JOINT INDUSTRY PROJECT

DURABOND OFFSHORE

EVALUATION OF THE DURABILITY OF COMPOSITE PATCH REPAIRS IN OFFSHORE ENVIRONMENT

Bonding is an attractive assembly solution in many ways. Indeed, it is a non-intrusive and cold solution that enables to assemble mono or multi-material structures. This assembly technique is particularly interesting for the installation of equipment or repairs when welding is prohibited, such as in ATEX-type risk areas.

Bureau Veritas, in collaboration with Gustave Eiffel University and its partners TotalEnergies, Petrobras, Naval Group, ColdPad, InfraCore Company and Siemens, developed a robust methodology for the design assessment of composite patch repairs within the Joint Industry Project (JIP) StrengthBond Offshore (SBO). Based on the testing of more than 250 specimens and around 150 numerical simulations, a dedicated guideline has been issued at the end of the project covering the design and the manufacturing of a composite patch.

While the JIP StrengthBond Offshore primarily focused on static and fatigue tests at the initial stage of patch without assessing the ageing effect, **Bureau Veritas is now proud to introduce a new initiative** to investigate the effect of the offshore environment on **the durability of a composite patch repair** on steel structure – the **DuraBond Offshore Joint Industry Project.** This project aims to explore the impact of the environment on the long-term durability of composite patches used in steel structure repairs. The objective is to assess how factors like temperature, seawater and oils affect the long-term performance of these patches in design evaluations. Evaluations will be based on a large testing campaign performed on aged and unaged specimens in static and in fatigue, as well as numerical simulations. The project will also focus on the non-destructive test methods used for the control and the survey of such repair to ensure a high installation quality and the patch longevity.

OBJECTIVES

The proposed JIP will allow:

- to be confident on the **long-term behaviour** of composite patch repair,
- to understand different **damage mechanisms** and the competition between them,
- to challenge existing **safety factors.**

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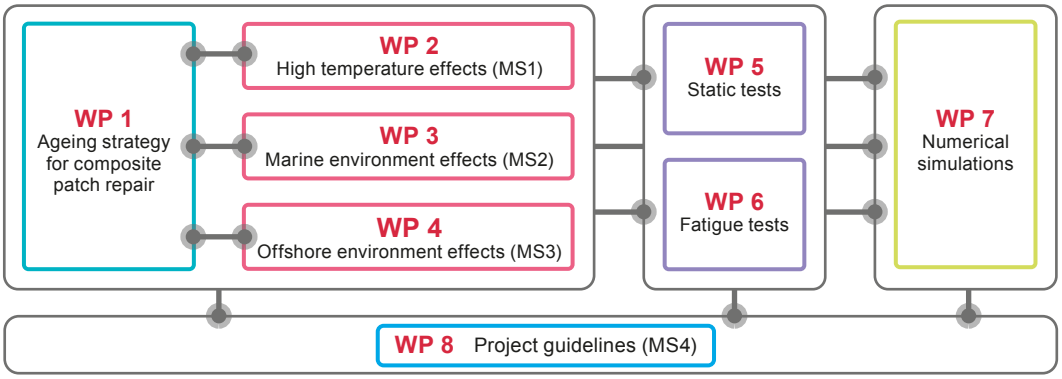
SCOPE OF WORK



WORK PACKAGE (WP) 1: AGEING STRATEGY FOR COMPOSITE PATCH REPAIR (M0-M30)

The first Work Package of the project will be dedicated to the development of the ageing strategy for three environmental effects: temperature, water and oil. Investigations will allow to determine the ageing method and the testing protocol applied in WP 2, WP 3 and WP 4.

WP 2: HIGH TEMPERATURE EFFECTS (M4-M18)

The characterisation of the effect of the temperature on the interface properties of a composite patch repair will be studied in WP 2. Fracture mechanical tests (DCB(1), ENF(2) and MMB(3) tests) on equivalent interface specimens, developed in JIP SBO, will be performed at different temperatures (up to 80°C) and the influence of the temperature on failure modes will be evaluated.

WP 3: MARINE ENVIRONMENT EFFECTS (M7-M24)

Based on the accelerated ageing protocol defined in WP 1, equivalent interface specimens will be immerged at different temperatures and during different times. Fracture mechanical tests (DCB, ENF, MMB) will be performed on aged specimens and impact of marine environment on interface properties will be assessed and extrapolated for long-term analysis.

WP 4: OFFSHORE ENVIRONMENT EFFECTS (M13-M30)

The tolerance of composite patch repair to offshore environment and especially to oil will be investigated in WP 4. Fracture mechanical tests (DCB, ENF, MMB) on equivalent interface aged specimens will be carried out and results will be compared with other environmental effects.

WP 5: STATIC TESTS (M10-M30)

In the work package 5, large specimens (SBO type) representing the composite patch repair will be tested in tensile at initial stage and after ageing for the worst conditions. The influence of the ageing on the strength will be evaluated and compared with unaged specimens.

WP 6: FATIGUE TESTS (M13-M33)

In addition of static tests, the effect of the ageing on fatigue life will be evaluated by cyclic tests (up to millions) on aged large specimens. Each obtained S-N curve will be analysed and compared with S-N curve from unaged fatigue tests.

WP 7: NUMERICAL SIMULATIONS (M13-M33)

Each mechanical test on equivalent interface and large specimens will be simulated to compare cohesive properties after every ageing conditions. The design assessment methodology developed along JIP SBO will be applied to confirm long-term behaviour. Diffusion models will also be made in order to reproduce the water and oil ageing.

WP8: PROJECT GUIDELINES (M18-M36)

The objective of this work package is to improve the project guideline developed within JIP StrengthBond Offshore by adding JIP DuraBond Offshore results. The final document will cover all design aspects including the ageing effect as well as the installation, the qualification and the control of composite patch repairs installed in marine and offshore environments.

SCHEDULE

The project is expected to start in the second/ third quarter of 2024 for a duration of 3 years.

Following milestones (MS) have been defined:

- **MS1** – High Temperature Effects (WP2, WP5, WP6 & WP7) ► **Month 18,**
- **MS2** – Marine Environment Effects (WP3, WP5, WP6 & WP7) ► **M24,**
- **MS3** – Offshore Environment Effects (WP4, WP5, WP6 & WP7) ► **M30,**
- **MS4** – Project Guidelines (all WPs) ► **M36.**

PARTICIPATION FEES

Tentative participation fees: between €35,000 to €50,000 by partners per year.

(1) DCB: Double Cantilever Beam for mode I.
(2) ENF: End-Notch Flexural for mode II.
(3) MMB: Mixed-Mode Bending.

LINK TO JIP STRENGTHBOND OFFSHORE

FOR MORE INFORMATION, CONTACT

Stéphane PABOEUF
Head of Composite Materials Section – Research Department
Mobile: **+33 6 70 91 51 12**
E-mail: **stephane.paboeuf @bureauveritas.com**

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