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WELCOME TO BUILDING ENCLOSURE COMMISSIONING

ONLINE TRAINING

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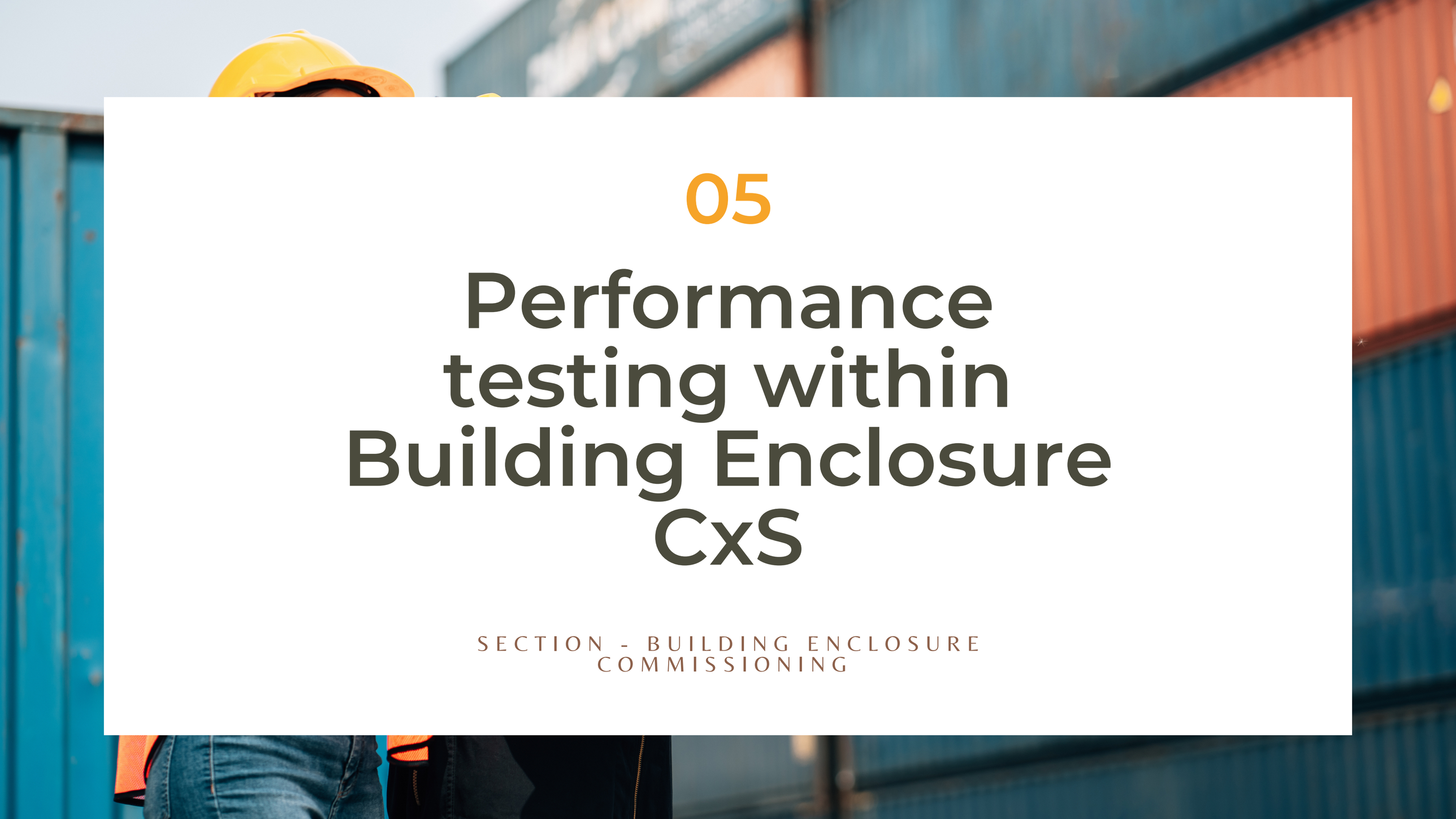

05

Performance testing within Building Enclosure CxS

SECTION - BUILDING ENCLOSURE COMMISSIONING

Performance testing within Building Enclosure CxS

05

WHAT YOU WILL LEARN

- Introduction
- Role of the building envelope commissioning agent
- Categories of functional performance testing
- Categories of functional performance

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INTRODUCTION

Building owners need a way to make sure that the building envelope is designed and built to meet the desired performance requirements. This is because there is a growing need to build buildings that use less energy and last longer.

This topic will discuss the many aspects of functional performance testing, from pre-construction laboratory materials and assembly testing to mockup testing and quality control and quality assurance onsite field testing, focusing primarily on the air, water, structural, and thermal performance of fenestration and cladding components used on building envelopes.

Role of the building envelope commissioning agent

- The building envelope commissioning process commences at BOD and continues through the duration of the project to completion. The tasks comprising the process are typically separated into five phases: pre-design, design, pre-construction, construction, and operations and maintenance (O&M).

- While the importance of the Pre-Design and Design phases cannot be understated, one emerging and disturbing trend is the reliance on the tasks conducted during these two phases to comprise most or all of the building envelope commissioning process, whereas tasks typically conducted during the Pre-Construction and Construction phases—specifically, functional performance testing of the building envelope system and its individual components—are minimized or omitted altogether.

- This approach toward commissioning often does not fulfill the main requirement of verifying building envelope performance because, without comprehensive and customized performance testing, it is impossible to confirm that the performance criteria outlined in the OPR have been satisfied.

Role of the building envelope commissioning agent

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Functional performance testing is an important part of the building envelope commissioning process because it ensures the quality of installations on-site. It is the job of the Building Envelope Commissioning Agent (BECA) to come up with functional performance testing protocols, which include test methods, parameters, and frequency.How much the BECA is involved in the actual physical testing depends on how big the commissioning process is for a given project.

- Testing of building envelope components may be part of the quality control programs of the contractors. The BECA will watch the tests as they are done and look over all the paperwork to make sure they follow the test protocol and that the tested system meets the performance requirements.
- All inspections and tests may be part of the BECA's quality assurance system and be done by the BECA or an independent testing agency that the owner and/or BECA have approved.
- It may be a combination of the above, where routine and simple testing of individual components or assemblies is conducted by the contractors and reviewed by the BEC, with more advanced and complex tests conducted on a more holistic scale by the BEC.

Categories of functional performance testing

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For simplicity, the functional performance testing process can be grouped into three categories:

(1) laboratory testing for general evaluation of product and assembly performance;

(2) Mock-up testing for evaluating project-specific performance prior to the onset of construction; and

(3) field testing for evaluating project-specific performance during the construction process.

These phases do not have to be mutually exclusive, and there may be more than one phase of testing for each performance category.

Categories of functional performance

Functional performance can be broken down in many ways, but in the building envelope, it is usually broken down into the following:

- Airtightness
- Energy Efficiency (combination of air, thermal, and material property testing)
- Water-tightness
- Thermal/Energy
- Acoustical
- Structural/Blast

Analysis of Test Results

- The role of the BECA does not end once a functional performance test has been completed. During the analysis of failure, it becomes clear how important it was for the BECA to be involved.It is not only important to identify issues of non-compliance but also to identify the cause of that non-compliance, be it workmanship, materials, design, or other factors, as the deficiency may only be a symptom of a greater issue.

- In some cases, this is relatively straightforward. Consider a membrane-to-substrate tensile adhesion test conducted on a self-adhesive wall air/vapor barrier membrane, where the project specifications require the membrane to remain adhered to the substrate under a prescribed tensile load.

- In the event of a failure where the membrane sample detaches from the substrate under a tensile load less than the specified, installation logs can be reviewed and the sample itself can be viewed post-test to assess potential causes of the failure, such as improper substrate preparation, moisture between the membrane, inadequate ambient environmental conditions, etc.

Analysis of Test Results +

In other cases, establishing causality is not nearly as simple. Determining the entry point and leak path of water infiltration detected during water penetration testing often requires additional diagnostic testing and/or disassembly of the test unit. Assessing the direct cause of failure in a multi-assembly test is often even more difficult and requires experience and understanding of:

(1) the material composition, installation, and design of all of the different assemblies;

(2) the different diagnostic tools and equipment available and the associated limitations of each; and

(3) how the interaction between the different assemblies affects overall system performance.

Item 3 is interesting because assembly interactions are complex and counterintuitive. In a multi-assembly test, one assembly can cause a second assembly to fail, even though each assembly would pass if tested alone. Imagine a system with a window unit and a metal panel wall assembly adjacent to it. The system was tested for air and water penetration, and the findings showed that more air and water went through the curtain wall system than allowed. Without more sample analysis, it may be impossible to determine whether the leak is in the window assembly or in the interface between the window and the wall assembly next to it. If the window unit were tested alone, the infiltration would not be present.

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SUMMARY

With the increased complexity of building envelope designs, the introduction of new building materials, and increasingly stringent performance requirements, a comprehensive building envelope programme has emerged as an invaluable process in ensuring the envelope's continued functionality and durability.

It not only ensures that the building envelope is built to fulfil the design intent, code requirements, and estimated service life, but it can also help to prevent numerous difficulties that arise during the construction process.

In order to ensure that the performance criteria as stated in the OPR are met, a detailed functional performance testing protocol might be used as part of the commissioning process.

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