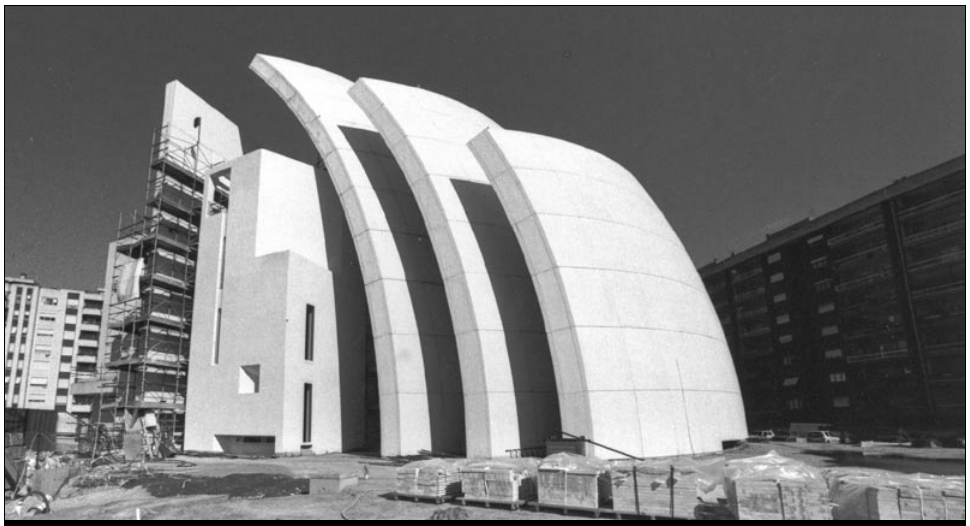


Class focus on how to accomplish something in built form with materials and methods available . .. Or un-available, as of yet.

CSI:

0300 concrete Allen, chapter 10, chapter 12.

03100 Concrete Formwork

03200 Concrete Reinforcement

03210 Reinforcing Steel

03230 Stressing Tendons

03410 Structural Precast Concrete-Plant Cast

03420 Structural Precast Post- Tensioned Concrete-Plant Cast

03450 Architectural Precast Concrete-Plant Cast

05100 Structural Metal Framing

05 Metals (steel)

05500 Metal Fabrications

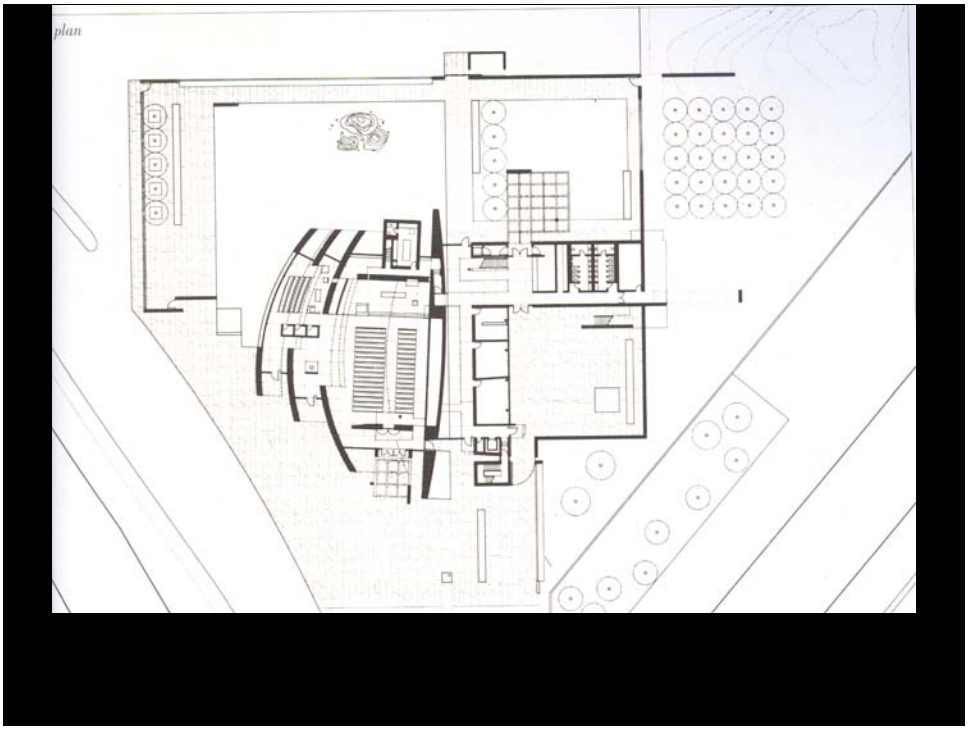
05900 Hydraulic Structures – positioning system

11500 Industrial and Process Equipment – positioning system

http://www.arcat.com/ - great resource will lay out both masterformat '95 and '04.

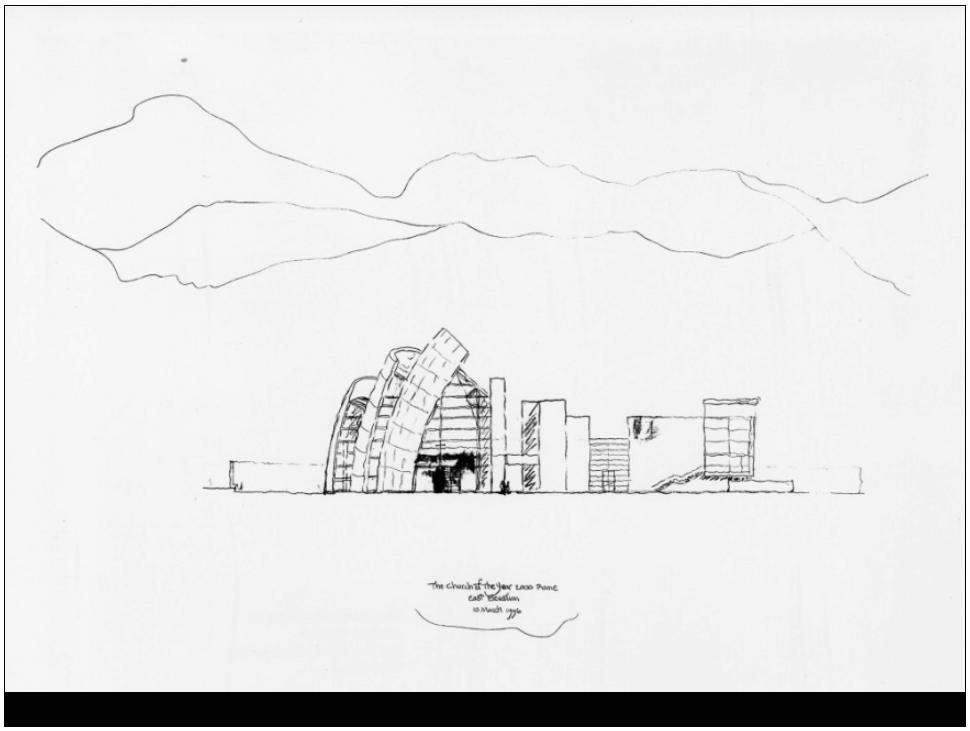
CSI masterformat 16 divisions Masterformat '04 more divisions mostly to accommodate new technologies in building systems, eg: Div.25: integrated automation.

Meier's Millennium Church, Rome:
0300 concrete Allen, chapter 10, chapter 12.
03100 Concrete Formwork
03200 Concrete Reinforcement
03210 Reinforcing Steel
03230 Stressing Tendons
03410 Structural Precast Concrete-Plant Cast
03420 Structural Precast Post- Tensioned Concrete-Plant Cast
03450 Architectural Precast Concrete-Plant Cast
05100 Structural Metal Framing
05 Metals (steel)
05500 Metal Fabrications – temporary positioning scaffold structure.
05900 Hydraulic Structures – positioning system
11500 Industrial and Process Equipment – positioning system

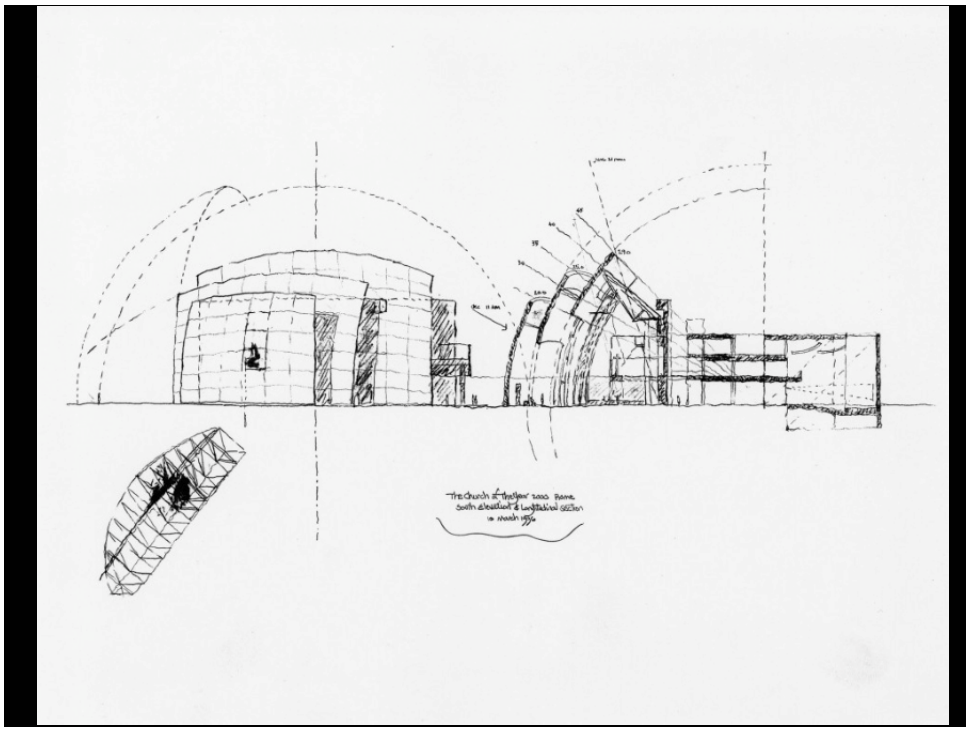


Corner: non-corner but space, an intent to create a space that induces its occupants to look upward and give a sense of the spiritual. (ref: RM vol.3)

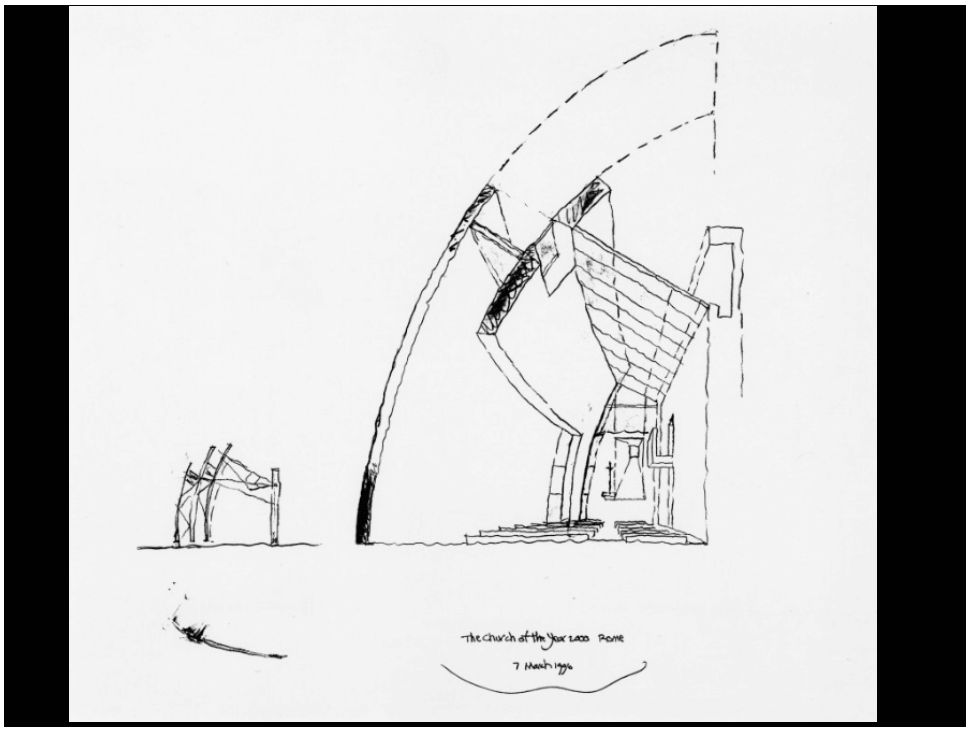
Problem is when you talk about corner, it's preconceived with a notion of part of a box. Corner definition can be simply a condition of where one thing intersects another.



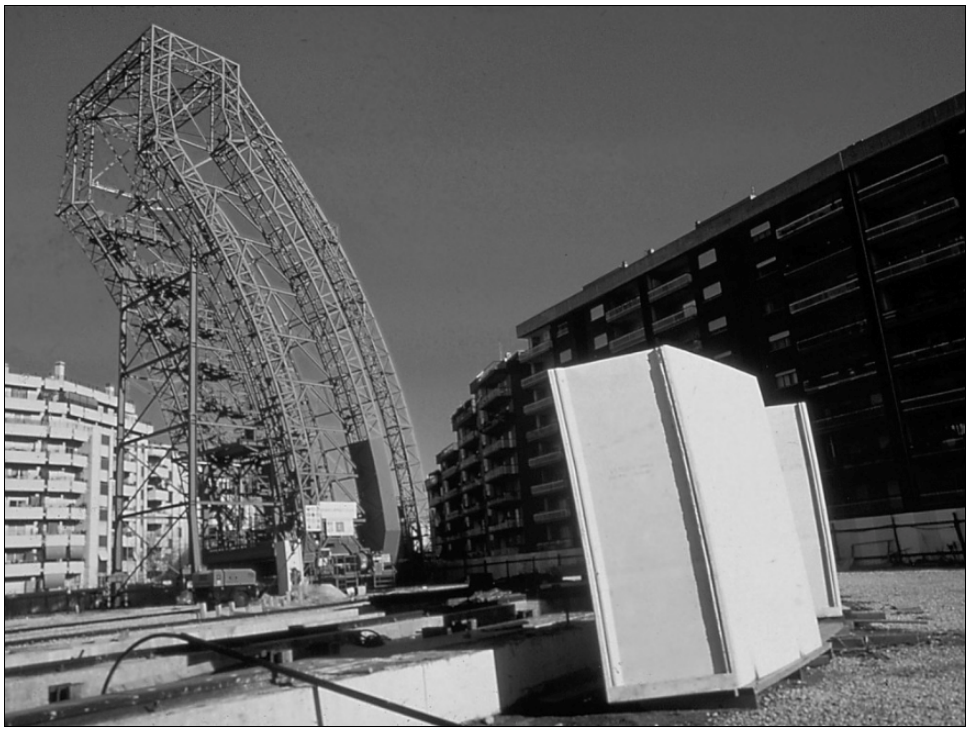
Composition of the south elevation showing the shells and how they define the space.

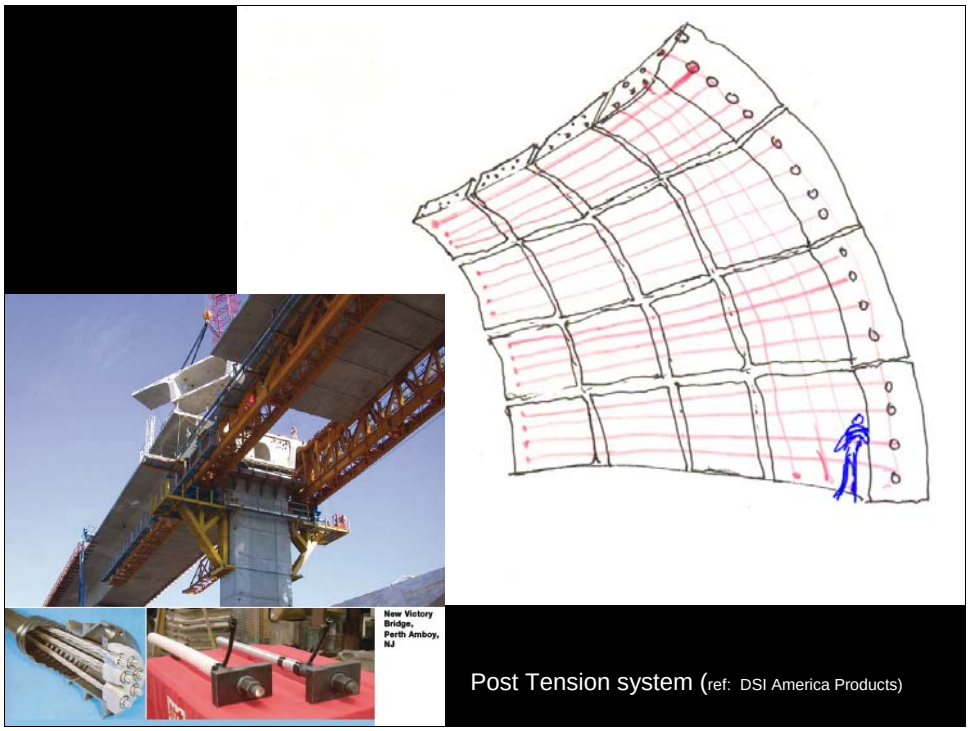


Generation of the proportions and dimensions of the elements of the space fine tuned relative to sun angles. The geometry becomes the tool to create the spatial as well as the structural system. Sphereical shell becomes self supporting and transmits forces through its skin resolving them in the foundations.

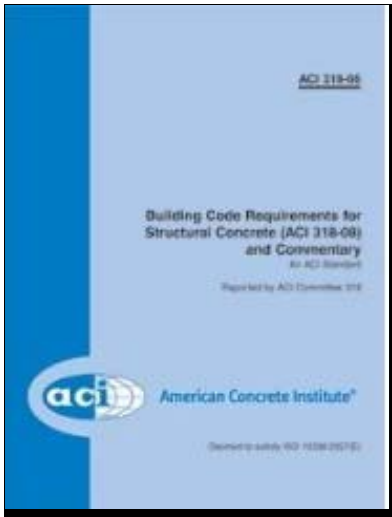


Here you can see how the shells must have integral beam system within them to bridge over the interior space defined.

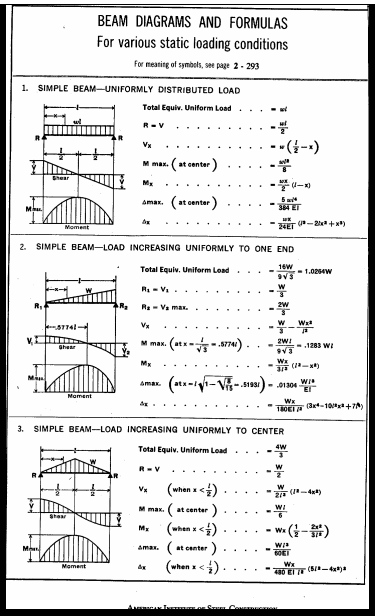




High tension cables or rods (150KSI+ yield strength (150,000psi+)) Kip (K) = 1000lb. Ref. Local crosstown elevated lane recently constructed. Series of “loose” pieces strung together with a cable, put into compression by tensioning the cable and you have a moment resisting “force couple”. ‘T’ vs. ‘C’. Geometry helps with the Millennium Church shells, imagine a loose sheet of paper, now curve it in one direction . . . Now wet, vacuum form, and bend in 2 directions . . . Very stiff just due to geometry.



ACI 318-08: Building Code Requirements for Structural Concrete and Commentary



BEAM DIAGRAMS AND FORMULAS

For various static loading conditions

For meaning of symbols, see page 2 - 293

1. SIMPLE BEAM—UNIFORMLY DISTRIBUTED LOAD

Total Equiv. Uniform Load . . . = wl

$R = V$ . . . . . = $\frac{wl}{2}$

V_x . . . . . = $w\left(\frac{l}{2}-x\right)$

M max. (at center) . . . . = $\frac{wl^2}{8}$

M_x . . . . . = $\frac{wx}{2}(l-x)$

Δmax. (at center) . . . . = $\frac{5\,wl^4}{384\,EI}$

Δ_x . . . . . = $\frac{wx}{24EI}(l^3-2lx^2+x^3)$

2. SIMPLE BEAM—LOAD INCREASING UNIFORMLY TO ONE END

Total Equiv. Uniform Load . . . = $\frac{10W}{9\sqrt{3}} = 1.0264W$

$R_1 = V_1$ . . . . . = $\frac{W}{3}$

$R_2 = V_2$ max. . . . . = $\frac{2W}{3}$

V_x . . . . . = $\frac{W}{3}-\frac{Wx^2}{l^2}$

M max. $\left(\text{at } x=\frac{l}{\sqrt{3}}=.5774l\right)$ . . = $\frac{2Wl}{9\sqrt{3}} = .1283\,Wl$

M_x . . . . . = $\frac{Wx}{3l^2}(l^2-x^2)$

Δmax. $\left(\text{at } x=l\sqrt{1-\sqrt{\tfrac{2}{15}}}=.5193l\right) = .01304\,\frac{Wl^3}{EI}$

Δ_x . . . . . = $\frac{Wx}{180EI\,l^2}(3x^4-10l^2x^2+7l^4)$

3. SIMPLE BEAM—LOAD INCREASING UNIFORMLY TO CENTER

Total Equiv. Uniform Load . . . = $\frac{4W}{3}$

$R = V$ . . . . . = $\frac{W}{2}$

V_x $\left(\text{when } x<\frac{l}{2}\right)$ . . . . = $\frac{W}{2l^2}(l^2-4x^2)$

M max. (at center) . . . . = $\frac{Wl}{6}$

M_x $\left(\text{when } x<\frac{l}{2}\right)$ . . . . = $Wx\left(\frac{1}{2}-\frac{2x^2}{3l^2}\right)$

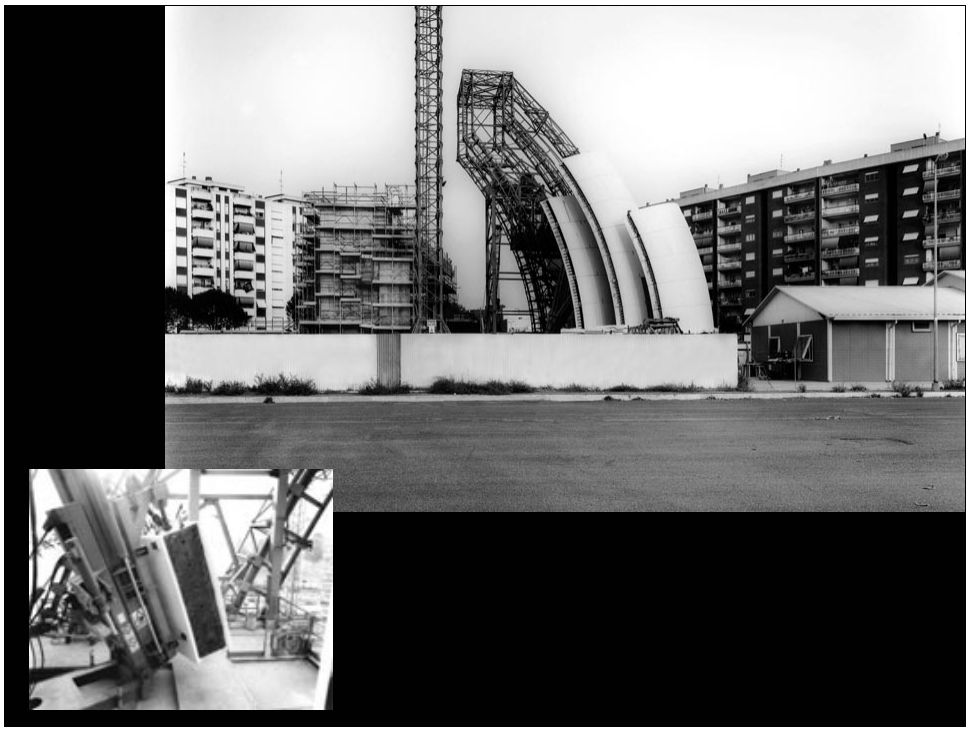
Δmax. (at center) . . . . = $\frac{W\,l^3}{60EI}$

Δ_x $\left(\text{when } x<\frac{l}{2}\right)$ . . . . = $\frac{Wx}{480\,EI\,l^2}(5l^2-4x^2)^2$

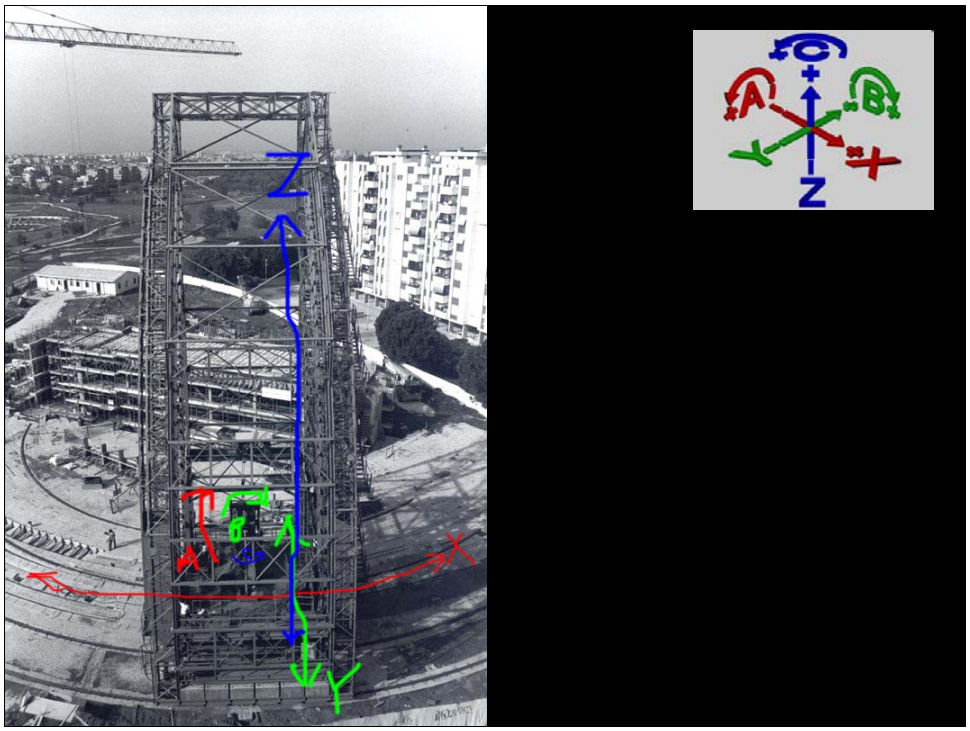
Moments and reactions are computed with same statics equations which can be found in the AISC Manual of Steel Construction

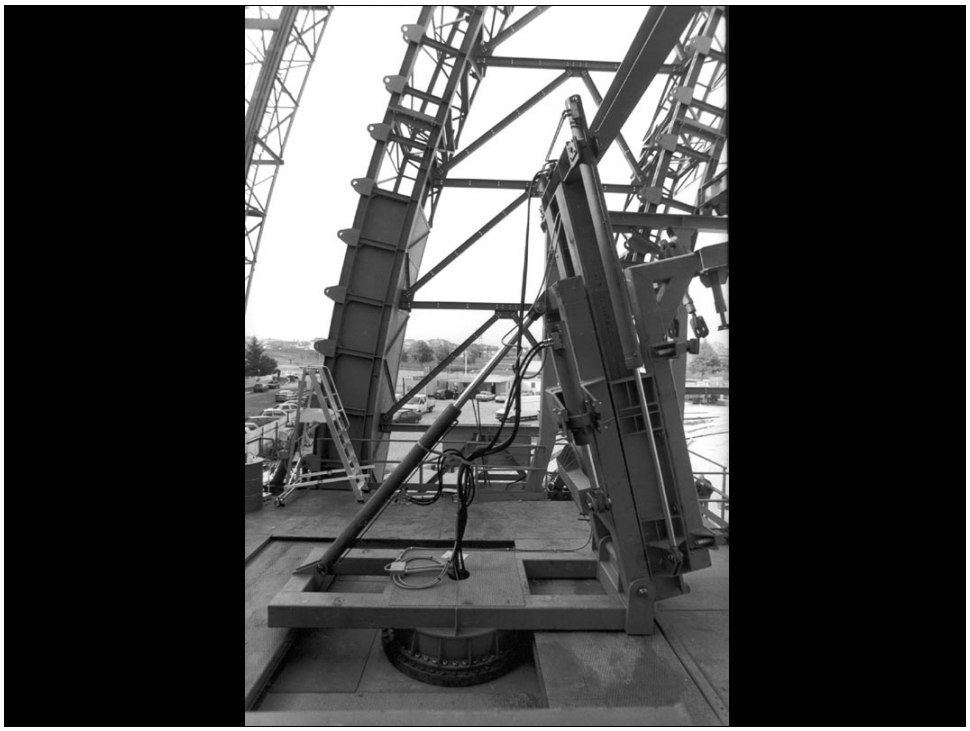
Deflections and unit stresses are computed differently, more lengthy discussion.

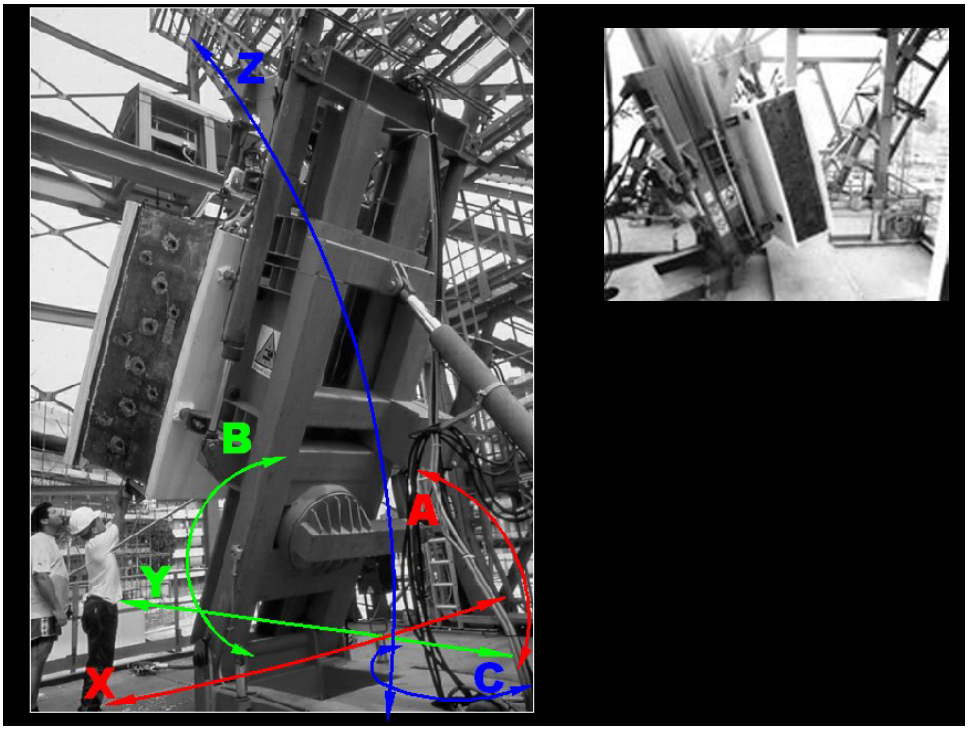
Deflection calculations and design procedures for concrete design are found in the ACI 318. American Concrete Institute publication 318.

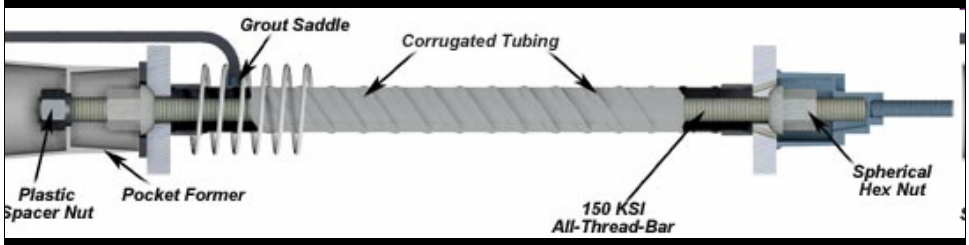


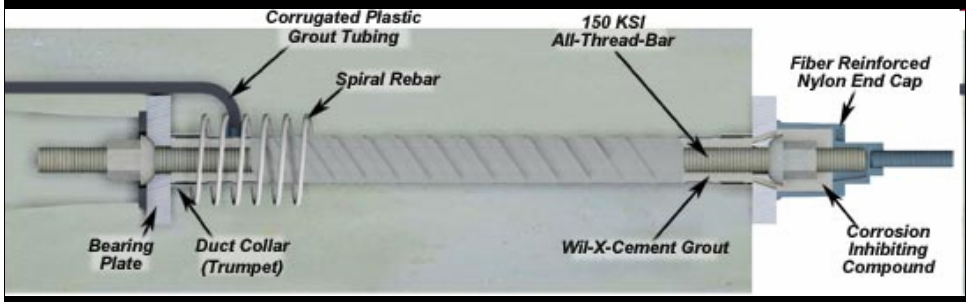
Some methods to build don't exist and must be developed. Shells to develop the light condition, corner is now defined as that intersection of glazing plane with the shell. How to accomplish this. Another discussion perhaps, but here is a good place to note that "corner" conditions may be defined by a set or rules defined by a larger concept. In this case, the shells and the other masses are composed as a sort of sculpture defining the spaces to be used. The "corners" then are defined nearly by default because of the generative geometries. One condition is a "corner" where a plane (or spherical shell) are intersected by a glass plane defining inside and out. In this case, the detail will be developed by letting the mass be dominant and the glazing plane touch it with a reveal. Back to the concrete discussion and the shell construction. The use of Concrete, Italcemti group's TX_ millenium mix. Technology plays an important part and when taken in proper perspective, it can lead to the accomplishment of things that were, up until that time, not possible.


C
A
B
Z

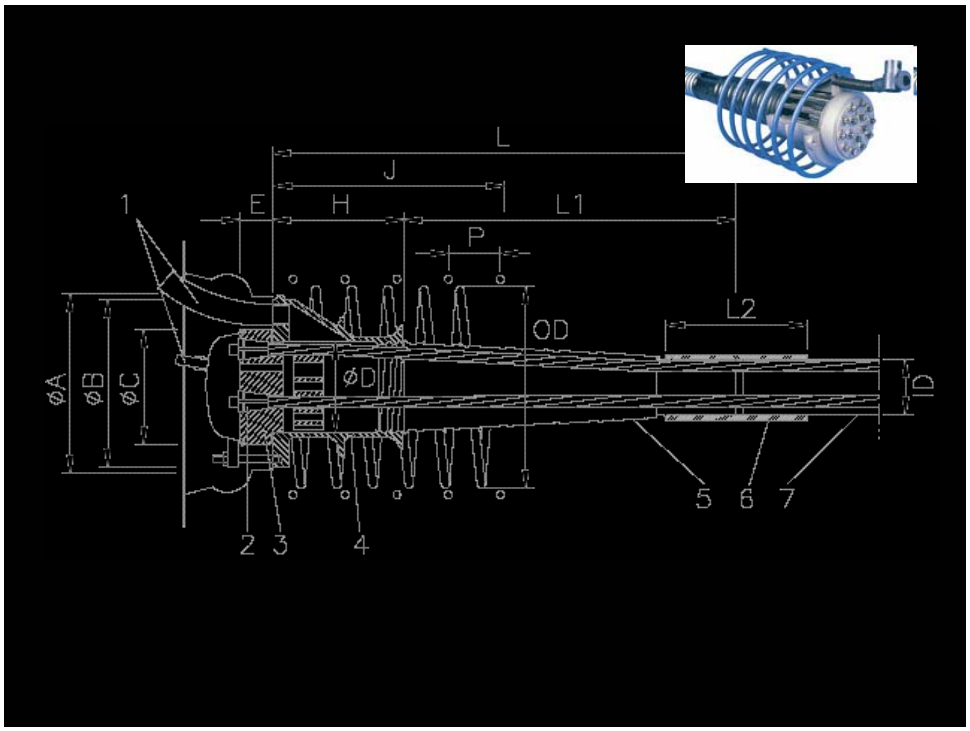



Z
B
A
Y
X
C

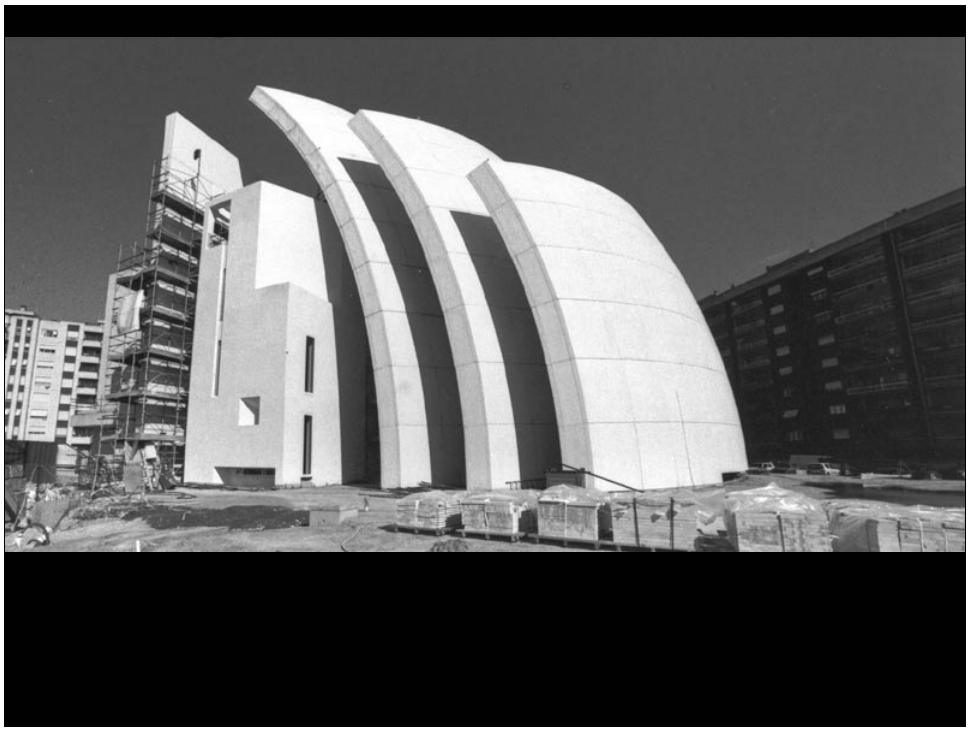


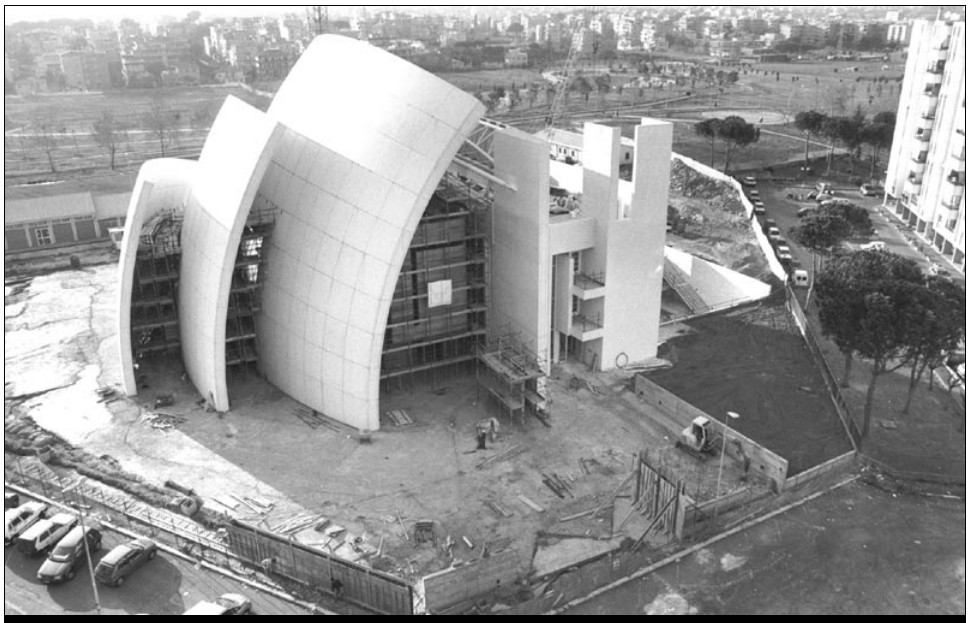


Article on Blackboard: ***Issues in Post-tensioned Concrete***, Concrete Construction Magazine, Hanley Wood publisher.

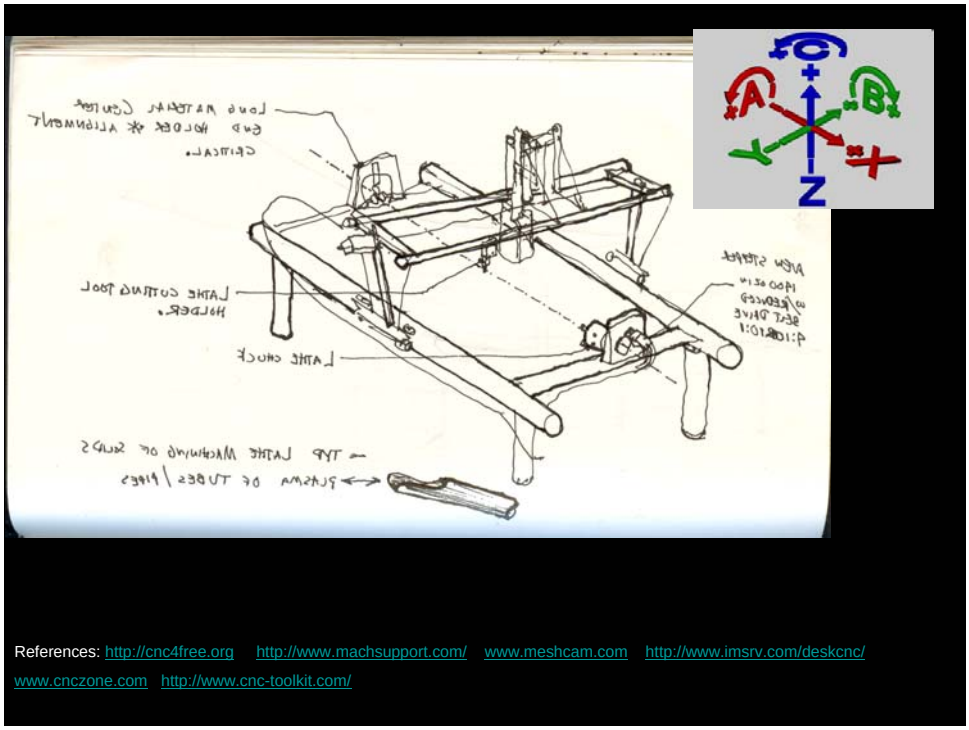


Multistrand system, use a setting tool to set malleable iron wedge clamps into wedge plate once hydraulic jack is used to tension strands. End is grouted to finish.



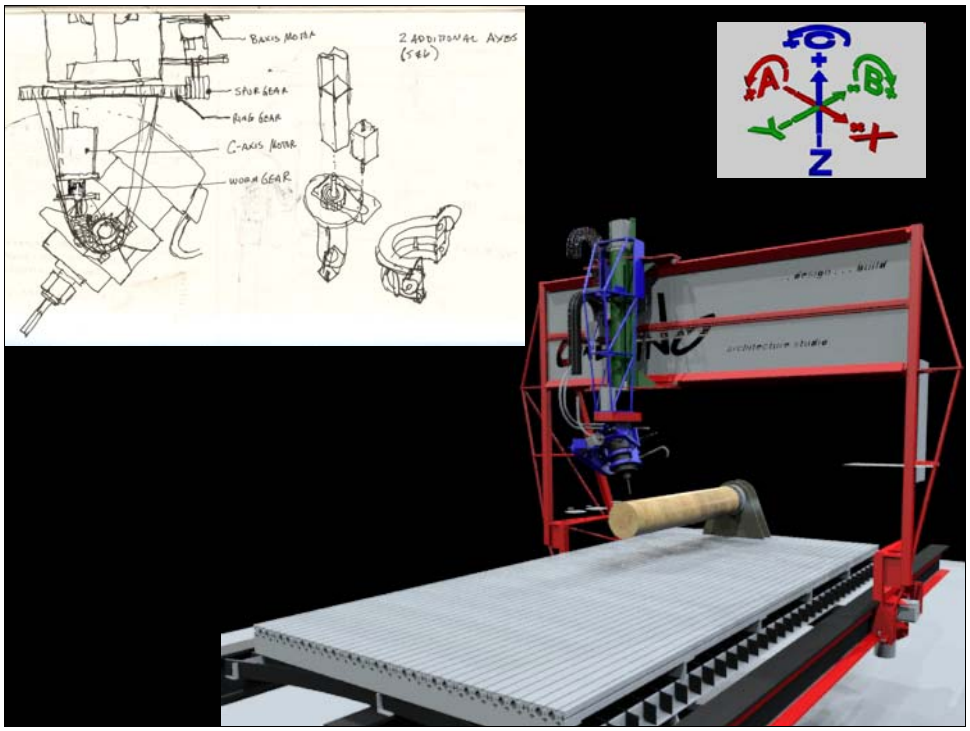


References: http://www.richardmeier.com, Richard Meier, Architect Volume 3 and 4 (red and grey books)
http://www.italcementigroup.com

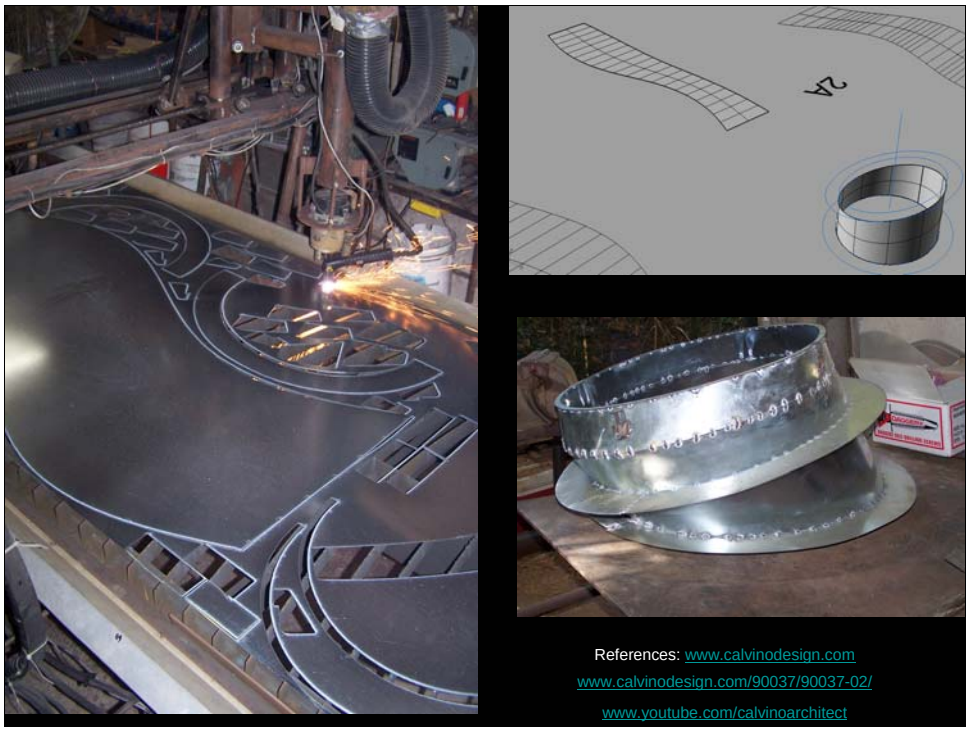


References: http://cnc4free.org http://www.machsupport.com/ www.meshcam.com http://www.imsrv.com/deskcnc/ www.cnczone.com http://www.cnc-toolkit.com/

Use of cnc technology: Computer Numerical Coordinate. Basically uses cartesian coordinates to locate points in space and to sequence a cut path. The cutter can be anything. Simple concepts: axis conventions, same as most cad programs color convention for axes.



CNC machines, basic concept of XYZ but can add swivel head for B/C axis plus a lathe/indexing axis: “A”. I have not thought of a case where all 6 would be required for the same part, but that does not mean it will not become a requirement. Next Class, a deeper look into the components of the machine and applications.



Next class will delve into CNC machines, their components, the operation, CAD/CAM, the control software, open source, and application in an overhead plane defining project. The polka-dot skylights.