The Institution of Engineers (India)

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33rd Indian Engineering Congress

December 21-23, 2018, Udaipur

Hosted by: **Udaipur Local Centre**

Venue : Udaipur

Theme

"Integration of Technologies: Emerging Engineering Paradigm"

CALL FOR PAPERS

About The Institution of Engineers (India)

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Indian Engineering Congress

The aim of the Indian Engineering Congress is to bring to fore the developments in various fields of engineering and prepare our engineers to face the future challenges for sustainable development of the country.

The objectives of the Indian Engineering Congress are:

- To debate and discuss the theme of the Congress to create awareness, promote ideas, innovations in their respective engineering disciplines.
- To provide Engineers with a forum for exchange of knowledge, updating information and developing a sense of responsibility in their professional functioning.
- To promote and inculcate social responsibilities of engineers towards fulfilling the basic needs of common citizen of our country.
- To promote the Engineering practice that meets the challenges of sustainable resource management.
- To promote Emergent Engineering Challenges.

Theme of the 33rd Indian Engineering Congress

"Integration of Technologies: Emerging Engineering Paradigm"

Technology integration is the approach that is used to choose and refine the technologies employed in a new product, process, or service - either in academia or in industries.

Technology integration in academia is the application of technology tools in the field of education which allows the students to use computer and technology skills for learning and problem-solving purposes. It can also be defined as the use of technology to enhance and support the educational environment. Effective integration of technology is achieved when students are able to select technology tools to help them in obtaining information in a timely manner, analyze and synthesize the information, and present it professionally. In seamless integration, students are not only using technology but they have access to a variety of tools that match the task at hand and provide them the opportunity to build a deeper understanding of content. Standard education curriculum with an integration of technology can provide tools for advanced learning among a broad range of topics. Integration of information and communication technology is often closely monitored and evaluated due to the current climate of accountability, outcome based education and standardization in assessment. Willingness to accept change is also a major requirement for successful technology integration. Technology is continuously and rapidly developing, it is an ongoing process and demands continual learning.

In industry, if a company selects technologies that don't work well together, it can end up with a faulty product or manufacturing process. The loss of market potential will defeat envisioned purpose of selection of technologies. Therefore, access to good researches is immensely important. The amount a company spends on R&D is an indicator of its competitive strength. Business analysts also supplement the fact. Product life cycles have shortened dramatically, forcing companies to develop and commercialize new technologies faster than ever. Therefore it is of high importance how the company's process is rapidly and efficiently translating its R&D efforts into products that satisfy the market's needs. After all, a company's return on investment on R&D ultimately matters. In many industries, superior technology integration is the key to achieving superior R&D productivity and speed—and superior products.

Technology integration has always been important, but in the last decade it has become much more important and challenging too. The number of technologies to be chosen by the companies has grown dramatically. Another important fact about technology integration is that there is not just one successful approach. Rather, the approach to be adopted must be in harmony with a company's capabilities and its local culture and conditions. Advances in materials science, information technology, electronics, computer science etc. have enabled the technological bases of many industries changed rapidly and unpredictably causing a paradigm shift in application of engineering and technology.

Call for Papers

Engineering professionals from Industries, Academic Institutions, Research & Development Organisations, Government Departments and Entrepreneurs are invited to contribute papers pertaining to the theme and sub-themes of the Congress under each of the following 15 engineering disciplines of IEI. The papers should focus on sharing the experience, concepts, innovative ideas, research findings etc.

Aerospace Engineering	**Agricultural Engineering**
Architectural Engineering	**Chemical Engineering**
Computer Engineering	**Civil Engineering**
Electrical Engineering	**Electronics and Telecommunication Engineering**
Environmental Engineering	**Marine Engineering**
Mechanical Engineering	**Metallurgical & Materials Engineering**
Mining Engineering	**Production Engineering**
Textile Engineering	The above areas are indicative. Authors may also submit papers on other areas based on the main theme of the 32nd Indian Engineering Congress

Submission of Synopsis / Full Text

The authors are requested to submit the synopsis and full text (post-acceptance of synopsis) through e-mail to **iectech@ieindia.org**

Nodal Dates

Submission of Synopsis	September 15, 2018
Intimation of acceptance of synopsis	October 10, 2018
Submission of full-text	November 15, 2018
Intimation to authors regarding session details	December 10, 2018

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Synopsis will be reviewed by domain experts and the decision will be communicated to those authors whose synopsis is accepted.

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Udaipur, 2018
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A Hybrid FEM–ANN Approach for Slope Instability Prediction

1.50 cm

A. K. Verma[1] · T. N. Singh[2] · Nikhil Kumar Chauhan[1] · K. Sarkar[3]

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Abstract Assessment of slope stability is one of the most critical aspects for the life of a slope. In any slope vulnerability appraisal, Factor Of Safety (FOS) is the widely accepted index to understand, how close or far a slope from the failure. In this work, an attempt has been made to simulate a road cut slope in a landslide prone area in Rudrapryag, Uttarakhand, India which lies near Himalayan geodynamic mountain belt. A combination of Finite Element Method (FEM) and Artificial Neural Network (ANN) has been adopted to predict FOS of the slope. In ANN, a three layer, feed- forward back-propagation neural network with one input layer and one hidden layer with three neurons and one output layer has been considered and trained using datasets generated from numerical analysis of the slope and validated with new set of field slope data. Mean absolute percentage error estimated as 1.04 with coefficient of correlation between the FOS of FEM and ANN as 0.973, which indicates that the system is very vigorous and fast to predict FOS for any slope.

Body of the paper including tables, caption of figures, etc. should be in Times Roman: 10 font single spacing

Keywords ANN · FEM · FOS · LEM · Neurons

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Introduction

The slope instability problems are very chronic natural disaster in Himalayan region. Rudraprayag is one of the districts in Uttarakhand, where many major and minor landslides have occurred in past with loss of human life and civil infrastructure [1]. Due to frequent landslides in region, it is one of the exploreable sites for geological engineers and researchers. Latest numerical analysis was used for evaluating the unstable road cut slopes in Rudraprayag area [2]. Low and high landslide hazard zonation maps of the area were prepared by using remote sensing and Geographic Information System (GIS) [3]. The unstable road cut slopes along NH-109 of Rudraprayag area were identified using Continuous Slope Mass Rating (CSMR) classification scheme and a kinematic analysis was performed in order to evaluate types of failure and their potential failure directions [4], while other researchers have studied for slope stability of road cut slopes along NH-58 (Garhwal Himalaya) using Rock Mass Rating (RMR) and Geological Strength Index (GSI) [5].

Limit equilibrium (LE) based on method of slices is most conventional technique preferred in majority of slope stability analysis. But, with the advancement in technology and computing ability the numerical modelling techniques (FEM) has been developed as a computational tool to solve differential equations in engineering. It gains its power from the ability to simulate physical behavior using high performance computing without the need to simplify the problem. Indeed, complex engineering problems need finite element methods to obtain more reliable and accurate results.

The FEM can be used to study the stability of slopes using a failure definition similar to that in the limit equilibrium method (such as the finite element strength reduction method). Among FEM methods for slope

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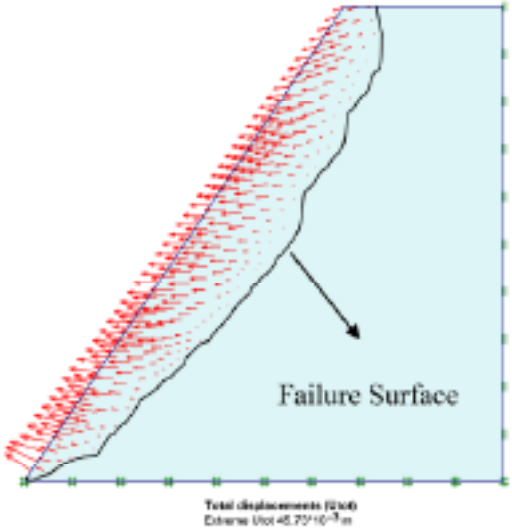

Fig. 4 Magnitude and direction of total displacements, expressed with *arrows*

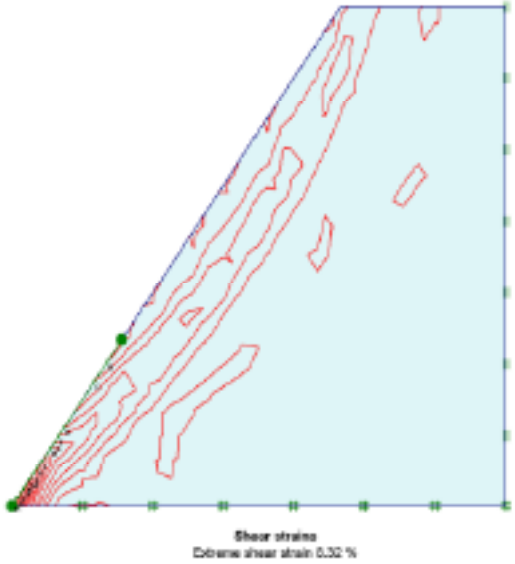

Fig. 5 Plot of shear strain

Figure 4 shows the total displacement vector of the slope after failure with magnitude and direction. The total displacement was found to be 45.73 mm. The factor of safety was calculated to be 0.7 and the slope is unstable.

Figure 5 shows the accumulation of total shear strain contour in the slope. This indicate that failure plane of the slope in circular mode.

Implementation of ANN Model

Network Architecture

Artificial neural network consists of a complex structure made up of elementary units called neurons. It is capable of performing data processing and knowledge representation using immense parallel computation.

A neural network predicts an output pattern when it recognizes a given input pattern [30, 31]. Each neuron has n inputs and calculates its output 'a' using equation.

$$a = f\left(\sum_{i=0}^{n} w_i p_i + b\right)$$

where p_i are the ith input, w_i are the ith weights, b is the bias and f is the activation function or transfer function for the neuron.

A three layer feed forward back propagation neural network model was selected because of its efficiency and found to be appropriate one in this case. It generally consist of three layers i.e. input, hidden and output layer. Number of neurons in the input layer depends on the number of input data sources. Input in the form of neurons compromise the first layer and each neuron is connected to the neuron of the successive layer, where each connection is carrying the initial set weights. Features extracted from the thematic layers was used as input in the input layer, Number of hidden layers and number of neurons in the hidden layers are determined by the hit and trial process.

One of the basic element of the any ANNs architecture is the squashing function or signal function. The role of the signal function is to squash (limit) the output signal of the neuron to a certain (finite) range. Squashing function maps a (possibly infinite) domain (the input) to a pre specified range (the output). A great number of mathematical functions should be suitable for the role of the activation function of a neuron. Any nonlinear function can be used as a squashing function, but a tan-sigmoid function which constrains the output of network between 0 and 1 is widely in use [32]. A feed forward back-propagation neural network architecture model is given in Fig. 6.

Network weights are adjusted during the training sessions and the application of the learning rule. Learning is realized through updation at synaptic, neural and network levels, as it take place in the entire network.

One of the widely used paradigms of learning algorithm in neural network is the Back Propagation Learning Algorithm (BPLA). The BPLA is applied on multilayer feed forward networks, also known as Multi Layer Perceptrons (MLP). It is based on an error correction learning rule i.e on the minimization of the mean squared error that is a measure of the difference between the actual and the desired output, and is the most commonly used

Table 6 Observed, predicted values and percentage error for factor of safety (FOS)

Pore pressure, MPa	Cohesion, MPa	Slope angle, deg	Friction angle, deg	FOS_{FEM}	FOS_{ANN}	%Error (FOS)
2.53	5	56	31.5	1.1	1.14	−3.64
2.89	5.3	50	35	1.35	1.44	−6.67
3.05	5.8	47.5	36.8	1.44	1.62	−12.5
3.12	6	45	36.9	1.54	1.56	−1.3
3.81	3.5	63.4	30.1	0.97	0.954	1.65
2.38	3.9	59.7	30.9	1.067	1.05	1.59
4.11	3.2	67.3	30.6	0.863	0.854	1.04
4.85	2.8	71.56	29.8	0.767	0.625	18.51
4.76	2.5	71.56	29.5	0.675	0.684	−1.33
5.01	2.4	80.53	29.3	0.587	0.574	2.22

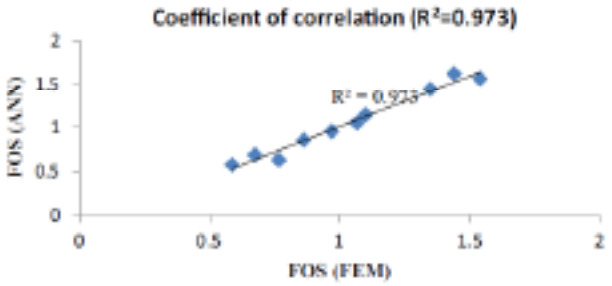

Fig. 10 Coefficient of correlation between values obtained by ANN and FEM

FOS_{FEM} and FOS_{ANN} is presented in Table 6. Figure 10 plotted between FOS values by FEM and ANN, shows higher value of coefficient of correlation ($R^2 = 0.973$) and confirms good agreement between FOS by FEM and ANN.

Conclusion

In this study, the datasets for training and testing were obtained from strength reduction method (Phi-C reduction method) using PLAXIS-2D (FEM). A three layer feed forward back propagation neural network with architecture 4-3-1, one input layer and one hidden layer with three neurons and one output layer was selected. A close agreement was found between factor of safety computed through ANN and FEM expect few cases. The percentage error estimated is very less which indicates that the approach is useful, applicable and fast as compared to FEM. The results obtained from this analysis are encouragable, which gives reasonable hope for the practical application of this model.

Therefore, based on the results, it has been concluded that artificial neural network (ANN) can be implemented successfully for slope instability problems of complex road cut slopes in a most feasible and quick way.

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