EMS402U – Engineering Design

Coursework Cover Sheet

Design Project Report

Due date: **23:55 on 16th December 2021**

Complete this page and copy it into your submission as your coursework title page.

Team Number: 34

Project Name: Rain Harvesting Tank for Irrigation

All Team Members:

SURNAME, First Name(s)	Student ID Number
ISPAS, Ioana	210061590
JAMJOOM, Abdullah WF	200396381
JAVED, Mohammed M	200921161
JASIM, Firas	210331806

Team Members who have not contributed to this assignment:

SURNAME, First Name(s)	QM Email Address

What do we do?

We are a London based company that works to improve the sustainability and practicality involved in water storage systems and methods. We specifically look into improving the environmental sustainability involved in irrigation systems, as hoses and other domestic methods tend to be wasteful and more costly in the long run. We cater for both domestic and agricultural needs, from garden irrigation systems to greenhouses and even sizeable farmlands. Through the use of our extensive tank size range and intelligent pump system, we can help you find a sustainable answer to any arid weather problem.

Brief:
The client in question is interested in finding an alternative to the hose for watering their garden plants. They are considering investing in a rain harvesting tank, however the designs currently available are not an aesthetically pleasing match for the client's taste. Design a rainwater harvesting tank that functions appropriately to create a sustainable plant irrigation system whilst keeping the aesthetics of the product in consideration with the clients wants and needs.

In response to our client's request, we have made a quote based on their current garden space. The client is looking to use this tank for watering his garden plants, but not much else.

Quote:
Garden size: 140 square metres
Average water needed a day for plants in that space: 20 litres

Table 1: The 5W's

5W's	
Who	The client, the one who is interested in finding the alternative to the hose to water their plants.
What	Rainwater harvesting tank, its purpose is to replace the hose.
When	This tank will be used during the rain to filter and process the rainwater for the users' plants. The client wants this product concept designed by 16th of December.
Where	We are based in London; it will be used in gardens or greenhouses. The tank will be situated in the users back garden and sizing are mainly focused on average sizes of London back gardens.
Why	The Rain Harvesting tank is used as a sustainable replacement for regular everyday hoses used in gardening. This tool aims to reduce water consumption highlighting its importance.
How	**How big:** For this item, we offer standard and large sizes. Based on the needs of this client, the water tank size needed would be a standard 1000-liter tank. This should be able to store a weeks' worth of irrigation water based on the size of their garden, with some extra water to spare in case rain is scarce. **How long:** As excavation work is needed, the tank installation time may take up to 5 days. This may cause some disruption, but care will be taken to ensure that everything is replaced accordingly. **How much:** The cost of the tank plus the filter would total around £1000, yet the construction costs may increase this price tag based on the final design choice.

Table 2: Versus table

	Function	Aesthetics	Cost	Environmental Impact	Reliability	Quality	Weighting
Function	----------	1	1	0	1	0	3
Aesthetics	0	----------	1	0	0	0	1
Cost	0	0	-----	1	0	1	2
Environmental Impact	1	1	0	----------	1	0	3
Reliability	0	1	1	0	----------	**0**	**2**
Quality	1	1	0	1	**1**	----------	**4**

Table 3: Explaining the aspects on the Versus Table

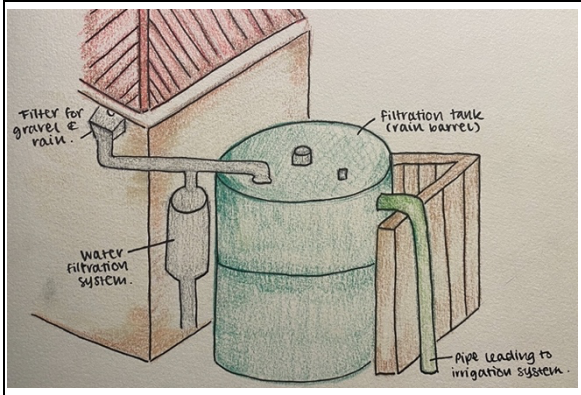
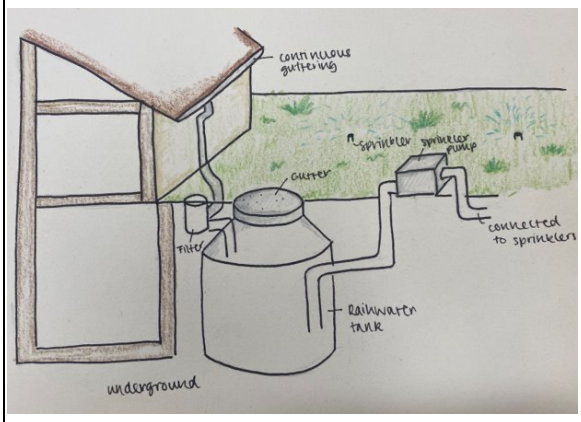
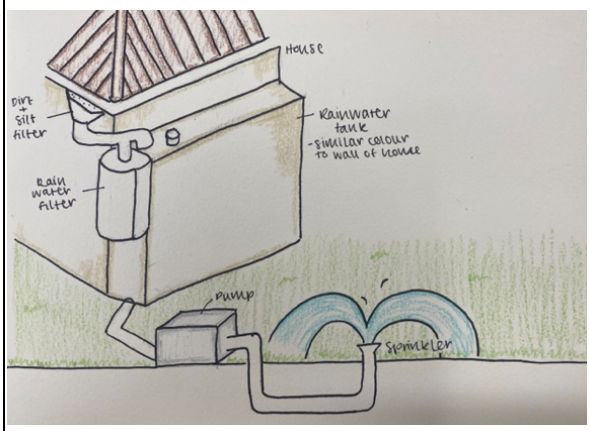
Function:	Ensuring that the water tank concept works properly and achieves its' expectations.
Aesthetics:	Whether or not the water tank looks appealing to the buyer.
Cost	The cost covering the tank materials and distribution. Installation costs not included.
Reliability:	This dictates whether the tank will consistently work up to standard or if, for example, the power generated by it is inconsistent.
Quality:	The materials used and if it's been built well. For example, as a water tank it would need a material which is waterproof and will not wear down by the rain.

Based on the Versus table, we can deduce that the most important factors we need to focus on are Function, Environmental Impact, and Quality. All these factors can be met by ensuring the materials used are sustainable and resistant, as this improves all three.

Materials: To further improve the sustainability of the product, we believe that the materials used should be as environmentally friendly and long lasting as possible. A beneficial solution for this is using bioplastics for the main build-up of the tank, as the material doesn't biodegrade, but is also made out of naturally viable components. Another viable choice would be the use of scrap metals to build up the outside.

DESIGN IDEAS

Table 5: showcasing the different design ideas

Design	Description	How does it work?
	Concept 1 follows the more traditional styling of a water tank, which is known to be simple and effective. However, this design may be unsuitable for the client, as the tank appears garish and stands out too much.	Water is collected via a pipe connected to the guttering, which has a sediment filter connected at the top. **Installation:** This style provides a relatively simple installation process, in which the already prepared tank is installed and connected to the respective pipes.
	**Concept two** is a traditionally sized rainwater tank which is built underground. This eliminates the aesthetic issue that the client has, as the tank in question isn't visible at all in this case. The tank is directly below a gutter which collects all the water. The gutter can be positioned close to the pipes to reduce hassle and minimise negative visual effect overall.	Like in concept one, water is collected from a continuous guttering system and goes through a filter. In this design however, water can also be collected via the gutter, and, after a quick filtration process, it goes straight into the tank. A pump can again be connected via a pipe to this underground tank and then to the garden sprinklers. **Installation:** The ground needs to be excavated to allow space for the tank, which will require a maximum of 5 days disturbance for the client.
	**Concept three** consists of a rainwater tank that has a rectangular shape instead of a traditional cylindrical one. This is mainly in order to prevent it from standing out too much and looking garish. The colour of the tank would match that of the wall, to further improve aesthetics. The one thing that stands out in this design is the rainwater filter, which adds a bit of bulk but not too much.	Rainwater is collected from the gutter system near the roof. The drain has a silt and dirt filter which removes large particles from the rainwater. The rainwater filter then filters out any other debris or impurities. When the plants need water and the tank is full above the minimum level, the water travels through the pipe to the pump, which is connected to any sprinkler positioned in the garden. **Installation:** The tank can be manufactured off site and then transported and fitted to the client's house by professionals.

Decision Matrix

Table 4 shows a decision matrix evaluating the 3 concepts against the attributes.

		Concept 1		Concept 2		Concept 3	
Attribute	**Weight**	**Score**	**Result**	**Score**	**Result**	**Score**	**Result**
Function	**3**	7	**21**	7	**21**	5	**15**
Aesthetics	**1**	6	**6**	9	**9**	4	**5**
Cost	**2**	7	**14**	6	**12**	8	**16**
Environmental Impact	**3**	8	**24**	8	**24**	6	**18**
Reliability	**2**	5	**10**	6	**12**	4	**8**
Quality	**4**	8	**32**	8	**32**	7	**28**
Total		**41**	**107**	**44**	**110**	**34**	**90**

The decision matrix depicts which concept would perform the best and fulfil the buyer's needs. According to the matrix, concept 2 will be the final concept which will proceed to be manufactured. Concept 1 scored 107 points, concept 2 scored 110 and concept 3 scored 90. Concept 2 is the sprinkler with the underwater tank. Although this will be expensive, aesthetically it will fulfil the buyer's needs. The function, environmental impact, and quality scored the same for both concept 1 and 2. In everything else excluding cost, concept 2 scored higher making it a more satisfactory choice. Cost scores lower for concept 2 as it's more expensive to install underground. As the accumulated points show, concept 2 is still the best design for the buyer.

Refinement step:

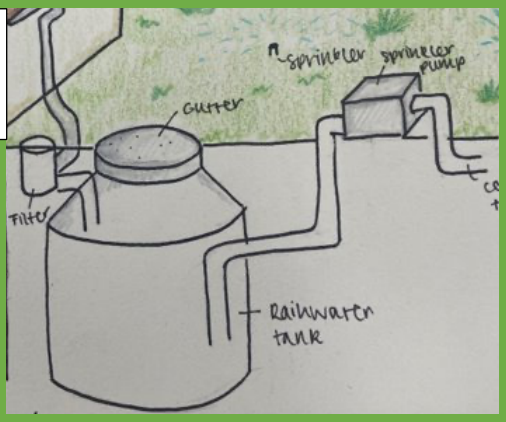
After discussing the final design with our client and other start-up companies, the most common question asked was 'How do you know how much water is left in the tank if its situated underground?'. To answer this, we came up with the idea of using sensor technology in our design.

The sensor technology we will implement helps the user know how much water is left in the tank and calculates the amount of watering time left in that amount. To further improve efficacy and ensure easy monitoring of the system, the sprinklers can be turned on and off via an app connected to the sensors. The user can choose to receive notifications on whether the soil needs to be watered, thanks to a soil moisture sensor. These features ensure that the client uses the right amount of water without needing to overdo it.

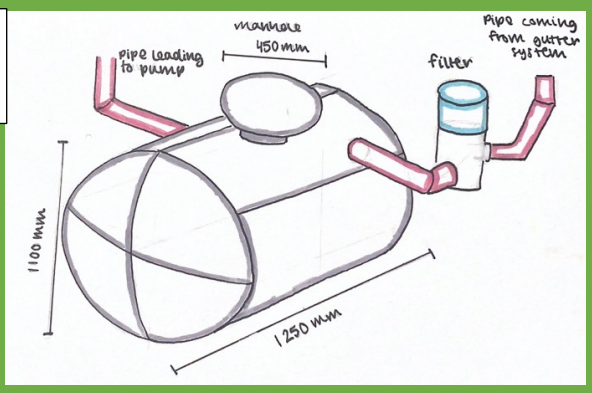
Size refinement: As discussed at the beginning, the tank would hold around 1000 litres when at full capacity. We decided that the best decision for the client in regard to the manhole, its size would be somewhere around 450mm, in order to ensure that maximum amount of water is transferred to the tank, yet the manhole size isn't too large so as to not make the garden aesthetically displeasing. Furthermore, the decision was taken to switch from an upright tank to placing it on its side, as this would make the digging depth smaller.

Shape of the tank before and after the refinement step:

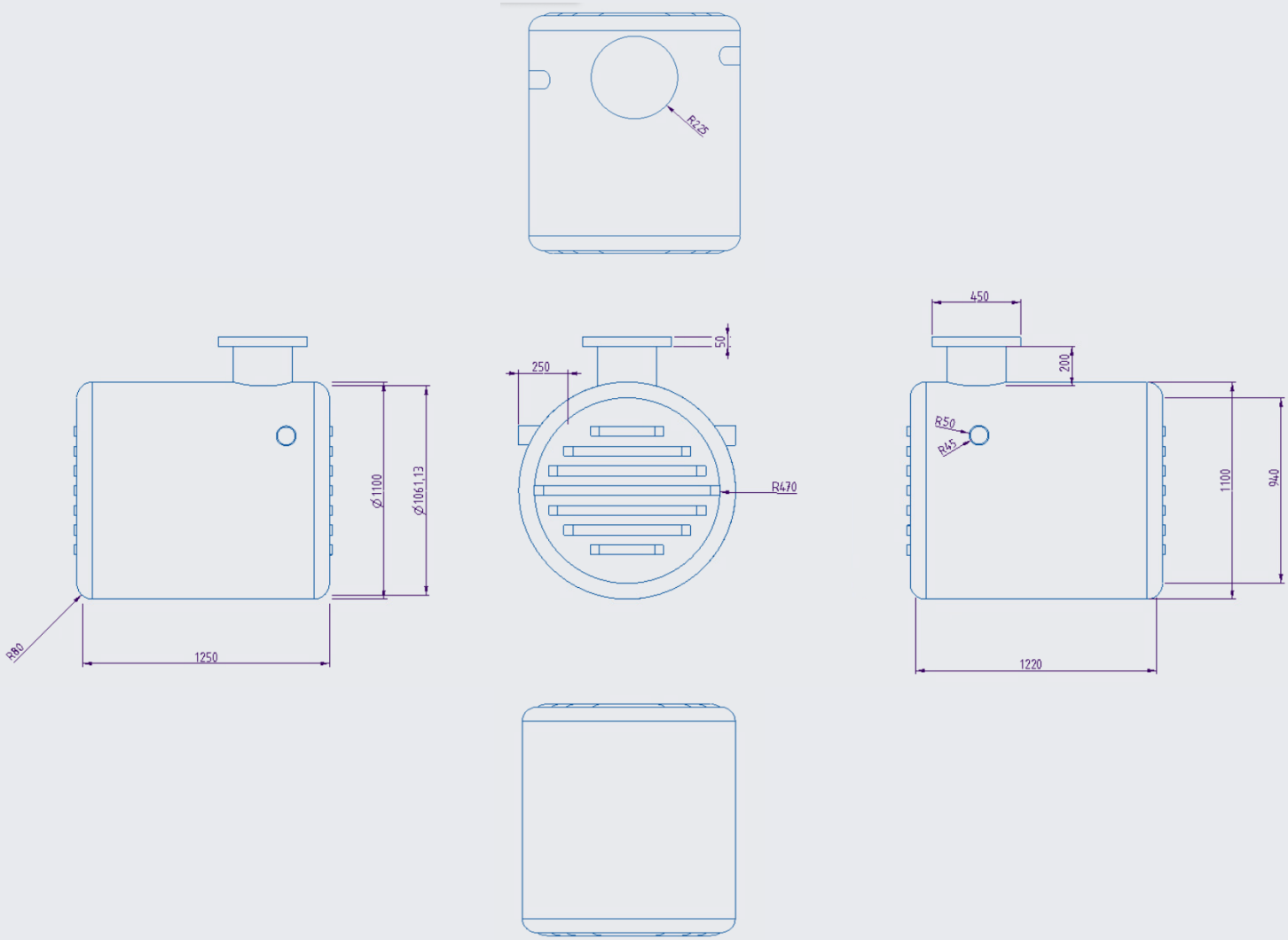
Before



After



ORTHOGRAPHIC DRAWING OF UNDERGROUND TANK



3D VERSION OF FINAL DESIGN