

Specialist Diploma: Seismic Design

Thursday 3 January 2019

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.

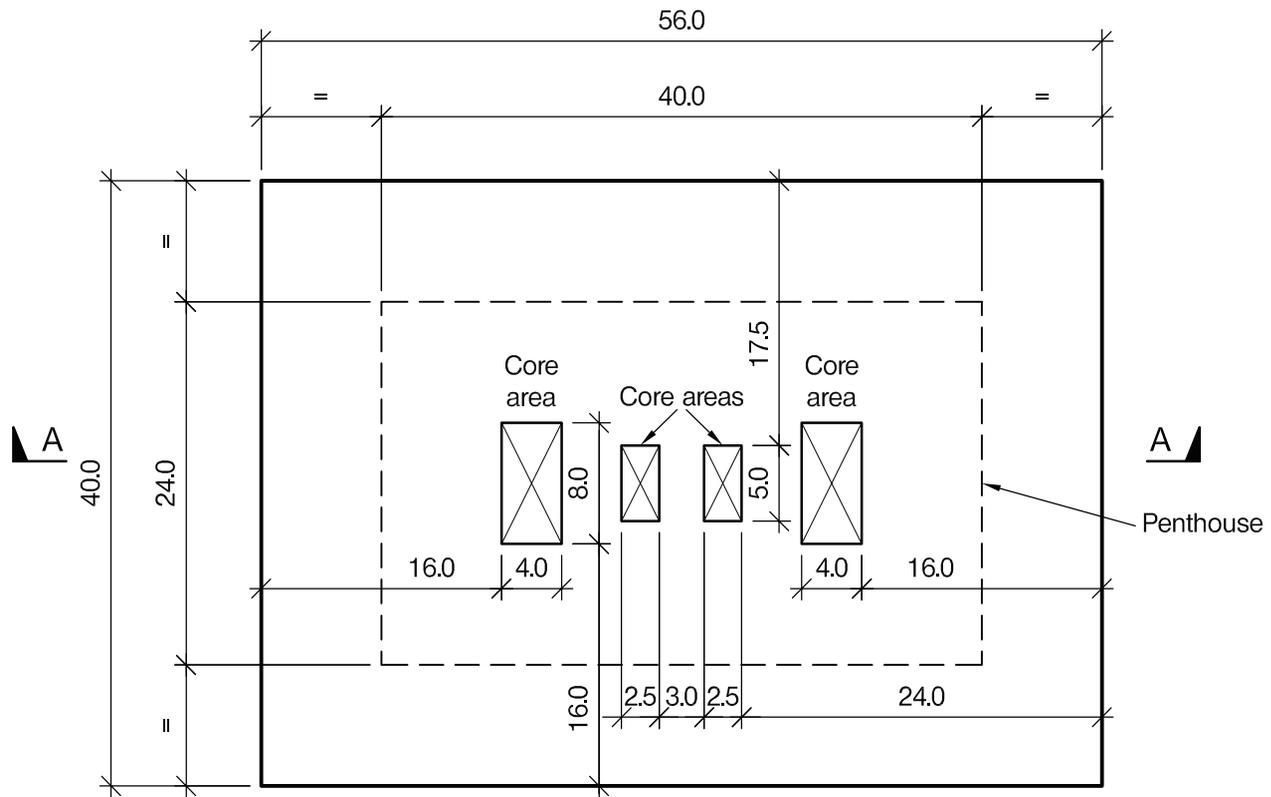




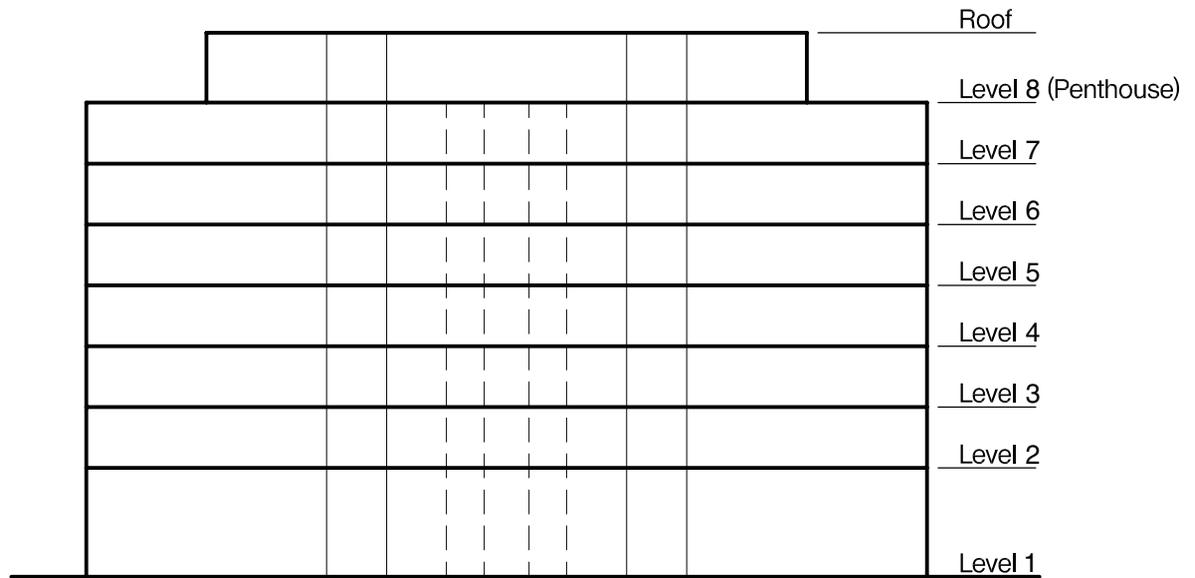
A reminder on codes of practice

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.





TYPICAL FLOOR PLAN



SECTION A - A

NOTE: All dimensions are in metres

FIGURE 1

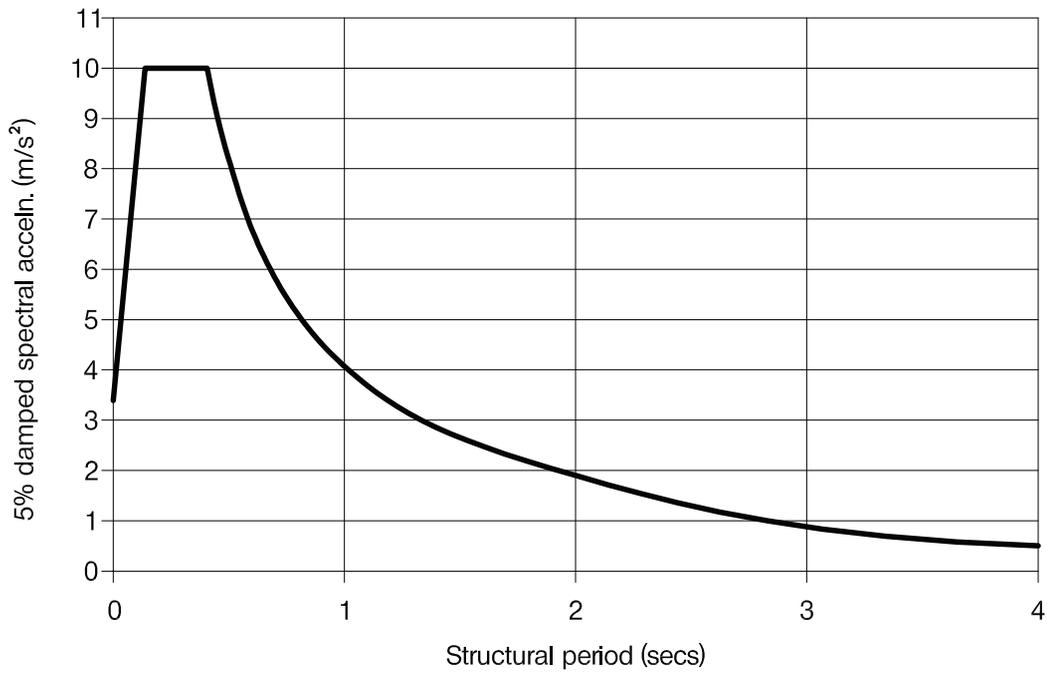


FIGURE 2 : 475 year return period motions for rock outcrop at site

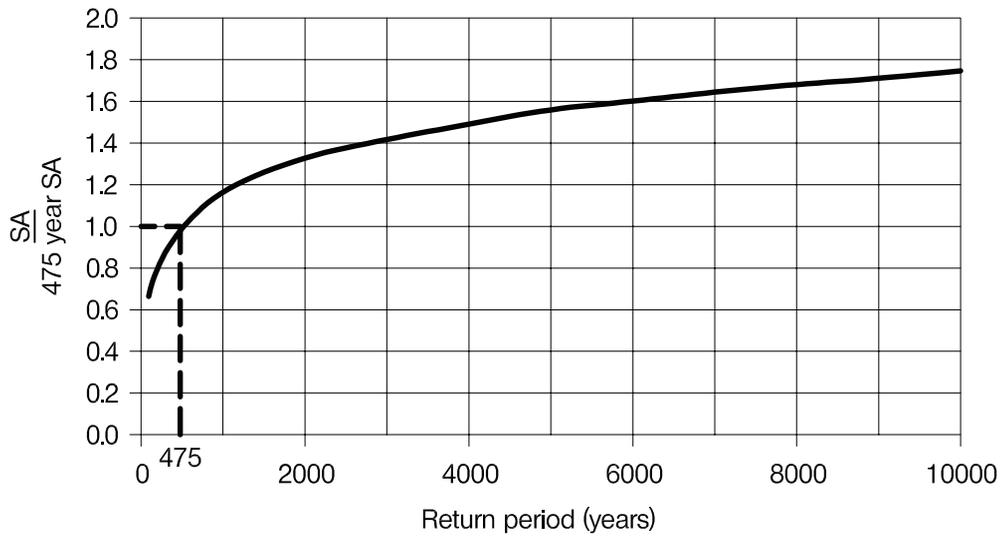


FIGURE 3 : Variation of spectral acceleration SA with return period

FIGURES 2 and 3



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An 8-storey office building in a town centre with high seismicity

Client's requirements

1. A new 8-storey office building including a penthouse is to be built in a town in an area of high seismicity. See Figure 1.
2. The building is rectangular in plan laid out on a square grid of 8.0m spacing (column spacing) in both directions. The roofs are flat and elevations are fully glazed.
3. Service cores containing lifts, stairs, risers and services are located in the central bays as indicated in Figure 1.
4. Column spacing shall not be less than 8.0m throughout.
5. No bracing/shear wall is allowed anywhere except in core walls, which can extend between associated columns.
6. All floors have an overall height of 4.0m except for the ground floor which is 7.0m high and penthouse which is 5.0m high.
7. With the exception of the penthouse, 10% of each floor area is allocated for heavy filing cabinets. The exact locations shall suit the design.

Imposed loading

8. Flat roofs: 1.0 kN/m²
 Floors: 5.0 kN/m²
 Heavy filing areas: 10.0 kN/m²

Site Conditions

9. The site basic wind speed is 42.0 m/s based on a 3-second gust. The equivalent mean hourly wind speed is 21.0 m/s.
10. Ground Conditions

0 - 0.3m	Made Ground
0.3m - 5.0m	Medium sand, N=26
Below 5.0m	Rock (shear wave velocity = 1050m/s)
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)

Carry out design checks on key members/connections of the lateral load resisting system including a beam, column, bracing/shear wall, and foundation for the proposed scheme.

Discuss the impacts on the scheme if heavy filing cabinets on levels 2 and 3 are moved to the penthouse.



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