Building Blocks

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Winery Supports its Liquid Assets on HSS and Cast Steel Connections

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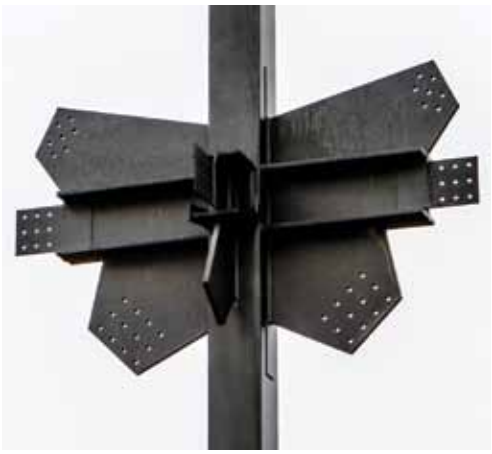
To facilitate the streamlined performance that is essential to large-scale wine production, massive fermentation tanks at a new facility in Livingston, California had to be supported at a height such that their contents could be rapidly discharged into a press at grade level. In addition to the significant seismic demand imparted on the structure by the tanks – which, when full, weigh up to 3,000 tons – other constraints specific to the wine-making process dictated the design, as did the client's challenging schedule.

The Owner engaged Summit Engineering to carry out a complete structural design in a time frame that would require completion of bid packages within six weeks and construction packages within three months. In addition to the rigorous design schedule, the new facility had to be ready to receive its first shipment of grapes within mere months of the award of the construction contract. This dictated the design of a structure that could be constructed quickly and efficiently in the field.

It was immediately clear that a steel-framed structure was best suited to the application; however, the type of steel frame was based on a more thorough analysis of the Owner's requirements. The flexibility of a moment-resisting frame would have been problematic with respect to piping tolerances, and open perimeter bays were not a priority for the client. The choice, then, was between Ordinary Concentrically Braced Frames (OCBFs) and Special Concentrically Braced Frames (SCBFs). Selecting SCBFs decreased the seismic design loading significantly by allowing the use of a response modification coefficient R = 6, rather than R = 2.5 for OCBFs. This reduced foundation sizes and resulted in a significantly lighter and more economical superstructure.

With the seismic force-resisting system selected, design could begin in earnest. Studying various construction scenarios revealed that field welding and the associated special inspection would impede the construction schedule. High-strength cast steel connectors emerged as an excellent solution for the SCBF connections. These connectors are configured to accommodate field-bolted installation of shop-fabricated brace-to-connector assemblies, thereby eliminating field welding at the brace-to-gusset connections. As the connectors accommodate double-shear bolted joints, their use results in highly compact gusset plate connections. By contrast, shear lag in conventional field-welded brace connections, where hollow structural section (HSS) members are slotted and reinforced, requires the use of significantly larger gusset plates. The high-strength connectors fit well with the design philosophy for this project, which capitalized on the simplicity of the connection details and ease of construction and maintenance.



"Butterfly" gusset plate connection. The gusset plate is continuous through the column to accommodate the significant pass-through forces imparted to the braces during an earthquake; beams and braces are field-bolted to the column.

10.750- and 8.625-inch diameter braces equipped with Cast ConneX High-Strength Connectors framing into a "butterfly" gusset plate connection at the beam-column intersection.

At first the Owner was hesitant, expressing some concern regarding the specification of a proprietary product. In addition, the testing and documentation that the connector manufacturer, Cast ConneX, had completed for ICC-ES certification of the connections was still under review during preparation of construction documents, creating some concern from the Merced County Building Department. However, both concerns were quickly put to rest, as representatives first worked with the design team to demonstrate to the Owner the significant cost and time savings that their connections provided, and then submitted ample permitting support documentation.

Utilizing cast steel connectors also aided in expediting the design process, since the manufacturer provided standardized connection details in its design manuals, as well as customized connection detailing support. Early in the design, it became apparent that a larger size of brace would be required than was accommodated by the connectors available at the time. Cast ConneX developed a new size of high-strength connector – one to fit

10.750-inch outer diameter HSS – and was able to design and qualify the part in time for production for the project. This was in part because of the Owner's willingness to engage the manufacturer in advance of the bidding process for the structural steel – a testament to the value that the connectors represented.

Cast ConneX designs its cast steel connectors to accommodate round HSS brace members; the design team also selected HSS sections over wide flange shapes for the structure's columns. HSS are the most efficient members for resisting not only axial loading, but also biaxial bending. In this project, several columns had to withstand loads from as many as three directions, so a symmetric section was ideal. HSS also lend themselves to consistent and repeatable detailing from both a design and construction perspective. Coordination with the tank manufacturers and the piping engineers was facilitated by the uniform sections of the frames; tolerances within the structure were critical as piping was to weave between the already compact configuration of the tanks. Finally, the design team recognized that the HSS column and brace sections would be easier to clean and maintain in service, which was important to the Owner since a winery is essentially a food production facility.

The new Special Concentrically Braced Frame (SCBF) structure at the winery, configured to support massive fermentation tanks at their second story.

Steel contractor Lloyd W. Aubry Company provided fabrication and erection services for the primary structural steel on the project. Cast ConneX provided technical support to ensure that the cast steel connectors were properly implemented, and the design team provided additional support with respect to erection sequencing in one tight area of the structure where braces had to be installed prior to a beam above. The result of this overall cooperative effort was a smooth process of erection; there was not a single RFI or change order generated in relation to the fabrication or installation of the braces fitted with the connectors. Eliminating costly and time-consuming field welding of the SCBF brace connections resulted in an efficient structure that met the schedule and budget constraints of the project.▪

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