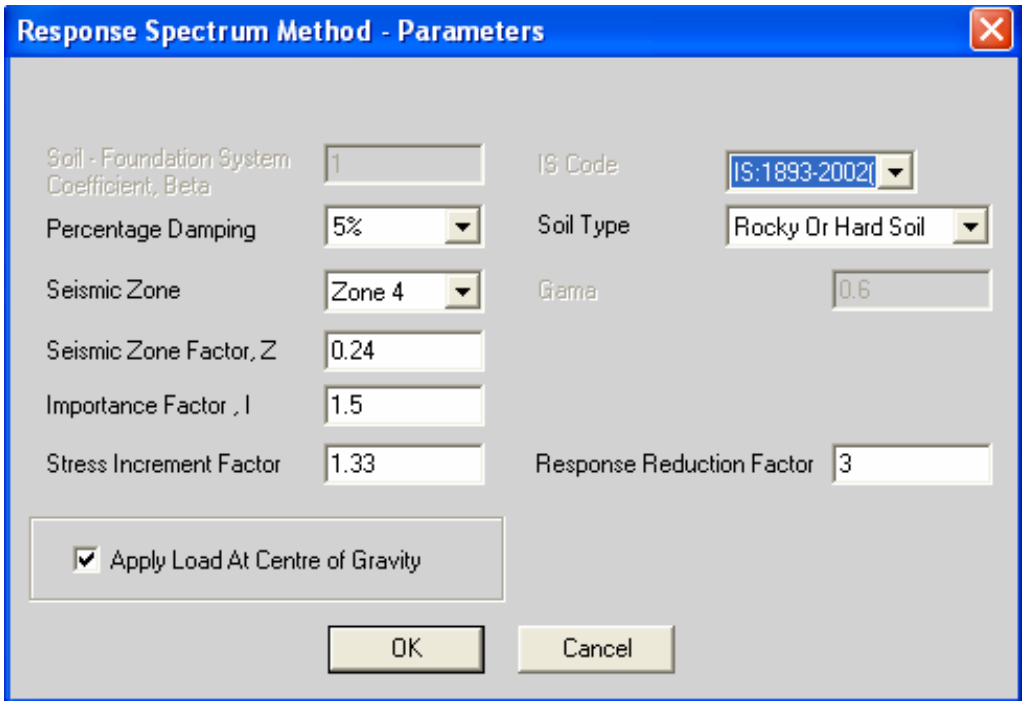
Release notes for ESRGSR 3.2

1. Implementation of IS 1893: 2002 part 2 which is given for Liquid retaining structures.



a) Using this total weight of the structure is calculated first.

Total weight calculations:

(a) Weight of top slab	= 73619.30 kg
(b) Weight of tank wall	= 78027.20 kg
(c) Weight of bottom slab	= 73619.30 kg
(d) Weight of top beams	= 11860.06 kg
(e) Weight of bottom beams	= 14895.37 kg
Self weight of tank,(W1)	= (a) + (b) + (c) + (d) + (e)
	= 252021.23 kg
Water load,(W2)	= 527321.00 kg
(f) Self weight of staging beams	= 80275.87 kg
(g) Self weight of columns	= 65384.40 kg
Total weight of staging,(W3)	= (f) + (g)
	= 145660.27 kg

CASE I : TANK EMPTY CONDITION

Total weight,(W)	= W1 + ((1/3) x W3)
	= 252021.23 + ((1/3) x 145660.27)
	= 300574.66 kg
Time period	= natural period of the structure , in seconds
	= 2 x PI x sqrt(Delta/g)

where

Delta	= the static horizontal deflection at the top of the tank under a static horizontal force equal to a weight W

b) Then the lateral force in X and Y direction are calculated for tank empty condition.

CASE I : TANK EMPTY CONDITION

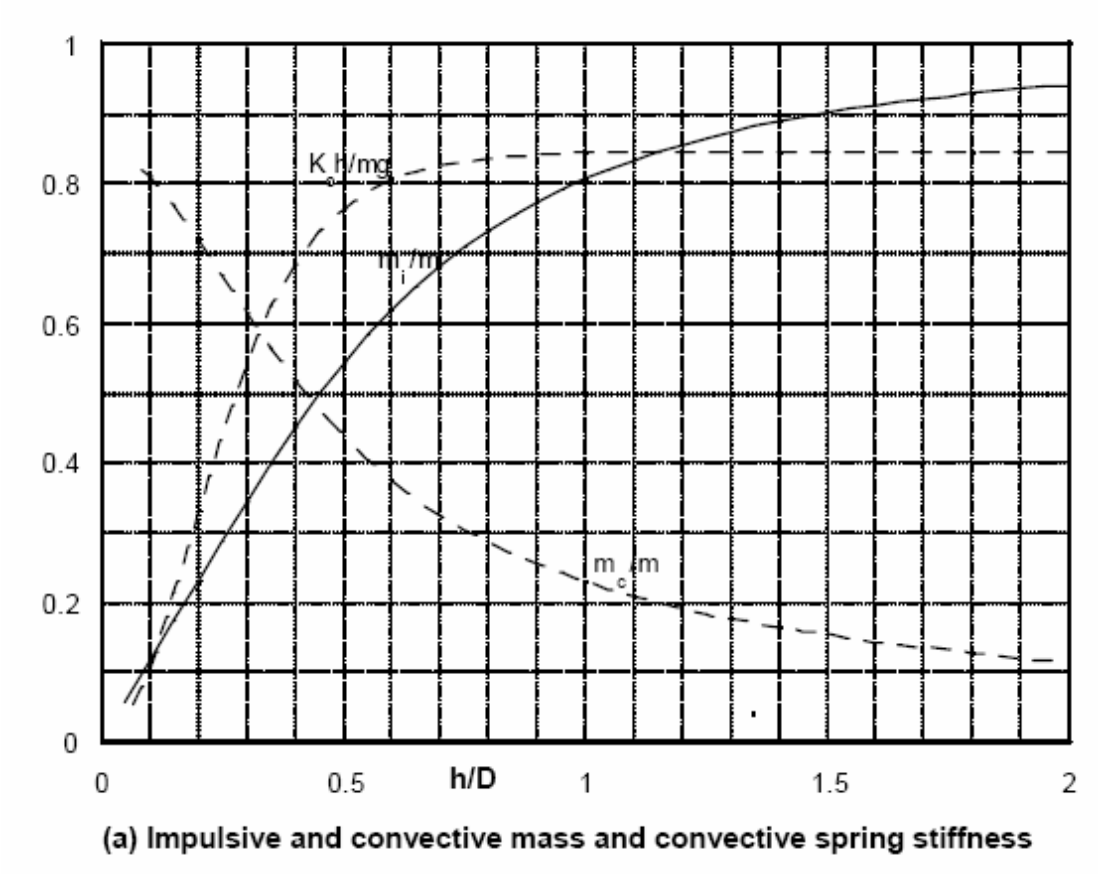
Total weight,(W)	= W1 + ((1/3) x W3)
	= 252021.23 + ((1/3) x 145660.27)
	= 300574.66 kg
Time period	= natural period of the structure , in seconds
	= 2 x PI x sqrt(Delta/g)
where	
Delta	= the static horizontal deflection at the top of the tank under a static horizontal force equal to a weight W acting at the centre of gravity of the tank.
g	= acceleration due to gravity
	= 981.00 cm/second

The damping in the concrete structure is assumed to be 5%

Earthquake force in X direction :

Delta-X	= 4.266433E+001 cm
Time period-X	= 2 * PI * sqrt(4.266433E+001 cm / 981.00 cm/sec) seconds
	= 1.310321 seconds
Beta	= 1.000000
Importance factor,(I)	= 1.500000
SaX/g	= 0.763171
alpha-hX	= Beta x I x F x (SaX/g)
	= 1.000 x 1.500 x 0.240 x 0.763171
	= 0.274742

b) For tank full condition the impulsive and Convective mass are calculated using Section 4.2.2.2 of IS.



(a) Impulsive and convective mass and convective spring stiffness

CASE II : TANK FULL CONDITION

Total mass,(M)	$= M_i + M_s$
where	
M_i	= Impulsive Mass
	= 121740.92 kg
Where M_i is Calculated from	
$M_i/m = (\tanh 0.866\ D/d)/(0.866\ D/h)$	
	(Section 4.2.2.2)
m	= Mass of Water
M_s	= Structural Mass
	= W1 + ((1/3) x W3)
	= 252021.23 + ((1/3) x 300574.66)
	= 827895.69 kg
M_c	= Convective Mass
	= 380056.44 kg
Where M_c is Calculated from	
$M_c/m = 0.23(\tanh(3.68h/D))/(h/D)$	
	(Section 4.2.2.2)
Time period Impulsive	= natural period of the structure , in seconds
	$= 2 \times \pi \times \sqrt{(\Delta/g)}$
where	
Δ	= the static horizontal deflection at the top of the tank under a static

Earthquake force in X direction :

Δ_x	= 5.994436E+001 cm
Time period-X Impulsive	= 2 x π x $\sqrt{}$ (5.994436E+001 cm / 981.00 cm/sec) seconds
	= 1.553172 seconds
Time period-X Convective	= C_c x $\sqrt{}$ (D/g) (Clause 4.3.2.2)
	= 4.14 $\sqrt{}$ (15.00 / 981.00) seconds
	= 5.115988 seconds
C_c	= Coefficient of time period for convective mode
C_c	= 2π/($\sqrt{}$ (3.68tanh(3.68h/D)))
h	= Depth of water
D	= Inner diameter of tank
Importance factor,(I)	= 1.50
SaX/g Impulsive	= 0.644
alpha-hX Impulsive	= Z/2 x I/R x $(SaX/g)_i$
	= 0.24 /2 x 1.50/3.00 x 0.644
	= 0.038631
SaX/g Convective	= 0.342
alpha-hX Convective	= Z/2 x I/R x $(SaX/g)_c$
	= 0.24 /2 x 1.50/3.00 x 0.342
	= 0
Lateral force Impulsive V_i	= alpha-$hX_{(i)}$ x (M_i+M_s)
	= 0.038631 x 422315.58
	= 16314.32 kg
Lateral force Convective V_c	= alpha-$hX_{(c)}$ x M_c
	= 0.020524 x 380056.44

d) For these masses the time period and lateral forces are calculated.

	= 0.24 /2 x 1.50/3.00 x 0.342
	= 0
Lateral force Impulsive V_i	= alpha-hY x (M_i+M_s)
	= 0.038631 x 422315.58
	= 16314.32 kg
Lateral force Convective V_c	= alpha-hY x M_c
	= 0.020524 x 380056.44
	= 7800.24 kg
Total Lateral force V	= $\sqrt{}$ (V_i^2+V_c^2)
	= $\sqrt{}$ (16314.315²+ 7800.238²)
	= 18083.16 kg

SUMMARY

CASE I : TANK EMPTY CONDITION

Earthquake force in X direction = 13763.40 kg

Earthquake force in Y direction = 13763.40 kg

Force is applied at 1.71 m from bottom level.

CASE II : TANK FULL CONDITION

Earthquake force in X direction = 18083.16 kg

Earthquake force in Y direction = 18083.16 kg

Force is applied at 1.71 m from bottom level.

2. Grid value related changes in Slab Beam type of tank are made.

3. Column editing related changes in cylindrical type of tank is made.

4. Modification in Flat slab detailing regarding min. steel.