



SOLUTIONS FOR THE BUILT WORLD

Mitchell Park Horticultural Conservatory Domes



Peer Review — Precast and Cladding

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Peer Review

- Document review (GRAEF reports)
- Site visit and meeting (visual)
- WJE repair option and cost estimate

History of Mitchell Park Domes

- Donald L. Grieb, a local architect, won a design completion
- Construction began in 1959
- Show Dome (1964), Tropical Dome (1966), and Arid Dome (1967)
- Super Sky was the designer and installer of the glass and aluminum cladding
- Original construction was \$4.2 million



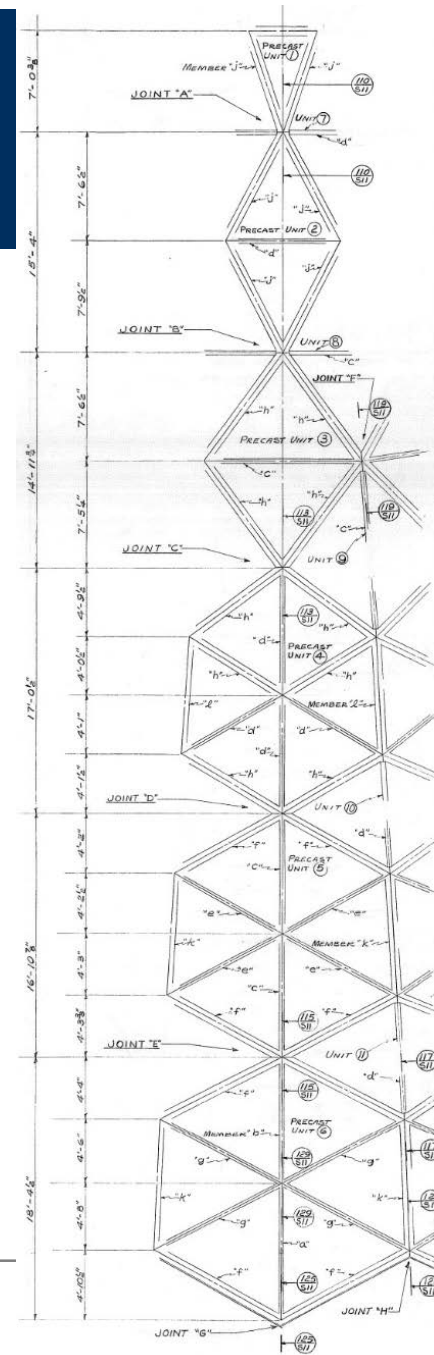
Background

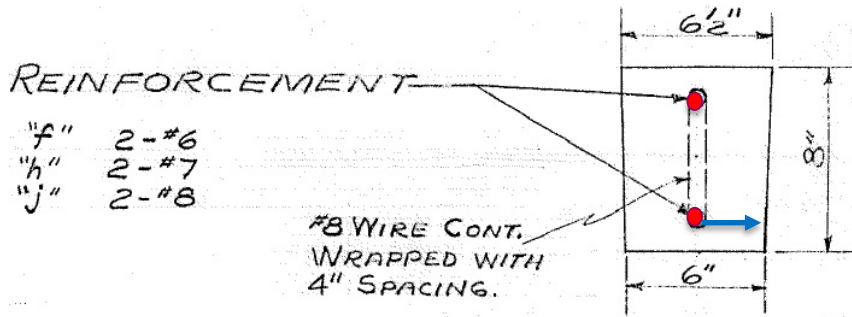
- GRAEF has been working on Domes since 1993
- Primary issues have included: water leakage, issues with cladding internal drainage system, concrete deterioration, glass breakage
- In 2013-2014, GRAEF performed a close-up inspection and subsequent repair of precast concrete members
- Stainless steel mesh installed to mitigate falling concrete
- GRAEF has provided options to repair Domes with estimated costs from \$14 million to \$64 million



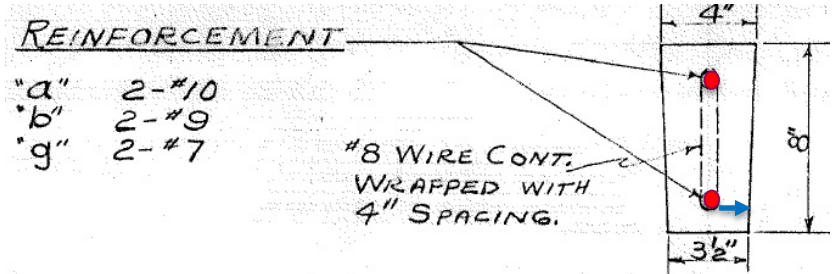
Precast Construction

- Structural precast concrete frame supports cladding
- Precast concrete members were fabricated onsite
- 11 frame member types
- Precast arranged in triangular patterns to form a conoid-shape
- Assembly repeats around the Domes 25 times

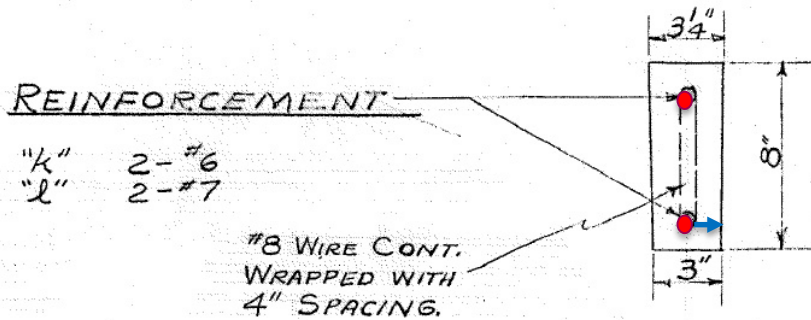




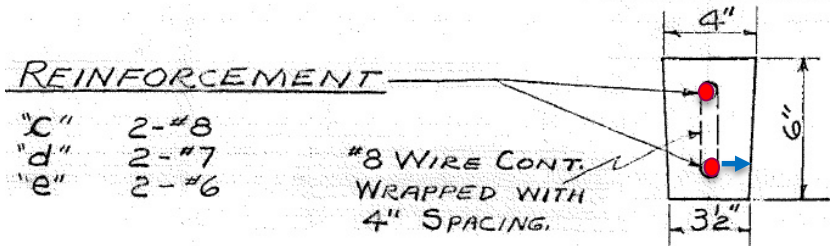
MEMBERS "f", "h", & "j"



MEMBERS "a", "b", "g"



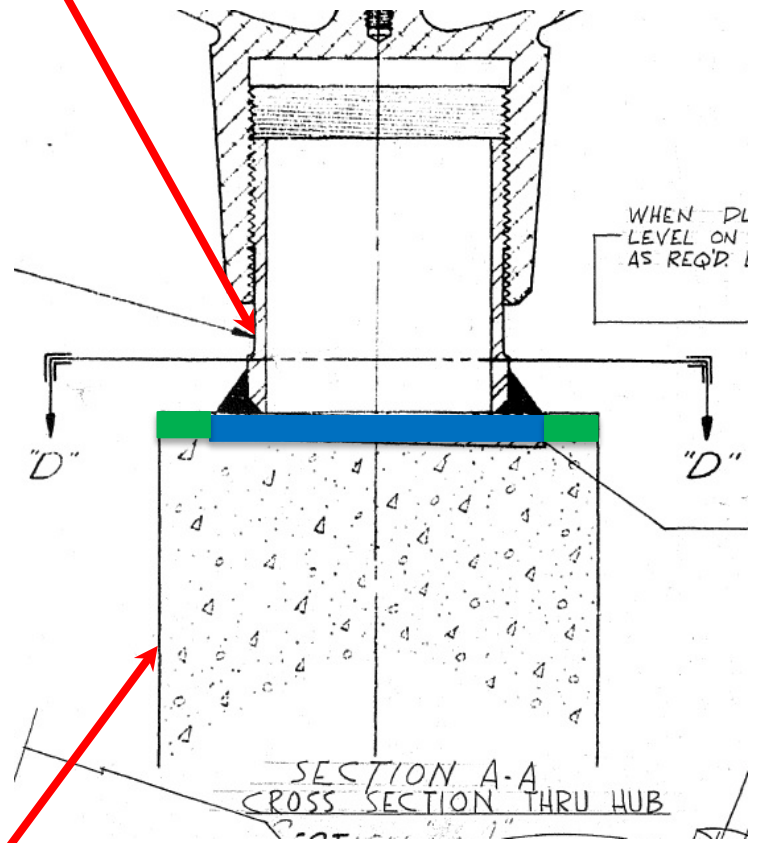
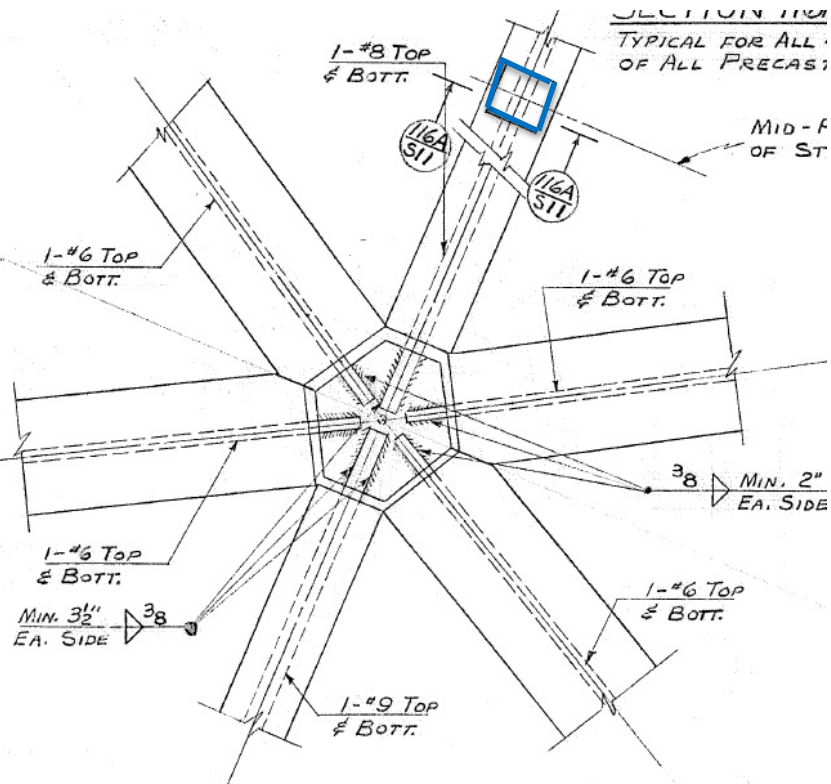
MEMBERS "k" & "l"



MEMBERS "c", "d", & "e"

DETAILS OF PRECAST UNIT MEMBERS

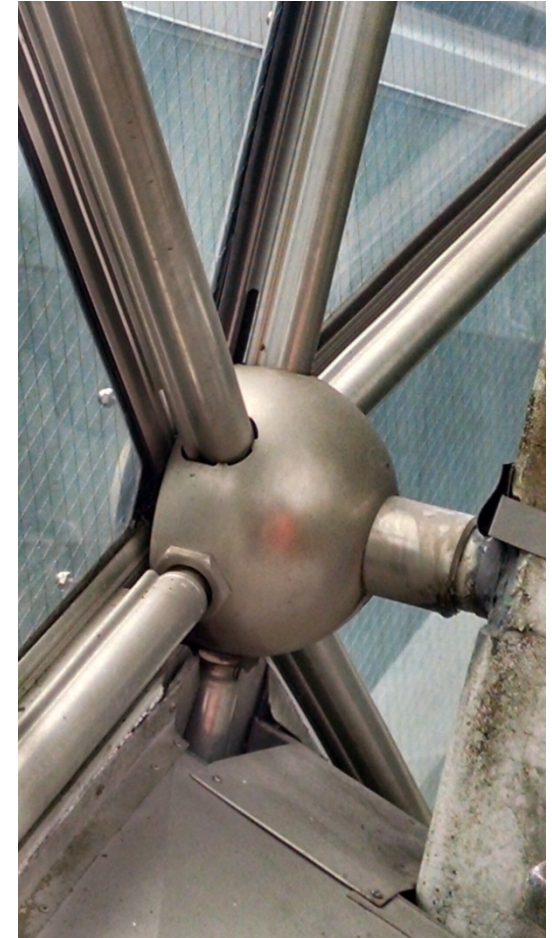
Tube at cladding hub
welded to embedded plate

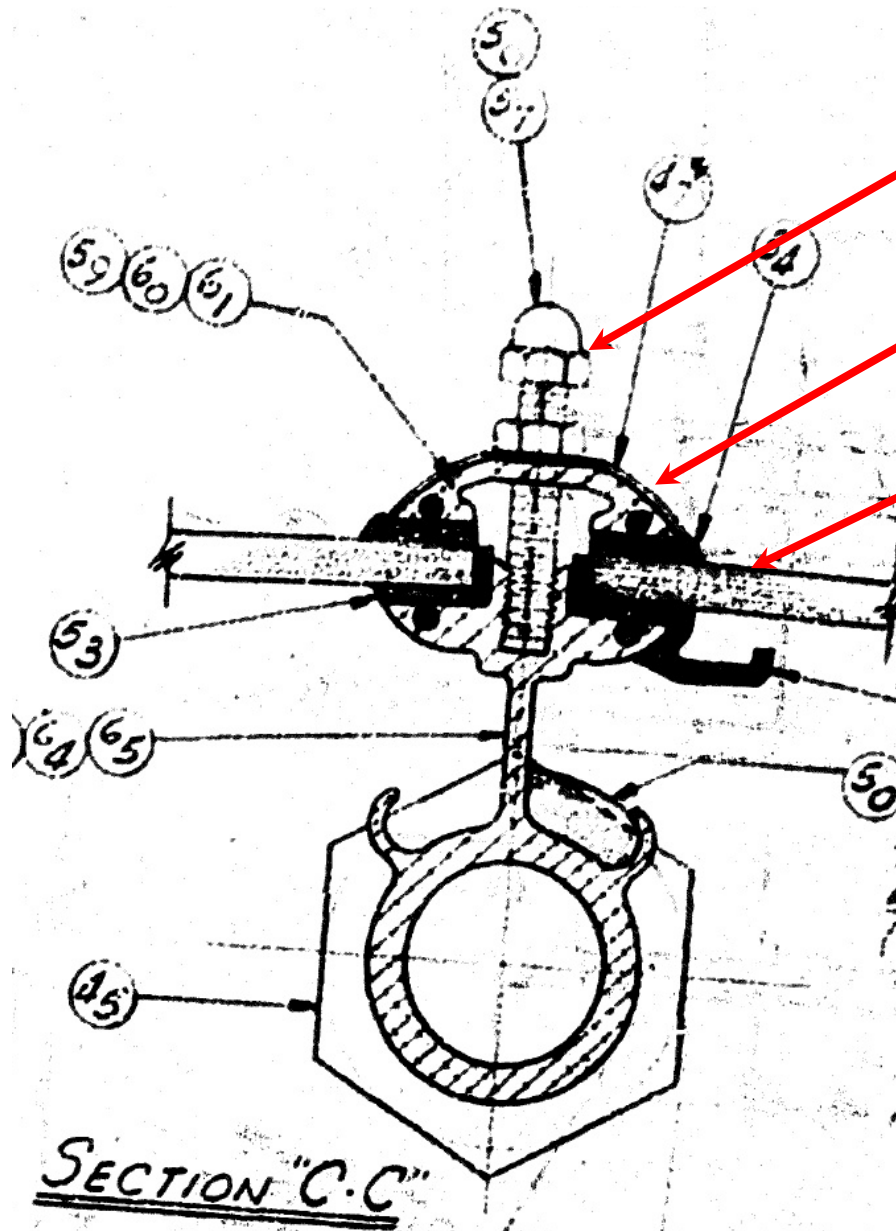


Precast member

Cladding Construction

- Glass-and aluminum clad dome
- 1/4 inch patterned wired glass
- Glass is held in place with a pressure cap and fasteners
- Aluminum rafters which are part of the cladding drainage system
- Circular hubs





Fasteners

Pressure cap

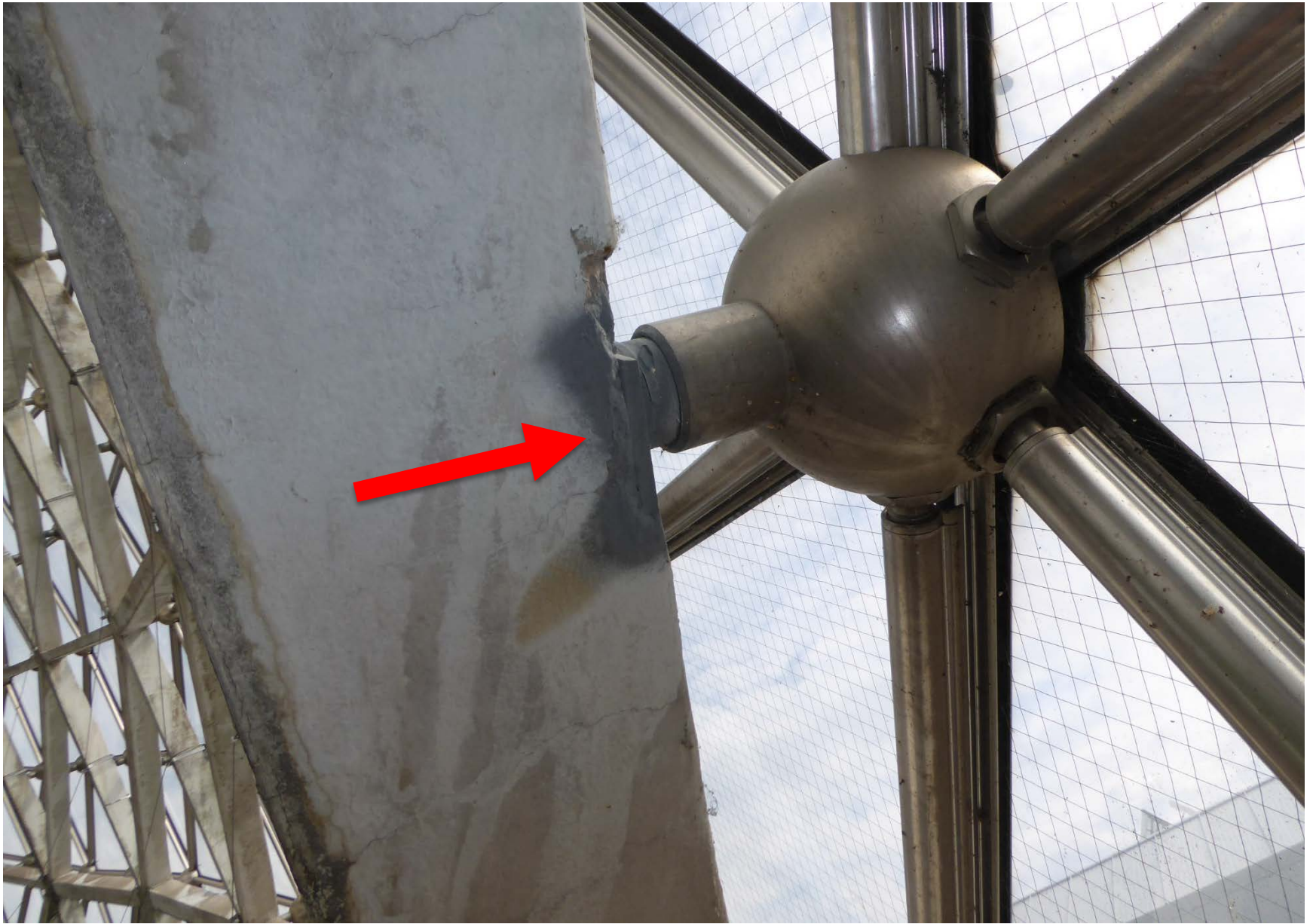
Glass



Observations

- Precast concrete framing
- Glass and aluminum cladding





Small Concrete Fragments











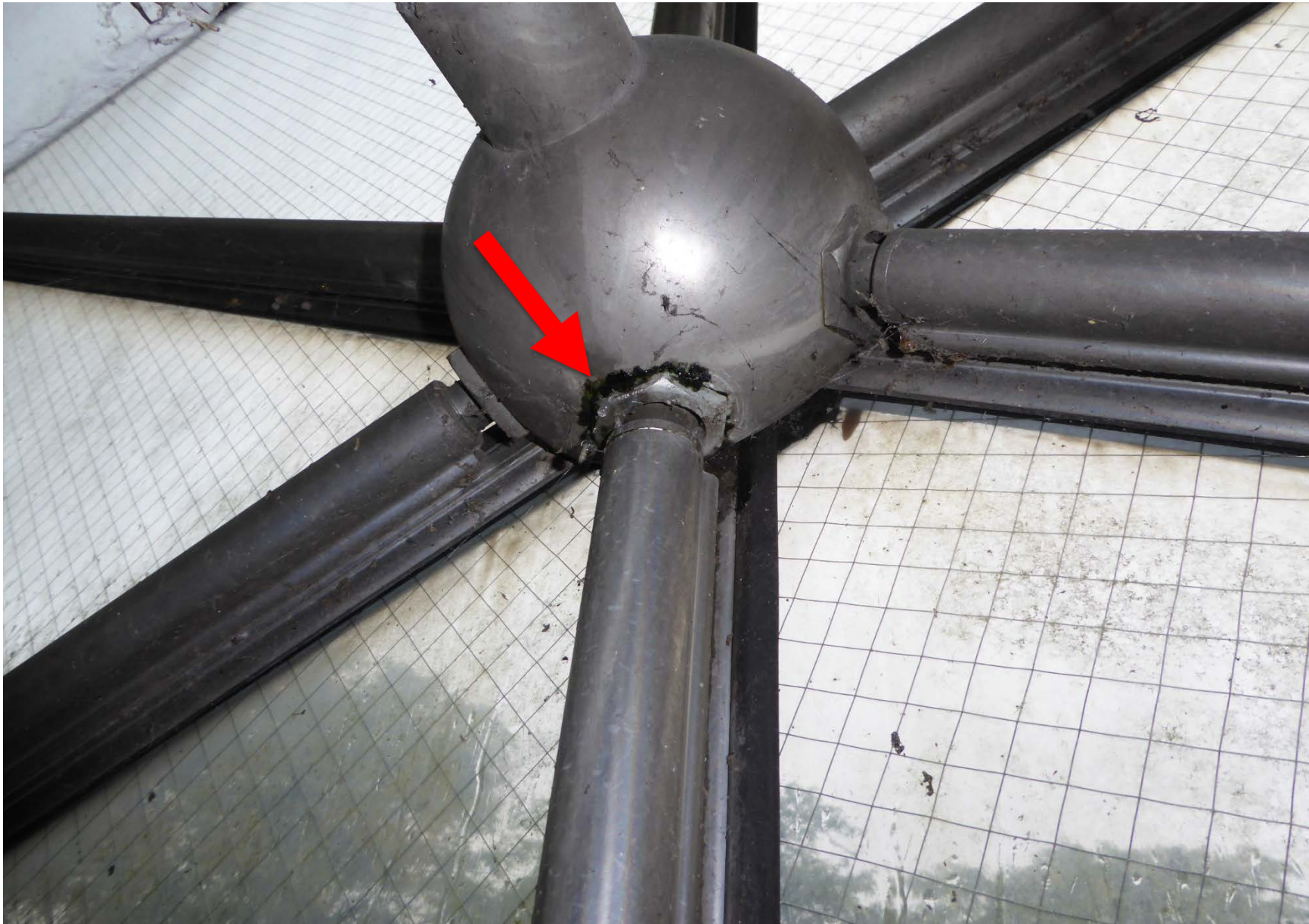












GRAEF Options

- **Option 1** - Replace broken glass, repair cladding and concrete frame
- **Option 2** - Replace all glass with coated insulating glass, repair cladding and concrete frame
- **Option 3** - Replace all glass with coated insulating glass and install new cladding supported on repaired concrete frame
- **Option 4** - Install new coated insulating glass and new self-supporting cladding system, and repair concrete frame
- **Option 5** - Install new coated insulating glass and new self-supporting cladding system, and remove concrete frame
- **Option R** - Install new cladding system with coated insulating glass and rebuild concrete frame per original construction

GRAEF Options

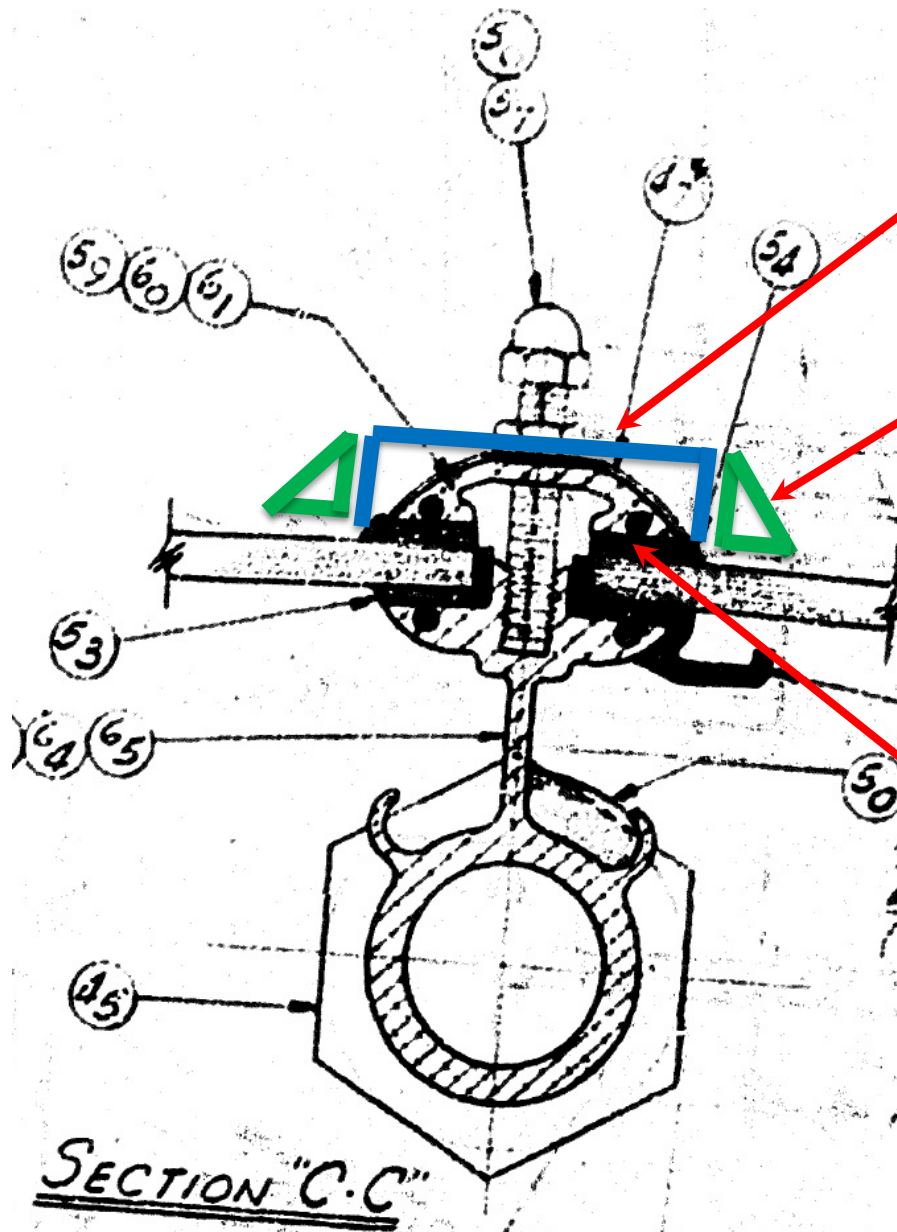
Option	Estimated Cost	Estimated Life	Maintenance	Wire Mesh
1	\$14 million	5-10 years	Very High	Remains
2	\$38 million	15-20 years	High	Remains
3	\$47 million	25-30 years	High	Remains
4	\$54 million	25-30 years	High	Remains
5	\$50 million	50 years	Normal	Removed
R	\$64 million	50 years	Normal	Removed

WJE Comments

- Options 2 through 4 use coated insulating glass at a cost of approximately three to four times the repair cost of Option 1
- Difference between Options 1 and 2 is the replacement of all wired glass with coated insulating glass (\$24 million additional)
- Based on reported energy savings, the coated insulating glass would pay for itself in over 200 years.
- Insulating glass not recommend:
 - Energy savings are slight
 - Not beneficial for plant life (discussion with Greenhouse expert)
- Option 1 has a slightly higher cost related to glass maintenance.
- Maintenance costs for the precast framing are the same for Options 2 through 4.



WJE Considerations for Enhancement



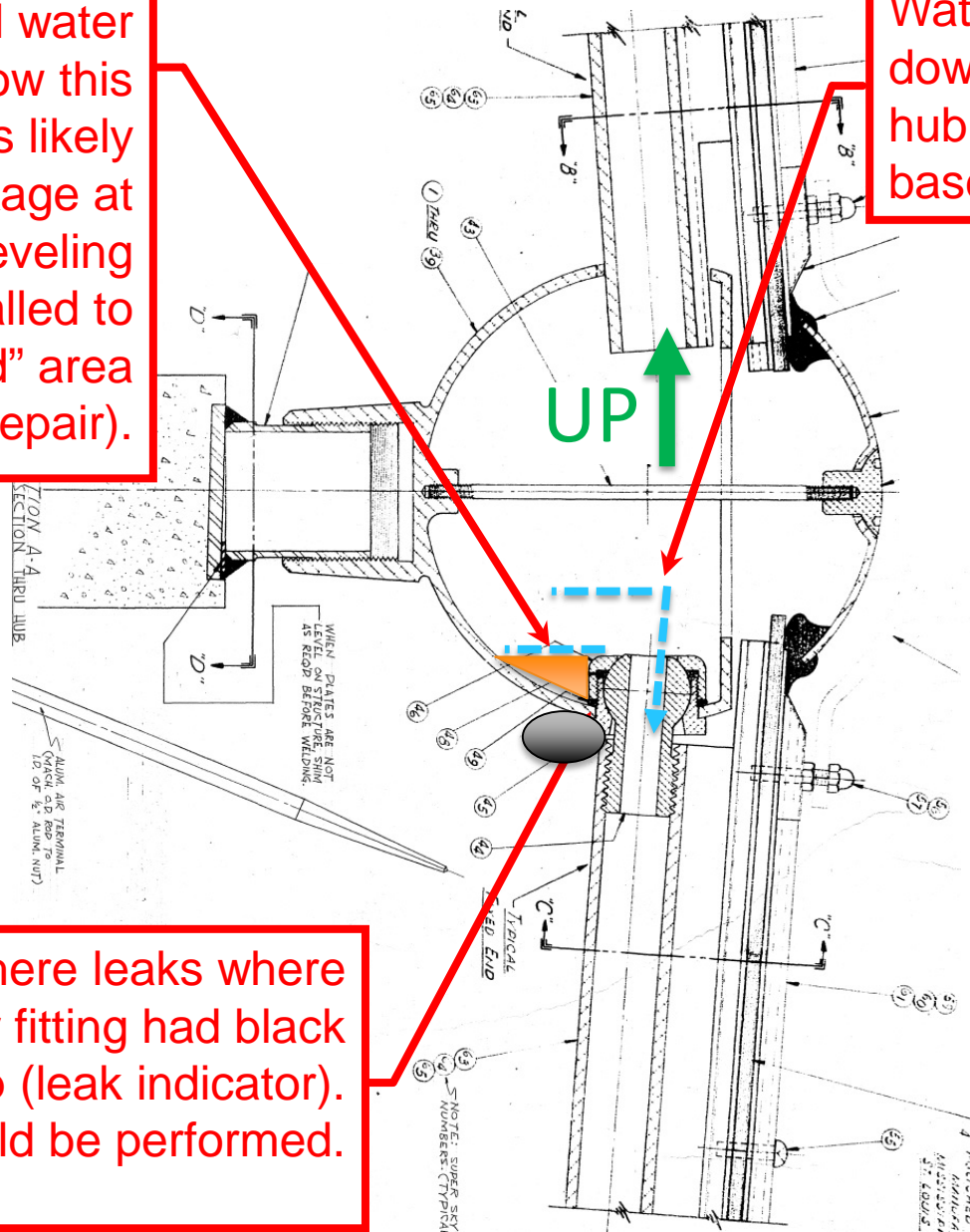
New pressure cap to enhance water tightness

New Sealant joint (wet seal)

New gasket

GRAEF observed water sitting in the hub below this elevation, which is likely causing water leakage at fittings. A self-leveling sealant can be installed to fill in the “depressed” area (GRAEF repair).

Water can then flow down the rafter at each hub and out at the base of the dome



At locations where leaks were observed, the rafter fitting had black material build-up (leak indicator). Target repairs could be performed.

Other Considerations

- Laminated glass instead of replacing with similar wired glass
- Further research on coating system
 - Stain not recommended
 - Laboratory analysis of the concrete
- Proactively removing potential spalls at embedded connections
- The wire mesh could be removed after the repairs are completed to address water infiltration and spalling at embedded plates (regular inspections and maintenance)

WJE Repair Cost Estimate

- WJE Option (GRAEF Option 1 with enhancements) will provide a long-term repair for the Domes
- WJE's estimated cost to repair all three Domes is approximately \$18.6 million (assistance from Berglund Construction)
- Primary difference related to replacing all the pressure caps on each dome:
 - Better weather protection
 - Increase the service life of repairs and Domes

Closing

- Domes are unique, architecturally significant structures that can be repaired and preserved
- Domes have performed well during their first fifty-eight years of service
- Primary issues are water leakage and spalling concrete at embedded connections
- Trial installation of the recommended repairs and evaluation prior to implementation on a wide basis is recommended