Special Thanks to:

John Chong
RM Towill

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# Table of Contents

Introduction  
Objectives  
Limits of Master Plan  
Evaluation Criteria  
  Walkways  
  Ramps  
Field Evaluation Process  
  Walkways  
  Ramps  
Evaluation Summary  
  Walkways  
  Central Campus  
  South Campus  
  North Campus  
  West Campus  
  Ramps  
Recommendations  
  Typical Recommendations for Walkway Repair  
  Recommendations for Additional Walkways  
  Specific Recommendations  
  Ramps  
Cost Analysis  
Conclusion
INTRODUCTION

The University of Hawai‘i at Manoa is the flagship campus of the University of Hawai‘i (UH) college system, being the oldest and largest of the ten UH campuses. As the only public higher education system in the state, the University of Hawai‘i at Manoa, hereinafter referred to as UH Manoa, is among the top 30 U.S. public institutions in federal research funding for engineering and science, priding itself on high research activity, academic excellence, and a large degree of community involvement. It is internationally acclaimed and accredited by the Western Association of Schools and Colleges, and its campus environment is continually adapting and improving to reflect the high caliber reputation of the institution.

As stated in the University of Hawai‘i at Manoa 2011-2015 Strategic Plan, kuleana, ‘ohana, and ahupua‘a (responsibility, family, and community connectivity), are the fundamental Native Hawaiian concepts embedded in the culture at UH Manoa. This master plan reflects these values by upholding the responsibility to maintain the beauty of the campus, to promote the safety and well-being of the UH community, and to personify the unified reverence for the land upon which UH Manoa was built. To complement the university’s vision and goal, the UH Manoa Campus Walkways Restoration and Improvement Master Plan (Walkways Master Plan) shall aid in maintaining and improving the physical foundation upon which Hawai‘i’s future generations may grow and successfully participate in the global community.

Since its establishment in 1907, UH Manoa has experienced much expansion with the addition of specialized schools, buildings, sports facilities, and over eight miles of walkways. The campus covers a vast 320 acres, and the ever growing facilities and student population has greatly increased the demand on its infrastructure.

As of 2012 the student population is over 20,000 and increasing annually with the campus walkways serving as the primary means of interconnecting campus life. Just as the university provides students pathways to success through education, the campus walkways also aid in the students’ educational journey in a physical sense. The walkways are thus vital assets that must be maintained, not only to uphold visual aesthetics of the campus, but also to act as a means of safe passage for campus users.
OBJECTIVES

The purpose of the *University of Hawai‘i, Manoa Campus Walkways Restoration and Improvement Master Plan* is to improve walkway access for students, faculty, staff, and visitors, promoting a safe pedestrian oriented environment. This is accomplished through the inventory of existing walkways, identifying and evaluating existing deficiencies and hazards, and prioritizing recommended restorations and improvements. The development of the *Walkways Master Plan* included coordination with other UH Manoa master plans and projects. Probable construction cost estimates of general improvement are also provided to assist in financial planning.

The objectives of the master plan include improving pedestrian access between facilities on campus, improving safety, and verifying conformance to the 2010 American Disabilities Act (ADA) standards for ramps along the UH Manoa designated accessible routes.

LIMITS OF MASTER PLAN

The physical limits of the *Walkways Master Plan* is confined within UH Manoa’s legal boundaries and the following general areas:

**South Campus (Lower)** – Lower Campus Road, Kalo Lane, Portions of Kalele Road, Student dormitories, Wa’ahila Faculty Housing, and Hawaiian Studies Facilities

**Central Campus (Upper)** – Campus as bounded by Dole Street, University Avenue, Maile Way, and pathways adjacent to East-West Road

**North Campus** – Magoon Facility, Institute for Astronomy, and portions of the campus north of Maile Way, and west of Parnoa Road

**West Campus** – University Laboratory School campus area bounded by University Avenue, Dole Street, and Metcalf Street
Exclusions from the master plan’s scope of work, as defined by UH Manoa, are as follows:

- Walkways associated with Maile Way, McCarthy Mall, Correa Road, Andrews Outdoor Theatre, Kalele Road from the parking structure to the baseball walkway (from Murakami Stadium to the Practice Fields/Softball Stadium), University Press portable buildings, Manoa Innovation Center, Kau’okahaloa Nui Faculty Apartments, and Kau’ikahloa Iki Condominiums

- Walkways associated with the East-West Center and the National Marine Fisheries Service Walkways associated with building pads; a general 5-foot offset will be assumed if a building pad is not clearly defined

- Building courtyards

- Sidewalks within City & County of Honolulu public right-of-ways

- Bicycle Paths

- Accessible route evaluation, planning, and mapping

- Areas under construction during the time of the field survey (indicated in Figure X.XX)

Figure X.XX further illustrates the boundaries of the master plan.
FIGURE 1.1
UNIVERSITY OF HAWAI‘I AT MANOA
GENERAL SITE PLAN
EVALUATION CRITERIA

UH Manoa is a public institution funded by the State of Hawai‘i that must abide by federally set standards for pedestrian safety. The following government agencies provide standard accessible regulations and guidelines for the evaluation and design of publicly utilized campus walkways:

- **Federal** – Federal Highway Administration, United States Access Board, Department of Justice
- **State** – Hawai‘i Disability and Communication Access Board
- **Local** – City and County of Honolulu Department of Planning and Permitting

WALKWAYS

Technical guidelines established by the Federal Highway Administration (FHWA) for evaluating walkway conditions served as the basis for the evaluation and analysis of UH Manoa’s walkways. Definitions for typical deficiencies that would detrimentally affect pedestrian safety, as identified by the FHWA document “Designing Sidewalks and Trails for Access Part II of II: Best Practices Design Guide”, are listed in Table 1 and are paired with corresponding photographic examples from the UH Manoa field survey.

<table>
<thead>
<tr>
<th>Potential Hazard</th>
<th>Definition</th>
<th>Sample Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cracking</td>
<td>A fracture or discontinuation within the pavement of a walkway ranging from hairline cracks to indentations wider than 1/2-inches.</td>
<td>![Cracking Illustration]</td>
</tr>
<tr>
<td>Depressions</td>
<td>Settled areas, reverse cross slopes, or other indentations that make the sidewalk path lower than the curb. These depressions trap silt and water on the sidewalk and reduce the slip resistant nature of the surface.</td>
<td>![Depressions Illustration]</td>
</tr>
</tbody>
</table>

Table 1 – Sidewalk Deficiencies
<table>
<thead>
<tr>
<th>Potential Hazard</th>
<th>Definition</th>
<th>Sample Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Deterioration</td>
<td>A condition where the joint or joint sealant of a walkway panel deteriorates and/or horizontal separation has been extended along the walkway.</td>
<td></td>
</tr>
<tr>
<td>Obstacles</td>
<td>Objects located on the walkway, in setbacks or on properties adjacent to the walkway that obstruct the passage space. Obstacles may include, but are not limited to trash receptacles, utility pipes and poles, and vending machines.</td>
<td></td>
</tr>
<tr>
<td>Spalling</td>
<td>A condition where the aggregate in the concrete becomes exposed, caused by high pressure loads and excess water during initial installation.</td>
<td></td>
</tr>
<tr>
<td>Tree Root Damage</td>
<td>Roots from trees growing in adjacent landscaping that cause the walkway surface to buckle and crack.</td>
<td></td>
</tr>
<tr>
<td>Vertical Separation</td>
<td>A vertical displacement at any point in the walkway that could cause pedestrians to trip or prevent the wheels of a wheelchair or stroller from rolling smoothly.</td>
<td></td>
</tr>
</tbody>
</table>
RAMPS

The 2010 Americans with Disabilities Act, enacted by the US Department of Justice, defines a ramp as a walking surface that has a running slope steeper than a ratio of 1-foot vertical to 20-feet horizontal (1:20). Along the UH Manoa walkways, ramps and curb ramps provide accessible alternatives to stairs along paths or building entrances, and create accessible transitions between sidewalks and roadways.

The term “accessible” is defined by the Americans with Disabilities Act as a site, facility, work environment, service, or program that is easy to approach, enter, operate, participate in, and/or use safely and with dignity by a person with a disability. Ramps evaluated for this report include those within the UH Manoa designated accessible route as identified by the UH Cartography Laboratory, Department of Geography. A map of the accessible route is included in Appendix X.XX. Additional ramps within the UH Manoa campus that are not associated with the pre-defined accessible route were also evaluated.

Ramps were evaluated for conformance with the ADA standards, which provide minimum requirements for the design of government and commercial facilities. A summary of the evaluation criteria for ramps is as follows:

- Level maneuvering area or landing at the top of the curb ramp 2.0 percent maximum (1:48)
- Grade ramps perpendicular to the curb
- Ramp grade not exceeding 8.33 percent (1:12)
- Slopes of flared sides not exceeding 10.0 percent (1:10)
- Ramp and gutter cross slope not exceeding 2.0 percent (1:48)
- Adequate drainage to prevent the accumulation of water or debris on or at the bottom of the ramp
- Flush transitions from ramps to gutter and streets, free of level changes
- Curb ramp aligned with crosswalk; straight path of travel from top of ramp to center of roadway to curb ramp on the other side
- Physical width, minimum of 36 inches
- Rise for any ramp run, maximum of 30 inches
- Landing clear length, minimum of 60 inches long
- Handrails required for ramp runs with a rise greater than 6 inches
FIELD EVALUATION PROCESS

WALKWAYS

To evaluate the UH Manoa walkways, a rating system was developed based on the main potential safety hazards defined in Table 1 - Sidewalk Deficiencies. A standard method of evaluating the walkways was important in prioritizing maintenance and repair recommendations. The rating system is as follows:

Rating System (A-F)

A. Like-New Condition, no structural defects

B. Good Condition – Slight cracking, slight joint deterioration, no vertical separation

C. Potential Failure – Moderate cracking, slight joint deterioration, vertical separation up to ½-inches, irregular side slope, spalling up to 35%

D. Imminent Failure – Severe cracking (no loose pieces), joint deterioration up to ½-inches, vertical separation up to ½-inches, spalling up to 35%

E. Structural Failure – Severe cracking (loose pieces), joint deterioration over ½-inches, vertical separation over ½-inches, spalling over 35%

F. Tripping Hazard – Tree root damage, manholes, exposed utility lines and wires, or beyond structural failure

A sample field evaluation sheet is included in Appendix ____.
For each letter rating, a portion of the walkway needed to consist of at least two of the defined characteristics in each rating. Where deficiencies of different rating overlapped, professional judgment was employed.

D-, E- and F-rated walkways include but are not limited to those with severe cracking, vertical separation over ½-inches, uplift from tree root damage, and utilities that are potential tripping hazards. These deficiencies can create unsafe conditions for pedestrians. Spalling and depressions that trap water and silt also provide slipping hazards as they decrease the traction of the typical broom finished concrete. The D-, E-, and F-rated areas are further defined in the “Evaluation Summary” section.

**Ramps**

For the purposes of this report, UH Manoa campus ramps will be identified as being compliant or non-compliant with the 2010 ADA standards previously summarized in *Evaluation Criteria*. Mainly ramp grade, and slopes of flares and landings were surveyed. If one criterion is not met, a ramp is deemed non-compliant. A sample field evaluation sheet is included in Appendix ____.
EVALUATION SUMMARY

WALKWAYS

Survey work for UH Manoa walkways was conducted by Bow Engineering & Development, Inc. from July 2012 through October 2012. This included observations of the walkway conditions, identification of tripping hazards, measurements of deficient concrete panels to recommend repairs, and measurements of existing asphalt for recommended replacement. Field records include written field evaluation sheets and corresponding photographs.

Survey results are reported for North, South, Central and West Campus. Each section includes figures that show the locations of the walkway deficiencies with ratings of D, E and F. Photographs are also included to further illustrate the extent of the deficiencies.

D-, E-, and F-rated deficiencies (Imminent Failure, Structural Failure, Tripping Hazard) were identified as the most critical safety hazards in need of repair, and are thus the focus of the Walkways Master Plan. In the following figures, F-rated deficiencies are indicated in red, E-rated in orange, D-rated in blue and asphalt walkways are indicated in purple. The deficiencies are labeled with numbers which correspond to photographs on either the same page as the figure or the facing page. Descriptions of the deficiencies are included with the photographs.

Walkways with ratings of B and C are not represented in the figure maps, but are listed in Appendix _____. These were identified for future capital improvements planning and are not considered an imminent hazard for pedestrian users. Ratings of A were determined in the field but were not included in the field evaluation sheets since maintenance or repair of these walkways are not necessary.

The walkways’ pavement material was also inventoried, and is recorded as concrete, asphalt or none in the field evaluation sheets. Those marked as none are walkways that are unpaved but appear to be well traveled. Unpaved walkways that are highly traveled and are unsafe for pedestrians were given an F-rating.
West Campus houses the University Laboratory School (UH Lab). Common deficiencies found in West Campus include severe cracking and vertical separation of concrete panels, which create perilous tripping hazards and ruin campus aesthetics. The age of the campus is clearly reflected in the wear on its walkways. There are also a number of main walkways paved with asphalt, as well as a lack of clearly defined pedestrian paths in shared vehicular-pedestrian routes.
Joint deterioration, vegetation growth through joints, severe cracking of panels

Severe cracking, vertical separation over 1/2 in.

Severe cracking, vertical separation

Severe cracking, spalling, vertical separation

Severe cracking, spalling, vertical separation

Medium cracking, depression, spalling, vertical separation

Medium cracking, depression

Medium cracking

Severe cracking, depression

Asphalt pavement

Asphalt pavement

Spalling, severe cracking, depression

Curb - tripping hazard
FIGURE 2

LEGEND
- Asphalt Pavement
- UH Designated ADA Route
- Walkway Number

RATING
- F
- E
- D
Severe cracking, tree root damage

Vertical separation before ADA ramp

Cracking, bollard - tripping hazard

Spalling, joint deterioration

Cracking, joint deterioration

Depression, vertical separation at curb

Vertical separation over 1/2 in.

Asphalt pavement

Cracking, joint deterioration

Vertical separation over 1 in.

Severe cracking, loose concrete

Vertical separation over 1/2 in.

Vertical separation, cracking

Cracking, joint deterioration
Ramps

During the preliminary evaluation of the campus walkway, it was observed that many of the walkway ramp and curb ramp designs were outdated and do not meet current design criteria set by the ADA and DPP. Over 140 building accessible ramps and curb ramps were evaluated during the field survey. Of the ramps evaluated, nearly 70-percent were determined to be non-compliant. Steep ramp and/or landing slope grades are the primary cause of non-compliance. Spalling and cracking are also apparent in the evaluated ramps. Completed field evaluation logs are located in Appendix XX. Table 2 summarizes the campus ramp evaluation and is categorized by the general campus location.

### TABLE 2 - UH Manoa Campus Ramp Evaluation

<table>
<thead>
<tr>
<th>Campus Location</th>
<th>Total No. of Ramps</th>
<th>Within ADA route</th>
<th>Not within ADA route</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No. of Compliant Ramps</td>
<td>No. of Non-compliant Ramps</td>
</tr>
<tr>
<td>North</td>
<td>23</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>South</td>
<td>28</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Central</td>
<td>92</td>
<td>13</td>
<td>34</td>
</tr>
<tr>
<td>West</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>146</td>
<td>17</td>
<td>50</td>
</tr>
</tbody>
</table>

Total Number of Compliant Ramps: 44  
Total Number of Non-Compliant Ramps: 102  
Figures XX through XXX depict the locations of all evaluated ramps in the UH Manoa campus. Ramps compliant with ADA standards are indicated in blue, and non-compliant ramps are indicated in red.
FIGURE 3.1
NORTH CAMPUS - RAMP EVALUATION
FIGURE 3.2
SOUTH CAMPUS - RAMP EVALUATION

LEGEND
- ADA NON COMPLIANT RAMP
- ADA RAMP COMPLIANT
- UH DEFINED ACCESSIBLE ROUTE
FIGURE 3.3
CENTRAL CAMPUS - RAMP EVALUATION
FIGURE 3.4
WEST CAMPUS
RAMP EVALUATION
South:
Steep concrete transition

Central:
Inadequate ramp landing width (less than 36 inches)

Central:
Poorly constructed asphalt curb ramp

West:
Overgrown vegetation

Central:
Inadequate landing before ramp

Central:
Excessive spalling and cracking

North:
Lack of handrails, Rise greater than 6 inches
RECOMMENDATIONS

Recommendations for walkway renovations and improvements are provided based on the analysis of the campus field evaluation. Typical recommendations apply to the majority of general deficiencies identified within the UH Manoa campus walkways and supplement Table 1 – Sidewalk Deficiencies. Priority is assigned to hazards that create a high risk of tripping or difficult maneuvering within the accessible route for mobility-impaired individuals. Details and specifications related to these general recommendations are included in Appendix _____. Other recommendations included in this Walkway Master Plan include recommendations for additional walkways for areas that are not currently paved, but show evidence of a need by pedestrian-made paths. Deficiencies that may require detailed attention are also noted and addressed.

TYPICAL RECOMMENDATIONS FOR WALKWAY REPAIR

For all repairs, there should be a smooth transition to the existing walkway, and undesirable vegetation should be removed. If the repair is within an accessible route, a maximum 2.0% cross slope is needed. If this smooth transition is not possible, adjacent panels should be replaced, or the area to be sawcut should be expanded, until the cross slope criterion can be met.

Cracking

Either remove and replace cracked concrete panels or transversely sawcut the concrete walkway at the ends of the deficient area and replace.

Vertical Separation

If a vertical separation greater than ½-inches is experienced within the joint of two concrete panels, both concrete panels should be removed and replaced. Since the vertical separation most likely occurred due to ground settlement beneath the walkway, the ground should also be leveled and compacted before concrete installation.

If a vertical separation is experienced at the intersection of walkways, the cause of the separation should be investigated. It may only be necessary to replace concrete from one of the walkways if the soil has only settled in that area. The replaced concrete should be flush with the existing walkway.

Depressions

The walkway pavement in these areas should be removed, filled with appropriate soil material, regraded, compacted, and repaved with concrete.
Joint Deterioration

The severity of joint deterioration between panels needs to be evaluated before repair. Severe joint deterioration, characterized by cracking and spalling, warrants the removal and replacement of affected panels. Minor joint deterioration, characterized by slight cracking, slight spalling at panel joints, and/or horizontal separation less than ½-inches, can be remedied with the application of joint sealant, which minimizes the amount of water and dirt penetrating the joint and subgrade, preventing further damage.

Spalling

Severe spalling that covers over 35% of a concrete panel or a large part of a monolithically poured walkway should be addressed by replacing the concrete.

Tree Root Damage

Tree root damage is exhibited through cracks and vertical displacements in pavement caused by the extension of underlying roots. Affected concrete panels should be removed, and a proper root barrier should be installed to prevent damage to the replacement pavement. An experienced arborist should be consulted on the pruning of existing roots if preservation of the tree is desired. The effective life of a root barrier is 15 years, and requires routine replacement to minimize future potential walkway damage and maintenance costs.

Obstacles

Obstacles, such as newspaper stands, fire hydrants, and informational signs, should be removed and relocated to allow an unobstructed clearance of 36-inches minimum along walkways or 60-inches minimum at intersections.

Utilities and Bollards

Utility features such as manhole covers, meter boxes, or remnant bollards that are not at a flush grade within a walkway should be adjusted or relocated to mitigate any tripping hazards. Electrical, telecommunication, or gas utility work should be coordinated with the respective utility company.

Asphalt Walkways

The majority of walkways at UH Manoa are comprised of Portland Cement Concrete (PCC) with a broom finish. However, asphalt walkways are also prevalent. A common form of temporary walkway paving, it is recommended that all asphalt walkways that were evaluated be replaced with PCC as they now serve as a permanent path for campus users. Such recommendations have also been made in the Landscape Master Plan.
RECOMMENDATIONS FOR ADDITIONAL WALKWAYS

The Walkways Master Plan aims to make recommendations for the addition of paved walkways. Recommended additional walkways were determined based on evidence that the paths were well traveled (trampled grass, dirt paths, etc.) and their locations were physically acceptable for pavement installation. These recommendations are meant to safely guide pedestrian traffic and are indicated in Figure XX by the <<color>> dashed paths.

Notable areas for additional walkways include:

Central Campus – Path North of Webster Hall

Students use this inclined dirt path, disrupted by tree roots, as a means of walking from the entrance of Webster Hall to the sidewalk along Farrington Road. Tree roots pose a tripping hazard and the unpaved, steep path provides little traction. Installation of a concrete staircase is highly recommended. See photograph below.

West Campus – Roadway between University High School 1 and University High School 2 Buildings

This shared vehicular-pedestrian path is a designated accessible route without a clearly defined pedestrian walkway. This is considered a high safety hazard condition. It is recommended that curbs be installed to provide separation between vehicular and pedestrian traffic. Striping and signage should also be installed to further promote visibility. For long term consideration, it is recommended that vehicle traffic be re-routed to enter from Metcalf Street.

<<INSERT FIGURE>>

SPECIFIC RECOMMENDATIONS FOR DEFICIENCIES REQUIRING DETAILED ATTENTION

The following sections address unique deficiencies that require a detailed explanation for remediation.
RAMP RECOMMENDATIONS

As stated in the evaluation summary, approximately 70% of the campus ramps and curb ramps do not meet current ADA and DPP standards. It is recommended that all ramps identified as non-compliant be demolished and reconstructed to comply with current ADA criteria. Standard City and County of Honolulu DPP curb ramp details are provided in Appendix X.

For planning and phasing purposes, it is noted that any on-campus construction work that is adjacent to and affecting non-compliant ramps requires the replacement of the non-compliant ramps according to ADA.
Probable costs associated with the recommended restoration and improvements are estimated for budgeting purposes. Unit cost estimates were determined by averaging recent construction bids by local contractors and are assumed to reflect general costs for materials and installation as of 2012. Items associated with the construction cost estimate include erosion control, demolition, concrete pavement, concrete curb and gutter, manhole and meter box adjustments, bollard adjustments, concrete ramps, and traffic control.

The probable cost estimate includes a 20-percent contingency to allow for discrepancies of actual contractor bids.

Table 3 below lists the average unit cost per anticipated construction item.

<table>
<thead>
<tr>
<th>TABLE 3 – Opinion of Probable Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item</td>
</tr>
<tr>
<td>Temporary Facilities</td>
</tr>
<tr>
<td>Erosion Control - BioSock</td>
</tr>
<tr>
<td>Demolition</td>
</tr>
<tr>
<td>Concrete/Asphalt Sidewalk Removal</td>
</tr>
<tr>
<td>Concrete Curb and Gutter Removal</td>
</tr>
<tr>
<td>Concrete Ramp</td>
</tr>
<tr>
<td>Site Improvements</td>
</tr>
<tr>
<td>4” Concrete Sidewalk</td>
</tr>
<tr>
<td>Concrete Curb and Gutter</td>
</tr>
<tr>
<td>Concrete Ramp</td>
</tr>
<tr>
<td>Traffic Control (per section of</td>
</tr>
<tr>
<td>improvement along roadway up to 200 LF)</td>
</tr>
<tr>
<td>Utility</td>
</tr>
<tr>
<td>Manhole/Meter Box Adjustments</td>
</tr>
<tr>
<td>Bollard Adjustments</td>
</tr>
</tbody>
</table>

Total (to include 20% Contingency of Construction Cost)
Not included within the table, but should be independently factored is the cost of construction mobilization. Mobilization costs are typically estimated as 10-percent of total construction cost but may vary and increase due to the timing and proximity of the work. It is recommended that walkway improvements and renovations should be planned, phased and coordinated with contractors to be grouped in close proximity to allow for a more efficient and effective mobilization cost.

Probable construction cost estimates associated with F-, E- and D- ratings were analyzed per deficiency ratings and further sub-categorized by campus area. Table 4 – Cost Estimate summarizes the probable costs.

For the purposes of future improvement planning and budgeting, probable construction costs have been estimated for deficiencies with ratings of B and C. These estimates are based on a future projection 5- and 10- years and assume an inflation rate of 3-percent annually, and are converted to a present day value. Attachment XX located in Appendix XX summarizes the Cost Estimate Analysis for walkways with deficiency ratings of B and C.