

WOOD DESIGN FOCUS

A JOURNAL OF CONTEMPORARY WOOD
ARCHITECTURE AND ENGINEERING

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PARAMETRIC TIMBER

REFORMING THE TERRASCAPE

**China Pavilion
Milano Expo 2015**
Studio Link-Arc

**Jiuzhaigou Visitor
Service Facilities**
THAD

**Temple
Galaxia**
Arthur Mamou-Mani

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Phone: +1 (770) 861-5078
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Editorial Assistant: Paulina Fernandez

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Cover Image: Jiuzhaigou Visitor Service Facilities by THAD
Photography:

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@wooddesignfocus

EDITORIAL

For many contemporary architects, the landscape is no longer a soothing naturalistic background for geometrically pristine buildings but a landscape/architecture hybrid that effectively blends the natural and the synthetic. The most important influence on the development of landform buildings has been the availability of new digital technologies that allowed architects to explore the design of fluid organic forms and engineers to calculate complicated stresses while simulating the effects of active forces on natural forms.

Rene C. Davids
“Landform Buildings and the Future of
Constructed Topographies”

Buildings have a vibrant history of being directly tied to the land upon which they reside. Whether they find themselves emerging from, perching upon, blending with or covering completely; architecture desires a special relationship with the earth. You might in fact say that landform gives the beginning of life to architecture. Our ancestors built directly from the earth - extracting, harvesting, selecting, and forming their habitation.

There is a Sioux Indian saying that insightfully questions, “You ask me to dig in the earth. Do I have to take a knife and plunge it into my Mother’s breast? You say that I must dig and take away the stones. Do I have to remove her flesh to reach down to her bones?”

In this instance, the act of taking is brought into question and we are forced to pause while considering to what end our actions

are leading us and at what cost. Indeed, developing a consciousness toward how, where and with what we build should be at the center of our architectural ethic.

To this end, this issue of Wood Design Focus highlights three projects that are meant to reframe architecture’s contextual relationship to the surrounding terrascape. Each building expresses a unique formal and geometric condition which emerges from an understanding and reverence for place, tradition and purpose. Three distinct approaches are demonstrated:

The China Pavilion Milano Expo 2015 references an idealized condition wherein building and nature coexist harmoniously. A rolling bamboo screen serves as a covering and is referred to as a “cloud”, perhaps conjuring up and encapsulating the hopes and dreams of a nation. Beneath the expansive shade of the roof rests a primarily timber frame structure. The elegant and sometimes elongated curvature of repeating glulam timbers seem to swell as great waves or as a reference to Huà Shan, one of the five great mountains of China. No matter the reference, the encapsulated volumes of space both embrace and aspire. The building references tradition and culture while also advancing a narrative toward the future, highlighting renewable materials.

The Jiuzhaigou Visitor Service Facilities finds itself nestled at the base of the intersection of three towering mountain peaks in the Jiuzhai Vally of Aba Prefecture, China. The building is a confluence of

movement, both swirling and meandering its way within its natural boundary. Roof geometries rise and fall, but in subtle, gentle movements. The underside of which reveals a timber diagrid that reaches and strides across the land.

Temple Galaxia, temporarily positioned in the flat desert of Nevada, poses an existential question of one’s existence and relation to the cosmos. Envisioned as a swirling galaxy, the timber frame pavilion gathers participants under its modulated and economized frame, then immediately funneling the gaze toward the heavens. Built of dimensional lumber, the frames fold in on themselves adding strength and dimension within a configuration of shared burden and resistance. Like a lacy veil, Temple Galaxia provides a covering in an environment demanding protection. Then, in an instant, the pavilion is gone - returning to the heavens in a cloud of carbon. Reminding us all of the very temporality of life.

These diverse projects merge advancing digital fabrication technology with the artful consideration of building geometry and contextual situationality. It can be argued that these buildings exist, or have existed, primarily because of where they reside or the visions of a distant terrascape wherein our dreaming self longs to be.

Jacob Gines
Editor-in-Chief, Wood Design Focus
Associate Professor
School of Architecture
Mississippi State University

CHINA PAVILION MILANO EXPO 2015

by Studio Link-Arc

Rejecting the notion of cultural pavilion as an object in a plaza, the China Pavilion is conceived as a field of spaces located beneath a floating cloud. The Pavilion embodies the project's theme, "The Land of Hope," through its unique roof form, which merges the profile of a city skyline on the building's north side with the profile of a rolling landscape on the south side, expressing that "hope" can be realized when city and nature exist in harmony. Beneath this roof, a landscaped field representing the concept of "Land," incorporates the building's exhibition program.

The China Pavilion at Expo Milano 2015 is the first independent pavilion built by China to participate in the World Expo overseas. Its design concept is based on the understanding and thinking of the theme of Expo Milano 2015: "Nourish the Earth, Fuel Life" and the theme of the China Pavilion: "Field of Hope, Source of Life".





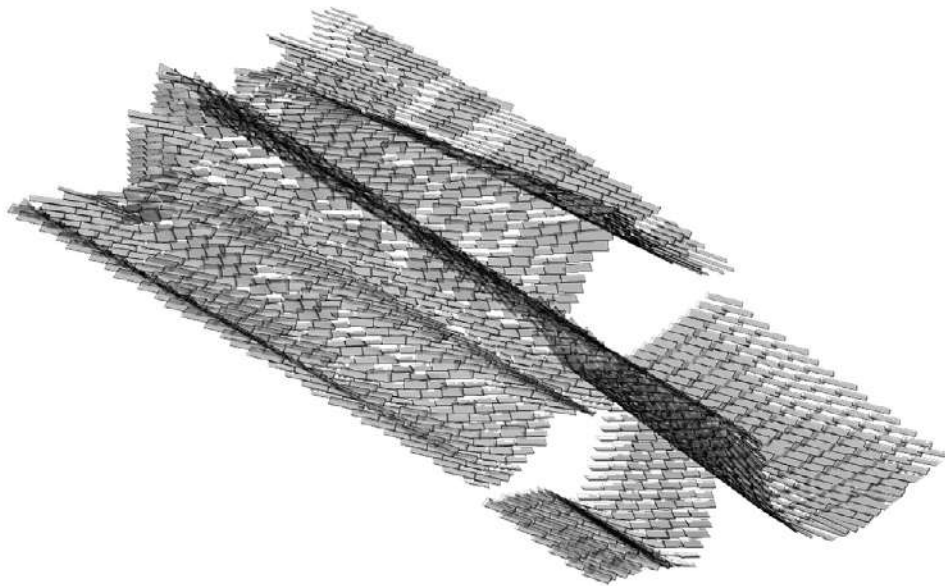
On the two main facades facing the main entrance on the south side and the landscape river on the north side, the architect topologies the abstract form of “landscape skyline” and “city skyline” respectively, and generates the exhibition space in the way of loft. Finally, on the main south-facing facade, three “Deep facades” with different depths are introduced to form the effect of “mountains”, in homage to the traditional Chinese beam type timber frame roof.



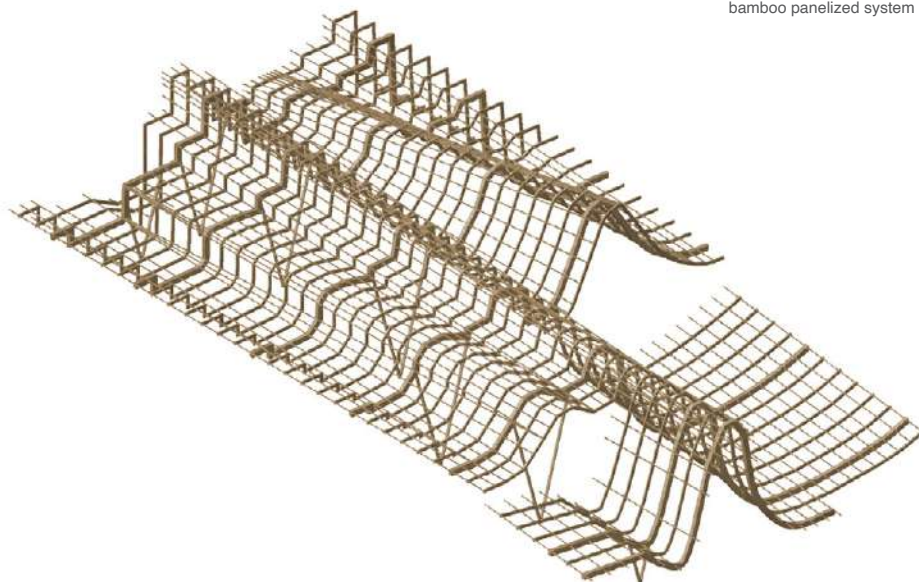


The Cloud

Located at the top of the roof is a sunshade skin system made up of bamboo strips spliced plates. The 75 percent perforated bamboo panels reduce direct light on the roof and reflect strong light inside the China Pavilion, and provide shade in summer. At the same time, the facade of the building is canceled as much as possible to let abundant natural air into the interior space and reduce the consumption of electric energy. Light diffuses into the interior space of the China Pavilion through the bamboo woven skin, casting a mottled projection on the PVC skin. The architect hopes to express the quality of space belonging to China through this “emptiness” of nature.

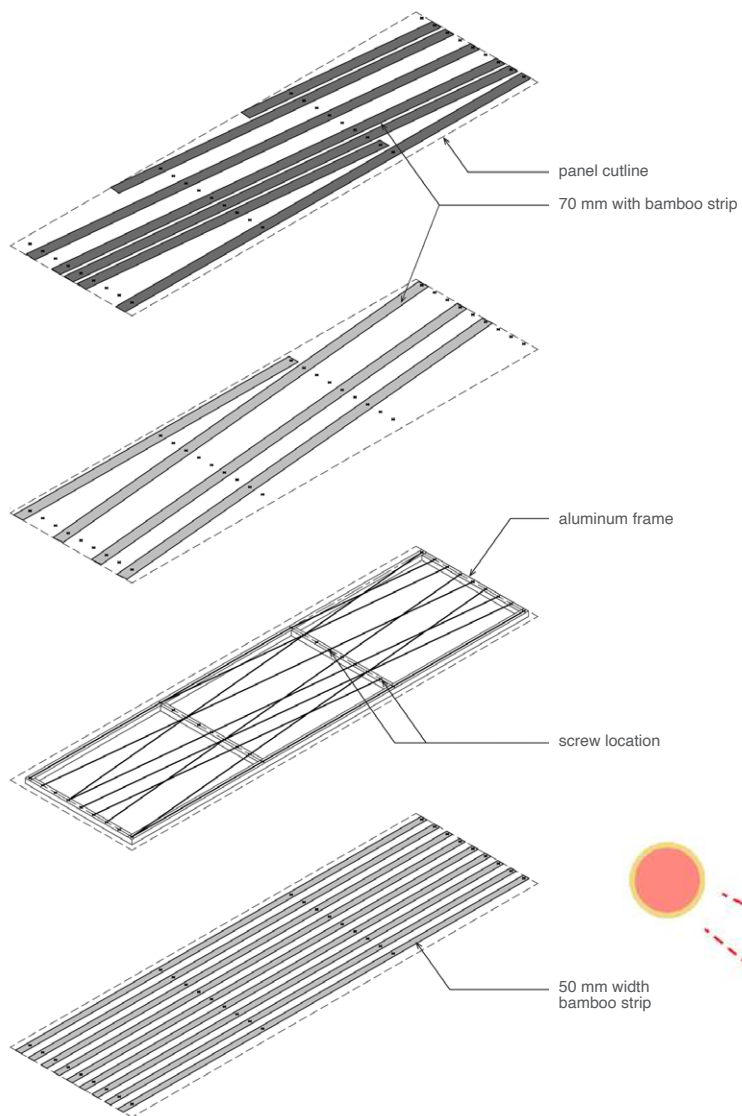


bamboo panelized system

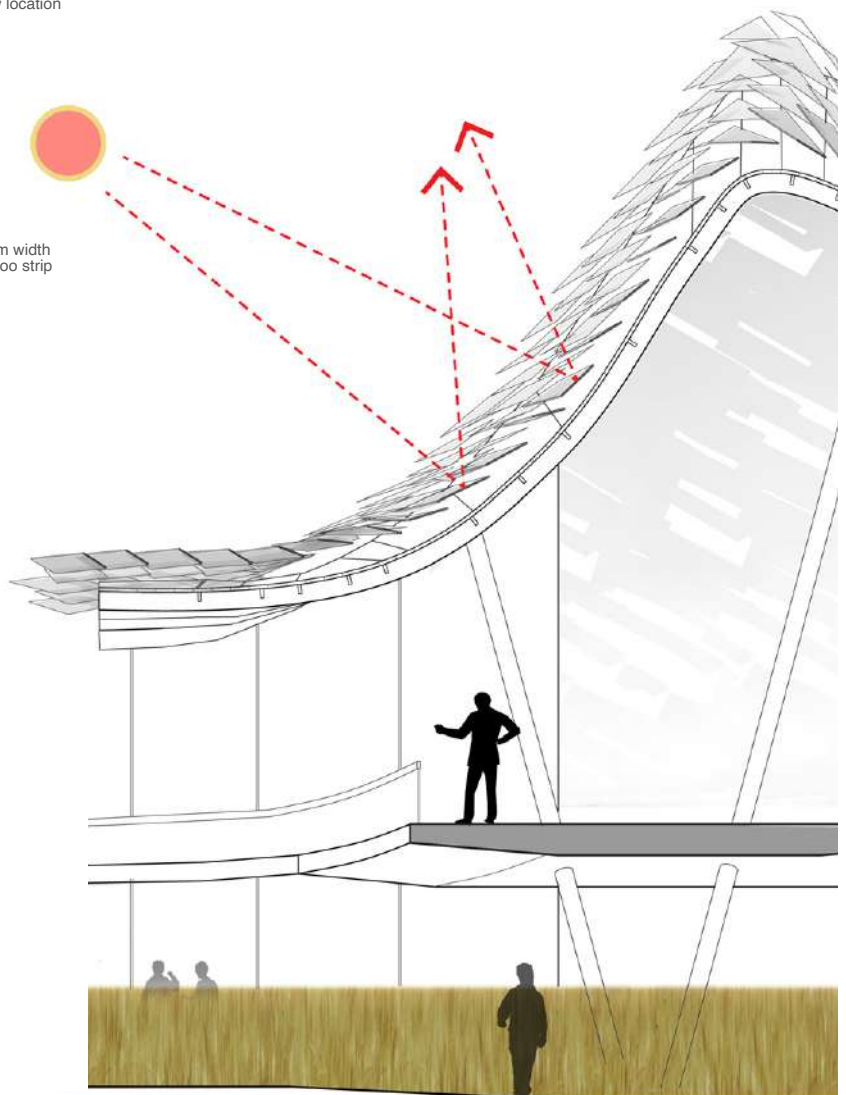


+ tectonic assembly of roof “cloud”

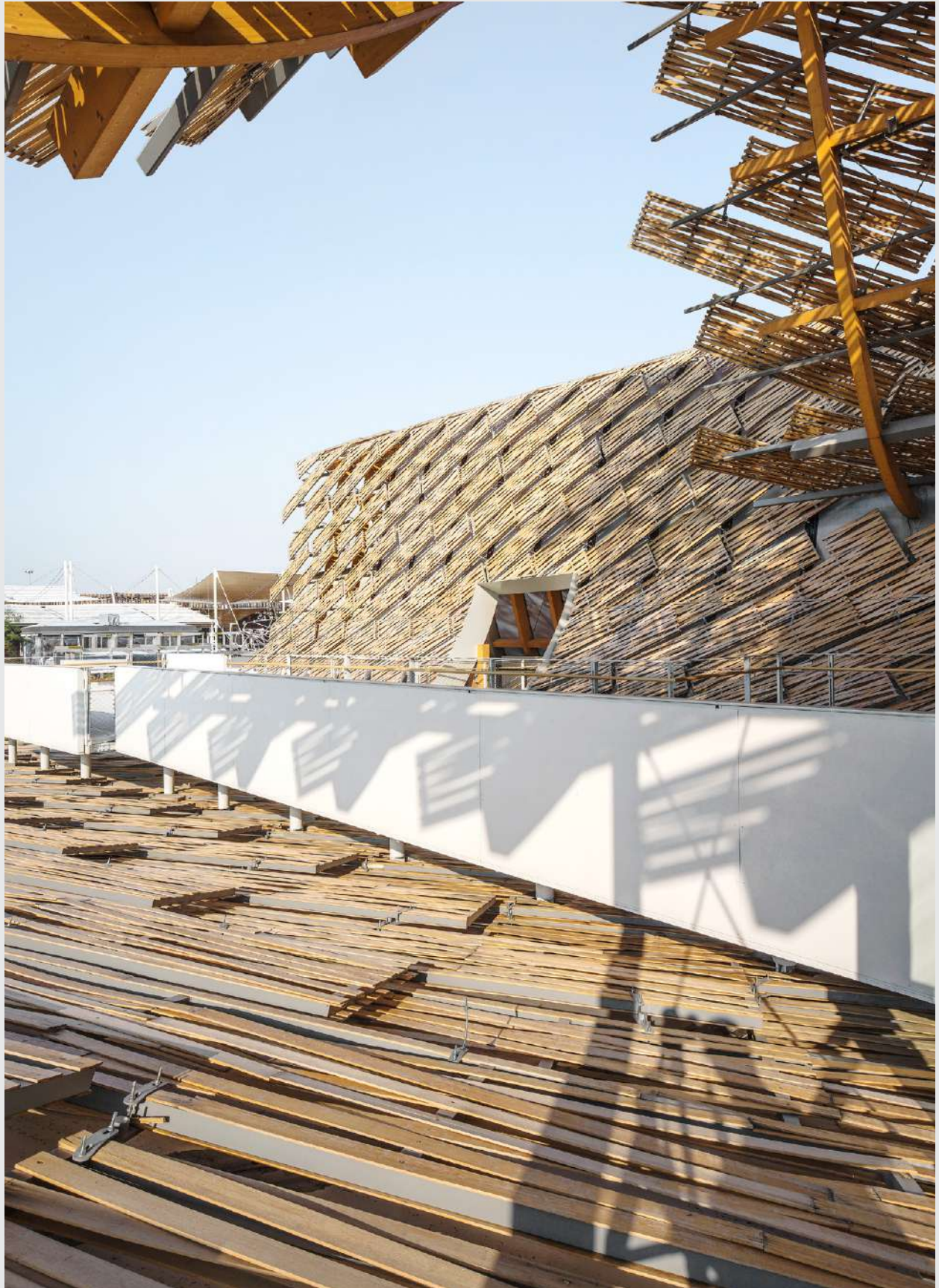
glulam timber structure

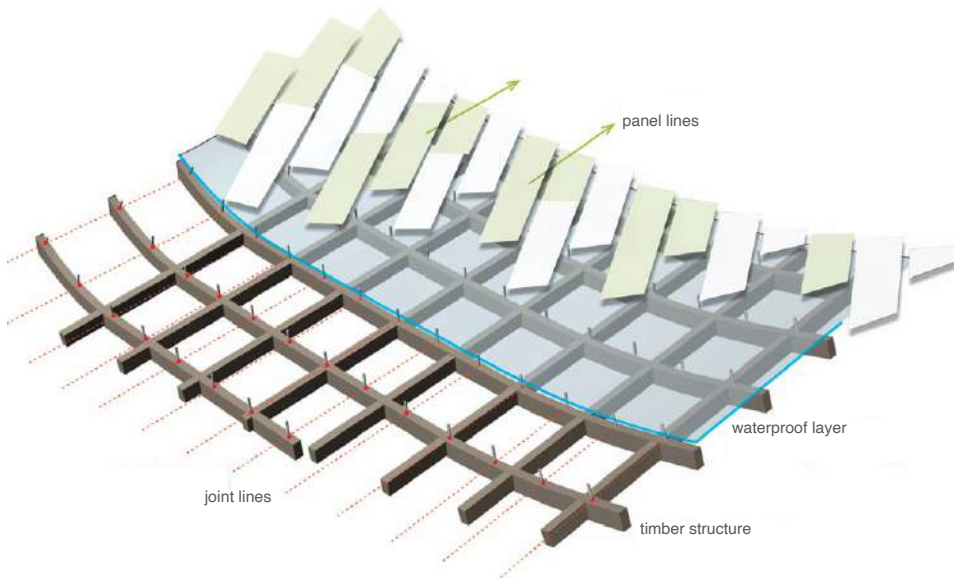


+ roof shingle assembly



+ solar shading strategy





+ roof assembly components

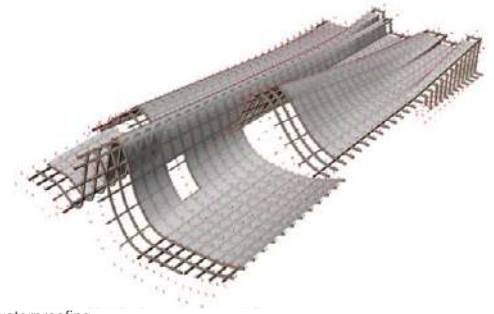
Roof Assembly

A layer of shingled bamboo panels covers the roof, adding texture and depth to the Pavilion's silhouette and creating evocative light and shadow effects on the building's translucent waterproofing membrane. These roof panels were designed via a uniquely digital process, which began by programming their geometry directly using Processing. This was followed by an intense optimization and rationalization effort intended to ensure that the panels would closely follow the roof form while streamlining fabrication and construction.

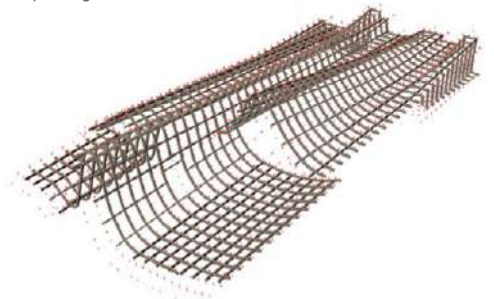
In order to achieve a light roof and meet the requirements of the large-span interior exhibition, the China Pavilion creatively adopts an open sandwich construction system composed of glulam wood structure, PVC waterproof layer and bamboo woven sun shield.



bamboo panels



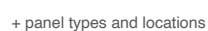
waterproofing

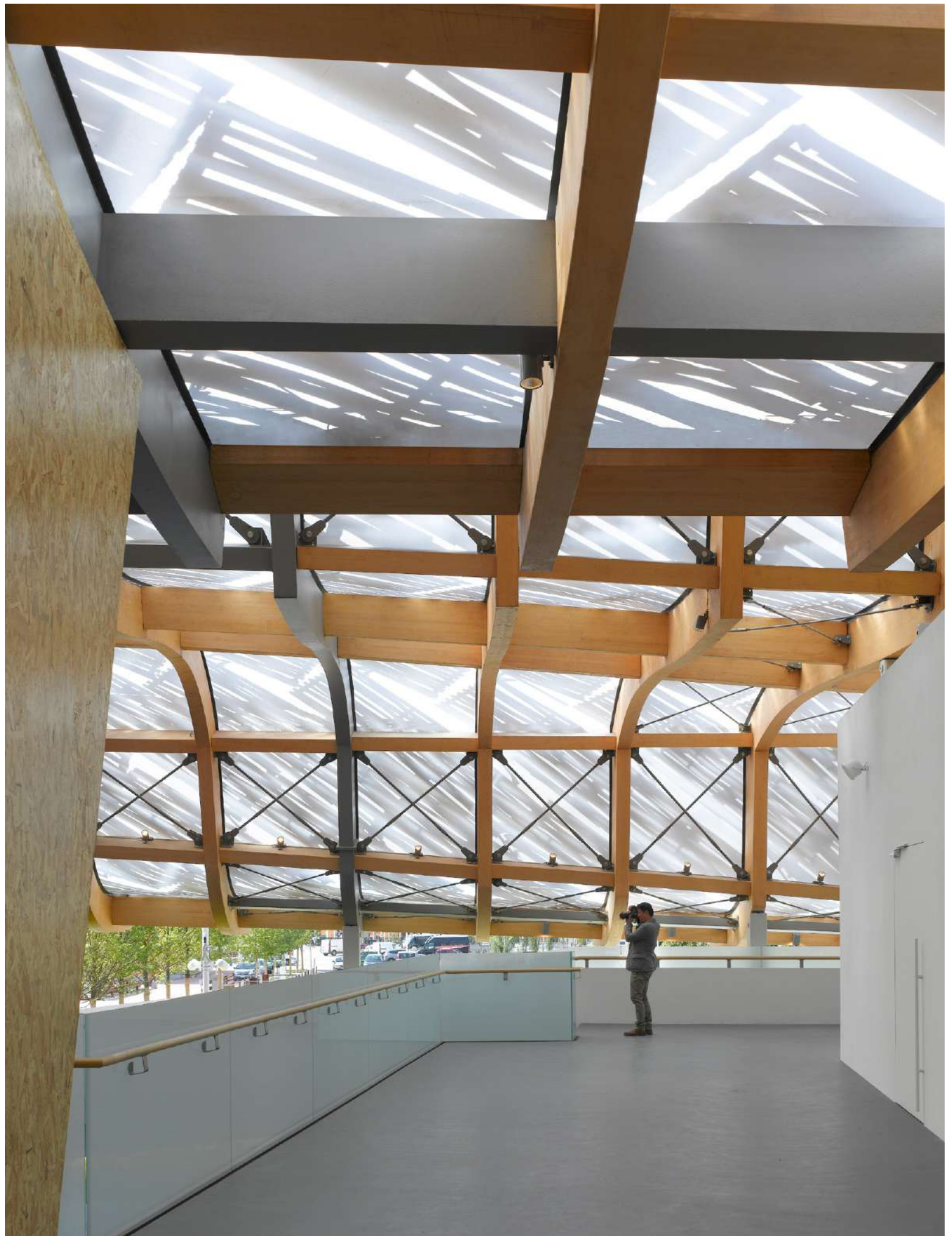


supporting joints



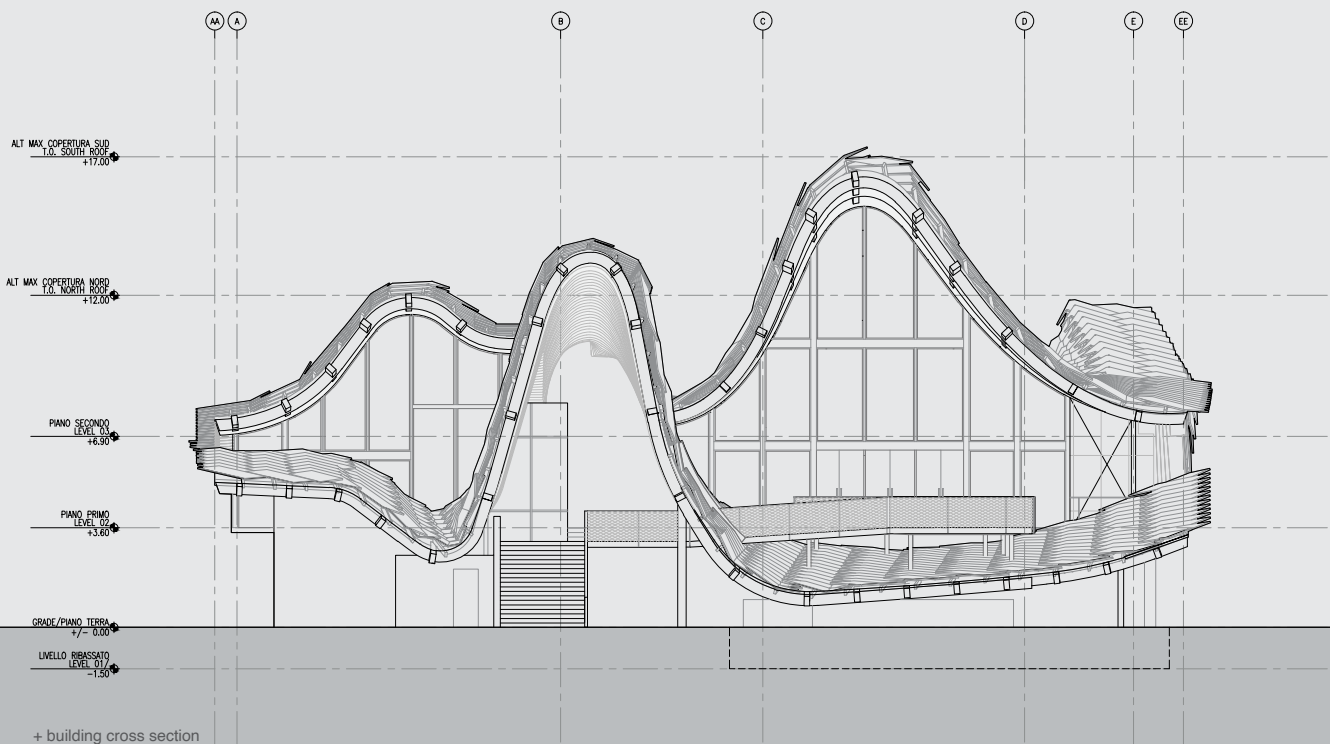
timber structure

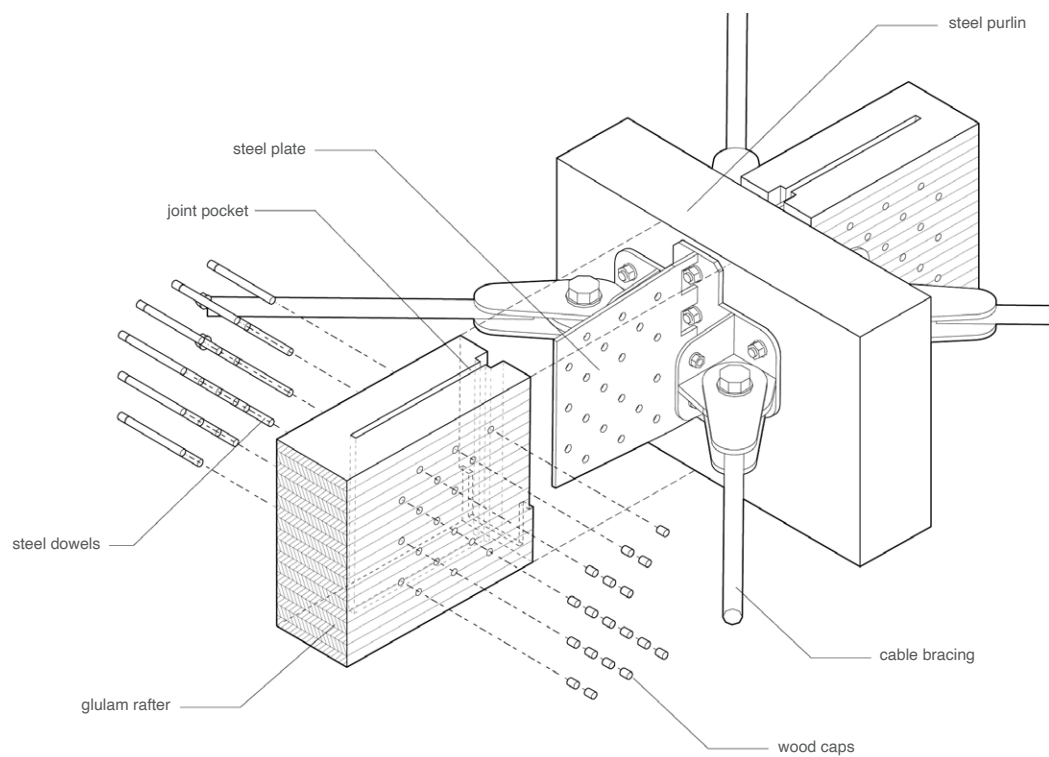




Primary Structural Framework

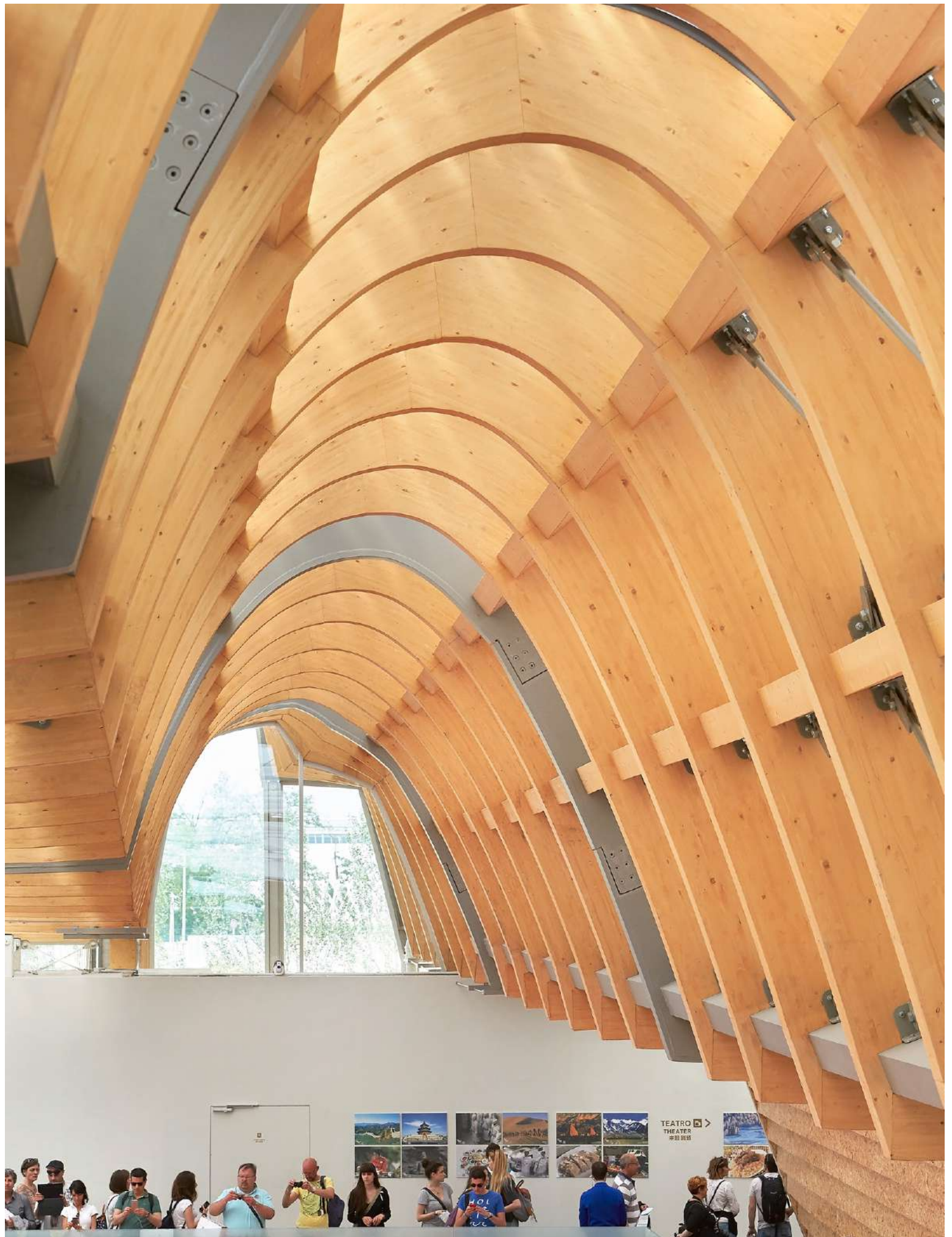
A contemporary expression of traditional Chinese architectural culture, the China Pavilion uses a mixture of glulam wood and steel to achieve a large span of exhibition space. The main structure of the roof is composed of nearly 40 north-south structural purlins and 37 east-west special-shaped wood beams. The 1,400 different inbuilt glulam joints formed by the roof are the perfect combination of structural design and construction technology.

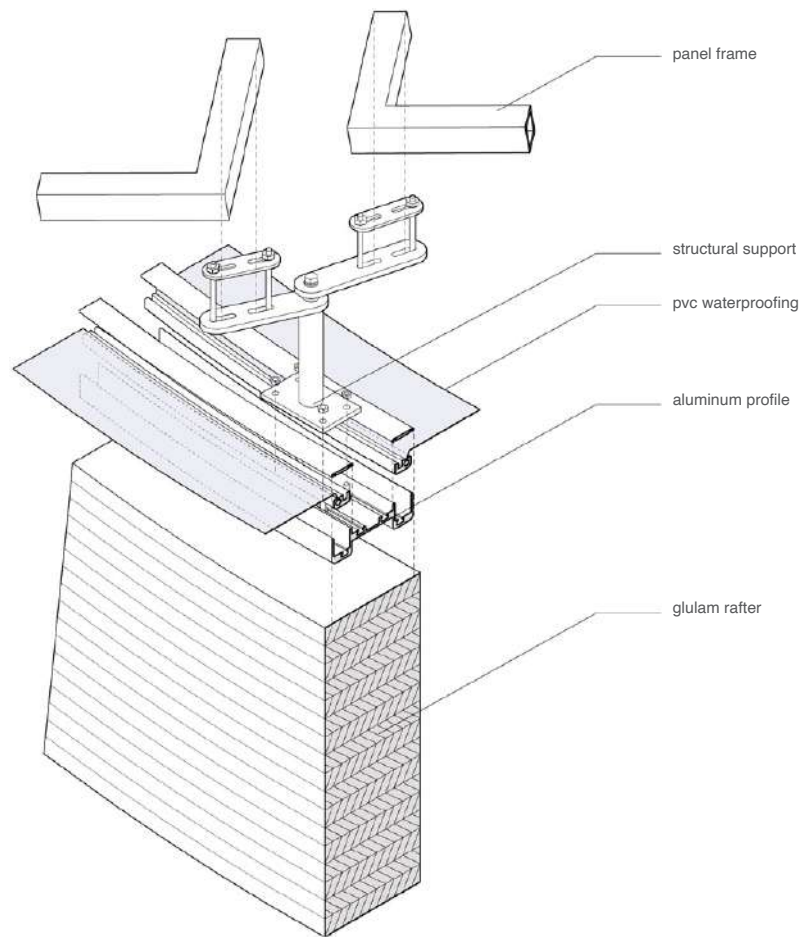




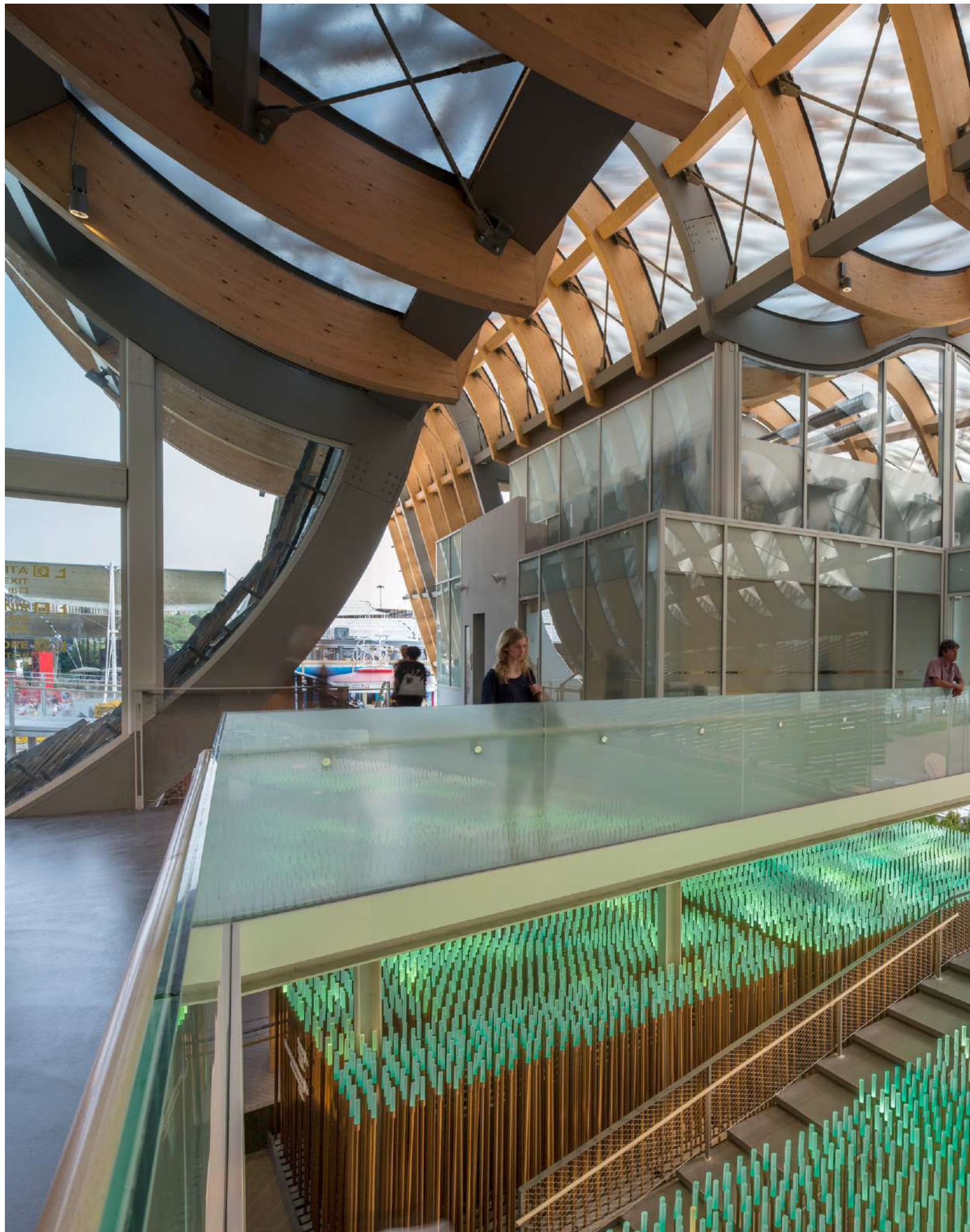
+ lateral bracing detail







+ roof assembly detail





Project information

Site Area: 4,590 m²

Project Area: 3,500 m²

Client: China Council for the Promotion of International Trade

Architect: Tsinghua University + Studio Link-Arc

Chief Architect: Yichen Lu

Project Manager: Kenneth Namkung, Qinwen Cai

Architect and Engineer of Record: F&M Ingegneria

Structural Engineer: Simpson Gumpertz & Heger + F&M Ingegneria

General Contractor: China Arts Construction and Decoration Company + Unique Europe + Bodino Engineering

Landscape Design: Xiaosheng Cui

Interior Design: Jiansong Wang

Photographer: Sergio Grazia, Roland Halbe, Hufton Crow, Hengzhong Lv

Awards

2018 APDCIDA Design Excellence Awards Architecture; 2017 Architectural Design Award Architecture Production Gold Medal; 2016 Architecture Creation Awards; 2016 AAP Gold Prize Winner: Architectural Design/Recreational Architecture; 2016 ACEC National Recognition Award; 2016 Most Innovative Projects, Architectural Engineering Institute

About the Architect

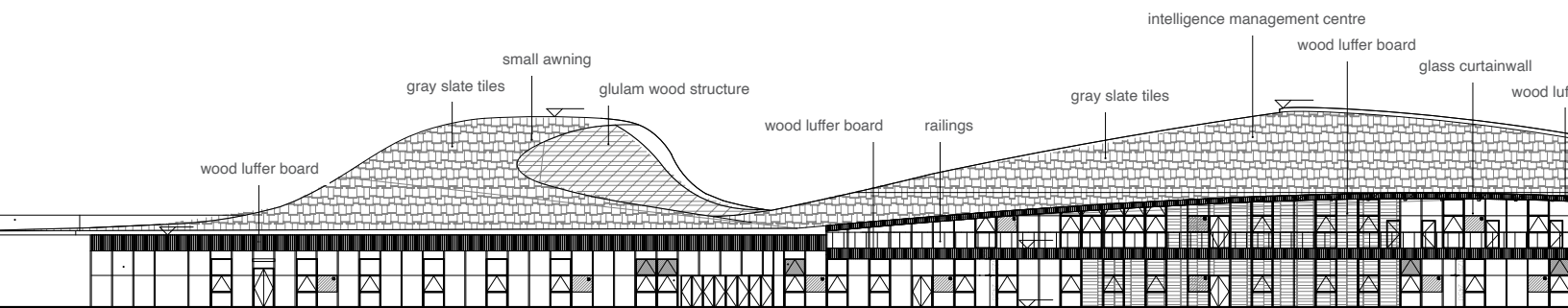
Studio Link-Arc is an international design team of architects and designers based in New York, founded by architect Yichen Lu in 2012, with branches in Shanghai and Shenzhen. It has a portfolio of completed cultural and educational buildings worldwide, including the China Pavilion for the 2015 EXPO Milano, China Resources Archive Library, Shenzhen Nanshan Foreign Language School Kehua school, and Shenzhen Luhu Cultural Center. Link-Arc has been invited to participate in international exhibitions such as the 2020 AIA Architecture Exhibition, the 2021 Venice Architecture Biennale, the 2022 Shenzhen-Hong Kong Bi-City Biennale of Urbanism\Architecture, the "Towards a Critical Pragmatism: Contemporary Chinese Architecture Exhibition" at Harvard University Graduate School of Design in 2016, and the "A Decade of Asian Architecture Retrospective Exhibition" at Yale University School of Architecture in 2018.

JIUZHAIGOU VISITOR SERVICE FACILITIES

by Architectural Design and Research Institute of
Tsinghua University (THAD)

A 7.0-magnitude earthquake hit Jiuzhaigou Nature Reserve on Aug 8, 2017. The original visitor center sustained heavy damage. As a post-disaster reconstruction project, this project explores how to effectively use the limited land area and balance the protection of natural resources and human elements, so that environmental protection, scientific research and scientific popularization can coexist sustainably. Unlike the strategy of building a large underground car park at other scenic spots, this project rethinks social resources, coordinates regional transportation planning and makes full use of social public spaces to provide visitors with not only a safe and efficient entrance, but also a natural and multicultural experience.



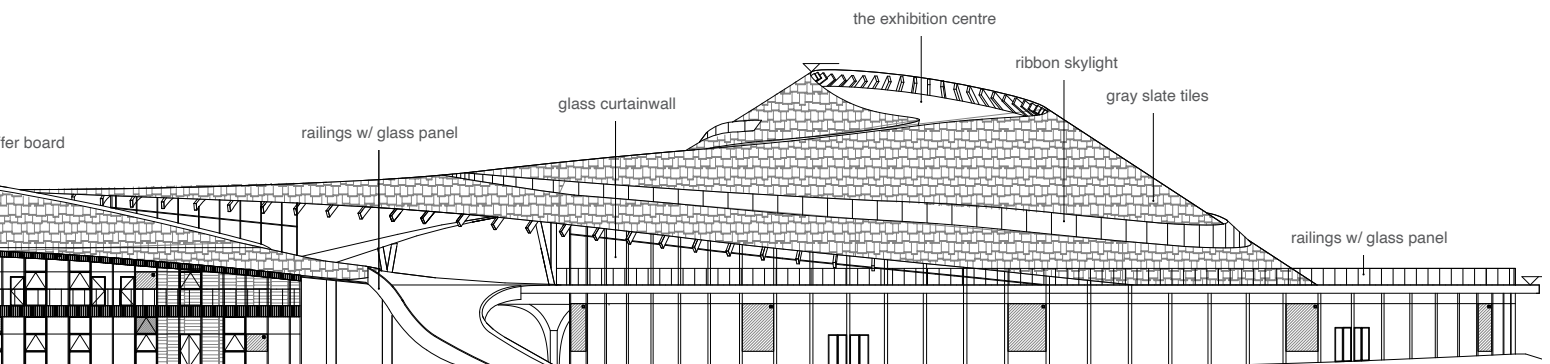


+ east building elevation

A New Landform

The design reconsiders the relationship between the building and its natural environment. It follows the original topography of the site, which is different from the local architectural style of general elevated fortress. As a new form of “landscape architecture”, it not only retains the natural order of the original environment of the World Heritage site, but is also deeply rooted in the local culture. Not only does it spatially echo the surrounding mountains, but it also creates a platform and weakens the building's bulk by linking the site's original 6m height differences to form a two-tier connected space. Traditional materials are given new life through modern techniques. For example, the awning boasts the largest cross-bearing glulam wood structure in China and the local slate tiles play as a symbol of the Jiuzhaigou Valley.

Through integration and reuse of resources, the Jiuzhaigou Visitor Service Facilities operates not only as a functional tourism facility, but also as the only open green public event space along the narrow valley road for both visitors and locals. The project explores how artificial construction can accommodate natural scenic spots. It achieves the exact requirements of multifarious tourism functions and remains the natural order of the original environment in a World Heritage site.





A Timber Covering

The project adopts the wood type of Douglas fir and the form of mutually bearing glulam wood structure. The awning at the entrance is cleverly shaped to associate with the Jiuzhaigou eye-like logo, which plays as a symbol of Jiuzhai Valley. It is currently the largest cross-bearing glulam wood structure in China with a span of 38 meters. Another awning with a massive span of 41 meters above the Tourist Transport Square is sealed by two curved steel beams, combined with the glulam beam of the Fermat spiral division.

The project avoided 2,301 tons of greenhouse gas emissions and a total potential carbon benefit of 3,547 tons through the use of wood construction, equivalent to reducing the annual emissions of 750 cars or 374 families. The wood used in this project is about 1,500 cubic meters, and about 1,246 tons of CO² are stored in the wood.

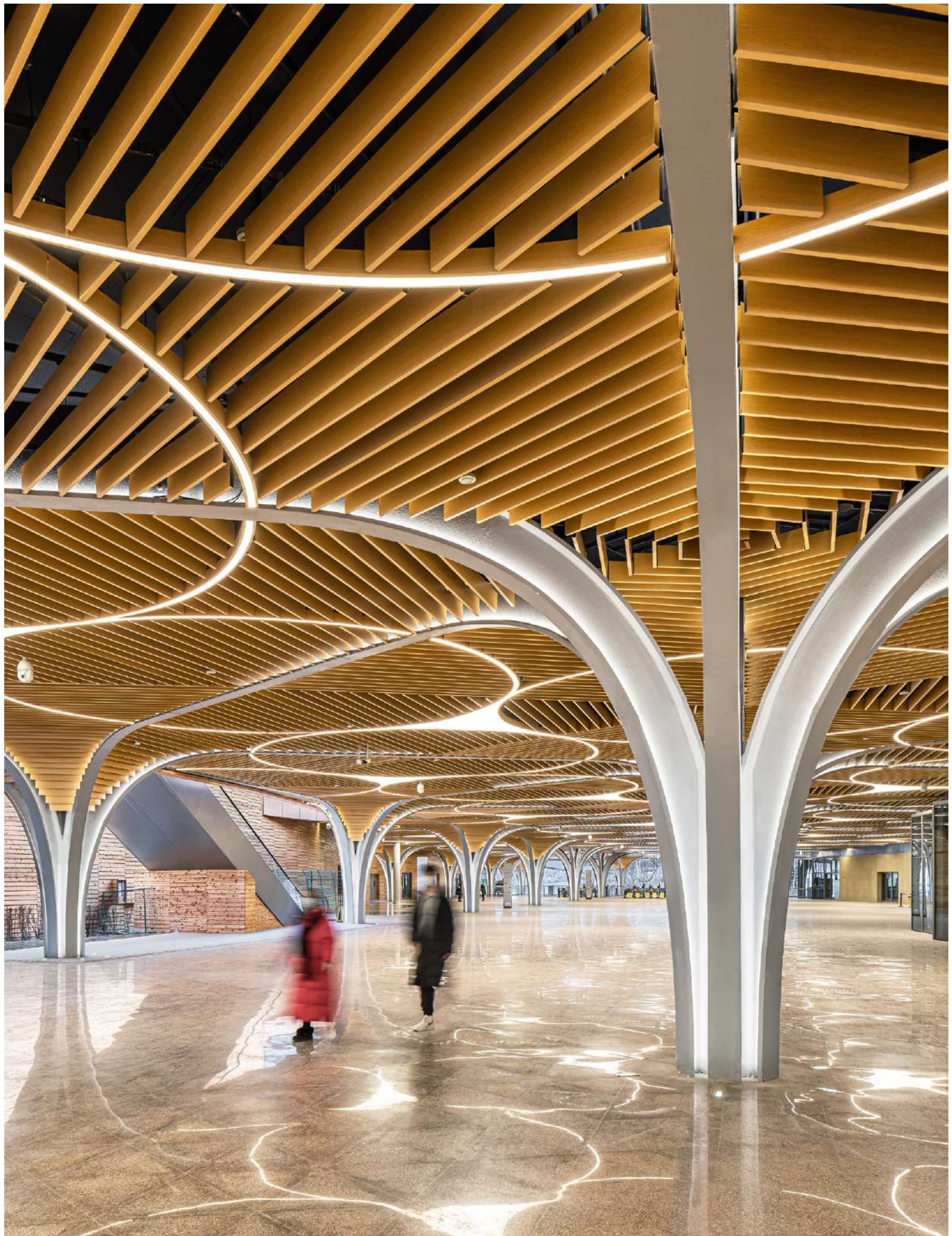




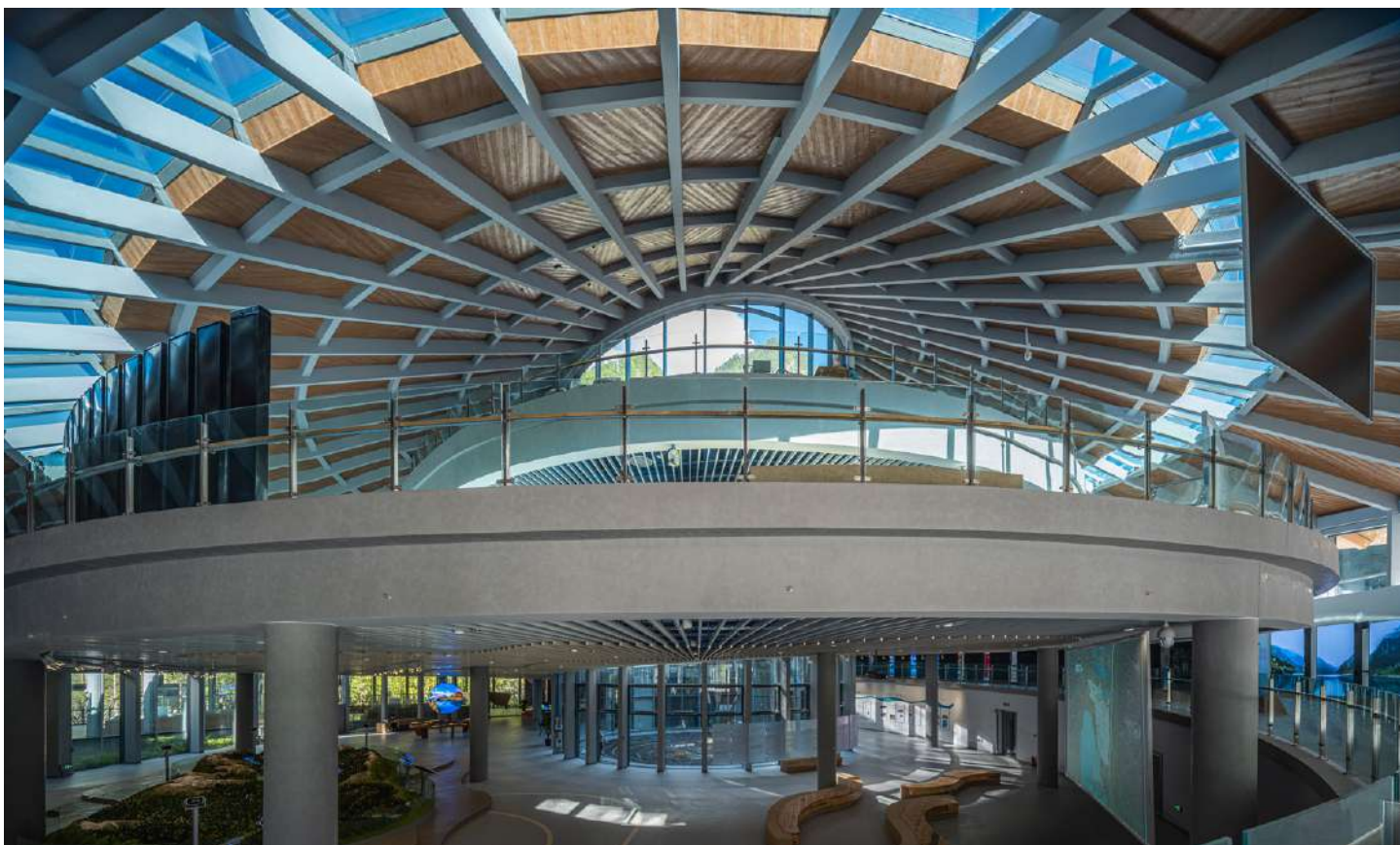


Precision Fabrication

The two awnings of this project have more than 400 glulam beams and columns, and about 1,800 customized components, which each piece of glulam is customized according to design. The flower-shaped wooden column finally adopts the mutual bearing glue-wood structure of one centimeter per timber board to achieve the perfect lap of the curved arc beam. The parametric digital model works together with the high-precision robot arm processing line to ensure the efficient coordination and accurate positioning of the production, processing and installation process. In addition, the finished architecture realizes the idea of structure as the decoration.







Reflecting Cultural Heritage

The project gives a new expression of landform architecture to a dynamic building complex that is deeply rooted in the indigenous culture with local characteristic input. Traditional materials and architectural techniques of Jiuzhaigou Tibetan, such as slate tile, patterned stone walls, timber structures, etc., are applied to both interior and exterior details. In the north of the Lingka, the giant flag tent with a massive scale and mysterious atmosphere inherit the Tibetan naturalism-religious identity. Therefore, tourists can not only experience a gentle transition space before entering and exiting the national park but also a distinctive space full of local culture.



Project information

Owner: Jiuzhaigou Valley Scenic and Historic Interest Area
Scenic Area Administration

Site Area: 89,960.92 m²

Building Area: 30,650 m²

Construction Finished: 2019-2021

Design Team: THAD

Project Director: Zhuang Weimin, Huo Chunlong

Architecture: Zhuang Weimin, Huo Chunlong, Liu Xiao,
Yin Guodong, Sing High, Ding Feng, Wen Qisheng, Sun
Zhongxuan, Sun Yuzhu, Gong Shiyuzhang, Wen Juan, Hao
Xiaoxu

Structural Engineering: Chen Hong, Liu Xiang, Jiang Bo, Xu
Jin, Yan Wang, Xiaopeng

Landscape Design: Zhu Yufan Design Team

Interior Design: Wang Zuming Design Team

Photography: Three Scene Imaging

Awards

2021 Excellent Engineering Survey and Design Award by
Ministry of Education; First Prize Ministry of Education (MOE),
China; First prize of 2022 China Lighting; 2022 Architizer A+
Awards Selection Award

About the Architect

Tsinghua's Architectural Design and Research Institute (THAD) was founded in 1958. It is an A-level national architectural design and research institute which undertakes public and civic engineering and consulting architectural project designs, urban designs, protection of cultural relics and ancient building projects as well as scenic and indoor design installations. The Institute has designed and constructed several masterpiece projects--the Beijing Ju'er Hutong Residential Area, the Tsinghua University Library, and Beijing's Tiaoqiao Theater are three examples. THAD independently has also undertaken many 2008 Beijing Olympic Games projects.





TEMPLE GALAXIA

by Arthur Mamou-Mani

Temple Galaxia was part of an annual open call for designers to create a new temple concept for Burning Man. This secular temple was initially established by the community to commemorate a member's passing, evolving into a space for communal rituals. The architect, Arthur Mamou-Mani, moved by the genuine emotions expressed within the temple, applied to the competition. Burning Man called for a design featuring intimate human spaces progressing into a central communal area, aligning with the project's architectural vision. Inspired by childhood experiences with computer programming, Mamou-Mani utilized a similar concept for a previous project, incorporating geometric and celestial inspirations into the temple's design. This led to the creation of a structure that represented the merging of concepts such as growth, celestial bodies, and the dynamics of a black hole, resulting in the unique and meaningful design of Temple Galaxia.

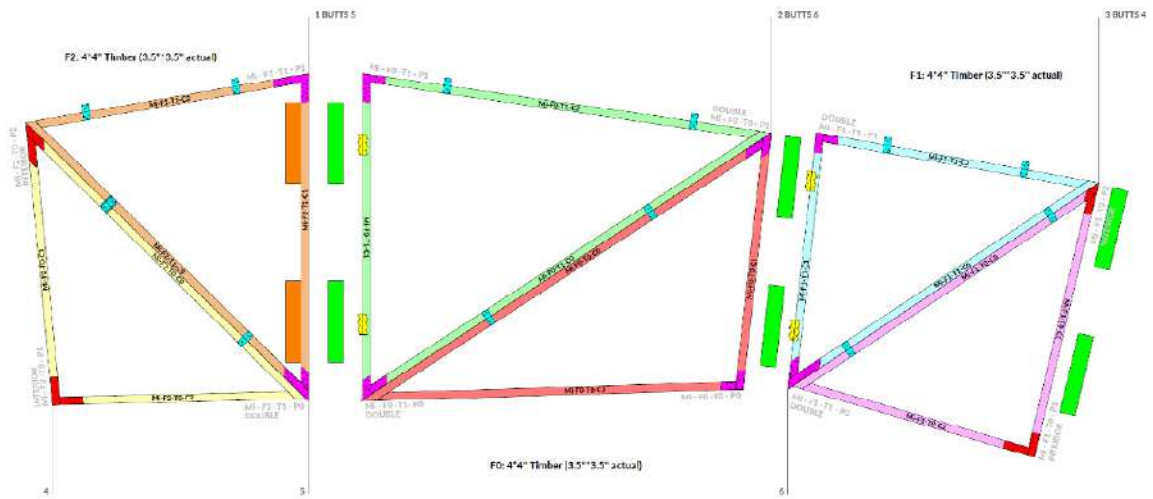






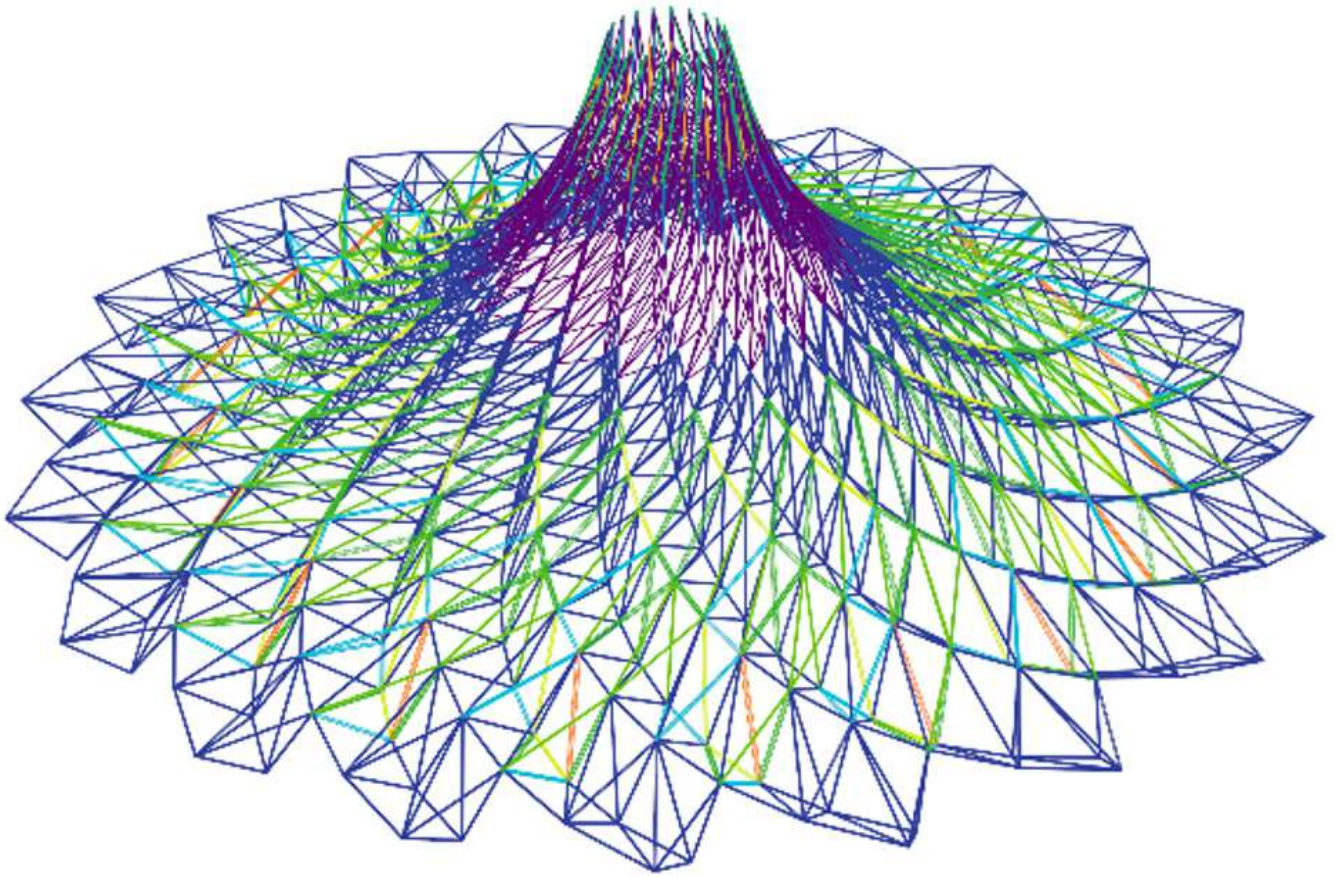
The Galaxy Manifest

The design concept for Temple Galaxia draws inspiration from the galaxy, with references to the movements and geometry related to creating a stack effect for bringing fresh air. The concept also embraces the notion of the sky and our relationship to it, incorporating ideas about celestial bodies, the sun, and even black holes. The design incorporates trusses and utilizes the imagery of a volcano emerging from the ground and swirling like a galaxy. Additionally, the concept involves the notion of compressing or extending wood, with modules starting as extruded triangles at the base and then metaphorically “spaghettifying” as they go up, resembling the movement influenced by a higher force.



+ fabrication drawings v10, module 1





+ structural modulation and aggregation

Material + Assembly

The wood used in the project was dried Douglas Fir, chosen for its accessibility. It was employed in two by two and four by four inch segments, which were laminated using wood screws. A mid-line parametric model generated trusses, with forces and tensions on the lines being determined using a Grasshopper plugin called Caramba.

The design aimed to minimize timber and steel usage by maximizing tension in the system and strategically using diagonals. Standard timber sizes were utilized, and larger sizes

were created from sections of standard sizes, which were glued and screwed at regular intervals. The project, which had to be self-funded at a cost of \$600,000 and prioritized off-the-shelf products due to budget constraints.

Custom elements included laser-cut brackets. Engineering calculations were utilized to determine the number of screws needed for specific components. The formula provided by the engineer enabled precise calculations to optimize the use of screws, reflecting the carefully managed resources of the project.





The construction of a desert structure faced a significant challenge due to about 30% shrinkage, highlighting the dry nature of the environment. However, this shrinkage played to the advantage of the project as it allowed for adjustments and flexibility during the assembly of modules, which were connected using joint straps instead of welded metal connectors. With limited time, a large workforce of unskilled individuals, and constrained budget, the unconventional use of ratchet straps as flexible connectors proved to be a successful and innovative solution. Despite facing skepticism, the adaptability, ease of assembly, and accommodating nature of the ratchet straps made them the ultimate solution for completing the project.









Project information

Architecture: Mamou-Mani Architects (Arthur Mamou-Mani, Maialen Calleja, Aditya Bhosle, Bilal Mian, Sandy Kwan)

Engineering: FORMAT Engineering (Stephen Melville, James Solly, Marco Pellegrino, Sara Andreussi)

Scaffolding: DHC Charles Engineering (Robin J. Ko, Brian Hilier)

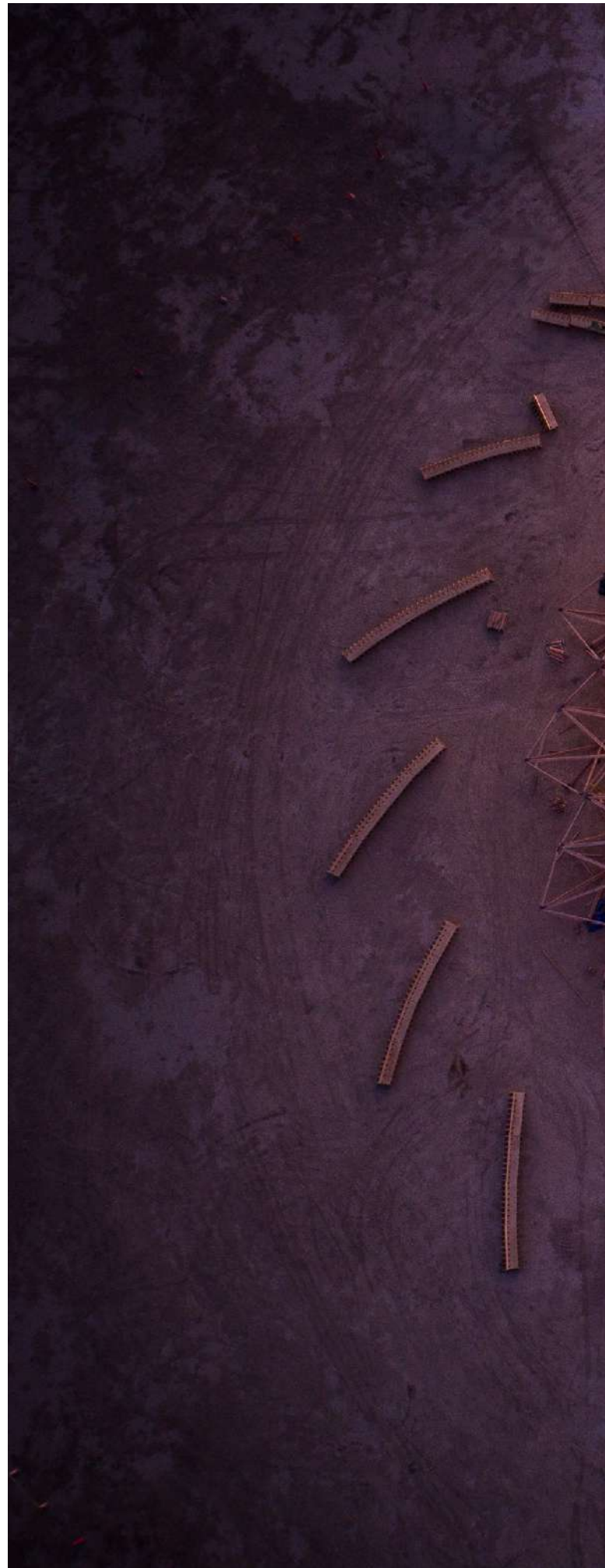
U.S. Leadership Team: Aaron Porterfield (U.S. Lead), Mikki Assada (site captain), Bruce Schena (scaffold Lead), Dave Keane (build Lead), Benoit Bergeret (camp lead), Jessica “gravity” Meisman (Kitchen Lead), Nick Moser (altar lead), “Sparklepony” Paul Franke (metal lead), Kirsten Straight (Reno site lead), Kai Dalglish (SF site lead), Micah Turner (3D printing), Jocelyn Simmons (graphic design), Dillon Nicholson and Desirée Tavera (Fundraising)

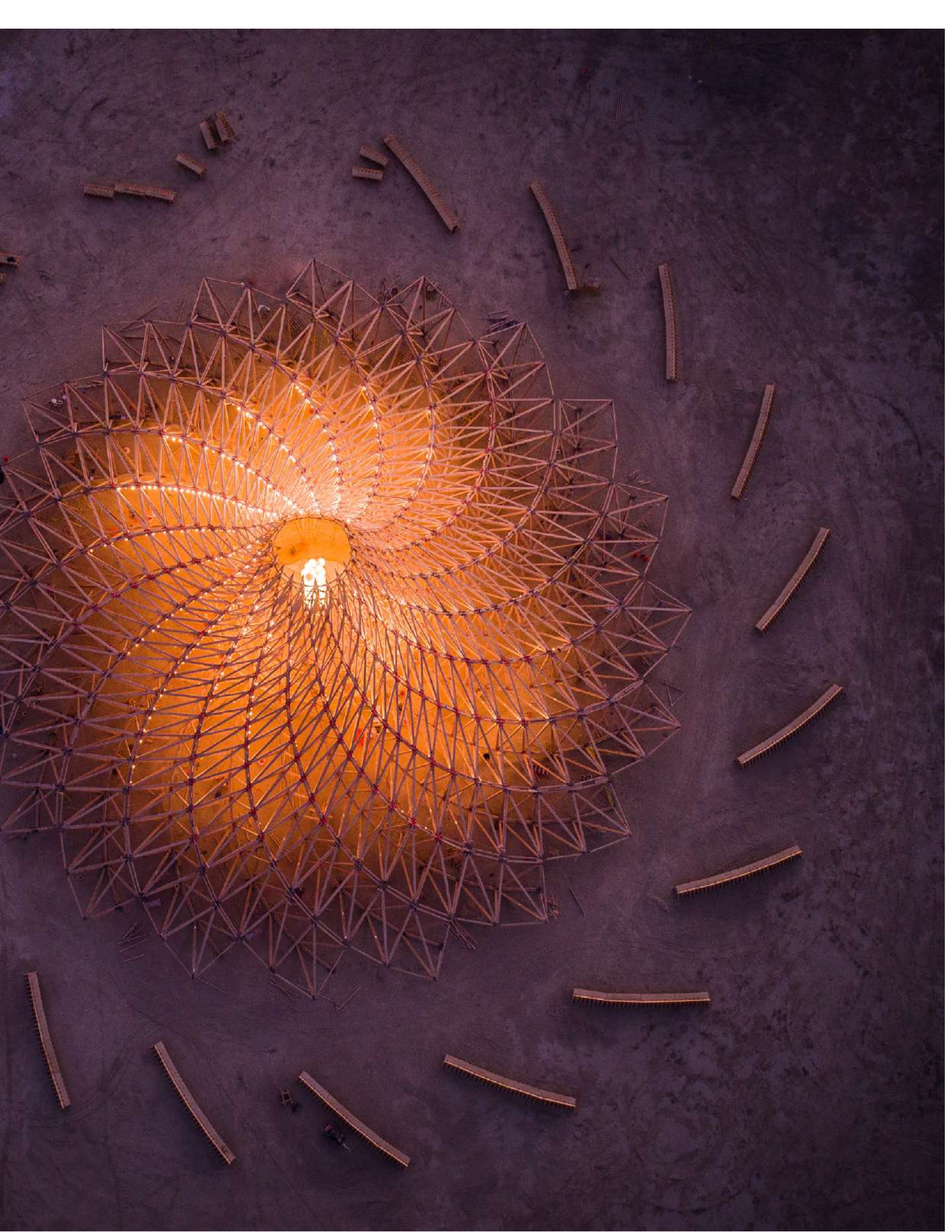
Lighting Design: Gerald Spencer, Bashir Ziady, Sage Gunderson (Teardrops).

About the Architect

Arthur Mamou-Mani is of French nationality and pursued his architectural studies Architectural Association School of Architecture in London. His upbringing was influenced by both his father, a computer scientist who imparted knowledge of coding and systematic mathematical thinking, and his mother, an environmentalist who contributed to the establishment of an environmental party in France. These diverse influences played a significant role in shaping the individual’s approach to architecture and are pertinent to their involvement with Galaxia and Burning Man.

Throughout this career, Mamou-Mani has focused on incorporating algorithmic thinking and exploring the relationship between geometry and architecture. This evolution led to a deepening understanding of parametric tools, ultimately culminating in Mamou-Mani becoming a teacher and establishing his own practice, driven by the demand for parametric work during the early stages of its adoption.





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CONTENT SUGGESTIONS WELCOME!

Do you have a project (built or unbuilt) that you think should be featured in Wood Design Focus? Then we want to know about it!

We have a growing database of exceptional projects that we'll be showcasing in future issues, but we are always on the lookout for the next best thing in wood/timber architecture, engineering and design. Shoot us an email or connect with us on Instagram.



jgines@caad.msstate.edu



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