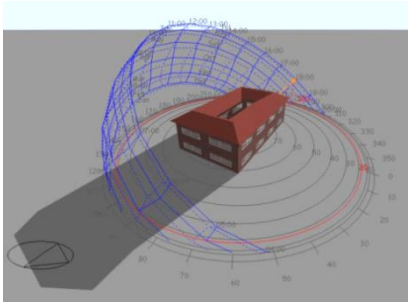
Building Performance Modelling

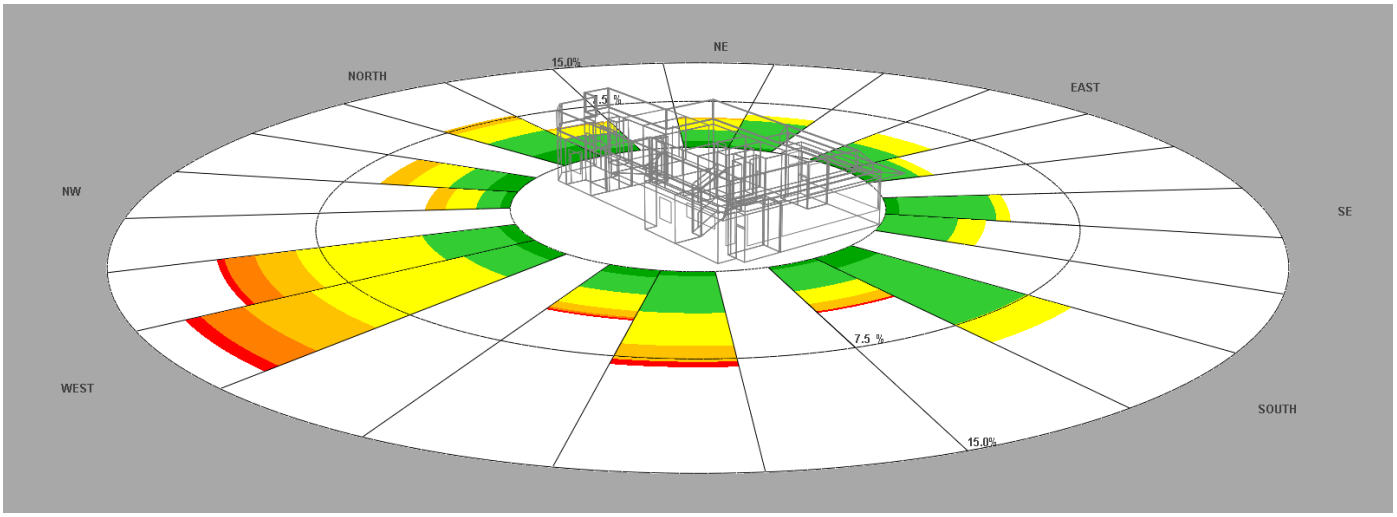
The Centre for the Built Environment (CeBE) Group within the Leeds Sustainability Institute (LSi) at Leeds Metropolitan University has a wealth of experience in the modelling and physical testing of building performance. This paper describes specific capabilities within the fields of dynamic simulation modelling.

Dynamic Simulation Modelling



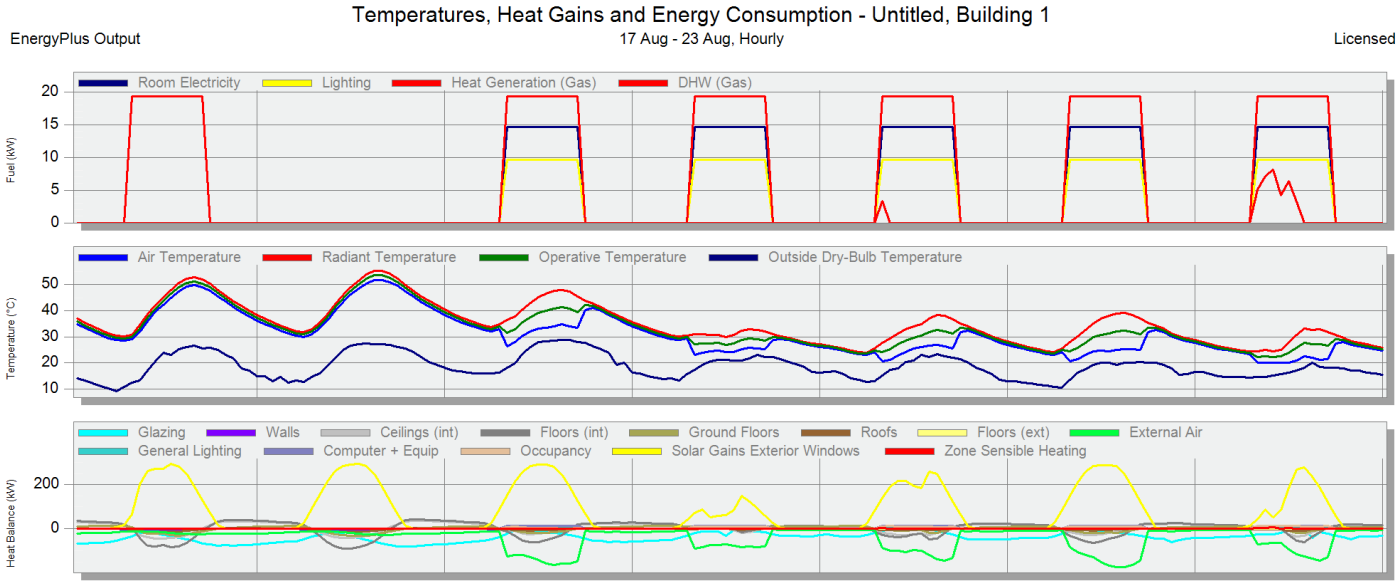
Models are by their nature abstract and represent a simplification of the infinitely complex real physical world. On-going research in CeBE aims to improve the accuracy of whole building dynamic simulation models by refining input data through robust building pathology investigations combined with forensic modelling of building fabric. The aim is to create sophisticated dynamic thermal simulation models which can then be used to produce reliable estimates of actual operational performance in both an academic and professional context.

Dynamic thermal simulation models have a wide range of applications from simple regulatory compliance calculations to advanced estimates of operational performance in large complex buildings. Advanced modelling techniques can be used to accurately predict thermal performance in both new build and retrofit projects; they can also be used to simulate day-lighting and complex air movement. Dynamic thermal simulation software is approved by the UK Government for the production of Building Regulation Part L compliance calculations and production of Energy Performance Certificates; more sophisticated models can be produced in the design and evaluation of energy efficient, low carbon buildings. When used as part of an iterative design process, building simulation can provide initial energy performance estimates and these can be refined as the design is developed throughout the procurement process.

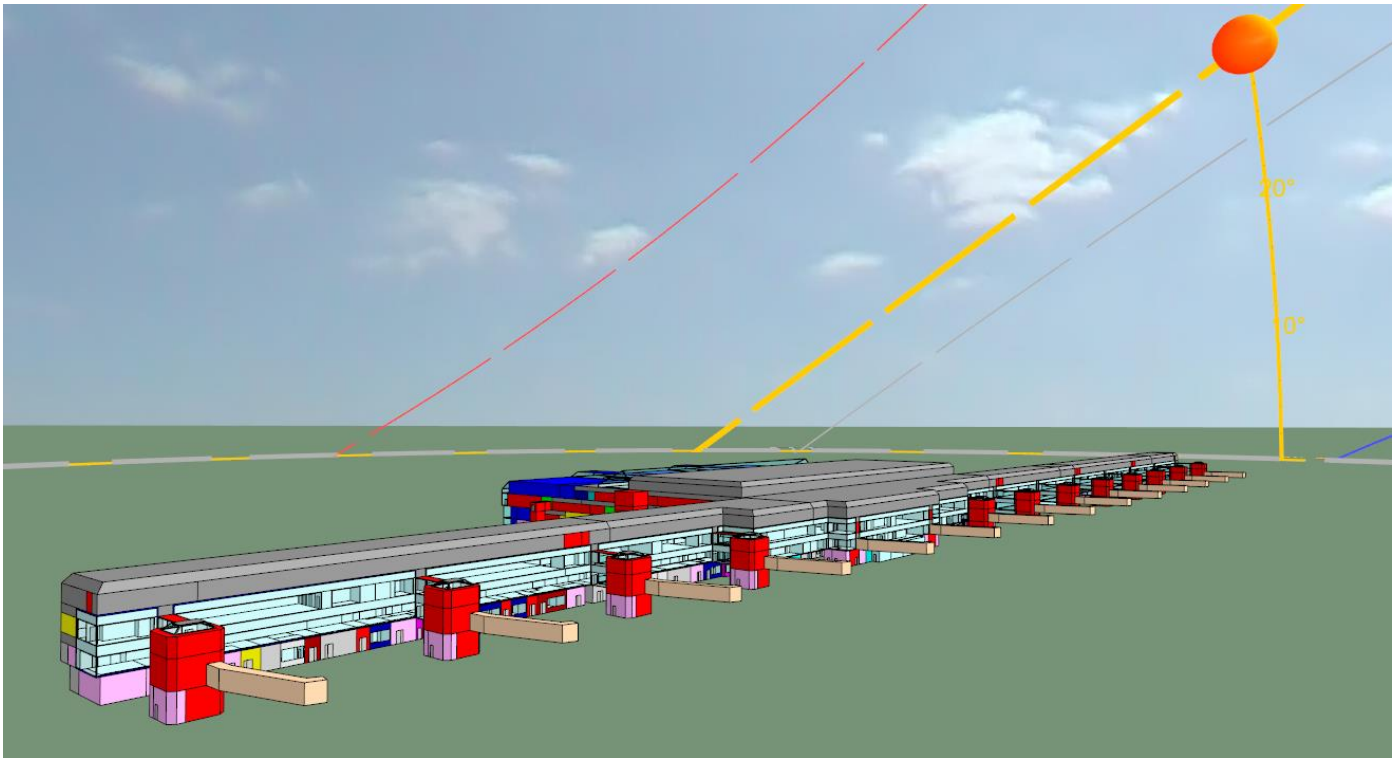


Dynamic thermal simulation models utilise an array of input parameters that create a virtual environment within which a building can be analysed; these input parameters provide the source data for a series of interactive and complex building physics calculations. External model input parameters include site global location and detailed simulation weather files: building specific parameters control values for building geometry, construction materials, heating, ventilation and cooling systems, air exchanges and internal heat gains from equipment, lighting and occupants.

Calibrated whole building simulation is recognised as the most effective way of predicting the impact of large scale interactive retrofit interventions. Models can be calibrated against real monitoring data from existing buildings to produce a baseline which is then used to more accurately estimate the impact of energy efficiency and carbon reduction measures. The baseline model is created using input data taken from a building during a specific, ideally annual, period; utility monitoring data from the same period is then used to measure the accuracy of the model using standardised error checking formulae. The resolution of the utility monitoring data will influence the accuracy of the model. Basic calibration exercises compare annual energy consumption whilst highly detailed calibration exercises compare model results with half-hourly monitoring data.



It is within the field of calibrated dynamic thermal simulation that the CeBE Group has specific expertise and developing research interests. Continuing research is focused upon the analysis of deep retrofit in domestic and non-domestic buildings with particular attention paid to the role that EPC calculations have on retrofit projects, especially in the context of the Green Deal and other policy instruments. Existing research excellence in the field of building pathology is underpinning this work by improving the accuracy of the input data available for this dynamic thermal simulation analysis. The holistic scope of all this work ultimately aims to address the performance gap that exists between predicted and operational building energy performance. A combination of detailed calibrated dynamic thermal simulation models, detailed site measurement and testing, in-use monitoring and hygrothermal simulation research aims to address the performance gap and improve the accuracy and quality of building simulation, ultimately closing the loop between estimated and operational energy consumption.



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