POST-TENSION INVESTIGATION AND 5 YEAR PLAN – JURAVINSKI CONCESSION GARAGE

HAMILTON HEALTH SCIENCES

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WALTERFEDY

HAMILTON HEALTH SCIENCES
POST-TENSION INVESTIGATION AND 5 YEAR PLAN
Juravinski Concession Garage

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EXECUTIVE SUMMARY

Hamilton Health Sciences (HHS) engaged WalterFedy to complete a condition assessment of the post-tensioning (PT) system at the Juravinski Concession Parking Garage. The purpose of this assessment was to develop recommendations for future post-tension testing and maintenance planning. This assessment builds on previous PT investigations completed in 2020 and 2024, which have not identified any tendon failures to date. Objectives of this review included identifying potential deterioration mechanisms affecting the PT system and to re-prioritize repair items in the current 5 year repair plan should that be necessary.

A visual review was carried out on November 14, 2025, following rainfall to help observe active water leakage. The assessment included a review of architectural and structural record drawings, past condition reports, and PT test results; a walkthrough of all garage levels; and an examination was performed of stressing pockets, test ports, waterproofing membranes, slab edges, beams, and expansion joints.

Overall, the post-tensioning system appears to be in fair condition, with no significant indicators of active deterioration. Stressing pockets visible at the roof level showed no signs of leakage, PT coating stains, or other signs of deterioration. Hairline longitudinal cracking at beams was observed; however, no flexural cracking patterns were noted nor any corrosion stains or delaminated concrete.

One roof-level expansion joint showed active water infiltration, resulting in saturation of the adjacent concrete beams. Deterioration of the traffic coating and expansion joint gland at this joint introduce the potential for these PT beams to deteriorate. Prolonged moisture exposure at beams represents a greater concern than slabs because deterioration in bonded systems can be significantly more complex and costly to repair.

Record drawings indicate that slab tendons utilize an encapsulated system, likely including epoxy-coated anchor hardware and a watertight plastic sleeves to the plastic sheathing. This detailing increases resilience to water infiltration. However, the system remains susceptible at locations where this detailing was not installed correctly, where restoration activities have disturbed components, and/or where the watertight plastic sleeve seal has deteriorated over time. Therefore ongoing maintenance to traffic coatings, expansion joints, and slab edges is essential to preserve the fair condition of the post-tensioning for a parking garage of this age.

Based on these findings, no immediate PT-related action is recommended. However, ongoing monitoring and PT testing are recommended to ensure the fair condition of the post-tensioning is maintained. A three-year evaluation cycle is recommended for a garage of this age, including screwdriver testing of slab tendons at representative locations and within areas of historic/active leakage, as well as exposing bonded beam tendons at targeted roof-level locations where saturation has been observed. A five-year post-tension testing plan has been developed to support budgeting and planning, with anticipated costs presented in Appendix B.

In addition, preventative maintenance items are recommended to be added to the current repair cycle: replacing the leaking roof-level expansion joint and adjacent membrane tie-ins, replacing the membrane-based expansion joint around the stair and elevator core with a more robust compression- or gland-type system, repairing deteriorated waterproofing at perimeter curbs where damaged, and applying protective coating at exposed stressing pockets at the roof level.

In summary, the garage's PT system is performing fairly for its age, with localized areas of moisture-related concern. Continued monitoring, targeted testing, and maintenance of critical waterproofing details will help preserve the long-term durability and serviceability of the post-tensioning system and mitigate the risk of sudden repair costs.

1.0 INTRODUCTION AND BACKGROUND

WalterFedy was engaged by Hamilton Health Services (herein 'HHS') to perform a condition assessment of the parking garage at 724 Concession St., Hamilton, ON, specific to the preservation of its post-tensioning system, and to provide recommendations for ongoing investigation associated with the post-tensioning in this parking garage.

It is our understanding that post-tension testing has previously been undertaken by Vector Corrosion Technologies in collaboration with Atkinson Engineering in 2024 and 2020 at the above noted property. To date, no issues with the post-tensioning have been found to our knowledge.

2.0 SCOPE OF SERVICES AND METHODOLOGY

2.1 Scope

The Scope of Services performed under this assessment are as follows:

1. Review condition assessment reports by Atkinson Engineering (2013 & 2022), post-tension testing reports by Vector Corrosion Technologies (2020 & 2024), and review architectural and structural record drawings for the existing parking garage.
2. Attend one (1) site visit on a rainy day to observe and document areas of leaking water.
3. Attend one (1) meeting with HHS (virtually) to review preliminary recommendations for additional post-tension investigation, including budget pricing based on Vector's quotation dated December 12, 2024.
4. Prepare a sealed letter that will include the following:
    a. An opinion on potential deterioration mechanisms observed resulting from leaking water that may affect the post-tensioning, if any. We will comment on specific items regarding the existing moisture protection system, such as waterproofing and expansion joints.
    b. Recommendations for future post-tension investigations will be provided, including high-level scope and frequency over a 5-year period (2026-2031). This will include budget pricing per year that testing is recommended, which will outline costs for testing by Vector or similar contractor, consulting costs, and emergency analysis costs assuming broken tendons are discovered.
    c. Recommendations for re-prioritizing repair items or funds under the current 5 year maintenance plan for this parking garage. Additional repair items will be recommended to be added to this plan, should these not currently be included.

2.2 Methodology

Mr. Ryan Schultz, P.Eng., and Mr. Mankirat Singh Sains, attended the property on November 14, 2025 to carry out a visual review of the moisture protection system and structural components of the parking garage. Each level was walked and visually examined from both above and below following a minor rain to identify potential deterioration mechanisms from leaking water that may affect the post-tensioning. The condition of existing moisture protection system was reviewed in general with a focus on essential details that are relevant to protection of the post-tensioning.

WalterFedy's review included the following:

1. Review foundation walls below slab edges to identify areas with leaking water.
2. Review slab edges and expansion joints to identify areas with leaking water.
3. Review locations of cracks within the slabs.
4. Review visible stressing pockets, to identify cracking and disintegration.
5. Establish any areas showing post tensioning (PT) coating stains through test ports, cracks and joints.
6. Review areas of possible tendon eruption through stressing pockets and test ports.
7. Identify longitudinal cracks or spalling at bottom of beams near mid span
8. Review any flexural cracks on the beams
9. Identify location of previous repairs to beams and slabs.

2.3 Limitations of Assessment

Visual assessment of the garage was typically obstructed by a large volume of parked vehicles at the interior of the garage and around the perimeter, and therefore minor localized issues associated with the slabs on the parking surface could have been overlooked. A comprehensive review of the stressing pockets was not possible as most are obstructed by cladding and between beams within expansion joints, and therefore some minor staining could have been overlooked. Although some limitations did exist with the review performed, in our opinion they do not fundamentally affect the findings and recommendations provided herein.

3.0 INVESTIGATION

3.1 Review of Record Drawings and Condition Assessment Reports

The following documentation was provided to WalterFedy by HHS, and reviewed for the purposes of our assessment:

Drawings and specifications:

a) A complete set of Issued for Tender drawings issued on November 5, 1991 drawn and issued by Parker Consultants.

Reports:

a) Conditional survey report for Concession Street Parking Structure (November 25, 2013) by Atkinson Engineering Inc.
b) Conditional survey report for Concession Street Parking Structure (July 14, 2022) by Atkinson Engineering Inc.
c) HHS PT Inspection letter (May 13, 2020) by Vector Corrosion Technologies Ltd.
d) HHS PT Inspection letter (October 31, 2024) by Vector Corrosion Technologies Ltd.

3.2 Site Observations

The following summarises our observations made while on site. A plan has been provided in Appendix A illustrating the approximate location of the observations discussed.

3.2.1 Stressing Pockets

Stressing pockets were visible only at the top level of the parking garage. All other areas were not visible due to the masonry cladding on the perimeter and structures concealing them. The stressing pockets observed showed no signs of leakage, PT coating stains, or other signs of deterioration. (See Photo 1) Signs of early stage efflorescence around pockets at both sides of the garage roof were observed. The stressing pockets were typically observed with shrinkage cracks around the cold joint to the parent concrete.

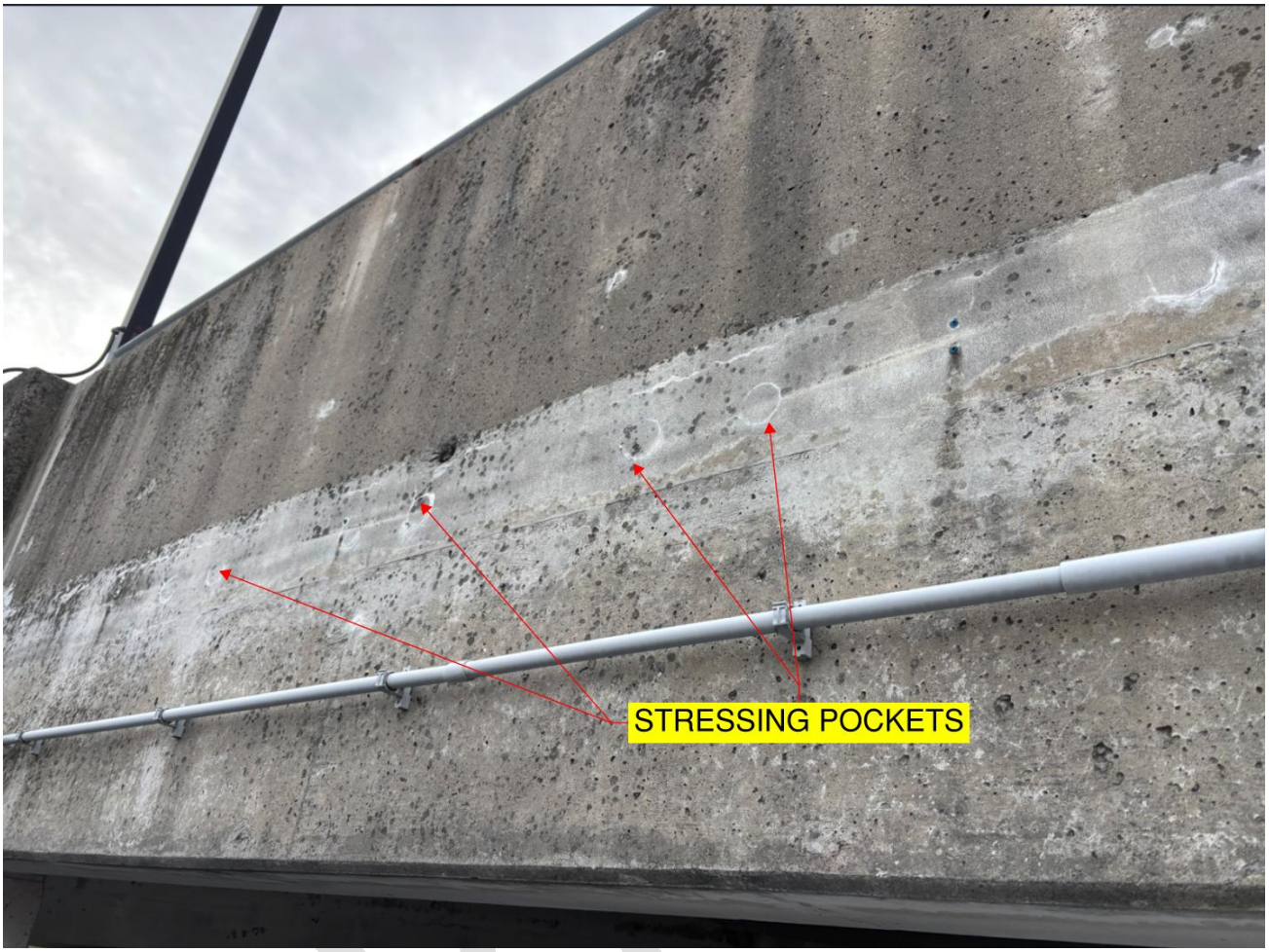


Photo 1: Stressing Pockets at Roof Deck

3.2.2 Test ports

Test ports were observed on slabs and beams at each level. Specific test ports that were reviewed in 2024 had information regarding the test results which all indicated the tendons were in good condition. The Appendix A provided shows exact locations of the test ports observed on the different levels (See Photo 2 and 3). Test ports were typically located at end parking bays. There were few test ports at the interior of the parking garage.

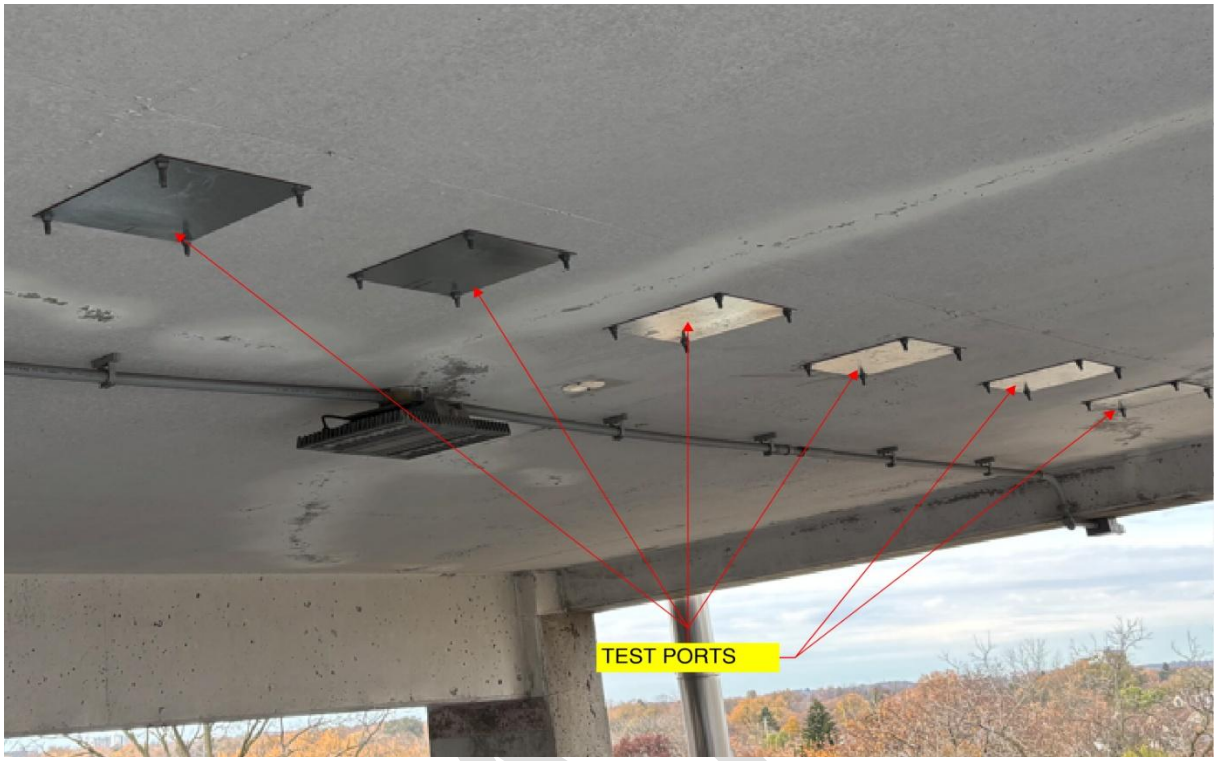


Photo 2: Test ports on underside of slab

P

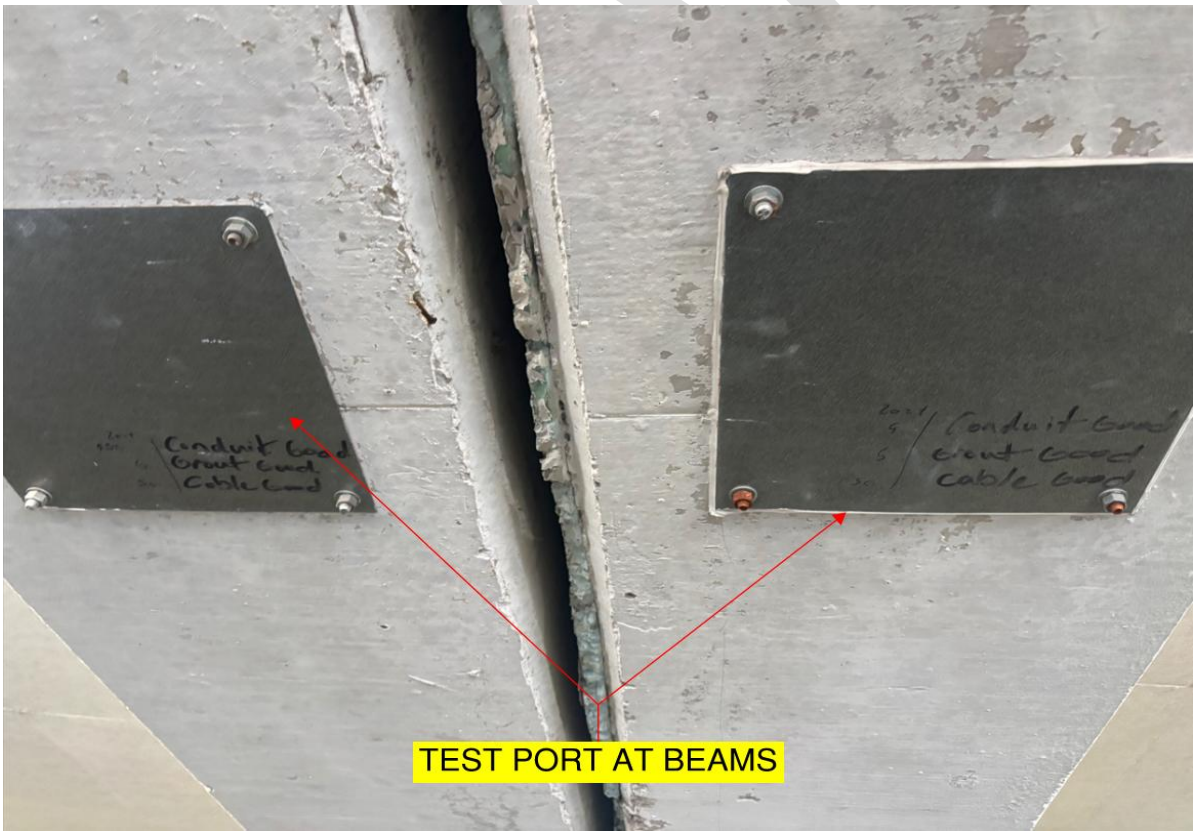


Photo 3: Test ports on underside of beam

3.2.3 Expansion Joints

One expansion joint and the traffic coating adjacent at the roof deck showed signs of cracking and deterioration (See Photo 4). This expansion joint when observed from level 5 below shows dampness saturating the concrete beams on either side of the expansion joint (See Photo 5). This area was displaying signs of active water leakage during the time of review. The other expansion joints, did not show any dampness or leaking water below. Many beams at expansion joints were observed at all levels with narrow longitudinal cracks centred about the width of the beam. These cracks were typically located at the mid-span of the beam. No beams were observed with flexural cracking patterns.

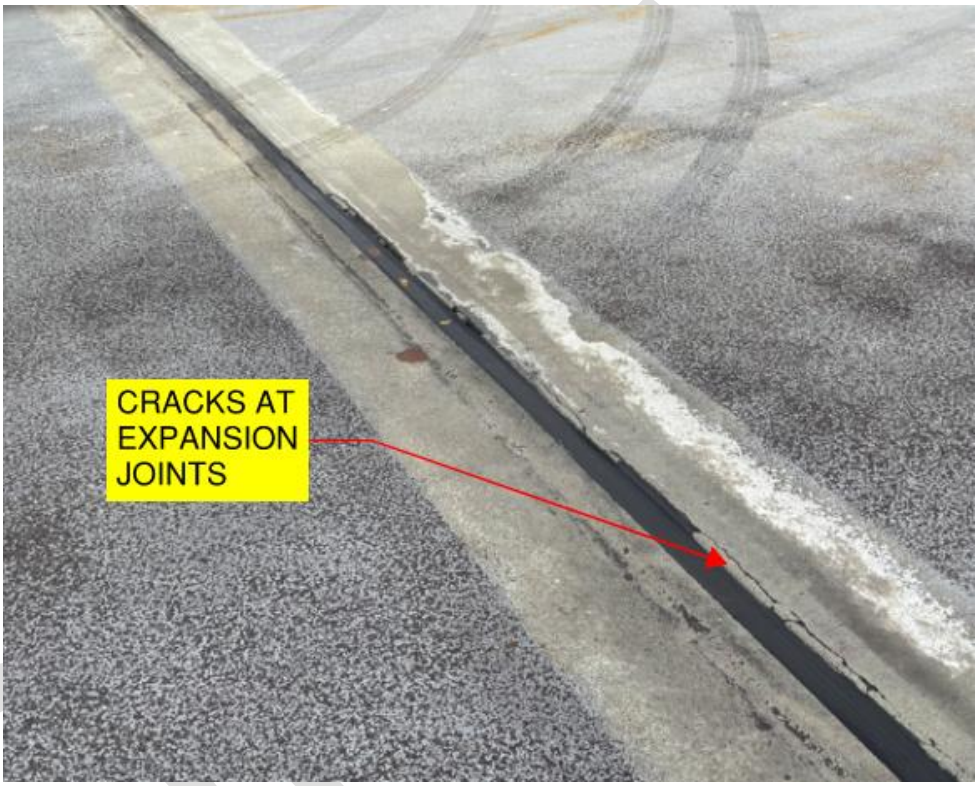


Photo 4: Expansion joint with cracks

Photo 5: Beams at leaking roof expansion joint

The concrete expansion joint around the Stair #1 and elevator on the north side of the parking garage at the roof level was observed with a concrete bulkhead below, which appeared to be the result of a leaking expansion joint. This expansion joint is detailed with a curb that is continuously waterproofed with an upturn. The joint is sealed with what appeared to a caulked joint covered with waterproofing.

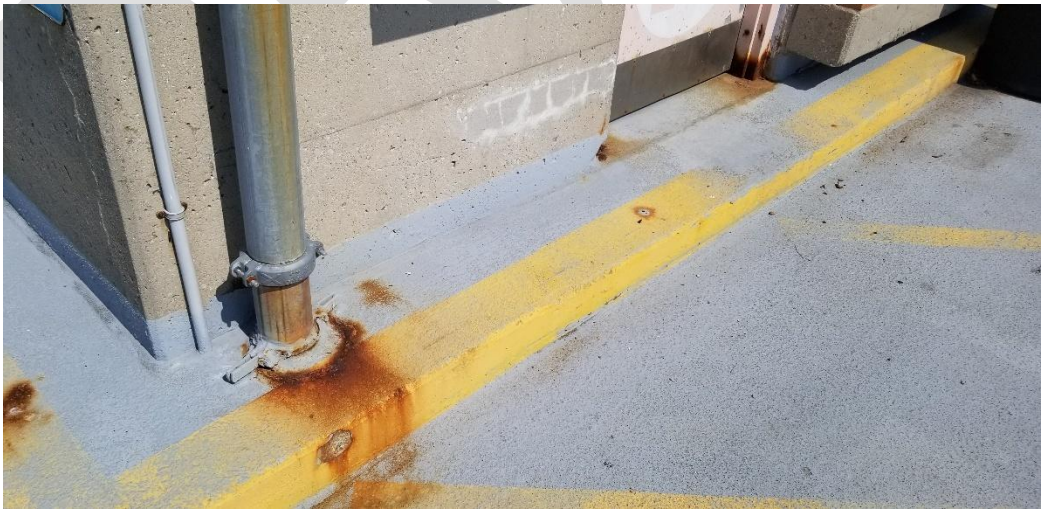


Photo 6: Expansion joint at Stair #1 and Elevator

3.2.4 Interior Concrete Beams

Numerous concrete beams not located at expansion joints were observed with hairline longitudinal cracking. These cracks were typically located at the mid-span of the beam (See Photo 7). No beams were observed with flexural cracking patterns.

Photo 7: Typical longitudinal beam crack

3.2.5 Waterproofing Membrane

The waterproofing membrane at the roof deck appeared to be a polyurethane-based product, except adjacent to expansion joints a more brittle epoxy type material was observed that did not appear to contain waterproofing. The membrane was found to be significantly deteriorated at the drive aisle. The membrane was detailed on the perimeter concrete curb around the parking deck with an upturn (See Photo 8).

Photo 8: Water proofing membrane extending to parapet.

4.0 FINDINGS

The post-tensioning technology in the slabs is fundamentally different than the technology in the beams. The slab strands are “unbonded” from the concrete, while the beam tendons are bonded to the concrete. When water enters unbonded slab strands and ultimately corrodes them to the point they break, the broken strand reduces the load-carrying capacity of the slab for the entire length of the strand which may be up to 160ft long in this parking garage. This means that a localized area of water infiltration can have a significant impact. Since the beam tendon is bonded, corrosion to the tendon affects only the area that has corroded and not the beam for its entire length.

Although the unbonded condition in the slab can have a large impact when breaks occur, repairs are relatively simple and straightforward by removing and replacing the strands, although this is costly. When beams begin to corrode, repairs are not as straight forward because the PT tendons cannot be removed. This means that beam repairs can be an order of magnitude more costly than slabs, therefore special attention should be paid to the beams to prevent them from deteriorating. The anticipated repair methods for deteriorated post-tension beams may involve carbon fibre reinforcement or external post-tensioning reinforcement.

Our review on site did not find any substantial indications that corrosion is actively deteriorating the post-tensioning in this parking garage. Based on our review of the record drawings, the unbonded slab tendons utilize an encapsulated system which likely includes epoxy coated anchor hardware and a plastic sleeve that provides a watertight seal between the tendons sheath and its anchor as shown in Figure 1 below at expansion joints and in Figure 2 at typical slab edge locations. This means that any water that penetrates slab edges and expansion joints cannot enter the sheathing as easily as it does with older PT systems. Water is mostly likely to enter areas that were not constructed properly or that are damaged via restoration works by contractors and trades not experienced with post-tension construction, or where the encapsulation has deteriorated over time. Given that no broken tendons have been discovered to date, its likely the encapsulated tendons have provided sufficient protection in spite of any leaks that exist or have historically existing. This can change if the moisture protection at the roof deck in particular is not maintained as the encapsulation of the strands deteriorates over time.

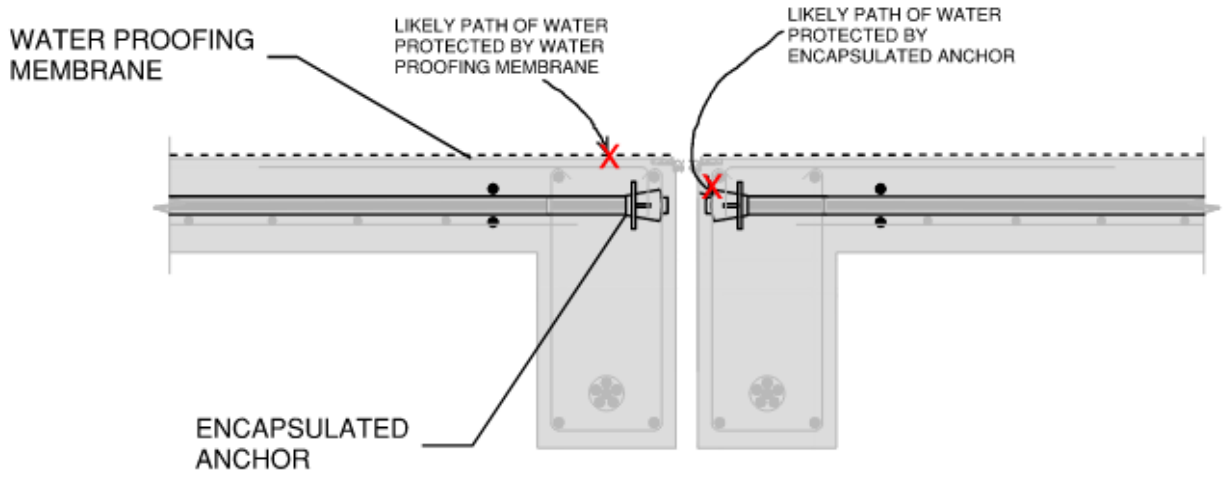


Figure 1: Water Infiltration Protection Mechanism at Expansion Joints.

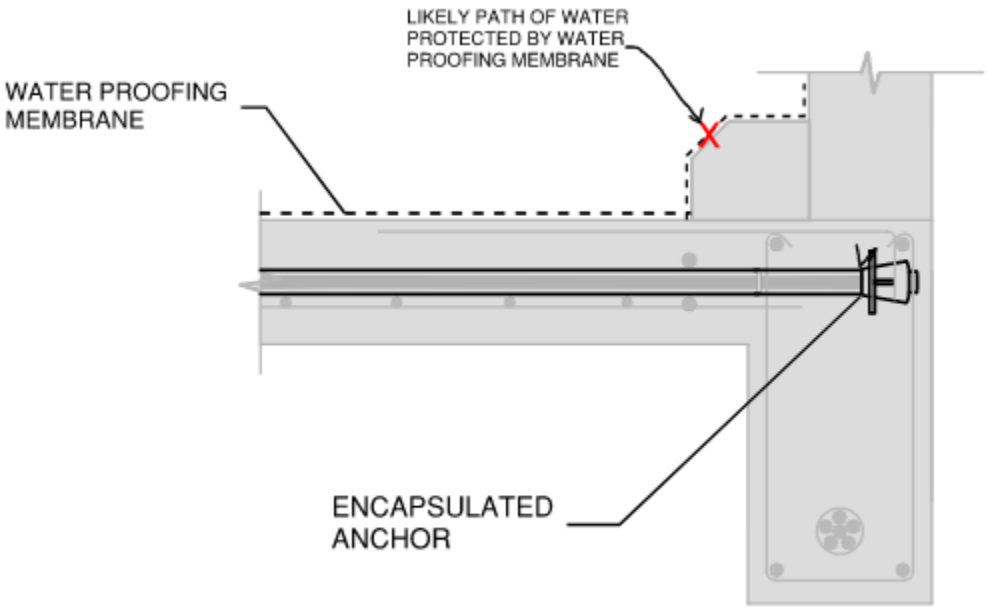


Figure 2: Water Infiltration Protection Mechanism at Slab Edges.

The leaking expansion joints at the roof deck has saturated the concrete beams below on either side. Although this leak did not appear to be penetrate the unbonded tendons in the slab, its likely to be saturating the bonded post-tensioning in the beams and/or its corrugated metal duct. If this leak is not addressed, in our opinion it's likely that the bonded tendon in the beam will be corroded and lose strength over time. Its also possible that water may migrate into the encapsulated tendons in the slab over time.

RECOMMENDATIONS

4.1.1 Ongoing Post-Tension Testing

Based on our findings, the post-tensioning in this garage appeared to be in fair condition. One area was observed that could be deteriorating, which is the saturated beams at the leaking roof deck expansion joint.

In our experience, the encapsulated detailing for unbonded post-tensioning in the parking garage slabs is often successful in reducing the frequency that the post-tensioning breaks when exposed to leaking water. With this in mind, the technology used in this parking garage is not perfect and can leak. This is most notably in areas where the work was not installed properly, where restoration efforts cause damage, or in areas that the watertight seal deteriorates over time. The industry has continued to develop since this garage was built to further improve hardware in recent decades that improves the durability and longevity of the post-tensioning.

In our opinion, a parking garage of this age should be evaluated by a professional experienced with maintenance and repair of post-tension parking garages every 3 years. The scope of the evaluation should include:

- Detailed review of the moisture protection systems at the roof deck
- Cursory review of the moisture protection systems at the covered levels to identify areas of actively leaking water
- Screwdriver testing of the unbonded post-tensioning at the roof deck in a random sampling of areas and at areas of known historic leaks and/or active leaks.
- Screwdriver testing of the unbonded post-tensioning at the roof deck in a random sampling of areas throughout the covered levels.
- Exposing bonded beam tendons at the roof deck in areas of known historic leaks and/or active leaks.

Enclosed in Appendix B is an opinion of probable testing costs over a five-year period between 2026-2030 accounting for post-tension inspection and testing costs, which includes consulting costs for oversight of this testing. These figures should be treated as “ballpark” in 2025 dollars and cannot be guaranteed to be accurate. We have not accounted for post-tension repair costs in these values. We have assumed that the 5 year repair program will remedy leaks in the moisture protection system and prevent any deterioration to the post-tensioning.

4.1.2 Proposed Revised 5 Year Repair Program

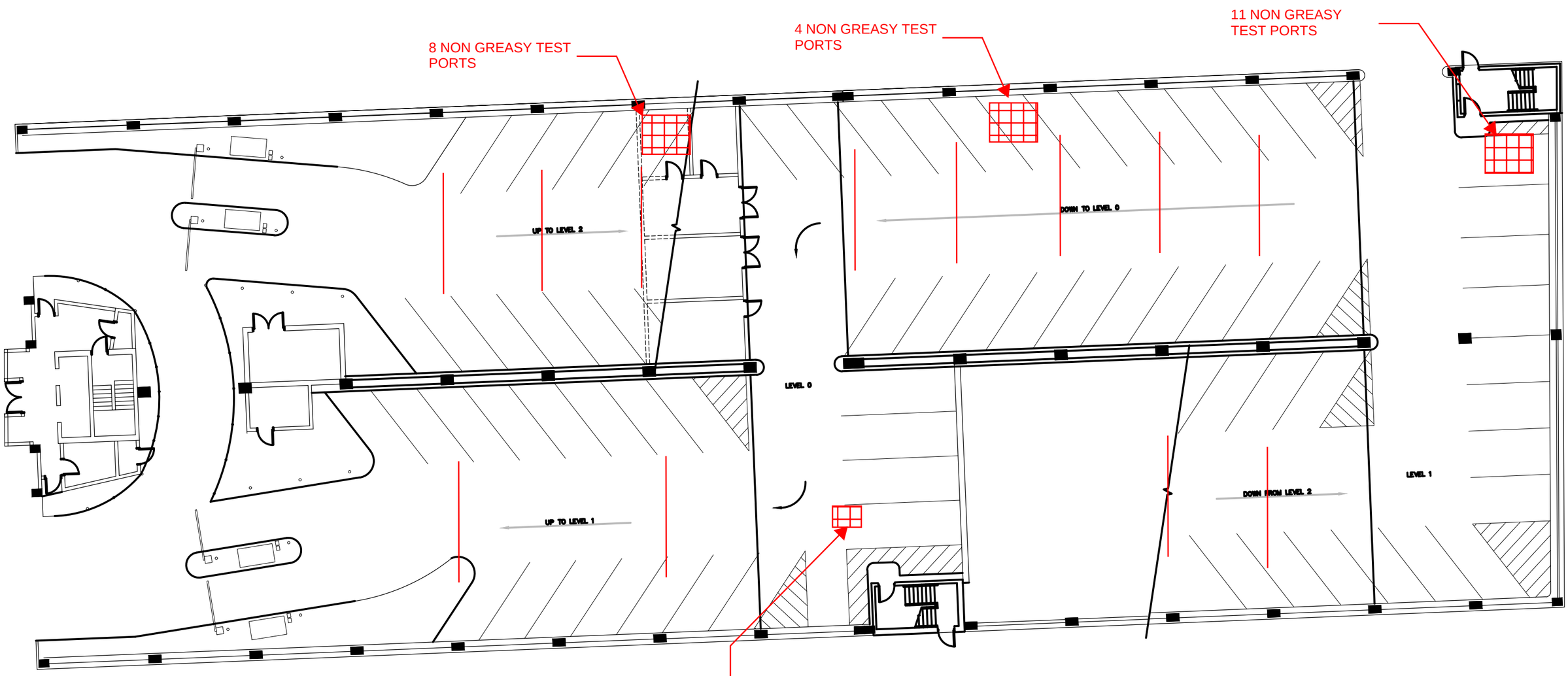
To our knowledge according to the 2022 Atkinson Engineering report, 2026 will be year 4 of the current 5 year repair program. Given the timing of submission of this report, we recommend the following preventative maintenance items be added to work performed in 2027:

- Replace leaking traffic deck expansion joint at roof deck, complete with polyurethane waterproofing tie-in to existing membrane (Do not use epoxy traffic coating).
- Replace leaking membrane-based expansion joint around stair/elevator cores. The current membrane joint is more susceptible to leaks than a compression foam expansion joint or rubberized gland joint. We recommend one of these two systems in this application.
- Repair damaged waterproofing at perimeter concrete curb.
- Provide waterproof coating over exposed stressing pockets around roof deck.

APPENDIX A

Field Sheets

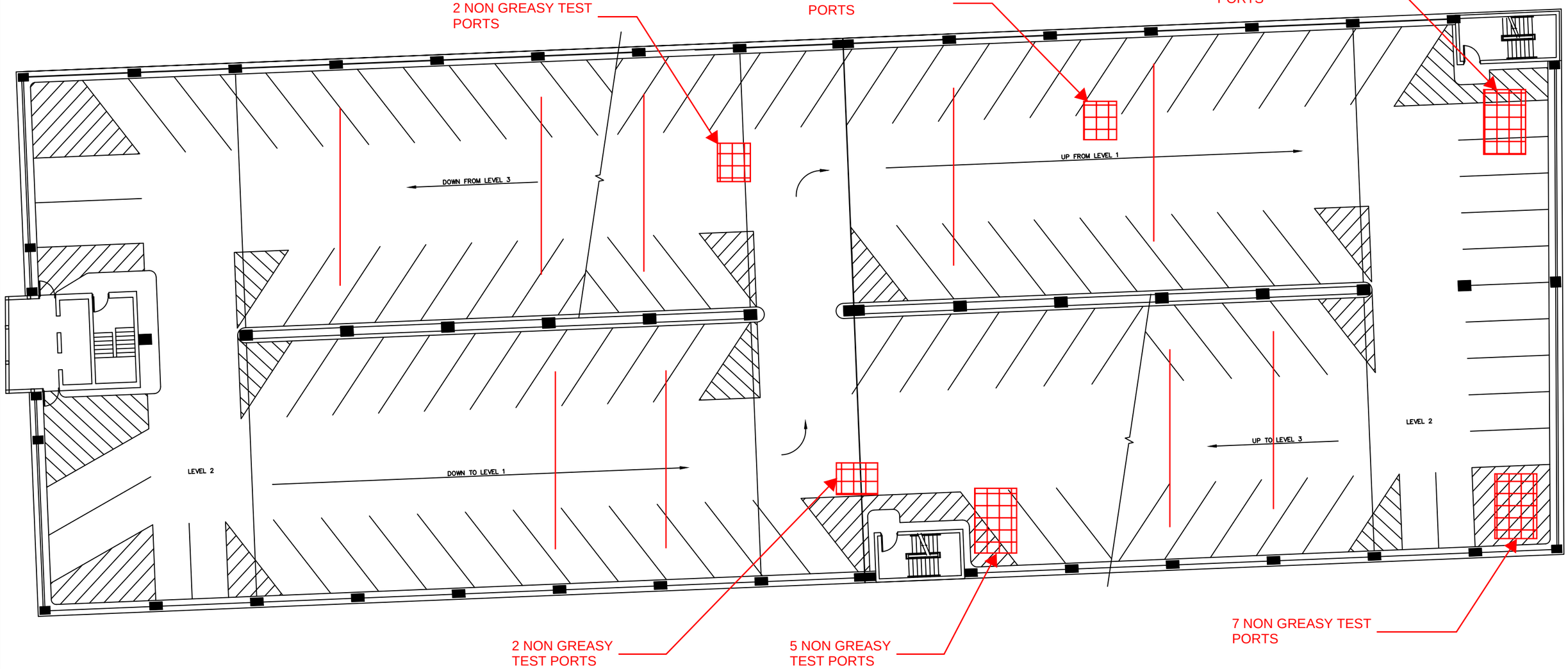
LEVEL 1



LEGEND

HAIRLINE CRACK IN BEAM ABOVE

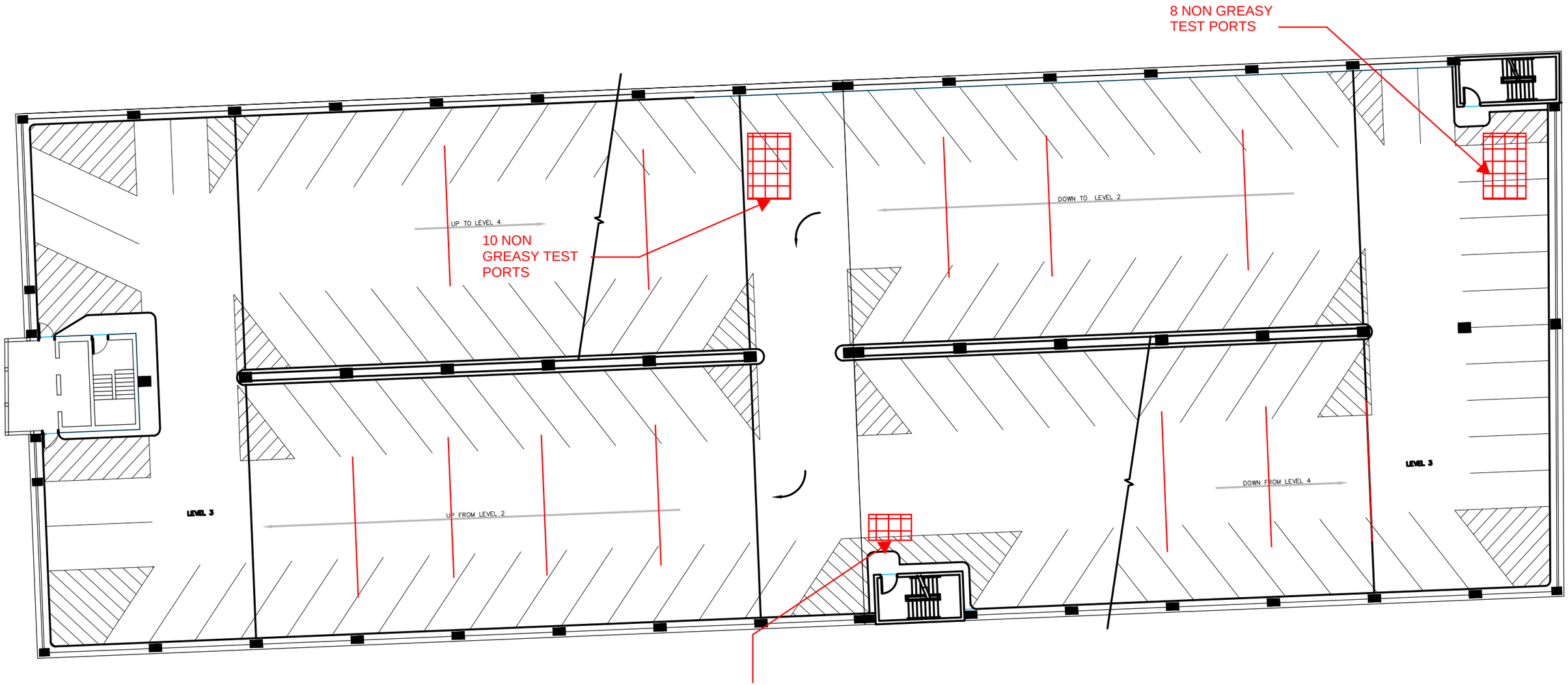
LEVEL 2



LEGEND

HAIRLINE CRACK IN BEAM ABOVE

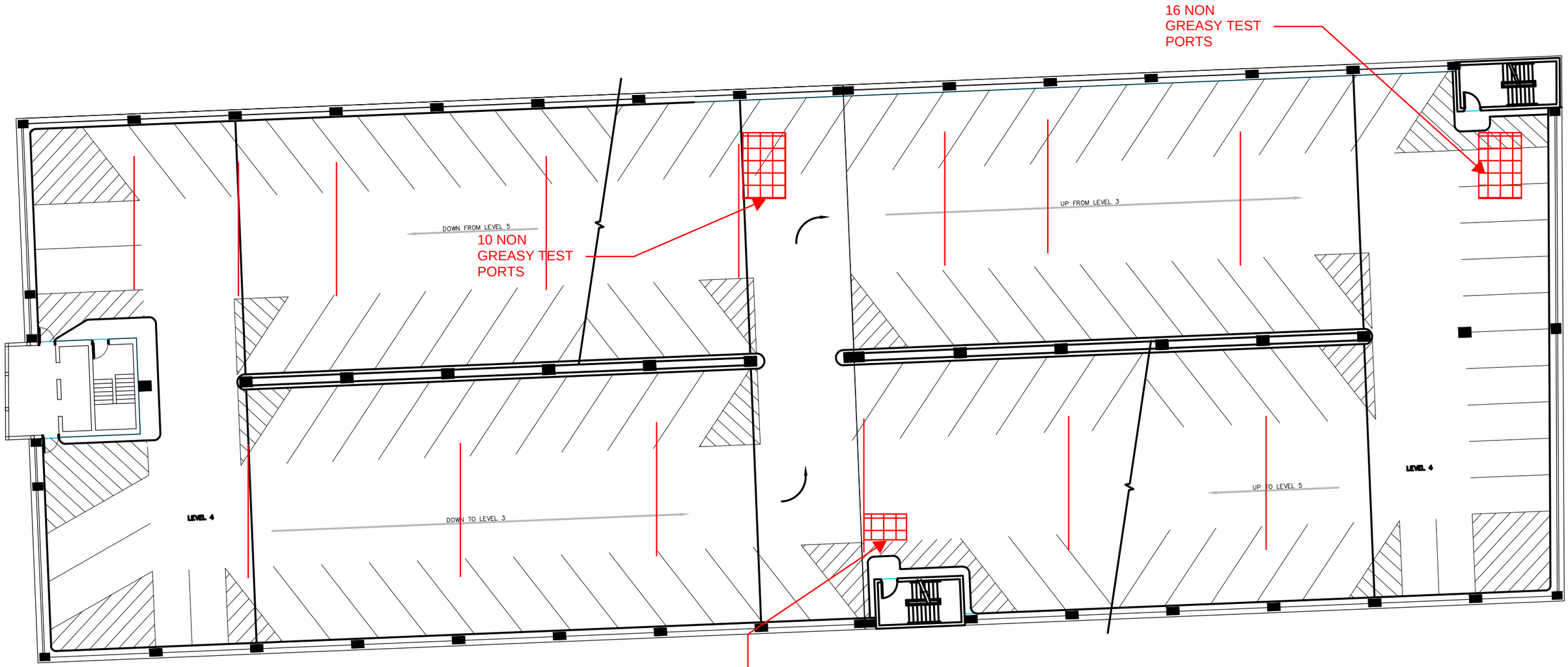
LEVEL 3



LEGEND

HAIRLINE CRACK IN BEAM ABOVE

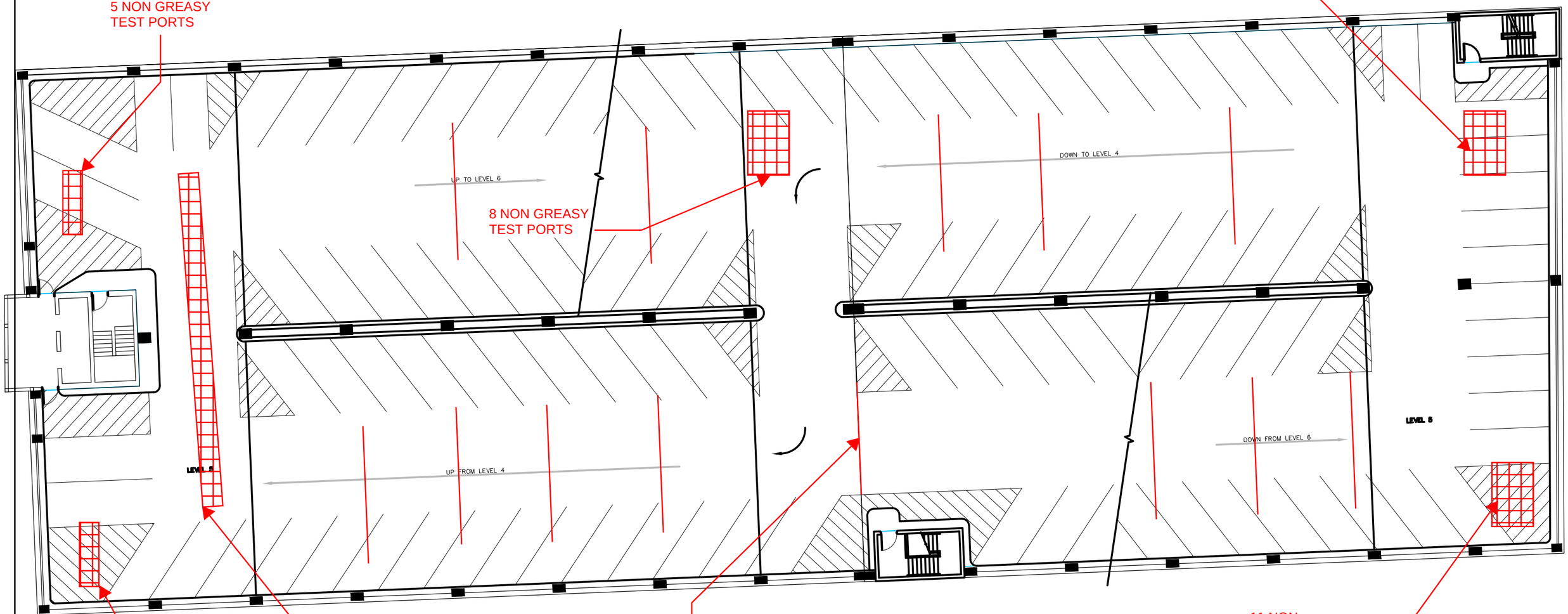
LEVEL 4



LEGEND

HAIRLINE CRACK IN BEAM ABOVE

LEVEL 5



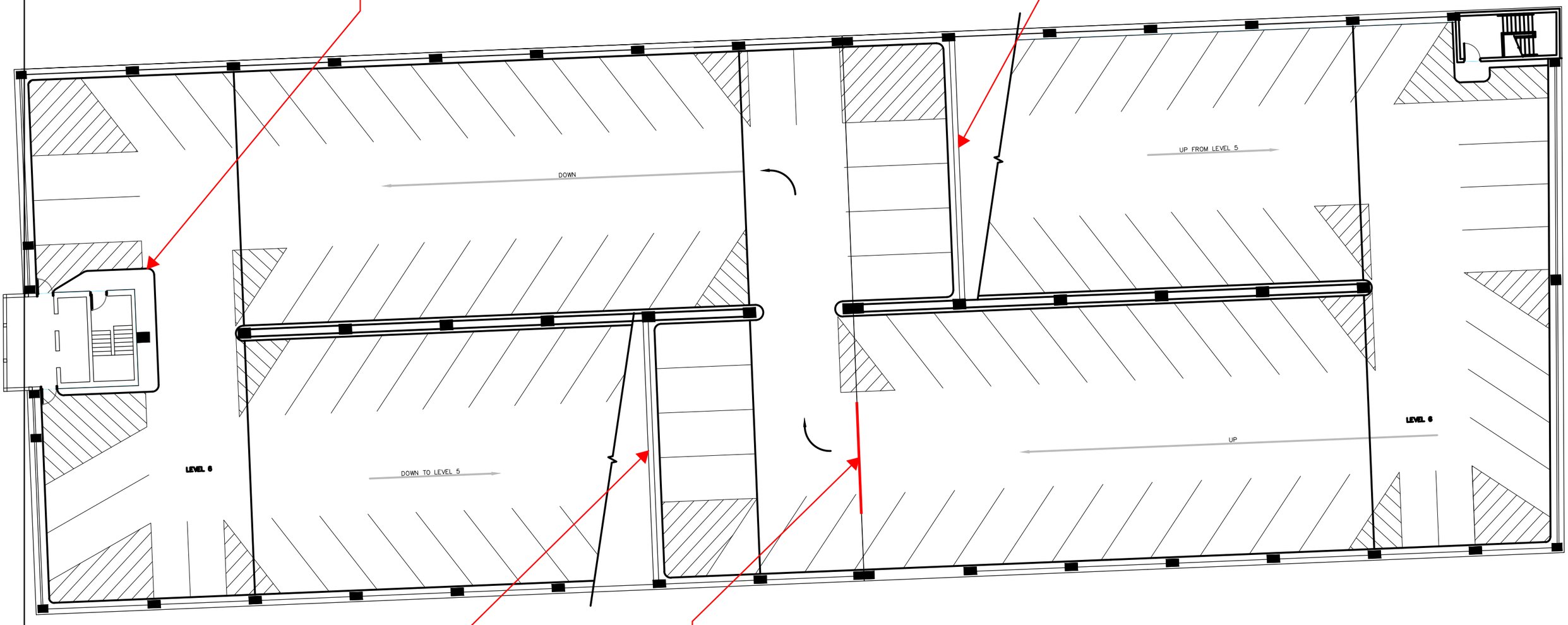
LEGEND

HAIRLINE CRACK IN BEAM ABOVE

LEVEL 6

EXPANSION JOINT AT STAIR WALL
SEALED WITH CAULKED JOINT

STRESSING POCKETS
SHOWING EARLY SIGNS OF
EFFLORESCENCE



STRESSING POCKETS
SHOWING EARLY SIGNS OF
EFFLORESCENCE

CRACKS AT EXPANSION
JOINT

APPENDIX B

5-Year Post-Tension Testing Plan

Hamilton Health Sciences Juravinski Concession Parking Garage - Five Year Post-Tension Testing Plan

Item No.	Location	Description of Post-Tension Testing, Repairs, Analysis, and/or Consultants Costs	Year of Implementation				
			Year 1 (2026)	Year 2 (2027)	Year 3 (2028)	Year 4 (2029)	Year 5 (2030)
1	Roof Deck (Level 6)	Screwdriver Penetration Testing (Slab Tendons)	$0.00	$7,000.00	$0.00	$0.00	$7,000.00
		Visual Observation of PT Beam Tendons	$0.00	$2,500.00	$0.00	$0.00	$2,500.00
2	Lower Levels	Screwdriver Penetration Testing (Slab Tendons)	$0.00	$8,000.00	$0.00	$0.00	$8,000.00
		Visual Observation of PT Beam Tendons	$0.00	$0.00	$0.00	$0.00	$0.00
3	All Levels	Consulting Costs for Testing (Assumes HHS Carries Testing Agency Directly)	$0.00	$4,000.00	$0.00	$0.00	$4,000.00
		SUBTOTAL =	$0.00	$21,500.00	$0.00	$0.00	21,500.00
		Contingency (Assume 10% of Subtotal) =	$0.00	$2,150.00	$0.00	$0.00	$2,150.00
		HST (Assume 13% of Subtotal + Contingency) =	$0.00	$3,074.50	$0.00	$0.00	$3,074.50
		Total Annual Budget =	**$0.00**	**$ 26,724.50**	**$0.00**	**$0.00**	**$26,724.50**