Using Radiance to assess daylight quality in offices

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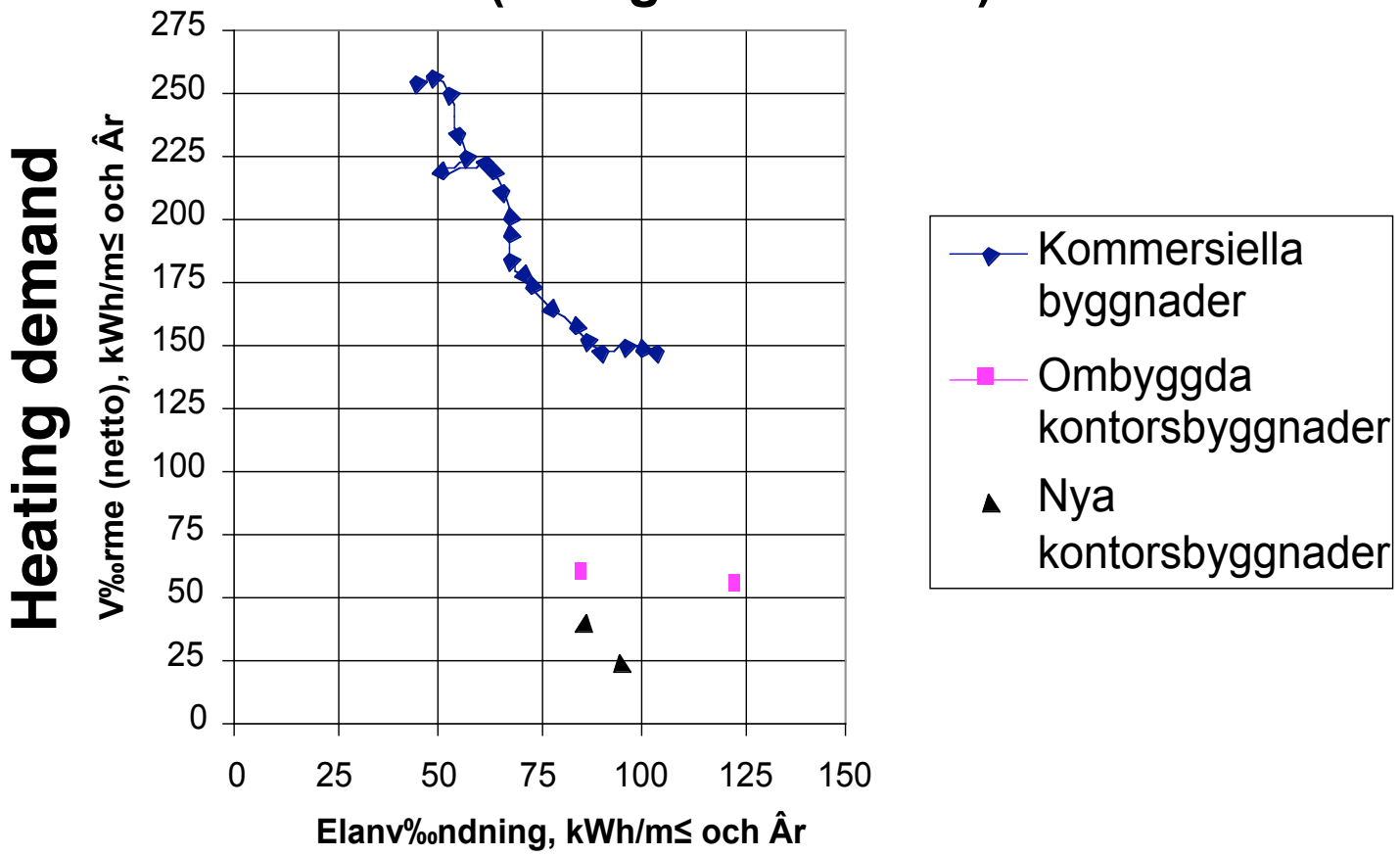
Energy use in Swedish office buildings

(Energiboken 1995)



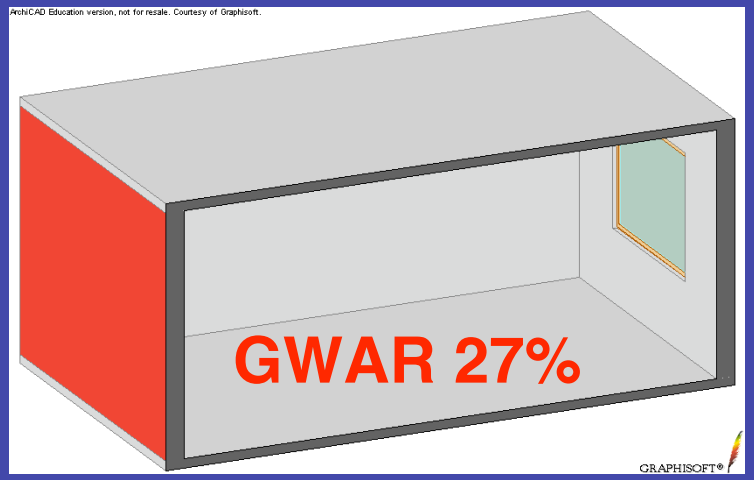
Electricity use

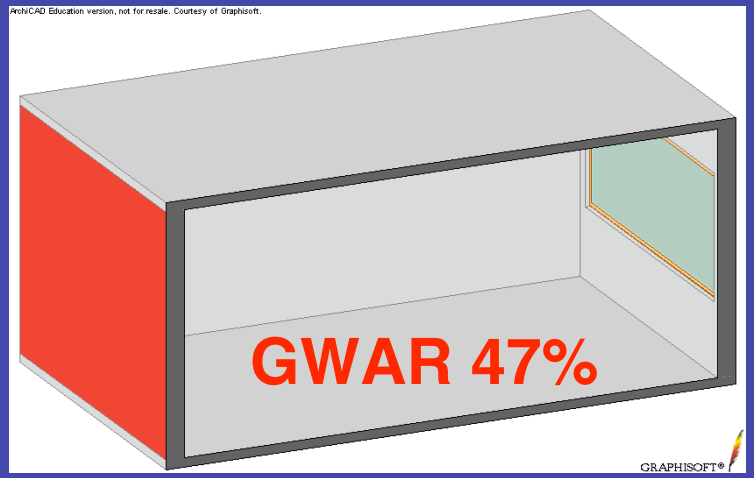
Glazed Office Building Project

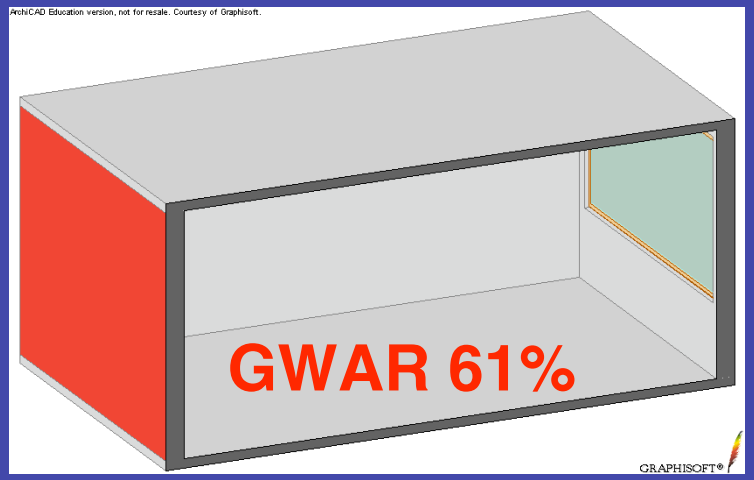
ABB headquarters

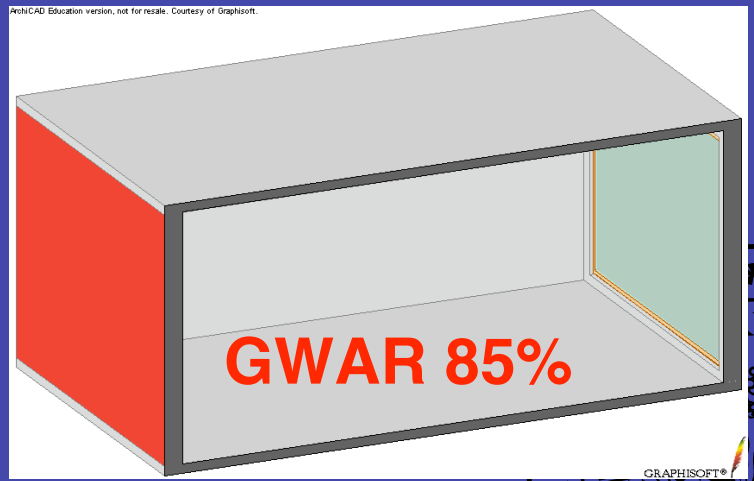
Post head office

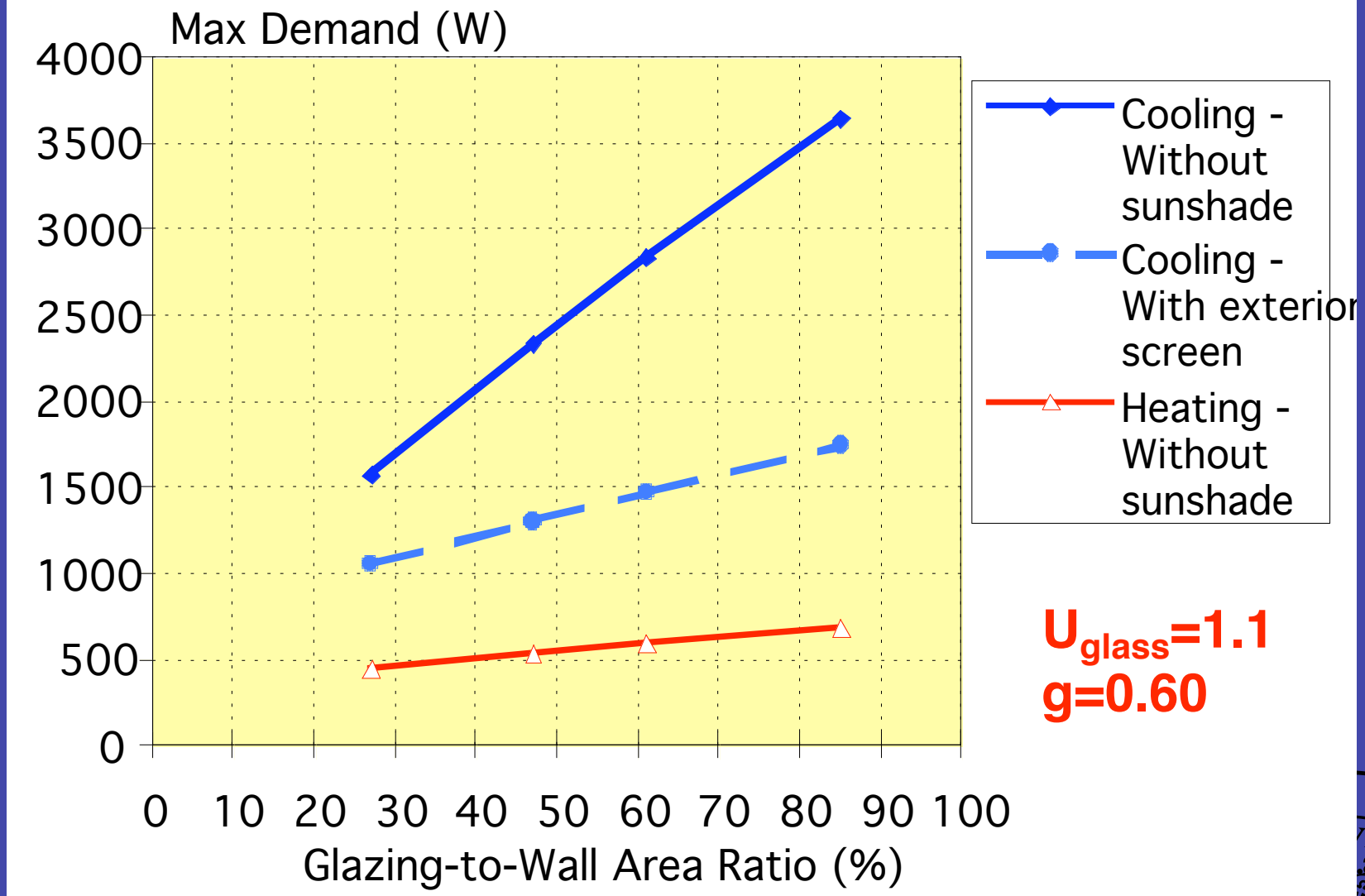
Effect of window size










Max Demand (W)
4000
3500
3000
2500
2000
1500
1000
500
0
0 10 20 30 40 50 60 70 80 90 100
Glazing-to-Wall Area Ratio (%)
Cooling - Without sunshade
Cooling - With exterior screen
Heating - Without sunshade
U_{glass}=1.1
g=0.60

Project: Glazed office buildings

- Funded by the Swedish Energy Agency, SBUF, SKANSKA and WSP
- Background
  - Glazed facades (both single and double skin) are in fashion
  - Increased problems with thermal and visual comfort
  - Despite technological improvements, potential for more energy-efficient solutions
  - Several case studies show a large disagreement between simulations of energy use and real measurements

Aims

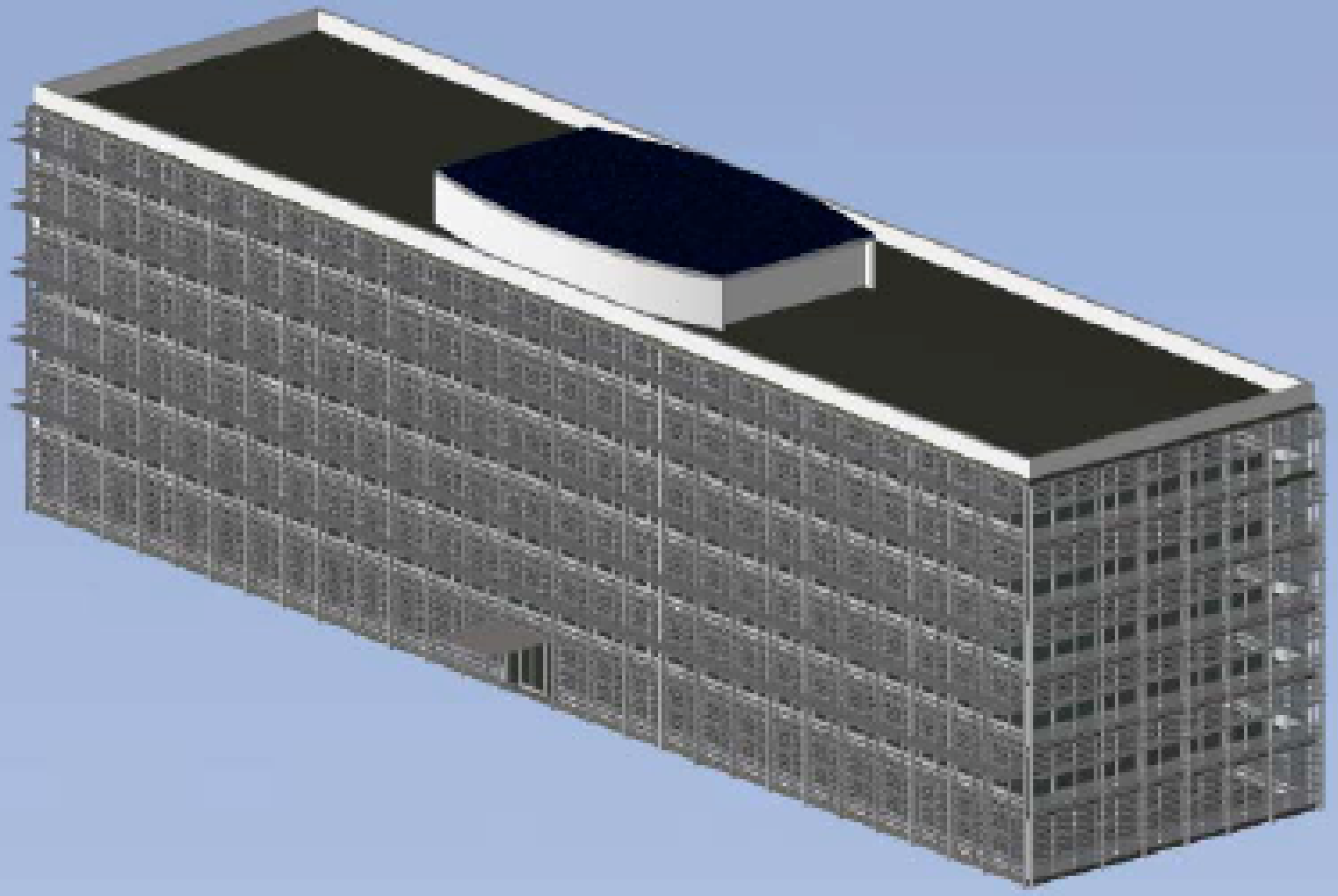
To gain knowledge concerning the possibilities and limitations with glazed office buildings in cold climates, mainly with regard to energy use and indoor climate

- Development of calculation methods and analysis tools
- Improvement of analysis methodology
- Calculation of life cycle costs
- Comparison of design alternatives regarding total energy use, thermal comfort, visual comfort, daylight availability and lighting electricity savings
- Development of guidelines for design/construction of glazed buildings in cold climates
- Strengthening and development of competence concerning energy-efficient advanced buildings in cold climates

Methods

- Design of a virtual building in ArchiCAD 9 (WSP architects, Malmö)
- Simulation of energy use of various facade designs using IDA-ICE (H. Poirazis, LTH)
- Calculation of building and life-cycle costs by linking ArchiCAD model to MAP-kalkyl (L. Sjödin, WSP Management, Malmö)
- Simulation of daylight quality and lighting energy use using Radiance (H. Bülow-Hübe, LTH)

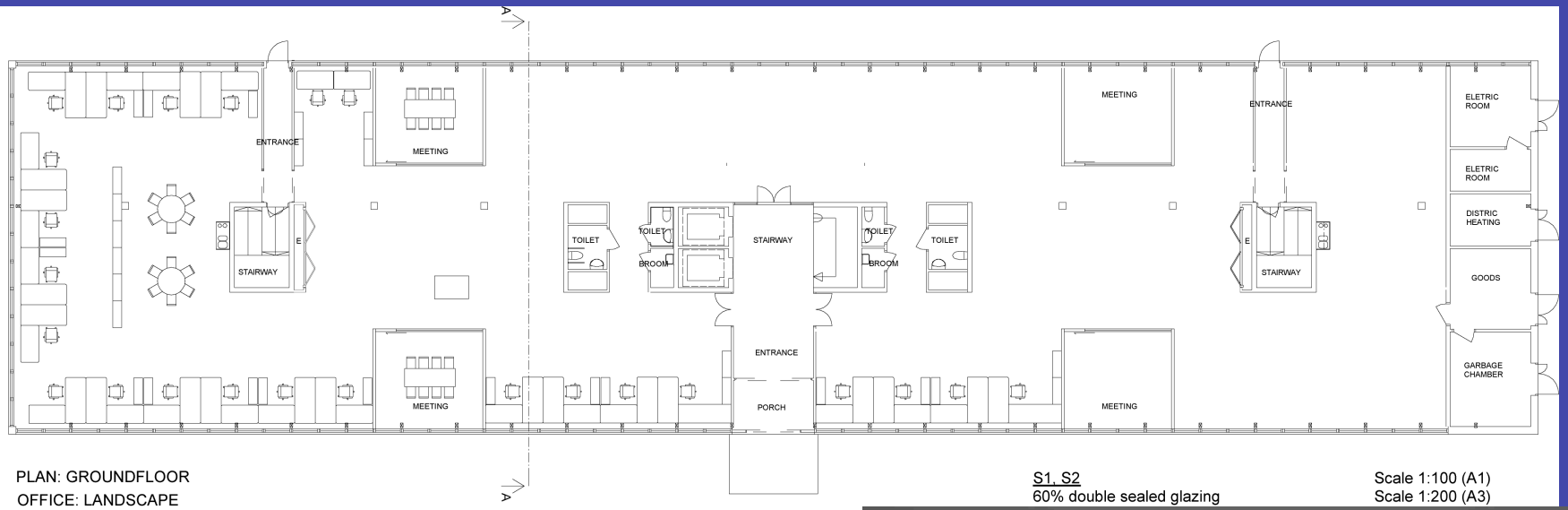
ArchiCAD office building model



Facade and Office Designs

- Variation of facade glass area: 30%, 60% and 100% window area
- Various shading devices, for example venetian blinds, awnings
- Open plan and cell type offices
- Evaluation of furnished office rooms

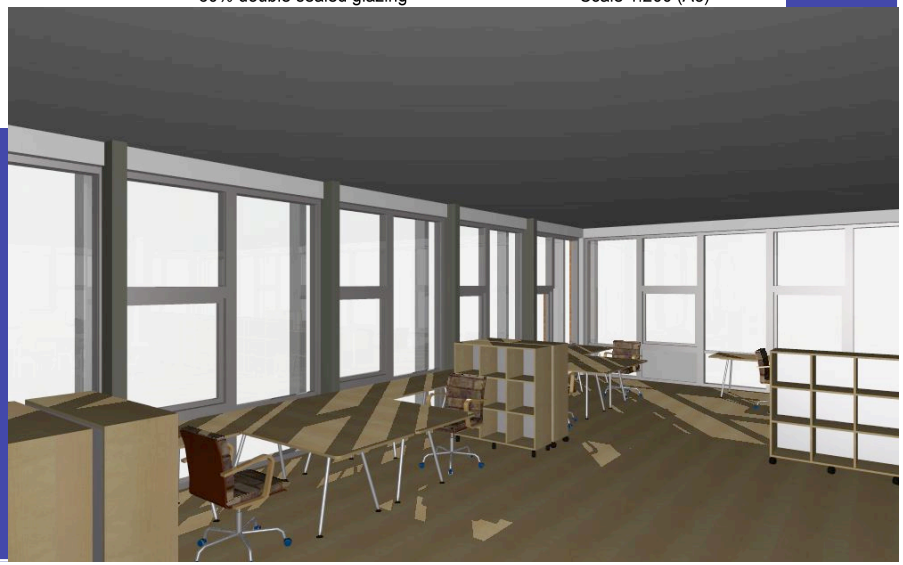
Virtual office – open plan



PLAN: GROUNDFLOOR
OFFICE: LANDSCAPE

S1, S2
60% double sealed glazing

Scale 1:100 (A1)
Scale 1:200 (A3)



Virtual office – cell type

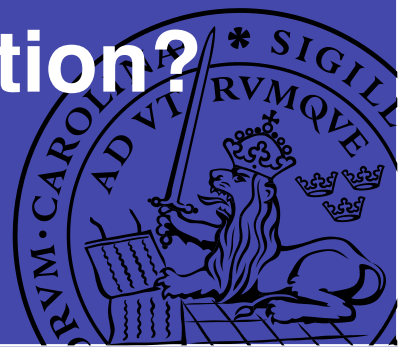
Visual quality estimation?

- What parameters should be calculated and in what interface?
  - Daylight factors / daylight autonomy
  - Illuminance values, hor/vert/cyl?
  - Luminance ratios, what direction?
  - Glare indices, which?
  - Others?
- Compare to Marie-Claude's work

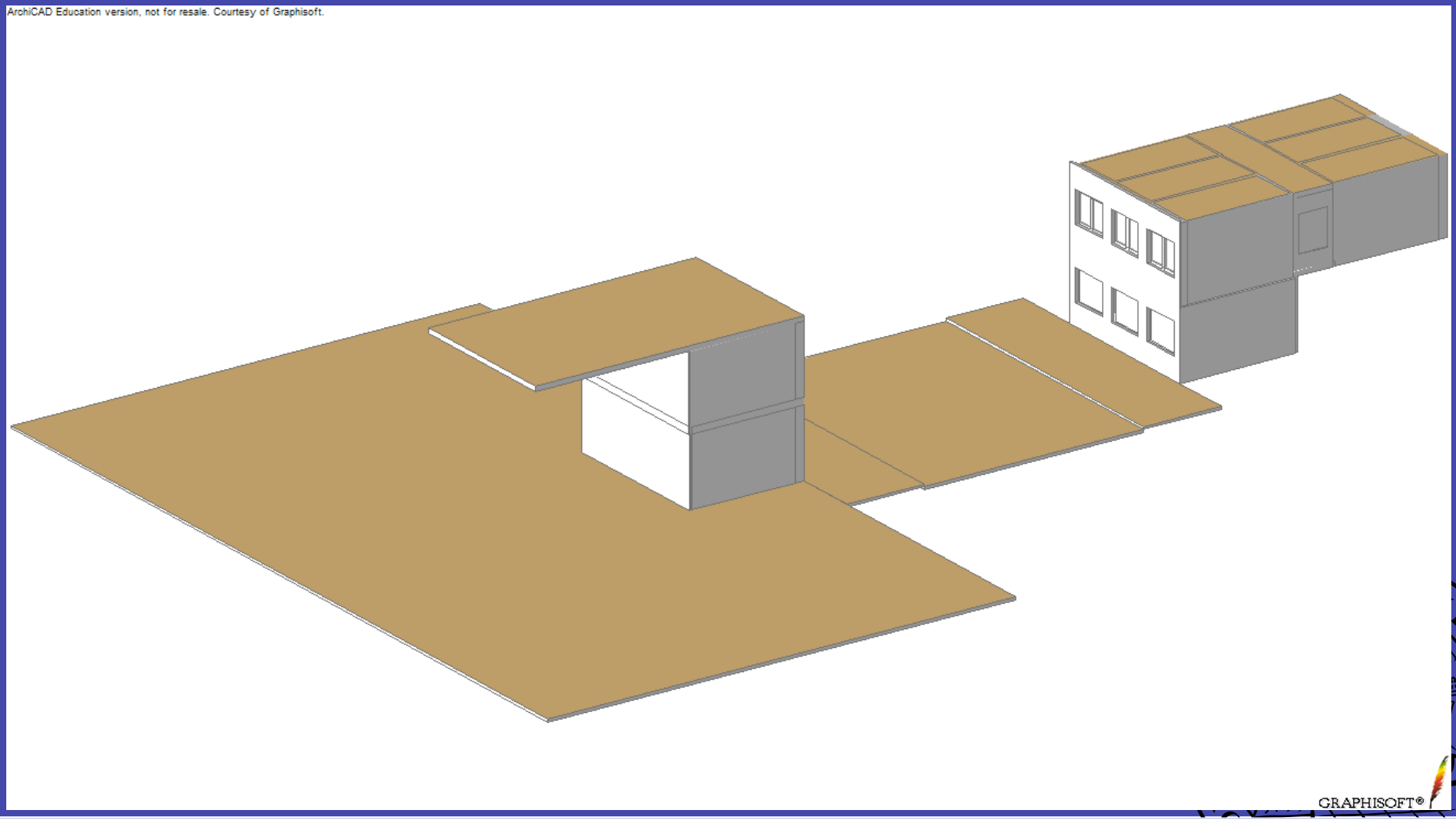
Idea to work methodology

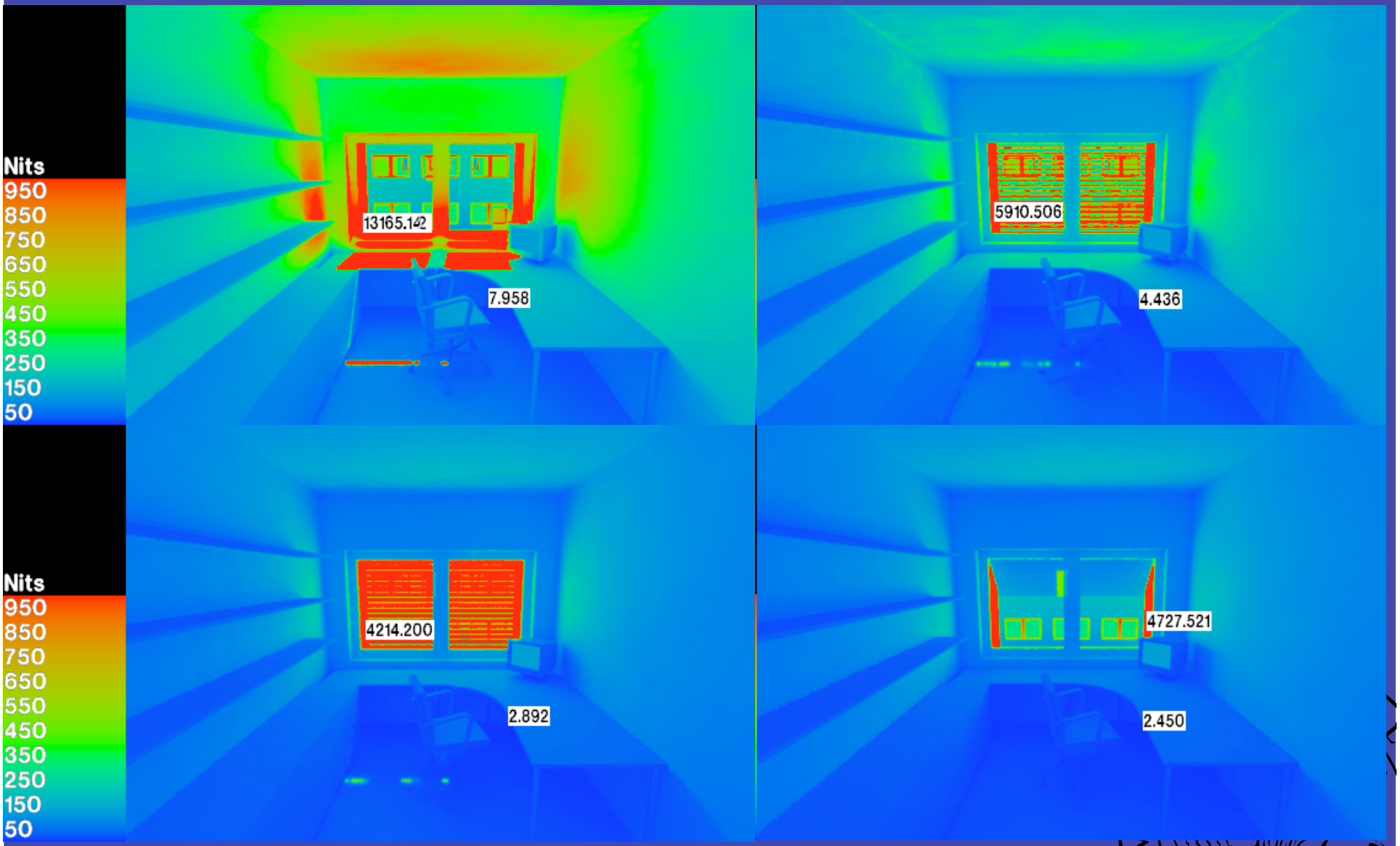
- Creation of simplified geometries for slice of office plan in ArchiCAD 7
- Import of models into Rayfront
- Simulation of illuminance and luminance values for a few selected sky models and hours of the year
- Creation of a rendered pictures for a few selected cases

- Creation of input files to DAYSIM
- Simulation of energy savings and daylight factors
- Daylight savings estimation separate from energy simulations (which are already performed)
- Visual quality parameter simulation?



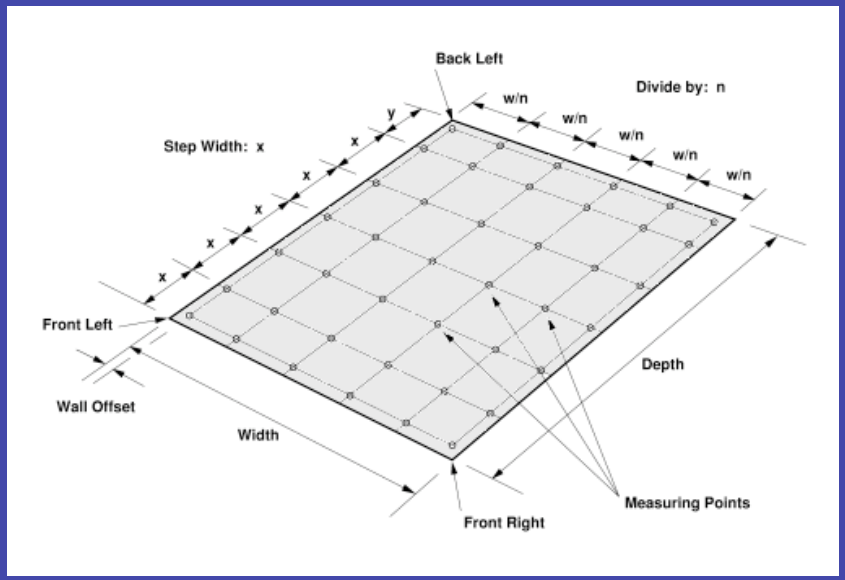
Simple office example

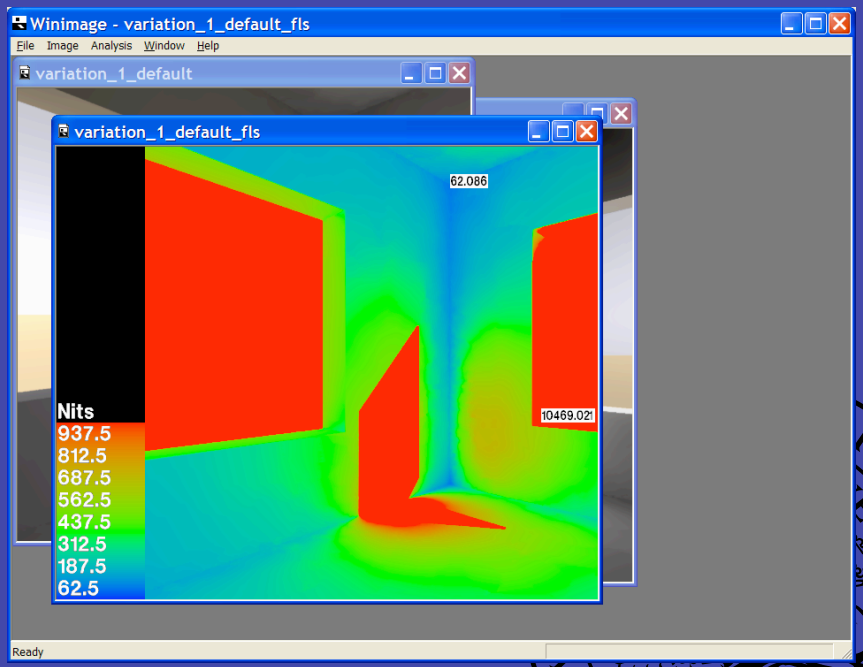


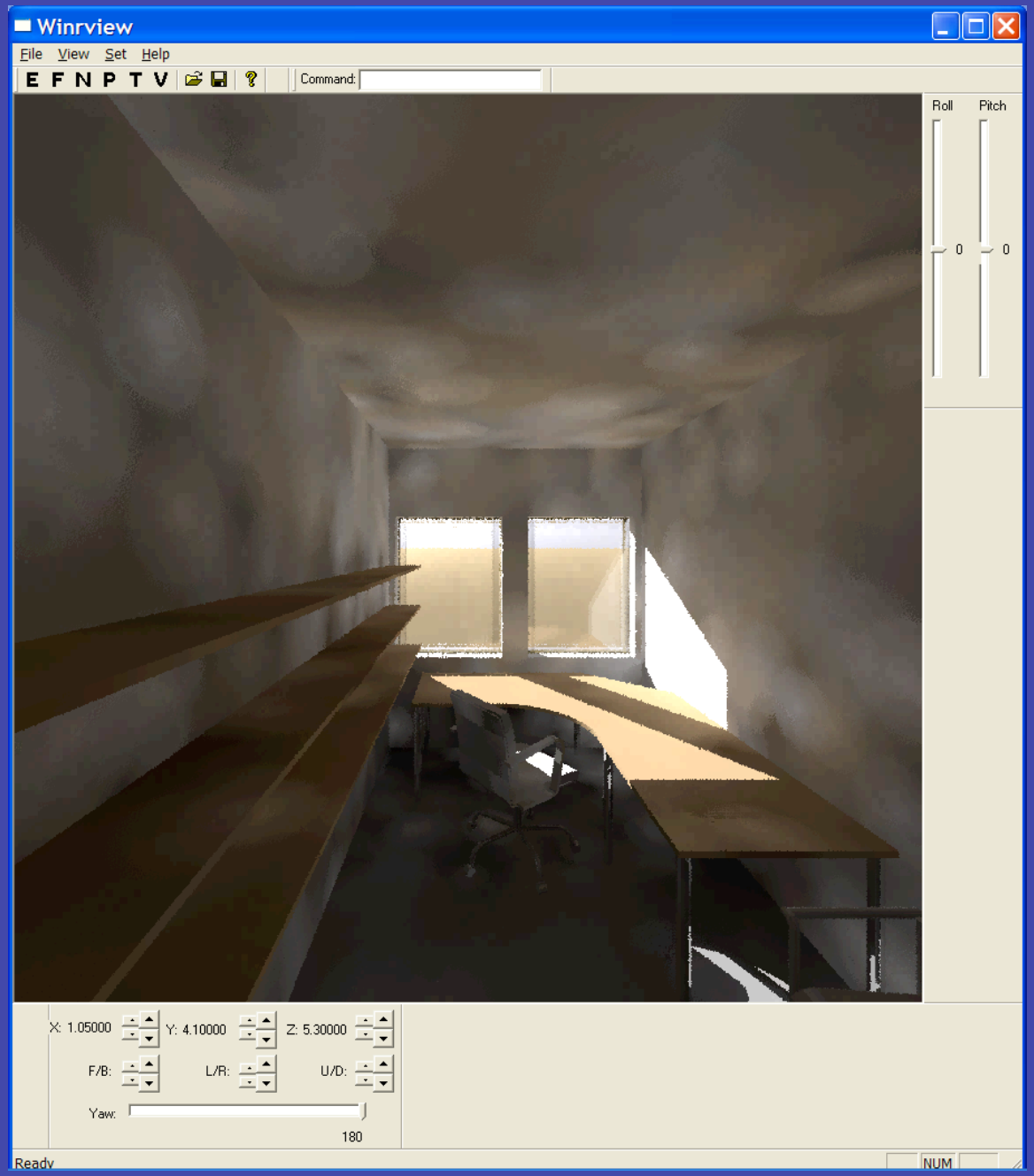

Nits
950
850
750
650
550
450
350
250
150
50
13165.142
7.958
5910.506
4.436
Nits
950
850
750
650
550
450
350
250
150
50
4214.200
2.892
4727.521
2.450

Keep on using Rayfront-interface ?

- Limited possibility with numerical calculations – only planar “grids”
- Facilitates picture generation and evaluation

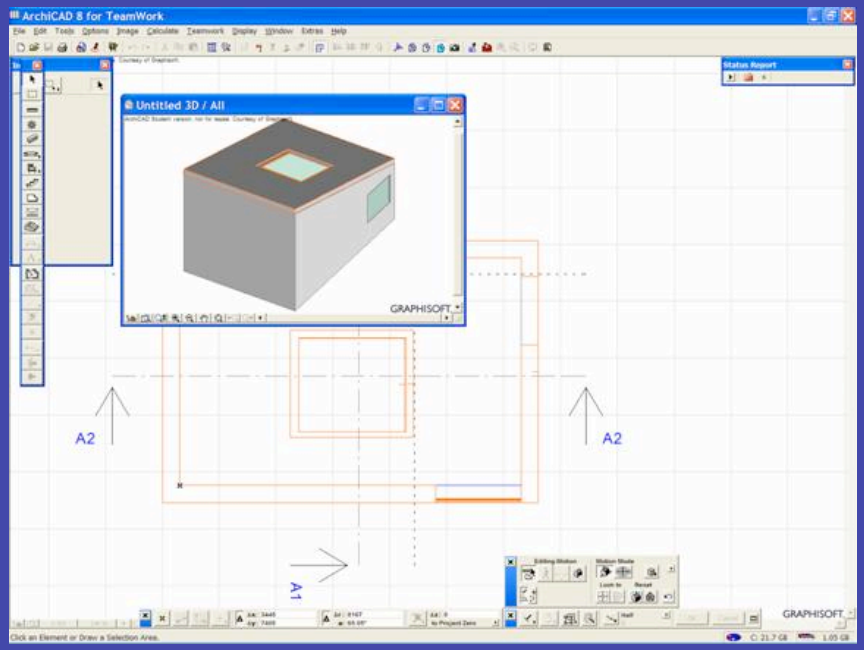


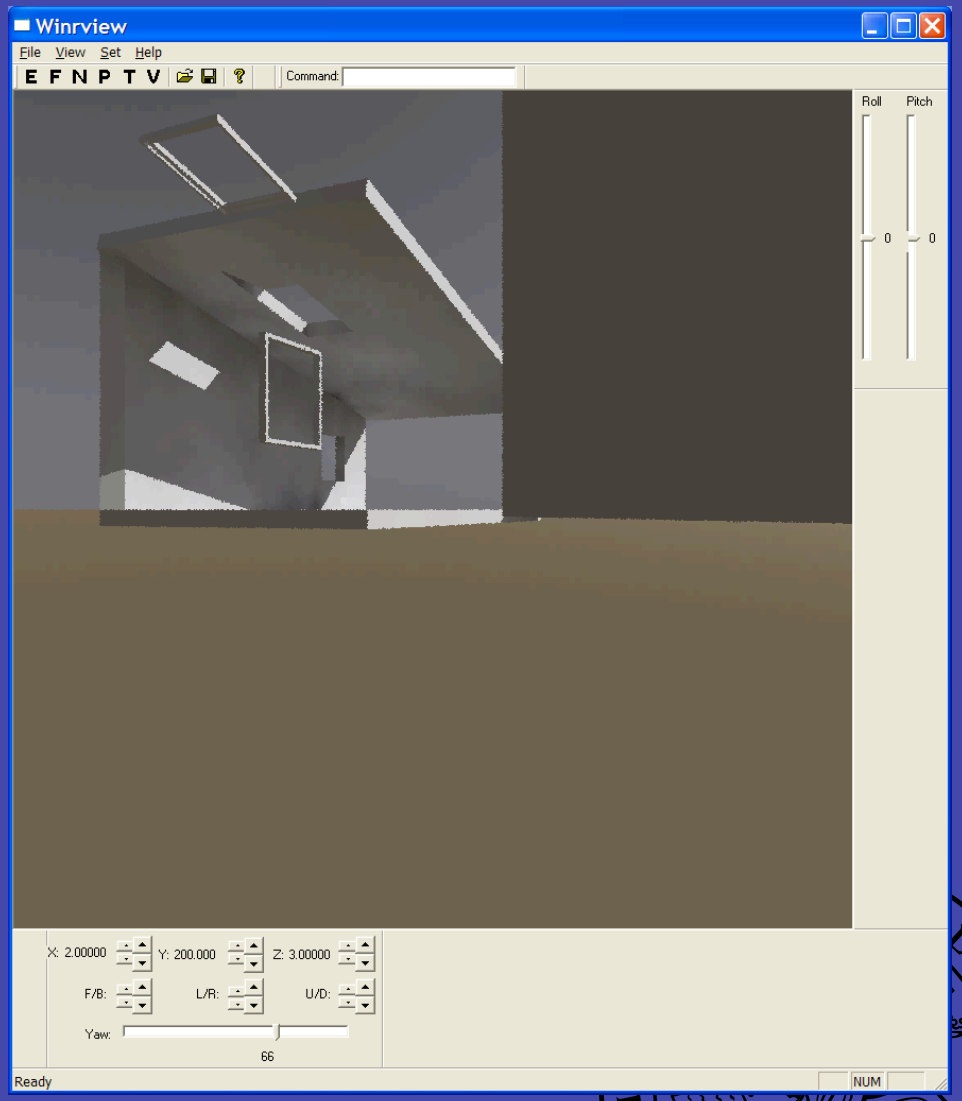



Winrview
File View Set Help
E F N P T V
Command:
Roll
Pitch
0
0
X: 1.05000
Y: 4.10000
Z: 5.30000
F/B:
L/R:
U/D:
Yaw:
180
Ready
NUM

Potential and real difficulties

- ArchiCAD 8/9 dxf-models do not convert correctly into Rayfront (new dxf-file version???), therefore new (simpler) models are built in ArchiCAD 7
  - Frustrating before it solved, but it is certainly solvable


ArchiCAD 8 for TeamWork
Untitled 3D / All
GRAPHISOFT
A2
A2
A1
GRAPHISOFT


Winrview
File View Set Help
E F N P T V
Command:
Roll
Pitch
0
0
X: 2.00000
Y: 200.000
Z: 3.00000
F/B:
L/R:
U/D:
Yaw:
66
Ready
NUM

Via ArchiCAD 7

Via ArchiCAD 9

Start using DAYSIM?

- Potentially stronger in selection of points for numerical values
- Better for annual estimations
- How to best transfer model from ArchiCAD to DAYSIM?
  - Via *.dxf ◊ Rayfront ◊ *.rad ??
  - Via *.3ds , but does it work properly from ArchiCAD?

Suggestions?