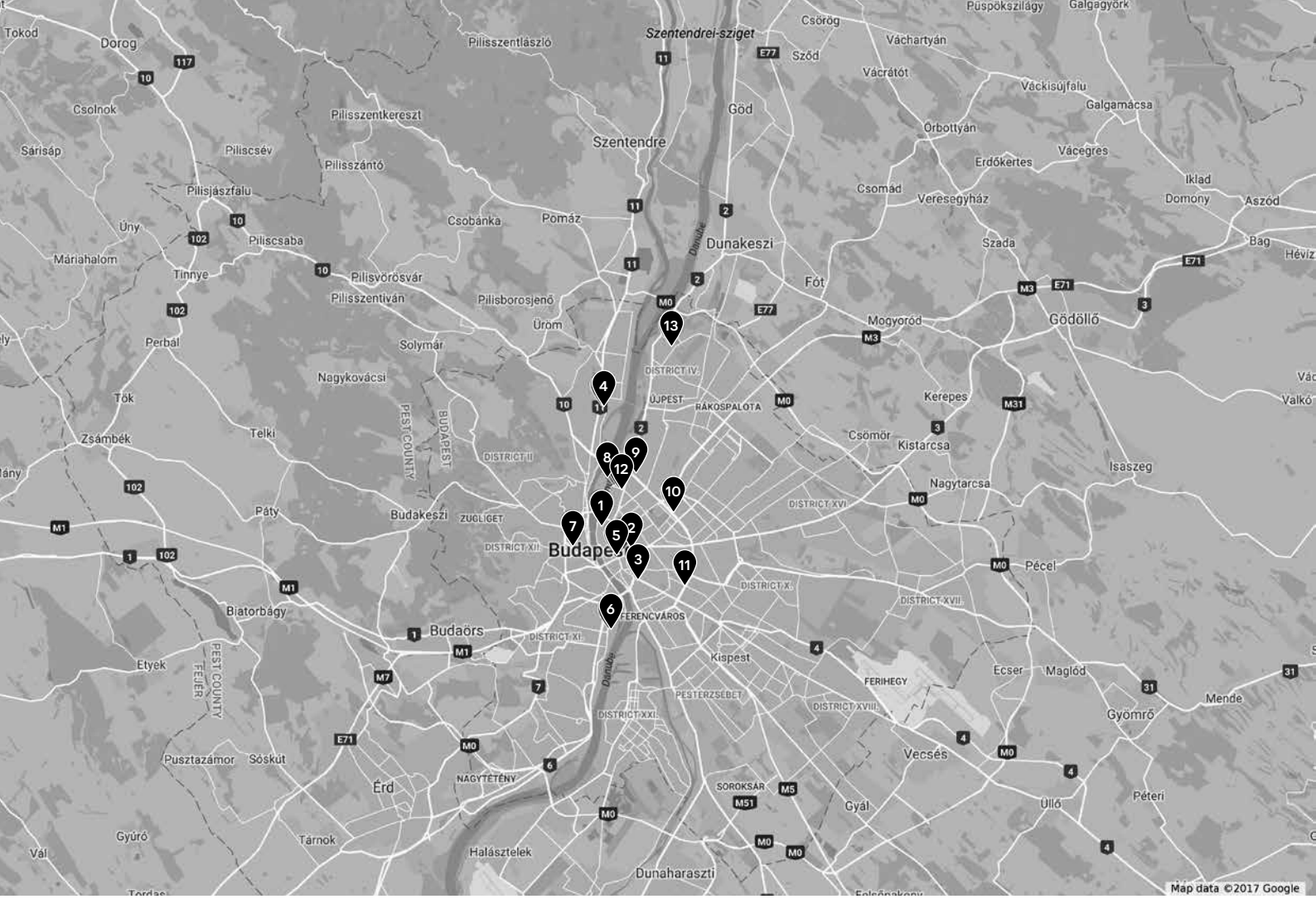


1. **Markó utca**
2. **Kazincy utca**
3. **Liliom utca**
4. **Szentendrei út**
5. **Downtown**
6. **Kelenföld**
7. **Attila út**
8. **Dráva-Kárpát utca**
9. **Dráva-Visegrádi utca**
10. **Városliget**
11. **Vajda Péter utca**
12. **Csáky utca**
13. **Káposztásmegyer**

Industrial Heritage Utilization Transformer Stations in Budapest

Využitie industriálneho dedičstva Transformačné stanice v Budapešti

Eszter Baku, Ágnes Gyetvainé Balogh, Adrienn Lepel, Martin Pilsitz

Príspevok je zameraný na nový typ budov, konkrétne na elektrické transformačné stanice, ktoré sa objavili spolu s rozšírením využitia elektrickej energie v prvej polovici 20. storočia. Skúma ich pritom z architektonického a urbanistického hľadiska, ponúkajúc prehľad od vzniku prvých príkladov tohto stavebného typu, po impozantné budovy elektrických staníc medzivojnového obdobia. Toto časové vymedzenie korešponduje s dramatickými zmenami v spôsobe distribúcie energie. Architektonický prístup skúmania bude v súvislosti s dynamickým rozvojom Budapešti doplnený analýzami aj niekoľkými otázkami súvisiacimi s urbanizmom.

Mestský rozvoj Budapešti bol priamo spojený s procesom industrializácie konca 19. a začiatku 20. storočia. Z dôvodu prevládajúcej poľnohospodárskej výroby v Maďarsku sa v prvej polovici 19. storočia rozvíjal najprv potravinársky priemysel (mlyny, pivovary, bitúnky). Paralelne s rozvojom železničnej siete sa najvýznamnejším odvetvím v meste po roku 1850 stala strojárska výroba. Následne v poslednej tretine 19. storočia možno pozorovať výrazný rozmach elektrotechnického a chemického priemyslu.

Podobne ako továrenské stavby ani transformačné stanice sa nemôžu obracať k hlbokej dejinnej tradícii, ich výskum je zameraný na vznik nového stavebného typu. Proces vývoja výrobných závodov, od tradičných dielní až po moderné priemyselné prevádzky, sa prejavil v takých rozmeroch, ktoré nevyhnutne zanechali silný vplyv aj na samotný vývoj urbanizmu svojho okolia. Skutočnosť, že všeobecný dobový názor považoval navrhovanie industriálnych budov za okrajovú architektonickú činnosť, prispela k tomu, že nebola viazaná žiadnymi ďalšími architektonickými úlohami. Tieto diela sa stali východiskovým bodom pre uplatnenie inovatívnej tvorivosti. Keďže sa nemohla odvolávať na skoršie príklady alebo modely, mohli byť vyvinuté inovatívne koncepcie vychádzajúce z troch hlavných kompotentov – z funkcie, zo štruktúry a z formy. Tento smer vývoja stimulovali aj novoobjavené stavebné technológie a moderné stavebné materiály. Uvedená skutočnosť vysvetľuje, prečo je architektonicko-historická klasifikácia historických industriálnych budov vo všeobecnosti taká zložitá.

Naša štúdia sa podrobne pozrie na nový typ budovy – transformačnej stanice, ktorý sa zrodil vďaka technologickým potrebám daného obdobia, no v súčasnosti nie je preň vo svojej pôvodnej funkcii uplatnenie. Príspevok zároveň poukazuje na dôležitosť výskumu historických industriálnych budov a na potrebu ich rehabilitácie.

Na začiatku 20. storočia z dôvodu zmenených potrieb mesta, ako aj kvôli prudkému nárastu počtu obyvateľov hlavného mesta nastal v Budapešti, rovnako ako vo všetkých veľkých európskych mestách, rozsiahly rozmach distribúcie elektrickej energie.

Mestská elektrárenská spoločnosť s názvom Budapest Székesfőváros Elektromos Művei, ďalej len ELMŰ (Elektráreň hlavného mesta Budapešti), bola založená 1. júna 1914, pre sústavu, ktorú mesto zakúpilo, najprv Magyar Villamossági Rt. (Maďarské elektrické závody) a o rok neskôr tiež Budapesti Általános Villamossági Rt. (Budapeštianske všeobecné elektrické závody). V nasledujúcom desaťročí potreba elektrickej energie zo strany priemyslu a obyvateľstva natoľko vzrástla, že na uspokojenie tohto dopytu už nepostačovala len jedna vysokovýkonná elektráreň a niekoľko malých lokálnych elektrární. V dvadsiatych rokoch 20. storočia bolo preto nevyhnutné vybudovať nový celý sieťový systém.

Koncom dvadsiatych rokov 20. storočia sa dostala do popredia otázka transformácie vytvorenej energie na prúd vysokého napätia a budovanie novej prenosovej siete (v súčasnosti nazývanej hlavný distribučný systém). Vychádzajúc z možností dobovej káblovej technológie bolo zvolené napätie 30 kV namiesto predchádzajúcim 10 kV. Cieľom založenia novej 30 kV káblovej siete bola distribúcia elektriny na dlhšie vzdialenosti a prepojenie jednotlivých elektrární. Inžinieri chceli túto potrebu vyriešiť výstavbou transformátorov a rozvodní situovaných na uzlových spotrebných miestach, zásobovaných jednou hlavnou distribučnou sieťou.

Pri výbere umiestnenia rozvodní bolo jedným z dôležitých aspektov ich situovanie uprostred spotrebiteľskej oblasti a taktiež najjednoduchší spôsob napojenie na existujúce rozvodné siete. Zohľadnené boli aj požiadavky ďalšieho mestského rozvoja a očakávaný nárast spotreby elektrickej energie.

ELMŰ pristupovalo k realizácii budov s veľkou starostlivosťou. Navrhovali ich prominentní architekti a montážne práce realizovala spoločnosť Ganz és Társa (Ganz a Co.). Ich projekty predstavovali najvyššie štandardy vtedy dostupné v Maďarsku, a to tak z technickej, ako aj z estetickej stránky.

Tento nový typ budov nemal žiadne historické pozadie ani vzory, takže jedine historické priemyselné budovy im mohli slúžiť ako referencia. Funkcia v plnej miere určila rozloženie pôdorysu a tvar transformátorových domov: fungovali ako určitý druh stroja, takže ich rozmery a prevádzkový princíp

mechanických zariadení inštalovaných do budov dali základnú koncepciu návrhu. Rozvodne boli postavené v takzvanom bunkovom systéme, aby v prípade požiaru alebo výbuchu bola ohrozená len menšia časť celého elektrického zariadenia.

Keďže tieto objekty boli situované aj v mestských centrách a obytných zónach, bolo nevyhnutné, aby mali nové budovy transformátorov vstavané do mestského tkaniva pôsobivé fasády. Nielen, že naznačovali svoju priemyselnú funkciu, ale dotvárali aj uličnú fasádu. Na dosiahnutie tohto cieľa boli transformačné stanice často budované spolu s obytnými domami spoločnosti ELMŰ. Napriek skutočnosti, že iné firmy väčšinou pracovali s vlastnými architektmi, spoločnosť ELMŰ zámerne oslovovala známych a uznávaných architektov, a preto z času na čas vyhlásili otvorenú architektonickú súťaž.

V dôsledku premien technológií elektrickej rozvodnej siete mnohé objekty transformátorov a iných prvkov elektrárenskej infraštruktúry stratili funkciu. Preto sa v súčasnosti stáva nevyhnutnosťou zamýšľať sa nad využitím týchto opustených industriálnych pamiatok. Téma znovuvyužitia transformačných staníc, ktorá siaha nad rámec bežného historického výskumu sa stáva novým horizontom v ich interpretácii aj v zrkadle so zahraničnými príkladmi.

Osud priemyselných budov, ktorých pôvodné využitie zaniklo, možno rozdeliť do troch typov. Prvým z nich je opustenie, keď budova zostáva bez využitia, druhým je opätovné využitie, s dočasnými alebo výraznejšími zásahmi architektov a inžinierov, a tretím je devastácia a zbúranie.

V dôsledku straty funkcie týchto diel a ich lokalizovaní v mestskej štruktúre, cieľ zachovania týchto pamiatok možno dosiahnuť zmenou využitia. Prispôsobiť industriálne objekty novej funkcii je relatívne ľahké. Ako dôkaz toho môže slúžiť široká škála príkladov takýchto konverzií na celom svete. Adaptácia bunkového systému projektov transformačných staníc vyplývajúca z technológie a zo špeciálnych vnútorných štruktúr pôvodných objektov predstavuje pre dizajnérov väčšiu výzvu, ale prezentované príklady jasne ukazujú, že riešenie úlohy je možné. Významná časť skúmaných budov bola obnovená na kultúrne účely, existujú však aj príklady konverzií s komerčným využitím.

V štúdii predstavené príklady naznačujú, že bývalé priemyselné objekty, hoci stratili svoju pôvodnú funkciu, sú využiteľné vďaka zmene funkcie a ich rekonštrukcie s väčšou či menšou mierou zásahov. Takým spôsobom ostávajú integrálnou súčasťou každodenného života mestskej štruktúry, ale rovnako uchovávajú aj rôznorodosť architektonického dedičstva.

Industrialization as part of the urbanization process in Budapest at the turn of the 19 — 20th century

The urban development of Budapest was directly related to the industrialization processes of the late 19th and early 20th century. From the mid-19th century, a close relationship can be observed in urban areas between the location of residences and workplaces. At the same time, the production technology of industry burdened its environment with a number of highly stressful effects, for example noise and emission of harmful substances. The city's development process entered a dynamic phase with a subsequent development of the public transport system (i.e. the horse-drawn tram was introduced in 1866, and the electric tram in 1887). This innovation created the possibility of separating residence and workplace, which meant that the industrial facilities of the time started to be concentrated in the then-peripheral zones of the city. With the industrial plants moving from the downtown to the outskirts of the city, one result was the separation of the manufacturing facilities from the closed urban tissue of the downtown, which meant that these plants were inserted into a previously undeveloped landscape. On the urban outskirts, these structures appeared in as the form of freestanding buildings, resulting in a visual effect entirely the opposite of that found in the former downtown developments. The huge dimensions of industrial buildings further strengthened the striking contrast between the building and the surrounding landscape. And, as this effect continuously accumulated over time, the effect of the industrial buildings on the viewer grew increasingly intense.

The topographical features of the land located along Váci út and Soroksári út were also favorable, and in many cases, even enjoyed direct access to the Danube waterfront, ensuring the water supply of the factories. Moreover, the lack of extensive development in the neighborhood also contributed greatly to the freedom of the siting, which was based on the guiding principle of functionality.[1] In addition to the actual manufacturing buildings, other buildings were also placed on the factory sites (e.g. technical outbuildings, small workshops, warehouses and internal power generation facilities (engine room, boiler room), social and welfare facilities (canteen and changing rooms) as well as offices and administrative buildings). Roads, squares and streets linked these facilities to each other, such that complete urban structures evolved on the industrial sites. Often, the connection between the plant and the surrounding urban tissue was created with the construction of factory sidings. Because of the agricultural dominance in Hungary, it was the food industry (mills, breweries, slaughterhouses) that first started to flourish in the first half of the 19th century.

Later, in parallel with the development of the railway network, machinery production became the most important industry in the city after 1850,[2] and finally, in the last three decades of the 19th century, a significant development can be observed in electricity generation and chemical production.

Factory buildings: the built manifestations of industrialization

Similarly to the industrialization process itself, neither factory buildings nor transformer stations can invoke a long historical tradition: in consequence, they represent the characteristics and development of a new building type. Starting from traditional workshops and moving toward modern industrial plants, the development process of manufacturing structures was manifested in extensive built dimensions that inevitably exerted a strong influence as well on the urban development of their surroundings. Indeed, perhaps the general opinion of the time regarding factory planning only as a marginal architectural activity, and therefore not bound to other traditional architectural tasks, proved to be a real starting point for the emergence of innovative creativity. As earlier examples or models were absent, completely novel concepts could develop from the three main requirements, i.e. function, structure and form. Additionally, newly discovered building technologies and modern building materials stimulated this trajectory of development.[3] The manufacturing process and the operational organization jointly determined the functional processes formed inside the factory site, often even in three-dimensional processes. This association makes it evident why a purely visual approach is insufficient to explain the formation and development of the model of the industrial building. In a specific analysis on the above aspect of the manufacturing facilities of various industries, highly differentiated results were found that, in fact, point in the opposite direction.

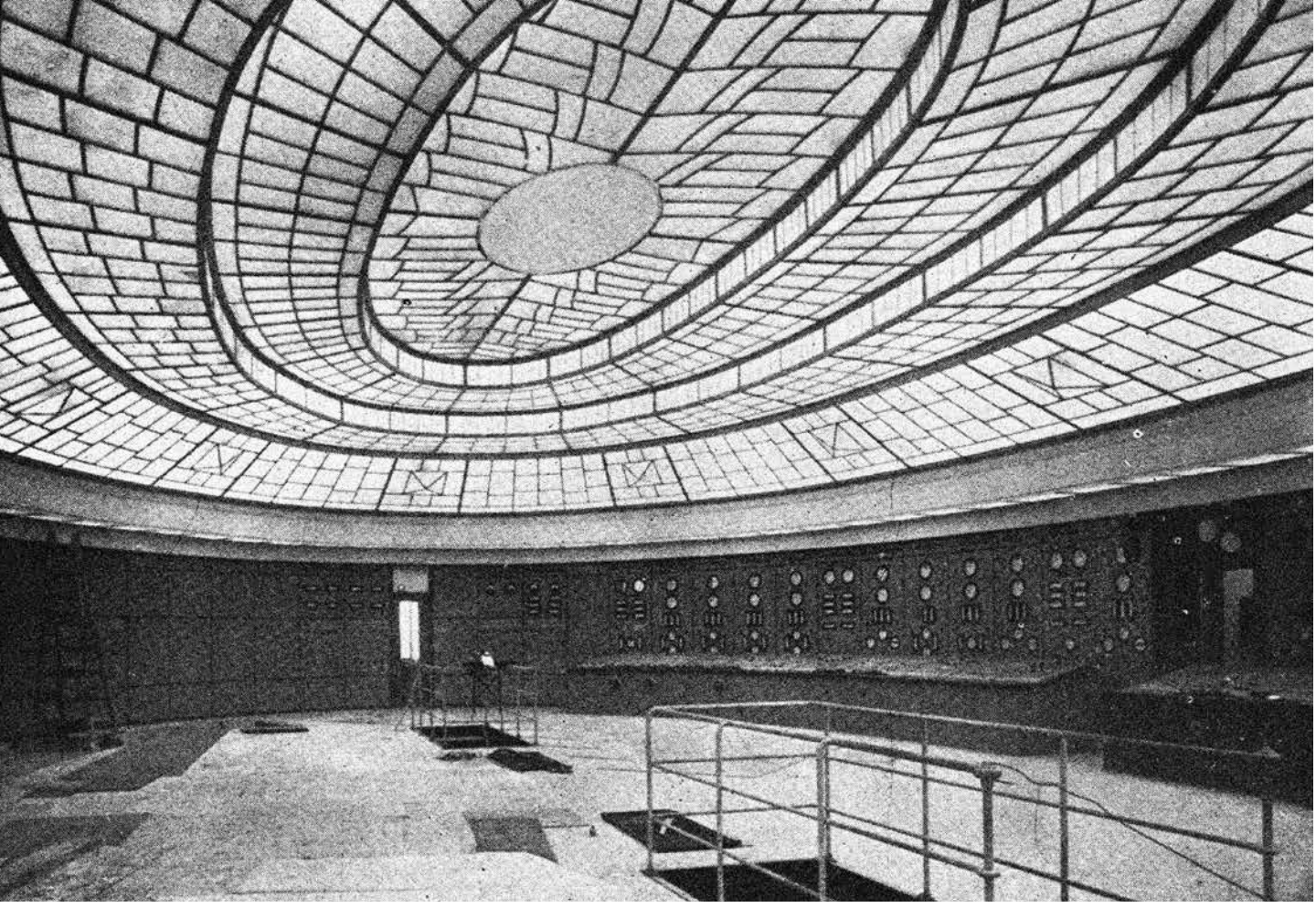
The spread of industrial buildings in Budapest

In parallel with the development of industrial buildings, the appearance of buildings for urban utility infrastructure was both cause and consequence of Budapest's dynamic urban development. In addition to the city's impressive railway stations, specifically the service buildings such as gas works, water towers, cold storage houses and transformers can be classified within this category. Generally speaking, these historical engineering objects have not sparked much interest in the architectural history research. One primary reason is that these businesses provided their services less visibly, not visually perceptible to the public, so their importance was often left in the background deliberately. However, in addition to the basic infrastructure facilities such as sewage pipes or street-lighting fixtures, these historical engineering facilities also made an important part of the urbanization processes that led to the formation of today's Budapest, and the industrialization of the city would never have occurred without them.

Today, the historical industrial buildings and engineering facilities are often hastily assigned to the category of 'previous environmental damage from earlier times' (see: Altlasten), so most of them have simply been demolished, and thus are lost to future generations forever.[4] Seemingly, the adaptation of old factories to the changed production processes and working conditions is not particularly rapid, easy or cost-effective; their operation is not considered profitable, so effacing them from the map often seems to be the most economical option. And as a result, these buildings are quick to disappear irretrievably from the built environment. Systematic research on the remaining structures, carried out with scientific methods, could mean an alternative to the often thoughtless demolition, since in this case an examination using a fixed set of criteria could mean the condition for objective assessment of the specific building type. If the assessment of an industrial building finds that the building to represent a cultural value, then the specific facility may even be considered a monument worthy of protection.[5] Our study will put a new type of building under the microscope, a type born out of the technological endowments of the given era if now unsustainable in its original function –, namely the transformer station. In addition, the paper highlights the importance of research on historical industrial buildings, and the need for a belated rehabilitation.

Development of the power supply of Budapest in the first half of the 20th century

Under the 1879 contract with the Általános Osztrák Légszesztársaság (General Austrian Gas Distilling Company), Budapest had no independent rights to the use of electricity until 1891. In 1893, relatively late with regard to technical developments, two private companies started to offer service



CONTROL ROOM OF THE KELENFÖLD THERMAL POWER PLANT, BUDAPEST, VIRGIL BIERBAUER (BORBÍRÓ)

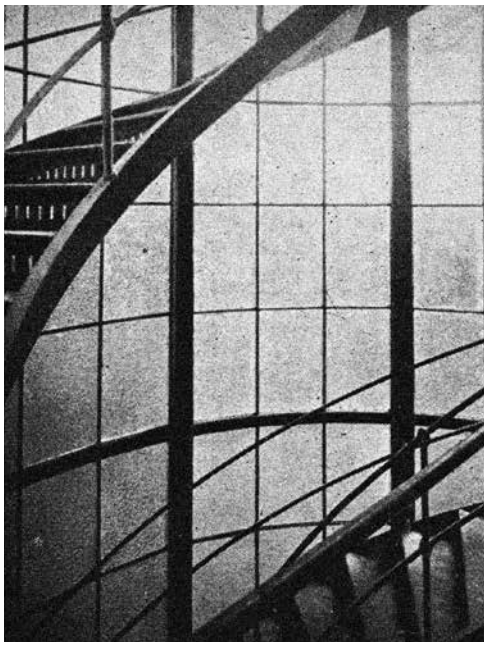
VELÍN TEPELENJ ELEKTRÁRNE, BUDAPEŠŤ – KELENFÖLD, VIRGIL BIERBAUER (BORBÍRÓ)

Source Zdroj: Tér és Forma, 1930, 9, p. 411

for public electricity supplies.[6] As of 1 June 1914, the capital-owned power company was already established under the name Budapest Székesfőváros Elektromos Művei, hereinafter ELMŰ (Electric Works of Budapest Capital), with founding capital first supplied by Magyar Villamossági Rt. and one year later Budapesti Általános Villamossági Rt. as well, assuming control over the entire system of private companies.[7] In addition to the operating power plant on Váci út and the power generation plant in Berzenczey (later Csáky) utca, the Kelenföld Power Plant, designed by architect and university professor Kálmán Reichl, began its construction in 1912 to ensure the city's own power needs. The plant was put into operation in July 1914 with a capacity of 10.000 kW. After 1918, the city became the sole owner of the power supply in Budapest.[8]

By the next decade, the electricity needs of industry and the general population increased to such an extent that neither a single high-performance power plant nor even several smaller local generating plants could satisfy these demands economically. In the 1920s, building a new network system became a vital necessity. On 29 March 1928, Lajos Deutsch, then chief executive officer of the Elektromos Művek, presented his plans for expanding the networks and increasing their economic profit in a detailed proposal. The grid of Budapest, implemented on basis of this concept, served as the base for the capital's electricity service for decades, and at that time *"took a leading position among the most advanced European power grid systems"*[9].

In the late 1920s, the issue of transforming the generated current to higher voltage and the establishment of a new backbone network (today called the main distribution system) came to the fore. Based on the possibilities offered by the cable technology of the time, 30 kV voltage was chosen instead of the previous value of 10 kV. In establishing the new 30 kV cable network, the aim was to transport electricity over longer distances and to connect the individual power generation plants among themselves. The engineers wanted to satisfy this need with the construction of transformer stations and substations situated at the nodes of consumption, supplied by a single main distribution network. *'The generous concept, planned with implementation over several years, includes the construction of a 30kV capacity network, and the establishment of substations first within*



HUNGÁRIA KORÚT SUBSTATION, BUDAPEST, VIRGIL BIERBAUER (BORBÍRÓ)

SPÍNACIA STANICA NA TRIEDE HUNGÁRIA, BUDAPEŠŤ, VIRGIL BIERBAUER (BORBÍRÓ)

Source Zdroj: Tér és Forma, 1930, 9, p. 410

the Kelenföld Power Plant, then at five specified points in the capital – in order: Hungária körút, Markó utca, Szentendrei út, Kazinczy utca, Ferencváros[10]*."*[11] – Though implementation of the program had already begun in 1925, it could be finished only in 1935 due to the economic crisis. When selecting the location of the substations, one of the important considerations was to place the buildings in the center of the consumer area, and also to provide the easiest method of connecting them to the existing grids. Requirements of urban development and the expected growth of electricity consumption were also taken into account.

ELMŰ implemented the buildings with great care. Design was entrusted to the most prominent architects of the era, and the construction of the machinery was performed by the Ganz Corporation (Ganz és Társa). Their design represented the highest standards available in Hungary at that time, in both the technical and aesthetic sense.[12]

During this period, architect Virgil Bierbauer (Borbíró) planned several power buildings, among which the first was the 30 kV switching house for the Kelenföld Power Plant, built in 1927 – 1929. The elliptical control room with its glass roof and wrap-around instrument panel, placed next to the modern switch hall resembling a factory building, was conceived as an elegant, imposing space. During the construction of the new main distribution network, a large-scale improvement of the Kelenföld Power Plant was also carried out, making it then Hungary's largest power plant, as well as one of the most modern ones in Central Europe.[13]

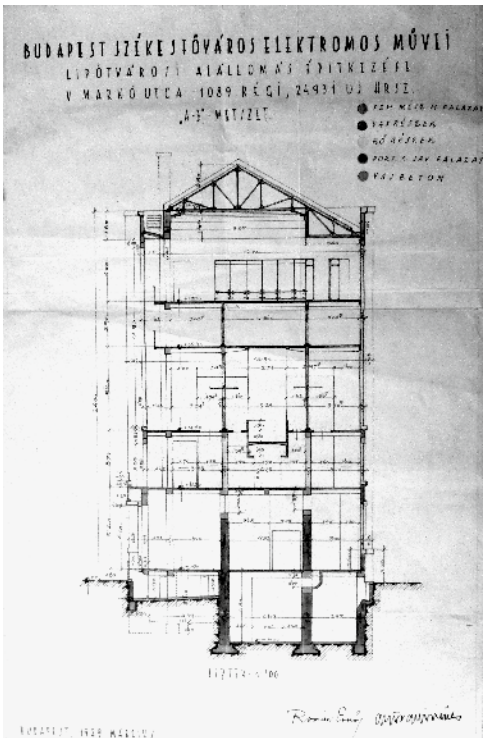
The Hungária körút (now Városliget) station was put into operation in 1930. Also built to the design of Virgil Bierbauer (Borbíró), its own architecture resembles that of the switching house in Kelenföld, using a cellular system. The operating rooms were matched with comfortable social areas and blocks of company flats.[14]

The substation in Markó utca was built in 1929 – 1931 in the second phase of the investment program of Elektromos Művek, and it was responsible for ensuring the power supply of the city centre (Belváros), Lipótváros and Margitsziget.[15] Following the architectural competition announced in 1926, Dénes Györgyi and Ernő Román won the commission for the design of the ELMŰ apartment block next to the transformer house: in fact, Román, the winner of the competition, collaborated with Györgyi, the architect of the plan found the most suitable, but ineligible for an award because of its differences from the call for the competition. Györgyi's concept was in fact realized as a collaboration. Originally, the ELMŰ wanted to entrust Virgil Bierbauer (Borbíró) with the design of this building as well. The structural arrangement of the substation was cellular, but because of the building's small footprint, vertical expansion was most reasonable here, hence the architects decided to plan a multi-storey structure. The control room with marble instrument panels was situated on the top (fourth) floor, in an imposing glass-roofed hall that forms one of the most successful

THE MARKÓ UTCA TRANSFORMER STATION, BUDAPEST, DÉNES GYÖRGY, ERNŐ ROMÁN, PRESENT STATE

TRANSFORMAČNÁ STANICA NA MARKOVEJ ULICI, BUDAPEŠŤ, DÉNES GYÖRGY, ERNŐ ROMÁN, SÚČASNÝ STAV

Photo Foto: **authors** autori



THE MARKÓ UTCA TRANSFORMER STATION, BUDAPEST, DÉNES GYÖRGY, ERNŐ ROMÁN, CROSS SECTION, BUILDING PERMIT PLAN, 1929

TRANSFORMAČNÁ STANICA NA MARKOVEJ ULICI, BUDAPEŠŤ, DÉNES GYÖRGY, ERNŐ ROMÁN, REZ, PLÁN NA STAVEBNÉ POVOLENIE, 1929

Source Zdroj: Magyar Elektrotechnikai Múzeum

designs among the substations of ELMŰ. With its monumental if somewhat archaic clinker façade, despite its generally modern style, the building is an excellent representative of functionalist principles with its characteristic exposed-brick architecture and strictly enclosed volume.[16] At the time of the designing of the Hungária körút and Markó utca substations, the major provider of power supply in Budapest was still the Kelenföld Power Plant. However, after 1928, the Bánhida Power Plant of the Magyar Dunántúli Villamossági Rt. also came into use, and soon entered into collaboration with the city government, the Budapest Székesfőváros Elektromos Művei and the Budapesti Közlekedési Rt. (B.Sz.K.R.T.).

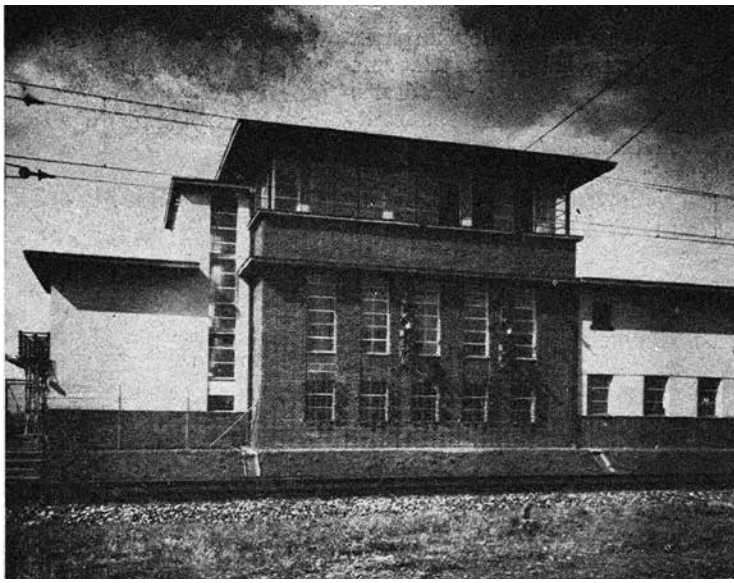
The practical implementation of cooperation required the construction of a so-called "receiving" transformer station. This installation was erected on the corner plot bordered by Dráva and Kárpát utca, next to the power plant of B.Sz.K.R.T. in Révész utca, where all three corporate entities separately established their switching equipment (substations). Originally, the ELMŰ wanted to give the design commission to Virgil Bierbauer (Borbíró) again. The U-shaped factory building was constructed by the building construction department of the Ganz Group member Magyar Építő Rt. On the drawings, the name listed as the architect is that of Géza Rusznyák, who was the director of the company. The structural solution of the control room on the 3rd floor was identical to the previous ones, but with a more intimate atmosphere.

The designer of the new substation built in 1932 on the corner of Dráva and Visegrádi utca was Magyar Építő Rt. again, and the equipment installation was performed by the Ganz Electric Works. The station circuit breakers – for the first time among the substations in Budapest – were operated by remote control from the control room on Váci út.[17]

TRANSFORMER STATION BÁNHIDA, SKUTECZKY AND BORAY COMPANY

TRANSFORMAČNÁ STANICA, BÁNHIDA, SKUTECZKY A BORAY

Source Zdroj: Tér és Forma, 1933, 7 – 8, p. 235



DÉNES GYÖRGYI– ERNŐ ROMÁN: BUDAPEST, SZENTENDREI ÚT TRANSFORMER STATION

TRANSFORMAČNÁ STANICA NA SZENTENDREISKEJ ULICI, BUDAPEŠŤ, DÉNES GYÖRGY, ERNŐ ROMÁN

Source Zdroj: Tér és Forma, 1933, 4 – 5, p. 158

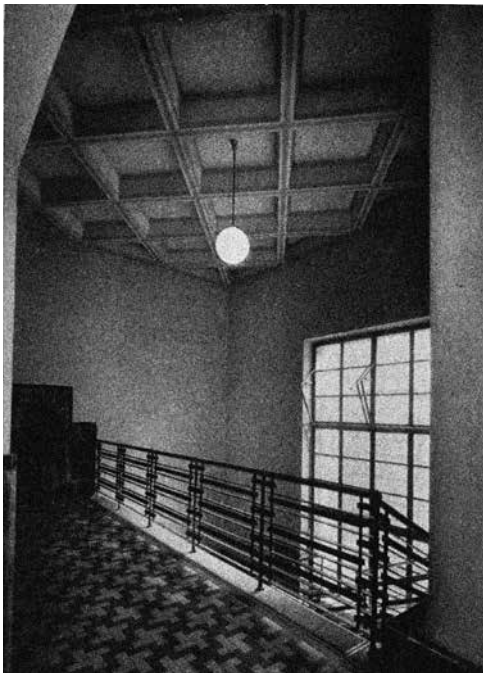
Also in 1932, the transformer house first called Budavidék, later Gázgyár, and finally Aquincum was built on Szentendrei út. ELMŰ gave the design commission to the Györgyi – Román architectural team, who had previously collaborated for the construction works in Markó utca. The irregularly formed U-shaped building was built from the design of Ernő Román, with a façade reflecting ancient Roman architecture. The elegant, glass-roofed control room was again situated upstairs, behind the portico of the main façade, and the transformers were positioned in the chambers of the southern side wings. In addition, the basement level had to be used to accommodate the electrical equipment, because here the building height could be raised only up to one storey.[18]

In subsequent years, the development of the 30 kV network and the construction of substations slowed down. The substation in Kazinczy utca was put in use in 1934, and the building was situated on the street line as a block in the continuous frontage, modifying the traditional design of interior structures. The imposing staircase, as well as the relay and control rooms with the usual marble panel design, were placed behind the main street façade. Design of the U-shaped, two-storey building was entrusted Ágost Gerstenberger[19] and Károly Arvé; and their working tandem was

THE KAZINCZY UTCA SUBSTATION, BUDAPEST, ÁGOST GERSTENBERGER, KÁROLY ARVÉ, ORIGINAL STATE

SPÍNACIA STANICA NA KAZINCZYHO ULICI, BUDAPEŠŤ, ÁGOST GERSTENBERGER, KÁROLY ARVÉ, PÔVODNÝ STAV

Source Zdroj: Tér és Forma, 1935, 10, p. 289; source: http://elektromuzeum.hu/galeria/a-muzeum-epulete/0/



THE KAZINCZY UTCA SUBSTATION, BUDAPEST, ÁGOST GERSTENBERGER, KÁROLY ARVÉ, ORIGINAL INTERIOR VIEWS

SPÍNACIA STANICA NA KAZINCZYHO ULICI, BUDAPEŠŤ, ÁGOST GERSTENBERGER, KÁROLY ARVÉ, POHĽADY NA PÔVODNÝ INTERIÉR

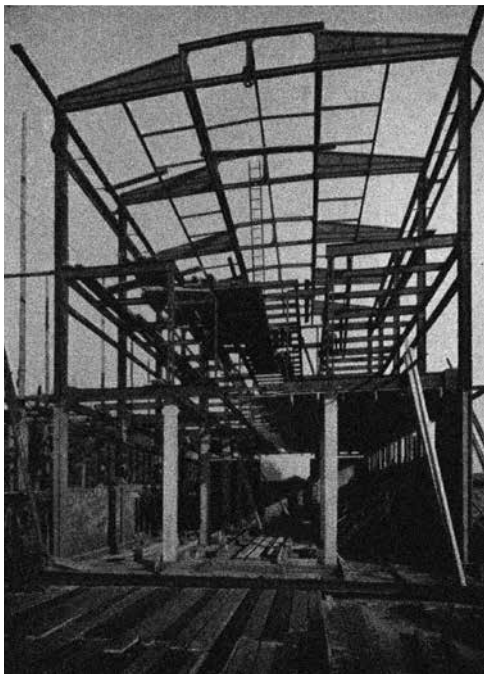
Source Zdroj: Tér és Forma, 1935, 10, p. 289

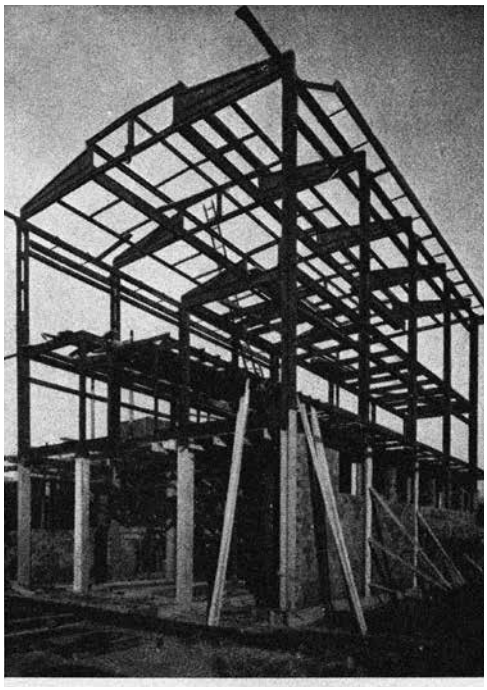
assigned a number of other tasks from the Elektromos Művek. During the construction of the substation, the entire plant in Kazinczy utca was also rebuilt.[20]

The Káposztásmegyeri Vízmű (Waterworks) substation was also put into use in 1934.[21]

As the final component of the development program approved in 1928, the Simor utca (today Vajda Péter utca) substation (in Ferencváros) was built by 1935, thus making the development of the 30 kV network complete. Again designed by Virgil Bierbauer (Borbíró), it was more structurally innovative: first, the steel framework of the prefabricated switching house was assembled; the enclosed spaces were finished by the end of 1934, and in February 1935 the cell walls of the switch rooms were also completed. An operational building using a traditional structure was built in front of the switching house, which housed both the relay and control rooms.[22]

The Belváros (Downtown) substation was built in the courtyard of the Central City Hall from the design of Kálmán Reichl and Virgil Bierbauer (Borbíró). After putting the downtown trans-





THE SIMOR UTCA SUBSTATION, BUDAPEST, VIRGIL BIERBAUER (BORBÍRÓ), THE STEEL FRAME UNDER CONSTRUCTION

SPÍNACIA STANICA NA SIMOROVEJ ULICI, BUDAPEŠŤ, VIRGIL BIERBAUER (BORBÍRÓ), OCEĽOVÝ SKELET POČAS VÝSTAVBY

Source Zdroj: Tér és Forma, 1935, 10, p. 293

former station in operation, the expansion of the other stations also started. Large-scale redevelopment plans were prepared by Ágost Gerstenberger and Károly Arvé. First, the reconstruction of the powerhouse in Horn Ede utca started in 1930, later followed by the buildings in Murányi utca, Liliom utca and Kazinczy utca. In the case of the last-mentioned building, its original architecture was simplified and completed with large windows, and a control room with a double glass roof was also constructed.[23]

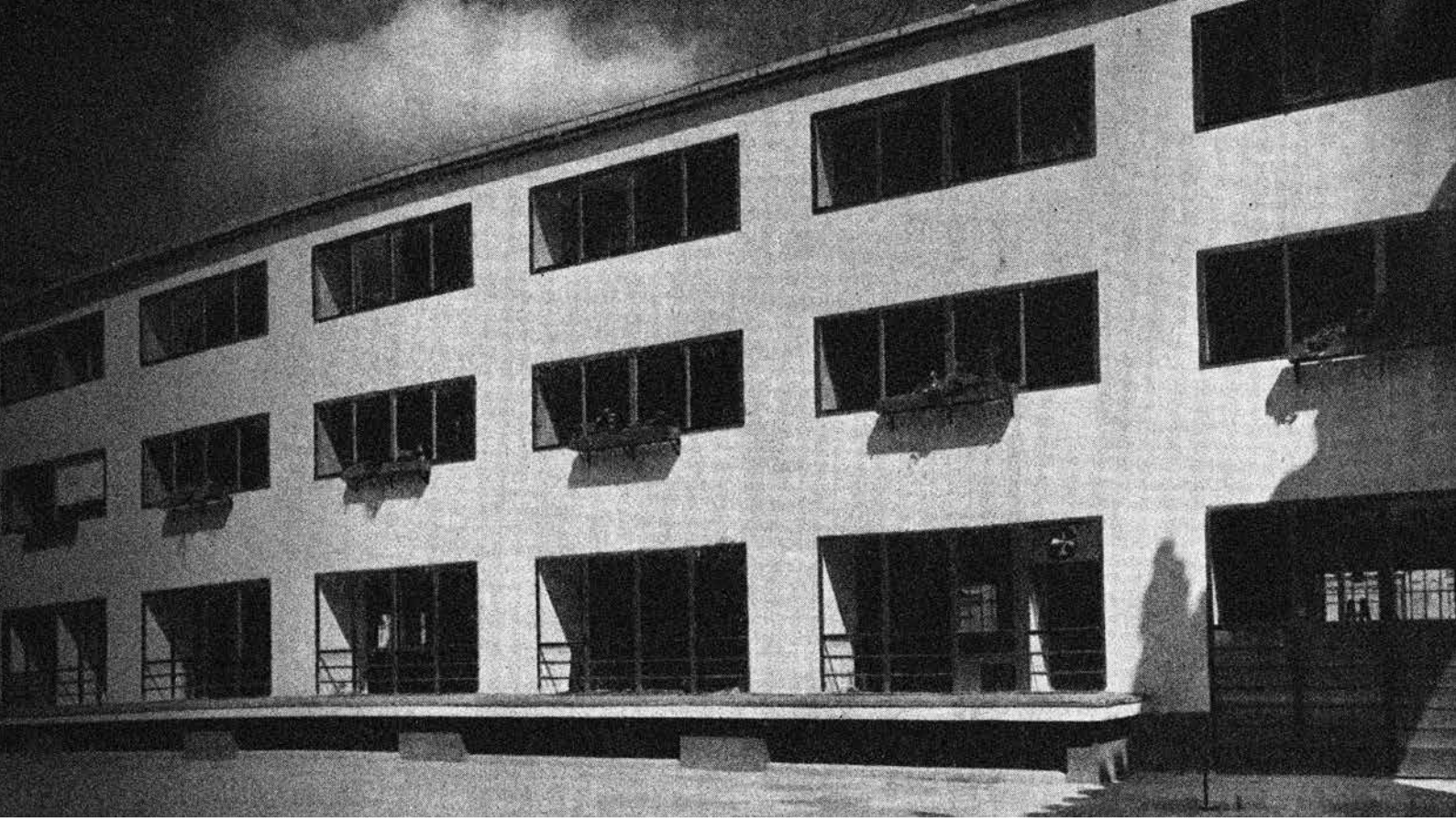
In 1938, the central electric power distributor was established on the ground floor of the central headquarters in Váci Street 74. This development made possible the parallel operation of the Kelenföld and Bánhida power plants at night, thus enabling the economical operational use of the network.[24]

In continuation of the developments, a temporary supply point was established on Soroksári utca, the building in Simor utca was expanded (1938 – 1939, design by Bierbauer), and then a substation was erected in Attila utca as well. The latter, long considered as the Bugát utca substation, was built in 1936 – 1939 from the design of Dénes Györgyi. In addition to the substation, the complex also included flats, a showroom and an air-raid shelter.[25]

The Népliget substation (1942 – 1944), the expansion of the Simor utca building (1942 – 1944), the substation first called Óbudai, later Kaszásdűlő (1942 – 1944) and the substation on Soroksári út (1942 – 1943, design by Dénes Györgyi) were implemented for the reception of the electricity arriving from the newly built Mátra Power Plant to the capital with voltage of 100 kV.[26]

Even the most prominent architect of the era, Farkas Molnár, prepared plans for the company (1937) regarding the Csáky utca site.[27] His assignment reveals that the current trend towards the re-utilization of industrial buildings was already in evidence between the two world wars – although with a different motivation than nowadays. With the commission of the ELMŰ, one of the shutdown machine halls of the power generation plant in Csáky utca was converted to offices, workshop and storage rooms by inserting three new floors, demolishing the courtyard wall and retaining the pillars.[28]

During 1944, increasingly frequent Allied air raids caused serious disruptions to the power supply of the capital. Because of the intense combat at the war's end, almost all of the substations were damaged. It was only in November 1945 that extensive reconstruction work provided unrestricted power supply for all consumers in the city. In Budapest, the 30 kV system reached its largest size in 1965, before it was replaced with the system of 120 kV voltage,[29] which sealed the fate of several transformer-station buildings.



THE CSÁKY UTCA PLANT, BUDAPEST, CONVERSION, FARKAS MOLNÁR

ELEKTRÁREŇ NA CSÁKYHO ULICI, BUDAPEŠŤ, PRESTAVBA, FARKÁS MOLNÁR

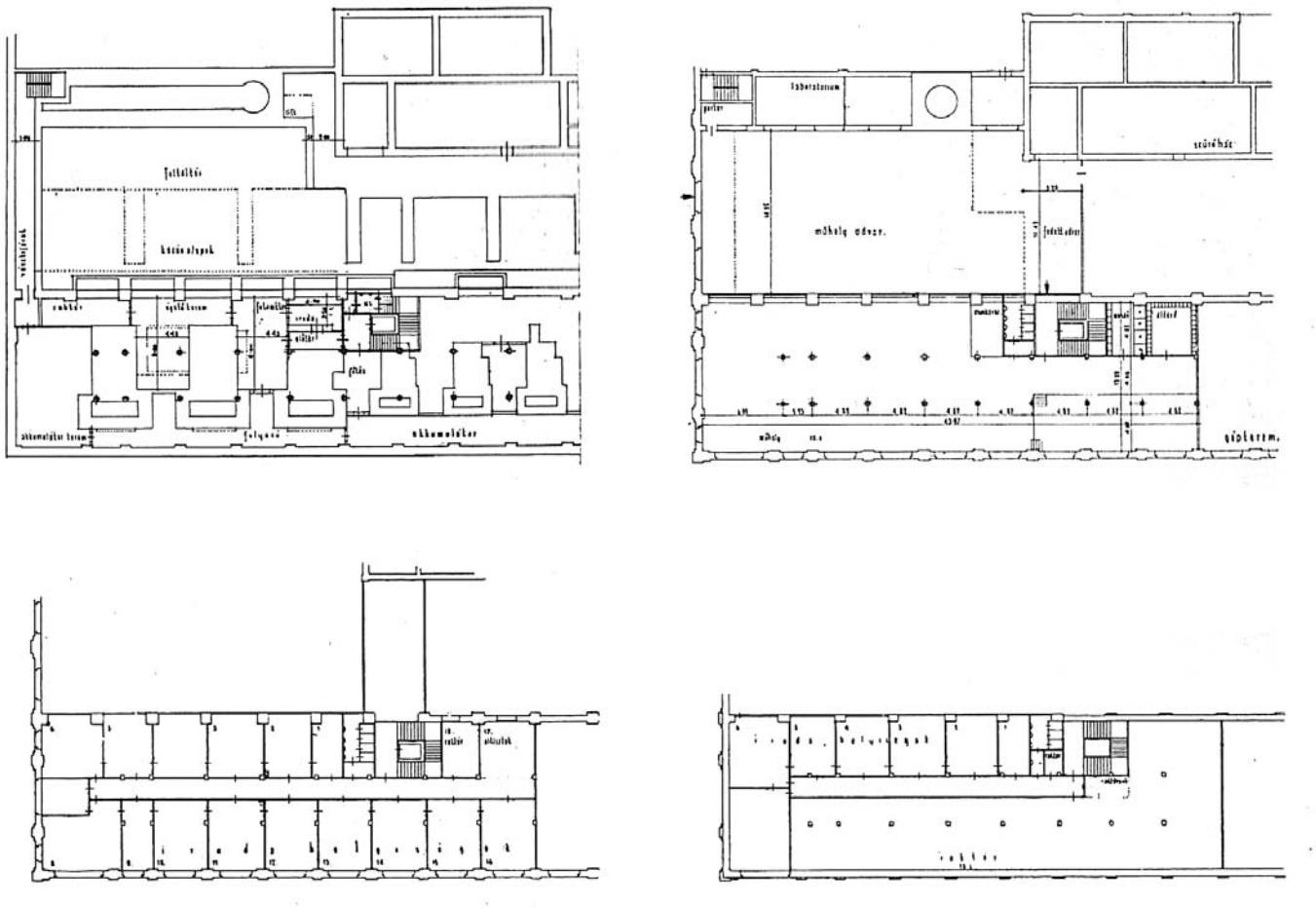
Source Zdroj: Tér és Forma, 1937, 1, p. 19

The transformer station as the new building type of the era

In the early 20th century, because of the changed urban needs and the sharp increase of Budapest's population, the large-scale development of electricity supply began in a manner no different to any other large city of Europe. Both the number of customers and the demand for electricity increased steadily. In response, the concession companies for power supply continuously expanded their production facilities and networks. Although the Budapest city government was the sole owner of the capital's electricity supplies from after 1918, World War I and the following years often paralyzed the power supply service. Moreover, instead of improving productivity, the company did not encouraged the consumers to increase their use of electricity but, on the contrary, enacted restrictive provisions.[30] The greatest drop in the power supply came in the immediate post-war year of 1919. Yet afterward a rapid increase of electricity consumption could be noted, posing a major problem for the Elektromos Művek. In addition to the increase in consumer demand, electricity consumption also increased through the floodlighting of many famous places in Budapest in the 1930s, such as the buildings of Parliament, Buda Castle, Vajdahunyad Castle and the Millennium Monument.

Lajos Deutsch's concept, as described above, fundamentally reformed the power supply in Budapest, and created the system of 30kV transformer stations and substations. The new building type did not have any historical background or extant models, so only previous types of industrial buildings could serve as a reference. The function fully determined the floor plan layout and form of the transformer stations: these buildings genuinely operated as a kind of machine, and consequently the dimensions and operating principle of the mechanical equipment installed into the buildings determined the basic concept of the design.

The substations were built in a so-called cell system, so that in case of fire or explosion only a small part of the electrical equipment was at risk at any given time. In addition, the stations' equipment was very similar on each floor level. Terminations of the incoming and outgoing cables, the cable protecting the choking-coils and the voltage regulators were placed on the bottom floor. The transformers were located on the ground floor, in ventilated chambers created especially for this purpose. In order to make the mounting and replacement of the choking-coils easy, large



THE CSÁKY UTCA PLANT, BUDAPEST, CONVERSION, FARKAS MOLNÁR

ELEKTRÁREŇ NA CSÁKYHO ULICI, BUDAPEŠŤ, PRESTAVBA, FARKÁS MOLNÁR

Source Zdroj: Tér és Forma, 1937, 1, p. 19

doors provided access on the ground-floor zone of the courtyard façade. In the course of time, the transformers were repeatedly replaced because of the increasing capacity demand. The next floor was designed as the combustion chamber of the oil circuit breakers, in order to limit any damage resulting from a possible explosion. From the 1920s onwards, strong slabs and walls separated the sensitive structural elements in the transformer station as a precaution. The cells of the current regulators and the relay board were also placed here.[31] The switching equipment was spatially arranged in a way that the oil switches were lowered into the concrete slab, which meant that only the switch covers and bushings protruded into the compartment containing high-voltage electrical equipment, while the oil tanks were placed in the combustible corridor space.[32] The oil switches, their drive assemblies, the section switches and the busbars were located on the upper levels, as along with the control panel, as the "brain" of the whole system. Usually, the actuators of the switching elements and the control rooms were implemented with an impressive design.

As the transformer stations were located in the center of residential areas, it was also necessary for all new transformer buildings to indicate their presence in the cityscape with imposing facades embedded in the urban fabric, which not only indicated their function as industrial buildings but simultaneously merged harmoniously with the row of street-front facades. In order to reach this goal, the combined form of a transformer house and an ELMŰ apartment was often built, creating a sense of unity. Even though other companies generally worked with their own architects in practice, the ELMŰ, following a deliberate concept, asked the best-known and widely recognized architects of the era to perform the design work, or announced an open architectural competition for the design of new buildings.

The contemporary media constantly reported on the transformer houses under construction, as well as on the related design competitions. In addition to the plans and façade illustrations of the commissioned buildings, Hungarian architectural journals often published photos of the impressive control room as well, which in almost all cases equally revealed the impressive architectural quality of the buildings.

Reutilization and functional change of transformer stations in European examples

The development of Budapest's energy supply – whether through expansion of the network or improvements in technology – often resulted in the loss of function for early transformer stations and other infrastructural elements. If their original function is no longer technically feasible, industrial buildings generally are faced with three different fates. First is abandonment, when the building is (officially) not used; second is reutilization, which can be a long-term recovery with a temporary or permanent architectural and engineering intervention; third is destruction and demolition.[33] Demolition is irreversible, regardless of whether it is the consequence of technical conditions or the failure to recognize the value of historical industrial buildings. The lack of documentation makes research into architectural and industrial history difficult and the historical identity of certain settlements or areas may be ruined as well.

The design of industrial buildings emerged from the periphery of architecture, as a sideline activity, yet it won increasing importance and, as we have seen, in some cases even received considerable publicity. Some industrial buildings display architectural, cultural and/or industrial-historical value, and therefore it is essential to preserve a portion of these values for posterity. Keeping the sustainability aspects in mind, the most practical way of preservation is to put the buildings into actual use. With the buildings' combined loss of function and prominent physical location in the urban fabric, this aim usually can be achieved with a change in function.

In the reutilizing process of buildings, a number of technical and economic factors need to be considered. From the real-estate development point of view, a building's most important feature is its location. The transformer stations under discussion were typically built into the dense urban fabric, close to residential areas, and the city has by now grown around them as a result of urbanization processes. Essentially, this circumstance is a clearly favorable condition for reutilization. The design and the technical condition of the buildings are also important factors. The former aspect depends on the original function and the associated industrial technology, and the chosen – available – architectural solution, while the latter one is dependent on the historical era and method of use, in addition to the building materials and applied construction technologies.[34]

It is relatively easy to adapt industrial buildings to changed usage, and as a result, a wide variety of examples can be found all over the world. The pillar-framework or hall-like structure of production and storage buildings makes the spatial arrangement easy – appropriate adaptation for the new function requires little demolition or other structural interventions. In addition to the load-bearing structure, the façade design and the order of doors and windows can themselves form important components of the design. However, they only offer minor problems easy to overcome, because in most cases the reutilized buildings can provide sufficient natural light for the new function as well. For electricity-supply buildings, both the cellular design based on the technology and the special internal structures pose a greater challenge for the designers, yet the following examples clearly show that solving the task is possible. A significant part of the examined buildings have been renewed with a cultural function, but there are also examples of market-based recovery.

Umspannwerk Recklinghausen was originally built for the Vereinigten Elektrizitätswerke Westfalen (United Westphalian Electricity Works), and went into operation in 1928. The complex

included a transformer, 110kV and 10 kV switches and service apartments as well. Despite the multiple transformations, the building no longer met essential technical and functional requirements by the 1980s; but instead of the planned demolition, the investors decided on a complex refurbishment. In parallel with the renewal, the transformer was also replaced, so in 2000 the building opened again as an operating industrial facility and at the same time as Germany's largest museum of electricity. The complex is located somewhat away from the city center, yet in a built-up environment on the bank of a canal; and the buildings faithfully preserve the industrial functionality.[35]

The former power plant in Bamberg, built in 1901 – 1902 but operating as a transformer house from 1926 to 1977, was also revitalized with a cultural function. After the shutdown of the building, the city government decided in favor of demolition, yet for reasons of heritage protection as well as public pressure, the demolition decision was withdrawn in 1983, and the building converted to an educational institute in 1986 – 1988. The classrooms and the staircase were placed in the boiler house, while the machine hall housed the event room. Here and in the courtyard, the original mechanisms of the cranes were kept in place. The city could realize savings with the reutilization of the building and the received subsidies. [36]

In Berlin, just like in Budapest, many transformer houses were built during the early development of electricity networks. In several cases, the designer was Hans Heinrich Müller, architect of the Berliner Elektrizitätswerke AG (BEWAG) company. A number of Müller's buildings designed for the BEWAG (including several transformer houses) are listed buildings.

One such design is the transformer house on Leibnizstrasse (1929), which – despite its steel structure – was finished with a clinker-brick façade resembling more of an office block due to the urban location. With changes in the electricity grid, the building was closed in 1986, and the equipment was removed. The reutilization planning process started in 1996, while the construction came to an end in 2002, keeping the original appearance and spatial structure to the greatest possible extent, but allowing for contemporary usage. The building was reborn as an office building under the name MetaHaus, referring to the builder.[37]

In addition, Müller designed the five-part building complex built in 1924 – 1928, located in the Kreuzberg district, on the bank of the Landwehrkanal. The current transformer center was shut down in 1989, yet afterward it started operations again in 2001, after the completed renovation and revitalization. In addition to the rented office spaces, the complex also contains an event center, a restaurant and a café.

The Scharnhorst transformer house is also part of Müller's oeuvre: completed in 1928, it is a typical example of Müller's brick architecture.[38] The plant was switched off in 1984 (according to other sources in 1982), and closed in 1992. The goal of the renovation-conversion, completed in 2002 – 2006, was to design an office building, sales and customer center for Vattenfall Europe Berlin AG, successor of BEWAG. During the construction work, the architects tried to keep the original building structures as much as possible. However, the floor levels had to be adjusted to the new function, so seven stories were created instead of the sixteen original floors of the plant, also resulting in slight modifications of the façade and the stairs. The project led to the creation of more than 500 office jobs. The architects of the makeover, of the same team in charge of MetaHaus, were Petra and Paul Kahlfeldt.

In Budapest as well, we can find examples of the reutilization of transformer stations that lost their function due to development of the power grid. The best-known example is Trafó Kortárs Művészetek Háza (House of Contemporary Arts, District IX, Liliom utca 41). With noteworthy Secessionist touches, the building was erected in 1909 from the design of Ágost Gerstenberger and Károly Arvé. It was rebuilt in 1930, operating as a transformer stations until 1945. In subsequent years it was barely used, and the privatization of the building did not do much to improve this situation either. In the early 1990s, a group of French artists moved in (unofficially), and the use of the building for cultural purposes began at this time. The central-city location was a clear benefit for the new function. Currently owned by the Municipality of Budapest, the building was subjected to rebuilding in 1998, and the institution is operated by a non-profit company.[39]

The transformer house in Markó utca, listed under heritage protection, was operating according to its original function until 1990, with its original form and layout largely preserved apart from physical deterioration. The original equipment was dismantled in 1991, when the 30kV block was rebuilt because by then 10kV capacity switching stations were needed. In this period, several other transformer buildings – e.g. the buildings in Óbuda and Kárpáti utca – were also assigned new

functions, but kept in at least partial operation. Since 1992, Általános Értékforgalmi Bank has used the Markó utca building as a bank branch. The most important conversion was the splitting of the the high-ceilinged main floor and second floor using new concrete floor slabs, creating two lower gallery levels – thus making the previously four-storey building into a six-storey one. Since the bank no longer makes use of the building, at present the transformer station is being refurbished, with the aim of keeping the office function. The basement is still in use by the Elektromos Művek.[40]

The Aquincum transformer house on Szentendrei út, Óbuda has been redesigned twice to accommodate a new function. Listed as a protected monument as early as the start of the 1980s, this building lost its original function by the start of the 1990s. At that time, the basement area was sufficient for accommodating the power distribution functions. In 1990, it was rebuilt for the Óbuda branch of ELMŰ: customer service, offices, storage rooms, workshops and social rooms were created in the interiors. The former glass-roofed switch room, located on the first floor behind the portico of the main front, was transformed into an impressive meeting and lecture room. As a result of new redevelopments implemented in recent years (2007), the completely restructured interior of the former transformer house now serves as the exhibition building of the Aquincum Museum.[41]

The transformer house in Kazinczy utca operated until the middle of the 20th century, after which time it became an office building used by the ELMŰ. In 1999, the building including the technical equipment was donated to the Hungarian Association of Electrical Engineering (Magyar Elektrotechnikai Egyesület) to form a museum, although the collection was started in 1975 and granted museum status in 1982. Since 2001, the former transformer building with its machinery hall has been listed as a protected monument.

The Museum of Electrical Engineering has been able to use the building without significant alterations: the facades and the main staircase are now restored to their original form. The former switch rooms became exhibition rooms, named after the greatest figures in the history of Hungarian electrical engineering. The concrete cells of the switches were turned into show-cases. Several items of the equipment, such as busbars, section switches, or part of the cable network, have been preserved in their original form. Besides its numerous exhibits from the history of electrical engineering, the museum offers guided tours, hosts presentations and conferences.

The machinery hall operates independently from the Museum as an event center with a bistro and a café.

A long series of further examples could by rights be provided, yet the present paper does not aim at providing a complete list. The buildings presented above give us a taste of the possible forms of reutilization, pointing out that former industrial spaces can function well even after the end of their original use, and that renovations can be appropriately matched to the change of function or to larger- and smaller-scale conversions. In this way, such industrial heritage sites remain integral parts of both the everyday life and the urban fabric; by preserving their industrial character, they also play an important role in maintaining the diversity of a city's built heritage.

ESZTER BAKU
Assistant Research Fellow, Ph.D. candidate
ÁGNES GYETVAINÉ BALOGH, Ph.D.
Senior lecturer
MARTIN PILSITZ, Ph.D.
Assistant Research Fellow
FACULTY OF ARCHITECTURE
DEPARTMENT OF HISTORY OF ARCHITECTURE AND MONUMENTS

ADRIENN LEPEL, Ph.D.
Senior lecturer
FACULTY OF ARCHITECTURE
DEPARTMENT OF CONSTRUCTION TECHNOLOGY AND MANAGMENT

BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS
Műegyetem rakpart 3
1111 Budapest
Hungary

bakueszter@gmail.com
gybaloghagnes@gmail.com

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2 BENCZE, Imre: A budapesti gyáripar területi elhelyezkedése. Földrajzi Közlemények, 1963, 2, pp. 148 – 158.

3 BANNISTER, Turpin: The first iron-framed buildings. Architectural Review, 1950, 108, pp. 231 – 246.

4 VÁCZI, Piroska: Az ipari épületek védelmének lehetőségei. Műemlékvédelem, 2001, 6, pp. 376 – 380.

5 PILSITZ, Martin: Műemlék az ipari építészetben. Építés – Építészettudomány, 2012, 1 – 2, pp. 97 – 112; on the topic also see VUKOSZÁVLYEV, Zorán – URBÁN, Erzsébet: Value saving and community use regarding urban renewal – Protection of Hungarian industrial heritage and possibilities for its reutilization at the turn of the millennium. Architectúra & urbanizmus, 2014, 3 – 4, pp. 156 – 177; CSÁSZÁR, László: Ipari műemlékek és védelmük. Műemlékvédelem, 1990, 1, pp. 36 – 40.

6 The plants of the two companies, namely the Magyar Villamossági Részvénytársulat (M.V.Rt.) and the Budapesti Általános Villamossági (BÁV) Rt., were established to provide the power supply of the capital, so that the company received a concession for 45 years. However, they were not entitled either to exclusive rights, or to issue privileges to others. SITKEI, Gyula: Száz év állomásai. Budapest, 1993, p. 8 and 16.

7 The redemption of the Budapesti Általános Villamossági Rt. actually took place in April 1918, although the General Assembly resolution in this regard had been issued already in 1915: Budapest City Archives XI.1509. 29. Folder 284. file 2; 100 éves az Elektromos Művek 1893 – 1993 – a fővárosi áramszolgáltatás 100 éve. Ed. Dezső Börcsök. Budapest, Budapesti Elektromos Művek Rt. 1993. p. 14; SITKEI, Gyula: 1933, p. 17.

8 BÖRCSÖK, Dezső: 1933, p. 12; SITKEI, Gyula: 1933, pp. 18 – 19; FERKAI, András: Buda építészete a két világháború között. Művészeti Emlékek. Budapest, MTA Művészettörténeti Kutató Intézet 1995, p. 26, pp. 181 – 182.

9 SITKEI, Gyula: 1933, p. 6.

10 Simor (today Vajda Péter) utca.

11 SITKEI, Gyula: 1933, p. 21.

12 Ibid.

13 As an editor of the journal Tér és Forma, Virgil Bierbauer (Borbíró) dealt with industrial architecture among other topics, and he also referred to German and Italian examples in his articles. On the one hand, this finding proves that at that time there was a lively interest for the architecture of these areas. On the other hand, the direct or indirect effects can be inter-

preted as sources, especially in case of Bierbauer, for example the cited power plant in Berlin-Rummelsburg (Walter Klingenberg and Werner Issel, 1925 – 1926). The photos of the Kelenföld buildings were published in Tér és Forma. –: Ipari építkezések. Tér és Forma, 1930, 2, pp. 55 – 75. See at pp. 59 – 66, –: A XII. Nemzetközi Építészkongresszus Budapesten / The XII. International Congress of Architects in Budapest. Tér és Forma, 1930, 9, pp. 410 – 411. An article was published on the expansion of the building: Dr. B. V. [Bierbauer, Virgil]: 30.000 voltos kapcsolóház a székesfőváros elektromos művei kelenföldi telepén. Tér és Forma, 1931, 4, pp. 109 – 116; A….f: Budapest Székesfőváros Elektromos Művei kelenföldi áramfejlesztő telepének újabb építkezései. Tér és Forma, 1934, 11, pp. 311 – 323; see also FERKAI, András: 1995, p. 26, pp. 181 – 182.

14 A contemporary description is published in Tér és Forma. –: Ipari építkezések. Tér és Forma, 1930, 2, p. 66; photo published in Tér és Forma. –: A XII. Nemzetközi Építészkongresszus Budapesten / The XII. International Congress of Architects in Budapest. Tér és Forma, 9, 1930, p. 410. See also Pest építészete a két világháború között. Ed. András Ferkai. Budapest, Modern Építészetért Építészettörténeti és Műemlékvédelmi Kht. 2001, pp. 448 – 449.

15 – : Budapest áramellátásának története 1893 – 1933. Budapest, 1934, p. 174; SITKEI, Gyula: 1933, p. 29 – 32.

16 BAKU, Eszter – GYETVAINÉ BALOGH, Ágnes: A Györgyi Dénes – Román Ernő „építészpáros" működése. Adalékok Györgyi Dénes és Román Ernő közös munkásságához. Építés – Építészettudomány, 2016, 1 – 2, pp. 45 – 85. See at pp. 55 – 73. The two ELMŰ-buildings (the transformer station and the adjoining apartment block) were presented in contemporary journals: P. [adányi] G. [ulyás Jenő]: Budapest Székesfőváros Elektromos Műveinek Markó uccai építkezései. Tér és Forma, 1932, 2, pp. 33 – 44. (Also published as reprint, pp. 1 – 12). The apartment block also housed the imposing exhibition rooms of the ELMŰ. For a contemporary description written by the architect see: GYÖRGYI, Dénes: Budapest Székesfőváros Elektromos Műveinek kiállítási helyiségei. Tér és Forma, 1934, 7, pp. 133 – 134.

17 SITKEI, Gyula: 1933, p. 35; András Ferkai: 2001, pp. 335 – 336.

18 Because of its exterior appearance, the building was the target of harsh criticism in the contemporary press from Virgil Bierbauer (Borbíró), who had previously worked for ELMŰ several times. Discussing the building in the column entitled 'Kritika oldalai' of the journal Tér és Forma, he regretted that the designer (no name mentioned) 'was forced by the authorities to place a Roman colonnade in front of a transformer station, and to be paid off in front of the general public, especially the vast majority of the architect community". The reason for this situation was that 40 years earlier, when the excavations brought the Roman city of Aquincum to the surface, an official decision stated that only the "Roman style" could be used in the area. Bierbauer, who was firmly dedicated to modern architecture, called this architectural solution the "commitment of a lie". BIERBAUER, Virgil: A kritika oldalai IX. Transzformátorház az aquincumi ásatások területén. Tér és Forma, 1933, 4 – 5, p. 158; BAKU, Eszter – GYETVAINÉ BALOGH, Ágnes: 2016, p. 77. See also: FERKAI, András: 1995, pp. 169 – 170.

19 Mentioned in the literature either as Ágost Gerstenberg or Gerstenberger.

20 VUKOSZÁVLYEV, Zorán – URBÁN, Erzsébet: 2014, p. 166; E. N.: Budapest Székesfőváros Elektromos Műveinek új állomásai. Tér és Forma, 1935, 10, pp. 288 – 291; András Ferkai: 2001, pp. 186 – 188; CSORDÁS, Lajos: Áramházak. Budapest, 5, 2006. Available at http://www.budapestfolyoirat.hu/archivum/2006/5/140-aramhazak. Accessed 3 April 2015.

21 SITKEI, Gyula: 1933, p. 37.

22 Ibid, pp. 41 – 42.

23 CSORDÁS, Lajos: 2006.

24 SITKEI, Gyula: 1933, pp. 47 – 48.

25 On the Simor utca substation: E. N.: Budapest Székesfőváros Elektromos Műveinek új állomásai. Tér és Forma, 1935, 10, pp. 289 – 294; András Ferkai: 2001, p. 256; on the Attila utca substation: FERKAI, András: 1995, p. 36.

26 SITKEI, Gyula: 1933, pp. 56 – 57.

27 –: Az O.T.I. munkáskórházának személyzeti háza. Tér és Forma, 1937, 1, p. 19.

28 Photo published: ibid, p. 19. See also SITKEI, Gyula: 1933, p. 22; András Ferkai: 2001, p. 496.

29 SITKEI, Gyula: 1933, p. 7, 58 – 59.

30 BÖRCSÖK, Dezső: 1933, pp. 16 – 17.

31 – : Budapest Székesfőváros elektromos művei 30 kV-alállomása. Ganz Közlemények, 1936, 10, pp. 3 – 18.

32 – : Budapest áramellátásának története 1893 – 1933. Budapest, 1934, p. 167.

33 LEPEL, Adrienn: Changing the function of industrial buildings – survey. Facta Universitatis Series: Architecture and Civil Engineering, 2006, 2, pp. 71 – 84; Ipari épületek védelméről, újrahasznosításáról, see also CSÁSZÁR, László: 1990, pp. 39 – 40; MERHÁN, Orsolya: Ipari műemlékek hasznosítása. Műemlékvédelem, 2001, 6, pp. 380 – 382.

34 LEPEL, Adrienn: Characteristic structures of the industrial buildings from the XIX – XX centuries and technical interventions for the re-utilization. Facta Universitatis Series: Architecture and Civil Engineering, 2006, 1, pp. 1 – 17.

35 Available at: http://www.umspannwerk-recklinghausen.de/museum.html. Accessed 10. 10. 2016. st

36 Neuer Nutzen in alten Industriebauten, Vereinigung der Landesdenkmalpfleger in der Bundesrepublik Deutschland, Arbeitsgruppe Industriedenkmalpflege, 2003. Available at: http://www.stadtentwicklung.berlin.de/denkmal/liste_karte_datenbank/de/denkmaldatenbank/daobj.php?obj_dok_nr=09096308. Accessed 10. 10. 2016. st

37 Ibid.

38 Other examples are the Humboldt transformer station (built in 1925 – 1927), and the Christiania transformer station (built in 1928 – 1929), which are also good examples of successful reutilization. Available at: http://www.stadtentwicklung.berlin.de/denkmal/liste_karte_datenbank/de/denkmaldatenbank/daobj.php?obj_dok_nr=09065209http://www.stadtentwicklung.berlin.de/denkmal/liste_karte_datenbank/de/denkmaldatenbank/daobj.php?obj_dok_nr=09030452. Accessed 10. 10. 2016. st

39 CSORDÁS, Lajos: 2006.

40 KISS, Katalin: Ipari műemlékek. /A mi Budapestünk/. Budapest, Budapest Főváros Önkormányzata Főpolgármesteri Hivatala 1993. (Angol nyelven: KISS, Katalin: Industrial monuments. /Our Budapest/ Budapest, the Municipality of Budapest 1997.) pp. 32 – 33; VÁRADY, Tibor: Régi bank – új arculat: Az Általános Értékforgalmi Bank Székháza. Budapest, Markó Street 9. Magyar Építőipar, 1993, 7, pp. 229 – 232. The conversion was designed by Tibor Váradi. See also: BAKU, Eszter – GYETVAINÉ BALOGH, Ágnes: 2016, pp. 63 – 65.

41 KISS, Katalin – PÁL, Balázs: A Budapesti Elektromos Művek óbudai kirendeltsége. *Műemlékvédelem*, 1990, 2, pp. 92 – 97; PÁL, Balázs: A Budapesti Elektromos Művek Óbudai kirendeltségéről. Magyar Építőművészet, 1992, 2 – 3, pp. 64 – 65. The restoration was designed by Balázs Pál. See also: KISS, Katalin: 1993, pp. 24 – 25. The new conversion and the reinterpretation of the building as an exhibition space can be linked to the name of the architect László Rajk.