Back-span cantilever at temporary pier tie-in.

Construction of the new Harbor Bridge tower and superstructure.

Analysis

The structural analysis of the bridge consisted of both local and global models, each with different modeling approaches for specific design checks. Local models using three-dimensional (3-D) brick elements were used to determine the transverse design deck effects. The primary global model, consisting of 3-D grillage elements, included the construction stage analysis. A central database was used to store model input and output data and served as the sole source of authoritative information for the design partners.

The construction engineering team used a local 3-D brick model for the nodal regions of the delta frame and box girders, two-dimensional shell elements for the thin slab portions of the box girders, and one-dimensional frames for the delta-frame main members. The transverse stiffness in the global model was calibrated to resemble the behavior observed from the more granular local model. The local model was essential to capture local effects from post-tensioning, stay force tensioning, local live load, and transverse bending of the median slab, and this model could quickly investigate the effects of heavy equipment during construction. Separate local models were used in regions such as the back-span pier segments, the expansion joint segments, the tower table nodal zone, and the stay-cable anchor boxes.

Given the high risk for hurricanes in the Gulf Coast region, the project required a rigorous wind-loading analysis. Wind tunnel testing confirmed the bridge's satisfactory behavior. Additional wind-buffeting analyses were performed based on the modal behavior and

AESTHETICS **COMMENTARY**

by Frederick Gottemoeller

Corpus Christi is in the flat Coastal Bend region of Texas's Gulf shore. Prominent landscape features are visible for miles. The Harbor Bridge stands slightly apart from the downtown, so the bridge occupies its own visual space, clear of the city's skyline. Even so, it is near important regional landmarks, including Corpus Christi's minor league baseball stadium, Whataburger Field. Indeed, the bridge dominates the view from left field. So, it is no surprise that the community wanted it to be a "beacon of coastal beauty." And, wow, is it ever.

The bridge owes its beacon status in large part to a combination of improvements in concrete segmental construction. The most visible of these is the unusually wide deck system featuring two segmental box girders connected by delta frames. The system allows support from the median by a pair of cable planes emanating from single centerline towers. Visual simplicity is always important in creating landmark bridges, and this deck system is as visually simple as it gets. It is easy to understand from nearby and from a distance, and even from below. Even fans at Whataburger Field can enjoy the elegance of the solution between innings. And the designers solved the problem of installing a shared-use path on just one edge of the bridge in the simplest way possible: they made one box girder a bit wider than the other.

The innovations do not end there. Because of their V-shaped bases, the towers appear to be striding across the channel. Vertical tapers on the legs and tops of the towers, combined with the diagonal placement of the legs' square cross sections and the hexagonal cross sections of the tops (which make those elements appear narrower), give the whole structure a sense of elegance. The two-box system also contributes at each pier line, requiring only two slim piers, made to look even slimmer by their octagonal cross sections.

The Harbor Bridge is a masterpiece. Its designers, the Texas Department of Transportation, and the community are to be congratulated on their achievement.