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3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai 600 097, India

hello@verified.realestate
+91 9996 12 9996
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Prestige Palm Court - Residential, Chennai
Preliminary STRUCTURAL DESIGN BRIEF REPORT



Client	:	**Prestige Group** Moolakadai, Madhavaram, Chennai 600060
SMEP Consultants	:	**DESIGNTREE SERVICE CONSULTANTS PVT LTD** #64/9, Kembathalli Main Road, 9th Phase, J.P.Nagar, Bangalore 560083
Architects	:	**Zachariah Consultants** No.5, Ashley Park, Off Brunton Road, Richmond Town, Bengaluru - 560025

DesignTree Service Consultants Pvt. Ltd
Bangalore

ISSUE RECORD

PROJECT : **Prestige Palm Court**

TITLE : **Preliminary Design Brief Report**

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1. STRUCTURAL SERVICES

DATE	ISSUE	PREPARED	CHECKED	REVISION
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1. STRUCTURES

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RCC:

IS:456 -2000(2016)	Code of Practice for plain and reinforced concrete
IS:458 -1988	Specification for precast concrete pipes
IS:3370-2009	Code of Practice for concrete structures for the storage of liquids: (All parts)
IS:4326-2013	Code of Practice for earthquake resistant design and construction of buildings
IS:5525-1969(2013)	Recommendation for detailing of reinforced concrete works
IS:1786-2008	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS:10262-2009	Recommended guidelines for concrete mix design
IS: 1893 (Part-1)-2016	Criteria for earthquake resistant design of structures (General provisions and building).
IS:16700 - 2023	Criteria for structural safety of Tall Concrete buildings
IS:13920 - 2016	Ductile design and Detailing of Reinforced concrete structures subjected to Seismic forces - Code of practice
IS:1343 - 1980	Code of practice for Prestressed concrete

Structural steel:

IS:800 -2007(2012)	Code of Practice for general construction in steel
IS:802 -1995	Code of Practice for use of structural steel in overhead transmission line towers: (All parts)
IS:806 -1968(2013)	Code of Practice for use of steel tubes in general building construction
IS:808 -1989	Dimensions for hot rolled steel beam, column channel and angle section
IS:816 -1998	Code of Practice for use of metal arc welding for general construction in mild steel
IS:1161-1998	Steel tubes for structural purposes
IS:4000-1998	High Strength bolts in steel structures - Code of Practice
IS:7215 -1995	Tolerances for fabrication of steel structures

Miscellaneous:

IS: 432(part 2)-1995	Specification for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement
IS: 6313(part II)-2001	Standards for anti-termite treatment
IS:1905-1998	Code of Practice for structural use of unreinforced masonry
IS:3067-1995	Code of Practice for general design details and preparatory works for damp proofing and water proofing of buildings
SP:6 -1998	Handbook for structural engineers (all parts)
SP:7 -2005	National Building Code of India
SP:16-1999	Design Aids for reinforced concrete to IS:456-1978
SP:22-1982	Explanatory handbook on codes for earthquake engineering (IS:1982-1975 and IS:4326-1976)
SP:24-1983	Explanatory handbook on Indian Standard code of Practice for plain and reinforced concrete
SP:34-1987	Handbook of concrete reinforcement and detailing (SCIP)

Wherever appropriate Indian Regulation does not exist for any particular item, appropriate British standards will be used.

Material :

IS: 269 -2015	Specification for Ordinary, rapid hardening and low heat Portland cement.
IS: 455 -1995	Specification for Portland blast furnace slag cement.
IS: 1489-1991	Specification for Portland pozzolana cement
IS: 4031-1991	Method of physical tests for Portland cement.
IS: 383 - 2016	Specification for coarse and fine aggregates from natural sources for concrete.
IS: 516 - 1999	Method of test for strength of concrete.
IS: 1199-1999	Method of sampling and analysis of concrete.
IS: 1566-2000	Specification for plain hard drawn steel wire fabric for concrete reinforcement.

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1.1 FOREWORD

1.1.1 - Description of Project

M/s. Prestige Estates projects Pvt. Ltd., intends to develop a residential and commercial building at Chennai. Project architecture by Zachariah Consultants, Bengaluru and Engineering Services including Structure and MEP are provided by DesignTree Service Consultants Pvt Ltd, Bengaluru.

1.1.2 - Objective of the Report.

The objective of this report is to provide and furnish complete details related to Project and structural analysis and design considerations.

1.1.2 - Scope of the Report.

The Structural Report covers the complete Structural Elements design considerations for analysis of lateral loads & estimated gravity loads.

1.2 CODES, STANDARDS AND REFERENCES

Statutory Requirements:

The design of structural and other building services will comply with the following requirements:

- National Building Code
- The Building Regulations
- The Environmental Protection Act in liaison with the Environmental Agency.
- Fire prevention and detection in compliance with the local Fire Regulation.

DESIGN STANDARDS:

Specific applicable codes and standards will be identified and adopted in the design philosophies as appropriate to the structural elements. The latest editions of the Codes and Standards will be used in designs. All design work shall be based on Indian Standards and Codes with latest revision, with amendments if any, as on date. Software used for designing ETABS, SAFE AND STAAD PRO.

Loads:

IS:875 -2015	Code of Practice for design loads (other than earthquake) for Buildings and structure (All parts)
IS:1893-2016	Criteria for earthquake resistant design of structure

Foundations:

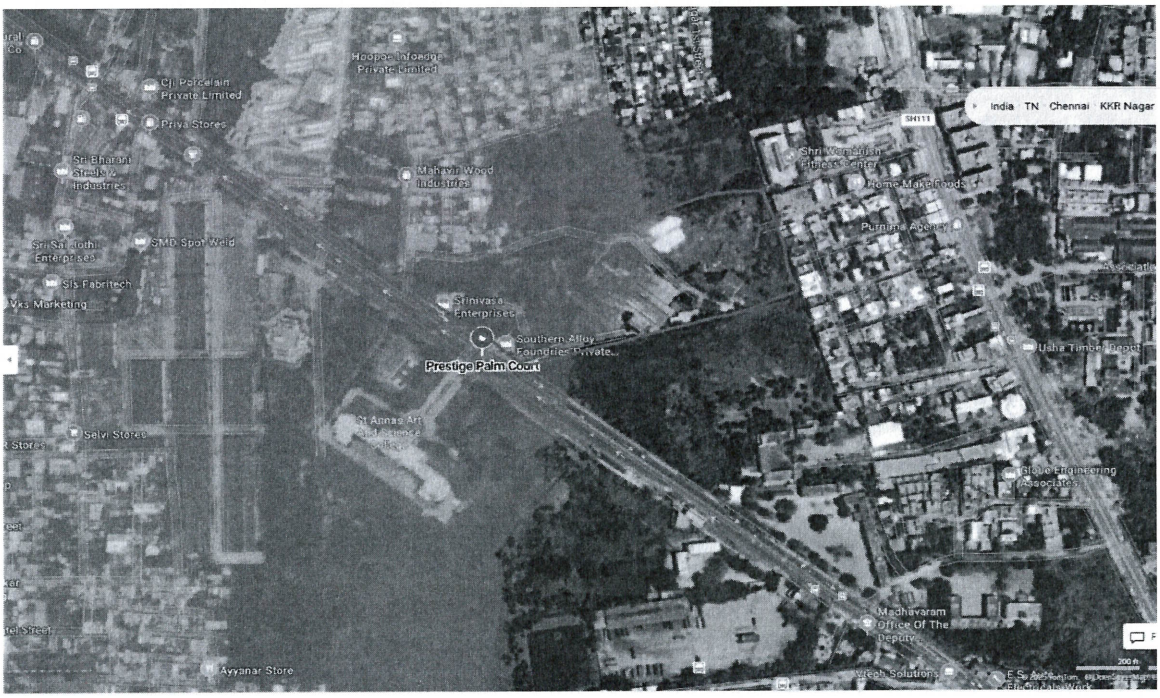
IS:1080-1985(2016)	Code of Practice for design and construction of shallow foundations on soils (other than raft, ring and shell)
IS:1904-1986(2015)	Code of Practice for design and construction of foundations in soils general requirement
IS:2950-1981(2013)	Code of Practice for design and construction of raft foundations
IS:2974-1998(2013/2015)	Code of Practice for design and construction of machine foundations (All parts)
IS:8009-1976/1980(2013/2015)	Code of Practice for calculation of settlement of foundations (All parts)

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IS: 4990-1998	Specification for plywood for concrete shuttering works.
IS: 2645-1999	Specification for integral cement water proofing compounds.

1.3- DESCRIPTION OF STRUCTURE

1.3.1 - Location.



1.3.2 - Building Description.

The Residential Development consists of the following: proposal is to build 5 residential towers and 1 club house of following configuration:

Consist of 5 towers and 1 Club house. Tower 1, 2, 3, 4 and 5 is proposed with 2 basement, ground floor with 22 upper floors and terrace i.e., 26 slabs in total, along with connected extended podium, along with connected extended podium. Total height above Ground floor level is approximately 79.65m. Club house is proposed with 2 basements, ground floor with 2 upper floors and terrace.

Note: Refer architectural drawing for section indicating the floor heights.

Floors	Details
Basements	Space for services along with Car parking and two wheeler parking, including proposed UG sump and STP
Stilt floor	Amenities with Double height entrance lobby and some parking
Ground, first and second floor	Residential units ,
Typical floors	Residential units,

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1.3.3 - Structural Arrangement:

- The Structural System comprises of RC walls and slabs construction along with lift core walls. Extended Ground floor podium slab and basement 1, basement 2 and first floor slab is proposed to be with RC flat system. Floor slabs and column/walls are considered to act as a rigid diaphragm to transfer the lateral forces to the lateral load resisting elements.
- The slabs for balcony are sunk by 50mm/100mm and the slabs for toilet areas are sunk by 225mm in 1st floor and 50mm sunk in typical floor. The cutouts in slab are based on the provisions given in Clause 31.8 of IS 456-2000. Core cutting shall be considered to accommodate utility services if any. Staircases are provided with mid-landing between the floors as per architectural layout.

	Description	Residential units	Extended podium
a)	Column grids	Varies as per plan	Varies as per parking requirements
b)	Structural system	Beam and slab system with RC walls	Flat slab system
c)	Slab thickness	Varies	Varies
e)	Column drop	NA	600/450 for Podium slab
f)	Column size	As per design	As per design
g)	Peripheral beams	As per design.	As per design.

1.3.4 - Special features.

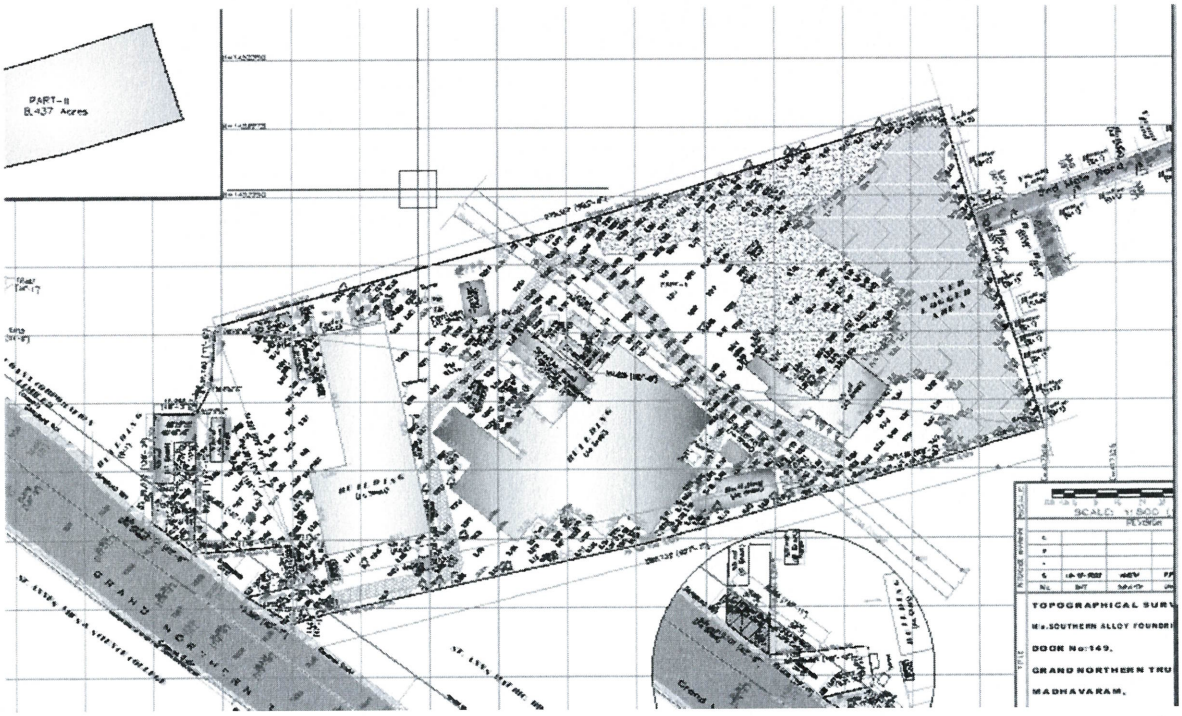
Any additional features that need to be considered in the design needs to be highlighted by the clients or architects.

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1.4 DESIGN APPROACH

1.4.1 - Design Data Provided by Client.

Site Survey Plan:



1.4.2 - Design Life.

The design life of the building is assumed as 50 years. This requirement is applicable only for concrete works and not applicable to replaceable finishing materials, water proofing membrane and thermal insulations (if any). Hence periodic maintenance / refurbishment is required for all replaceable material for longer life.

1.4.3 - Material Properties.

Materials specified will conform to the latest edition of the relevant Indian Standard or other accepted standard. Specifications for materials will include sampling and testing as stipulated in the design standards. Detailed material specifications will be included in the Technical Specification.

Concrete:

- All structural concrete shall have cube crushing strength of M40 to M30 N/sq.mm at 28 days.
- Plain cement concrete shall have cube crushing strength of 10 N/sq.mm (M10) at 28 days.

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Concrete Mix:

Concrete item	Grade - Tower 1,2 & 3
Foundation	M30 (as per soil report, chlorides and sulphates are within limits and no special steel or cement is required)
Columns & Shear walls	M40 to M30-TOWER M30 - EXTENDED BASEMENT
Slab, beams	Typical floor beams and slabs to have the same grade of M30 grade free flow conventional concrete. Extended podium will have M25 grade concrete. (Slab drops same as grade of column below)

Reinforcement steel:

- All reinforcement shall confirm to IS: 1786 - 1985 having minimum yield strength of 500 N/sq.mm. Corrosion resistant steel is not required

Structural Steel.

- All structural steel shall confirm to IS: 2062 with minimum yield strength of 250 N/sq.mm

Expansion Joint Material.

- Elastomeric expansion material - React 1000, Sonalastic NP2. / Shrinkage strips

Mechanical Splicing Material.

- Moment Coupler - Threaded Type for 16mm dia rebar's and higher.

1.4.4 - Design loads.

Loads:

Dead loads:

Dead load shall include weight of all structural and Architectural components. Self-weight of the materials shall be calculated on the basis of unit weights given in IS: 875.

- Floor finish of 50mm thick for Residential floors : 100kg/sq.m (1.0kN/sq.m)
- Floor finish of 100mm thick for Parking Areas : 240kg/sq.m (2.4kN/sq.m)
- False ceiling + ducting + Sprinklers : 50 kg/sq.m (0.5 kN/sq.m) only on

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		Parking floor slabs]
• Partition walls	:	As per actual
• Wall loads	:	As per actual
• Self-weight of Plain concrete	:	2400 kg/cu.m (24 kN/cu.m)
• Self-weight of RCC	:	2500 kg/cu.m (25 kN/cu.m)
• Solid block masonry (with plastering)	:	2200 kg/cu.m (22 kN/cu.m)
• Brick Wall	:	1900 kg/cu.m (19 kN/cu.m)
• Aerated block masonry	:	865 kg/cu.m (8.65 kN/cu.m)
• Soil (Dry)	:	1800 kg/cu.m (18 kN/cu.m)
• Soil (Wet)	:	2000 kg/cu.m (20 kN/cu.m)
• Water	:	1000 kg/cu.m (10 kN/cu.m)
• Glass	:	2800 kg/cu.m (28 kN/cu.m)
• Stainless steel	:	7850 kg/cu.m (78.50 kN/cu.m)
• Masonry with plastering	:	2200 kg/cu.m (22 kN/cu.m)
• Cinder Filling for sunken portion including toilets, balconies and utilities	:	1000 kg/cu.m (10 kN/cu.m)
• Waterproofing (membrane)	:	15kg/sq.m (0.15kN/sq.m)
• External finishes	:	As per actual
• Gardening/Landscape loads	:	600mm earth fill load on central podium area (as marked in shuttering layout) and 250mm fill on fire Tender driveway. Terrace landscaping, if any, to be specified.
• Any other equipment loads	:	As per Vendor details

Live loads:

The superimposed loads shall be calculated in accordance with IS: 875(Part-2) based on Occupancy Classification. For multiple occupancies of use in the building shall be referred with the other appropriate comparable occupancy classification as per Table.1 of IS 875(Part-2)-1987.

Following live loads are considered while designing the structural elements apart from the dead loads as per codes.

Club House	: 400 kg/ sq.m(4 kN/sq.m)
Parking Area	: 250 kg/ sq. m (2.5 kN/sq.m) + 25% Impact
Fire tender Loading	: 60 MT (Moving loads) at 2 T/sq. m uniformly distributed.

Residential Floors.

Residential areas	: 200 kg/sq.m(2.0 kN/sq.m)
Stairs	: 400 kg/sq.m(4.0 kN/sq.m)
Corridors / Balcony/Utility	: 300 kg/sq.m(3.0 kN/sq.m)
Toilets	: 200 kg/sq.m(2.0 kN/sq.m)

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Lift Machine room	: 1000 kg/ sq.m or as per actual.
Generator, Pump, Electrical Rooms	: 750 kg/sq.m (7.5kN/sq.m)
Terraces	: 300 kg/ sq.m(3 kN/sq.m) (assumed as place of assembly)
Ramps	: 300 kg/sq.m(3 kN/sq.m) (Without fire truck movement)

Actual loading due to lifts loads shall be ascertained and design live loads are suitably modified (if required) and considered.

Gardening / Landscape Loads: As per actuals / shall be referred from landscape drawings.

Wind Loads:

The Wind pressure shall be calculated in accordance with IS: 875 (Part-3):2015.

Chennai has a high wind speed of 50m/s.

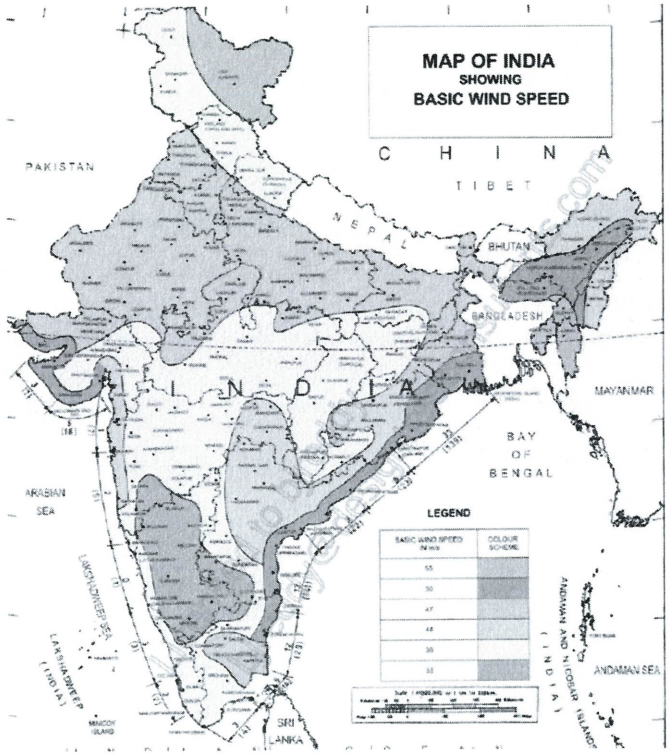
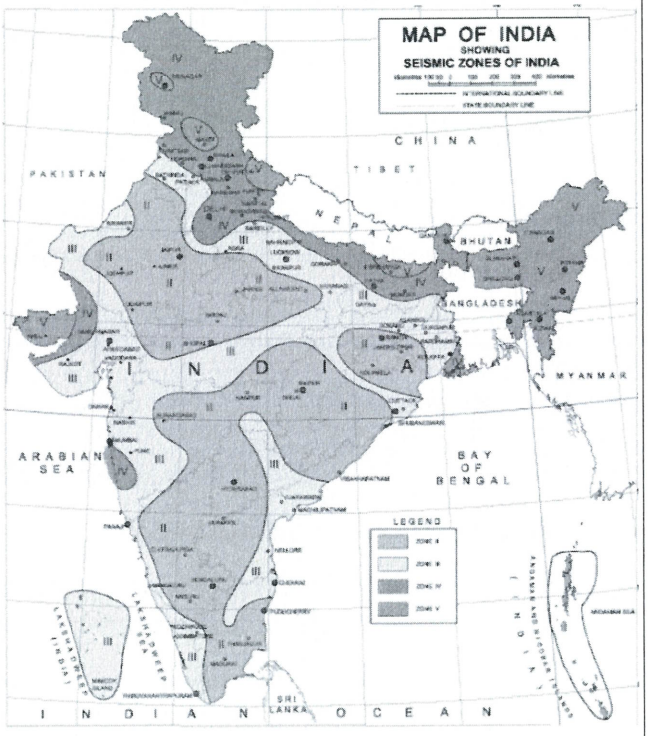
Basic Wind Speed V_b	: 50 m/s
Risk Coefficient k_1	: 1.00 (k_1 corresponds to 50 years Mean Probable Design Life of Structure)
Terrain, height, structure size factor k_2	: To suit the height of the structure for terrain category 2
Topography factor k_3	: 1.00
Importance factor for cyclonic region k_4	: 1.00

The external and internal pressure co-efficient shall be as per respective clauses of IS: 875 (Part 3):2015

Design wind speed V_z : $V_b \times k_1 \times k_2 \times k_3 \times k_4$

Design wind pressure p_z : $0.6 \times V_z^2$

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Map showing basic wind speed	Map showing seismic zones
	
Basic wind speed in m/s (based on 50-year return period)	Seismic zones of India

Seismic Forces:

Chennai falls under seismic zone III as per IS 1893-2016 (Part 1) (Sixth Revision) and has the following factors to be considered for designs. Ductile detailing is required as the structure is located in zone 3. (Please refer attached map above)

Seismic Zone	: III
Seismic Zone factor, Z	: 0.16 (As per Table 3; IS: 1893-2016)
Design horizontal seismic coefficient (Ah)	: $(Z/2)*(S_a/g)*(I/R)$
I -Importance factor	: 1.2 (Ref Table 8; IS: 1893-2016)
Response reduction Factor	: 4
Soil type	: Type -1 with N<100 at the founding levels
Damping Ratio for RCC	: 5 %

R as per Table 7 of IS: 1893-2016 is based on Structural wall systems - Buildings with Ductile RC structural walls.

Sa/g - Average response acceleration coefficient for soil sites as per Fig.2 of IS: 1893-2016 and it is arrived based on appropriate fundamental natural period of structure as per Cl 7.6.2 (b)

Design horizontal seismic coefficient (A_h) : $(Z/2)*(S_a/g)*(I/R)$

: $(0.16/2)*(1.2/4) * (S_a/g)$

A_h : $0.024 * (S_a/g)$

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Design seismic base shear, V_b	: A_h * w where, w - seismic weight of building
Effect of infill panels	: Considered in the analysis (By default, RC Wall system Once analyzed, results in time period which will match with time period with infill panels)
Dynamic Analysis	: Considered in the analysis

Table No : 03

Seismic Zone Factor Z

(Clause 6.4.2)

Seismic Zone	II	III	IV	V
Seismic Intensity	Low	Moderate	Severe	Very Severe
Z	0.10	0.16	0.24	0.36

Design Vertical earthquake effects:

As per code, vertical earthquake effects will have to be considered if any of the following conditions apply:

Structure is located in seismic zone 4 and 5	NA, since the building is located in zone 3
Structure has vertical and plan irregularities	NA, since not all RC walls extend till the foundation
Structure is rested in soft soil	As per soil investigation report, structure is supported on hard strata with N>50
Bridges	NA
Structure has long spans	Structure is proposed with usual grids and does not have such long spans (It shall be noted that the definition of long span is not given in the code and we presume that any span greater than 15m would be considered as long, as applicable to building structures only)
Structure has large horizontal overhangs of structural members or sub-systems	NA, since structure is not proposed with huge cantilevers anywhere.

Since one of the above conditions does not comply with code provisions, the vertical component of earthquake force will be considered in the design.

Temperature Loads:

The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. Minimum & maximum temperatures considered are as per IS 875 (Part 5) and BS EN 1991-5-2003 and relevant calculations are shown in the Annexure (i). Same will be used for the analysis & design. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

Shrinkage effect:

In order to counter the differential temperatures and resulting shrinkage, entire stretch of podium is further divided by providing pour strips.

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Exceptional Loads:

Loads due to the following catastrophe scenarios are not considered in the design:

- Exceptional loads due to terrorist attacks (Explosions)
- Accidental loads (Falling of aircraft on the building)
- Accidental collision of vehicles on the façade of the building

Landscape Loads:

Landscape loads will be considered as per the final landscape intent based on the soil filling grade plan.

Landscape Location	Soil filling depth
Podium	fill load varies as per landscape drawing, maximum filling (600mm considered) podium area maximum (as marked in shuttering layout) and 250mm fill on fire Tender driveway
Terraces	No filling *

[*-to be confirmed]

1.4.5 Durability Considerations:

Environmental conditions, Corrosion and Fire protection for concrete and structural steel

- Environment : Moderate

Table 5 Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size

(Clauses 6.1.2, 8.2.4.1 *and* 9.1.2*)*

Sl No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	-	300	0.55	M 20
ii)	Moderate	240	0.60	M 15	300	0.50	M 25
iii)	Severe	250	0.50	M 20	320	0.45	M 30
iv)	Very severe	260	0.45	M 20	340	0.45	M 35
v)	Extreme	280	0.40	M 25	360	0.40	M 40

NOTES

1 Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.

2 Minimum grade for plain concrete under mild exposure condition is not specified.

- Exposure conditions : Concrete surfaces sheltered from severe rain or freezing whilst wet Environment.
- Minimum grade of concrete : Moderate exposure - M25
- Nominal cover to reinforcement : For Moderate exposure condition, nominal cover Should not be less than 30mm.

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1.4.6 Fire Rating:

- Thickness of the structural elements as per table 15, 16 & 16A clause 26.4 of IS 456-2000.

Fire Resistance h	Minimum Beam Width b	Rib Width of Slabs b_w	Minimum Thickness of Floors D	Column Dimension (b or D)			Minimum Wall Thickness		
				Fully Exposed	50% Exposed	One Face Exposed	$p<0.4\%$	$0.4\%\leq p\leq 1\%$	$p>1\%$
	mm	mm	mm	mm	mm	mm	mm	mm	mm
0.5	200	125	75	150	125	100	150	100	100
1	200	125	95	200	160	120	150	120	100
1.5	200	125	110	250	200	140	175	140	100
2	200	125	125	300	200	160	–	160	100
3	240	150	150	400	300	200	–	200	150
4	280	175	170	450	350	240	–	240	180

NOTES

1 These minimum dimensions relate specifically to the covers given in Table 16A.

2 p is the percentage of steel reinforcement.

FIG. 1 MINIMUM DIMENSIONS OF REINFORCED CONCRETE MEMBERS FOR FIRE RESISTANCE

- Nominal covers for 2 hr. fire resistance :

Nominal Cover							
Beams		Slabs		Ribs		Columns	RC Walls
Simply supported	Continuous	Simply supported	Continuous	Simply supported	Continuous		
mm	mm	mm	mm	mm	mm	mm	mm
40	30	35	25	45	35	40	25

1.5 ANALYSIS METHODOLOGY:

This structure has physical interface with almost all the disciplines like geotechnical works, MEP services, landscape etc. The structure proposed is of cast in-situ concrete construction with columns suitably placed. The core walls around lifts, stairs are of cast in-situ concrete to resist lateral forces.

Analysis model with Ultimate limit state condition, to be used for the design of all structural elements with Modifiers for structural members applied as detailed below, to study the effect of seismic forces on to the structure.

The Vertical Loads including the dead and super imposed loads are transferred to the soil through columns, core walls and footings. Footings are sized with consideration to the safe bearing capacity of soil at the level of transfer of load recommended by specialist soil investigation consultants. The Lateral loads due to wind and seismic forces are dissipated to soil through the proposed Reinforced Concrete Core Walls/columns.

1.5.1 Assumptions:

- The structure is idealized as 3D space frame and analyzed using ETAB software package for both vertical and lateral loads.
- The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and for the load combinations as given in the relevant codes.

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- The floor slab is considered as rigid diaphragm which would not undergo any in-plane deformations and would transfer the lateral forces to vertical lateral load resisting elements.
- The foundation is represented in analysis model using fixed end conditions.

1.5.2 Mathematical model.

Mass Modelling:

Mass Source as per IS: 1893_2016 is considered as follows.

Mass source = DL+SDL+ 0. 25LL (for load less than3 kn/m^2)

= DL+SDL+ 0. 5LL (for load greater than3 kn/m^2)

Where DL - Dead Load;

SDL - Super Imposed Dead Load;

LL - Live Load

Stiffness Modelling:

Stiffness modifiers that are used both for analysis and design are as detailed below:

Members	**Ultimate limit state model to study earthquake effect**
Wall Piers	f_{11}=0.7; f_{22}=0.7; f_{12}=0.7; m_{11}=0.7; m_{12}=0.7; m_{22}=0.7; V_{13}=1.0; V_{23}=1.0
Floating Wall Piers (complete floating walls)	f_{11}=0.01; f_{22}=0.7; f_{12}=0.01; m_{11}=0.7; m_{12}=0.7; m_{22}=0.7; V_{13}=1.0; V_{23}=1.0
Spandrels	f_{11}=0.35; f_{22}=0.35; f_{12}=0.35; m_{11}=0.35; m_{12}=0.35; m_{22}=0.35; V_{13}=1.0; V_{23}=1.0
Columns	I_{22} & I_{33}=0.7
Beams	T=0.25; I_{22} & I_{33}=0.35
Girder beams	T=1; I_{22} & I_{33}=1
Slabs(Shell)	f_{11},f_{22},f_{12}=0.25, m_{11},m_{12},m_{22}=0.25; V_{13}=1.0; V_{23}=1.0
Slabs(Membrane)	f_{11},f_{22},f_{12}=0.25; m_{11},m_{12},m_{22}=1.0

1.5.3 Static Analysis:

Following Static loads cases are considered in the analysis

DL - Dead Load which includes self-weight of the structure.

SDL - Super Imposed Dead Load, including load due to finishes, wall Loads, Soil filling loads etc.

LL - Live Load.

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1.5.4 Dynamic Analysis:

1.5.4.1 Earthquake:

Response spectrum method of Dynamic Analysis is considered. Following are the details pertaining to dynamic analysis.

Time period	: Based on buildings with RC structural walls formulae given in Clause 6.3.4 of IS 16700:2023
Base Shear Enhancement	: Initial Scale factor of Ig/2R is used to enhance the base shear.
Number of modes Considered	: Min. 12 or higher up to 90% mass participation
Modal Combination Method Used	: Complete Quadratic combination (CQC).
Spatial Combination Method used	: Square root of the sum of Square (SRSS).
Modal case type	: Ritz vector Method
Orthogonal directional seismic effect	: Not applicable
Accidental torsion considered	: Additional eccentricity is considered in the analysis
Missing mass correction	: Missing mass correction is taken care with Ritz vector method.

P-Delta effects:

Following Load Combinations is used for second order analysis to capture P-Delta effects:

1.2DL+1.2SDL+ 0.5LL±1.5EQ or Wind Load

1.5.4.2 Wind:

Dynamic Effects -(As per Clause 9 of IS 875 (part 3), page No. 45)

Case (i) -Ratio of height of the building to least lateral Dimension shall not exceed 5

i.e., 62.55/64.15 = 0.974 which is less than 5 (for tower 1)

Case (ii) -Fundamental natural frequency to be not less than 1.0Hz

$Ta = 0.0672*H^{0.75} = 0.0672*79.975^{0.75} = 1.658$ sec

Natural frequency = 1/Ta = 0.603Hz <1.0Hz

Hence, dynamic effects of wind are required to be considered in the analysis.

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1.6 LOAD COMBINATIONS:

Load combinations Used for Strength, Serviceability are tabulated below:

Load Combination	Limit State of Collapse			Limit State of Serviceability		
	DL+SDL	*LL*	*WL/EL/TL*	*DL+SDL*	*LL*	*WL/EL/TL*
DL + LL	1.5	1.5	–	1	1	–
DL + WL	1.5 or 0.9*	–	1.5	1	–	1
DL + EL	1.5 or 0.9*	–	1.5	1	–	1
DL + TL	1.5	–	1.5	1	–	1
DL+LL+WL	1.2	1.2	1.2	1	0.8	0.8
DL+LL+EL	1.2	1.2	1.2	1	0.8	0.8
DL+LL+TL	1.2	1.2	1.2	1	1	1
DL+WL+TL	1.2	–	1.2	1	–	1
DL+EL+TL	1.2	–	1.2	1	–	1
DL+LL+EL+TL	1.2	1.2	1.2	1	1	1

The various loads are combined in accordance with the stipulations in IS: 875 (Part 5)-1987; whichever combination produces the most unfavorable effect in the building foundation or structural member concerned may be adopted.

*This value is to be considered when stability against overturning and stress reversal is critical where DL/LL/WL/EL denotes,

DL - Dead Load; LL - Live Load; TL - Temperature Load; WL - Wind Load;

EL - Earthquake Load

Wind load and earthquake loads are considered for both x & y directions. Whenever imposed load is combined with earthquake load, the appropriate part of imposed load as specified in IS: 1893-2016 / Clause 7.3.3 of seismic code will be used both for evaluating earthquake effect and for combined load effects used in such combination. Serviceability loads combinations with suitable live load reduction factor as per IS: 875(Part-2) will be used for foundation design.

1.7 DESIGN METHODOLOGY:

- All R.C.C structures shall be designed according to the Limit State Method as specified in IS: 456 - 2000.
- Forces and moments from the 3D analysis output for the worst combinations are used for the design of the structure.
- The foundations are designed for critical load combination.
- The structure is analyzed for specific loads like dead load, live load, wind and seismic loads and for the load combinations as given in the relevant codes.
- The slab is analyzed as two-way and one way slabs.
- Design of special members like retaining wall, water tanks will be done in accordance with the relevant IS Codes.

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- Design of structural steel members are done using elastic method as per IS: 800 with relevant allowable stresses.

1.8 ACCEPTANCE CRITERIA:

1.8.1 Deflection Limits:

For Reinforced concrete works:

Limiting values of deflection (Short and Long term) as per clause 35.3 of IS: 456-2000 is followed in the design.

- Limiting value for long term deflection is considered as span/250 and for the long term deflection after erection of partitions & finishes is considered as span/350 or 20mm whichever less as per IS 456 - 2000.

1.8.2 Cracking Limits:

Limiting values of crack width as per clause 35.3 of IS: 456-2000 is followed in the design.

- In general for slabs and beams, the crack width is limited to 0.3mm.
- For basement retaining wall and water retaining structures, crack width is limited to 0.2mm.

1.8.3 Permissible Drift Limits:

- Short term deflection for RC elements = Span/250
- Long term deflection for RC elements = Span/350
- Storey drift in any storey due to minimum specified design seismic lateral force shall not exceed 0.004 times the storey height i.e., $h_i/250$.
- Lateral sway due to wind load should not exceed H/500 (H is the total height of structure).

1.8.4 Expansion/ Separation Gap:

Separation joints are provided in between the building, as per requirement, where necessary.

1.8.5 Soil data:

Foundations are designed based on Geo Technical investigation report and will dissipate all the vertical and horizontal loads safely to the soil below. In case of lateral forces increase in allowable bearing pressure for footing proportioning shall be done in accordance with the relevant IS codes. Grade slab of 150mm thick is proposed for basement area.

1.9 DETAILING REQUIREMENTS:

- All columns and RC walls including beams are detailed as per ductile detailing requirement.
- Detailing for all structural members shall be in accordance with IS: 456, SP: 34 & IS 13920.

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1.10 ANNEXURES.

- All blocks typical floor shuttering layouts indicating the location of structural walls/columns shall be referred from the drawings furnished from our end.
- Water proofing specifications - Will be included once after finalization of the system to be adopted with client
- Soil report: Excerpts from soil report is attached herewith. For complete details, reference shall be made to detailed soil investigation report, as submitted by soil investigating agency.
- Temperature load calculations
- Typical temperature load calculation:
  The effect of temperature will be considered wherever applicable in accordance with relevant Indian Codes. Minimum & maximum temperatures considered are as shown in the table below. Same will be used for the analysis & design of relevant floors and supporting elements. The coefficient for thermal expansion and contraction will be in accordance with IS: 456 and IS: 800 for concrete and steel respectively.

Station Name	Month	Period	No. of Years	Mean Temperature in Degree C		Mean rainfall in mm
Maximum	**Minimum**			Max	Min	35.3
Chennai	January	1901-2000	100	28.8	20.4	13.0
Chennai	February	1901-2000	100	30.5	21.1	14.5
Chennai	March	1901-2000	100	32.6	23.0	15.9
Chennai	April	1901-2000	100	34.7	25.8	42.4
Chennai	May	1901-2000	100	37.4	27.6	53.9
Chennai	June	1901-2000	100	37.3	27.4	99.6
Chennai	July	1901-2000	100	35.3	26.1	129.9
Chennai	August	1901-2000	100	34.5	25.5	123.5
Chennai	September	1901-2000	100	33.9	25.2	284.6
Chennai	October	1901-2000	100	31.8	24.2	353.0
Chennai	November	1901-2000	100	29.4	22.6	146.3
Chennai	December	1901-2000	100	28.4	21.2	35.3

- [Source: National Data Centre: ndc@imdpune.gov.in
  DGM (Sectt.): dgm.hq@imd.gov.in]

Considering the average **daily** maximum temperature as 35.5 degrees and minimum as 26.5 degrees, the variation in temperature for analysis is considered as **10 degrees**.

[Source:https://www.wunderground.com/weather/in/ Chennai]

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- **Annexure (i)** Excerpts from Soil report:

GEO MARINE
THE SPIRIT OF ENGINEERING

GEO MARINE CONSULTANTS (P) LTD.,
11, 2nd Main Road, Kannappa Nagar Ext,
Kottivakkam, Chennai – 600 041.
Ph. No. 044 - 24481485 & 24480305.
drcvp@geomarineindia.com/geotech@geomarineindia.com

PROJECT

GEOTECHNICAL INVESTIGATION FOR THE PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING CONSISTING OF TWO BASEMENT + STILT + TWENTY-TWO UPPER FLOORS AT MOOLAKADAI, MADHAVARAM CHENNAI

CLIENT

M/S PRESITGE ESTATES PROJECTS LTD,
NO 471, PRESTIGE POLYGON, PRESTIGE FLOOR,
ANNA SALAI,
CHENNAI – 600 018.

TITLE

GEOTECHNICAL INVESTIGATION REPORT

REPORT NO.: GT- 2804

DATE	REVISON	DESCRIPTION		AUTHORISED SIGNATORY
09/08/2024	0.0	SUBMISSION OF GEOTECHNICAL REPORT	SIGN	
02/07/2025	1.0	SUBMISSION OF ADDITIONAL RECOMMENDATION	DATE	09/08/2024
05/11/2025	2.0	REVISED REPORT FOR TWO BASEMENT RECOMMENDATION	DESIGNATION	**MANAGING DIRECTOR**
			NAME	**DR. C.V.PRASAD**

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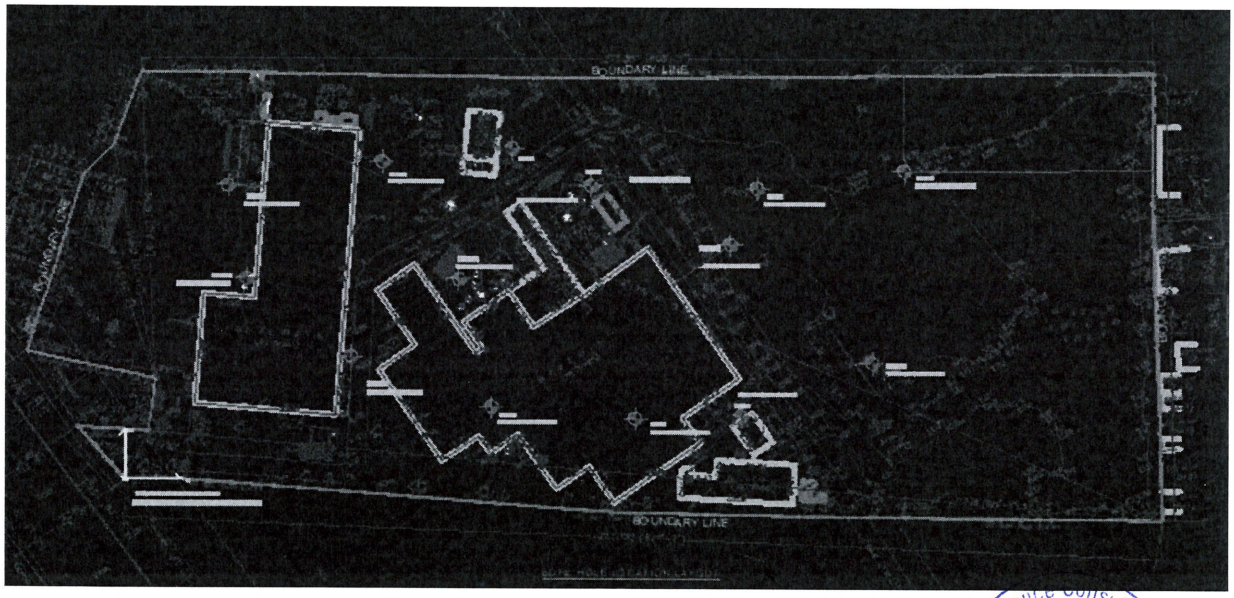
TABLE 5.1 RECOMMENDED ALLOWABLE NET BEARING PRESSURE							
S. NO.	DEPTH OF LOWER BASEMENT FLOOR	DEPTH OF FOUNDATION EXCAVATION BELOW NGL (m)	LOCATION	SHAPE OF FOUNDATION	SIZE OF FOOTING/RAFT CONSIDERED (m)	ALLOWABLE NET SAFE BEARING PRESSURE (kPa)	ELASTIC SETTLEMENT FOR MAXIMUM SIZE OF 5.0m (mm)
TWO BASEMENT FLOOR							
1.0	7.0	Beyond 9.0	NON-TOWER AREA	ISOLATED FOOTING	1.00	300	2.5
2.0					2.00	350	5.7
3.0					3.00	450	11.1
4.0					4.00	500	16.4
5.0					5.00	550	22.6
6.0			TOWER AREA	RAFT	10.00	750	61.5

GEOMARINE

Adopt R.C.C. Raft beyond 9.0m below the existing ground level. The recommended allowable net safe bearing pressure for the design of raft shall be 750 kPa. Typical computations are presented in Annexure-I

For the design of raft, the recommended modulus of subgrade reaction of the bearing strata is 50,000 kN/m^3.

BORE HOLE POINTS:



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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

Verified RealEstate™

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

Verified RealEstate
3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai 600 097, India
hello@verified.realestate
+91 9996 12 9996

Prepared from the registers named on the page each finding sits on. Where a register could not be read, this document says so in its place rather than leaving the gap to be read as a clean result.