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Repair of Cracked Metallic Marine Structures with Smart Composite Patches

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Extended Abstract

Ships and offshore structures are occasionally damaged by rough waves and strong winds which cause many structural damages such as macroscopic cracks.

An increasingly novel technology for life extension of damaged marine structures is the use of bonded polymer composite patches for repair of these structures because of light weight, high strength, ease of fabrication, and excellent corrosion resistance. Adhesively bonded repairs are the most common types of repair carried out with conventional and composite structures. Repairs based on adhesively bonded fibre composite patches or reinforcements are more structurally efficient and much less damaging to the parent structure than standard repairs based on mechanically fastened metallic patches.

Investigation into the mechanical behavior and strength and durability of the patched repaired structures and also the crack growth behavior of the bonded patch repaired structures is at the top of agenda, especially for safety issues.

This paper, deals with the experimental study of mechanical behavior of an edge notched steel plate repaired by polymer composite and smart patches. The polymer composite patches are made of Kevlar/epoxy and glass/epoxy or combination of both, while the base metal is CK75 steel. The plate is single edge notched with constant length and the repair is done on both side of the notched plate. Four types of patches are considered according to their lay-ups. Tensile and bending tests are conducted on the specimens according to ASTM standards. Young's modulus, Ultimate Tensile/Bending Strength, Energy absorption, Specific Strength, and Specific Stiffness are used as comparison tools.

The results obtained are compared with the results for un-notched and un-repaired notched specimens. Patching has significant effect on mechanical properties of notched plate. The best patches in each loading case are reinforced with Nickel-Titanium (NiTi) shape memory wires and the repaired specimens with these smart patches again tested in tension, and three point bending loadings. Smart patches had more significant effect on the above behavior as compared to composite patches.