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RIVERPARK SQUARE PARKING STRUCTURE

PRECAST CONCRETE WALL PANELS

A structural investigation of the precast concrete wall panels at the Riverpark Square Parking Structure was performed. The precast wall panels act as a guardrail for the vehicles within the parking structure. The investigation was initiated as a result of complete failure of a precast panel after a vehicle impacted it. The purpose of the investigation was to determine if the guardrails are safe with respect to containing vehicles within the parking structure after impacting a panel.

Panels are "L" shaped 3'-6" high, 3'-0" wide, 6" thick and approximately 10'-0" long. The panels are radiused where the two legs come together. Panels are reinforced with 3/4" diameter rebar at 12" o.c. Steel connectors placed into the panels are field welded to steel connections that were placed in the concrete beams at the edge of the floor. These connections hold the panel in place and transfer impact loads for vehicles to the beam in the floor slab.

The Uniform Building Code (U.B.C.) requires that the guardrail be designed to resist a horizontal load of 6000# located 1'-6" above the floor. Since an impact load usually occurs when a vehicle's front wheels are on top of the bottom leg of the panel, which is 6" above the floor, 2'-0" was used in the analysis as height above the floor, which is more conservative. This analysis assumed that the 6000# force would be spread over a 3'-0" length of panel or 2000#/ft.

The strength of the concrete was determined by Budinger & Associates' "Windsor Probe" tests. The result of the tests are shown in Budinger's letter dated June 21.

Based on the preceding information, an analysis of the concrete panel was performed. The results of the theoretical analysis indicate that the panels are capable of resisting the force required by the Uniform Building Code. Since the panel did break, however, further evaluation is necessary. Either the analysis is incorrect or the 6000# loading is not representative of the actual loading on the panel.

The panels were analyzed assuming the reinforcing steel was in the center of the panel. In reality it is difficult to place the steel in the center of the panel especially at the radiused segment of panel. The steel would require a special bend and exact placement to achieve the required panel strength. This could account for the observed discrepancy between the analysis and the actual breakage.

A 3000# auto traveling at 30 mph would exert a force of 3000 lbs on the panel. This is one-half the loading required by the U.B.C. which is a good indication that the loading is correct.

In our opinion, the panels are not resisting the required lateral loading of 6000# although the engineering analysis indicates that they should. Steel placement at the radius may account for the difference between theoretical analysis and observed panel strength. The panels did break in this location substantiating that misalignment of reinforcing may have been the problem.

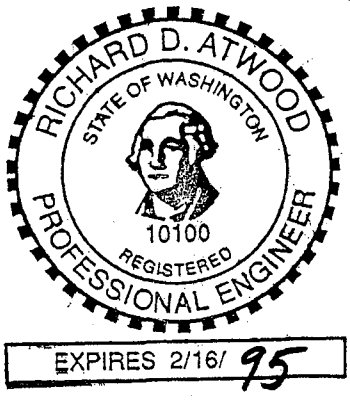
It is our understanding that several panels cracked in the past when they were struck in a similar way. Based on this information, it appears that a problem exists. When this panel was removed, the welded connection holding the panel in place had deteriorated which also reduced the panel's ability to resist the impact of vehicles.

It appears that we have contradictory information, and an informed decision with respect to load capacity can't be made. There are two logical solutions to the problem:

(1) Remove and test load a panel to failure so the load capacity can be established.

(2) Assume that the panel will fail and add steel cables to stop vehicles before they impact the panels.

Respectfully submitted,



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