TECHNICAL ARTICLE

Schöck Isokorb type KST – effective thermal insulation in steel construction

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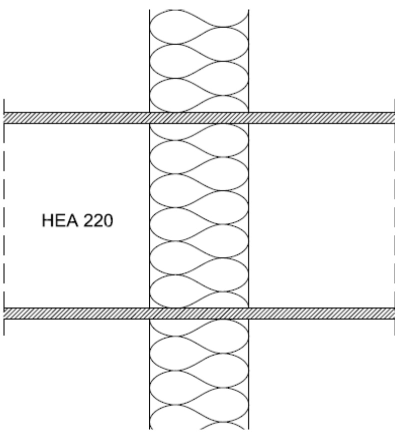
Reducing energy consumption in new buildings to achieve global CO_2 reduction targets was the objective set by the European research project **E**nergy **E**fficient **B**uildings Through **I**nnovative Systems In **S**teel – EEBIS, which was run under the auspices of the European research program's Research Fund for Coal and Steel. Well-known companies in the steel industry and research institutes for steel construction from all over Europe took part in this project, including the RWTH Aachen University's Institute of Steel Construction and Light-weight Structures. The Institute researched energy efficiency in buildings and therefore looked into the problem of thermal bridges (further information on the European EEBIS research project is available at www.cordis.europa.eu).

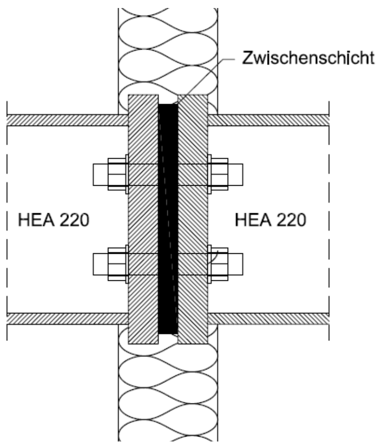
The European EEBIS research project provided the impetus for RWTH Aachen to carry out further detailed studies on thermal bridges in steel construction.

Supporting structures which penetrate the building envelope, but also projecting roofs which serve to break up the visual impact and also as protection for the façade produce thermal bridges in the classical sense on account of the thermal conductivity of the steel. Continuous steel members affect the building physics and have a particularly negative impact on the building's thermal insulation. The results are increased heating energy losses and the risk of construction damage from condensation or mould.

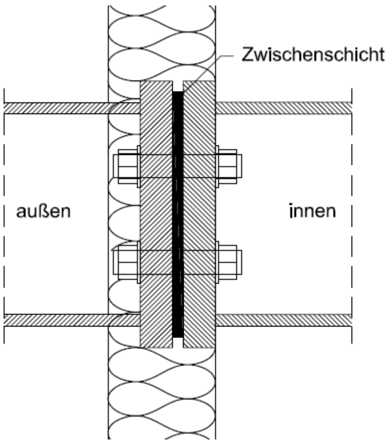
RWTH Aachen University carried out a comparison of uninsulated steel members with steel members separated thermally using intermediate layers of plastic and the Schöck Isokorb type KST. The resulting designs were subject to numerical analysis and verified by tests.



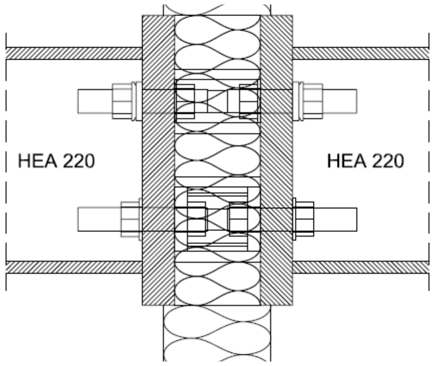
1.) Continuous steel member HEA 220



2.) Steel member separated using intermediate plastic layer (Thickness t=10 mm; 20 mm)



3.) Steel member separated using intermediate plastic layer (t=10 mm) + additional 30 mm insulation on outside faceplates



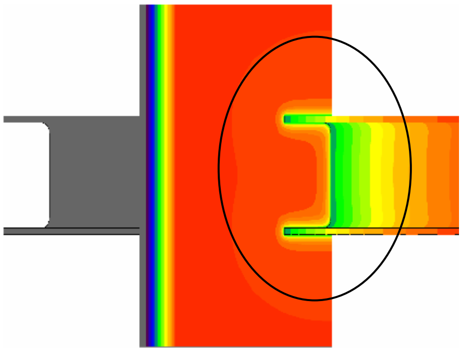
4.) Steel member separated using composite thermal element Schöck Isokorb type KST 22

All four designs were based on building insulation of 100 mm thickness. The intermediate plastic layers for thermal separation of the steel members can be made from various materials. Besides elastomer and Teflon, most applications nowadays use glass-fiber reinforced plastic. The thickness of the intermediate plastic layers varies from 5 mm – 20 mm, depending on the compressive load. The thermal conductivity of these layers is specified in the literature as being in the range of 0.2 W/mK – 0.5 W/mK The best thermal conductivity of 0.2 W/mK was purposely used as a basis for all the research. On account of the fourfold lower thermal conductivity of stainless steel in comparison with conventional steel and the comparability with the Schöck Isokorb type KST which is made entirely of stainless steel, it was also specified that stainless steel screws should be used for the designs with intermediate plastic layers, although this is not always the case in practice.

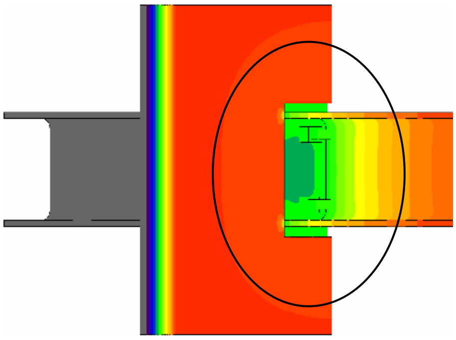
Despite these assumptions which were chosen as being on the safe side, the result is clear-cut – the KST is the only effective thermal insulation in steel construction which meets the requirements for thermal protection of thermal bridges and complies with energy conservation regulations.

For continuous steel members which adjoin surfaces which can absorb moisture, the temperature factor $f_{Rsi} \geq 0.70$ must be complied with – i.e. maintenance of a room surface temperature of $\Theta_{Si} \geq 12.6$ °C – in order to avoid the development of mold. For all other designs, the minimum surface temperature must be greater than the condensation point temperature i.e. $\Theta_{Si} \geq 9.3$ °C. These are the minimum thermal protection requirements for thermal bridges according to DIN 4108-2, Section 6.2.

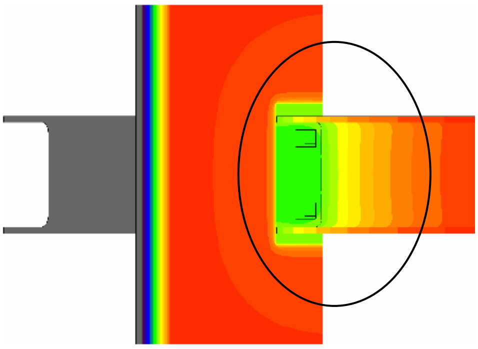
1.) Continuous steel member:



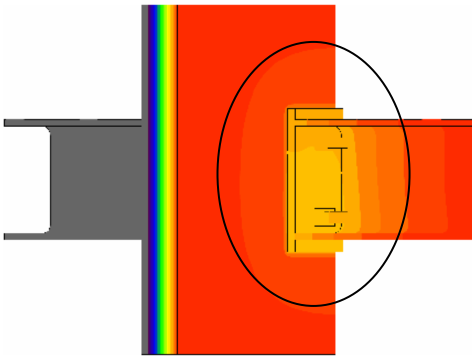
2.) Steel member with intermediate layer

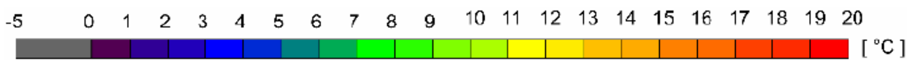


3.) Steel member with intermediate layer + insulation



4.) Steel member separated using KST 22



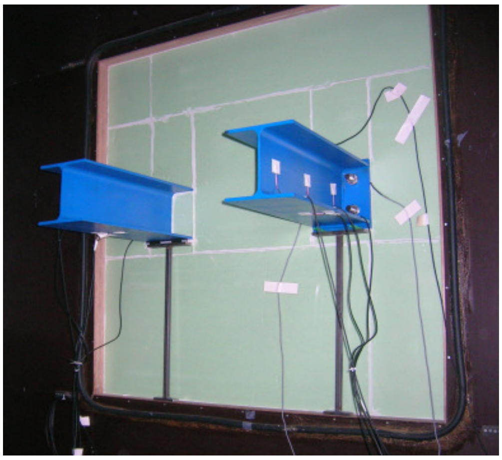


The temperature profile clearly shows that the minimum surface temperature of the steel member separated using the KST lies in the warm orange range (above 13 °C), whilst the minimum surface temperature with all the other designs lies in the green 6-9 °C range.

Design	Minimum surface temperature in room $\Theta_{si,min}$ [°C]	Temperature factor f_{Rsi} (-)	Thermal protection requirements
Continuous steel member HEA 220	6.1	0.44	not compliant
Steel member HEA 220 with Isokorb KST 22	13.6	0.74	compliant
Steel member HEA 220 with 10 mm intermediate layer	7.1	0.48	not compliant
Steel member HEA 220 with 10 mm intermediate layer + additional 30 mm insulation	8.7	0.55	not compliant
Steel member HEA 220 with 20 mm intermediate layer	9.6	0.58	not compliant

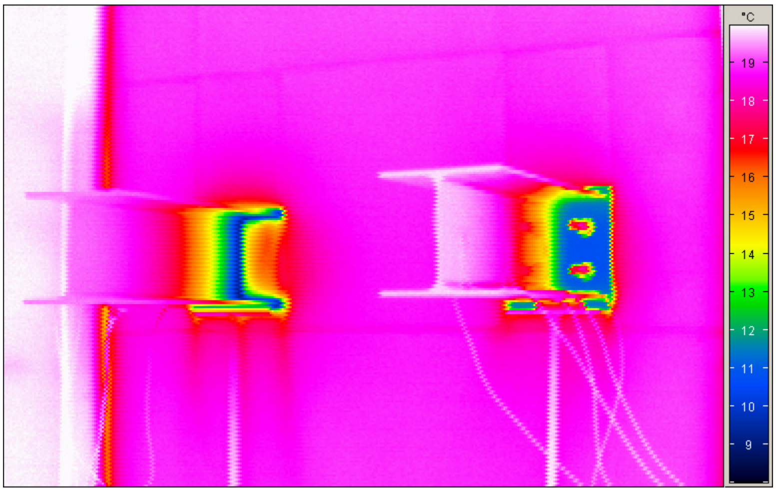
The results in the table illustrate that the thickness of the load-bearing thermal separation is the decisive criterion for achieving adequate thermal insulation and for complying with the requirements in the standard. Additional insulation before the separation layer does not have the necessary effect, as the result using the 20 mm separation layer is significantly better than that using additional thermal insulation. The Schöck Isokorb KST is the only solution which complies with the requirements due to its effective insulation thickness of 80 mm.

The numerical calculations were verified by means of tests in the hot box test rig at RWTH Aachen University.

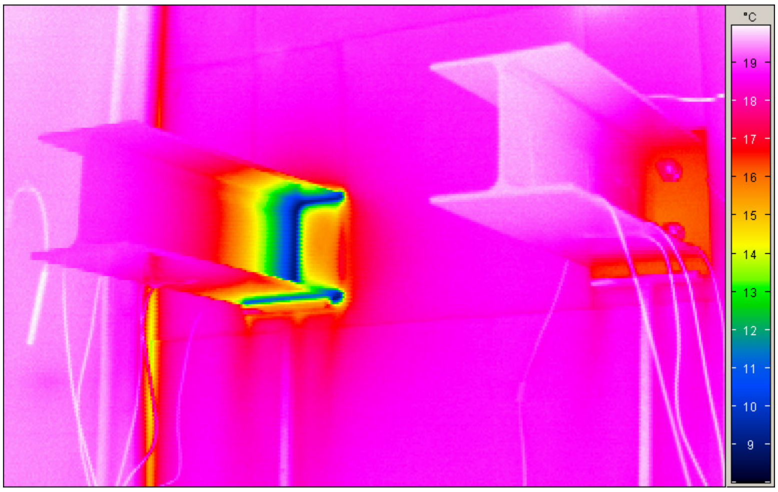


Installation of the test piece in the hot box.

The thermal images illustrate the high level of outward heat flow and therefore the energy loss in the non-insulated design and in the design with a separation layer. The outward heat flow can only be reduced to a minimum with certainty using the 80 mm thick insulation provided by the KST. Unnecessary losses of heating energy can be avoided.



Thermal image of continuous steel member - steel member separated using elastomer intermediate layer



Thermal image of continuous steel member - steel member separated using KST 22

The result is clear-cut:
The requirements for thermal and moisture protection are effectively met using the Schöck Isokorb type KST. Due to its good thermal insulation properties it can be used with confidence for all designs and for all situations. The designs with separation layers made

from Neoprene, elastomer or glass-fiber reinforced plastic are not effective and fail to reduce the outward flow of heat, meaning that the thermal requirements are not met.

You can rely on the research carried out by RWTH Aachen University for steel construction with Schöck insulation.

The test report giving details of the thermal bridge research carried out by RWTH Aachen University "Determination of thermal bridge effects of façade penetration with and without thermal separation using three-dimensional numerical and experimental analyses" as well as all technical documents on the Schöck Isokorb type KST are available for free download at www.schoeck.de.