TECHNOLOGY

#4719

Cold bridge war

How much heat is lost through your curtain walling? More than you think, according to one testing house. Matthew Coomber *hears how current thermal efficiency calculation methods may contain fundamental errors.*

A SMALL testing house in the Midlands is single-handedly taking on the mighty European curtain wall companies over the claims they make for the thermal efficiency of their systems.

Maurice Rogers, of Rugby-based Thermal Measurement, believes that European manufacturers operating in the UK have, deliberately or otherwise, been trading on false information.

His argument stems from a unique profiling analysis technique (see box). This has revealed that the advertised thermal conductivity figures (U-values) for the structural elements of many proprietary curtain walling systems are as little as one quarter of their true value.

He has traced the inaccuracies back to U-values calculated for box-section aluminium transoms and mullions. These calculations are based on the West German Rosenheim Institute's DIN standard methods.

Rogers claims the DIN calculation methods contain fundamental errors. Further, he maintains these errors are known and accepted by many European manufacturers because they produce results that suggest better thermal performance than that indicated by the measurement.

He also claims the Aluminium Window Association, the UK curtain walling industry's trade organisation, is content to do nothing to rectify the situation. Rogers says this inaction is because many UK suppliers of curtain walling systems work under subcontract from European manufacturers.

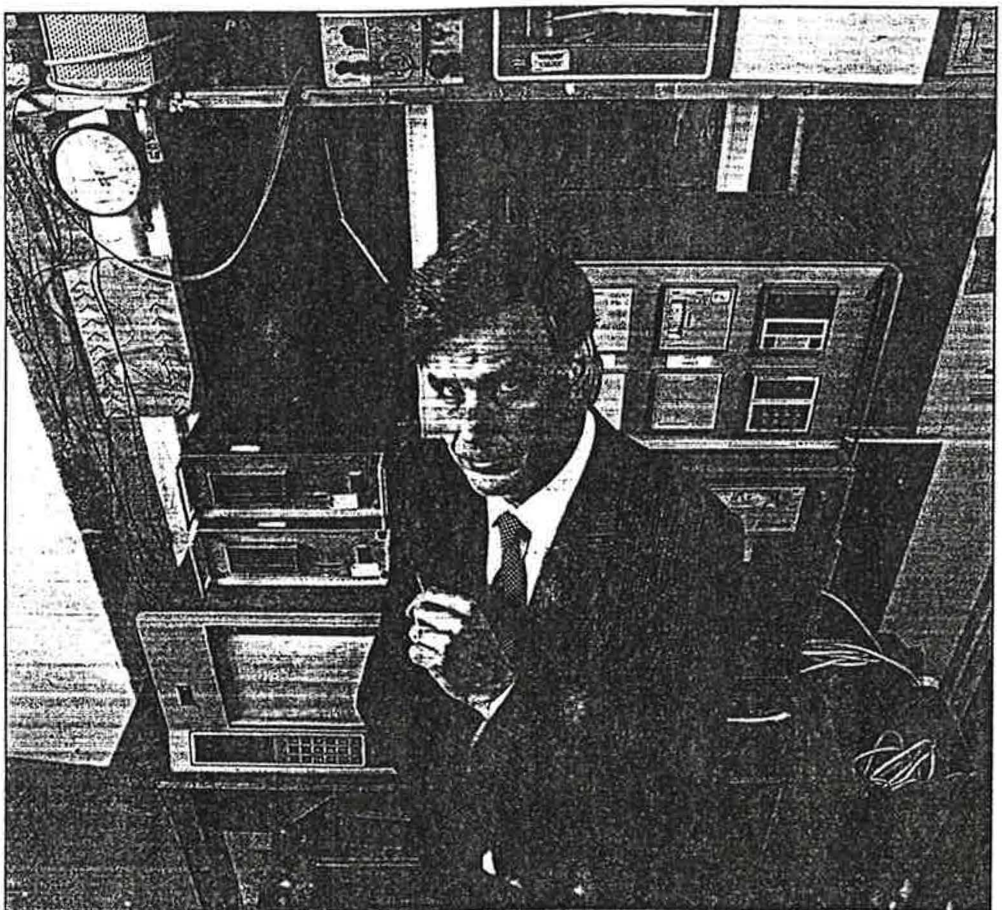
As a result, he says some UK manufacturers are forced to operate at a serious commercial disadvantage and British architects and specifiers have to work with "information designed to impress rather than to inform".

He adds: "In some cases I have measured results that show the advertised U-values are as much as 400% in error in favour of the manufacturer.

"Not only does this present a false commercial advantage over UK competition, but it means that the finished buildings, although deemed to have passed Building Regulations, are losing much more heat than their design criteria would suggest."

Rogers has produced a specifiers' guide to the thermal performance of curtain walling based on the results of his work.

"Either I am desperately right or I am desperately wrong," he says. "But I have challenged people to shoot me down constructively, and no one has yet done so."



Maurice Rogers and hot box rig — he claims it reveals "errors" in curtain wall U-values.

Fundamental errors

The nub of his argument lies in the West German DIN standards 4108 and 52619 covering the method for determination of U-values for hollow box section transoms and mullions. Rogers thinks the standards contain two fundamental errors. These errors arise from "a misunderstanding of the principles of heat flow in thermal bridging structures and their associated thermal fields".

Thermal bridges are formed when a heat conducting material such as aluminium divides a less conductive material, such as glass. Heat passes more easily through the more conductive material, which forms a bridge. The resulting pattern of heat flow through the structure is called the thermal field.

Rogers says the first mistake is purely mathematical. For calculation purposes, the DIN standards assume that the thermal bridge does not extend beyond the surface of the glass and uses a correction factor for the conductivity of the bridging material.

Rogers holds that almost every commercial system uses box-section mullions and transoms that extend past the glass. But the simple correction factor applied by the DIN standards ignores the extra surface area created by the box-section, through which more heat can flow.

"A simple comparison is the way water flows across a weir with a box-shaped recess upstream," explains Rogers. "The larger the recess, the more water flows across the weir. Similarly, the larger the protruding box section, the greater the heat flow through the mullion." The increase in heat flow relates directly to the perimeter to width ratio for the protruding part of the mullion.

Paradoxically, this greater heat flow gives a greater resistance to condensation – one of the first signs that something is wrong in the design of a curtain walling system.

"There is a continuing misconception on the part of specifiers that highly heat conductive cold bridges will be dripping with condensation," states Rogers. "But when you put the perimeter to width ratio correction back into the calculation, it shows that to be untrue and gives a higher U-value." The higher the U-value, the lower the thermal efficiency.

The second mistake is experimental. When testing curtain walling systems, the Rosenheim method replaces the glazed elements with a layer of highly insulating material.

Rogers feels this "completely mucks up the thermal field", particularly for systems incorporating a thermal break.

"In real life, much of the heat flows from the aluminium box section through the spacer bars between the panes of glass, with far less passing through the thermal break than under the Rosenheim test," he says.

While he claims never to have any of his mainly British clients contest his results, he says very few have publicised the results of his tests on their products.

"In fact I have received a terrifying silence from the industry," says Rogers.

The European standards organisation subcommittee looking at curtain walling is due to meet for the first time in April. Roger's concern is that as there is no British Standard to rival the DIN standards, the resulting Eurostandard will contain the same errors.

But apart from the European angle, he also holds there is a more sinister side to the apparent deception.

"There is a possibility that building control officers will receive one set of calculations for Building Regulation approval, while the developer will be working with measured figures that show the curtain walling to be letting through much more heat. That is very worrying."

EXPERT OPINION

STEVE GREEN, of cladding consultants Cladtech, concludes that there is "probably a great deal of truth" in Rogers's claims.

He says there is every reason to believe that architects and specifiers assume the U-values quoted to be accurate.

But he disagrees with Rogers over the relative importance of the greater heat flow. "It must be remembered that the heat loss through transoms and mullions is minimal when taken in the context of the entire curtain wall fabric. The only real benefit offered by a high U-value is a resistance to condensation.

"No doubt if condensation had proved to be a problem, something would have been done a long time ago. It's a case of ignorance is bliss."

According to Green, the fact that nothing is happening on the Eurostandards is part of the same old problem – no British Standard for curtain walling exists to rival the DIN standards.

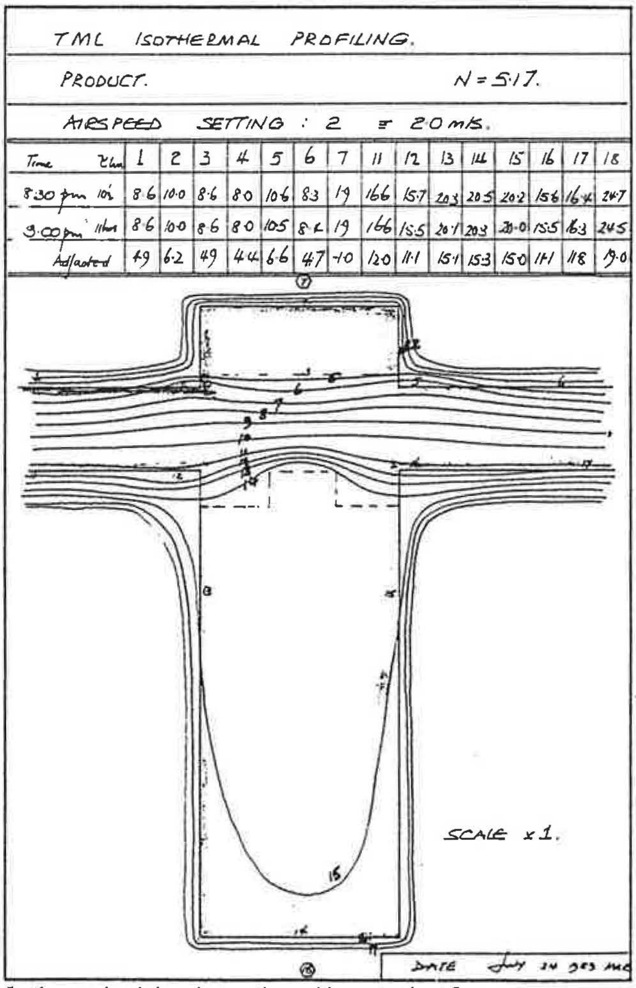
HOW ISOTHERMAL PROFILING WORKS

MAURICE ROGERS'S isothermal profiling technique produces thermal "maps" of curtain wall sections, with lines linking points of equal temperature. They are similar to the concept of isobars connecting points of equal pressure shown in weather forecasts..

He uses a self-made "hot box", set up to match the Chartered Institution of Building Services Engineers standard exposure conditions, with still internal air at 19°C and external air at – 1°C moving at 2 m/s. Although it does not comply with BS 874 Part 3.1 (the 1989 standard for hot box measurement methods), Rogers says it does meet the tighter American Society for Testing Materials C236-66, the equivalent US standard.

A test piece is fitted with a series of very fine thermocouples positioned at regular intervals across both sides of mullion, transom and glass. It is placed in the hot box and allowed to reach a steady state. The temperature at each thermocouple is then recorded, and the resulting isotherms plotted on a scale drawing of the test piece section. From this the heat flow rates and critical dew point lines can be calculated.

Rogers holds that his testing method, established over seven years, yields a much more accurate thermal field and predictions of condensation peformance.



Isotherms clearly bunch at sections with greatest heat flow.