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# SunTrac Design Team

## Presentation 2

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# Project Description

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The task for this capstone project is to design a braze welding jig that is compatible with SunTrac's 4', 6' and 8' solar thermal panel.

- Create detailed drawings
- Provide a 1:4 scaled model
- Build first braze welding jig
- Ensure design is easily repeatable

SunTrac will take our drawings and build multiple braze welding jigs over the next three years as they expand to a bigger facility.



**Figure 1:** 8' Braze Welding Jig

# Black Box Model



Figure 2: Black Box Model

# Functional Decomposition Model

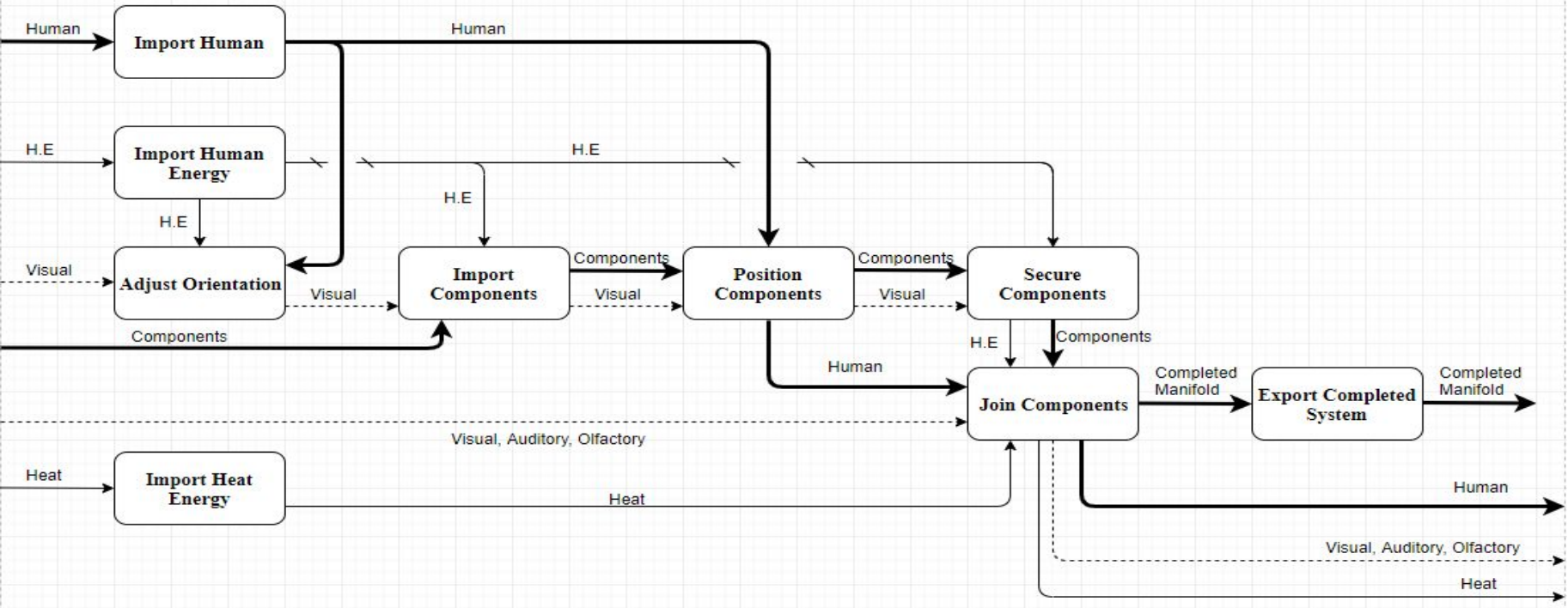


Figure 3: Functional Decomposition

# Concept Generation

We met with SunTrac to know what the client was looking for in the design of the jig. While SunTrac was open to new ideas they wanted the following:

- A skeleton for easy access.
- Multiple locking positions.



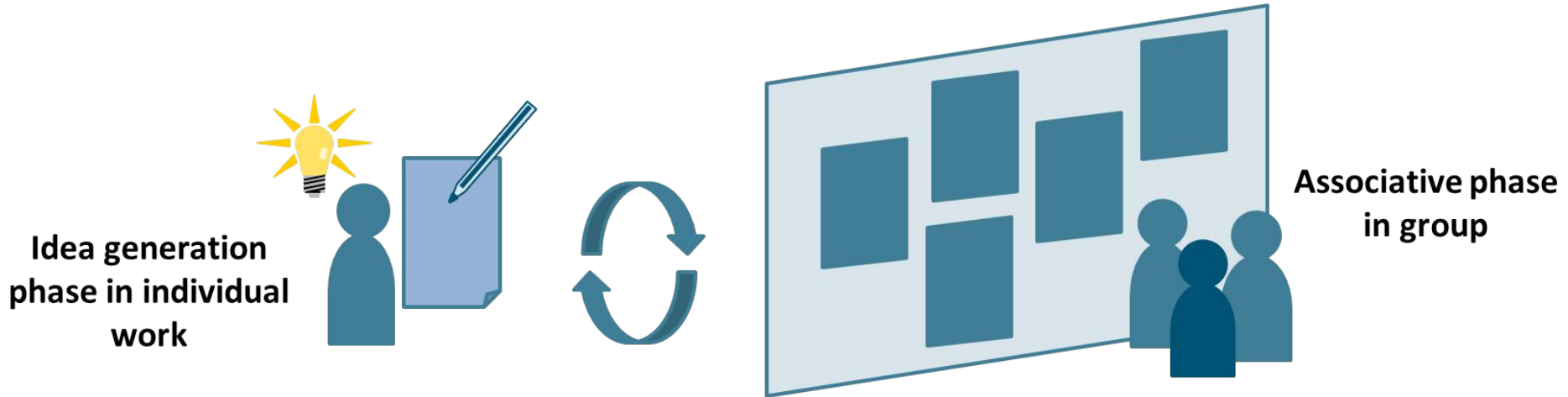
**Figure 4:** SunTrac, Tempe, AZ.



**Figure 5:** Meeting with SunTrac

# Concept Generation

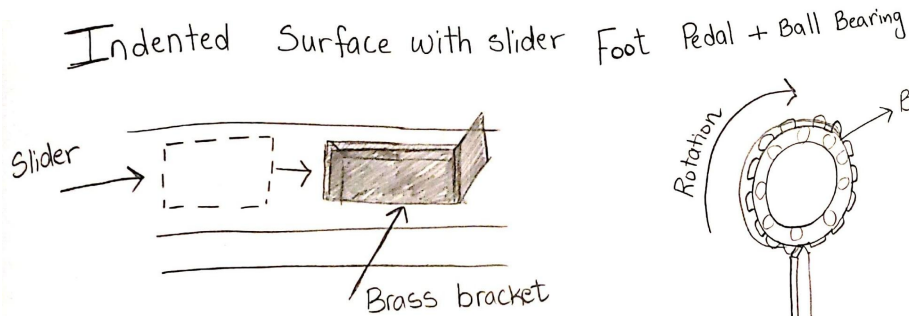
After speaking with SunTrac the concepts were generated by using the Gallery Method.



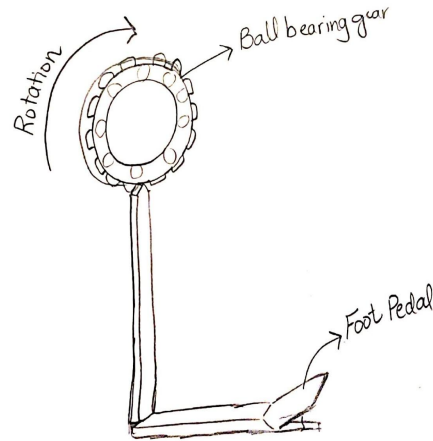
**Figure 6:** Gallery Method [1]

# Concept Generation

Some of the creative concepts the team came up with:

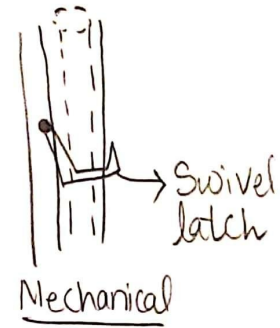


**Figure 7:** Concept 1

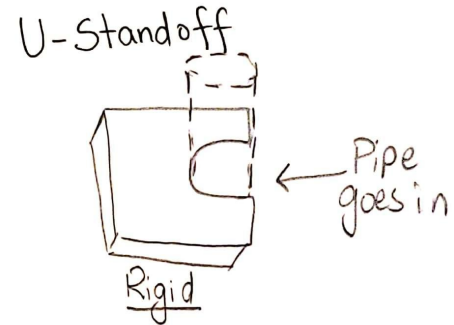


**Figure 8:** Concept 2

Swivel Latch



**Figure 9:** Concept 3



**Figure 10:** Concept 4

# Concept Evaluation - Pugh Chart

Table 1: Pugh Chart

Concept / Criteria	Datum	D.A. 1	D.A. 2	D.A. 3	D.A. 4	D.A. 5	D.A. 6
Safe To Operate	D	S	S	S	S	S	S
Cost Within Budget		S	-	-	S	-	S
Fit a 4', 6', 8' Manifold	A	+	+	+	+	+	+
Machinable Parts		S	S	S	S	S	S
Fits within 5'x5' square	T	+	+	+	+	+	+
Easy access to Copper		+	+	+	+	+	+
Rotate and Lock	U	+	S	+	+	+	+
Durable and Robust		-	S	-	S	S	+
Reliable	M	S	-	-	+	-	S
$\Sigma+$		4	3	4	5	3	5
$\Sigma-$		1	2	3	0	2	0
$\Sigma S$		4	4	2	4	4	4
$\Sigma Net$		3	1	1	5	1	5



# Concept Evaluation - Top 3 Design Alternatives

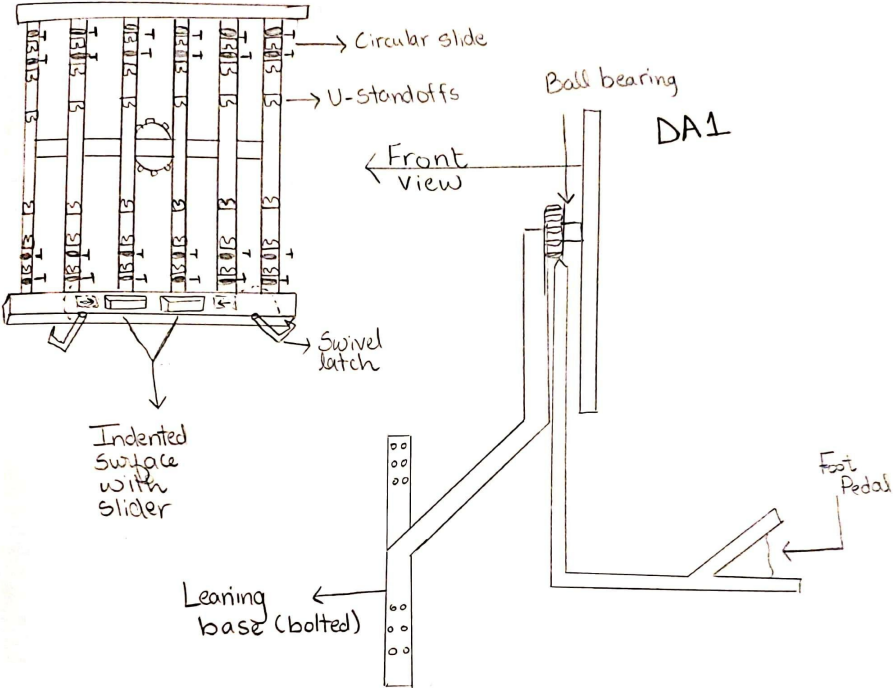


Figure 11: Design Alternative 1

# Concept Evaluation - Top 3 Design Alternatives

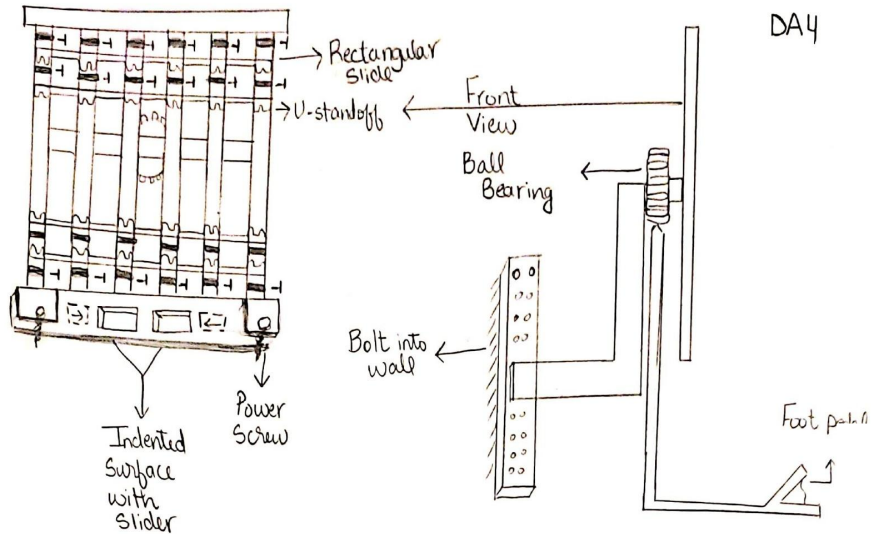


Figure 12: Design Alternative 4

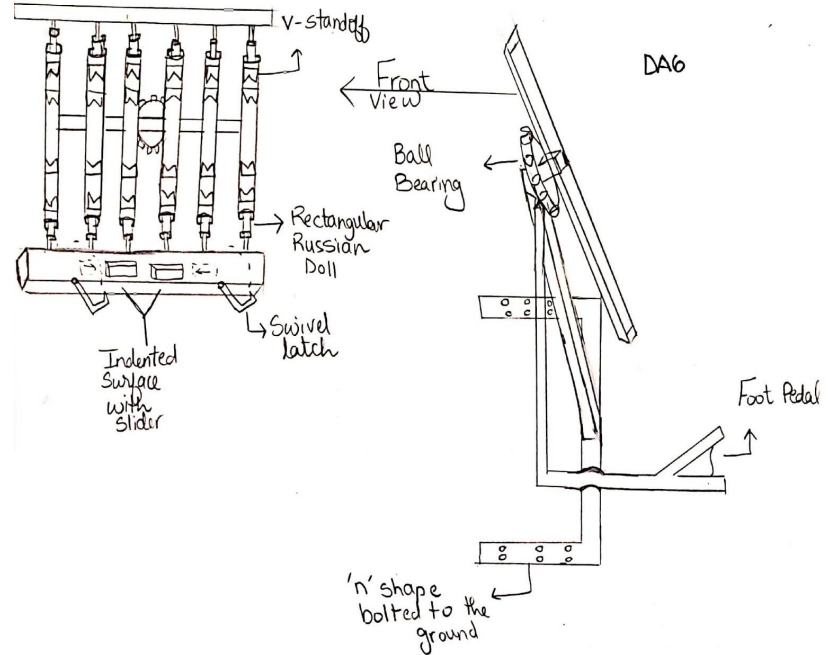


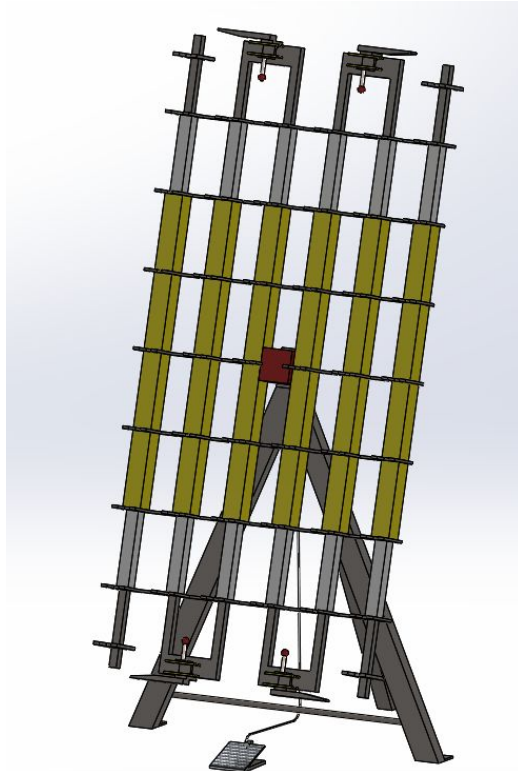
Figure 12: Design Alternative 6

# Concept Evaluation - Decision Matrix

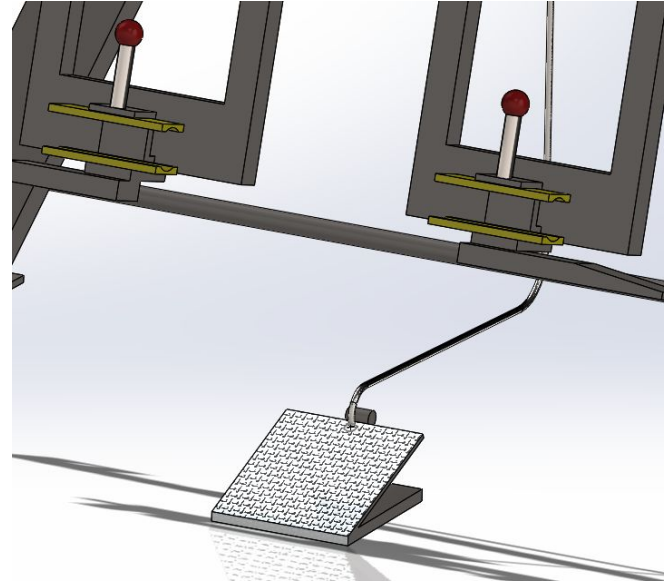
**Table 2: Decision Matrix**

Criterion	Weight	Design Alternatives (DA's)					
		DA1		DA4		DA6	
Melting Temperature	0.08	100	8	100	8	100	8
Force to Rotate	0.07	90	6.3	90	6.3	90	6.3
Cost	0.17	60	10.2	60	10.2	60	10.2
Versatility	0.11	100	11	100	11	100	11
Standardized Parts	0.1	100	10	100	10	100	10
Footprint	0.08	90	7.2	95	7.6	90	7.2
Degree of Rotation	0.1	100	10	100	10	100	10
Adaptability	0.07	100	7	100	7	100	7
Durability	0.11	80	8.8	85	9.35	85	9.35
Error	0.11	70	7.7	75	8.25	75	8.25
Totals	1	/	86.2	/	87.7	/	87.3
Relative Rank		3		1		2	

# The Concept - 3D CAD Model



**Figure 13:** CAD of Chosen Design Alternative



**Figure 14:** CAD Foot Pedal and Power Screw

# Budget Planning - Bill of Materials

Table 3: Bill of Materials

Bill of Materials								
Team			Suntrac					
Part #	Part Name	Qty	Description	Functions	Material	Dimensions	Cost	Link to Cost estimate
1	Steel tube	6	4 foot center	Comprised of the stationary middle skeleton structure	Carbon Steel	2.5" x 2.5" x 4'	\$32.16	<a href="https://www.mcmaster.com/steel-tubing">https://www.mcmaster.com/steel-tubing</a>
2	Steel tube	12	Variable length	Slides in part # 1 to allow for manifold variation	Carbon Steel	2.25" x 2.25" x 2'	\$14.52	<a href="https://www.mcmaster.com/steel-tubing">https://www.mcmaster.com/steel-tubing</a>
3	Steel tube	12	Variable length	Slides in part # 2 to allow for manifold variation	Carbon Steel	2" x 2" x 1'	\$6.75	<a href="https://www.mcmaster.com/steel-tubing">https://www.mcmaster.com/steel-tubing</a>
4	Steel beam	2	End structure	Stations part # 6	Carbon Steel	2.5" x 2.5" x 52"	\$36.18	<a href="https://www.mcmaster.com/steel-tubing">https://www.mcmaster.com/steel-tubing</a>
5	Steel beam	3	Tripod	Holds welding jig upright	Carbon Steel	2.5" x 2.5" x 8'	\$62.62	<a href="https://www.mcmaster.com/steel-tubing">https://www.mcmaster.com/steel-tubing</a>
6	L Bracket	2	End structure	Stations the horizontal (top and bottom) copper pipes	Mild Steel	2.5" x 2.5" x 1" x 22.875"	\$120	<a href="https://www.mcmaster.com/corner-brackets">https://www.mcmaster.com/corner-brackets</a>
7	L Bracket	8	Pipe fastener	Secure vertical pipes	Mild Steel	2.5" x 2.5" x 1" x 52"	\$273	<a href="https://www.mcmaster.com/corner-brackets">https://www.mcmaster.com/corner-brackets</a>
8	Power screw	2	Pipe fastener	Secure horizontal pipes	Mild Steel	Thread size 1/4" length 9"	12.855	<a href="https://www.mcmaster.com/power-screws">https://www.mcmaster.com/power-screws</a>
9	Foot switch	1	Washdown protection foot switch	Wedges in gear to stop rotation	Iron housing with Aluminum gaurd	N/A	\$126.52	<a href="https://www.mcmaster.com/foot-switches">https://www.mcmaster.com/foot-switches</a>
10	Steel plate	1	Bracket slide holder	Secures the mounted bracket	321 Stainless Steel	6" x 6"	\$4.27	<a href="https://www.mcmaster.com/steel-plates">https://www.mcmaster.com/steel-plates</a>
11	Bearing	1	Ball bearing	Allows rotation of skeleton frame	Steel	ID 1.25" Housing ID 2 5/8"	\$65.06	<a href="https://www.mcmaster.com/ball-bearings">https://www.mcmaster.com/ball-bearings</a>
12	Gear	1	Rotating gear	Attached to ball bearing to allow for locking by part # 9	Mild Steel	ID 1.25" OD 3.96"	\$30.67	<a href="https://www.mcmaster.com/gears">https://www.mcmaster.com/gears</a>
13	Rod	1	Vertical rod	Connects from part # 9 to 12 to stop rotation	Carbon Steel	Dia 3/8" length 72"	\$27.87	<a href="https://www.mcmaster.com/steel-rods">https://www.mcmaster.com/steel-rods</a>
14	Nut	2	Power screw tightener	fastens to part # 8 for tightening of horizontal pipes	Cast Iron	1.344" Dia 3/4" lngth	\$25.99	<a href="https://www.mcmaster.com/power-screws">https://www.mcmaster.com/power-screws</a>
<b>Total Cost Estimate:</b>							<b>\$838.46</b>	

# Budget Planning - Other Expenses



Final design: \$838

Prototyping (¼ scale model): \$250

Travel: \$100

Spare parts: TBD

Broken parts : \$200

Total estimated: \$1,390

**Thank You For Listening**

*Any Questions?*

# References



- [1] Startseite, Z. (2019). *Gallery Method - Methodos @ TU Braunschweig*. [online] Methodos.ik.ing.tu-bs.de. Available at: <https://methodos.ik.ing.tu-bs.de/methode/GalleryMethod.html> [Accessed 7 Oct. 2019].
- [2] “Carr,” McMaster. [Online]. Available: <https://www.mcmaster.com/>. [Accessed: 08-Oct-2019].