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Standard Practice for Sandwich Plate Repair of Steel Structures

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Foreword

Oil and gas industry onshore and offshore drilling, production, storage, and transportation generally experience very corrosive environments. Even though corrosion prevention systems, such as cathodic protection, protective coatings, and liquid/vapor phase inhibitors are usually used for corrosion protection, severe corrosion of the structures is still unavoidable without effective corrosion protection and appropriate corrosion management. The repair of degraded structural members having substantial corrosion damage is critical for maintaining structural integrity for safe and continuous operations.

The "crop-and-replace" repair method (by cutting and welding) is normally used in the oil and gas industry. However, such repairs are considered as hot-work**,** which creates a considerable safety concern for continuous oil and gas operations (drilling, production, and storage). When hot work repair of a tank is planned, safety regulations require the tank to be repaired, as well as adjacent tanks, to be in a "gas-free" condition. Due to significant impact on the continuous operation of the units, preparing for these repairs is very costly.

Safety and cost-effective solutions are the driving forces for consideration of non-hot-work repair methods. Thus, sandwich plate repairs without cutting and welding, using a new steel plate bonded to the existing steel structure, are generally preferred. With the increased use of sandwich plate repairs, more performance data and better repair practices make it possible to develop better industry standards. This repair method is preferable for applications on site-specific onshore and offshore structures which require immediate repair of severe corrosion and/or mechanical damage. It can also be applicable to other structures, vessels, or tanks, where permitted.

This standard practice formalizes a methodology of steel sandwich plate repair technology. This methodology uses a new steel plate or prefabricated structural component laid on top of the existing steel plate to be repaired. An elastomer core is used to bond the new plate/component and the existing steel plate to form a steel sandwich plate structure, thereby repairing the existing steel substrate without it being cut and replaced. This method is intended to restore the strength of the damaged structural members, or to reinforce existing structures.

Several classification societies, such as the American Bureau of Shipping (ABS),[(1)] Lloyds Register (LR)[(2)], Det Norske Veritas **(**DNV**)**[(3)], and the China Classification Society (CCS)[(4)] have set out their own rules, guidelines, or provisions for sandwich plate construction and/or repairs for steel structures, which serve for classifications for specific marine and offshore vessels. This standard practice covers only steel sandwich plate repairs for more general applications, including use on non-classed structures, civil structures, onshore storage tanks, as well as in refineries. This standard practice may serve as a unified standard of steel sandwich plate repairs for all industry applications, where permitted.

Scope

This standard covers the methodology and guidelines for accomplishing structural repairs by using steel sandwich plate technology. It is mainly applied to steel structure repairs for damages from corrosion deterioration and mechanical damages. It can also be applied to repairs of aluminum structures.

This standard includes assessment, design, qualification, installation, and inspection of the repairs using steel sandwich plate technology.

This standard does not cover use of fiber reinforced plastics (FRP). The repair materials used include steel plates as face plates and elastomer as a core material.

Rationale

The steel sandwich plate repair technology provides an alternative to traditional hot work renewal repairs, especially where hot work is considered risky to the unit´s operation. The steel sandwich plate repair technology can be used to reinstate the integrity of the structure by utilizing a new steel plate bonded to the degraded existing steel structure using a core elastomer material. Figure 1 provides a schematic representation of a damaged structure repaired using sandwich plate. This sandwich plate repair method can also be used for modification or upgrading of the existing structures for reinforcement.

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(1) American Bureau of Shipping (ABS), 1701 City Plaza Drive, Spring, TX 77389, https://ww2.eagle.org/
(2) Lloyds Register (LR),71 Fenchurch Street, London, EC3M 4BS, UK, https://www.lr.org
(3) Det Norske Veritas (DNV), Thormøhlensgt. 49A, 5006 Bergen, Norway, https://www.dnv.com
(4) China Classification Society (CCS), CCS Mansion,9 Dongzhimen Nan Da Jie, Beijing, PRC, https://www.ccs.org.cn/ccswzen/