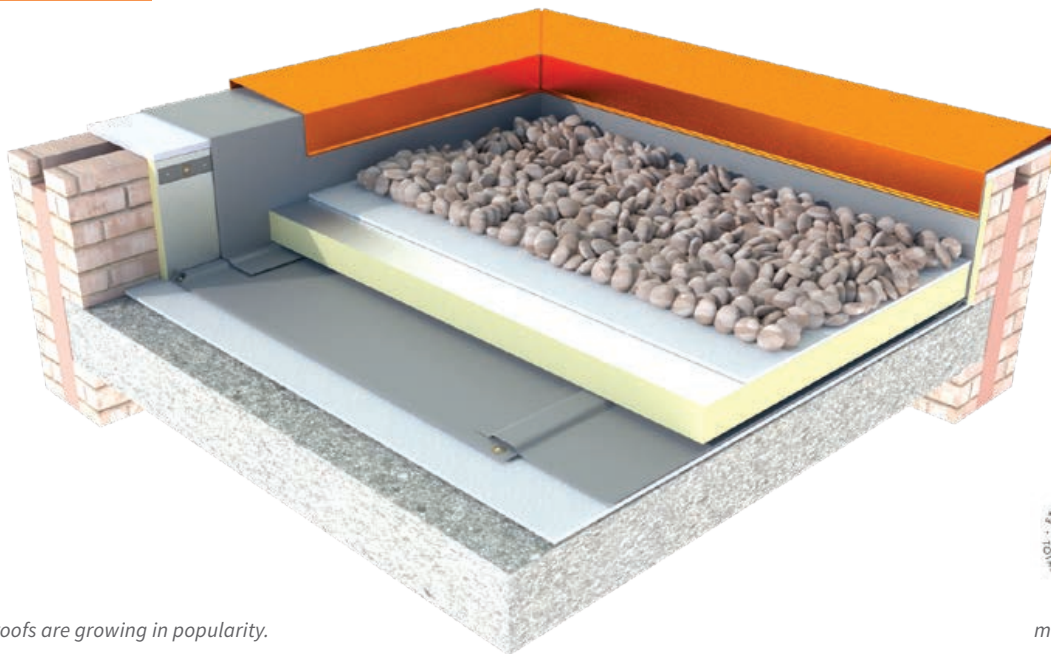


The science of inverted roofs

The roof is the most critical component of the building enclosure. However, flat roofs in particular, are often ignored until a water leak occurs. Unfortunately, extensive damage to the roof system may have already occurred by the time the leak is recognised.

By Richard Polling



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■ *Inverted roofs are growing in popularity.*

Generally, there are two types of flat roofing systems available. The conventional system, has the insulation placed below the waterproofing membrane and then there is the inverted roofing system. Inverted roofs are designed with the waterproofing layer, usually a liquid-applied/single ply/derbigum membrane, beneath the insulation. Insulation boards are loose-laid on top of the membrane and then weighted down with paving slabs or gravel ballast.

Stone-ballasted roof systems began appearing sometime in the early 1970s. While they appear superficially like built-up roofing (BUR), there are major differences.

In a ballasted roof, the stones are much larger and applied much more heavily. In fact, the weight of the stone 'ballast' is the only item holding the roof components in place.

Within a few years, inverted roof systems came along, where the membrane was laid directly on the structural roof, with insulation and filter fabric placed on top. Once again, the ballast held the components together.

By the 1980s, designers were integrating concrete pavers into ballast roof designs, creating access paths, pedestrian walkways and even rooftop plazas. When the green building movement came along in the late

1990s, it was natural to transition the ballast from stone to soil, creating vegetated or green roofs.

Features and benefits

By eliminating all the adhesives and fasteners required by other systems, inverted roofing can greatly reduce cost of the roof, as well as the time required to install it.

Another great benefit of inverted roofs is that the insulation protects the membrane from extremes of weather, such as frost, UV exposure and the expansion and contraction that comes about with summer and winter cycles.

All images courtesy of the MRC.



Ballast inverted roof.

Rain that falls on the roof percolates through the ballast and between the insulation boards until it reaches the membrane. It then drains away through rainwater outlets. The build-up of the roof means that some water is almost always trapped beneath the insulation boards by capillary action. Consequently, the insulation is expected to be wet for most its lifetime. This is taken in consideration when determining the U-value of the roof.

The thermal insulation boards placed on top of the roofing membrane provide protection against several damaging factors:

- Temperature extremes: with inverted roofs the temperature of the membrane stays within a narrow interval.
- Climatic impacts and UV-radiation.
- Mechanical impacts during the construction period, use and maintenance.
- Blistering of the membrane: the waterproofing membrane on the warm side of the thermal insulation acts also as a vapour barrier.

The closed cell structure of the insulation boards is the basis of the excellent physical and thermal properties. A good quality insulation board should meet the following requirements for insulation regarding inverted roofs:

- No capillarity
- Negligible water absorption
- Resistance to freeze-thaw cycles
- High mechanical resistance

Advantages

- Protected waterproofing-membrane
- The roofing membrane is installed on the roof-deck (concrete deck)
- Simple build-up without additional vapour barrier
- The installation of the layers above the membrane is independent from weather
- Easy and fast installation

The inverted roof insulation system has been proven successful for more than 35 years in Europe. The life-term and long-term behaviour of the system has been examined by independent institutes and building experts several times.

Compared to conventional roofs the life expectancy of the membrane is greater, the risk of failure is reduced, due to effective and permanent protection for the membrane.

1. Conventional flat roof without gravel covering
2. Conventional flat roof with gravel covering
3. Upside-down flat roof insulated with insulation boards protecting the waterproofing membrane

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An inverted roof with paving.

“ The inverted insulation system is applicable for all types of flat roofs.”

The inverted insulation system is applicable for all types of flat roofs. The standard build-up is the non-accessible roof with gravel ballast on top. The inverted roof system also works in utilised roof areas such as terraces, roof gardens and parking decks.

Since insulation is placed on the roofing membrane, an energy saving and cost efficient solution for renovation of flat roofs is possible by installing an inverted roof over the existing roof build-up. ☞

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Liquid-applied inverted roof.