HVAC CFD Update: Recent Projects and Developments at ANSYS UK

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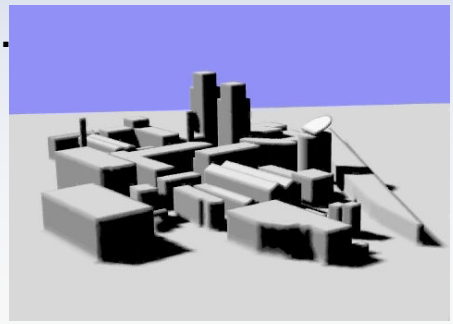
Agenda

- ANSYS – company overview
- Geometry and meshing advances
- Some 'new' problems…



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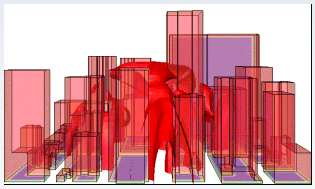
ANSYS – Company Overview

- **Founded 1970**
- **Engineering simulation software**
  - Structural Mechanics
  - Explicit Dynamics (blast and impact)
  - ANSYS CFD
    - CFX and FLUENT
      - Flexible, advanced CFD tools
    - Airpak
      - Customised tool
- **1750 employees**
- **Revenues $478M**
  - 15% spent on R&D



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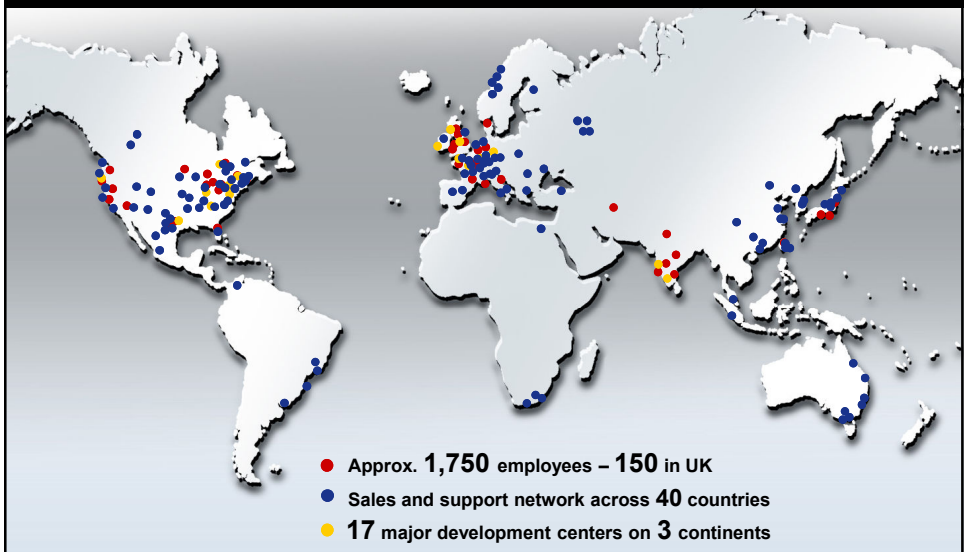
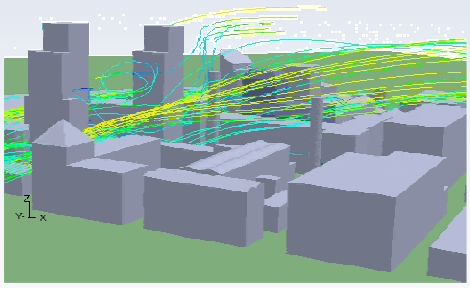
ANSYS - Global Presence



Theme of Presentation

- **CFD technology has evolved enormously**
- **Built environment sector was early adopter**
- **Requirements and expectations have evolved**
  - Diverse range of users
  - Increasing demands
  - Newer questions



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Geometry and Meshing

- **The creation of a fit for purpose CFD mesh is an important part of using CFD**
  - Good mesh leads to good solutions
- **The CFD meshing process must be streamlined against the backdrop of:**
  - Geometries becoming more complicated and detailed
    - CFD mesh must be true and faithful to the “real” geometry
  - Desire to make use of CAD data from multiple sources
    - AutoCad, Rhino, Sketch-up, Revit, Bentley..
  - The need to consider multiple geometrical designs
    - Earlier stage influence
- **ANSYS CFD meshing facilitates fast-turnaround times to create fit for purpose CFD meshes**

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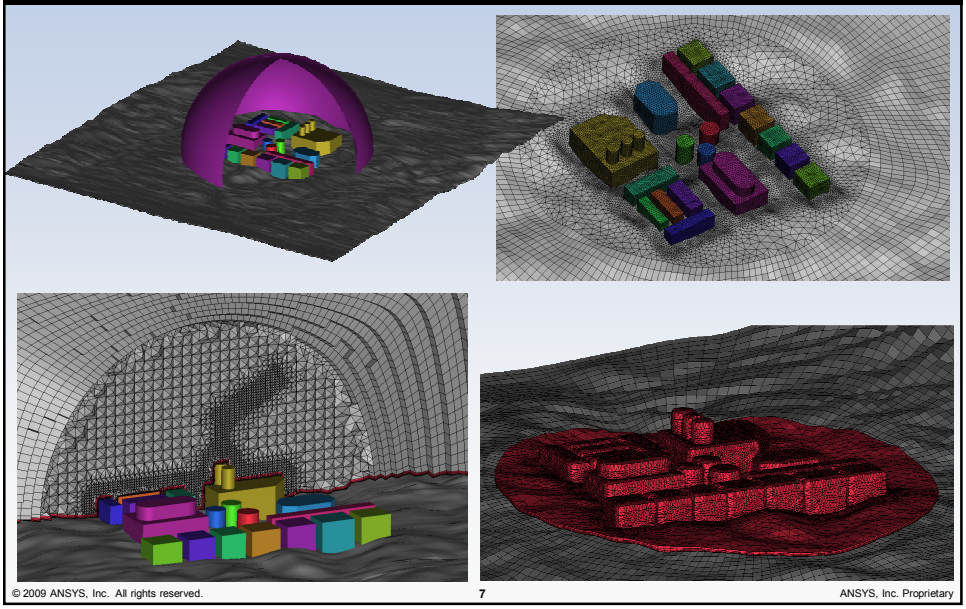
ANSYS Geometry and Meshing



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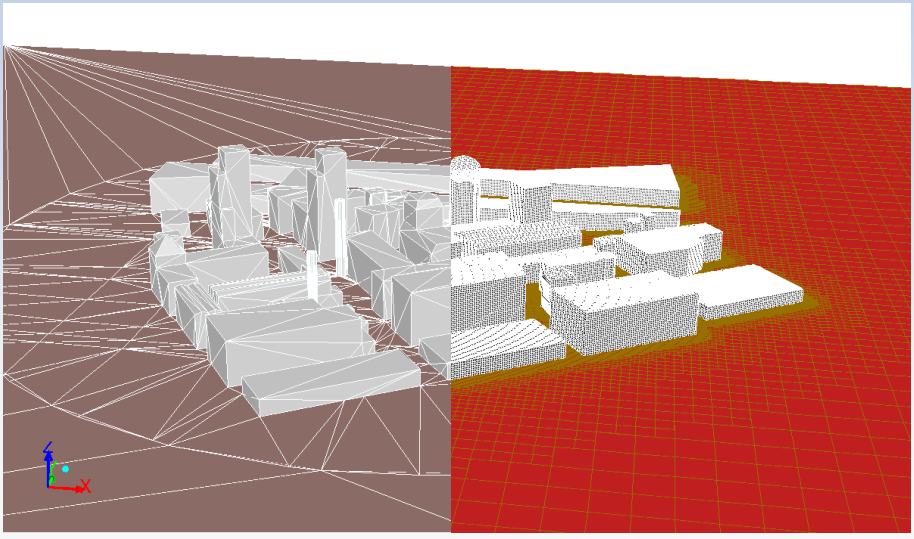
ANSYS Geometry and Meshing Current Developments



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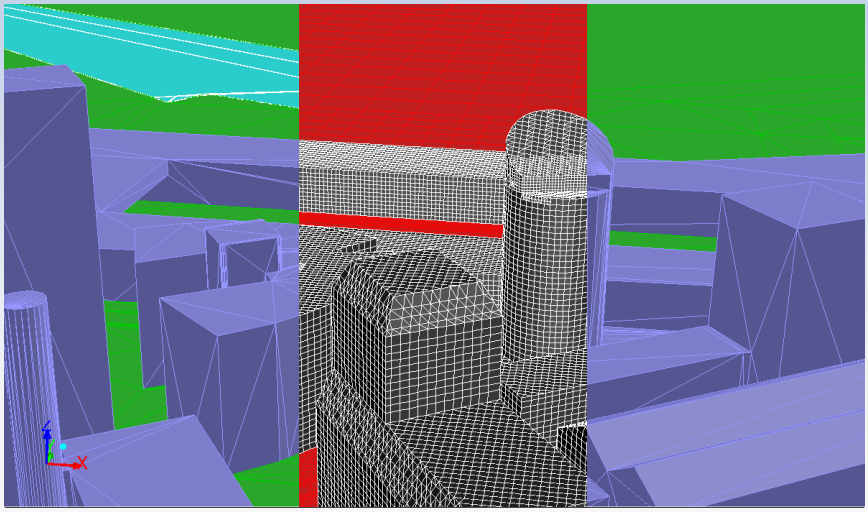
ANSYS Geometry and Meshing Current Developments



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ANSYS Meshing

- **Accurate representation of geometry**
  - Flexible range of cell types
- **Complex and dirty CAD/ 3D geometry**
- **Automated tools and controls**
- **Manual control if desired**

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Sand Movement
in Arid Environments

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Sand Movement
The Problem

- **Infiltration during normal operation**
  - Contamination
  - Servicing
- **Buildup during sand storms**
  - Infrastructure
  - Access and usage
  - Servicing

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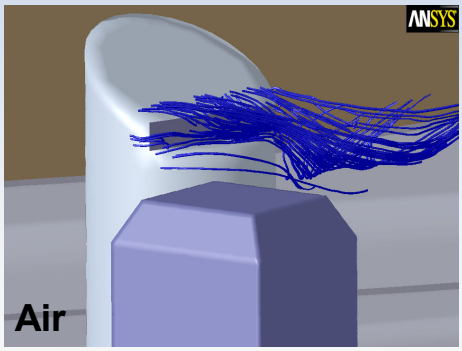
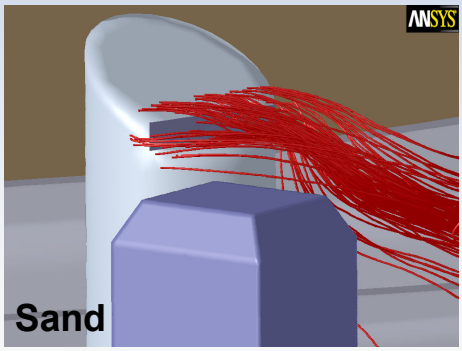
Sand Movement Lagrangian

- **Simple particle tracks**
  - Look for deviation from bulk flow





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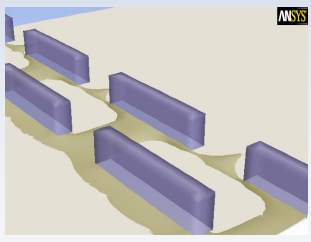
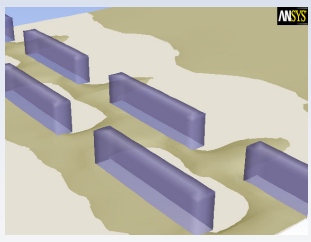
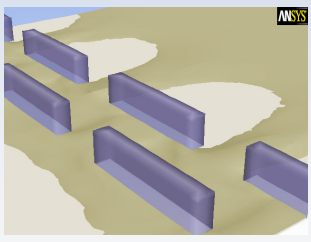
Sand Movement Eulerian

- **Development of whole field**
- **Predict formation trends over some period**







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Sand Movement

- **Particle tracking for intake analysis**
- **Eulerian for whole-field buildup**
  - Full multiphase model as standard
  - Simpler single equation methods
    - Some more assumptions

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Glazed Facades in Large Models

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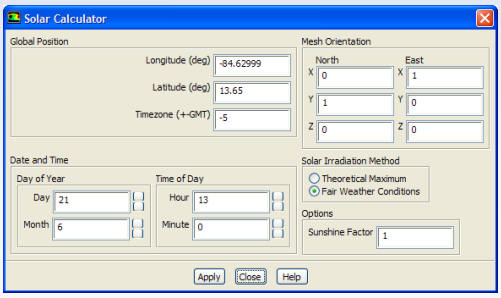
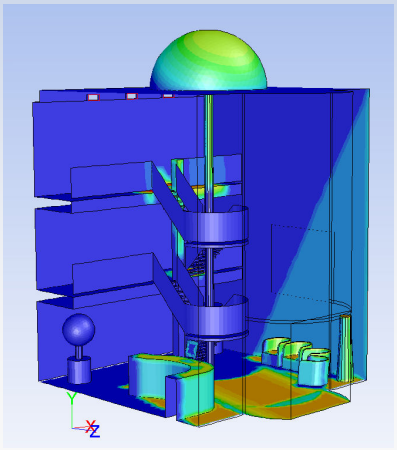
Glazed Facades
The Problem

- **Solar Gains**
  - Summer
- **Radiant Losses**
  - Winter





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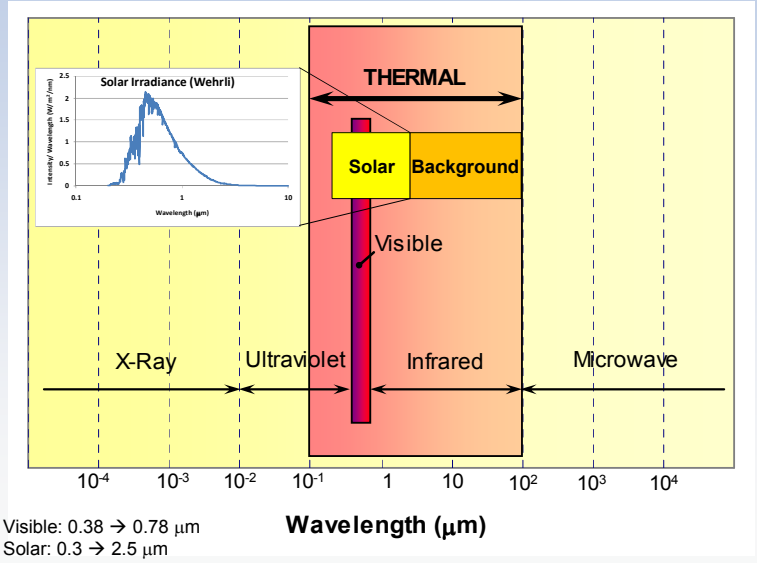
Glazed Facades
Electromagnetic Spectrum



Visible: 0.38 → 0.78 μm
Solar: 0.3 → 2.5 μm

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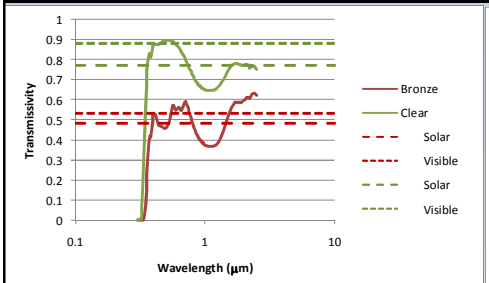
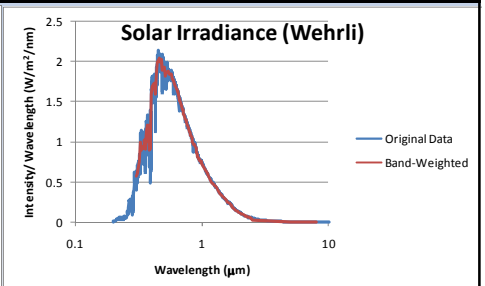
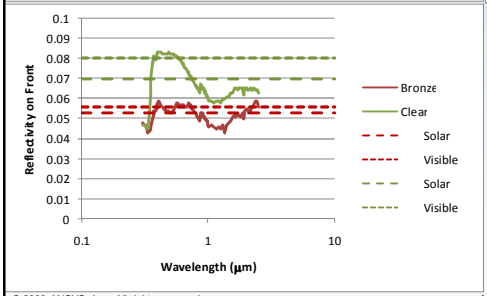
Glass Properties
Spectral Response







		R	A	T
Tinted	Solar	0.053	0.461	0.486
101	Visible	0.056	0.411	0.533
Clear	Solar	0.070	0.159	0.771
103	Visible	0.080	0.036	0.884

Visible: 0.38 → 0.78 μm
Solar: 0.3 → 2.5 μm

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Glazed Facades
Glass Properties - IGDB

```
Window v Glazing System Thermal and Optical Properties
ID : 45
.
.
Layer Data for Glazing System '45 CFD SHGC Single Clear'
ID     Name             D( ") Tsol 1 Rsol 2  Tvis 1 Rvis 2  Tir  1 Emis 2  Keff
------ ---------------- ----- ---- ---- ---- ---- ---- ---- ---- ---- ---- ----
Outside
XXX    CLEAR.DAT       #0.225 .771 .070 .070 .884 .080 .080 .000 .840 .840 .578
Inside
.
.
Angle       0     10    20    30    40    50    60    70    80    90    Hemis
Vtc     : 0.884 0.883 0.882 0.879 0.872 0.852 0.804 0.688 0.427 0.000 0.805
Rf      : 0.080 0.080 0.081 0.083 0.089 0.106 0.152 0.267 0.528 1.000 0.144
Rb      : 0.080 0.080 0.081 0.083 0.089 0.106 0.152 0.267 0.528 1.000 0.144
Tsol    : 0.771 0.770 0.767 0.761 0.750 0.727 0.680 0.575 0.346 0.000 0.689
Rf      : 0.070 0.070 0.070 0.072 0.077 0.093 0.134 0.239 0.484 1.000 0.128
Rb      : 0.070 0.070 0.070 0.072 0.077 0.093 0.134 0.239 0.484 1.000 0.128
Abs1    : 0.159 0.160 0.163 0.167 0.173 0.180 0.185 0.186 0.170 0.000 0.173
SHGCc   : 0.818 0.817 0.815 0.811 0.801 0.781 0.735 0.630 0.396 0.000 0.740
.
.
```

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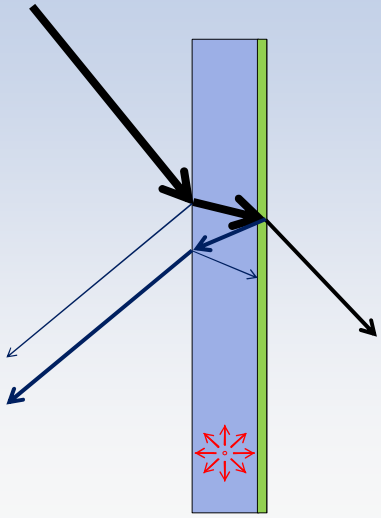
Glazed Facades Radiative Properties

- **Reflection**
  - Surface effect
    - Refractive index in S/T
    - Enhanced in coating
- **Absorption/ Emission**
  - **Volumetric** effect (m^{-1})
    - Only surface effect in opaque materials
- **Transmission**
  - Whatever's left



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Glass Properties

- **Focus on solar properties**
- **Consider IR emissivity for re-radiation**
  - Not just winter cases
  - Body-tinted and coated glass in summer?
- **Consider non-constant response to incidence**
  - Reflectivity
  - Absorptivity/ Emissivity
- **Solar gains best effected with a fast SLM**
  - Speed
- **Reradiation needs a good radiation model**
  - Specified properties needs to be renormalised

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Summary

- **ANSYS CFD tools continue to evolve**
  - Geometry and mesh
  - Ease of use
  - Increased interest in multiple scenarios
- **Lots of new & interesting questions to be solved**
  - Can be solved
  - Wide range of physical models address new challenges
- **Benefit from crossover from other industries**

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Thank You

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