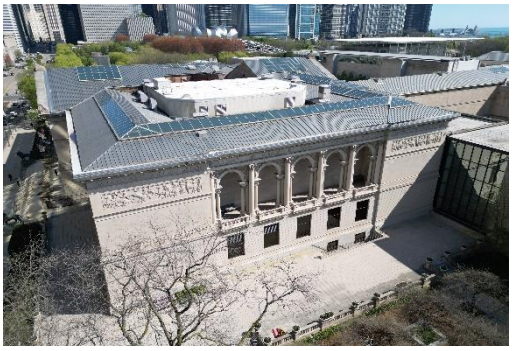
PROJECT PROFILE

The Art Institute of Chicago Loggias

Restoration Design and Laboratory Testing | Chicago, IL



CLIENT

The Art Institute of Chicago

BACKGROUND

Constructed circa 1893, the original Michigan Avenue building of The Art Institute of Chicago boasts a classical Beaux-Arts design by Shepley, Rutan and Coolidge of Boston, Massachusetts. The original structure consists of clay tile arch floors that span between early-vintage steel beams, supported on load-bearing masonry walls founded on timber piles. The facades are mass masonry construction with limestone on the exterior. Loggias (inset balconies open on the exterior and enclosed on the inner three sides) exist along the north, south, and west elevations.

During stone balustrade maintenance at the south loggia, severe corrosion of underlying steel members was discovered. Archival review revealed the corroded elements were circa-1893 triple I-beams supporting a clay tile arch deck and stone facade. Field exploration found that corrosion and section loss from long-term water infiltration extended several feet from the ends of the beams, through a heavily loaded region below a stone plinth. Severe corrosion and section loss were present at twenty total triple I-beam locations among the south and north loggias.

SOLUTION

After implementing elevation monitoring and provisional shoring, WJE developed structural repair options. The most straightforward required underside access. However, because the art galleries below the loggias would need to be deinstalled to allow repairs from below, an innovative option was devised to repair from the topside only, thus saving the museum substantial disruption and associated costs.

The topside repair concept entailed removal of the clay tile between the corroded ends of the triple beams without allowing debris to fall into the gallery spaces below and without compromising the thrust in the clay tile arch. Afterward, new reinforced concrete was cast between the triple beams to strengthen them, using the corroded beams as forms. Unlike traditional composite steel-concrete design, the resulting hybrid beams consist of three regions that act like a tube inserted into a tube: (1) in the corroded region, the new reinforced concrete acts alone, (2) in the overlap of the concrete with the uncorroded beams, a force couple between the concrete and existing steel flanges resists the loads, and (3) beyond the overlap, the clay tile infill remains and the original I-beams act alone.

Given the unusual nature of the repair, WJE performed a laboratory mockup and load test to verify the performance and refine the repair details. The innovative design ultimately saved the museum millions of dollars as well as substantial disruption to its art collections. The project received a 2024 Excellence in Structural Engineering Award from SEAOI.

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS