PHASE I AND II PARKING STRUCTURE CONDITION SURVEY

COMMENTS
PARKING STRUCTURE CONDITION SURVEY
PRE-FINAL SUBMITTAL COMMENTS

Comments from Kirk Yuen, UH FMO Design Section
5/19/11

1) ARCHITECTURAL 4.4.B (Page 10) says the vertical and horizontal expansion joints should be modified to bring them into alignment. Question: How do we do that? Break concrete and repour?

2) ARCHITECTURAL 4.7.A (Page 17) Recommends UH to review with Building Department the conflict between code sections: When doors are revised to swing into Phase I stairwells at levels 2 thru 5 to comply with one code section, another code section will be violated because the door swing will reduce the width of the landing by more than 50%. Question: Assuming that the Building Department requires us to satisfy the building code without any exceptions or compromise, what would be the simplest solution to satisfy both code sections and make us code-compliant?

3) ARCHITECTURAL 4.7.E (Page 18) Recommends UH to review with Building Department the conflict between code sections: Phase I electrical room needs ventilation for transformer, which is provided by louvers, but the building code also calls for the wall and openings in the room to be 3-hour rated. Question: Assuming that the Building Department requires us to satisfy the building code without any exceptions or compromise, what would be the simplest solution to satisfy both code sections and make us code-compliant?

4) ARCHITECTURAL 4.11.C (Page 22) recommendations say to install new guardrail. Should it say install new handrail?

5) ARCHITECTURAL 4.14.A (Page 23) says the existing stair guardrails are not compliant to the current building code, but that they are not required to comply with the current code if they were installed in accordance with the code in effect at the time of construction. Question: Does this statement also pertain to the existing handrails at the stairs?

6) ARCHITECTURAL – Photograph captions for the bottom photo on each page often appear on the next page. Ex: Page 34 has caption of Photo A14 shown at the top of the page. This happens also on pages 39, 47, 52, 55, 57, 61, 63, 64, 66, 68, 69, 71, 74, 76, 79, 80, 82, 85 and 87. Please fix. Maybe its only a matter of backspacing.

7) STRUCTURAL 5.2.A (Page 91) says repairs can be programmed to be made over the next 5 years. Does this mean that this particular repair should be completed no later than 5 years from now?
8) FIRE PROTECTION – Photograph captions for the two bottom photos on page 156 need to be corrected. Photograph captions for the two tcp photos on page 167 need to be corrected.

No Mechanical Comments

Comments from Dennis Kamite, UH FMO Utilities
5/19/11

1) ELECTRICAL 8.1 (Page 184)
   Item No. 3 – Emergency power system, which is located in the Phase II portion of the Parking Structure. Question: Was Generator / ATS system tested to see if operating properly? Many of our systems on campus are not operable due to lack of maintenance.

2) ELECTRICAL 8.1 (Page 184)
   Item No. 5 – Emergency lighting units. Question: Were units tested to see if operational? Need to indicate so. In many of our buildings emergency units are inoperable and need replacement.

3) ELECTRICAL 8.4.B (Page 186)
   Reference 4th paragraph – UHM requested that a generator be provided to provide standby power for some of the lights in the structure to allow people and vehicles to exit the parking structure if there is a normal power outage to the Stan Sheriff Center, Athletic Complex and Parking Structure. Clarify: That power outage in Stan Sheriff Center and HPER Facility will not trigger generator connected to Parking Structure electrical system.
PHASE I AND II PARKING STRUCTURE CONDITION SURVEY

RESPONSES TO COMMENTS
May 24, 2011

VIA: EMAIL

Nagamine Okawa Engineers
1003 Bishop Street
Pauahi Tower Suite 2025
Honolulu, Hawaii 96813

Attention: Mr. Dwight Okawa

RE: UH Parking Garage, Phase I and II
   Existing Conditions Survey
   University of Hawaii, Manoa

Dear Mr. Okawa,

This is in reference to Kirk Yuen’s comments dated 5/19/11 of the pre-final submittal. Regarding the items identified as ARCHITECTURAL following is our response:

1) ARCHITECTURAL 4.4.B (Page 10)
   It appears our submitted recommendation was revised in the report submitted to the University. Our recommendation was to conduct a study of the misaligned expansion joint condition. Please address this comment.

2) ARCHITECTURAL 4.7.A (Page 17)
   This comment is regarding the conflict in code requirements for door swing and required clearance in the stair well path of travel. The current code requires the doors on Levels 2 through 5 to swing into the stairs. The existing doors swings out of the stairs.

   It is not possible to satisfy both conditions in the code without reconstructing the stairs.

   The intent of our comment was to identify this situation, and to recommend to the University to discuss this conflict with the code official when the door repair project is initiated. It is not required to bring the door swing to compliance with the current code, however it may pose a greater safety hazard than the infringement to the path of travel within the stairway.

3) ARCHITECTURAL 4.7.E (Page 18)
   This comment is regarding the non-compliance of the existing enclosure walls of the Phase I Electrical transformer room and the need to replace the doors serving this room. The current code requires the transformer to be in a fire rated enclosure.
If the building official requires compliance with the fire rated enclosure provision, space allowing, duct to ventilate the electrical room should be installed or the electrical room should be relocated to a location on the exterior wall, where the room can be ventilated directly from the exterior.

Again, the intent of our comment was to identify this situation, and to recommend to the University to discuss this conflict with the code official when the coor repair project is initiated. If the existing electrical room was installed in compliance with the code in effect at the time, the enclosure is not required to comply with the current code. Since we must replace the existing door, our recommendation to is to discuss with the code official, if a rated door is required or not.

4) ARCHITECTURAL 4.11.C (Page 22)
The referenced sentence should read “handrail” rather than “guardrail”.

This comment relates to code compliance of existing handrails. Our response relates to all existing building components.

Chapter 34-Existing Structures. Section 3403.1 of the 2003 International Building Code states:

"Portions of the structure not altered and not affected by the alteration are not required to comply with the code requirements for new structures."

Assuming that a building component was installed in compliance with the code in effect at the time, if there is no alteration to that building component, the code does not require compliance with the new code. This would apply to all building component.

6) ARCHITECTURAL - Photographs
This appears to be a formatting issue. Please address directly.

We hope this information is useful. We attach the referenced comment sheet.

Should there be any questions please feel free to call.

Sincerely,

Ken Kajiwara, AIA

Encl.
PARKING STRUCTURE CONDITION SURVEY
PRE-FINAL SUBMITTAL COMMENTS

Comments from Kirk Yuen, UH FMO Design Section
5/19/11

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PHASE I & II PARKING STRUCTURE CONDITION SURVEY  
UNIVERSITY OF HAWAII AT MANOA  

RESPONSE TO STRUCTURAL COMMENTS

COMMENT:  "7) STRUCTURAL 5.2.A (Page 91) says repairs can be programmed to be made over the next 5 years. Does this mean that this particular repair should be completed no later than 5 years from now?"

RESPONSE: The 5 year time period was specified to coincide with the recommended inspection/maintenance cycle indicated in paragraph 5.2.
Dwight,

Changes to my response to electrical comments are in red below.

Thanks,
Tim

---

From: Tim Higa
Sent: Tuesday, May 31, 2011 7:27 PM
To: 'dwrighto@nagamineokawa.com'
Cc: Ken Kajiwara; Jeffrey K. Kohara; dkam@thermaleng.com; elevations.nell@hawaiiantel.net
Subject: RE: Parking Structure Condition Survey - PreFinal Comments from UH FMO

Dwight and Norman,

The following are our responses to the electrical comments:

1) We are not able to check the operation of the automatic transfer switch (ATS) and generator because the generator is inoperable due to an inoperable water pump.

2) Most of the emergency lighting units are not operational; only 3 of 27 are working. Hence we have added to the report to replace emergency lighting units.

3) Will add a statement in the report clarifying that a power outage only in the Stan Sheriff Center and HPER Facility will not trigger the generator in the Parking Structure to start and in this case, UHM Parking staff will have to manually start the Parking Structure generator to power the lights on emergency power.

Thanks,
Tim Higa

file://C:\DOCUME~1\ADMINU~1\LOCALS~1\Temp\eud5A9.htm 6/6/2011
This document is a report on the condition of the existing Phase I & II parking structure at the University of Hawaii at Manoa. The survey included a visual inspection of architectural, structural, mechanical, fire protection and electrical components of the parking structure. Also included is an assessment of the existing elevators. Items requiring repair or maintenance are identified and estimated construction costs associated with each item is provided.
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<th>Page</th>
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<td>8.0 ELECTRICAL</td>
<td>180</td>
</tr>
<tr>
<td>9.0 ELEVATORS</td>
<td>187</td>
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</table>
0.0 EXECUTIVE SUMMARY

The scope of this condition survey is to provide a planning document to identify anticipated repair and maintenance items for the five story parking structure at the University of Hawaii at Manoa. The condition survey was based on a visual inspection of exposed portions of the existing structure.

The disciplines participating in the condition survey included architectural, structural, mechanical, fire protection, electrical and a specialty elevator consultant. Estimated construction costs are provided for each repair item. The estimated construction costs to be used as a budgeting tool to determine the priority of when the repairs are to be made and the construction funding for these repairs.

A summary of the estimated cost of repairs is shown on the next sheet. A detailed breakdown of each discipline’s cost estimate can be found in this condition survey report.
## Preliminary Opinion of Probable Cost

### Phase I & II Parking Structure Condition Survey Report

**Summary of Estimated Costs of Repairs**

<table>
<thead>
<tr>
<th>Item</th>
<th>Phase I Cost</th>
<th>Phase I Subtotal</th>
<th>Phase II Cost</th>
<th>Phase II Subtotal</th>
</tr>
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<td><strong>Architectural</strong></td>
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<tr>
<td>Elastomeric Deck Coating</td>
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<td>Expansion Joints</td>
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<td>Finishes</td>
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<td>Guardrails (See Structural)</td>
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<td>Roofing</td>
<td>$155,214</td>
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<td>Doors and Louvers</td>
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<td>Ventilation Suits/Wet Ducts</td>
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<td>Pavement, Striping, and Markings</td>
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<td>Misc. Repairs</td>
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<td>Elevator Upgrade</td>
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<td>Phase I Stairs, 5-10 Floor/Enclosure Upgrade</td>
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<td>Ph II Makai Facing Sealant Replacement</td>
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<td>Railings</td>
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<td>Concrete Spalls</td>
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<td>Metal Rail at 5th Level</td>
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<td><strong>Stor Duct System</strong></td>
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<td>$130,000</td>
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<td>Domestic Cold Water System</td>
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<td>Elevator System: Oil Water Separator</td>
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<td>Elevator System: AC</td>
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<td>Emergency Generator Auxiliary System</td>
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<td>Optional – Painting of Piping</td>
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<td><strong>Fire Protection</strong></td>
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<td>Phase 1 Wet Stairpipe System</td>
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<td>Phase 2 Wet Stairpipe System</td>
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<td><strong>Electrical</strong></td>
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<td>Power System</td>
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<td>$34,800</td>
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<td>New Lighting System</td>
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<td>$516,200</td>
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<tr>
<td>Generator for Lights</td>
<td>$230,490</td>
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<td><strong>Existing Fire Alarm System</strong></td>
<td>$2,000</td>
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<td>Fire Alarm System</td>
<td>$500,000</td>
<td>$360,000</td>
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<tr>
<td>Elevator System</td>
<td>$353,480</td>
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<td>New Elevators</td>
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<tr>
<td>Subtotal</td>
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<td><strong>Elevator</strong></td>
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<td>Modernize 6 Elevators</td>
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<td>Subtotal</td>
<td>$840,000</td>
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<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* The ventilation system in the Phase I parking structure is not required under current regulations. If the ventilation system is removed then the total cost is $11,051,926 - $427,655 - $1,293,030 = $9,394,201.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>** If the ventilation system is retained and repaired then the total cost is $11,051,926 - $202,753 - $20,088 = $9,848,085.</td>
<td></td>
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</tr>
</tbody>
</table>
1.0 INTRODUCTION

This report was prepared for the University of Hawaii, Facilities Management and Planning Office – Design Section, under contract number UHM 001A-006-11.

The scope of this project was to conduct a condition survey of the 5-story parking structure at the Lower Campus of the University of Hawaii at Manoa (See Figure 1). The goal of the condition survey was to identify Architectural, Structural, Mechanical and Electrical items at the parking structure requiring repair, maintenance and/or upgrade. The items are prioritized in order of urgency to provide the University a means of planning for and budgeting to perform the recommended repairs and maintenance. Estimated construction costs associated with each item is provided.

Excluded from the condition survey were the escalators and landscaping.

2.0 DESCRIPTION OF THE EXISTING PARKING STRUCTURE

The existing parking structure is an open 5-level concrete structure built in two phases. Phase I was constructed in the early 1970’s and Phase II was constructed in the early 1990’s. Both phases are of similar construction. The parking structure deck consists of a concrete topping cast on precast, prestressed concrete elements at each elevated level. The deck is supported on concrete beams spanning between concrete columns. Pedestrian vertical circulation between the five levels of the parking structure is provided by 3 sets of elevators and 12 sets of concrete stairs.

The significant features that differentiate the Phase I and Phase II portions of the parking structure are as follows:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PHASE I</th>
<th>PHASE II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Construction</td>
<td>1970’s</td>
<td>1990’s</td>
</tr>
<tr>
<td>Plan Dimension</td>
<td>304’x526’</td>
<td>136’x502’</td>
</tr>
<tr>
<td>Deck Openings</td>
<td>2 large openings in the deck on either side of the vehicle ramp</td>
<td>None</td>
</tr>
<tr>
<td>Number of Elevators (See Figure 2)</td>
<td>2 elevator cores (2 elevator cabs per core)</td>
<td>1 elevator core (2 elevator cabs)</td>
</tr>
<tr>
<td>Number of Stairs (See Figure 2)</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Handrails</td>
<td>Steel</td>
<td>Aluminum</td>
</tr>
<tr>
<td>Precast, Prestressed Concrete Deck Elements</td>
<td>Tri-tees</td>
<td>Hollow core planks</td>
</tr>
<tr>
<td>Ventilation Systems</td>
<td>Mechanical exhaust system at levels 1 to 4 and natural ventilation at all levels</td>
<td>Natural ventilation at all levels</td>
</tr>
<tr>
<td>Ancillary Structures</td>
<td>Steel framed metal roof over 5th level vehicle ramp.</td>
<td>None</td>
</tr>
</tbody>
</table>
FIGURE 1
UNIVERSITY OF HAWAII SITE PLAN
ELEVATOR AND STAIR NUMBERING PLAN

FIGURE 2
3.0 CONDITION SURVEY

The condition survey of the parking structure was based on only visual observations of exposed elements of the structure. The survey was conducted by the architectural/engineering (AE) team indicated in Section 3.1 between February and April of 2011.

3.1 CONDITION SURVEY AE TEAM

The condition survey team consisted of the following AE companies:

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architect</td>
<td>Ken Kajiwara Architects</td>
</tr>
<tr>
<td>Structural</td>
<td>Nagamine Okawa Engineers Inc.</td>
</tr>
<tr>
<td>Mechanical</td>
<td>Thermal Engineering Corporation</td>
</tr>
<tr>
<td>Electrical</td>
<td>ECS, Inc.</td>
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<tr>
<td>Elevator</td>
<td>Elevations, Inc.</td>
</tr>
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4.0 ARCHITECTURAL

4.1 Scope of Architectural Condition Survey

This section contains the architectural assessment of selected components within the Phase I and Phase II parking structure with repair recommendations and construction cost estimates. Record construction and renovation/repair contract documents, were reviewed in the survey process.

The following are the architectural components reviewed:

1. Elastomeric Coating
2. Expansion Joints
3. Finishes
4. Roofing
5. Doors, Frames, Door Hardware and Louvers
6. Makai Planters/Makai-Mauka Walkway
7. Parking structure Ventilation Soffits/Vertical Ducts
8. Pavement Striping and Markings
9. Miscellaneous Repairs
10. Elevator Upgrade
11. Facility Upgrade Options
   a. Elevator Lobby Upgrade
   b. Phase I - Stair No. 5 thru 10, Roof/Enclosure Upgrade
   c. Phase I – Ventilation Soffit Demolition
   d. Phase II – Makai Facing Precast Panel/Door Sealant Replacement
12. General Comments
13. List of Resources

4.2 Elastomeric Coatings

A. Phase I – Level 5 Elastomeric Traffic Bearing Coating

The original 1973 Phase I parking structure construction drawings indicates a waterproofing membrane was placed between the structural concrete deck and a nonstructural protective concrete topping slab at level 5. In the mid-1990’s, due to apparent failure of the original waterproofing, holes were drilled on the underside of the Level 5 deck to drain trapped water and an elastomeric waterproof deck coating was applied over the surface of the protective concrete topping slab.

The mid-1990’s deck coating is deteriorated and no longer functioning as a waterproof membrane for the Phase I structure (See Photo A1 and A2).

A project is currently under design by the University which will replace the existing waterproof deck coating at level 5.

The majority of the water damage observed on the lower levels can be attributed to the failure of the level 5 deck waterproofing system. The following impacts to the lower levels were observed:
1. The building’s expansion joint system appears to be a conduit in which water is being delivered to levels below promoting deterioration of the concrete (See Photo A3 and A4).

2. Holes were drilled in the deck soffit to drain trapped water between the protective concrete topping and structural deck at level 5. With the failure of the waterproof coating, these holes now are functioning as a secondary drainage system for the level 5 deck. These holes in the deck allow water to drip on level below (See Photo A5 and A6).

3. The level 5 deck appears to slope towards the four stairs adjacent to the two large atrium openings at the Phase I parking structure. These stairs are not covered with a roof and the stair openings are not rimmed with a curb. Consequently, water is draining down the stairwell, on to the lower levels and creating standing water at the stair landings (Photo A7, A8 and A9).

4. The ramp between levels 4 and 5 is not protected by a deck coating. In observing the walls under the ramp on Level 4 and under the mid-ramp expansion joint, water stains are visible on the walls and ramp slab surfaces (Photo A10, A11 and A12).

Recommendations:

Water intrusion on to the lower levels of the parking structure should be remedied with the proper installation of a new waterproof deck coating at level 5.

If it is not already included in the design of the new deck coating at level 5 of the Phase I parking structure, it is recommended to modify the level 5 deck slope around the atrium stair openings and to install curbs at the non-landing edges of these stair openings. Also, recommend waterproofing the ramp between Levels 4 and 5, as part of the ongoing level 5 waterproofing project and enclosing and adding a roof over the six level 5 open stairs.

B. Phase I – Level 4 Fan Room Elastomeric Floor Coating

The fan rooms are exposed to the element since they are covered with an open grating at level 5. Based on the original construction documents, the floors of these rooms were not waterproofed but a project in 1976 added surface applied elastomeric waterproofing on the fan room floors.

No active leaks were found in the floor slab at the fan rooms; however significant wear was noted, along with hairline cracks on the slab surface were visible through the floor coating. Algae and mold growth were also noted on the floor surface (See Photo A13 and A14).

Recommendations:

Recommend replacing the worn waterproof deck coating on the fan room floors. If it is not already included, this work should be included with the Level 5 waterproofing project. Inclusion will ensure single product and installation date for deck waterproofing serving Phase I.
C. Phase II – Level 5 Elastomeric Traffic Bearing Coating

The original 1992 Phase II parking structure construction drawings indicates a waterproofing membrane was placed between the structural concrete deck and an architectural concrete topping slab at level 5. In the early-2000’s, due to apparent failure of the original waterproofing, holes were drilled on the underside of the Level 5 deck to drain trapped water and surfaced applied elastomeric waterproof deck coating was added on the architectural concrete topping.

The deck coating appears to be intact over approximately 80% of the deck surface; however the following active damage was observed:

1. Elastomeric coating has failed along the control joints on column lines K1 and 40. The coating was split or delaminated along these lines (See Photo A15).

2. Elastomeric Traffic coating has failed along column lines G2, 26 and 44, below the existing guardrails. The coating was split or delaminated along these lines (See Photo A16).

3. The sealant in the joint between the wall and deck at Elevator 5/6 and Stair 11 and 12 enclosure has failed (See Photo A17).

4. The deck coating was worn through, exposing the concrete substrate at the top of the ramp from level 4A (Photo A18).

5. The elastomeric coating missing is on the Phase I side of the expansion joint along column line 23 (interface with Phase I) (See Photo A19).

6. The sealant along the Phase I planter wall base and the Phase II horizontal deck surface has failed (Photo A20).

Limited water intrusion was noted on Level 4 ceiling. Water was not noted in the drainage holes drilled under the Level 5 deck.

Discussion:

Four (4) elastomeric coating manufacturers were consulted to determine whether re-coating over the existing coating is warrantable. The coating manufacturers consulted stated that assuming the existing coating passes the adhesion pull-test, the existing coating can be re-coated and a 5 year warranty issued for the new coating work.

While recoating is possible, the following concerns were cited:

1. There may be entrapped moisture throughout the deck at the level of the original waterproofing which is between the structural deck and nonstructural concrete topping which exceeds allowable limits for coating the deck.

2. There may be delaminations of the concrete under areas where the existing coating is currently well bonded.
3. Coating over an existing coating with entrapped moisture below may compromise the bond between the new and existing coatings. Over time the entrapped moisture in the concrete may be driven up to the coating level.

4. Any warranties issued will be a limited warranty, which typically excludes pre-existing conditions. With the existing conditions at the Phase II parking structure deck, a limited warranty may not be enforceable.

**Recommendations:**

It appears if a project is initiated immediately, before further deterioration of the existing coating, a waterproofing system with a 5-year limited warranty is possible. If the deck coating is limited to re-coating, for the basic work we estimate approximately $400,000. For basic strip off and replacement work, we estimate approximately $1,100,000.

The recoating relies heavily on the condition of the existing coating and substrate. With the known problematic condition of the existing coating and deck, any warranty issued will be highly qualified and the long-term performance of the waterproofing may be compromised.

Based on the above, we recommend the following:

1. Immediately repair the items noted above to prevent further deterioration of the existing coating and water infiltration into the structural deck down to Level 4.

2. Initiate a project that includes the complete removal of the existing coating and the application of new traffic bearing coating.

3. The coating should be inspected annually and a maintenance plan to top coat the deck on a 5 year cycle be instituted.

**E. Phase I and II – Elastomeric Coating at Building Perimeter and Atrium Opening Guardrails**

Phase I guardrails are painted steel guardrails, composed of tubes and square bars. Review of the existing guardrails found corrosion damage primarily at the vertical tube post embedment into the concrete deck.

The vertical post corrosion appears to have been a long term problem. We noted 3 types of past repairs affecting approximately 60% of the vertical supports:

1. Addition of a cementitious crown at the vertical post base to shed water away from the post.

2. Removal and replacement of the bottom 4" of the vertical post base.

3. Addition of an offset steel bracket, where the vertical post base has rusted through.
Even with these past repairs, we found 20% of these repairs have failed. These failures include continued corrosion at the base of the posts, cracks in the cementitious post base crown and spalling of the cementitious crown. In addition, 5% of all post bases were completely corroded through.

Also there is significant amount of water stains on the interior face of the precast spandrel panels. The source of the stains appears to be the unprotected joint between the panel and the parking deck topping slab.

**Recommendations:**

The past repairs appear to have been insufficient in preventing water damage to the guardrail posts. Even with the introduction of the cementitious crown to the post base, water has initiated corrosion of the metal post and resulted in spalling many of the crowns.

To address this condition we recommend the following:

1. Install cementitious crown where required. Replace cementitious crown where damaged.

2. Apply elastomeric deck coating at post base, extending 4” up the vertical post and 12” from the PC spandrel continuously under the guardrail. Apply continuous deck coating application under the guardrail to protect the spandrel panel/slab joint.

3. The existing offset steel bracket repair, utilized only a single expansion bolt to anchor the post. The structural adequacy of this detail should be verified for compliance with the building code.

4. Repaint guardrail complete.

The current building code contains requirements for a vehicle barrier and clear open spacing of the guardrail not to exceed 4 inches. The existing parking structure does not appear have a vehicle barrier or meet the 4 inches maximum open spacing of the vertical bars in the guardrail. While the code does not require an existing building to comply with these requirements, if the guardrails were to replaced, the installation of the vehicle barriers may be required and the new guardrails need for comply with code requirements. (See related comments in Section 4.12 A.)

4.3 Expansion Joints

A. Phase I – Level 5 Horizontal Expansion Joints

These joints are preformed neoprene expansion joint, typical for a waterproof installation. Water stains were noted under level 5 deck, at all these joints. It could not be determined if the water was migrating due to a breach in the neoprene material or due to the failure of the adjoining waterproofing (See Photo A21 and A22).
Recommendations:

Recommend replacing the expansion joints as part of the present level 5 deck recoating project. The new coating should integrate with the expansion joint, which typically requires the replacement of the expansion joints, to establish a watertight installation.

As a preventative measure, we also recommend the installation of a secondary drainage gutter below the expansion joints, to intercept any future water intrusion.

B. Phase I - Level 5 Vertical Expansion Joints

At select vertical expansion joints on parapets adjoining the atrium stairs, the expansion joint cover and/or sealant to fill the joint was missing. These open joints allow water to enter into the stairwells promoting concrete spalls to develop and standing water to accumulate on the stair landings (See Photo A23 and A24).

At these same locations, the horizontal expansion joints do not align with or was offset from the vertical expansion joint. While only minor structural distress was observed, the expansion joint and the attendant waterproofing cannot be properly terminated due this condition (Photo A25 and A26).

Recommendations:

Recommend installing joint sealant and/or expansion joint cover as part of the present level 5 deck recoating project.

The vertical and horizontal expansion joints should be modified to bring them into alignment.

C. Phase I – Lower Level Horizontal Expansion Joints

The water intrusion from Level 5 is damaging the expansion joints on the lower levels. Rainwater appears to be migrating through these expansion joints from Level 5 all the way down to Level 1 (See Photos A27 and A28).

There are two types of expansion/control joints on the lower levels:

1. Pourable Sealant Filled Expansion Joints – A majority of the lower level horizontal expansion joints are pourable sealant filled joints supported by a metal plate below (Photo A29). 75% of the sealants were intact, however due to its degraded condition; the sealant was highly pliable and susceptible to damage. This type of sealant is pliable by design and it appears that a brass plate was added for added to protection the sealant (See Photo A30). The brass plates are present at approximately 40% of the expansion joints. These expansion joints do not appear to be for an installation required to be waterproofed.

Also observed was the deterioration of many of the cementitious fill material on either sides of the expansion joint. Due to the migration of
water, deterioration and abrasion of the material, cracks and spalls were observed in the cementitious material (See Photos A31 and A32). While the overall expansion joints appeared to be intact, the condition of the existing metal plates, which supports the pourable sealant could not be verified.

Although still functional, these expansion joints appear to have reached their serviceable life.

2. Steel Angle Expansion Joints – At the vehicular ramps connecting the respective levels, the expansion joint is formed with a pair of down turned steel angles embedded in the concrete slab with a sealant or a preformed compression-type seal between the angles (See Photo A33 and A34).

While these joints appear to be functional, the joint filler material has lost its elasticity and pliability.

Recommendations:

Recommend replacement of the pourable sealant expansion joint with a pre-formed neoprene expansion joint or an auxiliary resilient expansion joint cover to protect the existing joint. The replacement of the existing expansion joint with a pre-formed neoprene expansion joint or an auxiliary resilient expansion joint cover will also address the noise generated by the brass cover presently protecting the expansion joint.

For the steel angle expansion joints, recommend replacing the joint filler material. In addition, auxiliary expansion joint cover to protect the existing joint is also recommended.

D. Phase I – Lower Level Vertical Expansion Joints

All interior sealant filled vertical expansion joints have failed. The concrete walls forming the interior expansion joint have minor spalls along the joint and the sealant material has lost its elasticity (See Photos A35 and A36).

Spalls were also observed along the expansion joints in the exterior beams at the Ewa and Diamond Head sides of the parking structure. The sealant in the joints was cracked and had adhesion failure (See Photo A37 and A38).

Recommendations:

The concrete spalls around the expansion joints should be repaired and the sealant in the expansion joints should be replaced or covered with a metal expansion joint cover.

E. Phase II – Horizontal Expansion Joints

Level 5 horizontal preformed neoprene expansion joints appeared to be intact, however these joints were protected by a secondary gutter and unavailable for visual inspection from below. The following were observed:
1. Approximately 40% of the protective sealant over the fasteners securing the expansion joints were missing or deteriorated and the fasteners heads were corroded (See Photo A39).

2. There was a gap or an opening at the horizontal to vertical section of the preformed neoprene expansion joint (See Photos A40 and A41).

On the lower levels, the preformed neoprene expansion joint appeared to be intact, except where the joint transitions from horizontal to vertical where a gap typically exists (See Photo A42).

Recommendations:

To prevent further deterioration rusted fasteners securing the expansion joint should be replaced and all sealant protecting the fastener heads removed and resealed. The gaps between at the expansion joint transition should be sealed at all levels of the parking structure.

With the recommended Phase II, Level 5 deck coating work, the Level 5 expansion joints should be replaced. The new coating should integrate with the expansion joint, which typically requires the replacement of the expansion joints, to establish a watertight installation.

4.4 Finishes

A. Exterior Finishes

The vertical exterior concrete surfaces for both Phase I and Phase II parking structure is composed of three types of finishes as describe as follows:

1. Cast in place concrete (CIP) with exposed aggregate finish, primarily on Ewa and Diamond Head elevation columns, spandrel and stairwells (Photo A43 and A47).

2. CIP concrete with smooth finish on Ewa and Diamond Head Elevation columns (Photo A43 and A45).

3. Pre-cast (PC) concrete with exposed aggregate finish on spandrel panels of Mauka, Makai and atrium elevations (Photo A44, A46 and A48).

Primary distresses to the finished concrete surfaces were found at the following locations:

1. Vertical expansion joints on Phase I Ewa and Diamond Head Elevations (Photo A49 and A50).

2. Vertical steel guardrail supports at Phase I Ewa and Diamond Head elevations (Photo A51 and A52).


4. Concrete fascia on Phase I elevator and stair roofs (Photo A55 and A56).
5. Vertical concrete guardrail posts at Phase I, Level 5 (Photo A57 and A58).

**Precast Concrete Panel Design**

Pre-stressed Concrete Institute (PCI) manual entitled *Architectural Precast Concrete*, states, “as pre-cast concrete is high strength durable concrete, it does not require painting”. It also states, “the quality of concrete normally specified for architectural pre-cast concrete, even with minimum practical thickness, does not need sealers for water-proofing.” While these statements do not apply absolutely, for exposed aggregate finished precast concrete work, applied finishes are not typically intended. Exposed aggregate finished precast concrete relies on the proper concrete mix, strength and quality control in its fabrication process for its durability. The PCI manual recommends 5,000 psi compressive strength concrete be used to construct precast concrete elements to address both production requirements and for proper robustness in service. However, 4,000 psi compressive strength concrete was specified in the original contract documents for the construction of the precast concrete planters, fins and panels. The compressive strength of the concrete used of the precast elements in the Phase I parking structure is less than what is suggested by industry standards. (This does not apply to the precast prestressed deck elements.)

**Natural Concrete versus Applied Finishes**

The type and condition of the concrete finish is significant in determining if applied finishes should be considered for this structure. With the exception of those areas indicated in paragraph A. above, and incidental spot repairs, the finished exterior surfaces of the concrete work appeared intact.

A natural exposed aggregate concrete finish on the parking structure indicates that substantial first cost investment was made by the University to obtain this look. With the majority of the exterior surfaces of the parking structure being precast exposed aggregate concrete spandrels, the design intent was for a robust, low maintenance exposed aggregate concrete finish.

Aesthetically to paint the building, would be a significant departure from the building’s original design intent. In addition, once the structure is painted, it will require regular repainting to maintain an acceptable appearance.

On the other hand, to maintain the natural exposed aggregate concrete finish, all the spall repairs must be made to match the existing adjoining surface’s texture, finish and color. In general, this is difficult and costly to execute. Poorly executed, the result will have an unappealing “patch work” appearance where the repairs occur (See Photo A59 and A60).

Issues relating to the aesthetics of the parking structure are as follows:

i. Most of the concrete spalls are occurring on vertical and horizontal faces of CIP concrete surfaces and not on the precast exposed aggregate concrete spandrel panels.
ii. On the Diamond Head and Ewa vertical surfaces and on stair walls, inconsistent application of exposed aggregate and smooth finished CIP concrete were seen (See Photo A61).

iii. On CIP exposed aggregate concrete surfaces, the aggregates are not distributed uniformly and color rendition between concrete lifts is inconsistent (See Photo A56).

iv. The exposed aggregate finish for the CIP concrete does not match those for precast surfaces (See Photo A47 and A48).

**Recommendations:**

In balancing the various considerations noted above, our recommendation is to apply solid bodied elastomeric wall coating only on all CIP concrete surfaces to conceal spall repairs and to provide additional protection to the concrete finish. The coating has the capacity to bridge small cracks and factures, and prevent moisture migration. These surfaces should be recoated on an 8 to 10 year cycle. For precast surfaces, any repairs should be executed matching the existing adjoining surfaces finish and textures. A clear penetrating water repellent sealer should then be applied over all exposed PC surfaces. While not a waterproofing, the water repellent sealer will provide additional protection to this surface. These surfaces should be resealed on a 5 to 8 year cycle.

While minimal damage to exposed aggregate precast spandrel finish was seen, at the guardrails located on top of the spandrels, numerous corrosion related defects were observed at the base of the vertical support posts. Any design and repair procedure for the guardrail posts, should avoid damage to the precast spandrel finish.

**B. Phase I Level 4 Fan Room Walls and Beams**

The existing four fans rooms at Level 4 are exposed to weather since they are only covered with open metal grating at level 5. The existing concrete beams exhibit some minor spalling and the paint on the concrete masonry unit (CMU) walls is chalking (See Photo A101).

**Recommendations:**

Coat the concrete beams and CMU walls in fan rooms with an elastomeric coating.

**C. Phase I – Building Perimeter, Atrium Opening and Stair Guardrails and Handrails**

Phase I guardrails are painted steel guardrails, composed of tubes and square bars. Corrosion of the vertical tube post embedment into the concrete spandrel and miscellaneous rust, corrosion, chipped paint, etc. were observed at various locations.

At select areas, paint on the guardrails appears to have been acid etched from water dripping down from the precast spandrel/deck joint and/or planter drains above.
4.5 Roofing

A. Elevator- Stair Roofing

Elevator 1/2 and Stair 1, Elevator 3/4 and Stair 2, Elevator 3/4 Machine Room, Elevator 5/6 and Stair 11, Elevator 5/6 Machine Room and Stair 12 roofs are modified bitumen roofing with alumastic coating. The alumastic coating is exhibiting signs of wear and “fish mouthing” along the lap seams (See Photo A62, A63, A64, A65, A66 and A67).

Elevator 1/2 and Stair 1, Elevator 3/4 and Stair 2, Elevator 5/6 and Stair 11 and Stair 12 roofs are rimmed with a concrete parapet.

Elevator 1/2 and Stair 1, and Elevator 3/4 and Stair 2 roofs are modified bitumen roofing terminated with a copper sheet metal counter flashing mounted on the inner face of the parapet. The parapet is not capped or waterproofed. The roof is drained by a roof drain. No over flow drains or scuppers were observed.

Elevator 5/6 and Stair 11, and Stair 12 roofs are also rimmed by a concrete parapet. The parapet is capped by a modified bitumen membrane but no termination bar or flashing was observed. The base flashing is missing a termination bar or sheet metal counter flashing where the modified bitumen roofing abuts the elevator penthouse. These roofs are drained with both roof drains and overflow drains.

Roofs for Elevator 3/4 Machine Room, Elevator 5/6 Machine Room and penthouses for Elevators 1/2, 3/4 and 5/6 are terminated with a copper sheet metal edge flashing. The lower edges of these roofs are provided with a copper sheet metal gutter and downspout. The gutters on Elevator 3/4 and 5/6 Machine Rooms and penthouse for Elevator 5/6 are damaged.

Stair 3 and 4 roof system is built up roofing. Significant wear was observed. The roof is scoured, gravel is missing and the fiberglass reinforcing is exposed. The built up roofing is terminated with a copper sheet metal counter flashing mounted on the inner face of the parapet. The parapet is not capped or waterproofed. The roof is drained by a roof drain. No over flow drains or scuppers were observed (See Photo A68 and A69).

No active leaks were observed on the underside of these roofs.

Recommendations:

The following are our recommendations for the various roofs:

1. Replace roofing with new 3-ply modified bitumen roofing.
2. Install termination bar at roof to wall termination.
3. Encapsulate roof edge, roof to wall termination, parapet and fascia with fluid applied roofing.

4. Encapsulate all roof penetrations with fluid applied roofing.


Note:

The 3-ply modified bitumen roof with fluid applied roofing augmentation, described above is the current University standard.

B. Phase I Level 5 Metal Roof Over Ramp

The roof over the ramp connecting Level 4 and 5 is a corrugated metal roof and parapet structure supported on light gage steel purlins and structural steel beams and columns. Corrosion of the corrugated metal roof was observed, however there are no active leaks (See Photo A70 and A71).

The sheet metal gutters, on the Ewa and Diamond Head sides of the roof are severely corroded and no longer serviceable. The 4 sheet metal downspouts connected to the gutter are also severely corroded and damaged. One of the downspouts is completely crushed. No overflow scuppers were noted for the gutters (See Photo A72, A73 and A74).

Recommendations:

Following are our recommendations for the metal roof:

1. Replace existing gutter and downspouts.

2. Replace corrugated metal roof.


4. Repaint parapet, roof beams and columns, purlins and base plates.

4.6 Doors, Frames, Door Hardware and Louvers

A. Phase I Stair Doors

The existing doors and frames serving Stairs 3 and 4 are single, painted steel hollow metal doors and frame. Hardware on these doors consists of knob lockset, door closer, 3 butt hinges and a floor stop.

The paint on the doors and frames is degraded and varying degrees of corrosion were observed. Four of the doors were racked, making them unable to fully close. One of the doors could not be opened (See Photo A75).

The locksets with the knob hardware do not meet the Americans with Disabilities Act (ADA) requirements.
Recommendations:

Replace all doors, frames and hardware with 2-hour fire rated assemblies.

Note:

The doors swing into the parking structure at Levels 2 through 5. The current code requires these doors to swing into the stairs. However, the code also requires the doors do not reduce the width of landing by more than 50%. With the existing stair/door arrangement, if the door were to swing in, the landing width will be reduced by more than the code allows. When this repair work is executed, it is recommended this conflict between code sections be reviewed with the building officials.

B. Phase I Elevator 1/2 and 3/4 Machine Room Doors

The existing door and frame serving the machine room is a single, painted steel hollow metal door. Hardware and accessories on these doors consist of a full height louver, lever lockset, door closer, 3 butt hinges and floor stop.

Door, frame and louver exhibit varying degree of corrosion (See Photo A76).

Recommendations:

Repaint door and frame.

Note:

The elevator consultant for this project is recommending the conversion of the elevator to a solid state, electronic controlled elevator. If this recommendation is exercised, the louvered doors serving this room must be replaced with a 2-hour fire rated door.

C. Phase I Parking Structure Ventilation Fan Room and Storeroom Doors

The existing doors and frames serving these rooms are single, painted steel hollow metal doors. Hardware on these doors consist of knob lockset, door closer, 3 butt hinges and floor stop.

The paint on the doors and frames is degraded and varying degrees of corrosion were observed (See Photo A77).

Recommendations:

Replace all doors, frames and hardware,

D. Phase I Electrical Room Doors

The existing doors and frame serving the electrical room is a pair of painted steel hollow metal doors and frame with fixed louvers. Hardware on these doors consists of knob lockset, door closers, 3 pairs butt hinges, flush bolts and wall stops.
The paint on the doors and frames is degraded and varying degrees of corrosion were observed. The knob hardware on the locksets do not meet the Americans with Disabilities Act (ADA) requirements (See Photo A78).

**Recommendations:**

Replace all doors, frame and hardware.

**Note:**

This room contains a transformer with large louvers for ventilation. The current electrical code requires the wall and openings in the room be 3-hour fire rated. The doors can be changed to comply with the code; however, with the existing louvers the room will not meet the required fire rating. When this repair work is executed, it is recommended this conflict be reviewed with the building officials.

**E. Phase II Stair Doors and Frames**

The existing doors and frames serving the stairs are single, painted steel hollow metal doors. Hardware on these doors consists of lever lockset, door closer, 3 butt hinges and floor stop.

Varying degrees of corrosion were observed on the doors and frames. Also, the locksets do not properly retract and engage (See Photo A79).

**Recommendations:**

1. Prepare and repaint door and frame.
2. Inspect and service the lockset.

**F. Phase II Miscellaneous Doors and Frames**

The existing doors and frames serving the elevator machine room, electrical room and pump room are single painted steel hollow metal doors. The existing doors and frames serving the transformer, emergency generator, storage, security and maintenance rooms are pair of painted steel hollow metal doors. Hardware on these doors consists of lever lockset, door closer, 3 butt hinges and floor stop.

Varying degrees of corrosion was observed on the doors and louvers (See Photo A80).

**Recommendations:**

Repaint doors and frames.

**G. Phase I and Phase II Louvers**

The typical louvers at both Phase I and Phase II parking structure are dark bronze anodized aluminum fixed louvers. Phase I Level 1 Storage Room louvers are operable aluminum louvers. The fixed louvers appeared to be a serviceable
condition. Operable louvers do not appear to be functional but appeared to be frozen and functioning as a fixed louver. Majority of the insect screens were damaged (See Photo A81).

**Recommendations:**

Replace louver insect screens.

**Note:**

The elevator consultant for this project is recommending the conversion of the elevator to solid state, electronic controlled elevator. If this recommendation is exercised, the louvers serving the elevator machine room will be eliminated. To address weathering concerns to the existing elevator machinery within the shaft way, the elevator consultant is recommending the replacement of the existing standard louvers with storm resistant louvers.

4.7 **Makai Planter/Makai-Mauka Walkway**

A. **Phase I Makai Planters**

The planters are filled with gravel with no vegetative material planted in them. Water stains were observed under the planter at Column A-9 on Level 3. Water stains were also observed at other planters at the planter drainage pipes (See Photo A82).

B. **Phase I Level 5 Mauka-Makai Mall Planter/Walkway**

The planters along the Mauka-Makai Mall between the elevator lobbies for Elevator 1/2 and 3/4, are typically planted with grass, shrubs and small caliper trees. The planters are approximately 20” high.

The record drawings indicate the original waterproofing under the planters and the adjoining walkway slabs are integrated. The same waterproofing extends under the nonstructural topping slab of the parking deck. The waterproofing does not tie into the traffic bearing deck coating that was later installed over the Phase I or II parking decks.

The following were observed at the Level 4 ceiling below the Mauka-Makai Mall planters and walkways:

1. Significant water intrusion was observed along the expansion joint running Ewa-Diamond Head between column line F and G. In the mid-1990’s a sheet metal gutter was installed at the Level 4 ceiling to intercept this water. However, this gutter is severely corroded and has failed (See Photo A83 and A84).

2. Water stains were observed on the ceiling above Stair 1 (See Photo A85).

3. Water damage to the gypsum board soffit was observed at both the Makai and Mauka ventilation soffits (See Photo A86).
4. PVC gutters were installed at the precast element joints between column lines L and M apparently to intercept water leaks (See Photo A87).

There are active leaks throughout Mauka-Makai Mall area; however the waterproofing in this area is concealed beneath the planters and slab. Therefore, the source of the leaks cannot be determined. Unlike the Level 5 parking area, where a waterproof deck coating was applied in the mid-1990’s, the waterproofing in this area appears to be the original waterproofing installed in the mid-1970’s.

**Recommendations:**

Corrective work to address water intrusion to Level 4 will potentially impact the existing waterproofing, expansion joints, stairs, and paving at the Mauka-Makai Mall, in addition to the planters. It also may affect the waterproofing interface with the Phase I and Phase II parking areas.

A comprehensive replacement of the waterproofing system for the Mauka-Makai Mall planters and walkways is recommended.

Until the project is executed, we recommend the replacement of the damaged expansion joint gutter at the level 4 ceiling to prevent further damage to the structure.

### 4.8 Phase I Parking Structure Ventilation Soffit/Vertical Ducts

Portions of Level 1 through 4 Phase I parking structure are equipped with drywall/metal framed soffits which serve as a plenum for the exhaust ventilation system. These soffits are connected to the four fans rooms at level 4 via vertical sheet metal duct shafts.

The following were observed on the soffits and ducts:

1. Collision damage to the soffits. The damage observed included abrasion marks on the drywall soffit, crushed soffit edge and missing sections of drywall (See Photo A88, A89 and A90)

2. The metal corner bead along the soffit edge is corroding on the Diamond Head side at each floor (See Photo A91).

3. Substantial number of the soffit bottom mounted, metal exhausts vents were sagging and dislodged. The metal framing supports for the soffits are interrupted at the vents and the vents are only fastened to the drywall. The drywall alone does not appear to have sufficient capacity to support the vents resulting in the vents sagging over time (See Photo A92 and A93).

4. The vertical sheet metal ducts are damaged, apparently from vehicle collision. At many of these damaged locations, the ducts below are visible and temporary repairs with plywood and lumber were observed. Rust and corrosion were noted on these ducts (See Photo A94).
Recommendations:

The various damages noted above should be repaired, and all soffit surfaces re-finished and repainted.

The vertical sheet metal ducts should be repaired, however the current building code requires the existing vertical sheet metal ducts to be enclosed in a two-hour fire rated shaft. Our recommendation is to repair the ducts, enclose the duct work with 2-hour fire rated concrete masonry unit partition and to add steel pipe bollards around the duct for protection.

Note:

Refer to the MECHANICAL Condition Survey section of this report. The State Department of Health, Indoor and Radiological Health Branch has indicated that the existing ventilation system is not required under current regulations and the system does not need to be replaced.

4.9 Pavement Striping and Marking

The following is an approximation of worn striping and markings based on our observations:

1. PHASE I:

   - Parking Stall Striping 25% wear (See Photo A95)
   - Crosswalk Striping 75% wear (See Photo A96)
   - Markings 40% wear (See Photo A97)
     (Arrows, Stop, Yield)

2. PHASE II:

   - Parking Stall Striping 10% wear (See Photo A98)
   - Crosswalk Striping 10% wear (See Photo A99)
   - Markings 15% wear (See Photo A100)
     (Arrows, Stop, Yield)

Recommendations:

Repaint the Phase I parking structure crosswalk striping and floor marking.

Budget for the repainting of the Phase I parking structure stall striping and repainting of the Phase II parking structure stall striping, crosswalk striping and marking.

4.10 Miscellaneous Repairs

A. Phase I Parking Structure Speed Bumps

The existing asphalt speed bumps are deteriorated or missing (See Photo A102).

Recommendations:

Replace or repair speed bumps.
B. Phase II Parking Structure Fire Extinguisher Cabinets

There are 8 fire extinguishers per level at the Phase II parking structure. Approximately 30% of the cabinets are severely corroded and the balance exhibits some lesser degree of corrosion (See Photo A103).

Recommendations:

Replace all fire extinguisher cabinets with stainless steel cabinets.

C. Phase I Parking Structure Electrical Room Handrail

The handrail at the stairs to the Level 1 Electrical Room is missing.

Recommendations:

Install new handrail at stairs to Level 1 Electrical Room

4.11 Elevator Upgrade

The elevator consultant is recommending the conversion of the existing elevator to solid state, electronic controlled elevator. To accompany this conversion, the following architectural modification is required:

1. At Elevator 1/2, 3/4 and 5/6 Machine Rooms: Remove all existing louvers and infill all walls with 2-hour rated partition.

2. At Elevator 1/2, 3/4 and 5/6 Machine Rooms: Replace all existing doors and frames with 2-hour rated doors and frames.

4.12 Facility Upgrade Work

A. Elevator Lobby Upgrade

Debris is blown into the elevator shaft way at the level 5 elevator lobbies of Elevators 1/2, 3/4 and 5/6. To remediate this condition the following upgrades to the lobbies are recommended:

1. Install an aluminum storefront glazing at the Makai and Mauka entrances to the respective elevator lobbies.

2. Install aluminum storefront doors at the Makai and Mauka entrances to the respective elevator lobbies.

B. Stair No. 5 to Stair No. 10 Roof/Enclosure Upgrade

Presently, Stair No. 5 to 10 are unprotected, allowing rain water to enter the parking structure creating areas of slip-fall hazard on the stairs and landings. To remediate this condition the following upgrades at the stairs are recommended:

1. Install a roof canopy, similar to the Level 5 Ramp canopy over the stair opening.
2. Install an aluminum storefront glazing enclosure around the stair opening.

C. Phase I Parking Structure Ventilation System Soffit Demolition

Since the ventilation system is not required by current regulations, recommend removing the drywall soffit together with the ventilation system.

D. Phase II Parking Structure Makai Facing Precast Panel/Door Sealant Replacement

The vertical precast panel sealant joints on the Makai side of the parking structure are cracked and “alligatoring”. This condition was also noted at the joints sealing the doors frames at Level 5 (See Photo A104).

The sealant joint are intact, however the elasticity of the joints on Makai side of the building is markedly less than the Mauka side.

Recommendations:

Monitor the condition of the sealant joints.

Budget for future replacement of the joints.

4.13 General Comments

A. Stair and Garage Perimeter Guardrails

The existing guardrails are not compliant to the current building code, however they are not required to comply with the current code, if they were install in accordance with the code in effect at the time of construction and no substantive alteration is performed on the guardrail.

Chapter 34-Existing Structures, Section 3403.1 of the 2003 International Building Code states:

"Portions of the structure not altered and not affected by the alteration are not required to comply with the code requirements for new structures."

Assuming that a building component was installed in compliance with the code in effect at the time, if there is no alteration to that building component, the code does not require compliance with the current code. This code provision would apply to any building component.

B. Phase I Level 5 Parking Structure Deck Coating

The Phase I level 5 deck coating project should proceed as soon as possible. It is recommended the following be included in the scope of work of the Phase I level 5 deck coating project:

1. Modify the Level 5 deck slope around the atrium stair openings.

2. Install curbs at the non-landing edges of the atrium stair openings.
3. Waterproof the ramp between Levels 4 and 5, as part of the level 5 waterproofing project.

4. Install joint sealant and/or expansion joint cover at vertical parapet joints adjoining the atrium stairs.

5. Waterproof the Level 4 Fan Room Floors.

4.14 List of References

A. Drawings


5. General Repairs and Non-Skid Treatment to Stairwells, Parking Structure, University of Hawaii at Manoa, Project No. UHM 001-021-94a, January 1996.

6. General Repairs to Fifth Floor Parking Garage Phase 2, University of Hawaii at Manoa, Project No. UHM 001-021-94b, February 1996.

B. Specifications


C. Building Codes:


D. Manuals:

1. Architectural Precast Concrete, Prestressed Concrete Institute, 1973.

E. Miscellaneous:

1. Paul Kane, Aloha Marketing, Sika Products, Watson-Bowman Products
2. Michael Nishimura, Sonneborn Products
3. John Walsh, Pacific Polymer Products
4. Steve Kramer, Neogard Products
### Phase I Elastomeric Deck Coating

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Estimated Cost</th>
<th>Urgency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove existing corrosion on existing 2&quot;x2&quot; parked steel tube post. Apply elastomeric coating 4&quot; up tube.</td>
<td>$85,025</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Apply elastomeric traffic coating at parking deck perimeter under guardrails.</td>
<td>$108,993</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$194,018</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Elastomeric coating for Level 4, Fan Rooms is excluded from this estimate. It is assumed it will be executed with Level 5 Deck Coating project.*

### Phase II Elastomeric Deck Coating

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Estimated Cost</th>
<th>Urgency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove existing elastomeric traffic coating to bare concrete substrate. Prepare concrete deck to accept new elastomeric traffic coating.</td>
<td>$412,207</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Apply elastomeric traffic coating on concrete substrate.</td>
<td>$893,796</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Remove sealant at wall/roof joint. Prepare and apply new sealant and elastomeric traffic coating.</td>
<td>$3,519</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Remove sealant at slab/roof joint. Prepare and apply new elastomeric traffic coating.</td>
<td>$43,157</td>
<td>Immediately</td>
</tr>
<tr>
<td>Remove prepare existing 2&quot;x2&quot; aluminum tube post. Apply elastomeric coating 4&quot; up tube.</td>
<td>$101,813</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Apply elastomeric traffic coating at parking deck perimeter under guardrails.</td>
<td>$83,512</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Apply elastomeric traffic coating to parking street stalls.</td>
<td>$14,976</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,582,980</strong></td>
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</tbody>
</table>

### Phase I Expansion Joint

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Estimated Cost</th>
<th>Urgency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove existing expansion metal cover plates.</td>
<td>$12,400</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Provide and install new expansion joint cover. (To replace metal covers)</td>
<td>$228,185</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Provide and install new gutter under expansion joint.</td>
<td>$25,444</td>
<td>Immediately</td>
</tr>
<tr>
<td>Furnish and install new metal plate expansion joint on vertical wall face.</td>
<td>$50,123</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Remove 1&quot; wide sealant and backer rod on vertical exterior concrete beams. Prepare joint to accept new sealant.</td>
<td>$960</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Furnish and install 1&quot; wide sealant joint and backer rod on exterior concrete beams.</td>
<td>$6,144</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Remove 1&quot; wide sealant and backer rod on vertical wall face. Prepare joint to accept new sealant.</td>
<td>$2,174</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$330,629</strong></td>
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### Phase II Expansion Joint

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Estimated Cost</th>
<th>Urgency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove existing expansion joint and associated block out. Install new cementitious block out and expansion joint.</td>
<td>$50,674</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Provide and install new expansion joint cover.</td>
<td>$44,684</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Provide and install new gutter under expansion joint.</td>
<td>$14,901</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$110,209</strong></td>
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<tr>
<td>Recommendation</td>
<td>Estimated Cost</td>
<td>Urgency</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td><strong>Phase I Finishes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare and apply elastomeric coating on CIP conc. walls, parapets, etc. (5</td>
<td>$108,997</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>story bldg.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare and apply clear water retardant sealer on PC conc. exposed aggregate</td>
<td>$95,237</td>
<td>Within 6 Years</td>
</tr>
<tr>
<td>finish (5 story bldg.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare and paint concrete and CMU walls at Level 4, Fan Room with interior</td>
<td>$9,141</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>paint.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repaint Level 5 ramp canopy frame</td>
<td>$33,600</td>
<td></td>
</tr>
<tr>
<td>Remove rust, prep and repaint guard and stair rails</td>
<td>$211,092</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>Repaint 2&quot; diameter handrail</td>
<td>$1,836</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$489,893</td>
<td></td>
</tr>
<tr>
<td><strong>Phase II Finishes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare and apply elastomeric coating on CIP conc. walls, parapets, etc. (5</td>
<td>$45,792</td>
<td>Within 5 Years</td>
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<tr>
<td>story bldg.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare and apply clear water retardant sealer on PC conc. exposed aggregate</td>
<td>$28,460</td>
<td>Within 5 Years</td>
</tr>
<tr>
<td>finish (2 story bldg.)</td>
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<tr>
<td><strong>Total</strong></td>
<td>$74,252</td>
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<tr>
<td><strong>Phase I Roofing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevator 1/2 and Star 1 - Reroof</td>
<td>$55,434</td>
<td>Within 2 Years</td>
</tr>
<tr>
<td>Elevator 3/4 and Star 1 - Reroof</td>
<td>$55,434</td>
<td>Within 2 Years</td>
</tr>
<tr>
<td>Elevator 3/4 Mach Room - Reroof</td>
<td>$6,150</td>
<td>Within 2 Years</td>
</tr>
<tr>
<td>Star 3 - Reroof</td>
<td>$19,098</td>
<td>Immediately</td>
</tr>
<tr>
<td>Star 4 - Reroof</td>
<td>$19,098</td>
<td>Immediately</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$155,214</td>
<td></td>
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<tr>
<td><strong>Phase II Roofing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevator 5/6 and Star 11 - Reroof</td>
<td>$55,344</td>
<td>Within 2 Years</td>
</tr>
<tr>
<td>Elevator 5/6 Mach Room - Reroof</td>
<td>$5,790</td>
<td>Within 2 Years</td>
</tr>
<tr>
<td>Star 12 - Reroof</td>
<td>$26,460</td>
<td>Within 2 Years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$87,594</td>
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<tr>
<td>Recommendation</td>
<td>Estimated Cost</td>
<td>Urgency</td>
</tr>
<tr>
<td>----------------</td>
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</tr>
<tr>
<td><strong>Phase I Doors, Frames, Door Hardware and Louvers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove existing 3x7’ single steel door, frame and HW</td>
<td>$1,141</td>
<td>Immediately</td>
</tr>
<tr>
<td>Install new 3x7’ 2-hour fire rated single steel door, frame and hardware.</td>
<td>$33,000</td>
<td>Immediately</td>
</tr>
<tr>
<td>Install new 3x7’ single steel door, frame and HW.</td>
<td>$15,000</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Remove existing 6x8’ pair steel door, frame and HW.</td>
<td>$152</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Replace with new 3 hour rated 6x8’ pair steel door, frame and hardware.</td>
<td>$5,400</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Paint 3x7’ single door and frame, interior and exterior faces.</td>
<td>$2,015</td>
<td>Immediately</td>
</tr>
<tr>
<td>Paint 6x8’ pair door and frame, interior and exterior faces</td>
<td>$3,30</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Remove and replace louver insect screens</td>
<td>$3,181</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Remove existing louvers at elev. penthouse, Replace with aluminum storm resistant louvers with insect screen.</td>
<td>$2,724</td>
<td>Within 5 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$82,922</td>
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</tr>
<tr>
<td><strong>Phase II Doors, Frames, Door Hardware and Louvers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paint 3x7’ single door and frame, interior and exterior faces.</td>
<td>$3,565</td>
<td>Within 2 years.</td>
</tr>
<tr>
<td>Paint 6x8’ pair door and frame, interior and exterior faces</td>
<td>$1,550</td>
<td>Within 2 years.</td>
</tr>
<tr>
<td>Adjust door and hardware</td>
<td>$2,400</td>
<td>Immediately</td>
</tr>
<tr>
<td>Remove and replace louver insect screens</td>
<td>$3,728</td>
<td>Within 2 years.</td>
</tr>
<tr>
<td>Remove existing louvers at elev. penthouse, Replace with aluminum storm resistant louvers with insect screen.</td>
<td>$2,724</td>
<td>Within 2 years.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$10,566</td>
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</tr>
<tr>
<td><strong>Phase I Planter/Makal-Mauka Walkway</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove existing grassing and planter mix material</td>
<td>$209,320</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Replace with new grassing and planter mix material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apply elastomeric traffic coating on concrete subgrade.</td>
<td>$225,798</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Remove sealant at wall/ slab joint. Prepare and apply new sealant and elastomeric traffic coating.</td>
<td>$57,289</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Remove existing horizontal waterproofing, protection board and 2” thick protective slab Furnish and erect new horizontal waterproofing and protection board.</td>
<td>$335,808</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Remove existing vertical waterproofing and protection board. Furnish and install new vertical waterproofing and protection board.</td>
<td>$33,000</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Remove existing expansion joint and associated door out. Install new cementious block out and expansion joint.</td>
<td>$2,216</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Provide and install new expansion joint cover.</td>
<td>$5,237</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Install new 24” high, exposed aggregate finished concrete knee wall.</td>
<td>$3,993</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$876,281</td>
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<tr>
<td>Recommendation</td>
<td>Estimated Cost</td>
<td>Urgency</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td><strong>Phase I Ventilation/Vertical Duct</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove damaged (holes) 5/8&quot; exterior gypsum soffit. Repair to match existing finish.</td>
<td>$72,000</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Repair surface damage (scratches) and refresh gypsum soffit.</td>
<td>$36,000</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Remove rusted or damaged drywall edge bead and replace with new. Refresh soffit finish.</td>
<td>$13,248</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Temporarily remove 2x2&quot; ventilation registers. Remove existing drywall to install new framing to support registers. Repair drywall and reinstall registers.</td>
<td>$64,512</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Paint drywall soffit (F.A.F.F.)</td>
<td>$131,376</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Install 2 hour fire rated CMU mechanical shaft enclosure</td>
<td>$73,415</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Install 4&quot; diameter bollards 2 each at shaft enclosure</td>
<td>$34,560</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Fire seal penetration holes in fire rated shaft enclosure</td>
<td>$2,555</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$427,665</td>
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<tr>
<td><strong>Phase I Pavement Striping and Markings</strong></td>
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<td></td>
</tr>
<tr>
<td>Repaint traffic area marks</td>
<td>$25,402</td>
<td>Immediately</td>
</tr>
<tr>
<td>Repaint directional floor markings</td>
<td>$39,600</td>
<td>Immediately</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$65,002</td>
<td></td>
</tr>
<tr>
<td><strong>Phase I Miscellaneous Repairs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove and reinstall asphalt speed bumps</td>
<td>$2,016</td>
<td>Immediately</td>
</tr>
<tr>
<td>Install and paint handrail at Electrical Room stairs</td>
<td>$711</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$2,727</td>
<td></td>
</tr>
<tr>
<td><strong>Phase II Miscellaneous Repairs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove existing fire extinguisher cabinet, replace with new stainless steel cabinet</td>
<td>$22,800</td>
<td>30% Immediately, Balance within 5 years.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$22,800</td>
<td></td>
</tr>
<tr>
<td><strong>Phase I Elevator Upgrades</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove existing louvers. Furnish and install aluminum storm resistant louvers with insect screen.</td>
<td>$12,967</td>
<td>To coincide with Elevator Upgrade.</td>
</tr>
<tr>
<td>Remove existing louvers. infill with 2 hour rated CMU wall.</td>
<td>$11,318</td>
<td>To coincide with Elevator Upgrade.</td>
</tr>
<tr>
<td>Remove existing 3x7&quot; single steel door, frame and HWV</td>
<td>$152</td>
<td>To coincide with Elevator Upgrade.</td>
</tr>
<tr>
<td>Install new 3x7&quot; 2-hour fire rated single steel door, frame and HWV</td>
<td>$6,600</td>
<td>To coincide with Elevator Upgrade.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$30,737</td>
<td></td>
</tr>
<tr>
<td>Recommendation</td>
<td>Estimated Cost</td>
<td>Urgency</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
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<tr>
<td>Phase I Elevator Lobby Upgrades</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storefront glazing Elev. 1/2</td>
<td>$46,595</td>
<td>To coincide with Elevator Upgrade</td>
</tr>
<tr>
<td>Storefront glazing Elev. 3/4</td>
<td>$46,595</td>
<td>To coincide with Elevator Upgrade</td>
</tr>
<tr>
<td>Storefront doors (3x5) Elev. 1/2</td>
<td>$23,760</td>
<td>To coincide with Elevator Upgrade</td>
</tr>
<tr>
<td>Storefront doors (3x5) Elev. 5/6</td>
<td>$23,760</td>
<td>To coincide with Elevator Upgrade</td>
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<tr>
<td>Total</td>
<td>$152,710</td>
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<td>Phase II Elevator Lobby Upgrades</td>
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<tr>
<td>Storefront glazing Elev. 5/8</td>
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<tr>
<td>Storefront doors (3x5) Elev. 3/4</td>
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<td>Total</td>
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<tr>
<td>Phase I Level 5 Stair No. 6 thru 10 Roof/Enclosure Upgrade</td>
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<tr>
<td>Stair 5 - Roof/Enclosure</td>
<td>$170,231</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Stair 6 - Roof/Enclosure</td>
<td>$170,231</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Stair 7 - Roof/Enclosure</td>
<td>$170,231</td>
<td>Within 5 years.</td>
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<tr>
<td>Stair 8 - Roof/Enclosure</td>
<td>$170,231</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Stair 9 - Roof/Enclosure</td>
<td>$170,231</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Stair 10 - Roof/Enclosure</td>
<td>$170,231</td>
<td>Within 5 years.</td>
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<td>Total</td>
<td>$1,021,387</td>
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<tr>
<td>Phase I Ventilation Soffit Demolition Work</td>
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<tr>
<td>Phase I Ventilation Soffit Demolition Remove existing soffit forward metal framing (24&quot; o.c.) suspension wiring (48&quot; o.c.)</td>
<td>$262,762</td>
<td>To coincide with removal of garage ventilation system.</td>
</tr>
<tr>
<td>Total</td>
<td>$262,762</td>
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</tr>
<tr>
<td>Phase II Metal Facing Sealant Replacement</td>
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<td></td>
</tr>
<tr>
<td>Phase II Metal Facing PC Panel/Door Coolant Replacement Remove 1&quot; wide sealant and backer rod on vertical PC panel face. Prepare joint to accept new sealant.</td>
<td>$11,620</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Furnish and install 1&quot; wide sealant joint and backer rod on vertical panel face</td>
<td>$51,610</td>
<td>Within 5 years.</td>
</tr>
<tr>
<td>Remove sealant and backer rod around doors</td>
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<tr>
<td>Furnish and seal all around doors</td>
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</tr>
<tr>
<td>Total</td>
<td>$64,297</td>
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Photo A1  Phase I, Level 5 waterproof coating delamination

Photo A2  Phase I, Level 5 waterproof coating delamination
Photo A3  Phase I, Expansion joint failure and concrete spall

Photo A4  Phase I, Expansion joint failure and concrete spall
Photo A5  Phase I, Level 5 deck drainage hole

Photo A6  Phase I, Level 4 Ponding Water under Deck Drain Hole
Photo A7     Phase I, Stair No. 8, Level 5 deck sloping towards stair opening.

Photo A8    Phase I, Stair No. 5, water stains on wall, view from Level 4
Photo A9     Phase I, Stair No. 7, ponding water at Level 3 landing

Photo A10    Phase I, Level 5, top of ramp, no waterproofing
Photo A11  Phase I, Level 5, top of ramp, no waterproofing

Photo A12  Phase I, Level 4, water stains on wall under ramp to Level 5.
Photo A13  Phase I, Level 4 Mauka-Diamond Head Fan Room floor. Coating deteriorated.

Photo A14  Phase I, Level 4 Mauka-Ewa Fan Room floor. Mold and algae on coating.
Photo A15  Phase II, Level 5, Elastomeric coating split at control joint.

Photo A16  Phase II, Level 5, Elastomeric coating split at deck perimeter.
Photo A17  Phase II, Level 5, Elastomeric sealant joint failure at Stair No. 11.

Photo A18  Phase II. Level 5, Elastomeric coating wear at top of ramp.
Photo A19  Phase II, Level 5, Elastomeric coating missing.

Photo A20  Phase II, Level 5, Sealant failure at wall/deck joint.
Photo A21  Phase I, Level 5 Elastomeric deck coating failure at expansion joint.

Photo A22  Phase I, Level 5 Elastomeric deck coating failure at expansion joint.
Photo A23  Phase I, Level 5 Open vertical expansion joint

Photo A24  Phase I, Level 5, Open vertical expansion joint, water stain and concrete spall.
Photo A25  Phase I, Level 5 Miss aligned expansion joint

Photo A26  Phase I, Level 5 Miss aligned expansion joint.
Photo A27   Phase I, Level I Water stain on beams at garage ramp to Level 2

Photo A28   Phase I, Level I water stains at slab, beam and beam at ramp to Level 2.
Photo A29  Phase I, Level 4 Pourable sealant expansion joint

Photo A30  Phase I, Level 2, Pourable sealant. Brass cover plate at section below.
Photo A31  Phase I, Level 2, Expansion joint and cement block out damage.

Photo A32  Phase I, Level 3, Expansion joint and cement block out damage.
Photo A33  Phase I, Level 2 Steel angle with sealant expansion joint at ramp.

Photo A34  Phase I, Level 3 Steel angle with sealant expansion joint at ramp.
Photo A35  Phase I Level 4, Failed sealant joint.

Photo A36  Phase I, Level 4, Failed sealant and concrete stall at expansion joint.
Photo A37  Phase I, Ewa, Level 3 Perimeter Expansion Joint

Photo A38  Phase I, Diamond Head, Level 2, Spandrel beam expansion joint.
Photo A39  Phase II, Level 5, Missing sealant at expansion joint fasteners.

Photo A40  Phase II, Level 5, Gap in expansion joint cover.
Photo A41  Phase II, Level 5, Rusted expansion joint fasteners and gap in expansion joint.

Photo A42  Phase II, Level 2, Gap in expansion joint cover.
Photo A43  Phase I, CIP conc. exposed aggregate spandrel/smooth finish columns

Photo A44  Phase I, Precast exposed aggregate concrete spandrel panels
Photo 4A5  Phase II, Cast in place smooth faced concrete columns, beams and walls.

Photo A46  Phase II, Precast exposed aggregate finish.
Photo A47  Phase I Cast in place (CIP) smooth and exposed aggregate finish

Photo A48  Phase I Precast (PC) exposed aggregate finish.
Photo A49  Phase I, Ewa Elevation, Concrete spall at expansion joints

Photo A50  Phase I, Diamond Head Elevation, Concrete spall at expansion joints.
Photo A51  Phase I, Level 2, Diamond Head elevation, concrete spall at guardrail.

Photo A52  Phase I, Level 5, Ewa planter, concrete spall at planter guardrail.
Photo A53  Phase I, Stair No. 9, Concrete spall at guardrail.

Photo A54  Phase I, Stair No. 10, Concrete spall at guardrail.
Photo A55  Phase I, Stair No. 4, Concrete spall on fascia.

Photo A56  Phase I, Level 5, Elevator 3/4 Lobby, Concrete spall on fascia.
Photo A57    Phase I, Level 5, Scour at concrete posts.

Photo A58    Phase I, Level 2, Diamond Head Atrium, Concrete spall at concrete post.
Photo A59  Phase I, Mauka Elevation, Concrete patch

Photo A60  Phase II, Makai Elevation, Concrete patch.
Photo A61  Phase I, Stair No. 2, Concrete wall.

Photo A62  Phase I, Elevator 1/2 and Stair 1 Roof
Photo A63  Phase I, Elevator 3/4 and Stair 2 Roof

Photo A64  Phase I, Elevator 3/4 Machine Room Roof
Photo A65  Phase II, Elevator 5/6 and Stair 11 Roof

Photo A66  Phase II, Elevator 5/6 Roof
Photo A69  Phase I, Stair No. 4 Roof

Photo A70  Phase I, Level 5 Ramp Canopy Roof
Photo A73  Phase I, Level 5 Ramp Canopy Rainleader

Photo A74  Phase I, Level 5 Ramp Canopy Downspout
Photo A75    Phase I, Level 2 Stair 4 Door.

Photo A76    Phase I, Level 1 Elevator 3/4 Machine Room Door.
Photo A77  Phase I, Level 1, Storeroom Door

Photo A78  Phase I, Level 1, Electrical Room Door
Photo A83  Phase I, Level 4 Sheet metal gutter under planter/expansion joint.

Photo A84  Phase I, Level 4 Ponded water under planter/expansion joint.
Photo A85    Phase I, Level 4 Water stains at Stair No. 1

Photo A86    Phase I, Level 4 Soffit water damage.
Photo A87  Phase I, Level 4, PVC gutter under precast member panel joint.

Photo A88  Phase I, Level 4, Soffit damage.
Photo A91  Phase I, Level 4, Rust on Diamond Head facing soffit edge.

Photo A92  Phase I, Level 4, Detached metal vents.
Photo A93  Phase I, Level 4, Soffit vent framing.

Photo A94  Phase I, Level 2, Vertical ventilation duct.
Photo A95     Phase I, Level 1, Parking Striping

Photo A96     Phase I, Level 1, Crosswalk Markings
Photo A97  Phase I, Level 1, Directional Marking

Photo A98  Phase II, Level 1, Parking Stall
Photo A99  Phase II, Level 2, Crosswalk Marking

Photo A100  Phase II, Level 1, Directional Marking
Photo A101  Phase I, Level 4, Ventilation Fan Room

Photo A102  Phase I, Level 3 Missing Speed Bump
PHASE I & PHASE II PARKING STRUCTURE CONDITION SURVEY REPORT  
PROJECT NO. UHM 001A-006-11  

Photo A103  Phase II, Level 5 Fire Extinguisher Cabinet

Photo A104  Phase II, Makai Pre-cast Panel Sealant Joint
5.0 STRUCTURAL

5.1 Scope of Structural Condition Survey

This section contains the structural assessment of the following items at the Phase I and Phase II parking structure:

A. Concrete delaminations/spalls in the deck, precast-prestressed elements, beams, columns, walls, parapets and stairs.

B. Metal guardrails and handrails

C. Steel framed roof structure at the 5th level of the Phase I parking structure

D. Light standards at the 5th level

E. Expansion joints

5.2 Concrete Delaminations / Spalls:

Definition: No distinction was made between a delamination or spall since the repair of either one is the same.

Given the age of the structure, especially the Phase I portion of the parking structure, additional spalls should be anticipated in the future due to active corrosion of embedded ferrous metals (embedded railing posts and reinforcing bars). The spalls that develop would be similar to those observed during this condition survey. A majority of the concrete deterioration that has occurred was observed at the Phase I parking structure. Preventative measures can be taken to slow down the rate of corrosion but will be difficult and costly to halt or stop the corrosion. Consequently, additional concrete spalls should be anticipated in the future and will be a continuous maintenance item. We recommend periodic inspection of the parking structure on a 5-year cycle to identify new areas where concrete spalls will develop and to initiate maintenance repairs.

Estimated cost to repair the concrete spalls observed in this condition survey = $500,000.

The following is a summary assessment of the delaminations/spalls in the various concrete elements:

A. Concrete Deck:

The deck of the parking structure consists of a composite concrete topping cast on precast, prestressed concrete elements. The concrete topping is in satisfactory to fair condition. The concrete topping is sound but has minor spalls with exposed rebars scattered throughout at all levels with a the majority of deck spalls located in the Phase I parking structure (See Photo S1 to S4). Corrosion of the rebars is present, but loss of section due to corrosion does not significantly affect the overall strength of the deck. A number of the deck spalls are found where the metal guardrail and handrail posts are embedded in the concrete deck (See Photo S5 to S7). These spalls resulted from reactivity of the aluminum posts with concrete and corrosion of the embedded steel metal posts. Other
deck spalls where reinforcing bars are exposed is primarily due to insufficient concrete cover over the reinforcing bars. The present deck spalls are not a high priority repair item. Repairs can be programmed to be made over the next 5 years.

B. Precast, Prestressed Concrete Elements:

The precast, prestressed concrete elements are in satisfactory condition (See Photo S8 to S11). These elements show minor deterioration in the form of hairline cracks some with efflorescence but the observed cracks do not affect their strength and/or serviceability. No repairs are required.

C. Concrete Beams and Columns:

The reinforced concrete beams and columns are in satisfactory to fair condition. Minor cracks and spalls with exposed rebars are present but they do not significantly affect the strength of the members (See Photo S12 to S20). The exposed rebars are either a beam stirrup or a column tie. No beam flexural reinforcing bars or column vertical reinforcing bars are exposed. The present beam and column spalls are a medium priority repair item. Repairs can be programmed to be made over the next 5 years.

D. Concrete Parapets and Concrete Guardrail Posts:

The concrete parapets and concrete guardrail posts are in fair condition. Cracks and spalls with exposed rebars are present but they do not significantly affect the strength and/or serviceability of the element (See Photo S21 to S26). The present spalls are a medium priority repair item. Repairs can be programmed to be made over the next 5 years.

E. Concrete Stairs, Stair Wells and Roof Slab:

The concrete stair well walls are in good to satisfactory condition with only minor hairline vertical and diagonal cracks that do not affect the strength of the walls. No repairs are required.

The concrete stairs and roof slab are in fair condition. Most of the spalls observed in the stairs are caused by corrosion of the metal handrail posts embedded along the sides of the concrete stairs (See Photo S27 to S29). The present spalls in the concrete stairs and roof slab are not a high priority repair item. Repairs can be programmed to be made over the next 5 years.

5.3 Metal Guardrail and Handrail:

The metal guardrails located around the perimeter of the parking structure, deck openings and handrails at the stairs are fabricated of painted steel in the Phase I parking structure and aluminum in the Phase II parking structure. The aluminum guardrails and handrails are in good condition with only minor deterioration. A 25’ length of railing at the center of the Phase II parking structure between levels 1 and 2 has sustained collision damage (See Photo S30). The damaged section of railing has been marked with yellow warning tape. The painted steel guardrails and handrails are in fair condition. Active corrosion of the steel railings is occurring primarily at the base of the
railing posts resulting in spalling of the concrete around the posts (See Photo S27 to S29). At a few locations the steel stair handrailings were severely corroded (See Photo S31 to S33). Minor collision damage was observed at two locations where the vertical steel rods were bent out of vertical alignment (See Photo S34 and S35). The paint on the steel railings was chalking, cracking and peeling especially where the railings are exposed to weather (See Photo S36 to S38). The corroded steel railings are in need of repair and repainting. Because the guardrails and handrails are a safety element, repairs should be programmed for the next 1 to 2 years and coordinated with the concrete spalls around the post bases.

Estimated cost to repair the metal railings observed in this condition survey = $230,000.

5.4 Steel Framed Roof

The steel framed roof over the central ramp at the 5th level of the Phase I parking structure is in fair condition. The structural steel tube steel columns, wide flange roof beams and light gage zee-purlins have active corrosion (See Photo S39 to S41). Surface or freckled rust is prevalent. The corrosion of the column base plates is severe causing some section loss but does not appear to have significantly affected the structural capacity (See Photo S42 and S43). The corrugated metal roof decking shows signs of active corrosion at the fasteners and surface or freckled rust on the undersides of the decking (See Photo S41). The metal gutters and downspouts are in poor condition. Severe corrosion of the gutters and downspouts has caused perforations through these elements which has impacted the serviceability of the gutters and downspouts (See Photo S39, S44 and S45). The paint on the steel frame members was chalking with some areas of exposed metal showing evidence of paint system distress. The metal roof deck should be replaced, as well as the gutters and downspouts. The steel frame should be cleaned and repainted. The repair/maintenance work is a medium priority item. Due to active corrosion and to minimize further deterioration of the structure, repair/maintenance should be programmed to be done over the next 1 to 2 years.

Estimated cost to repair and repaint the metal roof structure at the 5th level of the Phase I parking structure = $250,000.

5.5 Light Standards

An inspection of the light standards at the 5th level of the parking structure was conducted to assess the condition of the base plates and anchor bolts connecting the light poles to the top of the concrete pedestal supports. We were unable to remove some of the cover assemblies concealing the base plates because the screws securing the cover assembly to the base of the light pole was either frozen or stripped. The majority of the light pole base plates and anchor bolts observed were in good to satisfactory condition with some minor deterioration. Only 2 light poles at the Ewa end of the Phase II parking structure had severely corroded anchor bolts (See Photo S46 and S47). Some of the cover assembly connection plates which secure the cover assembly to the base of light pole are severely corroded, but the corrosion of this element does not affect the structure support of the light poles (See Photo S48). The repair of the corroded anchor bolts at the 2 light poles at the Ewa end of the Phase II parking structure is a high priority repair. Repairs should be done within 1 year. The repair of the corroded cover assembly connection plates is not a high priority item.
Repairs can be programmed over 5 years. Maintenance should be performed however to clean out the accumulated rust products from around the base plate.

Estimated cost to repair the corroded light standard bases observed in this condition survey = $17,000.

5.6 Expansion Joint

The expansion joints showed signs of deterioration with adhesion failure resulting in joint leakage. The added metal cover plates are missing over sections of the expansion joint at the 2nd and 3rd levels of the Phase I parking structure (See Photo S49 to S51). Minor spalls in the desk are present adjacent to the joint (See Photo S52 and S53). The repairs to the expansion joints are not a high priority item. Repairs to the expansion joints should coincide with the deck spall repairs.

The horizontal expansion joint in the deck is not aligned with the vertical expansion joint in the concrete parapet wall at 5th level deck at the Phase I parking structure (See Photo S26).

Estimated cost to repair the deteriorated expansion joints observed in this condition survey = $62,000.
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<tbody>
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<td>Railings - Phase II</td>
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<td>Concrete Spalls Phase I</td>
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<td>Concrete Spalls Phase II</td>
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<tr>
<td>Metal Roof at 5th Level Phase I</td>
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<td>Metal Roof at 5th Level Phase II</td>
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<td>Light Standards Phase II</td>
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NA = Not Applicable

**TOTAL** $1,070,000.00
PHOTO S1  TYPICAL DECK SPALLS WITH EXPOSED REINFORCING AT LEVEL 2, PHASE I PARKING STRUCTURE

PHOTO S2  TYPICAL DECK SPALL WITH EXPOSED REINFORCING AT LEVEL 3, PHASE I PARKING STRUCTURE
PHOTO S3  TYPICAL DECK SPALLS WITH EXPOSED REINFORCING AT LEVEL 4, PHASE I PARKING STRUCTURE

PHOTO S4  TYPICAL DECK SPALL WITH EXPOSED REINFORCING AT LEVEL 5, PHASE I PARKING STRUCTURE
PHOTO S5   TYPICAL CONCRETE SPALL AT BASE OF EMBEDDED RAILING POST

PHOTO S6   TYPICAL CONCRETE SPALL AT BASE OF EMBEDDED CORRODED STEEL
            HANDRAIL POST AT STAIRS
PHOTO S7  TYPICAL DELAMINATION AND RUST STAIN AT BASE OF EMBEDDED CORRODED STEEL RAILING POST

PHOTO S8  TYPICAL VIEW OF PRECAST, PRESTRESSED TRI-TEES AT PHASE I PARKING STRUCTURE (SEE PHOTO 9)
PHOTO S9  CLOSE-UP VIEW OF PRECAST, PRESTRESSED TRI-TEES

PHOTO S10  TYPICAL VIEW OF HOLLOW CORE PLANKS AT PHASE II PARKING STRUCTURE (SEE PHOTO 11)
PHOTO S11  CLOSE-UP VIEW OF HOLLOW CORE PLANKS

PHOTO S12  TYPICAL DELAMINATION AT BASE OF 1ST LEVEL CONCRETE COLUMN AT PHASE I PARKING STRUCTURE
PHOTO S13  TYPICAL DELAMINATION AT BASE OF 3rd LEVEL CONCRETE COLUMN AT PHASE I PARKING STRUCTURE

PHOTO S14  TYPICAL DELAMINATION AT BASE OF 4th LEVEL CONCRETE COLUMN AT PHASE I PARKING STRUCTURE
PHOTO S15 TYPICAL SPALL WITH EXPOSED REINFORCING (COLUMN TIES) IN 4TH LEVEL COLUMN AT PHASE I PARKING STRUCTURE

PHOTO S16 TYPICAL HAIRLINE CRACKS IN CONCRETE BEAM AT WEST SIDE OF PHASE I PARKING STRUCTURE
PHOTO S17  TYPICAL SPALL WITH EXPOSED REINFORCING (BEAM STIRRUPS) IN 5TH LEVEL BEAM SOFFIT AT PHASE I PARKING STRUCTURE

PHOTO S18  TYPICAL SPALL WITH EXPOSED REINFORCING (BEAM STIRRUPS) IN 5TH LEVEL BEAM SOFFIT AT PHASE I PARKING STRUCTURE
PHOTO S19  TYPICAL SPALL WITH EXPOSED REINFORCING (BEAM STIRRUPS) IN 5TH LEVEL BEAM SOFFIT AT PHASE I PARKING STRUCTURE

PHOTO S20  TYPICAL SPALL WITH EXPOSED REINFORCING (BEAM STIRRUPS) IN 4TH LEVEL BEAM SOFFIT AT PHASE I PARKING STRUCTURE
PHOTO S21 VERTICAL CRACK AND SMALL SPALLS WITH EXPOSED REINFORCING IN TOP OF CONCRETE PARAPET AT 2ND LEVEL OF PHASE I PARKING STRUCTURE

PHOTO S22 MAP CRACKING AND TYPICAL SPALL WITH EXPOSED REINFORCING IN CONCRETE RAILING POST AT 3RD LEVEL OF THE PHASE I PARKING STRUCTURE
PHOTO S23  TYPICAL SPALL WITH EXPOSED REINFORCING IN CONCRETE RAILING POST AT 4TH LEVEL OF THE PHASE I PARKING STRUCTURE

PHOTO S24  TYPICAL SPALL IN CONCRETE RAILING POST AT 4TH LEVEL OF PHASE I PARKING STRUCTURE
PHOTO S25  TYPICAL DELAMINATION/SPALL IN CONCRETE RAILING POST AT 5TH LEVEL OF PHASE II PARKING STRUCTURE

PHOTO S26  SPALL IN CONCRETE PARAPET WALL AT 5TH LEVEL OF PHASE I PARKING STRUCTURE
PHOTO S27  TYPICAL SPALL WITH EXPOSED REINFORCING AT EMBEDDED CORRODED STAIR HANDRAIL POST

PHOTO S28  TYPICAL SPALL WITH EXPOSED REINFORCING AT EMBEDDED CORRODED STAIR HANDRAIL POST
PHOTO S29  TYPICAL SPA LL WITH EXPOSED REINFORCING AT EMBEDDED CORRODED STAIR HANDRAIL POST

PHOTO S30  COLLISION DAMAGE TO ALUMINUM RAILING AND FIRE HOSE CABINET IN PHASE II PARKING STRUCTURE
PHOTO S31  CORROSION ALONG TOP OF RAILING AT 5TH LEVEL OF PHASE I PARKING STRUCTURE

PHOTO S32  SEVERE CORROSION OF STAIR HANDRAIL
PHOTO S33  SEVERE CORROSION OF STAIR HANDRAIL

PHOTO S34  COLLISION DAMAGE TO STEEL RAILING AT 3RD LEVEL OF PHASE I PARKING STRUCTURE
PHOTO S35  COLLISION DAMAGE TO STEEL RAILING AT 5\textsuperscript{TH} LEVEL OF PHASE I PARKING STRUCTURE

PHOTO S36  TYPICAL DETERIORATION OF PAINT ON METAL RAILING
PHOTO S37  TYPICAL DETERIORATION OF PAINT ON METAL RAILING

PHOTO S38  TYPICAL DETERIORATION OF PAINT ON METAL RAILING
PHOTO S39  TYPICAL CORROSION OF STEEL COLUMN, BEAM AND DOWNSPOUT

PHOTO S40  TYPICAL CORROSION OF STEEL COLUMN, BEAM AND DOWNSPOUT
PHOTO S41  TYPICAL CORROSION OF LIGHT GAGE PURLINS AND METAL DECKING CONNECTION TO PURLINS

PHOTO S42  CORROSION OF COLUMN BASE PLATE
PHOTO S43  CORROSION OF COLUMN BASE PLATE

PHOTO S44  SEVERE CORROSION OF DOWNSPOUT
PHOTO S45  TYPICAL SEVERE CORROSION OF GUTTER

PHOTO S46  SEVERE CORROSION OF ANCHOR BOLTS AT BASE OF LIGHT STANDARD AT PHASE II PARKING STRUCTURE
PHOTO S47  SEVERE CORROSION OF ANCHOR BOLTS AT BASE OF LIGHT STANDARD AT PHASE II PARKING STRUCTURE

PHOTO S48  TYPICAL SEVERE CORROSION OF CONNECTOR PLATE FOR COVER ASSEMBLY
PHOTO S49  MISSING ADDED COVER PLATE OVER EXPANSION JOINT AT 2ND LEVEL OF PHASE I PARKING STRUCTURE

PHOTO S50  TYPICAL ADDED STEEL COVER PLATE OVER EXPANSION JOINT AT PHASE I PARKING STRUCTURE
PHOTO S51  MISSING ADDED COVER PLATE OVER EXPANSION JOINT AT 2ND LEVEL OF PHASE I PARKING STRUCTURE

PHOTO S52  DELAMINATION AND SPALLS ALONG EXPANSION JOINT SHOWN IN PHOTO 51
PHOTO S53  TYPICAL SPALLS ALONG EXPANSION JOINT AT 4TH LEVEL OF PHASE I PARKING STRUCTURE
6.0 MECHANICAL

6.1 Scope of Mechanical Condition Survey

The mechanical scope of work includes the assessment of existing system conditions and recommendations for repair/replacement of the parking structure ventilation system, storm drain piping system, domestic cold water piping system, elevator sump pump system, and emergency generator auxiliary systems.

6.2 Description of Existing Mechanical Systems:

A. Ventilation Systems:

The existing ventilation systems installed at the parking structure include the Phase I parking structure ventilation system, Phase I parking structure electrical room ventilation system, and Phase II parking structure electrical room ventilation system.

1. Phase I Parking Structure Ventilation System:

The Phase I parking structure ventilation system consists of sixteen (16) tubeaxial exhaust fans, sound attenuators, ductwork, ceiling plenums, exhaust registers and carbon monoxide monitoring and control system. There are four fan rooms located on the 4th level spaced evenly throughout the structure. Each fan room functions as a discharge plenum and exhausts air at the fifth level through grated discharge openings. In each fan room, four exhaust fans are connected in parallel to an intake plenum which then connects to a duct riser that goes down to the first level ceiling. At each level, the duct riser is connected to a ceiling plenum that extends about 200 feet. Exhaust air registers are spaced evenly in each ceiling plenum to draw exhaust air from each level. The carbon monoxide monitoring and control system is a packaged unit consisting of a vacuum pump, flow meters, switching valves, and infrared analyzer. Based on the control diagram on the reference drawings, it appears air samples are drawn from each level by the vacuum pump through copper tubing and are sequentially analyzed for carbon monoxide. If the sample exceeds the setpoint, the controller switches the fan to high speed for a timed period. The drawings indicate that all fans should be running at low speed under normal conditions.

2. Phase I Parking Structure Electrical Room Ventilation System:

The phase 1 parking structure electrical room ventilation system consists of one tubeaxial exhaust fan and ductwork. The exhaust fan is located in an adjacent storage room and draws air from the electrical room through a wall mounted exhaust air register. The discharge side of the fan is connected to a plenum and air register that discharges the warm air into the storage room. The storage room has a wall louver on an exterior wall that allows the exhaust air to transfer outside. The exhaust system is controlled by a thermostat located in the electrical room.
3. **Phase 2 Parking Structure Electrical Room Ventilation System:**

   The phase 2 parking structure electrical room ventilation system consists of one inline centrifugal exhaust fan and ductwork. The exhaust fan is located in an adjacent storage room and draws air from the electrical room through a wall mounted exhaust air register. The discharge side of the fan is connected to ductwork that discharges the exhaust air to wall louvers. The exhaust system is controlled by a thermostat located in the electrical room.

B. **Storm Drain and Overflow Drain System:**

   The Phase 1 portion of the parking structure has 23 existing storm drain risers spaced throughout the parking structure. The Phase 2 portion of the parking structure has 19 existing storm drain risers and 7 existing overflow drain risers spaced throughout the parking structure.

   The storm drain risers collect water from deck drains and planter drains on the 5th level and convey it to storm drain mains at ground level, or to grade via splash blocks.

C. **Domestic Cold Water System:**

   The Phase 1 portion of the parking structure has 18 cold water risers spaced throughout the structure supplying hose bibbs for utility use on each level. The Phase 2 portion of the parking structure has 4 cold water risers spaced throughout the structure supplying hose bibbs for utility use on each level. The cold water risers are copper piping supplied from the ground level. The cold water system also supplies water to the irrigation system on the 1st and 5th levels.

D. **Elevator Sump Pump System:**

   Elevators are numbered as follows: Phase 1 makai (closest to Stan Sheriff center) are numbered elevators 1/2, Phase 1 mauka are numbered elevators 3/4, and Phase 2 mauka are numbered elevators 5/6.

   Each elevator hoistway has a pit with an approximate 2’ x 2’ sump with sump pump. The sump pumps are Hydromatic model OSP50 with diaphragm pressure level switch. All three sump pumps appear to be the same model.

   Discharge piping is a mix of PVC, ABS, copper and cast iron. 2” sump pump discharge piping runs mauka from elevator shaft 1/2 towards elevator shaft 3/4 where it connects to discharge pipe for elevator shaft 3/4, then travels Ewa toward phase 2 storage room. 2” sump pump discharge piping runs DH from elevator shaft 5/6 towards phase 2 parking structure storage room. Both pipes terminate above a floor sink in phase 2 parking structure storage room. Drawings show the floor sink is connected to sanitary piping.

E. **Emergency Generator Auxiliary Systems:**

   The existing emergency generator is located in a generator room in Phase 2 parking structure. The generator itself is addressed in the electrical section of
this study. The generator auxiliary systems consist of intake ductwork, engine exhaust piping, and fuel supply piping.

1. Galvanized steel intake ductwork is connected between the engine radiator and an exterior wall louver.

2. The engine exhaust manifolds are connected to the exhaust muffler with flexible corrugated metallic connectors and Y-fitting. The muffler is connected to generator exhaust piping which is insulated and jacketed.

3. The engine fuel supply is propane. Propane cylinders are stored in an exterior CMU enclosure adjacent to the generator room. Cylinders are connected to a black steel propane supply piping manifold with ball shut-off valves. Propane supply piping is routed to a regulator, a solenoid shut-off valve, then to the generator. The piping is connected to the generator subbase with a braided metallic flexible connector, and further connected to the engine with two rubber flex hoses.

6.3 Condition Assessment of Existing Mechanical Systems:

A. Ventilation Systems:

1. Phase 1 Parking Structure Ventilation System – See Photos
   a. Fans – Only a few fans were running during the field visit. Some fan starters were in the off position, indicating that they are not functioning automatically as designed and may be isolated because they are not operational. The flexible connections at fan inlet and discharge flanges are deteriorated with large holes. Some vibration spring isolators have baseplates that have corroded away completely, and spring coils that are very corroded.
   b. Sound attenuators – The casings and perforated inner liners of the sound attenuators are corroded, some severely enough that the casing and liner has rusted through completely, exposing the fiberglass media.
   c. Carbon monoxide monitoring and control system – The control system does not appear to be functioning. The unit has power, but the vacuum pump is not running and the unit is not sampling any air samples.
   d. Exhaust air registers – There are a total of 488 exhaust air registers. There are 112 exhaust air registers on the 4th level, 128 exhaust air registers on the 3rd level, 128 exhaust air registers on the 2nd level, and 120 exhaust air registers on the 1st level. Of those, 214 exhaust air registers are damaged and 14 exhaust air registers have been removed and the ceiling patched. The ceiling plenum is damaged in 175 places.

2. Phase 1 Parking Structure Electrical Room Ventilation System
The existing tubeaxial exhaust fan is operational and in fair condition. The inlet duct connection to the fan is misaligned. The flexible connections to the fan are deteriorated and starting to tear. The discharge plenum shows signs of corrosion.

3. Phase 2 Parking Structure Electrical Room Ventilation System
The existing inline centrifugal exhaust fan and ductwork are in very good condition.

B. Storm Drain and Overflow Drain System – See Photos

The Phase 1 parking structure horizontal storm drain piping at the 4th floor ceiling (from 5th floor deck and planter drains) shows longitudinal cracks in pipe and fittings in the vicinity of gridline 3. Several sections of piping have already been replaced with a combination of ABS, PVC and cast iron. Pipes passing through the beams are routed through cored holes which were then grouted in place.

One penetration has shifted such that the grout plug is extending past the beam face on one side and recessed on the other, indicated relative movement between structure and piping.

The riser clamps for the storm drain piping risers are corroded.

Horizontal storm drain piping is inadequately supported with pipe hangers. Cast iron no-hub piping is not supported at each joint, and there are sections of plastic piping showing signs of sagging and slope reversal.

There are a few leaking joints.

The existing vertical storm drain pipe risers show signs of surface corrosion which is mostly cosmetic in nature. There are a few risers with heavier corrosion. The top half of horizontal storm drain piping also shows signs of surface corrosion which is mostly cosmetic in nature. There are localized locations of heavier corrosion caused by water leaks from above.

There is one broken no-hub coupling clamp.

There is one area where a 5” deck drain is connected to 8” piping, which then connects to 5” riser.

Existing drain inlets are covered to varying degrees with vegetation and dirt.

C. Domestic Cold Water System – See Photos

There are a few areas where the external piping corrosion appears heavy and caked, possibly indicating a leak.

The riser clamps for the copper piping risers are corroded or missing. It appears the steel riser clamps are deteriorating due to galvanic corrosion from contact with the copper piping.
All of the clevis type pipe hangers for the horizontal copper piping are corroded. It appears the steel pipe hangers are deteriorating due to galvanic corrosion from contact with the copper piping. The spacing for pipe hangers exceeds the recommended spacing for a given pipe size and additional hangers are required. There are some areas where the piping has been bent, possibly by someone hanging on it.

There is one area where the piping appears bent due to damage from a car. There is one 4" gate valve that is corroded.

The hose bibbs are a mixture of types – some with fixed handles, some with removable handles, some are missing handles, a few with vacuum breakers, but most without vacuum breakers. Many hose bibbs are missing.

The cold water connections to the irrigation system have the proper backflow prevention devices – either a reduced pressure backflow preventer (RPBP) or atmospheric vacuum breakers. There are a few irrigation valves that are leaking.

D. Elevator Sump Pump System – See Photos

The existing elevator sump pumps appear in good condition. Pump discharge piping has a bronze lift type check valve with copper pipe nipples, but no gate valve.

The sump pump discharge piping does not go through an oil water separator prior to discharging into the existing floor sink.

The sump grates do not sit correctly in the sump recess due to interference with brackets and piping.

1. Sump grate 1/2 hits a steel bracket and doesn’t quite sit flush in recess.

2. Sump grate 3/4 was sitting on top of sump pump electrical and pressure switch cables, pinching the cables. Cables were moved clear of grating and cable insulation appears intact. Grate sits flush in recess.

3. Sump grate 5/6 was found leaning up against the elevator shaft wall. Grate has an insufficient cutout for discharge pipe that prevents grate installation.

E. Emergency Generator Auxiliary Systems – See Photos

1. Galvanized steel intake ductwork is in good condition.

2. Exhaust system - The flexible corrugated metallic connectors for the exhaust system do not have a protective mesh enclosure around them for personnel protection as indicated on the drawings. The generator exhaust piping terminates at a rain cap at the 2nd floor level, adjacent to open stairway.

3. The propane supply ball shut-off valves were shut at the time of the field visit, and UH Parking personnel indicated generator was not operational.
due to water pump failure. The propane supply rubber flex hoses (2 each) to the engine are stiff and appear kinked.

6.4 Recommendations for Mechanical Systems:

Recommendations are categorized by capital improvement and maintenance. Estimated costs are only provided for those recommendations involving capital improvement. It is assumed UH Parking and Transportation Services does general maintenance of the piping, valves, etc.

A. Ventilation System:

UH asked if the parking structure ventilation system was still required by current code and whether the system needed to be repaired or replaced.

TEC researched the regulations in effect on the Phase 1 date of design to determine if the ventilation system was required at the time. It appears that for a design date of 1973, Public Health Regulations, Chapter 28, dated 1964 would be applicable. In that edition of the regulations, there appears to be a ventilation requirement of 3 CFM/SF for garages. There is no distinction between open and closed garages.

Based on the current edition of Title 11, Chapter 39, section 13, Garage Ventilation, a ventilation system would not be required for the parking structure since 1) more than half the wall area is open, in a wall length of at least forty percent of the perimeter, 2) there is no parking attendant or other employee normally working in the space, and 3) there is no unusual or irregular shape of the level that would prevent natural air motion.

TEC sent a memorandum to the State Department of Health, Indoor and Radiological Health Branch and obtained concurrence that the existing system is not required under current regulations and the system does not need to be replaced, see attached memorandum.

If desired, the following items are required to replace the system:

Capital Improvements:

1. 16 tube axial fans, sound attenuators and spring vibration isolators.
2. 2-speed fan starters.
3. Direct digital control (DDC) system.
4. Carbon monoxide sensing system with local sensors and transmitters.
5. Repair gypboard ceiling plenums. Replace all exhaust air registers.
6. Provide shaft enclosure for duct riser and fire/smoke dampers where required.
Maintenance:

For Phase 1 Electrical Room Ventilation System – Correct misalignment at fan inlet. Replace flexible connections at fan inlet and discharge flanges. Clean and paint discharge plenum.

B. Storm Drain and Overflow Drain System:

Capital Improvements:

1. Replace all Phase 1 horizontal storm drain piping with ABS piping for added flexibility. Provide adequate pipe hanger supports. Where piping penetrates beams, leave existing cored holes ungrouted to minimize relative movement between structure and piping. Connect new ABS piping to existing deck drain nipples and to fittings at vertical cast iron risers.

2. Replace corroded sections of vertical cast iron risers.

3. Replace all riser clamps on the existing vertical cast iron risers.

4. Provide additional pipe hangers at existing cast iron piping joints in accordance with the Cast Iron Soil Pipe and Fittings Handbook.

5. Repair leaking joints.

6. Replace section of 8” piping that is connected to 5” riser.

Maintenance:

1. Clean and paint areas of localized pipe corrosion caused by leaks from above.

2. Clean drain inlets of vegetation and dirt.

3. Replace broken no-hub coupling clamp.

C. Domestic Cold Water System:

Capital Improvements:

1. Repair all leaking piping.

2. Replace all riser clamps on the copper risers with new riser clamps to ensure piping is properly supported. Provide proper dielectric insulation between steel and copper materials.

3. Replace all pipe hangers on the horizontal copper water pipe with new pipe hangers and at the correct maximum spacing to ensure piping is properly supported. Provide proper dielectric insulation between steel and copper materials.
4. Replace damaged piping.
5. Replace corroded gate valve.
6. Replace all hose bibbs with vacuum breaker type, with removable key handle and lockshield.

Maintenance:
1. Replace/repair leaking irrigation valves.

D. Elevator Sump Pump System:

Capital Improvements
1. Provide above-ground oil water separator in the storage room. Reroute sump pump discharge piping to inlet of oil water separator. Route outlet of oil water separator to existing floor sink.
2. Provide gate valve and swing check valve in each sump pump discharge piping.

Maintenance:
1. Modify sump grating to fit around existing pipe and bracket interferences.

E. Emergency Generator Auxiliary Systems:

Capital Improvements:
1. Replace generator exhaust piping to terminate above top parking level. Exhaust pipe will need to be resized to meet generator backpressure requirements. If backpressure requirements do not allow terminating at top level, at minimum, add a 90 degree elbow and rain cap to extend piping away from structure.
2. Provide protective mesh enclosure around the flexible corrugated metallic connectors for the exhaust system for personnel protection.

Maintenance:
1. Replace two each kinked rubber flexible hoses for propane supply.

6.5 Code Considerations:

There is an existing storage room in the Phase 2 structure that has been converted to an interim workshop/office area. This conversion of unoccupied storage space to occupied office area might create a requirement to provide a new garage ventilation system for each level of the Phase 2 parking structure.
Based on the current edition of Title 11, Chapter 39, section 13, Garage Ventilation, a ventilation system shall be provided for each level of the Phase 2 parking structure if there is a parking attendant or other employee normally working in the space. UH should be aware of this code requirement and clarify with the State Department of Health, Indoor and Radiological Health Branch on whether a garage ventilation system is required prior to further developing occupied spaces in the parking structure.
## 6.6 Summary of Recommended Corrective Actions and Associated Capital Improvement Costs

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Estimated Cost</th>
<th>Urgency</th>
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</thead>
<tbody>
<tr>
<td><strong>Phase 1 Parking Structure Ventilation System</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace fans, sound attenuators, starters, control system, plenums, registers</td>
<td>$1,283,000</td>
<td>Immediately</td>
</tr>
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<td><strong>Total</strong></td>
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<tr>
<td><strong>Storm Drain System</strong></td>
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<td></td>
</tr>
<tr>
<td>Phase 1 - Replace horizontal piping with ABS, replace riser clamps, replace pipe hangers, repair leaking joints</td>
<td>$138,000</td>
<td>Immediately</td>
</tr>
<tr>
<td>Phase 2 - Repair leaking joints, replace riser clamps, replace pipe hangers</td>
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<td>Immediately</td>
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<td><strong>Total</strong></td>
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<tr>
<td><strong>Domestic Cold Water System</strong></td>
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<td></td>
</tr>
<tr>
<td>Phase 1 - Repair leaking joints, replace damaged piping, replace riser clamps, replace pipe hangers, replace hose bibbs</td>
<td>$21,000</td>
<td>Immediately</td>
</tr>
<tr>
<td>Phase 2 - Repair leaking joints, replace pipe hangers</td>
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<td>Immediately</td>
</tr>
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<td><strong>Total</strong></td>
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<tr>
<td><strong>Elevator Systems</strong></td>
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<td></td>
</tr>
<tr>
<td>Phase 2 - Install above-ground oil water separator</td>
<td>$32,000</td>
<td>Immediately</td>
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<tr>
<td>Phase 1 - Install air conditioning for new elevator machine rooms</td>
<td>$12,000</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Phase 2 - Install air conditioning for new elevator machine rooms</td>
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<td>Within 5 years</td>
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<tr>
<td><strong>Total</strong></td>
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<tr>
<td><strong>Emergency Generator Auxiliary Systems</strong></td>
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<tr>
<td>Phase 2 - Replace exhaust piping</td>
<td>$33,000</td>
<td>Immediately</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td></td>
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<tr>
<td><strong>Optional – Painting of piping</strong></td>
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<td></td>
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<tr>
<td>Phase 1 - Paint ferrous piping for cosmetic and corrosion resistance</td>
<td>$76,000</td>
<td>Within 5 years</td>
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<tr>
<td>Phase 2 - Paint ferrous piping for cosmetic and corrosion resistance</td>
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<td>Within 5 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$211,000</td>
<td></td>
</tr>
</tbody>
</table>
6.7 References:


B. Hawaii Administrative Rules, Department of Health, State of Hawaii, Title 11, Chapter 39, Air Conditioning and Ventilation.

MEMORANDUM

5/2/2011

TO: Ms. Reiko Otsuka  
State of Hawaii, Department of Health  
Indoor and Radiological Health Branch  
591 Ala Moana Blvd., Suite 133  
Honolulu, HI 96813-4921

FROM: Jeffrey K. Kohara, P.E.  
Thermal Engineering Corporation (TEC)

SUBJECT: University of Hawaii, Manoa Campus  
Parking Structure Ventilation Requirements

Ms. Otsuka,

The University of Hawaii at Manoa is currently conducting a condition survey of the parking structure located adjacent to the lower campus athletic facilities. The purpose of the survey is to assess the condition of the structure and its utility systems to plan for future repairs and renovations. One of the systems being evaluated is the parking structure ventilation system. The purpose of this memo is to obtain concurrence from the department that a ventilation system is not required for the parking structure under current regulations, and that the existing ventilation system does not need to be replaced.

Background Information:

The parking structure was constructed in 2 phases. Phase 1 was completed around 1976. Phase 1 is rectangular in geometry, approximately 526 ft. in length and 293 ft. in width, with a foot print of approximately 154,118 square feet. There are five levels. There are two atrium areas in the structure that pass through all levels and is open at the top and along its perimeter. These openings are approximately 193 ft. x 30 ft. and 170 ft. x 30 ft. in size. The perimeter is comprised of open “walls” with only structural columns and enclosed stair wells to block air flow. At the center of the structure, there is a two-way traffic ramp to move from level to level. Otherwise, there are no features that would restrict airflow through each level. There are no permanent stations for parking attendants or other employees in the Phase 1 parking structure.

Phase 2 was added to the Phase 1 structure around 1995. Phase 2 is also rectangular in geometry, though smaller at approximately 502 ft. in length and 136 ft. in width, with a foot print of approximately 68,272 square feet. There are four levels. The perimeter is comprised of open “walls” with only structural columns and enclosed stair wells to block air flow. The only
Ms. Reiko Otsuka  
May 2, 2011  
Page 2

Wall area that is not open for each structure is the intersection between the 2 phases. There are no features that would restrict airflow through each level. There are no permanent stations for parking attendants or other employees in the Phase 2 parking structure.

**Ventilation System Description:**

Phase 1 was constructed with a mechanical ventilation system. This system was designed to provide ventilation to all levels of Phase 1. The exhaust system consists of 16 tubeaxial ventilation fans and sound attenuators, pulling exhaust air from each floor through a shaft and connecting ceiling plenums with multiple exhaust registers at each level. The exhaust system was designed to be controlled via a carbon monoxide infrared analyzer system.

Phase 2 does not have a ventilation system.

**Regulations:**

TEC researched the regulations in effect on the Phase 1 date of design to determine if the ventilation system was required at the time. It appears that for a design date of 1973, Public Health Regulations, Chapter 28, dated 1964 would be applicable. In that edition of the regulations, there appears to be a ventilation requirement of 3 CFM/SF for garages. There is no distinction between open and closed garages.

Based on the current edition of Title 11, Chapter 39, section 13, Garage Ventilation, a ventilation system would not be required for the parking structure since 1) more than half the wall area is open, in a wall length of at least forty percent of the perimeter, 2) there is no parking attendant or other employee normally working in the space, and 3) there is no unusual or irregular shape of the level that would prevent natural air motion.

**Condition Survey Results:**

The condition survey revealed that the existing ventilation system is in poor condition and is not operating as designed. The ventilation fan housings, vibration isolators and sound attenuators are very corroded and at the end of their service lives. Several of the fan controls were in the off position, indicating that the system is not functioning in automatic mode. The carbon monoxide analyzer did not appear to be functioning. TEC has estimated that the replacement cost would be about $1,300,000.

**Request:**

Because of the high cost of system replacement, the University of Hawaii asked if TEC could determine whether the current Title 11, Chapter 39, section 13 requirements supersede the original design requirements as it relates to system replacement.
TEC's interpretation of the current Chapter 39 requirements is that replacement of the existing ventilation system is not required since current regulations would not require a ventilation system for an open garage meeting the requirements previously stated. We request the Department's concurrence on this interpretation.

Reiko Otsuka, Department of Health  
Date 3/3/11

Thank you for your time and consideration. Should you have any questions or comments regarding this request, or if you need additional information to review such as reference drawings of the parking structure, please do not hesitate to contact me.

Sincerely,

Jeffrey K. Kohara, P.E.  
Sr. Vice President  
Thermal Engineering Corporation  
512 Kalihi Street  
Honolulu, Hawaii  
Ph. 356-2448
Parking Structure Ventilation System

Typical fan arrangement in fan room

Deteriorated flexible connection to fan
Typical vibration isolator

Corroded vibration isolator base plate and spring coil
Severe corrosion of sound attenuator

External corrosion on sound attenuator casing
Non-operational carbon monoxide monitoring system

Typical damaged exhaust air register
Phase 1 Storm Drain System

Cracked pipe

Cracked fitting at beam
Cracked pipe

Typical patched piping
Corroded riser clamp

Sag in pipe, missing pipe hanger
Sag in pipe, missing pipe hanger

Typical condition of storm drain riser
Corroded storm drain riser

Typical horizontal pipe corrosion
Localized corrosion from leak above
Broken no-hub clamp

Big pipe connected to small pipe
Phase 2 Storm Drain System

Leaking pipe

Possible leaking joint
Domestic Cold Water System

Leaking pipe

Leaking pipe
Possible pipe leak

Possible pipe leak
Possible pipe leak

Typical corroded riser clamp due to galvanic corrosion
Galvanic corrosion between copper pipe and steel pipe hanger

Possible leak and galvanic corrosion of pipe hanger
Typical corroded pipe hanger due to galvanic corrosion

Bent piping
Pipe damaged by car

Corroded gate valve and pipe clamp
Possible leaking irrigation valve
Elevator Sump Pump System

Typical sump pump

Typical sump pump discharge check valve, no gate valve
Sump pump discharge piping (2 each) draining into floor sink in storage room

Sump grate doesn’t sit flush – interfering with piping
Emergency Generator Auxiliary Systems

No protective mesh enclosure around exhaust components

Exhaust pipe terminates at 2nd floor level
Kinked propane supply hose
7.0 FIRE PROTECTION

7.1 Scope of Fire Protection Condition Survey

The fire protection scope of work for this study includes assessment and recommendations for the dry standpipe systems, wet standpipe systems, and fire sprinklers. The wet standpipe system for the Phase 2 portion of the Parking Structure includes a booster pump. Fire sprinklers are only installed in a limited number of rooms in the Phase 2 portion of the Parking Structure. Fire extinguisher cabinets are addressed in the Architectural section of this study. Fire alarm systems are addressed in the Electrical section of this study.

The Phase 1 portion of the Parking Structure is the Diamond Head side and the Phase 2 portion is the Ewa side.

7.2 Description of Fire Protection Systems:

A. Fire Protection System:

Existing fire protection systems installed at the Parking Structure include Class I dry standpipe systems, Class II wet standpipe systems, fire sprinklers, and portable fire extinguishers. Fire extinguishers are located in either Class II wet standpipe fire hose cabinets or fire extinguisher cabinets.

Class I standpipe systems have 2.5 inch hose connection outlets and are intended for use by the fire department. Class II standpipe systems have 1.5 inch hose connection outlets are intended for use in first aid firefighting by trained persons or the fire department during the initial stage of a response.

Reference drawings for Phase 1 are dated 1973, so the fire protection requirements were most likely based on the 1970 edition of the Uniform Building Code. (The City and County of Honolulu did not adopt the 1973 edition of the UBC until 1975.) 1970 UBC Section 3803 required dry standpipe systems for all buildings four or more stories in height. 1970 UBC Section 3804 required wet standpipes for open parking garages with four or more stories.

Reference drawings for Phase 2 are dated 1992, so the fire protection requirements were most likely based on the 1988 edition of the Uniform Building Code. (The City and County of Honolulu did not adopt the 1991 edition of the UBC until 1993.) 1988 UBC Table 38-A required both Class I and Class II standpipes for buildings four or more stories, but less than 150 feet, in height.
B. **Phase 1 Parking Structure - Class I Manual Dry Standpipe System:**

The Phase 1 portion of the Parking Structure has four existing dry standpipe systems. The first “Ewa” system serves Stairs 2 and 5 on the west end. The second “Ewa” system serves Stair 1 at the southwest corner. The “Central” system serves Stairs 3, 7, 10 in the middle. The “Diamond Head” system serves Stairs 4, 8, 9 on the east end.

The original construction drawings show three dry standpipe systems. System #1 which served Stairs 1, 2, 5 at the west end was reconfigured, most likely due to a problem with the piping routed underground between the stairs. The new piping for the system serving Stair 2 and 5 is routed overhead at the first parking level. The system serving Stair 1 has a new fire department connection with the piping routed aboveground directly to the standpipe riser. The standpipe riser is concealed in a CMU pipe chase adjacent to Stair 1.

![“Diamond Head” fire department connection serving Stairs 4, 8, and 9.]

![“Central” fire department connection serving Stairs 3, 7, and 10.]

Only the “Central” system still has the original nameplate above the fire department connection. Name plates for the other systems are missing.
Each of the existing dry standpipe systems have a fire department connection located along the Access Road side of the Parking Structure. Fire department connections have four 2.5 inch inlets except for the system serving Stair 1 which has two 2.5 inch inlets. Except for the system serving Stairs 2 and 5, the fire department connections are installed in or on the stair enclosure wall of the stair along the Access Road side of the Parking Structure.

The original construction specifications required piping to be Schedule 40 ASA B36.20 galvanized piping with Victaulic 300 lb fittings. It required underground piping to be “protected by coal tar protective coating in tape form manufactured by Tapecoat CT with primer.”

Hose valves are located at each floor level above the first floor in or near each stair. Hose valves are gate type and mounted at approximately four feet above the floor. Two-way roof manifolds are located on the roof parking level.
Standpipe risers are either routed in the stair enclosure or in the cell of a CMU pipe chase where serving an open stair. The original construction drawings refer to the CMU pipe chase as a “fire-rated enclosure”. The 1970 Uniform Building Code required that “Portions of dry standpipe systems not located within an enclosed stairway or smokeproof enclosure shall be protected by a degree of fire resistance equal to that required for vertical enclosures in the building in which they are located.” Stair enclosures were required to be rated 2 hours per the 1970 UBC section 3308. If the CMU cell wall is 1.5 inch thick as called out on the detail, then it does not provide a 2 fire rating when calculated in accordance with the current Building Code.

Detail of CMU pipe chase for dry standpipe riser piping which is called out as “fire-rated enclosure” on reference plans.
The original construction drawings show a 1 inch drain connection with a gate valve connected to the underground portion of the piping for each system. The drain valve could not be located in the field. The original construction drawing indicates the drain piping is directly connected to the storm drain piping. Direct discharge to storm drain is not permitted per City and County of Honolulu and State of Hawaii water quality standards for storm drain systems since the water drained from the standpipe system may contain pollutants such as dirt, grease, rust, and/or metals. Water drained from the standpipe system needs to be checked for pollutants (and pollutants removed/filtered) before water is discharged to storm drain.

![Isometric diagram on reference plans showing drain piping to storm drain.](image)

**C. Phase 1 Parking Structure - Class II Wet Standpipe System:**

The Phase 1 portion of the Parking Structure has a Class II wet standpipe system which is supplied from the domestic water system.

Fire hose cabinets are distributed throughout each level of the Parking Structure with 14 cabinets per level. The roof level does not have fire hose cabinets since it is not an interior space.

Fire hose cabinets contain 75 feet of 1.5 inch hose connected to an adjustable fog nozzle and a fire extinguisher. Fire extinguishers are either 3A:40B:C rated or 4A:60B:C rated multipurpose dry chemical type fire extinguishers. The fire hoses and fire extinguishers are tagged with a UH Fire Safety Program inspection tag dated October 2010. The fire hose cabinets are supplied by a 2 inch copper pipe riser adjacent to each fire hose cabinet. A gate valve is installed at the base of each riser. The gate valve is sealed open with wire and a lead crimp.
D. Phase 2 Parking Structure - Class I Manual Dry Standpipe System:

The Phase 2 portion of the Parking Structure has one existing dry standpipe system. The system is interconnected by underground piping beneath the Parking Structure. Standpipe risers are located in Stair 3 and 4 and adjacent to columns 27M, 28G, and 38G.

The standpipe risers in Stair 3 and 4 are located within the stair enclosure. The standpipe risers adjacent to columns 27M, 28G, and 38G are located in pipe chases. The original construction drawings refer to the pipe chase as a “fire rated enclosure”. The detail for the “2-hr D.S.P. Enclosure” calls out cement plaster on metal lath supported by metal studs. The current Building Code does not provide guidance on calculating the fire resistance of cement plaster up to 2 hours, so the fire rating of the pipe chase could not be verified. Based on visual observation, it does not appear the plaster to concrete wall-to-ceiling and wall-to-floor joints are firestopped.
Detail of plaster pipe chase for dry standpipe riser piping which is called out as “fire rated enclosure” on reference plans.

Top of dry standpipe chase which does not appear to be firestopped at the plaster to concrete joints.

Hose valves are located at each floor level above the first floor. Hose valves are gate type and mounted at approximately 3.5 feet above the floor. The standpipe risers located adjacent to the columns have a single hose valve at the top on the 5th level (which is the top parking level). The standpipe risers in Stair 3 and 4 have two-way roof manifolds at the top on the roof of the stair enclosure.
Dry standpipe hose valve at 5th level.

Dry standpipe 2-way roof outlet above Stair 4.

The original construction drawings show three underground valves to isolate the standpipe risers. UH Parking and Transportation Services identified one valve hand hole for the standpipe riser serving Stair 3. The other two valve hand holes could not be located. The operational condition of the isolation valves is not known.

The original reference drawings do not show a check valve for the fire department connection. A check valve was not observed.
Underground piping connects all five standpipe risers. Underground piping is routed under the Parking Structure from the fire department connection to the grass area on the Dole Street side of the Parking Structure. Piping is then routed back underneath the Parking Structure toward the Access Road side to each standpipe riser.

The fire department connection monument is located next to the entrance between the Phase 1 and 2 portions of the Parking Structure. The fire department connection has six 2.5 inch inlets. It does not have a nameplate to identify it as serving the Phase 2 portion of the Parking Structure. It has a faded sign reading, “INOPERABLE”.

UH Fire Safety Program and the UH Parking and Transportation Services have indicated the system has been inoperable for an extended period.
E. Phase 2 Parking Structure - Class II Wet Standpipe System:

The Phase 2 portion of the Parking Structure has a Class II wet standpipe system which is supplied from a booster pump.

Fire hose cabinets are distributed throughout the each level of the Parking Structure with five cabinets located on parking level 1, four cabinets on levels 2, 3 and 4, and 3 cabinets on level 5.

Fire hose cabinets contain 1.5 inch fire hose connected to an adjustable fog nozzle and a fire extinguisher. Fire extinguishers are either 3A:40B:C rated or 4A:60B:C rated multipurpose dry chemical type fire extinguishers. The fire hose cabinets are supplied by a 2 inch copper pipe risers adjacent to each fire hose cabinet.

The Phase 2 Class II wet standpipe system is supplied by a booster pump located on parking level 1. The pump room is located adjacent to Stair 3. The pump assembly consists of an Aurora vertical end suction pump coupled to a US Electrical Motors electric driver. The following information was obtained from the nameplate:

Aurora
No 2-18134
Type 342A BF
Size 1.5x2x9C
GPM 100
Head Feet 255
RPM 3500

The pump controller appears to be a standard across-the-line starting controller with only a hand-off-auto dial switch. The following was handwritten on the controller:
UH Fire Safety Program has indicated test reports for the booster pump are not available.

System piping is copper and is routed overhead at parking level 1. Piping is supported by steel hangers which appear to have a black coating to prevent contact between the copper piping and steel hanger ring to prevent galvanic corrosion.

**F. Phase 2 Parking Structure – Fire Sprinklers**

Fire sprinklers are located in the Generator Room and Electrical Room on the parking level 1. The fire sprinklers are supplied from the Class II wet standpipe system.
Fire sprinklers are Viking model M 200 degree F, standard response standard spray uprights. Fire sprinklers are connected to 0.5 inch piping.

Piping is supported by steel hangers which appear to have a black coating to prevent contact between the copper piping and steel hanger ring to prevent galvanic corrosion.

The Generator Room has two fire sprinklers supplied by 1 inch copper piping. The fire sprinklers are monitored by a waterflow switch. A gate valve is located upstream of the waterflow switch. The gate valve does not have a tamper switch.

The Electrical Room has four fire sprinklers supplied by a 1.5 inch copper piping. The fire sprinklers are monitored by a waterflow switch. The waterflow switch is connected to a 1 inch tee fitting, so the piping reduces from 1.5 inch to 1 inch before the tee and increases back to 1.5 inch after the tee. A gate valve is located upstream of the waterflow switch. The gate valve does not have a tamper switch.
7.3. Condition Assessment of Existing Fire Protection Systems:

An assessment of the fire protection systems is provided. Corrective actions to address deficient conditions are addressed in the next section.

A. Phase 1 Parking Structure - Class I Manual Dry Standpipe System:

Existing hose valves exhibit moderate corrosion which would be expected since it is exposed to the weather.

Only lateral sway (seismic) bracing is installed and is spaced approximately every 20 feet on the new aboveground piping for the system serving Stairs 2 and 5. Longitudinal sway (seismic) bracing is missing. UH Parking and Transportation Services indicated the new aboveground piping was installed around 1990. The fittings used for the lateral sway bracing appear to be modified hanger components instead of listed sway bracing attachments as required in current editions of NFPA 13. (NFPA 14 Standard for the Installation of Standpipe and Hose Systems references NFPA 13 Standard for the Installation of Sprinkler
Systems for sway bracing requirements.) The sway brace attachment for the piping appears to be a U-hanger and U-bolt connected together, which was an acceptable method of pipe attachment in the 1987 edition of NFPA 13. The sway brace attachment for the building appears to be an angle bracket and pipe strap bolted together. This method of building attachment was not described in the 1987 edition of NFPA 13. The 1987 edition of NFPA 13 required that, “Sway bracing shall be designed to withstand a force in tension or compression equivalent to not less than half the weight of the water-filled piping.” The size of the fasteners (i.e. expansion shield in concrete) installed could not be determined in the field. However, the maximum load allowed for the smallest (i.e. diameter and length) fastener listed in NFPA 13 is adequate for the calculated load for the lateral sway bracing. Adequacy of the sway bracing cannot be calculated in accordance with current editions of NFPA 13 since the maximum design load of the pipe attachment and building attachment are unknown.

Sway bracing on dry standpipe system piping.

Sway bracing attachment to the pipe appears to be a U-hanger and U-bolt connected bolted instead of a listed sway bracing Attachment.

Sway bracing attachment to the building appears to be an angle bracket and pipe together strap together.
The standpipe risers do not have sway (i.e. seismic) bracing.

Pipe clamps are installed instead of riser clamps. Riser clamps have longer "ears" to support the pipe riser. Also the floor penetration appears to have been chipped instead of cored or sleeved. So the combination of pipe clamps and chipped concrete reduce the amount of floor available to support the pipe riser.

![Pipe clamp installed instead of riser clamp to support dry standpipe riser.](image)

The condition of original system piping, which is installed underground beneath the Parking Structure, is unknown. The newer aboveground piping is exhibiting corrosion on the exterior of the piping and paint is peeling off the piping. The internal condition of the piping was not observed. Camera snaking the piping is not within the scope of this study.

UH Fire Safety Program is unable to locate the last 5-year test reports for the dry standpipe systems hydrostatic and flow tests. The UH Fire Safety Program indicates they are coordinating with UH Parking and Transportation services to schedule the 5-year tests.

B. Phase 1 Parking Structure - Class II Wet Standpipe System:

Many of the fire hose cabinets are severely corroded. At least one cabinet is missing the entire cabinet floor due to corrosion. Many cabinets have doors that are difficult to open or are completely missing the door.
More than half of the fire hose cabinets on each parking level are missing one or more of the following items: the fire extinguisher, the fog nozzle, the door window, the door lock, and/or the entire door. UH Fire Safety Program was notified of the missing fire extinguishers.

The riser clamp for the copper pipe riser is missing for many of the fire hose cabinets. It appears the riser clamps were steel which deteriorated due to galvanic corrosion from contact with the copper piping. All 14 riser clamps are missing on parking level 3.

The concrete at the top of many of the copper pipe risers is spalling around the penetration through the floor/ceiling assembly. See structural section for discussion of concrete spalling.
An electrical grounding clamp is connected to the copper pipe riser for the fire hose cabinet behind the ramp in the middle of the parking level 1. Grounding to a fire protection system is generally discouraged.

The fire extinguisher in the fire hose cabinet at the southwest corner of parking level 3 indicated low pressure on the pressure gauge. UH Fire Safety Program was notified of the fire extinguisher with low pressure.

UH Fire Safety Program is unable to locate the last 5-year test reports for the wet standpipe systems hydrostatic and flow tests. The UH Fire Safety Program indicates they are coordinating with UH Parking and Transportation services to schedule the 5-year tests.
C. Phase 2 Parking Structure - Class I Manual Dry Standpipe System:

Existing hose valves exhibit moderate corrosion which would be expected since it is exposed to the weather.

The standpipe risers in Stairs 3 and 4 are galvanized piping and appear to have minimal corrosion on the exterior of the piping. The piping for the rest of the system is either concealed in the pipe chases adjacent to the concrete columns or routed underground beneath the Parking Structure. The internal condition of the piping was not observed. Camera snaking the piping is not within the scope of this study.

The riser clamp is missing on the dry standpipe riser in Stair 3 at parking level 2. Riser clamps are not installed at the 5th floor level for the top of the dry standpipe risers located next to columns.

Sway (i.e. seismic) bracing is not installed for the standpipe risers.

UH Fire Safety Program indicated the dry standpipe system failed the 5-year hydrostatic test in 2001, due to a leak in the underground piping. Because the system did not pass the last hydrostatic test, it is considered inoperable since the fire department may not be able to fill and pressurize the system piping with water.
D. Phase 2 Parking Structure - Class II Wet Standpipe System

Most of the fire hose cabinets are installed on the guard rails in front of the parking spaces. Therefore the cabinet door cannot be opened if a car is parked in front.

The fire hose cabinet next to the Storage Room on parking level 1 is mounted to a guard rail which appears to have been damaged by a vehicular collision. The fire hose cabinet has severe paint peeling and corrosion. The copper piping supplying the fire hose cabinet is bent.

![Damaged fire hose cabinet due to vehicular collision](Image1)

![Side view showing bent piping that supplies the fire hose cabinet.](Image2)

The two fire hose cabinets in the middle of Parking Level 2 have severe paint peeling and corrosion. The copper pipe riser supplying the two back-to-back fire hose cabinets is also corroded. This corrosion appears to be due to water dripping down the copper pipe riser from the gap between the upward and downward sloping floor/ceilings above. The copper pipe riser for the fire hose cabinet at the east end of parking level 2 is also exhibiting more corrosion compared to the other risers.
Water from gap dripping down wet standpipe riser causing corrosion of copper piping.

All three fire hose cabinets on parking level 5 are severely corroded due to exposure to the weather. (Parking level 5 is the top parking level.) The fire hose cabinet at the west end is missing the door and the floor of the cabinet was replaced with a piece of sheet metal. The door for the fire hose cabinet in the middle is falling apart. The fire hose cabinet at the east end has numerous holes due to corrosion.

Two of the three fire hose cabinets on parking level 5 were missing the fire extinguisher. The fire extinguishers in the fire hose cabinets at the west end of parking levels 3 and 5 had a low pressure reading on the pressure gauge. UH Fire Safety Program was notified of the missing fire extinguishers and fire extinguishers with low pressure.

The copper pipe risers supplying the fire hose cabinets have pipe clamps installed instead of riser clamps. Riser clamps have longer “ears” to support the pipe riser. Several pipe clamps are covered with concrete, most likely to prevent the pipe clamp from causing a tripping hazard.
the Phase 1 and 2 portions of the Parking Structure. Grounding to a fire protection system is generally discouraged. In addition, the grounding path is routed through the booster pump. There may also be dielectric fittings between the non-similar metals (e.g. copper piping and steel valves) which would interrupt the electrical continuity of the grounding path.

![Electrical grounding clamp connected to wet standpipe piping supplying fire hose cabinet.](image)

The booster pump head is exhibiting corrosion on the casing, most likely due to copper piping connected to the steel pump head casing.

![Corrosion of pump head casing.](image)

The existing pump does not appear to be a listed fire pump (i.e. a pump listed for fire protection use by Underwriters Laboratory or Factory Mutual). Pumps supplying standpipe systems are required to be listed fire pumps per NFPA 14. Aurora brand fire pumps are 900 series. The existing booster pump is a 300 series pump. Fire pumps are designed and manufactured to the requirements of NFPA 20 which emphasize reliability of the pump operation under emergency conditions.

Calculations to verify the sizing of the booster pump is not within the scope of this study.

A backflow preventer was not installed to isolate the standpipe system from the domestic water system. The Plumbing Code requires a double check valve backflow preventer assembly.
UH Fire Safety Program is unable to locate the last 5-year test reports for the wet standpipe systems hydrostatic and flow tests. The UH Fire Safety Program indicates they are coordinating with UH Parking and Transportation services to schedule the 5-year tests. There are no test reports for the booster pump.

E. Phase 2 Parking Structure – Fire Sprinklers:

Piping is exhibiting corrosion at joints where copper piping is connected to bronze fittings and valves.

Two of the four fire sprinklers in the Electrical Room are installed with the deflector approximately 10 inches below the concrete ceiling. The other two fire sprinklers are installed with the deflector approximately 14 inches below the concrete ceiling. This difference is due to the sloped ceiling from the parking ramp above. The maximum distance permitted between the fire sprinkler deflector and the ceiling is 12 inches per NFPA 13 (1987) and NFPA 13 (2010).

Fire sprinklers in the Generator Room and Electrical Room are connected to 0.5 inch piping. The minimum pipe size permitted for copper piping is 0.75 inch per NFPA 13 (1987) and NFPA 13 (2010).

Inspector’s test connections are not installed in either the Generator Room or Electrical Room. Inspector’s test connections are required to flow water through the piping to test the waterflow switch.

7.4 Recommendations for Fire Protection Systems:

Recommendations are categorized by capital improvement, inspection and testing, and maintenance. Estimated costs are only provided for those recommendations involving capital improvement. Testing and inspections are required to be conducted periodically by the Fire Code and therefore wouldn’t be funded by a capital improvement project. Maintenance and replacement of the fire extinguishers and fire hose is performed by the UH Fire Safety Program. It is assumed UH Parking and Transportation Services does general maintenance of the piping, valves, etc.

A. Phase 1 Parking Structure - Class I Manual Dry Standpipe System:

1. Capital Improvements:
   a. Replace corroded hose valves.
   b. Replace sway bracing on aboveground piping, including addition of longitudinal sway bracing. Install 4-way sway braces on standpipe riser piping.
   c. Replace pipe clamps with riser clamps to ensure standpipe risers are properly supported.
d. Provide nameplates or designations for each system at each fire department connection, similar to the “Central” dry standpipe system.

Existing “Central” fire department connection nameplate

2. Inspection and Testing:
   a. Conduct 5-year testing of dry standpipe systems as required by Fire Code.

3. Maintenance:
   a. Operate all hose gate valves and isolation gate valves to check for proper operation and conduct maintenance as required. (e.g. Lubricating the valve stems.)
   b. Verify fire department connection clappers (if present) and check valves for proper operation. Verify clapper or check valve can swing to full open position, provides a proper seal in closed position, etc.

B. Phase 1 Parking Structure - Class II Wet Standpipe System:

1. Capital Improvements:
   a. Replace all existing fire hose cabinets with new fire hose cabinets.
   b. Replace all riser clamps on the copper wet standpipe risers with new riser clamps to ensure piping is properly supported.

2. Inspection and Testing:
   a. Conduct 5-year testing of wet standpipe system as required by Fire Code.

3. Maintenance:
   a. Replace all missing fire extinguishers.
C. Phase 2 Parking Structure - Class I Manual Dry Standpipe System:

1. Capital Improvements:
   
   a. Replace the dry standpipe system. If it can be determined that the problem is in the underground piping portion of the system, the aboveground piping could be re-used.

   UH should consider installing a manual wet standpipe system instead of another dry standpipe system. Dry standpipe systems are intended for areas subject to freezing and are therefore not allowed to be installed in locations such as Hawaii by the current Building Code. A manual wet standpipe system is normally filled with water under normal pressure (i.e. same pressure as domestic plumbing system). The piping is filled with water, so the system can be utilized more quickly by the fire department since they won’t have to fill the system before water will discharge from the hose outlets. Also, the system is automatically supervised similar to a wet pipe fire sprinkler system, so leaks will be identified sooner as opposed to a dry standpipe system when testing is conducted at five year intervals. The difference in installation cost between the two types of systems is similar.

2. Inspection and Testing:
   
   a. None (because the system failed the last test).

3. Maintenance:
   
   a. None (because the system is inoperable).

D. Phase 2 Parking Structure - Class II Wet Standpipe System:

1. Capital Improvements:
   
   a. Replace the existing booster pump with a listed fire pump. This will also require modifications to the pump room and electrical system to meet current code requirements for fire pump systems. NFPA 20 (2010) requires the fire pump room to be of 1-hour fire rated construction and the room to be dedicated for the fire pump system only. The existing pump room does not meet current NFPA 20 (2010) requirements for a fire pump room due to unprotected openings (louvers in doors), unprotected penetrations, and storm drain riser piping in the room. The electrical system will also need modifications to meet NFPA 70 National Electrical Code requirements for fire pumps. Based on the NFPA 70 (2008), it appears the existing fused disconnect switch is undersized, there are circuit breakers in series with the fused disconnect switch, and the supply circuit source is at a
lighting panel instead of ahead of the main circuit breaker. A double check valve backflow preventer assembly will be required to isolate the standpipe system from the domestic water system.

b. Replace all fire hose cabinets on parking levels 1 through 4. (Most urgent are the severely corroded fire hose cabinet near the Storage Room on parking level 1 and the two severely corroded fire hose cabinets in the middle of parking level 2.)

c. Replace all three fire hose cabinets on parking level 5 which are severely corroded with weather resistant fire hose cabinets (e.g. marine type fiberglass cabinets).

d. Replace the bent and damaged standpipe riser piping for the fire hose cabinet near the Storage Room on parking level 1 that appears to have been damaged from a vehicular collision.

e. Replace all riser clamps on the copper wet standpipe risers with new riser clamps to ensure piping is properly supported.

2. Inspection and Testing:

a. Conduct 5-year testing of wet standpipe system as required by Fire Code.

3. Maintenance:

a. Replace the missing fire extinguishers on parking level 5. Recharge the one fire extinguisher on parking level 3 and one fire extinguisher on parking level 5 with a low pressure reading on the pressure gauge.

b. Remove the electrical grounding connection on piping supply the fire hose cabinet outside the Storage/Shop Room next the parking entrance between the Phase 1 and 2 portions of the Parking Structure.
c. Verify all gate valves and check valves in the pump room are in good operational condition, check for proper operation, and conduct maintenance as required. (e.g. Lubricating the valve stems.)

E. Phase 2 Parking Structure – Fire Sprinklers:

1. Capital Improvements:
   a. Install inspector’s test connections for the Generator Room and Electrical Room to allow testing of the waterflow switch in each room.
   b. Adjust the installation height of the two sprinklers in the Electrical Room that are installed more than 12 inches below the ceiling. Replace the 0.5 inch piping with 0.75 inch piping.

2. Inspection and Testing:
   a. Conduct testing of waterflow switches after inspector’s test connections are installed.

3. Maintenance:
   a. As required by the Fire Code.
### 7.5 Summary of Recommended Corrective Actions and Associated Capital Improvement Costs (1)(2)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Estimated Cost</th>
<th>Urgency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1 Dry Standpipe System</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace hose valves</td>
<td>$28,000</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Install sway bracing on standpipe risers and replace sway bracing on aboveground piping.</td>
<td>$20,000</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Replace riser clamps on standpipe risers</td>
<td>$3,250</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Install nameplates to identify each system</td>
<td>$1,000</td>
<td>Immediately</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<tr>
<td><strong>Phase 1 Wet Standpipe System</strong></td>
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<tr>
<td>Replace fire hose cabinets</td>
<td>$136,000</td>
<td>Immediately</td>
</tr>
<tr>
<td>Replace riser clamps on standpipe risers</td>
<td>$3,000</td>
<td>Within 5 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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</tr>
<tr>
<td><strong>Phase 2 Dry Standpipe System</strong></td>
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<td>Replace entire system</td>
<td>$462,750</td>
<td>Immediately</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$462,750</strong></td>
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<tr>
<td><strong>Phase 2 Wet Standpipe System</strong></td>
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<td></td>
</tr>
<tr>
<td>Replace booster pump with a fire pump and associated architectural, electrical, mechanical support</td>
<td>$125,000</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Replace fire hose cabinets levels 1-4 with steel cabinets</td>
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<tr>
<td>Replace fire hose cabinets level 5 with fiberglass cabinets</td>
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<tr>
<td>Replace bent/damaged piping</td>
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<tr>
<td>Replace riser clamps on standpipe risers</td>
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<tr>
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<tr>
<td><strong>Phase 2 Fire Sprinklers</strong></td>
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<tr>
<td>Install inspector’s test connections</td>
<td>$4,500</td>
<td>Immediately</td>
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<tr>
<td>Replace 0.5” piping with properly sized piping and adjust fire sprinkler heights</td>
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<td>Within 5 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$8,500</strong></td>
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</tbody>
</table>

(1) Inspection, testing, and maintenance related items are not included since these are required to be done periodically for the existing systems.

(2) Replacement of missing fire extinguishers, fire hose and/or nozzles, etc. are not included since they are replaced by the UH Fire Safety Program.
7.6 References:


8.0 ELECTRICAL

8.1 Scope of Electrical Condition Survey

The general scope of this study is to observe electrical systems and identify items that should be repaired. This study does not include studying the existing electrical systems for current code or ADAAG compliance. This study includes the following systems:

1. Interior power distribution and lighting systems.

2. Interior fire alarm system.

3. Emergency power system, which is located in the Phase II portion of the Parking Structure.

4. Illuminated exit signs.

5. Emergency lighting units.

6. Power system for elevators.

7. Security cameras

8.2 PHASE I PARKING STRUCTURE POWER SYSTEM

A. General Description

The main power system for the Phase I portion of the Parking Structure is the original power system provided with the Phase I portion of the Parking Structure around 1974. The electrical service equipment consists of a secondary unit substation which has 2 primary air switches (loop-feed configuration), a 1000kVA oil-filled transformer and a secondary distribution switchboard. The primary switches are fed by two 12.47kV feeders and the distribution switchboard is rated at 1200A 480/277V, 3-phase, 4-wire. The switchboard feeds 480/277V, 3-phase, 4-wire panels which serve individual loads such as elevators, lights, and fans. Step-down transformers provide 208/120V, 3-phase, 4-wire power for convenience receptacles and other 120V loads.

B. Observations and Recommendations

The main secondary unit substation, original panels and original step-down transformers are currently in satisfactory condition. Preventive maintenance services on the equipment have kept the equipment in satisfactory condition. However, these equipment are over 35 years old and are reaching their end of life, so they should be programmed to be replaced.

During a preventive maintenance check performed by GE Energy Services, GE noticed that one of the high-voltage cables feeding one of the primary switches for the Phase I main secondary unit substation was burnt. The high-voltage cables feeding the main secondary unit substation are old and should be replaced to maintain reliability for the power system.

Some of the spaces for future breakers in the switchboard and panels are covered with cardboard. The cardboard covers should be replaced with metal covers.
In the elevator machine rooms, supports for conduits that serve elevator equipment are corroded and should be replaced.

There is insufficient clearance for safety switches and motor controllers that serve the parking structure exhaust fans. If the parking structure exhaust fans will remain, these safety switches and motor controllers should be replaced and located in location that will provide sufficient space for maintenance as required by the NEC.

8.3 PHASE II PARKING STRUCTURE POWER SYSTEM

A. General Description

The main power system for the Phase II portion of the Parking Structure was installed along with the structure around 1993. The electrical service equipment consists of a secondary unit substation which has 2 primary air switches (loop-feed configuration), a 1500kVA oil-filled transformer and a secondary distribution switchboard. The primary switches are fed by two 12.47kV feeders and the distribution switchboard is rated at 1200A 480/277V, 3-phase, 4-wire. The switchboard feeds 480/277V, 3-phase, 4-wire panels which serve individual loads such as elevators, lights, and fans. Step-down transformers are provided to provide 208/120V, 3-phase, 4-wire power for convenience receptacles and other 120V loads.

B. Observations and Recommendations

In general the power system in the Phase II portion of the Parking Structure is less than 20-years old and still in good condition.

Some of the spaces for future breakers in the switchboard and panels are covered with cardboard. The cardboard covers should be replaced with metal covers.

In the elevator machine rooms, supports for conduits that serve elevator equipment are corroded and should be replaced.

Portions of the Storage Room on the Ground Floor are now used as a shop and office. Hence, a new panel should be provided to feed shop equipment and new air conditioning.

The 80kW engine-generator is currently not operating due to a broken water pump.

Spring isolators should be provided for the 80kW engine-generator.

8.4 PHASE I PARKING STRUCTURE LIGHTING SYSTEM

A. General Description

The lighting system in the Phase I covered portion of the Parking Structure was replaced in 1997. In the parking area, the lighting system consists of high-pressure sodium (HPS) parking garage luminaires and HPS wall-pack luminaires mounted on columns. In stairwells, luminaires are wall-mounted fluorescent type. Exit signs are self-illuminated tritium filled light tube type. Emergency lighting units are twin-head units.
The lighting system for the Phase I 5th Floor Parking Structure was replaced in 1997.

There is no generator in the Phase I portion of the Parking Structure to provide standby power for the electrical systems.

B. Observations and Recommendations

Most of the lenses for the square-type HPS luminaires are cracked where the screw fastens the lens to the luminaire. These lenses will eventually need replacement or if the luminaires last for 5 or more years, the luminaires should be replaced.

The square-type HPS luminaires, fluorescent luminaires and wall-pack HPS luminaires have dirt in the lenses and will require cleaning.

The fluorescent luminaires in the stairwells exposed to the weather should be replaced with luminaires listed for wet locations. The fluorescent luminaires in the stairwells enclosed stairwells should be replaced with luminaires listed for damp locations.

Most of the emergency lighting units are not operating and should be replaced with new weatherproof units. The scope of this report is not to identify required upgrades to the emergency egress lighting system. However, the additional emergency lighting units may be required to meet current code.

UHM requested that a generator be provided to provide emergency power for some of the lights in the structure to allow people and vehicles to exit the parking structure if there is a normal power outage to the Stan Sherriff Center, Athletic Complex and Parking Structure. In the event there is a normal power outage to the Stan Sherriff Center and Athletic Complex but not to the Parking Structure, UHM will need to manually open the normal power circuit breaker feeding the automatic transfer switch for the emergency lighting system to start the generator and transfer the lights to emergency power.

Illuminated exit signs on the 5th Floor seem to be discolored and damaged by the sun. These luminaires should be replaced with LED exit signs.

To save energy, UHM requested that additional time switches be provided and luminaires be rewired to allow turning off some of the luminaires when the parking structure is not used.

There were some luminaires that were inoperative or seemed like the lamp was about to burn out. These luminaires should be repaired by normal maintenance.

8.5 PHASE II PARKING STRUCTURE LIGHTING SYSTEM

A. General Description

The lighting system in the Phase II portion of the Parking Structure is the original lighting system provided with the Phase II portion of the Parking Structure around 1993. In the parking area, the lighting system consists of high-pressure sodium (HPS) parking garage luminaires and HPS wall-pack luminaires mounted on columns. In stairwells, luminaires are wall-mounted fluorescent type. Exit signs are self-illuminated tritium filled light tube type. Emergency lighting units are twin-head units.
There is a 80kW generator in the Phase II portion of the Parking Structure to provide standby power for the lighting system.

B. Observations and Recommendations

The fluorescent luminaires in the stairwells exposed to the weather should be replaced with luminaires listed for wet locations. The fluorescent luminaires in the stairwells enclosed stairwells should be replaced with luminaires listed for damp locations.

Illuminated exit signs on the 5th Floor seem to be discolored and damaged by the sun. These luminaires should be replaced with LED exit signs.

Portions of the Storage Room on the Ground Floor are now used as a shop and office. Hence, lighting should be improved in this area.

To save energy, UHM requested that additional time switches be provided and luminaires be rewired to allow turning off some of the luminaires when the parking structure is not used.

8.6 PHASES I and II PARKING STRUCTURE FIRE ALARM SYSTEM

A. General Description

The single fire alarm system was provided for Phases I and II around 2003. The system consists of manual pull stations, combination horn/visual alarms, visual alarms, and smoke detectors in Elevator Machine Rooms.

B. Observations and Recommendations

Devices are deteriorating and often need repair/replacement. Original devices are not weatherproof. The big flood that occurred about 7 years ago damaged the booster/expansion panel in the Phase I Main Electrical Room. Dirty conditions in the Elevator Machine Rooms have set off the smoke detectors and cause the fire alarm system to recall the elevators. The fire alarm system should be replaced with a more weather resistant system. The new system should consist of manual pull stations, combination speaker/visual devices, visual devices, and smoke detectors for the Elevator Machine Rooms.

8.7 PHASES I and II PARKING STRUCTURE SECURITY CAMERA SYSTEM

The security camera system was provided in 2004 and appears to be in good condition.
## ELECTRICAL COST ESTIMATE

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Estimated Cost</th>
<th>Urgency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase I Power System</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace HV Cables</td>
<td>$19,700</td>
<td>Immediately</td>
</tr>
<tr>
<td>Install PFB covers to switchboard and panels.</td>
<td>$3,300</td>
<td>Immediately</td>
</tr>
<tr>
<td>Replace disconnect switch and motor starter and associated conduit and wiring</td>
<td>$27,200</td>
<td>Immediately</td>
</tr>
<tr>
<td>Replace secondary unit substation, 1000KVA transformer</td>
<td>$1,090,000</td>
<td>Within 5 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$1,140,200</td>
<td></td>
</tr>
</tbody>
</table>

| **Phase I Existing Lighting System**                                          |                |               |
| Replace HID Lens                                                              | $4,000         | Immediately   |
| Clean HID Lens                                                                | $9,800         | Within 5 years|
| Removal and disposal of self-illuminating exit sign; Install new exit sign, LED | $7,000         | Immediately   |
| Removal and disposal of surface wall mounted fluorescent luminaire; Install new fluorescent, surface wall mounted luminaire | $10,100        | Immediately   |
| Replace and add emergency lighting units.                                     | $100,000       | Immediately   |
| **Total**                                                                     | $130,900       |               |

| **Phase I New Lighting System**                                               |                |               |
| Renovate light control and additional time switches for energy efficiency; Replace light fixtures, conduit, and wiring affected by rewiring work; Replace light fixtures in stairwells | $1,168,000     | Within 5 years|
| **Total**                                                                     | $1,168,000     |               |

| **Phase I Generator for Lights**                                             |                |               |
| Provide new 100kW generator for parking garage lights; New generator room and power distribution equipment | $298,400       | Within 5 years|
| **Total**                                                                     | $298,400       |               |

| **Phase I Existing Fire Alarm System**                                        |                |               |
| Seal FA Junction box knockout                                                 | $500           | Immediately   |
| Replace FA pull station WP cover                                              | $1,500         | Immediately   |
| **Total**                                                                     | $2,000         |               |
### Phase I Fire Alarm System

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace Phase I fire alarm system; System to have visual and speaker devices and new fire alarm control panel</td>
<td>$620,000</td>
<td>Within 5 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$620,000</td>
<td></td>
</tr>
</tbody>
</table>

### Phase I Elevator System

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace elevator conduit supports</td>
<td>$3,000</td>
<td>Immediately</td>
</tr>
<tr>
<td>Provide generator to power one (1) elevator</td>
<td>$350,400</td>
<td>Within 5 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$353,400</td>
<td></td>
</tr>
</tbody>
</table>

### Phase I New Elevators

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demolition of existing electrical wiring system for elevators and installing new electrical wiring system for elevators</td>
<td>$100,000</td>
<td>See Elevator Section</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$100,000</td>
<td></td>
</tr>
</tbody>
</table>

### Phase II Power System

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>New panel, 120/208V, 3Φ, 4W, 24 CKTS for shop and office in Storage Room</td>
<td>$16,800</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Install PFB covers to switchboard and panels.</td>
<td>$3,300</td>
<td>Immediately</td>
</tr>
<tr>
<td>Replace spring isolators for generator</td>
<td>$4,400</td>
<td>Immediately</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$24,500</td>
<td></td>
</tr>
</tbody>
</table>

### Phase II Existing Lighting System

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace HID lens</td>
<td>$1,000</td>
<td>Immediately</td>
</tr>
<tr>
<td>Clean HID lens</td>
<td>$12,200</td>
<td>Within 5 years</td>
</tr>
<tr>
<td>Removal and disposal of self-illuminating exit sign; Install new exit sign, LED</td>
<td>$7,000</td>
<td>Immediately</td>
</tr>
<tr>
<td>Removal and disposal of surface wall mounted fluorescent luminaire; Install new fluorescent, surface wall mounted luminaire</td>
<td>$14,600</td>
<td>Immediately</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$34,800</td>
<td></td>
</tr>
</tbody>
</table>

### Phase II New Lighting System

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rewire light switching and additional time switches for energy efficiency; Replace light fixtures, conduit, and wiring affected by rewiring work</td>
<td>$508,200</td>
<td>Within 5 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$508,200</td>
<td></td>
</tr>
<tr>
<td>Phase II Existing Fire Alarm System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Seal FA Junction box knockout</td>
<td>$500</td>
<td>Immediately</td>
</tr>
<tr>
<td>Replace FA pull station WP cover</td>
<td>$1,500</td>
<td>Immediately</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$2,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase II Fire Alarm System</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace Phase II fire alarm system; System to have visual and speaker devices and new fire alarm control panel</td>
<td>$360,000</td>
<td>Within 5 years</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$360,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase II Elevator System</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace elevator conduit supports</td>
<td>$3,000</td>
<td>Immediately</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$3,000</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase II New Elevators</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Demolition of existing electrical wiring system for elevators and installing new electrical wiring system for elevators</td>
<td>$200,000</td>
<td>See Elevator Section</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$200,000</strong></td>
<td></td>
</tr>
</tbody>
</table>
9.0 ELEVATORS

9.1 Scope of the Elevator Condition Survey:

This elevator Design Analysis discusses the final recommended work scope for the modernization of the existing elevator equipment in University of Hawaii Parking Garage, Phase I & II. The report provides information on existing equipment inventory, existing equipment which should be replaced and/or refurbished, and also discusses the requirements involved in conducting a large-scale elevator modernization. Included is a section discussing related "Additional Work Items" that will be required as a result of the modernization and our field-work.

9.2 Description of the Elevators:

The elevators in Phase I and Phase II parking structures were originally installed by Westinghouse Elevator Company, and subsequently modernized in 1994 by Schindler Elevator Corporation.

All three (3) elevator cores contain two (duplex) elevators, with common elevator duties and sizes. The elevator lobbies are open at the top landings, protected only above, but with open sides on both the Makai and Mauka ends of the lobby. All elevator shafts also have elevator hoistway ventilation louvers, which allow rain and moisture to penetrate into the elevator hoistways during both trade wind and Kona rain storms.

9.3 Condition Survey of Elevators:

The elevator modernization by Schindler Elevator Corporation in 1994 was very comprehensive; however, due to the exposed condition of the elevator hoistways, lobbies, and machine rooms, the equipment is due for another overhaul and modernization as a result of corrosion to hoistway equipment. The machine rooms had reported episodes of water/moisture penetration through vent louvers and flooding. The machine rooms are also susceptible to dust/dirt penetration through the louvers as well as heat build-up due to inadequate ventilation.

The two elevator cores in the Phase I (Elevator Nos. 1 & 2, and 3 & 4) have elevator cabs that do not meet ADAAG requirements for clear can plan for elevators having center opening door panels. The measured floor plan of these four elevators was 80"W x 48"D. ADAAG requires a minimum clear floor plan of 80"W x 51"D. The two elevators in the third elevator core (Phase II) were designed with cab floor plans meetings this requirement. The Architect should study whether the provision of these two elevator unit, located in the NW corner of the facility meet proper accessibility requirements for this facility.

A. Existing Equipment Condition & Recommended Upgrades:

This section provides a summary of each major elevator system and/or component, and our assessment of the condition and recommended upgrades required to the system or component. The overall cost estimate for the Elevator Contractor's work scope based on these recommendations is anticipated to be approximately $1,410,000.00 for the six (6) elevators. Following is a summary of the major portions of the Elevator Contractor's work:
1. Machines (Geared):

The Westinghouse basement/adjacent geared traction machines are worn, have numerous oil leaks, and are recommended to be replaced with new geared traction machines complete with new vector rated AC motors and machine room deflector sheaves.

Scope: Provide completely new basement adjacent geared traction machines, vector AC motors, bedplate, deflector sheaves, and isolation utilizing existing structural hold-down.

Value: Improves motion control and ride quality, decreases noise levels, and decreases down-time and expense for future maintenance repairs. Approximate cost: $198,000.00.

2. Drive/Motors:

New A.C. vector rated variable voltage and frequency (VVVF) motors will be provided to replace worn and inefficient D.C. hoist motors and motor-generator sets.

Scope: Provide new vector-rated VVVF motors and solid-state drive units for both geared traction elevator units. Motor drives may be either regenerative or non-regenerative type, depending on connection to emergency power unit and ability of facility to absorb the regenerative power.

Value: New VVVF drives and motors will result in decrease in electrical use by 35-50% over existing motor generator and up to 60% for regenerative drives. Elimination of motor generator sets will reduce heat release in machine rooms and also reduce carbon dust build-up and thereby decrease maintenance by eliminating carbon brushes. Approximate cost: $48,000.00.

3. Controllers:

The elevators utilize analog relay logic elevator controllers, which operate on hundreds of contacts to operate and control the elevator system. New microprocessor-based elevator controls are proposed for the modernized elevators.

Scope: Provide new solid-state, microprocessor based elevator controls for elevator control and dispatch functions. Provide new group dispatch systems utilizing fuzzy-logic/artificial intelligence logarithm to improve dispatch efficiency. Replaces discrete wiring with serial-link wiring.

Value: Improves dispatch efficiency, and reduces the amount of heat generated in the machine rooms. Improves on elevator reliability by reducing the number of electro-mechanical devices and moving parts by substituting with solid-state devices. Adds valuable features such as load-weighing, anti-nuisance, and motor pre-torque for improved motion control. Provides easily upgradeable security and remote monitoring.
features, which would be valuable for the facility. Provides more efficient trouble-shooting and less down time due to diagnostic functions. Provides quieter operation. Approximate cost: $114,000.00.

4. Door Operators:

Existing Schindler QKS door operators are worn and are in need of replacement. Propose an upgrade to newer generation of solid-state, closed loop door operator.

Scope: Replace all door operators with newer solid-state, closed loop door operators to enhance door control and operation under varying operating conditions.

Value: Improves door operation in variable wind and pressure conditions. Improves on the elevator door operator reliability as a result of the solid-state control systems. Improves overall elevator system reliability since industry estimates show that 70-75% of all elevator callbacks are related to elevator door problems. Provides safer door operation as a result of the enhanced door control. Approximate cost: $48,000.00.

5. Selector Systems:

Replace existing Schindler selector system and mechanical limits with new tape-less, solid-state leveling system.

Scope: Selector system will be replaced to provide pre-engineered selector system matching the new control system.

Value: Improves reliability due to the use of solid-state components. Improves leveling accuracy to within +/- 1/4” under all car-loading conditions, with no changes over time. Approximate cost: $36,000.00.

6. Door Hardware:

Schindler door interlocks, drive block/vane, pick-ups, and rollers, and hangers are in adequate condition for complete overhaul and refurbishment.

Scope: Rebuild and refurbish existing Schindler interlocks, drive blocks/vane, hangers, rollers, and eccentrics to a new condition. Replace all door rollers with new. Replace all closers and relating cables with new. Replace all door-gibs with new. Refurbish galvanized steel header case and formed door tracks to a new condition.

Value: Improves overall elevator reliability since industry estimates show that 70-75% of all elevator callbacks are related to elevator door systems. Approximate cost: $49,000.00.

7. Car & Counterweight Guides:

Existing Schindler car and counterweight guides are worn.
Scope: Provide new active/full suspension roller guides units. Provide static balance of all counterweight assemblies, guides, and rails.

Value: Improves ride quality and motion control of the elevator during transit. Approximate cost: $36,000.00.

8. Counterweight:

Reuse, rebalance, refurbish, rust remediate and repaint.

Value: Counterweight assemblies are essentially dead weight in a rolling frame. The dynamic parts of the system should be overhauled and replaced (guide assemblies). Replacement with a new counterweight will not noticeably improve operation of the elevators. Static rebalance of the system will be required prior to final testing. Approximate cost: $15,000.00.

9. Buffers:

Reuse, refurbish, and repaint. Provide new connecting and support hardware. Paint elevator pits with Masonry paint.

Value: Buffers appear to be in visually good condition for reuse and refurbishment, and can be rebuilt to OEM standards for the weight and speed of the specific elevator unit. Buffers should be dis-assembled, all parts inspected for wear and replacement, and rebuilt to a new condition with OEM parts and with new oil. Provide new buffer switches. Approximate cost: $33,000.00.

10. Cab Enclosures:

Cab enclosures are rigidized stainless steel and are in a good condition for reuse and refurbishment.

Scope: Reuse and refurbish the existing rigidized stainless steel enclosures, and refurbish car-tops. New durable interior finishes to the cab walls, ceilings, and floors can also be accomplished at this time for all elevators.

Value: Improves and enhances the aesthetic appeal of the modernized elevator. Most economically feasible to upgrade cab interiors coincident with the modernization. Approximate cost: $90,000.00.

11. Fixtures:

The existing fixtures are worn and in need of replacement.

Scope: Provide new vandal-resistant elevator operating panels, hall stations, directionals, and position indicators. Provide new LED halo button illumination. Provide new LED signalization. Provide serial-link
wiring and communication. Provide NEMA 4X fixtures and wiring for top exposed lobbies.

**Value:** Improved reliability due to solid-date and serial link upgrades. New LED fixtures are more efficient and last longer than incandescent illumination on the existing fixtures. Enhances aesthetic appeal in the cabs and in the elevator lobbies. Fixtures to meet all ADAAG requirements. Approximate cost: $90,000.00.

12. **Wiring:**

All machine room and hoistway wiring shall be replaced as required per Code for a major modernization and upgrade to new elevator controllers.

Approximate cost: $90,000.00.

13. **Cables:**

Replace hoist and governor cables with new.

**Value:** It is most feasible (economically and to reduce elevator down-time) to provide new cable and cable changes during the modernization, while the elevators are already down for the long period of time due to related modernization work. Brings the important load-carrying and safety activating portions of the elevator system into a new condition.

Approximate cost: $85,000.00.

14. **Door Protection:**

Replace existing detectors with new NEMA 4X infrared door detectors.

**Value:** Enhances reliability due to providing new hardware with the rest of the door retrofit. Approximate cost: $21,000.00.

15. **Pit Float Switch:**

Provide new pit float switch in each elevator pit to indicate the presence of water in the pits and to prevent the elevators from coming down to the lowest floor landing which would damage all electrical wiring under the cab and platform. Approximate cost: $18,000.00.

B. **Additional Work Items:**

During our field investigations, and also as a standard part of any large-scale elevator modernization, there are additional work items that are not normally provided by the Elevator Contractor but are required to meet Elevator Code. These related areas in the Fire Protection, Electrical, Mechanical, and Architectural disciplines will be required as a result of the elevator modernization work scope, and should be accounted for in the planning of this project.
1. "Foreign Equipment":

Any pipes, traps, ducts, or conduit which is determined by the HIOSH Elevator Bureau to be "foreign" (not directly required for the operation of the elevators) may need to be either re-routed outside the machine room enclosures, or boxed-in with a rated enclosure. This may increase work scope.

2. Smoke Sensors:

Smoke sensors must be provided in each machine room and in each enclosed elevator lobby for each single or group of elevators to provide fireman's phase I recall service, per ASME A17.1 Elevator Code.

3. Preaction Systems:

If water sprinklers are to be provided in the elevator hoistways and/or the elevator machine rooms, then a preaction system shall be provided per the requirements of the HIOSH Elevator Bureau.

4. Emergency Power:

A test of the emergency generator system should be conducted to determine how many elevators are connected and operate on the emergency generator prior to the modernization. The capacity of the generator should be determined and discussions with the User should be initiated to determine the number of elevators to be connected to the generator for emergency power operation. Depending on Electrical Engineer's calculations, it must be determined how the elevators are to operate under a loss of normal power.

If it is desired that all elevators shall sequentially lower (one-at-a-time) to the designated level to release people, then conduit and pre-transfer/transfer signals must be provided from the ATS to each elevator machine room.

This requirement is only applicable if emergency power and generator are to be provided for this facility.

5. Remote Elevator Fire Panel:

Per Life Safety and Fire Code requirements, a remote elevator panel installed at the designated level may need to be provided for Fire Fighter personnel to use in the event of a fire emergency. This panel basically shows the position, direction of travel, and power status of each elevator in the facility. This panel is required for buildings that exceed 75 feet of height.

6. Public Announcing & Security Cameras:

During our survey, we could not confirm the presence of any public announcing systems, Life Safety, or security camera hardware in any of
the elevator cabs. Any upgrades to provide such a system would be considered "Additional Work". The Architect should confirm the work scope in this area with the Project Engineer.

7. Fireman's Telephones:

Fireman's telephones are not provided in the elevators. Any upgrades to provide such systems would be considered "Additional Work" by other disciplines.

8. Asbestos:

All design documents should be written and drawings should show disclosure of any asbestos containing hardware. Such a study should be undertaken prior to bidding of any design package to inform any Bidders and Contractors that they will be required to implement an approved asbestos-handling and abatement/containment program.

9. Repair of Pit Sump and Pumps:

These elevators have a history of having pits flooded during periods of heavy rainfall. Any work associated with the elevator sump pits and sump pumps are not included in the Elevator Contractor's work scope and must be accommodated in the design.

10. Hoistway Ventilation:

Upgrades to elevator hoistway ventilation louvers and changing of louvers to hurricane, storm proof designs are considered work outside of the Elevator Contractor's scope and should be accommodated in the overall design.

11. Machine Room Air Conditioning:

Due to historical damage of these elevators due to extreme moisture and dirt/debris penetration into the elevator machine rooms, as well as to protect the new microprocessor based elevator controls, it is recommended that these elevator machine rooms be air conditioned. This work scope should be accommodated in the overall design work scope.

C. Modernization Options:

1. Escalated Installation Schedule:

Typically one elevator car will be removed from public use throughout the modernization period, leaving one car to provide service to the public in each elevator core. This will have an impact on the hall waiting times. For this work scope, each elevator is anticipated to be out-of-service for approximately 10 weeks. An escalated installation schedule utilizing additional shift work can result in the downtime being reduced to approximately 6 weeks per elevator.
The cost to provide an escalated installation schedule, based on double shift work or weekend work is estimated to be approximately $22,000.00 per elevator.

2. Elevator Remote Monitoring & Control (ERM):

All elevator systems have, as an option, a remote elevator monitoring and control system that provides various functions and monitoring capability for all the elevators connected to the ERM. Since the parking structure has Security Personnel that monitor among other things the elevators and the security functioning of the elevators, this would be a desirable option to consider.

With ERM, the following features may be realized:

a. On a single computer screen, instantly find the position, direction of motion, and the condition of the elevator door movement for each elevator unit.
b. Provide security lock-down of individual elevator units at various times and on various dates.
c. Secure certain floors from access for each elevator unit.
d. Provide minor diagnostics.
e. Access elevator fault logs.
f. Conduct traffic analysis studies.

Some systems have more capability than others, however, all provide at a minimum the above listed features. To provide ERM for the elevators, conduit would need to be run from each machine room to the remote location (ie. Security Room etc...).

Elevator Contractor's cost to provide this type of system is estimated to be approximately $25,000.00, which includes ERM software, desk-top computer and screen, and wiring from each machine room. Conduit runs would be by Electrical Design. Electrical has mentioned the possibility of a wireless system connection, which should also be investigated.

D. Proposed Construction Time Periods:

Elevator Contractor work in each duplex elevator core is estimated to take 10 weeks per elevator, with one (1) crew (crew equals one Lead Mechanic and one Helper) working on one elevator. Once one elevator is completed, work begins on the next until both are complete.

Depending on the number of crews that the Elevator Contractor designates to the job, all three elevator cores may be under construction simultaneously.

9.4 Conclusion:

The existing Westinghouse/Schindler elevators have been maintained to an average condition, and based on our visual reconnaissance are in an average condition for their vintage and usage. Due to the modernization performed in 1994, the majority of the
elevator hoistway equipment is in an acceptable condition for reuse and refurbishment in the modernization program.

Despite the average condition of the equipment, the controllers are old and the facility would greatly benefit from the large advances made in control and motor drive technology. Since much of the equipment has been properly maintained, it is feasible to reuse portions of the equipment in the modernization program (as identified earlier in this report) with overhaul and refurbishment to OEM specifications. Elimination of the motor-generator drives for all the elevators, and replacement with new solid-state direct motor drive units will reduce electrical consumption. New controllers will improve dispatch efficiency and reliability. The recommended comprehensive elevator modernization will serve to meet the following objectives:

A. Improvements in Reliability:

The acceptable industry standard for "Mean Time Between Failure" (MTBF) is currently one (1) callback per elevator every three (3) months. This rate applies to microprocessor-based elevators such as the existing Schindler Elevators. Due to the age of the elevators along with the wear and tear caused by the exposure, it is likely that these average MTBF rates no longer are attainable. A comprehensive modernization would serve to improve the MTBF rates to industry average ratios.

B. Improved Energy Efficiency:

Reductions in energy consumption can be expected due to improvements in motor and motor drive efficiencies. Industry studies show an average reduction in power consumption of 35-50% for VVVF motor drive vs. motor-generator drive.

C. Improvement in Dispatch Efficiency:

There will be noticeable improvements in dispatch efficiency for the duplex passenger elevators as a result of the solid-state dispatch system utilizing "Fuzzy Logic/Artificial Intelligence" to learn and anticipate high traffic periods and the dispatch cars in advance.

D. Improved Motion Control:

There will be improved motion control and car ride due to upgrades to solid-state selectors, closed-loop motor control, load-weighing, and rail and car guide assembly work.

E. Improved Machine Room Environment:

Upgrades to solid-state motor drives and controllers will result in cooler machine rooms and a reduction in carbon dust and contaminants in the machine rooms. Machine rooms will also operate quieter without the constant drone of motor-generator sets. Air conditioning and sealing of the machine rooms will also result in a cleaner environment for the solid-state equipment.
F. Improvements in Safety:

Solid-state selector systems and motor controls will result in consistent leveling accuracy of ±1/4" sill-to-sill under all car-loading conditions. Elevator speed will be maintained at ±2% of rated speed under all load conditions. New non-contact infrared door detectors, upgraded fireman's service, anti-nuisance features, load weighing, new hoist and governor cables, and refurbishment of car safeties will serve to improve overall safety of the modernized elevator units.
## Preliminary Opinion of Probable Cost

### Summary Elevator Repair/Upgrade/Modernize Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Units</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machines: New basement adjacent geared traction machines, vector AC motors, bedplate, deflector sheaves, and isolation utilizing existing structural hold-down</td>
<td>Is</td>
<td>1</td>
<td>$198,000.00</td>
<td>$198,000</td>
</tr>
<tr>
<td>Drive Motors: New vector-rated VVVF motors and solid-state drive units for both geared traction elevator units</td>
<td>Is</td>
<td>1</td>
<td>$48,000.00</td>
<td>$48,000</td>
</tr>
<tr>
<td>Controllers: New solid-state, microprocessor based elevator controls for elevator control and dispatch functions</td>
<td>Is</td>
<td>1</td>
<td>$114,000.00</td>
<td>$114,000</td>
</tr>
<tr>
<td>Door Operators: Replace all door operators with newer solid-state, closed loop door operators</td>
<td>Is</td>
<td>1</td>
<td>$48,000.00</td>
<td>$48,000</td>
</tr>
<tr>
<td>Selector Systems: Replace existing Schindler selector system and mechanical limits with new tape-less, solid-state leveling system</td>
<td>Is</td>
<td>1</td>
<td>$36,000.00</td>
<td>$36,000</td>
</tr>
<tr>
<td>Door Hardware: Rebuild and refurbish existing Schindler interlocks, drive blocks/vane, hangers, rollers, and eccentrics to a new condition. Replace all door rollers with new. Replace all closers and relaying cables with new. Replace all door-gibs with new. Refurbish galvanized steel header case and formed door tracks to a new condition</td>
<td>Is</td>
<td>1</td>
<td>$49,000.00</td>
<td>$49,000</td>
</tr>
<tr>
<td>Car &amp; Counterweight Guides: Provide new active/full suspension roller guides units. Provide static balance of all counterweight assemblies, guides, and rails.</td>
<td>Is</td>
<td>1</td>
<td>$36,000.00</td>
<td>$36,000</td>
</tr>
<tr>
<td>Counterweights: Reuse, rebalance, refurbish, rust remediate and repaint. Reuse, refurbish, and repaint. Provide new connecting and support hardware. Paint elevator pits with Masonry paint</td>
<td>Is</td>
<td>1</td>
<td>$15,000.00</td>
<td>$15,000</td>
</tr>
<tr>
<td>Cab Enclosures: Reuse and refurbish the existing rigidized stainless steel enclosures, and refurbish car-tops. New durable interior finishes to the cab walls, ceilings, and floors can also be accomplished at this time for all elevators.</td>
<td>Is</td>
<td>1</td>
<td>$33,000.00</td>
<td>$33,000</td>
</tr>
<tr>
<td>Fixtures: Provide new vandal-resistant elevator operating panels, hall stations, directionals, and position indicators. Provide new LED halo button illumination. Provide new LED signalization. Provide serial-link wiring and communication. Provide NEMA 4X fixtures and wiring for top exposed lobbies.</td>
<td>Is</td>
<td>1</td>
<td>$90,000.00</td>
<td>$90,000</td>
</tr>
<tr>
<td>Wiring: Replaced as required per Code for a major modernization and upgrade to new elevator controllers.</td>
<td>Is</td>
<td>1</td>
<td>$90,000.00</td>
<td>$90,000</td>
</tr>
<tr>
<td>Cables: Replace hoist and governor cables with new.</td>
<td>Is</td>
<td>1</td>
<td>$85,000.00</td>
<td>$85,000</td>
</tr>
<tr>
<td>Door Protection: Replace existing detectors with new NEMA 4X infrared door detectors.</td>
<td>Is</td>
<td>1</td>
<td>$21,000.00</td>
<td>$21,000</td>
</tr>
<tr>
<td>Pit Float Switch: Provide new pit float switch in each elevator pit.</td>
<td>Is</td>
<td>1</td>
<td>$18,000.00</td>
<td>$18,000</td>
</tr>
</tbody>
</table>

**Subtotal 1** $971,000

<table>
<thead>
<tr>
<th>Item</th>
<th>Units</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escalated installation schedule</td>
<td>ea</td>
<td>6</td>
<td>$22,000.00</td>
<td>$132,000</td>
</tr>
<tr>
<td>Elevator remote monitoring and control (ERM)</td>
<td>ea</td>
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<td>$25,000.00</td>
<td>$25,000</td>
</tr>
</tbody>
</table>

**Subtotal 2** $157,000

**Subtotal 1 + 2** $1,128,000

**Contingency** % 1 25% $282,000

**Total** $1,410,000
Subject: Re: UH Parking Structure Cost Estimate  
From: Neil Kunihisa <elevations.neil@hawaiiantel.net>  
To: "dwrighto@nagamineokawa.com" <dwrighto@nagamineokawa.com>

Dwight:

Did not get the email, however, if you are looking for the split between Parking Structure Phase I (Elevator Nos. 1&2, and 3&4), the estimate for those units would be approx. $940,000.00, and for Phase II (Elevator Nos. 5&6- Ewa end of Parking Structure), that would be approx. $470,000.00.

Alohal

Neil M. Kunihisa, President

Elevations, Inc.
Vertical Transportation Consultants
2514 Malama Place
Honolulu, Hawaii  96822
PH:  (808) 988-6583
FX:  (808) 988-6571

On 5/20/11 12:20 PM, "dwrighto@nagamineokawa.com" <dwrighto@nagamineokawa.com> wrote:

> Please submit your revised cost estimate separate out between Phase I
> work and Phase II work similar to how the fire protection cost
> estimate was done in the prefinal condition survey report. I assume
> you all got the e-mail last week that it was due today.
> 
> > Dwight
> >