Sefaira's Method for Rapidly Calculating Daylight Metrics Using Radiance

New York • London

Trimble®

Kerger Truesdell, AIA, LEED AP

Product Manager, Sefaira
New York, NY

Experience:
MBH Architects
Hart | Howerton
FME Architecture + Design

Education:
University of Notre Dame
B. Arch '07 MBA '14

Best coast?
The West Coast.

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Howard Roark — Greg Ward

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Today's guiding questions:

- What problem does Sefaira solve, and for whom?
- What unique challenges does Sefaira face?
- How does Sefaira apply Radiance in meeting those challenges?

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Sefaira makes it easy for teams to meet project performance goals.

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Sefaira Daylighting supports Architects and Specialists at early-stage design.

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Project teams won't meet goals by accident.

They must assess performance early and often, in order to:

- **support comparative iteration**
- **ensure their project is on track** to meeting performance goals
- **construct a design narrative** around high performance solutions
  - *Supports and justifies design decisions*
  - *Fosters a trusting relationship with the client*

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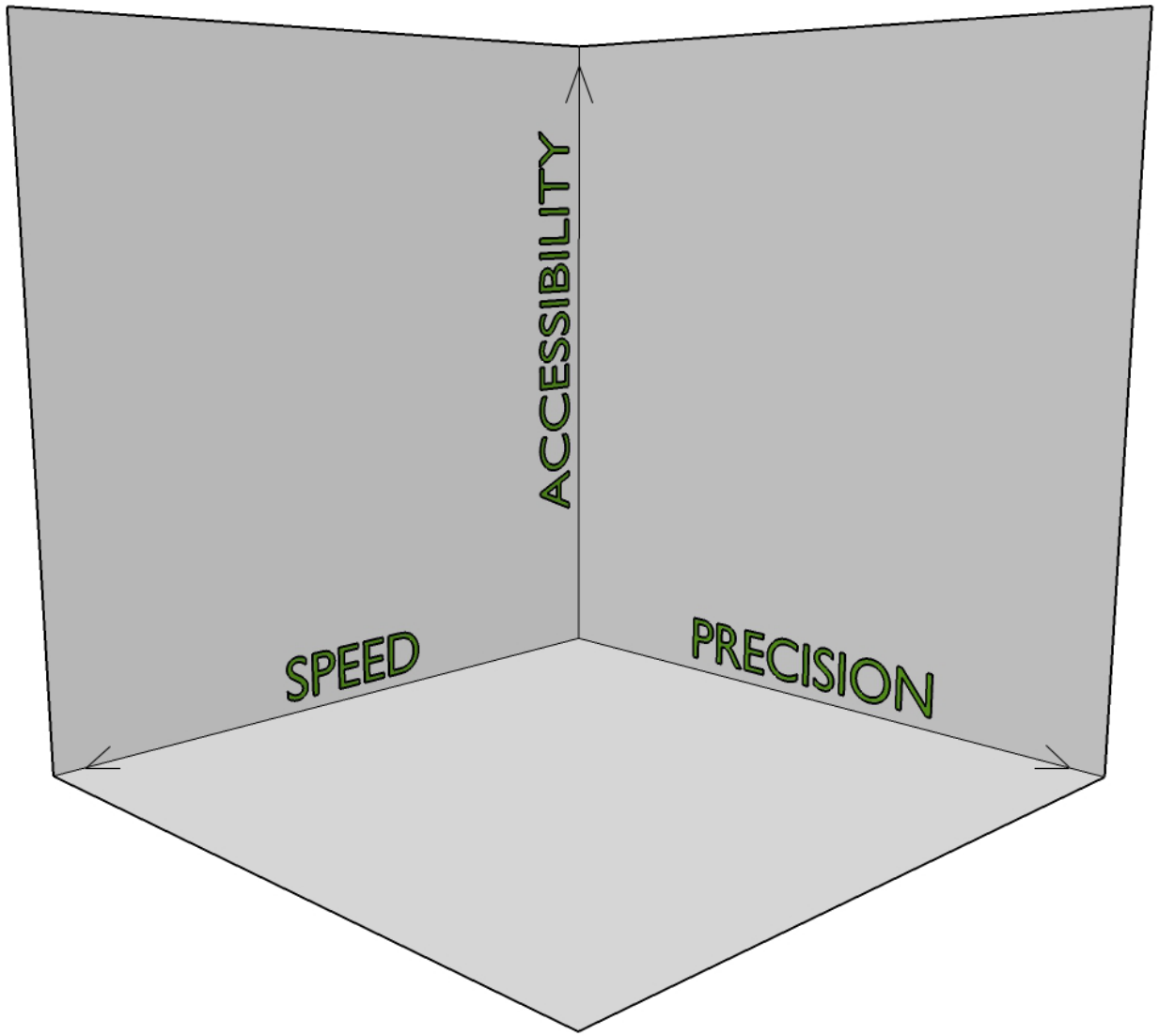
Project teams need the right tools.



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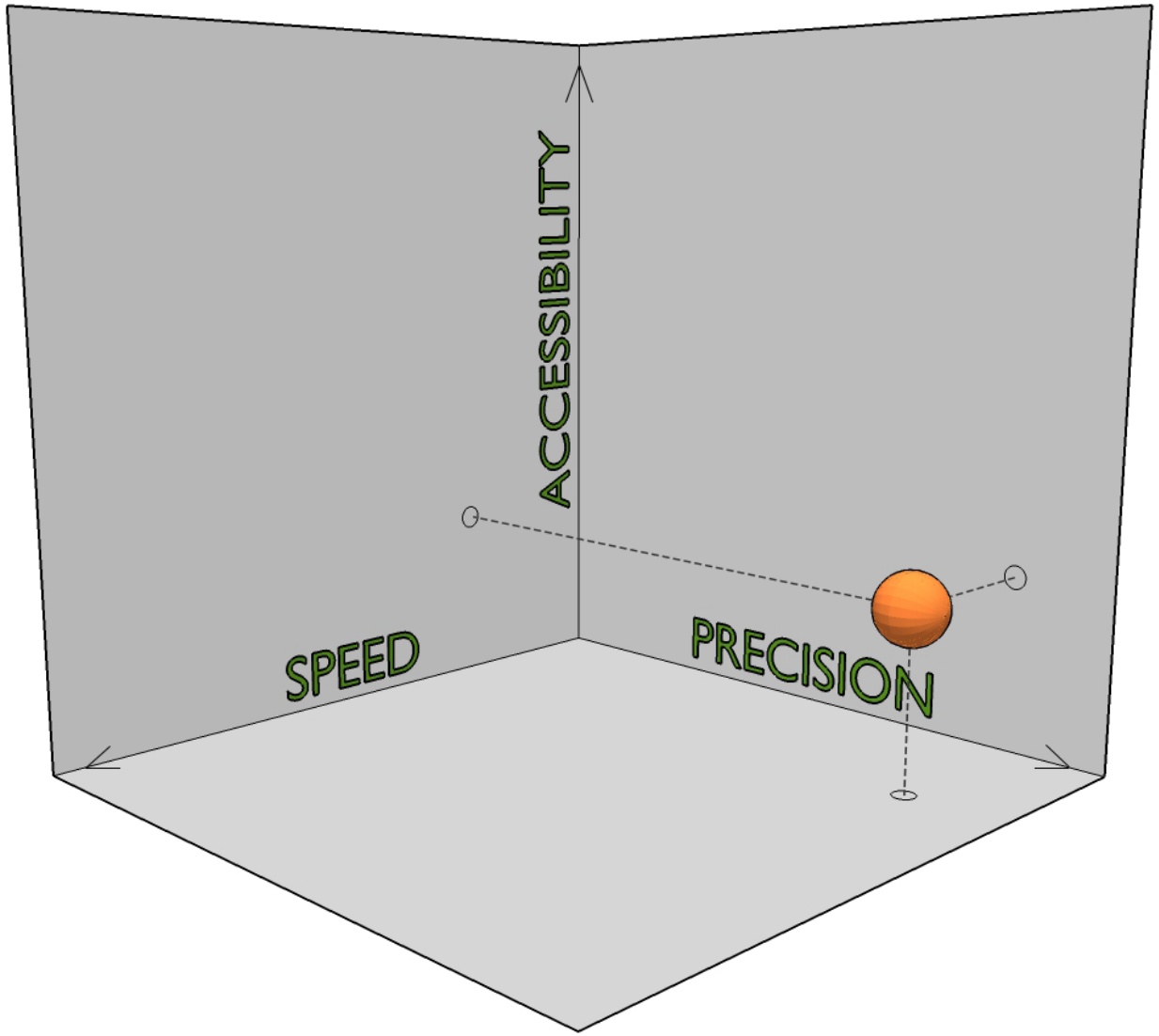

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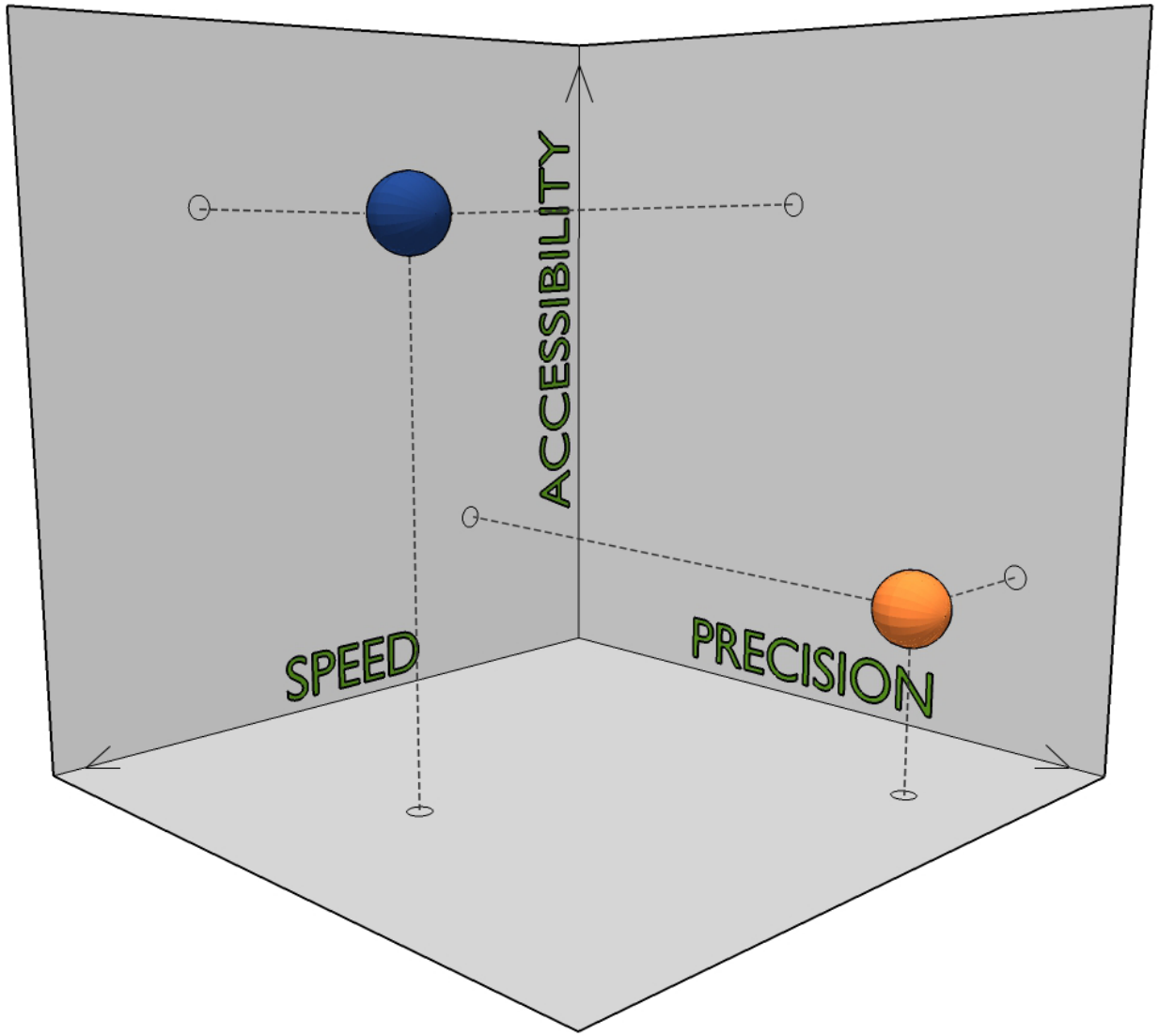

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Speed • Accessibility • Precision

How do we deliver the right balance of Speed, Accessibility, and Precision for early-stage performance analysis?

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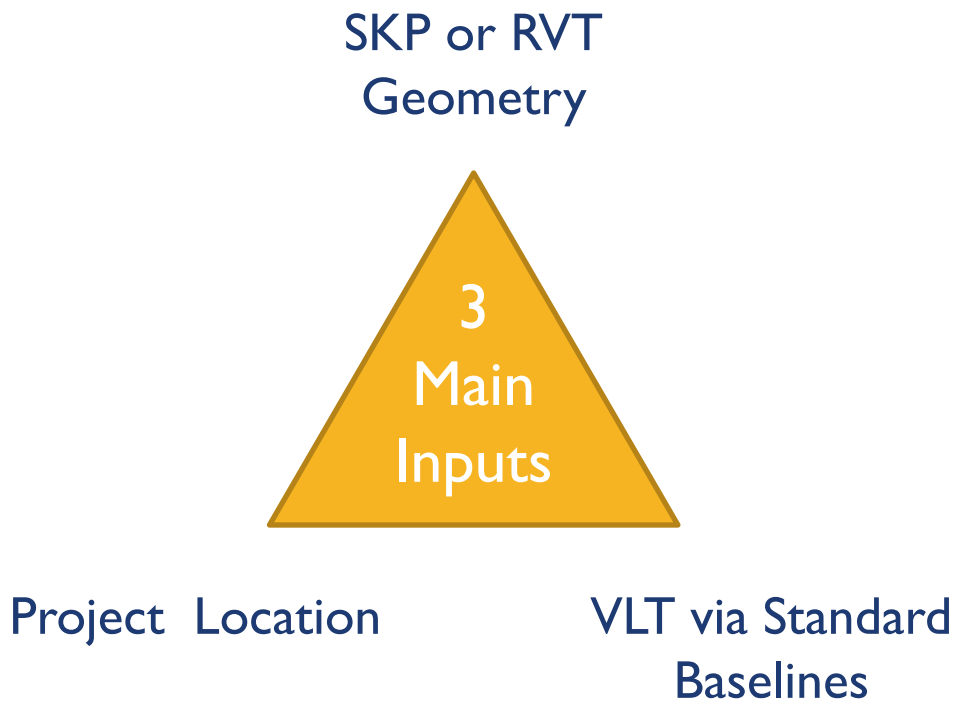
Speed • Accessibility • Precision

- Fast setup
- Parallelization in the cloud
  - Consume sensor array in pieces.
  - Use multiple processors to churn through rtrace.
- Daylight Coefficients (DAYSIM)



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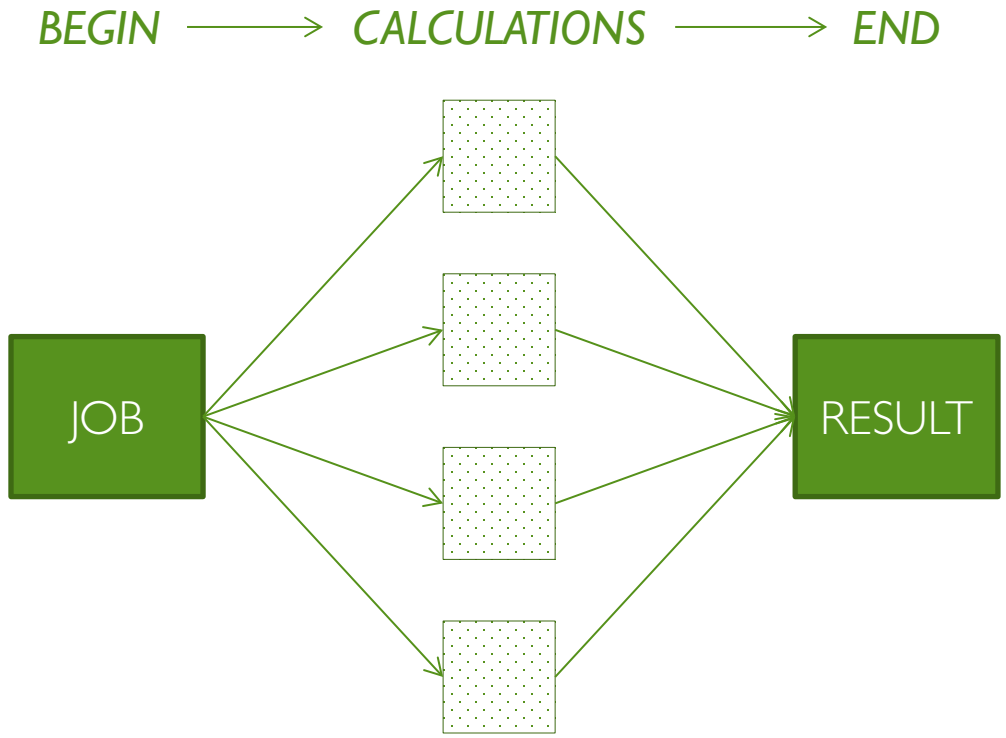

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  - Geometry & Materials
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  - Location-based information
  - Simulation-specific settings
- Communication
  - Metrics
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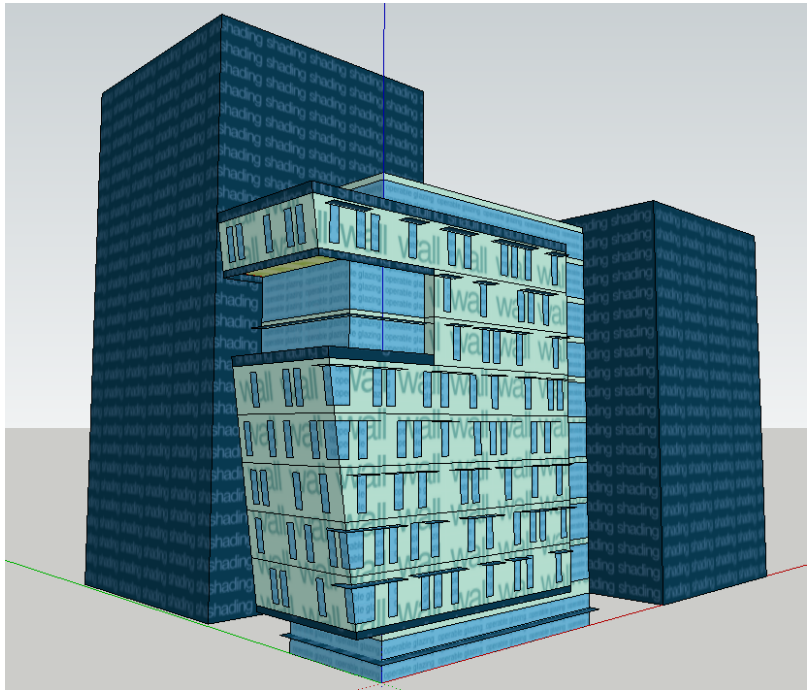

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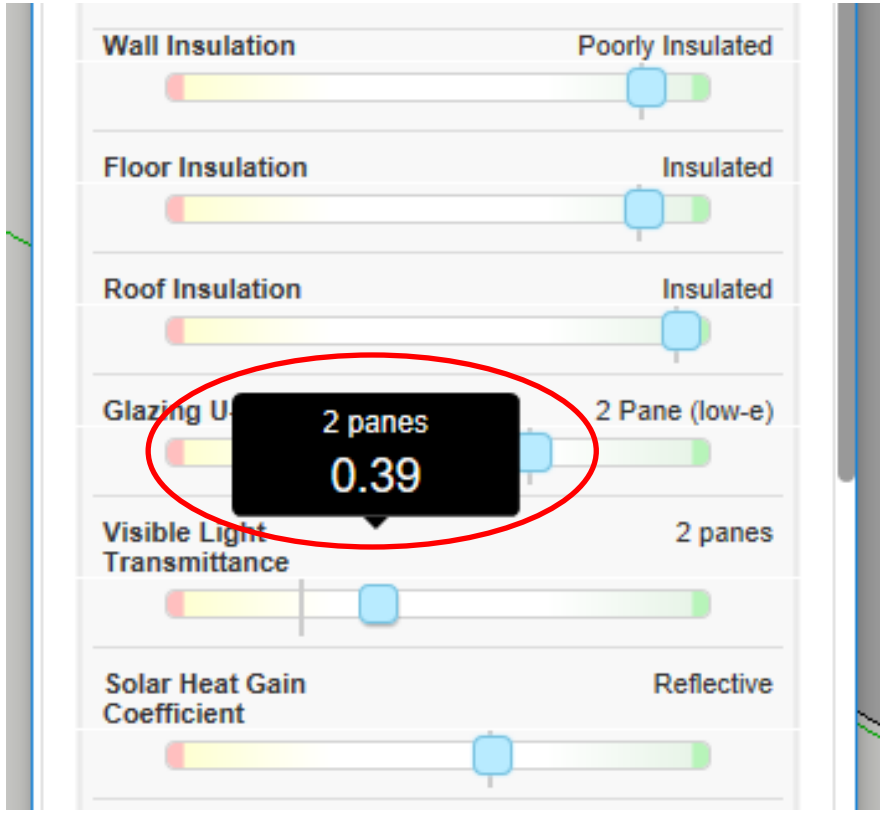

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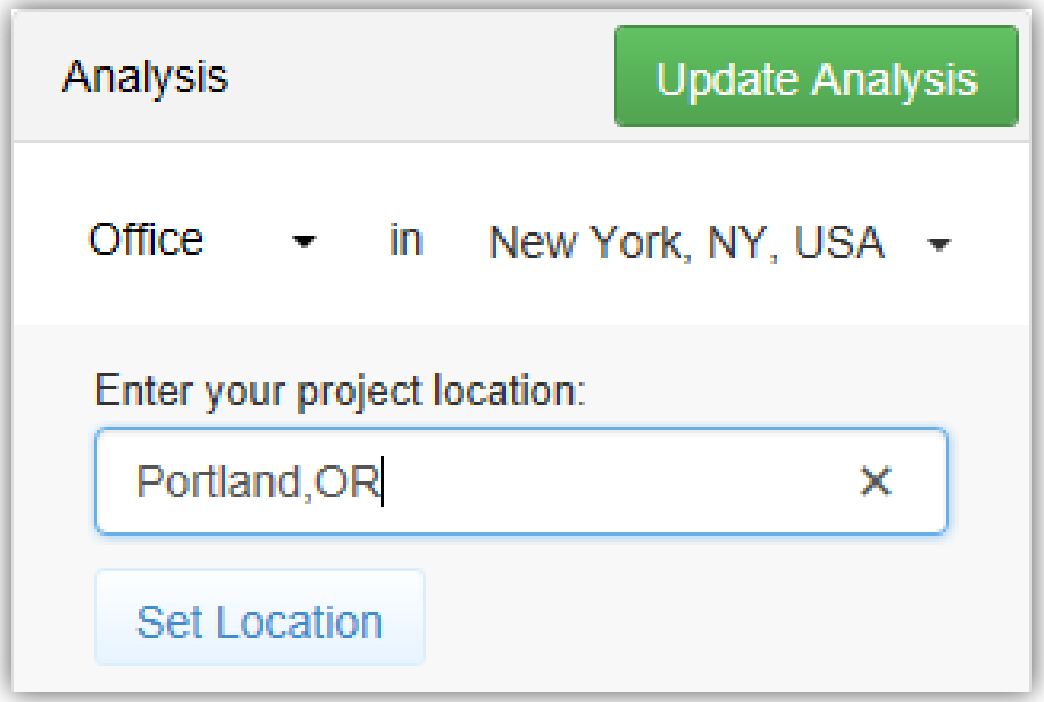

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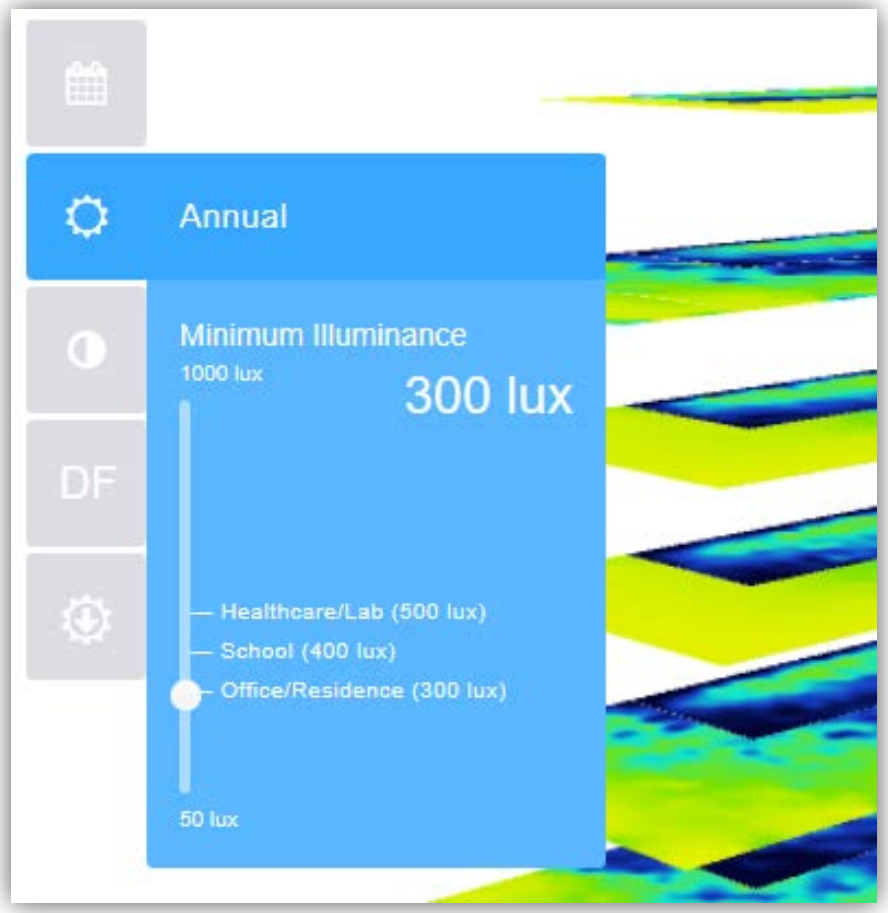

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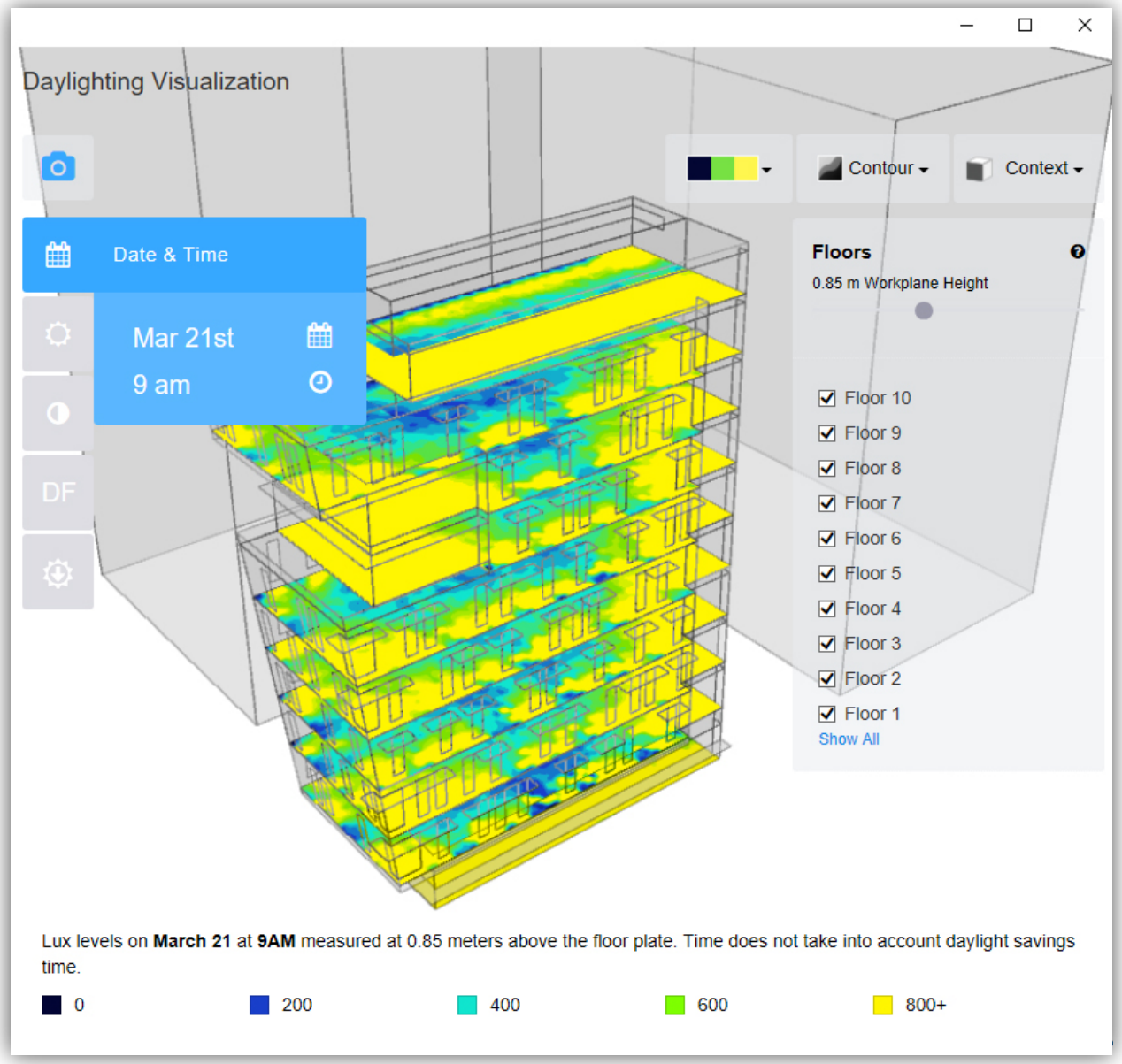

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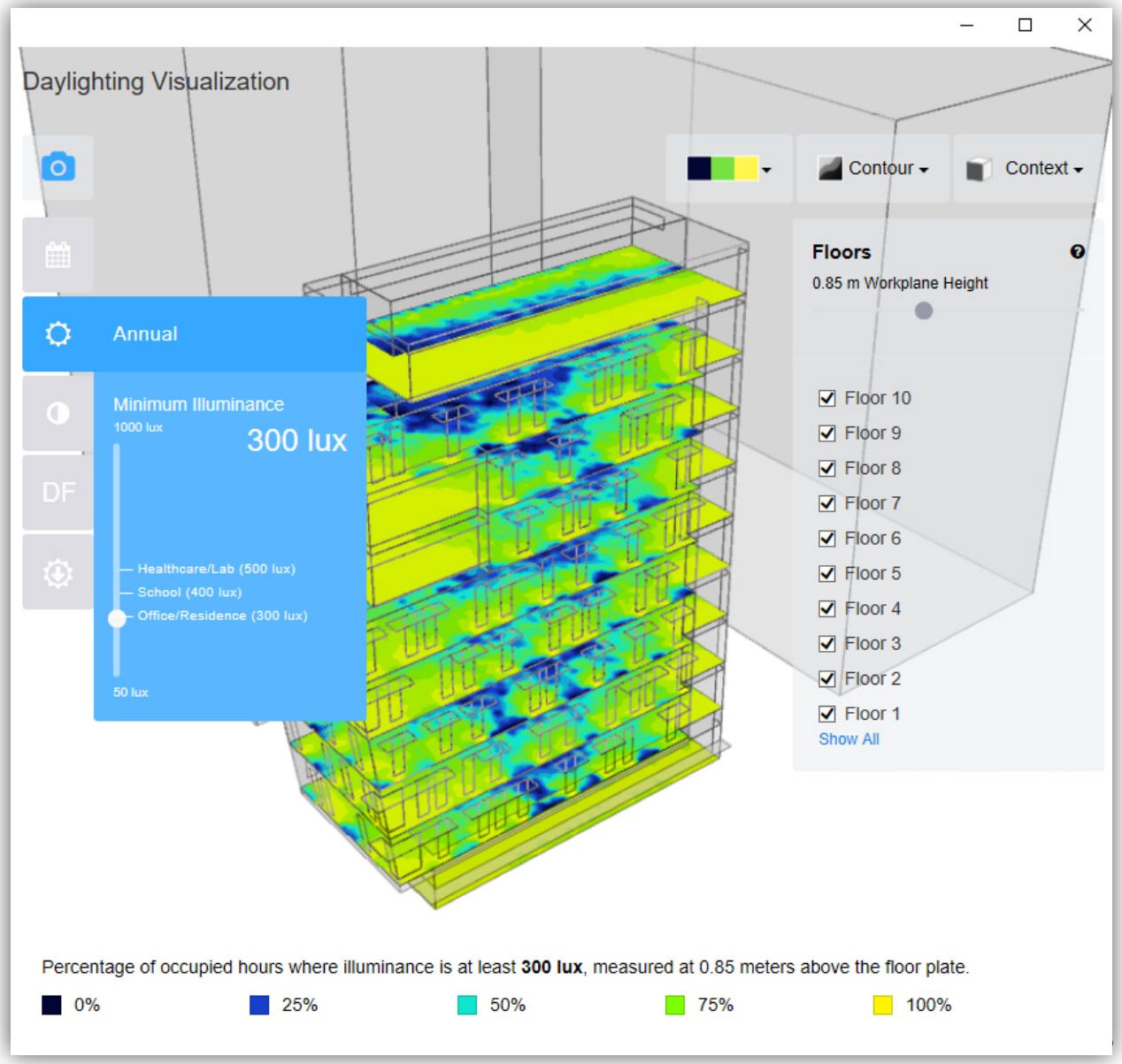

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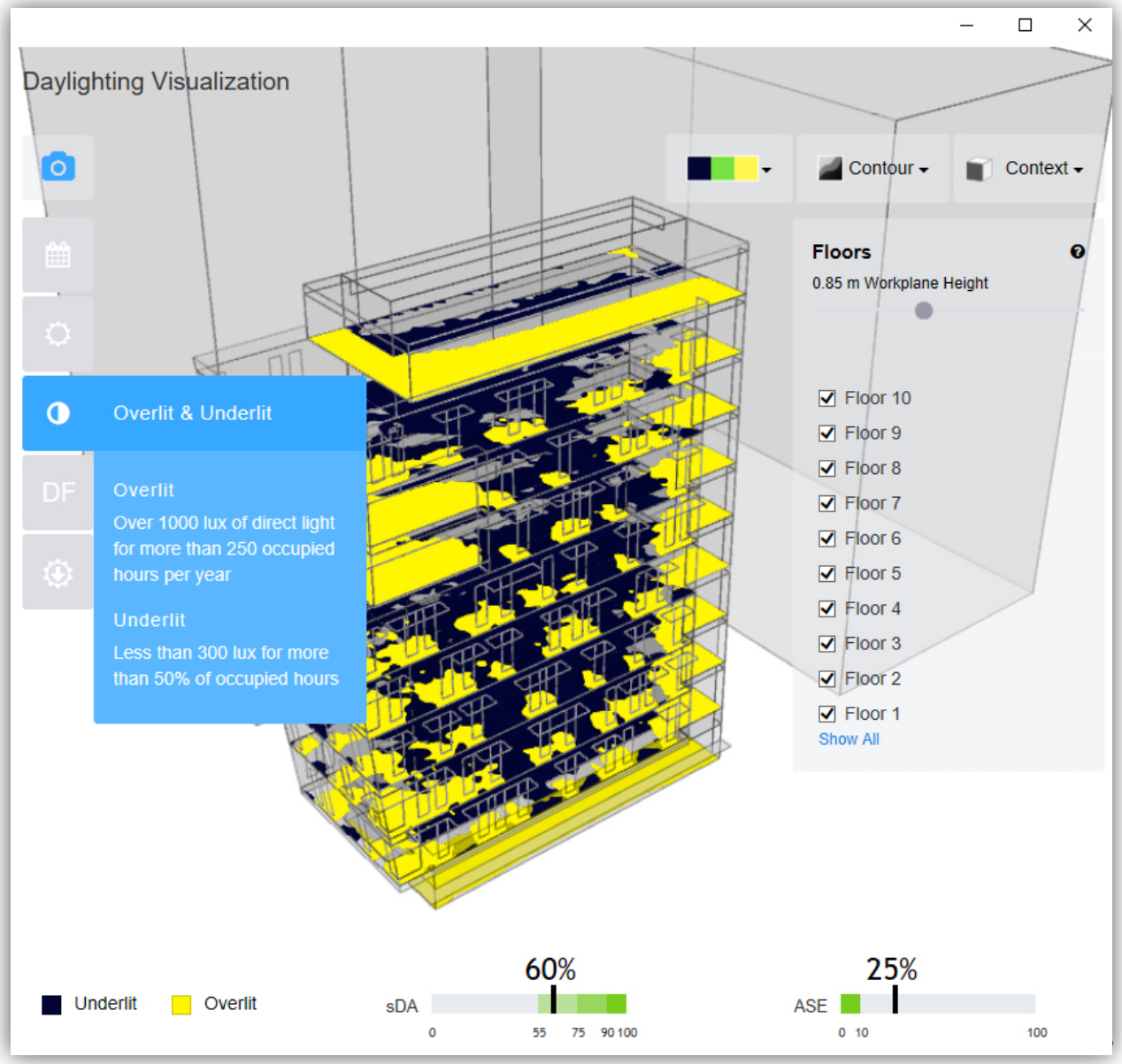

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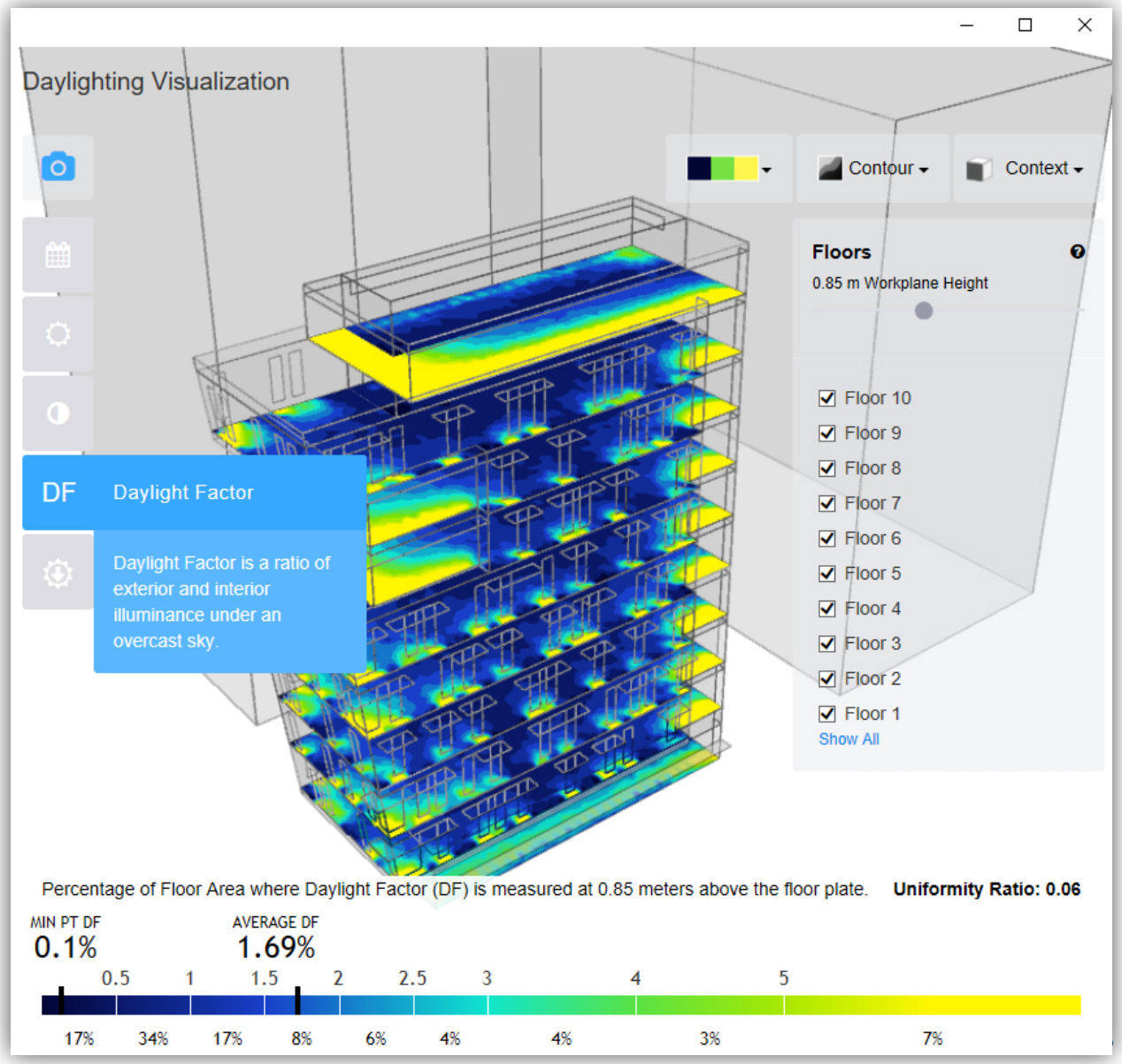

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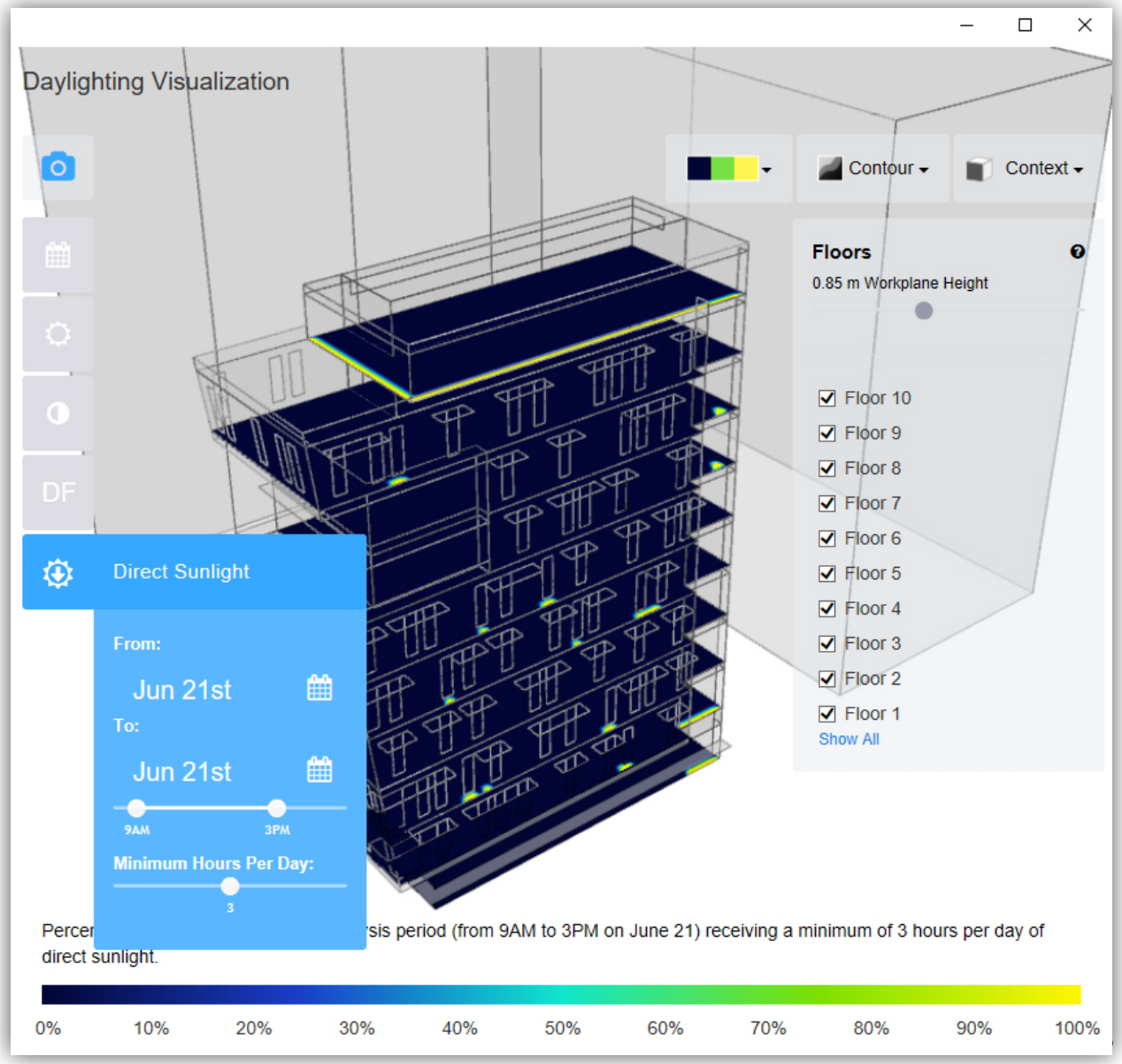

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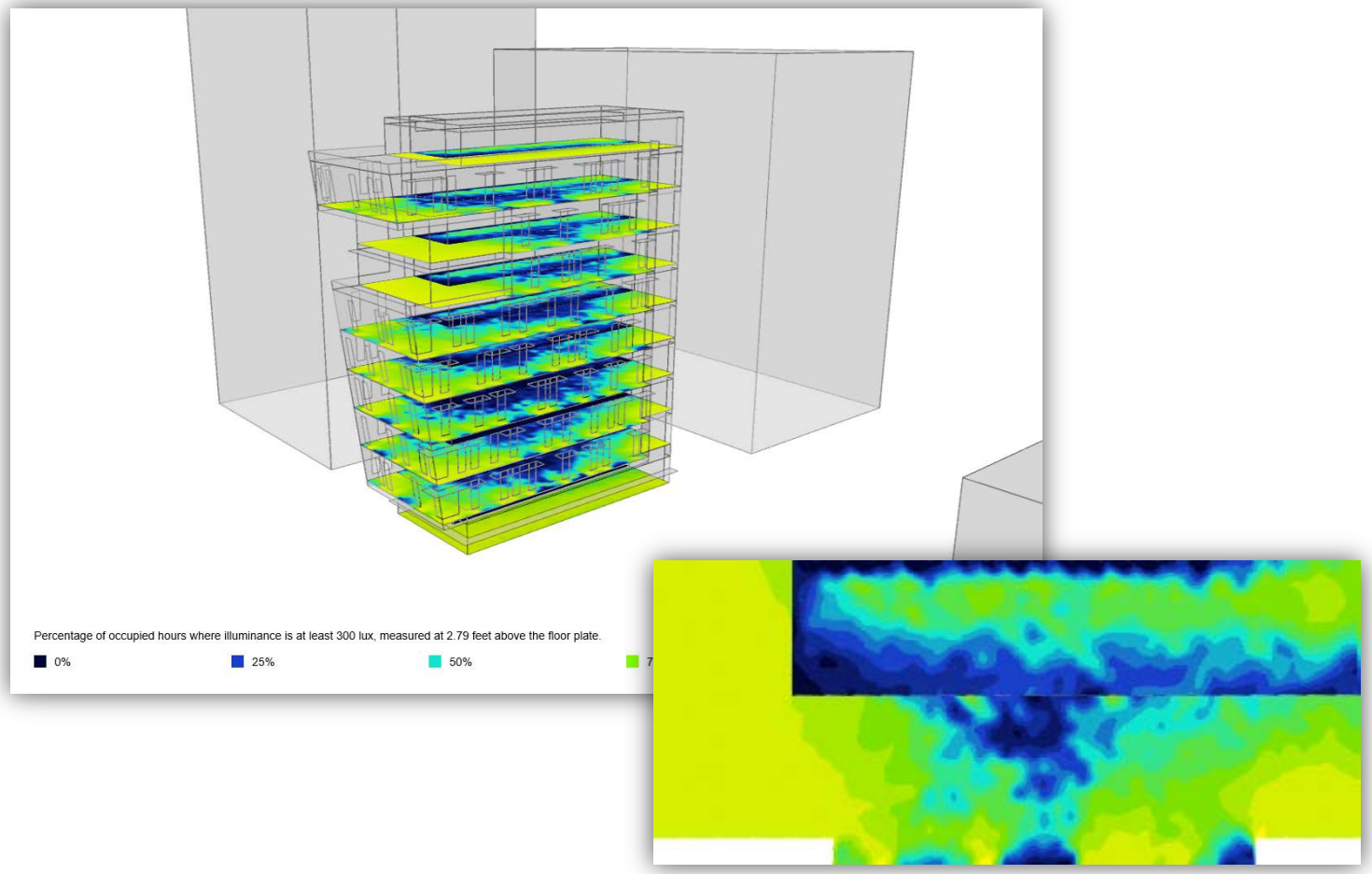

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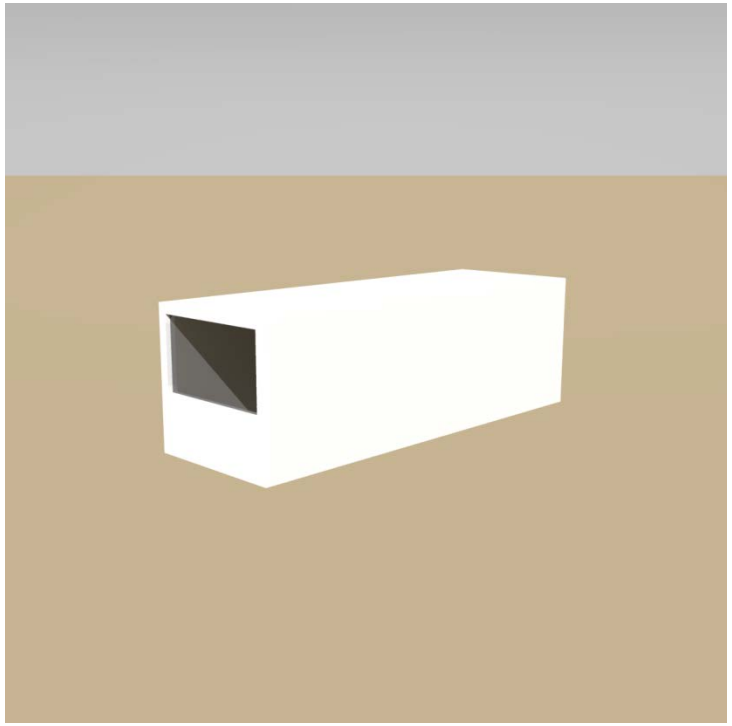
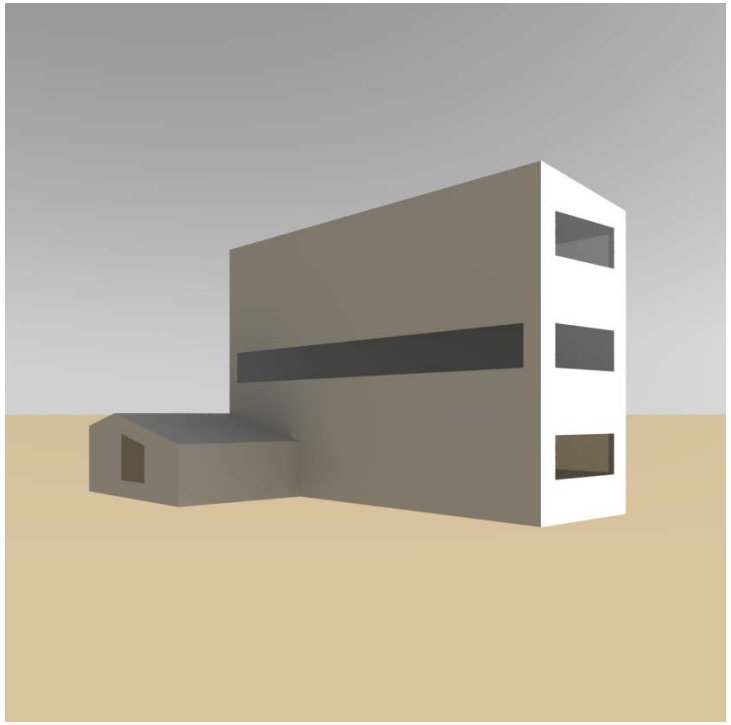
Seeking optimum parameters for Radiance and DAYSIM





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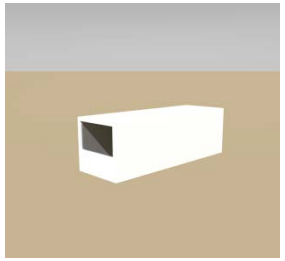

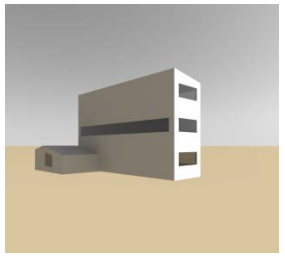

Assessment

Compare rtrace parameters for their impact on illuminance values and simulation time.

- *Point-in-time illuminance assessed at sensor points.*
  - *Radiance rtrace run locally.*
- *Three models, five sets of Radiance parameters:*
  - *Sefaira settings*
  - *Radiance default "Medium" settings*
  - *"Daysim3.0Tutorial" settings*
  - *Specialist-suggested settings*
  - *Radiance 2.4 "Accurate" settings via radsite.lbl.gov*
- *Geometry, materials, and lighting kept constant.*

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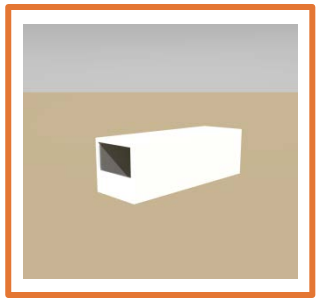

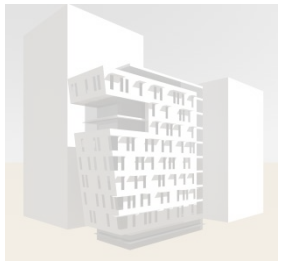

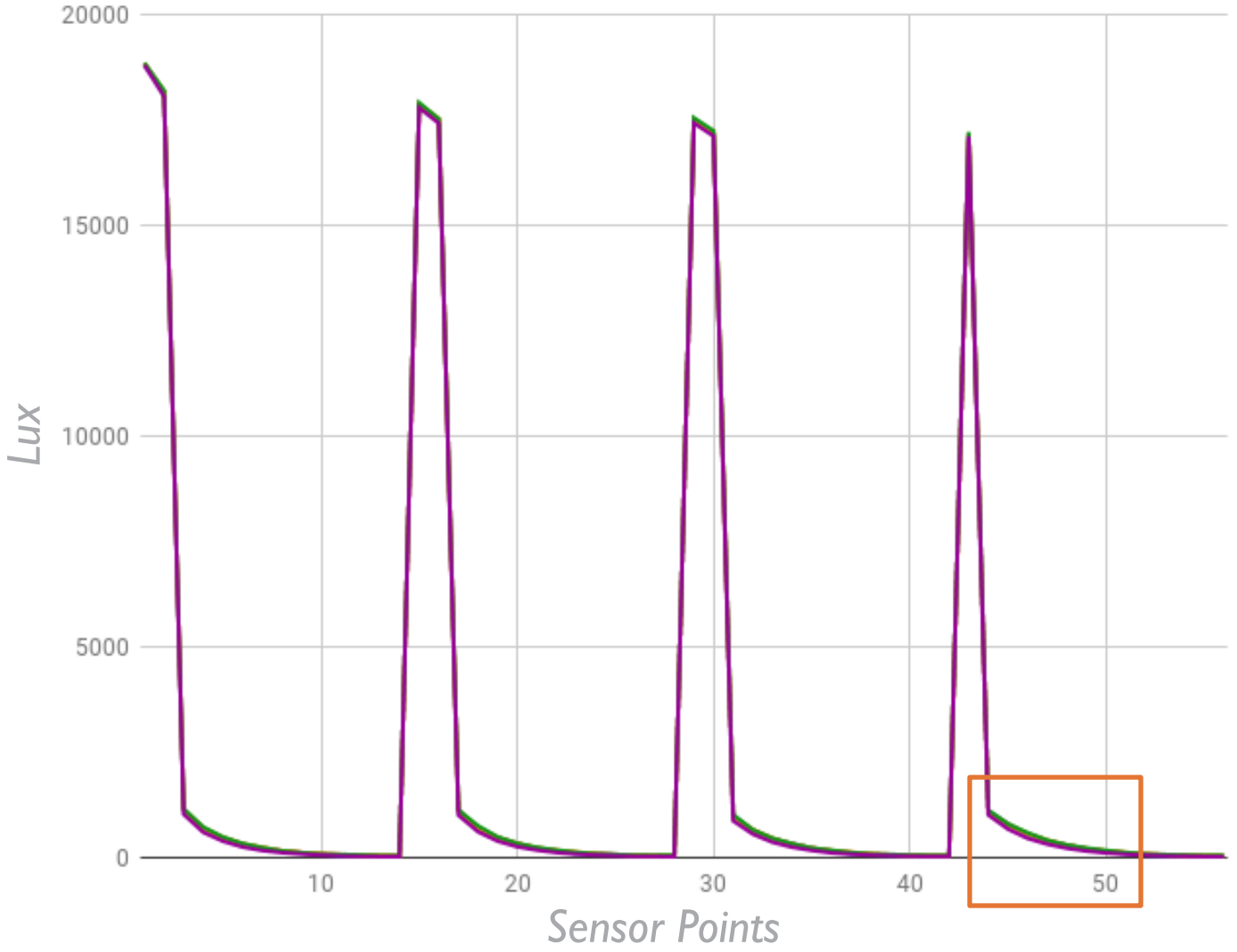

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Radiance Medium Quality

Daysim 3.0 Tutorial

Specialist-suggested

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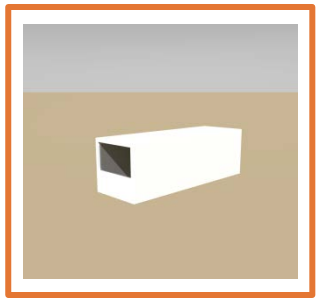

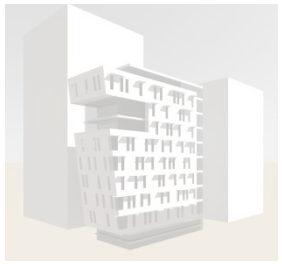

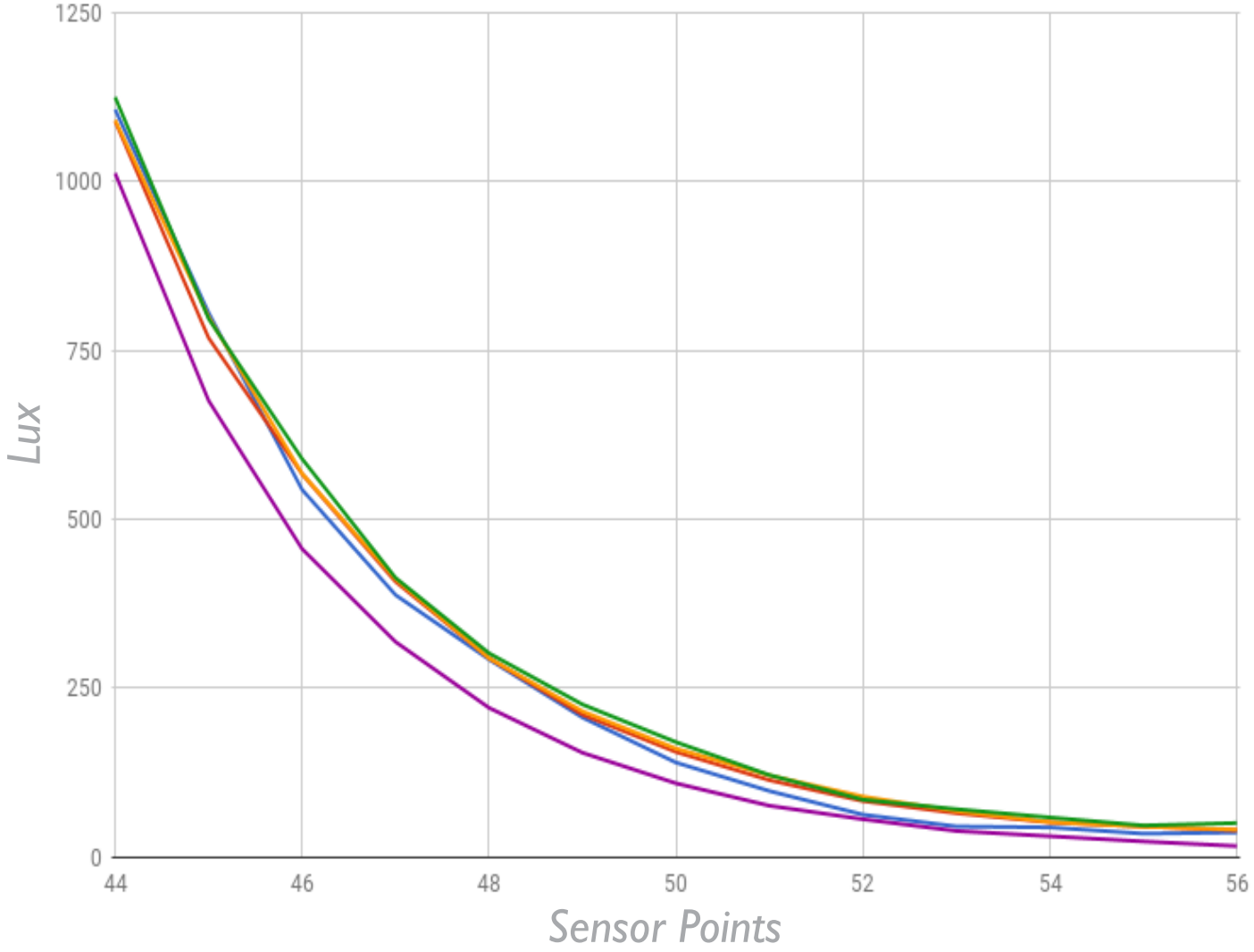

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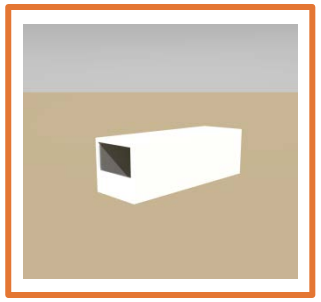

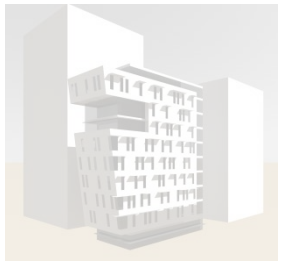

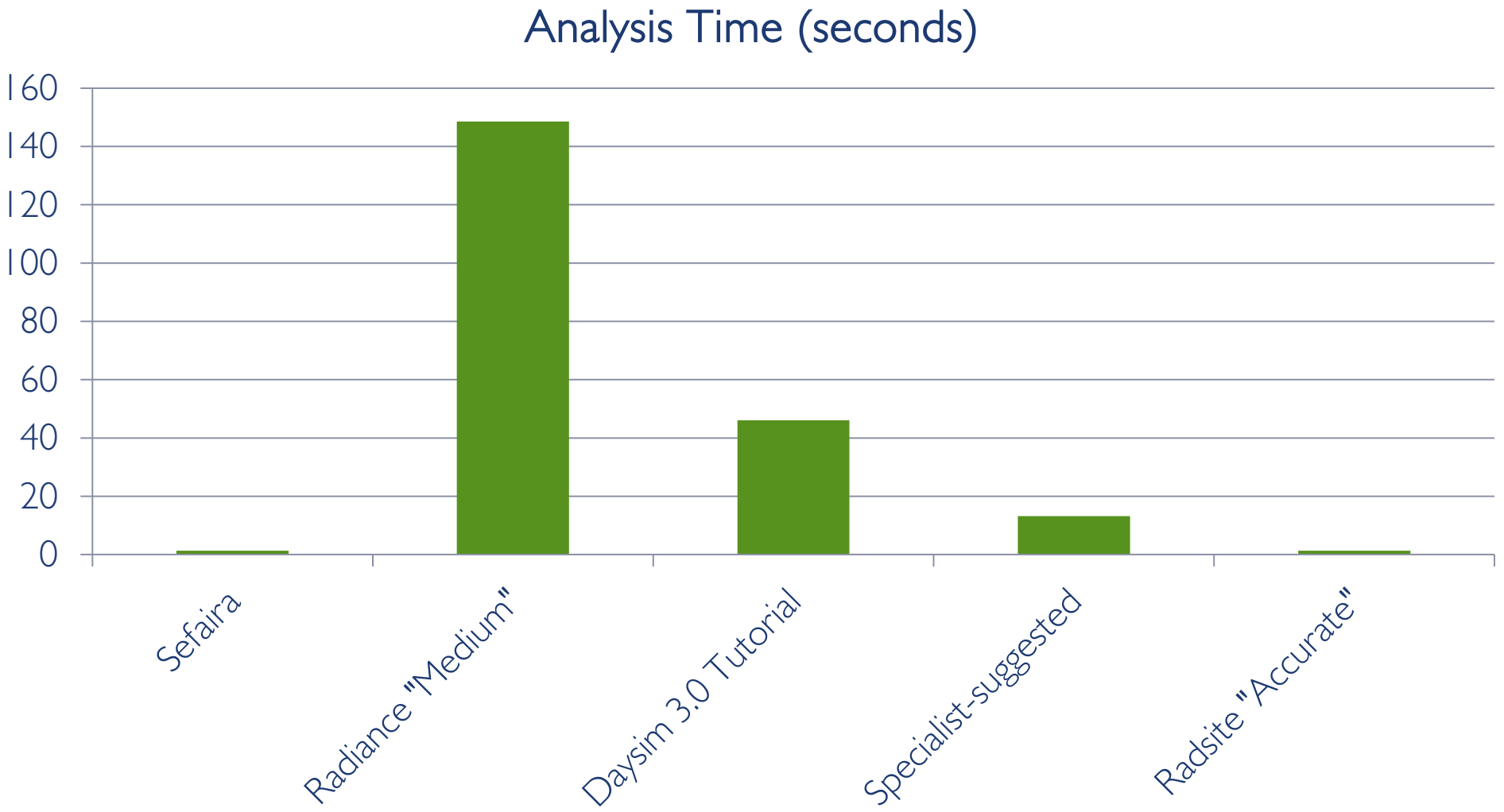

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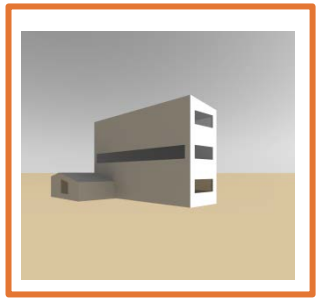

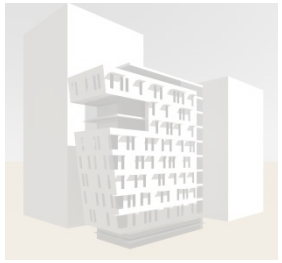

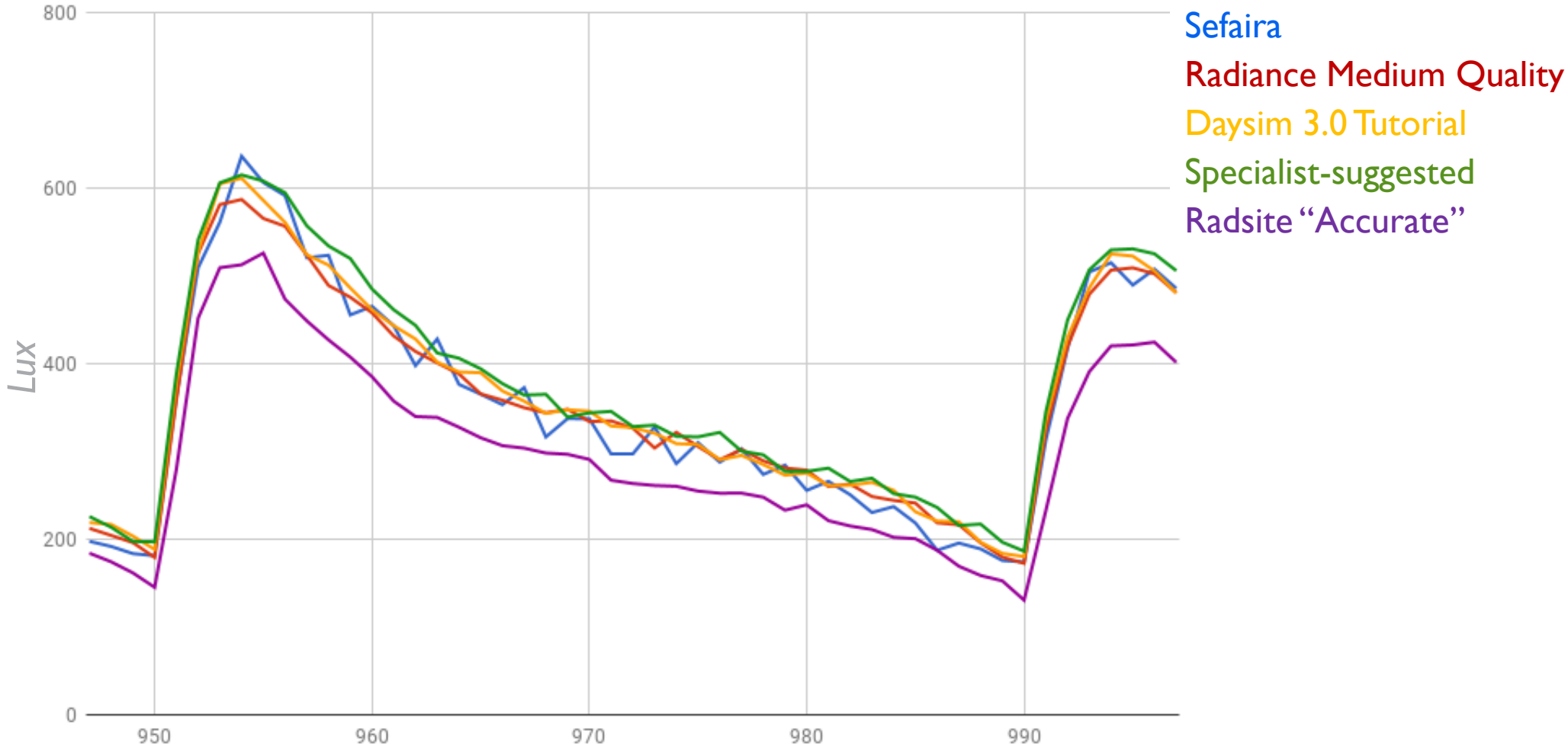

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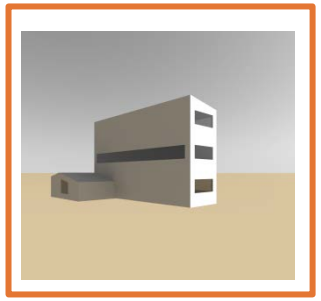

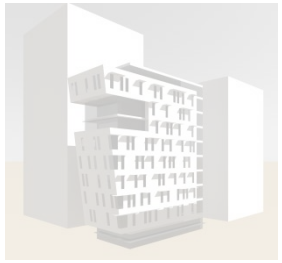

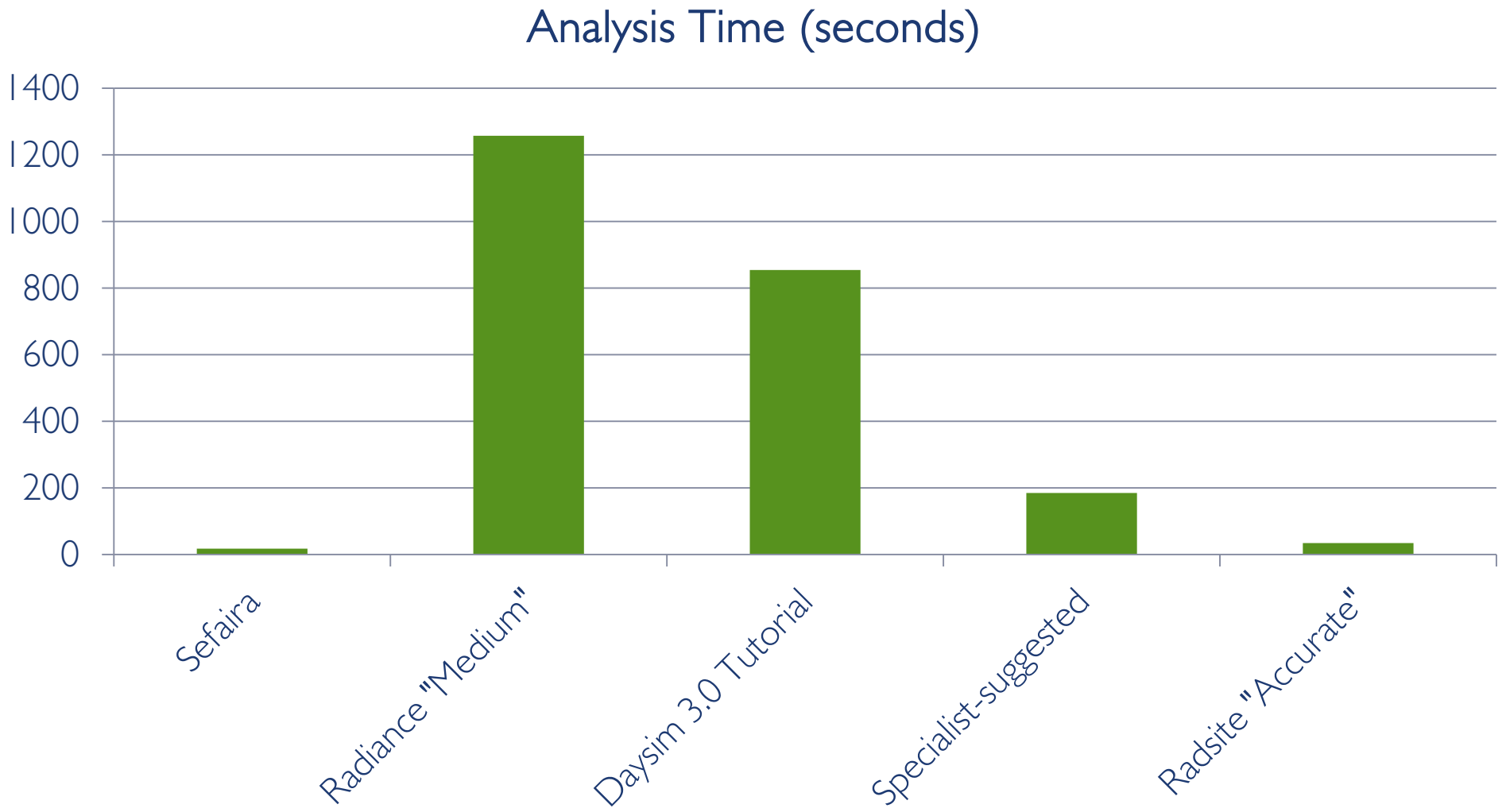

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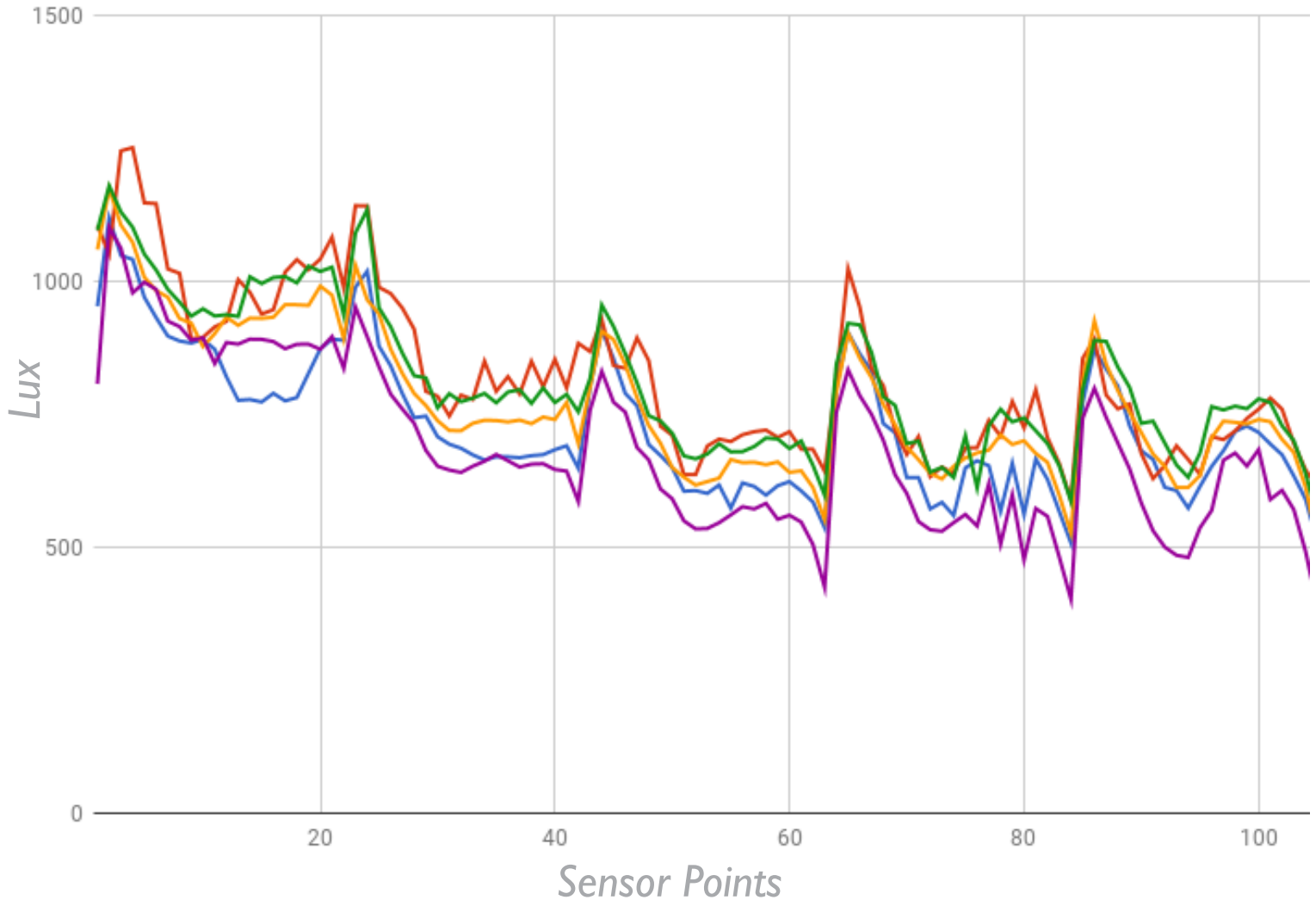

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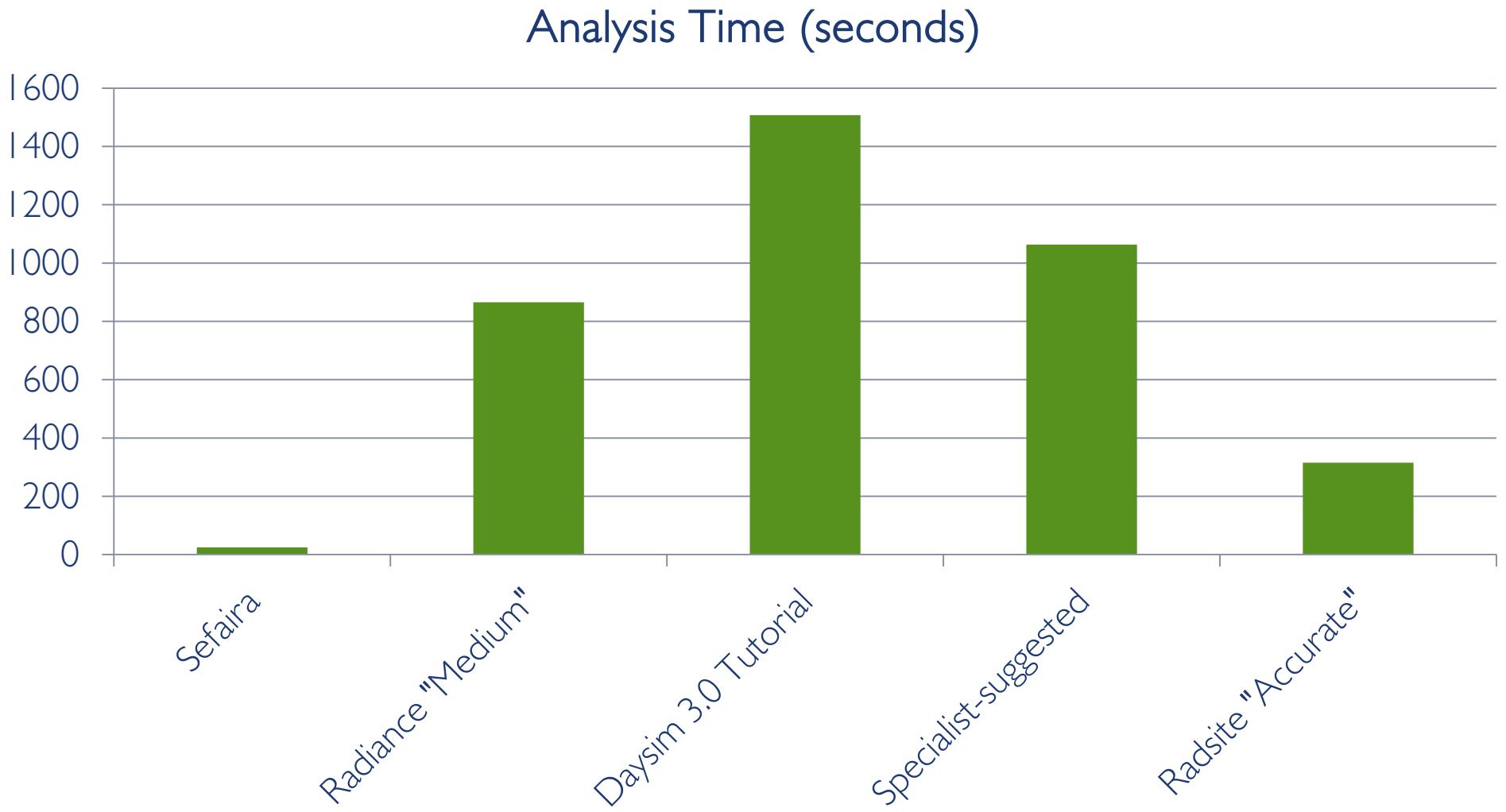

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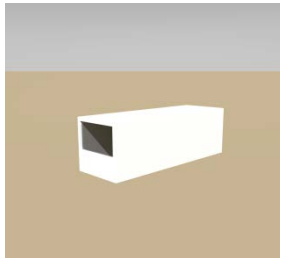

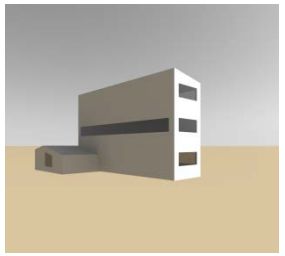

Key Takeaways

- **Sefaira settings balance speed and precision.**
  - Using defaults also eliminates setup burden from non-specialists.
- **Context is key:**
  - Early-stage comparative analyses demand analysis that is fast enough and precise enough to inform decision-making.
- **There is room for fine-tuning and expanded analysis:**
  - Sensitivity analysis to tease out greater precision / greater consistency compared to benchmarks
  - Expand scene description detail (e.g. materiality)
  - 5-phase! BDSFs!

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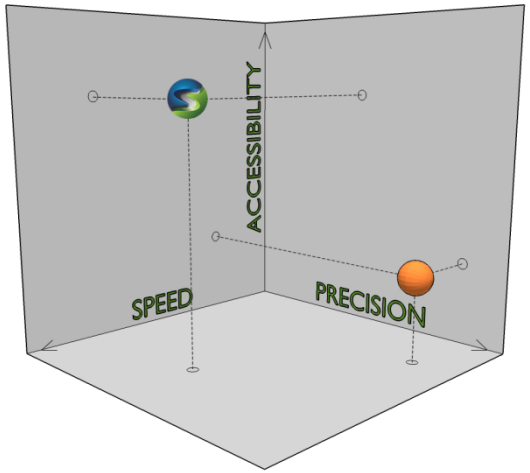

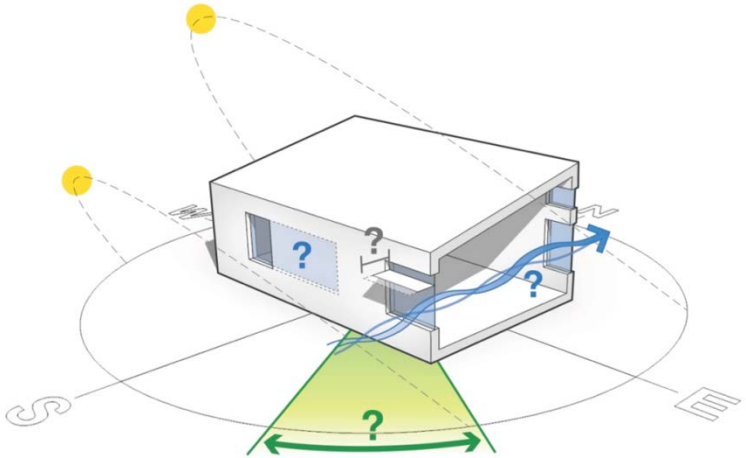

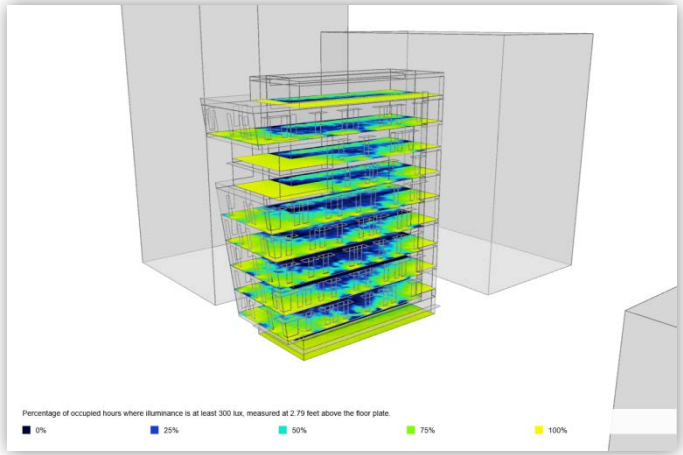

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Sefaira Inc.
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United States

Making it easy for building project teams to meet performance goals.

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Product Manager / Sefaira Daylighting Visualization

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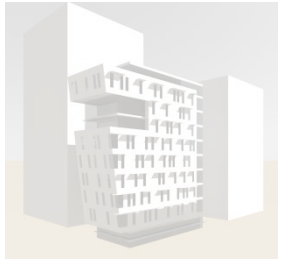
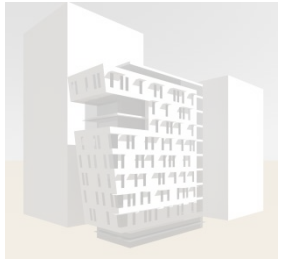
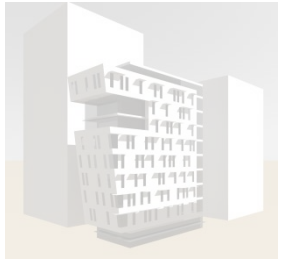
Appendix







Settings Summary

	Sefaira	Radiance "MEDIUM"	Daysim 3.0 Tutorial	Specialist-suggested	Radsite "Accurate"
-aa	0.15	0.15	0.1	0.15	0.15
-ab	4	4	5	6	2
-ad	256	800	1000	1024	512
-ar	32	1904	300	96	128
-as	20	128	20	2	256
-st	1	0.1	0.15	0.05	0.15
-lw	0.05	0.0001	0.004	0.000001	0.002
-dc	0	0.5	-	0	0.5
-lr	-	8	6	6	8
-dj	0.7	0	0	0	-
-dp	32	4096	512	4096	-
-dr	0	1	2	3	-
-ds	0	0.3	0.2	0.01	-
-ms	-	0.01	-	1.1	-
-ss	-	1	-	32	-
-av	-	0.01 0.01 0.01	-	0 0 0	-
-dt	-	0.1	-	0	-

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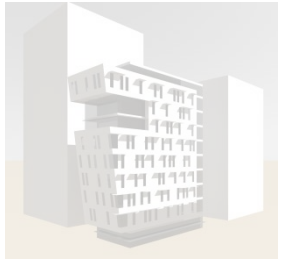
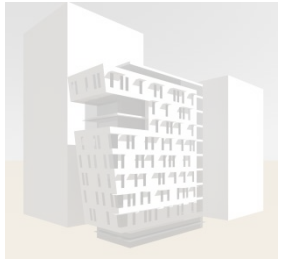
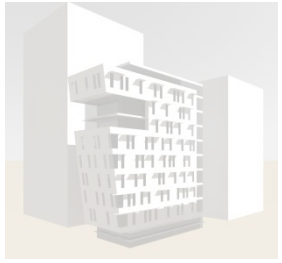
Appendix







Rtrace execution command

rtrace -w -h -I+ -u {*Radiance parameters*}
dat_oct_file.oct < sensor_points_file.pts | rcalc -e
"$1=($1*0.265+$2*0.670+$3*0.065)*179" >
dat_results.ill

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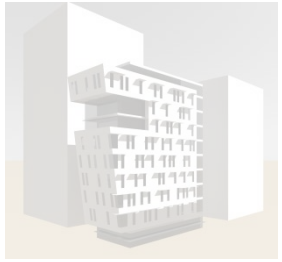
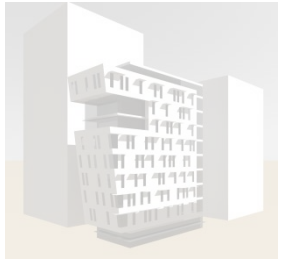
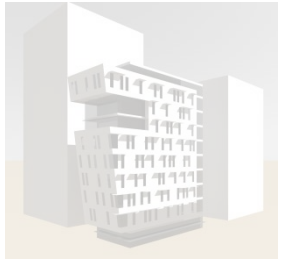
Appendix







Material Definitions

void plastic Massing

0 0 5 0.4000 0.4000 0.4000 0.0000 0.0000

void glass Glazing

0 0 3 tn tn tn {*we incorporate user's VLT setting*}

*tn = (sqrt(.8402528435+.0072522239*Tn*Tn)-.916653066 1)/.003626 1 1 9/Tn*

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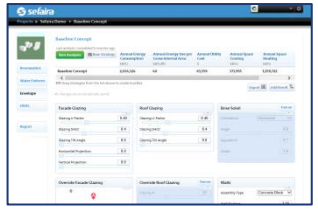

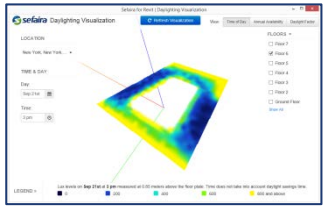

2009
Sefaira Founded
Performance Analysis in the cloud

2012
Energy Analysis Introduced

2014
Daylighting Visualization Introduced

2015
EnergyPlus Integration

2016
Sefaira Acquired by Trimble SketchUp

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