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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.

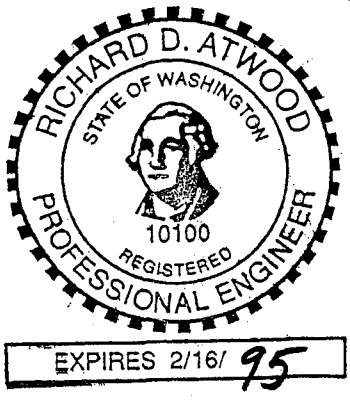
It is our understanding that several panels cracked in the past when they were struck in a similar way. Based on this information, it appears that a problem exists. When this panel was removed, the welded connection holding the panel in place had deteriorated which also reduced the panel's ability to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



Richard D. Atwood, P.E.

931106.RPT

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Atwood Hinzman
E. 1819 Springfield
Spokane, WA 99202

July 21, 1993

Project Number M93159

Attention: Dick Atwood

PROJECT: Riverpark Square Parking Garage
Spokane, WA

SUBJECT: Pre-cast Concrete Wall Panels

Gentlemen:

In accordance with your request, we have provided field testing services for the subject structure. Our services were limited to examination and testing of specific structural components, selected at your discretion. The subject structure is a multi-level parking garage in downtown Spokane constructed in 1973. In question was the compressive strength of concrete in pre-cast wall panels, which surround the exterior of the structure at the parking levels.

Tests were conducted to determine in-place compressive strength of the panels using the Windsor Probe test system. The "Windsor Probe" method uses a powder charge to fire and embed a stud into the concrete. The distance that the stud penetrates the concrete, coupled with the hardness of the concrete aggregate using MOH's scale, is indicative of compressive strength.

Tests were conducted on panels randomly selected from each parking level. Panels were visually examined and exhibited some deterioration (surface cracks, spalling), probably due to weathering. Test results indicate compressive strengths ranging from 6,600 psi to 8,000 psi, which we believe to be well within the generally accepted range for the panels in question. Compressive strength results are detailed on the attached "Results of Windsor Probe Testing" form.

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F.C. Budinger PE
Stephen D. Burchett EIT
John E. Finnegan EIT

It is a pleasure to be of service to you on this Project. Should you have any questions regarding this Report, please do not hesitate to call.

Respectfully Submitted:
BUDINGER & ASSOCIATES

Scott L. Walters
Mgr., Construction Services

SLW/rb
Addressee - 3

RESULTS OF WINDSOR PROBE TESTING

TEST #	LOCATION	PROBE & POWER LOAD	MOH'S SCALE	PROBE GAUGE HEIGHT (in.)	COMPRESSIVE STRENGTH (PSI)
1	Purple Level (elevator), E. end, 5th panel from S. end	Silver Std	5	2.250	6900
2	Purple Level, S. side, 11th panel W. of SE elevator	Silver Std	5	2.118	6700
3	Purple Level, N. side, 6th panel from NE corner	Silver Std	6	2.225	7200
4	Orange Level, 11th panel, from NE corner	Silver Std	5	2.150	7000
5	Pink/Orange Level, 14th panel from NE corner	Silver Std	5	2.250	7800
6	Orange Level, 15th panel from SE corner	Silver Std	6	2.150	6600
7	Pink Level, 12th panel from SE corner	Silver Std	5	2.264	7800
8	Pink/Green Level, 15th panel from NE corner	Silver Std	6	2.200	7000
9	Green Level, 10th panel from SW corner	Silver Std	4	2.715	7700
10	Green/Yellow Level, 15th panel from NW corner	Silver Std	4	2.200	7900
11	Yellow/Red Level, 16th panel from NW corner	Silver Std	4	2.225	8000
12	Yellow Level, 12th panel from SW corner	Silver Std	6	2.175	6800
13	Red Level, 7th panel from SW corner	Silver Std	5	2.250	7800
14	Blue Level, 4th panel from NW corner	Silver Std	4	2.088	7000
15	Red Level, 15th panel from NE corner	Silver Std	4	2.175	7700