

Report on L& T training workshop for HE IC titled  
**“Fundamentals of Mechanics for Design of Process Plant Equipment and Structures.”**

L& T approach Department of Civil Engineering, through Dean MPSTME Dr. Alka Mahajan for training their young engineers from HE IC during 1<sup>st</sup> week of December 2020.

After finalizing the offer for training from L & T, Head of Department, Dr. Meenal Mategaonkar assigned Dr. Tanuja Bandivadekar as coordinator for the training.

The team was formed for the said assignment, consisting of Dr. Tanuja Bandivadekar, Dr. Shirish Vichare and Professor Prasad Gharat as per their expertise and Industry exposure.

Dr. Bandivadekar coordinated for the above said training with Mr. Girish Savant, General Manager & Head, MRU – Design & Engineering L & T for deciding the content and duration of training.

Initially the program was proposed for six sessions with two hours each. Finally, 9 sessions each for 2.5 hours were conducted. One test at the end of part A was given to candidates to assess the understanding of theory taught.

The proposed training program was divided into two parts, Part A “Fundamentals of Solid Mechanics” and Part B “Application of the part A to design of structures and pressure vessels” based on the extensive discussions with L&T. The syllabus for the training program was dynamic to suit the needs of L&T.

Each part consisted of 5 sessions of 2.5 Hrs each followed by QA session and a MCQ. A tutorial and a test was conducted at the end of part A to assess the understanding the fundamental principles of solid mechanics.

The program was for 83 mandatory participants and 37 optional participants as per the list provided by L & T and was attended by more than 90 participants for each session including engineers from Design section as well as Execution team from Mumbai and Hazira. Mr Anil Modi ,Vice President Process plant Equipment & Chief Technology Officer , Mr. Girish Savant, along with engineers from senior level attended the training.

The details of the training sessions are as follows.

Part A : Fundamentals of Solid Mechanics for Design of Process Plant Equipments and Structures			
Date	Session	Faculty	Topic
23/12/2020	1A	Dr. Shirish Vichare	Introduction to Solid Mechanics
	1B	Dr. Tanuja Bandivadekar	3D Stress and Strain Analysis
30/12/2020	2A	Dr. Tanuja Bandivadekar	Recap of Session 1B and Differential Equations for Deformable Bodies
	2B	Prof. Prasad Gharat	Stress-Strain Relation including temperature effect and Bending Theory
06/01/2021	3A	Dr. Tanuja Bandivadekar	Torsion determinate and Indeterminate problem

	3B	Prof. Prasad Gharat	Buckling Theory
13/01/2021	4A	Prof. Prasad Gharat	Energy Approach for determinate and Indeterminate analysis
	4B	Dr. Tanuja Bandivadekar	Three Moment Theorem for Continuous Beam Analysis
20/01/2021	5A	Prof. Prasad Gharat	Pressure Vessels, Fundamentals.
	5B	Dr. Tanuja Bandivadekar	Lifting Lug Analysis and Design for Pressure Vessels handling
27/01/2021	Test	---	---

Part B : Fundamentals of Design of Process Plant Equipments and Structures for HE IC			
Date	Session	Faculty	Topic
03/02/2021	1A	Dr. Shirish Vichare	Introduction to Limit State Method of design for steel sections
	1B	Dr. Tanuja Bandivadekar	Structural Planning for Industrial Structures
10/02/2021	2	Prof. Prasad Gharat	Design of Connections
17/02/2021	3A	Prof. Prasad Gharat	Design of Connections
	3B	Dr. Tanuja Bandivadekar	Wind Loads and Seismic Loads on Pressure Vessel for Design
24/02/2021	4A	Prof. Prasad Gharat	Design of horizontal Pressure Vessel
	4B	Dr. Tanuja Bandivadekar	Design of Tall Pressure Vessel

We received feedback from Mr. Girish Savant after 1<sup>st</sup> session and the overall feedback after the end of training program, which is attached in the appendix.

At the end of 9<sup>th</sup> session, Mr Anil Modi and Mr. Girish Savant appreciated our efforts and told us that sessions we delivered were meeting high expectations of L & T.

Our comments:

- It was very good experience for us individually
- Interacting with senior level professionals and understanding their needs will help us to prepare for further such activities.

- Since the number of attendee was large and participants are form totally different departments (design engineers and execution engineers, new joined and engineers with experience) it was difficult to live up to every one's expectation. Hence, we kept our syllabus dynamic. After each session, we use to modify content to be delivered after discussion and feedback from participants.
  - The efforts involved are more as against the fees L & T has paid us.
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# Appendix

Feedback at the end of 1<sup>st</sup> session.

## Fundamentals of Mechanics for Design of process Plant Equipment and Structures

Feedback for Session 1  
23/12/2020

Total Participants – 125  
Total respondents - 58

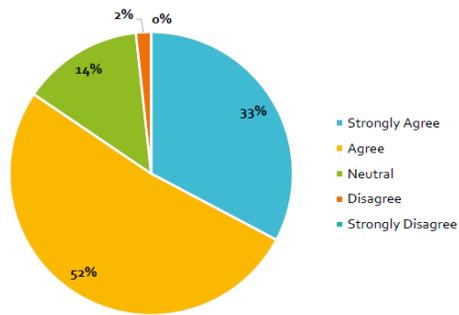
### Q 1. The online Session lived up to my expectation.

Total Respondents -58

Response	Percentage
Strongly Agree	22%
Agree	45%
Neutral	26%
Disagree	7%
Strongly Disagree	0%

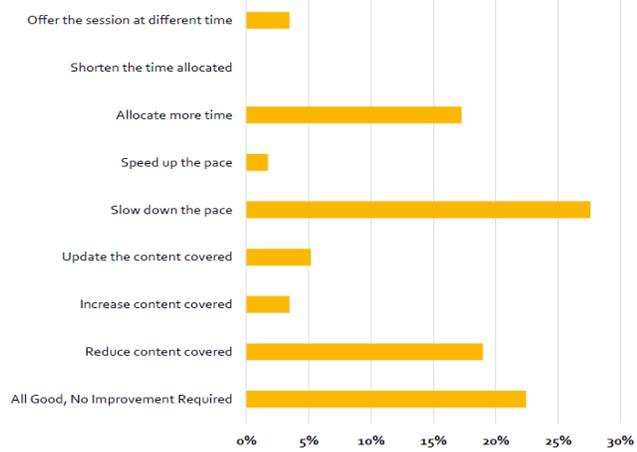
Q2. The Subject Matter Expert was well prepared.

Total Respondents - 58



Q3. Your suggestion to improve the Online Sessions.

Total Respondents - 58



Q4. How would you rate Faculty?

Dr. Tanuja Bandivadekar



4.24 Average Rating

Q5. How would you rate the Faculty?

Dr. Shirish Vichare



4.22 Average Rating

## Q6. Mention specific inputs, if any.

- Too much of content in very short period of time.
- A small 5 min break in the middle would have been beneficial.
- Session was very good considering basics related to Stress-strain & theories of failure. If it is possible, please correlate the basic topics with pressure vessel and ASME Codes calculations also so that it will also help us in better way in our work.
- Knowledge on practical use related to our products should be focused.
- Speed was too high and time was quite less. Sums of principal stresses & von-mises cannot be solved verbally. It was like reading the syllabus only. faculty have good knowledge but time is quite less.
- More focus should be on videos and audio. Teaching Pace to be slower and less topic to be covered in a day
- Session in the 1<sup>st</sup> half would be better
- There was less time allotted and many things to explain and thus due to this it was problematic for teacher as well as student to gain or grasp
- More Practical Examples Required
- Reduce the amount of content at a time & relate it to pressure part calculations which we do on daily basis.
- Reduce the session time and content covered in one session, because we have to do daily project work also.
- Increase content, make it more application oriented,
- Need to update methodology of teaching . Instead of traditional method , need to explain by relevant video, real examples.

## Q7. Rate Overall Session.



4.07 Average Rating

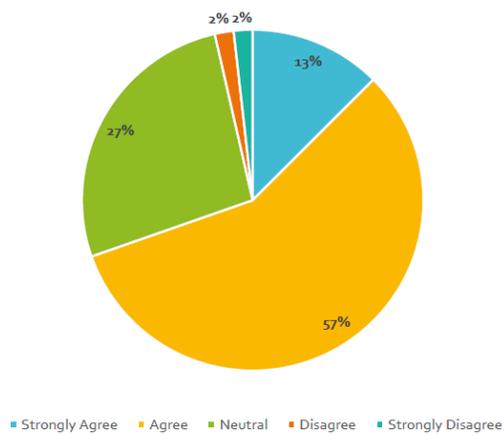
## Feedback at the end of training program

# Fundamentals of Mechanics for Design of process Plant Equipment and Structures

Total respondents - 56

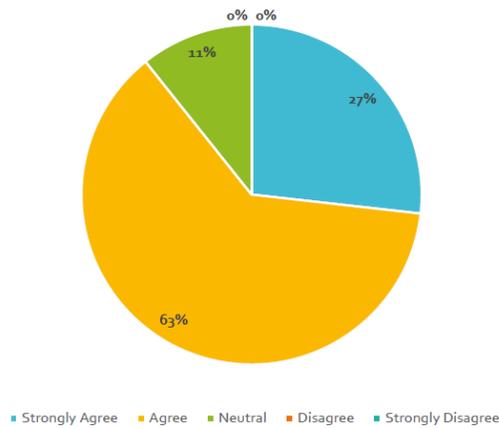
Q 1. The online  
Session lived up to  
my expectation.

Total Respondents -56



Q2. The Subject Matter Expert was well prepared.

Total Respondents -56



Rate the following parameters

(Highest rating = 4  
1=Poor,  
2=Good,  
3=Very good,  
4=Excellent)

Total Respondents -56

1. Extent of Content covered

Average Rating = 3.11

2. Extent of Objective achieved

Average Rating = 2.91

3. Rate the session overall

Average Rating = 3.07

## Specific feedback and inputs

- Work tasks on working days were an interruption during sessions
- Technical glitches could be avoided
- Provide the recordings and assignments on ATLNext
- Time to grasp all these important content was not enough. But still its a good effort and really appreciate the step taken.
- The guru session was excellent from new learning point of view
- Less content per lecture could have made things more clear and a value addition for practical usage point of view
- Handwritten exams are time consuming and hence are not relevant in this hectic work schedule. Conducting only online examinations will save time and effort.
- Should be more focused on our designed product, instead of complete theory classes

# Thank You

# Guest Lecture Report

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DR. GOPAL RAI

Kalp Pandya

Mo26, 6MCI | REPAIRS AND RESTORATION | 22<sup>ND</sup> MARCH, 2021

## Dr. Gopal Rai

The students of the sixth semester, studying the elective “Repairs and Restoration” were privileged to attend a guest lecture by Dr. Gopal Rai on the 23<sup>rd</sup> of March, 2021, arranged by their professor Dr. Tanuja Bandivadekar.

Dr. Gopal Rai is a founding member and also presently the CEO and Managing Director of Dhirendra Group of Company. His educational qualifications include Ph.D. (IIT Bombay), Structural Engineer, MACI, MASTR, MIEI, MISSE, MIASE, MICJ.

He completed Graduation and Masters from Penn Engineering College and Sardar Patel Engineering College Mumbai, respectively Both in Civil Engineering. Then he obtained PhD from IIT Powai, Mumbai. Since then, he has been involved in civil industry especially in Repairs and retrofitting of structures. He used his PhD thesis on “Instantaneous and Long-Term Performance of Externally Pre-stressed Beam and Joints” & introduced laminate Pre-Stressing in the Indian market which is today widely used.

Dr. Gopal Rai started off by explaining how the Repairs and Restoration field would be booming in the upcoming 10-20 years. He referred to the various metro and infrastructure projects, and explained how it is not feasible for everyone to afford a new construction. Hence, a large number of people would go in for repairs and rehabilitation of existing structures.

He explained basics of crack formation, flexural members, punching shear, shear members, etc. Different materials such as reinforcement woven fiber and uni-directional fiber were shown. He then covered a number of his projects. On each slide of his, he displayed work done on Indian projects only, which provided the required relevance of this field in India.

He showed how work was done in 2D and later converted to 3D for analysis. A G+3 frame structure model was constructed in CPRI Bangalore, for a shake table test. The model showed the resistance to an earthquake by a combination of dampers with fiber wrapping. He showed cracks in an actual buildings frame, and how they were strengthened with carbon-fiber wrapping (FRP- fiber reinforced polymer). This provided up to 90% of the original strength.

Another project was the Runway Bridge of Chhatrapati Shivaji International Airport. A *naala* passes under the runway, and the runway was built on a bridge. The bridge has deteriorated from underneath, and the reinforcement of the girders and slabs

was exposed. Micro-concrete was used to restore the structure. He displayed the method for restoring the structure as follows:

1. Chip off the loose concrete.
2. Give treatment to the bars, such as corrosion/rust remover.
3. Add shear connectors, connecting the new concrete to the old concrete.
4. Add additional reinforcement.
5. Apply shuttering.
6. Use micro-concrete to build the section.

The FRP process can be started only once the section has been built. Various challenges were faced while restoring on a live airport. The said bridge was unsafe for the largest aircraft to land in 2008, and hence it was strengthened using carbon-fiber wrap laminates. This was Dr. Gopal's first project as a contractor. He also showed how the rehabilitation of a box girder below the runway was completed, without stopping a single aircraft.

Dr. Gopal advised the students to pursue this domain in civil engineering, as it would greatly increase in the coming few years. He said that a major field in civil engineering would be rehabilitation, and this is a good time to start a venture in rehabilitation.

Other projects such as bridges were discussed. A Rail-Over Bridge (ROB) for the Jawaharlal Nehru Port Trust at Karal, Navi Mumbai was explained. The task assigned was the strengthening of bridge spans. To tackle this task, prestressing of carbon laminates was undertaken. Carbon fiber wrapping was later carried out. Omega type sensors and read-out instrument strain indicators were used.

Rehabilitation of another Rail-Over Bridge, the Markapur ROB, for the Public Works Department of Hyderabad was done. Design defects were found in 13 slabs, where the reinforcement provided was 28% less than that of what was required. Hence, strengthening had to be carried out. Various cracks were already present, and a linear potentiometer was used to measure the deflection caused. Two testing vehicles (trucks) of 41.5-ton capacity each were placed over the deck slab. The cost for demolishing and reconstructing the span of 7 meters was ₹27 crores, while the rehabilitation cost was ₹2.5 crores. Since the rehabilitation cost was less than 10% that of reconstructing, it was a very beneficial method. A check for extreme loading condition was carried out.

The last project was a Rail-Over Bridge for the Western Railway. The bridge being restored in this case was a 40-year-old bridge, numbered as Bridge 114. It had a 20-

meter-long, 1.7-meter depth PSC girder, having permissible limit of deflection of 8-9 mm. However, the deflection had gone up to 22 mm. A simple solution to such a problem in the railways would be to reduce the speed of trains passing in that section. The Railways wished to monitor the bridge for two years, and hence a number of sensors were installed. Grouting of cracks, rust protection of reinforcement and rust removal were carried out. A window of two hours was given to carry out the 8 pre-stressings required. After the project was complete, a total of 17 minutes were saved on the Rajdhani route. Before strengthening the speed restriction on that section was 20 kmph, but later it was increased to 100 kmph.

Rehabilitation of the Narmada bridge from Surat to Bharuch was explained. It was a 55-year-old central hinge bearing bridge. A similar process of micro-concrete, carbon lamination and fiber wrapping was used.

After construction of the Bilaspur bridge, it was found that the said bridge had a lesser amount of reinforcement than required. Hence, groove laminates in combination with fiber wrapping were used to strengthen the structure instead of demolishing it.

Dr. Gopal later shared some of the various accomplishments and awards that he had received for his work.

The lecture ended with a brief interactive session of the students with Dr. Gopal, and with Tanuja ma'am giving a vote of thanks for the inspiring speech.