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Introduction



Kanagawa Institute of Technology 'KAIT' studio/workplace constructed on the campus in the suburbs of Tokyo in 2008. The client wanted this structure to be a place where students could work on diverse self-initiated projects to make things, and to also have a high public capacity, as it would be open for use by local children.

Background

This 21,410-square-foot workshop is modest in scale. Articulated with minimal means—exterior walls of 10mm thin glass and interior clusters of randomly distributed slender white columns—The architect ethereal structure is barely a building at all. The size of the plan which is not a typical square shape is 47x46m While the transparent enclosure exposes everything inside, the delicate steel columns define scattered oases of open space, each one a different functional component. Awash in soft daylight admitted by glass bands overhead as well as the building's transparent envelope, Ishigami's meandering interior landscape creates the ambience of a tree-filled forest, not a typical college classroom.





Junya Ishigami

Junya Ishigami (石上純也) is a Japanese architect born in Kanagawa prefecture in 1974.

He acquired a master's degree in architecture and planning at Tokyo National University of Fine Arts and Music in 2000. And he worked in with Kazuyo Sejima and Associates from 2000 to 2004 at SANAA. In 2004 he established his own firm: Junya Ishigami + Associates.

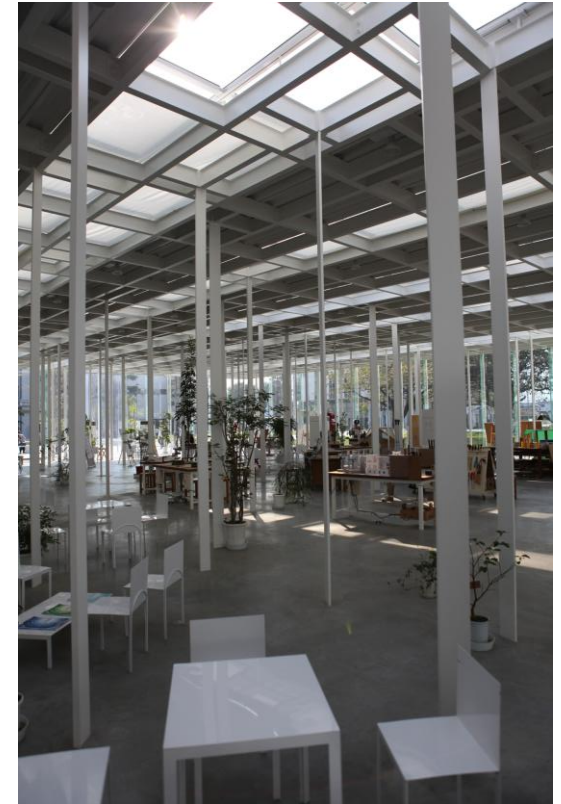
Video

Design Concept



To blur the boundary between indoors and out, Ishigami eliminated all openings on the glass. Like traditional Japanese borrowed scenery, the surrounding landscape serves as the backdrop for the interior.

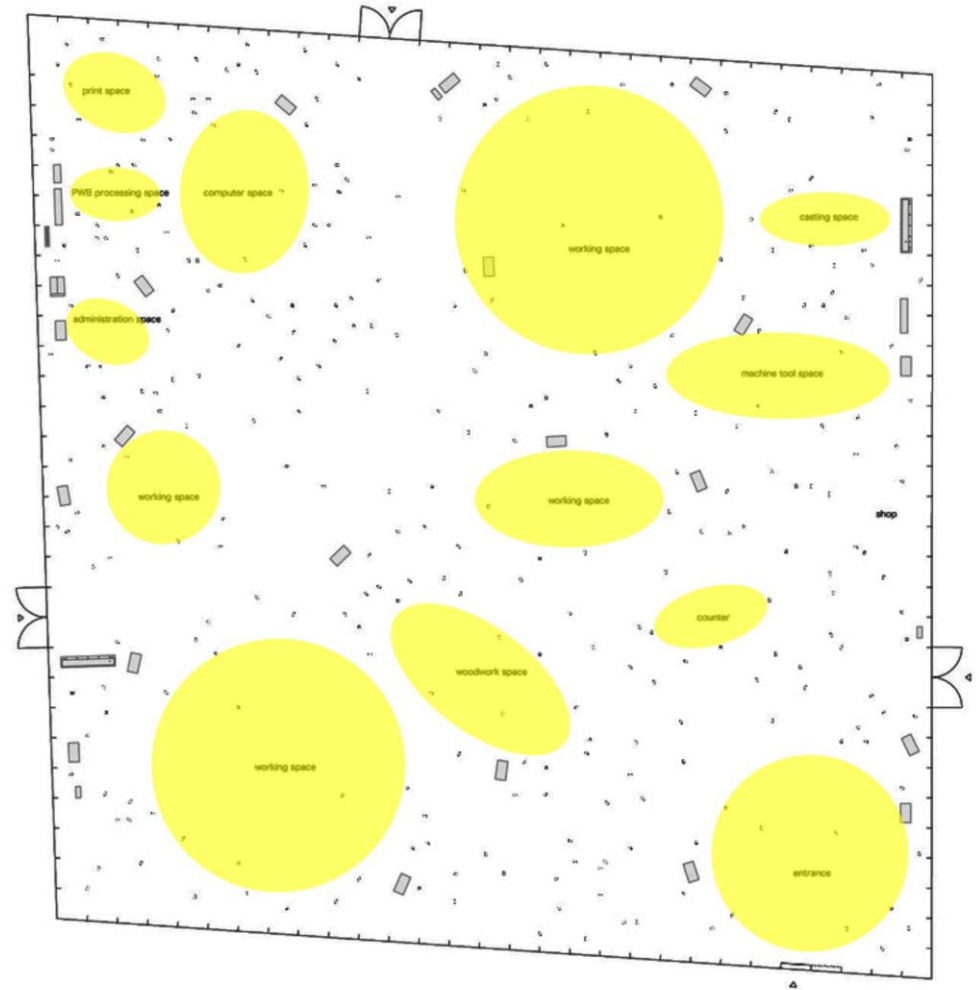
Design Concept



Inside, the columns function as abstract trees and potted greenery serves a bona-fide design role, not just a decorative one. By blending architecture and nature in a remarkably fresh and dynamic way, KAIT Workshop plants Ishigami solidly among those Japanese designers striving to reduce buildings to their bare minimum.

Building Layout

This one-room building contains 14 freely arranged, open spaces. As the figures show, these include a check-in area, donut-shaped counter, as well as specialized areas for pottery, woodworking, computer graphics, metal casting, and other media. There are also four multipurpose work spaces, a small supply shop, and an office like alcove for the facility supervisors.



KAIT workshop seems to be a big glass box with random columns, and be filled in many different programs.

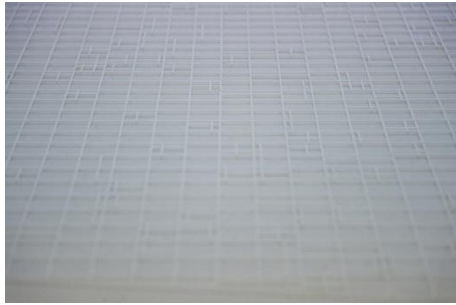
It consists of 3 main steel components:



1. conventional two-way roof frame

2. **42** compression columns for vertical loads

3. **263** post-tensioned columns that carry horizontal loads like mini shear walls



「 steel grid 」

The system forms a rigid roof structure. Slight deformation of roof confirms anticipated scale of shape. Even though the draining slope are considered.



「 vertical support 」

42 columns
act as a stress member
withstand a vertical load



「 horizontal resistance 」

263 columns
are given prestressed
as a tension member

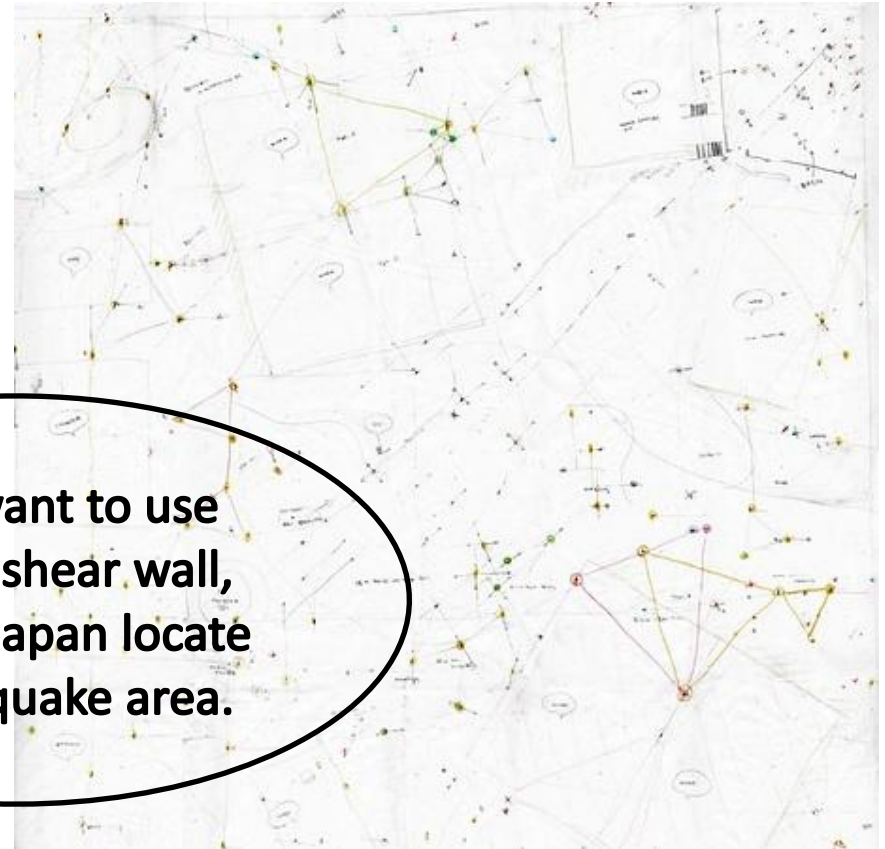
Total : 305 column

Junya Ishigami spent 3 years to study those every functions and scale of space and the location of columns.

He used hand drawing, CAD and make more than 1000 models.



I don't want to use common shear wall, although Japan locate on earthquake area.



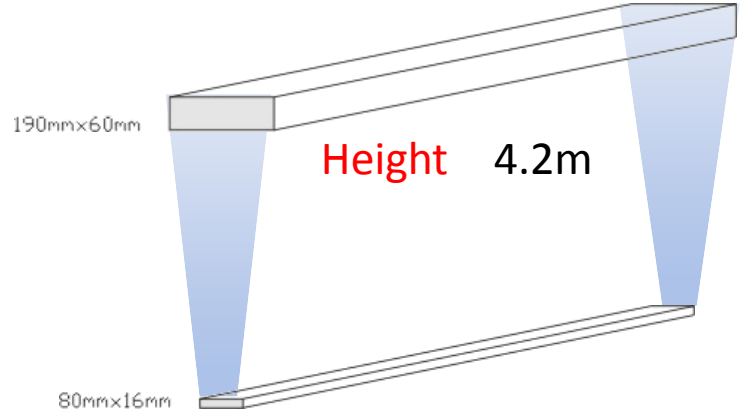
The studio developed a CAD program to make sure column's location, as well as connected EXCEL to calculate load capacity. However, the concept is like current popular parametric design .



図 4 テーブルに座りたわみを確認する筆者
(図 1・2・4 ©石上純也建築設計事務所)

Structure Engineer
Yasutaka Konishi

Column scale range



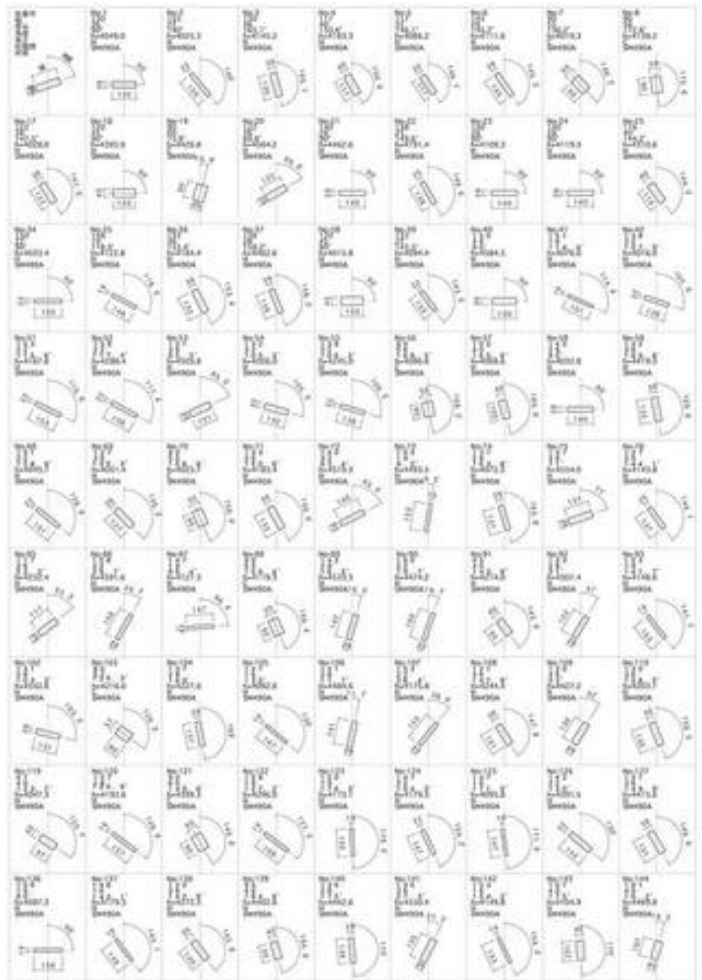
Length 80 to 190 mm **Thick** 16mm to 60mm

Unit section

16mm x 145mm  the thinnest tension member

63mm x 90mm  The thickest stress member

Flat steel column sectional view



Cuboid



Glass wall are around. Installing a glass rib helps it stability.



Columns are all thin and flat cuboid. And everyone has different orientations.

Building Components And System



Can you recognize which column is stress member or tension member?

Description of Main Structural System



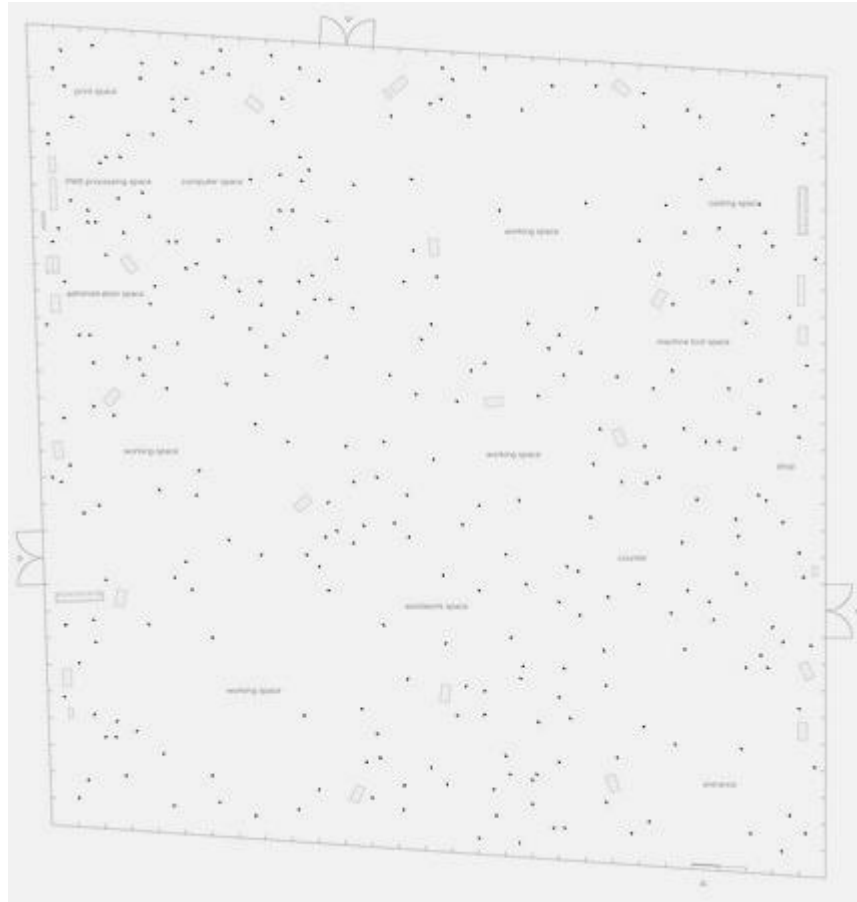
Articulated with minimal means—exterior walls of thin glass and interior clusters of slender white columns—Ishigami's ethereal structure is barely a building at all.

Description of Main Structural System



“Due to the complexity of the columns, it was important to keep the structural system as simple as possible,” says structural engineer Yasutaka Konishi, a contemporary of Ishigami’s who worked on SANAA projects during his five-year tenure at Sasaki Structural Consultants.

Identification of Components



It consists of three main steel components: a conventional two-way roof frame, 42 compression columns for vertical loads, and 263 post-tensioned columns that carry horizontal loads like mini shear walls. Because many of the supports do not align with the roof's 5-by-3-foot girder grid, Konishi inserted extra beams to bridge the gaps.

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Identification of Components



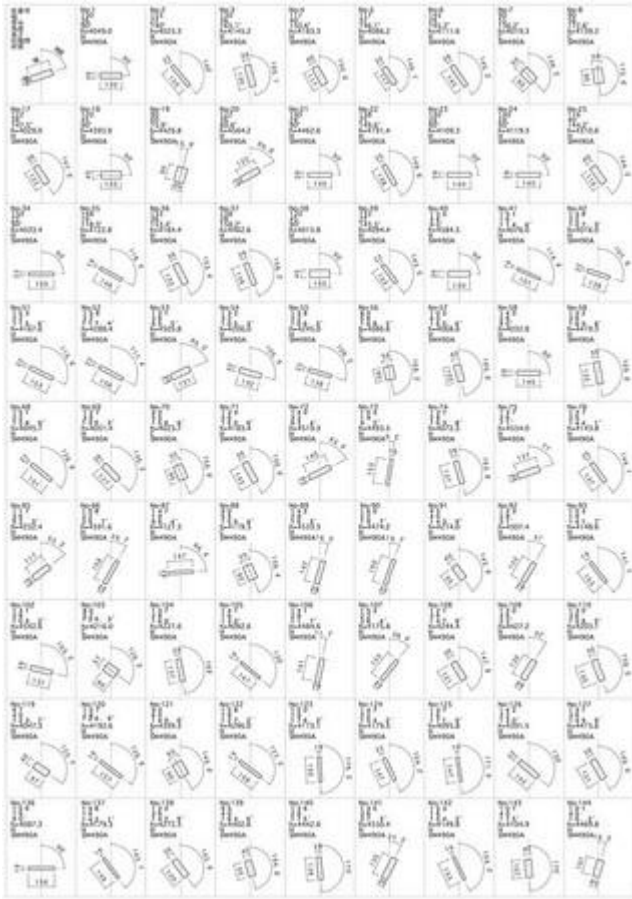
Despite their separate roles, the tension and compression members look the same to the naked eye. “I was striving for ambiguity even among the columns,” explains Ishigami. But due to their oblong shapes, individual columns may appear different depending on the visitor’s viewpoint—an illusion that compounds the intricacy of Ishigami’s composition.

Identification of Components



Coated with white paint, each column is actually a slice of steel plate. Cut in various widths from slabs of three different thicknesses, each was tailored to the architect's exacting specifications.

Identification of Components



This unusual fabrication technique accommodated every permutation from the thinnest tension member, measuring 0.63-by-6 inches (16-by-145 mm), to the thickest compression member, measuring 3-by-4 inches (63-by-90 mm).

Connection Description



Though both types of columns are anchored with simple concrete footings, the compression and tension members connect to the roof frame with welded and pin joints, respectively.

Connection Description



Because many of the supports do not align with the roof's 5-by-3-foot girder grid, Konishi inserted extra beams to bridge the gaps.

Lateral Resisting System Description

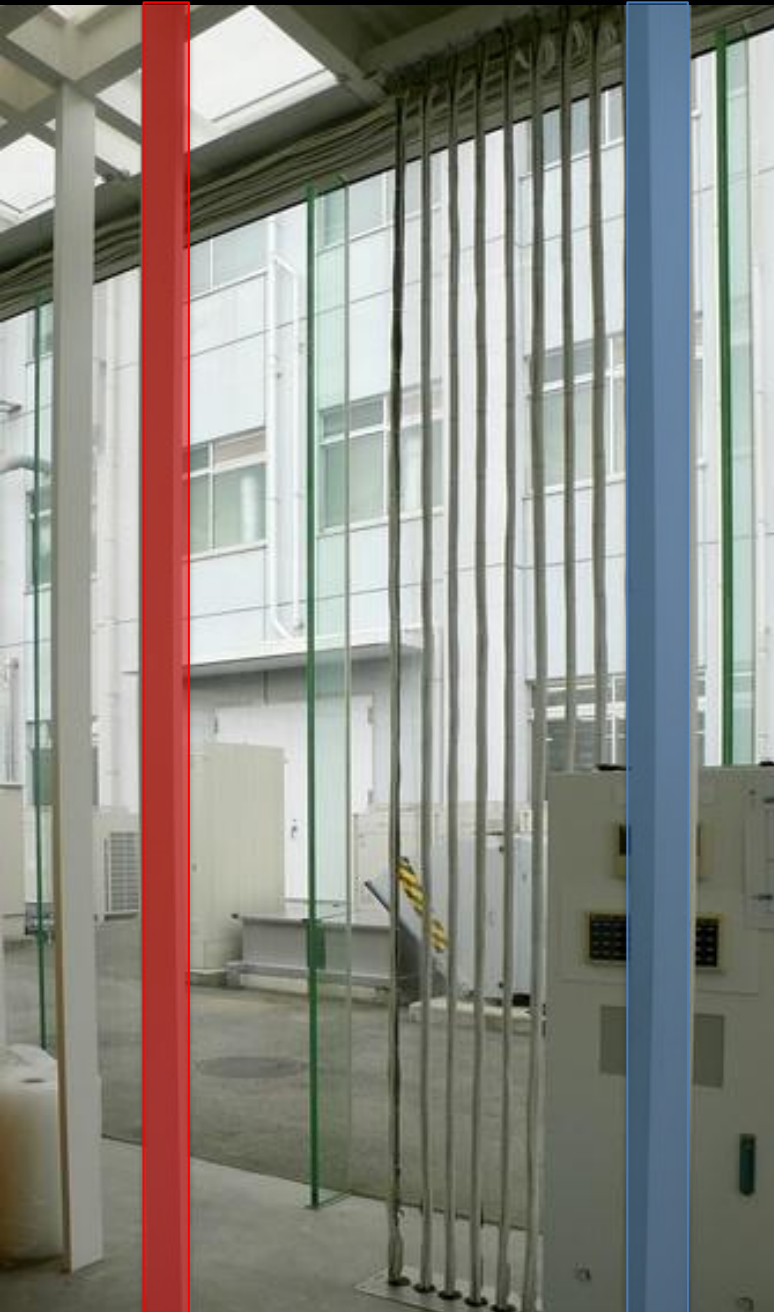


There are 301 columns randomly distributed in this 21,410-square-foot workshop.

42 compression columns for vertical loads,

263 post-tensioned columns that carry horizontal loads like mini sheer walls.

Lateral Resisting System Description

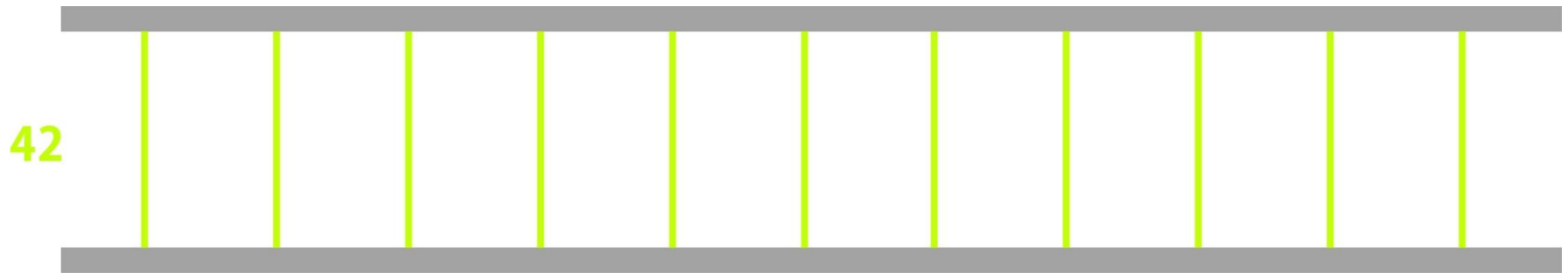


The thickest compression member,
measuring 3-by-4 inches.

The thinnest tension columns, measuring
0.63-by-6 inches.

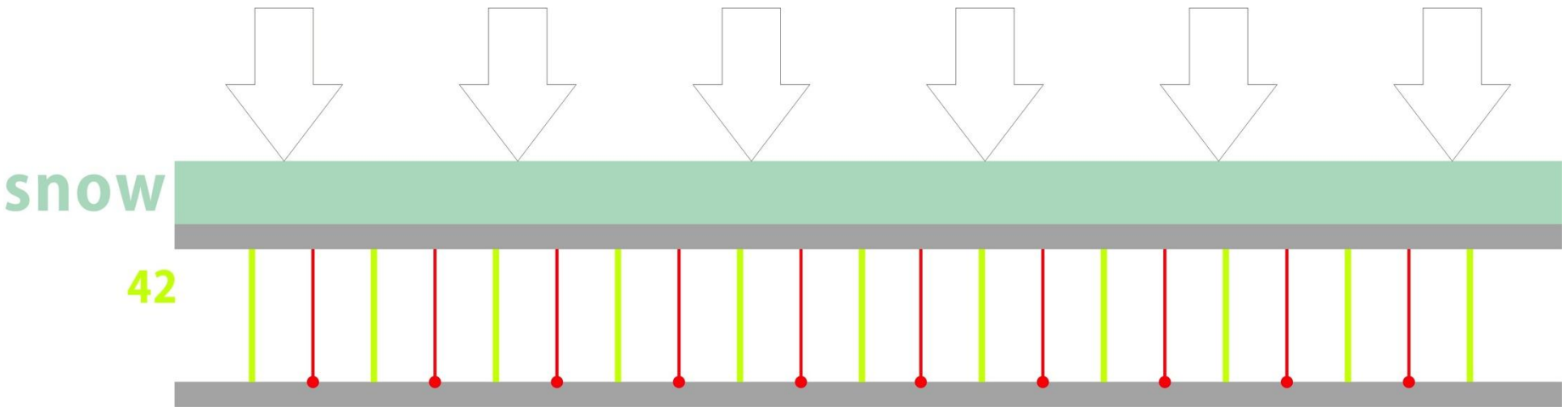
Lateral Resisting System Description

Construction was equally unorthodox:



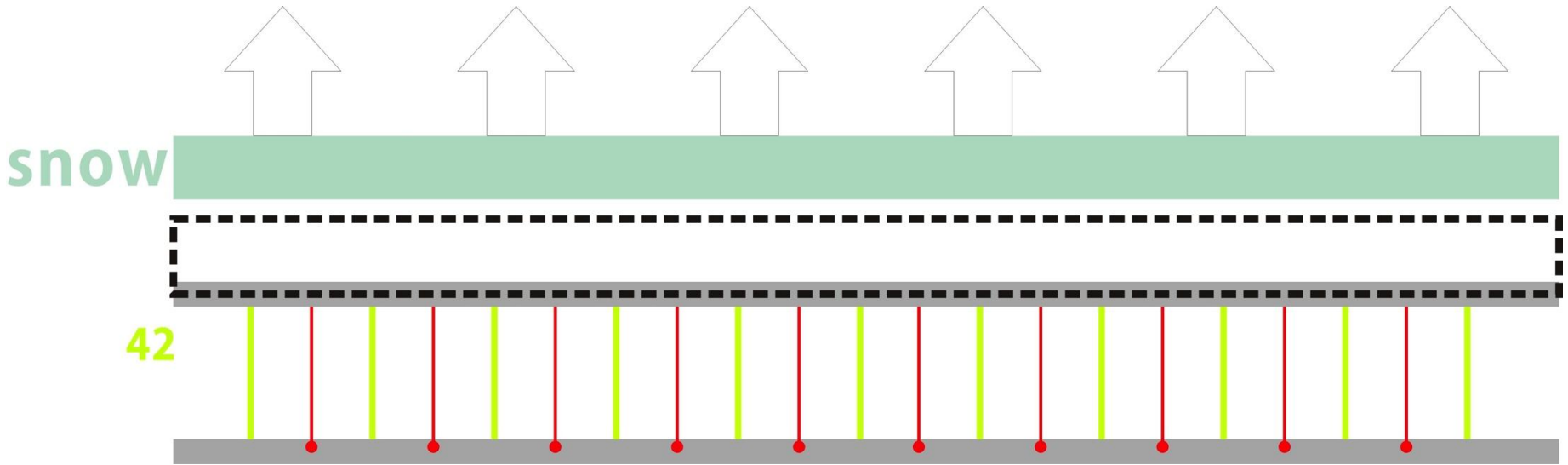
- First the workers put compression members and the roof frame in place.

Lateral Resisting System Description



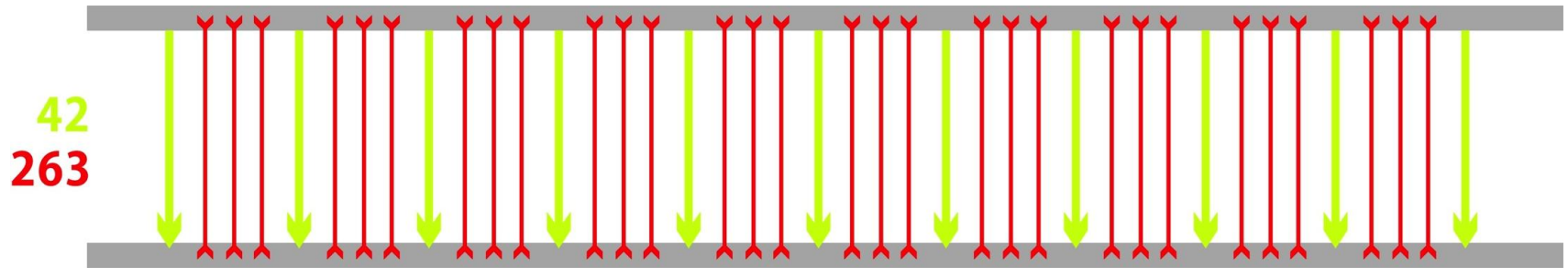
- Thirdly, they weighted the roof to simulate the snow load.

Lateral Resisting System Description

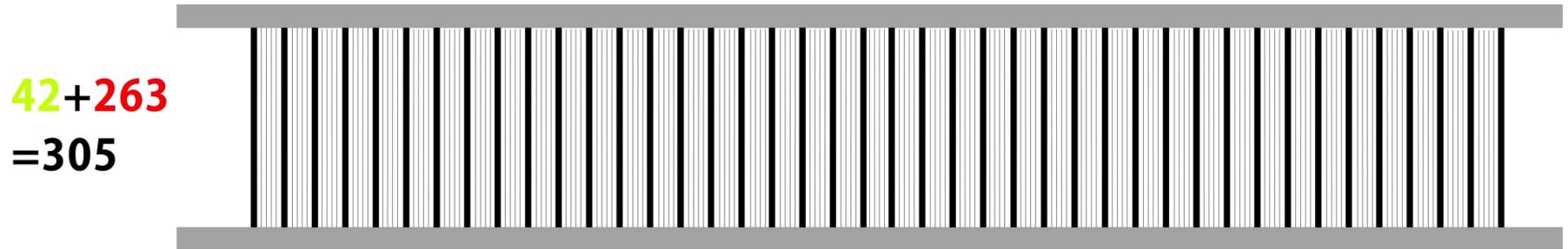


- After that, they attached the tension members to the bottom, then they removed the snow load.

Lateral Resisting System Description



42 compression columns for vertical loads;
263 tension columns that carry horizontal loads.



- when the weights were removed, the taut steel planes snapped into place and the roof popped up as expected.

Lateral Loading Behavior

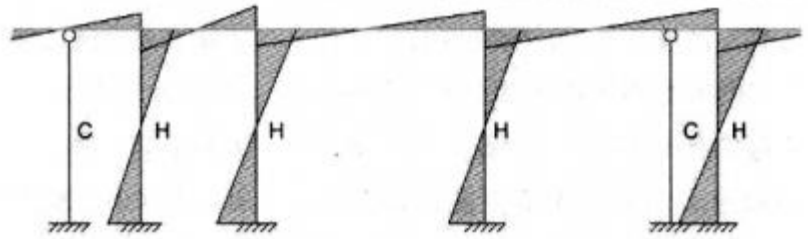


How it works?

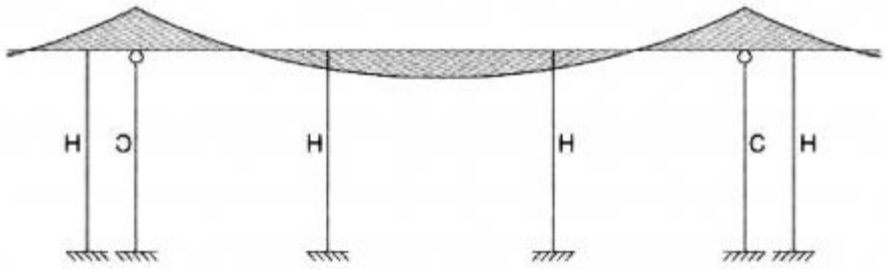
The post-tensioned columns are anchored with simple concrete footings, And also connect to the roof frame with welded and pin joints, respectively. By doing this, it makes the building a whole system, make it has better responds to the twisting and side-way.

Description of Loads

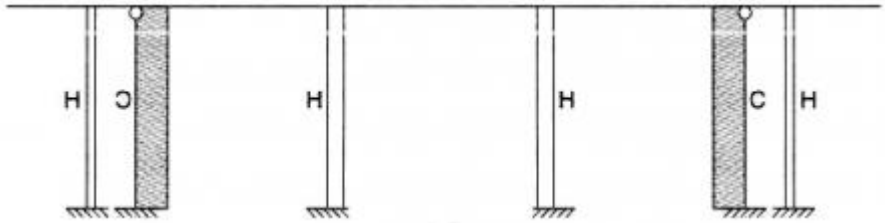
C: compression columns for vertical loads,
H: post-tensioned columns that carry horizontal loads.



Shear Force Diagram
OF the post-tensioned columns when earthquake happen.



Bending Moment Diagram
OF the roof system.



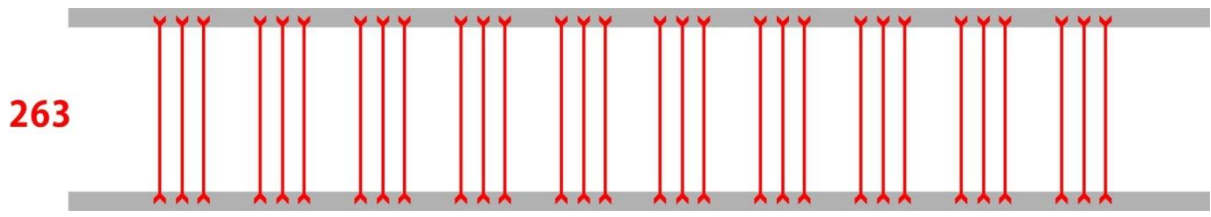
Axial Stress Diagram
OF compression columns for vertical loads

Load Transfer Path

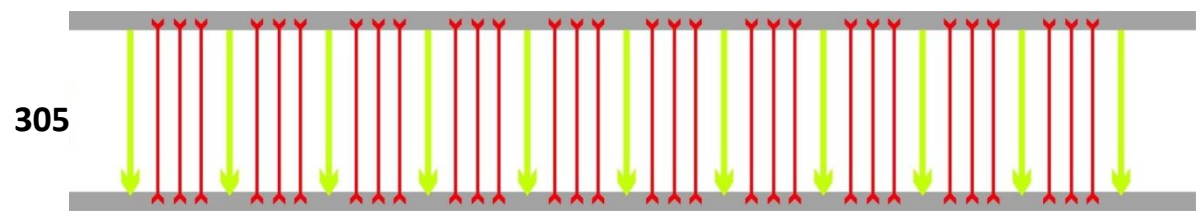
42 compression columns for vertical loads



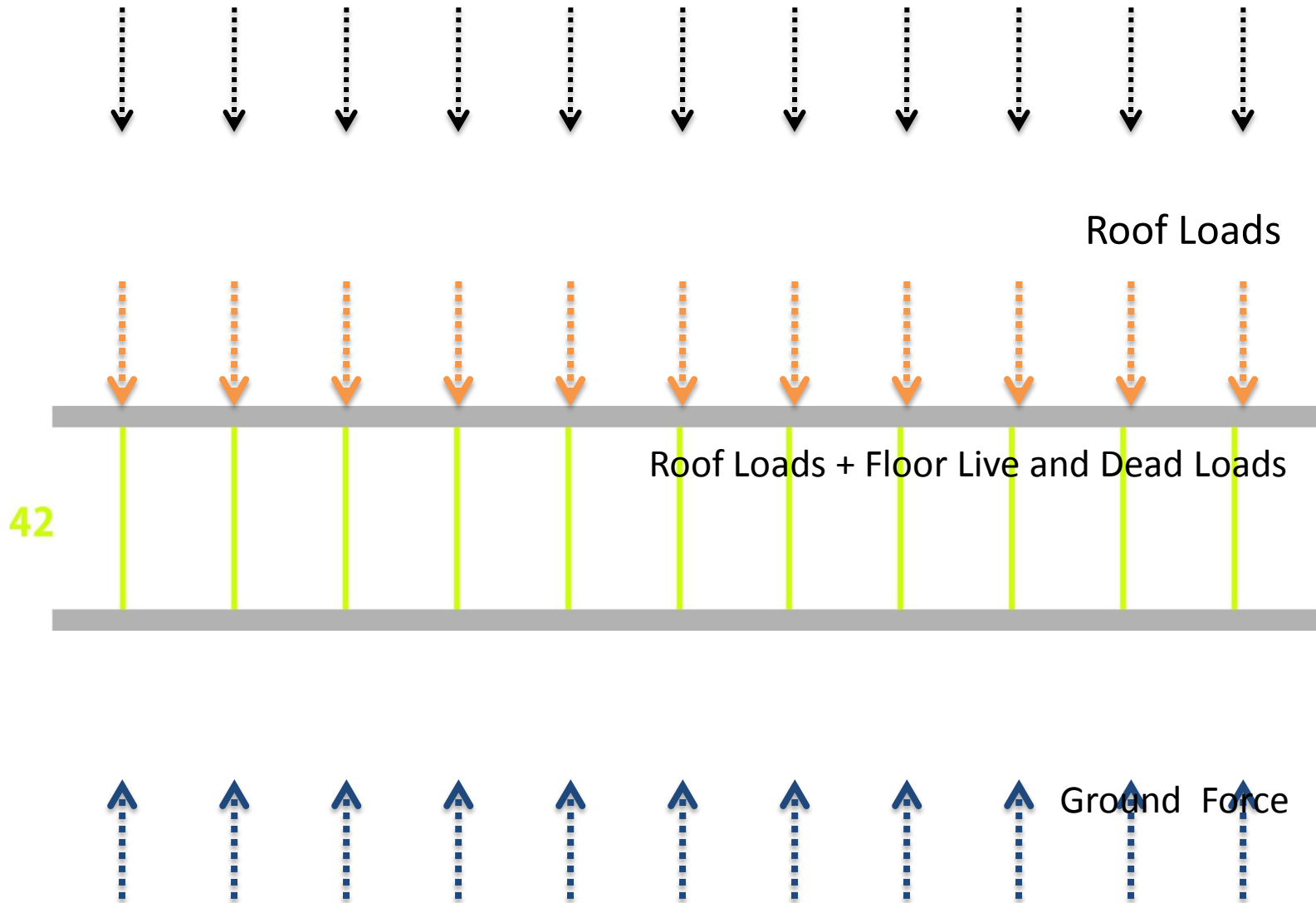
263 tension columns that carry horizontal loads



system

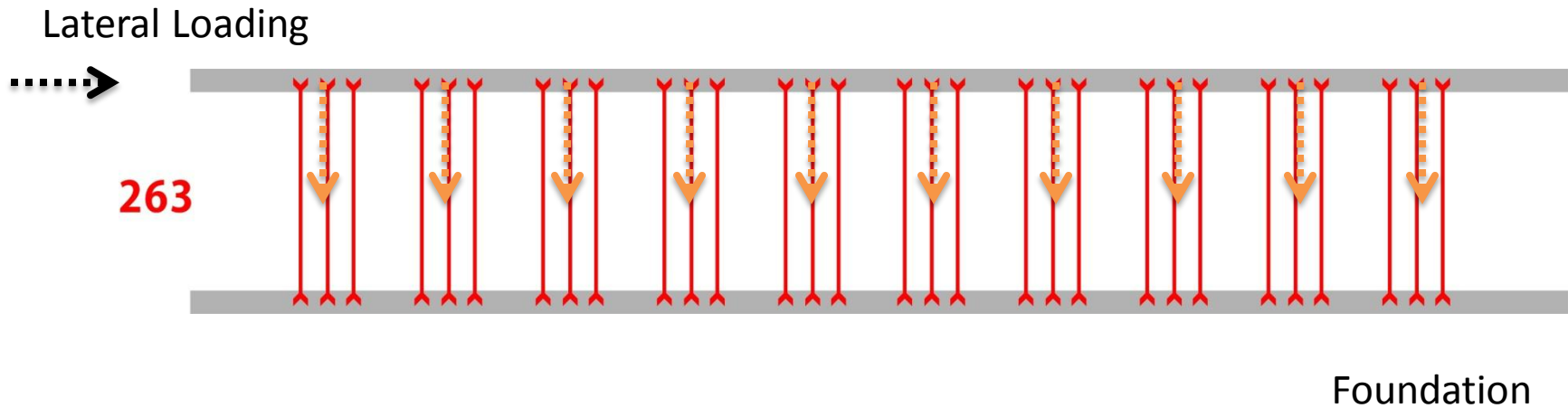


Load Transfer Path - Vertical Loads



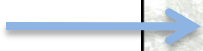
Load Transfer Path - Horizontal Loads

263 post-tensioned columns that carry horizontal loads like mini shear walls.



Lateral loading behavior

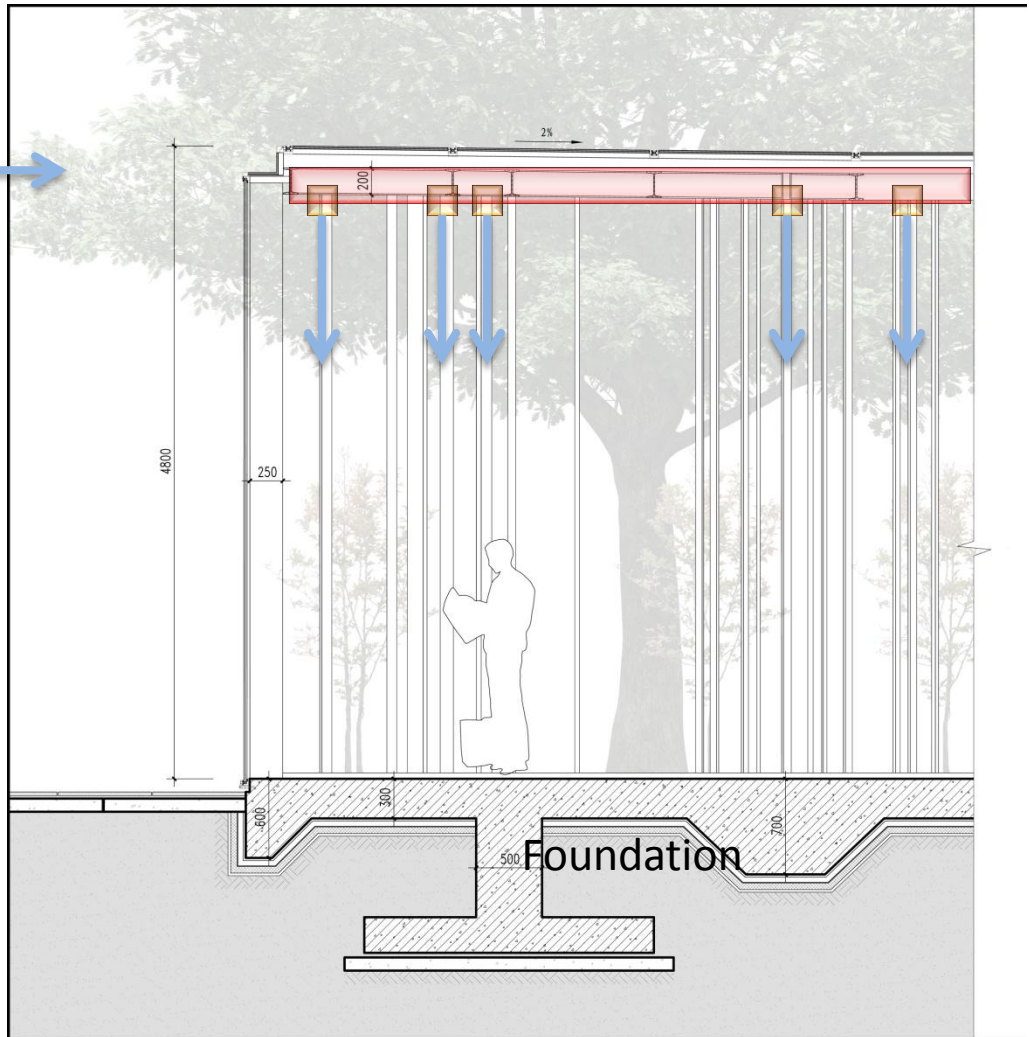
Lateral Loading (wind load)



Transferred to the Ring Beam

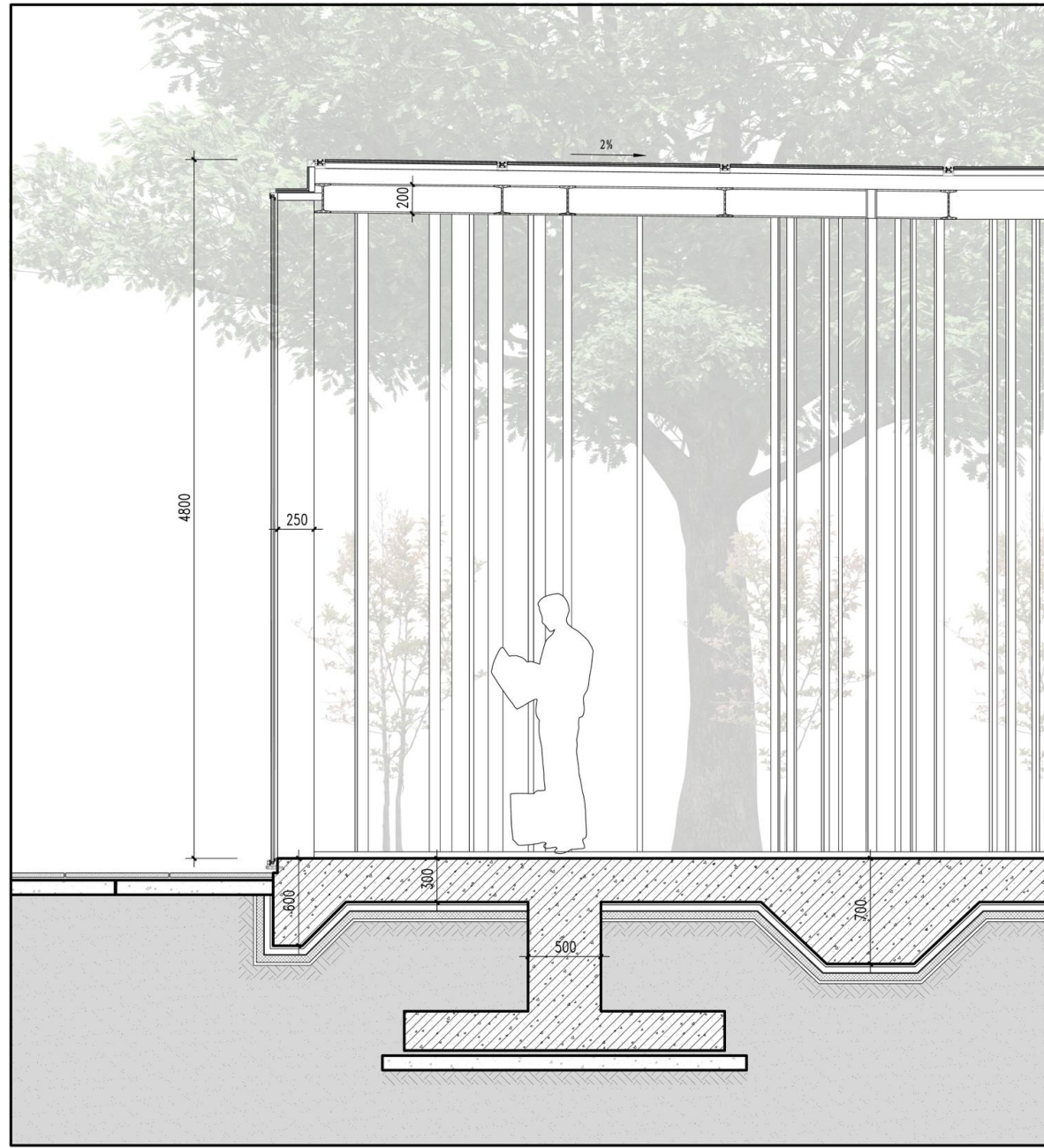
Transferred to the Piers

Finally, it is transferred to the foundation.

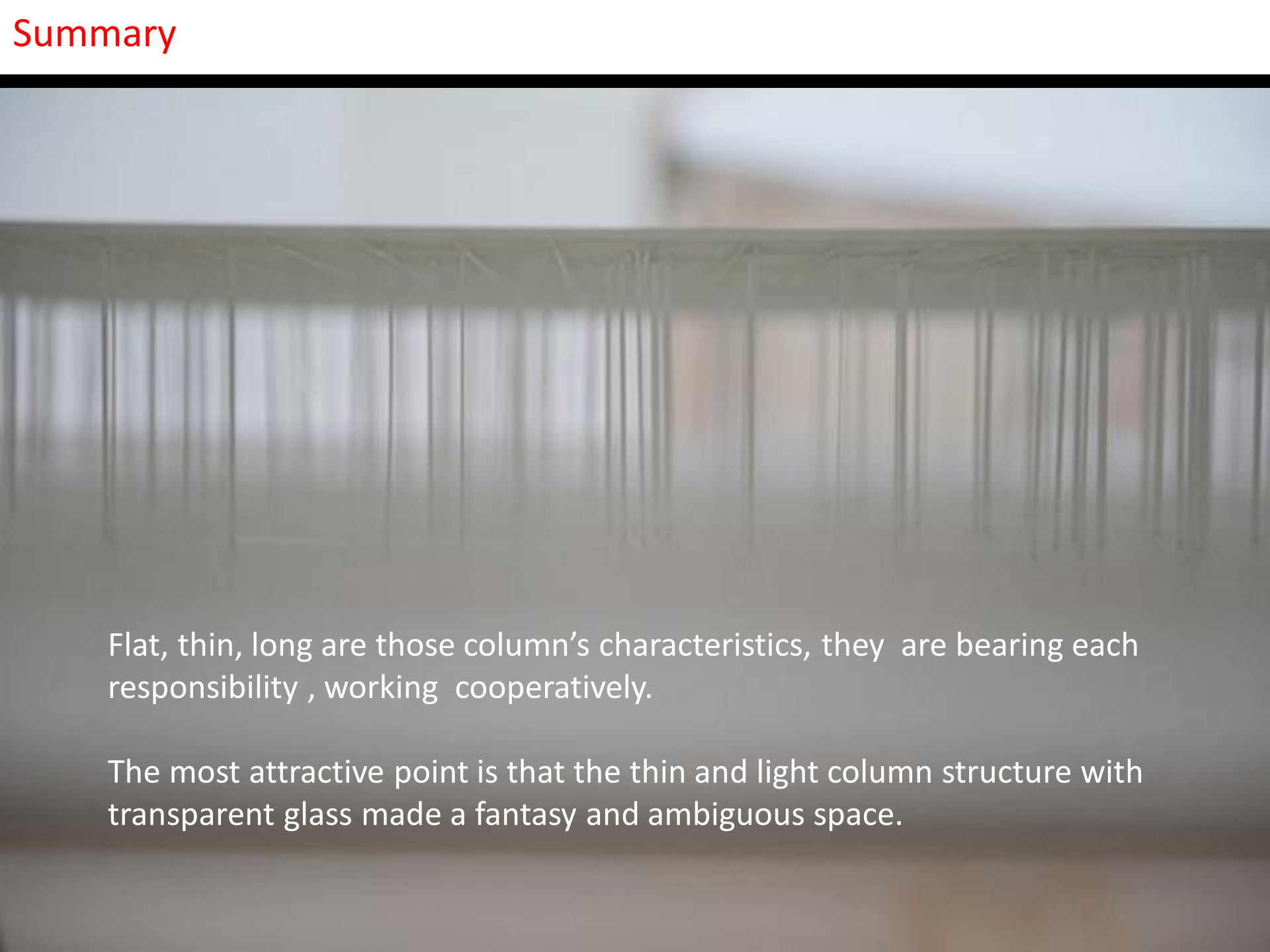


Foundation and Soil

This building is located in Japan which is a country with frequent earthquake. So it designed to float in the soil and relies on the dead load of the structure for stability. It is one-story building which uses the concrete raft foundation with the waterproof and insulation.



Summary



Flat, thin, long are those column's characteristics, they are bearing each responsibility , working cooperatively.

The most attractive point is that the thin and light column structure with transparent glass made a fantasy and ambiguous space.

Summary

Otherwise, there is a furniture-Shaky Table- design by Junya Ishigami. It is using the same prestress structure idea with KAIT Workshop.

