भारतीय मानक
Indian Standard

IS 3370 (Part 4/Sec 3) : 2021

जलीय तरल पदार्थों को प्रतिधारित करने के लिए कंक्रीट संरचनाएँ — रीति संहिता

भाग 4 डिजाइन तालिकाएँ

अनुभाग 3 वृत्ताकार टैंक

(पहला पुनरीक्षण)

Concrete Structures for Retaining Aqueous Liquids — Code of Practice

Part 4 Design Tables

Section 3 Circular tanks

(First Revision)

ICS 23.020.01; 91.080.40

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FOREWORD

This Indian Standard (Part 4/Sec 3) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

The design and construction methods in reinforced concrete and prestressed concrete structures for retaining aqueous liquids are influenced by the prevailing construction practices, the physical properties of the materials and the climatic condition. To lay down uniform requirements of structures for the retaining liquids giving due consideration to the above mentioned factors, this indian standard has been published in four parts. The other parts in the series are:

Part 1 General requirements

Part 2 Plain and reinforced concrete

Part 3 Prestressed concrete

This standard (Part 4) was first published in 1967. The present revision has been brought out with a view to keeping abreast with the rapid development in the field of structural analysis and the results available from finite element analyses of rectangular plates and tanks, and circular tanks (without prestressing), and also to bring further modifications in the light of experience gained while applying the earlier version of this standard. In this revision, the title of the standard has been modified from 'Concrete structures for storage of liquids — Code of practice: Part 4 Design tables' to 'Concrete structures for retaining aqueous liquids — Code of practice: Part 4 Design tables' for better representation of the contents of the revised standard. Furthermore, this standard (Part 4) has been trifurcated into 3 sections for giving due emphasis to each topic covered and convenience of use and handling as:

Sec 1 Plates

Sec 2 Rectangular tanks

Sec 3 Circular tanks

This Standard (Part 4/Sec 3) deals with design tables for circular tanks. The object of the design tables covered in this part is mainly to present data for ready reference to designers and as an aid to speedy design calculations. The designer has the option to adopt any established method of analysis, such as classical elastic plate analysis, finite element analysis or use of deign tables given in this standard as long as the design complies with the requirements of IS 3370 (Parts 1 to 3), and the structural adequacy and safety are ensured.

Tables relating to design of rectangular as well as cylindrical tanks have been given and by proper combination of various tables it may be possible to design different types of tanks involving many sets of conditions for rectangular and cylindrical containers built in or on ground.

In this standard it has been assumed that the design of liquid retaining structures, whether of plain, reinforced or prestressed concrete is entrusted to a qualified engineer and that the execution of the work is carried out under the direction of a qualified and experienced engineer.

The requirements of IS 456 : 2000 'Plain and reinforced concrete — Code of practice (*fourth revision*)' and IS 1343 : 2012 'Prestressed concrete — Code of practice (*second revision*)', in so far as they apply, shall be deemed to form part of this standard except where otherwise laid down in this standard.

Following are the significant modifications incorporated in this revision:

a) Title of the standard has been modified from 'Concrete structures for storage of liquids — Code of practice: Part 4 Design tables' to 'Concrete structures for retaining aqueous liquids — Code of practice: Part 4 Design tables, Section 3 Circular tanks'.

b) Coefficients of ring tension and moments have been revised and enlarged to cover wider range of loading configurations and end-restraint conditions.

c) Coefficients of shear, load and stiffness have been included for use as an aid in the design of circular reinforced concrete structures for retaining liquids.

(*Continued on third cover*)

Indian Standard

CONCRETE STRUCTURES FOR RETAINING AQUEOUS LIQUIDS — CODE OF PRACTICE

PART 4 DESIGN TABLES

Section 3 Circular tanks

(First Revision)

1 SCOPE

1.1 This standard (Part 4/Sec 3) gives design tables of ring tension, shear, moment, load and stiffness coefficients for use as an aid in the design of circular reinforced concrete structures for retaining liquids.

1.2 This standard does not apply to circular concrete tanks with prestressing. Specialist literature may be referred to in cases, such as the liquid retaining structures having tapered/stepped walls or resting on varying soil strata or subjected to temperature forces.

2 REFERENCE

The following standard contain provision, which through reference in this text constitute provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

IS No.	*Title*
456 : 2000	Plain and reinforced concrete — Code of practice (*fourth revision*)

3 CIRCULAR TANKS

3.1 Circular Tank Analysis Results

The coefficients of ring tension (F_{tc}), shear (V_c), moment (M_c), load (P_c) and stiffness (K_c) for use as an aid in the design of circular tanks with different loading configurations and end-restraint conditions (*see* **3.1.6**) obtained from finite element analyses have been tabulated in Tables 3 to 20.

3.1.1 *Tension*

Tension in circular ring per unit height, F_t (in N/m) is given by the following equation:

$F_t = F_{tc}\, wHD/2$, in case of triangular loading;

$= F_{tc}\, pD/2$, in case of rectangular loading;

$= F_{tc}\, V_a D/2H$, in case shear, V_a (in N/m) is applied at top; and

$= F_{tc}\, M_a D/2H^2$, in case moment, M_a (in N-m/m) is applied at base.

where

F_{tc} = tension coefficient (*see* col 3 of Table 1) ;

w = unit weight of liquid, N/m^3;

H = height of loaded area of the tank, m;

p = uniform rectangular loading, N/m^2; and

D = inside diameter of the tank (in m), if impermeable lining is used, else inside diameter + wall thickness (in m).

3.1.2 *Shear*

Shear at the base of cylindrical wall per unit height, V (in N/m) is given by the following equation:

$V = V_c\, wH^2$, in case of triangular loading;

$= V_c\, pH$, in case of rectangular loading; and

$= V_c\, M_a/H$, in case moment, M_a (in N-m/m) is applied at base.

where

V_c = shear coefficient (*see* Table 18).

3.1.3 *Moment*

a) Moment in cylindrical wall per unit height, M (in N-m/m) is given by the following equation:

$M = M_c\, wH^3$, in case of triangular loading;

$= M_c\, pH^2$, in case of rectangular loading;

$= M_c\, V_a H$, in case shear, V_a (in N/m) is applied at top; and

$= M_c\, M_a$, in case moment, M_a (in N-m/m) is applied at base.

where

M_c = moment coefficient (*see* col 4 of Table 1).

b) Moment in circular slab per unit height, M (in N-m/m), is given by the following equation:

$M = M_c\, pD^2/4$, in case of rectangular loading; and

= M_c M_a, in case moment, M_a (in N-m/m) is applied at edge.

where

M_c = moment coefficient (*see* col 3 of Table 2).

3.1.4 *Load*

Load, P (in N), on centre support for a circular slab is given by the following equations:

P = P_c $pD^2/4$, in case of hinged and fixed support; and

= P_c M_a, in case moment, M_a (N-m/m) is applied at edge.

where

P_c = load coefficient (*see* Table 19).

3.1.5 *Stiffness*

a) Stiffness, K (in N), of a circular plate is given by the following equation:

$$K = K_c\ 2E_c t^3/D$$

where

K_c = stiffness coefficient (*see* Table 20);

E_c = Modulus of elasticity of concrete, MPa (*see* IS 456); and

t = thickness of plate, mm.

b) Stiffness of cylindrical wall is given by the following equations:

Moment stiffness per unit rotation = $2\ \eta\ Z$;

Thrust (radial) stiffness per unit rotation = $2\ \eta^2\ Z$;

Moment stiffness per unit radial displacement = $2\ \eta^2\ Z$; and

Thrust (radial) stiffness per unit radial displacement = $4\ \eta^3\ Z$.

where

$$\eta^4 = 12 / (D^2\ t^2);\ \text{and}$$

$$Z = E_c\ t^3 / 12\ .$$

3.1.6 *Loading Configurations and End-restraint Conditions*

The various loading configurations and end-restraint conditions of circular tanks for which design coefficients of tension in circular rings (F_{tc}) and moment (M_c) have been tabulated in Tables 3 to 13 are given in Table 1, and those of circular slabs for which design coefficients of moment (M_c) have been tabulated in Tables 14 to 17 are given in Table 2.

Additionally, the shear design coefficients (V_c) have been given for the shear at the base of the cylindrical wall in Table 18, load design coefficients (P_c) for load on centre support for circular slab in Table 19 and stiffness design coefficients (K_c) for cylindrical plates in Table 20.

3.2 General Assumptions in Design

3.2.1 *Top Edge of Wall*

For estimating hoop tension and vertical bending moments in circular wall, the top of wall can be assumed to be free that is, without any radial or rotational restraint. This assumption is conservative and makes very little difference, except in top portion of wall where hoop tension, shear and moment are already very small.

For design of roof slab connected to wall, continuity analysis shall be done for wall and slab joint, allowing for rotation of wall top due to liquid pressure on wall in membrane case. In absence of such an analysis at the junction, the slab can be assumed to be hinged to wall and nominal reinforcement to limit cracks may be provided in slab to resist negative moment at wall junction.

3.2.2 *Base of Wall*

If wall base is monolithic with a slab, it acts as a diapharm and prevents the radial displacement to a negligible value. Thus, wall base can be assumed to be restrained from radial displacement. In many cases, the slab at base of wall provides rotational restrain in radial direction.

For ground supported tanks, bottom edge of wall panel may be assumed as per the following:

a) If foundation strata is rock or hard soil (corrected standard penetration 'N' value > 30 or refusal), the rotation of wall base will be very small, and may be assumed to be fixed at bottom.

b) For soft soils in foundation (N < 15), moments and shear may be taken as the algebraic sum of the one third of difference (between fixed and hinged condition) and hinged case. Moment and shear at bottom edge may be taken as average of fixed and hinged end-restraint case.

c) In cases other than covered in (a) and (b), the base provides partial restrain against rotation, and wall base may be assumed to be partially fixed that is, condition in between fixed and hinged. Design moments and shear in wall (except bottom edge) may be taken as average of fixed base and hinged base end-restraint. However, design moment and shear at bottom edge should be reduced by one third of the difference of fixed and hinged end-restraint cases from fixed end-restraint case.

Table 1 Loading Configurations and End-restraint Conditions for Cylindrical Walls

(*Clauses* 3.1.1, 3.1.3 *and* 3.1.6)

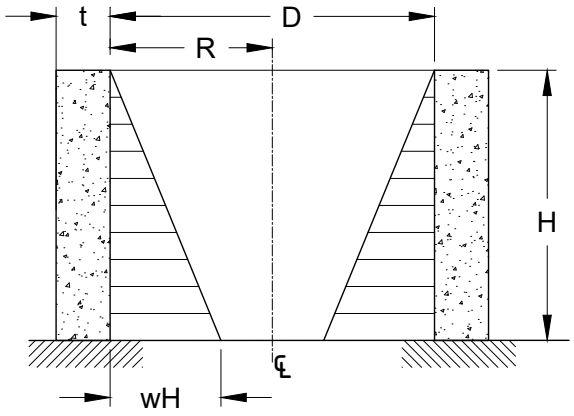
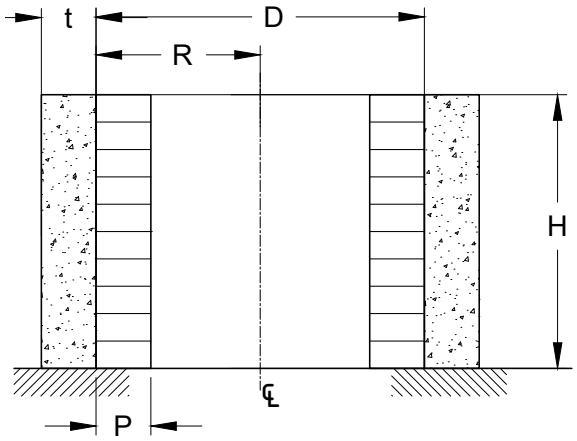
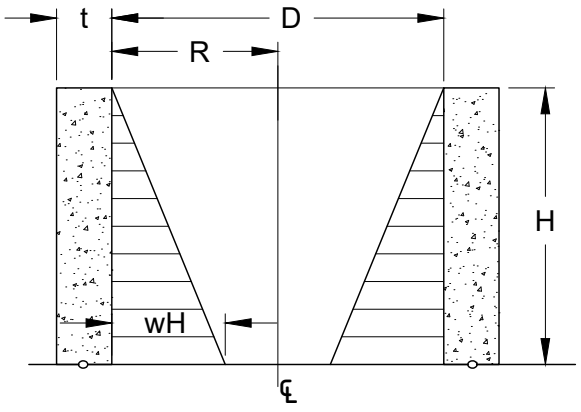
Case	Figure	Tables of (Ref to)	
		Ring Tension Coefficients, F_{tc}	Moment Coefficients, M_c
(1)	(2)	(3)	(4)
Case 1		Table 3	Table 4
	a) Fixed base, free top, subjected to triangular loading		
Case 2		Table 5	Table 6
	b) Fixed base, free top, subjected to uniformly distributed loading		
Case 3		Table 7	–
	c) Hinged base, free top, subjected to triangular loading		

Table 1 *(Concluded)*

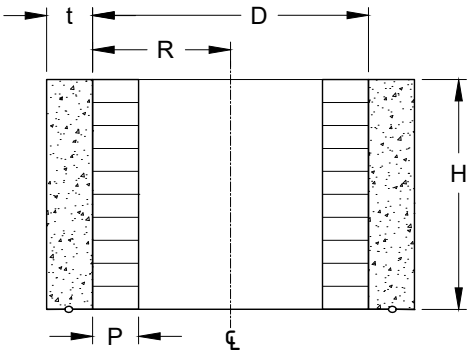
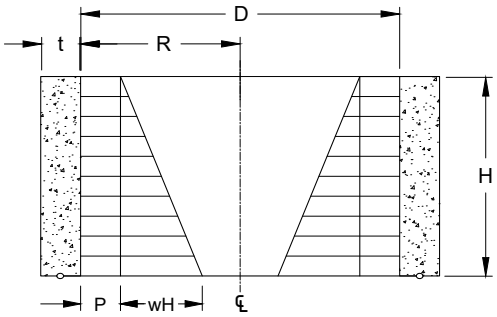
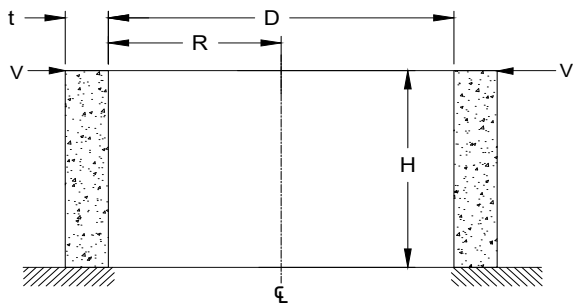
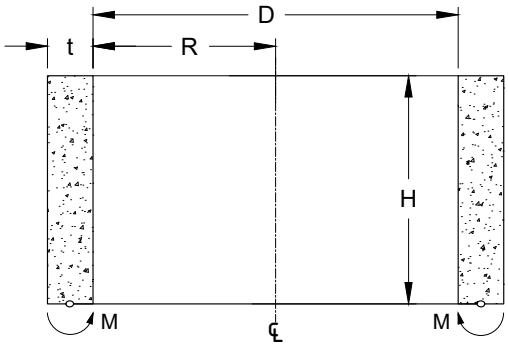
Case	Figure	Tables of (Ref to)	
		Ring Tension Coefficients, F_{tc}	Moment Coefficients, M_c
(1)	(2)	(3)	(4)
Case 4	 d) Hinged base, free top, subjected to uniformly distributed loading	Table 8	–
Case 5	 e) Hinged base, free top, subjected to trapezoidal loading	–	Table 9
Case 6	 f) Fixed base, free top, shear applied at the top	Table 10	Table 11
Case 7	 g) Hinged base, free top, moment applied at the base	Table 12	Table 13

Table 2 Loading Configurations and End-Restraint Conditions for Circular Slabs

(*Clauses* 3.1.3 *and* 3.1.6)

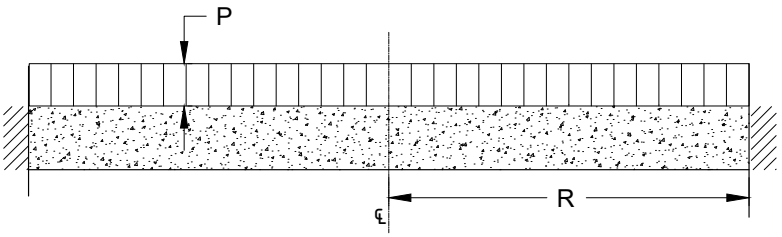
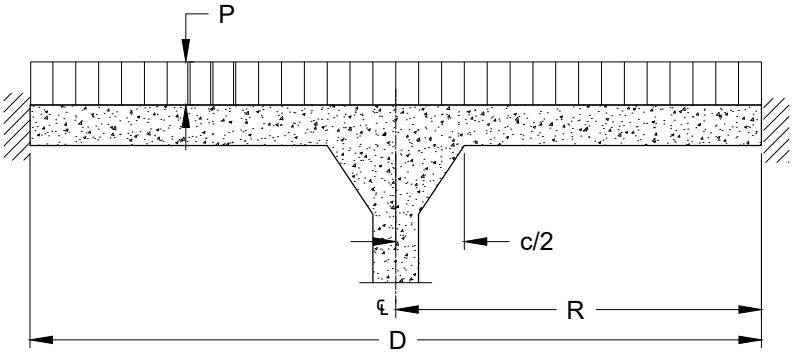
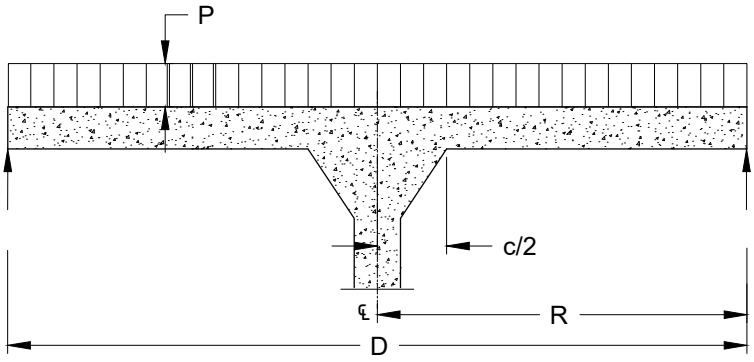
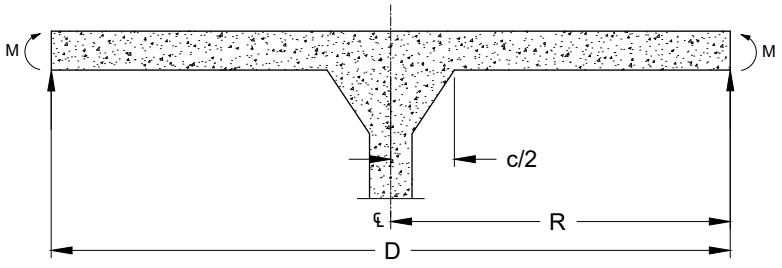
Case	Figure	Tables of Moment Coefficients, M_c (Ref to)
(1)	(2)	(3)
Case 8	 a) Fixed base, without centre support, subjected to uniformly distributed loading	Table 14
Case 9	 b) Fixed base, with centre support, subjected to uniformly distributed loading	Table 15
Case 10	 c) Hinged base, with centre support, subjected to uniformly distributed loading	Table 16
Case 11	 d) Hinged base, with centre support, subjected to moment at edge	Table 17

Table 3 Ring Tension Coefficients for Case 1 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2 at the end of Table 3A)									
	0.0*H*	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*
0.4	+0.149	+0.134	+0.120	+0.101	+0.082	+0.066	+0.049	+0.029	+0.014	+0.004
0.8	+0.263	+0.239	+0.215	+0.190	+0.160	+0.130	+0.096	+0.063	+0.034	+0.010
1.2	+0.283	+0.271	+0.254	+0.234	+0.209	+0.180	+0.142	+0.099	+0.054	+0.016
1.6	+0.265	+0.268	+0.268	+0.266	+0.250	+0.226	+0.185	+0.134	+0.075	+0.023
2.0	+0.234	+0.251	+0.273	+0.285	+0.285	+0.274	+0.232	+0.172	+0.104	+0.031
3.0	+0.134	+0.203	+0.267	+0.322	+0.357	+0.362	+0.330	+0.262	+0.157	+0.052
4.0	+0.067	+0.164	+0.256	+0.339	+0.403	+0.429	+0.409	+0.334	+0.210	+0.073
5.0	+0.025	+0.137	+0.245	+0.346	+0.428	+0.477	+0.469	+0.398	+0.259	+0.092
6.0	+0.018	+0.119	+0.234	+0.344	+0.441	+0.504	+0.514	+0.447	+0.301	+0.112
8.0	-0.011	+0.104	+0.218	+0.335	+0.443	+0.534	+0.575	+0.530	+0.381	+0.151
10.0	-0.011	+0.098	+0.208	+0.323	+0.437	+0.542	+0.608	+0.589	+0.440	+0.179
12.0	-0.005	+0.097	+0.202	+0.312	+0.429	+0.543	+0.628	+0.633	+0.494	+0.211
14.0	-0.002	+0.098	+0.200	+0.306	+0.420	+0.539	+0.639	+0.666	+0.541	+0.241
16.0	0.000	+0.099	+0.199	+0.304	+0.412	+0.531	+0.641	+0.687	+0.582	+0.265

Table 3A Supplementary Ring Tension Coefficients for Case 1 Arrangement

(*Tables* 1 and 3, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2)				
	0.75*H*	0.80*H*	0.85*H*	0.90*H*	0.95*H*
20	+0.716	+0.654	+0.520	+0.325	+0.115
24	+0.746	+0.702	+0.577	+0.372	+0.137
32	+0.782	+0.768	+0.663	+0.459	+0.182
40	+0.800	+0.805	+0.731	+0.530	+0.217
48	+0.791	+0.828	+0.785	+0.593	+0.254
56	+0.763	+0.838	+0.824	+0.636	+0.285

NOTES

1 Positive sign indicates tension.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank.

Table 4 Moment Coefficients for Case 1 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2 at the end of Table 4A)									
	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*	1.0*H*
0.4	+.000 5	+.001 4	+.002 1	+.000 7	-.004 2	-.015 0	-.030 2	-.052 9	-.081 6	-.120 5
0.8	+.001 1	+.003 7	+.006 3	+.008 0	+.007 0	+.002 3	-.006 8	-.022 4	-0.46 5	-.079 5
1.2	+.001 2	+.004 2	+.007 7	+.010 3	+.011 2	+.009 0	+.002 2	-.010 8	-.031 1	-.060 2
1.6	+.001 1	+.004 1	+.007 5	+.010 7	+.012 1	+.011 1	+.005 8	-.005 1	-.023 2	-.050 5
2.0	+.001 0	+.003 5	+.006 8	+.009 9	+.012 0	+.011 5	+.007 5	-.002 1	-.018 5	-.043 6
3.0	+.000 6	+.002 4	+.004 7	+.007 1	+.009 0	+.009 7	+.007 7	+.001 2	-.011 9	-.033 3
4.0	+.000 3	+.001 5	+.002 8	+.004 7	+.006 6	+.007 7	+.006 9	+.002 3	-.008 0	-.026 8
5.0	+.000 2	+.000 8	+.001 6	+.002 8	+.004 6	+.005 9	+.005 9	+.002 8	-.005 8	-.022 2
6.0	+.000 1	+.000 3	+.000 8	+.001 9	+.003 2	+.004 6	+.005 1	+.002 9	-.004 1	-.018 7
8.0	.000 0	+.000 1	+.000 2	+.000 8	+.001 6	+.002 8	+.003 8	+.002 9	-.002 2	-.014 6
10.0	.000 0	.000 0	+.000 1	+.000 4	+.000 7	+.001 9	+.002 9	+.002 8	-.001 2	-.012 2
12.0	.000 0	-.000 0	+.000 1	+.000 2	+.000 3	+.001 3	+.002 3	+.002 6	-.000 5	-.010 4
14.0	.000 0	.000 0	.000 0	.000 0	+.000 1	+.000 8	+.001 9	+.002 3	-.000 1	-.009 0
16.0	.000 0	.000 0	-.000 1	-.000 2	-.000 1	+.000 4	+.001 3	+.001 9	+.000 1	-.007 9

Table 4A Supplementary Moment Coefficients for Case 1 Arrangement

(*Tables* 1 and 4, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2)				
	0.80*H*	0.85*H*	0.90*H*	0.95*H*	1.00*H*
20	+.001 5	+.001 4	+.000 5	-.001 8	-.006 3
24	+.001 2	+.001 2	+.000 7	-.001 3	-.005 3
32	+.000 7	+.000 9	+.000 7	-.000 8	-.004 0
40	+.000 2	+.000 5	+.000 6	-.000 5	-.003 2
48	.000 0	+.000 1	+.000 6	-.000 3	-.002 6
56	.000 0	.000 0	+.000 4	-.000 1	-.002 3

NOTES

1 Positive sign indicates tension in the outside.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank.

Table 5 Ring Tension Coefficients for Case 2 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2 at the end of Table 5A)									
	0.0*H*	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*
0.4	+0.582	+0.505	+0.431	+0.353	+0.277	+0.206	+0.145	+0.092	+0.046	+0.013
0.8	+1.052	+0.921	+0.796	+0.669	+0.542	+0.415	+0.289	+0.179	+0.089	+0.024
1.2	+1.218	+1.078	+0.946	+0.808	+0.665	+0.519	+0.378	+0.246	+0.127	+0.034
1.6	+1.257	+1.141	+1.009	+0.881	+0.742	+0.600	+0.449	+0.294	+0.153	+0.045
2.0	+1.253	+1.144	+1.041	+0.929	+0.806	+0.667	+0.514	+0.345	+0.186	+0.055
3.0	+1.160	+1.112	+1.061	+0.998	+0.912	+0.796	+0.646	+0.459	+0.258	+0.081
4.0	+1.085	+1.073	+1.057	+1.029	+0.977	+0.887	+0.746	+0.553	+0.322	+0.105
5.0	+1.037	+1.044	+1.047	+1.042	+1.015	+0.949	+0.825	+0.629	+0.379	+0.128
6.0	+1.010	+1.024	+1.038	+1.045	+1.034	+0.986	+0.879	+0.694	+0.430	+0.149
8.0	+0.989	+1.005	+1.022	+1.036	+1.044	+1.026	+0.953	+0.788	+0.519	+0.189
10.0	+0.989	+0.998	+1.010	+1.023	+1.039	+1.040	+0.996	+0.859	+0.591	+0.226
12.0	+0.994	+0.997	+1.003	+1.014	+1.031	+1.043	+1.022	+0.911	+0.652	+0.262
14.0	+0.997	0.998	+1.000	+1.007	+1.022	+1.040	+1.035	+0.949	+0.705	+0.294
16.0	+1.000	0.999	+0.999	+1.003	+1.015	+1.032	+1.040	+0.975	+0.750	+0.321

Table 5A Supplementary Ring Tension Coefficients for Case 2 Arrangement

(*Tables* 1 and 5, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2)				
	0.75*H*	0.80*H*	0.85*H*	0.90*H*	0.95*H*
20	+0.949	+0.825	+0.629	+0.379	+0.128
24	+0.986	+0.879	+0.694	+0.430	+0.149
32	+1.026	+0.953	+0.788	+0.519	+0.189
40	+1.040	+0.996	+0.859	+0.591	+0.226
48	+1.043	+1.022	+0.911	+0.652	+0.262
56	+1.040	+1.035	+0.949	+0.705	+0.294

NOTES

1 Positive sign indicates tension.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank.

Table 6 Moment Coefficients for Case 2 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2 at the end of Table 6A)									
	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*	1.0*H*
0.4	-.002 3	-.009 3	-.022 7	-.043 9	-.071 0	-.101 8	-.145 5	-.200 0	-.259 3	-.331 0
0.8	.000 0	-.000 6	-.002 5	-.008 3	-.018 5	-.036 2	-.059 4	-.091 7	-.132 5	-.183 5
1.2	+.000 8	+.002 6	+.003 7	+.002 9	-.000 9	-.008 9	-.022 7	-.046 8	-.081 5	-.117 8
1.6	+.001 1	+.003 6	+.006 2	+.007 7	+.006 8	+.001 1	-.009 3	-.026 7	-.052 9	-.087 6
2.0	+.001 0	+.003 6	.006 6	+.008 8	+.008 9	+.005 9	-.001 9	-.016 7	-.038 9	-.071 9
3.0	+.000 7	+.002 6	+.005 1	+.007 4	+.009 1	+.008 3	-.004 2	-005 3	-.022 3	-.048 3
4.0	+.000 4	+.001 5	+.003 3	+.005 2	+.006 8	+.007 5	-.005 3	-.001 3	-.014 5	-.036 5
5.0	+.000 2	+.000 8	+.001 9	+.003 5	+.005 1	+.006 1	-.005 2	+.000 7	-.010 1	-.029 3
6.0	+.000 1	+.000 4	+.001 1	+.002 2	+.003 6	+.004 9	-.004 8	+.001 7	-.007 3	-.024 2
8.0	.000 0	+.000 1	+.000 3	+.000 8	+.001 8	+.003 1	-.003 8	+.002 4	-.004 0	-.018 4
10.0	.000 0	-.000 1	.000 0	+.000 2	+.000 9	+.002 1	+.003 0	+.002 6	-.002 2	-.014 7
12.0	.000 0	.000 0	-.000 1	.000 0	+.000 4	+.001 4	+.002 4	+.002 2	-.001 2	-.012 3
14.0	.000 0	.000 0	.000 0	.000 0	+.000 2	+.001 0	+.001 8	+.002 1	-.000 7	-.010 5
16.0	.000 0	.000 0	.000 0	-.000 1	+.000 1	+.000 6	+.001 2	+.002 0	-.000 5	-.009 1

Table 6A Supplementary Moment Coefficients for Case 2 Arrangement

(*Tables* 1 and 6, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2)				
	0.80*H*	0.85*H*	0.90*H*	0.95*H*	1.00*H*
20	+.001 5	+.001 3	+.000 2	-.002 4	-.007 3
24	+.001 2	+.001 2	+.000 4	-.001 8	-.006 1
32	+.000 8	+.000 9	+.000 6	-.001 0	-.004 6
40	+.000 5	+.000 7	+.000 7	-.000 5	-.003 7
48	+.000 4	+.000 6	+.000 6	-.000 3	-.003 1
56	+.000 2	+.000 4	+.000 5	-.000 1	-.002 6

NOTES

1 Positive sign indicates tension in the outside.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank.

Table 7 Ring Tension Coefficients for Case 3 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2 at the end of Table 7A)									
	0.0*H*	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*
0.4	+0.474	+0.440	+0.395	+0.352	+0.308	+0.264	+0.215	+0.165	+0.111	+0.057
0.8	+0.423	+0.402	+0.381	+0.358	+0.330	+0.297	+0.249	+0.202	+0.145	+0.076
1.2	+.0350	+0.355	+0.361	+0.362	+0.358	+0.343	+0.309	+0.256	+0.186	+0.098
1.6	+0.271	+0.303	+0.341	+0.369	+0.385	+0.385	+0.362	+0.314	+0.233	+0.124
2.0	+0.205	+0.260	+0.321	+0.373	+0.411	+0.434	+0.419	+0.369	+0.280	+0.151
3.0	+0.074	+0.179	+0.281	+0.375	+0.449	+0.506	+0.519	+0.479	+0.375	+0.210
4.0	+0.017	+0.137	+0.253	+0.367	+0.469	+0.545	+0.579	+0.553	+0.447	+0.256
5.0	-0.008	+0.114	+0.235	+0.356	+0.469	+0.563	+0.617	+0.606	+0.503	+0.294
6.0	-0.011	+0.103	+0.223	+0.343	+0.463	+0.566	+0.639	+0.643	+0.547	+0.327
8.0	-0.015	+.0.96	+0.208	+0.324	+0.443	+0.564	+0.661	+0.697	+0.621	+0.386
10.0	-0.008	+0.095	+0.200	+0.311	+0.428	+0.552	+0.666	+0.730	+0.678	+0.433
12.0	-0.002	+0.097	+0.197	+0.302	+0.417	+0.541	+0.664	+0.750	+0.720	+0.477
14.0	0.000	+0.096	+0.197	+0.299	+0.408	+0.531	+0.659	+0.761	+0.752	+0.513
16.0	+0.002	+0.100	+0.198	+0.299	+0.403	+0.521	+0.650	+0.764	+0.776	+0.536

Table 7A Supplementary Ring Tension Coefficients for Case 3 Arrangement

(*Tables* 1 and 7*, Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2)				
	0.75*H*	0.80*H*	0.85*H*	0.90*H*	0.95*H*
20	+0.812	+0.817	+0.756	+0.603	+0.344
24	+0.816	+0.839	+0.793	+0.647	+0.377
32	+0.814	+0.861	+0.847	+0.721	+0.436
40	+0.802	+0.866	+0.880	+0.778	+0.483
48	+0.791	+0.864	+0.900	+0.820	+0.527
56	+0.781	+0.859	+0.911	+0.852	+0.563

NOTES

1 Positive sign indicates tension.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank.

Table 8 Ring Tension Coefficients for Case 4 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2 at the end of Table 8A)									
	0.0*H*	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*
0.4	+1.474	+1.340	+1.195	+1.052	+0.908	+0.764	+0.615	0.465	+0.311	+0.154
0.8	+1.423	+1.302	+1.181	+1.058	+0.930	+0.797	+0.649	+0.502	+0.345	+0.166
1.2	+1.350	+1.255	+1.161	+1.062	+0.958	+0.843	+0.709	+0.556	+0.385	+0.198
1.6	+1.271	+1.203	+1.141	+1.069	+0.985	+0.885	+0.756	+0.614	+0.433	+0.224
2.0	+1.205	+1.160	+1.121	+1.073	+0.011	+0.934	+0.819	+0.669	+0.480	+0.251
3.0	+1.074	+1.079	+1.081	+1.075	+1.049	+1.006	+0.919	+0.779	+0.575	+0.310
4.0	+1.017	+1.037	+1.053	+1.067	+1.069	+1.045	+0.979	+0.853	+0.647	+0.356
5.0	+0.992	+1.014	+1.035	+1.056	+1.069	+1.062	+1.017	+0.906	+0.703	+0.394
6.0	+0.989	+1.003	+1.023	+1.043	+1.063	+1.066	+1.039	+0.943	+0.747	+0.427
8.0	+0.985	+0.996	+1.008	+1.024	+1.043	+1.064	+1.061	+0.997	+0.821	+1.486
10.0	+0.992	+0.995	+1.000	+1.011	+1.028	+1.052	+1.066	+1.030	+0.878	+0.533
12.0	+0.998	+0.997	+0.997	+1.002	+1.017	+1.041	+1.064	+1.050	+0.920	+0.577
14.0	+1.000	+0.998	+0.997	+0.999	+1.008	+1.031	+1.059	+1.060	+0.952	+0.613
16.0	+1.002	+1.000	+0.998	+0.999	+1.003	+1.021	+1.050	+1.064	+0.976	+0.636

Table 8A Supplementary Ring Tension Coefficients for Case 4 Arrangement

(*Tables* 1 and 8, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2)				
	0.75*H*	0.80*H*	0.85*H*	0.90*H*	0.95*H*
20	+1.062	+1.017	+0.906	+0.703	+0.394
24	+1.066	+1.039	+0.943	+0.747	+0.427
32	+0.064	+1.061	+0.997	+0.821	+0.486
40	+1.052	+1.066	+1.030	+0.878	+0.533
48	+1.041	+1.064	+1.050	+0.920	+0.577
56	+1.021	+1.059	+1.061	+0.613	+0.613

NOTES

1 Positive sign indicates tension.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank.

Table 9 Moment Coefficients for Case 5 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2 at the end of Table 9A)									
	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*	1.0*H*
0.4	+.002 0	+.007 2	+.015 1	+.023 0	+.030 1	+.034 8	+.035 7	+.031 2	+.019 7	0
0.8	+.001 9	+.006 4	+.013 3	+.020 7	+.027 1	+.031 9	+.032 9	+.028 2	+.018 7	0
1.2	+.001 6	+.005 8	+.011 1	+.017 7	+.023 7	+.028 0	+.029 6	+.026 3	+.017 1	0
1.6	+.001 2	+.004 4	+.009 1	+.014 5	+.019 5	+.023 6	+.025 5	+.023 2	+.015 5	0
2.0	+.000 9	+.003 3	+.007 3	+.011 4	+.015 8	+.019 9	+.021 9	+.020 5	+.014 5	0
3.0	+.000 4	+.001 8	+.004 0	+.006 3	+.009 2	+.012 7	+.015 2	+.15 3	+.011 1	0
4.0	+.000 1	+.000 7	+.001 6	+.003 3	+.005 7	+.008 3	+.010 9	+.011 8	+.009 2	0
5.0	.000 0	+.000 1	+.000 6	+.001 6	+.003 4	+.005 7	+.008 0	+.009 4	+.007 8	0
6.0	.000 0	.000 0	+.000 2	+.000 8	+.001 9	+.003 9	+.006 2	+.007 8	+.006 8	0
8.0	.000 0	.000 0	-.000 2	.000 0	+.000 7	+.002 0	+.003 8	+.005 7	+.005 4	0
10.0	.000 0	.000 0	-.000 2	-.000 1	+.000 2	+.001 1	+.002 5	+.004 3	+.004 5	0
12.0	.000 0	.000 0	-.000 1	-.000 2	.000 0	+.000 5	+.001 7	+.003 2	+.003 9	0
14.0	.000 0	.000 0	-.000 1	-.000 1	-.000 1	.000 0	+.001 2	+.002 6	+.003 3	0
16.0	.000 0	.000 0	.000 0	-.000 1	.000 2	-.000 4	+.000 8	+.002 2	+.002 9	0

Table 9A Supplementary Moment Coefficients for Case 5 Arrangement

(*Tables* 1 and 9*, Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1 and 2)				
	0.75*H*	0.80*H*	0.85*H*	0.90*H*	0.95*H*
20	+.000 8	+.001 4	+.002 0	+.002 4	+.002 0
24	+.000 5	+.001 0	+.001 5	+.002 0	+.001 7
32	.000 0	+.000 5	+.000 9	+.001 4	+.001 3
40	.000 0	+.000 3	+.000 6	+.001 1	+.001 1
48	.000 0	+.000 1	+.000 4	+.000 8	+.001 0
56	.000 0	.000 0	+.000 3	+.000 7	+.000 8

NOTES

1 Positive sign indicates tension in the outside.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank.

Table 10 Ring Tension Coefficients for Case 6 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1, 2 and 3 at the end of Table 10A)									
	0.0*H*	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*
0.4	-1.57	-1.32	-1.08	-0.86	-0.65	-0.47	-0.31	-0.18	-0.08	-0.02
0.8	-3.09	-2.55	-2.04	-1.57	-1.15	-0.80	-0.51	-0.28	-0.13	-0.03
1.2	-3.95	-3.17	-2.44	-1.79	-1.25	-0.81	-0.48	-0.25	-0.10	-0.02
1.6	-4.57	-3.54	-2.60	-1.80	-1.17	-0.69	-0.36	-0.16	-0.05	-0.01
2.0	-5.12	-3.83	-2.68	-1.74	-1.02	-0.52	-0.21	-0.05	+0.01	+0.01
3.0	-6.32	-4.37	-2.70	-1.43	-0.58	-0.02	+0.15	+0.19	+0.13	+0.04
4.0	-7.34	-4.73	-2.60	-1.10	-0.19	+0.26	+0.38	+0.33	+0.19	+0.06
5.0	-8.22	-4.99	-2.45	-0.79	+0.11	+0.47	+0.50	+0.37	+0.20	+0.06
6.0	-9.02	-5.17	-2.27	-0.50	+0.34	+0.59	+0.53	+0.35	+0.17	+0.01
8.0	-10.42	-5.36	-1.85	-0.02	+0.63	+0.66	+0.46	+0.24	+0.09	+0.01
10.0	-11.67	-5.43	-1.43	+0.38	+0.78	+0.62	+0.33	+0.12	+0.02	0.00
12.0	-12.76	-5.41	-1.03	+0.63	+0.83	+0.52	+0.21	+0.04	-0.02	0.00
14.0	-13.77	-5.34	-0.68	+0.80	+0.81	+0.42	+0.13	0.00	-0.03	-0.01
16.0	-14.74	-5.22	-0.33	+0.96	+0.76	+0.32	+0.05	-0.04	-0.05	-0.02

Table 10A Supplementary Ring Tension Coefficients for Case 6 Arrangement

(*Tables* 1 and 10*, Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1, 2 and 3)				
	0.00H	0.05H	0.10H	0.15H	0.20H
20	-16.44	-9.98	-4.90	-1.59	+0.22
24	-18.04	-10.34	-4.54	-1.00	+0.68
32	-20.84	-10.72	-3.70	-0.04	+1.26
40	-23.34	10.86	-2.86	+0.72	+1.56
48	-25.52	-10.82	-2.06	+1.26	+1.66
56	-27.54	-10.68	-1.36	+1.60	+1.62

NOTES

1 Positive sign indicates tension.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank, when shear is applied at the top and vice-versa, when shear is applied at the base with fixed top.

3 Shear applied inward is positive and outward is negative.

Table 11 Moment Coefficients for Case 6 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1, 2 and 3 at the end of Table 11A)									
	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*	1.0*H*
0.4	+0.093	+0.172	+0.240	+0.300	+0.354	+0.402	+0.448	+0.492	+0.535	+0.578
0.8	+0.085	+0.145	+0.185	+0.208	+0.220	+0.224	+0.223	+0.219	+0.214	+0.208
1.2	+0.082	+0.132	+0.157	+0.164	+0.159	+0.145	+0.127	+0.106	+0.084	+0.062
1.6	+0.079	+0.122	+0.139	+0.138	+0.125	+0.105	+0.081	+0.056	+0.030	+0.004
2.0	+0.077	+0.115	+0.126	+0.119	+0.103	+0.080	+0.056	+0.031	+0.006	-0.019
3.0	+0.072	+0.100	+0.100	+0.086	+0.066	+0.044	+0.025	+0.006	-0.010	-0.024
4.0	+0.068	+0.088	+0.081	+0.063	+0.043	+0.025	+0.010	-0.001	-0.010	-0.019
5.0	+0.064	+0.078	+0.067	+0.047	+0.028	+0.013	+0.003	-0.003	-0.007	-0.011
6.0	+0.062	+0.070	+0.056	+0.036	+0.018	+0.006	0.000	-0.003	-0.005	-0.006
8.0	+0.057	+0.058	+0.041	+0.021	+0.007	0.000	-0.002	-0.003	-0.002	-0.001
10.0	+0.053	+0.049	+0.029	+0.012	+0.002	-0.002	-0.002	-0.002	-0.001	0.000
12.0	+0.049	+0.042	+0.022	+0.007	+0.000	-0.002	-0.002	-0.001	0.000	0.000
14.0	+0.046	+0.036	+0.017	+0.004	-0.001	-0.002	-0.001	-0.001	0.000	0.000
16.0	+0.044	+0.031	+0.012	+0.001	-0.002	-0.002	-0.001	0.000	0.000	0.000

Table 11A Supplementary Moment Coefficients for Case 6 Arrangement

(*Tables* 1 and 11, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1, 2 and 3)				
	0.05*H*	0.10*H*	0.15*H*	0.20*H*	0.25*H*
20	+0.032	+0.039	+0.033	+0.023	+0.014
24	+0.031	+0.035	+0.028	+0.018	+0.009
32	+0.028	+0.029	+0.020	+0.011	+0.004
40	+0.026	+0.025	+0.015	+0.006	+0.001
48	+0.024	+0.021	+0.011	+0.003	0.000
56	+0.023	+0.018	+0.008	+0.002	0.000

NOTES

1 Positive sign indicates tension.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank, when shear is applied at the top and vice-versa, when shear is applied at the base with fixed top.

3 Shear applied inward is positive and outward is negative.

Table 12 Ring Tension Coefficients for Case 7 Arrangement

(*Table* 1, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1, 2 and 3 at the end of Table 12A)									
	0.0*H*	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*
0.4	+2.70	+2.50	+2.30	+2.12	+1.91	+1.69	+1.41	+1.13	+0.80	+0.44
0.8	+2.02	+2.06	+2.10	+2.14	+2.10	+2.02	+1.95	+1.75	+1.39	+0.80
1.2	+1.06	+1.42	+1.79	+2.03	+2.46	+2.65	+2.80	+2.60	+2.22	+1.37
1.6	+0.12	+0.79	+1.43	+2.04	+2.72	+3.25	+3.56	+3.59	+3.13	+2.01
2.0	-0.68	+0.22	+1.10	+2.02	+2.90	+3.69	+4.30	+4.54	+4.08	+2.75
3.0	-1.78	-0.71	+0.43	+1.60	+2.95	+4.29	+5.66	+6.58	+6.55	+4.73
4.0	-1.87	-1.00	-0.08	+1.04	+2.47	+4.31	+6.34	+8.19	+8.82	+6.81
5.0	-1.54	-1.03	-0.42	+0.45	+1.86	+3.93	+6.60	+9.41	+11.03	+9.02
6.0	-1.04	-0.86	-0.59	-0.05	+1.21	+3.34	+6.54	+10.28	+13.08	+11.41
8.0	-0.24	-0.53	-0.73	-0.67	-0.02	+2.05	+5.87	+11.32	+16.52	+16.06
10.0	+0.21	-0.23	-0.64	-0.94	-0.73	+0.82	+4.79	+11.63	+19.48	+20.87
12.0	+0.32	-0.05	-0.46	-0.96	-1.15	-0.18	+3.52	+11.27	+21.80	+25.73
14.0	+0.26	+0.04	-0.28	-0.76	-1.29	-0.87	+2.29	+10.55	+23.50	+30.34
16.0	+0.22	+0.07	-0.08	-0.64	-1.28	-1.30	+1.12	+9.67	+24.53	+34.65

Table 12A Supplementary Ring Tension Coefficients for Case 7 Arrangement

(*Tables* 1 and 12, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1, 2 and 3)				
	0.75*H*	0.80*H*	0.85*H*	0.90*H*	0.95*H*
20	+15.30	+25.9	+36.9	+43.3	+35.3
24	+13.20	+25.9	+40.7	+51.8	+45.
32	+8.10	+23.2	+45.9	+65.4	+63.6
40	+3.28	+19.2	+46.5	+77.9	+83.5
48	-0.70	+14.1	+45.1	+87.2	+103.0
56	-3.40	+9.2	+42.2	+94.0	+121.0

NOTES

1 Positive sign indicates tension.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank, when moment is applied at the base and vice-versa, when moment is applied at the top with hinged top.

3 Moment applied at an edge is positive when it causes outward rotation at that edge.

Table 13 Moment Coefficients for Case 7 Arrangement

(*Table 1, Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1, 2 and 3 at the end of Table 13A)									
	0.1*H*	0.2*H*	0.3*H*	0.4*H*	0.5*H*	0.6*H*	0.7*H*	0.8*H*	0.9*H*	1.0*H*
0.4	+0.013	+0.051	+0.109	+0.196	+0.296	+0.414	+0.547	+0.692	+0.843	+1.000
0.8	+0.009	+0.040	+0.090	+0.164	+0.253	+0.375	+0.503	+0.659	+0.824	+1.000
1.2	+0.006	+0.027	+0.063	+0.125	+0.206	+0.316	+0.454	+0.616	+0.802	+1.000
1.6	+0.003	+0.011	+0.035	+0.078	+0.152	+0.253	+0.393	+0.570	+0.775	+1.000
2.0	-0.002	-0.002	+0.012	+0.034	0.096	+0.193	+0.340	+0.519	+0.748	+1.000
3.0	-0.007	-0.022	-0.030	-0.029	+0.010	+0.087	+0.227	+0.426	+0.692	+1.000
4.0	-0.008	-0.026	-0.044	-0.051	-0.034	+0.023	+0.150	+0.354	+0.645	+1.000
5.0	-0.007	-0.024	-0.045	-0.061	-0.057	-0.015	+0.095	+0.296	+0.606	+1.000
6.0	-0.005	-0.018	-0.040	-0.058	-0.065	-0.037	+0.057	+0.252	+0.572	+1.000
8.0	-0.001	-0.009	-0.022	-0.044	-0.068	-0.062	+0.002	+0.178	+0515	+1.000
10.0	0.000	-0.002	-0.009	-0.028	-0.053	-0.067	-0.031	+0.123	+0.467	+1.000
12.0	0.000	0.000	-0.003	-0.016	-0.040	-0.064	-0.049	+0.081	+0.424	+1.000
14.0	0.000	0.000	0.000	-0.008	-0.029	-0.059	-0.060	+0.048	+0.387	+1.000
16.0	0.000	0.000	+0.002	-0.003	-0.021	-0.051	-0.066	+0.025	+0.354	+1.000

Table 13A Moment Coefficients for Case 7 Arrangement

(*Tables* 1 and 13*, Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Notes 1, 2 and 3)				
	0.80*H*	0.85*H*	0.90*H*	0.95*H*	1.00*H*
20	-0.015	+0.095	+0.296	+0.606	+1.000
24	-0.037	+0.057	+0.250	+0.572	+1.000
32	-0.062	+0.002	+0.178	+0.515	+1.000
40	-0.067	-0.031	+0.123	+0.467	+1.000
48	-0.064	-0.049	+0.081	+0.424	+1.000
56	-0.059	-0.060	+0.048	+0.387	+1.000

NOTES

1 Positive sign indicates tension.

2 The point, 0.0 *H* denotes the top of the tank and the point, 1.0 *H* denotes the base of the tank, when moment is applied at the base and vice-versa, when moment is applied at the top with hinged top.

3 Moment applied at an edge is positive when it causes outward rotation at that edge.

Table 14 Moment Coefficients for Circular Slabs for Case 8 Arrangement

(*Table* 2, *Clauses* 3.1 *and* 3.1.6)

Coefficients at Point (*see* Note)										
0.00R	**0.10R**	**0.20R**	**0.30R**	**0.40R**	**0.50R**	**0.60R**	**0.70R**	**0.80R**	**0.90R**	**1.00R**
Radial Moments, M_r										
+0.0625	+0.0606	+0.0550	+0.0456	+0.0325	+0.0156	-0.0050	-0.0294	-0.0575	-0.0894	-0.1250
Tangential Moments, M_t										
+0.0625	+0.0619	+0.0600	+0.0569	+0.0525	+0.0469	+0.0400	+0.0319	+0.0225	-0.0119	0

NOTE — Positive sign indicates compression in surface loaded

Table 15 Moment Coefficients for Circular Slabs for Case 9 Arrangement

(*Table* 2, *Clauses* 3.1 *and* 3.1.6)

Coefficients at Point (*see* Note)													
c/D	**0.05R**	**0.10R**	**0.15R**	**0.20R**	**0.25R**	**0.30R**	**0.40R**	**0.50R**	**0.60R**	**0.70R**	**0.80R**	**0.90R**	**1.00R**
Radial Moments, M_r													
0.05	-0.2100	-0.0729	-0.0275	-0.0026	+0.0133	+0.0238	+0.0342	+0.0347	+0.0277	+0.0142	-0.0049	-0.0294	-0.0589
0.10		-0.1433	-0.0624	-0.0239	-0.0011	+0.0136	+0.0290	+0.0326	+0.0276	+0.0158	-0.0021	-0.0255	-0.0541
0.15			-0.1089	-0.0521	-0.0200	+0.0002	+0.0220	+0.0293	+0.0269	+0.0169	+0.0006	-0.0216	-0.0490
0.20				-0.0862	-0.0429	-0.0161	+0.0133	+0.0249	+0.0254	+0.0176	+0.0029	-0.0178	-0.0441
0.25					-0.0698	-0.0351	+0.0029	+0.0194	+0.0231	+0.0177	+0.0049	-0.0143	-0.0393
Tangential Moments, M_t													
0.05	-0.0417	-0.0700	-0.0541	-0.0381	-0.0251	-0.0145	+0.0002	+0.0085	+0.0118	+0.0109	+0.0065	-0.0003	-0.0119
0.10		-0.0287	-0.0421	-0.0354	-0.0258	-0.0168	-0.0027	+0.0059	+0.0099	+0.0098	+0.0061	-0.0009	-0.0108
0.15			-0.0218	-0.0284	-0.0243	-0.0177	-0.0051	+0.0031	+0.0080	+0.0086	+0.0057	-0.0006	-0.0098
0.20				-0.0172	-0.0203	-0.0171	-0.0070	+0.0013	+0.0063	+0.0075	+0.0052	-0.0003	-0.0088
0.25					-0.0140	-0.0150	-0.0083	-0.0005	+0.0046	+0.0064	+0.0048	0.0000	-0.0078

NOTE — Positive sign indicates compression in surface loaded.

Table 16 Moment Coefficients for Circular Slabs for Case 10 Arrangement

(*Table* 2, *Clauses* 3.1 *and* 3.1.6)

Coefficients at Point (*see* Note)													
c/D	**0.05R**	**0.10R**	**0.15R**	**0.20R**	**0.25R**	**0.30R**	**0.40R**	**0.50R**	**0.60R**	**0.70R**	**0.80R**	**0.90R**	**1.0R**
Radial Moments, M_r													
0.05	-0.3658	-0.1388	-0.0640	-0.0221	+0.0058	+0.0255	+0.0501	+0.0614	+0.0629	+0.0566	+0.0437	+0.0247	0
0.10		-0.2487	-0.1180	-0.0557	-0.0176	+0.0081	+0.0391	+0.0539	+0.0578	+0.0532	+0.0416	+0.0237	0
0.15			-0.1869	-0.0977	-0.0467	-0.0135	+0.0258	+0.0451	+0.0518	+0.0494	+0.0393	+0.0226	0
0.20				-0.1465	-0.0800	-0.0381	+0.0109	+0.0352	+0.0452	+0.0451	+0.0368	+0.0215	0
0.25					-0.1172	-0.0645	+0.0055	+0.0245	+0.0381	+0.0404	+0.0340	+0.0200	0
Tangential Moments, M_t													
0.05	-0.0731	-0.1277	-0.1040	-0.0786	-0.0569	-0.0391	-0.0121	+0.0061	+0.0175	+0.0234	+0.0251	+0.0228	+0.0168
0.10		-0.0498	-0.0768	-0.0684	-0.0539	-0.0394	-0.0153	+0.0020	+0.0134	+0.0197	+0.0218	+0.0199	+0.0145
0.15			-0.0374	-0.0516	-0.0470	-0.0375	-0.0175	-0.0014	+0.0097	+0.0163	+0.0186	+0.0172	+0.0123
0.20				-0.0293	-0.0367	-0.0333	-0.0184	-0.0042	+0.0065	+0.0132	+0.0158	+0.0148	+0.0103
0.25					-0.0234	-0.0263	-0.0184	-0.0062	+0.0038	+0.0103	+0.0132	+0.0122	+0.0085

NOTE — Positive sign indicates compression in surface loaded.

Table 17 Moment Coefficients for Circular Slabs for Case 11 Arrangement

(*Table* 2, *Clauses* 3.1 *and* 3.1.6)

Coefficients at Point (*see* Note)													
c/D	**0.05R**	**0.10R**	**0.15R**	**0.20R**	**0.25R**	**0.30R**	**0.40R**	**0.50R**	**0.60R**	**0.70R**	**0.80R**	**0.90R**	**1.00R**
Radial Moments, M_r													
0.05	-2.650	-1.121	-0.622	-0.333	-0.129	+0.029	+0.268	+0.450	+0.596	+0.718	+0.824	+0.917	+1.000
0.10		-1.950	-1.026	-0.584	-0.305	-0.103	+0.187	+0.394	+0.558	+0.692	+0.808	+0.909	+1.000
0.15			-1.594	-0.930	-0.545	-0.280	+0.078	+0.323	+0.510	+0.663	+0.790	+0.900	+1.000
0.20				-1.366	-0.842	-0.499	-0.057	+0.236	+0.451	+0.624	+0.768	+0.891	+1.000
0.25					-1.204	-0.765	-0.216	+0.130	+0.392	+0.577	+0.740	+0.880	+1.000
Tangential Moments, M_t													
0.05	-0.530	-0.980	-0.847	-0.688	-0.544	-0.418	-0.211	-0.042	+0.095	+0.212	+0.314	+0.405	+0.486
0.10		-0.388	-0.641	-0.608	-0.518	-0.419	-0.233	-0.072	+0.066	+0.185	+0.290	+0.384	+0.469
0.15			-0.319	-0.472	-0.463	-0.404	-0.251	-0.100	+0.035	+0.157	+0.263	+0.363	+0.451
0.20				-0.272	-0.372	-0.368	-0.261	-0.123	+0.007	+0.129	+0.240	+0.340	+0.433
0.25					-0.239	-0.305	-0.259	-0.145	-0.020	+0.099	+0.214	+0.320	+0.414

NOTE — Positive sign indicates compression in surface loaded.

Table 18 Shear Coefficients at the Base of Cylindrical Wall

(*Table* 2, *Clauses* 3.1 *and* 3.1.6)

H^2/Dt	Coefficients at Point (*see* Note)			
	Triangular Load, Fixed Base	Rectangular Load, Fixed Base	Triangular or Rectangular Load, Hinged Base	Moment at Edge
0.4	+0.436	+0.755	+0.245	-1.58
0.8	+0.374	+0.552	+0.234	-1.75
1.2	+0.339	+0.460	+0.220	-2.00
1.6	+0.317	+0.407	+0.204	-2.28
2.0	+0.299	+0.370	+0.189	-2.57
3.0	+0.262	+0.310	+0.158	-3.18
4.0	+0.236	+0.271	+0.137	-3.68
5.0	+0.213	+0.243	+0.121	-4.10
6.0	+0.197	+0.222	+0.110	-4.49
8.0	+0.174	+0.193	+0.096	-5.18
10.0	+0.158	+0.172	+0.087	-5.81
12.0	+0.145	+0.158	+0.079	-6.38
14.0	+0.135	+0.147	+0.073	-6.88
16.0	+0.0127	+0.137	+0.068	-7.38
20.0	+0.114	+0.122	+0.062	-8.20
24.0	+0.102	+0.111	+0.055	-8.94
32.0	+0.089	+0.096	+0.048	-10.36
40.0	+0.080	+0.086	+0.043	-10.62
48.0	+0.072	+0.079	+0.039	-12.76
56.0	+0.067	+0.074	+0.036	-13.76

NOTE — Positive sign indicates shear acting inward.

Table 19 Load Coefficients for Load on Centre Support for Circular Slab

(*Clauses* 3.1.4 *and* 3.1.6)

c/D	0.005	0.10	0.15	0.20	0.25
Hinged	1.320	1.387	1.463	1.542	1.625
Fixed	0.839	0.919	1.007	1.101	1.200
Moment at edge	8.16	8.66	9.29	9.99	10.81

Table 20 Stiffness Coefficients for Stiffness of Circular Plates

(*Clauses* 3.1.5 *and* 3.1.6)

c/D	0.05	0.10	0.15	0.20	0.25
With centre support	0.290	0.309	0.3332	0.358	0.387
Without centre support	0.104	0.104	0.104	0.104	0.104

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Cement and Concrete Sectional Committee, CED 02

Organization	*Representative(s)*
In Personal Capacity (*Grace Villa, Kadamankulam P.O., Thiruvalla 689 583*)	Shri Jose Kurian (***Chairman***)
ACC Ltd, Mumbai	Shri Rajesh J. Modi Dr Manish V. Karandikar (*Alternate*)
Ambuja Cements Limited, Ahmedabad	Shri Umesh P. Soni Shri Sukuru Ramarao (*Alternate*)
Atomic Energy Regulatory Board, Mumbai	Shri L. R. Bishnoi Shri Sourav Acharya (*Alternate*)
Builders' Association of India, Mumbai	Shri Sushanta Kumar Basu Shri D. R. Sekor (*Alternate*)
Building Materials & Technology Promotion Council, New Delhi	Shri C. N. Jha
Cement Manufacturers' Association, Noida	Dr V. Ramachandra Ms Shashwati Ghosh (*Alternate*)
Central Public Works Department, New Delhi	Shri D. K. Garg Shri Naveen Kumar Bansal (*Alternate*)
Central Soil and Materials Research Station, New Delhi	Director Shri U. S. Vidyarthi (*Alternate*)
Central Water Commission, New Delhi	Director (CMDD) (N&W) Deputy Director (CMDD) (NW&S) (*Alternate*)
Conmat Technolgies Pvt Ltd, Kolkata	Dr A. K. Chatterjee Dr Subrato Chowdhury (*Alternate*)
Construction Chemical Manufacturers' Association, Mumbai	Shri Samir Surlaker Shri Nilotpol Kar (*Alternate*)
CSIR – Central Building Research Institute, Roorkee	Shri S. K. Singh Shri Subhash Gurram (*Alternate*)
CSIR – Central Road Research Institute, New Delhi	Dr Rakesh Kumar Dr V. V. L. Kanta Rao (*Alternate*)
CSIR – Structural Engineering Research Centre, Chennai	Dr K. Ramanjaneyulu Dr P. Srinivasan (*Alternate*)
Delhi Development Authority, New Delhi	Shri Laxman Singh Shri Vijay Shankar (*Alternate*)
Department of Science and Technology, Ministry of Science and Technology, New Delhi	Shri S. S. Kohli
Engineers India Limited, New Delhi	Shri Rajanji Srivastava Shri Anurag Sinha (*Alternate*)
Gammon India Limited, Mumbai	Shri Shriram B. Kulkarni Shri Rahul Biradar (*Alternate*)

Organization	*Representative(s)*
Hindustan Construction Company Limited, Mumbai	Shri Satish Kumar Sharma Shri Mukesh Valecha (*Alternate*)
Housing and Urban Development Corporation Limited, New Delhi	Representative
Indian Association of Structural Engineers, New Delhi	Shri Mahesh Tandon Shri Ganesh Juneja (*Alternate*)
Indian Concrete Institute, Chennai	Shri Vivek Naik Secretary General (*Alternate*)
Indian Institute of Technology Delhi, New Delhi	Dr Shashank Bishnoi Dr Dipti Ranjan Sahoo (*Alternate*)
Indian Institute of Technology Madras, Chennai	Dr Devdas Menon Dr Manu Santhanam (*Alternate*)
Indian Institute of Technology Roorkee, Roorkee	Dr V. K. Gupta Dr Bhupinder Singh (*Alternate*)
Indian Roads Congress, New Delhi	Shri S. K. Nirmal Shri R. V. Patil (*Alternate*)
Military Engineer Services, Engineer-in-Chief's Branch, Army HQ, New Delhi	Maj Gen S. K. Srivastav Shri Man Singh (*Alternate*)
Ministry of Road Transport and Highways, New Delhi	Shri Y. Balakrishna Shri Sanjeev Kumar (*Alternate*)
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National Test House, Kolkata	Shri D. V. S. Prasad Dr Somit Neogi (*Alternate*)
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Nuvoco Vistas Corporation Limited, Mumbai	Shri Pranav Desai Shri Ravindra Khamparia (*Alternate*)
Public Works Department, Govt of Tamil Nadu, Chennai	Superintending Engineer Executive Engineer (*Alternate*)
The India Cements Limited, Chennai	Representative
The Indian Hume Pipe Company Limited, Mumbai	Shri P. R. Bhat Shri S. J. Shah (*Alternate*)
The Institution of Engineers (India), Kolkata	Dr H. C. Visvesvaraya Shri S. H. Jain (*Alternate*)
The Ramco Cements Limited, Chennai	Shri Balaji K. Moorthy Shri Anil Kumar Pillai (*Alternate*)
Ultra Tech Cement Ltd, Mumbai	Shri Surya Valluri Dr M. R. Kalgal (*Alternate*)
Voluntary Organization in Interest of Consumer Education, New Delhi	Shri M. A. U. Khan Shri B. Mukhopadhyay (*Alternate*)
In personal capacity [*B-803, Oberoi Exquisite, Oberoi Garden City, Goregaon (East), Mumbai*]	Shri A. K. Jain

Organization	*Representative(s)*
In personal capacity (*36, Old Sneh Nagar, Wardha Road, Nagpur*)	Shri L. K. Jain
In personal capacity (*EA-92, Maya Enclave, Hari Nagar, New Delhi*)	Shri R. C. Wason
BIS Directorate General	Shri Sanjay Pant, Scientist 'F' and Head (Civil Engineering) [Representing Director General (*Ex-officio*)]

Member Secretaries

Shri S. Arun Kumar
Scientist 'E' (Civil Engineering), BIS

and

Shri Milind Gupta
Scientist 'C' (Civil Engineering), BIS

Concrete Subcommittee, CED 2:2

Organization	*Representative(s)*
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ACC Limited, Mumbai	Shri Prahlad Mujumdar Shri Anil Kulkarni (*Alternate*)
Ambuja Cements Limited, Ahmedabad	Shri Umesh P. Soni Shri Sukru Ramarao (*Alternate*)
AFCONS Infrastructure Limited, Mumbai	Shri Manish Mokal
Association of Consulting Civil Engineers (India), Bengaluru	Shri Avinash D. Shirode Shri K. K. Meghashyam (*Alternate*)
Atomic Energy Regulatory Board, Mumbai	Shri L. R. Bishnoi Shri Sourav Acharya (*Alternate*)
Building Materials and Technology Promotion Council, New Delhi	Shri Pankaj Gupta
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Bureau Veritas India Ltd, Mumbai	Representative
Central Public Works Department, New Delhi	Shri D. K. Garg Shri Rajesh Khare (*Alternate*)
Central Soil & Materials Research Station, New Delhi	Shri Rajeev Kumar Shri Raj Kumar (*Alternate*)
Creative Design Consultants & Engineers Pvt Ltd, Ghaziabad	Shri Aman Deep Garg Shri Manik Chatterjee (*Alternate*)
CSIR – Central Building Research Institute, Roorkee	Dr Rajesh Deolia Shri H. C. Arora (*Alternate*)
CSIR – Central Road Research Institute, New Delhi	Shri J. B. Sengupta Shri Satish Pandey (*Alternate*)

Organization	*Representative(s)*
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Department of Science and Technology, Ministry of Science and Technology, New Delhi	Shri S. S. Kohli
Elkem South Asia Pvt Ltd, Navi Mumbai	Shri Brajesh Malviya Shri Surendra Sharma (*Alternate*)
Engineers India Limited, New Delhi	Shri Rajanji Srivastava Shri Anurag Sinha (*Alternate*)
Gammon India Limited, Mumbai	Shri Sudeesh Rajendran
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Indian Concrete Institute, Chennai	Shri K. C. Tayade Secretary General (*Alternate*)
Indian Institute of Technology Delhi, New Delhi	Dr B. Bhattacharjee Dr Shashank Bishnoi (*Alternate*)
Indian Institute of Technology Kanpur, Kanpur	Dr Sudhir Mishra
Indian Institute of Technology Madras, Chennai	Dr Manu Santhanam Dr Radhakrishna G. Pillai (*Alternate*)
Indian Institute of Technology Roorkee, Roorkee	Representative
Indian Society of Structural Engineers, Mumbai	Shri Umesh Joshi Shri Hemant Vadalkar (*Alternate*)
Irrigation and Power Research Institute, Amritsar	Chief Engineer (Research) Research Officer (*Alternate*)
Larsen and Toubro Limited, ECC Division, Chennai	Dr B. Sivarama Sarma Shri S. Manohar (*Alternate*)
Military Engineer Services, Engineer-in- Chief's Branch, Integrated HQ of MoD (Army), New Delhi	Maj Gen S. K. Srivastav Shri Man Singh (*Alternate*)
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NBCC (India) Limited, New Delhi	Shri H. S. Yadav Shri Arun Kumar Sharma (*Alternate*)
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In personal capacity (*36, Old Sneh Nagar, Wardha Road, Nagpur*)	Shri L. K. Jain
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In personal capacity (*EA-92, Maya Enclave, Hari Nagar, New Delhi*)	Shri R. C. Wason
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(*Continued from second cover*)

The Sectional Committee responsible for the formulation of this standard has taken into consideration the views of engineers and technologists and has related the standard to the practices followed in the country in this field. Due weightage has also been given to the need for international coordination among the standards prevailing in different countries of the world. These considerations led the Sectional Committee to derive assistance from published materials of British Standards Institution and Portland Cement Association, Illinois, USA. Tables have been reproduced from the following publication of Portland Cement Association, Illinois, USA, namely '*Circular Concrete Tanks without Prestressing*' and the same is thankfully acknowledged.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 `Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard

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