

Specialist Diploma: Seismic Design

Friday 7 July 2017

Timetable: 09.30 – 13.00

Notes to Candidates

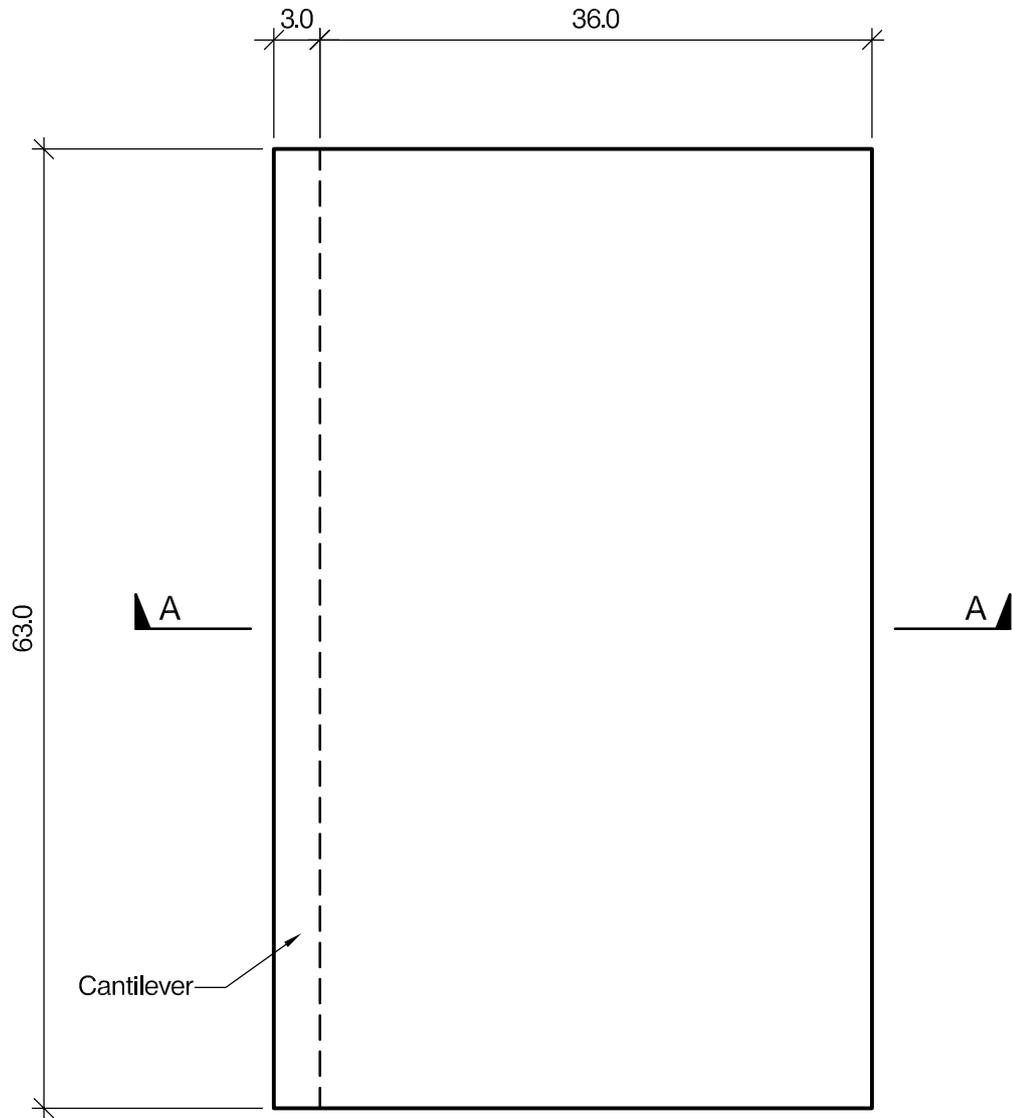
1. TO PASS THE EXAMINATION, CANDIDATES MUST SATISFY THE EXAMINERS IN BOTH PARTS OF THE QUESTION.
2. Examiners will only mark work written by hand during the examination. Candidates will not be allowed to include any previously prepared calculations, notes, sketches, diagrams, computer output or other similar material in their answer sheets. Any previously prepared information submitted by candidates will be ignored by the examiners.
3. A fair proportion of marks will be awarded for the demonstration of an understanding of fundamental engineering concepts, as distinct from calculation of member forces and sizes. NOTE: In the calculation part, establishing “form and size” is taken to mean compliance with all relevant design criteria, i.e. bending, shear, deflection, etc.
4. 60 marks are allocated to Section 1 and 40 marks to Section 2.
5. The Examiners are looking for sound structural designs. It should also be remembered that aesthetics, economy and function are important in any competent engineering scheme.
6. Any assumptions made and the design data and criteria adopted must be stated.
7. Good clear sketches are required; they should show all salient and structural features and should incorporate adequate details.
8. Candidates may not bring into the examination room any electronic devices capable of wireless communication, optical photography or scanning.

The following devices are not permitted: Mobile phones, Laptops, notebooks or portable computers and similar devices, iPads, tablets and similar devices, E-readers (e.g. Kindle) and similar devices, cameras, optical scanners and similar devices.

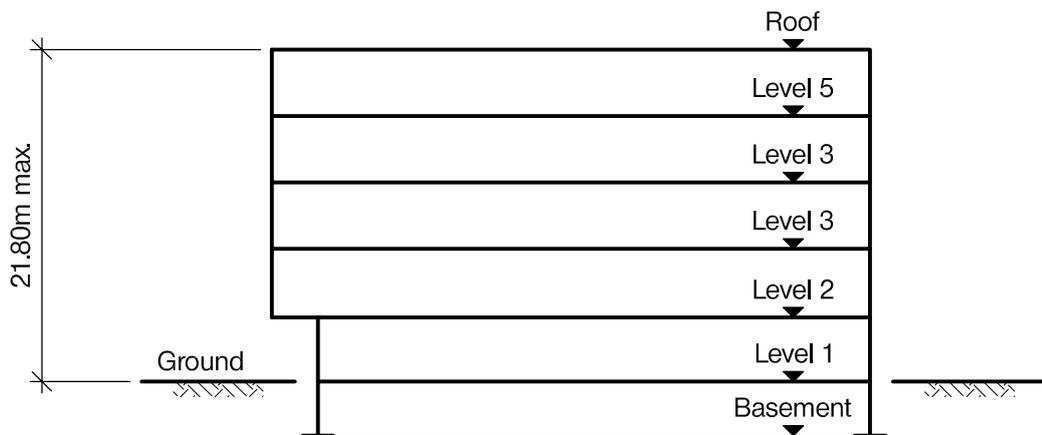
Any candidates arriving at the examination room with such devices will be asked to switch them off and place them in a sealed bag kept by the Invigilator for the duration of the exam.
9. This paper is set in SI Units.

A reminder on codes of practice

Any design code or standard may be used to answer the question in the paper, as long as reference to that code is consistent throughout and any assumptions made or design data adopted (including loadings other than those specified in the question) are stated at the beginning of the answer.



PLAN



SECTION A - A

NOTE: All dimensions are in metres

FIGURE Q1

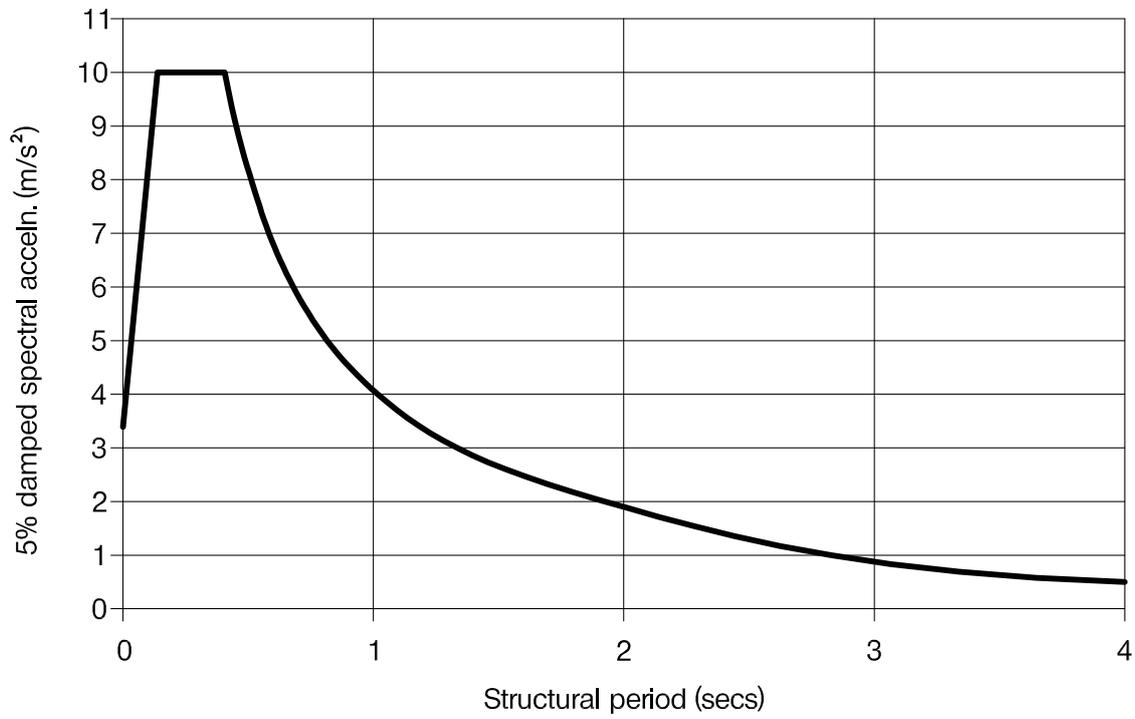


FIGURE 2 : 475 year return period motions for rock outcrop at site

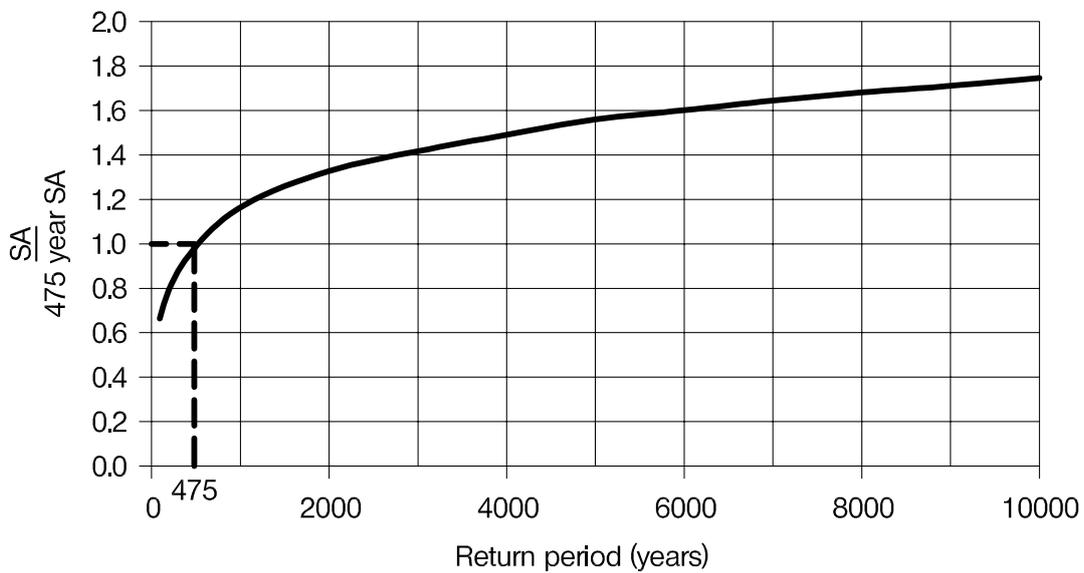


FIGURE 3 : Variation of spectral acceleration SA with return period

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A 5-storey educational building in a town with high seismicity

Client's requirements

1. A new 5-storey educational centre with a basement floor is to be built in a town in an area of high seismicity. See Figure 1.
2. The building is of a rectangular shape in plan and is cantilevered above Level 1 by 3.0m along one elevation facing the rear. The cantilever is fully glazed. Other elevations are 60% glazed.
3. The basement is used to accommodate plantrooms and some car parking.
4. Only one line of internal columns is allowed in the longitudinal direction on all floors. Elsewhere, including the basement, column spacing must not be less than 9.0m.
5. The roof is flat and requires access for maintenance. Service cores are non-structural and not shown.
6. No bracing nor shear walls are allowed internally (except in the basement), but are permitted in elevations.
7. A minimum 2.7m clear floor-to-ceiling height is required from Level 1 upwards, and 2.3m in the basement. The maximum height of the building above ground must not exceed 21.80m.

Imposed loading

- | | |
|---------|--------------------------------------|
| 8. Roof | 1.0 kN/m ² |
| Floors | 5.0 kN/m ² (see Figure 1) |
- Loadings include an allowance for ceiling services.

Site Conditions

9. The site basic wind speed is 48.0 m/s based on a 3-second gust. The equivalent mean hourly wind speed is 24.0 m/s.
10. Ground Conditions

0 - 0.5m	Made Ground
0.5m - 3.0m	Soft sand, N=10
3.0m - 6.0m	Medium dense sand, N=25
Below 6.0m	Very dense sand, N=50

Ground water was encountered at -3.0m.
11. Figs 2 and 3 show the design 5% damped seismic response spectrum for the region. It applies to level ground for a 475-year return period assuming the ground surface is rock with shear wave velocity of not less than 800m/s.

Section 1

(60 Marks)

Prepare a design appraisal with appropriate sketches indicating two distinct and viable solutions for the proposed structure. Indicate clearly the functional framing and the structure's method of load transfer and stability aspects for each proposed scheme. Recommend one solution, to be further developed in Section 2.

Section 2

(40 Marks)

For the solution recommended in Section 1

- a. Carry out design checks on key members of the lateral load resisting system including a beam, column, bracing/shear wall, and foundation for the proposed scheme. (30 mark)
- b. If more car parks are needed, two options are available: adding one more basement floor, or moving plantrooms to upper floors. Discuss the effects on the scheme in each case ignoring the space gain/loss. (10 marks)

