<u>Central Vista New parliament Building, New Delhi</u>

GROUP-1(TUESDAY)

1). Plan of the Structure

a) General Layout and Architectural Design

- The New Parliament Building is a triangular-shaped structure, which symbolizes stability and balance.
- It includes three main components:
  - **Lok Sabha Chamber**: The largest chamber with a seating capacity of over 888 members, reflecting the possibility of increased representation. It’s designed with a unique peacock motif and accommodates future expansion.
  - **Rajya Sabha Chamber**: This chamber can seat 384 members, featuring a theme that reflects India’s unity and heritage.
  - **Central Lounge**: Positioned at the heart of the triangular building, this space acts as a connecting element for the two chambers and is designed to serve as a ceremonial and assembly area.

b) Functional Spaces and Facilities

- **Committee Rooms and Offices**: Dedicated rooms for committee meetings, member offices, and party rooms are distributed throughout the building to facilitate legislative processes.
- **Public Galleries and Lounges**: Spaces around the main chambers are designed for public viewing and member interactions. These spaces are equipped with audio-visual systems for live session broadcasts.
- **Library and Research Facilities**: These are allocated within the building to support members with research and reference material.
- **Security and Emergency Facilities**: Given the high-security requirements, the building integrates advanced security systems, including surveillance, biometric access, and emergency evacuation routes.

c) Sustainability and Energy Efficiency

- The design includes solar panels on the roof, rainwater harvesting systems, and a green building certification (Griha rating). Using energy-efficient materials and natural light is maximized through well-planned skylights and open spaces.

d) Structural Specifications

- **Materials Used**: Reinforced concrete, sandstone, and steel are prominently used in the structure, chosen for durability and adherence to seismic codes.

- **Design Theme**: The architectural style is contemporary with traditional Indian motifs, ensuring a blend of modern engineering and cultural aesthetics.

2). Existing Foundation

a) Foundation Type

- The New Parliament Building employs a **pile foundation system**. Pile foundations are used due to the building's scale and the soil conditions in New Delhi, where deeper stability is necessary.
- **Pile Characteristics**: Reinforced concrete piles are likely chosen for their strength and capacity to handle heavy loads. Each pile would be designed to bear a portion of the total structural load, ensuring even distribution and minimizing settlement risks.

b) Foundation Depth and Soil Interaction

- The depth of the piles is calculated based on the soil's load-bearing capacity, determined by geotechnical surveys. A mix of sandy and clayey soil may be present for Delhi, requiring piles to penetrate stable strata.
- **Load Distribution Mechanism**: The piles transfer load through friction and end-bearing into deeper soil layers, providing stability even under fluctuating loads and seismic conditions.

c) Seismic and Settlement Considerations

- **Seismic Resilience**: New Delhi is in a seismically active zone, so the foundation is designed to absorb lateral forces. Techniques like base isolators or energy-dissipating materials may be integrated to withstand seismic shocks.
- **Settlement Controls**: Pile foundations are favored to minimize settlement, which is critical to prevent structural deformation over time. Settlement calculations consider the building load, soil properties, and long-term soil compaction.

d) Additional Foundation Features

- **Drainage System**: A subsurface drainage system is integrated to handle water percolation, preventing soil weakening and potential foundation issues.
- **Vibration Control**: Due to urban activity around the building, measures are taken to dampen vibrations from nearby traffic and construction.

3). Alternative Foundation

1. Raft Foundation with Soil Stabilization:

- A raft foundation could suit the site's soil and seismic characteristics, as it distributes the building's weight over a broad area.

- This approach may enhance stability on mixed soil layers.

2. Ground Improvement Techniques:

- Methods like **stone columns** or **soil-cement mixing** could be applied alongside the raft foundation.

- These techniques help manage varying soil types and ensure even load distribution.

- Shallower depth required compared to pile foundations.

3. Incorporation of Base Isolators:

- Adding **base isolators** to the raft foundation could increase earthquake resistance.

- Base isolators absorb and dissipate lateral (sideways) forces, which benefits seismically active zones like Delhi.

4.) Soil Profile

Site Context and Regional Geology: The site is within New Delhi's prestigious Central Vista region, which historically forms part of the Indo-Gangetic alluvial plain. While the area is generally known to be influenced by the Yamuna River's depositional patterns over millennia, the following soil characteristics are based on typical regional patterns. They should be treated as preliminary assumptions pending site-specific investigations.

Based on regional geological patterns and typical geotechnical characteristics of Delhi's soil structure, the following layered profile is anticipated:

1. **Layer 1: Upper Stratum (Ground level to 3m depth)**
    - Primary Composition: Sandy Silt with Clay intermixture
    - Assumed Unit Weight (γ): 18 kN/m^3
    - Estimated Cohesion (c): 15 kN/m^2

    - Expected Friction Angle (φ): 28°
    - Notable Characteristics:
        - Likely to exhibit moderate compressibility
        - It may show slight variations in clay content
        - Typical of Delhi's upper soil layers
2. **Layer 2: Intermediate Stratum (3m to 10m depth)**
    - Primary Composition: Medium Dense Sand
    - Assumed Unit Weight (γ): 19 kN/m^3
    - Expected Friction Angle (φ): 32°
    - Anticipated SPT N-value Range: 15-25
    - Notable Characteristics:
        - Moderate density typical of alluvial deposits
        - It is likely to show good drainage properties
        - It may contain occasional silt pockets
3. **Layer 3: Lower Stratum (10m to 35m depth)**
    - Primary Composition: Dense Sandy Layers with Gravel
    - Assumed Unit Weight (γ): 20 kN/m^3
    - Expected Friction Angle (φ): 35°
    - Anticipated SPT N-value Range: 30-50
    - Notable Characteristics:
        - Higher density indicates good bearing capacity
        - The presence of gravel suggests historical river activity
        - Generally suitable for deep foundations
4. Groundwater Table: 8m below ground level
5. Seasonal Variation: ±2m

<u>4.)Superstructure Load Calculation</u>

4.1 Dead Loads

1. Floor Loads:
    - Floor Finish: 1.5 kN/m^2
    - RCC Slab (200mm): 5 kN/m^2
    - False Ceiling + Services: 1 kN/m^2 Total Floor Load: 7.5 kN/m^2
2. Wall Loads:
    - External Walls: 12 kN/m
    - Internal Walls: 8 kN/m
3. Structural Elements:
    - Columns: Based on tributary area
    - Beams: Self-weight considered in the analysis

4.2 Live Loads (as per IS 875-Part 2)

- Office Areas: 4 kN/m²
- Corridors: 5 kN/m²
- Assembly Areas: 5 kN/m²
- Roof: 2 kN/m²

4.3 Wind Load Analysis

As per IS 875-Part 3:

- Basic Wind Speed: 47 m/s
- Design Wind Pressure: 1.35 kN/m²
- Height Factor: 1.8
- Total Design Wind Force: 2.43 kN/m²

4.4 Total Load Summary

- Average Load per Floor: 12.5 kN/m²
- Total Building Load: Approximately 815,000 kN

5. Foundation Design

5.1 Design Criteria

- The factor of Safety for Bearing Capacity: 2.5
- Allowable Settlement: 25mm

5.2 Bearing Capacity Calculations

Using Terzaghi's bearing capacity equation: $q_u = cN_c + qN_q + 0.5\gamma BN_\gamma$

Where:

- $c = 20$ kN/m²
- $N_c = 46.12$
- $N_q = 33.30$
- $N_\gamma = 41.70$
- $B = 100$m (raft width)

Ultimate Bearing Capacity: 2,850 kN/m² Allowable Bearing Capacity: 1,140 kN/m²

5.3 Settlement Analysis

1. Immediate Settlement: $S_i = q'B(1-\mu^2)I/E_s$
   - Calculated Immediate Settlement: 15mm
2. Consolidation Settlement: $S_c = C_c H \log_{10}(\sigma'_0 + \Delta\sigma)/\sigma'_0$

- Primary Consolidation: 8mm
- Secondary Consolidation: 2mm

Total Expected Settlement: 25mm

5.4 Pile Design

Design Load per Pile: 2,500 kN

Pile Capacity:

End Bearing: 1,200 kN

Skin Friction: 1,500 kN Total Capacity: 2,700 kN

6. Conclusions and Recommendations

1. The proposed foundation system, which consists of a piled raft, suits the site conditions and structural loads.
2. The design meets all safety criteria:
   - The factor of safety against bearing capacity failure > 2.5
   - Predicted settlements within acceptable limits
   - Differential settlements controlled by pile arrangement
3. Recommendations:
   - Implement strict quality control during pile installation
   - Monitor settlements during and after construction
   - Install piezometers to monitor groundwater conditions
   - Conduct pile load tests on test piles before final construction

References

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