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Computing Upward Forces on Vault Bases

By Ronald Thornton, PE

We are occasionally questioned about the appropriate method for computing the upward bearing pressure on vault base slabs, particularly in the presence of hydrostatic forces. We have found ASTM C890 to be a bit misleading with respect to this issue.

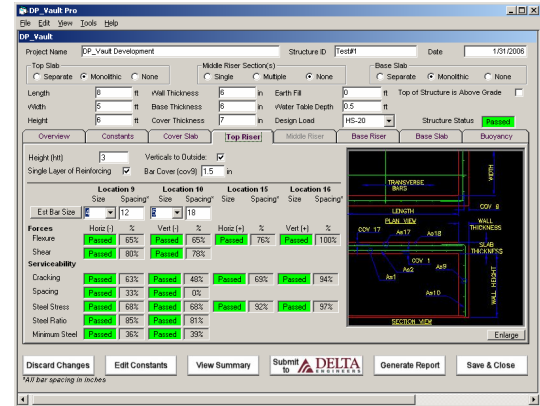
Upward bearing pressure is essentially the reaction of compressible soil to the sum of all downward forces acting on it. Downward forces include the weight of the structure plus any additional live or dead loads applied to the structure. The base slab weight plus any forces acting directly on the slab, such as internal liquid, are neglected in the downward forces since they act to resist the resulting upward pressure. The computation for upward pressure is then equal to the sum of the vertical forces divided by the base contact area, neglecting any base extension.

Figure 7 of ASTM C890 shows hydrostatic forces in addition to the upward bearing pressure. In reality, the hydrostatic force due to high groundwater can be neglected. The reason for this is due to the effect of buoyancy. The overall weight of the structure in a buoyant condition is reduced by an amount equal to the weight of displaced water. Therefore, if the weight of the structure is reduced, then the upward bearing pressure is likewise reduced.

Delta Rolls out Version 2.0 of DP_Vault

DP_Vault is a unique program developed by Delta Engineers to allow precast manufacturers the ability to determine member thickness and reinforcing requirements for nearly any square or rectangular underground vault. The powerful built-in design function analyzes each structure based on a user defined set of conditions including live load, earth cover and water table depth. The user also identifies how the structure is to be built by selecting a com-

bination of separate top slabs, monolithic top sections, riser sections, monolithic or integral base sections, and/or separate base slabs. The program continually tells the user if the design is adequate through a series of **RED** and **GREEN** indicator fields. A percent field next to the **RED/GREEN** light shows how far over or under the current attribute is from the required value. Extra fields have been added to Version 2.0 allowing for more detailed descriptions and status tracking of bids and proposals.



The output of this program displays and prints total concrete quantity for each component in both cubic feet and cubic yards. Rebar quantities are displayed in pounds both by component and by bar size. The component weight is also displayed. All of these values may be exported to a comma delimited text file for use in other programs.

Once the structure is sold and ready for production, the design can be immediately transmitted to Delta Engineers for review by an engineering professional. Detailed calculations sealed by a PE (limited to certain states) can be requested as well.

Stop by the Delta Booth (#1338) at MCPX in Anaheim for a demonstration or contact Delta Engineers for more information. Current DP_Vault users will receive a special upgrade price.



