

The old power plant at Silahtarağa in Istanbul

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Industrial buildings are largely designed considering their machine equipment and production process. Therefore, their architectural development are slightly investigated by architectural historians in contrast to other structures. These engineering buildings have been recognised and gained importance by help of the industrial heritage concept. And they are analysed and evaluated in the context of this concept.

In these buildings developments in technology have deeply influenced architectural design and form. The analysis of these structures gives us important information about technological and consequently structural development process.

Ottoman empire had attempted to join the industrial revolution developed in Europe by westernisation movement generated especially in mid 19th century. In this extend some factories have been founded in the country in order to realize the western lifestyle. These buildings have been constructed by following western style and technology and by the time due to changes in production ways have lost their functions and have been abandoned. In Turkey around 90's they have been considered in the content of industrial heritage and gained importance.

At the beginning of 20th century the illumination of Ottoman capitol Istanbul by electricity had become a current issue as an extension of westernisation. As a result it had been decided to build a power plant in the city.

In this paper Silahtarağa power plant which is the

first electricity producing plant in Turkey has been studied as an important edifice of industrial heritage.

BRIEF HISTORICAL BACKGROUND

The first proposal for electrification of Istanbul had been made in 1878 by a French firm but given no result. In 1908 the Ministry of Public Works prepared a regulation about the issue since electrification of the city would be a model for other cities of the empire. Under the rules of this regulation an invitation has been made for construction bids. Among eight firms submitting bids the Hungarian firm Gans has been awarded for the venture. (Ergin 1995, 5: 3692)

In 1910 the firm has taken privileges of construction and operation of the establishment for fifty years and founded a domestic firm Ottoman Electrical Company. Later the firm Gans made an agreement with other two companies and capacity of the plant has been increased from 3000 KW to 14400 KW. (Önay 1972, 31)

Because there is no powerful stream enough to operate a hydraulic plant in the vicinity of Istanbul a steam plant has been the solution. The best place for the plant has been determined on the deep inlet Haliç at the junction of two streams (Aytar 1957a, 5). Due to the easy transportation of coal through the natural harbour Haliç and sufficient supply of fresh water from streams and effective distribution of power to whole city this place has clear advantages (Figure 1).

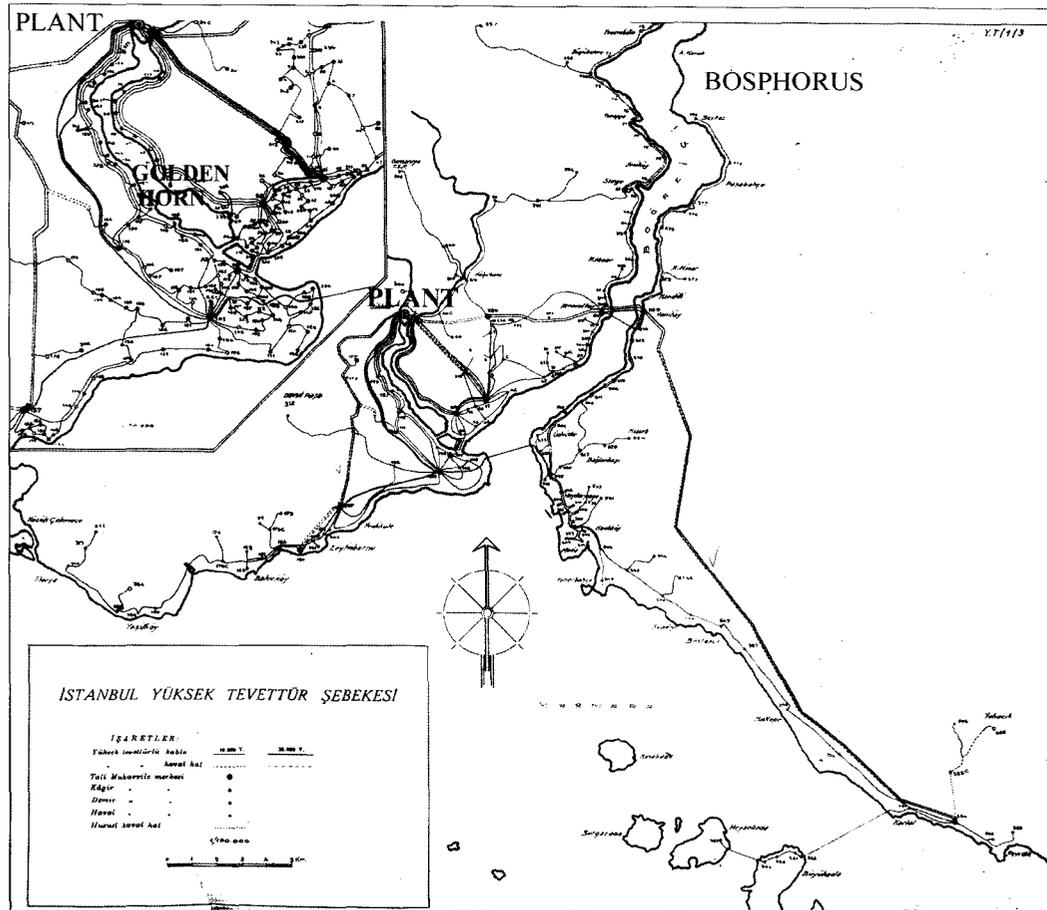


Figure 1
Power distribution network of the Plant

In electrification of Istanbul the city has been divided into two parts as European and Asian sides and a transmission cable would cross the Bosphorus under the sea (Erengil 1957, 3). The plant and power distribution network have been planned to finish in 1913 but because of war and flood they have been completed in 1914 (Önay 1972, 33).

GENERAL INFORMATION

The power plant has been founded on the area of 120 000 m² (Acar 1976, 323). From the first general

plan of plant dated 1911 its understood that the plant has been designed for four expansion stages.¹ It has been thought that four boiling rooms would be placed in south-north direction in front of the engine room. General rule of planning of the plant was to allow any capacity increase in future. The longitudinal axes of boiling and engine rooms have been placed in such a way that new expansions could be realised easily. This planning furthermore has facilitated passing of steam pipes and entering to buildings.²

The plant completed in 1914 has composed of the following buildings: the main production unit with T shaped plan containing one engine and one boiling

rooms, pier and quay, storage and transportation system for coal supply, channels for fresh and waste water, repair and maintenance workshops, administration office and residential buildings for personnel^{2,3} (Figure 2).

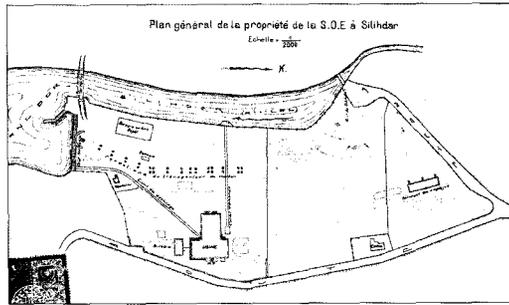


Figure 2

The main production unit has been placed near the city road. The pier on the shore has been connected to the plant by a monorail system of 225 m in length transporting coal from boats to storage area and from there to boiling room. (Cengizkan 2001, 5)

The capacity of storage area was around 40 000 tons of coal. Cinder coming from furnaces in boiling room has been used in producing briquette by mixing it with cement. This product was for sale in market and a protection material for underground power distribution system.

Cooling water taken from stream after filtered and set-aside has been passed through condensers and delivered to Haliç being slightly warmer by the outlet channel (Acar 1976, 325).

The plant has continued to produce electricity in its original capacity until 1920. In 1921 two new boilers have been added to the existing boiling room and a new engine room (engine room 2) has been constructed containing a turbine and a generator. The extra power produced by new equipment was expected as around 12 000 KW but the turbine could not be operated in desired productivity. Because of partly for this reason and partly increased necessity for electricity the turbine portion of the plant has been expended in the years 1923, 24,29. The existing

boiling equipment has provided the continuously increasing need for electricity with great difficulty until 1928. In 1929 a new boiling room (boiling room 2) has been constructed containing for new boilers. It is seen in general plan dated 1931⁴ that the all expansion works have been realised following the ways proposed in the original plan dated 1911. In 1939 due to the increasing need of electricity another boiling room (boiling room 3) has been constructed with two boilers. And total capacity of the plant has arrived to 70 000 KW (IE.T.T. 1940, 71). In 1944 a new engine room (engine room 3) and 1956 a new boiling room (boiling room 4) have been added to the plant and then the total producing capacity has arrived to 100 000 KW in 70's.⁵ The general plan referred to 70's shows the last configuration of the plant just before closing (Acar 1976, 330) (Figure 3). There were existed four engine rooms and four boiling rooms in 1983 the year plant was closed. But the first engine and boiling rooms (rooms 1) and first added engine room (engine room 2) have survived until present day in their original conditions. Besides the engine room dated 40's, and boiling room dated more recent years has also survived until now.

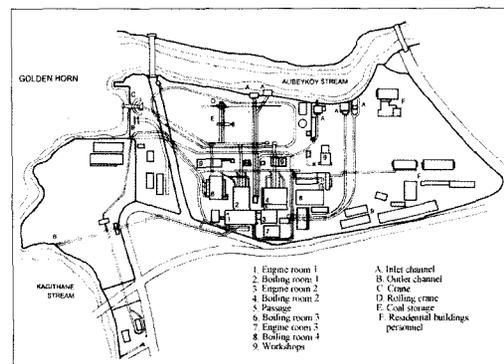


Figure 3

The plans dated years between 1912 and 1970 show that the plant with its original buildings and expansions has become a large complex. Plant and working units were located at south on Haliç shore and residential units moved to north. At the south there were plant and office buildings, workshops, coal storage and lodgings for director and guards. At

the north far from pollution of the plant there were housing facilities for workers and restaurant.

engine room 2 and field observations the construction of first building has been tried to analyse.

CONSTRUCTIONAL ANALYSIS OF FIRST BUILDINGS (BUILDINGS 1)

The report dated 1912 has documented the first decisions about construction in the founding stage of the plant and specifications of spaces and equipments. It also defines the operation scheme of the plant. In this report the dimension of buildings have been given as following values: for boiling room length 37.40 m, span 24.80 m, height from ground 3.60 m, height for space 11.40 m and for engine room the corresponding values are 50 m, 22.30 m, 6 m and 14 m respectively. Besides, it is declared in this report that the buildings have been constructed little longer than project values to allow expansion. From this report it is understood that the engine and boiling rooms 1 have been constructed on reinforced concrete platforms as metal skeleton filled with brick (Figure 4). And these buildings have been equipped with cathedral type windows for daylight and fresh air.²

It could not be arrived to any information about these buildings other than those given in this report. But there are detailed drawings in the state archives belonging to the engine room 2 constructed in 1921. Since the existing engine room 1 and 2 are greatly similar to each other by the help of the projects for

The Project Data for Engine Room 2

The structural system is consisted of latticed steel columns and steel roof trusses at the top of them. Steel columns are supported by a reinforced concrete foundation slab 0.70 m in thickness and 27.4×23.4 in plan dimensions. There is a brick wall 0.52 m in width and 3.0 m in height between columns.

The report dated 1918⁶ about drilling work performed in the field declares the soil profile, it is quite possible that this information has affected the selection of foundation system (Figure 5). The foundation slab is supported by reinforced concrete piles 7.3 m in length 25/25 cm in cross section.⁷ Reinforcement is made of 4•20 longitudinal bars and •6/30 stirrups. The piles have been inserted 0.45 cm into the slab. The slab has also been reinforced at both surfaces, upper and lower, in two directions by •20/25 bars as a grid and •8/50 vertical stirrups. The pile groups have been located just under the heavy machines. The slab and piles were assumed to share the total weight of the upper structure; this can be understood from the technical report prepared for the foundation system.⁷ There is also an intermediate story at level 7.4 m made of steel and supporting the generators. The condensers have been placed on the main floor.

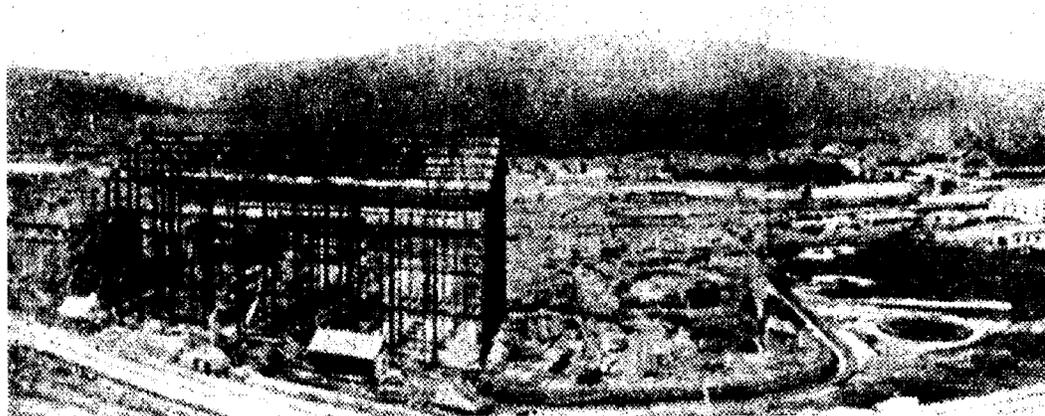


Figure 4

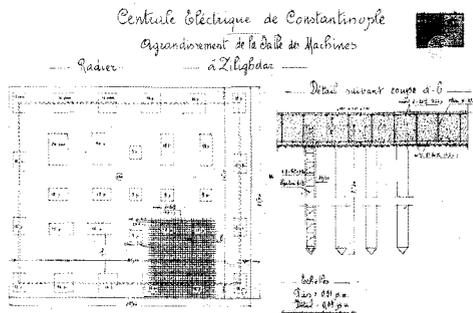


Figure 5

The inner and outer dimensions of the building are respectively 20×25 m and 20.24×25.32 m. Inner eave and ridge heights are 19.9 m and 24.5 m. Steel trusses spaced 5 m in bay width have covered the span of 20 m. These are supported by riveted lattice type of steel columns supporting a heavy crane at level 147m and having tiny sections upwards of this level^{8, 9, 10} (Figure 6, 7, 8).

There are three rows of windows on the façade of the building. The window system has been applied as a metal construction in harmony with whole building.

The outer walls of the building have been formed by a thin brick filling placed between light I-beams supported on the outer surface of columns. Inner and outer surfaces of walls have been plastered. To keep the filling in its place and to provide stability for the system in the direction perpendicular plane of trusses a horizontal bracing system rigidly connected to the columns has been arranged. The total metal construction has been exhibited on façades. Between engine rooms 1 and 2 there are the office room for chief of the plant 5×6.7 m in plan dimensions and a passage 2.5 m in width.

Field Observations for Engine Room 2

The inner dimensions of the building have been measured as 20×25 m just as the same value given in the project. In the west, façade lines of two engine rooms (1 and 2) are same but engine room 2 has been constructed narrower than engine room 1. Eave height is measured as 19.7 m but it is 19.90 m in the project. In general, the building has been constructed obeying the project values with one exception observed in column details. Construction detail is shown in figure 9.

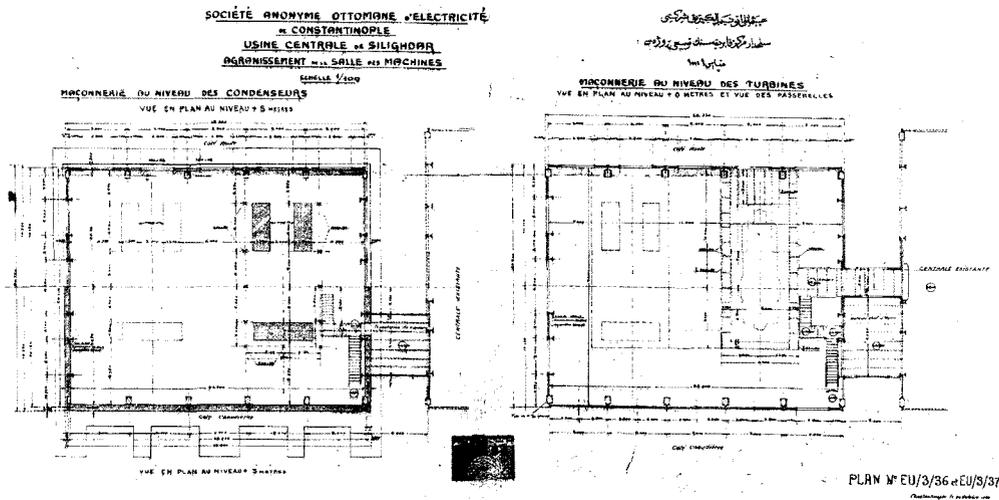


Figure 6

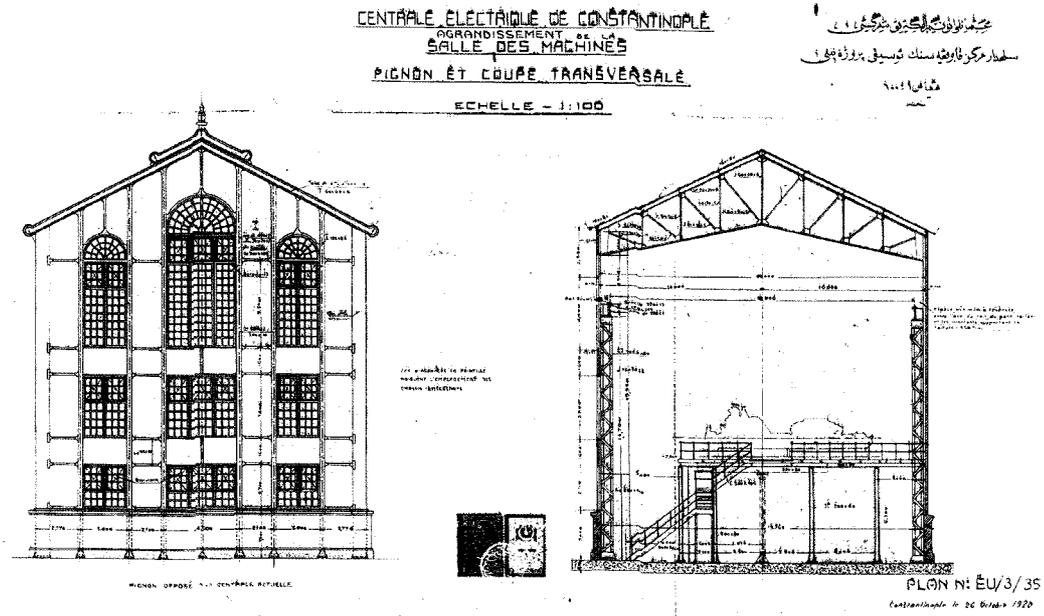


Figure 7

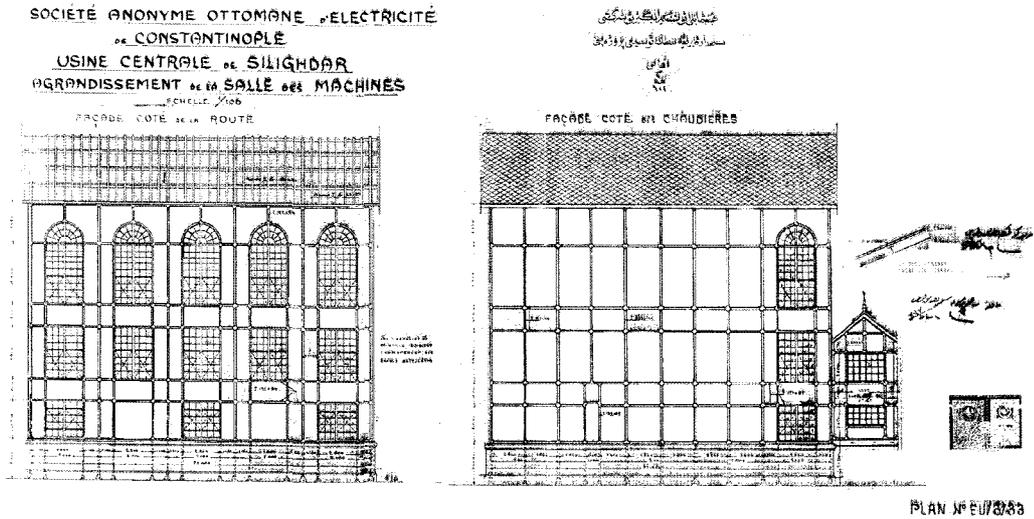
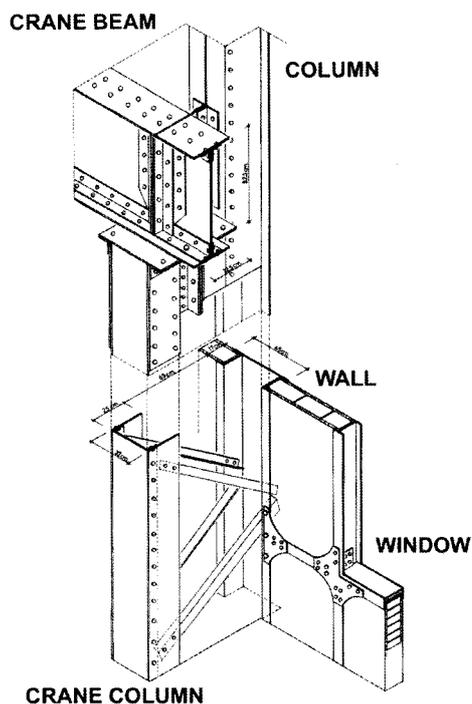
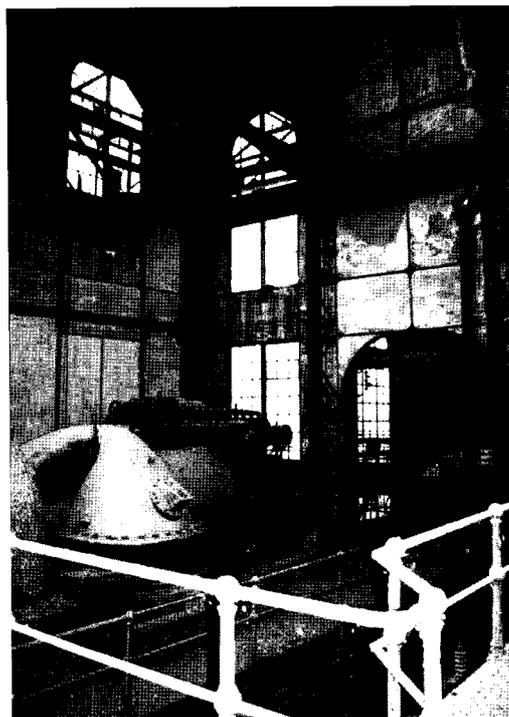


Figure 8



Figures 9a and 9b



Field Observations for Engine Room 1

The inner dimensions of the building have been measured as 23.36×50 m namely the width is larger than the value given in the report dated 1912 but the length is unchanged.

There is a great similarity between engine rooms 1 and 2. The only difference is observed on the details of steel columns. In the drawings for engine room 2 column details are same as the column construction in engine room 1. It shows that the engine room 2 has been designed similar to engine room 1 but in application different column details have been used (Figure 10).

The intermediate stories supporting generators have been observed as made of reinforced concrete in both engine rooms. It is thought that this change (from steel to reinforced concrete) has occurred by the renewal of tribunes with time.

It is not possible to enter the boiling room 1 and make its measurements because of the negative

conditions of the building. But from outer observation it is said that this building has great similarity to engine room 1.

Monorail Construction

Coal for furnaces transported by boats has been transmitted to the coal storage by help of the crane on the pier and the monorail conveyor (Aytar 1957, 5). From here to furnaces a similar system has been used for coal transportation. After burning cinder has been carried to the briquette workshop (Cengizkan 2001, 7) (Figure 11, 13).

This equipment has worked until 1940 without any problem. In the following years due to the weak soil conditions foundation settlements on columns have been observed on monorail system causing heavy damage. There was a serious necessity for repairing (IETT 1940). In 1955 during the modernizing activities of the plant in general the monorail system

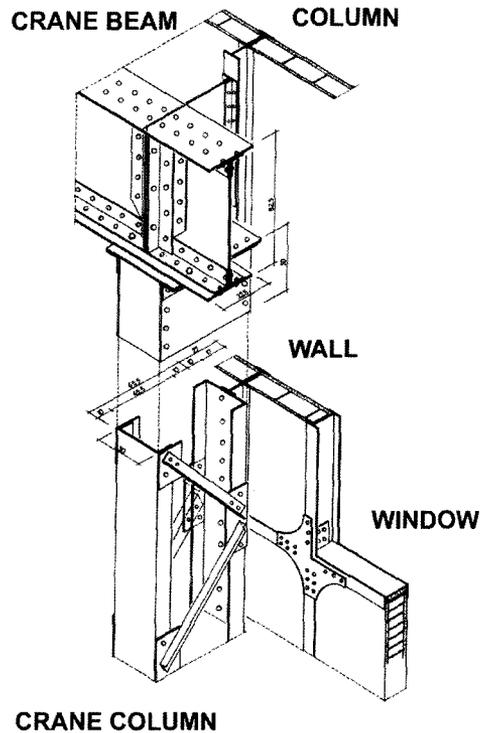


Figure 10a and 10b



has also been renewed. There is no evidence from this equipment to our present day. It is predicted that the whole equipment has been removed together with boiling room 4 in 1985–86. Today the pier has been closed by a concrete wall and abandoned. The

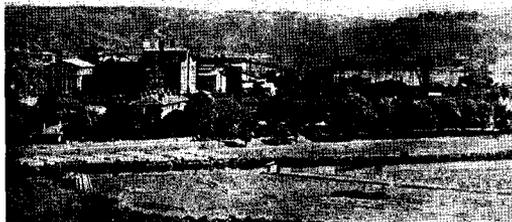


Figure 11

following definition of monorail system depends on the exiting documents. From the drawing dated 1928 it is observed that there were a pier toward Haliç in dimensions of 5×30 m and a quay of 70 m on the shore with a crane at its mid point.¹¹ The construction system is composed of two rows of piles with 5 m apart from each other and vertical retaining walls between them. The space between these walls has been filled with soil. The material used in piles and walls has been predicted as timber depending on drawings (Figure 12).

The rotating crane on the quay has also been supported by piles.² This crane could cover the circular area 8 m in diameter and fill up a bucket at the level of 19 m and the bucket has transmitted the coal to the monorail system at the level of 16 m (Cengizkan 2001, 8).

The plan dated 1923 shows that the coal storage

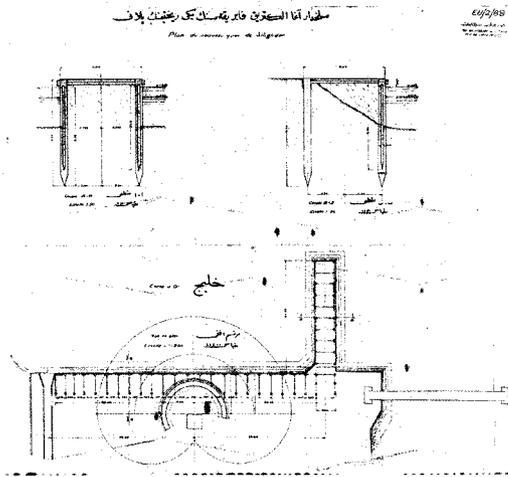


Figure 12

was located between the plant and the stream and equipped with a rolling crane system reaching the whole area of 50×124 m in dimensions¹² (Figure 13).

PRESENT SITUATION OF THE PLANT

The plant has been nationalized in 1937. It has been directed by the Municipality of Istanbul until 1970. At this year Turkish Electricity Association took over the establishment. Production of electricity has finished in 1983 because of lack of the cooling water in the stream. From this year up to now plant has been

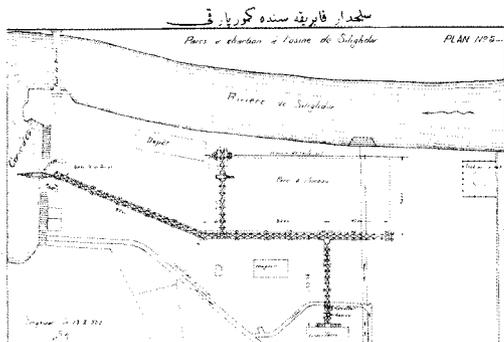


Figure 13

working for a power distribution station. In our days the existing buildings are first engine and boiling rooms (both number 1, dated 1914) in fairly good conditions, engine room 2 (dated 1921), boiling room 3 (dated 1939) and engine room 3 (dated 1944). In these buildings whole equipment used in the past for production are existed. But boiling room 2 just in front of the engine room 2 has been demolished. The surviving parts of this building are reinforced concrete platform supporting the upper structure and few details. The boiling room 4 starting to the service in 1956 has been completely removed and its vacant lot is used as a storage area.

After loosing its function the plant also goes on to exhibit its identity (Figure 14). During the rehabilitation works of the district the importance of the plant has been recognized and a serious attempt has been made to preserve it. The plant has been registered by Ministry of Culture in 1990 as a monument of industrial heritage and intended to refunction as Industrial Museum. From this year to now the restoration works of the plant has been put on the agenda. But besides some ownership problems there are other difficulties in convention process of this large and important complex. Although all negative conditions it would be suitable to refunction the plant specially as energy museum and so it will be preserved and reused in future in harmony with its original function.

NOTES

1. Exploration map for the plant, which will be constructed in Silahtarğa. Date 11.05.1911 and number 34E/750, (number Republic of Turkey Prime Ministry,



Figure 14

- General Directorate of State Archives-RTPMGDSA 230/48.73.2).
2. «Memoire descriptif et justificatif des dispositions dans l'Usine»; Date 09.09.1912 and number 34E/734, (RTPMGDSA 230/48.73.4).
 3. The plans of magazine, workshops and other buildings. Date 19.07.1921 and number 34E/774, (RTPMGDSA 230/48.74.14), plan U 160.
 4. General plan of Silahtaraĝa Power Plant. Date 05.06.1933 and number 34E/820, (RTPMGDSA 230/49.78.7).
 5. Report from Turkish Electricity Association Archives.
 6. Drilling works on the field to observe soil conditions in the area of Silahtaraĝa Power Plant. Date 01.03.1919 and number 34E/768, (RTPMGDSA 230/48.74.7)
 7. The plans of changing to be made in Silahtaraĝa Power Plant. Date 31.01.1921 and number 37E/771, (RTPMGDSA 230/48.74.11).
 8. The plans of changing to be made in Silahtaraĝa Power Plant. Date 31.01.1921 and number 37E/771, (RTPMGDSA 230/48.74.11), plan EU/3/36, EU/3/37.
 9. The plans of changing to be made in Silahtaraĝa Power Plant. Date 31.01.1921 and number 37E/771, (RTPMGDSA 230/48.74.11), plan EU/3/35.
 10. The plans of changing to be made in Silahtaraĝa Power Plant. Date 31.01.1921 and number 37E/771, (RTPMGDSA 230/48.74.11), plan EU/3/34, EU/3/38.
 11. Pier and quay plans for Silahtaraĝa Power Plant. Date 20.05.1923 and number 34E/809, (RTPMGDSA 230/49.77.7), plan EU/2/69.
 12. Coal transportation system in Silahtaraĝa Power Plant. Date 19.08.1924 and number 37E/800, (RTPMGDSA 230/49.76.13), plan EU/4/120.

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- Erengil, Sadık. 1957. İstanbul Boĝzı'nın 154 KW. ile atlanması l zum ve faydaları», *İ.E.T.T. Dergisi*, S.7, s.3–5.
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