**THESIS BOOKLET**

for the Ph.D. dissertation titled

# Connections between Structure, Technology and Aesthetics In Hungarian Industrial Architecture from 1947 to 1970

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## I. Theme and concept

The dissertation discusses the changes in Hungarian industrial architecture between 1947 and 1970 resulting from the new trends in structural design and production technology, and explores the related aesthetic ambitions in architectural planning. The interval covered by the dissertation is determined by two radical turning points that marked out a completely new path for Hungarian industrial architecture and signifies a distinct period for research. The theme extends to the economic policy context of industrial architecture too, considering that the planning concepts of industrial facilities were influenced not only by the autonomous set of criteria of architectural and engineering sciences but also by the changes in industrial development in the Rákosi and Kádár eras and the available production technologies at the time. In order to facilitate a comprehensive understanding of the above processes and interactions, the research also looks at the intellectual background of the design activities of the discussed period to map out the defining approaches of the era's leading creative communities as well as the debates on the characteristics of industrial architecture, its tasks and its societal role.

The dissertation also reviews the relations between the Hungarian and international trends in industrial architecture, but mainly focuses on the typical processes in the Eastern bloc countries. It discusses how the strained expansion of the industry, the increasing obsolescence of production technology systems and having to adapt to the Soviet building industry development concepts set the industrial architecture of socialist countries of Central Eastern Europe on a similar course in many respects: key objectives in the region constituted the introduction of prefabricated and standardised building structures, the modular co-ordination of industrial plants based on generally accepted and applied principles, as well as the design of multifunctional and flexible industrial halls. The dissertation, however, mainly concentrates on the Hungarian relevancies of these processes, and especially on ambitions aimed at creating structural design and standardisation approaches, sensitively adapting to the country's geo-economic and building industrial attributes, moreover, at the development of entirely new planning methodologies based on these approaches. Such a dynamic structural innovation opened the way for the development of new methods of architectural forming and systems of aesthetic principles that signify the focal point of the research: they encapsulated the fundamental characteristics and

problems of Hungarian industrial architecture, as well as the essence of all the answers given to the challenges of the Rákosi and Kádár era. They clearly show the solutions proposed by the architects of the time to create autonomous designs in industrial architecture, an area severely restricted by technical barriers, while confirming the high architectural quality they managed to achieve by looking beyond the confining realities of structural engineering, available materials, and production technologies. Since the dissertation presents a historical analysis, its focal points will mainly be those changes that took place in regard to the aforementioned trends of form-creation in industrial architecture between 1947 and 1970.

The dissertation also focuses attention on the reception of the main achievements of industrial architecture by professional circles and society. The analyses and critiques published in the 1950s–1960s provide a "contemporary panorama" of Hungarian industrial architecture that throws light upon the complexity of hopes and concerns connected to the highly ambitious mission, dubbed "socialist industrialisation". Hence, research conducted into the theme of this dissertation is not only important in that it explores the 20th-century Hungarian architectural heritage, but also on account of its detailed analysis of social history in the post-war decades.

## II. Research methods and the basis of analysis

Considering that none of the works published on architectural history in Hungary are based on the concept adopted by this dissertation, and that extensive comprehensive research of industrial facilities from the 20th century was conducted both domestically and internationally mainly in connection with the ambitions aimed at revitalising architecture after the post-industrial change – in other words, applied as a quasi sub-discipline of architectural history – authoritative sources providing a solid basis for the methods of this research and for the analysis of buildings of industrial architecture were relatively few in number. Of these sources, the research relied primarily on volumes reviewing issues pertaining to structural changes in the history of industrial architecture, and secondly on fundamental works discussing the interaction between modernist preferences of form and technological innovation. Studies on the aesthetic aspects of the general developments in the 20th-century history of building structures also provided important material, and so did analyses exploring industrial architecture as an area playing a vital role in the development of modernism.

Far more significant data could be gained from the study of text sources from the decades after World War II. A fundamental database in regard to the basic industrial architecture design principles and the technical constraints specific to the period were those Hungarian and foreign reference books published in the 1950s–1960s that sum up the then fresh criteria of planning industrial plants. While these sources mainly provided useful information about the general production technologies and building design principles of the period, the reviews of buildings and industrial plants published in contemporary domestic and foreign specialist publications included examples of individual solutions in the specific planning tasks, and thus greatly contributed to providing an insight into individual design approaches. However, the information found in these text sources was not always sufficient for the comprehensive analysis of architectural projects: a significant part of them only gave a partial description of the facilities since their primary objective was the rigorous technical presentation of production technology systems and solutions for load-bearing structures. Thus, other data sources had to be incorporated in the in-depth analysis of the projects discussed in this dissertation; especially helpful were the more than 17,000 photographs in the archives of the Industrial Building Design Company (IPARTERV): these photos document buildings from aspects – important especially for an aesthetic analysis – that were rarely paid due attention to by the specialist publications of the period. In some cases, the original drawings made for a specific building needed to be studied; these were mainly located in what has survived of IPARTERV's storage of designs. Of course these documents could not substitute the experiences gained during the on-site visits to the buildings: great emphasis was placed on collecting information about the most important industrial plants that still exist and can be accessed. The methodical analysis of this rich and diverse pool of information produced the main outcome of the entire research: a picture was gradually shaping of the unique ambitions in Hungarian industrial architecture resulting from the complicated interactions between structural design, production technology planning and the personal aesthetic preferences of designers.

In addition to the above, one of the main methodological questions raised by the dissertation derived from the extremely complex typology of industrial architecture. The large number and structural heterogeneity of industrial building types makes their unified discussion difficult, hence the dissertation looks at the facilities based not on their function but according to the types of

physical connections (both spatial and structural) between the production technology systems and the architectural constructions. Hence, the following categories were distinguished: (1) large-span industrial halls, (2) multi-storey buildings (further divided into subcategories based on their structural and production technology attributes) and (3) facilities – radically different from the previous two groups – dominated by gigantic equipment; in these facilities production technology constructions and architectural structures are completely intertwined, blurring the borderlines between the machinery and the buildings.

## III. Structure

The time interval surveyed by the dissertation is discussed in three periods based on the turning points in industrial policy, structural development and architectural theory, each forming the theme of a larger chapter.

The first chapter is devoted to the architectural activities in the service of the industrial programme of the three-year economic plan in 1947–1949. It mainly focuses on ambitions aimed at the creation of new structural design and implementation methods based on the country's limited resources and catering to the large-scale capacity expansion of the building industry that ensued at the time as well as to the fast-paced development projects that were to be launched in the years to come. The second chapter examines the gigantic industrial construction projects within the first five-year plan, which was at the focal point of the Rákosi regime's economic policy: it discusses how on-site precasting, (i.e. the prefabrication of reinforced concrete structural units on the building site) had become the dominating building technology thanks to the architectural and engineering achievements of the late 1940s, and what structural design methods and systems of aesthetic principles came into being in its wake. The chapter also looks at the multifarious standardisation attempts in industrial architecture, providing a main pillar of technical innovation expected by policy-makers. This section of the dissertation ends with the analysis of design strategies aimed at relaxing the confrontations between the stylistic dictates of socialist realism and the production technology constraints that dominated industrial architecture. The third chapter first studies the crucially important paradigm shift in industrial architecture closely linked to the corrective economic policy and the boost in international professional relations in the early years of the Kádár era. This is followed by the study of

new building technology, structural design and standardisation trends that were brought about by the change – with special attention paid to the accelerating development of monolithic structures and steel constructions, the radically changing role of on-site precasting, the issues of architectural flexibility and adaptability and the introduction of plant prefabricated standard structures. This part also contains a detailed analysis of the far-reaching renewal of architectural forms that resulted from these processes, and delivers an in-depth discussion of the recurring problem of aesthetic autonomy generated by the ever increasing standardisation of the building industry in the 1960s.

The first three chapters mainly deals with facilities falling in the previously defined types 1 and 2 – i.e. industrial halls and multi-storey industrial buildings, since their design in the 1947-1970 period was based on similar structural and building technological principles. In contrast, the buildings in typological group 3 are treated in a separate chapter due to their distinct structures and forms and their significantly different functional characteristics when compared with the other two types. The timeframe of this chapter is also at variance with the rest of the chapters in that it encompasses the entire period discussed. Hence, it becomes clear from this chapter that typological group 3 can also be set apart from 1 and 2 in regard to its historical evolution.

The closing section of the dissertation delivers the final conclusions, and touches upon the professional, political and social background to the prestige that the industrial architecture of the 1950s–1960s enjoyed and has retained to the present day.

## IV. New scientific findings of the dissertation

### Thesis 1: Seeking new paths to rebuild the industry (1947–1949) [2]

*The vast rebuilding launched within the three-year economic plan (1947–1949) required the radical renewal of Hungarian industrial architecture. Design communities were looking for new structural development and standardisation methods enabling them to complete the vast amount of tasks within a short time amidst the grave challenges of the building industry and the economy. The diverse attempts created the basis for those professional sets of principles and building technologies that would be developed from the early 1950s and lead to the emergence of new methods of architectural forming.*

The main problems in industrial construction projects in the post-war years were the shortage of rolled steel supplies and the high market price of timber. Implementation procedures able to reduce the use of these raw materials to the lowest level had already come to the attention of the profession around 1946–1947: architect communities mainly focussed their efforts on the further development of the latest variants of on-site precasting and monolithic technologies. Two main versions of on-site precasting technology was introduced: one fully applicable to building structures, and one partly applicable and combined with monolithic technology.

Fully on-line precasting was only applied experimentally and in a narrow scope at the time, but thanks to the architect team led by Gyula Mátrai this technology had been developed into a complex structural design system by 1949–1950. This process proved to be forward-pointing in an aesthetic sense too: although it was a formative period in regard to the configurations and detailing of structures, they had the rudiments of the bold and mature industrial hall design compositions of the 1950s.

The variants of the far more frequently applied partial onsite precasting and the new monolithic technologies were widely adopted mainly thanks to the efforts of Sándor Major’s planning team and the Industrial Building Design Institute. Compared with the pre-WW II reinforced concrete hall structures, these methods did not bring about an aesthetic renewal in the links between material, form and construction, individual architectural inventions triggered by engineering innovation added new colour to the overall ambitions of modern Hungarian industrial architecture aimed at renewing architectural forms.

**Thesis 2: Upswing in on-site precasting and the "new concrete aesthetic" (1950–1956)** [1, 2, 4, 6, 7, 9]

> *The stepped up pace of industrialisation and constructions introduced by first five-year plan (1950–1954) increasingly urged architects to intensely develop fully on-site precasting, pushing other building technology innovations into the second place. Thanks to the diversified engineering innovations, the method was used in a wide range of systems, while planning and implementation principles increasingly converged over time, also in regard to form, since the various trends of structural design based on on-site precasting were generally pervaded by the same "new concrete aesthetic".*

From 1950–1951 onwards fully on-site precasting was important not only for its primary benefits but also because it was a process based on easily standardised principles and methods applicable to a significant part of industrial architectural tasks. Inherent in the method was also a flexibility that gave a relatively free hand to architects in regard to form, allowing greater space for creative autonomy.

Fully on-site precasting soon became the dominant method and was further developed along various configurational principles. For example, the organised prefabrication system with large-scale units applied by the Mátrai Group was based on frames prefabricated in one piece, while Miklós Gnädig and his circle gave preference to structural systems built from so-called linear and arched members. These trends, however, were not sharply opposed to each other; there was much mutually beneficial interaction between them, similarly to the areas of planning and implementation principles that soon came to a common denominator.

Structural design based on on-site precasting introduced a ground-breaking renewal of form in Hungarian industrial architecture. As it allowed an extremely diverse division and articulation of structural components, architects were able to impart a brand new character and aesthetic unity to their designs. Some architects applied an overall systematisation of forms and divisions – i.e. created unified spatial patterns – not merely to emphasise the beauty of pure order resulting from the laws of statics, but with the ambition to "monumentalise" the structural quality of designs resulting from the progressiveness of on-site building technology.

**Thesis 3: The dilemma of socialist realism (1951–1956)** [1, 2, 7]

*The stylistic attributes of industrial architecture in the Rákosi era were not only shaped by structural and production technology trends but also by socialist realist ideology. While amidst the strictly technical tasks of industrialisation the issues of socialist realism were obviously secondary in importance, the stylistic dictates – and the dilemmas they triggered in architectural theory – produced a range of solutions pertaining to architectural form, especially in the case of industrial facilities the structure and production technology of which allowed a certain adaption to social realist ideology.*

While the processes that led to the "socialist realist turn" of 1951 did not directly impact industrial architecture, the effect of its dictates reached this area too. However, it occurred with a significant delay and far less intensely than in public and residential architecture, and in the design of many building types architects were exempt from having to meet prescribed stylistic criteria thanks to the technological requirements being treated as the priority.

An increasing ideological pressure was primarily aimed at industrial halls with a more representative function (especially the main factory buildings of heavy industry plants, power stations, etc.), creating a huge dilemma for architects: how could the stylistic requirements of socialist realism (the application of classicising forms) and the architectural configurations demanded by production technology systems be harmonised? A wide range of strategies came into being to answer this question: some of them were akin to form creation methods used in other areas of architecture at the time, while others differed from these completely and strove to adapt to the specifications of industrial buildings. The most important attitude among the latter group of architects was to modulate the prefabricated reinforced concrete constructions in a classicising fashion to satisfy the ideology of socialist realism, while not violating either the inherent features of structures or the function of buildings.

In light of the above, it seems timely to revise the generally held view in the architectural profession – and thus in the writing of architectural history – claiming that industrial development projects were "protected against" socialist realism and only rare exceptions existed on the margins of architecture.

**Thesis 4: Paradigm shift in industrial architecture (1957–1960)**

[3, 4, 5, 6, 7, 8, 9]

*A far-reaching paradigm shift occurred in Hungarian industrial architecture around 1957–1960 closely linked to the so-called corrective economic policy of the Kádár regime and the revision in the engineering sciences based on the experiences of the Rákosi era. The dominance of structural innovations based on on-site precasting ended, and opportunities opened up for the further development of previously side-lined implementation methods and structural systems; the professional foundations were laid for new and successful standardisation methods after the mainly failed attempts aimed at the same in the Rákosi era.*

The Kádár era's economic policy striving to radically break with the development concepts of the Rákosi era challenged the methods of how industrial constructions were managed in general, including the principles of architectural planning and implementation. The deepest changes in this process was brought about by initiatives aimed at the radical repositioning of on-site precasting and its comparison with other implementation and planning methods, i.e. at the "heterogenisation" of industrial architectural structures after the "homogenous" period of engineering innovation reduced to one building technology for the most part. The generally held contention that on-site precasting is the primary most cost-effective solution in industrial development projects increasingly lost ground, giving new impetus to the development of monolithic technologies in general and the exploitation of the advantages inherent in shell structures in particular; the idea of introducing a wider use of steel constructions – only used in the Rákosi era in exceptional cases – also came to the fore.

These changes were not only facilitated by the improving situation of the building industry and the expanding international relations of engineers, but also by a lively spirit of experimenting that generally pervaded the architect communities of the time, and resulted in a barely comprehensible wealth of forms and an impactful aesthetic revival in industrial architecture. Standardisation efforts were placed on new foundations too: the excessively diverse experimentations of the previous years pursued under unfavourable professional conditions were stopped, and the development of factory prefabricated universal standard hall structures based on scientifically founded modular coordination began.

**Thesis 5: The changing roles of on-site precasting (1957–1970)** [3, 4, 6, 7]

*The paradigm shift in industrial architecture in the late-1950s and the waves of building industry development that followed resulted in radical changes in the role of on-site precasting. While retaining its innovative character, in the years 1957-1965 it was increasingly combined with the ever more widely used monolithic and steel structure technologies as well as the new plant-prefabrication methods; after 1965 it actually lost its previous leading role. Thus, the aesthetic ambitions specific to the earlier structural design were forced into the background.*

On-site precasting was in a rather ambiguous situation in the late-1950s. The structural complexity of the facilities built at the time using the Mátrai group's organised prefabrication system with large-scale units exhausted the maximum potential of the building industry. On the other hand, having gradually lost its earlier priorities, on-site precasting was increasingly regarded as simply one among many successfully applied building technologies, although it continued to be widely used. Apart from the extent of its use, the practise on on-site precasting became far more differentiated to be more adaptable to the new situation in the building industry and the economy. This adaptability, however, was bound to damage the integrity of structural innovations in regard to both engineering science principles and the specific design solutions pertaining to form: it was common practice in the 1960s that the on-site precast elements were combined with components produced in temporary prefabrication plants (so-called ancillary plants) set up near the construction site and with monolithic reinforced concrete and steel constructions. This period was not lacking in fresh innovations based on on-site precasting either, especially in the area of developing systems based on three-dimensional structures as well as ones using smaller-scale and more lightweight elements and thus being competitive with the new building technologies. From the mid-1960s the vast-scale prefabrication carried out in large-capacity, permanent plants and based on standard plans gained more and more ground in the area of reinforced constructions; it was gradually assuming a level of standardisation and slowly pushed into second line those structural development traditions that were based on on-site precasting, thus diminishing one of its main strengths: striving towards aesthetic autonomy.

**Thesis 6: Flexibility and universality: the new concept of the industrial building (1957–1970)** [6, 7, 8]

*The production technology systems becoming increasingly obsolete coupled with the building industry policy of the Kádár regime required a revision of the concept of the industrial building from the late-1950s. It had become clear that industrial facilities must be flexible systems both structurally and functionally enabling them to be adaptable to technological changes and to simultaneously cater to the various needs of different industries. The new ideal of the industrial building urged not only the continuous development of flexibly convertible unique constructions and plant-prefabricated universal standard hall structures but also encouraged the practice of on-site standardisation.*

The concept of a flexible industrial plant was manifest in the designs of the period in two ways. *Spatial flexibility* meant that structures were constructed from partly or fully moveable and replaceable elements allowing the opportunity to design unique configurations that are still accurately adapted to the available production technologies. *Functional flexibility* meant that buildings had a fixed structure for the most part while allowing for some functional changes since their architectural system and machinery were mostly independent of the given production technological structures, or they were of a vast enough scale enabling them to be optimally used for a range of purposes. The latter was realised to the fullest in universal standard halls designed for the light, machine and food industries. The first functionally flexible structures were introduced in industrial architecture after the experiments of 1957–1960 but their large-scale production and adaptation started only in the mid-1960s – urged by a strong economic and building industrial policy. On-site standardisation, which means the planning of the facilities of monumental industrial plants based on standardised dimensions and structural system, is generally included in the category of functional flexibility. The increasingly unified sets of elements used for plant-prefabricated standard structures provided fewer and fewer opportunities for architects to lend buildings their own aesthetic character, while ensembles of buildings designed based on the principle on on-site standardisation came to be regarded as embodying the ideal of total standardisation and at the same time could be seen as autonomous architectural designs – their aesthetic system conveyed a kind of “autonomous universality”.

**Thesis 7: Production technology as a rival: architectural integrity challenged (1947–1970)** [3]

> *During the design of facilities belonging to typological group 3 the scope of competence of architects, structural designers and mechanical engineers. The resulting situation created serious challenges in regard to preserving both the functional and aesthetic integrity of these buildings. It had become a key objective that architects should be involved not only in the design of production equipment but also respond to the processes of production technology innovation and be prepared to provide high quality architectural solutions to the new innovations.*

Entrusted with this task, the designers of production technology equipment determined not only some of the parameters of architectural constructions but also their overall design. Hence, the question arose: what is the point where these buildings can still be regarded as structurally and functionally 'full-fledged' buildings, and at what point does architectural integrity end as a result of the expansion of production technology planning? This dilemma was especially stark in those industries where open-air equipment was used on an increasingly large scale.

The new situation demanded a radically new planning strategy not only from the architects but also the other professionals of industrial architecture. The central issue was the recognition that in the design of both the machines and the architectural structures the scientific-technical considerations of technologists and the artistic invention of architects must be synthesised following the practice of industrial design. It had become clear that the professionals involved had to reinterpret their roles in the planning process: architects and structural engineers had to keep pace with the new production technology innovations by designing flexibly adaptable and at the same time aesthetic and coherent systems, while mechanical engineers had to adopt an openness to architectural considerations.

**Thesis 8: The nimbus of Hungarian industrial architecture (1950–1970)** [7, 9]

*From the 1950s onwards Hungarian industrial architecture and its centre, the IPARTERV Company, were elevated to a special status: the former was increasingly regarded as an area synonymous with success, and the latter was seen as a unique creative workshop showing the way forward with its technical progressiveness, intellectual openness, and professional autonomy. The theoreticians of this period, the leading figures of IPARTERV, as well as the various politicians and press organs equally contributed to the creation of this idealised image.*

The reasons for the still existing idealised image of post-WW II industrial architecture must be primarily sought in the contemporaneous reception of the achievements in the area in the 1950s–1960s. Especially important was the ample professional recognition and praise shown to the structural renewal of the early 1950s and the years around 1960, as well as its international success. While professional forums mainly emphasised the inventiveness of the massive engineering efforts of the Rákosi era, they praised the Kádár era for its receptiveness and responsiveness to the latest international innovations and trends as well as to the local requirements which was combined with an economically and politically responsible attitude. In this period the prestige of industrial architecture was also enhanced by the political media through numerous publications using the "spectacular" solutions of new industrial facilities as a visual backdrop of party propaganda. The architectural theoreticians of the time began to emphasise the high aesthetic standard and professional integrity of industrial architecture, especially in association with the dictates of socialist realism and the standardisation of the building industry. Although industrial architecture was not fully protected against socialist realism, it was regarded in informal professional circles as a symbol of loyalty to modernist architectural principles from the first half of the 1950s.

These interdependent processes resulted in the unique image of industrial architecture that was passed on by the profession for decades despite the fact that mass production in the building industry had led to schematic solutions in this area too. However, this image is not an exact reflection of reality but much rather a summary of the intellectual background of concepts created about the unique situation of Hungarian industrial architecture.

## V. Publications used for the dissertation


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[3.] Expression of energy. The architecture of power stations in Hungary between 1945 and 1970, Part II. *Periodica Polytechnica Architecture* XLIII. (2012) 2. 57–75. http://www.pp.bme.hu/ar/article/view/7289/6241

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[7.] Nimbusz és identitás. Az IPARTERV tevékenységének recepciója a korai Kádár-korszakban [Idealisation and identity. The reception of IPARTERV in the early Kádár era]. *Művészettörténeti Értesítő* [Art History Bulletin] LXIV. (2015) 2. 387–408.

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