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DIGITALLY VERIFIED RECORD

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Date : 02/02/2026

CERTIFICATE FOR STRUCTURAL DESIGN SUFFICIENCY AND SAFE & SOUND

With respect to the proposed construction of Residential unit in

Residential Building – S.No: 21/1A2,21/1B at Thuvariman Village/Panchayat Thiruparankundram Panchayat Union,Madurai Local Palanning Authority, Madurai west Taluk, Madurai District. Site area 4169.77 Sq.m Proposal of residential building (G+1 Floor) for FSI area of 3350.94 SQ.M (14 Blocks)

We certify that the designs are being done after detailed soil investigation and the design is being done to meet all the structural stability requirements as stipulated in IS456,IS 875 and other relevant codes, and it is structurally safe & sound.

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STABILITY CERTIFICATE

Date : 02/02/2026

The detailed engineering and structure design of the proposed building comprising of G+1 floors at S.No: 21/1A2,21/1B at Thuvariman Village/Panchayat Thiruparankundram Panchayat Union,Madurai Local Palanning Authority, Madurai west Taluk, Madurai District. Site area 4169.77 Sq.m Proposal of residential building (G+1 Floor) for FSI area of 3350.94 SQ.M (14 Blocks) has been done by me/us based on the report of geotechnical investigation (soil test) done by Geomatrix Report No. 366/RB/GMC/2025-26 Dated 13/01/26 and considering the functional requirement of the building.

2.It is certified that among other factors, the proposed building has been designed to resist earthquake. I/We have checked various parameters and found that the proposed building would be safe.

3. I/We further certify that:

(i) The minimum grade of concrete is M20

(ii) The design and analysis has been done using the code of practice for plain and reinforced concrete as per IS 456, design loads as per IS Codes No IS 875 and design of earthquake resistant structure as per IS Code No IS 1893

4.The building will be safe and sound when used for the purpose for which it is designed.

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Encl.: Structural Design Calculation

Stamp and Signature

Date: 02/02/2026

STRUCTURAL DESIGN STABILITY CERTIFICATE

This is to certify that the PROPOSED NEW CONSTRUCTION OF RESIDENTIAL Units in S.No: 21/1A2,21/1B at Thuvariman Village/Panchayat Thiruparankundram Panchayat Union,Madurai Local Palanning Authority, Madurai west Taluk, Madurai District. Site area 4169.77 Sq.m Proposal of residential building (G+1 Floor) for FSI area of 3350.94 SQ.M (14 Blocks). Is designed as per the following IS Codes

1. IS: 456:2000,code of practice for plain and reinforced concrete
2. IS:875-1987,code of practice for design loads for building and structures.
3. IS:1893-2016,criteria for earthquake resistant design of structures.

The building Designed by meconsists of Ground+ First floor + Stair Case Head Room, and Water Tank, the R.C.C .building frame of the structure is designed as per the Indian Standard code of practice for concrete and loadings. The loading stress parameters are within limits of practice of National Building Code and other Bureau of Indian standards code.

The Structure will be Constructed as per our structural Design and detailing of reinforcements given in our drawing from foundation to roof slab. Regular Site Inspection will be done to ensure Quality of Work and Materials used.

As per calculations & Detailing the above said building is structurally safe.

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STRUCTURAL DESIGNCALCULATIONS

(LOAD CALCULATIONS)

Date : 02/02/2026

STRUCTURE:

The proposed Building has been en visages R.C Framed Structure with Ground + First floor. The Ground +First Floor is intended for Residential Utility.

ANALYSIS&DESIGN:

TheStructurehasbeenidealizedas3DFrame,withR.CSlab&Beam.All BeamsareinterconnectingwithColumns.ThedesignofallR.Ccomponentsisdone usingLimitStateMethod. ThefollowingcodesoftheIndianStandardsareadoptedintheStructuralDesign:

IS: 456-2000	Plain and Rein forced Concrete-code of Practice(Fourth Revision)
IS:875-1987	Code of Practice for Design loads (other than Earthquake) for Building sand Structures. Part(1) – Dead Loads –Unit Weightsof Building Materials and Stored Materials (second revision) Part(2)- Impact Loads (second revision) Part(3) – Wind Loads (second revision) Part(4) – Snow Loads (second revision) Part(5) – Special Loads and Load Combinations.
IS:1893-2002	Criteria for Earthquake Resistant Design of Structures (Fifth Revision).

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IS:13920-1993		DuctileDetailingof ReinforcedConcrete StructuresSubjectedto SeismicForces-Codeof Practice.
SP7:1983		NationalBuildingCodeofIndia1983.
SP:34(S&T)-1987	-	Hand Book on Concrete Rein for cement and Detailing.
SP:23(S&T)-1982	-	Hand Book on Concrete Mixes.
SP:16(S&T)-1980	-	Design Aids for Rein forced Concrete to IS: 456-1978.

The concrete grade assumed for all R.CC members is .The Steel grade considered in the design is Fe500.

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	SHRI BALAJI CONSULTANCY
	- DESIGN OF ISOLATED FOOTING F1

1 MATERIAL PROPERTIES

Unit weight of reinforced concrete	γc	=	25.000 kN/m3
Environmental exposure condition (Table 3 of IS 456)		=	Moderate
Grade of concrete (Table 5 of IS 456)		=	M25
Grade of steel		=	Fe500
Characteristic strength of concrete (Table 2 of IS 456)	fck	=	25.000 N/mm2
Characteristic strength of reinf. steel = Yield stress of reinf. steel (cl. 36.1 of IS 456)	fy	=	500.000 N/mm2

2 DIMENSIONS

Footing plan dimension along X axis	L	=	2.286 m
Footing plan dimension along Z axis	W	=	2.286 m
Thickness of footing	t	=	0.450 m
Column plan dimension along X axis	a	=	0.230 m
Column plan dimension along Z axis	b	=	0.450 m
Depth of footing below NGL	D	=	2.100 m
Eccentricity of the column along X axis	ex	=	0.000 m
Eccentricity of the column along Z axis	ez	=	0.000 m

3 SOIL PROPERTIES

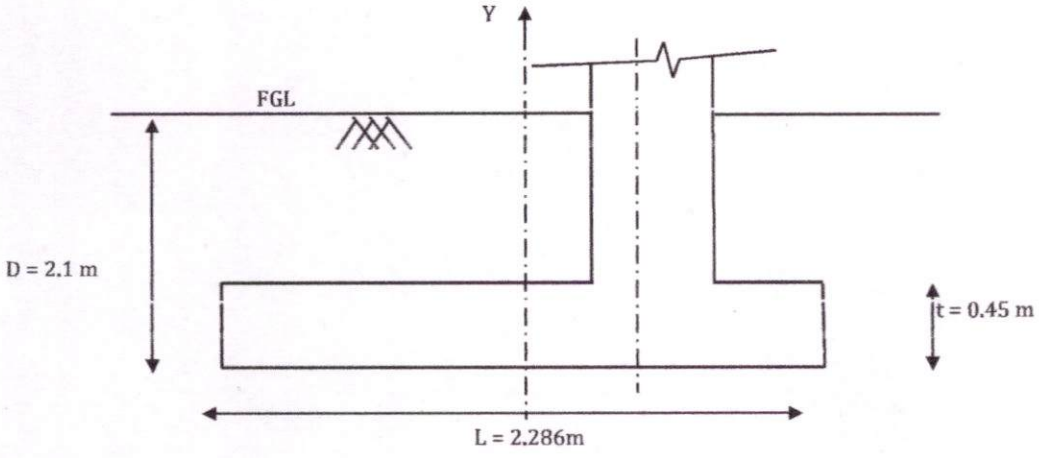
Density of soil	γsoil	=	18.000 kN/m3
Net bearing capacity of soil (from soil report)		=	111.200 kN/m2
Allowable gross SBC		=	111.2 + 18*2.1
		=	149.000 kN/m2
Coefficient of soil friction, μ		=	0.400
Depth of water table from NGL in m		=	NA
Uplift force due to water table		=	0.000 kN

4 DESIGN PARAMETERS

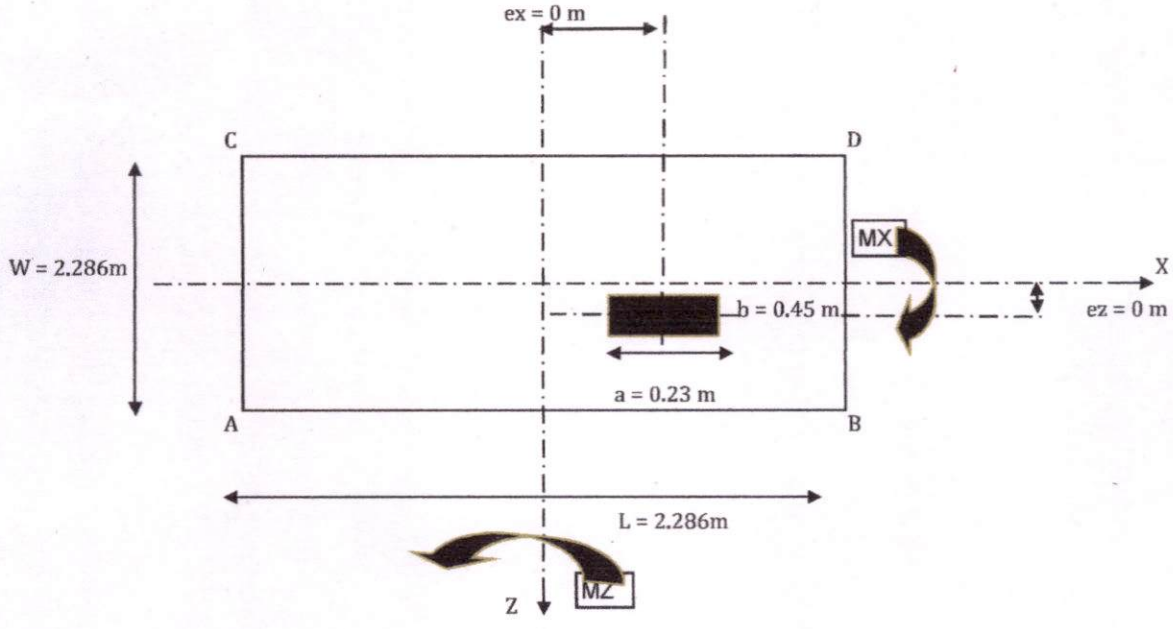
Factor of safety against overturning (Cl. 8.1 of IS:875 (Part 5)	=	1.400
Factor of safety against uplift	=	1.200
Factor of safety against sliding (with 0.9 DL) (Cl. 8.1 of IS:875 (Part 5)	=	1.400
% increase in SBC for load combinations with seismic loads Table 1 of IS:1893 (part1):2002	=	25.000 %
% increase in SBC for load combinations with wind loads Cl.8.1 of IS: 875 (part 5) - 1987	=	25.000 %

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5 *GEOMETRICAL SKETCH*



Section



Plan

Note :

The above sketch is not to scale. The dimensions are shown only for illustrative purpose.

The sign conventions followed are same as that of STAAD.

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6 *LOADS AT TOP OF FOOTING*

The signs of the STAAD reactions are reversed to transfer it as loads in the appropriate directions.

Horizontal load in X direction at top of footing = Fxt

Vertical load in Y direction at top of footing = Fyt

Horizontal load in Z direction at top of footing = Fzt

Moment about X axis at top of footing = Mxt

Moment about Z axis at top of footing = Mzt

Table 1 : Loads at top of footing (from the reactions from STAAD)

Load cases	Fxt (kN)	Fyt (kN)	Fzt (kN)	Mxt (kNm)	Mzt (kNm)
DEAD LOAD (DL)	-1.691	-484.984	0.256	0.000	0.000
LIVE LOAD (LL)	-0.029	-64.710	0.038	0.000	0.000
WIND LOAD IN +X -CPI	0.000	0.000	0.000	0.000	0.000
WIND LOAD IN +X +CPI	0.000	0.000	0.000	0.000	0.000
WIND LOAD IN -X +CPI	0.000	0.000	0.000	0.000	0.000
WIND LOAD IN -X -CPI	0.000	0.000	0.000	0.000	0.000
WIND LOAD IN +Z +CPI	0.000	0.000	0.000	0.000	0.000
WIND LOAD IN +Z -CPI	0.000	0.000	0.000	0.000	0.000
WIND LOAD IN -Z +CPI	0.000	0.000	0.000	0.000	0.000
WIND LOAD IN -Z -CPI	0.000	0.000	0.000	0.000	0.000
SEISMIC LOAD IN +X direction	0.000	0.000	0.000	0.000	0.000
SEISMIC LOAD IN -X direction	0.000	0.000	0.000	0.000	0.000
SEISMIC LOAD IN +Z direction	0.000	0.000	0.000	0.000	0.000
SEISMIC LOAD IN -Z direction	0.000	0.000	0.000	0.000	0.000
LIVE LOAD ON ROOF (LLR)	-0.002	-9.493	0.000	0.000	0.000

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Table 2 : Load combinations (Unfactored - Serviceability load combinations) - as per table 18 of IS 456 : 2000 - Loads at top of footing

Load combinations	Fxt (kN)	Fyt (kN)	Fzt (kN)	Mxt (kNm)	Mzt (kNm)
1.0 DL + a*1.0 LL+a*1.0 LLR	-1.710	-529.506	0.279	0.000	0.000
1.0 DL + 1.0 WL +X +CPI	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 WL +X -CPI	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 WL -X +CPI	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 WL -X -CPI	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 WL +Z +CPI	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 WL +Z -CPI	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 WL -Z +CPI	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 WL -Z -CPI	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +X+CPI	-1.706	-520.601	0.274	0.000	0.000
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +X-CPI	-1.706	-520.601	0.274	0.000	0.000
1.0 DL +a*0.8 LL+a*0.8 LLR + 0.8 WL -X+CPI	-1.706	-520.601	0.274	0.000	0.000
1.0 DL +a*0.8 LL+a*0.8 LLR + 0.8 WL -X-CPI	-1.706	-520.601	0.274	0.000	0.000
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +Z+CPI	-1.706	-520.601	0.274	0.000	0.000
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +Z-CPI	-1.706	-520.601	0.274	0.000	0.000
1.0 DL + a*0. 8LL+a*0.8 LLR + 0.8 WL -Z+CPI	-1.706	-520.601	0.274	0.000	0.000
1.0 DL + a*0. 8LL+a*0.8 LLR + 0.8 WL -Z-CPI	-1.706	-520.601	0.274	0.000	0.000
1.0 DL + 1.0 EL +X	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 EL -X	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 EL +Z	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + 1.0 EL -Z	-1.691	-484.984	0.256	0.000	0.000
1.0 DL + b*0.8 LL + 0.8 EL +X	-1.697	-497.926	0.264	0.000	0.000
1.0 DL + b*0.8 LL + 0.8 EL -X	-1.697	-497.926	0.264	0.000	0.000
1.0 DL + b*0.8 LL + 0.8 EL +Z	-1.697	-497.926	0.264	0.000	0.000
1.0 DL +b* 0.8 LL + 0.8 EL -Z	-1.697	-497.926	0.264	0.000	0.000

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Table 3 : Load combinations (Factored - Strength load combinations) - as per table 18 of IS 456 : 2000 - Loads at top of footing

Load combinations	Fxt (kN)	Fyt (kN)	Fzt (kN)	Mxt (kNm)	Mzt (kNm)
1.5 DL + C*1.5 LL + C*1.5 LLR	-2.564	-794.259	0.418	0.000	0.000
1.5 DL + 1.5 WL +X +CPI	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 WL +X -CPI	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 WL -X +CPI	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 WL -X -CPI	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 WL +Z +CPI	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 WL +Z -CPI	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 WL -Z +CPI	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 WL -Z -CPI	-2.537	-727.476	0.384	0.000	0.000
0.9 DL + 1.5 WL +X +CPI	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 WL +X -CPI	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 WL -X +CPI	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 WL -X -CPI	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 WL +Z +CPI	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 WL +Z -CPI	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 WL -Z +CPI	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 WL -Z -CPI	-1.522	-436.486	0.230	0.000	0.000
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X +CPI	-2.052	-635.407	0.335	0.000	0.000
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X -CPI	-2.052	-635.407	0.335	0.000	0.000
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X+CPI	-2.052	-635.407	0.335	0.000	0.000
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X-CPI	-2.052	-635.407	0.335	0.000	0.000
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z +CPI	-2.052	-635.407	0.335	0.000	0.000
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z -CPI	-2.052	-635.407	0.335	0.000	0.000
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z +CPI	-2.052	-635.407	0.335	0.000	0.000
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z -CPI	-2.052	-635.407	0.335	0.000	0.000
1.5 DL + 1.5 EL +X	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 EL -X	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 EL +Z	-2.537	-727.476	0.384	0.000	0.000
1.5 DL + 1.5 EL -Z	-2.537	-727.476	0.384	0.000	0.000
0.9 DL + 1.5 EL +X	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 EL -X	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 EL +Z	-1.522	-436.486	0.230	0.000	0.000
0.9 DL + 1.5 EL -Z	-1.522	-436.486	0.230	0.000	0.000
1.2 DL + b*1.2 LL + 1.2 EL +X	-2.038	-601.394	0.319	0.000	0.000
1.2 DL + b*1.2 LL + 1.2 EL -X	-2.038	-601.394	0.319	0.000	0.000
1.2 DL + b*1.2 LL + 1.2 EL +Z	-2.038	-601.394	0.319	0.000	0.000
1.2 DL + b*1.2 LL + 1.2 EL -Z	-2.038	-601.394	0.319	0.000	0.000

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7 *LOADS AT BOTTOM OF FOOTING (Load combinations for serviceability check)*

Self weight of footing	SW =	25 * 2.286 * 2.286 * 0.45
	=	-58.790 kN
Weight of soil above footing	WS =	18 * (2.286*2.286 - 0.23*0.45) * 1
	=	-152.132 kN
Uplift force due to water table	Fu =	0.000 kN
Horizontal load in X direction at bottom of footing	Fx =	Fxt
Vertical load in Y direction at bottom of footing	P =	Fyt + SW + WS - Fu
Horizontal load in Z direction at bottom of footing	Fz =	Fzt
Moment about X axis at bottom of footing	Mx =	Mxt + Fzt * t + Fy*ez
Moment about Z axis at bottom of footing	Mz =	Mzt - Fxt * t + Fy*ex

Table 4 : Loads at bottom of footing (Unfactored load combinations for pressure & overturning check)

Load Combinations	Fx (kN)	P (kN)	Fz (kN)	Mx (kNm)	Mz (kNm)
1.0 DL + a*1.0 LL+a*1.0 LLR	-1.710	-740.428	0.279	-0.125	-0.769
1.0 DL + 1.0 WL +X +CPI	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 WL +X -CPI	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 WL -X +CPI	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 WL -X -CPI	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 WL +Z +CPI	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 WL +Z -CPI	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 WL -Z +CPI	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 WL -Z -CPI	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +X+CPI	-1.706	-731.524	0.274	-0.123	-0.768
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +X-CPI	-1.706	-731.524	0.274	-0.123	-0.768
1.0 DL +a*0.8 LL+a*0.8 LLR + 0.8 WL -X+CPI	-1.706	-731.524	0.274	-0.123	-0.768
1.0 DL +a*0.8 LL+a*0.8 LLR + 0.8 WL -X-CPI	-1.706	-731.524	0.274	-0.123	-0.768
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +Z+CPI	-1.706	-731.524	0.274	-0.123	-0.768
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +Z-CPI	-1.706	-731.524	0.274	-0.123	-0.768
1.0 DL + a*0. 8LL+a*0.8 LLR + 0.8 WL -Z+CPI	-1.706	-731.524	0.274	-0.123	-0.768
1.0 DL + a*0. 8LL+a*0.8 LLR + 0.8 WL -Z-CPI	-1.706	-731.524	0.274	-0.123	-0.768
1.0 DL + 1.0 EL +X	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 EL -X	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 EL +Z	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + 1.0 EL -Z	-1.691	-695.906	0.256	-0.115	-0.761
1.0 DL + b*0.8 LL + 0.8 EL +X	-1.697	-708.848	0.264	-0.119	-0.764
1.0 DL + b*0.8 LL + 0.8 EL -X	-1.697	-708.848	0.264	-0.017	-0.764
1.0 DL + b*0.8 LL + 0.8 EL +Z	-1.697	-708.848	0.264	-0.119	-0.764
1.0 DL +b* 0.8 LL + 0.8 EL -Z	-1.697	-708.848	0.264	-0.119	-0.764

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Table 5 : Loads at bottom of footing (Unfactored load combinations) - for sliding check

Load Combinations	Fx s (kN)	P s (kN)	Fz s (kN)	Mx s (kNm)	Mz s (kNm)
0.9 DL + a*1.0 LL +a*1.0 LLR	-1.541	-691.026	0.253	-0.114	-0.693
0.9 DL + 1.0 WL +X +CPI	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 WL +X -CPI	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 WL -X +CPI	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 WL -X -CPI	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 WL +Z +CPI	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 WL +Z -CPI	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 WL -Z +CPI	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 WL -Z -CPI	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL +X +CPI	-1.537	-661.933	0.249	-0.112	-0.692
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL +X -CPI	-1.537	-661.933	0.249	-0.112	-0.692
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL -X +CPI	-1.537	-661.933	0.249	-0.112	-0.692
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL -X -CPI	-1.537	-661.933	0.249	-0.112	-0.692
0.9DL + a*0.8 LL + a*0.8 LLR + 0.8 WL +Z +CPI	-1.537	-661.933	0.249	-0.112	-0.692
0.9DL + a*0.8 LL + a*0.8 LLR + 0.8 WL +Z -CPI	-1.537	-661.933	0.249	-0.112	-0.692
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL -Z +CPI	-1.537	-661.933	0.249	-0.112	-0.692
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL -Z -CPI	-1.537	-661.933	0.249	-0.112	-0.692
0.9 DL + 1.0 EL +X	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 EL -X	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 EL +Z	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + 1.0 EL -Z	-1.522	-626.316	0.230	-0.104	-0.685
0.9 DL + b*0.8 LL + 0.8 EL +X	-1.528	-639.258	0.238	-0.107	-0.687
0.9 DL + b*0.8 LL + 0.8 EL -X	-1.528	-639.258	0.238	-0.015	-0.687
0.9 DL + b*0.8 LL + 0.8 EL +Z	-1.528	-639.258	0.238	-0.107	-0.687
0.9 DL +b* 0.8 LL + 0.8 EL -Z	-1.528	-639.258	0.238	-0.107	-0.687

8 ***CHECK FOR PRESSURE***

Base area A = 2.286 * 2.286

= 5.226 m2

Section modulus (X axis) Zx = 2.286 * 2.286^2 / 6

1.991 mm3

Section modulus (Z axis) Zz = 2.286 * 2.286^2 / 6

1.991 mm3

Pressure at corner A PA = -P/A + Mx/ Zx + Mz / Zz

Pressure at corner B PB = -P/A + Mx/ Zx - Mz / Zz

Pressure at corner C PC = -P/A - Mx/ Zx + Mz / Zz

Pressure at corner D PD = -P/A - Mx/ Zx - Mz / Zz

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Table 6 : Pressures at four corners of the footing

Load Combinations	Gross pr. at four corners (kN/m2)			
	PA	PB	PC	PD
1.0 DL + a*1.0 LL+a*1.0 LLR	141.24	142.01	141.36	142.14
1.0 DL + 1.0 WL +X +CPI	132.73	133.49	132.84	133.61
1.0 DL + 1.0 WL +X -CPI	132.73	133.49	132.84	133.61
1.0 DL + 1.0 WL -X +CPI	132.73	133.49	132.84	133.61
1.0 DL + 1.0 WL -X -CPI	132.73	133.49	132.84	133.61
1.0 DL + 1.0 WL +Z +CPI	132.73	133.49	132.84	133.61
1.0 DL + 1.0 WL +Z -CPI	132.73	133.49	132.84	133.61
1.0 DL + 1.0 WL -Z +CPI	132.73	133.49	132.84	133.61
1.0 DL + 1.0 WL -Z -CPI	132.73	133.49	132.84	133.61
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +X+CPI	139.54	140.31	139.66	140.43
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +X-CPI	139.54	140.31	139.66	140.43
1.0 DL +a*0.8 LL+a*0.8 LLR + 0.8 WL -X+CPI	139.54	140.31	139.66	140.43
1.0 DL +a*0.8 LL+a*0.8 LLR + 0.8 WL -X-CPI	139.54	140.31	139.66	140.43
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +Z+CPI	139.54	140.31	139.66	140.43
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +Z-CPI	139.54	140.31	139.66	140.43
1.0 DL + a*0. 8LL+a*0.8 LLR + 0.8 WL -Z+CPI	139.54	140.31	139.66	140.43
1.0 DL + a*0. 8LL+a*0.8 LLR + 0.8 WL -Z-CPI	139.54	140.31	139.66	140.43
1.0 DL + 1.0 EL +X	132.73	133.49	132.84	133.61
1.0 DL + 1.0 EL -X	132.73	133.49	132.84	133.61
1.0 DL + 1.0 EL +Z	132.73	133.49	132.84	133.61
1.0 DL + 1.0 EL -Z	132.73	133.49	132.84	133.61
1.0 DL + b*0.8 LL + 0.8 EL +X	135.20	135.97	135.32	136.09
1.0 DL + b*0.8 LL + 0.8 EL -X	135.25	136.02	135.27	136.04
1.0 DL + b*0.8 LL + 0.8 EL +Z	135.20	135.97	135.32	136.09
1.0 DL +b* 0.8 LL + 0.8 EL -Z	135.20	135.97	135.32	136.09

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Table 7 : Pmax

Load Combinations	Pmax kN/m2	Net SBC kN/m2	% increase in SBC	Allowable net SBC kN/m2	Overburden pr. kN/m2	Gross SBC kN/m2
1.0 DL + a*1.0 LL+a*1.0 LLR	142.14	111.200	0	111.2	37.8	149
1.0 DL + 1.0 WL +X +CPI	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 WL +X -CPI	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 WL -X +CPI	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 WL -X -CPI	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 WL +Z +CPI	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 WL +Z -CPI	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 WL -Z +CPI	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 WL -Z -CPI	133.61	111.200	25	139	37.8	176.8
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +X+CPI	140.43	111.200	25	139	37.8	176.8
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +X-CPI	140.43	111.200	25	139	37.8	176.8
1.0 DL +a*0.8 LL+a*0.8 LLR + 0.8 WL -X+CPI	140.43	111.200	25	139	37.8	176.8
1.0 DL +a*0.8 LL+a*0.8 LLR + 0.8 WL -X-CPI	140.43	111.200	25	139	37.8	176.8
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +Z+CPI	140.43	111.200	25	139	37.8	176.8
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +Z-CPI	140.43	111.200	25	139	37.8	176.8
1.0 DL + a*0. 8LL+a*0.8 LLR + 0.8 WL -Z+CPI	140.43	111.200	25	139	37.8	176.8
1.0 DL + a*0. 8LL+a*0.8 LLR + 0.8 WL -Z-CPI	140.43	111.200	25	139	37.8	176.8
1.0 DL + 1.0 EL +X	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 EL -X	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 EL +Z	133.61	111.200	25	139	37.8	176.8
1.0 DL + 1.0 EL -Z	133.61	111.200	25	139	37.8	176.8
1.0 DL + b*0.8 LL + 0.8 EL +X	136.09	111.200	25	139	37.8	176.8
1.0 DL + b*0.8 LL + 0.8 EL -X	136.04	111.200	25	139	37.8	176.8
1.0 DL + b*0.8 LL + 0.8 EL +Z	136.09	111.200	25	139	37.8	176.8
1.0 DL +b* 0.8 LL + 0.8 EL -Z	136.09	111.200	25	139	37.8	176.8

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Table 8 : Pmin

Load Combinations	Pmin kN/m2	Uplift	% loss of contact
1.0 DL + a*1.0 LL+a*1.0 LLR	141.24	No Uplift	0.000
1.0 DL + 1.0 WL +X +CPI	132.73	No Uplift	0.000
1.0 DL + 1.0 WL -X +CPI	132.73	No Uplift	0.000
1.0 DL + 1.0 WL +Z +CPI	132.73	No Uplift	0.000
1.0 DL + 1.0 WL -Z +CPI	132.73	No Uplift	0.000
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +X+CPI	139.54	No Uplift	0.000
1.0 DL +a*0.8 LL+a*0.8 LLR + 0.8 WL -X+CPI	139.54	No Uplift	0.000
1.0 DL + a*0.8 LL+a*0.8 LLR + 0.8 WL +Z+CPI	139.54	No Uplift	0.000
1.0 DL + a*0. 8LL+a*0.8 LLR + 0.8 WL -Z+CPI	139.54	No Uplift	0.000
1.0 DL + 1.0 EL +X	132.73	No Uplift	0.000
1.0 DL + 1.0 EL -X	132.73	No Uplift	0.000
1.0 DL + 1.0 EL +Z	132.73	No Uplift	0.000
1.0 DL + 1.0 EL -Z	132.73	No Uplift	0.000
1.0 DL + b*0.8 LL + 0.8 EL +X	135.20	No Uplift	0.000
1.0 DL + b*0.8 LL + 0.8 EL -X	135.25	No Uplift	0.000
1.0 DL + b*0.8 LL + 0.8 EL +Z	135.20	No Uplift	0.000
1.0 DL +b* 0.8 LL + 0.8 EL -Z	135.20	No Uplift	0.000

P max Without Wind load	=	**142.14**	kN/m2	
	<	149.00	kN/m2	**Hence Safe.**
P max With Wind load	=	**140.43**		
	<	186.25	kN/m2	**Hence Safe.**
% loss of contact	=	**0.0**	%	
	≤	0.0	%	**Hence Safe.**

The Bearing pressure reached upto 95% of SBC

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9 CHECK FOR OVERTURNING

Table 9 : Factor of safety against overturning

Load Combinations	Moment about X axis (kNm)			Moment about Z axis (kNm)		
	Overturning	Resisting	FOS	Overturning	Resisting	FOS
1.0*1.2 DL + a*1.0*1.4 LL+a*1.0*1.4 LLR	-0.153	-846.3094	Safe	-0.925	-846.309	Safe
1.0*1.2 DL + 1.0 WL +X +CPI	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 WL +X -CPI	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 WL -X +CPI	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 WL -X -CPI	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 WL +Z +CPI	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 WL +Z -CPI	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 WL -Z +CPI	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 WL -Z -CPI	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	-0.150	-836.1317	Safe	-0.923	-836.132	Safe
1.0*1.2 DL + a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	-0.150	-836.1317	Safe	-0.923	-836.132	Safe
1.0*1.2 DL +a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	-0.150	-836.1317	Safe	-0.923	-836.132	Safe
1.0*1.2 DL +a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	-0.150	-836.1317	Safe	-0.923	-836.132	Safe
1.0*1.2 DL + a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	-0.150	-836.1317	Safe	-0.923	-836.132	Safe
1.0*1.2 DL + a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	-0.150	-836.1317	Safe	-0.923	-836.132	Safe
1.0*1.2 DL + a*0. 8*1.4LL+a*0.8*1.4 LLR + 0.8 W	-0.150	-836.1317	Safe	-0.923	-836.132	Safe
1.0*1.2 DL + a*0. 8*1.4LL+a*0.8*1.4 LLR + 0.8 W	-0.150	-836.1317	Safe	-0.923	-836.132	Safe
1.0*1.2 DL + 1.0 EL +X	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 EL -X	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 EL +Z	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + 1.0 EL -Z	-0.138	-795.421	Safe	-0.913	-795.421	Safe
1.0*1.2 DL + b*0.8*1.4 LL + 0.8 EL +X	-0.143	-810.2137	Safe	-0.764	-810.214	Safe
1.0*1.2 DL + b*0.8*1.4 LL + 0.8 EL -X	-0.021	-810.2137	Safe	-0.917	-810.214	Safe
1.0*1.2 DL + b*0.8*1.4 LL + 0.8 EL +Z	-0.143	-810.2137	Safe	-0.917	-810.214	Safe
1.0*1.2 DL +b* 0.8*1.4 LL + 0.8 EL -Z	-0.166	-810.2137	Safe	-0.917	-810.214	Safe

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10 *CHECK FOR SLIDING*

Table 10 : Factor of safety against sliding

Load Combinations	Along X axis (kN)			Along Z axis (kN)		
	Sliding force	Resisting force	FOS	Sliding force	Resisting force	FOS
0.9 DL + a*1.0 LL +a*1.0 LLR	-1.541	-276.4103	179.429	0.253	-276.41	1091.668
0.9 DL + 1.0 WL +X +CPI	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 WL +X -CPI	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 WL -X +CPI	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 WL -X -CPI	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 WL +Z +CPI	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 WL +Z -CPI	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 WL -Z +CPI	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 WL -Z -CPI	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL +X +CPI	-1.537	-264.7733	172.291	0.249	-264.773	1064.886
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL +X -CPI	-1.537	-264.7733	172.291	0.249	-264.773	1064.886
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL -X +CPI	-1.537	-264.7733	172.291	0.249	-264.773	1064.886
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL -X -CPI	-1.537	-264.7733	172.291	0.249	-264.773	1064.886
0.9DL + a*0.8 LL + a*0.8 LLR + 0.8 WL +Z +CPI	-1.537	-264.7733	172.291	0.249	-264.773	1064.886
0.9DL + a*0.8 LL + a*0.8 LLR + 0.8 WL +Z -CPI	-1.537	-264.7733	172.291	0.249	-264.773	1064.886
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL -Z +CPI	-1.537	-264.7733	172.291	0.249	-264.773	1064.886
0.9 DL + a*0.8 LL + a*0.8 LLR + 0.8 WL -Z -CPI	-1.537	-264.7733	172.291	0.249	-264.773	1064.886
0.9 DL + 1.0 EL +X	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 EL -X	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 EL +Z	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + 1.0 EL -Z	-1.522	-250.5263	164.614	0.230	-250.526	1087.354
0.9 DL + b*0.8 LL + 0.8 EL +X	-1.528	-255.7031	167.378	0.238	-255.703	1074.383
0.9 DL + b*0.8 LL + 0.8 EL -X	-1.528	-255.7031	167.378	0.238	-255.703	1074.383
0.9 DL + b*0.8 LL + 0.8 EL +Z	-1.528	-255.7031	167.378	0.238	-255.703	1074.383
0.9 DL +b* 0.8 LL + 0.8 EL -Z	-1.528	-255.7031	167.378	0.238	-255.703	1074.383

Minimum factor of safety = 164.614

Allowable factor of safety = 1.400

< 164.614 **Hence Safe**

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11 *CHECK FOR UPLIFT*

Table 11 : Factor of safety against uplift

Load combinations	Uplift	Downward load	FS
1.0*1.2 DL + a*1.0*1.4 LL+a*1.0*1.4 LLR	0.000	-740.4282	100
1.0*1.2 DL + 1.0 WL +X +CPI	0.000	-695.9064	100
1.0*1.2 DL + 1.0 WL +X -CPI	0.000	-695.9064	100
1.0*1.2 DL + 1.0 WL -X +CPI	0.000	-695.9064	100
1.0*1.2 DL + 1.0 WL -X -CPI	0.000	-695.9064	100
1.0*1.2 DL + 1.0 WL +Z +CPI	0.000	-695.9064	100
1.0*1.2 DL + 1.0 WL +Z -CPI	0.000	-695.9064	100
1.0*1.2 DL + 1.0 WL -Z +CPI	0.000	-695.9064	100
1.0*1.2 DL + 1.0 WL -Z -CPI	0.000	-695.9064	100
1.0*1.2 DL + a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	0.000	-731.5238	100
1.0*1.2 DL + a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	0.000	-731.5238	100
1.0*1.2 DL +a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	0.000	-731.5238	100
1.0*1.2 DL +a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	0.000	-731.5238	100
1.0*1.2 DL + a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	0.000	-731.5238	100
1.0*1.2 DL + a*0.8*1.4 LL+a*0.8*1.4 LLR + 0.8 W	0.000	-731.5238	100
1.0*1.2 DL + a*0. 8*1.4LL+a*0.8*1.4 LLR + 0.8 W	0.000	-731.5238	100
1.0*1.2 DL + a*0. 8*1.4LL+a*0.8*1.4 LLR + 0.8 W	0.000	-731.5238	100
1.0*1.2 DL + 1.0 EL +X	0.000	-695.9064	100
1.0*1.2 DL + 1.0 EL -X	0.000	-695.9064	100
1.0*1.2 DL + 1.0 EL +Z	0.000	-695.9064	100
1.0*1.2 DL + 1.0 EL -Z	0.000	-695.9064	100
1.0*1.2 DL + b*0.8*1.4 LL + 0.8 EL +X	0.000	-708.8484	100
1.0*1.2 DL + b*0.8*1.4 LL + 0.8 EL -X	0.000	-708.8484	100
1.0*1.2 DL + b*0.8*1.4 LL + 0.8 EL +Z	0.000	-708.8484	100
1.0*1.2 DL +b* 0.8*1.4 LL + 0.8 EL -Z	0.000	-708.8484	100

Minimum factor of safety	=	100	
Allowable factor of safety	=	1.200	
	<	100.000	**Hence Safe**

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12 LOADS AT BOTTOM OF FOOTING (Load combinations for strength check)

Table 12 : Loads at bottom of footing (Factored load combinations)

Load Combinations	Fx (kN)	P (kN)	Fz (kN)	Mx (kNm)	Mz (kNm)
1.5 DL + C*1.5 LL + C*1.5 LLR	-2.564	-1110.642	0.418	0.188	1.154
1.5 DL + 1.5 WL +X +CPI	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 WL +X -CPI	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 WL -X +CPI	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 WL -X -CPI	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 WL +Z +CPI	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 WL +Z -CPI	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 WL -Z +CPI	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 WL -Z -CPI	-2.537	-1043.860	0.384	0.173	1.141
0.9 DL + 1.5 WL +X +CPI	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 WL +X -CPI	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 WL -X +CPI	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 WL -X -CPI	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 WL +Z +CPI	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 WL +Z -CPI	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 WL -Z +CPI	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 WL -Z -CPI	-1.522	-752.869	0.230	0.104	0.685
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X +CPI	-2.052	-951.791	0.335	0.151	0.923
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X -CPI	-2.052	-951.791	0.335	0.151	0.923
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X+CPI	-2.052	-951.791	0.335	0.151	0.923
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X-CPI	-2.052	-951.791	0.335	0.151	0.923
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z +CPI	-2.052	-951.791	0.335	0.151	0.923
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z -CPI	-2.052	-951.791	0.335	0.151	0.923
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z +CPI	-2.052	-951.791	0.335	0.151	0.923
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z -CPI	-2.052	-951.791	0.335	0.151	0.923
1.5 DL + 1.5 EL +X	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 EL -X	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 EL +Z	-2.537	-1043.860	0.384	0.173	1.141
1.5 DL + 1.5 EL -Z	-2.537	-1043.860	0.384	0.173	1.141
0.9 DL + 1.5 EL +X	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 EL -X	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 EL +Z	-1.522	-752.869	0.230	0.104	0.685
0.9 DL + 1.5 EL -Z	-1.522	-752.869	0.230	0.104	0.685
1.2 DL + b*1.2 LL + 1.2 EL +X	-2.038	-917.777	0.319	0.143	0.917
1.2 DL + b*1.2 LL + 1.2 EL -X	-2.038	-917.777	0.319	0.143	0.917
1.2 DL + b*1.2 LL + 1.2 EL +Z	-2.038	-917.777	0.319	0.143	0.917
1.2 DL + b*1.2 LL + 1.2 EL -Z	-2.038	-917.777	0.319	0.143	0.917

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13 PRESSURE AT BASE FOR STRENGTH CHECK

Table 13 : Pressures at four corners of the footing

Load Combinations	Gross pr. at four corners (kN/m2)			
	PA	PB	PC	PD
1.5 DL + C*1.5 LL + C*1.5 LLR	213.20	212.05	213.02	211.86
1.5 DL + 1.5 WL +X +CPI	200.41	199.26	200.24	199.09
1.5 DL + 1.5 WL +X -CPI	200.41	199.26	200.24	199.09
1.5 DL + 1.5 WL -X +CPI	200.41	199.26	200.24	199.09
1.5 DL + 1.5 WL -X -CPI	200.41	199.26	200.24	199.09
1.5 DL + 1.5 WL +Z +CPI	200.41	199.26	200.24	199.09
1.5 DL + 1.5 WL +Z -CPI	200.41	199.26	200.24	199.09
1.5 DL + 1.5 WL -Z +CPI	200.41	199.26	200.24	199.09
1.5 DL + 1.5 WL -Z -CPI	200.41	199.26	200.24	199.09
0.9 DL + 1.5 WL +X +CPI	144.46	143.78	144.36	143.67
0.9 DL + 1.5 WL +X -CPI	144.46	143.78	144.36	143.67
0.9 DL + 1.5 WL -X +CPI	144.46	143.78	144.36	143.67
0.9 DL + 1.5 WL -X -CPI	144.46	143.78	144.36	143.67
0.9 DL + 1.5 WL +Z +CPI	144.46	143.78	144.36	143.67
0.9 DL + 1.5 WL +Z -CPI	144.46	143.78	144.36	143.67
0.9 DL + 1.5 WL -Z +CPI	144.46	143.78	144.36	143.67
0.9 DL + 1.5 WL -Z -CPI	144.46	143.78	144.36	143.67
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X +CPI	182.67	181.75	182.52	181.59
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X -CPI	182.67	181.75	182.52	181.59
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X+CPI	182.67	181.75	182.52	181.59
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X-CPI	182.67	181.75	182.52	181.59
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z +CPI	182.67	181.75	182.52	181.59
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z -CPI	182.67	181.75	182.52	181.59
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z +CPI	182.67	181.75	182.52	181.59
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z -CPI	182.67	181.75	182.52	181.59
1.5 DL + 1.5 EL +X	200.41	199.26	200.24	199.09
1.5 DL + 1.5 EL -X	200.41	199.26	200.24	199.09
1.5 DL + 1.5 EL +Z	200.41	199.26	200.24	199.09
1.5 DL + 1.5 EL -Z	200.41	199.26	200.24	199.09
0.9 DL + 1.5 EL +X	144.46	143.78	144.36	143.67
0.9 DL + 1.5 EL -X	144.46	143.78	144.36	143.67
0.9 DL + 1.5 EL +Z	144.46	143.78	144.36	143.67
0.9 DL + 1.5 EL -Z	144.46	143.78	144.36	143.67
1.2 DL + b*1.2 LL + 1.2 EL +X	176.16	175.24	176.01	175.09
1.2 DL + b*1.2 LL + 1.2 EL -X	176.16	175.24	176.01	175.09
1.2 DL + b*1.2 LL + 1.2 EL +Z	176.16	175.24	176.01	175.09
1.2 DL + b*1.2 LL + 1.2 EL -Z	176.16	175.24	176.01	175.09

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14 *REINFORCEMENTS & ONE WAY SHEAR ALONG X AXIS*

Mu= (0.87*fy*Ast*d) * (1 - (fy*Ast)(fck*b*d))

Reinforcements	Bar dia (mm)	Spacing (mm)
Along X axis	10	145.000

Effective depth = 395 mm

Minimum Ast = 1234.44 mm2

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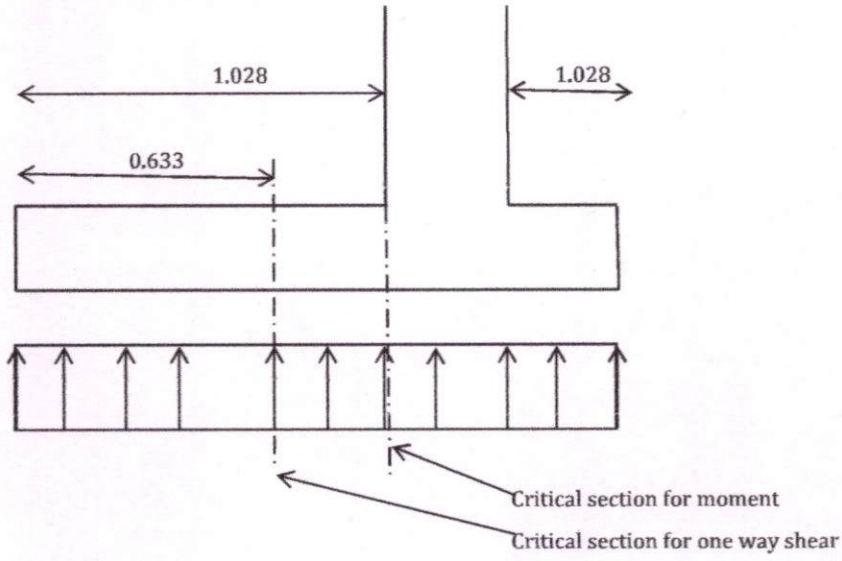
Table 14 : Pressures at edges, moment and shear

Load Combinations	Edge pressures (kN/m2)		Moment	Ast reqd.	Shear
	PAC	PBD	(kNm)	mm2	kN/m
1.5 DL + C*1.5 LL + C*1.5 LLR	213.110	211.951	183.144	1092.300	220.307
1.5 DL + 1.5 WL +X +CPI	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 WL +X -CPI	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 WL -X +CPI	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 WL -X -CPI	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 WL +Z +CPI	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 WL +Z -CPI	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 WL -Z +CPI	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 WL -Z -CPI	200.325	199.178	167.712	998.131	201.810
0.9 DL + 1.5 WL +X +CPI	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 WL +X -CPI	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 WL -X +CPI	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 WL -X -CPI	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 WL +Z +CPI	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 WL +Z -CPI	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 WL -Z +CPI	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 WL -Z -CPI	144.412	143.724	100.627	593.439	121.086
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X +CPI	182.597	181.669	146.515	869.442	176.245
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X -CPI	182.597	181.669	146.515	869.442	176.245
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X+CPI	182.597	181.669	146.515	869.442	176.245
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X-CPI	182.597	181.669	146.515	869.442	176.245
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z +CPI	182.597	181.669	146.515	869.442	176.245
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z -CPI	182.597	181.669	146.515	869.442	176.245
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z +CPI	182.597	181.669	146.515	869.442	176.245
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z -CPI	182.597	181.669	146.515	869.442	176.245
1.5 DL + 1.5 EL +X	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 EL -X	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 EL +Z	200.325	199.178	167.712	998.131	201.810
1.5 DL + 1.5 EL -Z	200.325	199.178	167.712	998.131	201.810
0.9 DL + 1.5 EL +X	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 EL -X	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 EL +Z	144.412	143.724	100.627	593.439	121.086
0.9 DL + 1.5 EL -Z	144.412	143.724	100.627	593.439	121.086
1.2 DL + b*1.2 LL + 1.2 EL +X	176.085	175.164	138.655	821.921	166.825
1.2 DL + b*1.2 LL + 1.2 EL -X	176.085	175.164	138.655	821.921	166.825
1.2 DL + b*1.2 LL + 1.2 EL +Z	176.085	175.164	138.655	821.921	166.825
1.2 DL + b*1.2 LL + 1.2 EL -Z	176.085	175.164	138.655	821.921	166.825

Note : The maximum of PAC and PBD is considered for moment calculation.

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	- DESIGN OF ISOLATED FOOTING F1



Ast required		=	1234.440 mm2	
Spacing of 10mm dia bars required		=	145.444 mm	
Provided spacing		=	145.000 mm	**Hence Safe.**
Dear shear force		=	220.307 kN/m	
Design shear stress		=	Vu/bd	
		=	0.244 N/mm2	
100Ast/bd		=	0.060	
Allowable shear stress	Tc	=	0.280 N/mm2	
		>	0.244 N/mm2	**Hence Safe.**

100Ast/bd	Tc
0.15	0.28
0.25	0.36
0.060	0.280

15 *REINFORCEMENTS & ONE WAY SHEAR ALONG Z AXIS*

Mu= (0.87*fy*Ast*d) * (1 - (fy*Ast)(fck*b*d))

Reinforcements	Bar dia (mm)	Spacing (mm)
Along X axis	10	145.000

Effective depth	=	385 mm
Minimum Ast	=	1234.44 mm2

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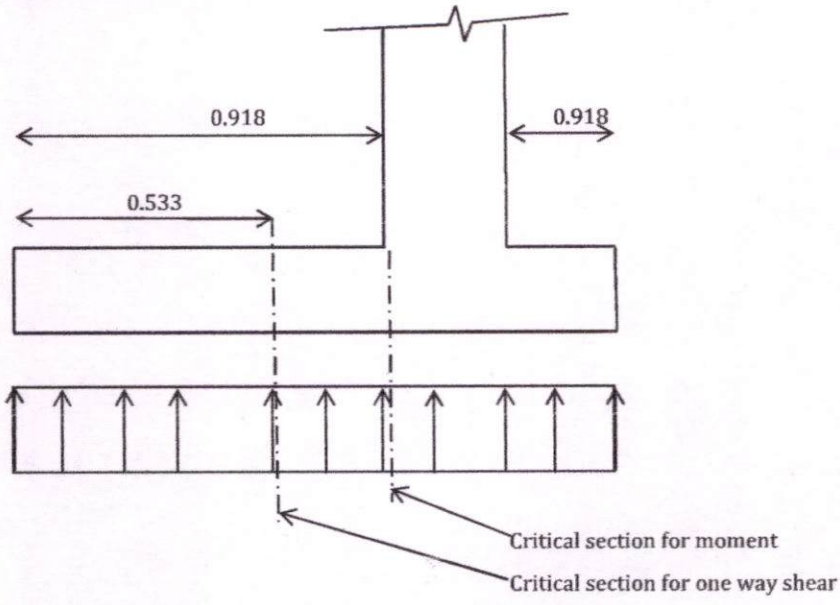
Table 15 : Pressures at edges, moment and shear

Load Combinations	Edge pressures (kN/m2)		Moment	Ast reqd.	Shear
	PAB	PCD	(kNm)	mm2	kN
1.5 DL + C*1.5 LL + C*1.5 LLR	212.625	212.436	146.333	891.837	185.127
1.5 DL + 1.5 WL +X +CPI	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 WL +X -CPI	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 WL -X +CPI	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 WL -X -CPI	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 WL +Z +CPI	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 WL +Z -CPI	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 WL -Z +CPI	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 WL -Z -CPI	199.838	199.665	134.029	815.403	169.561
0.9 DL + 1.5 WL +X +CPI	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 WL +X -CPI	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 WL -X +CPI	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 WL -X -CPI	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 WL +Z +CPI	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 WL +Z -CPI	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 WL -Z +CPI	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 WL -Z -CPI	144.120	144.016	80.418	485.533	101.736
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X +CPI	182.209	182.058	117.067	710.481	148.101
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X -CPI	182.209	182.058	117.067	710.481	148.101
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X+CPI	182.209	182.058	117.067	710.481	148.101
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X-CPI	182.209	182.058	117.067	710.481	148.101
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z +CPI	182.209	182.058	117.067	710.481	148.101
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z -CPI	182.209	182.058	117.067	710.481	148.101
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z +CPI	182.209	182.058	117.067	710.481	148.101
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z -CPI	182.209	182.058	117.067	710.481	148.101
1.5 DL + 1.5 EL +X	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 EL -X	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 EL +Z	199.838	199.665	134.029	815.403	169.561
1.5 DL + 1.5 EL -Z	199.838	199.665	134.029	815.403	169.561
0.9 DL + 1.5 EL +X	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 EL -X	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 EL +Z	144.120	144.016	80.418	485.533	101.736
0.9 DL + 1.5 EL -Z	144.120	144.016	80.418	485.533	101.736
1.2 DL + b*1.2 LL + 1.2 EL +X	175.696	175.552	110.800	671.848	140.173
1.2 DL + b*1.2 LL + 1.2 EL -X	175.696	175.552	110.800	671.848	140.173
1.2 DL + b*1.2 LL + 1.2 EL +Z	175.696	175.552	110.800	671.848	140.173
1.2 DL + b*1.2 LL + 1.2 EL -Z	175.696	175.552	110.800	671.848	140.173

Note : The maximum of PAB and PCD is considered for moment calculation.

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	- DESIGN OF ISOLATED FOOTING F1



Ast required		=	1234.440 mm2	
Spacing of 10mm dia bars required		=	145.444 mm	
Provided spacing		=	145.000 mm	**Hence Safe.**
Dear shear force		=	185.127 kN/m	
Design shear stress		=	Vu/bd	
		=	0.210 N/mm2	
100Ast/bd		=	0.062	
Allowable shear stress	Tc	=	0.280 N/mm2	
		>	0.210 N/mm2	**Hence Safe.**

100Ast/bd	Tc
0.15	0.28
0.25	0.36
0.062	0.280

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CHECK FOR TWO WAY SHEAR

16 Check for punching shear

Load Combinations	Edge pressures (kN/m2)		s.w of footing + above soil +load	soil pressure at centre (kN/m2)	shear (kN)
	PAB	PCD			
1.5 DL + C*1.5 LL + C*1.5 LLR	213.110	212.436	-936.534	212.807	-436.436
1.5 DL + 1.5 WL +X +CPI	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 WL +X -CPI	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 WL -X +CPI	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 WL -X -CPI	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 WL +Z +CPI	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 WL +Z -CPI	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 WL -Z +CPI	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 WL -Z -CPI	200.325	199.665	-869.752	200.028	-399.685
0.9 DL + 1.5 WL +X +CPI	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 WL +X -CPI	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 WL -X +CPI	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 WL -X -CPI	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 WL +Z +CPI	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 WL +Z -CPI	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 WL -Z +CPI	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 WL -Z -CPI	144.412	144.016	-578.761	144.234	-239.811
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X +CPI	182.597	182.058	-777.683	182.354	-349.149
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +X -CPI	182.597	182.058	-777.683	182.354	-349.149
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X+CPI	182.597	182.058	-777.683	182.354	-349.149
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -X-CPI	182.597	182.058	-777.683	182.354	-349.149
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z +CPI	182.597	182.058	-777.683	182.354	-349.149
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL +Z -CPI	182.597	182.058	-777.683	182.354	-349.149
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z +CPI	182.597	182.058	-777.683	182.354	-349.149
1.2 DL + C*1.2 LL + C*1.2 LLR + 1.2 WL -Z -CPI	182.597	182.058	-777.683	182.354	-349.149
1.5 DL + 1.5 EL +X	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 EL -X	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 EL +Z	200.325	199.665	-869.752	200.028	-399.685
1.5 DL + 1.5 EL -Z	200.325	199.665	-869.752	200.028	-399.685
0.9 DL + 1.5 EL +X	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 EL -X	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 EL +Z	144.412	144.016	-578.761	144.234	-239.811
0.9 DL + 1.5 EL -Z	144.412	144.016	-578.761	144.234	-239.811
1.2 DL + b*1.2 LL + 1.2 EL +X	176.085	175.552	-743.67	175.846	-330.431
1.2 DL + b*1.2 LL + 1.2 EL -X	176.085	175.552	-743.67	175.846	-330.431
1.2 DL + b*1.2 LL + 1.2 EL +Z	176.085	175.552	-743.67	175.846	-330.431
1.2 DL + b*1.2 LL + 1.2 EL -Z	176.085	175.552	-743.67	175.846	-330.431

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Perimeter of the critical section (b0)	=	2920 mm
Effective depth	=	385 mm
Punching shear stress	=	0.388 N/mm2
Ratio of short side to long side of the column βc		
	=	0.511111
Allowable punching shear stress	=	(0.5+βc) * 0.25 * √fck
	=	1.250 N/mm2
	>	0.388 N/mm2

Hence Safe.

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	SHRI BALAJI CONSULTANCY
	DESIGN OF TWO WAY SLAB - S1

1 MATERIAL PROPERTIES

Unit weight of reinforced concrete	γ_c	=	25.000 kN/m^3
Environmental exposure condition (Table 3 of IS 456)		=	Mild
Grade of concrete (Table 5 of IS 456)		=	M20
Grade of steel		=	Fe500
Characteristic strength of concrete (Table 2 of IS 456)	f_{ck}	=	20.000 N/mm^2
Characteristic strength of reinf. steel = Yield stress of reinf. steel (cl. 36.1 of IS 456)	f_y	=	500.000 N/mm^2

2 DIMENSIONS

Shorter span	lx	=	3580.000 mm
Longer span	ly	=	4730.000 mm
Span ratio	ly / lx	=	1.321
		≤	2.000
		Hence it is a two way slab.	
Thickness of slab		=	115.000 mm
Clear cover to reinforcements (Table 16 of IS 456)		=	15.000 mm
Width of slab considered for design (width of compression face)	= b	=	1000.000 mm

3 REINFORCEMENTS

Zone	Bar dia mm	Spacing mm	Ast mm2/m	Eff. Depth d mm
Along short span at bottom	8	200.000	251.327	96
Along long span at bottom	8	200.000	251.327	88
Top bars at short edge	8	200.000	251.327	88
Top bars at long edge	8	200.000	251.327	96

4 DEAD LOAD

Weight of finishes		=	1.150 kN/m^2
Self Weight of slab		=	25 * 0.115
		=	2.875 kN/m^2
Total		=	4.025 kN/m^2

5 LIVE LOAD

Live load on slab (Table 1 of IS 875 Part 2)		=	2.000 kN/m^2

6 FACTORED LOAD COMBINATION

Partial safety factor for DL (Table 18 of IS 456)		=	1.500
Partial safety factor for LL (Table 18 of IS 456)		=	1.500
Factored Load	= [1.5 DL + 1.5 LL] = w	=	9.038 kN/m^2

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SHRI BALAJI CONSULTANCY

DESIGN OF TWO WAY SLAB - S1

7 BENDING MOMENTS

Edge condition : One long edge continuous

As Per Table 26 of IS 456:2000 the moment coefficients are as follows

Ratio of ly/lx	Short span coefficient αx	
	- ve moment at continuous Edge	+ ve moment at midspan
1.300	0.076	0.057
1.400	0.080	0.060
1.321	0.077	0.058

Long span coefficient αy	
- ve moment at continuous Edge	+ ve moment at midspan
0.000	0.043

Negative Bending moment at the short span	$= M_{-x} = \alpha_{-x} \times w \times lx^2$	=	8.902 kNm
Positive Bending moment at the short span	$= M_{+x} = \alpha_{+x} \times w \times lx^2$	=	6.676 kNm
Negative Bending moment at the long span	$= M_{-y} = \alpha_{-y} \times w \times lx^2$	=	0 kNm
Positive Bending moment at the long span	$= M_{+y} = \alpha_{+y} \times w \times lx^2$	=	4.981 kNm

8 LIMIT STATE OF COLLAPSE - FLEXURE & SHEAR

Minimum reinforcements (Cl. 26.5.2.1 of IS 456)		=	0.12 %
		=	138 mm^2

A REINFORCEMENTS ALONG SHORT SPAN AT BOTTOM

Positive Bending moment at the short span		=	6.676 kNm
Area of reinf. steel required is calculated as per Annex G of IS 456 :			
Area of tension reinforcement required =	Ast reqd.	=	167.141 mm^2
Spacing of 8 mm dia. bars required		=	300.737 mm
Maximum spacing allowed as per cl. 26.3.3. of IS 456 is three times the effective depth or 300mm which ever is smaller		=	288.000 mm
Hence spacing of 8 mm dia. bars required is the minimum of the above two values		=	288.000 mm
Spacing of 8 mm dia. bars provided		=	200.000 mm
Area of tension reinforcement provided =	Ast prov.	=	251.327 mm^2
		>	167.141 mm^2
			Hence Safe

Moment of resistance is calculated as per Annex G of IS 456 :

Ratio between depth of neutral axis and effective depth =	x_u / d	=	$(0.87 f_y A_{st})/(0.36 f_{ck} b d)$
		=	0.158
Depth of neutral axis =	x_u	=	0.158 * 96
		=	15.168 mm
As per cl. 38.1 of IS 456, the limiting value of xu/d =	$x_{u,max} / d$	=	0.460
		>	0.158
			Hence Safe

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Limiting value of the depth of neutral axis		=	44.160 mm
Moment of resistance Mu =	0.87 fy Ast d (1-(Ast fy / b d fck))	=	9.809 kNm
		>	6.676 kNm
			Hence Safe

Limiting moment of resistance of the section without compression reinforcement

$= 0.36 * x_{u,max}/d\ (1-0.42\ x_{u,max}/d) * bd^2\ fck =$	$M_{u,lim}$	=	24.626 kNm
		>	9.809 kNm

Hence compression reinforcements are not required.

Design stress in compression reinforcement =	f_{sc}	=	500.000 N/mm^2
Depth of compression reinf. from compression face =	d'	=	15 + 8/2
		=	19.000 mm
Area of compression reinforcement = $(M_u - M_{u,lim}) / (f_{sc}\ (d-d'))$ =	A_{sc}	=	0 mm^2
Area of compression reinforcement provided		=	0 mm^2
Additional tension reinforcement required =	A_{st2}	=	0 mm^2
Area of tension reinforcement required for a singly reinforced section for $M_{u,lim}$ =	A_{st1}	=	167.141 mm^2
Total tension reinforcement required = $A_{st1} + A_{st2}$ =	Ast	=	167.141 mm^2

B REINFORCEMENTS ALONG LONG SPAN AT BOTTOM

Positive Bending moment at the long span		=	4.981 kNm
Area of reinf. steel required is calculated as per Annex G of IS 456 :			
Area of tension reinforcement required =	Ast reqd.	=	135.322 mm^2
Spacing of mm dia. bars required		=	371.450 mm
Maximum spacing allowed as per cl. 26.3.3. of IS 456 is three times the effective depth or 300mm which ever is smaller		=	264.000 mm
Hence spacing of mm dia. bars required is the minimum of the above two values		=	264.000 mm
Spacing of mm dia. bars provided		=	200.000 mm
Area of tension reinforcement provided =	Ast prov.	=	251.327 mm^2
		>	138.000 mm^2
			Hence Safe

Moment of resistance is calculated as per Annex G of IS 456 :

Ratio between depth of neutral axis and effective depth =	x_u / d	=	$(0.87\ fy\ Ast)/(0.36\ f_{ck}\ b\ d)$
		=	0.173
Depth of neutral axis =	x_u	=	0.173 * 88
		=	15.224 mm
As per cl. 38.1 of IS 456, the limiting value of xu/d =	$x_{u,max} / d$	=	0.460
		>	0.173
			Hence Safe
Limiting value of the depth of neutral axis		=	40.480 mm

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Moment of resistance Mu =	0.87 fy Ast d (1-(Ast fy / b d fck))	=	8.934 kNm
		>	4.981 kNm
			Hence Safe

Limiting moment of resistance of the section without compression reinforcement

$= 0.36 * x_{u,max}/d\ (1-0.42\ x_{u,max}/d) * bd^2\ fck =$	$M_{u,lim}$	=	20.693 kNm
		>	8.934 kNm
			Hence compression reinforcements are not required.

Design stress in compression reinforcement =	f_{sc}	=	500.000 N/mm^2
Depth of compression reinf. from compression face =	d'	=	15 + 8/2
		=	19.000 mm
Area of compression reinforcement = $(M_u - M_{u,lim}) / (f_{sc}\ (d-d'))$ =	A_{sc}	=	0 mm^2
Area of compression reinforcement provided		=	0 mm^2
Additional tension reinforcement required =	A_{st2}	=	0 mm^2
Area of tension reinforcement required for a singly reinforced section for $M_{u,lim}$ =	A_{st1}	=	135.322 mm^2
Total tension reinforcement required = $A_{st1} + A_{st2}$ =	Ast	=	135.322 mm^2

C REINFORCEMENTS AT LONG EDGE AT TOP

Negative Bending moment at the short span		=	8.902 kNm

Area of reinf. steel required is calculated as per Annex G of IS 456 :

Area of tension reinforcement required =	Ast reqd.	=	226.535 mm^2
Spacing of mm dia. bars required		=	221.889 mm
Maximum spacing allowed as per cl. 26.3.3. of IS 456 is three times the effective depth or 300mm which ever is smaller		=	288.000 mm
Hence spacing of mm dia. bars required is the minimum of the above two values		=	221.889 mm
Spacing of mm dia. bars provided		=	200.000 mm
Area of tension reinforcement provided =	Ast prov.	=	251.327 mm^2
		>	226.535 mm^2
			Hence Safe

Moment of resistance is calculated as per Annex G of IS 456 :

Ratio between depth of neutral axis and effective depth =	x_u / d	=	$(0.87\ fy\ Ast)/(0.36\ f_{ck}\ b\ d)$
		=	0.158
Depth of neutral axis =	x_u	=	0.158 * 96
		=	15.168 mm
As per cl. 38.1 of IS 456, the limiting value of xu/d =	$x_{u,max} / d$	=	0.460
		>	0.158
			Hence Safe
Limiting value of the depth of neutral axis		=	44.160 mm
Moment of resistance Mu = 0.87 fy Ast d (1-(Ast fy / b d fck))		=	9.809 kNm

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		>	8.902 kNm
			Hence Safe

Limiting moment of resistance of the section without compression reinforcement

$= 0.36 * x_{u,max}/d\ (1-0.42\ x_{u,max}/d) * bd^2\ fck =$	$M_{u,lim}$	=	24.626 kNm
		>	9.809 kNm
			Hence compression reinforcements are not required.
Design stress in compression reinforcement =	f_{sc}	=	500.000 N/mm^2
Depth of compression reinf. from compression face =	d'	=	15 + 8/2
		=	19.000 mm
Area of compression reinforcement = $(M_u - M_{u,lim}) / (f_{sc}\ (d-d'))$ =	A_{sc}	=	0 mm^2
Area of compression reinforcement provided		=	0 mm^2
Additional tension reinforcement required =	A_{st2}	=	0 mm^2
Area of tension reinforcement required for a singly reinforced section for $M_{u,lim}$	A_{st1}	=	226.535 mm^2
Total tension reinforcement required = $A_{st1} + A_{st2}$ =	Ast	=	226.535 mm^2

D REINFORCEMENTS AT SHORT EDGE AT TOP

Negative Bending moment at the long span		=	0 kNm
Area of reinf. steel required is calculated as per Annex G of IS 456 :			
Area of tension reinforcement required =	Ast reqd.	=	0.000 mm^2
Spacing of mm dia. bars required		=	#DIV/0! mm
Maximum spacing allowed as per cl. 26.3.3. of IS 456 is three times the effective depth or 300mm which ever is smaller		=	264.000 mm
Hence spacing of mm dia. bars required is the minimum of the above two values		=	NA mm
Spacing of mm dia. bars provided		=	200.000 mm
Area of tension reinforcement provided =	Ast prov.	=	251.327 mm^2
		>	138.000 mm^2
			Hence Safe
Moment of resistance is calculated as per Annex G of IS 456 :			
Ratio between depth of neutral axis and effective depth =	x_u / d	=	(0.87 fy Ast)/(0.36 f_{ck} b d)
		=	0.173
Depth of neutral axis =	x_u	=	0.173 * 88
		=	15.224 mm
As per cl. 38.1 of IS 456, the limiting value of xu/d =	$x_{u,max} / d$	=	0.460
		>	0.173
			Hence Safe
Limiting value of the depth of neutral axis		=	40.480 mm
Moment of resistance Mu = 0.87 fy Ast d (1-(Ast fy / b d fck))		=	8.934 kNm
		>	0.000 kNm

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Hence Safe

Limiting moment of resistance of the section without compression reinforcement

$= 0.36 * x_{u,max}/d\ (1-0.42\ x_{u,max}/d) * bd^2\ fck =$ $M_{u,lim}$ = 20.693 kNm

> 8.934 kNm

Hence compression reinforcements are not required.

Design stress in compression reinforcement =	f_{sc}	=	500.000 N/mm^2
Depth of compression reinf. from compression face =	d'	=	15 + 8/2
		=	19.000 mm
Area of compression reinforcement = $(M_u - M_{u,lim}) / (f_{sc}\ (d-d'))$ =	A_{sc}	=	0 mm^2
Area of compression reinforcement provided		=	0 mm^2
Additional tension reinforcement required =	A_{st2}	=	0 mm^2
Area of tension reinforcement required for a singly reinforced section for $M_{u,lim}$ =	A_{st1}	=	0.000 mm^2
Total tension reinforcement required = $A_{st1} + A_{st2}$ =	Ast	=	0.000 mm^2

E TORSIONAL REINFORCEMENTS

Torsion reinforcements at corners, whose two edges are simply supported (Cl. D.1.8 of IS 456)	=	3/4 * 167.141
	=	125.356 mm^2
Torsion reinforcements at corners, whose one edge is simply supported (Cl. D.1.9 of IS 456)	=	1/2 * 125.356
	=	62.678 mm^2

F CHECK FOR SHEAR

As per Table 3.15 of BS 8110-1 the shear coefficients are as follows

Ratio of ly/lx	Short span coefficient βx	
	continuous edge	discontinuous edge
1.300	0.530	0.350
1.400	0.550	0.360
1.321	0.534	0.352

Long span coefficient βy	
continuous edge	discontinuous edge
0.000	0.290

Shear force at the long continuous edge	$= \beta_{cx} \times W \times lx =$	V_{cx}	=	17.286 kN
Shear force at the long discontinuous edge	$= \beta_{dx} \times W \times lx =$	V_{dx}	=	11.393 kN
Shear force at the short continuous edge	$= \beta_{cy} \times W \times lx =$	V_{cy}	=	0 kN
Shear force at the short discontinuous edge	$= \beta_{dy} \times W \times lx =$	V_{dy}	=	9.383 kN

Check for shear near long edge :

Shear force due to design loads	Vu	=	17.286 kN
Effective depth	d	=	96.000 mm
Nominal shear stress (Cl. 40.1 of IS 456)	τ_v	=	Vu / bd
		=	0.180 N/mm^2
Maximum shear stress (Cl. 40.2.3.1of IS 456)	$\tau_{c\ max}$	=	1.400 N/mm^2

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			>	0.180 N/mm^2
				Hence SAFE
Area of reinf. provided			=	251.327 mm^2
Percentage of reinf. provided	= 100As/bd =	pt	=	0.262

From table 19 of IS 456,

pt	τ_c
0.250	0.360
0.500	0.480
0.262	0.366

Factor k as per cl. 40.2.1.1 of IS 456		k	=	1.300
Design shear strength of concrete		τ_c k	=	0.475 N/mm^2
			>	0.180 N/mm^2
				Hence SAFE

Check for shear near short edge :

Shear force due to design loads		Vu	=	9.383 kN
Effective depth		d	=	88.000 mm
Nominal shear stress (Cl. 40.1 of IS 456)		τ_v	=	Vu / bd
			=	0.107 N/mm^2
Maximum shear stress (Cl. 40.2.3.1of IS 456)		$\tau_{c\,max}$	=	1.400 N/mm^2
			>	0.107 N/mm^2
				Hence SAFE
Area of reinf. provided			=	251.327 mm^2
Percentage of reinf. provided	= 100As/bd = pt		=	0.286

From table 19 of IS 456,

pt	τ_c
0.250	0.360
0.500	0.480
0.286	0.377

Factor k as per cl. 40.2.1.1 of IS 456		k	=	1.300
Design shear strength of concrete		τ_c k	=	0.490 N/mm^2
			>	0.107 N/mm^2
				Hence SAFE

9 ***LIMIT STATE OF SERVICEABILITY - DEFLECTION & CRACKING***

A CHECK FOR DEFLECTION

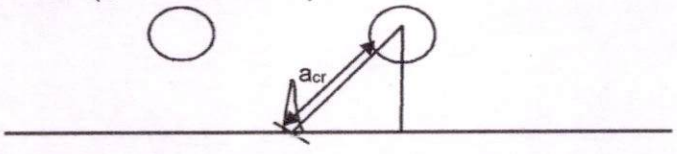
Allowable long term deflection (Cl. 23.2 of IS 456)	=	lx / 350	
	=	10.229 mm	
Basic allowable span to effective depth ratio (Cl. 23.2.1 of IS 456)	=	26.000 mm	

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Steel stress at service loads	fs	=	0.58 f_y $A_{st,reqd.}$ / $A_{st,prov.}$
		=	192.860 N/mm^2
Modification factor for tension reinforcement (Fig. 4 of IS 456)		=	2.000
Modification factor for compression reinforcement (Fig. 4 of IS 456)		=	1.000
Allowable span to effective depth ratio		=	52.000
Actual span to effective depth ratio		=	37.292
		<	52.000
			Hence SAFE

B CHECK FOR CRACK WIDTH AT MIDSPAN

Allowable crack width (Cl. 35.3.2 of IS 456) = 0.3 mm



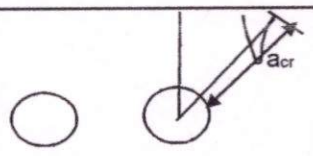
Distance of the point considered to the surface of the nearest longitudinal bar	a_{cr}	=	97.789 mm
Minimum cover to the longitudinal bar	C_{min}	=	15.000 mm
Overall depth of the member	h	=	115.000 mm
Depth of neutral axis	x	=	15.168 mm
Effective depth	d	=	96.000 mm
Modulus of elasticity of steel reinf.	E_s	=	200.000 kN/mm^2
Modulus of elasticity of concrete	E_c	=	5000 $\sqrt{f_{ck}}$
		=	22.361 kN/mm^2
Modular ratio	m	=	8.944 mm
Maximum moment	M	=	6.676 kNm
Section modulus	Z	=	bd^2 / 6
		=	1536000.000 mm^3
Maximum compressive stress in concrete	fc	=	M/z
		=	4.346 N/mm^2
Maximum tensile stress in reinf. Steel	fs	=	fc * m
		=	38.875 N/mm^2
Average steel strain at the level considered		=	fs / Es
		=	0.194
Maximum allowable strain		=	0.8 Fy / Es
		=	0.002
Average steel strain at the level considered	ε_m	=	0.002
Design surface crack width (Annex F of IS 456)	W_{cr}	=	$\frac{3\, a_{cr}\, \varepsilon_m}{1 + 2(a_{cr}-C_{min})/(h-x)}$
		=	0.221 mm

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	<	0.300 mm
		Hence Safe

C CHECK FOR CRACK WIDTH AT SUPPORT OF LONG EDGE

Allowable crack width (Cl. 35.3.2 of IS 456) = 0.3 mm

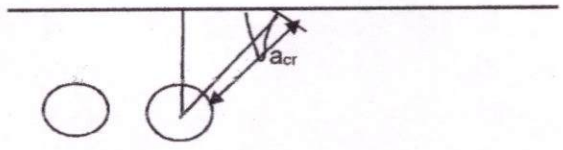


Distance of the point considered to the surface of the nearest longitudinal bar	a_{cr} =	101.789 mm
Minimum cover to the longitudinal bar	C_{min} =	15.000 mm
Overall depth of the member	h =	115.000 mm
Depth of neutral axis	x =	15.168 mm
Effective depth	d =	96.000 mm
Modulus of elasticity of steel reinf.	E_s =	200.000 kN/mm^2
Modulus of elasticity of concrete	E_c =	$5000 \sqrt{f_{ck}}$
	=	22.361 kN/mm^2
Modular ratio	m =	8.944 mm
Maximum moment	M =	8.902 kNm
Section modulus	Z =	$bd^2 / 6$
	=	1536000.000 mm^3
Maximum compressive stress in concrete	fc =	M/z
	=	5.796 N/mm^2
Maximum tensile stress in reinf. Steel	fs =	fc * m
	=	51.837 N/mm^2
Average steel strain at the level considered	=	fs / Es
	=	0.259
Maximum allowable strain	=	0.8 Fy / Es
	=	0.002
Average steel strain at the level considered	ε_m =	0.002
Design surface crack width (Annex F of IS 456)	W_{cr} =	$\frac{3\, a_{cr}\, \varepsilon_m}{1 + 2(a_{cr}-C_{min})/(h-x)}$
	=	0.223 mm
	<	0.300 mm
		Hence Safe

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D CHECK FOR CRACK WIDTH AT SUPPORT OF SHORT EDGE

Allowable crack width (Cl. 35.3.2 of IS 456) = 0.3 mm



Distance of the point considered to the surface of the nearest longitudinal bar	a_{cr} =	101.789 mm
Minimum cover to the longitudinal bar	C_{min} =	15.000 mm
Overall depth of the member	h =	115.000 mm
Depth of neutral axis	x =	15.224 mm
Effective depth	d =	88.000 mm
Modulus of elasticity of steel reinf.	E_s =	200.000 kN/mm^2
Modulus of elasticity of concrete	E_c =	$5000 \sqrt{f_{ck}}$
	=	22.361 kN/mm^2
Modular ratio	m =	8.944 mm
Maximum moment	M =	0.000 kNm
Section modulus	Z =	$bd^2 / 6$
	=	1290666.667 mm^3
Maximum compressive stress in concrete	fc =	M/z
	=	0.000 N/mm^2
Maximum tensile stress in reinf. Steel	fs =	fc * m
	=	0.000 N/mm^2
Average steel strain at the level considered	=	fs / Es
	=	0.000
Maximum allowable strain	=	0.8 Fy / Es
	=	0.002
Average steel strain at the level considered	ε_m =	0.000
Design surface crack width (Annex F of IS 456)	W_{cr} =	$\frac{3\, a_{cr}\, \varepsilon_m}{1 + 2(a_{cr}-C_{min})/(h-x)}$
	=	0.000 mm
	<	0.300 mm
		Hence Safe

10 SLAB REACTIONS

Refer code SP 24-1983 Cl:23.5

On the long span, $w l_x/6*(3-(l_x/l_y)^2)$

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Unfactored long beam UDL reaction due to dead load

Unfactored load = 4.025 kN/m^2

= ***5.829*** kN/m

Unfactored long beam UDL reaction due to live load

Unfactored load = 2.000 kN/m^2

= ***2.896*** kN/m

On the short span, $wl_x/3$

Unfactored long beam UDL reaction due to dead load

Unfactored load = 4.025 kN/m^2

= ***4.803*** kN/m

Unfactored long beam UDL reaction due to live load

Unfactored load = 2.000 kN/m^2

= ***2.387*** kN/m

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BEAM NO. 1735 DESIGN RESULTS

M20 Fe500 (Main) Fe500 (Sec.)

LENGTH: 3162.0 mm SIZE: 230.0 mm X 300.0 mm COVER: 25.0 mm

FLANGE WIDTH: 1000.0 mm FLANGE DEPTH: 115.0 mm

SUMMARY OF REINF. AREA (Sq.mm)

SECTION	0.0 mm	790.5 mm	1581.0 mm	2371.5 mm	3162.0 mm
TOP REINF.	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)	0.00 (Sq. mm)
BOTTOM REINF.	0.00 (Sq. mm)	308.41 (Sq. mm)	427.81 (Sq. mm)	308.41 (Sq. mm)	0.00 (Sq. mm)

SUMMARY OF PROVIDED REINF. AREA

SECTION	0.0 mm	790.5 mm	1581.0 mm	2371.5 mm	3162.0 mm

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TOP	2-12í	2-12í	2-12í	2-12í	2-12í
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
BOTTOM	2-12í	3-12í	4-12í	3-12í	2-12í
REINF.	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)	1 layer(s)
SHEAR	2 legged 8í	2 legged 8í	2 legged 8í	2 legged 8í	2 legged 8í
REINF.	@ 200 mm c/c	@ 200 mm c/c	@ 200 mm c/c	@ 200 mm c/c	@ 200 mm c/c

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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.