4.430 Daylighting

Christoph Reinhart
4.430 Scale Models

Seinäjoki Library

Project: Seinäjoki Library, Finland (1965)
Architect: Alvar Aalto

Photo by Cemre Gungör on Wikimedia Commons.
Seinäjoki Library

Latitude 63º N

Summer

Winter

Plan: Donovan Nelson

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Different Shading Strategies

- Static vs. dynamic systems
- Interior vs. exterior systems
- Manual control, automated control, automated with manual override
Scale Models

Computer Simulations & Scale Models I

Computer Simulations & Scale Models II

- costs 10000 Euro
- accuracy under artificial skies within 20%
- provides opportunity to walk around
- used for presentational purposes

Computer Simulations & Scale Models III

- costs ~10000 Euro (including analysis)
- accuracy within 20%
- influenced façade design
- walk around and within
Photographs of manual heliodons from Pacific Energy Center and University of Washington Daylighting Lab, and motorized heliodons from UI-Integrated Design Lab and High Precision devices removed due to copyright restrictions.

Photographs from heliodon facade analysis of Mixed Use Building in Scottsdale, AZ removed due to copyright restrictions.
Photographs of interior of Idaho Central Credit Union in Pocatello, ID with and without shading removed due to copyright restrictions.

Photographs of Idaho Central Credit Union in Pocatello, ID removed due to copyright restrictions.
Artificial Sky – Sky Dome – Sky Simulator

Photographs of Welsh School of Architecture sky dome removed due to copyright restrictions.

Artificial Sky – Sky Dome – Sky Simulator

Photographs of Bartenbach Lichtlabor sky dome and University of Washington daylighting lab removed due to copyright restrictions.
Artificial Sky – Daylight Factor Analysis I

Photograph of model and daylight factor diagram of Ada County Weed and Pest Abatement in Meridian, ID removed due to copyright restrictions.

Artificial Sky – Daylight Factor Analysis II

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Artificial Sky – Visual Analysis

Diagram of control cell and photocell array removed due to copyright restrictions.

Photographs from case study of Rainier Vista Boys & Girls Club in Seattle, WA removed due to copyright restrictions.
Comparison – Scale model Measurements vs. Reality Gallery


‘Scale models tend to overestimate interior illuminances by about 20%’

Reference: S W A Cannon-Brookes, Simple scale models for daylighting design: Analysis of sources of error in illuminance prediction”, Lighting Research and Technology 1997 29(3) 135-142

Parallax Errors in Sky Simulators

Low accuracy (±50%): > tested area
Mid accuracy (±25%): 0.5R long and wide and 0.2R high
High Accuracy (±10%): 0.15R long, 0.05R wide and 0.05R high

‘...on the basis of a credible design goal for the sky simulator dome, high accuracy illuminance predictions (±10%) are practically unattainable ...’

Discussion

- Costs of simulations vs. physical models. Comparable if the infrastructure already exists.
- Different tools for different objectives: Physical models shine when it comes to complicated materials with ‘imperfections’. Another application are getting a sense for massings and proportions.
- Simulations can look at all sky conditions of the year.

Material Selections
Using the Heliodon

Adjust 3 angles:
\( \theta = 90^\circ \) - site latitude
\( \alpha = \) stand should directly face the sun
\( \beta = \) rotate until the sun’s shadow corresponds to the desired day of the year

Modes of Analysis

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