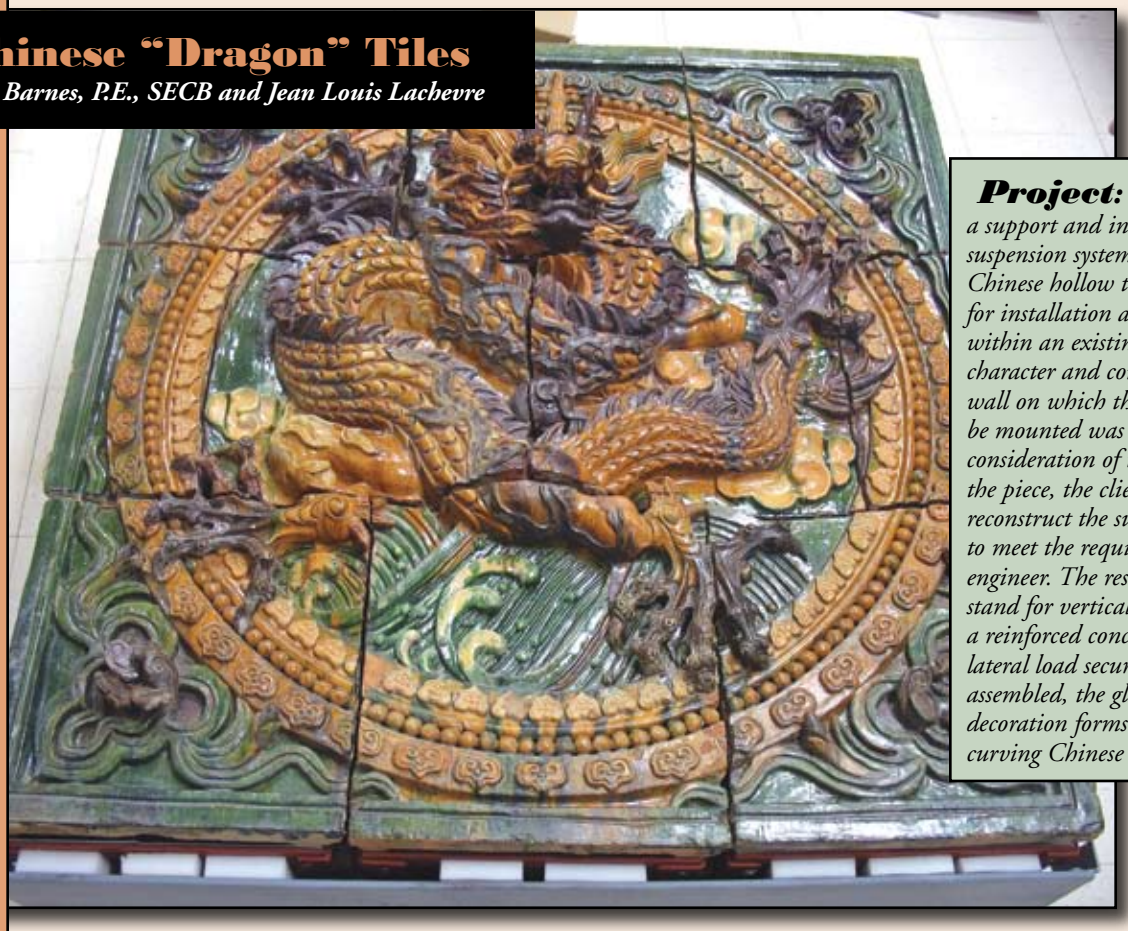
Ten Chinese "Dragon" Tiles

By Craig E. Barnes, P.E., SECB and Jean Louis Lachevre



Mounted Object.

Project: *to develop a support and independent suspension system for ten ancient Chinese hollow terra cotta tiles for installation and display within an existing structure. The character and condition of the wall on which the object would be mounted was unknown. In consideration of the value of the piece, the client agreed to reconstruct the support system to meet the requirements of the engineer. The result was a steel stand for vertical support and a reinforced concrete wall for lateral load securement. Properly assembled, the glazed, high-relief decoration forms a decorative, curving Chinese dragon.*

Object Description and Condition

Each of the ten tiles is in a form of a hollow block approximately 16 inches high, 8 inches wide and 6 inches deep, weighing between 30 and 65 pounds. Mounted together the tiles cover a 50-inch x 50½-inch area.

The unglazed sections of the tiles are very soft, chalky and structurally weak, with fire cracks in the panel joints of the blocks. The low-fired pink earthenware relief decoration depicts a dragon.

Restoration

The glazed decoration had previously been stabilized, infilled and inpainted. For one tile, it was necessary to reconstruct the back side and outside wall of the block. Another tile required reconstruction of a 1-inch deep void in the back wall of the block. Care was taken not only to keep the individual contour accurate throughout the process, but also to maintain the proportions with the adjoining tiles. The epoxy fill material was sanded with stone rasp tools to correct the over fills and shapes of the modeling.

Armature System

The goal of the project was to design a mounting system whereby the tiles could be individually suspended on an armature that could hold each in proper position within the wall. As the tiles were originally designed to be displayed closely together, so as not to disrupt the flow of the relief decoration, a strong but minimally intrusive system was needed to firmly support each tile from the back and undersides of the clay, with no damage or abrasion to the soft terra cotta edges. Additionally, zero tolerance for vertical or lateral movement during shipping, installation or display was required.

As is often the case in challenges of this sort, the engineering beauty and complexity of the armature is fully concealed by the object. In fact, that is the mission of the structural engineer. In this case that complexity is seen in the plan of the armature *Figure 1*, an assembly of metal that weighs over 400 pounds. The structure must be sufficiently robust to be moved by forklift, suspended during erection, and stiff enough so that the inevitable plate warping that occurs when handling bulky objects will not be such that the tiles touch. In addition, the armature must be designed to allow the restoration specialist a way to accomplish blind attachments of the tiles to the support structure. The coordination between fabricator, engineer, and restorer, in finding a way to combine all these needs, is a task in itself.

The bottom row of blocks rests in a set of lined (padded) metal brackets with straps which extend vertically up from the bottom of the frame along the solid sides of the tiles. The tiles rested on padding, and were held in position with high-density polyethylene plugs at the tops of the brackets. The 3/16 inch brackets allowed the walls of the tiles to be displayed approximately ⅜ inch apart. This assemblage forms a shelf *Figure 2*.

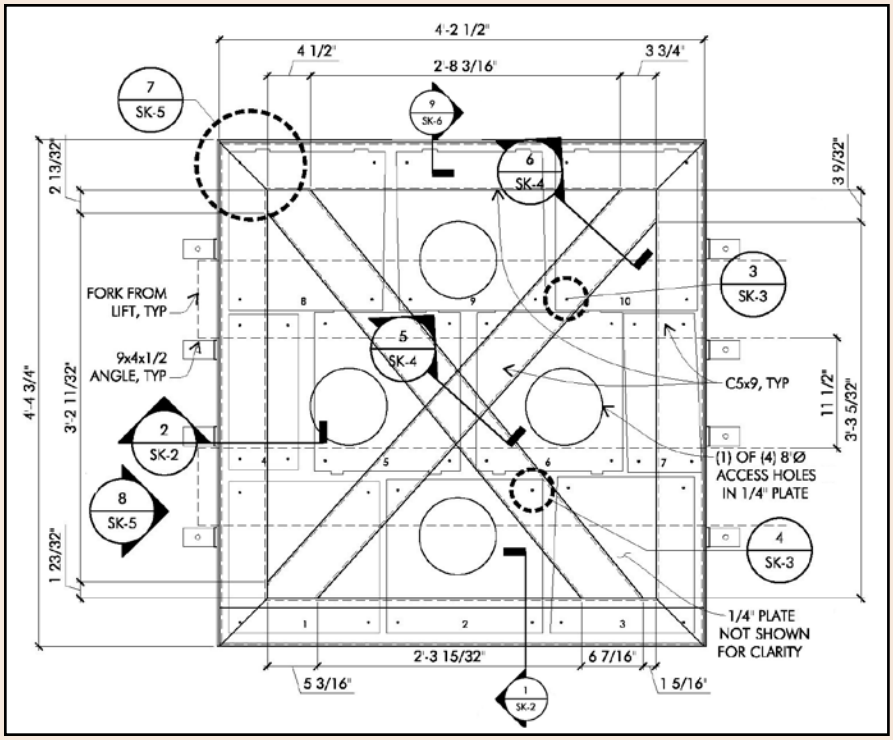


Figure 1: Armature Plan.

This "shelf" system could not be employed for the middle and top rows of tiles because the irregular contour of the solid sides would elevate all blocks to a common height, creating an unacceptable gap between the tiles thereby disturbing the decoration. A single support would also not allow the fine tuning of the surface plane required of each tile in order to properly complete the design, as each tile would be knocked out of position by its neighbor.

Figure 2: "Shelf".

The middle and top rows were therefore addressed by hanging each tile in a cradle (*Figure 3*) constructed of two 3/16-inch thick x ½-inch wide wide flat steel bars (pressure strap) placed strategically so that each bar, as it is clipped to the top and bottom openings of the tile, lies in a recess of the modeling to minimize contact with adjacent surfaces and reduce the gaps between the front of the tiles.

Individual wooden templates were cut and shaped. The templates were then duplicated in metal. The metal plates were used as guides for fitting the C-shaped brackets that would cradle the blocks, and also to receive interior pressure straps. The tiles were test-fitted onto the plates, and the contours were marked for placement of the brackets that would hold the tiles and to undertake possible refinement of edges. It was also necessary to ensure that no brackets would abut brackets from adjacent tiles, pushing them out of place. Precise contours were crucial so that the brackets would sit perfectly on the form to avoid shifting or falling out of plane when presented with the heavy tiles, or prevent proper alignment during final installation.

Later, the tile-bracket-plate system will be bolted by these plates to the exterior frame.

Procedure

Bottom Row of Tiles

Each tile in the bottom row was supported by an individual shelf. Two vertical angle arms from the shelf were connected to the tiles through existing holes in the side wall of each tile. The pre-existing holes, conveniently left by the ancients, were fitted with polyethylene rod as a plug. The arms were secured to the plug with a stainless steel machine screw on each side, and locked with a wing nut from the interior of the tile.

Figure 3: Top Row.

Middle and Upper Row of Tiles

Each tile was supported individually in a metal cradle along with two ½-inch wide C-shaped straps, secured to top of the plate with slotted screws. These pressure straps extend through the inside of the tile, and are secured to the bottom angle.

Steel Armature Pallet

All ten steel plate tile backs were predrilled and threaded to receive 5-inch long ⅜-inch diameter stainless steel threaded studs. Each bracket

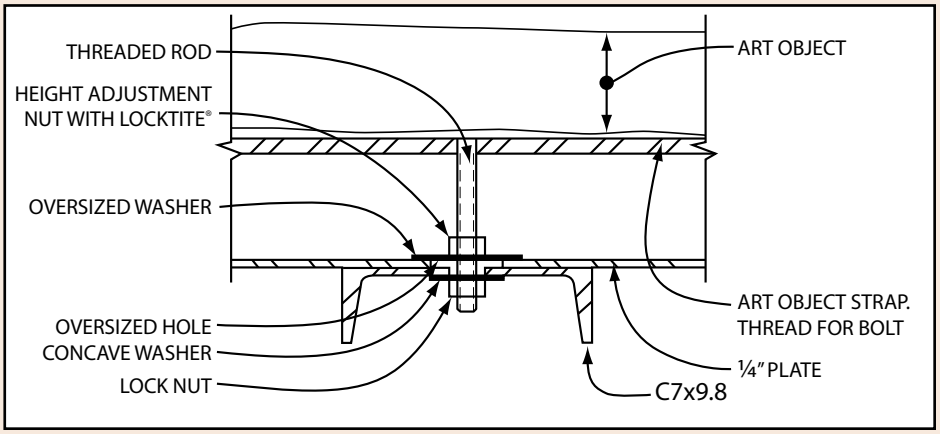


Figure 4: Tile Securement Section.

was measured 2¾ inches away from the face of the steel armature to allow for working space and leveling the top surfaces of the tiles. Refer to the access hand holes shown on the armature plan.

An aluminum sheet 50 inches x 50 inches x 3/16-inch thick was used to locate all forty ⅜-inch holes on the steel palette. This aluminum sheet and a Mylar template were completed for fabrication blueprints. It was critical to have the precise location of all the studs so that no critical element of the structure would be cut. The holes were over drilled to ½-inch diameter to give flexibility in location of the tiles (*Figure 4, page 41*).

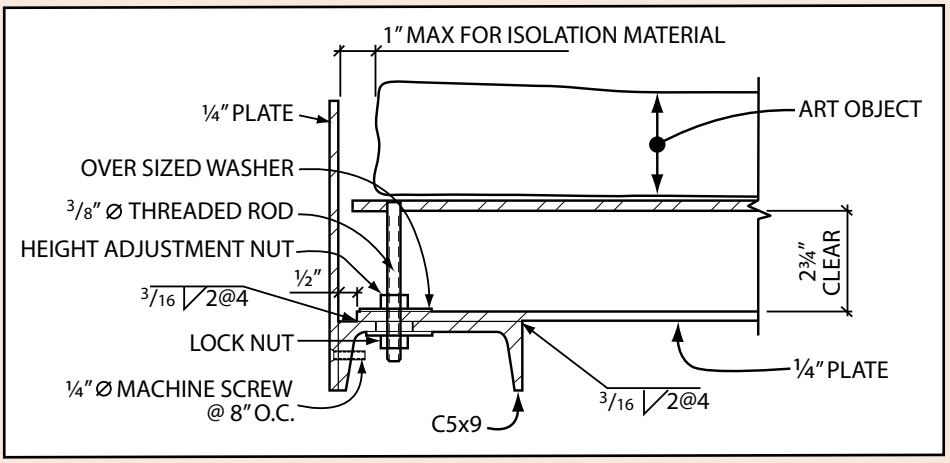


Figure 5: Perimeter Section.

Concave washers prevent the rods from slipping in the oversized holes when the frame is shifted. Flat washers and hex nuts were locked onto the ends of the rods from the underside of the frame. Once top hardware was secured, all the hex nuts on the underside of the frame were tightened as well, thus locking the locking the tiles into position. When in position, the top and sides of the palette were fitted with a border of ¼ inch steel plate (*Figure 5*), and lined with 1-inch Ethafoam to protect the object on the sides during shipping. A 7-inch by 4-inch bottom angle was welded to the frame for stability and balance during handling and installation. Final installation in the gallery would require that the tile/support assembly rest on a structural I-beam, and be tied directly to a structural concrete wall. A wooden trim would cover the wall gap and steel frame.▪

Craig E. Barnes, P.E., SECB is principal and founder of CBI Consulting Inc. As an engineer registered in both the civil and structural fields, Mr. Barnes has over 40 years experience designing, coordinating, and managing structural and civil engineering projects throughout New England. Mr. Barnes can be reached via email at ***cbarnes@cbiconsultinginc.com****.*

Jean-Louis Lachevre is Senior Conservation Engineer at the Museum of Fine Arts, Boston, specializing in the care of monumental and large-format two- and three-dimensional sculptures, including condition assessment, stabilization and conservation, handling and transport, and custom installation mounts. He has worked at the Museum of Fine Arts as a conservator for 35 years.