typologies—schools, housing and community buildings—that essentially correspond to the three main areas of infrastructural investment by the post-war Norwegian welfare state.[105] This thematic and typological division allows me to tame a vast array of actors involved in the design, development, sanctioning, regulation and approval of Moelven structures. In turn, each typology provides a singular vantage point that illuminates different parts of the actors' networks. Each chapter works as a microcosm of its own, full of ideas, people, objects, technological artefacts, buildings and regulations. Put together, the chapters strive to offer a more complete picture of what it meant to build prefabricated architecture for the Norwegian state.

103 Manfredo Tafuri, *The Sphere and the Labyrinth: Avant-Gardes and Architecture from Piranesi to the 1970s* (Cambridge, Mass: MIT Press, 1987), 14.
104 Ibid.
105 Torgersen, "Housing: The Wobbly Pillar under the Welfare State," 118.

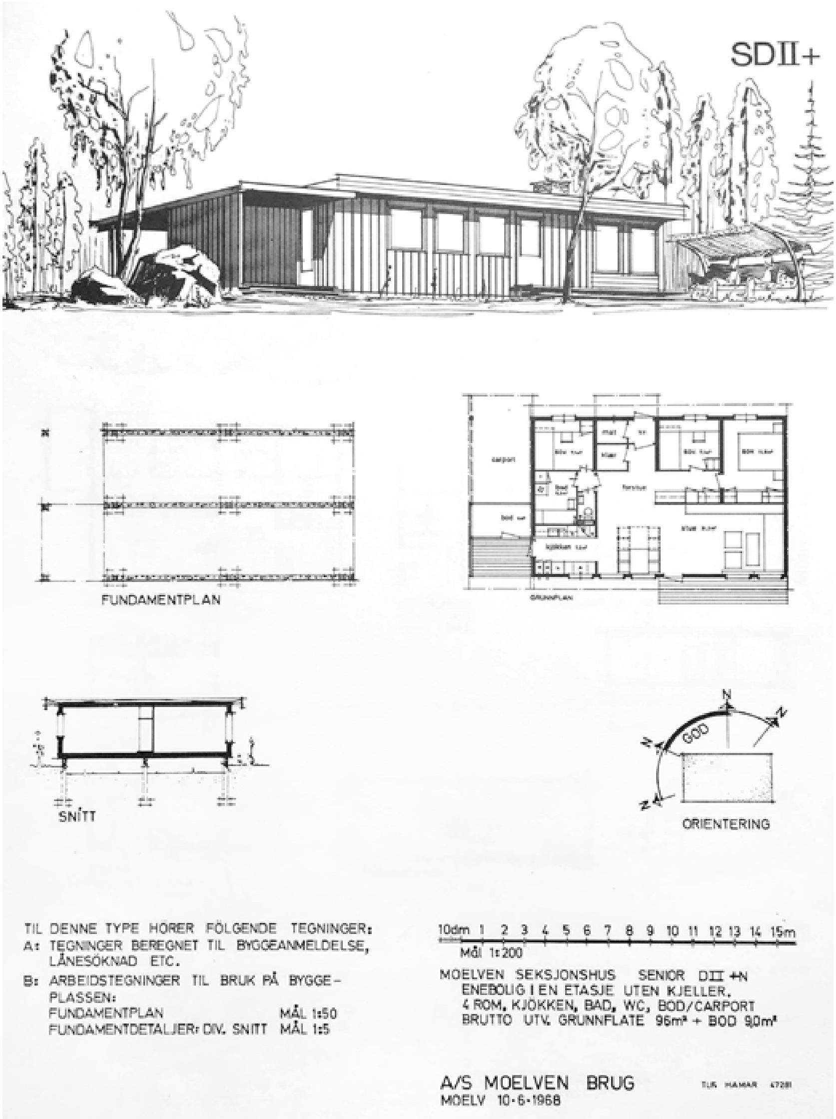
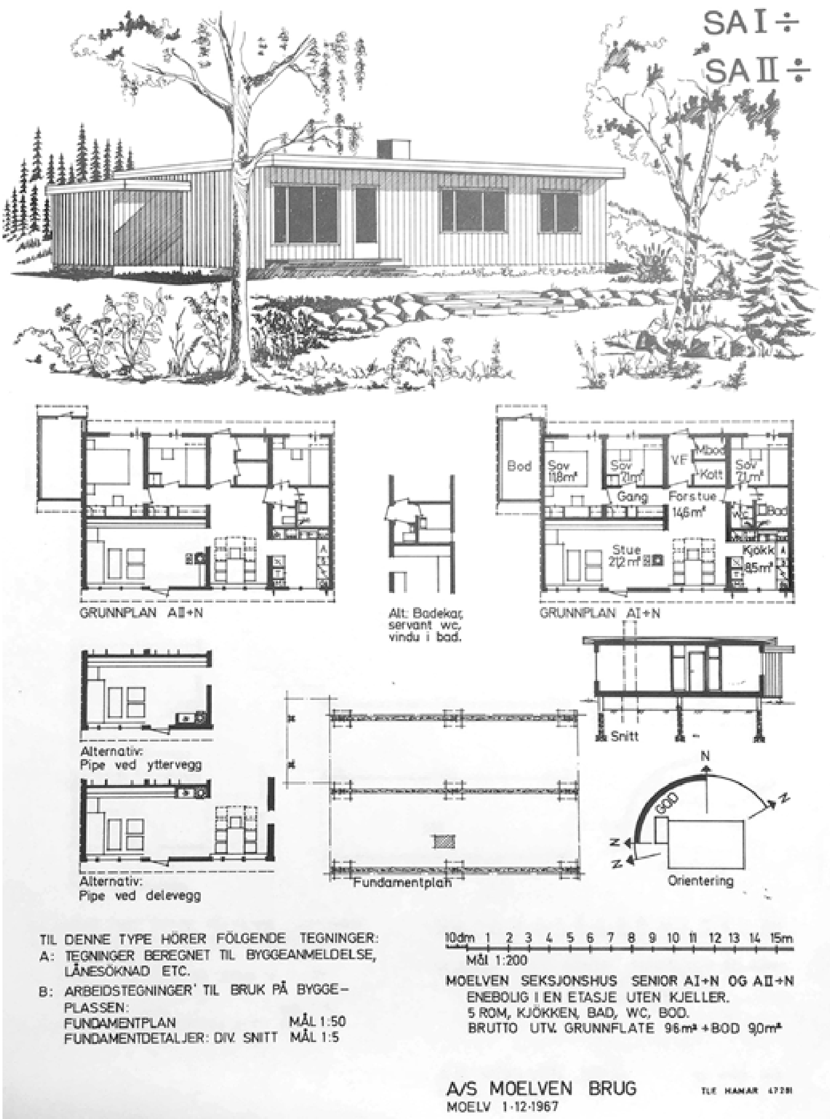


Fig. 17. In addition to row-houses built for larger developers and cooperatives, Moelven sold “section-houses” to individual consumers through catalogues. Assembled from several prefabricated sections, they were nearly entirely factory-made. Images from Moelven prefabricated house catalogue, 1969. Archives of the National Library.


SA I ÷
SA II ÷
Bod
Sov 11,8m²
Sov 7,1m²
V.F.
Mbod
Kott
Sov 7,1m²
Gang
Forstue 14,6m²
WC
Bad
Stue 21,2 m²
Kjökk 8,5m²
GRUNNPLAN AII+N
Alt: Badekar, servant wc, vindu i bad.
GRUNNPLAN AI+N
Snitt
Alternativ:
Pipe ved yttervegg
Alternativ:
Pipe ved delevegg
Fundamentplan
N
GOD
Orientering
TIL DENNE TYPE HÖRER FÖLGENDE TEGNINGER:
A: TEGNINGER BEREGNET TIL BYGGEANMELDELSE, LÅNESÖKNAD ETC.
B: ARBEIDSTEGNINGER' TIL BRUK PÅ BYGGE-PLASSEN:
FUNDAMENTPLAN MÅL 1:50
FUNDAMENTDETALJER: DIV. SNITT MÅL 1:5
10dm 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15m
Mål 1:200
MOELVEN SEKSJONSHUS SENIOR AI+N OG AII+N
ENEBOLIG I EN ETASJE UTEN KJELLER.
5 ROM, KJÖKKEN, BAD, WC, BOD.
BRUTTO UTV. GRUNNFLATE 96m² +BOD 9,0m²
A/S MOELVEN BRUG
MOELV 1·12·1967

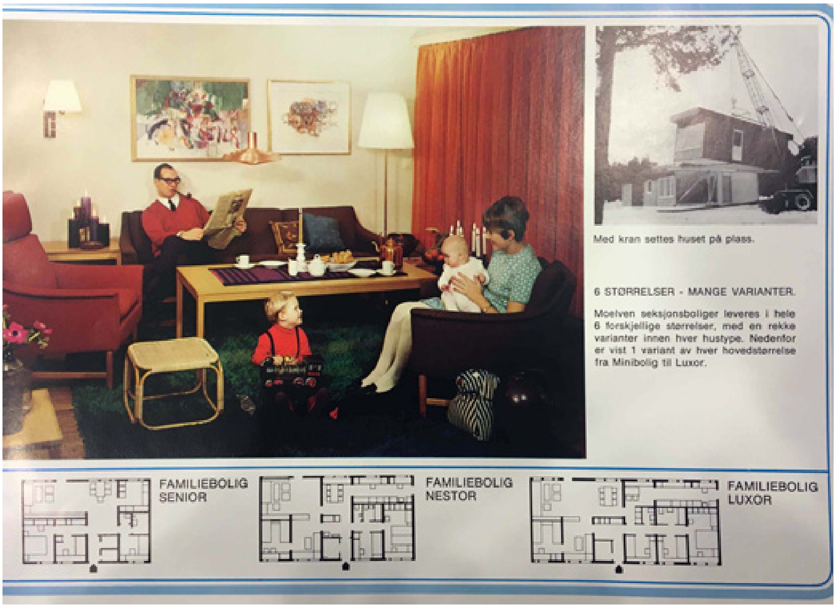


Fig. 18. Moelven prefabricated houses offered a wide variety of layouts that could be adjusted according to different budgets and demands. Interiors of these prefabricated houses as depicted in the company's catalogues, 1969. National Library Archives.

Chapter one explores the intersection between post-war scientific rationality driven by the pursuit of productivity, quantification and standardisation and architectural production. It does so by examining the new managerial structure introduced to Moelven by a rationalisation agency and generally examines the implications of this new organisational structure on the company's business practice, work processes and future products. The chapter expands on the role of engineers and managers in designing prefabricated products and outlines the position—or, more precisely, the absence—of architects within the company's managerial structure. In short, by focussing on white-collar work, the chapter examines the relationship between architects and industrial producers and situates Moelven Brug within the post-war debate on the industrialisation of construction in Norway.

Chapter two is primarily concerned with Moelven's technological processes that became the company's hallmark. This section of the dissertation is concerned with workers and machines, that is, with the labour and technology behind the production of Moelven's prefabricated structures. The chapter explores the social and cultural implications of technology transfer and looks at how imported techniques and technologies of production were negotiated and selectively assimilated to fit the realities of Norwegian working life. As mechanisation (and later automation) allowed for higher profits, Moelven embedded a wide range of social benefits and welfare provisions within its structure, playing an important role in local and regional development.

Chapter three moves the discussion into the analysis of built objects. Specifically, it explores how school spaces were reconceptualised as technocratic objects with the introduction of a common nine-year school reform that posed new standardised spatial and programmatic requirements. In the absence of a state-led solution to alleviate the school shortage, Moelven adapted its production system to deliver cheap, turnkey-ready prefabricated schools conceived as mass-produced objects. The chapter positions Moelven schools within the broader context of school building in Norway and abroad, and explores the twofold tension between, on the one hand, permanence and obsolescence, and on the other, the economy of production and the lived experience of these buildings.

Moelven's complex relationship with regulatory bodies is further expanded in chapter four, which explores a tripartite constellation between state actors, industrial production and architects involved in the development of Moelven's prefabricated housing. Specifically, the chapter studies large low-rise high-density developments built with prefabricated timber elements produced by the Ringsakerhus factory. A joint OBOS-Moelven enterprise, its goal was to provide an affordable small-house alternative to large high-rise developments. In addition, the chapter explores how Ringsakerhus's prefabricated elements became incorporated into the changing architectural discourse of the late 1960s. As the Ringsakerhus buildings provided a physical form to ideas of user participation, flexibility and change, the chapter deals with broader questions of individual and collective, mass production and adaptability.

Finally, chapter five is a history of Moelven's pioneering venture into glued laminated timber (or "glulam"), a technology which in the mid-1950s was re-introduced to Norway from the United States. The largest producer on the Norwegian market, Moelven supplied glulam beams for a variety of public buildings from sports halls to churches, making the construction of these buildings more affordable for tight municipal budgets. This chapter is particularly interested in how the company developed this new material in cooperation with research institutes, founded new regulatory bodies to oversee its production and devised an elaborate marketing narrative that reconciled new technology with a century-long tradition of building with timber. With time, this marketing narrative became closely associated with a "new Norwegian building style," a story that persists until today.

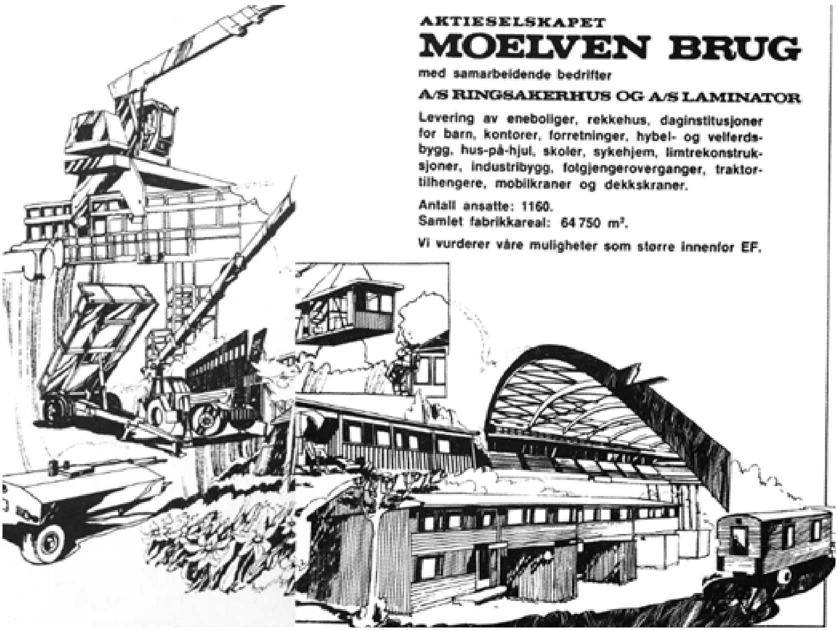


Fig. 19. The company developed a complimentary ecosystem of production, including a mechanical workshop that produced building cranes and a new facility for glued laminated timber. Images of the new technological process were often used in the company's advertisements. Newspaper clipping, 1969.

SOURCES

ARCHIVES

Studying the ordinary requires extraordinary effort. At times, working on this project required adopting a method largely similar to that of studying fossils: stitching together "imprints, tracks and trails of a once-living thing."[106] While it was clear that this once-living thing was quite large, it was hard to pin down its exact dimensions. This project has thus largely progressed inductively, shaped by material discovered in the archives. However, time and again it has encountered significant archival resistance. First and foremost, this has to do with the nature of the study object, an industrial company. Currently, a private archive of Moelven Industrier is held by the State archive in Hamar, but it is a rather scattered collection that has been extensively curated. Certain materials that seemed worthy of archiving were preserved, while others were discarded. For example, not a single project drawing exists in the entire archive of the company that constructed thousands of buildings across the country, while "Produktspekter" folders are thin and limited to marketing booklets and brochures. At the same time, a substantial, thick binder holds more than 100 resumes and the personal information of applicants for one position of a regular sales consultant in the mid-1960s that were never hired for that position. Unlike other studies that have the luxury of multi-thousand folder collections, this research has had to navigate conditions of extreme archival scarcity.

In "Archive Fever," Jacques Derrida offered a psychoanalytic reading of archives: they preserve records of the past and embody "the promise of the present to the future."[107] The selection of what counts as knowledge appropriate for archival study is a strong act that excludes the possibility of studying objects and events that were deemed unimportant at the time of their creation. According to David Greetham, a specialist in textual studies, any decision on what is excluded or included in an archive is highly self-referential, and even self-laudatory: archives strive to preserve the best, that which is at the current moment considered useful for future generations.[108] However, future actors are excluded from this decision-making: one may want to study precisely

106 See a description of fossils tracing at https://jurassiccoast.org/what-is-the-jurassic-coast/all-about-fossils/what-are-fossils/, accessed January 12, 2020.

107 Marlene Manoff. "Theories of the Archive from Across the Disciplines." *portal: Libraries and the Academy* 4, no. 1 (2004): 11. Jacques Derrida and Eric Prenowitz, "Archive Fever: A Freudian Impression," *Diacritics* 25, no. 2 (1995): 9, https://doi.org/10.2307/465144.

108 David Greetham, "Who's In, Who's Out: The Cultural Politics of Archival Exclusion," *Studies in the Literary Imagination* 32, 1 (Spring 1999): 1–28.

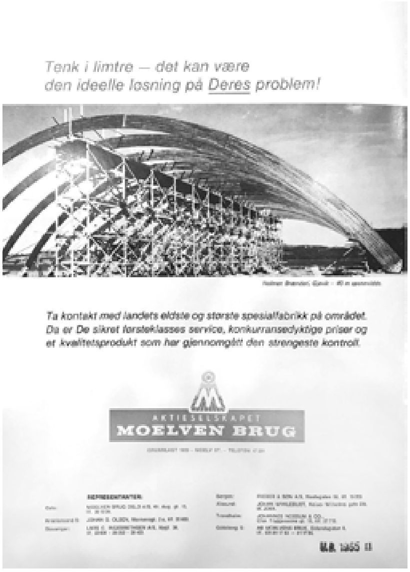


Fig. 20. Moelven glued laminated timber elements were used—quite literally—for barns, as well as churches. Moelven advertisements for glued laminated timber members. Newspaper clippings, 1962.

Fig. 21. To the left, interior of Jar church built with Moelven glulam elements. To the right, interior of Gimlehallen sports hall. Newspaper clippings, various.

that which is deemed inappropriate, that which is excluded, silences in the archive. The case of Moelven Brug is exemplary in this regard: their products were considered mundane and everyday, a kind of non-architecture not worth being documented. The collection curated by the company's archivists, in turn, amassed finalised documents, brochures and pamphlets, excluding the processes of development, drafts and other communications that were deemed unnecessary. It is mostly official financial documents, stock returns and yearly board meeting notes that were deemed interesting to future researchers. As the practice of "archivisation" produces as much as it records the event, the Moelven Brug archive has been largely pre-mediated and re-produced.

However, the archival resistance did not stop there. Upon asking the company, which is still in operation, whether there might be additional documents, I was told that due to the lack of space all the remaining archival material has been shredded in 2006. Same was the fate of OBOS' archive—the main Oslo housing cooperative that had worked with Moelven. Feeling like a kind of inverse King Midas—for whom, instead of gold, all archives I tried to get my hands on turned into dust—I learned that the archive of the architectural office of Grinde, Abrahamsen and Philipp, with whom Moelven worked, was also shipped to a dumpster, and not a single project drawing remains in the office.[109] According to Derrida, the nature of the archive is constantly shaped by political, social and technological forces. Indeed, as the majority of Moelven documents were paper-based, their storage for an indefinite period with an indefinite purpose posed a significant problem of space—and thus the physical medium of paper set definitive constraints on what could be preserved.

In order to trace Moelven imprints through archival gaps and silences, the study had to follow up on clues and hints, tracing barely visible threads, similar to the approach proposed by Carlo Ginzburg in his essay "Clues: Roots of an Evidential Paradigm."[110] To understand those barely detectable imprints, the Moelven Brug archive was cross-referenced with a wide variety of supplementary collections: the archives of the Norwegian Productivity Institute (NPI), the Federation of Norwegian Industries (NI), Association of Norwegian Architects (NAL), documents of the Committee for Rationalisation, Committee for Standardisation, Industrial Union Bureau of Rationalisation (IRAS), archives of the Church and Education Ministry (KUD), the Norwegian Electricity Regulatory Author-

109 Interview with Geir Grinde, May 3, 2021.
110 Carlo Ginzburg, preface to the Italian edition in *Clues, Myths and the Historical Method* (London: The John Hopkins University Press, 1989), xi.

ity, holdings of the National Library, Oslo City archives, and the Labour Party archives (ABB). This breadth is symptomatic of the subject of the research subject—a large socio-technological network that required cutting across several disciplines in a broad, but focused, search. For that matter, although scarce, Moelven's own multi-disciplinary archive was quite fitting for the purpose of the study: as Thomas Osborne notes, the benefit of any archive is its elasticity, its ability to integrate multiplicities of uses and meanings, fusing disciplines and perspectives.[111]

NEWSPAPERS AND MAGAZINES

Since information from the archives proved insufficient to reconstruct the history of Moelven, these archival gaps and absences had to be filled by information from other sources. To this end, digitalised National Library holdings were of invaluable assistance. Through a targeted search within an OCR-accessible database of all major Norwegian periodicals and books published in the second half of the 20th century, it was possible to trace questions, people and events that were untraceable before. If, according to Svadberg et al., advancement in digital technology has profoundly transformed business and society and brought higher complexity, it is particularly the history of the *ordinary* that has been most profoundly transformed by the advent of digitalisation.[112] With the ambition of making information more accessible and democratic, this digitalisation project was instrumental in allowing a new type of history to be written—a history of the oft-overlooked and nearly-impossible-to-trace using conventional methods.[113] However, dealing with such a suddenly enlarged scope of vision—holdings that are not limited to books, but also include magazines, newspapers, photographic collections, catalogues, conference proceedings, audio- and visual materials—poses a question of scale and requires new techniques of digital material selection and management which, in turn, leave their own footprint upon the research.

111 Thomas Osborne, "The Ordinariness of the Archive," *History of the Human Sciences* 12, 2 (May 1999): 51–64.

112 Silje Svadberg, Andrea Holand, and Karl Joachim Breunig, "Beyond the Hype: A Bibliometric Analysis Deconstructing Research on Digitalization," *Technology Innovation Management Review* 9, no. 10 (October 30, 2019): 39, https://doi.org/10.22215/timreview/1274

113 See more on digitalisation efforts at Norsk digitalt bibliotek (program): Arbeidsgruppa for digitalisering and Ranveig Låg Gausdal, *Cultural Heritage for All: On Digitisation, Digital Preservation and Digital Dissemination in the Archive, Library and Museum Sector: A Report* (Trykt Utg.), no.32 (Oslo: ABM-utvikling, 2006). It is all the more unfortunate that upon my enrolment into the AHO PhD program, AHO as an institution was neither considered one of "the knowledge and culture" nor its PhD students had access to National Library online holdings. It is a truly extraordinary effort to make knowledge accessible, and this opportunity should be made known to all incoming researchers in Norway.

Ved Moelven Brug økte omsetningen fra 2 millioner i 1950 til 30 millioner i dag

Bedriften produserer nå årlig 3000 tilhengere og 1500 rullende hus. – Og har levert skoler til 30 kommuner

Mjølke-stoppen avblåst!

Transportable ferdighus ikke fremtidsmusikk

Moelven Brug er storprodusent av «rullende» kjede- og seksjonshus

Ferdighusene ble publikums yndlinger på Byggevaremessen «Bygg reis deg» i Oslo, og samlet lange køer av skuelystne.

Blant ferdighusene ble Moelven Brugs «rullende» kjede- og seksjonshus kanskje de mest populære. Den praktiske og lekre innredningen fikk folk til å sperre øynene opp.

Ferdighusene fra Moelven Brug hadde bare en feil, mente mange. De er bare foreløbig utviklet for bruk som boliger ved langvarige anlegg, og bedriften har først og fremst tatt sikte på å dekke dette store behov. Til gjengjeld kan Moelven Brug glede seg over at dets kjedehus og seksjonshus i dag er i bruk på anleggsplasser over hele landet, og at titusener av arbeidere og funksjonærer i anleggsvirksomhet på denne måte har fått høyverdige boliger.

Det var i 1950 bedriften begynte å bygge

«HUS PA HJUL»

Det viste seg å være en fulltreffer. Moelven-husene oppfylte boligbehovet til den ikke helt lille del av den norske befolkning som befinner seg på permanent flyttefot fra det ene anlegg til det andre. Byggherrene og entreprenørene var også storlig fornøyd med de «rullende» husene. Lembrakkene som var alminnelig tidligere kunne være lite egnet som boliger med dagens krav, og dessuten gikk det med både tid og penger til opp- og nedmontering, og flytning av brakkene.

«Husene på hjul» fra Moelven ble ganske enkelt hektet til en bil, en traktor, eller et annet transportmiddel, og flyttet fra det ene anlegg til det annet —

SKOLER TIL 30 KOMMUNER

PRISKONKURRANSE FOR LIMT TRE

1500 HUS PA HJUL I ÅRET

480 ANSATTE PÅ 20.000 KVADRATMETER

Ferdige hus med jernbane fra Moelv til Mo i Rana —

I samarbeid med Moelven Brug har Statsbanene løst et problem og dermed skapt et stykke «jernbanehistorie» –

Fig. 22. Sources: newspapers. A sample set of screen-shots of newspaper articles dedicated to Moelven. Newspaper clippings, 1961.

This thesis could not have been written before this digitalisation effort. If this story had been limited to conventional methods and sources—mentions in architectural history books and professional magazines—it would end on page three. However, as Moelven played a significant role in regional development—its unconventional products often making sensational local headlines—it was broadly documented in the local and regional press. An OCR-accessible collection of all newspapers published in Norway—including returned searches from the very small regional editions—made this study possible. Local papers such as *Hamar Arbeiderblad*, *Lillehammer Tilskuer*, *Ringsaker Blad* were frequent illuminators of Moelven marketing stunts. In fact, as the company held no records of its built work, these newspapers' archives were vital for tracing both Moelven projects and different discussions around the company's processes. However, this selection has its shortcomings: many of press appearances were carefully curated by the company's publicity team and former *Ringsaker Blad* editor-cum-PR-stunt-manager, Per Granberg. Many of the interviews focus on what the company deemed important and lack discussion around broader ideas or projects' development. As some chapters—for example, chapter four—more than others rely on newspaper articles, it has been important to try to mitigate these pitfalls by cross-referencing other sources. However, the OCR database of the National Library made no concept, organisation, person or idea too obscure to trace. It is only because of this digitalisation effort that projects venturing into the history of the ordinary—much like this PhD—are made possible.

BUILDINGS AND PEOPLE

Visiting Moelven buildings is not an easy task: due to the absence of any building records in either professional literature or the company's archive, and their inconspicuous appearance, Moelven structures are hard to trace. At the same time, there are quite many of them, perhaps thousands, and most are still standing today (more than one would expect of wooden buildings deemed "temporary" and "barrack-like" by their critics). In a way, Moelven structures are ubiquitous in the greater Oslo region, but hardly visible to the untrained eye. One morning, after three years of providing books for this project, an AHO librarian conspiratorially whispered to me over the library counter: "I now see Moelven houses everywhere!" Later, she realised that she grew up in one of them.

Several Moelven schools still are in operation today—including Nøklevann and Sofiemyr; Moelven houses house many happy dwellers that are oblivious to the exciting industrial past of their homes, while

Fig. 23. Moelven house in Maihaugen open-air folk museum in Lillehammer. Originally built in Lyngveien, Gardermoen in 1974, it was moved to Maihaugen in 1997. This move caused a significant debate around its value and contribution to the exposition. Image from *Moelven 1899-1999*.

Moelven laminated timber beams feature in many prominent buildings, including Oslo Gardermoen Airport and Hamar Olympic halls. A Moelven-Senior house even stands in a residential area of Maihaugen open-air museum at Lillehammer, dedicated to the preservation of residential environments from different eras.[114] One of the ambitions of this PhD project has been to create an interactive map, where information about different Moelven projects was collected, processed and mapped. Although interviews could have significantly aided in reconstructing the history of the ordinary, only a couple were conducted over the phone. Interviewing was largely hindered by the onset of the pandemic, which made personal contacts with many of the potential interviewees, most of them aged seventy and above, nearly impossible. That said, interviewing remains an ambition to be explored should this project be developed further.

THE OUTSIDE GAZE

Presenting my work at a number of Nordic conferences early on, I often encountered a rather sceptical reaction: why write about something so uninteresting, so clearly not "architecture"? This PhD project hopes to argue that there is something interesting even in the commonplace. In doing so, this thesis perhaps has an advantage, as certain elements stand out more to a researcher who is an outsider. As Marc Augé was

114 Stine Hoel, "Samtidens bolig på museum," (MA thesis, Univeristy of Oslo, 2007).

criticised by Bruno Latour for failing to apply the same totalising approach to research back home in Paris as he successfully managed to do in Ivory Coast, this research enjoys the benefit of perceiving the architecture of the near from afar.[115] This position admittedly has many drawbacks: as a non-native Norwegian speaker, dealing with the obscure intricacies of a culture different from my own was challenging. Nuances that might be obvious to a researcher native to Norway did not appear so to me, and thus some observations might be offbeat. While the majority of sources are in Norwegian—in a variety of dialects, and at times handwritten—most of the quotes have been translated by myself. And so, any mistakes or inaccuracies are fully my responsibility.

115 Latour, *We Have Never Been Modern*, 100-01.

OF MANAGERS AND ENGINEERS

CHAPTER 1

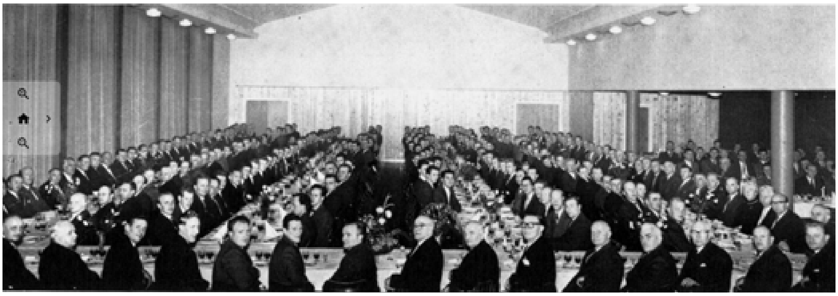


Fig. 1. Moelven's 60th anniversary celebration dinner, 4 December 1959, Tingvang. From *Moelven Brug i forvandling og vekst*, 47.

“[THIS BOOK] IS MOSTLY ABOUT MANAGERS AND ENGINEERS. AT THIS POINT IN HISTORY, 1952 A.D., OUR LIVES AND FREEDOM DEPEND LARGELY UPON THE SKILL AND IMAGINATION AND COURAGE OF OUR MANAGERS AND ENGINEERS, AND I HOPE THAT GOD WILL HELP THEM TO HELP US TO STAY ALIVE AND FREE.”[1]

1 Preface to Kurt Vonnegut, *Player Piano* (New York: The Dial Press, 1999).

Similar to the way Kurt Vonnegut warns readers of *Player Piano* that his book is about managers and engineers, so is this chapter about managers and engineers, their skill and imagination that allowed a local-run sawmill in Hedmark to venture into new areas of production—most notably prefabricated architecture. Set in the mid-1950s—contemporary to Vonnegut's ironic critique of automation and mechanisation—this is also an account of a particular moment in Norwegian history, animated by the unwavering belief in rationality, productivity, quantification, standardisation and scientific inquiry that permeated different spheres of everyday life, from management and labour relations, to architecture and construction. This chapter strives to correct the common assumption that prefabricated buildings are "architecture without architects," exploring the role of Moelven's managers, engineers, rationalisation experts and architects in the development of new prefabricated products. With an educational background very different from that of architects, Moelven managers and engineers conceived of prefabricated architecture as yet another product suited for factory production, whose process of assembly could be closely measured, standardised, quantified and controlled. Architects, on their part—Grinde, Abrahamsen, Philipp (and Johannessen)—worked closely with Moelven engineers on the design of the element prefabrication system and were responsible for the majority of the company's architectural projects. Moelven's prefabricated buildings produced on conveyor belts from hundreds of standardised parts were thus not just a result of "imagination and courage" of the company's managers and engineers. Designed through a collective effort of hundreds of technical professionals, rationalisation specialists, architects and engineers, they were complex industrial aggregates that carried the spirit of the era at their core.

American business and economic historian Alfred Chandler in his book *The Visible Hand: The Managerial Revolution in American Businesses* argues that "any theory of the firm that defines the enterprise merely as a factory or even a number of factories, and therefore fails to take into account the role of administrative coordination, is far removed from reality."[2] This chapter heeds that warning, studying the role of the new managerial structure in the development of Moelven's prefabricated products and positioning the company's transformation within a broader discussion on rationalisation and modernisation

2 Alfred D. Chandler, *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, Mass: Belknap Press, 1977), 490.

of the building industry both in Norway and abroad. This chapter has two parts: an industrial history, followed by architectural discussions on building industrialisation. In adopting this structure, this study reverses the bipartite course charted by Nicholas Bullock in his book *Building the Post-War World* where he first, traces the key architectural debates on industrialisation—the domain of the architectural elite—and then examines how these discussions influenced post-war industrial construction.[3] Instead, as this study argues, ideas of rationality, productivity and mechanisation first imported and applied by industrial actors have significantly shaped the post-war architectural discourse. Vice versa, discussions of the international architectural avant-garde have informed the experiments of construction companies, as the two fields—industry and architecture—developed a close osmosis of ideas. In this way, while industrial actors and companies like Moelven Brug remain absent in Norwegian architectural history, they were equally important in developing new ways of building and thinking about architecture.

This chapter, thus, is not just the story of a new business structure or of a company's development, but rather a snapshot of the era, where international models and new modes of thinking fuelled by the belief in technological progress and scientific thinking permeated a wide range of professional realms. By tracing these ideas, people, processes and institutions, this chapter offers the reader an introductory map of the Moelven universe, full of managers and engineers.

PRODUCTIVITY FRENZY

The 1950s was a decade of productivity. Although ideas of rationalisation, mechanisation and industrialisation were high on Norwegian political agenda since the WWII, as Norway emerged from the war-time turmoil with significant destructions, most resources were prioritised for post-war reconstruction. The 1945 Price and Rationing Law introduced strict frameworks for industrial output and currency exchange, as the state maintained tight control over import, export and the prices of consumer goods. This left little to no incentive for small industrial companies of the scale of Moelven to optimise and modernise their production. And productivity was indeed low: most enterprises utilised outdated equipment and ineffective methods, and thus required high

3 Nicholas Bullock, *Building the Post-War World: Modern Architecture and Reconstruction in Britain* (London: Routledge, 2002), introduction, xiii.

Fig. 2. In the post-war period, the gospel of productivity seeped into different areas of life. On the image, the 1st of May demonstration in Oslo in the early 1950s. The slogan reads: "High production means high living standard." From *Storhetstid (1945-1965)*.

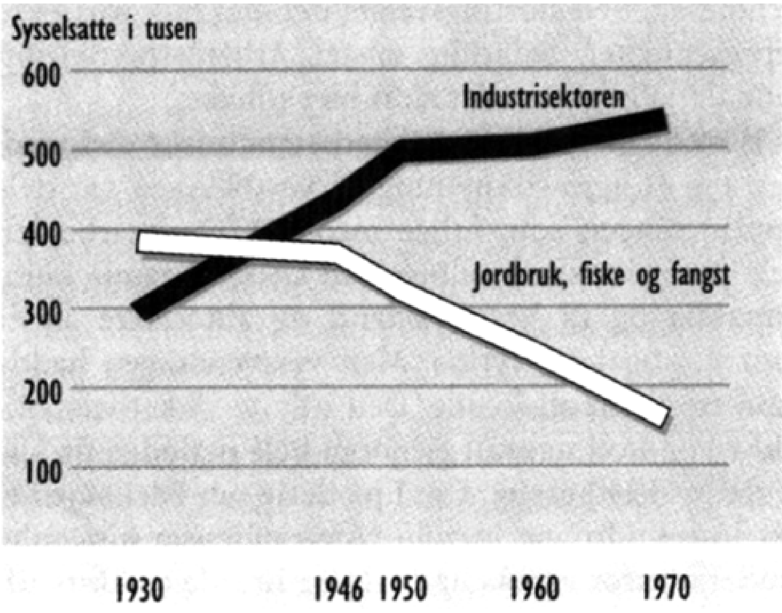


Fig. 3. A graph tracing changes in employment in the industrial sector (black) and primary industries (white), 1930 to 1970. From *Samling om felles mål*, 207.

labour input per unit produced.[4] By the early 1950s as Norway entered a period of "normalisation," the Labour government was faced with a political choice between continuing the planned economy and moving towards a more open market alternative, supported by generous American funding. According to Norwegian business historians Amdam and Yttri, under pressure from business and industrial elites and the Marshall Plan representatives in Oslo, the choice tilted towards the latter. Consequently, rationing regulations were upheld and a Norwegian Productivity Institute (NPI), similar to already-existing productivity centres in most OECD countries was established in June 1953, landing into a fertile ground provided by a handsome four million US dollars grant from the Benton-Moody program issued a couple months prior.[5] NPI's foundation did not just mark the start of the new gleaming era of productivity and mechanisation, but also cemented the alliance between the Labour Party and business and industrial elites, providing a foundation for the next two decades of Norwegian economic development.[6]

Under the auspices of the EPA—an umbrella-organisation for all national European productivity centres—the American "cult of productivity" and new ideas of business organisation and management made their way into Europe.[7] By the end of the 1950s, nearly 15.000 American engineers, economists and statisticians equipped with new methods developed by the American Bureau of Labour Statistics were sent to Europe to measure productivity levels and offer advice on how to improve them. In return, more than 19.000 European technicians, specialists and industry leaders went to the United States on so-called "productivity trips" to observe American practices of management and manufacturing and visit factories, farms, stores and offices.[8] Thousands of technical manuals and information booklets were shipped from the United States to Europe, as the American statistics specialists devised key performance indicators to measure and compare industrial productivity

4 Even Lange, *Samling om felles mål: 1935-1970*, *Aschehougs norgeshistorie* (Oslo: Aschehoug, 2005), 210.

5 On the political struggle around the establishment of NPI see Rolv Petter Amdam and Gunnar Yttri, "The European Productivity Agency, the Norwegian Productivity Institute and the Management Education," in *Missionaries and Managers: American Influences on European Management Education, 1945-60* (Manchester: Manchester University Press, 1998), 4–6.

6 Lange, *Samling om felles mål*, 214–30.

7 Haldor Byrkjeflot and Tor Halvorsen, "The Institutionalization of Industrial Administration in Norway 1950-90: Consequences for Education in Business Administration of Domination by Engineering," Særtrykk Nr 5 (Bergen: Institutt for administrasjon og organisasjonsvitenskap, Universitetet i Bergen, 1996), 43.

8 *European Productivity and Technical Assistance Programs, a summing up (1948-1958),* Paris, International Cooperation Administration, technical Cooperation Division, May 15, 1958, 7.

across different European countries.[9] Conceived of as unambiguous, impersonal measures of productivity, these indicators were neither neutral nor objective, imbued with theoretical assumptions about what should be counted, producing the phenomenon of productivity as much as measuring it. Although, according to anthropologist Sally Engle Merry, such comparative indicators are essential for allocating foreign aid, they tend to ignore local specificity and particularities in favour of universal categories and standardised knowledge.[10] As American measures of productivity were implemented in post-war Europe, so were the implicit American values and social norms, associated with this new approach to work, often at odds with specific local realities.[11]

And particularly in Norway these international industrial and business standards could hardly be applied. Most Norwegian industrial companies were small—by 1953, 63% had less than 20 employees, with no tradition of management and business administration.[12] According to economic historian Tor Halvorsen, Norwegian businesses often retained a patriarchal form of organisation, where the owner and the manager were often the same person, and relationships with workers approximated familial relations.[13] Managerial education was not common, and many positions were filled by engineers: even by 1967, only 10% had a proper managerial education.[14] This lack of managerial training was just one among 35 other problematic aspects of Norwegian businesses identified in a 1963 NPI's overview report.[15] Other problems included limited production capacity, little specialisation of production, outdated and inappropriate machinery, little production planning and little application of standards, inaccurate tolerances and ineffective quality control. Advertisement and sales practices were not developed, and there was little coordination between budgeting, sales office and production, while the companies

9 Solidelle F Wasser, "BLS and the Marshall Plan: The Forgotten Story," *Monthly Labour Review* 128, no.6 (June 2005): 50.

10 Sally Engle Merry, "Measuring the World: Indicators, Human Rights, and Global Governance," *Current Anthropology* 52, no. S3 (2011): 584–86, https://doi.org/10.1086/657241.

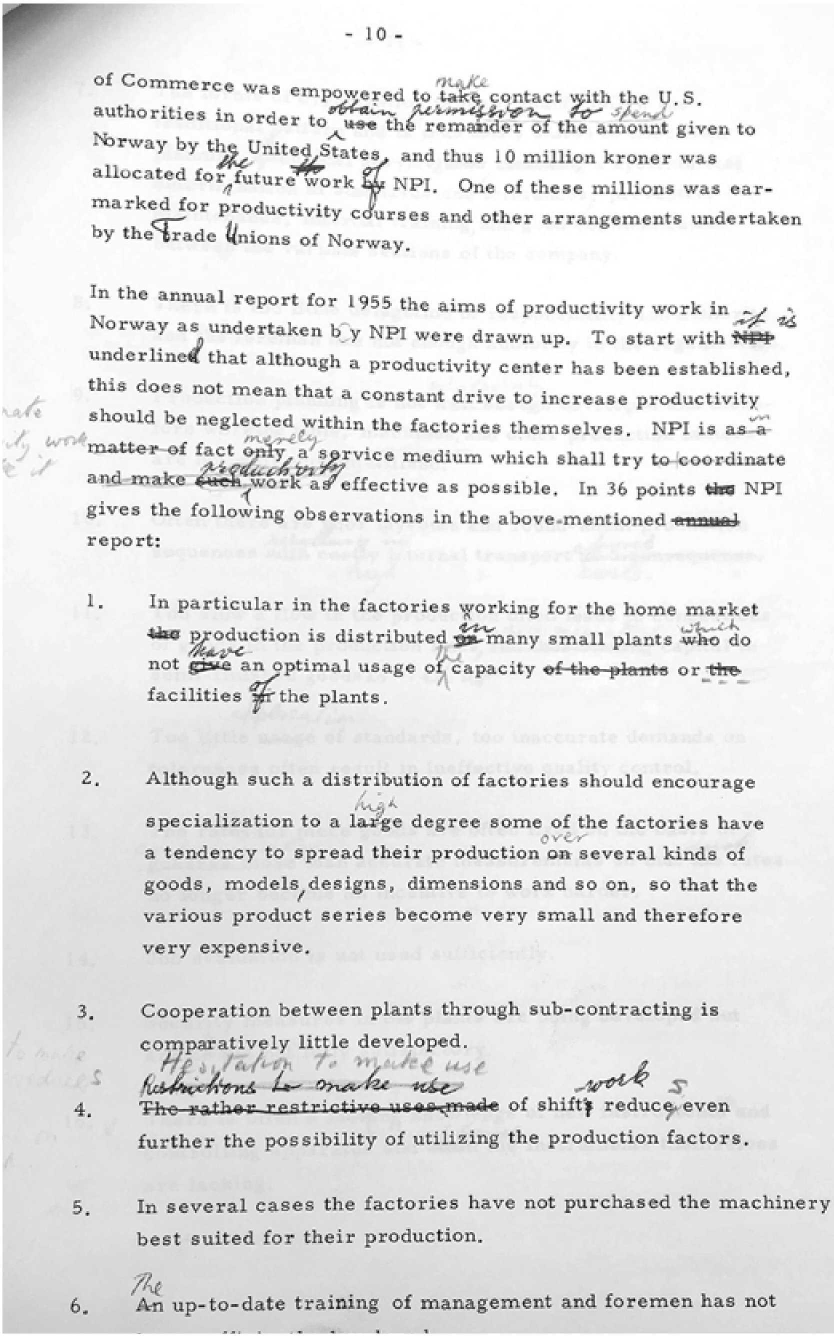
11 On further critique of EPA see Bent Boel, *The European Productivity Agency and Transatlantic Relations, 1953-1961:* (Museum Tusculanum, 2003), https://vbn.aau.dk/en/publications/the-european-productivity-agency-and-transatlantic-relations-1953.

12 Norsk Produktivitetsinstitut, *Uderleveandørsystemet (Sub-constracting) i De Forente Staters industri: Rapport fra den norske studiegruppe (TA 48-174) som etter Mutual Security Agency's program besøkte USA i tiden 24. april til 26. juni 1953. Oslo, 1954*. In Rolv Amdam and Ove Bjarnar, "Regional Business Networks and the Diffusion of American Management and Organisational Models to Norway, 1945-65," *Business History* 39 (January 1, 1997): 75, https://doi.org/10.1080/00076799700000004. See more in RA/S-1623/D/Da/L0123 Folder 0004 - 201 "Selvfinansierte TA-studiereiser til USA."

13 Tor Halvorsen, *Profesjonalisering - Taylorisering* (Bergen, 1982), 11.

14 Rolv Petter Amdam, "Foreign Influence on the Education of Norwegian Business Managers, before World War II," Særtrykk 12 (Sandvika: Norwegian School of Management, 1994), 87.

15 NPI project no. 503 "NPIs 10-års beretning på engelsk," 11-13. Folder 0001, RA/S-1623/D/Df/L0417, State Archive, Oslo, Norway.



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of Commerce was empowered to ~~take~~ make contact with the U.S. authorities in order to obtain permission to spend ~~use~~ the remainder of the amount given to Norway by the United States, and thus 10 million kroner was allocated for the future work ~~the~~ ~~by~~ of NPI. One of these millions was earmarked for productivity courses and other arrangements undertaken by the Trade Unions of Norway.

In the annual report for 1955 the aims of productivity work in Norway as undertaken by NPI were drawn up. To start with ~~NPI~~ it is underlined that although a productivity center has been established, this does not mean that a constant drive to increase productivity should be neglected within the factories themselves. NPI is as ~~a~~ in ~~matter of~~ fact ~~only~~ merely a service medium which shall try ~~to~~ coordinate ~~and make~~ ~~such~~ productivity work as effective as possible. In 36 points ~~the~~ NPI gives the following observations in the above-mentioned ~~annual~~ report:

1. In particular in the factories working for the home market ~~the~~ production is distributed ~~on~~ in many small plants ~~who~~ which do not ~~give~~ have an optimal usage of the capacity ~~of the plants~~ or ~~the~~ facilities ~~in~~ of the plants.

2. Although such a distribution of factories should encourage specialization to a ~~large~~ high degree some of the factories have a tendency to spread their production ~~on~~ over several kinds of goods, models, designs, dimensions and so on, so that the various product series become very small and therefore very expensive.

3. Cooperation between plants through sub-contracting is comparatively little developed.

4. Hesitation to make use ~~Restrictions to make use~~ ~~The rather restrictive uses made~~ of shifts work reduces even further the possibility of utilizing the production factors.

5. In several cases the factories have not purchased the machinery best suited for their production.

6. ~~An~~ The up-to-date training of management and foremen has not

Fig. 4. A draft of the NPI's report on problems identified within Norwegian industries. NPI project no. 503 "NPIs 10-års beretning på engelsk," 10-11. Folder 0001, RA/S-1623/D/Df/L0417, State Archive, Oslo, Norway.

7. The forms of organization in many plants follow the traditional pattern and ~~is~~ are thus badly suited to undertake planning, technical service, ~~also including~~ a systematical determination of standards and tolerances, preventive maintenance, internal training, and good communication between the various sections of the company.

8. There is too little delegation of responsibility and authority, and the foreman has not enough authority in the organization.

9. Production planning is not ~~well enough~~ satisfactorily developed and therefore working time, machines, and other production factors are not well enough utilized.

10. Often there are poor lay-outs and round-about production sequences ~~with~~ resulting in costly internal transport ~~is a consequence.~~ high costs.

11. Too slow a flow in the production often leads to congestions of goods ~~in~~ on the production lines, ~~and thus binding~~ which means that capital in semi-finished goods is tied up.

12. Too little ~~usage~~ application of standards, too inaccurate demands on tolerances often result in ineffective quality control.

13. The rates for piece goods are often fixed on the basis of ~~guesses more~~ conjecture rather than accurate measurements so that ~~the~~ such rates no longer become an incentive to work harder.

14. Job evaluation is not used sufficiently.

15. Security measures in the plants are being developed but are as yet not fully satisfactory.

16. There is often a ~~lacking~~ faulty knowledge of new instruments and controlling apparatus and ~~often~~ at times the instruments themselves are lacking.

lacked trained sales personnel. Research institutions were not in the position to offer any guidance in regard to process control and tooling, and neither transportation nor tax systems facilitated industrial development.[16] To counteract these shortcomings, NPI's engineers and productivity specialists mobilised principles of scientific management and rational business organisation, promoting quantification of processes, further mechanisation and new managerial and business education.

NPI's productivity efforts were primarily directed towards structural issues prevalent in different branches of Norwegian industry, while productivity questions of individual companies were left to private rationalisation agencies. Perhaps the most prominent of them was Industriforbundets Rasjonaliseringskontor, a rationalisation bureau of the Norwegian Federation of Industries—IRAS for short—that carried the new productivity ideology into smaller industrial companies, such as Moelven Brug. Established in 1928, the bureau particularly flourished in the post-war period with the onset of the productivity frenzy: both public and private actors turned to IRAS for advice on more efficient organisation and streamlined technological processes. Its clients ranged from industrial giants like Freia and Norsk Hydro, producers of consumer items like Apothekernes Laboratorium, Hansa Bryggeri, Jordans Børste & Penselfabrikk and Stabburet Gunnar Nilsen, to public entities, like Scandinavian Airlines, Oslo Sporveier, Norsk Tipping or Oslo municipal Road Agency. Despite its broad engagement in Norwegian industrial life, IRAS activities remain little researched.[17] IRAS collaborated closely with NPI, as generous American funding allowed the bureau's experts to travel to the United States and in turn, invite prominent American researchers to lecture in Norway.[18] As IRAS specialists were well-aware of the most recent industrial developments in Europe and abroad, the bureau became one of the key modernisation agents of post-war Norway, directly translating American models of business management and organisation into Norwegian businesses through concrete studies, reports and suggestions. Moelven was one of its many clients.

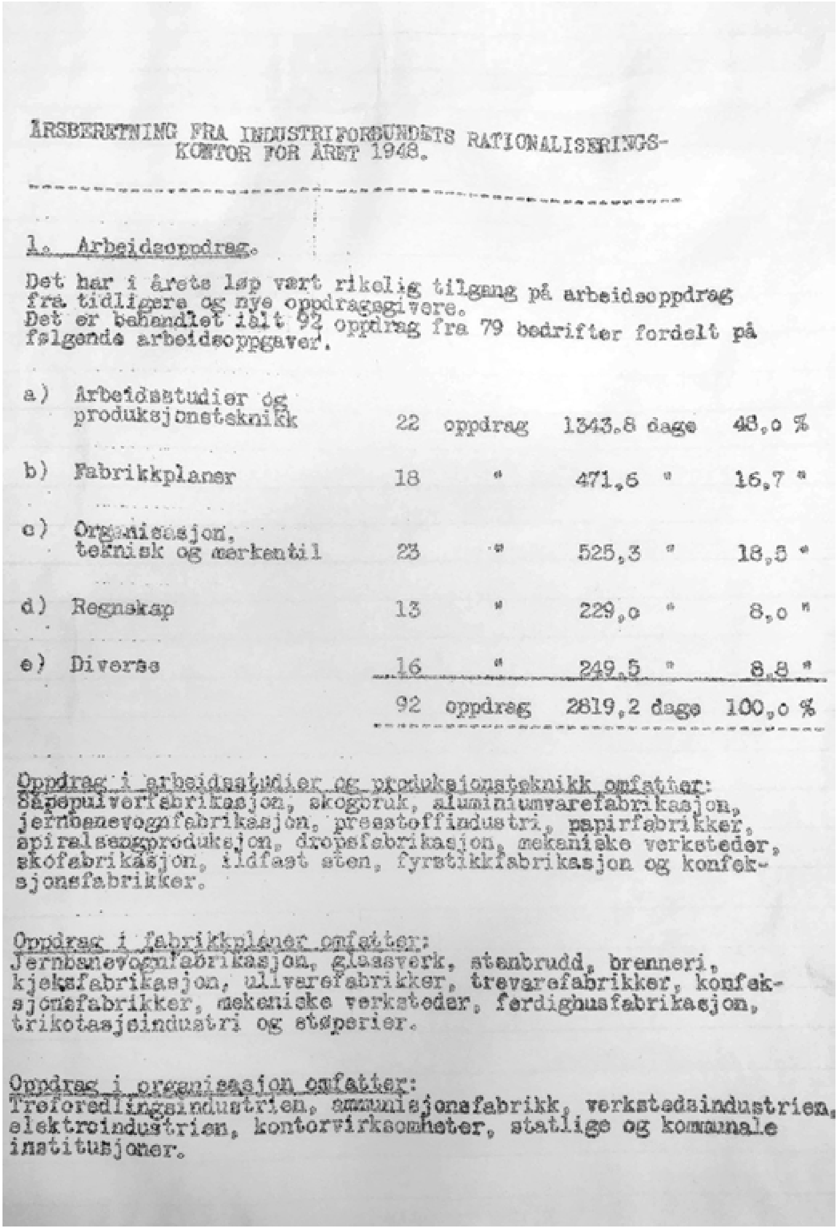
16 NPI project no. 503, RA/S-1623/D/Df/L0417/0001.
17 For an exhaustive list of clients, see IRAS debtor lists from 1939 onwards in RA/PA-0636/A/Ab/L0132.
18 See "Årsberetning for året 1948" in RA/PA-0636/A/Ab/L0133; "Årsberetning for året 1949" in RA/PA-0636/A/Ab/L0133.

A NEW-OLD FACTORY

Coming into this productivity frenzy of the 1950s, Moelven Brug was not in its best form. From its foundation in 1899, the company worked mostly with timber products—wheels, trailers, carriages and equipment for agriculture.[19] Wheels were a local Ringsaker speciality and were often exported to nearby regions. In the early 1900s, the company developed a specific technology boiling each wheel in 900 grams of flax seed oil for more sturdiness. Following this, Moelven wheels became a trademark well-known across the country and even abroad: more than 500.000 units were sold in the first 50-year period.[20] In 1902 Moelven bought its own birch forest, and with more high quality timber available, the company expanded its operations to making planks, boards, beams, doors, window frames and furniture—basically, all the elements required to build a house. In the early 1910s the company briefly ventured into construction with a pre-cut method—not an unusual development for a sawmill at the time.[21] Among Moelven's first prefabricated structures were "Doktorgården" for doctor Wergeland, a pharmacy in Tynset, a house for the Hjelt sisters, who had returned from the Unites States, a villa for a merchant from Messelt and Augedal Bros Hotel in Brandbu.[22] However, this venture was short-lived, as house-building required too much coordination and with resistance from local carpenters proved nearly impossible.[23] Wheels and carriages thus were Moelven's bread-and-butter. In a way, they also contained the core of the company's future transformation: wheels consisted of both wooden and metal parts, requiring expertise of carpenters and blacksmiths. As Moelven general manager Johannes Mageli later recalled, having both metal and timber workshops allowed the company to quickly restructure its operations and venture into production of prefabricated houses in the mid-1950s.[24]

From its foundation, Moelven Brug was run as a shareholder enterprise, headed by a board of directors. All daily matters were resolved by the *disponent*—a now-outmoded Norwegian term for a hired managing director of a smaller shareholder company.[25] The first Moelven disponent,

19 Trygve Dalseg, *Med Moelven-hjul på vei gjennom tiden: historien om Aktieselskabet Moelven Brug i de første 50 år, 1899-1949* (Moelv: Moelven Brug, 1966), 28.
20 Dalseg, 38.
21 More on early prefabrication see Kari Amundsen, *Complet færdige Huse: Strømmen trævarefabrik - ferdighusproduksjon 1884-1929* (Oslo: Bonytt, 2002). Elsa Reiersen, *Fenomenet Thams* (Oslo: Aschehoug, 2006).
22 Dalseg, *Med Moelven-hjul på vei gjennom tiden*, 48–52.
23 Dalseg, 53–54.
24 Interview with Mageli by Per Granberg, titled "Moelven-notater i hovedsak bygget på samtaler med Mageli i febr./mars. 1998," dated Moelv, March 17, 1998, 9. Folder L001, Box 08, SAH/ARK-287-01.
25 Store Norske Leksikon, https://snl.no/disponent, accessed March 1, 2021.



ÅRSBERETNING FRA INDUSTRIFORBUNDETS RATIONALISERINGS-
KONTOR FOR ÅRET 1948.

1. Arbeidsoppdrag.

Det har i årets løp vært rikelig tilgang på arbeidsoppdrag fra tidligere og nye oppdragsgivere.
Det er behandlet ialt 92 oppdrag fra 79 bedrifter fordelt på følgende arbeidsoppgaver.

a)	Arbeidsstudier og produksjonsteknikk	22	oppdrag	1343.8 dage	48,0 %
b)	Fabrikkplaner	18	"	471,6 "	16,7 "
c)	Organisasjon, teknisk og merkantil	23	"	525,3 "	18,5 "
d)	Regnskap	13	"	229,0 "	8,0 "
e)	Diverse	16	"	249,5 "	8,8 "
		92	oppdrag	2819,2 dage	100,0 %

Oppdrag i arbeidsstudier og produksjonsteknikk omfatter:
Såpepulverfabrikasjon, skogbruk, aluminiumvarefabrikasjon, jernbanevognfabrikasjon, presstoffindustri, papirfabrikker, spiralsengproduksjon, dropsfabrikasjon, mekaniske verksteder, skofabrikasjon, ildfast sten, fyrstikkfabrikasjon og konfeksjonsfabrikker.

Oppdrag i fabrikkplaner omfatter:
Jernbanevognfabrikasjon, glassverk, stenbrudd, brenneri, kjeksfabrikasjon, ullvarefabrikker, trevarefabrikker, konfeksjonsfabrikker, mekaniske verksteder, ferdighusfabrikasjon, trikotasjeindustri og støperier.

Oppdrag i organisasjon omfatter:
Treforedlingsindustrien, ammunisjonsfabrikk, verkstedsindustrien, elektroindustrien, kontorvirksomheter, statlige og kommunale institusjoner.

Fig. 5. IRAS yearly report identifying different aspects of operations, for example "factory plans" or "technical and business organisation." "Årsberetning for året 1948" in RA/PA-0636/A/Ab/L0133, State Archive, Oslo, Norway.

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Oppdrag i regnskapsvesen omfatter:
Verkstedsindustrien, treforedlingsindustrien, skofabrikker, statlige og kommunale institusjoner.

2. Kontorets statutter.

I statuttene for Industriforbundets Rationaliseringskontor A/S er det i årets løp foretatt endel endringer. Således er antall styremedlemmer endret fra 5 til 7 medlemmer.

3. Avdeling i Bergen.

IRAS' har gjennom Norges Industriforbund fra Industriavdelingen i Bergen Håndverk- og Industriforening mottatt forespørsel om opprettelse av en avdeling av IRAS i Bergen, særlig for arbeidsstudieservice.

4. Psykotekniske prøver.

Etter henvendelse fra Norges Industriforbund er det behandlet en forespørsel fra Industriforbundet om muligheten for opprettelse av en psykoteknisk avdeling ved Industriforbundet eller ved IRAS.
Kontorets styre besluttet å sende et skriv til Industriforbundet med anbefaling om at det nedsettes et utvalg med representanter fra industri, håndverk, Arbeidsdirektoratet og Universitetet for å legge en praktisk plan for en rasjonell løsning vedrørende utbygging av psykoteknikken i Norge.

5. Studiereiser.

Ingeniøren Fernholt, Hirsch, Vetlesen og Langberg har i årets løp foretatt studiereiser til Sverige med et samlet antall av 64 studiedager.
Cand. jur Eddy Larsen deltok i Cios-kongressen i Stockholm.
Sjefingeniør Folkvard avsluttet sitt studieopphold i U.S.A. den 15. mars og deltok i juli måned i Cios-kongressen i Stockholm.

6. Kurser og foredrag.

I årets løp er det av ingeniørene Folkvard, Fernholt, Hirsch og Bjerkhoel Nielsen gitt undervisning i et arbeidsstudiekurs arrangert av IRAS for Papirindustriens Arbeidsgiverforening.

Ingeniørene Folkvard og Fernholt har forelest ved arbeidsstudiekurs arrangert av De Mekaniske Verksteders Landsforening.

Videre har sjefingeniør Folkvard i årets løp holdt flere foredrag.

Otto Minken, was a former telegraphist at the local train station; he carried out the combined duties of a manager, accountant and treasurer. With neither experience in the industry nor business education, he nevertheless cultivated a strong interest in PR and advertisement.[26] Under his initiative, the company started to publish attractive product catalogues and through numerous press appearances became known as "Scandinavia's largest wheel- and advertisement maker."[27] Otto Severin Myrbakken with a background in military schooling took over in 1911, serving several terms up until 1948.[28] By then, the company was in a bad shape: price regulation and low productivity of the post-war period stalled the production, mechanisation of agriculture made timber wheels obsolete, while the last attempt at production restructuring dated back to Minken's times. When a 30-year-old manager Johannes Mageli was hired in 1949, although he expected to see an "old and well-established business" he soon realised that Moelven was in "a very lousy condition."[29]

According to Mageli, reactionary business management, unchanged since 1911, had run the company into the ground, "[threatening] the business's very existence [...] Radical transformation [was] unavoidable."[30] By the 1950s, the company was running out of money, there was little division of work, production largely relied on workers' experience and productivity was low, "even if measured by [Norwegian] industrial standards of the time."[31] The company lacked technical and business leadership, two foremen led the workforce of 130 while the administration consisted of only six people.[32] The work went after 50-year-old templates and there was not a single construction engineer on staff. Thus, by the 1950s the company faced a dramatic choice: either modernise its production entirely or bring its half-a-century history to a close. As Mageli later maintained: "although it could have been a pleasurable experience to modernise and rationalise the production, it was no longer needed: the wooden wheels were out, and we had to find something new."[33] And something new it was: Mageli soon came up with the idea of temporary workers housing—the so-called

26 Dalseg, *Med Moelven-hjul på vei gjennom tiden*, 65–66.
27 Dalseg, 66.
28 Dalseg, 163.
29 In Geir Vestad and Hamar arbeiderblad, *Hedmarks profiler: Hamar Arbeiderblad 1925-2000*, *Littforsk* (Hamar: Hamar media, 2000), 54–55. and Ola Alsvik and Jan Haug, *Storkommunen: Ringsaker* (Brumunddal: Brøttum historielag, 2006), 192.
30 Dalseg, *Med Moelven-hjul på vei gjennom tiden*, 192.
31 Alsvik and Haug, *Storkommunen*, 168.
32 Johs Mageli, *A/S Moelven brug: karakteristika og synspunkter*, Kristofer Lehmkuhl forelesning 1977 (Bergen: Norges handelshøyskole, 1977), 4.
33 *Gudbrandsdølen*, October 18, 1957, 3.

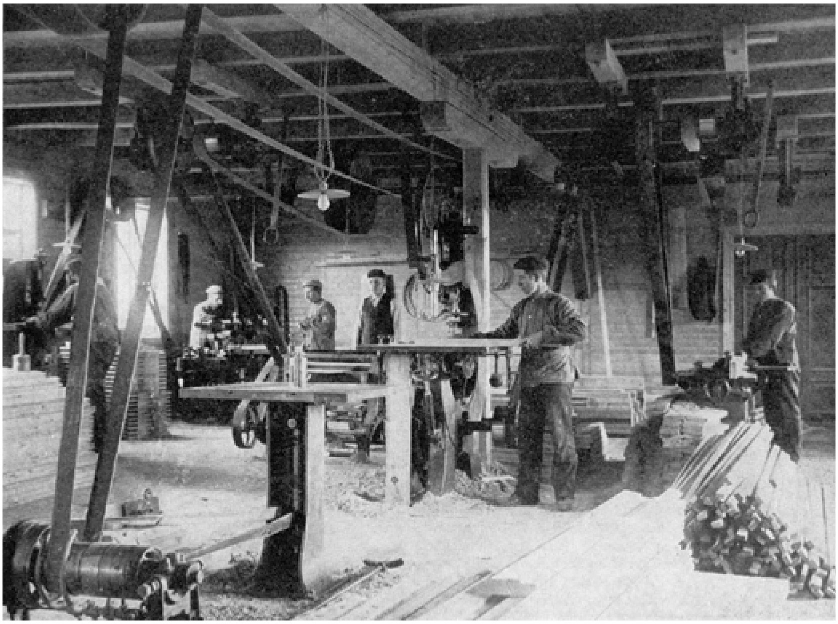


Fig. 6. Moelven workers in the factory’s workshop, ca. 1900. From *Moelven Brug i forvandling og vekst*, 8.

Fig. 7. Otto Minken and office assistant Alf Bjørnstad in Moelven office, 14th of May 1903. From *Med Moelven-hjul på vei gjennom tiden*, 26.

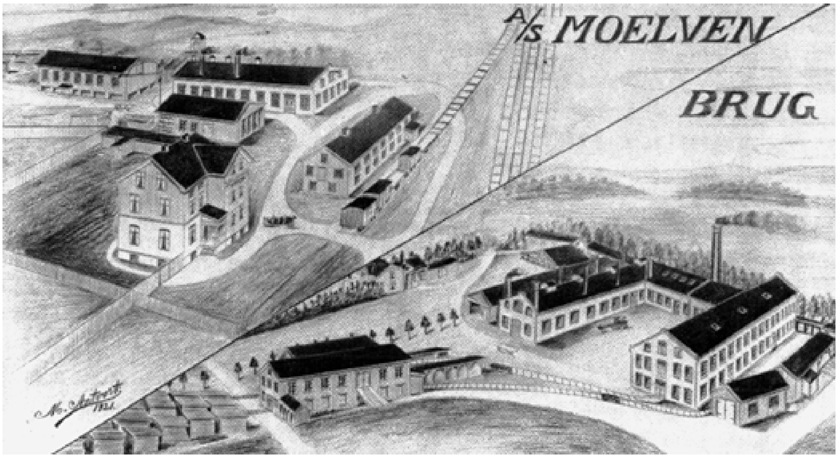


Fig. 8. A drawing of Moelven factories, 1921. From *Moelven Brug i forvandling og vekst*, 32.

"houses-on-wheels."[34] With construction of new industrial facilities across the country, such housing hit the right spot in the market: they became Moelven's "golden egg" and the company's new trademark.[35]

While the company was at the beginning of its venture into prefabrication, its administrative and technical structures lagged behind. In 1954, Moelven reached out to IRAS. This was not the first time the bureau was summoned to solve product and management issues at Moelven: Mageli himself was hired through IRAS assistance in 1949, and three years earlier, in 1946, IRAS engineer Bernhard Hellern—the "Norwegian Taylor"—had prepared a detailed report with suggestions for potential product expansion.[36] However, these early rationalisation attempts required large capital investments, and were hardly possible to implement without a clear long-term vision of product diversification. In 1955, guided by the strong managerial grip of Mageli, the company was already more financially stable, new prefabricated products were in the works and the expanding scope of operations demanded a clear design of work processes. The new era of rationalisation, scientific management and mechanisation—brought about by IRAS—was just about to reshape the firm.

LAX GRIP OF THE VISIBLE HAND

In the spring of 1955, IRAS rationalisation managers spent several months observing and analysing Moelven work processes. The initiative was not only to introduce a new administrative structure, but mediate the shortcomings of a traditional form of business organisation that, according to American experts, was "badly suited to undertake planning, technical service, preventive maintenance, internal training and good communication."[37] After several drafts, by April 1955 a new organisational structure was settled upon. An elaborate tree-like chart diagram divided Moelven production processes into five specialised functional units.

A construction department headed by engineer Edland was to develop new product lines and improve existing ones; a production-technical section with engineer Høstmark was to introduce more planning, provide technical maintenance, and introduce benchmark controls for quality and efficiency of production. In addition, it managed all

34 Torbjørn Hovde, *Moelv - fra ødemark til by*, *Norbok* (Brøttum: Hovde forl., 2011), 39–40.
35 On Moelven new products see Oddvar Hemsøe, *Moelven 1899-1999* (Moelv: Moelven industrier, 1999), 28–33.
36 Due to the limited archival scope of both Moelven and IRAS archives, direct correspondence between the two companies is hard to trace. However, Moelven appears in IRAS debtor lists several times throughout the 1950s-60s. See RA/PA-0636/A/Ab/L0133.
37 NPI project no. 503 "NPIs 10-års beretning på engelsk," points 7, 11.

production flows, planned storage of raw materials and finished products.[38] A separate economic department headed by the office chief Pedersen was to apply new accounting techniques, including dynamic budgeting for a more accurate business administration and correct product prices.[39] A new HR department—jointly supervised by the three departments' heads—was to improve hiring routines, personnel training and communication. Finally, a sales department, the cornerstone of American business practice, was to conduct market research and analysis, develop sales routines, arrange international and national exhibition presence and manage all public relations of the business.[40] Headed by Per Granberg, a former editor of the local newspaper *Ringsaker Blad*, the department picked up Moelven's tradition for daring advertisements with a renewed American rigour: it hired professional agencies of international profile and devised aggressive advertising campaigns that made Moelven a household name across the country. The IRAS administrative reorganisation plan shook up a 50-year-old business tradition and refurbished it to fit new American standards of business administration.

This administrative transformation was a Norwegian analogue of what Chandler called "the managerial revolution," where the invisible hand of the market was substituted by the visible hand of managers.[41] Although in the case of 1950s Norway it was the hand of the state that was substituted by that of managers, this administrative transformation nonetheless ushered in an entirely new culture of work relations. The IRAS *Instansplan* is a particularly curious artefact, since it visualised the labour of management, and by extension, a transformation of Moelven from a local business run largely ad-hoc, into one governed by market analysis and modern managerial methods. American historian Michael Osman argues that similarly to the way new ecological representations made principles of natural regulation visually evident, graphs and diagrams that visualised managerial work made it into a new form of labour and knowledge.[42] In the case of Moelven, IRAS chart visualised not just new regulatory thinking, but defined a new phenomenon—the labour of managers, a phenomenon that did not exist previously in Norwegian business culture. This was largely due to the fact that Norway belonged to a German tradition of business education that considered

38 "Instansplan" and "Organisasjonsplan," 4.1-4.6.
39 "Instansplan" and "Organisasjonsplan," 5.1-5.7.
40 "Instansplan" and "Organisasjonsplan," 3.1-3.5.
41 See introduction to Alfred D. Chandler, *The Visible Hand*, 2–3.
42 Michael Osman, *Modernism's Visible Hand: Architecture and Regulation in America* (Minneapolis: University of Minnesota Press, 2018), 127.

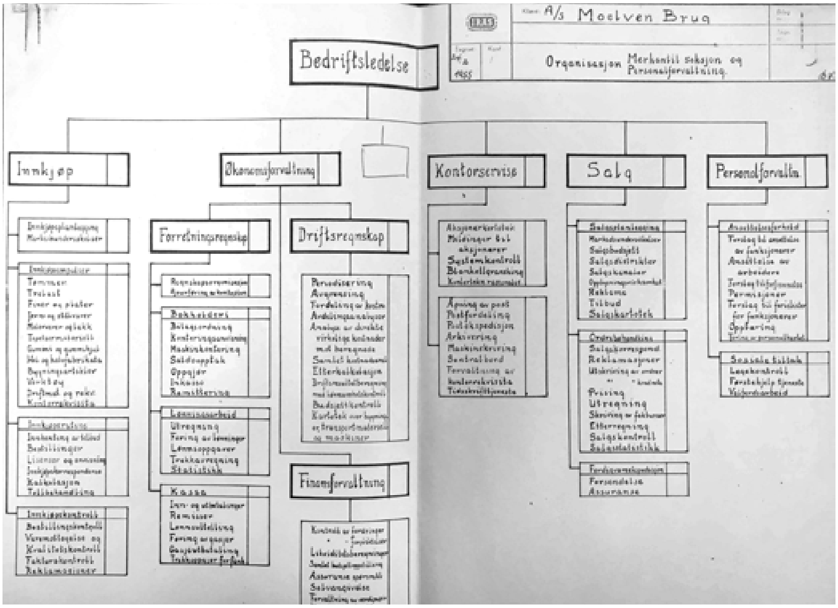


Fig. 9."Instansplan IRAS-LN-april 1955," in Folder 0001 "Lover/vedtekter, organisasjonsplaner," p. 4.1-4.6 in SAH/ARK-287-01/N/L0001, State Archive in Hamar, Norway.

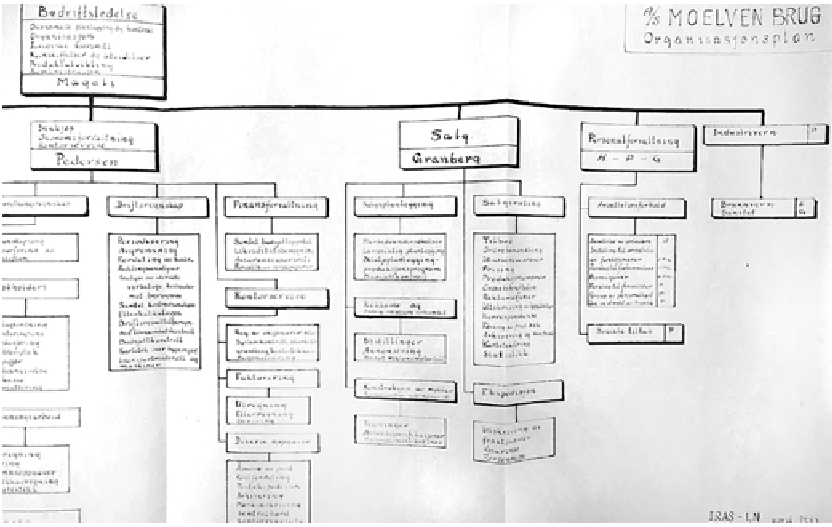


Fig. 10. Another verision of the chart. "Organisasjonsplan IRAS-LN-april 1955," in Folder 0001 "Lover/vedtekter, organisasjonsplaner," SAH/ARK-287-01/N/L0001, State Archive in Hamar, Norway.

Fig. 11. Moelven's new managers. From left to right: Høstmark, Granberg, Tjønnfjord (later repaced by Pedersen), Edland. From *Moelven Brug i forvandling og vekst*, 43.

management a "non-science"—business management was thought of in terms of accounting and budgeting, while leadership was not thought of as something that could be taught, but rather obtained through specialised technical educational and work experience.[43] Economic historian Robert Locke defined this attitude as "the halfway house": in many European countries, business administration was not established as a separate discipline in the American sense until well into the 20th century.[44] Indeed, a 1963-NPI report still earmarked management as a problematic area within Norwegian businesses, claiming that "up-to-date training of management and foremen [had] not [yet] been sufficiently developed."[45] Finding professionally-educated managers able to take on the sophisticated industrial production planning was particularly hard for the company since "Moelv was a little bit too remote" and, perhaps, not so glamorous for the few high-class professionals that existed in Norway.[46]

To develop the grip of those managers that the company managed to hire, IRAS supplemented its administrative chart with an elaborate "how-to" manual for each unit manager.[47] For example, functional hierarchy and subordination within the structure were to be respected: "Nobody is to give orders to anyone else but their direct subordinates. One must not look for contact with anyone at the lower level of responsibility without notifying the leader that is directly responsible for this work. Inversely, one must not look to establish contact with people above within the hier-

43 Byrkjeflot and Halvorsen, "The Institutionalization of Industrial Administration in Norway 1950-90," 8–9." Byrkjeflot, "Management Education and Selection of Top Managers in Europe and the United States," 96–97.
44 Robert R. Locke, *Management and Higher Education Since 1940: The Influence of America and Japan on West Germany, Great Britain, and France* (Cambridge: Cambridge University Press, 1989), 69.
45 NPI project no. 503 "NPIs 10-års beretning på engelsk," points 6, 8, 26, 11-13.
46 *Arbeiderbladet*, March 18, 1964, 14.
47 See "Generell Hovedinstruks," in IRAS "Organisasjonsplan LN/ITL," 1955, 0.1 in Folder 0008, SAH/ARK-287-01/N/L0001.

archical ladder without notifying their direct superior."[48] The instructions encouraged planning and delegation of work in the most "rational" and "productive" manner: "each functionary should engage in a stimulating cooperation with their subordinates, closely follow their work, advice and explain the background and the relationship between different work tasks in order to obtain a core staff of expert, interested colleagues."[49] The manual even addressed ethical aspects of the new business culture: "a superior functionary shall never talk about the incorrect actions or reprimand a subordinate in the presence of others."[50] Each manager was considered an essential part of the complex business ladder, had to "always advance the business' interests" and refrain from talking about the company's works, with the exception of "strictly necessary information that follows from one's work in the company."[51] IRAS administrative chart with supplementary instructions worked as a short hands-on introduction into the western style of management, promoting what historian JoAnne Yates calls a "rational and impersonal" systematic management supported by new communication systems, surpassing the previously informal and oral mode of communication.[52] Since nearly all Moelven managers—including Høstmark, Edland, Pedersen and Granberg—came from engineering backgrounds, the IRAS manual was essential for the successful implementation of the new managerial order.[53]

Since most of Moelven's technical research, product design and construction responsibilities were carried out by engineers, this development found a reflection both in the company's products and internal work processes. As economic historians Byrkjeflot and Halvorsen note, engineers-turned-managers approached product and process design differently, often relying on scientific principles, abstract models and experimental trials with scientifically controlled variables.[54] This, however, was not specific to Norway: technology historian David F. Noble maintains that American engineers-cum-managers did not only devised new products according to the principles of scientific

48 See point 1.1 in "Generell Hovedinstruks."
49 See point 3.2 "Opplaring, samarbeid" in IRAS "Organisasjonsplan LN/ITL," 1955, 0.2 in Folder 0008, SAH/ARK-287-01/N/L0001.
50 See points 3.3 in IRAS "Organisasjonsplan LN/ITL."
51 See points 4.0 and 4.1 in IRAS "Organisasjonsplan LN/ITL."
52 JoAnne Yates, *Control through Communication: The Rise of System in American Management*, vol. [6], Studies in Industry and Society (Baltimore, Md: Johns Hopkins University Press, 1989).
53 Previously, Høstmark worked a technical engineer at Ankerløkkens Mekaniske Verksted in Hamar, while Einar Edland was an engineer with broad experience in mechanical industry. Ola Alsvik et al., *I krig og fred*, *Ringsakboka* (Brumunddal: Brøttum historielag, 2001), 398. *Ringsaker Blad*, Tirsdag 4 mai 1950, 1. *Ringsaker Blad*, August 19, 1958, 4. Trygve Dalseg and Moelven brug, *Moelven Brug i forvandling og vekst: en jubileumskavalkade 1899-1974* (Moelv: Moelven Brug, 1974), 43.
54 Byrkjeflot and Halvorsen, "The Institutionalization of Industrial Administration in Norway 1950-90," 176.

A/S Moelven Brug	GENERELL HOVEDINSTRUKS	Side 0.1

1. Myndighet og ansvar

1.0 En overordnet funksjonær har innenfor sitt arbeidsområde myndighet til å lede det daglige arbeid og til å kontrollere såvel utførelsen av arbeidet som de oppnådde resultater.

1.1 Ingen skal gi ordre til andre enn sine direkte underordnede. Det må således ikke søkes kontakt med personer på et lavere ansvarstrinn uten å underrette den leder som er ansvarlig for vedkommendes arbeid. Omvendt skal ikke personer på et trinn søke kontakt med personer på et høyere trinn uten å underrette sin direkte overordnede (jfr. dog punkt 1.2 nedenfor). Resultatet skal rapporteres til den direkte overordnede.

1.2 Prinsippet om at tjenesteveien skal følges, skal imidlertid ikke være til hinder for at det etableres krysskontakt mellom funksjonærer i forskjellige avdelinger. Er denne kontakt av rutinemessig art, dvs. faller innenfor de løpende arbeidsoppgaver, behøver en ikke å rapportere til overordnet. Oppstår det derimot tvilsspørsmål, skal saken forelegges for deres overordnede. Det samme gjelder spørsmål som ikke kan avgjøres innenfor den myndighet som er gitt dem.

Enhver arbeidsleder skal i det hele søke å stimulere samarbeidet også når det gjelder arbeidskontakter utenom avdelingen.

1.3 Enhver funksjonær er over for sin overordnede ansvarlig for utførelsen av de arbeidsoppgaver som er lagt under hans (hennes) arbeidsområde, og for spesielle oppgaver som er tildelt ham (henne).

Funksjonæren treffer selv avgjørelser i vanlige saker innenfor sitt ansvarsområde. I saker av mer omfattende eller spesiell karakter skal funksjonæren rådføre seg med sin direkte overordnede. Hvis forholdene ikke gjør en slik henvendelse mulig, konfererer vedkommende med sin overordnedes stedortreder eller han (hun) rådfører seg med sideordnede funksjonærer. En overordnet funksjonær har på sin side plikt til å bistå med råd og veiledning i spørsmål som gjelder hans (hennes) arbeidsområde.

2. Tilrettelegging av arbeidet. Arbeidsfordeling

2.0 En funksjonær har innenfor sitt ansvarsområde rett til og plikt til å planlegge og tilrettelegge utførelsen av de forskjellige arbeidsoppgaver. Alle funksjonærer må søke å løse arbeidsoppgavene på en rasjonell måte og om mulig komme med forslag til forbedringer.

Fig. 12. IRAS managerial instructions. General instructions on new avenues of communication on the left, and specific instructions for sales manager Granberg on the right. IRAS "Organisasjonsplan LN/ITL," 1955 in Folder 0008, SAH/ARK-287-01/N/L0001, State Archive in Hamar, Norway.

A/S Moelven Brug	STILLINGSINSTRUKS FOR SALGSSJEF GRANBERG	Side 3.1

1. <u>Plass i organisasjonen</u>

Salgssjefens nærmeste overordnede er disponenten. Salgssjefen er overordnet salgspersonalet.

2. <u>Ansvars- og myndighetsområder</u>

Salgssjefen har full linjeautoritet over salgspersonalet. Vedrørende salgssjefens generelle rettigheter og plikter henvises til generell hovedinstruks. Salgssjefens ansvarsområde omfatter ifølge organisasjonsplanen salget. De ulike funksjonene fremgår av organisasjonsplanen. Dessuten har salgssjefen personalforvaltning hva gjelder hans myndighetsområde. I ordinære og løpende saker innen sitt ansvarsområde treffer salgssjefen selv alle avgjørelser. I viktigere saker og saker av prinsipiell karakter plikter han alltid å konferere med disponenten.

3. <u>Samarbeid</u>

Salgssjefen plikter å samarbeide med kontorsjefen hva gjelder kredittkontroll av kundene, forslag til priser på standardvarer (prislister), fastsettelse av priser for varer som ikke er oppført i prislister og arbeidet i forbindelse med faktureringen. Med driftsingeniøren samarbeider salgssjefen hva gjelder forslag til produksjonsprogram og terminene når de ulike varer skal være klare for salg. Salgssjefen plikter videre å stå i daglig kontakt med teknisk avdeling hva gjelder den løpende tilpassing av salgets ordredata og produksjonen.

I forbindelse med produksjonen av brakker samarbeides med driftsingeniøren slik at salgsavdelingen har den rutinemessige kontakt med formann for brakkeverkstedet hva gjelder de enkelte brakkers detaljutstyr.

Videre samarbeides med driftsingeniøren eller en av dennes underordnede hva gjelder transport av ferdige varer. I forbindelse med brukets møbelproduksjon skal salgsavdelingen samarbeide med teknisk avdeling hva gjelder konstruksjon, planlegging og produksjonskontroll.

<u>Ansvars- og myndighetsområder</u>

4. <u>Salgsplanlegging</u>

Innenfor området salgsplanlegging arbeider salgssjefen i nær kontakt med disponenten. Salgssjefen skal bistå disponenten med forslag etc. vedrørende følgende punkter:

technology, but also applied the same principles to managing people.[55] In the case of Moelven, since engineers occupied most managerial positions they streamlined all production processes, drove mechanisation and conditioned the company's continuous pursuit of rationalisation that distinguished Moelven from its competitors. They were also perhaps the main reason why Moelven equated industrial development with higher levels of automation and the company's buildings were often advertised through their exact percentages of prefabrication.

A CRYSTAL BALL FOR SEEING THE FUTURE

If Moelven's middle-managers were engineers that lacked managerial education, business leadership and a strategic vision of the future, Johannes Mageli had plenty. It was under his guidance that the company grew from a regional business with 140 employees and a yearly turnover of 1,5 million NOK into one of the largest industrial enterprises in Norway, with profits of 460 million NOK and 1490 employees.[56] Unlike most Moelven managers, Mageli had a professional business education: he was among the first graduates of the first business school in the country, the Bergen School of Economics (NHH), which opened in 1936. Mageli's educational background had left a significant mark on his future professional endeavours: although NHH was established after the German *Handelshochschulen* and was strongly influenced by the *Wissenschaft* tradition, by the 1940s it also incorporated other models borrowed from the United States and Sweden. NHH students read Fredrick Taylor's *Shop Management,* as well as American and Swedish books on business administration and leadership.[57] NHH offered perhaps the most international-oriented education in the country, both employing professors from abroad and looking at the best international practices. At NHH, Mageli studied under the Swedish actuary enthusiast Robert Kristensson who introduced dynamic budgeting to Norway—an innovative system later introduced also to Moelven.[58] In addition, he

55 David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (Oxford: Oxford University Press, 1979), 258.

56 In 1976, Moelven group was ranked 62 out of 1000 of the Norway's largest industrial companies. *Norges 1000 største bedrifter: med nøkkeltall for næringsliv i* ...(Oslo: Økonomisk literatur, 1973). Interview with Mageli by Per Granberg, March 17, 1998, 9. Folder L001, Box 08, SAH/ARK-287-01.

57 From 104 books prescribed for reading at NHH at 1936, 41 were Swedish; 41 German, 13 American or English, 7 written by Sillén and 2 by Schmalenbach. Rolv Petter Amdam, *For egen regning: BI og den økonomisk-administrative utdanningen 1943-1993*, *Norbok* (Oslo: Universitetsforl., 1993), 56.

58 See "Innstilling vedrørende avdelingsregnskapets organisering i 1950-åra. avdelingsregnskap," particularly an algorithm-document titled "Skjematisk framstilling av driftsregnskap." In SAH/ARK-287-01/N/L0001/0010.

Fig. 13. Johannes Mageli photographed in front of the factory buildings, ca. 1965. MB-02-07, Hedmark museum photo archive. Photo by Kåre Hovde.

pursued four core courses in social economy, business economy, jurisprudence and English language. This choice can be attributed to the already-formed fascination with the Anglo-Saxon model of business management: during his tenure at Moelven, Mageli would frequently visit both the United Kingdom and the United States for business inspiration and industry research.[59] After passing the written exam with a "very good score" in 1940, Mageli graduated with the official title of *handelskandidat,* the highest distinction in economic education at the time.[60]

59 See Mageli's lecture at NHH that has references to many American industries, and General Motors in particular. Mageli, *A/S Moelven brug*, 14. For Mageli's first visit to England in 1949 see Trygve Dalseg, *Moelven Brug i forvandling og vekst: en jubileumskavalkade 1899-1974* (Moelv: Moelven Brug, 1974), 37.

60 *Avskrift. Rektor og lærerrådet ved Norges Handelshøiskole*, signed by I. Wedervang (rektor) and dated Bergen, 13.12.-1940. In SAH/ARK-287-01//Pc/L0001 "Ansettelser, instrukser."

However, it was not only his education, but also his professional experiences that shaped Mageli's role at Moelven. Prior to joining the company, he worked at Norske Meieriers Salgcentral, Bergen Privatbank and Fåvang sawmill, eventually taking on a managerial position at Norsk Boligindustri A/S at Elverum—a company that in the post-war period delivered prefabricated houses for the reconstruction of Northern Norway.[61] During his time at Elverum, Mageli took on several large expansion projects, managing to double the production within two years.[62] As he wrote in a cover letter when applying for the position at Moelven Brug, he had experience with "an all-encompassing administrative and management practice," had led a workforce of 60 people and had "grown familiar with many of the problems the business leader faces today."[63] Through this manifold track-record, it is possible to see that Mageli belonged to the first generation of general managers as defined by the Anglo-Saxon tradition—those that had a business, rather than technical education and could lead a wide range of business ventures. According to Byrkjeflot and Halvorsen, general managers had transferable, rather than technical skills that allowed them to manage any type of industry and deal with all leadership and administrative functions.[64] They were particularly hard to come by in 1950s Norway. Although Mageli was hired by Moelven's board mostly because he asked for the lowest salary among other applicants, this was a lucky hire for Moelven.[65] If Moelven engineers-managers represented the technocratic elite responsible for running the everyday technology, Mageli with his business education and exposure to international practices was in a position to implement macro-innovations and offer visions of the future that no one else was yet able to see.

In his approach, Mageli was a modernisation agent that broke with previously established models of thinking and organising work.[66] According to local Ringsaker historians Alsvik and Haug, Mageli wanted to see Moelven as a "modern, industrial enterprise that was based on the factory production of goods [..] and would not let traditions, clients or the market define his work."[67] Business historian Asbjørn Karlsen, who

61 Johs. Mageli CV "Redegjørelse for personlige forhold, utdannelse og praksis," dated Elverum, 12 mai 1948. In SAH/ARK-287-01/P/Pc/L0001 "Ansettelser, instrukser." *Ringsaker Blad*, 15 October 1957, 1-2.
62 Mageli's cover letter to IRAS regarding "Disponentstilling ved A/S Moelven Brug," dated Elverum, 11. Mai 1948. In SAH/ARK-287-01/P/Pc/L0001 "Ansettelser, instrukser."
63 Mageli's cover letter, in SAH/ARK-287-01/P/Pc/L0001 "Ansettelser, instrukser."
64 Byrkjeflot and Halvorsen, "The Institutionalization of Industrial Administration in Norway 1950-90," 6–8.
65 Item no. 3 at the meeting from 21/12 1949, 60; Moelven board meeting notes, 1906-1966, SAH/ARK-287-01/A/Aa, Box L0001, Folder 0001.
66 Asbjørn Karlsen, "Fra håndverk til masseproduksjon: en studie av omstillinger ved Moelven Brug" (Nordlandsforskning, 1994), 118–19.
67 Alsvik and Haug, *Storkommunen*, 167.

Fig. 14. Mageli, pictured talking to Moelven employees Erik Granlien and Kåre Sveen in 1948. MB 234-6, Hedmarksmuseum photo archive.

studied the Moelven transformation from an economic standpoint, argues that since Mageli came from "the outside" and was largely shaped by his academic experiences at NHH, he had an entirely different set of cultural values than other local actors who were no longer able to respond to changing economic conditions, references and norms.[68] For example, he saw little value in handcraft and was fascinated with new technology and process automation. An economist by education, Mageli quickly attained a good technical understanding of Moelven's products, and, according to his contemporaries, played a significant role in product development.[69] After his first trip to the United Kingdom in 1949, Mageli came back convinced that the era of wooden wheels was over.[70] Instead, he wanted to seize the "yet barely visible needs" by looking for developments of similar businesses in more industrialised countries—Denmark, Germany, England and the United States. Contextualising Moelven alongside similar international businesses became Mageli's "crystal ball" for seeing the future and developing new products.[71] His orientation towards new markets and innovative practices corresponded well with the general "Americanisation" of Norway at the time, and IRAS's modernisation of the company in particular. Mageli was the first general Moelven manager in a contemporary meaning of the word, and although remembered as "quite a harsh leader" since managerial power was hard to legitimize in a Norwegian democratic egalitarian society, he was considered by his contemporaries a "businessman of the highest calibre."[72] Together with IRAS, he drove Moelven's transformation into an industrial enterprise of national and international calibre.

INDUSTRIAL MITOSIS

A new organisational model, coupled with the strong grip of Mageli's leadership, offered not just new pathways for product development and research, but also an opportunity to expand to new markets, both nationally and internationally. In 1959, just four years after the functional structure was introduced, Moelven ventured into works with laminated timber and established a separate daughter enterprise, Laminator A/S, with own administrative units, sales, construction and economy departments. Moelven Brug's Oslo office was opened as a separate enterprise

68 Karlsen, "Fra håndverk til masseproduksjon," 65.
69 Alsvik and Haug, *Storkommunen*, 52.
70 Dalseg, *Moelven Brug i forvandling og vekst*, 37.
71 Alsvik and Haug, *Storkommunen*, 166–68.
72 Alsvik and Haug, 167.

Fig. 15. Moelven's growing managerial structure, ca. 1965. From *Med Moelven-hjul på vei gjennom tiden*, 199.

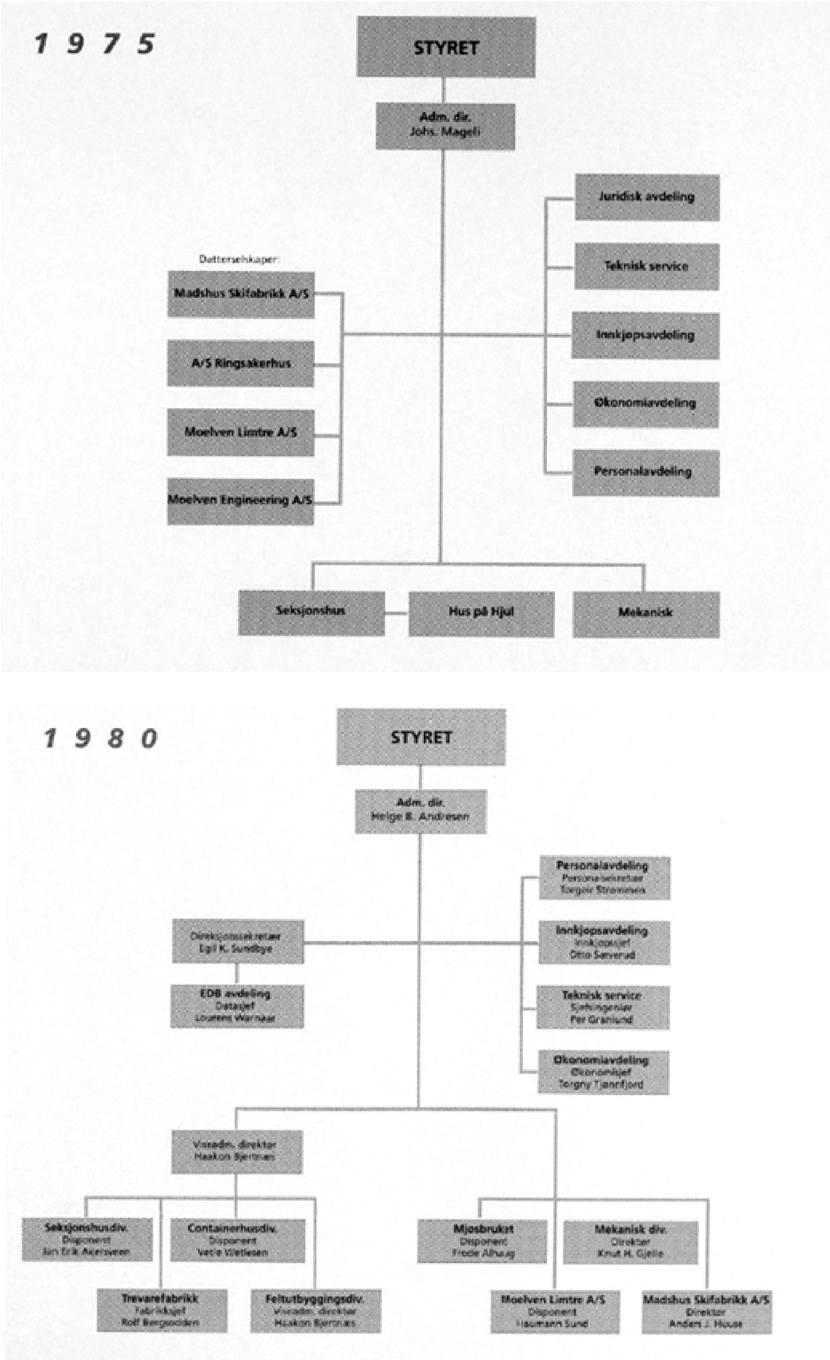


Fig. 16. Moelven's industrial mitosis. The company's administrative organisation expanded over the years to accommodate new products and services. From *Moelven 1899-1999*, 49.

in 1961, and a new Moelven Transport unit was founded the same year.[73] From the mid-1960 this mitosis was unstoppable: mechanical and timber departments were separated as of May 1, 1966, each with a manager and own departments of construction, production and sales.[74] Moelven offices abroad also opened as separate units: in Sweden—Moälvens Bruk AB Göteborg in 1964 and Stockholm in 1966, and in Germany—Moelven Brug GmbH in Hamburg in 1973.[75] Ringsakerhus A/S that produced prefabricated houses based on flat timber elements was opened in 1965, with its own construction, accounting and sales departments. Moelven Engineering A/S and Madshus Skifabrikk A/S were in place by 1975.[76]

Over time, the company gradually transferred to a hybrid organisational model, where each product line was could operate as an independent enterprise—with own sales, HR, accounting and administrative staff.[77] As Moelven adopted a hybrid model, each of these units had its own managers, but remained within the vertical hierarchy managed by Mageli. Although this model was more costly to operate, it provided better control of the products' profitability, simplified managerial oversight, and made it easier to locate production problems. Moelven was not alone in devising such model: according to Amdam and Sogner, other industrial companies in Norway—for example, Elkem and Norsk Hydro—searched for and adapted new organisational models around the same time. Norwegian scholars of technology transfer often emphasise the hybrid nature of these models: new organisations existed alongside old ones.[78] In a similar manner, as Byrkjeflot and Halvorsen argue, management was never imported to Norway as a coherent ideology. Rather, techniques most relevant to local conditions were chosen and implemented. Thus, Moelven's hybrid organisational model testifies to the amalgamation of international business practices and existing ones, a conscious import adjusted to yield higher efficiency within given conditions.

73 See "Personaladministrativ håndbok," "Omkring Hovedadministrasjonen" in SAH/ARK-287-01/A/Aa, Box L0001, Folder 0008.
74 Dalseg, *Med Moelven-hjul på vei gjennom tiden*, 198.
75 Trygve Dalseg and Moelven brug, *Moelven Brug i forvandling og vekst: en jubileumskavalkade 1899-1974*, *Norbok* (Moelv: Moelven Brug, 1974), 50.
76 Hemsøe, *Moelven 1899-1999*, 41.
77 Alfred D. Chandler, *The Visible Hand*, 2–3
78 Rolv Petter Amdam and Knut Sogner, "The Diffusion of American Organisational Models to Norwegian Industries, 1945-1970," in *Americanisation in 20th Century Europe: Business, Culture, Politics. Volume 2* (Lille: Publications de l'Institut de recherches historiques du Septentrion, 2018), 204.

THE LEAST INDUSTRIALISED INDUSTRY

If Moelven was successful at modernising its production, that was not the case for the Norwegian construction industry at large. "Modernisation of our medieval building methods does not show any results!"—lamented architect Frode Rinnan in 1947.[79] The situation did not improve with time: since 1949, all building materials had been rationed, and a strict system of building permits halted nearly all single-house construction in urban areas.[80] Building machines were barely used, construction cranes did not exist, and even multi-storey apartment houses were built mainly from brick, a technique that required many working hours on site.[81] In addition, there was increased competition for the qualified labour force, especially in labour-intensive industries, a development that significantly affected construction in Oslo. The Norwegian building sector was extremely fragmented, dominated by small firms, individual entrepreneurs and craftsmen, often with divergent interests. A typical firm would build on a small scale, with very few contracts in the course of a year.[82] As architect Einar Vaardal-Lunde summarised in 1949: "what is called a building industry is not at all an industry."[83] While industrialisation was seen as the single path forward, there were few available resources to effectuate necessary structural change.[84]

Another problem of building industrialisation was a lack of consensus over who should be its main driver: the state, industrial companies,and research institutions, or entrepreneurs, engineers, and architects? There was little cooperation between architects and the building industry, and if this situation persisted, Rinnan warned, "the result would be German barracks"—referring to the commonly loathed make-shift timber construction of the immediate post-war period.[85] At a 1953 architectural conference dedicated to industrial building methods, architect P.A.M. Mellbye identified bureaucracy and lack of available resources as two of the three main obstacles to building industrialisation.[86] This must have had some kernel of truth to it: considering the number of discussions around building industrialisation, few practical steps were taken. In

79 Frode Rinnan, "Arkitektur eller bygningsproduksjon" a reprint from KONTAKT no.2 in *Byggekunst* 29, no. 3-4 (1947): tillegget, 7.
80 E. Vaardal-Lunde, "Monterignsferdige Trehus i Norge," in *Byggekunst* 31 (1949): 84-88.
81 Mette Sjølie and Norsk arkitekturmuseum, "Sosial boligbygging i Norge 1945-1980: forskning om bygningsvern og utviklingsplanlegging" (Norsk arkitekturmuseum, 1989), 69.
82 Komiteen for analyse av byggekostnader and Norge: Kommunal- og arbeidsdepartementet, *Innstilling fra komiteen for analyse av byggekostnader: komitéen er oppnevnt ved kgl. res. av 3. februar 1950*, *Norbok* (Oslo: Kommunal- og arbeidsdepartementet, 1953), 26.
83 E. Vaardal-Lunde. "Monterignsferdige Trehus i Norge," 84-88.
84 Skeie, 109.
85 Frode Rinnan, "Arkitektur eller bygningsproduksjon," *Byggekunst* 29, no.3-4 (1947): tillegget, 7.
86 *Arbeiderbladet*, January 7, 1953, 1, 2, 4.

Fig. 17. Construction work in Oslo, as captured by photographers of Henriksen & Steen, 1956. Even on the larger construction projects—multi-storey housing buildings—labour was mostly performed manually, without the use of machines or building cranes. National Library photographic archive, public domain.

the absence of state-funded research, the burden of experimentation with building rationalisation fell on private entrepreneurs or cooperative members, and thus was rarely undertaken.[87] In the early 1950s this void in industrial building research was partially filled by the projects carried out by NPI in cooperation with the newly-established Norwegian Institute of Building Research (NBI). Headed by engineer Øivind Birkeland, NBI was the first agency to research new construction systems and building methods.[88] In the 1950s, several practical NBI studies were financed by NPI, including projects for the standardisation of building elements and wooden frames, the development of rational building types, and time-studies of construction work.[89] One of the joint NPI-NBI projects that measured productivity and introduced new methods for quantifying labour in construction, for example, was authored by Jan F. Reymert, who would go on to become the director of Moelven's element factory in 1965.[90] However, with limited financing, the institute could pursue only a small range of studies and this work resulted merely in theoretical compilations and informational guidelines for other building actors.[91]

87 Sjølie and Norsk arkitekturmuseum, "Sosial boligbygging i Norge 1945-1980," 38.

88 On the history of NBI see Norges byggforskningsinstitutt et al., *Byggforsk gjennom 50 år*, *Norbok* (Oslo: Norges byggforskningsinstitutt, 2003).

89 See NPI projects no. 33 "Standardisation in house-building"; no.54 "Information leaflet on building machines"; no. 136 "Development of rational building types at NTH"; no. 766 "Time studies in building industry." All in RA/S-1623/D/Df, diverse project folders.

90 Jan F. Reymert and Norges byggforskningsinstitutt, "Produktiviteten i bygningsindustrien," Særtrykk 11 (Oslo: NBI, 1954). Also see Einar Gabrielsen and Norges byggforskningsinstitutt, *Arbeidsstudienes anvendelse i bygningsindustrien*, *Norbok*, Anvisning 10 (Oslo: Norges byggforskningsinstitutt, 1959).

91 See Norges teknisk-naturvitenskapelige forskningsråd, *Oversikt over norske forskningsinstitutter og andre institusjoner innen naturvitenskap og teknikk*, *Norbok* (Oslo: Norges teknisk-naturvitenskapelige forskningsråd, 1950), 9–10. Also Hans Granum, Sven Erik Lundby, and Norges byggforskningsinstitutt, *Trehus*, Anvisning (Oslo: NBI, 1958).

Fig. 18. Norwegian productivity trip's participants at the UN. From left to right: Hans Mollø-Christensen, Laurentius Eide, Nils Stiansen, Trygve Lie, Olaf A. Engh, Jacob Christie Kielland, Lorang Kristiansen, Peder Framnes, Nils Christensen, N. A. Christensen, F. Bollman. P. Mellbye is not in the picture. From *Bygningsindustrien i U.S.A*, 49.

Among the NPI-sponsored projects for the building industry was a "productivity trip" to the United States in the fall of 1951, organised at the initiative of Birkeland.[92] Although representatives of the Norwegian building industry were initially reluctant to partake, eventually the six-week trip to New York, Chicago, Nashville and Washington D.C. convened ten architects, planners and building practitioners headed by the housing director Jacob Christie Kielland.[93] The participants were to study the mechanisation of the American building industry, with particular focus on the rationalisation of small-house construction and administration of the building processes. In the United States, they met with American entrepreneurs, building researchers and contractors, and visited several factories, architectural offices and construction sites.[94] Norwegian trip participants also toured a number of completed projects. Among them were Levittown in Long Island, a 13,000-units prefabricated-housing development in Chicago, and a site in Lafay-

92 A letter from Birkeland to Byggeteknisk Utvalg, "Studium av mekaniseringen av amerikansk bygningsindustri," August 1, 1950, Kontoret for Byggforskning, in RA/S-1574/D/Da/L0047/0001.

93 Members of the team included architect Mollø-Christensen, civil engineer Laurentius Eide, byggmester Nils Stiansen, civil engineer Olaf A. Engh, housing director Jacob Christie Kielland, Lorang W. Kirsiansen (Norks Murerforbund), Peder Framnes (Borsk Bygningsindustriarbeiderforbund), Nild Chr Christensen (Murenmesterforening), F. Bollman (american trip leader), architect PAM Mellbye among others. Interestingly, the group was comprised of representatives of different construction industry sides: from the state planning offices and research (Kielland), to architects, entrepreneurs, and representatives of professional worker unions (Frammes, Kristiansen). *Bygningsindustrien i U.S.A: rapport fra det norske bygningsteams studietur september-oktober 1951*, *Norbok* (Oslo: I kommisjon hos Aschehoug, 1954), 7.

94 For more details see *Bygningsindustrien i U.S.A*, 6-7.

ette, Indiana, comprised of industrially-made single-family timber houses. During the trip it became apparent that the American building industry enjoyed a larger scale and market, was better organised, and made greater use of new technology and industrially prefabricated components.[95] US building firms were larger and thus more interested in process industrialisation: less than 4% of firms built more than 50% of all housing. In Norway, firms were much smaller: around half of all workers in the building industry worked for companies with one or two employees.[96] Unless larger construction companies were to engage with prefabrication, industrial building would hardly be possible. A good example of this was USBL—the Youth Building Cooperative that was among the first companies in Norway to undertake research into prefabricated building components in concrete—a venture that, as we learn from the USBL application to NPI, proved too expensive in the long run.[97]

Some innovative solutions for how to enact industrialisation within conditions of scarcity had been voiced in the late 1940s. If investments into new factory facilities were too costly, then the already-existing saw-mills and concrete plants could be upgraded to produce certain types of prefabricated products. Originally put forward in 1946 by architects John Engh and Fred Severud, who had studied prefabricated productions in the United States, this alternative was reiterated a couple of years later by Vaardal-Lunde, an ardent advocate of building industrialisation. Engh and Severud argued that existing factories had an already developed infrastructure of material sourcing and supply, and their locations corresponded to the population density—thus, they were well-positioned to satisfy popular demand.[98] This alternative would be particularly attractive for producers like Moelven Brug that had access to their own forest resources and qualified workforce. Vaardal-Lunde went a couple of steps further: he suggested that sawmills could produce a limited number of standardised elements that required the largest amount of work—for example, walls. If they were made according to pre-set modular dimensions, then they could be combined

95 *Bygningsindustrien i U.S.A*, 8. Also in John Engh, "Trehus fra fabrikk eller bygd på plassen? *Byggekunst* 28 (1946): 56.

96 Jon Skeie, *Bolig for folk flest: Selvaagbygg 1920-1998* (Oslo: Tano Aschehoug, 1998), 121. The original number in NOS; Norges Industri, *Bedriftstelling* (1953).

97 See correspondence of USBL and NPI, NPI project no. 65a "Planlegging og undersøkelser angående prefabrikasjon av småhus ved Ungdommens Selvbyggerlag." RA/S-1623/D/Df/L0417/0001, State Archive, Oslo, Norway.

98 Engh and Severud were commissioned to produce this report by the Norwegian Industrial Committee in New York. See Fred N. Severud and John A. Engh, *Hurtigbyggning [Sic] Av Boliger i U.S.A.* (New York: Det Kongelige norske forsynings- og gjenreisningsdepartement, Industrikomiteen, Underkomiteen for husbyggningsteknikk, 1944), 5–6. On the Industrial Committee in New York see Rolv Petter Amdam, "Industrikomiteen i New York 1943-1945: ein kanal for kunnskapsoverføring frå USA til Norge," *Historisk tidsskrift* 79, no. 1 (2000): 3-21.

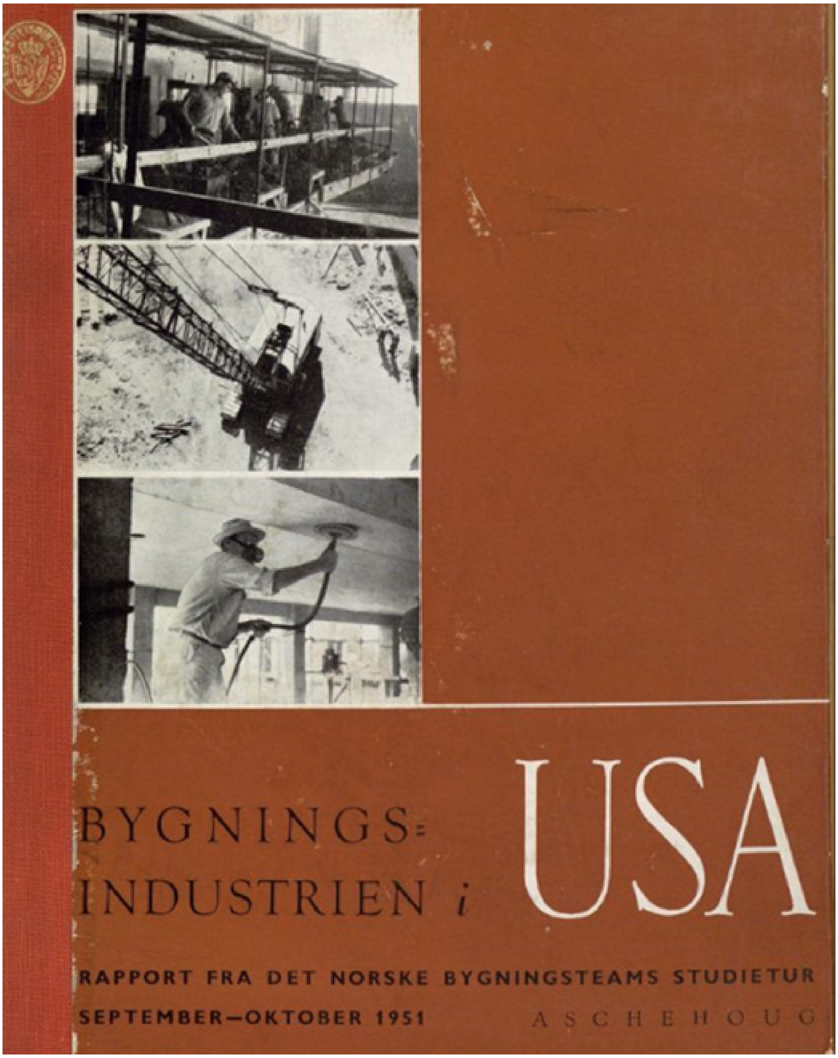


Fig. 19. A report "Building Industry in the USA," produced by the Norwegian building industry productivity trip participants after the project's completion. September-October 1951.

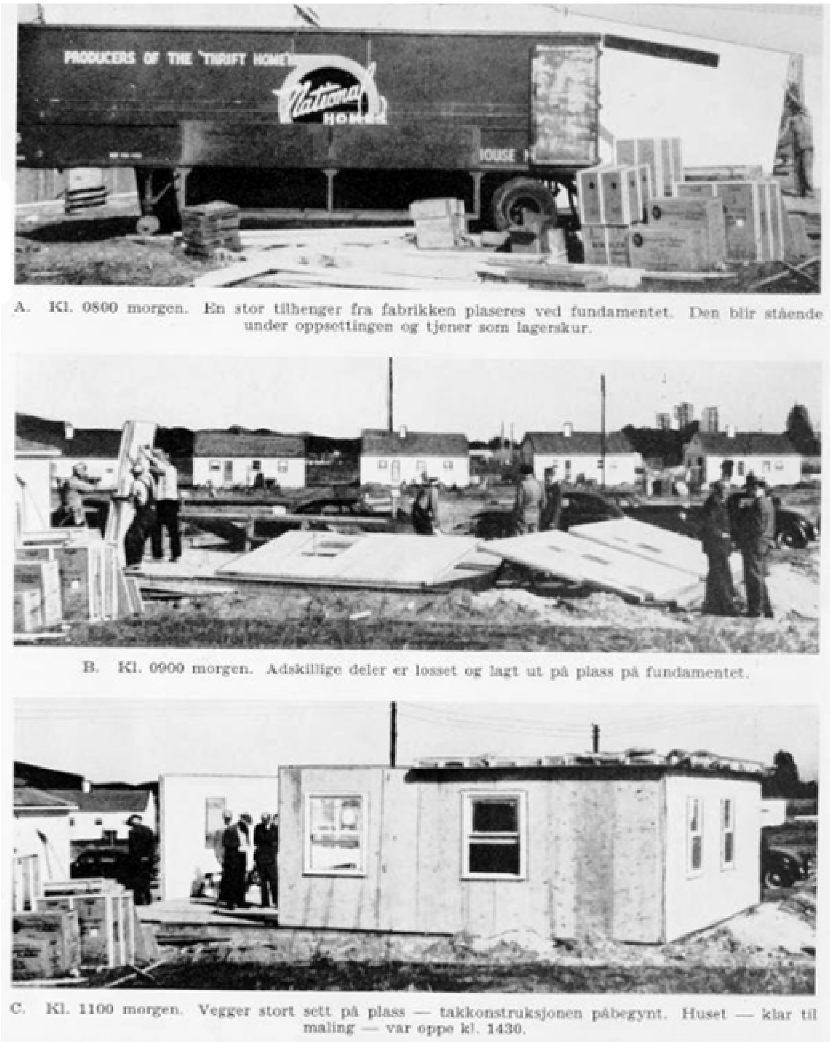


Fig. 20. Norwegian participants were impressed with different aspects of American building industry organisation, and in particular, levels of industrialisation and building site processing logistics. A spread documenting house construction with prefabricated timber elements that happened over the span of one work day. National Homes, Lafayette, Ind. From *Bygningsindustrien i U.S.A*, 66.

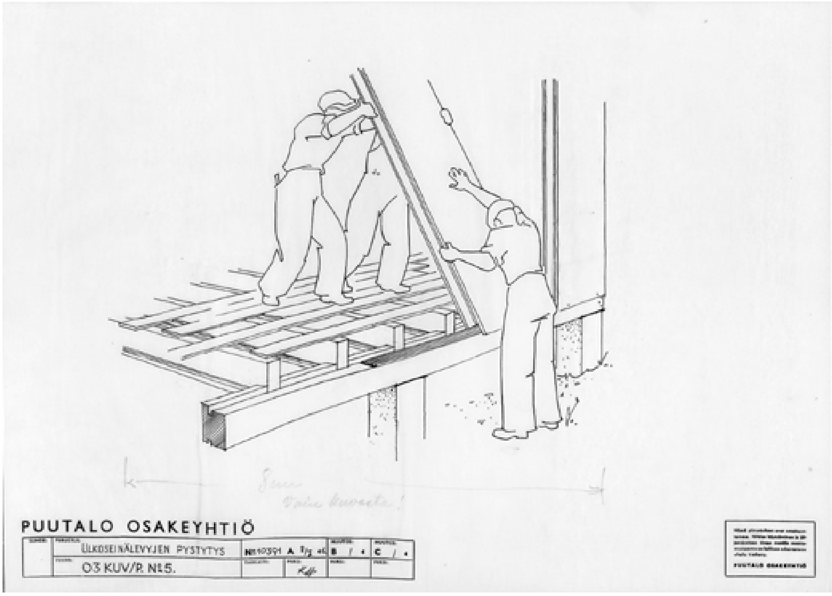


Fig. 21. Assembly drawing of Puutalo Oy houses based on prefabricated timber panels. Drawing by Kaarlo Humalisto, 1946 for Puutalo Oy. Image by ELKA. From "New Standards" project, https://newstandards.info/puutalo-export, accessed 21 February 2022.

with other standard building materials. Later, these elements would be catalogued, alleviating the largest share of work without having to prefabricate entire buildings.[99] In this way, producers could gradually transition to prefabrication without having to commit to large start-up investments. This ingenious solution was largely inspired by the Finnish example of Puutalo Oy, a consortium of 22 forest industry companies and existing sawmills that in the years following WWII successfully mass-produced prefabricated timber houses for domestic and international markets.[100] As Frode Rinnan remarked in 1947, "Finnish prefabricated houses will no doubt come to play an important role in the world market. [...] Finnish industrialists can no doubt be proud of themselves."[101]

Although it is hard to say whether Moelven managers were aware of these suggestions voiced by architects and published in the main Norwegian architectural magazine *Byggekunst* in the late 1940s, they were most likely familiar with the Finnish development, which was the

99 E. Vaardal-Lunde. "Monterignsferdige Trehus i Norge," *Byggekunst* 31 (1949): 84-88.
100 Pekka Korvenmaa, "Destruction, Scarcity and a New Rise" in Marja-Riitta Norri et al., *Finland* 7 (Helsinki: Museum of Finnish Architecture, 2000), 71–81. Jacob Christie Kielland, "Bolig- og byplankongressen i Hastings," *Byggekunst* 28 (1946): tillegget, 21. Also see Finnish project at the 17th International Architecture Venice Biennale "New Standards" about the history and legacy of Finnish timber conglomerate Puutalo Oy https://newstandards.info/, accessed June 10, 2021.
101 Frode Rinnan, "Arkitektur eller bygningsproduksjon," *Byggekunst* 29, no. 3-4 (1947): tillegget, 7.

main source of inspiration at the time. IRAS rationalisation specialists, for example, had been to Finland to study the advancements of the "ready-made house building industry" already in 1949.[102] Moelven was a sawmill with its own forest resources and a well-established infrastructure of raw material procurement; it had a qualified labour force and an already-existing system of sales and distribution. Thus, it could gradually adapt its existing facilities for new product lines. In turn, Moelven as a company was large enough, and by the mid-1950s had enough resources for innovation and product research. The new administrative structure, in turn, allowed them to reconcile interests of different stakeholders within the same factory, and thus avoid the many pitfalls that a single-product entrepreneur faced. While the exact translation of ideas is hard to trace, there was a clear convergence between industrial and architectural contexts in post-war Norway. Both professional fields were interested in technology, rationalisation and new means of production, and both were thinking of the most optimal and creative solutions to achieve that within the impoverished state of the post-war Norwegian building industry. References to international development were equally shared, as Norwegian practitioners were looking to adapt the most innovative experiences from abroad—the United States, England, Sweden and Finland. The new era of productivity and rationalisation permeated not only industrial, but also architectural realms.

ARCHITECT, WHERE TO?

In 1953, the Norwegian design magazine *Bonytt* ran a translated reprint of Walter Gropius's article from the May 1952 issue of *Architectural Forum*, titled "Architect, where to?"[103] In the article, Gropius warned contemporary architects against the "very real danger of losing [the] grip in competition with the engineer, the scientist and the builder."[104] Engineers and scientists, he maintained, had played an instrumental role in developing industrial components, while the architect, "deserted by the best craftsmen [...] has continued thinking in terms of the old craft methods, pathetically unaware of the colossal impact of

102 For example, from IRAS archives it is possible to learn that engineer Folkvard visited Helsinki in March 1949, where he toured a number of industrial businesses, including the ready-made house assembly, machine workshops, sawmills and a cellulose factory. Although the name of the company is not given, most likely the goal of the visit was factories of the Puutalo Oy congolomerate. See "Referat fra styremøte i IRAS 15. Mai 1950," in RA/PA-0636/A/Ab/L0133.

103 Walter Gropius, "Arkitekt Hvorhen? " *Bonytt* 13, no. 3 (1953): 56-60.

104 Walter Gropius, *Scope of Total Architecture* (New York: Collier, 1962), 73. The reprint was from *Architectural Forum*, May 1952, original title "Gropius Appraises Today's Architect."


ARKITEKT HVORHEN?

Nedenstående artikkel er skrevet av professor Walter Gropius, leder av Harvard-universitetets arkitektavdeling, og en av verdens mest kjente arkitekter. Arkitektene Lise Bøgelund-Jensen og Olaf Liisberg har oversatt og bearbeidet artikkelen — vi har hentet oversettelsen fra det velredigerte og friske danske tidsskriftet «A5, meningsblad for unge arkitekter». Artikkelen gjelder et meget stort spørsmål til arkitektene — spørsmålet om arkitekten kan gjenvinne stillingen som «master builder», leder av og skaper av god og vakker byggekunst, eller om han er i ferd med å dø ut i en kultur hvor industrialiseringen feier vekk alle gamle begreper, uansett om det er barn eller badevann.

Et spørsmål til alle. — Vil god byggekunst dø ut med ham? Artikkelen har adresse i alle retninger og til de fleste land, også Norge. Hvorfor er arkitektene blitt en trett, nattarbeidende stand? Kan det skapes god byggekunst og almen tillit under slike forhold? Kan det være riktig at jo mer en arkitekt arbeider for å gjøre et hus billig og godt, jo — matematisk nøyaktig — mindre tjener han? Debatten her hjemme mellom ingeniør Selvaag og arkitektene kjenner de fleste. Ingeniør Selvaag planlegger og bygger sine hus selv — han har kontroll over hele prosessen fra første strek på tegnebordet til det endelige produkt står der ferdig.

Arkitektene kan bare planlegge husene — de har ikke lov til å bygge dem selv, og må overlate planene til andre, d.v.s. de mister lett kontrollen. Er det riktig?

Professor Gropius' artikkel resulterte i en sverm av svar. Små karakteristiske utdrag av svarene er gjengitt i margen nedenfor for å vise det spektrum av følelser og tanker som ble vakt i USA av artikkelen.

Walter Gropius.

I fortidens glansperioder var det arkitekten, håndverksmesteren eller «master builder» som spilte en meget fremtredende rolle innenfor hele produksjonsprosessen på sin tid. Men ved overgangen fra håndverk til industri er han ikke lenger i denne ledende stilling.

I dag er arkitekten ikke «master» i byggeindustrien. Forlatt av de beste håndverkere (som er gått inn i industrien, verktøyfabrikasjonen, undersøkelser og forskning) er han blitt sittende på sin anakronistiske murstensdynge, tragisk uvitende om industrialismens kolossale muligheter. Arkitekten er i stor fare for å miste taket i byggingen i konkurranse med ingeniøren, vitenskapsmannen og byggmesteren, med mindre han forandrer sin innstilling og søker å møte den nye situasjon.

Fullstendig adskillelse av planleggingen og utførelsen av byggingen slik det er i dag, synes unaturlig, hvis vi sammenligner byggeprosessen med fortidens store tidsepoker.

Vi er kommet altfor langt vekk fra den opprinnelige, naturlige innstillingen at planleggingen og selve byggingen må være én prosess og arkitekt og byggherre én og samme person. Hvis han vil ha tilbake sin tidligere lederstilling må fremtidens arkitekt, tvunget av utviklingen, igjen komme i nær kontakt med byggets utførelse.

Fig. 22. A Norwegian reprint of Gropius article from Architectural Forum. *Bonytt* 13, no. 3 (1953): 56-60.

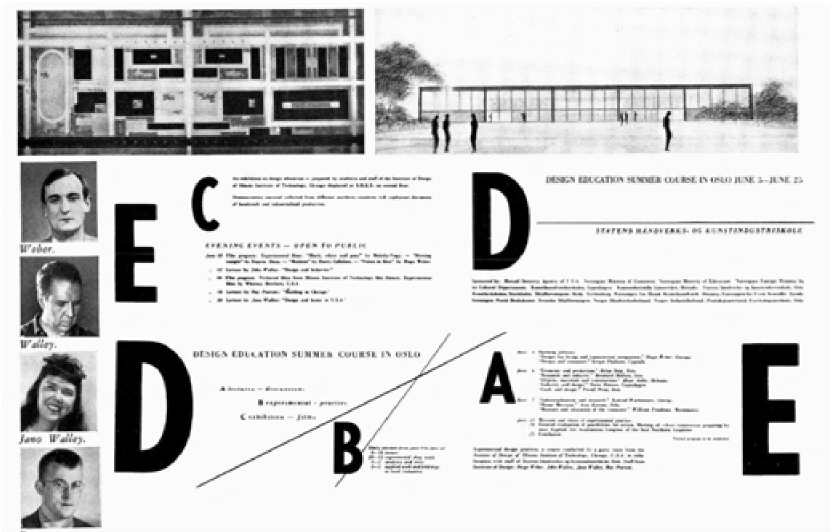
civilisation."[105] This call for a "fruitful collaboration" between art, industry and craft, a "happy union between art and techniques" had been voiced since the Deutsche Werkbund and was reiterated by several generations of modernist architects across geographic regions.[106] Post-war Norwegian practitioners voiced similar demands on the pages of professional and trade magazines. In a 1949 *Byggekunst* article on building rationalisation, engineer Birkeland called for a reconciliation of the stark division between architectural, building and research

105 Gropius, 76.
106 Stanford Anderson, *Peter Behrens and a New Architecture for the Twentieth Century* (Cambridge, Mass: MIT Press, 2000), 110. Also in "Gropius at Twenty-six," *Architectural Review* (July 1961): 49-51.

work.[107] The Architect's Autumn Exhibition the same year featured an IRAS stand urging rationalisation experts to work together with planners and architects on questions of welfare and housing provision.[108] Housing director Jacob Christie Kielland in many press appearances maintained that rational construction could only be achieved if architects worked closely with building entrepreneurs and planners.[109] "Architects should not be hindered, but inspired by new building methods," reiterated architect Thomas Tostrup.[110] How could this aspired synthesis of architecture and engineering be achieved in practice?

"If architects are to enjoy opportunities offered by the industrialised society, then the entire educational process should be thoroughly revised," concluded the progressive architects of the PAGON group (the Norwegian chapter of CIAM) in 1952.[111] The first attempt to do so was done in June the same year, just a month after Gropius's original article appeared in *Architectural Forum*. The National College of Applied Art and Craft (SHKS), soon to become the Oslo School of Architecture, held a "Design Education Summer Course" in cooperation with the Illinois Institute of Technology (IIT).[112] Largely a result of Arne Korsmo's sojourn in the United States a year prior, the course was designed with the ambition to overcome the separation between design and industry and align SKHS education with the most recent developments in the field. Specifically, the IIT's educational programme that brought together engineering, architecture, science and technology at the service of industry and business, was to serve as a model.[113] The roster of speakers reflected this ambitious goal: it featured design and architecture practitioners—Gregor Paulsson, Alvar Aalto, Arne Korsmo, Konrad Wachsmann and Hugo Weber—as well as politicians, industrialists, and rationalisation specialists. Although architects dominated the agenda, speakers from all disciplines addressed similar questions in the field of industrial design and economy of industrial production. Wachsmann, for example, talked about "Industrialisation and Research," matched by a palindrome lecture on "Research and Industry" by Bernard Hellern, the director of

107 Øivind Birkeland, "On rationalization," *Byggekunst* 31, no.4 (1949): 60.
108 "Arkitektenes Høstutstilling," *Byggekunst* 31, no.12 (1949): 197.
109 Jacob Christie Kielland "Tilsynsrådet, boligbygging og byens utseende," *Byggekunst* 36, no.7 (1954): 186-188.
110 Thomas Tostrup, "Utradisjonell bygging," *Byggekunst* 37, no.1 (1955): 5.
111 PAGON stood for Progressive arkitekters gruppe Oslo Norge, "Vi vil slutte oss til," *Byggekunst* 34, no.6-7 (1952): XVI.
112 The course was held between June 9 and June 23 and featured ten lectures, twelve experimental workshops, two analysis and open crits, three applied field trips to local industries. See event advertisement in *Byggekunst* 34, no.6-7 (1952): XVI.
113 Astrid Skjerven, *Arne Korsmo: designvirksomhet i etterkrigstiden* (Oslo: Universitetet i Oslo, Avdeling for kunsthistorie, 1996), 11.



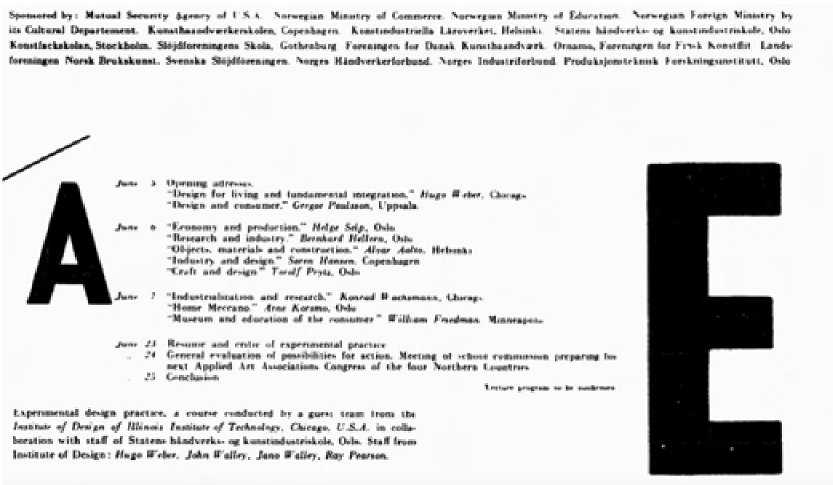


Fig. 23. Advertisement of the joint IIT and SHKS "Design Education Summer Course" (above) and detailed programme (below). From *Byggekunst* 34, no.6-7 (1952): XVI.

IRAS and a "Norwegian Taylor."[114] These sibling titles testify to a cross-pollination of ideas, across both industries and geographic contexts. Sponsored primarily by the MSA (American Mutual Security Agency), the Norwegian Ministry of Commerce, the Norwegian Federation of Industries, and the Norwegian Craftsman Union, the summer course was an all-inclusive institutional attempt to harness the opportunities offered by mass-production and new industrial building methods for architecture.

In practice, however, prefabrication was far less enticing that in theory. With the industrialisation of the Norwegian building industry lagging behind (and lacking investments), industrial construction was used to a very limited extent in large housing projects, which by 1954 had already become a *via dolorosa*.[115] In a *Byggekunst* article with the telling title "The Violence of the Slide Rule," Engh argued that "Norwegian architects have developed a sort of apathy" towards large housing projects, since economic concerns were prioritised above aesthetics and usability.[116] By extension, this meant that the architects also developed a sort of apathy for prefabrication. Beyond housing, prefabricated elements were used in a small number of public buildings—for example, the concrete facades of Erling Viksjø or John Engh—but these were mostly ready-made industrial components, as architects rarely collaborated with building producers on custom-made elements.[117] With limited practical application, "non-traditional" building methods hardly made it to the pages of architectural magazines, and in the two decades between 1945 and 1965, the sole issue of *Byggekunst* dedicated to industrial construction dates to 1955.[118] Questions of building industrialisation fostered a small but devoted circle of followers, and most *Byggekunst* entries on industrialised construction were authored by the same handful of people. Among these were a former OBOS director, architect and politician Kielland—an ardent advocate of building industrialisation—and Mollø-Christensen, who completed several buildings with prefabricated elements upon his return from the US productivity trip, as well as architects Vaardal-Lunde, Tostrup, Engh, Granum and engineer Birkeland.[119] From those, only two worked directly with the prefabrication industry: Vaardal-Lunde was a designer behind

114 A rooster of speakers listed in advertisement in *Byggekunst* 34, no. 6-7 (1952): XVI.
115 See *Byggekunst* 36, no.7 (1954) issue illustrated with Årvoll housing project by USBL, 186-188.
116 John Engh, "I regnestavens vold," *Byggekunst* 36, no.7 (1954): 192.
117 See *Byggekunst* 33, no.3 (1951): 98; *Byggekunst* 36, no. 6 (1954): 145.
118 See *Byggekunst* 37, no. 1 (1955).
119 For Kielland's articles on industrialisation see "Bolig og Byplankongressen in Hastings," *Byggekunst* 28 (1946): tillegget, 21; "Bolig og Byplankongressen i Zürich 1948," *Byggekunst* 30, no. 9 (1948): tillegget, 35-36. For Mollø-Christensen see "Høghus" in *Byggekunst* 34, no. 3 (1952): 37-39. For trial houses in Eiksmarka see *Bonytt* 16, no.7 (1956): 138-140.

timber prefabrication company Norsk Boligindustri A/S, and later headed Norske Trekonstruksjoner A/S.[120] Tostrup first worked for NBBL, a Norwegian union of building cooperatives, then moving to USBL, the first and the only cooperative to engage with prefabrication in the country, where he directed all architectural work.[121] On their part, Granum and Birkeland often represented Norway in international events and committees related to standardisation, modular coordination and industrial building techniques—not least heading the Norwegian contribution to the famous EPA 174 project on a standardised building module.[122] In practical terms, however, there were still too few industrial producers to turn to for those Norwegian practitioners who were interested in prefabrication.

Internationally, while some architects—for example, Gropius and Wachsmann—attempted to develop industrial building systems, ventures like the Packaged House and the General Panel Corporation hardly left the realm of avant-garde experiments and rarely found broad application in popular construction.[123] Although system-building was marketed by its post-war advocates as the "architects' powerful ally," in practice, as prefabrication historian Gilbert Herbert notes, most industrial building systems were developed by anonymous designers, often engineers or technicians familiar with materials, machinery and production, rather than architects.[124] For designs of individual projects, as construction historian Dunleavy argues, industrial companies and element producers often prioritised large architectural practices that operated within the constraints of the already-developed building systems.[125] As architects worked alongside managers, engineers and process planners within a large industrial production apparatus, their agency became hardly discernible precisely because of the multifaceted nature of such industrial pro-

120 Hild Sørby, *Klar - ferdig - hus: norske ferdighus gjennom tidene* (Oslo: Ad Notam Gyldendal, 1992), 72. *Byggekunst* 30, no.6 (1948): tillegget, 27; on his work with NBI see Hild Sørby, "Ferdighus før og nå," *Byggekunst* 75, no.2 (1993): 90-93.

121 Thomas Tostrup, "Utradisjonell bygging," *Byggekunst* 37, no.1 (1955): 1-5. Also see Tostrup's correspondence with NPI in project no. 65a "Planlegging og undersøkelser angående prefabrikasjon av småhus ved Ungdommens Selvbyggerlag." RA/S-1623/D/Df/L0417/0001, Riksarkivet, Oslo, Norway.

122 On EPA 174 project see The Organisation for European Economic Cooperation European Productivity Agency, *Modular Co-Ordination: Second Report of EPA Project 174* (Paris: sn, 1961). On the importance of EPA 174 project for building industrialisation see Christine Wall, "Modular Men: Architects, Labour and Standardisation in Mid 20th Century Britain," in *Industries of Architecture*, ed. K. Lloyd Thomas, T. Amhoff, and N. Beech (London: Routledge, 2015).

123 In fact, even the most vocal advocates of cooperation between architects and industrialists like Gropius had little practical experience: prior to the General Panel Corporation, Gropius never worked with the industry. Wachsmann, however, prior to emigrating to the United States was a chief architect at Niesky timber prefabrication factory by Christoph and Unmack. Gilbert Herbert, *The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsmann* (Cambridge, Mass: MIT Press, 1984), 97–99.

124 Thomas Schmid and Carlo Testa, *Systems Building: An International Survey of Methods*, First Edition (London: Pall Mall Press, 1969), 24.

125 Patrick Dunleavy, *The politics of mass housing in Britain, 1945-1975: a study of corporate power and professional influence in the welfare state* (Oxford: Clarendon Press, 1981), 12–13
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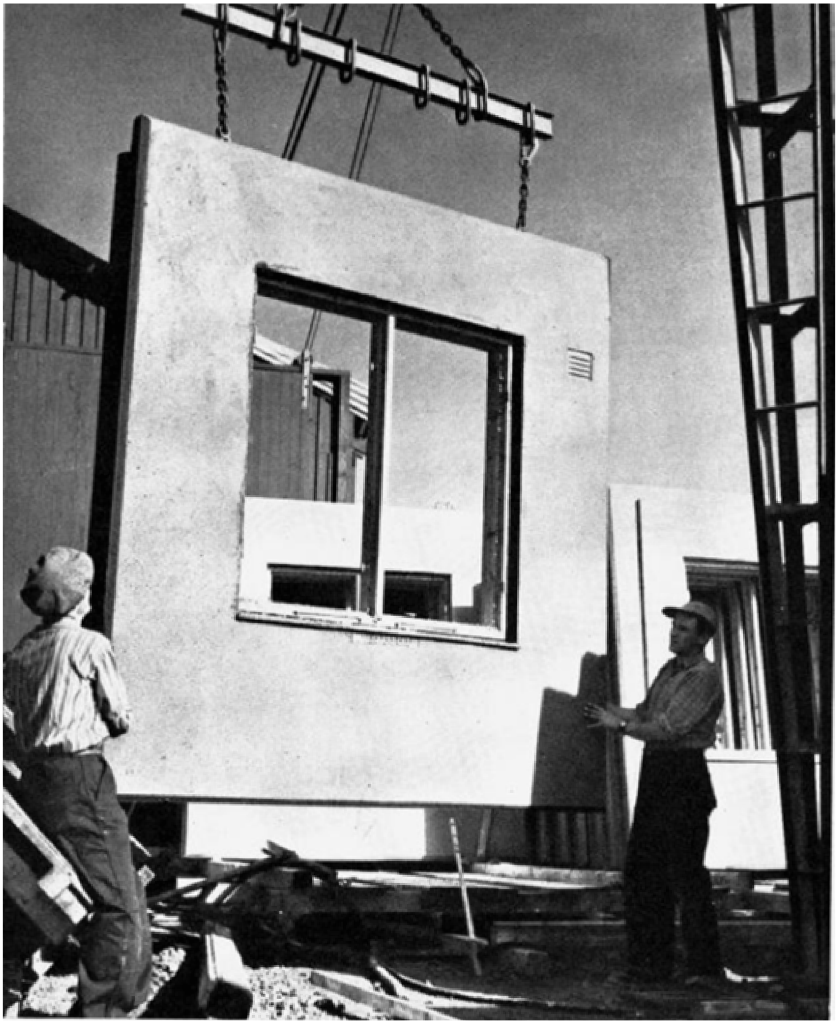


Fig. 24. By 1955 prefabricated elements finally started to make way into Norwegian construction. Ungdommens Selvbyggerlag (USBL)—a Youth Housing Cooperative—pioneered the use of prefabricated concrete elements in the greater Oslo area. On the image, USBL project in Årvoll. From *Byggekunst* 36, no.7 (1954): 188. Photo by Bjørn Winsnes.

duction.[126] If, for architects like Gropius, system-building was a holistic enterprise, an artistic synthesis of parts equally defined by the needs of the user and creative skills of the architect, industrial actors were mostly guided by pragmatic forces of economic and technological efficiency. Although in practice the two groups—architects and industrialists—often had divergent interests, some post-war collaborations, especially for individual building systems, were quite successful, even if little-known.[127]

In Scandinavia, experiments with prefabricated timber systems stand out in this regard. For example, Alvar Aalto had worked closely with one of the largest Finnish timber companies, A. Ahlström Oy, since the 1930s, where he was commissioned to develop a prefabricated housing system in wood, later known as the "AA-system."[128] This collaboration was followed by Juhani Pallasmaa and Kristian Gullichsen, who in 1969 developed a "Moduli 225" home system for the same company, prefigured by Raimo Kallio-Mannula's wooden Domino system (1964) and Arno Ruusuvuori's kit-of-parts sauna for Marimekko (1968).[129] In Denmark, Jørn Utzon developed his Espansiva system (1969), based on a grid of columns and rafters in laminated timber with non-load-bearing external and internal walls.[130] Norway, however, unlike its neighbouring countries, lacked a notable industrial construction system designed by a prominent architect. Korsmo's evasive manifesto "Hjemmets Mekano", with its proposed modular network, perhaps came closest to any semblance of an experimental Norwegian building system.[131] In this case, Moelven's system of prefabricated timber panels, developed roughly at the same and used for a variety of everyday typologies, therefore could fill the void and serve as an example of a successful Norwegian building system designed by architects in cooperation with the industrial producer.

126 Gropius, "The Architect Within Our Industrial Society," in Gropius, *Scope of Total Architecture*, 75.

127 John Engh, "Trehus fra fabrikk eller bygd på plassen? Kan vi tillempe amerikanske erfaringer," *Byggekunst* 28 (1946): 59.

128 Pekka Korvenmaa, "The Finnish Wooden House Transformed: American Prefabrication, War-Time Housing and Alvar Aalto," *Construction History* 6 (1990): 52–54.

129 Jaime J Ferrer Forés, "Modern Timber Structures in Finland," *Proceedings of the 16th International Docomomo Conference Tokyo Japan 2020+1 "Inheritable Resilience: Sharing Values of Global Modernities"* (Lisboa: Docomomo International, 2021), 583–86. Alvar Aalto's Moduli 225 system also in Norri, Paatero, and Suomen rakennustaiteen museo, *Rakennettu puusta=Timber construction in Finland* (Helsinki: Suomen rakennustaiteen museo, 1996), 72–73.

130 Jørn Utzon, *Jørn Utzon Logbook: Vol. 5: Additive Architecture* (Hellerup: Edition Bløndal, 2009), 132–80.

131 *Byggekunst* 34, no.4 (1952): 110-113. "Praktisk eksperimentoppgave 1953, 48m2 leiligheten" in SHKH, *Statens håndverks-og kunstindustriskole årsmelding 1952-1953, 1953-1954*, unpaginated.

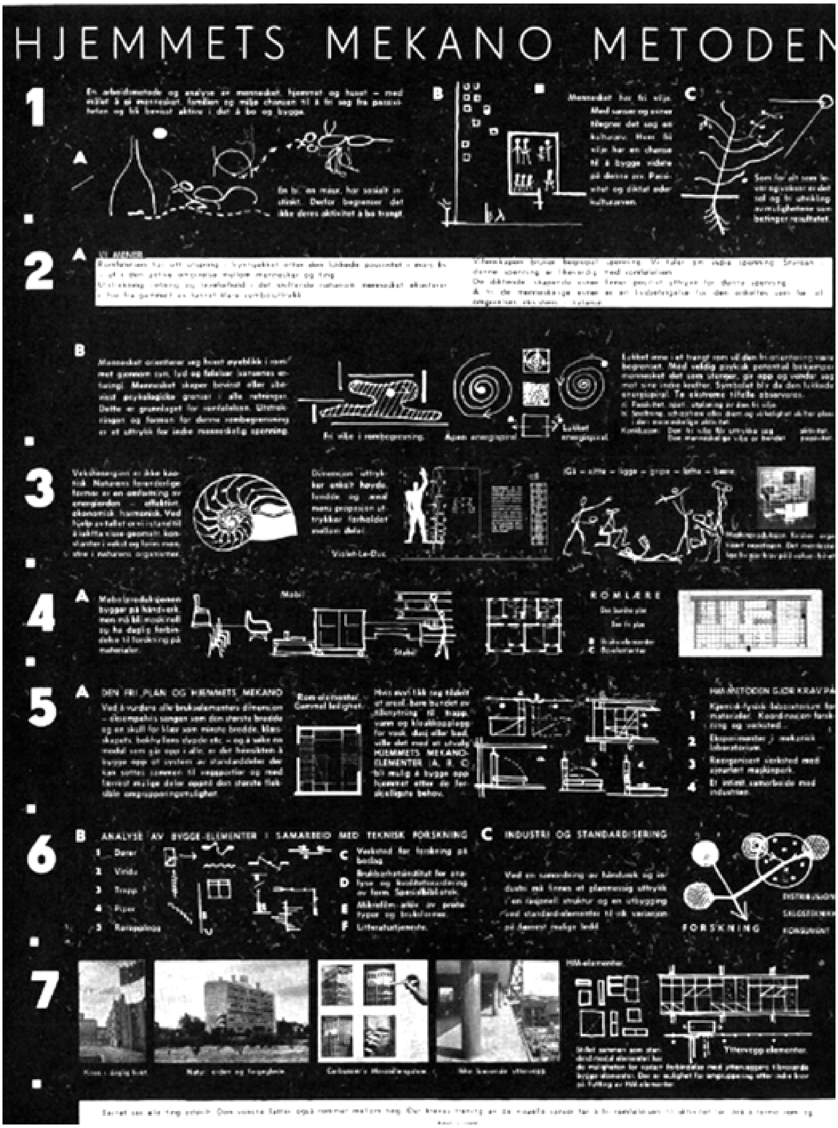


Fig. 25. Arne Korsmo's manifesto "Hjemmets Mekano"—the Meccano of the home, that featured references to Le Corbusier's *Le Modulor*, Japanese tatami mats and geometric sequences found in nature, i.e. seashells. From *Byggekunst* 34, no. 6-7 (1952).

ARCHITECTS OF THE INDUSTRIAL COMPLEX

Tracing the Moelven architects has not been an easy feat. While the IRAS's organisational chart detailed the responsibilities of new managers and engineers, architects were notoriously absent both in the company's managerial documents and its archive. If one was to write this story based solely on Moelven's archival holdings, one might think architects were never involved, either in the process of system development or in actual construction. However, this conjecture could hardly be true, as the company completed a wide range of built projects across the country, from housing to schools, sports halls and other typologies. In fact, for most of its projects, Moelven Brug cooperated with the architectural office of Helge Abrahamsen and Hans Grinde, which in 1962 was joined by the Swiss architect René Philipp.[132] Before the office started working with Moelven in the mid-1950s, Grinde and Abrahamsen won a number of architectural competitions, including one for Herøya church, a bathing park in Sandefjord, and a regulation plan for the area of Schøyen-Opsahl.[133] The office had a strong profile in public buildings—for example, projects for city halls in Strømmen and Skedsmo.[134] Grinde in particular worked on many projects for swimming and sports halls, together with civil engineer Sven Thaulow completing swimming pools in Modum, Hønefoss, Flekkefjord and Moheia.[135] Abrahamsen, on his part, was involved with post-war Norwegian church construction, lecturing widely on the subject with a particular emphasis on the merger between new materials and traditional forms.[136] This interest and experience in public buildings—not least sports halls and churches—explains why Persbråten gym, Elverum sports hall, and a church in Søre Ål were among the first significant public buildings completed by Moelven. They were also the first buildings in the country constructed in load-bearing glued laminated timber.

The interest in timber shared by all three office architects was perhaps another reason for their continuous collaboration with Moelven. Hans Grinde was born on a farm in Enebakk and, according to his son Geir, spent a lot of time in the farm's wooden workshop, carrying his fascination with the malleability and adaptability of timber into his later professional practice.[137] Helge Abrahamsen's interest in the material

132 *Akers-Posten*, June 16, 1973, 5.
133 *Sandefjords Blad*, March 11, 1954, 3.
134 *Svelviksposten*, February 18, 1955, 2; *Svelvikposten*, November 27, 1956, 1.
135 *Bygdeposten*, May 13, 1955, 1; *Ringerikes Blad*, April 6, 1956, 4; *Fæderlandsvennen*, June 28, 1956, 5; *Rana Blad*, October 24, 1956, 1. For more on swimming pools see an edited compilation Sven Thaulow et al., *Bad og svømmeanlegg*, *Norbok* (Oslo: Norges badeforbund, 1965).
136 *Morgenposten*, February 24, 1959, 5.
137 Interview with Geir Grinde, May 5, 2021.

stemmed from a more theoretical standpoint and research into traditional Norwegian construction. In a 1951 *Byggekunst* article, for example, Abrahamsen harshly criticised schematic formalism and uniformity of contemporary timber house construction, which, according to him, bred "mass-produced boring sameness" and became a "refuge of the lazy and the untalented."[138] Instead of "parasitically" holding onto traditions of timber construction, Abrahamsen encouraged young Norwegian architects to instrumentalise new building methods for renewed architectural expression.[139] In 1956, Grinde and Abrahamsen edited *Bonytts hyttebok*, that amassed an eclectic collection of timber projects, from Knut Knutsen's summer house in Portør to Grinde's own cabin in Vågå and a house by René and Liv Philipp near Oslo.[140] On his part, Philipp was not only building with timber, but fostered a particular interest in the history of prefabrication as he held a significant private archive of Christian Thams, a 19th century pioneer of element timber prefabrication in Norway.[141] In 1961, the office of Abrahamsen-Grinde-Philipp completed what was deemed by *Bonytt* to be an "exceptional" house in timber full of custom-designed solutions for the carpenter and skiing champion Knut Johannessen.[142] In this way, all three architects shared an interest in historical and contemporary timber constructions, informed by both theoretical and historical perspectives and practical experience of building with timber.

In addition, both Grinde and Abrahamsen were fascinated with new technological developments in construction and the ways in which mechanised production could be harnessed for more flexible and adaptable housing. In a 1954 *Bonytt* article, the architects called for more industrialised construction, claiming that "it was the only right way" to meet growing demand for individualised housing: "there are no technical or economic obstacles on the way [to flexible apartments], only conventional habits."[143] The architects were inspired by industrial buildings with their flexible arrangement of spaces, and hoped that a similar strategy could be applied to housing. In their suggestion for type houses in Odda municipality, Grinde and Abrahamsen proposed to place all infrastructural fixtures within a building core, which in turn would free the floor plan and allow for flexible internal partitions. These

138 *Morgensbladet*, August 15, 1955, 3, 7.
139 *Morgensbladet*, August 15, 1955, 3, 7.
140 Helge Abrahamsen and Hans Grinde, *Bonytts hyttebok* (Oslo: Bonytt, 1956). *Morgenbladet*, December 19, 1956, 3.
141 Reiersen, *Fenomenet Thams*, 168. Thams archive donated by Philipp to the National Architecture Museum can be found at NMK.2008.0599.
142 Helge Abrahamsen and Hans Grinde, "Nye tendenser i boligbyggingen," *Bonytt* 21, no.5 (1961): 24.
143 *Bonytt* 14, no.11/12 (1954): 217.

Fig. 26. Architect Hans Grinde in Grinde-Abrahamsen office, photographed in front of Herøya church project. Newspaper clipping, *Morgenbladet*, August 28, 1952, 4.

Fig. 27. Architects Helge Abrahamsen and Ruth Bilow Johannessen in Grinde-Abrahamsen office. Newspaper clipping, *Morgenbladet*, August 28, 1952, 4.

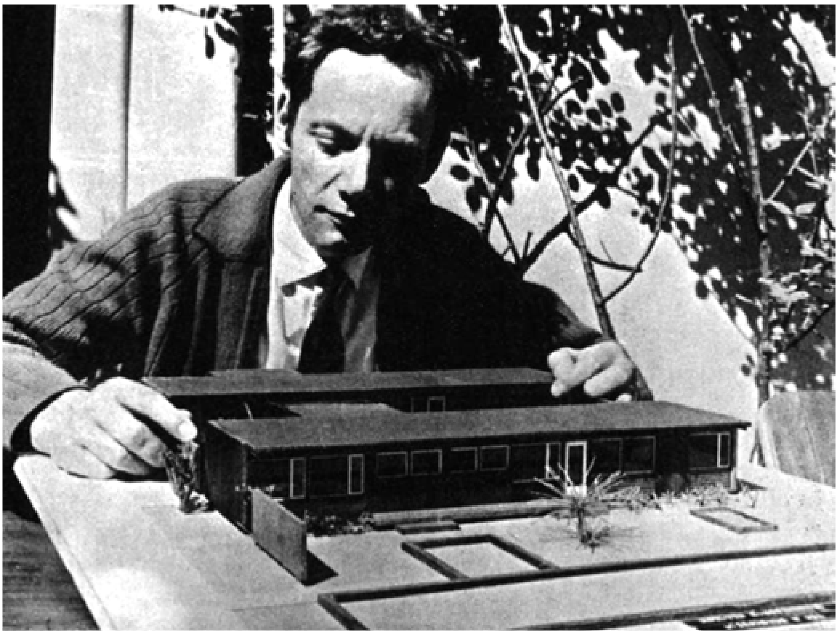


Fig. 28. Swiss architect Rene Philipp in front of a Moelven model house, winner of *Bonytt*'s "House of the Year" award. Newspaper clipping, 1970.

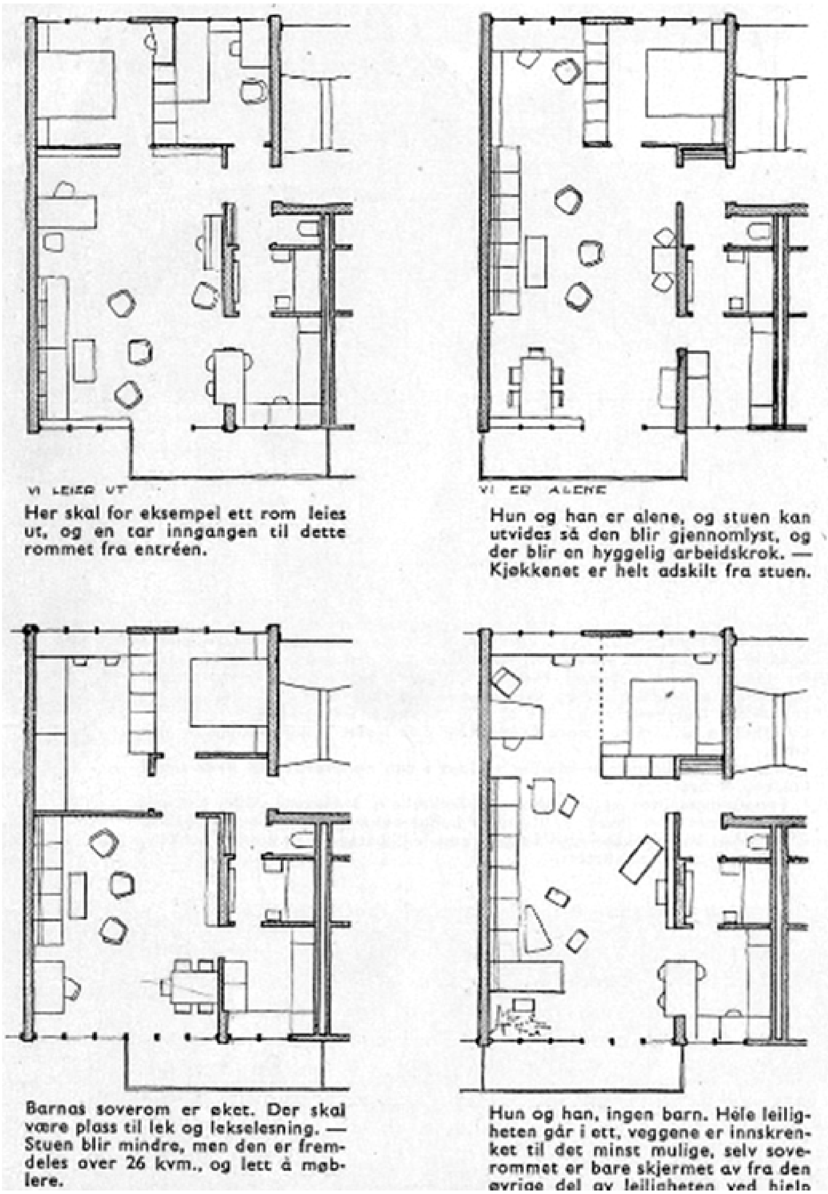


Fig. 29. Grinde and Abrahamsen's early take on flexible space arrangements and moveable partitions in Odda municipal housing project. From *Bonytt* 14, no.11/12 (1954): 216.

ideas were later realised in the first Ski housing produced by Moelven Ringsakerhus factory in 1965 and developed further in the Skjetten project and Ringsakerhus-building system devised in the early 1970s.[144] An "outer-space" or a U98A Moelven type-house designed by Rene Philipp in 1968 followed a similar principle of fixed core and movable partitions.[145] All three architects shared an interest in the opportunities for new form offered by industrial production and, in particular, a more flexible, adaptive housing responsive to dwellers' needs.

However, the original reason behind the office's involvement with Moelven was more prosaic. Grinde's wife—Turid Grinde *neé* Vogt, was a daughter of Fredrik Vogt, former rector of the Norwegian Institute of Technology (NTH), and director of the Norwegian Ministry of Water Energy and Resources (NVE) since 1947.[146] NVE commissioned the Grinde-Abrahamsen office for a number of projects throughout the 1950s, including 24 temporary worker houses in Telemark, built from prefabricated timber elements.[147] At the same time, NVE had been one of the largest Moelven clients for "houses-on-wheels," and in 1956 became the second ever client for Moelven element houses.[148] Most likely, an element building system designed by Hans Grinde for the Telemark project was transferred from one producer—Barbøl Sag og Høvleri—to Moelven Brug. Although direct evidence is very scarce, it is possible to estimate that this was not a typical involvement of the architect-consultant: Grinde operated within the industry and worked with the company to develop both conceptual and technical aspects of Moelven's new prefabrication system, based on vertical panel elements and sections. For example, in a 1996 interview Mageli confirmed that Grinde proposed his idea of a building system to Moelven and was indeed the creator of Moelven section houses. Consequently, he received a small commission for each house the company sold in the coming years.[149]

144 Abrahamsen, Grinde and Philipp collaborated with the core design team at Skjetten; see more in Chapter 4.

145 See more on the U98A house in Chapter 4. Philipp was generally interested in prefabrication, winning a second prize and a commission for Ruter station kiosk organised by the Norwegian Concrete Association. *Norske Arkitektkonkurranser*, no. 55 (1959): 2-5.

146 I am thankful to Geir Grinde for pointing out this connection that otherwise would have been impossible to trace. A reference to Turid Vogt can be found in Helge Solberg and Norges teknisk-naturvitenskapelige universitet: Fakultet for arkitektur og billedkunst, *Arkitektur i hundre: arkitektutdanningen i Trondheim 1910-2010*, *Norbok* (Trondheim: Tapir, 2011), 111.

147 Helge Abrahamsen and Nordisk byggedag, *Nordiske småhus*, *Norbok* (Oslo: Nordisk byggedag, 1958), 186. Grinde is listed as the main architect of the project.

148 Moxelven order books "Orderbøker, 1956-1973, Elemenseksjonsbrakker, 1956-1973," 1956, SAH/ARK-281-01/K/Kc.

149 Johs. Mageli, "A/S laminator. Etablering, vekst og utvikling," 6-7. March 1996. In SAH/ARK-287-02/E/Ea.

Grinde's system of prefabricated timber elements first found a broad application in schools—among them schools in Persbråten, Jessheim, Nøkklevann, Fredheim and Enebakk—industrial buildings, offices and, eventually, housing.[150] By the mid-1960s, the office of Abrahamsen, Grinde and Philipp was behind most of Moelven's cluster housing projects—for example, large developments in Ski, Nedre Stovner, Stigenga, Stovnerskogen, Gjøvik—that were built from the system of flat timber panels. With the advance of era of building systems, this originally ad-hoc industrial kit-of-parts was later reworked into a comprehensive Ringsakerhus-system (RH) by Abrahamsen-Grinde-Philipp in cooperation with HRTB architects and the Apeland og Mjøset engineering firm.[151] Used in numerous Moelven housing projects in the 1970s, the RH-system was a pragmatic realisation of a modernist dream that sought to reconcile architecture, engineering and science at the service of the consumer. Cooperation between the Grinde-Abrahamsen office (Philipp seemed to had gone his own way) and Moelven continued well into the 1980s, as the architects designed Moelven's serially produced Sol-Varmehus: a new generation of prefabricated houses powered by renewable energy systems and sunlight.[152]

These were not the only architects that Moelven worked with: many projects were carried out in cooperation with local architects. Among the recurrent Moelven collaborators were a duo of Paul Cappelen and Torbjørn Rodahl, Skedsmo school architect Ernst Ekra, Fredrikstad architect Aksel L. Fronth and the HRTB team—Hultberg, Resen, Throne-Holst and Boguslawski.[153] Cappelen and Rodahl, in fact, are the only architects that appear in the company's archive: for example, a contract from 1962 describes the scope of the architects' intellectual property rights and delineates their area of responsibility in relation to Moelven's managers and engineers:

"[Cappelen and Rodahl] had come up with an idea for section houses. Mediated by engineer Borring, the architects were put in touch with [Moelven], which was already in the process of producing and selling section houses designed by architect Hans Grinde. [...] The architects transfer their idea of manufacturing prefabricated homes to [Moelven], according to drawings 40/02-06-07-08 and 09, for exclusive production.

150 *Morgneposten*, September 12, 1962, 1,2; *Romerikes Blad*, October 19, 1962, 1; *Morgenbladet*, December 14, 1962, 5; *Aftenposten*, January 28, 1967, 15. More on schools, see Chapter 3.
151 More on RH-system see in Chapter 4.
152 Birgit Cold et al., *Nye boligformer: en eksempelsamling*, *Norbok* (Trondheim: Tapir, 1984), 109.
153 On Ernst Ekra see Chapter 3, on HRTB architects—Chapter 4.

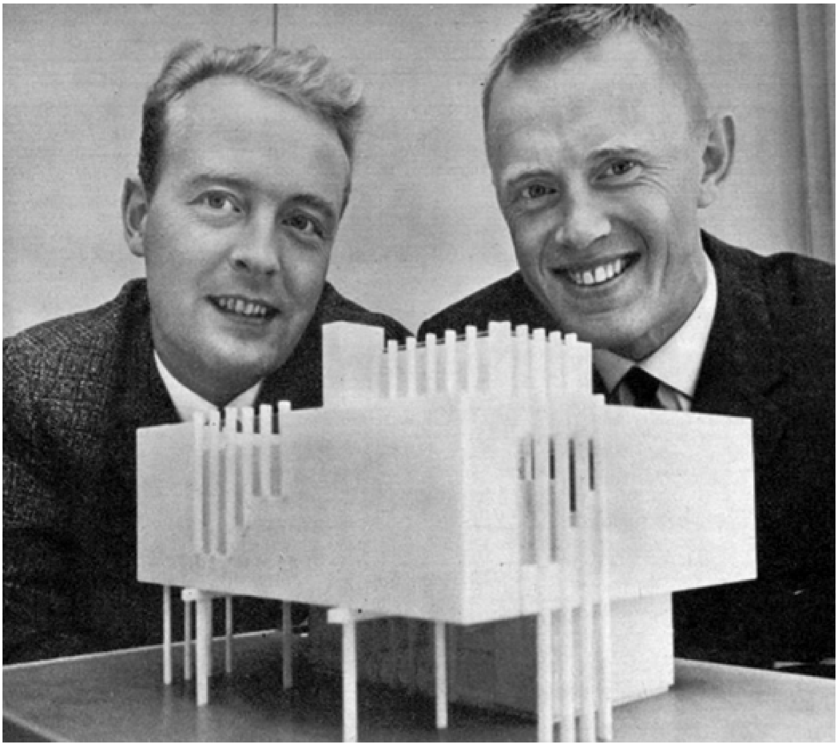


Fig. 30. Moelven's frequent collaborators, Paul Cappelen and Torbjørn Rodahl. Photo from *Aktuell* 18, no. 36 (1963).

Architectural work that has been carried out to date and work that will be carried out in the project later, is the architects' own intellectual idea and their property. In this regard, the architects are to continue their work on the project in collaboration with engineers and consultants that both parties agree on."[154]

Beyond collaborations with architects, Moelven sought advice from academic researchers: among them, NTH professor Hans Granum, engineers and timber specialists from NBI and the Wood Technology Institute.[155] However, in the absence of archival evidence, exact details of these collaborations are hard to reconstruct: for example, the ar-

154 "Kontrakt mellom A/S Moelven Brug og Arkitektene M.N.A.L. Paul Capplene og Torbjörn Rodahl, Oslo." 19 January 1962, Moelv, Oslo. See Folder L0006 "Ordrebøker/salgskontrakter" in SAH/ARK-287-01/K/Kc/L0006.

155 More on this cooperation see Chapter 5.

MOELVEN BRUG
MOELV

Kontraktsarkiv
DATO:
ARK:

K O N T R A K T

mellom
A/S Moelven Brug
og
Arkitektene M.N.A.L. Paul Cappelen og Torbjörn Rodahl, Oslo.

Mellom A/S Moelven Brug (i det etterfölgende kalt Bruget) og arkitektene MNAL Paul Cappelen og Torbjörn Rodahl, Oslo, (i det etterfölgende kalt arkitektehe) er dags dato inngått fölgende kontrakt:

Grunnlag:

Arkitektene hadde utformet en ide til seksjonshus. Ved formidling av ingeniör Borring ble arkitektene satt i forbindelse med Bruget, som allerede var igang med produksjon og salg av seksjonshus og seksjonsbrakker tegnet av arkitekt Hans Grinde. Disse seksjonshus var levert bl.a. til Statskraftverkene og til Statens Vegvesen, - produksjon og leveranse som også fortsetter på det tidspunkt nærværende kontrakt undertegnes.

Overenskomst:

I.

Arkitektene overlater til Bruget sin ide for fremstilling av prefabrikerte boliger, jfr. tegninger 40/02 -06 - 07 - 08 - og 09, datert den 1. september 1961, for enefabrikasjon. Det arkitektarbeide med prosjektet som er utfört til idag og arbeidet med samme som kommer til utförelse senere,er arkitektenes åndsverk og deres eiendom. I den forbindelse påtar arkitektene seg å tegne og lede det videre arbeide med prosjektet i samarbeide med konsulenter som partene blir enige om å knytte til seg. Bruget har anledning til å anvende de tekniske resultater man måtte oppnå også til andre formål, men först etter at de rettmessig er lansert i forbindelse med arkitektenes prefabrikerte bolig.

II.

Det er forutsetningen at man skal söke prosjektet ferdig bearbeidet for at produksjonen kan settes igang snarest mulig. Straks grunnlaget finnes å være til stede, forplikter Moelven Brug seg til å fremme produksjonen av typehusene så raskt og i så stort omfang som forholdene muliggjör.

III.

Partene er enige om at man skal söke å komme frem til et salgbart produkt som såvel teknisk som estetisk skal ligge på det höyest mulige nivå. Arkitektene forplikter seg i den

Fig. 31. A curious archival artefact and an example of a copywright negotiation between the architects and the industrial producer. “Kontrakt mellom A/S Moelven Brug og Arkitektene M.N.A.L. Paul Capplene og Torbjörn Rodahl, Oslo.” Dated January 19, 1962, Moelv, Oslo. See Folder L0006 “Ordrebøker/salgskontrakter” in SAH/ARK-287-01/K/Kc, State Archive in Hamar.

ELVEN BRUG
MOELV

DATO:
ARK: 2.

III - forts.

forbindelse til å bistå med råd, såvel når det gjelder materialvalg som tekniske utförelsesmåter.

IV.

Samarbeidsavtalen innebærer at arkitektene skal ha plikt til etter eget initiativ eller når Bruget önsker det å foreta kontroll av produksjonen og i den forbindelse bistå med råd og veiledning med henblikk på å nå det under pkt. 3 oppstillede mål.

V.

Arkitektene skal honoreres av Bruget etter fölgende skala:
For de förste 0 - 100 hus (eneboligenhet) kr. 1.000.- pr. stk.
For de etterfölgende hus - " 300.- " "
Arkitektene har krav på å få sitt honorar betalt hver 3.måned på basis av oppgave over de i perioden solgte og betalte enheter.

VI.

Arkitektene dekker selv de utgifter til reise, telefoner etc. som nærværende avtale medförer.

VII.

Hvis det skulle bli brakt på markedet i Norge konkurrerende seksjonshustyper basert på noenlunde tilsvarende prinsipper, vil arkitektene söke denne konkurrerende produksjon stoppet ved den beskyttelse loven måtte gi deres utforming. Spesielle utgifter til juridisk eller annen bistand som i denne forbindelse måtte oppstå, dekkes med 80 % av Bruget og 20 % av arkitektene.

VIII.

Bruget forplikter seg til ikke å söke andre arkitekters bistand ved utvikling av den under pkt. I angitte seksjonstype. Arkitektene forplikter seg til å forelegge Bruget nye ideer til forbedringer eller forandringer som kan gjöre hustypen lettere salgbar. Så lenge nærværende kontrakt löper, har arkitektene ikke adgang til å yte andre firmaer bistand til produksjon og markedsföring av seksjonshus.

IX.

Bruget er ansvarlig for salget av hustypen.

X.

Bruget har anledning til - innenfor rammen av denne avtale - å igangsette produksjon ved datterselskap eller eventuelt bortsette produksjonen til andre bedrifter.

chive of the Abrahamsen-Grinde-Philipp office was entirely discarded, with not a single drawing remaining. Grinde's son, Geir Grinde, offered some memories, but they could barely cover the basic factual questions, let alone specifics of close collaborations that spanned several decades.[156] Helge Abrahamsen was a prolific writer who authored several books on Norwegian architecture and published consistently in *Byggekunst*, *Bonytt* and *Morgenbladet*—making his ideas somewhat easier to trace. At the same time, he is less relevant for the story of Moelven: according to Geir, it was mostly Hans Grinde that worked with the company. Thus, information on Moelven architects had to be patched together through scattered mentions in a wide range of print sources. That is when I discovered that the office of Grinde-Abrahamsen-Philipp in fact had another member: Ruth Bilow Johannessen.

An architect from Larvik, Johannessen graduated from NTH in 1951 with the highest project diploma grade in *Byggekunst IV* ever achieved.[157] In August 1952, together with her NTH colleagues Bjørg M. Myhrer and Grethe Hejer she won the second prize in an architectural competitions for a cancer-patient recovery home.[158] Later the same month, she was featured alongside Helge Abrahamsen in a newspaper photograph from AGP office.[159] Johannessen stayed with the office for quite a while—at least until the mid-1960s, where among other projects she prepared plans for Abrahamsen-Grinde's edition of *Bonytts Hyttebok* and worked on designs for swimming pools in Odda and Mo i Rana.[160] Scattered credits here and there point to the fact that as a woman, she was delegated many of the office's meticulous work tasks. In parallel to her office work, Johannessen continued to collaborate with her female NTH colleagues, completing a single-family house in Hønefoss with Myhrer in 1955, and a "forest" house with Hejer in 1958.[161] She also shared the office's interest in industrial buildings, as, together with Myhrer (tellingly misspelled by *Byggenytt* as Bjørn instead of Bjørg), Johannessen worked on a new building for the Jordan brush factory.[162] These experiences, coupled with the fact that the visual language of Johannessen's diploma largely resembles that of Moelven's project drawings, could perhaps

156 Geir Grinde, interview on May 5, 2021.
157 *Adresseavisen*, November 3, 1951, 3. See project drawings in *Byggekunst* 34, no.3 (1952): tillegget, 10-11. Other (smaller) top marks went to Johannessen's future collaborator Bjørg M. Myhrer and Erik Langdalen.
158 *Nordly*s, August 15, 1952, 2.
159 *Morgenbladet*, August 28, 1952, 4.
160 See dedication in Abrahamsen and Grinde, *Bonytts hyttebok*, 2. Sven Thaulow et al., *Bad og svømmeanlegg*, 129, 137. For Johannessen's early swimming career, see *Østlands-posten*, June 4, 1947, 3.
161 Abrahamsen and Nordisk byggedag, *Nordiske småhus*, 171. *Bonytt* 25, no. 2 (1965): 39-40.
162 *Ukens byggenytt* 4, no. 6 (1959): 8.

indicate that Johannessen was also one of the architects behind some Moelven designs—although there is little archival evidence to prove it directly. This limited information—discovered largely through an accidental photograph and scattered newspaper records—proves how little we know about architects (and particularly, female architects) who chose to work with industrial producers and whose work remains largely outside of the conventional canon. Although absent both in the company's archives and architectural historiography, these ordinary practitioners nevertheless played a significant role in shaping the built environment at the time—not least through the designs of new prefabricated systems and their built products—leaving plenty of room for potential future research on the place of architects within industrial production.

THE IMPERSONALISED EXPERIMENT

At a January 1974 conference in England, organised by the Scandinavian Institute for Administrative research, the administrative and functional development of Moelven was presented as a special case study.[163] The company was just about to enter the German market, and thus the Institute analysed the company's development over the last 25 years. The conclusion was that it was Moelven's product diversification specifically that had allowed the company to gain its prominent market position.[164] The managing director, "Mr. Mageli," with his strong leadership, wide range of responsibilities and a nearly-unchecked freedom of decision-making was singled out as the second most important factor.[165] Both these elements—new managerial order and product diversification—have their roots in the mid-1950s modernisation of Moelven carried out by IRAS that ushered in a new era of "American" productivity, efficiency, quantification, rationality and control. Moelven's new organisational structure charted by IRAS provided the kernel of all future transformation and product diversification and visualised the work of managers and engineers, but, most importantly, served as a tangible testimony of the new era of managerial capitalism.

The IRAS managerial chart also provided the main point of departure for this chapter, that has hoped to counteract the commonly-held assumption that prefabricated buildings belong to "architecture without

163 Dalseg, *Moelven Brug i forvandling og vekst*, 53. Barbara Czarniawska and Guje Sevón, *The Northern Lights: Organization Theory in Scandinavia*, *Norbok* (Malmö: Liber, 2003), 137.
164 Dalseg, *Moelven Brug i forvandling og vekst*, 52.
165 Dalseg, 53.

architects," anonymous and generic. The chart allowed me to map the multiplicity of authors behind Moelven products: managers, engineers, architects, rationalisation experts, accountants, technical specialists, sales managers, external consultants and researchers. A cohort of new Moelven managers—Edland, Høstmark, Pedersen and Granberg—headed by the resourceful and ambitious Mageli, was looking to test the best international examples, new "American" ways of doing business, and expand the company's operations. With many mid-range managerial positions filled by engineers, this fascination with rationality and the technological production process grew into the core of Moelven's prefabricated products. Architects like Abrahamsen, Grinde, Philipp (and Johannessen) or Cappelen and Rodahl played a significant role in developing Moelven's prefabricated system and products, but remain little recorded both in conventional architectural history and the company's archives. Although the Moelven system remains less known than the more architect-driven experiments in timber—for example, Moduli 225 or Espansiva—it was produced and implemented on a far wider scale than similar precedents in neighbouring countries.

While this chapter consists of two parts—one about the managers, the other about the architects—it hopes to complicate the narrative, showing that the differentiation between architectural debate and industrial practice was largely artificial. Instead, these industrial and architectural storylines should be woven together in a single, comprehensive narrative—a similar conclusion reached by Bullock in his study of post-war British construction. As the gospel of rationalisation and productivity spread to other areas beyond industry, architects grew increasingly interested in opportunities offered by the industrialisation of construction, prefabrication and mass-production. This new approach to building required new facilities and skills: as architectural imagination was supplemented with quantitative calculations and process rationalisation, architectural production partially became a realm also of managers and engineers. This intertwined relationship is confirmed by the fact that the same actors—for example, Kielland, Birkeland, Granum and Engh—appear in both parts of the story, while different agencies—for example NPI, IRAS, and NBI—worked with professionals from both industrial and architectural realms. This chapter thus is not just a history of Moelven or building industrialisation, but a snapshot of the era of Norwegian modernisation, when similar ideas of rationalisation, quantification, productivity and mechanisation permeated different spheres of everyday life. In this context, Moelven's prefabricated buildings assembled on conveyor belts from a kit of standardised components appear as “brain-children” of their time, and, in particular, of the newly-emerged white-collar managerial class. If architects, managers and engineers were the “authors” of this prefabricated architecture, who actually made Moelven buildings, and how were they made?

THE INDUSTRIAL COMPLEX

CHAPTER 2

Fig. 1. Moelven workers, 1959. From Antonsen, *75 år med Moelven-klubben i medgang og motgang: 1913-1988*.

“THE COMPANY’S LIFE MUST FUNCTION WITHIN THE FRAME-WORK CONDITIONS SET BY THE SOCIETY.”[1]

1 Johs Mageli, *A/S Moelven brug: karakteristika og synspunkter*, Kristofer Lehmkuhl forelesning 1977 (Bergen: Norges handelshøyskole, 1977), 13.

IN SEARCH OF LOST TIME

In December 1956, a new era of productivity descended from Moelven's administrative offices onto the factory floor. IRAS, the same rationalisation agency that introduced a new managerial structure just a year prior, was now commissioned to rationalise Moelven's production. From December 5 to 14 1956, and from January 10 to 19 1957, IRAS section manager Torbjørn Kårhus assisted by engineer R. Westby Erichsen conducted two sets of productivity studies held in Moelven workshops.[2] Each study gathered ten participants from the mechanical workshop and volunteers from other departments, compensated with 4,25 NOK per hour.[3] The studies were supposed to provide the basis for new time-based payment tariffs and serve as a departure for the further rationalisation of the company. Essentially implementing one of the main techniques of scientific management, time-motion studies, IRAS engineers analysed problems related to internal transport and process planning, workers' movements and work methods, division of work and communication of tasks, and the quality of tools and workplace arrangement. Records of these studies were collected in a substantial 70-page report with ten attachments, including detailed process diagrams, suggestions of concrete rationalisation measures and drawings of more rational production space and workshop arrangements.[4]

Among the five major operations observed were "assembly welding in a team of two men," "welding by one person," "reinforcement of beams," "assembly of elements by two men" and "studies in the painting workshop," with an overall observation time tallying to 80 hours.[5] During these studies, an IRAS observer with a stop-watch closely followed each operation from start to finish, meticulously timing all work flow sequences and recording them in a detailed process scheme. Every action was classified either as "operation," "transport," "control," "stay" or "storage," measured in fractions of time—cmin—and distance travelled to perform it. A separate table measured and documented all "lost" and productive time, assigned a specific percentage value relative to the entire process duration. While the observation time took only a couple of weeks, the

2 The idea of work studies at Moelven Brug was introduced and discussed several times throughout 1955 and 1956, but a final decision was taken on November 20, 1956. See meeting notes from December 23, 1955; October 2, 1956; all in Folder 0002 "Møtereferat" in "Produksjonsutvalget i Moelven Brug" SAH/ARK-287-01/A/Ac/L0000A

3 "Forhandlingsprotokoll," Folder 0001 in "Produksjonsutvalget i Moelven Brug" SAH/ARK-287-01/A/Ac/L0000A.

4 "Rapport vedrørende rasjonaliseringsundersøkelser i mekanisk verksted," dated December 1956 - 9 April 1957. Folder 0009 in SAH/ARK-287-01/N/L0001.

5 "Tids- of metodsstudiene," 2 in "Rapport." SAH/ARK-287-01/N/L0001/0009.

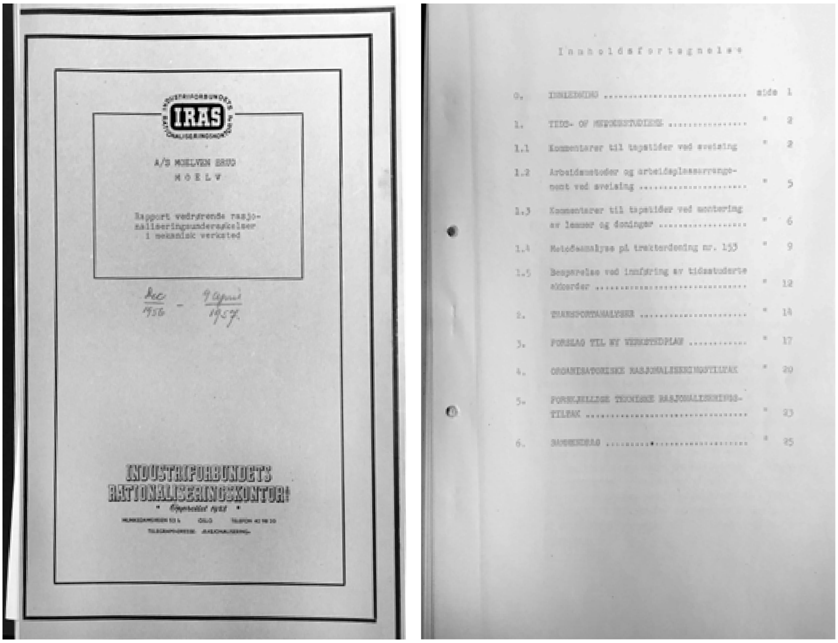


Fig. 2. 1956-1957 IRAS rationalisation report for Moelven's mechanical workshops. The report provided a comprehensive analysis of Moelven work processes, and suggested changes both to the spatial and labour organisation. "Rapport vedrørende rasjonaliseringsundersøkelser i mekanisk verksted", Folder 0009 in SAH/ARK-287-01/N/L0001. State Archive in Hamar.

findings were then studied and systematised by IRAS engineers for several months.[6] For example, analysing "welding in a team," IRAS experts identified that "lost time" comprised actions ranging from "a conversation with a colleague," "getting materials," "getting tools" and "clearing the work place" to "waiting for a colleague," "going around the work station" and "correcting mistakes." Put together, these actions corresponded to 45,6% of overall production time, effectively making it possible to eliminate one of the two workers originally needed to perform the operation.[7] In other processes, for example, welding by a single person, "lost time" accounted for only 11 or 15% and could hardly be reduced any further.

IRAS time studies of Moelven represented one of the essential techniques of scientific management that was making significant inroads in 1950s Norway. While prior to WWII, Taylorism as an individualising ideology was largely at odds with the collective pay bargaining system

6 See the final date of the report April 7, 1957, while the last workshop observation took place in January.
7 "Bilag no.1," "Samleplan for tapstider; Motasjesveising i gigg;" or "Rapport," 3. SAH/ARK-287-01/N/L0001/0009.

in Norway, in the post-war period its "scientific neutrality" fitted hand-in-glove with the state-mandated pursuit of productivity that relied on foreign resources and expertise.[8] IRAS engineers were the main transmitters of this American ideology onto the floors of Norwegian factories.[9] In this "scientific" approach to work, as Osman argues, rationalisation experts went beyond the previously accepted idea of identifying labour power with the body of the worker and instead located lost time in the mechanical relationship between machines and men who operated these transactions.[10] Adapting the tools and techniques of the natural scientists, including methods of direct observation and data collection, rationalisation experts could now record and quantify physical labour—a phenomenon previously resistant to visualisation.[11] This data then could be fed into mathematical models that provided a new insight into the relationship between profitability and labour. As IRAS engineers observed Moelven's operation, they deconstructed factory work processes into discrete units of data recorded in standardised forms. If labour input variables could be controlled, or at least standardised, this would allow to set more precise product prices, impose better managerial oversight and introduce the possibility of serial production. In the words of IRAS engineer Bernhard Hellern, standardisation of work operations allowed "to stabilise the human factor": standardised workers could now perform standardised tasks with standardised tools in a standardised time, all neatly configured into a modern accounting formula.[12]

Numerical forms used to record labour facilitated the pre-processing of information and extended managerial oversight, heralding what the 18th-century political theorist Henri de Saint-Simon described as a shift from "the government of men to the administration of things."[13] This standardisation, however, left little space for nuance or tacit knowledge. According to technology historian James Beniger, implementation of standardised forms to record knowledge required "destruction or ignoring of information."[14] These seemingly impartial forms introduced

8 See Tor Halvorsen, *Profesjonalisering - Taylorisering* (Bergen, 1982), 95. On the workers' resistance to pre-1950s attempts to introduced methods of scientific management see Bernhard Hellern, *Trekk av rasjonaliseringens historie i Norge* (Oslo: Håndverkstrykkeriet, 1963), 51–54. Trond Bergh, *Storhetstid (1945-1965)* (Oslo: Tiden, 1987), 133.

9 See Bernhard Hellern, *Produksjonsteknikk: en veiledning i bedrifts-rasjonalisering*, Cappelens håndbøker for handel og industri nr 5 (Oslo: Cappelen, 1933).

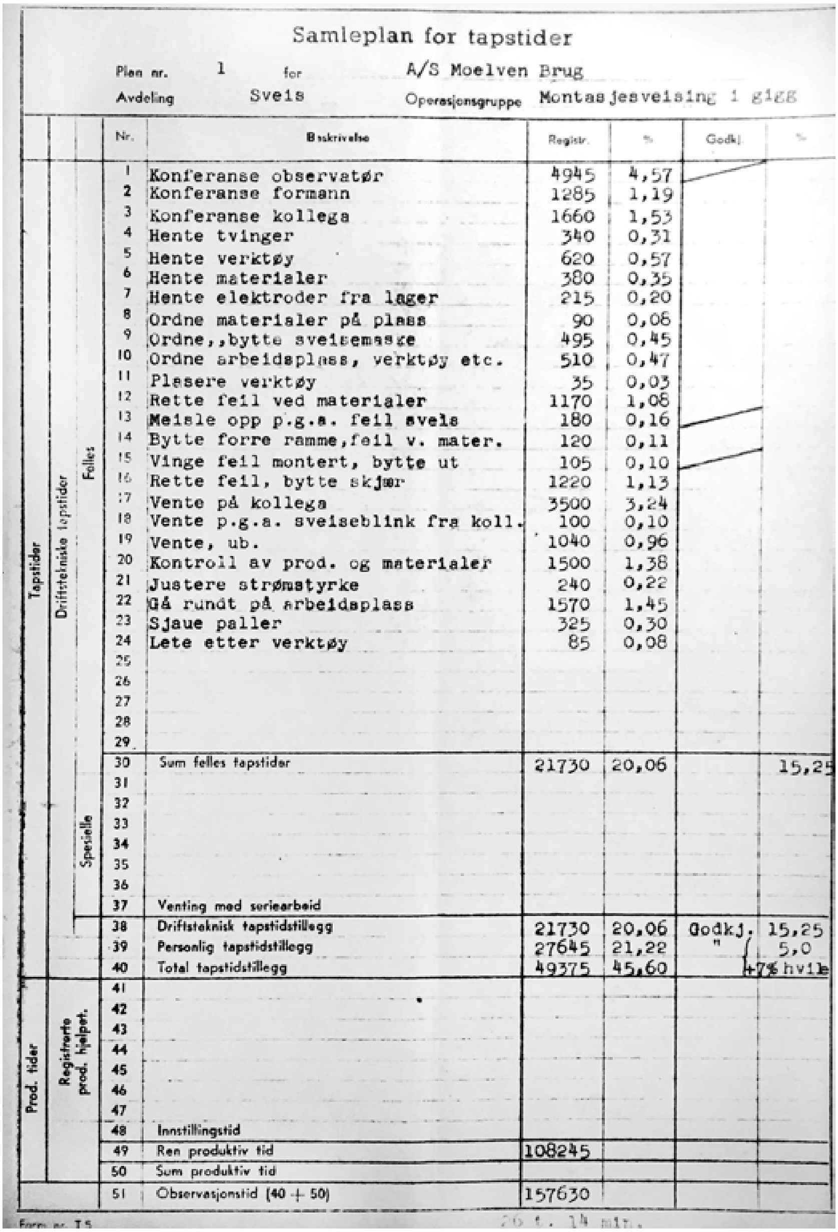
10 Michael Osman, *Modernism's Visible Hand: Architecture and Regulation in America* (Minneapolis: University of Minnesota Press, 2018), 130.

11 Osman, 7–8.

12 B. Hellern, *Rasjonell bedriftsledelse* (Oslo: Norges industriforbund, 1943), 36.

13 H. Saint-Simon, *Henri Saint-Simon (1760-1825): Selected Writings on Science, Industry, and Social Organisation* (London: Croom Helm, 1975), 3.

14 J. R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society*, (Cambridge, Mass: Harvard University Press, 1986), 15–16.



Samleplan for tapstider

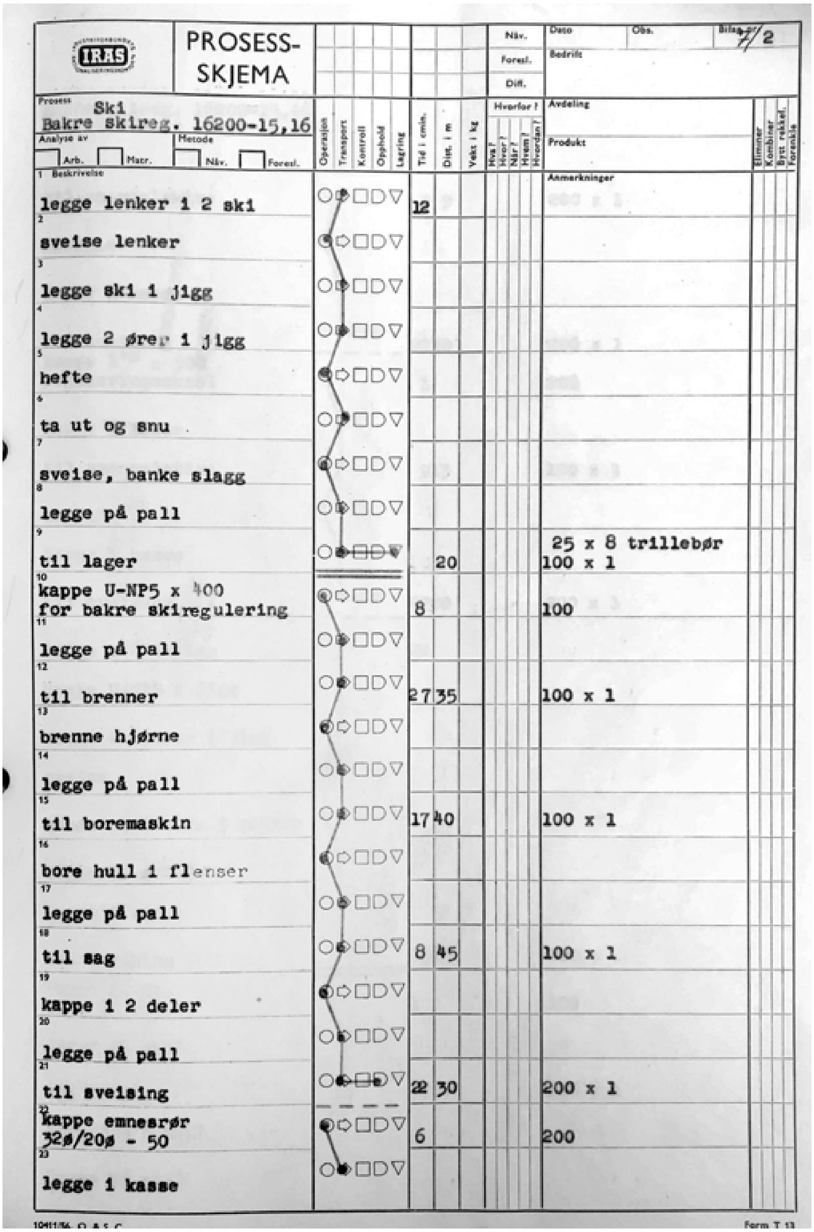
Plan nr. 1 for A/S Moelven Brug

Avdeling Sveis Operasjonsgruppe Montasjesveising i gigg

			Nr.	Beskrivelse	Registr.	%	Godkj.	%
Tapstider	Driftstekniske tapstider	Felles	1	Konferanse observatør	4945	4,57		
			2	Konferanse formann	1285	1,19		
			3	Konferanse kollega	1660	1,53		
			4	Hente tvinger	340	0,31		
			5	Hente verktøy	620	0,57		
			6	Hente materialer	380	0,35		
			7	Hente elektroder fra lager	215	0,20		
			8	Ordne materialer på plass	90	0,08		
			9	Ordne,,bytte sveisemaske	495	0,45		
			10	Ordne arbeidsplass, verktøy etc.	510	0,47		
			11	Plasere verktøy	35	0,03		
			12	Rette feil ved materialer	1170	1,08		
			13	Meisle opp p.g.a. feil sveis	180	0,16		
			14	Bytte forre ramme,feil v. mater.	120	0,11		
			15	Vinge feil montert, bytte ut	105	0,10		
			16	Rette feil, bytte skjær	1220	1,13		
			17	Vente på kollega	3500	3,24		
			18	Vente p.g.a. sveiseblink fra koll.	100	0,10		
			19	Vente, ub.	1040	0,96		
			20	Kontroll av prod. og materialer	1500	1,38		
			21	Justere strømstyrke	240	0,22		
			22	Gå rundt på arbeidsplass	1570	1,45		
			23	Sjaue paller	325	0,30		
			24	Lete etter verktøy	85	0,08		
			25					
			26					
			27					
			28					
			29					
			30	Sum felles tapstider	21730	20,06		15,25
		Spesielle	31					
			32					
			33					
			34					
			35					
			36					
			37	Venting med seriearbeid				
			38	Driftsteknisk tapstidstillegg	21730	20,06	Godkj.	15,25
			39	Personlig tapstidstillegg	27645	21,22	"	5,0
			40	Total tapstidstillegg	49375	45,60		+7% hvile
Prod. tider	Registrerte prod. hjelpet.		41					
			42					
			43					
			44					
			45					
			46					
			47					
			48	Innstillingstid				
			49	Ren produktiv tid	108245			
			50	Sum produktiv tid				
			51	Observasjonstid (40 + 50)	157630			

Form. nr. T5 26 t. 14 min.

Fig. 3. IRAS accounts of "lost time" and process diagrams. In "Rapport vedrørende rasjonaliseringsundersøkelser i mekanisk verksted", Folder 0009 in SAH/ARK-287-01/N/L0001. State Archive in Hamar.



IRAS

PROSESS-SKJEMA

Nåv. / Foresl. / Diff. | Dato | Obs. | Bilag 7/2 | Bedrift | Avdeling | Produkt

Prosess: Ski
Bakre skireg. 16200-15,16

Analyse av: Arb. / Matr. — Metode: Nåv. / Foresl.

Nr.	Beskrivelse	Tid i cmin.	Dist. i m	Vekt i kg	Anmerkninger
1	legge lenker i 2 ski	12			
2	sveise lenker				
3	legge ski i jigg				
4	legge 2 ører i jigg				
5	hefte				
6	ta ut og snu				
7	sveise, banke slagg				
8	legge på pall				
9	til lager		20		25 x 8 trillebør 100 x 1
10	kappe U-NP5 x 400 for bakre skiregulering	8			100
11	legge på pall				
12	til brenner	27	35		100 x 1
13	brenne hjørne				
14	legge på pall				
15	til boremaskin	17	40		100 x 1
16	bore hull i flenser				
17	legge på pall				
18	til sag	8	45		100 x 1
19	kappe i 2 deler				
20	legge på pall				
21	til sveising	22	30		200 x 1
22	kappe emnesrør 32ø/20ø - 50	6			200
23	legge i kasse				

10411/56. O. A. S. C. — Form T 13

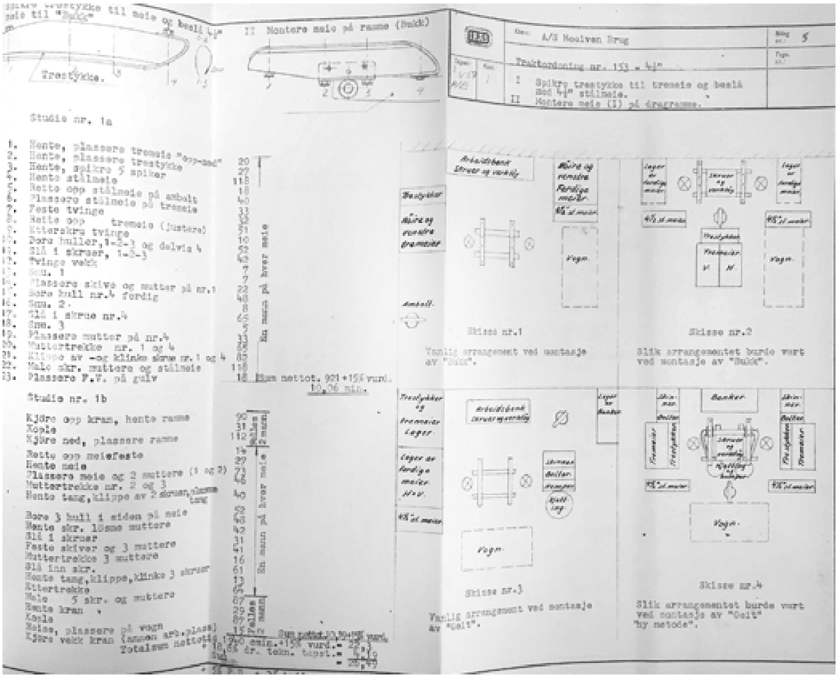


Fig. 4. Reorganisation of the work station suggested by IRAS following the results of time-studies. In "Rapport vedrørende rasjonaliseringsundersøkelser i mekanisk verksted", Folder 0009 in SAH/ARK-287-01/N/L0001. State Archive in Hamar.

to Moelven by IRAS engineers essentially made social and technological choices that assigned value to certain aspects of the production process over others. Instead of a complex craft with a variety of nuances, work at the factory was now comprised of series of discrete steps, each action measured, rationalised and standardised. It allowed to free the knowledge from a single worker—a Taylorist dream—and instead, defined each task as a collection of normative actions.[15] American literary scholar Martha Banta described 20th century Taylorism in the United States as a new "rationalised" system in which "all the wild and the idle have been co-opted by productivity managers."[16] In this way, while IRAS's time-motion studies of Moelven ushered in a new era of rationality and scientific expertise, this expertise was at odds with a decades-long tradition of handcraft and apprenticeship established at the company. IRAS rationalisation of Moelven not only profoundly

15 Frederick W. Taylor, "A Piece-Rate System: A step Toward Partial Solution of the Labour Problem," *Transactions of the American Society of Mechanical Engineers* 16 (1895): 856-57.

16 Martha Banta, *Taylored Lives: Narrative Productions in the Age of Taylor, Veblen, and Ford* (Chicago: University of Chicago Press, 1993), 34.

transformed the ways in which labour at the company was thought of and performed, but had a significant impact on Moelven products. I argue that it was precisely this parcelling of work, "scientific" rationalisation of processes and quantification of parameters that facilitated the introduction of conveyor belt lines that in their turn introduced a shift from *building* to *assembly*. Moelven's fascination with technologies of scale has its roots in these timed work operations of 1956.

This chapter is particularly interested in technology and labour, people and machines behind the production of Moelven's prefabricated buildings. In other words, if the previous chapter was about how Moelven products were conceived and by whom—i.e. architects, managers and engineers—this chapter is about how they were actually made. As Douglas Spencer, paraphrasing Marx writes in his book the *Architecture of Neoliberalism*, argues, architectural objects in their mystifying, phantasmagorical form strive to conceal the concrete labour through which they are produced.[17] Similarly, architectural historian Christine Wall argues that, although the labour processes involved in the production of architecture are central to understanding built form and the conditions under which it was constructed, architectural history is still reluctant to engage with histories of production.[18] This chapter strives to do precisely the opposite: to study the concrete labour, people and machines behind what Theodor Adorno referred to as the "occultation of production."[19] The case of Moelven Brug, a company that cultivated its public image through dazzling depictions of a highly advanced technological process, lends itself perfectly to such a study. IRAS's rationalisation of work marked just the beginning of the new "administration of things," followed by an array of technological objects: from standardised accounting slips and work-study charts to new equipment, advanced machines, conveyor belts and electronic computers. In just two decades, Moelven Brug transformed from a small local business that relied on handcraft to a large industrial enterprise with high levels of mechanisation. A "rational" production process became the company's hallmark, and Moelven products were often quantified in exact percent-

17 Douglas Spencer, *The Architecture of Neoliberalism: How Contemporary Architecture Became an Instrument of Control and Compliance* (London: Bloomsbury Academic, 2016), 74.

18 Christine Wall, *An Architecture of Parts: Architects, Building Workers and Industrialization in Britain 1940-1970*, Routledge Research in Architecture (London: Routledge, Taylor & Francis Group, 2013), 4–5. A similar argument is voiced by Timothy Hyde, who suggests to "decipher the temporalities that govern the material and immaterial aspects of work [...] and the need to demonstrate the actual experience of labouring bodies" through a close study of a construction site. Timothy Hyde, "The Building Site, Redux," *Journal of Architectural Education* 75, no. 1 (January 2, 2021): 87, https://doi.org/10.1080/10464883.2021.1859890.

19 Theodor W. Adorno, *In Search of Wagner* (Verso, 2005), 74.

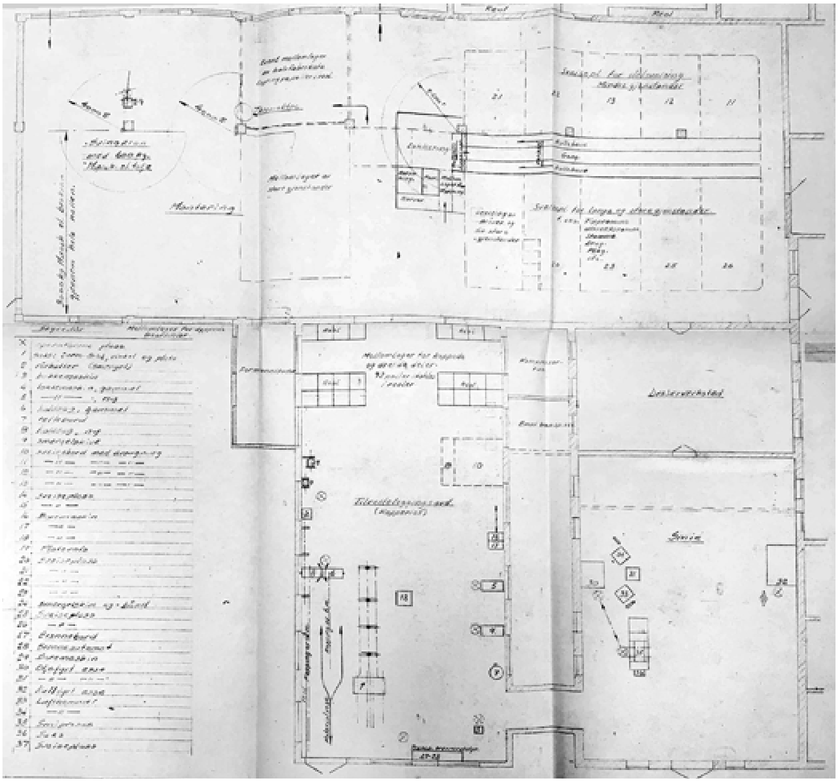


Fig. 5. IRAS "rational" spatial reorganisation of the entire assembly workshop. Note the notations of the production flow and crane movements. In "Rapport vedrørende rasjonaliseringsundersøkelser i mekanisk verksted", Folder 0009 in SAH/ARK-287-01/N/L0001. State Archive in Hamar.

ages of prefabrication.[20] However, although representations of new machines and technologies of mass-production featured prominently in many of Moelven's press appearances—both interviews and sales booklets—far fewer records exist of how work, products and the daily lives of its workers changed in this period of rationalisation. This chapter will first address how work at the company changed as new work technologies and ideologies were adapted to the realities of Norwegian working life, and, second, explore these adaptations in the context of the "welfare capitalism" model into which Moelven Brug developed.

20 See, for example *Lillehammer Tilskuer*, January 15, 1962, 2; *Ringsaker Blad*, September 10, 1964, 4; *Lillehammer Tilskuer*, February 20, 1960, 7; *Hamar Arbeiderblad*, August 19, 1960, 12; *Stavanger Aftenblad*, December 13, 1958, 17; *Lillehammer Tilskuer*, June 9, 1965, 1-2.

SPECIALISTS WITHOUT SPIRIT

Although official records from Moelven's production committee meeting—*produksjonsutvalg*—of November 20 1956 maintained that "no one had showed or expressed and resistance or dissatisfaction about [the implementation of work studies]," and thus the meeting moved on to more information from IRAS representatives, in practice this "unanimous" attitude proved to be less straightforward.[21] Devised after the example of war-time industrial committees in Britain, production committees were consensus-building entities that brought together representatives of labour, management, and technical experts around question of productivity, work environment and rationalisation in order to increase transparency and avoid conflicts.[22] It was specifically the Moelven's production committee that was to decide in what way the IRAS work studies should be implemented. In practice, this decision was not reached without tension. In his May 1957 speech to the representative assembly, Mageli mentioned that "negotiations with the workers about this transition had posed some difficulties," but he hoped that "the matter could be resolved in a reasonable way."[23] While the company's official records are silent on how this innovation was perceived by the workers, some scattered notes reveal that it did give rise to significant discontent. From select interviews with Moelven employees conducted in 1988 by Magne Antonsen, an active union member and Ringsaker representative of the Labour Party, it is possible to learn that both Peder Langaard and Olav Skar—two long-time Moelven employees who began working in a carpentry workshop in 1928 and 1929—were not "particularly enthusiastic that time work-studies were implemented." Langaard was strongly against it, saying that "if [the company] would have continued with work studies, [he] would no longer be working at Moelven."[24] This shows that although work studies were perhaps less contentious in Norway than in their country of origin—the United States—they did have a significant impact on the daily life of Moelven workers, whose voices were largely excluded from official records. In this respect, Antonsen's book *75 år med Moelven-*

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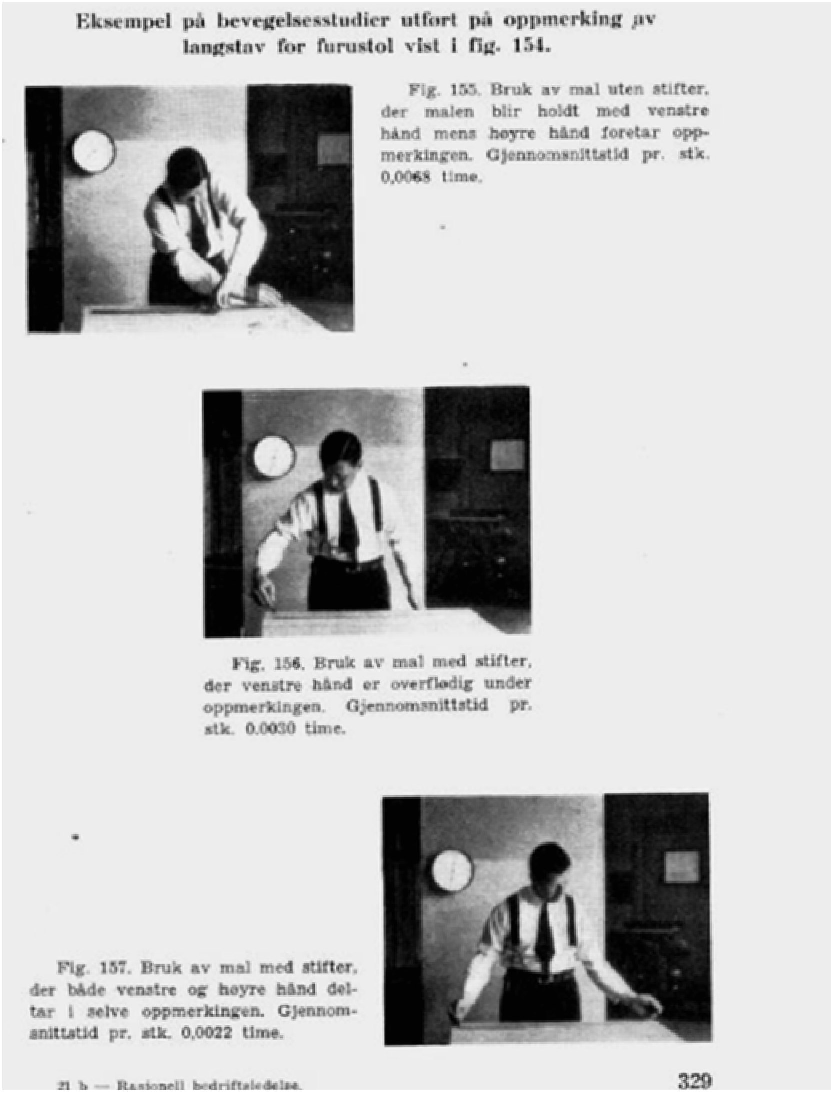
21 Notes from Produksjonsutvalg meeting November 20, 1956. Folder 0002 "Møtereferat" in "Produksjonsutvalget i Moelven Brug" SAH/ARK-287-01/A/Ac/L0000A.

22 Berge Furre, *Norsk historie 1905-1990: vårt hundreår* (Oslo: Samlaget, 1992), 125. In fact, similar 'shop committees' or Samarbejdsudvalg were created in Denmark in the post-war period so that the work negotiations would be more transparent for all parties involved. Caspar Jørgensen, "Rational Planning as a Sign of Modernism," in *Industry and Modernism: Companies, Architecture and Identity in the Nordic and Baltic Countries During the High-Industrial Period* (Helsinki, Finland: Finnish Literature Society, 2007), 77. Also in Bergh, *Storhetstid (1945-1965)*, 217. Thorvald Gran, *The State in the Modernization Process: The Case of Norway 1850-1970*, *Norbok* (Oslo: Ad notam Gyldendal, 1994), 267.

23 "Beretning til representantskapsmötet" October 1957, Folder 0001 in SAH/ARK-287-01/I.

24 Magne Antonsen, *75 år med Moelven-klubben i medgang og motgang: 1913-1988* (Moelv: Bedriftsklubben Moelven, 1988), 67.



Eksempel på bevegelsesstudier utført på oppmerking av langstav for furustol vist i fig. 154.

Fig. 155. Bruk av mal uten stifter, der malen blir holdt med venstre hånd mens høyre hånd foretar oppmerkingen. Gjennomsnittstid pr. stk. 0,0068 time.

Fig. 156. Bruk av mal med stifter, der venstre hånd er overflødig under oppmerkingen. Gjennomsnittstid pr. stk. 0.0030 time.

Fig. 157. Bruk av mal med stifter, der både venstre og høyre hånd deltar i selve oppmerkingen. Gjennomsnittstid pr. stk. 0,0022 time.

21 b — Rasjonell bedriftsledelse. 329

Fig. 6. An example of method studies, as illustrated in Hellern's *Rasjonell bedriftsledelse* (1947).

klubben i medgang og motgang: 1913-1988 provides a valuable insight into how daily life at the factory changed through the period of 1960s.[25]

Many of Moelven's long-term workers, like Johan Karlsen, witnessed the company's development first hand: when Karlsen started in 1936, there were 80 people and by 1980 there were nearly 2000. Many of Antonsen's interviewees mentioned that with this dramatically increased scale of production it was no longer possible to know everyone and it became easier to be "anonymous in the mass." As many of the older-generation workers were no longer with the company, there was a significant change in social relations and sense of belonging. Syver Smikkerud—a carpenter who started working for Moelven in 1925—remembered that the "best part" of working in the carpentry workshop was that one could leave tools or money and find them in the same place upon return. There were few people, and very little turnaround.[26] Langaard and Skaar also reminisced about the time when "everybody knew everybody."[27] Magnus Kamperud, a carpenter who started working for Moelven in 1939 at the age of 16, was nostalgic about the good camaraderie of former times: as he put it, he "never dreamt that one day the company would be so big that the workers would no longer know each other."[28] Kåre Kirkevold, Sverre Olsen and Kristian Johannessen, who had worked at Moelven since 1925, all talked about how an altered sense of belonging: from being a part of a small group where everyone knew all the intricacies of production it shifted to identification with the company as a whole. [29] At the same time, this feeling of larger unity was important: Kamperud specifically attributed Moelven's growth and success over the past 20 years to the fact that "both the workers and the leadership pulled in the same direction."[30] In other words, despite the fact that both the output and type of production had changed significantly with the period of industrialisation, Moelven workers and managers seemed to be invested in the company's long-term stability, and thus expansion.

As the company scaled its operations, the nature of work had profoundly changed. When IRAS first examined Moelven's serial production in 1957, its engineers found it largely "irrational" and ineffective, since the work tools were often imprecise and produced elements were crooked,

25 See Antonsen, *75 år med Moelven-klubben i medgang og motgang*.
26 *Bedriftavis* no. 17 (1975): 11.
27 Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 67.
28 Kamperud unlike other correspondents did not just notice the social change at the factory floor, but also worked actively as a community organizer to counteract it. His political engagement brough him in Ringsaker municipal board where he served two terms and later acted as a depute. Antonsen, 72–73.
29 Antonsen, 64.
30 Antonsen, 72.

with significant deviation of profiles.[31] New technology and organisation of work allowed for a faster and more accurate serial production. When studying these processes, however, it is important to recognise that this new technology is never neutral, nor is its spread innocent. As technology historian Andrew Feenberg argues, it is not an abstract notion of "progress" that brings automation, deskilling of work and bureaucratisation, but rather specific social and cultural choices made by social groups entrusted with decision-making powers.[32] New technological artefacts are usually introduced to solve certain "problems"—for example, "irrational" processes or irregular production—which are seen and defined as such, for example, by Moelven managers or engineers.[33] And while for Moelven managers technology came to be seen—similarly to how David Noble described American techno-positivism of the 1960s—as an "autonomous process, having a life of its own which proceeds automatically, and almost naturally, along a singular path," the experience was different for Moelven workers.[34] The company's discussions around the introduction of the new conveyor belt assembly are particularly illuminating in this regard. While for managers and rationalisation experts an assembly line was a definitive element of technological progress that improved productivity, for Moelven workers, in a culture based on collective negotiations and workers' councils, it was seen as an imposition constraining the ways in which work was defined, valued and performed.[35]

Although conveyor belt assembly simplified work, it also made it more mechanical and repetitive, causing unease and industrial alienation. In an interview with the company's magazine in 1975, Smikkerud emphasized that, with increased scale of production, workers were put in a position where little could be improved in the particular action assigned to them and where one had little influence on the final product. Smikkerud thought that, in the long term, this parcelling of work and industrial alienation would neither do service to the workers nor the company.[36] Similarly, Kåre Kirkevold and Sverre Olsen reminisced

31 "Rapport vedrørende rasjonaliseringsundersøkelser i mekanisk verksted," 22, Folder 0009 in SAH/ARK-287-01/N/L0001.
32 Feenberg, *Questioning Technology*, 10–11.
33 Trevor J. Pinch and Wiebe E. Bijker, "The Social Construction of Facts and Artefacts: Or How the sociology of Science and the Sociology of Technology Might Benefit Each Other" in Wiebe E. Bijker, Thomas Parke Hughes, and Trevor Pinch, *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge, Mass: MIT Press, 1987), 30.
34 David F. Noble, *Forces of Production: A Social History of Industrial Automation* (London: Routledge, 2017), preface. See also a discussion on automation and work organisation by Asbjørn Karlsen, "Fra håndverk til masseproduksjon: en studie av omstillinger ved Moelven Brug" (Nordlandsforskning, 1994), 98.
35 See a similar discussion in Feenberg and Feenberg, *Questioning Technology*, 87.
36 *Bedriftavis*, no. 17 (1975): 11.

Fig. 7. On the left. Olav Skar, a machine carpenter, employed at Moelven since 1948. On the right, carpenter Johannes Karlsen. From Antonsen, *75 år med Moelven-klubben i medgang og motgang*.

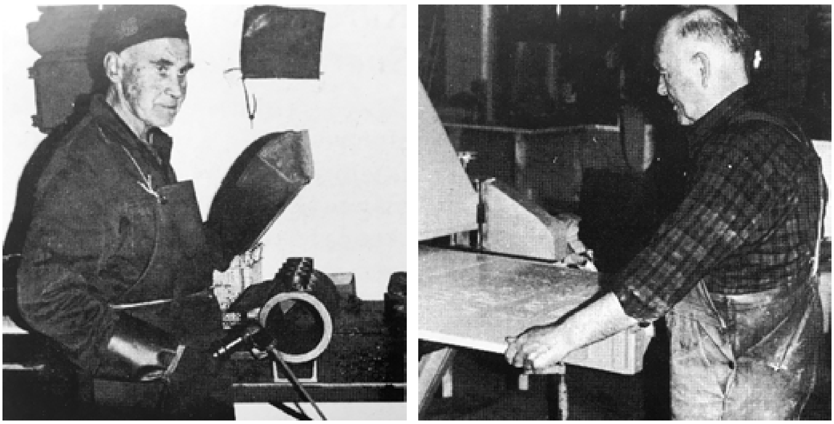


Fig. 8. Kåre Kirkevold and Sverre Olsen. From Antonsen, *75 år med Moelven-klubben*.

about the time "one had a feeling for making things themselves."[37] This was no longer possible with the new organisation of work: according to Olsen and Kirkevold, the work became too monotonous, as each worker had only a small part in the final product, and there was little job satisfaction in what they produced.[38] Kristian Johannessen also complained about the increased monotony in the job. He noted that, compared to the previous generation of workers, the new ones were not interested in learning a specific craft, and instead were happy just fulfilling the mechanical tasks required from them.[39] These stories testify to a rather inescapable social transformation that happened with increased mechanisation—work became simplified, specialised and more monotonous. The sense of belonging shifted from taking pride in something one produced to the pride in the company as a whole, a sense of belonging to a much larger and elaborate production process.

With increased mechanisation, work at the factory became less physically demanding. Prior to this industrialisation, according to Moelven workers, "there was no talk of taking five minutes off in the middle of the shift or taking a smoke break during work."[40] Now, new machines alleviated physical strain and, somewhat counterintuitively, allowed for a more relaxed pace. Magnus Kamperud and Kristian Johannessen emphasized that contemporary work at Moelven was far easier, and could not even compare with physically demanding old work pace and conditions: formerly, a welding workshop went by the nickname of "little hell."[41] Both Peder Langaard and Olav Skar—soon turning 65 and 66—said that, although they were both considered "elderly workers," they had no problems in keeping up with the work tempo.[42] As new machines alleviated heavy lifting, one of perhaps less intended consequences was introduction of women into a traditionally male-dominated Moelven shop-floor. Up until 1968, women held only a select few office positions as secretaries or office assistants, and were never a part of the actual production work.[43] In 1968, the Laminator factory employed the first woman

37 Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 64.
38 Antonsen, 64.
39 Antonsen, 65.
40 Antonsen, 64.
41 Antonsen, 65. Trygve Dalseg, *Med Moelven-hjul på vei gjennom tiden: historien om Aktieselskabet Moelven Brug i de første 50 år, 1899-1949* (Moelv: Moelven Brug, 1966), 39–40.
42 Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 71.
43 For example, in the end of the 1950s different leaving age and pension allowances were negotiated for women-functionaries: at the moment there were three—a cashier Margit Överli, an office assistant Kirsten Dalseth and a secretary Ingrid Höstmark. For workers, women pension age was not even defined as there were no women. For managerial pension agreement see a letter from Norske Folk to Moelven Brug from 19 August 1953. Folder 0002 "Pensionsordning 'Norske Folk" in SAH/ARK-287-01/P/Pd/L0000A. For workers' pension agreement see a letter from Norske Folk to Moelven Brug from August 27 1956, Folder 0001 "Moelvens pensjonsfond for arbeidere" in SAH/ARK-287-01/P/Pd/L0000A.

worker—Aud Karlsen.[44] Following the initiative of the Ministry of Labour in 1971, Moelven set up a committee to evaluate the feasibility of hiring female workers.[45] The committee completed a survey of jobs suitable for women, concluding that they could work with at least 16 different tasks, and that the company "without problems should be able to take on 30 women with part-time positions."[46] In addition, the committee concluded, it was more beneficial to hire women from Moelv than male workers from other districts, as this did not put additional strain on the local housing market and schools in the region.[47] Series of interviews were set up with current male workers to probe the ground, and although the older generation was initially sceptical, by 1974 Moelven hired 20 new women workers for its Ringsakerhus factory. With the nearly automated process, the company's magazine claimed that "the work was not harder than working in conserving industry, in a store, doing the washing, or any other jobs commonly held by women."[48] In just eight weeks of training and an additional four-week transition period, Moelven's women workers could take nearly any job in the assembly line and received a full salary on par with their male counterparts according to collective agreements.

Thus, the new production process significantly modified social relations within Moelven Brug. With serial production and conveyor belt assembly, labour was deconstructed into mechanised work momenta, bringing industrial alienation. As workers could no longer influence the final product, their sense of pride shifted from being satisfied with the result of one's own work towards a feeling of contributing to a larger industrial process. However, new machines also simplified and alleviated heavy work, realising the modernist idea of "economic efficiency," where production demanded a minimum working effort.[49] This transformation brought women workers onto the factory floor that now were part of production on par with men.

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44 *Bedriftavis*, no.4 (1968): 5.
45 A letter from Elsa Rastan Bråten from Arbeidsdirektoratet to personell manager Strømmen at Moelven Brug, 21 January 1971. Also a report "Instilling fra komiteen for utredning av behov og muligheter for kvinnelig arbeidskraft ved A/S Moelven Brug," February 28, 1972; all in folder 0003 "Ansettelse av kvinnelige produksjonsarbeidere" in "Ansettelser, instrukser" SAH/ARK-287-01/P/Pc/L0001.
46 A note from K. Ferger to Strömmen, November 12, 1973. The list of jobs included items form cleaning/painting finished products, to insulation, assembly, storage, work with sanitary or electric components, wall-papering, windows and doors assembly, truck-driving among others. Folder 0003 "Ansettelse av kvinnelige produksjonsarbeidere" in SAH/ARK-287-01/P/Pc/L0001.
47 Instilling fra komiteen for utredning av behov og muligheter for kvinnelig arbeidskraft," 3. Folder 0003 "Ansettelse av kvinnelige produksjonsarbeidere" in SAH/ARK-287-01/P/Pc/L0001.
48 *Bedriftavis*, no.16 (1974): 4.
49 See "General Economic System" in CIAM La Sarraz Declaration, 1928, *Programs and Manifestoes on 20th-Century Architecture* (Cambridge, MA: The MIT Press, 1971), 109-110.

Fig. 9. First woman working on the shop floor was hired by Moelven in 1968. By 1974 there were more than twenty female employees. Cover of Moelven internal magazine, *Bedriftavis* no.16 (1974).

THE NEW MACHINE AGE

The company's development was paralleled by the increased complexity of its machinery. For example, Peder Langaard, who began working at the wooden workshop in 1928 with a hand-guided cutting machine, switched to a stencil machine in the 1960s, and eventually ended up with a modern optically-controlled cutting machine.[50] As Mageli maintained, "better and newer production equipment plays an essential role as it allows for a more rational, serial production."[51] According to Karlsen, Mageli's approach to production, influenced by his academic environment, often clashed with old Moelven's culture: he saw handwork as something less valuable when compared to advanced methods of modern industrial production.[52] This attitude seemed to affect the managerial approach, as some Moelven workers complained that the machines were taken better care of than the humans.[53] Here, the idea of Moelven Brug as a socio-technical enterprise, where both human and non-human actors were closely intertwined, is rendered most visible.

While examples of how large technological systems affected the company's work and vice versa are many, the scope of this inquiry allows to name just a few. For example, in the early 1950s, as the company's own electricity facilities were outdated and unreliable, Moelven mechanic Arne Stalsberg had to make regular visits to electrical facilities both day and night to ensure the station did not stop. The company's production had to be scheduled in night shifts, when the electricity supply was most reliable.[54] This caused significant frictions, as workers demanded extra pay for time worked outside normal hours. The company, however, refused to accommodate these requests, since the electric supply was outside of its immediate control and the price of the products could not change.[55] In 1957, when standard time-based tariff payments were introduced, an additional time allowance for workers that operated heavy machines was factored in.[56] The body of a machine that required more time to move became closely intertwined with that of its operator, affecting the rate of performance and thus pay. In 1962, as smoking was not

50 Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 67.
51 See Årsberetning 1950/1951 in Folder L0001 "Årsberetninger" SAH/ARK-287-01/I/L0001.
52 Karlsen, "Fra håndverk til masseproduksjon," 65.
53 *Bedriftavis* no. 17 (1975): 11.
54 Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 66–67. Also Antonsen, 21.
55 See a letter from Moelven accountant to Norsk Arbeidgiverforening, 15 December 1947. See Folder 0003 "Lønnsoverenskomster for tilsatte ved Moelven Brug" in SAH/ARK-287-01/P/Pf/L0002. On the effect of external factors, such as electricity or power supply on large technological systems see Thomas Hughes, "The Evolution of Large Technological Systems" in Bijker, Hughes, and Pinch, *The Social Construction of Technological Systems*, 52–54.
56 Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 24.

permitted in timber workshops, Moelven's line production was greatly disturbed when employees still took smoke breaks. In turn, the company considered introducing fixed five or ten minutes smoke pauses throughout the day when the entire line assembly would be brought to a halt, adapting line production to accommodate workers' demands.[57] In 1968, when the company shortened the work week from 45 to 42 ½ hours, Mageli wrote a bitter article, explaining how this shortening would have a dramatic impact on machines that had to be manned at all hours.[58] To compensate for this "lost time," workers had to use machines more intensely and at higher speeds, locking both humans and machines into a complex, interdependent performance mechanism.[59] In this way, it was not just Moelven workers that had to adapt to the new technology, but technological artefacts were also adapted to accommodate some of the workers' demands. If, according to historian Anson Rabinbach, "automation promised to liberate work from the materiality and physicality—muscles, nerves, energy—of the body," humans and machines were still two interdependent entities within one system.[60] This close interdependence was reflected in the name-change for Moelven shop-floor employees, who began to be referred to as "operators" instead of "workers."[61]

New and better technical equipment improved quality and accuracy, and facilitated new types of production. The company continuously acquired new motorised carpentry tools, machines for gluing, traverse cranes for storage and assembly halls.[62] In 1968, for example, the company bought the largest planing machine in Scandinavia, in addition to a new horizonal boring machine and a milling machine.[63] New equipment allowed to improve the problem of tolerances: to ensure fast and accurate assembly on-site, prefabricated building elements had to be produced with tolerances close to those of the machine- and ship-building industries.[64] In 1969, Moelven purchased a new Japanese CITIZEN drilling bench controlled by a computer program, which

57 See a letter regarding the smoking breaks from Moelven staff manager R. Gröttum to Mekanisk Verksteders Landsforening, October 20, 1962. Folder 0001 "Moelven Brug A/S" in "Teknologibedriftenes Landsforening TB" archive, RA/PA-1700/M/L0101.

58 *Bedriftavis* no.3 (1968): 1-2.

59 *Bedriftavis,* no.4 (1968): 3.

60 Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Los Angeles, Calif: University of California Press, 1990), 11.

61 While this name was first used in relation to EDB "operators," it was applied to the rest of the workforce by the 1970s. See Bedriftavis no.14 (1973); or Bedriftavis no. 17 (1975): 11.

62 See "Årsberetning 1954/55" 3, in Folder L0001 "Årsberetninger" SAH/ARK-287-01/I/L0001.

63 *Bedriftavis* no.3 (1968): 8; Bedriftavis no.4 (1968): 17.

64 SAR Erik Friberger on "Mechanised housing production" G. Øvergård.Jørgen. *Byggekunst* 28, (1946): tillegget, 8. "Mekanisert boligproduksjon." Also in Thomas Tostrup, "Non-traditional construction" in *Arkitektnytt*, no.5 (1954). *Bedriftavis*, no.4 (1968): 13-14.

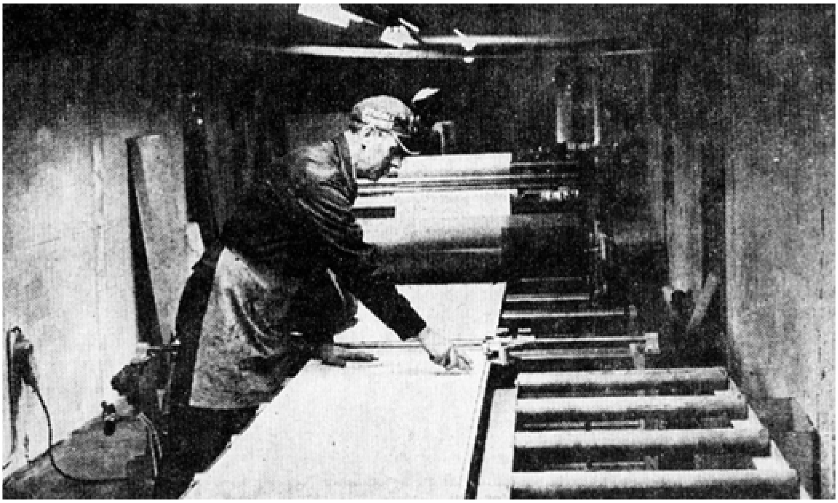
Fig. 10. Moelven's Johs. Mageli in front of a new production hall full of machinery. Newspaper clipping, 1965.

brought tolerances down to a hundredth of a millimetre.[65] Often, however, specialised equipment was not available in Norway, and was too expensive to buy abroad. Moelven's in-house mechanical workshop, then, was tasked with building these necessary tools and machines, at times copying them after blueprints of similar equipment elsewhere.[66] According to Mageli, without close collaboration between the timber and metal workshops—which served as the de-facto R&D unit of the factory—Moelven's advanced prefabrication system would hardly have been possible.[67] Industrial equipment designed in-house made other types of production possible. For example, construction cranes were hardly used in Norway well into the late-1960 and up until then most of industrial producers had to design prefabricated elements that two workers could lift by hand. In 1967, Moelven's mechanical department

65 *Bedriftavis* no.5 (1969): 11; 1968; see a Citizen-contract in Folder 0003 "Salgs- og kjøpekontrakter 1960/-70-åra" SAH/ARK-287-01/K/Kc/L0006/0003. *Bedriftavis*, no.18 (1975): 15. For the importance of tolerances in prefabrication industry see Christine Wall, *An Architecture of Parts: Architects, Building Workers and Industrialization in Britain 1940-1970*, Routledge Research in Architecture (London, New York: Routledge, Taylor & Francis Group, 2013), 71. Also The Organisation for European Economic Cooperation European Productivity Agency, *Modular Co-Ordination: Second Report of EPA Project 174* (Paris: EPA, 1961).

66 This was particularly the case of Laminator factory equipment. See more in Chapter 5, as well as *Hamar Arbeiderblad*, July 8, 1960, 3.

67 Johs Mageli speech at the 75 anniversary celebration, 2. In Folder 0002 "Celebreringsarrangement" in SAH/ARK-287-01/P/Pb/L0001. This was also an important feature in Moelven export project: equipment required for prefabrication factories could only be delivered by Moelven own mechanical department. '1.0 Introduction', Moelven Housing System, Norelektro-Moelven A/S. ARK-287-01/J/Jc, Folder L0005.



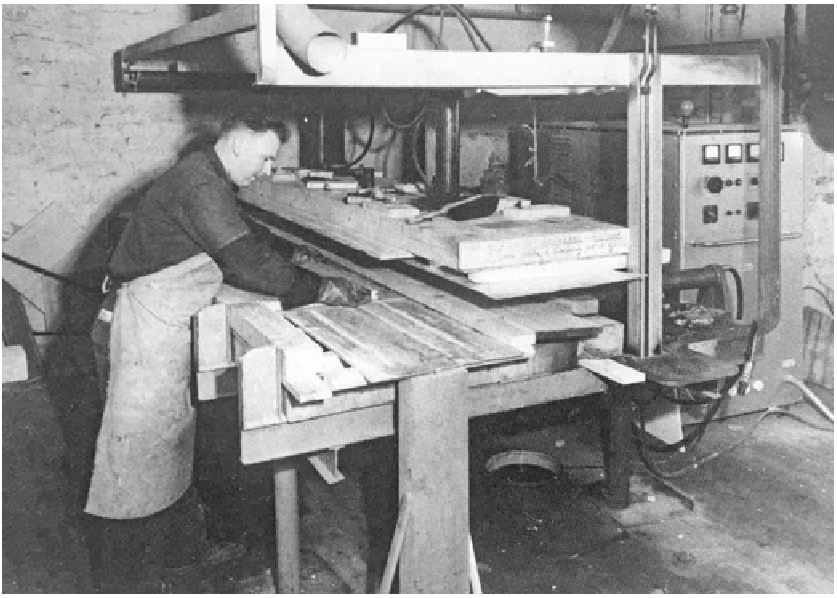


Fig. 11. Moelven workers with a tapering machine (above) and a pressure gluing machine (below). Newspaper clippings, ca. 1965.

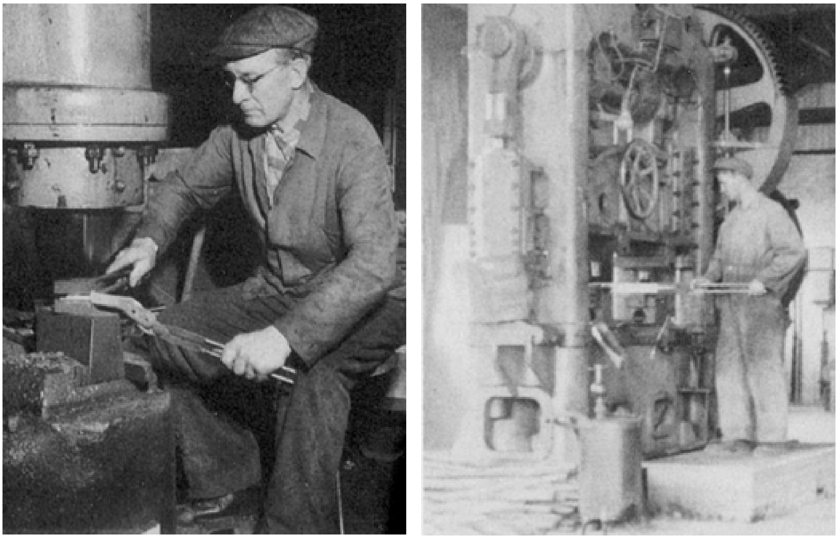


Fig. 12. Andreas Nysveen with a welding hammer, and Jørgen Kirkevold with a welding press. From *75 år med Moelven-klubben*.

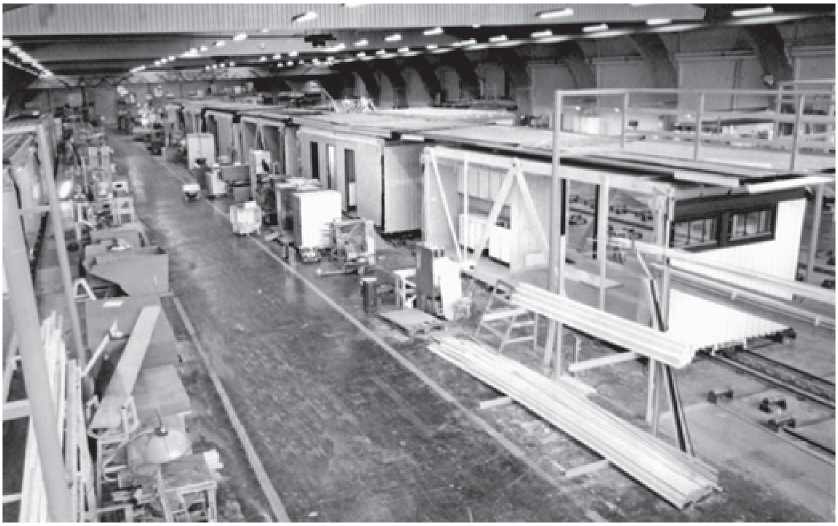


Fig. 13. By the 1960s, Moelven production was based on a conveyor belt assembly. A photograph of the assembly line for Moelven "section"-houses. From *Moelven 1899-1999*.

launched its own telescopic crane that greatly simplified the site assembly of Ringsakerhus panel houses and, by doing so, encouraged their market proliferation.[68] Moelven's production process thus was not only dependent on new tools and machines, but also prompted the development of new equipment that had no analogues in Norway.

New machines that grew larger and more complex required respectively larger production spaces. The Moelven archive holds a peculiar map that recorded gradual expansions of factory facilities that occurred in parallel with production diversification and increased mechanisation.[69] From a symmetrical building with two equal wings for timber and metal workshops in the 1940s, the factory grew nearly yearly through additive structures with nested functions. Already in 1951, a new assembly space had to be built for “houses-on-wheels.”[70] Lamination processes introduced in 1960 required bulky equipment and thus a new factory was built in Lundemo. A 2400 m^2 section house factory at Mobruk was ready in 1963, extended with another 1400 m^2 in 1964 and another 3500 m^2 in 1966, totalling 19000 m^2 by 1970. New production spaces for Ringsakerhus were built in 1966, and both house factories were furnished with elaborate conveyor belt assemblies.[71] By the mid-1960s, the overall factory area at Mobruk had developed to over 80000 m^2.[72] Unfortunately, and despite the company’s near-obsession with process representation, detailed production layouts and factory floor plans are missing from the archive.[73] However, from project documentation for a 1974 “modern industrial complex” abroad, modelled after Moelven’s own facilities, it is possible to see that different production spaces were closely interrelated both in terms of machinery and flows of materials and products. Conveyor line assembly allowed process engineers to join previously discrete work operations in a single continuous process, bringing about a new, networked enterprise.[74]

A brief anecdote illustrates well the broader implications of Moelven’s new machinery, which reached beyond the factory spaces into the local social and urban fabric. In 1963, when a new laminating machine at the Laminator factory interfered with local TV signal reception, man-

68 *Aftenposten,* March 3, 1967, 19. Also in *Arbeiderbladet*, March 3, 1967, 5.
69 See Folder 0009 “Kart over bygninger. Satt årstall på bygningene,” in SAH/ARK-287-01/Q/L0002.
70 Ibid.
71 “Kart over bygninger.”
72 “Personaladministrativ håndbok” B-1, 5, 1983-07-01. In Folder 0001 in SAH/ARK-287-01/P/Pg.
73 See, for example Folder 0002 “Takster, Hustegninger, Kart” dedicated to property maps, in SAH/ARK-287-01/Q/L0002.
74 See drawings of factory plans in “Moelven Housing System” by Norelektro-Moelven A/S, in Folder 0004, SAH/ARK-287-01/J/Jc/L0004.

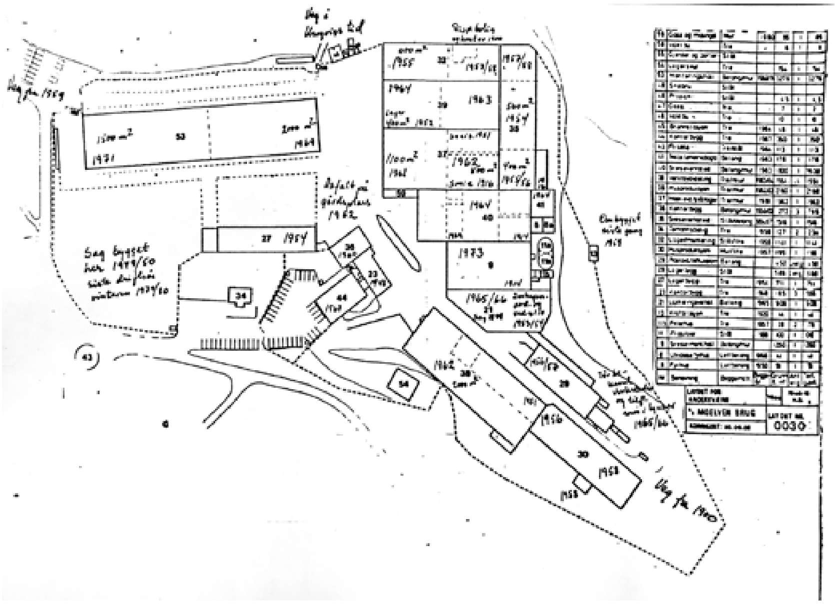


Fig. 14. A map of Moelven factory buildings, with dates of additions indicated on the right. Folder 0002 "Takster, Hustegninger, Kart" dedicated to property maps, in SAH/ARK-287-01/Q/L0002, State Archive in Hamar.

ager Carl Erik Swensson said that although the company was aware of the situation, they could not shield the machine effectively. However, they could rotate it in a way that it would not affect signal reception for antennas at Nordhue (a mountain top on the border of Løten and Elverum municipalities), and thus advised Moelv residents to install antennas there.[75] In this way, Moelven's new work processes closely intertwined people and machines—human and non-human actors—into a complex interdependent socio-technological system. Moelven operators had to adapt to the workings of technical artefacts and in return, these artefacts were adapted to workers' demands. The new conveyor belt assembly altered not just the ways in which work was performed, but also the spatial layout of the factory and its workshops.

75 *Ringsaker Blad*, January 31, 1963, 1. Those that could not receive TV signal from Nordhue would have to depend on Gjøvik or Oslo transmitters.

FROM SITE TO FACTORY

The new Moelven production strove to transfer as much construction work from site to factory as possible. However, unlike the British post-war construction industry, which saw prefabrication as a way to mitigate a shortage of skilled workers, Moelven's expansion was far less concerned with the absence of skilled workers. On the contrary, the new production process, with its simplified work largely benefited from the surplus of unskilled workforce left unemployed by the modernisation of forestry and agriculture. Prior to the rapid industrialisation of the 1960s, most Moelven workers were professionally educated—*fagarbeidere*—and went through a traditional system of apprenticeship. With the transition towards prefabrication and work that did not require a knowledge of craft, the majority of new Moelven hires, particularly in the housing sector, were "non-professionals." New employees went through a couple of weeks of learning through practice and supervision. In a course of just over eight weeks one was thought to have enough knowledge and skills to take nearly any job in the production.[76] While the "old crew" lamented the diminished autonomy and the fact that the new generation did not want to learn a craft, new employees first and foremost wanted secure work places.[77] Thus, although Moelven's industrialisation diminished with the value of craft, this transformation, in fact, only affected a very small group of workers. By the end of the 1960s, new employees outnumbered "the old crew" by a ratio of 10 to 1, and the majority of new employees actually learned new skills.[78] To some extent, this was a result of post-war "solidarity politics" that dramatically levelled out the difference between professional and non-professional workers' salaries.[79] In this way, Moelven's development was part of the broader post-WWII transformation of labour, as the company benefited from an abundant non-professional workforce moving across industries.

Based on a traditional Marxist reading, industrialisation, with its increased mechanisation, fragmentation of tasks and line-assembly, is often associated with de-skilling of workers.[80] However, as Christine Wall in her study of construction labour in post-war Britain notes, this idea of "de-skilling" (commonly associated with prefabrication) stems

76 Karlsen, "Fra håndverk til masseproduksjon," 67. See also "Kort referat fra møte vedr. Kvinnelig Arbeidskraft 29/8 1974" in Folder 0003, "Ansettelser, instrukser" SAH/ARK-287-01/P/Pc/L0001.
77 Karlsen, 68.
78 See Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 65.
79 Bergh, *Storhetstid (1945-1965)*, 146–47. While the difference in pay between professional and non-professional workers in 1939 was 23%, in 1950 it was only 8,5%.
80 Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*, 25th Anniversary ed. edition (New York: Monthly Review Press, 1998), 443.

from a narrow Anglo-Saxon understanding of “skill” that defined it as something physically embodied, related to individual performance and the *object* of labour. Instead, Wall argues, “skill” can be understood as a socially and collectively determined phenomenon, negotiated between different parties within working life.[81] In this reading, “skill” is comprised of both social and technical competencies, integrated with a person, and thus able to adapt to new technologies and the changing organisation of work. These divergent understandings of labour and skills, according to Wall, found a reflection in different payment systems. “Embodied” labour was compensated through a piece-rate system and was mostly adopted in Britain, while the “social” reading of skill yielded a time-based compensation common in German factories.[82] IRAS’s time-studies conducted at Moelven in 1957 in fact, heralded a transformation from the piece-rate tradition to a new system based on collectively negotiated payments per hour, essentially adhering to the German understanding of skill.[83] In this new system, the worker, his actions and technical equipment all became part of the complex machinery of production that belonged to the employer. Wall argues that this German understanding of skill as a continuous process was more conducive to building industrialisation, as it incentivised employers to provide vocational training and technical education to workers. Thus, as Moelven changed to a time-based payment system, education and training of its workers became essential. Over time, the majority of Moelven employees were increasingly better educated, both technically and professionally: by the late 1970s, most people working in both section- and element-factories had one to three years of professional schooling.[84] Thus, it is possible to argue that, since the company adopted the German idea of labour, Moelven's industrialisation did not lead to de-skilling. Instead, the company’s workers continuously improved their skills and gained new ones through ample educational opportunities provided by the company.

81 Wall, *An Architecture of Parts*, 8–11.
82 Wall, 12.
83 Before transferring to the time-based tariffs, in 1955 Moelven Brug management suggested a mixed tariff system. However, a local representation of Jern og Metall labour union advised strongly against it, as such system was more beneficial for the company rather than its workers. See a letter to Magne Antonsen from J. Larsson and Håkon Thesen, November 25, 1955. See Folder 0006 “Moelven–Moelven Brug A/S” in AAB/ARK-1659/E/L0249, Arbeiderbevegelsens arkiv og bibliotek, Norsk jern- og metallarbeiderforbund archive. More on standard payment types in Norway see Finn Arvid Madsen and Yrkesopplæringsrådet for håndverk og industri, *Lønnssystemer*, *Norbok* (Oslo: Universitetsforl., 1969), 20-22.
84 Halvdan Buflod, *Teknologisk endring av småhusbyggingen: en analyse av drivkrefter og samfunnsmessige konsekvenser*, *Norbok*, NIBR-rapport (Oslo: Norsk institutt for by- og regionforskning, 1985), 82.

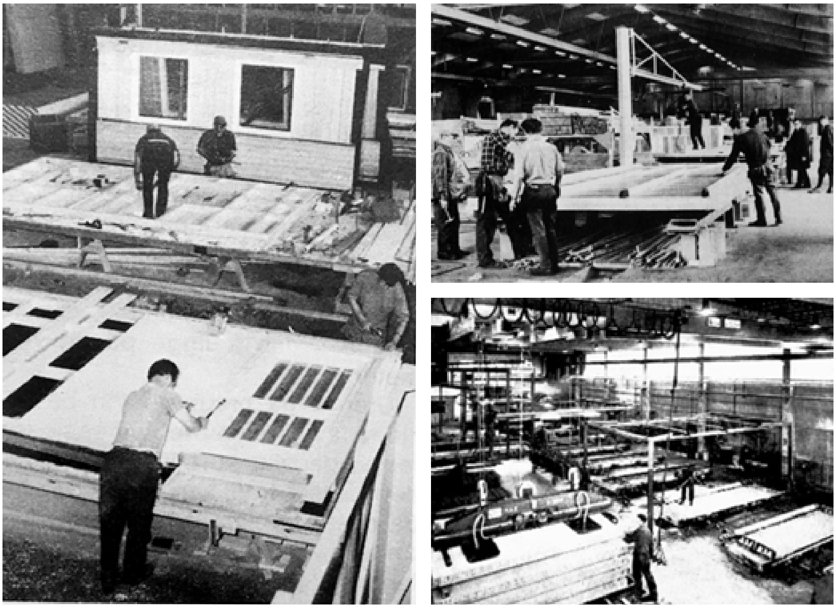


Fig. 15. Moelven production process, factory interiors. Newspaper clippings, 1969-1972.

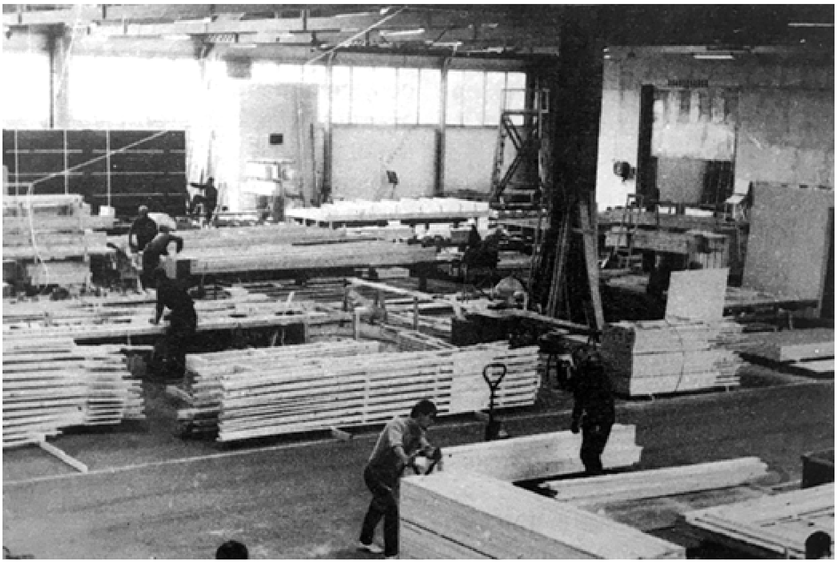


Fig. 16. Moelven production hall and storage of ready-made elements. Newspaper clipping, 1968.

Better technical education led to higher specialisation of work, which posed unexpected challenges within the specifically Norwegian tradition of union representation. In 1968, for example, Moelven's section-house factory employed more than 100 men that worked as carpenters, wall-paperers, piping and electrical specialists, and transport and storage workers. As nearly all Moelven workers were unionised, any conflict situation with a group of workers up or down the assembly line would paralyse the entire production.[85] Originally, most Moelven workers were a part of *Jern og Metallarbeiderforbund*, a union for metal and iron industry workers with strong local and national representation that maintained a powerful weight in professional negotiations.[86] However, as the prefabrication industry was new to Norway and had few practical precedents, it was hard to define which work fell under the jurisdiction of which union, and what guidelines were to be followed for professional representation.[87] For example, while union affiliation was easier to define for workers engaged solely with the assembly of ready-made houses, the situation was more complex for workers that produced components that later went into the construction of ready-made houses.[88] Negotiations on union membership and the reluctance of both the company and its workers to join the *Bygningsindustriarbeiderforbund*—the Unions of Construction Industry Workers—can be traced through a heated tripartite exchange between the company and the two unions in question.[89] However, by 1970, around 130 Moelven workers remained part of the Iron and Metal union, while the rest—around 900 people—joined the Union of Construction Industry Workers.[90] As the professional identification of Moelven's "operators" increased with time—particularly for electrical, piping and sewage specialists—the company's management constantly referred to the cautionary tale of the Danish and British shipbuilding industries, which drowned in union struggles following increased spe-

85 *Bedriftavis,* no. 4 (1968): 15-16.

86 See Bergh, *Storhetstid (1945-1965)*, 107–9. The union had an unusually large group that identified itself strongly with the profession. Also Karlsen, "Fra håndverk til masseproduksjon," 101.

87 See for example, a letter from Moelv Jern og Metall to Norsk Jern og Metall, on the problems of representation for house-building workers, December 9, 1959. See Folder 0006 "Moelven–Moelven Brug A/S" in AAB/ARK-1659/E/L0249, Arbeiderbevegelsens arkiv og bibliotek.

88 Eventually the union suggested that workers that only deal with prefabricated products would join the construction industry, while those that work with other departments—even if they worked with elements that were later used for prefabricated products—would remain with Jern- og Metall. See a letter from from Moelv Jern og Metall to Norsk Jern- og Metall, December 9, 1959.

89 See a letter from Moelven to Mekaniske Verksteders Lansforening, May 8, 1959; or a letter from Landsorganisasjonen in Norge (LO) to Norsk Arbeidsgiverforening on the transfer of workers; February 10, 1959; or a letter from Norsk Bygningsindustriarbeiderforbund to Moelven Brug on May 18, 1961. All in "Teknologibedriftenes Landsforening TB" archive, RA/PA-1700/M/L0101/0001. A protocol on the workers transfer between unions on September 18 1961; also a letter from Moelve Jern- og Metall to Norsk Jern-og Metall on November 23 1961. All in Folder 0006 in AAB/ARK-1659/E/L0249.

90 Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 22.

cialisation of work.[91] In this way, the imported technology of conveyor belt assembly joined several professionals along the line, and turned out to be at odds with a Norwegian tradition of collective pay-bargaining and professional representation. Through ample correspondence between the company and the different unions, it is possible to see that existing Norwegian structures of work relations had quite a hard time adapting these new technologies of production to the local context.

The new production that moved from site to factory influenced not just the make-up of the labour force, but also the construction process.[92] Wall-, floor-, window-, door-, and ceiling-elements were all produced on individual lines at the factory. Large flat elements were rotated with vacuum lifters that eased access for surface handling and installation of doors and windows. Flat elements were then either packaged for delivery and assembly on site or moved to a "rough-assembly" line, where they were set up in section-units. In the section-house factory, all internal and external finishes, piping and electricity works were preinstalled. By 1980, conveyor belt assembly was managed by programmable equipment and nailing was done with air and hydraulic pressure.[93] This factory-based production profoundly transformed a traditional process of building a house in-situ, from foundation up, to the assembly of flat elements into a three-dimensional unit. While traditional methods of construction at the time would require around 390 hours to assemble a house on site, Moelven's process transferred 245 of these hours to the factory, with only 35 hours were required on-site.[94] In this way, although savings of absolute construction time were not that significant—only around 50 hours—according to Moelven managers, factory assembly diminished material waste, allowed for more precision, and assured a year-round production. Most importantly, however, it brought significant economic savings on the difference between the price of work on-site and at the factory.[95] However, despite these technological advancements, the body of the house remained mostly the same. As Halvdan Buflod in his report on the Norwegian prefabrication industry, pointed out, the construction process was made only slightly more

91 *Bedriftavis*, no. 4 (1968): 14-15.
92 *Gudbrandsdølen*, October 26, 1963, 7.
93 Karlsen, "Fra håndverk til masseproduksjon," 98.
94 Halvdan Buflod, *Teknologisk endring av småhusbyggingen: en analyse av drivkrefter og samfunnsmessige konsekvenser*, *Norbok*, NIBR-rapport (Oslo : 1973-1996 : trykt utg.) 1985:2 (Oslo: Norsk institutt for by- og regionforskning, 1985), 77–81.
95 See calculations in Moelven Housing System project documents, Part 3.0 'Economics of the project.' Net savings on each Moelven section house tallied up to more than 50%, "Moelven Housing System, Norelektro-Moelven A/S." Folder L0005 in ARK-287-01/J/Jc.

Fig. 17. Moelven element assembly on site. Newspaper clippings, 1966-1970.

Fig. 18. On-site finish works. Photos by Fotohuset, Hamar. N-21797-4, Hedmark museum photo archive.

rational by pre-installing the water pipes.[96] Other than that, despite being produced with a highly technological system, Moelven houses were not that different from houses built with conventional methods.[97]

New processes of "assembly," however, demanded far more managerial work. Serial production was supported by finely-tuned supply and procurement systems and the efficient management of contractors, materials, transport and storage. While, before 1950, Moelven did not have a single engineer on its staff, by the 1960s a new class of professionals emerged. There were now as many constructors, engineers, economists, process planers, product and technical development managers, salesmen, rationalisation specialists, accountants and data managers as workers on the shop-floor, and this rapid surge reinforced a separation between the intellectual and operative parts of the production process.[98] Specially educated "calculators," for example, quantified work, material and product expenses sourced from a multitude of subcontractors and performed complex calculations on work pricing.[99] In turn, constructors, technical engineers and work leaders deconstructed each product into single composite parts and work momenta, then divided them across different teams of workers along a conveyor line.[100] Production technologists at the planning office developed elaborate cyclical systems that optimised work, raw material usage, machine capacity and storage, all governed by detailed time-scheduling schemes in order to avoid miscommunication and improvisation.[101] PERT-charts and network diagrams visualised complex flows of materials and the exact order of work operations, where all intermediate-stage elements had to fit together into one final product.[102] To increase oversight over the final stages of assembly of the many Moelven housing projects around the capital, a special office was set up in Oslo. For the company, moving the construction process from site to factory reduced the uncertainty in procurement and quality of work and increased precision. It also profoundly transformed not only the nature of construction—from on-site carpentry work to high-tech, machine-driven assembly—but also the lives of the company's workers.

96 Buflod, *Teknologisk endring av småhusbyggingen*, 83.
97 On the appearance of Moelven homes that with time became indistinguishable from houses built with traditional methods see Hild Sørby, *Klar - ferdig - hus: norske ferdighus gjennom tidene*, vol. 1, Kultbøker (Oslo: Ad Notam Gyldendal, 1992), 97–99.
98 Karlsen, "Fra håndverk til masseproduksjon," 98.
99 Moelven hiring ads from 1969 are particularly telling in this regard: in just one year, the company was looking for to hire a wide array of new mid-level professionals, for example, constructors, technical development managers, product development managers, sales men, data professionals, engineers, work-studies engineers, planning assistants, constructors, transport assistants, etc. For job description of a calculator see *Aftenposten*, April 7, 1972, 36.
100 Mageli, *A/S Moelven brug*, 4.
101 *Bedriftavis* no.10 (1971): 6, also in *Bedriftavis* no.18 (1975): 6.
102 *Bedriftavis*, no.9 (1971): 16.

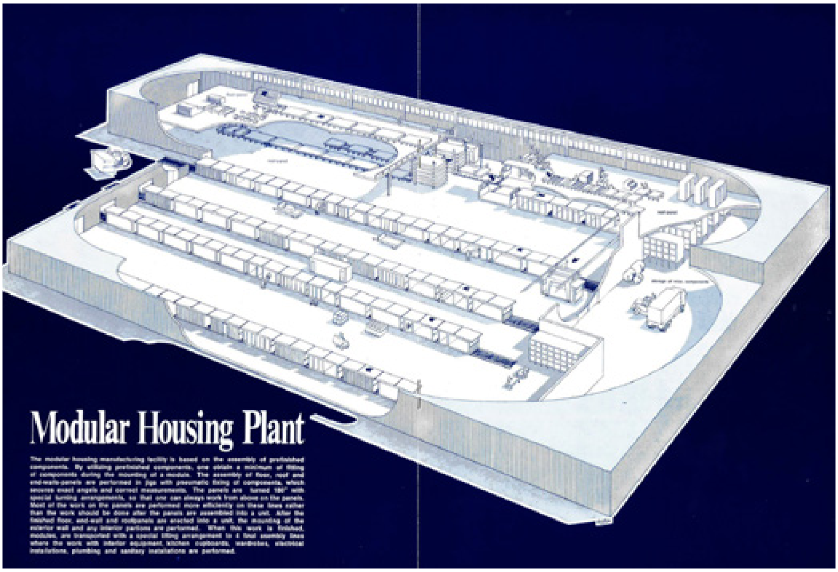


Fig. 19. Perfected automation. Moelven sales brochure depicting an ideal version of a conveyor belt house assembly, based on Moelven's prefabrication process. From "Moelven Housing System" marketing booklet, 1973. In "Produktspekter M-S," SAH/ARK-287-01/J/Je/L0003, State Archive in Hamar.

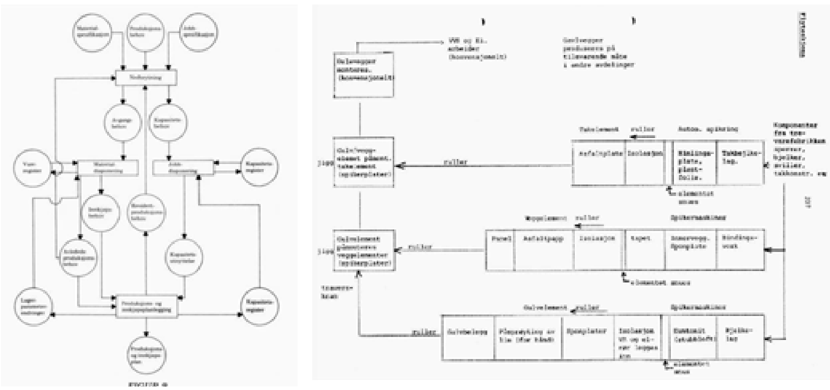


Fig. 20. Visualisations of new production planning principles, adopted by Moelven by the early 1970s. New diagrammatic notations were key not only to more "rational" process management, but also allowed to transfer some of the process planning to new computers. Process planning diagrams from *Materialstyring: effektiv produksjons- og lagerstyring*, *Teknologisk endring av småhusbyggingen: en analyse av drivkrefter og samfunnsmessige konsekvenser*.

BUILDING WELFARE

During the dinner festivities celebrating the 75th anniversary of the company, Mageli underlined that, despite the near seven-fold increase in employment over the last 25 years, "stability has been undoubtedly an advantage of our company."[103] Indeed, as a large technological system gaining momentum, Moelven Brug required stability, and thus provided its employees with various levels of incentives and ample benefits—from pension and sick leave schemes to health, safety and educational programs, loans for housing and consumer items, an improved work environment and organised leisure.[104] Moelven's "welfare capitalism" profoundly influenced not just the lives and livelihoods of its employees and their families, but also the region at large.

As Moelven was an industrial enterprise that converted labour power into a final product, the health and safety of its workers were essential to maintaining necessary levels of productivity. The company's sick leave payment scheme—*bedriftssykekasse*—was established already in 1957. It was an important development for an industrial enterprise where accidents happened regularly, both in the factory and on-site.[105] Workers' contribution fee was 0,80 NOK for each loan-earning week, matched by 1,40 NOK from the company, with a total compensation of up to 90% of usual income.[106] In 1971, Moelven established a permanent company doctor position: he was supposed to conduct regular health screenings of all employees. Health conditions of each worker were then evaluated against the demands of their specific workplace, potentially suggesting a change or a better fit.[107] Although primarily driven by the need to optimise work processes—following the Taylorist idea of the "right man in the right place"—the company provided preventative health care for its employees.[108] By 1975, concerns for work efficiency obtained a new name: ergonomics. A company's magazine article, titled "We have to work ourselves away from the physiotherapist's bench," suggested that

103 See Mageli's speech for the 75 years anniversary, In Folder 0002 "Celebreringsarrangement" in SAH/ARK-287-01/P/Pb/L0001.
104 Hughes, "The Evolution of Large Technological Systems," 76-77.
105 For example, in 1964 Laminator worker came home without a finger. In 1970, a 300-kg section fell on Einar Sandberg on construction site. A 25-year-old worker from Nes got his hand stuck in the glue applicator in 1971. See *Ringsaker Blad,* April 18, 1964, *Arbeiderbladet*, June 4, 1970, 16, *Hamar Arbeiderblad*, March 9, 1971.
106 An agreement from February 21, 1957, 187 in Folder 0003 "Styreprotokoll Moelven Brug 1944-1969" in SAH/ARK-287-01/A/Aa/L0001.
107 *Bedriftavis*, no.9 (1971): 2.
108 This was largely in line with 'work psycho-technique' movement popular in Norway. See Helga Eng, "Norsk psykoteknikk i ti år 1925-1935: historisk oversikt" (Hamar, 1935). Rolf Waaler was among the prominent advocates of work psychology in Norway. See Rolv Petter Amdam and Gunnar Yttri, "The European Productivity Agency, the Norwegian Productivity Institute and the Management Education," in *Missionaries and Managers: American Influencees on European Management Education, 1945-60* (Manchester: Manchester University Press, 1998), 121–40.

the way Moelven workers used their bodies, both in the factory space and in the office, significantly impacted overall productivity. A physiotherapist, Seinar Gullberg was employed "to help [Moelven workers] use the body in the right way."[109] Every Tuesday and Thursday, he spent time in different Moelven departments, studying specific work stations, adjusting tools and machines for better ergonomics, and making suggestions such as "limiting walking on the hard cement floors of the factory to a minimum."[110] Over time, the company's expanding pragmatic concerns with the well-functioning bodies of its workers yielded a structured system of preventative healthcare provided by the company.

Directly interested in better skills and improved performance of its employees, Moelven offered different types of educational opportunities.[111] Interest-free loans that could be paid over the course of five years were administered through the educational fund. First established in 1942, it was updated in 1960 and 1964 with a yearly budget of 35.000 NOK. The programme covered expenses for pursuing either professional or higher education programs in "the areas of importance for the company."[112] In order to qualify, one had to have worked at Moelven for at least two years, and to commit to another three upon completion of the studies. Many pursued the opportunity: in 1965, for example, Magne Olav Skullerud applied for a loan to support his studies at NTH for three years. He was granted funding with the condition that upon returning he would "undertake an appropriate position at Moelven Brug for at least two years" and work at the company throughout summer vacations.[113] In 1967, Jan Pedersen was supported in his studies at Oslo Elementærtekniske Skole, and Ole Gunnar Larsen for a course at Göteborg's Technical Institute.[114] Another applicant—Kåre Karlsen—pursued a two-year programme at the professional school in Dovre.[115] In addition to formal educational courses, Moelven also offered its employees an

109 *Bedriftavis*. no.18 (1975): 14.
110 *Bedriftavis* no.18 (1975): 14.
111 See Årsberetning 1951/1952 in Folder L0001 "Årsberetninger" SAH/ARK-287-01/I/L0001.
112 Board-meeting discussion on September 23, 1960, 246, item 303 in Folder 0003 "Styreprotokoll Moelven Brug 1944-1969" in SAH/ARK-287-01/A/Aa/L0001. Also in *Hamar Arbeiderblad*, September 28, 1964, 4. On 1964 update and development see Folder L0000A "Forhandlingsprotokoll" in SAH/ARK-287-01/P/Pe/L0000A.
113 See a letter from Moelven to Herr Magne Olav Skullerud, 13 August 1965. See Folder L0007 "Handelskontrakter, priser mm" in SAH/ARK-287-01/K/Kc/L0007. In other accounts it was mentioned that in the school year 1967/68 a scholarship was granted to Skllerud to study at the machine-line at Gjøvik Tekniske Skole. See *Bedriftavis,* no.1 (1967): 13. In fact, Skullerud continued working for Moelven and used diverse work opportunities the company offered. For example, in the late 1970s he worked for engineering projects in Tanzania, partially carried out by Moelven in cooperation with NORAD. See *Bedriftavis*, no. 26 (1979): 11.
114 *Bedriftavis* no.1 (1967): 13.
115 See a contract between Kåre Karlsen and Moelven Brug, August 11, 1964. See Folder L0007 "Handelskontrakter, priser mm" in SAH/ARK-287-01/K/Kc/L0007.

opportunity to follow short-term professional courses: for example, an American-style "training within industry" (TWI) programme or a course in reading technical drawings. From the late 1960s, the company arranged internal educational events, including lectures on the company's organisation, work safety, process management and product development.[116] As the courses were often quickly booked out and many complained about the lack of available spaces, it is possible to conclude that Moelven employees were actively interested in advancing their professional skills.[117] In practice, these educational opportunities did allow those who were interested to advance towards higher engineering and managerial positions—as was the case, for example, with Magne Skullerud.[118]

Perhaps one the most substantial benefits of working for a company that produced housing were subsidies offered to Moelven workers wanting to build or buy a new home. Already in 1953, Moelven Brug Byggelag A/S was established as a subsidiary business and building cooperative that constructed and maintained housing for the company's employees. In addition, the company offered interest-free loans for individual house construction. In order to qualify, one had to have worked for the company for at least two years, and pay the loan back over ten years.[119] These housing subsidies contributed to a significant part of the company's "welfare expenses."[120] As the company grew and hired new employees from other regions, housing built and managed by Moelven Brug Byggelag served as one of the main relocation incentives.[121] By the end of the 1960s, Moelven had created a discount and loan programme for employees that wanted to buy a Moelven section house. To qualify, one had to have worked for the company for five years, and construction had to take place in Moelv. While the precise number is hard to establish precisely, many Moelven workers indeed

116 *Bedriftavis*, no. 2 (1968): 15; *Bedriftavis*, no. 9 (1970): 2 and *Bedriftavis* no. 10 (1971): 6.

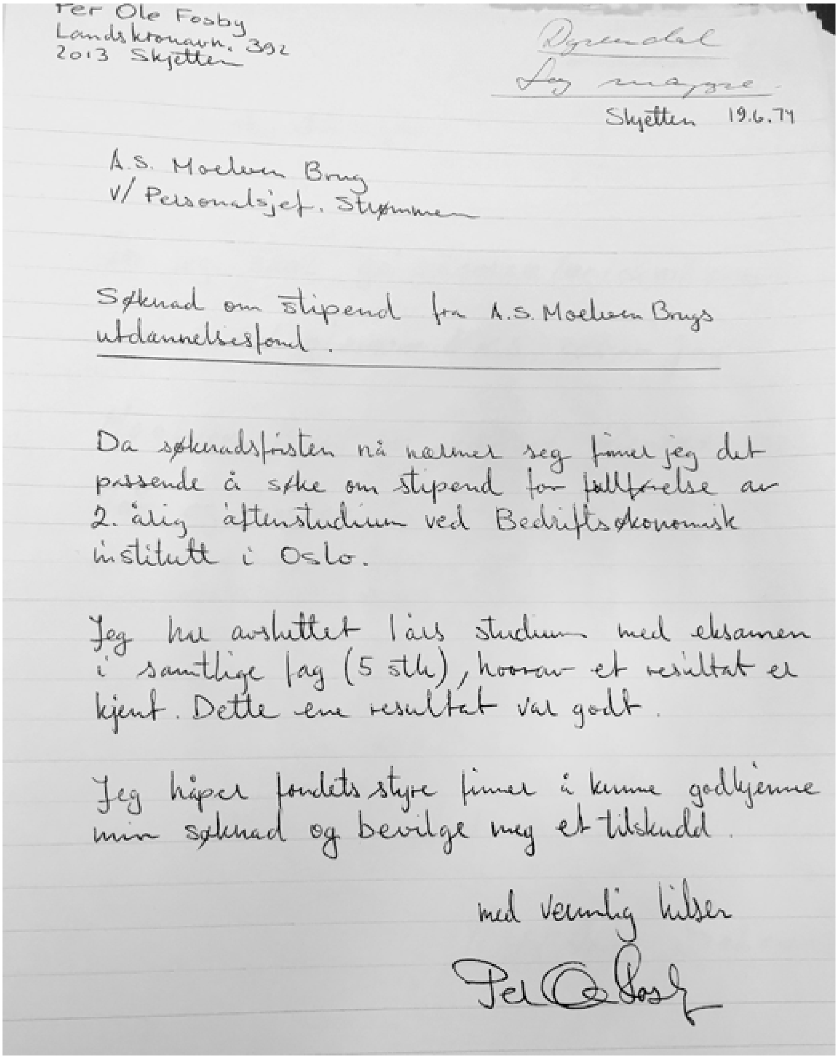
117 *Bedriftavis*, no. 9 (1971): 2.; *Bedriftavis*, no. 10 (1971): 6. "The course shows good results and it proves that workers are hungry to learn"—stated an article in *Bedriftavis* no. 14 (1973): 3.

118 See more in Folder L0007 "Handelskontrakter, priser mm" in SAH/ARK-287-01/K/Kc/L0007. Also in *Bedriftavis*, no. 26 (1979): 11.

119 On the establishment of housing support for employees see "Forslag om stötte til arbeidernes boligbygging," 171 item no.85 from 11 June 1956. While everyone was given an equal chance of applying for a company loan, financial support was also merit based: in an annotation to one of the employee's application, HR-chef Pedersen put a note that "the employee has a tendency to underperform; the situation has not improved and he would not advise the full [financial] support." See item no. 264; 28-5 1962, 265. All in Folder 0003 "Styreprotokoll Moelven Brug 1944-1969" in SAH/ARK-287-01/A/Aa/L0001.

120 See "Beretning til generalforsamling November 10 1956," also in "Beretning til representantskapsmötet" 1957, all in Folder L0001 "Årsberetninger" SAH/ARK-287-01/I/L0001.

121 On housing support to functionaries see item no .299, board meeting on June 14, 1960, 245 in Folder 0003 "Styreprotokoll Moelven Brug 1944-1969" in SAH/ARK-287-01/A/Aa/L0001. Often, the fact that the company offered housing support was highlighted in the hiring ads. The company owned about 54 apartment for functionaries, but with increasing employment, new building areas were acquired in Moelv throughout the 1960s. *Lillehammer Tilskuer*, December 16, 1965, 12. See also *Bedriftavis*, no. 5 (1969): 16.



Per Ole Fosby
Landskronavn. 392
2013 Skjetten

Skjetten 19.6.74

A.S. Moelven Brug
v/ Personalsjef. Strømmen

Søknad om stipend fra A.S. Moelven Brugs utdannelsesfond.

Da søknadsfristen nå nærmer seg finner jeg det passende å søke om stipend for fullførelse av 2. årig aftenstudium ved Bedriftsøkonomisk institutt i Oslo.

Jeg har avsluttet 1 års studium med eksamen i samtlige fag (5 stk), hvorav et resultat er kjent. Dette ene resultat var godt.

Jeg håper fondets styre finner å kunne godkjenne min søknad og bevilge meg et tilskudd.

med vennlig hilsen
Per Ole Fosby

Fig. 21. Moelven employee's application to study at the Business-Economic Institute in Oslo. In folder L0007 "Handelskontrakter, priser mm" in SAH/ARK-287-01/K/Kc, State Archive in Hamar.

lived in the factory-made homes.[122] From 1970, the length of required service was shortened to one year, and an additional discount of 8% was offered to incentivise a purchase in the low-activity months between February and May. The buyer had to prepare the foundation slab and all infrastructure, while the house would then be delivered entirely ready. When buying a house, Moelven workers were treated as conventional customers: the company underlined that no further reduction in the price was possible even if one wanted to contribute to the house assembly.[123] In this way, Moelven's housing loan programme provided its workers with the means to buy the products of their own work, creating what David Monteyne calls a "Fordist republic of dependent consumers."[124] Although produced by workers during their working day, Moelven section houses became objects for passive consumption in the after-work hours, with no possibility for adjustment or appropriation.

Even prior to Moelven Brug's expansion, it was not just the company's workers whose livelihood depended on stable factory jobs, but also their families: as a Ringsaker politician noted in 1950, "there are least 1600-1700 people whose living is directly connected to those 400-500 industrial jobs."[125] Economic historian Susanna Fellman argues that large modern companies often had significant influence on the local community and town planning. Business owners, professional experts and managers often "created modernity" in a local community, which was not the primary goal in itself, but rather a consequence of their daily activities.[126] Moelven Brug had a similar effect on its locality. Johannes Karlsen, one of Moelven employees remembered that regional welfare grew significantly with the company's expansion in the 1960s, and many of the "poor people's houses" in Moelv were substituted with modern housing that the company produced.[127] At a certain point, most employment in the region was differentiated by affiliation either with *bruket*, the main company, or *laminatoren*, the Laminator factory. In fact, Moelven was responsible for more than two-thirds of all

122 Karlsen, "Fra håndverk til masseproduksjon," 71, 123.
123 *Bedriftavis*, no. 7 (1970): 16. Due to logistical difficulties of delivery, the rules stated that the discount applied only for the construction within the area along the E6 road up to Ringsaker church in the South and Berg garden in the North. However these limitations were lifted since 1970.
124 David Monteyne, "Framing the American Dream," *Journal of Architectural Education* 58, no.1 (September, 2004): 24-33.
125 Karlsen, "Fra håndverk til masseproduksjon," 53.
126 Susanna Fellman, "Aesthetics in Modern Management," in *Industry and Modernism: Companies, Architecture, and Identity in the Nordic and Baltic Countries during High-Industrial Period* (Helsinki: Finnish Literature Society, 2007), 189.
127 Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 71.

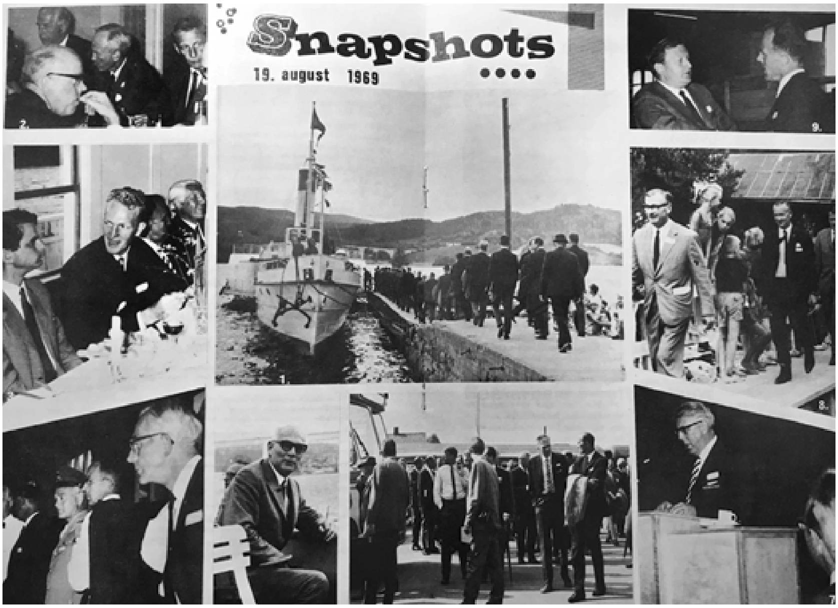


Fig. 22. Moelven holiday celebrations: a little boat tour with snaps. *Bedriftavis* no. 3 (1968).

Fig. 23. Moelven football team. Image from *Bedriftavis* no. 11 (1972).

industrial work places in the municipality.[128] The company's expanded production absorbed surplus workforce from local agriculture and forestry branches, significantly reduced regional unemployment, and prevented internal migration away from the town.[129] In a support letter for Mageli's nomination for the Order of King Olav in 1974, the role of the company as a region-defining enterprise was emphasised.[130] Locally, a multitude of smaller industrial businesses and workshops that served as contractors for the Moelven group flourished.[131] In 1963, the company headed the list of the ten largest taxpayers in Ringsaker, while Laminator was the 8th. In addition, Moelven actively lobbied for better regional infrastructure, transport connections and, later, even environmental preservation—particularly around lake Mjøsa.[132]

While the welfare elements provided by the company are too many to study here—from its pension institution and support, the company's organised sports teams, and family payments to arranged trips and culture evenings for pensioners, midsummer celebrations, company anniversaries, workers' tours and family visits to the factory—Moelven indeed played a formative role in regional development.[133] Its employees depended on the company not only for job security and the livelihoods of their families, but also on the housing and pension systems, health and safety check-ups, educational opportunities and organised leisure time. The company transformed both the urban and the social fabric of the region, and maintained stable and secure jobs. And Moelven employees were satisfied—the only strike action in the 1960s was a half-an-hour sit-down in support of the lowest-paid workers outside of the standard

128 *Gudbrandsdølen*, October 26, 1963, 7. In a 15-year period from 1955 to 1970 the number of industrial workers in the region increased by 1561. In the same period, Moelven employment increased from 182 to 1200—meaning that the company provided the majority of industrial workplaces in the region. Antonsen, 30.

129 *Arbeiderbladet*, March 18, 1964, 14; on municipal role see a letter from Bjarne Mork, "A/S Laminator — søknad om garanti for et lån på kr. 300.000," sak nr.78, Ringsaker formannskap möte, Moelv, February 24, 1959, 124-125. In SAH/ARK-287-02/E/Ea. Also see "Opplysninger angående adm. Dir. Johs Mageli" in Folder 0003 "St. Olavs orden til direktør Mageli" in SAH/ARK-287-01/P/Pb/L0001. Also *Bedriftavis*, no.6 (1969): 12; *Bedriftavis*, no. 13 (1973): 17.

130 See "Opplysninger angående adm. Dir. Johs Mageli," 3 in Folder 0003 "St. Olavs orden til direktør Mageli" in SAH/ARK-287-01/P/Pb/L0001.

131 See a letter from Johs. Krogvig to Ordensråden, in Folder 0003 "St. Olavs orden til direktør Mageli" in SAH/ARK-287-01/P/Pb/L0001. *Aftenposten*, October 28, 1963, 13; also *Aftenposten*, October 8, 1963, 9.

132 On preservation of lake Mjøsa and river Moelva, see *Bedriftavis*, no.6 (1969): 15. On infrastructural issues (a bridge over Mjøsa) see *Ringsaker Blad*, December 29, 1964, 1-2. *Oppland Arbeiderblad*, December 30, 1964, 3. *Dagningen*, August 20, 1969, 2

133 For pension schemes see SAH archive, "Instilling til representantskaped vedr. Pensjonsordning for arbeidere ved A/S Moelven Brug," All in Folder 0002 "Pensionsordning 'Norske Folk" in SAH/ARK-287-01/P/Pd/L0000A. For sports, see most of the issues of *Bedriftavis*. For pensioner trips see See *Bedriftavis*, no.2. (1968): 18, and no. 12 (1972): 11-12. Antonsen, *75 år med Moelven-klubben i medgang og motgang*, 90. For family evenings and celebrations see for example *Bedriftavis*, no.3 (1968): 7 or *Bedrifatvis,* no.8 (1970), various. *Lillehammer Tilskuer*, July 12, 1963, 2. *Hamar Arbeiderblad*, July 6, 1968, 4.

FAMILIEBESØK

Etter forslag som fremkom i bedriftsutvalget ble det i høst arrangert familiebesøk ved MB. Idéen var at også våre ansattes familier kunne få anledning til å bese bedriften og produktene. Av plasshensyn var det nødvendig å dele opp arrangementet og tre søndager ble brukt.

Alle ble først mottatt i spisesalen på Mobruk, hvor det ble ønsket velkommen samt vist film. Etter at produksjonslokalene for seksjonshus var besett gikk turen til Anderkværn der det foruten omvisning ble servert kaffe. — I alt hadde vi ca. 700 gjester disse søndagene, og vi har inntrykk av at gjestene hygget seg og satte pris på invitasjonen.

Fig. 24. Factory family days. A spread from *Bedriftavis* no. 8 (1970).

agreement.[134] By 1974, 236 Moelven employees had received Norges Vel medals for a service of over 50 years.[135] In this way, as a part of what Fellman calls "welfare capitalism," Moelven strove to make the worker an intrinsic element of the production process, but in turn provided ample welfare benefits and comfortable working facilities.[136] Moelven represented a new, modern type of Norwegian industrial enterprise. And while new methods of work and process organisation might have been imported from abroad, they were aptly modified through collective negotiations that adapted them to the conditions of Norwegian working life.

INVISIBLE LABOUR

As shown above, Moelven workers were far from invisible: they played an important part in the company's production, challenged and adapted imported technologies and negotiated welfare provision. Nevertheless, parallel to this increased representation in real life, Moelven workers were rendered increasingly invisible in the company's voluminous marketing material, often substituted with depictions of a nearly-automated technological process. For example, one of the most popular advertisement images depicted a Moelven worker on-site overseeing a part of a Moelven section house lowered by crane, a doctored version of a photograph taken for the cover of *A-Magasinet* in 1965. While in the original photograph the Moelven worker is standing inside another section to ensure correct set-up, the adjusted version used for advertisements underlined the overseeing role left for Moelven "operators," with the majority of the work was performed by advanced machines.[137]

This idea culminated in a series of Moelven advertisements in the early 1970s, where the company's production was depicted through images of abundance as a consequence of an entirely machinic process. One of these advertisements featured several conveyor belt lines, its title suggesting that "single houses, row houses, schools, offices, kindergartens, social institutions, housing for construction workers, business offices, laminated wooden constructions, bridges, deck cranes, mobile cranes, trailers" could all be mass-produced in

134 See *Lillehammer Tilskuer*, November 19, 1969, 1.
135 See "Utmerkelser ved Moelven" in Folder 0004 "Utarbeidet oversikt over arbeidstakere" in SAH/ARK-287-01/P/Pb/L0001/0004. The medal was matched with a cream set in silver, and later with a Moelven-branded watch or cross.
136 Susanna Fellman, "Aesthetics in Modern Management," 189.
137 See a popular newspaper advertisement with a crane—for example, in *Ringsaker Blad*, October 18, 1969, 5 — versus original image in *A-magasinet*, no. 23 (June 5, 1965): cover image.

an endless series.[138] The role of workers—or so it seemed from the image—was just to "cut off" ready-made products from a continuous production line. A similar absence of workers and overwhelming presence of machines—both factory equipment and mechanical products—defines another Moelven advertisement that collaged different stages of the company's un-manned production together.[139]

This fascination with advanced technological processes becomes most apparent in booklets selling Moelven "know-how": machines, equipment and planning processed were featured in the foreground, while workers were barely visible servicing the machines.[140] In a booklet "Moelven Housing System" depictions of a conveyor belt assembly, advanced machinery and internal factory transport dominate the image, while two workers featured on the fringes of the image are left solely with overseeing functions—one quite literally at the switchboard.[141] This fascination reached its pinnacle in a famous Moelven advertisement depicting a ready-made house, wrapped as a present with a note reading "To Jons. Hansen; From A/S Moelven Brug, Moelv," hanging in the sky by a hook resembling that of a helicopter of a lifting crane.[142] With the appropriate title of "This is how a house should be delivered," this was precisely the "phantasmagorical occultation" of production that Adorno referred to: produced and delivered by efficient machines, the house just materialised on your lawn.[143] Although the idea of a ready-made house "package" was not new—similar advertisements showing a house popping out of a briefcase were used by the Puutalo Oy Finnish conglomerate already in the 1940s—by the 1960s it was updated with depictions of new machines.[144] At the same time, other European and Norwegian architects and industrial producers—for example, Jean Prouve or Block Watne—also mobilised images of prefabricated house components delivered to hardly-accessible locations with the help of

138 See advertisement "På löpende bånd" featured in Moelven industrier et al., *Moelven 1899-1999* (Moelv: Moelven industrier, 1999), 67.
139 See "Aktiesleskapet Moelven Brug med samarbeidende bedrifter," in Moelven industrier et al., 67.
140 See booklet "Moelven offers" in Moelven catalogues, National Library Holdings.
141 "Moelven Housing System" in Moelven catalogues, National Library Holdings.
142 See advertisement "Slik skal et hus leveres" first published in *Gudbrandsdølen*, October 16, 1969, 5 with frequent reappearance in newspapers and magazines—it was published at least 17 times just in October that year. The next time it would appear in newspapers would be February 1971.
143 *Ringsaker Blad*, October 31, 1964, 5. A newspaper described a German helicopter that was able to life large loads—up to 50 tons—and introduced an idea that a helicopter would be able to deliver Moelven section houses in the most inaccessible places. The author claimed that with this new technology entire building complexes could not be assembled from prefabricated components.
144 See "New Standards" Finnish pavilion for the 17th Architectural Biennale in Venice, https://newstandards.info, accessed October 20, 2021.

Fig. 25. On the left, Moelven's advertisements on the cover of *A-Magasinet*, no. 23, 1965. On the right, a typical Moelven advertisement widely used in the 1960s. Image by Dasleg-Ervaco. Newspaper clipping.


Ferdig hus på 3 dager!
Fullt ferdige hus fra fabrikken. Med alt på plass. Klesskap og tørkeskap. Toalett og badekar. Panelovner. Tapeter på veggene, parkett på stuegulvet. Ferdig kjøkken.
Alt i førsteklasses kvalitet. Intet overlatt til tilfeldighetene. Dyktige fagfolk på alle områder – også på byggeplassen.
Huset ferdig på 3-4 dager – til fast pris. Moelven Brug – pioneren på ferdighus. 20 års erfaring – 20 år i utvikling. Solid økonomi. Cmfattende service. Et godt grunnlag å bygge på.
Moelven seksjonshus – forskjellige typer og størrelser. For enslige som for familier. En glede å flytte inn I.
„det ferdige ferdighus"
MOELVEN
SEKSJONSHUS
MED FULL ØKONOMISK GARANTI

Fig. 26. Moelven advertisement, emphasizing the conveyor serial production on conveyor belts. Note the worker, whose job seems to just cut off houses produced in one continous strip. Image by Dalseg-Ervaco. Newspaper clipping, 1960s.

a helicopter or aeroplane.[145] This changing advertisement iconography shows that Moelven's wholehearted embrace of technology was a child of its time, shared by architects and building professionals alike and with roots in the early 20th-century fascination with new machines.

An abundance of technological artefacts in Moelven marketing materials can also be attributed to the advertisement agency, Dalseg-Ervaco, responsible for producing most of Moelven Brug's publicity. Originally the Trygve Dalseg marketing firm based in Oslo, by 1960 it had merged with an inter-Scandinavian firm, Ervaco Scandinavian Advertising, a descendant of Erwin, Wasey and Co.—Henry Ford's original advertisement agency based in New York.[146] Although by the 1960s the agency was nearly entirely independent from the New York company,

145 For Block Watne idea of using a helicopter to deliver its Futurem type 21 and Futurum Block 141 houses see Sørby, *Klar - ferdig - hus*, 93. A similar drawing of prefab sections delivered by a helicopter was done by Kjell Norvin for Tjensvoll competition in 1967. *Byggekunst* 65, no.2 (1983): 59. For Jean Prouve and Tropical project see introduction by Barry Bergdoll, *Home Delivery: Fabricating the Modern Dwelling* (New York, Basel: Museum of Modern Art Birkhäuser, 2008), 22.

146 See *Stjørdalens Blad*, May 5, 1962, 4. On Ervaco Scandinavian advertisement see Visa Heinonen and Mika Pantzar, "'Little America': The Modernisation of the Finnish Consumer Society in the 1950s and 1960s," in *Americanisation in 20th Century Europe: Business, Culture, Politics. Volume 2* (Lille: Publications de l'Institut de recherches historiques du Septentrion, 2018), 41–59.

and had worked extensively across the Scandinavian market with offices in Stockholm, Gothenburg, Malmo, Copenhagen, Oslo, Bergen and Helsinki, its American legacy had left a significant mark on the company's approach to both its work and clientele.[147] The Norwegian Ervaco office managed clients ranging from Dow Chemicals to tobacco companies—much in line with the strategies of big Madison Avenue firms—and produced generally more daring advertisements than most rival local firms.[148] In addition, the Norwegian office maintained close contacts with American advertisement agencies, while Trygve Dalseg was personally interested in questions of contemporary marketing for large industries, well-aware of the recent economic and political developments in the United States at the time.[149] Thus, Moelven's interest in the most recent technology fitted well with the advertisement firm's technocratic strategy and background. Moelven advertisements are very telling in this regard, as they boil down the substance of how the company wanted to be seen: as a modern, technologically-driven enterprise where all physical labour and most of decision-making was delegated to machines. Both the workers and the customers could just sit back and enjoy the benefits of the new rational world.

SOFT EXPORT

As the computer decade of the 1970s rolled in, Moelven Brug's obsession with mechanisation, rationalisation and work automatisation fitted right in.[150] Since 1964, the company had been using automatic calculation and Astra accounting machines; by 1966, the company had signed a rental agreement with Bull-General Electric for using a punch-card machine at a cost of 172.000 NOK.[151] The machine was to take over all accounting from January 1, 1968, calculating not just the salaries but also general and specific departmental budgets and costs of all con-

147 See *Aftenposten*, May 29, 1962, 32. Also see Ervaco Scandinavian advertising, *Some Notes on the Scandinavian Market: A Statistical Snapshot* (Stockholm: Ervaco, 1963).

148 For example, Dalseg-Ervaco represented John Silver in Norway. On the "full-service" that Dalseg-Ervaco offered its customers see *Morgenbladet*, January 25, 1963, 12.

149 Trygve Dalseg, "Produksjonsøkning og markedsføring" in *Morgenbladet*, May 18, 1962, 10. On the visits of American colleagues see "Amerikansk reklamebesøk" *Morgenposten*, October 12, 1963, 2.

150 See, for example, Nicholas Negroponte, *The Architecture Machine: Toward a More Human Environment*, First Edition (Cambridge, Mass: The MIT Press, 1973).First Edition (Cambridge, Mass: The MIT Press, 1973 Nicholas Negroponte, *Soft Architecture Machines* (London, 1975).1975 Moelven discussions around the use of EDB started as early as 1963, but this was postponed until the late 1960s. See item no. 399, board meeting on April 20, 1963, 175, in Folder 0003 "Styreprotokoll Moelven Brug 1944-1969" in SAH/ARK-287-01/A/Aa/L0001.

151 See item no. 575, board meeting November 24, 1966, 331, in Folder 0003 "Styreprotokoll Moelven Brug 1944-1969" in SAH/ARK-287-01/A/Aa/L0001. Also see a contract between FACIT company in Hamar and Moelven from June 5 1964 in Folder 0003 "Salgs- og kjøpekontrakter 1960/-70-åra" SAH/ARK-287-01/K/Kc/L0006/0003.

Fig. 27. A popular Moelven advertisement, emphasizing the quick and seamless delivery. Image by Dalseg-Ervaco. Newspaper clipping, 1960s.

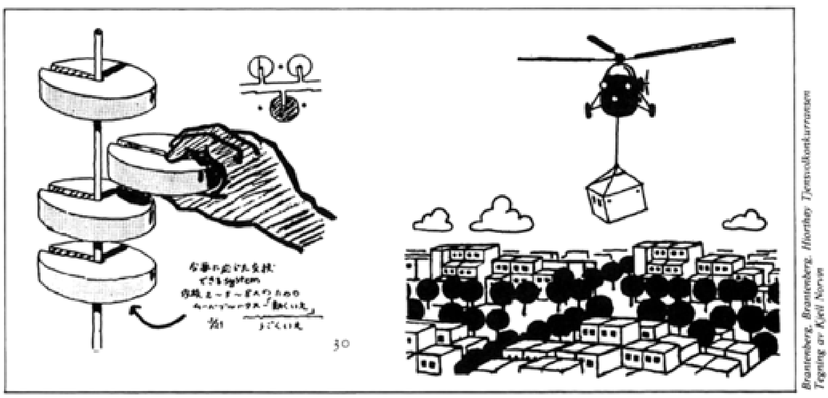


Fig. 28. A similar drawing of a prefab section delivered by a helicopter. By Kjell Norvin for Tjensvoll competition in 1967. In *Byggekunst*, no.2 (1983).

struction work.[152] The installation of *elektronisk databehandling* (EDB) for accounting tasks completed Moelven's transformation, as IRAS-standardised forms with parcelled time- and material-prices provided the basis for new accounting programs carried out by computers. Indeed, as Johnson and Kaplan note, when computers were introduced for accounting purposes in the late 1960s, they essentially automated the already-existing manual systems of managerial accounting.[153] However, unliked improved machines on the shop-floor, computers required new infrastructure—not least, powerful hosting systems—and specialists that were in high demand: a few short courses could not substitute for a proper programming education.[154] In 1969, Moelven hired an EDB-specialist, the civil engineer Ove Atle Hagestande, to develop Moelven's data management sector.[155] On Tuesday, May 15, 1973, a punch card machine was taken out for scrapping, replaced by a new EDB facilities.[156]

Since standardised computer programs were limited and often generic, the company's engineers had to develop their own programs based on specific aspects of Moelven prefabricated production—leading to a merger between computing and accounting departments in the mid-1970s.[157] Since 1972, Moelven Brug had used computers for all internal managerial calculations, sold an accounting program developed in-house to a company in Oslo, provided software assistance to several companies in Hedmark and Oppland, and negotiated with several others. With a diminishing market for ready-made products within the country and an absence of export opportunities, by 1974 the company briefly evaluated the possibility of turning programming software into one of its products.[158] Although Moelven's programs made specifically for the prefabrication industry had no market analogues, their development proved time- and resource-consuming, and since programming was

152 The company got not just one machine, but a whole set of tools delivered by April 1, 1967: an alpha-numerical punch card machine, a control punch card machine, machine that electronically sorted cards with a speed of 700 cards per minute, a transfer machine, electronic calculator and tabulator Gamma 172 among others. Folder 0003 "Salgs- og kjøpekontrakter 1960/-70-åra" SAH/ARK-287-01/K/Kc/L0006/0003.

153 H. Thomas Johnson, *Relevance Lost: The Rise and Fall of Management Accounting*, [Paperback ed.]. (Boston, Mass: Harvard Business School Press, 1991), 14.

154 D. Knutsen, *Bedriftavis,* no.13 (1973): 11-13. For example, many Norwegian industrial companies were connected to a central data processing facility in Stockholm through a time-shared system. See "What is EDB?" *Bedriftavis,* no.5 (1969): 4-5.

155 *Bergens Tidende*, March 26, 1969, 27; also see advertisements in *Stavanger Aftenblad, Aftenposten, Drammens Tidende og Buskeruds Blad* — the company was actively searching for EDB specialists. As the first EDB machines appeared on the west coast—particularly though close relations between NHH and IBM— most of the advertisements for EDB specialists were fist placed in *Bergens Tidende*, and later in all national newspapers.

156 The event was extensively covered in the company's magazine, with series of discussion on quick obsolescence of EDB different from other machines and explanation of why it was important. D. Knutsen, *Bedriftavis* no.13 (1973): 11-13.

157 See "Personaladministrativ håndbok," 1983. In Folder 0001 in SAH/ARK-287-01/P/Pg.

158 "EDB-programmer en salgsvare?," *Bedriftavis*, no.14 (1973): 16-17.

far from the company's primary area of expertise the idea was eventually put to rest. Nevertheless, new equipment to analyse building data was making steady inroads into the construction industry: for example, Byggedata A/S was founded in Oslo in 1964 and offered electronic data management services to architects, constructors, entrepreneurs and building companies. Similar to the Moelven programs, the company's algorithms helped to create more accurate project budgets.[159]

Sales of computer software tailored to a very specific type of production could hardly be successful without the export of the production process itself. With Norway turning down the EEC membership in 1972, export opportunities for products within the European Economic Zone were shrinking, and the Moelven management was frantically searching for alternatives. Thus, sales of "know-how" instead of physical products to regions other than EEC seemed to offer a potential solution. By 1973, a different type of Moelven marketing materials emerged: largely in English, they focused on Moelven technical system as such, rather than specific products. For example, a marketing booklet titled "Moelven Housing System" highlighted aspects such as "efficient work places," "automatic mechanisation," "efficient materials handling" and "shorter building periods," among others.[160] Quite surprisingly, the booklet specified that "by operating a factory based on assembly lines with repetitive work operations, the labour can be performed by low-skilled employees."[161] Although the precise target audience of these booklets is hard to establish, most likely they accompanied the company's 1970s-involvement in East Africa together with NORAD.[162] Moelven was among several Norwegian companies that participated in the expansion of the timber industry in Uganda, Kenya and Tanzania. Specifically, Moelven was to build a prefabricated timber enterprise in Kenya—a new industry which was in turn to become part of a larger social housing programme.[163] In this context, automation and process mechanisation were largely viewed positively, as they allowed to hire non-professional labour, while an advanced technological process was seen as a practical measure that could help solve social issues.

Similar process export ventures were developed by Moelven with Eastern Bloc countries: a project for a ready-made timber house factory

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159 *Norsk Lysningsblad*, July 1, 1964, 4.
160 "Moelven Housing System" marketing booklet, 1973. In "Produktspekter M-S," SAH/ARK-287-01/J/Je/L0003.
161 "Moelven Housing System," 1973. "Produktspekter M-S," SAH/ARK-287-01/J/Je/L0003.
162 NORAD is The Norwegian Agency for Development cooperation, still active. See www.norad.no.
163 See for example, "Moelven Brug inn i ferdighusproduksjon i Kenya?" in *Ringsaker Blad*, March 24, 1970, 1. Also in *Gudbrandsdølen*, March 23, 1970, 1; *Norges Handels og Sjøfartstidende*, March 20, 1970, 10.

Fig. 29. Cartoons about the new EDB computer, introduced to Moelven. On the left: "Our data machine is now ready to see you!"; on the right: "Oh my, it has started to talk to itself!" From *Bedriftavis*, no.5 (1969).

Fig. 30. Moelven employee photographed at the new EDB workstation. From *Bedriftavis*, no.19 (1976).

in the USSR, and a factory for prefabricated schools and housing for the Czechoslovak Socialist Republic (CSSR).[164] A new ready-made house factory near Lake Baikal was planned to have a capacity of around 15000 units a year—a production surpassing the one in Moelv three-to-four times—with buildings designed according to Norwegian standards and dimensions.[165] The "Moelven Housing System" for the CSSR proposed that an entire industrial complex modelled on Moelven own facilities and experience would be built from scratch. The project included a wood-working plant for structural components, a door- and window-factory, modular housing plant, mobile houses plant, mounting for trailers, and a number of miscellaneous buildings.[166] With a capacity of 5000 section-houses per year, in addition to 5000 "mobile houses," it featured detailed designs and layouts of all production facilities, listing specifications for every step of the production process, every work operation, and the tools required for each step.[167] Moelven's mechanical department was to design and deliver special equipment, while the company would provide all necessary process documents, as well as a 16-week training course in the manufacturing process in Norway for ten industrial leaders. The price tag for this systemic "know-how" was set to 43,2 million NOK, in addition to 3 million NOK for equipment.[168] While the details of the project are too many to discuss here, project documentation shows that the company thought of its production process as a complete product, a "know-how in the field of industrial housing" ready for export. However, in the end, none of these ambitious plans were realised.

Lastly, the Moelven process was not just exported abroad, but was also well-known within the country. The factory became a local landmark popular with visitors from Norway and abroad: just in 1975 alone, Moelven Brug hosted more than 900 guests from 40 different nations.[169] International visitors included professional architects and architecture students, different TV and film crews, European and international politicians, representatives of foreign missions, and foreign diplomats to Norway.[170] Among some of more peculiar visits were a UN-scholarship

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164 See CSSR project in "Moelven Housing System" Folders L0004 and L0005 in ARK-287-01/J/Jc; for USSR see *Hamar Arbeiderblad*, July 9, 1975, 1,6.

165 *Hamar Arbeiderblad*, July 9, 1975, 1,6; *Gudbrandsdølen*, July 8, 1975, 14. Also in Mageli's speech for the 75 years anniversary, In Folder 0002 "Celebreringsarrangement" in SAH/ARK-287-01/P/Pb/L0001.

166 "Moelven Housing System," in Folder L0004 in ARK-287-01/J/Jc.

167 Process description part 7.0 in "Moelven Housing System" Folder L0004 in ARK-287-01/J/Jc.

168 See Part 3.0 "Economics of the project" in "Moelven Housing System," Folder L0004 in ARK-287-01/J/Jc. The project price today would equal to approximately 340.000.000 NOK.

169 Mageli's speech for the 75 years anniversary, In Folder 0002 "Celebreringsarrangement" in SAH/ARK-287-01/P/Pb/L0001.

170 A substantial box in Moelven archive is dedicated solely to records of factory visits and programs of the visit. Box "L0001 – Bedriftsbesøk," in SAH/ARK-287-01/M/L0001.

Fig. 31. Moelven housing system sales catalogue for export abroad, most likely to East Africa, 1973. In "Produktspekter M-S", SAH/ARK-287-01/J/Je/L0003, State Archive in Hamar.

holder from Indonesia, Mr. Abbas, who led a research unit on building materials at the Regional Housing Centre in Bandung, Indonesia, and a civil engineer, Barnavass Lugonzo, from the National Construction Company in Kenya.[171] Domestic visitors ranged from students of technical, architectural or professional schools and universities to representatives of Norwegian industry, union groups, workers from other factories, prominent state politicians and functionaries. The company was showcased not just as a collection of factories but rather as a single, streamlined enterprise that relied on the most modern technology and "rational" production process. Similarly to Fellman's discussion of the notion of new aesthetics closely associated with modern factory production in Finland, for Moelven, the efficiency of the technological process harboured aesthetic qualities that could be showcased.[172]

In this way, although Moelven Brug borrowed technology from abroad—through work-studies, new accounting systems, conveyor belt lines and EDB—these technologies were adapted and reworked into a unique product that could now be exported as a specialised "know-how." As the Moelven Housing System project description

171 A letter from engineer Thor Furuholmen A/S to Moelven, October 11, 1968; a letter from NBI to Moelven about UN-scholarship holder Mr. Abbas from Indonesia dated October 31, 1968 and his UN-application form. All in Folder 0003 "Bedriftsbesøk fra forskjellige" in SAH/ARK-287-01/M/L0001.
172 Fellman, "Aesthetics in Modern Management," 190.

underlined: “one may not find more advanced building systems and manufacturing facilities in the world.”[173] Although these international ventures were perhaps somewhat overambitious in their scope, the export of technology, “know-how,” soft-skills and organisational practices, rather than physical products, seemed rather reasonable for Moelven, which increasingly struggled to find a suitable application for its well-oiled and highly technological apparatus.

WHAT’S GOOD FOR MOELVEN IS GOOD FOR THE COUNTRY

During his 75th anniversary speech, Mageli argued that Moelven’s technological process was a homegrown Hedmark product, as “there has been little to learn from others.”[174] While there was, perhaps, little that Moelven could learn from other prefabrication producers in Norway, the company’s elaborate production apparatus was nevertheless informed by a wide variety of sources. Work-study methods that deconstructed labour into standardised units of time were implemented after the best rationalisation practices in Europe and the United States. A conveyor line assembly imported from abroad joined these discrete units of work into continuous production flows. By the 1970s, these flows were harnessed into an elaborate logistical system managed through network-planning, PERT-charts and, eventually, computers. New technology made it possible to transfer most construction work from site to factory, and transformed the process from building to assembly. This chapter has adapted a constructivist view of technology, arguing that technological choices are normative choices, while technological artefacts—particularly those imported from abroad—are complex entities closely intertwined with social context and institutions that mediate their implementation.[175] As Moelven imported new technologies from abroad—from work-studies to conveyor belt assembly and computer programming—ideological assumptions implicit in these artefacts were continuously challenged by the essential scaffolding of Norwegian working life—union representation, collective negotiations and welfare systems. With time, these imported technologies and ideologies of work were modified, assimilated and rethought as unique socio-technical hybrids,

173 “Moelven Housing System,” Folder L0004 in ARK-287-01/J/Jc.
174 Mageli’s speech for the 75 years anniversary, In Folder 0002 “Celebreringsarrangement” 2 in SAH/ARK-287-01/P/Pb/L0001.
175 Feenberg and Feenberg, *Questioning Technology*, 103.

then exported abroad as total products, a new industrial "know-how."

This chapter has tried to lift the curtain of "occultation" and to study the people, processes and technology that were behind the production of Moelven prefabricated buildings. The company's striving for mechanisation and fascination with technologies of scale, so often became the centrepiece of its daring advertisements, had few analogues in Norwegian industry. However, technology is a powerful force whose effects often remain unaccounted for. IRAS engineers brought a new era of rationality onto the Moelven shopfloor that profoundly transformed the way labour was thought of and performed. As work at the factory became more standardised, it became more repetitive, devoid of nuances of craft and, as a side effect, produced industrial alienation. People and technology became enveloped in a dynamic socio-technical system, where workers' bodies were closely related to the workings of machines, affecting productivity, payment and rest times. However, although the role of craft diminished, Moelven employees had to learn new skills, operating increasingly sophisticated machines. More efficient production led to increased prosperity, shared in part by the company's workers. Moelven incorporated elements of welfare support into its own system, providing health and pension benefits, housing and education opportunities to its employees. What seemed as a technocratic stride was in fact balanced by a strong system of worker representation: by 1973, for example, the company had introduced a system of "industrial democracy" where employees could purchase shares in the company and receive the right of not just representation, but co-determination.[176] The company played an important role not just in providing secure livelihoods for its workers, but also in the region at large—an ambition confirmed by Mageli paraphrasing the famous Charles Erwin Wilson's remark of "what's good for General Motors is good for the country" in his 1977 NHH lecture.[177] If that was an ambition, what role did this rational company, with its highly automated production apparatus play in shaping the built environment across the country? What did the architectural objects, developed and produced in this highly rationalised environment look like?

176 See for example, *Bedriftavis*, no.13 (1973): 8; or *Bedriftavis* no. 14 (1974): 3.
177 Mageli, *A/S Moelven brug*, 14–15.

SCHOOLS FROM A CONVEYOR BELT

CHAPTER 3

Industrialisert skolebygging vil også bli design-problem

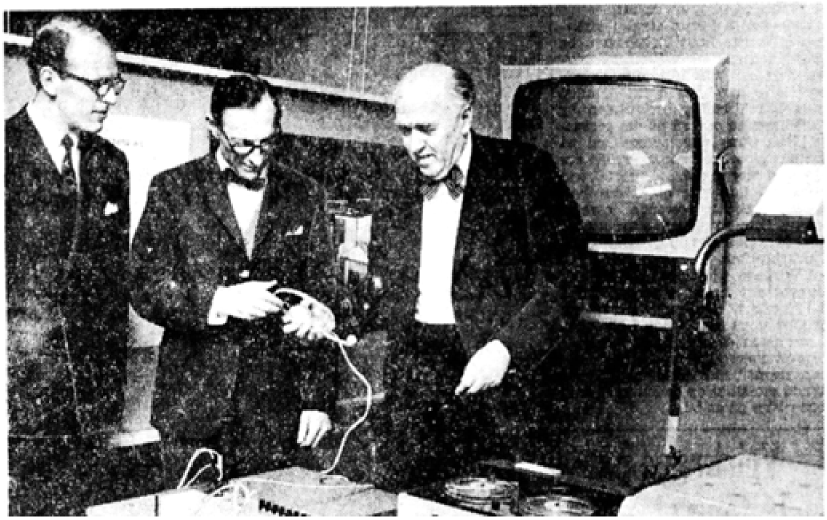


Fig. 1. From right to left: minister of education Kjell Bondevik, NI’s director Jan Didriksen, press secretary John O. Engh all pictured at the opening of the Design Centre exhibition “Form and function in the school.” Newspaper clipping, 1969.

“INDUSTRIAL SCHOOLBUILDING WILL SOON BECOME A DESIGN ISSUE.”[1]

1 Jan Didriksen *Aftenposten*, April 9, 1969, 2. Original quote: “Industrialisert skolebygging vil også bli design-problem.”

From the photographs taken at the opening of the "Form and Function in the School" exhibition at the Norwegian Design Centre in Oslo in April 1969, one was particularly popular. It featured the administrative director of the Federation of Norwegian Industries (NI), Jan Didriksen, the Centre's press secretary, John O. Engh, and the minister of education Kjell Bondevik picking up a headset against a backdrop of futuristic tape recorders, TV screens and multimedia players.[2] The exhibition display, designed by interior architect Aud Dalseg showcased ten innovative school projects, studying how new "rational" ways of building had evolved in response to new pedagogical methods and multimedia equipment used in schools.[3] The exhibition fitted well with the overall objective of the Centre which, sponsored by the Federation, strove to promote industrial production in different fields.[4] As the Centre's director, Alf Bøe, argued, since schools were built according to standardised spatial requirements, they could make use of standardised components. School-building would, then, turn into an issue of product, rather than architectural, design, and architects would take on a role closer to that of industrial designers.[5] In practice, however, school building had not come as far in harnessing the new technology as the futuristic multimedia teaching devices. According to Engh, while the featured school projects included some industrialised parts, in reality there were only two "turnkey" school producers in Norway—Moelven Brug and Block Watne. Of the two, Moelven was the only one that relied on a fully-industrialised production process.[6] By 1969, the company had been building schools for more than a decade, delivering on average 12.000 m^2 of educational space per year. What originated as a transitional solution to the acute 1958 school-space crisis by the mid-1960s had evolved into an elaborate production apparatus as the company developed typological solutions for the new Norwegian secondary schools, producing them on conveyor belts.[7] These "turnkey" industrial solutions were sold to more than 50 municipalities across the country.[8]

Industrially-built schools are an exceptionally yielding subject for a study interested in mass-produced architecture and the role it played in post-war Norway. In the lecture series that accompanied the 1969

2 *Aftenposten*, April 9, 1969, 2.
3 *Dagbladet*, April 9, 1969, 2.
4 *Stavanger Aftenblad*, April 12, 1969, 6.
5 *Stavanger Aftenblad*, April 12, 1969, 6. Norsk lærerlag, *Norsk skoleblad* 33, 28/29-52 (Oslo: Norsk lærerlag, 1969), 377.
6 *Stavanger Aftenblad*, April 12, 1969, 6.
7 Conveyor belt was a common trope used in Moelven school advertisements, see *Ringsaker Blad*, May 27, 1958, 2.
8 See Moelven prefabricated schools catalogues, ca. 1965, in SAH/ARK-287-01/J/Jc-0003.


Rasjonelle skolebygg i Designcentret

«Form og funksjon i skolen» åpnes av Bondevik i dag

Fig. 2. Exhibition's architect Aud Dalseg photographed at the exposition. Newspaper clipping, 1969.

exhibition, Einar Myklebust, a professor from the NTH's architecture department, emphasised that school building was uniquely situated at the intersection between political, pedagogical and architectural concerns.[9] Indeed schools, perhaps more than any other building typology, bring together the interests of the local population, educators, architects, politicians, state officials, entrepreneurs and industrial producers, continuously negotiating functionality and cost, efficiency and architectural expression. Moelven's prefabricated schools offer a particularly appropriate lens to study this amalgamation. Produced entirely at the factory, they accommodated both centralised educational and spatial requirements, and were designed in cooperation with local architects and school boards in response to the demands of the local community. The modular system of prefabricated timber panels made it possible to create flexible plan arrangements, adaptable to different programmes, budgets and terrains, much in line with the most recent international recommendations on school construction at the time.

The study of these prefabricated schools allows not just to map a

9 *Stavanger Aftenblad*, May 24, 1969, 2, 8.

force-field of actors involved in school building in Norway at the time, but also to trace an interdisciplinary osmosis of ideas that permeated professional realms and national boundaries. Although the history of Norwegian post-war school building still remains to be written, this chapter argues that in the absence of state-led initiatives for new school construction, Moelven prefabricated buildings fashioned a specifically Norwegian contribution to the international discussion of industrialised school construction in the 1960s. This chapter thus situates Moelven schools not just within a Norwegian architectural discourse on school building at the time, but positions them in a broader international context of post-war pedagogical experiments and architectural solutions used to house these experiments.

A BATTLE OVER SOULS

Educational buildings have always been laden with ideology, reflecting priorities and ideological aspirations on behalf of a new generation of citizens.[10] However, in the period following WWII, education acquired a new social dimension, as many European countries extended their compulsory basic schooling with the aim of fostering a new generation of post-war citizens.[11] As architectural historian Andrew Saint pointed out, school buildings became "a battleground [...] in dispute over the souls of the adolescents."[12] While education in the interwar period was influenced by the child-centred approach of Pestalozzi, Froebel and Montessori, post-war educators turned to Dewey and Kilpatrick, who emphasised a more citizen-oriented democratic atmosphere and conceived of the school as a microcosm of a larger community.[13] The Norwegian approach to education at the time was also shaped by the changing international context, and took on a more social dimension: common school reform was to become an essential element of the post-war social-democratic order under the leadership of the Labour Party. [14] The new school was to

10 See for example H.C. Dent, *Secondary Education for All. Origins and Development in England* (London: Routledge, 1949; 2013).

11 Alfred Oftedal Telhaug, *Utdanningsreformene: oversikt og analyse*, *Norbok* (Oslo: Didakta norsk forl., 1997), 29.

12 Saint, *Towards a Social Architecture*, 39.

13 Amy F. Ogata, "Building for Learning in Postwar American Elementary Schools," JSAH 67 (4): 562-591. See references to Dewey in Telhaug, Haugaløkken, and Forsøksrådet for skoleverket, *Forsøksrådet - fornyer i norsk skole*, 45. Also in Saint, *Towards a Social Architecture*, 40.

14 Anglo-Norwegian Education Conference, *A Record of the Hundorp Conference: For British and Norwegian Teachers*, *Norbok* (Oslo: Gyldendal, 1948), 15. Forsøksrådet for skoleverket, *Barne- og ungdomsskolen for alle tar form* (Oslo: I kommisjon hos Aschehoug, 1957), 183. Nina Volckmar, "Helge Sivertsen: Education Philosophy and Reform Policy in Norway in the 1950s and 60s," in *Proceedings from Education and Nationbuilding Conference*, *Volda University College, 14-15 June 2001* (Volda: Norbok), 71–75.

eliminate social differences, promote values of democracy and civic liberal ideas and—echoing developments in Britain and the United States—model a larger society within the school.[15] This meant that new schools had to foster the public spirit and fellowship of students, and nurture individual responsibility and cooperation.[16] In practical terms, the new school was to erase the distinction between academic and vocational education—*realskole* and *framhaldskole*—and thus eliminate class division, offer a combination of academic, practical and aesthetic subjects and create conditions for every student to participate in cultural life.[17] This ambitious plan required not just new ways of teaching, but posed different demands on the scale and composition of school buildings.

While previously as many as 20% of applicants to the *realskole* had to be turned down due to limited space, new schools had to provide opportunities for all.[18] Centrally located schools with more students offered a wider variety of subjects and could be more efficiently staffed: thus, larger schools were prioritised.[19] Since the new comprehensive education was to combine academic, practical and aesthetic subjects, new schools had to accommodate special rooms for music, languages, and natural sciences, workshops for metal, clay, woodworking and home science. Ambitions for an "active cultural life" required a stage for performances and corresponding technical spaces and dressing rooms. Since sports were seen as essential for social equalisation, all new schools were expected to have well-equipped sports facilities that could double as community assembly spaces, particularly important in rural areas.[20] Lastly, as the reform strove for equality across the country, a certain level of uniformity was imposed. As Norwegian politician and school-reform advocate Helge Sivertsen underlined, it was "important that particular national and common cultural elements can be found in schools regardless of whether they are located in Oslo or Finnmark."[21] Thus, reform for a common nine-year school had profound implications, not just for the

15 Helge Sivertsen, "Arbeiderpartiets langtidsprogram for skolen," *Arbeiderbladet*, 24, 25, 26 April 1952.
16 Forsøksrådet for skoleverket, *Barne- og ungdomsskolen for alle tar form*, 33.
17 Eva Nordland, Verdier i gammel og ny skole: fra debatten om reform i skolen i svenske aviser 1920-1956, (Oslo, 1958), 10. Traditionally, *realskole* offered a more academic-oriented education for mostly urban children from upper social classes, while *framhaldskole* was a continuous school education, more accessible for lower class students. *Education and Nationbuilding*, 73.
18 *Østlendingen*, January 17, 1958, 4: "Parents whose children intend to enrol in *realskole* are often very desperate. [...] Both parents and children end up sleepless when thinking about it."
19 Alfred Oftedal Telhaug, *Utdanningsreformene: oversikt og analyse* (Oslo: Didakta norsk forl., 1997), 53.
20 *Verdier og skole: om verdier, verdiformidling og verdikonstruksjon i grunnskolen*, *NFFO* (Bergen: Fagbokforl., 2005), 58. Also *Instilling fra Folkeskolekomiteen*, 1965, 113-114. On the role of team sports see Volckmar, "Helge Sivertsen" in *Education and Nationbuilding*, 77. See a lecture by Ivar Otto Iversen, "School as a place for social activities in the village" in Bjarne Lous Mohr et al., "Skolebygging: kurs ved NTH 1958," (Trondheim: NTH, 1959), 122-123.
21 Volckmar, "Helge Sivertsen," in *Education and Nationbuilding*, 73.

pedagogical objectives of the new schools, but also on the physical space, scale and programming of educational buildings. Schools ceased to be monumental landmarks and were instead to become more open, accessible and democratic, adapted to children's scale and needs.[22]

Egalitarian in its aspirations, in practice the reform also had a more practical foundation. As the Norwegian Pedagogical Magazine articulated in 1956: "mechanisation of all industries in the country sets new demands for the workers and managers that can't fulfil them because they have not received the education that provides that."[23] The new school leaving age meant that students would receive a more comprehensive education, while a common school ensured that both technical and academic aspects were incorporated to meet the demands of the new job market. The new school was to educate those managers, engineers and workers who appeared in the previous two chapters of this study and who were expected to further Norwegian industrialisation. If post-war education was to respond to the needs of the mechanised society, the process of school building was to do the same.

SCHOOL TECHNOCRACY

Technically, the transition towards a common nine-year school was complex. Forsøksrådet for Skoleverket (FRS)—the National Council for Innovation in Education—was established in July 1954 and became the main agency that implemented pedagogical innovations.[24] The urgency of the Council's work was underlined by the fact that it was allowed to forego a lengthy process of bureaucratic approval. However, it was no exception to the spirit of rationality that permeated different spheres of everyday life. The Council sourced expertise from teachers, pedagogical professionals and social scientists, and relied heavily on empirical studies, socio-economic knowledge and psychologically-oriented pedagogy.[25] The same experts that shaped new industrial work relations—for example, Rolf Waaler, a founder of the psycho-technique movement in Norway—also contributed to the Council's work on educational reform.[26]

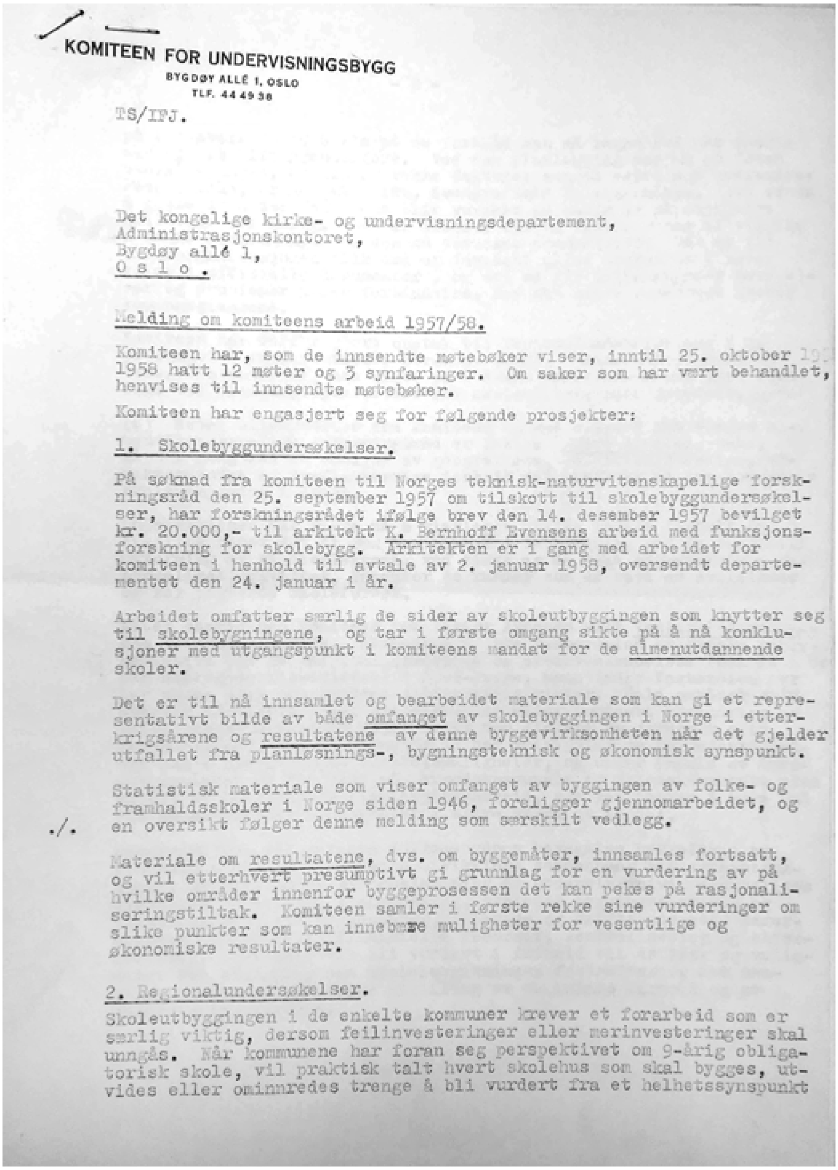
22 See for example, UNESCO 1957 school-building conference guidelines in KUB archive, RA/S-5489/D/L0001 and Kristen Bernhoff Evensen in Mohr et al., "Skolebygging," 17.

23 *Norsk pedagogic tidskrift* 40 (1956): 284.

24 See *Stortings meld*. no. 9, 1954. Also see Telhaug, *Utdanningsreformene*, 35.

25 *Education and Nationbuilidng*, 82. Alfred Oftedal Telhaug, Ove Kristian Haugaløkken, and Forsøksrådet for skoleverket, *Forsøksrådet - fornyer i norsk skole: historisk beskrivelse* (Oslo: Forsøksrådet for skoleverket, 1984), 29–30.

26 On Waaler see Arne Fostvedt and Rolf Jangård, *Professor Rolf Waaler 60 år 15. februar 1958: [festskrift* (Oslo: Bedriftsøkonomen, 1958). Waaler represented "social studies" in the first council of 1954; see Telhaug, Haugaløkken, and Forsøksrådet for skoleverket, *Forsøksrådet - fornyer i norsk skole*, 44.



KOMITEEN FOR UNDERVISNINGSBYGG
BYGDØY ALLÉ 1, OSLO
TLF. 44 49 38

TS/IFJ.

Det kongelige kirke- og undervisningsdepartement,
Administrasjonskontoret,
Bygdøy allé 1,
O s l o .

Melding om komiteens arbeid 1957/58.

Komiteen har, som de innsendte møtebøker viser, inntil 25. oktober 19[illegible] 1958 hatt 12 møter og 3 synfaringer. Om saker som har vært behandlet, henvises til innsendte møtebøker.

Komiteen har engasjert seg for følgende prosjekter:

1. Skolebyggundersøkelser.

På søknad fra komiteen til Norges teknisk-naturvitenskapelige forskningsråd den 25. september 1957 om tilskott til skolebyggundersøkelser, har forskningsrådet ifølge brev den 14. desember 1957 bevilget kr. 20.000,- til arkitekt K. Bernhoff Evensens arbeid med funksjonsforskning for skolebygg. Arkitekten er i gang med arbeidet for komiteen i henhold til avtale av 2. januar 1958, oversendt departementet den 24. januar i år.

Arbeidet omfatter særlig de sider av skoleutbyggingen som knytter seg til skolebygningene, og tar i første omgang sikte på å nå konklusjoner med utgangspunkt i komiteens mandat for de almenutdannende skoler.

Det er til nå innsamlet og bearbeidet materiale som kan gi et representativt bilde av både omfanget av skolebyggingen i Norge i etterkrigsårene og resultatene av denne byggevirksomheten når det gjelder utfallet fra planløsnings-, bygningsteknisk og økonomisk synspunkt.

Statistisk materiale som viser omfanget av byggingen av folke- og framhaldsskoler i Norge siden 1946, foreligger gjennomarbeidet, og
./. en oversikt følger denne melding som særskilt vedlegg.

Materiale om resultatene, dvs. om byggemåter, innsamles fortsatt, og vil etterhvert presumptivt gi grunnlag for en vurdering av på hvilke områder innenfor byggeprosessen det kan pekes på rasjonaliseringstiltak. Komiteen samler i første rekke sine vurderinger om slike punkter som kan innebære muligheter for vesentlige og økonomiske resultater.

2. Regionalundersøkelser.

Skoleutbyggingen i de enkelte kommuner krever et forarbeid som er særlig viktig, dersom feilinvesteringer eller merinvesteringer skal unngås. Når kommunene har foran seg perspektivet om 9-årig obligatorisk skole, vil praktisk talt hvert skolehus som skal bygges, utvides eller ominnredes trenge å bli vurdert fra et helhetssynspunkt

Fig. 3. Archival documents on the establishment of the Committee for Educational Buildings (KUD), delineating the scope of its work, as well as responsibility of architect Tor Skjånes within it. "Komite for undervisningsbygg," dated Oslo July 22, 1957. RA/S-5489/D/L0001, Oslo State Archive.

- 3 -

(b) Komiteen har vendt seg til arkitekt Tor Skjånes, Oslo, om en undersøkelse med tilsvarende siktemål som lektor Arnesens, for kommunene Ringsaker, Furnes og Nes i Hedmark, som med sine både grisgrendte og tettgrendte områder og sitt naboskap med bysamfunn vil være representative for mange kommuner. Arkitekten har i det forløpne år utført en generell regionundersøkelse i de tre kommuner med stipend fra Norges Tekniske Høgskole, og hensikten er på bakgrunn av dette arbeid å få en spesialundersøkelse av faktorer og forhold som er bestemmende for planleggingen av skoleutbyggingen. Komiteen har hatt konferanse med arkitekt Skjånes og med representanter for de tre kommuner og for Hedmark fylke om denne saken (jfr. møtebøker nr. 8, 9 og 12).

Arkitekt Skjånes vil, på bakgrunn av krav og muligheter som skolelovgivningen har skapt grunnlag for eller banet vei for, ta opp til vurdering forskjellige alternativer for skoleplasering og skolestørrelse. I den sammenhengen er det forutsetningen at forhold som omfatter timeplaner, lærerposter og skyssutgifter skal utredes. Det vil bli foretatt kostnadsberegninger både for kapital- og driftsbudsjett. Kapitalbudsjettet vil omfatte kalkulerte utgifter til endringer og utvidelser ved skoler hvor dette måtte komme på tale, og innsparte beløp i tilfelle det blir spørsmål om å avhende skoler til annet formål.

Arkitekt Skjånes vil kunne bygge på materiale fra sin regionalundersøkelse og på en prognose for elevtallene som er utarbeidet av Områdeplanleggingen i Hedmark fylke ved konsulent Albert Jacobsen. For øvrig vil han søke hjelp hos skolesakkyndige sentralt og regionalt, bl.a. vil han samarbeide med de tre kommuners skoleinspektører. Til befaringer og teknisk vurdering av planens konsekvenser for de enkelte skolebygg vil han samarbeide med distriktsarkitekten, idet fylkesarkitekten har gitt uttrykk for at han vanskelig kan avse tid til denne oppgaven. Dessuten vil det bli behov for konsultativ bistand av spesialist i trafikkøkonomi (bussrutene).

En nærmere redegjørelse for arkitekt Skjånes's spesialprosjekt, med beregnede utgifter vil bli oversendt særskilt.

Arkitekt Skjånes og lektor Arnesen har i mai 1958 for komiteens regning i fellesskap konsultert lederne av de danske undersøkelser for "Nytt skolebyggeri".

3. Veiledning om bygging av skolehus.

Komiteen har engasjert skoleinspektør Johan Ivesdal, Trøgstad, til å skrive utkast til en veiledning for skolefolk og folkevalte i kommunene om bygging av skolehus. Skoleinspektøren har levert sitt første utkast til manuskript, som er under behandling i komiteen.

The Council served as a "knowledge bank," collecting information related to pedagogical research and the most recent international experiments from the United States, United Kingdom, France, West Germany, Italy, and even the USSR.[27] However, not all knowledge from these international endeavours could be applied directly: unlike other European counties, the Norwegian educational system was more centralised.[28] The Ministry of Church and Education was the main administrative body in charge, followed by elected county and municipal school boards. The Ministry prescribed a centralised educational curriculum implemented across the country and issued detailed laws, guidelines and teaching plans for local school actors to follow. In addition, it approved programming and building plans for all new schools before any construction could take place.[29]

As the new common school programme was to be put into effect from 1958 onwards, most school planning from the mid-1950s was placed on hold. In 1957, under the auspices of the Council for Innovation, the Committee for Educational Buildings (KUB) was established. Similarly to the Council, the Committee mobilised expertise from technical professionals in different fields, offering a platform for "school people and architects to work together to figure out how to build school facilities in the most rational way."[30] Headed by a rector, Tønnes Sirevåg, the committee convened a director of NBI, engineer Øyvind Birkeland, NTH professor and specialist on modern timber constructions, Hans Granum, head of the housing directorate, Odvar Hedlung, and teacher, Kåre Norum. The architects Kristen Bernhoff Evensen and Tor Skjånes consulted the group on technical and architectural questions.[31] The committee was founded as a response to both the demands of Norwegian architects, who since the early 1950s had called for a more organised coordination of technical knowledge, and similar school-building research initiatives abroad.[32] A UNESCO conference on Public Education held in Geneva in July 1957 urged participants from 70 countries to find "the most rational building methods," while nearly identical bodies of educationalists, archi-

27 Telhaug, *Forsøksrådet - fornyer i norsk skole*, 51. Forsøksrådet for skoleverket, *Ungdomsskole for alle*, *Norbok*, Forsøk og reform (trykt utg.) 1 (Oslo: I kommisjon hos Aschehoug, 1956), 183.

28 Yaw Amoako-Addo, *Education and Norwegian Society*, *Norbok* (Oslo: International Summer School, University of Oslo, 1978), 13.

29 Telhaug, *Utdanningsreformene*, 54. See also "Rundskriv nr. 13, L 1959 fra KUD to Skoledirektörene of skolestryrene; Oslo 18 Juni 1959." In RA/S-1587/D/Da/L0041 in Riksarkivet, Oslo.

30 "Komite for undervisningsbygg," Oslo July 22, 1957. RA/S-5489/D/L0001.

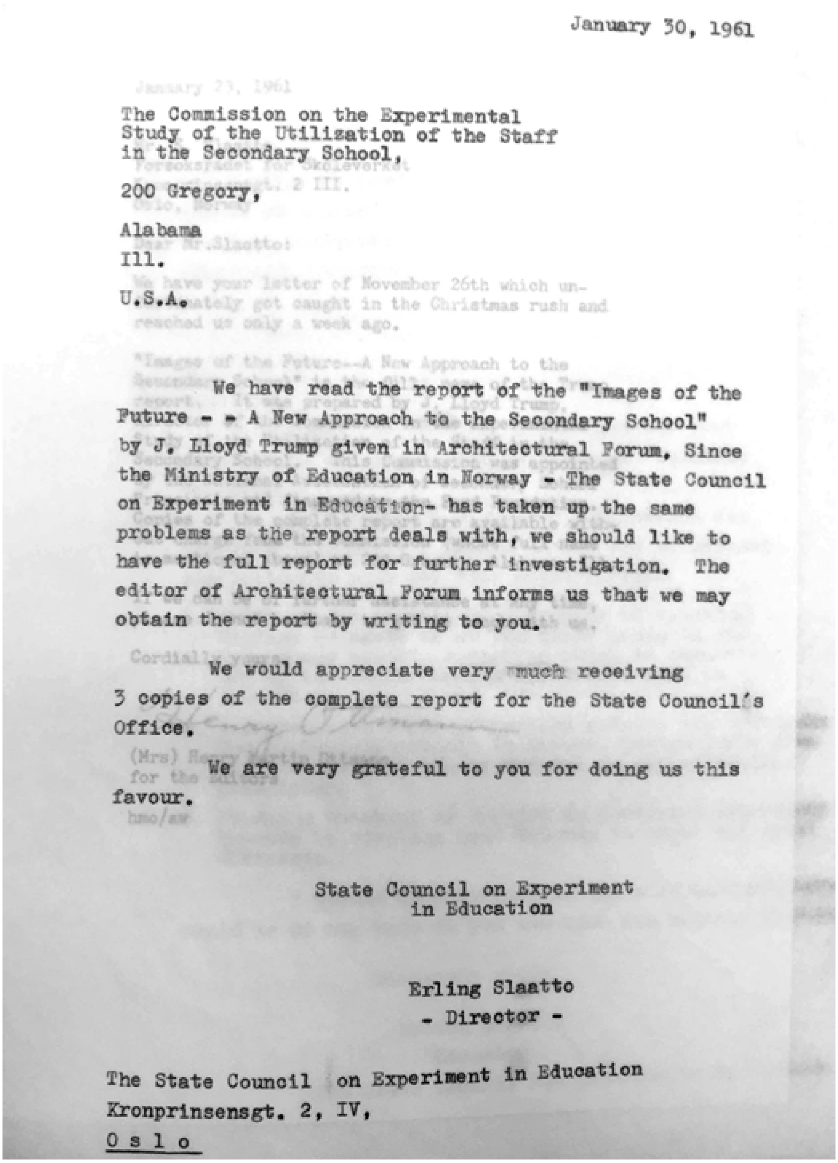
31 See a letter from E. Slaato to Folkskolekontoret, Oslo, February 2, 1962; from Forsøksrådet for Skoleverket archive; RA/S-1587/D/Da/L0013.

32 See John Horntvedt "Skolebyggingen—kan de rasjonaliseres?," *Byggekunst* 32, no.4 (1950): 67.

tects and technical experts were established across Europe.[33] In particular, the UK Architects and Building Branch, established at the British Ministry of Education—an outpost of British experiments in new school construction—served as the main model for the Committee.[34] Indeed, since the mid-1950s, Norwegian school professionals had established close contacts with their British colleagues, going on numerous study trips to the UK and visiting experimental projects, including the Junior School at Amersham (1956-57), and schools in Nottinghamshire and Hertfordshire.[35] The Committee also subscribed to the British publication *Building Bulletins*—the main means of propaganda and research dissemination about new school construction in the UK—which is prominently featured in its archive.[36] Similar to its counterparts in Europe and the United States, the Committee enlisted the help of invited specialists, and amassed information on technical aspects of school construction, which were then analysed and processed as guidelines for local municipal authorities in order to construct more modern, economic schools.[37]

As Andrew Saint argues, this technocratic approach to post-war school building stemmed from a particular vision of a planned, and thus efficient and equitable, society that emerged in the post-war period.[38] Empowered by developments in statistical thinking and information gathering, this technocratic attitude found a reflection in the discussions on school construction, which was now thought of as a sum of separate quantifiable variables. For example, construction costs could be assessed either in terms of gross and net costs per square or cubic metre, or per student. Following later developments in Britain, a system of element cost analysis allowed one to trace the precise allocation of resources.[39] When, in 1960, the Committee published a 213-page *School Building Report* with detailed recommendations for more economic schools, the process of school-building was deconstructed into different elements, each analysed through an elaborate series of graphs, tables and

33 Roth, *The New Shoolhouse*, 6. A copy of proceedings from the conference can be found in KUB archive, "The International Conference on Public Education," Geneva, 8th of July 1957, 10th session. KUB archive, RA/S-5489/D/L0001.
34 Correspondence between Sirevåg to the UK Ministry of Education, London, Oslo 29th of May 1958, KUB archive, RA/S-5489/D/L0004. Also a letter from Sirevåg to Birger Bergersen, KUB, Oslo, June 14, 1958, from FRS archive, RA/S-1587/D/Da/L0013.
35 See extended correspondence between KUB and British colleagues in RA/S-1587/D/Da/L0013.
36 See a letter from D.A. Pidgeon to Sirevåg, February 24, 1956, RA/S-1587/D/Da/L0013.
37 "Vedrörende Komiteen for undervisningsbygg—utredning om nyere skolebygg," Komiteen for Undervisningsbygg, Oslo, February 12, 1958. KUB archive, RA/S-5489/D/L0001.
38 Saint, *Towards a Social Architecture*, 8.
39 Andrew Rabeneck, "Building for the Future - Schools Fit for Our Children," in *Journal of the Construction History Group 26* (2011): 59.



January 30, 1961

The Commission on the Experimental
Study of the Utilization of the Staff
in the Secondary School,

200 Gregory,

Alabama

Ill.

U.S.A.

We have read the report of the "Images of the Future - - A New Approach to the Secondary School" by J. Lloyd Trump given in Architectural Forum. Since the Ministry of Education in Norway - The State Council on Experiment in Education- has taken up the same problems as the report deals with, we should like to have the full report for further investigation. The editor of Architectural Forum informs us that we may obtain the report by writing to you.

We would appreciate very much receiving 3 copies of the complete report for the State Council's Office.

We are very grateful to you for doing us this favour.

State Council on Experiment
in Education

Erling Slaatto
- Director -

The State Council on Experiment in Education
Kronprinsensgt. 2, IV,
Oslo

Fig. 4. Correspondence between KUD and FRS and their foreign partners. On the left, a letter inquiring on the educational materials of American educator J. Lloyd Trump (1961). On the right, a letter to Sirevåg confirming the details of the study trip to the United Kingdom (1958). RA/S-1587/D/Da/L0013 and RA/S-5489/D/L0004, Oslo State Archive.

juni 1958.

5-2

ARCHITECTS AND BUILDING BRANCH
MINISTRY OF EDUCATION
CURZON STREET · LONDON · W.1

Your reference:
Please quote in reply: G.866/2/53

MAYfair 9400
Ext.:

FORSØKSRADET
Jnr.001123 -5.JUL.58
FOR SKOLEVERKET

26th June, 1958.

Dear Sir,

I write in answer to your letter of the 20th June, to confirm that we will expect you for your week's visit on Monday, 21st July. We have arranged for you to spend the first day (i.e., the Monday) here at the Ministry. You will spend the morning with Mr. W. D. Pile who is Joint Head of our Architects and Building Branch. You will probably also meet the other Joint Head of the Branch who is Mr. A. Pott, the Ministry's Chief Architect.

In the afternoon you will meet various representatives of our Development Group. I represent the administrative side and will accompany you when you meet Mr. L. F. Gibbon who is a senior member of H.M.Inspectorate, attached to us. This is arranged for 2.15 p.m. Then at 3.15, we will meet the Architects concerned with one of our development projects, namely, the Primary School at Amersham which you will be seeing later in the week. Finally, at 4.15 p.m., you will meet two other Architects who have been engaged on another development project, namely, the Arnold Grammar School in Nottinghamshire, on which building operations have just started.

/I will

Mr. T. Sirevag,
Forsoksradet For Skoleverket,
Henrik Ibsensgt 5 III,
Oslo.
Norway.

Jnr.001049 23.JUN.58

pie-charts.[40] Among the aspects analysed were location, room programming, load-bearing structures, roof, cellar and floor elements, interior and exterior finishes, ventilation, sound insulation, heating, sewage, fire-safety requirements, rational production, and organisation of administrative work. Analysis of specific systems was carried out by specialised research institutions: for example, the Building Technology Institute (NBI) studied problems related to ventilation and acoustic regulations, while Norges Standardiserings Forbund (NSF) provided recommendations for the dimensions of doors, windows and interior furnishings, and evaluated the potential implementation of a standardised module in school building.[41] While this heavy technocratic focus was not unusual—according to American historian Amy Ogata, it was also fairly common in post-war school building also in the US—it shifted the focus from school building as a holistic process to the cost-optimisation of individual components.[42]

This focus constitutes the main difference between the Norwegian committee and its international counterparts: offering some advice in terms of costs and construction, the Committee stopped short of issuing any tangible recommendations on school typologies, materials or building systems. Prefabrication was discussed, but never studied or explicitly encouraged—new building systems did not make it to any part of the 1960 report.[43] Internationally, however, prefabrication was not just discussed but actively recommended as the most optimal solution. The 1957 UNESCO conference concluded that only standardised, cheap and lightweight constructions would be able to meet the needs of a more democratic post-war education.[44] These calls to mobilise prefabrication resulted in several OECD school-building programmes in the 1960s, including the Mediterranean Regional Project and the work of Educational Facilities Laboratories.[45] Other agencies—for example, UK Architects and Building Branch—established a practical Development Group, "the most revolutionary measure" that experimented with industrial components and built demonstration schools.[46] Although archival evidence points to the fact that Norwegian specialists were undoubt-

40 Komitéen for undervisningsbygg and Tønnes Sirevåg, *Planlegging og bygging av skolehus: innstilling*, (Oslo: FRS, 1960).
41 Komitéen for undervisningsbygg and Sirevåg, 187.
42 Ogata, "Building for Learning," 569. Kristen Bernhoff Evensen, "Økonomi og skolebygging" in Forsøksrådet for skoleverket, *9-årig skole: planlegging, bygging*, Forsøk og reform (trykt utg.) 4 (Oslo: I kommisjon hos Aschehoug, 1960), 81.
43 Komitéen for undervisningsbygg and Sirevåg, *Planlegging og bygging av skolehus*.
44 "The International Conference on Public Education," Geneva, July 8, 1957, 10th session. KUB archive, RA/S-5489/D/L0001.
45 On OECD involvement in school projects see Oddie, *School Building Resources and Their Effective Use* (Paris: OECD, 1966).
46 Eric Pearson, lecture IV in Konferanse om skolebygging and Den norske ingeniørforening, "Konferanserapport" (Oslo: Den Norske Ingeniørforening, 1966), unpaginated.

edly familiar with the prefabrication experiments of their UK colleagues, these experiences were not translated to the Norwegian context.[47] This reluctance to provide any tangible solutions can be attributed to the decentralised nature of school building in Norway—unlike centralised decisions on the educational programme, local school boards remained in charge of all construction—and a general resistance towards the "one-size-fits-all" approach. Although prefabrication, as, for example, practiced in the UK, did not mean designing a building but a *method* of building, the Norwegian Committee lacked the resources, agency and expertise to engage in such demanding research.[48] The Committee's interest in prefabrication was limited to a brief note, stating that "prefabricated timber walls have significant possibilities for schools. Interested companies are already working with these questions, and there is hardly any need for special studies on the issue of school buildings, beyond the previously mentioned need for a study on the module problem."[49] And so it was: while the Committee did not find that there was any need to study industrial building systems, limiting its work to process planning and cost-analysis of singular components, industrial actors, such as Moelven Brug filled this space by offering an industrial solution to a school building problem that came with a fixed price-tag.[50]

THE TIME OF TRANSITION

In the absence of a practical state-led initiative, the problem of school space became acute: while there were 287.000 students in 1946, this number grew to 426.000 by 1960.[51] One immediate solution was to introduce after-dinner teaching so that classrooms could be used more evenly throughout the day. Another solution was to install additional classrooms to complement the existing schools' capacity. However, there was little experience with such structures: until then, schools were mostly thought of as monumental buildings, "a symbol of municipal power."[52] Most often, the problem was solved with local initiative and the help of private companies. By then, Moelven Brug, together with the architect Hans Grinde, had already devised a building system based on 60cm-wide vertical timber elements for storage buildings, office spaces

47 See a letter from D. E. Lloyd Jones to Sirevag, July 3, 1958, FRS archive, RA/S-1587/D/Da/L0013.
48 Saint, *Towards a Social Architecture*, 64.
49 Komitéen for undervisningsbygg and Sirevåg, *Planlegging og bygging av skolehus*, 186.
50 *Ringsaker Blad*, January 30, 1965, 1, 4.
51 Telhaug, *Utdanningsreformene*, 44–45.
52 Fredrik Winsnes, "Ny Østensgård skole, København," *Byggekunst,* no.2 (1952): 21-25.

and worker housing, delivered to large construction sites across the country. The principle could be adjusted and scaled to accommodate educational buildings—in fact, the company had delivered a kindergarten at Heimdal already in 1957.[53] So when the Vestre Toten school board, specifically interested in prefabrication, reached out directly to Moelven in 1957, it resulted in the commission of timber pavilions for a school in Raufoss.[54] The bidding cost was 96.000 NOK, which was reduced to 94.704 NOK as the building was completed in under three weeks. This included all expenses related to the foundations, assembly, furniture, electrical works and finishes.[55] Each classroom of 56 m^2 came at a cost of 20.000 NOK—a radical departure from the cost of conventional school building at the time.[56] While some concerns regarding the potential quality of the buildings were raised, the pavilions were thought to be "practically furnished, light and airy" spaces where "students thrived."[57] Raufoss school inspector Einar Opjordsmoen confirmed that the community was "very satisfied with the pavilion" and that "smart Moelven schools" were "set to a standard totally acceptable for the time of transition."[58] For the company, Raufoss school was a successful marketing showpiece: it was widely featured in the local and national press, sparked animated public debate on school-building, and attracted a string of visits by school officials from across the country. The company harnessed this tide of public attention, carefully orchestrating press appearances and converting these visits into new commissions.

However, Moelven was not the only producer that experimented with pavilion additions. As the Raufoss classrooms welcomed their students at the start of the 1957 school year, so did three other timber pavilion schools in Oslo area: one in Hasle, by architect Frederik Winsnes, an active proponent of new school typologies; another in Manglerud by Turid and Kristen Bernhoff Evensen, advisors to the Committee on Educational Buildings, and a small pavilion in Veitvedt, by Ringnes and Selvaag.[59]
It was specifically the latter firm—Ringnes and Selvaag—that had the necessary infrastructure to turn this commission into a serially-produced solution for school additions. By then, engineer Olav Selvaag had been

53 *Adresseavisen*, November 6, 1957, 2.
54 *Stavanger Aftenblad*, December 13, 1958, 17. *Dagbladet*, September 3, 1957, 4. *Aftenposten*, September 3, 1957, 4.
55 *Ringsaker Blad*, July 20, 1957, 2. *Varingen*, September 20, 1957, 2.
56 Moelven Industrier, Moelven Industrier archive, SAH/ARK-287-01/K/Kc-0003 Ordrebøker, year 1957. *Friheten*, August 30, 1957, 3. *Varingen*, September 6, 1957, 2.
57 *Varingen*, 20 Septmber 1957, 2.
58 *Dagbladet*, September 3, 1957, 4. *Hamar Stiftstidende*, June 19, 1957, 3.
59 *Dagbladet*, August 16, 1957, 4.

Fig. 5. Raufoss school pavilion under construction. The school was particularly cheap compared to similar offers on the market. Newspaper clipping, 1958.

an ardent advocate of cost-saving building techniques for more than a decade, a position that was often met with significant resistance from the professional architectural community, not least due to his political persona.[60] So when the Moelven pavilions at Raufoss were shortlisted together with Selvaag's venture in a bid for new school additions in the Oslo area, the company's schools received unexpected praise and were deemed a far better alternative.[61] As the popular newspaper *VG* attested, "a foreman in the Oslo board has accepted [Moelven's alternative] with open arms, in part since the current offer from Olav Selvaag was met with a lot of resistance."[62] With this, Moelven's venture into prefabrication took off, even if it was partially more indebted to Oslo's dislike for Selvaag than the particularly outstanding spatial qualities of its pavilions.

In practice, however, the two offers were not directly comparable: while Selvaag's bid accounted for classrooms within a larger complete school project, the Moelven pavilions were thought of as temporary

60 Selvaag in Mohr et al., "Skolebygging," 156. See also a newspaper debate between Selvaag and Odd Brochmann in *Rjukan Arbeiderblad*, October 22, 1957, 4 and *VG*, October 7, 1957, 9.
61 *Arbeiderbladet,* August 30, 1957, 2; *VG*, August 31, 1957, 16.
62 *VG*, August 31, 1957, 16.

Fig. 6. A section of Moelven prefabricated school as shown at *Bygg reis deg* 1958 exhibition in Oslo. On the photograph, Johs. Mageli (center of the image) is explaining the production to King Olav V (pictured on the right) who was particularly interested in the project. From *Moelven Brug i forvandling og vekst*.

additions. As Oslo's school board foreman Olaf Solumsmoen underlined, "it is rather clear that this concerns exclusively a temporary solution [...] Moelven pavilions, for example, have a small corridor that is by no means satisfactory over the long term, but they are usable as an emergency aid in the time of transition."[63] After visiting Raufoss school later the same month, Solumsmoen seemed to have changed his opinion: "I am surprised how good the pavilions at Raufoss proved to be [...] the school spaces are better than we have thought, and we expect it will be a good solution for us [...] although some work has to be done to improve the façade and layout."[64] Moelven architects then reworked the Raufoss pavilion designs to include broader corridors, double doors and larger windows in order to make them more attractive, and by September 1957 the deal was sealed.[65] The company was to deliver 24 classrooms for Oslo municipality: six new Moelven classrooms were erected in Ris and Grorud, four in Grefsen, Teisen, Sinsen,

63 *Arbeiderbladet,* August 30, 1957, 2.
64 *Ringsaker Blad*, September 7, 1957, 2.
65 *Varingen*, September 20, 1957, 2.

Nordstrand, Vahl and Berg respectively, and two in Ullern.[66] In 1958, a section of Moelven element-prefabricated schools was displayed at the "Bygg reis deg" exhibition in Oslo, and received particular attention from King Olav V, who was interested in new methods of construction. Many of the exhibition images feature Mageli and the sales chief Per Granberg, explaining the building method to the King and his adjutant.[67]

Since the demand for new educational buildings did not seem to abate, Moelven set off to rework its temporary pavilion solutions into comprehensive and permanent school projects. With the standardised spatial requirements issued by the Council, schools proved to be "an alluring rationalisation object", where, according to Moelven managers, "the benefits offered by standardisation and industrial assembly methods could be fully realised."[68] The first permanent prefabricated school was built in Nadderud, Bærum, a municipality with which the company had extensive contacts, and one that had experienced an acute school space crisis due to large internal migration.[69] Building a conventional school was not possible in the short time available, and the municipality was ready to accept alternative solutions.[70] Designed by Bærum municipal architect Baard Hjelde together with Moelven, the school was built with Moelven's system of vertical prefabricated timber elements and floor and ceiling beams in laminated timber. Since all building components were produced at the factory and assembled on site within 10 weeks, the school was extensively marketed as "Norway's first factory-built school."[71] It was also the first school in Scandinavia to be heated with hot air.[72] U-shaped, the building was arranged in three single-floor, flat-roofed pavilions around a central courtyard with a reflective water pool.[73] Two pavilions accommodated 12 classrooms of 56 m^2 and special rooms, while a middle section housed a gym with changing rooms and showers.[74] With a flat roof—it had a barely visible tilt of 60-70 centimetres, vertical window panels that continued in a ribbon along the entire façade, and "festive red" timber walls, the school's modernist appearance reflected both the new production process behind its construc-

66 *Varingen*, August 30, 1957, 1, 4. *Lillehammer Tilskuer*, September 28, 1957, 3. *Morgenposten*, September 7, 1-2. Another 12 pavilions were to be produced by Trysil municipal sawmill after Moelven drawings. *Gudbrandsdølen*, January 14, 1958, 2. *Arbeiderbladet*, October 25, 1957, 1-2.
67 Dalseg, *Moelven Brug i forvandling og vekst*, 45–46.
68 *Lillehammer Tilskuer*, February 20, 1960, 7.
69 *Asker og Bærum Budstikke*, September 11, 1959, 5.
70 *Morgenbladet*, June 17, 1958, 2.
71 *Ringsaker Blad*, January 14, 1958, 2. *Dagbladet*, June 23,1958, 4.
72 *Ringsaker Blad*, August 14, 1958, 1, 4
73 Usually, Moelven schools had either a flat roof or one with a 1 to 50 angle.
74 *Gudbrandsdølen*, January 14, 1958, 2.

NORGES første fullstendige skole etter ferdighusprinsippet

Moelven Brug har bygget billigere enn Selvaag, hevder kommunearkitektens kontor i Bærum.

Fig. 7. Nadderud municipal high-school, “the first prefabricated school in the country made after the ready-made house principle.” Newspaper clipping, 1958.

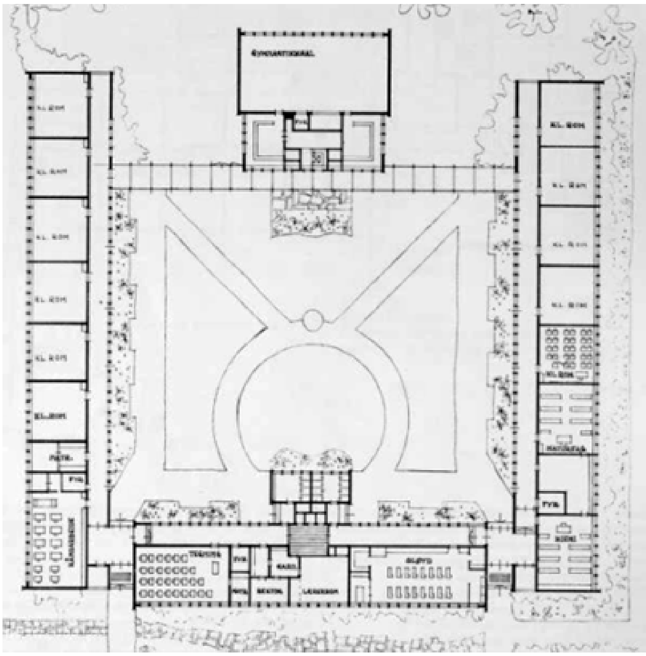


Fig. 8. A floor plan of Nadderud school. Newspaper clipping, 1958.

tion and the non-monumental scale dictated by post-war pedagogical priorities and changing architectural aesthetics.[75] The Nadderud project was presented by Baard Hjelde at the landmark 1958 NTH course on school construction, and garnered largely favourable reviews.[76]

Other commissions for permanent schools soon followed. In 1958, Moelven signed a contract for the 16-classroom Persbråten school at Røa that welcomed 540 new students in the fall of 1959. Designed by Moelven architect Hans Grinde, the project was chosen over a more expensive design from the Oslo city architect's office.[77] The school consisted of four pavilion buildings housing four 60 m^2 classrooms each, connected by series of wind-protected outdoor corridors. A special classroom wing accommodated music, drawing and craft studios, alongside chemistry and physics laboratories.[78] A gym and two additional pavilions were to be constructed in the second building stage.[79] In fact, similarly to the "flexible" American schools that appeared in *Byggekunst* in 1950, Persbråten was envisioned with potential extensions.[80] With an overall cost of 2.567.000 NOK, it was significantly cheaper than any other school built in the Oslo area.[81] Another school at Fredheim (located in Gjøvik, north of Oslo) was originally planned after the same drawings as Nadderud, but had to be revised several times to accommodate the specific demands of the local board, which proved quite sceptical of Moelven's prefabricated solution.[82] After several design iterations, the Fredheim school eventually came to house four classrooms and special rooms, a doctor's office, a staff room, and a library that could be used as a reading room. Its model was presented at the National Fair—*Riksmessen*—in 1958 as a token of good design, and was eventually considered a success even by the sceptical school board.[83] Thus, soon after its initial success with provisional pavilions, Moelven Brug quickly realised that school building offered a stable stream of commissions, since there were no other industrial producers with both the material and industrial basis to rival Moelven.

From 1958, one was hardly able to "open a newspaper without see-

75 *Ringsaker Blad*, September 6, 1958, 1-2.
76 See a lecture by Baard Hjelde in Bjarne Lous Mohr et al., "Skolebygging: kurs ved NTH 1958," in *Norbok* (Trondheim: NTH, 1959), 183. Hjelde characterised the school as a "success."
77 *Arbeidrebladet*, September 23, 1958, 1-2.
78 *Akers-Posten*, August 21, 1959, 3.
79 *Aftenposten*, November 14, 1958, 5.
80 *Aftenposten*, September 23, 1958, 1, 12. For American prototypes, see *Byggekunst*, no.4 (1950): 68.
81 *Arbeiderbladet*, November 10, 1958, 3.
82 Mageli himself had to present the new school design to the local school board to convince them. *Ringasker Blad*, June 10, 1958, 1, 4. *Ringsaker Blad*, May 27, 1958, 2.
83 *Ringsaker Blad*, June 3, 1958, 1. Erik Skjeseth and Ringsaker historielag, *Ei lita Ringsakbok: artikler 1980-2011*, *Norbok* (Moelv: Ringsaker historielag, 2012), 262.

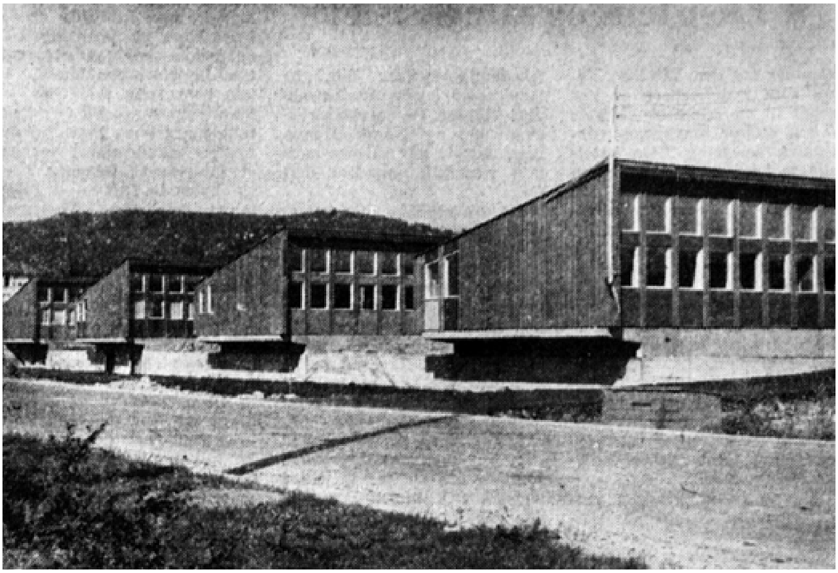


Fig. 9. Persbråten school in Roa, photograph. Newspaper clippings, 1960.

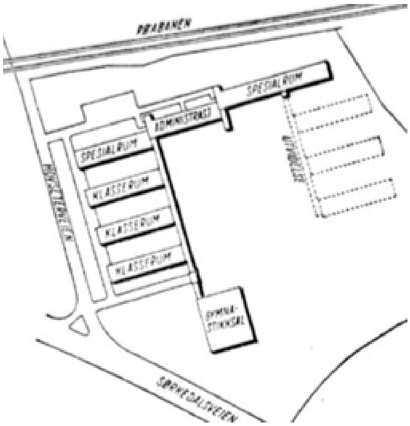


Fig. 10. Persbråten school photo and projected flexible additions. Photo by Paul A. Røstad, DEXTRA Photo, 1964, Norsk Teknisk Museum. Plan drawing from a newspaper article, 1960.

Bare godord om den nye Fredheim skole

I dag føler vi oss ikke snytt, sier tidligere kretsform. E. Skjeseth

DEN BILLIGSTE SKOLEN I RINGSAKER I SENERE ÅR

Fig. 11. New Fredheim school. Newspaper clipping, 1959.

Billig-skoler på løpende bånd

Gymnastikk-saler i løs vekt snart?

Av Aftenbladets utsendte medarbeider SVEND EILIF PEERSEN

Moelv, i desember:

— Dersom vi bestiller en skole med fem klasserom til en bygd i Rogaland, når kan den leveres?

— Om en måned, lover Per Granberg, som selger ferdig-skoler. Og som om kort tid lanserer en »ferdig-pakket« gymnastikksal.

Pre-fabrikerte skoler fra Hedmark koster halvparten av „vanlig pris"

Slik omtrent vil den pre-fabrikerte gymnastikksalen ta seg ut i standardformat. Den kan utvides med elementer i 1,22 meters bredde i det uendelige.

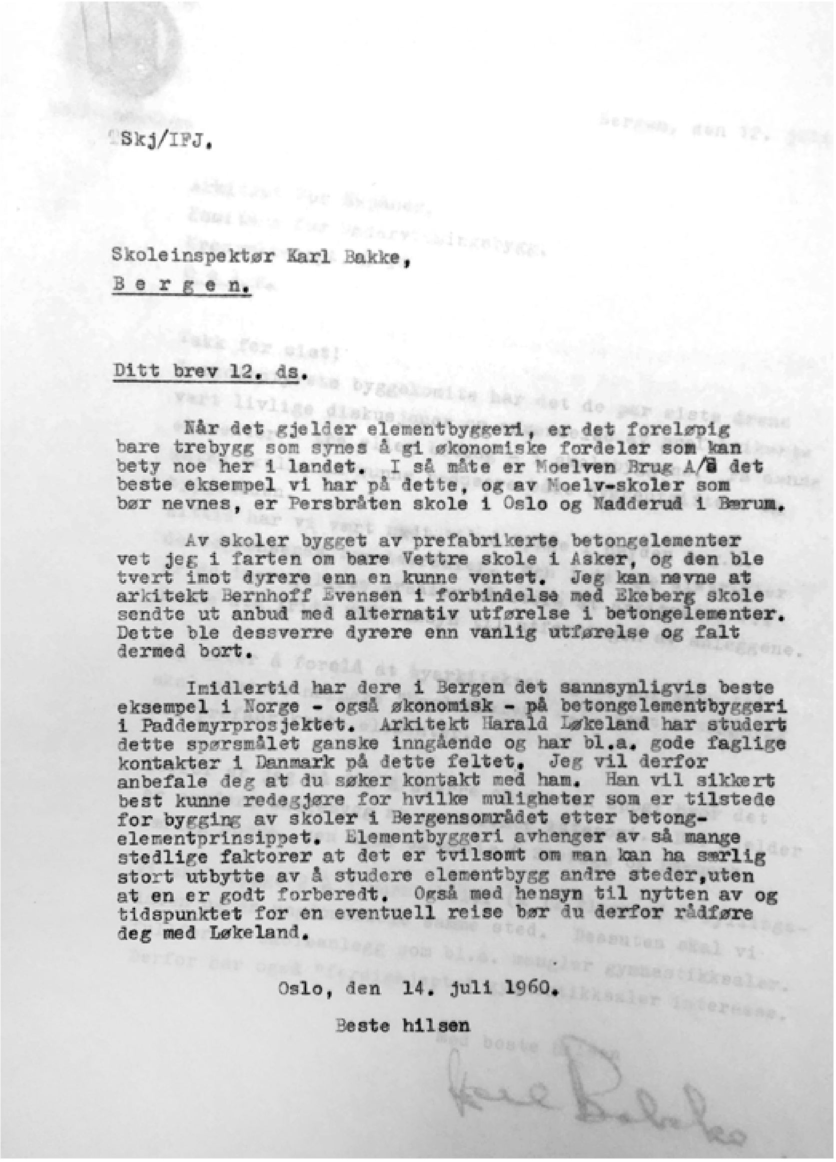
Fig. 12. In its school-building production, Moelven continued to employ the trope of a "conveyor-belt", referring to the fact that the buildings were serially produced. Above, newspaper headline reads "Cheap schools for a conveyor belt. Gyms soon sold wholesale?" Newspaper clipping, 1960.

ing something about Moelven schools there."[84] Indeed, the company's projects and discussions around their construction often occupied the front pages of local and regional newspapers. In comparison with conventionally-designed schools, Moelven's buildings offered three main advantages: speed of delivery, adaptability of designs, and a relatively low price that was often maintained in final budgets.[85] The completed buildings were visited by school officials from around the country looking for quick, cheap and reliable solutions.[86] State entities involved in school building, such as the Committee on Educational Buildings, were aware of the Moelven's venture, and although still steering away from prefabrication, connected interested parties with industrial producers. For example, in July 1960, Bergen municipal school inspector Karl Bakke inquired about possibilities for prefabrication in Norwegian schools, and stated that he was particularly interested in "Moelven-schools [...], as well as concrete buildings made with prefabricated components."[87] The Committee replied that "in terms of element prefabrication, it is still only wooden buildings that seem to provide economic advantages that could mean something in this country. Moelven Brug A/S is the best example we have of this; among notable projects are Persbråten school in Oslo and Nadderud in Bærum."[88] Moelven remained the sole industrial producer of schools on the Norwegian building market for a while, providing a quick fix for the rapidly urbanising Oslo area.

A FOREIGN TYPOLOGY

In fact, Moelven pioneered not just unconventional building methods but an entirely new school typology—that of the low-rise pavilion. In the United States, experimental low-rise pavilion schools had been built by Richard Neutra already in the 1930s and by Eliel and Eero Saarinen in the 1940s.[89] In 1949, Wilfred F. Clapp wrote an article in *Architectural Forum* discussing post-war school building in England, concluding that "there [was] a clear tendency towards smaller and friendlier school facilities."[90] Pavilion schools were seen as "by far the best solution for modern pedagogic requirements," and offered the advantages of bet-

84 *Ringsaker Blad*, September 6, 1958, 1-2.
85 *Hamar Arbeiderblad*, September 25, 1958, 1, 5.
86 *Ringsaker Blad*, September 6, 1958, 1-2.
87 Correspondence between Karl Bakke and the Committee for Educational Buildings, Bergen, July 12, 1960; KUB archive, RA/S-5489/D/L0004.
88 A letter from KUB to Karl Bakke, Oslo, July 14, 1960, in KUB archive, RA/S-5489/D/L0004.
89 Ogata, "Building for Learning," 565-566; Roth, *The New Schoolhouse*, 34.
90 Quoted in Bernt Heiberg, "Som barn igjen...," *Byggekunst* 32, no.11 (1950): 208.



Skj/IFJ.

Skoleinspektør Karl Bakke,
B e r g e n.

Ditt brev 12. ds.

Når det gjelder elementbyggeri, er det foreløpig bare trebygg som synes å gi økonomiske fordeler som kan bety noe her i landet. I så måte er Moelven Brug A/S det beste eksempel vi har på dette, og av Moelv-skoler som bør nevnes, er Persbråten skole i Oslo og Nadderud i Bærum.

Av skoler bygget av prefabrikerte betongelementer vet jeg i farten om bare Vettre skole i Asker, og den ble tvert imot dyrere enn en kunne ventet. Jeg kan nevne at arkitekt Bernhoff Evensen i forbindelse med Ekeberg skole sendte ut anbud med alternativ utførelse i betongelementer. Dette ble dessverre dyrere enn vanlig utførelse og falt dermed bort.

Imidlertid har dere i Bergen det sannsynligvis beste eksempel i Norge - også økonomisk - på betongelementbyggeri i Paddemyrprosjektet. Arkitekt Harald Løkeland har studert dette spørsmålet ganske inngående og har bl.a. gode faglige kontakter i Danmark på dette feltet. Jeg vil derfor anbefale deg at du søker kontakt med ham. Han vil sikkert best kunne redegjøre for hvilke muligheter som er tilstede for bygging av skoler i Bergensområdet etter betong-elementprinsippet. Elementbyggeri avhenger av så mange stedlige faktorer at det er tvilsomt om man kan ha særlig stort utbytte av å studere elementbygg andre steder,uten at en er godt forberedt. Også med hensyn til nytten av og tidspunktet for en eventuell reise bør du derfor rådføre deg med Løkeland.

Oslo, den 14. juli 1960.

Beste hilsen

Fig. 13. Correspondence between Bergen school inspector Karl Bakke and the Committee for Educational Buildings regarding advancements in prefabrication and Moelven schools in particular. Bergen, July 12, 1960; Oslo, July 14, 1960. KUB archive, RA/S-5489/D/L0004. Oslo State Archive.

ter lighting, cross-ventilation and community spirit.[91] Positioned freely within the landscape, they also provided closer contact with nature and allowed activities to spill into shared courtyards. Most importantly, pavilion schools could be built with standardised prefabricated elements, and thus faster and cheaper. New construction methods allowed for more flexible buildings, as pavilions could be added or taken apart as the school needs changed. Thus, pavilion schools became a popular typology in post-war Europe, actively promoted by prominent advocates such as the Swiss architect, Alfred Roth.[92] In Norway, on the other hand, this typology was met with unease. Architect Fredrik Winsnes, a local pioneer of pavilion schools bitterly noted that in Norway "structures built in a single floor [were] most often synonymous with barracks."[93] Until then, most Norwegian schools were built in several floors, with double-sided corridors, identical classrooms, bad acoustics and poor ventilation.[94] In the post-war period, according to Winsnes, they "remained basically unchanged, besides the fact that now they [were] painted in brighter colours."[95] Instead, he argued that "single floor schools were the most modern" and that "there was a lot [Norwegian architects] could learn from others"—pointing to recent developments in school construction in other European countries.[96]

And from others it was: first English pavilions and American low-rise "elastic" first schools appeared in *Byggekunst* in 1950, a 1952 issue of *Byggekunst* featured Copenhagen's Østensgård prefabricated pavilion school by F.C. Lund, while in an edition from 1955, Ulf Colbiørnsen introduced Hertfordshire schools.[97] Norwegian architects read issues of *The Architectural Forum* dedicated to school construction, and often cited Alfred Roth.[98] Architects Ola Mørk Sandvik and Bernt Heiberg specifically went to study this new typology in Sweden, completing two school projects in Tåsen and Abildsø in 1953.[99] These two projects served as a reference for Moelven pavilions, as Mageli claimed Moelven schools were built after the "Swedish example."[100] As this international type trickled down, by the late 1950s several pavilion-schools were

91 Roth, *The New Schoolhouse*, 36–38.
92 Roth, 28–42.
93 "Fem nye folkeskoler," *Byggekunst* 35, no.6 (1953): 141.
94 Fredrik Winsnes, "Én-etasjeskolen," *Byggekunst* 32, no.11 (1958): 202.
95 Winsnes, "Skolehus," *Byggekunst* 32, no.4 (1950): 65.
96 "Skolehus," *Byggekunst* 32, no. 4 (1950): 65; "Én-etasjeskolen," *Byggekunst* 32, no.11 (1958): 202-204.
97 "Én-etasjeskolen," *Byggekunst* 32, no. 11 (1958): tillegget 41-42. "Ny Østensgård skole, paviljongskole," *Byggekunst* 34, no.2 (1952): 21-24; Ulf Colbiørnsen "England legger om," *Byggekunst* 35, no.6 (1953): 157-159. John Horntvedt, "Skolebyggingen—kan den rasjonaliseres?" in *Byggekunst* 32, no. 4 (1950): 67-69.
98 *Byggekunst* 32, no.4 (1950): 64, 204.
99 Heiberg, *Byggekunst* 32, no.11 (1950): 208. "Fem nye folkeskoler," *Byggekunst*, no.6 (1953): 141-147.
100 *Aftenposten*, September 3, 1957, 4.

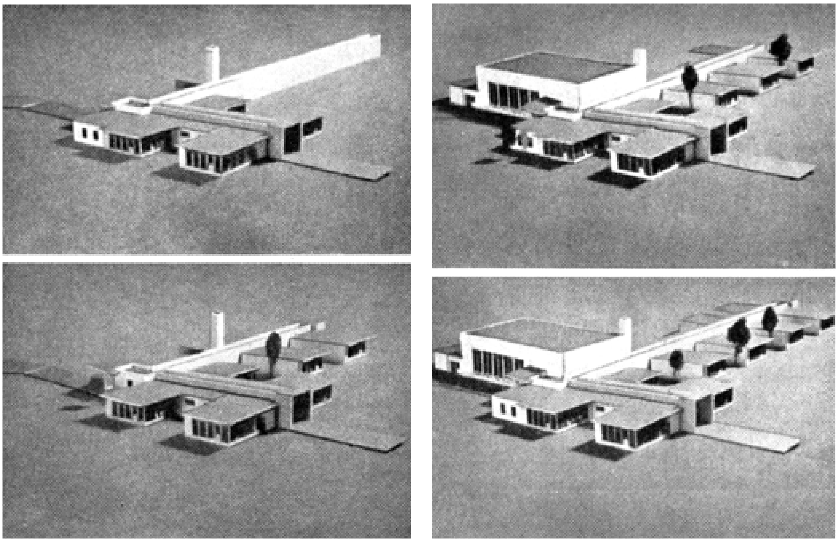


Fig. 14. Flexible American pavilion schools, where more classrooms could be added over time if needed. From *Byggekunst* no. 4 (1950).

constructed in Norway. Among them were Lambertseter school by Winsnes—considered today an example of "Scandinavian humanistic modernism," Ekeberg school by Berner and Bernhoff Evensen, Messenlia school by Versterlid and Osterhaug, Madla school by Retzius and Bjoland, and Oppsal school by Heiberg and Sandvik.[101] Low-rise pavilion structures started to appear in school-building architectural competitions, for example in projects by Molle and Per Cappelen, Turid and Kristen Bernhoff Evensen, and Paul Cappelen and Torbjørn Rodahl. Fredrik Winsnes was often on the school competitions' jury, no doubt impartial towards low-rise typologies.[102] Nevertheless, not everybody was convinced that pavilion typology with its origins in warmer climates was appropriate for Norwegian climate and terrain.[103] Architects like Frode Rinnan and Tor Skjånes argued against the traditional "mammoth-school," but were also critical of low-rise pavilions that required large flat building plots, hardly available in many regions in Norway.[104]

Thus, few attempts were thus made to "domesticate" this imported

101 Mohr et al., "Skolebygging," 10–24. Undervisningsbygg Oslo KF, *Verneplan for osloskolene. Vedlegg 3*, 73.

102 See NAL *Konkurransen*, 1953 "Kristiansand offentlige Lærerskole," 1954 "Folkeskole på Manglerud sør," 1958 "Vangen Folkeskule på Voss." Winsens was in the jury for "Ny yrkeskole" competitions in 1953 and 1954, "Folkeskole på Manglerud sør" in 1954, "Vangen Folkeskule på Voss" in 1958.

103 See a discussion after Lambertseter school presentation, Mohr et al., "Skolebygging," 169–70.

104 Frode Rinnan and Tor Skjånes, *Byggekunst* 35, no.6 (1953): 157.

Fig. 15. Other Norwegian pavilion schools at the time. Above, Lambertseter children's school by Fredrik Winsnes. Middle, Eiksmarka school in Bærum by Baard Hjelde. Below, Messenlia school by Are Vesterlid and Hans Østerhaug. Images from *Byggekunst* 39, no. 5 (1957).

typology and utilise one of its main advantages—the fact that pavilion schools could be constructed with light prefabricated elements. While pavilion schools in Europe were often built from concrete, steel or aluminium, timber was the most viable alternative for Norway. Already in 1950, Norwegian architect John Horntvedt questioned whether school building could be rationalised, calling for serial production of standardised elements and organised cooperation between different agencies.[105] Most of the 1950s low-rise school projects—Grefsen, Prinsdal, Frogn or Lambertseter—were built with Siporex blocks.[106] Others were built with a timber stud frame, including schools in Oppsal and Messenlia, but made no use of prefabricated elements. Although proprietary timber systems for schools were developed in England already in 1955-57, these experiments did not make their way to Norway.[107] Here, as Winsnes concluded in his 1957 article, "it would be hard to imagine [a standardised] system for school construction implemented in practice, since the Norwegian building industry is so badly organised"—voicing the same sentiment that was discussed in Chapter 1.[108] Presenting his Lambertseter school in 1958, Winsnes bitterly noted that, since there was no existing school-building system on the market, "there is no form of standardisation in any of the building elements."[109] Other architects were less concerned with the absence of industrial building systems: although the terms "rationalisation," "standardisation" and "mass-production" were key in international discussions on school construction at the time, they made only marginal appearances in two of the forty lectures delivered at the famous 1958 NTH conference dedicated to post-war Norwegian school building.[110]

Similar to the way a small group of Norwegian practitioners in the 1950s continuously engaged with questions of building industrialisation, a small number of architects—Winsnes, Bernhoff Evensen, Cappelen and Rodahl—were continuously dedicated to advancing industrial school construction. By then, the pavilion school typology was gradually making inroads and Norwegian architects were aware of international experiments with prefabrication. However, there was still too little technical and professional momentum for any meaningful change to take place in terms of school-building industrialisation. When Moelven devised a proprietary

105 John Horntvedt, *Byggekunst* 32, no.4 (1950): 67.
106 *Byggekunst* 38, no.2 (1956) and *Byggekunst* 39, no.5 (1957)
107 Saint, *Towards a Social Architecture*, 164–66.
108 Winsnes, *Byggekunst* 39, no.5 (1957): 118.
109 Mohr et al., "Skolebygging," 168.
110 Mohr et al., "Skolebygging."

building system for pavilion schools in timber assembled from prefabricated elements, it filled the gap left not just by state actors, but also by architects. Although the precise degree to which ideas were cross-pollinated between industrial and architectural realms is hard to define, Mageli's references to the "Swedish" pavilions and claims that the "[the company] had sensed the latest tendency towards single-floor schools" point to the fact that Moelven was most likely up-to-date on the latest architectural discussions around school building at the time and international guidelines for economic construction.[111] However, how did the Moelven system work in practice and what kind of spaces did it create?

FACTORIES AND CHILDREN

For Moelven, the venture into school-building was an all-round profitable business choice. On the one hand, schools were yet another product that could be constructed with the same system of prefabricated timber panels, ushering the economy of scale. On the other hand, timber was a material deemed particularly appropriate for school building, favoured both for its natural tactile qualities and structural properties. NBI particularly advised timber for school construction, since wooden walls were deemed "more practical" and "resistant to wear" in comparison with other materials, and could in theory even be used as hanging curtain walls.[112] Prefabricated timber elements—made possible with the proliferation of light-frame construction and new insulation materials like mineral wool—were easy to transport and quick to assemble. In addition, they were flexible enough to accommodate a variety of programmes over time: internal partitions could be easily dismantled, added or moved.[113] Moelven schools were also more flexible from a long-term perspective. For example, as the Nadderud proposal showed, new classrooms and pavilions could be joined with the already-existing ones if the school decided to expand.[114] For the company, school-building was an opportunity to test the possibilities and limitations of its prefabrication system before venturing into housing construction some five years later.

Overall, Moelven elements were made to facilitate quick construction. A storey high and 1,22 meters wide, they arrived on site entirely prefabricated and were suited for quick manual assembly. An entire

111 *Lillehammer Tilskuer*, February 20, 1960, 7.
112 "Endel momenter til innstillingens kap.7: Konstruksjoner og materialer," 1-2 in KUB archive, RA/S-5489/D/L0003.
113 *Aftenposten*, August 16, 1958, 2. *Aftenposten*, 23 September 1958, 1, 12.
114 *Aftenposten*, August 16, 1958, 2.

school could be raised by just two workers in a couple of days.[115] From interior to exterior Moelven prefabricated elements consisted of 3/4" of specially cut flat panel, one layer of reflection paper, a wooden frame—three 2” by 4” timber studs, 7,5-10cm of mineral wool, 12,5mm of porous-asphalt glued wood-fibre plate, one layer of asphalt impregnated paper of 600g/m^2 and two types of timber panel cladding (“tømmermannspanel”) of 3/4” of outer elements and 7/8” of under elements.[116] The outer wall panels were joined together after the tongue-and-groove principle, a connector designed to conceal joins. All elements arrived from the factory with complete finishes: outer walls covered with pressure impregnate panels or façade plates, inner walls most often in varnished wood.[117] Both internal and external finishes could be adjusted in materials and quality based on the individual project’s budget and demands.[118] Wall elements arrived with already-painted door and window frames, while pipes, electrical boxes and ventilation openings were pre-installed. Depending on the project, windows consisted of two. or three-layer glass or Thermopane.[119] Usually, they were painted white or made opaque in the top level to protect children from direct sunlight—a development significantly different from previous generations when the lower part of the window was painted to prevent the children from looking outside.[120] Internal walls were built with 2” by 3” studs and insulation of 4cm of glass wool, covered with 16mm chipboard or 3/4” timber panels.[121] Sound insulation was indeed the biggest problem of light timber-frame buildings. Internal partitions were made as special “sound-walls,” built from two double walls with a 4 cm soft layer in between, following the insulation guidelines issued by the Housing Ministry.[122] In later schools, internal load-bearing walls were substituted with a system of load-bearing glulam beams and columns.[123] Outer doors were made of pine, while interior doors made from Gaboon or Limba sanded and varnished veneer. These intimate details of con-

115 *Lillehammer Tilskuer*, February 20, 1960, 7. See images of building process at *Glåmdalen Odal*, July 31, 1964, 3. On details of construction process, see for example Stav skole, *Stav skole 1965-1975*, 43–52.
116 *Stavanger Aftenblad*, December 13, 1958, 17. Also see *Østlendingen*, March 20, 1959, 5. On the discussion of the use of imperial units and resistance to the metric system in Norwegian carpentry see Jorge Otero-Pailos, “Norberg-Schulz’s House” in *Arkitektur N, An Online Review of Architecture*, https://www.architecturenorway.no/questions/histories/otero-pailos-planetveien/, accessed March 1, 2021.
117 “Moelven Prefabrikerte Skoler” catalogue, folder L-0003 “Produktspekter,” in SAH/ARK-287-01/J/Je.
118 *Akershus*, August 15, 1964, 5.
119 In practice, Thermopane was too expensive to use in school buildings. See more of Granum on school windows in Mohr et al., “Skolebygging,” 163.
120 *Ringsaker Blad*, August 14, 1958, 4.
121 *Østlendingen*, March 20, 1959, 5.
122 See BD-blad no. 1522 drawing no. 10.
123 See a description of a school prefabrication system in Moelven project for CSSR, 1974, 7.02. 1974, Moelven Industrier archive, SAH/ARK-287-01/J/Jc-0004.

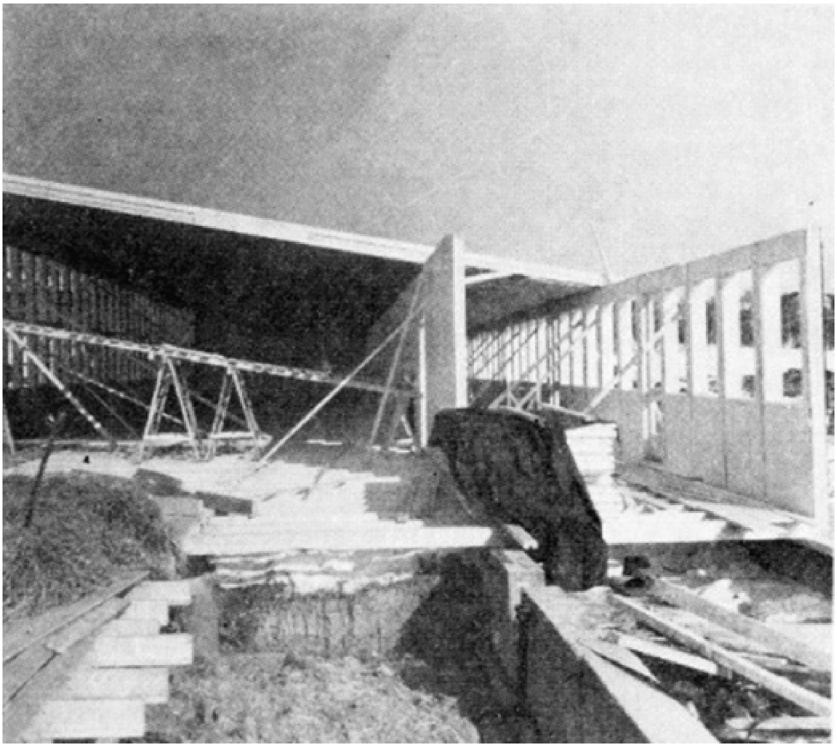


Fig. 16. On-site assembly of Nadderud school made from prefabricated Moelven elements. From *Skolebygging: kurs ved NTH 1958*.

struction were revealed in an early newspaper article written to convince the audience that Moelven schools were *not* “barracks.”[124] Overall, Moelven developed its structural solutions together with researchers from technical institutes—such as NBI or NTI—sharing its technocratic approach to design with the Committee on Educational Buildings.[125]

Timber was not just used for wall elements, but for the main load-bearing constructions. Glued laminated timber was earmarked by KUB and recent research at NTI as a particularly suitable material for school construction, but Moelven was the only company that produced both prefabricated schools and glulam beams in-house.[126] All roof and floor elements in Moelven schools were built from nailed and glued laminated beams. This allowed to accommodate larger spans, made schools buildings lighter and less dependent on com-

124 *Østlendingen*, March 20, 1959, 5.
125 *Dagbladet*, May 14, 1959, 5.
126 “Endel momenter til innstillingens. Kap. 7: Konstrukjoner og materialer,” 5, in KUB archive RA/S-5489/D/L0003. Prior to developing its own production of engineered timber—for example, in Nadderud school—Moelven used products from Trækonstruktioner. See Mohr et al., “Skolebygging,” 185.

plex anchoring, thus reducing the need for expensive groundwork. For schools with a side corridor, only two foundation beams were necessary, and for those with a middle corridor, perpendicular foundation beams could be reduced from six to four.[127] They were then covered with asphalt-impregnated hardwood-fibre plates, 10 cm of glass wool "Glava 60," 12,5mm of porous wood-fibre plates, all finished with 1 1/4" of floor board or 3,5mm of hard wood. Sometimes, special health-standardised vinyl floors were used in the corridors, foyers and wet-rooms. Other areas had a linoleum or a special floor finish that could be made on demand.[128] Ceilings were made of in 20mm of porous wood fibre plates, one layer of paper, 10cm of glass wool and 3/4" of hard panel. Glued laminated beams allowed for large spans, and were particularly suited to gyms and performance spaces. Thus, school gyms soon became another standard Moelven product. For example, a gym for Persbråten school with arches spanning 40 meters was assembled in 1962—jumpstarting Moelven's specialisation in sports facilities.[129] Kjellervolla gym, with foldable partitions, was built in 1965, and other gyms with arched roofs were built at Moelv and Askim schools.[130]

The materiality of timber influenced not just the structural performance of Moelven schools, but also the experience of interior spaces. Moelven schools were often smaller when compared to traditional, "mammoth-like" buildings. Often arranged in series of low-rise pavilions around a central courtyard, they were considered more friendly and appropriate for children. During the 1958 conference, architect Sven Erik Lundby particularly emphasised the material and tactile qualities of timber that, unlike new synthetic fabrics and colours, were better suited to create warm, child-friendly interiors.[131] Similarly, Are Vesterlid argued that schools had to use materials and forms "most adaptable for children," and his widely-praised Messenlia school made abundant use of timber in its interiors.[132] Moelven schools thus featured exposed timber in their interiors, but the material was used cautiously "to avoid the monotonous feeling that using too much wood can give."[133] Architectural historian Geraint Franklin argues that British post-war schools strove to "reconcile factory production with a humane social architecture,

127 Catalogue "Ungdomsskoler i Skedsmo," 1965, SAH/ARK-287-01/J/Je/L-0003.
128 Catalogue "Ungdomsskoler i Skedsmo."
129 *Lillehammer Tilskuer*, January 29, 1965, 2, 4. Also see Chapter 5.
130 *Ringsaker Blad*, January 30, 1965, 1, 4.
131 Sven Erik Lundby, "Materials meaning for construction economy" in Mohr et al., "Skolebygging," 161.
132 Lundby, "Materials meaning for construction economy," 161.
133 See, for example, description of a Nadderud school in *Ringsaker Blad*, September 6, 1958, 1-2.

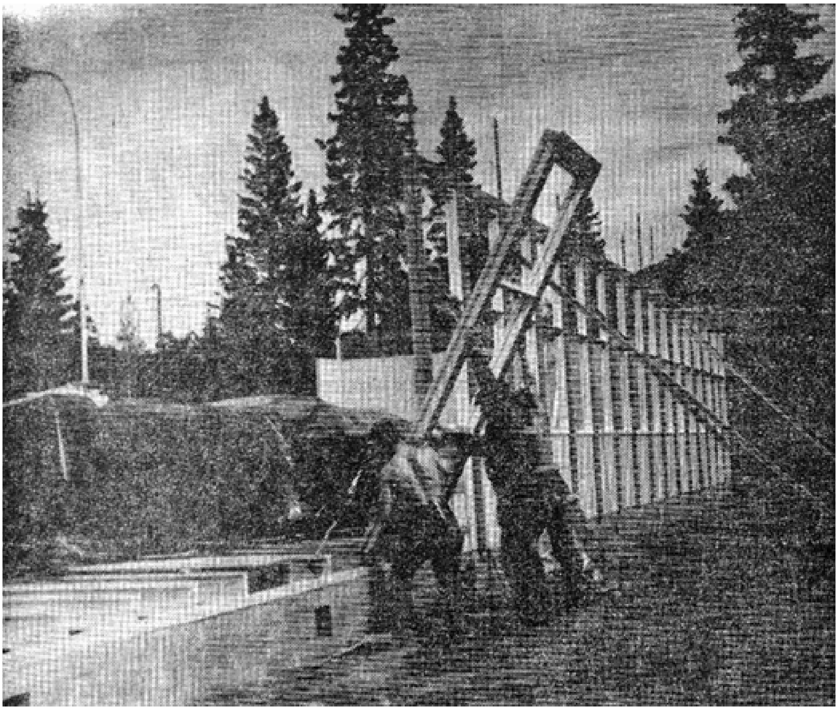


Fig. 17. Construction of Moelven school in Kongsvinger. It would take around 1000 work hours to assemble the entire school, carried out by two workers and a foreman. Newspaper clipping, 1964.

ultimately in the service of the child."[134] In a similar manner, Moelven schools continuously negotiated the austerity of factory production with the adaptability and performance of internal spaces in the service of the child, following the most recent research on internal colours and furnishing. For example, Moelven classrooms and corridors were coloured in "bright and appealing tones."[135] Produced at the factory, Moelven schools shared some typological similarities with their British counterparts, described by Andrew Saint as "an assortment of modern, quiet, low, broken-up elements [...] meant for children and teachers, not for the paltry world of architectural fashion."[136] However, differently from its English counterparts built in steel, aluminium and glass, the timber in Moelven schools served as a direct mediator between factory production and the children's experience of space. If, according to Saint, English schools were the most familiar manifestations of the post-war

134 Geraint Franklin, "'Built-in variety': David and Mary Medd and the Child-Centred Primary School, 1944-80," in *Architectural History* 55, 324. doi:10.1017/S0066622X00000149.
135 Sonya Milla, "The Work of the Development Group, Department of Education and Science," *Official Architecture and Planning* 29, no.9 (September 1966): 1282.
136 Saint, *Towards a Social Architecture*, 234.

British welfare state, Moelven schools were likewise manifestations of the post-war Norwegian welfare state that tried to reconcile centralised planning, scientific control, pragmatism of costs, design adaptability and the democratic aspirations of new common schools with attention to children's experience of space. Although egalitarian aspirations accommodated by means of mass-production and standardisation could, potentially, result in homogeneity, monotony and sameness, the Moelven system harboured the promise of a flexible system, able to accommodate different site conditions, programmes, budgets and demands.

PLANNING FOR FLEXIBILITY: THE SKEDSMO SCHOOLS

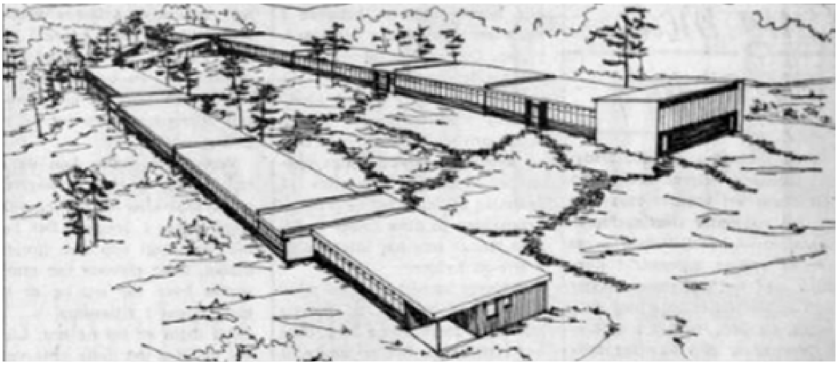
"Joined planning from the first hour is the secret to Moelven Brug's success in school planning," claimed one of the articles on Moelven schools in 1965.[137] As Mageli underlined, one of the benefits of working with Moelven was the fact that, in addition to local decision-makers, both "the producers and the architects cooperated from the first hour."[138] Moelven's long-term planning process was often compared to similar developments in the United States (a benchmark of rationality), as the company's managers argued that "Moelven schools [were] planned in two years, but built in two months."[139] This also meant that instead of the traditional process, in which the school board first approved a building programme, then an architect proposed a design solution that was then sent out for an open tender among several entrepreneurs, school planning turned into a tri-partitive affair that brought school building committees, architects and industrial producers together at the very beginning of the process. The committee could adjust designs according to the programme and budget, selecting customised add-ons at a fixed price. Architects Thomas Schmid and Carlo Testa in their 1969 book *Systems Building* defined such a process—essential to any project with the ambition to implement system-building—as "total planning." This approach required that different stakeholders were brought together at an early stage, and that considerations of design, functions, construction and economy were approached in a non-hierarchical manner.[140] According to Schmid and Testa, only in this case "total planning" could serve as a viable alternative to the usual "hit-or-miss" process.[141]

137 *Ringsaker Blad*, January 30, 1965, 1, 4. *Hamar Arbeiderblad*, January 30, 1965, 7.
138 *Ringsaker Blad*, January 30, 1965, 1, 4.
139 *Ringsaker Blad*, May 16, 1959, 2.
140 Schmid and Testa, *Systems Building*, 22–24.
141 Schmid and Testa, 24.

The “total planning” approach is perhaps best visible in the case of three Skedsmo schools, built largely after the same drawings but adapted to local conditions and programme demands. After two municipalities—Lillestrøm and Skedsmo—were merged together into one “stor-Skedsmo” in 1961-62, the freshly-baked region required three additional secondary schools.[142] In December 1962, the municipality invited a selection of architectural firms and school producers to participate in a competition for two projects—one at Kjellervolla and another at Stav, with the idea that both schools would be similar in terms of materials and design.[143] The competition brief specified that architects had to work together with industrial producers to offer a fixed price for the entire building project.[144] Remarkably, three of the four proposals were pavilion buildings, and Strømmen architect Ernst Ekra with a proposal of 2 750 000 NOK per school won over a project by Paul Cappelen (4 680 000 NOK) and Erik Hoberg (3 760 000 NOK).[145] Thus, Ekra together with Moelven Brug received the commission and the three large prefabricated secondary schools—Kjellervolla, Stav, and Skedsmovollen—were built between 1962 and 1965. These were the largest school projects undertaken by Moelven to date, and Skedsmo was claimed to be “the first municipality in the country to realise all the advantages offered by close collaboration between municipal authorities and industrial producers.”[146] This was also the first school project for Ernst Ekra, who would go on to specialise in school buildings in his home municipality.[147]

Skedsmovollen school, completed in 1963, was conceived as a “model institution,” with a “simple and thought-through plan solution that will satisfy all practical and aesthetic needs.”[148] The school consisted of three educational buildings and a central pavilion that housed a large assembly hall and two gyms, doubling as performance spaces and wardrobes for the public. In addition, there was a community swimming pool in the basement and special mechanical rooms to accommodate stage equipment.[149] Two classroom wings were situated parallel to each other around a courtyard, joined by perpendicular weather-protected corridors. All buildings were constructed with standardised Moelven

142 Håkon Skulstad, “Orientering om diverse kommunale anlegg i forbindelse med befaringer og innvielse: fredag 5. og lørdag 6. desember 1969” (Strømmen, 1969), 3. *Romerikes Blad*, October 24, 1995, 6.
143 Stav skole, *Stav skole 1965-1975: jubileumsbok* (Skjetten: Stav skolen, 1975), 39. *Akershus*, August 12, 1964, 4.
144 *Akershus*, February 13, 1964, 5.
145 *Akershus*, February 12, 1964, 5. *Arbeiderbladet*, August 31, 1964, 4.
146 *Romerikes Blad*, January 7, 1966, 1.
147 More on Erns Ekra see *Romerikes Blad*, October 24, 1995, 6.
148 *Romerikes Blad*, October 5, 1962, 5.
149 *Aftenposten*, February 13, 1963, 10.



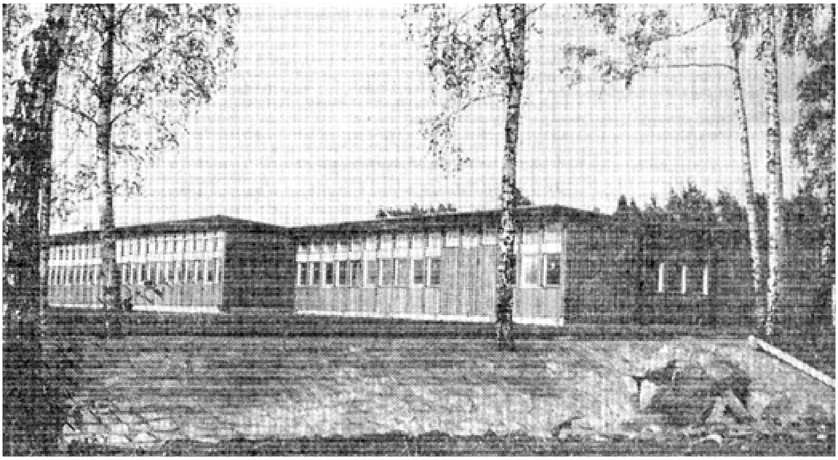
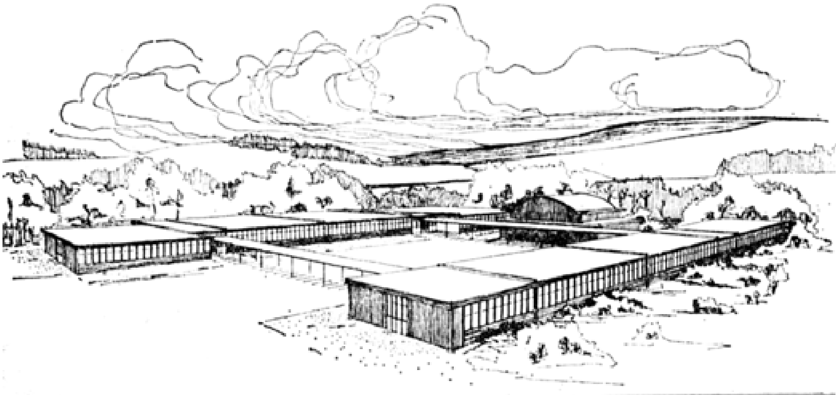


Fig. 18. Skedsmovollen school, perspective drawing and photographs. Newspaper clippings, 1964; photograph from Oslo Byarkiv.

elements developed specifically for the project. Both floor and roof constructions were made in laminated timber. Fire-dividing walls were carried out in laminated brick, while outdoor walls were constructed with pressure-impregnated panels and façade plates. The students would enter the classrooms directly from the main foyer. Educational buildings housed 13 classrooms and 12 special rooms for music, home science, textile and drawing workshops, photography, ceramics, wood- and metal-work, hobby and study rooms. [150] In addition, the classroom wing accommodated administrative offices, a library, special rooms, offices for the school doctor and dentist, a small school cinema, a workshop for audio-visual tools, and a teachers' lounge.[151] Classrooms were joined as "two-and-two," and shared a group room, used for different joint activities. With an overall ground plate of 4165m^2, the school was considered "a first-class, good, beautiful and solid [building]," delivered within budget and with nearly no delays.[152] The school, housed in geometrically shaped pavilions with a slightly slanted roof and continuous and generous window panelling, conveyed a sense of the new modernity of the 1960s: the non-imposing, approachable and rational.

Kjellervolla was the first secondary school built in Lillestrøm. Completed in 1964, it welcomed 450 students to its 18 different classrooms. With an overall ground plate of 4265 square meters, the school was designed in two parallel educational wings bridged by covered corridors, with an arched-roof sports-hall closing the courtyard.[153] Fire-resistant brick walls divided the structure into segments of 425m^2 each, but a voluminous roof cornice running along the entire façade underlined the horizontal definition of the school's volume. The building was set on a flat asphalted land plot, and without a visible foundation wall it seemed to float above the courtyard, anchored by simple ground-level entrances. Through a slight shifting of classroom volumes, the architects managed to achieve a carefully defined internal courtyard space that served as a large school living room, used for play, music and sports, fondly remembered by the students.[154] All classrooms could be accessed directly from the foyer and wardrobes. One educational wing accommodated twelve classrooms, teachers' rooms and administrative offices, while special rooms for textile, wood and metal workshops, hobby and

150 *Akershus*, September 28, 1962, 2.
151 *Akershus Folkeblad*, August 15, 1963, 3.
152 *Akershus*, August 6, 1963, 5, 8.
153 *Akershus*, February 1, 1964, 3.
154 See a comment from Tone Lintorp on the school's Facebook page: "Sent 70-tall, tidlig 80. I storefri spiltes det musikk ut fra vinduet på musikkrommet så de som våget kunne danse!" https://www.facebook.com/kjellervolla/photos/utfordring-akseptert/1208973599167602/ Accessed 10 November, 2021.



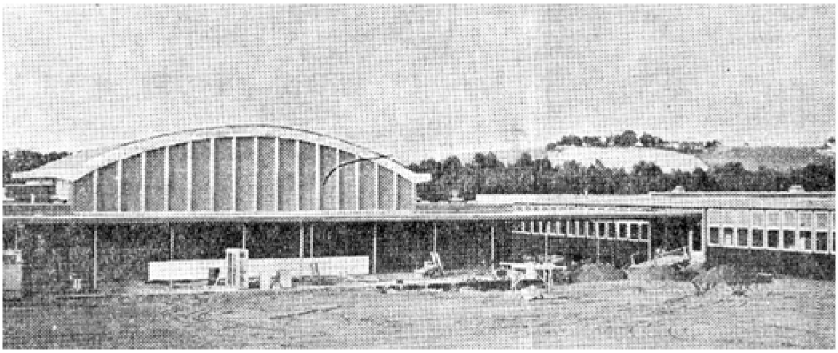


Fig. 19. Kjellervolla Skedsmo school, perspective drawing and photographs. Newspaper clippings, 1964.

music rooms, doctor's and dentist offices were located in another wing. A third section with a half-circle arched roof in laminated constructions with a span of 29 meters housed a school gym of 400 m^2 which could be divided for different activities with folding walls.[155] The gym also accommodated a performance scene of 60 m^2 and special theatre storage spaces, wardrobes and showers for the actors located underneath. The floor was done in Belinga parquet with a special plastic varnish; walls were covered with pressure impregnated panels, hardened glass and aluminium profiles.[156] The exterior did not require a lot of maintenance, as the outer walls were partially made from un-rendered brick.

Stav school in Strømmen was similar to Kjellervolla, although the original plans were rotated and placed within a more complex hilly terrain and included a large garden of 90 acres.[157] While the two schools were based on similar drawings, each design was adjusted to accommodate specific programming and site demands. It not only saved on construction time but architects' labour—the designs came about 125.000 NOK cheaper than if three different architects were paid.[158] This could not have been popular with Norwegian architects at the time: during the 1958 conference, Odd Brochmann underlined that "in architecture, everything should be skimped on, except the architects' work."[159] However, the project architect Ernst Ekra, interested in "rational" solutions for schools, was impressed by Moelven's speed of construction, and although he found collaborating with school rectors that "seemed to be experts in everything" hard, he retained good memories of the project.[160] When completed, the three Skedsmo schools were extensively visited by public officials from around the country. Moelven's system proved flexible enough to accommodate not just the complex programming of the new common school, but individual demands of each school building committee. With economical means, Moelven was able not just to provide a variety of educational spaces, including sports and arts facilities, but also to democratise access to them, previously reserved for students in large urban centres.

In his study of post-war British school-building, Nicholas Bullock points out the shared aesthetics of these buildings, attributing it to the common underlying structural and spatial principles that conditioned

155 *Ringsaker Blad*, January 30, 1965, 1, 4.
156 *Akershus*, August 19, 1964, 5-6.
157 *Ringsaker Blad*, January 30, 1965, 1, 4.
158 *Dagbladet*, August 26, 1965, 7. *Akershus*, February 12, 1964, 5.
159 Mohr et al., "Skolebygging," 158–59.
160 *Romerikes Blad*, October 24, 1995, 6. Stav skole, *Stav skole 1965-1975*, 43–52.

Fig. 20. Stav school, done largely after the same drawings as Skedsmovollen school. Newspaper clippings, 1964. Photo by Thomas, from *Stav skole 1965-1975: jubileumsbok*.

their designs.[161] It is not surprising, then, that Moelven schools also shared a common visual language, not just with each other, but also with their international counterparts built around the same time. For example, although built in a different material—timber, instead of steel and aluminium—Moelven schools were similar to British experimental school buildings that had flat, gently sloping roofs and large windows. They were often "domestic" in scale, and generally light and spacious, with bright indoor colours and wooden elements. Built in a series of clustered pavilions extended or nested within a hilly terrain, they were joined either by indoor or covered outdoor corridors, resulting in large, landscape-like horizontal structures—child-friendly and inviting.

SAME, BUT DIFFERENT

Perhaps one of the best examples of how Moelven schools were both standardised but adaptable at the same time is Nøklevann primary school, designed by the Oslo city architect in cooperation with Moelven's René Philipp. Built in the Oslo neighbourhood of Bøler between 1963 and 1965, the school was located in the green area near Lake Nøklevann, between Bølerlia's high-rise flats and row-houses to the north. Built after a terrace principle in several stepping floors, Nøklevann school stands out both from other Moelven schools and other educational buildings at the time.[162] Its flat-roofed, incremental horizontal volumes, with dark

161 Nicholas Bullock, "Reconstruction, School Building and the Avant-Garde," in *Team 10 and its Context*, 57. http://www.team10online.org/, accessed November 20, 2021.
162 *Lillehammer Tilskuer*, January 29, 1965, 2, 4.

vertical panelling and continuous fenestration, master a modernist idiom of the 1960s, enriching it with specific local characteristics. Designed with exquisite attention to the surrounding landscape of Østmarka and a stepping terrain, it is the opposite of the austere and deserted modernist "towers-in-the-park." Rather, it is a "school-in-the-forest" that managed to harness the benefits of mass-production, while crafting unique spatial affordances with attention to the children's experience of space.

The school consists of four individual buildings. The main teaching and classroom space is composed of several volumes stepping down along the slanted terrain from east to west. A single-floor special rooms wing is located on a flat land-plot in the south, and a two-floor stepping down gym building with administrative offices occupies the north-western part. The main building, constructed from concrete, brick and timber is closely adapted to the terrain: its horizontal volumes gradually descent from the most northern part with two floors, to the middle section with three floors, to the most southern—and the lowest—volume with one floor. Nearly transparent with continuous horizontal window panelling, these volumes rest on the solid framework of the yellow brick staircases that provide both the rhythm to the volumetric division and serve as the main circulation arteries. The staircases are connected with two horizontal corridors running along the building's main axes: one on the bottom, and another parallel corridor towards the back. With large windows overlooking the forest, this corridor introduced the landscape of Østmarka into the school, carefully staging splendid nature views along the route. These networked circulation spaces orchestrate a peculiar movement through the school that approximates that of moving across hilly terrain. When completed, the school had 14 ordinary classrooms, a gym, a cantina, a dentist and doctor offices, rooms for music and choir and housing for a caretaker. Designed to "a very different standard," both in terms of exterior and interior design, it was more expensive than other Moelven schools built in the area and showed that Oslo municipality could afford to build projects after custom-made designs.[163]

Although all the Nøklevann school buildings featured flat roofs, prefabricated Moelven panels in the façades, and glued laminated timber elements, they were not typical Moelven buildings. In order to accommodate a more complex site programme and construction in several floors, other materials had to complement Moelven's usual timber-based construction system: thus, brick and concrete were introduced.

163 *Ringsaker Blad*, January 30, 1965, 1, 4.

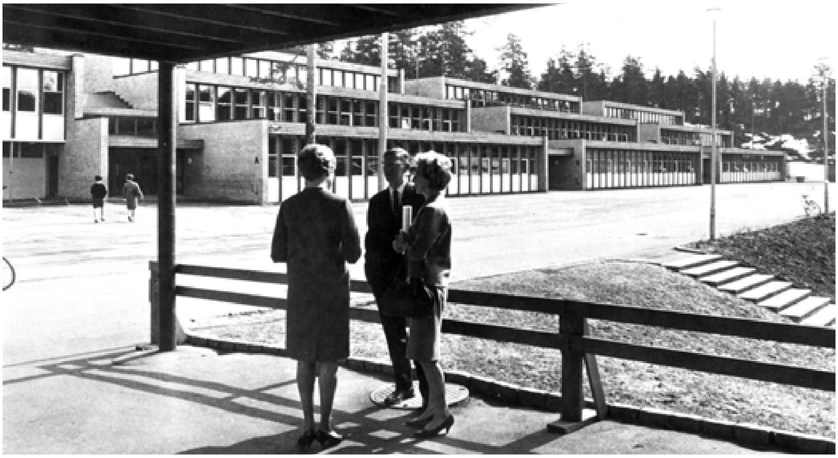


Fig. 21. Nøklevann school in Oslo. Photographs from wikimedia commons, newspaper clipping.

Fig. 22. Sofiemyr school in Oppegård. From a catalogue "Moelven prefabrikerte skoler," SAH/ARK-287-01/J/Jc-0003. State Archive in Hamar.

In addition, the school had little exposed timber in its interiors—while there was some horizontal timber panelling, the interiors were dominated by laminated yellow brick. These customised adjustments resulted in higher costs: unlike other Moleven projects, which usually remained within budget, the school turned out to be one million more expensive than originally planned, at a total cost of around 5 million NOK.[164] However, it is precisely these alterations that made Nøklevann school so special: according to an evaluation report produced by Oslo KF—the city's municipal corporation for housing— in 2011, Nøklevann's stepping shapes, original volume setting, and peculiar organisation of space adjusted to site conditions, make it a landmark building. Oslo KF later noted that the school, with its "wooden cladding, simple repetitive fenestration and flat roof is very typical of the public construction of the 1960s," and "illustrates the breadth of the form grammar of the time."[165] In fact, it is the only Moelven school complex that obtained a 2nd-level cultural heritage protection status, which protects both the volumes and form, structural elements, facades, stairwells, corridors and the caretaker's house, built with the same system of prefabricated elements. In 2000, the school housed more than 295 students, and underwent a climate-upgrade which re-insulated parts of the façade, windows and roof. The caretaker's house was renovated in 2010.[166]

By the mid-1960s, Moelven completed several other significant projects—including Sofiemyr school in Oppegård (a town south of Oslo), designed by Moelven's Hans Grinde and Brattås school in Nøtterøy, also designed in-house. Images of these two large projects were often used for marketing purposes and illustrated a comprehensive 36-page prefabricated schools sales-catalogue produced by the company. [167] The catalogue suggested more than 30 layout variations for a three-year secondary school with four parallel classes, and the same number of design alternatives for a six-year primary school with two parallel classes. Pavilions of 400 m^2 could be grouped either in in H-, L- or U-shapes, depending on site conditions. Clustered or arranged in a line with outdoor corridors, these pavilions could accommodate different combinations of educational and administrative spaces, special and group rooms, music and arts workshops. While some, like types A and B were "more practical," others, like type D, were a "turnkey" solution pre-approved by the

164 *Friheten*, July 27, 1964, 3.
165 Undervisningsbygg Oslo KF, *Verneplan for osloskolene. Vedlegg 3*, 103.
166 Undervisningsbygg Oslo KF, 103–13.
167 "Moelven prefabrikerte skoler," SAH/ARK-287-01/J/Jc-0003.

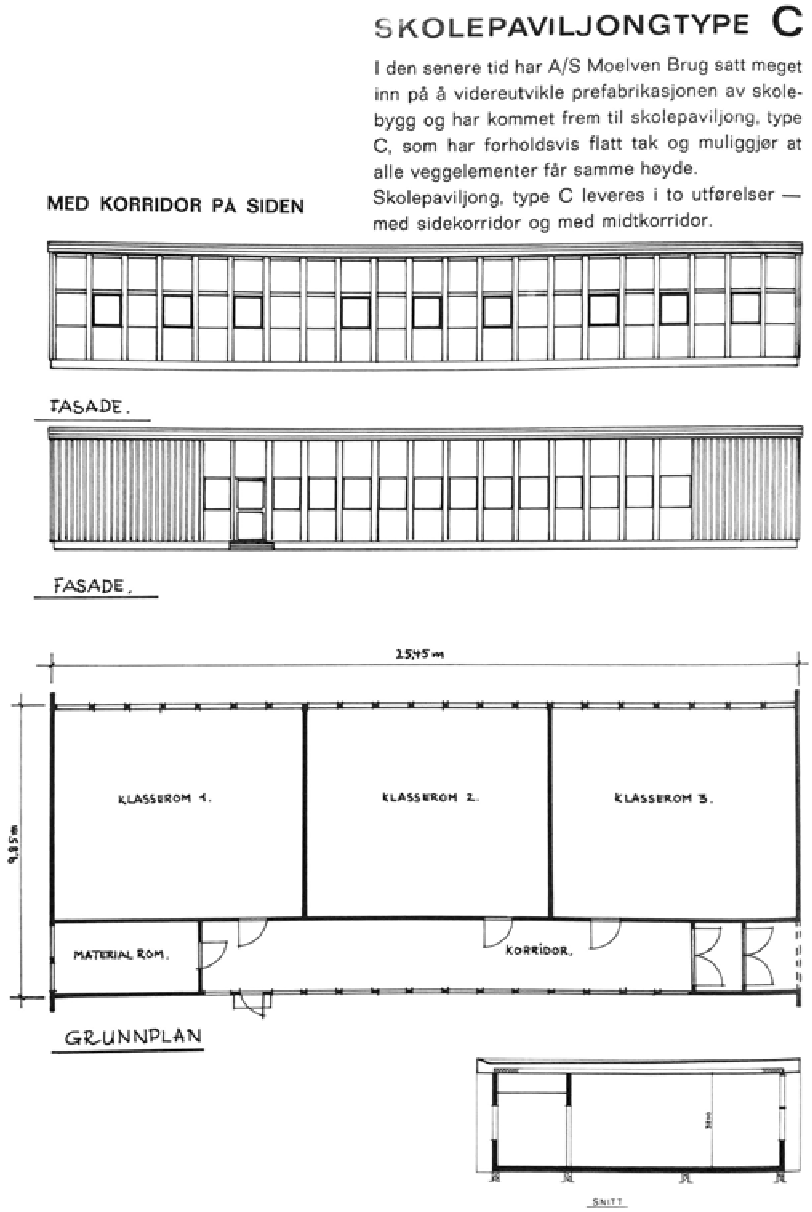
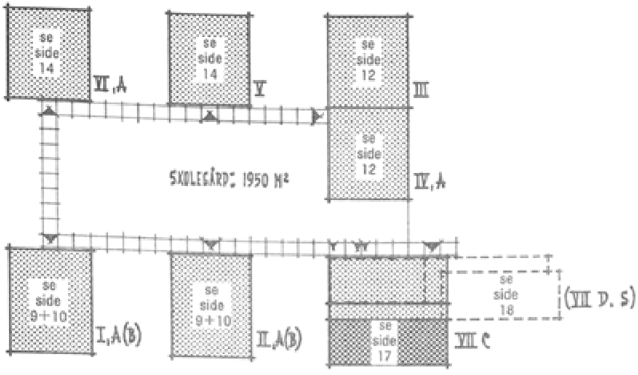


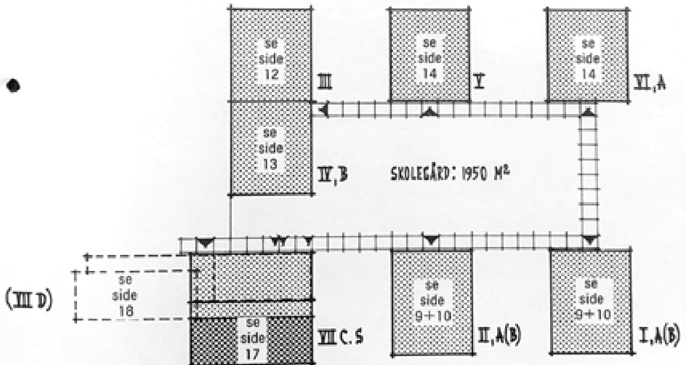
Fig. 23. Moelven catalogue of prefabricated schools. On the left, a sample plan of a pavilion type C. On the right, a suggested combination of pavilions for a three-year high-school with four parallel classes. From "Moelven prefabrikerte skoler," SAH/ARK-287-01/J/Jc-0003. State Archive in Hamar.

MOELVEN



SITUASJONSPLAN, ALTERNATIV III.

Sidehenvisningene gjelder detaljerte grunnplaner for de enkelte paviljonger.



SITUASJONSPLAN, ALT. III, SPEILVENDT.

A/S MOELVEN BRUG - 3-årig linjedelt ungdomsskole med 4 parallellklasser
Situasjonsplaner (mål 1:1000) - Alternativ III

KUD. Moelven engineers were to closely guide their clients in order "to guarantee a successful result at a low price."[168] The company's architects, for their part, were particularly familiar with "special problems that arise in the industrial production and planning of schools."[169] These prefabrication catalogues show that, with time, Moelven's construction system was able to accommodate both standardised types and customised architectural designs. The already-completed school projects—developed both in-house and in cooperation with external architects—proved successful adaptations of this system to different site conditions, programmes and demands and often illustrated the company's sales catalogues.

Although developed for industrial system-building and limited budgets, Moelven's horizontal landscape-like schools with a clear division between educational and circulation spaces can be situated within a broader setting of the European avant-garde experiments of the 1960s and more specifically the architecture of Team X. Dissatisfied with urban planning driven by technological rationalism, post-war generations of architects strove for a different type of architecture of relations, able to reconcile the needs of the individual and collective. They hoped to do so by providing a clear differentiation between the structure and infill, where different programmes could be accommodated within a fixed structural order.[170] This ambition reminds of Moelven's aspiration to provide flexible programming within a limited system of industrial components. Formally, according to Allan Colquhoun, the new generation of architects sought an alternative to the modernist superblock, disintegrating the structure into smaller volumes and aggregate cells joined by a public system of circulation, a reference to the spatial experience of the city.[171] For Team X members, it was important to differentiate between the spatial units and infrastructural circulation spaces that joined them, as additional units could be built in or taken apart with time.[172] This ambition became most apparent in the large, landscape-like educational buildings designed by Team X members in the 1960s. Aldo van Eyck's Children's Orphanage in Amsterdam (1960) and Candilis-Josic-Woods's Free University in Berlin (1963) share a common architectural language, where low-rise pavilions connected through circulation spaces provide different spatial experiences within an overall ordered structure.

168 "Moelven prefabrikerte skoler."
169 Ibid.
170 Risselada et al., *Team 10*, 15.
171 Alan Colquhoun, "Central Beheer," *Essays in Architectural Criticism* (Cambridge: MIT Press, 1981), 59
172 Alison Smithson, "How to Recognize and Read Mat-Bbuilding: Mainstream Architecture as It Developed Towards the Mat-building," *Architectural Design*, 9 (1974), 573-590.

It is possible to argue that, although visually modest, Moelven schools, with their repetitive low-rise volumes adaptable to different programmatic demands connected by separated circulation spaces, belong to the same genealogy of buildings. If, as Tom Avermaete argues, the material articulation of MAT-buildings was defined by prefabricated elements and a composition of clustered and interrelated spaces, then Moelven schools, built with a system of prefabricated timber components and based on series of clustered pavilions that could be added or taken apart as the schools' needs changed, could be defined as MAT-buildings.[173] Similarly to the structuralist architecture that blended the distinction between the exterior and interior, larger Moelven schools—for example, Persbråten, Sofiemyr or Nøklevann—incorporated outdoor playground space into the street-like circulation landscapes within the school. In Norway, these structuralist ideas applied to educational buildings crystallised more clearly some five years later in Henning Larsen's proposal "22183" for Trondheim University in Dragvoll in 1970. The project included a series of large flat pavilion structures, connected by covered corridors and arcades in a "structure capable of absorbing the future's unpredictable demands."[174] Although visually less striking, Nøklevann school, with its low-rise volumes connected by the in-between covered streets, shares a lot of similarities with what is claimed to be the first structuralist project in Norway.[175] If, according to *Team X Primer,* the new architecture of the 1960s strove to create buildings that would both be capable of translating social relations into physical structures and able to accommodate transformation and change, then Moelven schools represent a localised, pragmatic version of this new architecture of relations.

CRITICAL RECEPTION

Since Moelven schools were never covered by professional architectural magazines such as *Byggekunst, Bonytt* or *Arkitektnytt,* it is hard to assess the experience of studying in a Moelven school or to trace how they fared over time. Based on scant evidence from brief notes in newspapers and local history books we can learn, for example, that

173 Tom Avermaete, "Designing for the Anonymous Collective," in *Nordic Journal of Architecture* 2, no.1 (2012): 54.
174 Henning Larsen Tegnestue, *Universitetet i Trondheim—konkurranceprojektet 1969-1970* (Copenhagen: Henning Larsen Tegnestue, 1970), 2.
175 For details of Larsen's Dragvoll project and its place in Norwegian architectural history see Mujezinović, "The Architecture of the Urban Project" (PhD diss., AHO, 2016), 55–118.more specifically projects such as new universities, urban redevelopments and waterfront transformations. Usually, such projects have one investor (either public or private

Fig. 24. Moelven schools in use. Photos of Nøklevann school from *Aftenposten*, Arbeiderbevegelsens arkiv og bibliotek.

students at Stav school found the bare walls somewhat unwelcoming in its first year, but the situation improved as students appropriated their classrooms.[176] Similarly, the construction of Persbråten school was so rushed, that it was "barely finished" when the school year started.[177] From a detailed building diary re-published for a school anniversary in 1975, we learn that Moelven erected and roofed the entire special-classroom wing building at Stav in about a month.[178] In Skedsmo, students at all three schools were explicitly prohibited to wear steel heels not to damage the wooden floors. However, by 1966 Kjellervolla pupils had already managed to "jump through the parquet in the gym," so that Moelven had to repair the entire section.[179] From other notes we learn that Kjellervolla's theatre stage was successful, holding a very popular performance critiquing contemporary teaching, while parts of Skedsmovollen's underground spaces were later refurbished into activity and meeting rooms.[180] Although clues to the specific role prefabricated architecture might have played in these environments remain very scarce, the majority of newspaper articles point to the fact that the schools performed their educational tasks well. Architecture seems to nearly entirely disappear in the later mentions of the schools in newspaper, with little to no complaints about structural or systemic failures. This absence perhaps indirectly proves that Moelven schools actually fared well, as prefabricated architecture grew to be a muted frame filled with everyday life. And although this lived experience is hard to assess, other aspects, for example the critical reception of Moelven schools and their position within the political spectrum at the time, are easier to trace.

Although Moelven schools were deemed particularly "relevant in the construction market in Oslo," other regions, like Northern Norway, swore against them.[181] Rector Hans E. Wold at the 1958 NTH conference found these school "utterly inappropriate" and raised hope that "these things would never be built in Northern Norway."[182] Beyond obvious explanations—for example, the weather—two other factors could account for this discrepancy in reception: personal and political preferences among state officials in certain municipalities and the structure of the job market. For example, Kristian Haugen, mayor of Skedsmo municipality and an ardent member of the Labour Party, was very interested in new

176 Stav skole, Stav skole 1965-1975, 62–64.
177 Falkenberg, Meidell, and Persbråten skole, *Persbråten-russen 1963 i tekst og bilder*, 6.
178 Stav skole, *Stav skole 1965-1975*, 43–52.
179 *Akershus*, September 5, 1964, 1; *Romerikes Blad*, September 27, 1966.
180 *Romerikes Blad*, September 24, 1969, 1. Nationen, May 21, 1970, 9.
181 *Hamar Arbeiderblad*, January 30, 1965, 7.
182 Mohr et al., "Skolebygging," 169.

construction methods, and had particular ideas about what architecture should provide. Haugen was convinced that "factory production of schools and other building belongs to the future," and that something had to be done "to develop this system further in practical terms."[183] Thus, when three secondary schools had to be built quickly and within limited budgets, prefabrication seemed to be an obvious choice. In addition, Haugen thought that the school buildings would become obsolete in 30 years anyway, and in this case, new light constructions were particularly suitable since they offered a faster and cheaper way of building schools that could be disassembled when no longer needed.[184]

On his part, Olaf Solumsmoen, chairman of the Oslo school board and another Labour Party member, was convinced that if Oslo was to meet its school demand, new schools had to be cheaper.[185] This was particularly relevant for new districts with large influx of population where new schools had to be raised in a short time: Oslo municipality was among the first large Moelven clients back in 1958-59.[186] Solumsmoen was personally interested in new economic methods for school building. In the mid-1950s he went to England, where he studied British experiments in school construction. Upon return, Solumsmoen appeared on the BBC Norwegian transmission, where he talked about British school building and advocated for "more rigorous school planning and production chains" that could help avoid another school crisis.[187] According to social historian Alfred Telhaug, since municipal school boards were comprised of publicly elected representatives, school building in Norway was a politically charged affair.[188] Some connections can perhaps be drawn between political affiliations and preference for prefabrication. Members of the Labour Party were usually more open to innovation and new technological methods of construction that would yield more school spaces at a lower cost, or in other words, provide cheaper schools for more children. More conservative representatives—like rector Wold—often opted for traditional designs by well-known architects, and did not find that school building necessarily had to be economical.[189]

183 *Romerikes Blad*, January 7, 1966, 1.
184 Bjørn Meyer Herdlevær and Skedsmo arbeiderparti, *Opp den bratte bakken: Skedsmo arbeiderparti 100 år*, *Norbok* (Lillestrøm: Partiet, 2003), 87. Also in Mohr et al., "Skolebygging," 157. *Arbeiderbladet*, May 12, 1969, 12.
185 *Arbeiderbladet*, September 23, 1958, 1-2.
186 *Aftenposten,* September 23, 1958, 1, 12.
187 *Haugaland Arbeiderblad*, June 17, 1954, 6. *VG*, June 19, 1962, 2.
188 On the political representation in school boards see Alfred Oftedal Telhaug, Odd Asbjørn Mediås and Petter Aasen, "From collectivism to individualism? Education as nation building in a Scandinavian perspective," in *Education and Nationbuilding*, 55.
189 See, for example, the division of votes along political lines in a competition for a Nøklevann school. *Ringsaker Blad*, September 20, 1962, 2.

The structure of the local labour market was another significant factor that affected the proliferation of Moelven schools. For example, Skedsmo was a young, fast-growing municipality that had an influx of new population, required large investments in infrastructure but lacked a qualified labour force. In order to meet the demand for quick construction, the municipality had to engage with new building methods that would rely on specialised work performed in other municipalities. According to Haugen, Moelven's prefabrication process was particularly suitable for work conditions in the municipality, since the construction went quickly and the company used its own workers. Thus, school building did not put additional pressure on the already-stretched labour market.[190] As Haugen concluded in one of the newspaper articles, "cooperation with Moelven Brug had been important and useful for all parties," and "Skedsmo had very good experiences with prefabricated schools."[191] Similarly, Oslo, owing to its extensive construction activity, had a limited available workforce, and the fact that Moelven would bring its own workers largely simplified the construction process.[192] This was, however, not the case in other parts of the country, as many municipalities did not want an external company to enter the local job market with its own carpenters and assembly workers. For this reason, the Fredheim school project in Gjøvik caused a lot of tension, as businessmen and politicians feared competition from factory producers.[193] In many cases, pressure from local interest groups was so strong that a school-building committee would retract a commission after an agreement had already been reached. Mageli described this situation in one of the interviews:

"We meet broad understanding from the side of state officials; they think economically and rationally. But locally, the situation is totally different. We often face a very negative reaction to everything that is factory-made. Nowadays, people believe that everything that is handmade should be somehow better. No one seems to think that here we have an entirely different apparatus than an ordinary builder would have. The complications we meet with local authorities are often based not on evaluations of quality or price, but on artificial local patriotism."[194]

190 Kristian Haugen in a preface to a catalogue "Ungdomsskoler i Skedsmo," SAH/ARK-287-01/J/Je-0003.
191 *Akershus*, August 15, 1964. 5
192 *Hamar Arbeiderblad*, January 30, 1965, 7.
193 *Hamar Arbeiderblad*, February 6, 1958, 5.
194 *Lillehammer Tilskuer*, February 20, 1960, 7.

According to Mageli, this “local patriotism” often resulted in “artificial custom borders.” In practice, the choice of school projects ultimately came down to the choice of construction methods, often in favour of the more traditional ways of building. Mageli was convinced that “this had gone a little bit too far [...] It is crazy to have borders around each county.”[195] This tension between the company’s own interests and the priorities of local municipal authorities—whether to build cheaper and faster or to protect local workers—strongly conditioned where Moelven schools were eventually constructed.

Moelven prefabricated schools, then, were not just new building typologies competing with other school producers at the time. The company’s schools were closely associated with an entirely different means of production, a new technical process that moved most construction work from site to the factory. Thus, the decision to build a Moelven school went beyond design considerations—it was also a political choice, based on the priorities of local actors, budgeting decisions, political affiliations and the structure of the local labour market. While a particularly appropriate solution for the greater Oslo area and other neighbouring municipalities, it was decidedly less so for other areas, where local protectionism and distrust of the new factory-production prevailed. The company was aware of these structural limitations, as Mageli confirmed in a 1965 interview: “Moelven schools can be particularly suitable in certain situations, while other places would have more appropriate building solutions.”[196]

THE AGE OF SYSTEMS

Moelven’s industrial school production was ahead of its time. While prefabrication and system-building were not seen as particularly viable in the late 1950s, by the mid-1960s ideas of building industrialisation regained the spotlight. Rational building methods were seen as a way to meet the official goals, not just for housing but for healthcare and education.[197] In April 1966, the Association of Norwegian Architects (NAL), this time together with the Association of Norwegian Engineers, held a second landmark conference on school building in Norway.[198] Different

195 *Lillehammer Tilskuer*, February 20, 1960, 7.
196 *Hamar Arbeiderblad*, January 30, 1965, 7.
197 “Boligproduksjonen økes ved nyere produksjonsmetoder,” *Arbeiderbladet*, January 22, 1965, 9. Norge: Stortinget, *Stortingsforhandlinger. 1966/67 Vol. 111 Nr. 5*. Norge: Stortinget, *Stortingsforhandlinger. 1967/68 Vol. 112 Nr. 3c*.
198 Den norske ingeniørforening, *Konferanse om skolebygging, Oslo 25-26 april 1966.*

from the event in 1958, this conference focused mostly on structural and technical questions. Now, prefabrication for schools was considered very desirable, but, as many participants pointed out, the Norwegian building industry still had innumerable deficiencies.[199] Despite many calls for more state engagement to facilitate school-building rationalisation, the only practical measure adapted from the international tool-kit was a set upper cost limit of 800 NOK per square metre for all new school projects that applied for state funding. To many Norwegian architects, this limit seemed outrageous—"200 kroner too low" for Oslo, and generally impossible to follow.[200] For others, it was seen as a sensible measure to promote industrial methods and the use of prefabricated components.[201]

For example, architects Paul Cappelen and Torbjørn Rodahl—frequent Moelven competitors in economic school projects—were ardent advocates of prefabrication for school construction. In a 1965 interview, Cappelen passionately argued that to diminish the costs, "architects now have to get their hands dirty and set on prefabrication."[202] By the mid-1960s, the young duo developed a "system-school"—a compact solution based on a square planning grid of 260 x 260cm with columns instead of walls. Built from standard industrial materials, Siporex blocks, the schools were cheap—varying from 585 to 678 NOK per square metre, and could compete in terms of price with the entirely prefabricated Moelven schools.[203] The first Stella Polaris school was built in Bodø in 1962. Throughout the 1960s-70s, more than 90 of these "compact-schools" were constructed across the country, and even exported to Tanzania in cooperation with NORAD.[204] By the mid-1960s, more industrial producers in Norway realised that industrial school building offered lucrative business possibilities. Block Watne developed turnkey timber schools in 1964. Assembled in under five months, they cost 525 NOK per square metre.[205] Engelsvoll school built in Klepp in 1966 was the first of this type; another project in Sola was finished the same year, followed by a school in Hellvik and several projects in Rogaland.[206] Siporex-Ytong—a light concrete producer—also delivered standardised schools made from Leca blocs. Quite cheap—694 NOK per square meter, these schools

199 Karl Bakke, Lecture I "Flexibility in school construciton" in *Konferanse om skolebygging*, 18.
200 *Haugesund Avis*, July 26, 1967, 3.
201 Selvaag argued that 800 NOK limit was not just possible for school construction, but should be implemented for all public buildings in the country. *VG*, August 10, 1967, 10-11.
202 Cappelen's interview in *Rogalands Avis*, December 7, 1965, 3.
203 Norsk lærerlag, *Norsk skoleblad, no. 25, 26-52* (Oslo: Norsk lærerlag, 1961), 572.
204 *Aftenposten*, July 21, 2016, 31. *Vårt Land*, April 20, 1974, 11.
205 *Stavanger Aftenblad*, December 23, 1964, 1.
206 See *Rogaland*, December 11, 1965, 16; *Sunnmørsposten*, October 29, 1966, 6.

could be built in one or two floors, with flat or pitched roof. Among Siporex-Ytong projects were Blommenholm and Jessheim schools, Ingeberg school in Hamar and a school in Dale, Fet. [207] Acknowledging the growing role of industrial producers in school construction, in 1967 the Oslo school board held the first competition for ten new schools in the area specifically for industrial producers, and not just architects. Moelven Brug was invited alongside Siporex-Ytong, Ungdomsbygg, Selvaag Bygg and Moderne Bygg. The last two tied for first place, and the winning proposal for new schools set a price at 760 NOK per square metre.[208]

While Moelven's industrial school production gradually slowed down towards the end of the 1960s, its experiments with prefabrication contributed to the growing fascination with cyclical planning and modular coordination particularly for educational buildings. In 1967, IRAS together with KUD published a booklet on network-based planning for school construction.[209] The same year, the Ulveseth committee tasked with researching new industrial building methods recommended standardisation of school construction based on a 3dm planning module.[210] In 1968, the NBI published a series of further recommendations that encouraged the use of prefabricated components in secondary schools, followed by another SINTEF report by Hans Granum and Birgit Brantenberg on planning principles for industrial school building.[211] An OCR search for "school building standardisation" through digitalised holdings at the National Library returns with more than 120 mentions, peaking between 1965 and 1969.[212] This fascination with system-planning culminated in 1974, when NTH engineers bought an EDB algorithm based on British experiments with industrialised school construction—the CLASP and SCOLA systems—and adapted it to new network planning methods and existing building practices of the Norwegian construction market.[213] This rise of systems-thinking was not specific to Norway, as industrialised school building remained high on the international agenda. In 1972, the OECD established a special Programme on Educational Buildings, and a report produced in 1975 was dedicated specifically to industrial building

207 *Aftenposten*, January 29, 1965, 4; *Romerikes Blad*, January 23, 1967, 5.
208 *Dagbladet*, February 7, 1968, 14.
209 For more see IRAS, *Nettverksplanlegging av skolebygg for 9-årig grunnskole*, *Norbok*, ERFA (trykt utg.) nr 3 (Oslo: Kirke- og undervisningsdepartementet, Kontoret for bygg og læremidler, 1967).
210 Stortinget, *Stortingsforhandlinger. 1967/68 Vol. 112 Nr. 3c*, 96.
211 Utredningsutvalget for byggemåte ved universitetsutbyggingen i Trondheim and Statens bygge- og eiendomsdirektorat, *Industrialisert bygging for universiteter og høgskoler*, *Norbok* (Oslo: Statens bygge- og eiendomsdirektorat, 1968). Granum, *Prosjekteringsgrunnlag for skoler*.
212 See National Library newspaper holdings search for "skolebygg standarisering," www.nb.no.
213 Larsen, Bjørberg, and Norges tekniske høgskole, Institutt for husbyggingsteknikk, "EDB-assistert prosjektering av skolebygg."

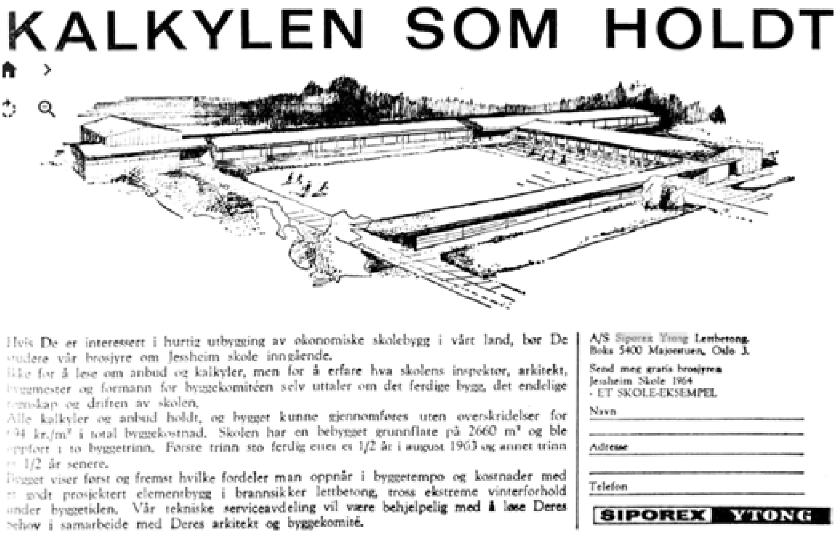


Fig. 25. An advertisement for Siporex-Leca schools, developed by Paul Cappelen and Torbjørn Rodahl. Jessheim school built with prefabricated Siporex-Ytong elements resembled low-rise pavilions of Moelven schools joined by outer corridors. Newspaper clipping, 1969.

systems.[214] Around the same time, in 1974 Moelven negotiated an offer to export its industrial school construction system to Czechoslovakia.[215] Similar to its Norwegian counterpart, the plant was supposed to produce prefabricated timber panels used in standardised kindergartens, nurseries, primary schools and gym designs.[216] Although never implemented in practice, the project shows that the company thought of its school-building process as a streamlined closed-loop system, flexible enough to accommodate variety and change. It also shows that experimental ideas and typologies imported from abroad were not only adapted and assimilated to the local conditions of production, but were rethought and exported as a completely new product: system-built timber schools.

BEGINNING OF A NEW HISTORY

Moelven continued to deliver prefabricated schools well into the 1970s, however these commissions gradually grew smaller and were supplanted by the company's new venture into prefabricated housing. For the

214 "Industrialised Building for Schools," OECD Programme on Educational Building, OECD, Paris, 1975.
215 School prefabrication system, Moelven project for CSSR, non-binding offer, 1974 in SAH/ARK-287-01/J/Jc-0004.
216 Moelven project for CSSR, SAH/ARK-287-01/J/Jc-0004.

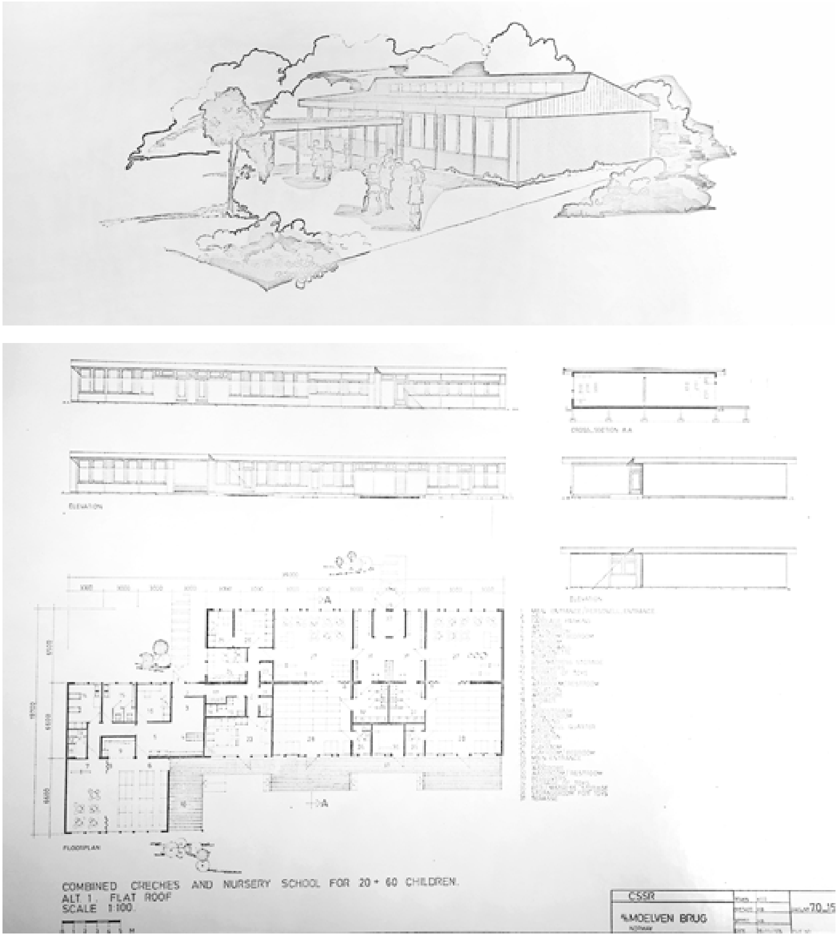


Fig. 26. Sample prefabricated school designs for CSSR. Export documents. ARK-287-01/J/Jc/L0004, State Archive in Hamar.

company, the production of prefabricated schools was not just another way to utilise materials and technical knowledge. These projects made it possible to test the possibilities of Moelven's element-based prefabrication system, develop new structural solutions and expand its contact network within local and regional political actors. In the absence of both state- and architect-led initiatives, the company filled the market gap with its proprietary prefabricated system for schools. Although initially conceived as a temporary solution for a transitional period, Moelven soon developed its system to build permanent, large-scale school projects. In doing so, it also pioneered a new building typology for Norwegian schools: that of low-rise pavilions. Moelven's prefabricated timber pavilions curiously aligned with the most recent international recommendations on school construction at the time, offering scaled, child-friendly and tactile school environments. Continuously negotiating the economy of means and experience of educational spaces, the company developed a set of standardised solutions that could be adapted to different programmes, site conditions and budget constraints.

Unfortunately, both the general history of post-war school building in Norway and the more specific history of industrial school production remain to be written. Although the pedagogical experiments of the Council for Innovation have attracted some research—among them, a volume of essays edited by Alfred Telhaug, the architectural discussions of the Committee for Educational Buildings remain entirely unstudied.[217] As this chapter has argued, Norwegian debates on post-war school building were firmly anchored within a broader international context. School officials went on study trips abroad, and educational policymakers maintained close professional relations with their foreign colleagues and invited external experts and practitioners to lectures and conferences in Norway. Among the references were not just projects from immediate Scandinavian neighbours, Denmark and Sweden, but also the most recent developments in England, Germany, Switzerland and the United States. These experimental projects were disseminated through publications in professional architectural magazines, but were also known to industrial producers at the time. While architects like Winsnes or Bernhoff Evensen worked on experimental pavilion school projects—many today considered heritage objects representative of "humanistic Scandinavian modernism"—industrial producers like Moelven Brug developed a reproduceable system for this new typology.[218] They thus represent a significant Norwegian contribution to international experiments with school prefabrication and testify to a cross-pollination of ideas between educators, policy-makers, school officials, architects and entrepreneurs.

An anecdote on the place of Moelven schools in Norwegian history will aptly conclude this discussion. An early draft of this chapter was presented at the "Architecture and Welfare State" conference in April 2019 in Copenhagen, and was met with a general unease about Moelven industrial structures and their place in Norwegian architectural history. At the end of the discussion, a professor from the University of Oslo approached me, explaining that he recognised one of the schools as his

217 Telhaug, *Utdanningsreformene*.
218 Undervisningsbygg Oslo KF, *Verneplan for osloskolene. Vedlegg 3*, 72.

own that he fondly remembered for the experience and environment. Although initially sceptical, the presentation had made him appreciate the larger design process beyond these structures. This tale hints that, although Moelven schools are little heeded today, they did have a profound impact on Norwegian everyday life in the 1960s, not just as industrial buildings—structures of utility conditioned by economy—but also as architectural objects, designed with care for children’s experience of space. This chapter serves as the first stepping stone to discussing Moelven Brug's contribution to post-war Norwegian school building. Other industrial actors and architects involved in post-war school construction warrant as much research and can unearth a wealth of connections between state actors, architects and entrepreneurs.

AN URBAN DWELLERS' DREAM

CHAPTER 4

Fig. 1. To the left, Moelven's Johs. Mageli with OBOS Odvar B. Solberg in the middle and minister Helge Seip to the right at the opening of Ringsakerhus factory in May 1966. Newspaper clipping, 1966.

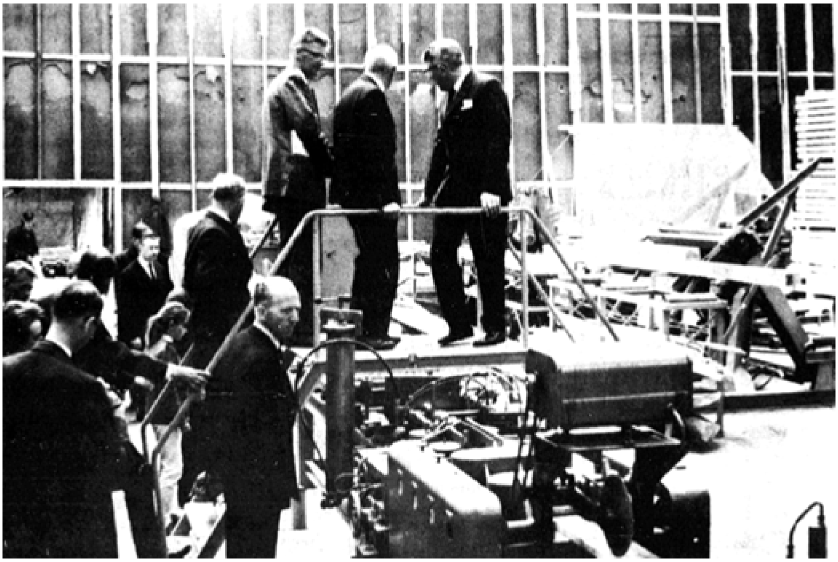


Fig. 2. Opening tour of the Ringsakerhus factory facilities. In the centre, Mageli and important guests atop of a platform at the start of the conveyor belt assembly. Newspaper clipping, 1966.

“MANY URBAN DWELLERS DREAM OF HAVING AN OWN HOUSE. LET IT HAVE THREE ROOMS OR FOUR ROOMS. LET IT BE WITH OR WITHOUT BALCONY. LET IT BE NEAR THE FOREST OR WATER, WITH A NICE VIEW, OR WITH A WINDOW TO THE MOUNTAINS. [...] FOR MOST OF US, THIS DREAM REMAINS A DREAM. WE HAVE NO LAND, WE HAVE NO MONEY. INSTEAD, WE ENLIST IN OBOS, WHERE WE ARE ASSIGNED OUR SQUARE METERS ON THAT FLOOR IN THAT HALLWAY IN THAT BLOCK. ISN’T THERE ANY POSSIBILITY FOR OUR DREAM TO BECOME REALITY?”[1]

1 Finn Resnes, “Kan fardighusprinsippet dekke boligproduksjonen?” in *Morgenposten*, February 17, 1961, 9.

A *Lillehammer Tilskuer* photograph taken on May 16, 1966 depicts three officially suited men basking in the festive pre-17th of May sun outside of the Moelven production hall.[2] On the left, Moelven's Johannes Mageli leans back in a relaxed manner, proudly showcasing Moelven's new factory to the Minister of State, Helge Seip, pictured smiling to the right. Behind them, a tall man in a black suit—Odvar B. Solberg, the director of Oslo's largest housing cooperative, OBOS, and Mageli's accomplice—seems content with the general course of the events. This photograph was taken to commemorate the opening ceremony of the just-completed 6200 m^2 Ringsakerhus factory, the latest joint venture of OBOS and Moelven. The factory was to provide liveable, affordable houses with flexible layouts that would meet the growing middle-class's demand for small-scale housing. Part of the grand marketing effort, orchestrated by Moelven's sales manager Per Granberg, the "show-tour" convened politicians of local and national calibre—including Hedmark's new county governor, Ringsaker spokesman Peder Esbjørnsen, departmental advisor Erling Anger, secretary of state Torstein Slungård, and the director of Local Government, Odvar Hedlund—and was extensively documented by an array of invited journalists.[3] The three men standing together outside the new factory mark a new era of Moelven production. Now, instead of building for the needs of the rapidly urbanising Norwegian state, as was the case with the prefabricated schools, Moelven was building together with state actors. During his opening speech, Seip underlined this symbiotic relationship between the state and industrial producers: "Moelven Brug has made a pioneering contribution to the housing sector. Serial production of houses—in the way that it is being done here with ready-made elements and sections—will undoubtedly become a building method of the future."[4] Cooperation with OBOS, which was not just a partner but also a market regulator, promised stability, clearings in the bureaucratic jungle, prime access to available land and an all-around comfortable ride hitched on the back of the Leviathan. While the previous chapter focused on how Moelven filled the gap left by the lack of state initiative in school building, this chapter instead explores a different model of cooperation between the company and the state, as it worked closely with a wide array of state and municipal politicians and decision-makers.

2 *Lillehammer Tilskuer*, May 18, 1966, 2.
3 *Dagningen*, May 13, 1966, 10.
4 *Lillehammer Tilskuer*, May 18, 1966, 2.

An industrial venture, Ringsakerhus production was indebted in equal measure to the international fascination with a modular coordinated architecture of parts, changing Norwegian land politics, and growing environmental concerns. Designed by in-house and contracted architects, the Ringsakerhus projects became closely intertwined with a changing architectural discourse. They straddled the tensions between monotony and variation, mass production and adaptability, individual and universal through a kit of industrially prefabricated building parts that could accommodate different individual programs within a larger order. Flexible elements offered an alternative to the straight-jacket of post-war modernism, and responded to the changing role of the architectural user. As the prosperity of the Norwegian middle class rose throughout the 1960s, Ringsakerhus's prefabricated housing, optimistically harnessing opportunities presented by mass-production, satisfied the urban dweller's dream of living in a single-family house. The factory and its products thus represented a peculiar meeting point between state, industrial and architectural interests, actors and ideas in the search for a more democratic and adaptable housing system. This chapter aims to unwrap these three threads of the story and map a variety of actors, ideas and policies that conditioned both the appearance and proliferation of the Ringsakerhus projects.

A SMALL HOUSE REVOLUTION

The fact that Moelven cooperated with state actors in housing provision was not surprising. In Norway, the state had consistently maintained a strong grip on housing politics. In the post-war period, the provision of good, affordable housing became one of the fundamental aspects of the Labour Party's *fellesprogrammet*—a long-term programme set to create a better, more just society.[5] Husbanken—the state's "housing bank"—established in March 1946 was one of the main instruments to achieve this goal. The bank provided housing loans and rent subsidies to ensure that every citizen could live in a "socially justifiable dwelling with a socially justifiable rent."[6] Husbanken's regulations addressed not just the financial aspects of housing provision but also established practical spatial and planning standards that had to be met if the building was to qualify for a state loan. Stirred by parliament, Husbanken

5 Jon Skeie, *Bolig for folk flest: Selvaagbygg 1920-1998* (Oslo: Tano Aschehoug, 1998), 61.
6 Elsa Reiersen et al., *De tusen hjem: Den norske stats husbank 1946-96* (Oslo: Ad notam Gyldendal, 1996), 11. The original quote is "en sosialt forsvarlig bolig til en sosialt forsvarlig leie."

transformed abstract state policies into concrete spatial regulations that conditioned how Norwegians lived. To streamline the process, the bank worked together with architects to develop catalogues of pre-approved type drawings for single houses, pre-empting the industry of ready-made house catalogues.[7] More importantly, through its rigid regulatory framework and quantitative approach to the evaluation of housing quality, Husbanken played an essential role in advancing standardisation and modular coordination in Norwegian house design. Standardisation and typification of housing were largely seen as positive elements, as they assured compliance both with architectural aesthetic demands and state regulations. As nearly one-third of the country's population were clients of the bank, and a little over half of all house construction was Husbanken-financed, most industrial producers also had to continuously adapt to the fluctuating regulations mandated by the bank. [8]

Specifically for Oslo, OBOS—*Oslo Bolig og Sparelag*—was perhaps the most influential actor engaged in housing planning, construction, provision and maintenance of over half of all building stock in the city and surrounding areas. Founded in 1929 after a Swedish cooperative model, by 1934 it was entrusted with the responsibility for all housing provision by Oslo municipality.[9] Closely aligned with the ideology of the Labour Party, the cooperative's goal was to provide good and secure mass-housing of a reasonable standard.[10] This alliance was not just ideological: many OBOS managers were prominent members of the Labour Party or held positions in both institutions. For example, Odvar B. Solberg—a famous OBOS director in the 1960s—was an active Labour Party politician with strong political connections both on the city board and municipal government.[11] And precisely because of this close affiliation, OBOS housing was closely aligned with state regulations as its apartments had to fit within Husbanken's spatial framework, figuring into the state interest of keeping apartment prices down so that people with lower- and middle-income could afford them.[12] Moelven's cooperation with OBOS meant not

7 A little over 34.000 type drawings were produced and sold by Husbanken during its time. Knut Selberg and Vegard Hagerup, "Husbanken former Norge: Den norske stats husbank: innflytelse på arkitektur og tettstedsutvikling 1946-1980," (Trondheim: Norges tekniske høgskole. Institutt for by- og regionplanlegging, 1981), 26.

8 Reiersen et al., *De tusen hjem*, 12.

9 Per Nestor, *OBOS bladet*, 5 (1979).

10 OBOS and Arnfinn Guldvog, "Oslo bolig- og sparelag: 1929-1954 : utgitt i anledning 25-års jubileet september 1954" (Oslo: OBOS, 1954), 66. Per Otto Riis, "OBOS og boligmarkedet: en analyse av transaksjoner med andeler i borettslag tilknyttet Oslo Bolig- og Sparelag" (Oslo: Universitetet i Oslo, 1975), 2. Also see Johan-Ditlef Martens, "Norsk boligpolitikk fra sosial profil til fritt marked" (Oslo: AKP, 1982), 66.

11 Bjørn Bjørnsen and OBOS, *Hele folket i hus: OBOS 1929-1970*, *Norbok* (Oslo: Boksenteret, 2007), 164.

12 Riis, "OBOS og boligmarkedet," 7.

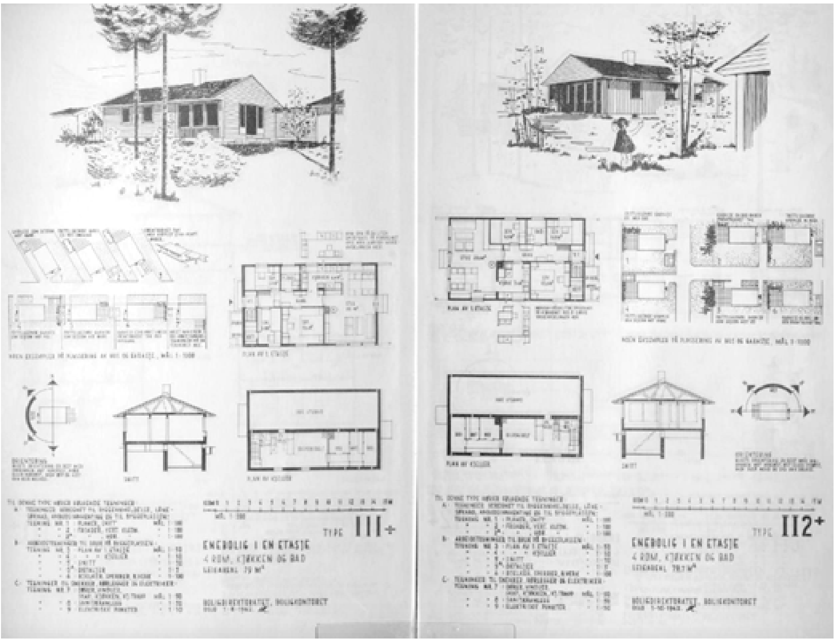


Fig. 3. Typification of residential construction was well underway since 1945, as most of new construction had to comply with floor-plan regulations established by Husbanken. Sample single-house type drawings from *Boligdirektoratets typetegninger: katalog*.

just an increasingly close alliance with state actors, but also a shared ideology of providing affordable mass-housing to a good standard.

Up until 1965, OBOS housing was closely associated with apartment blocks and high-rises. During Ulrik Olsen's "housing drive" in 1954, Norway became the country with the highest per-capita housing production in Europe.[13] Apartment blocks allowed for higher density when compared to row-houses or detached homes. Between 1953 and 1963, the share of multistorey apartment buildings grew from 20 to 45% of the total construction volume, while construction of single-family housing decreased dramatically.[14] Being an OBOS member did not just mean living in apartments: it also presupposed a certain "OBOS mentality" based on a specific ownership model positioned between an owner and a renter.[15] Dwellers shared not just the costs of coopera-

13 Reiersen et al., *De tusen hjem*, 161. Solberg in *Arbeiderbladet*, October 8, 1965, 3. *Dagbladet*, September 21, 1965, 2.

14 Selberg and Hagerup, "Husbanken former Norge," 35. Halvdan Buflod, *Teknologisk endring av småhusbyggingen: en analyse av drivkrefter og samfunnsmessige konsekvenser* (Oslo: Norsk institutt for by- og regionforskning, 1985), 44.

15 Riis, "OBOS og boligmarkedet," 5.

tive living and maintenance provision but also had to follow a set of rules and regulations that structured responsibilities for the upkeep of all shared spaces. This, however, did not always fare well in a country where the majority of the population traditionally lived in single-family homes, often with no neighbours in sight.[16] A small-house revolution was in the works. Already in a 1959 letter to *OBOS bladet*—the magazine for cooperative members—a reader wondered, whether a desire to move to a smaller-scale house could be considered one of the basic human instincts.[17] As middle class welfare grew towards the "golden sixties," OBOS members also grew increasingly tired of prescriptive communal rules, fostering a new desire for urban small-house living.[18] The smaller house typology offered closer contact with the ground and was more flexible for long-term family needs—a sentiment sustained by an increasing public and professional discontent that culminated in the so-called "Ammerud report"—a very critical evaluation of high-rise typology and "the greatest watershed in the Norwegian discourse on satellite towns."[19] In addition, there was a perceived inequality in the way housing typologies were distributed across social classes and the growing middle class also wanted their share.[20] As the tidal wave started to turn, Mageli too commented on the issue, saying that "by now it is clear, that the high-rise typology had already seen its better days."[21]

Implementing a small-house revolution within the cooperative framework was difficult. Single-family homes comprised only 7% of all OBOS's building volume in 1960.[22] Largely, this was due to considerations of cost. Single-family typologies required more investments in infrastructural development, and since the costs were shared across fewer dwellers, the houses turned prohibitively expensive and often exceeded Husbanken's cost-framework. Secondly, OBOS officials argued that it was not up to them to decide on specific house typologies. By setting a strict financial framework, politicians and Husbanken's decision-makers practically ruled out smaller-scale typologies. In Oslo, there was also another issue—lack of land plots available for construction. OBOS management concluded that small-house construction was "just not

16 Johan-Ditlef Martens, *Norwegian housing*, *Norbok* (Oslo: Norsk arkitekturforl., 1993), 7.
17 *OBOS bladet*, no. 4 (1959).
18 Riis, "OBOS og boligmarkedet," 7. Also in Riis, 24 and *OBOS bladet*, no. 4 (1959): 23-24; *OBOS bladet*, no.6 (1960); *OBOS Årsmelding og Regnskap* 1974, 7.
19 Th Hansen and Anne Sæterdal, "Ammerud i Planlegging av en ny bydel," *Rapport 58* NBI, 1969. See more in Guttorm Ruud, "Sites of Crisis: Histories of the Satellite Town" (PhD Diss., The Oslo School of Architecture and Design, 2021), 39, http://hdl.handle.net/11250/2725351.
20 "Konsentrert småhusbebyggelse: innlegg i debatten," Artikler og foredrag samlet av Treopplysningsrådet 1 (Oslo: Treopplysningsrådet, 1972), 2.
21 *Gudbrandsdølen*, June 5, 1964, 5.
22 *OBOS bladet*, no. 6 (1960).

Fig. 4. OBOS housing grew synonymous with living in apartment blocks. A painting of Lambertseter OBOS housing by Arne Stensberg, 1957. From *De tusen hjem: Den norske stats husbank 1946-96*.

possible" within the boundaries of Oslo, and advised those who wanted to live in private homes to move to neighbouring municipalities.[23] By the 1960s, lack of available land for construction was not just apparent but became a real "Achilles heel" of Norwegian housing politics.[24] Regional planning was centralised, and thus not very effective, and there was little land available next to dense urban areas. In addition, land prices increased dramatically after price regulations were dissolved in 1954.[25] Those few available plots, on their part, were not developed rationally, since different jobs were outsourced to innumerable subcontractors, too many to supervise and manage coherently. The problem of land

23 *Aftenposten*, June 10, 1965, 11.
24 *Arbeiderbladet*, October 8, 1965, 3. *Arbeiderbladet*, December 30, 1965, 7.
25 Reiersen et al., *De tusen hjem*, 202.

procurement was so dramatic that the parliament-mandated Ulveseth committee on building rationalisation concluded that technological developments alone would not significantly increase housing production.[26]

And production of housing was high on political agenda at the time. In the early 1960s, several initiatives were set up to study the opportunities and bottlenecks of increased housing provision. Besides the Ulveseth committee, the "land plot" committee was to study the problem of land management and propose possible solutions. In fact, land reform was essential if the lofty promises of the new government were to be fulfilled. In the 1965 electoral "number war," the centre-right coalition unexpectedly outbid the Labour Party on their home turf, promising 40.000 new houses per year.[27] That same year, the new political agenda, coupled with the committees' suggestions, set in motion a large-scale reform of the planning and building law. The reform decentralised physical planning, and delegated all responsibility and oversight of housing construction to municipalities that were in charge of developing both general and regional plans. Tax incentives were introduced for landowners to encourage the sale of available plots, while municipalities were prioritised over other buyers. Most importantly, the new building law updated the rules on land compensation. Now, municipalities could expropriate the ground before it was fully developed and request full compensation for their expenses on infrastructural development—a regulation that was supposed to make more plots available at a lower price.[28] It was particularly this building law of 1965 that, according to historians Elsa Reiersen and Elisabeth Thue, had the most profound effect on the housing market of the 1960s.[29] Infrastructural development fell on the shoulders of house buyers instead of municipalities, making single house construction very expensive. To distribute the costs more evenly, more houses had to be placed on a single plot of land, paving the way for discussions on land-utilisation and experiments with concentrated small-house typologies. Growing environmental concerns and problems of land preservation—now also administered by local municipalities—favoured new types of clustered construction. Although it took some time for the new regulations to come into full effect, the 1965

26 Komiteen for rasjonalisering av byggevirksomheten and Norge: Kommunal- og arbeidsdepartementet, *Innstilling om rasjonalisering av byggevirksomheten: Innstilling I fra Komitéen for rasjonalisering av byggevirksomheten*, *Norbok* (Bergen, 1965), 6. Also in *Hamar Arbeiderblad*, December 17, 1966, 3.
27 Reiersen et al., *De tusen hjem*, 210–11.
28 See Haugland in *Arbeiderbladet*, August 22, 1964; flat tax in *Arbeiderbladet*, July 11, 1966; *St. meld. no. 14* (1964-65); *St. meld. Nr. 63* (1967-68); *St. meld. Nr. 87* (1966-67); as well as *Bygningsloven av 18. Juni 1965*: 4 foredrag, §46 and §47. Also in Reiersen et al., 218–20.
29 Reiersen et al., 220–22.

building law dramatically changed the nature of construction, particularly around Oslo. It was among the most influential factors that conditioned not just the proliferation of concentrated small house typology, but also opened new market opportunities for industrial housing producers.

MOELVEN X OBOS

This gradual turn towards a new housing typology can also be detected in Mageli's interviews. Up until 1965, on many occasions Mageli emphasised that the company would "never" engage with the production of prefabricated houses. Having previously worked with Norsk Boligindustri—the first modern prefabrication firm in Norway—Mageli was well-aware of the complications that arose with house prefabrication. This type of production required "painfully-precise planning," top-level specialists and large investments.[30] With the current state of affairs, factory production of housing was not just complicated, but an experience more akin to "banging on a wall." In addition to outdated building and handcraft laws that prohibited building workers to carry out their tasks in other counties beyond their own, public opinion was set against prefabrication.[31] Although the changing land politics could aid the development of industrialised construction, Mageli continuously swore that "our company is not going to do it."[32] However, by 1964, as clear signals in favour of building industrialisation trickled down, Mageli's tone changed. Now, Moelven "could" produce prefabricated houses, but it would require large investments, new planning methods, cooperation of professionals from different sectors and a steady demand for large series.[33] Reluctance melted into urgency: "if there won't be a change very soon, the Norwegian market will be taken over by Swedish prefabricated houses."[34] Thus, it is not surprising that when OBOS director Solberg approached Mageli in 1964, the deal was quickly sealed.

Solberg, according to OBOS historians Bjørnsen and Kronborg, was a classical modernist who believed in "progress, renewal, machines and the political left in Norway."[35] However, after visiting Paris in 1962, where he saw giant colossi of social housing next to motorways, he grew disillusioned with the urban renewal taking place elsewhere in Europe.

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30 *Ringsaker Blad*, October 15, 1957, 1-2. For NBI, see Øystein Kock Johansen, *Å bo: II: Tradisjon og nyskapning*, vol. II (Oslo: Kagge, 2012), 351–52.
31 *Ringsaker Blad*, October 15, 1957, 1-2.
32 *Morgenposten*, February 17, 1961, 9.
33 *Arbeiderbladet*, March 18, 1964, 14. *Gudbrandsdølen*, June 5, 1964, 5.
34 *Nationen*, June 8, 1964, 1.
35 Bjørnsen and OBOS, *Hele folket i hus*, 200.

Solberg became convinced that development in Oslo had to go a different way.[36] By 1965, the Romsås development was earmarked as the testing ground for the new low-rise OBOS typologies. [37] Out of 1200 apartments, 400 were to be built as row-houses. Solberg encouraged the architects' team, consisting of Alf Bastiansen, Christiansen-Kleiven, Klippgen-Holm-Halvorsen and Nils Rosland, to think "new and bold."[38] These new house typologies had to follow the spatial standards set by OBOS, yet be cheap enough to fit within Husbanken's framework. In order to achieve this precarious balance of price and quality, the cooperative would have to maintain close control of both the design and production process. This meant that OBOS had to partner with an industrial producer. By then, NBBL—an umbrella organisation of all housing cooperatives in Norway—had helped to set up Eidskog Industrier, a timber prefabrication company founded in 1964. However, it was too small, had little practical experience and a limited technical apparatus to deliver commissions of the scale required by OBOS.[39] Moelven, on the other hand, had extensive experience with prefabrication, well-known in the industry. By June 1965, an agreement had been reached—OBOS and Moelven established a new Ringsakerhus factory with an evenly shared capital contribution of 50/50 percent. Starting with Romsås, the new company was to produce all small-scale timber housing for OBOS.

The new joint factory was planned with a capacity of at least 600 houses a year, with the possibility of two- or three-fold expansion.[40] Setting up a new factory together with Moelven meant that OBOS could maintain close control over both quality and the production process.[41] For Moelven, Ringsakerhus was a way to diversify the company's production, expand operations, and incorporate products from other departments. Close collaboration with OBOS meant that the factory could maintain a fixed stream of commissions and large serial orders in years to come. In order for this kind of production to be profitable, the factory had to produce at least 1000 houses per year.[42] In addition to deliveries for OBOS, Ringsakerhus would sell prefabricated row-houses for other cooperatives and developers at a profit for both partners.[43] Most im-

36 Bjørn Bjørnsen, Anne-Kristine Kronborg, and OBOS, *Hele folket i hus: OBOS 1970-2009*, *Norbok* (Oslo: Gaidaros, 2009), 42–43.
37 *Hamar Arbeiderblad*, June 10, 1965, 3.
38 Bjørnsen, Kronborg, and OBOS, *Hele folket i hus*, 43.
39 Bjørnsen, Kronborg, and OBOS, 50–51.
40 *Bergens Tidende*, June 9, 1965, 8. *Arbeiderbladet*, October 8, 1965, 3.
41 *Lillehammer Tilskuer*, June 9, 1965, 1-2. Also in *Aftenposten*, June 10, 1965, 11.
42 *Arbeiderbladet*, March 18, 1964, 14.
43 *Aftenposten*, June 10, 1965, 11.

OBOS systematiserer sitt arbeid i Oslo-området

Teknisk revolusjon pågår i norsk bygningsindustri

ELEKTRONISKE DATAMASKINER FØLGER BYGGEARBEID SOM MER OG MER BLIR MONTERING AV FERDIGE ELEMENT

Den tekniske revolusjon ser nå ut til å holde sitt inntog i bygningsbransjen, og slå ut i en virkelig bygningsindustri her i landet. Prefabrikasjon av trehus vil i åra som kommer sette sitt preg på boligstrøkene. Også reisningen av boligblokker endrer seg, fra byggearbeid i tidligere forstand til montering av store enheter fra fabrikk. Opptil hele kjøkkener kjøres nå fram til byggeplassene. Forskningsapparatet er i sterk vekst, og samordnet planlegging og kalkyleopplegg har fått et eget konsultativt organ. Som en av de sentrale skikkelser i norsk boligbygging, direktør Odvar B. Solberg i OBOS, uttrykker seg: «En god del nytt er i emning.»

Her er noen eksempler:

■ I disse dager søker Norges Byggforskningsinstitutt etter en rekke nye medarbeidere med

pert på området, professor Hans Granum, innleder til debatt, og den videre drøftelse finner sted som en rundbordkonferanse ved arkitektavdelingen

Fig. 5. An interview with OBOS director about the “new technical revolution” that is happening in Norwegian building industry, referring to the new ready-made element factory. Newspaper clipping, 1965.

portantly, however, deliveries for OBOS allowed one to bypass the main bottleneck—lack of available land—and access uniform, easy-to-build areas.[44] Since industrial actors involved in housing construction no longer depended solely on the technical efficiency of their production apparatus but also on municipal land politics, cooperation with OBOS with its particular political affiliations allowed Moelven to access new actors within local and regional administrations. This became quickly visible when the factory became a destination for high-profile policy-makers.[45]

In 1966, after overcoming the initial hiccup of finding appropriate land for construction, a 6500 m^2 factory building was built over just a couple of months with Laminator elements.[46] Upon completion, the factory was featured widely in the national and local press (following the general marketing strategy of Mageli, who was convinced that industrial producers bore the sole responsibility for promoting their products).[47] The main goal of the new venture was set as “building

44 *Arbeiderbladet*, October 8, 1965, 3.

45 See a string of visits in 1966-67, in Box “L0001–Bedriftsbesøk,” in SAH/ARK-287-01/M/L0001.

46 Symptomatically, an updated land law also contributed to the factory establishment: Ringsaker municipality was going to invoke the new expropriation law to get 43 mål of cultivated land and 6 mål from a farmer Even Glestad if no amicable agreement about it would be reached. *Gudbrandsdølen*, June 11, 1965, 12; *Gudbrandsdølen*, June 29, 1965, 5; *Lillehammer Tilskuer*, July 12, 1965, 2; *Ringsaker Blad*, September 16, 1965, 1 and *Hamar Arbeiderblad*, September 23, 1965, 1, 11.

47 Nordisk byggedag and Kai Christensen, “Nordisk byggedag, VIII: København 18.-20. september 1961: referat” (København, 1962), 118.

reasonable, serial-produced housing of a high standard with particular attention to economy," an intention which aligned with both OBOS's politics and changing public opinion at the time.[48] Prior to the famous Seip visit in May 1966, 25 OBOS functionaries and 60 people in total visited the factory, finding it "very impressive."[49] While the media was quick to draw a conclusion, claiming that Ringsakerhus would make a "significant contribution" to Seip's housing programme, Mageli still warned that "fabrication of housing [was] not some kind of Sesam."[50]

The Ringsakerhus building system, indeed, was not a magic solution. Element construction—successfully used for school buildings for several years—was now reworked for housing needs.[51] The element assembly allowed for more flexible designs and was a popular solution for prefabricated housing at the time which, until then, had always been carried out in concrete. The new Ringsakerhus leader—a 41-year-old civil engineer, Jan F. Reymert—was perhaps the best-suited man to advance this new venture. After graduating from NTH in 1949, he briefly worked for Ringnes and Selvaag. Between 1951 and 1952, Reymert studied building research in Sweden and, as architectural historians Erik Sigge and Erik Steinberg note, was a close follower of the industrial entrepreneur Ernst Sundh who was among the Swedish pioneers of large prefabricated elements.[52] Returning to Norway, Reymert worked with NBI and Øivind Birkeland on problems of productivity and rationalisation in the building industry. At NBI, he carried out research projects financed by the NPI and the US Technical Assistance Program and published several reports on new machines, transportation on construction sites and building workers' productivity.[53] Prior to joining Ringsakerhus, he was a technical leader at Pre-Fab A/S, a company that specialised in large concrete elements. No doubt Reymert's experience with element prefabrication at home and abroad and extensive research into questions of productivity in construction matched Moelven's drive for a more technological form of production. Equipped with this managerial expertise on prefabrication, the cushion of OBOS's network, and cutting-edge production apparatus, the factory's conveyor belt lines were ready to set off.

48 *Sarpsborg Arbeiderblad,* October 4, 1968, 6-7.
49 *Ringsaker Blad*, May 10, 1966, 1.
50 *Norges Handels og Sjøfartstidende*, May 20, 1966, 4. *Nationen*, November 30, 1965, 12.
51 *Hamar Arbeiderblad*, May 21, 1966, 8. *Glåmdalen*, June 16, 1970, 7.
52 Erik Stenberg and Erik Sigge, an unpublished manuscript with background research for "Svensk flygande betong," private correspondence.
53 Jan F. Reymert and Norges byggforskningsinstitutt, "Produktiviteten i bygningsindustrien," Særtrykk (Norges byggforskningsinstitutt: Oslo, 1954). Jan Reymert, *Bygningsarbeideren* 28, no.7-8 (1953): 198-199.

Fig. 6. To the right, civil engineer Jan F. Reymert, future manager of Ringsakerhus. In the middle, NBI director Øivind Birkeland, with whom Reymert worked for several years. To the left, architect O. H. Grimsgaard. Photograph taken at the course on prefabrication for housing. Newspaper clipping, 1958.

Fig. 7. A truck loading flat prefabricated elements in front of the new Ringsakerhus factory. Newspaper clipping, 1966.

ELEMENTAL APPROACH

And so they did: the factory produced a series of row- or semi-detached single or two-storey family houses for large housing developments in Oslo and neighbouring municipalities. The house types were developed so that the buildings could be clustered together, providing the most optimal land-use value required by the land politics of the time. Production was based on serial orders made for larger construction companies, cooperatives and private developers—not private consumers. Series larger than 15 houses were prioritised, and the company did not deal with infrastructural development of land but delivered only "above-the-foundation-wall" structures. A system of narrow vertical elements developed by Grinde in 1957 was reworked into a system based on load-bearing timber wall panels. Yielding an overall 60% prefabrication grade, the panels came with inside and outside finishes, but a significant part of the final works had to be carried out on-site.

The Ringakerhus elements were large: two to three metres high and up to six metres wide, based on a planning module of 60 cm. Defining for all Ringsakerhus housing projects, this modular dimension had quite a prosaic origins. According to historian Jon Skeie, in the years following WWII Norwegian industrial stone-wool producers switched from standardised rolls of 80 cm to those 60 cm wide. Consequently, most timber-frame construction in the country also switched to a 60 cm module, which was standardised with the publication of *Moderne Trehusbygging* book issued by the Ministry of Housing in 1953.[54] This proliferation of standardised timber frame structure and insulation simplified construction, made it more economical, and allowed to separate wall and floor elements.[55] Most importantly, however, it enabled the long-aspired transformation from building with individual construction materials—i.e. planks, studs or bricks, towards one where entire parts of the building—i.e. walls, floor or ceiling elements—could be prefabricated.

Architectural historian Christine Wall, who explores a similar transformation in post-war Britain, argues that this "architecture of parts" required innovation in both structures and methods of building and de-

54 Boligdirektoratet, *Moderne trehusbygging* (Oslo: Direktoratet, 1953). Among notable projects that also used the 60 cm module were Arne Korsmo's experimental SHKS apartments and Korsmo and Norberg-Schulz's Planetveien houses outside Oslo. "Praktisk eksperimentoppgave 1953, 48m2 leiligheten" in *SHKH, Statens håndverks-og kunstindustriskole årsmelding 1952-1953, 1953-1954*, unpaginated. Elisabeth Tostrup, *Planetveien 12: Arne Korsmo og Grete Prytz Kittelsens hus* (Oslo: Pax, 2012), 52.

55 David Monteyne, "Framing the American Dream," *Journal of Architectural Education* 58, no.1 (September, 2004): 24-33.

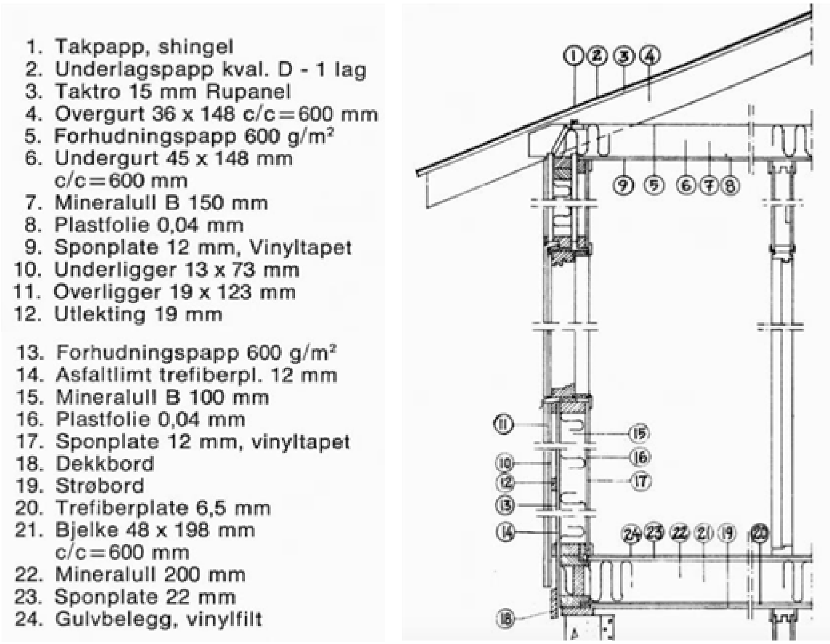

Fig. 8. Details of Moelven panel construction. From *Byggekunst* 55, no. 2 (1973).

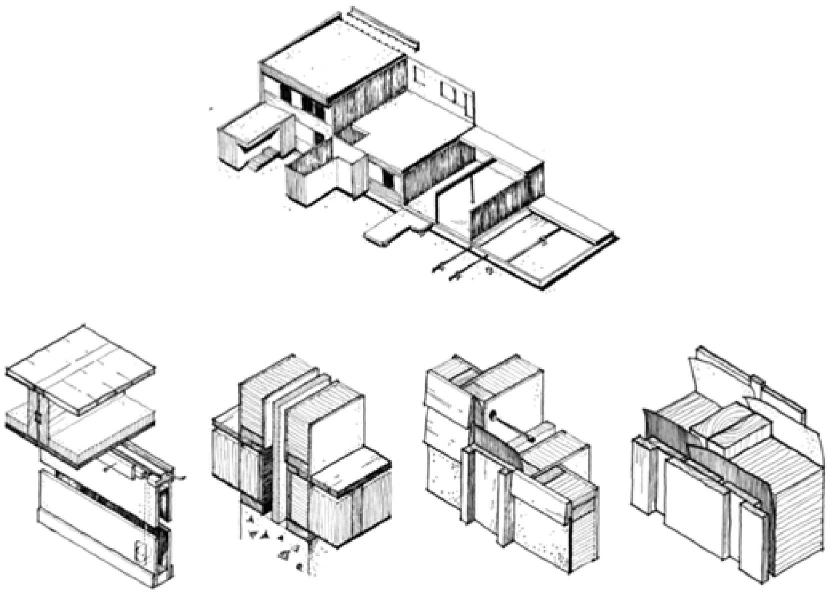

Fig. 9. Construction details of Ringsakerhus building system. From *Trehus 70*.

sign.[56] Although ideas of prefabricating large elements had been voiced by practitioners like Vaardal-Lunde already in the immediate post-war period, up until 1965, Norwegian companies lacked a technological apparatus sophisticated enough to produce such elements. Moelven's assembly-line process consolidated previous innovations in timber construction and introduced a new building approach—an assembly of parts. The Ringsakerhus wall elements were complex technological artefacts that amassed layers of timber frame, sheathing cardboard, asphalted glulam, wood-fibre plastic, mineral wool, cling film, chipboard and gypsum panels sourced from 70 to 80 contractors.[57] They were produced at the factory, sealed off and shipped to site, where they were assembled together with floor and ceiling parts. According to Mageli, this type of production required rigorous planning and coordination, and those unprepared to deal with it were in for certain bankruptcy.[58] Only one other company in Norway engaged with this kind of element prefabrication—Eidskog Industrier, a venture unsuccessful and short-lived.[59]

The Ringakerhus factory employed around 50 workers, divided into teams in charge of different building parts.[60] Production of a wall element required a team of two people; to complete all walls for a single house, twelve two-person teams were needed. Floor and ceiling elements were produced on two conveyor belts; frames and beams were nailed together by a team of two or three workers and then layered with sponge plates, insulation and plastic foil as the conveyor belt progressed.[61] Few elements of the same type were produced at the factory twice, as precise element dimensions and configurations varied depending on project specifications. Therefore, both technical equipment and the production process had to be flexible enough to accommodate different element dimensions. At the end of the production line, finished elements were picked up by two large traverse-cranes and placed into storage, flat-packaged, and delivered to the site in the order of assembly.[62]

56 Christine Wall, *An Architecture of Parts: Architects, Building Workers and Industrialization in Britain 1940-1970*, Routledge Research in Architecture (London: Routledge, Taylor & Francis Group, 2013), 100–101.
57 Johs. Mageli, "Synspunkter på ferdig-husindustrien," *Byggekunst* 55, no. 2 (1973): 51.
58 *Gudbrandsdølen*, June 5, 1964, 5. *Nationen*, June 8, 1964, 1.
59 For Eidskog problems see Bjørnsen, Kronborg, and OBOS, *Hele folket i hus*, 51. *Aftenposten*, July 14, 1970, 6.
60 *Bedriftavis,* no.12 (1972): 9-10.
61 *Bedriftavis,* no.12 (1972): 13.
62 *Ringsaker Blad*, September 1, 1966, 1. Moelven industrier et al., *Moelven 1899-1999*, *Norbok* (Moelv: Moelven industrier, 1999), 48.

Fig. 10. On-site Moelven element assemly. Photographs from https://munkerudsletta.no/?p=12047, acessed March 8, 2022. Below, Raufoss housing, from *Moelven 1899-1999*.

If the foundation was already in place, three or four workers could assemble one housing unit per day with the help of a building crane. In order to do that, Moleven had to develop its own telescopic crane built in the mechanical workshop. Up until 1965, there were few cranes used in Norwegian building industry, and prefabricated buildings producers tended to design their elements light enough so that two workers could lift them manually.[63] Each Ringsakerhus element weighed around 300 kg, and the assembly of each living unit required around 50-60 crane operations.[64] According to first-hand witnesses, it was "quite impressive" for non-professional people to observe the process: "at 7 o'clock in the morning the foundation has started. At 14.15

63 *Aftenposten*, March 3, 1967, 19. *Arbeiderbladet*, March 3, 1967, 5. NPI 053 project "Datablad for byggemaskiner," RA/S-1623/D/Df/L0417/0001, State Archive, Oslo, Norway.

64 *Bedriftavis*, no.1 (1967): 14-15.

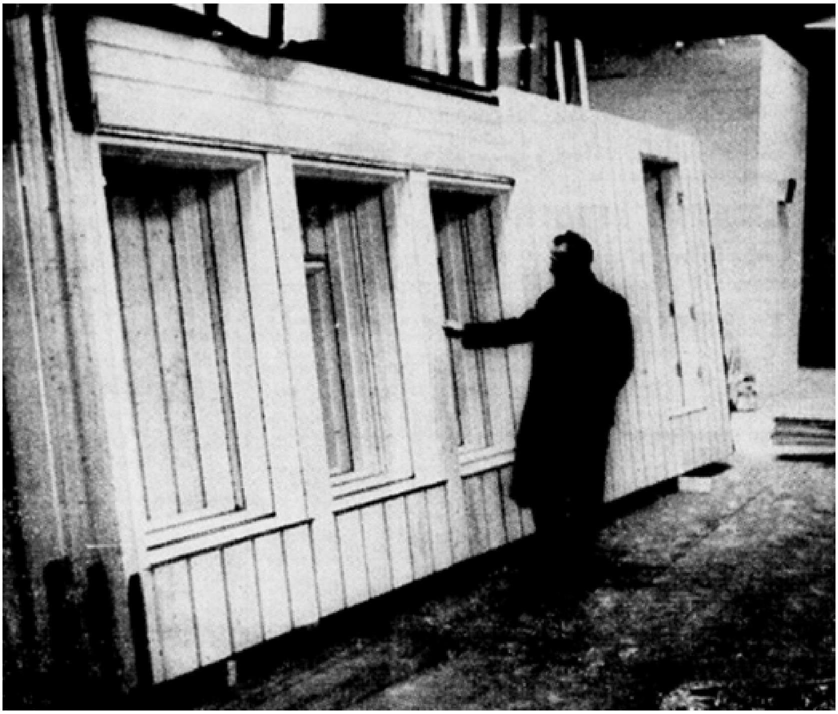

Fig. 11. Jan Reymert in front of stored Ringsakerhus wall panels. Newspaper clipping, 1966.

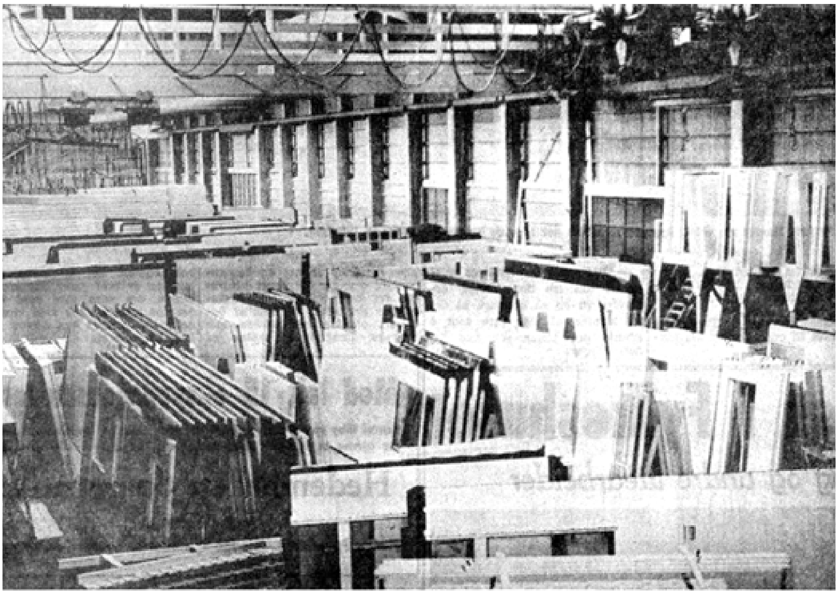

Fig. 12. Storage of Ringsakerhus panels. Newspaper clipping, 1967.

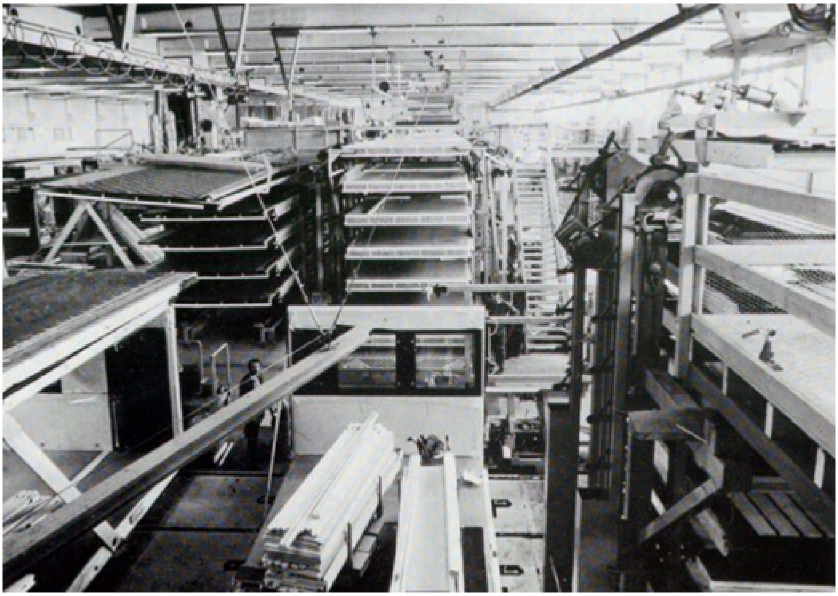

Fig. 13. Ringsakerhus later production process. Above, panel construction; below, automated storage of elements. From *Moelven 1899-1999*.

the house is already in place and the internal finishes can begin."[65] The speed of construction was documented through a series of photographs, employing a language similar to that of comic-strips or building manuals—the same method used to document Levittown's construction in the United States. This comparison is not too far off: as previously mentioned, Norwegian professionals toured Levittown during the 1952 productivity trip, and Mageli visited the project during his 1967 trip to the United States to study small-house construction.[66]

However, different from the United States, Norwegian building legislation was less flexible, and the company had to work hard to adapt its element construction to the realities of Norwegian working life. For example, while Ringsakerhus wall, floor and ceiling elements had doors and windows already installed, internal finish work with piping and electric installations had to be done on-site.[67] Mageli called these challenges—including an outdated 1913 craft law that prohibited professional builders from performing work beyond their home municipality—"a wall of inflexible provisions."[68] In other words, Norwegian work regulations were not prepared to accommodate a new type of production, and caused significant disruption to Ringsakerhus operations, which required specially educated people to assemble building parts on-site, often in a municipality different from Ringsaker.[69] Consequently, Moelven had to design creative work-arounds: for example, bathroom and toilet units were pre-packaged at the factory as "wet boxes" with all internal cladding and sanitation equipment built in, reducing the need for elaborate plumbing work on-site.[70] After a building unit had been assembled by Ringsakerhus workers, another team consisting of local builders would work on the plumbing, sanitation and internal finishes. Other adaptations followed: Moelven Systemrør A/S, founded in 1966, was to manage all water and sanitation works.[71] A year later, Moelven Consult A/S was established to manage the procurement and development of land for construction sites more efficiently. Moelven Oslo A/S was opened the same year to oversee many of the company's building sites around the capital.[72]

Ringsakerhus's production thus heralded the long-awaited transfor-

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65 *Nye bonytt: norsk spesialblad for hus, hjem og boliginnrednin* 31, no. 7 (1971): 5-10.
66 *Bygningsindustrien i U.S.A: rapport fra det norske bygningsteams studietur september-oktober 1951*, *Norbok* (Oslo: I kommisjon hos Aschehoug, 1954), 58. For Mageli trip see *Bedriftavis*, no.1 (1967): 12-13.
67 *Ringsaker Blad*, December 30, 1967, 1.
68 Komiteen for analyse av byggekostnader and Norge: Kommunal- og arbeidsdepartementet, *Innstilling fra komiteen for analyse av byggekostnader: komitéen er oppnevnt ved kgl. res. av 3. februar 1950*, *Norbok* (Oslo: Kommunal- og arbeidsdepartementet, 1953), 176. *Ringsaker Blad*, October 15, 1957, 1-2.
69 E. Vaardal-Lunde. "Monteringsferdige Trehus i Norge," *Byggekunst* 31 (1949): 88.
70 Moelven industrier et al., *Moelven 1899-1999*, 70.
71 *Norsk Lysningsblad*, October 11, 1966. *Hamar Arbeiderblad*, December 21, 1966, 9.
72 *Norsk Lysningsblad*, December 9, 1967. *Norges Handles og Sjøfartstidende*, June 27, 1967, 7.

mation from building to assembly: standardised prefabricated elements allowed one to save on construction work on-site, speed the delivery and reduce the costs. Element-based construction introduced design variation within a standardised production apparatus framework. This new type of production, however, required not just more rigid planning and oversight, but also creative adaptations to already-existing building regulations: the elemental approach had to be adapted beyond the factory, with work parcelled between the newly-established subsidiary companies that accounted for all stages of this assembly of parts.

LIFESTYLES OF THE FUTURE

In order for Ringsakerhus houses to be cheap, they had to be produced in types and as large series.[73] From the beginning, Solberg envisioned that the Ringsakerhus factory would not just reproduce the already-existing building types but develop new typologies in cooperation with architects and through architectural competitions.[74] With load-bearing external walls and flexible internal partitions, the Ringsakerhus houses could even pre-empt future lifestyle changes of their dwellers. Most often, external architects worked on a project design together with Moelven planners and engineers, who then adapted it for serial production. House types had to be designed in a way so that the houses could be clustered together, in order to achieve higher land utilisation and lower the shared infrastructural costs. Among the first major projects delivered by Ringsakerhus in 1967 were OBOS row-houses in Stovner, social housing for Ski municipality, and a large project in Nittedal, developed for the Oslo Police Union. Different in ambition and scale, these three projects provide a broad overview of the variety of tasks and limitations faced by Ringsakerhus production.

Since the Romsås commission was never realised, Stovner was Moelven's first housing project delivered for OBOS in the summer of 1967. The delivery consisted of 192 two-storey, flat-roofed houses with four-room apartments, each divided into two types. Type A was a more conventional row house, and type B was adapted to a slanted terrain. The house designs were first drafted by the NBBL architects' office, then adjusted for Ringsakerhus production.[75] Rather conservative in design, the houses had a conventional layout with an entrance, kitchen and living

73 *Ringsaker Blad*, September 25, 1965, 1. *Bedriftavis,* no.12 (1972): 9-10.
74 *VG*, June 9, 1965, 19.
75 *Arbeiderbladet*, August 2, 1967, 6. Also on Stovner see Bjørnsen and OBOS, *Hele folket i hus*, 203.

Fig. 14. The first Ringsakerhus project—Stovner housing—on the cover of *OBOS-bladet*, 1968.

room on the first floor and bedrooms on the second floor.[76] Nevertheless, the Stovner development provided a successful alternative to OBOS's multistorey apartment buildings—an affordable row house. The first project to be designed entirely in-house by Abrahamsen, Grinde and Philipp was a social housing project for Ski municipality. Three two-storey row houses, built on a flat foundation plate with no cellar accommodated 14 apartments.[77] Designed by the same architects that developed the entire production system, the Ski buildings fully utilised the system's structural advantages. The gable walls were divided in four elements, while each floor had just one joint element. Bathrooms and toilets arrived as ready-made "wet-boxes" that, together with stair blocks, served as stabilising components. A social housing project financed by Husbanken, each flat cost only 77.250 NOK, excluding the price of land. This was very cheap, considering that the apartments were quite large—each between 89 and 95m^2. In addition to the social housing part of the project, RH also erected three larger apartments for Ski Electricity workers, which were more expensive, but had flexible internal partitions so that the dwellers could divide the spaces according to their needs.[78] The Ski project garnered largely positive publicity, and the project showed that buildings of a good standard could be constructed at a low cost in just under 75 days.[79]

Another large serial order was carried out for Oslo Police Cooperative members: a Nittedal project at Tøyen Gård 30km north of Oslo, consisted of 130 row- and terraced two-storey buildings. With apartments of 92 and 96m^2, the Nittedal buildings were arranged in clusters of four placed along the sloping terrain. Flat-roofed and clad in dark-brown vertical timber panels, they offered a local take on modernist forms, adapting them both to local materials and specific site conditions. Unlike Stovner and Ski, the Nittedal project was built for a private entrepreneur to a slightly higher standard. With a cost of 91.000 NOK each, the double-facing apartments featured hardwood floors, modern kitchen equipment, three bedrooms, two storage places and a washing room.[80] House designs were drawn specifically for the project by a Yugoslavian architect, D. Trifunovic, and had a "very tasteful execution."[81] These first three Ringsakerhus projects—Stovner, Ski and Nittedal—illustrate how the Ringsakerhus modules could be adapted to different

76 Anne-Kristine Kronborg, *OBOS: 100 borettslag 1929-2013* (Oslo: Press, 2014), 182.
77 *Lillehammer Tilskuer*, April 18, 1967, 3. *Hamar Arbeiderblad,* September 5, 1967, 8.
78 *Aftenposten*, August 31, 1967, 9.
79 *Romerikes Blad*, August 31, 1967, 5. *Hamar Arbeiderblad,* September 5, 1967, 8.
80 *Gudbrandsdølen*, May 11, 1967, 4. Also in *Varingen*, May 26, 1967, 1.
81 *Ringsaker Blad*, May 11, 1967, 1, 2.

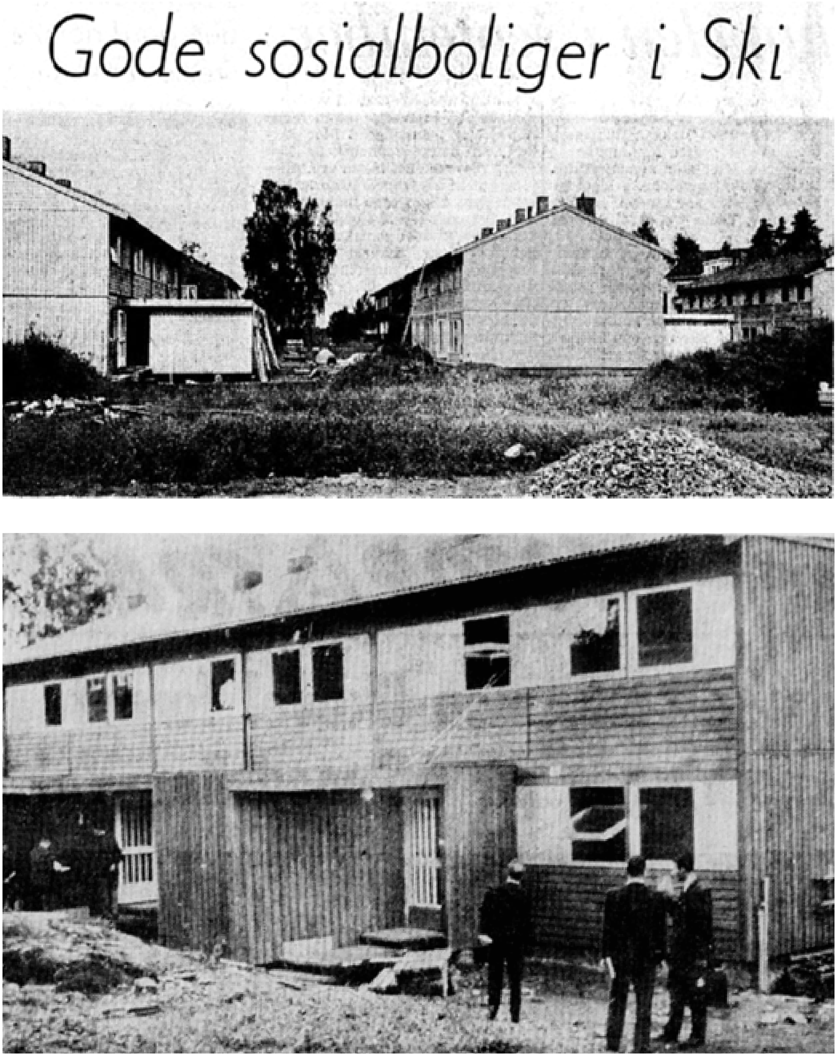

Fig. 15. Social housing project in Ski designed by Grinde-Abrahamsen-Philipp. Newspaper clippings, 1967.

Fig. 16. Nittedal housing project developed by Yugoslavian architect Trifunovic specifically for slanted terrain. Above, project drawing and photograph from newspapes, 1966. Below, contemporary google maps image.

price and quality categories, with designs that varied from state architects working within limited budgets and minimum-standards regulations to custom-made projects drawn by international architects.

Quite quickly, in addition to producing elements for individual projects, Ringsakerhus set out to develop their own fixed house-types that would be marketed to municipalities and entrepreneurs through catalogues and developed by Moelven Consult.[82] The idea was to create a concentrated small-house type that could offer the advantages of a single house but be serially produced and competitively priced.[83] Already in 1968, Moelven developed the so-called "outdoor-space" house—*uteromshus* or U89A type—with the Swiss René Philipp as the architect in charge.[84] The house was a cheaper alternative to the atrium-type that, although fashionable by the mid-1960s, was not suitable for budget construction since its customised structural solutions usually put it beyond Husbanken's cost limits. At the same time, atrium or corner-house types allowed to group several buildings together and optimise land-utilisation grade—an essential quality considering the increasing costs of infrastructural development. A single-floor "outdoor" house was based on a rectangular footprint of 20 by 4,5 metres, with all windows facing in one direction. Each house had a storage shed of 3 by 4,5 metres positioned at a 90-degrees angle to the rear end, so that, despite a linear design, each house got a private garden space shielded from the neighbours and the outside gaze. Large windows along one side of the façade allowed direct contact between the house and the garden—exactly what the new generation of house owners was craving for. With an overall brutto floor print of 108 m^2 (including storage) it fit right under Husbanken's eligible area of 89 m^2 and costed around 65.000 NOK—a very cheap offer at the time. Creatively utilising simple geometric volumes, the "outdoor" house thus offered all the advantages of the atrium type without the structural complications, and at a much lower cost.

U89A was built entirely from Ringsakerhus elements, one storey high and up to 6-metres in length, with windows and doors already pre-installed. To make construction cheaper and faster, the houses were built on a concrete foundation slab with no cellar.[85] Each house would take one day to assemble in a team of four men, given that the ground work was ready. Comprised of a living room, a kitchen,

82 *Aftenposten*, November 18, 1966, 12. *Oppland Arbeiderblad*, November 21, 1966, 5.
83 *Sarpsborg Arbeiderblad*, October 4, 1968, 6-7.
84 *Ringsaker Blad*, July 20, 1968, 3.
85 *Sarpsborg Arbeiderblad*, October 4, 1968, 6-7.

Fig. 17. A model of a U98A type house, developed by Rene Philipp, 1969. Moelven Ringsakerhus catalogue, 1969. From The National Library Archives, Oslo.

Fig. 18. U98A house awarded the “best prefabricated house of the year” award by *Bonytt*. Magazine clipping, 1970.

Fig. 19. Floor plan variations of a U89A type house. From *Bonytt typehus og ferdighus 1: råd om valg, økonomi, huskritikk*.

Fig. 20. Interiors of a U98A type house. From *Bonytt typehus og ferdighus 1: råd om valg, økonomi, huskritikk.*

three bedrooms, a bathroom and a washroom, it offered more than ten different plan layouts for future dwellers to choose from.[86] Since the house had to fit under Husbanken's space limits, some plan solutions were somewhat unconventional. For example, an 11-metre corridor between the master-bedroom and the bathroom, lack of oversight of the children's room, and the south-facing kitchen were met with a certain scepticism from architecture professionals.[87] Still, when the house was first presented at the exhibition "Bygg reis deg" in 1967, it received an overwhelmingly positive response, both from the professional audience and the general public. The fact that the total price for such house, including groundwork, was under 100.000 NOK, was considered a "record in itself."[88] By the summer of 1968, there was already a half-year waiting time for the delivery of this type.[89] In 1970, the project was chosen as the best "ready-made house of the year" in the category of concentrated small-house types according to *Bonytt*.[90] Around 182 houses of this type were built in Grålumåsen in Tune, Løken Nordre in Svelvik and a number of other large developments throughout the 1970s.[91] This "outdoor-space" type was a small-house revolution put in practice. It represented that "good and reasonably priced" architecture for ordinary people that Ringsakerhus set on to deliver.

At the same time, Ringsakerhus modules were used not only for price-conscious solutions, but also by architects interested in the spatial possibilities offered by a modular construction system. The Sankthansfjellet project at Haugerud (a north-eastern Oslo suburb) was designed for OBOS by Paul Cappelen and Thorbjørn Rodahl in 1969-71. The development consisted of 183 atrium houses placed along a sloping terrain.[92] Situated on small parcels of 9 by 13 metres each with no cellar, the design explored various grouping opportunities in order to achieve a high land-utilisation grade. Inspired by North African urban morphology patterns, the buildings were arranged in stepping, back-to-back clusters, which allowed for spacious outdoor terraces, good views and screened gardens.[93] Two-storey flat-roofed houses were decisively modernist in their clean geometric volumes.

86 *Ringsaker Blad*, July 20, 1968, 3.
87 *Morgenbladet*, June 9, 1970, 4.
88 Moelven Consult was the developer in Grålumåsen project. *Sarpsborg Arbeiderblad*, October 4, 1968, 6-7.
89 *Ringsaker Blad*, July 22, 1968, 2.
90 *VG*, 1 June 1970, p. 8. Also in *Bonytt* 31, no. 7 (1971): 79–82.
91 *Sarpsborg Arbeiderblad*, October 4, 1968, 6-7.
92 *Byggekunst* 49, no.6 (1967): 161.
93 *Byggekunst* 52, no. 3 (1970): 119.

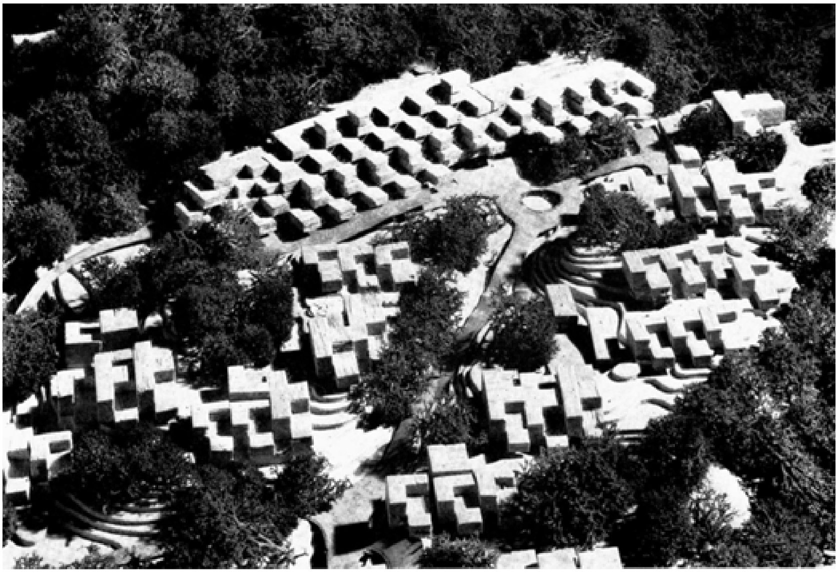

Fig. 21. Sankthansfjellet housing project. Model from *Byggekunst* 49, no. 6 (1967). Photograph from *Moelven 1899-1999*.

However, clad in vertical dark-timber panels with an imposed horizontal datum of a roof cornice, delightfully embedded within the hilly terrain and with intricate attention to landscaping, these houses offered a particularly Norwegian reading of the modernist form-language. With overall 92m^2 of floor space, each house had three bedrooms, a large living room and a spacious kitchen. Considering their rather particular spatial qualities and unique design, the apartment price was set at 128.000 NOK—significantly higher than the average OBOS apartment and thus not entirely affordable for common cooperative members.[94]

In addition to St. Hansfjellet, Cappelen and Rodahl built another project for OBOS in cooperation with Ringsakerhus: Kringsjå development at Sognsvann, north of Oslo. Constructed with the same cubic typology it was deemed very attractive, as it featured large terraces and offered great views of the Sognsvann lake. The stepped typology allowed a clear distinction between private and public areas. Outer load-bearing walls constructed with RH elements allowed for flexible spatial arrangements: the dwellers were free to choose an internal layout as they saw fit. A typical plan featured a large corner living room, four bedrooms, spacious washrooms, a cellar and a garage.[95] Although built for OBOS, Kringsjå was considered one of the most attractive housing areas in the city. When completed, the houses were divided among municipal functionaries, rather than common OBOS members, which caused a significant media stir, as a certain discrepancy over housing quality and social class became subject to a heated public debate.[96] Curiously, both of these projects, with their box-like shapes, have their roots in Cappelen and Rodahl's travels to North Africa, Morocco and Egypt, where "little Arabic villages with their peaceful introverted atmosphere" seemed to offer an alternative to the straight-jacket, modernist slab block, providing a different model of local community.[97] And although Cappelen and Rodahl were not the only architects inspired by the Mediterranean vernacular, few Norwegian practitioners explored the way prefabricated elements could be used to accommodate these new community-based housing types.[98] These two RH projects—St.Hansfjellet and Kringsjå—show how inspiration from "vernacular" urban morphologies that permeated the architectural discourse of the 1960s was adapted to available industrial

94 *Ringsaker Blad*, January 20, 1970, 1; *Gudbrandsdølen*, January 21, 1971, 2.
95 *Dagbladet*, June 6, 1969, 9.
96 *Dagbladet*, June 6, 1969, 9.
97 *Byggekunst* 49, no.6 (1967): 161. Susanne Villadsen, "History behind Munkerudsletta housing cooperative," https://munkerudsletta.no/?p=12047, accessed October 10, 2020.
98 Jon Guttu, "'Den gode boligen': fagfolks oppfatning av boligkvalitet gjennom 50 år" (PhD Diss., Arkitekthøgskolen i Oslo, 2003), 264–66.

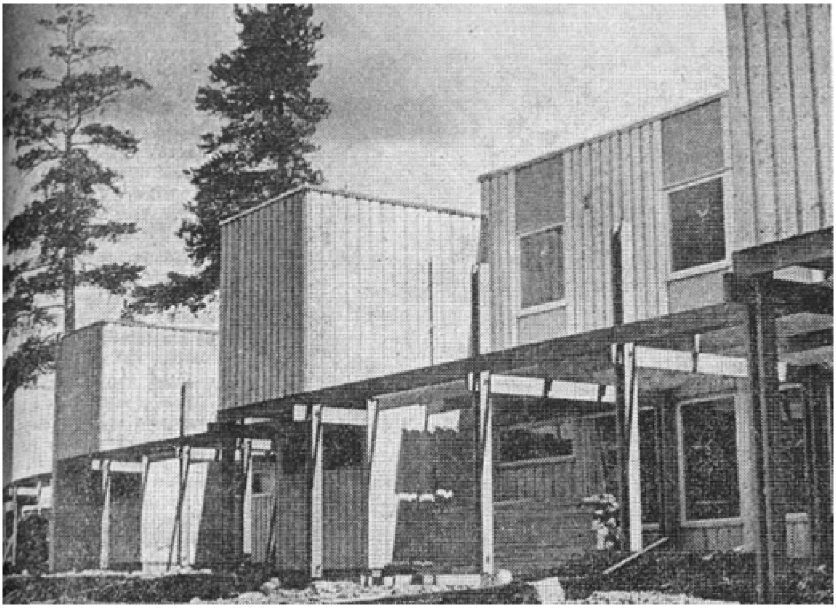

Fig. 22. Kringsjå housing project, Oslo, developed by Cappelen and Rodahl, 1968. Above, newspaper clipping contemporary to construction. Below, google maps view.

solutions—prefabricated timber elements—to offer a particularly Norwegian reading of a low-rise high-density housing typology. These two projects begin to shed light on the more profound entanglement between prefabricated timber elements and a changing architectural discourse that aspired to a non-hierarchical architecture of relations.

Although a very narrow selection from Ringsakerhus' multitude of projects, this sample survey illustrates the aspirations of flexibility implicit in RH elements that could accommodate different levels of cost and comfort. They were equally as appropriate for construction of economical housing as they were for more spacious custom-designed developments, adapted to different sites and terrains. In addition, the Ringsakerhus elements were particularly attractive to architects since they worked as an open-ended, industrial kit-of-parts, offering an opportunity for variation and diversity within an overall order. Moelven's element-based construction system grew closely intertwined with the architectural discourse, as debates on order and variation, universal and individual, entered the pages of architectural magazines—starting, in Norway, with the famous 1966 "structuralist" *Byggekunst* issue and the "Order and variation" article by Christian Norberg-Schulz.[99] Ringsakerhus elements offered a practical economic solution to this new architecture of relations that was explored at scale in the Skjettenbyen project.

"THE AIMS OF THE PLANNERS: FLEXIBLE HOUSING"[100]

Perhaps the best-known Ringsakerhus project, and the largest single commission of the company, was Skjettenbyen, built in the late 1960s north of Oslo. Danish architect Nils-Ole Lund won the 1965 architectural competition for a 1200-units housing development that called to "reconsider the common housing types."[101] Three young architects, Erik Hultberg, Jan Resen and Einar Throne-Holst, received second prize for the design of individual houses. Eventually, the two prizewinners formed a team, and thirteen architects, engineers and planners worked together under the name of Skjettenprosjektering IS.[102] It was the first, and the largest, project in the country that had an ambition of *totalprojektering*—a turnkey development, that took responsibility over the entire building process, from land acquisition to final finish-

99 On order and variation in mainstream architectural discourse see Christian Norberg-Schulz, "Orden og variasjon i omgivelsene," *Byggekunst* 48, no. 2 (1966): 45.
100 *Bonytt*, no. 7 (1971): 5.
101 *Norske Arkitektkonkurranser*, no. 116 (1965), unpaginated..
102 *Romerikes Blad*, May 28, 1970, 1.

Fig. 23. Skjetten houses were supposed to adjust and grow over time. Skjetten under construction, 1970. From *Norske typehus*.

es.[103] An experimental departure from the conventional way of building at the time, the project faced relentless criticism—from claims that the architectural competition was too expensive to heavy politically-laden financial problems.[104] Project development was halted several times due to lack of funding and discussions on house allocations. The Skedsmo Labour Party pushed back against the use of prefabricated elements, and the choice of building contractor to deliver the actual structures was delayed.[105] Nevertheless, Skjettenbyen was the first project of its scale that brought together three different actors: the government, in the form of Skedsmo municipality; a team of architects and engineers that translated international avant-garde ideas and adapted them to local conditions; and an industrial producer, Ringsakerhus, that had to significantly upgrade its production apparatus and iron out the assembly process in order to meet the delivery.[106]

103 *Nationen*, August 18, 1970, 9.
104 *Romerikes Blad*, July 22, 1966, 3; *Romerikes Blad*, November 5, 1968, 1; *Arbeiderbladet,* October 30, 1969, 11; *Vårt Land*, January 3, 1970, 10.
105 *Aftenposten*, September 23, 1967, 8. *Romerikes Blad*, October 10, 1969, 3. *Rogalands Avis,* June 4, 1970, 4. *Aktuell* 27, no.18 (1972): 14-17.
106 *Bedriftavis*, no.7 (1970) 21.

While Skjetten is well-known in Norwegian architectural history—multiple accounts position its flexible modular design within the general low-rise high-density movement, international avant-garde and Nordic housing politics—the fact that it was built by Moelven remains little discussed.[107] The Ringsakerhus elements are usually referred to as a generic "wood-based prefabrication system" or a prefabrication system that was never realised.[108] In a 2012 issue of the *Nordic Journal of Architecture* dedicated to Skjetten, only Gunnulv Eiesland, a civil engineer involved with the project, talks about how it was actually constructed. This uncertainty can perhaps be attributed to the fact that the commission was originally intended for NBBL's Eidskog Industrier, and that the professional architectural community was somewhat sceptical of Moelven's production. As Eiesland recalled:

"When detailing the Skjetten houses, we depended on the dialogue with several possible producers to make houses fit for prefabrication and assembly on site. Our client was keen to use Eidskog Industrier [...]. Not trusting the competence of Eidskog, however, we decided to bring a second company into the discussion: Ringsakerhus, owned by Moelven Brug. [...] Later, Eidskog Industrier went bankrupt, leaving us without competition all together, and the contract went to Ringsakerhus."[109]

Ringsakerhus was, in fact, the only company that had a production apparatus suitable for a commission of such scale. As Skjetten's construction chief, Haugen, later noted, "it was a disappointment to discover that no ready-made house producers were able to compete with Moelven Brug and meet the tender for 1100 houses!"[110] Upon landing this landmark contract—90 million NOK, the largest single order in Norwegian prefabrication history—Ringsakerhus expanded its workforce to more than 100 people and recruited the rationalisation firm Asbjørn Habberstad to streamline its production. By early 1970, more efficient layouts were devised for production and storage halls, with new equipment, better management and planning systems.[111] The overall factory

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107 See Guttu, "Den gode boligen," 230.; 284; Ulf Grønvold "Norsk strukturalisme" in *Byggekunst* 65 no. 2 (1983): 60-63; as well as the entire volume of *Nordic Journal of Architecture*, no.2 (2012).

108 See Karl Otto Ellefsen, "Homely Structures" In *Nordic Journal of Architecture*, no.2 (2012): 44-48. Also see Mari Hvattum, "Modified Modernism," in *Nortopia. Nordic Modern Architecture and Postwar Germany.* (Berlin: jovis Verlag, 2009), 105.

109 Gunnulv Eiesland "New Forms of Collaborations. The Skjetten Experience," *Nordic Journal of Architecture*, no 2 (2012): 39.

110 *Aftenposten*, July 14, 1970, 6. *Gudbrandsdølen*, May 29, 1970, 1. *Ringsaker Blad*, May 26, 1970, 1. *Bedriftavis*, no.7 (1970): 4-6.

111 *Bedriftavis*, no.7 (1970): 4-6.

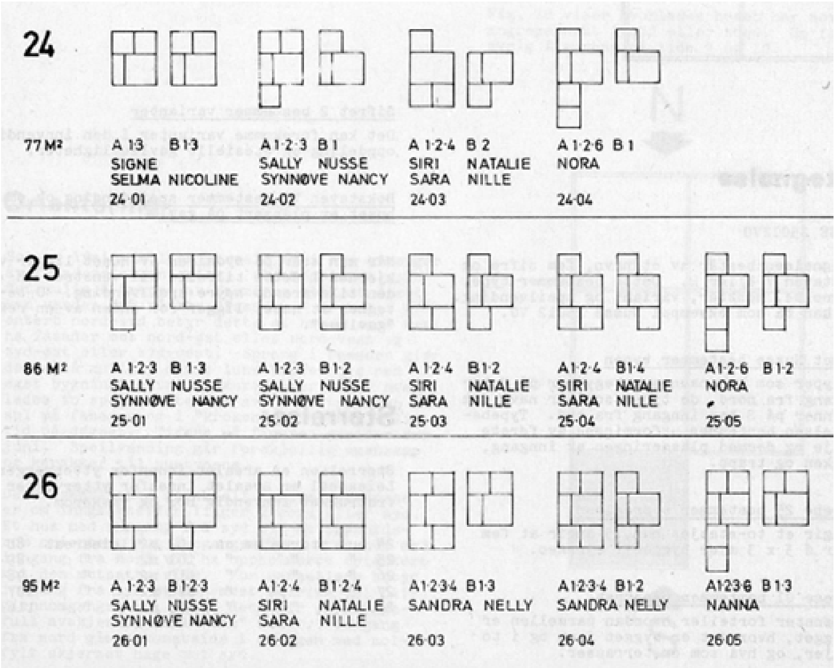


Fig. 24. Different typological variations possible within the Skjetten design system. From *Skjettenbyen håndbok*.

capacity was eventually increased to 1000 housing units per year, as the company still delivered projects to other clients beyond Skedsmo.[112]

Skjettenbyen particularly stands out from other Ringsakerhus projects for its ambition to implement ideas of user participation, adaptability and change at the scale of mass-housing. The project was set up in row-houses on elongated plots of 6,4 metres in width and length that varied between 25 and 30 metres. The houses were designed based on cubic modules of 3 by 3 metres made from prefabricated Ringsakerhus elements, which could be added or taken apart as the users' needs changed: no two houses needed to be alike.[113] Although the system potentially yielded more than 3400 possible spatial configurations within a given plot, since the cooperative system did not allow for direct house allocations, eventually only 29 variations of roughly the same price were offered for future dwellers to choose from, based on their membership seniority.[114] Nevertheless, the house was thought of as a tool-kit where

112 *Bedriftavis*, no.9 (1971): 9-10.
113 Margrethe Dobloug, "Skjetten. A User's Manual," *Nordic Journal of Architecture*, no 2 (2012): 30.
114 *Arbeiderbladet,* September 5, 1969, 27.

different spatial possibilities could be achieved with a limited number of components. Load-bearing external walls allowed for flexible internal arrangements, while a system of laminated posts and beams visible throughout the house communicated the difference between the structure and infill. All building elements, including walls, floors, constructive members, doors and windows were designed based on the standardised planning networks and prefabricated. Timber was chosen as a material that was easy to adjust, as wooden constructions were familiar to most Norwegians experienced in DIY building.[115] Non-loadbearing partitions could be dismantled and movable cupboards and doors added to accommodate different arrangements of internal spaces. Theoretically, even the external wall panels made from Ringsakerhus elements—each around 150kg—could be dismantled and moved, if necessary.[116] According to Margrethe Dobloug, one of the designers behind Skjetten, the structural element system was designed both to comply with demands for construction rationality and to be able to accommodate changing requirements, wants and needs in the long-term.[117] As Jens Bjørneboe, another of the project designers, maintained, the planners "did not want to force anything on anyone," and "wanted to define as little as possible so that the dwellers would define as much as possible."[118]

Although Skjetten is the best-known Norwegian flexible housing project, this chapter argues that it was equally—if not more—indebted to the inherent properties of its industrial elements as to the creative ideas of its architects. The project consolidated planning experience and solutions tested in previous Ringsakerhus developments over the years. For example, Skjetten's planning system was based on a standard dimension of RH elements. The flat concrete foundation slab was a project-specific innovation that required a special dispensation from the construction law, but a similar kind of a simplified foundation slab with no cellar had been implemented for many RH projects.[119] External loadbearing walls and wet-room core and stairs used as stabilising elements that allowed for non-bearing internal partitions had all been tested in previous Ringsakerhus projects. Already in the first development—the unrealised Romsås project—houses were envisioned with flexible partitions, where the dwellers would be able to "add a room or two."[120] More expensive apartments in

115 Jens Bjørneboe, "Brukernes Medvirkning på Skjetten," *Byggekunst* 53, no. 4 (1971): 136.
116 Nils-Ole Lund, "Skjetten Town Norway," (1973) in *Nordic Journal of Architecture*, no 2 (2012): 26-27.
117 Dobloug, "Skjetten. A User's Manual," 34.
118 Jens Bjørneboe, "Brukerenes medvirkning på Skjetten," *Byggekunst* 53, no.4 (1971): 135-137. Also in *Aftenposten*, October 16, 1970, 7.
119 *Aftenposten*, February 14, 1970, 8..
120 Bjørnsen, Kronborg, and OBOS, *Hele folket i hus*, 51.

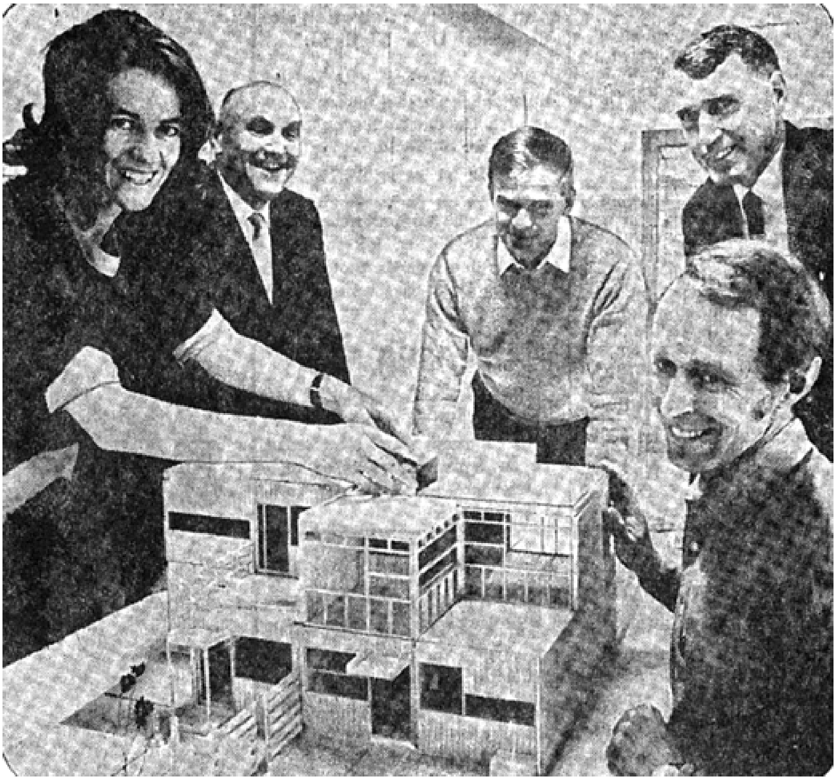


Fig. 25. Skjetten was one of the first “total planning” projects, where planners and architects worked alongside engineers, politicians, local decision makers and future dwellers. On the photograph (from left to right): project planner Turid Haaland, politician Kristian Haugen, civil engineer Vigleif Næss, Skedsmo financial planner Bjørn Herdlevær, architect Erik Hultberg. Newspaper clippings, 1969.

Ski also entailed a degree of flexibility, and in Kringsjå the walls could be “moved and adjusted when the need arose.”[121] St. Hansfjellet provided different internal layouts and the “outer-space” house offered more than ten plan variations.[122] Although designed with pragmatic purposes in mind—accommodating as many plan variations as possible at a low cost—RH elements responded well to the demands of the time, providing a physical counterpart to the ideas of variation, flexibility and change.

These ideas of flexibility and open-ended architecture, tested in the Skjetten project, marked a significant shift in the role of the architect. The architects designed only a structural system, a muted frame, while

121 *Aftenposten*, August 31, 1967, 9.
122 *Dagbladet*, June 6, 1969, 9.

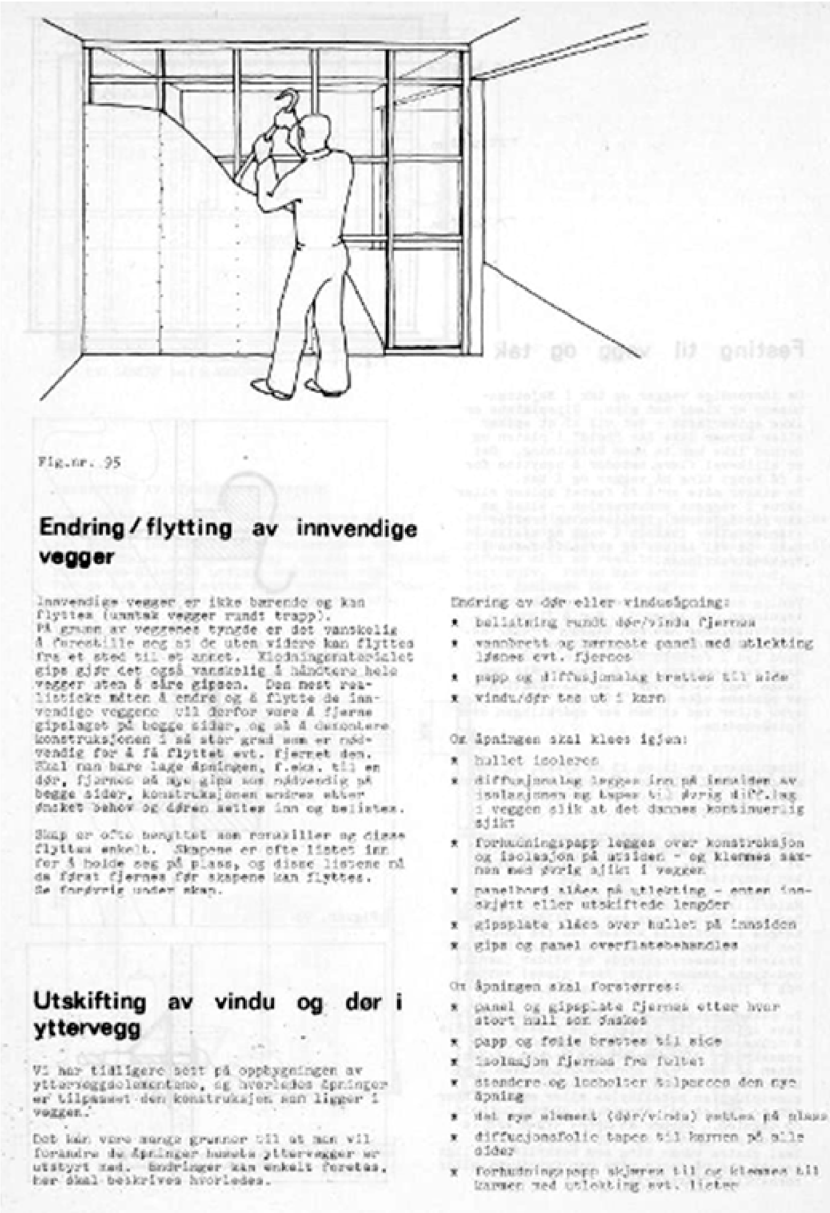


Fig.nr. 95

Endring / flytting av innvendige vegger

Innvendige vegger er ikke bærende og kan flyttes (unntak vegger rundt trapp).
På grunn av veggenes tyngde er det vanskelig å forestille seg at de uten videre kan flyttes fra et sted til et annet. Kledningsmaterialet gips gjør det også vanskelig å håndtere hele vegger uten å skade gipsen. Den mest realistiske måten å endre og å flytte de innvendige veggene vil derfor være å fjerne gipslaget på begge sider, og så å demontere konstruksjonen i så stor grad som er nødvendig for å få flyttet evt. fjernet den.
Skal man bare lage åpningen, f.eks. til en dør, fjernes så mye gips som nødvendig på begge sider, konstruksjonen endres etter ønsket behov og døren settes inn og belistes.

Skap er ofte benyttet som romskiller og disse flyttes enkelt. Skapene er ofte listet inn for å holde seg på plass, og disse listene må da først fjernes før skapene kan flyttes.
Se forøvrig under skap.

Utskifting av vindu og dør i yttervegg

Vi har tidligere sett på oppbygningen av ytterveggselementene, og hvorledes åpninger er tilpasset den konstruksjon som ligger i veggen.

Det kan være mange grunner til at man vil forandre de åpninger husets yttervegger er utstyrt med. Endringer kan enkelt foretas, her skal beskrives hvorledes.

Endring av dør eller vindusåpning:

* belistning rundt dør/vindu fjernes
* vannbrett og nærmeste panel med utlekting løsnes evt. fjernes
* papp og diffusjonslag brettes til side
* vindu/dør tas ut i karm

Og åpningen skal klees igjen:

* hullet isoleres
* diffusjonslag legges inn på innsiden av isolasjonen og tapes til øvrig diff.lag i veggen slik at det dannes kontinuerlig sjikt
* forhudningspapp legges over konstruksjon og isolasjon på utsiden – og klemmes sammen med øvrig sjikt i veggen
* panelbord slåes på utlekting – enten innskjøtt eller utskiftede lengder
* gipsplate slåes over hullet på innsiden
* gips og panel overflatebehandles

Og åpningen skal forstørres:

* panel og gipsplate fjernes etter hvor stort hull som ønskes
* papp og folie brettes til side
* isolasjon fjernes fra feltet
* stendere og losholter tilpasses den nye åpning
* det nye element (dør/vindu) settes på plass
* diffusjonsfolie tapes til karmen på alle sider
* forhudningspapp skjæres til og klemmes til karmen med utlekting evt. lister

Fig. 26. A spread from the Skjetten manual, explaining physical manipulations and possible structural adjustments. From *Håndbook*.

Fig. 27. Skjetten interiors, photographed in *Bonytt* 31, no. 7 (1971).

most form-giving responsibility was delegated to future dwellers: it was up to them to fill the structural frame with life. In order to explain the inherent possibilities of the element system, all first-time Skjetten residents were provided with a comprehensive, 120-page user manual. With a series of detailed drawings and diagrams, the manual described the planning and constructive principles, components and technical fixtures of the house, and offered instructions on possible additions, internal and external finishes, garden arrangements and planting.[123] Architects ceased to be experts, and moved to the role of facilitators that put together and managed a catalogue of industrial building parts for the users to choose from—much in line with the then-popular Whole Earth Catalogue. The Skjetten manual in fact reconceptualised Ringsakerhus modules from industrial artefacts, produced by sophisticated technological apparatus, into DIY elements that could be adjusted by users. In this project, industrial architecture curiously merged with counter-culture, an adaptation that could hardly have been envisioned by the system creators.

Skjetten thus marked a paradigmatic shift from housing *for* the people towards housing *by* the people, foreshadowing the 1970s fascination with horizontal networks of knowledge exchange and democratic planning ideals.[124] Pragmatic factory production, based on an architecture of parts that could be catalogued, fitted well with new democratic aspirations, offering a realistic expansion of the DIY model to the scale of homes and entire housing developments. Skjettenbyen's democratic approach inspired not just other flexible-housing projects constructed from prefabricated elements—for example, the Haugtussa development near Stavanger by Brantenberg, Brantenberg and Hiortøy, and Risvollan near Trondheim—but also the use of "house-manuals," adopted in several other projects including Ringsakerhus' own developments of the late 1970s.[125]

ARCHITECTS AGAINST RUTHLESS MACHINES

Although Skjetten is often hailed for its ambition to implement flexibility on the scale of mass-housing, it represents not a "sophisticated peak" but rather the result of continuous efforts by several generations of Norwegian architects to harness the possibilities offered by

123 Dobloug, "Skjetten. A User's Manual," 30-37. Also in Margrethe Dobloug, "Håndbok 2 etg rekkehus og hage: til og for folk i Skjettenbyen" (I/S Skjettenprosjektering, 1972).

124 Øystein Bergersen quote in Hilde Gunn Slottemo, *Skedsmo: en historie om samhold og splittelse*, *Norbok* (Oslo: Scandinavian Academic Press, 2012), 426.

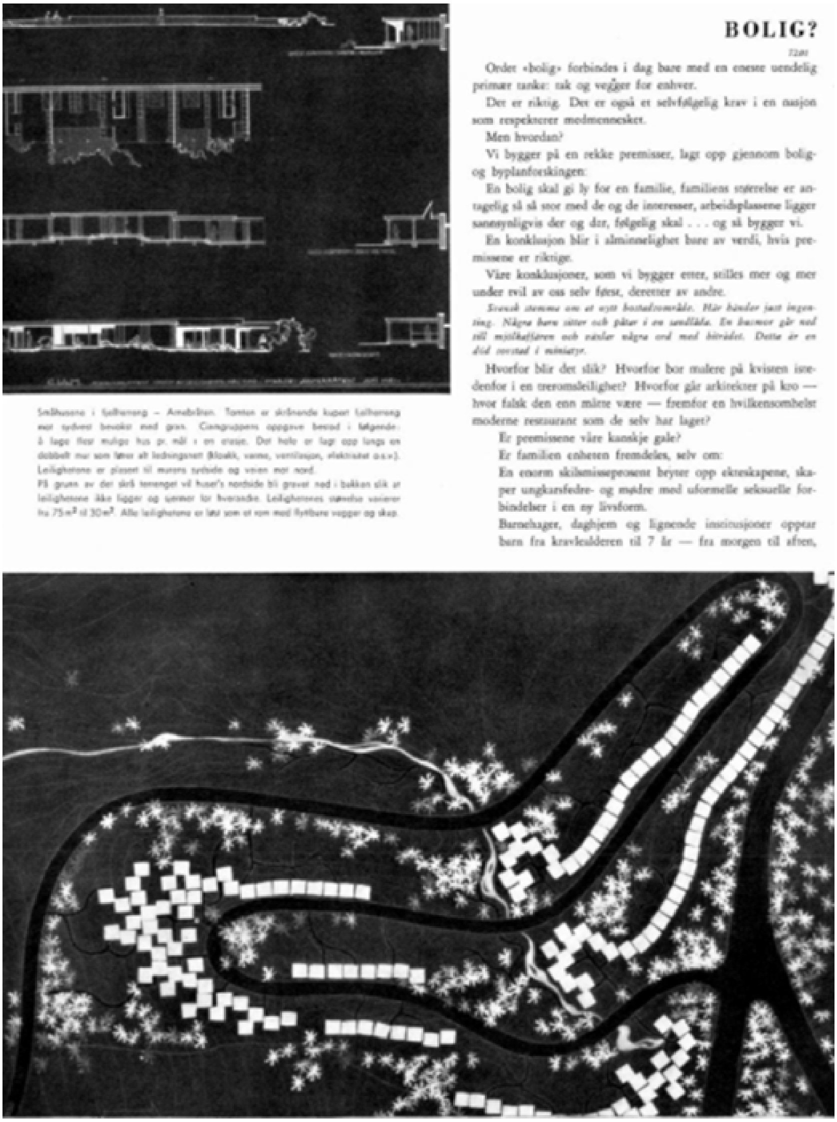
125 *Byggekunst* 58, no. 5 (1976): 140-145. For Haugtussa manual see "Lykke til med ny bolig 1975," Haugtussa Borettslag web-page, http://i.bevarhms.no/Portal/side.aspx?Portal=1000&Fane=2. For other Ringsakerhus manuals see "Bruker-veildening," 1979, Moelven Industrier, National Library archive.

industrialisation and mass-production in order to produce better, more "humane" housing. In the years following WWII, European architects grew increasingly dissatisfied with the clinical austerity of interwar modernism and paternalistic planning that left little space for nuance and individual expression. Norwegian practitioners, on their part, had maintained a particular focus on the lived experience of an individual even before this became the dominant narrative in post-war architecture.

Already during the 1952 CIAM Sigtuna conference that was characterised by an extensive theoretical discussion among the group's younger members, Norwegian representatives advocated for the spiritual and creative life of an individual who "lives in society, in larger or smaller groups, where he collaborates with, influences, and is influenced by, other people."[126] As the result of this June meeting, CIAM formulated a new idea of "habitat" that was associated with a "more human approach" to modern architecture and served as a precursor to the new architecture of relations.[127] Just a month later, in the summer issue of *Byggekunst* dedicated to CIAM, PAGON group members presented several projects that reflected this new architectural thinking, including the Arnebråten housing development, where single-family houses were densely clustered in organic shapes along sloping terrain.[128] In a corresponding article, the architects argued that "mechanical tools should be first of all used to create a framework for a house, and then to produce a rich selection of house-building elements."[129] The architects were willing to take a step back, delegating design agency to future dwellers: "Leave it to each individual family to create a home that fits, and give it an expression both internally and externally. [...] Build stairs, posts and beams [..] and let the renters choose facades, windows, porches, internal programmes and décor."[130] This manifesto-like statement shows that Norwegian CIAM members did not reject industrial means of production, but rather sought to harness them for a more "humane" version of prefabrication, where an industrial kits-of-parts would provide dwellers with an opportunity for individual architectural expression.

This focus on the individual was reiterated again four years later by the Norwegian delegation during the 10th CIAM meeting in Dubrovnik in 1956. Grung, Korsmo and Gundersen argued against paternalistic

126 Note 23, in Annie Pedret, *Team 10: An Archival History* (London, New York: Routledge, 2013), 85.
127 "IX CIAM—Habitat," *Cronologia do Pensamento Urbanistico*, http://www.cronologiadourbanismo.ufba.br/apresentacao.php?lang=en&idVerbete=205, accessed December 6, 2021.
128 "Bolig?" in *Byggekunst* 34, no.6/7 (1952): 108-109.
129 "Bolig?" 109.
130 Ibid.



BOLIG?

Ordet «bolig» forbindes i dag bare med en eneste uendelig primær tanke: tak og vegger for enhver.

Det er riktig. Det er også et selvfølgelig krav i en nasjon som respekterer medmennesket.

Men hvordan?

Vi bygger på en rekke premisser, lagt opp gjennom bolig- og byplanforskingen:

En bolig skal gi ly for en familie, familiens størrelse er antagelig så så stor med de og de interesser, arbeidsplassene ligger sannsynligvis der og der, følgelig skal . . . og så bygger vi.

En konklusjon blir i alminnelighet bare av verdi, hvis premissene er riktige.

Våre konklusjoner, som vi bygger etter, stilles mer og mer under tvil av oss selv først, deretter av andre.

Svensk stemme om et nytt bostadsområde. Här händer just ingenting. Några barn sitter och påtar i en sandlåda. En husmor går ned till mjölkaffären och växlar några ord med biträdet. Detta är en död storstad i miniatyr.

Hvorfor blir det slik? Hvorfor bor malere på kvisten istedenfor i en treromsleilighet? Hvorfor går arkitekter på kro — hvor falsk den enn måtte være — fremfor en hvilkensomhelst moderne restaurant som de selv har laget?

Er premissene våre kanskje gale?

Er familien enheten fremdeles, selv om:

En enorm skilsmisseprosent bryter opp ekteskapene, skaper ungkarsfedre- og mødre med uformelle seksuelle forbindelser i en ny livsform.

Barnehager, daghjem og lignende institusjoner opptar barn fra krabbealderen til 7 år — fra morgen til aften,

Småhusene i fjellheng – Arnebråten. Tomten er skrånende kupert fjellheng mot sydvest bevokst med gran. Gangruppens oppgave bestod i følgende: å lage flest mulige hus pr. mål i en etasje. Det hele er lagt opp langs en dobbelt mur som fører alt ledningsnett (kloakk, vanne, ventilasjon, elektrisitet o.s.v.). Leilighetene er plasert til murens sydside og veien mot nord. På grunn av det skrå terrenget vil huset's nordside bli gravet ned i bakken slik at leilighetene ikke ligger og sjenerer for hverandre. Leilighetenes størrelse varierer fra 75 m² til 30 m². Alle leilighetene er lagt som et rom med flyttbare vegger og skap.

Fig. 28. A housing project in Arnebråten by PAGON group, illustrating a manifesto-like article on housing and industrial production. From *Byggekunst* 34, no. 6/7 (1952).

planning principles that turned inhabitants into passive subjects, and suggested that urban and architectural designs should actively involve dwellers in creating a "a personalised society with a more active individual in it."[131] In Norway, this attitude was shared also by other Norwegian practitioners beyond the small, internationally-oriented PAGON circle: for example, already in 1954 Abrahamsen and Grinde voiced similar ideas in *Bonytt*, arguing that industrial production and new building typologies should be used to provide a possibility for individual expression.[132]

Although "elastic," "flexible" and "growing" homes became buzzwords in the architectural agenda of the later 1950s, with a poor state of Norwegian building industry, these idealistic intentions were hard to implement in practice, beyond the individual architect-designed homes. In 1952, Korsmo, together with Norberg-Schulz, built modular adjustable low-rise homes at Planetveien.[133] A couple of years later, Korsmo's close friend and collaborator, Jørn Utzon, inspired by Chinese gardens, built Kingohusene, a clustered atrium-house development in Skåne.[134] Widely published and discussed in the professional Norwegian press, atrium houses, a variation of low-rise high-density developments that managed to reconcile rationality of means, industrial production and individual expression, seemed to offer an answer to the Norwegian architects' search for economic and adaptable housing types.[135] By 1963, the first Norwegian atrium houses were built in Hamar by the ARKITIM office with Finn Bø and Are Vesterlid, and several experimental atrium houses were constructed by the Housing Ministry together with the NBI for the "Bygg reis deg" exhibition in Sjølyst, Oslo.[136] Other cluster-housing developments soon followed: Christian Norberg-Schulz is said to have exclaimed, "Finally atrium-houses!" upon seeing the model of the low-rise OBOS Ammerud development designed by Håkon Mjeva in *Arkitektnytt* for the first time.[137] However, most of these developments (perhaps with the exception of Ammerud, built with light concrete elements by Norsk Leca and Siporex Ytong) remained one-off projects, hardly reproduceable on the scale of mass-housing.

131 "CIAM Oslo Grid," Grieg, Korsmo and Gundersen, panel 1, NAi Bakema Archive, in Tom Avermaete, "Designing for the Anonymous Collective. The Architectural Culture of the 1960s," in *Nordic Journal of Architecture*, no 2 (2012): 52.

132 *Bonytt* 14, no.11/12 (1954): 215-217.

133 First presented in works of PAGON members in *Byggekunst* 34, no.6/7 (1952): 114-115. Later in *Byggekunst* 37, no. 7 (1955): 174-189.

134 Guttu, "Den gode boligen," 272–73. Jørgen Michelsen, "Attraktive atriumhus," *Bonytt* 15, no.2 (1955): 39.

135 Dag Rognlien, "Et virkelig fremskritt," *Bonytt* 21, no. 9 (1961): 188.

136 Roar Bjørkto, *Atriumhus i norsk klima: om størrelse og utforming av kringbygde uterom*, *Norbok*, Rapport (Oslo: Norges byggforskningsinstitutt, 1965). Nils-Ole Lund, "Atriumhuse på Hamar," *Byggekunst* 45, no 2 (1963): 46-49.

137 Guttu, "Den gode boligen," 272. Project presentation in *Arkitektnytt* (1964): 122. Also "Atriumhus på Ammerud," *Byggekunst*, no.6 (1967): 148-151.

As the building industry picked up pace in the mid-1960s, large high-rise housing projects were completed across the country: Ammerud in Oslo, Kolstad in Trondheim, Fyllingsdalen in Bergen, Skåretoppen in Lørenskog. Although quite far from "ruthless machines," they were met with vigorous criticism from the professional community.[138] Among the most vocal critics of these large housing estates was Thorbjørn Rodahl—one of Moelven's frequent collaborators and, according to some, the successor to Knut Knutsen as "the architect" of the Labour Party.[139] In many public appearances throughout the 1960s, he called out Norwegian post-war housing estates for being a "national shame," dramatically rendering them pinnacles of a Kafka-esque "hopelessness and greyness" akin to prisons or concentration-camps, "with the only difference that the barbed wire was missing."[140] However, it was not prefabrication per se that was rejected, but rather the lack of imagination, the "arrogance of planners," and the rigidity of Husbanken regulations. Instead, Norwegian architects of the 1960s hoped to finally materialise the ambitions of the previous decade, and harness the possibilities of prefabrication for a more complex architecture of relations that could accommodate diversity and variation within a larger order.[141] Now that the building industry was advanced enough to supply prefabricated elements for low-rise high-density developments, this typology was seen as a particularly suitable alternative to anonymous high-rise towers, both economically viable and "humane." Industrial producers like Moelven quickly picked up on this sentiment: in many interviews, Reymert and Mageli maintained that Ringsakerhus's prefabricated elements "offered many combinatorial possibilities—as well as a limited number of type solutions—to provide greater flexibility at a low cost."[142]

According to Tom Avermaete, low-rise high-density housing projects built with prefabricated components—like Skjettenbyen—managed to reconcile the inherent tension between "collective frames and individual

138 Torstein Thomassen in Slottemo, *Skedsmo*, 427. Torstein Thomassen and Boligbyggelaget Romerike, *"-nå bor vi i bori-": "100 års" bolighistorie som ble til Boligbyggelaget Romerike: historien om fire boligbyggelag tett i tett - som ble til ett, Norbok* (Lillestrøm: Bori, 2006), 9. Mari Hvattum, "Nordic Monumentality" in *Nordic Journal of Architecture*, no 2 (2012): 9.

139 "Den siste modernist," interview with Einar alias Aina Dahle, *Arkitektnytt,* April 17, 2020, https://www.arkitektnytt.no/nyheter/den-siste-modernist, accessed December 13, 2020.

140 "Ung arkitekt med voldsom bredside, flere av våre boligområder står som en national skam" in *Arbeiderbladet,* September 24, 1965; "Hvem presser vår byggeutvikling?" *Arbeiderbladet*, September 20, 1965. Also in *Aktuell* 2, no. 8 (1965): 26-29. *Bonytt*, no.5 (1966): 3.

141 Civil engineer Johan N. Prøven lecture, Moelven Industrier; *Konferanse om: byggesystemer og hustyper for konsentrert småhusbebyggelse: 24.-26. september 1979*, Fagernes, Norske sivilingeniørers forening NIF, 1979. Also in *Arbeiderbladet,* October 8, 1965, 3 and Kari B. Thorp, *Småhus for alle: konsentrert småhusbebyggelse : nye og eldre områder, prosjekter, systemer : planleggernes synspunkter og erfaringer* (Oslo: Treopplysningsrådet, 1973), 11.

142 *Arbeiderbladet*, October 8, 1965, 3; *Ringsaker Blad*, August 4, 1966, 2 among others.

Fig. 29. Norwegian architects were critical of the monotonous housing estates produced by prefabrication. A cover of *Byggekunst*, no. 2 (1979).

autonomy" fundamental to the Nordic model of social democracy, and thus represent a specific regional contribution to post-war European models of mass-housing.[143] Similar projects were indeed built in other Scandinavian countries, for example the Albertslund South development in Copenhagen (1963-68), which became a "mecca" for many Norwegian architects.[144] Stemming from the same critique of paternalistic planning, these projects shared many similarities with the structuralist architecture of the 1960s. Built with a set of prefabricated components that could be added or taken apart depending on the users' needs, these projects found a way to economically accommodate aspirations for "growth, diminution, and change" voiced by the new generation of European architects.[145] Differentiated housing volumes nested within a larger planning grid allowed to weave in a variety of programmes but convey an idea of "apparent sameness," similar to the large, horizontal landscape-like structures of MAT-buildings. In this way, the Ringsakerhus elements, with their origins in industrial construction and the economy of scale became closely intertwined with the most avant-garde ideas of the time, and became tools at the hands of the new generation of Norwegian architects.

And the new generation was not far behind their European colleagues: as European architects increasingly looked towards traditional settlements in North Africa and the Mediterranean that seemed to preserve the organic "interchangeability" of components, Norwegians closely followed in their footsteps.[146] Per Cappelen visited Greece, Torbjørn Rodahl and Paul Cappelen went to Egypt and Morocco, and Erik Anker worked with Doxiades, interested in increasingly more complex theories underlying physical planning.[147] New structuralist ideas also seeped through Norwegian architecture schools: the roster of international lecturers at NTH in 1965-66 included, among others, Shadrach Woods, James Stirling, Jean Prouvé and Jørn Utzon.[148] Alexander and Chermayeff's *Community and Privacy* from 1963 was widely read by the young Norwegian architects, while most of the Skjetten architects had studied abroad and worked on flexible hous-

143 Tom Avermaete, "Designing for the Anonymous Collective," in *Nordic Journal of Architecture*, no 2 (2012): 53; 56.

144 Guttu, "Den gode boligen," 278–79.

145 Alison Smithson, "How to Recognize and Read MAT-BUILDING: Mainstream Architecture as It Developed Towards the Mat-building," *Architectural Design* 9 (1974): 573-590.

146 Among others, on the North African inspiration for European architects see Jean-Francois Lejeune, Michelangelo Sabatino, and Michelangelo Sabatino, "CIAM, Team X, and the Rediscovery of African Settlements: Between Dogon and Bidonville," Modern Architecture and the Mediterranean (Routledge, December 4, 2009), 252, https://doi.org/10.4324/9780203871904-22. Smithson, "MAT-Building," 576.

147 Erik Anker, "Hus i Hellas," *Byggekunst* 44, no.8 (1962): 214.

148 *Dagbladet,* 7 December 1966, 7.

Fig. 30. Inspiration for a new type of architecture also came from other sources, for example, international travels. A drawing from Per Cappelen travels to Greece. From *Byggekunst* 44, no.8 (1962).

ing projects and competitions prior to Skjetten.[149] It is not surprising, then, that by the end of the 1960s the ideas of low-rise high-density housing, so dear to the hearts of many Norwegian practitioners for nearly two decades, were finally realised en masse. Industrial actors, like Ringsakerhus, that were able to produce adjustable prefabricated components, fitted well with this unique moment of convergence between social democratic politics and anti-monumentalist aesthetics.[150]

Although the Skjetten project was the first and the largest of its kind to be realised, it also marked the beginning of a new wave of these low-rise high-density projects. For example, in May 1967, a provocative image of an urban densification project by HRTB architects appeared in *VG* newspaper: a neo-classical structure built over with a series of repetitive blank box-like shapes.[151] Titled "Roma midt imot," the project

149 Mari Hvattum, "Modified Modernism," in *Nortopia*. *Nordic Modern Architecture and Postwar Germany*, Berlin: jovis Verlag, 2009, 105. Also see note 609, in Guttu, "Den gode boligen," 270. Erik Hultberg finished university of Edinburg in 1957 and went on to pursue a master's degree in University of Pennsylvania, Jan Resen graduated from TU Graz in 1957 and Einar Throne-Holst a year later from Edinburg. American Seth Seablom—HRTB's frequent collaborator—had a Master's degree from University of Pennsylvania, and obtained a Fulbright scholarship to study in Denmark. Marcin Bogulawski, studied at the Polytechnical University in Warsaw and came from a dynasty of well-known architects and met Hultberg, Resen and Throne-Holst through his travels in Norway. *Byggekunst* 69, no. 8 (1987): 497. For other projects see PH 1964 flexible-house competition won by Seablom, Jylland competition in Denmark, in *Byggekunst* 48, no. 4 (1966); and Gullstrup competition *Vårt Land*, June 3, 1967, 7.

150 Hvattum "Nordic Monumentality," 8.

151 See *VG,* May 13, 1967, 16; *VG*, July 11, 1967, 10; *Dagbladet*, September 30, 1967, 18.

evoked principles similar to those of Skjetten, arguing that architects were not in a position to decide how other people should live.[152] Instead, future dwellers should be provided with both practical and theoretical tools to plan and build their own apartment within a larger structural framework. The architects concluded: "we have tried to do the most possible, but instead we should have done the least possible."[153] And the least possible it was: this radical idea of user participation was carried into many housing competitions of the 1960s-1970s. Many of them awarded first prizes to the projects based on low-rise flexible-housing typologies, where the architects only provided a bare structural system to be filled with life by future dwellers.[154] The Dyster Eldor competition for a housing development south of Oslo was quite symptomatic in this regard: in one of the competition entries, the architects only delineated a rectangular land plot, where a "plan of around 50 houses" was to be determined by the residents.[155] However, as Mari Hvattum points out, despite this idealistic aspiration to create a "modified modernism" responsive to individual needs and yet uncompromisingly rational, in practice dwellers' participation rarely lived up to the architects' expectations.[156] Most often, these skeletal geometric structures were left barren and incomplete, and their restrained aesthetics, according to Hvattum, "unwittingly paved the way for figurative post-modernism."[157]

A MIDDLE-CLASS TYPOLOGY

While these experiments with the architecture of parts developed, on the one hand, towards abstract non-figurative projects, one the other they were assimilated into the ordinary typologies of middle-class housing. In 1965, the Norwegian Association of Architects (NAL) held a planning conference titled "Tett eller spredt" where alternative solutions to the prevailing planning paradigm were discussed. The new low-rise high-density typology—*tett-lav*—was considered to be the most optimal solution that combined the benefits of density, important for minimising the costs of infrastructural development, with the flexibility of a private house, so desired by the growing middle class. By the mid-1960s, these

152 *VG*, July 11, 1967, 10.
153 Ibid.
154 See for example, Risvollan in Trondheim and Tjensvoll in Stavanger. *Byggekunst*, 54, no.5 (1972): 158-160. *Byggekunst* 61, no.2 (1979): 102-104. Also *Norske Arkitektkonkurranser*, no. 140, (1967), *Norske Arkitektkonkurranser*, no. 181 (1971).
155 *Norske Arkitektkonkurranser*, no. 181 (1979). In Hvattum, "Modified Modernism," 107.
156 Hvattum, "Modified Modernism," 106.
157 Hvattum, "Modified Modernism," 107.

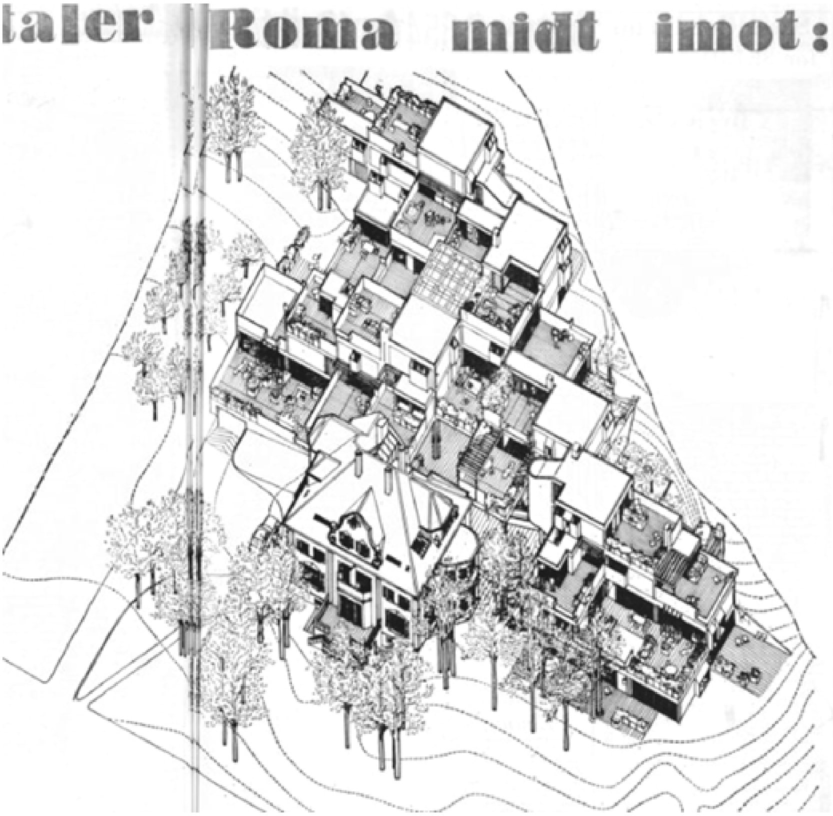


Fig. 31. A speculative project in which the architects proposed a box-like parasitic structure, to be defined by the dwellers. Drawing by Seablom, Hultberg, Resen, Throne-Holst. Newspaper clipping, 1967.

ideas made their way into mainstream discourse: *"fleksible boliger"* have appeared in *OBOS bladet* already in 1965, *Forbrukerrapporten* in 1968, and even in a TV-debate in 1968.[158] Towards the 1970s, ideas of user participation and democratic planning principles grew to become essential elements of any planning brief and were extensively covered in reports produced by the Norwegian Building Research Institute (NBI).[159] Skjetten's planners—for example, Jens Bjørneboe—continued to work with these ideas, but now in a more systemic manner, trying to introduce them within a planning policy framework. Prefabricated kits-of-parts developed by industrial producers like Ringsakerhus allowed to eco-

158 *Tidens Krav*, June 24, 1958, 10. *Rana Blad*, June 24, 1968, 7; *OBOS-bladet* nr. 5 (1965): 13; *Forbrukerrapporten*, no.9 (1968).

159 *Tæt lav—en boligform. Eksempelsamling*. Statens byggeforskningsinstitut, SBI-rapport 75, København 1971. Jens Bjørneboe, *Vurderingskriterier for rekkehus: en utredning for Den norske stats husbank*, Arbeidsrapport 75 (Norges byggforskningsinstitutt F-3003, Oslo, 1975).

nomically implement these ideas in practice—delivering something of a "budget version" of Skjetten's experimental flexibility. The concentrated smallhouse form not only made its way into Norwegian everyday life, but managed to merge the complex ideas of participatory architecture of the late 1960s into the most optimal form for new suburban developments.

In addition, specifically in Norway, there was a particular synergy developed between the low-rise high-density typology and timber producers. Indeed, wood, as Nils-Ole Lund underlined in 1973, was "well-suited to system building, as it allowed for large elements with low weight, a dry construction system, and possibilities for additions."[160] Because of these qualities, industrial timber producers were looking at the low-rise high-density typology as one that harboured lucrative market opportunities that came with large state commissions. For example, Treopplysningsrådet—the Wood Council—founded in 1960 with the goal to advance the interests of industrial timber producers and find new market areas for timber application, became one of the champions of this new typology.[161] Headed by engineer John Bohn, in 1972 the council published a compilation of articles and lectures by Norwegian building professionals—*Konsentrert småhusbebyggelse: innlegg i debatten*—promoting the concentrated small-house typology.[162] From statistical comparisons between high-rise and row-houses—largely in favour of the latter—to critical discussions of the psychological effects of both building types and extensive references to traditional Norwegian construction, the compilation promoted low-rise high-density as the most optimal alternative for contemporary house construction. In another publication, a curated selection of all cluster-projects carried out to date was paired with inspirational quotes from prominent Norwegian architects, intended to prove that this was not just good housing, but also good architecture.[163] These books reveal a peculiar alignment between the interests of architects, planners and industrial producers, as the concentrated small-house typology became the most democratic meeting point between the economic, social and environmental interests at the time.

Soon after the Skjetten project was completed, in the spring of 1973 Ringsakerhus collaborated with HRTB architects to develop the project's main principles into a comprehensive industrial building system. A limited number of dimension-coordinated components designed to

160 Nils-Ole Lund, "Skjetten Town, Norway," (1973), in "Nordic Monumentality," 26.
161 *Fædrelandsvennen*, September, 12, 1960, 3. Also see Chapter 3
162 "Konsentrert småhusbebyggelse."
163 See introductory quotes, as well as Thorp, *Småhus for alle*, 13–22.

Fig. 32. An opening page from *Småhus for alle* book, produced by the Wood Council. Architects like Mari and Erik Kollandsrud were quoted arguing in favour of the new typology. From *Småhus for alle: konsentrert småhusbebyggelse: nye og eldre områder, prosjekter, systemer*.

comply with Husbanken's regulations, were to accommodate different typologies in terms of scale, orientation, and relationship to site.[164] The resulting "RH-system" was very similar to the one used in Skjetten: it consisted of loadbearing external walls and a series of laminated poles and beams set throughout the house on the same modular network of 60cm. House dimensions were optimised according to NBI studies, and façade breadth of 7,5 metres was chosen as one that would allow for

164 *Byggekunst* 58, no.4 (1976): 104-108.

a wide variety of internal layouts.[165] Houses could be designed according to different modes of cooperation between owners, builders and developers, and different percentages of assembly work could carried out at the factory—the houses could be 40, 50 or 65% prefabricated. From the fall of 1975 to 1978, around 1300 houses were built with the RH-system, serving, according to Ringsakerhus engineer Odd Bergli, "as an efficient planning tool for private and cooperative developments."[166]

The RH-system thus deconstructed both the body of a house and the process of building into an assembly of parts, positioning the process of designing a house somewhere between choosing industrially-made elements from a catalogue of parts and a set of instructions for self-building. At the same time, although produced with the most sophisticated technology and the most avant-garde architectural ideas in mind, buildings constructed with the RH-system appeared very conventional. Built in timber with pitched roofs and balconies, they reminded little of the abstract experiments of the late 1960s. Yet by the early 1970s it was less important how these houses looked; what mattered was how they were assembled. System-building was seen as a pragmatic compromise between industrial rationality and architectural expression and an affordable way to incorporate the voice of the user.[167]

Moelven was not the only company to develop a building system: the Norwegian housing market, strongly regimented by Husbanken's space and cost standards, was particularly susceptible to this ascendancy of systems. In 1973, Husbanken presented its own building system for type houses that offered "better spatial qualities and higher land utilisation," and incorporated user input into a modular design.[168] The same year, architect Bjørn Larsen, together with AHO students, started working on an "open-source" catalogue on Norwegian building systems, *Systembyggehåndboka*, intended to provide a comprehensive overview of different aspects of system-building in Norway and "democratise" this technology for popular use.[169] In this way, what Ringsakerhus products offered from the mid-1960s—the possibility of

165 Jens Bjørneboe and Asbjørn Nedrebø, *Vurderingskriterier for rekkehus: en utredning for Den norske stats husbank*(Oslo: Norges byggforskningsinstitutt, 1975) Also Sæterdal, Bjørneboe, Nedrebø, *Grunnlag for planlegging av boliger* (Oslo: NBI, 1972).

166 Odd Bergli lecture, 1979. Among large developments built with RH-system was Øreåsen development, where 153 houses were built with this particular system. See *Byggekunst* 63, no.4 (1976): 14 and *Byggekunst* 61, no. 6 (1979).

167 Guttu, "Den gode boligen," 236.

168 *Husbankens prosjekteringssystem for småhus*, (Oslo: Den Norske stats husbank, Arkitektkontoret, 1973), 4. Buflod, *Teknologisk endring av småhusbyggingen*, 25.

169 Bjørn Larsen, "Vi trenger en systembyggehåndbok," *Byggekunst* 55, no.1 (1973): 13-15. Bjørn Larsen, *Åpen systembygging: om teori og praksis [Open system building - on theory and practice]* (Oslo: Arkitekthøgskolen, 1977).

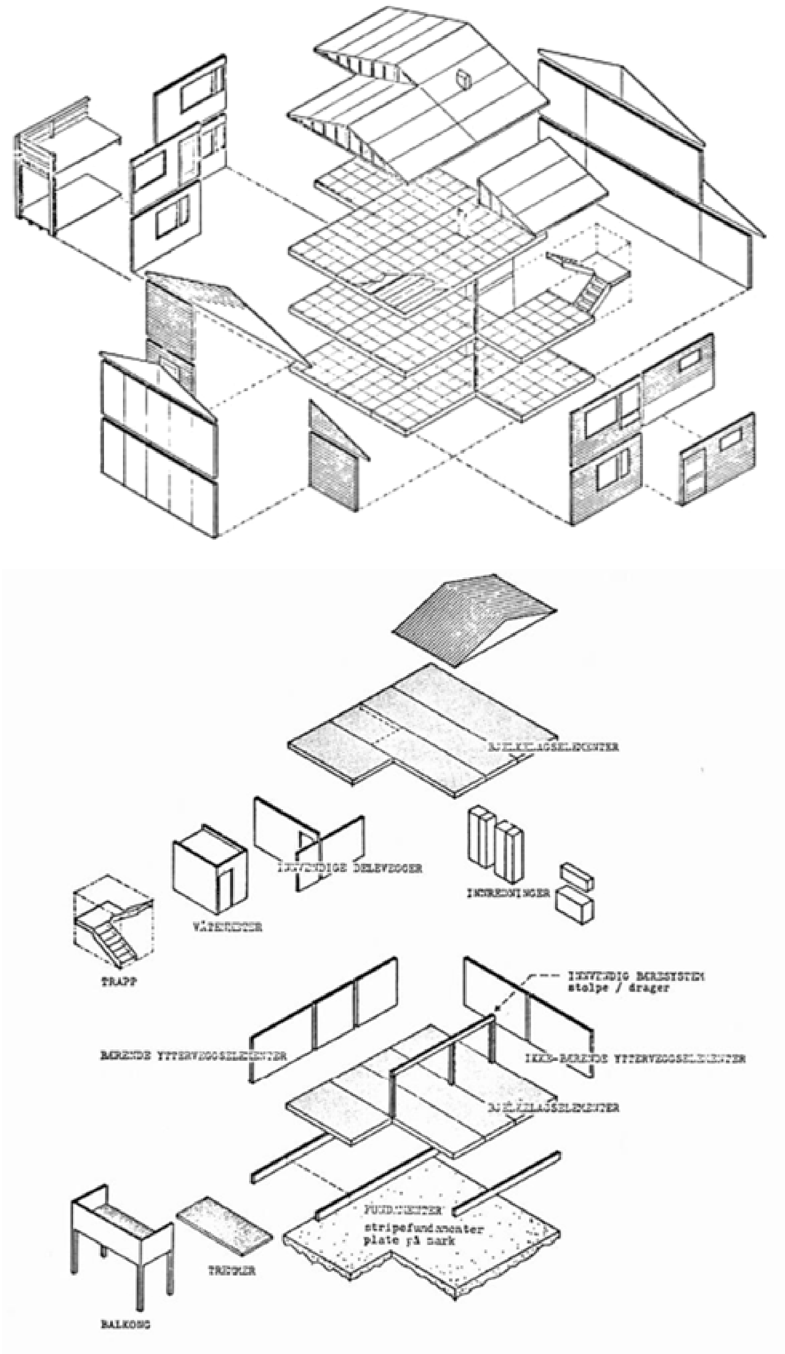
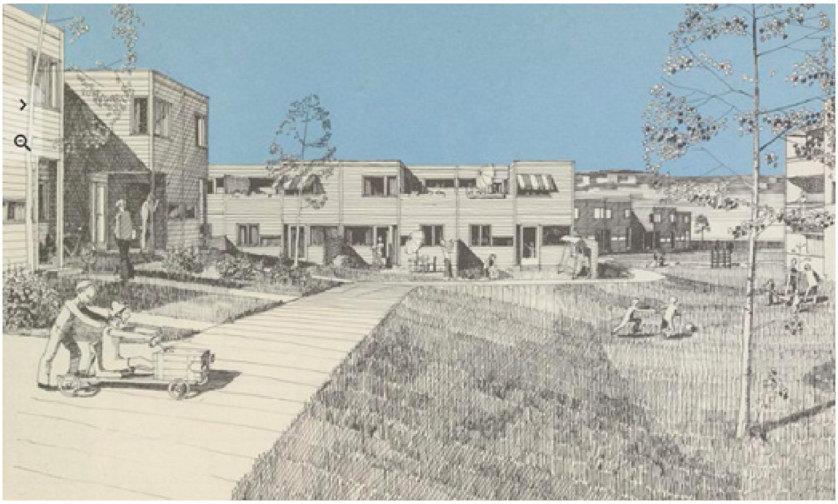


Fig. 33. Ringsakerhus-branded construction system developed by Moelven architects together with HRTB. In *Byggekunst* 58, no. 4 (1976).



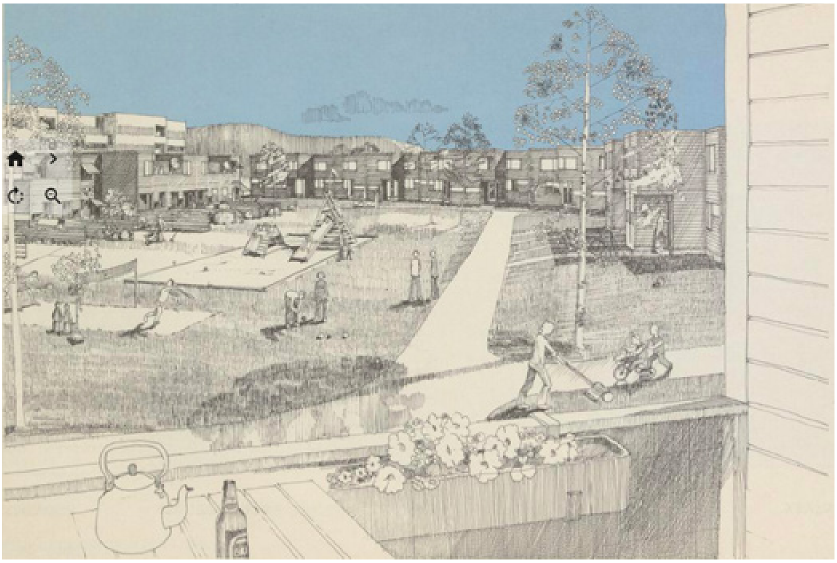


Fig. 34. In the 1970s, more than 1500+ row houses were built using Ringsakerhus industrial building system that allowed to accommodate variation and users' choice at a low cost. Project drawings from *Ulsholt borettslag felt C1, Furuset Nord feltene B-C-D*.

choice offered by industrial production—became an essential paradigm of housing provisions with the 1970s shift that favoured user participation and the democratic horizontality of all decision-making processes.

BIM PREDECESSORS

Ringsakerhus came very close to achieving the ultimate dream of post-WWII modernism: a system of modularly coordinated components, able to reconcile order and variation, economy of construction and flexibility of choice. Enabled by the post-war standardisation of light timber-frame construction and new insulation materials, Moelven element construction came into spotlight when the Per Borten government set its sights on the industrial production of housing. With a changing political climate, revisions of construction law, concerns for land conservation, and growing middle-class prosperity, the low-rise high-density typology built in timber provided an opportunity for small-scale economic living. In this venture, instead of building for state actors, as was the case with prefabricated schools, Moelven worked closely with financial regulators: Husbanken, municipal and national politicians, and, most importantly, OBOS. The partnership with OBOS brought a steady influx of commissions, opened access to both municipal land plots and a network of state contacts, and allowed the company to enact its ambition of working as a full-cycle developer.

Ringsakerhus element production profoundly transformed not just the process of construction—from building to assembly—but also the way work at the company was performed. Faced with rigid building laws unable to accommodate a new type of production, Moelven had to set up smaller units (made possible by its managerial organisation)—Moelven Consult and Moelven Systemrør—to carry out different aspects of turnkey development. Large low-rise high-density developments in timber became not just a new housing typology, but grew entangled with both the interests of industrial material producers and architectural discourse. In particular, flexible prefabricated timber panels allowed to economically accommodate user choice, democratic planning principles and horizontal cooperation. Part of a broader discussion on the tension between individual and collective, singular and universal, Ringsakerhus came close to realising the perfectly catalogued, modularly-coordinated architecture of parts. With the changing role of architects and planners—moving towards facilitators, rather than designers—Ringsakerhus's timber panels provided an ideal blank canvas for the new user-centred architecture of the 1970s. Their economic production assimilated this avant-garde discourse into an essential component of Norwegian middle-class housing.

The history of Ringsakerhus production is a story of an aspiration to provide good affordable middle-class housing, able to accommodate aspects of user choice. An industrial solution to the urban dwellers' dream of a small-scale living, Ringsakerhus's "architecture of parts" marks a brief moment of convergence between the interests of common people, politicians, material producers and architects. Although this fascination with the architecture of parts still persists today—for example, in BIM-tools that allow architects to source elements from industrial producers in real time—such a tripartite alliance is hard to imagine in a world where middle-class housing remains overwhelmingly dominated by concerns of cost over choice.

THE BUILDING MATERIAL OF THE FUTURE

CHAPTER 5

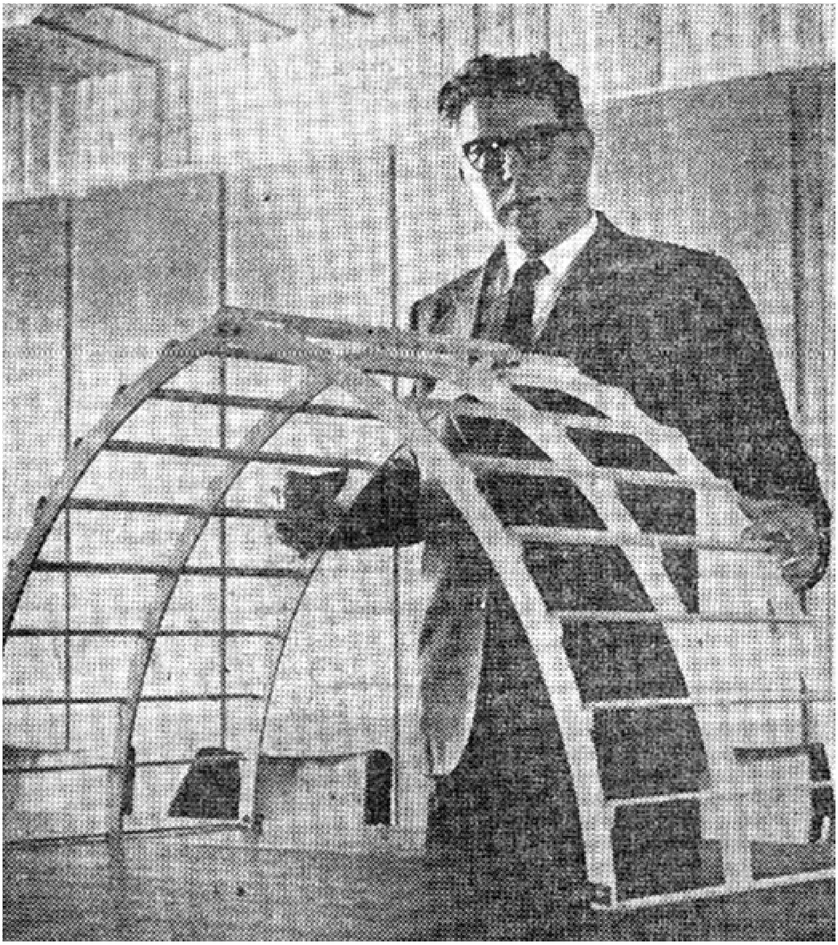


Fig. 1. Mageli with a model of Laminator structure. Newspaper clipping, 1961 (original image from 1959).

“THE PRIME CONSEQUENCES OF THE INDUSTRIAL EVOLUTION IN ‘BUILDING’ SHOW THEMSELVES IN THIS FIRST STAGE; THE REPLACING OF NATURAL MATERIALS BY ARTIFICIAL ONES, OF HETEROGENEOUS AND DOUBTFUL MATERIALS BY HOMOGENEOUS AND ARTIFICIAL ONES (TRIED AND PROVED IN THE LABORATORY) AND BY PRODUCTS OF FIXED COMPOSITION. NATURAL MATERIALS, WHICH ARE INFINITELY VARIABLE IN COMPOSITION, MUST BE REPLACED BY FIXED ONES.”[1]

1 Le Corbusier, *Towards a New Architecture*, trans. Frederick Etchells, Reprint of the translation of the 13th French edition from 1931 (New York: Dover Publications, 1986), 232.

A 1961 *Morgenposten* photograph depicted Moelven's Johannes Mageli standing behind a large 1:10 model of a latticed wooden arch carried out in glued laminated timber. Although the article primarily interrogated the market potential of prefabricated housing, the laminated timber structures pioneered by the company were too peculiar not to be mentioned. Since 1959, Moelven had produced new types of beams and arches for large continuous spans. Used for storage halls, barns, gyms and schools, these structures were gradually—as the article claimed—"winning over" other construction materials.[2] The timber structure on the photograph was, in fact, a model of the first glued laminated arch produced by another Moelven subsidiary company—Laminator A/S—and shown at the company's stand at the Ekeberg exhibition in 1959.[3] The fact that Mageli was photographed with the model is not insignificant for this story: it was largely through his initiative that this forgotten technology of the 1920s was re-introduced to the Norwegian market in the late 1950s. Unlike other Moeven products developed in cooperation with state actors, glued laminated timber was primarily marketed to individual clients—either private or public—and used to provide space for a wide range of activities in the Norwegian everyday—from barns to sports halls and churches. Particularly suitable for large-scale public functions, the new structural elements developed by Moelven redefined the cultural role attributed to timber in Norwegian representative buildings. As the company's marketing efforts carved a position for its products, the new material of glued laminated timber was situated between tradition and innovation, craft and industry, local culture and imported technology.

Glued laminated timber offers a particularly suitable lens for a study interested in the translation of ideas across cultural contexts. In the early 20th century, the technology of timber lamination was first exported from Germany to the rest of Europe, and then to the United States, where it was studied and enriched with new structural and material properties. It was then re-imported back to Europe, now as an "American" material.[4] As glulam made its way back to Norway in the 1950s, it proved a cheaper and easier alternative to conventional steel or concrete structures, particularly appropriate for a forest-rich country like Norway. Together with a local forest cooperative Ringsaker Almenning, Moelven pioneered glulam in Norway, and through the company's active marketing efforts it soon became associated with "a

2 *Morgenposten*, February 17, 1961, 9.
3 Moelven industrier et al., *Moelven 1899-1999* (Moelv: Moelven industrier, 1999), 32.
4 *Hamar Arbeiderblad*, July 22, 1959, 4.

new Norwegian building style." This chapter is particularly interested in how this implicit overlap between the local and the global conditioned the proliferation of Laminator elements, and the role this new material came to play within Norwegian everyday life. Although presented with an attractive marketing narrative, this imported technology was assimilated to the conditions of the local labour market, technical opportunities, material sourcing and physical infrastructure, anchoring the "empty shell" of technology to the locality of production in a manner more complex than could be conveyed in a marketing booklet.

While two previous chapters focused on the relationship between the company and large single state actors—municipalities, school-building committees, OBOS—Laminator products were developed in contact with a wide range of heterogeneous public actors—from specialists at the Wood Technology Institute, NTH, and the Agricultural College (Landbrukshøyskolen) to clients like the Norwegian Army, Felleskjøpet, local municipalities and the State Youth and Sports Office (STUI). These clients conditioned the appearance and spatial standardisation of the Laminator projects, as for example, sports halls, churches or agricultural barns were developed as types suited for mass-production. However, more than any other Moelven product, glued laminated timber was a material of architects and engineers, individual practitioners that experimented with its structural and aesthetic properties in a wide range of architectural projects. Thus, this chapter explores its application in both reproduceable types and in singular projects, eventually narrowing its lens into the study of a handful of projects. It positions glued laminated timber within the broader context of Norwegian architecture, investigating the changing cultural role attributed to timber in representative structures. By doing so, it fills in the missing element of this story, studying the particular relationship that Moelven fostered with the material of timber.

"ALLER ANFANG IST SCHWER"[5]

1958 was the year of glulam in Europe. Brussels World's Fair, held in April, featured an exceptional number of pavilions in glued laminated timber.[6] The Norwegian pavilion was no exception: designed by Sverre Fehn, it featured one metre tall, 15cm wide beams in glued laminated

5 A quote from Mageli's interview, describing Laminator's beginnings. Johs. Mageli, "A/S Laminator. Etablering, vekst og utvikling." March 1996, 14. In SAH/ARK-287-02/E/Ea.

6 Halvor Skjelmerud, NTI, in a letter to Moelven Brug, dated Oslo, August 22, 1958. In SAH/ARK-287-02/E/Ea. Rika Devos and Fredie Floré, "Modern Wood. De Coene at Expo 58," in *Construction History* 24 (2009): 103-20. www.jstor.org/stable/41613947, accessed July 22, 2020.

timber, with a total length of 37 metres that were fastened only with 48 bolts in total.[7] The dominant roof structure was a defining element of the project. According to Christian Norberg-Schulz, in the absence of vertical supports it articulated different spatial potentialities against the datum of the terrain, pre-empting Fehn's poetic approach to space.[8] Architect and former *Byggekunst* editor, Ulf Grønvold, hails Fehn as a pioneer of laminated timber in Norway, arguing that the Brussels pavilion provided new inspiration for the material's use.[9] Moelven's Johannes Mageli, however, had spotted glulam a year prior to the opening of Fehn's pavilion: in 1957, he visited an "eye-opening" exhibition of building materials in Stockholm, where he came across the glued laminated products of the Swedish company Töreboda Fribärande Träkonstruktioner. He quickly realised that laminated wood fitted "hand-in-a-glove" with the products and facilities of Moelven Brug.[10] Laminated loadbearing arches and beams complemented the prefabricated products already developed by Moelven and could be used for schools, gymnastic halls, storage and factory buildings.

Three months after the Brussels Fair, on August 15, 1958, Mageli presented a project proposal to the board of Moelven Brug that contained research on new technology of glued laminated timber, assessed its market potential in Norway and suggested that it could become a lucrative venture as a new product branch.[11] A couple of weeks later, the board resumed the discussion of this initiative, now titled "Limte Trækonstruktioner" in connection with a business trip to Holland proposed by Mageli.[12] Together with Haakon Bergseng, the head of Ringsaker Almenning, a local forest cooperative, and two engineers from the Norwegian Institute of Wood Technology (NTI), Karl Mørkved and Eirik Raknes, the group was to study glulam factories in Europe with the ambition of developing a similar technology in Norway.[13] The case was promptly followed up at the next meeting on November 3, where it was the only item on the agenda. The urgency of the matter was emphasised: "one should not wait too long to introduce the new production," since another Norwegian company—most likely, Splitkon—had already prom-

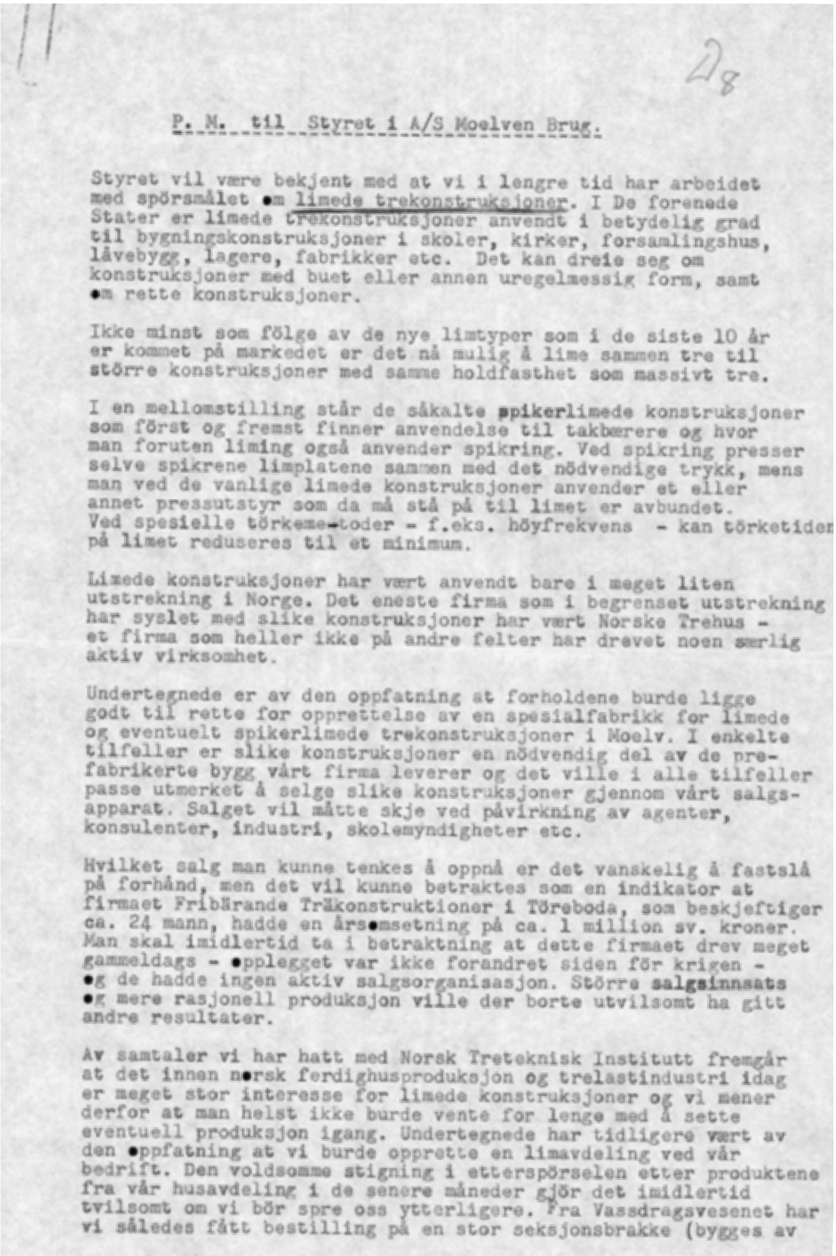
7 Sverre Fehn, "Paviljongen i Bryssel," *Byggekunst* 40, no. 4 (1958): 85-94.
8 Christian Norberg-Schulz, Gennaro Postiglione, and Sverre Fehn, *Sverre Fehn: samlede arbeider*, trans. Maja Cappello (Oslo: Damm, 2003), 73.
9 Ulf Grønvold, "Linjer hos Fehn" in Norberg-Schulz, Postiglione, and Fehn, 292.
10 Mageli, "Laminator," 6.
11 "PM til Styret i A/S Moelven Brug," August 15, 1958, p.1 in SAH/ARK-287-02/E/Ea.
12 Moelven Brug board meeting notes, item 228 from October 24, 1958, 217. In Moelven board meetings books, SAH/ARK-287-01/A/Aa, Box L0001, Folder 0001.
13 Norsk treteknisk institutt and Per Skogstad, *Kunnskap for fremtiden: Norsk treteknisk institutt 1949-1999* (Oslo: NTI, 2000), 67. The factories visited were Verbeco and Nemaho..

Fig. 2. Sverre Fehn's Brussels pavilion with long horizontal glulam beams. Below, details of roof construction. Photo Hervé. From *Byggekunst* 40, no. 4 (1958).

ised to visit Holland to discuss opportunities for cooperation. It "would be a pity" if they outpaced Moelven Brug.[14] The business of lamination held a lucrative promise: the only other company on the Scandinavian market was the Swedish firm Töreboda Träkonstruktioner, whose equipment and technology were utterly outdated.[15] Although positioned as technology novel to the Norwegian market of the late 1950s, the history

14 Moelven Brug board meeting notes, item 233 from November 3, 1958, 219. SAH/ARK-287-01/A/Aa, Box L0001, Folder 0001. Splitkon was founded by Laila Schou Nilsen in Hønefoss in 1959; more on her see Gunnar Jerman, *Kvinnelige pionerer i menns verden*, *NFFO* (Oslo: Kolofon, 2009), 184–85. Mageli, "Laminator," 17-18.

15 Per-Øivind Sandberg, Jan Haug, and Eidsberg sparebank, *Eidsberg gjennom 150 år*, *Norbok* (Mysen: Eidsberg sparebank, 1998), 46.



28

P. M. til Styret i A/S Moelven Brug.

Styret vil være bekjent med at vi i lengre tid har arbeidet med spörsmålet om limede trekonstruksjoner. I De forenede Stater er limede trekonstruksjoner anvendt i betydelig grad til bygningskonstruksjoner i skoler, kirker, forsamlingshus, låvebygg, lagere, fabrikker etc. Det kan dreie seg om konstruksjoner med buet eller annen uregelmessig form, samt om rette konstruksjoner.

Ikke minst som fölge av de nye limtyper som i de siste 10 år er kommet på markedet er det nå mulig å lime sammen tre til större konstruksjoner med samme holdfasthet som massivt tre.

I en mellomstilling står de såkalte spikerlimede konstruksjoner som först og fremst finner anvendelse til takbærere og hvor man foruten liming også anvender spikring. Ved spikring presser selve spikrene limplatene sammen med det nödvendige trykk, mens man ved de vanlige limede konstruksjoner anvender et eller annet pressutstyr som da må stå på til limet er avbundet. Ved spesielle törkeme-toder - f.eks. höyfrekvens - kan törketiden på limet reduseres til et minimum.

Limede konstruksjoner har vært anvendt bare i meget liten utstrekning i Norge. Det eneste firma som i begrenset utstrekning har syslet med slike konstruksjoner har vært Norske Trehus - et firma som heller ikke på andre felter har drevet noen særlig aktiv virksomhet.

Undertegnede er av den oppfatning at forholdene burde ligge godt til rette for opprettelse av en spesialfabrikk for limede og eventuelt spikerlimede trekonstruksjoner i Moelv. I enkelte tilfeller er slike konstruksjoner en nödvendig del av de prefabrikerte bygg vårt firma leverer og det ville i alle tilfeller passe utmerket å selge slike konstruksjoner gjennom vårt salgsapparat. Salget vil måtte skje ved påvirkning av agenter, konsulenter, industri, skolemyndigheter etc.

Hvilket salg man kunne tenkes å oppnå er det vanskelig å fastslå på forhånd, men det vil kunne betraktes som en indikator at firmaet Fribärande Träkonstruktioner i Töreboda, som beskjeftiger ca. 24 mann, hadde en årsomsetning på ca. 1 million sv. kroner. Man skal imidlertid ta i betraktning at dette firmaet drev meget gammeldags - opplegget var ikke forandret siden för krigen - og de hadde ingen aktiv salgsorganisasjon. Större salgsinnsats og mere rasjonell produksjon ville der borte utvilsomt ha gitt andre resultater.

Av samtaler vi har hatt med Norsk Treteknisk Institutt fremgår at det innen norsk ferdighusproduksjon og trelastindustri idag er meget stor interesse for limede konstruksjoner og vi mener derfor at man helst ikke burde vente for lenge med å sette eventuell produksjon igang. Undertegnede har tidligere vært av den oppfatning at vi burde opprette en limavdeling ved vår bedrift. Den voldsomme stigning i etterspörselen etter produktene fra vår husavdeling i de senere måneder gjör det imidlertid tvilsomt om vi bör spre oss ytterligere. Fra Vassdragsvesenet har vi således fått bestilling på en stor seksjonsbrakke (bygges av

Fig. 3. Mageli's "PM til Styret" with a proposal about setting up a production of glued laminated constructions. August 15, 1958. In SAH/ARK-287-02/E/Ea. State Archive in Hamar.

of lamination in Norway was in fact much older: unknowingly, Moelven Brug was entering a vast network of actors, institutes and international knowledge exchange that spanned decades and continents.

Although early 20th-century glued laminated constructions are well-studied in continental Europe, particularly in Belgium, Switzerland and Germany, their history in Scandinavia still remains to be written.[16] Civil engineer Guttorm Brekke was a pioneer of glued laminated timber in Norway: he studied in Germany with Otto Hetzer AG, and in 1916, at a cost of 60.000 NOK, bought a patent for the use of the Hetzer-Binder system in Norway, Sweden, "North Russia south to Vilna," and the United States.[17] The purchase of the licence included a two-month course at the Hetzer factory in Weimar, and a set of detailed technical instructions for all production aspects, including the recipe for the glue.[18] Post-WWI food rationing and the short supply of milk in Germany—the main ingredient for the casein glue used in lamination—combined with low steel and concrete prices, forced Hetzer out of the glulam business. The situation was different in Norway, Sweden and Switzerland, which remained neutral throughout WWI.[19] In Norway, Brekke established a laminated timber company A/S Trækonstruktion in Mysen, outside Oslo, in March 1918, with equipment and facilities modelled after the Hetzer factory.[20] For example, an assembly hall of 60 by 100 feet had plain wooden floors so that curves of glued laminated arches could be drawn on a one-to-one scale. The factory included large storage and wood conditioning facilities, a dry kiln and a small steel workshop, along with hoists, monorails and mechanical equipment necessary for assembly. The technology transfer from Germany was so precise that Brekke obtained all equipment—from a special combined mixer and a grinder for manufacture of casein glue, to "excellent" screw clamps—directly from Weimar.[21]

Brekke's glued laminated timber elements found broad application in Norway and Sweden: from a pavilion for a Nordic-American exhibition at Tivoli in Oslo in 1919 and Andreas Bugge's experimental "American" houses at NTH in 1922, to a Norwegian pavilion at the World Exhibition in

16 Mario Rinke and Roshanak Haddadi, "Transforming the traditional timber roof—the sport hall in Birsfelden as an early glulam application in Switzerland," in *Iron, Steel and Buildings: the Proceedings of the Seventh Conference of the Construction History Society*, 2020, 665.
17 Andreas Rhude, "Structural Glued Laminated Timber: History and Early Development in the United States," *APT Bulletin* 29 (January 1, 1998): 11–12, https://doi.org/10.2307/1504543.
18 Guttorm N. Brekke, "Glued laminating timber for the building industry," Report no.2, Folder 0001-C-111r, in RA/S-2079/E/Eb/L0034/0010, 7-8.
19 Brekke, Report no. 2, 6.
20 Sandberg, Haug, and Eidsberg sparebank, *Eidsberg gjennom 150 år*, 46. Norsk treteknisk institutt and Skogstad, *Kunnskap for fremtiden*, 66.
21 Brekke, Report no.2, 7.

Fig. 4. Advertisements of Trækonstruktion A/S, the first Norwegian venture into glued laminated timber. Newspaper clippings, 1919.

Rio de Janeiro in 1922-23.[22] The company fostered a close relationship with railway agencies, delivering structures for train stations and platforms in Oslo, Trondheim and Lillestrøm, continuing the long-standing tradition where railway expansion was paralleled and accompanied by innovations in timber construction.[23] An expanding partnership with Swedish State Railways (SJ) led Brekke to open another factory in Töreboda, Sweden, already in 1919, as the company was commissioned to deliver a number of train stations and platform buildings all over the country, including large train station halls for Stockholm, Malmö and Gothenburg.[24] In addition to railway buildings, the factory produced sports and tennis halls—including the King's tennis hall—theatres, factory and storage facilities, with just over 300 structures built in the first couple of years. However, casein glue was not entirely water-resistant, and Brekke's glulam structures showed some signs of decay under prolonged exposure to moisture and rain—an inherent aspect of the Scandinavian climate. With increased competition from the concrete and steel producers that gradually returned to the market in the post-WWI period, high operating costs, general liquidity problems, and the fact that glulam "had not yet gained the confidence of the public," the first venture into laminated construction in Norway came to a halt. In 1925 Brekke

22 Verdensutstillingen, *Beretning om Norges deltagelse i Verdensutstillingen i Rio de Janeiro, 1922-1923*, *Norbok* (Kristiania, 1924). Andreas Bugge and Norges tekniske høgskole, *Forsøkshuser: opført ved Norges tekniske høiskole, Trondhjem: resultat av forsøk med vægkonstruktioner og materialer for bygning av varme og billige boliger*, *Norbok* (Trondhjem: F. Bruns bokhandels forlag, 1922), 21–22. *Nationen,* September 9, 1919, 3.

23 Brekke, Report no. 2, 16.

24 "Aktiebolaget Fribärande Träkonstruktioner till tak och broar Töreboda" booklet in RA/S-2079/E/Eb/L0034/0010/0001-C-111r. Also see E/GLA/10839 collection at Swedish Riksarkivet.

Fig. 5. Advertisements for Brekke's Swedish factory, Töreboda Fribärande Träkonstruktioner, 1920s. Glued laminated constructions were used for Stockholm central station. Similar halls were built in Malmö and other Swedish and Norwegian cities. From Brekke's Report no.2, Folder 0001-C-111r, in RA/S-2079/E/Eb/L0034/0010. Oslo State Archive.

discontinued production at Mysen. When the factory burned down the following year, it was never rebuilt. Träkonstruktioner in Sweden, with its established name and well-developed technological apparatus, was sold to a new owner, and Brekke emigrated to the United States, where he worked for the National Bureau of Standards in Washington DC.[25]

While failing on the business front, Brekke's pioneering talets were put to other uses. In 1945, the Norwegian Industrial Committee in New York and architect John Engh commissioned Brekke to produce a report on the possibility of re-introducing glulam to post-WWII Norway.[26] Completed just a week after the end of the war—May 16, 1945—Brekke's exhaustive report amassed information on the early history of lamination, detailed the technical specifications of Brekke's own venture, and assessed the most recent international research. It was Brekke's company—Fribärande Träkonstruktioner from Töreboda—that in 1957 inspired Mageli to produce laminated timber constructions at Moelven. In fact, a list of Töreboda's building typologies in laminated timber accompanied a market research note produced by the Institute of Wood Technology for Moelven in 1958.[27] Mageli later regretted that he "did not get to meet the old pioneer and the founder of lamination in Norway."[28] In 1982, Töreboda Limtre was bought by Moelven, in a way closing the loop: technology imported from Germany to Sweden by an entrepreneurial Norwegian engineer returned to its Norwegian origins.[29] However, contemporary European structures in glued laminated timber would not be the same without another part of this story: its American chapter.

THE AMERICAN CHAPTER

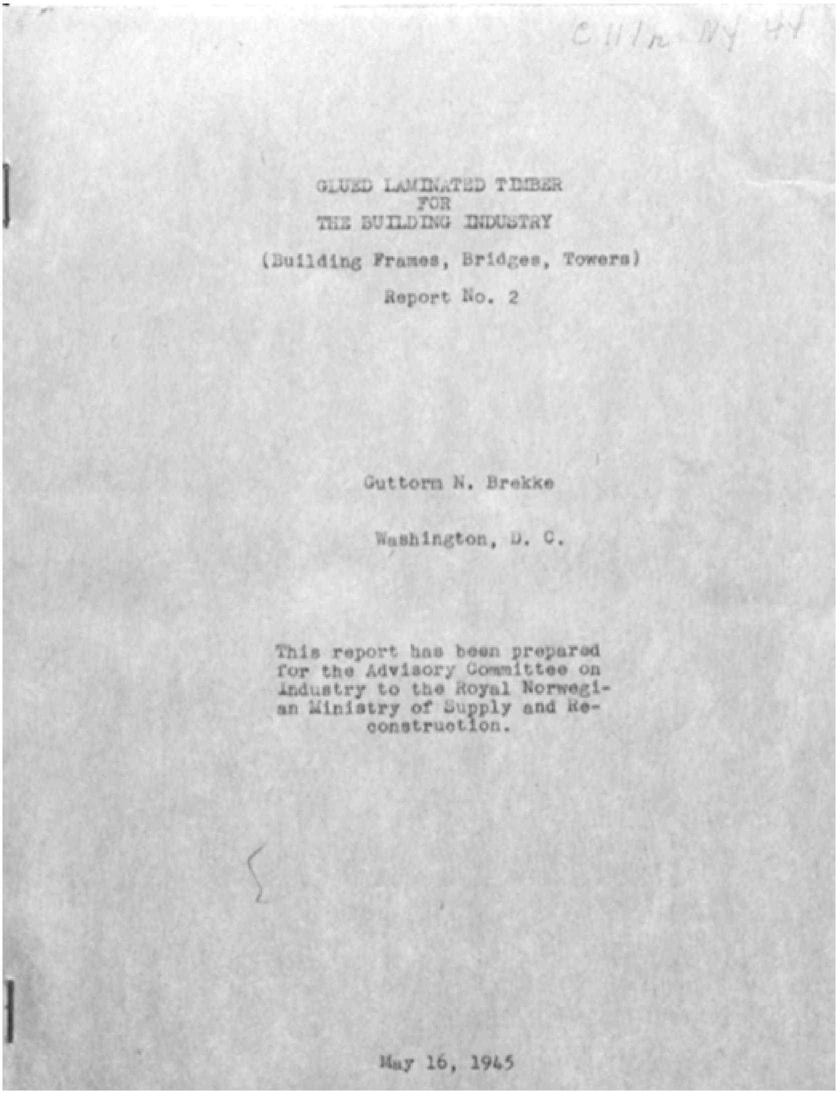
Although decidedly European in its origins—patented in Germany in the early 20th century, and developed in Scandinavia in the 1920s—in the absence of truly water-resistant glue the technology of lamination could not compete with steel and concrete in inter-war Europe. With waves of European immigration, the technology was exported to the

25 Brekke, Report no.2, RA/S-2079/E/Eb/L0034/0010 0001-C-111r, 15.
26 Rolv Petter Amdam, "Industrikomiteen i New York 1943-1945: ein kanal for kunnskapsoverføring frå USA til Norge," *Historisk tidsskrift* 79 (2000): 3-21.
27 Mageli, "Laminator," 21-26. In SAH/ARK-287-02/E/Ea. Brekke, Report no. 2, 6.
28 Mageli, "Laminator," 6.
29 Moelven industrier et al., *Moelven 1899-1999*, 71. Today, Moelven Limträ positions itself as a direct descendant of Brekke's venture and claims design of all train station projects done by Fribärande Träkonstruktioner AB. See more at https://www.swedishwood.com/publications/wood-magazine/2019-3/active-centenarian-that-changed-the-industry/, accessed July 6, 2020.

United States before WWII.[30] Up until then American researchers have been more interested in plywood—a material that could be used for quick construction. Plywood experiments with synthetic adhesives and particularly wartime efforts, also contributed greatly to the development of lamination technology.[31] One of the first institutes in the US to start a comprehensive research programme on the technology of lamination in 1934 was the Forest Products Laboratory (FPL) in Madison, Wisconsin, established two years prior. At the initiative of Max Hanisch—a German engineer, pioneer of laminated timber in the US, and yet another student of Otto Hetzer—the laboratory conducted a number of stress tests for glued laminated arches, publishing the results in *USDA Technical Bulletin* No. 691 "The Glued Laminated Wooden Arch" in 1939.[32] Incredulous about the structural properties of glulam, the project's director, T.R.C. Wilson, made a trip to Europe in summer of 1936 to study around 50 different laminated structures in Norway, Sweden, Denmark, Germany and Switzerland—a significant portion of which were produced by Brekke. Upon returning, Wilson reported that many, including the Trondheim train platform building inaugurated in 1921, were in "excellent condition."[33]

While the main goal of the Laboratory was to find new market areas for forest resources, its studies of the structural properties of American timber species greatly advanced research on glued laminated timber constructions.[34] FPL studied the mechanical properties of wood in tension, bending and compression, degrees of shear, toughness and rigidity through series of stress tests and controlled experiments.[35] These studies provided an accurate reading of timber performance, avoiding the "irrational" use of materials and recording the discrepancy between different wood species—a factor never accounted for before. The results of these studies were recorded in detailed tabulations of numbers and parameters, graphs and force diagrams.[36] Similar to the way Michael Osman argues that concrete was transformed from a "liquid stone" material derived from natural components to a material of analytical control and managerial organisation, FPL research transformed timber from a "natural" to a "scientific" material whose structural qualities and production

30 McNall and David C. Fischetti, "Glued Laminated Timber," in Thomas C. Jester, ed. *Twentieth-century Building Materials: History and Conservation*, University of Michigan: McGraw-Hill, 1995, 137.
31 Rhude, "Structural Glued Laminated Timber," 15–16.
32 Rhude, 13.
33 Brekke, Report no.2, 16.
34 "Forest Products Laboratory. A brief account of its work and its aims," Brekke's Report no.2, 4.
35 "Forest Products Laboratory," 15.
36 See, for example, Exhibit no. 47, or Technical Note no. 240, "A Hundred Definitions Pertaining to Wood and Other Forest Products" that listed and explained more than 100 variable affecting the quality of timber. Brekke's Report no.2.


C 111r NY 44

GLUED LAMINATED TIMBER
FOR
THE BUILDING INDUSTRY

(Building Frames, Bridges, Towers)

Report No. 2

Guttorm N. Brekke

Washington, D. C.

This report has been prepared
for the Advisory Committee on
Industry to the Royal Norwegi-
an Ministry of Supply and Re-
construction.

May 16, 1945

Fig. 6. Cover and table of contents of Brekke's "American" report "Glued laminating timber for the building industry," May 1945. Report no. 2, Folder 0001-C-111r, in RA/S-2079/E/Eb/L0034/0010. Oslo State Archive.

CONTENTS

process could be controlled and adjusted through a series of parametric variables.[37] In addition, US research on synthetic resin adhesives, fire retardants, chemical seasoning of wood, protection against fire, fungi pathology and decay, glue solvents and catalysts significantly upgraded the technology of lamination and made engineered timber competitive with other post-war construction materials. In this way, although European in its origins, the technology of lamination was updated in the US with state-of-the-art research that challenged the role of timber as a "natural" material and enhanced it with new resistance and stability.

The influence of this American chapter on the development of glued laminated timber technology in Norway should not be underestimated. US was eagerly transferred back to the continent. Brekke's report was a key element in this knowledge transfer: during his research, Brekke visited the plants of several producers—for example, Gamble Brothers in Louisville, Kentucky—and developed close ties with the FPL director, visiting the laboratory several times throughout September 1944. Brekke's report was supplemented with an array of white papers, reports and technical notes on the structural qualities of timber, adhesives, chemicals and the technological details of production, providing solid background research for anyone interested in developing this technology in Norway. However, it was not widely distributed. And although Mageli was familiar with some existing research on lamination, he did not see Brekke's compendium until 1958—an unfortunate oversight, considering the magnitude and scale of research that went into it.[38] Brekke's report was known to other practitioners, however, for example Hans Granum, or the specialists at the new Wood Technology Institute—trickling down to Moelven through their work.[39]

It was particularly the latter, the Norwegian Institute of Wood Technology—Norske Treteknisk Insititutt (NTI)—that played an important role in Moelven's venture with glulam. Established in March 1949, the institute was to engage with research similar to that of the Forest Products Laboratory, amassing knowledge on wooden products, typologies and material properties of timber species, new methods of production, storage, and areas of market application. Through initiatives sponsored by the Norwegian Productivity Institute and the abundant American funding of the Technical Assistance and Productivity programme, the institute

37 Michael Osman, "The managerial aesthetics of concrete," *Perspecta* 45 (2012): 67-76. www.jstor.org/stable/24728116. Accessed July 20, 2020.
38 Mageli, "Laminator," 15. In SAH/ARK-287-02/E/Ea.
39 See a detailed reference to Töreboda 1938 catalogue in Hans Granum letter to Moelven, dated Trondheim, September 30, 1958. In SAH/ARK-287-02/E/Ea.

became a hotbed for the most recent technological knowledge exchange between Norway and the United States. [40] For example, with Marshall Aid funding, the institute acquired a substantial research library, while many engineers received of Fulbright scholarships and some interned directly at FPL.[41] The institute's leader—engineer Halvor Skjelmerud—spent a year in the United States and Canada, where he visited a number of wood and timber research institutes, including the Institute of Forest Genetics in California and the Oregon Forest Products Laboratory, developed professional contacts, and "educated himself about different aspects of wood technology." [42] As NTI and FPL became part of a joint research collaboration, the Norwegian Institute worked on a number of similar topics: for example, the structural, static and material properties of Nordic timber species were closely studied and catalogued. NTI was the first and only institute in Norway to engage with research on glued laminated timber construction, testing various glues, timber species and drying technologies. NTI engineer Hvamb went to a year-long research stay in the US, and came back with a positive impression of the increasing role of laminated technology in the American market.[43] In 1957, Magnus L. Selbo—a key FPL specialist on lamination technology in the US—came to NTI as part of a professional exchange program and worked with Ole Grønvold on a report on loadbearing laminated constructions made with industrial adhesives.[44] Following these studies, NTI assembled a vast technical library on lamination technology, a compilation that was available to any private company to consult. When Moelven went on its 1958 "technology hunt" for glued laminated timber, NTI was one of the first academic institutes the company consulted.[45]

Moelven closely collaborated with NTI in the development of its lamination technology. Upon Moelven's first inquiry on the potential of glued laminated constructions for the Norwegian market, Skjelmerud wrote an enthusiastic reply and offered support. According to Skjelmerud, "it is not clear to [the Institute] what the reservations in

40 Norsk treteknisk institutt and Skogstad, *Kunnskap for fremtiden*, 80.
41 Foslie, "Fra etablering til 1978," 13-14.
42 Michael Foslie, "Fra etablering til 1978" in Norsk treteknisk institutt and Skogstad, *Kunnskap for fremtiden*, 11. Other institutions included British Columbia Research Council and Forest Products Laboratory in Vancouver. Halvor Skjelmerud Skjelmerud, "Rapport fra besøk ved tretekniske forskningsinstitusjoner og trelastog treindustrier i det vestlige USA og Canada ; Bilag til reiserapporter" (Oslo: Norsk Treteknisk Institutt, 1952), 5.
43 Halvor Skjelmerud, NTI, in a letter to Moelven Brug, dated Oslo, August 22, 1958. In SAH/ARK-287-02/E/Ea.
44 Per Lind, "Limtre—med norsk drivkraft," in Norsk treteknisk institutt and Skogstad, *Kunnskap for fremtiden*, 70. Selbo is listed as an author of six different reports on "Gluing of Fire-Retardant-Treated Wood" published between 1955 and 1959. See Forest Products Laboratory (U.S.), *Forest Products Laboratory Research Program*, 1958, 53–54.
45 Mageli, "Laminator," March 1996, 15. In SAH/ARK-287-02/E/Ea.

Table 2.--Summary of minor tests for flanges

Beam No.	Douglas-fir compression-flange material								Sitka spruce tens					
	Compression parallel to the grain				Static bending				Compression parallel to the grain				Sta	
	Moisture content	Specific gravity[1]	F_{cu}	E_{Lc}	Moisture content	Specific gravity[1]	F_{bu}	E_L	Moisture content	Specific gravity[1]	F_{cu}	E_{Lc}	Moisture content	Sp gr
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
	Percent		lb. per sq. in.	1,000 lb. per sq. in.	Percent		lb. per sq. in.	1,000 lb. per sq. in.	Percent		lb. per sq. in.	1,000 lb. per sq. in.	Percent	
-T-1	9.9	0.432	7,240	1,974	10.6	0.430	12,360	1,772	8.4	0.362	6,580	1,837	9.8	0
-T-2	9.8	.477	7,190	1,856	9.9	.478	13,330	1,740	9.3	.389	6,870	1,902	10.1	
-T-2A	9.7	.488	7,460	1,841	9.7	.465	13,260	1,777	8.7	.384	6,730	1,822	8.8	
-T-3	9.7	.479	7,440	1,810	10.0	.479	13,380	1,709	9.6	.408	7,040	1,956	10.3	
-T-1	9.9	.461	7,310	1,961	9.9	.459	13,000	1,794	8.8	.395	7,160	1,868	8.5	
-T-1A	8.5	.442	7,320	1,758	8.6	.439	11,900	1,544	8.8	.363	6,380	1,759	8.5	
-T-2	9.9	.470	7,420	1,909	10.2	.471	12,710	1,704	8.6	.391	6,600	1,820	8.8	
-T-2A	10.1	.488	7,870	2,141	9.9	.488	13,170	1,854	8.7	.389	6,980	1,817	9.2	
-T-3	10.0	.490	8,140	2,185	10.5	.490	13,100	1,890	8.7	.363	6,240	1,728	8.5	
-T-1	9.6	.442	7,020	1,730	9.8	.446	12,630	1,625	9.5	.417	7,080	1,999	10.4	
-T-2	10.0	.510	8,010	2,102	9.9	.508	13,770	1,921	8.6	.407	6,990	1,942	9.1	
-T-3	10.3	.501	7,810	2,036	10.1	.501	13,510	1,927	8.9	.380	6,800	1,862	9.0	
-T-1	9.4	.476	7,590	1,953	9.6	.471	12,620	1,707	8.7	.385	6,820	1,833	9.5	
-T-2	9.1	.455	7,710	2,033	9.4	.455	12,420	1,811	8.4	.398	7,070	1,919	10.0	
-T-3	8.7	.479	8,330	2,261	9.0	.476	13,390	1,909	8.9	.363	6,210	1,667	9.5	
-T-1	9.9	.460	7,500	1,799	10.1	.459	12,570	1,635	8.1	.454	8,220	2,413	8.0	
-T-2	9.2	.488	8,860	2,237	9.8	.485	14,240	1,992	9.6	.489	8,800	2,330	9.8	
-T-3	9.2	.462	7,720	1,848	9.4	.460	12,840	1,714	9.0	.403	7,250	1,916	8.4	
-T-1	9.4	.464	7,770	1,860	10.3	.461	12,390	1,668	9.2	.472	8,270	2,421	10.9	
-T-2	8.4	.469	8,370	2,026	9.3	.468	13,210	1,812	8.2	.405	7,510	2,124	8.8	
-T-3	8.2	.445	7,500	1,706	10.1	.441	11,550	1,527	8.1	.372	6,720	1,711	9.0	
-T-1	10.0	.495	7,180	1,805	10.2	.490	13,240	1,598	8.5	.397	6,860	1,950	8.8	
-T-2	9.5	.464	7,770	2,107	9.8	.465	12,970	1,865	8.5	.395	6,690	1,873	8.6	
-T-3	8.9	.427	7,140	1,810	9.1	.425	11,930	1,608	8.5	.408	7,110	2,087	9.2	

[1] Specific gravity based on volume at test and oven-dry weight.

Fig. 7. A technical summary of the performance of different wood species with different moisture content in response to gluing. In RA/S-2079/E/Eb/L0034/0010, Oslo State Archive.

regards to lamination technology on the Norwegian market could be." NTI engineers saw no "special Norwegian conditions" that would hinder successful application of glulam, besides "the technical conservatism of the Norwegian building sector."[46] Skjelmerud assured Mageli, that NTI had been working with glulam for "quite some time," had amassed an impressive array of literature, and was willing to assist any private company ready to embark on their glulam journey. Luckily for Moelven, "the best American specialist Mr. Selbo," had just spent a year at the Institute.[47] Thus, a productive cooperation between Laminator and NTI emerged: two Institute engineers Karl Mørkved and Eirik Raknes were a part of the 1958 study trip that visited Dutch factories; Johannes Moe—a civil engineer from NTI who had studied in the US—assisted Laminator with the research on the dimensioning for laminated con-

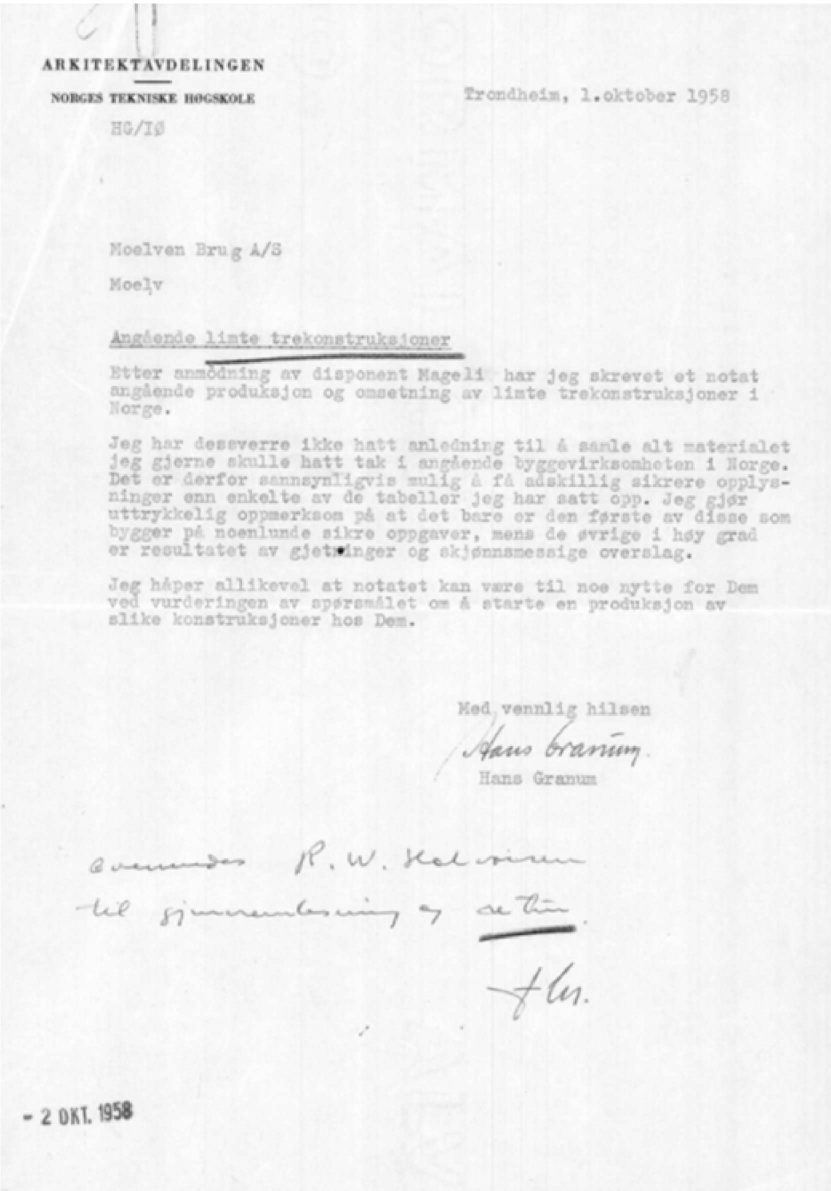
46 Skjelmerud letter to Moelven, 1958.
47 Skjelmerud to Moelven, 1958.

structions and, according to Mageli, provided "invaluable assistance in the problematic starting period."[48] Both Laminator and NTI representatives were among the founders of the *Lamineringsutvalg*—a self-assessment organ for quality compliance among producers of laminated wood established at Moelven's initiative. Laminator's former production chief and administrative director Haumann Sund later became a board leader at NTI.[49] In this way, through close cooperation between Laminator and NTI, which in turn had extensive ties with the research environment of the US, the company experienced an indirect knowledge transfer from this "American" technology. However, this knowledge still had to be assimilated through the practice of local researchers, and adapted to the available technical resources and labour force. The second chapter of laminated timber in Norway was about to begin.

LOCAL ADAPTATIONS

Imported technology was assimilated to the practical conditions of Norwegian life through four main aspects: access and quality of raw materials, available labour force, technology and infrastructure. Similar to the way Ringsakerhus was established in cooperation with OBOS, Laminator was established as a shared enterprise together with Ringsaker Almenning (RA), which held 40% of the company's stock.[50] Ringsaker Almenning was in fact ahead of Moelven in considering the production of glued laminated timber: as Mageli later recalled, the head of the cooperative, his "dear friend" Haakon Bergseng, had close contacts with NTI and had already opened a construction office that worked with new timber structures.[51] Bergseng was, in this regard, similar to OBOS's Solberg: a local director, interested in technological innovations and new market opportunities for products of Ringsaker Almenning.[52] For Moelven, cooperation with the local forest cooperative simplified the access to raw materials and reduced the need for new machinery: the cooperative already had a new sawmill, drying chambers, and a workshop for roof truss manufacture. For Ringsaker Almenning, cooperation with Moelven meant that their timber "sold out like hotcakes" and a steady stream of commis-

48 Johs. Mageli, "A/S laminator. Etablering, vekst og utvikling." March 1996, 13. In SAH/ARK-287-02/E/Ea.
49 See 'Forord' in Norsk treteknisk institutt and Skogstad, *Kunnskap for fremtiden*, 5.
50 Sevatdal and Grimstad, "Norwegian Commons in Perspective" in Erling Berge, Lars Carlsson, and Landscape, Law and Justice (program), "Commons: Old and New: Proceedings from a Workshop : Centre for Advanced Study, Oslo, 11-13 March 2003," ISS Rapport (Trykt Utg.) Nr 70 (Trondheim: Department of Sociology and Political Technology, Norwegian University of Science and Technology, 2003), 99.
51 Mageli, "A/S Laminator," 8.
52 Mageli, "A/S Laminator," 8-9.


ARKITEKTAVDELINGEN

NORGES TEKNISKE HØGSKOLE

Trondheim, 1.oktober 1958

HG/IØ

Moelven Brug A/S

Moelv

Angående limte trekonstruksjoner

Etter anmodning av disponent Mageli har jeg skrevet et notat angående produksjon og omsetning av limte trekonstruksjoner i Norge.

Jeg har dessverre ikke hatt anledning til å samle alt materialet jeg gjerne skulle hatt tak i angående byggevirksomheten i Norge. Det er derfor sannsynligvis mulig å få adskillig sikrere opplysninger enn enkelte av de tabeller jeg har satt opp. Jeg gjør uttrykkelig oppmerksom på at det bare er den første av disse som bygger på noenlunde sikre oppgaver, mens de øvrige i høy grad er resultatet av gjetninger og skjønnsmessige overslag.

Jeg håper allikevel at notatet kan være til noe nytte for Dem ved vurderingen av spørsmålet om å starte en produksjon av slike konstruksjoner hos Dem.

Med vennlig hilsen

Hans Granum

Hans Granum

Oversendes R. W. [illegible]

til gjennomlesning og [illegible].

Hls.

- 2 OKT. 1958

Fig. 8. On the left, a letter from Hans Granum to Moelven, discussing opportunities for glued laminated timber in Norway (1958). On the right, a letter from NTI's Halvor Skjelmerud, summarising NTI's work with glued laminated timber to date (1958). All in SAH/ARK-287-02/E/Ea, State Archive in Hamar, Norway.

- 2 -

Det vil forstås at det ligger utenfor vår oppgave å forsöke å foreta en markedsvurdering av det eventuelle behov det er her i landet for slike konstruksjoner. Vår oppgave er primært å studere de rent tekniske forhold i forbindelse med liming og laminering av tre samt å være de bedrifter som er interessert i den slags produksjon til assistanse ved utpröving og ved opplysninger om limtyper, produksjonsmetoder etc. Vi vil gjerne understreke dette for å gjöre begrensningene i vår kompetanse klar. Imidlertid har vi ansett det som vår oppgave å fölge med i den tekniske og produksjonsmessige utvikling i lamineringsindustien og vi har samlet et meget rikholdig litteraturmateriale, såvel når det gjelder produksjon som anvendelse av limte buer, takstoler, bjelker etc. Disse står selvsagt til disposisjon på vårt bibliotek for de som måtte være interessert. Den rike utvikling vi således her finner i utlandet har gjort at vi i hvertfall har spurt oss selv om vi her i landet skal betrakte oss som "tilbakeliggende" på dette punkt. Vi har ingen formening om årsaken til dette og vi har heller ikke sett det som vår oppgave å studere disse noe markedsbetonte spörsmål nærmere. På den annen side har vi svært vanskelig for å se at noen spesielle norske forhold her skulle gjöre seg gjeldende som skulle stille seg vesentlig hindrende i veien for en lignende utvikling av lamineringsindustrien her i landet.

Såvidt vi kan forstå burde det samarbeid som her er innledet mellom Ringsaker Almenning og Moelven Brug teknisk sett ligge vel til rette for en utvikling av limte konstruksjoner i vid forstand. Vi har bemerket at Ringsaker Almenning nå går til anskaffelse av kammertörke. For en god limforbindelse er det meget viktig at trevirket har den riktige fuktighet og en jevnest mulig fuktighet gjennom virket, samt at virket er mest mulig spenningsfritt. Dette oppnås erfaringsmessig sikrest med en vel drevet kammertörke og i og med at denne nå er under anskaffelse synes det oss at man her allerede har löst en viktig del av produksjonskjeden. En god og jevn törking av trematerialene er faktisk en forutsetning for å oppnå en god limet trekonstruksjon.

Vi håper disse opplysninger kan være av noen interesse for Dem for de beslutninger De står i ferd med å treffe. Vi vil gjerne legge til at det rikholdige materiale av litteratur, tekniske rapporter etc. selvsagt står til disposisjon for Dem når De måtte önske.

Med hilsen

for NORSK TRETEKNISK INSTITUTT.

Halvor Skjelmerud.

sions.[53] By the mid-1960s, Laminator used on average 1500 standards (a traditional unit for timber measure approximating 270 cubic feet) of first-class boards of 1 ½ inches per year, delivered almost entirely from Ringsaker Almenning.[54] Second, new production created new work places, much needed in a municipality where the mechanisation of forestry and agriculture had left much of the population with seasonal jobs and no stable income. As the municipal decisionmaker Bjarne Mork emphasised, "the unemployment [in the municipality] would have been significantly worse if Moelven did not develop to the level it did."[55] When the company solicited a municipal loan, Mork concluded that he could "see no other way forward but, in the best municipal interest, to guarantee a loan and thus create new workplaces."[56] Starting with 27 employees in 1960, the company grew to 55 workers in 1964 and 65 by 1970.[57] For Laminator, an unskilled labour force was an advantage: at a cost of around 3000 NOK for teaching expenses over the course of several weeks, workers could be quickly taught the technical specifications of the lamination process, and the majority of them stayed with "laminatoren" for many years. [58]

Third, while Moelven engineers went out to source expertise from other countries that had been working with glued laminated timber—Sweden, Finland, Germany, Belgium and Holland—technological developments elsewhere proved of little practical use. During their visit to Nemaho factory in Holland, the Moelven delegation only got to see the raw material storage and some ready-made constructions, without any information shared on the technological process.[59] When Mageli and Bergseng visited production facilities at Töreboda, according to Mageli, "even with limited knowledge at the time" it was clear that its equipment and machinery were technically outdated, "as if its development stopped more than 35 years ago."[60] Laminator sales manager John Giæver went on a year-long trip to the United States, studied at the University of Minneapolis, and worked with Rilco products—one of the largest laminated timber producers in the US—bringing home a number of film recordings of their facilities and production process that were shown at the first

53 *Hamar Arbeiderblad*, 15 September 1961, p.4; and *Hamar Arbeiderblad*, January 4, 1961, 4.
54 *Bedriftavis*, no.01 (1967): 10-11.
55 Bjarne Mork, "A/S Laminator — søknad om garanti for et lån på kr. 300.000," sak nr.78, Ringsaker formannskap möte, Moelv, February 24, 1959, 124-125. In SAH/ARK-287-02/E/Ea.
56 Mork, "A/S Laminator," 124-125.
57 Mageli, "Laminator," 28. *Aftenposten*, October 8, 1963, 9.
58 Mageli, "Laminator," 8. On personal identification associated either with "bruket" or "laminatoren" see *Gudbrandsdølen*, October 26, 1963, 7.
59 Mageli, "Laminator," 13.
60 Mageli. "Laminator," 15.

exhibition of Laminator products at Ekeberg in 1959.[61] Although hopeful, the venture was short-lived and, as Mageli later recalled, provided "little substance": Moelven could not afford to buy state-of-the-art equipment from the US. Instead, Moelven's mechanical engineers had to improvise and design in-house analogues that would carry out lamination tasks at a low cost. This led to unexpected innovations: new end-joint machines and hydraulic automated press were later sold to Germany on a licence.[62]

Lastly, while there was hardly a limit to the dimensions of glued laminated beams—Moelven claimed that it could achieve unlimited spans—since the company was located in-land and the elements were often transported by trucks and trains, their scale was conditioned by existing infrastructure. For example, the E6 road connecting Moelv and Oslo, with its many narrow overpasses was not suited for large cargo. This hitch made Laminator deliveries 20-25% more expensive, as specific permits had to be obtained for each delivery.[63] Often transported at night and with a police escort, these processions, prominently covered in the local press, were turned into marketing stunts, harnessing the bizarre juxtaposition between these outsized and out-of-place elements and their everyday surroundings. Thus, the "American" technology of lamination was only nominally "foreign." In practice, it was assimilated by the local workforce and technology, while the elements themselves were shaped by networks of raw-material supply and conditions of local infrastructure.

"CONSTRUCTION METHOD OF THE FUTURE"

Originally, Moelven's idea was to use laminated timber for own design projects, for example, schools and sports halls. However, already in the first year the company received commissions for a number of smaller buildings.[64] Following the success of Fehn's 1958 pavilion in Brussels, architects and builders inquired about custom-made, glued-laminated elements even before production had begun, giving Laminator an excellent opportunity to test the market.[65] First presented at the Ekeberg exhibition in 1958, the company's laminated structures soon became popular by word-of-mouth. Originally, the company produced straight, slanted, throttle-shaped or curved beams for free

61 *Hamar Arbeiderblad*, October 16, 1959, 3. On Giæver's time in the US see *Ringsakerblad*, November 6, 1958, 1.
62 Mageli, "Laminator," 15.
63 *Ringsaker Blad*, December 14, 1965, 1. *Ringsaker Blad*, December 28, 1967, 2. "17-18 meters transport fra Moelv i natt," *Gudbrandsdølen*, October 31, 1961, 2.
64 *Ringsaker Blad*, August 13, 1959, 1.
65 Johs. Mageli, "PM til Styret i A/S Moelven Brug," August 15, 1958, 1. Mageli, " Laminator," 13.

spans between 5 and 18 metres, as well as two- and three-joint arches, several joint frames, and arches on poles that accommodated spans from 10 to 60 metres depending on the construction.[66] By 1959, Laminator sales manager Giæver boasted that "the requests are so many that we need to introduce work in shifts, and more people would need to be hired."[67] That year, Laminator delivered several factory and storage buildings in Oslo, roof constructions for Persbråten school in Oslo, a building in Voksenåsen (Norway's national gift to Sweden in Nordmarka), Jar church in Bærum, and several agricultural buildings.[68]

Despite the fact that glued laminated timber was not an entirely new material, Laminator faced similar challenges to those described by Brekke 40 years earlier. There was a need for a "great deal of propaganda work" if the material was to be successful in the Norwegian construction market.[69] In a note to Moelven's board from December 1958, Mageli underlined the crucial importance of marketing efforts:

"Although engineers and architects have been in contact with us [regarding the laminated timber constructions], it is not an exaggeration to say that most people in the branch have very little understanding of the possibilities of wooden construction. Thus, there must be a lot of emphasis on information and propaganda to cover the yet invisible needs."[70]

Unlike other Moelven products, developed in close collaboration with municipal and state actors, glued laminated timber beams were a new construction material that could be used for a wide range of different building typologies. Laminator worked directly with different professionals in constructions industry—architects, builders, engineers, general contractors, and developers. If the new material was to survive the tough competition of steel and concrete, architects and engineers had to be convinced that the material had superb structural and aesthetic qualities. An aggressive marketing campaign ensued, emphasising the ability of glued laminated timber to balance rationality and architectural expression, efficiency and aesthetics.

66 See "Moelven Laminator-konstruksjoner" advertisement, also in *Byggekunst* 49, no.7 (1967).
67 John Giæver, *Hamar Arbeiderblad*, October 16, 1959, 3.
68 *Hamar Arbeiderblad*, October 16, 1959, 3. *Arbeiderbladet*, November 20, 1959, 3.
69 Brekke, Report no.2, 13. RA/S-2079/E/Eb/L0034/0010/0001-C-111r.
70 Mageli, Moelv December 12, 1958, "PM vedr. Opprettelse av fabrikk i Moelv for limte trekonstruksjoner." In SAH/ARK-287-02/E/Ea.

Rationality of production became one of the main selling points, underlined throughout Laminator advertisements. For example, a 1960 marketing booklet titled “Morgendagens byggemetode”—”Construction Method of the Future”—promised that, thanks to the rational use of material and optimal shape, the Laminator beams offered “simple, economical solutions.”[71] In order to fulfil this promise, glued laminated beams had to follow the most optimal form calculated according to force diagrams. Construction historians Rinke and Hadaddi point out that early glued laminated structures in Switzerland often followed construction logic of standard steel or traditional timber connections and thus often failed to realise the full structural potential of the new material. Moelven beams also required new types of calculations to be efficient.[72] Although, originally, Moelven intended to rely on the company’s own engineers, computational calculations of the static properties of the new material proved too complex.[73] The early Laminator beams were often over-dimensioned, and used nearly twice as much material as strictly necessary. With the help of NTI researchers and structural engineers, Laminator gradually developed more efficient shapes for the laminated beams and arches. With building engineers in mind, Laminator booklets emphasised the technical aspects of the new material through a series of tabulations, formulas, graphs and calculations. The material qualities of timber, moisture content, temperature, pressure, and time needed for gluing were meticulously listed, while compliance with international standards and cooperation with similar factories in the US—a token of modernity—were underlined.[74] However, shaped according to force diagrams and built from timber planks, Laminator beams were not only rational, but also aesthetically expressive.

Architect Hans Granum—a specialist in light timber constructions and a professor at NTH—consulted Moelven on the potential interest that glued laminated timber might awake among architects. Enthusiastic about the venture, he suggested that laminated beams' aesthetics would appeal to architects and be appropriate for visible loadbearing constructions.[75] Among the advantages Granum pointed out were the elements’ “beautiful, concentrated form and significant height.” Laminated constructions would be suitable for “more modern architecture where clear

71 “Morgendagens byggemetode,” Laminator A/S, Moelven Industrier, 1960, NB archives.
72 Guttorm N. Brekke, Report no.2, 6. Rinke and Haddadi, “Transforming the traditional timber roof,” 676.
73 Mageli, “Laminator,” 13. Also in “Instilling til representantskapen angående opprettelse av fabrikk for limte trekonstruksjoner,” all in SAH/ARK-287-02/E/Ea.
74 “Moderne lamineringsteknikk har flyttet ‘tregrensen’” Laminator catalogue, 1965, NB archives.
75 Hans Granum, a letter to Moelven. Trondheim, September 30, 1958. In SAH/ARK-287-02/E/Ea.

Fig. 9. A popular Moelven Limtre advertisement from *Byggekunst*. Magazine clipping, 1960s.

material effects and simple forms are sought after," he concluded.[76] Laminator turned Granum's advice into a new advertisement strategy: a minimalist section of a slick, loadbearing timber column, with scarlet or blue lettering in a custom-made 1960s font, appeared in nearly every issue of *Byggekunst*, from 1963 onwards.[77] The ads differed significantly from Laminator's technical booklets, with an image that exuded the modernist aesthetics of efficient, expressive structure.[78] Marketing to architects and design professionals, the company significantly adjusted its vocabulary and emphasised both the aesthetic and architectonic qualities of the exposed timber work: "thanks to the beautiful, natural structure of the wood and our qualified work, the construction does not have to be plastered, covered or hidden," claimed a booklet from 1960.[79] Laminated beams promised to provide not only "natural, timeless beauty" but also "beauty, warmth, atmosphere and character to any interior."[80] Since the beams could be used for "representative buildings that place the strictest architectonic demands: churches, schools, assembly places," the company underlined the possibilities of customisation.[81] From design to finish, each beam would be produced according to individual specifications, and the only hindrances in the way of architectural expression were transport limitations. To encourage architects and engineers to incorporate engineered timber into architectural projects, Laminator set up a trained group of professional consultants that were to help their clients find "the simplest, most affordable, and the best solution for any construction problem" in laminated wood.[82] Five engineers, with all together 37 years of construction practice, and 21 planners and operators served as a "customer service" unit, helping architects and engineers to calculate foundational and structural loads, providing information on material specifications.[83] The main premise was that laminated timber could be used in any structure, as a Moelven booklet from 1965 concluded: "Think glulam—it can be an ideal solution to your problem!"[84]

Lastly, fire resistance was an important aspect. As Brekke underlined in his 1945 report, one of the most significant obstacles to popular use of laminated wood was its fire-prone qualities.[85] Although

76 Granum, 1958. In SAH/ARK-287-02/E/Ea.
77 See, for example, from *Byggekunst* 45, no. 8, 1963 until 1968, reappearing in the 1970s.
78 *Byggekunst* 53, no.2 (1971): 79.
79 "Morgendagens byggemetode," 1960, 2.
80 "Morgendagens byggemetode," 2.
81 Laminator catalogue, 1965, NB archives.
82 "Moderne lamineringsteknikk har flyttet 'tregrensen'" Laminator catalogue, 1965, NB archives.
83 *Bedriftavis*, no. 23 (1978): 15.
84 "Moderne lamineringsteknikk," 1965.
85 Brekke, Report no.2, 53. RA/S-2079/E/Eb/L0034/0010/0001-C-111r.

new fire retardants significantly improved its qualities, professional builders were still to be convinced that glued laminated timber could ever be fire resistant. In order to do so, in 1961 Moelven sales office headed by Granberg organised a spectacular real-life test, documented by an invited cohort of local journalists. Two arches loaded with two tons each were set on fire in a soon-to-be-demolished house—one built from laminated wood and another from steel.[86] With dramatic headlines like "Fire duel between steel and wood," and "Wood from Moelv won over steel," the absolute victory of laminated timber was proclaimed.[87] Steel could not tolerate temperatures higher than 500 degrees and folded uncontrollably within eight minutes, while the massive wood structure stood for more than 50 minutes.[88] In addition to providing factual information about material properties, the experiment provided great visuals for the local and regional press. A collage of these press articles, carefully crafted by the Dalseg advertisement agency was used for Laminator ads in the following years.[89]

The aggressive marketing campaigns bore fruits, as architects and engineers were growing steadily more interested. Already in 1961, Laminator engineer, Odd Brynildsen, and sales chief Arne Kjell Sognar held a "record-setting attendance" lecture on laminated wood constructions at the Bergen Engineers Union.[90] Students from both NTH and SHKS toured Laminator facilities to learn more about the new material of engineered timber.[91] Beyond these educational visits to the factory, Moelven's technical and structural experience with glued laminated timber was comprised into *Limtreboka* (*The Glulam Book*), first published in 1973 and distributed to Norwegian building professionals and schools. Originally published in more than 5000 copies, and with multiple reprints, it was the first book on glued laminated timber in Norway, soon becoming a "glulam bible" for engineers and architects.[92]

Setting out to introduce engineered timber to the Norwegian construction market in the late 1950s, Moelven had to enter unknown waters, optimising the material's structural properties and performance, testing new adhesives and fire retardants while, at the same time, convincing a conservative construction industry of the positive as-

86 *Hamar Arbeiderblad*, December 7, 1959, 9.
87 *Morgenposten,* May 31, 1961, 8.
88 *Hamar Arbeiderblad*, June 3, 1961, 9. *Morgenposten*, June 3, 1961, 12; *Morgenbladet*, June 3, 1961, 13; same in *Aftenposten*, June 3, 1961, 27; *Bergens tidende*, June 5, 1961, 18.
89 The event was extensively covered in *Vårt Land*, *Arbeiderbladet, Morgenposten* and *Morgenbladet*.
90 *Ringsaker Blad*, July 6, 1961, 2.
91 *Ringsaker Blad*, September 20, 1962, 2. *Ringsaker Blad*, February 1, 1968, 2.
92 Nils Ivar Bovim and Haumann Sund, *Limtreboken*, 2. utg. (Moelv: Moelven limtre, 1977).

Fig. 10. An early Laminator sales booklet indicating potential application based on the typologies tested in the United States. From Moelven catalogues at the National Library archives, 1960.

Fig. 11. To the left, Laminator booklet with a title "Modern lamination technology has moved the "wood boundary." From Moelven catalogues at the National Library archives, 1965.

Fig. 12. Laminator advertisement. Most often, the company would use images of its own completed projects. Magazine clipping, 1960s.

Fig. 13. Laminator elements were used for both foot bridges and churches—the fact widely utilised in advertisements. Magazine clipping, 1960s.

Fig. 14. Fire safety was an important aspect of Laminator's advertisements as the company had to convince its clients that the new material was safe to build with. Thus, images from fire-tests were used for marketing purposes. Moelven advertisement from the 1960s, newspaper clipping.

pects of building with engineered timber. Although wood was a familiar material, the company had to walk a narrow line between traditional associations and modern expectations, convincing construction professionals that although the new material looked like timber, it had new, improved qualities. Ultimately, the company was successful in its venture: optimised form calculations made the beams light, cheap, easy to transport, and quick to assemble. They offered large spans, were fire resistant, and—most importantly—the structure did not have to be clustered and covered. By 1967, according to Laminator product manager Haumann Sund, laminated timber became one of the most sought-after construction materials on the Norwegian construction market.[93]

STRUCTURES OF UTILITY

Since the benefits of using laminated beams included low cost and quick assembly, they were often used in situations where budgets were tight. Mageli expected that military and state road agencies would be particularly interested in quick, dry assembly and standardised constructions.[94] Indeed, similar to the way the military became one of the largest contractors for glued laminated timber in the United States, the Norwegian Armed Forces were among the early adopters of new material in Norway. Already in 1959, Laminator delivered a 680m^2 storage building for the Army, followed two years later by a teaching space assembled at a military base at Håkonsvern, three airport hangars in Andøya consisting of 54 half-frames 22,5 metres each, and military airports in Hamar, Gardermoen and Bodø.[95] Beyond military construction, Laminator was attractive for many Norwegian municipalities, as glued laminated timber constructions could be used for pedestrian bridges—considered the most modern solution to the problem of traffic separation at the time. In 1962, Moelven delivered a number of laminated projects to Bærum municipality, including a 75-metre-long pedestrian bridge, developed together with consultants Borrig and Rognerud and raised over Drammensveien at Lysaker.[96] As pedestrian bridges became one of the company's staple products, Moelven received frequent visits from municipal decision-makers. Mageli later remembered that the sale

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93 *Ringsaker Blad*, December 28, 1967, 2.
94 Rhude, "Structural Glued Laminated Timber," 16. Andrew McNall and David C. Fischetti, "Glued Laminated Timber," in Thomas C. Jester, ed. *Twentieth-century Building Materials: History and Conservation* (University of Michigan: McGraw-Hill, 1995), 139.
95 *Hamar Arbeiderblad*, December 7, 1959; *Gudbrandsdølen*, October 31, 1961, 2, 9; *Hamar Arbeiderblad*, July 7, 1962, 5; *Gudbransdsdølen*, June 16, 1962, 8. *Hamar Arbeiderblad*, March 27, 1974, 9.
96 *Lillehammer Tilskuer*, January 15, 1962, 2.

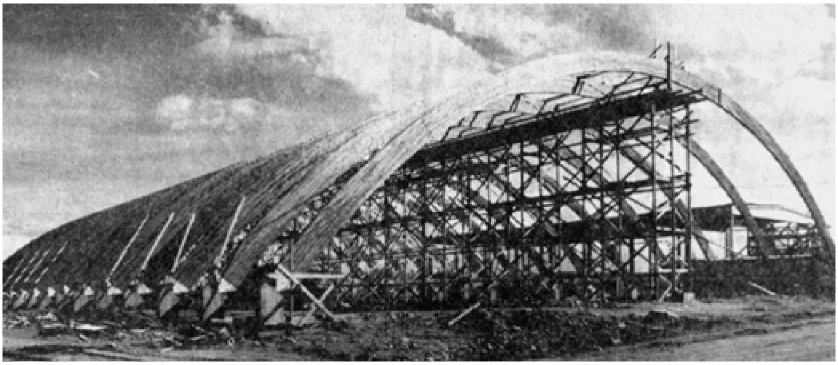


Fig. 15. Laminator elements were first used in industrial buildings. On the photograph a structure for Holmen distillery. Newspaper clipping, 1959.

of Laminator objects was done not just through the network of agents, consultants and industry professionals, but also through state and municipal authorities.[97] Many projects were commissioned by the State Road Agency, including a number of bridges, traffic stops and garages.[98] In order to meet growing demand, the factory had to implement further process rationalisation and expand its facilities already in January 1962.[99]

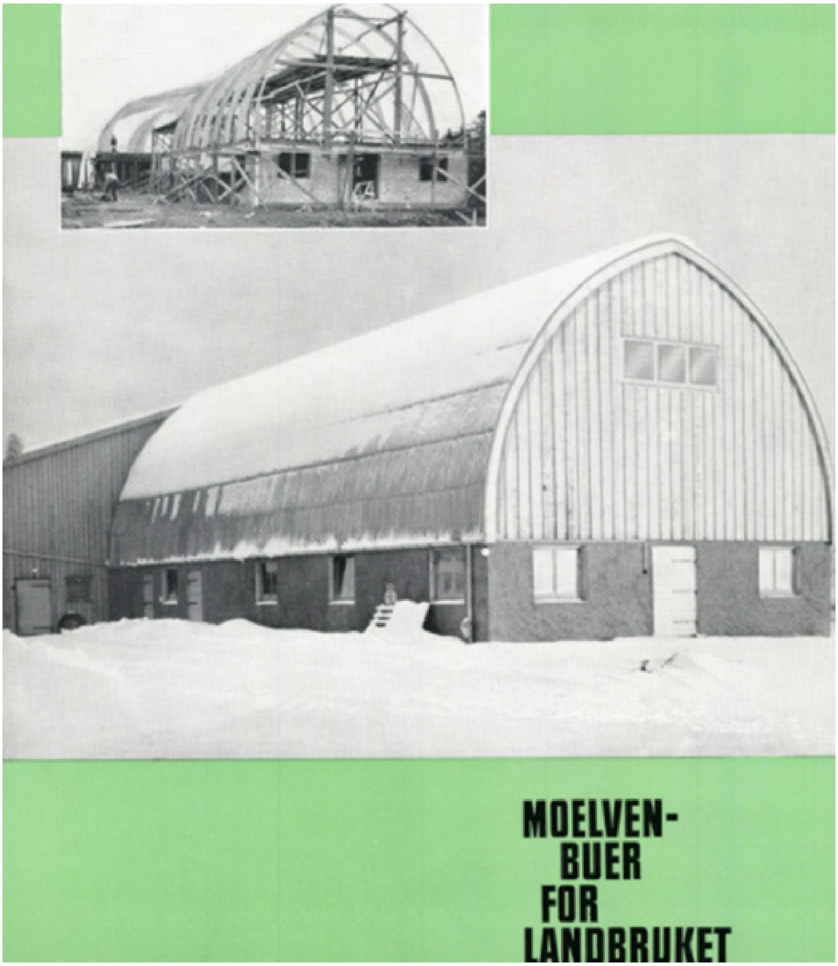
Perhaps one of the more unconventional solutions offered by Laminator was the prefabricated barn. The red-painted barn with a pitched roof was an image closely associated with the Norwegian countryside. With Moelven's laminated barns, however, this rural idyll became a contested site of technological transformation.[100] Already in 1958, Hans Granum had suggested that agricultural buildings harboured a potential profit of nearly 1,5 million NOK a year.[101] The idea was not new. Prefabricated barns had already been tested in Ireland, and Brekke built "Gothic"-type barns in the United States in 1937 (with a particular dome shape devised by Brekke specifically for laminated constructions), publishing an article in *American Builder* praising its economy over conventional structures. American Rilco Laminated Products specialised nearly exclusively in barn rafters for agricultural

97 Mageli, "PM til Styret I A/S Moelven Brug," August 15, 1958, 1. In SAH/ARK-287-02/E/Ea.
98 *Namdal Arbeiderblad*, May 20, 1965, 6; *Gubrandsdølen*, September 5, 1967, 2. *Ringsakerblad*, October 28 1967, 1.
99 *Lillehammer Tilskuer*, January 15, 1962, 2.
100 Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 1964)., and Sigfried Giedion, *Mechanization Takes Command: A Contribution to Anonymous History* (Norton, 1969).
101 A letter to Moelven by Hans Granum, Trondheim, September 30, 1958, 5. In SAH/ARK-287-02/E/Ea.

buildings, a production lasting well into the 1950s.[102] The first barn with a glulam roof structure in Norway was built by Laminator in Stor-Stav, at the farm of Johan Røhr in Veldre, in 1960.[103] Sized 10 by 56 metres, with a step of 2,4 metres between the load-bearing beams the building used half the materials of a conventional barn. At a cost of 13 NOK per square metre, this offer, according to the Laminator sales chief, was one that "no one could say no to." [104] The roof was optimised for Norwegian weather conditions, able to withstand snow and wind loads, but was light—with each beam weighting between 200 to 430kg, it was easy to assemble by unskilled workers without any special equipment.[105] The beams could be produced either 9.6, 10, 12, 13.2 or 14 meters wide, depending on the client's needs.[106] Despite the price and extensive press coverage, not everybody was convinced by this technological offer. The barns were deemed "not beautiful," and many observers claimed that their appearance "did not harmonise with the construction style of Norwegian farms."[107] To counter the resistance, Mageli appealed to "American" pragmatism, arguing that since American farmers "were not interested in building technical buildings that are more expensive than necessary," future Norwegian farmers would feel the same.[108] Mageli remained convinced that "in a couple of years no other barns but the ones looking like this would be built."[109] In practice, Moelven barns were particularly popular in northern Norway. In 1961, around 90 "Moelven-barns" were built in Jæren, Østfold, Tromsø, Løten and Våler.[110]

Hoping to take over larger parts of the building market for agricultural buildings, Laminator set off to develop mass-produced types. In 1967, Laminator engineer Odd Paulsen worked together with the Agricultural College and the County Agronomist on a project for a universal prefabricated agricultural building.[111] By then, the University's Institute of Building Technology, headed by Professor Halvor Nordbø, had been researching "rational and economically responsible" production for agricultural buildings for quite some time.[112] This joint research resulted

102 Gary A. Boyd, "Almost Nothing Almost Anywhere: The Metal Barn in Ireland," *The Irish Review (1986-)*, no. 51 (2015): 1–2. Rhude, "Structural Glued Laminated Timber," 15. Guttom Brekke, "Bent, Glued Rafters Make Strong Barns" in *American Builder*, May 1937, 4. Exhibit no.3 in Brekke's report.
103 Laminator order books, July 27, 1960. In SAH/ARK-287-02/E/Ea.
104 *Hamar Arbeiderblad*, August 19, 1960, 12. *Ringsaker Blad*, August 23, 1960, 1, 4. *Nationen*, November 17, 1961, 16.
105 *Nationen*, November 17, 1961, 16. *Hamar Arbeiderblad*, August 19, 1960, 12.
106 *Nationen*, November 17, 1961, 16.
107 *Østerdølen*, October 5, 1960, 6.
108 Mageli was indeed familiar with similar structures raised in the US. *Østerdølen*, October 5, 1960, 6.
109 *Ringsaker Blad*, August 23, 1960, 1, 4.
110 *Hamar Arbeiderblad*, July 7, 1962, 5. *Ringsaker Blad*, August 23, 1960, 1, 4.
111 *Haugesunds Avis*, October 18, 1967, 1.
112 *Nationen*, November 17, 1961, 11.



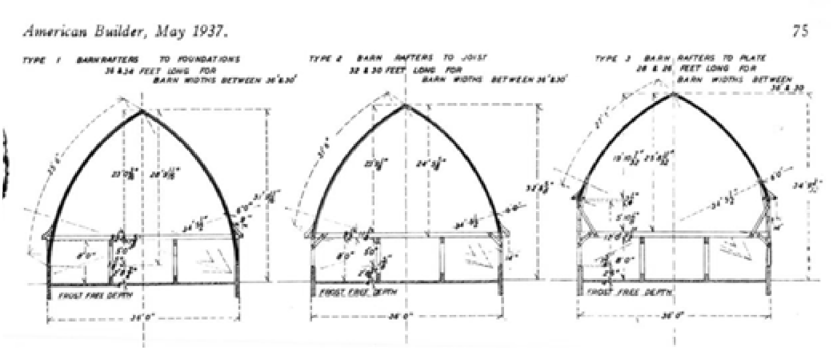


Fig. 16. A sales booklet “Moelven arches for agriculture” with a barn built at Stor-Stav on the cover. Moelven catalogue from National Library archives, 1960. Below, drawings of a similar type of barns from American Builder (1937) developed and built by Brekke. From RA/S-2079/E/Eb/L0034/0010, Oslo State Archive.

in a trial structure built at Løten: the 475m² building was constructed with loadbearing constructions in laminated timber and walls built from prefabricated timber panels, also produced by Moelven. This "universal building" with uninterrupted spans could accommodate a variety of agricultural programmes—from an animal shelter and greenhouse to storage or a factory building. It was designed with practical considerations in mind: with the lack of a specialised labour force in agriculture, the building could be assembled with minimal effort, needing only a small movable crane for a day.[113] A similar type was exhibited in 1968 at the stand of Felleskjøpet—the Norwegian agricultural cooperative—at Ekeberg agricultural exhibition.[114] However, glued laminated constructions were used not only in structures of utility, but extended to other projects that required carefully crafted architectural expression and required a new type of aesthetics—for example, post-war Norwegian churches.

UNCONVENTIONAL AESTHETICS

"Laminated wood constructions from Moelven used for barns as well as churches"—claimed the heading of a 1960 newspaper article dedicated to Laminator products.[115] And indeed they were: glued laminated timber beams fitted well with a new formal language in post-war Norwegian church architecture.[116] Jar church in Bærum built in 1959, was the first church in Norway to fully utilise the aesthetic qualities of the new material.[117] The office of Morseth, Gedde and Qvam won a 1939 architectural competition, but since war- and post-war turmoil postponed the construction many times, the design was significantly revised.[118] Architect Peer Qvam—a frequent collaborator of John Engh with whom he shared an interest in industrial buildings and prefabricated construction—completed the project in 1958.[119] Instead of the plain rectangular construction with narrow-slit windows that elicited much criticism back in the 1930s, the new design was defined by an elongated triangular-shaped timber roof with skylight openings, resting on yellow-brick walls.[120] Laminator delivered 23 straight, 17-metre long beams for the church's loadbearing roof constructions, which were then arranged

113 *Østlands-posten*, October 18, 1967, 10.
114 *Rogaland Nationen*, March 22, 1968, Stavanger, 4.
115 *Ringsaker Blad*, August 23, 1960, 1, 4.
116 "Brummunddal kirke," *Norske Arkitektkonkurranser*, no. 65 (1960): 2-3.
117 *Hamar Arbeiderblad*, December 7, 1959, 9.
118 *Byggekunst* 21 (1939): 116-117. Jar kirke and Jar menighetsråd, *Jar kirke 50 år 1961-2011*, ed. Øystein Sørbye and Ole Andreas Husøy (Jar: Jar menighetsråd, 2011), 20.
119 *Byggekunst* 32 (1950): 211-213. *Byggekunst*, no.5 (1954): 119.
120 Jar vel and Geir Engebretsen, *Boken om Jar: Jar vel 75 år : 1924-1999* (Stabekk: Vellet, 1999), 91.

Fig. 17. Jar church's interior details. Images from *Jar kirke 50 år 1961-2011*.

in triangular rafters, gathered in nodes of four at the ridge.[121] With its "nautical" form that had recently come into vogue, the church had an unconventional appearance and some complained that the exterior was missing a "church character."[122] However, according to the bishop, the church interior fully compensated for this perceived shortcoming, as "faces lit up" when one entered the room: dimmed light trickled

121 *Hamar Arbeiderblad*, October 16, 1959, 3.
122 Jar kirke and Jar menighetsråd, *Jar kirke 50 år 1961-2011*, 22.

down from narrow roof openings into the timber-filled interior, creating a feeling of "quaint calm and comfort."[123] Roof windows positioned in the triangular openings at the ridge were doubled with lamps, to ensure the same light both night and day. The choice of material, according to the review in *Ukens byggenytt*, underlined the sacred character of the building, but also connected it with the surrounding villa environment.[124] The timber roof structure was not only expressive, but also functional: special acoustic panels were built-in between the beams for sound absorption.[125] Overall, after more than 25 years of waiting for the church to be completed, parishioners were happy with the new "magnificent" building.[126] Although it is hard to know exactly why Laminator elements were chosen for the roof structure, Bærum municipality was one of Moelven's most important clients: Nadderud school had been built a year prior, and municipal architect Baard Hjelde was engaged in both projects.[127] In addition, Peer Qvam was one of the judges for the Herøya church competition, won by Abrahamsen and Grinde around the same time, and was no doubt familiar with Moelven.[128] Although unconventional for Jar, the church's triangular structure was similar to a chapel in Larvik, built by Engh and Qvam a couple of years prior, and generally shared the language of post-war Norwegian church aesthetics developed, for example, by Viksjø, featuring strong geometric shapes and large central volumes.[129] Glulam beams were perfectly suited for this task.

Laminator went on to deliver other religious buildings—a chapel in laminated wood was built in Østfold in 1960, and two chapels in Ramsund and Borge in 1964.[130] One year earlier, the company completed another church in Søre Ål, Lillehammer, designed by local architect Bjarne B. Ellefsen together with Arne Berg and Ove Johansen.[131] According to Ellefsen, the Søre Ål church design was defined by its position in the Gudbrandsdal landscape and the shape of the terrain.[132] Both exterior and interior materials were chosen based on their locality: internal wall panels and the roof were made of timber, while the foundation and walls were carried out in chiselled concrete. Concrete

123 Jar kirke and Jar menighetsråd, 20–22.
124 *Ukens byggenytt* 6, no.2 (28 February, 1961): 5-6.
125 *Asker og Bærums budstikke*, May 20, 1959, 3. Jar kirke and Jar menighetsråd, *Jar kirke 50 år 1961-2011*, 40–41.
126 *Morgenposten*, May 19, 1959, 7.
127 Jar kirke and Jar menighetsråd, *Jar kirke 50 år 1961-2011*, 20.
128 *Vårt Land*, August 22, 1957, 1, 8; *Aftenposten*, August 23, 1957, 4.
129 *Byggekunst* 33 no. 11 (1951): 171. See *Byggekunst* 46, no.7 (1964) on post-war church architecture. Also *Byggekunst* 65, no. 5 (1983).
130 *Harstad Tidende*, February 21, 1964, 5, *Ringsakerblad*, July 14, 1964, 1. *Hamar Arbeiderblad*, July 8, 1960, 3.
131 *Hamar Arbeiderblad*, September 18, 1963, 12.
132 *Byggekunst* 46, no.7 (1964): 181-183.

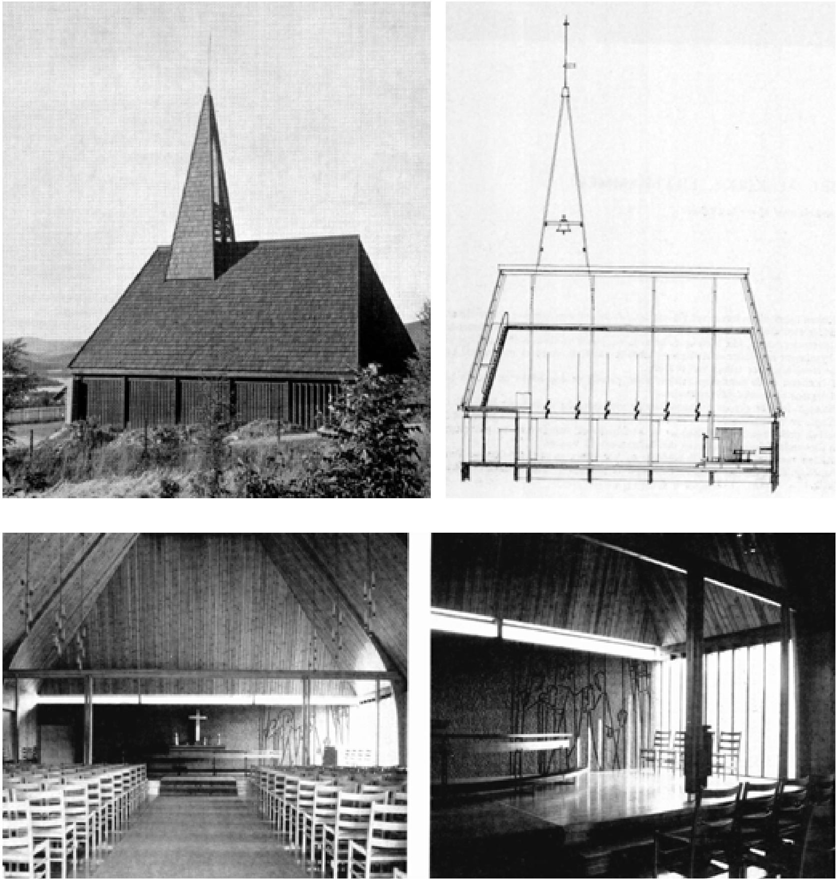


Fig. 18. Søre Ål church in Lillehammer, architect Bjarne B. Ellefsen. Photos by Terje Lund, from *Byggekunst* 46, no. 7 (1964).

surfaces that extended from the foundation were given some line structure, further extended with the spacious volume of a gable-shaped roof. Different from Jar church, glued laminated beams featured less prominently but more elegantly: slightly rounded “tudor”-shaped arches offset the strictly triangular roof structure, softening the interior envelope. Although both churches featured exposed timber in their interior, the experience of space and light differed significantly.

Ellefsen was no stranger to church architecture: already in 1960, together with Moelven’s Abrahamsen he chaired a competition for Brumunddal church, won by Per Capellen and Sven Erik Lundby.[133] Although not using laminated timber, the winning entry featured largely the same

133 “Brummunddal kirke,” *Norske Arkitektkonkurranser*, no. 65 (1960): 2-3.

roof shape and abundant use of timber in its interior. While timber was a seemingly obvious choice for Norwegian churches, it was not a default choice. Other churches—for example Viksjø's concrete Bakkehaugen—were shaped in a similar "nautical" way, but their constructions were solved differently.[134] Others, like Nordseter Fjellkirke by Erling Viksjø, used a "stave"-like principle with large spruce trunks leaning against each other, striving to achieve a "regional character."[135] This proved complex and expensive—the trunks were twisting, which required metal joining, and had to be covered in copper. With glued laminated timber, one could achieve the same aesthetic in a simpler and more efficient way.

By the mid-1960s, Laminator actively incorporated Norwegian history of wooden churches into its marketing narrative, claiming that laminated timber that was "both strong and decorative" was particularly appropriate for church architecture.[136] With time, this narrative grew into the material. In 1974 when Ellefsen completed another church—Espedalen fjellkirke—built with glued laminated timber from Moelven, he was directly inspired by old stave churches.[137] Also built as a nautical *naustkirke*, and with all structure in glued laminated timber, the church was assembled in a record time—in just under six months, at a cost of 500.000 NOK.[138] Triangular motifs, largely defined by the structure, were repeated throughout the interior, acquiring the symbolic connotations of the Holy Trinity and Eye of Providence.[139] In addition, the triangular roof structure, defined by loadbearing laminated timber beams, allowed to open the gable façade into a large vertical window that provided a magnificent view onto the forest and surrounding landscape. "No one could wish for a more beautiful altarpiece," concluded one of the reviewers.[140] This aesthetic innovation was largely a result of the structural opportunities implicit in such a structure: similar façade openings can be found both in the Borge chapel, completed with Laminator elements in 1961 by the architects Leif Lindgren and Aksel Fronth, and Ramsund chapel from 1964, by entrepreneur Olsen Ruud.[141] While in Ramsund the decision was mainly functional, providing an additional light source behind the organ, in Borge the decision was more intentional. The front

134 For naustkirke see https://kunsthistorie.com/fagwiki/Naustkirke, accessed Nov 20, 2021.
135 *Byggekunst* 46, no.7 (1964): 178-180.
136 *Ringsaker Blad*, August 23, 1960, 1, 4.
137 Kalle Seip and Pia Wall, *Valdres, Gudbrandsdalen*, *Norbok*, Aschehoug reise (Oslo: Aschehoug, 2002), 37.
138 *Dagningen*, July 15, 1974, 13.
139 See "Kirkene i Espedalen og Skåbu," https://www.dalseter.no/kirkene, accessed September 5, 2021.
140 "Kirkene i Espedalen og Skåbu," https://www.dalseter.no/kirkene.
141 Andreas Vevstad et al., *Søndeled kirke og kirkegård: 1000 års fellesskap i liv og død*, *Norbok* (Tvedestrand: Søndeled og Risør historielag i samarbeid med Indre Søndeled menighetsråd, 2000), 154.

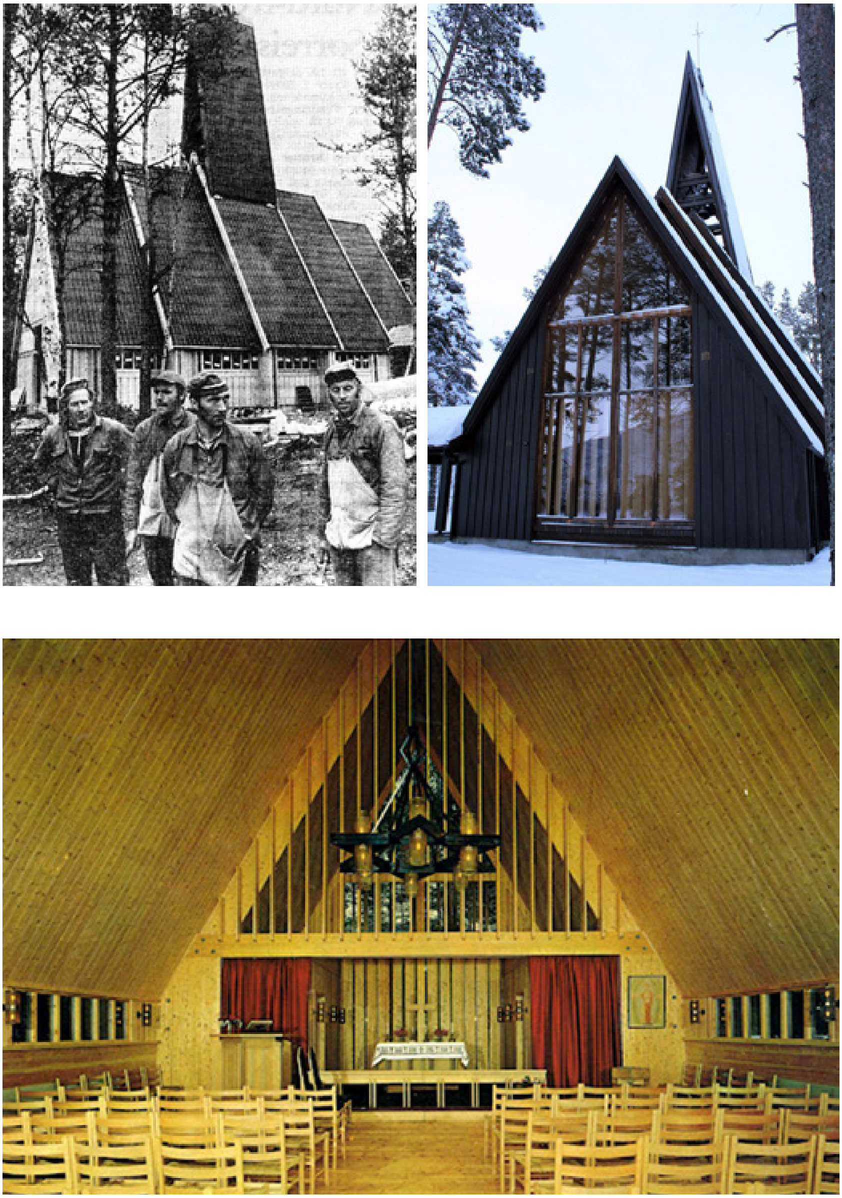


Fig. 19. Espedalen church, architect Bjarne B. Ellefsen. Above left, a photograph of the church under construction. Newspaper clipping. Above right and below, contemporary view and interior. From https://www.norske-kirker.net/home/oppland/espedalen-fjellkirke/, accessed November 11, 2021 and *Limtreboken*.

Fig. 20. Borge chapel. Architects L. Lindgren and A. Fronth. Photos from *Åbygge*, no. 37 (2016).

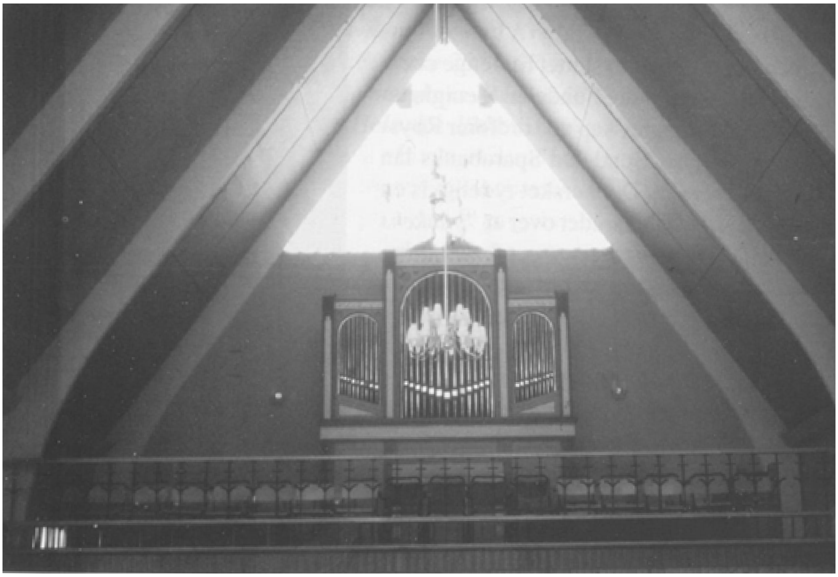


Fig. 21. Interior of Ramsund chapel. Photo on by Harald Berg, from *Glimt fra Ramsunds historie*.

Fig. 22. Architects Bjarne Bystad Ellefsen, Leif Lundgren and Axel Ludvig Fronth. Newspaper clipping; photoraphs from *Arkitekturen i Fredrikstad: arkitektur- og byplanhistorien 1567-2014*.

wall dissolves into nature, with large window panels blending the building with its surrounding landscape, as “God’s free nature” serves as an altar piece.[142] Borge’s chapel was deemed a particularly successful project, and was used in many Laminator advertisements. With these projects, it is possible to see that churches built with engineered timber shared several typological aspects: they had an elongated “nautical” shape, dominated by a triangular roof structure resting on a foundation of walls usually built from light-coloured brick or concrete. Load-bearing timber beams allowed for different lighting conditions, either from vertical slits in the roof, or by entirely opening the gable walls. These aspects—largely conditioned by the use of laminated timber beams for roof construction—allowed Laminator to devise a typological solution for Norwegian churches, much in line with the company’s determination to develop types, suitable for mass-production.

In 1971, the chaplain Sigurd Osberg from Hamar reached out to Moelven Brug to enquire whether it would be possible to develop a design for Storhamar church based on prefabricated components.[143] The chaplain wanted a simple, cheap structure that would be an alternative to expensive custom-made designs that drained the congregation's means. Amassing experience from already-completed church projects, Moelven suggested a solution: a series of loadbearing laminated timber arches would rest on a first-floor “foundation” built from large prefabricated timber wall-panels. This idea was quickly abandoned, however. Transport complications posed limitations on the size of the elements, that made the construction unnecessarily complicated and hard to adapt to specific site conditions and programmes. Instead, it was proposed that, with a loadbearing roof structure in glued laminated timber, walls could be made from any material manageable by non-specialised workforce: i.e. bricks, concrete, or Leca-blocks.[144] For the Storhamar church—designed by the company together with architect Willy Sveen—walls were built in corrugated steel panels and Leca blocks, and all elements besides laminated wood were delivered by local entrepreneurs. The main congregation space was shaped as a square of 20 by 20 meters and accounted for 400 visitors, while an additional rectangular block accommodated a reception room for 165 people, as well as a kitchen, storage and offices. The space of the church was deemed “intimate and calm, creating a good environment for those working there,” however with some

142 Borge historielag and Borge og Torsnes historielag, *Åbygge* (Sellebakk: Historielaget, 2016, no. 37), 103.
143 Willy Sveen, “Storhamar Kirke” in *Byggekunst* 57, no.6 (1975): 154.
144 *Byggekunst* 57, no.6 (1975): 154.

Fig. 23. Interiors of Storhamar church built with Moelven prefabricated elements. Photos by Arild Jonstad, from *Byggekunst* 57, no.6 (1975).

acoustical problems for the choir.[145] Moelven's typological solution was flexible enough to work on both smaller and larger land-plots: while in a more "compact-variant" meeting rooms could be accommodated under the main church space, in larger plots, like Storhamar, they were placed side-by-side. This flexible typology based on prefabricated elements allowed for large savings: completed in less than a year, the church cost around 2.140 NOK per sitting place, a fraction of the usual cost of 4.000 to 6.000 NOK.[146] With a total price just under 2,3 million NOK, it was claimed to be the "cheapest and the best" in the country: newspaper

145 Gert Bjøntegård, Tor Holm, and Storhamar blandede kor, *Storhamar blandede kor 1944-1994: et sangereventyr gjennom 50 år*, *Musikk* (Hamar: Koret, 1994), 20.
146 *Byggekunst* 57, no.6 (1975): 155.

headlines colloquially referred to it as “billig-kirke”—“cheap church.”[147] Interest in the church, according to the foreman in the building committee, was “impeccable,” as church-builders from around the country flocked to its opening in 1975. Other municipalities wanted the same type of church, and the Ministry of Construction was particularly interested in the calculations—since the state approved the design, it gave the green light to “serial production of churches at a reasonable price.”[148]

Laminator closely worked with architects and delivered glued-laminated structures for many Norwegian churches—an important element of Norwegian everyday life. This engagement with church architecture was not surprising, considering that Moelven’s Abrahamsen and Grinde were both particularly interested in church construction, and Abrahamsen specifically lectured on tendencies in post-war Norwegian church architecture.[149] A loadbearing structure of glulam beams responded well to the particular formal language developed in post-war Norwegian church architecture, as buildings across the country shared similar constructive and aesthetic elements. With time, the company reworked these elements into a typological solution for prefabricated church construction, developed together with architect Willy Sveen, allowing to accommodate large and diverse church programs at a low cost. Laminator continued to build churches into the 1980s, completing structures in Volsdalen and Helgerud, among others.[150] The same architects that had previously cooperated with the company continued to build with laminated timber—in particular, the architect of Borge chapel, Aksel Fronth, who also completed Asker sports hall. Churches, however, were not the only representative typology that the company worked with, as sports halls became another staple Laminator product.

SPORTS HALLS

What originally started as a complementary production for schools, soon evolved into a separate product line, as Laminator grew to specialise in sports halls. The first gym of this type was built in 1962 as an addition to the Persbråten school in Oslo, completed by Moelven two years prior (in fact, glued laminated beams had already been used in

147 *Vårt Land*, October 4, 1975, 24. *Nordisk Tidende*, January 23, 1975, 4.
148 *Nordisk Tidende*, January 23, 1975, 4.
149 *Oppland Arbeiderblad*, August 16, 1962, 3; *Morgenposten*, February 24, 1959, 5; *Vårt Land*, February 25, 1959, 1.
150 See Bovim and Sund, *Limtreboken*; Nils Ivar Bovim et al., *Limtreboka*, Åge Holmestad, Haumann Sund, Vidar Stenstad (Moelv: Moelven limtre A/S, 1984), 55.

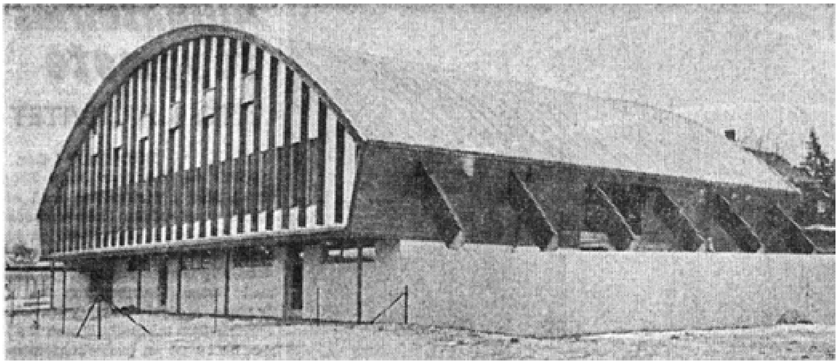


Fig. 24. Persbråten sports hall, 1963. From *Arbeiderbevegelsens arkiv og bibliotek*, newspaper clipping.

the body of the school).[151] Twelve half-beams were transported on site in sets of four, and assembled together into a structure with a span of 40 metres.[152] This was the first sports hall in laminated wood built in the country, and with its distinctive appearance it soon became the district's landmark.[153] Commissions for school gyms continued: in 1964, architect Hans Grinde together with the State Youth and Sports Office (STUI) designed the Elverum sports hall, which featured a spectators' arena, a gallery built in glued laminated timber, and elaborate glass-work on the façade.[154] The hall provided sports facilities for two neighbouring schools and, with a roof height of seven metres and flexible internal partitions, its space could be reprogrammed for different simultaneous activities.[155] In addition to sports halls, the company delivered other sports infrastructure: for example, a ski overpass at Holmenkollen for the 1966 World Ski championship, and a jumping slope at Lierbakken, that soon became an "Eldorado" for the entire district.[156] Similarly to churches, laminated structures used for sports halls collated principles of utility and representation: both rational and pragmatic with their unusual shapes and exposed materiality of wood, they became important assembly places for local communities.

The first significant commission that put Laminator on the map for sports construction was Askerhallen, completed in 1969. It was the largest covered ice-hockey stadium in the country, with a ground slab of 105

151 *Lillehammer Tilskuer*, May 6, 1959, 2. *Akers Posten*, January 27, 1962, 3.
152 *Hamar Arbeiderblad*, November 29, 1962, 1. *Hamar Arbeiderblad*, July 8, 1960, 3.
153 Ove Olsen et al., "Oslo byleksikon" (Oslo: Kunnskapsforl., 2010), 459.
154 *Hamar Arbeiderblad*, January 31, 1964, 9.
155 *Nationen*, October 13, 1965, 8.
156 *Ringsaker Blad*, December 14, 1965, 1, *Hamar Arbeiderblad*, August 31, 1970, 11, *Hamar Arbeiderblad*, October 25, 1971, 12.

Fig. 25. Private investor Bjørn Mortensen with a model of Askerhallen. Newspaper clippings, 1960s.

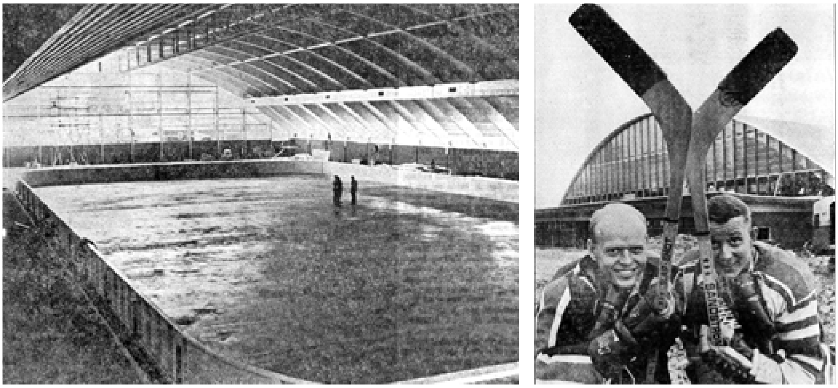


Fig. 26. Askerhallen was among the first interior skating rinks completed in Norway, which significantly advanced the interest in winter sports all-year-round. To the left, interior of the hall. To the right, hockey players with Askerhallen in the background. Newspaper clippings, 1969-70.

by 51 metres, the fourth indoor ice-hockey rink ever built in Norway, and the first in the Oslo area.[157] Developed at the initiative of a local entrepreneur, Bjørn Mortenson, it was built by Fredrikstad architect Aksel Fronth who, in addition to working with Laminator on Borge chapel, was also the architect behind Siddishallen in Stavanger, Sparta Amfi and Bergenshallen.[158] The roof structure consisted of 20 three-frame parable arches that provided an overall span of 52 metres.[159] When completed, the hall had an ice arena of 30 by 60 metres and a curling lane of 20 by 45 metres and could accommodate other programming: exhibitions, concerts and even baptisms.[160] In addition to housing more than 3000 spectators, the hall had a cafeteria and a kiosk, and its ground floor housed technical facilities like wardrobes, bathrooms, ice-machine storage, and large gathering spaces for professional school.[161] Essentially, Askerhallen turned hockey and figure skating into all-year-round sports in Norway's capital region, and contributed to the high level of ice-hockey in the region.[162] In turn, Moelven's glued laminated beams accommodated new programs not available before—such as winter sports, an important part of Norwegian everyday life that until now had been confined to the winter months.

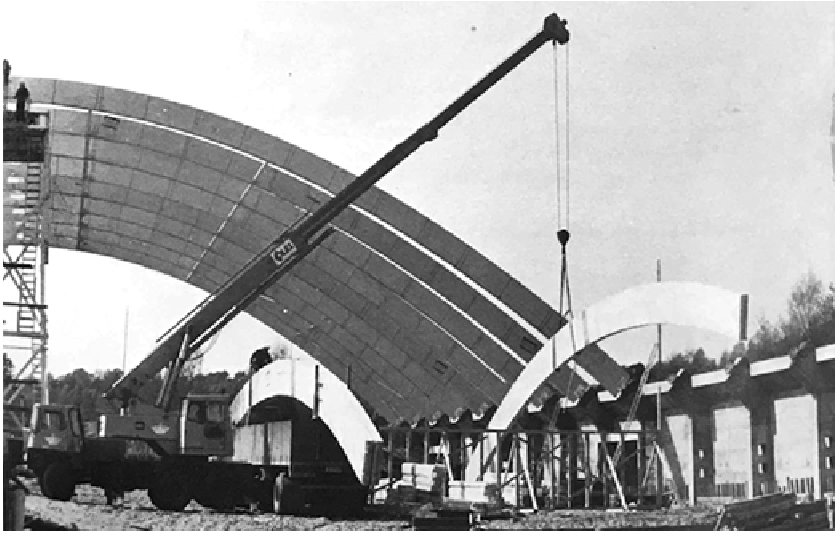
As hockey was gaining popularity in Norway, and a growing number of teams needed home-lanes, Moelven's glued laminated timber beams offered an affordable way to raise a sports structure for communities with limited budgets. Perhaps the best example of such economical construction was Sykkylven sports hall, delivered by the company in 1973-74. At the initiative of a local sports-team leader Elias Vinje, the hall was designed in cooperation between engineer Torbjørn Aasen and architect Karstein Oddmund Vil. Resting on a foundation slab of 52 by 70 metres, the hall was composed of 16 30-metre long, 12-metre-tall curved beams. Such a large delivery to the Norwegian west coast posed significant transport complications: the original plan of shipping the beams to Sykkylven by sea proved too expensive. Instead, Moelven negotiated with the national railway agency, NSB, and three train cars were refurbished to accommodate the cargo. With very narrow margins to fit under the overpasses—mere centimetres—and special clamps loaned for transport from Moelven, the transport was a "nerve-racking

157 *Bærums budstikke*, March 27, 1968, 3.
158 *Vårt Land*, August 30, 1969, 8.
159 *Hamar Arbeiderblad*, March 16, 1971, 31.
160 *Nå*, no.29 (1979): 22. *Drammens Tidende of Buskeruds Blad*, August 1969, 2.
161 Bleiker videregående skole and Arild Gabrielsen, *Ungdom under utdanning: Asker yrkesskole - Bleiker videregående skole, 1969-1994* (Asker: Bleiker videregående skole, 1994).
162 *Arbeiderbladet*, September 4, 1968, 15.

Fig. 27. Sykkylven hall, whose construction and transportation had been a "nerve-wrecking affair." Images from *Mot høgare mål*.

affair."[163] Since most of the hall's reinforcement and foundation work was completed through *dugnad*—voluntary cooperative effort—engineer Aasen coordinated all technical questions, while Kjell Slinning gathered volunteers that took on tasks ranging from foundation works to assembly and finish. The Sykkylven hall proved that Laminator beams were simple enough to be assembled by non-professional workers, and that the company was willing to go the extra mile to accommodate their clients' limited budgets. The Sykkylven team even convinced Moelven to loan them special working platforms, and a professional engineer

163 Nils-Einar Rye and Sykkylven idrottslag, *Mot høgare mål: Sykkylven IL 1906-2006* (Sykkylven: Laget, 2005), 135.



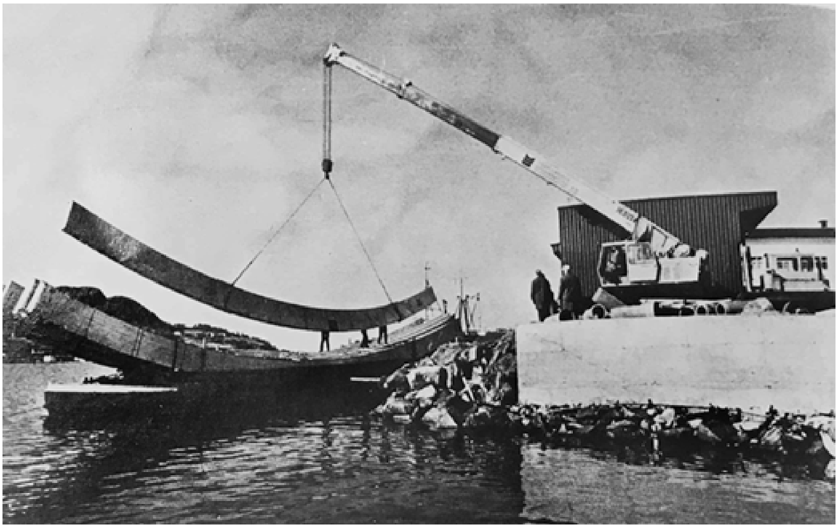
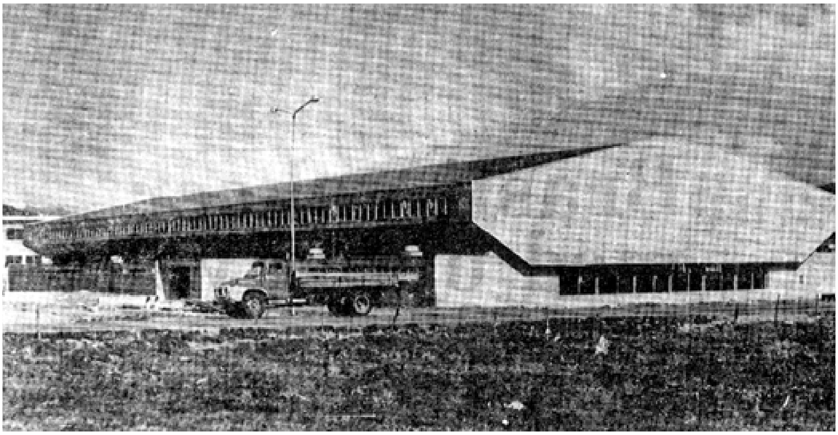


Fig. 28. Transport of glulam arches for Sykkylven hall was a complicated logistical process that involved both railway and boat transport. Images from *Mot høgare mål* and *Bedriftavis* no. 15 (1974).

to supervise the assembly process, for free. Even when carried out by an unskilled workforce, the foundation and beams worked perfectly together, an achievement for which the "free" engineer Løkken was credited.[164] Another ice-hockey rink with loadbearing Laminator elements was built in 1977 in Leangen, deemed "one of the most beautiful in the country."[165] A municipal project, it was drawn by Lien and Risan, with Tore Tønsen and Børre Amundsen as architects in charge, and housed an ice-rink and 400-metres skating track, in addition to a series of service spaces, wardrobes, changing rooms, and ticket machines.[166] The hall had an amphitheatre gallery seating more than 1800 spectators and, according to the ice-hockey president, Erik Sture Larsen, was to "become the epicentre for spreading interest in hockey in Central Norway."[167] Built as a part of a new political program to stimulate mass-engagement in sports, it was the eight covered sports hall in the country, according to Larsen, still far behind Sweden that had 85.

Indeed, with the growing prosperity of the 1970s, investments in sports infrastructure was high on the political agenda across the country. Moelven's expertise with large loadbearing constructions proved particularly applicable: during the 1970s, eight large sports halls were built in Norway, and Laminator delivered the loadbearing laminated wood structures for seven of them.[168] These were not just ice-hockey rinks, but rather multi-functional halls that accommodated a wide range of sports activities and were planned for flexible use. For example, in 1974 Moelven delivered roof structures for Lekneshallen, "one of the most beautiful and most practical swimming halls in the country."[169] The hall accommodated two swimming pools, a sports hall of 22 by 44 metres, an amphitheatre gallery for more than 700 spectators, showers, changing rooms, saunas, spacious wardrobes, a foyer, cafeteria, and recreational zone. Moelven roof constructions in glued laminated timber made the main swimming pool space "tall and airy," with "plenty of space," as timber arches together with abundant natural lighting produced an exquisite play of reflections on the water's surface. As one of the commentators noted, with such a roof structure, "even on the packed days one could always breathe freely."[170] However, Moelven can only be credited for providing the roof structure: the project itself

164 Rye and Sykkylven idrottslag, 138.
165 *Adresseavisen*, November 16, 1977, 17.
166 *Adresseavisen*, November 15, 1977, 15.
167 *Adresseavisen*, November 16, 1977, 17.
168 *Bedriftavis*, no. 23 (1978): 15.
169 *Nordlands Framtid*, June 26, 1974, 12-13.
170 *Nordlands Framtid*, June 26, 1974, 12-13.



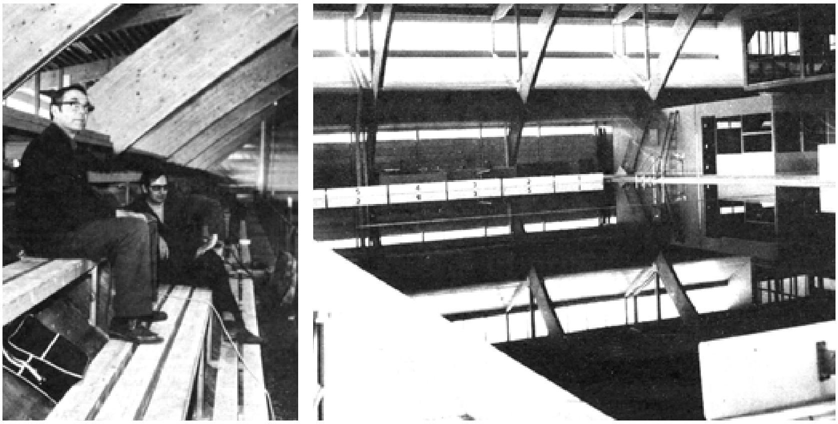


Fig. 29. Interiors of Leknes swimming pool with glulam constructions. Newspaper clippings, 1971.

was designed as a part of the Systemhall Norden type, developed by Bodø civil engineer Kjel M. Soløy.[171] In fact, with the hall's unconventional shape—reminiscent of a sci-fi UFO—the construction could not be carried out in timber alone, and consisted of a system of statically-defined laminated beams and rafters and columns in steel.[172] Following this successful collaboration, Moelven glued laminated beams became a part of the Systemhall package, as the company provided laminated roof construction for a hall of this type in Harstad.[173]

171 *Bedriftavis*, no. 13 (1973): 13.
172 *Bedriftavis*, no. 13 (1973): 13.
173 *Bedriftavis*, no 20 (1976): 21.

With the popularisation of mass-sports, most municipalities wanted "an all-in-one" solution, looking for sports spaces that could be flexible and open to different programmes. Technically, however, these demands posed significant technical problems: the desired movable walls and partitions raised issues of acoustics, ventilation and light. Some of the halls Moelven worked on, like Leknes and Gimle, solved the problem with net-walls raised as large shutters, but this solution affected the programming of space: activities with a longitudinal direction were prioritised.[174] Since Laminator—by then Moelven Limtre—had amassed extensive experience with multi-functional sports halls, by 1978, the company developed a typological solution for flexible sports halls. Successful solutions had to be typified: in 1960, architects Frode Rinnan, Olav Tveten and Roar Wik were already discussing the problem of multi-functional sports facilities in *Byggekunst,* arguing that "once the best solution is found, it has to be reproduced, to help the many architects struggling with the problem."[175]

Thus, instead of working with architects on individual commissions, or being a part of a larger "package-solution," Moelven developed its own complete product—"Moelven-Halls." With a floor area of 50 by 70 metres, these sports halls had flexible internal layouts that could accommodate nearly any type of ball games. All building elements were produced by Moelven factories: loadbearing structures were carried out in glued laminated timber, wall panels made at the element factory, while infrastructural facilities like showers, changing rooms, storage, equipment rooms and kiosks were delivered as container elements produced by the section-house factory.[176] In order to ensure compliance with prescribed spatial regulations, the company closely cooperated with the State's Youth and Sports Office, which set standardised spatial requirements for all sports facilities in the country. Standard Moelven-Halls offered a ready-made solution for local authorities, offering an opportunity to obtain a new sports facility at a low cost and forego the lengthy process of design development and approval. According to Mageli, since the sports halls were needed all across the country, "it would be unnecessary and too costly to construct a new one in each place."[177] Thus, by the end of the 1970s, more than 16 halls of this type were built "from Karasjok in the North to Egersund in the South." Delivered for a fixed price, always within the promised timeframe, these

174 *Fæderlandsvennen*, November 19, 1974, 15.
175 Njårdhallen sports hall project, *Byggekunst*, no.3 (1960): 70-71.
176 *Bergens Tidende*, December 1, 1976, 14.
177 *Bergens Arbeiderblad*, December 1, 1976, 2.

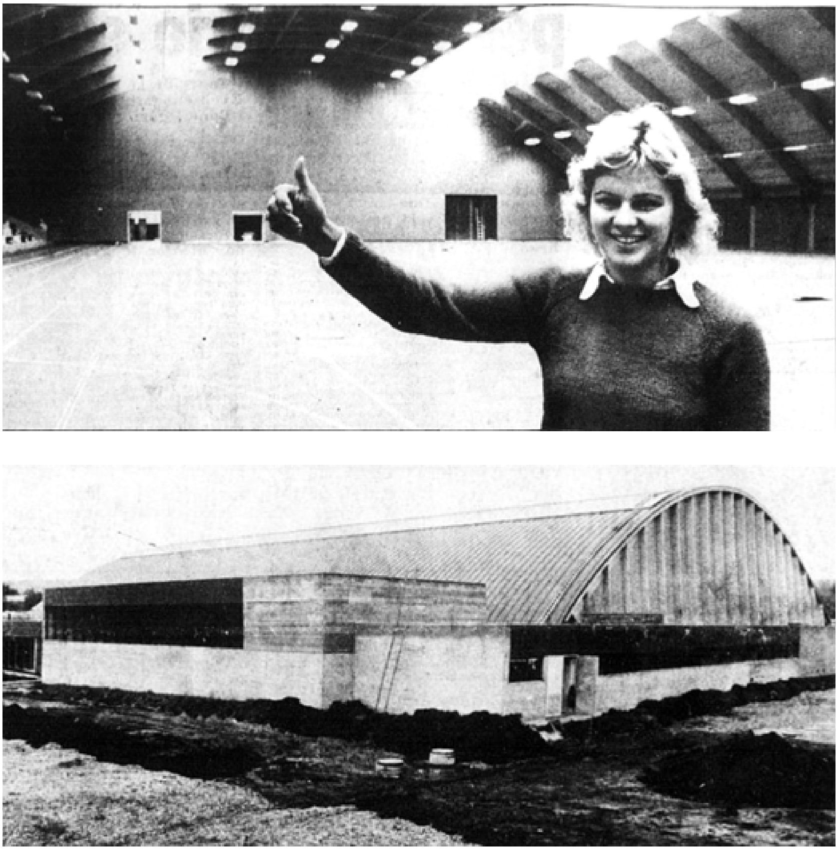


Fig. 30. Gimlehallen in Kristiansand. Newspaper clippings, 1974.

halls were attractive to local authorities because they saved money and construction time, allowing significant control over tight local budgets.

Laminator sports halls were a particular typology that merged concerns of function, economy, and representation. They provided new meeting places for local communities and, with their unconventional shapes, quickly became local landmarks. Developed in cooperation with local and state actors, Laminator sports halls responded to changing political priorities and regulations and offered a fixed-price solution for expanding sports infrastructure.[178] The application of laminated timber not only allowed to accomodate new programmes, but provided functional structures across the country.

178 *Bergens Arbeiderblad*, December 1, 1976, 2.

Fig. 31. Moelven's standardised sports halls. Above, advertisement headline claiming that "Moelven Limtre carries the most beautiful sports halls in the country." Below, "Oslo municipality also chose a sports hall from Moelven Limtre." Newspaper clippings, 1970.

TIMBER RENEWAL

Laminator fostered a very particular relationship with timber. Today, timber is heavily laden with ideas of sustainability, palliative environmental effects and implicit ethical values. In the 1950s, however, Moelven's choice of timber for its prefabricated products was largely practical, based on the material's proximity and abundance—rich forests around Lake Mjøsa—and previous carpentry experience of the company's workforce. Since timber was a default choice, few Moelven products explicitly addressed established narratives around the use of timber. Laminator would change that. From the early 1960s, its marketing booklets emphasised that technology of lamination allowed to "to bring back our most appropriate building material" and "rearrange our previous notions of wood as a construction material."[179] A 1968 advertisement for "Sne-Tre" (referring to the Oslo School of Architecture's winter snow projects) claimed that one must "submit to the beautiful natural properties of the material," suggesting that more expression could be achieved with laminated timber.[180] New technology enhanced timber with "new loadbearing functions" and moved the "boundary of wood construction," making it possible to use timber for a wider range of programmes and functions.[181] This marketing narrative, with more cultural emphasis—quite unusual for Moelven—must be seen together with a changing architectural discourse around building with timber in 1960s Norway.

In 1960, Håkon Mjelva in his *Byggekunst* article reviewing buildings from the Danish Wood Prize, insisted that a similar measure to popularise timber construction should be introduced to Norway.[182] In 1961, at the initiative of the architectural community and with the support of Treopplysningsrådet, a Norwegian equivalent of the Wood Prize was established to encourage architects to build with timber. Here, the interests of architects—Christian Norberg-Schulz in particular—and industrialists curiously aligned. Treopplysningsrådet—the Wood Council—was a lobbying organisation that represented timber producers, and sought to popularise the material and develop new markets.[183] Norberg-Schulz for his part was particularly concerned with the "degenerating"

179 Laminator catalogue, 1965, NB archives.
180 *Nye bonytt* 28, no.1 (1968): 9.
181 Laminator catalogue, 1965, NB archives.
182 Håkon Mjeva, *Byggekunst,* no.2 (1960): tillegget, 8.
183 On Treopplysningsrådet see *Fædrelandsvennen*, September 12, 1960, 3; *Morgenbladet*, November 30, 1960, 10.

culture of wood construction, hoping that contemporary architects would be able to counteract that tendency.[184] Glued laminated constructions—despite their industrial origins—were largely absolved from this damning degeneration. In fact, Norberg-Schulz drew a genealogical lineage between glulam beams and post-and-beam timber skeletons in traditional Norwegian architecture.[185] In his introduction to a 1964 issue of *Byggekunst*, he voiced his approval of "glued laminated timber constructions that made it possible to create a wooden house that is a little more sophisticated than panel-clad boxes," an idea reiterated in a later essay, arguing that laminated beams were particularly "appropriate to the traditional Norwegian sense of articulate structure."[186]

The same year the Wood Prize was introduced, 1961, glued laminated timber made a grand appearance in *Byggekunst*. It included a summer issue that featured large meeting halls in Stavanger by Retzius and Bjoland on the cover, and several smaller projects in the short-list of 15 single houses hand-picked by Norberg-Schulz.[187] Laminated timber, together with flat roofs and glass walls were perceived as tokens of modernity—as we learn from an article by Kjell Lund—and most often used in singular architect-designed modernist houses and villas.[188] This category indeed dominated most mentions of glued laminated timber on the pages of *Byggekunst*, and the only public building with glulam elements featured in the magazine was Cappelen and Rodahl's Akershus central library.[189] Laminated constructions in public buildings started to receive more publicity with the proliferation of new church projects—for example, Åssiden kirke in Drammen by Halvard Hille and Odd-Kjeld Østbye, Tromsdalen Kirke by Jan Inge Hovig, Brumunddal Kirke by Molle and Per Cappelen and Sven Erik Lundby, and Haslum crematorium, by John Engh and Jon Seip.[190] It seems particularly strange that, although glued laminated timber was used prolifically across the country, this new material did not make it into a single project description in a 1971 *Byggekunst* issue dedicated specifically to large halls.[191] This could perhaps be attributed to the

184 Dag Rognlien and Norske arkitekters landsforbund*, Treprisen 1961, 1962, 1964, 1966. Four Norwegian Prize-winning Architects* (Oslo: Norske arkitekters landsforbund, 1968), 7.
185 Dag Rognlien and Norske arkitekters landsforbund, *Treprisen 1961, 1962, 1964, 1966 = Four Norwegian prize-winning architects*, *Norbok* (Oslo: Norske arkitekters landsforbund, 1968), 10.
186 Christian Norberg-Schulz, "Tre og sten," *Byggekunst* 46, no.8 (1964): 197. Christian Norberg-Schulz, introduction to Makoto Suzuki, Yukio Futagawa, and Christian Norberg-Schulz, *Wooden Houses*, First Edition edition (New York: Harry N Abrams Inc, 1979), 16.
187 "Messehaller i Stavanger," *Byggekunst* 43, no.6 (1961): 203-207. "Femten eneboliger," *Byggekunst* 43, no.8 (1961): 53, 265.
188 Kjell Lund, "Hus som synger," *Byggekunst* 43, no.8 (1961): 247.
189 *Byggekusnt* no.1 (1962): 13, or *Byggekusnt* no. 7 (1965): 180-184.
190 *Byggekunst* 48, no. 5, no.8 (1966), *Byggekunst* 51, no.1 (1969).
191 *Byggekunst* 53, no.1 (1971).

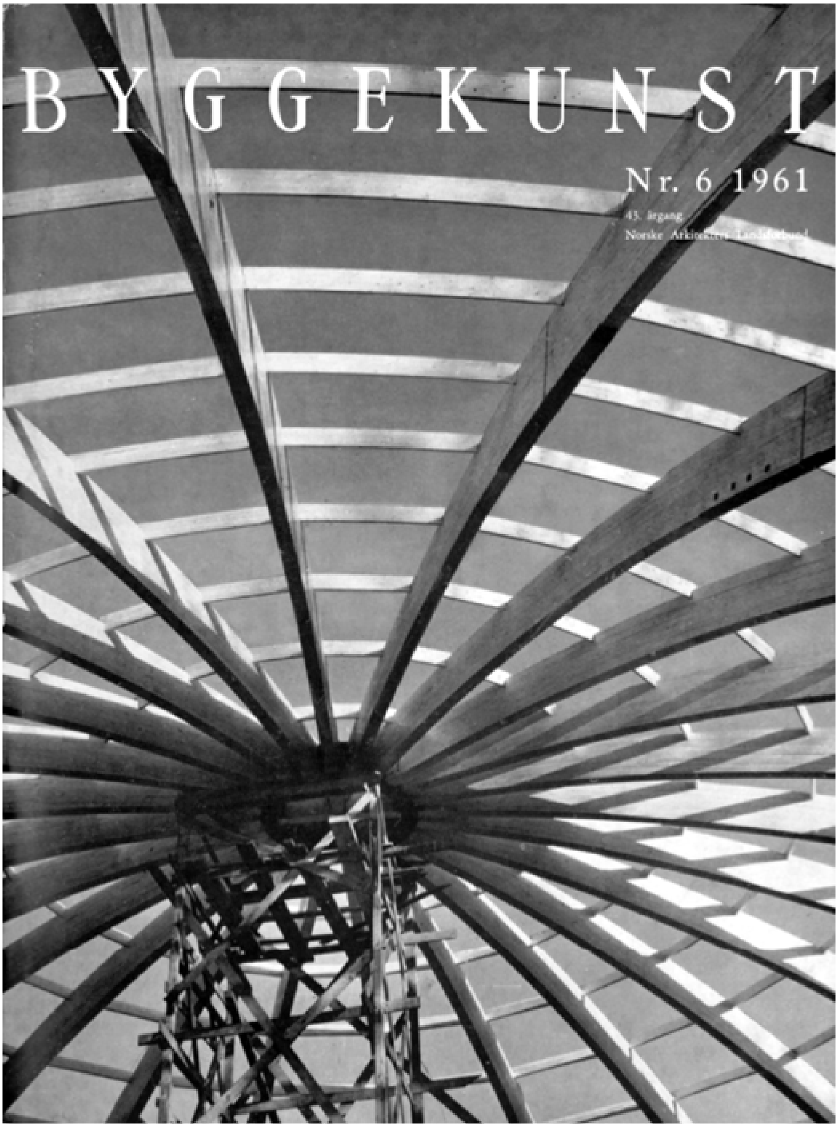


Fig. 32. Cover of *Byggekunst* 43, no. 6 (1961) featuring a meeting hall in Stavanger by Eyvind Retzius and Svein Bjoland built from laminated timber components.

fact that by some practitioners it was still seen as too experimental or too industrial. Nevertheless, glulam remained endowed with the narrative of joining the past and the present, tradition and renewal.[192] In 1975, Sverre Fehn used Moelven laminated beams for his Storhamar Museum at Domkirkeodden, a project, according to the architect, set "in a continuous confrontation between the Middle Ages and the present," and laminated beams seemed to offer a perfect material for that juxtaposition. [193]

The origins of this cultural narrative may, in fact, have been indebted to Laminator: the first claim for a "wooden renaissance" was made in its 1960 sales booklet, exactly the same phrase picked up by Norberg-Schulz in a 1964 *Byggekunst* article, then followed by an incessant cavalcade of similar newspaper headlines, no doubt prompted by Laminator's sales office.[194] While there were other producers of laminated timber—Splitkon, Trelamin, and smaller sawmills—their advertisement strategies were far more modest, concentrating primarily on constructive advantages and questions of economy.[195] For Moelven, this insistence on timber renewal, coupled with its extensive experience with sports halls, landed the company its commission for the 1994 Lillehammer Winter Olympics facilities. According to social historian Asbjørn Karlsen, the building committee that was looking for specifically "Norwegian architecture and construction style" chose Moelven, not least due to the narrative of "updated tradition" associated with the material of glued laminated timber.[196] The company eventually delivered laminated constructions for the Olympiahall (Vikingskipet) and OL-Amfi in Hamar, and Håkans Hall in Lillehammer.[197] Laminated arches were not only endowed with carrying the unprecedented span of 94 metres but also the idea of the new Norwegian building style, bridging tradition and modernity.[198] This persistent marketing narrative resulted in another Moelven commission of international calibre: Oslo Gardermoen Airport in 1995.[199] Since the parliamentary committee decided that this modern high-technology complex needed to reflect "good Norwegian construction tradition with an extensive use of natural materials," all steel loadbearing structures

192 Kjell Lund and Nils Slaatto, "Tradisjon og fornyelse," *Byggekunst* 46, no.8 (1964): 204.
193 Sverre Fehn, *Byggekunst* 57, no. 3 (1975): 64.
194 "Morgendagens byggemetode," 1960, Moelven Industrier, NB archives, 5. Christian Norberg-Schulz, "Tre og sten," *Byggekunst* 46 no.8 (1964): 197. *Nationen*, September 17, 1974, 6.
195 See Splitkon ads in *Byggekunst*, no. 4, 5, 7 (1962). Trelamin in *Byggekunst* 47, no.7 (1965): VI.
196 Kirke- og kulturdepartementet, quoted in Kjell Norvin, "Olympiske bygg og anlegg—en kulturoppgave," in *Byggekunst* 75, no.5/6 (1993): 288. Asbjørn Karlsen, *Institusjonelle perspektiver på næringsomstilling*, *Norbok* (Trondheim: Norges teknisk-naturvitenskapelige universitet, Fakultet for samfunnsvitenskap og teknologiledelse, Geografisk institutt, 1999), 183.
197 Moelven industrier et al., *Moelven 1899-1999*, 112–13.
198 Norge: Stortinget, "Stortingsforhandlinger. 1992/93 Vol. 137 Nr. 3a" (Oslo: Forvaltningstjenestene, 1992), 156
199 Moelven industrier et al., *Moelven 1899-1999*, 118.

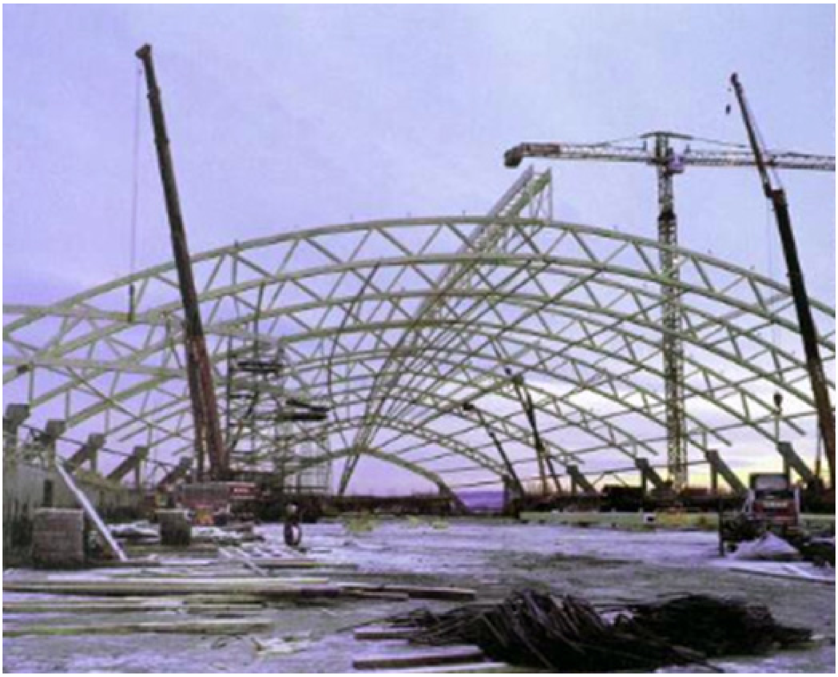


Fig. 33. Construction of Hamar Olympia-Hall for the 1994 Winter Olympics. From *Moelven 1899-1999*.

were exchanged with glued laminated beams produced by Moelven.[200] Norberg-Schulz, reviewing the building in a 1999 issue of *Byggekunst*, praised the laminated wooden beams for illustrating "the large space in a Norwegian way, [...] in relation to the Norwegian ground and sky."[201] In this way, Moelven Limtre managed to monopolise the idea of "a modern Norwegian construction style,"making it synonymous with the use of laminated wood, at a moment of soul-searching for a new national identity in an increasingly globalised world. [202] Today, when timber is imbued with many implicit qualities related to sustainability and locality, the glued laminated beams in Oslo Gardermoen Airport do convey a reading of the "Nordic" atmosphere: a quick search through online reviews reveals that, to many visitors, "[the airport] feels very Scandinavian."[203]

200 *Byggekunst* 81, no. 1 (1999): 16.
201 Christian Norberg-Schulz, "Storrommets arkitektur," *Byggekunst* 81, no. 1 (1999): 48; also in "The Art of Building," in *Timberwork*, Ed. Beate Hølmebakk (Oslo: Arkitekturforlaget, 2000), 249.
202 Karlsen, *Institusjonelle perspektiver på næringsomstilling*, 198–99.
203 J. Bolton from the United Kingdom, review on Airlinequality.com, October 25, 2019. Andreas Becker from Germany thought that "The airport was nice, typical Scandinavian architecture. Many woods used" (March 15, 2018). https://www.airlinequality.com/airport-reviews/oslo-airport/, accessed July 20, 2020.

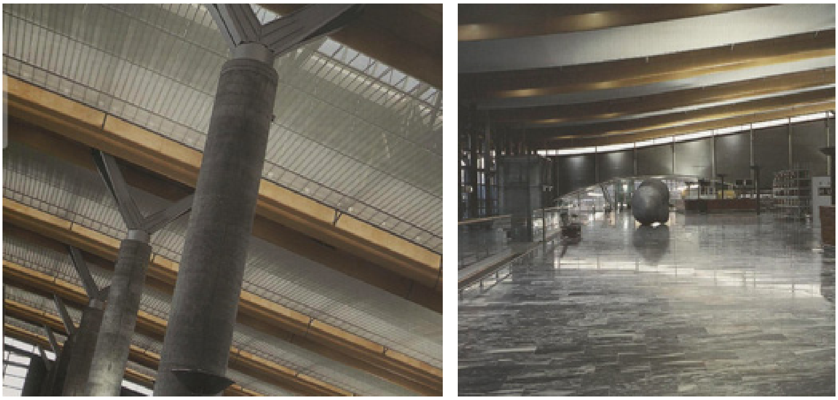


Fig. 34. Laminated timber beams featured prominently throughout Gardermoen airport. Photos by Guy Fehn. From *Byggekunst* 81, no.1 (1999).

Fig. 35. Moelven Mjøstårnet completed in 2019 with all load-bearing elements made in Moelven laminated timber. Photo by Woodify, https://www.woodify.no/mjostarnet-brumunddal/, accessed August 8, 2020.

NEW BEGINNINGS

This chapter hoped to provide a first stepping stone towards a history of glued laminated timber in Norway, a technology that has so far been overlooked by historians. Pioneered in Scandinavia by the entrepreneurial figure of Guttorm Brekke, glued laminated timber witnessed a revival through Moelven's aggressive marketing efforts. To be sure, the company was not alone in this; rather, they were accompanied by an array of consultants and experts from NTH and NTI, and figures like Hans Granum, Halvor Skjelmerud and Ringsaker Almenning's Håkon Bergseng. The new technology was based on different international models but found a particularly local resolution as it was assimilated into the specific conditions of Norway's construction market, raw material supply, availability of labour, technical equipment and infrastructure. Laminated timber structures found their application in a variety of everyday typologies—industrial and factory buildings, schools, churches, barns and sports halls. Closely intertwined with municipal policies, social welfare and changing political priorities it filled the imported shell of technology with a set of local meanings.

Unlike other Moelven products, glued laminated timber was distinctly an architects' material. Used for both structures of utility and representative architecture, it combined pragmatism of means and richness of architectural expression. This was particularly relevant in church architecture, where exposed loadbearing structures in glued laminated timber allowed to both accommodate the new formal language of post-war church architecture and convey a sense of locality. Moelven's marketing strategy was closely attuned to the changing architectural discourse, as it positioned glued laminated timber at the intersection between tradition and modernity, playing on the sentiment of bringing back the "most appropriate building material." It is precisely this alignment that brought Moelven Limtre its largest commissions, as glued laminated timber became associated with a new Norwegian building style. It is thus unfortunate that even architecturally significant structures completed by Laminator remain non-existent in Norwegian architectural historiography, mostly remaining on the pages of newspapers and some local history books. A select few of churches—including Storhamar church—made it to the pages of *Byggekunst* or *Bonytt,* while Laminator sports halls or pedestrian bridges are entirely unrecorded—a significant drawback for anyone interested in studying the history of glued laminated timber in 1960s Norway.

Today, these narratives acquire new meaning in the light of contemporary discourses on sustainability and locality, a meaning that the company whose operations still continue, has not failed to pick up on. Glued laminated constructions from Moelven were used recently in Mjøstårnet, the highest timber skyscraper in the world, Stavanger's Finansparken, the largest financial building in Europe built in wood, and Vennesla library by Helen & Hard, a prize-winning symbol of good Norwegian design.[204] When Moelven introduced glued laminated timber to the Norwegian building market, the company's intentions were more pragmatic. Today, aiming to build entirely out of timber poses not just a technological challenge for a pool of eager practitioners and researchers, but also carries the promise of redemption, where a better, more ethical and sustainable architecture can pave the way out of the global environmental crisis. Glued laminated timer—essential for this feat—has truly grown into a building material of the future.

204 See Moelven Limtre, https://www.moelven.com/no/inspirasjon-og-konsept/limtre/, accessed August 10, 2020.

THE SHAPE OF THINGS TO COME

CONCLUSION

Fig. 1. Moelven's 75th year anniversary selebrations. From *Bedriftavis*, no. 16 (1974).

“EVEN THOUGH THE PROCESS OF INDUSTRIALISATION HAS PUT US THROUGH MANY DIFFICULTIES, WE ARE PLEASED TO NOTE THAT AT OUR 75TH ANNIVERSARY WE HAVE REACHED A LEVEL WHERE PRODUCTION, TRANSPORT, ASSEMBLY AND SALES ARE RUNNING SATISFACTORILY.”[1]

1 A/S Moelven Brug, 75-års jubileum; “Opplysninger angående adm. Dir. Johs Mageli,” 3. Folder 0002 “Celebreringsarrangement” in SAH/ARK-287-01/P/Pb/L0001.

On September 25, 1972, a "political earthquake" shook Norway. In a popular vote held to determine whether Norway was to join the European community, the "no"-coalition, which mobilised the political left, students and intellectuals, architects, environmental and local activists won with a slight margin of 3,5% over the business-led "pro-EEC" side that was perceived as representative of the global capitalist-industrial project.[2] As the initial shock-waves receded, deep ruptures were left in Norwegian political and economic life, doing away with the stability and political consensus of the golden years of the welfare state.[3] In architecture, according to Elisabeth Tostrup, the continuous attack of left-wing activists on the perceived alliance between the Labour Party and large-scale business actors led to many large development projects being rejected or put on hold.[4] For Moelven, a company that had long championed the pro-EEC stance, this marked the beginning of a long and slow decline: now, the common European market was off-limits, the emerging oil economy was winning the politicians' attention, and both popular taste and press attention were diverging from the company's course. For Mageli, it felt like a betrayal. During the 75-year anniversary speech, he complained that although Norway's high standard of living "would not have been possible without the industry's creative and productive forces," the cultural and political tide was now turning against it.[5] According to Mageli, "in many circles [...] there is a prevalent idea that the industrial development has to stop and that resources instead should be [...] scaled down in favour of some homemade craft activities in the suburbs."[6] Moelven's fascination with technologies of scale and wholehearted embrace of mechanisation and mass-production no longer fitted a society where small was becoming beautiful.

Although an oil crisis in the following year impacted the company's transportation costs and material-sourcing infrastructure, Moelven's diversified business model weathered the changes then underway in the Norwegian system. New products related to the oil market could compensate for the parts of production that were no longer profitable.[7] Already in 1965, when the American Overseas Petroleum company started

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2 Martin Braathen, "The Magician and the Shoemaker: Debates on Open Form and Marxist-Leninism in Norway around 1970," Doktoravhandlinger Ved NTNU (Trykt Utg.) (PhD diss., Trondheim, Norwegian University of Science and Technology, Faculty of Architecture and Design, 2019), 64–65.

3 Francis Sejersted, "Norsk Historie Fra 1970 til 1990," Store Norske Leksikon, https://snl.no/Norsk_historie_fra_1970_til_1990. Accessed November 21, 2021.

4 Elisabeth Tostrup, "Tracing Competition Rhetotic," in *Nordisk Arkitekturforskning*, no. 2/3 (2009): 28.

5 *Bedriftavis*, no.15 (1974): 1.

6 A/S Moelven Brug, 75-års jubileum; "Opplysninger angående adm. Dir. Johs Mageli," 7. *Bedriftavis*, no.15 (1974): 1.

7 *Bedriftavis*, no. 18 (1975): 1.

its first drilling on Svalbard, Moelven had delivered workers housing. By the 1970s, Moelven's new "container-houses" grew to be an essential element of the Norwegian "oil adventure."[8] In addition, the company closely cooperated with Norwegian Contractors—an industrial company founded to build off-shore oil infrastructure. Moelven containers could be found on the largest oil platforms—for example, Statfjord and off-shore oil tankers like Ekofisk.[9] Moelven's mechanical department also delivered telescope-operated cranes to "Ross Rig" and "Deep Sea Driller" in 1975.[10]

However, the oil age influenced the company more profoundly than just prompting new products. The growing prosperity of the 1970s, and a changing political climate moving towards deregulation, post-industrialisation and a market-driven economy, had a devastating effect on Moelven's housing production. As boom-times rolled in, new aesthetic preferences entered the market. Hild Sørby in her book *Klar–ferdig–hus,* points out the changing appearance of prefabricated houses that now required bay windows, arches, columns, decorative mouldings and "American," "Swiss" or "old-Norwegian" stylisations.[11] And although more people wanted customised design solutions, these elements were increasingly expensive to produce. Compared to other producers in the prefab construction business, the company resisted for a long time before introducing these new "fashionable" elements, but eventually had to give in.[12] By the end of the 1970s things looked pretty grim for Moelven.

The final blow came in 1979, when it became clear that the Norwegian housing market was about to change dramatically.[13] The Labour Party was going to make severe cuts to its housing programme budget, private financial institutions were to overtake Husbanken in financing most new construction, regulations on housing prices and rents were about to be abolished, and restrictions on sales of cooperative housing introduced.[14] The prices of apartments and construction were gener-

8 A/S Moelven Brug, 75-års jubileum; "Opplysninger angående adm. Dir. Johs Mageli," 6.

9 For Norwegian contractors see https://snl.no/Norwegian_Contractors, Trygve Dalseg, *Moelven Brug i forvandling og vekst: en jubileumskavalkade 1899-1974* (Moelv: Moelven Brug, 1974), 60. *Bedriftavis*, no. 29 (1981): 24

10 Moelven industrier et al., *Moelven 1899-1999*, *Norbok* (Moelv: Moelven industrier, 1999), 58–59.

11 Hild Sørby, *Klar - ferdig - hus: norske ferdighus gjennom tidene*, vol. 1, Kult-bøker (Oslo: Ad Notam Gyldendal, 1992), 106–13.

12 Sørby, 110–11. See "Moelven Eneboliger" catalogues from the 1980s, NB archives.

13 Torbjørn Hovde, *Moelven: afstigning paa høire side : Moelv 125 år*, *Norbok* (Brøttum: Hovde forlag, 2019), 183.

14 Barbara Elisabeth Ascher, "The Hallagerbakken Housing Project in Holmlia, Norway: When Welfare Became Business," *The Journal of Architecture* 21, no. 3 (April 2, 2016): 444, https://doi.org/10.1080/13602365.2016.1181912. Jardar Sørvoll, "Fra totalreguleringsambisjoner til markedsstyring: Arbeiderpartiet og reguleringen av boligomsetningen 1970-1989," NOVA-rapport 1/08 (Oslo: Norsk institutt for forskning om oppvekst, velferd og aldring, 2008). Jardar Sørvoll, *Norsk boligpolitikk i forandring 1970-2010: dokumentasjon og debatt*, NOVA-rapport 16/2011 (Oslo: Norsk institutt for forskning om oppvekst, velferd og aldring, 2011).

Fig. 2. A bird's eye view of different Moelven factories, 1976. From Moelven marketing catalogues, National Library Archives.

ally rising, and while Moelven adapted its entire production apparatus to state regulations, these regulations were now being dismantled, and so was Moelven's goal to deliver "good" architecture "at a reasonable price." In the age of oil prosperity, cheap "everyman's houses" were no longer needed. In November 1979, 800 Moelven workers joined the first and largest strike in the company's history, protesting against this political decision.[15] Although Moelven actively attempted to counteract this demise—buying its own land-plots and acting as a de-facto land- and property-developer—most of it was done at a significant loss.[16] New investments and further automatisation could not compensate for an increasingly expensive production in an increasingly unexpected market.

In 1988, following an extensive crisis in the housing market, it became clear that 200-250 people would have to be laid off. A year after, the section and element house factories were dissolved. In 1991, the Swedish company Boro/Riquma took over the remaining shares of Moelven housing factories, but even that production soon had to be brought to a halt.[17] Business historian Asbjørn Karlsen descried the end of Moelven's house-production as he visited the factory in the early 1990s:

15 *Dagningen*, November 8, 1979, 1, 16. *Hamar Arbeiderblad*, November 7, 1979, 1.
16 Moelven industrier et al., *Moelven 1899-1999*, 71.
17 Moelven industrier et al., 104.

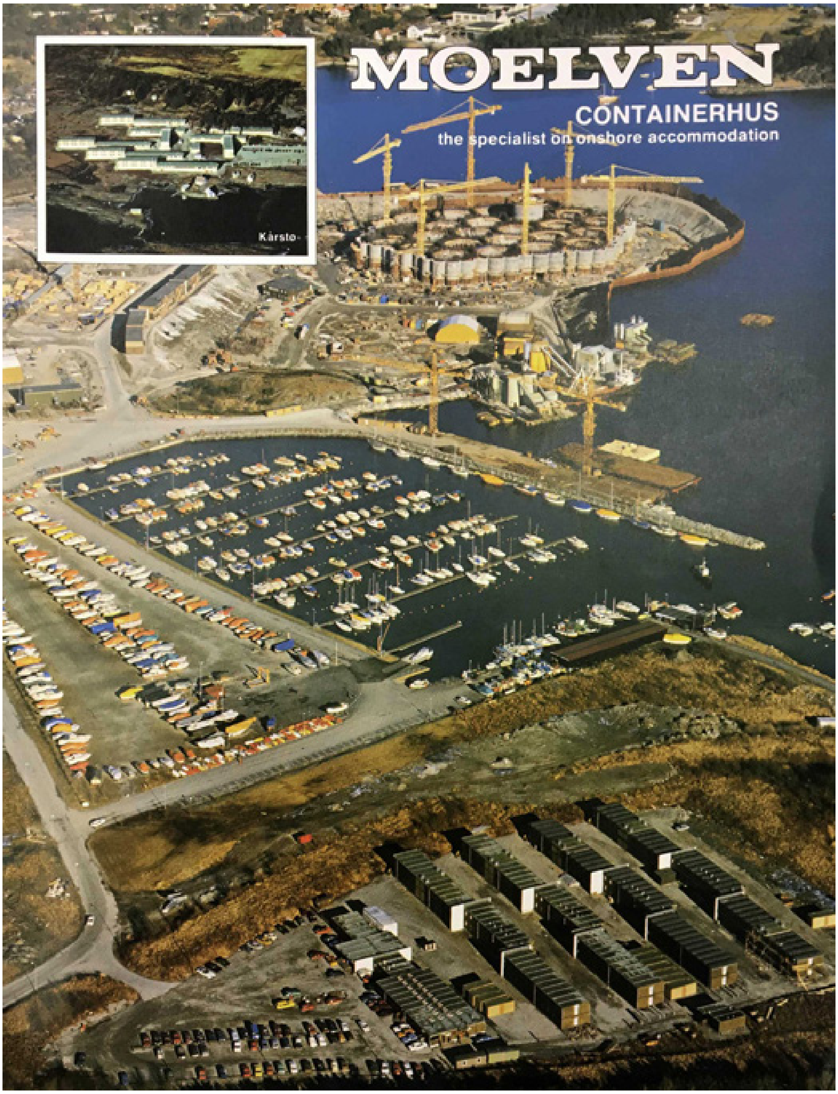

Fig. 3. By the late 1970s, the company discovered another market opportunity—container houses for oil platforms and exploration sites. On the image Moss Rosenberg Shipyard, where Moelven containers were used as officed for the Norwegian contractors, 1982. Moelven catalogues, National Library Archives.

"We find ourselves in a large factory hall. Even though it is the middle of the day on a regular work day, there are hardly any people here. Production has stopped, but there is both heating and light. This creates a somewhat eerie feeling. Everything stands as if ready to be started again, and tonly workers and materials are missing. The production equipment is impressive and looks very advanced. One understands that production had been shaped by assembly lines, visible in the rails that extend through large parts of the room."[18]

The history of Moelven has proved to be intimately intertwined with the history of the post-WWII Norwegian welfare state, and equally closely tied to its demise. Today, Moelven is still a Norwegian—or rather Scandinavian—enterprise that has gone through multiple organisational changes and ownership iterations. It is one of the largest Scandinavian sellers of raw timber materials for further processing by other industries, and it continues to produce glued laminated timber, building modules, interior systems, and flexible office solutions.[19] The company has several offices in and around Moelv, Brumunddal and Hamar, including Moelven Limtre, Mjøsbruket, Modus, Byggmodul Hjellum, Moelven Langmoen and Moelven Løten. In the Hjellum factory, assembly lines are up and running again, producing prefabricated section modules for apartment buildings, hotels and single-family houses.[20] Today, Moelven's workforce comes from different parts of Europe. Although contemporary Moelven production is strongly indebted to mid-century innovations, the company's official "historical" timeline as shown on the website locates its roots mostly in the post-1970s events, curiously oblivious to earlier developments.[21]

COMPANY AS A METHOD

This thesis is neither primarily a history of a company, nor a story of the Norwegian welfare state in the making. Rather, it is a history of a particular kind of architecture—ordinary seems the best way to describe it—to which a construction company, Moelven Brug, provided an appropriate entry and vantage point. And while conventional architectural history tends to focus on the architect's drawing board and the finished

18 Asbjørn Karlsen, "Fra håndverk til masseproduksjon: en studie av omstillinger ved Moelven Brug" (Nordlandsforskning, 1994), 72.
19 "About Moelven," https://www.moelven.com/about-moelven/, accessed November 20, 2021.
20 "Moelven Byggmodul AS," https://www.moelven.com/no/om-moelven/byggsystemer/moelven-byggmodul-as/, accessed November 20, 2021.
21 "The story of Moelven," https://www.moelven.com/about-moelven/moelvens-history/, accessed November 20, 2021.

result, I was interested in everything that happens in between, in the total process of getting a building on site. Differently from conventional construction history, this thesis was not interested in a single building system or material innovation, but in many aspects of Moelven products and processes: from managerial organisation, labour relations, selections of materials and equipment, aspects of production and transport, technological import and details of construction. I hoped to show that construction companies—a definition that can be extended to material producers, general contractors and real estate developers—potentially harbour a new methodology for studying ordinary architecture beyond housing. Embedded in large social, technological, political and economic systems, construction companies allow the researchers to access the entire production cycle of architecture. They serve as "assemblages" of thoughts and things, yielding a rich web of objects, people, ideas, ideals, materials and buildings that have until now escaped the pages of architectural history books, but allow for a different, multi-faceted architectural history both with an enlarged scope and a narrowed focus. In this ambition, the thesis follows the lead of the Aggregate Architectural History Collective, which strives to investigate the relationship between architecture and other epistemological and physical systems, interrogating the value and meanings assigned to the production of architectural systems.[22] A study of construction companies would thus allow to pursue more ambitious questions in architectural history, particularly those concerned with the societal roles of the built environment. This methodology provides an opportunity to write a more contextualised architectural history of the everyday, concerned with architecture as an applied, rather than theoretical discipline.

Although these disciplinary and methodological claims might seem too ambitious to pursue in a single thesis, my research has been inspired by the recent disciplinary establishment of design history. Kjetil Fallan argues that, due to a dissatisfaction with the theoretical framework and methodological tools offered by traditional art history, this field has come to acknowledge the difference between mass-produced utilitarian objects and unique artworks and expanded the subject matter to include expressions of visual culture normally shunned in conventional art history.[23] Doing so has required design history to turn into a fundamentally

22 See "Systems" umbrella of the Aggregate Architectural Collective, http://we-aggregate.org/umbrella/systems, accessed November 10, 2021.
23 Kjetil Fallan, "A Matter of Design" lecture, 5th STS Italia Conference, "Making Society through Science and Technology," Politecnico di Milano, Italy, Plenary Session II June 13, 2014. https://www.youtube.com/watch?v=7pEDzWJ3N14&ab_channel=FondazioneGianninoBassetti Accessed August 13, 2021.

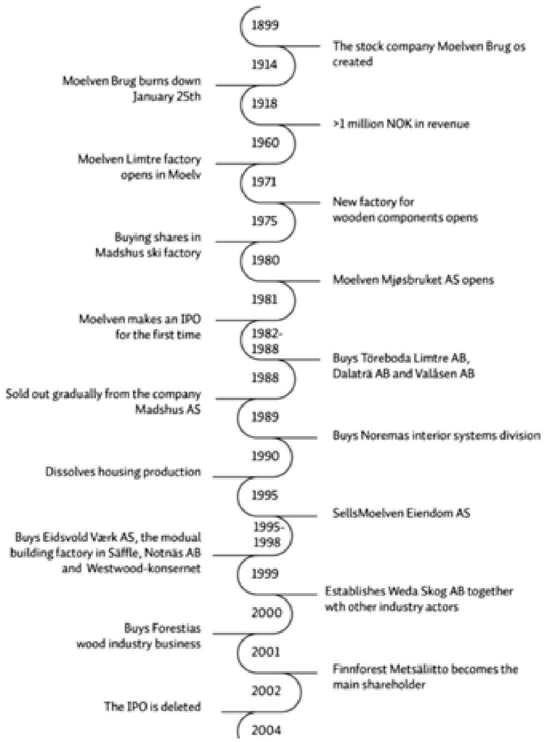

Fig. 4. The company's timeline as presented on the website. It is mostly located in the post-1975 events, while the entire mid-century period is described through one blurb dedicated to the foundation of Moelven Limtre. https://www.moelven.com/about-moelven/moelvens-history/, accessed March 1, 2022.

interdisciplinary field that incorporates sociology, anthropology, social history, feminist studies, the history of technology and science, and technology studies. Similarly, in order to produce a different type of architectural history, this thesis had to mobilise a multifarious interdisciplinary framework drawing on a variety of fields, from business and managerial history, labour and technology studies, to the history of education, mobility and material studies. This new methodological approach aims to ignite interest not just in ordinary, but mass-produced architecture and to show that although the study of the ordinary requires extraordinary effort, it also opens the possibility for a more democratic and diverse architectural history, interested not just in buildings for the select few, but the processes and people behind the creation of ordinary buildings.

The ambition to write a more popular architectural history is also reflected in the sources I have relied on in the inquiry. Since Moelven's projects were nearly entirely absent in *Byggekunst*, *Bonytt* and other architectural and professional magazines of the time, my investigation had

Fig. 5. Moelven exhibition centre visited by King Olav in 1984. From *Moelven 1899-1999*.

to turn to sources usually neglected in conventional architectural history. Most Moelven building activities and projects were widely covered in local and national newspapers, whose titles—*Arbeiderbladet, Akershus Arbeiderblad, Bergens Arbeiderblad, Halden Arbeiderblad, Hamar Arbeiderblad*, *Haugaland Arbeiderblad, Helgeland Arbeiderblad, Hedmark Arbeiderblad, Namdal Arbeiderblad, Oppland Arbeiderblad, Sarpsborg Arbeiderblad, Drammens Tidende og Buskeruds Blad*—speak for themselves. If Moelven buildings and products were absent in the post-war version of Norwegian modernity as told by architectural magazines, they were very much present in the experience of ordinary people, as revealed by these lay press sources. Writing this kind of history required stitching a kilt-patchwork of mentions in hundreds of regional newspapers, yellow pages, advertisements, local history books, tracing names and connections through a variety of print media generously digitalised by the National Library. With the help of this technology, new histories of the production of everyday architecture can now be written.

The case of Moelven is just one of the many stories of everyday architecture that are waiting to be told. Other industrial producers and construction companies—both in Norway and abroad—could serve as equally appropriate study objects. While this research might come across as a laudatory piece for Moelven, my interest in the company was inversely proportional to its continuous absence in a mainstream architectural discourse that considered its buildings as “non-architecture” not worth studying and whose products remained nearly a cultural taboo. Largely indebted to its “outside gaze,” this thesis hoped to show that Moelven products and processes could in fact serve as appropriate research objects for a new, enlarged type of architectural history, stemming from a broader conviction that even seemingly-insignificant details, documents and buildings can reveal some of the most interesting stories. In this approach, the thesis parallels some of the more recent scholarly works that have expanded the scope of architectural history and explored the role of technical specifications, cultural material histories, questions related to labour in construction, the work of managers and engineers, investigations into organisation of the building site or paymet systems.[24] Recently, new research focused specifically on companies and industrial produces has emerged. Among them, Erik Steinberg’s investigation into the wealth of informal corporate relations between mid-century Swedish politicians and large construction firms, Claire Zimmerman’s research of the prolific built output of Albert Khan Associates, the work of Monika Motylinska that explores entanglements between developmental aid politics and German construction companies in the Global South, or Sarah Nichols’s intricate mappings of networks of actors involved in cement production in Switzerland.[25] I hope to see more emerging work and discussions in this field, as I will chair a panel, “Large Construction Companies in a Global Context,” during the 75th Annual International Conference of the American Society of Architectural Historians in May 2022.[26]

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24 For some inquiries of these kind see Katie Lloyd Thomas, *Material Matters: Architecture and Material Practice* (Routledge, 2006). Adrian Forty, *Concrete and Culture: A Material History* (Reaktion Books, 2013).Linda Clarke, *Building Capitalism (Routledge Revivals): Historical Change and the Labour Process in the Production of Built Environment* (Routledge, 2012). Christine Wall, *An Architecture of Parts: Architects, Building Workers and Industrialization in Britain 1940-1970*, Routledge Research in Architecture (New York: Routledge, Taylor & Francis Group, 2013). Michael Osman, *Modernism’s Visible Hand: Architecture and Regulation in America* (Minneapolis: University of Minnesota Press, 2018). Clarke, *Building Capitalism (Routledge Revivals)*. Amy Thomas, ‘Prejudice and Pragmatism: The Commercial Architect in the Development of Post-War London,’ *Grey Room* 71 (2018): 88–115.

25 Erik Stenberg and Erik Sigge, an unpublished manuscript with background research for “Svensk flygande betong,” a prototype for the “Flying Panels” exhibition, private correspondence. Among published sources, see Erik Stenberg’s chapter “D4-gruppen 1955-1961” in Pedro Ignacio Alonso and Hugo Palmarola, *Flying Panels: How Concrete Panels Changed the World* (DOM Publishers, 2020). Claire Zimmerman, “Albert Kahn’s Territories [Office US Catalogue 2014],” *Office US: Catalogue*, accessed May 4, 2021. Lisa Brunnström, *Det svenska folkhemsbygget: om Kooperativa förbundets arkitektkontor* (Stockholm: Arkitektur förlag, 2004). Monika Motylinska, “Conquering (with) Concrete. German Construction Companies as Global Players in Local Contexts,” Leibniz Institute for Research on Society and Space, https://leibniz-irs.de/en/research/projects/project/conquering-with-concrete-german-construction-companies-as-global-players-in-local-contexts. Sarah Nichols, “Pollux’s Spears,” *Grey Room* 71 (2018): 141–55, https://doi.org/10.1162/grey_a_00246.

26 See “SAH 2022 Pittsburgh Conference” at https://guidebook.com/g/#/guides/sah2022/details, accessed March 1, 2022.

MAIN TAKEAWAYS

Similar to the volume *Industries of Architecture*, this thesis was interested in the way "techniques and technologies of production affect those who labour in architecture, the buildings they produce and the discursive frameworks that are mobilised to understand them."[27] The thesis, then, was structured around three main lines of inquiry: first, concerned with new technologies and techniques of production; second, interested in Moelven's relationship with state actors and building regulations, and third, focused on the way the factory's production grew to be intertwined with professional architectural discourse. There are three main takeaways related to these three areas of inquiry.

Firstly, Moelven production was a result of the general spirit of rationality, productivity, quantification, standardisation and scientific inquiry that permeated through different areas of life in post-war Norway. At a time when the idea of progress was still inlayed with social concern, this spirit found a particularly poignant expression in the prefabricated architecture of Moelven Brug. For Johnson Marshal, the post-war British school builder, new rational building methods provided an answer to the question of "how can we built more justly," allowing one to share the proceeds of material, technical and cultural development in a more equitable manner.[28] Similarly, for Moelven, industrial production was a way to provide good affordable architecture for the "common people" that could be made both spacious and affordable, without sacrificing quality.[29] Rational industrial production and, as a consequence, prefabricated architecture, were means to this end. In order to modernise its production, Moelven enlisted the help of rationalisation agencies and experts that channelled international, and mostly American, models of modernity, business organisation and work relations. A new organisational model allowed the company to diversify its operations, venture into new areas and quickly adapt its production to the changing needs of state actors. It also ushered in a new era of managerial capitalism, where engineers occupied most of Moelven's managerial positions, driving "rationalisation," mechanisation and quantification of all processes, an idea that

27 Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech, *Industries of Architecture*, vol. 11, Critiques: Critical Studies in Architectural Humanities; (London: Routledge, Taylor & Francis Group, 2016), 9.

28 Andrew Saint, *Towards a Social Architecture: The Role of School-Building in Post-War England* (Yale University Press, 1987), 237–38.

29 *Hamar Arbeiderblad*, June 12, 1970, 14. Øystein Kock Johansen, *Å bo: II. Tradisjon og nyskapning*, vol. II (Oslo: Kagge, 2012), 365–66.

formed the core of Moelven buildings. These new technological models and modes of production were to make Moelven projects more "rational," and thus, affordable—even if at the cost of architectural expression.

Moelven buildings are a unique case study of what happens when the process of construction is transferred to the factory. Originally flat-roofed, with elongated horizonal clear geometric shapes, large windows, often in continuous strips dominating the facade, Moelven buildings relayed the aesthetic principles of early modernism that drew inspiration from those very industrial sources. Much of their appearance was defined by the conditions of a rigid technological apparatus that relied on conveyor-belt assembly, and thus yielded limited shapes and dimensions. In doing so, Moelven in fact managed to realise the early 20th-century dream of producing houses on conveyor-belts, "like Ford assembles cars."[30] The traditional process of on-site construction was transformed into a process of assembly that posed different demands on both the workforce and the process planners. Often, the Norwegian regulatory system was not prepared for this new process of construction, forcing the company into creative adaptions both in terms of labour representation and business organisation. With time, however, Moelven structures—products of a highly sophisticated production apparatus and process planning—grew hardly discernible from any traditionally-built structures as they gained pitched roofs, cornices, balconies and bay-windows. This, coupled with the perceived unsatisfactory—read: "factory-made"—quality of Moelven buildings is perhaps why Norwegian architectural historiography has traditionally steered away from discussing these buildings.

Norwegian inquiries into prefabrication have generally been concerned with its technical aspects and (often unfavourable) economic and qualitative comparisons with traditional construction.[31] To me, however, the main interest in Moelven was in the implicit idealistic aspiration attributed to new means of production that ran as a red-thread throughout the company's post-war history. New technologies and techniques were endowed with an implicit ethical (albeit positivistic) imperative—new rational building methods were to equalise the proceeds of material, technical and cultural development, contribute to a more "just" way of

30 Le Corbusier, quoted in Reyner Banham, *Theory and Design in the First Machine Age* (London: Architectural Press, 1960), 221.

31 See, for example, a comprehensive study by Halvdan Buflod, *Teknologisk endring av småhusbyggingen: en analyse av drivkrefter og samfunnsmessige konsekvenser*, NIBR-rapport 2 (Oslo: Norsk institutt for by- og regionforskning, 1985). Also earlier Reidar Hugsted, Ragnar Wiig, and Petter Lossius, *Prefabrikering av trehus*, Rapport 43 (Oslo: Norges byggforskningsinstitutt, 1965). Petter Lossius and Norges byggforskningsinstitutt, "Produksjon av trehus på fabrikk" (NBI, 1965).

Fig. 6. Moelven's highly automated production fascilities in the late 1970s. Moelven catalogues, National Library Archives.

building and provide a "a satisfactory life for the common man."[32] Different from other Norwegian producers—for example, Block Watne, which produced more "upscale" prefabricated houses—Moelven maintained this focus on ordinary, middle-class consumers that constituted the core of the Norwegian social-democratic model, while Moelven houses (and projects in general) were the most affordable on the market.[33] In this way, this thesis has been interested in the way prefabrication technology was mobilised for social ends, and how Moelven's ethical aspirations overlapped with those of the Modern movement.

Secondly, the case of Moelven brings to the fore an architecture that is not first and foremost, a consumable commodity. As the company worked on non-commercial projects mostly with state actors—municipalities, school building committees, housing cooperatives—it removed itself from the fast lifecycle of commercial development. In its non-commercial construction projects, Moelven continuously negotiated questions of quality and cost, limited budgets and time constraints, permanence and obsolescence. While in Norway Moelven architecture is commonly associated with the welfare state, the thesis has tried to steer away from this label, which did not capture Moelven's particular status and role. Instead, I looked at the partnerships fostered between the company and local decision-makers and studied the ways in which Moelven production developed in a symbiotic relationship with state regulations. Similar to the way Michael Osman traces the way 19th-century American architecture was transformed by emerging spatial and technical regulations, this thesis explores the way in which Norwegian everyday buildings of the 1960s were measured, quantified, evaluated, studied and transformed by different agencies, from Husbanken, OBOS and NBI to the Ministry of Education, KUB and STUI.[34] Each of Moelven's building typologies mobilised a different set of actors, crafting an intricate network of personal and corporatist relations. Similar to the way Helena Mattsson reveals Swedish post-war architecture's debt to a corporatist policy striving towards consensus between the state, the business world, and powerful interest groups, so Moelven's architectural production was indebted to the corporatist consensus between the company's management, local politicians, regional decision-makers and national regulatory actors.[35]

32 *Hamar Arbeiderblad*, June 1, 1968, 2. Saint, *Towards a Social Architecture*, 237–38.
33 Johansen, *Å bo*, 365–67.
34 Osman, *Modernism's Visible Hand*.
35 Helena Mattsson, "Where the motorways meet: architecture and corporatism in Sweden 1968," in *Architecture and the Welfare State*, ed. Swenarton, Avermaete, and Heuvel, 162.

Thirdly, although industrial building is often thought of as architecture without architects, as the case of Moelven shows, this is not true. Studying industrially-produced architecture allows architecture historians to recover the names of little-known architects, practitioners who laboured to produce many of the buildings we see and occupy in our everyday lives, but whose names did not make it to the architectural canon. This offers an opportunity to write a more inclusive architectural history that recognises the effort of common practitioners—which is the fate of a large majority of architects. Moelven's in-house architects Abrahamsen, Grinde, Philipp and Johannesen, were responsible for most of the company's projects, but their names remain little known. Beyond Moelven projects of the 1960s and the 1970s, the architects designed infrastructural buildings—Glomfjord Kraftverk, a station at Fykan and Eidfjord Nord—as well as many of Oslo's metro stations—Ensjø, Hasle, Linderud, Ammerud, Bergkrystallen, Rommen, and Vestli.[36] Swiss René Philipp would go on to specialise in multi-screen cinemas, designing Flerkinobygget at Gjøvik and refurbishing the Oslo Colosseum cinema centre.[37] Other frequent Moelven collaborators included the famous duo of Cappelen and Rodahl and the architects' collective HRTB. Beyond these, Moelven summoned a heterogeneous array of practitioners that either worked directly with Moelven or used Moelven's engineered timber in their projects. Some of these are Skedsmo's architect Ernst Ekra, Bærum's Baard Hjelde, Yugoslavian architect D. Trifunovic, Oslo's Per Qvam, Fredrikstad architect Aksel L. Fronth, Lillehammer architects Bjarne B. Ellefsen and Willy Sveen, Sarpsborg's Leif Lindgren and Bodø's Kjel M. Soløy. Each of these practitioners and their works warrant more research.

In his study of post-war British construction, Nicholas Bullock argues that any differentiation between architectural debate and building practice is ultimately artificial. This study shows that this was also the case in post-war Norway.[38] Originally an industrial company, Moelven initially had little architectural ambition. However, as its products were used by a wide range of building professionals, the company and its production grew closely embedded within professional architectural discourse,

36 Eivind Hartmann, Øistein Mangset, and Oslo sporveier, *Neste stopp!: verneplan for bygninger : sporveiens bygningshistorie*, *Norbok* (Oslo: Baneforl., 2001), 112–13. Sissel Riibe, Henning Weyergang-Nielsen, and Norges vassdrags- og energidirektorat, *Kraftoverføringens kulturminner*, *Norbok*, Rapport (Norges vassdrags- og energidirektorat: trykt utg.) 17-2010 (Oslo: Norges vassdrags- og energidirektorat, 2010), 360–61.

37 *Oppland Arbeiderblad*, September 23, 1989, 11; *Byggenytt* 32, no. 17 (1987): 2.

38 Nicholas Bullock, *Building the Post-War World: Modern Architecture and Reconstruction in Britain* (London: Routledge, 2002). Introduction, xiii.

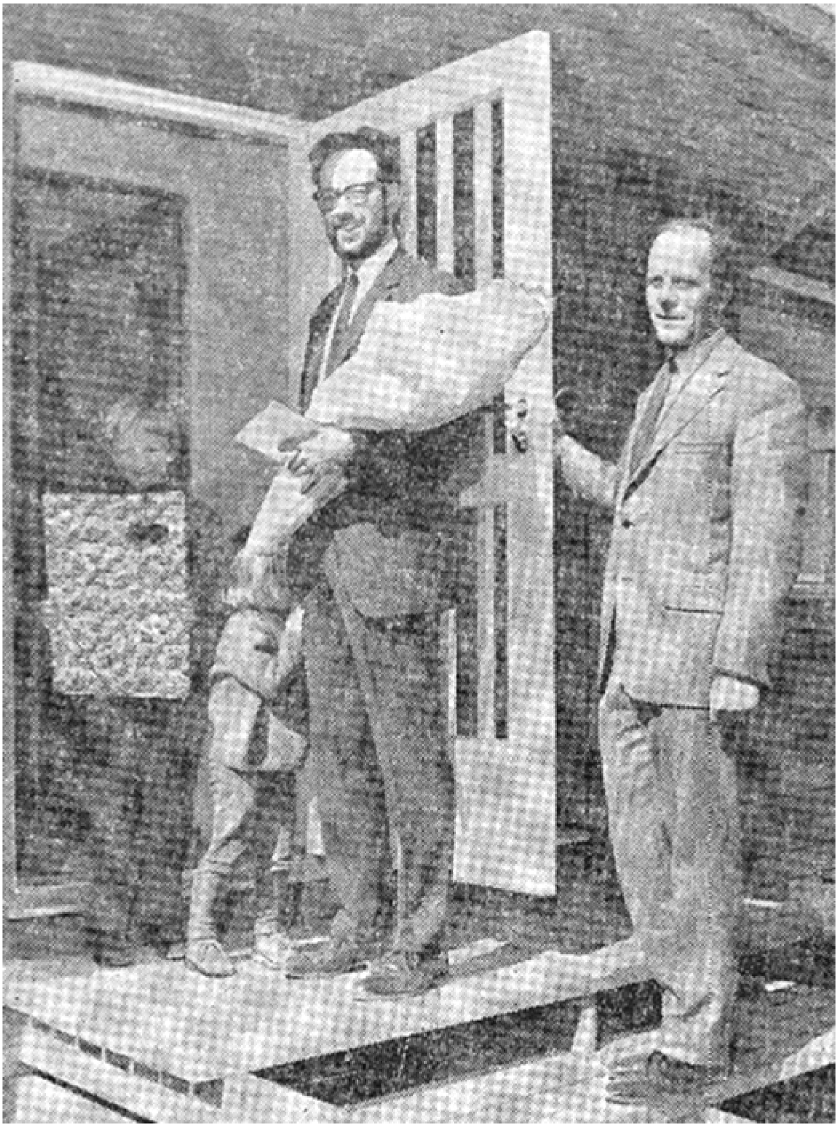

Fig. 7. Housing the “common people”: Gunder Runde and his children move into the house no. 1000 in Skjetten produced by Ringsakerhus. To the right, Ringsakerhus director J. F. Reymert. Newspaper clipping, 1971.

responding to changing fashions, ideas and narratives. It is precisely because of the openness of Moelven's building system that this industrial kit-of-parts could be adapted to different ends, from somewhat traditional building typologies to entirely new forms of architectural expression. While Moelven’s go-to office of Abrahamsen, Grinde and Philipp usually designed more cost-conscious projects, the same elements could be used for more audacious and generous design experiments—as the cases of Nøklevann school or Kringsjå housing developments prove. With time, Moelven’s open-ended building system grew closely intertwined with architectural discourse, providing a physical counterpart to the new architecture of relations. For example, Moelven schools, with a clear division between educational and circulation spaces, and aspirations of flexibility and change can be situated within a broader context of European avant-garde experiments and, in particular, structuralist educational buildings. Similar to these flexible school design solutions, Ringsakerhus elements were adopted and adapted by architects to communicate the paradigmatic shift in the role of planners, architects and architectural users.

While timber as a construction material was originally chosen by Moelven because of pragmatic concerns of availability and cost, it was precisely because the Ringsakerhus elements were made out of timber—a malleable material easy to build with and adjust—that they became a popular choice for the new 1970s flexible housing developments. These factory-made elements provided a specifically Norwegian alternative to the European models of post-war mass housing. Lastly, glued laminated timber components used for large, representative public buildings offered not only an economic way to accommodate large spans but, based on a different structural shape, allowed for a new type of architectural expression. Laminator's marketing narrative catered specifically to architects, redefining the cultural role of timber just at the moment when architects started searching for a specifically Norwegian architectural identity. These developments testify not only to a close osmosis of ideas between industrial and architectural fields, but also to the indeterminacy of architecture. The same industrial building system could yield a wide range of possibilities at the hands of different planners and architects, and yet the industrial apparatus provided the fundamental premise for this exchange. In its production, Moelven continuously negotiated the tension between the economy of means and opportunities for architectural expression offered by standardisation, serial production, flexible components and new material qualities.

Lastly, the story of Moelven is also a history of Norwegian modernisation and, to some extent, its Americanisation. This was what Amdam and Yttri called "Americanisation by invitation": Mageli and his cohort of international-minded managers and engineers, often looking at models from abroad and travelling extensively, shopping for technological precedents.[39] The United States—a beacon of rationality, pragmatism and innovation— served as a guiding light for Moelven's products, and provided a reference point in advertisements and interviews. IRAS, NPI and other external consultants were active facilitators of this internationalisation, ushering new managerial and labour relations, technical equipment, process planning and novel materials.[40] Moelven was not an exception in this regard. Other actors and institutions in this story—including the National Council for Education, Committee for Educational Buildings, NPI, OBOS, Wood Technology Institute, STUI, and individual politicians, engineers, architects and planners—were all looking abroad for successful models and experiences. Sweden, Denmark, Finland, Germany, Switzerland, the United Kingdom and the United States were among the most common references. However, foreign models and technologies could not be applied directly. Most often, they had to be rethought and adapted to the realities of Norwegian work life, producing novel socio-technological hybrids.[41] In this regard, Norway was not an exception: Matthias Kipping and Nick Tiratsoo in their volume on the Americanisation of Europe, trace similar trajectories in other European counties.[42] Moelven, preaching the gospel of the time—rationalisation and mechanisation—served as an active regional agent of modernisation, often at odds with local values. The history of the company is thus a particularly suitable object for this inquiry, as it allows the researcher to tap into the dichotomy between the universal and the particular, the global and the local, that defined Norway in the immediate post-war period. Moelven's prefabricated architecture—built in a modernist form and indebted to technological ideas adapted from abroad, yet carried out in timber according to local specifications and regulations—perfectly illustrates this duality.

39 Rolv Petter Amdam and Gunnar Yttri, "The European Productivity Agency, the Norwegian Productivity Institute and the Management Education," in *Missionaries and Managers: American Influences on European Management Education, 1945-60* (Manchester: Manchester University Press, 1998), 9.

40 On the international role of EPA see Bent Boel, *The European Productivity Agency and Transatlantic Relations, 1953-1961:* (Museum Tusculanum, 2003).

41 More on hybridisation and a process of "accretion" see Kerstin Sahlin-Andersson in Barbara Czarniawska-Joerges and Guje Sevón, *Translating Organizational Change* (Walter de Gruyter, 1996), 83.

42 *Americanisation in 20th Century Europe: business, culture, politics. Volume 2* (Publications de l'Institut de recherches historiques du Septentrion, 2002). Ove Bjarnar and Matthias Kipping, *The Americanisation of European Business: The Marshall Plan and the Transfer of US Management Models* (London: Routledge, 2000).

FURTHER RESEARCH

The history of Moelven is by no means exhausted by this investigation, and there is a wealth of possibilities for further research. For example, both Moelven's section- and container-houses have been left entirely out of this story. Partially, this is due to the fact that they are among the best-known and most "ready-made" of all Moelven products—nearly 95% of all works were completed at the factory. Architect involvement in these projects was very limited beyond the initial designs. These prefabricated solutions closely accompanied Norwegian industrialisation, and were often used as emergency solutions to house post offices, police stations, kiosks, bakeries, ticket sale stations, transit stations, and banks.[43] In the 1970s, container structures with several segments—up to 60—were used not just to provide temporary workers' accommodation, but also served as old peoples' homes, rehabilitation centres and student housing.[44] The flexibility and multifunctional adaptability of these structures pose questions for further inquiry, alongside an investigation of the politics of construction sites, to which the Moelven barracks served as integral but invisible companions.

Moelven's international operations also exceeded the scope of this inquiry. The company exported its products to Sweden: sales offices in Goteborg and Stockholm were opened in 1965 and 1966, and a "folkevilla"—"a people's villa"—sold to Sweden proved a huge commercial success.[45] Moelven's section houses played a significant role as part of Norwegian humanitarian aid, as they were delivered to house displaced populations following conflicts and natural disasters in Jordan, Italy and Iceland.[46] In 1976, the company expanded its cooperation with NORAD—the Norwegian Agency for Development Cooperation—delivering two large, 600-house projects to Via Real and Viseu in Portugal. Element-houses for refugees from Angola and Mozambique were designed by Moelven together with the local city architect, then assembled on-site by future dwellers under the supervision of Moelven engineers.[47] In 1973, Moelven was one of the founding partners of the NORHOUSE initiative, established under the auspices of NORAD, that joined several Norwegian ready-made housing producers to set up

43 *Hamar Arbeiderblad*, September 10, 1953, 8. Dalseg, *Moelven Brug i forvandling og vekst*, 41–44.
44 "Moelven Containerhus" catalogue, Moelven Industrier, 1978, NB archives. Dalseg, 62–64.
45 *Namdal Arbeiderblad*, February 14, 1966, 3, *Moss Dagblad*, February 16, 1966, 2, *Nordlys*, February 12, 1966, 9.
46 For Jordan refugee camp and a "mother-and-child" clinic see *Halden Arbeiderblad*, July 13, 1967, 2; Vårt Land, July 14, 1967, 2; Varden July 12, 1967, 9; Morgenbladet, July 22, 1967, 12. Dalseg, *Moelven Brug i forvandling og vekst*, 54–55. On houses sent to Sicily following an earthquake see *Lillehammer Tilskuer*, January 25, 1968, 1, 12. *Gubrandsdølen*, January 25, 1968, 1, 12. For assistance to Iceland, see *Bedriftavis*, no.13 (1973): 2-5.
47 Moelven industrier et al., *Moelven 1899-1999*, 50–51. *Bedriftavis*, no.19 (1976): 8-9. *Bedriftavis*, no. 20 (1976): 16-18.

prefabricated housing plants and build large housing projects in Algeria, Uganda, Kenya, Tanzania, Ghana, Ivory Coast, Malaysia and Indonesia.[48] Beyond humanitarian aid, Moelven exported glued laminated timber, standardised sports halls, and container houses to Qatar and the United Arab Emirates, and delivered commercial prefabricated housing projects to Scotland and France.[49] This international dimension of Moelven's work, as well as its relationship with aid and development organisations, harbour promising material for future research. Such a study would particularly benefit from the methodological framework mobilised by Lukasz Stanek in his study on architectural exports to West Africa, or in Tom Avermaete's investigation of the North African architecture of Candilis-Josic-Woods.[50]

Moelven's later years, as the company navigated the increasingly complex world of de-regulation and new aesthetic and architectural preferences, can offer insights on the adaptability of architectural production. For example, with the oil crisis and the new energy economy, Moelven had to develop prefabricated houses that would not just be more energy-efficient, but that could also generate energy with new heat exchange systems and solar panels.[51] In 1978, Abrahamsen, Grinde and Philipp designed a "Moelven Sol-Varmehus"—a sun-energy house—that was serially produced, exhibited at *Bygg for Fremtiden* in Bærum where it won several awards, including an official Prize for Building Quality—*Byggeskikkprisen*.[52] The company tried to adapt its production not only to changing economic and energy demands, but also new aesthetic preferences and imagery of sustainability, introducing large glass surfaces, bay windows, green houses, and timber as a "local" and "sustainable" material. These, and many more aspects of Moelven's history, remain beyond the framework of this thesis, which never intended to provide an exhaustive history of the company. Rather, it strove to develop a way of studying an architecture of the ordinary, hoping to show that these seemingly mundane buildings harbour a wealth of ideas, people and events—a case that Moelven's history (not exhausted even now) does prove.

48 *Hamar Arbeiderblad*, January 9, 1973, 1, 8. *Drammens Tidende og Buskerud Blad*, February 19, 1975, 15. *Fredriksstand Blad*, December 10, 1980, 2. Hans H. Engebrigtsen, *Næringslivets engasjement i utviklingsland*, Forum for utviklingsstudier (trykt utg.) 3, 1974 (Oslo, 1974), 14–26.

49 *Bedriftavis* no. 17 (1975): 16-17, *Bedriftavis*, no.18 (1975): 12. Moelven industrier et al., *Moelven 1899-1999*, 85.

50 Lukasz Stanek, *Architecture in Global Socialism: Eastern Europe, West Africa, and the Middle East in the Cold War* (Princeton, Oxford: Princeton University Press, 2020). Tom Avermaete, *Another Modern: The Post-War Architecture and Urbanism of Candilis-Josic-Woods* (Rotterdam: NAi Publishers, 2005).

51 Johs Mageli, *A/S Moelven brug: karakteristika og synspunkter*, Kristofer Lehmkuhl forelesning 1977 (Bergen: Norges handelshøyskole, 1977), 15.

52 Birgit Cold et al., *Nye boligformer: en eksempelsamling*, *Norbok* (Trondheim: Tapir, 1984), 109. *Solenergidagene* 1982, Trondheim, March 4-5.


YHETER.

DEL 1

Februari 1966

TELEFON 22 40 00
RIKSSAMTAL 08/22 40 20
TELEFONANNONSER 22 40 00
PRENUMERATIONER 22 40 00
VARDAGAR 45 öre
SÖNDAGAR 50 öre
5 ÖRE MER PÅ TÅG/BÅTAR
• A-EDITIONEN Nr 40

ud avgör

Norsk folkvilla blir prisbomb i Stockholm

FOTO: SVEN-ERIK SJÖBERG

Fig. 8. Moelven section house export to Sweden was very successful. A newspaper headline claiming that the "Norwegian 'people's-villa' is a price-bomb in Stockholm." Newspaper clipping, 1966.

Each chapter could have been a thesis on its own. For example, there is much more to say about how post-war managerial office relations and practices of scientific management seeped into architectural production, structuring the work of architectural offices, or about the many ways in which architects and industrial producers worked together. An entire thesis could have been written on post-war Norwegian school building and its relation to international experiments in Europe and the United States. Another book could certainly be dedicated to the specifically Nordic typology of low-rise high-density housing and its different material and architectural expressions. With archives becoming increasingly more accessible, I hope that someone will finally write the history of glued laminated timber in Norway, including its early 20th-century introduction and post-war proliferation. The scope of this inquiry, however, did not allow me to focus on individual projects, people, or events. Instead, I chose to examine the symbiosis of industry and architecture, hoping to contribute—as Timothy Hyde encourages—to make architectural history a little bit bigger.

If written by a Norwegian researcher, this thesis would no doubt have been different, better positioned within the cultural and historical context, and perhaps with more material obtained via oral history and interviews. A broader search in a wider number of architectural magazines could have provided an even firmer grounding within post-war architectural debates. In general, however, post-war Norwegian architectural history remains a fertile and unploughed field, where hundreds of fascinating interdisciplinary research projects can quickly bloom. I see more potential research stemming from the field of architecture and regulations, and the role that international bodies and committees—for example, the European Productivity Agency or the Norwegian Productivity Institute —played in post-war Norwegian architecture. In general, the role of post-war supranational agencies and organisations—like IRAS, NORAD, and the Norwegian Council on Building Standardisation—as well as national research institutions, like the Institute of Norwegian Building Research or Wood Technology Institute, and their influence on architectural and building culture, remain largely understudied. With thousands of digitised issues of the magazine *Bygningsarbeidere,* many aspects related to industrialisation, history of construction and labour relations open a potential for a new type of post-war architectural history. Lastly, the role of technology and technological artefacts—in particular, early computing in Norwegian building, planning, and architecture offer a fascinating field of inquiry.

This research wanted to show that even the most ordinary things can be extraordinarily fascinating. I hope that similar works on other industrial actors and material producers in Norway and abroad will follow soon.

NEW STANDARDS, OLD QUESTIONS

The 17th International Architectural Biennale in Venice in 2021 set out to answer the question "How Will We Live Together?" As different pavilions looked for more sustainable models of dwelling and living together in the future, the Finnish contribution particularly stood out as it searched for new models in the past. The "New Standards" pavilion was dedicated solely to the post-WWII history of Puutalo Oy—an industrial Finish conglomerate of timber producers that delivered prefabricated wooden buildings across the world and set new standards for residential construction within the country. The exhibition showcased how these "modest" houses were designed by some of the Finland's leading mid-century architects, and explored different aspects of the production and assembly of these houses, as well their geographic proliferation and local adaptations.[53] The Finnish pavilion foregrounds the relevance of the kind of research conducted in this dissertation. The pavilion creators seemed to hint that good architecture for all does not equal flashy projects and radical innovations. Prefabrication and local materials, designed for a decent, if modest, standard of living could provide if not a solution, then at least a suggestion towards solving the global housing crisis. Mid-century Nordic experiments with economic mass-housing and infrastructures of production that focused primarily on the experience of ordinary people offer particularly good examples of that.

Since Manfredo Tafuri deconstructed the claims of the architectural avant-garde in *Architecture and Utopia*, unconditioned belief in progress have been received with scepticism in architectural circles.[54] As a consequence of this, argue Dirk van den Heuvel and Max Risselada, architecture abandoned any concern for social issues and embraced the idea of autonomy and a "sublime uselessness." Architectural discourse, on its part, shifted away from any implied connection between architecture and everyday practice.[55] More recently, however, the question of ethics in architecture has become relevant once again—as illustrated by the growing interest in post-war architecture and particularly Team X.[56] In their work on the project of utopia in architecture, Hilde Heynen and Sarah Williams Goldhagen call to reconsider the "interlocking cultural,

53 "80 years," New Standards exhibition, https://newstandards.info/, accessed July 2021.
54 Manfredo Tafuri, *Architecture and Utopia: Design and Capitalist Development* (Cambridge, Mass: The MIT Press, 1976).
55 Dirk van den Heuvel and Max Risselada, "Utopia and Present," *Team 10 online*.
56 See, for example, an edited volume Tomas et al., eds., *Structuralism Reloaded: Rule-Based Design in Architecture and Urbanism* (Stuttgart: Edition Axel Menges, 2011).

Fig. 9. "New Standards" exhibition at the Finnish Pavilion, Venice Biennale 2021. Below, a sales image of Puutalo Oy, whose products largely resembled those of Moelven. Images from https://www.archdaily.com/960995/finnish-pavilion-presents-the-countrys-history-of-prefabricated-wooden-houses-at-the-2021-venice-biennale, accessed March 1, 2022.

political and social dimensions" of architecture of modernism.[57] Heynen argues that social aspirations can no longer be considered outside architectural practice, since the notion of utopia—even its rejection—has been never entirely abandoned by the architects. While this thesis steers away from any inclinations of "lessons learned," it suggests that Moelven's ambition to deliver good, mass-produced architecture for ordinary people is worth revisiting today. Similarly to the way Heynen maintains that the relevance of Team X today lies "in their ability to merge a sensibility for the concrete realities of everyday life with their refusal to give up utopian hope," to me the relevance of Moelven and its venture into prefabricated architecture also lies in its underlying social-democratic idealism, even if anchored within economic pragmatism.[58] Writing a history of Moelven's very non-utopian venture was paradoxically a way to revitalise the utopian tradition, a tradition that according to David Harvey, is necessary to fuel critical reflection and develop a more self-reflective stance towards contemporary architectural practice.[59]

The relevance of this mid-century experiment in timber is perhaps best illustrated by the "Urban Village" project, a speculative proposal developed by IKEA Denmark's SPACE10 research lab and EFFEKT architects as a possible solution for increasing global urbanisation, partially displayed at the "Ego to Eco" stand at the 2021 Venice Arsenale exhibition. The project proposed a new development model that would "allow for cheaper homes to enter the market, make it easier to live sustainably and affordably, and ensure more fulfilling ways of living together."[60] Not surprisingly—given its geographical context and genealogy—the project's formal language draws directly (and perhaps consciously) from the low-rise high-density Nordic housing projects of the 1960s. A three-dimensional loadbearing superstructure in laminated timber is to be filled with different combinations of prefabricated panels, adjusted at will: "[one] would be able to add and to an edit their home as they see fit," claimed the project's creators.[61] With CLT panels made from "sustainable wood," delivered flat-packaged by trucks and assembled on-site within days, this project—sprinkled with a dash of contemporary technology, communal living and iPhone applications—shares an uncanny resemblance

57 Sarah Williams Goldhagen, "Coda: Reconceptualizing the Modern," in Sarah Williams Goldhagen, Réjean Legault (eds.), *Anxious Modernisms. Experimentation in Postwar Architectural Culture* (Cambridge, Mass: the MIT Press, 2000), 301-324.
58 Hilde Heynen, "Engaging Modernism," in *Team 10 and Its Context*. Team 10 online.
59 David Harvey, *Spaces of Hope* (University of California Press, Berkeley, 2000), 159.
60 "Urban village project," https://www.urbanvillageproject.com/, accessed December 2, 2021.
61 See the description of "The Urban Village Project" at Space10 — an IKEA research and design lab. https://www.urbanvillageproject.com/. Accessed 10 October 2020.

Fig. 10. “The Urban Village Project” (2019), designed by IKEA SPACE 10 Lab in collaboration with EFFEKT Architects. With its low-rise high-density urban typology and prefabricated timber panels that could accomodate changing programs, the project closely resembles Ringsakerhus low-rise high-density housing. Images by EFFEKT architects from https://www.urbanvillageproject.com/, accessed March 1, 2022.

to Moelven's Ringsakerhus low-rise high-density housing projects that strove to reconcile the singular and universal, individual expression and economic pragmatism of a building system. The project drew a dense crowd of international visitors at the Biennale, attracted to its minimalist aesthetics and a seemingly simple solution to the global housing crisis.[62]

Today—as explicitly acknowledged in the main question posed for the latest Biennale—architecture is once again ready to take on an ethical dimension. The "Urban Village Project" shows that, in order to answer these contemporary questions, we might have to revisit some of the projects by the last generation of architects that grappled with social concerns. Beyond a formal language of restrained modernist aesthetics, these projects often relied on prefabricated components and systems of production, a technology that in itself carries over a set of implicit ethical and ideological assumptions. Today, the ambition to reconcile economic pragmatism and individual expression seems more relevant than ever, especially seen through the contemporary lens of global climate emergency and unchecked real estate speculation. While in Scandinavia, Moelven architecture might still evoke associations with low quality "social" housing—when seen from outside, Moelven's experiments with mass-produced architecture for ordinary people seem to offer a specifically Scandinavian answer to the question of how we might live together.

62 "EFFEKT to present "naturbyen" nature village at the venice architecture biennale 2021," https://www.designboom.com/architecture/effekt-naturbyen-nature-village-venice-architecture-biennale-05-11-2021/, Accessed 10 October, 2021.

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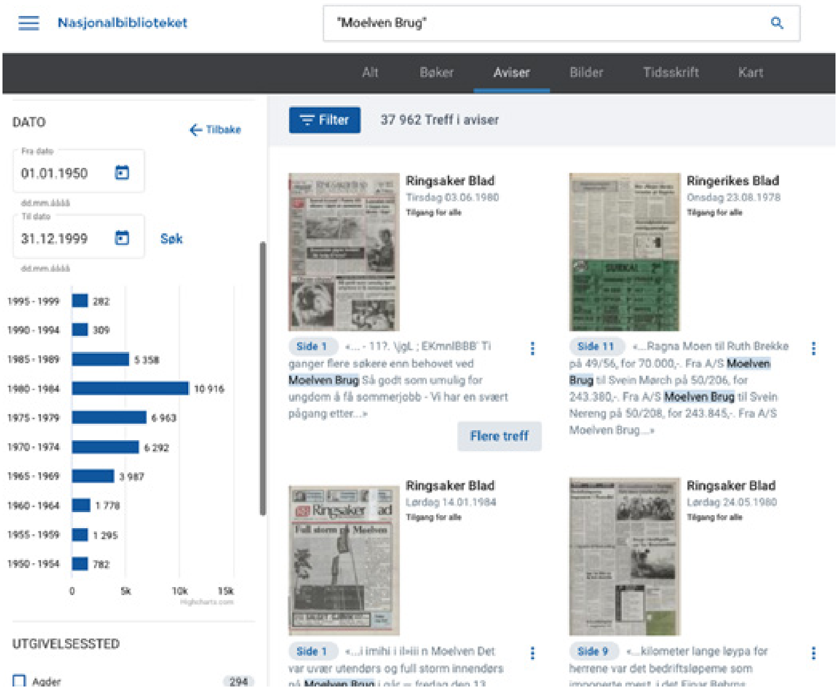

Fig. 00. An OCR-search through the National Library holdings for “Moelven Brug” returns with more than 43.000 mentions in newspapers, 850 in magazines and 740 in books. https://www.nb.no/, accessed March 8, 2022.

ARCHIVES

- Archives of Moelven Industrier ASA, State Archive in Hamar (SAH/ARK-287), several series (-01 to -16)
- Archive of the a rationalisation bureau of the Norwegian Federation of Industries (IRAS) at Riksarkivet, Oslo (RA/PA-0636)
- Archive of the Norwegian Institute of Building Research (NBI) at Riksarkivet, Oslo (RA/S-1574/D/Da/L0047)
- Archive of the Norwegian Productivity Institute (NPI) at Riksarkivet, Oslo (RA/S-1623)
- Archive of the Committee for Educational Buildings (KUB) at Riksarkivet, Oslo (RA/S-5489)
- Archive of the National Council for Innovation in Education (FRS) at Riksarkivet, Oslo (RA/S-1587)
- Oslo Byarkiv, diverse folders
- Archive of the Labour Movement, Norwegian Iron and Metal Workers' Union at Arbeiderbevegelsens Archive, Oslo (AAB/ARK-1659)
- Moelven Industrier archives at the National Library, Oslo, diverse folders (mostly print sources)

NORWEGIAN MAGAZINES

- *Aktuell (1950-1975) [Current Times]*
- *Bonytt (1945-1967) [Living New]*
- *Byggenytt: Norwegian building news (1957-1975)*
- *Byggekunst* (1945-1980) *[Architecture]*
- *Bygningsarbeideren (1950-1970) [The Construction Worker]*
- *Jern- og metallarbeideren: organ for jern- og metallindustriens arbeidere (1950-1975) [The Iron and Metal Worker]*
- *Moelven Bedriftavis for A/S Laminator, A/S Moelven Brug og A/S RIngsakerhus (1967-1990) [Moelven In-house Business Magazine]*
- *Nye bonytt: norsk spesialblad for hus, hjem og boliginnredning (1968-1975) [New Living New: Norwegian Special Magazine for Houses, Homes and Home Furnishings]*
- *Norsk pedagogisk tidsskrift (1956-1965) [Norwegian Pedagogical Journal]*
- *Norsk skoleblad (1961-1969) [Norwegian School Magazine]*
- *Nå (1955-1972) [Now, weekly magazine]*
- *Skogeieren: organ for Norges skogeierforbund (1950-1960) [Magazine of the Norwegian Forest Owners' Association]*
- *Ukens byggenytt: nyhets- og annonseorgan for bygg, anlegg, industri (1957-1975) [Building News of the Week]*

NORWEGIAN NEWSPAPERS (1952-1979)

- *Adresseavisen [Regional newspaper from Trondheim]*
- *Aftenposten [Evening Post, newspaper of record for Norway]*
- *Akershus [Local newspaper from Akershus]*
- *Akershus Amtstidende [Local newspaper from Drøbak]*
- *Akers Posten [Akers Post]*
- *Akershus Arbeiderblad [Akershus Workers' Paper]*
- *Arbeiderbladet [The Worker Paper, former party organ of the Norwegian Labour Party]*
- *Bergens Arbeiderblad [Bergens Workers' Paper]*
- *Dagbladet [Daily News, one of Norway's largest newspapers]*
- *Dagningen [The Labour Party's newspaper from Lillehammer]*
- *Drammens Tidende og Buskeruds Blad [Drammens and Buskeruds Times]*
- *Fremover [Forwards, regional newspaper from Narvik]*
- *Friheten [Freedom, biweekly newspaper by the Norwegian Communist Party]*
- *Fæderlandsvennen [Regional newspaper from Kristiansand]*
- *Glåmdalen [Local paper from Glåmdalen]*
- *Glåmdalen Odal [Local paper from Glåmdalen Odal]*
- *Gudbrandsdølen [Local daily paper from Lillehammer and Gudbrandsdølen]*
- *Halden Arbeiderblad [Halden Workers' Paper]*
- *Hamar Arbeiderblad [Hamar Workers' Paper]*
- *Haugaland Arbeiderblad [Haugaland Workers' Paper]*
- *Hedmark Arbeiderblad [Hedmark Workers' Paper]*
- *Helgeland Arbeiderblad [Helgeland Workers' Paper]*
- *Lillehammer Tilskuer [Lillehammer Spectator]*
- *Morgenbladet [Norwegian weekly newspaper covering politics, culture and science]*
- *Morgenposten [Morning Post, one of the largest daily newspapers in Norway]*
- *Namdal Arbeiderblad [Namdal Workers' Paper]*
- *Nationen [The Nation, daily newspaper with a focus on agriculture and rural districts]*
- *Nordlands Framtid [Nordlands Future]*
- *Nordlandsposten [Nordlands Post]*
- *Nordlys [Northern Lights, newspaper for Troms region, one of the largest newspapers for Northern Norway]*
- *Norges Handels og Sjøfarstidende [Norwegian Business and Shipping Times, large daily paper, originally an organ for the shipping industry]*

- *Oppland Arbeiderblad [Oppland Workers' Paper]*
- *Rogaland Avis [Local newspaper from Stavanger]*
- *Romerike [Romerike Paper]*
- *Romerikes Blad [Local newspaper from Lillestrøm]*
- *Sandefjords Blad [Daily newspaper from Sandefjord]*
- *Sarpsborg Arbeiderblad [Sarpsborg Workers' Paper]*
- *Stavanger Aftenblad [Daily newspaper from Stavanger]*
- *Stjørdalens Blad [Local newspaper from Stjørdal]*
- *Svelviksposten [Local newspaper from Svelvik]*
- *Telemark Arbeiderblad [Telemark Workers' Paper]*
- *Tidens Krav [Local newsppaer from Nordmørs district]*
- *Varden [Local newspaper from Skien]*
- *VG [World Walk, Norwegian tabloid newspaper]*
- *Vårt Land [Our Land, national Christian daily newspaper based in Oslo]*
- *Østlands-posten [Local newspaper from Larvik]*
- *Østlendingen [Regional newspaper from Elverum]*
- *Østerdølen [Regional newspaper from Stor-Elvdal]*
- *Øvre Smaalenene [Regional newspaper from Askim coveing Østfold]*

A NOTE ON SOURCES

Unless otherwise indicated, footnotes with numerical identification represent archival sources (mostly in Norwegian). For example, SAH/ARK-287-02/E/E/XX refers to an archival source from the Moelven Industrier archival holdings in Hamar, Series 02, Part E, Box Ea, specific folder ID.

Norwegian short titles in italics indicate names of magazines and newspapers (see a complete list of sources above). For example, *Byggekunst, Bonytt* or *Byggenytt* refer to professional and popular magazines dedicated to architectural and building industry news.

Bedriftavis refers to *Moelven Bedriftavis for A/S Laminator, A/S Moelven Brug og A/S RIngsakerhus*—Moelven's in-house publication.

Titles such as *Arbeiderbladet, Morgenposten, Nationen,* etc., with precise publication dates, refer to regional and national press articles.

Most primary and secondary sources used in the thesis are in Norwegian (Bokmål and Nynorsk), with no available English translations. Thus, translations of source titles in footnotes/bibliography were omitted due to reasons of scope and volume, but could be obtained on request.

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