Structural Analysis Report

1. Introduction

This report provides an analysis of the structural model provided in the `3D-MODEL-FINALMODEL.std` file, focusing on characteristics relevant to ASCE 7-17 load calculations. The analysis aims to identify the structural system type, rigidity classification, height category, seismic criteria, and other pertinent parameters.

2. Model Overview

The provided model is a STAAD.Pro file (`3D-MODEL-FINALMODEL.std`). The job information indicates the project name as "Sponge Factory" and the engineer as "OMB". The units used in the model are Meters (M) for length and KiloNewtons (KN) for force.

2.1. Dimensions and Height

To determine the overall dimensions and height of the structure, the joint coordinates were analyzed. The coordinates are defined in a Cartesian system (X, Y, Z). The Y-coordinate typically represents the vertical direction in STAAD.Pro models.

By examining the `JOINT COORDINATES` section, the minimum and maximum values for X, Y, and Z coordinates were found:

- **X-coordinates:** Ranging from 0 to 15.96 meters.
- **Y-coordinates (Height):** Ranging from 0 to 15.345 meters (for main structure) and up to 15.195 meters (for roof level members).
- **Z-coordinates:** Ranging from 0 to 80.9 meters.

Therefore, the overall dimensions of the structure are approximately:

- **Length (Z-direction):** 80.9 meters
- **Width (X-direction):** 15.96 meters

- **Maximum Height (Y-direction):** 15.345 meters

2.2. Structural Members

The model primarily consists of frame elements, as indicated by the `MEMBER PROPERTY` and `GROUP DEFINITION` sections. The defined groups are `_FRAMES`, `_BRACING`, and `_SECONDARY` members. The member properties indicate the use of various steel sections, including American (W-shapes), European (HD-shapes), German (IPE, HEA), and Japanese (H-shapes, Tapered sections) profiles. This suggests a steel-framed structure.

No explicit plate or solid elements were identified in the provided sections, implying that the primary structural system relies on beam and column elements, potentially with bracing.

3. Structural System Analysis

3.1. Primary Lateral Force Resisting System

Based on the presence of `_FRAMES` and `_BRACING` groups, the primary lateral force resisting system appears to be a combination of **moment frames** and **braced frames**. The `_FRAMES` group likely represents beams and columns forming moment-resisting connections, while the `_BRACING` group indicates the presence of diagonal bracing elements designed to resist lateral loads.

To definitively classify the system (e.g., Ordinary Moment Frame, Special Moment Frame, Ordinary Concentrically Braced Frame, Special Concentrically Braced Frame), further details on connection types and seismic detailing would be required, which are typically not explicitly defined in a `.std` file at this level of detail. However, the presence of both frames and bracing suggests a dual system or a system where bracing provides the primary lateral resistance.

3.2. Diaphragm Rigidity

The STAAD.Pro input does not explicitly define diaphragm rigidity. However, the presence of `ONEWAY LOAD` commands for mezzanine and roof live loads, applied over `YRANGE`, suggests that floor and roof systems are modeled as one-way load distribution elements.

This often implies that the diaphragms are considered **flexible** or **semi-rigid**, where loads are distributed to the vertical lateral force resisting elements based on tributary area or stiffness, respectively. If the diaphragms were rigid, a rigid diaphragm master-slave command would typically be used, or the loads would be applied as joint loads at the center of mass of each floor. Without explicit rigid diaphragm definitions, it is prudent to assume a flexible or semi-rigid diaphragm behavior for load distribution.

3.3. Building Height Classification

The maximum height of the structure is 15.345 meters. Based on common classifications:

- **Low-rise buildings:** Typically up to 3 stories or around 10-15 meters.
- **Mid-rise buildings:** Typically 4-12 stories or around 15-40 meters.
- **High-rise buildings:** Typically over 12 stories or over 40 meters.

Given its height of 15.345 meters, this structure falls into the category of a **low-rise building**, potentially bordering on mid-rise depending on the exact definition used by local building codes or specific project requirements. For ASCE 7-17, the height is primarily used in determining seismic design parameters and wind load calculations.

4. Seismic Criteria (ASCE 7-17)

To determine the seismic criteria according to ASCE 7-17, several parameters are required. These parameters are typically site-specific and depend on the building's occupancy and structural system. The provided STAAD.Pro file does not contain explicit seismic design parameters (e.g., site class, spectral response accelerations Ss and S1, seismic design category). However, it does define `FYLD` values for different member groups, which are yield strengths of the steel. This indicates that the design is considering material properties relevant to seismic performance.

To complete the seismic criteria, the following information would be needed:

- **Site Class:** This is determined by the soil properties at the building's location (e.g., A, B, C, D, E, F). This significantly impacts the ground motion parameters.

- **Mapped Spectral Response Accelerations (Ss and S1):** These values are obtained from seismic hazard maps (e.g., USGS maps) based on the building's geographic coordinates.
- **Seismic Design Category (SDC):** Determined based on the Occupancy Category and the values of SDS and SD1 (derived from Ss, S1, and site class). The SDC dictates the seismic design and detailing requirements.
- **Importance Factor (Ie):** This factor reflects the occupancy and use of the building (e.g., Ie=1.0 for standard occupancy, Ie=1.25 for essential facilities, Ie=1.5 for hazardous facilities). The

Occupancy Category is crucial for determining the Seismic Design Category and the seismic forces.

- **Response Modification Factor (R), Overstrength Factor (Ω0), and Deflection Amplification Factor (Cd):** These factors are dependent on the type of seismic force-resisting system (e.g., moment frames, braced frames, shear walls) and its detailing. Since the model indicates a steel-framed structure with both frames and bracing, the specific values for R, Ω0, and Cd would be selected from ASCE 7-17 Table 12.2-1 based on the precise classification of the lateral force resisting system (e.g., Special Moment Frame, Ordinary Concentrically Braced Frame, etc.). Without explicit detailing information, a definitive selection cannot be made from the STAAD.Pro file alone.

Conclusion for Seismic Criteria: The provided STAAD.Pro file defines material properties and member groups, but it does not contain the necessary site-specific or occupancy-specific data to fully determine the ASCE 7-17 seismic criteria (Site Class, Ss, S1, SDC, Ie). These parameters would need to be provided separately based on the project's location and intended use.

4.1. Special Items or Irregularities

ASCE 7-17 Section 12.3 identifies various types of structural irregularities that can significantly affect seismic performance and require special consideration in design. These irregularities are categorized as either horizontal or vertical.

Based on a review of the joint coordinates and member connectivity in the STAAD.Pro file, the following observations can be made regarding potential irregularities:

- **Plan Irregularity (Horizontal):** The structure appears to have a rectangular footprint based on the range of X and Z coordinates. There are no immediate indications of significant re-entrant corners, diaphragm discontinuities, or out-of-plane offsets in the lateral force-resisting elements that would suggest a Type 1a (Torsional Irregularity), Type 1b (Extreme Torsional Irregularity), Type 2 (Re-entrant Corner), Type 3 (Diaphragm Discontinuity), or Type 4 (Out-of-Plane Offset) horizontal irregularity. However, a detailed plan view and analysis of the mass and stiffness distribution would be required for a definitive assessment.
- **Vertical Irregularity:** The Y-coordinates indicate multiple floor levels. The `MEMBER PROPERTY` section shows different member sizes and types (American, European, German, Japanese sections, and tapered sections) assigned to various members. This variation in member properties across different levels could potentially lead to vertical irregularities such as:
    - **Stiffness Irregularity (Soft Story - Type 1a or Extreme Soft Story - Type 1b):** A sudden reduction in lateral stiffness in a story relative to the story above. This would require a story-by-story stiffness analysis.
    - **Weight (Mass) Irregularity (Type 2):** A significant change in effective mass from one story to an adjacent story. This would require a detailed mass distribution analysis.
    - **Vertical Geometric Irregularity (Type 3):** An abrupt change in the horizontal dimension of the lateral force-resisting system. The provided coordinates do not immediately suggest this, but a visual inspection of the model would be more conclusive.
    - **In-Plane Discontinuity in Vertical Lateral Force-Resisting Elements (Type 4):** Discontinuities in vertical elements, such as shear walls or braced frames, from one story to the next. The presence of `_BRACING` and `_FRAMES` groups suggests a continuous system, but specific member connectivity would need to be verified.
    - **Discontinuity in Capacity – Weak Story (Type 5):** A story in which the story lateral strength is less than that of the story above. This requires a strength-based analysis.

Without a visual representation of the model or further analysis results (e.g., story stiffness, mass distribution, strength ratios), a definitive identification of vertical irregularities is not possible. However, the varied member properties across different levels warrant further investigation for potential vertical irregularities.

5. Summary of Building Criteria for ASCE 7-17 Load Calculations

Based on the analysis of the provided STAAD.Pro model, the following building criteria are identified or inferred for ASCE 7-17 load calculations:

- **Structure Description:** Steel-framed building with multiple levels, approximately 15.96 m (width) x 80.9 m (length) x 15.345 m (height).
- **Primary Lateral Force Resisting System:** Appears to be a combination of moment frames and braced frames. Specific classification (e.g., Special Moment Frame, Ordinary Concentrically Braced Frame) requires further detailing information.
- **Diaphragm Rigidity:** Likely flexible or semi-rigid, given the use of `ONEWAY LOAD` commands and absence of explicit rigid diaphragm definitions.
- **Height Category:** Low-rise building.
- **Seismic Criteria (ASCE 7-17):**
    - **Site Class:** Not available in the model. Requires geotechnical investigation.
    - **Mapped Spectral Response Accelerations (Ss, S1):** Not available in the model. Requires geographic location data.
    - **Seismic Design Category (SDC):** Not available in the model. Depends on Occupancy Category and spectral accelerations.
    - **Importance Factor (Ie):** Not available in the model. Depends on Occupancy Category.
    - **Response Modification Factor (R), Overstrength Factor (Ω0), Deflection Amplification Factor (Cd):** Dependent on the specific classification and detailing of the lateral force-resisting system, which is not fully detailed in the provided file.

- **Special Items/Irregularities:**
  - **Horizontal Irregularities:** No immediate indications of significant horizontal irregularities, but a detailed plan view and analysis of mass/stiffness distribution are needed for definitive assessment.
  - **Vertical Irregularities:** Potential for stiffness, mass, or strength irregularities due to varied member properties across levels. Requires further analysis (story stiffness, mass distribution, strength ratios) for definitive identification.

This report provides a preliminary assessment based on the available STAAD.Pro input. A complete ASCE 7-17 load calculation would require additional information, particularly regarding the building's location, occupancy, and detailed structural drawings to confirm connection types and seismic detailing.