

Early concrete heritage in Istanbul, Turkey

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Abstract

Development of the construction technique and necessity for multi-storey buildings, massive concrete and cement arme technique using cement with iron rods and brick during last part of 19th century is followed by ferro-concrete of iron profiles filled with concrete and then reinforced concrete during the first part of 20th century. These rather recent structures form an important part of Turkey's cultural heritage.

Turkish conservation community which has competence for conserving earlier built heritage now faces conservation of Modern heritage buildings. The conservation techniques required for heritage of recent past of the Modern era are different from those appropriate to earlier buildings. These buildings included concrete that was used and manufactured according to the knowledge at the time of construction. The form of deterioration and crack propagation is different than the constructions of earlier heritage. Repair methods have changed considerably in the last few decades and are still changing. As the components of concrete have been undergoing continuous development, architects and engineers involved in the preservation of historic concrete structures need to understand the material of the period.

In the conservation of modern heritage, the repair of concrete raises conceptual and technical questions about longstanding principles of material and design authenticity. Like the programs aimed at conserving earlier heritage, conserving the built heritage of the recent past include a number of interrelated phases, namely diagnosis, safety evaluation and design of the intervention. These processes complement, and in many cases precede, physical interventions.

This study will outline the early use of concrete up to the 1930s as a building material in Istanbul, Turkey, that is trying to develop strategies for the heritage of the recent past. It will identify characteristic defects and patterns of deterioration in the material and propose

a set of evaluation procedures and conservation strategies for the preservation and repair of these structures.

Keywords: Early concrete buildings in Istanbul, preservation of early concrete buildings, ferro-concrete structure

1. Introduction

The first Ottoman reference to the use of concrete is during late 19th century, in the parks and gardens of the palaces as pedestrian walk ways, sculptures and park ornaments as cascades and banisters in the form of wood then in the renewal of the roads and making ballots for military.

Reinforced concrete construction technology entered Ottoman architecture in 1906 immediately preceding the Second Constitution Period with the proposal of an Ottoman architect educated in Europe for the reconstruction of the Customs Buildings, Loading Warehouses and Depots and Maritime Traffic Administration Building. This proposal was not appreciated by the bureaucracy that was alarmed by this unorthodox construction for during that time, stone and brick masonry was the dominant construction materials for most of the significant buildings. With the insistence of the architect and support of the government architect who was also educated in Europe, the projects started in France. During construction, it was hard to find workers for masons of the time did not favor this "new" material that necessitated structural analysis [1].

Development of the construction technique and necessity for multi-storey buildings, massive concrete and cement arme technique using cement with iron rods and brick is followed by ferro-concrete of iron profiles filled with concrete and then reinforced concrete using rectangular or round bars. The building elements using these techniques, sometimes in the same building, followed the timber construction technique till 1930s.

The reinforced concrete stock that began in the late Ottoman period and increased in the Early Republic period were developed and shaped by government policies. When most of the masonry buildings failed in 1912 Istanbul earthquake, the government buildings started to be built in reinforced concrete [2]. These rather recent structures form an important part of Turkey's architectural heritage.

2. Construction Standards

In order to have a homogenous city environment and make earthquake resistant buildings, Istanbul city standards were prepared starting from 1848. This standard advises to strengthen stone or brick walls with iron or copper ties at several rows and to use equal amount of lime and sand for mortar [1]. Strengthening of masonry walls with bars were

adopted even in the early applications of reinforced concrete buildings. If the columns of the system were of ferro concrete, the bars of the masonry walls were riveted to the iron profiles. If the columns were of reinforced concrete, walls were constructed first, then the bars of the columns were placed and concrete was cast. The joints between masonry walls and reinforced concrete columns were zigzagged. Such a system can also be considered as masonry wall with vertical ties. Figure 1 showing this application in reinforced concrete construction is drawn as described in the contracts made with architects.

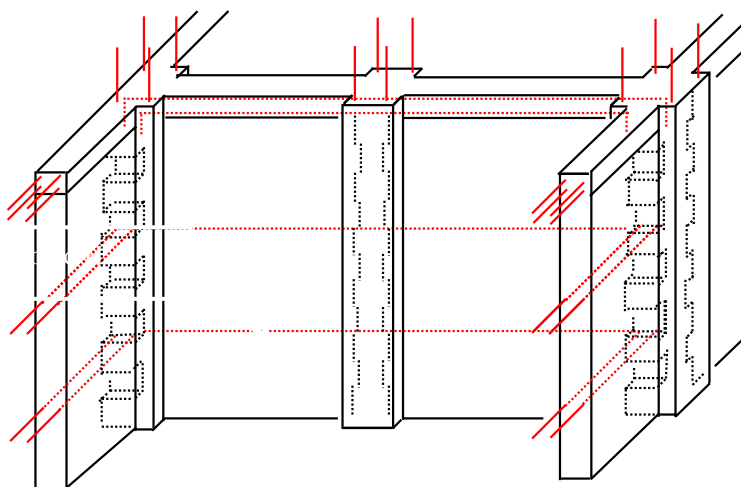


Figure 1

3. Early examples in Istanbul

The examples from Istanbul are limited to the period between 1906 and 1930 because the documents related to the early use of reinforced concrete begin in 1906. The RC constructions started with government buildings and increased in civil architecture after 1930.

3.1 Galata Customs Building

The building construction with 35x185m in plan dimension started in 1907 and after several pauses completed in 1911. The building has a symmetrical plan with eave height of 8.20m at sides and 12.40m in the middle part. The 15x30m of the 35x110m middle part that is crowned with a vaulted dome of cement arce takes day light from the lantern above.

The building situated on the seaside had a foundation of timber piles tied with iron mesh embedded in 1.80m thick concrete. The closely spaced columns of ~350x500mm are of ferro-concrete with double iron channels filled with concrete (Fig. 2). The ferro-concrete

~500mm high beams and columns are connected in gussets and arches. Closely spaced ~350mm high secondary beams support the ~150mm reinforced concrete floor. This is a transition from the jack arch floor system that was used from late 19th century on to the reinforced concrete system.



Figure 2: Galata Customs Building- column detail and façade

Today the building is used as maritime administration and hospital. Its plan scheme has lost its authenticity due to many interventions the building had passed.

3.2 The Church of Saint Anthony

The church first established in 1221 to serve Catholic community decided to construct a new church in Pera (Taksim) in 1905 and assigned Architects Guilio Mongeri and Eduardo de Neri for the projects and engineer Guglielmo Semprini for the control of the construction. The construction started in 1906, stopped in 1907 due to the financial problems, started again in 1910 and completed in 1911.

The church in the form of Latin cross of 20x50m in dimension is constructed on a sloped area that the ground floor is 26m above the back street (Fig. 3). Thickness of the foundation and basement walls of stone and brick laid alternatively are ~ 3100mm at the base and 1800mm at the top. The reinforced concrete ground floor is constructed over the reinforced concrete arches that tie the basement walls. The church of 23m in height have crypt in Romanesque style and façade reproducing the 14th century Tuscan-Lombard style. The brick veneered external walls are of stone and brick that are laid alternatively and strengthened with iron bars up to the arch base and solely brick above. Internal columns,

the arches tying the external wall piers and columns and the vaults above the arches are of reinforced concrete.

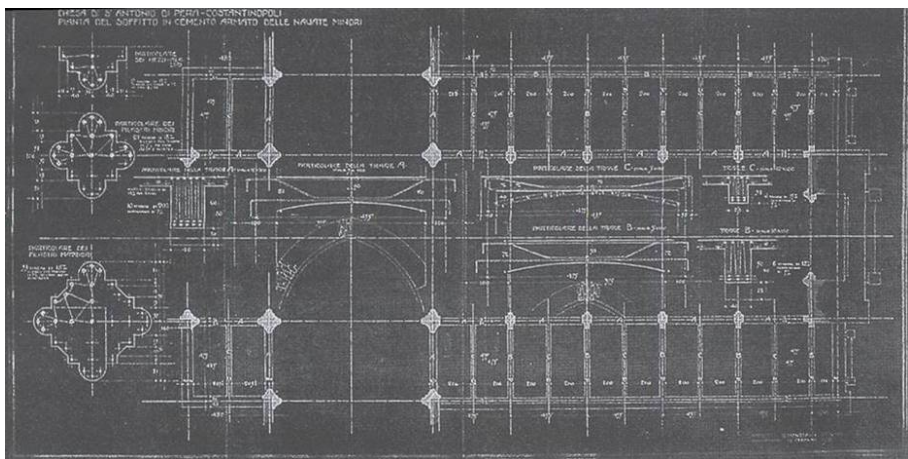
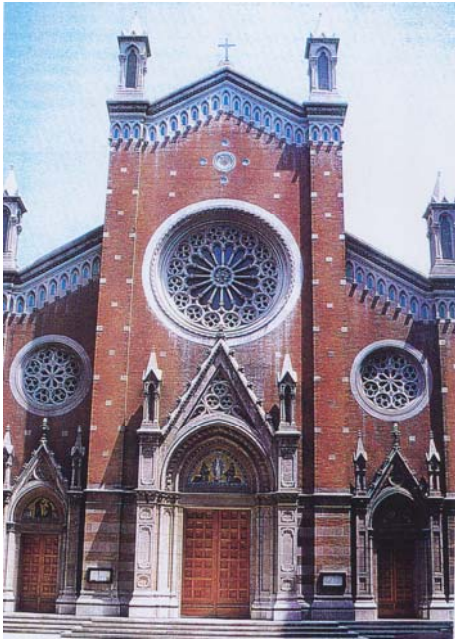


Figure 3: The church of Saint Anthony- front and back facade and floor plan

3.3 Fourth Vakıf Commercial Building

The projects of 4th Vakıf Commercial Building were first made by Le Mari for “Societe Anonyme Ottomane de Constructions” firm in 1911 and was approved in 1912 (Fig. 4a). It is not known if the construction had started but in 1917, another project in ferro-concrete system was prepared by a German firm, Reitschel & Henneberg GMH (Fig. 4b). In 1919, before the construction was finished, the building was used by French soldiers as headquarter named “Caserne Victor” [2]. The construction was finished in 1926 after the Republic was established.

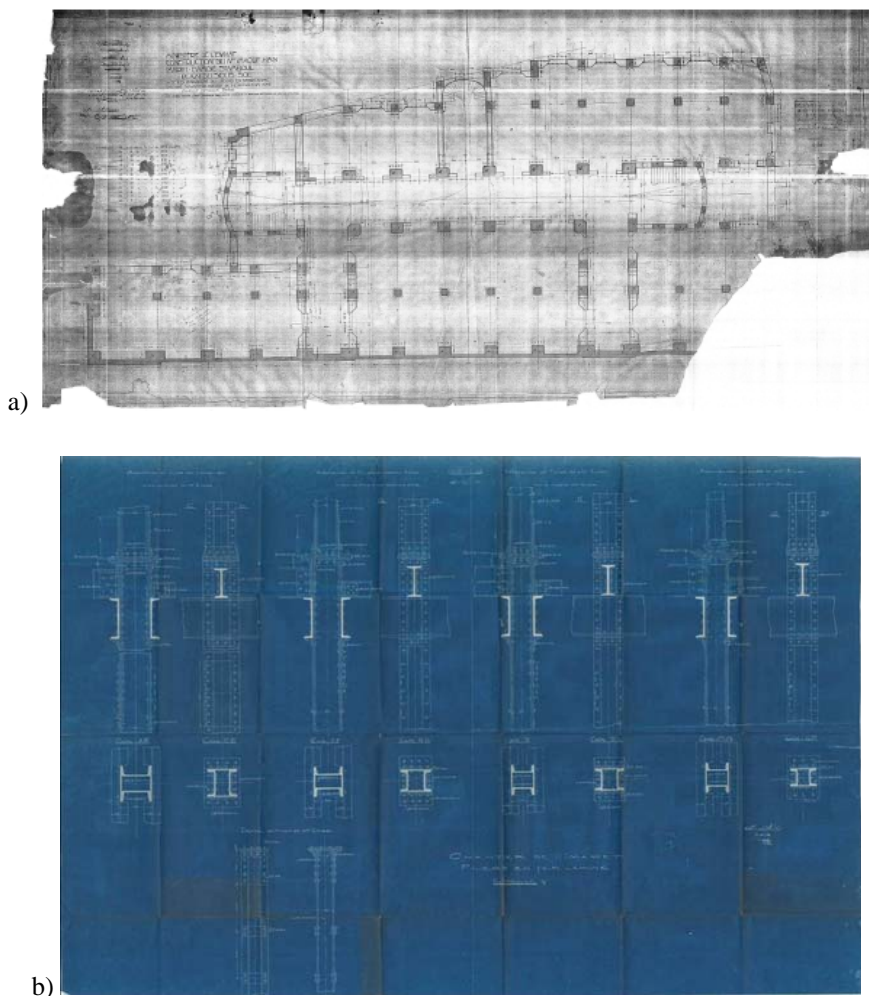


Figure 4: Plans of IV. Vakıf Commercial Building a) in 1912, b) in 1917



Figure 5: IV. Vakıf Commercial Building

The building of 78.7-59 x 32.6m in dimension and 27.21m in height consists of a basement and 6 office floors (Fig. 5). The atrium in the center is closed with iron frame and glass at first floor. During the restoration in 2004, it is seen that the columns of reinforced concrete of 800x1000mm and 800x1500mm at basement rest on a mat foundation. The columns of the ground floor and first floor of 500x500mm and upper floors of 300x300mm in dimension are of ferro-concrete with double iron channels filled with concrete. The beams tying the columns are of 2NPI300 iron. The 150mm thick floors are of iron jack arched floor with NPI240 joists. The thickness of the exterior walls veneered with stone on entrance facade and brick on the opposite façade becomes 800-1000mm.

3.4 Apartment Houses of Harikzadegan

Apartment houses in Laleli district were constructed to house families whose houses were destroyed during 1918 fire. The construction started in 1919 and completed in 1922. The project designed by architect Kemalettin, a government architect, consists of identical four apartment houses of four storey at the corners of a cross road. Each block of approximately rectangular shape has square patio in the center. This is the first apartment house and first completely reinforced concrete construction of Ottoman period (Fig. 6). The structural system of closely spaced two way reinforced concrete frame with secondary beams laid in 1.5m distance to support the reinforced concrete floor and the roof structure follow timber construction technique.



Figure 6: Apartment Houses of Harikzadegan- structural plan and elevation

These houses were not favored by the families affected from the fire for such house system was not suitable for their traditional way of living. Then the apartments were rented to families living in modern way. Later, the district lost its attractiveness and the buildings were abandoned for a long time. In 1984-87, the buildings were renovated to be a hotel. Now these buildings are used as Merit Antique Hotel.

4. Conservation of Early Concrete Heritage

Turkish conservation community which has competence in the development of appropriate solutions for conserving earlier built heritage of masonry and timber now faces conservation of Modern heritage buildings with monolithic materials. The conservators, while developing preservation strategies, have to raise awareness for the heritage of the recent past. Though these are listed, the early concrete buildings are not considered historical as earlier built heritage.

The conservation techniques required for heritage of recent past are different from those appropriate to earlier buildings. The early concrete or reinforced concrete constructions were built when this technology was in its infancy and masonry constructions at its peak. These modern buildings introduced structural frame with columns opening building to daylight and were manufactured according to the knowledge on material at the time of construction. The conservation criteria that constitutes acceptable for earlier heritage will be unlike for these modern structures.

The form of deterioration and crack propagation is different than the masonry or timber constructions of earlier heritage. Most common forms of concrete deterioration are cracks, spalling and disintegration. Cracks can be due to differential settlement of the soil caused by the blockage of the wells and discharge system of the underground water designed in the basement or ground floor of the buildings. This common practice in masonry and timber constructions of the time was also practiced in the early reinforced concrete structures. Cracks followed by spalling are due to rusting of the reinforcement or cast-in-place metal fittings by water penetrating into concrete elements. This type of spalling is often accompanied by rust-staining. Rusting of the iron beams, lintels and other metal fittings can cause disintegration of concrete and separation of adjacent elements.

Conserving the built heritage of the recent past, like those programs aimed at conserving the earlier heritage, include number of interrelated processes that complement interventions. These include diagnosis, safety evaluation and design of the intervention. In assessment of the deterioration, non-destructive testing to determine the extent of corrosion, location and size of reinforcement, voids and areas of poor concrete and loss in sections, partially destructive testing as core taking for laboratory evaluation are necessary. Before any intervention decision, the cause of the deterioration has to be identified and the necessity for the repair should be evaluated.

The reinforced concrete structures of the early 20th century that still remain essentially sound is quite different than today's reinforced concrete structures. The techniques for their repair ranging from crack injection and application of patching and recasting don't have long past for experimentation and assessment. In all repair procedures of cracks in massive

sections of early concrete building elements, necessary steps should be taken in minimizing shrinkage, using compatible materials and ensuring high standard workmanship. The change in quality of the concrete due to the change of cement, different hardening times, or variations in the water content of the mix could cause cracks and spalling of the concrete on either side of the crack.

Repair methods have changed considerably in the last few decades and are still changing. As the components of concrete have been undergoing continuous development, architects and engineers involved in the preservation of historic concrete structures need to understand the material of the period, design authenticity and structural design intentions in configuration.

Reference

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