Modeling the Past: Digital Design Tools for Masonry Restoration

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THE MASONRY SOCIETY

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Presentation Description

Digital modeling tools have typically had limited use in masonry restoration. However, these tools, which can produce detailed, coordinated 3D models, are beneficial in restoration, allowing the team to anticipate challenges and complete construction coordination before mobilizing. While hidden conditions can hinder the model's effectiveness, some restoration projects can benefit from 3D models.

The team used such tools at The First Church of Christ, Scientist Church facade restoration. This presentation will contrast the traditional approach used at the semi-domes with the digitally driven design-model-build process for the cupola. There, the design team developed a digital model, used for fabrication and quality control due to time constraints, challenging access, and lessons learned at the semi-domes. This presentation will discuss the collaborative process, model development, digital mockups, quality control strategies, and how digital fabrication streamlined construction.

Attendees will learn how to effectively integrate modeling tools in masonry restoration.

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Learning Objectives

1. Compare traditional and digitally driven restoration design approaches.
2. Understand how digital modeling tools can be adapted for use in historic masonry restoration projects to improve design coordination and construction outcomes.
3. Identify best practices for integrating 3D modeling into the restoration design and construction, including field data gathering, digital mockups, quality control strategies, and coordination with design and construction teams.

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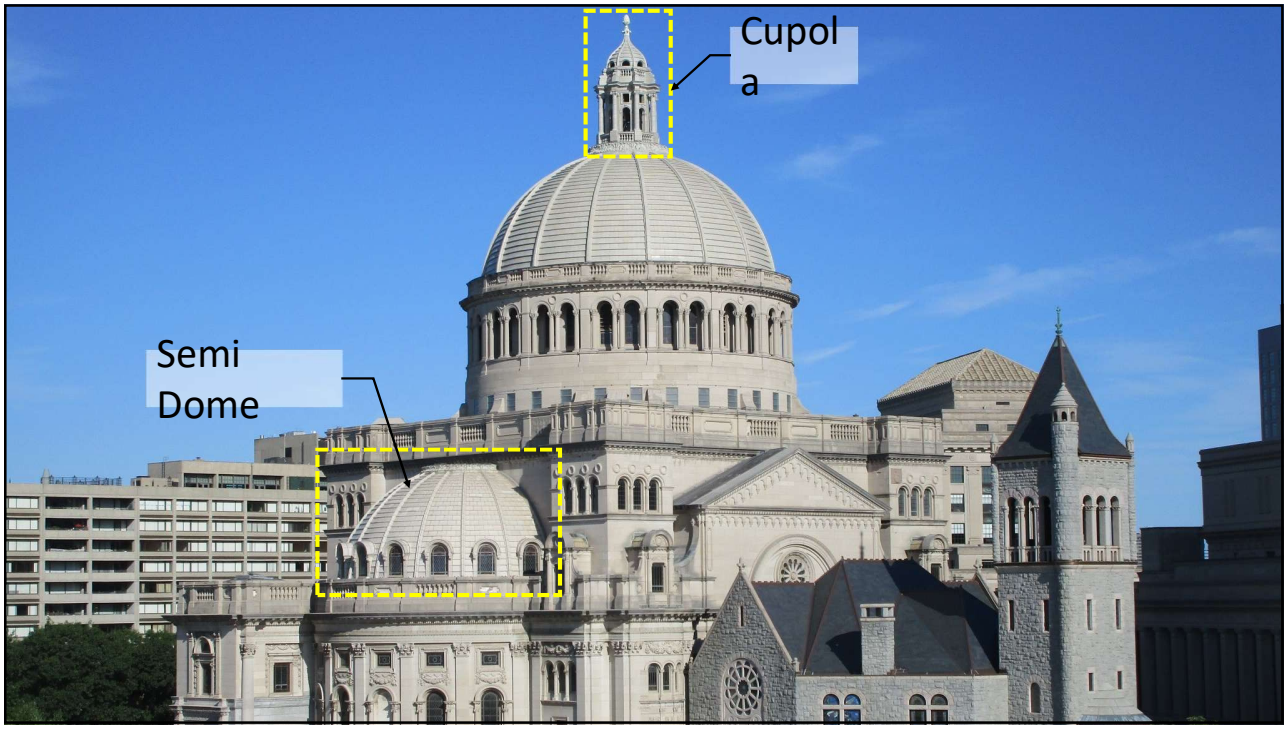

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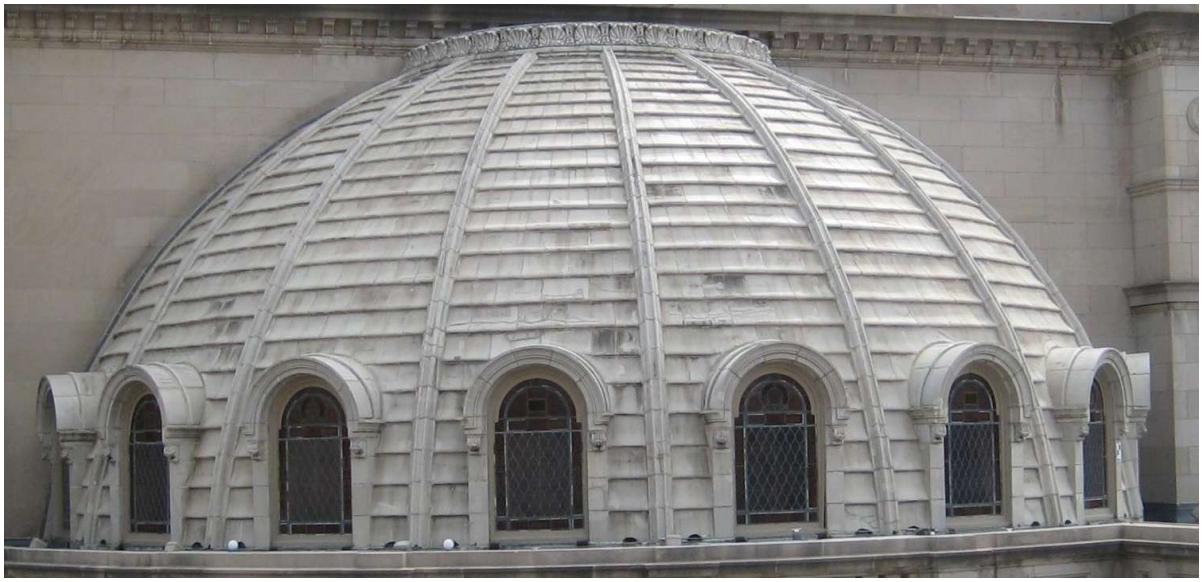
Terra Cotta Semi Domes



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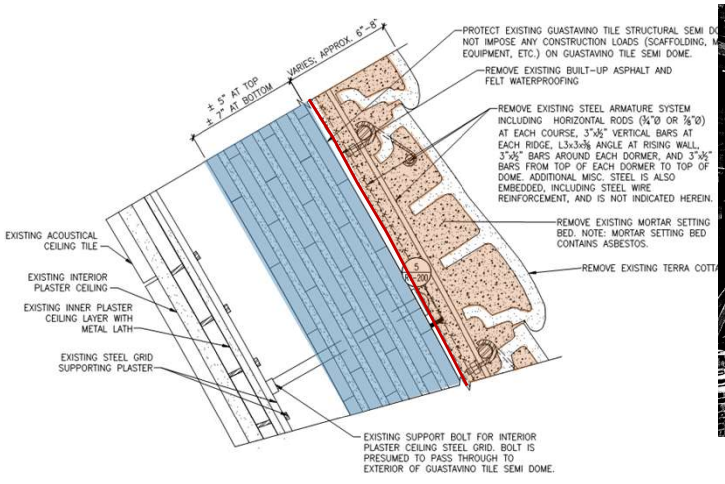
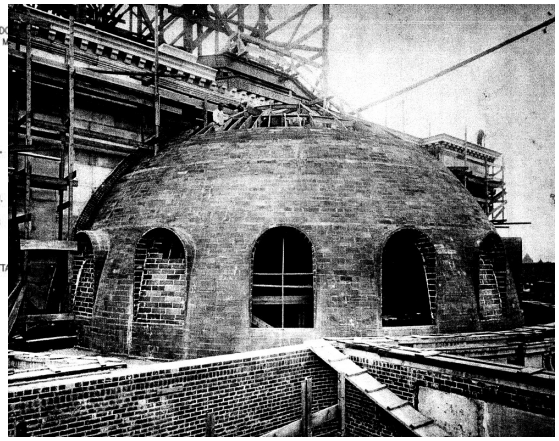
Existing Conditions





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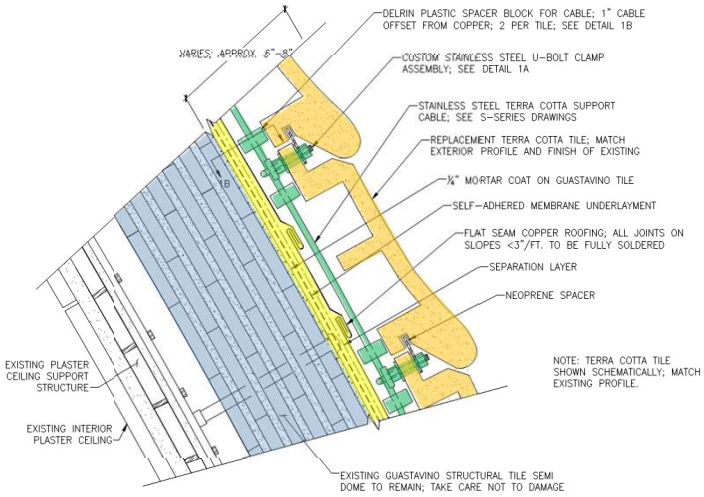
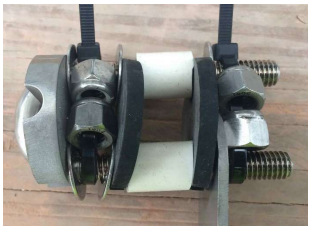
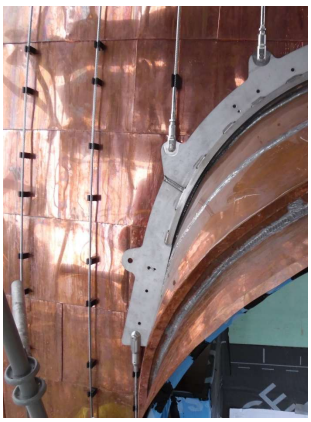
Semi-Dome System Design







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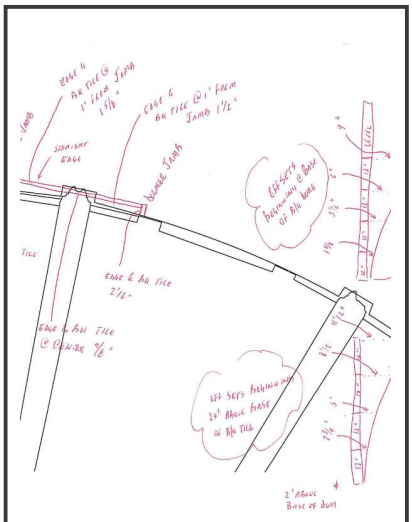
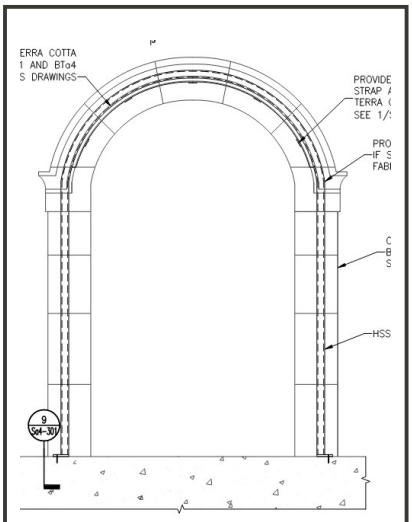
What Went Wrong?



Field Verification



Dormers

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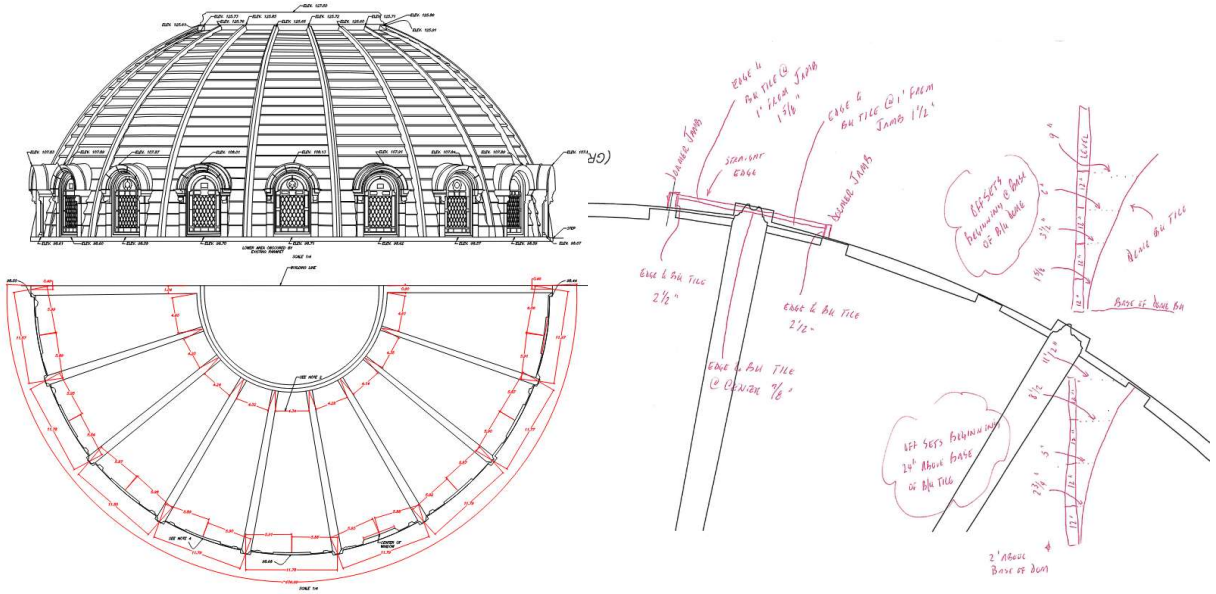
Field Scans and Measurements



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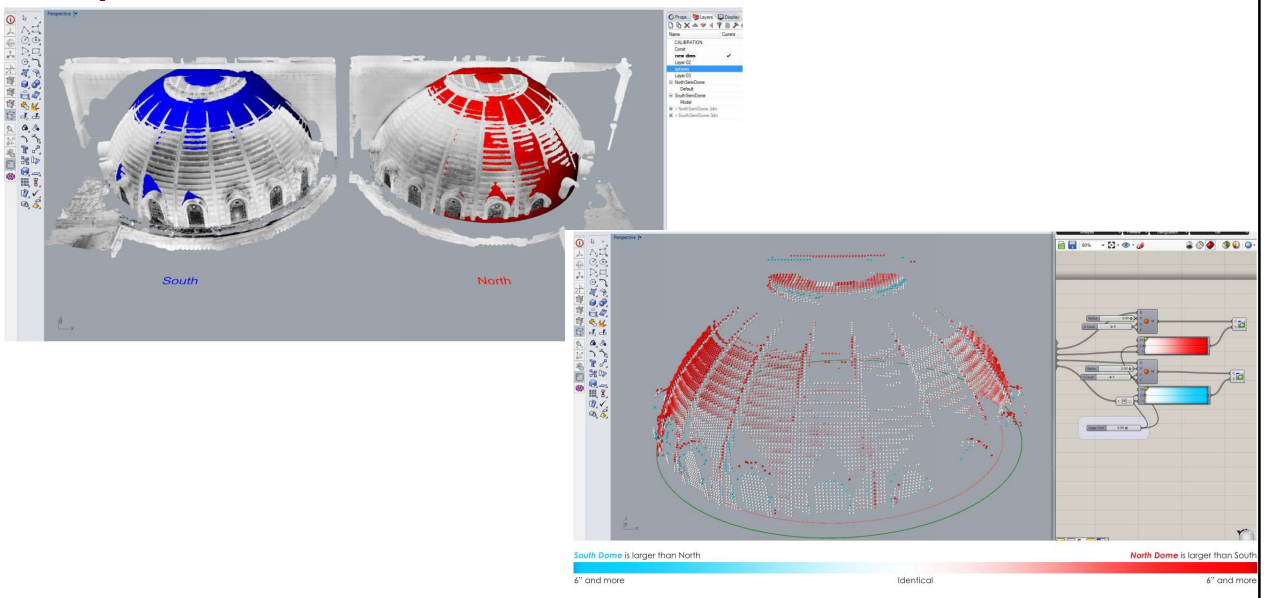
Compare the Semi-Domes



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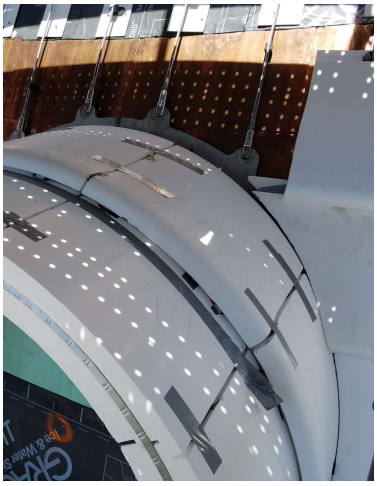
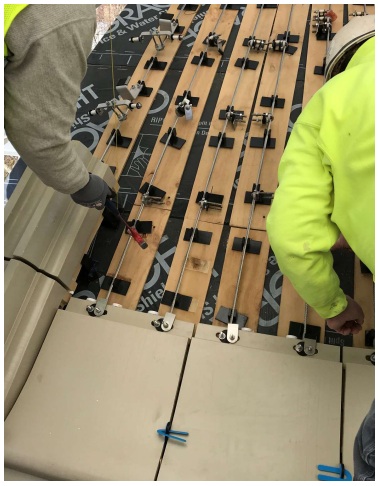
Mockups

Offsite Mockup



Malleable Mockup (Jun 2018)



Fired Mockup (Nov 2018)

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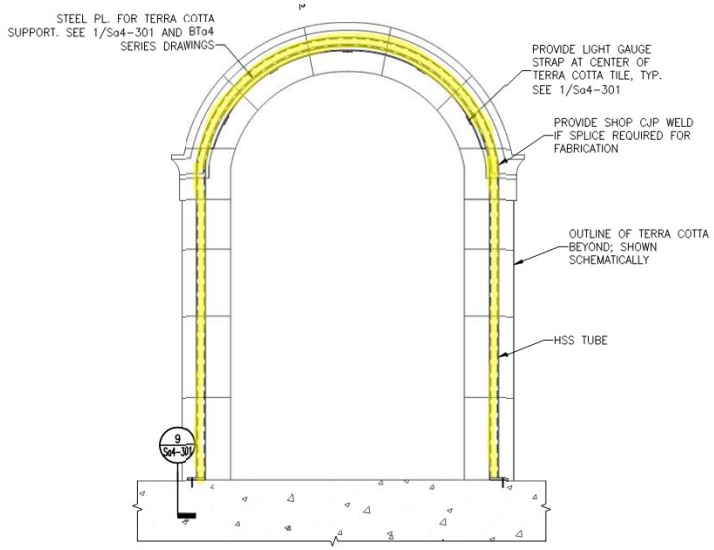
Semi-Dome Dormers



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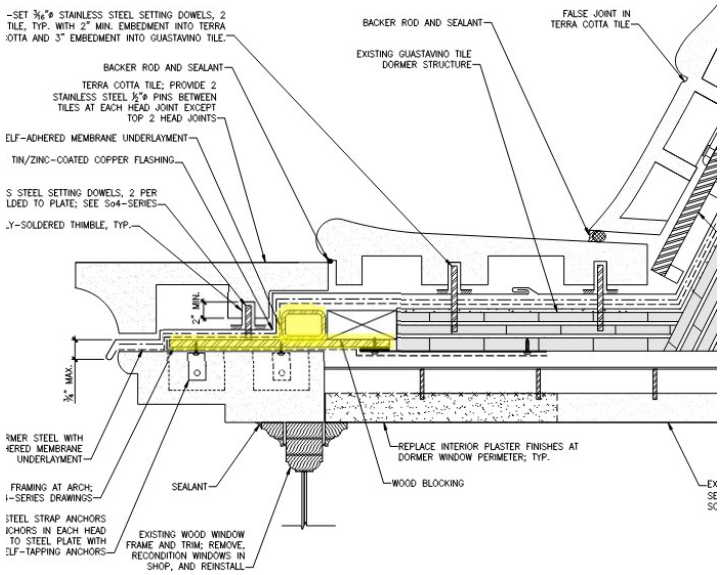
Semi-Dome Dormer Steel



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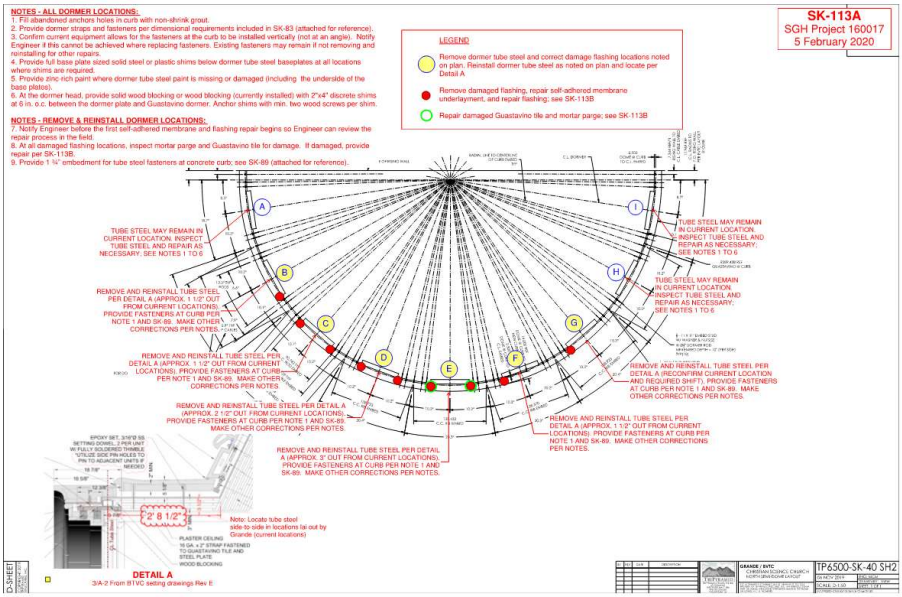
Semi-Dome Dormer Steel



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Semi-Dome Lessons Learned

- Large scale mockups were approximate and expensive
- Lack of ownership/responsibility for existing field dimensions and variability
- Limited coordination between trades
- No coordinated setting drawings

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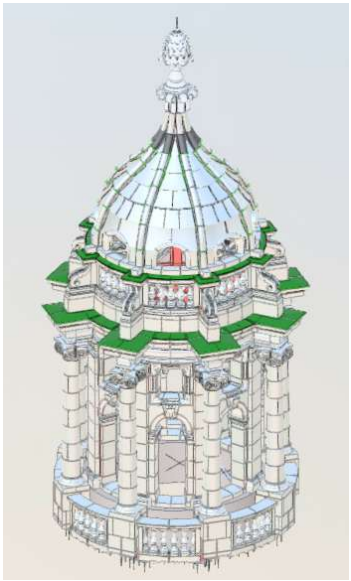
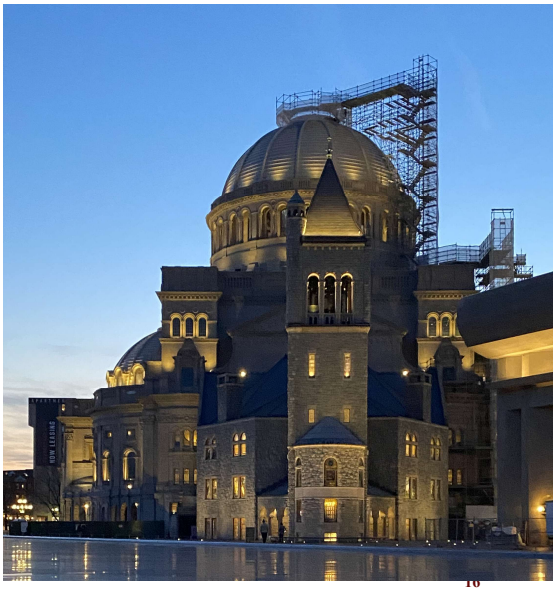
Cupola Replacement





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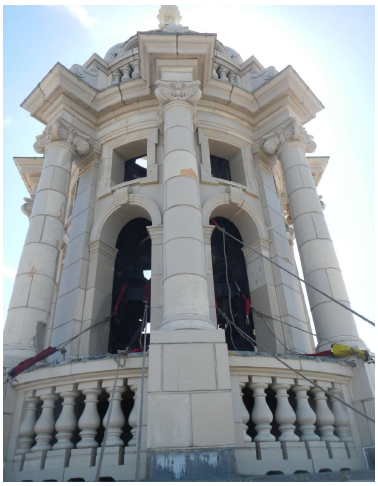
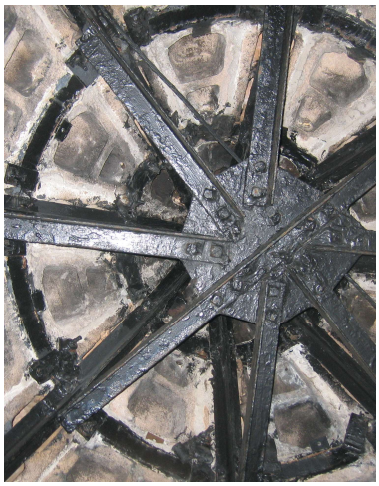
Cupola Components



Terra Cotta



Steel Frame

Flashing & Roof

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Rethinking the Process

TRADITIONAL

Design → Mockup → Build

CUPOLA APPROACH

Design/Model/Mockup → Build

- Fully removing and replacing
- Well known client and construction team
- Difficult access

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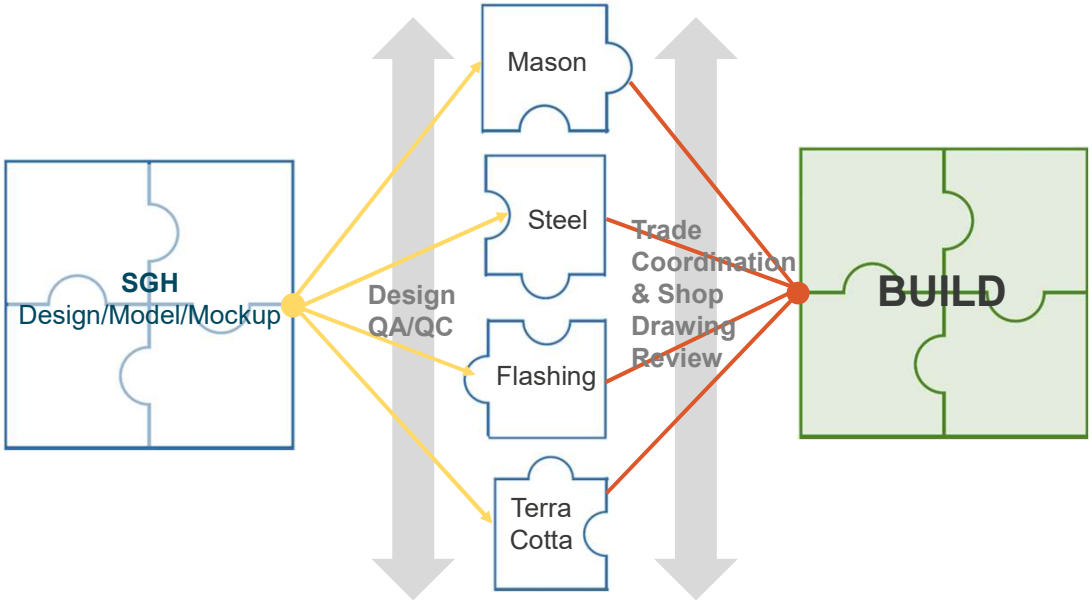
The Process



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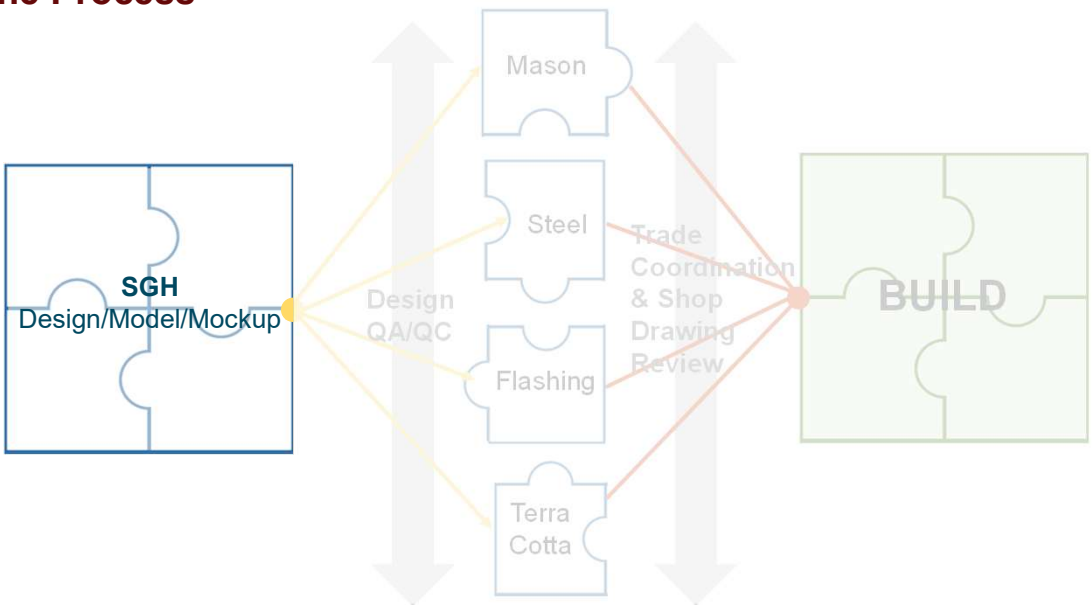
The Process



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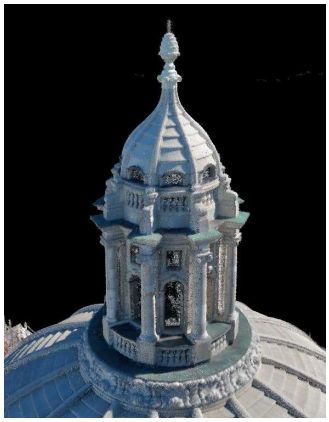
Existing Information Collection

CAPTURE

- Terrestrial capture from grade and adjacent roofs
- Aerial capture of LiDAR data (geospatially located)

POST PRODUCTION

- Process multiple scan files to compile reality mesh and photogrammetric orthomosaic.



Point Cloud of Existing Condition Scan by Aerial Genomics

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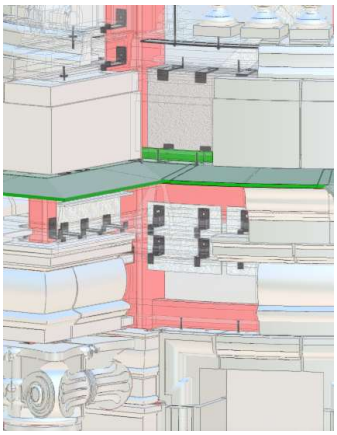
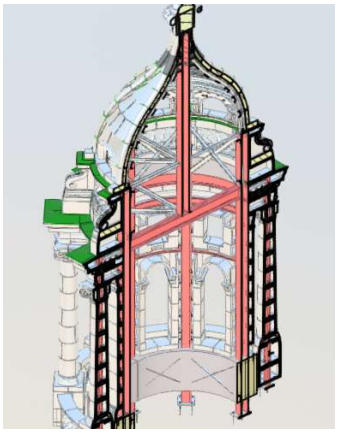
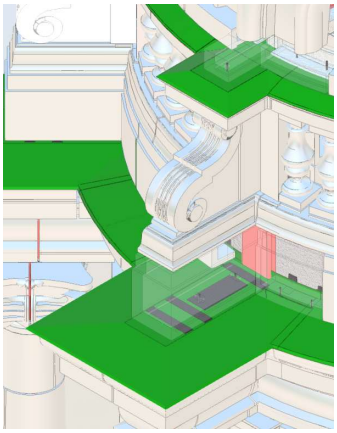
Cupola Model Components



Terra Cotta
including webs, holes/slots, and anchors



Steel Frame



Flashing

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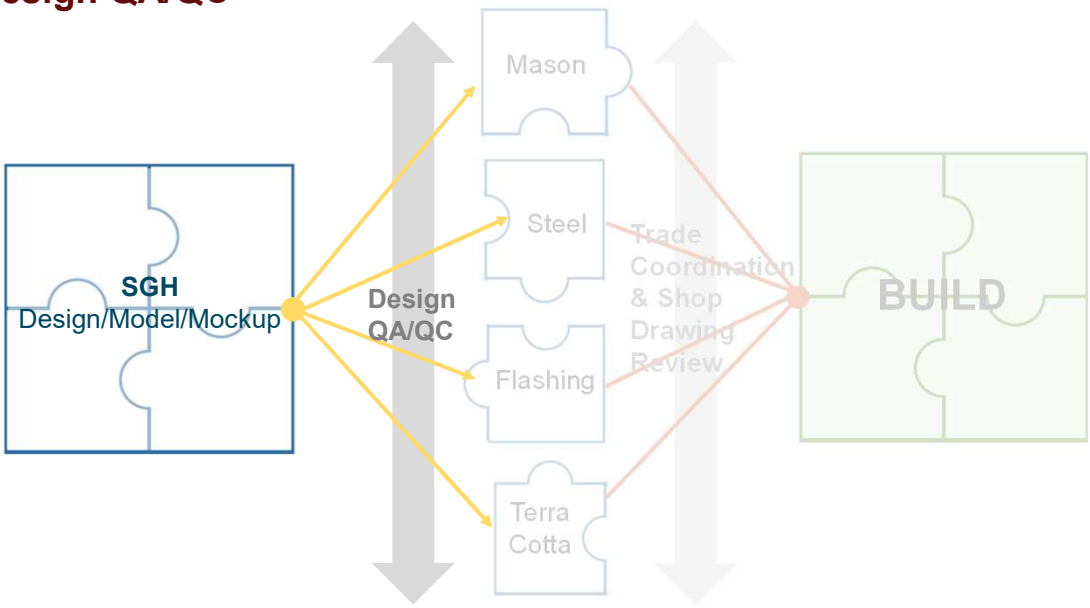
Design QA/QC



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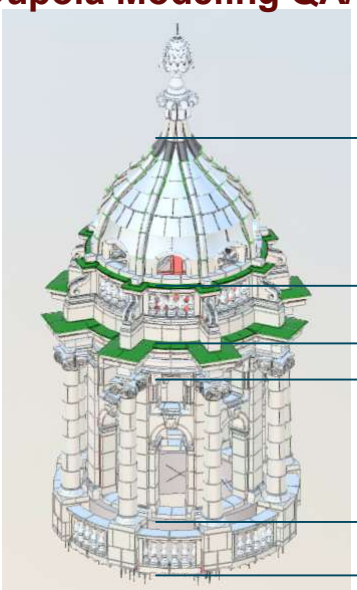
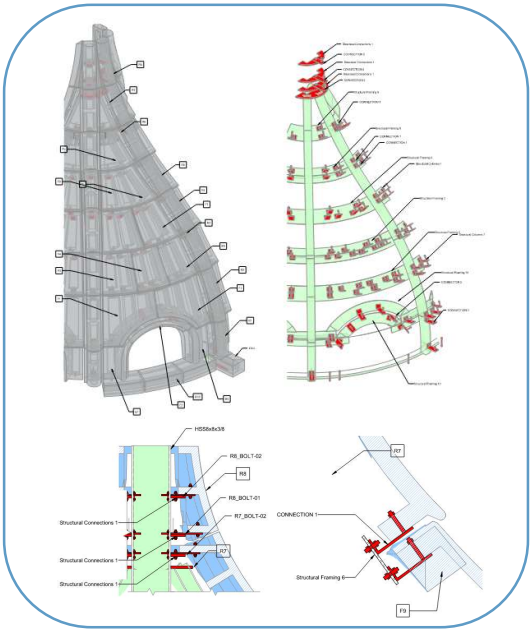
Cupola Modeling QA/QC





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Cupola Modelling QA/QC

2021-03-10 Cupola Roof Terra Cotta Attachment

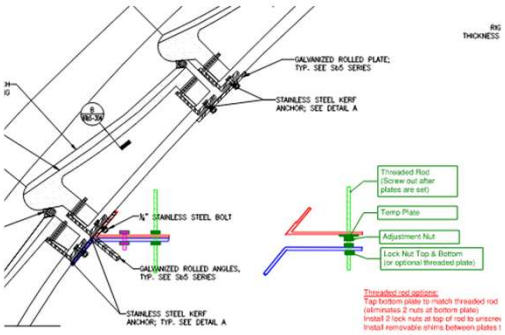
Wednesday, March 10, 2021 8:39 AM

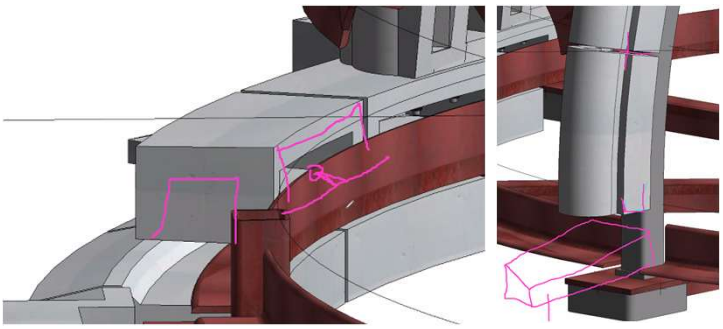
Stephanie, Toni, Dick, Tim W, Justin, Bruce, Rich, Jay, John

Flashing between typical tiles
- 3/8 in. slot is ok.
- TW gets the technical reasons and is fine.

Temporary anchorage and rigging support for rings (focusing on Ring 1)
- Bandcourse tile is bottom of first ring – GM wants to leave this bottom band out to allow placement of first piece easier. Install band course pieces after ring is installed:
  - Change the configuration of the TC piece. Use a bolted connection back to the steel (with steel backplate? Nut, bolt, nut) Slotted TC + slotted steel.
  - Don't need to extend horizontal leg of steel angle.
  - Need access at interior to make attachment. Will need access from the interior to make ring

- [ ] SGH check weight of rings. SDC to confirm crane loads. Please see the attached crane information for the Cupola. The crane proposed by Grande is a 250 ton crane, lifting a max load of 5,000lbs." 23 January 2019
- [ ] SGH will rework the attachment for R7 and R8
- [ ] SDC work on scaffolding/access approach for rebuild. Likely have option for demo and rebuild.
- [ ] John wants to know when we should have "intermediate check points" for costs





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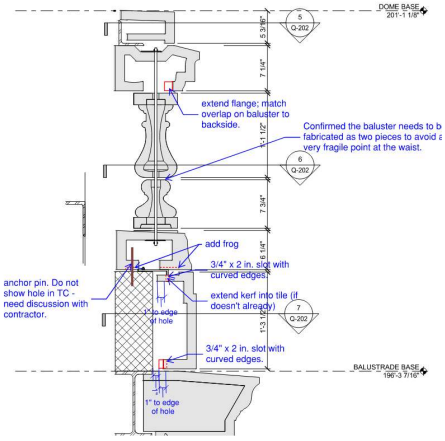
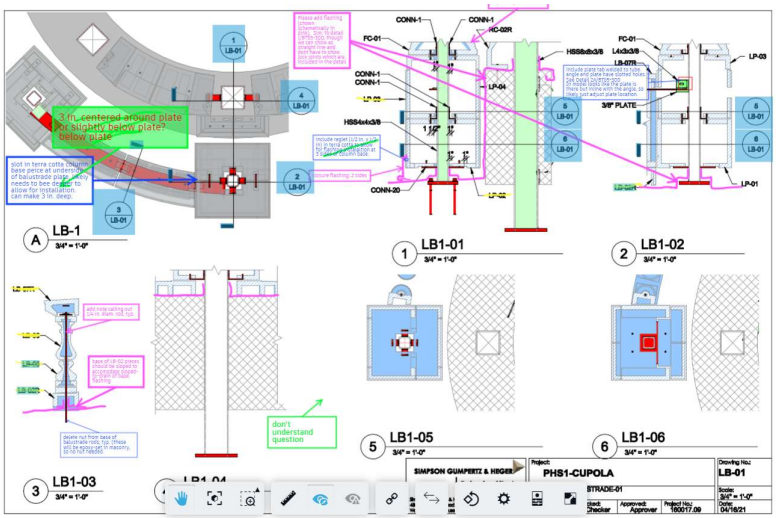
Cupola Modeling QA/QC





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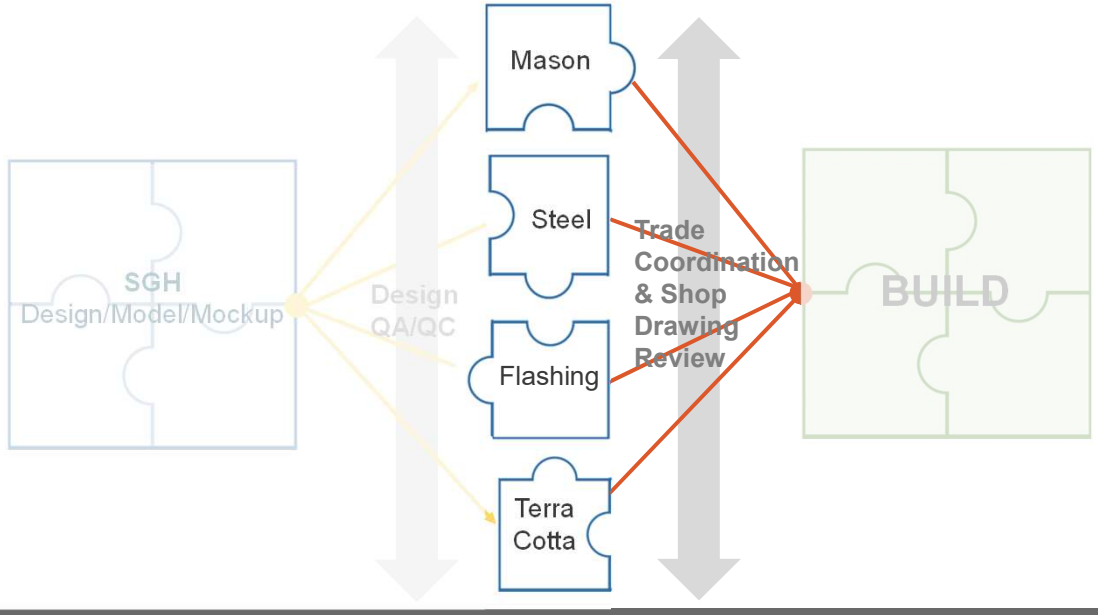
The Hand Over



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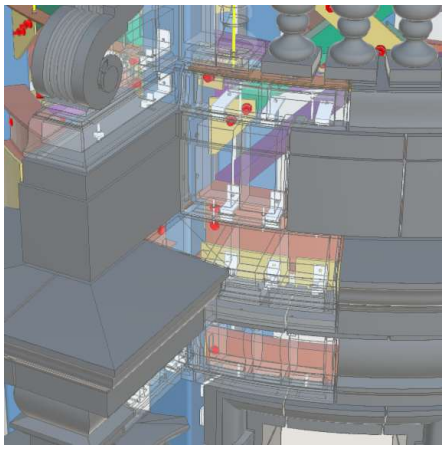
Cupola Shop Drawings



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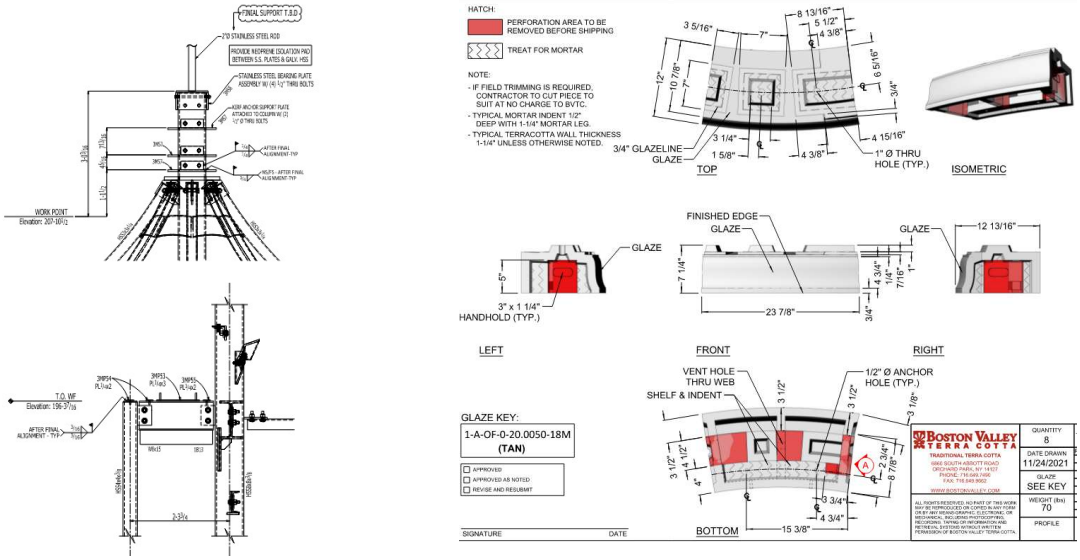
Cupola Shop Drawings



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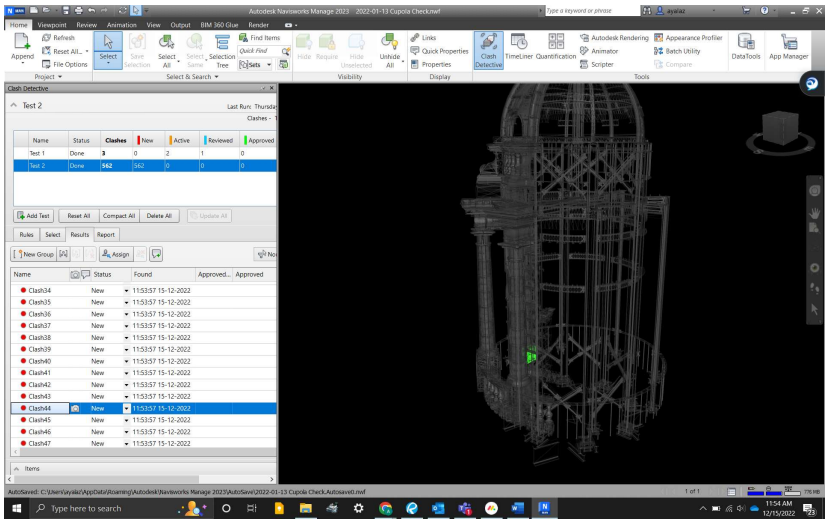
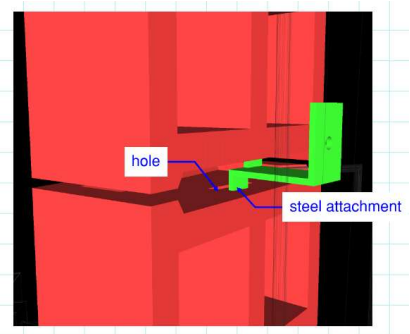
Shop Drawing Review – Clash Detection





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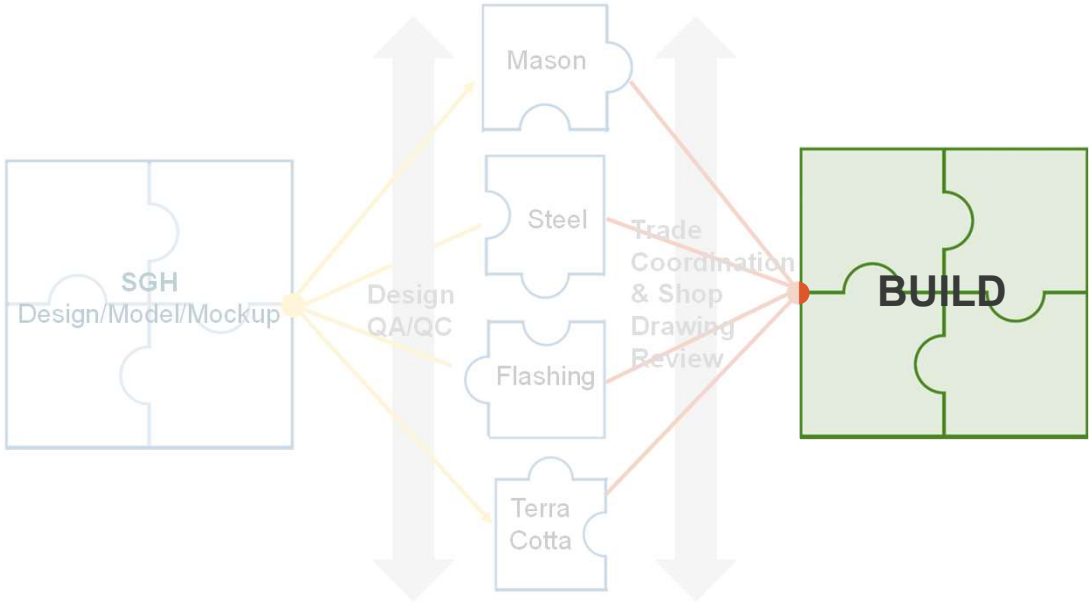
The Process



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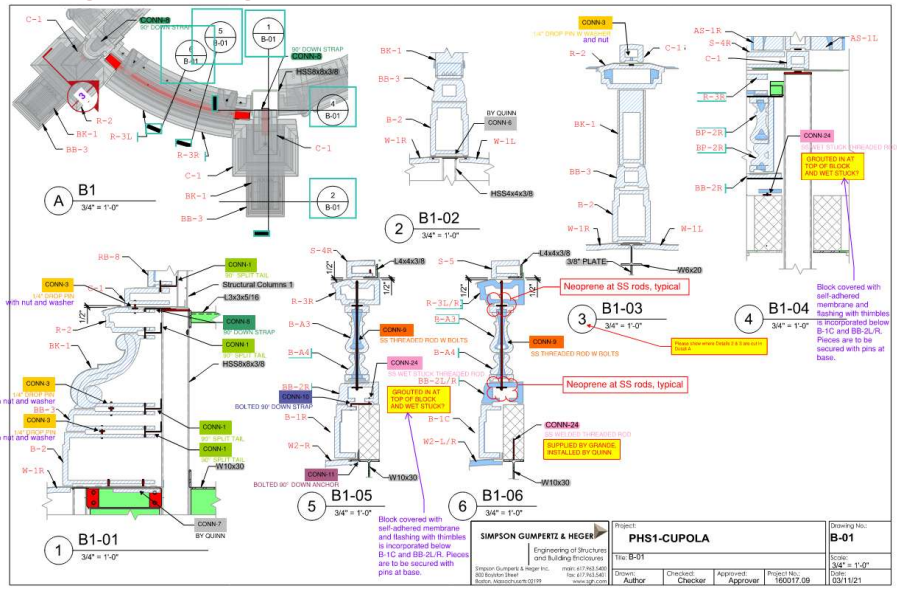
Cupola Setting Drawings



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Cupola Construction



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THE MASONRY SOCIETY

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