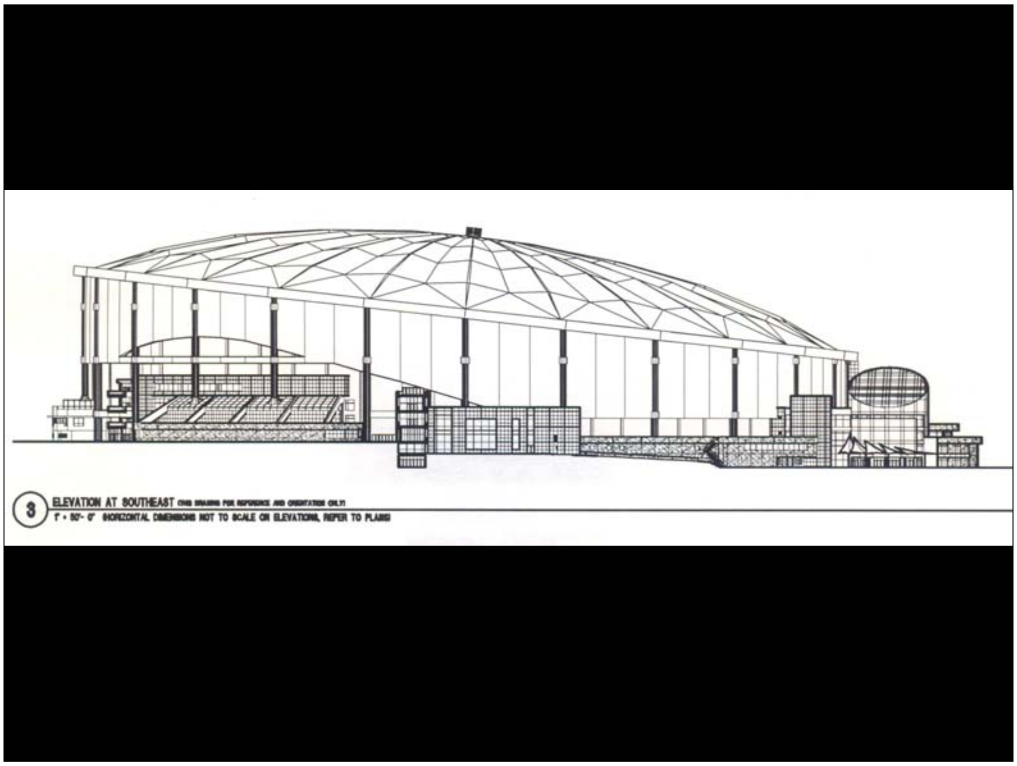
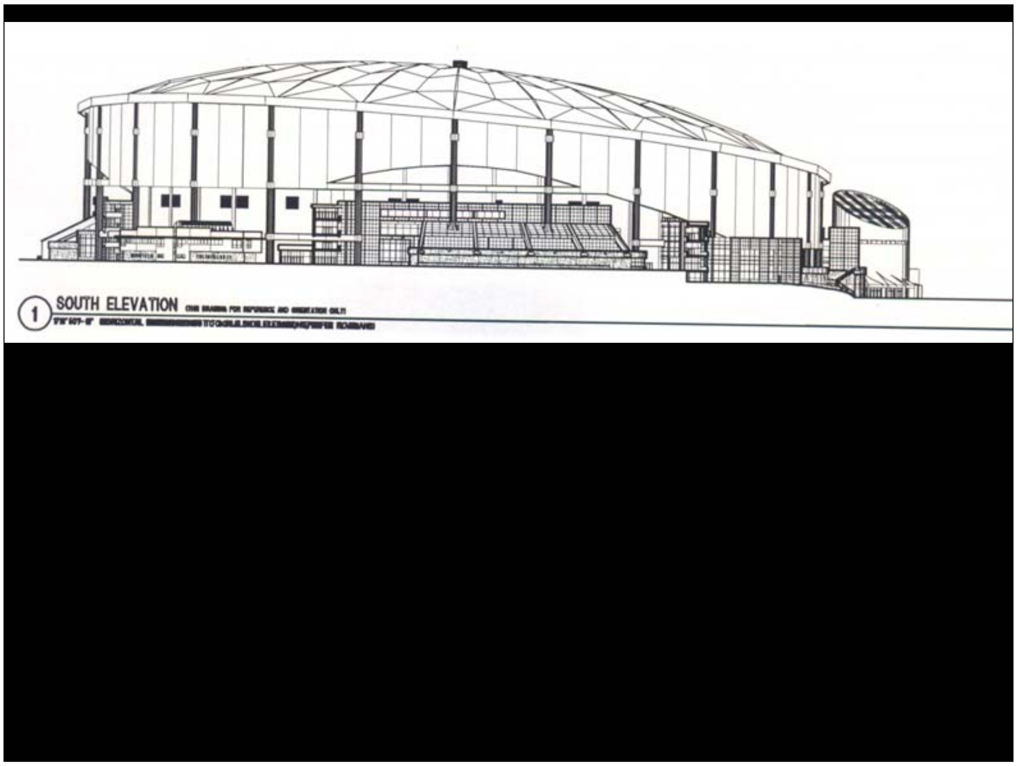


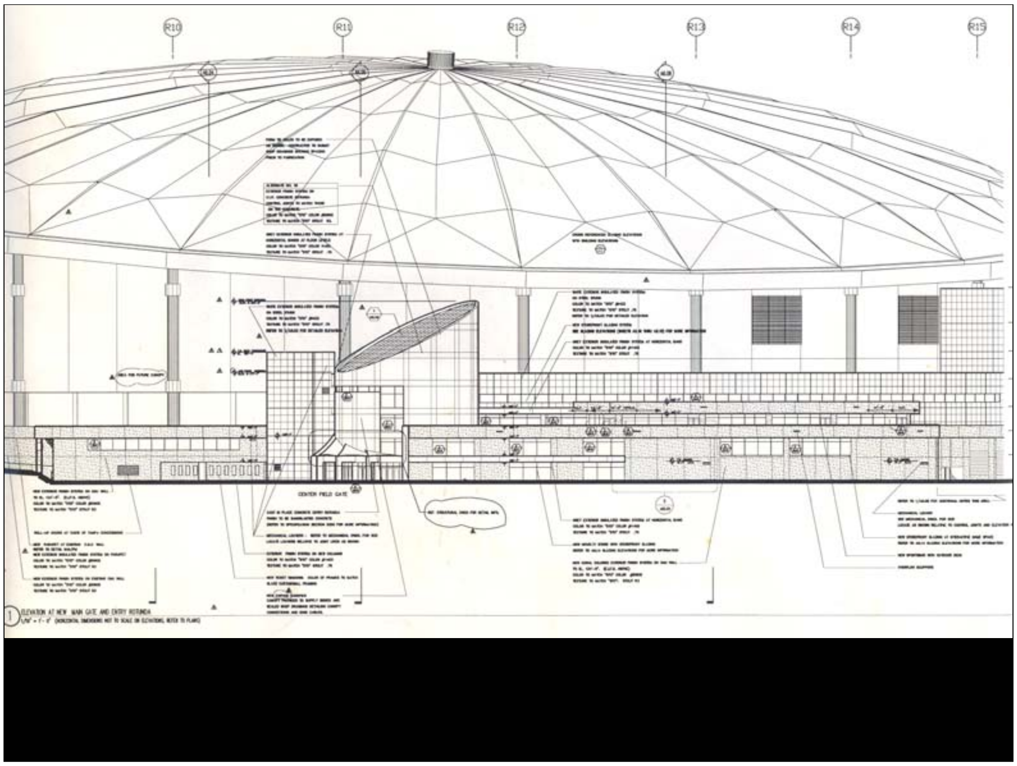
Concrete Construction. Case Study



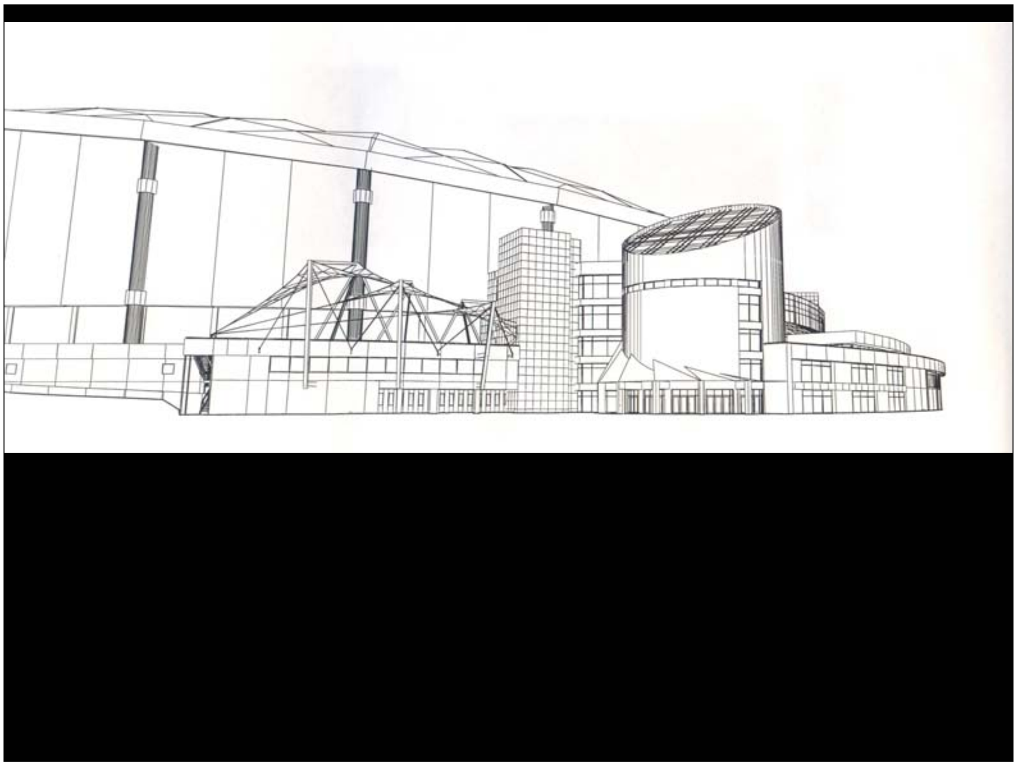
Project: Tropicana Field Renovations

Specific: Concrete entry cylinder at East Main Entry

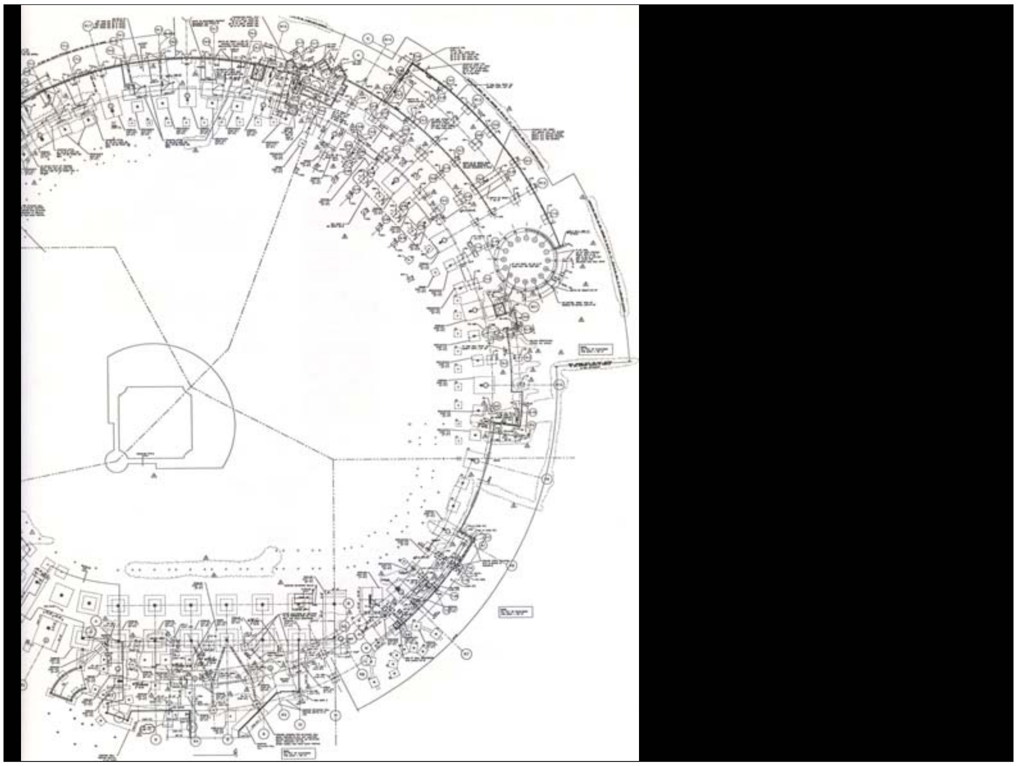
Project Scope: Add approx. 350,000sf of space (retail, food service, concourse, office) to the existing ‘Thunderdome’. The existing tensegrity structure is 225’ tall at its peak and is approximately 750’ in diameter. Due the nature of the round structure, drawing elevations could pose a serious challenge if drawn by conventional orthographic projection methods. With the use of AutoCadLT, the additions were drawn with extruded lines and 3dfaces to produce a 3d model of the entire structure. This way, the model could be rotated to any desired elevation to create the drawings. This method proved to be a significant time and cost saving tool for the project. And inevitably, as anticipated in the beginning, just before the submission deadline, we realized that we needed another angle of elevation because there was a loading dock that was not showing up well enough on the first-decided 5 elevations. With the 3d model completed, the 6th elevation was no problem at all and the model was simply rotated to the needed angle, a 2d file was exported, cleaned up, notes added, and we had our missing elevation in a short amount of time.



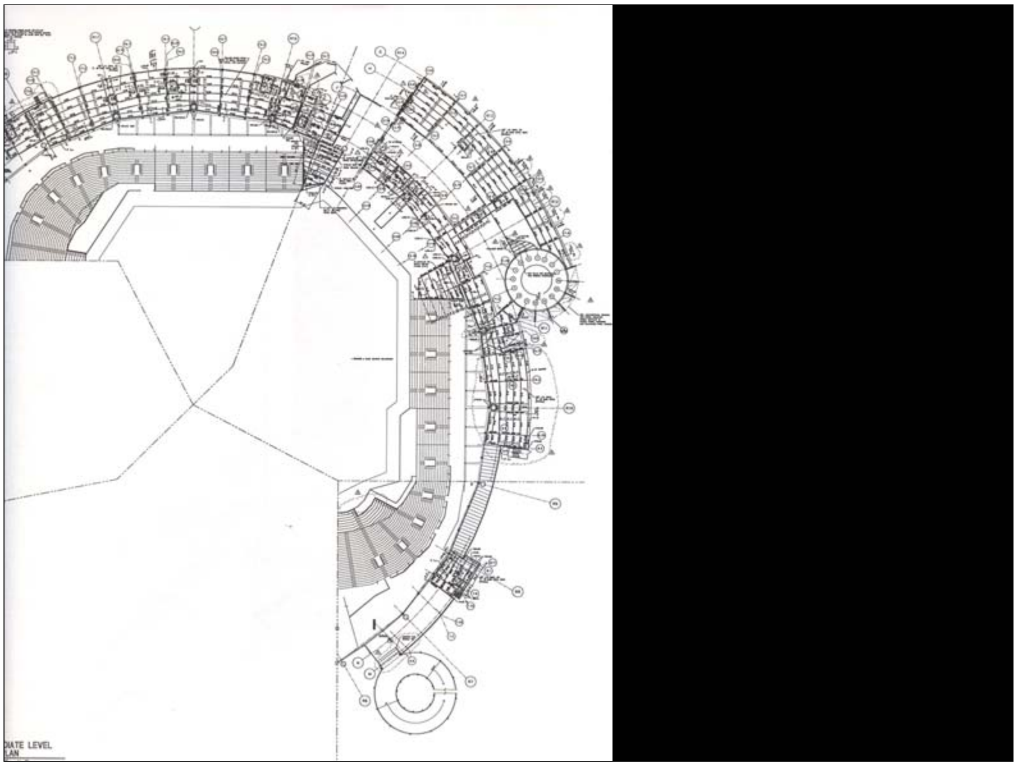
East Elevation Showing the Entry cylinder is made of cast in place concrete and structurally served as a later load anchor for the project. At a height of 90’ and a diameter of 71’, the space serves as the main entry for the indoor ball park. It is a single space inside and has a series of glazed slots to allow for specific views out to the entry walkway.



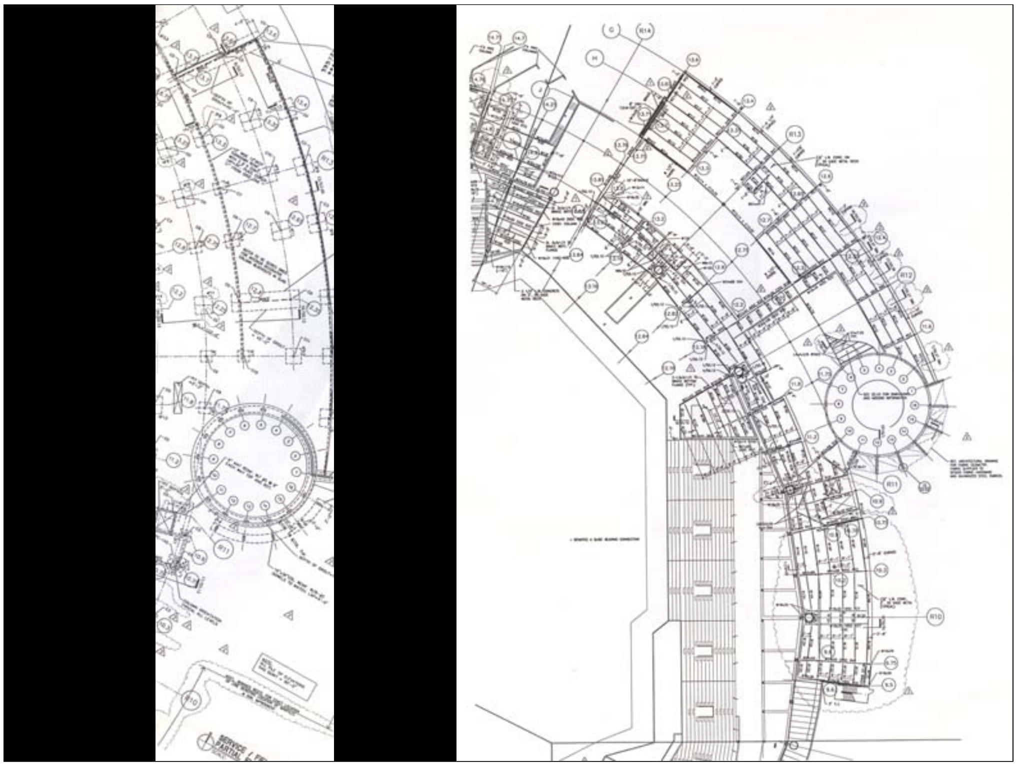
View from the Southeast showing the proportions of the structure and its scale. Part of the idea with showing this project is to compare the scale to the last presentation (the cantilevered concrete stair, Class8) showing a contrasting scale, but a similarity or consistency of process, both design and construction processes.



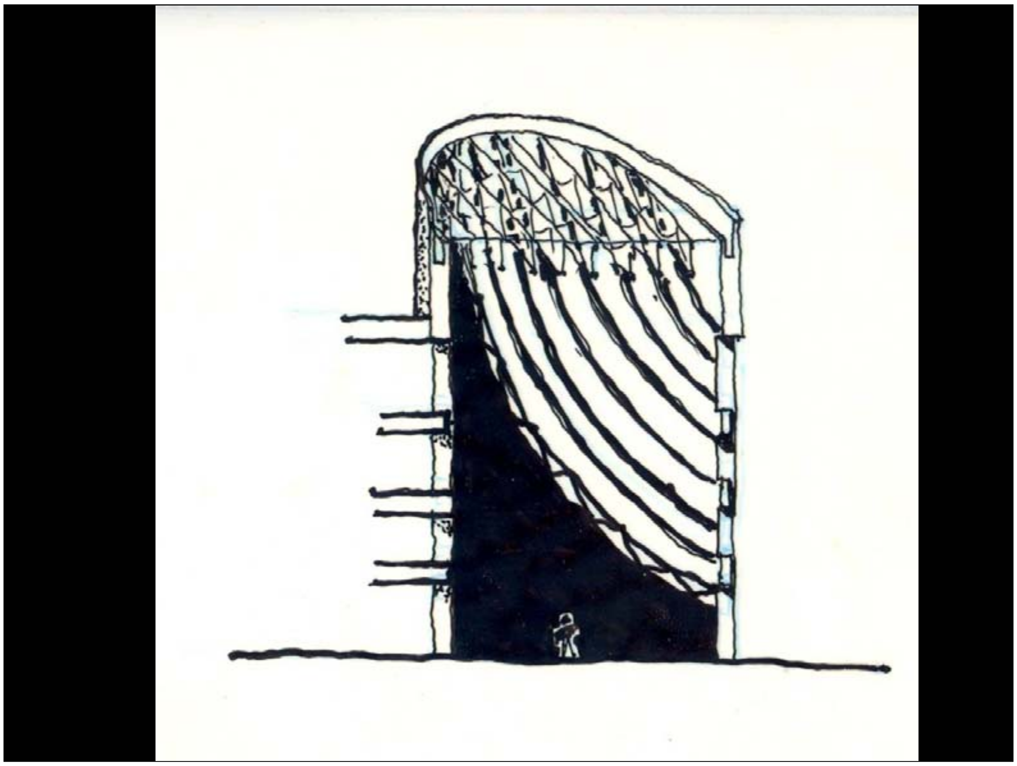
Partial structural foundation plan of the structure showing the entry cylinder at the east, right edge of the drawing.



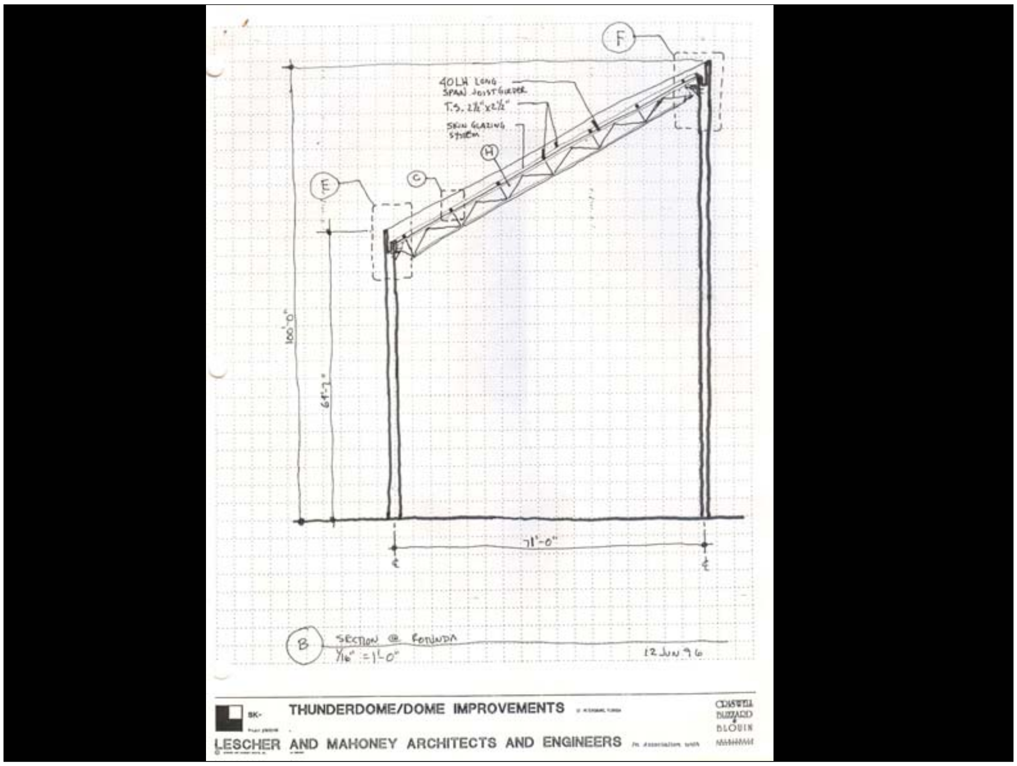
Parital Structural First Floor plan. Wide flange beams frame the floor and roof structures around the concrete entry cylinder.



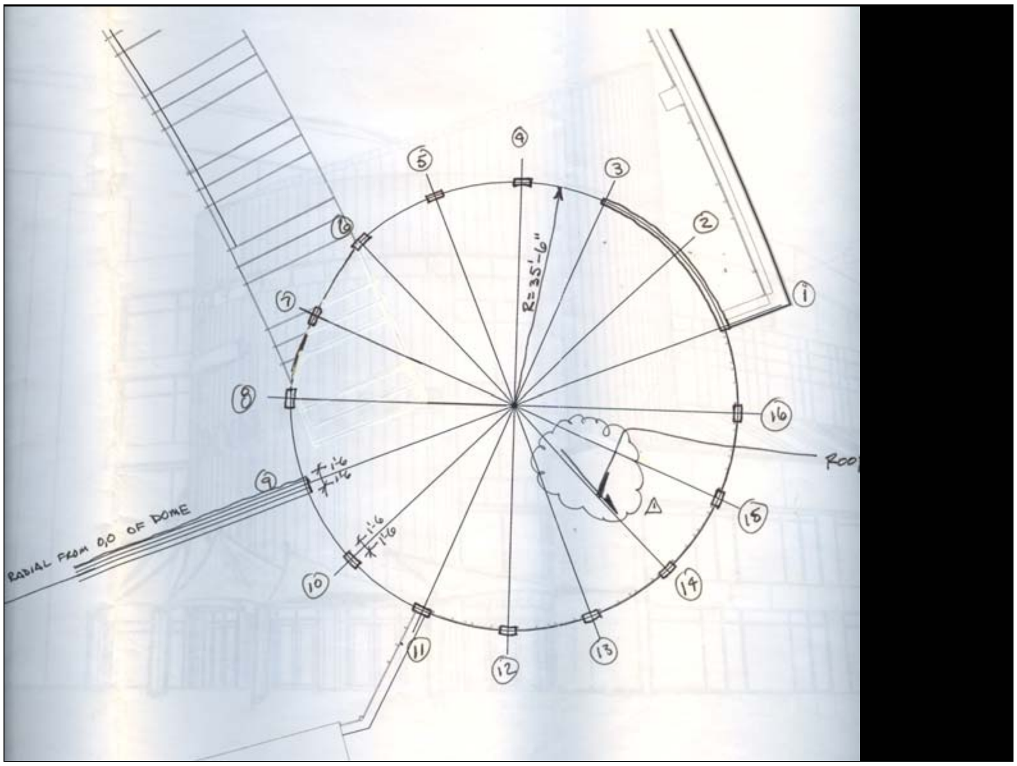
Closer look at the structural drawings, foundation level and second floor level.



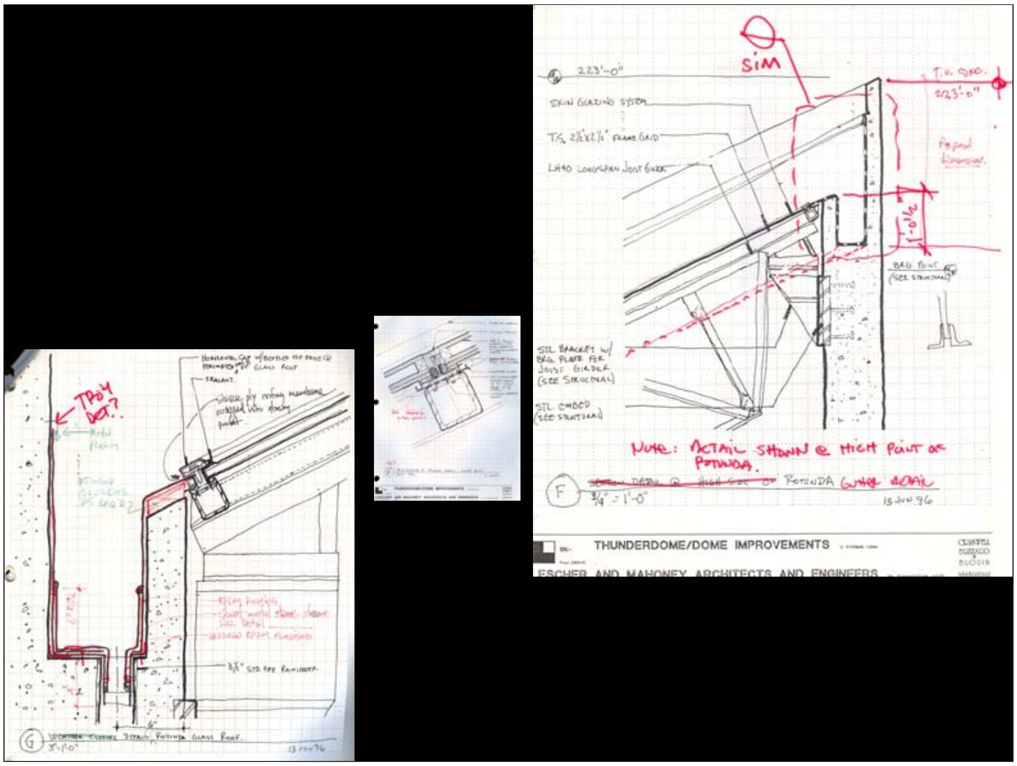
The initial sketch shows the design intent to have the inside of the cylinder as a grand space that induces one to look up and to the sky. The idea with the glass roof is to have it detailed in such a way as to perceive the least amount of frame at the edge of the concrete structure so the overwhelming perception is of the concrete cylinder.



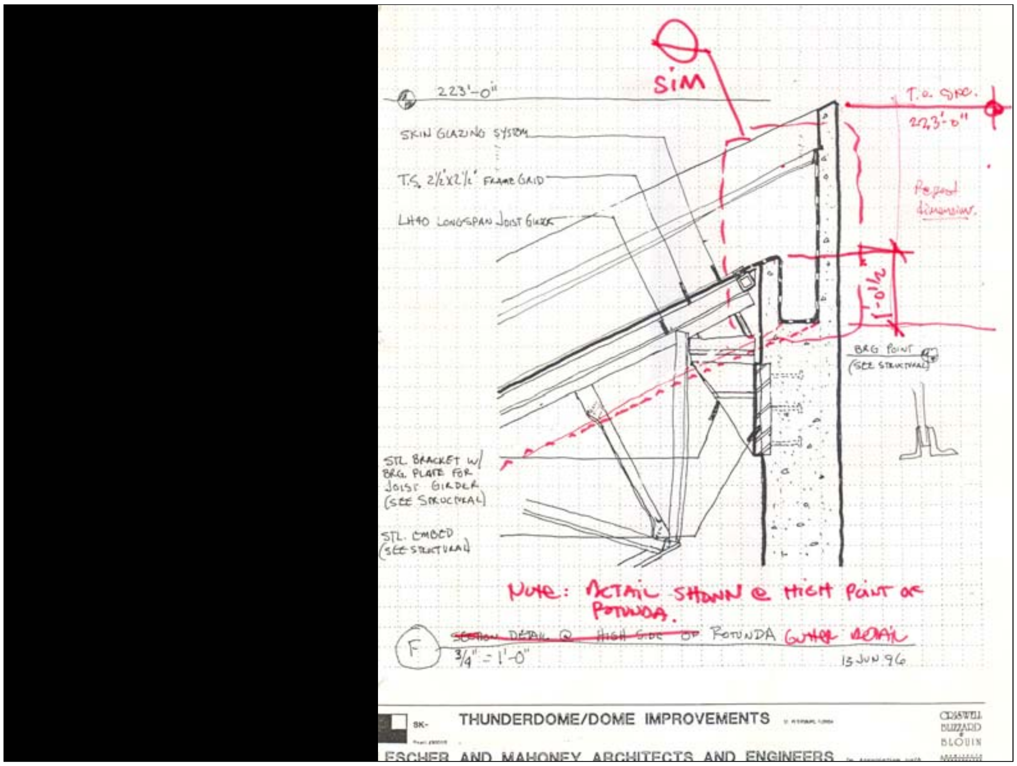
In order to manifest this concept, intent, and idea, the details of how the glass roof is supported and how the edge is detailed so that it remains as minimal as possible.



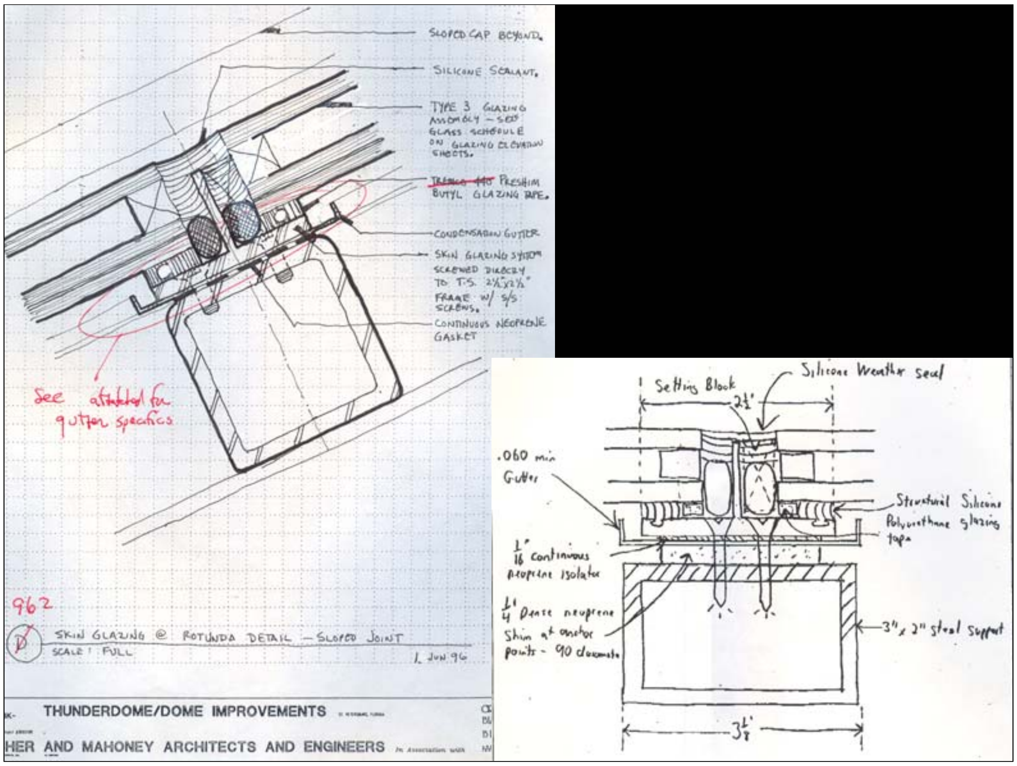
Plan at ground level showing the concrete 'columns' that effectively support the cylindrical form above. 16 column lines define the radial grid for the structure and a roughly 71' diameter.



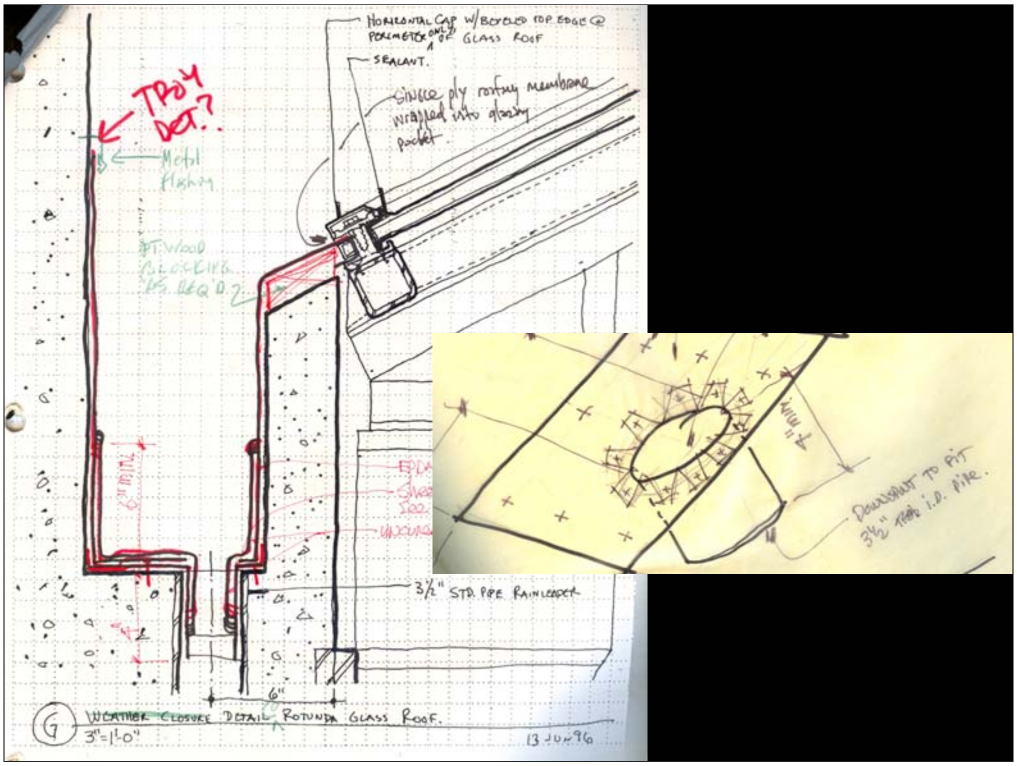
The critical dimension (the width of the wall) is defined partially by the glazing edge detail and the way in which water drainage is handled from the sloping roof which is in excess of 4,000sf. The top of the wall is formed to contain a gutter within the width of the walll and allows the water to be taken down to the storm drainage system via 3” diameter pvc pipes embeded into the concrete ‘columns’ at the southeast edge of the cylinder where the low side of the slope.



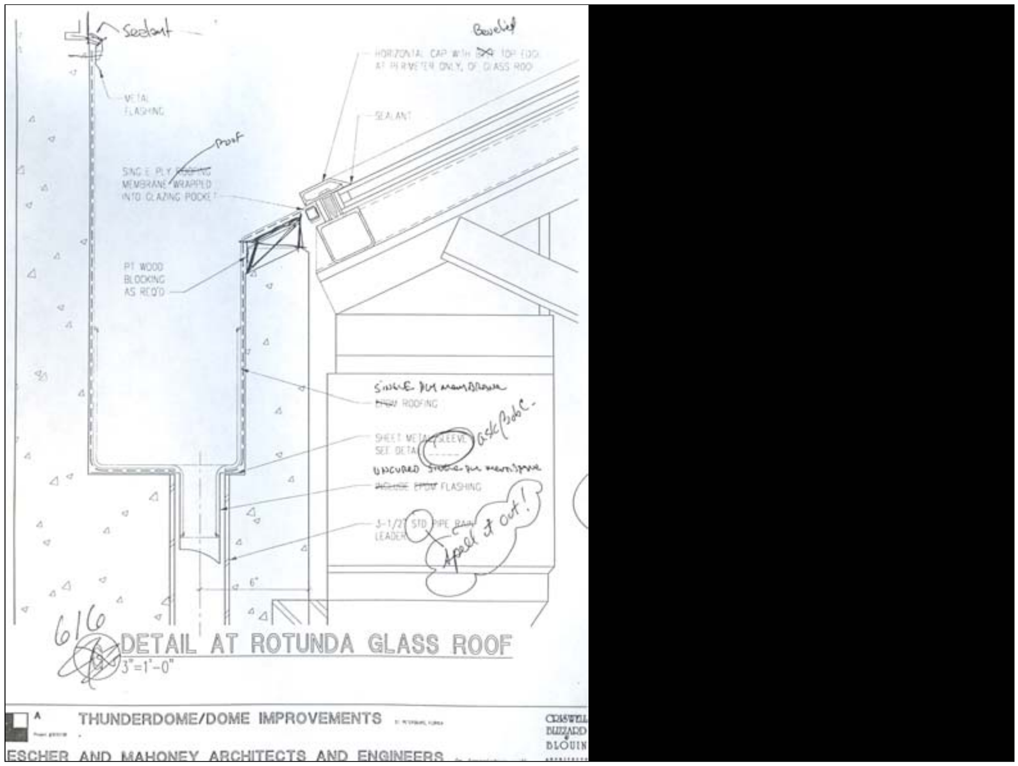
A closer look at the upper edge of the sloped eliptical glass surface shows how the wall minimum width is defined. The outer part of the concrete wall must extend up as a parapet wall to conceal view of the gutter system from the outside and to give the impression, from the inside, that the walls extend beyond the glass surface. This ‘parapet’ wall must have a minimum thickness of 4” for structural stability, the gutter must be 8” wide by water drainage calculations based on maximum rainfall for the area, the inside wall section must also be 4” min. for structural stability. The overall thickness is set at 16” and the structural engineer can then check it for adequacy for the structure.



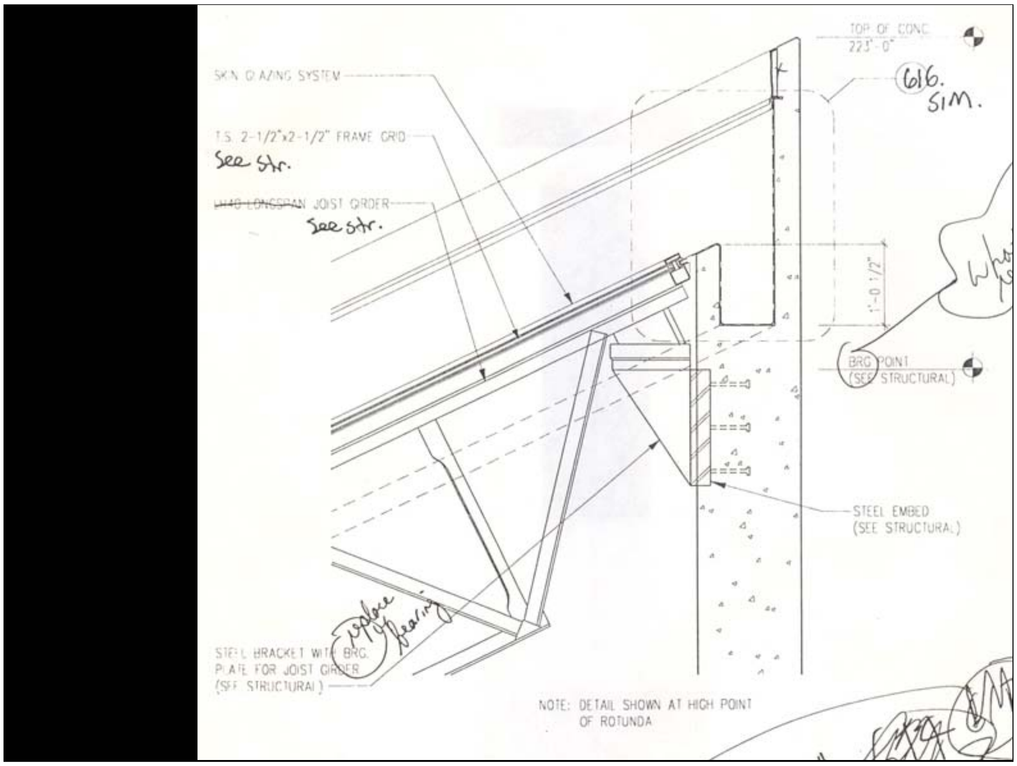
A closer look at the sloped glazing system shows the 'gutter' system made of sheet metal flashing that under-lays the extruded aluminum glazing track. This 'gutter' system is a backup system for the 'wet glazed' (refers to a method of sealing a glass, or other material, system using a gun-able sealant such as silicone from a tube) system above. Additionally, this 'gutter' system is for any condensation that may occur on the inside of the glass due to temperature and humidity differentials between inside and outside air. The double glazed lites ('lite' refers to a single panel of glass whether it has one layer or two) help tremendously with any condensation but when designing exterior systems a rule of thumb is to design in three lines of defense, so to speak, against weather penetration.



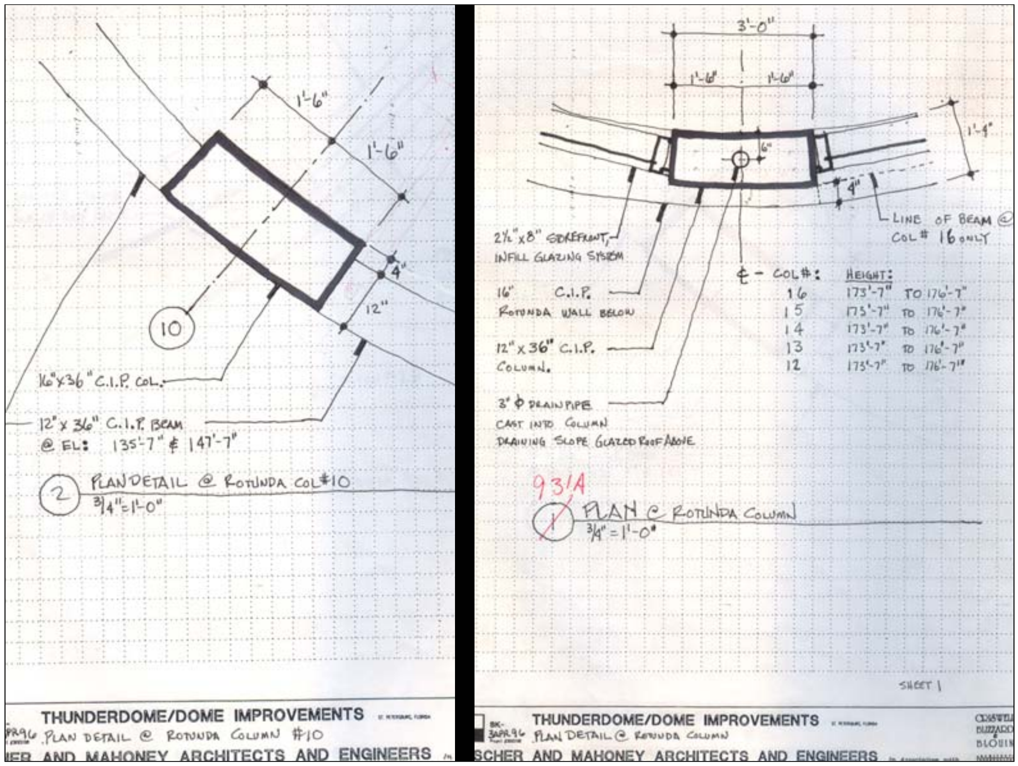
A closer look at the lower gutter detail shows how the edge is flashed (flashing refers to using either sheet metal or single-ply membrane to seal against water penetration) using a single ply roofing membrane and clamping it into the glazing cap on the lower side. The roofing system is brought up the inside face of the parapet wall enough to protect the concrete against splashing water from the sloped glazing.



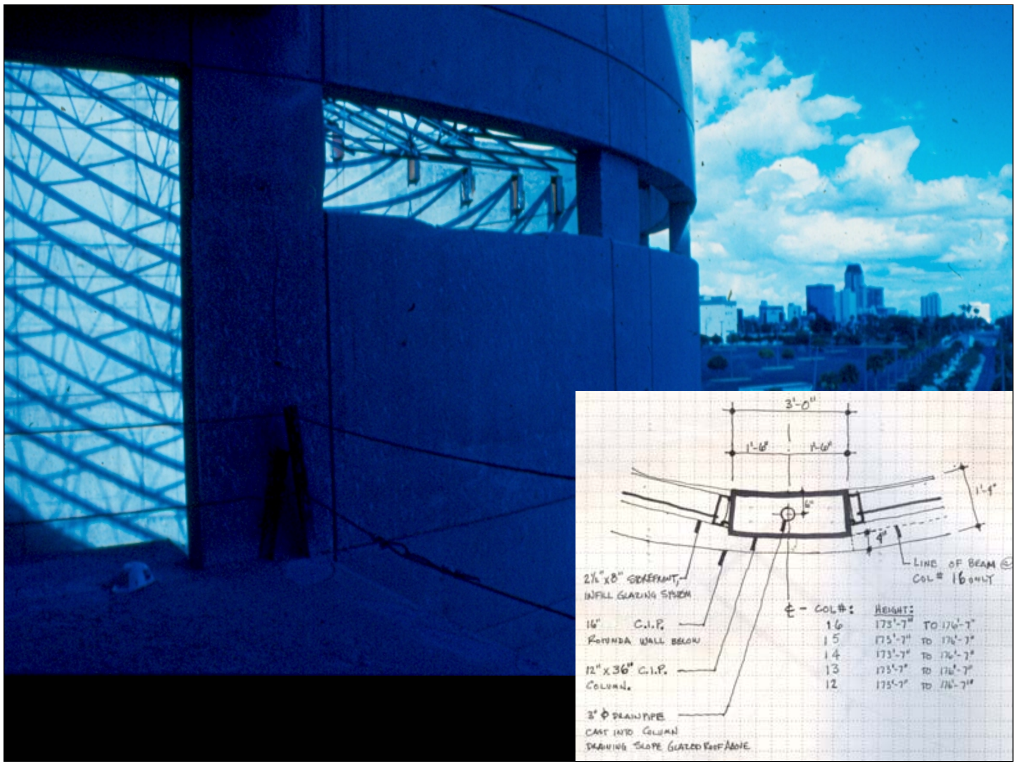
Note that the support for the steel truss is well below the bottom of the gutter in the wall to ensure that it is well into the 16" structural width of the wall.



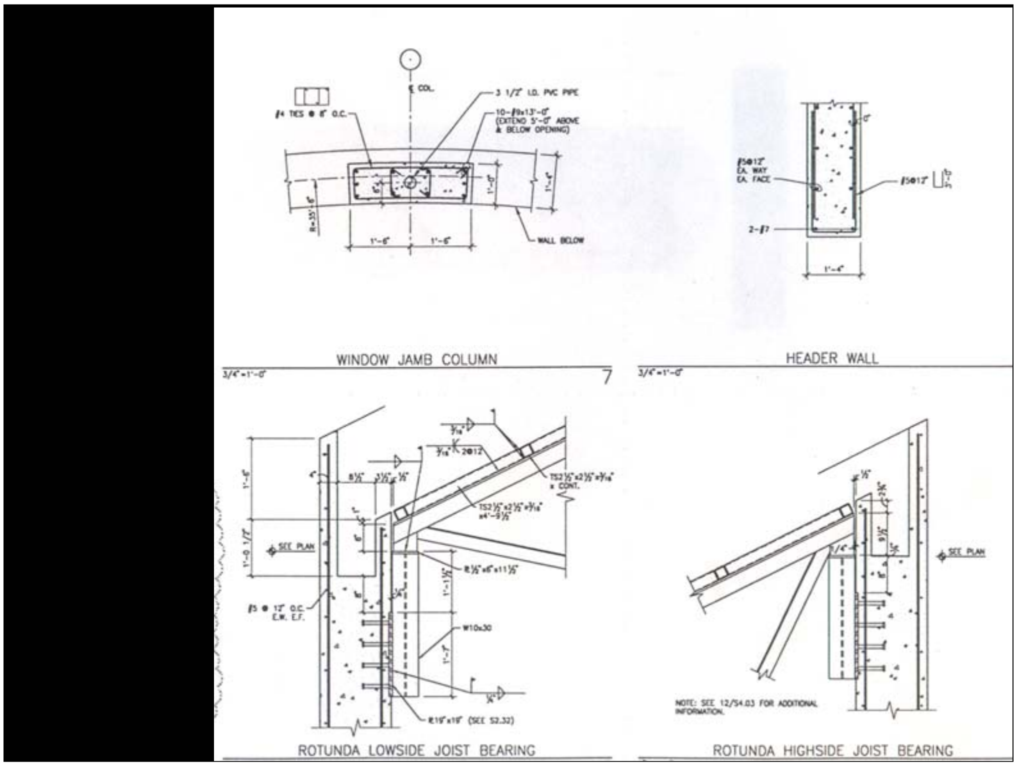
First concept of a welded embed seat for the steel trusses. This initial idea used cut flat plate to fabricate the angled seat and had it welded to the embed cast into the wall.



These details show the importance of showing what may seem to be small issues like having the face of some of the horizontal beams set back from the inside face of the cylinder, and also having other, outside faces of the columns set back from the face of the cylinder. Once the crew is on site with the forms, it can be easily missed if a big deal has not been made of a few areas where something different happens.



The column set back from the face of the cylinder making it read as a ‘slot’ rather than a series of punched openings.



Structural details showing the face setbacks and the final solution of using a wide flange beam section to make the seats for the steel trusses. Notice the annotations and how each member is called out by the industry sizes. These sizes and annotations can be found in the Manual of Steel Construction by the AISC. Refer to the class website for more information and where to find it.

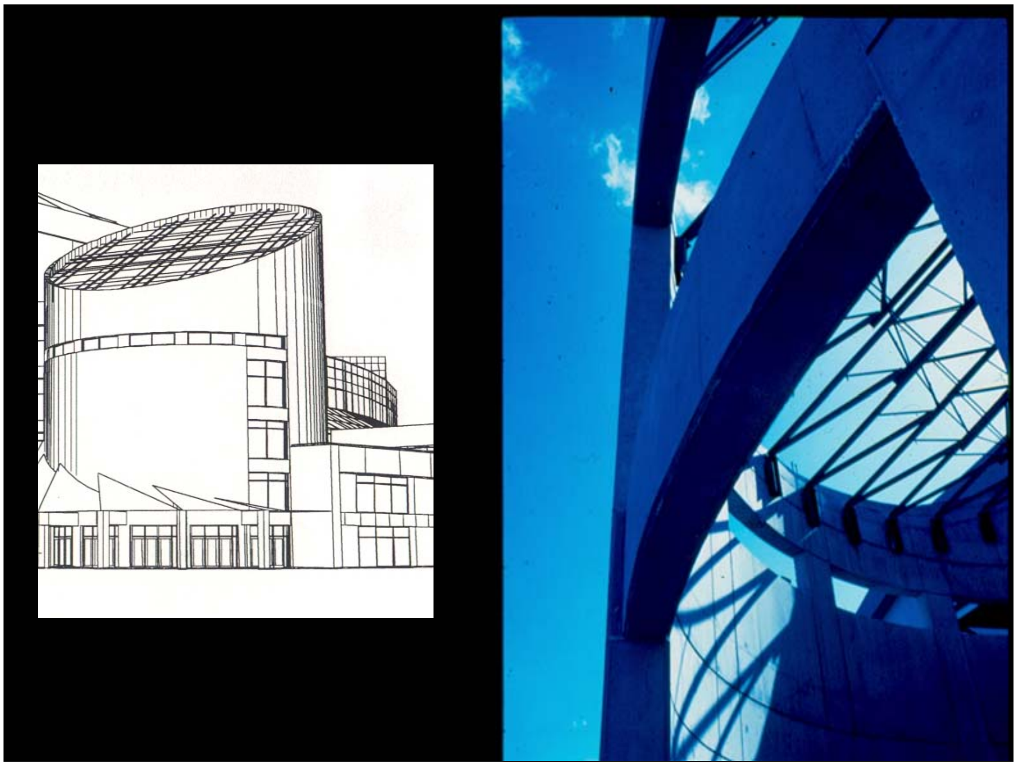
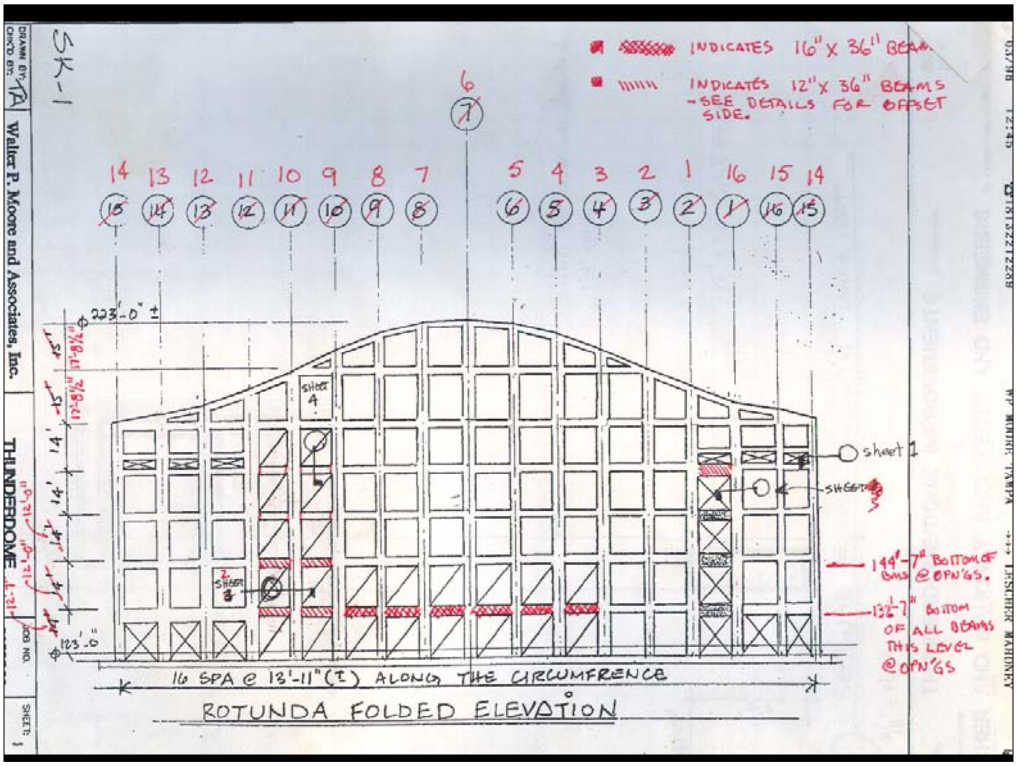
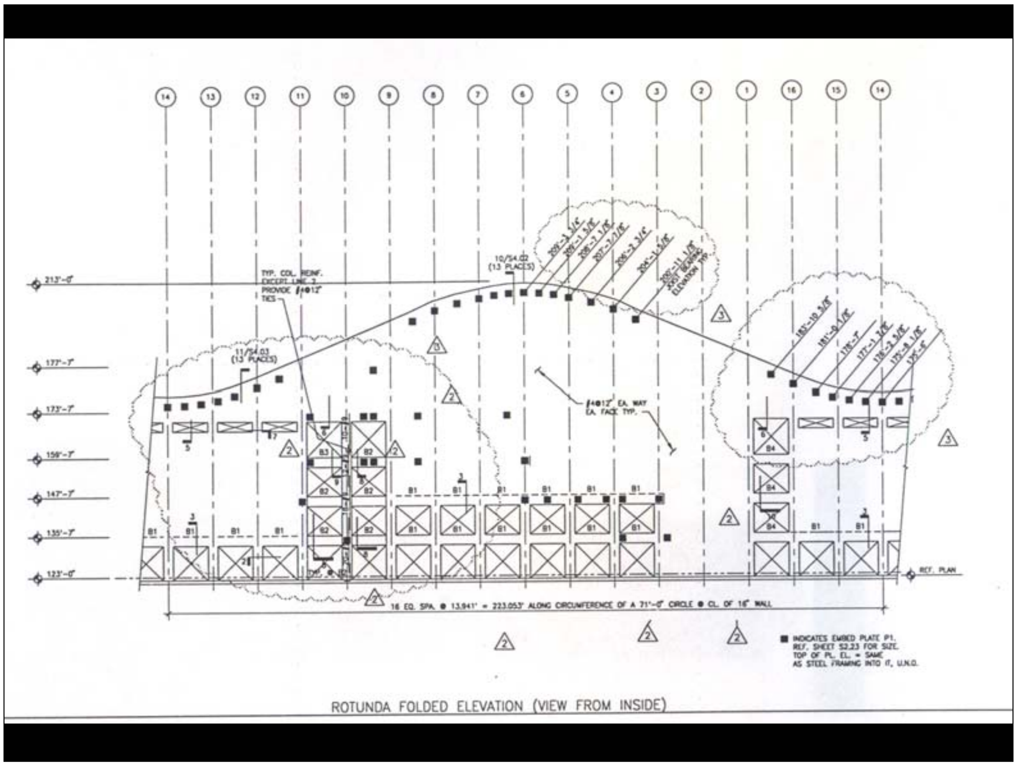


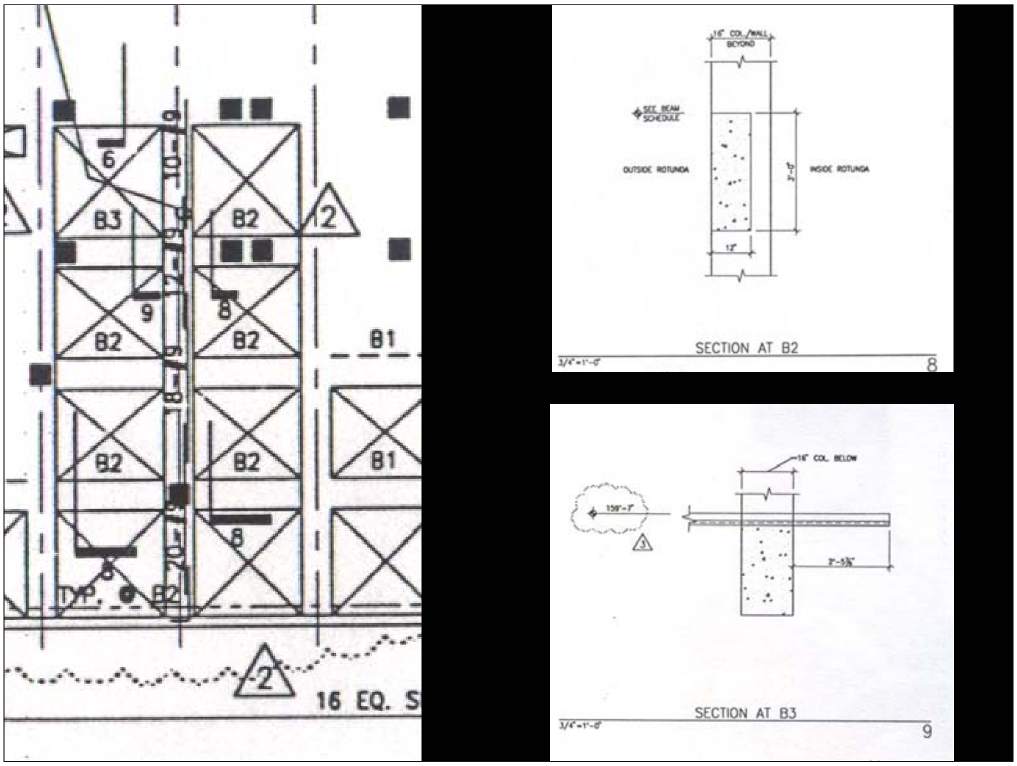
Photo and drawing showing the concept and manifestation of the openings reading as a depressed slot.



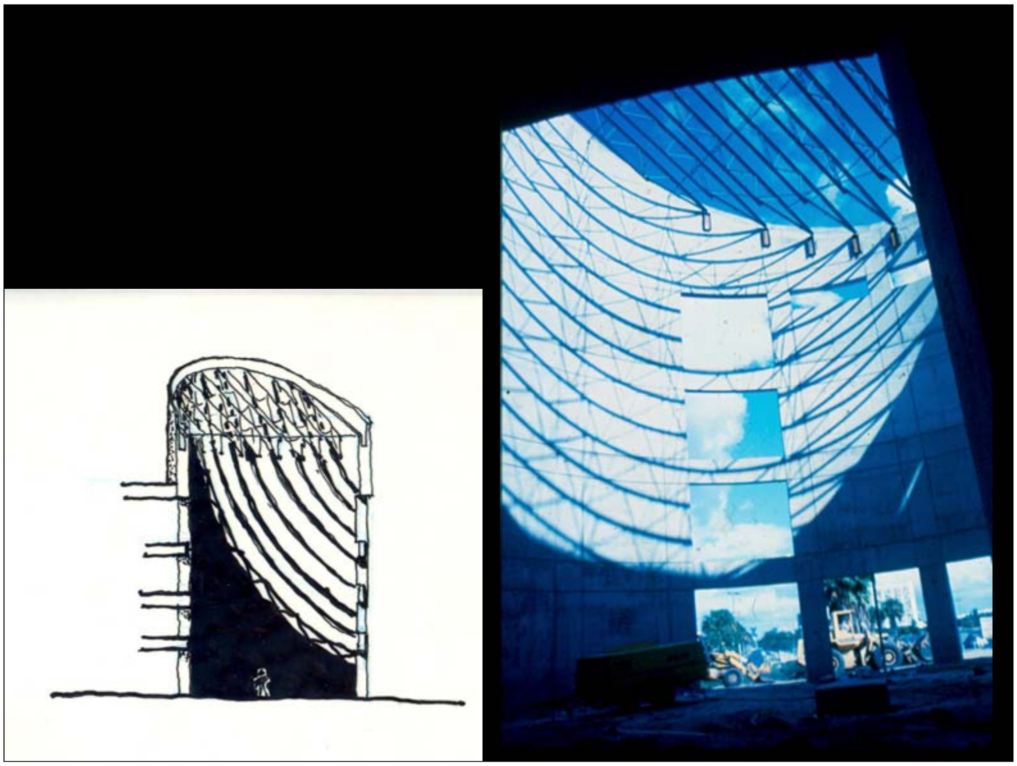
Structural drawing showing the wall of the cylinder as it would be if unrolled to a flat shape. This is in order to convey where reinforcing, openings, face setbacks, etc. are located. The numbers at the top in the circles correspond to the radial column lines shown in the plan.



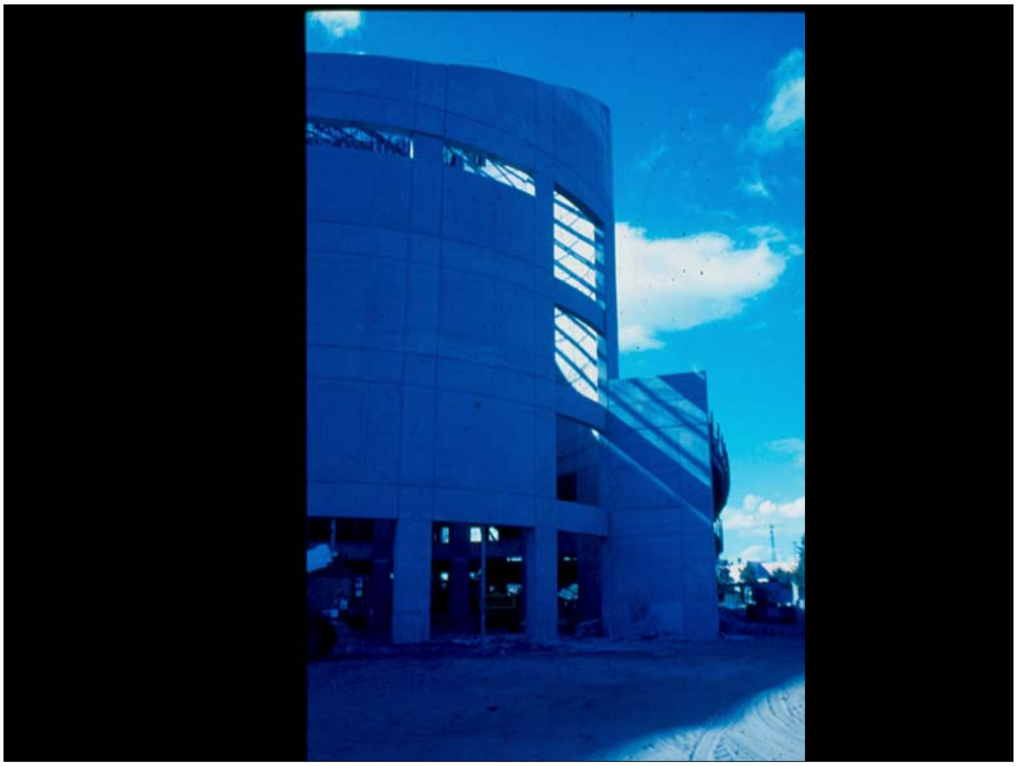
Same drawing but as it was in its final version on the drawing set.



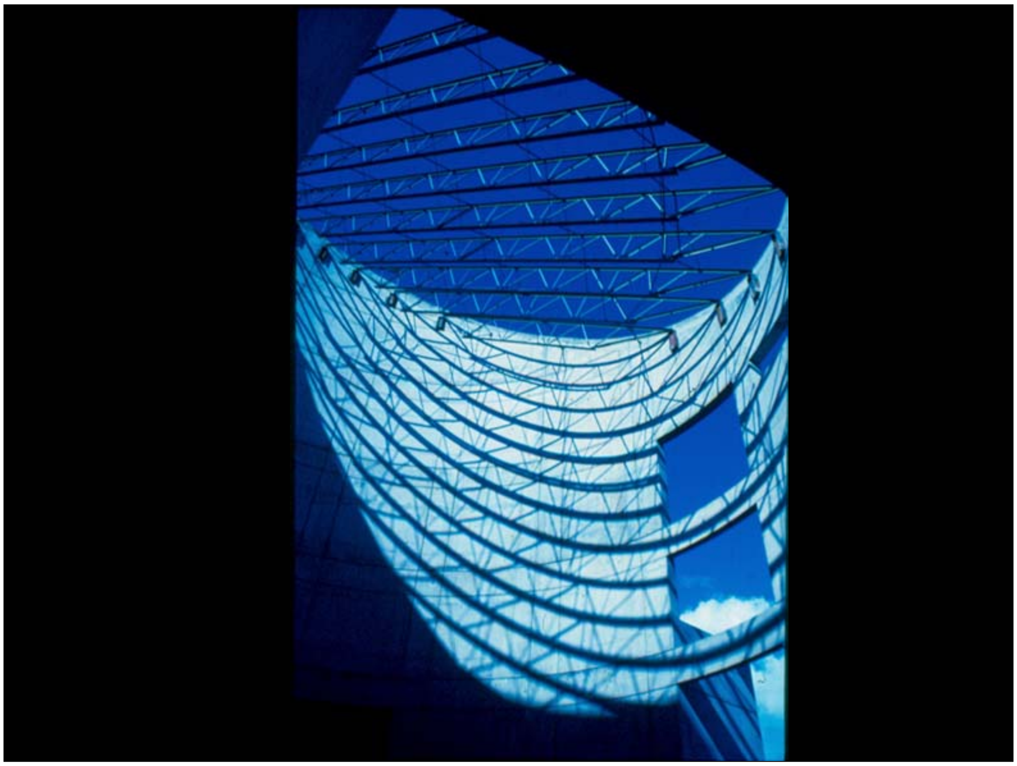
Close-up of the unrolled wall drawing showing how the details are keyed into the overall drawing and relate to the details. These show the face setback for some of the beams and how a floor section cantilevers into the space of the cylinder.



The test of how well the details and development of the concept has worked. Does the space do what it was intended to. I think that the truss seats could have been smaller and more minimal and probably could have done another tensegrity structure to support the glass to make it disappear even more, but alas budget sometimes is the strongest driver.

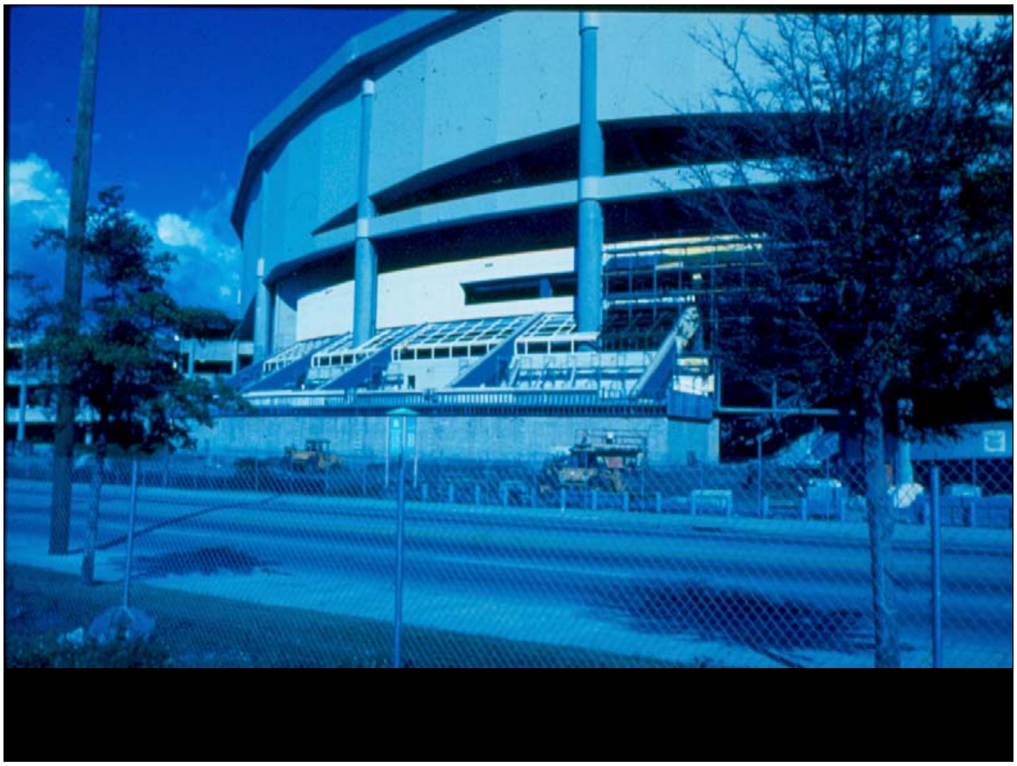


Photo, southeast.



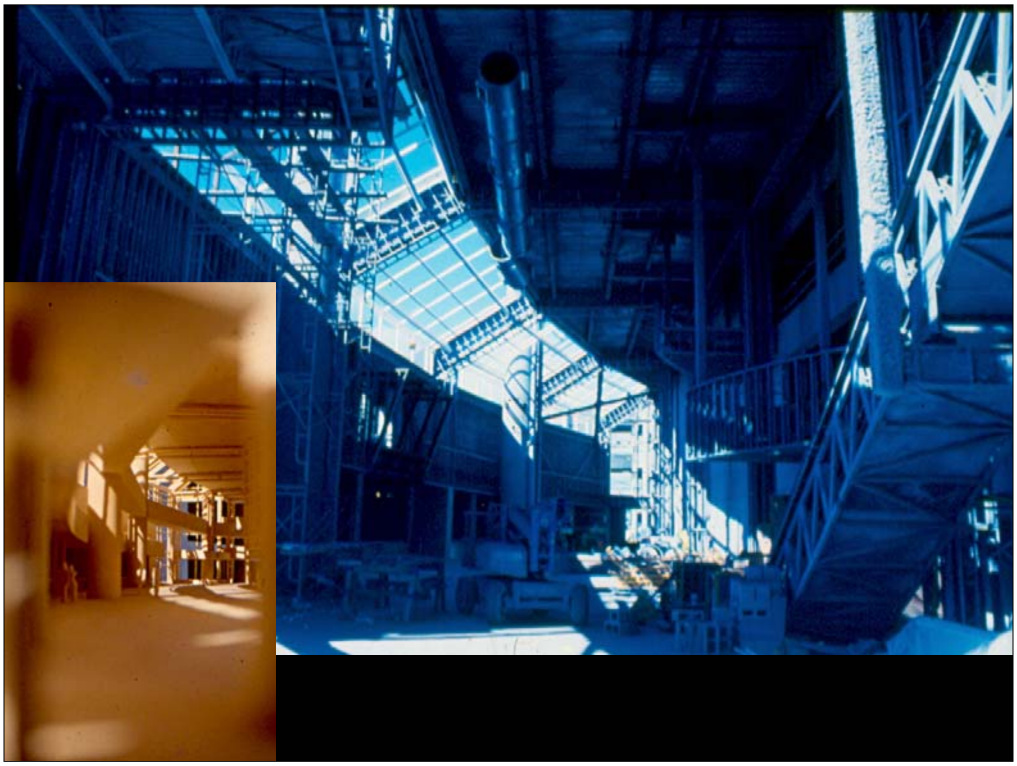
Showing the light quality as it was intended.

From inside the building next to the cylinder.

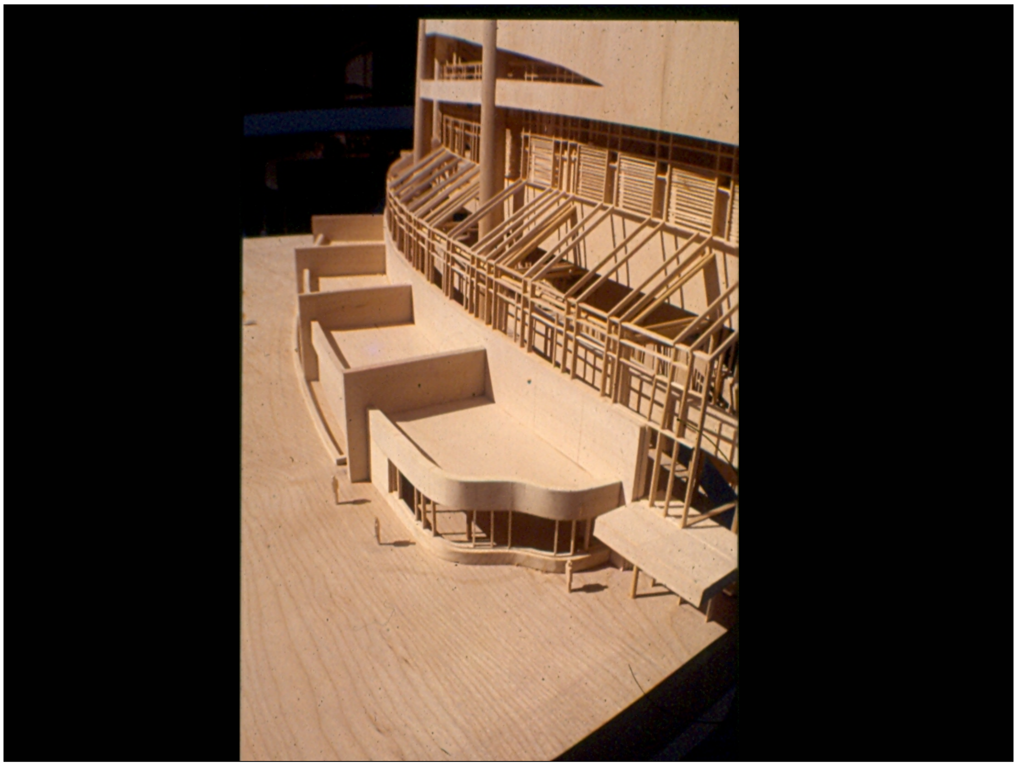


This detail shows the multiple issues to think about when proposing a concept like having an existing 6’diameter concrete column go through a new sloped glass roof system.

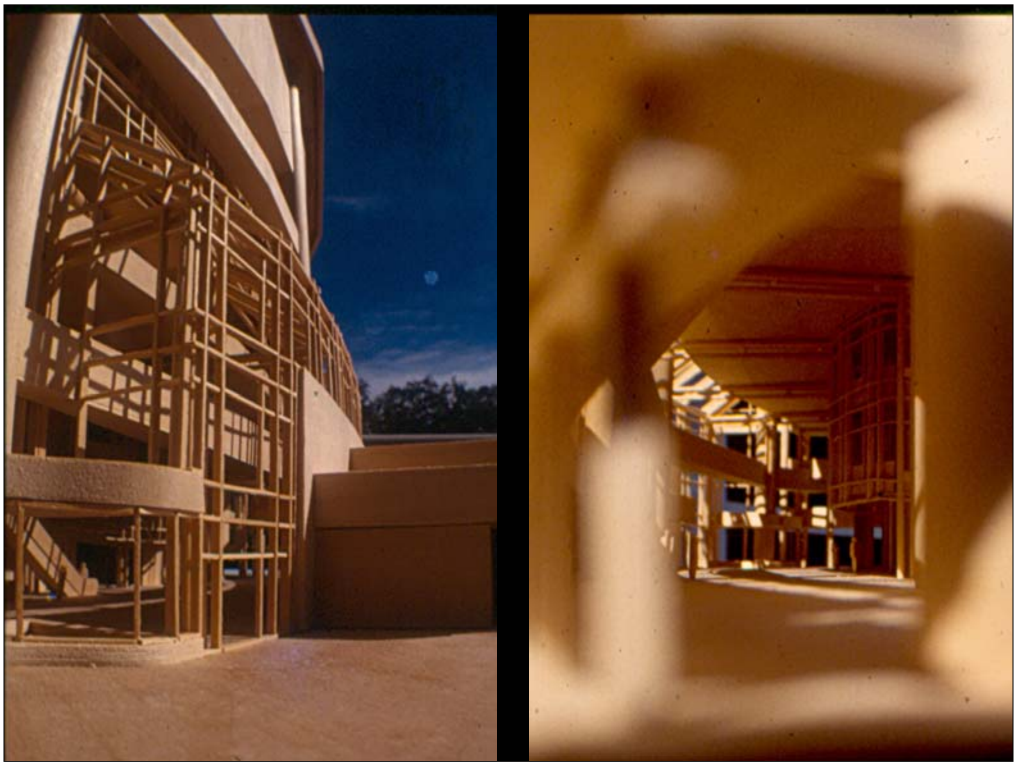
The major issue is that the existing 6’ column is moving, due to wind loads on the building, in the range of +/- 3” in any direction at this elevation. Additionally, the new structure is moving at a different rate and in possibly different directions in the range of +/- 1.5” because of its elevation. These deflections are normal in construction and are based on allowable deflection calculations for all of the structural systems. The solution is similar to the way that the gutter system in the sloped glazing system of the entry cylinder was sealed at the edges.



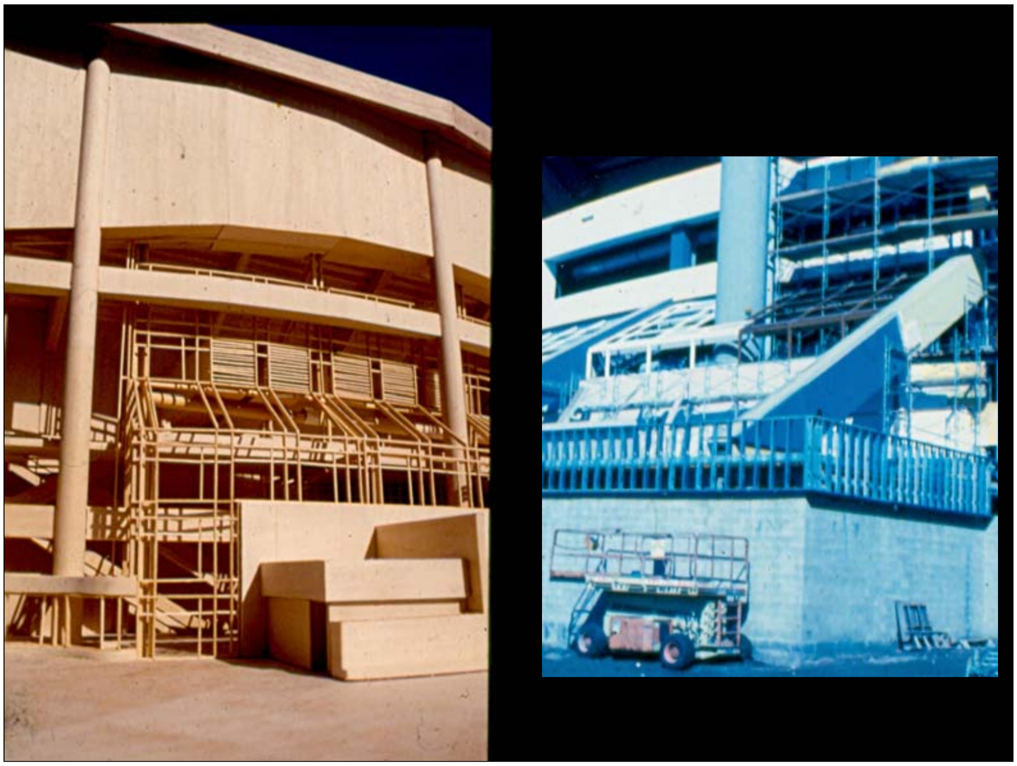
View of the basswood model and the atrium showing the space (a food-court by program) where the existing columns will slide through the overhead glazing system. An escalator can be seen at right, suspended from the steel structural frames above.



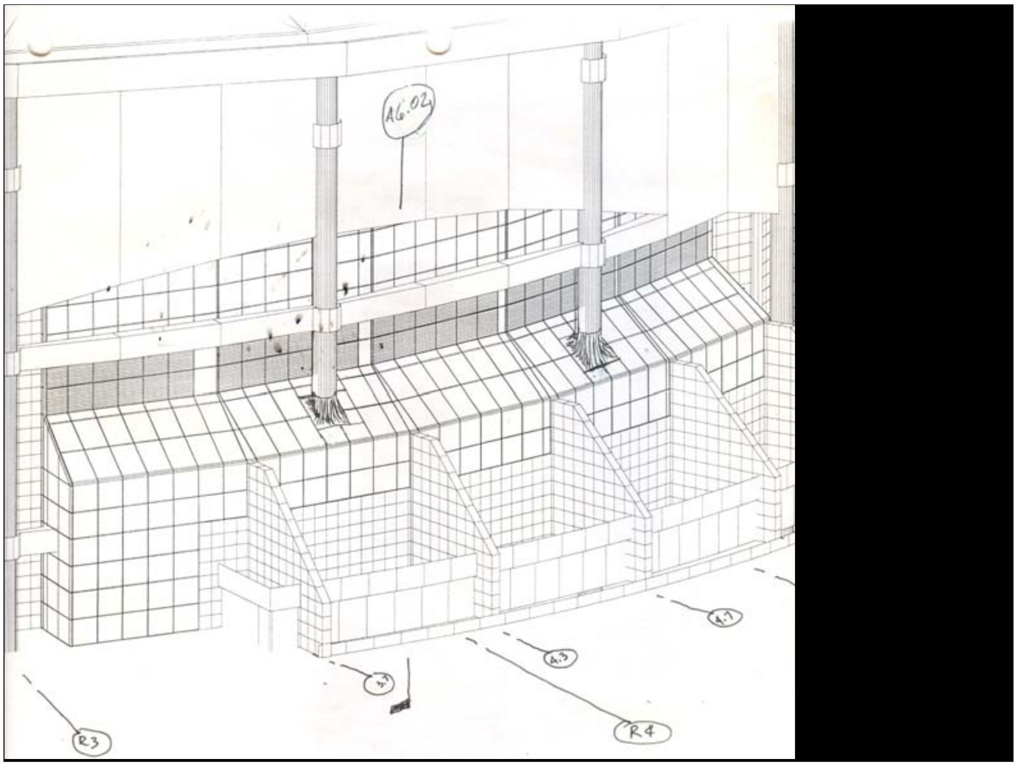
Model showing the concept of the glass system wrapping around the existing columns.



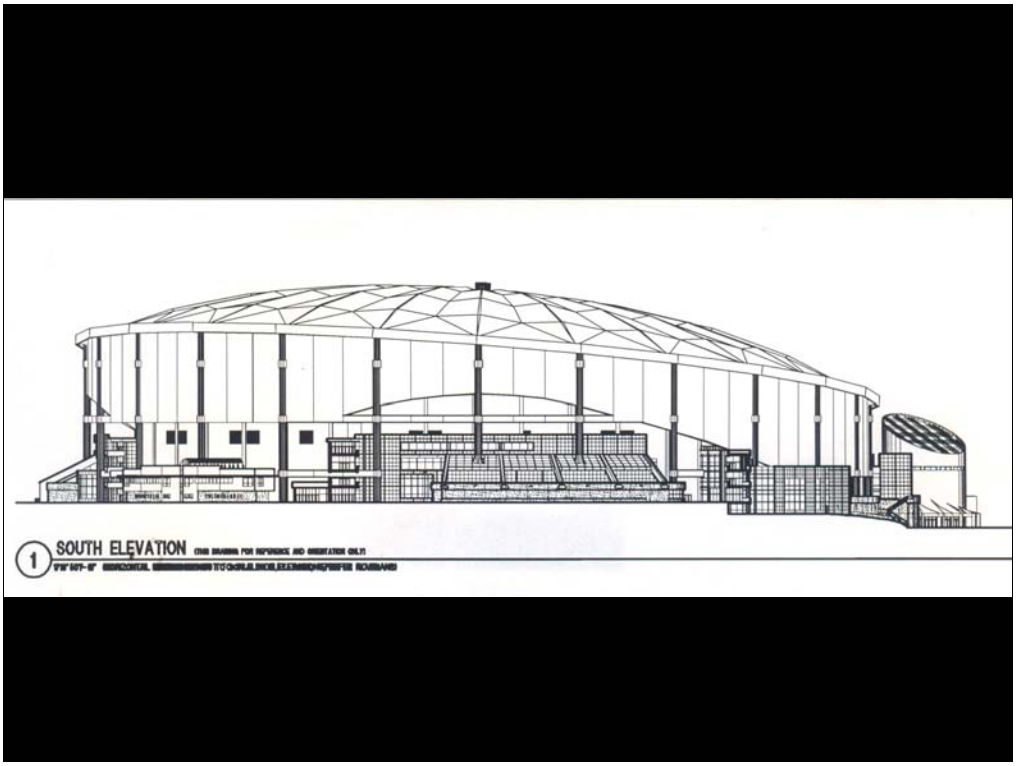
Basswood model showing how the glazing system is closing around the food-court bar outside of the existing building.



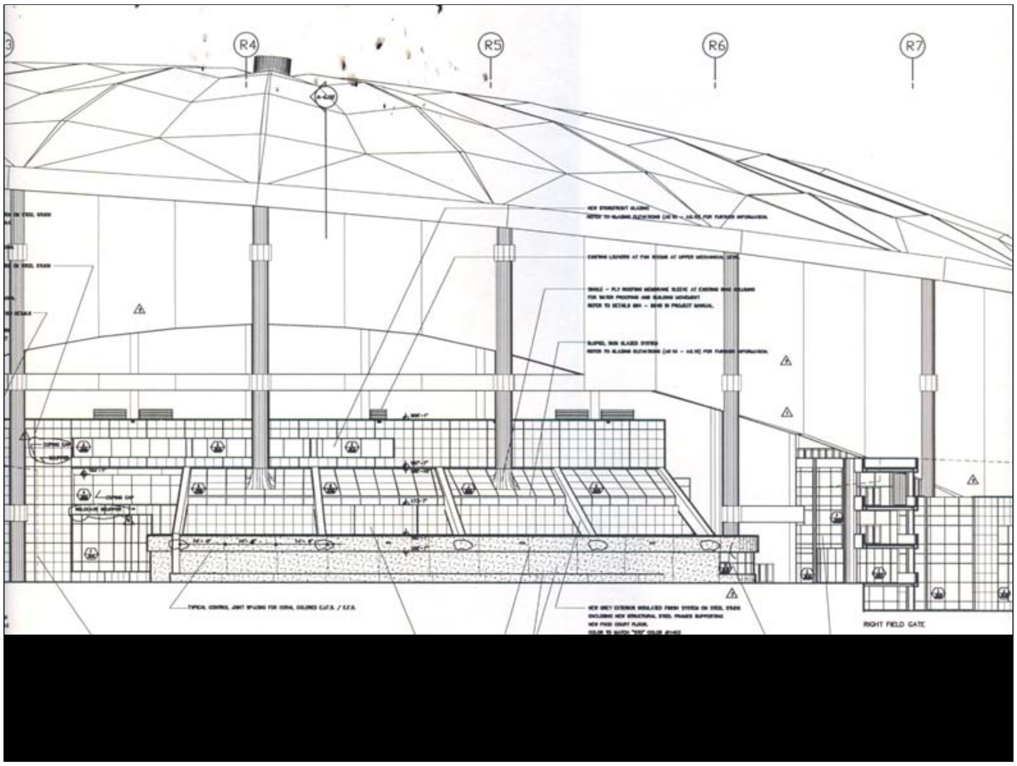
The solution for the column penetration is to frame an opening around the column with the aluminum glazing framing that has the required clearance at the 4 edges based on the combined deflections of the two structural systems. Then the glass opening is fit with an aluminum honeycomb panel that is glazed into the glass slot with the pressure bar of the glass extrusion system, and with it, a single-ply roofing membrane is clamped and glazed into the glazing slot.



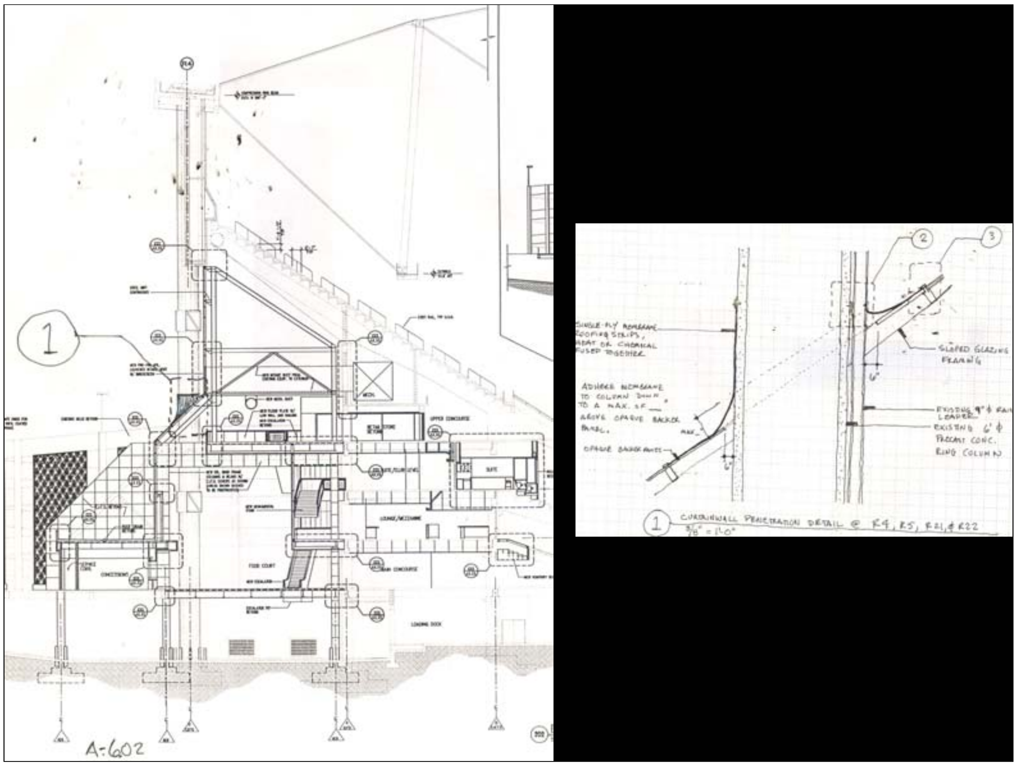
Sketch showing the concept for closure.



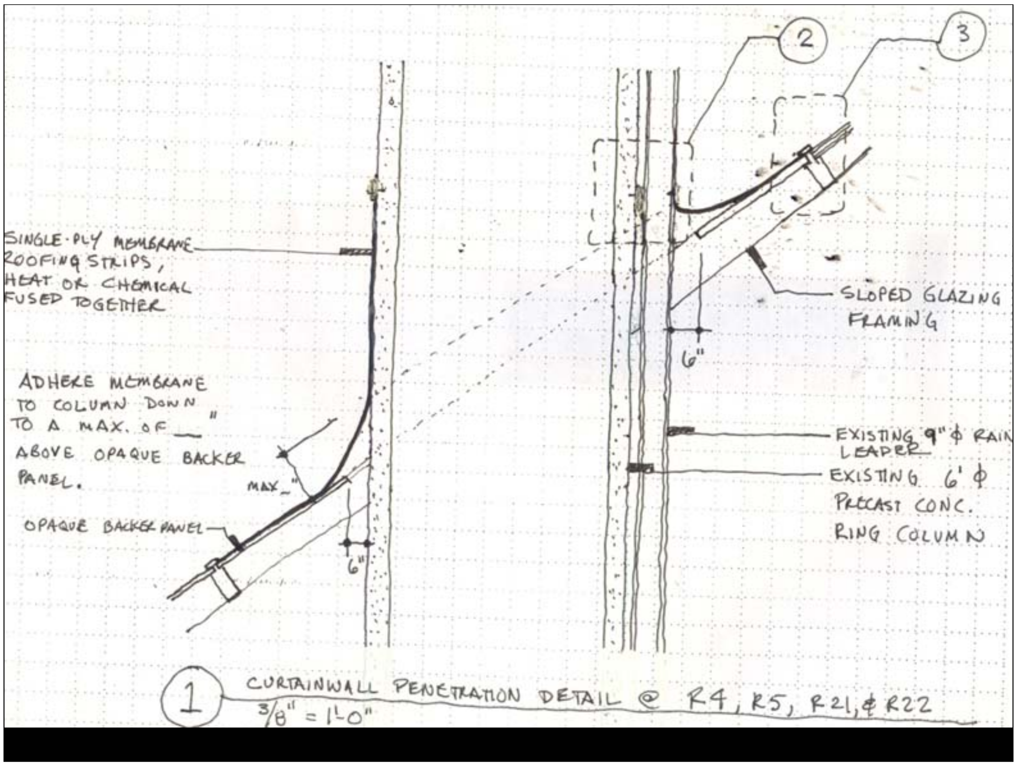
Contect for the glazing detail.



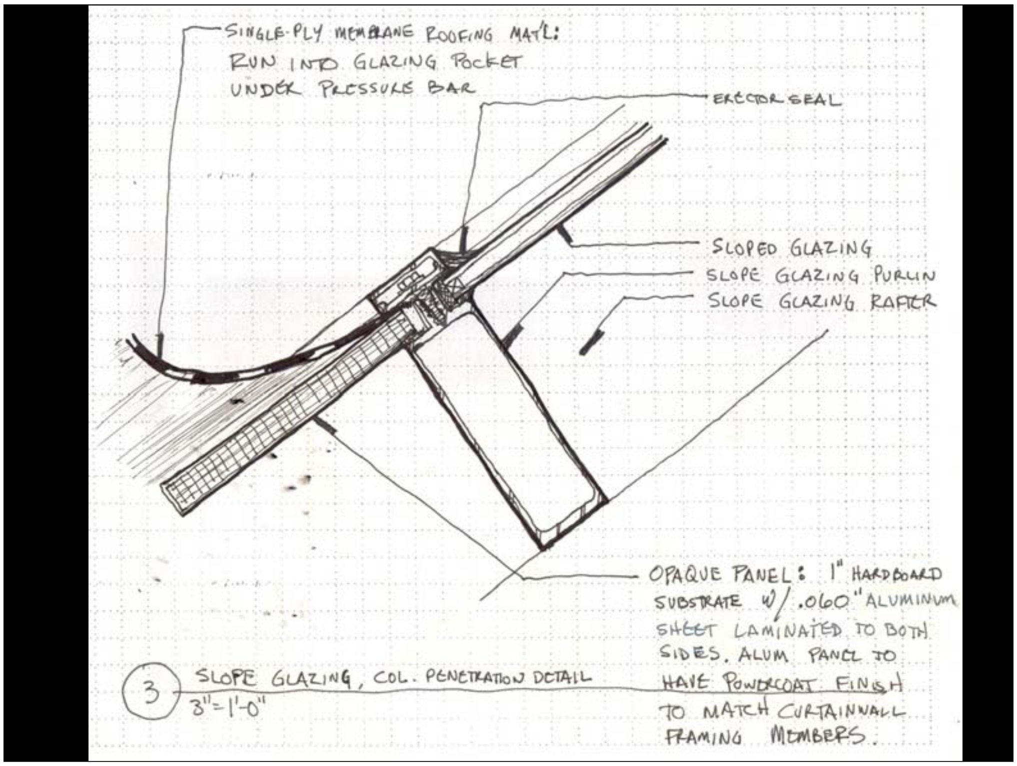
Close-up of the elevation containing the details.



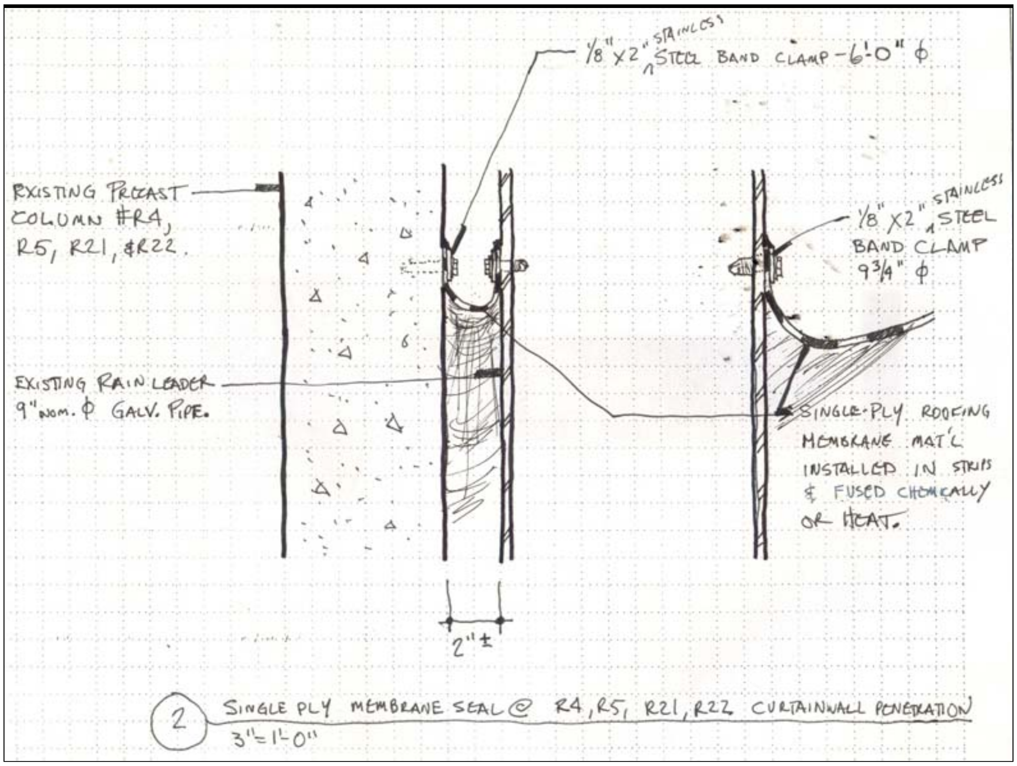
Section keyed from the previous elevation and detail keyed from the section.



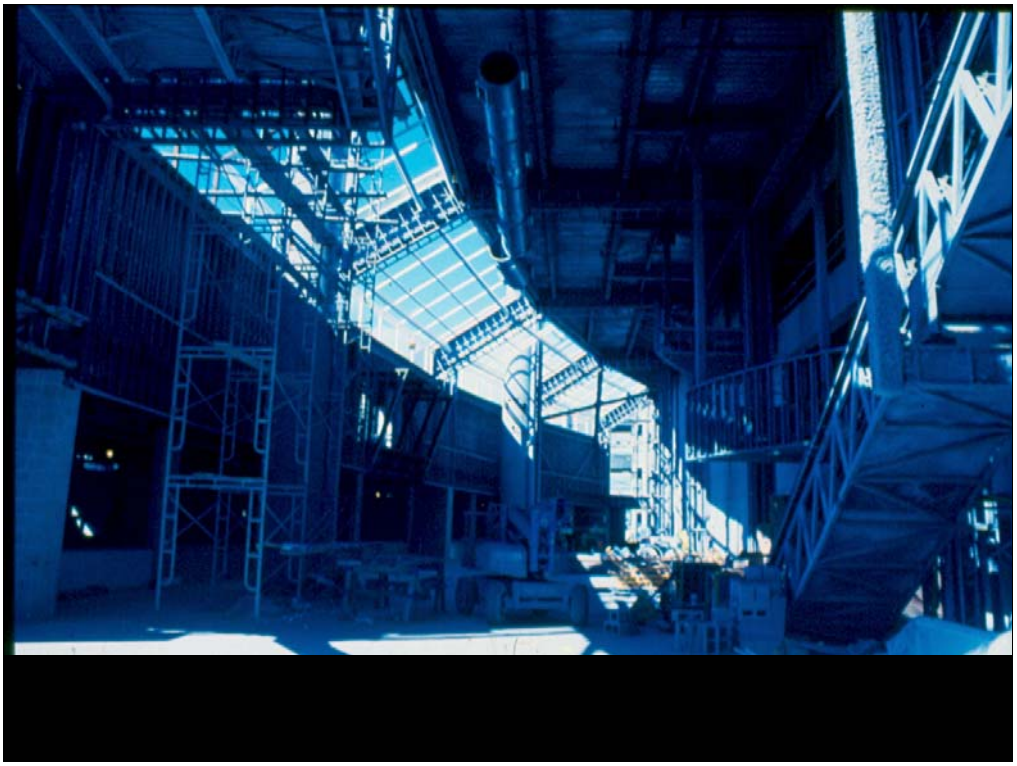
Here is the detail showing the honeycomb panel glazed into the slot, the space for differential deflection, calling out the materials and systems involved in the connection and two additional details keyed from here to explain exactly how the system will be put together.



Detail showing how the aluminum honeycomb panel and the single-ply membrane are glazed into the sloped system just like the glass panel on the other side.



In this case there was a steel drain pipe right next to the concrete column. This detail shows using screws penetrating the membrane and securing it to the steel and concrete columns however, the final detail used a stainless steel strap clamp, just like a radiator hose clamp to clamp the membrane to the two cylindrical elements.



Concrete column through glass wall.

For more info check the links on the class website.

Tabby Concrete, can be used in slip form walls.

Step 1

Burn a few dry oak logs down to ash.

Step 2

Add to the hot embers some oyster shells that have been bleached in the sun.

Step 3

Burn the oyster shells down to ash. This mixture of oak and oyster shell ashes makes an old-fashioned form of lime, the binding agent in cement.

Step 4

Mix the lime with sand and water. This makes the cement that binds the aggregate together.

Step 5

Add to the cement some oyster shells that have been thoroughly washed.

Step 6

Cast the concrete in wood forms to create walls, blocks or paving stones.

Step 7

Remove the forms when the concrete is set, and scrub the surface to remove the excess cement and expose the shells.

The small chapel was built of tabby and brick from 1742-1747 for the Episcopal parishioners on St. Helena Island.

Just for fun and FYI:

The small chapel was built of tabby and brick from 1742-1747 for the Episcopal parishioners on St. Helena Island.

South Carolina: Tabby Manse (1211 Bay Street, Downtown Beaufort): Built by Thomas Fuller in 1786, the house has exterior tabby walls two feet thick (finished with stucco). Held by wooden pegs, its structural timbers measure twelve inches thick. **Richard Fuller** (1804-1876), the famous Baptist clergyman, was one of the builder's seven children.

Tabby Manse (1211 Bay Street, Downtown Beaufort): Built by Thomas Fuller in 1786, the house has exterior tabby walls two feet thick (finished with stucco). Held by wooden pegs, its structural timbers measure twelve inches thick. **Richard Fuller** (1804-1876), the famous Baptist clergyman, was one of the builder's seven children.