STEEL CONSERVATORY

HSS members provided an elegant and economical solution for a bright and humid environment

THE FREDERIK MEIJER GARDENS SIT ON 70 ACRES OF PRISTINE WETLANDS, natural woodlands, rolling meadows, and colorful marshes. The property, located near Grand Rapids, MI, also houses feeding and nesting areas for migrating waterfowl, whitetail deer, and other species of land and water animals.

The Gardens is one of only 100 privately owned botanical facilities of this caliber in the United States. The conception of it began 10 years ago, when the West Michigan Horticultural Society began plans for a botanical showcase that would attract visitors to the area and serve as a valuable educational resource for the community.

The main focus of the Gardens is the tropical conservatory, the largest and—at the equivalent of five stories—tallest of its kind in Michigan. In March, butterflies began flying within the Lena Meijer Conservatory—especially appropriate given this year's exhibit theme of "Wings of Wonder." Now in its third year, the exhibit is increasing in popularity and stature. One of the largest temporary exhibits of live butterflies in the United States, thousands of people visited in 1997.

Next to the conservatory is the main building, which houses the visitor entrance, administration spaces, gift shop, café, classroom/banquet facilities, multimedia center and library. A long corridor that acts as a gallery for displays and arts shows connects the main structures. The public can also use the Gardens for meetings, parties and weddings.

The design of the Gardens had to take into account the special needs of a botanical structure. The main element of the facility's framing system is structural steel. In the conservatory, 186 tons of structural tubing was used and 104 tons in the remaining support facilities and administration building. According to the project's designers, structural steel provided aesthetics, strength and a maintenance-free environment.

The conservatory design was based around a modular, standard greenhouse system. The structural elements took on a uniform appearance, fitting within the greenhouse components. The structural system had to be open; it had to provide the highest level of natural lighting throughout the conservatory. Because of its northern location, wind and snow loadings had to be considered in the design. A greenhouse manufacturer provided the vented-glass roof system modules. Due to the glass systems, strict deflection criteria had to be met. The deflections were determined by applying lateral and gravity loadings to a computer model.

Inside the conservatory, the atmosphere is tropical with a high moisture level present. HSS tubing was used because of its minimum exposed surface area, performance and attractiveness in truss forms. The HSS tubing was galvanized because it was the most cost-effective means for preventing steel deterioration.

The conservatory has a stepped exterior appearance, supported by a series of truss/frames with spans ranging from 63' to 126'. They are constructed of TS8X8 and TS8X4 HSS tubing. The depth between compression and tension chords is usually 10'-6", which matches the dimensions of the greenhouse modular roof components. The top of the truss/frames forms a sawtooth configuration. While visually pleasing, this design created severe loading and stress design problems when coupled with the fact that the structure had to be open and airy with uniform and unobtrusive framework.

Before welding, small-diameter ports were drilled between members to allow for galvanization of the steel on the inside of all tube surfaces. The web members of the truss/frames were continuously welded to the main chord members. The truss component connections are field-bolted butt plates with galvanized bolts. The other connections are made by bolting tubes to welded clip angles. Structural tube purlins at the roof and along the walls between truss/frames support the glass systems. The purlins are designed to transfer wind and gravity loads to the truss/frames.

The main truss/frames are laterally supported by both wind truss/frames and cross bracing. The truss/frames are located in the interior of the building spaced 21' on center. The overall depth between compression and tension chords is 8'-3". Cross braces are used along exterior walls and perpendicular to the main truss/frames. Following the perimeter of the conservatory, there is an 8' wide by 12' deep concrete mechanical tunnel that functions as the foundation for the truss/frames.

Once the architectural floor plan for the administrative building had been completed, LFRD was chosen as a logical and economical structural framing system that allowed all spaces to be column-free. The structural steel members include W16 wide flange beams and 16K steel joists supporting 1-1/2" wide rib metal deck. The corridor that links the gallery consists of exposed structural tube supported by 14 concrete trees. Each tree is 22' tall and weighs 11 tons. Support for the trees comes from combined footing using grade beams and spread footings.

Since its completion, the Frederik Meijer Gardens has been a success, becoming one of the most popular attractions in West Michigan. Design is currently underway to expand the Gardens, adding approximately 60,000-sq.-ft. of additional classroom, banquet and meeting facilities. In the future, the Master Plan includes: two additional conservatories, specialty gardens, support greenhouses, an amphitheater, sculpture garden, grand atrium, sculpture gallery, and new lobby. Many site improvements are also being designed, including a new parking lot, main entrance drive, sculpture display plaza and a covered drop-off area.

Project Team:
Frederik Meijer Botanical Gardens

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