Empirical Validation

TAS building simulation software compared with monitored data contained in the following IEA report

INTERNATIONAL ENERGY AGENCY (IEA)

Energy Conservation in Buildings & Community Systems Annex 21 Subtask C

Empirical Validation of Thermal Building Simulation Programs Using Test Room Data

An important part of the programme of work undertaken by the IEA research team was the identification of good quality monitored data on building thermal performance. Careful scrutiny of data sets from around the world culminated in the choice of measured data produced by the Energy Monitoring Company (EMC) at their Cranfield University test site.

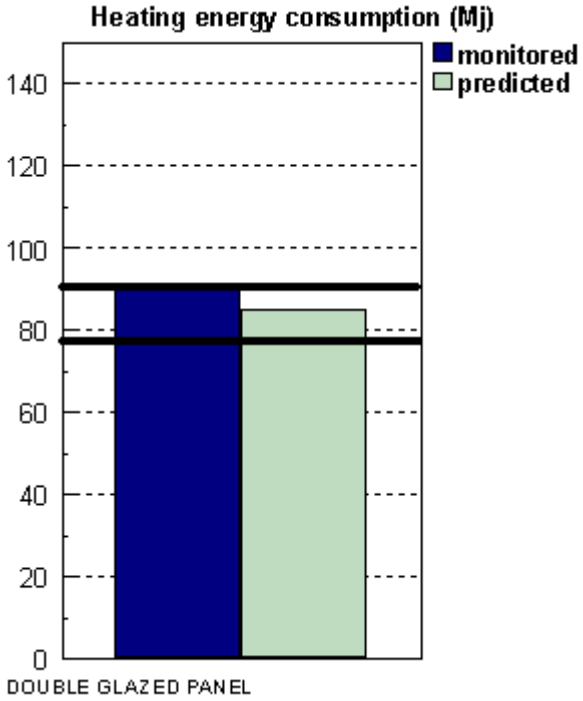
The EMC data is of high quality, meeting the many stringent criteria specified by the IEA team. The test rooms were carefully constructed and the monitoring equipment and procedures were of a high standard. Of fundamental importance was the fact that detailed hourly weather data was also collected at the site.

Comparison of Monitored and Predicted Data

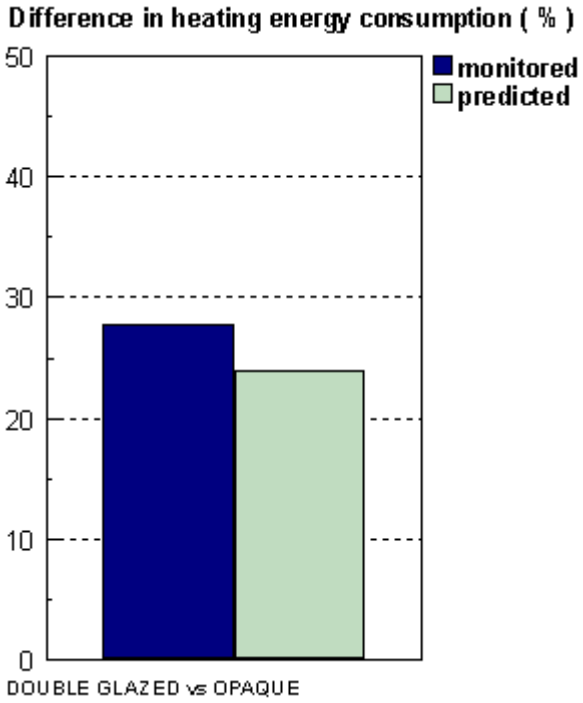
The monitored data chosen for the validation exercise consisted of two periods. Firstly an October period, of 7 days duration, when the rooms were heated (with an oil filled electric panel radiator) to 30 deg C from 6.00 hr to 18.00 hr. Secondly a May period, also of 7 days duration, when the rooms were allowed to free-float. The primary data for these two periods were available for the rooms with a panel of double glazing in the south facade and alternatively with an opaque insulated panel in the south facade.

The bold horizontal lines on the charts show the estimated uncertainty in the experimental data.

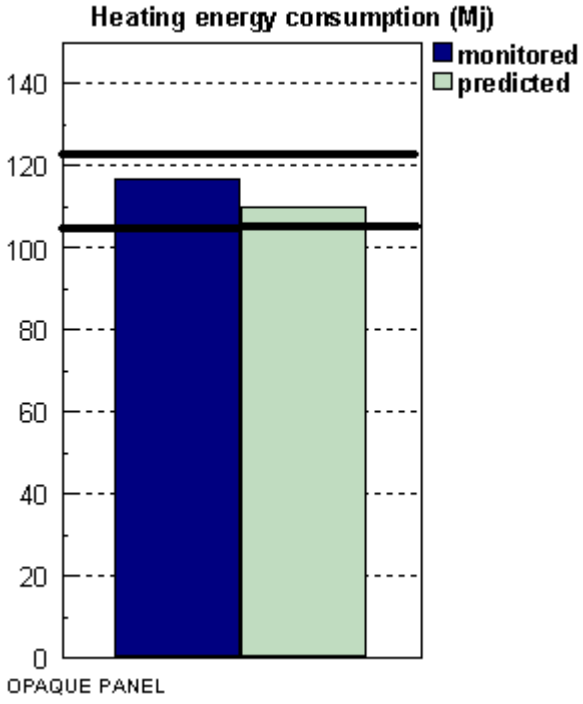
Results for the heated rooms



Monitored and predicted heating energy for room with double glazed panel.

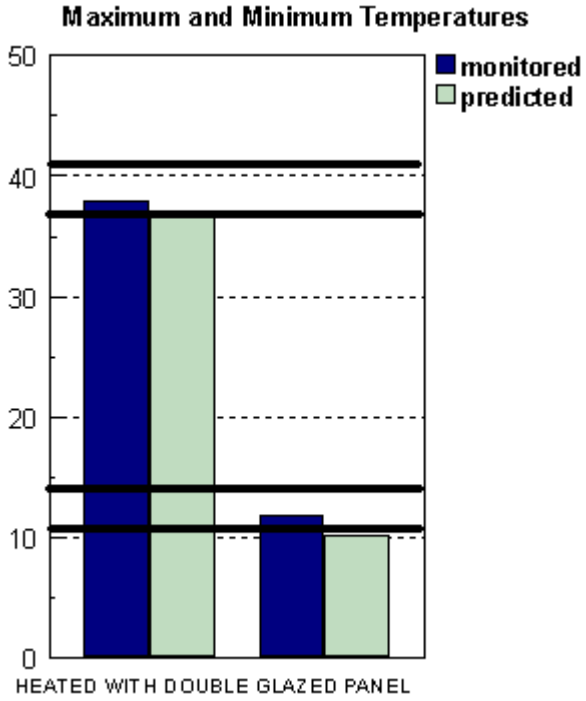


Monitored and predicted percentage difference in heating energy for the two types of room.

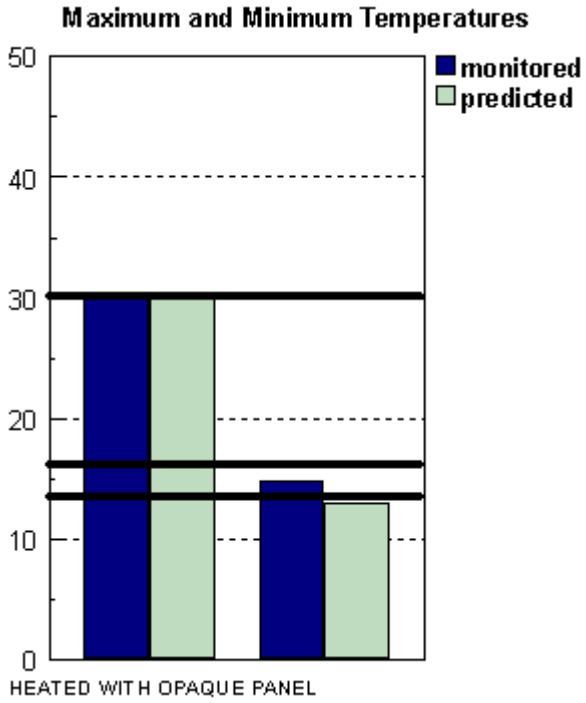


Monitored and predicted heating energy for room with opaque panel.

Monitored and predicted maximum and minimum room air temperatures were compared for both room types.



Monitored and predicted maximum and minimum air temperatures for room with double glazed panel.



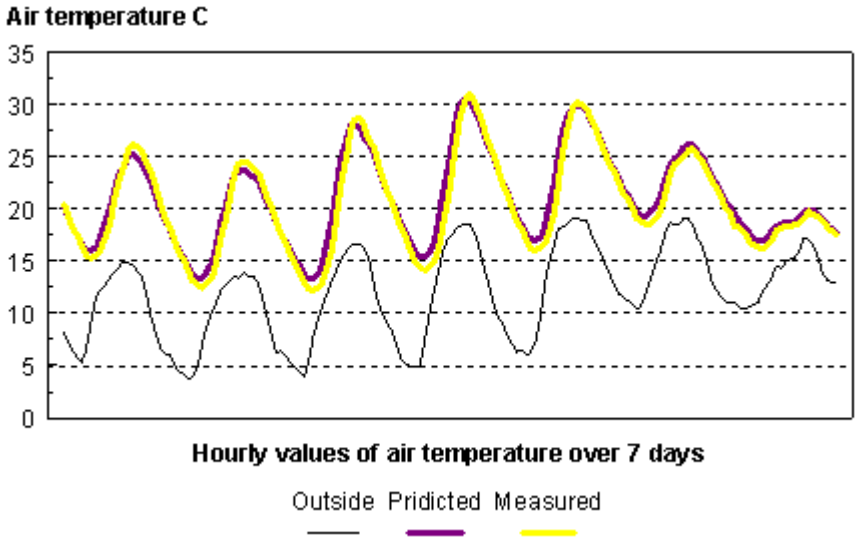
Monitored and predicted maximum and minimum air temperatures for room with opaque panel.

Hourly data for the free-floating room with double glazed panel

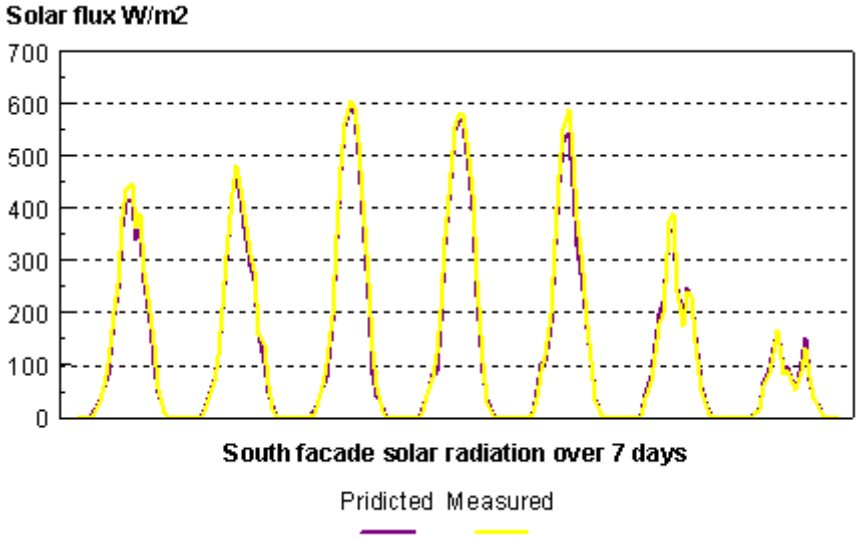
The predicted data is based on dynamic simulation on an hourly basis. It is, therefore, possible to compare the monitored and predicted performance of the test rooms in more detail than simply the maximum and minimum temperatures which occurred over the test period.

The test rooms were constructed with an outer shell of stud frame covered with plasterboard. The spaces were well insulated and sealed. Well insulated floor and ceiling constructions linked to unsealed floor and attic spaces. Concrete slabs laid on the floor of the test rooms provided some thermal mass.

The double glazed window area was equivalent to 43% of the floor area, which resulted in peak solar loads of around 150 W/m2.



Hourly comparison between monitored and predicted air temperatures in the free-floating double glazed room.

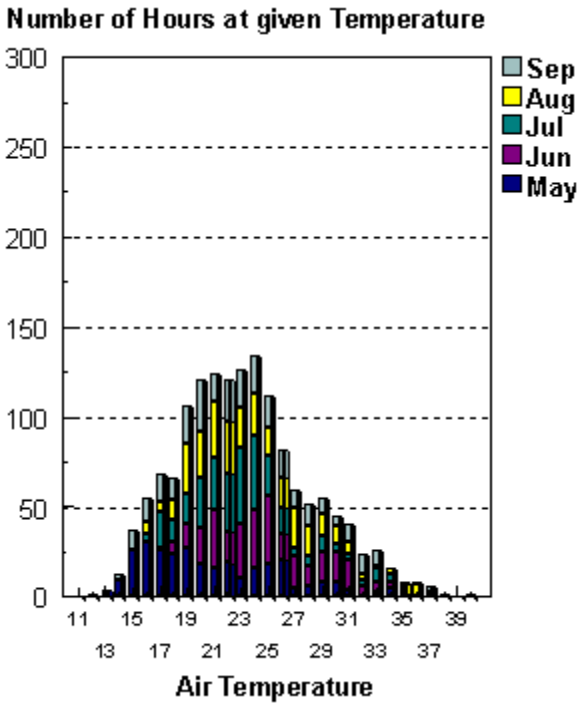


Hourly comparison between monitored and predicted south-facing global irradiance for the May free-floating period.

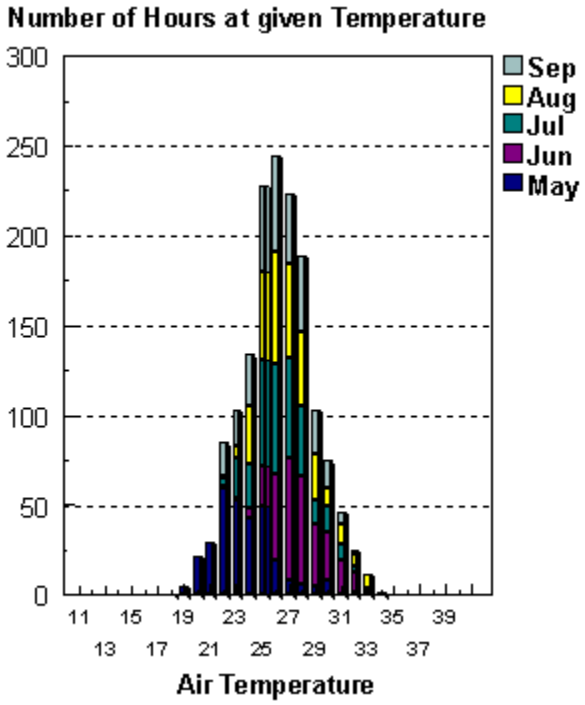
Comparing the Simulated Performance of the Test Rooms and a Typical Office

The test room model was run with the standard CIBSE weather year for Kew in London and the results compared with the simulation of a typical office, also with south-facing double glazing.

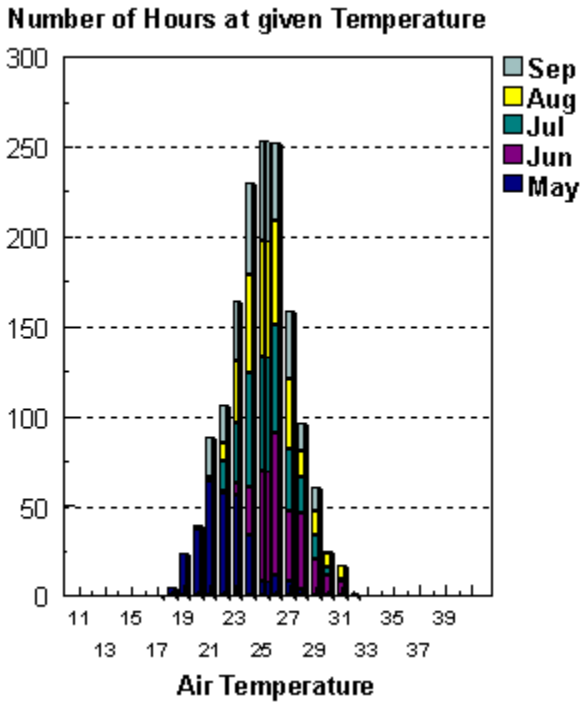
Two office glazing options were considered, firstly clear and secondly anti-sun with room-side blind.



Frequency distribution of test room air temperature over the summer (6.00hr to 18.00hr).



Frequency of office temperatures. Note the increased thermal mass reduces the extremes of temperature.



The number of hours above 26 deg C is halved compared to the clear glass