

Deliverable C



uOttawa

GNG 1103

Group D-1.4

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Submission date : 09 February 2022

Introduction :

Design criteria are requirements that allow to conceptualize the product based on interpreted **needs**. Essentially, these criterias are divided into functional requirements, non-functional requirements and constraints. Once the interpreted needs have been translated into design criterias, technical **benchmarking** can be performed which entails research of other similar products/parts available in the market. In particular, the goal of this type of benchmarking is to compare/hierarchize technical specifications and ideate some leads for the future product. Finally, the conclusion consists of a list of target **specifications** of the most relevant design criterias. Primarily, deliverable C focuses on the determination of measurable design goals which will help to elaborate the final solution accordingly.

Part 1: Design Criteria :

#	Needs	Design Criteria
1	The system has to extract its energy from the ground	<u>Extracts energy from the ground</u>
2	-It should be sustainable and environment friendly -It should not use any fossil fuels	Sustainable design/materials Environmental friendly energy source Product life
3	The system must allow heating, ventilation and air conditioning	Capable of basic HVAC system Thermal conductivity Specific heat capacity
4	The heating chamber is buried underground	Depth of more than 10 ft
4	-The heating chamber should be maintained at a constant temperature -The targeted temperature range is around 22/ 23°C -The system functions by a regular thermostat	Heats up/down to 22-23 °C Temperature range (°C)
5	-It must be inexpensive to install and to maintain compared to other HVAC systems	Low cost
6	The chamber shouldn't take a lot of space	Small in size: 12x7x7 (ft) or smaller

7	-Pipes can be sloped to collect condensation that could lead to health problems	Minimal weight
8	- Can be installed in both existing buildings and new constructions	<u>Adaptability</u>
9	-No need for maintenance: the only moving part is the blower fan which can be serviced or replaced when it malfunctions -The system should be long-lasting (35-40 years)	Self Sustainable Maintenance level
10	-Low tech: a technology utilizing equipment and production techniques that are relatively unsophisticated (opposite of high-tech).	Low cost Simple operation
11	-The facility should be located in the most accessible location of the building and is case specific	Thermostat installation
12	-An air filter can be installed at the blower -There should not be any unpleasant smell	Type of air filter/air control system
13	-The facility should be located in the most accessible location of the building and is case specific	Easily accessible

Part 2: Technical benchmarking of parts :

1- Tube material :

	Copper Piping	Aluminum Piping
Company	<i>Lebronze Alloys</i>	<i>Granges</i>
Price	High cost-variable	Low cost-variable
Thermal conductivity at 20°C	386 W/(m K)	237 W/(m K)
Specific heat capacity	0.385 J/(g °C)	0.44 J/(g °C)
Malleability/flexibility	Low (hard to shape)	High (easy to shape)
Material density	Heavy weight	Lighter weight
Sag resistance during manufacturing	High	Low
Resistance to corrosion	Prone to oxidation	Corrosion resistant

<https://matmatch.com/resources/blog/materials-heat-exchanger/>

	Importance	Copper Piping	Aluminum Piping
Company		<i>Lebronze Alloys</i>	<i>Granges</i>
Price	4	1	3
Thermal conductivity at 20°C	5	3	1
Specific heat capacity	4	2	3
Malleability/flexibility	4	2	3
Material density	3	1	2
Sag resistance during manufacturing	3	3	1
Resistance to corrosion	4	1	3
Total		51	62

2- Air Inlet :

	AIRLET™ TL98	DUNDAS-JAFINE Fresh Air Intake	FAMCO SWVA wall vent
Company	ALDES	DUNDAS-JAFINE	FAMCO
Control	(Damper) Manual: Discrete sliding control		gasketed backdraft damper

Filter	Standard filter + pollen filter optional		1/8 inch insect screen
Size	4"-8" Sleeve	6" intake cap and 6" diameter aluminum pipe Height of package: 9.90 in Width of package: 9.50 in	from 4 inch to 12 inch diameter
Price	\$67.20 USD	\$19.49 /EA	\$45.95 – \$84.00
Material		Aluminum	28 gauge galvanized steel
Installation locations		On brick/ concrete/ siding	

ALDES AIRLET™ TL98: [Aldes Airlet TL98 Spec Sheet.pdf \(hvacquick.com\)](#)

DUNDAS-JAFINE Fresh Air Intake: [Dundas-Jafine 6" Fresh Air Intake, with Tail | Home Hardware](#)

FAMCO SWVA wall vent: [Wall Vent w/ Reversible Damper - Galvanized Steel | FAMCO \(famcomfg.com\)](#)

	Importance	AIRLET™ TL98	DUNDAS-JAFINE Fresh Air Intake	FAMCO SWVA wall vent
Company		ALDES	DUNDAS-JAFINE	FAMCO
Control	3	3		3
Filter	4	2		2
Size	4	1	2	3

Price	3	2	3	2
Material	5		3	2
Installment locations	2		2	
Total		27	36	32

3- Thermostat :

Thermostats	Honeywell Home RTH2300B1038	Lux TX500U-A04	Nest T3008US
Price	CA\$35.75	CA\$58.67	CA\$219.00
Functionality	Basic programmable	5-2 day programmable	Smart
Build	Plastic	Plastic	Stainless Steel
Software Compatibility	None	None	Android & iOS via Nest app
Dimensions	8.9 x 2.5 x 12.1 centimeters	12.4 x 7.9 x 2.9 centimeters	8.382 x 8.382 x 1.0668 cm

Honeywell Home RTH2300B1038 : https://www.amazon.ca/Honeywell-Programmable-Thermostat-RTH2300B1038-E1/dp/B00CTSY6G0/ref=sbs_1/146-0798222-8054421?pd_rd_w=4Opqa&pf_rd_p=73befcf5-5444-47d0-9d11-73348354c83d&pf_rd_r=RNYRKD38VTKZVY92X362&pd_rd_r=d8ef47a3-d16b-4327-8078-660b15d97a66&pd_rd_wg=26VI1&pd_rd_i=B00CTSY6G0&psc=1

Lux TX500U-A04 :

https://www.amazon.ca/dp/B00F19KW0S/ref=as_li_ss_tl?language=en_US&ie=UTF8&linkCode=gs2&linkId=af27dc724ac6fc0f447d44987c948013&tag=msnshop04-20

Nest T3008US : <https://www.walmart.com/ip/Nest-Learning-Thermostat-3rd-Generation/47000649?athcpid=47000649&athpgid=Athenaltempage&athcgid=null&athznid=si&athieid=v0&athstid=CS004&athguid=KI8GpsBvIntfLYYGLLjXy9CqEIKFkfzoRHb1&athancid=null&athena=true>

	Importance	Honeywell Home RTH2300B1038	Lux TX500U-A04	Nest T3008US
Price	4	4	3	1
Functionality	5	3	2	4

Build	3	2	2	4
Software Compatibility	3	N/A	N/A	4
Dimensions	4	2	3	2
Total		45	40	56

4- Sump Pump :

Sump Pump	Product	Cost (CAD)	Material	Power Source	Dimensions	Weight	HorsePower	Flow Rate (gallons/minute)
https://www.amazon.ca/dp/B0062FTMV0	Superior Pump 91250	109	Thermoplastic	AC	17.78 x 17.78 x 30.48 cm	3.54 Kilograms	0.5	30
https://www.amazon.ca/dp/B000X05G1A	Wayne CDU1000	314	Stainless Steel	Battery	20.32 x 20.32 x 30.48 cm	8.62 Kilograms	1	102
https://www.amazon.ca/dp/B07H4S6X9N	Wayne WSS30V	636	Cast Iron	Battery (12 volt)	59.69 x 46.36 x 35.56 cm	16.87 Kilograms	0.5	48.3

Best
Medium
Worst

- https://www.amazon.ca/Wayne-Submersible-Stainless-Integrated-Vertical/dp/B0062FTMV0/ref=sr_1_6?keywords=WAYNE+CDU980E+3%2F4+HP+Submersible+Cast+Iron+and+Stainless+Steel+Sump+Pump+With+Integrated+Vertical+Float+Switch&linkCode=gs3&qid=1644178682&sr=8-6
- <https://www.amazon.ca/dp/B07H4S6X9N?linkCode=gs2&tag=spottingSCO0d-20&th=1>
- <https://www.amazon.ca/dp/B000X05G1A?linkCode=gs2&tag=spottingSCO0d-20&th=1>

	Importance	Superior Pump 91250	Wayne CDU1000	Wayne WSS30V
Cost	4	3	2	1
Material	3	3	2	2
Power Source	3	3	1	2

Dimensions	4	3	2	1
Weight	3	3	2	1
Horse Power	4	2	3	2
Flow Rate	5	1	3	2
Total		64	58	41

5- Chamber Box :

	Product	Cost (CAD)	Material	Dimensions (ft)	Weight (lb)	Coverage (sq.ft)
https://www.e	VENMAR PRO 250	1,917.26	Metal	2.28 x 2.26 x 1.5	54.4	up to 3,000
https://www.e	BROAN HRV 5.1	1,794.30	Polypropylene	3.3 x 1.7 x 1.3	54.2	Up to 2,700
https://www.e	Fantech Flex 100H	971.29	Metal	1.75 x 1.42 x 2	46.01	up to 1,000

	Best
	Medium
	Worst

- [Recirculating Heat Recovery Air Exchanger | eBay](#)
- [Heat Recovery Air Exchanger | eBay](#)
- [Fantech Heat Recovery Ventilator | Wayfair.ca](#)

	Importance	VENMAR PRO 250	BROAN HRV 5.1	Fantech Flex 100H
Cost	4	1	2	3
Material	5	3	2	3
Dimensions	5	2	1	3
Weight	3	1	2	3
Coverage	4	3	2	1

Total		44	37	55
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6- Furnace Blower :

Furnace Blower					
	Product	Cost	RPM	Horse power	Weight
https://allaroundindustriessupply.com/product/emerson-1865-48-frame-direct-drive-blower-motor-12-hp-115-volts-1075-rpm/	U.S. Motors Emerson 1865	131.13 CAD	1075	0,5	8.00 lbs
https://www.oemhvacpartscanada.ca/products/ge-3583-motor-115v-1050-rpm-1-4-hp-3-speed.html	GE 3583 Motor	180.00 CAD	1050	0,25	12.00 lbs
https://www.oemhvacpartscanada.ca/products/furnace-blower-motor-p257-8585-canada-1-3-hp-115v-1075-3-speed.html	Furnace Blower Motor P257-8585 Canada	194.96	1075	0,3333333333	10.00 lbs
	Best				
	Medium				
	Worst				

U.S. Motors Emerson 1865 : <https://allaroundindustriessupply.com/product/emerson1865-48-frame-direct-drive-blower-motor-12-hp-115-volts-1075-rpm/>

GE 3583 Motor : <https://www.oemhvacpartscanada.ca/products/ge-3583-motor-115v-1050-rpm-1-4-hp-3-speed.html>

Furnace Blower Motor P257-8585 : <https://www.oemhvacpartscanada.ca/products/furnace-blower-motor-p257-8585-canada-1-3-hp-115v-1075-3-speed.html>

	Importance	US Motors Emerson 1865	GE 3585 Motor	Furnace Blower Motor P257-8585
Cost	4	3	2	1
Airflow	5	3	2	3
Horse Power	4	3	1	2
Weight	2	3	1	2
Total		45	24	28

Part 3: Target specifications :

1- Functional requirements :

- Be able to heat to 22-23 degrees celsius
- Be self sustainable
- Able to install in new and existing buildings
- Able to extract energy from ground
- 10 feet of clay soil installed around the box
- System strong enough to be buried

2- Non-functional requirements :

- Environmentally friendly
- Long product life
- Easily accessible
- Easy installation
- Reduced technology

3- Constraints :

- Weight
- 4ft x 2.5ft x 2.5ft in size
- Cost
-

Target specifications according to each part :

Part	Target specifications	Metrics
Tube Material	must have a high thermal conductivity	350-400 W/(m K)
	must have a low thermal capacity	0.30-0.40 J/(g °C)
	must be flexible with high ductility	N.A
	must be corrosion resistant	N.A
	wants to be lightweight	around 0.1 lb/in ³
	wants to have a high sag resistance	N.A
	optimal tube material: aluminum	N.A
	must have damper control	N.A
Air Inlet	Must have a proper diameter	4-12 In
	must be made of aluminum	N.A
	wants to have a filter	N.A
Thermostat	must be smart	N.A
	must be made of stainless steel	N.A
Sump Pump	must be made of thermoplastic	N.A
	must have an AC power source	N.A
	must have a proper size	18x18x30 cm
	Wants to have a proper weight	3-15 kg
	Wants to have a sufficient horse power	at least 1/2
	Wants to have a high flow rate	at least 50 gallons/min

Chamber Box	Must be made of metal	N.A
	Must have the right size	4ft x 2.5ft x 2.5ft
	must have a proper weight	45-50 lb
	must have a sufficient coverage	2500-3000 sq.ft
Furnace blower	Must have a high RPM	1075
	Must have a sufficient horse power	At least 1/2
	Wants to be lightweight	Around or less than 10 lbs

Part 4 : Client Meeting Reflection :

Using the information the client has supplied to us, we were able to better understand the specifications he wants in the design. Understanding these needs, we can do benchmarking and compare current product specifications to each other to create a competitive final design for the client. Furthermore, empathizing with the client answered a lot of our initial uncertainties and a number of questions to the project. As a result, this allowed a greater comprehension of the desired system where we were able to translate all the relevant needs into design criterias.