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NCC SIGNATURE TOWERS, CHENNAI PROJECT

FOR

NCC LIMITED

STRUCTURAL DESIGN BASIS REPORT

SUBMITTED BY

OPTIMIZATION CONSULTANTS

DOCUMENT RELEASE AUTHORIZATION

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A. INTRODUCTION

This document specifies the various design considerations and assumptions for the Structural Design for NCC Signature Towers, Chennai project. The project has seven residential towers.

B. STRUCTURAL SYSTEM

Structural system for the residential towers shall be of vertical elements (columns/shear walls), beams and slabs in reinforced cement concrete (RCC) detailed to the requirements of IS 456: 2000, IS 875 (Part 3): 2015 and IS 1893 (Part 1): 2016. Ductile detailing shall be done per IS 13920: 2016.

C. METHOD OF ANALYSIS AND DESIGN

The structure shall be modelled using ETABS software. Seismic analysis shall be per IS 1893 (Part 1): 2016 for Zone III. Wind loads shall be per IS 875 (Part3): 2015 for basis wind speed of 50 m/s. The frame structure shall be modelled as line-elements, and the shear walls shall be modelled as finite elements. Residential towers shall be analysed including the non-tower area around them.

Slabs shall be modelled as shell elements. Floor diaphragm shall be considered as rigid, as clause 7.6.4 of IS 1893 (Part 1): 2016 reads, "Usually, reinforced concrete monolithic slab-beam floors ... can be considered to be providing rigid diaphragm action". However, shall examine the flexible diaphragm condition per Fig. 6 of IS 1893 (Part 1): 2016. Stiffness modifiers for slabs shall be applied if the tensile stress exceeds the tensile strength of concrete, fcr, per clause 6.2.2 of IS 456: 2000.

Reinforcement shall be of Fe 550 D grade high strength deformed steel bars produced by thermo-mechanical treatment process having elongation more than 14.5 percent and conforming to IS 1786: 2008.

For load combinations involving seismic forces, grade of shear reinforcement shall be Fe 550 D per clause 5.3.1 (b) of IS 13920: 2016. However, for load combinations not involving seismic forces, the grade of shear reinforcement shall be restricted to Fe 415 per clause 26.5.1.6 of IS 456: 2000 and the contribution of concrete to shear strength shall be considered per clause 40.2 and Table 19 of IS 456: 2000. For columns, the design shear force capacity shall be calculated per IS 456: 2000, as stipulated in clause 7.5.1 of IS 13920: 2016.

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Mass source for seismic forces shall be all the dead loads and 25% of the live loads up to 3 kN/m^2 and 50% for live loads beyond 3 kN/m^2.

P-delta analysis shall be performed considering the same load factors as considered in mass source. The load factors for gravitational dead loads shall be 1.0 and those for live loads shall be 0.25 and 0.5, respectively, for live load up to 3 kN/m^2 and higher that 3 kN/m^2.

Thermal analysis shall be performed for temperature variation for buildings having plan dimension more than 45 m. Temperature delta of +15 degree Celsius and -15 degree Celsius shall be applied on the roof slab, though it may not experience such temperature delta due to thermal insulation in the form of roof treatment.

Non-PT floor slabs shall be designed using SAFE modelling. Deflection shall be checked per clause 23.2 (a) and 23.2 (b) of IS 456: 2000. Beam reinforcement at support (hogging) shall be designed using the bending moment at the face of support and shear force per Fig. 2 of IS 456: 2000, with bending moment and shear force values obtained from ETABS analysis. Beam reinforcement for sagging moment shall be designed considering T or L beam action per clause 23.1 of IS 456: 2000, with bending moment and shear force values obtained from ETABS analysis.

D. DEAD LOADS

The dead loads for the RCC members shall be based on a density of 25 kN/m^3. Density of concrete block-work shall be taken as 20 kN/m^3. Density of plaster shall be considered as 21 kN/m^3.

The floor finish load for typical habitable floors shall be considered as 1.0 kN/m^2. The floor-finish load for the car-park area and driveways shall be considered as 1.5 kN/m^2.

The dead load for LMR shall be per lift manufacturer's specification, with a minimum of 5 kN/m^2, along with a floor-finish load of 1.5 kN/m^2. Overhead water tank shall have a water load of 10 kN/m^2 per m of water depth.

Dead load for sunken area shall be based on the sunken depth, and light-weight fill-material density of 18 kN/m^3.

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Soil-fill load in the landscape area shall be based on the saturated soil density of 19 kN/m^3.

The terrace-floor-finish load shall be considered as 2.0 kN/m^2.

E. IMPOSED/LIVE LOADS

The Imposed Loads shall be considered per IS 875 (Part 2): 1987 for the intended usage. Some of the imposed loads are as follows:

Bed Rooms, Dormitories, Wards & Lounges	2.0 kN/m^2
Balconies & Fire-check Areas	3.0 kN/m^2
Corridors, Passages and Staircases	3.0 kN/m^2
Kitchens, Laundries	3.0 kN/m^2
Dining Rooms, Cafeteria & Restaurants	4.0 kN/m^2
Baths & Toilets	2.0 kN/m^2
Store/Record Rooms	5.0 kN/m^2
Parking Areas (Single Car Parking)	2.5 kN/m^2
Parking Areas (Double Car Parking)	5.0 kN/m^2
Ramps	5.0 kN/m^2
Terrace (Access Provided)	1.5 kN/m^2
Terrace (Access Not Provided)	0.75 kN/m^2

F. SEISMIC LOAD

The Seismic load shall be considered for Zone III per IS1893 (Part 1): 2016 with the following factors:

Zone Factor (Z)	0.16
Importance Factor	1.2
Damping	5%

Response reduction factor (R) shall be based on the structural arrangement/configuration. Base shear per dynamic analysis shall be compared with that estimated from using fundamental natural period per clause 7.6.2 of IS 1893 (Part 1): 2016. All the response quantities shall be modified per clause 7.7.3 of IS 1893 (Part 1): 2016. For combining modal responses, Complete Quadratic Combination (CQC) rule shall be applied. Missing mass correction shall be applied.

Soil type shall be adopted on the basis of weighted average of corrected N-values from ground level to 30 m below ground level, per clause 6.4.2.1 of IS 1893 (Part 1): 2016.

All aspects of Table 5 and Table 6 of IS 1893 (Part 1): 2016 shall be followed during analysis and design.

Storey drift for unfactored earthquake forces shall not exceed 0.004 times the storey height per clause 7.11.1 of IS 1893 (Part 1): 2016.

G. WIND LOAD

Wind load shall be based on a basic wind speed (Vb) of 50 m/s. Design wind speed (Vz) shall be equal to Vb.k1.k2.k3 k4 per IS 875 (Part 3): 2015.

Risk coefficient (k1) shall be considered as 1. Terrain roughness and height factor (k2) shall be based on terrain category 2 per clause 6.3.2 of IS 875 (Part 3): 2015. Topographic factor (k3) and importance factor for cyclonic region (k4) shall both be considered as 1.

Dynamic wind analysis shall be performed per clauses 9 and 10 of IS 875 (Part 3): 2015.

For the purpose of design of glazing for wind load, building is considered to have normal permeability for calculating the internal pressure.

Lateral sway due to transient wind load shall not exceed H/500, where H is the total height of the building.

H. DESIGN LOAD COMBINATIONS

As the lateral load resisting elements are oriented along mutually orthogonal horizontal directions, the structures shall be designed for the following ultimate limit state (ULS) load combinations:

1.5 DL + 1.5 LL +/- 1.5 TL
1.5 DL +/- 1.5 WINDX
1.5 DL +/- 1.5 WINDY
1.5 DL +/- 1.5 ETHX

1.5 DL +/- 1.5 ETHY
1.2 DL + 1.2 LL +/- 1.2 WINDX
1.2 DL + 1.2 LL +/- 1.2 WINDY
1.2 DL + 1.2 LL +/- 1.2 ETHX
1.2 DL + 1.2 LL +/- 1.2 ETHY
0.9 DL +/- 1.5 WINDX
0.9 DL +/- 1.5 WINDY
0.9 DL +/- 1.5 ETHX
0.9 DL +/- 1.5 ETHY

The following load combinations shall be used for checking the serviceability limit states (SLS) of the structures:

1.0 DL + 1.0 LL
1.0 DL +/- 1.0 WINDX
1.0 DL +/- 1.0 WINDY
1.0 DL +/- 1.0 ETHX
1.0 DL +/- 1.0 ETHY
1.0 DL + 0.8 LL +/- 0.8 WINDX
1.0 DL + 0.8 LL +/- 0.8 WINDY
1.0 DL + 0.8 LL +/- 0.8 ETHX
1.0 DL + 0.8 LL +/- 0.8 ETHY

DL, LL, TL, WINDX, WINDY, ETHX and ETHY stand for dead load, live load, temperature load, wind load in X-direction, wind load in Y-direction, earthquake load in X-direction and earthquake load in Y-direction, respectively. Earthquake loads for SLS load combinations shall be unfactored.

Percentage of live load, for evaluating the seismic forces and for the load combinations involving dead, live and seismic forces shall be 25% for live loads up to 3 kN/m^2, and shall be 50% for live loads higher than 3 kN/m^2.

Live load reduction shall be considered per Fig. 1 of IS 875 (Part 2): 1987 for gravitational load combinations.

I. FOUNDATION DESIGN AND METHODOLOGY OF CONSTRUCTION

Foundation system will be designed for the following values of modulus of sub-grade reaction/bearing capacity per soil report.

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For the design of the retaining walls, the bulk soil density shall be taken as 18 kN/m^3.

J. MATERIALS AND TYPE OF CONSTRUCTION

RCC WORKS:

The cement used for RCC work in the sub structure & super structure will be OPC (Grade 43/53) or PPC conforming to relevant IS codes. All RCC works will be mechanically vibrated to produce dense, sound and durable concrete as per specifications. The water used in all stages of construction shall strictly conform to IS 456: 2000. Use of ground-granulated blast-furnace slag (GGBS) or fly ash as per IS codes is permitted for design mix of concrete. Minimum cementitious material for concrete mix design shall be per IS 456: 2000. Grades of concrete shall from M30 to M50, conforming to IS 456: 2000. All reinforcement bars shall be of Fe 550 D grade per IS 1786: 2008. Mechanical couplers shall be used for bars of diameter 16 mm and above.

LEAN CONCRETE:

Lean or plain cement concrete (PCC) of M10 shall be provided under all RCC foundations. PCC shall be of 75 mm thickness under rafts, isolated and combined footings, stitching slabs etc., and it shall be extended 75 mm on all sides beyond the edges of foundations.

K. CLEAR COVER TO REINFORCEMENT

Clear cover to reinforcement shall be as follows:

1. Slab (roof & floor), Canopy, Chajja, Waist Slab of Staircases	30 mm or dia. of bar whichever is higher
2. Beams (roof & floor) & Lintels	30 mm
3. Columns/Pedestals	40 mm
4. Retaining Walls (soil-side)	40 mm
5. Retaining Walls (inside)	30 mm
6. Foundation slab, base slab & footings in contact with soil	50 mm
7. Shear Walls	30 mm
8. Transfer Slab	40 mm
9. Raft Bottom	75 mm
10. Raft Top and Sides	50 mm

L. DETAILING OF RCC STRUCTURE

Detailing of RCC structure will conform to IS 456: 2000 and IS 13920: 2016.

M. CODES TO BE FOLLOWED

Structural analysis and design of the building shall be based on the following Bureau of Indian Standards (BIS) or IS codes:

1) IS 456: 2000 / SP 16
2) IS 13920: 2016
3) IS 875 (Parts 1 through 5)
4) IS 1893 (Part 1): 2016
5) IS 1904
6) IS 6403
7) IS 8009
8) IS 800: 2007
9) IS 1786: 2008

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THE LANDLENS SUITE

Eight ways to know a piece of land before you pay for it.

This report covers one part of the picture. These cover the rest, drawn from the same government records, for any property in Tamil Nadu.

LandLens One
Ask anything about a property and get an answer grounded in live government records, with the sources shown.
/landlens/one

Verify My Land
Every record check run on one property and returned as a single report.
/landlens/verify-my-land

Legal Opinion
An advocate's written opinion on the title, built on the records we pull for it.
/landlens

One Map
Every layer on one map: the parcel, its boundary, zoning, water bodies and what sits around it.
/landlens/one/map

PriceMap
What land actually changed hands for around this plot, taken from the registered deeds.
/landlens/pricemap

Build Scope
What you are allowed to build here: floor space, height, coverage and setbacks.
/landlens/build-scope

Property Tracker
Watch a property and hear about it when something new is registered against it.
/landlens/property-tracker

Deal Room
Run the transaction in one place: documents, stamping, signatures and the parties.
/landlens/deal-room

FREE TOOLS · NO ACCOUNT NEEDED

Twenty-four checks you can run yourself, at no cost.

Records and verification

The registers themselves, read for you.

- Encumbrance Certificate
- Patta and Chitta
- Field Measurement Sketch
- EC Analyzer
- Bank charge check
- Court case search
- Seller background check
- Approval check by survey

Value and duty

What it is worth and what it costs to register.

- Guideline value by street
- Guideline value by survey
- Stamp duty and registration fees
- Capital gains
- Floor space index
- Area unit converter

Zoning and land use

What the plan says can happen on this land.

- Land use zone finder
- CMDA land use check
- Coastal regulation zone
- Master plan check
- Water bodies finder
- Airport height clearance

Registers and directories

Who holds it, and which office keeps the record.

- Find your registering office
- Temple property check
- Waqf property check
- RERA register

Every free tool
/tools

Services we run for you
/services

The LandLens suite
/landlens/one

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Every claim in this document traces back to a government record.

- Legal opinions, due diligence and title verification
- Building plan, layout and sub-division approvals
- Completion and occupancy certificates, regularisation
- Escrow, negotiation and NRI property management
- Land survey, soil testing, architecture and construction

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