UNIVERSITY OF WOLLONGONG
Faculty of Engineering and Information Sciences
ENGG941 Sustainability for Engineers, Scientists and Professionals

PEER ASSESSMENT FORM

Assignment Title: Analysis of Building Sustainability

Please list the contributions of each group member for this assignment.

Student Name Student Number Contribution (%)

Student Name	**Student Number**	**Contribution** (%)
Student A	7289315	25
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Total		100

We the undersigned agree that the above is a fair and proper assessment of individual contributions to the above assignment.

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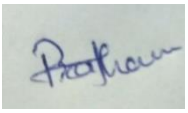
Signed:  date: 27-05-2022

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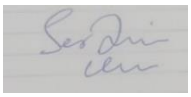
Signed:  date:27-05-2022

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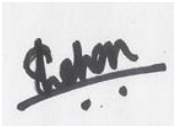
Signed:  date: 27-05-2022

OBJECTIVE

The objective of increasing water thermal and energy performance is to build a sustainable environment for the future generation and limit the consumption of natural resources. Earth only comprises only 3% of freshwater and only 1.2% water can be used for drinking purpose. Buildings consume energy at different level at different stages of life, further energy and water are also interconnected as every source of energy requires water in production process and vice versa. A coordinated improvement of the energy and water arrangements is of foremost significance and not in separation from one another. With high dangers that the energy area is presently presented to, the significance of remembering water for its smart course of action is more fundamental than any other time in recent memory. Thermal analysis of building aim is to provide maximum human thermal comfort considering minimum energy consumption and greenhouse gas effect. The major factor which needs to be taken into consideration are air temperature, humidity, physical activity level, solar gains and to provide comfort building sustainable building system services from ventilation, solar controls, combined heat and power, natural cooling to minimize the activity.

BUILDING WATER PERFORMANCE

	Specification	40%	52%	60%
Landscape				
Garden & Lawn	132 m2	132 m2	132 m2	132 m2
Indigenous species	60 m2	60 m2	60 m2	60 m2
Fixtures				
Showerheads	3 star (>7.5 but <= 9 L/min)	3 star (>7.5 but <= 9 L/min)	4 star (>4.5 but <= 6 L/min)	4 star (>4.5 but <= 6 L/min)
Toilets	3 star	Waterless toilets	Waterless toilets	Waterless toilets
Kitchen taps	3 star	4 star	4 star	4 star
Bathroom taps	3 star	4 star	4 star	4 star
Alternative water				
Rainwater tank	No	No	Yes	Yes
Roof area diverted for rain water collection	N/A	N/A	100 m2	100 m2
Rain Water Tank Storage capacity	N/A	N/A	1100 L	1000 L
Stormwater tank	No	No	No	No
Greywater				
Greywater treatment system	No	No	No	No
Greywater diversion system	No	No	No	Yes
Will water for recycling be collected from Laundry?	N/A	N/A	N/A	N/A
Will water for recycling be collected from Bathroom?	N/A	N/A	N/A	N/A
Water supply for Garden & lawn	Town water supply	Town water supply	Town water supply	Grey water system
Water supply for All toilets	Town water supply	waterless	waterless	waterless
Water supply for Laundry	Town water supply	Rain water tank	Rain water tank	Rain water tank
Water supply for All hot water	Town water supply	Town water supply	Town water supply	Rain water tank
Water supply for Drinking and other household	Town water supply	Town water supply	Town water supply	Town water supply
Private dam	No	No	No	No
Hot water recirculation or diversion system	No	No	No	No
Result	***27%-Fail***	***40 %***	***52%***	***60%***

Initial assessment

The BASIX score obtained initially for the case study building was 27% which failed to meet the energy standards of a building. A building requires a minimum of 40% so as to pass the energy requirements for the building.

- Showerhead, toiles, kitchen taps and bathroom taps have low rating which consumes more liter of water per minute.
- No alternate water system source available from which water can be reused or recycled.

1. BASIX score 40%

The BASIX score is achieved by making following changes

- Waterless toilets system implemented.
- Replaced bathroom taps and kitchen taps from 3-star rating to 4-star.

Reason to choose and its advantages are:

a) Reduces water consumption per litre of water per minutes from bathroom and kitchen taps.
b) Waterless toilets contribute to environmental sustainability and conservation.
c) Waterless toilets prevent contamination of water resources by treating human waste.

The disadvantages are:

a) Extra care and maintenance required for waterless toilets.
b) Proper hygiene conditions should be obtained in order to avoid any disease.

The cost of installation of waterless toilets is between $300-400 and cost installation ranges around $60-80 for bathroom and kitchen taps.

2. BASIX score 52%

- Changed showerhead to 4 star (>4.5 but <= 6 L/min)
- Rain water tank of storage capacity of 1100 L in installed.
- Rainwater will be used for laundry purpose

Reason to choose and its advantages are:

a) Showerhead will now consume less water per litre per minute.
b) Rainwater can be used for irrigation, flushing toilets, washing clothes, laundry and many others purpose.
c) It also helps to reduces bills, large financial implications.
d) Reduces the need of imported water.

The disadvantages are:

a) Limited rainfall can hinder the supply of rainwater.
b) Regular maintenance is required for rainwater.

The cost of rainwater tank ranges between $750-1500 and cost of showerhead ranges around $60-80.

3. <u>BASIX score 60%</u>

- Greywater diversion system introduced, here water will be collected from laundry and bathroom.
- Greywater will be used for garden and lawn purpose.
- Rainwater will be used for all hot water.

Reason to choose and its advantages are:

a) Reduction of waste water.
b) Organic filtering serves to ensure the environment's safety.
c) Reduces energy consumption and chemical consumption.

Disadvantages are:

a) Climate may be unsuitable for recycling.
b) It may also require more maintenance than a regular sewer or septic system.
c) Need to check soil conditions it may be too permeable or not permeable enough.

The cost of installation ranges between $1000-2000 while the cost of greywater treatment system is $10000-20000.

THERMAL BUILDING PERFORMANCE

Construction	Additional insulation required (R-value)
Concrete slab on ground	nil
Suspended floor/enclosed subfloor (R0.88)	0.92 (or 1.8 including construction) (down)
External wall - cavity brick (R0.67)	0.50 (or 1.17 including construction)
Internal wall shared with garage (R0.36)	nil
Flat ceiling and pitched roof (>10°)	ceiling: 3.45 (up), roof: foil backed blanket (55 mm)
Raked ceiling/Pitched or Skillion roof (>10°)	ceiling: 3.74 (up), roof: foil backed blanket (75 mm)

Initial Assessment

Since no insulation was provided to the building, the thermal performance indicated the failure of the building construction.

Passing criteria:

1. By adding a layer of insulation to the roof, the comfort inside the room is improved.
2. By applying external insulation, we can warm the wall and this in turn moves the dew point outwards, towards the colder external air. Thereby this reduces the risk of condensation appearing on the internal surface.
3. The floor makes up a large part of the external envelope of the project and by insulating, can greatly reduce the temperature variation inside the conditioned space caused by the transfer of heat through the floor.

The cost for roof insulation will range within $1500 - $3500 depending on the R-value, between $3200 - $4800 for external wall & floor insulation is between $1000 -$2500.

BUILDING ENERGY PERFORMANCE

			Initial	Achieve 50%	Achieve 65%	Achieve 80%
Hot water	Hot water system	What type of hot water system are you installing in your development?	electric storage	Solar (gas boosted, evacuated tube)	Solar (gas boosted, evacuated tube)	Solar (gas boosted, evacuated tube)
		Solar pump performance	N/A	26 to 30 STCs	26 to 30 STCs	26 to 30 STCs
Heating & Cooling	Cooling system	What type of cooling system(s) are you installing in your **living room**?	ceiling fans + 1-phase air-conditioning	ceiling fans + 1-phase air-conditioning	ceiling fans + 1-phase air-conditioning	ceiling fans + 1-phase air-conditioning
		What is the energy efficiency rating of the system?	3 Star	3 Star	6 Star	6 Star
		What type of cooling system(s) are you installing in your **bedrooms**?	ceiling fans + 1-phase air-conditioning	ceiling fans + 1-phase air-conditioning	ceiling fans + 1-phase air-conditioning	ceiling fans + 1-phase air-conditioning
		What is the energy efficiency rating of the system?	3 Star	3 Star	6 Star	6 Star
	Heating system	What type of heating system(s) are you installing in your **living room**?	1-phase air-conditioning	1-phase air-conditioning	1-phase air-conditioning	1-phase air-conditioning
		What is the energy efficiency rating of the system?	3 Star	3 Star	6 Star	6 Star
		What type of heating system(s) are you installing in your **bedrooms**?	1-phase air-conditioning	1-phase air-conditioning	1-phase air-conditioning	1-phase air-conditioning
		What is the energy efficiency rating of the system?	3 Star	3 Star	6 Star	6 Star
	Zoning	Is your air conditioning day-night zoned between bedrooms and living areas?	Yes	Yes	Yes	Yes
Ventilation	Bathroom exhaust	What type of exhaust system are you installing in your bathroom?	individual fan, not ducted	individual fan, not ducted	individual fan, not ducted	individual fan, not ducted
		How will its operations be controlled?	manual switch on/off	manual switch on/off	manual switch on/off	manual switch on/off
	Kitchen exhaust	What type of exhaust system are you installing in your kitchen?	individual fan, not ducted	individual fan, not ducted	individual fan, not ducted	individual fan, not ducted
		How will its operations be controlled?	manual switch on/off	manual switch on/off	manual switch on/off	manual switch on/off

	Laundry exhaust	What type of exhaust system are you installing in your laundry?	natural ventilation only, or no laundry		natural ventilation only, or no laundry		natural ventilation only, or no laundry		natural ventilation only, or no laundry	
Lighting	Windows and/or skylights	Are you installing windows or skylights in your kitchen?	Yes		Yes		Yes		Yes	
		How many separate bathroom/toilet(s) will be naturally lit by either a window or skylight?	2		2		2		2	
	Energy efficient lamps	Locations	Primarily lit by fluorescent or LED lamps	Dedicated fluorescent or LED fitting	Primarily lit by fluorescent or LED lamps	Dedicated fluorescent or LED fitting	Primarily lit by fluorescent or LED lamps	Dedicated fluorescent or LED fitting	Primarily lit by fluorescent or LED lamps	Dedicated fluorescent or LED fitting
		Bedrooms/study	4 Rooms	Yes	4 Rooms	Yes	4 Rooms	Yes	4 Rooms	Yes
		Living/dining	2 Rooms	No	2 rooms	No	2 Rooms	Yes	2 Rooms	Yes
		Kitchens	No		No		Yes	Yes	Yes	Yes
		Bathrooms/toilets	No		No		Yes	Yes	Yes	Yes
		Laundry	No		No		Yes	Yes	Yes	Yes
		Hallways	No		No		Yes	Yes	Yes	Yes
		Pool & Spa	None							
Alternative energy	Photovoltaic system	If you are installing a photovoltaic system, enter the rated electrical output.	0 peak kW		0 peak kW		1 peak kW		2 peak KW	
	Cooktop/ oven	Are you installing a cooktop/oven?	electric cooktop & electric oven		electric cooktop & electric oven		electric cooktop & electric oven		Gas cooktop & electric oven	

Other	Refrigerator space	Do you have a well-ventilated refrigerator space?	No	No	No	Yes
	Outdoor clothes drying line	Are you installing outdoor clothes drying line?	Yes	Yes	Yes	Yes
	Indoor clothes drying line	Are you installing an indoor or sheltered clothes drying line?	No	No	No	No
Result		Energy target :50	Your score: 25%	Your score: 54%	Your score: 70%	Your score: 87%

1. **Initial Assessment**

The BASIX score obtained initially for the case study building was **25%**, which failed to meet the energy standards of a building. A building requires a minimum of 50% so as to pass the energy requirements for the building.

- The type of hot water system used in the building is one of the main reasons that it doesn't pass the energy standards. Electric storage hot water heating system is used in the building and its operation can be expensive as it needs to be kept running so as to provide the heated water.

2. **BASIX Score: 54%**

We were able to achieve the passing percentage by:

- Changing the hot water system to Solar which is gas boosted and having evacuated tubes.
- Giving a STC performance between 26-30

The advantages of using solar water heating system are:

a. Reduces home energy costs
b. Gas boosted type can provide more efficiency
c. Possibility for government STC rebates
d. Low operating cost

The disadvantages can be:

a. High installation and purchase cost
b. Constant overcast weather can affect its efficiency

The cost of purchasing and installing a solar hot water system can be between $4000 - $8000.

3. **Basix Score: 70%**

The following changes were made so as to achieve over 65% score:

- Changing the star rating of cooling and heating devices from 3 star to 6 star
- Changing all the artificial lightings to dedicated fluorescent or LED lights
- Providing a Photovoltaic system with rated electrical output of 1 peak kW

The advantages are:

a. Better efficiency of air conditioning & heating devices
b. Less energy is used
c. Photovoltaic system can power a lot of equipment
d. Operating cost is less

The disadvantages are:

a. Higher purchase & installation cost
b. Photovoltaic system is weather dependent

The cost for a standard voltaic system will be between $4000 - $6000, LED Lights cost between $5 - $20 & 6-Star air conditioning cost around $600.

4. **BASIX Score: 87%**

To achieve 87%:

- Photovoltaic system output is raised to 2kW
- Gas cooktop & electric oven is introduced
- Well ventilated refrigerator space

The advantages are:

a. Well ventilation ensures lesser gas emission
b. Gas cook top is cheaper & easier control
c. Better peak value gives good electric supply

The disadvantages are:

a. More loss of heat from cooktop

The cost of has gas cooktop will be between $300 - $3000.

CONCLUSION AND RECOMMENDDATION

From the above building analysis, we have successfully completed the analysis for building water performance, thermal comfort and energy performance. We found out that in all three tasks if we implement some new methods such as rainwater tanks for water performance, insulation in walls for thermal comfort, photovoltaic system for energy performance their initial cost of is high due to which every single individual living in household can't afford all these types of implementations but considering long term objective for sustainable environment or for human comfort which may be in the form of saving electricity, protecting environment from greenhouse gas emission these techniques should be taken into consideration while building new homes.