CONVECTIVE AIR FLOW AND THE INSULATION VALUE

Construction Specifications Canada state in their **Tek-Aid** on air barriers: “Thermal insulation must be in intimate contact with the air barrier system. In this way the insulation is not subject to local convection currents and the insulation can perform its intended function. Even a small space between the insulation and the air barrier substrate will drastically reduce the thermal efficiency. **[1]**

If insulation is applied to a wall in a way that allows air to circulate around it or behind it, convection currents will be set up that will reduce its insulating value. Laboratory measurements show that if this kind of convection is allowed to occur through a 1/8” (3mm) gap between an insulation board and its backup, it will, under severe conditions, reduce the value of the insulation by 40%. This work was originally done in 1966 **[2]**. More recently (1991) it has been shown that a mere gap of between 1/32” and 3/64” (1mm) for walls is sufficient to initiate convective airflow around board insulation and reduce R-values. This study also showed that insulation gaps of 1/2 % of total wall area will more than halve (reduce by 55%) its total R-value **[3].**

Maintaining intimate contact between insulation and the substrate in a gap-free manner can clearly be shown to be critical to the long-term performance of any wall assembly. This can be challenging to achieve. Numerous construction details prevent intimate contact: Masonry walls are not flush or true line: the seams in sheet air barrier materials at masonry ties, joints and corners: extra mastic for sealing around masonry ties: The thickness of the masonry ties themselves. As a result, insulation boards may touch the backup wall in one place and be 10mm or more away in another.

FROM THE NATIONAL BUILDING CODE - 2005

5.3.1.3 Location and installation of material providing thermal resistance

2) Materials providing required thermal resistance shall have sufficient inherent resistance to airflow or be positioned in the assembly so as to prevent convective airflow through and around the material.

(Appendix A) – Position of Materials Providing Thermal Resistance

For a material providing thermal resistance to be effective, it must not be short-circuited by convective airflow through or around the material. The material must therefore be either:

- The component of the air barrier system providing principal resistance to air leakage or
- Installed in full and continuous contact with a continuous low air permeance component.

NOTE: WALLTITE® v.3 meets these criteria better than any other system. Good adhesion to the substrate, with no gaps or cracks or seams.

9.25.2.3 Installation of thermal insulation

3) Except where the insulation provides the principal resistance to air leakage, thermal insulation shall be installed so that at least face is in full continuous contact with an element with low air permeance.

NOTE: WALLTITE v.2 and WALLTITE v.3 polyurethane foam insulation can be located as either the principal thermal insulation or act as the air barrier system and vapour barrier (Refer to our Section Vapour Permeance (Yes or No) if installed on the exterior with the transition membranes, ref: CCMC report # CCMC 13588-L and 13467-R.

Appendix – Position of insulation

For thermal insulation to be effective, it must not be short-circuited by convective airflow through or around the material. If low-density fibrous insulation is installed with an air space on both sides of the insulation, the temperature differential between the warm and cold sides will drive convective airflow around the insulation. If foam plastic insulation is spot-adhered to a backing wall or adhered in a grid pattern to an air-permeable substrate, and is not sealed at the joints and around the perimeter, air spaces between the insulation and the substrate will interconnect with spaces behind the cladding. Any temperature or air pressure differential across the insulation will

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again lead to short circuiting of the insulation by airflow. Thermal insulation must therefore be installed in full and continuous contact with the air barrier or another continuous component with low air permeance.

NOTE: WALLTITE® v.2 and WALLTITE v.3 tenaciously adheres to backup walls and seals around masonry ties and corners. This provides a 100% gap free monolithic layer of insulation, totally eliminating and convective airflow and loss of R-value, ref: CCMC 13588-L and 13467-R and Adhesion Tests Section 4 of the BASF Technical Binder.

References:

1. CSC Tek-Aid (1990), "Digest 07195, Air Barrier", Alberta Building Envelope Council, Construction Specifications Canada.
2. Lorentzen, G. and Nesje, R.S. (1962), "Experimental and Theoretical Investigation of the Influence of Natural Convection in Walls with Slab Type Insulation", Norwegian Institute of Technology, Trondheim, Norway.
3. Trethowen, H.A. (1991), "Sensitivity of Insulation Wall and Ceiling Cavities to Workmanship", Journal of Thermal Insulation, Vol. 15.

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