Heat loss or gain can occur through a building envelope by three primary mechanisms: **conduction**, **convection** and **radiation**.

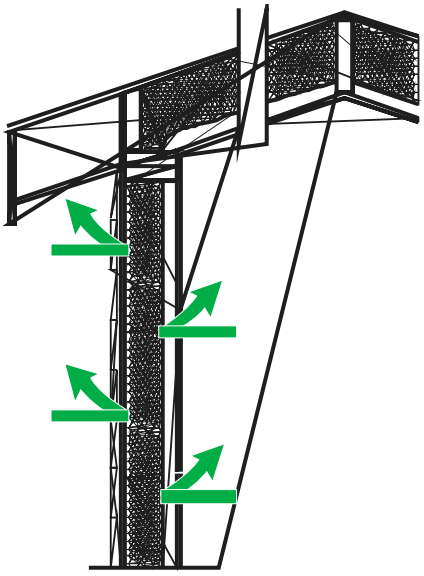
Three secondary mechanisms that influence the performance of insulation are air infiltration, air **intrusion** and **moisture accumulation**.

Spray polyurethane foam effectively controls the three primary and the three secondary mechanisms of heat transfer, resulting in insulation efficiencies well beyond that suggested by its high R-Value alone.

Conduction

R-Value is a well-publicized “status” to reflect insulation value to consumers. R-Value only measures conduction or the material’s ability to resist heat loss or gain. It is derived by taking the “k” value, determined by using an ASTM test method, and dividing it into the number one. The “k” value test is the actual measurement of heat transferred through a specific material. The test favors fiber insulation materials-fiberglass, rock wool, and cellulose fiber as the test does not account for air movement (wind), or moisture (water vapor). Zero wind and zero moisture are not real-world conditions.

Spray Foam Insulation: The predominant heat transfer mechanism for spray foam is conduction. However, because the polymer matrix forming the cells is a poor conductor of heat, spray polyurethane foam has a very high R-Value and effectively blocks heat transfer by conduction.



Convection

Convective heat transfer occurs when a liquid or vapors come in contact with a material of a different temperature. Within a stud wall cavity, “convective loops” will occur when the exterior and interior temperatures are different. For example, if the interior is warm and the exterior cold, air within the cavity in contact with the exterior wall will cool, becoming denser, and flow downward. On the other hand, air in contact with the interior wall will warm, becoming less dense, and rise. Air rising and falling within the wall cavity forms a “loop” which transfers heat from the warm wall to the cold wall. The result is increased heat loss/gain and costly energy bills. By stopping the air movement, convective heat loss will cease.

Spray Foam Insulation: Spray foam eliminates air movement within the insulation material eliminating convection as a heat transfer mechanism within the insulation mass.

Radiation

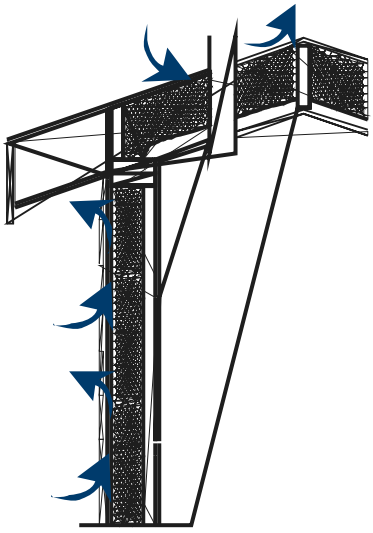
Radiation is the transfer of heat from one object to another by means of electromagnetic waves. Radiative heat transfer does not require that objects be in contact. Radiative heat transfer occurs in the void of a space.

Spray Foam Insulation: Heat transfer by radiation is effectively blocked by spray foam because of the cell structure. Heat can transfer by radiation across each cell. However, because the cells are at basically the same temperature, heat transfer by radiation is virtually non-existent. Additionally, the building interior walls insulated with spray foam tend to be nearly the same temperature as the room; therefore radiant heat variances to an occupant is minimal leading to greater indoor comfort.

Air Infiltration

Air infiltration transfers heat by the gross flow of air between the exterior and the interior. The primary force behind air infiltration is the air pressure difference between the exterior and the interior. Air pressure differences can be caused by wind or stack

Spray Foam Insulation: The bonding of spray foam plus the expansion of the material in place will create a total seal. Spray foam is one of the only insulation materials that will fill in corners, the cripples, the double studs, bottom plates, top plates, etc.



Air Intrusion

Unlike air infiltration, wherein air moves from the exterior to the interior, air intrusion occurs when air enters the insulation from the exterior and exits back to the exterior. Air intrusion is also called “wind wash.” There is no drafting of air to the interior of the building but the thermal gradient of the insulation is disrupted. In effect, air intrusion introduces forced convection into the building envelope (wall, ceiling, etc.). Air intrusion can substantially undermine the effective R-Value of conventional insulations and can occur independently of air infiltration. Like air infiltration, house wraps are traditionally used with conventional insulation systems

in an attempt to reduce air intrusion. Vapor retarders installed on the interior side of the building envelope will not affect air intrusion.

Spray Foam Insulation: Spray foam stops moisture accumulation by reducing air infiltration and air intrusion. In addition, closed-cell spray polyurethane foam retards both heat transfer and water vapor transfer making it an ideal material for use with flow-through designed building assemblies.