

Chateau on the Lake, Branson, Missouri

LOCATION

Branson, Missouri

PROJECT SCOPE

300 Room, 10-Story
Hotel/Convention Center;
1800+ Precast/
Prestressed Components

Convention Center Roof Specifications:

128 ft. (39m) Lightweight
Concrete Double Tees;
Density: 110 pcf (1760 kg/m³)
Strength: 6,000 psi (41 MPa)

OWNER

John Q. Hammons
Hotels, Inc.

STRUCTURAL ENGINEERS

Pellham-Phillips-Hagerman;
Prestressed Casting Co.

ARCHITECTS

Pellham-Phillips-Hagerman

GENERAL CONTRACTOR

Killian Construction

PRECAST/PRE- STRESSED CONCRETE MANUFACTURER

Prestressed Casting Co.

LIGHTWEIGHT AGGREGATE PRODUCER

Buildex, Inc.

Long-Span Lightweight Double Tees Enhance Spacious Convention Facilities



Artist rendering of Chateau on the Lake Hotel and Convention Center
Rendering by Gary Mullenbruch

The new Chateau on the Lake hotel and convention center is quickly becoming a landmark in the popular Branson, Missouri entertainment and lake recreation area. A major requirement in the design of the Chateau was the need for a nearly 130 ft (40 m) clear span for the roof of the ballroom and exhibit space and large conference rooms. To achieve this span, the designers used structural lightweight concrete precast/prestressed double tees with a specified density of 110 pcf (1760 kg/m³). The specified density concrete provided a solution that was not possible with the normal weight precast/prestressed concrete used in the rest of the structure.

PRECAST/PRESTRESSED CONCRETE SPEEDS CONSTRUCTION

Precast/prestressed concrete was specified for the structure largely because of the tight construction schedule and the need for construction to proceed during winter months. The Chateau project is the third convention facility that the owner and precaster had completed on a fast-track basis. From preliminary drawings in March 1995, the project was designed, constructed and ready for occupancy by the spring of 1997.

WEIGHT REDUCTION AND STRENGTH ARE CRITICAL

The Chateau project involved the fabrication of more than 1800 prestressed/precast components for a combined hotel and convention area of 350,000 sq ft (32,500 m²). The ten story hotel portion of the structure includes 300 rooms. Normal weight precast/prestressed concrete was used in the hotel and parking structure portions of the building, but to achieve the nearly 130 foot (40 m) clear span over the ballroom required structural lightweight concrete double tees, eight feet wide and four feet deep (2.44 m x 1.22 m), with a specified concrete density of 110 pcf (1760 kg/m³) maximum. This clear span provided adequate convention and ballroom space and a clear-span over the two parking bays below the convention center floor.

The specified 110 pcf (1760 kg/m³) density is lower than the precaster's typical lightweight concrete mixture of 115 -118 pcf (1840-1890 kg/m³). But the precaster knew from previous projects, and from working with Buildex, his lightweight aggregate supplier, that the 6000 psi design strength was achievable while still



Clear-span ballroom and convention space made possible by long-span lightweight concrete double tees (Courtesy: John Q. Hammons Hotels, Inc.)

maintaining 110 pcf (1760 kg/m³) maximum density. This density was needed not only for structural reasons, but also to make production, stripping and transporting the large pieces feasible.

The members were designed for a superimposed dead load of 25 psf (1.20 kPa) and a live load of 20 psf (0.96 kPa) plus drifting snow and hanging room partitions. The controlling factor of the design was the change in deflection due to the hanging moveable partitions which are suspended from the bottom of the double tee stems.

STRUCTURAL LIGHTWEIGHT PRECAST/PRESTRESSED CONCRETE PRODUCTION

The structural lightweight concrete mix design used Buildex 3/4" x No. 4 (19.0 mm x 4.75 mm) coarse aggregate from their New Market Missouri plant and Meremac River sand fines. A 7.5 sack (320 kg cement) air entrained mix with high range water reducing admixture was used to achieve specified minimum release strengths of 4500 psi (31.0 MPa)



Installation of 8 x 4 ft (2.44 x 1.22 m) section, 128 ft. (39 m) long lightweight concrete double tee. (Photo: Jordan Phillips, Jordan Specialty Advertising)



Giants On The Move

Transport of 128 ft (39 m) lightweight double tees using low-boy trailer in front and four-axle trailer in back
(Photo: Jordan Phillips, Jordan Specialty Advertising)



Arrival of lightweight double tee at site
(Photo: Jordan Phillips, Jordan Specialty Advertising)

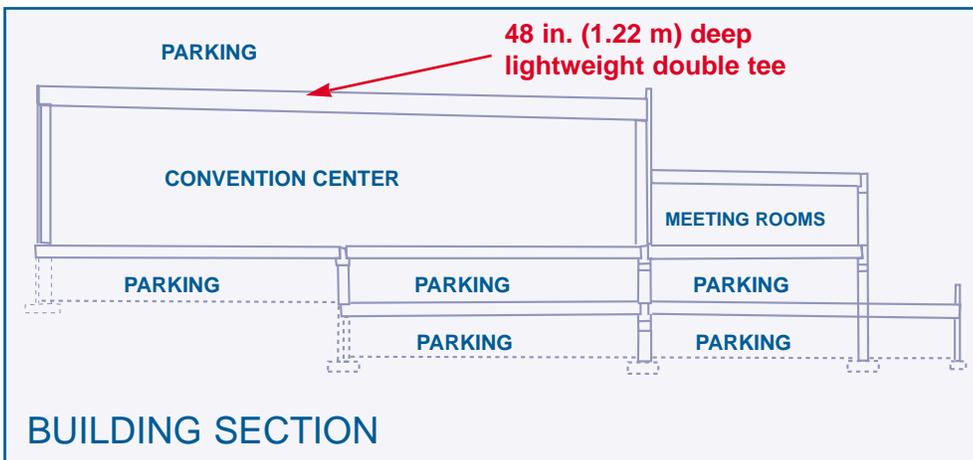
and specified minimum 28 day strengths of 6000 psi (41.4 MPa). The mixture was proportioned with 17.75 loose cubic feet (0.50 m³) of coarse light-weight aggregate per cubic yard (0.765 m³) of concrete to achieve the specified density of 110 pcf (1760 kg/m³) maximum. The average 28 day strength was over 6400 psi (44.1 MPa) and the 28 day camber ranged between 4 5/8 and 6 1/4 inches (117.5 mm - 158.8 mm).

The 110 pcf (1760 kg/m³) specified maximum density restricted the weight of each member to 80,400 pounds (36,470 kg). This reduction in weight was critical in facilitating stripping, handling and hauling of the double tees. During stripping, one end of the double tee was jacked up and

blocked and then the process was repeated for the opposite end. This allowed the 30 x 60 ft (9.1 m x 18.3 m) travelift and 90 ft (27.4 m) spreader beam to complete the stripping process without having to overcome the surface tension forces from the form.

LIGHTWEIGHT STRUCTURAL CONCRETE FACILITATES TRANSPORTATION & ERECTION

Conflicting State of Missouri and local requirements for shipping the oversized loads presented a challenge for the precaster, whose fabrication facilities were 40 miles (64 km) from the project site. The double tees were transported in groups of two, with escorts at the front and back of the group. The front of each long-span double tee was supported by a low-boy trailer and the back was supported by a steerable four-axle trailer. The convention center & parking facility portion of the project, including the 128 (39 m) foot long double tees, was hauled and erected in approximately seven weeks.





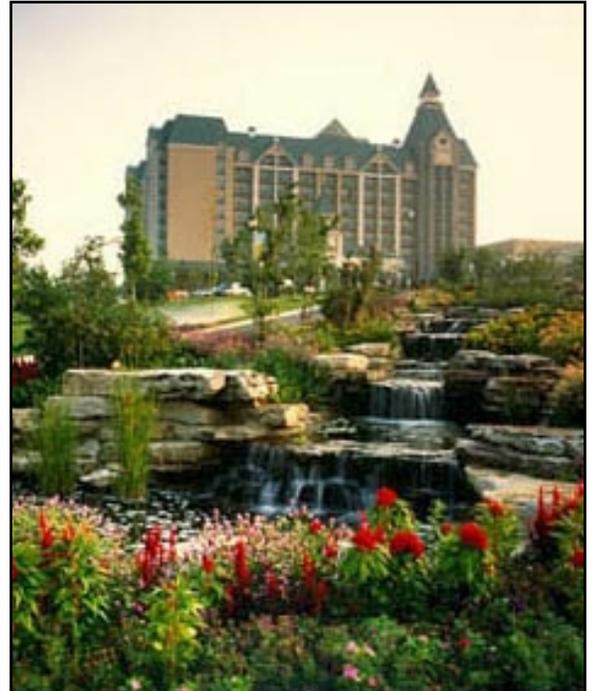
Erection played a big part in the decision between concrete and steel. The 48 inch (1.22 m) deep lightweight concrete double tees were priced against fire-proofed structural steel. Because the precast long-span convention roof double tees could be erected at the same time the two bays of floor tees and supporting beams, columns, and wall panels were being erected, there were significant logistic advantages to the all-precast system.

These advantages were reflected in the comparative pricing of precast concrete vs. structural steel. The cost savings reinforced the selection of long-span structural lightweight concrete double tees.

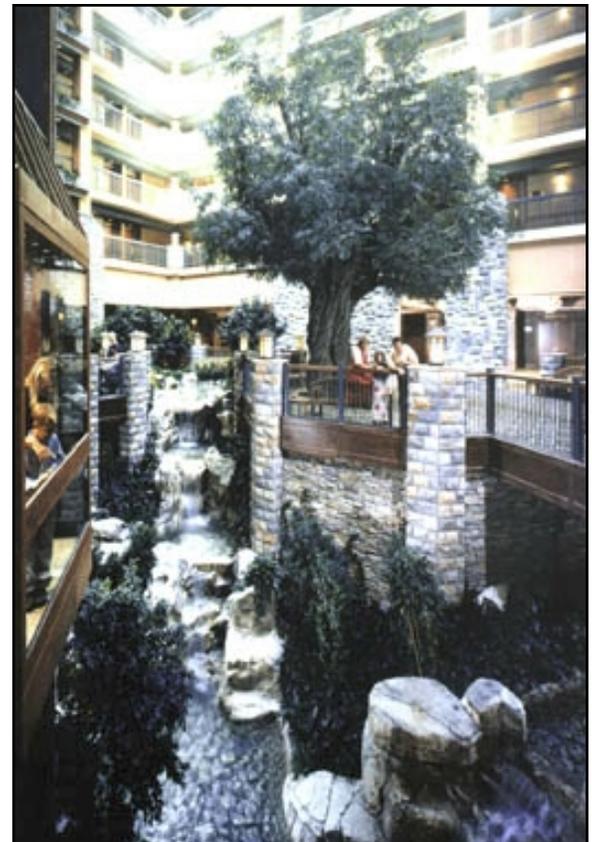
In addition, if a steel-framed structure had been used, multiple cranes would have been needed for the installation, which would have meant additional erection operators and longer time requirements, significantly increasing the cost of the project. The precaster designed the lightweight concrete long-span double tees to allow for the use of only one crane and a much quicker installation. Upon successful setting of the double tees, the general contractor was immediately ready to start the dry-in process for the roof structure. This saved a substantial amount of time over the alternative use of structural steel assembly.

SPECIFIED DENSITY CONCRETE USED ON MANY OTHER PROJECTS

While the Chateau project provides a dramatic example of the benefits that can be achieved with lightweight structural concrete, the precaster has used “specified density” concrete on numerous other projects. By being



Two views (above) of finished Chateau on the Lake Center with landscaping.
(Courtesy: John Q. Hammons Hotels, Inc.)



Chateau on the Lake lobby atrium
(Courtesy: John Q. Hammons Hotels, Inc.)

able to vary concrete density from 110 pcf (1760 kg/m³) to over 130 pcf (2080 kg/m³), the pre-caster can optimize structural requirements (for both span and loading), lifting requirements (both in production and at the project site), and hauling requirements.

By being able to vary the concrete density, the pre-caster can economize shipping by allowing multiple pieces per load in some cases. According to the pre-caster, this not only saves in shipping costs, it also improves installation efficiency by having fewer loads that need to be moved though the project site.

CONCLUSIONS

The total Chateau on the Lake project building cost, including the hotel and convention center plus ancillary structures and landscaping, was approximately \$35 million. The cost of production, transportation and erection of the precast components was \$4.3 million.

Chateau on the Lake was completed in the spring 1997 and was officially opened shortly thereafter. The new facility with its beautifully landscaped surroundings has become a tourist attraction and a striking landmark. Prestressed/Precast concrete, using the appropriate specified density concrete in critical design areas, provided an economical solution with fast track construction and a satisfied building owner.

Portions excerpted from: PCI Journal, Vol.43, No. 6, November/December 1998, "Long-Span Double Tees Enhance Spacious Convention Facilities In Chateau on the Lake," by Bill Johnson, PE, President and General Manager of Prestressed Casting Co., Springfield, Missouri; Other portions were provided by direct communication with Prestressed Casting Co.

| CONVENTION CENTER |
|--|
| <p>50 columns 63 beams 13 spandrels 179 wall panels (8 in) 31 8DT48 x 128 ft long-span lightweight double tees 70 10DT34 x 64 ft convention floor double tees 36 10DT34 x 65 ft pretopped parking double tees 83 10DT32 x miscellaneous length roof double tees</p> |
| HOTEL |
| <p>Approximately 1300 components of 5 in. flat slab deck, 8 and 6 in wall panels, precast beams and columns, and steel frames</p> |
| Total = approximately 1800 precast concrete components |

**For Additional Information About Structural Lightweight Concrete
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