Deep Foundations Institute of India

Students outreach initiative "Groundwork"

Laying Foundation for the Next Generation Foundation Practitioners

Problem solving competition – Level 1

Submit before end of 15 November 2020 @ activities@dfi-india.org

There are six problems stated in the following sheets, and any FIVE problems shall be attempted.
Up to maximum five students can group together to submit one set of solutions.
One group can submit only one set of solutions.
One student can be part of only any one group.
The solution sets shall be prepared using wide screen PPT, each problem covered in a single sheet (as far as possible).
There is no participation fee for this competition. Each participating student will receive a participation certificate. All participating students will automatically become DFI student member with access to several technical reference material.

The best two solution sets will be awarded free registration to DFI India 2020 virtual conference on 19-20 November 2020. Merit certificates shall be presented to all the students submitting the best two solution sets.
If there are identical solution sets, those may be excluded from the competition.

Any questions about the competition can be asked to activities@dfi-india.org. Visit www.dfi-india.org/DFII2020 for the conference details and other contact information.

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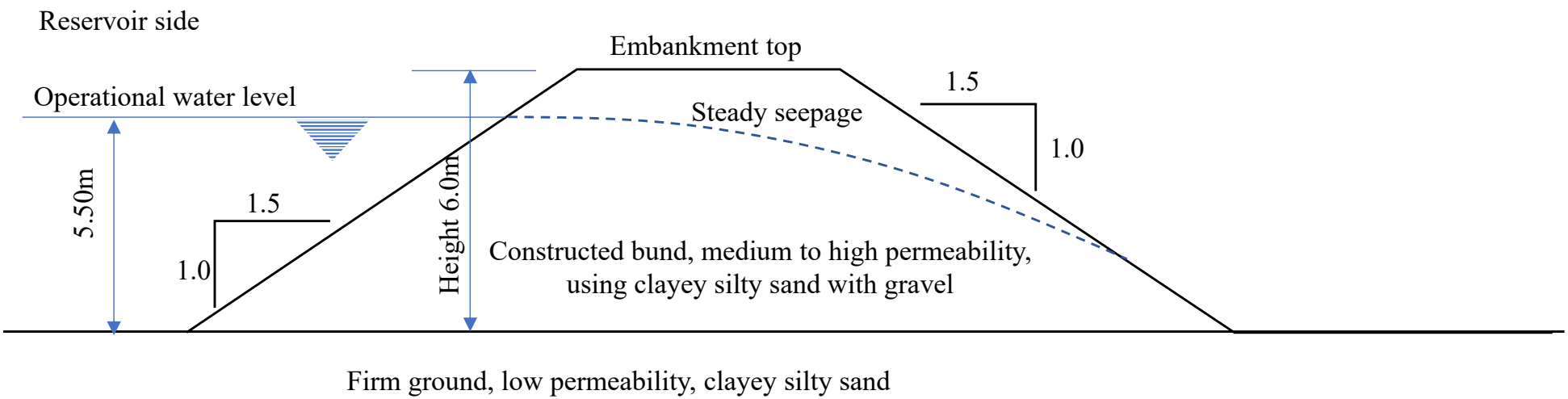
Details of the Students (all are required)

Sl No	Full Name	Programme	Year of completion	Roll No	Institution	Regn*
Name of the Reference Professor						
Email and phone number of the professor						
Contact details of one of the students						
Date of submission						

Regn* - whether registered at GoToWebinar link of DFI of India https://attendee.gotowebinar.com/rt/1097030439670558220 (Yes/No). It is suggested that all the students register at this link for future communication

PROBLEM 1



Problem:

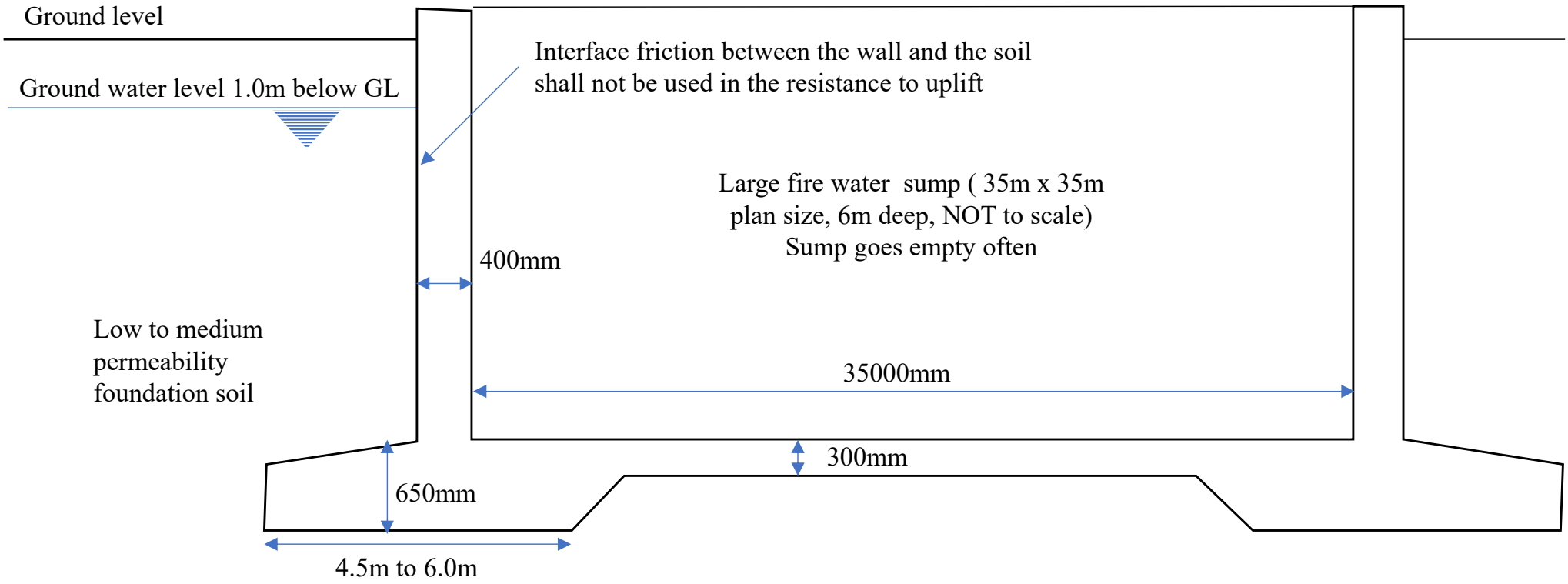
Shown in the figure is an earthen embankment section stable without full water storage. The base is firm and has low permeability. Steady seepage line under full storage (5.50m water depth) is shown. The embankment is not stable under steady seepage. Loss of water is more than allowable.

Solutions required:

Suggest measures to make the embankment stable and reduce the loss of water. Internal lining such as HDPE geomembrane or RCC is not acceptable. Calculations need not be provided.

Your solution can be illustrated with broad specifications and conceptual drawing/sketches with tentative dimensions. It will be nice to provide the logic behind the solution.

PROBLEM 2



Problem:

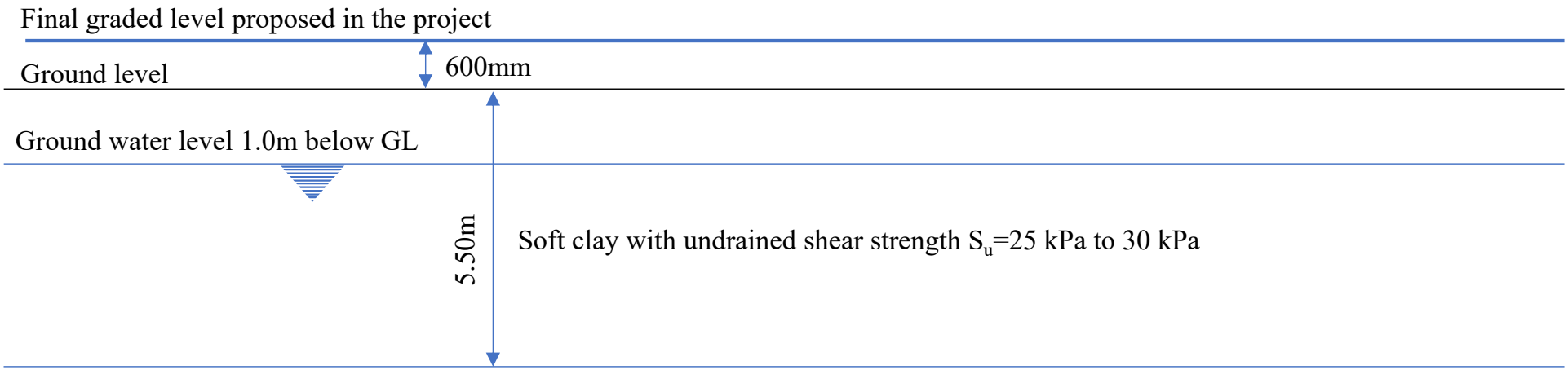
Shown in the figure is a below ground sump for fire water storage. The plan size is 35m x 35m and the water height in the sump is 6m. Ground water table is 1.0m below GL, while the sump base slab bottom is 6.8m below GL.

Solutions required:

What is the stability of the sump and the sump base when it is empty (against uplift due to ground water pressure)?
If it is not stable, what measures can be adopted in the design to make it stable?
(answer with illustrations only. Numerical values need not be reported. Logic behind the solutions shall be described.)

PROBLEM 3

Heavy plant and machinery is required for the construction of vibro-stone columns up to 10m deep. This foundation construction shall cover a large area requiring the movement of the construction machinery everywhere.



Firm to stiff sandy clay with undrained shear strength S_u=75 kPa to 130 kPa

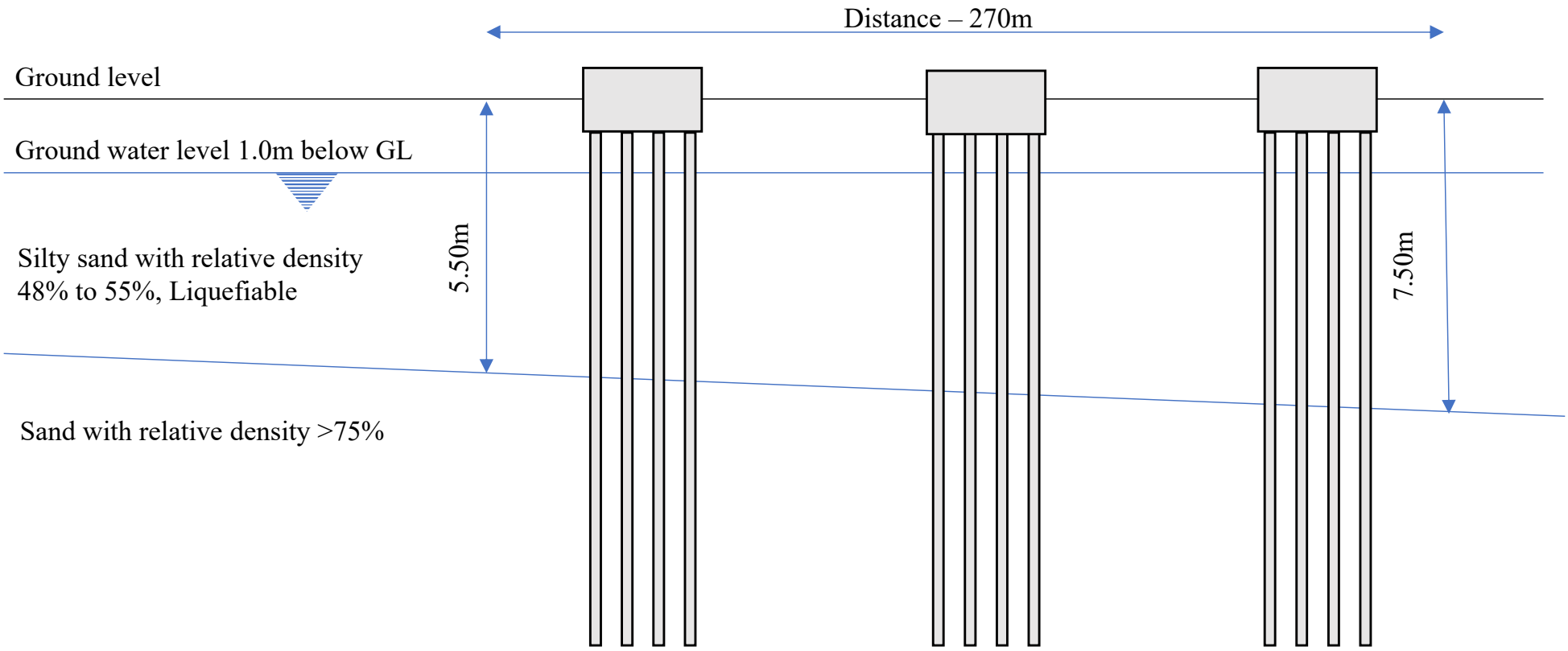
Problem:

This is a construction site. The top 5.5m soil is medium to high plasticity clay having undrained shear strength 25 to 30 kPa. Ground improvement using stone columns is to be executed for a large tank farm.

Solutions required:

How do you propose to prepare the platform for supporting the plant and machinery for installing the stone columns?
No numerical solutions needed. Only schematic. HINTS – Compacted fill (specify thickness), geosynthetic.
Please mention broad specifications and the logic behind the solution.

PROBLEM 4



Problem:

This is a construction site. The top 5.5m to 7.5 soil is loose to medium dense fine sand followed by dense sand. The top sand layer is liquefiable. The structures are to be supported on pile foundations penetrated well into the dense sand.

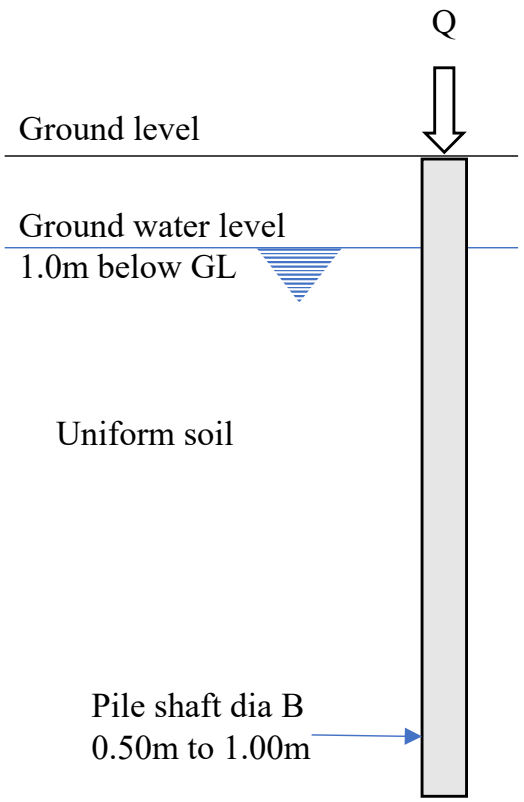
Solutions required:

What are the possible additional forces on the piles during seismic conditions and when the top layer liquefies? Try to use standard terms.

Suggest two procedures to mitigate liquefaction so that the additional forces on the piles are avoided/reduced.

Student is encouraged to suggest literature and codes that can help in providing these solutions.

PROBLEM 5



Problem:

A single pile is loaded vertically down until the pile moves down by more than 10% of the pile shaft diameter.

Solutions required:

Illustrate the load – settlement behaviour under the following conditions

1) The pile has side friction and base resistance (loaded in uniform increments)
2) The pile has very poor base resistance compared to side friction (loaded in uniform increments)
3) The pile is loaded in equal load intervals, each interval maintained for 2 hrs each. (pile has both side friction and base resistance)
4) The pile is loaded in equal intervals, but each load increments maintained for 10 minutes each.
5) The pile is loaded to 10% of the maximum load and unloaded to zero (The maximum load referes to the load correspond to a settlement equal to10% pile diameter. The pile is again loaded to 80% of the maximum load and unloaded to zero. Pile has base and side resistance (as in case 1).

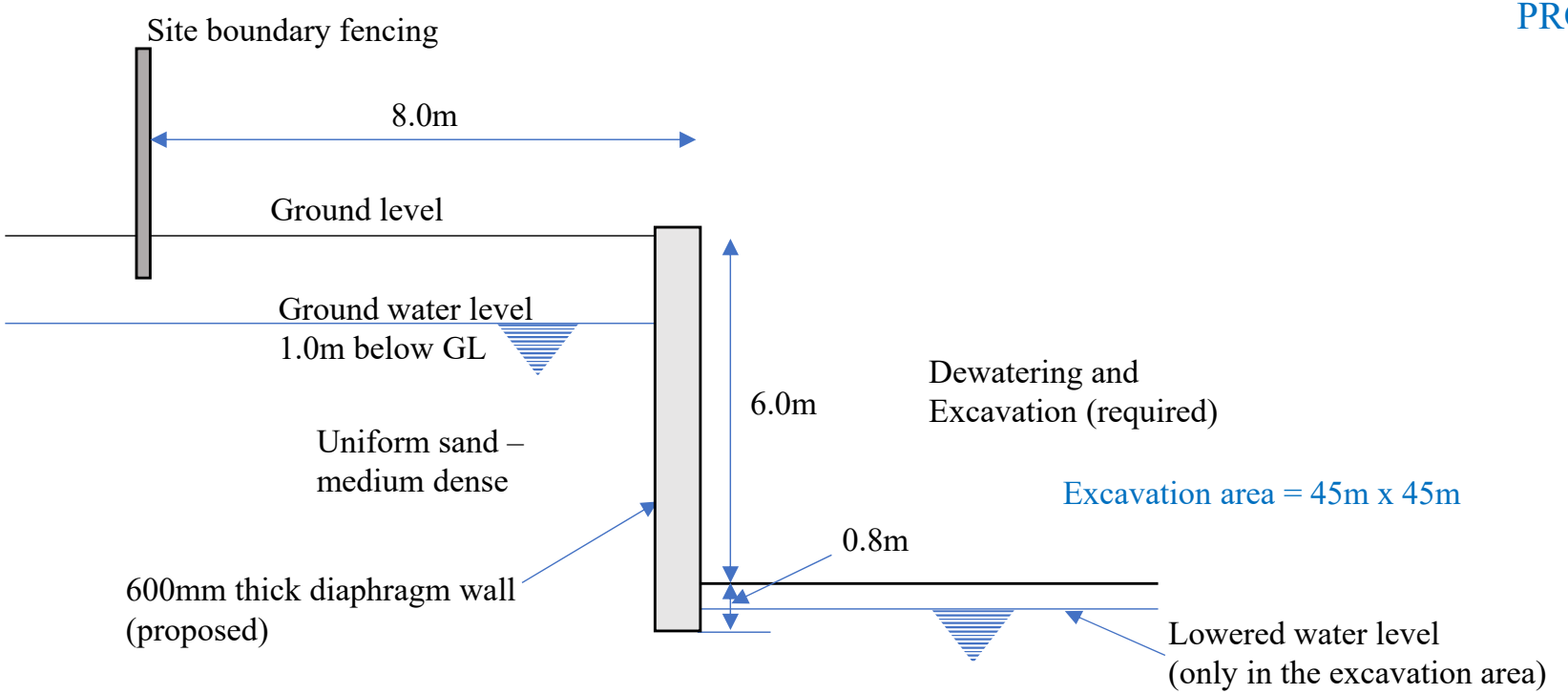
The load –settlement plots shall be with dimensionless parameters as

Settlement in terms of percentage of pile diameter (0 to 15%)

Load in terms of maximum load Q_{max} under settlement >10% pile diameter.

All plots shall be in one graphs expressing the relative performance. If needed numbers in realistic ranges can be used for plotting purpose.

PROBLEM 6



Problem:

6.0m deep excavation is to made in medium dense uniform sand. Ground water table is 1.0m below ground level. A 600mm thick diaphragm wall is proposed up to 7.0m depth. Need to excavate 6.0m simultaneously lowering the water level in the excavation area as shown in the figure.

Solutions required:

State with reasoning, whether a stable excavation is possible in this case.
If not, what remedies / changes in the system can be proposed.
Solutions in schematic sketches with rough dimensions. Explain the mechanism.