EasyChair Preprint

№ 2786

Behaviour of Concrete Structure Subjected to Open Fire - State of Art

C. Aravindhan and S. Nayannathara

February 26, 2020

BEHAVIOUR OF CONCRETE STRUCTURE SUBJECTED TO OPEN FIRE – STATE OF ART

C. Aravindhan and S. Nayannathara

Abstract When the structure subjected to fire, they undergo deformation and results in spalling, cracking, final leads to the distortion of the structures. The study intensify to improve the prolong time failure of the structure which are subjected to fire outrage and apply the rehabilitation techniques to improve the life span of the damaged structure for prolonged time. The retrofitting is applied to in order to improve the brittle failure. In this project, the beam is considered for investigating purpose and used to examine the beam behaviour before and after exposing to the fire. The retrofitting techniques are applied over the beam and their compressive strength is computed. The comparative study is encountered between ahead and subsequently applying the technique.

Keywords Reinforced Concrete Structures · Retrofitting techniques · CFRP · Fiber Reinforced Polymer (FRP) · Rubberized Coir Fibre Sheets (RCFS)

C. Aravindhan (✉)
Assistant professor
Department of Civil Engineering, Bannari Amman Institute of Technology, Sathyamangalam 638401, TN, India
e-mail: aravindhanc@bitsathy.ac.in

S. Nayannathara
PG Student, Bannari Amman Institute of Technology , Sathyamangalam 638401, TN, India

1 Introduction

In the modern world, they are upgrading different technologies. The present trending and remarkable development in technologies may also leads to different challenges in the construction field. In this modern world, the fire disasters are arriving as a threat to structural buildings. The major constituents for fire are fuel, oxygen and heat. The fire calamities occurring in the building causes damage to the structural elements. The major reasons for these hazards are volatile materials, electrical equipments, house hold appliances and human transgressions. These rationales direct them to destruction of the structural building. This may also affect the life lines of living creatures and wealth losses.

2 Literature Review

2.1 Lilly grace murali et al., (2014) represents the comparative study case studies of four fire accidents occurred in the different places. The huge fire disasters occurred in case study, they have discussed about the planning of the building, represented the reason for the occurrence of the fire, materials that feed the fire to the next stages, failure of the structure, reasons behind the life losses and wealth losses and remedial measure for each building are also enumerated in the case study. The major aspect behind the failure of the structure is improper design of the buildings; the passive and active measurements are recommended for to avoid the failure of the structure.

2.2 J.Gopi Krishnan et al., the existing reinforced concrete structures are in need of repair or reconstruction, rehabilitation, because of deterioration due to various factors like corrosion, lack of detailing, failure of bonding between beam-column joints, increase in service loads, improper design and unexpected external lateral loads such as wind or seismic forces acting on a structure, environment and accident events etc., leading to cracking, spalling, loss of strength, deflection, etc. strengthening of existing reinforced concrete structures is necessary to obtain an expected life span and achieve specific requirements. the need for efficient rehabilitation and strengthening techniques of existing concrete structures has resulted in research and development of composite strengthening systems. recent experimental and analytical research have demonstrated that the use of composite materials for retrofitting existing structural components is more cost-effective and requires less effort and time than the traditional means. fiber reinforced polymer (FRP) composite has been accepted in the construction industry as a capable substitute for repairing and strengthening of rcc structures. Static load responses of all the beams under two-point load method have been evaluated in terms of flexural strength, crack observation, compositeness between CFRP fabric and concrete, and the associated failure modes. The deflections of the beams are decreased due to full wrapping technique around all the four facets of the beam. The flexural strength and ultimate load capacity of the beams enhanced due to external strengthening of beams.

2.3 Poorna Prasad Rao.O.L et al., This paper offers retrofitting of strengthened concrete beams using Rubberized coir fiber, a herbal laminate, inboth flexure and shear for that is subjected beneath two point loading. The essential aim of this look at is to rehabilitate the structurally deficient beam and to make it serviceable in each flexure and shear. The beams retrofitted with rubberized coir fibre sheets (RCFS) are used to make structure green and to repair stiffness and strength values greater than those of manage beams. Understanding the reaction of these components all through loading is important to the improvement of an overall efficient and safe shape. Formation of first cracks, RCFS debonding and onset of concrete crushing are as compared and discussed. Load–deflection conduct, failure modes and crack propagation patterns are studied notably. The presence of shear straps to enhance shear electricity has the twin gain of delaying debonding of RCFS sheets used for flexural strengthening. The check results confirmed that the stiffness of the RCFS retrofitted beams are significantly increased compared to the manage beams and additionally the deflection of retrofitted beams was decreased predominantly on the early levels of loading. The closing loads at failure of the specimen were extended. Instead of replacing the entire structure, it might be better to go for retrofitting.

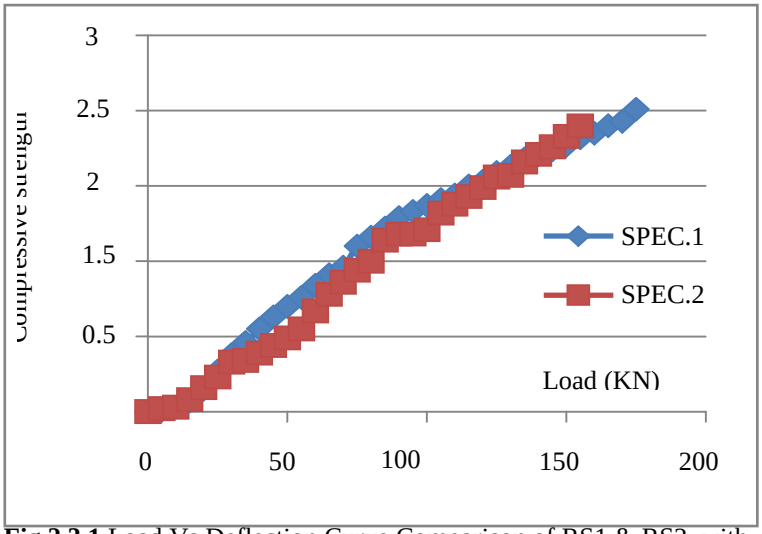

Fig 2.3.1 Load Vs Deflection Curve Comparison of RS1 & RS2 with Retrofitted Beam

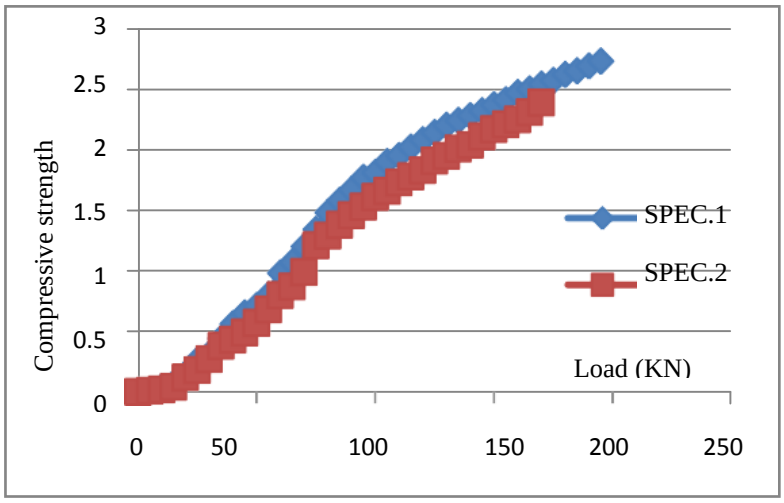

Fig 2.3.2 Load Vs Deflection Curve Comparison of RS1 & RS2 with Retrofitted Beam

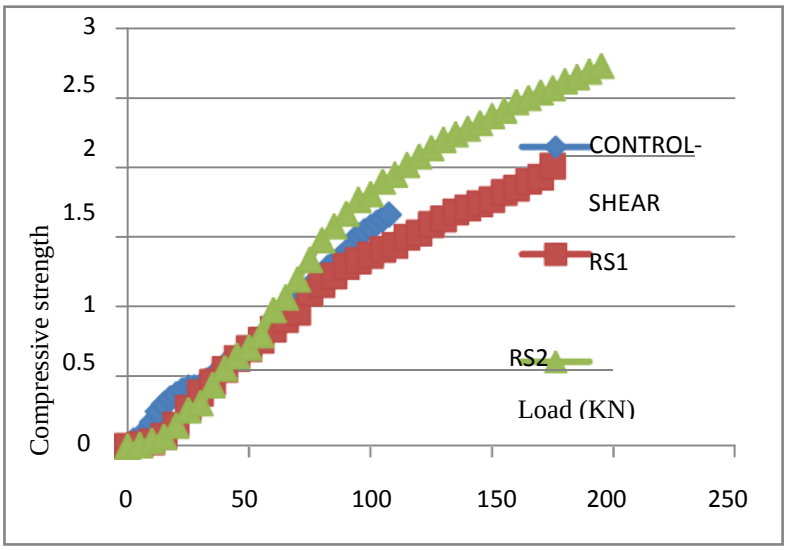

Fig 2.2 Load Vs Deflection Curve Comparison of RS1 & RS2 with Control Beam

2.4 LIU Ming et al.,(2013) this paper undergoes a study about three storeys industrial building occurred in January 2010. Reinforcement enlarging section method is enhanced to rectify the damage caused during fire causalities. Polymer mortar and gules CFRP are also adopted for strengthening the damaged structural elements. CFRP reinforcement is provided on each side of the column. Dealing with the ventures building harmed by fire can give us a decent reference of fixing the comparative enterprises building. The distinctive harmed individuals were reinforced with various support strategies, for model shot solid support strategy, utilizing CFRP sheets fortification method, embedded steel bars with enlarger segment supportive technique and so forth. The use of an assortment of support strategies arrive at load-conveying limit prerequisite and expand less asserts.

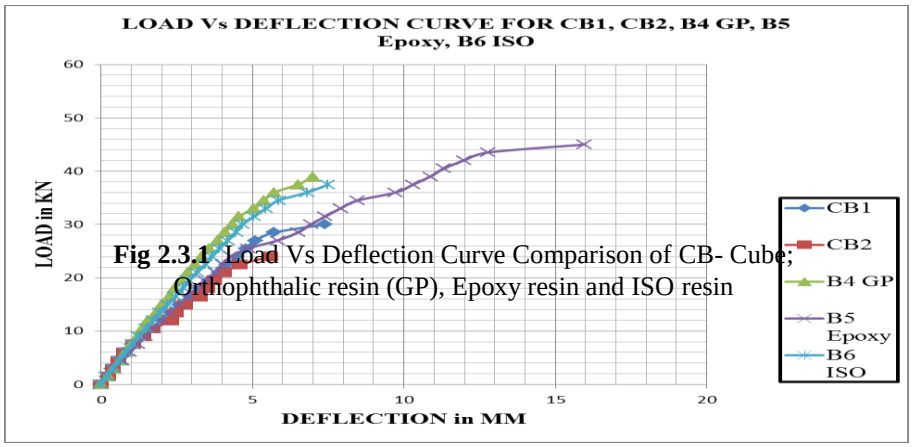

Fig 2.3.1 Load Vs Deflection Curve Comparison of CB- Cube; Orthophthalic resin (GP), Epoxy resin and ISO resin

Fig 2.4.1 Load Vs Deflection Curve Comparison of CB- Cube; Orthophthalic resin (GP), Epoxy resin and ISO resin

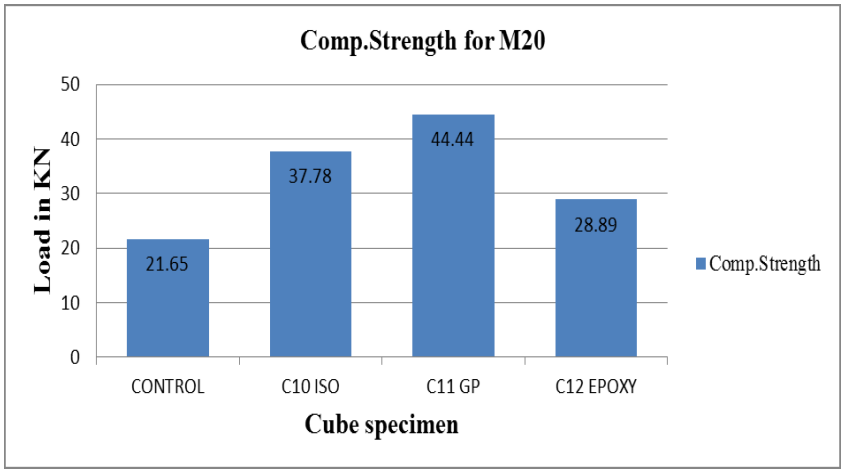

Fig 2.4.2 Compression Strength for M20 in CB- Cube; Orthophthalic resin (GP), Epoxy resin and ISO resin

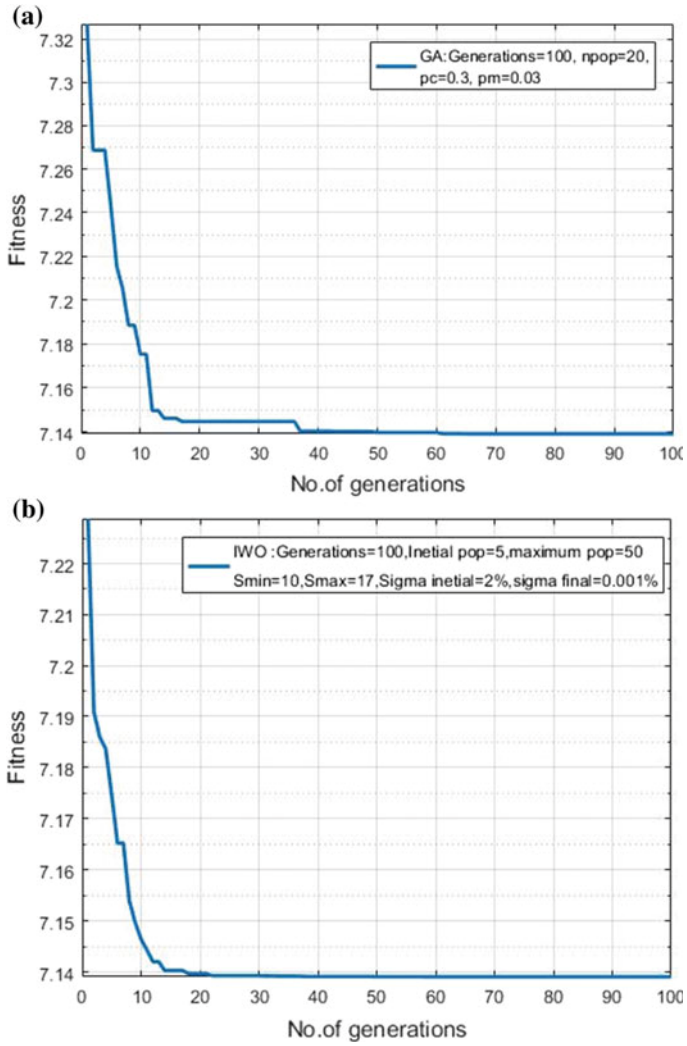

Fig. 1 Convergence graphs for **a** GA and **b** IWO algorithms

Table 2 Optimal values of the process parameters and their responses

Optimization method	Welding current (I)	Welding speed (N)	Plasma gas flow rate (G)	Bead width (BW) in mm	Bead height (BH) in mm
GA	86.001	300.00	2.296	5.600	1.656
IWO	86.049	300.00	2.298	5.666	1.620

4 Conclusions

In the present work, an attempt has been made to optimize the bead profile of the plasma arc welded BoP weld geometry of Inconel 617 plates using two non-traditional optimization techniques, namely GA and IWO. The regression equations obtained with the help of the response surface methodology are used to establish the objective functions for the study. It is observed that both the optimization methods are seen to perform with reasonably good accuracy. But the convergence rate of IWO is faster when are compared with GA. The results of optimization also show that IWO algorithm is found to perform better than GA in terms of both the bead width and bead height of the BoP weld.

References

1. Babu KK, Panneerselvam K, Sathiya P, Haq AN, Sundarrajan S, Mastanaiah P, Murthy CS (2018) Parameter optimization of friction stir welding of cryorolled AA2219 alloy using artificial neural network modeling with genetic algorithm. Int J Adv Manuf Technol 94(9–12):3117–3129
2. Nagaraju S, Vasantharaja P, Chandrasekhar N, Vasudevan M, Jayakumar T (2016) Optimization of welding process parameters for 9Cr-1Mo steel using RSM and GA. Mater Manuf Processes 31(3):319–327
3. Pal S, Pal SK, Samantaray AK (2010) Determination of optimal pulse metal inert gas welding parameters with a neuro-GA technique. Mater Manuf Processes 25(7):606–615
4. Satpathy MP, Moharana BR, Dewangan S, Sahoo SK (2015) Modeling and optimization of ultrasonic metal welding on dissimilar sheets using fuzzy based genetic algorithm approach. Eng Sci Technol Int J 18(4):634–647
5. Kanigalpula PKC, Pratihar DK, Jha MN, Derose J, Bapat AV, Pal AR (2016) Experimental investigations, input-output modeling and optimization for electron beam welding of Cu-Cr-Zr alloy plates. Int J Adv Manuf Technol 85(1–4):711–726
6. Vasudevan M, Bhaduri AK, Raj B, Rao KP (2007) Genetic-algorithm-based computational models for optimizing the process parameters of A-TIG welding to achieve target bead geometry in type 304 L (N) and 316 L (N) stainless steels. Mater Manuf Processes 22(5):641–649
7. Dey V, Pratihar DK, Datta GL, Jha MN, Saha TK, Bapat AV (2009) Optimization of bead geometry in electron beam welding using a genetic algorithm. J Mater Process Technol 209(3):1151–1157
8. Kim D, Rhee S, Park H (2002) Modelling and optimization of a GMA welding process by genetic algorithm and response surface methodology. Int J Prod Res 40(7):1699–1711
9. Meran C (2006) Prediction of the optimized welding parameters for the joined brass plates using genetic algorithm. Mater Des 27(5):356–363
10. Correia DS, Gonçalves CV, da Cunha Jr SS, Ferraresi VA (2005) Comparison between genetic algorithms and response surface methodology in GMAW welding optimization. J Mater Process Technol 160(1):70–76
11. Mehrabian AR, Lucas C (2006) A novel numerical optimization algorithm inspired from weed colonization. Ecol Inform 1(4):355–366
12. Pourjafari E, Mojallali H (2012) Solving nonlinear equations systems with a new approach based on invasive weed optimization algorithm and clustering. Swarm Evol Comput 4:33–43
13. Dhinakaran V, Shanmugam NS, Sankaranarayanasamy K (2017) Experimental investigation and numerical simulation of weld bead geometry and temperature distribution during plasma arc welding of thin Ti-6Al-4V sheets. J Strain Anal Eng Des

52(1):30–44

14. Dhinakaran V, Shanmugam NS, Sankaranarayanasamy K (2017) Some studies on temperature field during plasma arc welding of thin titanium alloy sheets using parabolic Gaussian heat source model. Proc Inst Mech Eng Part C J Mech Eng Sci 231(4):695–711
15. Pratihar DK (2014) Soft computing: fundamentals and applications. Alpha Science Interna- tional Ltd., Oxford, U.K