Quality Space

BY BEN WHITE

Architects Delawie Wilkes Rodrigues Barker

Steel trusses connect two new Qualcomm headquarters structures via a dramatic, column-free atrium.

THIS OFFICE BUILDING ISN'T JUST A PLACEHOLDER FOR CUBE FARMS. San Diego-based wireless technology giant Qualcomm expanded its corporate campus recently and chose to make a bold statement instead.

Its new headquarters structure, Building N, consists of a ten-story office tower adjacent to an integrated 534-seat lecture/concert hall, for a combined floor area of 473,000 sq. ft. The building is designed to accommodate 1,200-plus employees and encompasses private offices, research and development facilities, a fitness center, and a café.

While the tower and lecture hall are separated by a 12-in. seismic joint along the face of the tower, the two are architecturally connected; the tower atrium extends into the lobby of the lecture hall, creating a dramatic column-free space nearly 100 ft by 50 ft. Within the tower footprint, a seven-story atrium extends vertically from the ground floor up to a mechanical well, which houses three large fans, part of the required smoke exhaust system for the atrium. Steel trusses crossing the atrium support the floor and roof of the well, and the trusses also act as collectors, tying together the floor diaphragm of the two wings of the building. Six pivoting steel and glass doors, measuring 20 ft by 11 ft, are also connected to the atrium smoke exhaust system and create a unique architectural statement at the building's main entry.

Hewitt Garrison Architectural Photography

Interior view of completed atrium with steel cable-supported glazing system.


Hewitt Garrison Architectural Photography

Interior view of completed lecture hall/ theater.


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Overall construction view of lobby and lecture hall steel roof framing.


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View of completed lobby and tower looking northeast from site.

Taking the Right Steps

The design developed for the roof of the lecture hall lobby generally forms a pair of very shallow bowls, with a curved step between the surfaces that varies in height from 6 ft to 9 ft. A concrete shell structure was considered, but it was ultimately determined that the desired form could be achieved in steel using a series of sloped and stepped beams with positive or negative cambers, within the range of standard fabricating shop practice. The use of a steel system eliminated the need for erecting formwork, which saved time and improved construction access to adjacent areas of the project. The geometry of the roof was delivered by the architect to the engineering in the form of an AutoCAD 3D file. The points in the 3D mesh were then translated into a RAM Advanse 3D model, which was used to analyze the roof structure for vertical and lateral forces.

Within the lobby roof, a series of stepped steel beams span from a radiused W36×210 beam over the lobby entry to a W33×118 beam near the seismic joint adjoining the tower. Because of the curved and stepped roof surface, each of the 11 stepped beams has a unique profile, with spans ranging from 46 ft to nearly 57 ft, and cantilevers at one or both ends ranging up to 15 ft. During the preliminary design of the lobby roof, it became apparent that it would be difficult to limit deflections to the desired levels without introducing beams that were significantly deeper and heavier than required for strength. In order to avoid these increases in depth and/or weight, a two-way system was introduced along the curved roof step. This was accomplished by a series of wide-flange beams along the top and bottom of the step, forming a transverse vierendeel truss with its joints at the top and bottom of each beam step. The resulting structural form, created by the interaction of the stepped beams with the curved and tapered vierendeel truss, garnered enough visual interest that the architect chose to modify their interior design of the lobby to expose the vertical elements of the vierendeel.

The exterior face of the atrium is enclosed by a cable net glass wall system, which is suspended from the mechanical well truss and supported out-of-plane by pairs of pretensioned horizontal cables at each floor level. The architect and engineer worked closely with Advanced Structures Incorporated (ASI), the cable wall designer, in order to assure that the large tension forces required in the horizontal cables were adequately anchored to each floor level, and to study the relationship between the pretensioned cable system and the deformations of the supporting floor diaphragm at each level.

The seven-story atrium extends from the ground floor up to a mechanical space.

Acoustic Challenge

Another challenge to the design team was achieving the acoustical requirements for the lecture hall in spite of the frequent overflights from the nearby Miramar Air Station and occasional noise and vibration from the helipad on the tower roof. This required a complete acoustical envelope around the lecture hall, with all wall and roof surfaces requiring a minimum mass of 50 psf. The lecture hall roof is framed using four steel trusses in a radial pattern, supported by a girder truss over the backstage area and a concrete wall behind the balcony seating. In order to minimize the volume of concrete making up the acoustical envelope, the structural roof deck was supported from the bottom chords of the trusses, with the required top chord bracing hidden below a barrel roof framed of light-gage steel.

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