



SOLUTIONS FOR THE BUILT WORLD

Mitchell Park Horticultural Conservatory Domes



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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



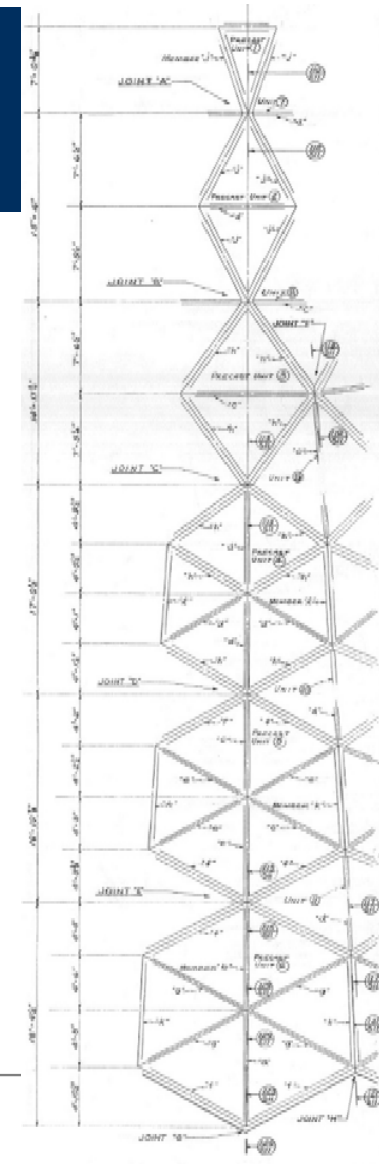
Background

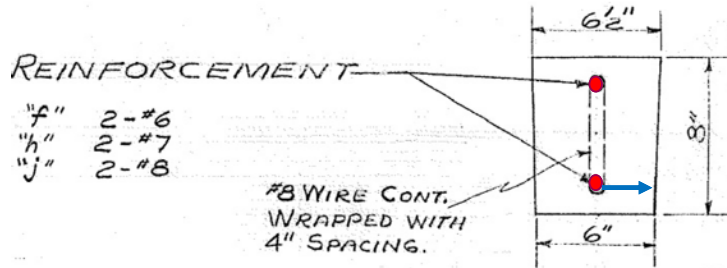
- GRAEF has been working on Domes since 1993
- Primary issues have included: water leakage, issues with cladding internal drainage system, concrete deterioration, glass breakage
- In 2013-2014, GRAEF performed a close-up inspection and subsequent repair of precast concrete members
- Stainless steel mesh 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



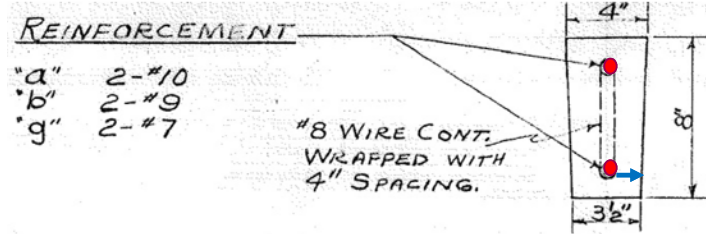


REINFORCEMENT

- "f" 2-#6
- "h" 2-#7
- "j" 2-#8

#8 WIRE CONT.
WRAPPED WITH
4" SPACING.

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

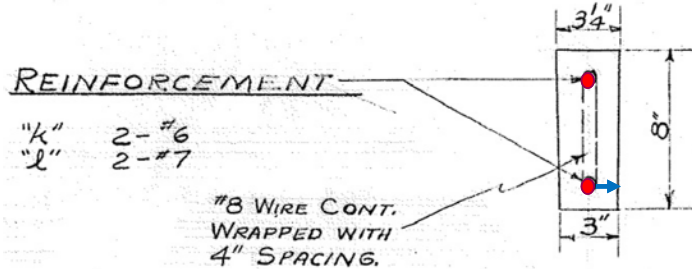


REINFORCEMENT

- "a" 2-#10
- "b" 2-#9
- "g" 2-#7

#8 WIRE CONT.
WRAPPED WITH
4" SPACING.

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

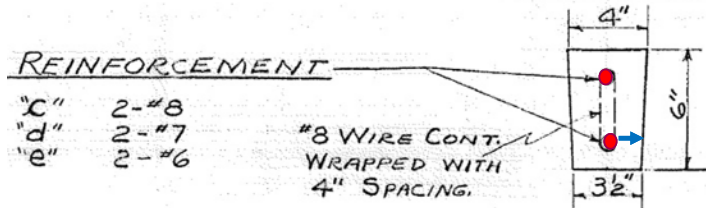


REINFORCEMENT

- "k" 2-#6
- "l" 2-#7

#8 WIRE CONT.
WRAPPED WITH
4" SPACING.

MEMBERS "k" & "l"



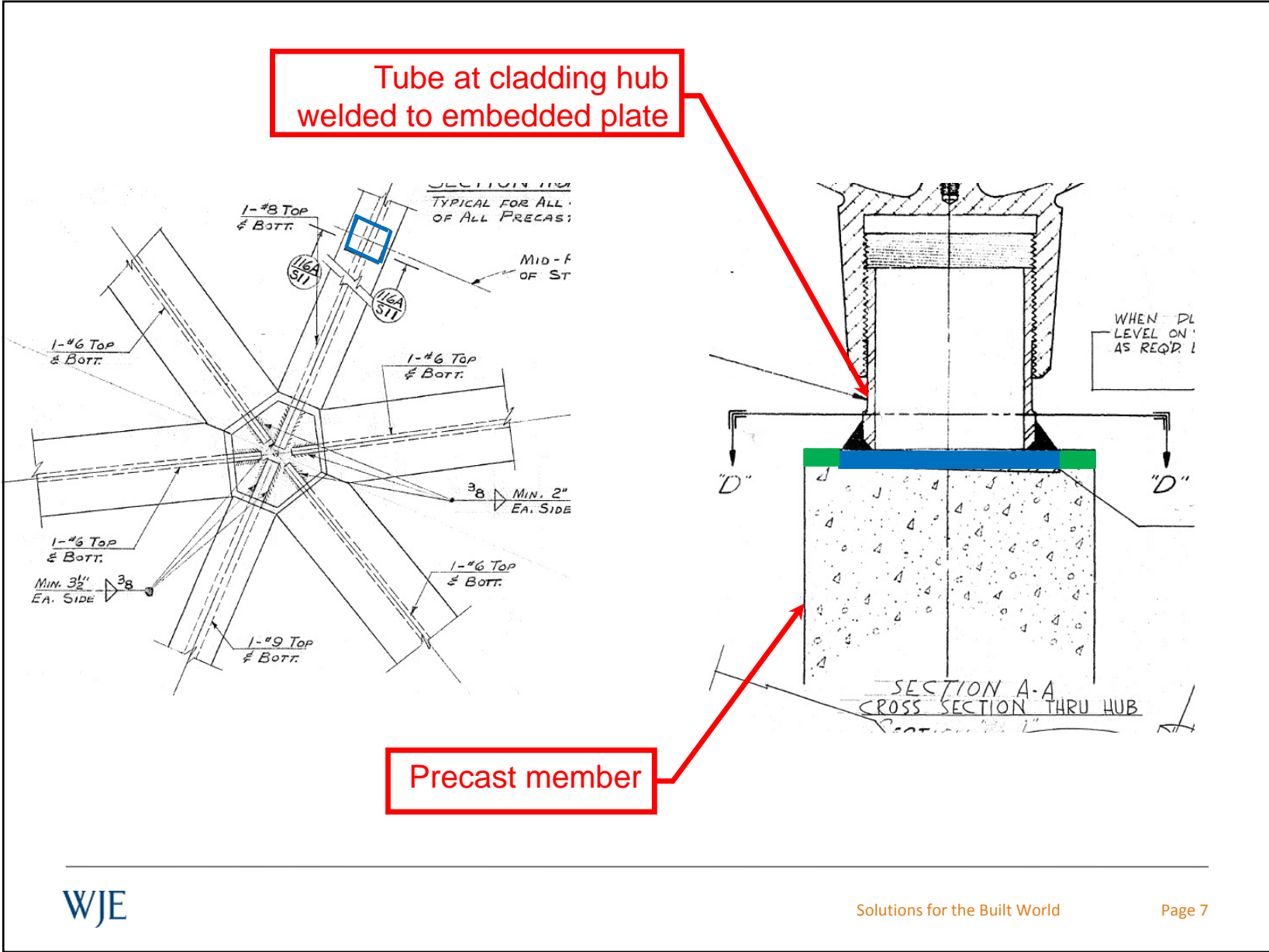
REINFORCEMENT

- "c" 2-#8
- "d" 2-#7
- "e" 2-#6

#8 WIRE CONT.
WRAPPED WITH
4" SPACING.

MEMBERS "c" "d" & "e"

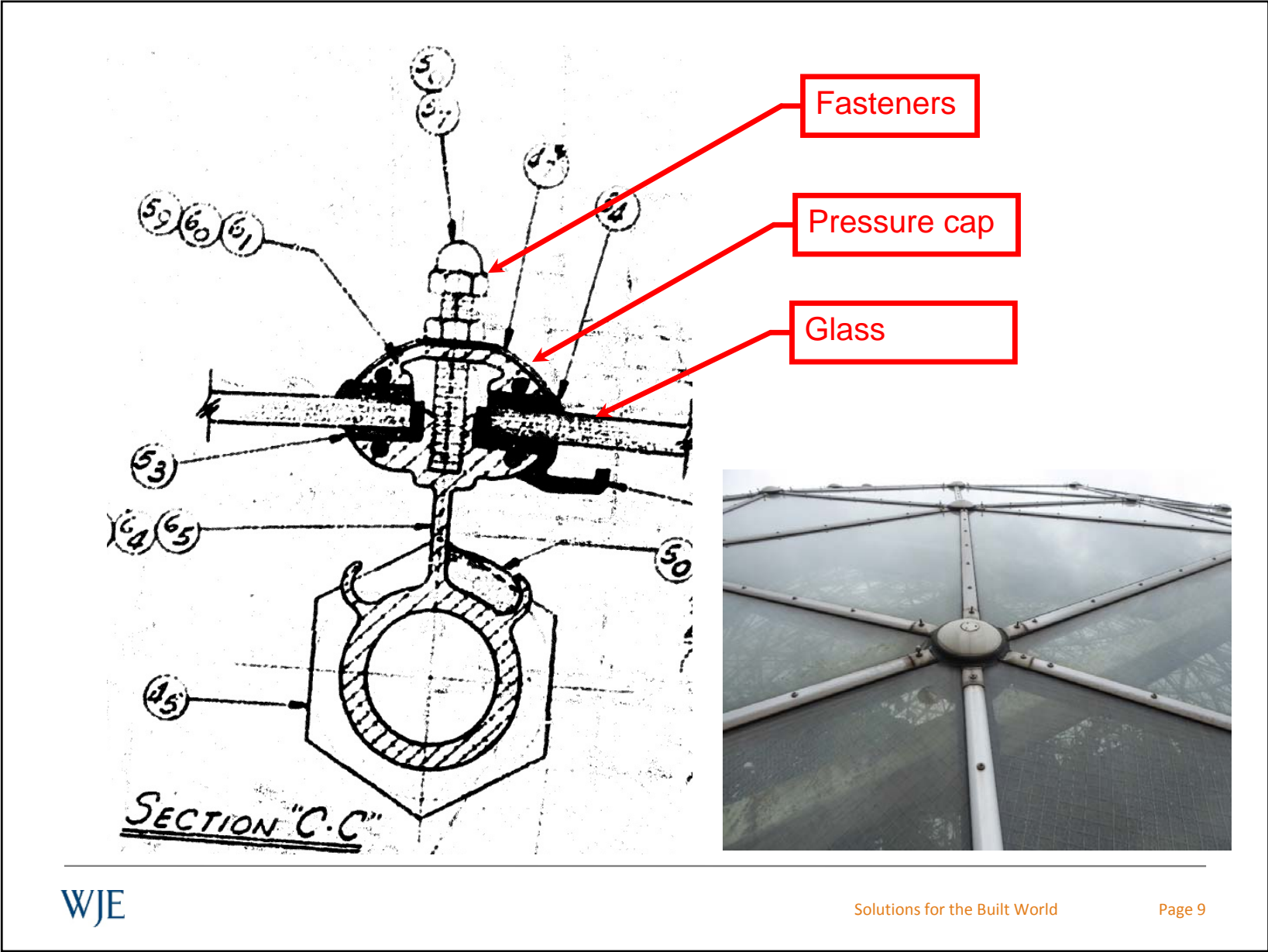
DETAILS OF PRECAST
UNIT MEMBERS

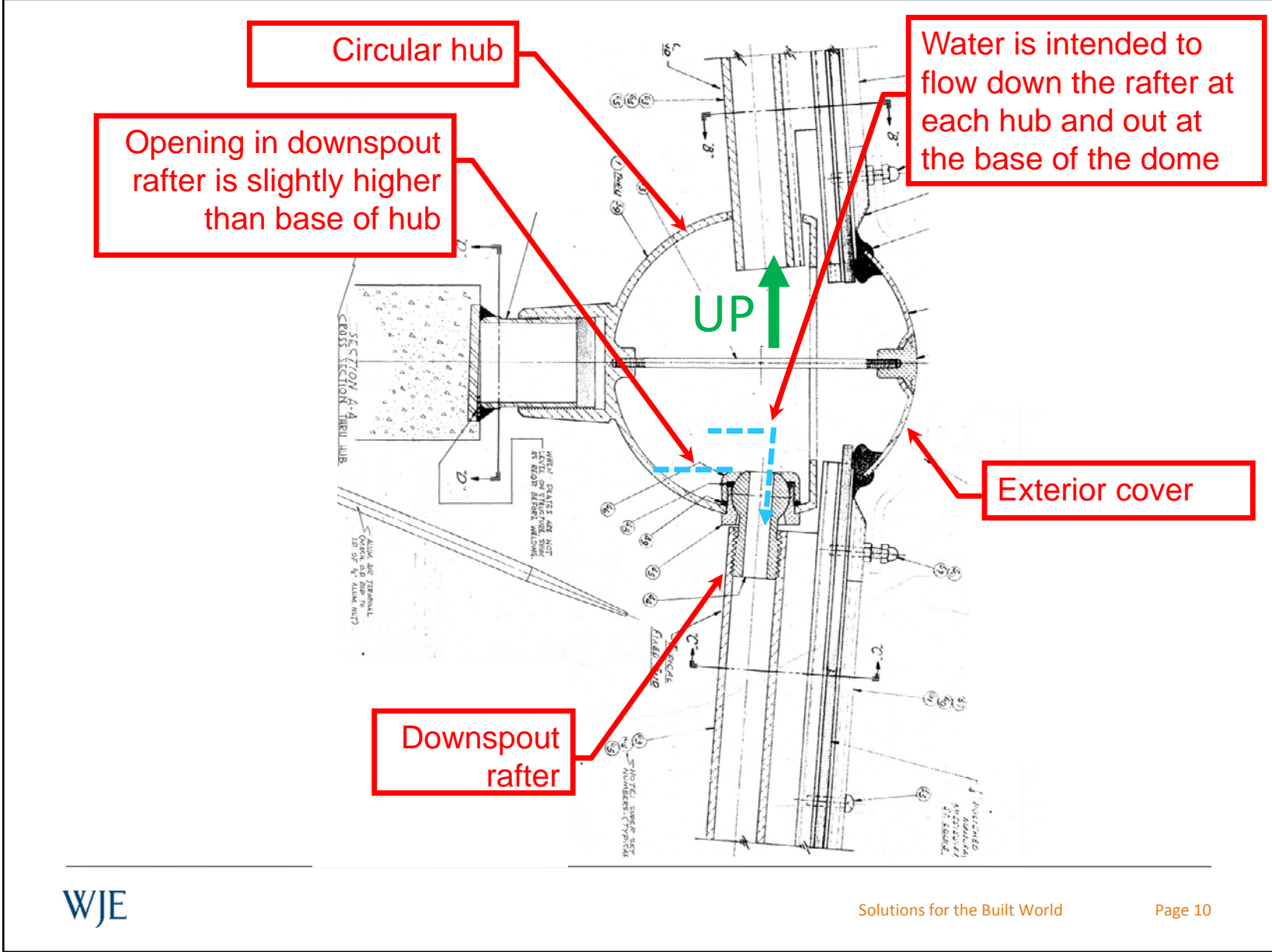


Cladding Construction

- 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









Observations

- Precast concrete framing
- Glass and aluminum cladding



Small Concrete Fragments









WJE

Solutions for the Built World

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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

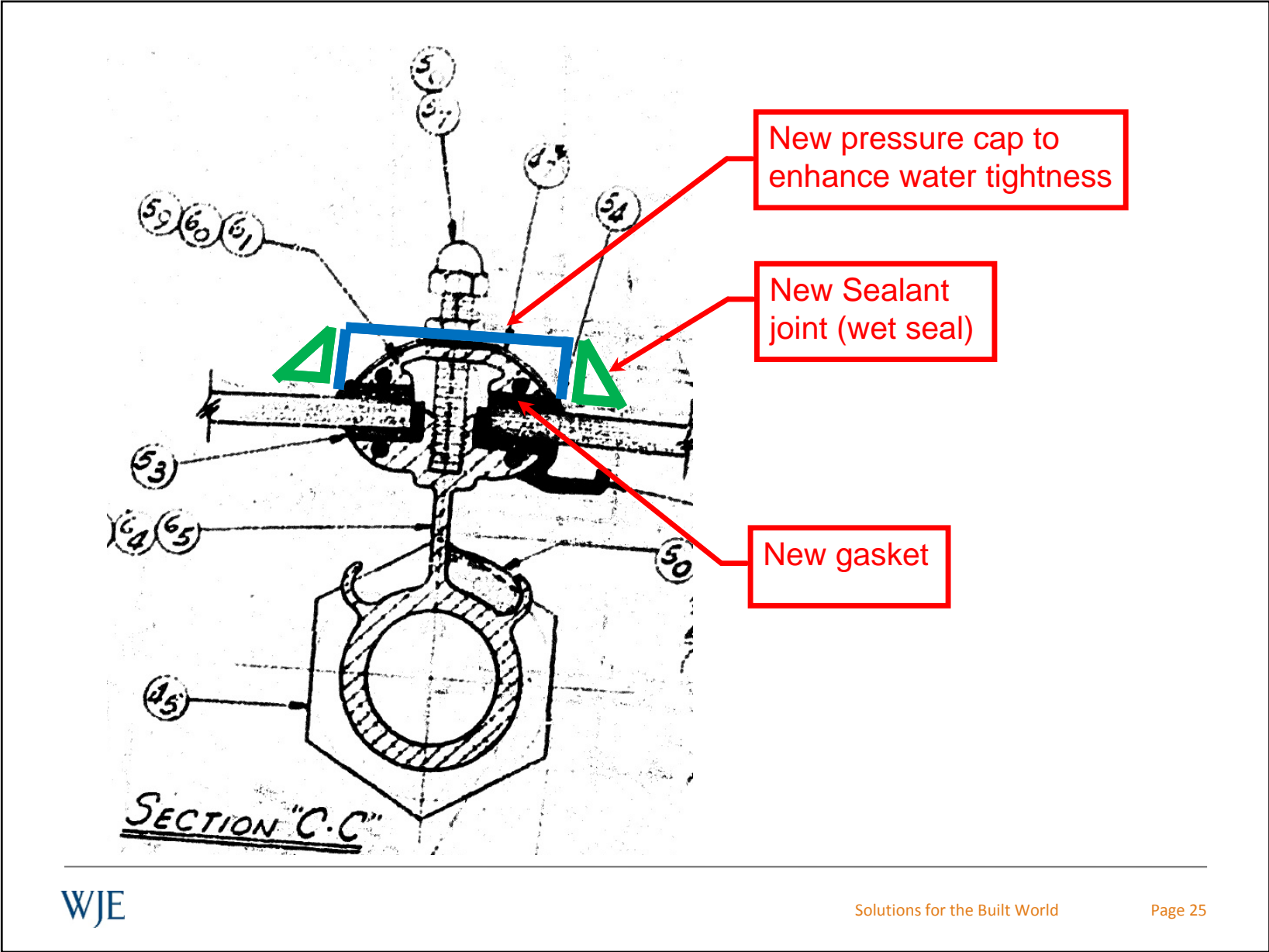
Option	Estimated Cost	Estimated Life	Maintenance	Wire Mesh
1	\$14 million	5-10 years	Very High	Remains
2	\$38 million	15-20 years	High	Remains
3	\$47 million	25-30 years	High	Remains
4	\$54 million	25-30 years	High	Remains
5	\$50 million	50 years	Normal	Removed
R	\$64 million	50 years	Normal	Removed

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



The diagram is a technical cross-section of a dome structure, showing the internal rafter system and the exterior shell. A green arrow labeled 'UP' points towards the center of the dome. Three red callout boxes with arrows pointing to specific areas of the dome provide detailed information:

- Top-left callout:** 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).
- Top-right callout:** Water can then flow down the rafter at each hub and out at the base of the dome.
- Bottom-left callout:** At locations where leaks were observed, the rafter fitting had black material build-up (leak indicator). Target repairs could be performed.

The diagram includes various technical annotations such as 'SECTION A-A', 'Rafter Hub', 'Rafter End', and 'Rafter'. It also features numbered callouts (1-10) and a note: 'WELD JOINTS ARE NOT TO BE WELDED AT JOINTS BEFORE WELDING.' The diagram is oriented vertically on the page.

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, eliminating falling hazard
- The wire mesh could be removed after the repairs are completed to address water infiltration and spalling at embedded plates (regular inspections and maintenance)
 - Anticipate visual inspection from grade every 2 to 3 years (causing no disruption to plants)
 - Up-close inspection would only be as-needed, and every 6 to 8 years (similar to facade ordinance requirements)

WJE Repair Cost Estimate

- WJE Option (GRAEF Option 1 with enhancements) will provide a long-term repair for the Domes
 - Wet sealing has been used on many projects to successfully address water infiltration, long history of field use
 - Comprehensive building envelope repair to address water infiltration
- WJE's estimated cost to repair all three Domes is approximately \$18.6 million (assistance from Berglund Construction)
 - ADA not included (add \$690k per GRAEF cost estimate)
- Primary difference related to replacing all the pressure caps and wet sealing 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
- Proposed repair strategy is a comprehensive building envelope solution to address water infiltration for an extended period of time.
- Trial installation of the recommended repairs and evaluation prior to implementation on a wide basis is recommended