Gujarat Technological University

Report on
FEM – Constitutive modelling and applications in Civil Engineering
at
Ahmedabad Management Association, Ahmedabad
from
26th June' 2012 to 29th June' 2012

Name of STTP	:	FEM – Constitutive modelling and applications in Civil Engineering.
Date	:	26/06/2012 to 29/06/2012
Organized by	:	Gujarat Technological University, Applied Mechanics Department, L. D. College of Engineering, Ahmadabad
Venue	:	Ahmedabad Management Association, Ahmedabad
Time	:	09:30 am to 05:30 pm (everyday)

Objectives of the program:

The short term training program was an attempt to provide theoretical and practical knowledge of finite element method and to tackle various issues related to simulation and modelling of real world problems of civil engineering. The main objective of the program was to link the gap between theoretical and practical part of finite element method. The finite element modelling and material modelling is one of the important issues in the method, and which is also the thrust area of this program. Following were the major topics covered during the program:

1. Introduction to Finite Element Analysis.
2. Solution to One Dimensional Finite Element Problems.
3. Two Dimensional Problems (plane stress & plane strain).
4. Constitutive Modelling & Elastic Models.
5. Plasticity Models
6. Material Testing
7. Finite Element approach for dynamic forces.
8. Problem Formulation for Finite Element Modelling.
9. Finite Element Analysis using STAAD Pro.
10. Advanced FEM Techniques.
11. Finite Element Analysis using ETABS and SAP.

Overview of the program

The STTP started at 09:30 and comprised of 32 participants, 16 of them were from government colleges, 2 professional engineers from multinational firms and rest were from Private institutions from all across the state.

Dr. R. K. Gajjar (HoD, Applied Mechanics, LDCE) gave a brief introduction on why and how the workshop had been designed, Guest of honour of the program, Dr. Akshay Aggarwal (Hon.Vice Chancellor, GTU) gave an insight of the need and importance of simulation in civil engineering, Prof. M. N. Patel (Principal, L.D.College of Engineering) said a few words about the Five workshops organised at LDCE during the summer break, Dr. Amit Prashant (IIT Gandhinagar) spoke on material modelling in FEM, Dr. B. J. Shah (Assoc. Prof. Applied Mechanics, LDCE) and Prof. Merool Vakil(Asst.Prof. Applied Mechanics,LDCE) introduced the dignitaries and participants.

Inauguration and Lamp Lighting by Dr. A. K. Aggarwal

After the inauguration, the session started with a lecture delivered by **Dr. Echempati** (Professor, IIT Gandhinagar). Dr. Echempati started with an Introduction to the Finite Element Analysis, going through a brief journey on Finite Element Analysis of Beams, Trusses, 2D and 3D Frames and basic finite element analysis using simple numerical methods. Prof. Echempati had continued his discussion with finite element application and real life problems in 2D and 3D Frames

Dr. Echempatty, Prof, Michigan State Univ.   **Dr.B.J.Shah**

Dr. Amit Prashant (Professor, IIT Gandhinagar) delivered his session on Introduction to Constitutive Modelling and Elastic Models. The lecture comprised of Deformation and strain, stress and strain states, Principal stresses and stress invariants, Elastic parameters and hyperbolic models. He gave the insight to the modelling problem by explaining about assumptions made in analysis and modelling taking into Account those assumption. Detailed discussion were made pertaining to Contact friction models, mohr-coulomb model, and analysis of various models.

Prof. Merool Vakil (Assistant Professor,L.D.College of Engineering)started with a very informative session on One Dimensional finite Element Analysis Problems wherein discussion were made pertaining to Bar and Beam elements, two nodded and three nodded bar elements, shape functions, generation of load vectors and Tapered one dimensional elements. Solved examples were also illustrated to enhance the theoretical sessions.
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Dr. B. J. Shah (Associate Professor, L.D.College of Engineering) delivered a lecture on Two Dimensional Plane Stress & Plane Strain Problems in FEA. The lecture hours comprised of an introduction to plane stress and plane strain problems, axisymmetric problems and plate bending problems. Dr. Shah further went on with Mathematical Idealization, Discretization, three nodded triangular four nodded rectangular elements, Isoparametric elements, and various methods of numerical integration.

Mr. Vaibhav Singhal (IIT Kanpur) than had his session on Case studies on Non-Linear Static Analysis of Buried Pipelines. The participants had their journey with Mr. Vaibhav on Types of Faults, Performance of buried pipelines at fault crossing in recent earthquakes, deformation of buried pipelines and analytical study. Mr. Vaibhav's session ended up with Design recommendations.

Dr.R.K. Gajjar (Professor,L.D.College of Engineering) gave an informative problem formulation in ANSYS software for finite element modelling, comparison on Experimental v/s Finite Element Analysis, Modelling, Element library in ANSYS, failure criteria and convergence criteria.

Miss. Mitali Patel demonstrated the detailed analysis in ANSYS software with modelling, importing, assigning material properties, Specifying boundary conditions and loads, and finally running Analysis in Ansys for deep beam analysis.

The next day participants had a detailed interaction with Dr. Ajanta Sachan (Assistant Professor, IIT Gandhinagar) on Material Testing. Dr. Sachan covered Laboratory testing methods in detail along with the criteria to be looked on to while testing. She had a detailed discussion on tests to be performed specifically on soils.

The next session was taken by Mr. Krishnan Sathia (Director of technical support from Bentley systems), he threw light on various aspects of modelling using STAAD. Mr. Krishnan's session comprised of various structural entities in STAAD, theoretical information on when and where to use plate and solid elements, material data requirements for members and elements, modelling special connectivity conditions, modelling errors and loads on elements. Session ended with discussions on interpretation of results in STAAD.

The Session taken by Ms. Neha Parool covered FEM Analysis Procedure, Mass and Damping Properties, Analysis Types and Solution procedures along with solution for free vibration of multi degree of freedom system. She had also demonstrated case study on non-linear time history analysis of bridges (specifically elastomeric pads as bridge bearings). The modelling aspects were discussed along with the behaviour of bearings modelled in Abaqus software.

On the last day of the STTP, the participants had done a case study on Dome Masonry session from Mr. Vaibhav Singhal. The study demonstrated mechanical properties of masonry, finite element analysis, material modelling, constraints and discretization, modal analysis, response spectrum analysis and time history analysis. Mr. Vaibhav also showed how to carry out discrete finite element modelling of masonry and extended finite element modelling (along with crack propagation in RC Beams.

As a part of second and third session we had Mr. Rajiv Sharma (Technical Director from Computers and Structures Inc.), who covered Finite Element analysis in ETABS and SAP software. Mr. Rajiv demonstrated the modelling aspects of both the software along with the modelling problems for specific issues. Application of loads and modelling using plates and solids for particular structural elements was looked forth in detail.

Valedictory Function; Dr. Amit Prashant and Dr. R.K.Gajjar

After tea break the valedictory of the event was started. Dr.Amit prashant and Mr.Rajiv Sharma had given certificates to the participants. The participants thereafter moved for a group photo and dispersed with the knowledge acquired from the STTP.A brief feedback was held in order to find out the outcome and short falls of STTP. The participants were very much satisfied with the content and the discussion about the various aspects of finite element and expressed their gratitude to Gujarat Technological University for organizing the STTP. They also suggested to conduct the course for more number of days instead of four days.

FEEDBACK:

Feedback of participants was very encouraging. Some of the enthusiastic participants want the coordinators to come up with an advance course on the same lines, but for a whole week. All participants unanimously voiced that it was an excellent programme giving a sound exposure to all aspects of FEM. Everybody also acknowledged that the presence of Technical Directors of both the software giants: Bentley and SAP2000 brought very refreshing hands on experience to the workshop.

Coordinators

Prof. Merool Vakil   Dr. B.J.Shah

Dr. R.K.Gajjar