



## Attachment A

**REQUEST FOR INFORMATION (RFI)**

**FABRICATION OF MULTIPLE STEEL**

**REACTION STRUCTURES FOR NASA-**

**MSFC STRUCTURAL TESTING**



# Large Steel Structure Procurements

- 28 steel structures totaling >4.5 million lb.
- Special Test Equipment (STE or Test Fixtures) Groupings:
  - Group 1 - Interface Rings (8)
  - Group 2 - Spiders (4)
  - Group 3 - Pedestals (3)
  - Group 4 - Reaction Structure (13)
- 20,000 lb. - 600,000 lb. (most <100,000 lb.)
- Delivery to MSFC
  - build up and deliver one piece
  - build up and teardown for delivery
- Schedule
  - Procurement Cycle starts January 2014
  - All deliveries end of 2014 through middle of 2015.

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# GROUP 1 – INTERFACE RINGS



- Qty 8 – 7 items, qty 1 of each item except qty 2 of Interface Ring #6
- General design requirements for each ring:
  - General Design Geometry
    - 27.5' barrel diameter
    - 10"-4' Height
    - Plate thicknesses – 1" – 4"
    - Flanged interfaces top and bottom with multiple holes ("T" x-section; 200-400 holes; 1"-3" hole D)
    - STRESS RELIEF REQUIRED for each interface ring.
  - Material
    - Steel plate per ASTM A572, Grade 50
  - Tolerances
    - Typical tolerances, except:
    - One Flange must be machined to tight tolerances (see charts for details):
  - Welding
    - CJP welds, groove welds, fillet welds (see charts for typical weld callouts)
    - Flanges are multi-piece welded together and welded to rolled barrel/web
    - Gussets welded to flanges/web
    - Welds per AWS D1.1, certified inspection (mag particle/ultrasonic/visual by supplier)
  - Weight
    - 30,000 lb. – >200,000 lb.
  - Transportation
    - All interface rings are ONE PIECE delivered to MSFC

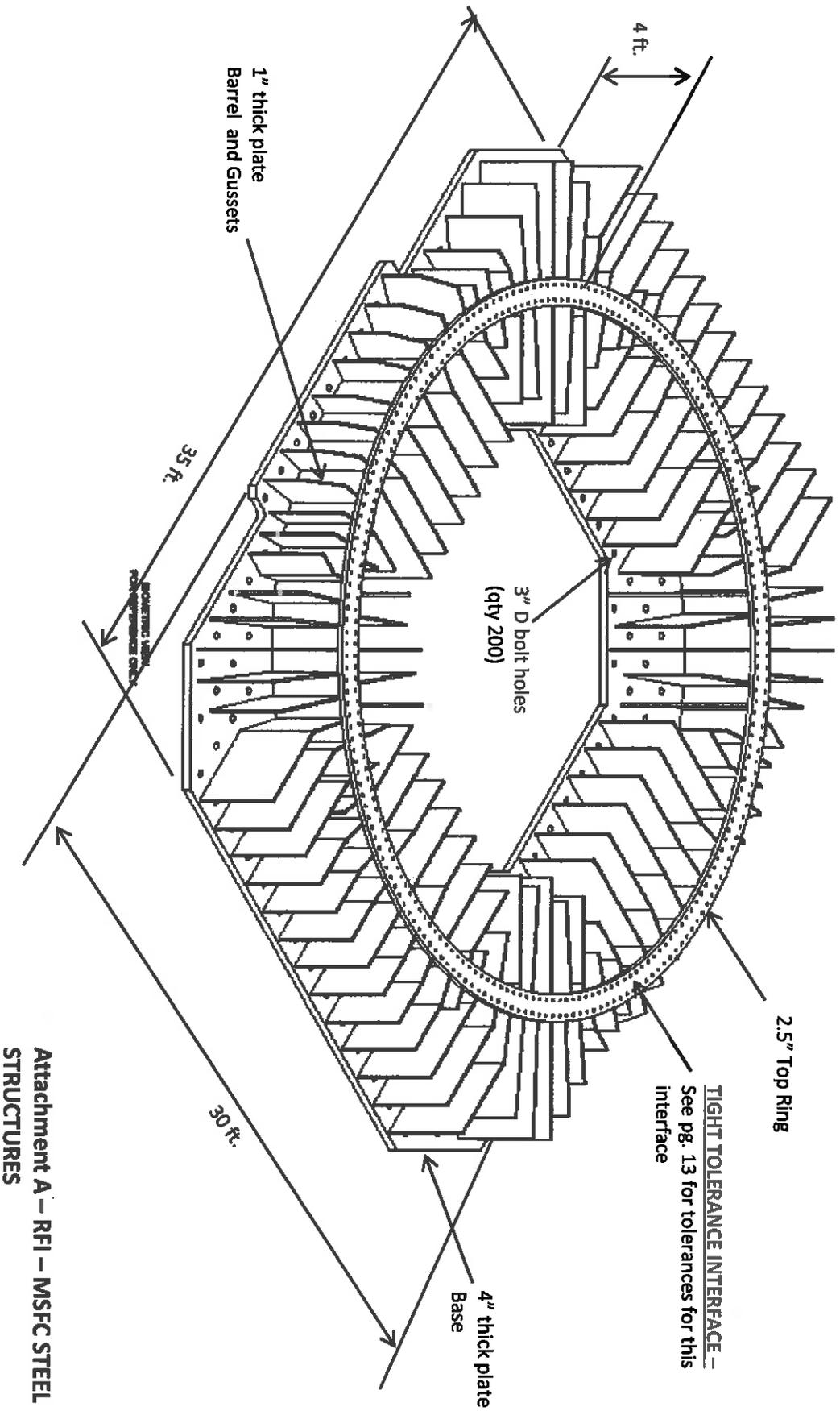
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# INTERFACE RING #1

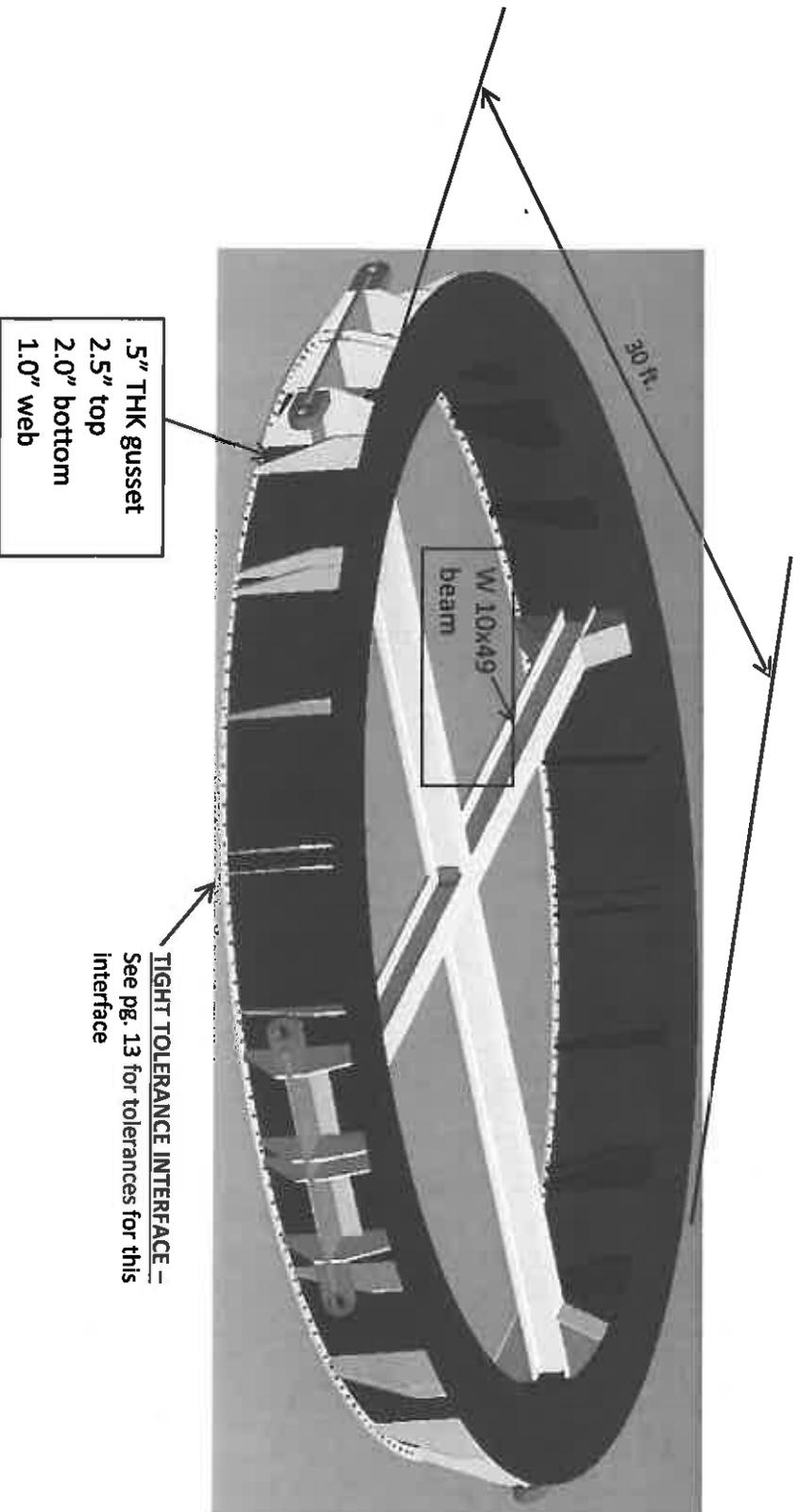
Weight: ~210K lbs.





# INTERFACE RING #2

Weight: ~50k lbs.

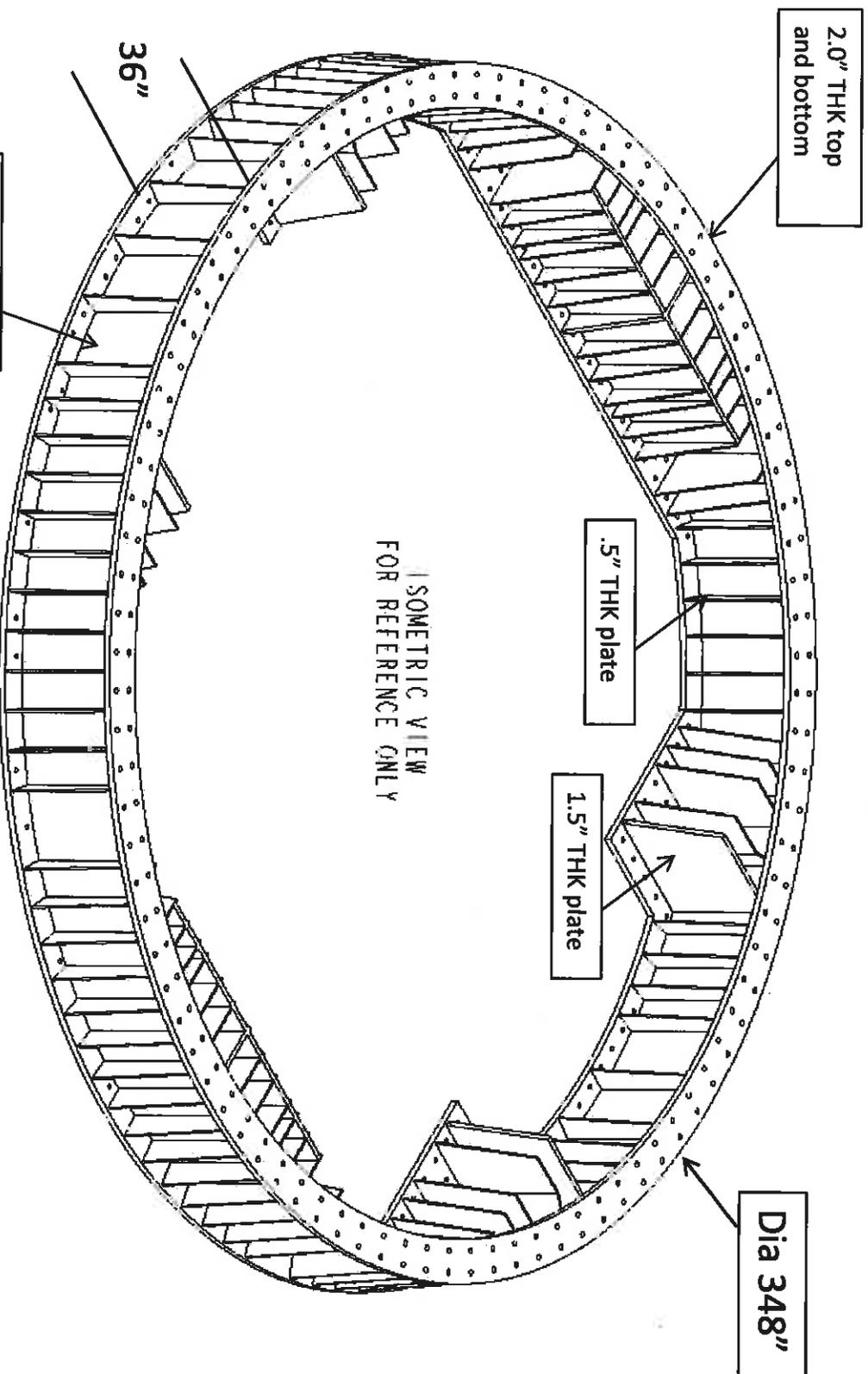


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# INTERFACE RING #3

Weight: ~45k lbs.

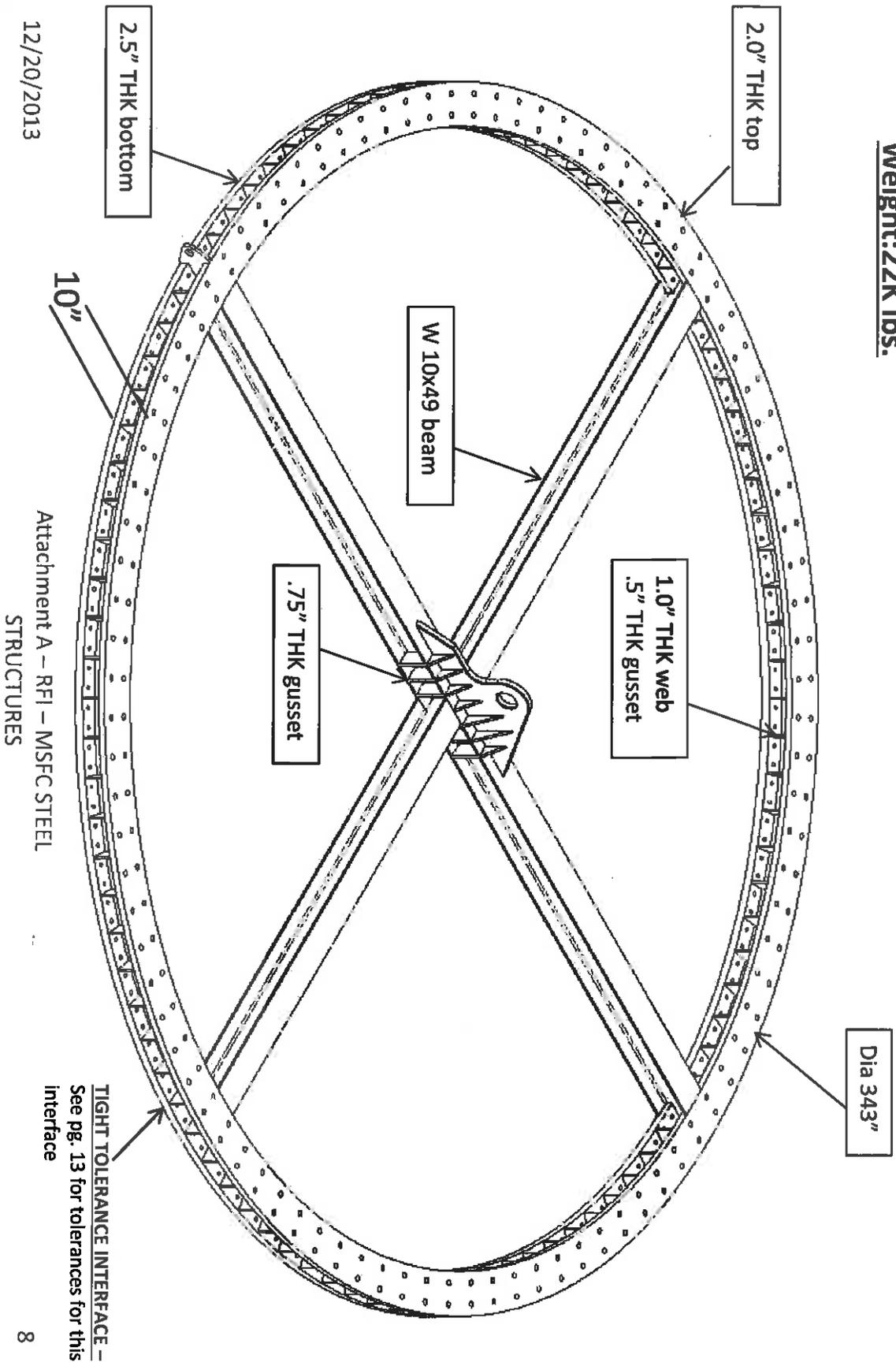


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Attachment A- RFI - MSFC STEEL STRUCTURES

# INTERFACE RING #4

Weight: 22K lbs.



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TIGHT TOLERANCE INTERFACE - See pg. 13 for tolerances for this interface



# INTERFACE RING #5

Weight: ~23K lbs.

Dia 346"

**TIGHT TOLERANCE INTERFACE -**  
See pg. 13 for tolerances for this interface

.5" THK gusset  
2.5" top  
2.0" bottom  
1.0" web

13"

ISOMETRIC VIEW  
FOR REFERENCE ONLY

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STRUCTURES

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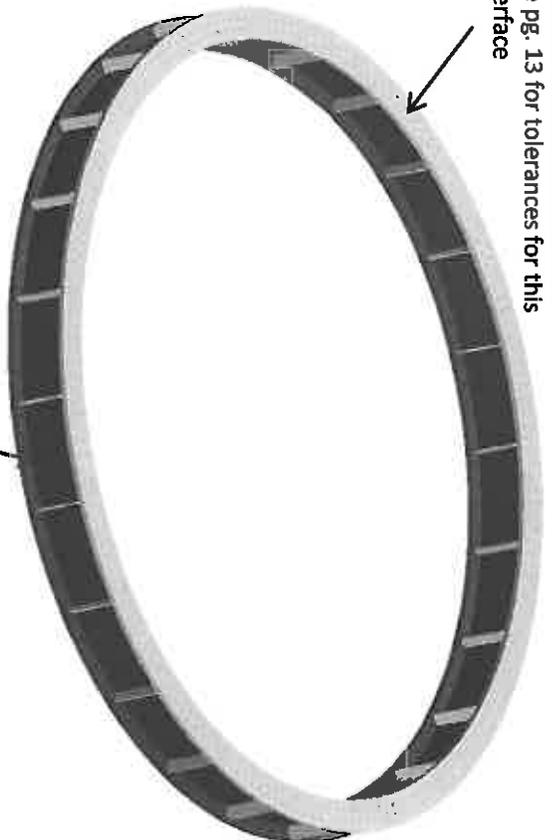
# INTERFACE RING #6



Weight: ~40K lbs.

TIGHT TOLERANCE INTERFACE -

See pg. 13 for tolerances for this interface



Web

Diameter: 27.5'  
Thickness: 1.5"  
Height: 23"

Flanges

OD: 28.7'  
ID: 26.3'  
T: 2.5"  
Holes (Top): 1" holes (2 rows of 192 each)  
Holes (Bot): 1.5" holes (2 rows of 120 each)  
Inner D: 27'  
Outer D: 28'

Interface Ring Gussets

Dimensions: 23" X 6" X 1"  
24 @ 15 degrees apart (inside and out)

Material: ASTM A572, Grade 50



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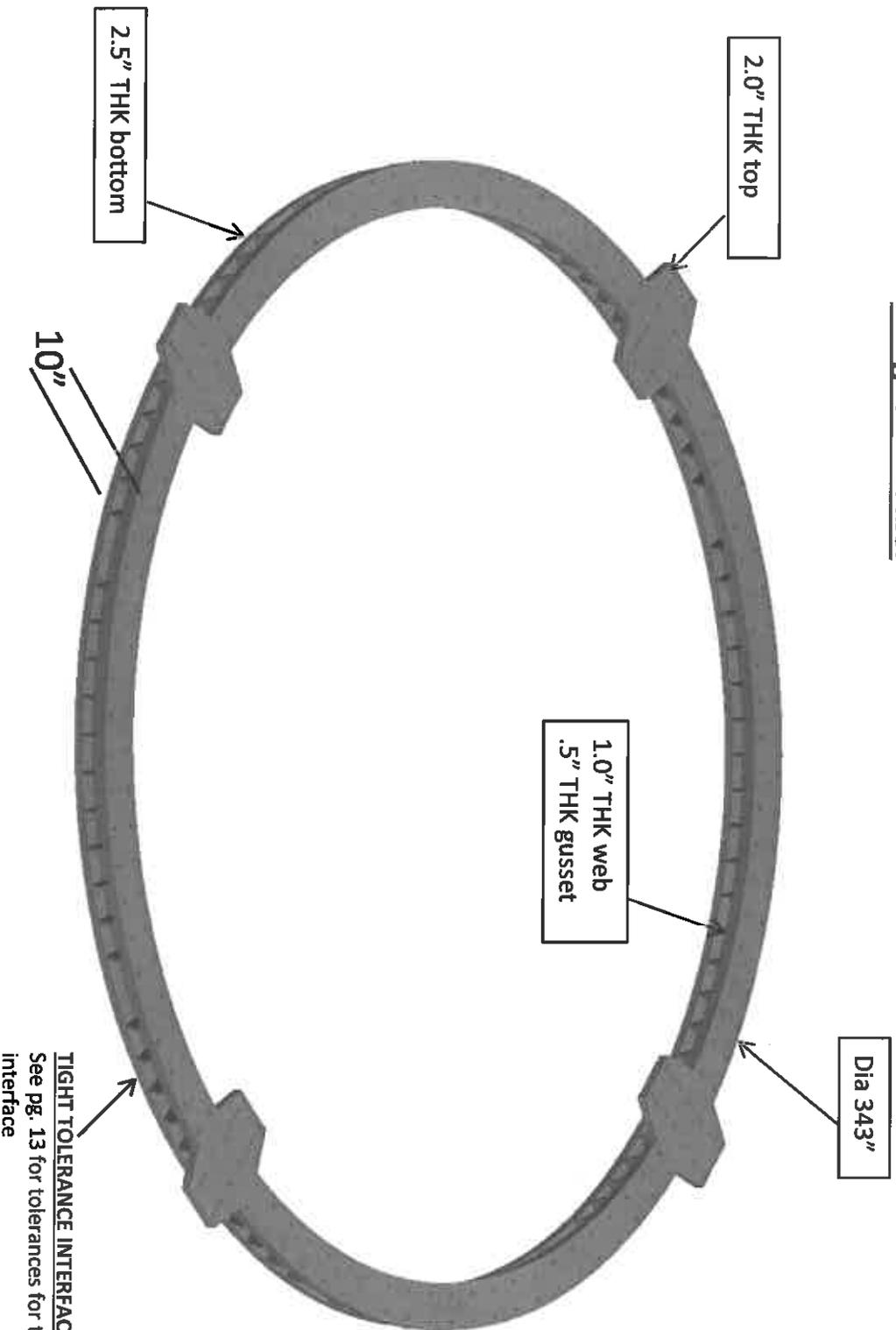
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# INTERFACE RING #7



Weight: 22K lbs.

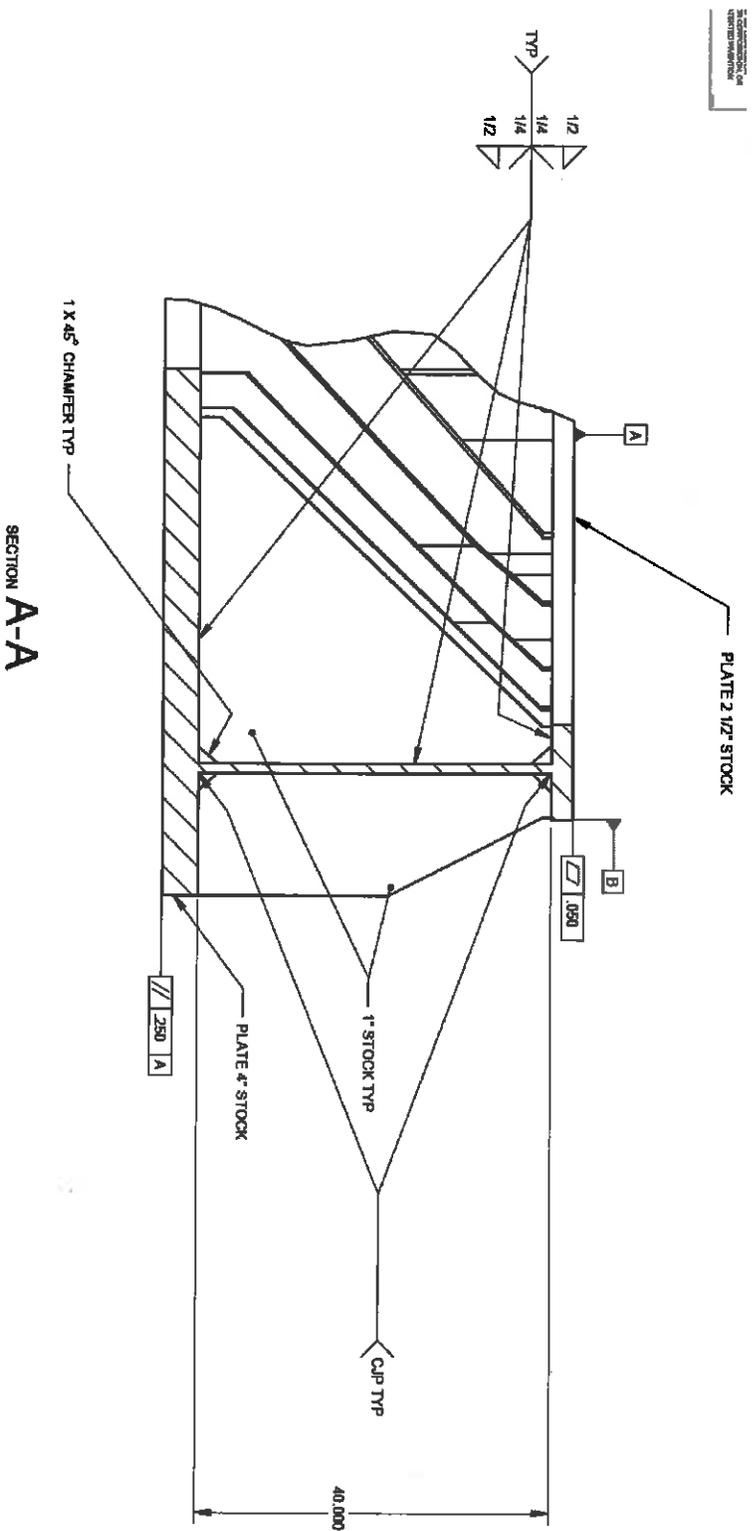


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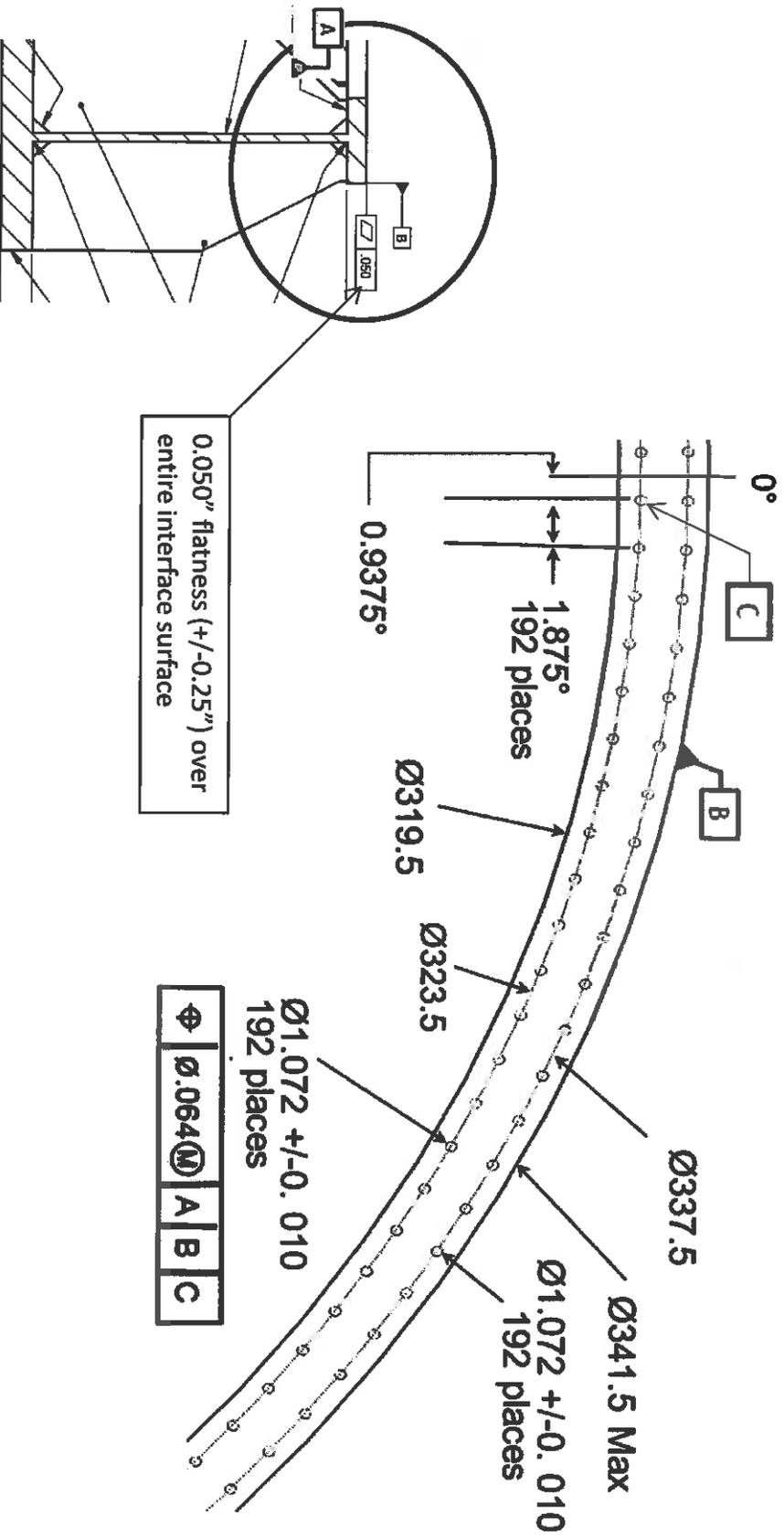
# Typical INTERFACE RING Weld Callouts



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# Typical INTERFACE RING Tight Tolerance Details



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# GROUP 2 - SPIDERS



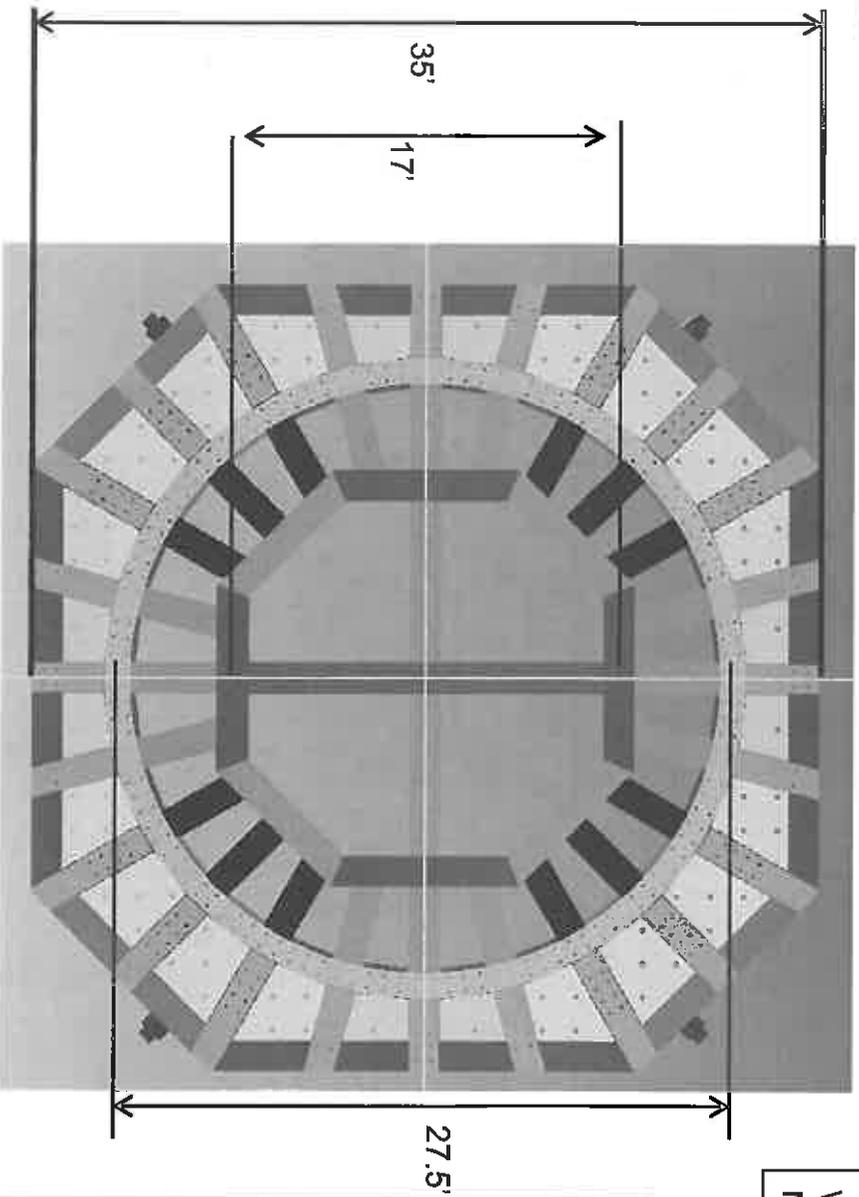
- Qty 4 – 4 items, qty 1 of each item
- General-design requirements for each Spider:
  - General Design Geometry
    - Welded wide-flange I-beams stiffened by plates
    - Large sections (e.g. W36x44.1)
    - 28' – 44' Diameter
    - 3'-4' Height
    - Plate thicknesses – 1" – 2"
    - STRESS RELIEF REQUIRED for each spider
  - Material
    - ASTM A992 Beams
    - Steel plate per ASTM A572, Grade 50
  - Tolerances
    - Typical tolerances for I-beam construction
    - Some machined surfaces (see charts for details)
  - Welding
    - CJP welds, groove welds, fillet welds (see charts for typical weld callouts)
    - Gussets welded to flanges/web
    - Welds per AWS D1.1, certified inspection (mag particle/ultrasonic/visual by supplier)
  - Weight
    - 66,000 lb. – 278,000 lb.
  - Transportation
    - 3 of 4 spiders are ONE PIECE delivered to MSFC
    - 1 spider (Spider #4) is MULT-PIECE delivery

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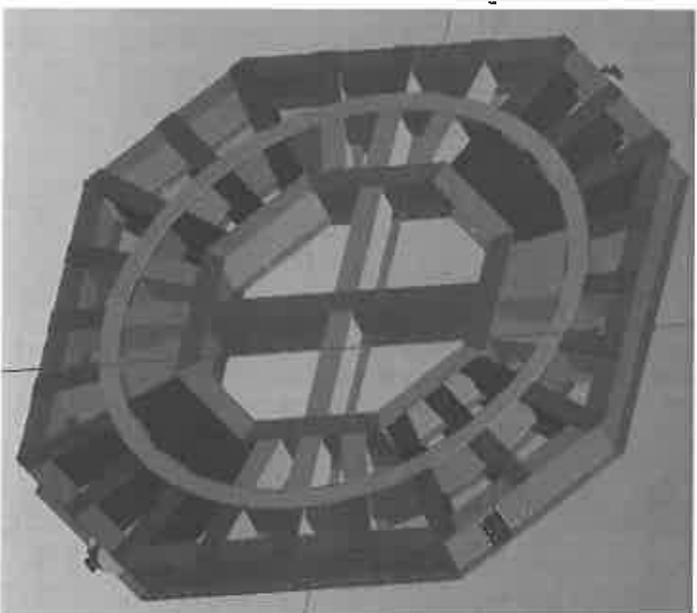
Attachment A – RFI – MSFC STEEL  
STRUCTURES



# Spider #1



Beams – W36X330  
 One piece – all welded  
 Weight – 180,000 lb.  
 Machined interface plate at 27.5' D



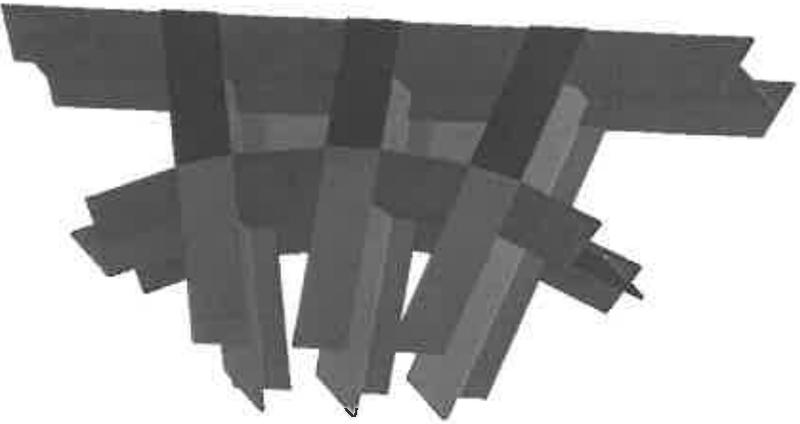
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Attachment A – RFI – MSFC STEEL STRUCTURES

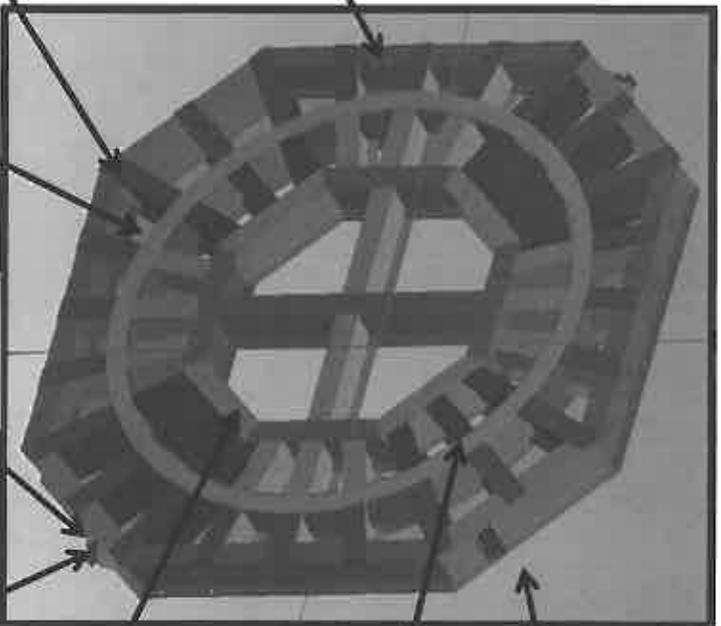


# Spider #1

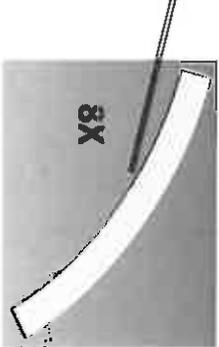
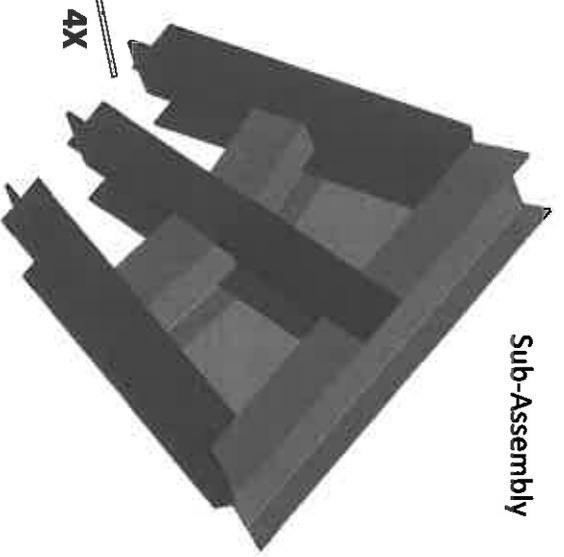
Sub-Assembly



Top Level Assembly



Sub-Assembly

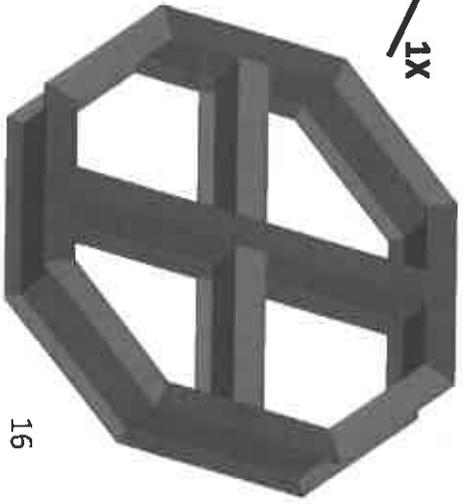


4X

4X

8X

Sub-Assembly



1X

8X

8X

8X

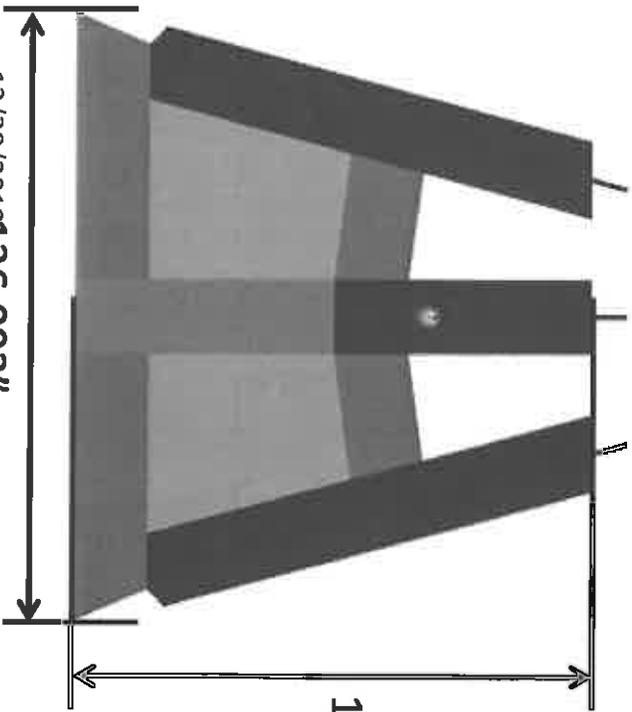
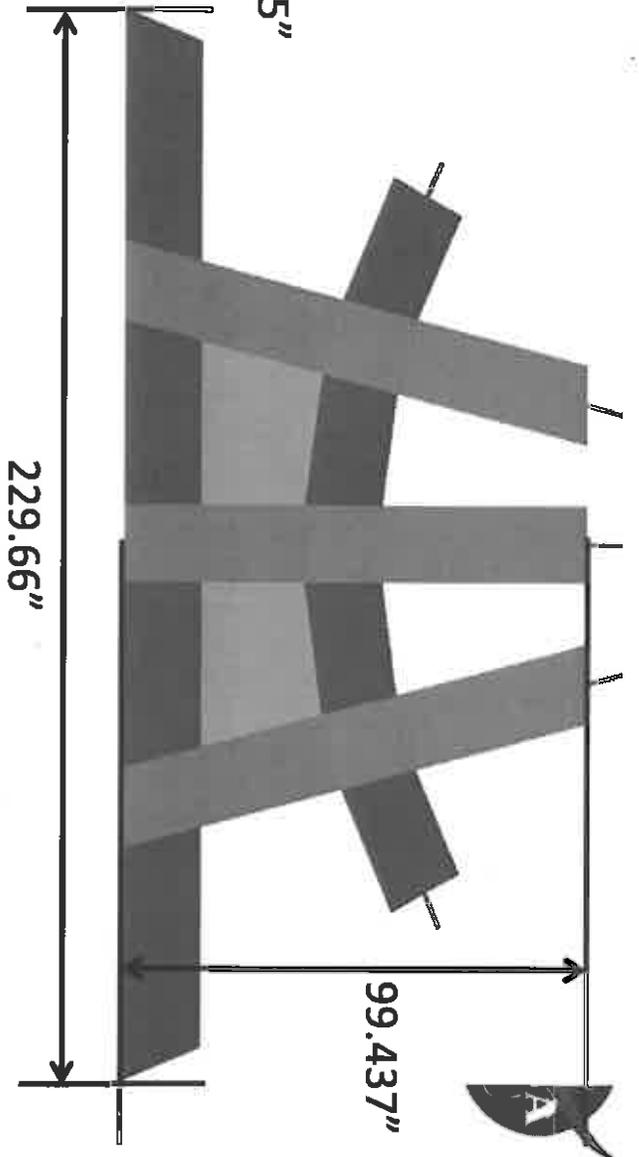
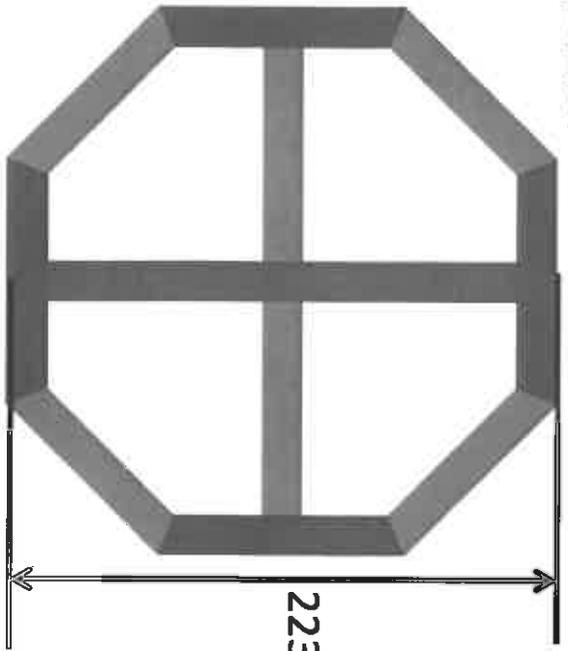
4X

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# Spider #1



Plates: 1.85" thickness

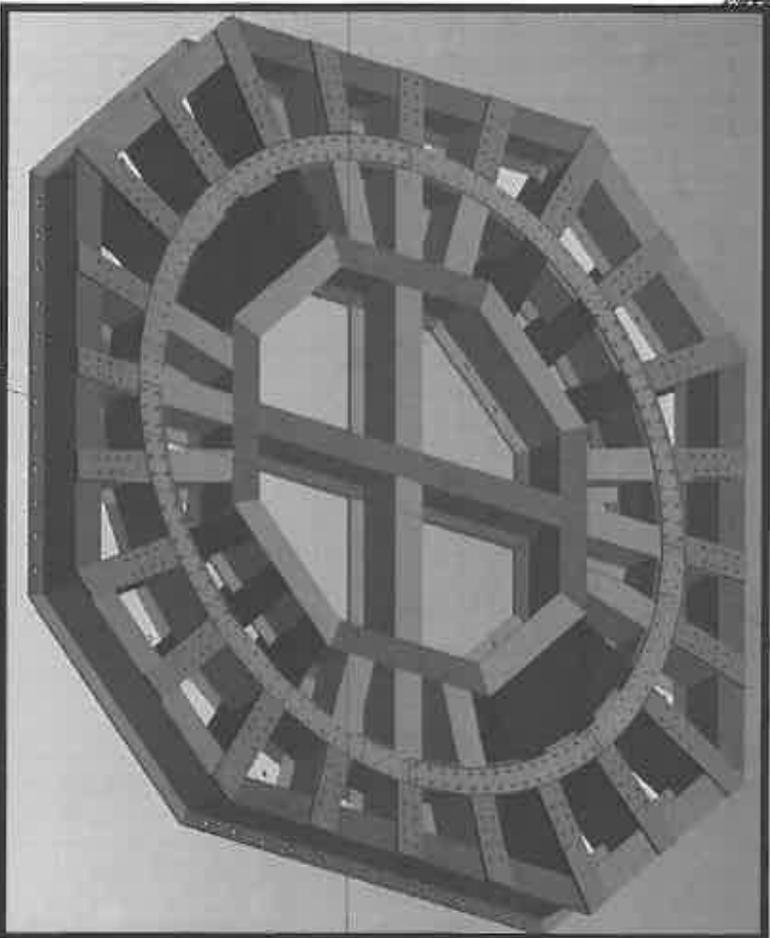
Doublers: 1.5" thickness

12/20/2013 136.093"

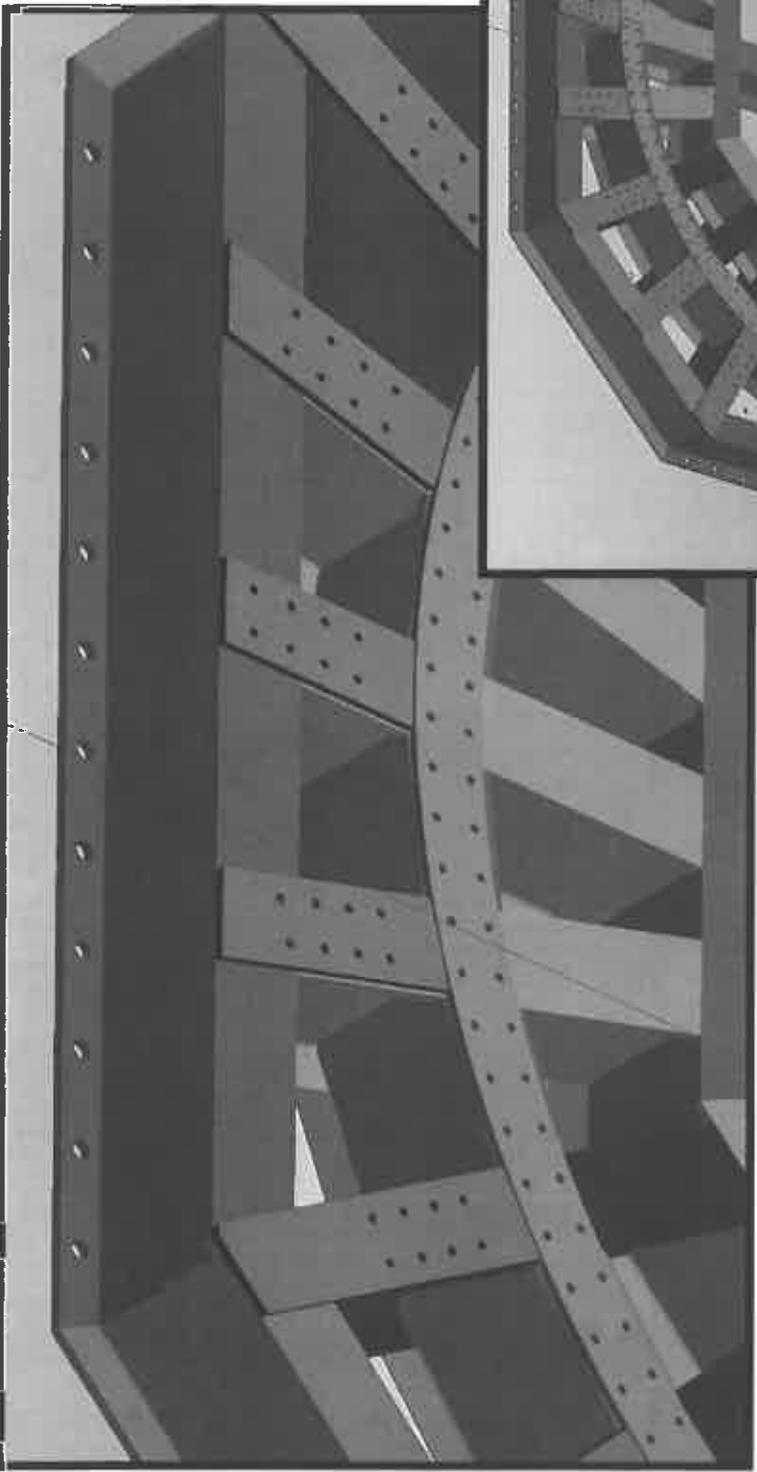
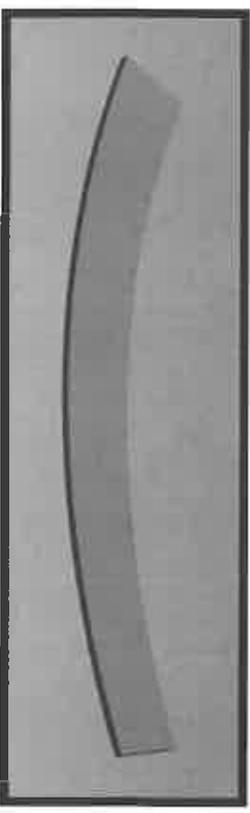
Attachment A- RFI - MSFC STEEL STRUCTURES



# Spider #1



Machined Inner Ring Plating: 8X @ 45 deg



Attachment A- RFI - MSFC STEEL STRUCTURES

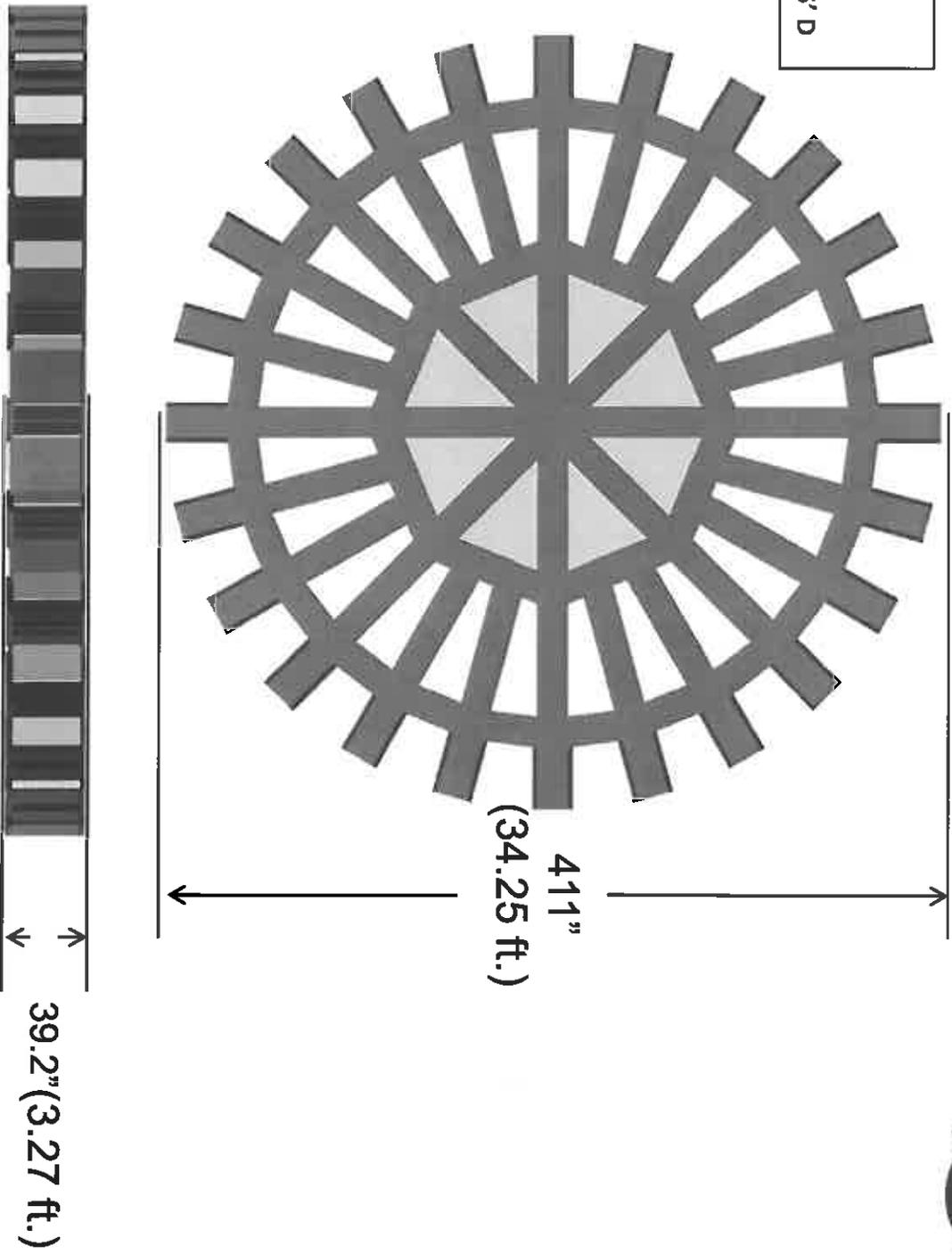
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# SPIDER #2



Beams – W36X330  
 One piece – all welded  
 Weight – 220,000 lb.  
 Machined interface plate at 27.5' D

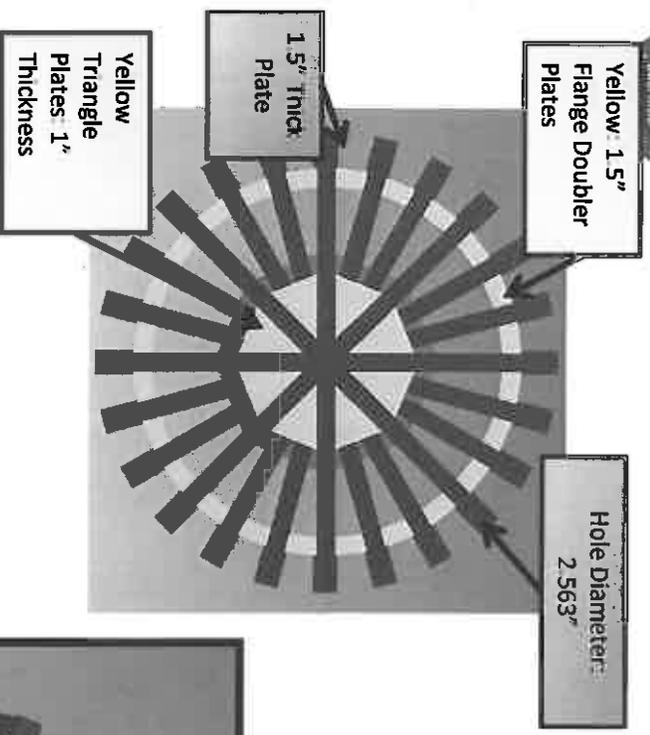


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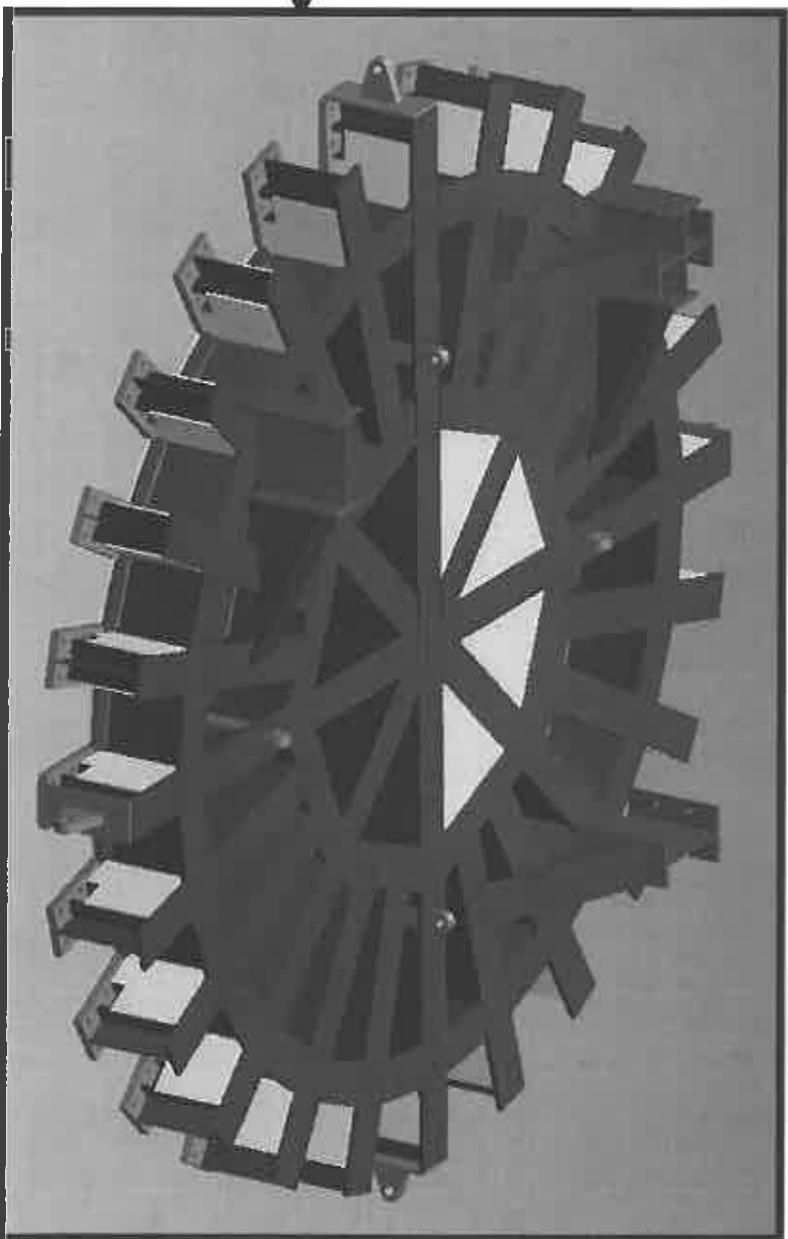
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# Spider #2



Upper Spider Assembly w/ Modifications to Weldment\_2\_FS\_1 OXassembly.





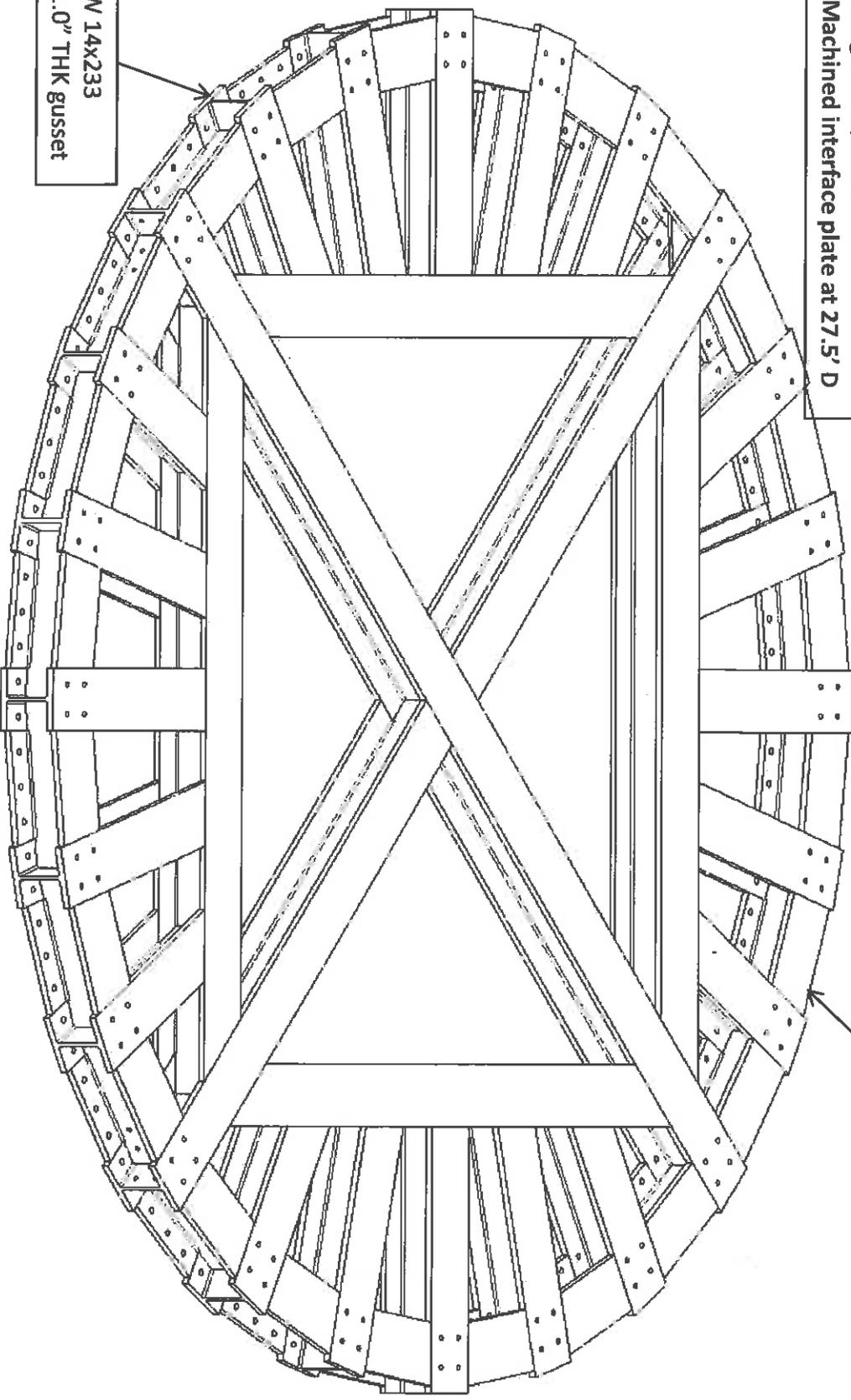
# SPIDER #3



Beams – W14X233  
One piece – all welded  
Weight – 66,000 lb.  
Machined interface plate at 27.5' D

W 14x233  
1.0" THK gusset

28' Diameter



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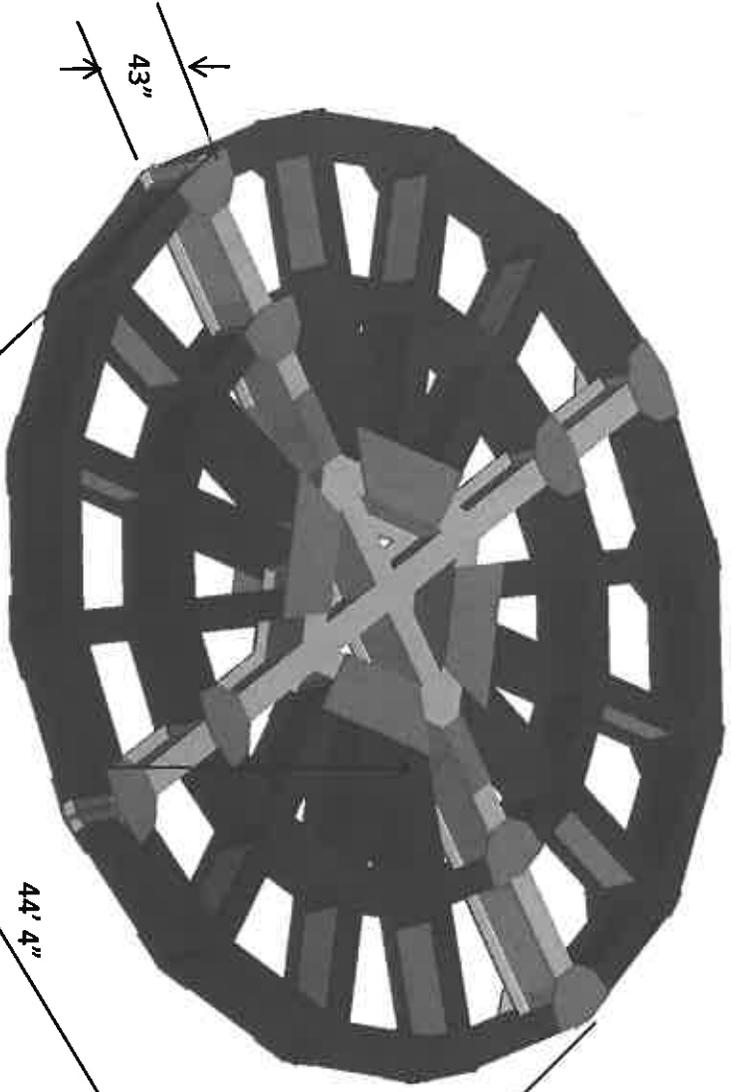
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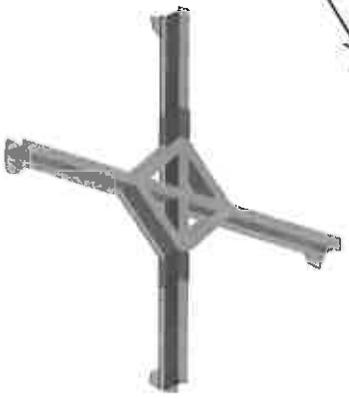
# SPIDER #4



Beams – W36X441  
 MULTI-piece – welded then bolted via splice plates  
 Weight – ~278,000 lb.  
 Machined interface plate at 27.5' D



Quadrant Weldment  
 50,000 lbs.



Cross-Member  
 61,500 lbs.

Attachment A – RFI – MSFC STEEL STRUCTURES

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SIS Core Stage Structural Testing



# GROUP 3 - PEDESTALS



- Qty 3 – 3 items, qty 1 of each item
- General design requirements for each Pedestal:
  - General Design Geometry
    - Welded wide-flange I-beams stiffened by plates; sections connected via bolted joints
    - Sections (e.g. W14x193)
    - 32' – 42' Diameter
    - 20'-34' Height
    - Plate thicknesses – .5" – 2"
    - Modular design
    - STRESS RELIEF REQUIRED for each Pedestal
  - Material
    - ASTM A992 Beams
    - Steel plate per ASTM A572, Grade 50
  - Tolerances
    - Typical tolerances with some machined surfaces (see charts for details)
  - Welding
    - CJP welds, groove welds, fillet welds (see charts for typical weld callouts)
    - Gussets welded to flanges/web
    - Welds per AWS D1.1, certified inspection (mag particle/ultrasonic/visual by supplier)
  - Weight
    - 160,000 lb. – 500,000 lb. when together; 20,000 – 40,000 lb. per section
  - Transportation
    - All pedestals are MULTI-PIECE delivery

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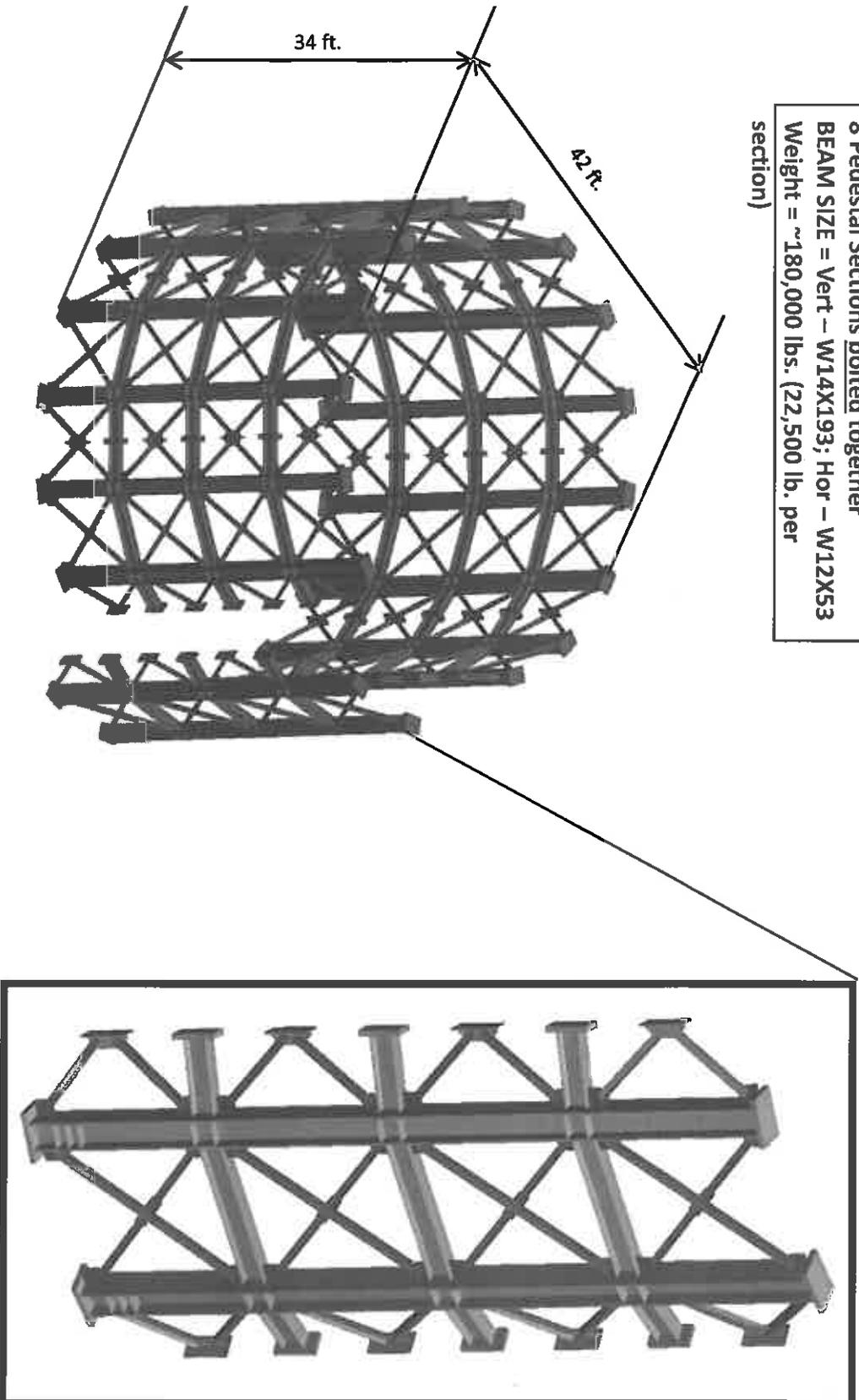
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# Pedestal #1



8 Pedestal Sections bolted together  
BEAM SIZE = Vert – W14X193; Hor – W12X53  
Weight = ~180,000 lbs. (22,500 lb. per section)

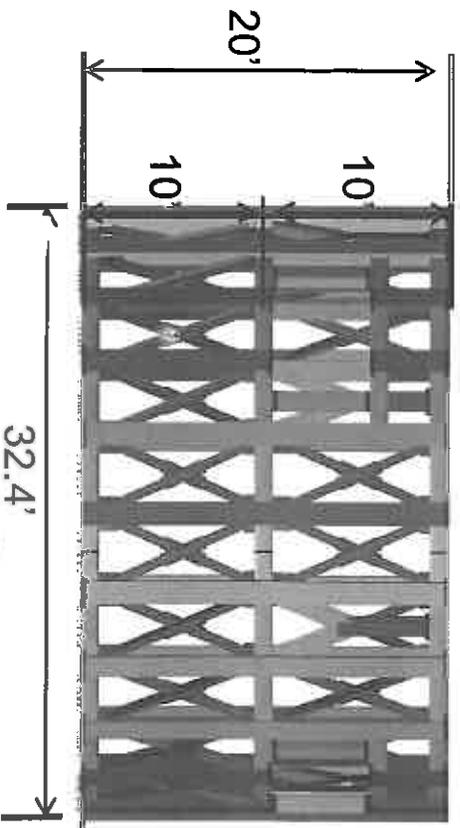


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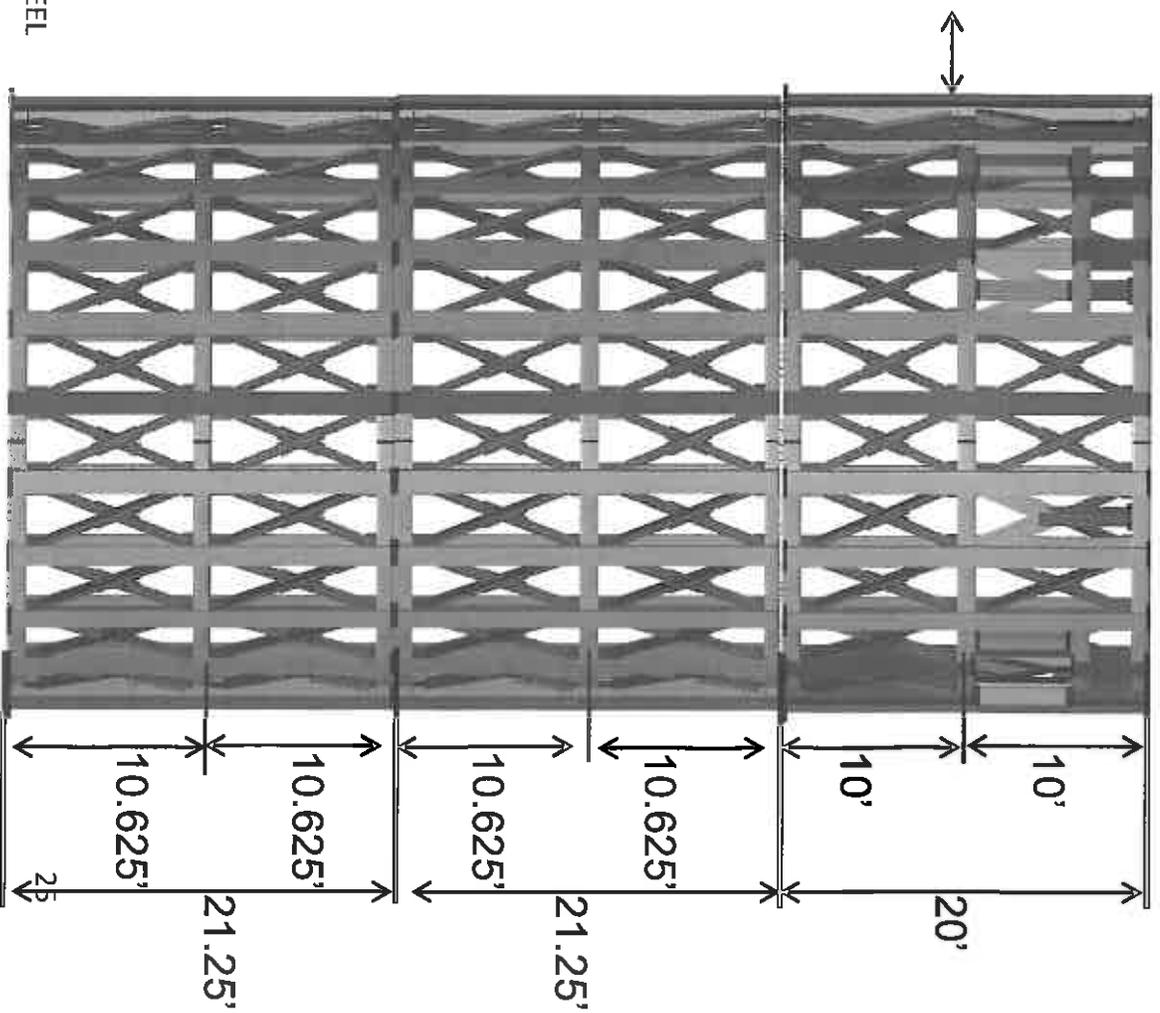
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# Pedestal #2 and #3

Pedestal #2



Pedestal #3



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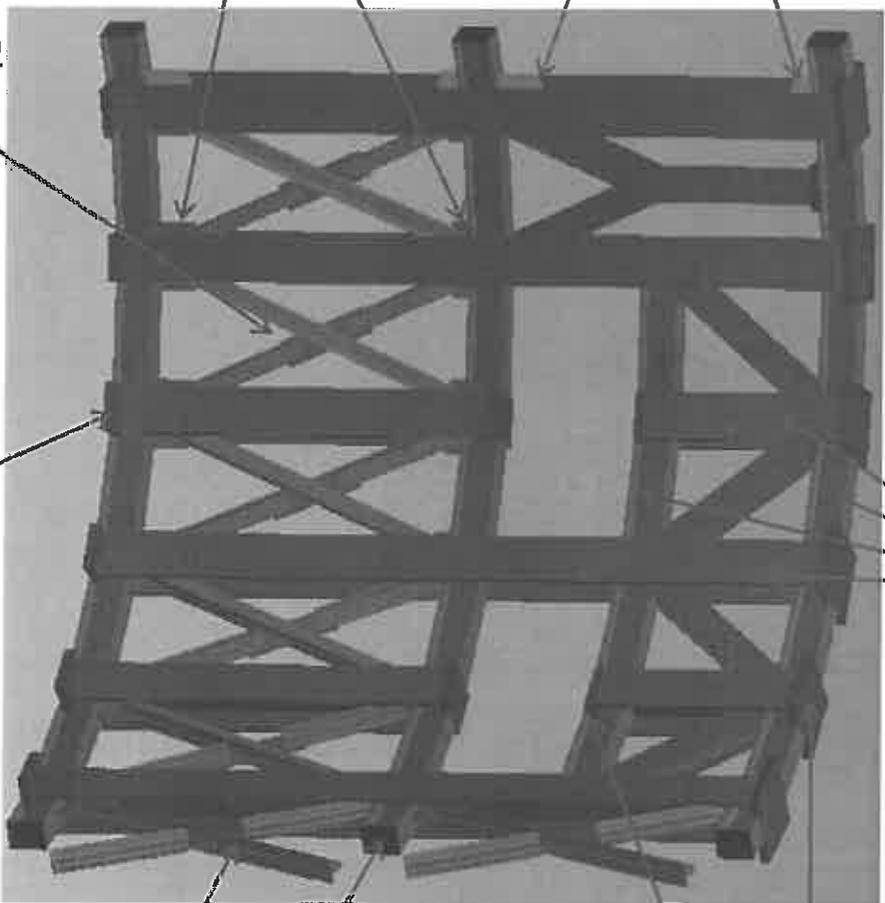


# Pedestal #2 and #3

General Beams

- W14X176 (Vertical)
- W12X58 (Horizontal)

4 welded pedestal sections bolted together  
 BEAM SIZE = Vert – W14X176; Hor – W12X58  
 Weight #2 = 160,000 lbs. (40,000 lb. per section)  
 Weight #3 = 500,000 lbs. (42,000 lb. per section)



–3" Weld Plates Top

–3" Weld Plates Opening

1/2" Section Connection Plates

Cross Brace Angles – L6X4X3/4

3/4" Cross Brace Gussets

3/4" Cross Brace Splice Plate

3" Base Plate

Weight per Section:

~40,000 lbs. 26

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Attachment A – RFI – MSFC STEEL STRUCTURES





# GROUP 4 – REACTION STRUCTURE



- Qty 13 – 6 items (#1=1; #2-#6=>1)
- General design requirements for each Reaction Structure:
  - General Design Geometry
    - Welded wide-flange I-beams stiffened by plates with some bolted joints
    - Welded plate structure
    - Plate structure joined by bolts
    - Some Large I-beam sections (e.g. W36x441)
    - See charts for sizes, geometry, plate thicknesses, etc.
    - STRESS RELIEF REQUIRED for welded Reaction Structure
  - Material
    - ASTM A992 Beams
    - Steel plate per ASTM A572, Grade 50
    - ASTM A514- 115 ksi Ult Tensile for Reaction Structure #3
  - Tolerances
    - Typical tolerances for steel structure construction
    - Some machined surfaces (see charts for details)
  - Welding
    - CJP welds, groove welds, fillet welds (see charts for typical weld callouts)
    - Gussets welded to flanges/web
    - Welds per AWS D1.1, certified inspection (mag particle/ultrasonic/visual by supplier)
  - Weight
    - 60,000 lb. – 600,000 lb.
  - Transportation
    - Some are ONE PIECE delivered to MSFC
    - Others are MULT-PIECE delivery

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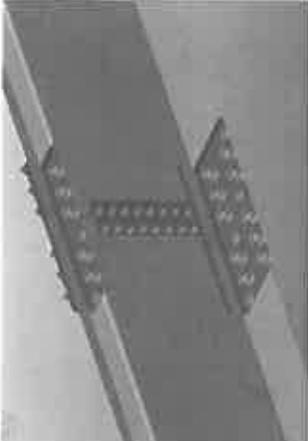
Attachment A – RFI – MSFC STEEL  
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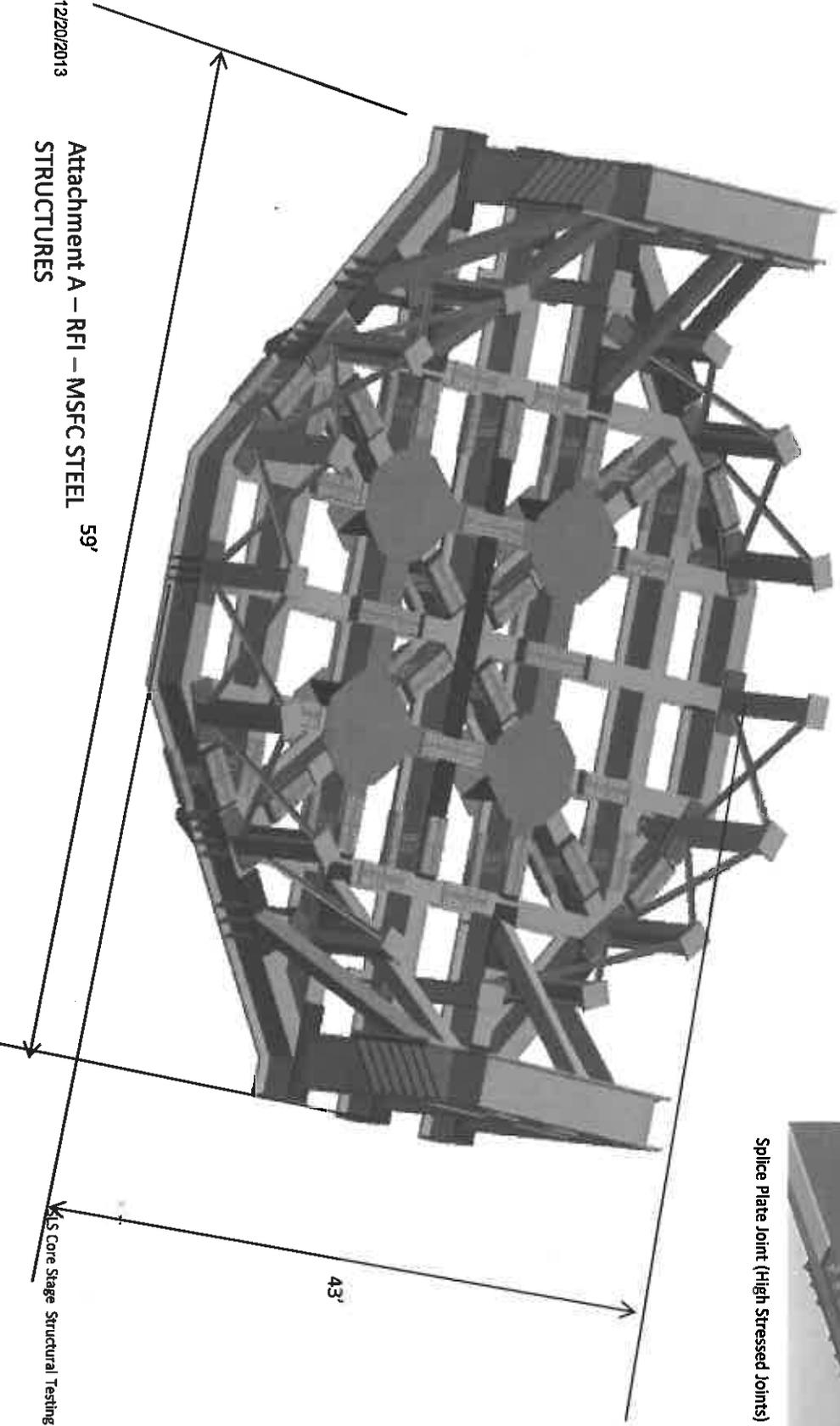
# Reaction Structure #1



Multi-piece welded sections bolted together  
 BEAM SIZE = Vert – W36X441  
 Weight = 600,000 lbs. total (all sections truck able)



Splice Plate Joint (High Stressed Joints)



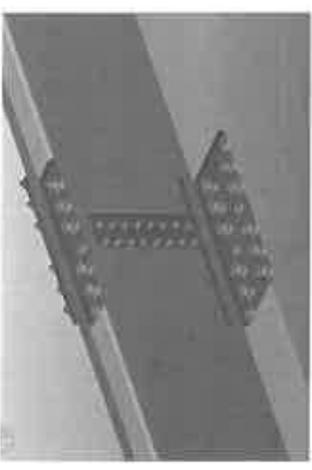
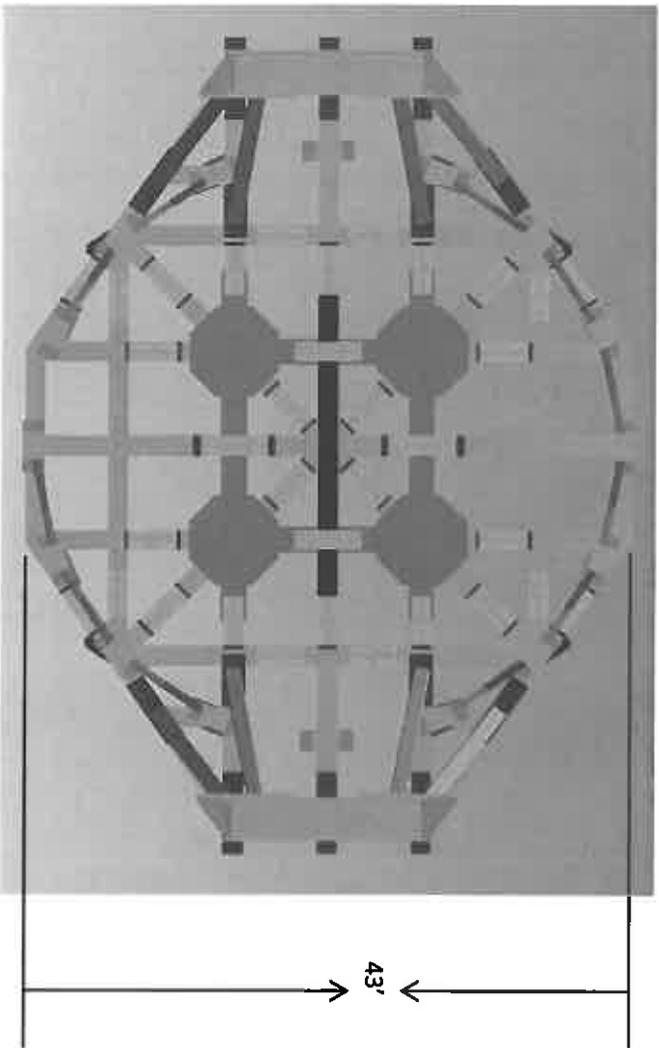
Attachment A – RFI – MSFC STEEL 59'  
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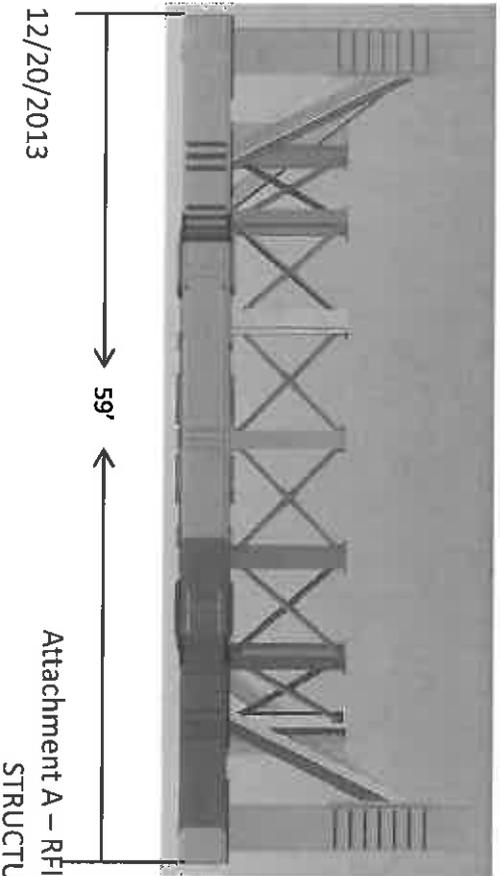
KIS Core Stage Structural Testing



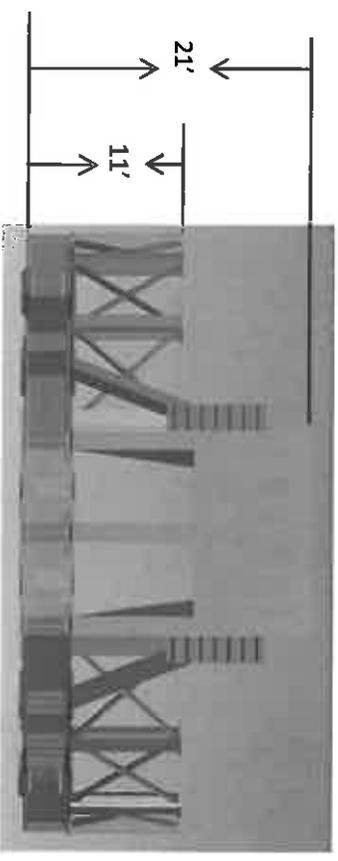
# Reaction Structure #1



Splice Plate Joint (High Stressed Joints)



Attachment A - RFI - MSFC STEEL STRUCTURES

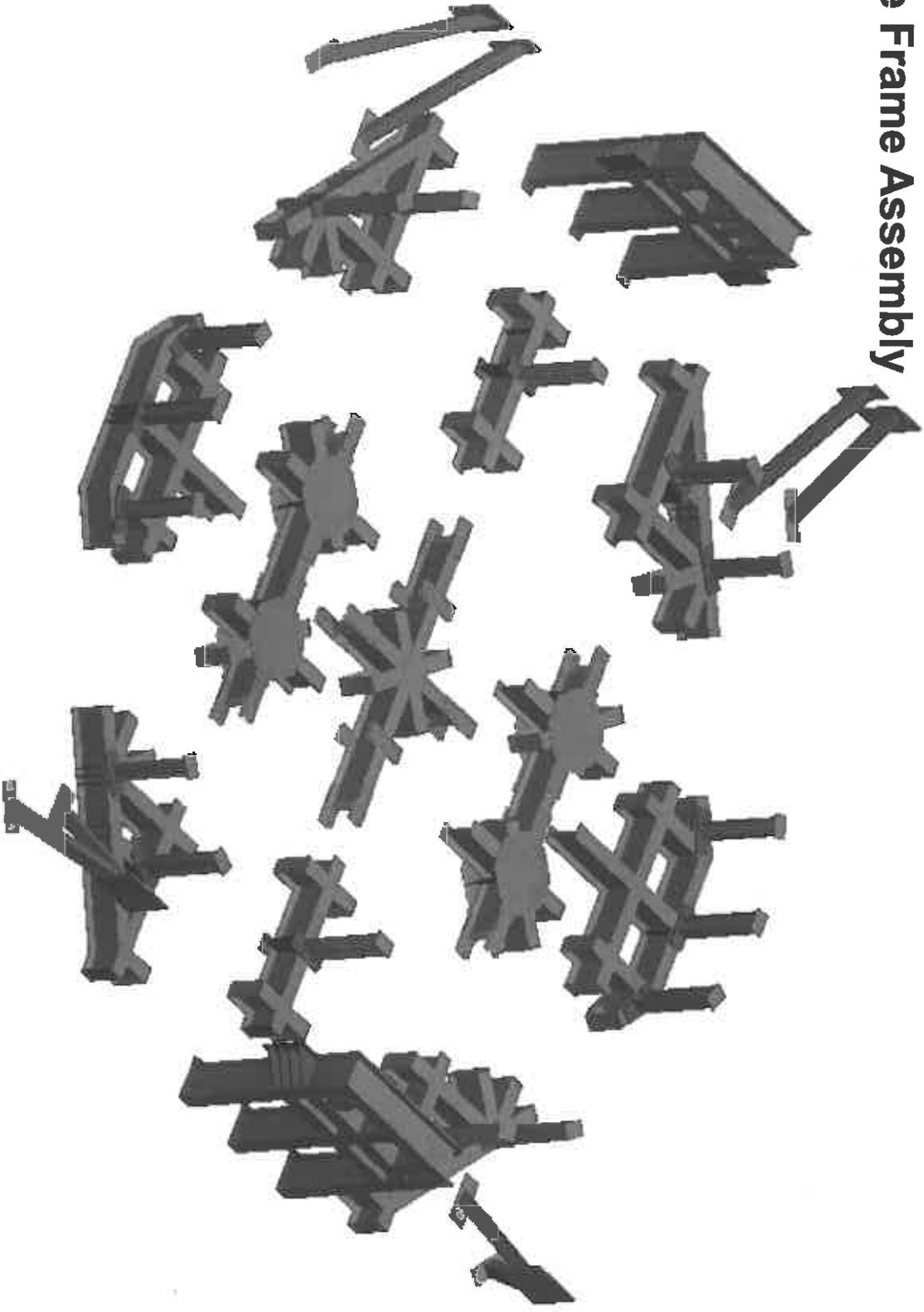




# Reaction Structure #1



## Base Frame Assembly





# Reaction Structure #2

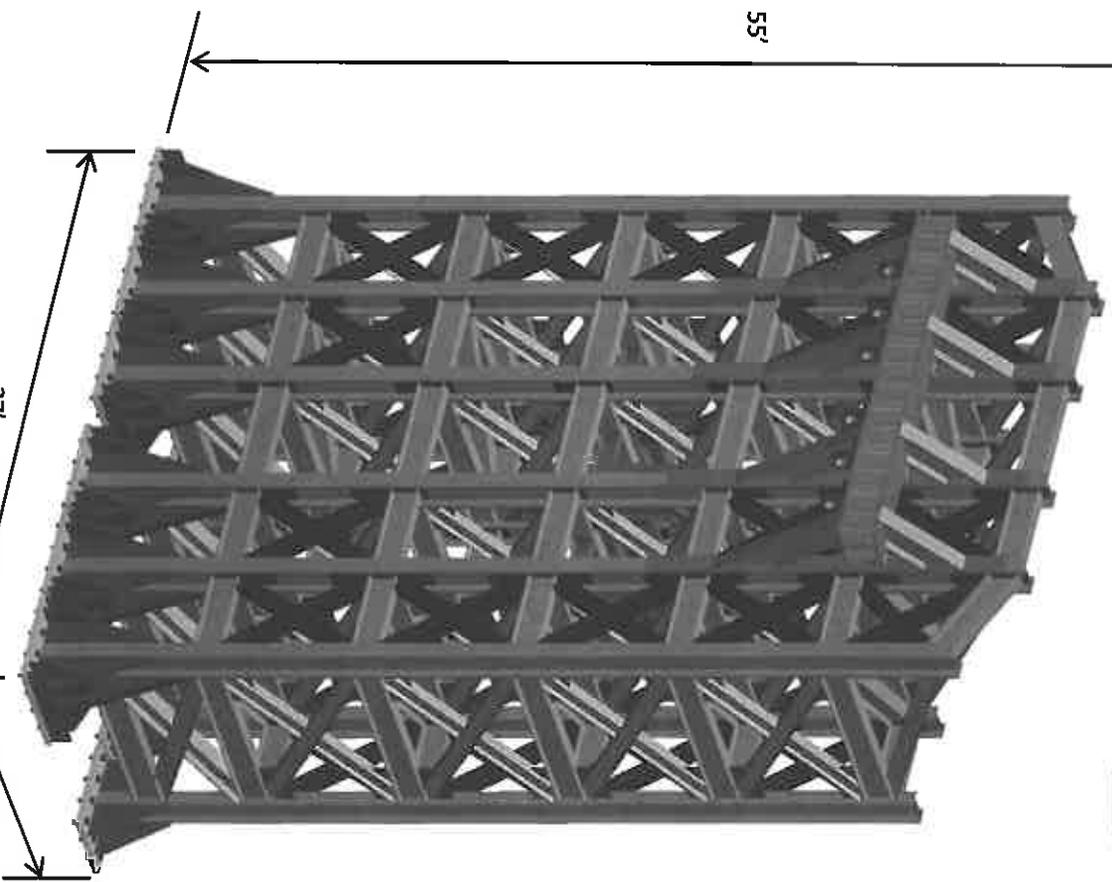
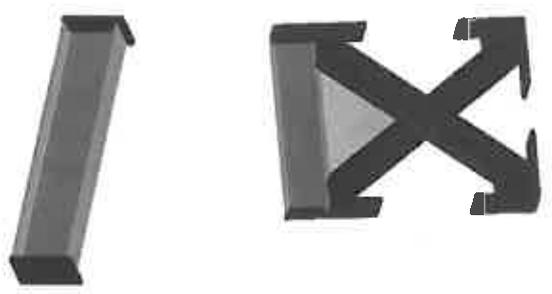


Qty 2

Modular welded sections with bolted X-braces and I-beams

BEAM SIZE = W18X330; W18X106 and smaller

Weight = 1,200,000 lbs. (600,000 lb. per tower, TBD weight per modular section; assume all sections truck able)



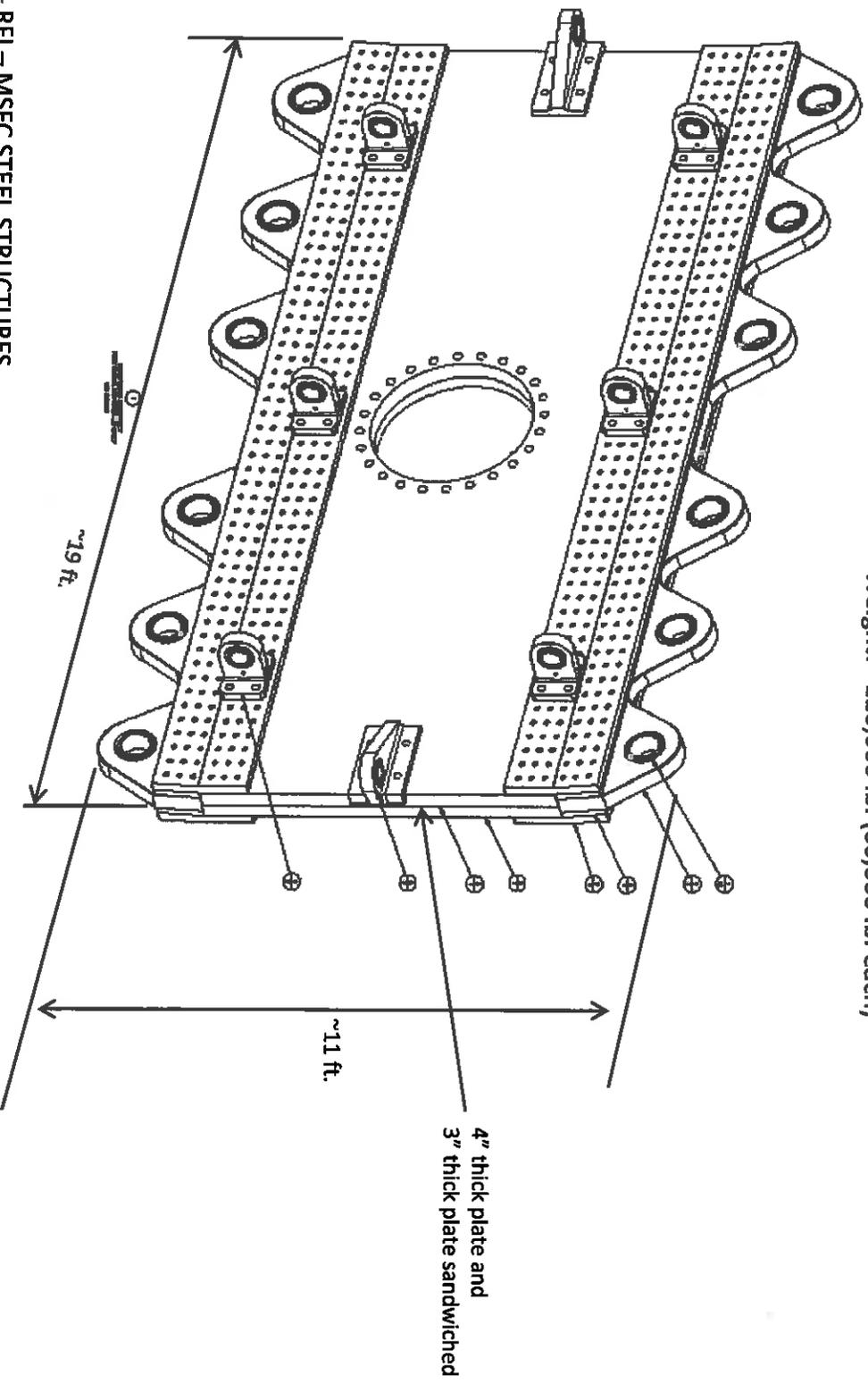
Attachment A – RFI – MSFC STEEL STRUCTURES

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# Reaction Structure #3

Qty 2  
 Matl: ASTM A514- 115 ksi Ult Tensile  
 Other: Spherical Bearings, fasteners, and machined load lugs  
 Weight: ~120,000 lb. (60,000 lb. each)

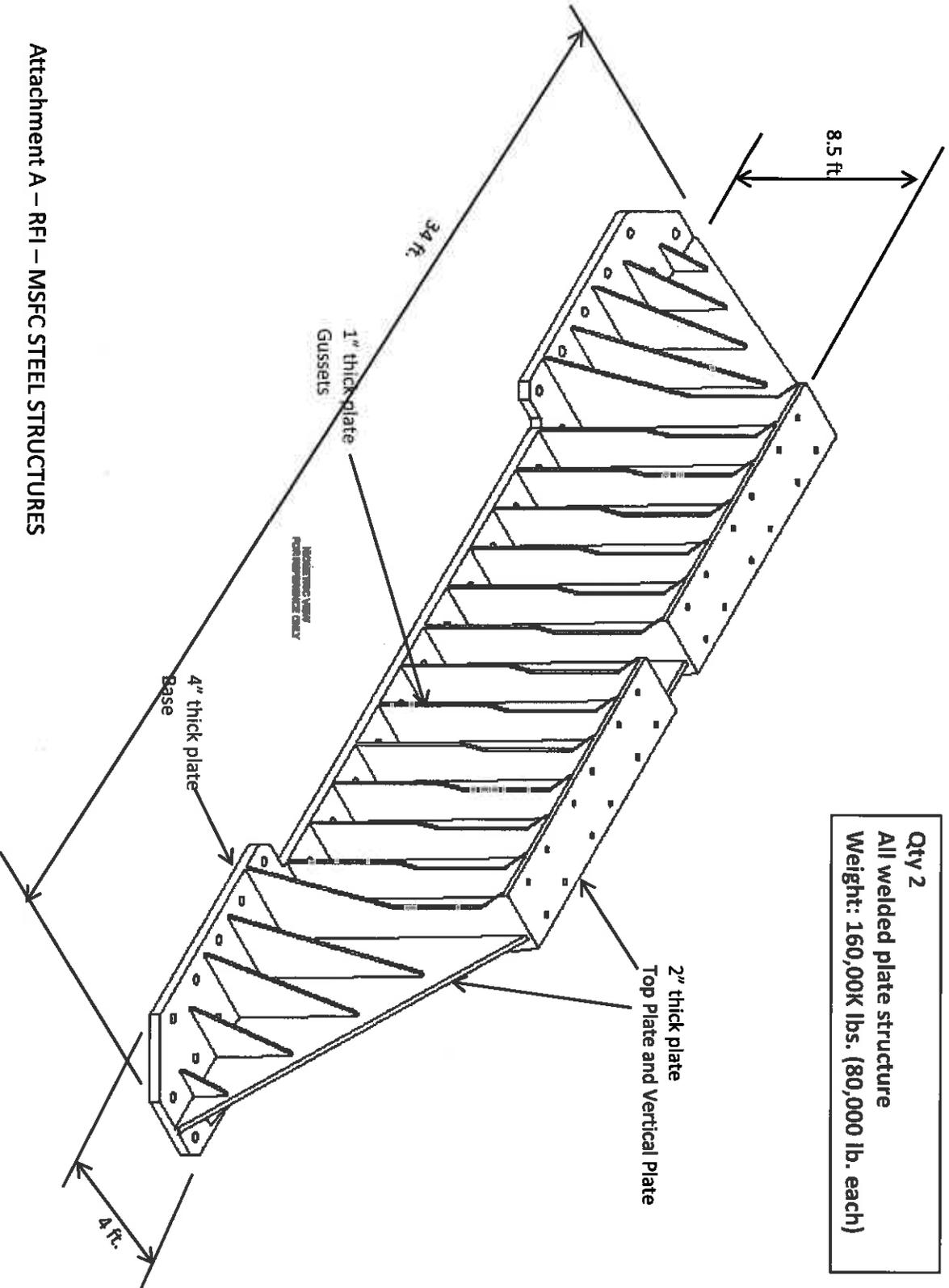




# Reaction Structure #4



Qty 2  
All welded plate structure  
Weight: 160,00K lbs. (80,000 lb. each)



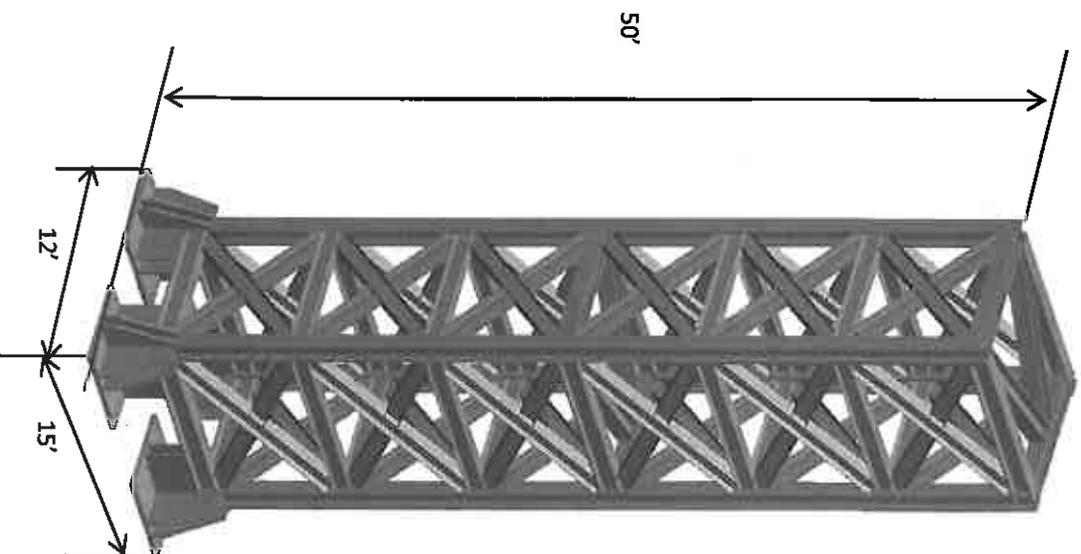
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# Reaction Structure #5



Qty 4  
Welded tower  
BEAM SIZE = W18x330; W14X176  
Weight = 600,000 lbs. (150,000 lb. per tower)



Attachment A – RFI – MSFC STEEL  
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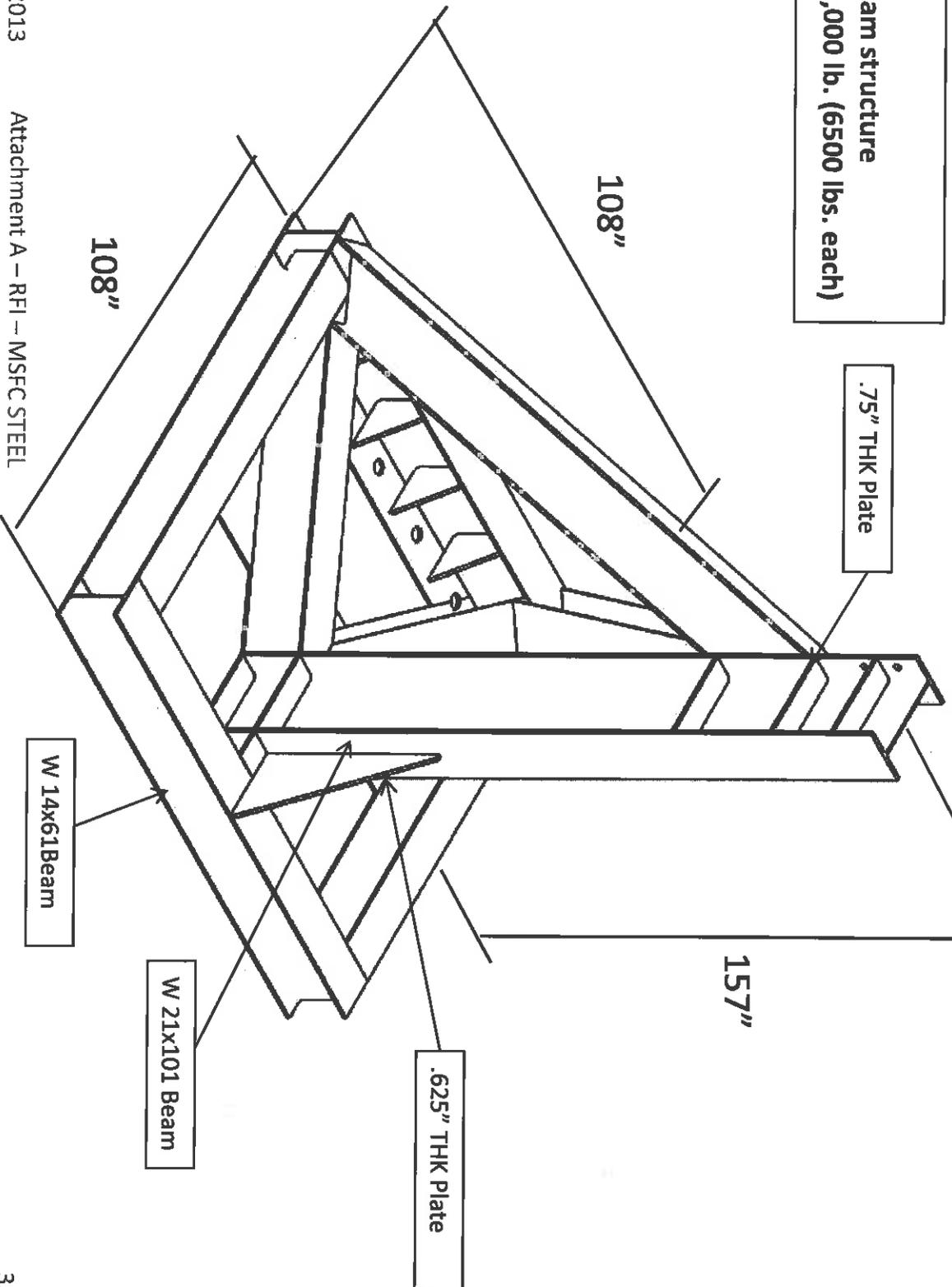
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# Reaction Structure #6



Qty 2  
 Welded beam structure  
 Weight: 13,000 lb. (6500 lbs. each)



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