

## INCREDIBLE CHANGE IN CONSTRUCTION ERA BY USING ARTIFICIAL INTELLIGENCE

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### ABSTRACT

Artificial intelligence (AI) is the capability of computers to execute tasks which actually need human brain. Tasks may comprise visual perception, decision-making, speech recognition and translation amongst languages. Genetic Algorithm, fuzzy methods in terms of Artificial Intelligence can be effectively applied to various civil engineering works like planning and optimization, prediction, decision making and risk analysis. AI Techniques like Artificial Neural Network, Swarm Intelligence, Particle Swarm Optimization, Ant Colony Optimization, Genetic Algorithm and Genetic Programming can intelligently ease open channel flow at large level, highway construction cost estimation, design and analysis of earthquake resisting buildings, structural health monitoring, failure monitoring of bridges, pavements, project evaluation, building design and optimization, and prediction regarding structural behaviour, analysis of bridge and highway, dam analysis and prediction, flood analysis and future prediction, under-water construction, self-repairing of the structure, waste management, GIS, Flood and tidal forecasting during river bank and marine areas. AI has brought boom in construction industry as this method can be used to evaluate optimal planning during construction also minimises both the time and cost. Sensors provided in the structures to analyse the deflection, stress and damage can reduce maintenance costs and increases the life of the structures. This paper aims towards some of the methods, techniques and theories in the field of civil engineering by application of artificial intelligent systems.

**Keywords:** Artificial Intelligence, Civil Engineering, Machine Learning

## I. INTRODUCTION

Artificial Intelligence works in civil engineering and construction industry with a goal of execution and pertaining functions of human brain, logically and intelligently. Artificial Intelligence is a branch of study that explain itself intelligent behaviour in the terms of computational processes (Robert J. Schalkoff, 1990). There are different methods used in Artificial Intelligence are Artificial Neural Network, Swarm Intelligence (SI), Genetic Algorithms (GA), Genetic Programming (GP), etc.

Machine learning also a division of Artificial Intelligence. Machine learning is Smart assistant that categorise the large data.

Artificial Intelligence can perform any tasks without human brain; it is based on computer system and programme developed by any human. Large amount of computations required to design any civil engineering structure can be eased by the artificial intelligent method (Bharanidhar T. S., Dr. J. Premalath 2018).

In Civil Engineering field AI covers a huge area in design of different types of structure and management. Traditional methods for design and optimization models are difficult and time consuming; AI improves the automated data collection and also reduces the time and chances of errors while design a structure (Adeli. H. & Hung, S. L. 1995).

Genetic Algorithm, fuzzy methods in terms of Artificial Intelligence can be applied to various civil engineering works with a great success like planning and optimization, performance prediction in different situations, decision making based on the situation, etc. It has a major

role in management, construction and maintaining different types of works related to civil engineering (Patil and Patted 2017).

Optimization techniques are the mathematical programming techniques that are characterized by the specification of an objective function to be optimized along with the constraints and bounds expressed mathematically.

## II. Artificial Neural Network

Artificial Neural Networks are helpful to solving various different types of civil engineering difficulties that cannot be solved by the conventional methods and models. ANN has capability to analyzing and collecting the large data (Flood, I.; Nabil, K. 1994).

Neural network is a very good approach to analyze open channel flow at large level as compared to conventional method. In highway construction cost estimation can be done by the BP neural network (S. N. Alacali, B. Akba and B. Doran 2011). After evaluation of neural network results, it can be predicted it is a diagnostician method. In case of non-linear problems for analyzing and solving the neural network is a very good method.

The Neural network is mostly used in information technology. The neural network, fuzzy logic and genetic algorithm together give excellent results. The bucking strength and deflection of steel plates of rectangular shape can be determined by the use of Neural Network (Cevik and Guzelbey 2016).

Schmidt hammer test method and Ultrasonic pulse velocity method proposed for correlation of Non destructive testing parameters by using

Artificial Neural Network. There is no direct relationship between rebound number and strength of concrete, ANN simulator development is the best solution for such kinds of the problems because there is a mathematical predefined relationship is not required.

### **III. Swarm Intelligence**

#### **(A) Particle Swarm Optimization**

Particle Swarm Optimization is an optimization method which is truly population based that empowers various numbers of solution and iteration. It is suitable for very complex systems. Application of PSO in design and analysis of earthquake resisting buildings also gives the best results (H. Shayeghi 2009).

#### **(B) Ant Colony Optimization**

ACO is based on establishing the shortest path from the source of food to nest by the Ants. Ant Colony Optimization is useful in constrained engineering design problems (Kaveh and Talatahari 2010).

### **VI. Genetic Algorithm**

Genetic algorithms (GAs) can be defined as 'The mechanics of natural selection natural genetics based algorithms'. The Genetic Algorithms are very popular methods and flexible methods, it can be used to solve optimization and search related problems (Goldberg 1989).

Genetic Algorithms is an algorithm using evolution principle and also based on the theory of survival of the fittest (Holland 1975). Genetic Algorithm has introduced various mathematical tools and models which can be used in development of civil engineering, optimization and construction techniques by using computer science. Optimization techniques are the mathematical programming techniques that are characterized by the specification of an objective function to be optimized along with the constraints and bounds expressed mathematically. This method can be used to evaluate optimal planning during construction also minimise both the time and cost (A. Senouci and H. R. Al-Derham, 2008).

### **V. Genetic Programming**

The soft computing techniques that based on the biological organism to solve difficult problems are known as Genetic Programming (W. Banzhaf, P. Nordin, 1998). Hybrid Method of integrating Genetic Programming (GP) and Simulated Annealing (SA) used to estimate the base shear of steel structures that are subjected to earthquake loading. It is also useful to calculate the length of pavement traverse cracking (Aminien and Javid, 2011).

### **VI. Application of Artificial Intelligence in Civil Engineering**

Different methods of Artificial Intelligence are used in various Civil Engineering fields like building materials, construction management, water management, reservoir operation and planning, hydraulic optimization, geotechnical engineering fields, structural design and analysis

and transportation engineering for analysis and design. AI used for project evaluation, building design and optimization, decision making and prediction regarding structural behaviour, analysis of bridge and highway, dam analysis and prediction, flood analysis and future prediction etc.

AI is to be useful in the automation and robotic system. In the field of civil engineering automation and robotics system helpful in case of smart construction materials and ready mix concrete plant. It is best for quality control and construction and based on the computer programming. Concrete mix design is very difficult and sensible. It is based on the workability, durability and strength. The concrete strength is calculated by the properties of cement, fine aggregate, coarse aggregate and water cement ratio. The system provided with a sensor can respond according to changes occurs in environment (Jeng and Cha 2003).

Artificial Intelligence used for monitoring of structural health. Sensors provided in the structures to analyze the deflection, stress and damage, it can reduce maintenance costs and increases the life of the structures. Best solution for monitoring of bridges.

Artificial intelligence is also useful in under water construction and at such places where self repairing of the structure is most important. It involves embedding thin tubes containing uncured resin into materials, when destruction

occurs, these tube breaks and exposing the resin and fills destruction and sort out. It could be best for isolated or unreachable environments.

Artificial Neural network has analogy based problem solving capabilities. So it can be most suitable for decision making during the estimation.

In the structural engineering Artificial Intelligence are used to evaluate durability and strength with respect to time. Developed oracle systems for design and analysis of concrete structures, R.C.C. and steel structures & its components design by use of artificial neural networks in the performance of non-destructive testing, behaviour of fibre reinforced concrete beams and predicting the major deflection response of rectangular plates were discussed clearly the advantages of using AI in these areas (Singh 2018). A case study prediction for both tests, concrete hammer and ultrasonic indicate that the neural networks are able to learn examples of non destructive testing and also predict the strength of concrete for new value of rebound number. Rapid analysis of flexural nature of two different types of steel fibre reinforced concrete beam neural network is best solution for built relationship between input and output data produced by experiment. The results observed for the both the problems are found to

be in very actual and best. It provides the results by less time consuming experiment.

Automation process of the waste management is good as compared to manual process. Manual process is a expensive, time consuming and challenging. Automation makes it easy.

AI applicable to generates plans at different stages of any project, it provides description of the steps taken along with their effects.

The robotic systems can be used to execution of construction works. In the designing, planning and alignment of new pavement, possible locations and numbers of bridges and tunnels AI helps with GIS. The major objective of AI is decision making in selecting an appropriate action for a defected pavement. Flood and tidal forecasting is an important factor in construction activity at the site presents at river bank and marine areas.

Artificial Intelligence helps in the planning and design of structures to protect against the earthquakes.

## VII. CONCLUSION

Due to rapid development of technology and computing techniques, Artificial Intelligence brings a new Era in construction technology.

Artificial Intelligence has been successfully applied to prediction, risk analysis, decision making and optimization in the various civil engineering areas. At present days Artificial Intelligence plays an important role in construction, maintenance and management of different civil engineering works. In large data collection and analysis of that data; different methods of Artificial Intelligence is playing a

major role. It gives the better results as compared with conventional methods. AI is a power tool for solving problems based on civil engineering by using algorithms and database which reduces the cost and time required.

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