

Designing the Eiffel Tower of Expo 2020 Dubai

Jerome T. TOBOLSKI*, Robert C. SINN*, John L. PERONTO*

*Thornton Tomasetti

330 N. Wabash Avenue, Suite 1500, Chicago, IL 60611-7622

jtobolski@gmail.com

Abstract

Throughout the years world expositions have been the genesis of some of the world's most iconic structures from the Eiffel Tower of the 1889 Exposition Universelle in France to the L'Albero della Vita (Tree of Life) of Expo 2015 in Milan. Continuing this strong tradition is Expo 2020 Dubai with Al Wasl Plaza, which acts the main centerpiece of the site and is anchored by an immense spherical structural steel gridshell nearly 70m in height and 135m in diameter at the base. Unlike traditional diagonalized gridshells, the unique structural framework of the trellis draws its inspiration directly from the logo of the Expo 2020 Dubai as a series of nested and tangent rings that results in a more flexurally governed and ductile system. Each of the rings are infilled with a PTFE fabric system that primarily functions as a projection surface that will allow for dramatic 360 degree immersive experiences for the Expo attendees and future visitors to the site after the event.

High Strength, S460, steel Cylindrical Hollow Sections 500 millimeters in outside diameter (with thicknesses ranging from 10 to 50 millimeters) resist the flexural demands inherent to the system as well as the added flexural stresses due to the base support located below the equator of the sphere. Not only were the members verified for strength and serviceability criteria, but essential stability and buckling verifications were also performed to validate the structure's resiliency to amplifications in design stresses due to possible geometric imperfections and unbalanced loading conditions. This investigation was done through direct modeling of critical deformed shapes that mimic the eigen mode shapes of the structure. As the distinctive connection methodology of tangent rings does not fall within any published hollow section design guidelines, multiple 3D finite element analyses of the ring interfaces were conducted to ensure the adequacy of the selected member thicknesses. The design team also worked closely with steel fabricators throughout both the design and construction phases to address the geometrically complex fabrication and achieve the polished look of the final structure.

This resulting highly efficient and elegant structure will serve as one of the main attractions of Expo Dubai 2020 and as an architectural landmark in Dubai for many years to come.

