

4.7 Excessive Stresses from Differential Material Properties

Description:

When concrete mixes of different physical properties are combined they may perform differently under stress. These differences can cause stress concentrations at the interface, leading to bond failure and cracking. In concrete construction it is possible to have concretes of different strength placed adjacent to each other while expected to perform as a uniform material with the same properties.

The purpose of this document is to determine if such conditions existed at the delamination area and contributed to the delamination.

Data to be collected and Analyzed:

- 1. Review original records for concrete mixes used in the construction of the structure (FM 4.7 Exhibit 3).
- 2. Review pour records for information on materials used in adjacent lifts (FM 4.7 Exhibit 4 is a graphical summary).
- 3. Test core samples from different concrete/grout mixes. (FM 4.7 Exhibit 1 is a summary of core tests, presented with original strength data for the corresponding pours)

Verified Supporting Evidence:

a. Three different concrete mixes were used in bay RBCN-0015. A total of four concrete mixes were used in the containment structure for the 5000 psi level.

Verified Refuting Evidence:

a. Different concrete mixes were used in the containment structure. It appears that this was allowed as long as the strength exceeded the design strength and the strength variation was acceptable. FM 4.7 Exhibit 2 is a statistical analysis of the two main mixes used anywhere in the containment structure. It shows that for mixes DM-5 and 727550-2 the average strength was 5640 psi and 5774 psi (with Standard deviation of 508 and 541 psi) respectively.

Discussion:

- a) The concrete mixes used in the containment wall had similar physical properties and are not expected to have significantly different strength properties.
- b) Even when placed on top of each other, different concrete mixes were blended at the interface by adequate vibration (see FM 2.7). This procedure prevents the creation of defined interface and eliminates differential properties at the location.
- c) All interfaces between different concrete mixes in the wall were horizontal and full depth. It is not expected that such interface could have a significant effect on delamination in the vertical plane.

Conclusion:

There were no excessive stresses from differential material properties in the containment wall and this Failure Mode did not cause the delamination.

1/11/2010



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