MERIT WINNER

ENGINEERING Awards of Excellence

EIFFEL TOWER II

Las Vegas, Nevada

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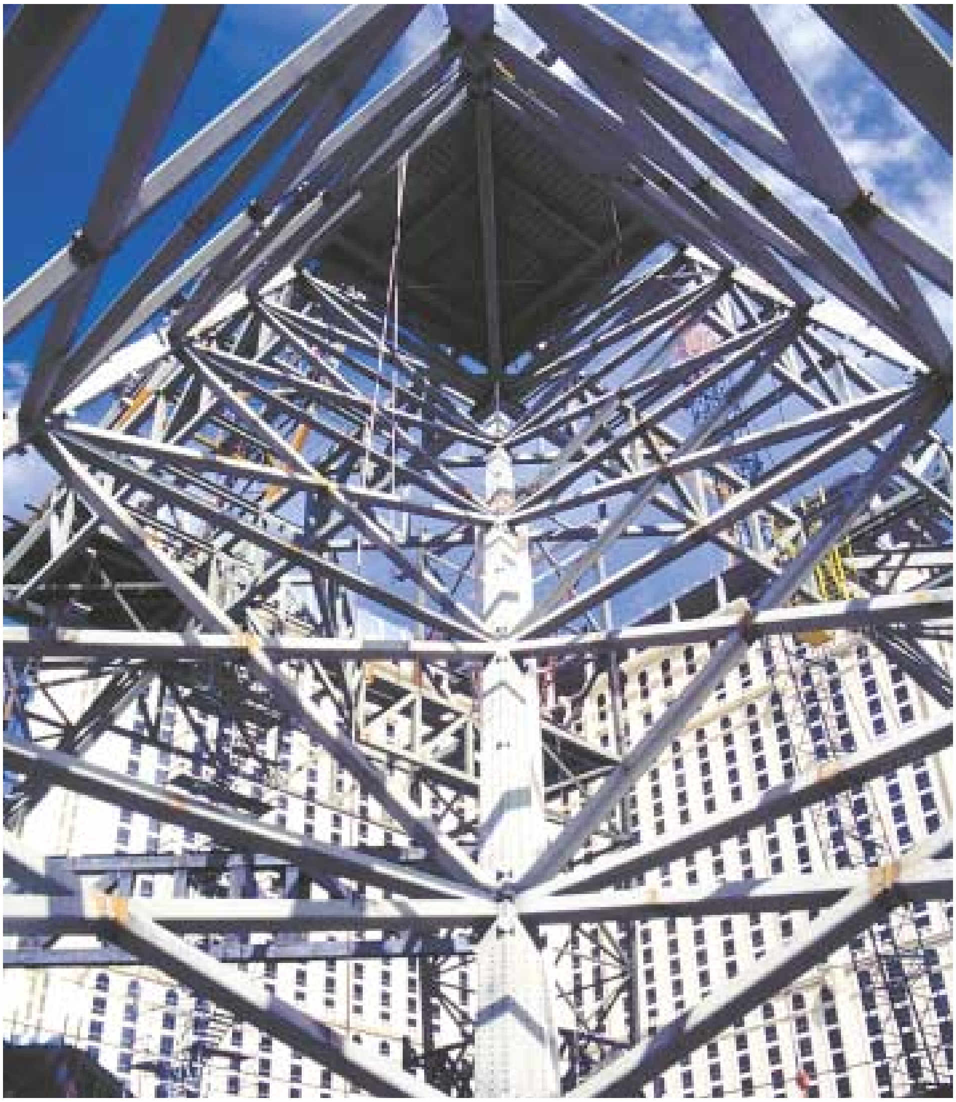

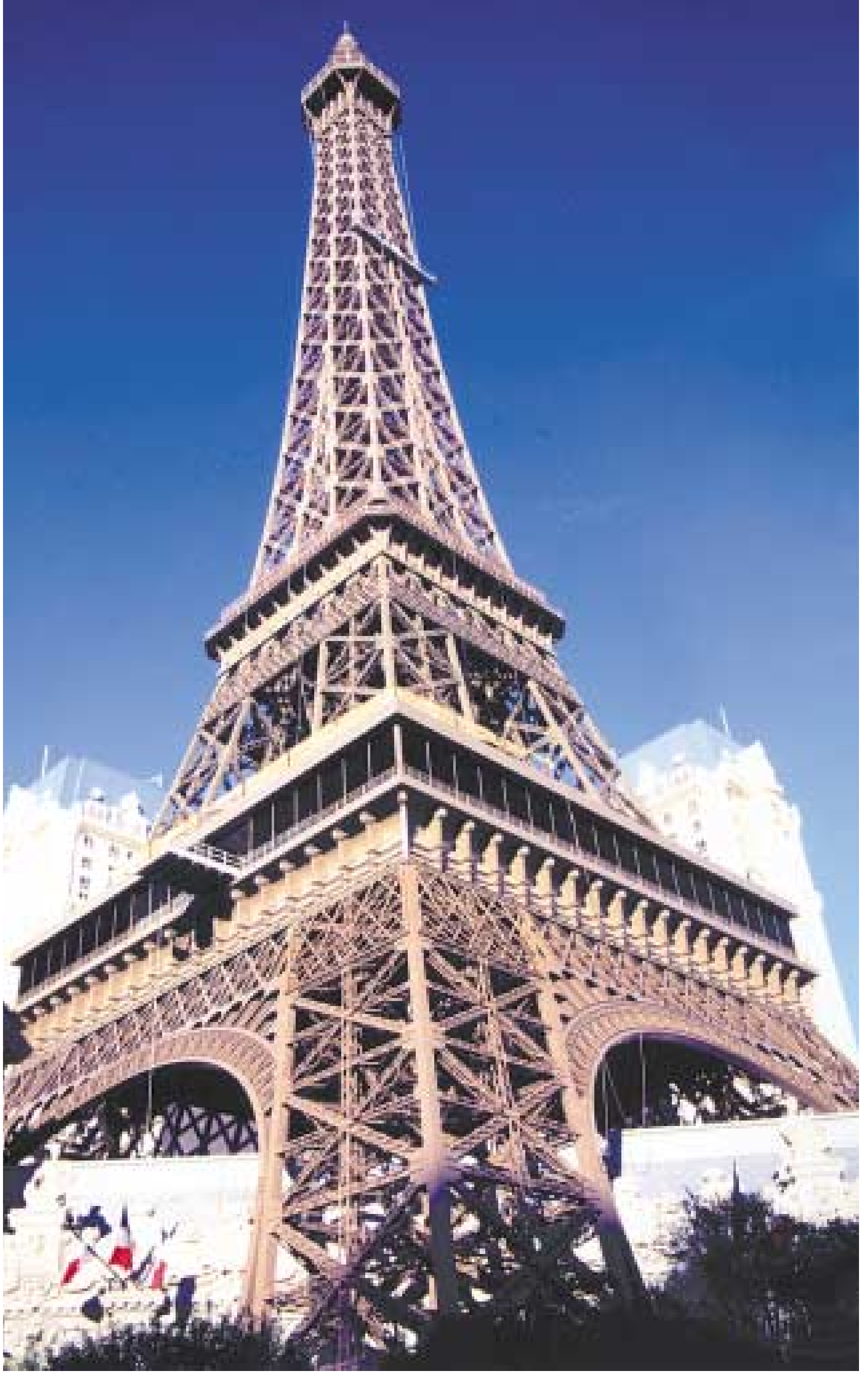

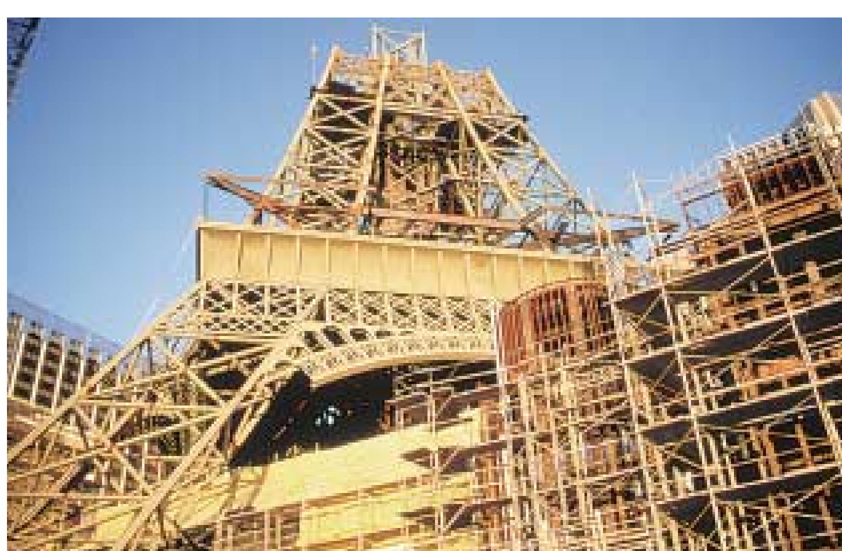

A 540′, 50-story reincarnation of the Gustav Eiffel masterpiece now stands in front of the Paris Hotel/Casino in Las Vegas. This half-scale replica of Eiffel's masterpiece, while preserving the authentic beauty of the original tower, utilizes a modern structural system conforming to the complex requirements of the contemporary codes and performance requirements. The Eiffel Tower II design had to specifically deal with the extremely hostile weather conditions of a desert environment as well as safeguard against the possibilities of arson and other terrorist activities.

CreativeStructural Design

In order to create this authentic replica of the 100-year-old Eiffel Tower icon, the design team had to develop innovative ways to create and meet today's standards, codes and life safety issues. While this tower looks like the original, the structural design is markedly different than the original tower. This is a welded structure, although approximately 300,000 fake rivets are used for aesthetic purposes. The lower one-third of the tower utilized tube sections camouflaged with nonstructural laces to retain the original look of the Eiffel Tower. The elevators from the restaurant level to the top are entirely supported by complex planar trusses that form the restaurant's floor. Special laboratory tests and nonlinear analytical studies were needed to validate the lacing angles, as used in the upper portions of the original tower, since these angles violate the letter of current codes.

Automated Fabrication

The tower chords and other main components were shop manufactured and prefabricated in Phoenix. Numerically controlled, AutoCAD-driven machines were used to automatically cut the plates to precise sizes. The chords were then knocked down and shipped in pieces to the site in Las Vegas for assembly.

Technical Innovations

Five main issues controlled the structural design of this project. Proper addressing of each of these issues required application of state-of-the-art technology as follows:

Extreme Changes of Temperature: 70°F day to night, 45° side to side (under the sun or in the shade). Extensive finite element analyses of thermal effects were necessary.

Detailed Fire/Arson Scenarios: 16 individual arson scenarios were investigated to optimize the performance and minimize the fireproofing requirements. Complex nonlinear buckling and thermal analyses were needed.

Innovative Welding and Manufacturing Technologies: Precision-welding technologies utilized in airplane and ship manufacturing were specified and executed.

Plumbness of the Tower: The tower as constructed could not be out of plumb by more than one inch along 540′ of height in order for the elevators to be functional. Laser technology was used to monitor the tower's plumbness under construction.

Wind Deformations and Vibration Control: Extensive computer analyses were performed to control vibrations due to operation of elevators and achieve optimum resistance to 90 mph winds.

Conclusion

Perhaps no other structure in the world represents the glory of sheer structural engineering know-how as the Eiffel Tower. In contrast with the prevailing architectural practice to hide the structure within the architecture, this tower standing in front of a most modern entertainment center is a vivid reminder of the achievements, complexity and vitality of the practice of structural engineering.

The structural design team faced many challenges in bringing the Eiffel Tower to the "Strip" in Las Vegas. The structural design used steel, in lieu of the originally proposed aluminum, in order to limit the movement at the top of the tower in a wind, so that the patrons would not get sick. The engineers were also required to make the tower stable if the support of one of the legs was lost due to a fire. These are only two of the many design obstacles that were involved in bringing this monument to the desert.

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Park Place Entertainment Corporation, Las Vegas, NV

STRUCTURAL ENGINEER:
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DESIGN ARCHITECT:
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PRODUCTION ARCHITECT:
Leidenfrost / Horowitz Associates, Glendale, CA

GENERAL CONTRACTOR:
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FABRICATOR:
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ERECTOR:
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DETAILER:
Schuff Steel Company, (AISC member) Phoenix, AR

SOFTWARE:
AutoCAD, SAP 2000, Robot