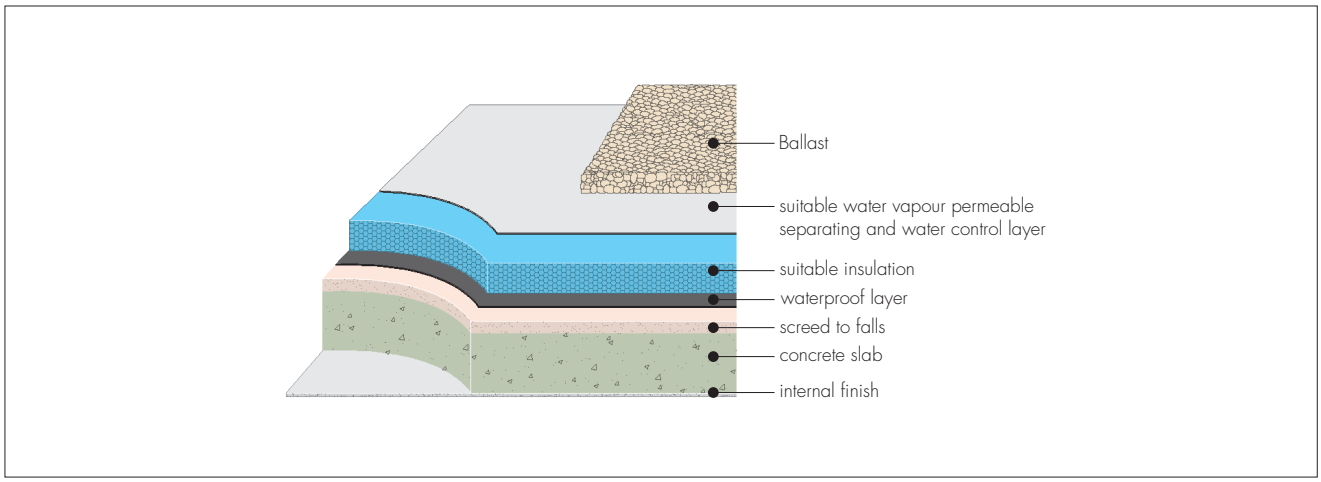
BBA Information Bulletin No 4

Inverted roofs – Drainage and U value corrections

Renewed interest in inverted roof specifications has focussed attention on two issues. These are correct drainage and corrections to calculated U values, resulting from cold rainwater seeping under the insulation, thus carrying heat away.



Drainage

It is essential that roof falls and drainage paths are correctly designed to avoid ponding and subsequent risk of silt build up, stresses in freezing conditions and to reduce water entry in the event of a waterproof layer failure.

Drainage points need to be located at the lowest point of the roof, to facilitate effective removal of rainwater. Care is needed to indentify these locations. For example, precast concrete decks will deflect between spans and mid-span and may be the lowest point of the roof, rather than at roof edges or column supports.

Where water control layers are used, drainage must be provided at two levels; at the water control membrane level and at the roof deck waterproofing level.

Zero pitch roofs

Zero pitch roofs have a slope which can vary between 0 to 0.7 degrees. On these roofs it is particularly important to identify the correct drainage points, to ensure that the drainage provided is sufficient and effective.

The effectiveness of water control layers in limiting cold rainfall reaching the roof deck must be robustly established by assessment and physical testing of the zero pitch roof assembly. See note 2.

British Board of Agrément
Bucknalls Lane
Garston, Watford
Herts WD25 9BA

tel: 01923 665300
fax: 01923 665301
e-mail: mail@bba.star.co.uk
website: www.bbacerts.co.uk

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U value corrections

Cold rainwater reaching the roof waterproof layer will temporarily affect the rate of heat loss from the roof and should be accounted for by adding a correction (ΔU_r) to the calculated roof U value in accordance with Section 7 and Annex D.4 of BS EN ISO 6946 : 2007, as follows:

$\Delta U_r = p \cdot f \cdot x \, (R_1/R_T)^2$ where:

ΔU_r correction to the calculated thermal transmittance of the roof element ($W \cdot m^{-2} \cdot K^{-1}$)

p average rate of precipitation during the heating season ($mm \cdot day^{-1}$)

f drainage factor giving the fraction of p reaching the waterproof layer

x factor for increased heat loss caused by rainwater flowing on the waterproof layer = 0.04 $W \cdot day \cdot m^{-2} \cdot K^{-1} \cdot mm^{-1}$

R_1 thermal resistance of the layer of the insulation above the waterproof layer ($m^2 \cdot K \cdot W^{-1}$)

R_T total thermal resistance of the construction before application of the correction ($m^2 \cdot K \cdot W^{-1}$).

Notes:

(1) Values for average rainfall during the heating season for different UK locations can be found at http://www.metoffice.gov.uk/climate/uk/averages/19611990/images/RainOctMar6190.gif and divided by 182 days to obtain p in $mm \cdot day^{-1}$

(2) f is established by test to ETAG 031 *Guideline for European Technical Approval of Inverted Roof Insulation Kits Part 1: General*. See http://www.eota.be

The test shall be on the thinnest board and thinnest most liquid permeable ballast layer at the lowest deck slope. Where a zero pitch roof construction is proposed, the tested assembly must also be flat, ie without falls.

The following values of f may be used without the need for testing (these may be conservative and in many cases suppliers may choose to seek improved values by carrying out a test on a specific construction):

0.5 roof gardens, green roofs and parking decks with cast concrete finish

0.75 insulation with rebated joints and an open covering

1.0 insulation with butt edged joints and an open covering

(3) Declared conductivity should be to the relevant product standard and include moisture corrections to BS EN ISO 10456 : 2007 (or ETAG 031) for declared limit values for water absorption by diffusion (EN 12088 : 1997) and water absorption by freeze thaw (EN 12091 : 1997).

These corrections need not be applied if a 'water control' membrane, between the insulation and the ballast, is able to prevent 100% of rainfall passing through in liquid or vapour form.

(4) The U value calculation should not include any value for the ballast layer and the correction may be ignored if the total correction is less than 3% of the uncorrected U value.

(5) Any water control layer should be permeable to water vapour but impermeable to liquid water. The effectiveness of detailing and the effects of the following shall be considered and its effectiveness confirmed by the designer:

- lime water, sodium chloride solutions and sulfurous acid (EN 1847 : 2009)
- UV water and heat (EN 13859-1 : 2005 modified by ETAG 031)
- puncturing to EN 12730 : 2001, Method A.

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