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Methodology for Predicting the Service Life of Two-Ply Roofing-Felt Membrane

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1 Introduction

The service life of a flat membrane roof is dependent of the material of the membrane but to a large extent also on the design of details and the workmanship. Among the factors affecting the service life are the slope, the number of details, the buildability (how easy it is to build the roof including underlay and details). However, it is a prerequisite that the membrane itself has a long service life, and it is the scope of this paper to propose a way to assess the service life of the membrane material. In the following, we set forth how estimation of reference service life for a roofing felt was performed in Denmark and give proposal to a methodology for assessing estimation of service life for roofing membranes.

2 Method

In this small study, a combination of visual inspections and laboratory testing was used to estimate/predict the reference service life of a two-layer roofing-felt membrane.

The inspections were only related to the roofing felt itself (not to the welded joints, penetrations etc.). The roofs were located all over Denmark, and had an inclination between 1.4° and 45°. The roofing felt was laid out on an underlay of wooden boards or insulation materials. The 12 inspected roofs were chosen randomly amongst several other roofs constructed in the period 1990 to 1999, *i.e.* 20-30 years old roofing-felt membranes. In six of the roofs, samples of 0.7 x 1.0 m were cut out to use for laboratory test. The samples were used to compare a number of material properties of the membrane wit a reference virgin material. For all roofs, a systematic visual inspection was conducted, and both the visual inspection and laboratory test were included in the service life estimation.

3 Results

The results of the *visual inspections* are that the top membrane in all inspected roofs are assessed as being in good condition. Only minor changes compared to new membranes were visible. The protection in form of slate granules on the surface of the membrane was almost intact, and there were only minor signs of degradation even in valleys and depressions where water may gather occasionally. There were in a few cases small cracks in the slate covering – known as “mud cracks” – but even here, there were no signs of degradation of the bitumen below.

3.1 Laboratory Tests

Tensile strength is often required to be above 500 N/50 mm per sheet of bituminous roofing material and above 1000 N/50 mm for a finished solution with two layers of membrane. This requirement was fulfilled for all the tested specimens.

Elongation at break: The results achieved during testing was all above normal used requirements in many other European countries.

For *flexibility under cold conditions* results under -15 °C were achieved for membranes aged 20-30 years under in use conditions *i.e.* better than the requirements used for new membranes after accelerated heat ageing (often considered to be equivalent to 10 years of natural ageing).

Testing for *static and dynamic load* was passed by all samples with results similar to those for virgin materials.

The *SBS content* in the tested membranes lies in the same range as by production and within the deviations that may be expected by the test method.

4 Service Life Prediction

In this case the prediction of service life of the roofing membrane is based om visual inspections and tests in the laboratory. It is our opinion that both parts of the investigation are important and both should be taken into account when the service life shall be predicted. If one of the two parts gives unsatisfactory output, the service life can at best be assessed to a little longer than the actual service life of the inspected roofs. If both factors are on a good level, the service life can be assessed to be longer than the actual service life of the inspected membranes – the question is only how much longer.

In this study inspections as well as laboratory tests showed very good results. Based on the results the reference service life was estimated to at least 50 years. This result is in accordance with earlier studies in Denmark performed by the Danish Roofing Advisory Board and results from Finnish investigations.

5 Conclusion

In this study we used a methodology based on a combination of visual inspections of “old” roofs in situ and test of material properties of samples taken from the inspected roofs. It is our opinion that this method is well suited for estimation of reference service life of roofing membranes. It should be noted that it is a prerequisite that the roofs to be inspected should be relatively “old” compared to the final estimated result of service life. It is also necessary to know the history of the roof membranes *i.e.* to avoid estimation of roof membranes that has been repaired or replaced roof, thus it interfere with the results. We believe that the used methodology may be used for other types of roofing membranes and maybe even more generally for estimation of service life for building materials.

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