ARCHITECTURE

EHLINGER & ASSOCAITES FIRST QUARTER 1991

PALACE OF THE GOVERNORS

This issue's limited edition signed print by Ladd P. Ehlinger is of the Palace of the Governors in Uxmal, Yucatan, Mexico. This palace was built in the eighth and ninth centuries A.D. by the Mayas in the Puuc style.

Uxmal is in the northern zone of Yucatan and the name 'Puuc' is a Mayan word meaning 'land of low hills'. Here the limestone plateau of the Yucatan peninsula is as flat as a tabletop and, although slight undulations of the ground appear here and there, the horizon line remains strictly rectilinear. The vegetation of the northern district of Yucatan is determined by the lesser rainfall of the almost arid region. The undergrowth is mostly a dry, deciduous scrub, and the trees seldom grow taller than forty feet.

These environmental factors played a large role in preserving Puuc style buildings. In more tropical rain forests that the Maya inhabited, such as the Peten, the vegetation is much more destructive, and buildings in those regions are much more difficult to restore. In addition, the low vegetation and flat land, coupled with the generally short stature of the Maya, affected the character and proportion of Puuc style buildings as they are low and squat with horizontal emphasis.

Puuc style buildings are characterized by smooth walls surmounted by decorative friezes, separated by a band of wide molding, with the ornamented portion of the wall surmounted by another wide molding as a cornice. This form of double girdle surrounding the upper portion of the building derives from the linking cords which served to strengthen the walls of the thatched huts that the Maya lived in. As with most early stone architecture, structural elements of perishable materials such as wood or thatch were translated into stone.

The actual function of the Palace of the Governors is unknown. The form and layout of the building however, does suggest that of a palace. It is 322 feet long, 39 feet in depth and 28 feet high. The building is composed of three blocks. The print depicts the central, largest block which is connected to the flanking blocks on both sides by lofty corbelled vaults that mimic the form of the thatched huts. The arched openings formed by the vaults were originally left open, but were later walled up and fronted with columns.

The building sits on a high plateau which functions as a podium and is reached by a monumental staircase in front of which sits the throne of the two-headed jaguar. The symmetrical, yet cleverly irregular spacing of the doors indicates a lively feeling for composition. The central entrance doorway is surmounted by a great decorative feature which forms the hub of the freize design. The horizontal elements represent celestial dragons one above the other, while the remainder of the freize consists of Greek key ornaments over a network resembling an open work grating.

The civilization of Uxmal deteriorated badly in the 12th century, with the city barely inhabited from that time onward until the arrival of the Spaniards in the 15th century. The major reconstruction of Uxmal took place in the late 1930's and was performed by the Archeological Department of the Mexican government. There are still major monuments in the city that need to be restored, however.

GREEK REVIVAL

The "White Pillars" style in American domestic architecture became most popular in the early 19th century (1820-60). Beginning with the mansions and important public buildings of Washington DC, the style quickly spread across the country with universal appeal.

The foremost characteristics of the Greek revival style in America were adapted from the Greek temple - pillared porticos and pediments, low or flat roofs, and the visual supression of chimneys.

Doorways take center stage and many existing homes of Federalist, Colonial or Georgian style were given a classic air by the addition of a Greek portico or a massive porch with wood columns, sanded and painted to look like smooth stone.

There were hundreds of variations of the theme across the country, both regional and local. Every city of consequence was anxious to become the Athens of America with a "white pillared" edifice at the center of town.

BRICKS

Bricks are among the oldest construction materials known to man. The earliest known civilizations (C. 5,000 BC) in what is present day Iraq and Iran in the northern highlands used a sun dried brick composed of clay with straw used as a binder. Later, after civilization moved further south (C. 3,000 BC) to Mesopotamia, between the Tigris and Euphrates rivers, to such City-States as Ur and Babylonia, bricks began to be 'fired'. Man discovered that the clay became much harder when heated to a very high temperature, and that it was no longer soluble in water.

Stone was used only for the most important buildings of these civilizations, as it did not have the economy of brick, though it was more durable. Brick was a very economical material for early man. It did not take heavy lifting equipment. It was easy to mold, not requiring any special tools, and it was easy to transport being capable of being moved on small carts.

The disadvantages of brick construction for the ancients were that it was a soft material. The unfired brick would dissolve in the rain, and even the early fired brick was poor in its weather resistance compared to stone. Ancient builders early on faced their brick structures with plaster to protect the brick. This plaster was subject to the same problems as the brick, but was more easily renewed or patched.

These early structures were solid brick, but as more experience was gained, the brick began to be constructed as a shell, cross tied with brick, and the interior filled with rubble and mortar, making the construction cheaper yet. Mortar at this time was also susceptible to deterioration in the weather and needed protection as well. There was no portland cement at that time and all mortars were lime based.

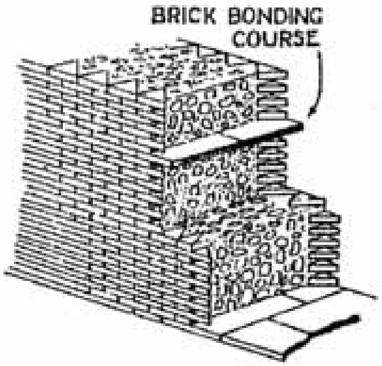
The ancient Egyptian and Greek builders followed the technology of the near east up until the time of the Roman civilization. The Romans extended the technology of brick construction by making different types and sizes of bricks, by utilizing a natural portland cement (mined in Italy) discovered by the Romans, 'pozzalana', in their mortars, and by facing many brick structures with a thin facing of stone for weather protection and aesthetic considerations.

The Romans' key improvement of the technology of brick was in the various shapes that they began to mold for various purposes. Previous civilizations did not utilize a true arch or dome. Horizontal spans across supports were short due to the practice of 'corbelling', where successive courses of bricks were extended outward slightly toward each other from opposite supports, as excessive corbelling would cause the course of brick to fall.

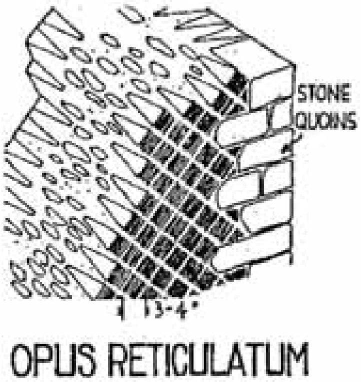
The Romans shaped their brick to be used in arches and vaults in triangular arc segments, today called 'voisseurs', and built true arches as we know them today. The brick units were also hollowed to save weight when utilized in a roof structure, and were also shaped three dimensionally for dome and vault type structures. Masonry structures were freed by the Romans from the horizontal span limitations of the past. Spans of Roman vaults were generally around 80 feet and domes exceeded 140 feet. Many of these brick vaults and domes combined concrete made with the pozzalana with the brick, and they were built without centering (a temporary form) as the bricks were shaped in such a way as to provide their own centering and act as form for the concrete.

The brick shapes for the walls devised by the Romans acted in similar ways. Shapes that keyed with stone, that keyed with concrete and rubble fill between the two halves of the wall, and that functioned as final aesthetic surface material were used.

All of the ancient brick construction was compressive in nature. These structures had no resistance to tensile forces, and were subject to cracking when foundations settled, when subjected to earthquakes, high winds, or the architect guessed wrong about the forces being generated by the weights being carried above. Only the shapes of the arches, vaults, and domes coupled with the mass of the walls provided stability to these structures. There was a primitive understanding of the equilibrium of these structures and the resolution of the forces within them. Also, ancient brick structures tended to be damp. The dampness of the ground rises through capillary action up the brick masonry. In especially porous brick it has been known to rise as high as 15 feet. Rain on the sides of solid brick walls will, during periods of excessive rainfall, saturate the brick masonry and spoil interior finishes. Solid brick walls depend upon a dense vertical mortar joint (collar joint) to serve as a barrier to moisture penetration to the interior. Extensive saturation of the exterior surface will penetrate this barrier, and cracks in the mortar and bricks from settlement and thermal effects will exacerbate the problem. While we don't think of brick as being porous, the effects are easy to see.



OPUS TESTACEUM



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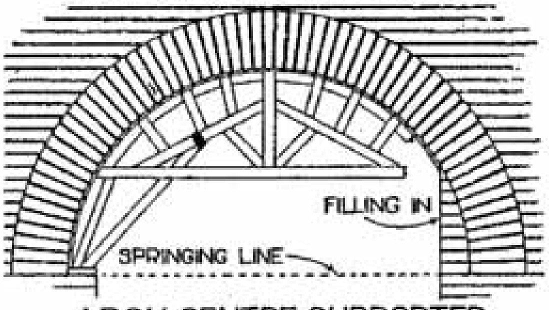
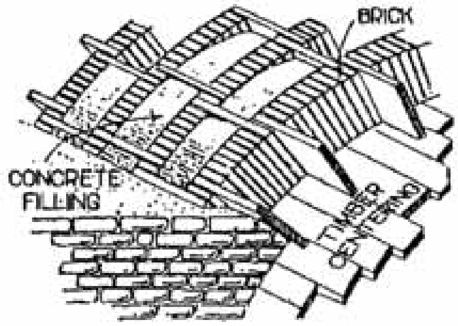


ARCH CENTRE SUPPORTED AT SPRINGING



VAULT CONSTRUCTION

During the Renaissance period (C. 15th to 17th centuries), architects began to introduce tensile materials to resolve the tensile forces within the structures. Tie rods of metal were used in arches, allowing a thinner arch with a greater span. Tension rings of metal were used at the outer edge of domes to absorb the thrust (horizontal force) produced by the dome, allowing greater spans with less materials. Also, waterproofing concerns began to be handled. A course of slate (a material noticed as being almost non-absorptive) was introduced in the wall at a level just above the ground to stop the 'rising damp'. Brick technology advanced with greater control over the type of clay being used, firing techniques were advanced with higher temperatures being used, making a harder and less absorptive brick. Thinner mortar joints were used, allowing less avenue for water entry. Better lime mortars were used, with some ingredients approaching the hardness of our modern day portland cement.

But it was not until the 19th & 20th centuries when the scientific method was applied to the problems of brick construction that the poor tensile resistance and high water absorption of brick construction began to be solved. This will be covered in a later article.