STEEL ERECTION FOR THE WALT DISNEY CONCERT HALL

Preview!

The Walt Disney Concert Hall is yet another incredible geometric creation of Frank O. Gehry & Associates. The Disney concert hall, which will seat 2500 people when finished in 2002, is yet another Gehry project that utilizes a "Catia" wire-frame computer model for steel geometry to define it's wild slopes, twists, and curves.

The structure, designed by John A. Martin & Associates, consists of eight architectural elements totaling 10,000 tons of structural steel, built on top of a five-story concrete parking structure. The steel generally follows the finished architectural surfaces, similar to the construction of the Rock and Roll Experience Museum in Seattle.

The detailing was done using geometry models from Catia files, translated to XSteel and Autocad for erection drawings and shop fabrication details. The detailing and fabrication of this creative shape offered a significant challenge. However, it was the erection planning and execution required to build the structure, within tight tolerances, on top of an existing concrete parking structure, which made this Gehry project an even greater challenge.

Erection challenges include the assembly of the main hall "box" with trusses spanning approximately 140 feet, connecting to east and west side box columns, which lean outward at 6 degrees. South wall box columns lean out 15 degrees, while the north wall, consisting of heavy box and built up wide flange members, cantilevers out 30 feet.

The erection of this heavy steel building, on the fifth floor of a parking structure, required careful planning and use of construction equipment. The substructure was analyzed by the engineer of record to define different zones of slab capacity, as the slabs vary from fifteen to forty-five inches in thickness. Areas were then established, and mapped for the anticipated cranes, forklifts, trucks, trailers, equipment storage, steel shake-out, and truss laydown areas. This plan was modified as needed and kept current throughout the duration of the erection, for communication between the Erector, General Contractor, the County of Los Angeles, and the Engineer of Record. The County of Los Angeles, as part owner of the project, had complete jurisdiction over the loads imposed on the substructure.

Based on the approved equipment-loading plan, erection procedure plans were developed on a step-by-step basis. Due to the complex geometry of the structure and the significant weight in the gusset plates, detailed erection plans were prepared during, and com-

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Walt Disney Concert Hall under construction.

pleted after the detailing of the work. Each plan presented the crane location with respect to substructure column grids, and showed the sequences to be erected in that crane position, along with radius and weights for critical picks. Corresponding crane outrigger or crane track pressure reactions were also submitted.

The erection started with an American 8470 Truck Crane, before an available Manitowoc M250 Crawler Crane was brought in. The crane positions were critical due to heavy box column picks, and a restriction on the crane reactions being at least a bay away from erected steel. The crane outrigger reactions/track pressures were checked against slab capacities for all critical picks in each crane position.

The erection procedure plans were created using the Catia files, which were converted to DXF files and brought into Autocad for the purpose of illustrating the next area to be erected. The main hall box, consisting of leaning columns on four sides, was erected as follows.

East and west walls were erected tier by tier with east and west side structures. The fifteen degree leaning columns were given sufficient stability by special erection aids, inherent heavy framing, bracing of side structures, and temporary struts where necessary.

The south wall was erected in a tier-by-tier sequence with the east and west walls. The fifteen degree "lean" of the massive south wall box columns (up to 40 Tons each) were supported laterally by a temporary space truss, designed to support the columns, and deliver the corresponding overturning load to the slab directly above the concrete columns below.

After the three tiers of steel were erected, the first truss would be ready to erect. The M250 was positioned in the center of the main hall at a reasonable radius. An assist crane was near a support column ready to erect stabilizing lateral struts to the top chord prior to releasing the truss from the M250. Six subsequent trusses were erected in the same manner. The trusses, all different in weight and geometry, ranged between 35 and 70 Tons.

Next, the inside seating erection was started with a small hydro crane, working inside the concert hall.

Meanwhile the north wall had begun erection. It required two pairs of temporary supports to carry the cantilevered wall, which was to hang out about thirty feet, unsupported, until completely erected and welded. This erection sequencing was by far the most challenging of the project. Each box section, brace, and strut had to be built into appropriate subassemblies and sequenced in order to accommodate erection stability, crane position and crane capacity. Deflections of the shoring had to be accounted for, as well as the loads from the shoring onto the concrete structure below. The crane had to step back, through an increasingly congested site as the erection progressed from the northwest corner to the northeast.

Other elements of the project, although lighter in weight, had their challenges in erection due to the complexity in geometry and stability. Sequencing of the work had to consider the site restrictions, the complex framing, and the contractor's schedule requirement to start follow-on trades. Often, due to many sloping primary columns and cantilevered members, the setting plans were controlled by completing critical bolted or welded connections in previous sequences.

The erector's superintendent constantly reviewed the erection plans and made hand drawn, scaled layouts to double-check the critical picks. The superintendent would offer refinements to the erection plans to suit the current site conditions and constraints. This system of checks and balances proved to be a great asset to the success of the project.

The project offered an experience in technology to all parties involved. The finished structure is an amazing sight and will be an unmistakable landmark structure in the City of Los Angeles.