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Structural Condition Assessment Report

Vail Transportation Center Parking Structure
Vail, CO

Prepared for:

Town of Vail
Dept. of Public Works/Transportation
1309 Elkhorn Drive
Vail, Colorado 81657

June 18, 2004

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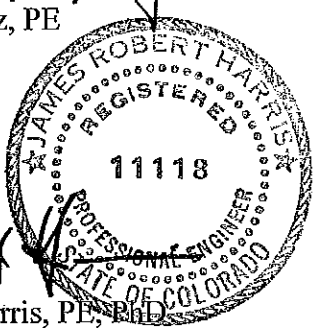
Prepared by:

Frederick R. Rutz, PE

Reviewed by:

James Robert Harris, PE, PhD



Executive Summary
We find the existing parking structure to be generally in good condition. There are areas of deterioration and damage; however, we believe these can be repaired for reasonable cost. Recommendations for repairs and maintenance actions are presented.

Scope
The scope of services included review of documents, site visits to make visual observations, and recommendations for corrective actions. Certain connections and construction were not accessible to view. The conclusions and recommendations presented are based on this work and the education and experience of the engineer and knowledge of conventional construction practices in this area, including prior experience with this structure.

Documents Reviewed
- Original plan set, dated Dec. 1973.
- Plan set for addition, dated April 1990.
- Drawing for beam repair, dated Jan. 1997.
- Drawings for tee bearing saddles repair, dated April 1998.

Description
This four-level parking structure is approximately 783 feet x 127 feet in envelope dimensions. Vehicular access is via ticket booths located near the structure center on level 3. Two buildings are situated on the structure. A plaza area associated with the buildings is located at the south center. The upper level also has some gates in the parapet that are opened for snow removal purposes. The main pedestrian stairs and tunnels are located on the south side. Smaller stairs are located on the north side.

We understand the building's history may be summarized as:

1973	Construction.
1990	Addition to the east and upper level topping removed and replaced.
1998	Addition of snowmelt to plaza areas

Significant structural repairs over the years include addition of tee bearing saddles in 1997 and beam repair saddles in 1998.

Observations
Fred Rutz, PE, and Eric Hunnes of our office visited the subject building on April 16, 2004 for the purpose of inspecting the building's existing structural condition. The locations of specific observations are noted in Appendix A and selected photographs are in Appendix B. A summary of observations is listed below. (Items observable from the specific levels are summarized here and

Evaluation and Recommendations

A discussion and evaluation follows. The original building is now 31 years old, except for the topping on the upper level deck, which is 14 years old. The addition to the east is 14 years old. Recommendations for maintenance repairs are offered, with the objective of maximizing service life.

Toppings

The toppings at all levels appeared to be generally in good condition. Some cracks were observed on the upper level. Various low spots where puddles formed were often associated with efflorescence and local damage to the tee flanges below. The addition of small drains at such low spots would help to alleviate this problem. The only delamination was observed at level 2, and it was all in a line, apparently associated with a rebar that had been placed too high. This area of very local distress could be either chipped out and repaired if you wish to address it now or deferred for future action. Several areas with exposed rebar or cracks over the bars were observed. These occurred on Grid 28 on both levels 2 and 4.

Concrete Columns

The concrete columns appeared to be satisfactory. One column that had been repaired previously (it had been hit by a vehicle) near grid B.5/15 appeared to be in satisfactory condition. It has moved approximately ½" laterally, and a previously installed lateral restraining device appears to be performing satisfactorily.

One pilaster, located on level 3 near A/29, had some large cracks. We hammered at the cracked area, and removed the loose concrete. The pilaster formerly acted a flexural member (it served as a stiffening rib) when the wall was subject to lateral pressure from soil. But the addition of an elevator lobby has removed the lateral pressure from this element. We suspect the top-level slab, which was placed over the top of the pilaster, has moved slightly, pulling on the pilaster at its top. This could have precipitated the cracks. We do not believe the crack is a cause for concern. Structurally, the pilaster is acceptable "as is". It should be patched simply for cosmetic reasons.

Concrete Beams

While some local spalls were noted for documentation purposes, the concrete beams appeared to be in good condition. Two former beam repairs, on level 3 at B/11 and B/15, were examined and appear to be satisfactory.

Precast Concrete Double Tees

The double tees appeared to be generally in good condition, with a few exceptions. There were several areas where the underside of the flange was cracked, sometimes with the mesh exposed and efflorescence showing. This type of distress usually occurred under puddles in low spots above. It appears that water, which can collect in the low spots and find its way down into the tee flange, is the culprit here. The most economical approach for a correction would be to install small floor drains in

the existing low spots, and routing a drain pipe to discharge the water directly. The locations of both the low spots and the tee flange damage are noted on the sketches in Appendix A.

Certain tee stems had local spalls. None of these were considered large enough to warrant corrective action.

The stems of two upper level tees, both located in the ventilation room near C/30, appear to have "walked" somewhat off the original bearing position. Remedial action would be appropriate here. The stems should be jacked up, the shim stacks repositioned, and the bearing pads replaced.

Exterior Bearing/Retaining Walls

All the walls appeared to be satisfactory. Certain walls had leaks, which permitted the introduction of water. That water is causing some paint to peel (near C/1 on level 3) and collects in low spots, contributing to the tee flange distress. The south wall on level 3, from about A/30 to A/38, had horizontal cracks in many of the precast wall panels. These were clearly old, and are not considered a cause for concern.

There was a spall in the corner where the semicircular wall intersects the north-south wall outside of level 3 (near A/1). There was also a horizontal crack at an old patch adjacent to this area. Neither is deemed a structural concern, but you may wish to patch them for cosmetic reasons.

Interior Bearing Walls

The interior bearing walls were found to be in satisfactory condition.

Expansion Joints

Some of the expansion joints had local damage to the elastomeric components at the surface. This was most prevalent on the upper level. The locations are indicated on the sketches in Appendix A. In one case a hole through the expansion joint was observed (near A/36). We recommend the expansion joints be repaired to prevent water from entering the structure.

The sliding devices, made from short rectangular steel tubes, at the underside of expansion joints in the original part of the structure appeared somewhat rusted, but functional. On the other hand, the sliding plate devices at the underside of expansion joints at the addition to the east were damaged. These sliding plates, both at the undersides of the expansion joint near grid 34 above levels 1 and 2, were cracked and broken. The tees flexed noticeably when a vehicle drove over the expansion joint. See photos in Appendix B. These connections transfer wheel loads across the expansion joint, thereby protecting the joint seal from excessive movements and the deck from impact load. They may also transmit some in-plane force parallel to the joint. They need to be repaired. The replacement should be designed to be stronger than the original design.

Stairs

The stairs are generally in good condition. One stair, at the lower plaza south of the Visitor Center building, had a rail post that was not bolted to its landing. An anchor bolt should be installed there.

Tunnels

The concrete tunnels were generally in good condition. There were several cracks in the tunnel walls, as well as associated retaining walls, but none were deemed a structural concern. These were most prevalent at level 2, near grid A/1. You may wish to entertain patching of the cracks for cosmetic reasons.

Foundation Settlement

We believe some foundation settlement has occurred near the SW corner of the structure (near A/1). The upper level topping cracks in this area, the separation crack between the tunnel and the parking structure at level 2, and the minor distress at the exterior wall at this area at level 3 all point to some small settlement in this area. We do not consider this a cause for concern; but it is reasonable to project some future distress (again minor), with associated minor maintenance repairs, due to minor foundation settlement.

Summary of Recommendations

Upper:	Rout and seal cracks in deck and sidewalk.
	Repair damaged expansion joints.
	Repair minor topping spalls.
	Repair tripping hazard at patch near A/1.
	Power wash joints to remove dirt.
	Remove and replace joint sealant as necessary.
	Sandblast, prime, and paint the rusted vent enclosure near C/20.
	Reinstall louver below the vent enclosure near C/20.
	Repair railing base connections along C/23 – C/28.
	Repair roof flashing near C/29.
	Install bolt at railing post on stair landing near A/11.
	Install local deck drains in low spots where puddles form.
Level 3:	Repair stair-step crack in CMU wall near entrance.
	Reset two tee bearings near C/30 (inside vent enclosure).
	Install new tee hanger at stem just east of the row of tee hangers near A/31.
	Repair spall and patch horizontal crack outside west end near A/1.
	Strip peeling paint and repaint near C/1.
	Tighten loose nut at tee stem hanger near C/19.
	Repair spalled concrete at pilaster in elevator lobby near A/30.

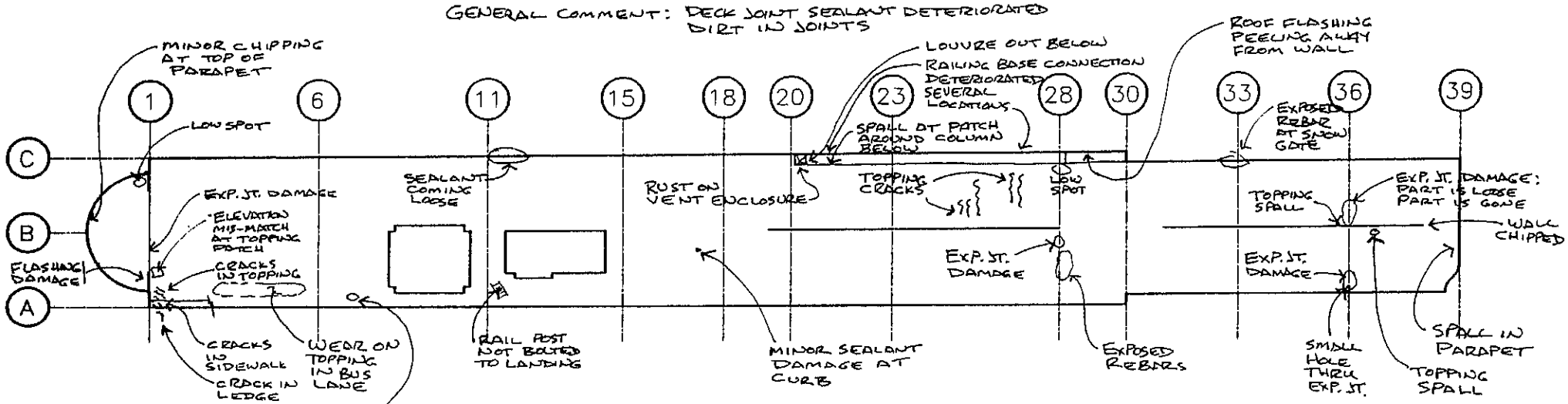
Level 2:	Repair loose floor seal at B/28. Repair loose sealant near B/30. Repair sliding plate devices on expansion joint near 34. Repair topping delamination 23 – 28, between A and B (optional). Install local floor drains in low spots along A/23 to 28. Install local floor drain in low spot near C/15. Patch cracks in tunnel wall and in retaining wall, both near A/1.
Level 1:	Repair sliding plate devices on expansion joint near 34. Rout and seal minor cracks in slab-on-grade.

Conclusion

We find the structure to be generally in good condition. The items discussed above are all repairable. In our opinion, it is possible to extend the building's useful life if the recommended repairs are made and it continues to receive careful maintenance in the future.

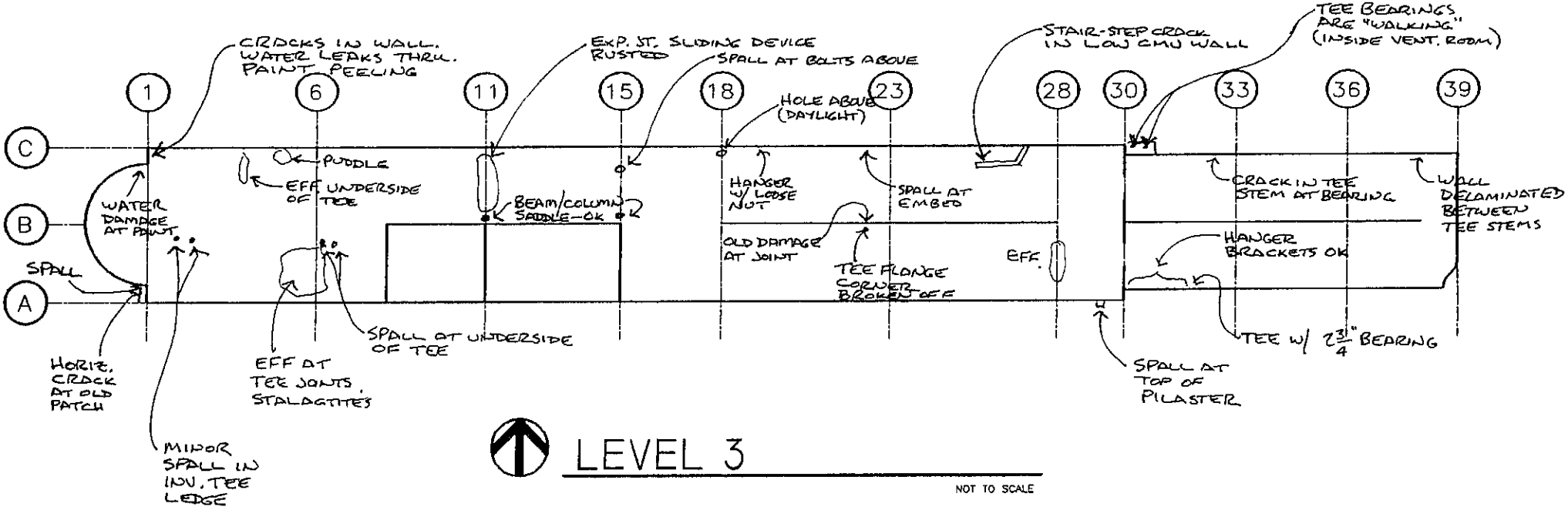
Attachments
Appendix A: Locations of noted damage/deterioration
Appendix B: Photographs

Appendix A
Vail Transportation Center Parking Structure
Diagrams with locations of noted damage/deterioration



LEVEL 4

NOT TO SCALE



LEVEL 3

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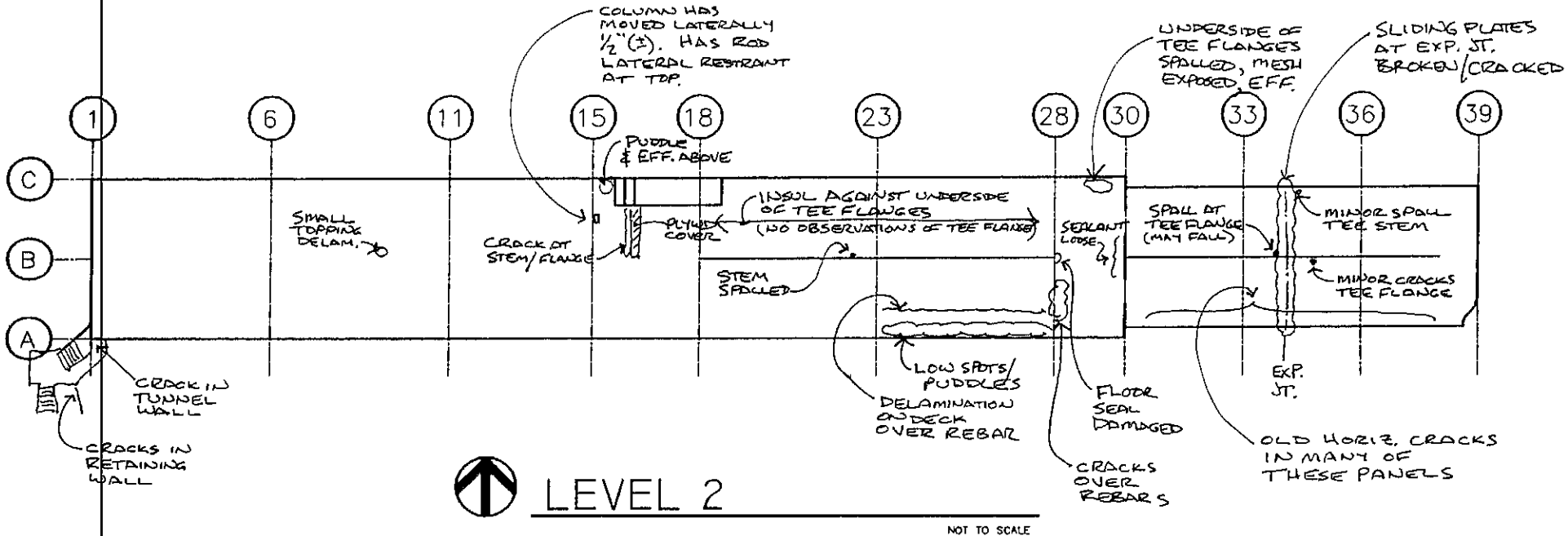

LEVEL 2

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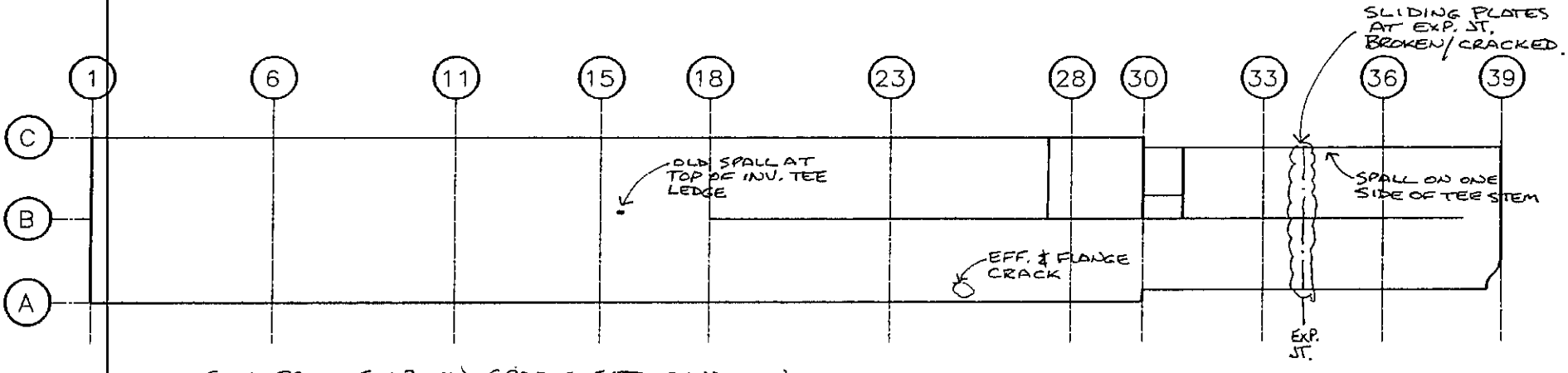

GENERAL: SLAB-ON-GRADE GOOD CONDITION (MINOR CRACKS)

LEVEL 1

NOT TO SCALE

Appendix B
Vail Transportation Center Parking Structure
Photographs taken April 16, 2004

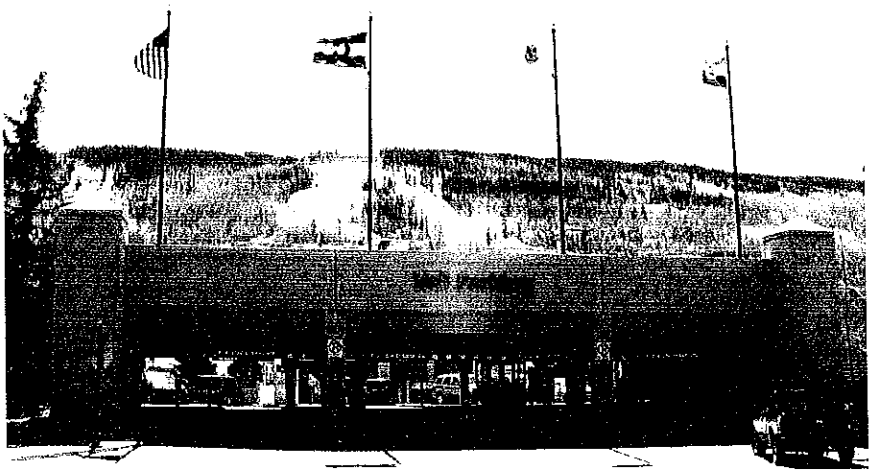

Photo 1. Vail Transportation Center Parking Structure main entrance on north side.

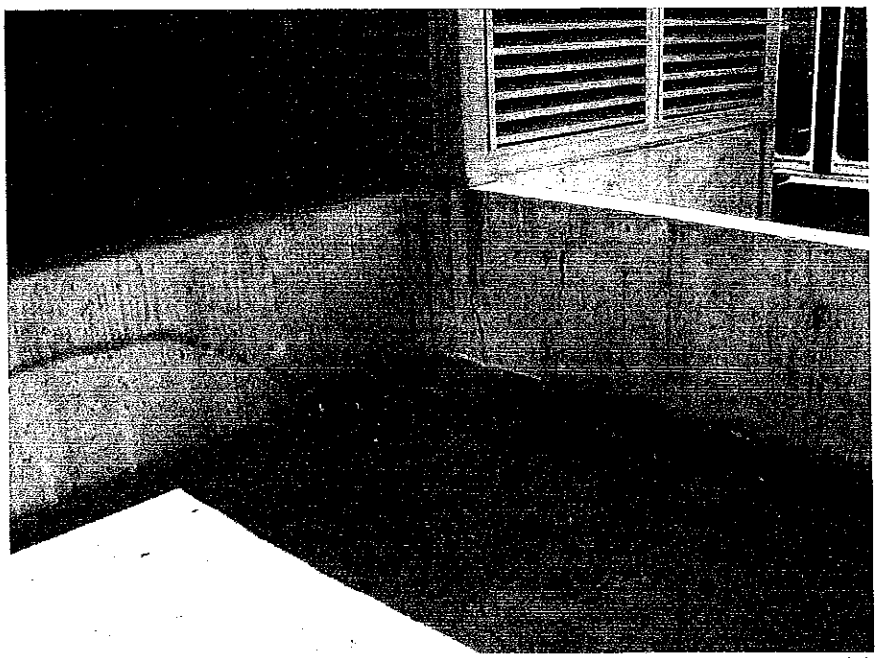

Photo 2. Low spot on upper level where water collects. Near Grid C/1.

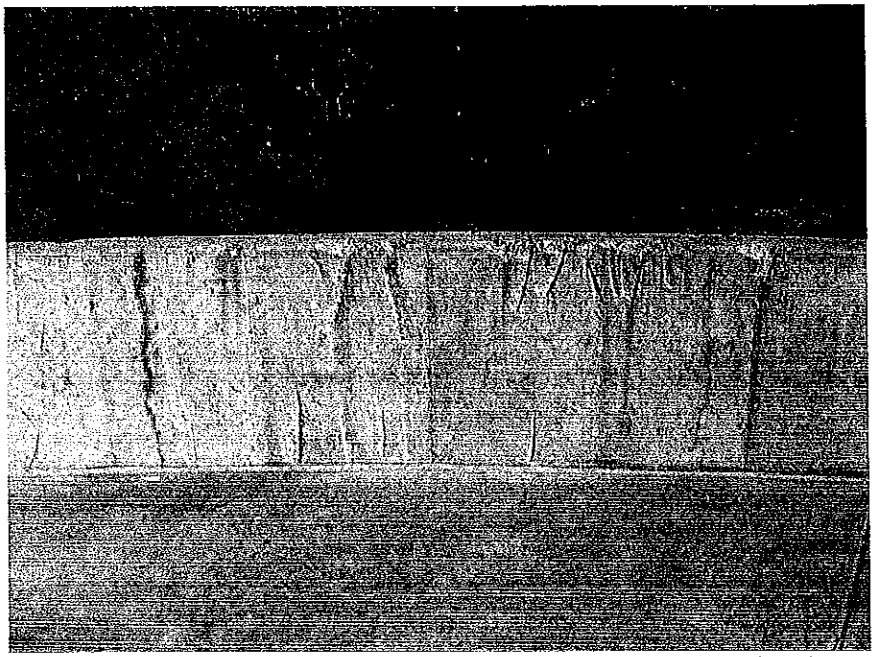

Photo 3. Minor chipping has occurred at parapet at upper level. While not a structural issue, cosmetic patches are an option.

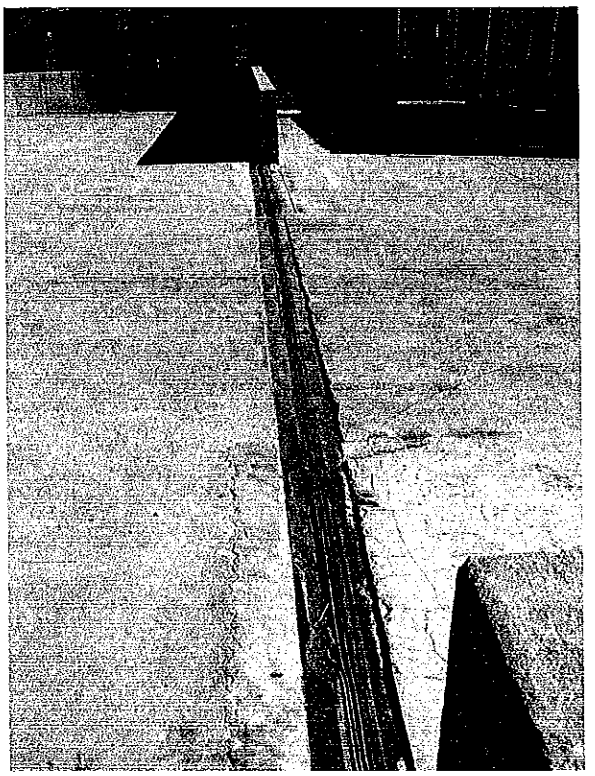

Photo 4. Local damage at expansion joint on upper level.

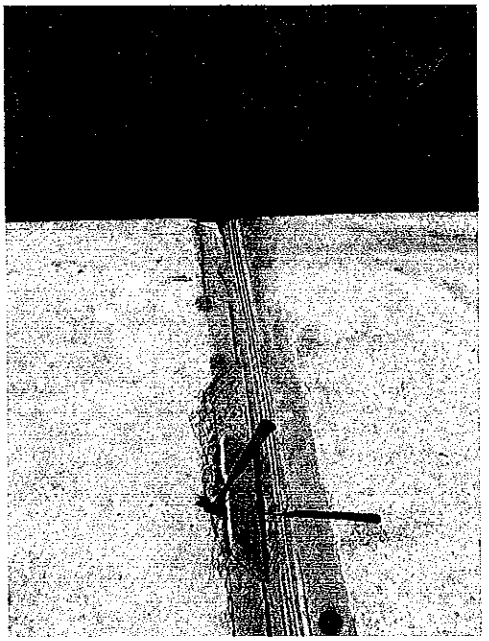

Photo 5. Exposed and rusty stirrups at precast concrete beam.

Photo 6. Deterioration at expansion joint on upper level.

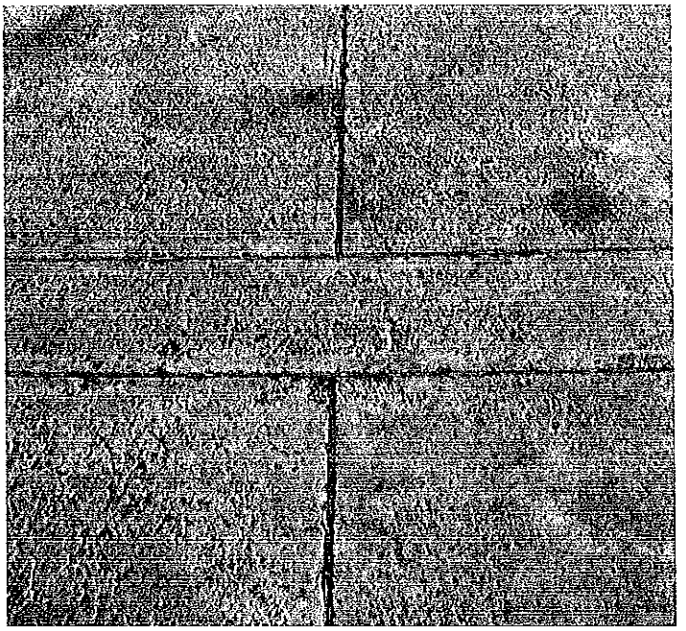

Photo 7. Typical condition of control joints on upper level. The accumulated dirt should be removed and the joints resealed.

Photo 8. Cracks in upper level topping topping near A/1. They should be routed and sealed.

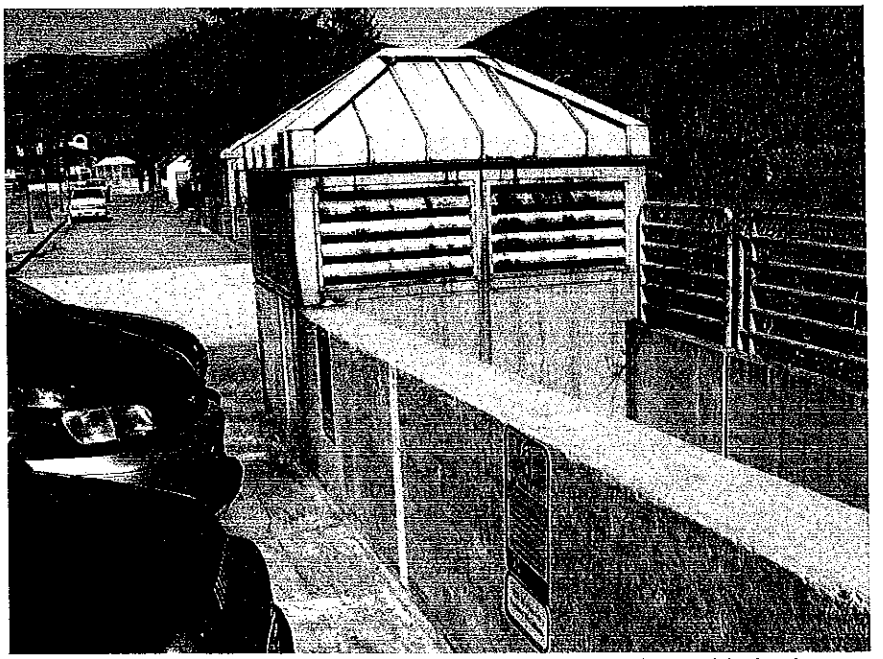

Photo 9. Exterior of ventilation enclosure near C/20. this is the only such enclosure in rusty condition. It should be sandblasted, primed, and painted.

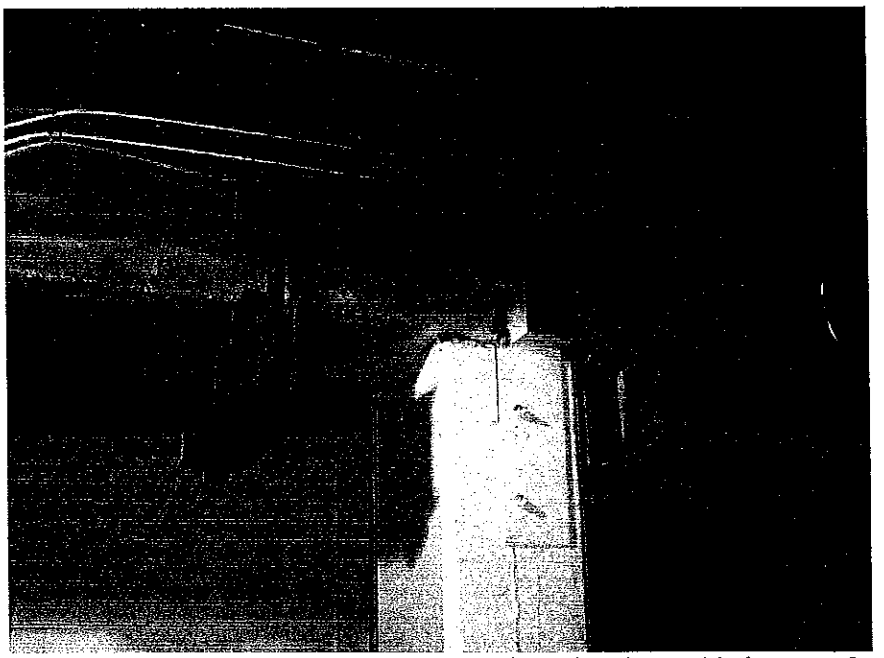

Photo 10. Beam/column saddle repair from level 3. This is one of two such repairs. Both are in good condition.

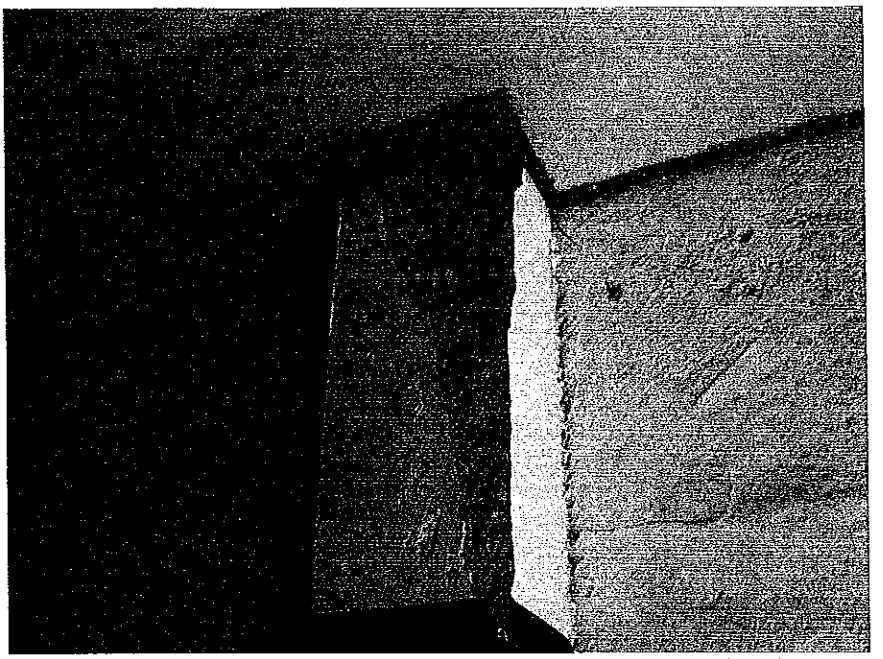

Photo 11. Spalled pilaster near A/30 in elevator loby of level 3. There is no structural issue here; the pilaster may be patched and painted to match for appearance.

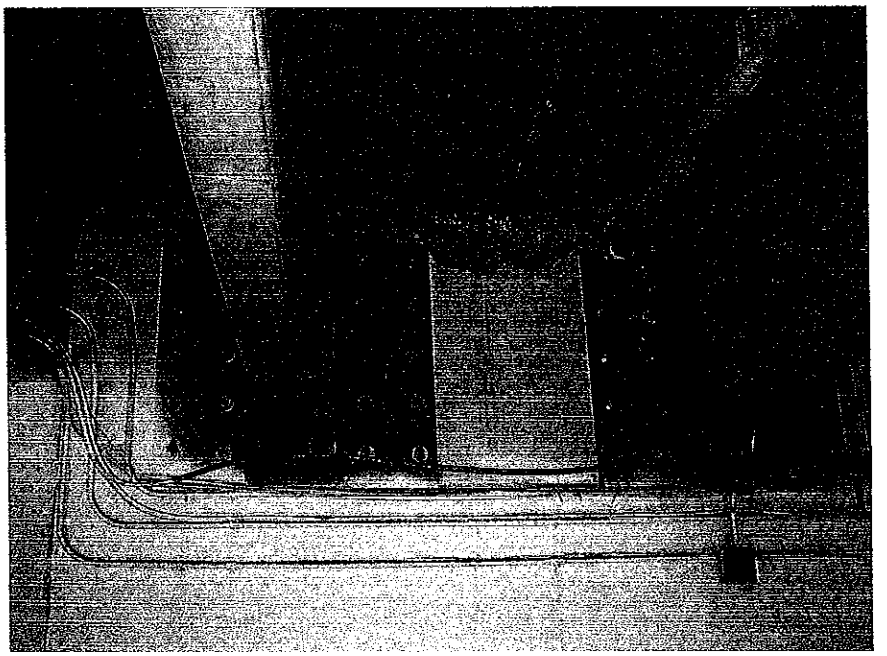

Photo 12. The condition of supplementary tee saddles is good.

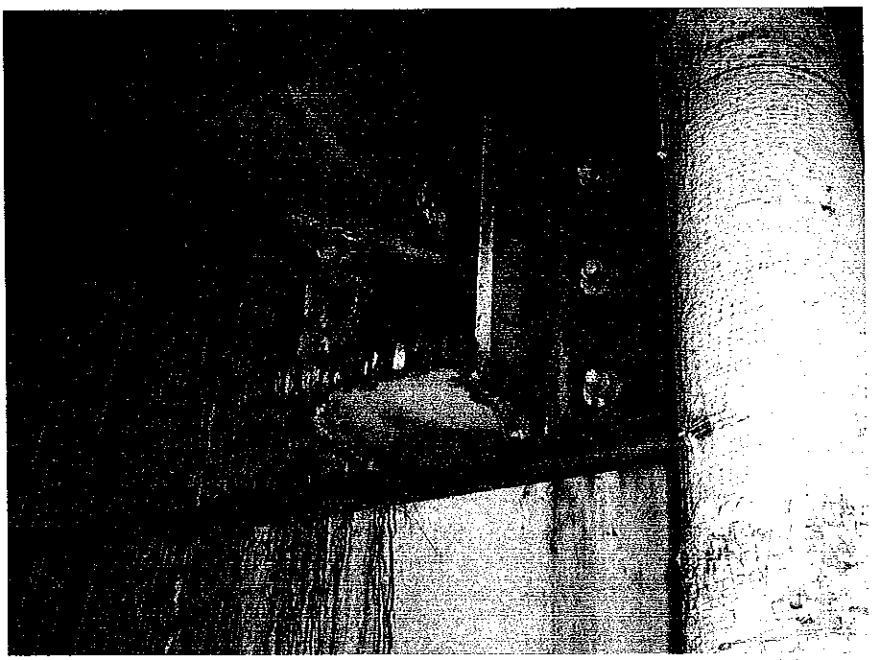

Photo 13. Tee stem has "walked" off its bearing location inside ventilation enclosure near C/30. This is typical of two. Both should be reset.

Photo 14. Connection of railing post to concrete wall is deteriorated. This is a typical condition along C from 20 to 30. The connection should be repaired.

Photo 15. Sliding devices at underside of expansion joint in original building. They are slightly rusted, but functional.

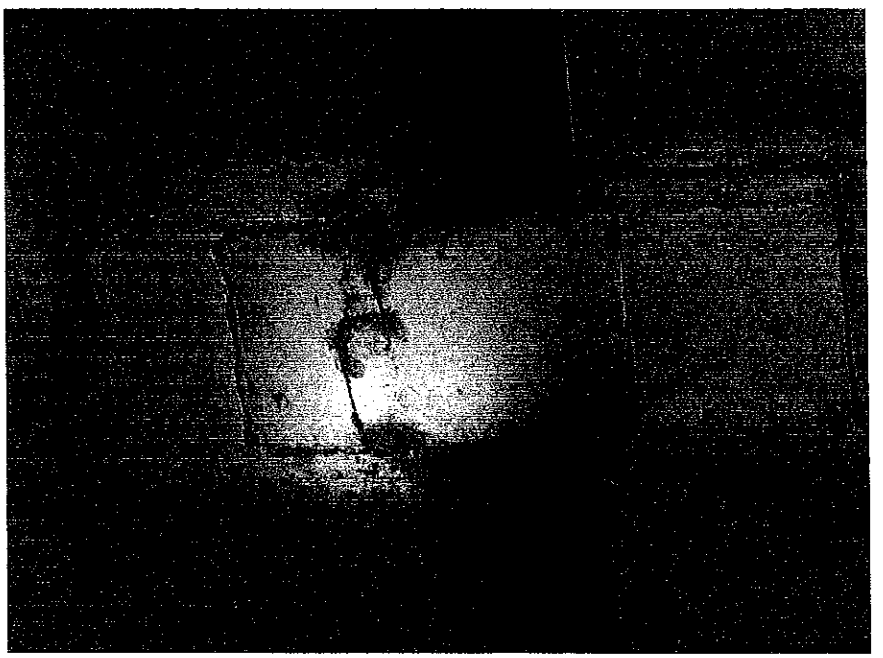

Photo 16. Sliding plate expansion joint device at expansion joint in the addition near grid 34. The plate is bent and cracked.

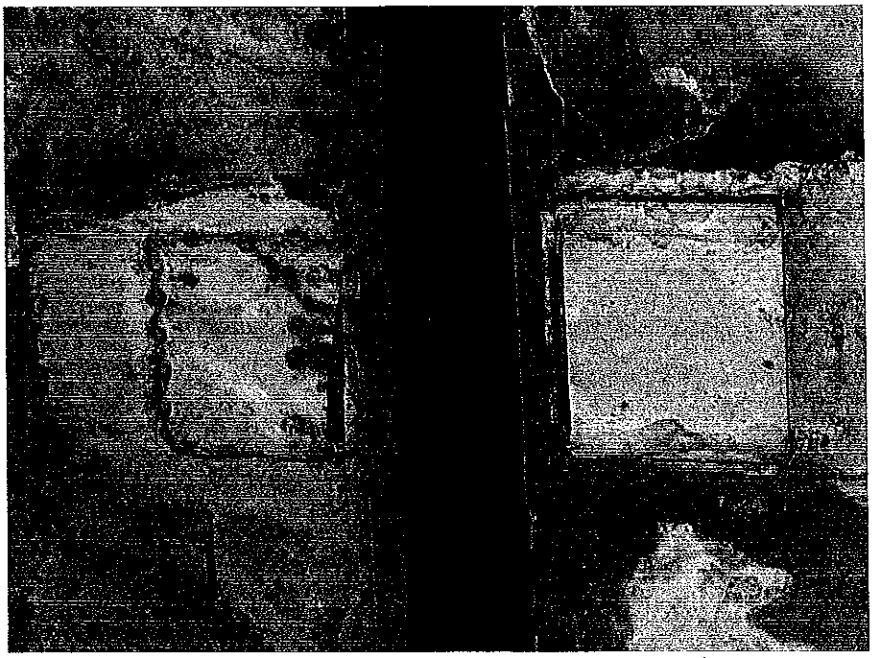

Photo 17. Photo 16. Sliding plate expansion joint device at expansion joint in the addition near grid 34. The plate is broken.