CALHOUN

FACT SHEET

OPEN WEB TRUSS

OPEN WEB TRUSS – A STRONG AND EFFICIENT SOLUTION FOR STRUCTURAL FRAMING IN FABRIC BUILDINGS

The engineering and design of a fabricated truss can be as complex as the weight of the truss itself. The weight of the supported structure, and live and dead loads, must all be considered. Fabric building companies who incorporate trusses with an economic design will use materials efficiently, selecting the right truss profile in the right proportions along with consideration of the cost to fabricate.

OPEN WEB TRUSS VS. BENT WEB TRUSS

There are two common framing systems when designing and engineering fabric buildings - open web and bent web trusses.

Open web trusses feature both top and bottom parallel chords spanned by triangulated steel bars, or angle iron connections, to effectively transfer live and dead loads to structural posts or columns. The cross-ties that traverse the truss serve to shed compression loads and will greatly add to the strength of the roofing system. This type of framing can carry heavy loads and will also serve double duty in preventing wind uplift of the fabric roofing membrane.

Bent web trusses may be used for fabric buildings and will feature an arched bottom and sometimes top chord. The cross-ties consist of vertical and angled bars, staggered in height to fit the arch radius. While a bent web truss may be faster to fabricate and will sometimes cost less, they tend to prevent proper interior application of the protective zinc coating at critical truss connection points. These unprotected points in the steel assembly may eventually rust and weaken the entire system - making it prone to buckling failure.

For engineered fabric structures, open web trusses are preferred as they use fabricated steel joists that are proportionally spaced between each load-bearing post to efficiently transfer loads imposed on the structure’s fabric roofing system. Aerating the corners of the open web truss welds also allows the protective zinc to fully penetrate the steel during the hot-dip galvanization process, preventing corrosion and buckling from the inside.

FOR INCREASED RELIABLITY OF OPEN WEB TRUSS:

3D NONLINEAR FINITE ELEMENT ANALYSIS

3D Nonlinear Finite Element Analysis should be used to simulate live and dead weights and determine the size of trusses along with spacing and slope to calculate the analysis of dynamic loading on an open web truss system.

When 3D Nonlinear Finite Element Analysis is applied to determine directional loads and the direction of concentrated load masses, a truss configuration can be designed to control the weight distribution and increase the strength at critical stress points.

In essence, the total framework of a fabric building must be analyzed for all possible loading conditions, and each component designed for the particular critical combinations that represent peak response conditions.

BENEFITS OF OPEN WEB TRUSS

HIGH PERFORMANCE STRENGTH

For typical roofing systems and long span structures, open web trusses are a preferred solution for applications which require strength and versatility. Open web trusses outperform other truss designs pound-for-pound for carrying and effectively transferring loads. Multiple configurations can be analyzed to determine the best truss components for fabrication cost economy, load bearing strength, and a pleasing appearance.

ACCESS TO MECHANICAL SYSTEMS

The open-web nature of an open web truss allows for installation of wiring, ductwork, and plumbing in the clear space between trusses. The unobstructed construction of open web trusses is also used as support for high-bay high-intensity lighting fixtures and sprinkler systems.

EFFICIENT DESIGN AND EASY TO INSTALL

Open web trusses reduce the weight of other load-bearing factors such as foundations, footings, and bearing walls. The main structure consists of a welded truss arch with parallel tube chords separated by web. A minimum 3” weld joins the web to the chord at each location. The web is an open section that allows access to all surface areas for hot-dip galvanization. Continuous web, or bent web, is not acceptable.

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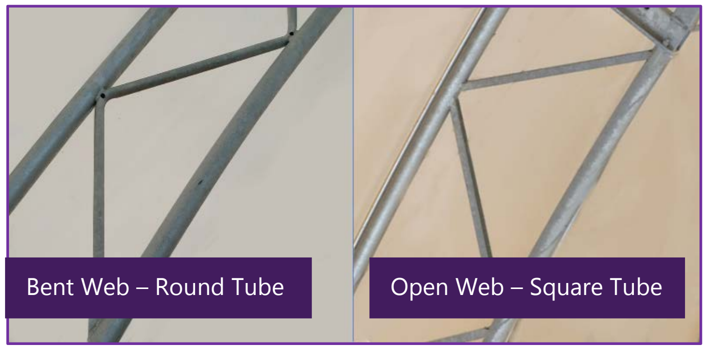
THE FIRST OPEN WEB STEEL TRUSS IS MANUFACTURED USING CONTINUOUS BENT ROUND TUBING

Source: Structure Magazine, 2009

OPTIMAL FOR HOT-DIP GALVANIZATION

The open web design allows the web to contour the cord, giving a stronger base connection and larger structural area of welding, Open web design allows for optimal coverage of hot-dip galvanization.

The continuous web, or bent web, design is not conducive to establishing an affective weld. The drain holes at the structural bend substantially reduces structural capacity. The pinched end of the web leaves very minimal room for the hot-dip galvanization to coat the area, leaving untreated steel in a critical connection point in a highly corrosive environment. The bent web design, therefore, does not allow for full coverage of hot-dip galvanization.



Source: Calhoun Super Structure, 2018

ROUND VS. SQUARE TUBING IN OPEN WEB TRUSS

Each member of a truss system is designed to carry the load at its connected point. When the direction and force of these loads are unknown, a round tube shape is often used as it resists twisting deformation better than a square shape.

For the purpose of carrying heavy loads, square tubing resists bending and buckling from the moment of inertia stressors, mainly because the same size square tube has more metal stock - and therefore more weight than round - making the square tube truss a stronger, more robust framing system.