Modelling of Reinforced Concrete Frames in Fire Following an Earthquake

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INTRODUCTION

Earthquakes are natural hazards which occur in seismic areas and can cause devastating damage in urban infrastructure and facilities. Sometimes earthquake events are followed by fires which may cause more damage than the earthquake itself. Essentially, seismic design codes are relevant for designing a structure for an expected level earthquake and do not consider fire safety. In general, these two events are considered to occur separately.

RESEARCH OBJECTIVES

1. Understand and model single storey of reinforced concrete frame under cyclic loading (simulated as an earthquake motion) and then, at elevated temperature
2. To study the behaviour of single storey of reinforced concrete frame under earthquake excitation and fire following an earthquake.
3. Identify the damage parameter and potential concern for damaged RC frame after exposed to fire.

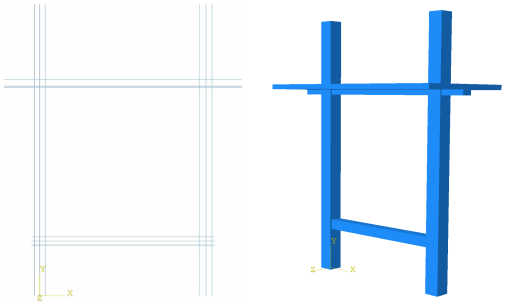

Figure 1 2D Finite Element Beam Model

NUMERICAL MODELLING

The computer program ABAQUS 6.8 is used to investigate the frame subjected to cyclic load and temperature exposures. Finite element beam element model (B21) is selected to simulate the reinforced concrete frame. Concrete strength of 34MPa and steel strength 415 MPa is used material properties. The total height of the frame is 6.0m. The cross section of the columns is 300mmx300mm and the beams is 250mmx250mm and slab thickness is 120mm. Temperature dependent material properties for concrete and reinforcements is assigned according to the EC2 and EC4 respectively. The compartment temperatures were increased from 20°C to 1000°C in 5 minutes and maintained for another 55 minutes.

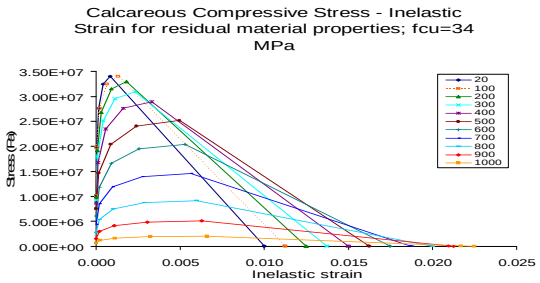

Figure 2 Stress-Strain Curve of Concrete in Compression

A maximum displacement of 100mm was applied over 4 cycles for case I, 70% of this for case II and 30% for case III.

RESULT ANALYSIS

Thermo-mechanical analysis of this frame as shows in the Figure 3 to Figure 6.

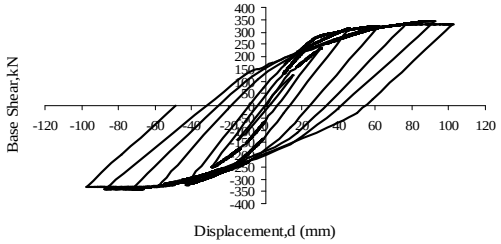

Figure 3 Hysteresis Curve

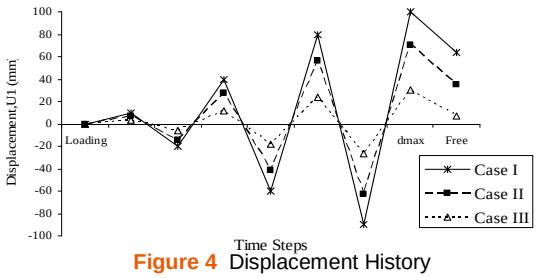

Figure 4 Displacement History

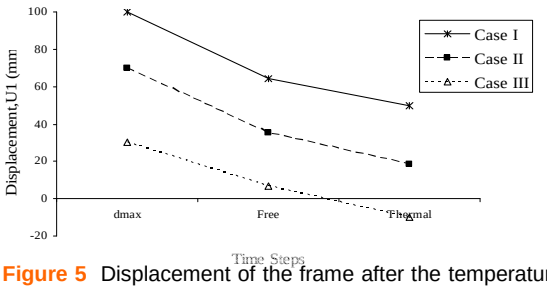

Figure 5 Displacement of the frame after the temperature applied

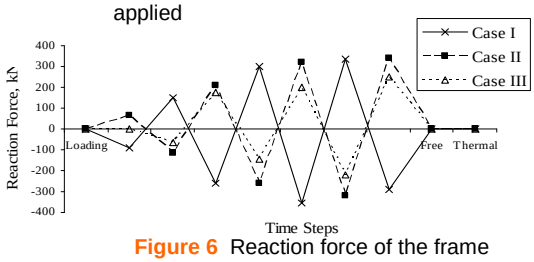

Figure 6 Reaction force of the frame

CONCLUSION

The computational analysis shows there is a reduction in the residual displacement of the frame after heating. The eventual aim of this work is to compare the computational results with the test results on real frame currently being carried out at IIT Roorkee in India. Both the model development and the tests are currently incomplete and full finding will be reported in future papers.