

Synthetic Aperture Radar Imager

Team 18

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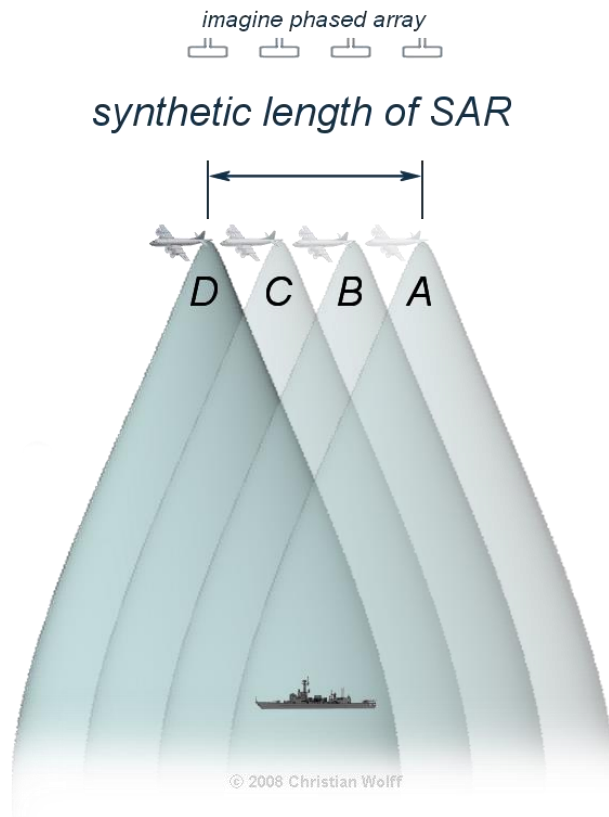
INSTRUCTOR: DR. NIKHIL GUPTA

DATE: 11/12/2015

Outline

- Introduction to Synthetic Aperture Radar System (SAR)
- Last Year: Overview
- Project Description
- Concept Selection
- Concept Iteration
- Schedule and Future Plans

Working SAR

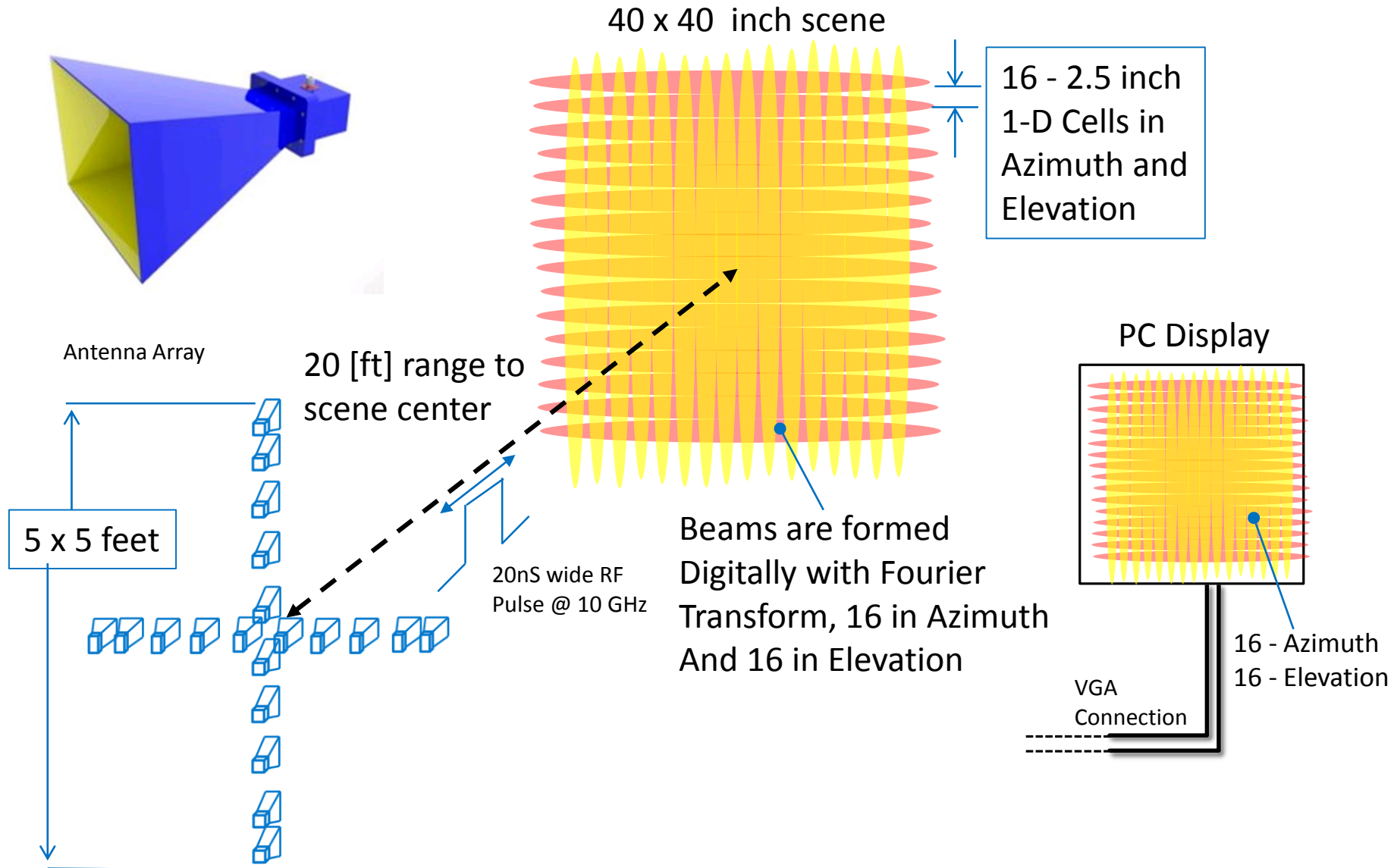


[1]

High-Resolution SAR Image



Imaging Radar Operational Concept



[4]

Project Goals

Create a Synthetic Aperture Radar:

- Project Features:
 - Weapons detection for homeland security
 - Stationary
 - Low resolution
 - Concealable
 - Low Cost
 - Relatively mobile



First Generation: Overview

- Pathfinder project
- Success:
 - First prototype
 - Able to transmit signal
- Needs Improvement:
 - Stability
 - Weight
 - Horn adjustment



Second Generation: Focus

- Mobility
 - Attach wheels
- Weight
 - < 80 lbs
- Horn Adjustment
 - Aligned within 1ft circle at 20ft away
- Stability
 - Movement causes artificial phase shift
 - Max movement: 1/72 inch
- Cost
 - Minimize

Concept Generation

- Project was divided into multiple parts:
 - Structure
 - Horn holders
 - Base
 - Hardware Box (EE Team)

Prioritizing Engineering Characteristics

Customer Requirements	Customer Importance	Engineering Characteristics								
		Structural Thickness	Material Used	Locking Mechanism	Axis Adjustability	Mounting Mechanism	Base size	Height Above Ground	Number of Crossbeams	Weight
Increased Stability	5	9	3	6		3	9	6	6	
Lower Weight	5	3	9				6	3	6	9
Good Images	5			6	9	9		3		
Better Horn Mounting	5			9	9	9				
Cost	4	3	6	3		3	3		3	
Hardware Box	2	3	6							3
Portability	2		6				9	6		9
Score		18	30	24	18	24	27	18	15	21
Relative Weight		78	108	117	90	117	105	72	72	69
Rank		6	3	1	5	1	4	7	7	9

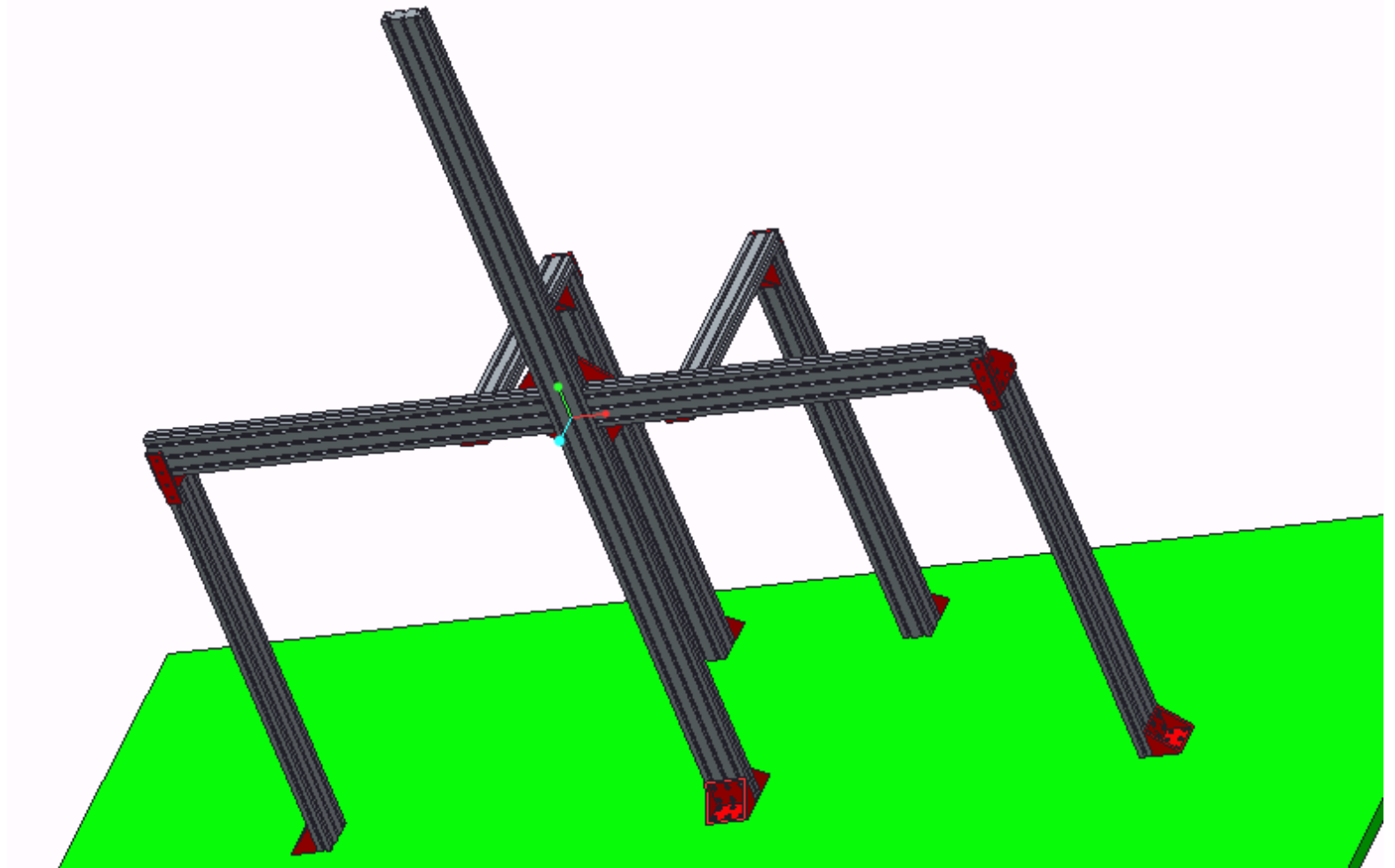
Most Important EC's:

1. Mounting Mechanism
1. Locking Mechanism
3. Material Used
4. Base Size
5. Axis Adjustability
6. Structural Thickness
7. Height Above Ground
7. Number of Crossbars
9. Weight

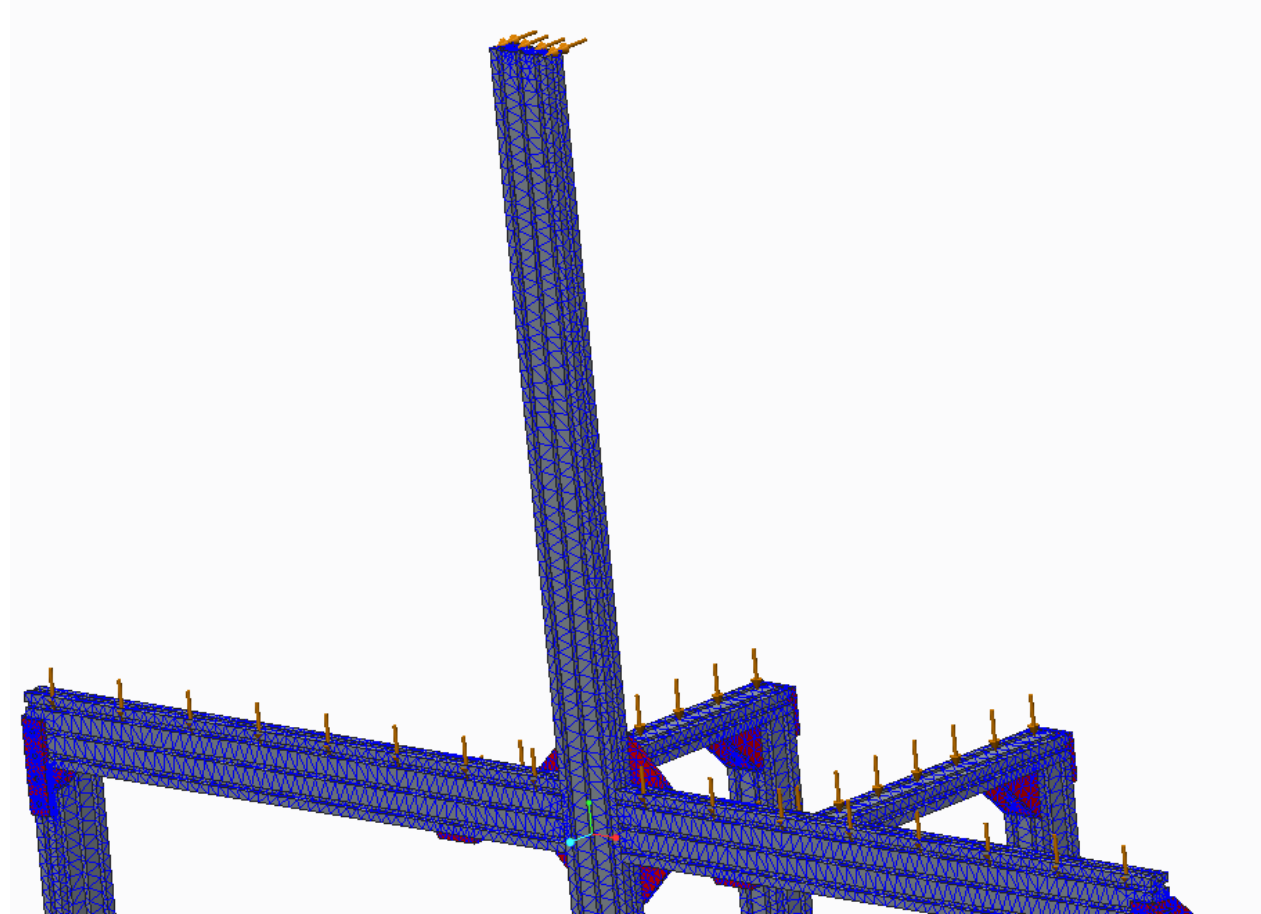
Key:	
■	#1 Important EC
■	#2 Important EC
■	#3 Important EC

Original Structure Concept Design

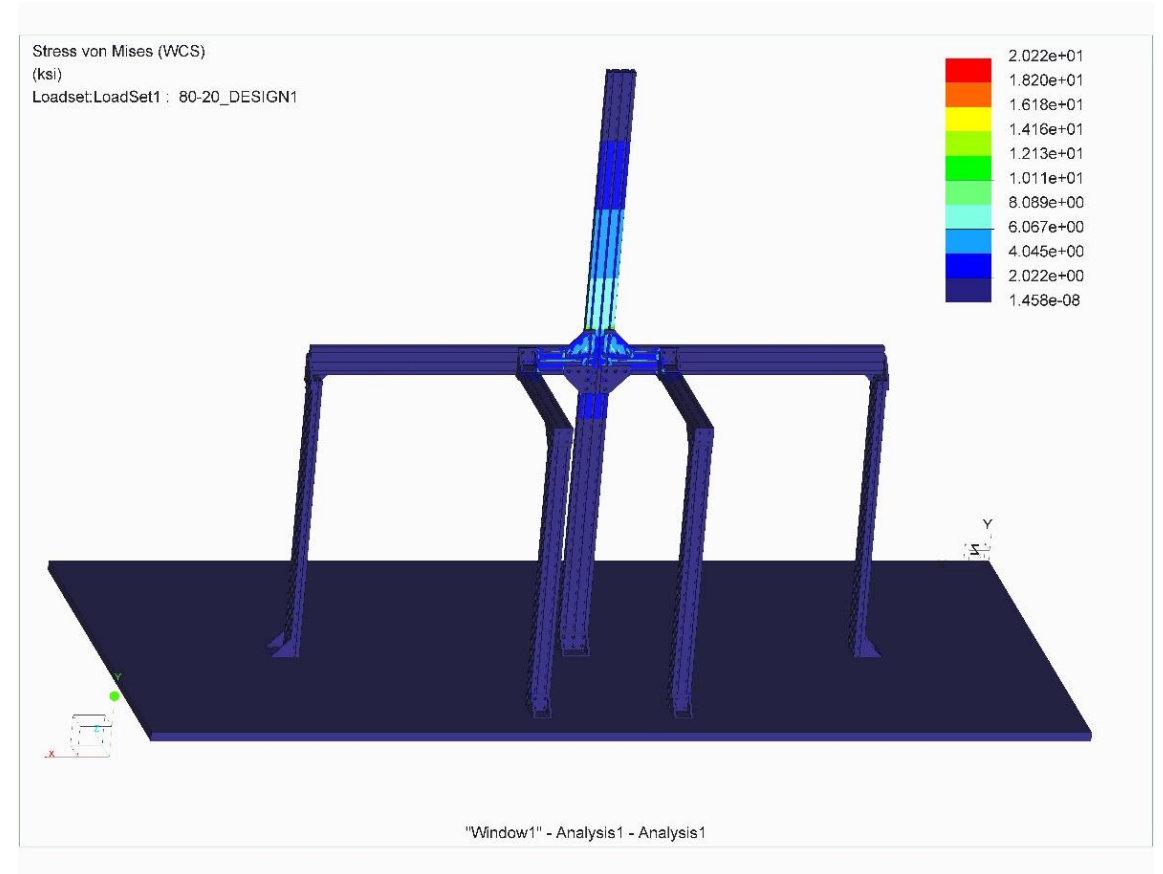
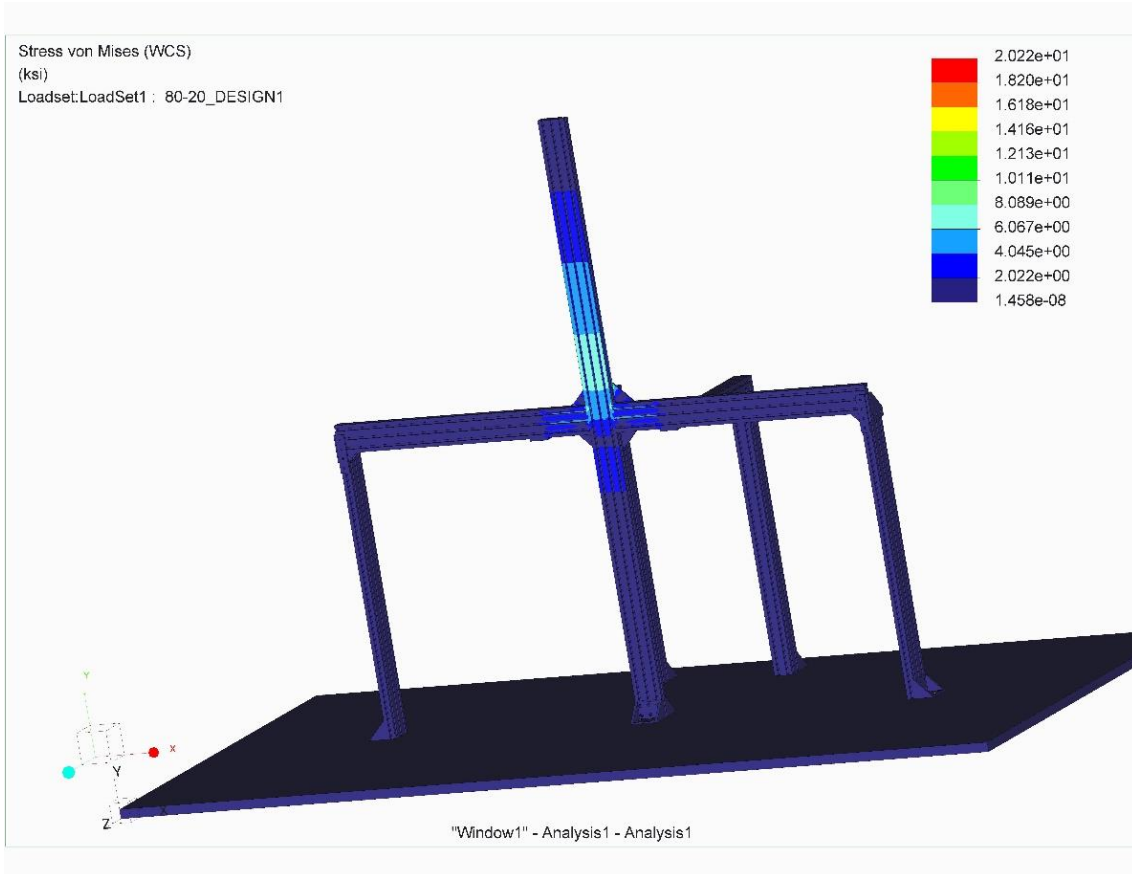
- 80/20 Design
- Lightweight
- Cheap
- Modular
- Light machining required



Finite Element Analysis

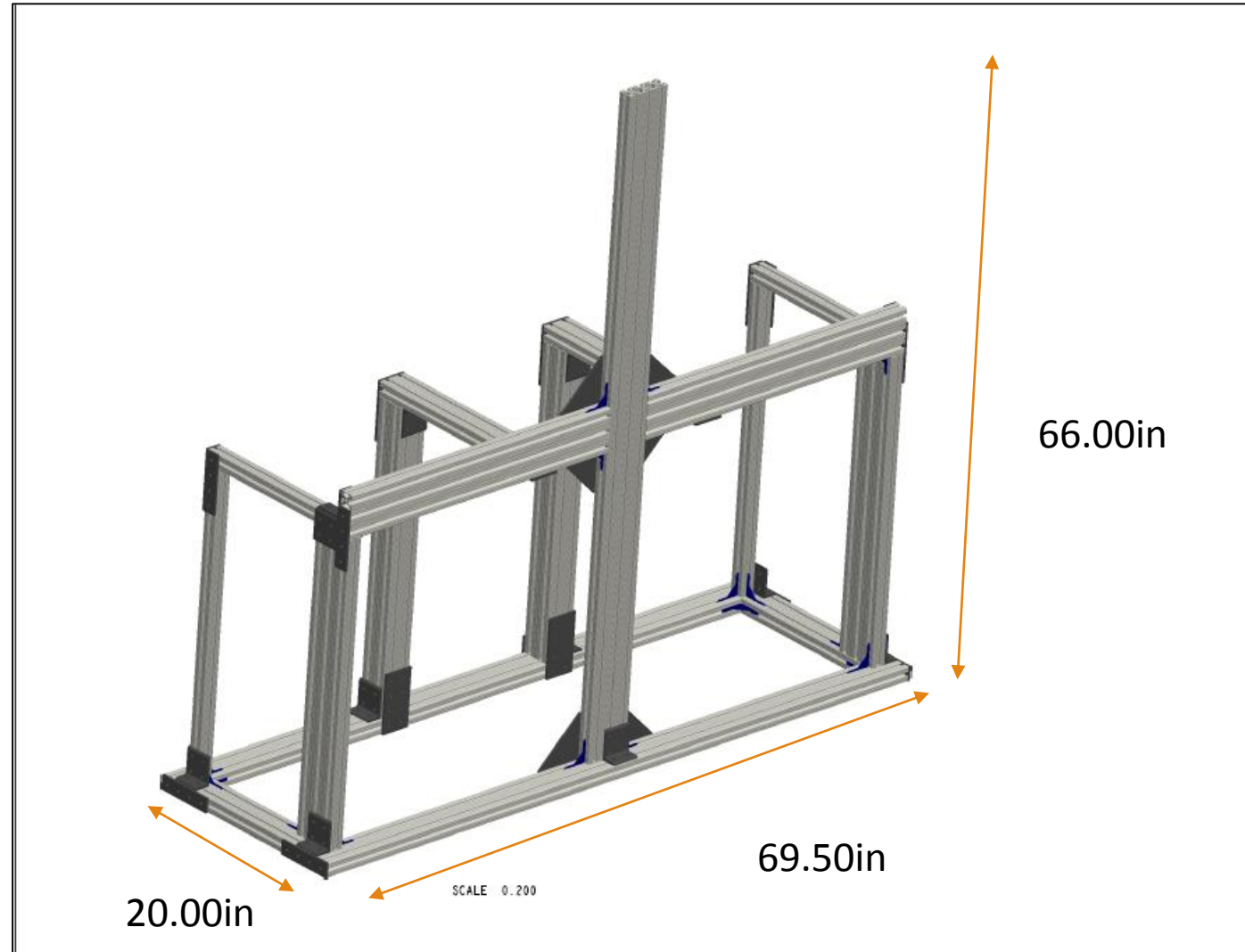


Finite Element Analysis



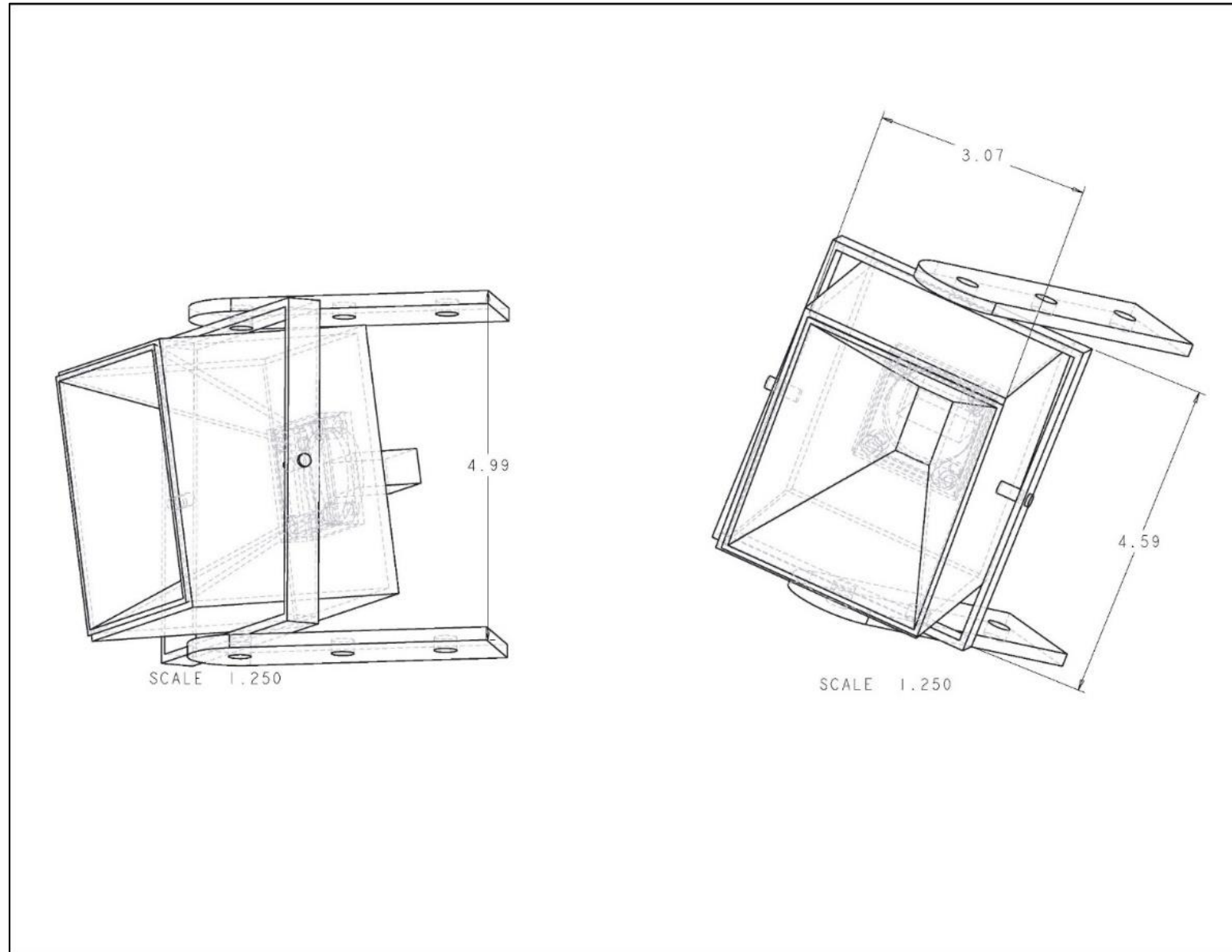
Structure Design Iteration

- Increased cross section area
- Added:
 - Bottom frame
 - Outer Braces
 - Brackets
- Possible leveling castors



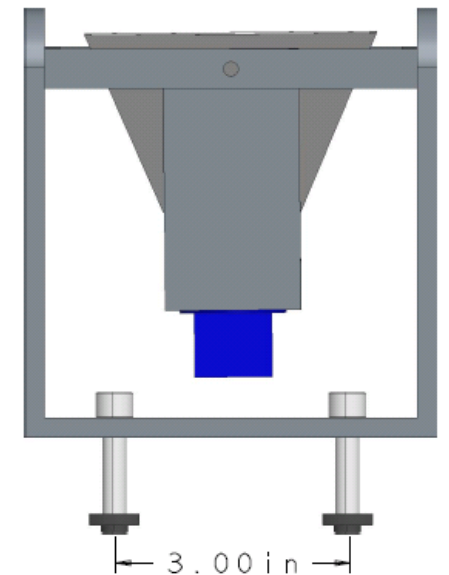
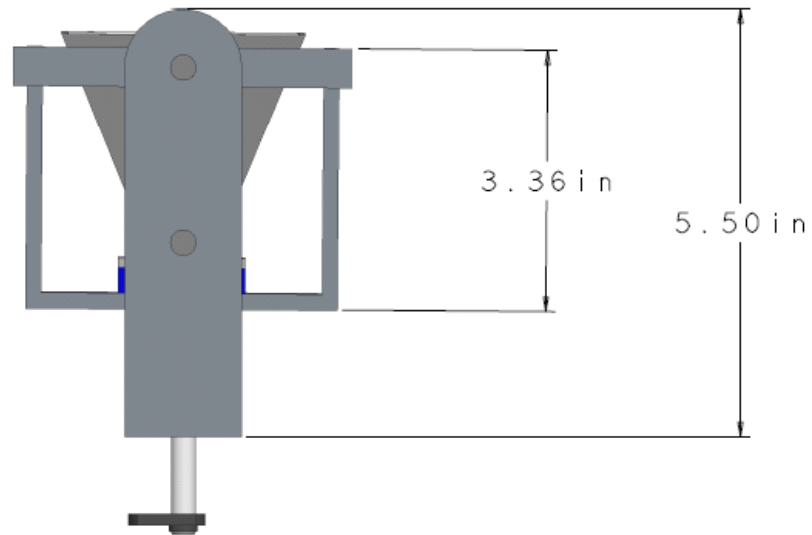
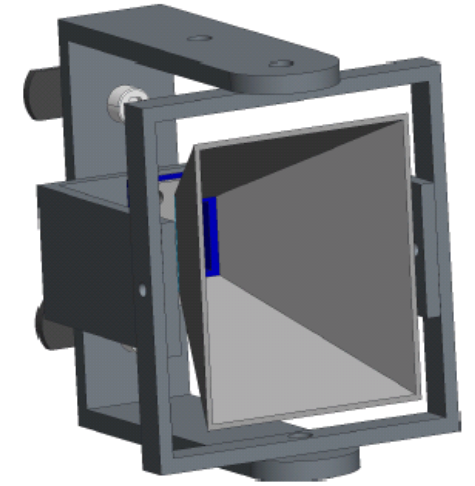
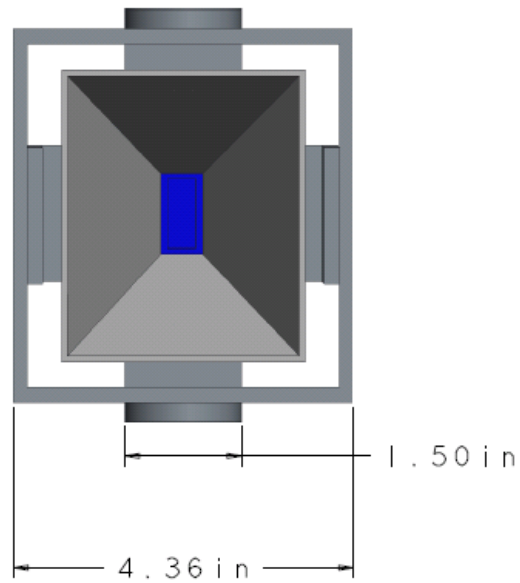
Original Horn Concept Design

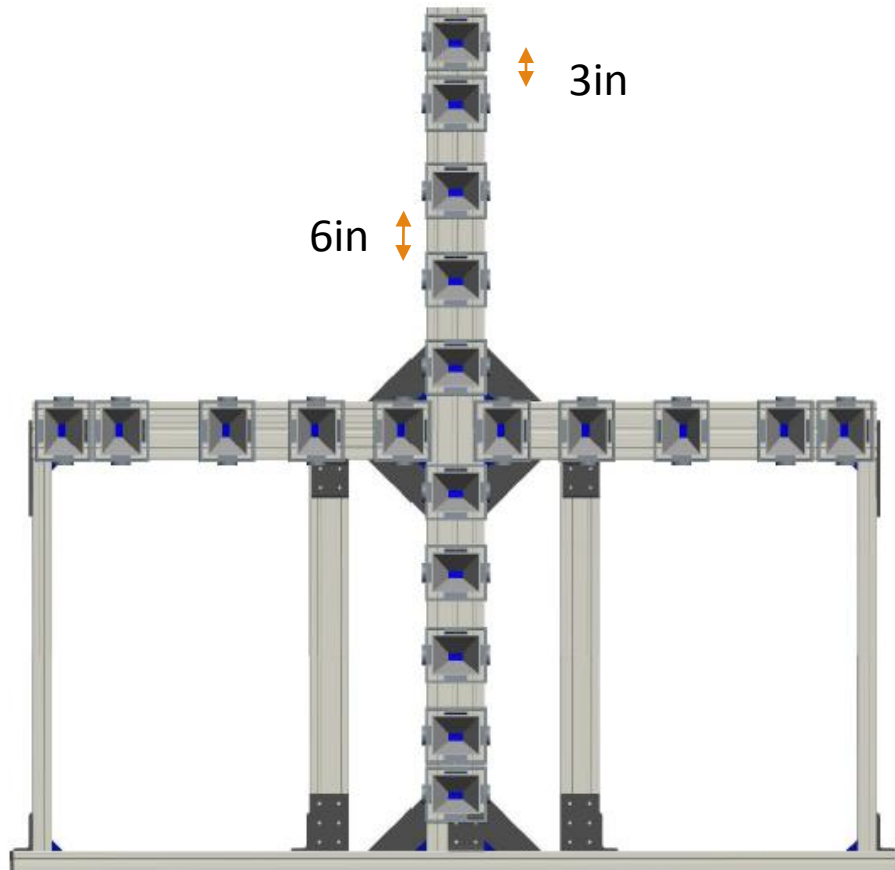
- Compatible with 80/20
- Independent locking and adjustability
- Compact



Horn Design Iteration

- Removed box shell
- Refined rotation locking
- Added 80/20 connection





Schedule

ID	Task Name	Duration	Start	Finish	Aug 30, '15	Sep 13, '15	Sep 27, '15	Oct 11, '15	Oct 25, '15	Nov 8, '15	Nov 22, '15	Dec 6, '15											
					S	T	M	F	T	S	W	S	T	M	F	T	S	W	S	T	M	F	T
1	Planning	27 days	Thu 9/3/15	Fri 10/9/15																			
2	Schedule Regular Meetings	7 days	Thu 9/3/15	Fri 9/11/15																			
3	Agree on Scope of Work with Sponsor	17 days	Thu 9/3/15	Fri 9/25/15																			
4	Project Plans and Product Specs	11 days	Fri 9/25/15	Fri 10/9/15																			
5	Concept Creation	16 days	Mon 9/28/15	Tue 10/20/15																			
6	Preliminary Ideas	11 days	Mon 9/28/15	Mon 10/12/15																			
7	Refine/Eliminate Ideas	1 day	Tue 10/13/15	Tue 10/13/15																			
8	Detailed Designs	4 days	Wed 10/14/15	Mon 10/19/15																			
9	Propose Concepts to Sponsor	0 days	Tue 10/20/15	Tue 10/20/15																			
10	Design Selection	27 days	Tue 10/13/15	Wed 11/18/15																			
11	CAD Modeling	17 days	Tue 10/13/15	Wed 11/4/15																			
12	Failure Modes Effects Analysis	14 days	Wed 10/28/15	Mon 11/16/15																			
13	Finite Elements Analysis	15 days	Thu 10/29/15	Wed 11/18/15																			
14	Propose Final Design	0 days	Tue 11/10/15	Tue 11/10/15																			
15	Procurement	14 days	Thu 11/12/15	Tue 12/1/15																			
16	Bill of Materials	8 days	Thu 11/12/15	Mon 11/23/15																			
17	Purchase Orders	14 days	Thu 11/12/15	Tue 12/1/15																			

Summary

- Review of SAR
- Review of last year's final product
- Project objectives
- Prioritize engineering characteristics
- Concept selection and iteration

Future Plans

- Submit final design to sponsor
- Complete bill of materials
- Submit purchase order

Acknowledgements

- Sponsor: Northrop Grumman
 - Mike Blue
 - Pete Stenger
- Senior design instructors:
 - Dr. Nikhil Gupta
 - Dr. Chiang Shih

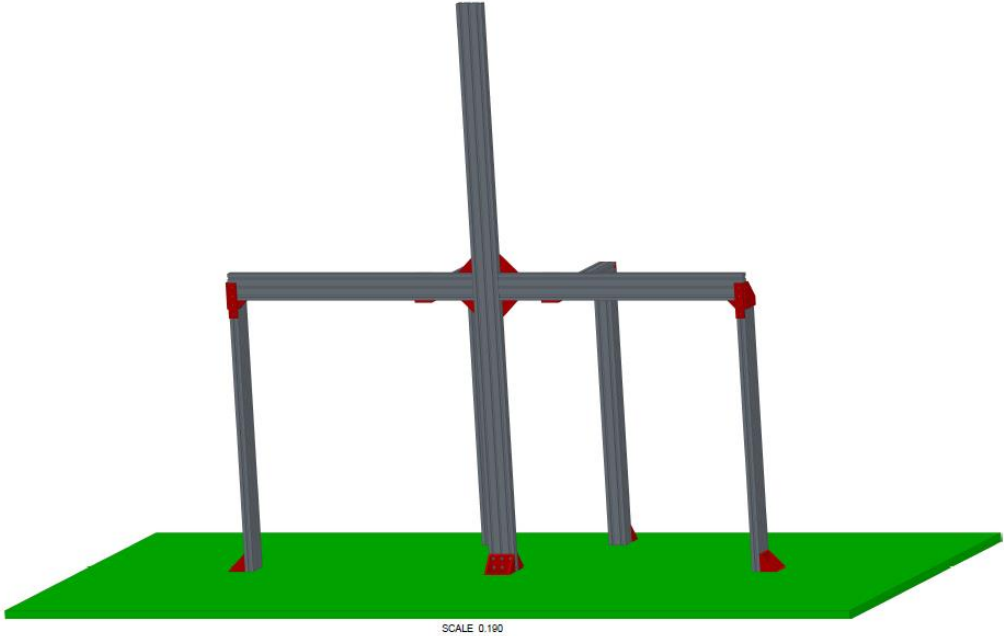
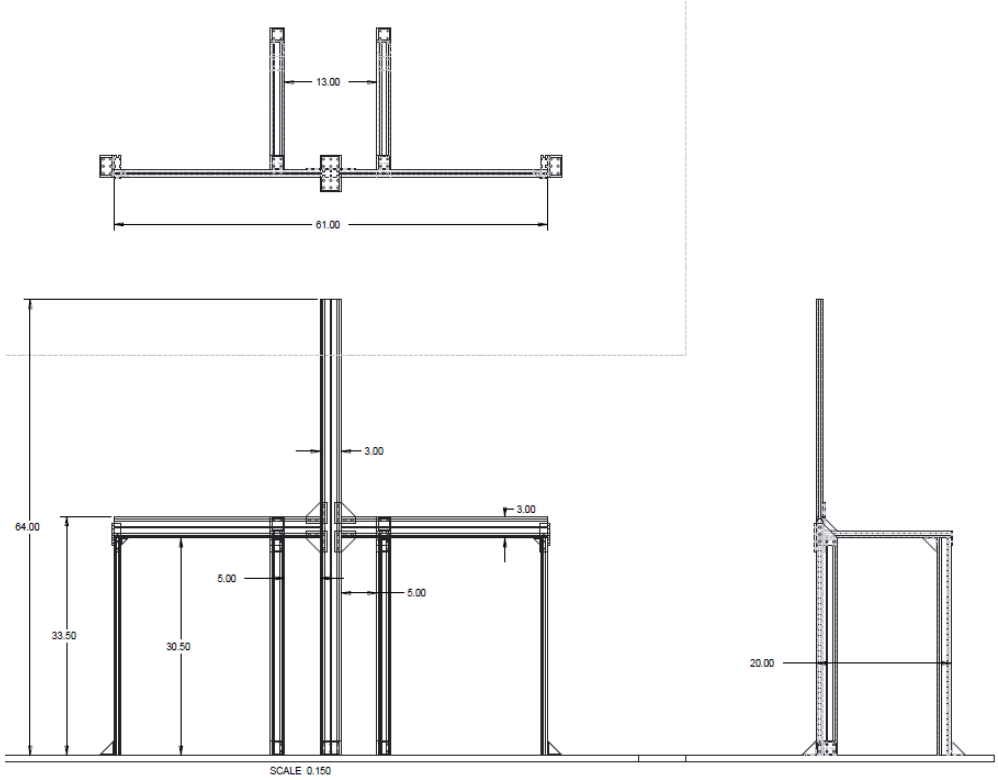
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6. <http://www.mcmaster.com/#carts/=zgsvoa>

Questions?

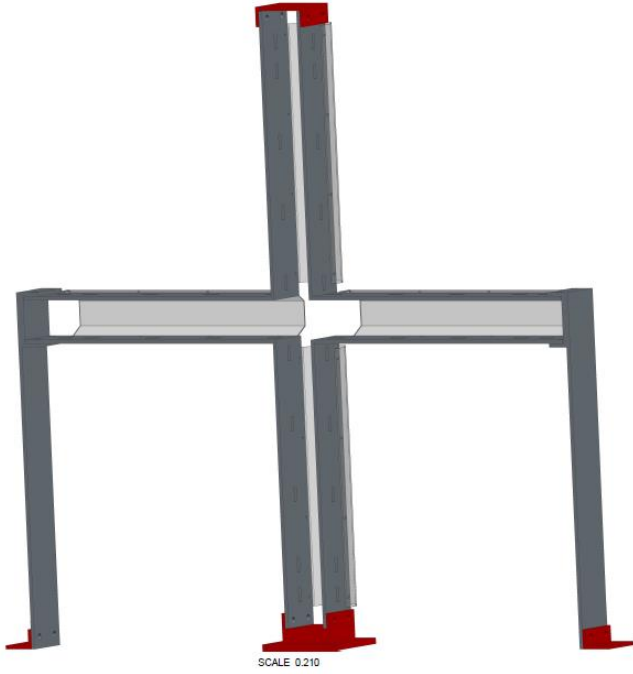
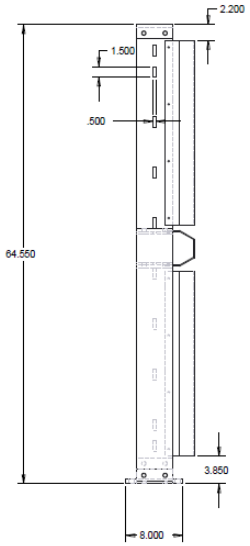
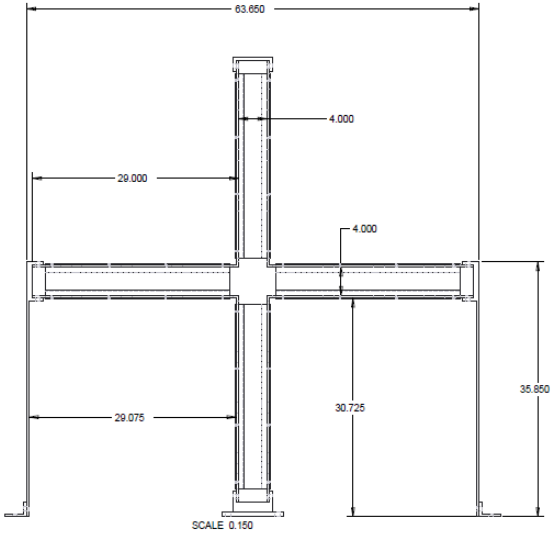
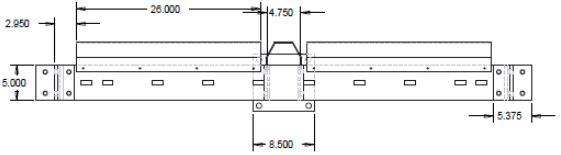
Design Concepts – Structure

Design A (80-20)



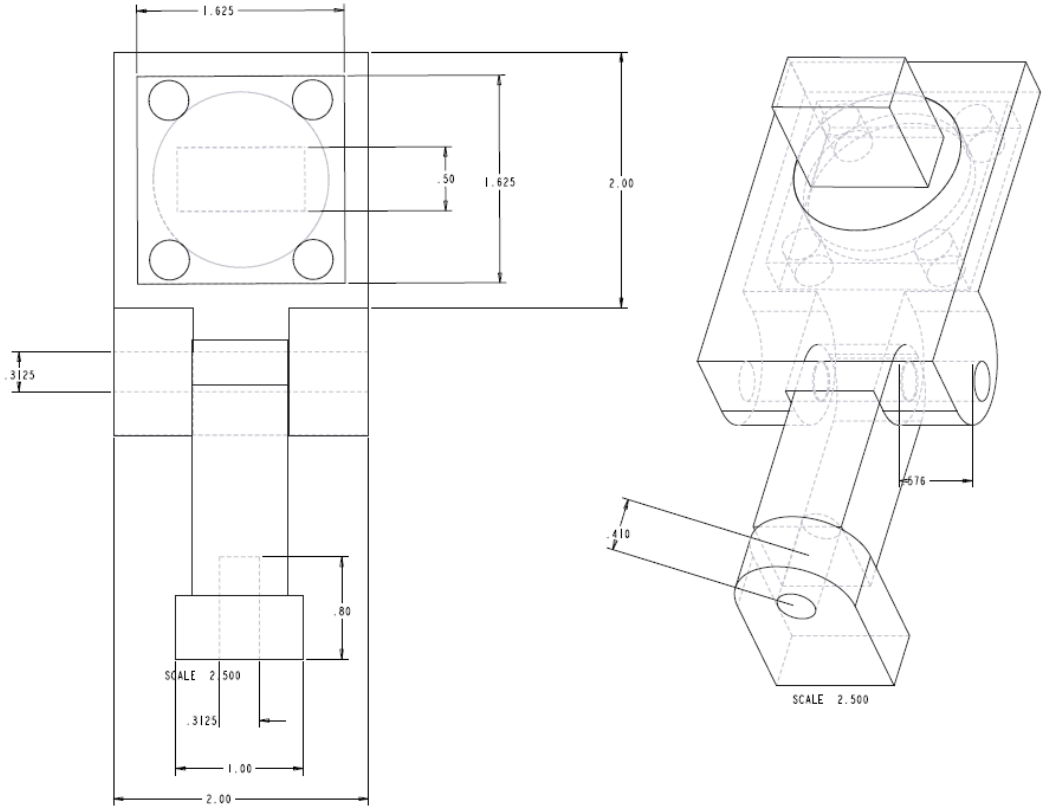
Design Concepts – Structure

Design B (Fabricated Al)



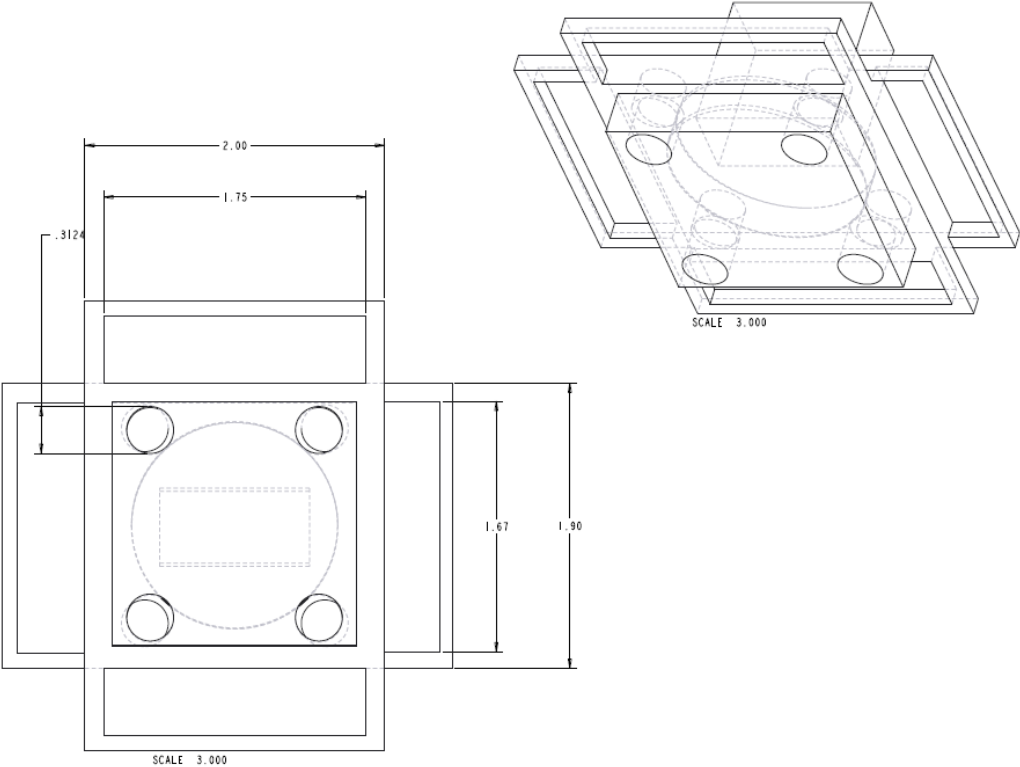
Design Concepts – Horn Holder

Design A (Articulating Arm)



Design Concepts – Horn Holder

Design B (Handle Tilt)



Design Concepts – Horn Holder

Design C (Covered Tilt)

