Built Environment

Learning & Teaching Showcase 2018

ARCH1161 Architectural Science and Building Environment 1 – Blended Learning Uplift

Philip Oldfield

Course Aims

“The primary aim of this module is to inform and inspire you to design sustainable, comfortable architecture. It is important to consider that ‘building science’ and ‘environmental design’ are not distinct fields separate from studio design. You do not design a building and then later consider ‘how can I make this comfortable?’ Nor is building science only concerned with maths and physics; instead it looks at how scientific principles should inform the design process”

$$Q = mc\Delta t \qquad P = UI \qquad h = \frac{1}{2}gt^2 \qquad r$$

$$\frac{2\cos\vartheta_1\cos\vartheta_2}{\cos(\vartheta_1-\vartheta_2)\sin(\vartheta_1+\vartheta_2)} \qquad p = \frac{E}{c} = \frac{hf}{c} = \frac{h}{\lambda} \qquad \Delta\varphi = \frac{2\pi\Delta x}{\lambda} = \frac{2\pi d\sin\vartheta}{\lambda} = \frac{2\pi dy}{xL} \qquad k = \pm\sqrt{\frac{2m}{\hbar^2}(E-V_0)}$$

$$\Delta\varphi = \frac{\Delta x}{\lambda} = \frac{x_2-x_1}{\lambda} \qquad tg\,\vartheta_B = \frac{n_2}{n_1} = n_{21} \qquad V = V_1(1+\beta_{\Delta t}) \qquad \beta = \frac{\Delta I_C}{\Delta I_B}$$

$$S = \frac{1}{hA}\frac{d\omega}{dt} \qquad H_\lambda = \frac{\Delta M_e}{\Delta\lambda_C} \qquad \oint \vec{B}\,d\vec{l} = \mu_0\sum I_i \qquad U_{ef} = \frac{U_m}{\sqrt{2}}$$

$$R = \frac{(n-1)^2+k^2}{(n+1)^2+k^2} \qquad \Phi_e = \frac{L}{\sqrt{2}} \qquad S_t = \frac{tg\,\tau'}{tg\,\tau} = \frac{d}{f}$$

$$\vec{\varphi} = \sqrt{2eU_{m_e}} \qquad \iint \vec{D}\,d\vec{S} = A_\lambda \qquad I_m^2 = U_m^2\left[\frac{1}{R^2}+\left(\frac{1}{X_C}-\frac{1}{X_L}\right)^2\right] \qquad 4\pi r^2 W_z = U_e I t \qquad \Phi = NBS$$

$$S_2 \qquad P = \frac{F}{\Delta S} = \frac{m\Delta V}{\Delta S\Delta t} \qquad \omega = 2\pi f \qquad v = \frac{1}{\sqrt{\varepsilon\cdot\mu}} \qquad M_\odot = \frac{4\pi^2 r^3}{G\,dT^2} = \frac{c\,dT^2}{\sqrt{\varepsilon_r\mu_r}} \qquad \oiint \vec{D}\,d\vec{S} = Q^*$$

$$\nabla\times\left(-\frac{\partial\vec{B}}{\partial t}\right) = -\frac{\partial}{\partial t}(\mathrm{rot}\,\vec{B}) = -\mu_0\frac{\partial}{\partial t}\left(\frac{\partial B}{\partial t}\right) = \varepsilon_0\mu_0\frac{\partial^2 E}{\partial t^2} \qquad R_2 = R_0\sqrt[3]{A}$$

$$T = \frac{4n_1n_2}{(n_2+n_1)^2} \qquad pV = nRT \qquad \sin\alpha = \frac{v_1}{v_2} = \frac{n_2}{n_1} \qquad S$$

$$R = \frac{U}{I} \qquad \sin\beta \qquad f_0 = \frac{1}{2\pi\sqrt{CL}} \qquad E = \frac{\hbar^2k^2}{2m} \qquad K_m = C$$

$$v = \frac{nh}{2\pi r m_e} \qquad U = \frac{W_{AB}}{q} = \frac{|E_{PA}-E_{PB}|}{q} = |\varphi_A-\varphi_B| \qquad E_k = \frac{h^2Q}{8mL^2} \qquad h^2 \qquad Q \qquad W = F_s\cos\alpha \qquad E = \frac{F_e}{q_0} = k\frac{Q}{r^2} \qquad T$$

Content

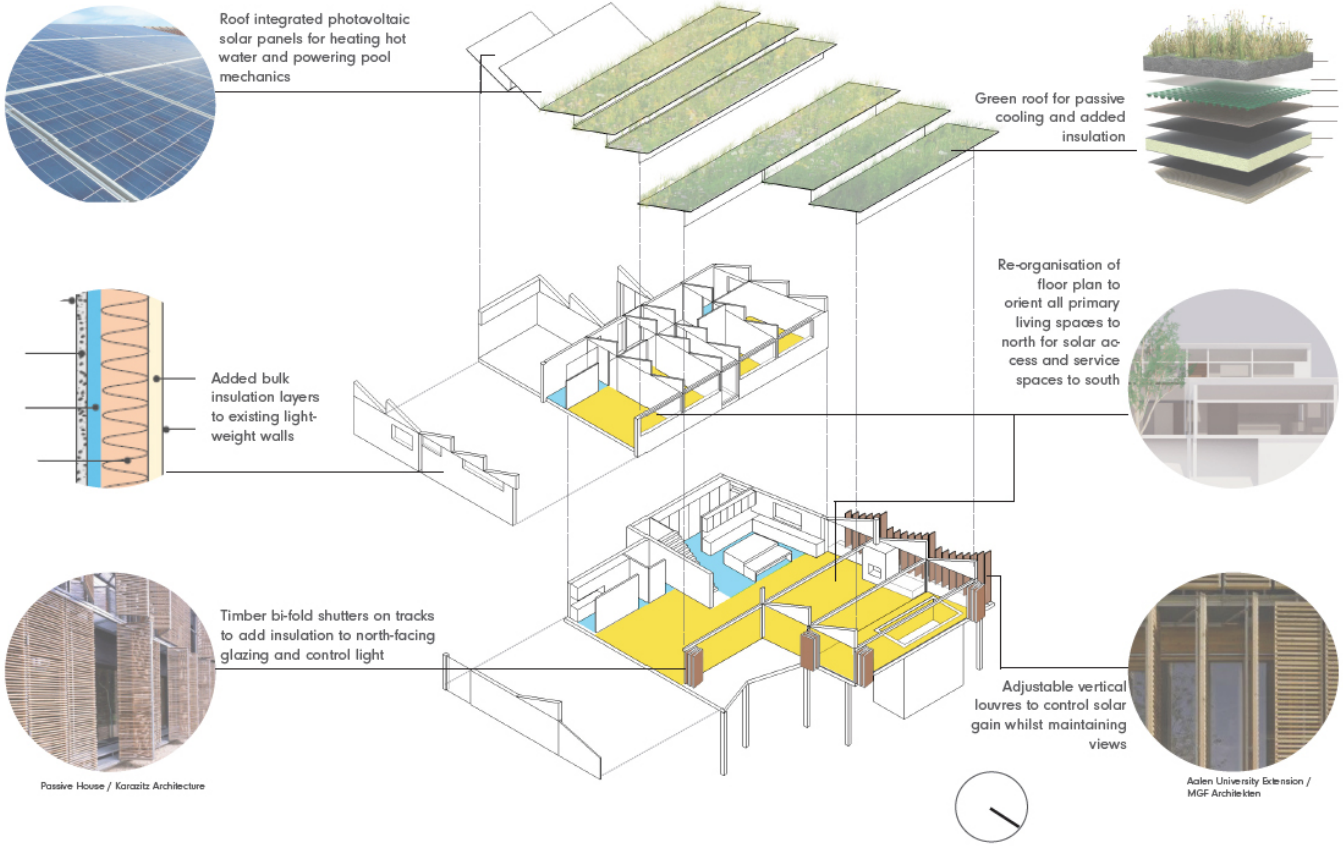
$$Q_c = \sum U A \Delta T$$

(in the exam – so remember this!)

Where….

Qc = heat loss rate by conduction (measured in W or kW)
U = U-value (measured in W/m^2K)
A = Area of surface (measure in m^2)
ΔT = Temperature difference between inside and outside (measured in ºC)

Content


Roof integrated photovoltaic solar panels for heating hot water and powering pool mechanics
Green roof for passive cooling and added insulation
Re-organisation of floor plan to orient all primary living spaces to north for solar access and service spaces to south
Added bulk insulation layers to existing light-weight walls
Timber bi-fold shutters on tracks to add insulation to north-facing glazing and control light
Adjustable vertical louvres to control solar gain whilst maintaining views
Passive House / Karazitz Architecture
Aalen University Extension / MGF Architekten

Challenges

1. A reliance on an outdated digital platform

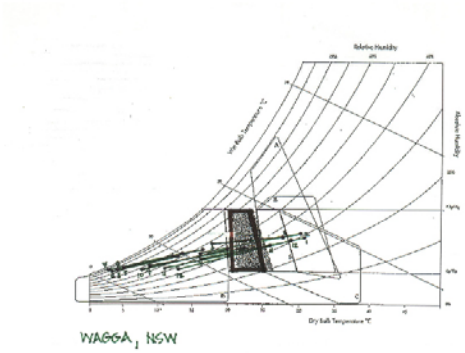
WAGGA, NSW

The Climate Data Sheet has the following assessment of Wagga's climate.

Qualitative comments:

A dry warm-temperate climate, where the summers are hot (regularly over 30?C and often reaching 40?C) and dry. In annual cumulative terms however underheating is a greater problem than overheating. In July frost occurs on almost half the days. Diurnal variations are large. Precipitation is fairly even, with a slight bias towards winter.

We plot the monthly mean maximum and minimum temperatures with the matching RH values:



We can see that the average temperatures are again rather low. The minima drop close to Canberra or Hobart, and the summers are quite hot, but not for very long. A comfort zone just above Canberra will be suitable.

Five months have maximum temperatures above the Comfort Zone, fitting clearly into the area dealt with by night ventilation of thermal mass, or quite well suited to evaporative cooling.

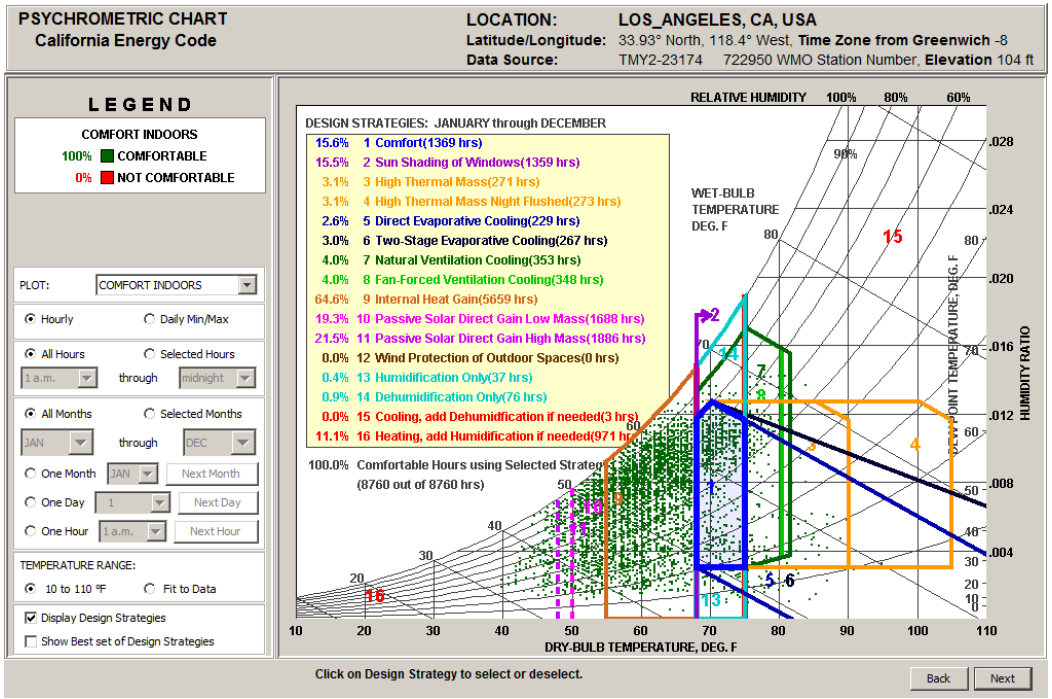
Thermal mass suits us, becausea long winter is clearly too cool; even the maximum temperatures of four months falling below the comfort zone. For this period, which is longer than the overheated one, passive solar design is a good idea. Passive solar design requires an appropriate disposition of thermal mass.

Challenges

2. A lack of accountability in group work

Challenges

3. The need to implement more climatic analysis software



What we did

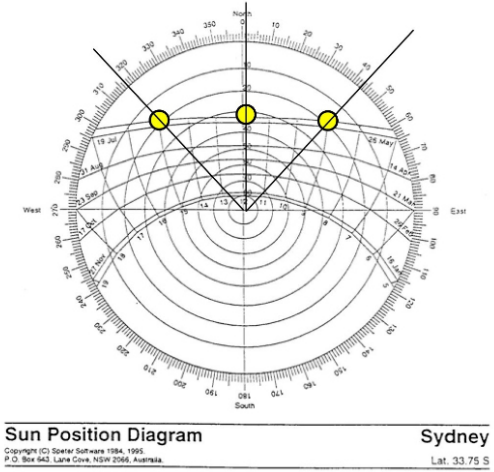
1. Re-built on-line learning resources

Step 2: Determine the Azimuth and Altitude of the sun at the times of day you want the shadows for

This step involves looking at and reading the sunpath diagram. Mark the position of the sun at the times you want to cast shadows for, and read the azimuth and altitude from the sunpath diagram. Then put these numbers into a table.

In this instance, June 21st is the uppermost date curve, and the times can be plotted from the time curves.

An example table can be found on the next screen.



Slide3

What we did

1. Re-built on-line learning resources

1. First calculate the Resistance and U-Value of the uninsulated wall:

To determine the U-value of a wall we use the formula U = 1 / ∑R. This means first we have to sum the total resistances (R-values) of all the wall elements, including the inside and outside air resistance.

In this case, this means:

R-outside air + R-brick + R-air gap + R-plasterboard + R-inside air film = ∑R

(enter these values in the spaces below in the order indicated)

0.04 ✔ + 0.10 ✔ + ~~0.58~~ ✖ + [ ] + [ ] = [ ]

U = 1 / [ ] = [ ] W/m²K

What we did

2. Created a Moodle-based team creation and evaluation tool

Assessment form

Criteria	Levels				
Contribution Contributing to the Team's Work	1 *Does not do a fair share of the team's work. Delivers sloppy or incomplete work. Misses deadlines. Is late, unprepared, or absent for team meetings. Does not assist teammates. Quits if the work becomes difficult.*	2 *Demonstrates behaviours described in higher and lower levels*	3 *Completes a fair share of the team's work with acceptable quality. Keeps commitments and completes assignments on time. Helps teammates who are having difficulty when it is easy or important.*	4 *Demonstrates behaviours described in higher and lower levels*	5 *Does more or higher-quality work than expected. Makes important contributions that improve the team's work. Helps teammates who are having difficulty completing their work.*
Interacting Interacting with Teammates	1 *Is defensive. Will not accept help or advice from teammates. Complains, makes excuses, or does not interact with teammates. Takes actions that affect teammates without their input. Does not share information. Interrupts, ignores, bosses, or makes fun of teammates.*	2 *Demonstrates behaviours described in higher and lower levels*	3 *Respects and responds to feedback from teammates. Participates fully in team activities. Communicates clearly. Shares information with teammates. Listens to teammates and respects their contributions.*	4 *Demonstrates behaviours described in higher and lower levels*	5 *Asks teammates for feedback and uses their suggestions to improve. Provides encouragement or enthusiasm to the team. Makes sure teammates stay informed and understand each other. Asks for and shows an interest in teammates' ideas and contributions.*
Commitment Keeping the Team on Track	1 *Is unaware of whether the team is meeting its goals. Does not pay attention to teammates' progress. Avoids discussing team problems, even when they are obvious.*	2 *Demonstrates behaviours described in higher and lower levels*	3 *Notices changes that influence the team's success. Knows what everyone on the team should be doing and notices problems. Alerts teammates or suggests solutions when the team's success is threatened.*	4 *Demonstrates behaviours described in higher and lower levels*	5 *Watches conditions affecting the team and monitors the team's progress. Makes sure that teammates are making appropriate progress. Gives teammates specific, timely, and constructive feedback.*

What we did

2. Created a Moodle-based team creation and evaluation tool

Workshop (UNSW) grades report

Visible groups (Group Assignment Teams) All participants

First name / Surname	Submission / Last modified	Grades received	Grade for submission (of 100)
[redacted]	Peer Evaluation Submission modified on Tuesday, 20 March 2018, 10:42 PM	67 (0)< 100 (0)< - (-)< 100 (0)<	89
[redacted]	Peer Evaluation Submission modified on Tuesday, 20 March 2018, 10:42 PM	83 (0)< 83 (0)< - (-)< - (-)< 67 (0)<	78
[redacted]	Peer Evaluation Submission modified on Tuesday, 20 March 2018, 10:42 PM	100 (0)< 100 (0)< 100 (0)<	100
[redacted]	Peer Evaluation Submission modified on Tuesday, 20 March 2018, 10:42 PM	83 (0)< 100 (0)< 100 (0)< 100 (0)<	96
[redacted]	Peer Evaluation Submission modified on Tuesday, 20 March 2018, 10:42 PM	92 (0)< 100 (0)< 50 (0)< 67 (0)<	77
[redacted]	Peer Evaluation Submission modified on Tuesday, 20 March 2018, 10:42 PM	75 (0)< 100 (0)< 92 (0)< 67 (0)<	83
[redacted]	Peer Evaluation Submission modified on Tuesday, 20 March 2018, 10:42 PM	50 (0)< 83 (0)< 42 (0)< 75 (0)<	63
[redacted]	Peer Evaluation Submission modified on Tuesday, 20 March 2018, 10:42 PM	42 (0)< - (-)< - (-)<	42
[redacted]	Peer Evaluation Submission modified on Tuesday, 20 March 2018, 10:42 PM	67 (0)< 75 (0)< 83 (0)< - (-)<	75

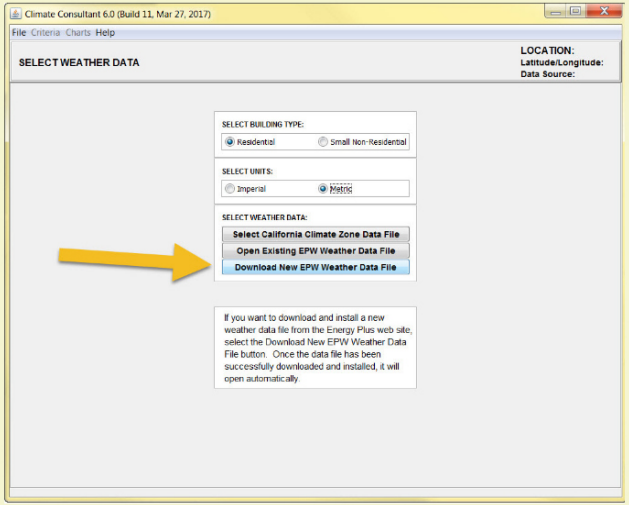
What we did

3. Created and integrated support tools for Climate Consultant

Installing and using Climate Consultant

3a. Choose download new epw file.

The Energy Plus web site will open automatically.



Slide7

4 / 8

What we did

Other things

Absolute Humidity

Acronym: AH

The measure of water vapour (moisture) in the air

Reference: "Ventilation for Designing Better Buildings," Zehnder, accessed October 14, 2017, http://info.zehnderamerica.com/blog/absolute-vs.-relative-humidity-whats-the-difference.

Acclimatisation

The process in which an individual organism adjusts to a change in its environment, allowing it to maintain performance across a range of environmental conditions.

Reference: "Acclimatization," Encyclopaedia Brittanica, accessed October 14, 2017, href="https://www.britannica.com/science/acclimatization.

AH

Absolute Humidity

The measure of water vapour (moisture) in the air

Reference: "Ventilation for Designing Better Buildings," Zehnder, accessed October 14, 2017, http://info.zehnderamerica.com/blog/absolute-vs.-relative-humidity-whats-the-difference.

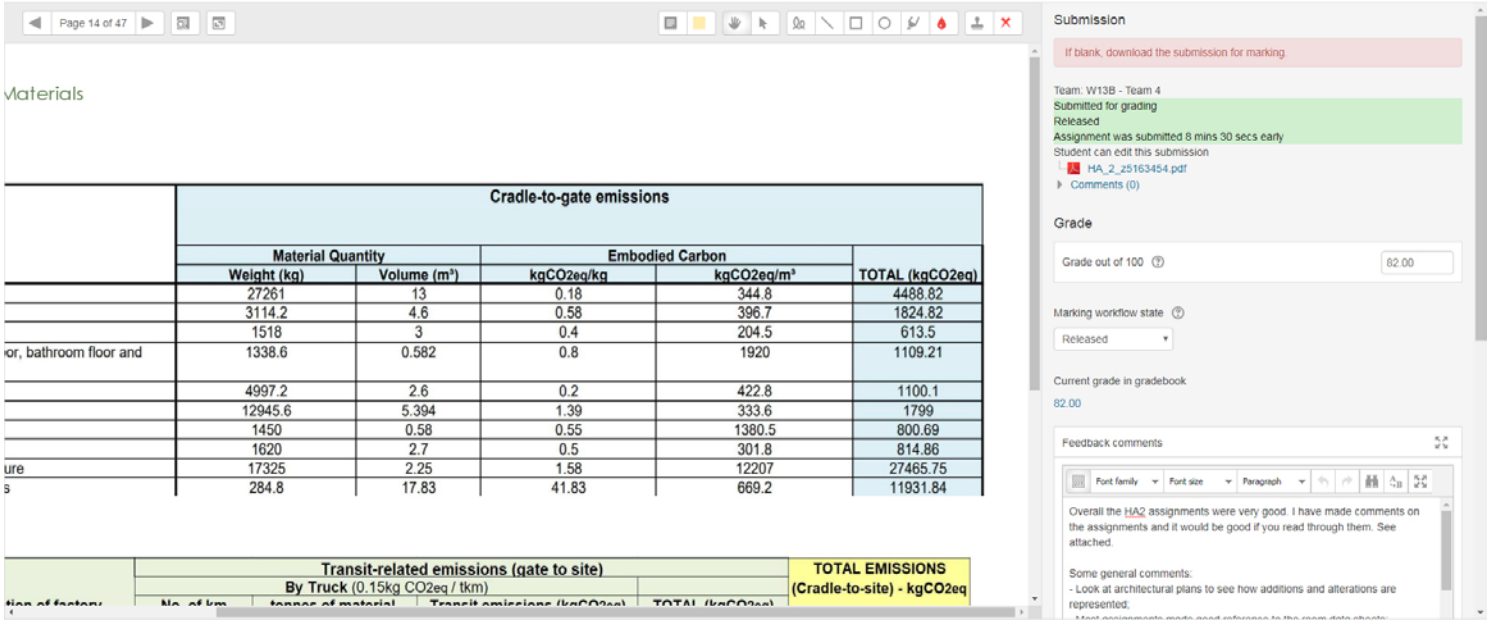
Altitude

The height of the sun in relation to the ground.

Reference: "Altitude," Dictionary.com, accessed October 31, http://www.dictionary.com/browse/altitude.

What we did

Other things



Page 14 of 47

Materials

	Cradle-to-gate emissions				
	Material Quantity		Embodied Carbon		
	Weight (kg)	Volume (m³)	kgCO2eq/kg	kgCO2eq/m³	TOTAL (kgCO2eq)
	27261	13	0.18	344.8	4488.82
	3114.2	4.6	0.58	396.7	1824.82
	1518	3	0.4	204.5	613.5
or, bathroom floor and	1338.6	0.582	0.8	1920	1109.21
	4997.2	2.6	0.2	422.8	1100.1
	12945.6	5.394	1.39	333.6	1799
	1450	0.58	0.55	1380.5	800.69
	1620	2.7	0.5	301.8	814.86
ure	17325	2.25	1.58	12207	27465.75
s	284.8	17.83	41.83	669.2	11931.84

	Transit-related emissions (gate to site)				TOTAL EMISSIONS (Cradle-to-site) - kgCO2eq
	By Truck (0.15kg CO2eq / tkm)				
tion of factory	No. of km	tonnes of material	Transit emissions (kgCO2eq)	TOTAL (kgCO2eq)	

Submission

If blank, download the submission for marking.

Team: W13B - Team 4
Submitted for grading
Released
Assignment was submitted 8 mins 30 secs early
Student can edit this submission
HA_2_25163454.pdf
Comments (0)

Grade

Grade out of 100 82.00

Marking workflow state
Released

Current grade in gradebook
82.00

Feedback comments

Font family Font size Paragraph

Overall the HA2 assignments were very good. I have made comments on the assignments and it would be good if you read through them. See attached.

Some general comments:
- Look at architectural plans to see how additions and alterations are represented;

What we did

Other things

- Construction type: Recycled timber
- consists of renewable energy that can allow the apartments to last up to 200 years.
- Provides solar water heating
- Photovoltaic Panels
- Collects rainwater
- Main facade and roof pods were designed to provide extra shading to the apartments below.
- Double glazed windows are placed to slow down the heat

Add comment

with a bunch of bugs and insects.Therefore, it will give good effect for Singapore's environment.

2.Because of open-sided designed gardens, the hotel no needs for mechanical ventilation for 314hotels and 100 office units. It saves huge emission of CO2.

3. Oasia hotel is designed by two sides, so there are no any units or rooms in the middle. This design is helpful to air cycle for the building and can control the temperature by itself.

Add comment

sunlight to illuminate the heart of the building whilst a vertical sun collector and an automated solar shade were built in to control the amount of sunlight.

2. Renewable Energy
This building uses biofuel to generate energy, which can reduce the use of traditional fossil fuel.

3. Efficient Use of ater.
The low flow fixtures and fittings were applied inside the building to help reduce the potable water requirement.

Add comment

plantation on the top of the structure, uncovered is also sustainable as it means the plants will require minimal attention due to the direct exposure to sunlight and rain.

Another sustainable feature of this feature of this building is the predominant use of glass along the exterior of the building offering the utilization of natural lighting within the building as opposed to artificial.

A very interesting sustainable feature of this building is the drainage system that has been introduced to effectively water all plants with minimal resources. This system relies on the watering of plants located highest on the building. The plants then will absorb the required nutrients, the remaining water is then transferred to the following plants below and so on and so forth in a ladder like motion.

Add comment

Impact / Results

MyExperience: Overall I was satisfied with the quality of this course

2016 = 5.38
2017 = 5.42
2018 = 5.27

(Due to ‘new’ content and an extra assessment)

Impact / Results

MyExperience: Feedback on digital resources

The digital resources helped me learn = 5.37 (highest of all questions)

“The plethora of resources and support provided by Phil and the tutors. I really appreciated feeling that I could ask questions and get help when I needed. This is by far the most well resourced course that I have completed.”

“The online Moodle resources were very helpful – it extended and added on the knowledge learnt in the lectures and tutorials. It also allowed me to go back to specific resources that were accessed/taught to us during the lectures.”

Impact / Results

Student Performance

Average Mark, 2016 = 70.3
Average Mark, 2017 = 65.1
Average Mark, 2018 = 66.6

Impact / Results

Future Plans

1. *Greater weighting of individual contributions to groupwork assessment*

2. *Implementing more practical on-site measurements (e.g. using thermal cameras)*

3. *Taking learning through the other environment courses (ARCH1361, ARCH7809, etc)*