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Review on Analysis of Fire Resisting Structure

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Abstract: Efficiency of structure in fire is depend on variety of factors such as material degradation of material at elevated temperature restrain rigidity of fire surrounded members.it is important to understand structural response to fire in order to face minimum damage of structure and in order to select appropriate fire-resistance measures. It is not feasible to carry out experiment on real structure as it requires space, time, fire control meseares as well as money. Therefore using of finite element based software's like ANSYS is always best option instead. In this paper the properties of concrete and steel that influence behavior of structure at elevated temperature have been examined.

Keywords: Fire load, Heat expansion, ANSYS, Fire resisting materials, Thermal analysis

I. INTRODUCTION

Every year, fire causes significant loss of life and property protection for humans, which is one of nature's most common and destructive disaster.There is a rise in number of accidents and other emergency situation which may caused by fire. As a result,it is necessary to develop calculations and analytical method for evaluation of fire resisting structure. There is different classes available for fire resistance rattings. The ability of structures to limit the spread of fire is measured by their fire resistance rating.

Concrete and steel structure is commonly used all over the world.In reinforced concrete steel adds strength concre teby bearing tensile forces. Increased temperatures cause the steel's strength and stiffness to deteriorate, ultimately result in failure lead to increasing deformations. This is especially important in steel, as compared to concrete or wood, since steel conducts temperature well and always appears in thinner or slender components. Fire always has been a harmful natural occurrence. It has been understood for centuries that it has significant structural damaging effects, which may vary from a building being fundamentally disable to collapsing.

II. METHODOLOGIES

A. ANSYS

ANSYS is finite element analysis based software and it was founded by Dr. John A. Swanson in 1970. The application of finit element method, known as finite element analysis, is the easiest way to understand it (FEA).ANSYS gives single user ,graphical, integrated and interactive environment for the generation of model. ANSYS is a user-friendly programme since it includes a command prompt and a session editor to help with data input and prevent commonly errors. Two-dimensional plates may be used to generate three-dimensional geometry. The inclusion of heat sources, such as condition and convection sources, facilitates the heat transfer modelling process.there is arrays for various properties and various parameters like thermal conductivity ,heat expansion and temperature with respect to time. Fire load can be provide at the specific point,location or regions . To model and solving the given equation, ANSYS utilizes a finite element process.[1]

B. Modeling and Results Output

ANSYS is a programme that solves problems using finite element analysis concepts. The following methods is used to model and analyse structures.

1) Generate geometry of structure and then assign the properties of material as per material selected.
2) Select type of the element. (It is depending upon the type of structure.) BEAM 188 for beam and for truss member link 1 as well as for solid structure member solid 185.
3) Meshing is completed after modelling and materials assigning.
4) Then select type of analysis. There is three type of analysis are as Steady state,transient and time step based.
5) Finally complete the analysis and result obtain result from general "postprocessor" tab.[1-4]

III. STANDARD FIRE EXPOSURE

In fire resistance tests, the time-temperature curve used is called the typical fire.

The basic test requirements most frequently used are ASTME119 (ASTM 2007) and ISO 8344. (ISO 1975).[4]

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IV. THERMAL AND MECHANICAL PROPERTIES

A. *Thermal Properties of Concrete*

Some main thermal properties of concrete which have to be studied and can be extracted from data provided in Eurocode are as Thermal conductivity, Thermal Expansion coefficient as well as Specific heat capacity.[4]

B. Thermal Properties of Steel

Thermal properties of steel, thermal Conductivity ,thermal Expansion as well as Coefficient are given in EN 1993-1-2. Steel density is 7800 kg/m3.[4]

C. *Mechanical Properties*

The stress- strain relationship is given in Eurocode. It is used to assess the resistance to tension, compression, moment, and shear by determining the strength and deformation properties of steel.
Coefficient of thermal elongation : Thermal elongation is assumed as function of temperature as given in eurocode 3.[4]

V. LITERATURE REVIEW

A. *"Structural Performance of Reinforced Concrete Walls under Fire Conditions", Jun Chen, Ehab Hamed, R. Ian Gilbert*

In this paper author investigate the behavior of structure and load bearing capacity of reinforced concrete wall under one side fire through the theoretical model.Thermal analysis is perform to chareacterizing temperature gradient within the wall.Thermal analysis is conducted with the help of finite element method. A numerical illustration is given to demonstrate the ability of the proposed model and to clarify the failure mechanism of RC walls in fire.Also author validate model through compare with the literature results. Reinforce concrete wall under one side fire results buckling failure.[9]

B. *"Analysis of Fire Resistance of Concrete Structural Members Based on Different Fire Models: An Illustrative Example of the Slab Panel Assessment", BENÝŠEK Martin, ŠTEFAN Radek, PROCHÁZKA Jaroslav*

The ISO fire curve and the parametric fire model are two of these fire models.In-house MATLAB coding is used to apply the fire curve.They are also CFAST software for the zonal model and FDS software for the computational fluid dynamics model. The fire resistance of the slab panel is evaluated using the outcome of the fire simulation results.It is conducted by one way couple numerical procedure based on heat transfer finit element model. The are use Eurocode norms to build the model. Using std fire curve ,obtain most conservative results.[10]

C. *"Behaviour of steel structure under the effect of fire loading" Harshad D Mahale, Prof S.B Kandekar*

In this paper author investigate behavior of steel structure at elevated temperature. . They build steel structure in ANSYS software which is based on finite element method. Assign all thermal and mechanical properties of steel and structure subjected to fire exposure ISO 834.Assume fire load , self weight ,live load and dead load as well.Study of thermal transfer in steel structure subjected to fire load becomes simple and needs less effort.They are also review the properties of material whwn the steel structure exposed to fire.[11]

D. *"Defining design fires for structural performance" A.E. Moore, L.D. Albano, R.W. Fitzgerald, and B.J. Meacham.*

This article discusses a research study that has been carried out to create design fires for an office room and to use such fires to evaluate structural efficiency at various temperatures. CFAST software is used to for parametric modeling for fire condition and ASTM E-119 Standard fire exposure is used as fire source..Load capacity of structure under fire condition is results in the form of graph.in this study it is observed that Protected beams did not fail in any of the examples, whereas unprotected beams did.[12]

E. *"Experimental study on local buckling of fire-resisting steel columns under fire load" Kuo-Chen Yang, Sheng-Jin Chen, Cun-Ci Lin*

Under a standardised fire load, the structural behaviour of stub columns made of fire-resistant steel was studied experimentally. The recently produced fire-resistant steel has been shown to have greater strength at higher temperatures than conventional steel. A total of 24 stub column specimens, with both box and H columns, exceeded their limit states due to axial load under fire conditions to investigate the structural behaviour of this kind of steel columns under fire load. The key goal of these studies is to determine how different width-to-thickness ratios affect the ultimate strength of steel columns at defined elevated temperatures, as well as to investigate the influence of increasing temperature on column strength.[13]

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F. "Experimental Study on Fire Resistance of Reinforced Concrete Frame Structure" Xuan ZHANG, Qing-Qing SHEN, Zhong-Yi LI, Song-Hua TANG, Ying-She LUO.

In this paper author experimentally conduct fire test on RC frame structure with ISO834 standard fire exposure.they are also tested static load test under room temperature above nine structure after cooling. The fire impact of temperature on the samples was found to be greater than the fire load in the experiments.[14]

VI. CONCLUSION

The following conclusions that can be obtained from the above studies are,

A. With the help of finite element program,the study of heat transfer in any structure subjected to thermal loading becomes easy and less effort consuming.

B. Behavior of material properties at elevated temperature is study with previous research papers.Also studied methodologies and modeling procedure of structure. As a temperature vs. time curve, standard fire curves like ISO834 can be modelled for study. As a result, the structure's reaction can be measured over time and provisions can be made in the fire protection design.

C. The ANSYS finite element package efficiently models fire loading and material property and stiffness degradation. Analysis precision can be improved by using a finer mesh and the proper element form.

D. Studied mechanical and thermal properties of steel and concrete. Some main thermal properties of concrete which have to be studied and can be extracted from data provided in Eurocode are as Thermal conductivity, Thermal Expansion coefficient as well as Specific heat capacity.

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[9] Jun Chen, Ehab Hamed, R. Ian Gilbert, Structural Performance of Reinforced Concrete Walls under Fire Conditions.
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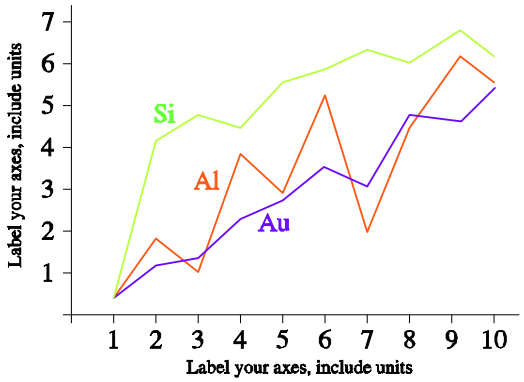

Fig. 1 A sample line graph using colors which contrast well both on screen and on a black-and-white hardcopy

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Fig. 2 Example of an unacceptable low-resolution image

Fig. 3 Example of an image with acceptable resolution

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CONCLUSIONS

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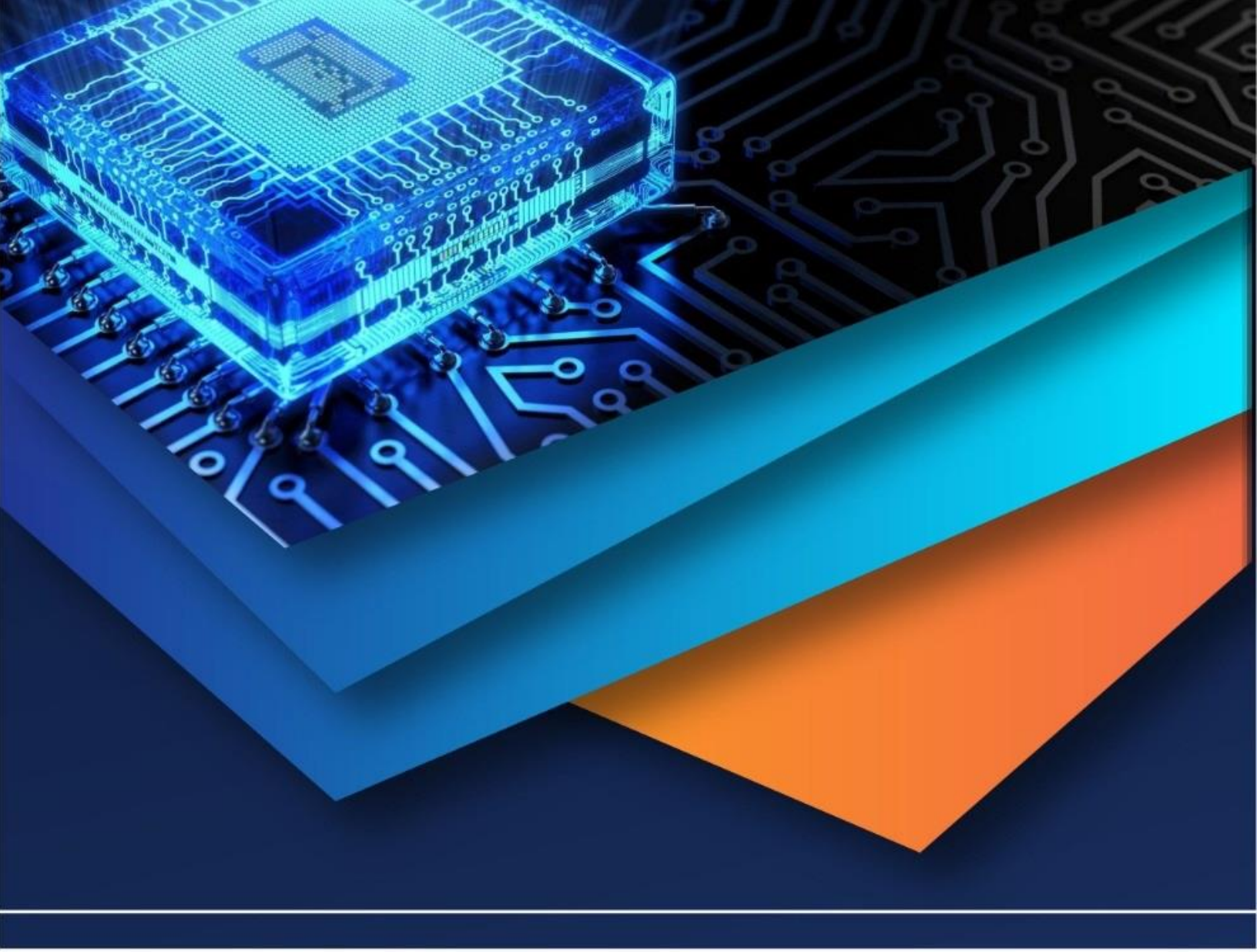

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