Faculty of Engineering

University of Ottawa

GNG 1103 C04 – Engineering Design

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Project Deliverable C: Design Criteria and Target Specifications

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Introduction:

In this project, our main objective is to design a durable, low-cost, and weatherproof bat box tracking system that allows bat conservationists in Canada to track bat visits without interfering its movements. To achieve this, this document will outline the client's interpreted needs, translating them into specific design criteria and will include all functional and non-functional requirements and the design constraints. A benchmarking analysis will also be conducted to evaluate similar products on the market, considering the specifications below. Additionally, a target specification table will be formed to ensure that our final design meets the necessary standards that our team put into practice. Finally, let us not forget the insights that we gained from our client meeting and how it reflects our design approach. Thus, as you can, this document, in general, will help us ensure that our final design meets our client's needs and expectations.

Table 1: Design Criteria Aligned with Interpreted Client's Needs

Interpreted Client's Needs	Design Criteria
The enclosure's size and dimensions are such that only bats will enter and use it	Bat Box Shape
	Bat Box Size (m^3)
The enclosure can withstand varying weather conditions reliably	Box's Face Thickness (m)
	Bat Box Color
	Material
	Ventilation System
The enclosure has only one opening for entry and exit	Bat Box Shape
The landing surface is notched and rough	Notch Shape
The enclosure has a built-in device that tracks and stores the number of bats that visit it over the summer season	Tracking Sensor
	Data Storage Media
The enclosure is easy to install and use	Bat Box Shape
	Weight (kg)
The tracking device does not interfere with the bats' natural movement	Tracking Sensor
The enclosure and device are low-cost	Cost ($)
The enclosure and device are easy to clean	Bat Box Shape
	Weight (kg)

Table 2: Design Functional and Non-Functional Requirements and its constraints

Functional Requirements	Non-Functional Requirements	Constraints
Track the number of bat visits	Aesthetics	Bat Box Size (m^3)
Attractive Bat Box Shape	Product life (years)	Eco-Friendly Materials
Predator-Proof	Lightweight for installation	Operating Conditions: Temperature (°C)
Number of bats supported (Bats)	Low-Maintenance	Operating Condition: Humidity (%)
Power Source for Sensor	Removable parts for cleaning	Entry/Exit Opening (m)
Data Stored Device	Weatherproof	Cost ($)

Table 3: Color Coded-Rating Scale

Colors	Numbers	Values
Green	3	High
Yellow	2	Average
Red	1	Low

Table 4: Technical Benchmarking Table for Bat Boxes

Specifications	Importance	Crevice Bat Box (Double Crevice) [1]	Mini Bat House – 1 Chamber [2]	Mini Single Chamber Bat House [3]
Company	-	Nestbox Company	PS Country Crafts	JCS Wildlife
Cost	5	£31.50 GBP ($56.14 CAD)	$60.00 USD ($81.49 CAD)	$51.37 USD ($69.77 CAD)
Weight	4	1.4 kg	9.5 lbs. (4.31 kg)	Not specified
Bat Box Material	2	FSC Certified Exterior Grade Plywood	Pine Wood	Recycled Poly Lumber
Bat Box Shape	2	Easy installation Removable roof	Easy installation Shingles Caulk sealant	Easy installation
Bat Box Size	3	(L 33 x W 16 x D 12) cm	(L 19.5 x W 11.5 x D 2.5)” (L 49.5 x W 29.2 x D 6.4) cm	(L 13.25 x W 7 x D 3)” (L 33.7 x W 17.78 x D 7.6) cm
Box’s Face Thickness	2	Not specified	¾"	Not specified
Bat Box Color	3	Black	Black or grey	Grey
Notch Shape	2	Grooved and notched	Large, netted landing	Notched with kerfs
Ventilation System	2	No	Optional	Yes
Tracking Sensor	5	No	No	No
Data Storage Media	4	No	No	No
Power Source	4	N/A	N/A	N/A
Total		80	69	65

Table 5: Target Specifications Table

	Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
	Functional Requirements				
1	Track the number of bat visits	=	yes	N/A	Test
2	Attractive Bat Box Shape	=	yes	N/A	Test
3	Predator-Proof	=	yes	N/A	Test
4	Number of bats supported (Bats)	>	15	Bats	Analysis
5	Power Source for Sensor	=	yes	N/A	Test
6	Data Stored Device	=	yes	N/A	Test
	Non-Functional Requirements				
7	Aesthetics	=	yes	N/A	Test
8	Product life (years)	<	8	years	Analysis
9	Lightweight for installation	=	yes	N/A	Test
10	Low-Maintenance	=	yes	N/A	Test
11	Removable parts for cleaning	=	yes	N/A	Test
12	Weatherproof	=	yes	N/A	Test
	Constraints				
13	Bat Box Size (m^3)	<	0.12	m^3	Analysis
14	Eco-Friendly Materials	=	yes	N/A	Test
15	Operating Conditions: Temperature (°C)	=	10 to 35	°C	Test
16	Operating Condition: Humidity (%)	=	40 to 60	%	Test
17	Entry/Exit Opening (m)	<	0.0254	m	Analysis
18	Cost ($)	<	150	$	Estimate, Final check

Client Meeting Reflection:

The client meeting provided important updates that influenced the design criteria and specifications. A key takeaway was the reinforced need for the enclosure to withstand varying weather conditions, including moisture, temperature fluctuations, and humidity, from April to October. This made weatherproofing a top priority, ensuring the bat box can last through these months without deterioration. Another crucial insight was the emphasis on the tracking system's accuracy. The tracking sensor must reliably count bat visits and store data without interfering with the bats' natural movements. The client stressed the importance of the system being both functional and cost-effective, with minimal maintenance. While there were no new requirements or changes to the existing needs from Deliverable B, the emphasis on weatherproofing and tracking accuracy has become more significant, guiding the design to align more closely with the client's expectations.

Conclusion:

In conclusion, the technical benchmarking analysis provided us with valuable insights, we didn't consider before, into existing bat box products, and helped us refine the design and ensure that our system aligns with industry standards. By comparing various bat box structures based on design specifications such as cost, material, ventilation, and size, we have identified the most effective design features to meet both functional and non-functional requirements and also the constraints. Additionally, the client meeting highlighted the importance of weatherproofing and tracking accuracy, guiding the development of a bat box that is not only durable and cost-effective but also capable of accurately monitoring bat visits without disturbing their natural behaviors. Thus, the results from benchmarking, combined with client feedback, ensure that our design will provide an optimal environment for bats while fulfilling the tracking needs of conservationists.

References:

[1] Crevice Bat Box (Double Crevice)

[2] Mini Bat House – 1 Chamber

[3] Mini Single Chamber Bat House