Canopy Arm Quality Issues
Investigation Status
June 6, 2019
Canopy Quality Issues

• HART was notified of quality issues on two of the station groups

• On the FHSG group, cracks in the steel were observed in 4 canopy arms not yet shipped

• Initial investigation indicates that the canopy arms may have developed cracks during the galvanizing process

• The 10 canopy arms that have been delivered to site are not being installed at this time

• HART has put both the contractor and designer on notice, and both are cooperating in developing an analysis and a resolution to the issue
Canopy Quality Issues

• The second of two of the station groups is WOSG

• On the WOSG group, cracks in the steel were observed in 1 canopy arm that was shipped to the site

• 16 canopy arms have been delivered to site and all except the one with the crack have been installed

• HART has put both the contractor and designer on notice, and both are investigating a potential fix
Defects

West Oahu Station Group – Ho’opili Station

Lower frame segment crack – 1 Frame
Nan, Inc. & TMP (fabricator)

Farrington Highway Station Group – West Loch Station (WLO)

Lower frame segment cracks – 4 Frames
HDCC, Inc. & SSW (fabricator)
Background

Side Platform Frame

Center Platform Frame
## Quality Issues

<table>
<thead>
<tr>
<th>West Oahu Station Group (Nan, Inc.)</th>
<th>Farrington Highway Station Group (HDCC, Inc.)</th>
<th>Kamehameha Highway Station Group (Nan, Inc.)</th>
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</thead>
<tbody>
<tr>
<td>Contractor Notification to HART: Last week April</td>
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<td>Notified: None</td>
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<tr>
<td>1 lower segment (Ho`opili - side platform) delivered cracked (Gr 100)</td>
<td>4 cracked lower segments @ factory in KS (WLO)</td>
<td>Proceeding with Center Platform fabrication (Gr 50)</td>
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<tr>
<td>All other frames erected</td>
<td>10 lower segments delivered to MSF (WTC)</td>
<td>Side Platform (Gr 100 Elements) – On Hold</td>
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<tr>
<td>Collecting documentation</td>
<td>Cracks occurred after welding, possibly during galvanizing</td>
<td>HART notified contractor &amp; designer</td>
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<td>Parties are cooperating, developing an analysis and resolution</td>
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Approach

HART’s Goals & Objectives for Roof Canopy Structures

A. Establish that Design is safe, and that Construction delivers on Design requirements

B. Based on metallurgical science and engineering, get failure analysis underway and establish causal contributing factors

C. Determine structural adequacy of fabrications performed and decide on their disposition

D. Determine the need for any modifications to current design and specifications

E. Determine the need for any modifications to current contractor/fabricator means & methods

F. Develop “Plan B” to fast-track alternate design and fabrication activities to avoid potential program delays associated with reported risks of high strength Gr 100 steels
FHSG Investigation – Task Force Team
Preliminary Analysis

- WOSG – collecting documentation; field weld repair was unacceptable
- FHSG - canopy frame lower segment analysis begun
  80%-90% of crack filled with zinc (galvanizing material)
- Preliminary hypothesis based upon Wiss, Janney, Elstner (WJE) assessment: Cracks are result of either liquid metal embrittlement (LME), hydrogen embrittlement (HE) or strain age embrittlement
- High residual stresses due to fabrication methods (e.g. welding and plasma cutting) and thermal shock due to hot dip galvanization (HDG)
  Lower segment is Grade 100 steel
- KHSG – Gr 100 fabrication on hold
Questions