

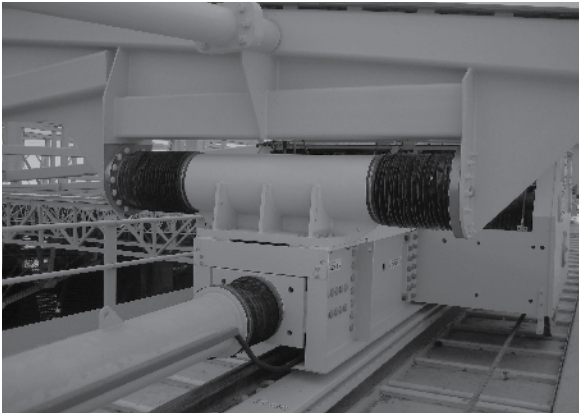
## TECHNOLOGY: COMPONENTS



USED AT RELIANT STADIUM, LUCAS OIL STADIUM

### FOUR-BAR LINKAGE

The Reliant Stadium retractable roof panels moves along two parallel rails, one on each side of the 675-foot stadium bowl. A 4-bar linkage lateral release system was installed on one side of the roof panel. The system accommodates 21.5 inches of relative lateral movement between the roof panels and the fixed building structure. This system maintains wheel alignment on both rails, regardless of structural changes caused by wind, sun and other forces.



USED AT UNIVERSITY OF PHOENIX STADIUM

### LINEAR BEARING

The University of Phoenix Stadium retractable roof is comprised of two low-profile panels that are driven along a parallel rails on either side of the stadium bowl. A lateral release system was required that would accommodate relative movement between the fixed building structure and the retractable roof caused by wind, thermal expansion and other structural forces. The limited vertical space between the roof panel and the fixed building structure made previously designed lateral release systems unusable.

Linear bearings on the west side of the stadium are connected to the retractable roof at both ends of the guide shaft. Each guide shaft is encased in a movable collar mounted to the transporter, which allows for 36 inches of relative movement between the roof panels and the transporters. This allows the wheels on both sides of the roof to stay engaged with the rails regardless of relative lateral movement.

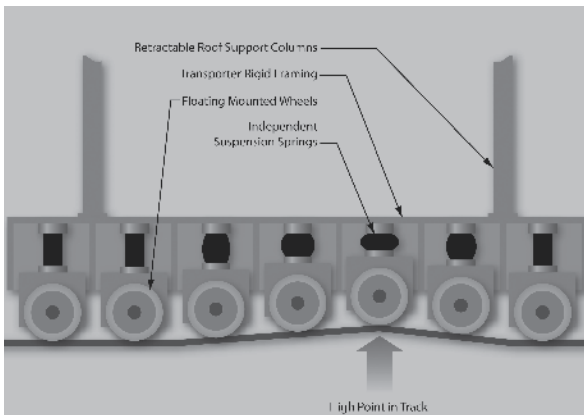
## TECHNOLOGY: COMPONENTS



USED AT MINUTE MAID PARK

### HINGE BEARING

Three independent, parabolic panels comprise the retractable roof at Minute Maid Park in Houston. The system includes eight trusses, some as large as 600 ft. by 50ft., and all are subjected to a variety of thermal and wind forces. A structural hinge at the top of the west wall allows the roof sections to flex to accommodate an almost endless combination of geometries.



USED AT MINUTE MAID PARK

### INDEPENDENT SUSPENSION

The long transporters at Minute Maid Park have multiple wheels that must at all times stay engaged with the rail while supporting the weight of the roof panels. Independent suspension allows each wheel to move up and down as needed to accommodate vertical changes in the rail without becoming overloaded or underloaded.

While the transporters run on a relatively flat rail track, deviations due to thermal expansion, load distribution or elevation imperfections could adversely affect traction. The independently suspended wheels distribute the load of the roof regardless of construction deviations or environmental conditions. This relatively even distribution of roof loads allow for the most cost efficient design of these building elements and result in significant construction cost savings.

### TECHNOLOGY: COMPONENTS



USED AT RELIANT STADIUM, LUCAS OIL STADIUM, UNIVERSITY OF PHOENIX STADIUM

#### LINKAGE SUSPENSION

The Reliant Stadium retractable roof is moved by 20 transporters, each equipped with two traction wheels. The five transporters in each quadrant are connected onto a train by linkage suspension arms that are pinned at each end, and rotate vertically as needed to accommodate changes in the steel rails. The linkage suspension system evenly distributes roof weight throughout movement, and prevents any of the wheels from becoming high-centered or overloaded.