CE242 August 3:0

Fire structural engineering

Instructor

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Department: Civil Engineering

Course Time: MWF9-10

Lecture venue: STLH, Department of Civil Engineering

Detailed Course Page:

Announcements

Brief description of the course

The notion of fire as a load is introduced. Issues related modelling structural behaviour under the action oft fire loads is covered. After reviewing elements of thermodynamics and heat transfer, topics related to thermo-mechanical stress analysis is covered in details. Fire load is expressed in terms of a time-temperature curve. FE modelling that includes material property variation with respect to temperature, material and geometric non-linearity is introduced.

Prerequisites

Background in solid mechanics and FE modelling.

Syllabus

Role of structural engineering in fire safety. Introduction to fire dynamics. Models for enclosure fire dynamics. Review of heat transfer and thermo elasticity. Material properties at elevated temperature. Behavior of beams, columns, walls, and slabs at elevated temperature. Thermal buckling. Finite element modeling of structures under fire. Treatment of material and geometric nonlinearities. Joint behavior. Modeling of building frames under fire. Review of fire resistant design. Treatment of uncertainties and

concepts of performance based design.

Course outcomes

How to model fire as a load.

How to analyse structures under fire loads by incorporating variation of material properties with respect to temperature, geometric and material non-linearities.

Grading policy

30% for class tests

20% for assignments (~4)

20% for term paper presentation

30% for final examination

Assignments

1. The assignments should be submitted before 12:00 hours of the last date announced for submission. Late submissions carry penalty of 10% of marks per day. Assignments that are submitted after five days of the last date would be assigned zero marks.

2. Work should be well organized and done neatly. All assumptions made must be clearly stated with adequate justifications. The pages should be numbered and stapled securely. All graphs must bear axes labels, legends and captions. Equations of motion should be derived based on clearly drawn free body diagrams. All numerical results should be reported with appropriate number of significant digits and must bear the correct units.

3. Problems requiring numerical work could be done on the Matlab platform. In this event, the Matlab code should be included in the document to be submitted along with suitable printouts of the numerical results and graphs.

Resources

A H Buchanan, 2002, Structural design for fire safety, Wiley, Chichester.
Y Wang, I Burgess, F Wald, and M Gillie, 2013, Performance-based fire engineering of structures, CRC Press, Boca Raton.
D Drysdale, 1998, An introduction to fire dynamics, 2nd Edition, Wiley, Chichester.

B Karlsson, and J Quintiere. 1999, Enclosure fire dynamics. CRC press, Boca Raton

J G Quintere, 2006, Fundamentals of fire phenomenon. John Wiley, Chichester.