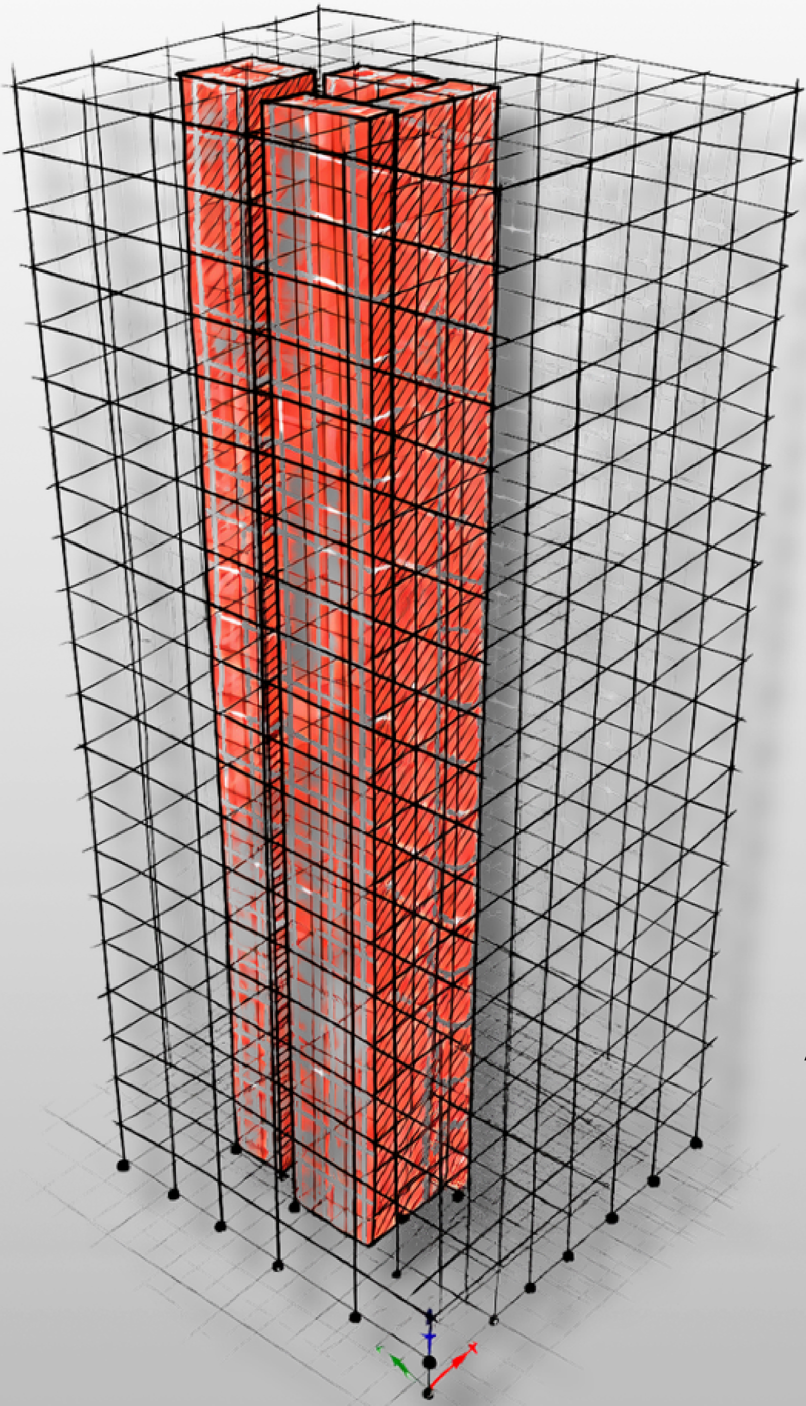
SQVe
Engineering



Automated Structural
Model Verification
in Seconds

SQVE-MV-ET-01 | VER 1.0

SQVE MODEL VERIFICATION TOOL

1. Why This Tool?

Structural model verification is often time-consuming and prone to oversight when performed manually. This tool is designed to **save time on every model iteration** by eliminating repetitive manual checks and delivering **instant verification results within seconds**. It helps engineers **avoid missing critical errors** by automatically identifying key issues that are often overlooked during manual review. By providing **instant structural insights**, the tool enables quick understanding of model behavior without the need to navigate multiple ETABS tables and outputs. It also supports a **standardized QA/QC process**, ensuring consistent and reliable verification across projects, teams, and iterations. Overall, the tool enhances efficiency while maintaining safety, allowing engineers to **focus more on critical engineering decisions rather than routine checking tasks**.

2. Current Scenario in Structural Engineering

Structural engineering practice is undergoing a significant transformation. With the continuous revision of design standards and increasing project complexities, engineers are required to handle more advanced analysis and design requirements. At the same time, project delivery timelines are becoming tighter, creating additional pressure on design teams.

Compounding this challenge is the evolving workforce landscape. Structural consultancies are often in a continuous hiring mode, and new engineers—whether experienced or fresh graduates—require time to align with company-specific processes and expectations. Additionally, a noticeable gap exists between academic learning and practical industry requirements, making it essential for organizations to establish robust systems that ensure consistency and reliability in design outputs.

3. Importance of Model Verification in Quality Assurance

Quality assurance is a critical component of any structural engineering project, directly influencing both the safety and cost-effectiveness of the structure. Within this framework, model verification plays a vital role.

A structural analysis model must be thoroughly checked through multiple parameters, which involves reviewing numerous tables, graphical outputs, and analytical results. This process is often time-consuming and prone to oversight if not handled systematically.

Inadequate or delayed verification can lead to significant rework during later stages of the project. In more critical cases, it may impact the structural safety or result in inefficient designs. Therefore, a structured and reliable approach to model verification is essential to ensure accuracy, reduce rework, and maintain high standards of engineering quality.

4. Introduction to SQVE-MV-ET-01

To address the challenges highlighted in modern structural engineering practice, particularly increasing complexity, reduced timelines, and the critical need for robust quality assurance, SQVE has initiated the development of specialized engineering tools.

As a first step in this direction, we present: SQVE-MV-ET-01 – Model Verification Tool for ETABS

This tool is specifically designed to assist structural engineers in performing systematic, fast, and reliable model verification as a key component of Quality Assurance (QA/QC).

5. Phased Development Strategy

Recognizing the wide scope of model verification, the tool is being developed in phases.

- ✓ Phase 1 (Current Release – Version 1.0)

Focuses on critical and high-impact verification checks that are essential for ensuring model correctness and structural behavior.

6. Scope of Checks – Phase 1

The tool performs automated verification across the following three major categories:

A. Mass & Model Definition Checks

- Mass source verification
- Mass source direction check
- Story mass validation
- Adjacent story mass difference check

Wrong mass definition can distort the entire structural behavior.

B. Seismic Load & Base Shear Checks

- Seismic load pattern verification
- Maximum base shear value check
- Base shear comparison with gravity loads
- Vertical seismic force check

Reliable seismic design starts with accurate base shear evaluation.

C. Response Spectrum & Dynamic Behavior Checks

- Presence of response spectrum load cases
- Maximum base shear for response spectrum
- Response spectrum scaling verification
- Dynamic behavior assessment
- 65% mass participation check
- 90% mass participation check
- Torsional mode identification
- Closely spaced modes check
- Torsional eccentricity check

Under tight deadlines, missing dynamic checks can lead to critical seismic behavior being overlooked.

7. Key Features & Benefits

Once the structural model analysis is completed, the tool performs **automated verification of all critical checks** and generates a **comprehensive report within seconds**. The report provides **detailed explanations for each verification check**, highlights **warnings and critical observations**, and offers **clear recommendations for further engineering action**, enabling engineers to quickly understand and act on key aspects of the model.
The tool is designed to support engineers across **multiple stages of the project lifecycle**, including model development, iterative analysis, self-checking, senior-level review, and proof-checking by third-party consultants. It delivers **instant insights into structural behavior** without requiring **navigation through multiple ETABS tables**, **manual extraction of results**, or **time-consuming graphical checks**, thereby simplifying the overall verification process.

Built as a **lightweight and high-performance solution**, the tool ensures **fast execution while maintaining reliability and safety**. It operates in a **read-only mode** and does **not modify the ETABS model**, eliminating any risk of unintended changes. At the same time, it enforces a **consistent QA/QC methodology** and ensures that **critical checks are not missed** during the verification process.

By automating repetitive verification tasks, the tool significantly reduces manual effort and **saves approximately 20 minutes per iteration**, depending on model complexity. This allows engineers to focus more on **engineering judgment and decision-making** rather than routine checking activities, improving both efficiency and productivity.

The tool is particularly useful for **quick validation during model development**, **iterative checking during trial-and-error modeling**, **pre-review before submission**, and **rapid screening during design reviews**. It also supports **internal QA/QC workflows** and **independent model reviews**, making it a valuable aid across different engineering roles.

Overall, the tool helps **identify critical issues at early stages**, **improves model quality and reliability**, and enables **faster, more confident engineering decisions**. It transforms model verification into a **structured, efficient, and dependable process** aligned with modern engineering practices.

"SQVE-MV-ET-01 transforms model verification into a fast, structured, and reliable process, enabling engineers to focus on critical design decisions."

The detailed output generated by the software is provided in ***Annexure A.***

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8. Important Notes & Limitations

This tool currently performs limited checks (Phase 1 scope) and is not a complete model verification system. The results generated are indicative in nature and intended for preliminary assessment only

- Accuracy of results depends on Model inputs, ETABS settings & Analysis conditions

- The verification logic is based on generalized modeling practices
- Certain project-specific conditions and complexities may not be fully captured
- This tool is designed to assist engineers, but does NOT replace engineering judgment
- All outputs must be reviewed and validated by a qualified structural engineer

The objective of the tool is to:

- Highlight critical modeling aspects
- Identify potential areas requiring attention
- Enable focused and efficient model review

The tool will be continuously refined and enhanced based on feedback from practicing engineers.

9. Software Dependency

- Developed using ETABS API integration
- Built on .NET Standard 2.0 framework (DLL-based architecture)
- Tested and validated with:
    - ETABS Version 22
    - ETABS Version 23

⚠️ The tool may not function correctly for ETABS versions below v22

10. Free Trial & Flexible Upgrade Options

🎯 **30-Day Free Trial Period:**

✓ Install and use the software free of cost for 30 days.
✓ Evaluate the tool using your own ETABS models and workflows.
✓ Helps consultants understand the practical benefits before subscription.

🔄 **Flexible Upgrade Options:**

✓ After completion of the free trial period, users can upgrade to:
- 1-Month Plan
- 6-Month Plan
- 12-Month Plan

✓ Flexible subscription options based on project requirements and usage needs.

11. Access Link for 30-Day Free Trial

Register using the link below to get access to the 30-day free trial version of the software.

https://sqve-academy.thinkific.com/courses/sqve-mv-et-01

Once registered, you will receive complete access to:

- ✓ Software download link
- ✓ Recorded demonstration videos
- ✓ Software brochure and features
- ✓ Installation procedure
- ✓ License key generation process
- ✓ User guidance and support information

All relevant information and resources required to start using the software are available through this registration link.

12. Pricing & Licensing

License Cost (Exclusive of GST)

Duration	Price
1 Month	₹2,000 + GST
6 Months	₹10,000 + GST
12 Months	₹18,000 + GST

GST (18%) will be applicable as per government regulations. GST credit can be availed by registered businesses.

Team / Multi-License Discounts

Attractive discounts are available for organizations and teams:

- 2 to 5 Licenses → 20% Discount
- 6 or More Licenses → 30% Discount

Discount is applied on the base license cost before GST.

Sample Cost Calculation (For Clarity)

Case 1: 1 License (6-Month Plan)

Base Cost = ₹10,000 × 1 = ₹10,000

GST (18%) = ₹1,800

Total Payable = ₹11,800

Case 2: 3 Licenses (6-Month Plan)

Base Cost = ₹10,000 × 3 = ₹30,000

Discount (20%) = ₹6,000

Discounted Cost = ₹24,000

GST (18%) = ₹4,320

Total Payable = ₹28,320

13. How to Purchase a License

Step 1: Select Your Plan

Choose: Duration → 1 Month / 6 Months / 12 Months

Number of Licenses

Step 2: Make Payment

Payment link for different options:

1. 1 License | 1 month
2. 1 License | 6 months
3. 1 License | 12 months
4. Customised option
    - To confirm the total cost for more than one licenses, please connect with us at: apps@sqveconsultants.com.

Step 3: Installation & Activation

After payment, you will receive:

- Software installation link
- License activation instructions
- Further onboarding guidance

14. Support & Assistance

For any queries related to pricing, licensing, or payment:

📧 Email: apps@sqvconsultants.com

ANNEXURE A

Automated Model Verification Report

(Detailed Output)

STRUCTURAL MODEL VERIFICATION REPORT

Automated Structural Model Verification Tool for ETABS | SQVE-MV-ET-01 | Ver 1.0

Model File : D:\1-Tech\Software demo\1-Tall building\1-Tall building.EDB

Report Generated : 28-Mar-2026 20:09:51

1. INTRODUCTION

Model verification is a key step in structural quality assurance.

The Structural Model Verification Tool performs automated checks on selected parameters of the ETABS model to assist engineers in reviewing model consistency and identifying potential issues at an early stage.

This report presents the results of Phase-1 verification checks.
Additional automated checks will be incorporated in future versions of the tool
to further enhance the reliability of structural model review.

2. MASS SOURCE VERIFICATION

ℹ Note:

The following mass source multipliers correspond to different load patterns defined in the model.

The user should verify that appropriate scale factors are assigned, and that no relevant load pattern is omitted from the mass source definition.

Mass Source Multipliers for different Load Patterns :

Dead : 1.00

Live : 0.50

ℹ Note:

For ready reference, the total dead load, live load, and reduced live load considered in the structure are presented below.
These values help in verifying the magnitude of gravity loads contributing to seismic mass.

Total Dead Load : 293340.69 kN

Total Live Load : 122880.00 kN

Reduced Live Load : 61440.00 kN

Total Gravity Load Used for Mass Calculation : 354780.69 kN

ℹ Note:

The structural mass calculated from applied gravity loads is compared with the mass extracted from the ETABS joint mass table.
This comparison helps identify inconsistencies in mass modeling or load application.

Calculated Structural Mass (from loads) : 36165208.23 kg

ETABS Mass Source (from Joint Mass Table) : 36177674.30 kg

ℹ Note:

Following shows the percentage difference between mass calculated from applied loads and that obtained from joint masses.

Mass Difference : 0.03 %

✓ Result : PASS

Mass source definition appears consistent with applied loads in one of the directions.

---

3. MASS SOURCE DIRECTION CHECK

ℹ Note:

As per structural dynamics principles, seismic mass should be considered in all three translational directions (UX, UY, and UZ).

The following values show the total mass in each direction for ready reference and user verification.

Total UX Mass (kg) : 36177674.30

Total UY Mass (kg) : 36177674.30

Total UZ Mass (kg) : 0.00

⚠ WARNING : Vertical mass is absent.

→ Recommendation : If vertical earthquake effects

are required to be considered as per the IS code provisions,

please enable vertical mass in the ETABS Mass Source definition.

---

4. STORY MASS CHECK

ℹ Note:

The following values represent story-wise seismic mass, taken as the maximum of mass values in UX, UY, and UZ directions.

Since mass is defined generally in three directions (UX, UY, and UZ), the maximum value among these is reported for each story.

The user should verify that the mass distribution is reasonable

and consistent across similar floors.

Story30 : 1045097.30 kg

Story29 : 1205922.40 kg

Story28 : 1205922.40 kg

Story27 : 1205922.40 kg

Story26 : 1205922.40 kg

Story25 : 1205922.40 kg

Story24 : 1205922.40 kg

Story23 : 1205922.40 kg

Story22 : 1205922.40 kg

Story21 : 1205922.40 kg

Story20 : 1205922.40 kg

Story19 : 1205922.40 kg

Story18 : 1205922.40 kg

Story17 : 1205922.40 kg

Story16 : 1205922.40 kg

Story15 : 1205922.40 kg

Story14 : 1205922.40 kg

Story13 : 1205922.40 kg

Story12 : 1205922.40 kg

Story11 : 1205922.40 kg

Story10 : 1205922.40 kg

Story9 : 1205922.40 kg

Story8 : 1205922.40 kg

Story7 : 1205922.40 kg

Story6 : 1205922.40 kg

Story5 : 1205922.40 kg

Story4 : 1205922.40 kg

Story3 : 1205922.40 kg

Story2 : 1205922.40 kg

Story1 : 1205922.40 kg

Base : 160827.40 kg

---

5. ADJACENT STORY MASS DIFFERENCE CHECK

ℹ Note:

For ready reference of the user, percentage difference in mass is also calculated for adjacent stories.

This provides an immediate indication of any inconsistencies in mass distribution.

Large variations may indicate modelling inconsistencies such as

missing loads, incorrect load assignment, or irregular geometry.

This will also help in identifying mass irregularities as per IS code provisions.

Base <-> **Story1** : 86.66 %

Story1 <-> **Story2** : 0.00 %

Story2 <-> **Story3** : 0.00 %

Story3 <-> **Story4** : 0.00 %

Story4 <-> **Story5** : 0.00 %

Story5 <-> **Story6** : 0.00 %

Story6 <-> Story7 : 0.00 %

Story7 <-> Story8 : 0.00 %

Story8 <-> Story9 : 0.00 %

Story9 <-> Story10 : 0.00 %

Story10 <-> Story11 : 0.00 %

Story11 <-> Story12 : 0.00 %

Story12 <-> Story13 : 0.00 %

Story13 <-> Story14 : 0.00 %

Story14 <-> Story15 : 0.00 %

Story15 <-> Story16 : 0.00 %

Story16 <-> Story17 : 0.00 %

Story17 <-> Story18 : 0.00 %

Story18 <-> Story19 : 0.00 %

Story19 <-> Story20 : 0.00 %

Story20 <-> Story21 : 0.00 %

Story21 <-> Story22 : 0.00 %

Story22 <-> Story23 : 0.00 %

Story23 <-> Story24 : 0.00 %

Story24 <-> Story25 : 0.00 %

Story25 <-> Story26 : 0.00 %

Story26 <-> Story27 : 0.00 %

Story27 <-> Story28 : 0.00 %

Story28 <-> Story29 : 0.00 %

Story29 <-> Story30 : 13.34 %

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6. SEISMIC LOAD PATTERNS | IS 1893 (PART 1)- 2016

ℹ Note:

The following seismic load patterns are defined in the model and are listed below for user reference.

In the subsequent sections, the total applied seismic load in the model will be cross-checked for verification.

Detected 'Seismic' Load Pattern : EQX

Detected 'Seismic' Load Pattern : EQy

Detected 'Seismic' Load Pattern : RSX

Detected 'Seismic' Load Pattern : RSY

---

7. MAXIMUM BASE SHEAR

ℹ Note:

The following values represent the maximum base shear in X, Y, and Z directions, extracted from all seismic load cases in the model.

These are envelope values and do not correspond to any single load case, but represent the maximum response observed in each direction.

Vx(max) : 9432.46 kN

Vy(max) : 8476.88 kN

Vz(max) : 0.00 kN

ℹ Note:

The total gravity load reported below represents the sum of total dead load and reduced live load considered for seismic mass calculation in the above sections.

Total Gravity Load (W) : 354780.69 kN

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8. RATIO OF BASE SHEAR TO GRAVITY LOAD

ℹ Note:

The following values represent the ratio of maximum base shear to total gravity load, as calculated in the above sections.

These percentages indicate the magnitude of seismic forces applied in the model relative to the total vertical load of the structure.

This ratio provides a quick understanding of the proportion of lateral forces acting on the structure with respect to gravity loads.

These values may also be cross-checked manually using the seismic coefficient as per IS 1893, given by (Z/2) × (I/R) × (Sa/g), based on the fundamental time period of the structure.

Vx(max) / W : 0.0266 (2.66 %)

Vy(max) / W : 0.0239 (2.39 %)

Vz(max) / W : 0.0000 (0.00 %)

---

9. RESPONSE SPECTRUM LOAD CASES DETECTED

ℹ Note:

The following response spectrum load cases are identified in the model.

In the subsequent sections, the base shear obtained from these load cases will be reviewed, and scaling of the response spectrum loads will be checked.

Response Spectrum Load Case : RSX

Response Spectrum Load Case : RSY

---

10. MAXIMUM BASE SHEAR FOR RESPONSE SPECTRUM LOADS

ℹ Note:

The following values represent the maximum base shear obtained

from all defined response spectrum load cases in the model.

These are envelope values, indicating the maximum response

in X, Y, and Z directions across different response spectrum load cases,

and do not correspond to any individual load case.

Vx(RS max) : 4976.00 kN

Vy(RS max) : 4876.64 kN

Vz(RS max) : 0.00 kN

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11. RESPONSE SPECTRUM SCALING CHECK

ℹ Note:

In this section, the maximum base shear obtained from response spectrum load cases

is compared with the maximum base shear from equivalent static analysis.

Based on this comparison, the response spectrum scaling check is performed.

This check is essential to ensure proper consideration of seismic forces,

Static Base Shear X : 9432.46 kN

Static Base Shear Y : 8476.88 kN

Response Spectrum Base Shear X : 4976.00 kN

Response Spectrum Base Shear Y : 4876.64 kN

Scaling Check Criterion :

Response spectrum base shear should not be

less than equivalent static base shear.

⚠ WARNING : Response spectrum scaling not satisfied.

→ Recommendation : Apply a suitable scale factor so that the response spectrum base shear

is not less than the equivalent static base shear as per code requirements.

The scaled response spectrum forces should be used only for strength design.

Response spectrum load cases defined exclusively for drift evaluation

do not require scaling, provided they are not used for strength design.

---

12. VERTICAL SEISMIC FORCE CHECK

ℹ Note:

In this section, a check is performed to verify whether vertical seismic force is considered in the model.

⚠ WARNING:Vertical seismic force not detected.

→ Recommendation : Check whether vertical earthquake load

is required as per IS 1893.

---

13. 65% MASS PARTICIPATION CHECK | TORSION MODE CHECK

ℹ Note:

In this section, the mass participation of initial translational modes

in X and Y directions is evaluated.

The position of torsional mode shapes is also reviewed

with respect to the translational mode shapes

to identify any irregular behavior.

ℹ Note:

Classification of modes :

Mode classification is performed based on mass participation

in translational (UX, UY) and rotational (RZ) directions.

Pure Translational Mode :

A mode is classified as a pure translational mode when

mass participation is dominant in a single translational direction

(UX or UY), while participation in rotational direction (RZ)

and the other translational direction remains negligible.

Mixed Mode :

A mode is classified as a mixed mode when there is

significant mass participation in translational direction(s)

along with noticeable participation in rotational direction (RZ),

or when participation is distributed across multiple directions.

Torsional Mode :

A mode is classified as a torsional mode when mass participation

is dominant in rotational direction (RZ), while participation in translational directions (UX and UY) is negligible.

Other Modes :

Modes having negligible mass participation in both

translational and rotational directions are classified

as 'Other' modes in this document.

Mode Classification Summary :

Mode 1 → Mixed (Translation + Torsion) | 3.75 sec

Mode 2 → Mixed (Translationa X & Y) | 3.2 sec

Mode 3 → Mixed (Translation + Torsion) | 2.27 sec

First three translational modes used :

Mode 1

Mode 2

Mode 3

Cumulative participation :

UX : 0.68*100 (%)

UY : 0.71*100 (%)

✓ Result: PASS

65% of mass participation is achieved

in both the directions.

⚠ WARNING: Mixed mode detected among early modes.

➜ Recommendation : Review the plan stiffness distribution,

mass–stiffness eccentricity, structural symmetry,

and diaphragm modelling to minimize unintended

torsional response in the structure.

14. CLOSELY SPACED MODES CHECK

ℹ Note:

In the following section, the closely spaced modes check is performed considering only the first three mode shapes.

However, if higher modes exhibit significant mass participation, they should also be reviewed for potential closely spaced behavior.

Modes considered :

Mode 1 : 3.75 sec

Mode 2 : 3.2 sec

Mode 3 : 2.27 sec

Required minimum separation : 10%

✓ Result: PASS

Message : Modal separation greater than 10%.

15. 90% MASS PARTICIPATION CHECK

ℹ Note:

In this section, the cumulative mass participation in X, Y, and Z directions is evaluated.

A minimum mass participation of 90% is required in each direction
as per code recommendations.

Mass participation has a direct influence on the accuracy of seismic force estimation,
and hence it is essential to achieve at least 90% participation in all directions.

Further recommendations are provided based on the results of this check.

Total modes considered : 30

Maximum frequency achieved : 11.27 Hz

Modal analysis type : Eigenvalue Analysis

Cumulative Mass Participation :

UX : 98 %

UY : 98 %

UZ : 0 %

Minimum required : 90%

Number of modes required to reach 90% mass :

UX : Mode 10

UY : Mode 9

UZ : Mode | Not reached

⚠ WARNING: Vertical seismic force is absent.

→ Recommendation :

Verify whether vertical seismic force is required as per IS 1893 provisions.

If applicable, ensure that vertical mass is included in the Mass Source definition
by enabling the 'Include Vertical Mass' option in the model.

If vertical mass is already enabled, consider increasing the number of modes to ensure adequate mass participation in the vertical direction.

---

16. TORSIONAL ECCENTRICITY CHECK RESULTS

ℹ **Note:**

IS 1893 Torsional Eccentricity Requirement :

As per IS 1893 (Part 1)-2016, torsional effects shall be considered using two eccentricity conditions for each horizontal direction.

Therefore, a minimum of two response spectrum load cases in X direction and two load cases in Y direction should be defined to represent positive and negative torsional eccentricity.

To account for eccentricity as per IS code, override diaphragm eccentricity values must be specified in the software.

In this section, a check is performed to verify whether the required override eccentricity values have been properly defined in the model.

Response Spectrum Cases Detected :

RS Case : RSX

RS Case : RSY

⚠ WARNING : Torsional eccentricity override not detected

for Response spectrum load case in X direction.

⚠ WARNING : Torsional eccentricity override not detected

for Response spectrum load case in Y direction.

---

17. SUMMARY OF WARNINGS

ℹ Note:

This section provides a consolidated summary of all warnings

identified in the report for quick reference.

Each warning listed below corresponds to a specific check

performed by this application.

For detailed explanation, associated calculations, and

recommended actions, refer to the respective sections

in the report.

⚠ 1. WARNING : Vertical mass is absent.

⚠ 2. WARNING : Response spectrum scaling not satisfied.

⚠ 3. WARNING:Vertical seismic force not detected.

⚠ 4. WARNING: Mixed mode detected among early modes.

⚠ 5. WARNING: Vertical seismic force is absent.

⚠ 6. WARNING : Torsional eccentricity override not detected

⚠ 7. WARNING : Torsional eccentricity override not detected

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18. IMPORTANT NOTE

This report provides a quick automated review of selected aspects of the ETABS structural model.
The information presented here is intended only as preliminary guidance to help identify potential areas that may require further attention during model review.

This tool does NOT replace a detailed engineering review of the structural model.
Only a limited set of checks are currently implemented, and engineering judgement should always be exercised while interpreting the results.

The purpose of this tool is to assist engineers in identifying critical modeling aspects and to help focus attention on specific areas of the model.

The logic implemented in this tool will continue to be refined and expanded based on feedback received from practicing engineers.

For suggestions, queries, or feedback, please contact :

apps@sqveconsultants.com

Total processing time of modal verification tool : 1.187 seconds