Heavy Metal Act Headlines New Pavilion

An exposed steel frame creates an exciting concert venue in suburban Washington, DC

By Robert L. Miller, AIA

When top-grossing concert promoter Cellar Door Productions decided to build and own—rather than rent—their first open-air performance venue some 35 miles from Washington, D.C. near Manassas, Virginia, their aim was to open one of the East Coast's largest and best-equipped concert facilities as soon and as economically as possible. And some 600 tons of mostly exposed structural steel enabled the $22 million, 25,000 seat Nissan Pavilion at Stone Ridge to deliver the goods for thousands of rock, pop, and country music fans, while garnering some rave reviews of its own.

"One Fine Heavy-Metal Act," headlined the Washington Post, referring not to Metallica or Aerosmith, but to "...exciting architectural features...made of structural steel—soaring columns, bridge weight girders and a network of trusses supporting the roof." In "refreshing" contrast to D.C.'s marble cladding and the rustic veneer of other music sheds, wrote architecture critic Benjamin Forgey, "steel's great strength is on open display at the Nissan Pavilion."

In addition to the pair of 20-ft. deep trusses flanking the stage house—each weighing 80 tons and spanning 200 ft. while supporting 50-ft. cantilevers—the most noticed elements were the tree-like steel column clusters, "bundles" of three or four wide flange sections sprouting branch-like diagonal bracing where they join each truss. Within each cluster, gaps between columns give a look of transparency that belies the true mass of these members. Rather than mimic the "woodsiness" of the 99-acre rural site, concluded Forgey, these steel trees honor nature with their own structural logic.

Equally important, says architect Mallory Reynolds Warner, AIA, of Washington, D.C.'s Hickok Warner Fox Architects, the cluster design helps reduce

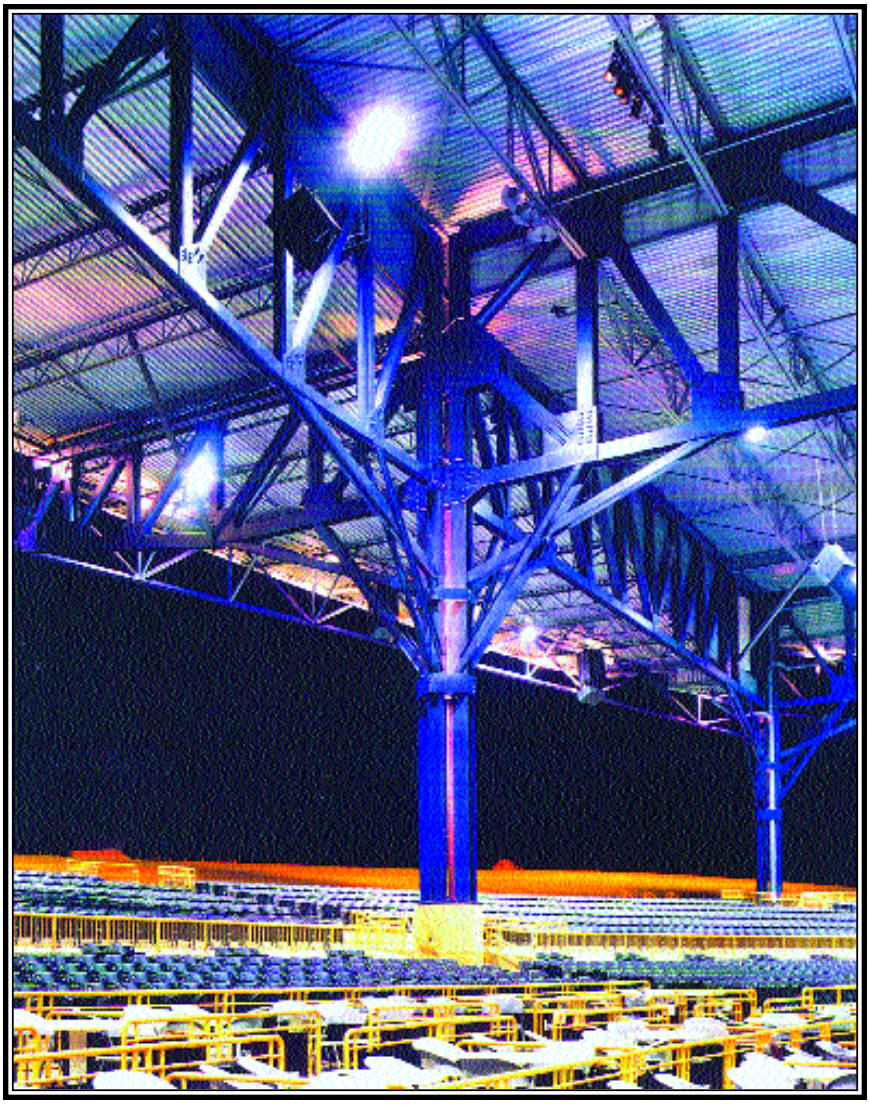
the total number of columns. For its size, the Nissan Pavilion, which shelters 1,500 VIP box seats and more than 8,500 regular seats under its 78,000-sq.-ft. roof, achieves something of a breakthrough in unobstructed sightlines. Only two main column clusters stand inside the amphitheater-like seating arc, planned by Warner with consulting theater architect Bill Bethmann, and these are strategically located astride aisles.

Architectural and structural design grew out of visits to existing, smaller facilities. Warner and structural engineer Jeffrey Overmiller, P.E., of Structural Design Group, Limited, in Rockville, MD, observed that many designers sought a visual blend with nature by adding natural-looking coverings and minimizing roof height—although this approach often resulted in added weight, shortened spans and sightline-limiting perimeter columns.

Among several alternates considered, a fabric roof alternate proved maintenance-intensive and acoustically difficult. Finally, the design team concluded that deep, open, exposed, long-span steel trusses supporting steel decks promised the lightest and most economical structure to buy, erect and maintain. For a pavilion of this scale, they now believe, it offers the most appropriate architectural expression as well.

"Well before modern architects theorized about nature and the machine, people admired the way steel bridges and structures complemented the natural landscape, " says Warner. "In this beautiful part of Virginia, we imagined coming over a hill to find a great old railroad bridge over a green valley. Surely walking up a berm to find our pavilion made of steel trusses could be just as pleasing and dramatic. We wanted people to cross the meadow parking and suddenly find this one-of-a-kind place."

To create this experience, and to create lawn seating for up to



The use of large trusses supported on giant "tree" columns located in aisles resulted in wonderful sightlines for visitors to the Nissan Pavilion near Manassas, VA. (Photography by Hoachlander Photography Associates)

15,000 people on this originally nearly level site, berms and grassy slopes were sculpted using 575,000 cubic yards of fill—calculated as the payload of a line of dump trucks stretching from DC to New York City. Integrated with the pavilion's steel structure and the surrounding concession, support and parking areas, the result has an intentionally man-made, even high-tech look that achieves its own kind of harmony with nature.

Although the architects and engineers studied a variety of roof configurations, the chosen design ultimately derived from the natural economy of trusses: as span diminishes, so does optimum depth. At the same time, analysis showed that a rectilinear profile of diminishing steps, using acoustical steel deck, would also combat the problems of irregular reverberations and other anomalies found in many covered outdoor amphitheaters. Performances bear out the theory: Nissan has been well-reviewed acoustically, both for intimate orchestral concerts and maximum-power hard rock.

Flanking the stagehouse, the twin, 200-ft.-long, 20-ft.-deep main trusses make a high, deep central rectangle. The roofline then steps down (all bottom chords being held at the same datum) to smaller rectangles defined by the next largest trusses, 130-ft. long and about 13-ft. deep. Four additional lower, triangular bays, and a front "eyebrow" that cantilevers 50 ft. over close-in lawn seating, extend the basic T plan to fill out the pavilion's fan-shaped footprint.

The main structural design challenge in this straightforward scheme lay in the pavilion's openness and lack of mass. Overmiller employed a finite element frame and truss design program by Enercalc to model loads that are often more a matter of uplift and aerodynamics than gravity. The stagehouse, its shear-resisting braced frames anchored 25 ft. down to bedrock, in turn serves to anchor the entire relatively light, sail-like steel structure.

Another bonus of the rectilinear, open-truss design is the ease with which it accommodates the catwalks, follow spot platforms, speakers and control booths (not to mention the occasional flying rig for a Reba McIntyre) that touring bands demand. Seen from below, this sometimes distracting clutter tends to disappear in the trusses' diagonal forest.

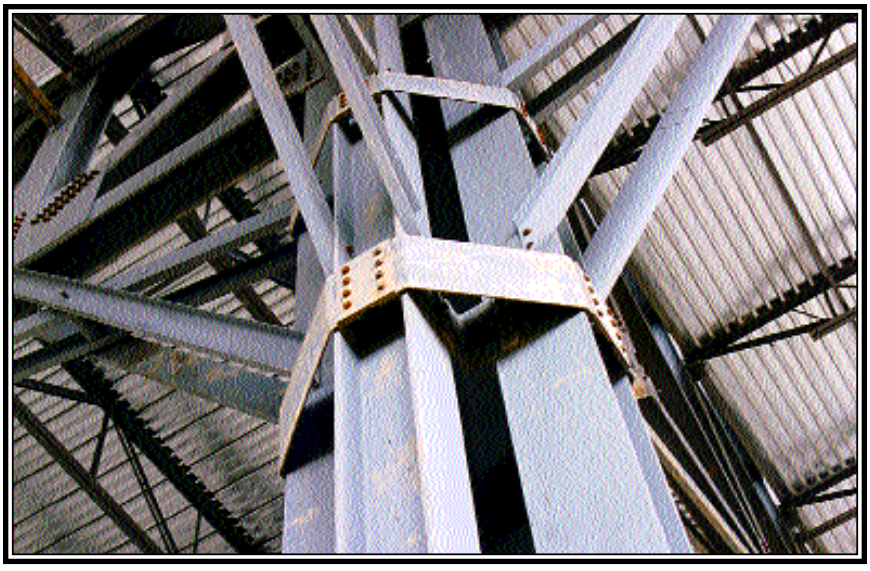
One more consideration that made this open trusswork possible was Hickok Warner Fox's interpretation of fire safety requirements, and its acceptance by Prince William County, VA, authorities. All parties agreed that wide open exit routes and an absence of combustible materials removed any danger to the audience from a bare—or in this case conventionally painted—steel structure. The stagehouse, however, is appropriately treated as a fire-protected, fully sprinklered building, and this facilitates one of Nissan's most-copied innovations: using the roof's deep open web trusses as part of the stage lighting grid, thereby eliminating the traditional separate, suspended show grid that in turn may support over 100,000 pounds of equipment.

The Nissan Pavilion makes selective use of AISC standards for exposed steel. Globe Iron Construction of Norfolk, Virginia, the steel contractor, helped develop a finish schedule that calls for removing rough edges and flaws on column assemblies and lower, visible bracing. Computer-generated designs for economical gusset plates and bolting patterns were selectively changed to provide cleaner-looking connections at lower elevations. Elsewhere, where the dark blue-painted truss members hover from 30 to almost 80 feet above patrons' heads, designers and fabricator agreed on more economical appearance criteria.

AISC-member Globe Iron and Structural Design Group engineers also cooperated closely on the design of details, typically turning Overmiller's freehand schematics into shop drawings and exchanging markups for each connection.

Overmiller praises Globe's people as problem-solvers who helped compress the whole structural design process to three months, allowing timely placement of a mill order and enabling the facility to open little more than a year after approval of Hickok Warner Fox's architectural schematics.

Primarily because of highway bridge clearances, there was limited opportunity for shop prefab-



rication of trusses, and welding was therefore largely confined to shop fabrication of moment connections on individual members. Instead, Globe created a veritable fabrication shop in the field, using the pavilion's vast unfinished seating area as the shop floor, and employing bolted connections for all members both on the ground and in place. Oversized holes and slip critical connections, including special high friction paint, facilitated this extensive bolted assembly—especially at its most critical point near the start of erection, when three cranes together lifted each of the main 80-ton trusses onto the supporting stagehouse and a single, freestanding column.

Here, and throughout the erection process, the tree-like clusters of three and four columns designed by Warner, Overmiller and their team revealed their most practical side. For each of the fabricated trusses, lifted into place by crane, had its own "private" wide flange section to receive it at at each end, with diagonal "tree branches" adding temporary as well as permanent bracing. Then, after all trusses were bolted in place, these individual columns were joined with custom-fabricated steel plate collars to form Nissan's distinctive, tree-clustered megacolumns—each one, appropriately, lighted by spotlights built into the column bases and collars themselves.

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