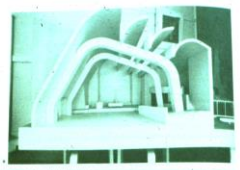
Daylighting Models



Jake Dunn* as Alvar Aalto

***Now Principal at ZGF, Portland**

1

You need three things:

Model **"light-tight and big enough"**	
Sky **"clear or cloudy… real or not"**	
Sensor **"eye, camera, or meter"**	

2

Real Skies…

The real sky…perfectly cloudy or perfectly clear…

Eden Project Grimshaw

3

Artificial Skies…

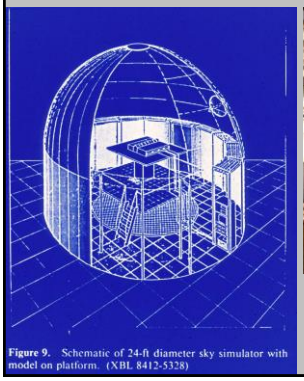
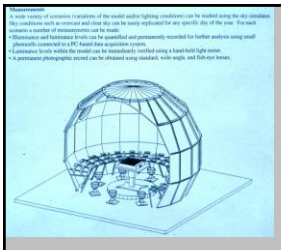


Figure 9. Schematic of 24-ft diameter sky simulator with model on platform. (XBL 8412-5328)

Hemispheric Skies
ECS Lab
UC Berkeley

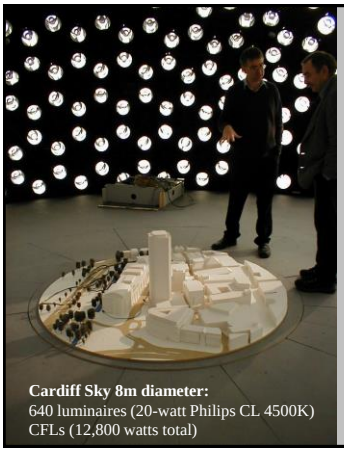
4



↑ **University of Michigan**

Cardiff University →

5



Cardiff Sky 8m diameter:
640 luminaires (20-watt Philips CL 4500K) CFLs (12,800 watts total)

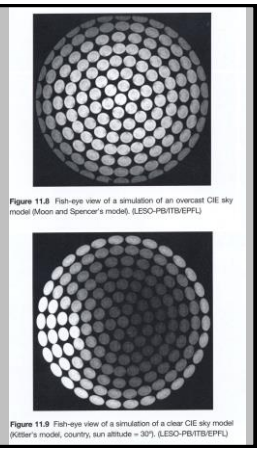


Figure 11.8 Fish-eye view of a simulation of an overcast CIE sky model (Moon and Spencer's model). (LESO-PB/ITB/EPFL)

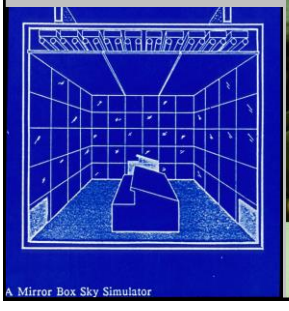
Figure 11.9 Fish-eye view of a simulation of a clear CIE sky model (Kittler's model, country, sun altitude = 30°). (LESO-PB/ITB/EPFL)

6

7

Mirror Box Skies

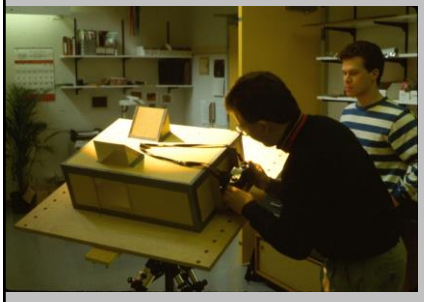
Seattle Lighting Design Lab



8

9

Sun Simulator…heliodons



Seattle Lighting Design Lab
(indoor)

UI Architecture
(outdoor)

10

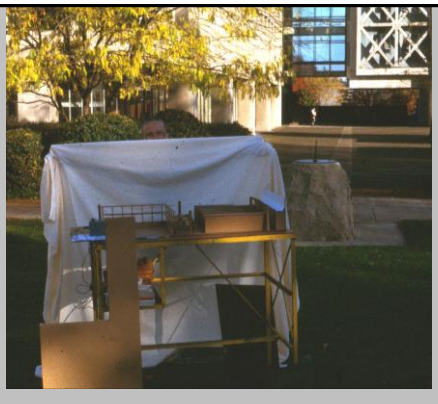
IDL Boise

Mirrorbox Sky

Heliodon

Mirror-Box Artificial Sky uses twenty-two
59-watt fluorescent lamps (1,298 watts total)

11



…when the sun shines relentlessly…use a diffuser

12

…or when it rains relentlessly…use a diffuser

13

Is a daylighted artificial sky possible?

Start with a napkin sketch…

14

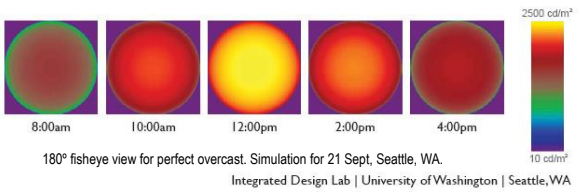
Why is a daylighted artificial sky desirable?

Three reasons—

- **Philosophical:** Is there a passive tool that could encourage this mindset and be used to test daylighting models?
- **Qualitative:** Could natural light be used for model testing?
- **Environmental:** Is there a zero-energy alternative to electrically lighted artificial skies?

15

Design Goal



180° fisheye view for perfect overcast. Simulation for 21 Sept, Seattle, WA.

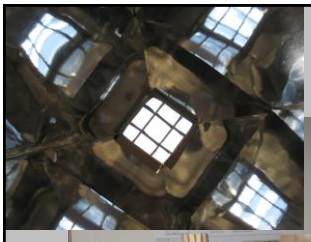
Integrated Design Lab | University of Washington | Seattle, WA

The brightness of even the ideal overcast sky varies significantly during each day.

However, the distribution of light is constant—3x brighter at the zenith.

So, our goal is to provide proper distribution, not specific luminance.

16



Experiment: Build some models…

17

YES!

18

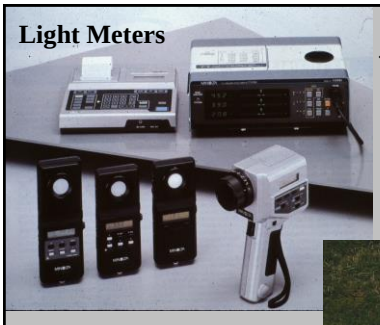
Sensors…

…your eyes…

…a camera…

19

Light Meters



…for full-size spaces…

…for models…

20

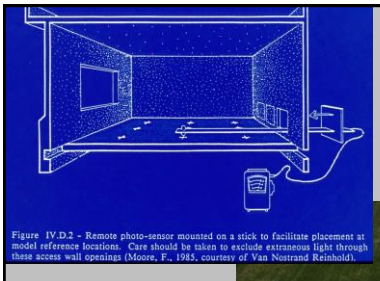
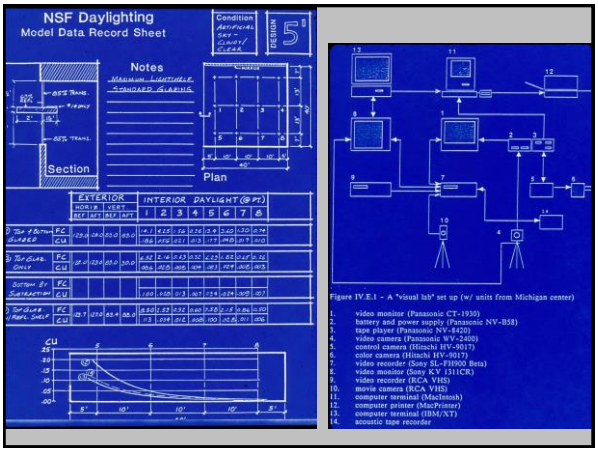


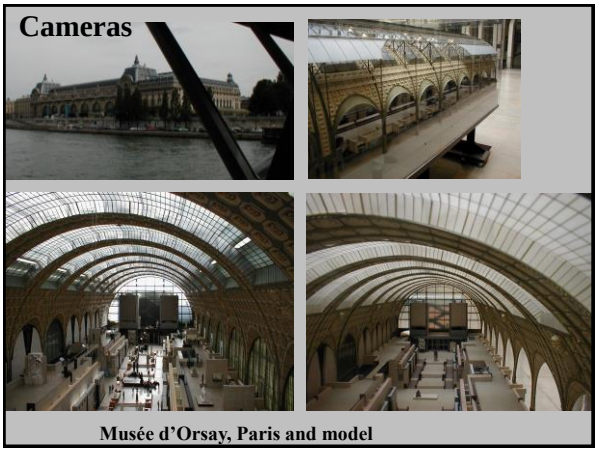
Figure IV.D.2 - Remote photo-sensor mounted on a stick to facilitate placement at model reference locations. Care should be taken to exclude extraneous light through these access wall openings (Moore, F., 1985, courtesy of Van Nostrand Reinhold).

Jeff Burke,
Now Assoc. Principal at
RTKL/Callison, Seattle

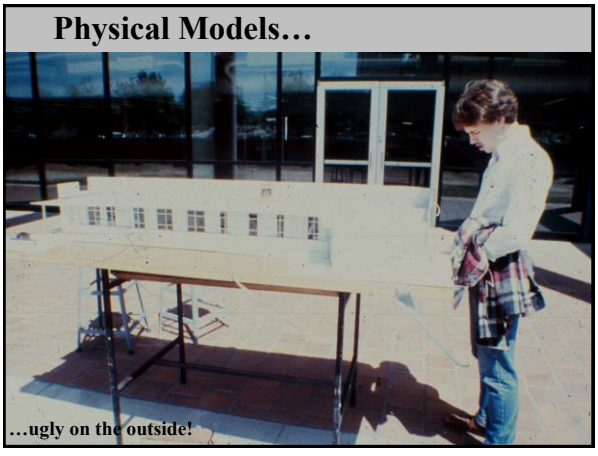
21


NSF Daylighting
Model Data Record Sheet
Notes
Section
Plan
EXTERIOR
INTERIOR DAYLIGHT (@ PT)
Figure IV.E.1 - A "visual lab" set up (w/ units from Michigan center)
1. video monitor (Panasonic CT-1930)
2. battery and power supply (Panasonic NV-B58)
3. tape player (Panasonic NV-8420)
4. video camera (Panasonic WV-2400)
5. control camera (Hitachi HV-9017)
6. color camera (Hitachi HV-9017)
7. video recorder (Sony SL-F1000 Beta)
8. video monitor (Sony KV 1311CR)
9. video recorder (RCA VHS)
10. movie camera (RCA VHS)
11. computer terminal (MacIntosh)
12. computer printer (MacPrinter)
13. computer terminal (IBM/XT)
14. acoustic tape recorder

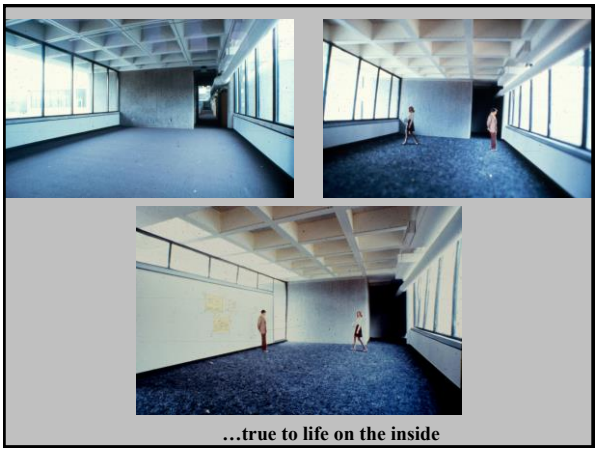
22


Cameras
Musée d'Orsay, Paris and model

23

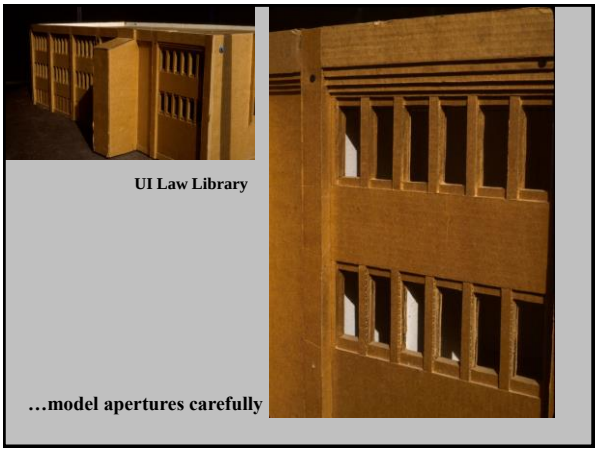

Physical Models…
…ugly on the outside!

24



…true to life on the inside

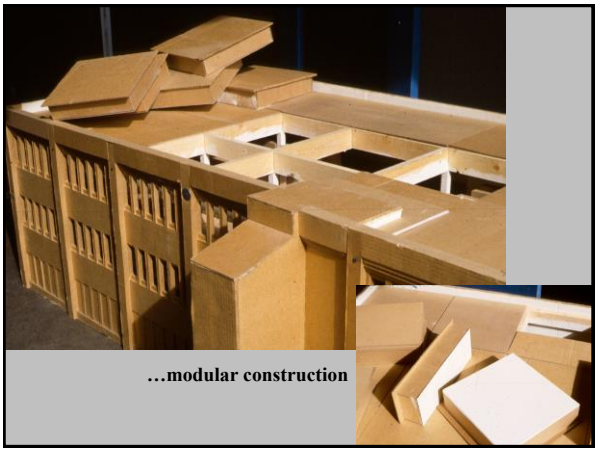
25



UI Law Library

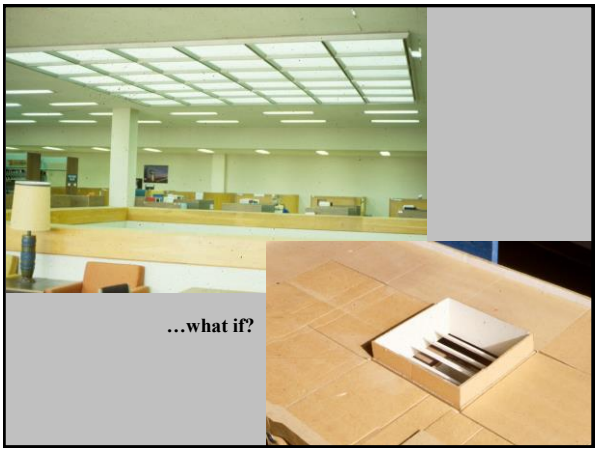
…model apertures carefully

26

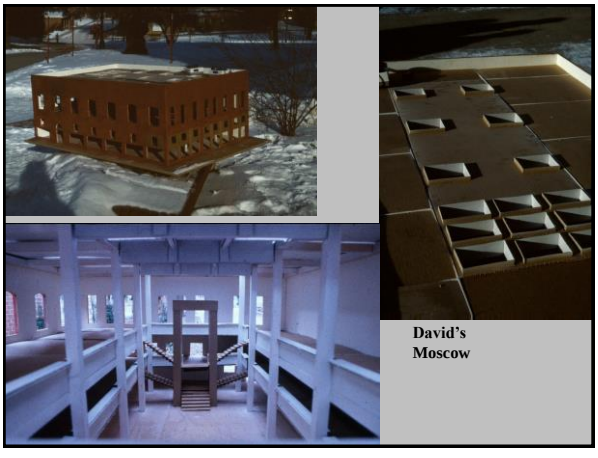


…modular construction

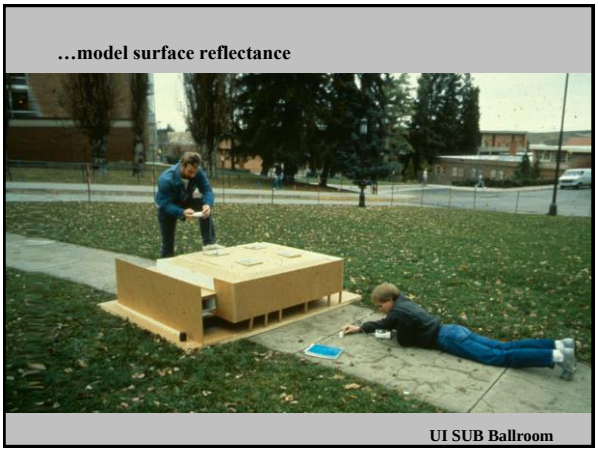
27


…what if?

28

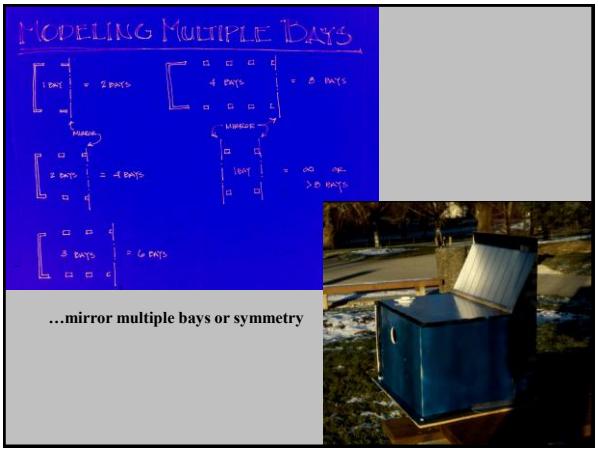

David's
Moscow

29


…model surface reflectance
UI SUB Ballroom

30

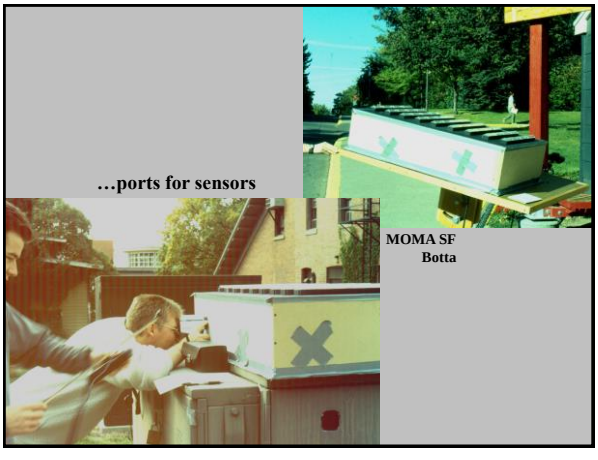
31



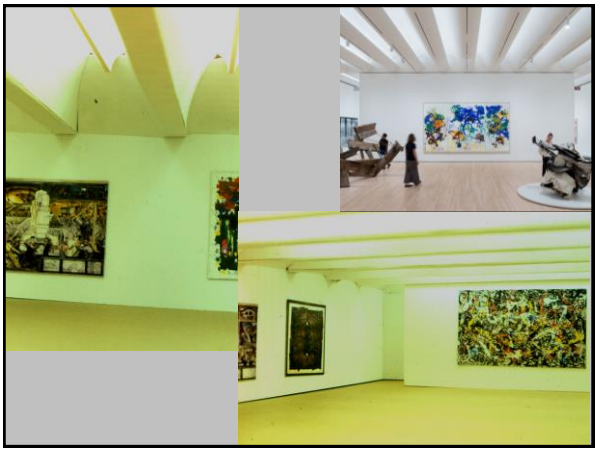
32

33

34



35

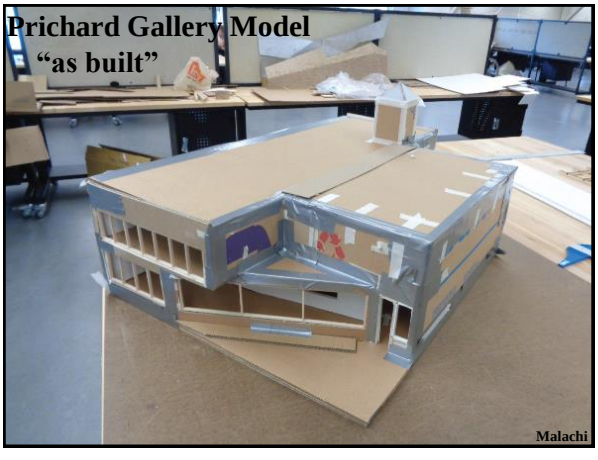


36

Kimbell Art Museum
Kahn

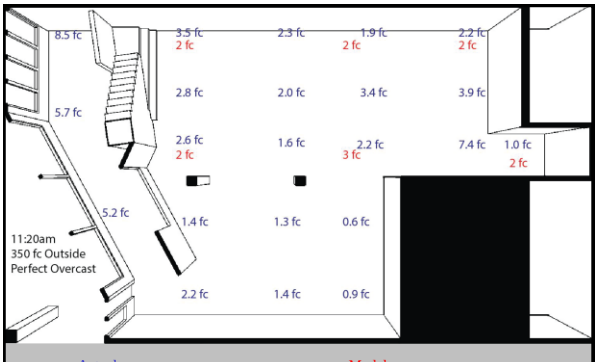
37

Prichard Gallery Model
"as built"



Malachi

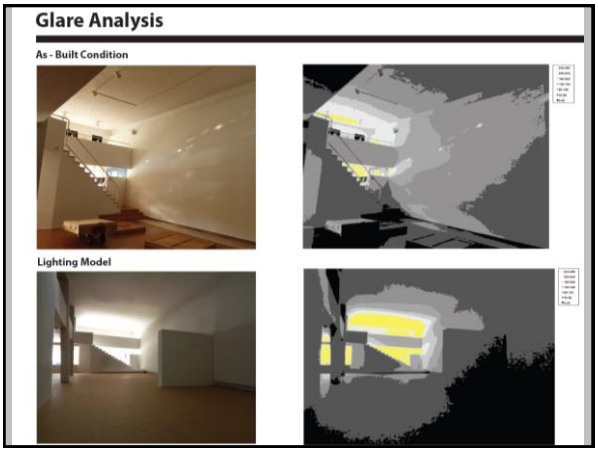
38



Actual
*readings taken with
WHITEGOODS Light Meter
*Sky Condition
10/8 Partial Overcast

Model
*readings taken with
Minolta Light Meter
*Sky Condition
11/3 Complete Overcast

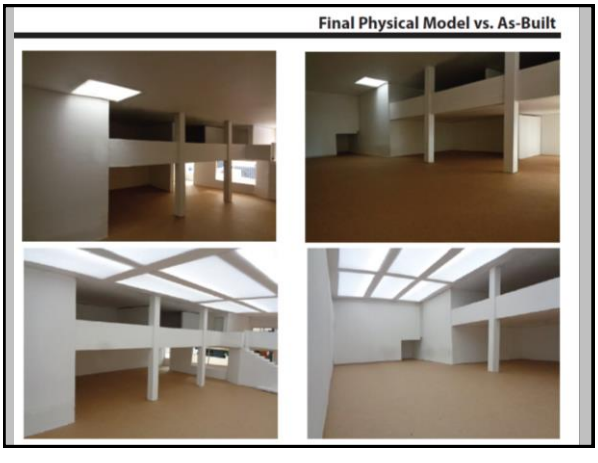
39


Glare Analysis
As - Built Condition
Lighting Model

40

AGi-32 Model

41


Final Physical Model vs. As-Built

42