PROJECT PROFILE

Indianapolis International Airport

Investigation of Fabric Canopy Failure | Indianapolis, IN

CLIENT

Indianapolis Airport Authority

BACKGROUND

The main terminal parking garage at the Indianapolis International Airport was constructed circa 2006 and contains an open atrium that extends across the garage at each of the four levels above grade. The original roof canopy consisted of an architectural fabric membrane covering a steel support structure that comprised ten 98-foot long arched steel trusses spanning across the atrium. The membrane was a woven fiberglass fabric impregnated with a PTFE polymer coating. The membrane was secured by a combination of extruded aluminum channels and aluminum clamping bars bolted to the steel supports and prestressed in the warp and fill directions by tensioning of the supports at the perimeter of the fabric panels.

At the request of the Indianapolis Airport Authority (IAA), WJE investigated the February 2014 collapse of a fabric canopy at the main airport parking garage to identify the probable cause of the failure. An accumulation of snow, water, and ice was present on the top surface of the fabric membrane at the time of the failure. The fabric failed along an intermediate supporting truss, resulting in the collapse of a 5,400-square-foot bay of the canopy roof into the atrium below.

SOLUTION

The collapse investigation included detailed visual examination of the structure and the failed membrane fabric, review of weather records, review of construction and previous repair documents, and calculations of expected stresses in the fabric at the time of the failure. Loads on the structure at the time of the failure were less than the minimum design loads specified by the building code, and no indications of fabric strength deficiency were identified. WJE concluded that the failure occurred as the result of improper installation of the membrane on the steel supporting structure, which allowed the connecting bolts to loosen over time and created stress concentrations in the fabric.

Following the collapse investigation, IAA retained WJE to conduct a detailed, nonlinear structural analysis and design review of the entire remaining membrane roof. Based on the findings of that review, WJE concluded that the existing roof, installed in accordance with the intent of the original design, was structurally adequate to resist code-prescribed design loads. In conjunction with the review, WJE provided recommendations for selective retrofitting of the panel edge attachments to minimize the likelihood of loosening of fasteners and misalignment of the aluminum extrusion segments. WJE provided a peer review of the contractor's repair and performed site visits and related construction-phase services during implementation of the repairs and retrofits.

WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS