UNIVERSITY OF CAMBRIDGE

ENGINEERING TRIPOS PART IIB
ENGINEERING TRIPOS PART IIA

Saturday 1 May 2004 9 to 10.30

Module 4D13

ARCHITECTURAL ENGINEERING

Answer not more than **three** *questions.*

All questions carry the same number of marks.

The **approximate** *percentage of marks allocated to each part of a question is indicated in the right margin.*

There are no attachments.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed that you may do so by the invigilator

(TURN OVER

1

It is proposed to rehabilitate a mid-19th-century industrial building for use as an industrial museum. The original structural system comprises cast-iron columns and beams, jack-arch floors and load-bearing masonry walls.

(a) Explain, with the aid of sketches, how the structure supporting the floors works and how the building carries wind loads. [50%]

(b) Discuss why there may be differences of opinion between structural engineers as to the viability of rehabilitating the building featured in this question. [50%]

2

(a) Outline briefly:

(i) the two most significant types of movement in buildings and the material(s) that are affected most by each type, and

(iii) the five less significant types of movement in buildings. [30%]

(b) Outline briefly the measures that you would consider taking to accommodate movement in external walls faced in each of the following materials:

(i) brickwork,

(ii) wood boarding, and

(iii) steel panels.

Include in your answer comments on the differences in the appropriate measures that would be needed based on material choice. [40%]

(c) You are designing a timber frame house with a flat roof. Describe briefly:

(i) where you would expect to find the greatest vertical movement in the structure, and

(ii) what measures you would take in designing the structure to ensure that the roof falls remain sufficient throughout the life of the building.

[30%]

3

(a) Outline briefly an integrated digital design and fabrication process, including stages of conceptual design, rationalisation and realisation, for a new building and indicate the flow of information. For each stage in the process, list two software and/or hardware technologies that have been employed over the past ten years. Briefly describe the main capabilities of CAD and CAM and their purpose in the process. [35%]

(b) Identify and discuss briefly one example of a recent building project, which was given in a lecture or directed reading, that has successfully employed components of an integrated digital process. In your discussion state which technologies were used and for what purpose. What was enabled in the project by using digital technologies that either could not have been achieved or not achieved as easily without them? Were there any disadvantages? [45%]

(c) Put forward a concise argument for "paperless" design. You should consider the role of physical models in design and whether total "paperless" design is achievable and/or desirable? [20%]

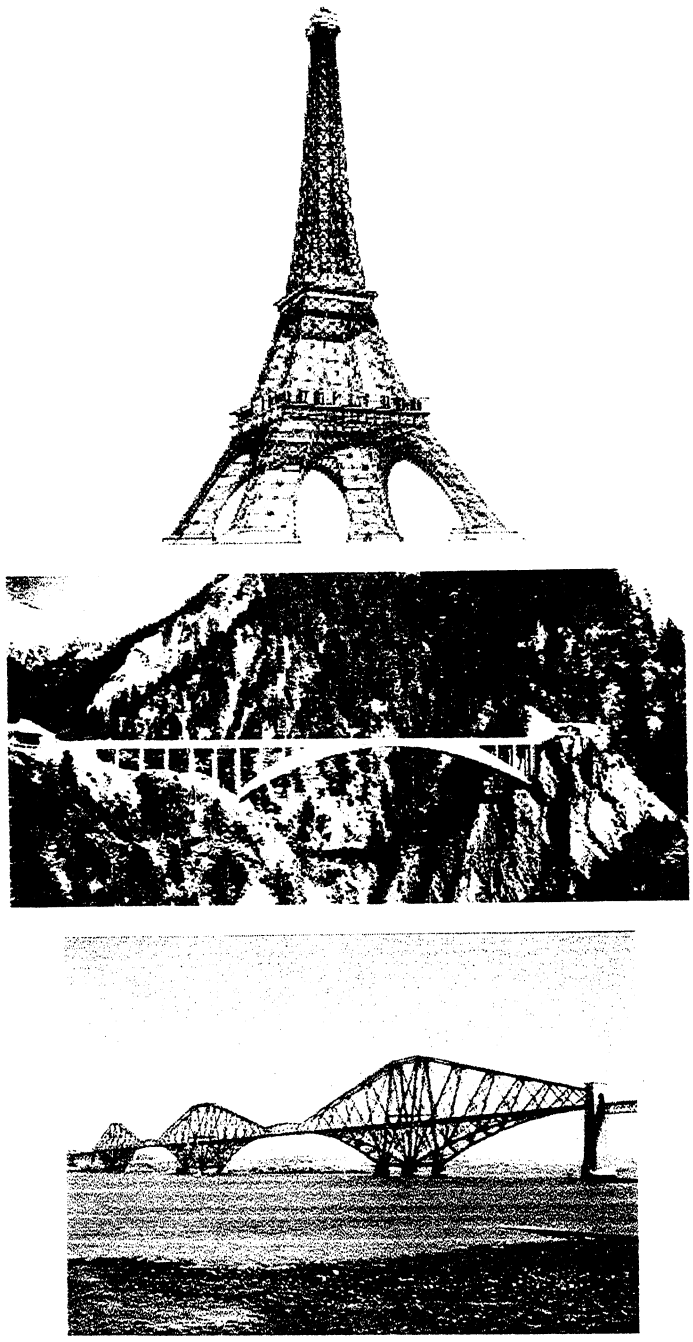

Fig. 1

4

Three structures are shown in Fig.1: the Eiffel Tower, the Salginatobel Bridge and the Forth Rail Bridge.

(a) For two of the structures shown carry out the following tasks:
   (i) draw a very simple planar free body diagram indicating the loading, and
   (ii) briefly explain the primary structural action. [40%]

(b) For two of the structures shown, briefly explain why the form of each structure was considered by its designers to be appropriate, making reference to the dominant loading, choice of structural type and choice of materials. [40%]

(c) Pick one structure from those shown in Fig. 1 and write a concise argument as to why you consider it to be, or not to be, an excellent example of structural engineering in relation to both the time it was built and today. [20%]

END OF PAPER