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REPORT ON STRUCTURAL ANALYSIS & DESIGN

PROPOSED CONSTRUCTION OF APARTMENT BUILDING IN PLOT NO:18,19,23&24 T.S NO:19/4 WARD-K, BLOCK NO-4, RAMALINGA NAGAR WEST EXTENSION, PUTHUR VILLAGE, TRICHY CITY CORPORATION

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Reg.No: SE/GR.II/DTCP/TRICHY/MAR 2021/301

TENSION O TECH STRUCTUTRES

CLIENT	VAIRAM PROPERTIES	DESIGN	Stilt + FOUR	TENSION O TECH STRUCTURES MADURAI design@tensionotech@gmail.com Ph No: 9487667754
STRUCTURE NAME	APARTMENT BUILDING	TITLE: REPORT ON STRUCTURAL DESIGN		
PLACE	TRICHY			

REPORT ON STRUCTURAL DESIGN

Name of Project:		Name of the Structure:
PROPOSED CONSTRUCTION OF APARTMENT BUILDINGS IN PLOT NO:18,19,23&24 T.S NO:19/4 WARD-K, BLOCK NO-4, RAMALINGA NAGAR WEST EXTENSION, PUTHUR VILLAGE, TRICHY CITY CORPORATION		Vairam properties apartment
Report by: G. MADHAN KUMAR	**Checked by:** D.VISHAL	**Approved by:** M.SETHUPATHI M.E.,

DESCRIPTION OF THE PROJECT:

The Proposed structure is located in plot no:18,19,23&24 t.s no:19/4 ward-k, block no-4, ramalinga nagar west extension, puthur village, trichy city corporation. The purpose of this structure is to house "Apartment Building" in the site jointly owned by Quality Promoters & Builder. The structure is designed with a configuration of Stilt floor + five upper floors. The dead load and live load are calculated based on IS 875: Part I & II. The structure is analyzed using the software STAAD-PRO V8i. The structural design is carried out meticulously, as per the latest version of the applicable codes.

Scope of Structural Design Basis Report (SDBR):

The Structural Design Basis Report (SDBR) caters to meet the functional requirements under the cardinal criteria, "Strength, Serviceability & Durability". This report provides a succinct overview of the structural analysis & design philosophies pursued in designing o the proposed private Apartment building. The SDBR aims to develop robust design solution that optimizes structural efficiencies and performances ensuring structural stability at large.

STRUCTURAL DESIGN CALCULATION

I DESIGN PARAMETERS:

(1) This structure is designed for Stilt floor + four floor.

(2) SBC Adopted : 323 kN/sq.m.

(3) Concrete grade adopted

For Footing : M25

Foundation to Terrace : M25 for RCC

(4) Grade of steel adopted : Fe 500.

(5) Floor height is 3.25m. (Typical)

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II LOAD DETAILS:

DEAD LOAD:

1. Self weight of slab (Assumed as 150mm Tk.) - 3.75 KN/m^2.

SUPER IMPOSED DEAD LOAD:

1. Floor finish - 1.5 KN/m^2.
2. Partition loads - 1.0 KN/m^2.
3. Unit wt. of brick * Tk of wall * Ht of wall

   (20 x 0.23 x (0.8 x (3.58-0.46)) - 11.50KN/m.

SUPER IMPOSED LIVE LOAD: (As per IS 875 Part II)

1. For Staircase - 4 KN/m^2
2. For Rooms without separate storage - 4 KN/m^2

III LOAD COMBINATION

Loads considered for calculation of horizontal seismic load = DL + 25 % LL

Load case:

1. Seismic Load in „X" direction (EQX)
2. Seismic load in „Y" direction (EQY)
3. Dead Load (DL)
4. Live Load (LL)

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Load combination:

1. LOAD COMB (1.0 DL + 1.0 LL)
2. LOAD COMB (1.5 DL + 1.5 LL)

Location and thickness of walls as depicted in the architectural drawings were considered for loads at appropriate locations in the analysis.

IV. ANALYSIS:

The grid reference guidelines as recommended in IS 5525:1969 (R2004), "Recommendations for detailing of reinforcement in reinforced concrete works" is adopted in numbering the grid columns. The columns and beams are grouped as shown in centerline drawing depending on the forces computed from the structural analysis. The analysis is performed using software STAAD Pro V8i.

V. DESIGN OF STRUCTURE:

1. Exposure Conditions:

The general environmental conditions prevalent in the site are mild without any aggressive external conditions. The exposure conditions stipulated in cl 8.2.2, Table 7 of IS 456: 2000 is duly factored in the design.

2. Sub-Structure:

The foundation system is designed to interact with the superstructure taking care of the dominant seismic forces and the conditions of sub-soil on which the structure is founded. The Geotechnical Investigation Report provides insight into the field tests done in the project site and the soil test reports available there for. Accordingly, the SBC of soil is adopted as 126 KN/sqm. The substructure is designed with M25 grade of concrete conforming to the requirements of IS 456:2000 and the allied family codes.

3. Superstructure:

The structural system comprising RCC frames with Columns and Beams are designed considering the wind and seismic forces besides the applicable imposed live loads and dead loads. The grid reference guidelines as recommended in IS 5525:1969 (R2004), "Recommendations for detailing of reinforcement in reinforced concrete works" is adopted. The superstructure is designed with the following standard grade of concrete conforming to the requirements of all the applicable IS codes. The dominant IS codes applicable are itemized below:

- ✓ M25 grade of concrete for Beams, columns and slabs as per IS 456-2000 (R2005) "Plain & Reinforced Concrete- Code of practice"
- ✓ IS 1893 : Part 1 : 2016: Criteria for Earthquake Resistant Design of Structures - Part 1 : General Provisions and Buildings
- ✓ IS 4326: 1993 "Earthquake Resistant Design & Construction of Buildings- Code of Practice" and
- ✓ IS13920:1993 "Ductile detailing of reinforcement".

The footing, column and beams are designed for the maximum forces in the group as per IS456-2000 and other applicable codes. The illustrative design calculation for Column, Footing, Beam and Slab is shown below for reference.

- Annexure (I) – Extract of Design Output (Typical).

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IS13920:1993 "Ductile detailing of reinforcement".

ANNEXURE – I

Extract of Design Output

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TYPICAL DESIGN OF COLUMNS

Input Data

Breadth	b	=	230.00 mm
Depth	D	=	450.00 mm
Clear cover	cc	=	40.00 mm
Effective cover	d'	=	56.00 mm
Effective Breadth	b'	=	174.00 mm
Effective Depth	D'	=	394.00 mm
Length of Column	L	=	3.58 m
Depth of Beam/Slab framing ino coin (Major)	Bd	=	0.45 m
Depth of Beam/Slab framing ino coin (Minor)	Bd	=	0.45 m
Clear lenth in major axis	Lc or Lo	=	3.13 m
Clear lenth in minor axis	Lc or Lo	=	3.13 m
Effective length factor	β	=	0.80
Effective length of column	Leff (x-dir)	=	2.50 m
Effective length of column	Leff (y-dir)	=	2.50 m
Axial Load (Factored)	N	=	300.00 KN
Moment about major axis (Factored)	Mx	=	37.00 KN-m
Moment about minor axis (Factored)	My	=	20.00 KN-m
Characteristic strength of concrete	fck	=	25.00 N/mm^2
Characteristic strength of steel	fy	=	500.00 N/mm^2

Design Calculations :

Step 1: **check for Slenderness ratio** Leff/D = 6.59 <12

check for Slenderness ratio Leff/b = 10.89 <12

Design a Short Column

eex = 0.00 mm

eay = 0.00 mm

Slenderness limits for column Lo < 60 b 3.13m < 13.80 m

Step 2: **Check for momentr due to minimum eccentricity**

Minimun Eccentricity (L/500+d or b/30) or 20 whichever is < ex = 18.93 mm

ey = 13.93 mm

A.) Moments due to Min eccentricity

Mex = 5.68 KN-m

Mey = 4.18 KN-m

Step 3: **Calculation of Additional Moments**

Assume Percentage of Reinforcement p = 1.30 %

Reinforcement Equality Distributed on Two face

Puz = 1409.33 KN

d'/d along x-dir = 0.15

d'/d along y-dir = 0.20

Along x-direction

k1 = 0.196

k2 = 0.104

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Along y-direcion

	k1	=	0.184
	k2	=	-0.001
Pb=(k1+k2 p/Fck)Fck b-d)	Pbx	=	444.08 KN
	Pby	=	401.93 KN
k = (Puz - Pu)/(Puz - Pb)	Kx	=	1.14
	Ky	=	1.10
	Max	=	0.00 Kn-m
	May	=	0.00 Kn-m

B.) Additional Moments

	Mux	=	**37.00** Kn-m
	Muy	=	**20.00** Kn-m

Step 4: Total Moments for which the column is to be designed are

D.) Final Moment

	Mux	=	0.14
	Muy	=	0.05

Step 5:

Pu/Fck bd

p/Fck

*Refer CHART 37 From SP 16 : 1980 for red values

Pu/Fck bD= 0.14 p/Fck = 0.052 d'/b = 0.20

	Mux1/Fck bD^2	=	0.025
	Mux1	=	**20.76** Kn-m

*Refer CHART 38 From SP 16 : 1980 for red values

Pu/Fck bD= 0.14 p/Fck = 0.052 d'/b = 0.20

	Muy1/Fck bD^2	=	0.025
	Muy1	=	12.56 Kn-m
	Mux/Mux1	=	1.78
	Muy/Muy1	=	1.59
	Pu/Puz	=	0.21
	αn	=	1.02
(Mux/Mux1)^αn + (Muy/Muy1)^αn		=	3.41 >1

Step 6: Longitudinal Reinforcement — Area of Steel required As = 1136.20 mm^2

Larger Dia		Smaller Dia		
Select Bar dia	16mm	Select Bar dia	=	12mm
No of bars Req	5.7	No of bars Req	=	-0.6
No of bars Prov	6	No of bars Prov	=	0
Area Prov.	1206	Area Prov.	=	0

Area of Steel Provided Asc (pro) = 1806 mm^2

Percentage of Steel Provided = 1.38 %

Provide 4Y20+ 4Y16 as longitudinal reinforcement

Step 7: **Lateral Ties**

1. Pitch: (take whichever is lesser)

i. 16x smaller dia of main steel		=	175.00 mm
ii. 300 mm		=	300.00 mm
	Pi	=	175.00 mm

2. Diameter (take whichever is lesser)

i. 1/4x largest dia of main steel		=	4.00 mm
ii. 8 mm		=	8.00 mm
	Dia	=	8.00 mm

Therefore provide Y8 @150c/c as Lateral ties.

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PLACE	TRICHY		

TYPICAL DESIGN OF FOOTING

Input Data

COLUMN

Length (l.dim II Z axis)	230	mm
Breadth (b.dim II X axis) =	450	mm

FOOTING:

Foot Length (L.dim II Z axis)	1.37	m
Foot Breadth (B.dim II X axis) =	1.37	m
Thickness of footing (t) =	450	mm
Clear cover of footing =	50	mm
Main bar dia of footing =	10	mm
Effective depth of footing =	395	mm
Selfweight of the footing =	26.16	KN
Area of Footing (A) =	2.31	m^2
Sect mod of foot about Z axis (Zz) =	0.59	m^3
Sect mod of foot about X axis (Zx) =	0.59	m^3

CHECK FOR GROSS BEARING PRESSURE

Safe NET bearing pressure =	350.00	KN/m^2	
Safe gross bearing pr. =	**368.00**	KN/m^3	(net pr. + depth of foot* soil unit wt)
Unfactored load case number =	0.00	KN	
Axial load from output (P1) =	540.00	KN-m	
Moment about Z axis (M_{z1}) =	3.00	KN-m	
Moment about X axis (M_{x1}) =	1.00	m	
Depth of top of foot from ground =	2	m	
Unit wt of soil =	19	KN/m^3	
Weight of soil retained above foot =	**85.05**	KN	
P= (P1+soil +foot self wt) =	**651.22**	KN	
Maximum bearing pressure =	**286.78**	KN/m^2	} $P/A \pm M_x/Z_x \pm M_z/Z_z$
Minimum bearing pressure =	**273.25**	KN/m^2	

Hence footing is safe against max gross bearing pr.

DESIGN FORCES

Factored load comb. No.	3	
Axial load (P_u) =	810	KN
Moment about Z axis (M_{uz}) =	4.5	KN-m
Moment about X axis (M_{ux}) =	1.5	KN-m
Maximum effective soil pressure p_{emax} (Pu/Area + Muz/Zz +Mux/Zx) =	**358.44**	KN/m^2
(Minimum effective soil pressure $p_{e\,min}$) (Pu/Area - Muz/Zz - Mux/Zx) =	**338.14**	KN/m^2
(Minimum effective soil pressure $p_{e\,min}$)		

CALCULATION FOR BOTTOM STEEL

Mu about X1 X1 = (pe max x length²/2)=

Ast = 0.5fck/fy *1-√(1-4.6Mu/(fck bd))+bd

75.14 KN-m per meter

Mulimit = 415.11 KN-m per meter

The section is singly reinforced

Hence,Ast =	460.361	mm^2	
Min Ast =	474.00	mm^2	(0.12 % for slab ,cl 26.5.2.1)
Spacing =	185.7	mm	nsidering max ofabove two calculated values of A
pt provided =	0.12	%	

Hence provide 10mm dia bar @ 150mm c/c parallel to length of footing(II to Z)

Mu about N1 N1 = (pe max x length²/2)= **58.74** Kn-m per meter

Calc. Ast =	**349.781**	mm^2
Min Ast =	**474**	mm^2
Spacing =	**165.7**	mm
pt provided =	**0.12**	%

The section is singly reinforeced

(0.12 % for slab, cl 26.5.2.1)

(considering max of above two calculated values of Ast)

Hence provide 10mm dia bar @150mm c/c parallel to breadth of footing (II to X)

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CHECK FOR ONE WAY SHEAR

One way shear at critical section L1-L1

Distance of crictical sec. from edge of footing = **0.2525** m

Shear force Vs=pe max x 0.2525 x 1m width of footing = **90.507** KN

Shear stress τ_v = Vs/bd = **0.229** N/mm^2

τ_c = **0.26** N/mm^2

tv < tc hence o.k.

One way shear at critical section L2-L2

Distance of crictical sec. from edge of footing = **0.1775** m

Shear force Vs=pe max x 0.1775 x 1m width of footing = 63.624 KN

Shear stress τ_v = Vs/bd= 0.161 N/mm^2

τ_c = **0.26** N/mm^2

tv < tc hence o.k.

CHECK FOR TWO WAY SHEAR

Ref. cl 34.2.4 and cl.3.1.6.3 of IS 456:2000

Allowable shear stress $\tau_{v\ allowable}$ = $K_s\ \tau_c$

K_s = (0.5+bc) = **1.5** > 1

Hence,Ks = **1**

$\tau_c = 0.25(fck)^{0.5}$ = **1.11803** N/mm^2

$\tau_{v\ allowable} = K_s \times \tau_v$ **1.11803** N/mm^2

Shear Force Vs = 358.44 (1.525 x 1.525 - 0.625 x 0.775) = **659.99** KN

Lenth of critical section = 2 x (625 + 775) = **2800** mm^2

Area of the critical section (length of critical sec x eff. d)= **1106000** mm^2

Hence shear stress τ_v = 0.567 N/mm^2

tv < allowable hence o.k.

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TYPICAL DESIGN OF TWO WAY SLAB

Input Data :

Grade of concrete	f_{ck}	=	25.00	N/mm²
Grade of steel	f_y	=	500.00	N/mm²
Density of concretre		=	25	KN/mm³
Clear cover		=	25.00	mm

Classification of slab

Clear Size of Room/Panel	1.37 m x 1.29 m				
Longer span	1.29 m + 0.230 m		=	1.52	m
Shorter span	1.37 m + 0.230 m		=	1.60	m
Aspect ratio		l_y/l_x	=	1.00	<2

Slab to be designed as TWO way slab

Assumed Span/effective depth ratio		=	26.00	
Overall depth provided	D	=	150.00	mm
Effective Depth provided	d	=	130.00	mm
Effective span	L	=	5.235	m

Design load

Self weight of the slab		=	3.75	KN/m²
Floor finish		=	1.50	KN/m²
Other loads		=	1.00	KN/m²
Total dead loads		=	6.25	KN/m²
Live loads		=	2.00	KN/m²
total load		=	8.25	KN/m²
factored load	W_u	=	12.38	KN/m²

Calculation of reinforcement required

Slab End condition :- [4] Two adjacent edges discontinous

		Shorter Direction		Longer direction	
		αx(-ve) support	αx(+ve) mid span	αy(-ve) support	αy(+ve) mid span
Bending moment Coefficient		**0.0474**	**0.0356**	**0.045**	**0.034**
Bending moment		16.71	12.53	15.967	11.975 Knm
Percentage of reinforcement required	P_{t1req}	0.20	0.178	0.23	0.17%
Area of reinforcement required	A_{st1min}	314.48	231.94	299.64	221.19 mm²
Minimum area of reinforcement		180.00	180.00	180.00	180 mm²
Area of reinforcement required	$A_{st,req}$	314.48	231.94	299.64	221.19 mm²
Diameter of reinforcement	ϕ	10.00	10.00	10.00	10 mm
Spacing of Reinforcement required		249.75	250.00	250.00	250 mm
Spacing of Reinforcement provided		150.00	150.00	150.00	150 mm
Area of main reinforcement provided	$A_{st,pro}$	523.81	523.81	523.81	523.81 mm²
Percentage of reinforcement provided	$P_{t,pro}$	0.40	0.40	0.40	0.40%

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Check for Deflection

Span/effective depth ratio		=	26.00	N/mm²
Service stress in steel	f_s	=	128.41	
Modification factor		=	2.00	
Effective depth required fordeflection limit		=	100.67	mm
Effective Depth provided	d	=	130	mm
Overall Depth provided	D	=	150.00	mm

Hence the limits state of deflection is satisfied

Check for Shear

Factored shear force	V_u	=	32.39	KN
Nominal Shear stress	τ_v	=	0.249	N/mm²
Percentage of steel	p_t	=	0.403	%
Designed shear stress	τ_c	=	0.439	N/mm²

Safe in Shear

Check for Crack Width

Modular ratio	m	=	8.94	
Modulus of elasticity of steel	E_s	=	200000	N/mm²
Tension steel percentage provided	p_t	=	0.403	%
Neutral axis depth factor	k	=	0.235	
Depth of Neutral axis	x	=	30.53	mm
Area of steel provided	$A_{st,pro}$	=	523.81	mm²
Cracked moment of inertia	I_{cr}	=	5.58E + 07	mm⁴
Service load moment	$M_{(+)}$	=	8.35	KNm/m
Service stress in steel	f_{st}	=	133.09	N/mm²
Strain in concrete at the level considered	ϵ_1	=	0.000799	
Average strain in concrete	ϵ_m	=	0.000343	
Distance of point from surface of reinforcing bar	a_{cr}	=	72.62	mm
Crack width	w_{cr}	=	0.038	<0.2mm

Crack width is within limit, Hence safe

Check for long term deflection

Short term modulus of elasticity	E_c	=	22361.00	N/mm²
Flexural strength	f_{cr}	=	3.13	N/mm²

Second moment of area of cracked and gross section

Distance of centroid of steel from neutral axis	r	=	99.47	mm
Second moment of area of cracked section	I_r	=	5.584E + 07	mm⁴
Gross section moment of area	I_{gr}	=	2.813E + 08	mm⁴

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Service load and cracking moment

Moment due to dead load and live load	M_{DL+LL}	=	8.354
Distance of extreme fibre in tension from centroidal axes of gross section	Y_t	=	75
Cracking moment	M_r	=	1.174E+07
	$0.7*M_r$	=	8.218E+06
Lever arm	z	=	119.826
Effective moment of inertia	I_{eff}	=	1.103E+08

$I_r < I_{eff} < I_{gr}$ hence ok

Maximum short term deflection

	$a_{i(perm)}$	=	9.668
	a_i	=	7.324

Long term defection

Deflection due to Shrinkage

Constant	k_3	=	0.063
Total shrinkage strain	ϵ_{cs}	=	0.0003
	k_4	=	0.457 <1
Shrinkage curvature	Ψ_{cs}	=	9.14E-07
Deflection due to shrinkage	a_{cs}	=	1.578

Deflection due to creep

Creep deflection due to permanent loads $a_{cc(perm)} = a_{i,cc(perm)} - a_{i(perm)}$

Creep coefficient	θ	=	1.6
Effective modulus of elasticity	E_{ce}	=	8600.261 N/mm^2
	m	=	23.255
	x	=	45.399 mm
	I_r	=	1.184E+08 mm^4
Lever arm	z	=	114.867 mm

Effective moment of inertia	I_{eff}	=	1.866E+08 mm^4
Moment due to dead load	M_{DL}	=	6.328 KNm
	$a_{i,cc(perm)}$	=	11.257 mm
	$a_{cc(perm)}$	=	3.932 mm
Long trem Deflection	a_{LD}	=	15.179 mm
Maximum permissible longterm deflection		=	20.94 mm

Safe with regard to limit state of deflection

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TYPICAL DESIGN OF BEAM

Input :

Breadth of the beam,B	300	mm
Depth of the beam,D	450	mm
Clear cover of the beam	25	mm
Grade of concrete	25	mm
Grade of steel	500	mm
Span of beam	5259	mm
Effective depth, d	530	m
Effective cover, d'	33	m

End Section:

Support moment of the beam,M_u	155	KN m
Shear force at End section of the beam,V_u	225	KN
Mu lim	256.55	KN m
pt lim	0.75	%
Ast1 req at Top	0.00	mm^2
d'/d	0.10	
Ast2 req at Top	0.00	mm^2
Ast req at Top	0.00	mm^2
Total Ast Required at End Support	**700.96**	mm^2

Reinforcement provided at End Support	No. of Rods	Dia of Rod	
	3	20	ST
	3	16	CTLD

Ast Provide at End Support **1546.29** mm^2

Prov>req

Mid Section:

Mid moment of the beam $M_{u\ Bottom}$	**350**	KN m
d'/d	0.10	
Total Ast Required at Mid Support	**1686.22**	mm^2

Reinforcement provided at Mid Support	No. of Rods	Dia of Rod	
	3	20	ST
	3	16	CTLD

Ast Provide at Mid Support **1546.29** mm^2

not ok

Check for shear in beams:

Shear force ,V_u	65	KN
τv	0.38	N/mm^2
τc	0.6	N/mm^2
τc max	2.8	N/mm^2
	τv<τc max,ok	
τc b d	102.06	KN
Assuming dia of Stirrup	**8**	mm
No.of Stirrup Legs	**2**	nos
Stirrup spacing	**150**	mm

Check for Deflection:

Type of Beam	Cont.Beam	
Span of Beam	7500	mm
Actual Span/Effective depth Ratio	13.23	
Allowable Span /Effective depth Ratio	26.88	

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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

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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.