"Design and Development of a Footing Analysis Application with Comparative Study Using Staad pro."

[1] Prof V.O.Shirsat , [2] Ashish Taware , [3] Devendra Jadhav,[4] Harshvardhan Gaikwad, [5]AdityaThorat

Department of Civil Engineering, Maharashtra, India

JSPM'S RSCOE Polytechnic, Tathawade, Pune – 33

Abstract: Due to rapid growth of population in urban areas, the demand for housing and commercial spaces has increased significantly. Since land availability is limited and land prices are very high in cities, multi-storey and high-rise buildings have become the most practical solution. These buildings help in increasing usable floor area without increasing land area and also represent the economic development of a city. However, the safety and stability of such structures mainly depend on the type of foundation system used.

Every building transfers its load to the ground through its foundation, and the behavior of the structure is closely linked with the soil beneath it. This interaction between soil, foundation, and structure, known as soil–structure interaction, plays an important role during conditions such as earthquakes and uneven settlement. Therefore, proper understanding of soil properties and structural loads is essential while selecting a foundation

1.Introduction

Rapid population growth in urban areas and the high cost of land have increased the need for multi-storey and high-rise buildings. These buildings help to maximize usable space without increasing land area and have also become symbols of a city's economic growth and identity. Modern high-rise structures are constructed using steel and reinforced concrete, along with advanced structural systems such as flat slabs and flat plates, which offer architectural and structural advantages.

Every building transfers its load to the ground through its foundation, and during events like earthquakes, the movement of the structure and the soil affect each other. This interaction, known as soil–structure interaction (SSI), plays an important role in the behavior of tall buildings, as soil properties can influence forces and moments in structural members.

High-rise buildings are subjected to heavy vertical and lateral loads, so a strong and well-designed foundation is essential to control settlement and ensure safety. Commonly used foundations for such structures include raft foundations, compensated rafts, pile foundations, and piled raft foundations. Proper selection of the foundation system is critical for the stability and long-term performance of high-rise buildings.

2. OBJECTIVES :-

1. To study structural analysis and design calculations of any structural plan using STAAD.Pro software under different loading conditions.

2.To develop a user-friendly website application for structural analysis and design calculations.

3. To compare the results obtained from the developed application with STAAD.Pro outputs for validation and accuracy assessment.

4.Time reduction due to application website generation

5.Psychological stress reduction through automatic complex calculations

6.Future prediction of design flaws

3.literature review

1. **S.G. Markarande (2019)**

   "A Review on Comparative Study on Analysis of a Conventional Multi-Storey Building & a Single Column Building'' JETIR, Volume 6, Issue .

2. **Jayesh magar (2020)**

   Study and Analysis of Types of Foundation and Design Construction'' International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056.

3. **Ms.Rawale(2022)**

   multiple-story building with and without a floating column: a comparative study''IJARIIE-ISSN(O)-2395-4396.

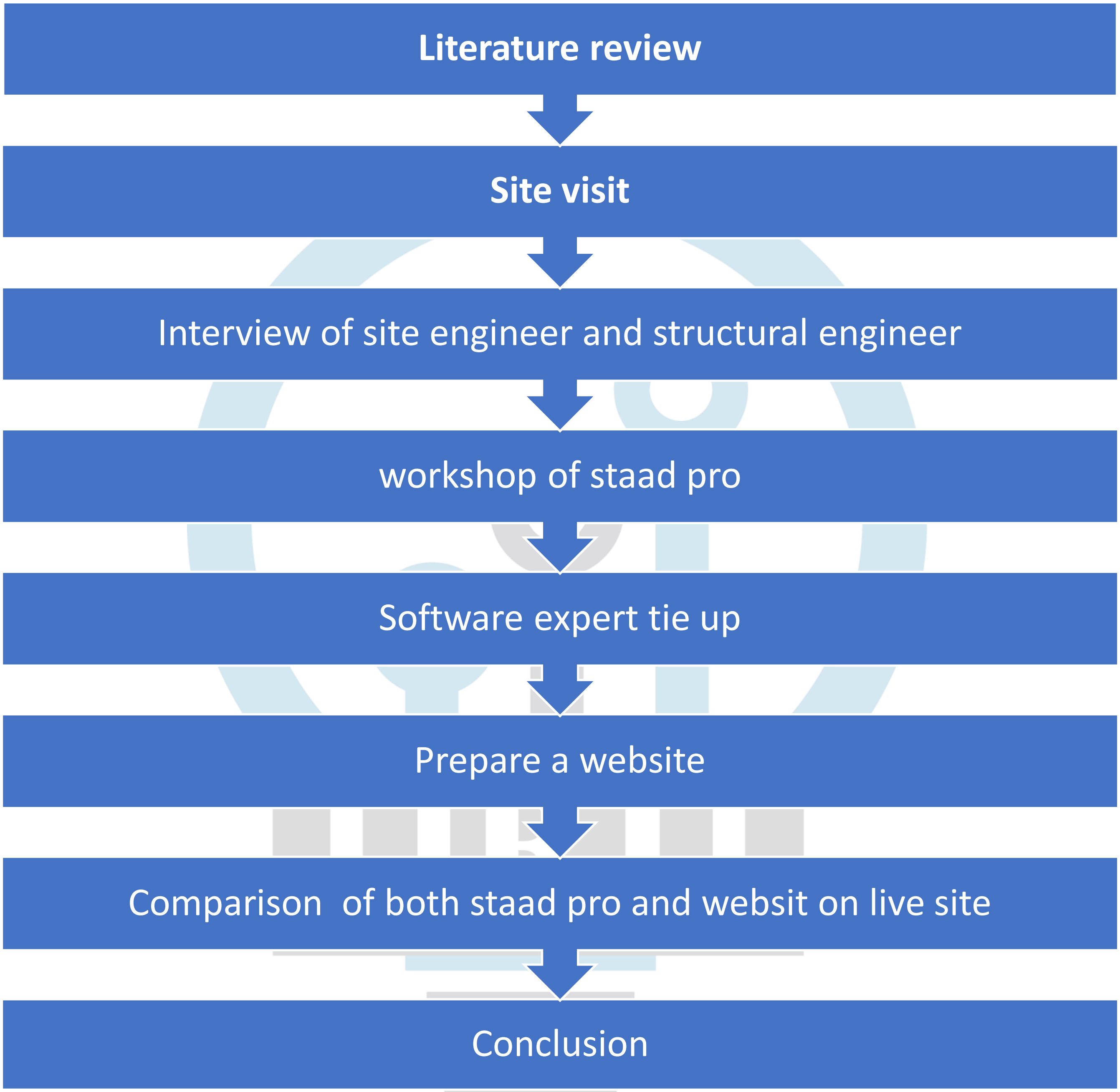
4. **Muhammad Suliman(2022)**

   Comparative study of different types of Foundations for High-rise building" Proceedings of the 2nd International Conference on Recent Advances in Civil Engineering and Disaster Management.

5. **Bhavin Ramesh waghela (2023)**

   Comparison of Building with and Without Foundation Resting on Soft Soil''IJRTI | Volume 8, Issue 4 | ISSN: 2456-3315.

4. Methodology



5. Site selection

We have selected only two sites as they are located in close proximity, maintain a good professional relationship with the site engineer, and are suitable and accessible for all team members.

- **Now we are focusing on commercial site**

1. **Devbaug resort**

6. Preparation of website

Our website was developed as a **structural footing design tool** to help calculate soil pressure, shear, moment, and reinforcement requirements for footings. We built it using **modern web technologies** and deployed it online so anyone can access it easily.

1. **Planning and Design**
   First, we planned what the website should do. We listed all the **inputs** needed from the user like footing size, loads (Pu, Mx, Mz), and soil properties. We also decided what **outputs** the site should show like soil pressure results, shear checks, and design safety messages.
2. **Choosing Tools and Technologies**
   We chose a **frontend framework** to build the user interface. The design is **responsive and easy to use**. All calculations and visualizations were done using **JavaScript functions** that run directly in the browser.
3. **Building the Input Form**
   We created input forms where the user can enter all necessary parameters:
   - Footing geometry
   - Applied loads
   - Soil safe bearing capacity and properties

   We ensured all inputs are validated so users cannot enter invalid values.

4. **Writing the Calculation Logic**
   We wrote the **calculation code** to compute:
   - Load normalization
   - Pressure distribution
   - One-way shear check
   - Punching shear check
   - Flexural moment and reinforcement
   - Development length check

   These calculations follow engineering formulas based on structural design principles.

5. **Displaying Results**
   After the user submits the form, the site:
   - Computes each step
   - Displays clear results
   - Highlights if any design checks fail
   - Shows safe/unsafe messages with values
6. **Comparison with STAAD.Pro**
   We added a feature to **compare results** from our calculations with **STAAD.Pro outputs** to check accuracy and reliability.
7. **Testing and Debugging**
   We tested the website with different input values to ensure the results were correct and consistent. We fixed bugs and optimized the UI for better user experience.
8. **Deployment on Vercel**
   Finally, we deployed the website online using **Vercel**. This gives the tool a live public link so users can access it from anywhere.

   The website is hosted at:
   https://footing-three.vercel.app

7.Information about of website

The process starts with **user input of footing geometry**, such as length, width, and depth. Then, the **applied loads** on the column (axial load *Pu* and moments *Mx* and *Mz*) are entered. After that, **soil properties and safe bearing capacity (SBC)** are provided by the user.

Next, **load normalization and pressure plane calculations** are carried out to determine how the load is transferred to the soil. Using this, the **soil pressure distribution and corner pressures** are calculated. A check is then performed to verify whether the **net soil pressure is within the safe bearing capacity**.

- If it is **not within limits**, the footing is marked as an **unsafe design**.
- If it is **safe**, the design proceeds further.

The next stage involves **one-way shear calculation at a distance 'd' from the column face**. If the footing is not safe in one-way shear, the design is modified by **increasing the depth or flagging failure**.

After passing the one-way shear check, a **punching shear check** is performed at the **critical perimeter (d/2)** around the column.

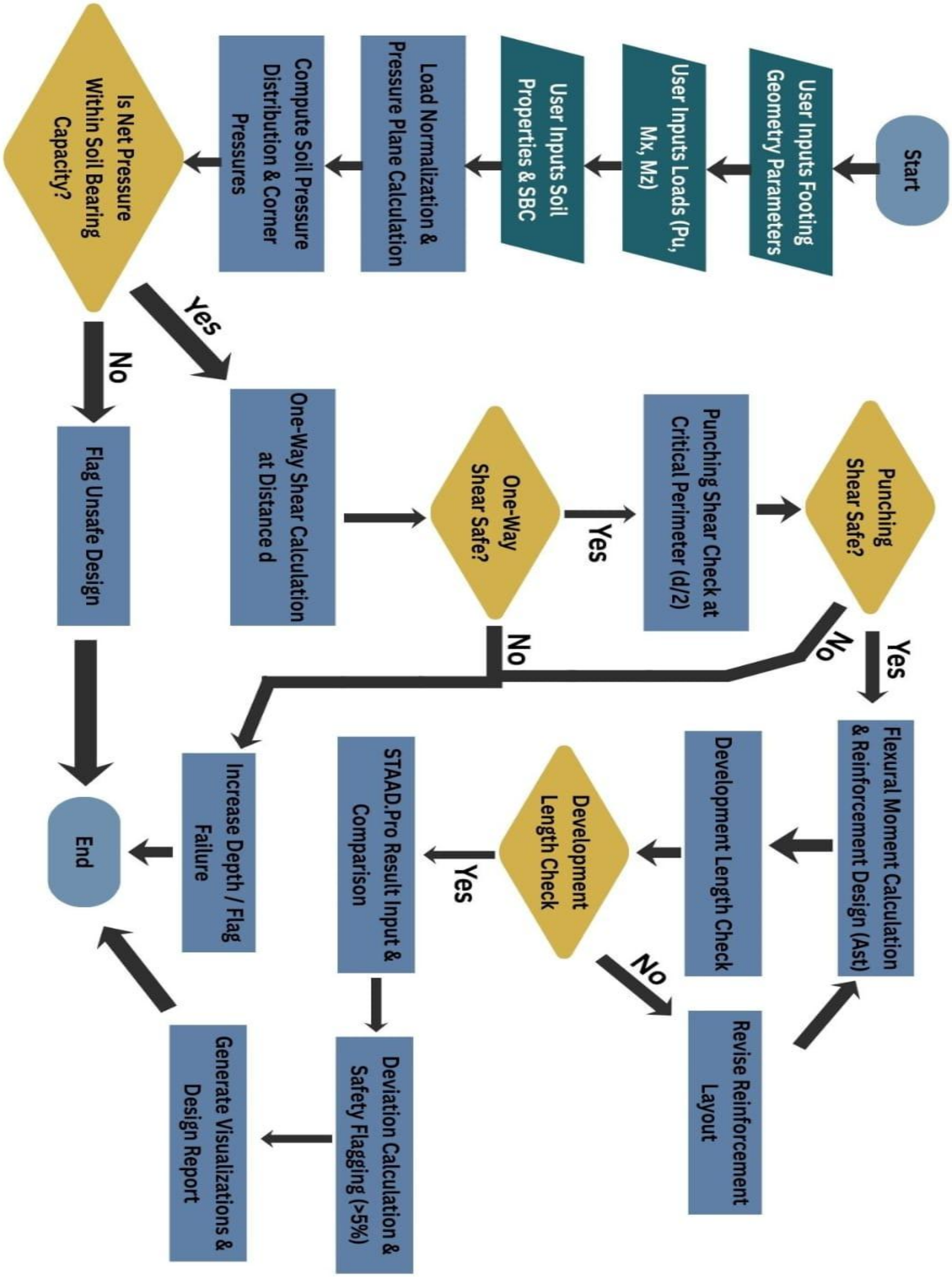
- If punching shear is unsafe, the footing depth is increased or the design is flagged as unsafe.
- If safe, the design continues.

Then, **flexural moment calculation and reinforcement design (Ast)** are carried out. A **development length check** is performed to ensure proper anchorage of reinforcement.

- If the development length is not adequate, the **reinforcement layout is revised**.

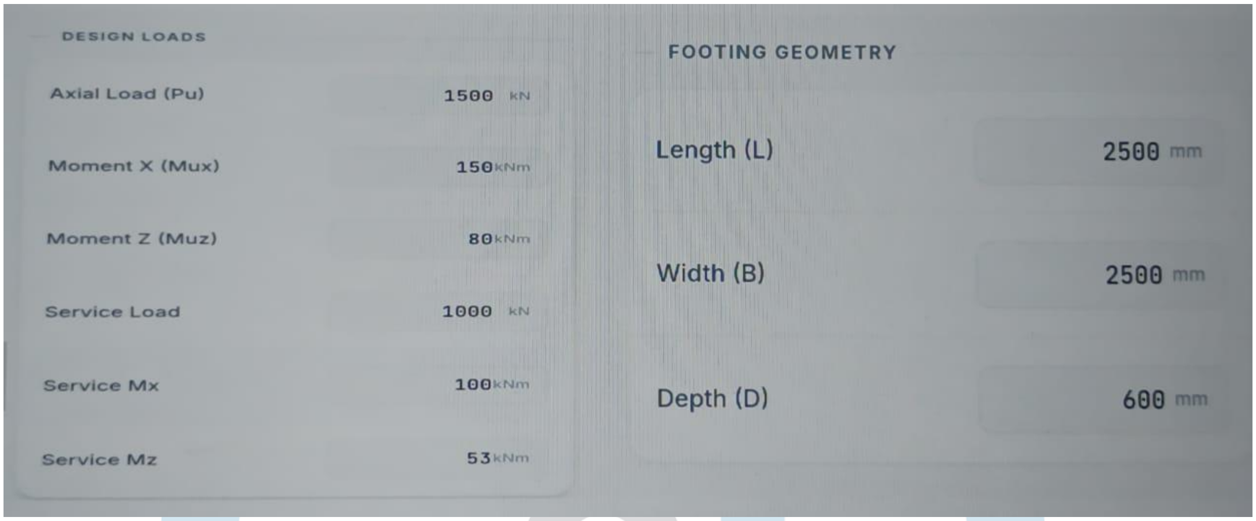
Once all checks are satisfied, the results are **compared with STAAD.Pro outputs**. Any **deviation greater than 5%** is highlighted as a safety concern.

Finally, the system **generates visualizations and a detailed design report**, and the process ends.

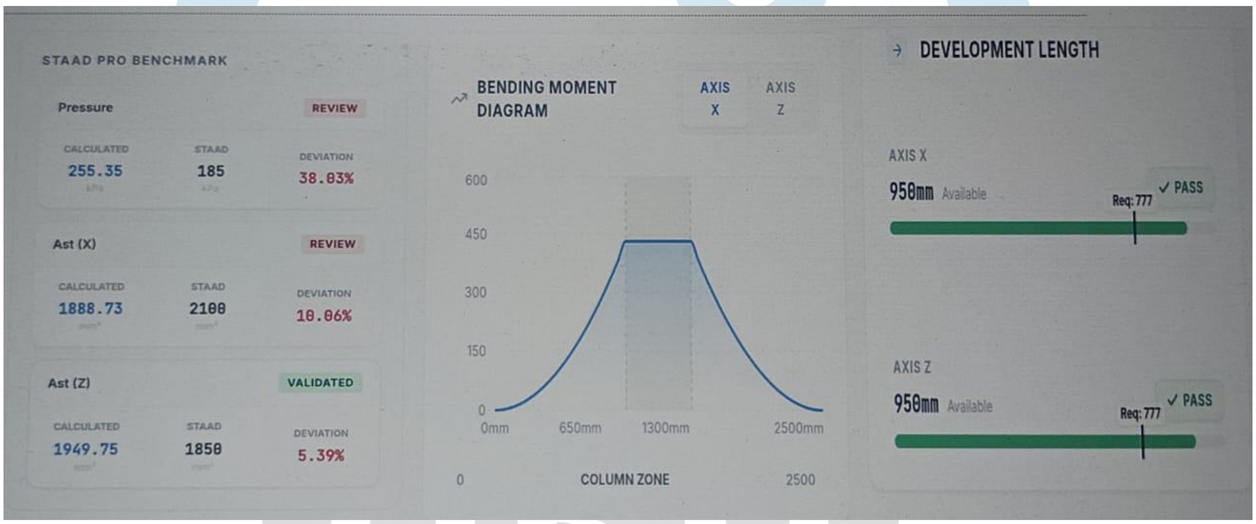


Flow chart of how website is work

7. DESIGN OF WEB SITE



8 .RESULTS AND CALCULATION



8.References

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