

## **OCTOBER 20 , 2004 - Forensic Investigation of Existing Warehouse Concrete Floor**

Speaker: [Andre G. Garner, P.E.](#), Tel. 512-358-7020 of Carrasquillo Associates, Austin TX.

### **PRESENTATION SUMMARY**

Mr. Garner, a licensed professional engineer with bachelors and masters degrees in civil engineering, presented a paper he co-authored, "Forensic Investigation of Existing Warehouse Concrete Floor" to a room of about 40. This paper was previously presented at the Texas Section Fall Meeting of the American Society of Civil Engineers, Dallas, Texas, September 26, 2003.

Carrasquillo Associates was retained as forensic experts in a lawsuit that was the subject of Mr. Garner's presentation. The complaint investigated by Mr. Garner was that a 4.5 year old 112,500 SF tilt-wall warehouse concrete slab floor in Pflugerville TX had cracked excessively. The 5" unstiffened slab was designed with a compressive strength of 3000 psi and was reinforced with reinforcing bars at 16" on center each way. The perimeter was a 4 ft. deep retaining wall / grade beam sitting on piers. Interior columns were also on piers and isolated from the slab.

Mr. Garner said they used ACI-302.1 extensively in their investigation. Other ACI codes such as ACI-201, ACI-311 and ACI-364 were very helpful in performing the condition survey, even to the extent of providing checklists for them to follow. One of the parties in the lawsuit also performed Ground Penetrating Radar (GPR) to determine the as-built slab thickness. Numerous cores were taken showing full depth cracks.

Their findings were as follows:

- There was no abnormal foundation movement
- The incorrect building class use was not followed in the design. ACI-302.1 gives 9 classes. For this use (forklifts with hard wheels), a Class 6 use should have been chosen, dictating a concrete strength of 4500 psi rather than 3000 psi and with a surface hardener applied.
- The outriggers from the crane that set the tilt-wall panels excessively loaded the slab.
- Expansion / Contraction joint spacings were excessive. They were found to be spaced at up to 30 ft whereas ACI-302.1 recommended 24t to 36t where, for t=5", the spacing should have been 10 ft. to 15 ft.
- The joints were not detailed properly, including lack of filling
- The surface finish was not adequate for the warehouse use
- The quality control during slab placement was poor. Some reinforcing bars were exposed at the top of the slab
- The concrete water content/cement ratio was high. They found ratios up to 0.62, which exceeded the maximum of 0.55

Mr. Garner sits on the ACI-302.1 committee. Although he used ACI-302.1-92 in his investigation, there is now a more current version out: ACD-302.1-04. He discussed some of the changes in the new revision, including a flow chart to decide if vapor barriers or vapor retarders are needed and new photos that identify various types of cracks such as drying shrinkage cracks and plastic shrinkage cracks.

Further points Mr. Garner mentioned were:

he believes that wet curing for 7 days is still the best option to avoid drying shrinkage cracks, and

if poly sheathing is used for a vapor barrier, it should be at least 10 mils thickness for durability, both during construction and during operation.

For a summary of Mr. Garner's previous FPA presentation on [17 December 2003, click here](#)

**PAST PRESENTATIONS** ([click here](#))