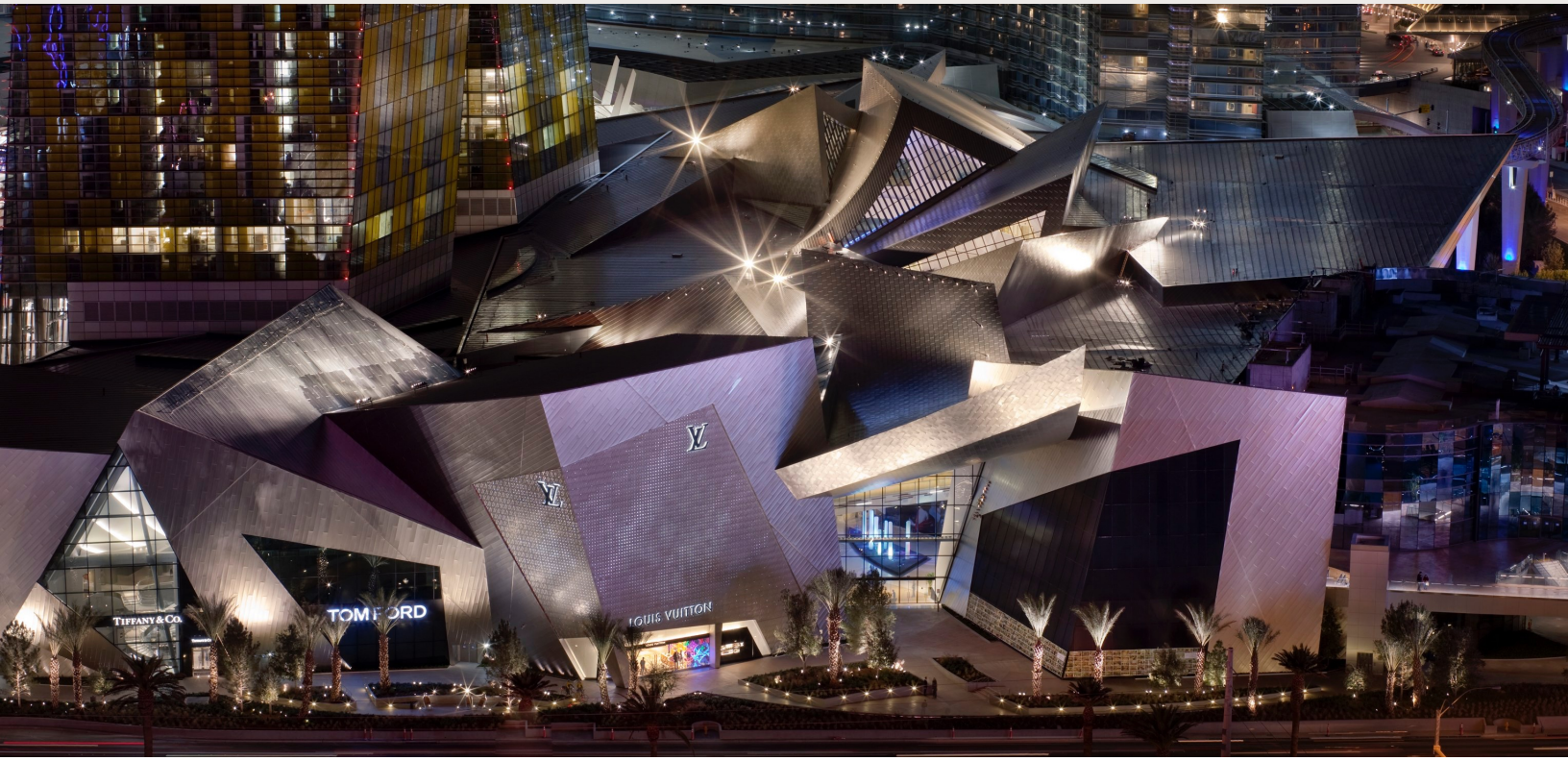
SCHUFF STEEL

CASE STUDY :
THE CRYSTALS AT CITYCENTER



Design Excellence

The Crystals is the centerpiece of CityCenter's retail and entertainment district. CityCenter is a joint venture between MGM MIRAGE and Dubai World. The development is an unprecedented architectural model for the ideal modern city. The more than $8 billion mixed-use development was built on 76 acres along the Las Vegas Strip and was the largest privately financed project in the United States at the time of the build.

CityCenter includes six architecturally stunning structures, including hotels, condos and The Crystals. Each structure is designed by a different prominent architect selected by MGM MIRAGE based on an international design competition.

Studio Daniel Libeskind designed The Crystals. Libeskind builds major projects throughout the world. His practice includes cultural and commercial institutions such as museums, concert halls, convention centers, and universities including the Military History Museum in Dresden, Germany and Memory Foundations, the site of the World Trade Center in New York City.

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Project Details

With dramatic architectural design including its spiraling rooftop, the building is positioned as a statement for the Las Vegas community that rivals builds around the world.

The 665,000 square foot facility includes a below-grade garage, two levels of retail and a one-of-a-kind roof that elevates the project into a class of its own.

The roof is made up of thousands of leaning columns, curving trusses and straight members that do not line up with any other piece of steel. The roof actually consists of 19 separate roofs that are intermingled and overlap one another. The roof includes 13 planar roofs and six dramatically sloped arcade roofs. The six arcade roofs were the most complex element of the project.

Project facts:

- 16,455 pieces of steel
- 13,900 tons of structural steel
- 52,766 connections
- 160 trusses, including 80 major trusses
- Weights of trusses vary from 5 to 90 tons
- Lengths of trusses vary from 10 to 180 feet
- 69 pipe columns varying from 20 to 84 feet (in three separate shafts)
- All trusses tie into one another, pipe columns and other columns
- Over 90% of the connections are bolted
- Project entailed over 15,000 shop drawings
- There are no right angles or repetition on any of the 13 planars and six arcades
- Entire project built with recycled steel
- Steel was delivered by 1,433 trucks

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Safety is a Culture

“Engineer it out and plan it right” is a common saying among us. Steel erection and fabrication rank among the top most hazardous occupations in the US. Our commitment to safety and respect for the tradespeople is what brings world-class safety to Schuff Steel. It is a culture that is fully integrated and a part of every team members mindset starting at the top in the boardroom and carried throughout every layer of our company.

At the point of planning and building The Crystals at CityCenter was the most complex project Schuff Steel had built at that point. From a safety standpoint, it was an exceedingly difficult project putting focused attention on the steel erection planning phase.

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Challenge 1: Finding the right team

With the complexity of The Crystals project, the right team was essential. At the time Las Vegas was booming with construction work that brought Ironworkers from all over the world. Because of the large-scale nature of The Crystals, we had to expand our manpower, which meant bringing on new workers that weren't accustomed to the Schuff Steel way.

Leading the way to a solution

Strong leadership was paramount when managing unfamiliar manpower. Working with the very best in the world was the goal when building out our team. We made a global search for a Safety Manager as we currently had the Superintendent on Staff.

During our worldwide search, it became apparent an even better strategy was to have a full time Safety Manager as well as a Safety Coordinator for complete coverage. This also allowed the Superintendent more time to focus on the difficult task of executing the erection plans. Additionally, we developed an extensive orientation for newly hired team members based on the vast amount of workers that had never worked on the Schuff Steel team before. That meant hands on fall protection training along with how the plan would be executed. Our workers were trained on equipment, logistics, and how to safely navigate around a congested site as well.

The combination of an aligned safety management team along with additional training for the workers set the tone for the entire project enabling us to maintain our top level safety record.

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Challenge 2: Operating within a congested worksite

With all the nearby construction happening around our project, our workspace was limited making Steel Erection of The Crystals more complicated than design alone. With 19 separate roofs, thousands of leaning columns, curving trusses and straight members with unique alignment requirements we needed the right plan to make it work in a tight space.

Planning a solution

Before Steel Erection was able to begin, we spent an extensive amount of time planning. Because we would be working in a congested construction site with limited space, the original thoughts of a normal laydown area were struck before we ever looked at the first blueprint.

With nearly 4,000 construction workers on site, we knew we would need to manage this project from a vertical operation as much as possible. A typical project would allow us to consume a fair amount of real estate for laydown and equipment. However, due to the unique schedule of multiple structures going up at once, the space allocated was going to be limited at best. Therefore the decision during the pre-planning stages was to use the structure we were building for a laydown space, minimizing the hazard of our workers to all other congested construction traffic.

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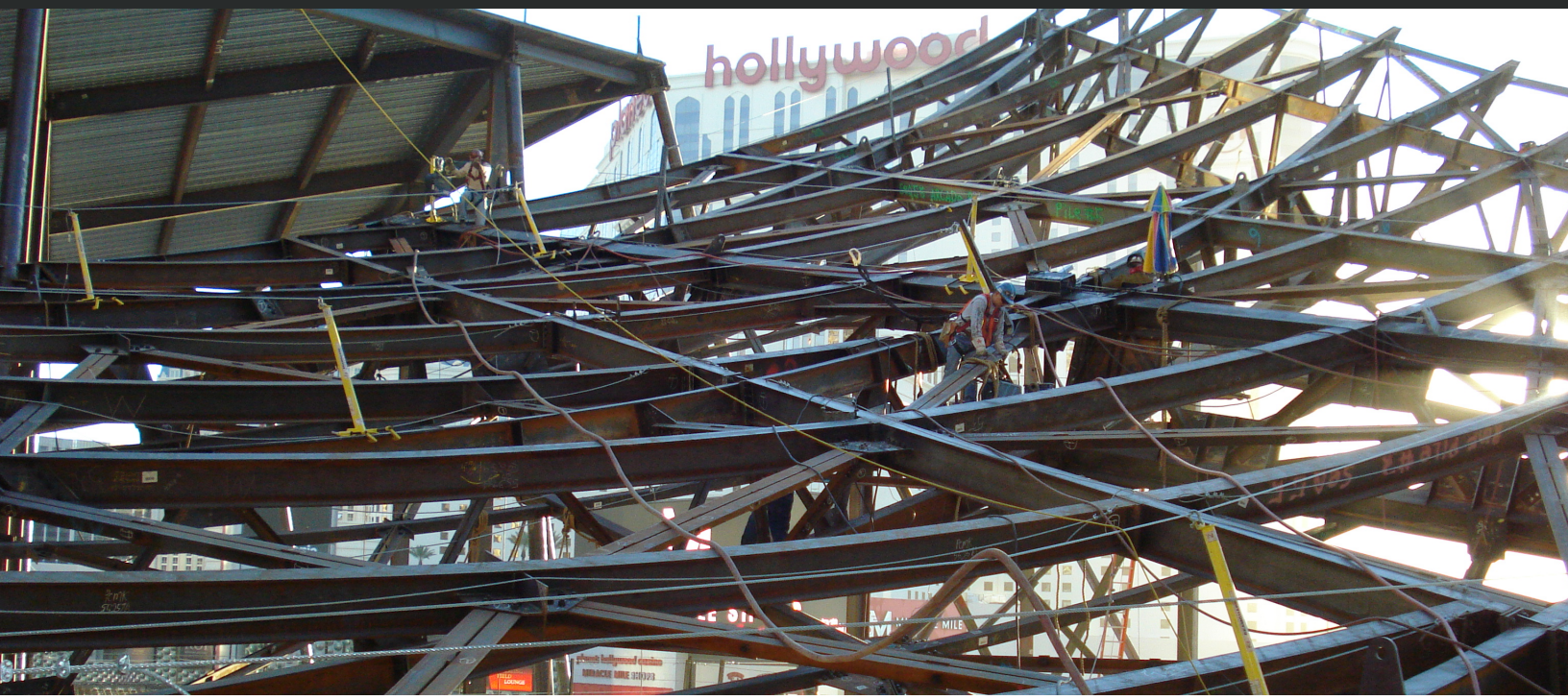

Challenge 3: Finding safe fall protection strategies from steep angles

The Crystals project involved working from steep angles, making fall protection increasingly more challenging. We would have to accomplish techniques that had never been accomplished in the steel erection industry before.

Innovating a solution

Early on we made the decision to expend the time and resources required to define a fall protection plan that was efficient and productive while prioritizing safety for our workers and keeping it user-friendly.

Pre-planning was an essential part of strategizing how we would execute the fall protection systems during the steel erection phase of The Crystals. We spent more than a year on this effort.

For the first time ever, we used our modeling programs to layout and plan our fall protection systems to work with the difficult design of the project. Different heights, slopes and angles of the roof featured beams that are flange-up (as an "I") and several that flange sideways (as an "H"). The roof slants from the low roof to several fragmented peaks and would require us to deck from the apex of the roof downward. The decking covers the slopes, the sides, and the edges of openings of the peaks in various configurations creating unique problems from both an access and installation standpoint. We had to use multiple different fall protection applications, such as Beam Guards, Horizontal Lifelines, Rope Grabs, Retractable lifelines, Sliders, Tie-off chokers, Boom lifts and Spider systems to make it work.

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Safety Stats

Despite the significant challenges, we were proudly able to successfully accomplish it without a single fall protection injury.

Manpower	-	148 at peak
Man Hours Worked	-	142,000 Ironworker person hours
Incident Rate	-	1.48
Lost Time Injuries	-	0 (Zero)

The amount of time and planning that is dedicated to the safety needs of our workers is a big part of what makes Schuff Steel successful. Utilizing the leadership of our Superintendent and Safety Manager helped us eliminate risk factors ensuring our team was trained to work within the safety limitations of their abilities and the project at hand.

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Project Team:

Owner:
MGM Mirage

Contractor:
Perini Building Company

Architect:
Daniel Libeskind, Design
Adamson Associates, Architect of Record

Steel Fabricator and Erector:
Schuff Steel

Steel Detailers:
BDS VirCon

Ironworkers:
Local 433

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