Christmas Ornament Display Structure

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Concept Generation and Selection

Document

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INTRODUCTION

The client, My Star of Bethlehem LLC, indicated that they do not have an aesthetically pleasing way to easily display their Christmas ornaments when marketing their products locally. Presently, when the company is promoting their products they use a square four legged tent with three tables setup underneath in a U-shaped configuration. The Christmas stars are both displayed on these tables and hung from the top of the tent frame.

The goal is to design a better way to display the Christmas ornaments when My Star of Bethlehem LLC is marketing their products to potential customers. This design will provide an effective means to display their products at trade shows, private properties, shopping malls etc. Currently, this display stand is being designed for promotional applications, however; it may also have potential consumer applications depending on cost and other design criteria.

CONCEPT GENERATION

The processes involved in design concept generation are brainstorming, discussing the designs that have been proposed, narrowing down those designs based on certain criteria and finally selecting the most viable design options to be considered for analysis and prototyping. During the brainstorming process team members present as many ideas as possible while taking into consideration that the only criteria is that the design provide a solution to the problem. This process often results in several designs that are easy to eliminate based on their practicality of application and manufacturing.

This practicality of design is another general criterion which sometimes causes the most extravagant and innovative designs to be eliminated. This tends to happen because the most creative designs are sometimes the least viable due to manufacturing or application restrictions. Through this process, the designs become more feasible in nature and fewer in number which results in a more concise design ranking and decision making process.

The final step in the concept generation process is to select a subset of the most practical designs based on design criteria. This process is intended to be carried out in an objective nature while assigning estimated values to the designs being considered. This data will be compiled into tables that will assist in making an informed decision based on a quantitative representation of how well each design meets certain criteria.

VIABLE OPTIONS

The following designs resulted from the concept generation process and were selected based on practicality, constraint satisfaction and project objectives.

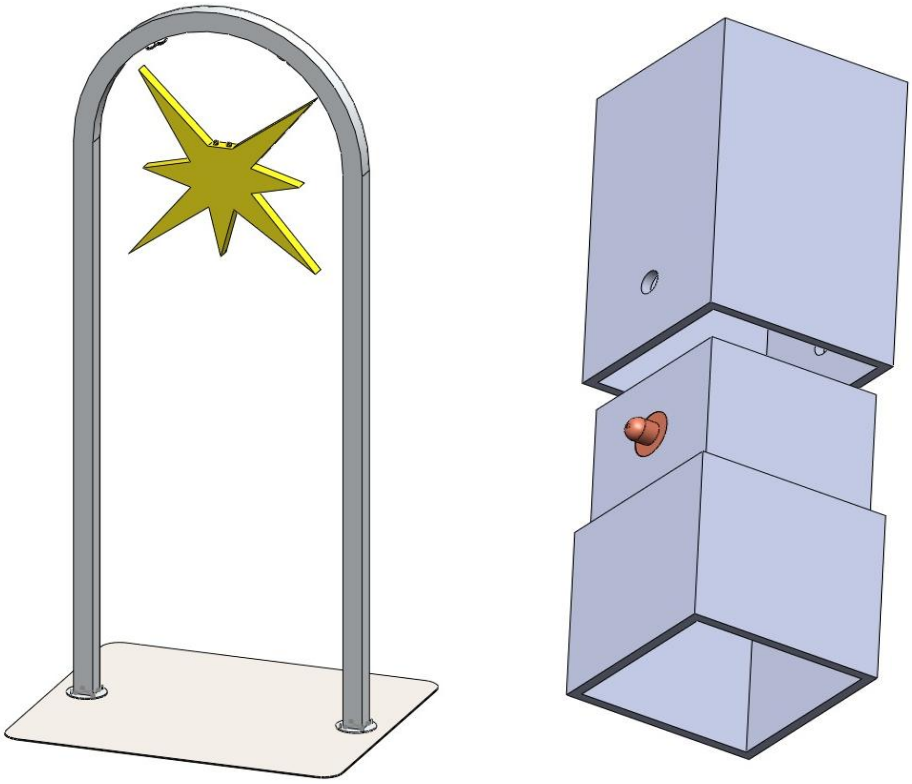

Figure 1: Design 1 – The Festive Arch

The Festive Arch is a design that resembles an altar from which the ornament will hang. This design incorporates four sections; the first section starting from the bottom is the base to which the support posts will mount. The second section, which includes both of the supporting posts, consists of two parts; these parts attach the base of the assembly to the remaining sections of the stand. The third section of the arch also contains two parts similar to those in the second section. The notable difference is that they serve the purpose of connecting the tubing mounted on the base to the arch using spring loaded locking pins which can be seen in Figure 1 on the right. The fourth section is the arch itself. The ornament will be suspended from two fastening cleats that are mounted on the underside of the arch using a rope that is provided in the ornament assembly kit. The electrical connection, which consists of a heavy duty cord, emerges from the ornament where it is missing a spire. This cord will be inserted in a hole underneath the apex of the arch and fed through the hollow square tubing. Upon reaching the base of the stand, the cord will be retrieved through a hole in the support post. This cord will be plugged into an electrical outlet thus illuminating the ornament.

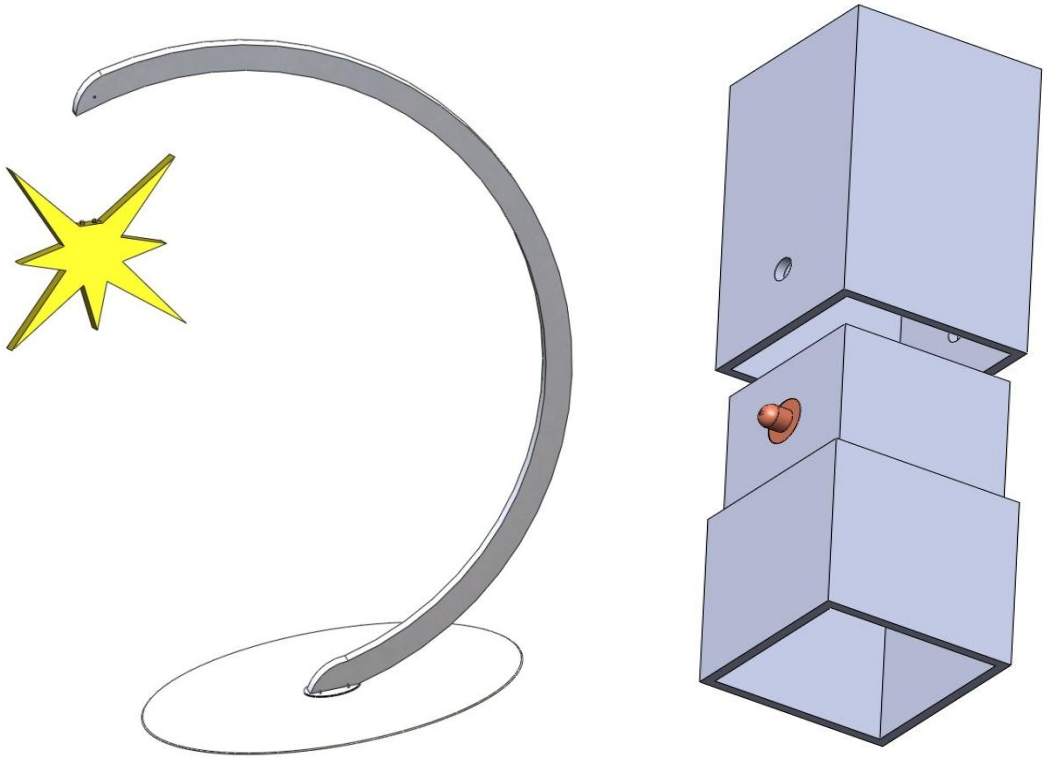

Figure 2: Design 2 – The Sideways Arch

The Sideways Arch, as shown in Figure 2, is similar to an egg shape and contains four sections. The first of these sections is the base to which the arch will be mounted. Studs embedded in the base will employ wing nuts to fasten the arch to the base. The second section contains the bottom of the arch that will facilitate the rest of the assembly. The third section is the middle of the arch that will be inserted between the first and final sections of the arch using spring loaded locking pins which can be seen on the right in Figure 2. Upon assembling the first three sections of the arch, the user will attach the ornament to the fourth section of the arch using the provided rope and the attachment holes at the tip of this section. The electrical cord will be passed through the hollow tubing via a hole underneath the fourth section. Once the plug located at the end of the cord reaches the most vertical section of the arch, located near the middle of the assembly, the plug will fall through a hole and allow the user to connect the cord to an electrical outlet.

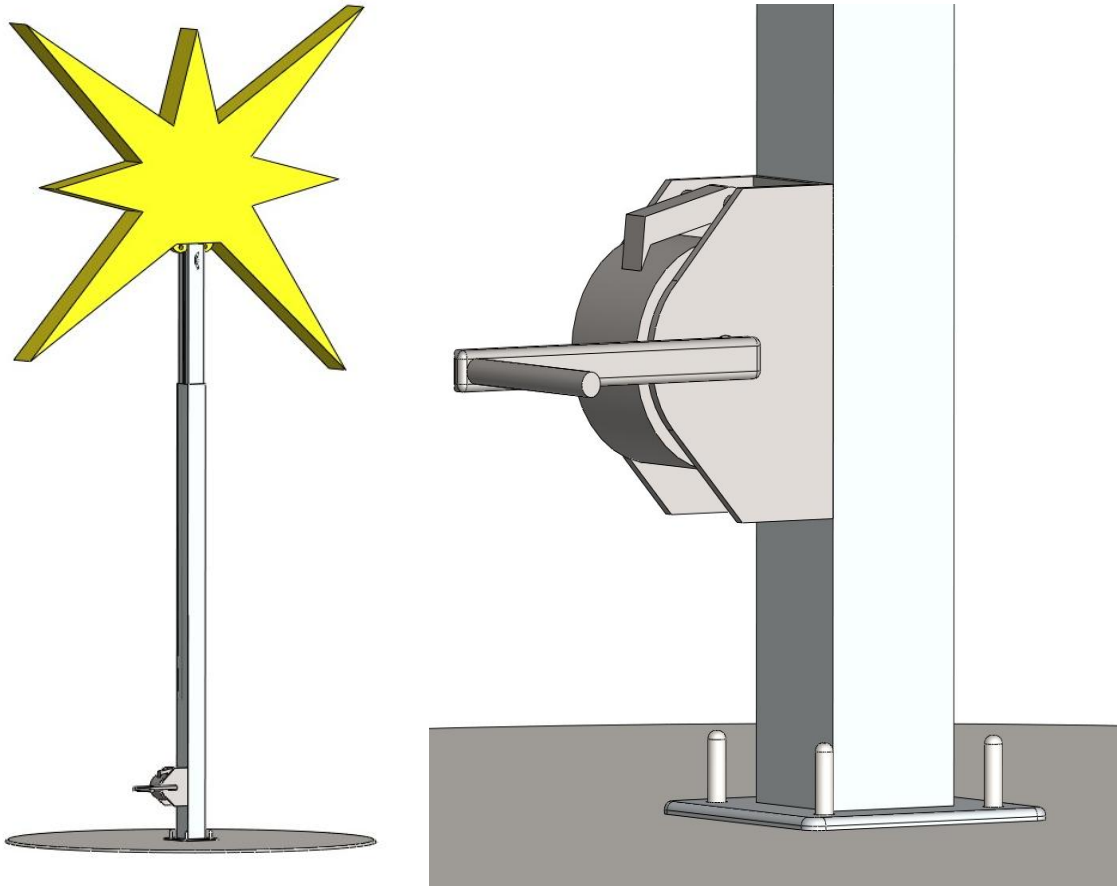

Figure 3: Design 3 – The Telescoping Light Post

The Telescoping Light Post is the only design that employs adjustable moving components and is comprised of two sections. The first is the base which secures the support post in the same way as the first two designs. This stand is designed to be collapsible to a height that is approximately half of the total height of the stand when fully extended. This collapsibility is accomplished by sliding the smaller top section into the bottom section. During assembly, the user will route the electrical cord down through the stand and out of a hole located at the base of the post. Then, the user must mount the ornament on top of the post using the provided rope and two small fastening cleats that are mounted on two opposing sides of the smaller top section of tubing. The post is equipped with a wench style crank that will shorten or lengthen a cable routed up the outside of the bottom section of tubing and inside of a crevice oriented along the length of the top section of tubing. This cable will be attached to the base of the top section of tubing so that when the cable is shortened, the top of the tubing will rise with the ornament attached to it. This assembly is very complex and will only be performed when the stand is manufactured. As such, the user's responsibility is only to feed the electrical cord through the hollow post and secure the ornament above.

CONCEPT SELECTION

During the concept selection process, two tables were used to rank the top three design options. The design options were then evaluated using the same criteria in another table which determined how the assumed performance of each design translated into design quality. This quality can then be used when comparing the designs to make a more informed selection when considering the designs for engineering analysis.

Table 1 ranked each design option according to criteria importance from most to least important where 1 is most important and 7 is least important. Eight criteria were utilized for this process which further differentiated the three designs. After speaking with the client, it was thought that The Telescoping Light Post would be better suited for promotional applications and that the two arch designs would be better suited for consumer applications. Keeping this in mind, two sets of the same eight criteria with different ranking systems were used in Tables 1 and 2. The Sideways Arch and Festive Arch received the same importance rankings assuming they would both be used for consumer purposes. As a result, these two designs had the same degree of importance. The Telescoping Light Post received a different set of scores assuming it would be used for promotional applications and thus incurred a different level of importance.

Table 1: Ranking design options from most important to least important

Design Option	Criteria							
	Assembly/Disassembly	Compact	lightweight	Height	Cost	Damage to Ornament	Life Expectancy	Recyclability
Telescoping Light Post	1	2	3	4	6	7	5	5
Sideways Arch	5	3	6	4	1	2	7	7
Festive Arch	5	3	6	4	1	2	7	7

Table 2 ranked each design by column with a numbering system from one to three where 1 = best, 2 = better and 3 = good. These scores were assigned based on several preliminary assumptions regarding design performance should each design be manufactured and tested.

Table 2: Ranking design options from best to good

Design Option	Criteria							
	Assembly/Disassembly	Compact	lightweight	Height	Cost	Damage to Ornament	Life Expectancy	Recyclability
Telescoping Light Post	1	1	1	2	1	1	1	2
Sideways Arch	3	2	2	1	3	1	2	1
Festive Arch	2	3	3	1	2	1	2	1

Using the same eight criteria as before with their corresponding units, Table 3 applies a range of numerical values to each criterion which assists in setting an achievable goal for these criteria that can then be applied to each design. Once a goal value is set for each criterion, a value on a standard scale from 1 to 8 can be assigned with its corresponding performance level. Each goal is assigned a numerical raw score which corresponds to a standard score found in the value column of Table 3.

Table 3: Criteria metrics used in design evaluation

Performance Level	Criteria Metrics								
	Value	Assembly/ Disassembly [min]	Compact [ft^3]	Lightweight [lb]	Height [ft]	Cost [$]	Damage to Ornament [$]	Lifetime [yr]	Recyclability [%]
Perfect	8	< 10.0	< 1.5	< 20.0	≤ 12.0	< 300	0.00	≥ 10.0	≥ 90
Very Good	7	< 12.0	< 1.8	< 25.0	≤ 11.0	< 350	< 3.00	≥ 9.0	≥ 80
Good	6	< 15.0	< 2.0	< 30.0	≤ 10.0	< 400	< 5.00	≥ 8.5	≥ 70
Satisfactory	5	< 20.0	< 2.2	< 35.0	≤ 9.0	< 450	< 8.00	≥ 8.0	≥ 60
Adequate	4	< 25.0	< 2.5	< 40.0	≤ 8.0	< 500	< 10.00	≥ 7.5	≥ 50
Tolerable	3	< 28.0	< 2.8	< 45.0	≤ 7.0	< 600	< 15.00	≥ 7.0	≥ 40
Poor	2	< 30.0	< 3.0	< 50.0	≤ 6.0	< 700	< 20.00	≥ 6.5	≥ 30
Inadequate	1	> 30.0	> 3.0	> 50.0	≤ 5.0	> 800	> 40.00	< 5.0	≥ 20

Table 4 is generated from Table 3. The raw score is obtained from the range of numerical values for each criterion in Table 3. The values on the standard scale similarly relate to the values in Table 3. Adding up the standard values, a total score is obtained from which a normalized score can be calculated. This is done by dividing the total score by the sum of all of the total scores. This decision matrix will assist in further design refinement, the goal of which is to obtain a single and best design option.

Table 4: Decision matrix

Criteria	Units	Design Option					
		Telescoping Light Post		Sideways Arch		Festive Arch	
		Raw Score	Value on Std. Scale	Raw Score	Value on Std. Scale	Raw Score	Value on Std. Scale
Assembly/ Disassembly	min	15	6	25	4	20	5
Compact	ft^3	1.5	8	2.8	3	3.9	1
Lightweight	lb	43	3.5	45	3	49	2.1
Height	ft	10	6	12	8	12	8
Cost	$	500	4	400	6	450	5
Damage to ornament	$	0	8	0	8	0	8
Lifetime	yr	10	8	10	8	10	8
Recyclability	%	90	8	90	8	90	8
Total			51.5		48		45.1
Normalized Total			0.356		0.332		0.312

PROJECT TIMELINE

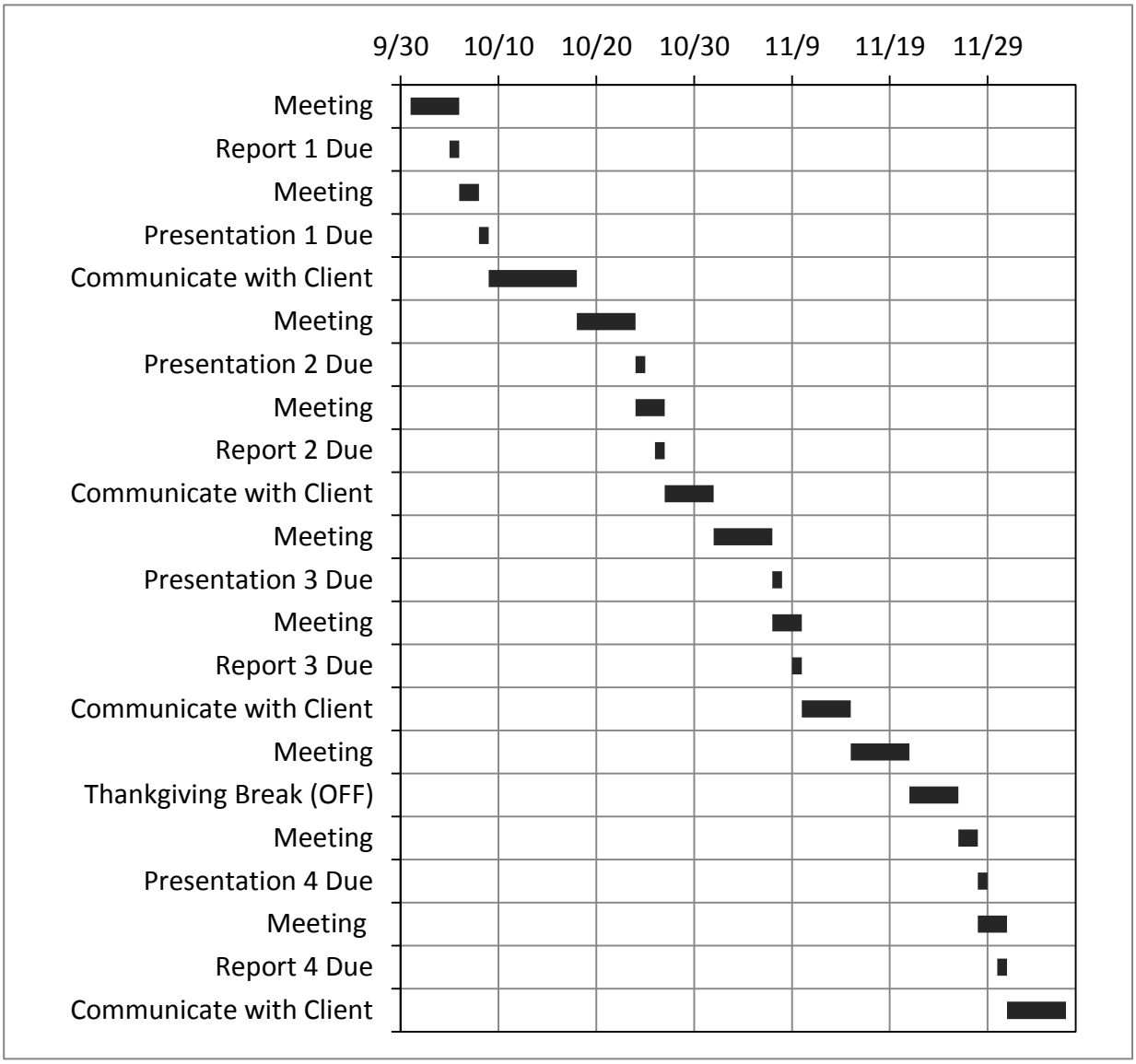

Figure 4: Project plan timeline

The project timeline represents the milestone events that occur throughout the design process. This graphical representation of a project timeline can be referred to throughout the design process and serves as a guide, ensuring that tasks are accomplished within the corresponding timeframe. The timeline features the aforementioned milestone events on the left column with their corresponding timeframe in chronological order on the right. The longer bars represent a duration over which an event takes place while the shortest bars represent deadlines. The dates are represented at the top of this chart in a time scale of 10 day increments.

CONCLUSION

Various designs were generated based on both the needs of the client and criteria relating to the constraints and project objectives. These designs were then analyzed and evaluated individually using multiple tables which resulted in numerical values that will assist in future analyses. The three designs consist of two fixed arches, and one design featuring a mechanical telescoping post. The two arch designs were more appealing for consumer applications while the Telescoping Light Post was better suited for promotional applications. Tables 1-4 were used to compare the three designs based on how they fared in eight different criteria which related directly to the project requirements. The project is currently on schedule with the Figure 4 timeline.

REFERENCES

[1] Otte, Dieter. (2012). *My Star of Bethlehem; The Star That Keeps on Giving*. Retrieved from http://mystarofbethlehem.com/