PASSIVE HOUSE
ALLIANCE
UNITED STATES

Passive House Institute US

Energy savings from Daylighting
Flash-estimating

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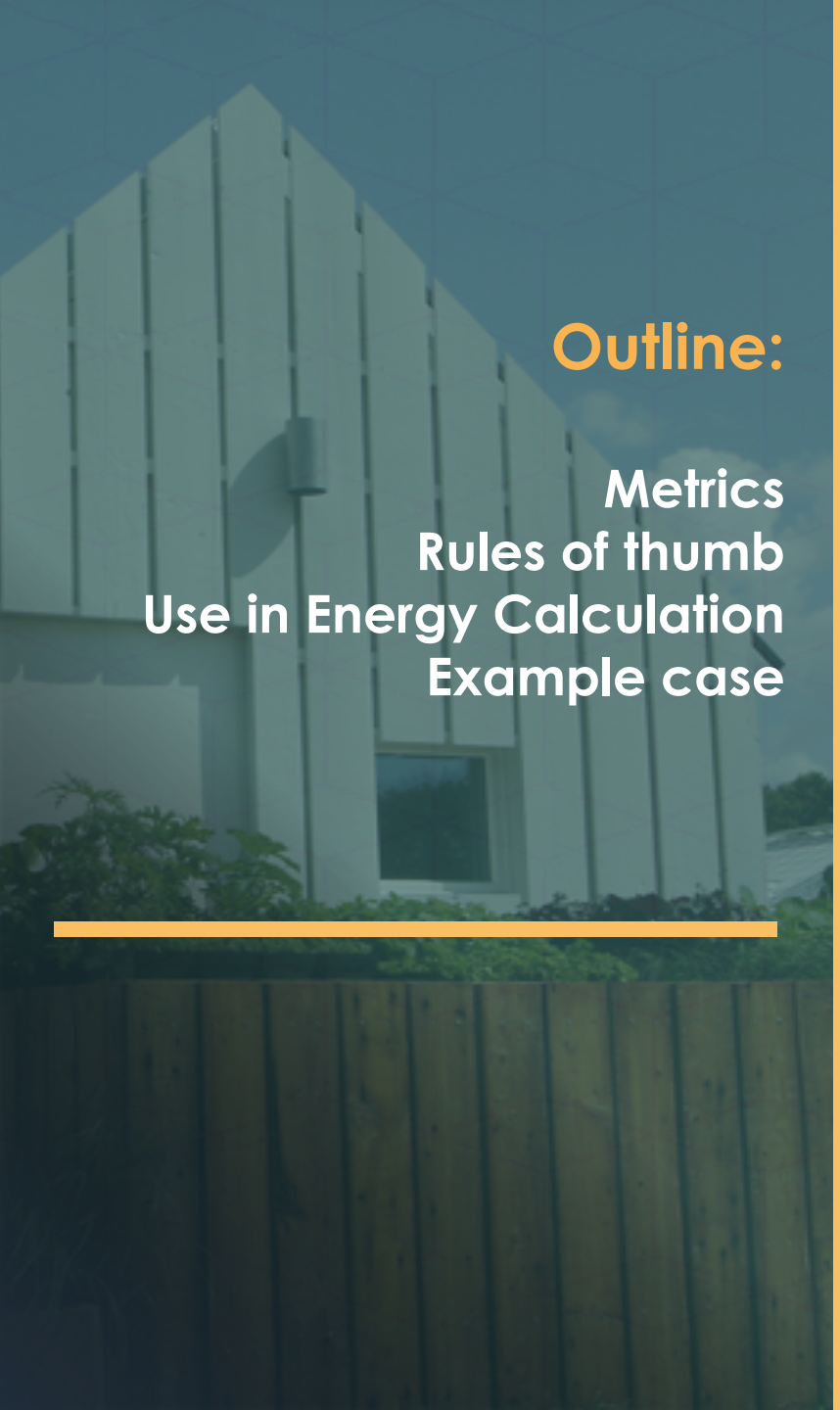


Outline:

Metrics
Rules of thumb
Use in Energy Calculation
Example case

LEARNINGOBJECTIVES

1. Know the metrics for lighting.

2. Learn Reinhart‘s Rules of thumb for pinning down a ”daylit area“.

3. Applying the Rules in a WUFI Passive energy calculation.

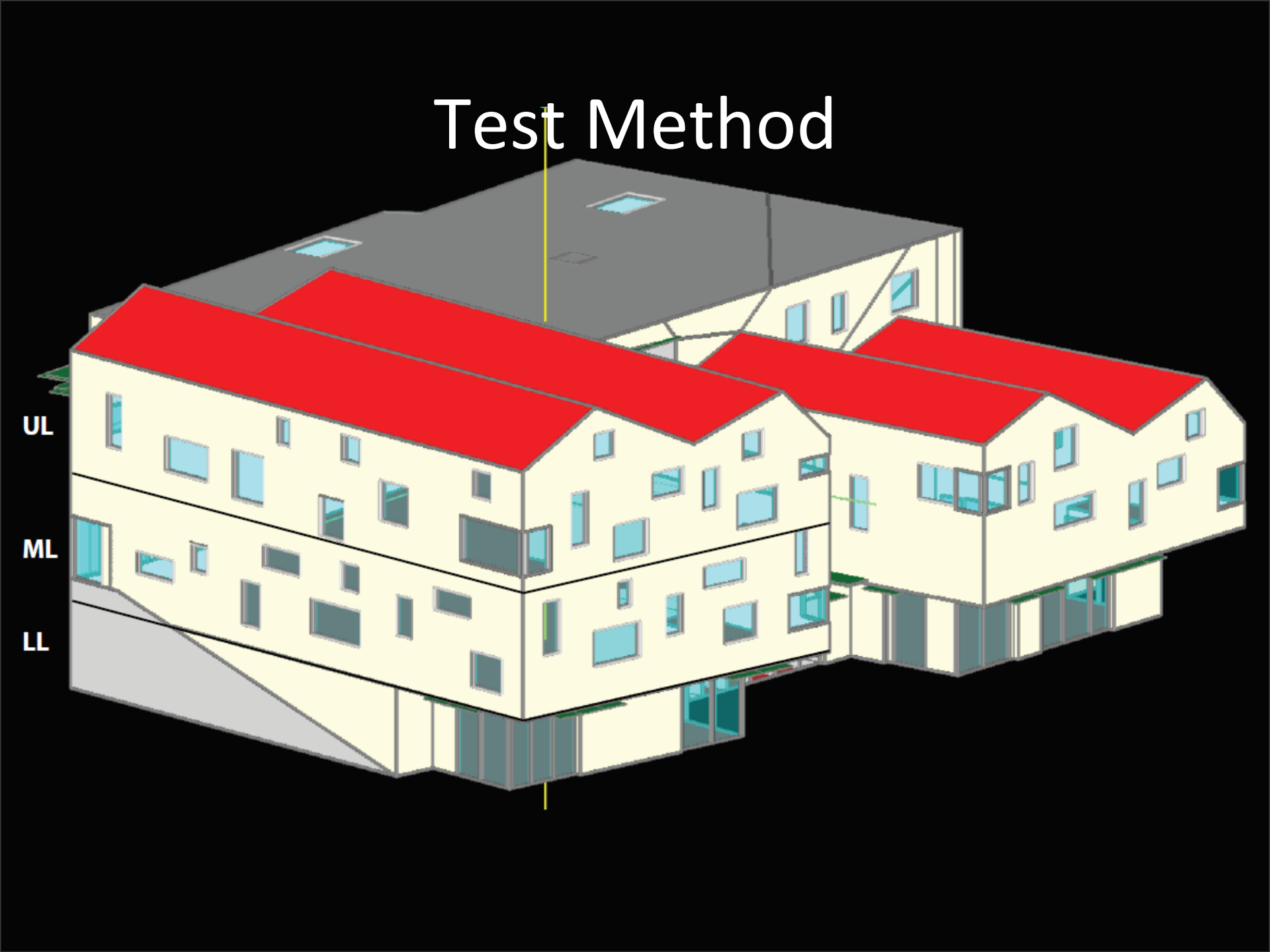
Metrics

- Luminous flux: **energy** weighted by spectral sensitivity of the human eye [lumens]
- Illuminance: luminous flux/area [lumens/m2 = lux, lumens/ft2 = footcandles]
- Luminous intensity: luminous flux/solid angle [lumens/steradian = candela]
- Luminance = luminous intensity/area [candela/m2]
- Daylight autonomy, e.g. DA-300lux-50%

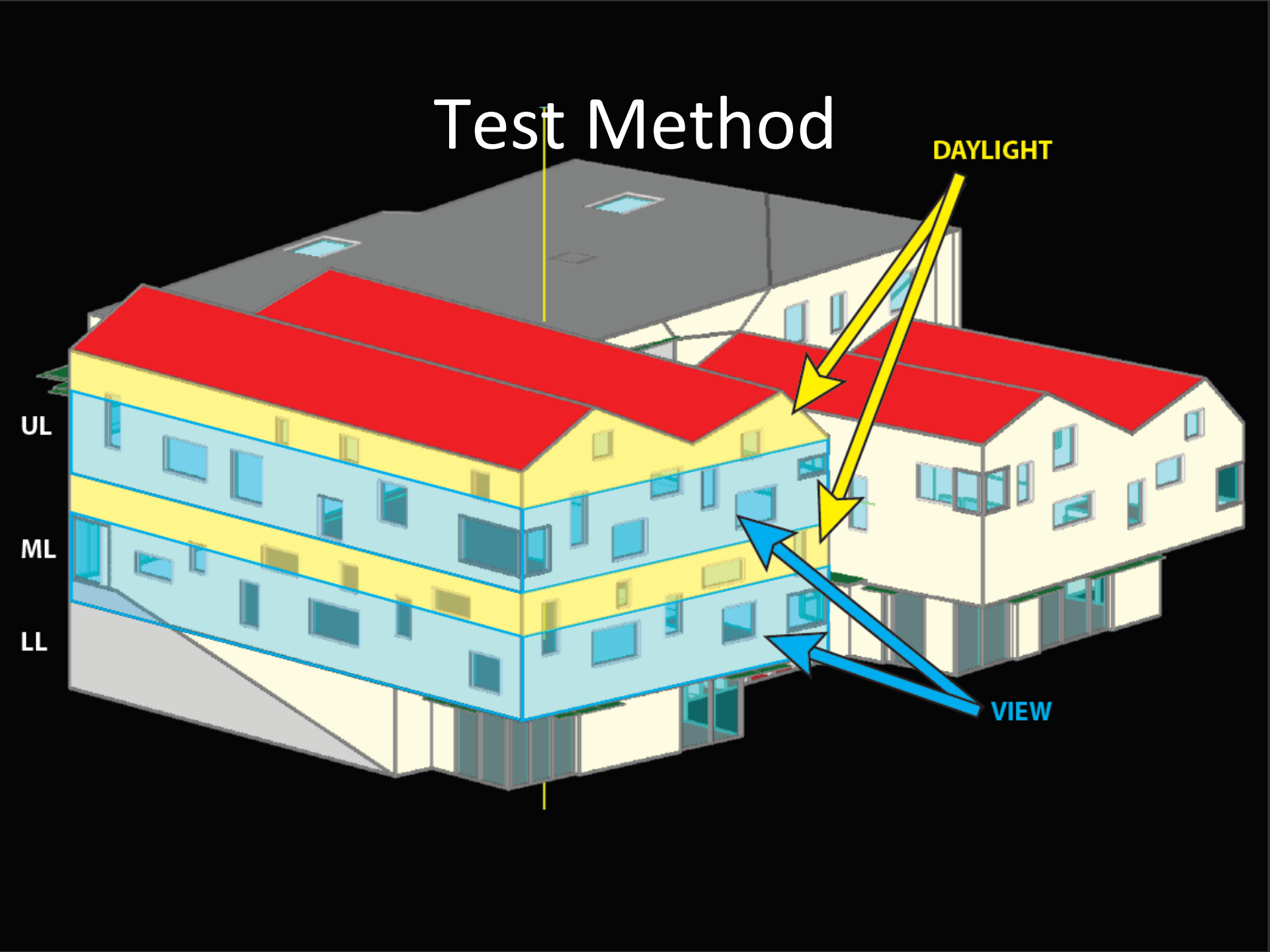
Rules of thumb

- Window-Head-Height (WHH)
  - Daylit Area Depth Approx. 1-2 x WHH
  - No dynamic shading system Approx. 2.5 x WHH
- Daylight Feasibility Test
  - Sky Angle (°) x WWR (%) > 2,000
- Atrium Max Height (not used for this example)
  - 2.5 x width

Test Method



Test Method

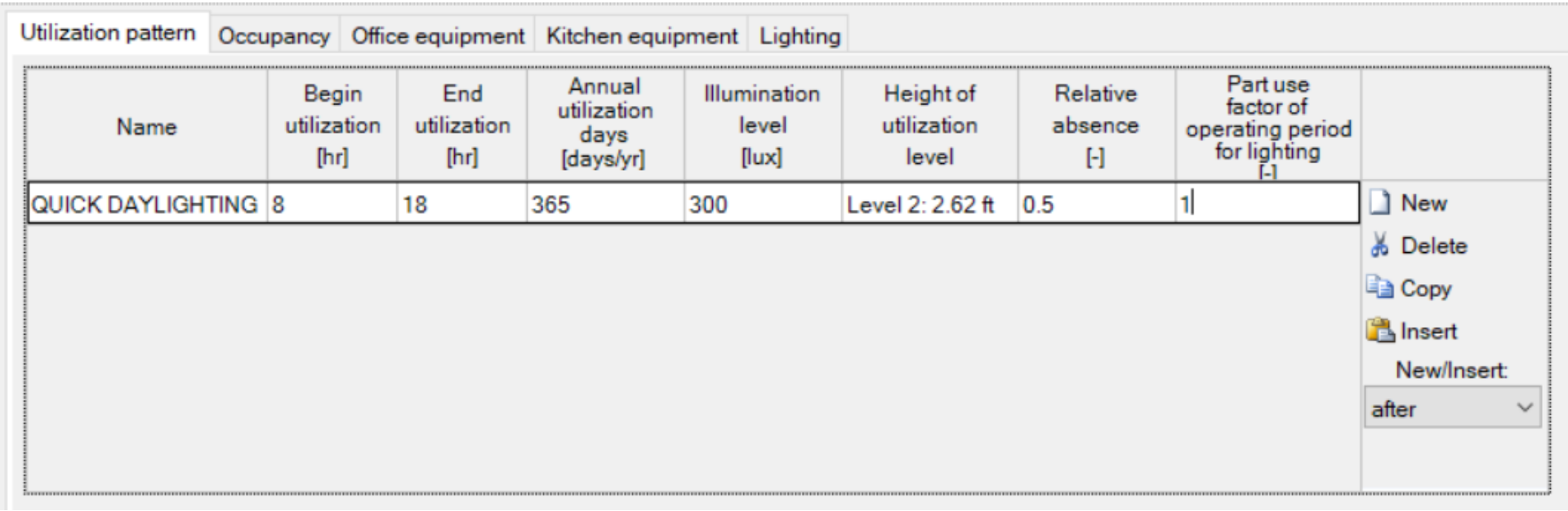


Method

- WP tree node “Internal loads / Occupancy”
- Utilization Pattern tab: Make a pattern “Quick Daylighting”
  - Begin hour 8, End hour 18
  - 365 days/yr
  - 300 lux (might be overridden by LPD)
  - Utiliz. height 2.6 ft (0.8 m)
  - Relative absence 0.5
  - Partial use factor for lighting 1.0

Method

- WP tree node “Internal loads / Occupancy”



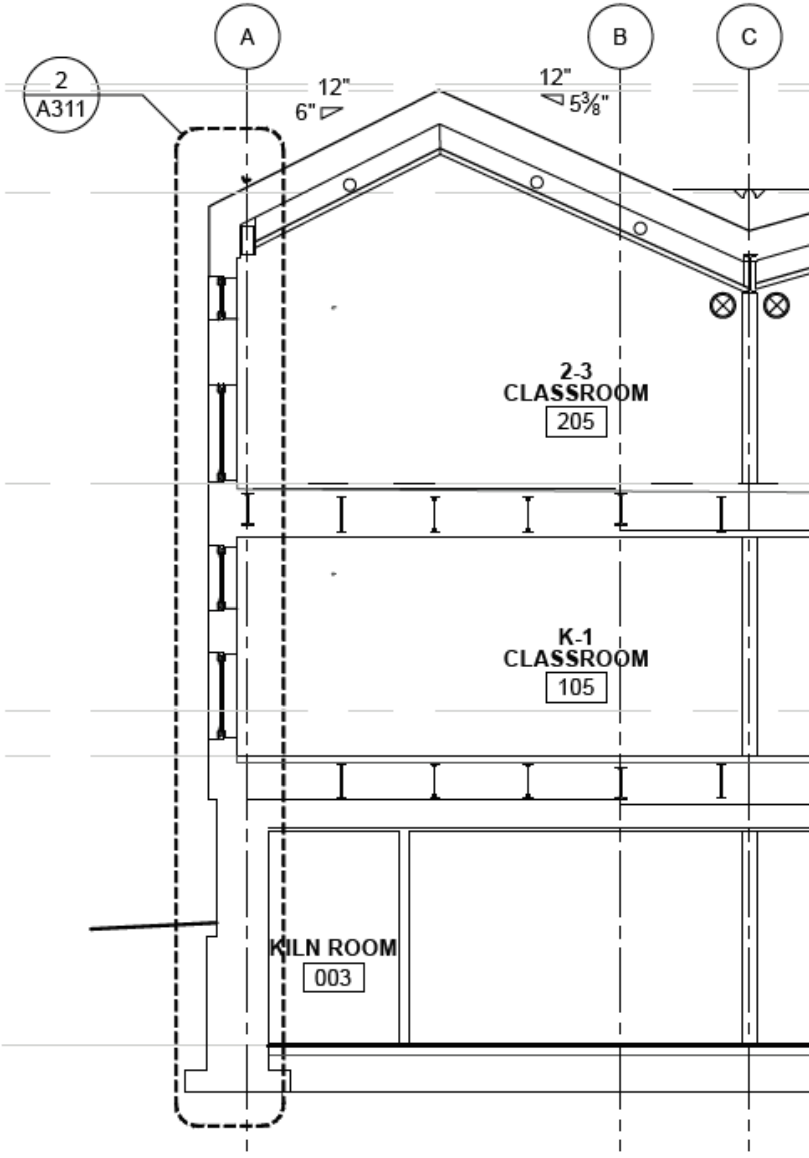
Method

- Determine daylit area(s) according to rules of thumb.
- Note room height.
- Note average/typical room width.

Room Height

- Note room height
  - Upper Level: 11’
  - Main Level: 10.5’
  - Lower Level: 10’

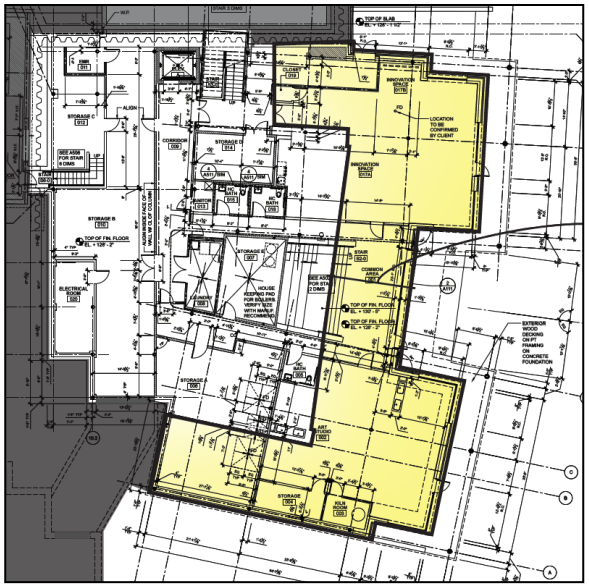
- Room Height: 10.5’
- WHH = 10.5’ – 1.5’ = **9’**



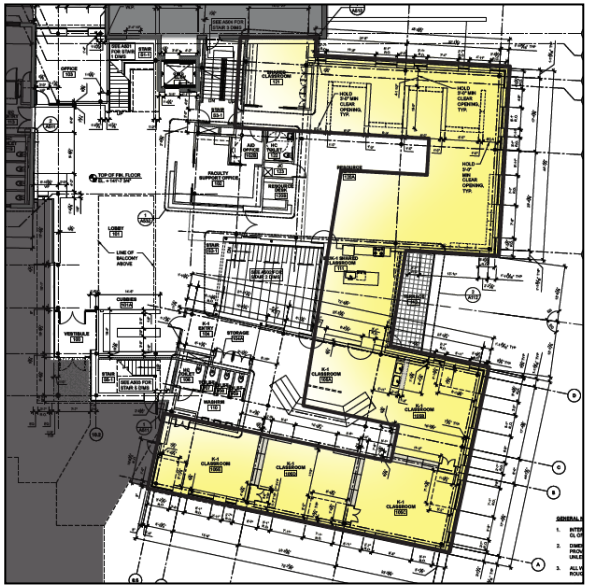
Daylit Areas

- Determine Daylit Area according to rule of thumb
- 18’ in from perimeter (2x 9’ WHH)
- Upper Level – Flat Roof Area (Skylight potential)

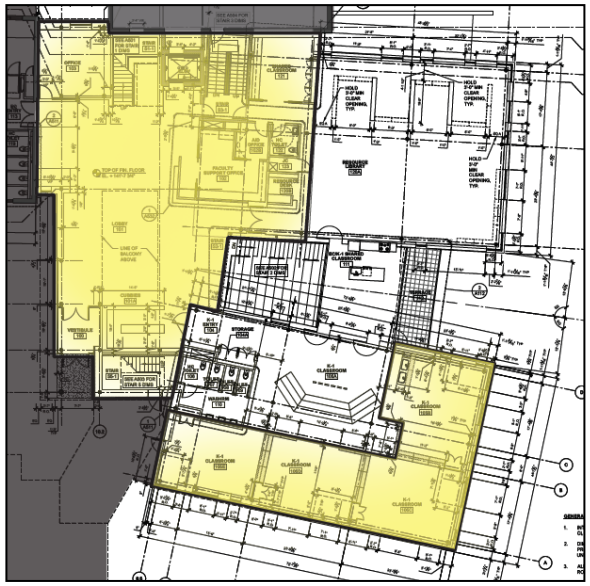
Lower Level



Main Level



Upper Level



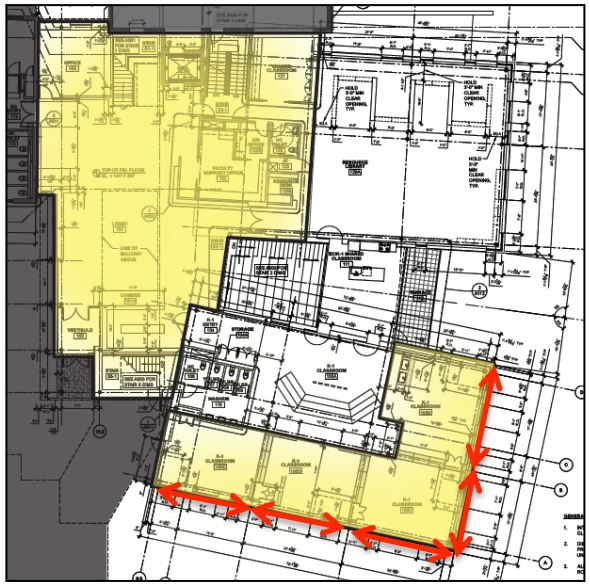
Average Room Width

- Note average/typical room width
  - Lower Level: 34.5’
  - Main Level: 30’
  - Upper Level: 24’

Lower Level

Main Level

Upper Level



Lighting tab entries

- Make entries for daylit area(s) AND the remaining non-daylit area as fraction of total floor area.
- Manual Control
- No Motion Detector
- Orientation South
- Light transmission 69%
- Daylit area(s)
  - Enter room height and average room width e.g. from inspection of plans.
  - Set Room depth = 2 x Room height
  - Set Lintel height = Room height minus 1.5 feet
  - Set Window width = 0.75 x Room width
- Remaining non-daylit area
  - Set Room Width = Room Depth = Room height
  - Uncheck “façade including windows”
- Temporarily Uncheck “façade including windows” for the daylit areas in order to get “without-daylighting” energy use and compute % reduction by daylighting.

Lighting tab entries

Utilization pattern | Occupancy | Office equipment | Kitchen equipment | Lighting

Name	Utilization pattern	Fraction of conditioned floor area [-]	Derivation from north [°]	Light transmission glazing	Room depth [ft]	Room width [ft]	Room height [ft]
LL	Pattern 1: QUICK DAY	0.16	180	Triple low-e glazing: 0.69	18	34.5	10.5
ML	Pattern 1: QUICK DAY	0.19	180	Triple low-e glazing: 0.69	18	30	10.5
UL (flat roof)	Pattern 1: QUICK DAY	0.15	180	Triple low-e glazing: 0.69	18	52	10.5
UL (pitch roof)	Pattern 1: QUICK DAY	0.08	180	Triple low-e glazing: 0.69	18	24	10.5
NON	Pattern 1: QUICK DAY	0.42	180	Triple low-e glazing: 0.69	10.5	10.5	10.5

New
Delete
Copy
Insert
New/Insert:
after

Additional data: LL

Facade including windows	☑
Lintel height [ft]	8.8
Window width [ft]	22.3
Lighting control	Manually
Motion detector	☐
Installed lighting power [W/ft²]	
Lighting full load hours [hrs/yr]	

Waynflete School

Pattern	Non daylit lighting kWh	% savings from daylighting	Lighting kWh with daylighting
Quick daylighting LPD auto (0.91 W/sf)	61547	14%	52654
Quick daylighting LPD 0.32 W/sf	21353	14%	18268
Waynflete 201*10, absence 0, LPD 0.32 W/sf	13830	14%	11802
Detailed study	16468	20%	13174

References

- Daylighting Handbook: Fundamentals, designing with the sun – Christoph Reinhart
- ASHRAE Tables 9.5.1 & 9.6.1 – Lighting Power Densities Using the Building & Space by Space Area Methods
- DIN V 18599-10:2007-02, Table 4 – Standard Default Patterns for Internal Loads & Occupancy Calculations for Non-Residential Buildings
- Jan de Boer (Ein einfaches Modell zur Klassifizierung der Tageslichtversorgung von Innenräumen mit vertikalen Fassaden, Fraunhofer-Institut für Bauphysik)

THANK YOU

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