Design Criteria and Target Specifications

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By Gruop 3.1

Introduction:

In this document we will determine the design criteria involved in creating a GCHE system to be used in a household application. The need determined in the previous document will be used in this one to create design criteria for the product. This document will also benchmark systems that are already on the market to try and improve our system. We will then create design specifications for our final product.

Design Criteria:

To explore one alternative system, the needs of the client were further defined by design criteria. These design criteria are used to address what parts of the process need to be worked on to satisfy the clients needs.Additionally, the design criteria were organized into three different types: functional criteria, non-functional criteria and design constraints. Functional criteria are attributes that affect the functionality of the application,while non-functional attributes do not. Design constraints are an essential part required by the client that must be factored into the design.

Need	Design Criteria
1. Maintenance costs should be made low so homeowners can save money.	- Low number of moving parts - The system is calculated at 35-40 years
2. Pipes to get air to the house.	- Discharge dirty air
3. Small fan to blow air around.	- Access to fresh air
4. Can switch between solar panels and other energy sources.	- Use solar panels - Use other energy sources
5. Thermal storage medium (water + clay).	- More cheaper - Save heat more easily - Cost.
6. The device should be able to raise its temperature to about 20°C during winter.	- Ensure proper operation of the thermostat in winter - Ensure adequate power supply
7. You will not need a solar water heater in summer.	- According to the client need

8. When operating as a closed loop the box will need to get fresh air without opening the air inlet.	- Install dumpers that allows either close or opened operation
9. Large box(Heat Exchange chamber) to hold air underground. Must be at least 6 ft under ground.	Size for box : - max height. (M) - max width. (M) - max length. (M) - minimum depth. (ft).
10. Box requires a sump pump.	-Ensure that the power of sump is sufficient -Work normally at least 6 ft underground
11.Cheap and recycled materials can include Aluminum, Plastic, and Concrete.	Material properties: - weight. (kg) - wear. - density. (kg/m^3) - heat transfer.
12. Be small enough to be installed in a “Standard townhouse yard.”	Size consideration: - min length. (M) - min width. (M) - Max Area: (M^2)
13. When operating as a closed loop the HEC will need to get fresh air without opening the air inlet.	- Ensure air circulation

Functional Critera	Non-Functional Criteria	Design constraints
- 22-23 C during winter - Zero emissions - Control system - Vent operation	- Looks - Material - Life span (years) - Reliability - Location	- Low cost - Available on different season - Size (M^3) - Operatic conditions: temperature. - Weight (kg)

Target Specifications:

Functional requirements:

	Design specification	Relation	Value	Units	Verification method
1	**Temperture control**	**=**	**22-23**	**ºC**	**Test**
2	**Emission**	**=**	**0**	**N/A**	**Test**

3	Control system	=	Yes	N/A	Test
4	Vent operation	=	Yes	N/A	Test

Non-functional requirements:

	Design specification	Relation	Value	Units	Verification method
1	Looks	=	Yes	N/A	Test
2	Life span	>	40	Years	Test
3	Reliability	=	Yes	N/A	Test
4	Material	=	Yes	N/A	Test
5	Location	=	N/A	N/A	Test

Constraints:

	Design specification	Relation	Value	Units	Verification method
1	Cost	<	20,000 - 30,000	CAD	Estimate/ Final check
2	Available different seasons	=	yes	N/A	Test
3	Maxmum Area	<	140	M^2	Estimate/Final Check
4	Operation conditions:	=	-60.8 to 49.6	ºC	Test
5	Weight	<	N/A	KG	Test

Technical Benchmarks:

Heating system: Specifications:	XL16I	S9V2	GHEX	NIBETM F2040
Company:	Trane®	Trane®	CaliforniaGeo	Geoexchange
Cost:	4,800 $	4,500 $	4,465 $	7,807 $

System:	Cooling	Heating	Heating & Cooling	Heating & Cooling
Life span:	15 Years	15 Years	10+ Years	25 Years
Size	Medium	Medium	Varied Smallest	Varied (Can be very small)
Closed Loop	No	No	Yes	Yes

	Importance	XL16I	S9V2	GHEX	NIBETM F2040
Cost:	3	1	2	3	1
Life span:	3	2	2	1	3
Size:	5	1	1	3	2
Closed Loop:	2	2	2	3	3
Total		18	21	33	28

Compare:

NIBETM F2040 is the most expensive type, the cost of the GCHE system (20,000-30,000) is higher than other brands. Although it is highly practical and the life span is longer, it is not enough to attract users. More ways should be found to reduce the product cost so that more users can use the product economically.

NIBETM F2040: https://www.geoexchange.com.au/ground-heat-exchanger/

Trane XL16I: https://www.trane.com/residential/en/products/air-conditioners/xl16i-air-conditioners/

Trane S9V2:https://www.trane.com/residential/en/products/gas-furnaces/s9v2/

Wrike:

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=iv6IXjzJcV4FUxHJpbBc6bsbxZ9szfSp%7CIE2DSNZVHA2DELSTGIYA