Performative Architecture | A Measurable Means of Evaluating Formal Systems

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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.

Form Follows Daylight
A Measurable Means of Formal Evaluation

Advisor: David Shanks
Dispensing the Organic Metaphor

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

- Top of Skylight: 23'-10"
- Top of Truss: 22'-1"
- Bottom of Truss: 20'-2"
- Bottom of Leaves: 17'-3"
- Leaf to Leaf Distance: 4'-0"
- Finish Floor: 0'-0"
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

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.

Source: AdvancedBuildings.net
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.

Surfaces & Control Points

These surfaces are joined via a shared side.

Shared sides (joints)

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

15 Sliders per Shade

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
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 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.
The Carnegie Museum of Art & Natural History
Pittsburgh, Pennsylvania
The Carnegie Museum of Art & Natural History
Pittsburgh, Pennsylvania
Proposed Gallery Addition