

Specialist Diploma: Seismic Design

Friday 6 January 2017

Timetable: 09.30 – 13.00

Notes to Candidates

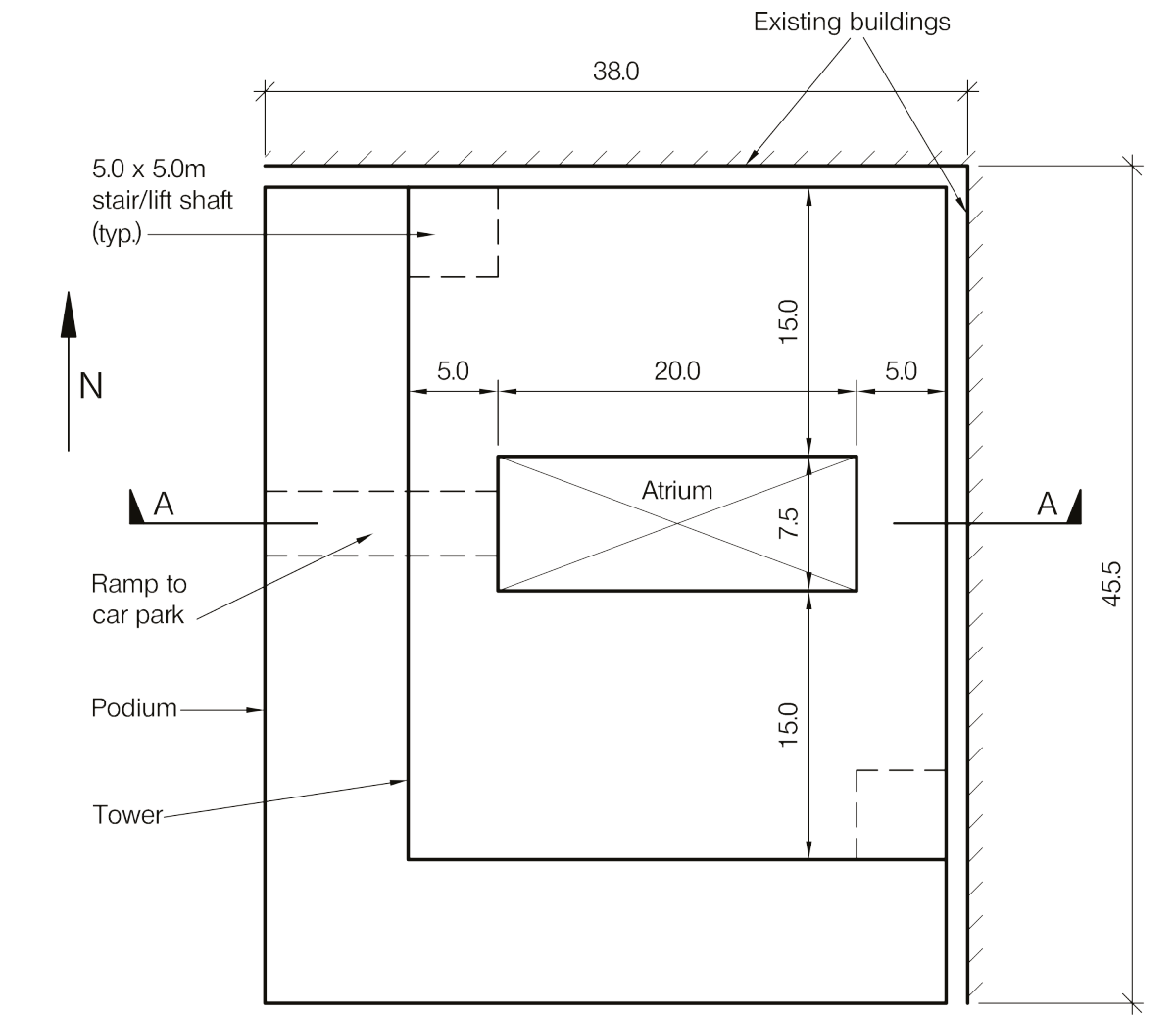
1. TO PASS THE EXAMINATION, CANDIDATES MUST SATISFY THE EXAMINERS IN BOTH PARTS OF THE QUESTION.
2. Examiners will only mark work written by hand during the examination. Candidates will not be allowed to include any previously prepared calculations, notes, sketches, diagrams, computer output or other 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.

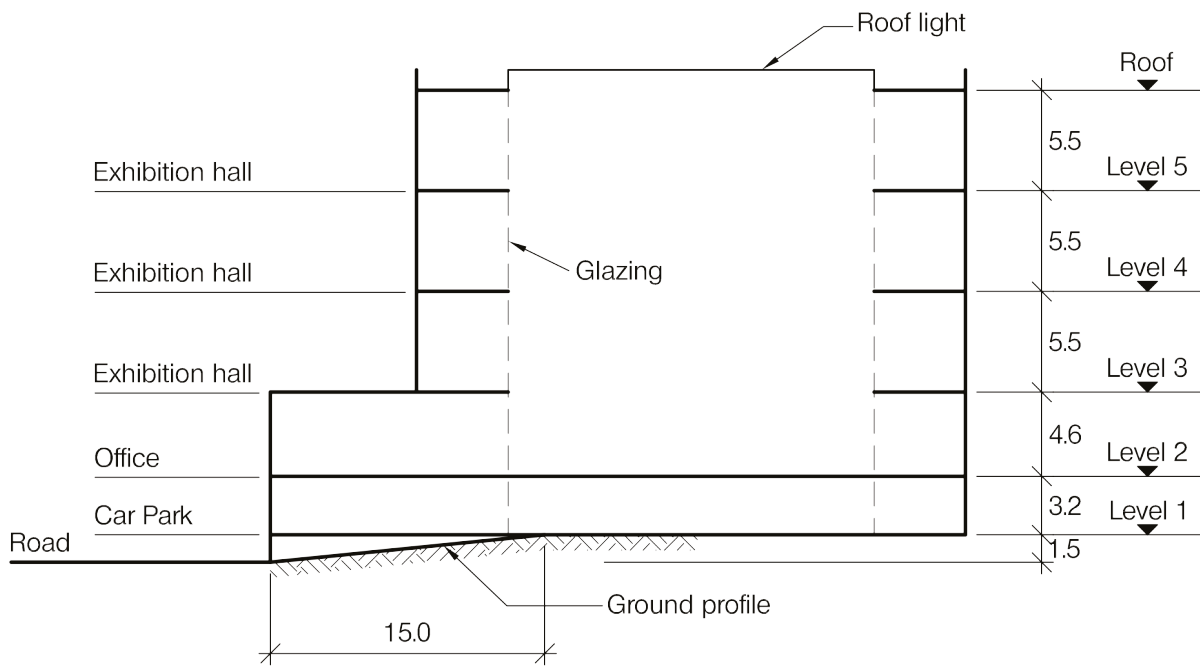
Any candidates arriving at the examination room with such devices will be asked to switch them off and place them in a sealed bag kept by the Invigilator for the duration of the exam.
9. This paper is set in SI Units.

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.

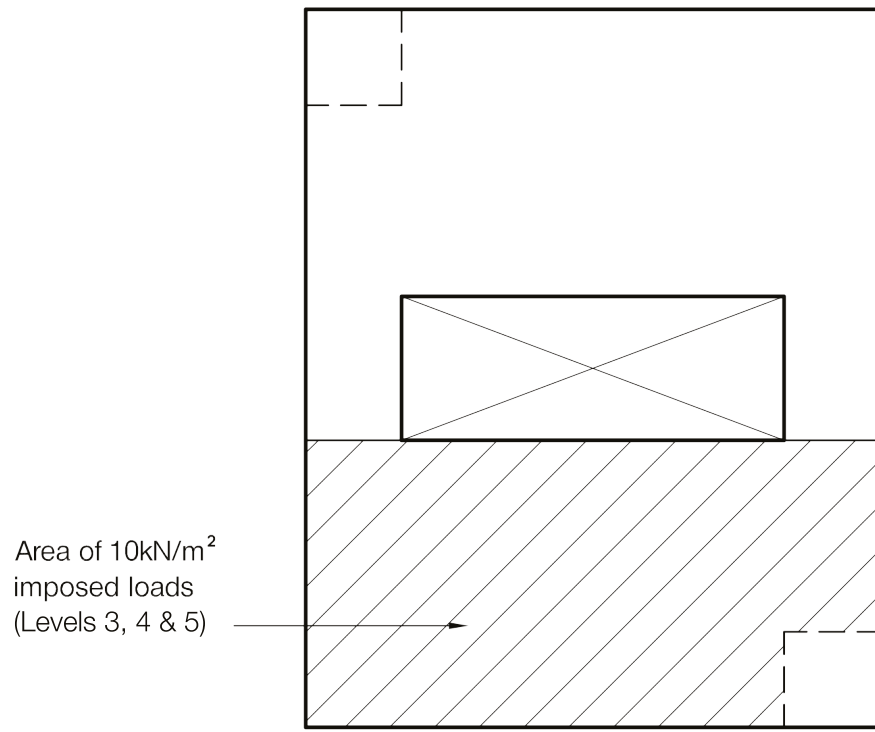


ROOF PLAN



SECTION A -A

FIGURE 1



FLOOR PLAN AT EXHIBITION HALLS

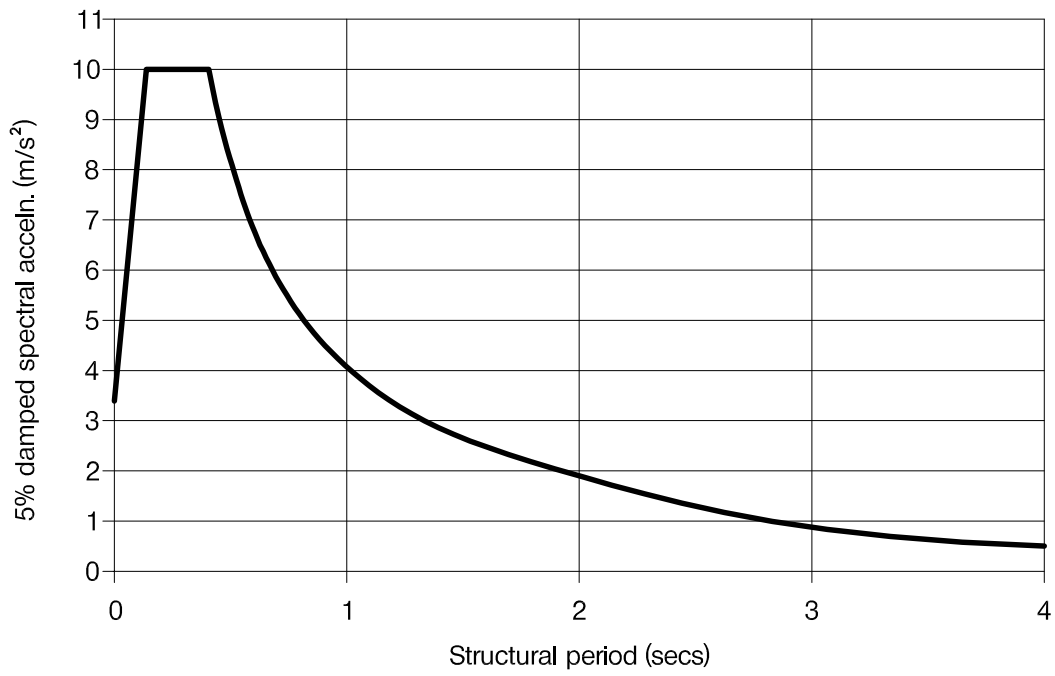


FIGURE 2 : 475 year return period motions for rock outcrop at site

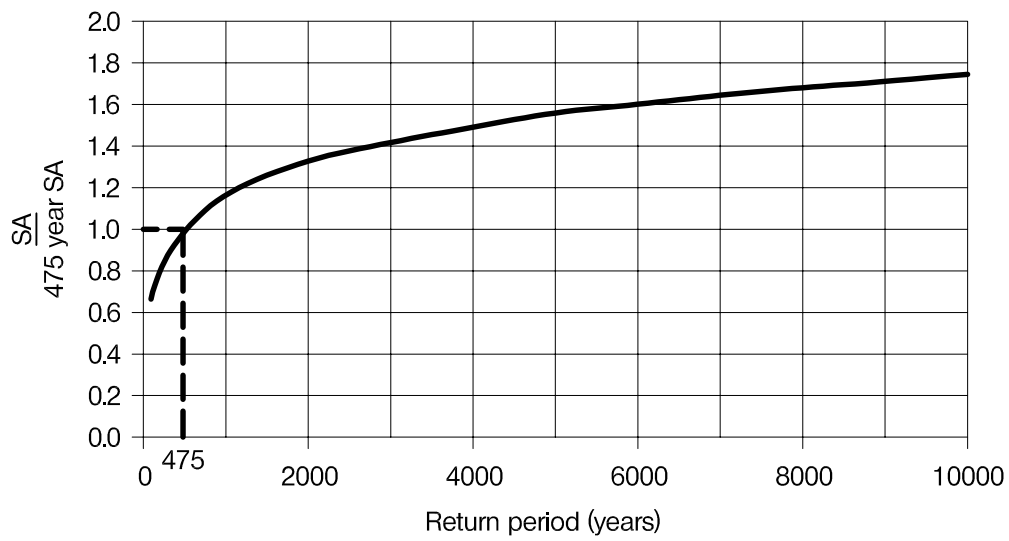


FIGURE 3 : Variation of spectral acceleration SA with return period

FIGURES 2 and 3

An exhibition centre in an area of high seismicity

Client's requirements

1. A new 5-storey exhibition centre is to be built in a major city in an area of high seismicity, see Figure 1.
2. The site is a corner plot with existing buildings to the north and east and streets to the south and west sides. The two street sides are glazed and the two sides away from the streets are bounded by fire resistant walls. The site is partially sloped along the east-west direction over a length of 15m across the site measured from the west side.
3. The building comprises a podium and a tower, accommodating a carpark and plant room on level 1, offices on level 2 and exhibition halls on levels 3-4.
4. All exhibition halls have full height glazing to the street sides and office-floor walls are 30% glazed facing the streets.
5. There is a fully glazed atrium with a glazed roof at the middle of the tower above level 2. Columns are permitted at a minimum spacing of 7.5m throughout except in the tower area, where a maximum of one line of internal columns is permitted along the north-south direction.
6. Diagonal bracing is not permitted in the interior of the building but unobtrusive bracing is permitted in the external elevations if required.
7. Clear floor-to-ceiling heights of 3.8m are required for exhibition halls, 2.7m for the office floor, and 2.3m for the carpark. The maximum overall floor heights given in section A-A of Fig 1 include allowances for service zones.

Imposed loading

- | | |
|--|------------------------------------|
| 8. Roof | 0.60kN/m ² |
| Exhibition floors to the south of atrium | 10kN/m ² (see Figure 1) |
| Other Floor areas | 5kN/m ² |

Loadings include allowances for floor finishes, ceilings and services.

Site Conditions

9. The site basic wind speed is 46m/s based on a 3 second gust; the equivalent mean hourly wind speed is 23m/s.
10. Ground Conditions
 - 0 – 1.0m Made Ground
 - Below 1.0m Very dense sand and gravel, N=50 No ground water was encountered
11. Figs 2 and 3 show the design 5% damped seismic response spectrum for the region. It applies to level ground for a 475yr return period assuming the ground surface is rock with shear wave velocity of not less than 800m/s.

Section 1

(60 Marks)

- a. 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)

- 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 marks)
- b. If only one imposed load is specified for all floors (except roof), e.g. 7kN/m² throughout, discuss the effect on the proposed structure. (10 marks)

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