

Lobby
Ceiling

Corporate
Office

Restaurant

Student
Center

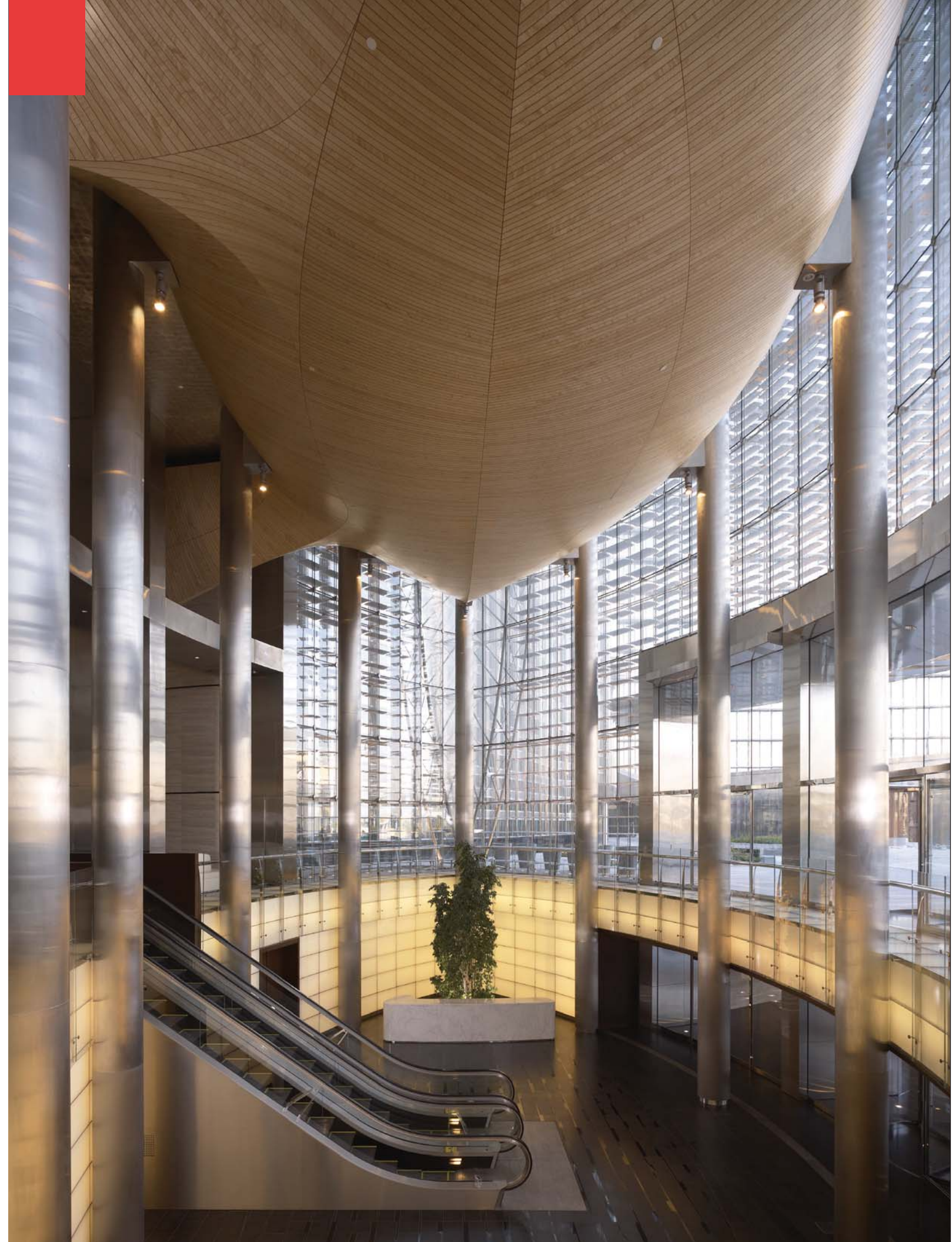


Architectural Woodwork Institute

design solutions

Summer 2013 | \$6.25





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eveloped by Emaar Properties PJSC, the Burj Khalifa is a global icon and the catalyst of Dubai's development.

Initiated in 2003 and completed in 2010 this 162-story intelligent building has over five million square feet of space, and houses the five-star Armani Hotel; 100 floors of luxury residences; 30 floors of corporate offices, and the world's highest observation deck.



A Global Icon.

Free-form, Suspended Sycamore Ceiling Landmark of the Burj Khalifa in Dubai.

The elliptical entry into the corporate offices in the Burj Khalifa was envisioned as a symbolic statement about the corporate vitality, global presence, reach, technological prowess and importance of business as Dubai's position in the global marketplace grows. Within this gateway, lays a highly articulated, free form suspended wood ceiling consisting of two related parts that reflect the organization of the lobby and relate to the curvilinear language of the building.

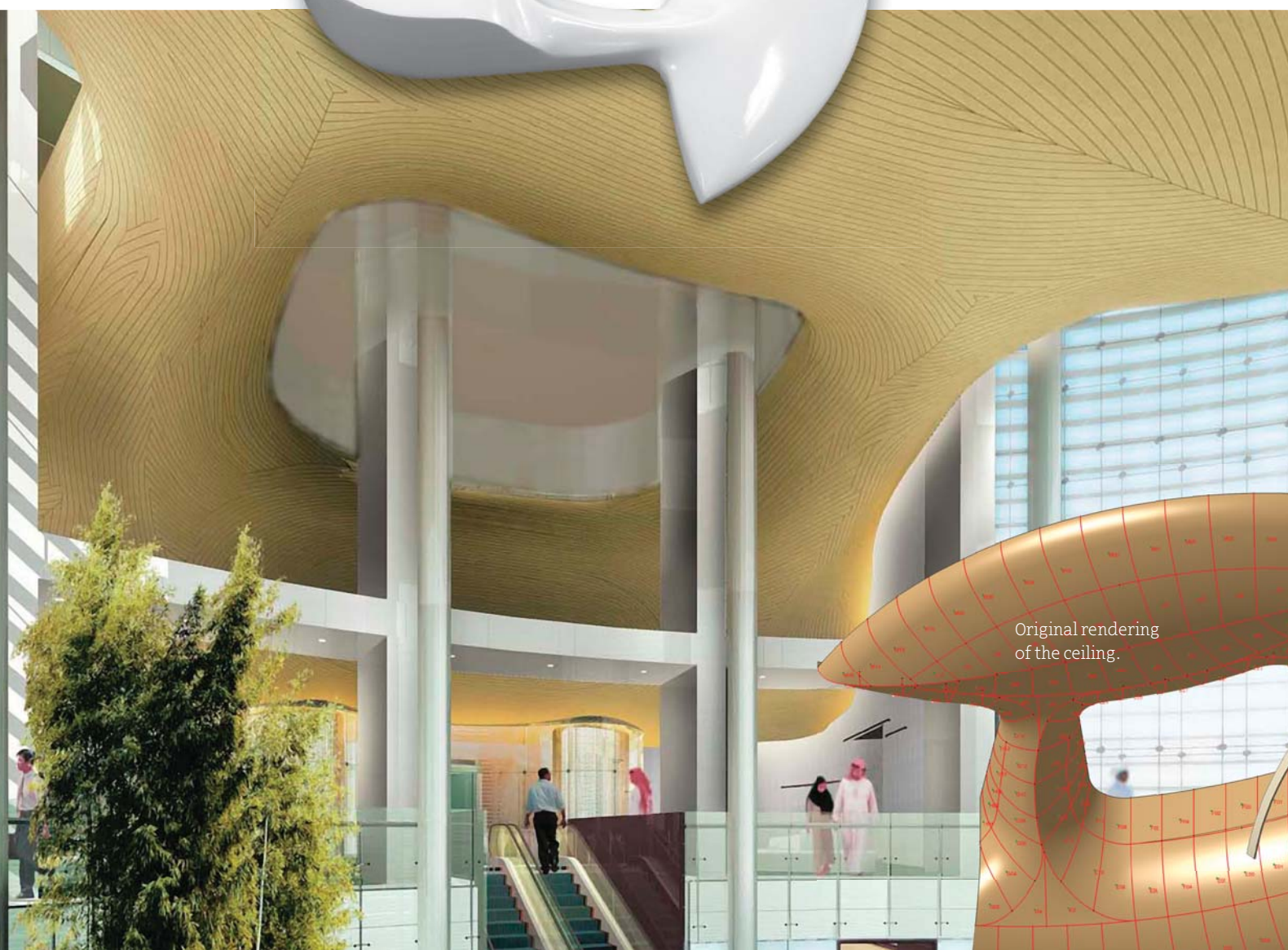
The magnificent ceiling of quartered, figured English Sycamore was fabricated and installed by Imperial Woodworking Company, a long-time AWI member firm located in Palatine, Illinois. Architects on the project were Skidmore Owings & Merrill LLP, Chicago (SOM).

The inherent complexity to the design of the lobby ceiling required the use of the sophisticated Catia computer program to design, engineer and build the structure. The ceiling surface is covered with four-inch wide, tapering wooden planks. The demand for precision and multiplicity of the planks required the utilization of computer numerical controlled routers for fabrication.

"An essential feature of the office lobby space, the free form ceiling connects the hotel space above to the upper level of the pavilion structure," explains Adrian Smith, original project designer of the building. "This feature continues the organic nature of the project into the office environment much the same way as the curved walls do for the residential entrance and public spaces. This highly sculpted feature becomes a landmark feature that differentiates this pavilion from all others."



◀ Original solid model of the ceiling's shape.



Original rendering of the ceiling.

at a glance

AWI MANUFACTURING
MEMBER:

**Imperial Woodworking
Company**

LOCATION:

Palatine, Illinois

ESTABLISHED:

50 years

FACILITY:

225,000 square feet

In 2009 because of their over 30-year relationship, the architects and owners sought out Imperial Woodworking and charged the firm with completing the complex ceiling in eight short months. "It was clear very early on that we didn't just have to make a ceiling; we had to develop a system to manage the complexity inherent to the design and aid in the engineering, fabrication, logistics, and installation," notes Imperial's Frank Huschitt III. "Eventually it would take our best efforts combined with those of the architects and consultants to complete that task. We had to engineer a solution, then build it in Illinois, ship it half way around the world and install it; all to our standard of excellence. It was an enormous task."

Masterful Modeling

Imperial assisted SOM in creating a technically correct wooden ceiling which worked with all of the environmental, HVAC, and coordination constraints in a lasting and beautiful way. The woodworking firm started with the base information supplied by SOM, renderings, a small physical model and drawings, and helped to interpret the geometry in a series of work sessions with SOM.

Using digital models to create and test the new shapes, the Imperial team combined their knowledge of wood with layout and installation techniques to solve the technical issues and fabricate and install 220 panels 60 feet in the air. There was no punch list, and as the chairman of the board of Emaar Properties told the architects, "this ceiling is the nicest part of the building, and it went in without a hitch."

Made to last a lifetime, special care was taken to assure that the 3,200 planks of fire rated core and veneer were able to expand and contract as needed in incremental ways, so that at no time would the ceiling bind or fail from too humid or too dry air. This detailing succeeded, and the use of splines at every plank joint assured incremental movement was absorbed locally.

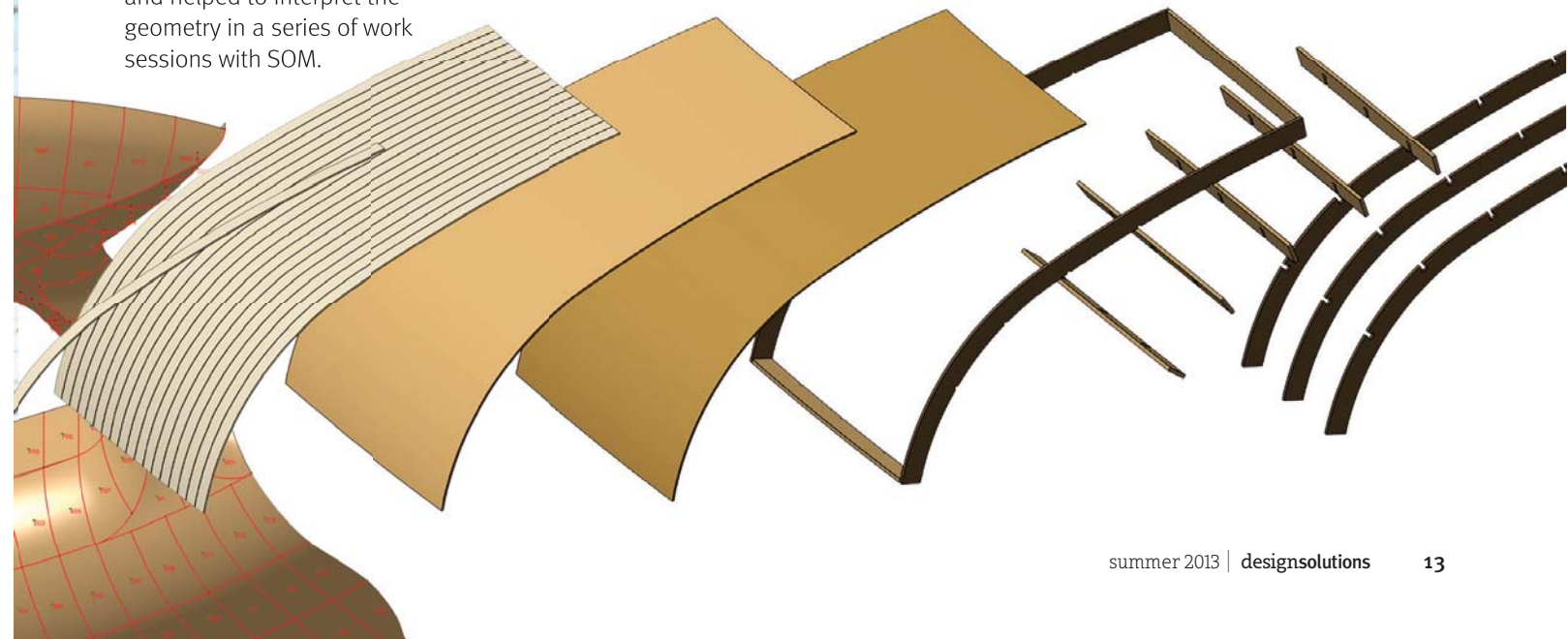
Working with Richard Herskovitz, of ICON Global, and James Kotronis and Gehry Technologies staff, Imperial coordinated all of the site survey information, with the designs and details from several surrounding subcontractors to create the "Issued for Construction" geometry needed for all stakeholders to coordinate their work. Establishing the built environments dimensions and placement was the first step in defining and constraining the final surfaces.

Using accurate survey information, a master model was created to assure that all components would fit inside and around the final components. The shape was then refined through multiple work sessions with SOM in Chicago and on site in Dubai. This intense work was accomplished within a strict time schedule. Agreement on concept was May 9, 2009 and all surfaces, shop drawings and a full sized mockup needed to be approved by June 22 in order to meet the schedule.

Material Testing

Understanding the physical constraints of the wood, Imperial conducted a bending test of the planks with veneer against curvatures from 18" radius to 36" radius, to ascertain that 3/8" core with one-ply veneer on both sides would consistently bend around a 24" radius, while still twisting along the long axis a few degrees. This formed the constraint for minimum radii in the ceiling.

▼ Exploded view of standardized panel showing ribs, bending ply and plank layers.

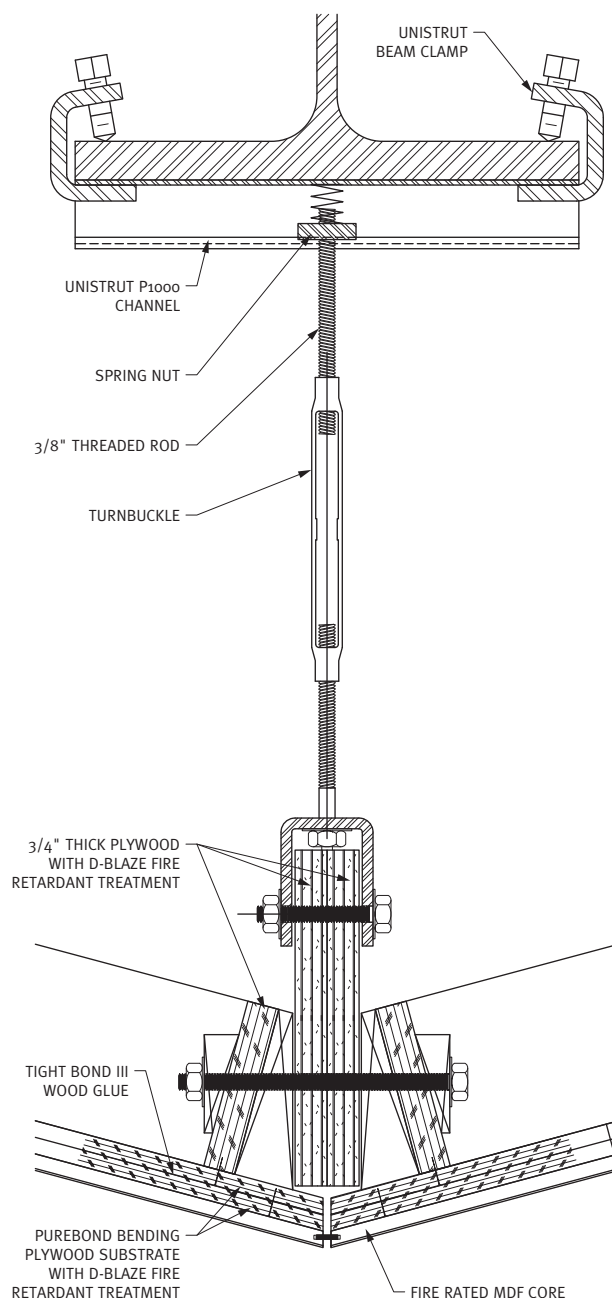


At the same time Imperial tested several methods of fabricating the double curved surfaces behind the plank face, finally coming to a standardized panel layout which would fit through the doorways, stack well in containers, and was able to be installed by hand. The original design contained horizontal planks, made of curved planks, and did not work with the nature of straight veneer. So a system of vertical planks was developed which allowed each plank to be fabricated from a straight piece of veneer.

“Through initial workshops we understood what the architects and clients wanted. We then had to constrain those desires with what was producible from a wood-working perspective. Using a sophisticated software system, we were able to parametrically define and protect the geometries thus honoring design intent while creating all of the complex parts and patterns which drove the ceiling’s shape. What emerged was more than an elegant compromise; it was a solution which fit all parties,” states Herskovitz.

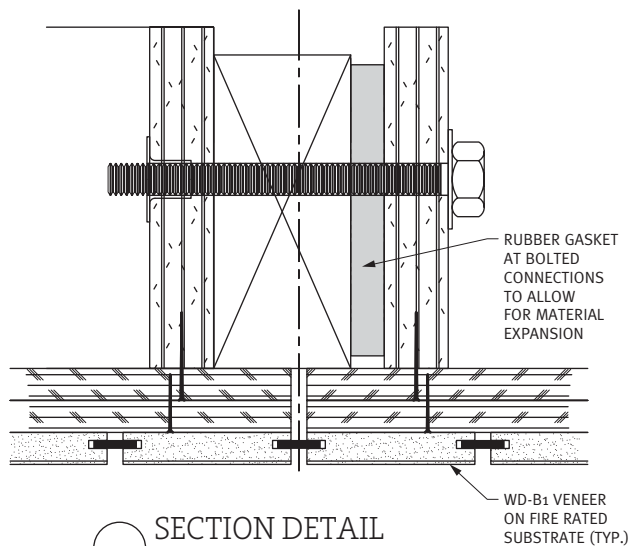
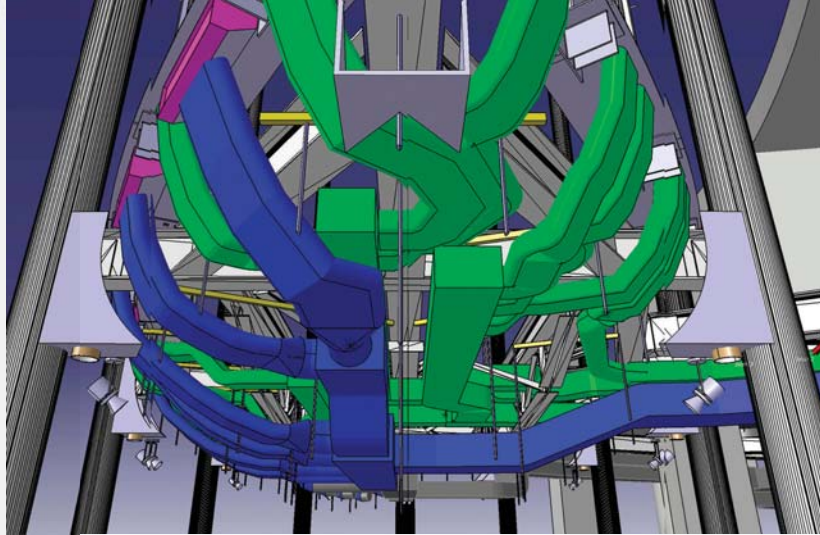
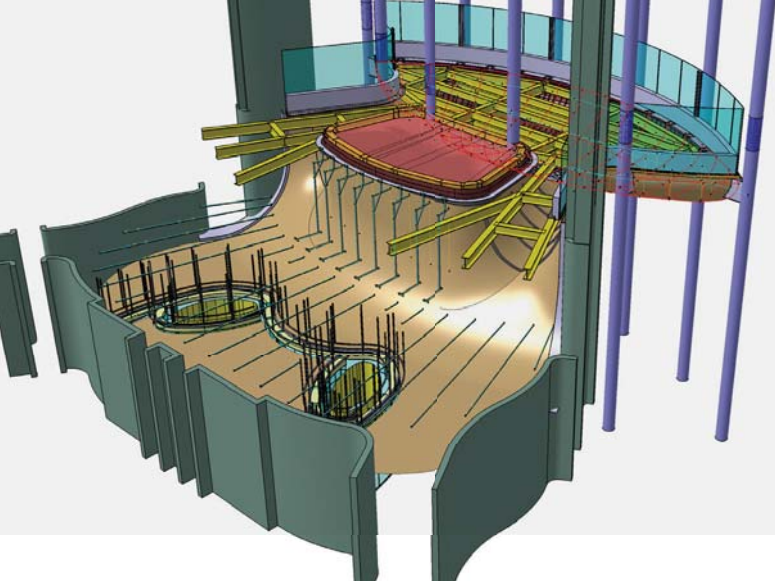
On June 22, 2009 architects and contractors met at Imperial’s plant to view and approve a full sized mockup of one of the most complicated areas of the ceiling, along with the veneer flitches. Following this meeting a full set of models, shop drawings and material submittals were formally made and approved on site in Dubai.

The Figured English Sycamore veneer was selected for its natural color and special grain characteristics. However, Sycamore comes from small trees and the veneer had to be collected from 20 flitches. In order for the veneer to be even across the whole surface, the veneer leaves were grouped by color, grain characteristics and size, and then using computer scripting, were randomized. Using color coding the veneer was then manually pulled and seamed into larger sheets for pressing.

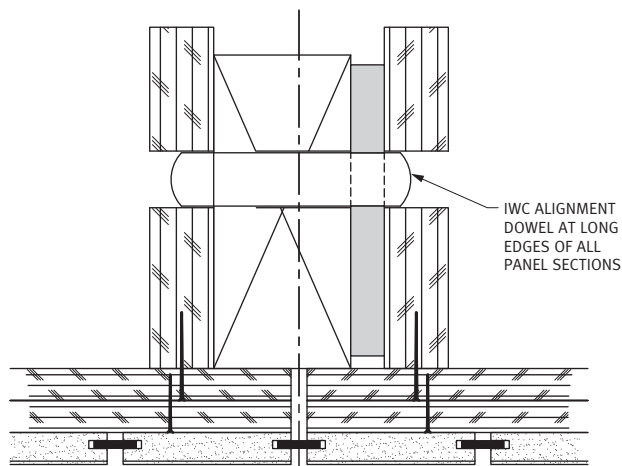


○ CENTER BEAM AT KEEL
Office Lobby

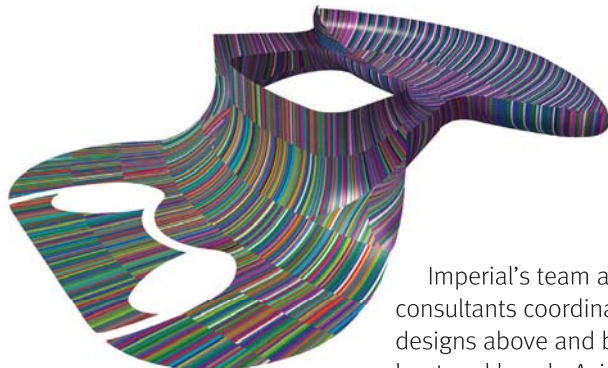
“ We have partnered with the top architectural design firms and general contractors in the country to produce award-winning projects. Our motto, ‘Quality without Compromise’ summarizes Imperial Woodworking Company’s reputation for delivering the best quality and service in the industry.” – **Frank Huschitt III**
CEO



SECTION DETAIL
@ Typ. Panel Joint



SECTION DETAIL
@ Typ. Panel Joint w/ Dowel



Site Management

Inherent in the preplanning and installation, was the means to physically lay out the complex shape in the field, to coordinate with other trades and check dimensions, and to accurately fabricate the work in the shop, so that it would fit when installed. The means used successfully on past projects and on this project, was to produce two sets of full sized templates for every edge. This technique also guided the installation of the ductwork, fire protection system, and glass support system above to fit seamlessly inside the complex wooden shapes.

In the shop, duplicate templates were installed on the floor and the frames fabricated upside down. While in the field, the templates were installed along all edges, with the work of all other trades using Imperial's templates and working closely with the contractor's surveyors.

Imperial's team and consultants coordinated the designs above and below the boat and beach. Aside from translating existing conditions into the model, the HVAC and fire protection contractor required a high degree of assistance in designing and fitting the complex ducting inside the wooden structure. The edges of the boat and beach were especially important, as the air outlets, glass, supports, lighting and valences all came together at a common edge.

"We facilitated the translation of the design given to us by the architects and applied it to Imperial's product by offering buildable solutions," recalls Herskovitz. "Our involvement was very broad, and included coordination with all of the other trades, designers and subcontractors in the entry pavilion, as well as the staff of the general contractor and the owner's representative. This 'cross trade coordination' emerged as the solution to manage the convergence that occurs in technically rigorous jobs."



The full ceiling was assembled upside down, using a template to control the shape.

Fabrication

Using a fully developed fabrication model, all of the parts and pieces were generated and coordinated by Imperial's staff and were then sent as digital files, with paper drawings, to the shop floor for fabrication.

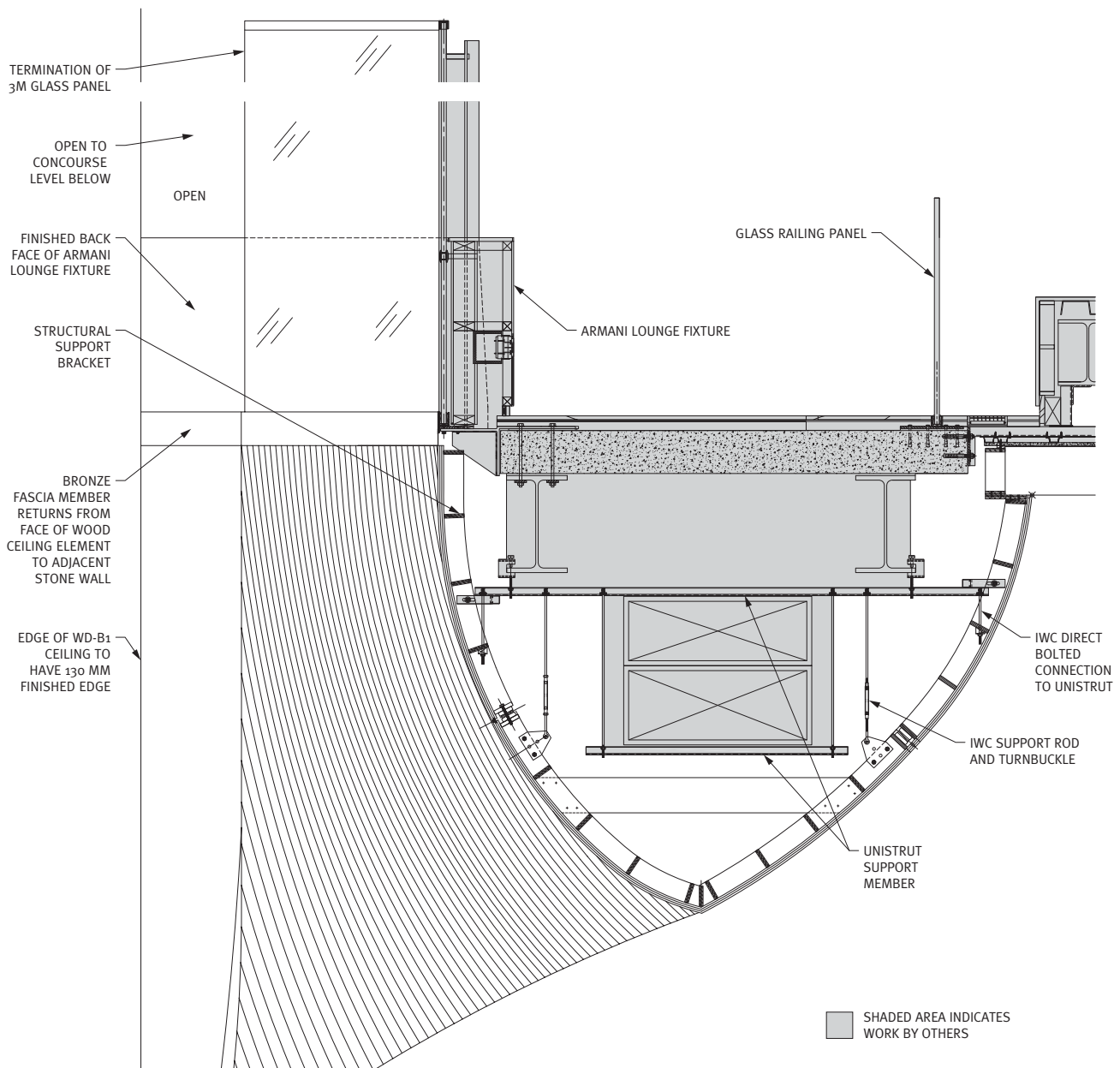
Preceding all of the fabrication were thousands of hours of modeling, drafting, engineering, shop drawing production, part and piece listings, CNC pattern development, materials orders, deliveries made and fasteners procured. Discreet programs for

each rib were created directly from the model. Interlocking joints were created to help hold the structure rigid.

There are over 3,200 planks on the surface of the ceiling. Each was precut with the CNC to a discreet size and shape, marked and organized

so that the attachment of the planks could progress logically, and each section fitted as a group, then disassembled, and sent to the finishing department. A spacer was used at each joint between planks to assure their alignment.





SECTION THROUGH ARM
Office Lobby



Imperial completely assembled the entire structure in its shop, with each frame and plank fitted to the adjacent until a whole large area was completed. Working to a strict shipping schedule, panels were finished, wrapped and loaded into containers for the 20-day

sea voyage to Dubai. The first containers left the shop on August 28th and arrived September 20th. The last container arrived October 25th. Using digital fabrication techniques and software scripting, work flow from model to machine was automated. This permitted the

on-time completion of every phase of the work.

Working in advance of delivery on site, Imperial facilitated the building of a fully enclosed, air conditioned staging and storage room adjacent to the lobby. There each of the 220 panels was acclimated to the site

and stored in an organized dirt-free environment until each was lifted to the scaffold deck 60' above by electric chain hoist. Throughout the shipping, storage, lifting and installation process, there was zero damage.

The clearance to the duct-work and piping was minimal, and required a huge amount of coordination and pre-planning.





Quality Without Compromise

50
YEARS
1963-2013

We've seen many changes over the last 50 years, but some things still remain the same: Our commitment to and focus on **quality, service** and **craftsmanship**. We'd like to thank our dedicated employees, loyal customers, steadfast business partners, and dependable vendors, without whom we could not have achieved such accomplishments.



IMPERIAL
WOODWORKING COMPANY



Layout


All of the work of all trades was coordinated geometrically. By the time the first panel was placed, a series of templates, and the “keel” of the boat was laid, guiding all of the components. Once started, installation progressed without any major

problems due to the early coordination and advanced layout techniques.

Installation of the center panels on the “boat” commenced on November 1, and the full ceiling was completed on December 15th allowing for the removal of the scaffold and the completion of

the surrounding work on time. All of the planning, on site coordination and templating allowed the ceiling to be a success.

“With a project of scale and size of Burj Khalifa, where the work force of 18,000 people had to be at all times at the right place,

the production and installation of the corporate entry ceilings by Imperial Woodworking went without any delays and problems. The client recognized that fact and keeps Imperial Woodworking in the highest esteem,” summarizes SOM’s Nada Andric. 

PROJECT:
**Burj Khalifa
Entry Ceiling**
Dubai, UAE

PROJECT OWNER:
**Emaar
Properties PJSC**
Dubai, UAE

WOODWORKER:
**Imperial
Woodworking
Company**
Palatine, IL

ARCHITECT:
**Skidmore Owings
& Merrill LLP**
Chicago, IL

GENERAL
CONTRACTOR:
**Samsung-
Besix-Arabtec
Joint Venture**
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