Non-destructive Leakage Location Analysis Method in Substrate Behavior Response Testing of Waterproofing Membrane Systems using Thermal Emission Camera

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Abstract

The substrate behavior response testing outlined in KS F 2622 evaluates the leakage cause of waterproofing membrane systems when subjected to the concrete joint load behaviors by removing the waterproofing layer after testing, relying mostly on visual observation and subjective analysis. A non-destructive leakage cause and failure type analysis method is proposed currently in this study by the means of detecting leakage paths using thermal emission imaging systems. Test specimens are placed in varying temperature conditions after the concrete joint movement testing and are scanned using the thermal emission camera to determine the location and dimension of the adhesion failure/leakage path beneath the waterproofing membranes.

Keywords : over-lap joint, evaluation method, thermal emission camera, joint movement,

1. Introduction

Waterproofing membrane sheets require forming overlap joint. In overlap joints, there is a possibility of a gap forming along the interface of the two waterproofing layers. This can be caused if the waterproofing membrane has not been sufficiently cured or if the concrete surface has not been cleaned beforehand. Also, thicker waterproofing sheets have higher elastic modulus, and the elastic recovery will apply as straining force on the adhesion interface at the overlap joint interface [1]. In most cases, ensuring a successful overlap joint adhesion is a very technical procedure failure at this section is often an indicator of poor workmanship.

2. KS F 2622 Test Method Evaluation Method (Overlap Joint)

The overlap joint section of sheet type waterproofing membrane systems is a key criterion for evaluating the workmanship of installation. This area is easily susceptible to adhesion failure due to poor workmanship. Poorly installed overlap joints can easily lose adhesion due to substrate movement. In KS F 2622 method, the overlap joint of waterproofing membrane sheet systems are checked for signs of leakage through visual observation during the testing. As shown in Figure 1, a punctual gap can form and distinct line of adhesion failure can be present.

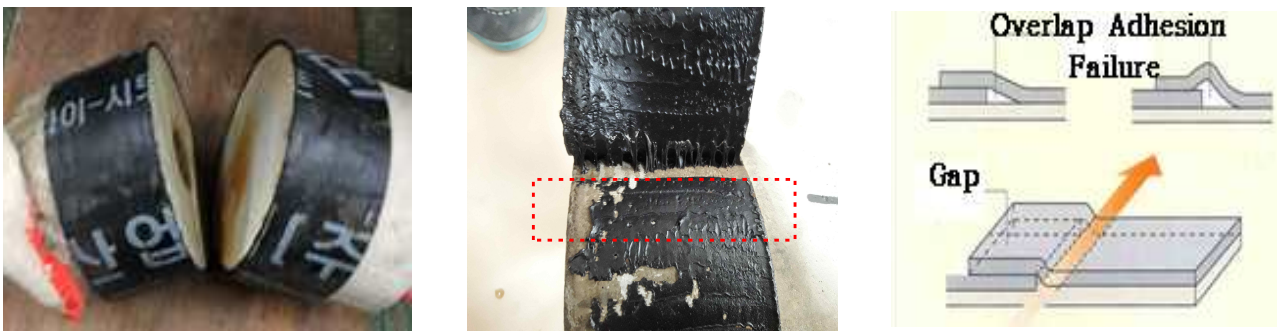

Figure 1. Punctual gap across the membrane and concrete surface under the over-lap joint

3. Overlap Joint Section Diagnosis using Thermal Emission Camera

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3.1 Thermal Emission Camera Setting: Testo 885

For this testing, a thermal emission camera product, TESTO 885 was used. Table 1 shows the thermal image setting that was used for the parameters of this testing;

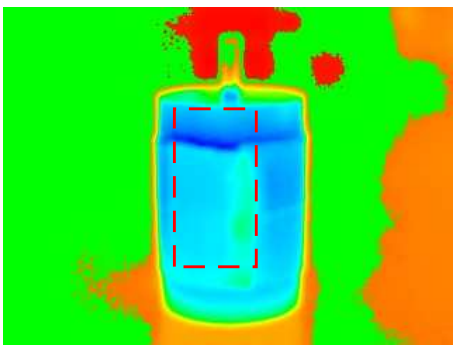
Table 1. IRSoft software thermal emission image setting

Item	Setting
Ambient Condition (Relative Temperature)	26±1℃
Temperature Scale	15~40℃
Spectral Emissivity	0.95
Color Palette	Hot/Cold
Reflected Temperature Compensation (RTC)	20.0

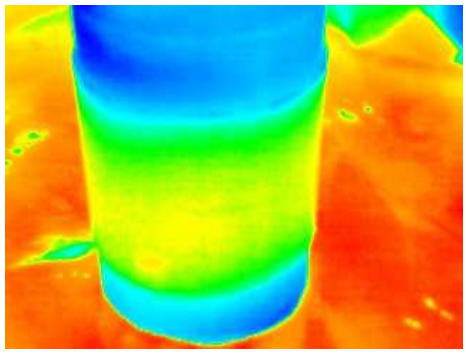
With the above settings, and thermal imaging of the completely installed test specimens after the testing was concluded was taken analyzed to confirm that the punctured adhesion failure across the interface can be detected.

3.2 Overlap Adhesion Failure Detection Results

The results of the thermal imaging was able to capture the gap forming beneath the waterproofing membrane layer. It is predicted that the temperature of the water remaining inside the gap after the substrate movement simulation testing in accordance to the KS F 2622 testing parameters was caught in the image, resulting in a contrasting reflection as opposed to the thermal imaging of the waterproofing membrane. As shown in Figure 2, the specimen that had a gap forming clearly after membrane removal (left) and the specimen without a gap forming (right) can be compared.



Specimen with a adhesion failure (Gap forming)



Specimen without adhesion failure (No Gap)

Figure 2. Punctual gap across the membrane and concrete surface under the over-lap joint

4. Conclusion

As a means to improve the reliability of this testing method, and to ensure that the evaluation results are not limited to the requirements for subjective visual observation in the evaluation process, a more accurate and non-destructive leakage cause and failure type analysis method is currently being developed by the usage of thermal emission imaging systems. It is expected that the future application of this test method can be used to improve the quality management of manufacturer specifications and guidelines for waterproofing installation procedure of below-grade concrete construction.

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참 고 문 헌

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