INTRODUCTION

Earthquake resistant design is becoming increasingly complex as we are gradually aligning to the global design practices. It is required to perform different types of analysis for seismic design such as response spectrum analysis, p-delta analysis, nonlinear static analysis (pushover analysis), nonlinear dynamic analysis, etc. It is imperative to understand the overall methodology, limitations as well as software applications for each type of analysis. Because, if type of analysis considered is not appropriate or if the software application is not right then the intended purpose of earthquake resistant design won't be achieved. Following are few of the clauses wherein advanced analysis are required as per IS codes.

IS 800:2007 mentions that the structure should be able to withstand inelastic displacement corresponding to joint rotation of 0.04 rad for Special Concentrically Braced Frames and for Special Moment Frame. As per IS 1893 (Part 4):2015, nonlinear time history analysis is required to verify the collapse mechanism as well as P-delta analysis is mandatory for all industrial structures. Nonlinear static analysis and nonlinear dynamic analysis are required as per IS 16700:2023.

In view of the above, we are glad to launch a unique online course EQ-STR-004: "Different types of analysis" which will exclusively focus on the advanced structural analysis along with the software applications in ETABS & STAAD. Following types of analysis which will be considered in the course:

- Response spectrum analysis
- P-Delta analysis
- Nonlinear static analysis (pushover analysis)
- Linear time history analysis
- Nonlinear time history analysis

For earthquake resistant design, it is utmost important to understand the basics of structural dynamics. Therefore, in the course, we will start with fundamentals of structural dynamics wherein we will understand single degree of freedom, mode shapes, natural frequency, time period, acceleration, damping, resonance, etc. along with study models in ETABS & STAAD. Thereafter, we will consider detailed discussion on each type of analysis wherein we will discuss software application along with the fundamentals. We will experiment different types of analysis on study models of single storey as well as for G+30 building. Results obtained from different types of analysis for the similar buildings will be compared. The participants will be encouraged to apply the same concepts whether on study models or on real projects and share their findings or queries during the course. The entire course is designed as a process of learning together.

The entire course will be extremely useful for preparation of in-house check-list, working procedure, Do's and Don'ts, etc. for different types of analysis for buildings.

WHAT IS UNIQUE ABOUT THIS COURSE?

The course is designed by the **experienced engineer** (Mr. Bhavin Shah) who has more than two decades of experience in the field of structural engineering.

- ✓ The entire course is designed from the **practical aspects** which can be readily used in the real projects.
- ✓ The course is designed to have an **interactive mode** so that the problems / doubts of the participants can be addressed effectively.
- ✓ A WhatsApp group will be created for **quick communication** between the participants and the faculty. The participants will be able to share the discussion points, doubts, queries, etc. in the group. The details in the group will be collated for further discussion in the next session.
- ✓ All the sessions will be recorded and recording of each session will be shared **within few hours**. If someone miss out the live session then he/she can go through the recording before attending the next session. After going through the recording, the participants can share their doubts/queries in the WhatsApp group, which will be addressed in the next session.
- ✓ **Recording** will be available with all the participants for **180 days**.
- ✓ Certificate for participation will be issued on successful completion of the online course (minimum 80% of attendance is required).
- ✓ We will create a **focused group** of engineers after the course who would like to contribute further for the design of machine foundations.
- ✓ The course is designed as a **process of learning together**.

WHO SHOULD ATTEND?

This course will be useful for following:

- ✓ Practicing Structural Consultants
- ✓ Senior Structural Engineers in the company
- ✓ Junior Structural Engineers in the company
- ✓ Owner's consultants
- ✓ Proof checking consultants
- ✓ Research scholars, Academicians
- ✓ Post Graduate students in Structural Engineering
- ✓ Civil engineering students who are interested in Structural Engineering.

COURSE FACULTY

Bhavin Shah – Founder & CEO, SQVe Consultants

Mr. Bhavin Shah is passionate about Engineering profession with two decades of experience. He is having a dream for enhancing the engineering profession in different organisations. He completed graduation in Civil Engineering and Masters in Structures from Sardar Patel University. He is having unique experience of working in the specialized firm of civil / structural consultancy which grew as multidisciplinary firm (VMS), large multidisciplinary firm (L&T Chiyoda Ltd.) and owner-based engineering set up (Adani Infra (I) Ltd.). He worked in different organisations at different levels, starting from junior design engineer to CEO. He is Founder & CEO of **SQVe Consultants**. He is pursuing Ph.D. in Structural Engineering related to earthquake resistant design of industrial steel structures.

METHODOLOGY

- ✓ The entire course is designed in the **ONLINE mode**.
- ✓ The course will spread over ~**four weeks** with **approximate 24+ contact hours.**
- ✓ During the program, the interaction can be done with faculty and the participants using **WhatsApp**.
- ✓ **Fundamentals and the concepts** will be demonstrated through study models in the **software**.
- ✓ The online sessions will be conducted using **ZOOM** software.

COURSE SCHEDULE

Start Date	25-JAN-2024
End Date	20-FEB-2024
Total contact hours	24+ (Sessions will be arranged on **Monday to Friday** from **8:30 PM to 10:00 PM IST**.)
Details of each session	Please refer subsequent page for details of each session.

FEES FOR THE COURSE**

For participant <u>from India</u>	Cost per participant shall be **9800 INR** (inclusive of 18% GST).
For students** pursuing Post graduation or Graduation <u>from India</u>	Cost per participant shall be **7800** INR (inclusive of 18% GST).
For participant <u>outside from India</u>	Cost per participant shall be **145 USD.**

Discount offered:

- ✓ To avail discounted <u>**fess for student**</u>, the participant shall have official email address of the institute. Please connect with us at email address for more details: earthquake@sqveconsultants.com
- ✓ **For continuous learner**: If you have attended earlier one course of SQVe Consultants than **5%** of discount will be offered. For prior two courses, **10%** of discount will be offered. For three or more prior courses, **15%** of discount will be offered. To avail the discount, please connect with us through the above-mentioned email address. We will arrange to send an invoice considering the discount for online payment.
- ✓ **Group participation** from a company or institute is encouraged to get the discounts on this course. For more details, pl contact us at the above-mentioned email address.

HOW TO REGISTER FOR THE COURSE?

Please click on the following link and thereafter click on "**Register Now**" button at bottom of the page. You will be directed to the **payment page**. Your registration will be confirmed after receipt of the payment at portal.

https://sqveconsultants.com/eq-str-004

Important notes:

- ⇨ There are several modes of payment are available at the above link such as net banking, card, UPI, etc. For transferring the amount through Google Pay, please connect with us at following email address. We will share the required details.

⇨ Payment gateway at the above-mentioned portal is configured only for **Indian participants**. Interested foreign engineers can contact us at the email address: **earthquake@sqveconsultants.com**. An invoice will be shared through **PayPal** for online payment.

Kindly note that there are limited seats.

Your any queries/ doubts related to the online course are welcome at the above-mentioned email address.

SCHEDULE OF THE COURSE : EQ-STR-004

Session no.	Title	Date	Time (IST)
1	**Fundamentals of structural dynamics (PART 1)** • Basics of structural dynamics • Single Degree of Freedom System (SDOF) • Importance of SDOF in structural dynamics • Time period • Generating computer model for SDOF • Understanding of free vibration, forced vibration, damping using computer model • Natural frequency vs forcing frequency, etc.	25-JAN-24	8:30 PM TO 10:00 PM
2	**Fundamentals of structural dynamics (PART 2)** • Multi degree of freedom systems (MDOF) • Mode shapes • Damping • Arrival time • Resonance • Importance of damping during resonance • Transient response and Steady state response • Understanding of underdamped system, overdamped system, resonance through computer models	26-JAN-24	8:30 PM TO 10:00 PM

Session no.	Title	Date	Time (IST)
3	**Response spectrum analysis (Part 1)** • Basics of response spectrum analysis • When Response spectrum analysis is required? • How response spectrum curves are generated? • Limitations of Response spectrum analysis • Methodology used in ETABS & STAAD for analysis as well as for design of structures, etc.	**29-JAN-24**	**8:30 PM** **TO** **10:00 PM**
4	**Response spectrum analysis (Part 2)** • Experimenting Response spectrum analysis on study models using ETABS • Consideration of torsional eccentricity as per IS code in ETABS • Appropriate procedure for scaling of earthquake force • Highlighting major limitations of Response spectrum analysis from the results of software models, etc.	**30-JAN-24**	**8:30 PM** **TO** **10:00 PM**
5	**Response spectrum analysis (Part 3)** • Performing Response spectrum analysis for G+30 building in ETABS • Consideration of torsional eccentricity as per IS code in ETABS • Appropriate procedure for scaling of earthquake force • Discussion on Do's and Don'ts for Response spectrum analysis, etc.	**31-JAN-24**	**8:30 PM** **TO** **10:00 PM**
6	**P-delta analysis (Part -1)** • Overview of P-Delta analysis • When P-Delta analysis is mandatory? • Methodology used in ETABS software for P-Delta analysis • Limitations of P-Delta analysis in software • Two approaches of P-delta analysis in ETABS & STAAD • Which load combinations are to be considered for P-Delta analysis?	**1-FEB-24**	**8:30 PM** **TO** **10:00 PM**

Session no.	Title	Date	Time (IST)
	• Performing P-Delta analysis on study models, etc.		
7	**P-Delta analysis (Part-2)** • Performing P-delta analysis for G+30 building • Study of results • Combination with response spectrum analysis • Discussion on Do's and Don'ts for P-Delta analysis, etc.	**2-FEB-24**	**8:30 PM TO 10:00 PM**
8	**Nonlinear Static Analysis (Pushover analysis) – (Part 1)** • Overview of Pushover analysis • When pushover analysis is required? • Overall methodology used in ETABS software • Importance of nonlinear properties for pushover analysis • What is non-linear hinge? • At which locations, non-linear hinges shall be specified? • Pushover analysis in STAAD • Limitations of pushover analysis, etc.	**5-FEB-24**	**8:30 PM TO 10:00 PM**
9	**Nonlinear Static Analysis (Pushover analysis) – (Part 2)** • Performing pushover analysis for study models • Options available in the software ETABS • Observations on the results • Interpretation of results from pushover analysis • Changing few important parameters in the software to study impact on the overall results, etc.	**6-FEB-24**	**8:30 PM TO 10:00 PM**
10	**Nonlinear Static Analysis (Pushover analysis) – (Part 3)** • Performing pushover analysis for G+30 building • Combining P-Delta analysis with Pushover analysis • Different options used in ETABS for pushover analysis	**12-FEB-24**	**8:30 PM TO 10:00 PM**

Session no.	Title	Date	Time (IST)
	• Observation on collapse mechanism • Finding out root cause for failure of the key elements • Revising the structural system as well as sizes of members to study impact on the collapse mechanism • Discussion on Do's and Don'ts for pushover analysis		
11	**Time history analysis (Part 1)** • Overview of Time history analysis • Different types of time history analysis in ETABS such as linear time history analysis, nonlinear time history analysis, Fast Nonlinear Analysis • Time history analysis in STAAD • When to use Time history analysis?...Which type of time history analysis should be used? • How to select ground motions for time history analysis • Scaling of ground motions • Limitations of time history analysis, etc.	**13-FEB-24**	**8:30 PM TO 10:00 PM**
12	**Time history analysis (Part 2)** • Performing nonlinear time history analysis on study models • Observations on the results • Interpretation of the results obtained from Time history analysis • Comparison of results with response spectrum analysis and pushover analysis • Comparison of collapse mechanism with the pushover analysis • Check for drift, etc.	**14-FEB-24**	**8:30 PM TO 10:00 PM**

Session no.	Title	Date	Time (IST)
13	**Time history analysis (Part 3)** • Performing time history analysis for G+30 building • Combine with P-delta analysis • Interpretation of the results • Comparison of the results with Pushover analysis • Impact of revised sizes and structural system on the output of time history analysis • Discussion on Do's and Don'ts for Time history analysis	**15-FEB-24**	**8:30 PM TO 10:00 PM**
14	**Overall approach for analysis of structure** • Approach for analysis of structure • Selection of appropriate types of analysis • Comparison of the results obtained from different types of analysis • Pros and Cons of each type of analysis • Discussion on findings of the participants by applying the different types of analysis on study models or real projects	**16-FEB-24**	**8:30 PM TO 10:00 PM**
15	**Basics of Performance based seismic design (PBD)** • What is PBD? • Basics of PBD • Brief history of PBD • Current status of PBD • Advantages of PBD • Limitations of PBD • How to set performance criteria for the buildings? • Which type of analysis is most suited for PBD? • Experimenting couple of PBD criteria on study models • Discussion and interpretation of the results, etc.	**19-FEB-24**	**8:30 PM TO 10:00 PM**

Session no.	Title	Date	Time (IST)
16	**Open discussions | Way-forward** • Quick comparison of different types of analysis • Addressing balance queries from the participants • Discussion related to problems encountered in real projects by the participants • Way-forward	**20-FEB-24**	**8:30 PM TO 10:00 PM**

About SQVe Consultants

SQVe Consultants is a company established with a vision of enhancing the engineering profession. The name of the company is derived from first letters of goals of engineering, i.e. **S**chedule adherence, **Q**uality assurance & **Ve** -Value Engineering.

Our ALL services are designed to have maximum of ONLINE interaction with the least OFFLINE interaction.

We look forward for long term association with different organisations for enhancement of engineering profession through our unique services. We also provide mentoring to the structural engineers through one-on-one session. Please get in touch with us for any requirements related to online training related to civi/structural engineering as well as in the area of people management (soft skills).

For more details, please refer website : https://sqveconsultants.com
You may contact us at email address : contact@sqveconsultants.com

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