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A Computational Model for Failure Analysis of High-Performance Fiber Reinforced Concrete (HPFRC) Displays Using VIKOR Method

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Abstract: *Due to its superior physical qualities versus plain concrete, "fibre reinforced concrete (FRC)" has seen a rise in popularity in recent years. Fire resistance is an inherent challenge when employing FRC in civil structures and other infrastructure that is crucial strategically. The fire resistance of FRC is influenced by different fibre kinds, fibre dosages, and cementitious matrix designs, per the results of the currently available tests. This article offers a thorough analysis of current studies on FRC's firefighting. We cover the creep, shear failure, compressive, elastic modulus, percentage of elongation, hardness, and mass loss heat mechanical and physical properties of steel fibre reinforced concrete, polypropylene "fibre reinforced concrete", and hybrid fibre reinforced concrete in detail. Also, a comparison and summary of the current dynamic simulation for FRC residual attributes are provided. It establishes a rating list of compromises depending on how closely they adhere to the ideal answer. Comprehensive VIKOR, fuzzy VIKOR, modified VIKOR, and intervals VIKOR approaches, in addition to the VIKOR method, have all been established according to the kind of choice problem and the needs of the decision maker. Based on two example instances, this study analyses the ranking achievement of the initial VIKOR approach and its five modifications. The fuzzy VIKOR approach should be chosen when the periodic VIKOR method doesn't quite perform well and the knowledge in the decision situation is ambiguous. Nonetheless, the classic VIKOR is the ideal way to solve any choice problem without needlessly complicating the related mathematical procedures. The alternatives are Normal concrete, Steel fibres concrete, Macro-polypropylene fibres concrete and Micro-polypropylene fibres concrete. The evaluation parameters are Compressive strength (MPa), Tensile strength (MPa) and Tensile strength in relation to compressive strength (%). Normal concrete is got first rank, Steel fibres concrete is got third rank, Macro-polypropylene fibres concrete is got fourth rank and Micro-polypropylene fibres concrete is second rank.*

Keywords *Fibre Reinforced Concrete, Numerical Influence, Alkaline Pore Water, MCDM.*

1. INTRODUCTION

The requirement for studying FRC's behaviour under fatigue loading grows as a result of its utilisation in engineering disciplines. Applications for pavements such as airports, roads, steel trusses, and industrial facilities that experience heavy cyclic loads during their useful lifetime are typical uses for FRC. The fatigue characteristics of FRC have a significant role in performance and design in many different application areas. Nevertheless, based on all relevant factors, such as the form of loading stage, strain rates, and fibre properties, there appears to be a knowledge gap about the fatigue behaviour of FRC. The behavior of concrete members during bending fatigue is generally reported to be greatly improved by the addition of steel. The amount of improvement in FRC's fatigue resistance can be anticipated to vary depending on the volume, kind, and shape of the fibres. These characteristics can be combined in numerous ways to provide distinct fatigue properties. While there is little data on the numerical influence and relative significance of fibre parameters such length, anamorphic widescreen, and fibre type, there does not appear to be a full assessment of the possible advantages of fibre addition at this time. In general, the incorporation of fibres raised the level of complexity of the research and gave a new aspect to the analysis of fatigue with concrete. A composite material called steel fibre reinforced concrete (SFRC) blends a cementitious matrix with discontinuous reinforcement made of randomly positioned steel fibres in the matrix. The term "SFRC" in this work refers to mix designs using Portland cement binders that have mix percentages and elasticity material performance similar to those of regular concrete. Because plain and fibre concrete have different properties, the techniques suggested in the Code of Practice for estimating the final shear strength of conventional beams cannot be used to calculate the maximum shear strength of fibre concrete beams. The shear resistance of concrete rectangle beam and steel fibre mortar have a lot of experimental data accessible. Some earlier researchers have also proposed predictive formulae for the strength properties of "fiber-reinforced concrete" beams. On testing of a particular kind of steel strand, some of these formulae are typically based. It is obvious that a general equation for shear strength is required if steel fibres are to be employed in actual structural components. As an MCDM technique, it VIKOR method was created to address issues involving incompatible or contradictory criteria. Reconciliation is regarded as appropriate for resolving disputes. The VIKOR approach is frequently employed in MCA. When resolving multi-criteria optimisation issues, there are a few issues. The objective of this research is to enhance the numerical process and remove some of the challenges that the conventional VIKOR method faces when attempting to solve some particular problems in order to maximize the productivity of the VIKOR approach. The modified VIKOR technique, which may be used to environmental management, was initially implemented in the context of public education. There is a presented extended VIKOR approach. The VIKOR approach will be justified by the background, integration, normalisation, and DM's preferred evaluation of it. In order to advance overall state of the art in MCDM, the TOPSIS, PROMETHEE, and ELECTRE methods are compared to the VIKOR approach. An example is used to demonstrate how the VIKOR approach is used, and the findings are compared with those from various methods, adding to the practise of MCDM.

2. FIBRE REINFORCED CONCRETE

The response of concrete mixtures under tensile loading is tractor trailer. Mechanical qualities including ultimate strength, ductility, and latent load carrying capacity are all improved by the addition of fibres. Here, we concentrate on the mesoscopic examination of relatively short, thin fibre reinforced concrete. For instance, the ratio between the transverse structure compared and the fibre length is roughly in the order of magnitude. high-performance fiber-reinforced concrete (HPFRC) displays strain-hardening behaviour and dispersed cracking, plain cement (C) and "fiber-reinforced concrete (FRC)" exhibit strain-softening behaviour coupled with localised cracking. These phenomena should be accurately reflected in a model created for the study and design of fibre reinforced cementitious composites in a way that makes a direct connection to the underlaying processes. Each component of the matrix takes some of the strain off as a fresh concrete is dynamically agitated. As a polymeric substance, synthetic fibre has the ability to absorb energy due to its viscous energy dissipation properties. FRC composites is not a suitable viscoelastic material since it often has a low figure of fibres, despite the fact that its synthetic fibres are elastic and also have higher dampening rates than concrete. Due to cyclic power losses in the matrix brought on by strain cycling at fibre ends or synthetic fibres, effective damping may not be necessary in certain circumstances. Debonding between the fibres and the matrix, which can happen under specific stress and strain circumstances around the fibres, may be the cause of this. When there is alternating load, this may result in power loss. When subjected to dynamic pressure and flexure, concrete's microcracks can open and close, making it a fragile material. These cracks have the potential to cause the matrices to rub on the surface of the fibre, resulting in energy waste during vibration and raising the ratio for FRCs. The impact of steel fibre insertion on the dynamic characteristics of FRC reveals that while the static modulus of elasticity is roughly unaltered, the damping characteristic of wet-cured FRC is over 50% greater when compared to plain concrete. Both for FRC and bare concrete, logarithmic shrinkage was dramatically reduced increasing age and drying. For many customers, the rheology and flow of fibre concrete are of great consequence. So, the simplicity of installing fibre concrete directly affects how the fibres are arranged inside the structure of the material and, as a result, how well the structural condition of hardened concrete will hold up under load. As was already mentioned, the biochemistry of the cementitious matrix modifies the distribution of fibres. The fibres have superior mobility inside the cementitious matrix and are more easily able to migrate and orient when subjected to light external vibrations in a liquid concrete, which is a concrete with such a low yield stress. In contrast, there is a chance of fibre balls forming in found that the strength with a greater yield stress; this limits fibre mobility and may even obstruct it. A consistent redistribution of fibres is not possible in this situation. The reduction in the number of fibres traversing a specific area is a direct result of this anisotropy. Nevertheless, concrete reinforced with jute, elephant grass, and straw natural fibres has very little hardness or energy absorption ability. Experimental research has been done on the mechanical and physical characteristics of jute fibre reinforced concrete. They claimed that as the fibre content rises, flexural stiffness and strength do as well. Notwithstanding all the aforementioned benefits, using natural fibres as concrete reinforcement raises several significant issues. They include a wide range of fibre characteristics, a high capacity for absorbing moisture, and the key issue is the resilience of the fibres in the alkaline cement matrix environment. As lignin and hemicellulose fibres dissolve in alkaline pore water, the fibres in the cement matrix deteriorate. The composite may become weaker and less resilient as it ages. The longevity of natural FRCs has been the subject of numerous experimental experiments. There are two approaches to increase the durability of composites, according to broad consensus. One is to use physically or chemically agents to change the fibres' surface. The first is to alter the matrix's composition by include pozzolanic substances that lower the matrix's alkalinity. Claremund et al. recently proposed pre-hornification of fibres and demonstrated that pre-treating cotton linters and softwood kraft pulp had positive impacts on the dynamic efficiency and long-term reliability of composites supplemented with these fibres. Experimental research on jute fibre endurance in an alkaline cement matrix environment was done by Merda et al. Finding a more potent preservation chemical was the goal in order to slow down the fibres' long-term loss of tensile strength and water absorption. Linseed oil, flaxseed oil with catalysis, beeswax, and beeswax are among the preservatives used to saturate the fibres and give resistance properties. A better defence against a highly alkaline with less loss of fibre tensile strength was seen in linseed oil with catalyst. Despite all the benefits of using natural fibres as reinforcement, this is still a new and difficult concept that requires more research. In this study, fibres from commonly accessible and reasonably priced plants in European nations were chosen in order to explore the impact of fibres on the elastic modulus of concrete. Jute, elephant grass, and wheat straw fibres were incorporated into the concrete matrix, and Tschegg's wedged split test (WST) method was used to determine the composites' single fracture toughness

3. MATERIALS AND METHOD

The proposed entire content of VIKOR is capable of helping rank and choose the best material after determining the material selection criteria and compiling a list of materials for a specific engineering application. Widely used, the VIKOR approach was created for multi-criteria optimisation in complex systems. It focuses on comparing and choosing amongst options that have conflicting and dissimilar unit criteria. The VIKOR approach ranks compromises based on how closely they resemble the best option and defines a compromise as an agreement reached through shared preferences. To eliminate numerical issues when using the conventional VIKOR approach to solve problems, Chang created a modified version. In this part, a novel normalising method is used to modify modified VIKOR. The benefit of recommending a thorough and reasonable model to the standard VIKOR is the fact that it addresses all MCDM objectives. The crucial VIKOR problem is also solved by the suggested approach, as proved by the work of Huang et al. The Analytical Hierarchy process (ahp Method (Analytic hierarchy process), Digital Logic Approach (DL), and modified version are three pairwise comparison methods that can be used to get subjective weights from the suggested model. Entropy or the standard deviation approach can be employed for objective weighting in the interim. The ranging from 1 alternative scale Rao introduced in subject selection can also be used to systematically translate qualitative qualities (linguistic words) into their equivalent fuzzy integers. The following is a step-by-step explanation of the suggested detailed version of VIKOR. The suggested method is shown in a flowchart. In addition to the aforementioned uses for the traditional VIKOR approach, numerous academics have refined the VIKOR method. Huang et al. suggested a new version of the VIKOR model that characterizes regret as just an involuntary usage and is based on the theory of regret. To prevent numerical issues while using the conventional VIKOR approach to solve issues, Chang created a modified VIKOR method. Leo et al. updated the VIKOR approach for domestic optimisation by substituting one criterion for each alternative for a paying attention to the shared criterion for all alternatives. They also offered a mechanism to score the unmodified alternative intervals. Taiwan's air service quality. Jahan et al. enhanced the VIKOR method to use a novel normalising method because it is occasionally beneficial to approach target values. AHP's fuzzy comparison matrices were used to determine the weights of the chosen criteria in Gaya and Kahraman's integrated VIKOR-AHP technique. Since ambiguity occurs frequently in daily life, the traditional VIKOR technique has been expanded in a number of ways to address it. Oprikovic created the fuzzy VIKOR approach, which resolves issues in a fuzzy situation in which both the criteria and the weight may be fuzzy sets, for such fuzzy MCDM problem involving conflicting and mismatched criteria. Triangular fuzzy integers were employed in his simulation to represent erroneous estimate the number. Chen and Wang chose the best vendors and suppliers for outsourcing information systems and technologies using the fuzzy VIKOR approach. Shemshadi et al. suggested the fuzzy VIKOR technique, which derived and tried to apply the objective weights to the criteria premised on the Entropy concept, and afterwards applied the method to the issue of selecting suppliers in the scenario where people who make decisions' opinions are depicted as trapezoidal fuzzy numbers. Chou and Cheng created a blend of the hazy analytical hierarchy technique (FANP) and soft VIKOR together to assess the effectiveness of professional accounting businesses' websites. The approach was expanded to include interval patterns by Sayadi et al. Guo presented a new MCDM approach that combines the VIKOR technique, Gray Relationship Analysis (GRA), and interval-valued fuzzy sets. He then used this approach to assess the quality of service of Chinese pass passenger airlines using customer surveys. In order to address MCDM situations where weights of the requirements as well as the evaluation of the choices were taken as a triangle fuzzy set of intuition, Devi modified the VIKOR approach to the fuzzy soft context. The robot choice problem was used to apply this expanded methodology. Park and co. This same VIKOR method is expanded to the increment intuitionistic fuzzy surroundings of cross collective decision, whereby the knowledge of the set of criteria weight training is only partially known as well as all preference data supplied by the decision - making is symbolised as an intermission intuitionistic fuzzy amount.

4. RESULTS AND DISCUSSION

TABLE 1. Fiber Reinforced Concrete Determination of best and worst value

	Compressive strength (MPa)	Tensile strength (MPa)	Tensile strength in relation to compressive strength (%)
Normal concrete	58.4	3.42	5.86
Steel fibres concrete	57.7	6.78	11.75
Macro-polypropylene fibres concrete	55.3	5.63	10.18
Micro-polypropylene fibres concrete	58.2	3.7	6.36
Best	55.3	6.78	11.75
worst	58.4	3.42	5.86

Shows the table 1. Fibre Reinforced Concrete for VIKOR method. The alternatives are Normal concrete, Steel fibres concrete, Macro-polypropylene fibres concrete and Micro-polypropylene fibres concrete. The evaluation parameters are Compressive strength (MPa), Tensile strength (MPa) and Tensile strength in relation to compressive strength (%) is the Best and Worst Value.

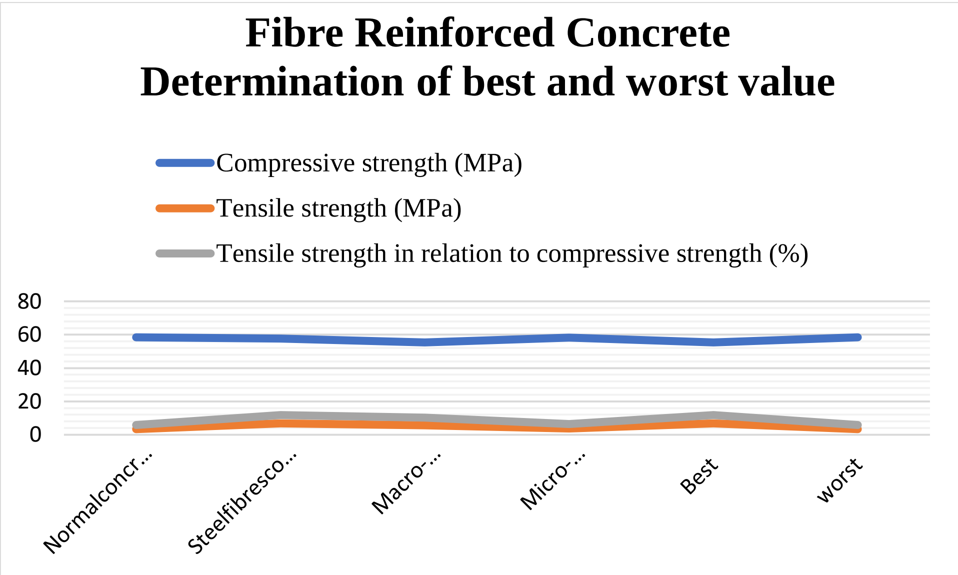

FIGURE 1. Fiber Reinforced Concrete Determination of best and worst value

Shows the figure 1. Fibre Reinforced Concrete for VIKOR method. The alternatives are Normal concrete, Steel fibres concrete, Macro-polypropylene fibres concrete and Micro-polypropylene fibres concrete. The evaluation parameters are Compressive strength (MPa), Tensile strength (MPa) and Tensile strength in relation to compressive strength (%) is the Best and Worst Value.

TABLE 2. Calculation of Sj and Rj

	Calculation of Sj and Rj				
				Sj	Rj
Normal concrete	0.25	0.25	0.25	0.75	0.25
Steel fibres concrete	0.193548	0	0	0.193548	0.193548
Macro-polypropylene fibres concrete	0	0.085565	0.066638	0.152204	0.085565
Micro-polypropylene fibres concrete	0.233871	0.229167	0.228778	0.691815	0.233871

Table 2 shows the calculation Sj and Rj is the sum of Normalization of the tabulation 1 which is calculated from the Determination of best and worst value.

TABLE 3. Final Result of Calculation Qj and Rank

	Sj	Rj	Qj	Rank
Normal concrete	0.75	0.25	1	1
Steel fibres concrete	0.193548	0.193548	0.362927	3
Macro-polypropylene fibres concrete	0.152204	0.085565	0	4
Micro-polypropylene fibres concrete	0.691815	0.233871	0.90229	2

Table 3 shows the Final Result of Calculation Qj calculated from the sum of the calculation from the Sj and Rj from the Qj value the rank is taken. first one Sj maximum value = 0.152203846 and minimum value = 0.75. Rj maximum value = 0.085565476 and minimum value = 0.25. Normal concrete is got first rank and Macro-polypropylene fibres concrete is lowest rank.

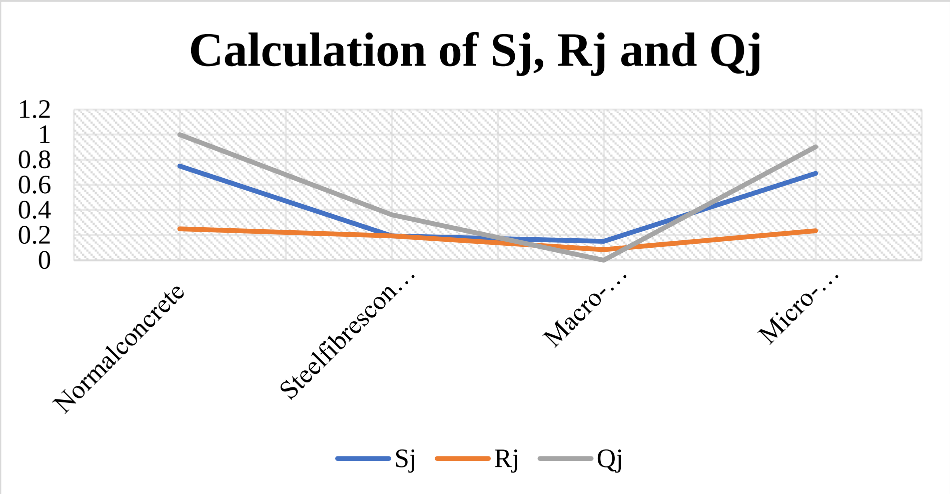

FIGURE 2. Calculation of Sj, Rj and Qj

Shows the figure 2 Calculation of Sj, Rj and Qj calculated from the sum of the calculation from the Sj and Rj from the Qj value the rank is taken. first one Sj maximum value = 0.152203846 and minimum value = 0.75. Rj maximum value = 0.085565476 and minimum value = 0.25.

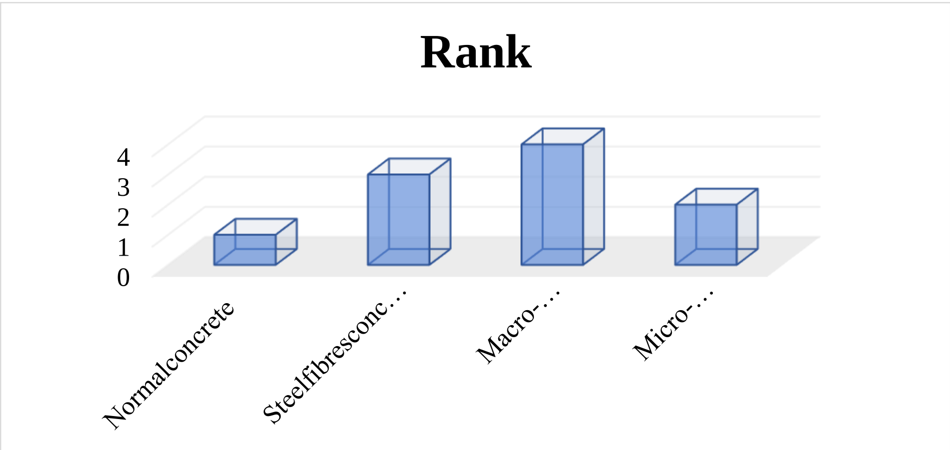

FIGURE 3. Final result of rank

Shows the figure 3 Fibre Reinforced Concrete using VIKOR method. Normal concrete is got first rank, Steel fibres concrete is got third rank, Macro-polypropylene fibres concrete is got fourth rank and Micro-polypropylene fibres concrete is second rank

5. CONCLUSION

The proposed simplified methods for materials have been thoroughly explored in this study, and they are offered in the linear perspective for assessing the residual axial tension strength that is mostly caused by fibre pull-out. Their dependability and shortcomings reflect diverse FRC materials with various matrices, steel fibre types, and fibre contents. The consolidated categorization of FRC composites according to the three-point bending moment, which has previously been recognised as a European standard, served as the basis for the design guidelines. The inclusion of this material in the next FIB model code represents a significant advancement in the FRC's research and may pave the way for the future development of structure rules in FRC elements in national or Eurocodes codes. In actuality, designers may only employ new structural materials with ease when building codes contain design guidelines. The main benefits of FRC are that the encouragement (fibres) distributed throughout the structural components increase resistance to pervasive tensile stresses and ensure reassurance even in huge concrete enclosures, frequently for fire resistance or longevity issues or at the edges of structural components. Despite the fact that information about FRC has grown significantly over the past ten years, additional research is still required to validate and enhance the suggested design rules, to look into the long-term behaviour of various FRCs, and to address other unresolved concerns. Also, a brand-new FRC generation is about to hit the market. To simultaneously optimise various structural qualities, they are built using a "cocktail" of various fibre kinds. Dora suggested a deliberately ambiguous set in these situations. A reluctant fuzzy set, where each requirement is given as a specified cautious fuzzy numbers based on the views of the decision makers, is particularly helpful in avoiding such issues. As a result, we expand the TOPSIS method and VIKOR method concepts to create an algorithm for handling non-hesitant fuzzy elements in MADM issues. To handle MCDM issues with hesitant fuzzy information, we design the E-VIKOR approach and the TOPSIS method. The developed E-VIKOR method & TOPSIS method's ideas and steps are then discussed in this study. The implementation of the E-VIKOR approach is demonstrated numerically, and the output of the Topsis was contrasted. We have basically illustrated the change trends of a results acquired by the E-VIKOR approach with increasing weight through an exemplary case. Normal concrete is got first rank and Macro-polypropylene fibres concrete is got lowest rank.

PREFERENCES

[1]. Chang, Chia-Ling. "A modified VIKOR method for multiple criteria analysis." Environmental monitoring and assessment 168 (2010): 339-344.

[2]. Madhusudhan Dasari sreeramulu, “Sensitive Analysis of Natural Language Processing Using for MOORA Method”, Computer Science, Engineering and Technology, 1(1), March 2023, 46-53.

[3]. Verma, Pradeep. "Sales of Medical Devices–SAP Supply Chain." *International Journal of Computer Trends and Technology* 70, no. 9 (2022): 6-12.

[4]. Prabakaran Nanjundan, M. Ramachandran, Ramya Sharma, Sathiyaraj Chinnasamy, "A Reappraisal of the Osteoarticular Manifestations of Psoriasis Using the WSM Method", Journal on Applied and Chemical Physics 2(4), December 2023, 10-17.

[5]. Radtke, F. K. F., A. Simone, and L. J. Sluys. "A computational model for failure analysis of fibre reinforced concrete with discrete treatment of fibres." Engineering fracture mechanics 77, no. 4 (2010): 597-620.

[6]. Wu, Heyang, Xiaoshan Lin, and Annan Zhou. "A review of mechanical properties of fibre reinforced concrete at elevated temperatures." Cement and Concrete Research 135 (2020): 106117.

[7]. Lee, M. K., and B. I. G. Barr. "An overview of the fatigue behaviour of plain and fibre reinforced concrete." Cement and Concrete Composites 26, no. 4 (2004): 299-305.

[8]. Inaganti Rambabu, “Preserving Patient Privacy: A Focus on Cyber Security in Healthcare”, International Journal of Emerging Technologies and Innovative Research, 10(10), d218-d222.

[9]. Barnett, Stephanie J., Jean-Francois Lataste, Tony Parry, Steve G. Millard, and Marios N. Soutsos. "Assessment of fibre orientation in ultra high-performance fibre reinforced concrete and its effect on flexural strength." Materials and Structures 43 (2010): 1009-1023.

[10]. Madhusudhan Dasari sreeramulu, “Optimizing Cloud Computing Networks in Information Security Controls using COPRAS Method”, Computer Science, Engineering and Technology 1(2), 2023, 42-54.

[11]. Murthy, Ashwin Narasimha, Souptik Sen, and Ramesh Krishnamaneni. "The role of supervised learning in enhancing diagnostic accuracy of neurodegenerative diseases." *International Journal of Advanced Research in Engineering and Technology (IJARET)* 11, no. 8 (2020): 1063-1076.
[12]. Dr. Abhay Kothari Neha Bharani, “Software complexity measurement using various techniques of neural network” Maharaja Sayajirao University of Baroda, 55, 2022.
[13]. Ramya Sharma, M. Ramachandran, Vimala Saravanan, Prabakaran Nanjundan, "Feasibility Analysis of Power Generation from Internal Combustion Engine (ICE) Using EDAS Method", R EST Journal on Advances in Mechanical Engineering, 2(4), December 2023, 8-17.
[14]. Saidani, Messaoud, Danah Saraireh, and Michael Gerges. "Behaviour of different types of fibre reinforced concrete without admixture." Engineering Structures 113 (2016): 328-334.
[15]. Sheela, Thangaraj, and Senthil Kumar Sadasivam. "Dye degradation potential and its degradative enzymes synthesis of Bacillus cereus SKB12 isolated from a textile industrial effluent." (2020): 42-46.
[16]. Marcos-Meson, Victor, Alexander Michel, Anders Solgaard, Gregor Fischer, Carola Edvardsen, and Torben Lund Skovhus. "Corrosion resistance of steel fibre reinforced concrete-A literature review." Cement and Concrete Research 103 (2018): 1-20.
[17]. Khan, Mehran, Mingli Cao, and Majid Ali. "Cracking behaviour and constitutive modelling of hybrid fibre reinforced concrete." Journal of Building Engineering 30 (2020): 101272.
[18]. Lau, A., and M. Anson. "Effect of high temperatures on high performance steel fibre reinforced concrete." Cement and concrete research 36, no. 9 (2006): 1698-1707.
[19]. Madhusudhan Dasari sreeramulu, “Analysis of Wireless Security and Networks using COPRAS Method” REST Journal on Data Analytics and Artificial Intelligence 2(4), December 2023, 32-41.
[20]. Noushini, Amin, Bijan Samali, and Kirk Vessalas. "Effect of polyvinyl alcohol (PVA) fibre on dynamic and material properties of fibre reinforced concrete." Construction and Building Materials 49 (2013): 374-383.
[21]. Al-Ta'an, S. A., and J. R. Al-Feel. "Evaluation of shear strength of fibre-reinforced concrete beams." Cement and Concrete Composites 12, no. 2 (1990): 87-94.
[22]. Senthil Kumar Sadasivam Baby Jooju , Sheela Thangaraj, “Degradation Potential and Enzyme Characterization of Aspergillus Flavus SKF8 Isolated from a Textile Industrial Effluent against Reactive Yellow 145”, Applied Ecology and Environmental Sciences, 10(6), 2022, 382-387.
[23]. Sen, Souptik, Ramesh Krishnamaneni, and Ashwin Narasimha Murthy. "THE ROLE OF MACHINE LEARNING IN ENHANCING SLEEP STAGE DETECTION ACCURACY WITH SINGLE-CHANNEL EEG." (2021).
[24]. Elliott, K. S., C. H. Peaston, and Kevin A. Paine. "Experimental and theoretical investigation of the shear resistance of steel fibre reinforced prestressed concrete X-beams—Part II: Theoretical analysis and comparison with experiments." Materials and Structures 35 (2002): 528-535.
[25]. Wang, Nianzhi, Sidney Mindess, and Keith Ko. "Fibre reinforced concrete beams under impact loading." Cement and concrete research 26, no. 3 (1996): 363-376.
[26]. Inaganti Rambabu, Yalavarthy Sreekanth, “Innovative Solutions: AI-Enabled Medical Devices and Digital Twin Technology Shaping Future Healthcare”, INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS, 11(12), 2023, e497-e506.
[27]. Bharani, Neha, and Abhay Kothari. "Tools for analysis of various static software complexities for mat lab code." Turkish Online Journal of Qualitative Inquiry 12, no. 6 (2021).
[28]. Verma, Pradeep. "Effective Execution of Mergers and Acquisitions for IT Supply Chain." *International Journal of Computer Trends and Technology* 70, no. 7 (2022): 8-10.
[29]. Di Prisco, Marco, Giovanni Plizzari, and Lucie Vandewalle. "Fibre reinforced concrete: new design perspectives." Materials and structures 42 (2009): 1261-1281.
[30]. Logeshwaran, J., Venkata Ashok K. Gorantla, Venkataramaiah Gude, and Bhargavi Gorantla. "The Smart Performance Analysis of Cyber Security Issues in Crypto Currency Using Blockchain." In *2023 6th International Conference on Contemporary Computing and Informatics (IC3I)*, vol. 6, pp. 2235-2241. IEEE, 2023.
[31]. di Prisco, Marco, Matteo Colombo, and Daniele Dozio. "Fibre-reinforced concrete in fib Model Code 2010: principles, models and test validation." Structural Concrete 14, no. 4 (2013): 342-361.
[32]. Soutsos, M. N., T. T. Le, and A. P. Lampropoulos. "Flexural performance of fibre reinforced concrete made with steel and synthetic fibres." Construction and building materials 36 (2012): 704-710.
[33]. Komloš, K., B. Babal, and T. Nürnbergerová. "Hybrid fibre-reinforced concrete under repeated loading." Nuclear Engineering and Design 156, no. 1-2 (1995): 195-200.
[34]. Liao, Huchang, Zeshui Xu, and Xiao-Jun Zeng. "Hesitant fuzzy linguistic VIKOR method and its application in qualitative multiple criteria decision making." IEEE Transactions on Fuzzy Systems 23, no. 5 (2014): 1343-1355.
[35]. Chang, Tsung-Han. "Fuzzy VIKOR method: A case study of the hospital service evaluation in Taiwan." Information Sciences 271 (2014): 196-212.

[36]. Devi, Kavita. "Extension of VIKOR method in intuitionistic fuzzy environment for robot selection." Expert Systems with Applications 38, no. 11 (2011): 14163-14168.
[37]. Ju, Yanbing, and Aihua Wang. "Extension of VIKOR method for multi-criteria group decision making problem with linguistic information." Applied Mathematical Modelling 37, no. 5 (2013): 3112-3125.
[38]. Sayadi, Mohammad Kazem, Majeed Heydari, and Kamran Shahanaghi. "Extension of VIKOR method for decision making problem with interval numbers." Applied Mathematical Modelling 33, no. 5 (2009): 2257-2262.
[39]. Zhang, Nian, and Guiwu Wei. "Extension of VIKOR method for decision making problem based on hesitant fuzzy set." Applied Mathematical Modelling 37, no. 7 (2013): 4938-4947.
[40]. Vahdani, Behnam, Hasan Hadipour, Jamshid Salehi Sadaghiani, and Maghsoud Amiri. "Extension of VIKOR method based on interval-valued fuzzy sets." The International Journal of Advanced Manufacturing Technology 47 (2010): 1231-1239.
[41]. Bhargavi Gorantla, Sreenath Devineni, “Harnessing AI for Optimized Decision-Making: A COPRAS Analysis”, REST Journal on Data Analytics and Artificial Intelligence, 2(3), 2023, 70-77.
[42]. Kim, Jong Hyen, and Byeong Seok Ahn. "Extended VIKOR method using incomplete criteria weights." Expert Systems with Applications 126 (2019): 124-132.
[43]. Opricovic, Serafim, and Gwo-Hshiung Tzeng. "Extended VIKOR method in comparison with outranking methods." European journal of operational research 178, no. 2 (2007): 514-529.
[44]. Chatterjee, P., and Sh Chakraborty. "A comparative analysis of VIKOR method and its variants." Decision Science Letters 5, no. 4 (2016): 469-486.
[45]. Jahan, Ali, Faizal Mustapha, Md Yusof Ismail, S. M. Sapuan, and Marjan Bahraminasab. "A comprehensive VIKOR method for material selection." Materials & Design 32, no. 3 (2011): 1215-1221.
[46]. Shemshadi, Ali, Hossein Shirazi, Mehran Toreihi, and Mohammad J. Tarokh. "A fuzzy VIKOR method for supplier selection based on entropy measure for objective weighting." Expert systems with applications 38, no. 10 (2011): 12160-12167.
[47]. Bhargavi Gorantla, Sreenath Devineni, “Evaluation of User Experience (UX) Design for Emerging Technologies”, Computer Science, Engineering and Technology, 1(3), 2023, 39-47

