ARCHITECTURE

EHLINGER & ASSOCAITES SECOND QUARTER 1992

THE ACROPOLIS, ATHENS, GREECE

In ancient Greek cities there was usually a place set apart for sacred activities that sometimes also functioned as a citadel. This place was usually located upon the highest ground in the city for dignity and safety and was walled to further enhance these functions. The walls of the Acropolis, as this place was called in the typical Greek city, were in addition to the walls of the city. The shape of the walls was irregular, in conformity to the topography. The Acropolis of Athens is the supreme example of this type of civic architecture.

In this month's limited edition signed print by Ladd P. Ehlinger, the view of the Acropolis is from the west on the plain below, looking slightly north of east. The building which served as the entrance to the Acropolis is called the Propylaea, indicated in the print in the upper center where the exposed columns are in view. The temple in the upper right is dedicated to Nike' Apteros and is in the Ionic style.

The entire Acropolis was designed and built in approximately twenty-five years, with most of the construction taking place between 437 and 432 BC, under the direction of the city leader Pericles under the design of the architect Mnesicles. The main sculptor for most of the buildings was Phidias, and other architects, such as Ictinus and Calicrates were involved in the design of other buildings (the Parthenon).

MORE ABOUT STUCCO

The methodology of stucco that changed after World War II occurred primarily in light commercial and residential structures. Expanded metal lath, paper backed on the exterior, was substituted for the wooden and corrugated paper laths. Metal control joints were introduced at the perimeter edges and within the field of the surfaces to control the type and location of the cracking that inevitably occurred.

These control joints were cold formed of thin sheet metal in various shapes: a "j" shape for perimeter edges as a terminus and as a screed (a constant depth member to control depth of the plaster or stucco as it is applied), two "j's" joined with a "V" to act as an expansion joint, perforated drip screeds for use at the bottom of a panel of stucco to allow pore water that has saturated the stucco to drain out are a few examples.

These changes improved the performance of the stucco and plaster when applied over the traditional masonry substrate. In the case of application over studs in light framing, metal studs were substituted for wooden studs. The stucco was applied over a water repellant gypsum sheathing board that was applied over metal studs to have a more inert substrate. The metal studs do not warp, check or split as wood does when it dries out, and the gypsum sheathing does not move as does wood sheathing, behaving more as the stucco does. In some cases the metal studs were load bearing, where they carried the weight of floors and/or the roof above. In other cases, they were not, and there was a structural frame of reinforced concrete or structural steel that carried the main loads of the building. The exterior metal stud walls in this instance are load carrying in the sense of resisting wind loading (and transferring same to the main structural frame) and are usually called a curtain wall.

While these improvements satisfied problems that occurred in the application of stucco over masonry and wood substrates, new problems arose as a result of the new reinforcement and edging techniques. Leaks appeared in structures where the control joints both were and were not coped properly (cut to fit one another when at right angles to each other). The metal allowed a crack to develop through which water traveled to the substrate more readily than before. When the galvanized ferrous metal members rusted, pure zinc control joints were then substituted, and in some cases aluminum control joints were substituted, with the resultant problem of corrosion due to galvanic and chemical action between the aluminum and the cementitious materials.

Various trade associations and manufacturers were also advocating stucco as a cladding for curtain walls on multi-story buildings. These types of buildings are subjected to much higher wind loading than are the traditional institutional and residential buildings that are low-rise (up to five floors). Structural and leak problems in all types of curtain walls resulted in ASTM devising tests to determine the strength and water resistivity of various assemblages (ASTM E330 and ASTM E331). Pure masonry walls were accommodated in ASTM E514.

The trade associations and the manufacturers then subjected stucco assemblages to these tests in the early 1980s. New components were then added to the stucco assemblages to resist water penetration at given wind pressures (20 PSF and 40 PSF). Elastomer type sealant alone was applied to the control joint right angle junctures before the stucco was applied to the 20 PSF assemblage, with the addition of a tape type sealant applied all along behind the entire control joint for the 40 PSF assemblage. These recommendations by trade associations and manufacturers are in effect today for stucco assemblages to be used in wind pressure environments of 20 PSF and 40 PSF.

The basic problem of the porosity of the stucco systems however, has remained. In the case of the application of stucco over a back-up stud system, the secondary line of defense against water intrusion is a layer of felt (asphalt impregnated paper) applied over the gypsum sheathing board, with drip screeds being used. In areas of the United States subject to large amounts of rainfall, such as the New Orleans area (60 to 90 inches per year), this has historically proved to be inadequate. The stucco becomes so saturated that it does not dry out between rainstorms, and each rainstorm introduces more water to keep the system saturated. This continuous saturation of water stresses and ultimately fails the felt membrane, with the water passing by capillary action to the gypsum board sheathing, through it to the insulation, the interior gypsum board and finishes. There are similar problems in the New Orleans area with solid masonry walls, where the vertical collar joint between the exterior wythe of masonry and the interior wythe(s) is overwhelmed by the constant saturation of water, never drying out, and ultimately passing water to the interior wythes by capillary action, and ruining interior finishes.

The local method of preventing water saturation of the stucco, and also to retard dirt buildup, algae and mildew growth, has been to apply a coating over the stucco to prevent the water from saturating the stucco to begin with. The weakness of the coating approach is primarily twofold: cracks in the stucco have to be "bridged" by the coating and frequently aren't, because of the size of the cracks and renewal of the cracks due to thermal and structural

2200 Houma Blvd., Metairie, LA 70001-1399 (504) 455-8911 • 3109 Ivy Ave. SW, Huntsville, AL 35805-4698 (256) 534-1900

movement of the stucco so that the coating is breached; and the coating deteriorates by weathering (heat and ultra-violet light coupled with water deterioration) and has to be renewed typically every three to eight years. Elastomeric tapes have been used to cover the cracks before the coating is applied with limited success, because they deteriorate as the coatings do.

The most recent advances in stucco technology are in the realm of a total elastomeric approach to the problem of joints and cracking. These systems are called Exterior Insulation and Finish Systems (EIFS), which we will cover in our next issue.

CHINESE ARCHITECTURE

A Brief Introduction

Traditional Chinese architecture is rooted in the rich, sublime culture of the Chinese; so much so that it is difficult to fully understand the intricacies involved in a Chinese building without an understanding of the philosophies of Chinese culture and history. While their buildings may easily be appreciated by anyone, a more complete understanding of the thought, history and philosophy that went into the design of these structures brings a deeper, fuller realization of their subtle beauties.

"Chinese architecture is the art of roof," one of my professors joked, dismissing the subject. Even so, he was right. The Chinese styled roof is massive, very often totalling well over two-thirds of the space, material and structure of the Chinese building. The roof is the dominating feature of any Chinese structure, yet at the same time appears light, well-proportioned, and properly placed. This is accomplished with a subtle, parabolic slope - curving greatly from the top to end in a gentle slide at the eave. The curved slope appeals to the eye of the viewer, almost as a natural terrain-form would. In fact, the Chinese roof can be considered most successful when viewed at a distance. Gatherings of houses appear to rise from the land like waves as the gentle slopes of each roof play against one another.

How did this style of roof originate? Similar to today's large corporations displaying their financial power by erecting monstrous skyscrapers, the ancient Chinese displayed their prominence and wealth by placing large roofs on their homes and palaces. The curved roof evolved from the origins of the Chinese, who were predominantly nomadic and therefore slept in tents. When more permanent structures were erected, the roofs copied the slope of the tents. What is interesting is that the Chinese were the only people to use slopes in their roofs - this style is seen in no other culture previous to contact with or influence by the Chinese.

Other than its appearance, how is the Chinese roof different from the angled roof? Is it better? In fact, there are several advantages to the design of a curved roof. It serves much better in drainage; as the water flows across the slope, it accelerates along the curve so that it is propelled to the ground some distance from the building itself, so the face of the building and the terrace entrance, disregarding heavy winds, never get wet. Another advantage to the Chinese slope is that it is easier to measure than an inclined plain. All of the heights at points along the slope are percentages of their horizontal length from the eve, so that with one precalculated formula (which the Chinese had) the roof will be to the same proportions for any building, as well as simple to design. Then, in the Chinese reverence for beauty and balance, the traditional colorful tiles and decorational eaves were used.

While the roof is the most obvious feature of any historical Chinese building, there are two other main parts: the body of the building, and the foundation that it rests on.

The terrace foundation used in Chinese architecture began merely as a platform elevated above the ground, its purpose to prevent ground water drainage from entering the building. It was a mound of packed earth, enclosed with brick and stone, and then surfaced with a finer grade stone for appearance. Later, as with the roofs, the size of the terrace was used as a means to show wealth and prominence, so the terraces became larger and larger. The most dramatic example of this trend is the Forbidden City in Beijing, where the terraces of the palace are six times the size of the structures! In general though, it was merely standard that the terrace be larger than the building so that the purpose of mechanics was satisfied and the building be supported firmly. Later, to enhance the beauty, and as an alternative to erecting a massive platform, the terraces were decorated by carving intricate designs into their sides. These designs were called the Xu-mizuo (Shoo-mee-zho), and originated from the supports of the statues of Buddha, and is a typical example of how the Chinese incorporated their religion and culture into their architecture.

The Chinese terrace plays the function of an elevated foundation - in effect lifting the strength of the ground and displaying it proudly, so that the building is separate from, but acts in union with the ground that it is built on. Also, it serves as a platform for displaying the building, so that it can be appreciated in itself, as well as with its surrounding environment, much like a statue in a museum.

The body of the Chinese building is the most difficult to analyze by Western standards for several reasons. To start, the proportion of the body is of little importance. It can be immensely small in relation to the terrace and roof, or it can be of multiple levels, as in a pagoda. In either case, the overruling factor of the body of the Chinese building is the connection it makes between the roof and terrace, allowing a balanced coexistence between the two. What makes this so is the subtle elevation techniques used. The elevation, as seen from outside, is divided into three layers. The first is the empty space between the terrace and the overhang of the roof. This negative space emphasizes the importance of the roof and terrace, and hides the structural function of support that the body plays by casting it into the background. The second elevation layer consists of the column. From the center of the building, the voids between the columns grow smaller and their heights increase - much like the hull of a Chinese junk ship. The appearance achieved allows the free ventilation of space and sight. Instead of cluttering the elevation, the arrangement of the columns produces a cylindrical appearance, and a smooth direction to viewing it. The third elevation is the true elevation of the building - the outside walls, with windows, doors, and partitions. It is the least noticeable from a far or middle distance, and can almost be considered in the same layer as the columns, since there its only appearance is as a background. At a closer range, the details and decorations of the facade become apparent and important, and can be appreciated as a separate entity from the total building.

It is the way the Chinese utilize this layering effect that makes it unique from other architectures. Each component of the building; the roof, the body, and the terrace, are separate entities from one another, yet are worked in such a way that allows them to coexist naturally and with beauty. The buildings are physically built layer upon layer, and while still retaining a separate identity, act as a unit. It is this way in a macrocosm as well, where the groups of buildings form a layer of their own against the horizon and natural background, creating another unit. But when the view narrows, the layers peel back, exposing a new layer underneath - the roof, the sculpted terrace, the columns, and finally, the facade of the building itself.

by R. Perrin Ehlinger, Auburn University Architecture Student