A single crane was used to erect each pier girder within the tight site conditions. The out-of-balance moment during erection was the controlling design load for the cap-to-column connection.

The CIP concrete construction used TxDOT's high-performance concrete,[2] which includes supplementary cementitious materials to counter the risks of alkali-silica reaction and delayed ettringite formation and to also reduce permeability.

Alternate Designs

TxDOT allows post-let alternate designs for select concrete elements to provide avenues for innovation with atypical precast concrete components.[3] On this project, TxDOT recognized the replication of form of the substructure caps and provided a plan note allowing substitution of precast concrete caps—instead of the CIP concrete pier caps in the original TxDOT design—for review and approval. In addition, the superstructure plans allowed for contractor alternates for the spliced-girder unit considering the range of cross-section forms and construction or design techniques that might surmount the transport limitations, as well as the segmental concrete box-girder alternate. The Sargent Beach Bridge was let to contract in July 2017 with nine bidders. Of the nine bidders, the six lowest bidders selected the spliced-girder option.

Alternate for the Spliced-Girder Unit

Before project letting, a precaster worked with an engineering firm to investigate an alternate spliced-girder design. After the project was awarded, the two parties worked with the general contractor to present the alternate design concept to TxDOT. The intent was to reduce the girder weights to within the handling and shipping weight limits of the precaster's equipment. All of the pier locations and span lengths from the original TxDOT design were maintained.

Considering the shipping route and available equipment, the maximum shipping weight for the girder sections was determined to be 280 kip. To maintain girder weights within this limit, the girders were designed with a cross section based on the TxDOT "Long Span Precast I-Girder" standards[4] so that the forms could be used on future projects that incorporate the same standards. The girder sections over the piers are 120 ft long and have variable depths of 96 to 150 in. to accommodate the negative moment caused by continuity while reducing girder weight. The bottom-flange thickness is tapered from the pier to the splice location at the end of the pier segment to provide a sufficient compression block over the piers. The end girders of the main-span unit are 133 ft long with a constant depth of 96 in. Owing to the structure's geometry, the main-span drop-in girder is 178 ft long. To maintain the established girder weight limit, each drop-in girder was cast in two segments and spliced on site before erection.

Because the navigation channel had to remain operational during construction, temporary falsework supports in the channel were not allowed. Therefore, the main-span drop-in girder had to be supported by the pier girders during erection using specific erection sequencing and staged PT details for the alternate design. A detailed analysis was performed for all stages of construction to ensure that the temporary stresses in

AESTHETICS **COMMENTARY**

by Frederick Gottemoeller

Simple, direct design solutions always have immense appeal because observers of the structure can immediately understand both the challenges and the solutions. Visually, the Sargent Beach Bridge is about as simple and direct as it gets.

Neither the island nor the mainland has room for linear approach viaducts? Fine, we'll bend the viaducts into spiraled corkscrews. The main span is too long for standard girders? Fine, we'll splice in deeper, tapered sections over the piers to accommodate the greater forces there. The pier caps are too heavy to ship? Fine, we'll carve away all of the unnecessary concrete and create an elegant shape in the process. The pier shafts look too massive? Fine, we'll pierce them with a wide vertical slot.

As I've often pointed out, attractive bridges use their shapes to illustrate how they work: they are thick where the forces are the greatest and thin everywhere else. People intuitively understand the reasons for these shapes, and this understanding results in a positive feeling of engagement and satisfaction. Here, the tapered haunches of the main span, the tapered arms of the pier caps, and even the vertical slots in the pier shafts reflect this differentiation of forces, making the bridge elegant as well as efficient and economical.

In the flat, Gulf-side landscape, I can imagine that this structure is the tallest thing around, making it a signature landmark for the community and its visitors. I predict that Sargent Beach residents are going to be proud of this structure for a long time to come.