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Attention: Andrew Smith

Dear Sir

Acoustic Testing of Roof System

This letter discusses the significance of the acoustic tests recently carried out on the Nuraply Nuratherm roofing system. Two different types of testing were carried out by the Acoustic Testing Services (ATS) at the University of Auckland. The first was the airborne sound transmission, measured according to ISO 10140-2: 2010, and the second was the noise generated by artificial rainfall, measured according to ISO 140-18:2006.

The roof that was tested consisted of the following elements (from top to bottom):

- 1 layer of Nuraply 3PM flame bonded, with lapped joints, to
- 1 layer of Nuraply 3PV-SA self adhesive layer, self-adhered to
- 80mm thick IKO Enertherm Polyisocyanurate foam insulation screw fixed to
- Dimond NPM 900 corrugated 0.55mm steel tray, screw fixed to 140 x 45 H1 treated timber purlins spaced at 600mm centres.

Airborne Sound Transmission

Roofs are important in controlling the transmission of noise into a building (for instance from aircraft or other environmental noise), or noise emitted from a building (e.g from a plantroom or entertainment venue to a nearby residential area). The transmission of sound is measured in a standardised way, over a range of frequencies, and commonly the result is expressed as a single number (STC or R_w). This can be used to compare different constructions, or used to calculate the internal noise environment due to a given sound level outside. A higher number indicates a better performance.

The measured sound insulation over the normal frequency range is given in the ATS report T1401-1a. The overall rating is STC 37 (R_w 36 dB). This is an excellent result for a single roof element (that does not have a ceiling below). As comparison, long-run steel roofing on purlins would have a rating of STC 15 – 20, and would require the addition of a suspended plasterboard ceiling below to achieve STC 35 – 40. An insulated steel panel roof (0.55 mm steel skins and 80mm PIR core) would typically achieve STC 22 – 25, and again would require a ceiling suspended below to achieve STC 35 – 40.

A "cold" roof construction consisting of a layer of Nuraply 3PM and a layer of 3PB on 17mm ply fixed to 150mm rafters with 90mm thick R1.8 fibreglass between the rafters would have a rating of STC 34 (R_w 34 dB). Some comparisons for various roofs are shown in the table below.

Rain Noise

In many commercial or educational buildings the noise produced by rainfall can be very disturbing (for instance for teaching purposes, use of telephone, meetings, etc). Moderate rainfall can produce noise levels sufficient to make conversation and listening very difficult.

A test (ISO 140-18) has been developed to measure roofs under standardised conditions. Artificial rainfall is generated above the test roof, and the noise generated below measured. The overall sound intensity produced is quantified as LIAM norm (dB). This can be used to compare roofs, and to calculate the noise level within a room under known rainfall conditions. A lower number indicates a better performance.

The Nuraply Nuratherm roof is relatively quiet under rainfall. At an artificial rainfall rate of 112mm/hr (equivalent in ISO terminology to "Cloud Burst") the roof produced a noise level LIAM norm of 50 dB. (ATS report T143-ICB112). Note that in the ATS test setup it was not possible to achieve the recommended height for the fall of the rain drops. However a reference panel (6mm monolithic glass) was tested and it was found to produce the same noise level as other laboratories have measured for the reference panel at 40mm/hr rainfall (in ISO terminology "Heavy"). Therefore the ATS test is taken to be equivalent to an ISO rainfall rate of 40mm/hr.

By comparison, a typical long run steel roof would produce a noise level of about 68 dB at this rainfall rate. In subjective terms this would be nearly three to four times louder. A suspended plasterboard ceiling and acoustic blanket in the cavity would be required to reduce the rain noise to about 50 dB. An insulated ceiling panel consisting of 0.55mm steel skins, with an 80mm PIR core would produce a noise level of 70 – 72 dB, and again would require a suspended plasterboard ceiling to reduce the rain noise level to comparable levels to the plain Nuralite Nuratherm roof. A "cold" roof as described in the section above is predicted to produce a level of 56 dB, appreciably louder than the Nuratherm roof. A comparison of some roof systems is shown in the summary table below. Note that none of these roofs have a ceiling.

Table: Comparison of Acoustic Performance

Roof System	Sound Transmission Loss (STC)	Rain Noise ($L_{IAM\ norm}$) 40mm/hr
Nuraply Nuratherm (Bitumen membrane, 80mm PIR, metal deck)	37	50
"Cold" roof: Nuraply membranes on 17mm ply fixed to 150mm rafters with R1.8 fibreglass blanket between rafters	34	56
Long run steel (0.55 mm) (typical profile)	15 – 20	70 – 75
Insulated steel panel (0.55 mm steel skins, 80mm PIR)	22 – 25	76 – 78
6mm monolithic glass	32	64

Variations

The test results apply directly only to the structure and components described in the test reports (and summarised above). However, it is possible to estimate the effect of variations to the construction on the sound transmission loss.

If the thickness of IKO Enerherm foam was increased to 100mm the STC would be expected to increase by 1 dB. If the insulation was decreased to 30mm the STC is expected to decrease by 2 dB.

If the metal decking were to be replaced with 15mm ply, the STC is expected to increase by 1 dB.

If a 13mm thick plasterboard ceiling were to be suspended below the roof, the STC is predicted to increase to STC 50.

At present it is not possible to accurately predict the effect on rain noise of variations to the roof structure, however it is not unreasonable to assume that rain noise would be reduced by about the same amount as the STC is improved. Thus, ± 1 – 2 dB for variations to the IKO Enertherm insulation, and 10 – 14 dB improvement with a plasterboard ceiling.

In summary, the Nuralite Nuratherm roof system has a good acoustic performance both for reducing sound transmission, and for suppressing rain noise. Comparable roof systems would generally require the addition of a plasterboard ceiling to achieve equivalent performance.

We trust this information is clear and understandable. If you should require any further discussion or information please do not hesitate to contact us.

Yours faithfully

MARSHALL DAY ACOUSTICS LTD

Keith Ballagh

Principal