

Specialist Diploma: Seismic Design

Thursday 8 April 2021

Notes to Candidates

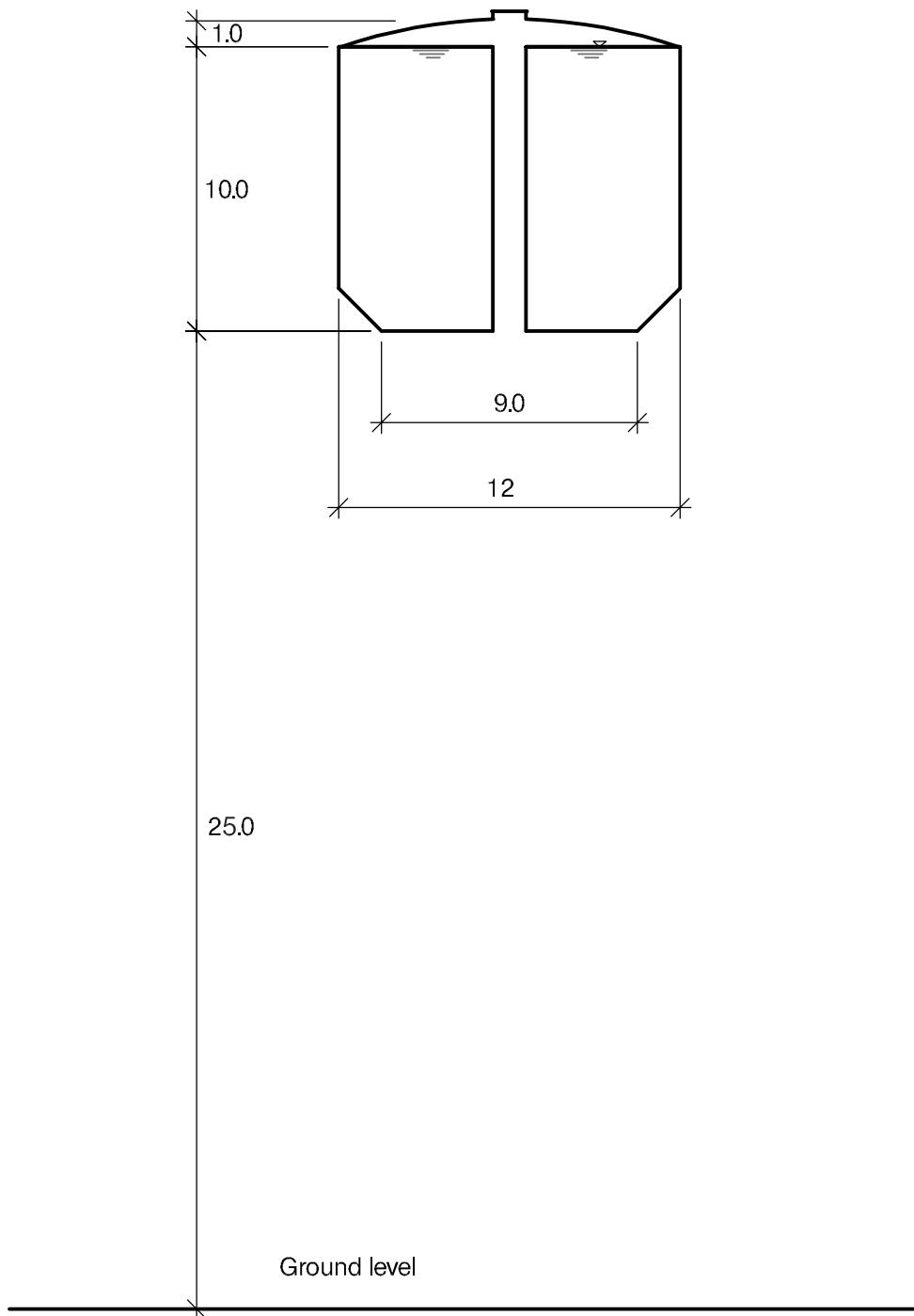
1. TO PASS THE EXAMINATION, CANDIDATES MUST SATISFY THE EXAMINERS IN BOTH PARTS OF THE QUESTION.
2. Examiners will only mark work written by hand during the examination. Candidates will not be allowed to include any previously prepared calculations, notes, sketches, diagrams, computer output or other 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.
10. Candidates should note that Figures are produced to illustrate the question and are not necessarily drawn to scale. Figured dimensions should be followed.

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.



WATER TANK ELEVATION

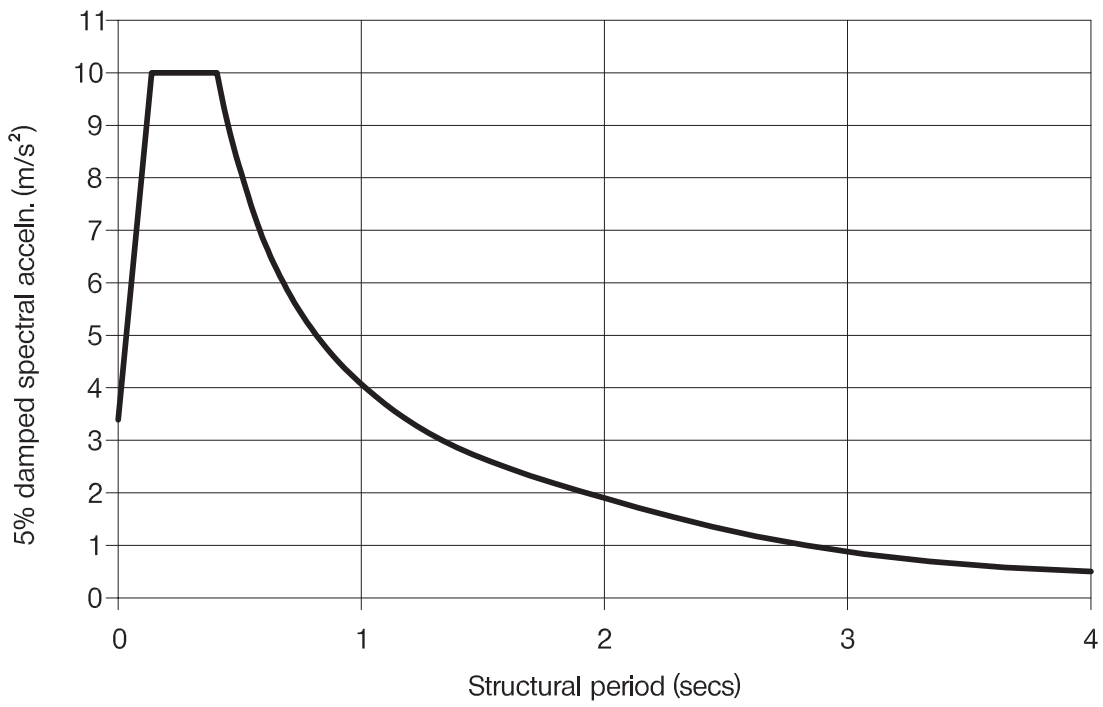


FIGURE 2 : 475 year return period motions for rock outcrop at site

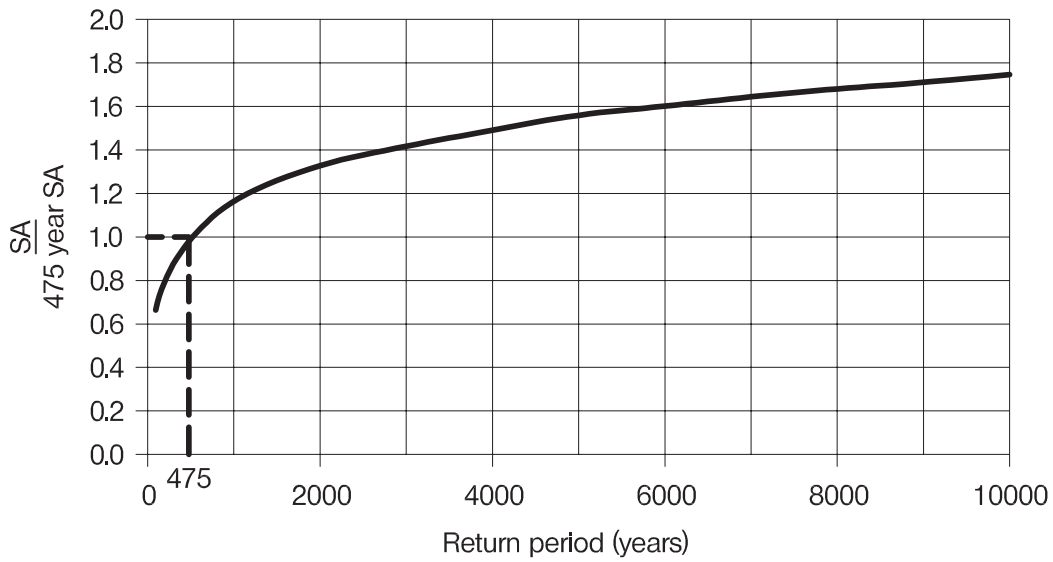


FIGURE 3 : Variation of spectral acceleration SA with return period

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Elevated water tank in a high seismic zone

Client's requirements

1. A new elevated cylindrical water tank is to be built in a city located in a high seismic zone, see Figure 1.
2. The container capacity is to be 1000 m³ with a framed, shaft, or pedestal supporting structure.
3. The supporting structure must be aesthetically appealing.
4. The site is enclosed and 40.0m x 40.0m in plan.
5. Maintenance access to the tank is via fixed ladders and associated platforms.

Imposed loading

- | | |
|------------|-----------------------|
| 6. Roof: | 1.5 kN/m ² |
| Platforms: | 5.0 kN/m ² |

Site Conditions

7. The site basic wind speed is 40.0m/s based on a 3-second gust. The equivalent mean hours wind speed is 20.0m/s
8. Ground conditions:
 - 0.0m - 1.0m Made ground
 - below 1.0m Dense sand, N=30m Groundwater was found at 2.0m below ground level.
9. Figures 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)

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

Section 2

(40 Marks)

- b. Carry out design checks on key elements of the lateral load resisting system including a beam, column, bracing/shear wall, and foundation for the proposed scheme. (30 Marks)
- c. Discuss the impacts of the fluid-structure interaction (sloshing) on the forces exerted on the container and ways to include this effect in the seismic response of the structure. (10 Marks)

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