Design and Analysis of Blast Resistant RC Beams for Concrete Structures at Off-Site Oil & Gas Plants

***Salah Al-Jasmi*[1, a *], *Nur Farhayu Ariffin*[2, b], *Mazlan Abu Seman*[3, c]**

[1]Faculty of Civil Engineering Technology, Universiti Malaysia Pahang, Malaysia
[2]College of Engineering, Department of Civil Engineering, Universiti Malaysia Pahang, Malaysia
[3]College of Engineering, Department of Civil Engineering, Universiti Malaysia Pahang, Malaysia

ABSTRACT

The impact resistance of Reinforced Concrete (RC) beams, as the major structural load-bearing member, is an integral consideration in the design of concrete structures at the off-site of oil and gas pants against powerful dynamic loads. As a result, impact-resistant design is crucial for the maintenance, preservation, and safety of such structures. The RC beams' impact performance, on the other hand, remain unclear, and approaches for reinforcing RC structures at oil and gas plants to withstand impact loads are currently limited. This paper presents the Finite Element Analysis (FEA) used to simulate the behavior of Reinforced Concrete (RC) beams strengthened with Carbon Fiber Reinforced Polymer (CFRP) laminates. Five beams were modelled in FEA software. In those five beams, one beam was used as control beam without CFRP reinforcement, two beams were reinforced with single CFRP sheet, and the other two were reinforced with two CFRP sheets. Total deformation, von Misses stress, shear stress and principal strain were obtained and compared with the experimental results. The numerical simulation results agree well with the test findings reported in Neagoe's experimental study. The simulation results demonstrated that CFRP could indeed relieve high stress in impact unstable concrete, decrease beam body deformation, constrain crack development, and offer additional impact resistance. Under various impact load scenarios, CFRP can successfully restrain deformation. As a result, strengthening RC beams with CFRP is an efficient way to improve impact load resistance. Using computer software to design and simulate these elements was also much quicker and less costly. As a result, ANSYS can be used to model experimental beams. Finite element ANSYS software can also be used to validate experimental results.

KEYWORDS

Blast loads, finite element analysis, RC beam, gas explosion, hydrocarbon blast, CFRP strengthening, off-site facilities, concrete structures

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