COMPARISON OF PRESTRESSED AND REINFORCED CONCRETE GROUND RESERVOIRS

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ABSTRACT

There is a great demand for new pipe borne water supply schemes as well as expansion of existing pipe borne water supply schemes due to rapid urbanization, industrialization and host of other reasons demanding construction of more and more ground reservoirs to feed water to meet these water supply needs. Traditionally, ground water storage reservoirs have been built out of reinforced concrete and most of them are rectangular in shape with a few being circular. In Sri Lanka only two pre stressed ground reservoirs have been constructed, one in Galle Water Supply Scheme in Beak and the other one is for Greater Colombo Water Supply Scheme in Maligakanda having capacities of 2.0 and 3.0 million gallons respectively (9000 m3& 13,500 m3).

The land and space available for construction of ground reservoirs in urban areas becoming less and less and construction materials such as cement, aggregates, reinforcing steel and skilled labor etc becoming scarce and construction of prestressed ground reservoir could offer a solution to these problems.

Based on data collected on some of the ground reservoirs already constructed in Sri Lanka it could be seen that the prestressed concrete reservoirs could offer economical solutions when compared with reinforced concrete construction with respect to the usage of land and construction materials due to structural configuration and the ability of prestressing to reduce concrete sections.

A major draw back in the prestressed reservoir design is its inability to adapt to the land shape due to shape restriction to circular only and also lack of experienced contractors in prestressed construction presently in Sri I.anka. The selected structural arrangement for the dome roof consists of spherical dome roof with shell structure with prestressed ring beam resting on a rubber pad which is resting on the top of the wall.

DECLARATION

I herewith declare that the work included in the thesis in part or whole, has not been submitted for any other academic qualification at any institution.

Date

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Certified by:

Date

Professor S.M.A.Nanayakkara
Supervisor

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NOTATIONS

This appendix contains a list of notations used in this paper.

a = Radius of cylinder, ring beam.

d = Depth of ring beam.

E = Young's Modulus of Elasticity.

H_0 = Horizontal force at an edge?

H_R = Radial force on ring beam.

h = Height of water above the crown of the bottom spherical dome.

h_1 = Depth of water in the cylindrical portion of the tank.

M = Bending Moment, Subscripts x & ϕ denote the meridional bending moments in the cylindrical shell and the spherical dome respectively. Subscript θ denotes the transverse bending moment. Subscript Φ denotes the redundant moment at an edge. Subscript R denotes the radial moment in a ring beam.

N = Direct force - subscripts x & ϕ denote the meridional forces in the cylindrical shell and the spherical dome respectively. Subscript θ denotes the hoop force.

P = Line load per unit length.

p = Load per unit area.

Q = Shearing force, subscription x & ϕ denote the shearing forces in the cylindrical shell and the spherical dome respectively.

R = Radius of a spherical dome.

s = Distance of a point in a conical shell from the vertex of the cone.

t = Thickness of shell, ring beam.

V = Membrane rotation. Subscripts c, and d denote the cylindrical shell, spherical shell.

v = Rotation due to edge forces moments. Subscripts c and d denote the cylindrical shell, spherical dome respectively. Subscripts H and M denote the horizontal force and redundant moment applied at an edge respectively.

x = Distance of a point from an end in a cylindrical shell.

y = Shell constant for a conical shell.

y	=	Shell constant for a conical shell.
		$y = 2\sqrt{\frac{12(I-\mu^2)s^2 \tan^2\alpha}{t^2}}$
α_1	=	Angle made by a point in the spherical dome with its edge.
α	=	Angle made by a conical shell with its base circle.
β	=	Shell constant.
		(1) $\beta = 4\sqrt{\frac{3(I-\mu^2)a^2}{t^2}}$ for a cylindrical shell
		(2) $\beta = 4\sqrt{\frac{3(I-\mu^2)R^2}{t^2}}$ for a spherical shell
γ	=	Density of water.
μ	=	Poisson's ratio.
Δ	=	Membrane displacement. Subscription c & d denote the cylindrical shell, spherical dome.
δ	=	Displacement due to edge force and moments. Subscripts c, d, denote the cylindrical shell, spherical dome respectively. Subscript R denotes the ring beam. Subscripts H and M denote the horizontal force redundant applied moment at an edge respectively.
γ_c	=	Density of Concrete (Kg/m^3)
E	=	Young's modules (kN/m^2)
δ_{RH}	=	Displacement of the ring beam due to radial force
δ_{RM}	=	Displacement of the ring beam due to radial moment
δ_{dH}	=	Displacement of the dome due to unit edge force
δ_{dM}	=	Displacement of the dome due to unit edge moment
Δ_d	=	Displacement of the dome
υ_{RH}	=	Rotation of the ring beam due to radial force
υ_{RM}	=	Rotation of the ring beam due to radial moment
υ_{dH}	=	Rotation of the dome due to unit edge force
υ_{dM}	=	Rotation of the dome due to unit edge moment
υ_d	=	Rotation of the dome