

# ICRI 2009 Project Award Winner

## Award of Merit: Special Projects Category

### Arizona Veterans Memorial Coliseum Roof Repairs



#### **Owner**

Arizona Exposition &  
State Fair  
Phoenix, Arizona

#### **Project Engineer/ Designer**

Gervasio & Associates, Inc.  
Phoenix, Arizona

#### **Repair Contractor**

Robert E. Porter  
Construction Co., Inc.  
Phoenix, Arizona

#### **Material Suppliers/ Manufacturers**

BASF Construction  
Chemicals/Building Systems  
Cleveland, Ohio

Sika Corporation  
Lyndhurst, New Jersey

The Arizona Veterans Memorial Coliseum, constructed in 1964 as a premier arena facility at the Arizona State Fairgrounds, was home to the Phoenix Suns professional basketball team for 24 years. The roof is a cable structure in the shape of a hyperbolic paraboloid, designed by T.Y. Lin, and is one of the only remaining structures of its type. The roof cables span almost 400 ft (122 m), post-tensioned to 420,000 lb (190,509 kg) each, and support precast concrete roof panels between them.

A new depression in the roof structure was discovered in 2006, which led to the discovery of 11 completely failed cables out of 72 total. Repair work in 1980 had attempted to correct a similar depression by adding structural steel beams to span across the depressed area and redistribute the load. That engineer failed to recognize that the cause of the depression was three broken cables, and further exasperated the overstress by the additional weight of the steel beams. Locating the failures involved a variety of destructive and nondestructive methods. Failures occurred near the end anchorage where the cables pass through the large perimeter cast-in-place concrete compression ring. These failures were caused by hydrogen embrittlement in the cable wires, a complex metallurgic process resulting in failures at very low stress.

A portion of each cable was replaced with new post-tensioning materials, coupled to existing cables with specially machined components. The cables were retensioned to original design forces of 420,000 lb (190,509 kg) each. All couplings and end anchorages were pumped full of grease, reducing future corrosion and failure.

What started as two failed cables was found to be 11, but the construction completion deadline did not change. All work was done during the summer in Phoenix, AZ, where roof air temperatures in the shade repeatedly exceeded 145°F (62.7°C).