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Performative Architecture | A Measurable Means of Evaluating Formal Systems

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Form Follows Daylight

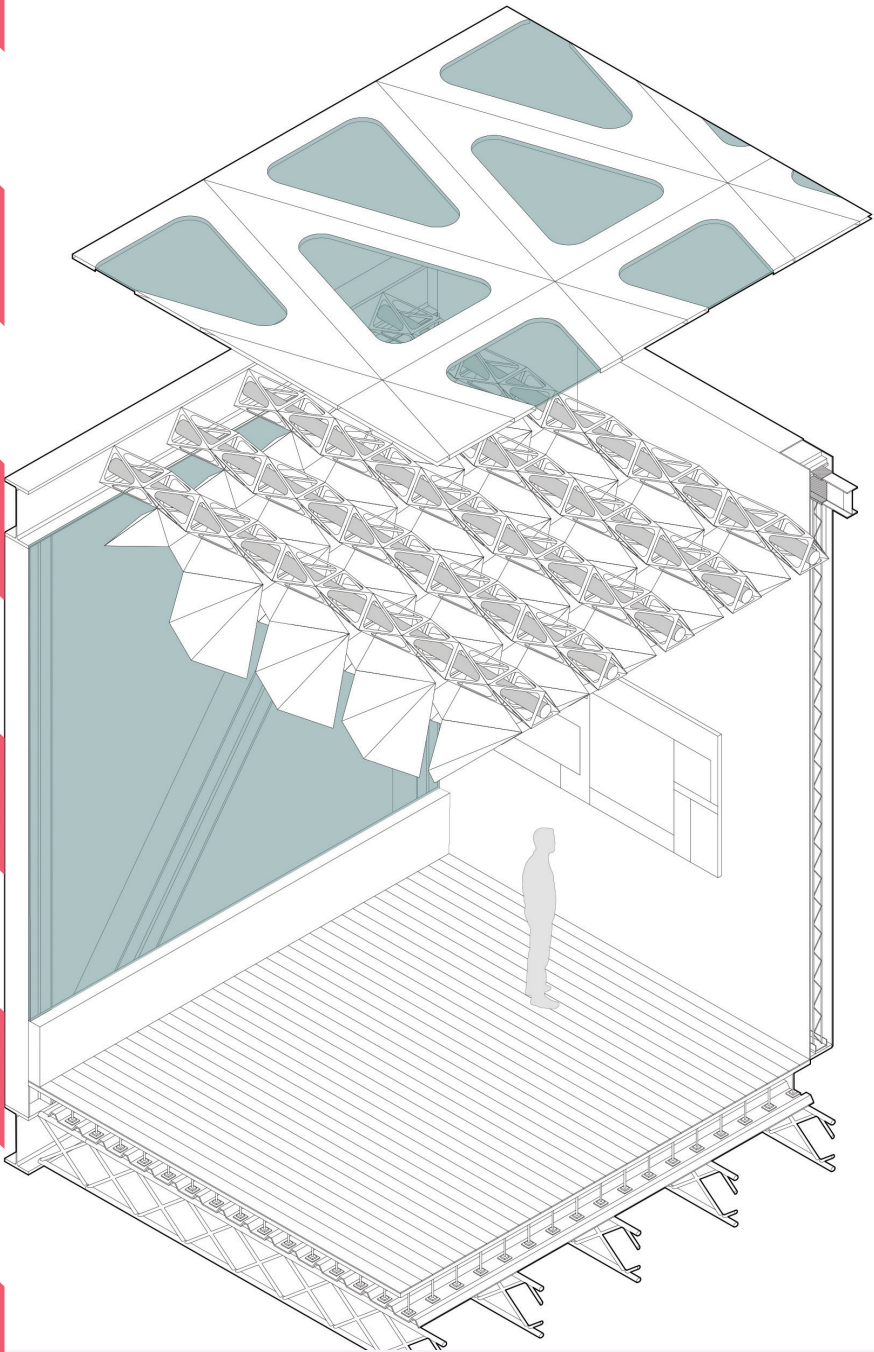
A Measurable Means of Formal Evaluation

The Gothic, Baroque, and Rococo architectural styles relied on perception and an underlying adherence to classical formulas to provide merit and deem an architecture valid. Up through the 19th century before the emergence of modernism these established canons would reemerge both in isolation and as an amalgam of styles. Henry Russell Hitchcock describes this latter episodic phase of building as exhibiting an eclecticism of style, where features of different styles are used together on a single building like those in the Beaux-Arts tradition. In the early 20th century, Louis Sullivan's modernist dictum of "Form Follows Function," while seemingly providing design with an explicit methodology and structure also created an architecture with an undefined basis for evaluation. With this prescribed mode of design and a strict adherence to employing a truth to materials, architecture succumbed to a type of sterilization. Buildings that were supposed to be liberated and announce their typology were whitewashed, further concealing their identity. Currently, the use of metaphor in contemporary practice frequently serves as a post-rationalized vehicle for design rationale, once again leading the discipline no further in establishing a measurable means of formal evaluation or value system.

At Renzo Piano's Menil Collection in Houston, Texas, we see the use of the metaphor used to derive a delaminated roof scheme that employed a series of fixed louvres referred to as "leaves". Although this building illustrates a type of performance driven formal strategy, this leaf reference is part of a larger

organic metaphor, as seen in other building elements. The form of the trusses from which these daylight modulators are suspended possess an organic bonelike rendering with no structural or construction based rationale, furthering this unfounded use of metaphor. This thesis posits that performance as a design criteria has to ability to serve as the primary guiding metric for the design process, providing the basis for a measurable means of evaluating formal systems. Using parametrics, analysis, and simulation tools guided by site and program specificity, it is hoped that an architecture where form truly follows function will emerge. This parametric design space will be defined through both construction logic and a set of predetermined geometric constraints that undergo an iterative optimization process.

GARRETT J. MARINI





DARWIN

FRANKLIN BRAMANTE PHIDIAS ICTINVS

AMPER

PRIESTLEY

THIS BUILDING DEDICATED TO LITERATURE SCIENCE AND ART IS THE GIFT OF ANDREW CARNEGIE TO THE PEOPLE OF PITTSBURGH

CARNEGIE MUSEUM OF ART

From Sep. 16 - Oct. 14, 1984. Sun. - Sat. 10 A.M. - 5 P.M. Closed Mon. - Tues. 10 A.M. - 5 P.M.

STOP

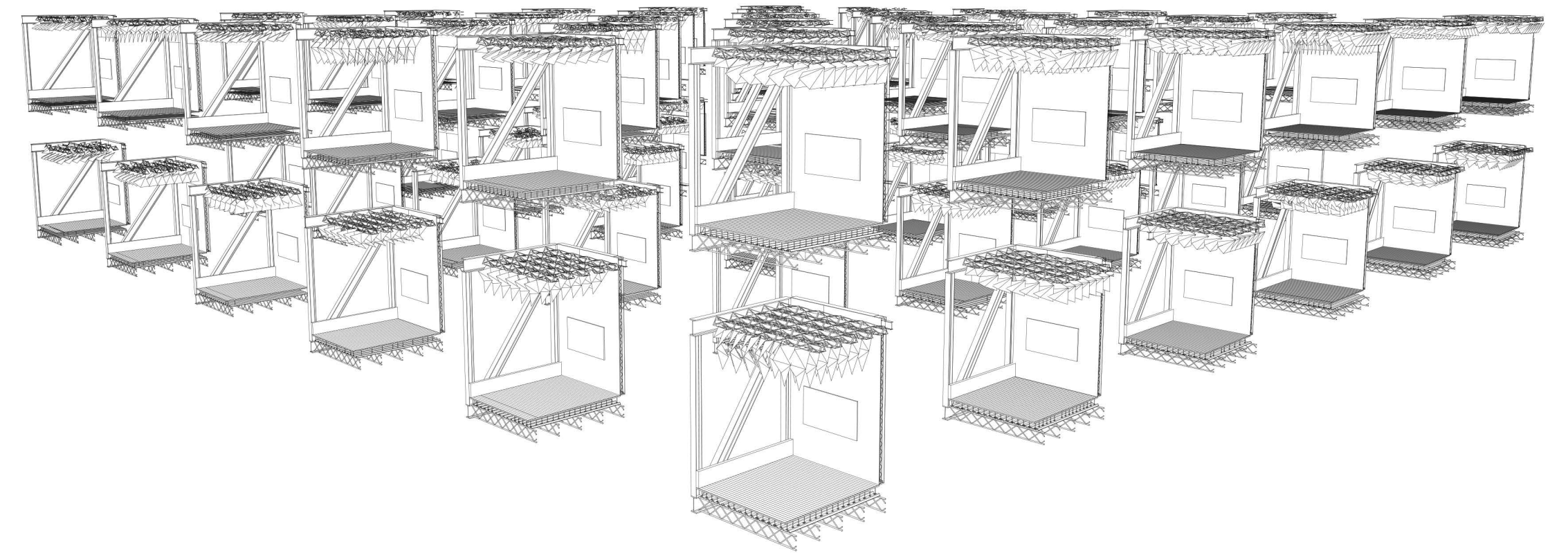
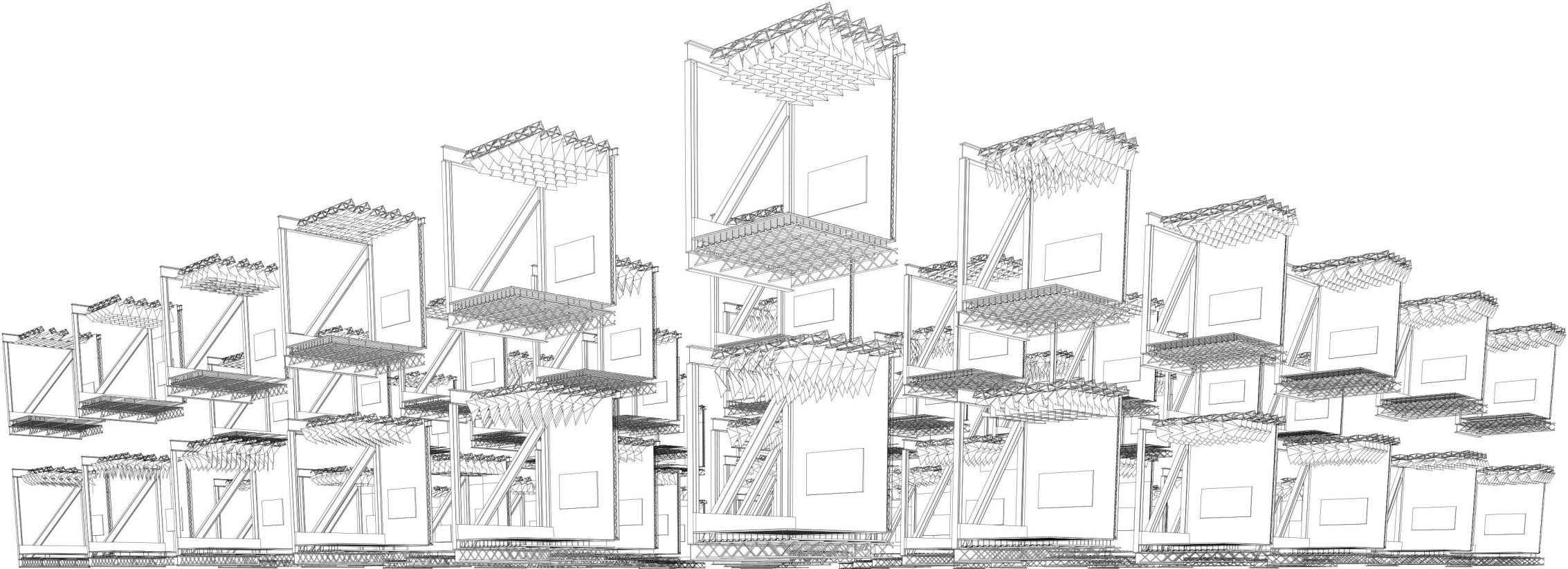
Forrest Ave

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1100





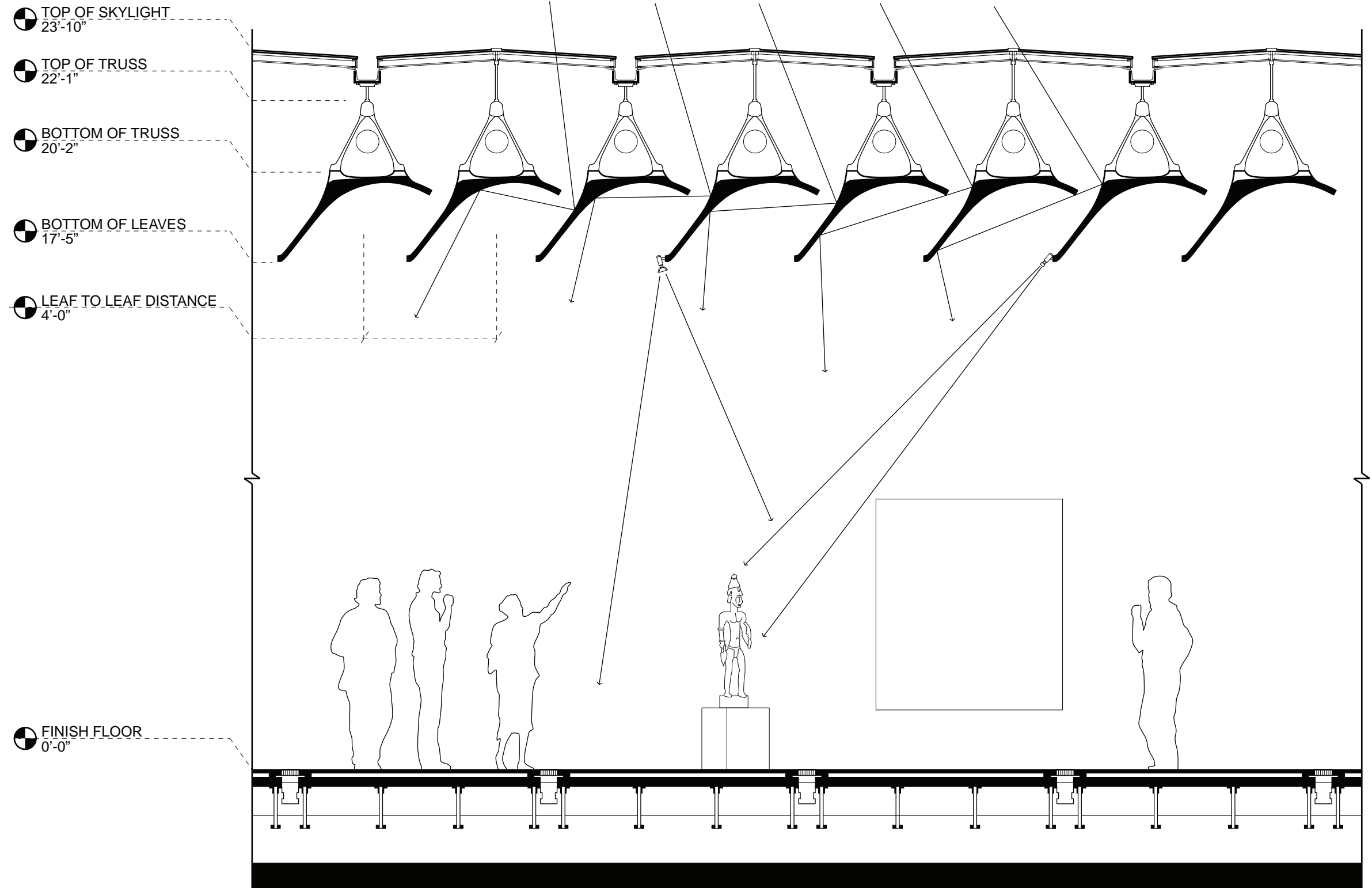


Dispensing the Organic Metaphor

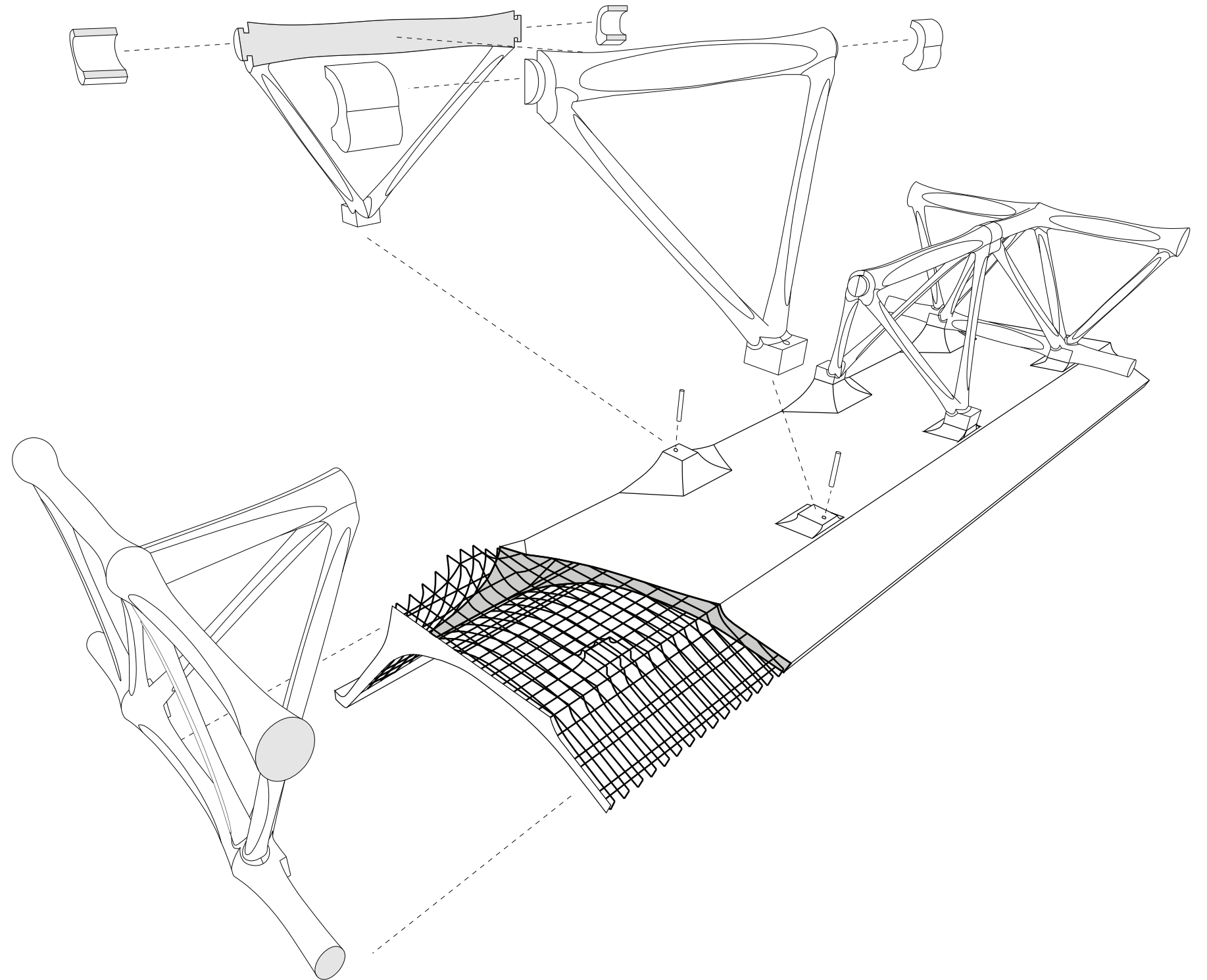
Renzo Piano Building Workshop
The Menil Collection, Houston, Texas - 1986

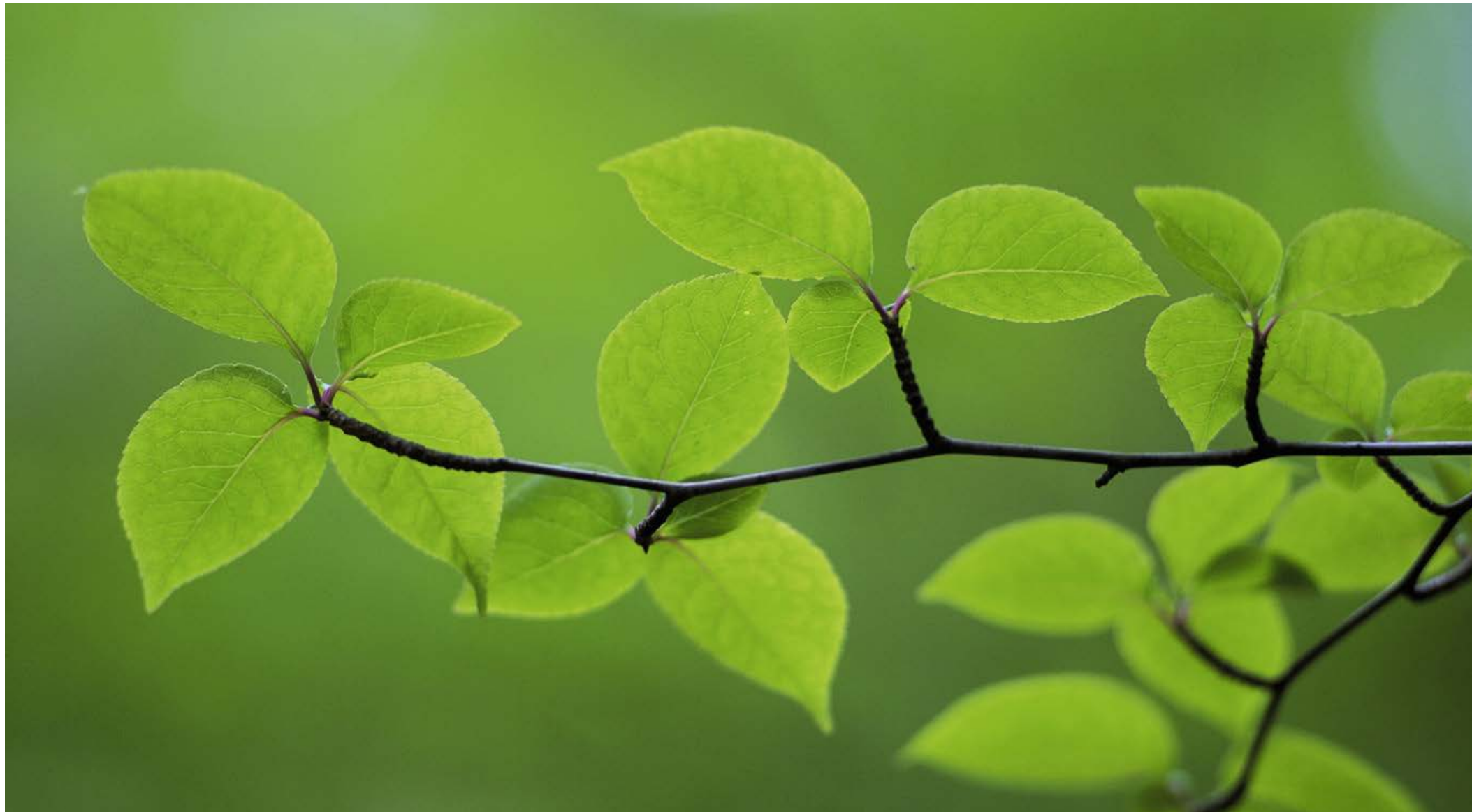


The Menil Collection Section

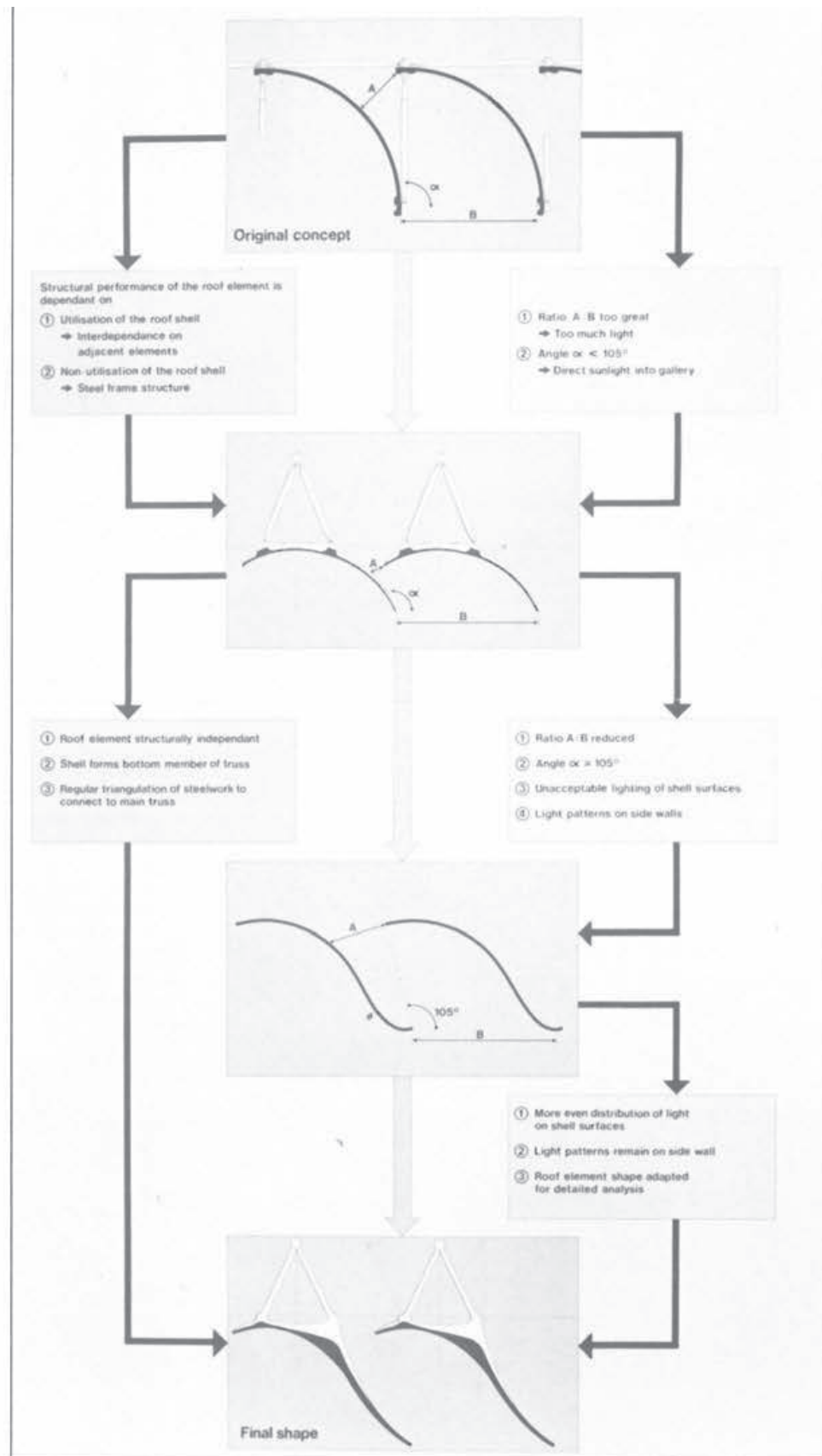


The Menil Collection Truss Diagram

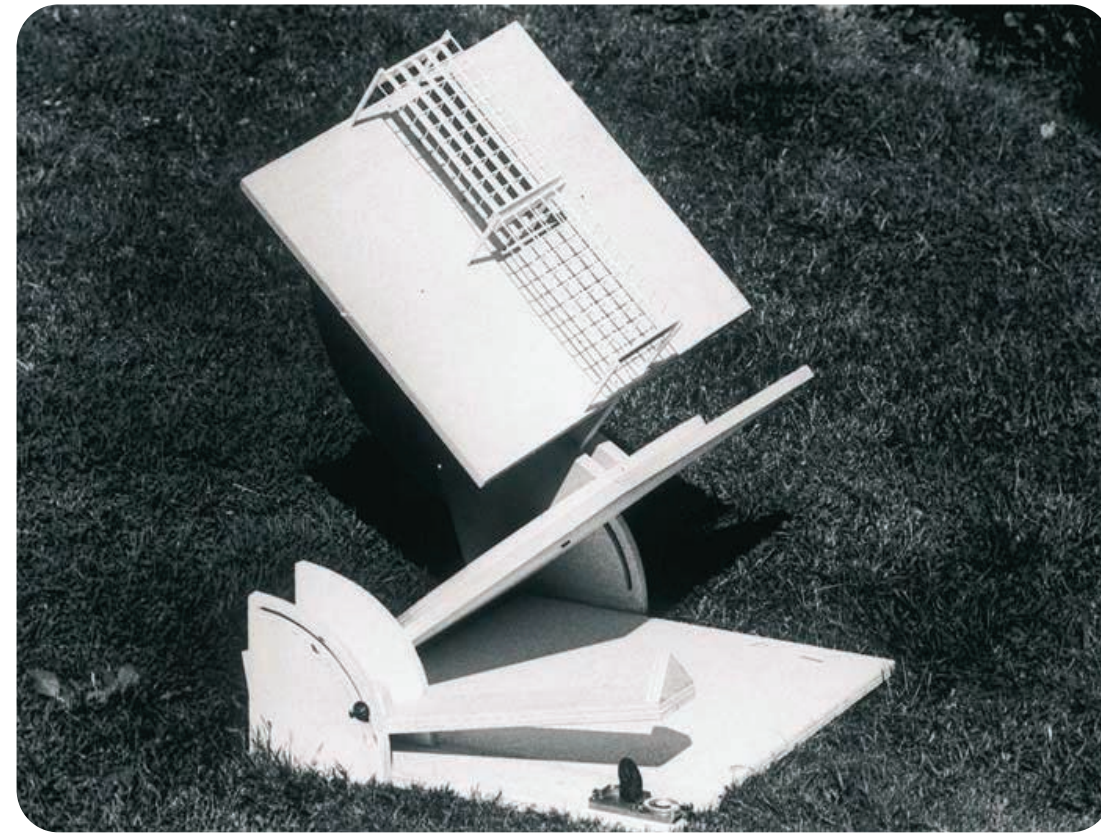




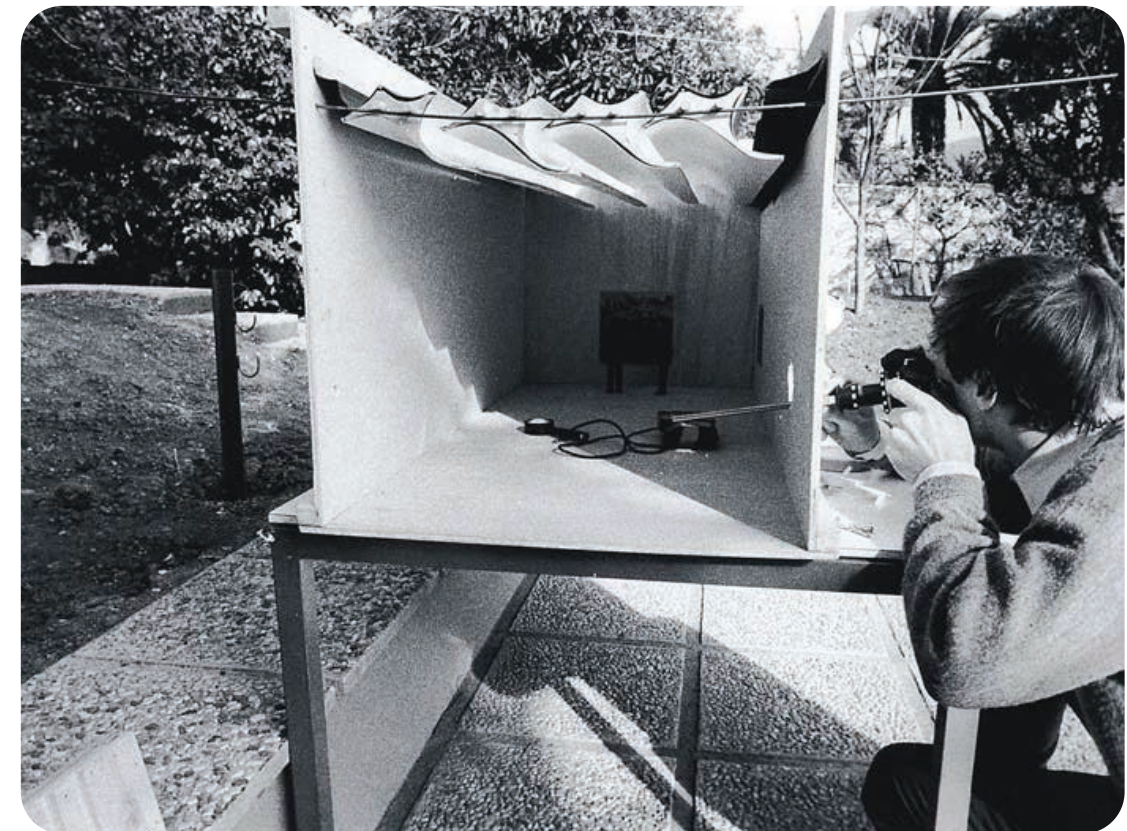
The Menil Collection Evolution and Analysis



Roof Element Shape Evolution



Heliodon

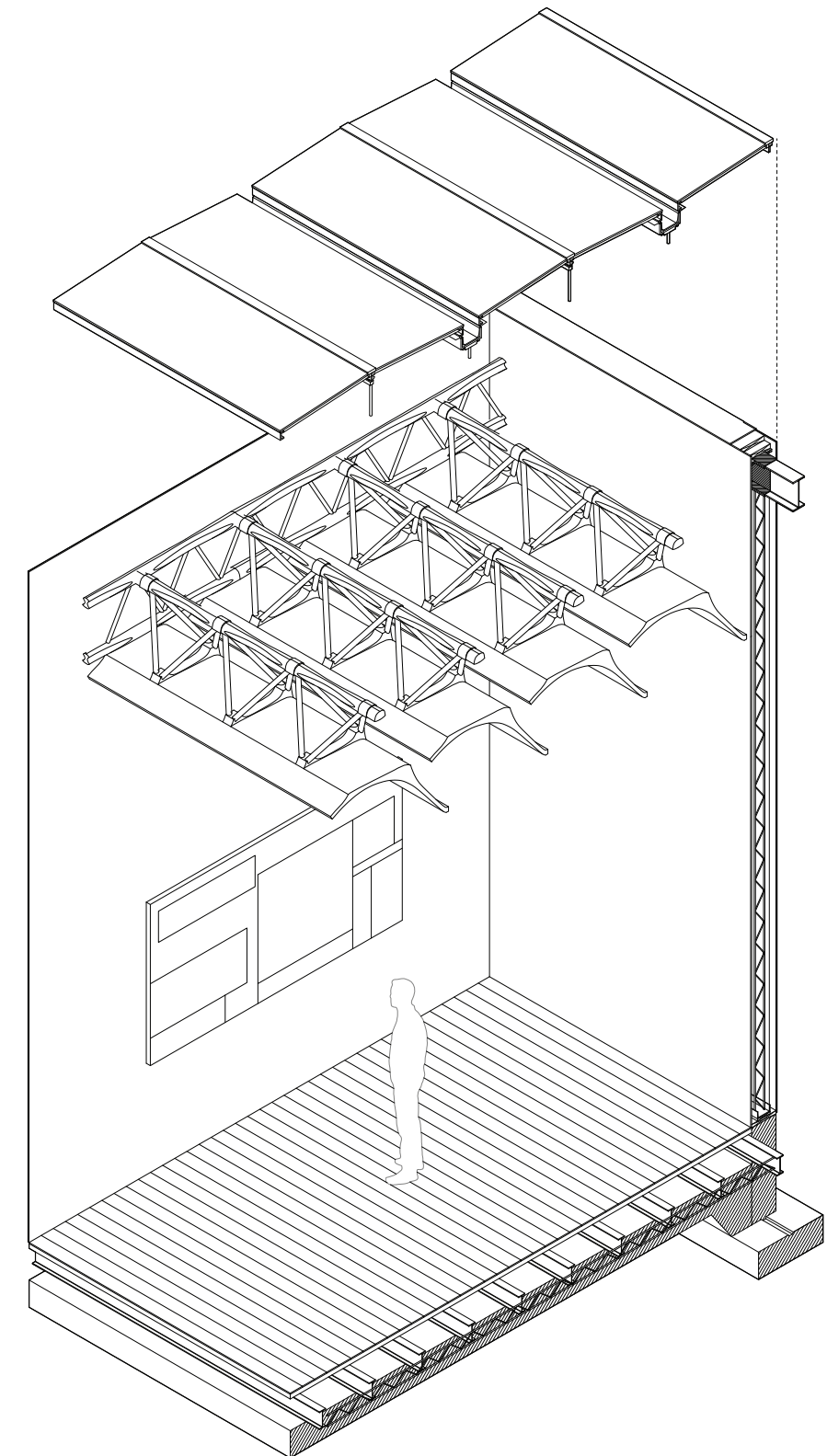
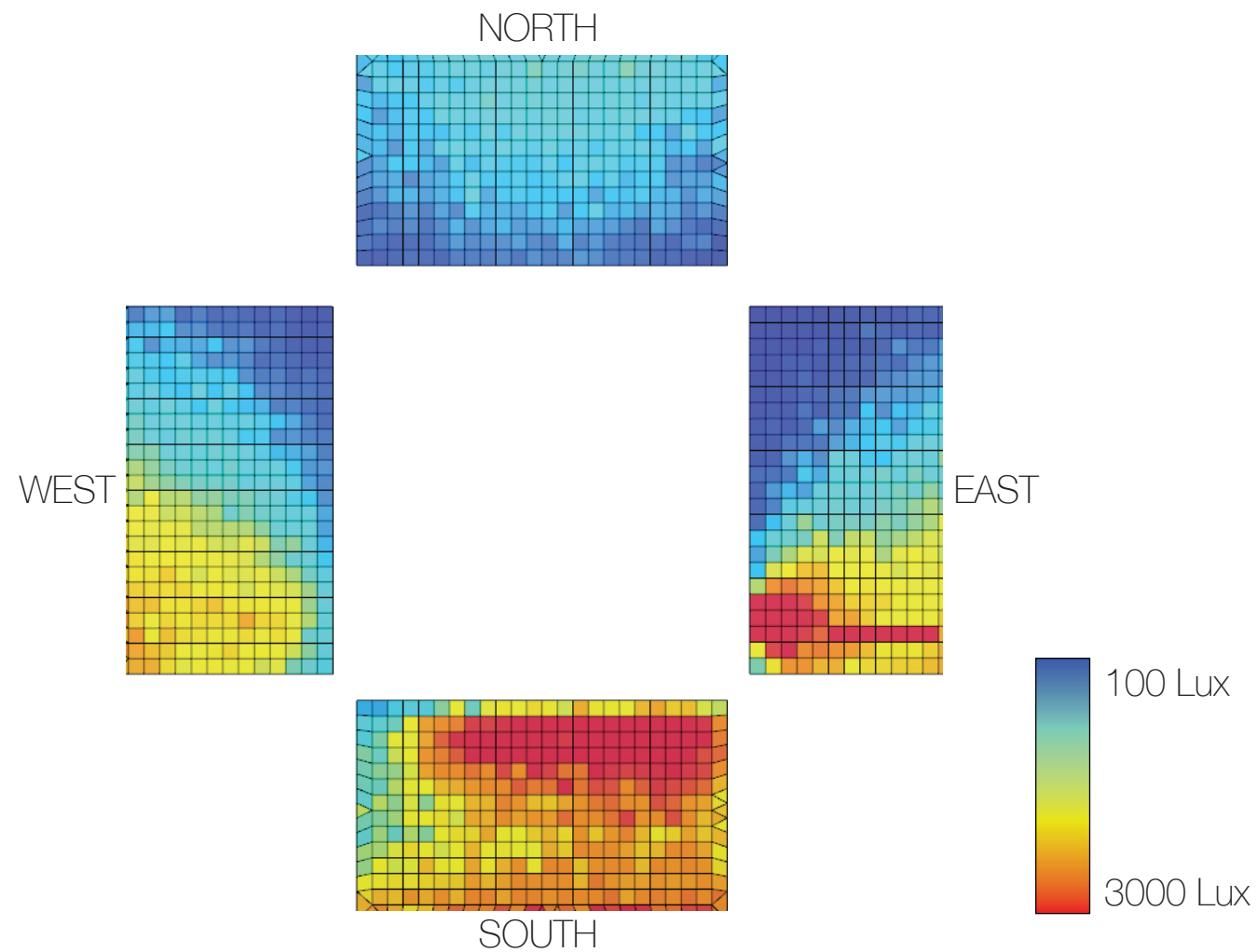


Prototyping/Analysis

The Menil Collection Lighting Requirements: 150-2000 Lux Annually

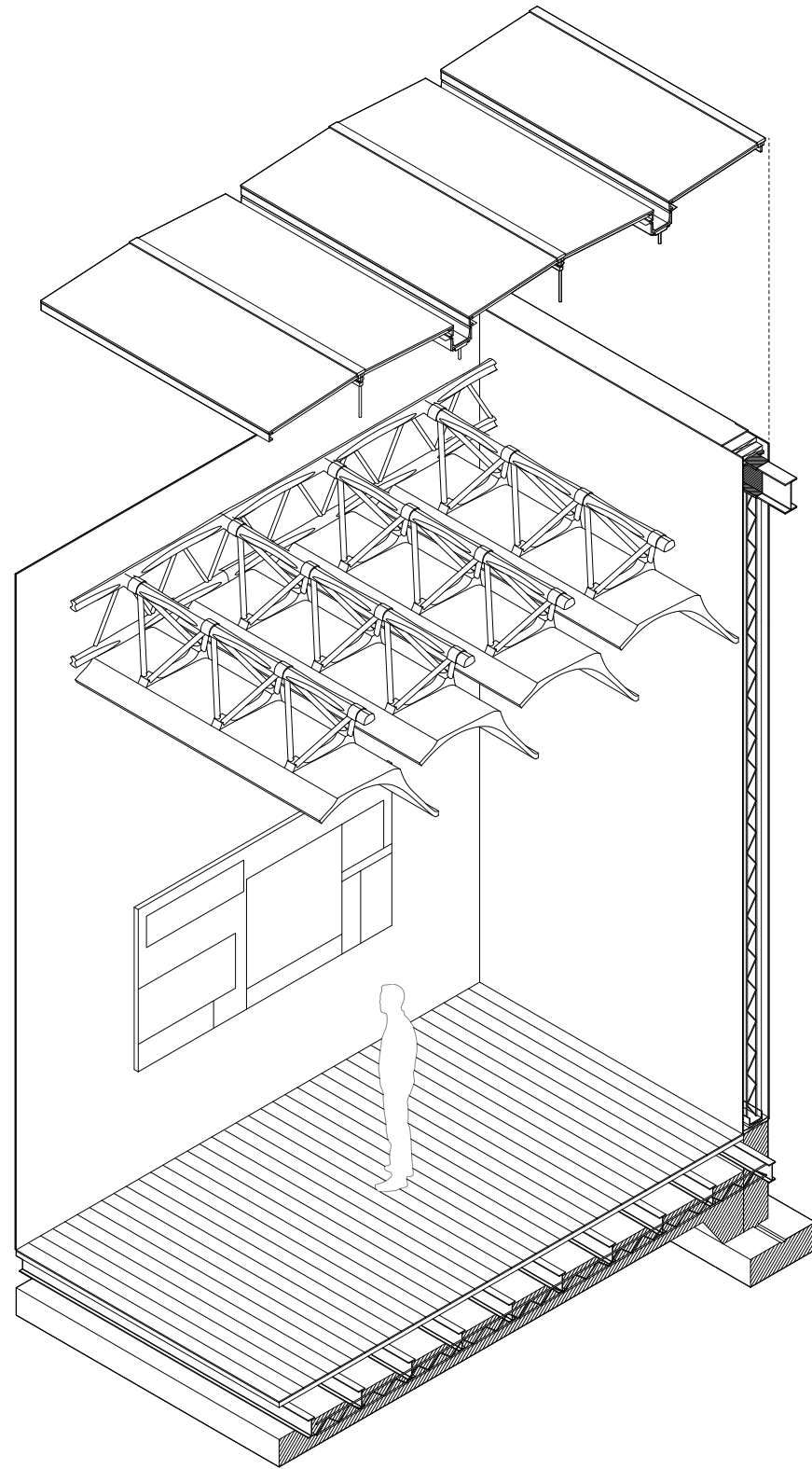


WALL ILLUMINANCE



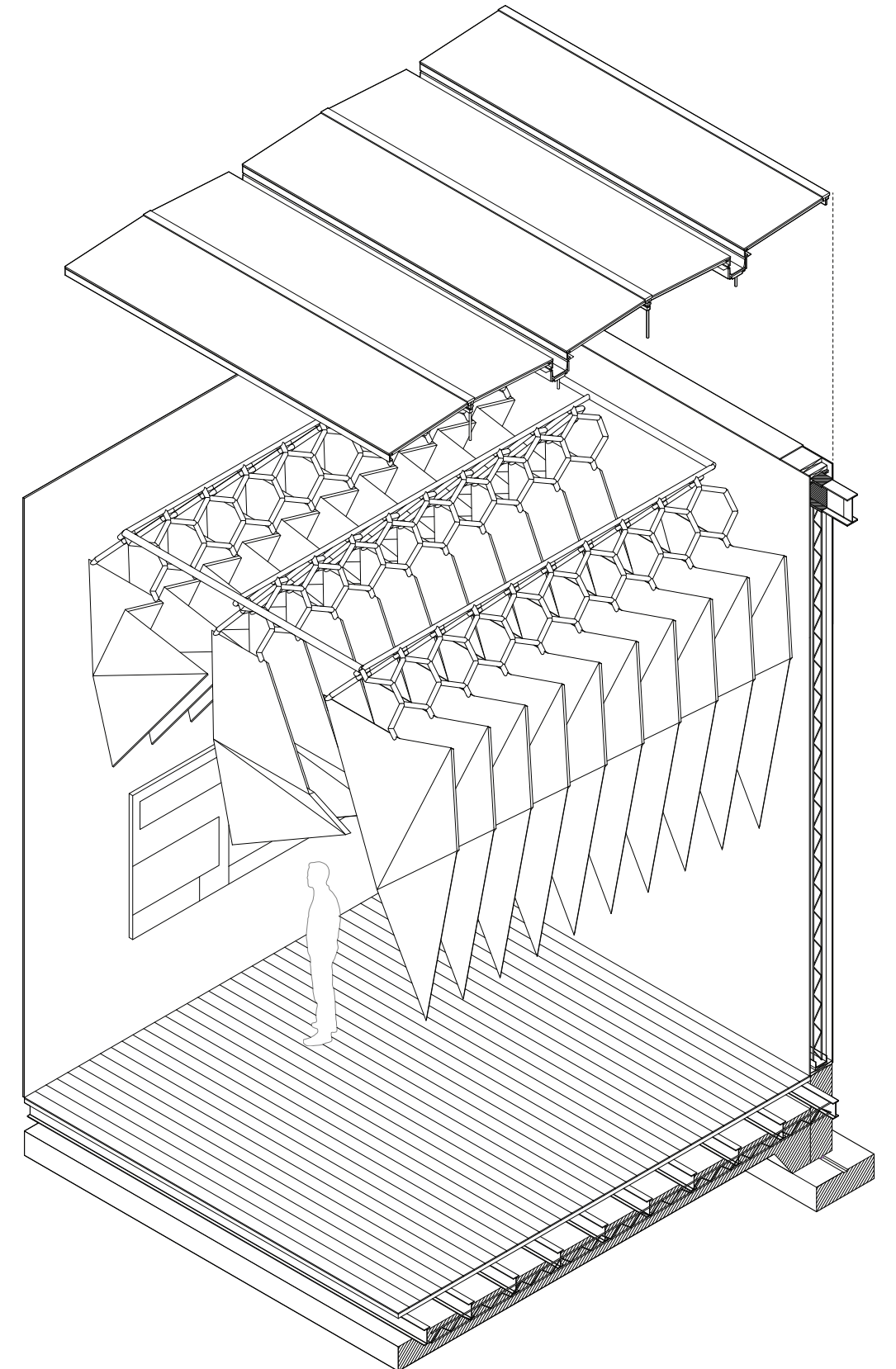
Values between 100 lux and 2,000 lux are considered appropriate for indoor working conditions, suggesting that horizontal illumination values outside of this range are not useful and may inhibit glare or thermal discomfort.

Existing Roof System



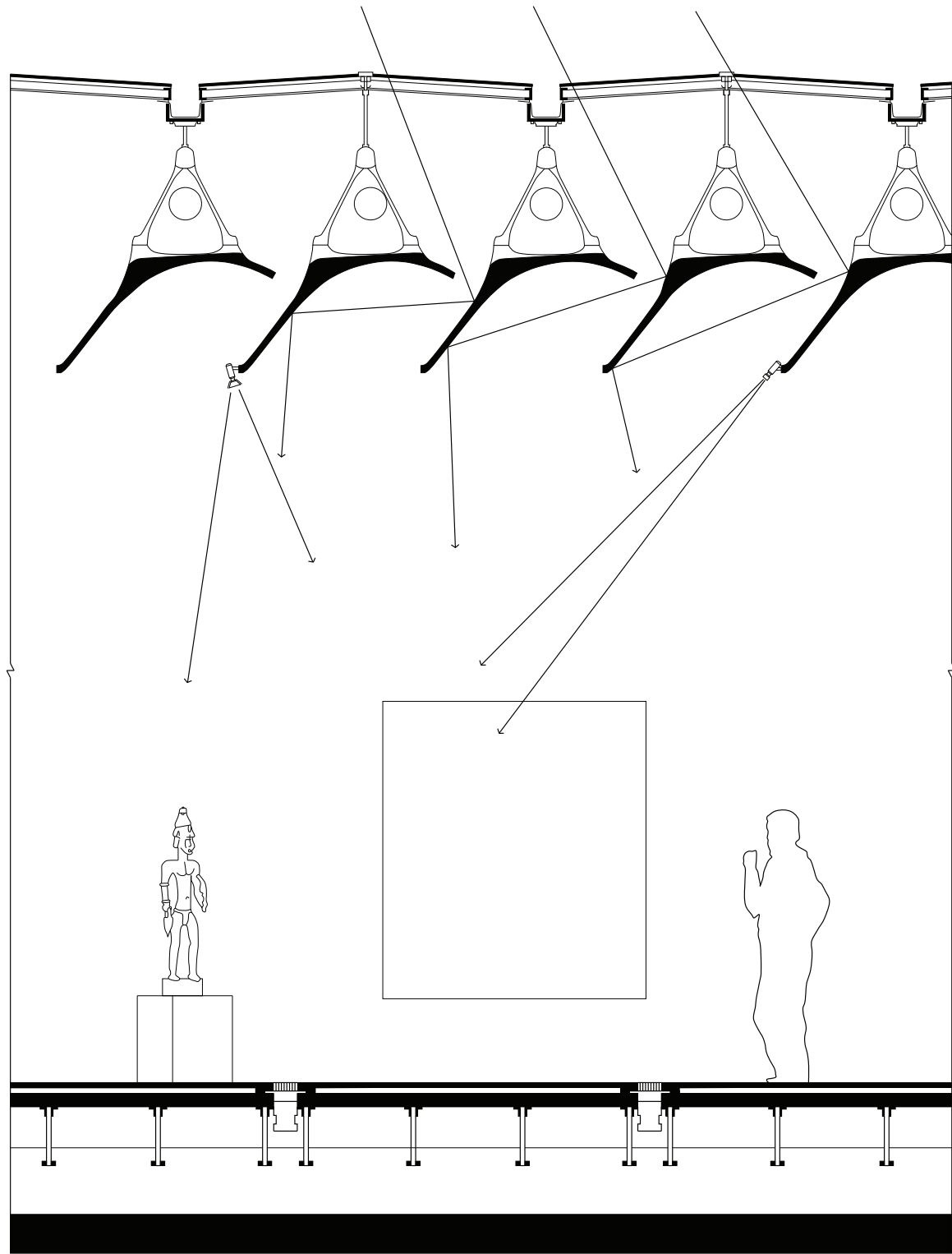
100-2000 Lux: 53% Hours Annually

Optimized Roof System

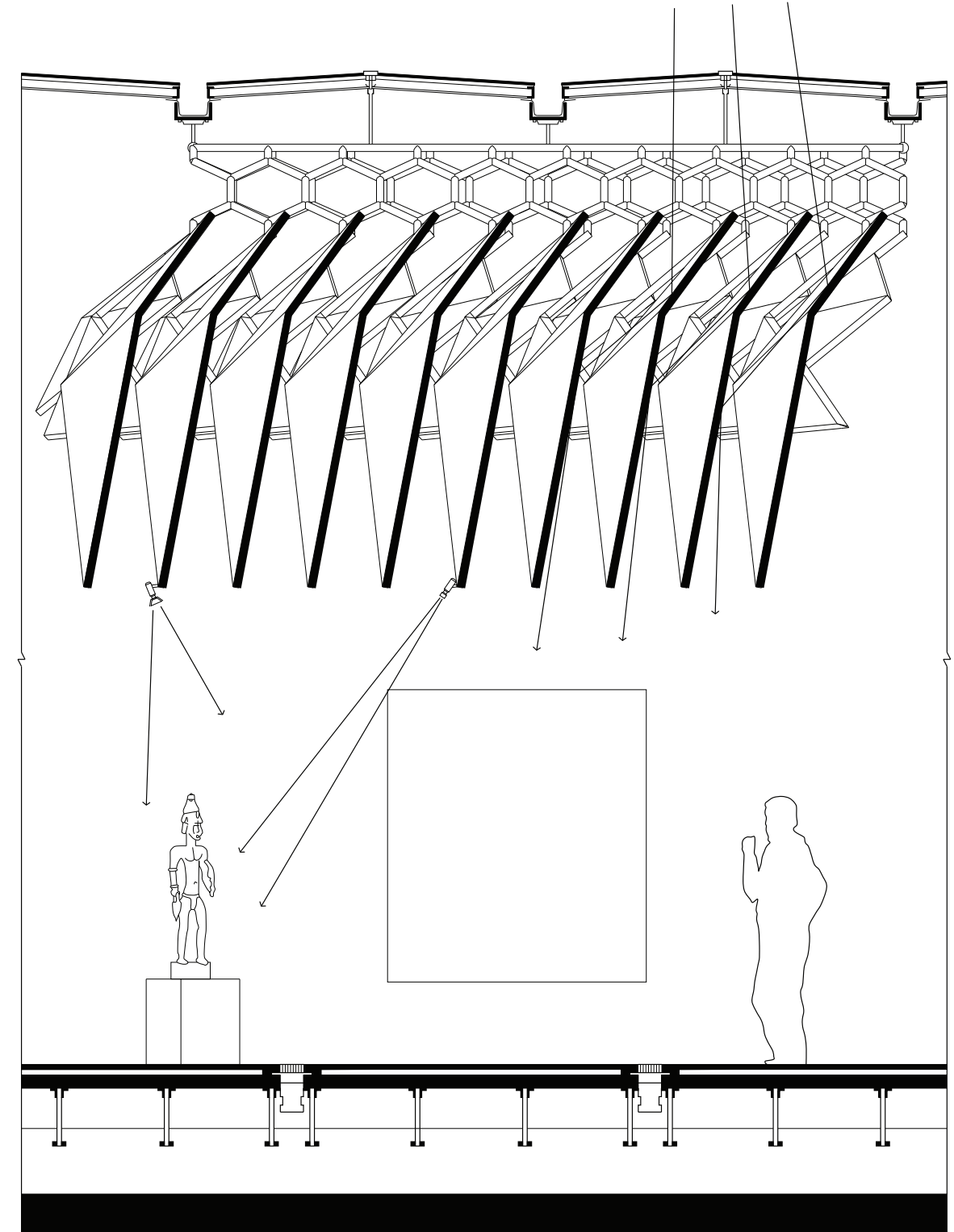


100-2000 Lux: 70% Hours Annually

Existing Roof System



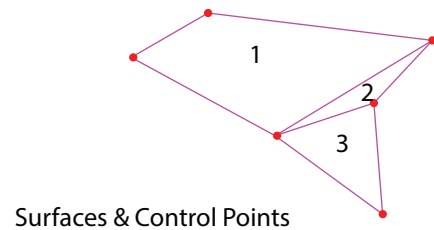
Optimized Roof System



+1400 Hours Between 100-2000 Lux

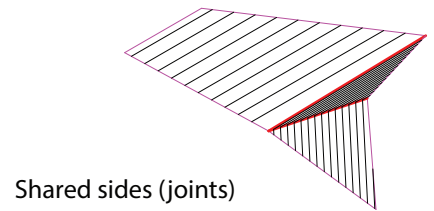
Parametric Framework

Shades are a composite of 3 surfaces each.
Each surface is made via control points.



Axon view

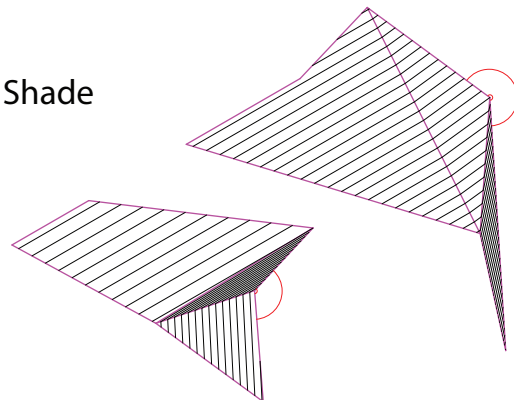
These surfaces are joined via a shared side.



Axon view

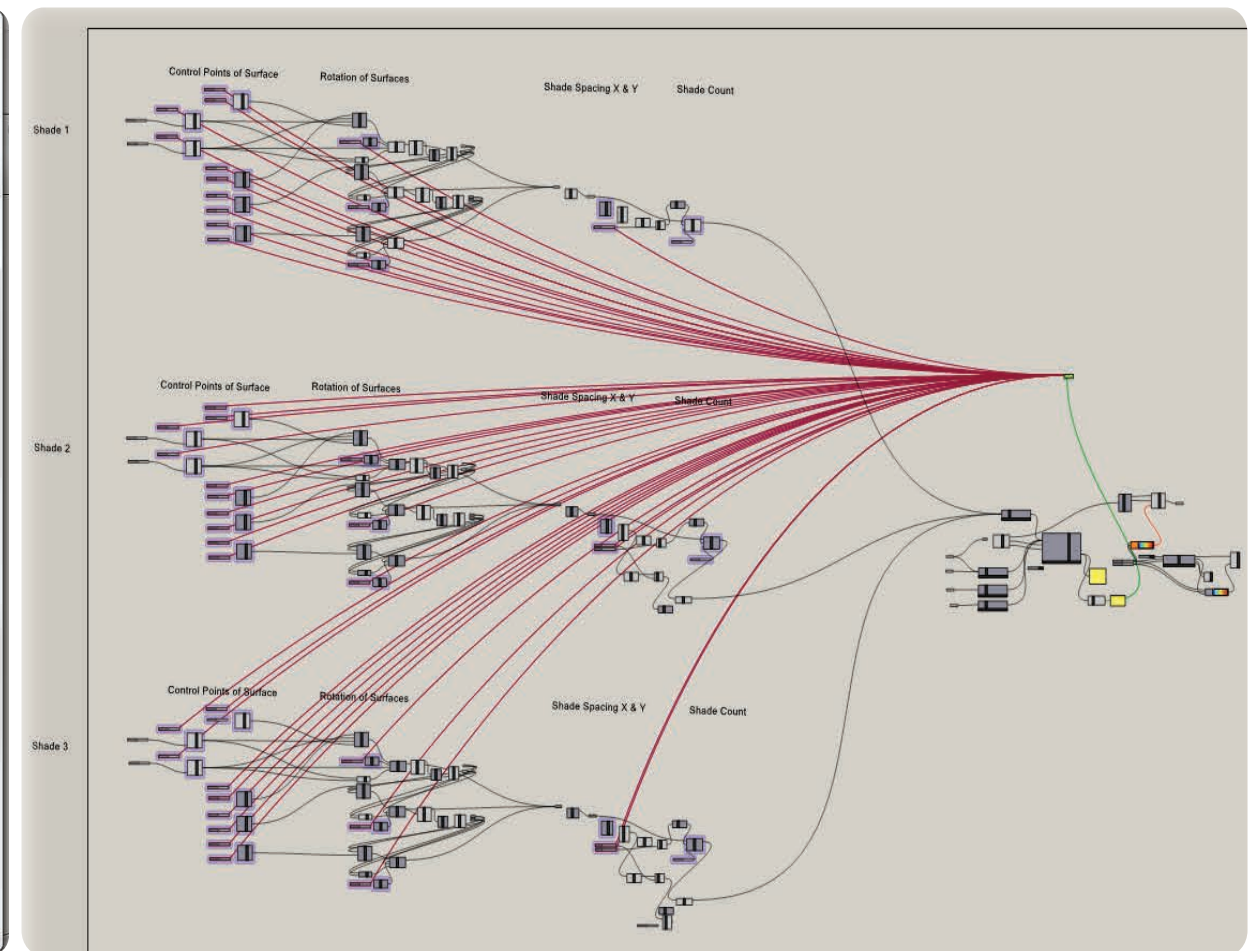
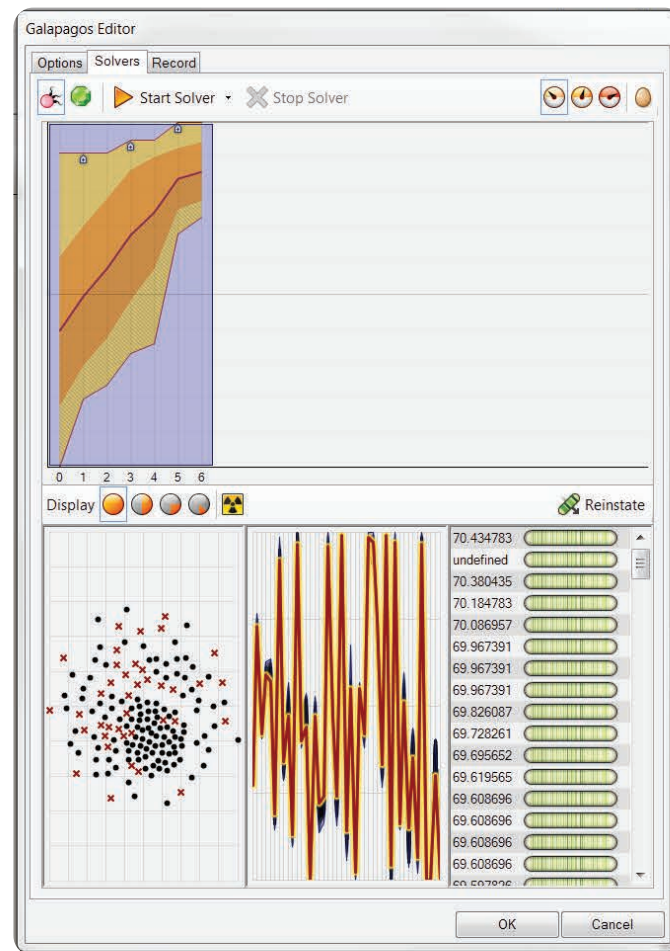
Control points are Parametric.
Each surface may be rotated along shared side, the angle of which is Parametric.

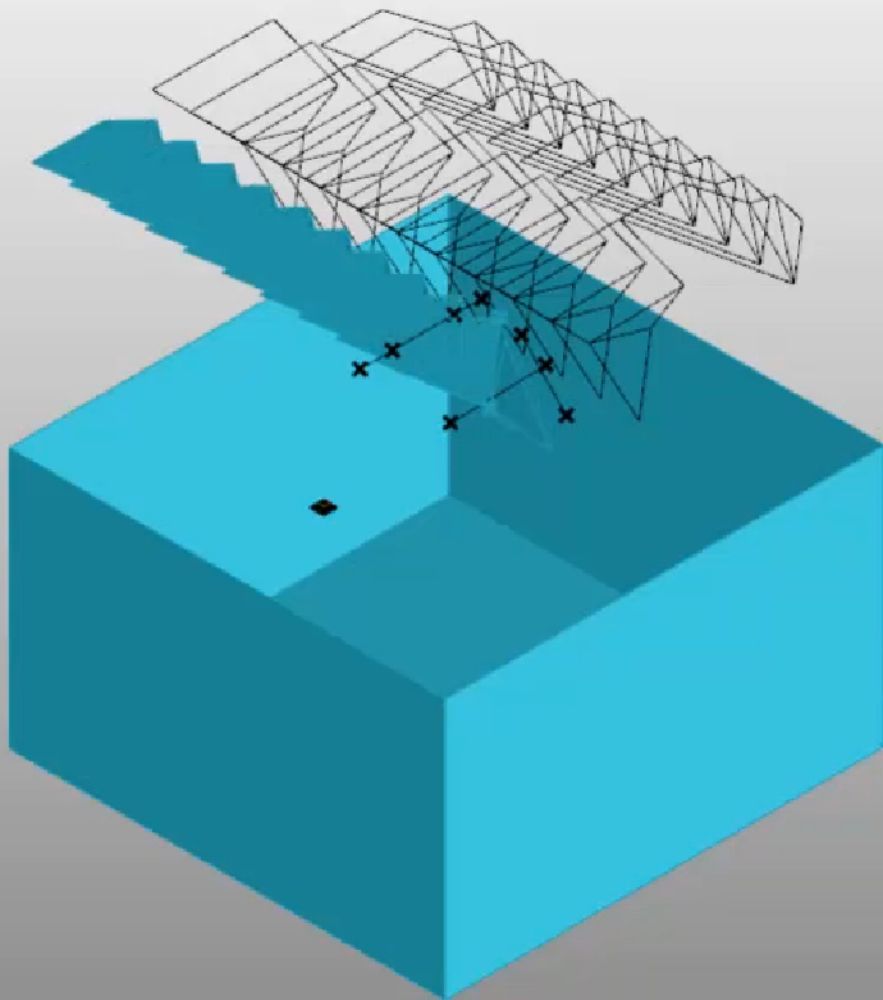
=
15 Sliders per Shade



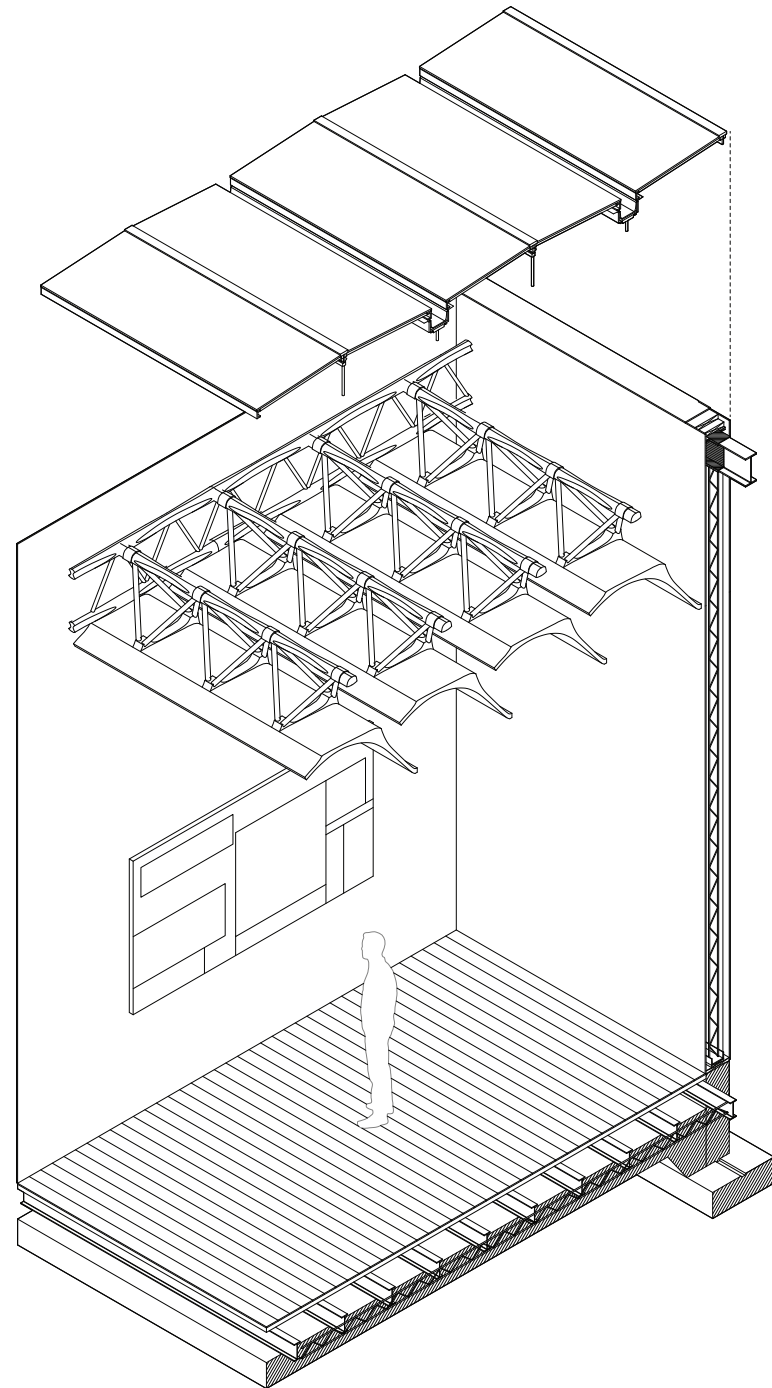
Axon view

The Evolutionary Solver and the Optimization Process



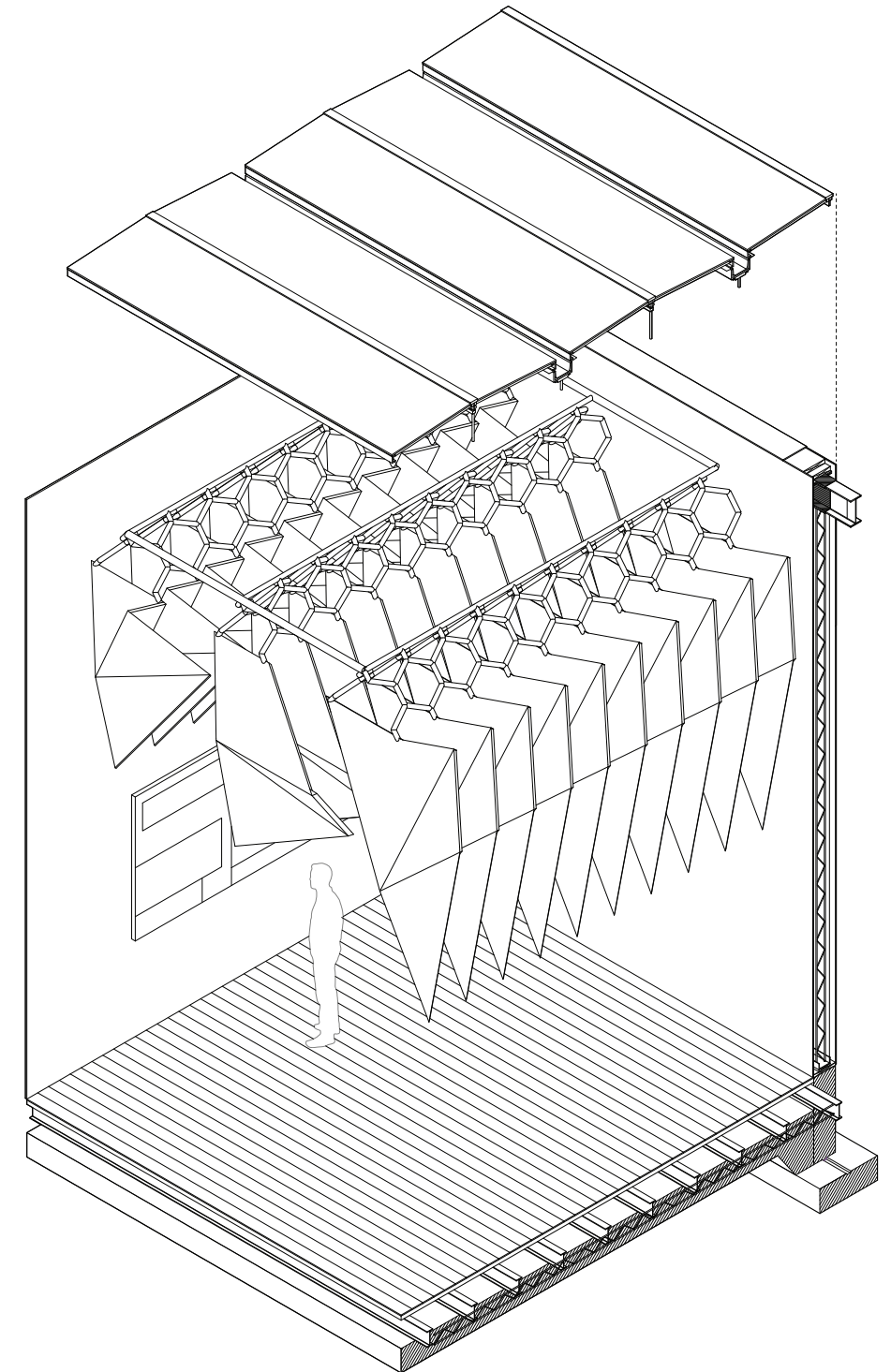


Existing Roof System



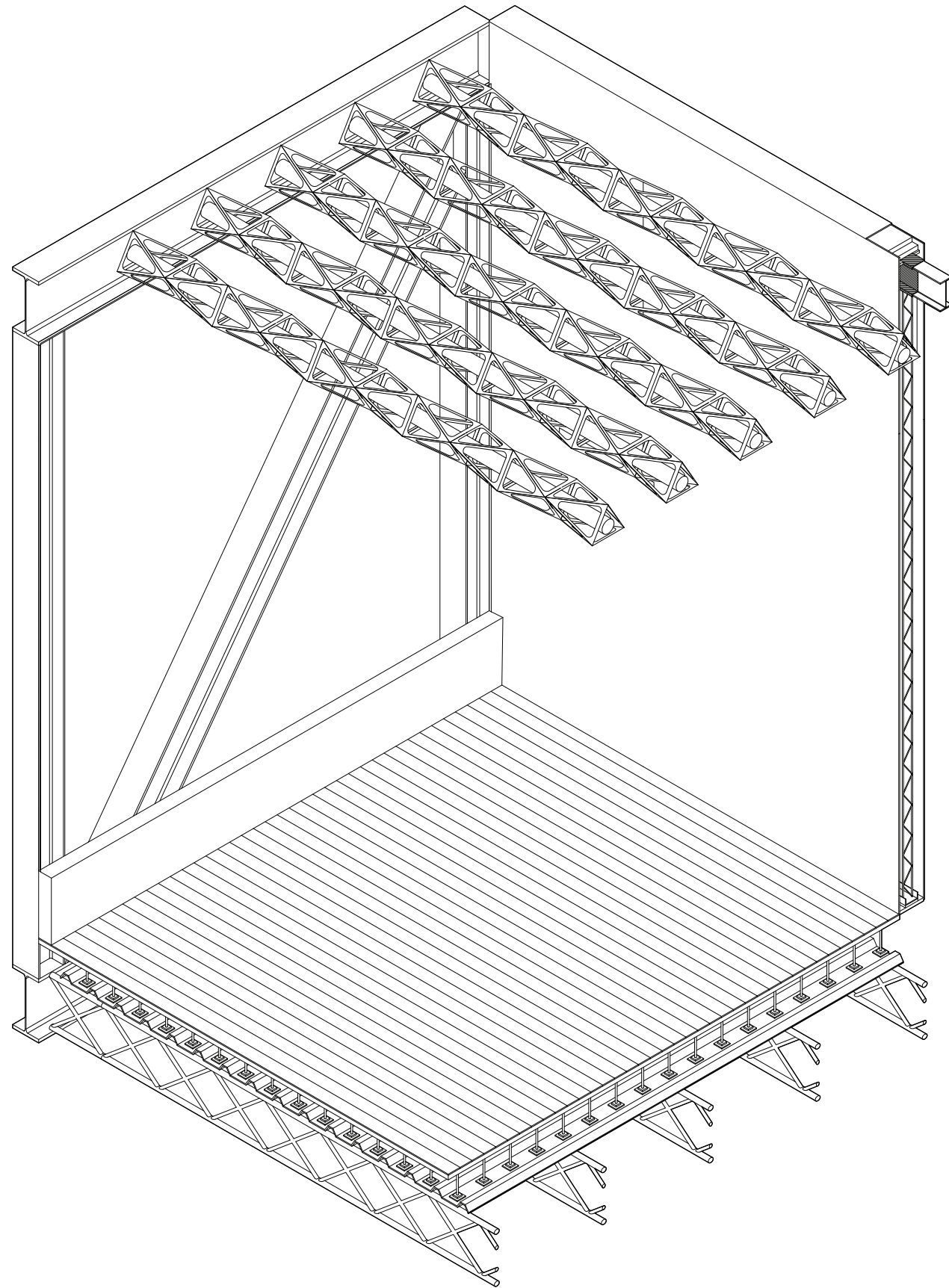
100-2000 Lux: 53% Hours Annually

Optimized Roof System

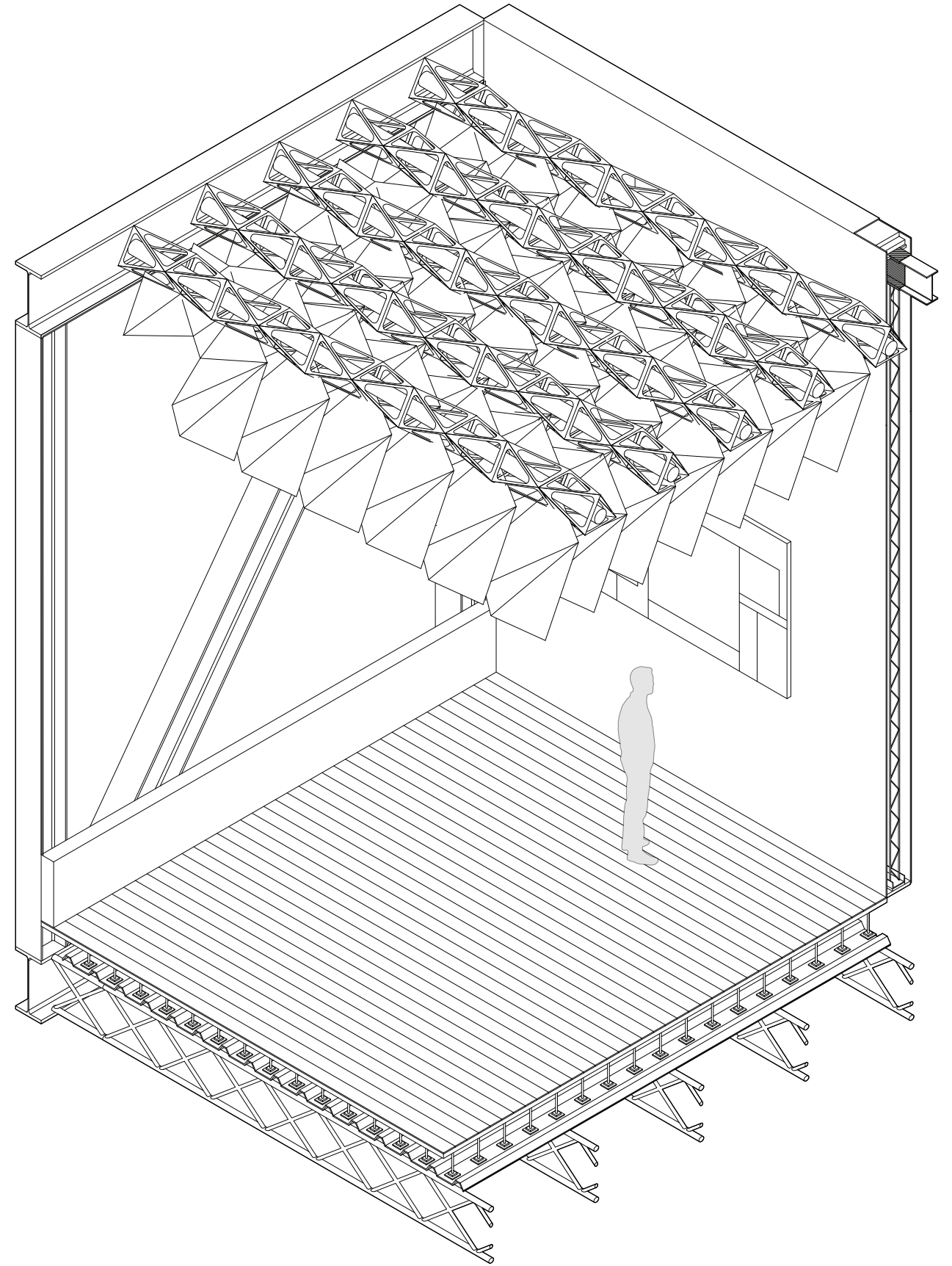


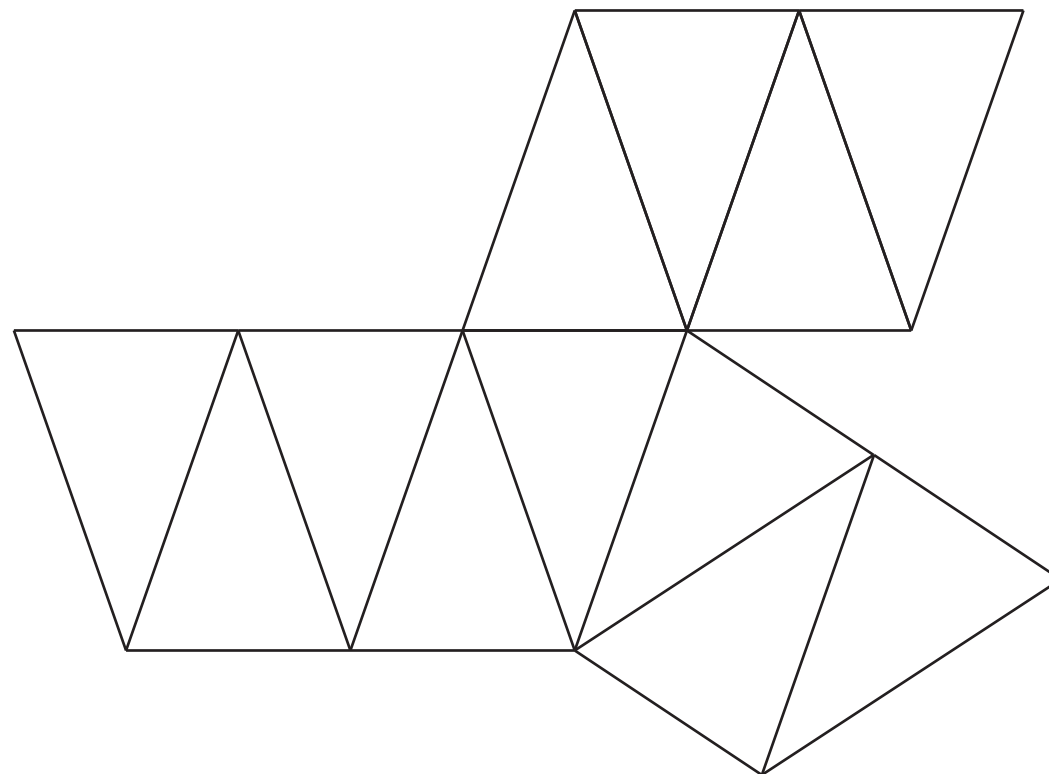
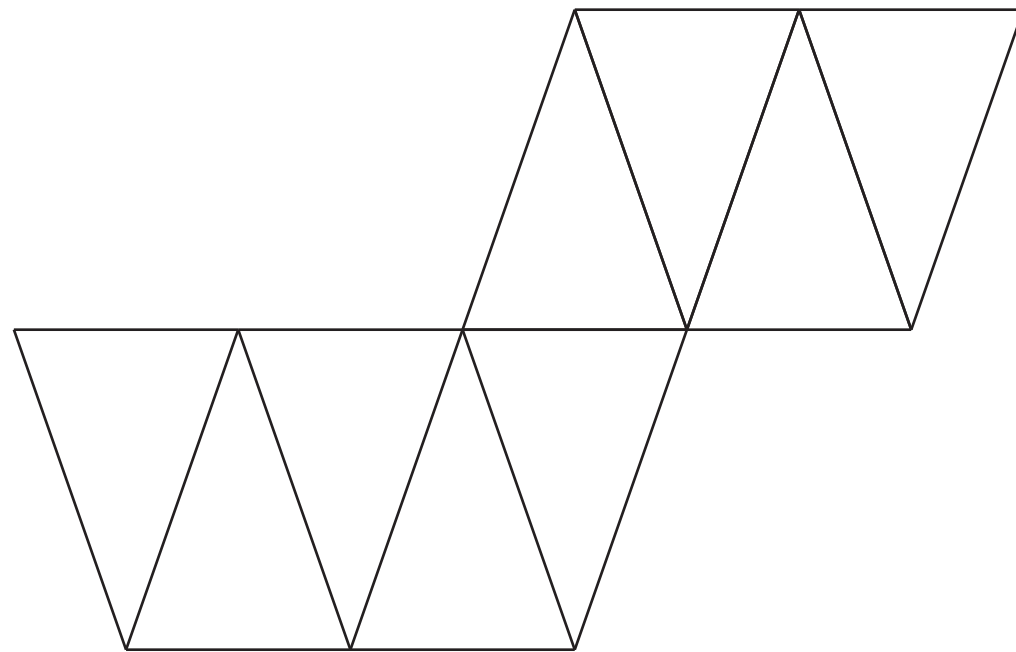
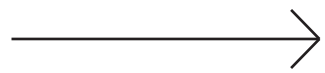
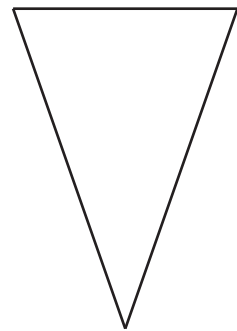
100-2000 Lux: 70% Hours Annually

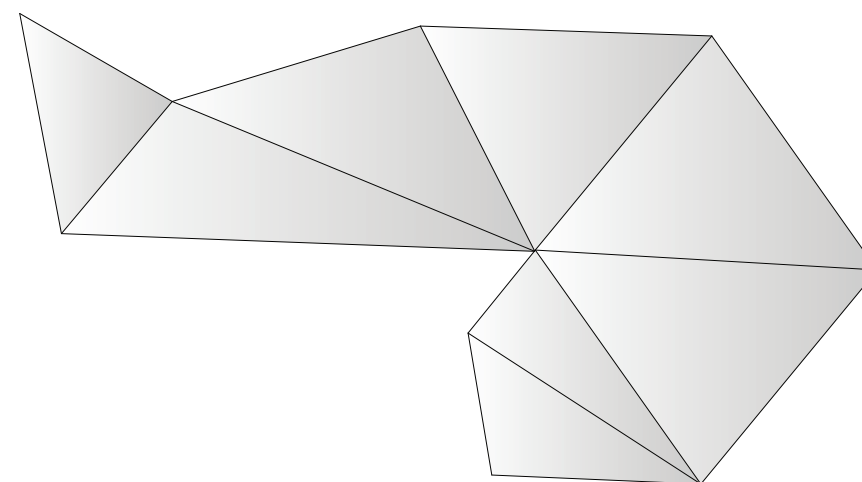
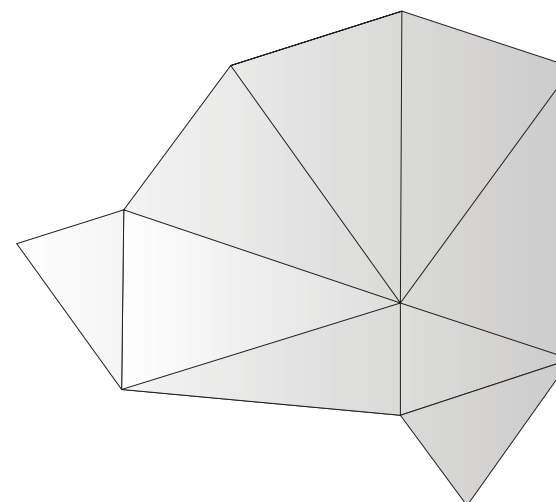
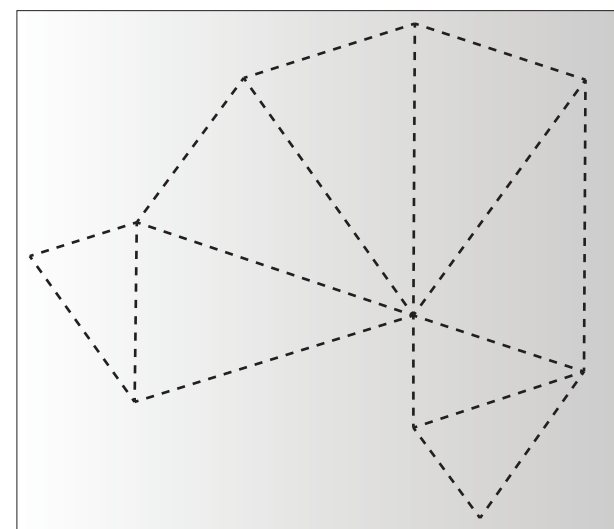
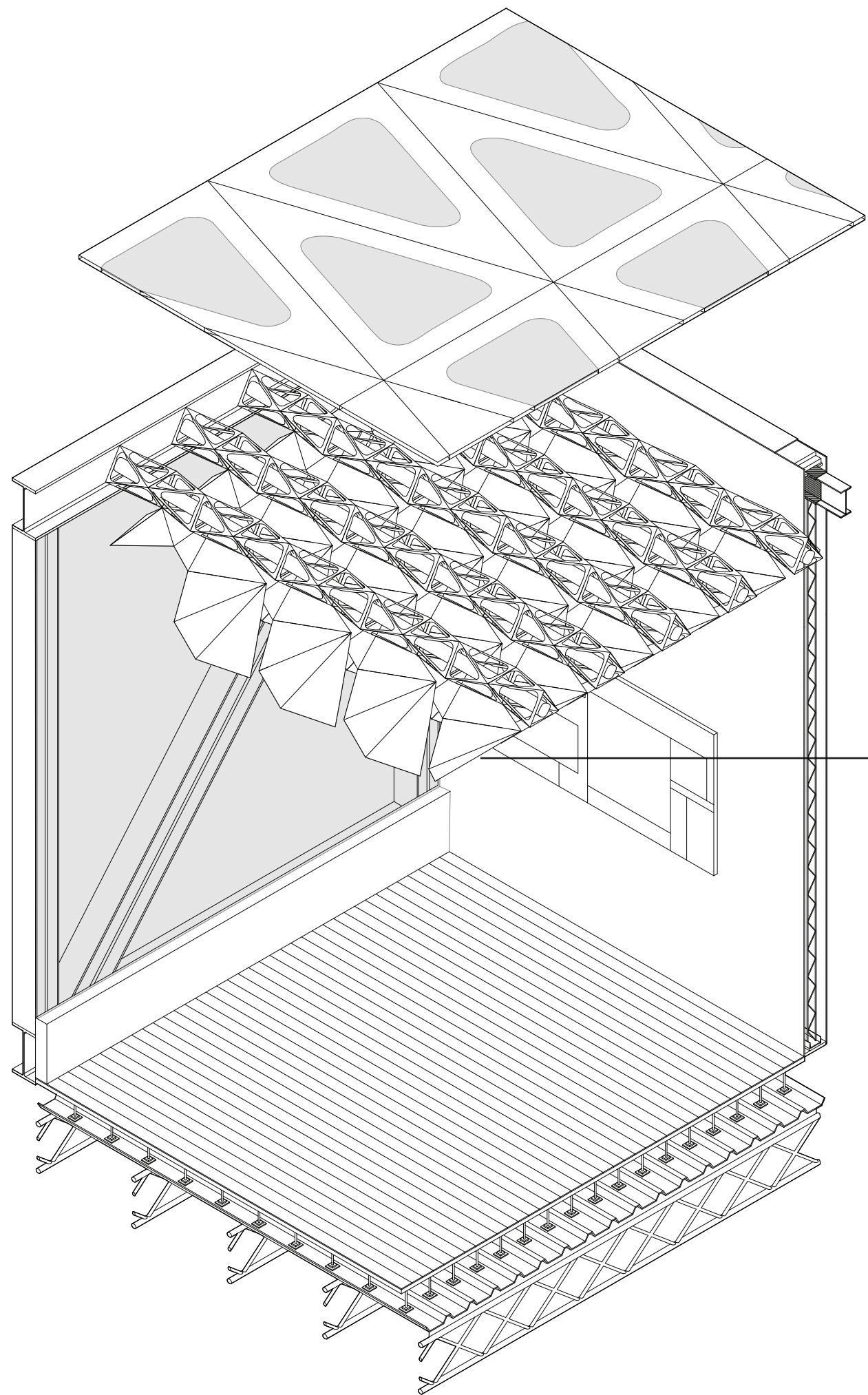
Truss Only

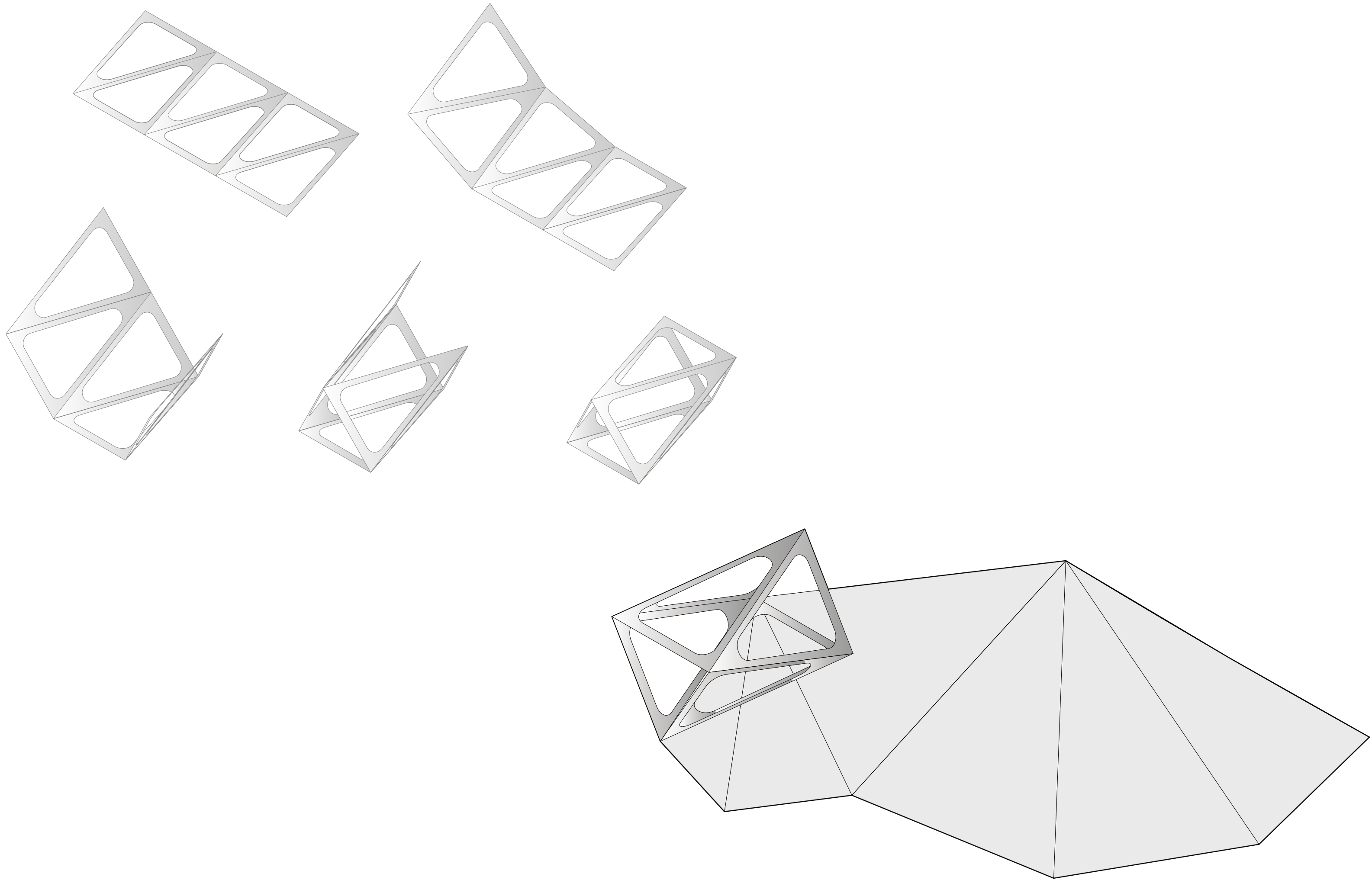


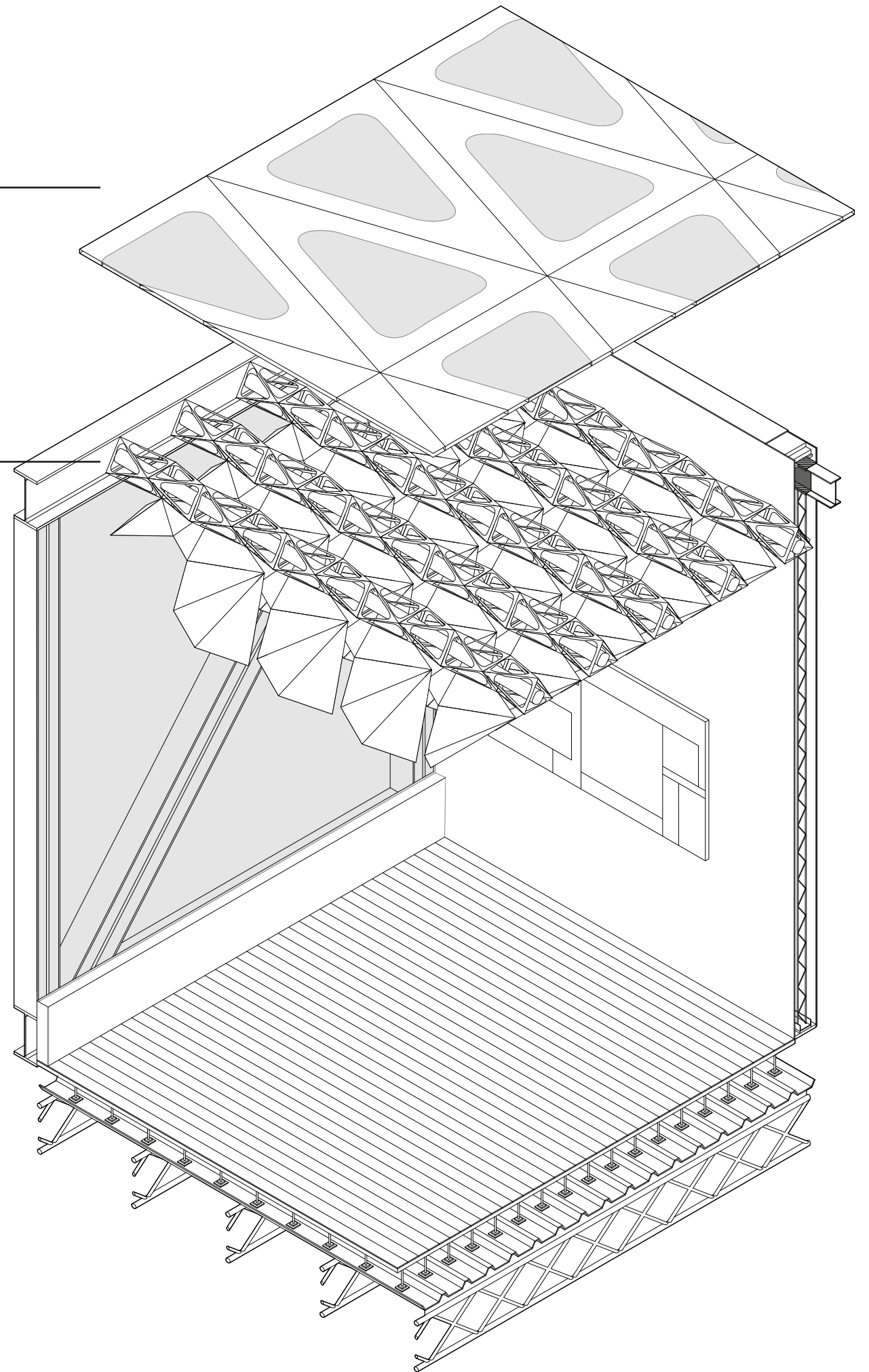
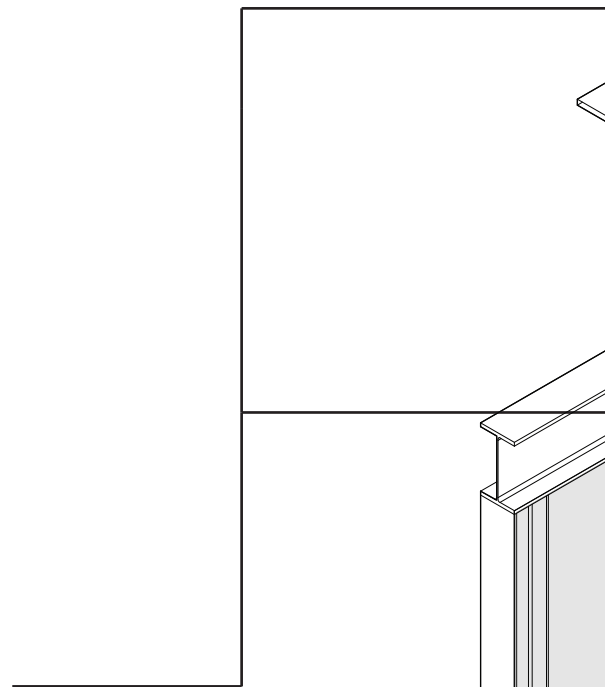
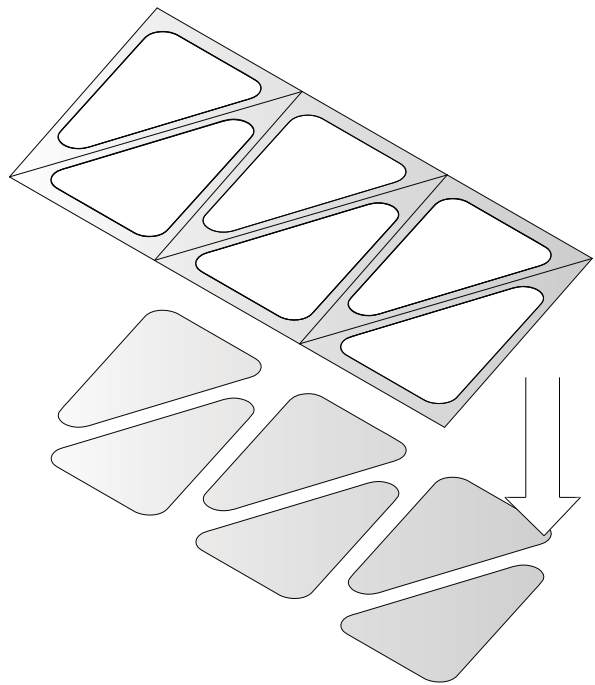
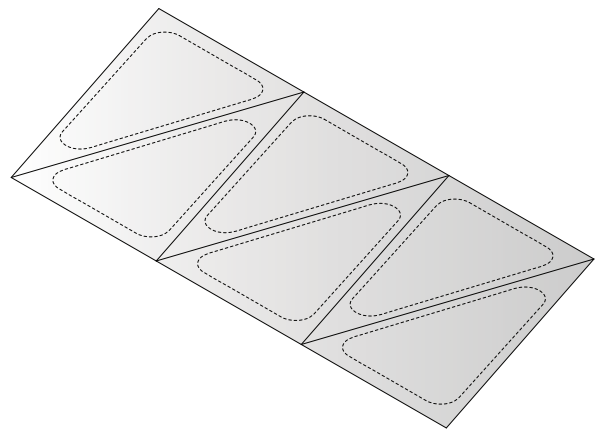
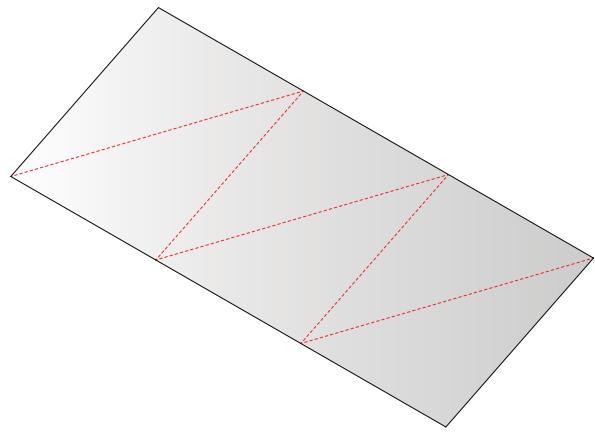
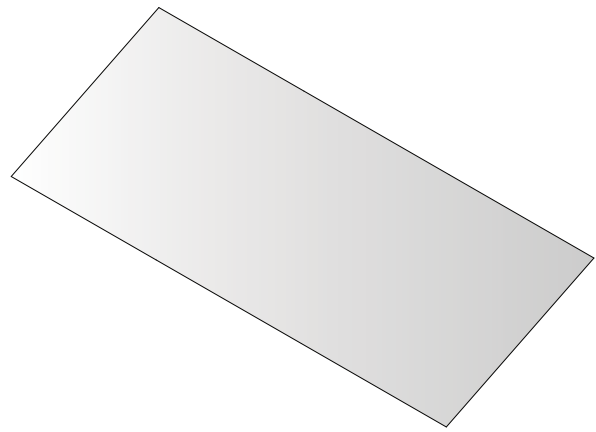
Truss with Sun Shades

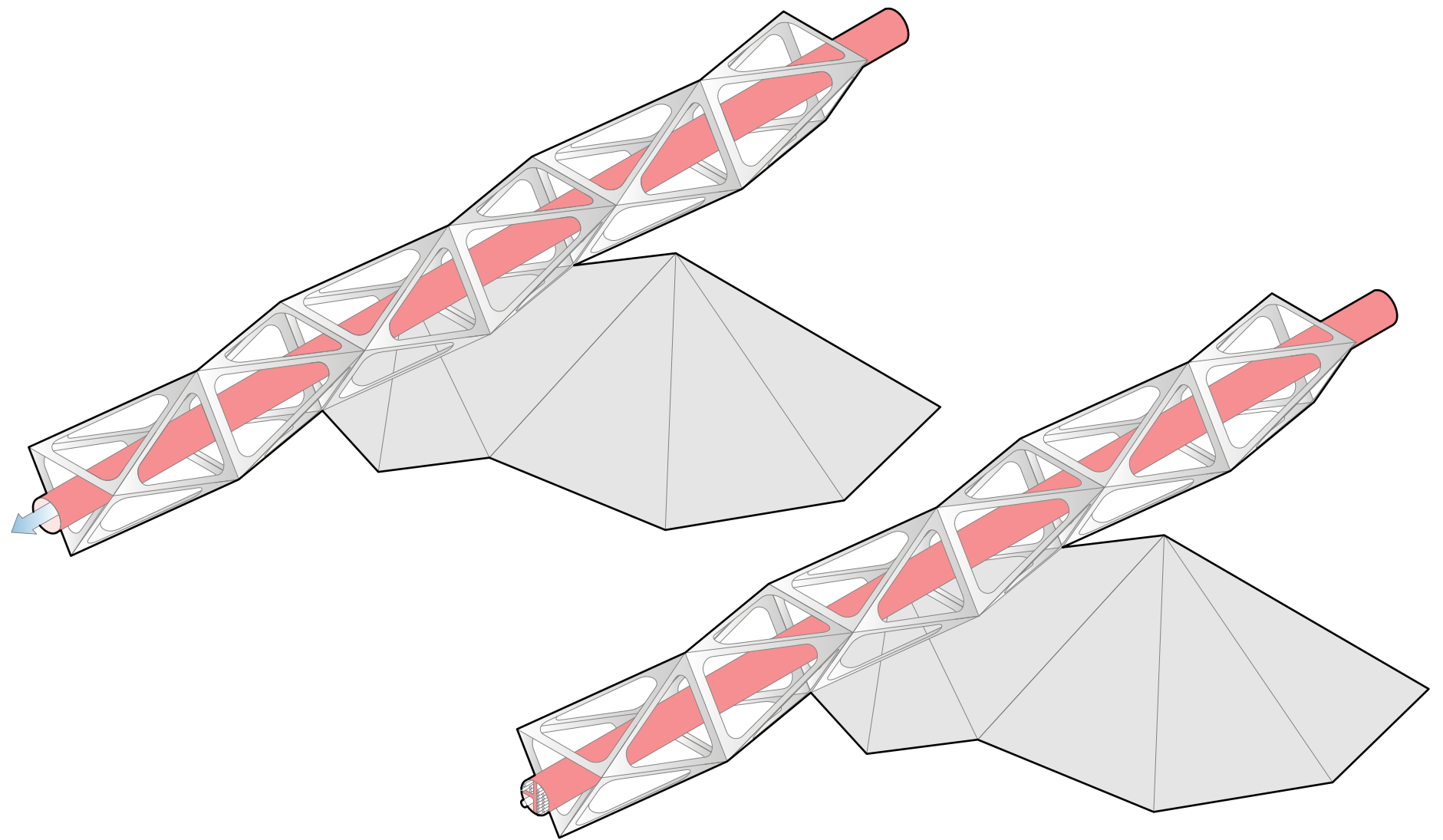
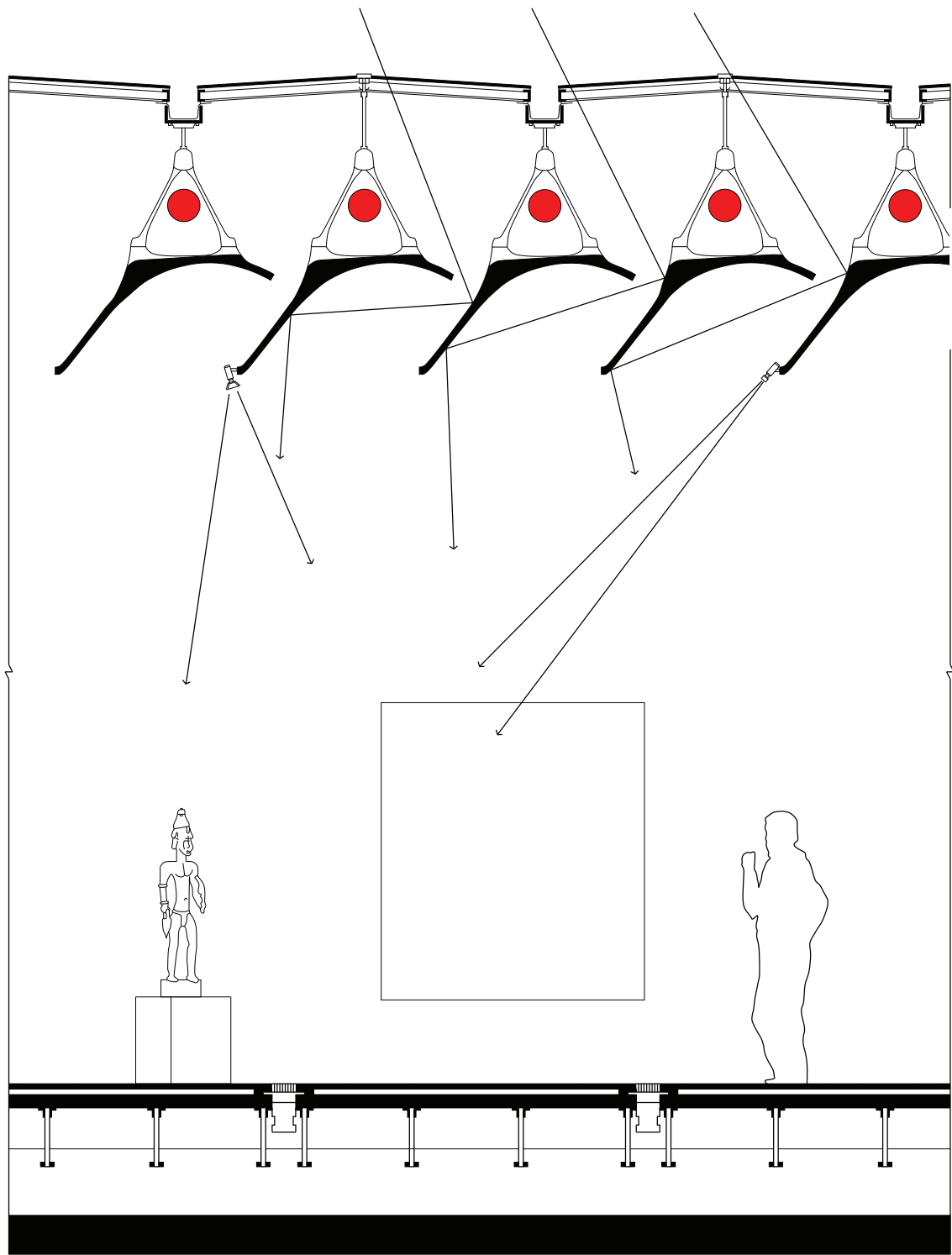




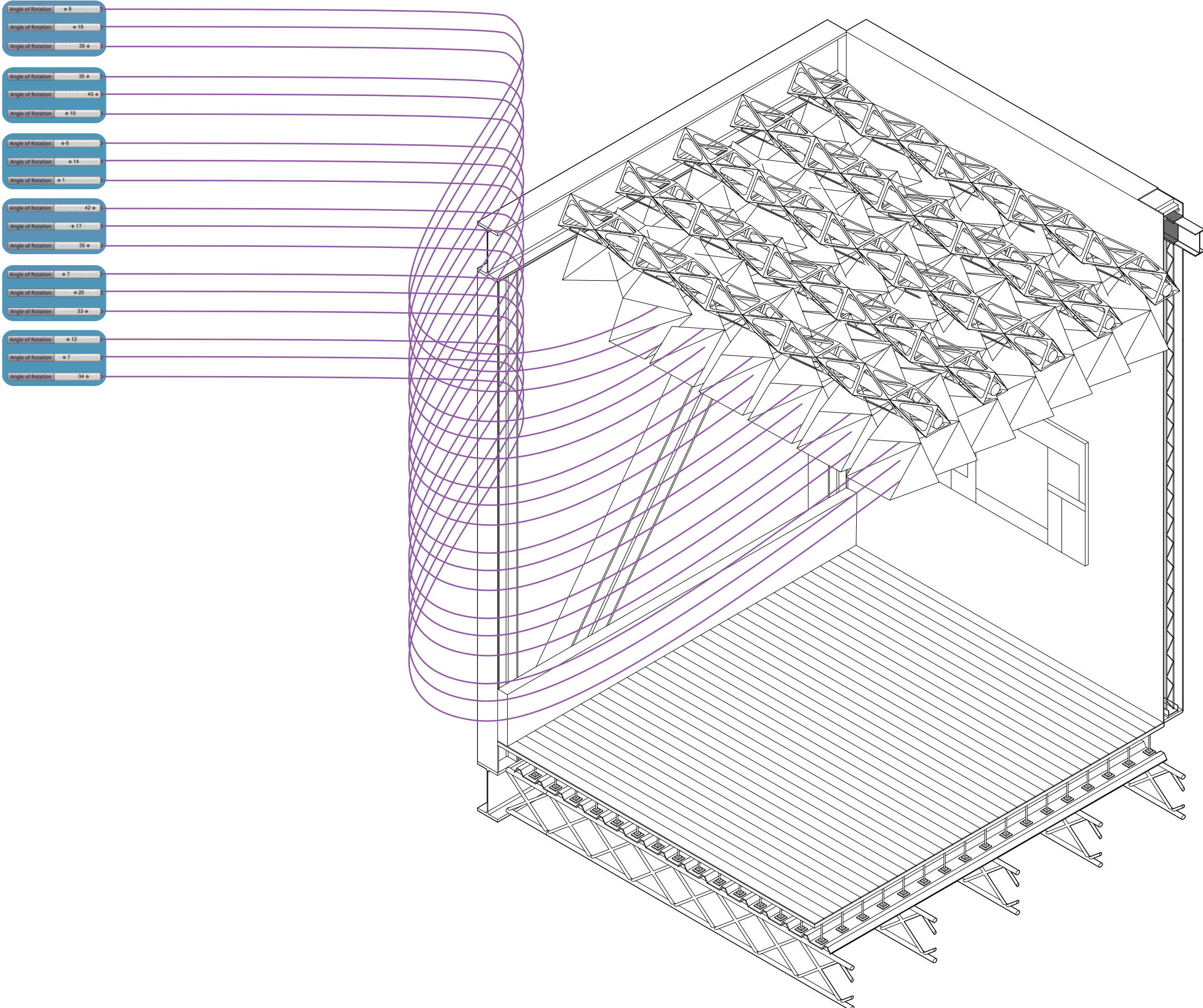




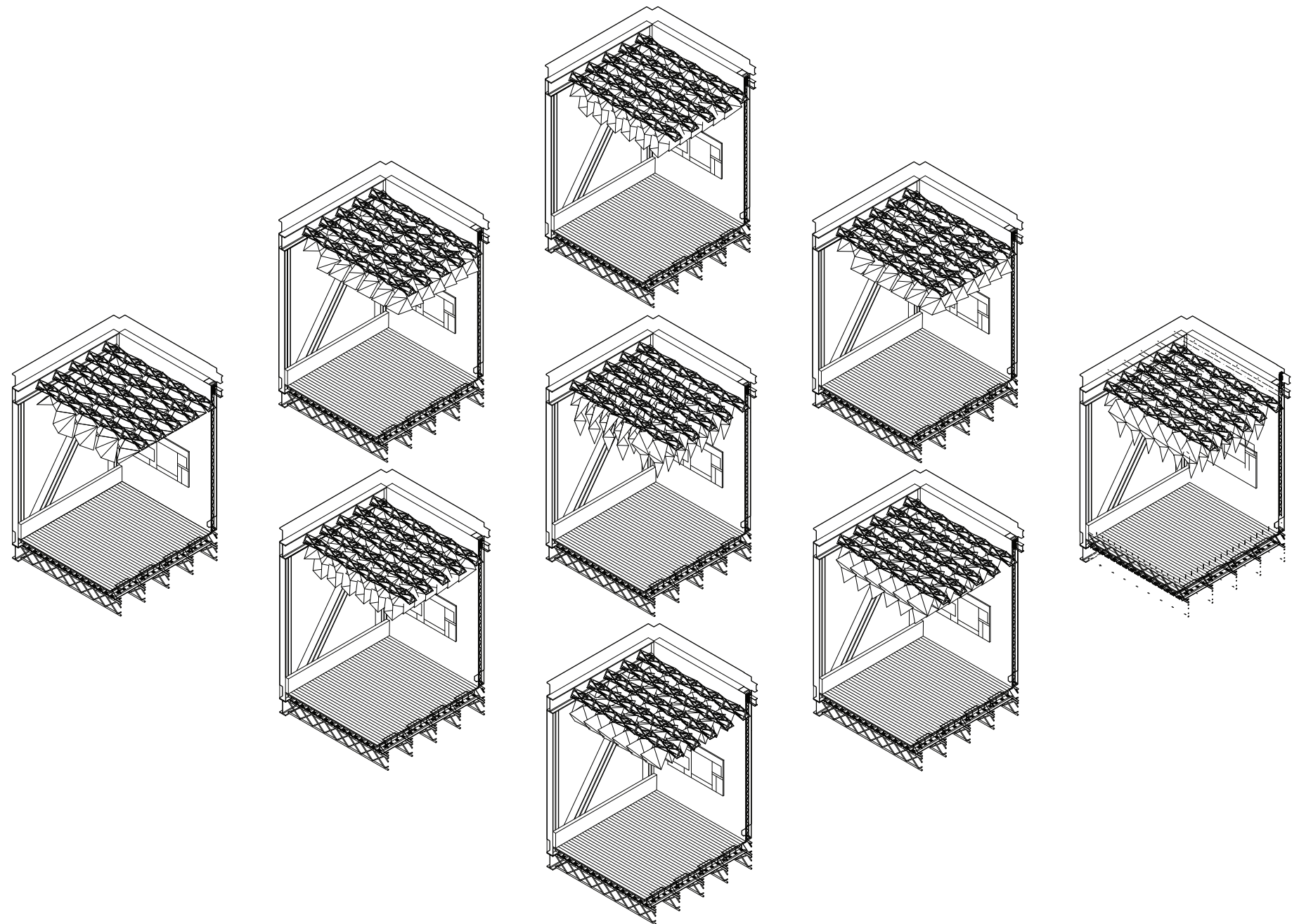
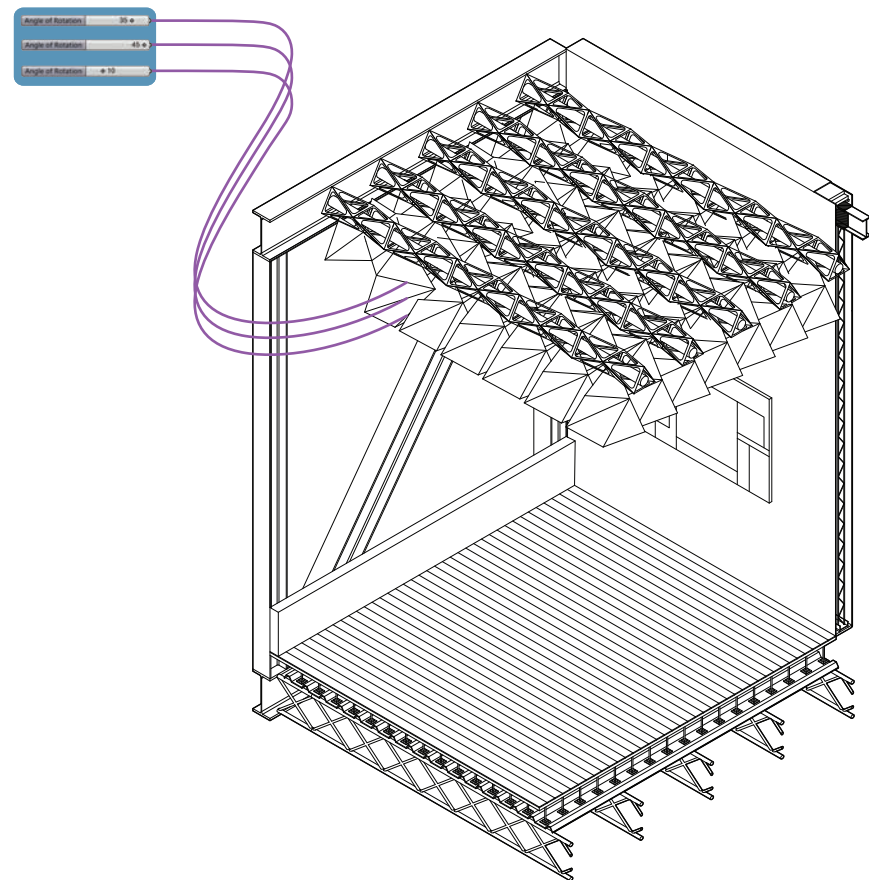
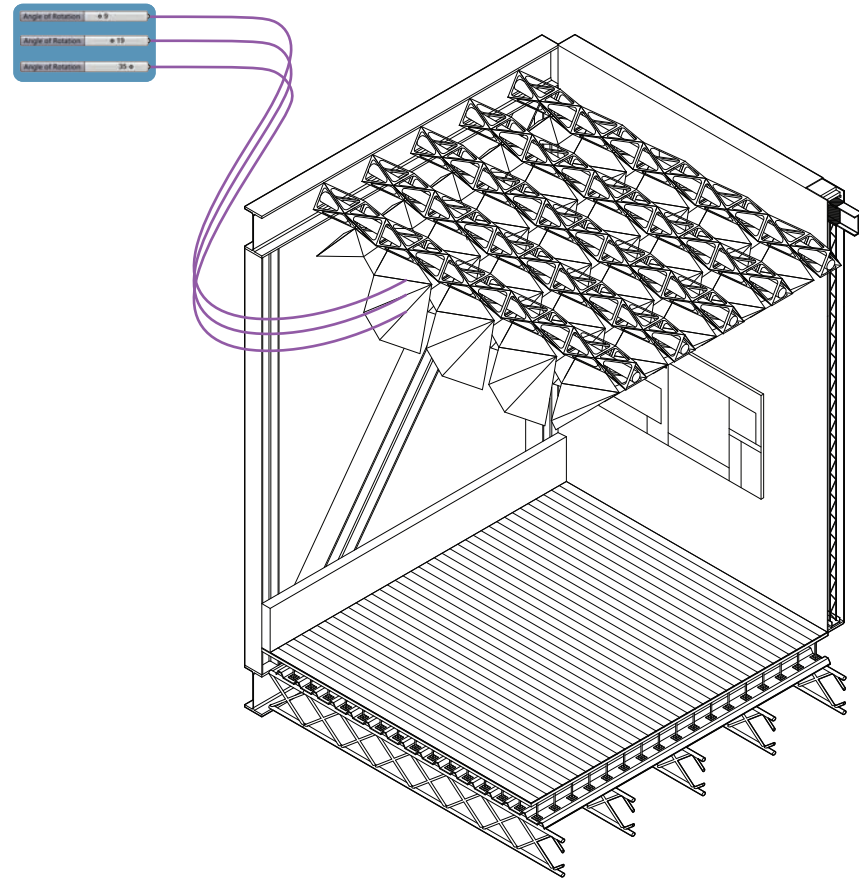


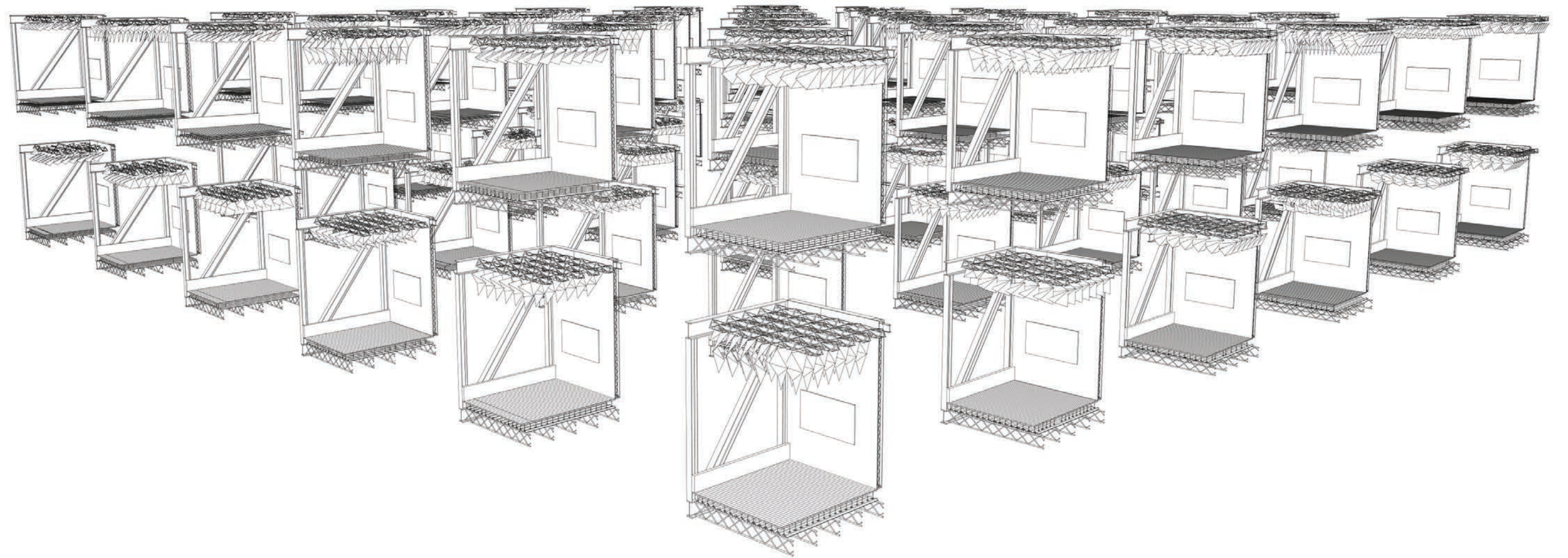
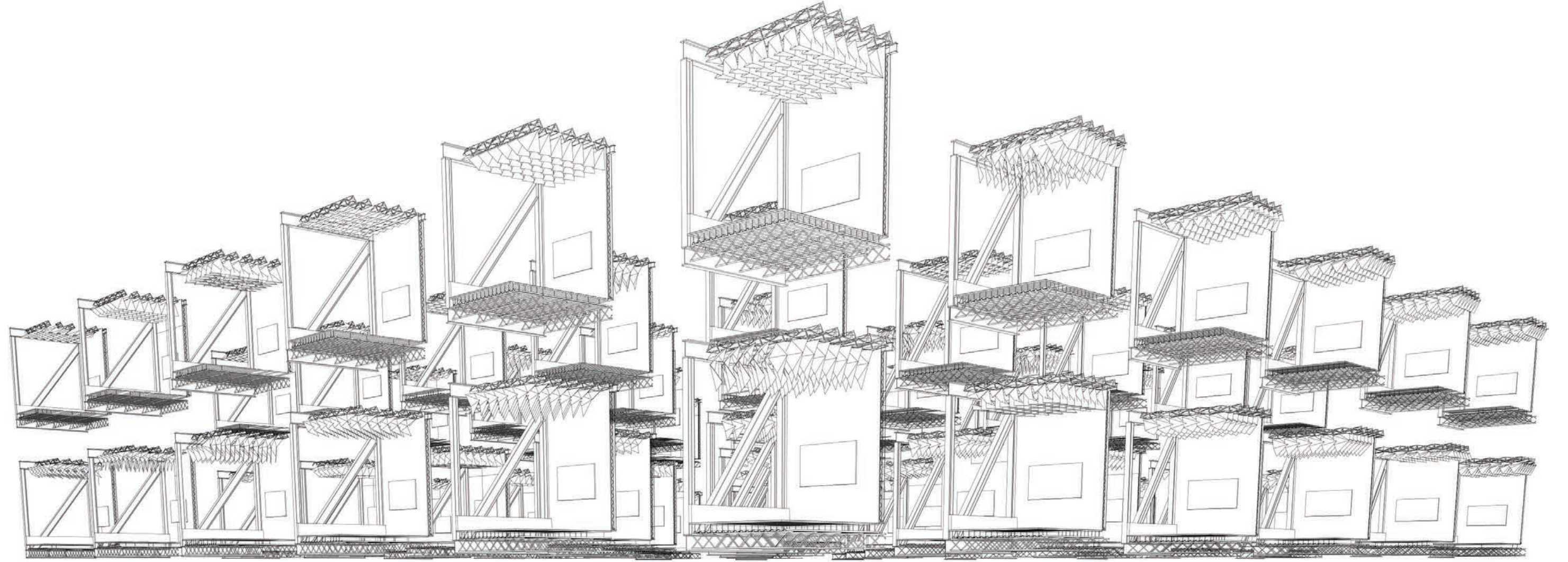


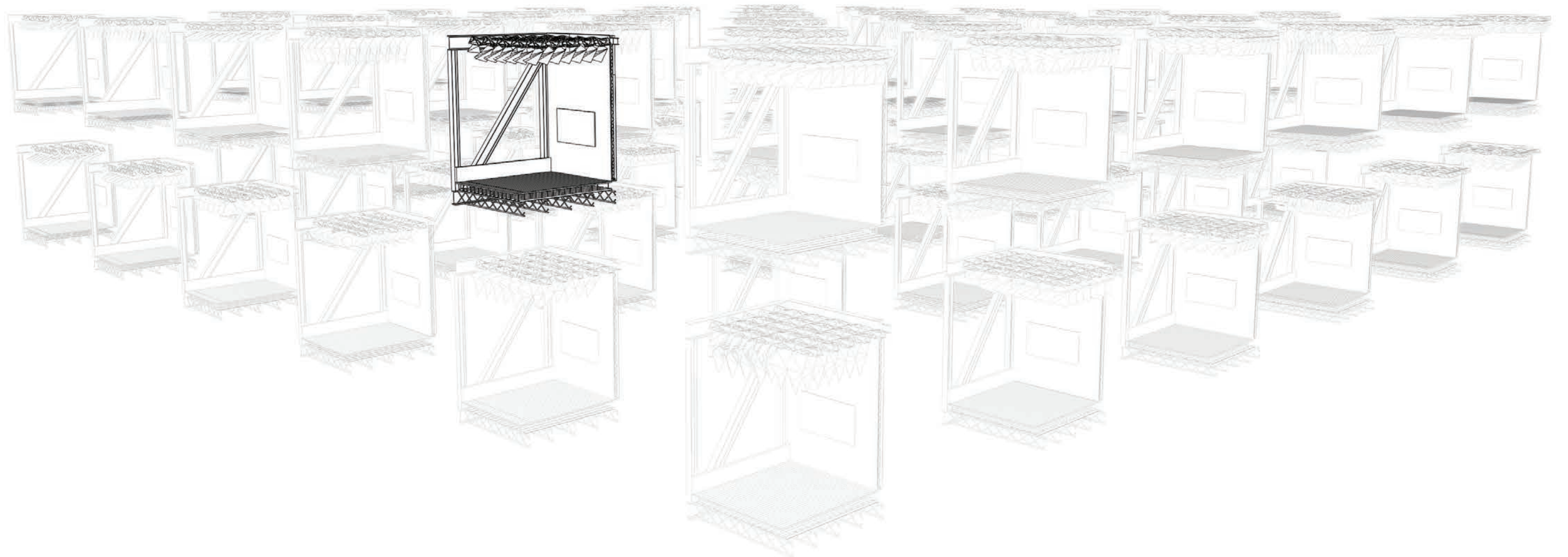
Parametric Framework

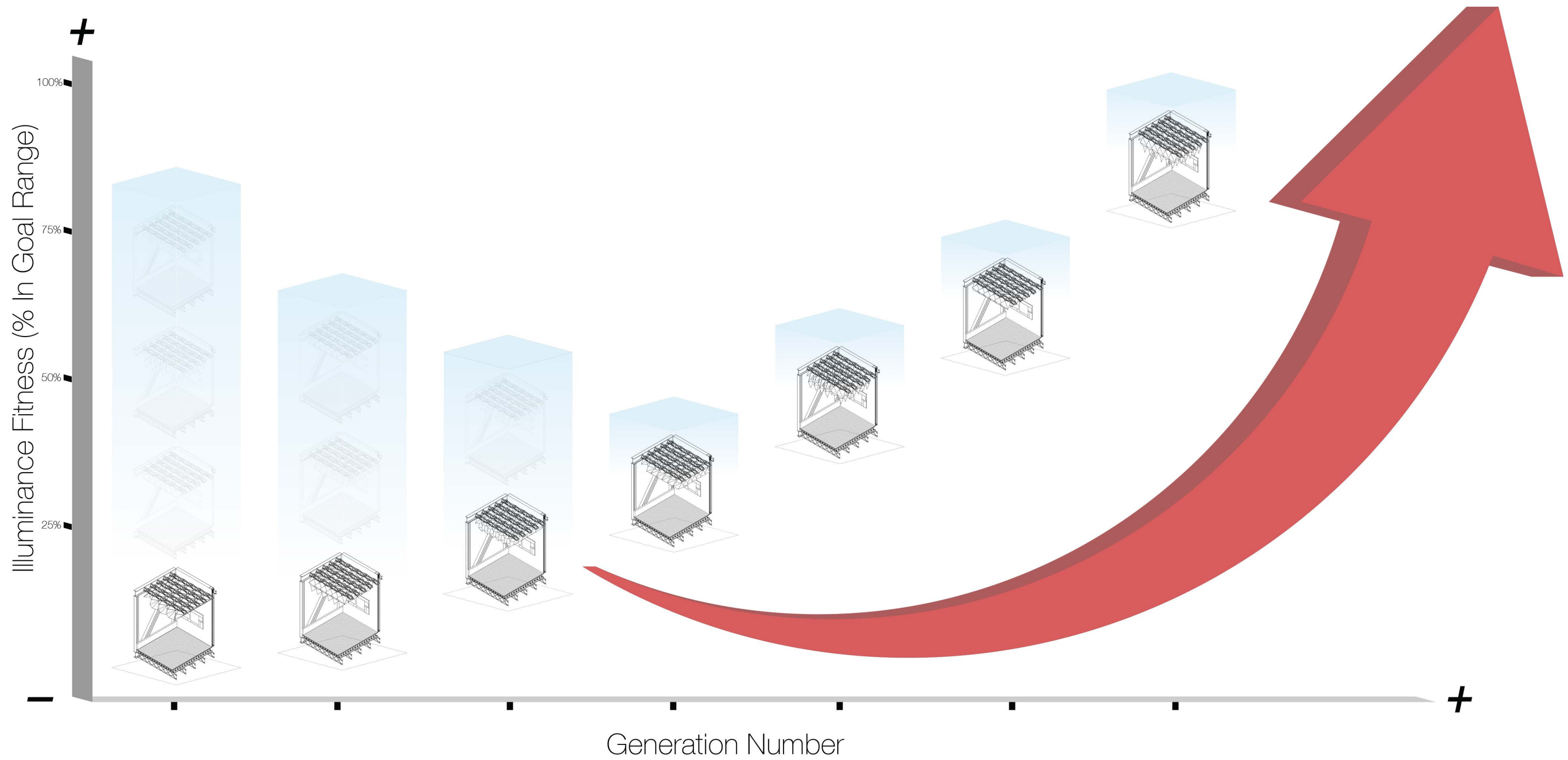


Variations within Parametric Framework

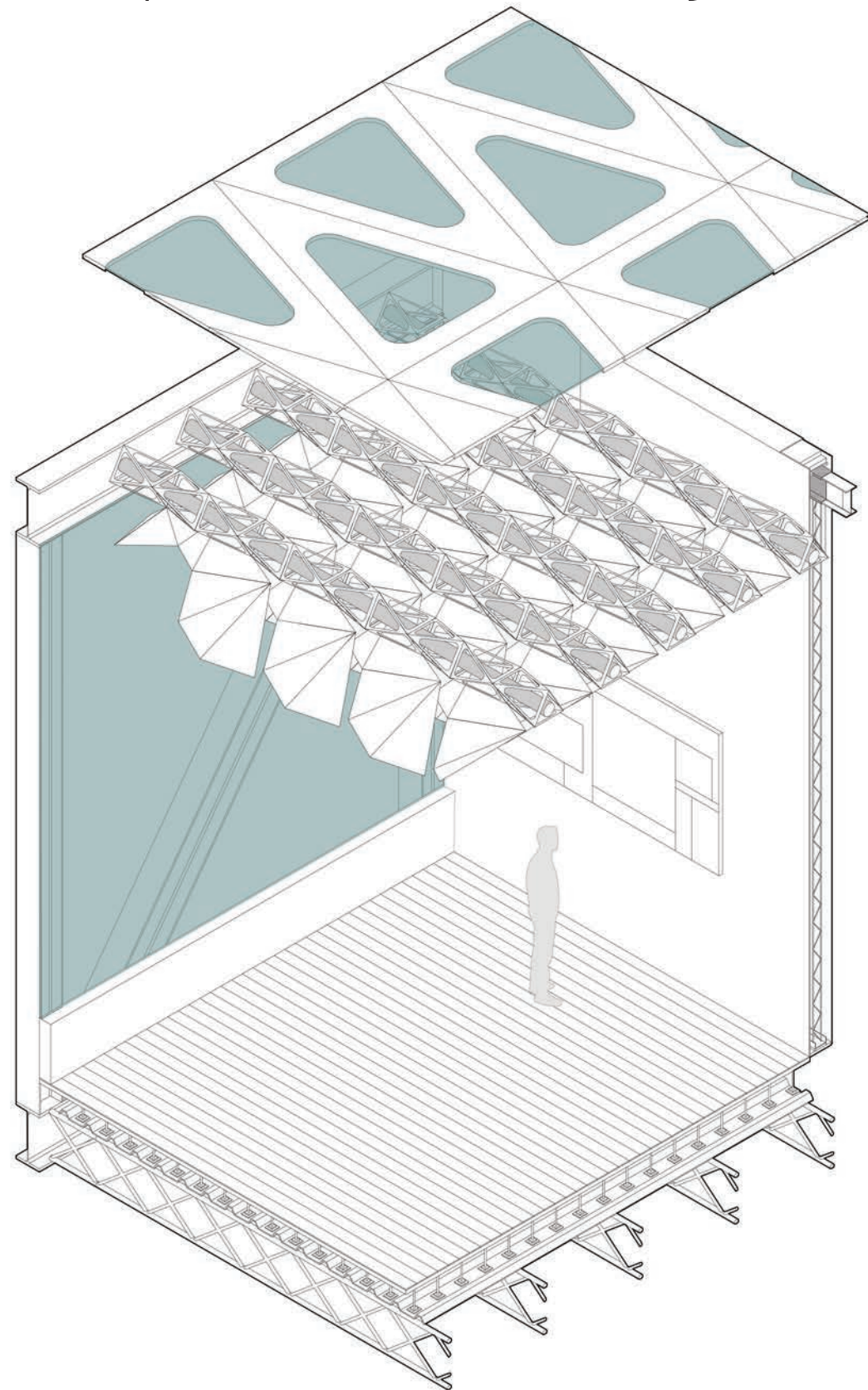






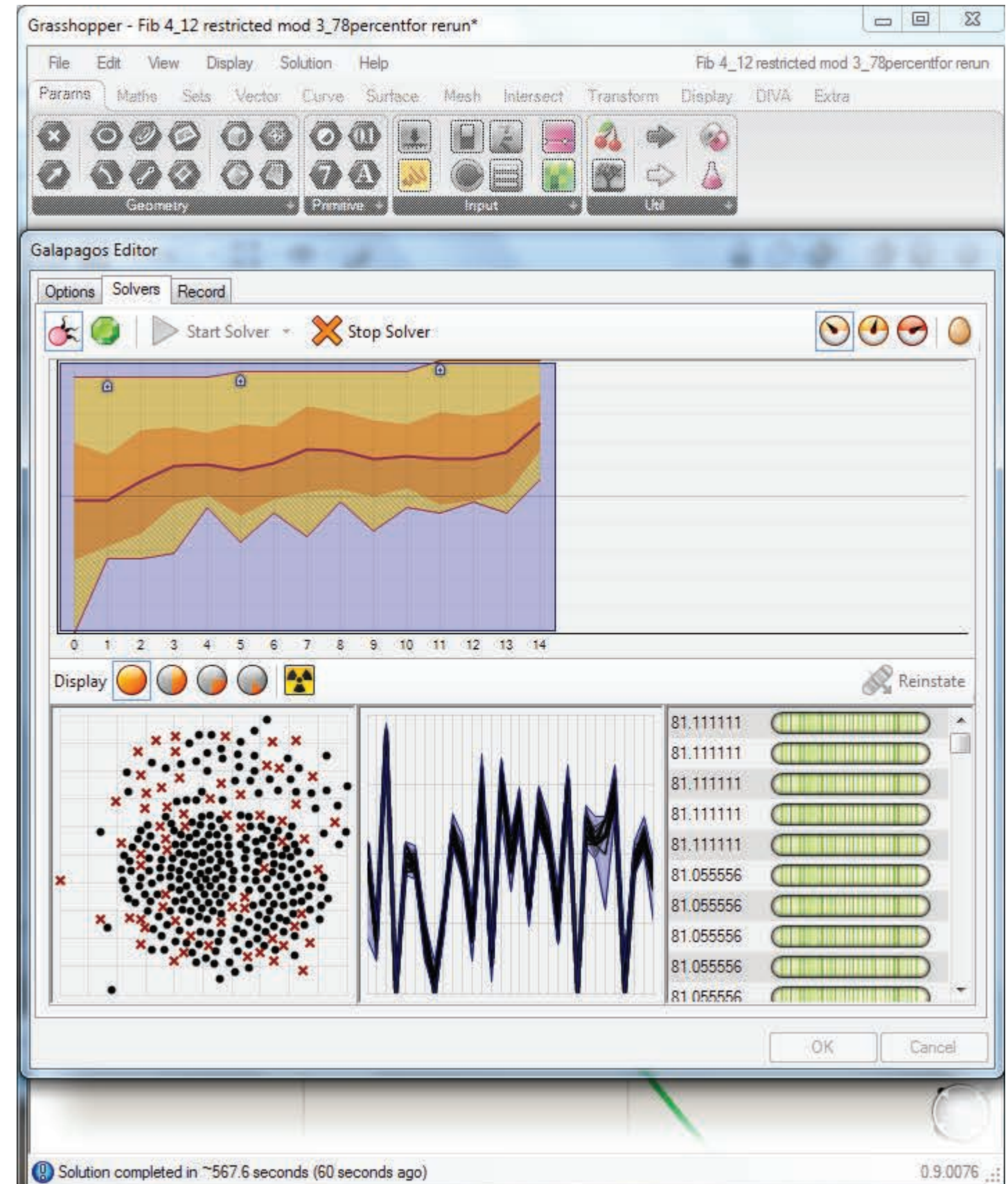


Optimized Roof System

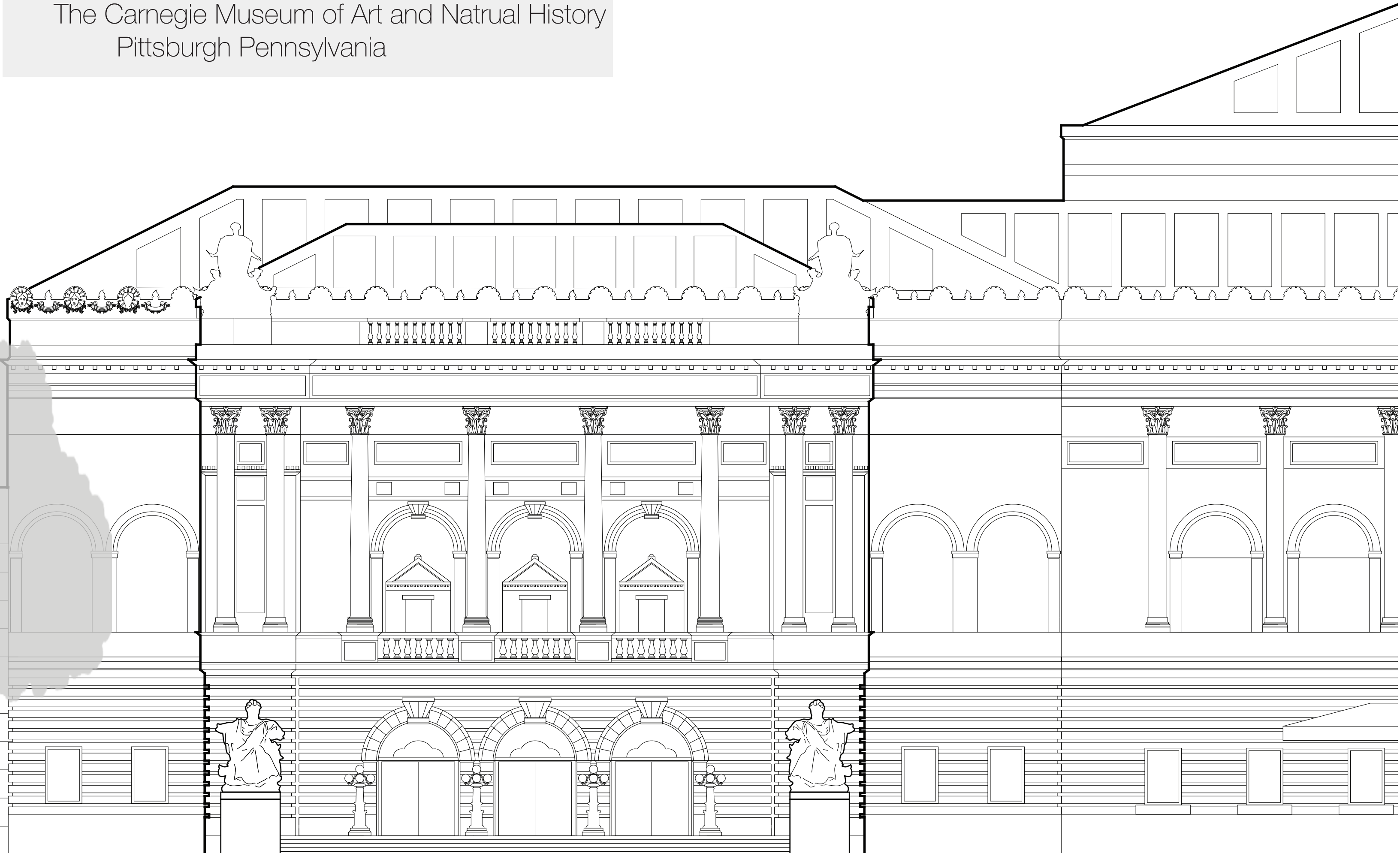


100-2000 Lux: 80% Hours Annually

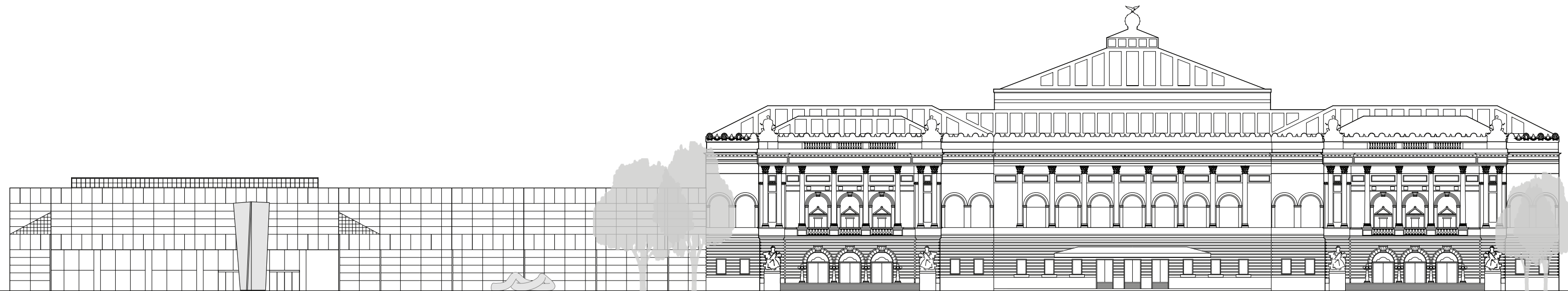
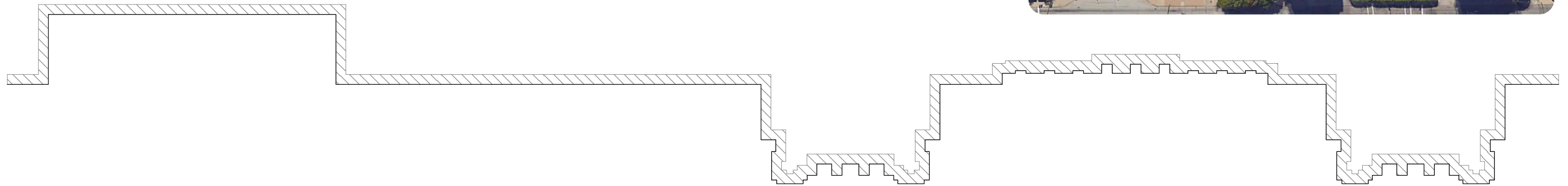
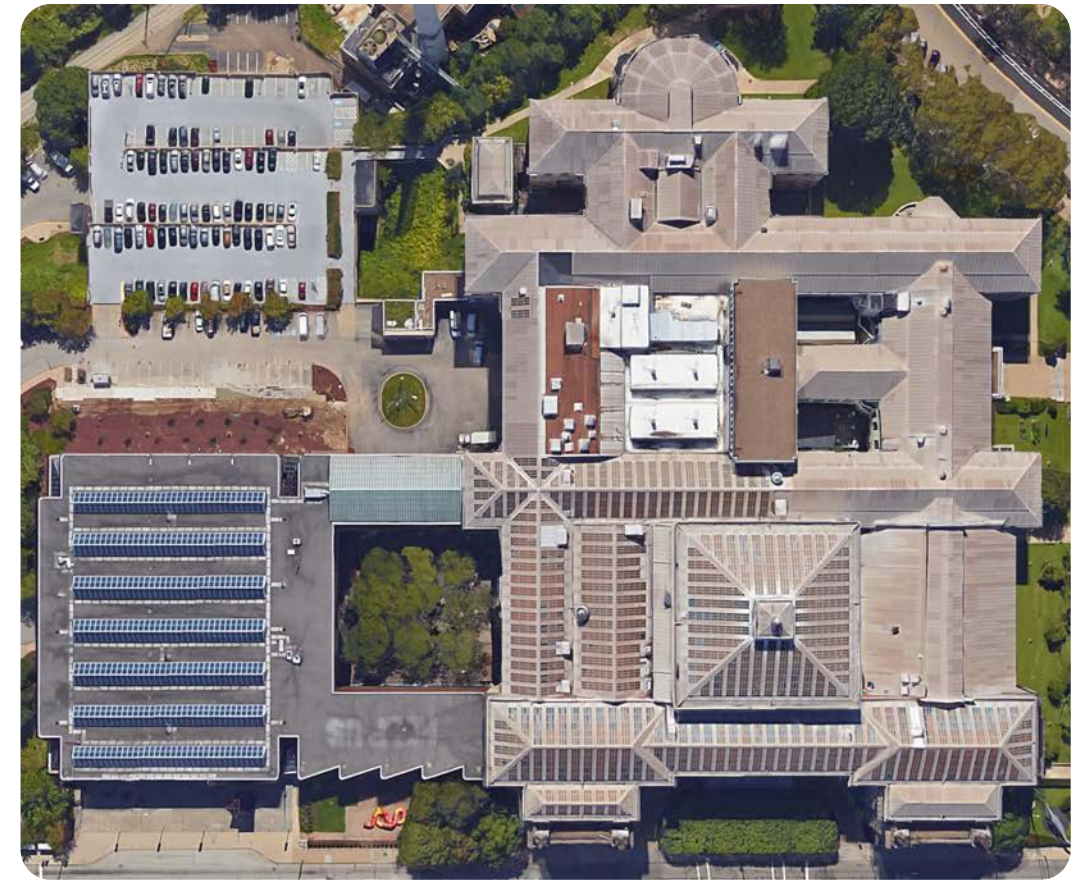
Optimization Process



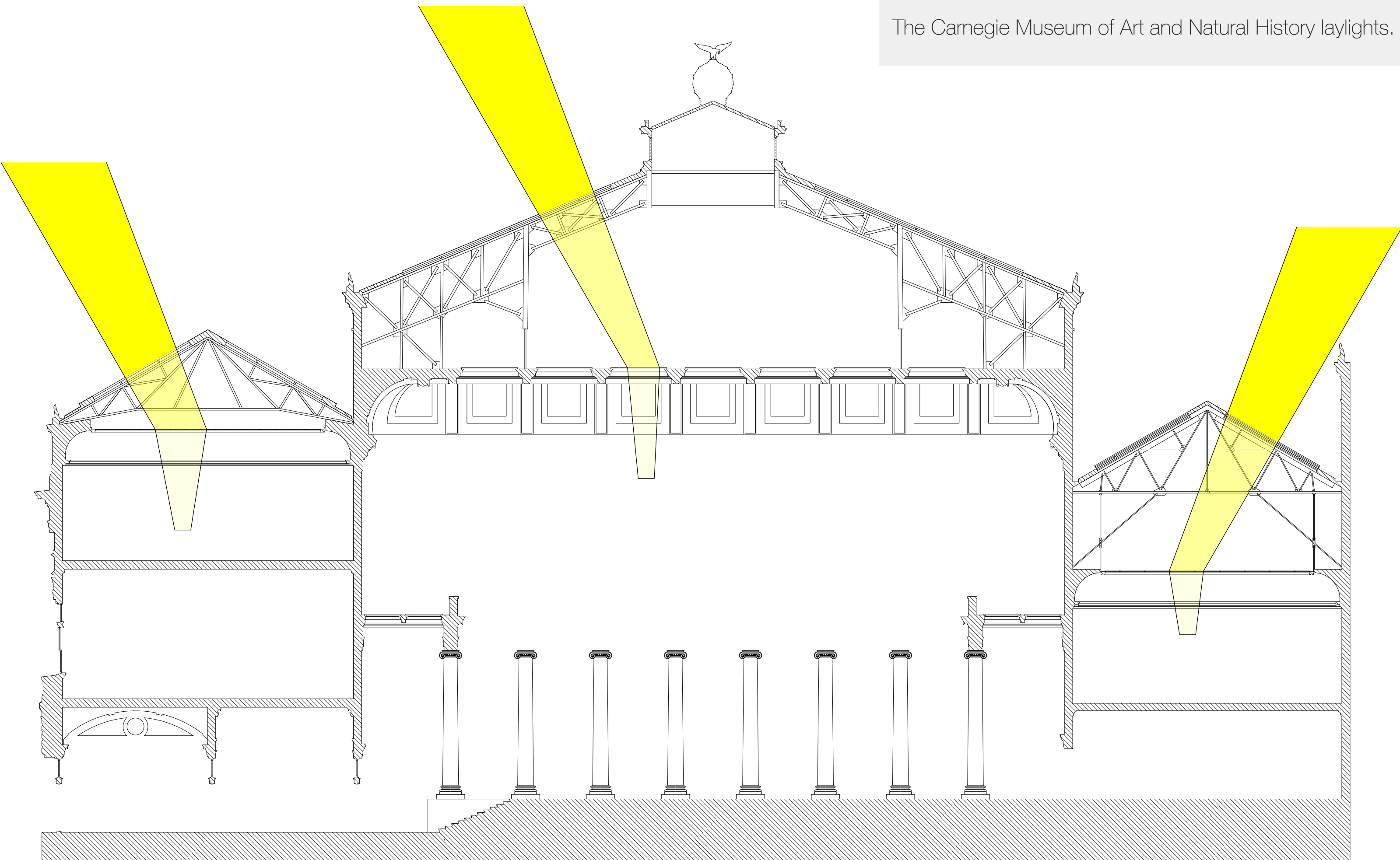
The Carnegie Museum of Art and Natural History
Pittsburgh Pennsylvania

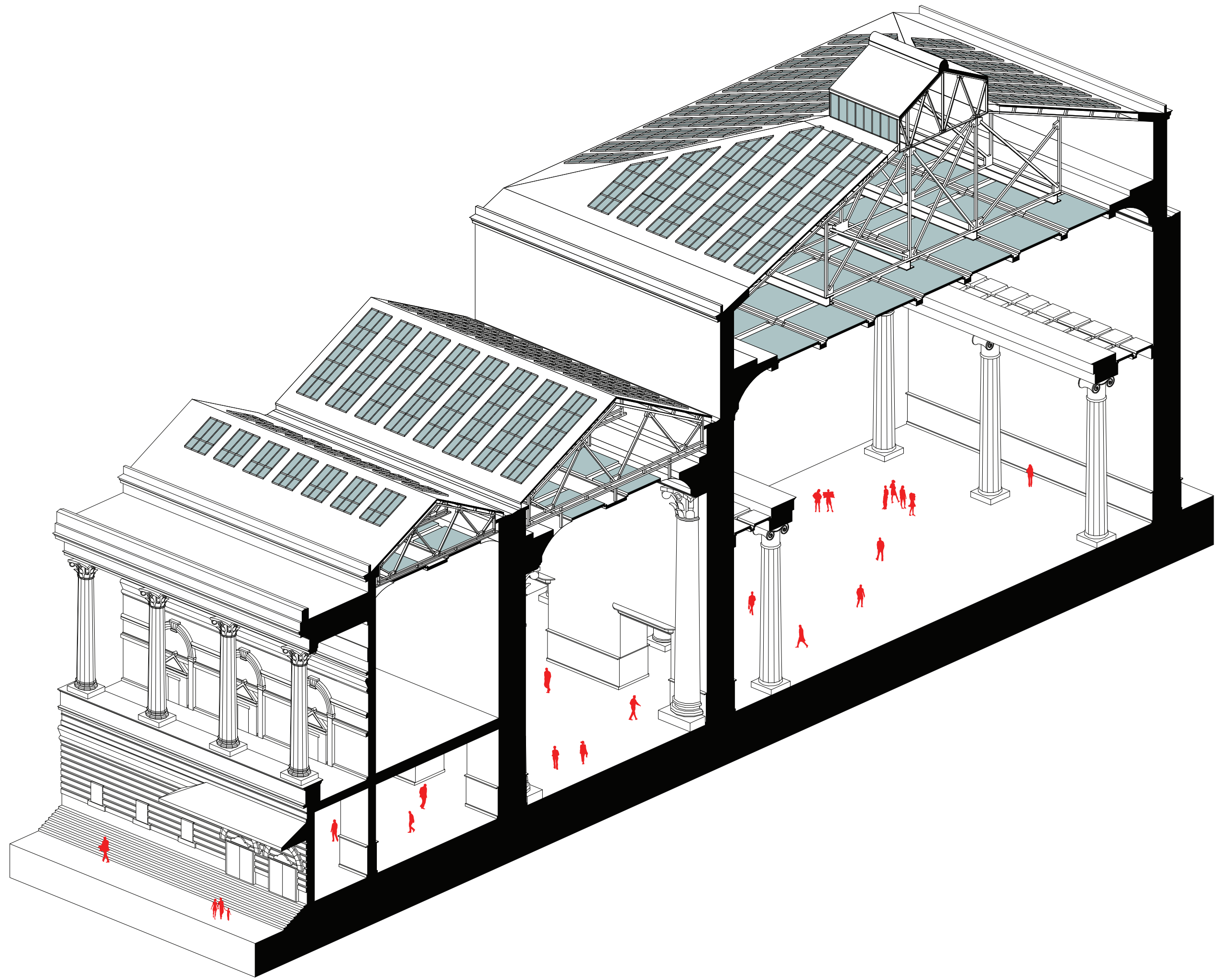




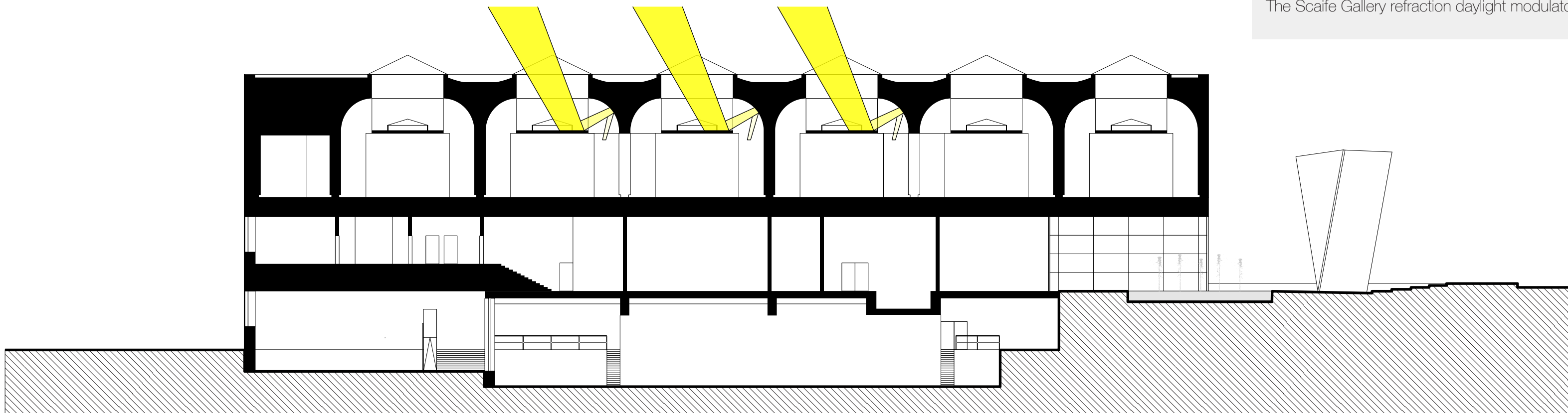


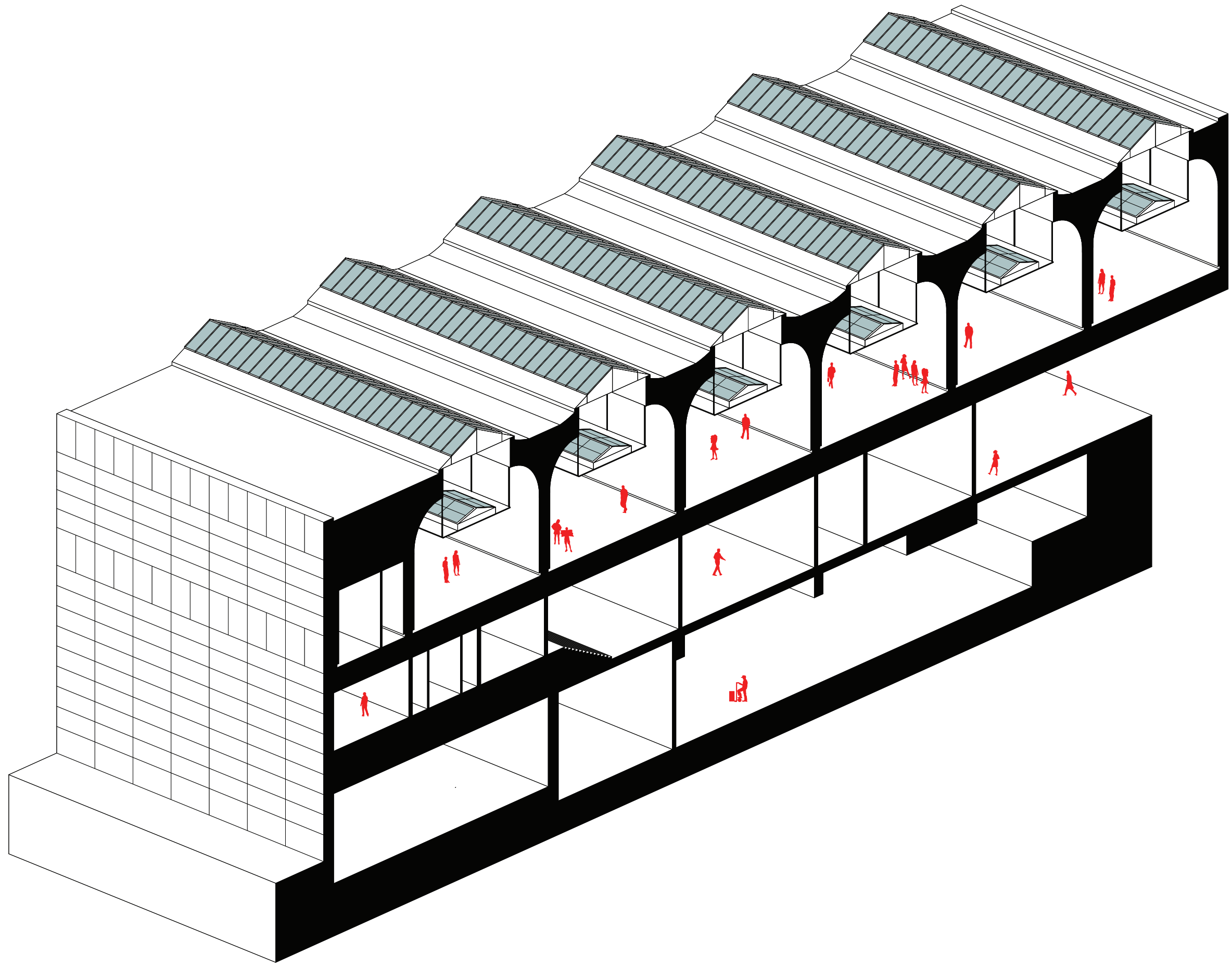
The Carnegie Museum of Art and Natural History laylights.





The Scaife Gallery refraction daylight modulators.





The Museum currently has 29,778 works in their collection, most of which are prints being 29% and drawings and watercolors 22% of the entire collection



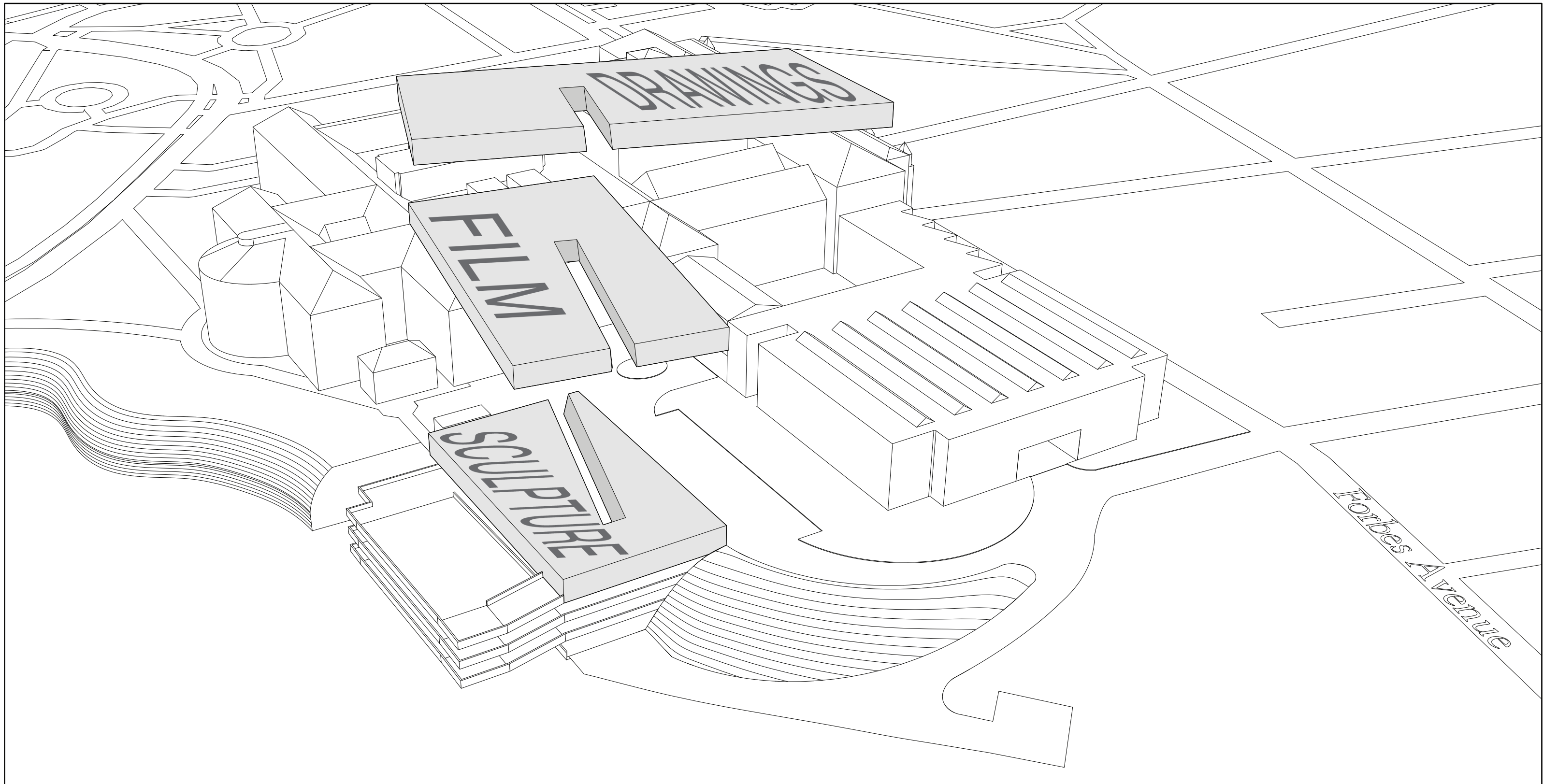
Of the total 29,778 works in the collection, only 7% (2,143) are currently on view at the museum with 1% on view in other places.

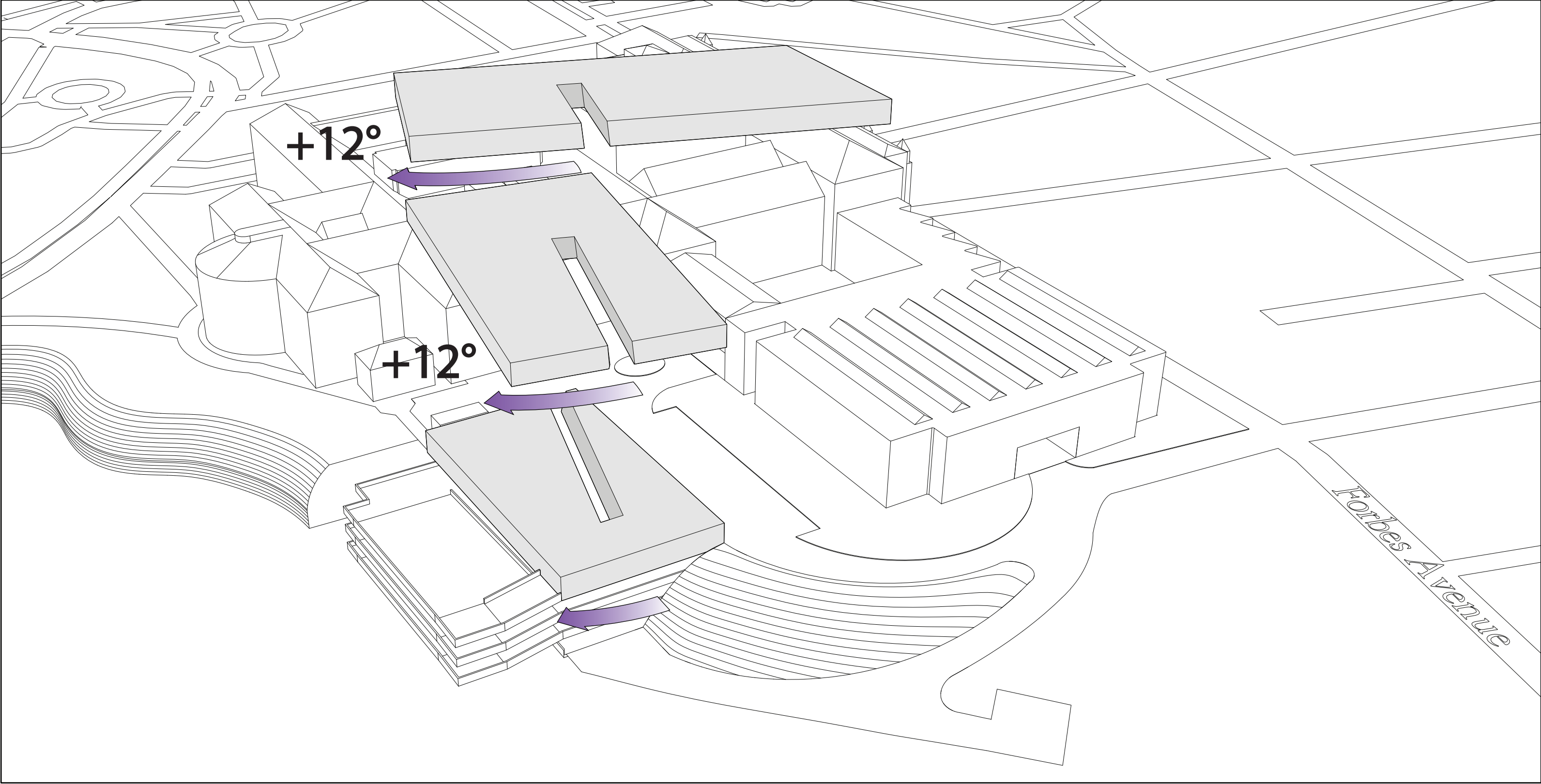


storage

on view in other places

on view

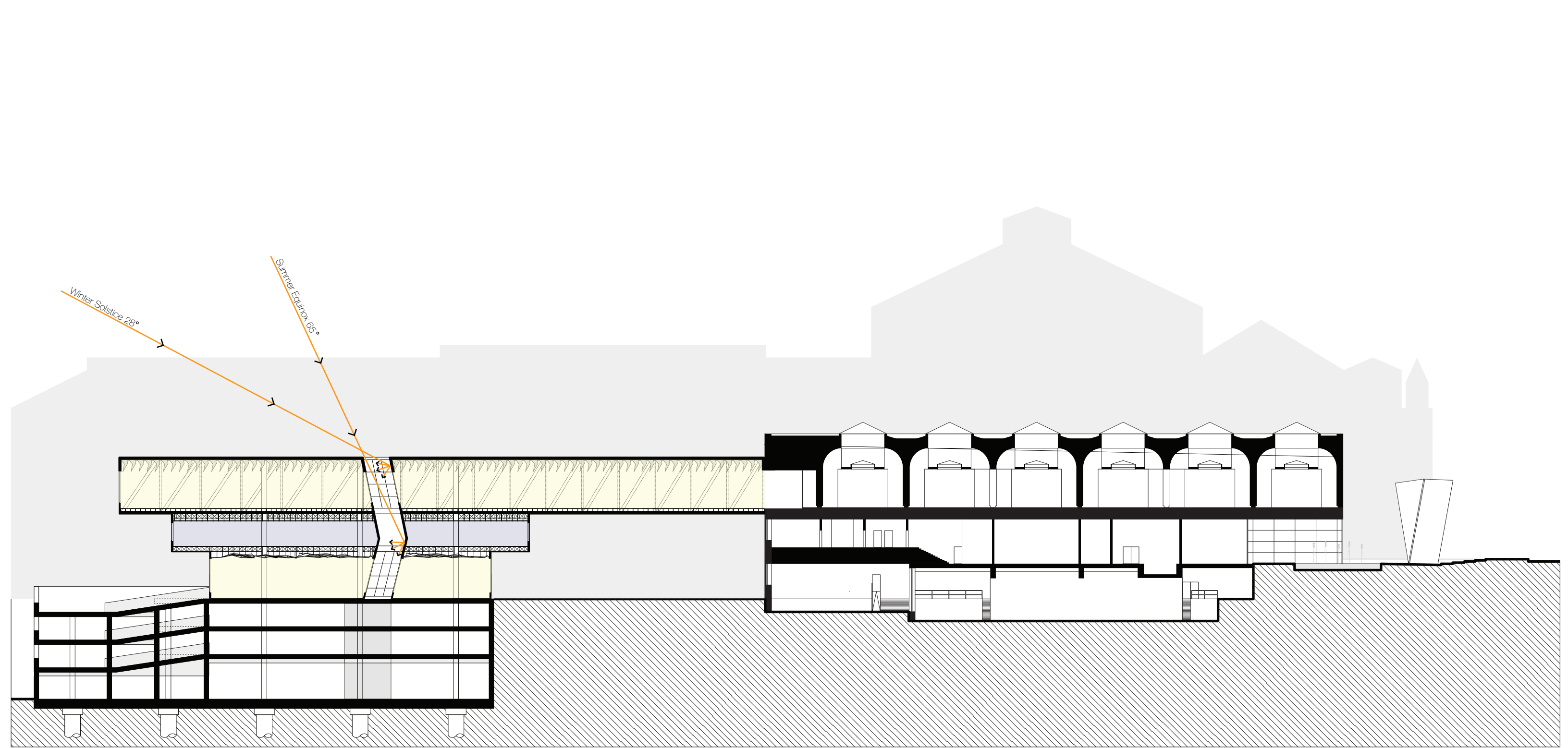


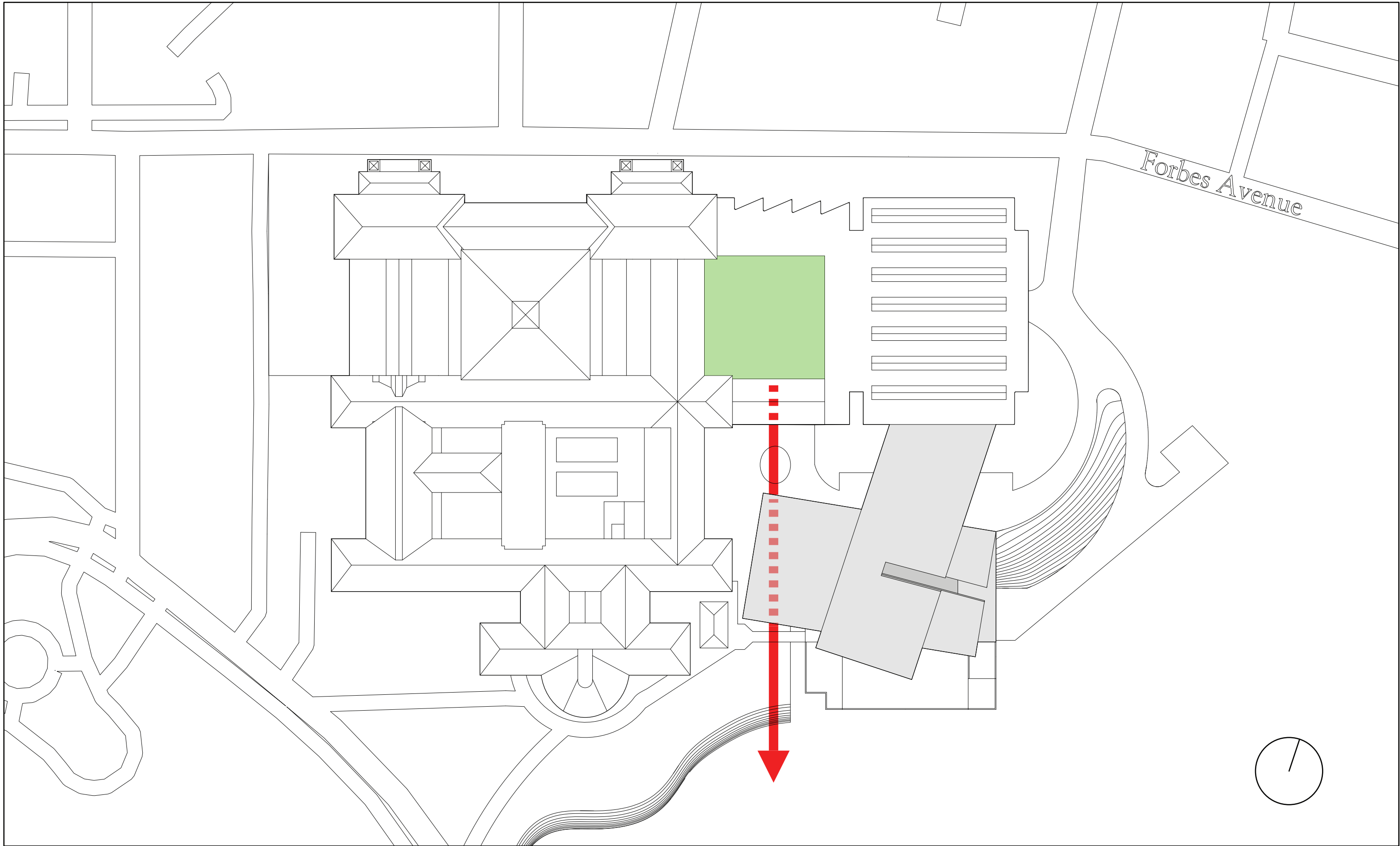


+12°

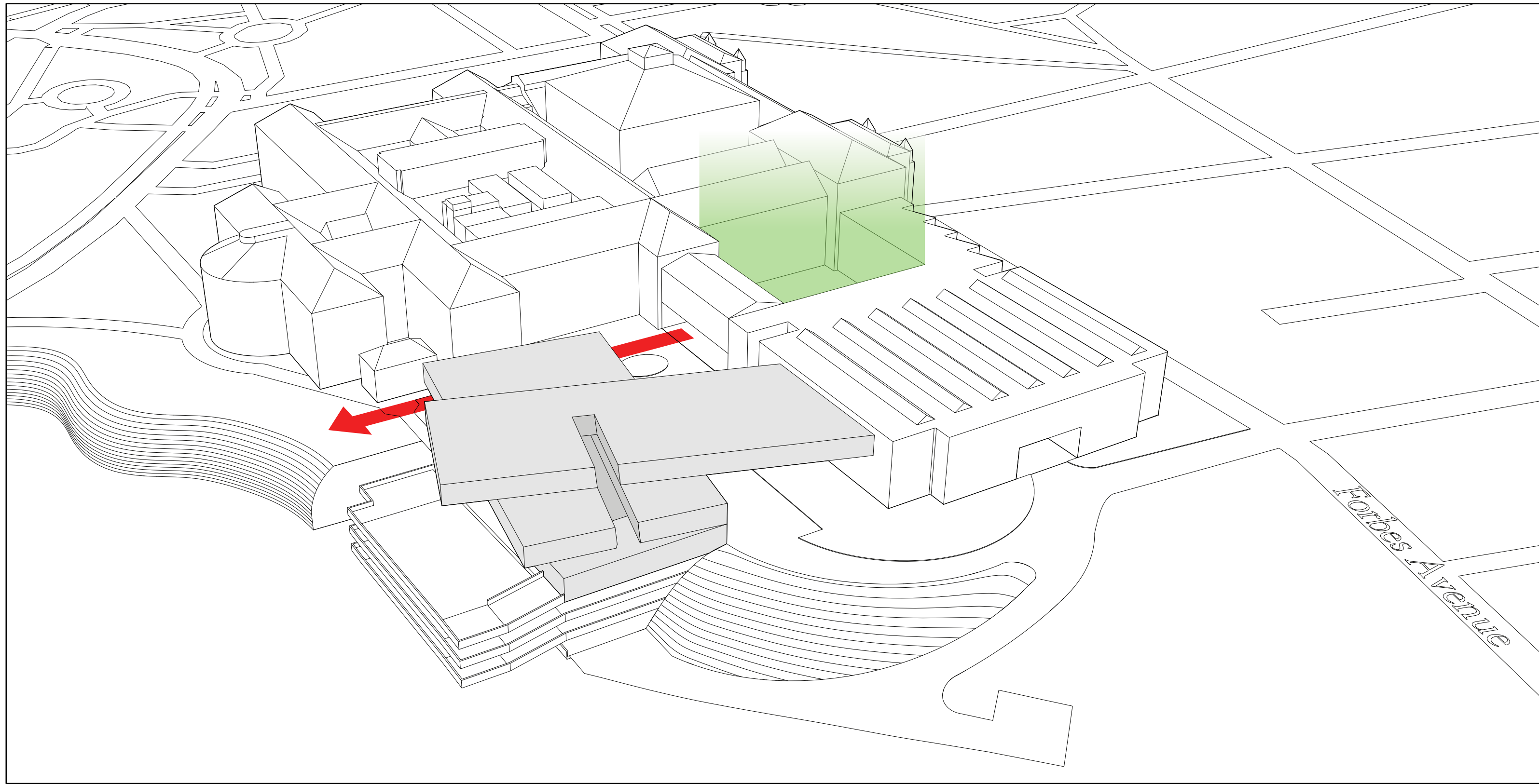
+12°

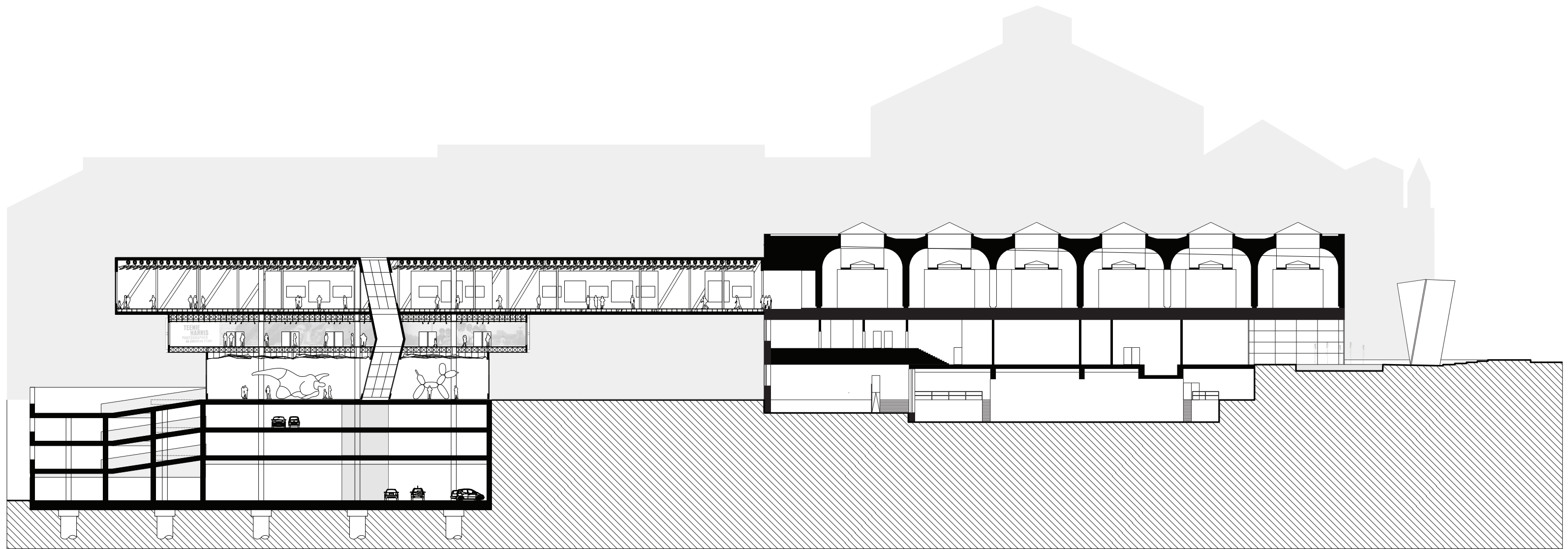
Forbes Avenue

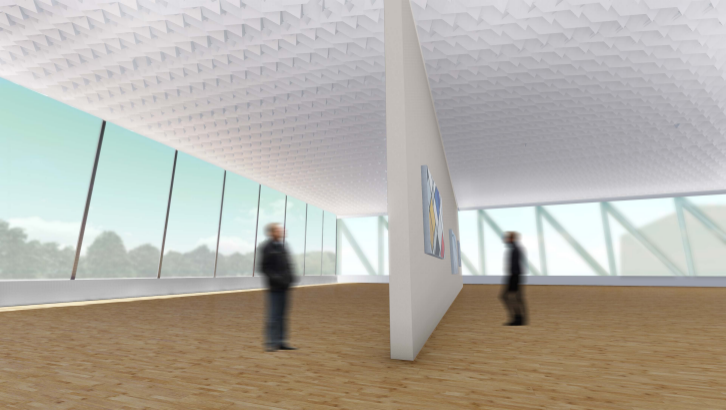




Forbes Avenue



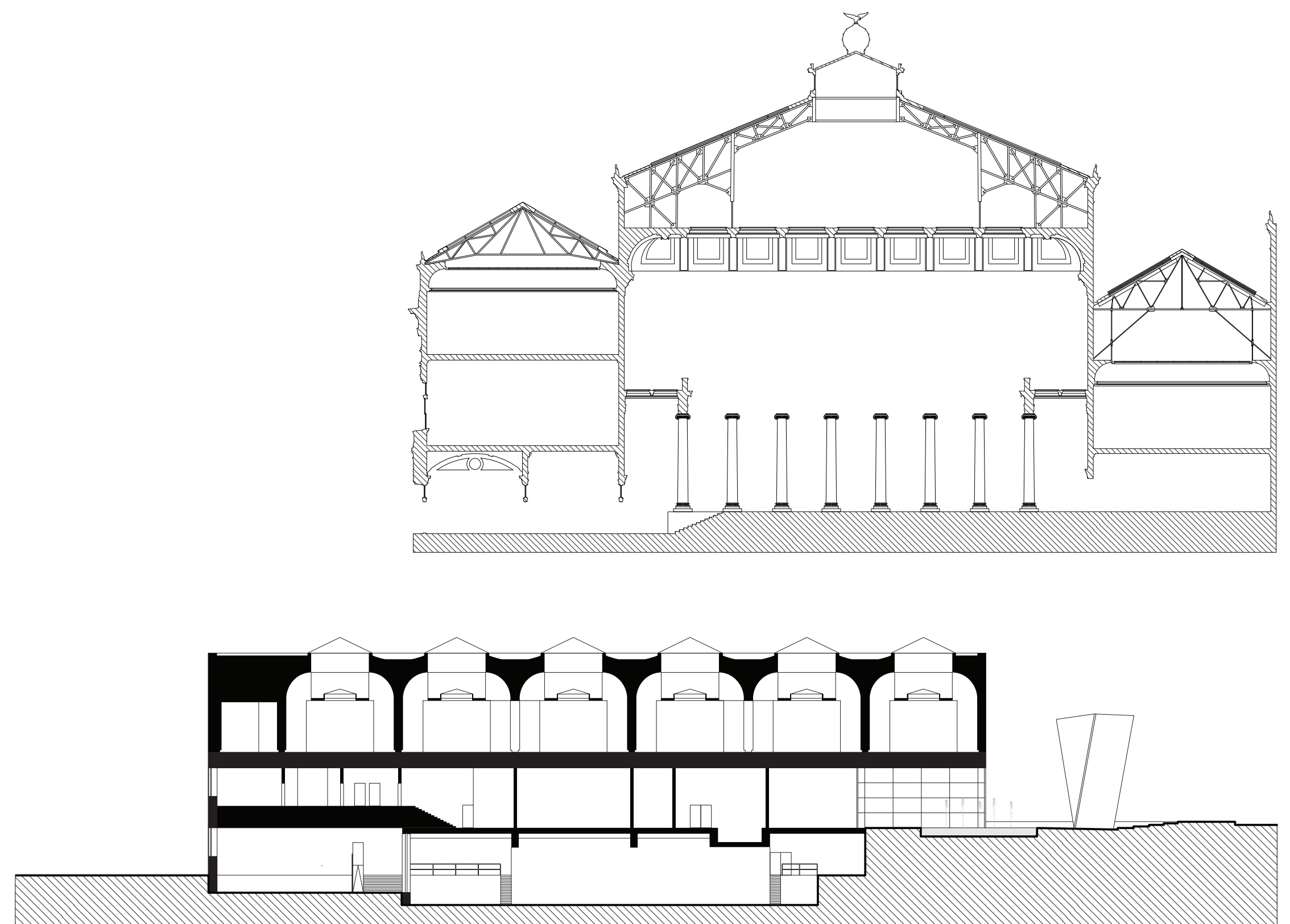
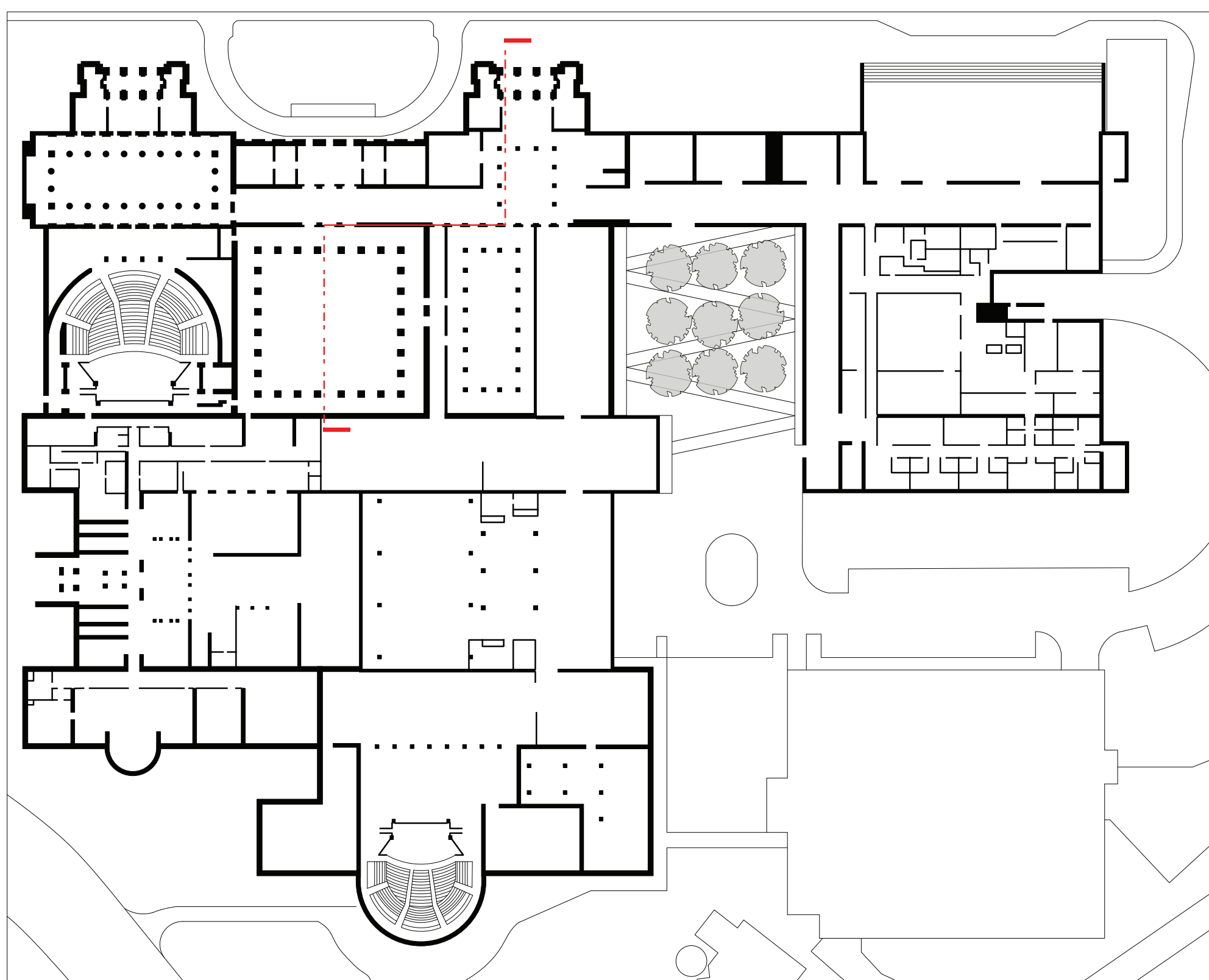
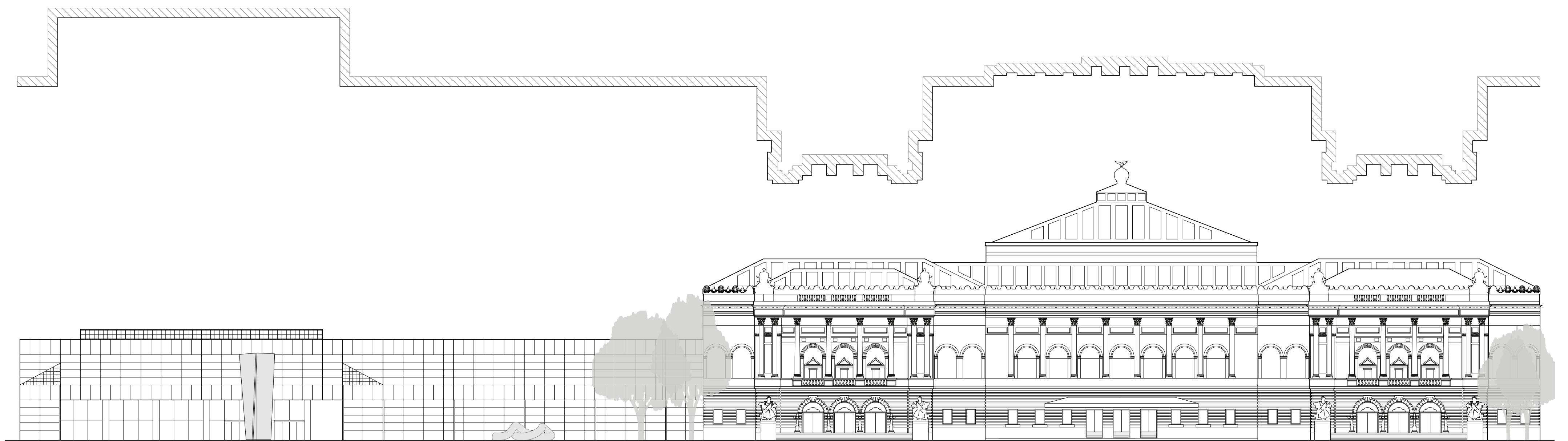
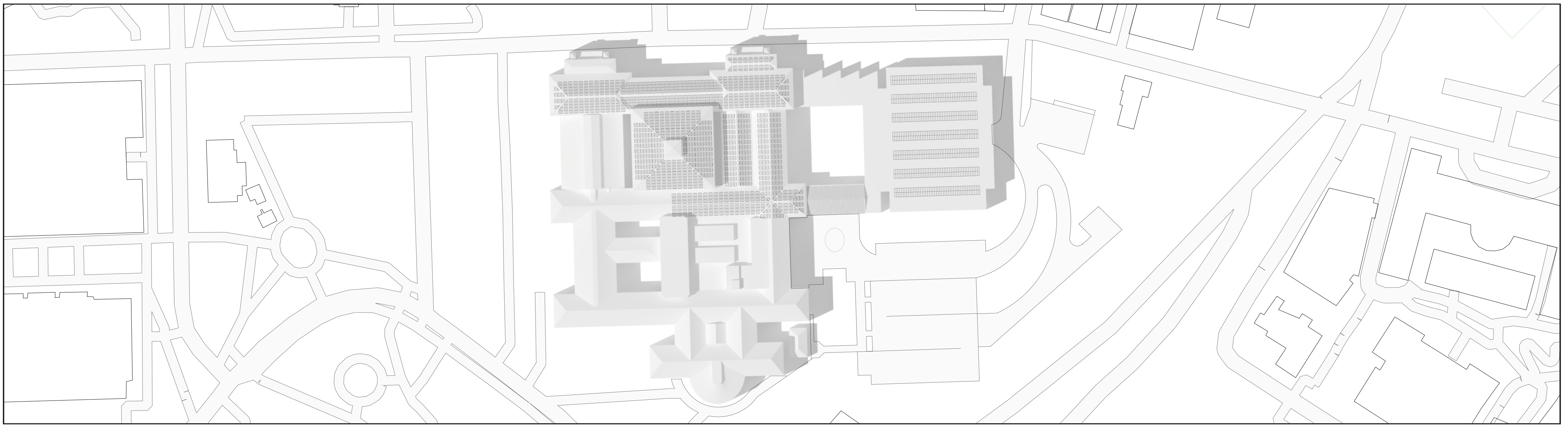






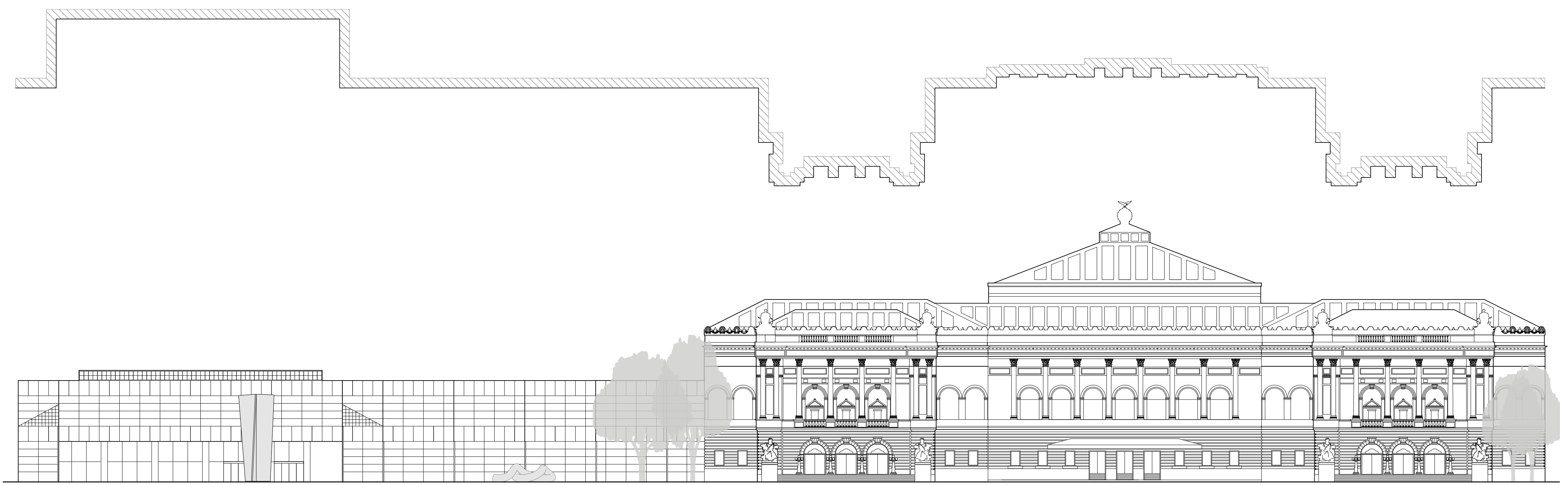
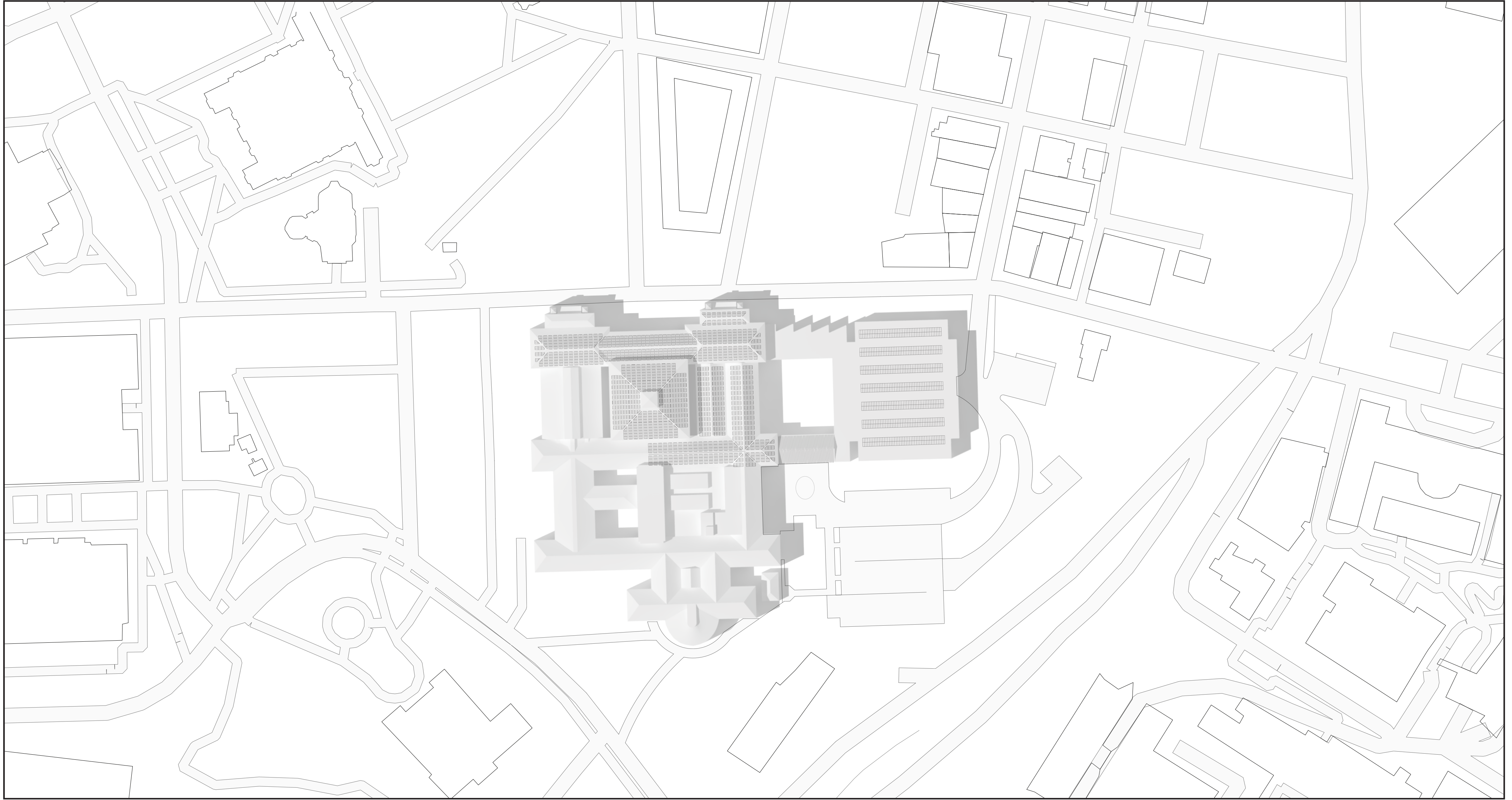
The Carnegie Museum of Art & Natural History

Pittsburgh, Pennsylvania

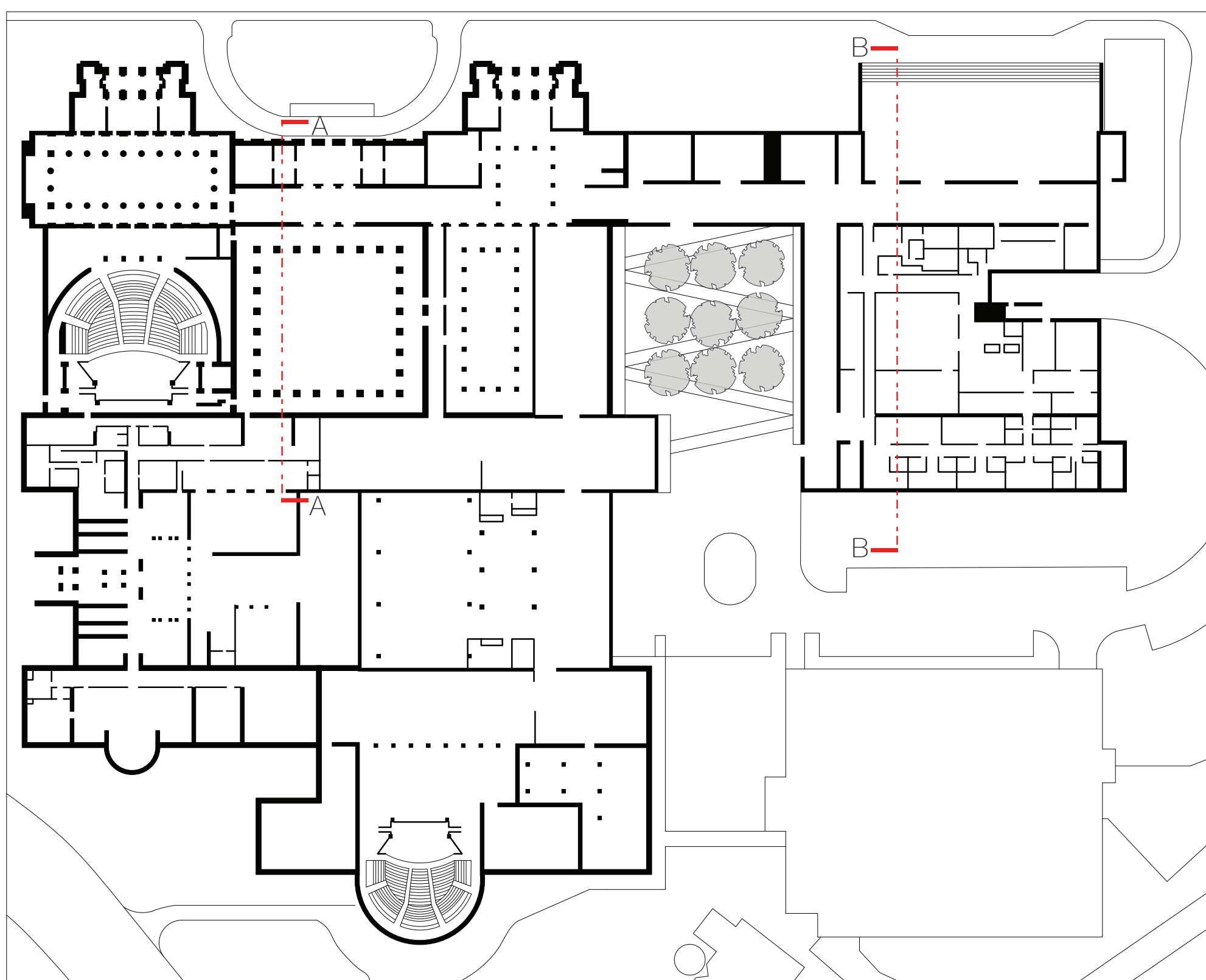


The Carnegie Museum of Art & Natural History

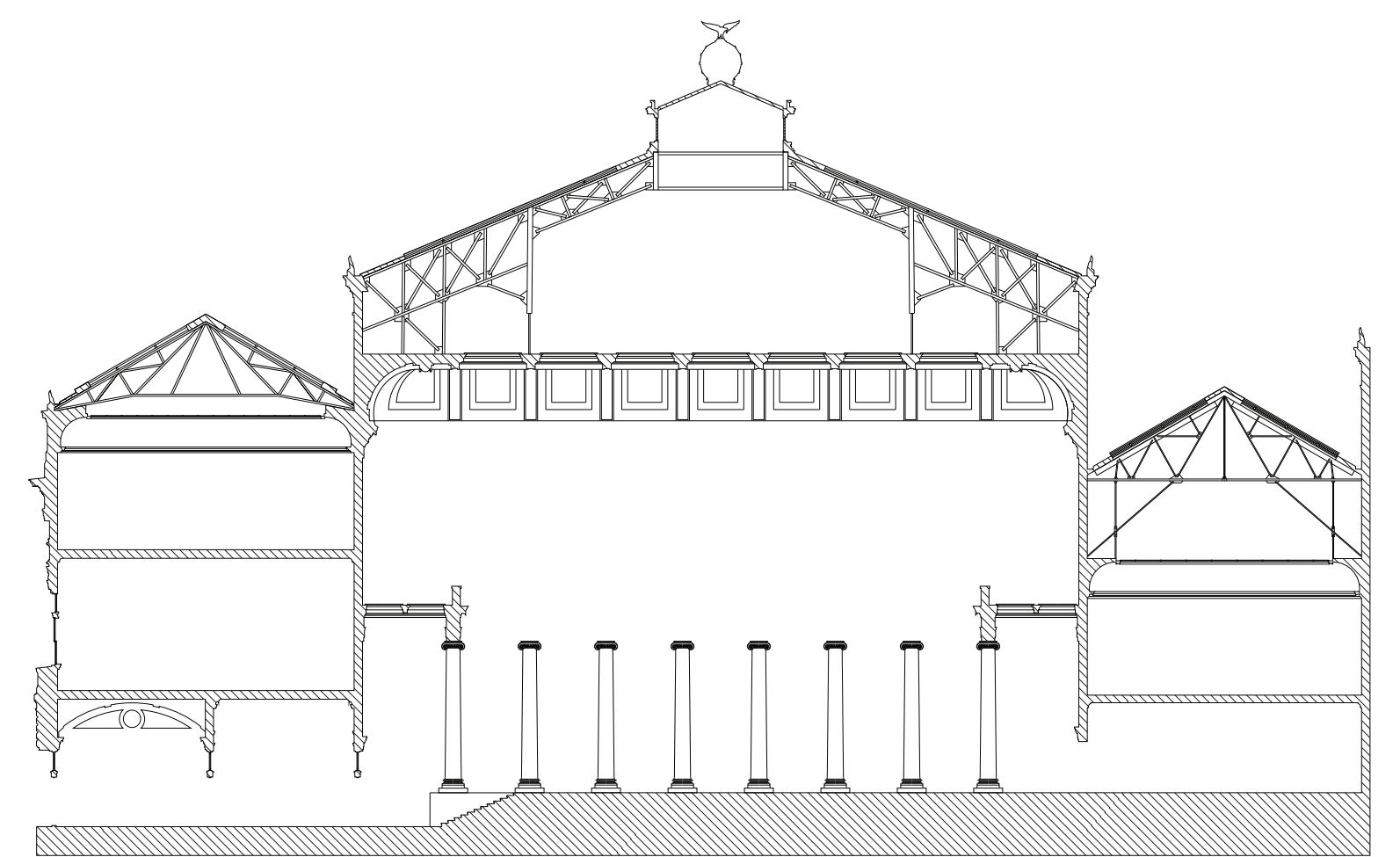
Pittsburgh, Pennsylvania



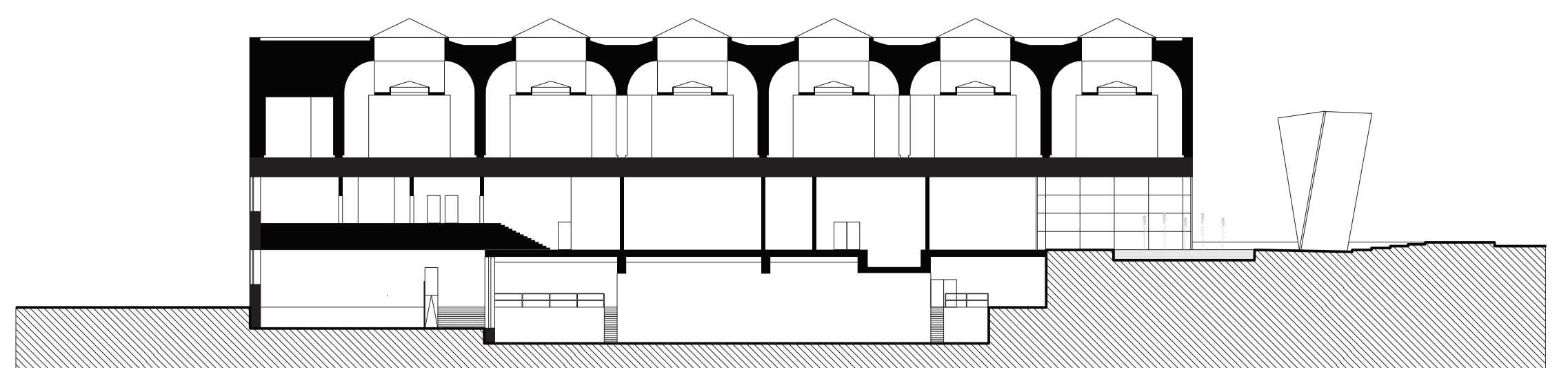
North Elevation & Profile of Building Envelope



Level 1 Plan

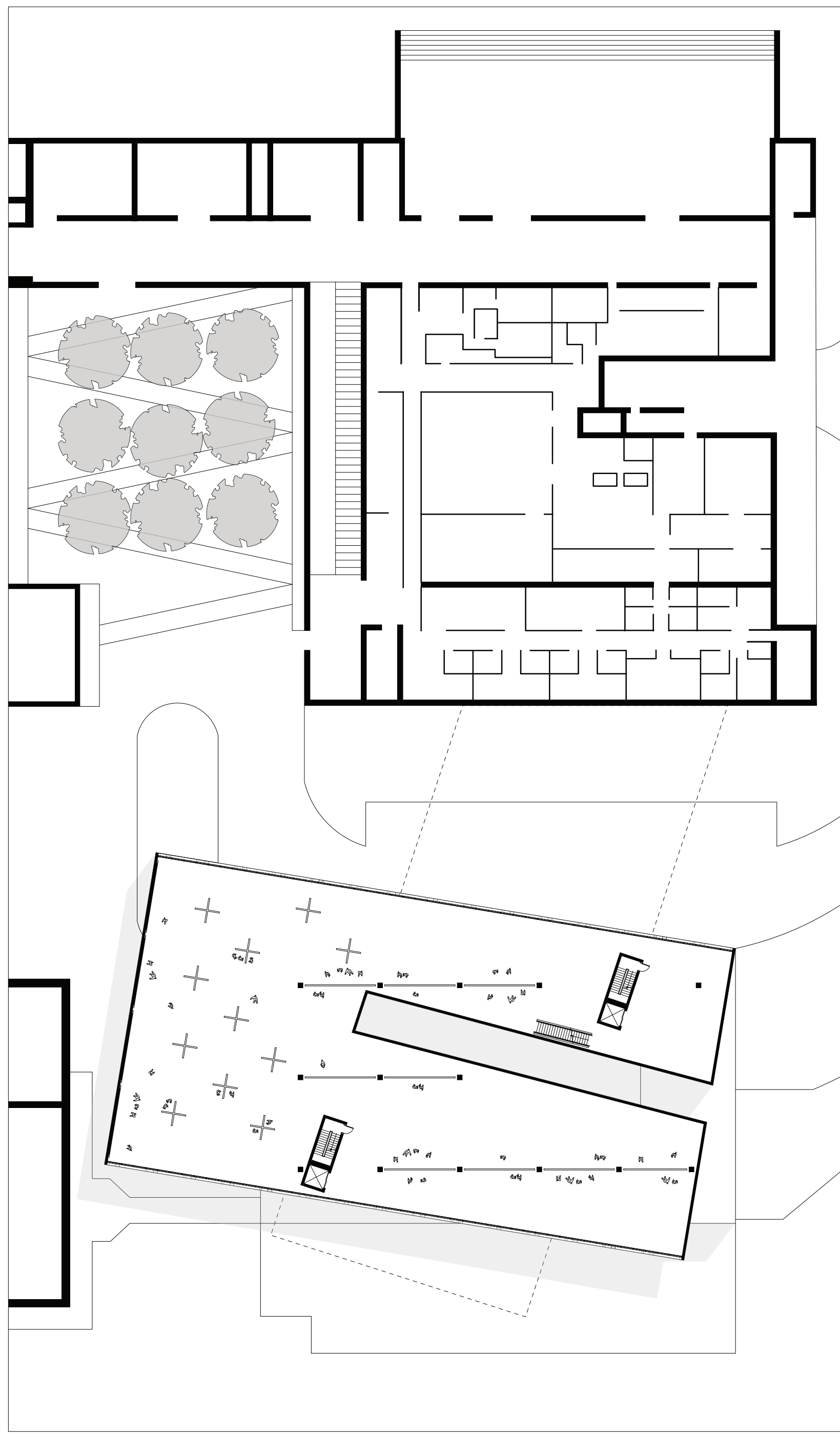


Section A-A

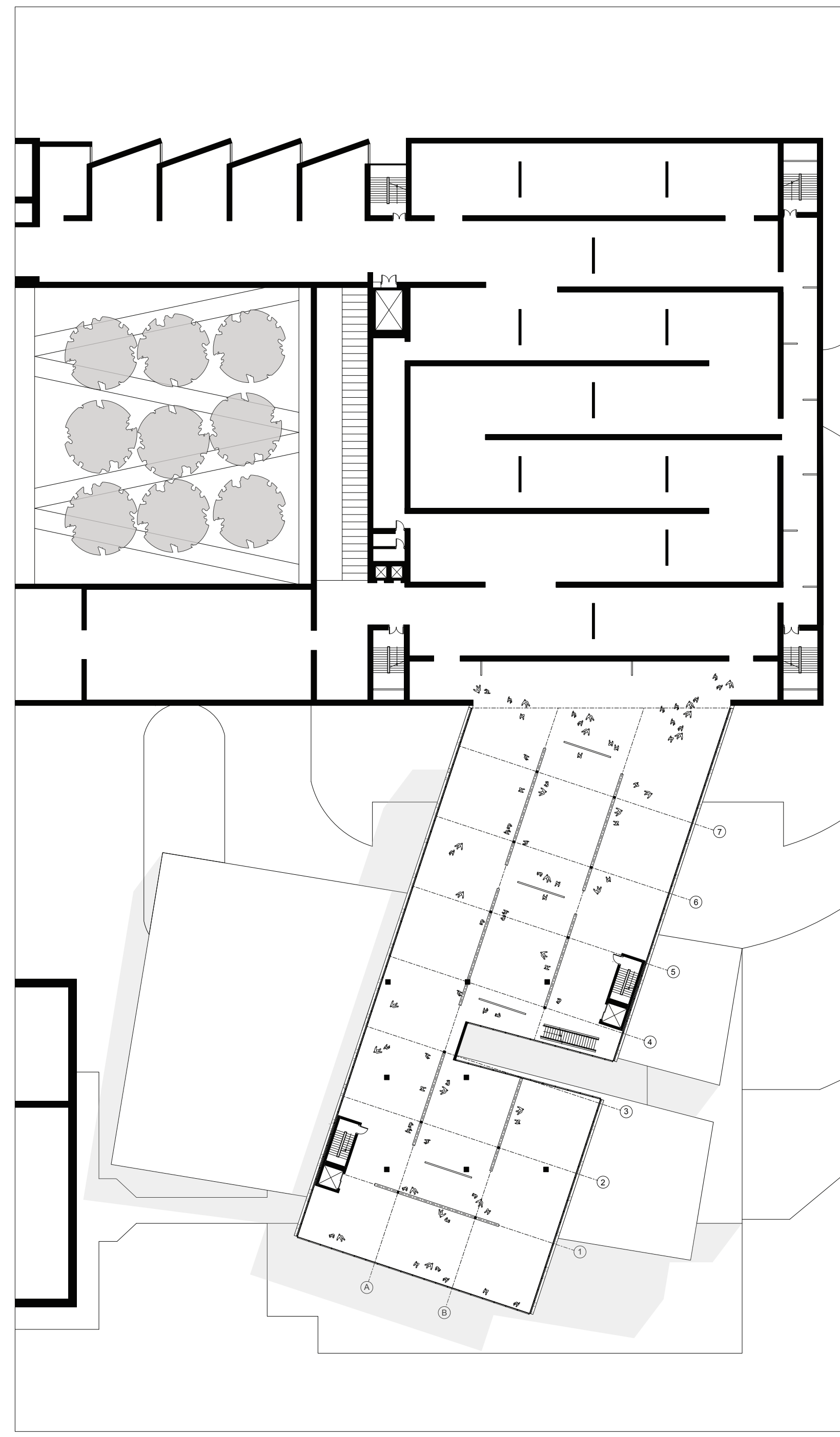


Section B-B

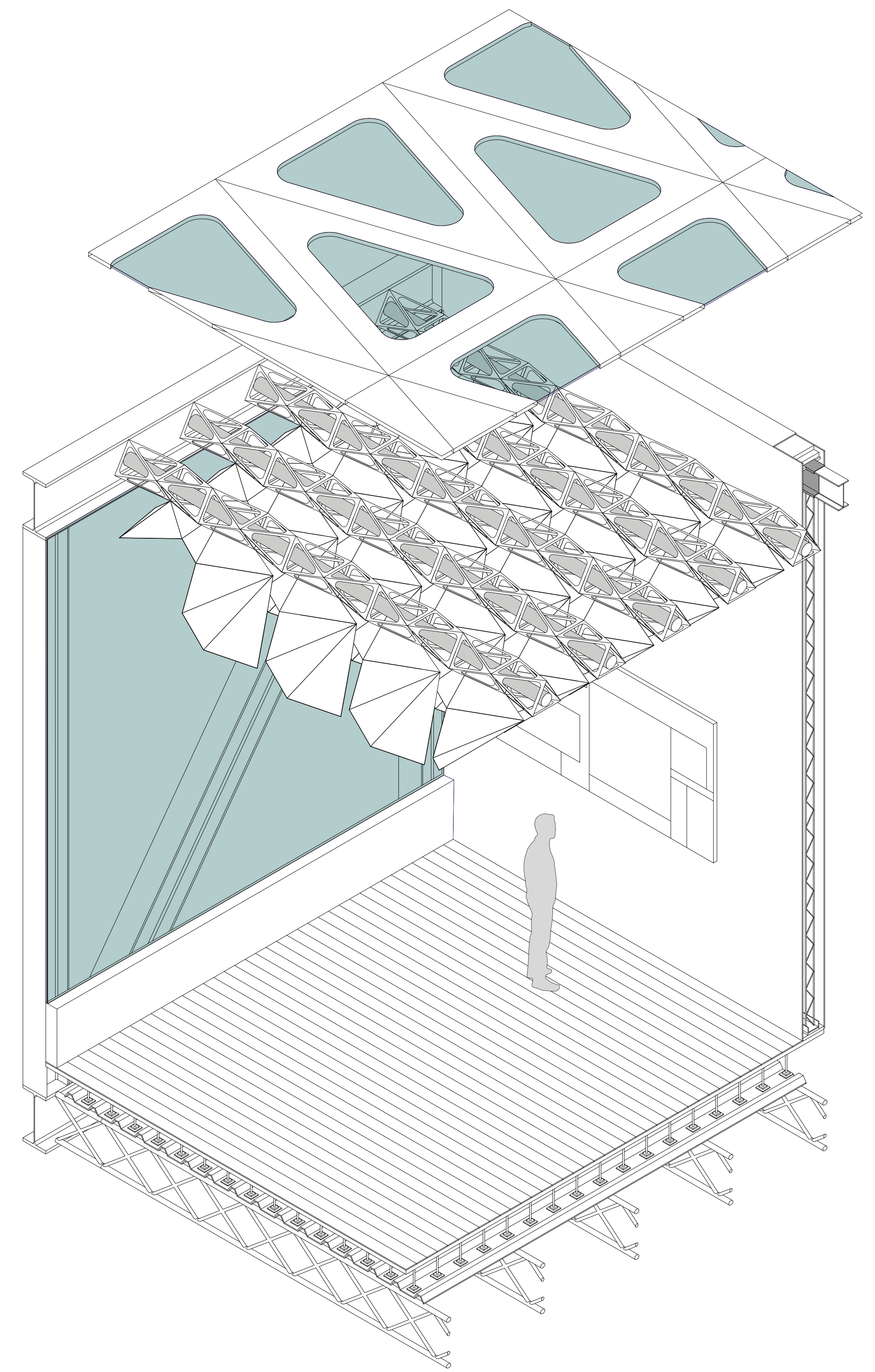
Proposed Gallery Addition



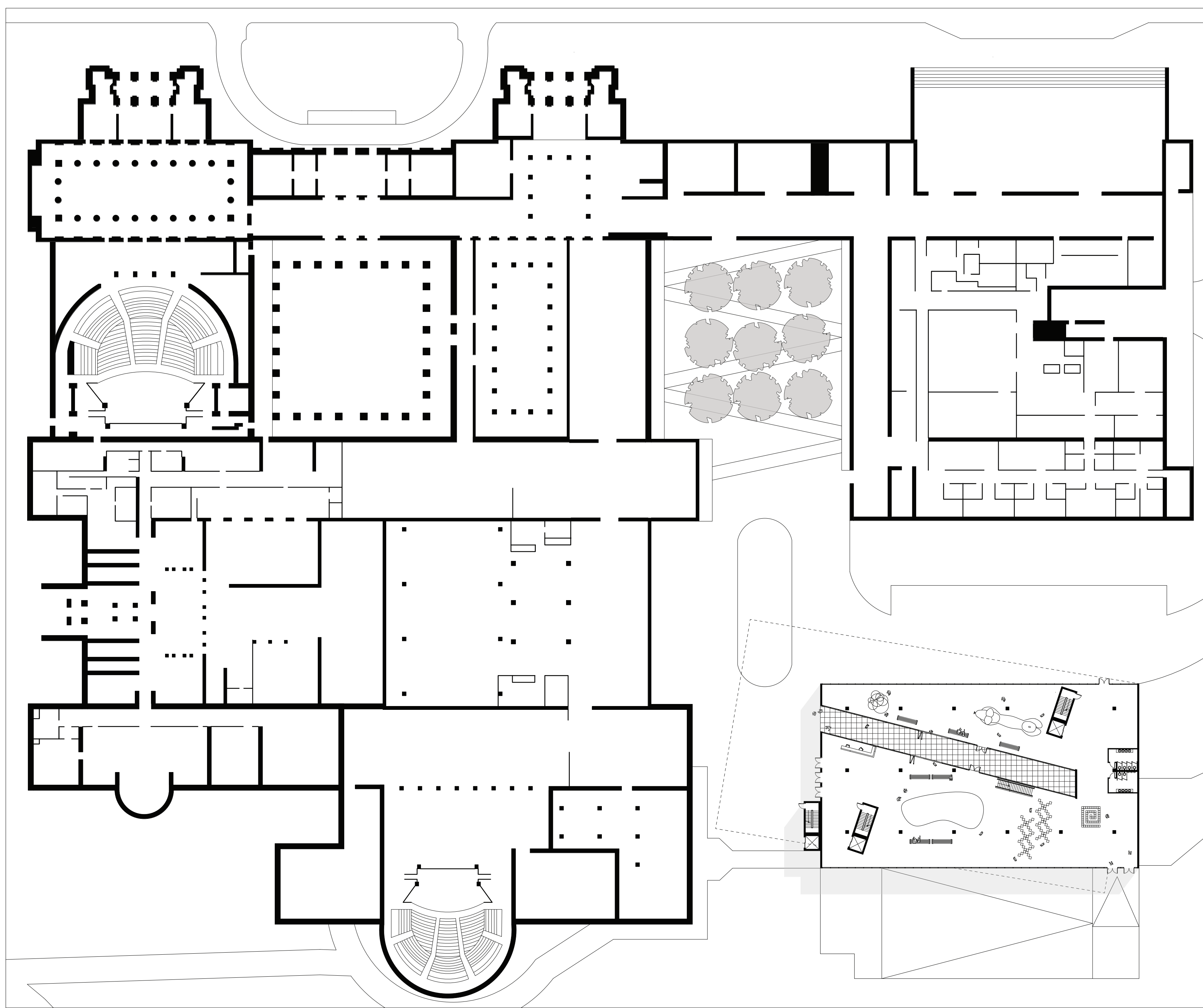
Level 2 Plan
1/40" = 1'-0"



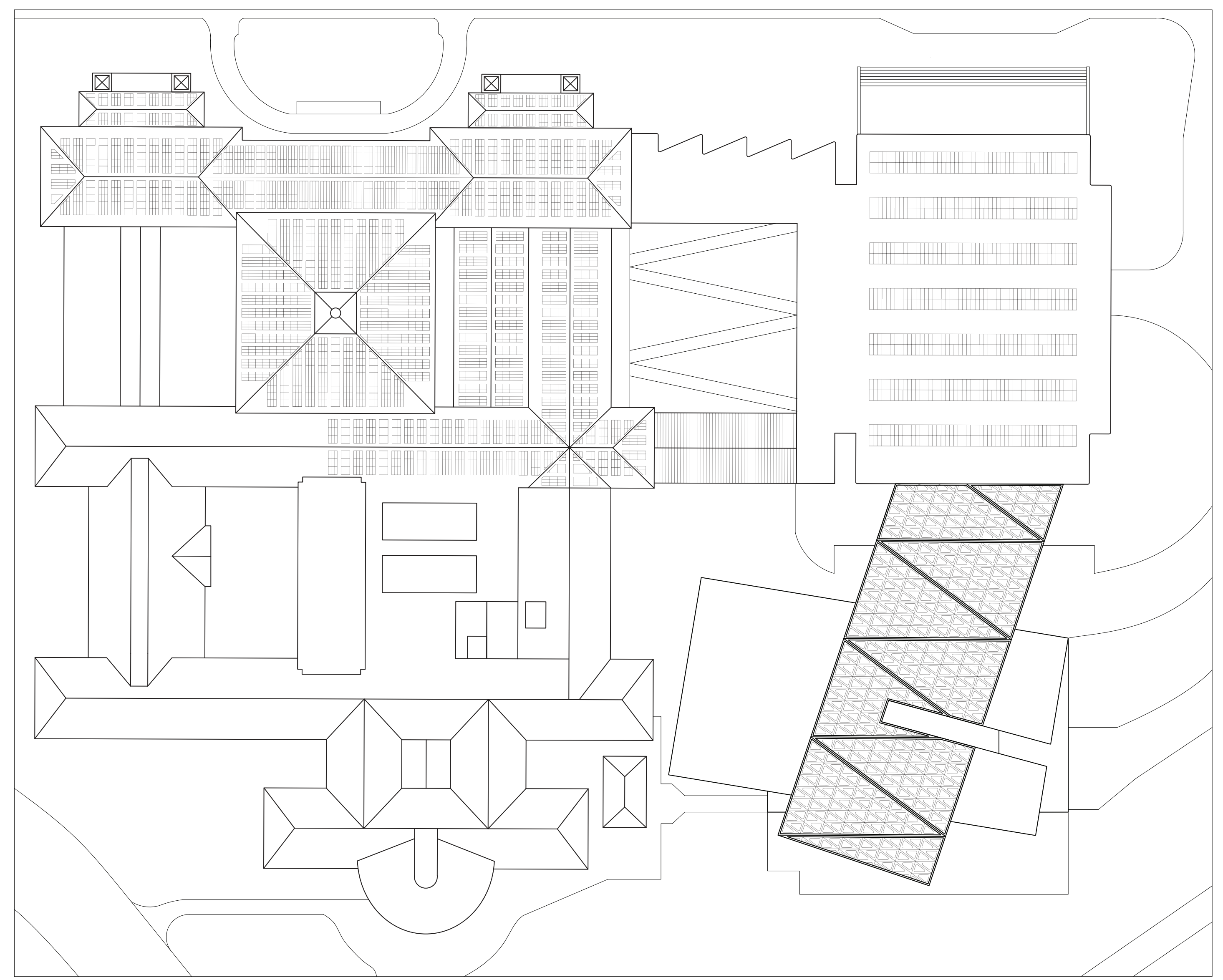
Level 3 Plan
1/40" = 1'-0"



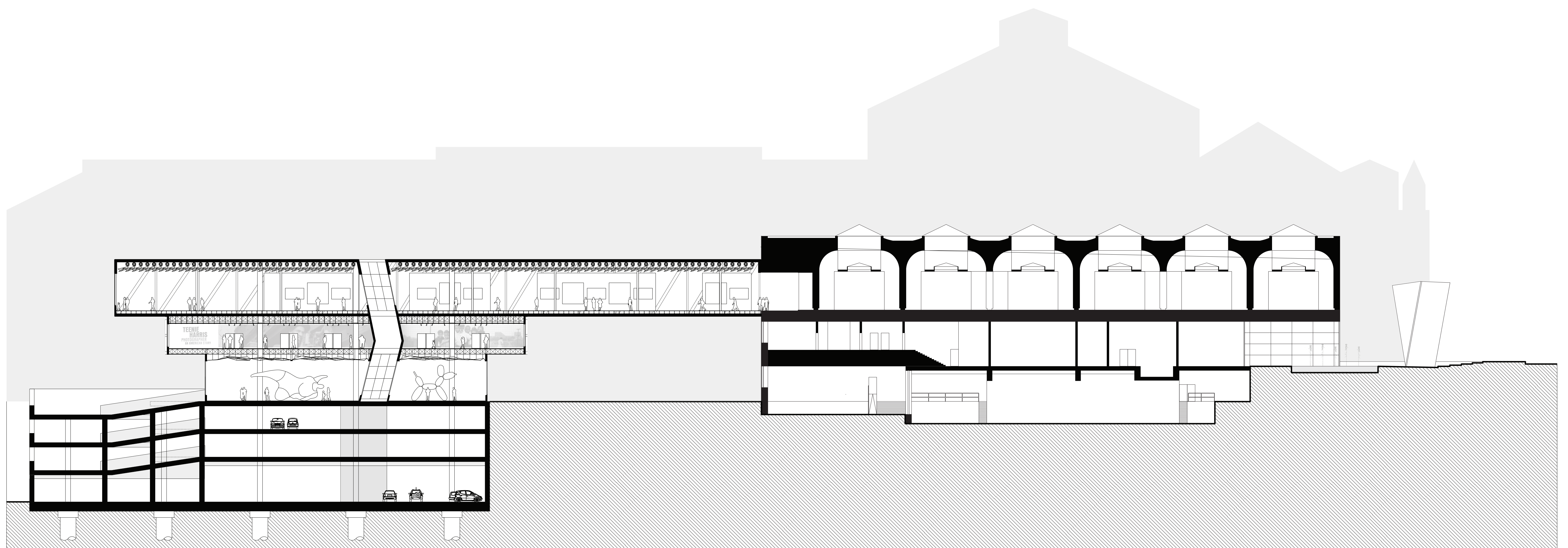
Level 3 Sectional Axon



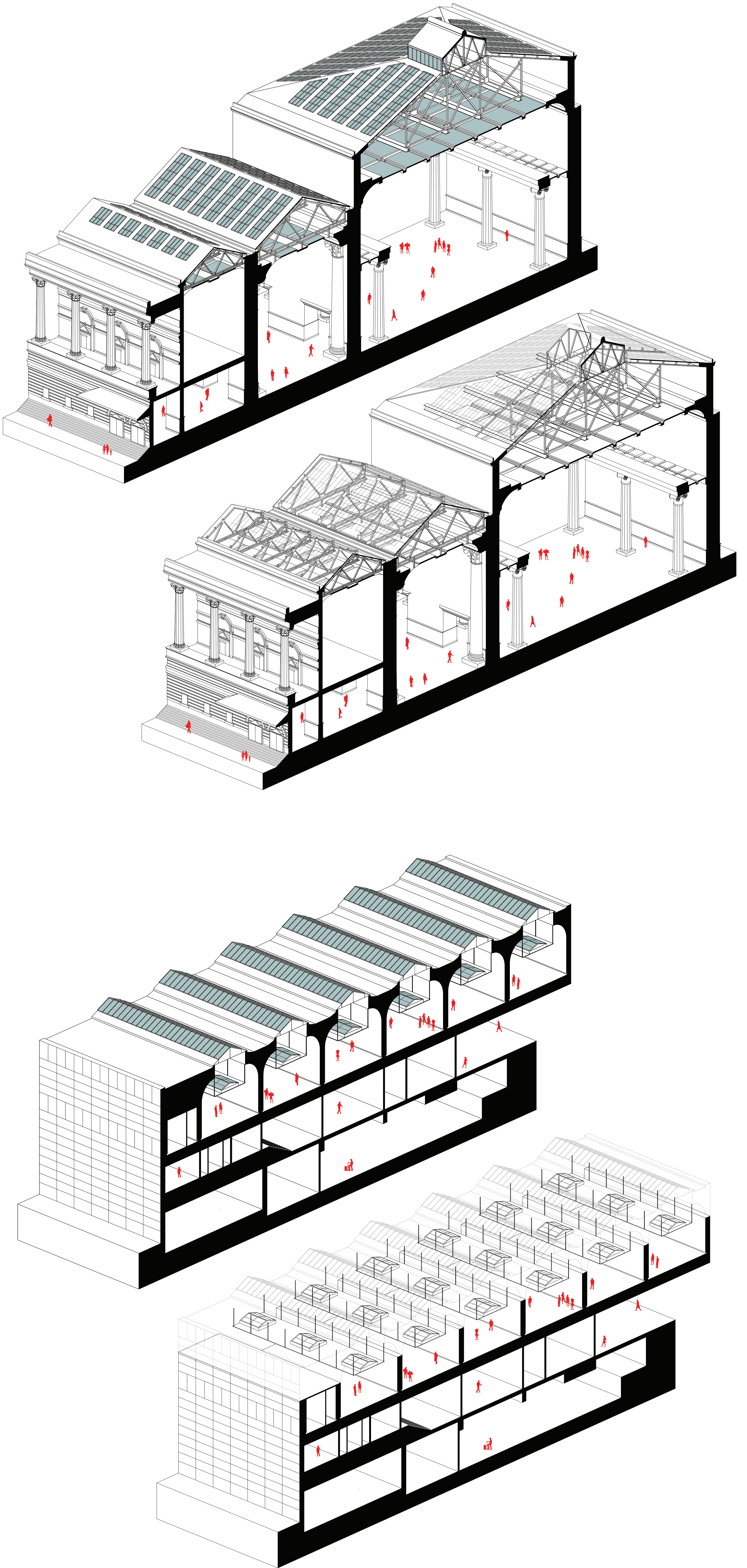
Level 1 Plan
1/40" = 1'-0"



Site Plan



Section A - A
1/20" = 1'-0"



March

June

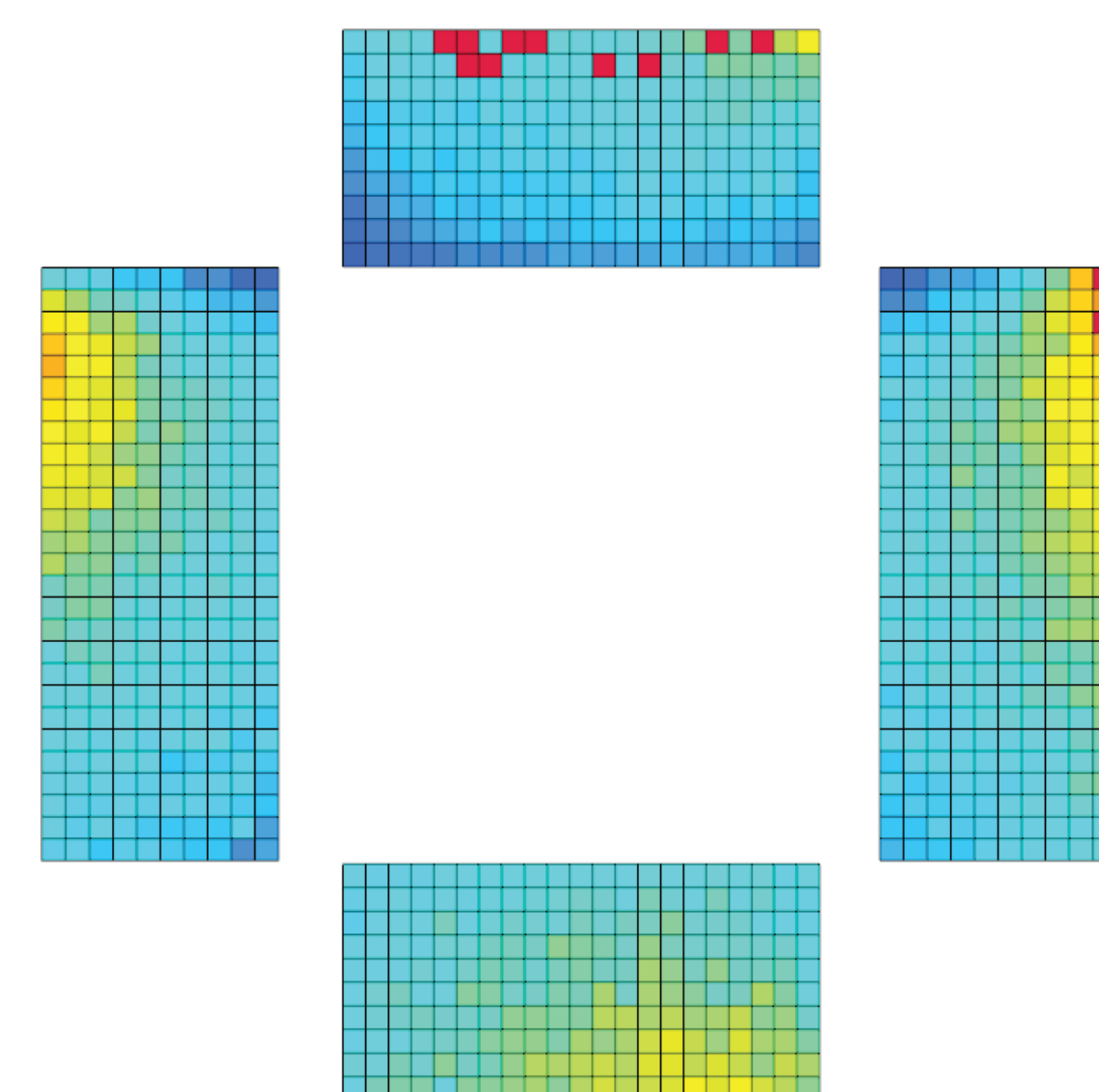
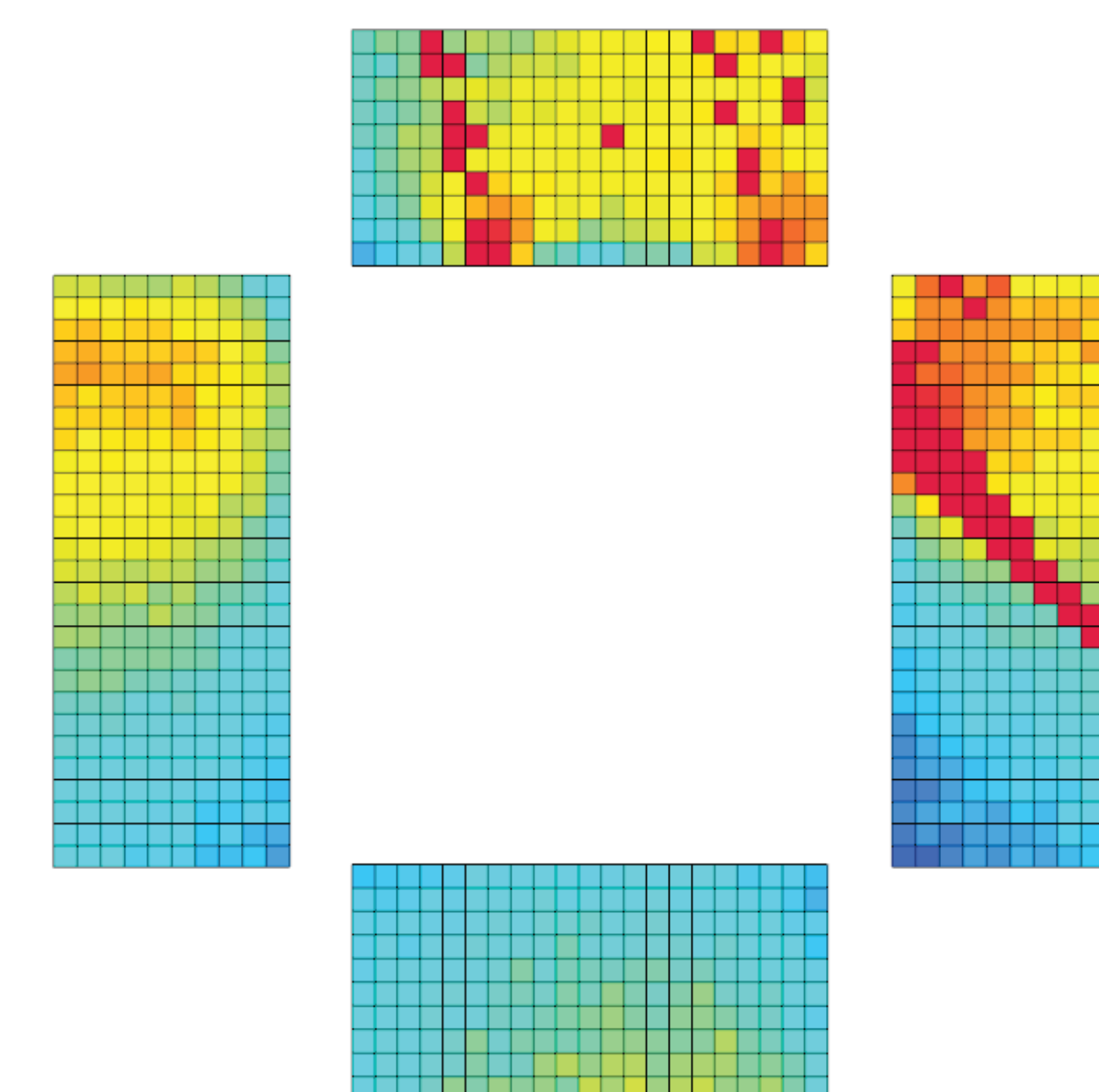
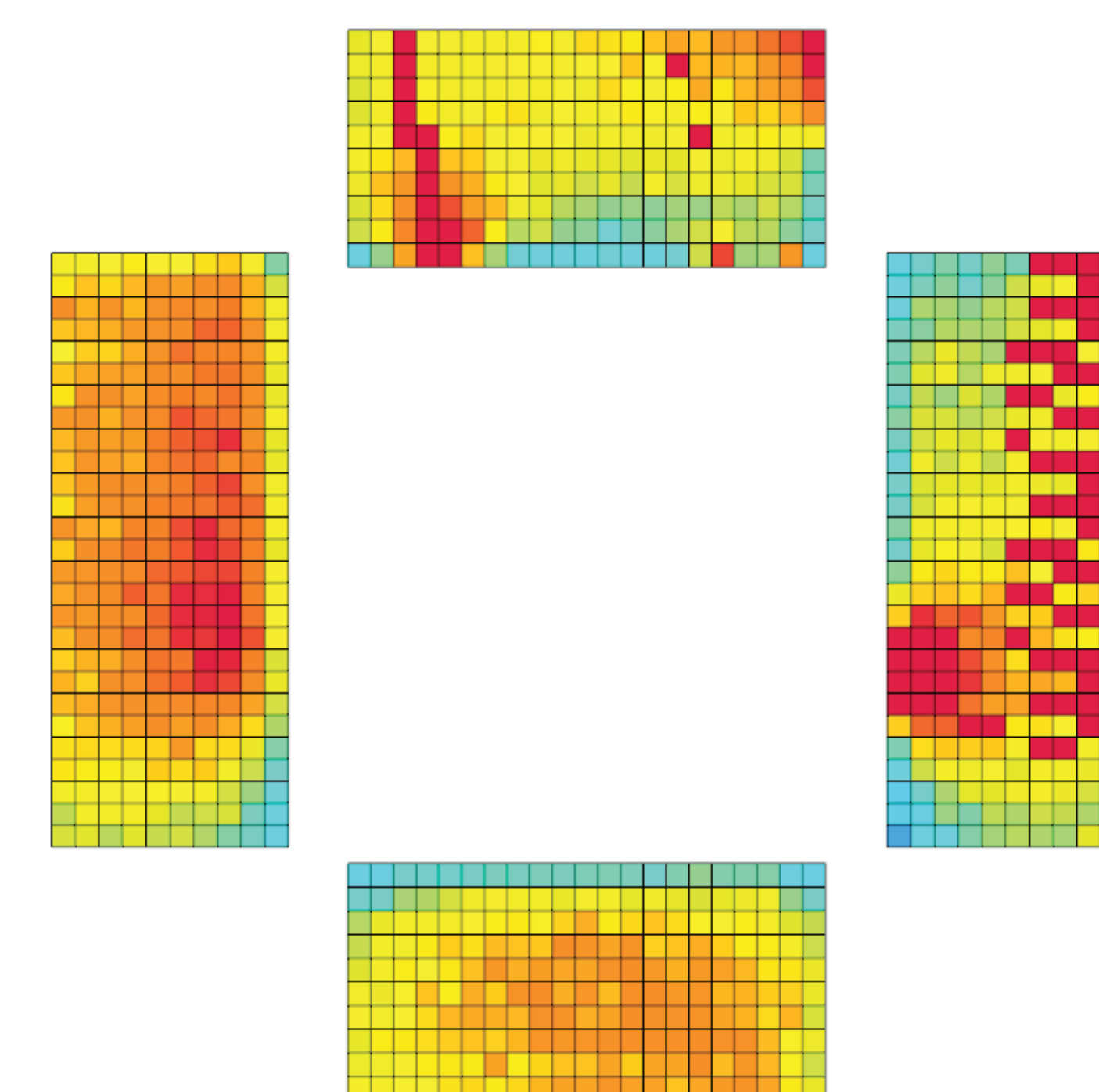
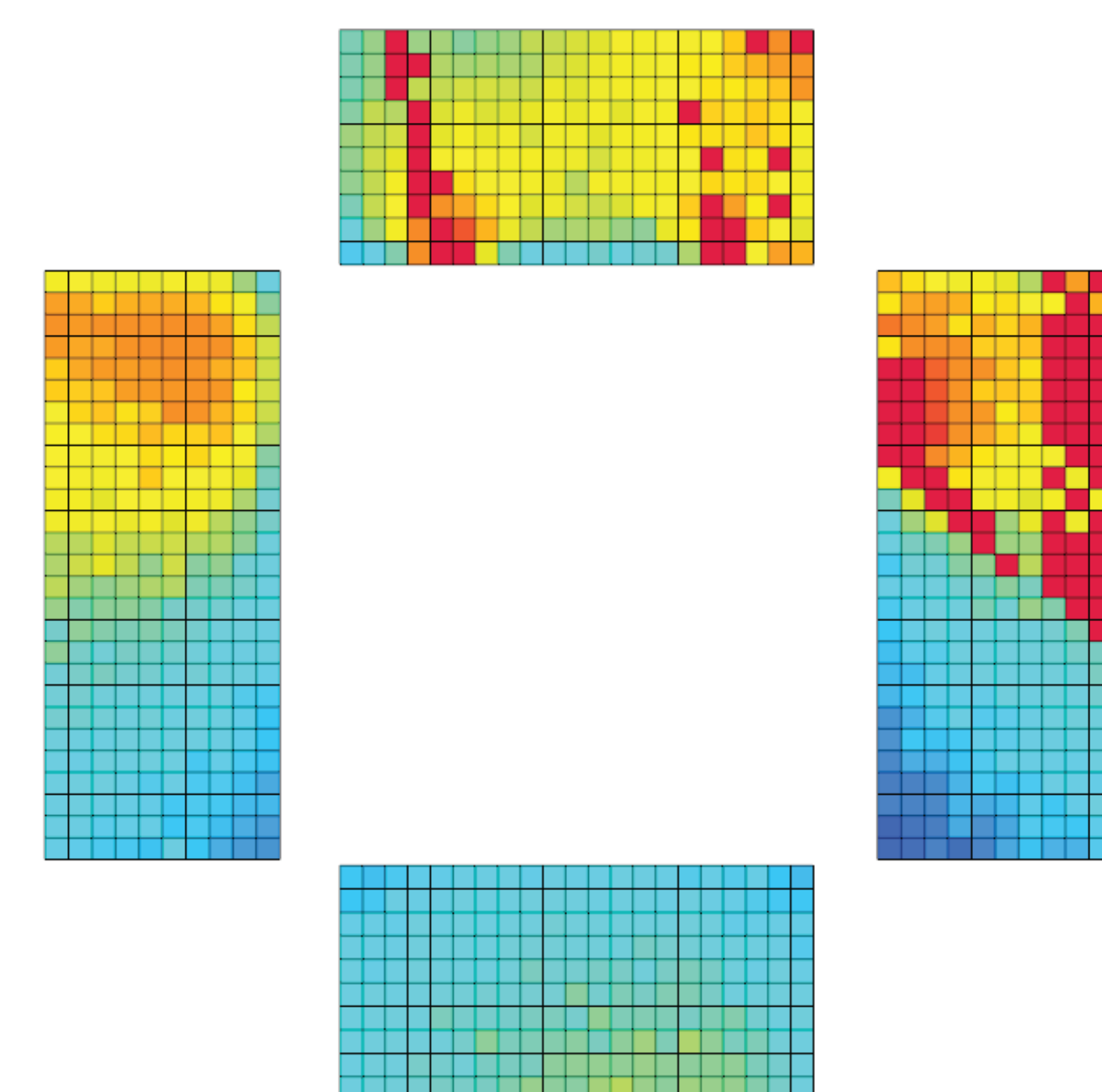
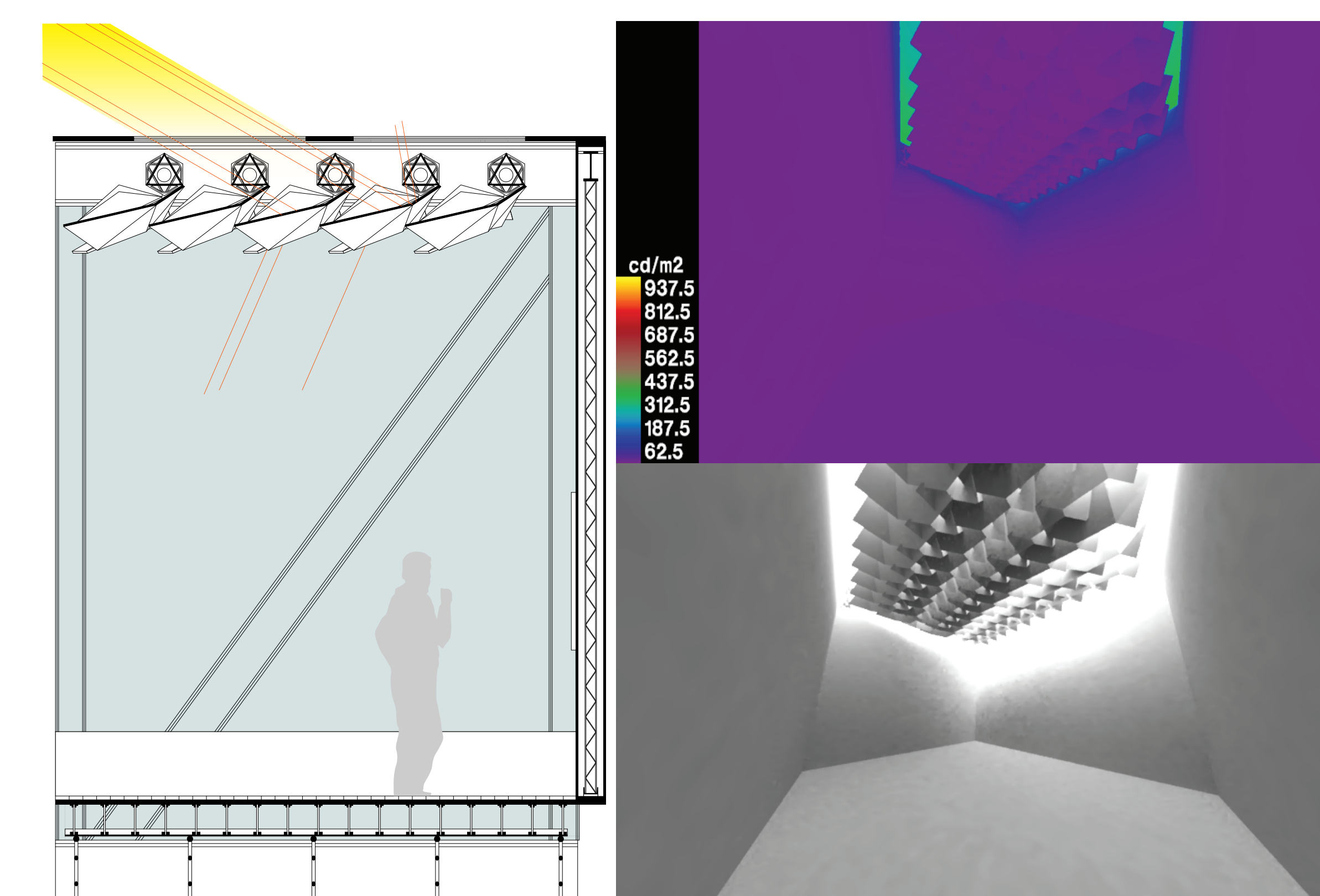
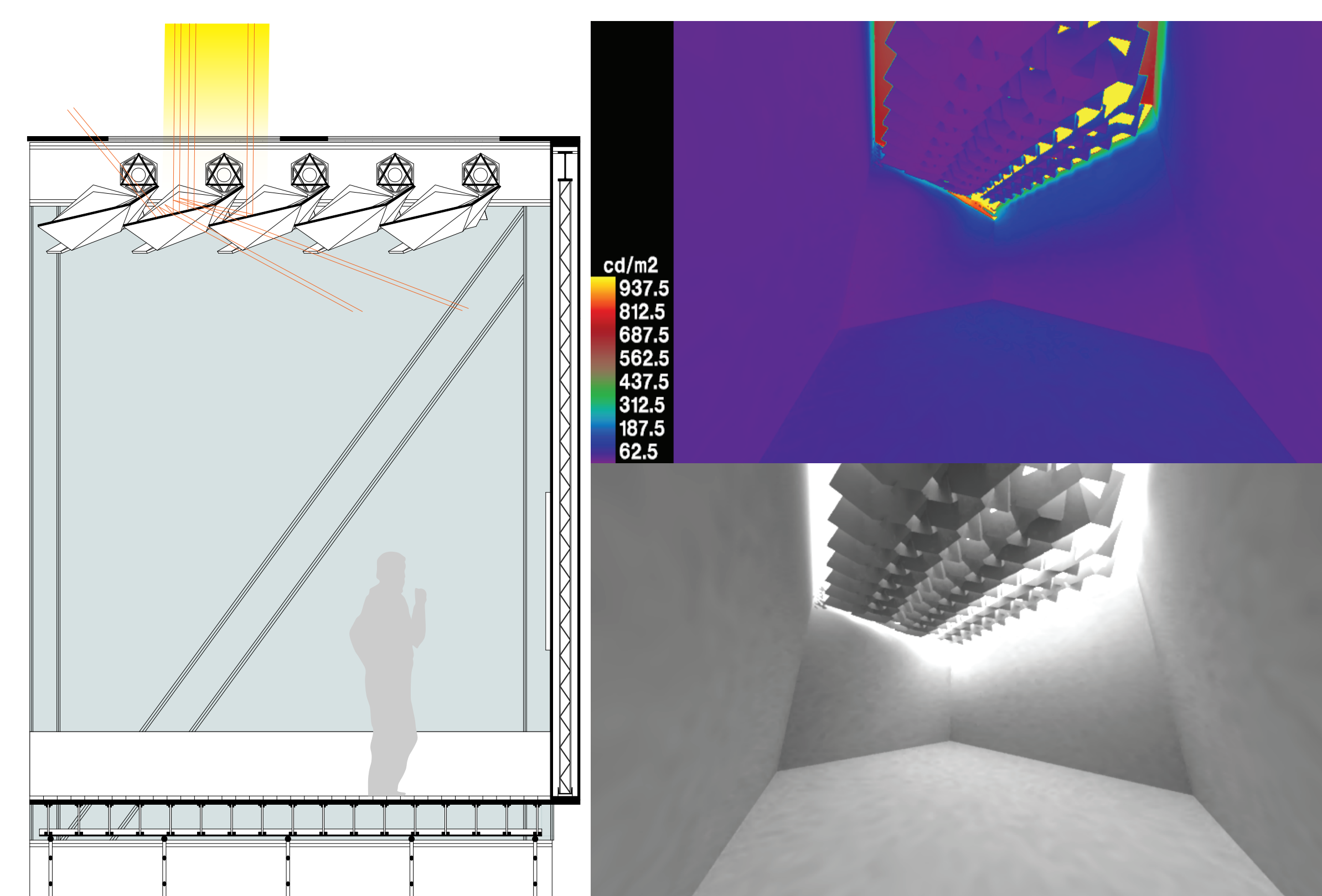
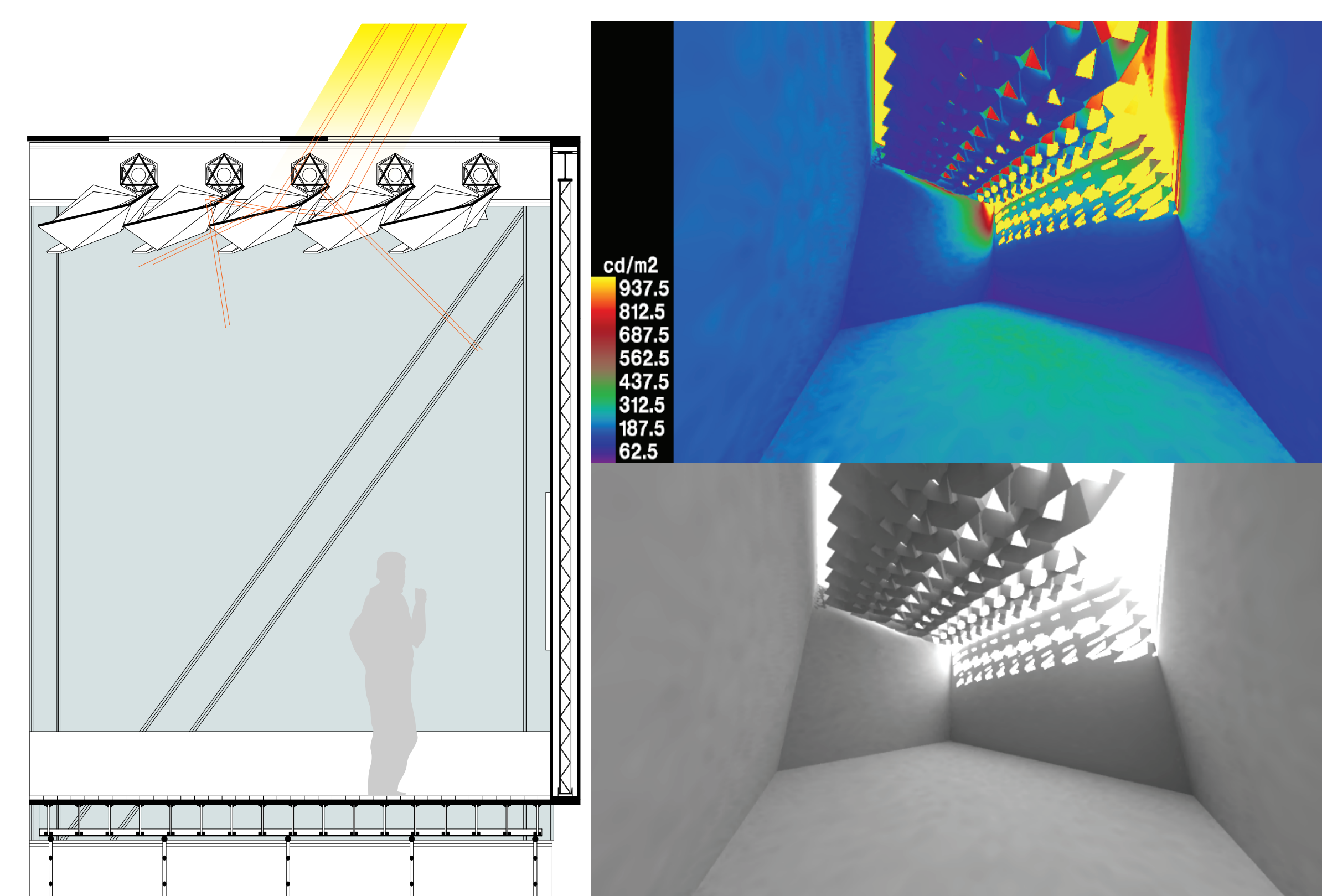
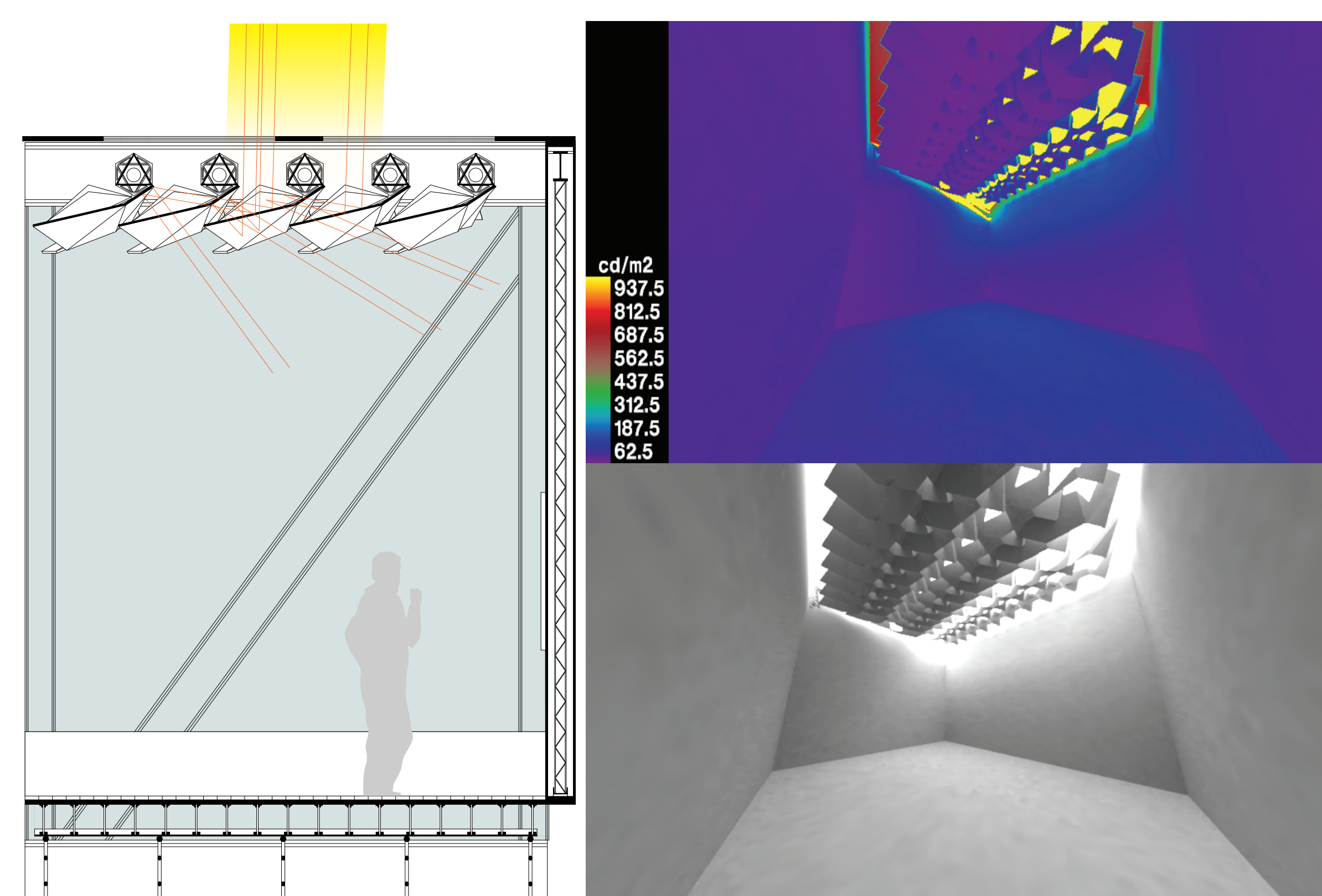
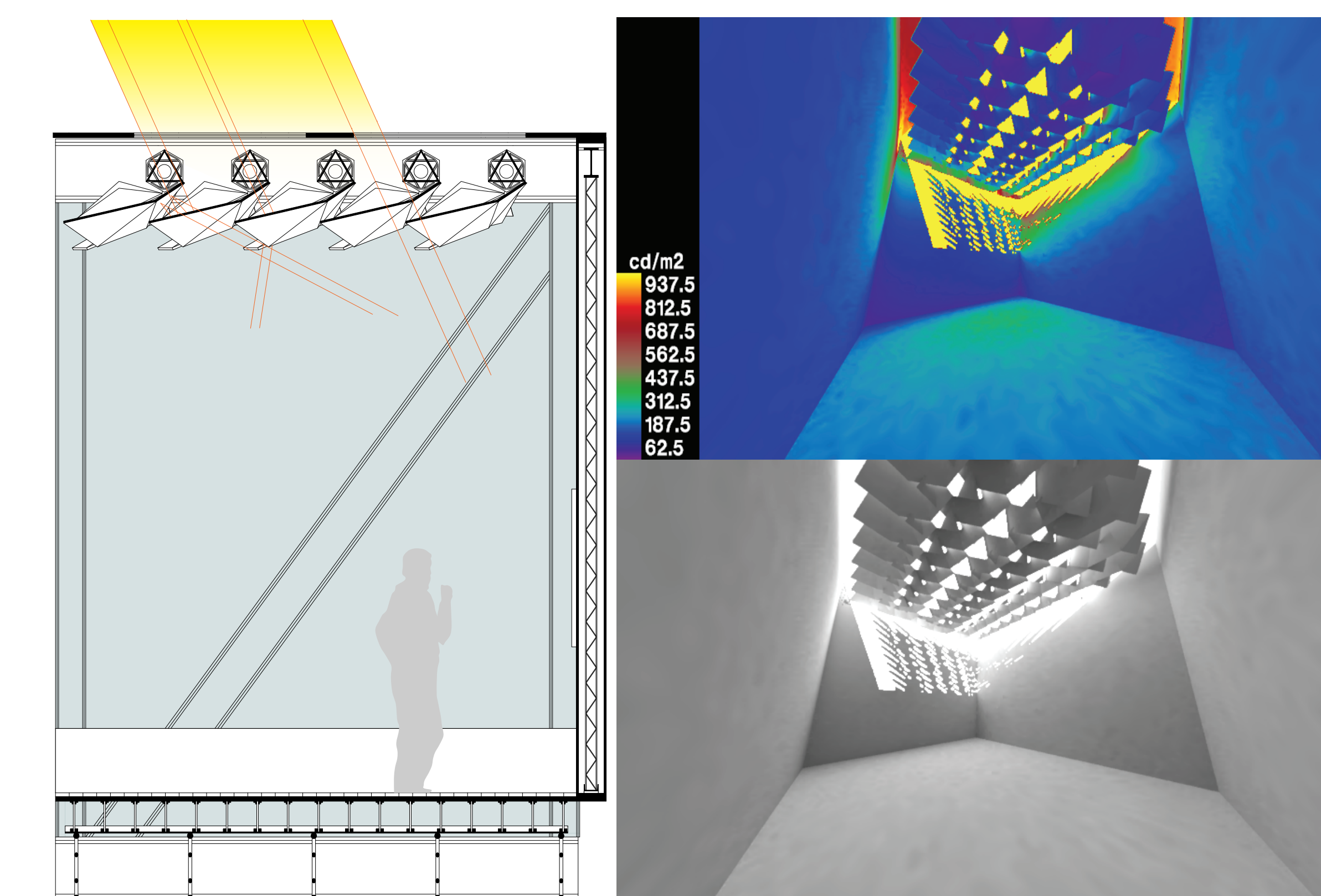
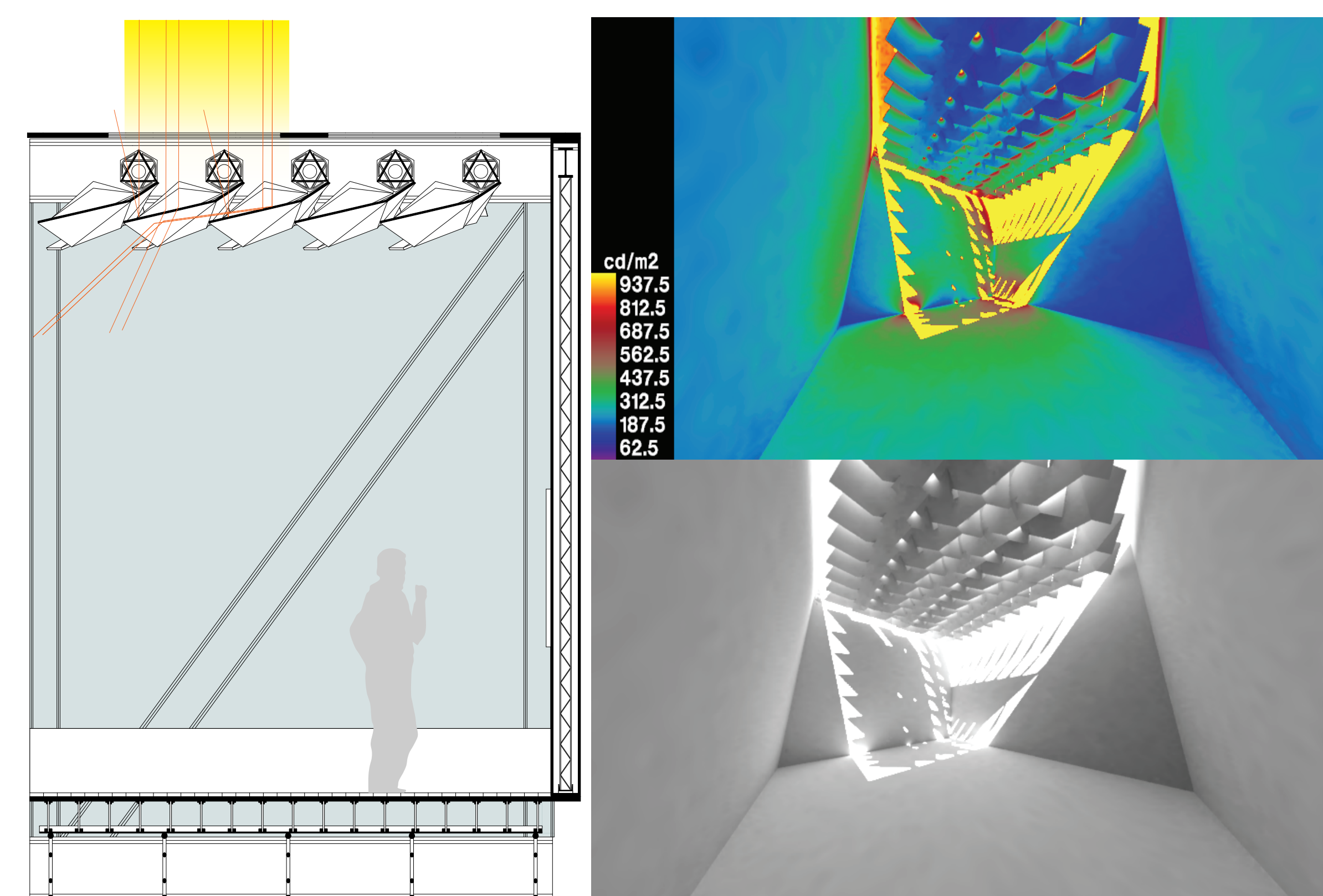
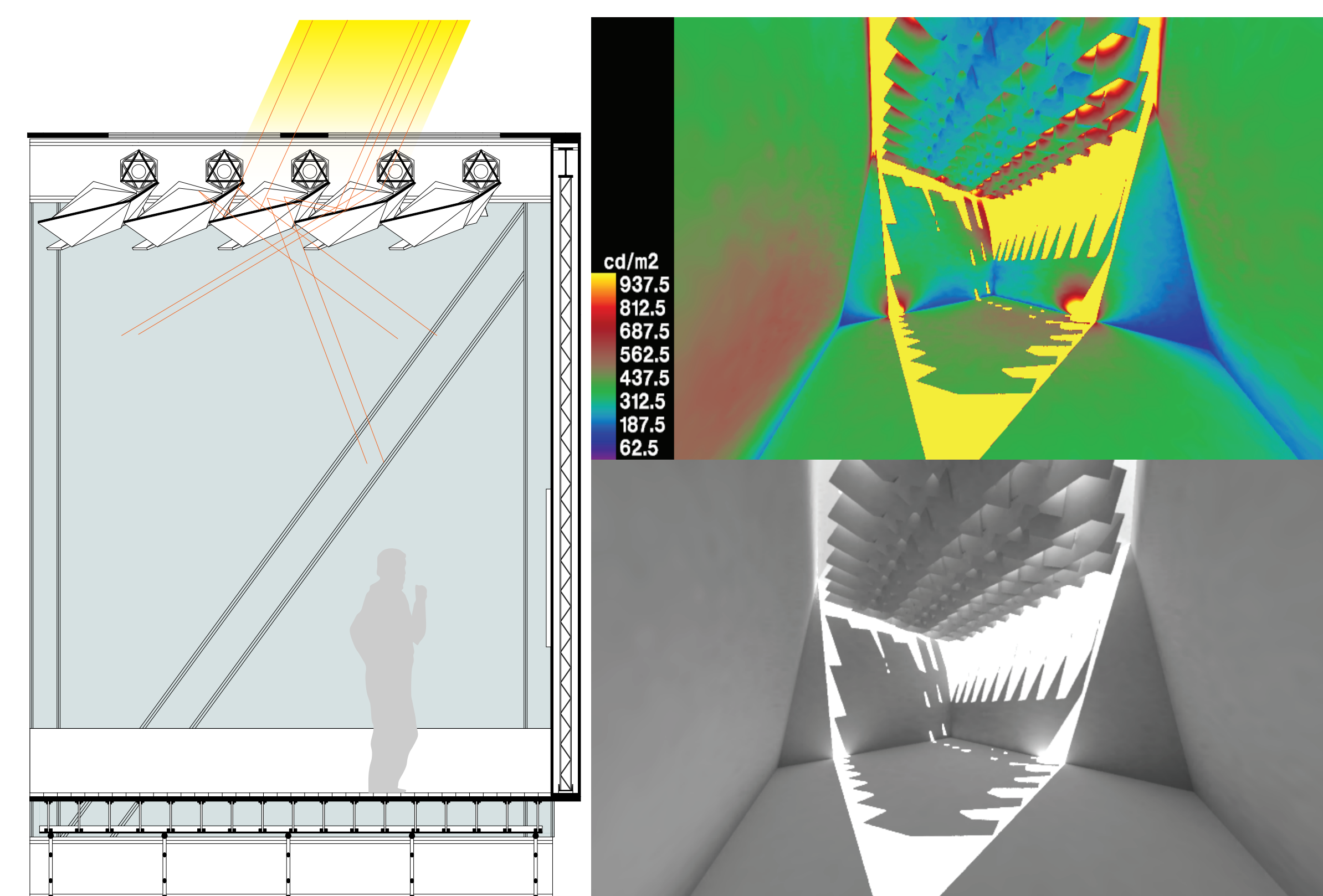
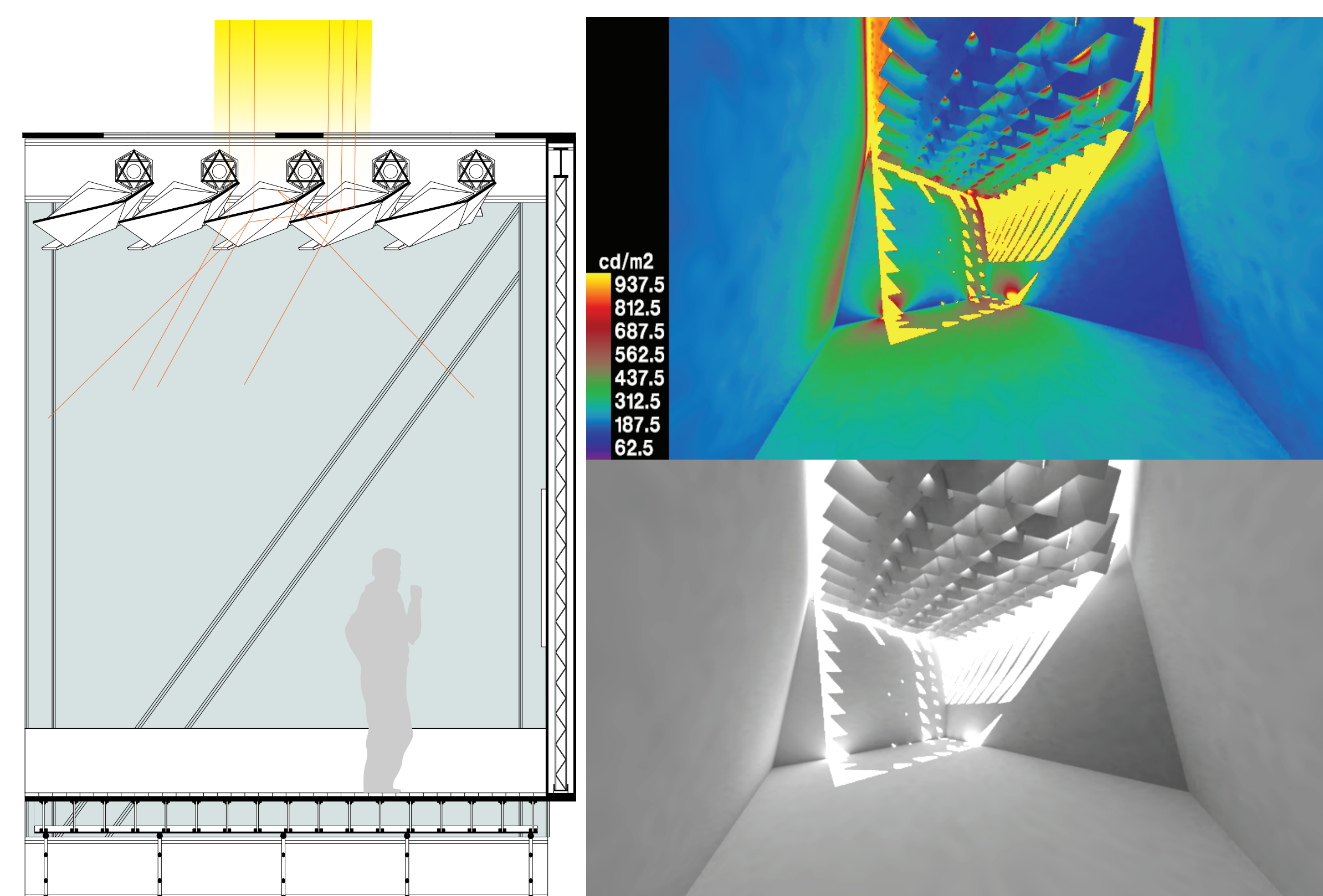
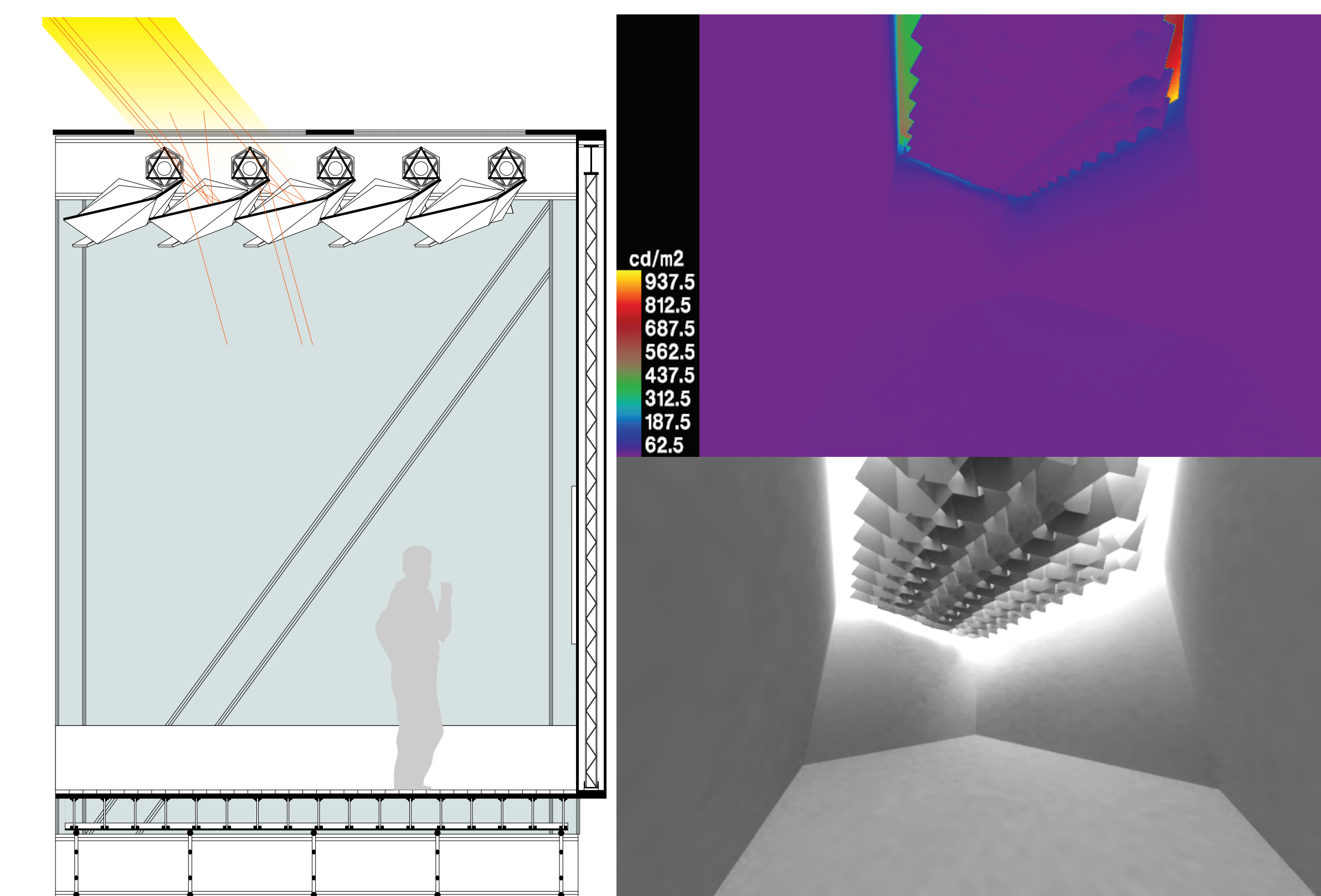
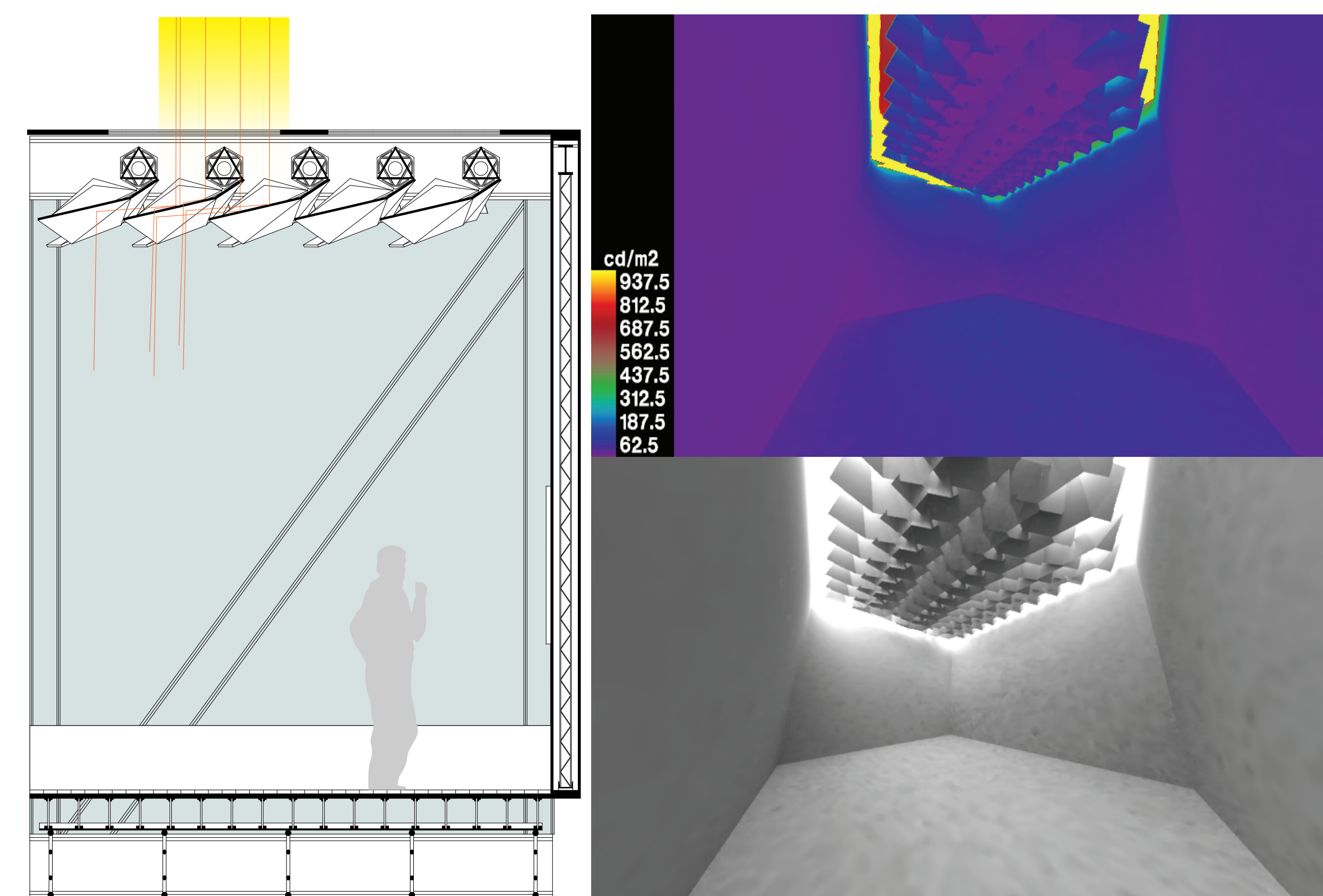
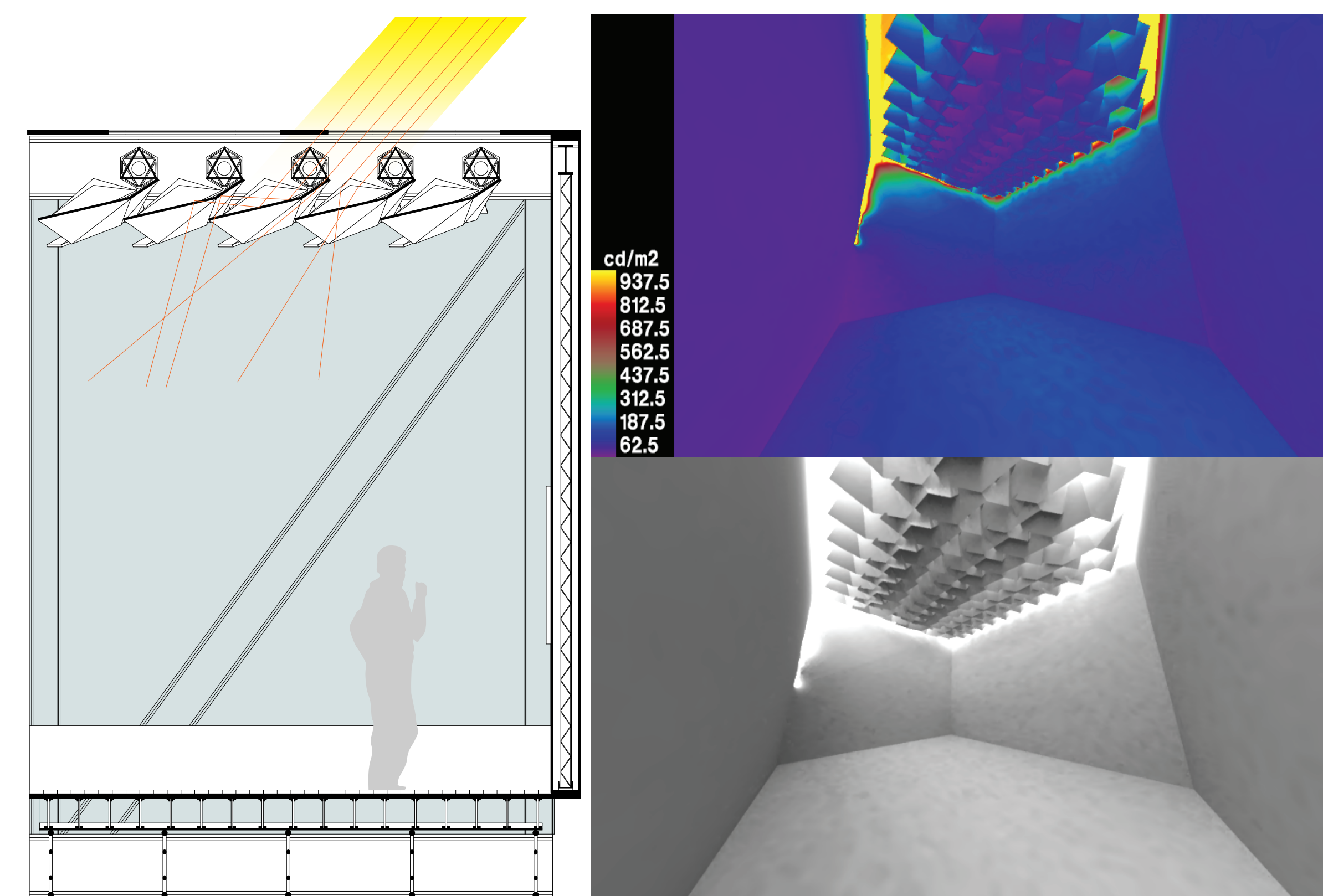
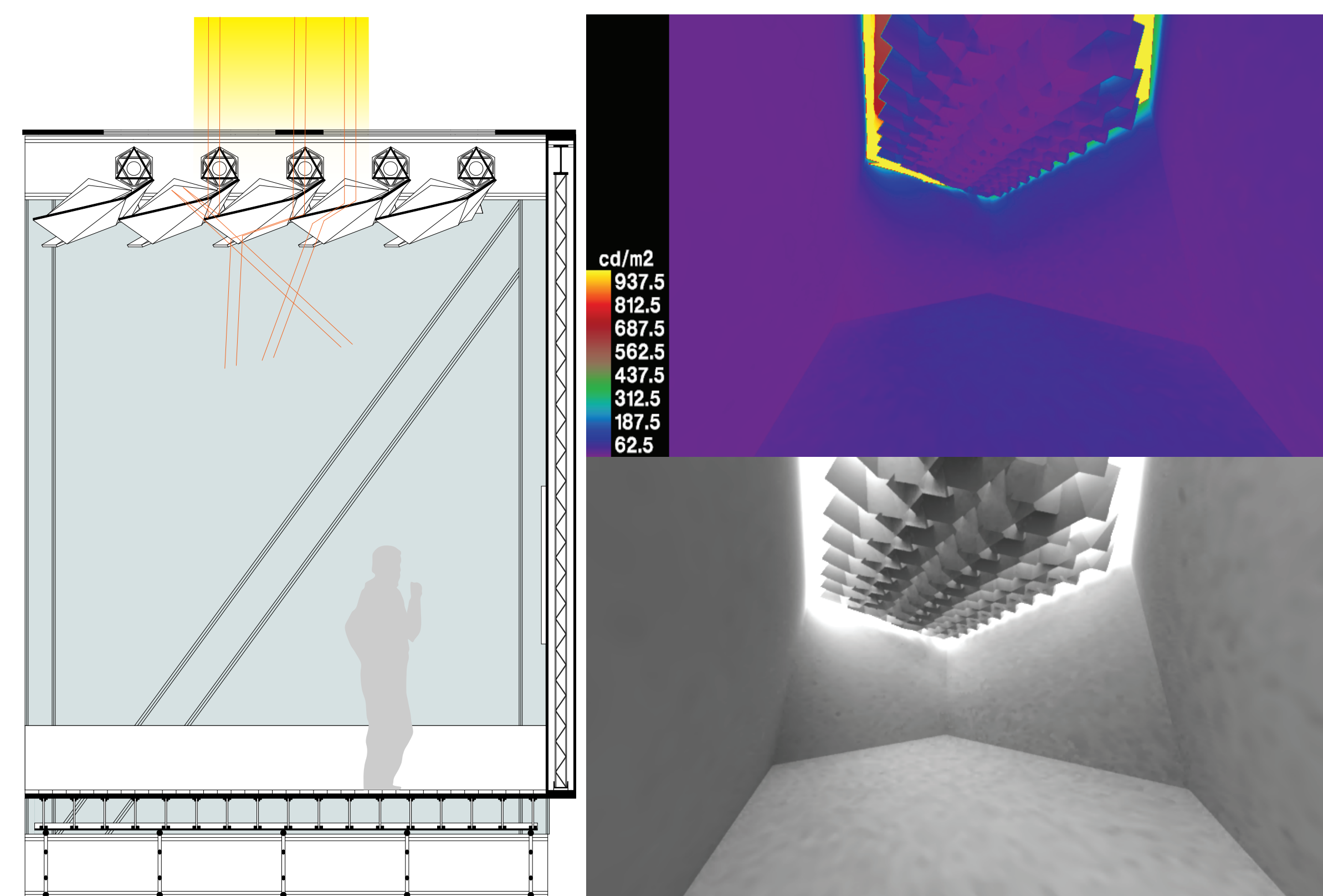
September

December

8AM

1PM

5PM



1PM Illuminance