LOW ENERGY BUILDING DESIGN
(21CVP309)

Semester 2 2021-22 Online Short-window Exam paper

This is an online short-window examination, meaning you have a total of **2 hours plus additional 30 minutes** to complete and submit this paper. The additional 30 minutes are for downloading the paper and uploading your answers when you have finished. If you have extra time or rest breaks as part of a Reasonable Adjustment, you will have further additional time as indicated on your exam timetable.

It is your responsibility to submit your work by the deadline for this examination. You must make sure you leave yourself enough time to do so.

It is also your responsibility to check that you have submitted the correct file.

Exam Help
If you are experiencing difficulties in accessing or uploading files during the exam period, you should contact the Exam Helpline. For urgent queries please call **01509 222900**. For other queries email examhelp@lboro.ac.uk

You may handwrite and/or word process your answers, as you see fit.

You may use a calculator for this exam.

Answer **THREE** Questions.

All questions carry equal marks.

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1. a) Loughborough University are planning to meet the Net Zero Carbon goal by 2050. With reference to the UK Green Building Council framework, apply the steps to achieving a Net Zero Carbon Building using examples. Expand on the rationale for offsetting.

[13 marks]

b) What is the design hierarchy and does the framework (above) follow it? Comment in your own words on why it is important that it does.

[10 marks]

c) The university has selected to follow the Passivhaus standard for all new buildings. What is the main principle of Passivhaus? Compare and contrast the Passivhaus standard with general passive house approaches to building design.

[10 marks]

Continues/…

2. a) With the aid of a sketch, demonstrate a building's heat balance and include the primary sources of heat gains and losses.

[7 marks]

b) How would you reduce the demand for mechanical heating and cooling? Select two methods, one for reducing heating demand and one for reducing cooling demand and justify your selection.

[8 marks]

c) In your own words, explain what is the base temperature of a building, what it depends on and how it is used in the Heating Degree Days (HDD) methodology.

[10 marks]

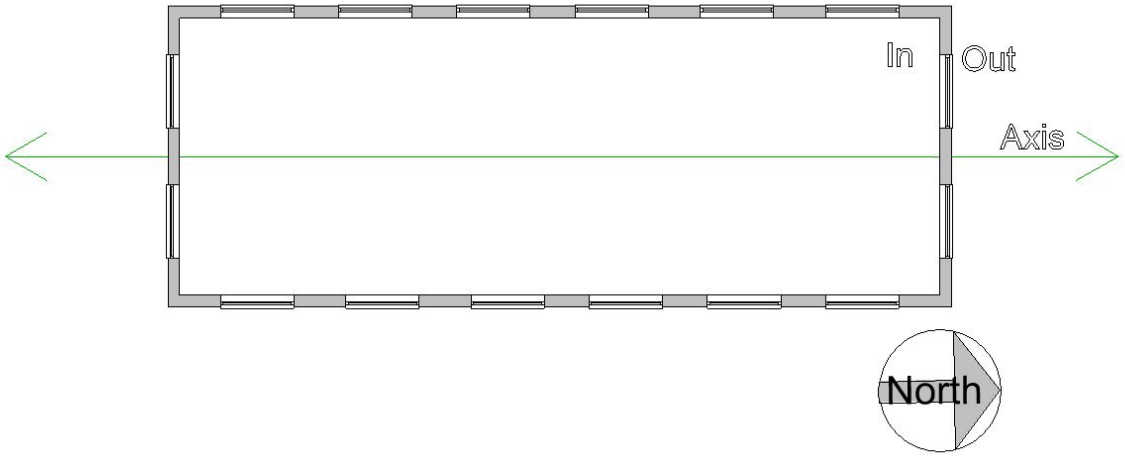
d) Compare the two weather files TRY and DSY, based on what information they include and what they are used for. Critically evaluate which weather files would be appropriate for predicting a building's future performance.

[8 marks]

3. a) A domestic building situated at Loughborough has an annual energy consumption of 14,250kWh. The annual global horizontal irradiation for the Midlands is approximately 950kWh/m^2. How many m^2 of solar potential need to be collected to equal the typical annual energy consumption of this household? Comment on the limitations of photovoltaic panels in meeting the household's total energy demand.

[6 marks]

b) Considering the building below and assuming it is located at Loughborough, decide on an orientation for the axis and explain your choice. You have the freedom to orientate the axis in any direction, e.g. north-south, east-west (as shown) or any value in between. Propose a shading strategy for each side of the building to improve actual daylighting performance whilst ensuring thermal comfort for the occupants.



[12 marks]

Question 3 continues/…

c) In your own words, explain what Sunlight Beam Index is. With the aid of sketches provide three examples.

[7 marks]

d) Briefly explain what the energy performance gap is and how it is applicable in daylighting for buildings. Expand on the reasons for the performance gap. How can the Soft Landings Framework approach be applied to bridge the performance gap?

[8 marks]

4. a) One of the driving forces of natural ventilation is buoyancy. Describe how buoyancy-driven natural ventilation works in non-domestic buildings.

[5 marks]

b) Explain, with the use of an equation, why buoyancy forces used for natural ventilation are smaller in summertime.

[5 marks]

c) Imagine you were asked to reconfigure a mechanically ventilated building for natural ventilation. Describe any low energy design features would you use to ensure the natural ventilation strategy was capable of delivering sufficient fresh air and maintaining thermal comfort?

[10 marks]

d) Describe the mixed-mode ventilation and cooling strategy employed in the School of Slavonic and East European Studies.

[7 marks]

e) Thinking about the Braunstone Health and Social Care Centre, if the client had refused to finance the construction of its subterranean labyrinth, how might this have changed the environmental performance of the building?

[6 marks]

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