



Upside Down Roofs

A roof system normally includes the following elements; a structural roof deck, an air-vapour barrier, insulation, and a water shedding or waterproof roofing. In relation to heat loss it does not matter how these are combined. Their relative location has a very important effect, however, on the performance of the individual elements in any system.

Insulation is usually placed on top of the structural deck because that is the most convenient place to put it. This has the added advantage that it protects the structural deck from large temperature variations. The air-vapour barrier must be placed inward of the insulation to prevent building moisture from penetrating to the cold parts of the system by diffusion or air leakage, and this works out well since the deck can provide support for a membrane type barrier. The roofing is normally the most outward element of the system to keep the weather from all the other elements. By having the correct specification and using dry materials under good weather conditions and with good workmanship, successful roofs of this sort are being built. Credit is due to the roofing industry that so many thousands of acres of successful roofing exist.

The system, however, has some disadvantages. The roofing membrane is subjected to the full onslaught of the weather, and has to ensure high and low temperatures and a wide range of daily and seasonal temperature variations. The fact that the insulation is sandwiched between two membranes produces a vapour and water trap.

The so called "upside down roof" is simply a rearrangement of the normal elements of a roofing system to try and overcome some of the disadvantages of the conventional arrangement. In it the air-vapour barrier and the roofing membrane are combined and located on the structural deck with the insulation placed outside the skin like the fur of animals or the clothing humans wear. Unless there is some good reason to do otherwise, precipitation can be disposed of on any roof by drainage. This requires sloping surfaced to ensure run-off and can best be accomplished by sloping the structural deck.

With a sloped structural deck, with a roofing membrane applied to the deck, and insulation placed outward of the membrane represents the simple principle of the upside-down roof, there are many details and ramifications that require consideration to ensure a successful job:

1. The structural deck must provide continuous support with a smooth surface for application of the membrane and insulation. Corrugated decks, such as steel must be covered with a suitable material to provide a proper roofing surface.
2. All deck surfaces must be designed to provide positive slopes to drains, and all materials above the membrane must be arranged to facilitate drainage. Water that does not drain is not likely to evaporate and will become stagnant. There is insufficient data on the longer term effects of stagnant water in constant contact with an asphalt membrane.
3. Although most of the in-service conditions are less severe than on the conventional membrane, the membrane should not be reduced. In fact, due to the difficulty of repair and the unknown

factors mentioned above it would be advisable to consider an increased membrane and a heavy top coating of bitumen.

4. Insulation should be non-absorptive of water, durable and reasonably stable dimensionally.
5. Insulation must be adequately anchored against wind uplift and flotation, either by adhesion to the membrane or by ballasting. When such roofs are used in roof terrace or podium systems, the traffic surface materials usually provide sufficient ballasting. For other roofs the adherence by asphalt or other adhesive will depend on the smoothness of the deck and membrane, and ballasting by gravel or concrete slabs should probably be considered. Some presently available insulations that are otherwise suitable for this type of system require cover for protection of the insulation from the degrading effect of the ultra violet rays from the sun.

It must be remembered, however, that this approach to design can be adapted to the conventional double membrane system, if the membrane at the deck (the usual vapour barrier) is considered to be the primary membrane and is properly flashed at roof penetrations and into drains. A membrane on top of the insulation will then provide moisture protection to any insulation on the market including the absorptive types, and carry off the precipitation to drains. If proper venting is provided in addition to drainage at both membranes, any water that gets into the system can get out again without causing undue deterioration of the insulation.

The Canadian Roofing Contractors' Association acknowledges the seeming inherent advantages to the "upside down roof" as opposed to the conventional roof. The association would, however, like to caution against too rapid acceptance for general use of a system not yet proven in practice and too rapid condemnation of a system which has, despite some often highly publicized failures, given good service over many years under varying Canadian climatic conditions.