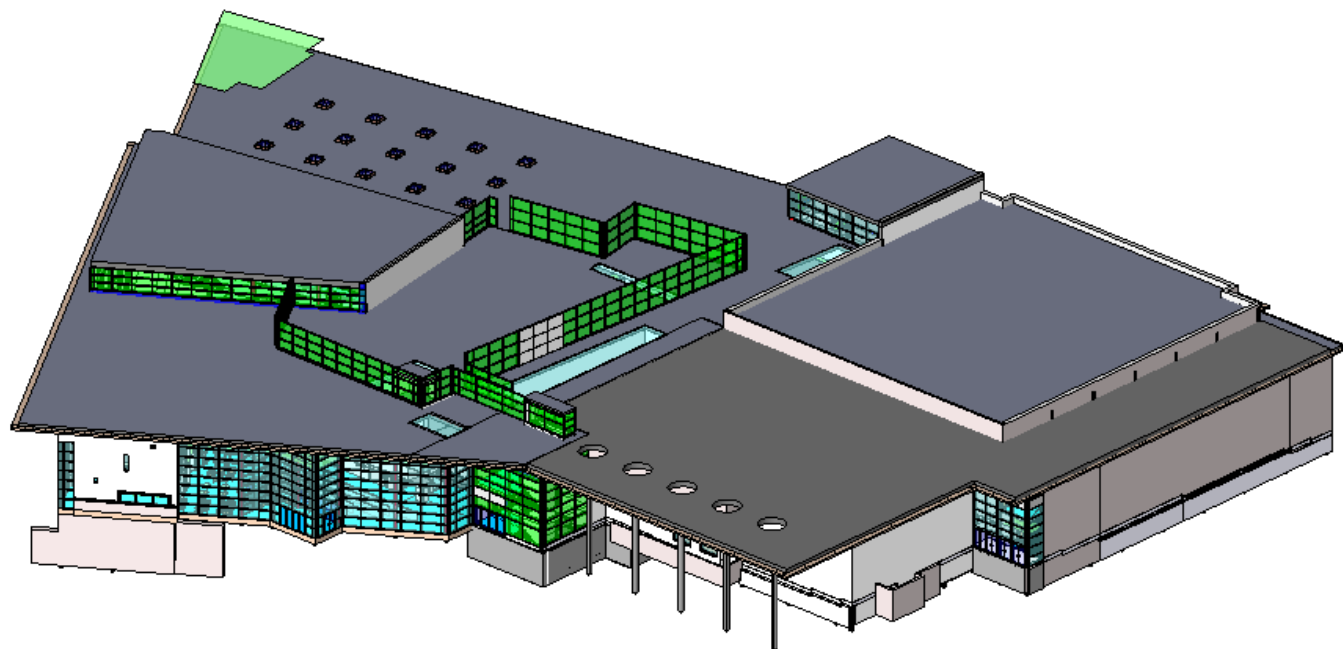


Developing building simulation tools that balance rigor with
efficient use

An insight into the Research and Development philosophy at
EDSL Tas

The efficient integration of energy and daylight simulations into the quickly emerging BIM based workflow is a significant challenge.

The Key stage is the conversion of the architectural model to an analytical model.

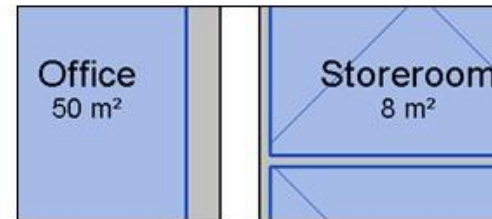


There are two key issues which hinder interoperability.

Architects are not aware of the simple rules for creating a model with good space definition.

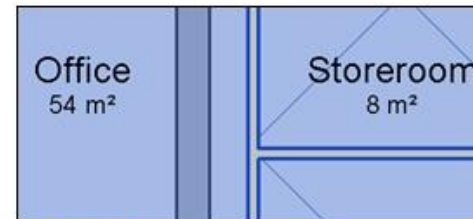
It takes 1 hour to make them aware of these simple rules

1.3 Wall Voids and Walls made of Multiple Elements



There can be no wall voids that do not contain rooms. As an example, see the picture above – two existing rooms are separated by two walls with a void between them. The geometry would be incorrect if a gbXML was made from this model; the two rooms would have no link and their walls would be marked as the wrong type.

Possible solutions:



1. Make one of the walls non-room-bounding.

This is one of the quickest solutions, and is best applied in cases where the wall void is very small or the wall separates off an area which logically belongs to the larger room (eg. a small storage area, or a thin wall hiding toilet cisterns). In the case above it wouldn't be a very good solution as the wall void is thick, as is the wall itself, and making the wall non-room-bounding has increased the floor area of the left-hand room significantly.



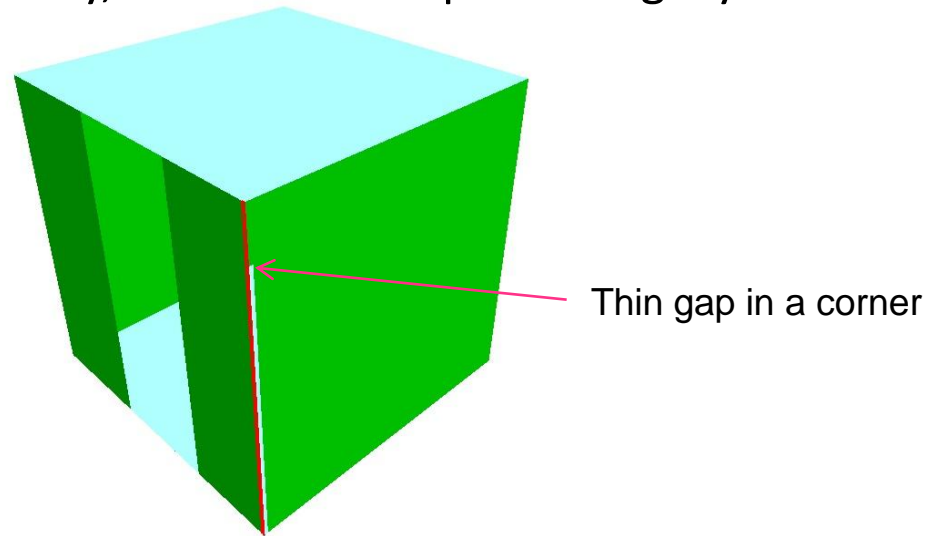
2. Place a new room between the two walls.

This is another quick solution, and is best applied in cases when the wall void is wide. For thinner voids (less than about 300mm) it should be avoided. In this case the wall void is quite wide and this solution would be reasonable.

Second, the geometry data in a gbxml file is an approximation of the architectural model .

advantage, fewer surfaces, hence faster simulations

Disadvantage, gaps in the geometry, hence loss of space integrity



The Tas 3D model uses **solid modelling techniques** which are topologically robust.

-Space boundaries are always enclosed by surfaces.

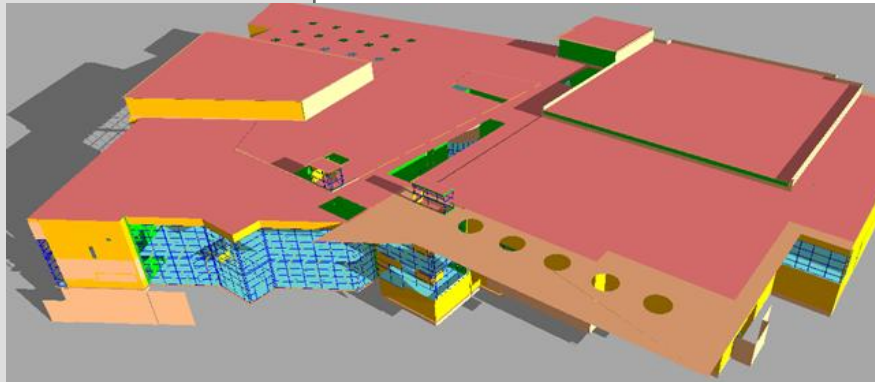
-The adjacency of rooms – surfaces and edges are explicitly represented in the data structure.

- *Integrity of the analysis model is guaranteed before simulation starts*

The Tas 3D model gbxml import creates an analytical model.

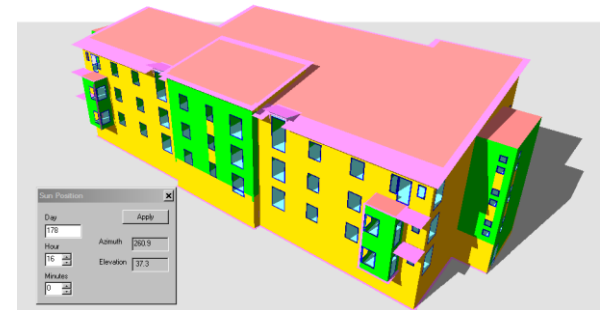
Identifies gaps in the space boundaries, incorrectly orientated surface and adjacency problems and fixes them.

218 complex spaces (43MB gbxml)



240 adjacency 118 small gaps and 117 orientation fixes

225 simple spaces (7MB gbxml)



100 adjacency
53 small gaps and
16 orientation fixes

gbxml files from revised architectural models may be MERGED into existing Tas models

3D view of Tas model generated from gbxml data

The screenshot displays the EDSL Tas 3D Modeller software interface. The main window shows a 3D perspective view of a building model with various colored zones and components. The interface includes a menu bar (File, Edit, Building, View, Tools, Window, Workspace, Analysis, Daylight, Help), a toolbar, and several panels on the right side. The '3D View Filter' panel shows a tree view of the model's structure, including 'gbXml Spaces'. The 'Zones' panel lists various zones such as 'F001 Boardroom', 'F002 Stair 5', 'F003 Office 1', 'F004 Office 2', 'F005 Servery Store', 'F006 Office 3', 'F007 Stair 4', 'F009 Main Pool Spectators', and 'F010 Stair 3'. The 'Elements' panel lists building elements like 'External Wall', 'Internal Wall', 'Ground Floor', 'Internal Floor', 'Exposed Floor', and 'Internal Ceiling'. The 'Sun Position' dialog box is open, showing settings for Day (178), Hour (18), Minutes (0), Azimuth (284.3), and Elevation (18.6). The 'Windows' panel lists window types like 'Air', 'Basic Wall: Generic Ext...', 'Curtain Wall Window: 150...', 'Curtain Wall: 1700mm', 'Curtain Wall: 1800mm', 'Obl Glass (5): Store Front...', and 'Door: Sl...'. The 'Analysis model errors and warnings' panel at the bottom left shows a list of messages, including '240 x Type: Info' and '235 x Type: Warning'. A white text box with an arrow points to the '235 x Type: Warning' message.

Model data courtesy of N G Bailey

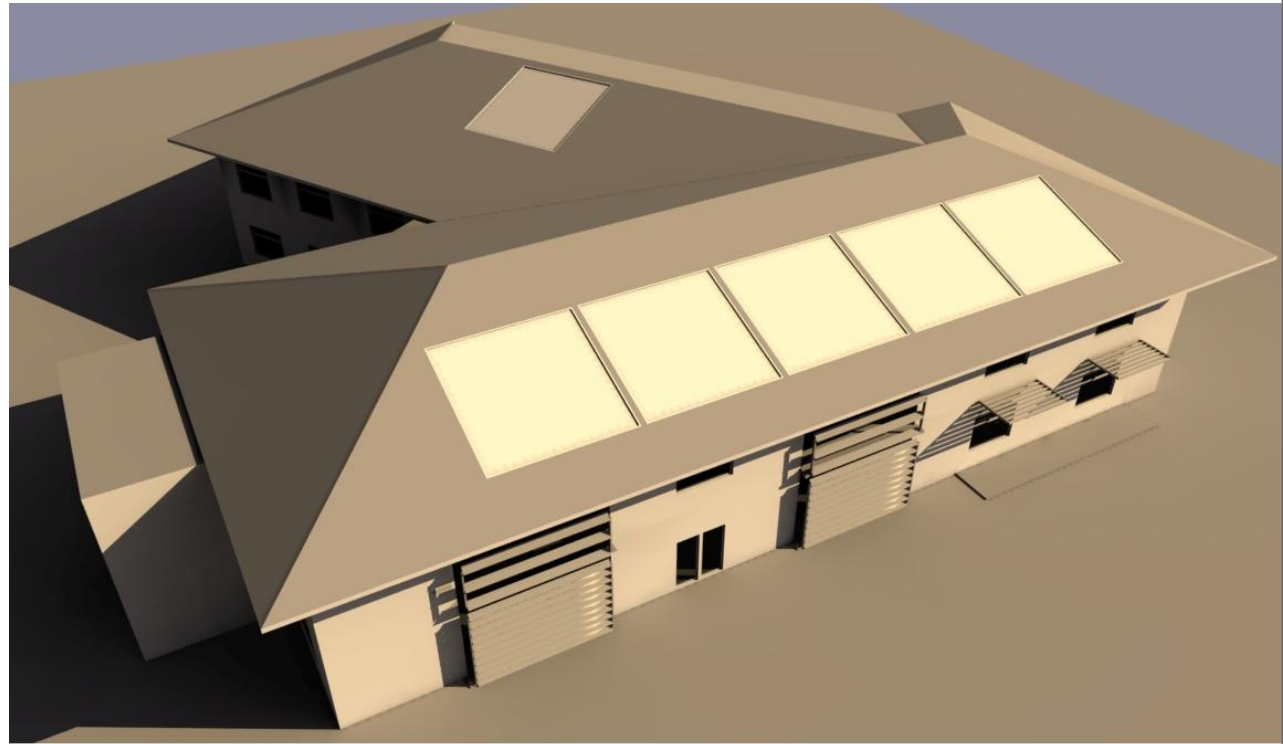
A total of 475 anomalies automatically identified and fixed

Analysis model errors and warnings

Message
240 x Type: Info
235 x Type: Warning

KEY TECHNOLOGY

daylight render

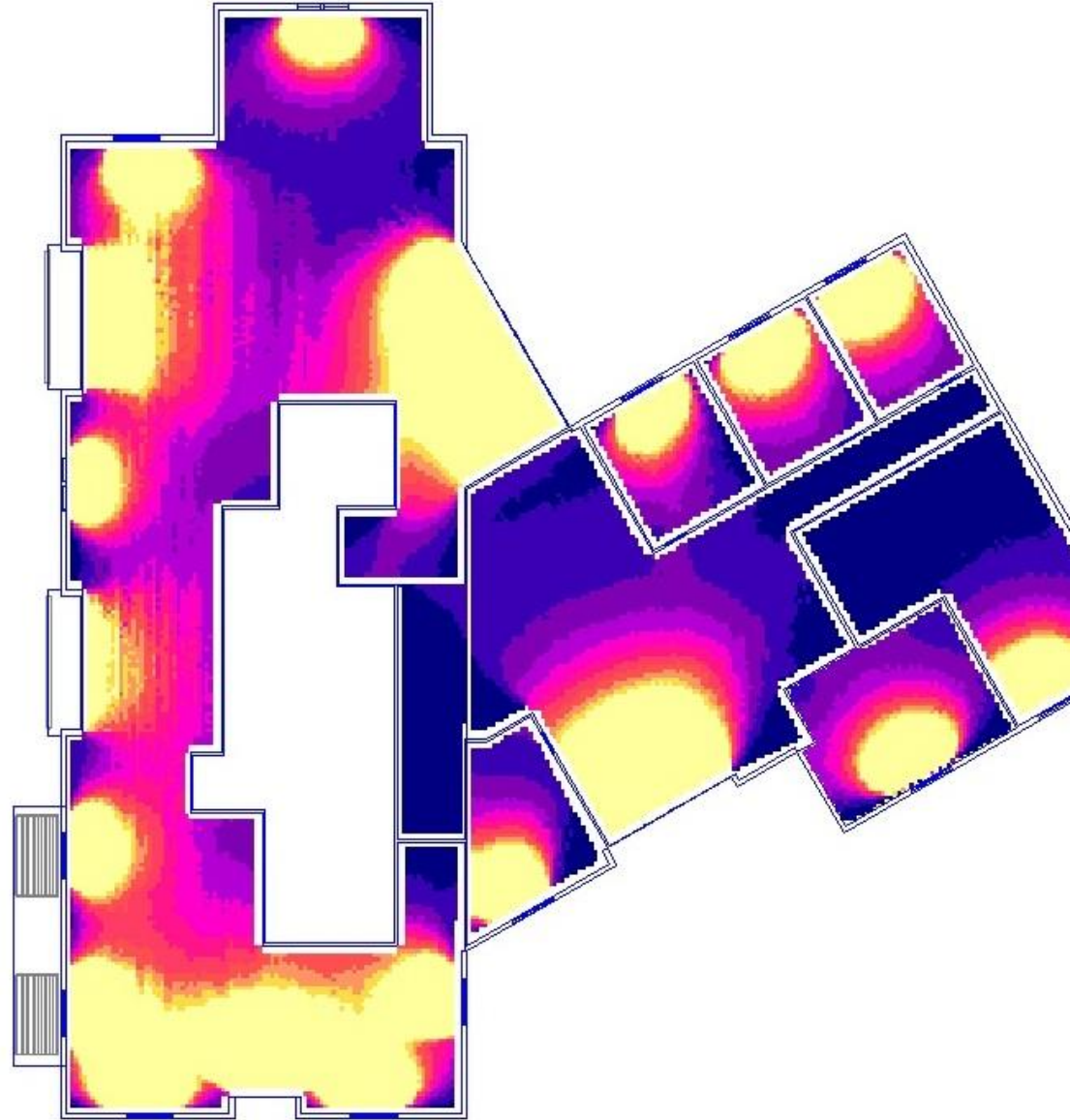
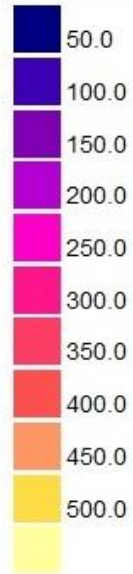


Tas daylight is based on
adaptive radiosity

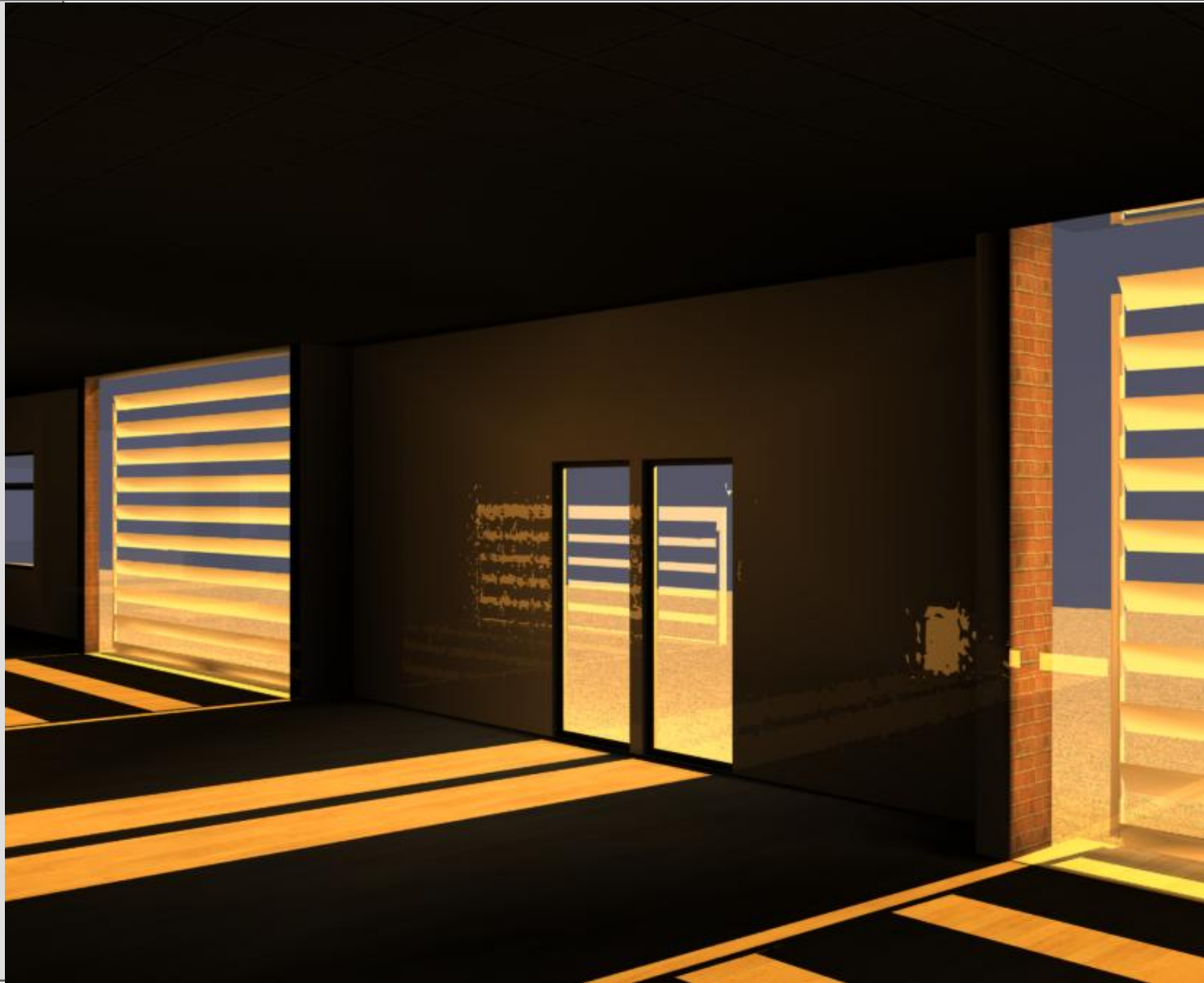
CIE 171,2006 compliant

Fast multi zone daylight simulations

Lux levels (<)

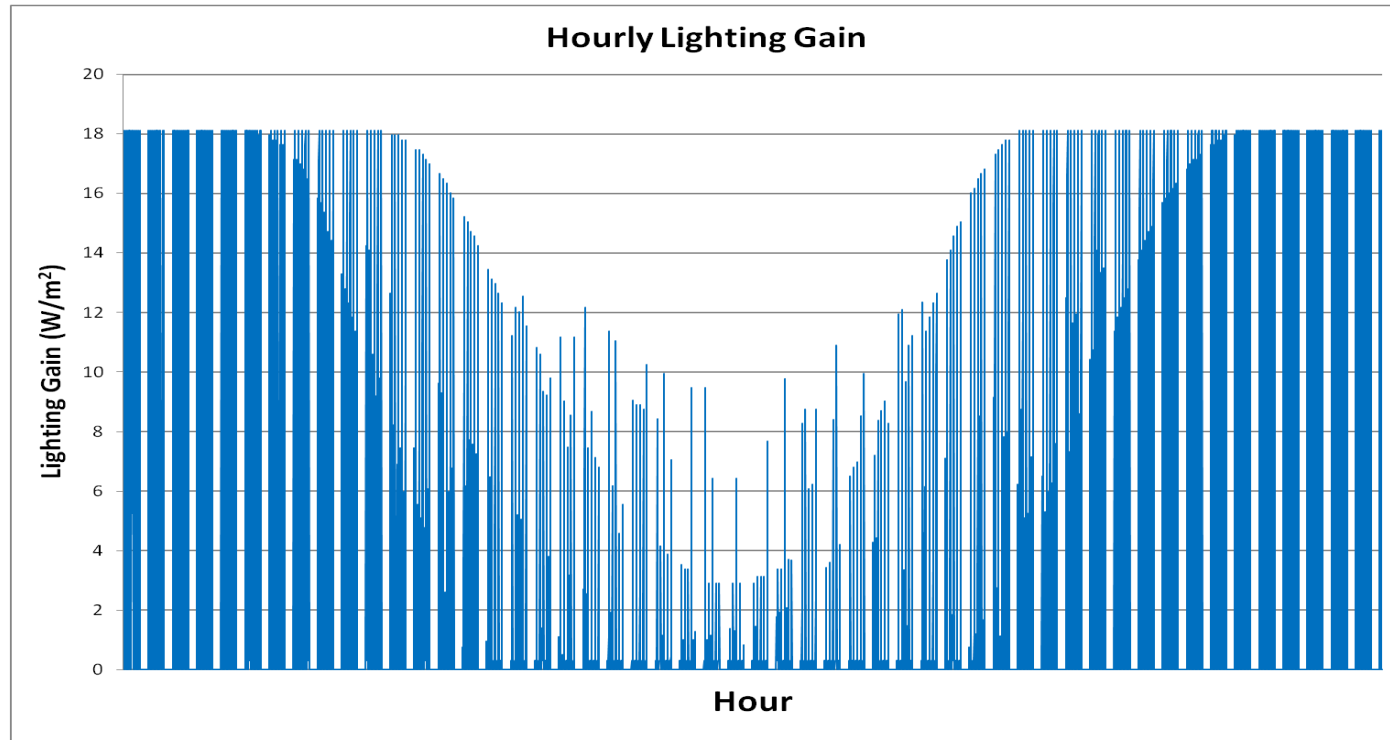


Inside and
outside
specular
reflection
analysis
using ray
tracing over
the radiosity
results





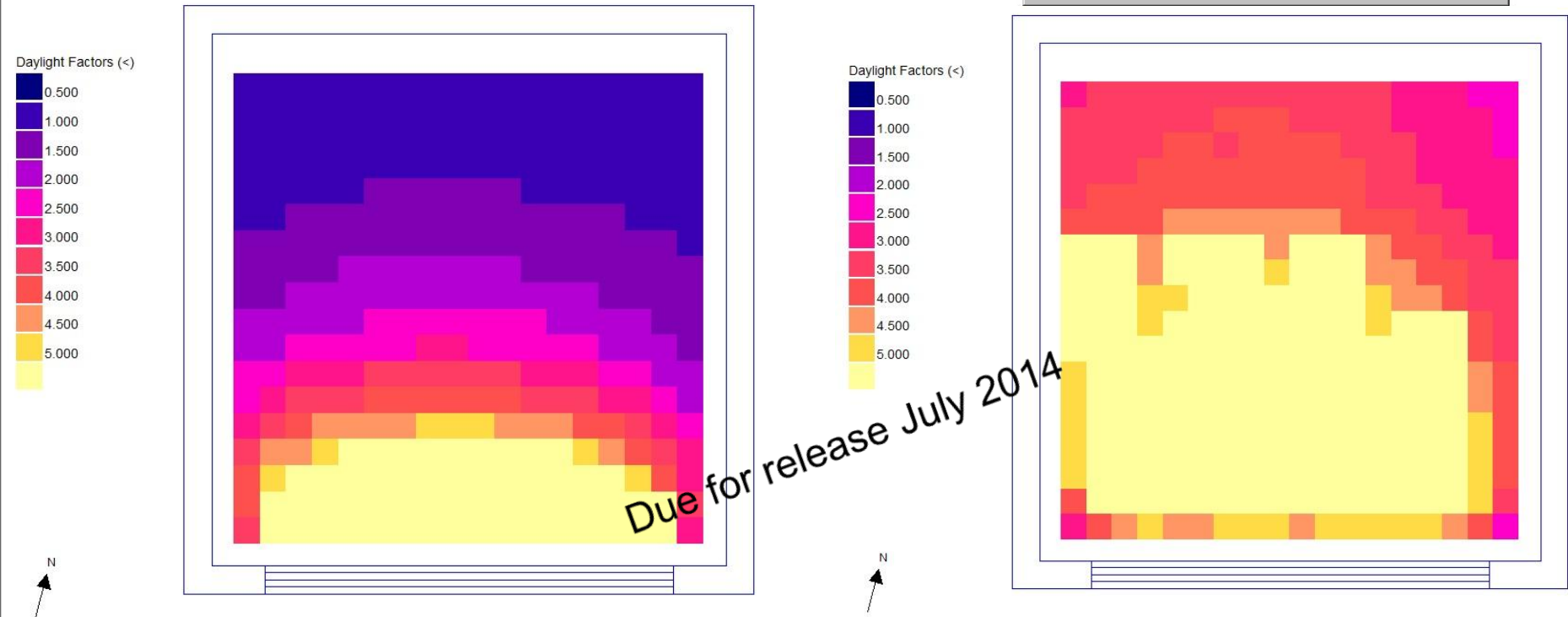
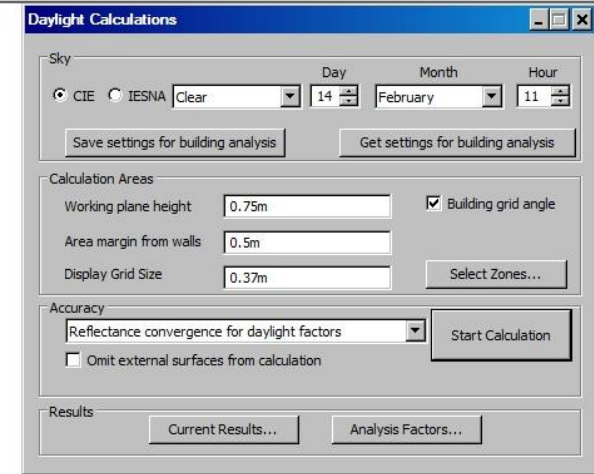
Space daylight data
automatically used
in energy simulation
to calculate daylight
savings



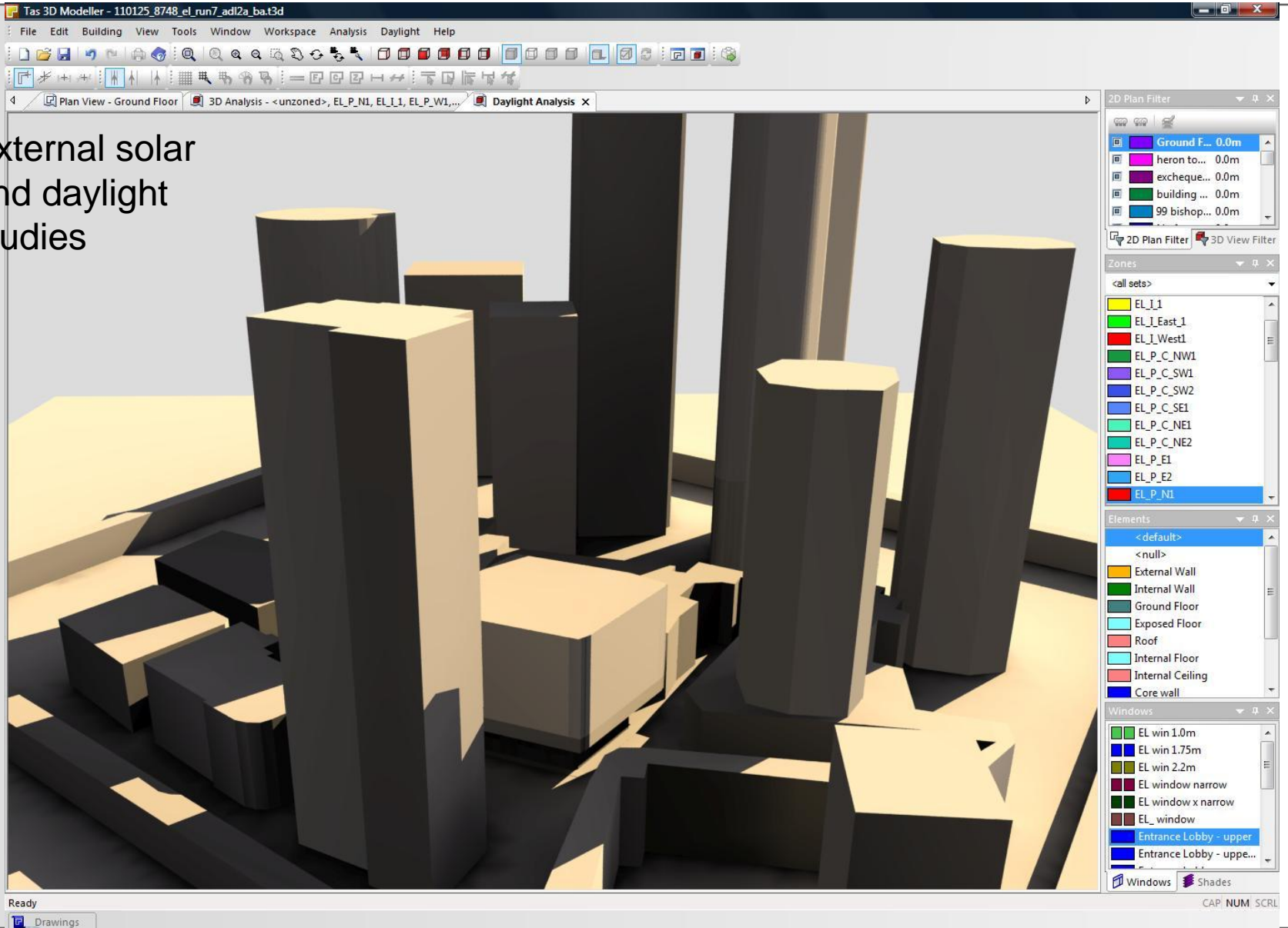
CBDM

Calibrate sampled beam and diffuse daylight analysis against equivalent solar gains from thermal simulations.

Calculate daylight levels from hourly solar gain over a year to produce UDI, DA and daylight distribution

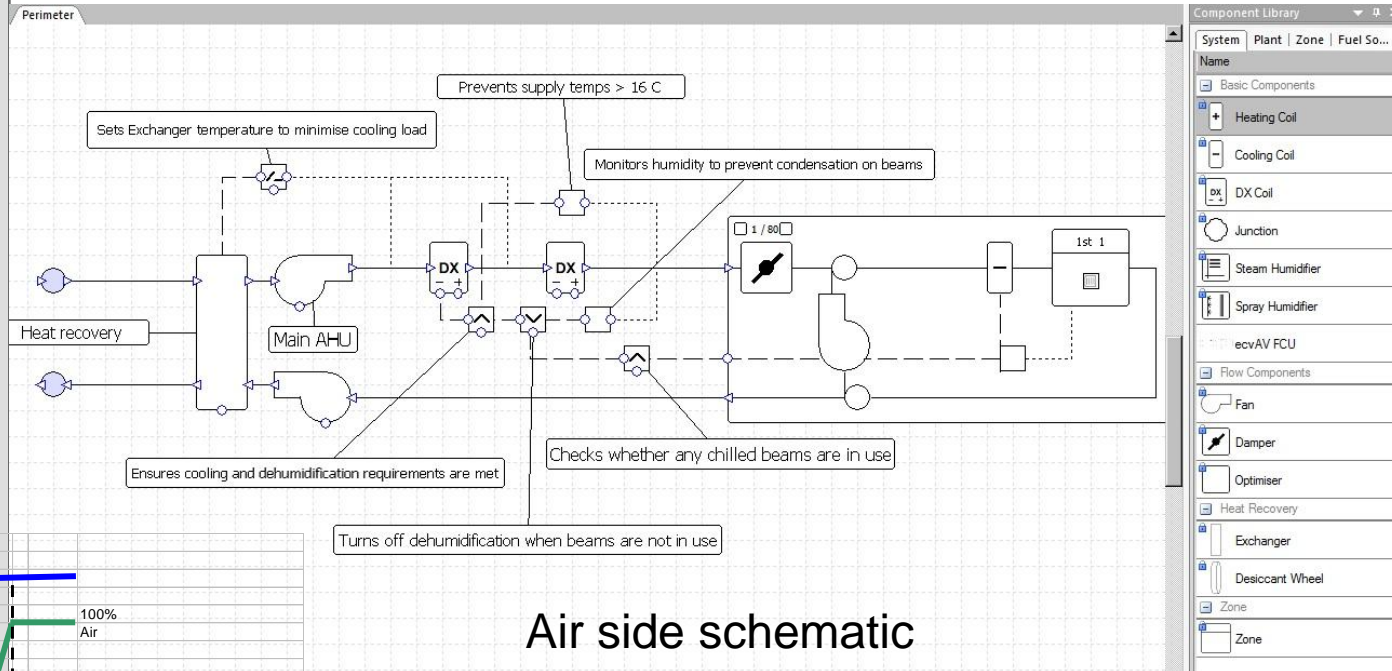


External solar and daylight studies

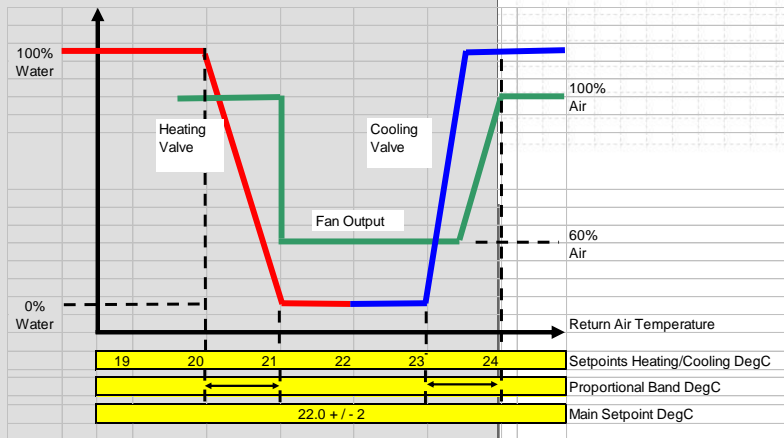


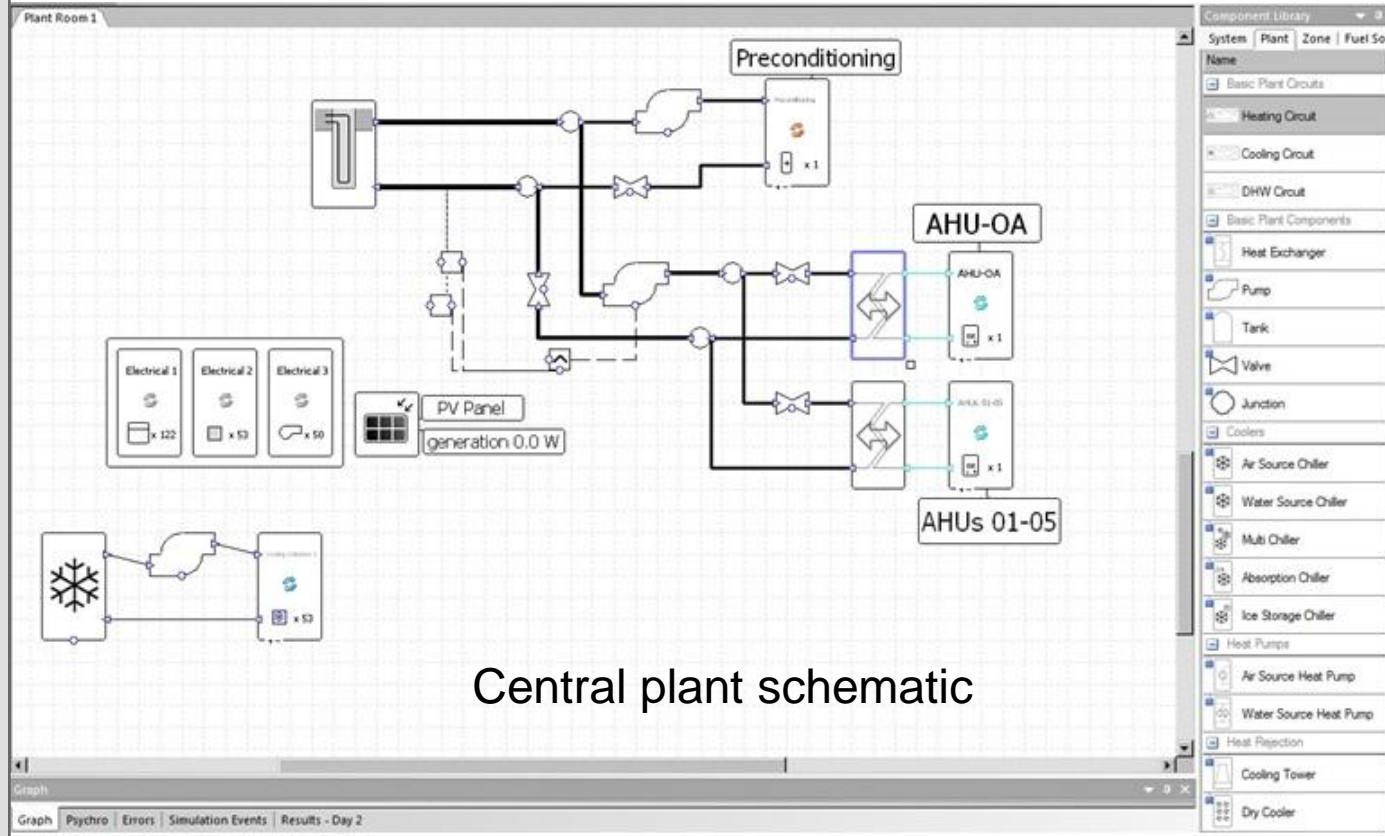
Component based plant and control modelling coupled to building simulation

KEY TECHNOLOGY



Air side schematic

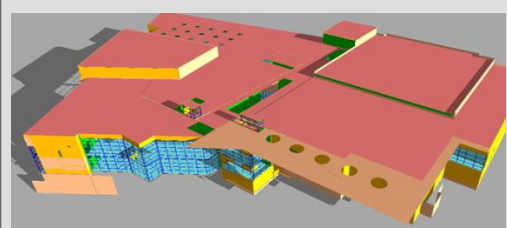




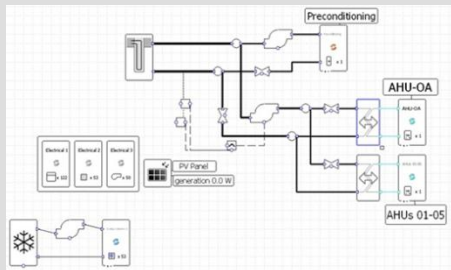
Central plant schematic

KEY TECHNOLOGY

Dynamic building thermal simulation uses a 'Heat Balance Method' as described in ASHRAE Fundamentals 2013 page 18.14



Annual building simulation completed in 80 sec.



Coupled space weighting factors and systems annual simulation 16 sec.

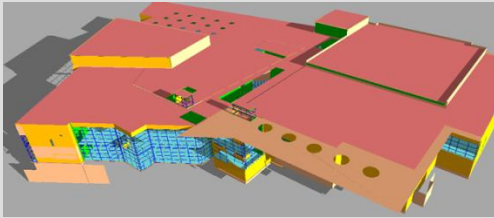
Smart coupling of building and plant simulation

Room 'weighting factors' can be calculated before plant simulation

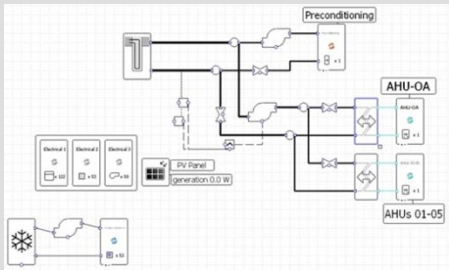
When plant operation alters the zone energy balance applying the time series weighting factor adjustments 'corrects' the result

Very accurate for simple adjustments, e.g. ventilation changes are typically within 1% of the exact solution

Smart coupling of building and plant simulation



Annual building simulation completed in 80 sec.

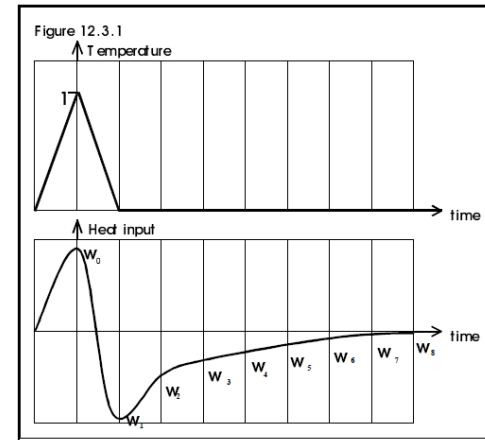
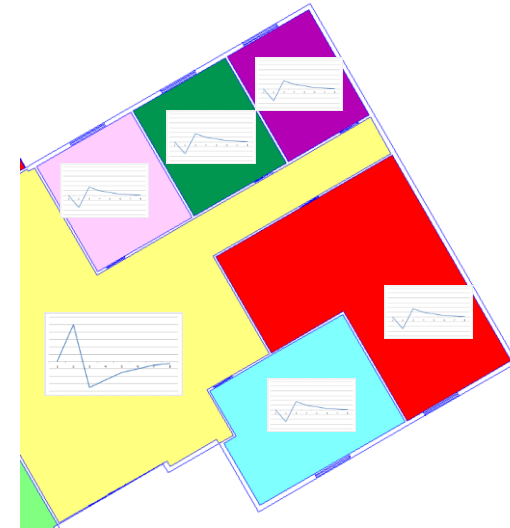


Coupled space weighting factors and systems annual simulation 16 sec.

As well as calculating the target zone's response, the effect of a temperature pulse on its neighbouring zones can be calculated and stored

When the plant simulation alters a zone's energy balance, the effect on neighbours is included and building heat balance is retained. Very important for underfloor systems and perimeter core zones in open plan

Convective and radiant weighting factors are calculated so systems with varying proportions of convective/radiant split may be modelled.



UK Building Regs Studio 2013 automates the calculation procedure for Part L/EPC. It is multi-core enabled, simulating actual, notional and reference models simultaneously.

**Accredited by CLG
1st May 2014**

Automation Interface

KEY TECHNOLOGY



Tas UK Building Regulations Studio 2013



Start a new UK
Regulations Project...



Open an existing UK
Regulations Project...

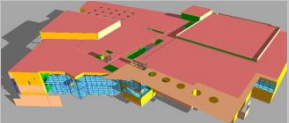
Studio automatic generation of notional & reference buildings, multi-core simulation and report generation.

Generation Options

Perform building steps for all sourcesets. ▼

Building	Generate Building	Simulate Building	Retrieve Results	Generate Systems	Simulate Systems	Produce Documentation
Actual	▶	▶	▶	▶	▶	▶
Notional	▶	▶	▶	▶	▶	▶
Reference	▶	▶	▶	▶	▶	▶

- ▶ Perform Task
- ✖ Do Not Perform
- ✖ Invalidated
- ✔ Already Performed
- ◐ Partially Performed
- Not Applicable

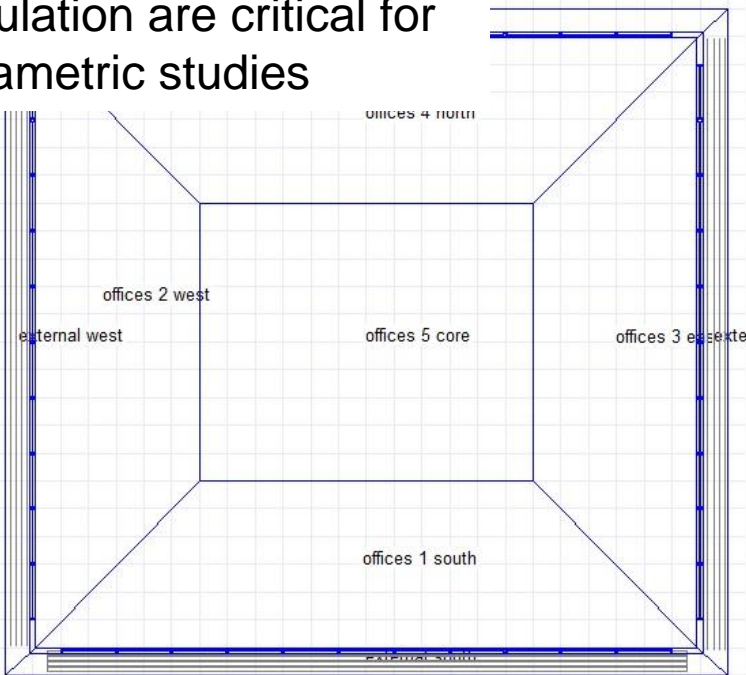


Task	State	Progress
<ul style="list-style-type: none"> Generate Buildings <ul style="list-style-type: none"> ✔ Actual: huddersfield leisure.tbd Completed ✔ Notional: huddersfield leisure.tbd Completed ✔ Reference: huddersfield leisure.tbd Completed Simulate Buildings <ul style="list-style-type: none"> Actual: huddersfield leisure.tbd Day 251 Notional: huddersfield leisure.tbd Day 172 Reference: huddersfield leisure.tbd Day 48 Retrieve Results <ul style="list-style-type: none"> Actual Queued Notional Queued Reference Queued Generate Systems <ul style="list-style-type: none"> Actual Queued Notional Queued Reference Queued Simulate Systems <ul style="list-style-type: none"> Actual Queued Notional Queued Reference Queued Generate Documentation <ul style="list-style-type: none"> Actual Queued Notional Queued Reference Queued 		<div style="display: flex; flex-direction: column; gap: 5px;"> <div style="background-color: #e0e0e0; padding: 2px;">Completed</div> <div style="background-color: #e0e0e0; padding: 2px;">Completed</div> <div style="background-color: #e0e0e0; padding: 2px;">Completed</div> <div style="background-color: #e0e0e0; padding: 2px;">Completed</div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, green, green, green, green, green, green, green, green, green, green);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> <div style="background-color: #e0e0e0; padding: 2px;"> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red, red, red, red, red, red, red, red, red, red);"></div> </div> </div>

218 zone building
Part L and EPC analysis
completed in 10 minutes

Part L and EPC analysis
for changes to plant and
controls design are
completed in 2.5 minutes

Accuracy and speed of simulation are critical for parametric studies



frmResults
1 of 1

Tas Facade Designer

Quick Energy Benchmark Results

Scenario	Value
larger windows	79.3
multiple facades 1	74.2
sloping shade	78.8
sloping shade and argon fill	78.3
sloping shades argon fill and pv	72.0

offices 1 south

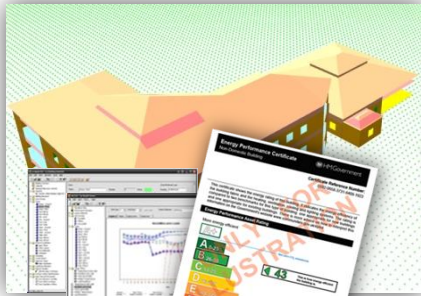
Building Name	Floor Area (m2)	Daylight Factor (%)	Solar Exceedance (%)	Internal Blind
larger windows	107.2299	7.92	-27.46377	False
multiple facades 1	107.2299	6.10	-52.38129	False
sloping shade	107.2299	6.82	-36.28601	False
sloping shade and argon fill	107.2299	6.82	-36.44553	False
sloping shades argon fill and pv	107.2299	6.82	-36.47341	False

offices 2 west

Building Name	Floor Area (m2)	Daylight Factor (%)	Solar Exceedance (%)	Internal Blind
larger windows	94.24611	8.03	-29.78436	False
multiple facades 1	94.24611	6.17	-53.4896	False
sloping shade	94.24611	7.97	-30.68942	False

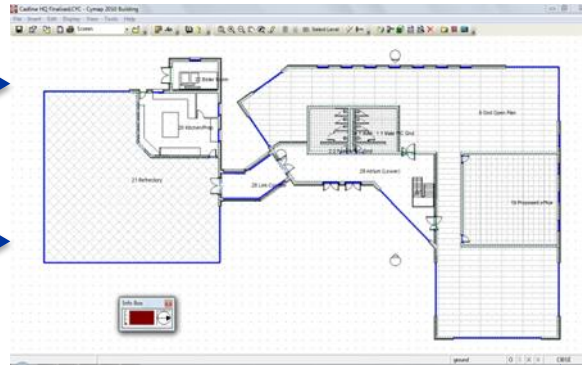
Copyright © 2010 EDSL

www.edsl.net

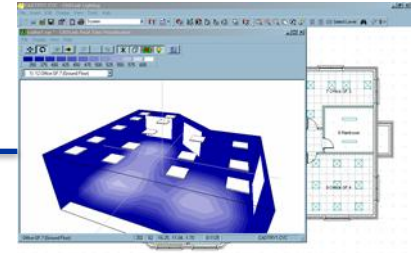


TAS SIMULATION

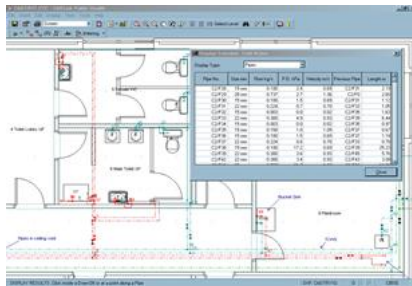
gbxml export from
Tas to Cymap



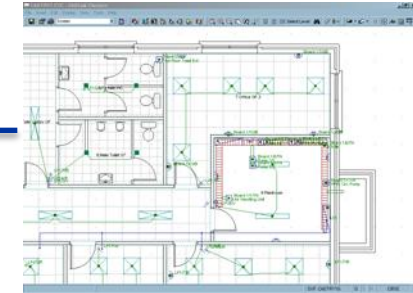
CENTRAL BUILDING
MODEL



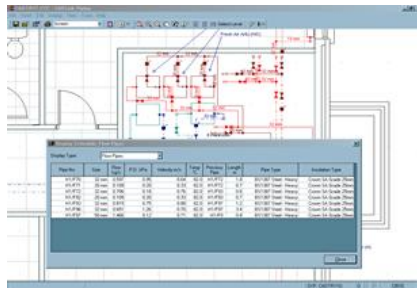
LIGHTING



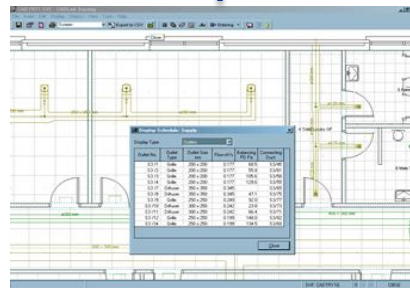
PUBLIC HEALTH



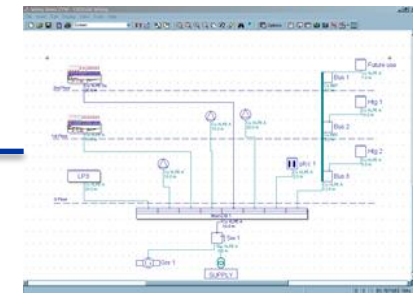
ELECTRICS



PIPEWORK



DUCTWORK



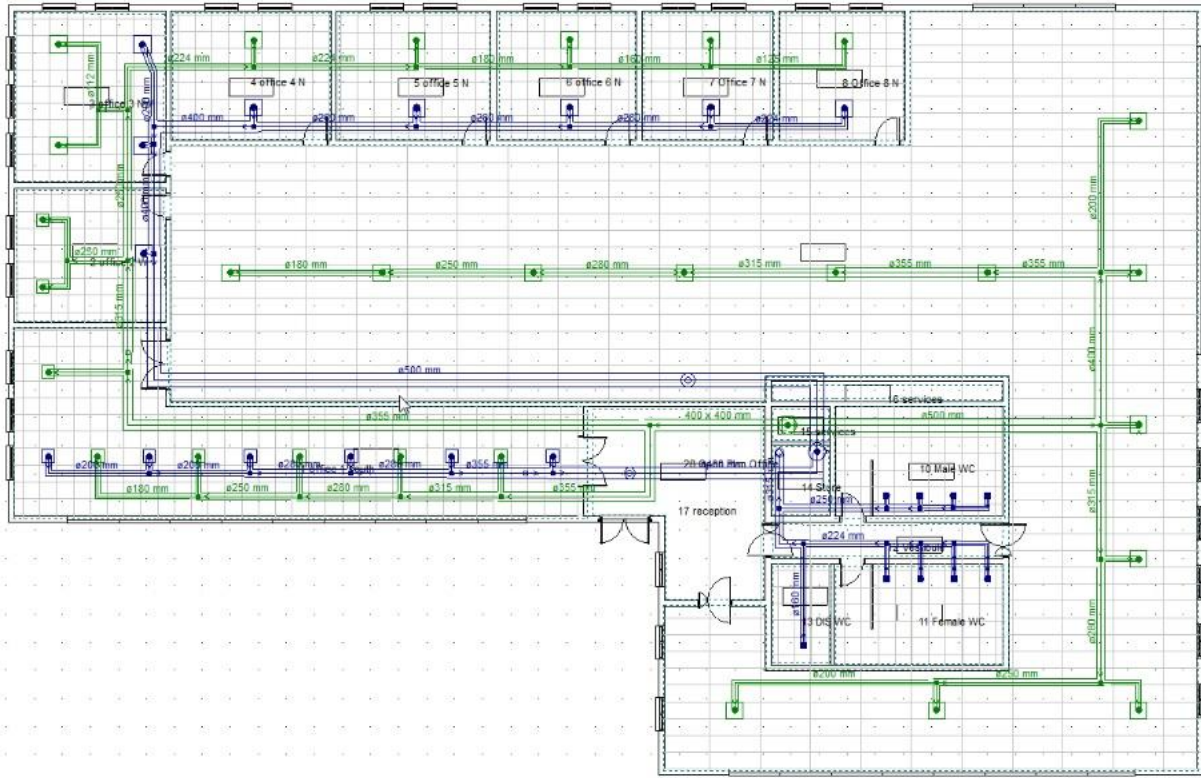
17TH EDITION WIRING

Cymap to Revit Ductwork.avi - VLC media player

Media Playback Audio Video Tools View Help

BIM Model.CYC - Cymap 2014 Ducting

File Insert Edit Display Checks View Tools Help



00:22

00:22

Floor 1 0 S N OBS

02:35

EN A [System Icons] 13:42 10/09/2013

Cymap to Revit Ductwork.avi - VLC media player

Media Playback Audio Video Tools View Help

Autodesk Revit MEP 2013 - Not For Resale Version - BIM model.rvt - 3D View: (3D)

Systems Architecture Insert Annotate Analyze Massing & Site Collaborate View Manage Cymap Modify

Upload Model Run Cymap 2014 Investigate Help About

Grilles

Properties

3D View

3D View: (3D) Edit Type

Graphics

View Scale: 1:100
Scale Value: 100
Detail Level: Medium
Parts Visibility: Show Original
Visibility/Grp: Edit...
Graphic Displ: Edit...
Discipline: Mechanical
Default Analy: None
Sub-Discipline: HVAC
Sun Path

Identity Data

View Template: <None>
View Name: (3D)
Dependency: Independent

BIM model.rvt - Project Browser

- Views (Discipline)
 - Mechanical
 - HVAC
 - Floor Plans
 - 0 - Mech
 - 1 - Mech
 - Level 2
 - Ceiling Plans
 - 0 - Ceiling Mecl
 - 1 - Ceiling Mecl
 - 3D Views (3D)
 - Elevations (Building)
 - East - Mech
 - North - Mech
 - South - Mech
 - West - Mech
 - Plumbing
 - Legends
 - Schedules/Quantities
 - Sheets (all)

Ducts: Round Duct: Segmented Bend / Equal Tee

00:53 02:35

1:100 192%

Start | Internet Explorer | Firefox | Microsoft Office Word | VLC media player | Autodesk Revit MEP 2013

EN 13:44 10/09/2013

Due for release July 2014

Ecobim

An early concept sustainability design tool
for architects

Compliant with UK Part L, CIBSE, ASHRAE and CEN standards

Technology Strategy Board Project:

Technology Strategy Board
Driving Innovation

London South Bank
University



- Increased automated analysis
- IPMVP compliance
- Demand control
- Integration with Verco Carbon Desktop
- Integration with TAS:
 - Interface with weather station
 - Exchange data (Using BIM Protocols)
 - Compare model Vs actual
 - Identify the 'Performance Gap'
 - Hone model
 - Use model to plan substantial refits

30 Month project
Value £822,500



KEY TECHNOLOGIES

Solid modelling 3D geometry

Radiosity and ray-trace daylight simulation

Dynamic building thermal simulation uses a
Heat Balance Method – Reference ASHRAE

Component based plant and control modelling
coupled to building simulation