Radiance in Practice: A Consultant’s Perspective

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Outline

1. Background – consulting environment
2. Other lighting design software
3. Moving towards Radiance
4. Examples
Enermodal Engineering Ltd.

- Sustainable building design (low energy use, better indoor environments)
- Mechanical, electrical, LEED & green consulting
- Research oriented (daylighting, energy studies)
- Just getting started with Radiance
Consulting Engineering

- Generally paid a flat rate for services
- Contracts are often won in a competitive bid
- This means the daily work of a consultant is a race against the clock (to be profitable now) while satisfying client objectives (to be profitable in the future)
Electric Lighting Design

- Engineers run simulations with commercial lighting simulation packages (i.e. Lithonia Visual, Lumen Designer, AGI32)
  - These packages have limitations, but (generally) do what they are designed for well
- Emphasis is generally on numbers: i.e. 500 lux, 2% daylight factor
- Typically electrical consultants design lighting and only target work-plane illuminance
Typical Engineering Software
Ultimate Lighting S/W Criteria

• Minimise time while maximising accuracy
• Pictures are great – as long as they mean something
• Quick to get numerical results
• Easy to model common spaces
• Integrated daylighting and electric lighting
Enter the Radiance

- Useful for demonstrating finer points of lighting/daylighting design
- Models have been verified by people with letters after their names
- Modeling of most construction materials
- Daylighting and electric lighting together
- Open architecture - easy to develop programs to extend what’s already there
First Impressions

• ... but then asked to do a comparison of several daylighting measures
• It took way longer than expected
• Why struggle?
  – Commercial s/w frustrating
  – I saw future possibilities
My Radiance Use

- Still a Radiance Novice™
- What do I use Radiance for?
  - Some lighting simulations
  - Daylighting simulations/evaluations
- Have been using Radiance via Cygwin
  - Trying out running Linux through VMWare
- Have written custom Python scripts
  - Analysis, generation
Lessons Learned

• Success with Radiance in consultancy hinges on workflow
• Model -> Check -> Analyse -> Repeat
• The lack of a unified view (i.e. a GUI) poses a problem to some
  – In addition to pictures, consultants need numbers
  – However, a bad GUI is worse than the command line
Modeling

- \texttt{!genbox} combined with \texttt{xform}
  - Covers just about everything
- Use \texttt{rshow} (hint: shift-R) and \texttt{rvu}
Analysis

- Need grid of illuminances
- Hacked together a script:

```bash
$ mshewFelt@msheWFelt-wxp "~/rad_sims/st_pats_2/all_glass"
$ mshewFelt@msheWFelt-wxp "~/rad_sims/st_pats_2/all_glass"
$ ../gengrid.py -o render.oct --ab 1 --lx 0.1 --ly 4 --rx 10 --ry 4 --ht 0.85
  echo '0.1 4.0 0.85 0 0 1' | rtrace.exe -l -ab 1 -dj 0.7 -ds 0.15 -dt 0.05 -dc 0.5 -dr 3 -sj 0.7 -aa 0.15 -ar 128
  r 8 -h -w render.oct
( 0.1, 4.0, 0.85 ); 940.9347294 lux
  echo '0.5 4.0 0.85 0 0 1' | rtrace.exe -l -ab 1 -dj 0.7 -ds 0.15 -dt 0.05 -dc 0.5 -dr 3 -sj 0.7 -aa 0.15 -ar 128
  r 8 -h -w render.oct
( 0.5, 4.0, 0.85 ); 13223.1065455 lux
  echo '1.1 4.0 0.85 0 0 1' | rtrace.exe -l -ab 1 -dj 0.7 -ds 0.15 -dt 0.05 -dc 0.5 -dr 3 -sj 0.7 -aa 0.15 -ar 128
  r 8 -h -w render.oct
( 1.1, 4.0, 0.85 ); 20927.5337735 lux
  echo '1.6 4.0 0.85 0 0 1' | rtrace.exe -l -ab 1 -dj 0.7 -ds 0.15 -dt 0.05 -dc 0.5 -dr 3 -sj 0.7 -aa 0.15 -ar 128
  r 8 -h -w render.oct
( 1.6, 4.0, 0.85 ); 581.721181 lux
  echo '2.1 4.0 0.85 0 0 1' | rtrace.exe -l -ab 1 -dj 0.7 -ds 0.15 -dt 0.05 -dc 0.5 -dr 3 -sj 0.7 -aa 0.15 -ar 128
```

- Future: graphical grid display
Challenges for Consultants

- Modeling can be tricky
- Virtual light sources are hard to understand
- Few graphical tools for analysis
- UNIX-based environments and software are unfamiliar to some
- Not enough specific tutorials (I’ll try)
- Need a powerful computer (2+ procs)
Examples

- Presentations on green design for RAIC
- New construction in Toronto
- Daylighting system study
RAIC Presentations

- Wanted to show “footcandles don’t tell the whole story”
- National Research Council – people like bright vertical spaces
- Radiance output = immediate response
RAIC Presentations

2-T8 Parabolic
Desk Illuminance: 400 lux
LPD: 8.8 W/m²

2-T5 Lensed
Desk Illuminance: 400 lux
LPD: 9.1 W/m²
**RAIC Presentations**

2-T8 Parabolic

Desk Illuminance: 400 lux  
LPD: 8.8 W/m²

2-T8 Pendant

Desk Illuminance: 400 lux  
LPD: 8.5 W/m²
Daylighting System Study

- Wanted to compare Solera, Frosted Glass, Light Shelf for daylighting efficiency
- Needed to produce a graph of illuminance values vs. distance from window
- Hard to model translucent materials in other packages
- Client wanted pictures
- Demonstrated daylighting systems c/w blinds
Daylighting System Study

- Light Shelf
Daylighting System Study

- Solera Glazing
Daylighting System Study

**Workplane Illuminance at 1 m, March 21 2:00 pm**

- Solera 70 (blinds on bottom)
- Frosted Glass (blinds on bottom)
- Solera 50 (blinds on bottom)
- Light Shelf (blinds on bottom)
- Clear top (blinds on bottom)
- Full Blinds

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**Average Illuminance-Exterior Wall Parallel (lux)**

Distance from Window (m)
Conclusion

• Radiance is a worthwhile tool for consultants to use
• It’s unconventional, but that’s a good thing
• My future plans:
  – Develop own library of objects/materials/skies
  – Pre-setup projects
  – Need to abstract all the difficult bits
  – Improve analysis tools