

CHANGES IN THE BUILDING TECHNOLOGY IN ISRAEL FROM ANCIENT TIMES UNTIL THE 20TH CENTURY AND THEIR INFLUENCE ON EVERYDAY LIFE

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SUMMARY

Israel's historical building technology is not different or outstanding in any of its technological characteristics relative to the Mediterranean Sea region and the Near East culture. But, since Israel is both the crossing point and passage for major historical events and cultures, it is not surprising that building technologies have been brought here relatively in a short period from their "official date" appearance. The most interesting point is the ties between these building technology cultures, their influence on the historic building technology in Israel and the concerns of how to conserve and save them.

3,000 - 1,000 B.C. - THE MUD BRICK TECHNOLOGY

The antique "mud brick" construction in Israel is a link in the technology chain in the Near East ranging from Egypt to Mesopotamia. This is characterized by public buildings, city gates, towers and walls, palaces, etc. and are present in almost all of the antique tells such as Tel Dan, Tel Hazor, Tel Beith Shean, Tel Megido, Tel Acco, Tel Yaffo, Tel Ashdod, Tel Ashkelon, etc. The technology of mud bricks consists of mud bricks reinforced with straw and mud bricks reinforced with crushed stone-technologies that were used both in Egypt and in Mesopotamia. The most spectacular examples of these technologies are the two Mud Brick Arched Gates of Tel Dan [1] and Tel Ashkelon [2] dating 3,600 and 4,000 years ago. Thus, arches were built here 1,500 years before the official Roman Arches appeared.

The mud brick buildings have barely survived in just a few sites, but those surviving sites provide us with enough information to comprehend the vast knowledge that these builders had. We can see this from the technology of the bricks, from the insulation that was applied to the buildings. It is known that the Mud Brick Technology had been widely used in

countries that lacked stone near the building sites but had wide silt and clay deposits, and also in areas lacking the stone cutting technology or tools . Since stone was available in Israel, it is strange that the Mud Brick Technology was used. The Mud Brick Technology in Israel spread quickly due to the direct influence of the passing and governing Antique Imperial States of Egypt, Assyria and others with their imported architecture and technology. This stage existed in public construction for more than 1,000 years, until it began to lose popularity and be replaced by local stone architecture and technology that had been influenced by the Phoenicians, the builders of the Temple from stone and wood, and by other Mediterranean Islands' population invasions such as the Filistees, who also brought the Iron Technology necessary for a good stone cut and dressing.

60 B.C. - 1,900 A.D. – THE ROMAN TECHNOLOGY

Beginning with the 4th century B.C., the whole region including Israel was under the influence of the Greek Hellenistic Culture, which was characterized by very accurate buildings and finishes although very few examples still exist. Unlike in other countries where the Hellenistic culture and technology penetrated easily, it was very difficult to infiltrate the local culture and architecture because of the gap between the Hellenistic and the Judaic-Samaritan cultures. Before it could have a major impact on the culture, another imperial power, Rome took over the country in the 1st Century BC. and brought with it the biggest building technology revolution in Israel.

If we define the 60's B.C. as the official Roman domination in Israel, just a few years later we had already incorporated the main characteristics of the Roman building technology, such as the engineering arch and vault, the lime lime "cociopesto" concrete, mortar and plaster. This technology with few changes and adaptations to different architecture styles, was used here until the end of the 19th century B.C.

The spread of the arch as a system of bearing and spreading of stresses and weights and a means for connecting walls, covering spaces and eventually as floors spread through Israel and was implemented in the rehabilitation of the Second Temple in Jerusalem 40 - 10 B.C. as well as in the buildings of the new city of Caesarea in 20 - 10 B.C. [3], Herodion, Massada, Samaria, etc. All of these public buildings and cities were built with lime mortar mixtures and arched -vaulted ceilings, roofs and bridges. In the next 200-300 years this system spread to all kinds of buildings including vernacular ones . We have many examples from this period of vaults, domes, roman plasters, tiles and mosaics, underwater hydraulic cements and concrete and water systems .

Although the later periods -- Early Islamic, Crusade, Mameluch and Ottoman -- had important architecture styles, needs and origins, none of them introduced substantial and wide spread new building technologies. Most of the interior environmental climates, as well as the width of walls, floors and ceilings remained intact for almost 2000 years. It is amazing that the Roman technological elements were employed uniformly throughout the Roman empire 's hemisphere, but always with the maximum use of the available local materials . In Israel the mortar had been used but with few dust bricks and more crushed stone because of the lack of large good

burning materials for the clay brick industry. The Romans and the Byzantines (here until the 7th century B.C.) used the arch and vault with lime-sand stone on the coast, lime stone in the interior mountains and basalt stone in the north and the Jordan Valley. In places where all these materials were lacking, they used small undressed stones and Roman concrete. There was almost no use of clay brick vaults and arches.

1,900 - 2,000 AND MORE – MODERN BUILDING TECHNOLOGY

The Steel Beams Technology and the appearance of the Portland cement are, in my opinion comparable to the appearance of the Roman Arch and Cociopesto lime Roman concrete. This technology appeared in Europe in the middle of the 19th Century and first arrived in Israel at the end of the 19th Century, only 40 years later. In less than 30 years all public and important buildings were constructed with the new technology as the Roman building technology disappeared. The Steel Beams Technology employed I Beams and Reinforced Concrete in ceilings and roofs which eliminated completely the arches and vaults (the last ones known to be built in 1910). In less than 40 years the Portland cement based plaster, mortar and concrete replaced and eliminated all the lime based plaster, mortar and roman concrete. The thick stone walls and cross/vaulted bearing systems were replaced in less than 20 years by cement bricks and blocks and the concrete frame. [4] This was the second major technology revolution after the Roman Technology revolution. In Israel 2000 years elapsed between the Roman and the Modern Industrial Technology revolutions and about another 2000 years separated the Ancient Mud Brick Technology and Roman Technology.

CONCLUSIONS

Almost all the antique and historic buildings are characterized and represented through monumental and public buildings. Little attention has been paid to the vernacular building technology, which in many cases lasts much longer than the modernized public ones. Although it is an important to analyze this point, this paper concentrated on the public buildings.

In the past the absorption of most new building technologies occurred when important buildings were erected by newcomers to the country or imperial powers governing the country. The absorption and spread of the technology was always quick, in less than 100 years. The two major building revolutions in Israel were similar to the building revolutions throughout the world -- the Roman Empire technology revolution followed by the Modern Industrial. [5] The main question still remaining to be analyzed is whether a link can be found and used between the two technology revolutions for the good of the human being. Can we find the links between the same technologies in different countries around the Mediterranean area, what was the behavior of the technologies in the different countries, and the dual spread of knowledge from this research. Some of the answers can be found in the following points.

CONSERVATION OF OLD TECHNOLOGY FOR WHOM AND HOW?

Now, that we know about the building technologies in the last 4000 years in Israel, we have set four goals to reach:

A. Understand better old building technologies and the changes from the original prototypes.

This goal can be achieved by creating an international research team aimed at implementing a thorough research and analysis starting with the mud brick technology and ending with the modern period and focusing on the structural point of view of the building environment.

B. To conserve the old technologies in buildings as part of the building engineering history.

The easiest and best method for engineers is to study and employ to their maximum potential the techniques, methods and knowledge they can obtain from the old technology of antique buildings in order to integrate the technologies in the whole conservation approach and implementation.

C. Where possible, to adapt these buildings together with their old technology, to modern uses.

In the readaptive use of buildings there is still a large tendency of engineers not to structurally trust the old systems and building technologies. With better knowledge of these old technologies and the dissemination of this knowledge, planners will be able to adapt approaches that are more economical by using the residual potential of the old technologies.

D. To try to use, the old technologies in the modern building field.

Many of the old building technologies, although having less structural strength, have usually used local materials which may differ from one country to the next, although the same building technology is employed. These local building materials are in many cases less harmful to the environment and to humans. It might be useful to characterize these materials and to create a modern technology for modern buildings using old building materials that are friendly and not harmful to the environment.

The lecture will be followed by slides.

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