

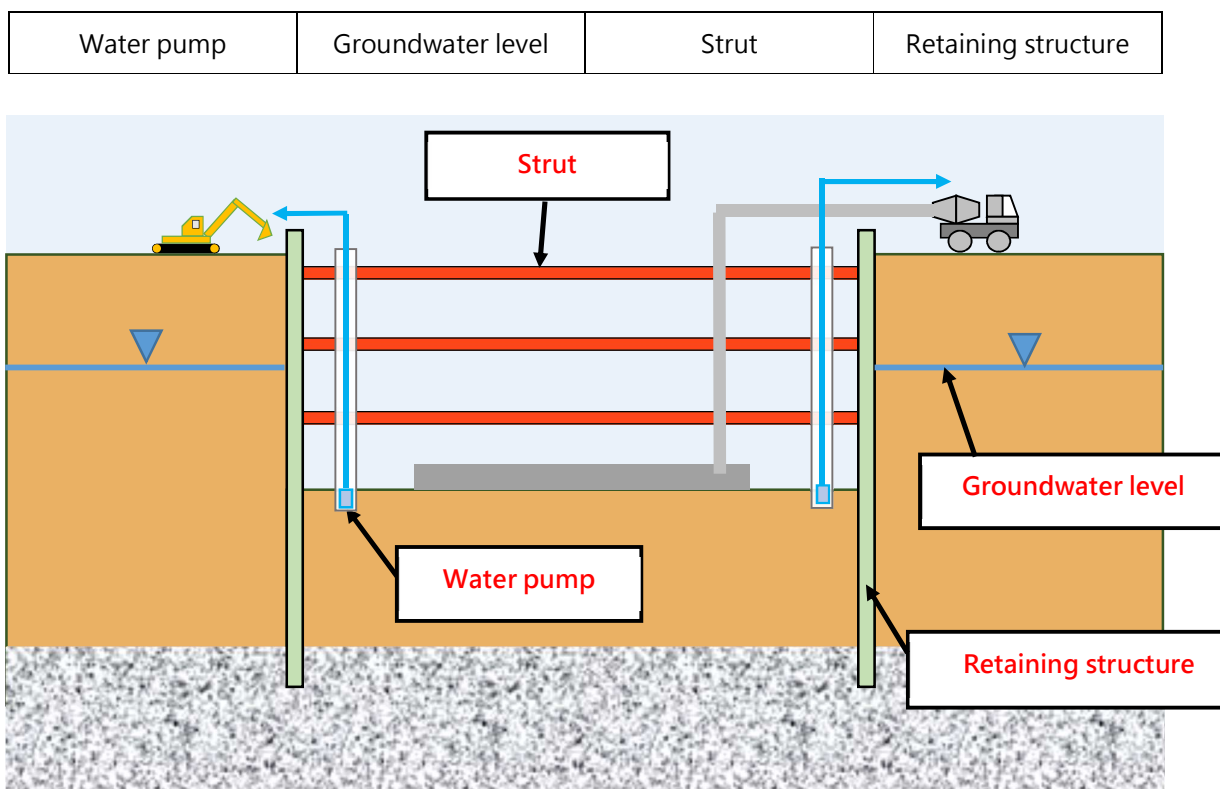
# Central Kowloon Route (CKR) - Excavation and Lateral Support (ELS) Works

## Answer of Worksheet (Secondary School)



ELS works are typically used to provide support for excavation of the existing ground for the purpose of construction of pile caps, basement and underground structures. Various works of the CKR Project, including the construction of depressed roads, cut-and-cover underwater tunnel and ventilation buildings, involve ELS works.

1) Fill in the blanks to finish the set-up.



2) Prioritise the construction sequence of ELS works.

<b>4</b>	<b>Excavation</b> – To Remove soil from the excavation area to make room for further construction work
<b>1</b>	<b>Installation of vertical retaining structures</b> – To avoid collapse of soil outside the excavation area
<b>3</b>	<b>Installation of struts (lateral support)</b> – To support the retaining structures
<b>2</b>	<b>Removal of water from the soil within the excavation area</b> – To reduce soil moisture to facilitate excavation work

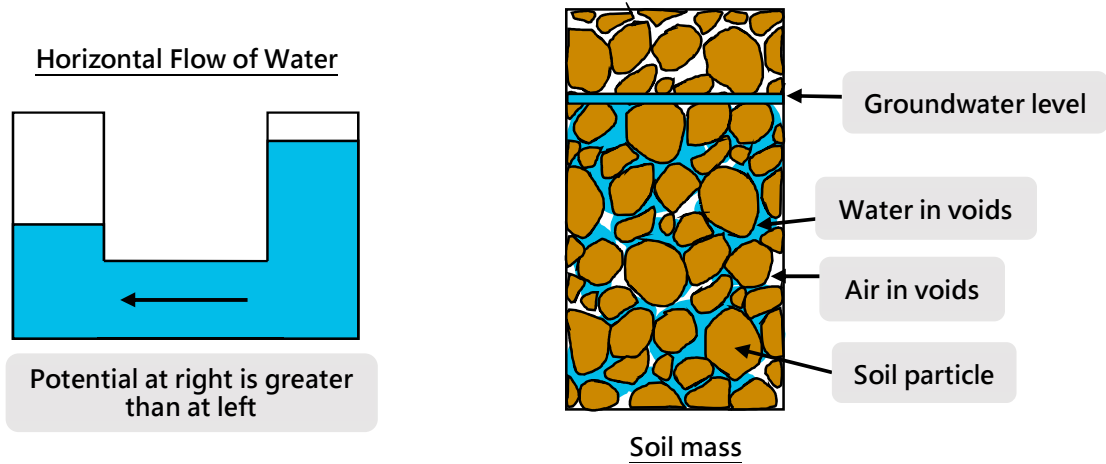
### Do You Know?

The above is a simplified sequence for ELS works. In the actual construction process, the steps will be repeated every time when the excavation works at a certain depth are completed and until the excavation reaches the required underground depth. If, during excavation work, the soil in the excavation area becomes excessively wet, the water will be withdrawn again to a condition suitable for further excavation.

### Works Characteristics - Settlement

When designing ELS works, engineers need to consider different factors such as excavation depth, soil pressure and groundwater level to minimise the impact on the surrounding environment. Ground settlement is a common phenomenon during ELS works. Monitoring points will be set up at the site to ensure that the settlement values are within a safe range.

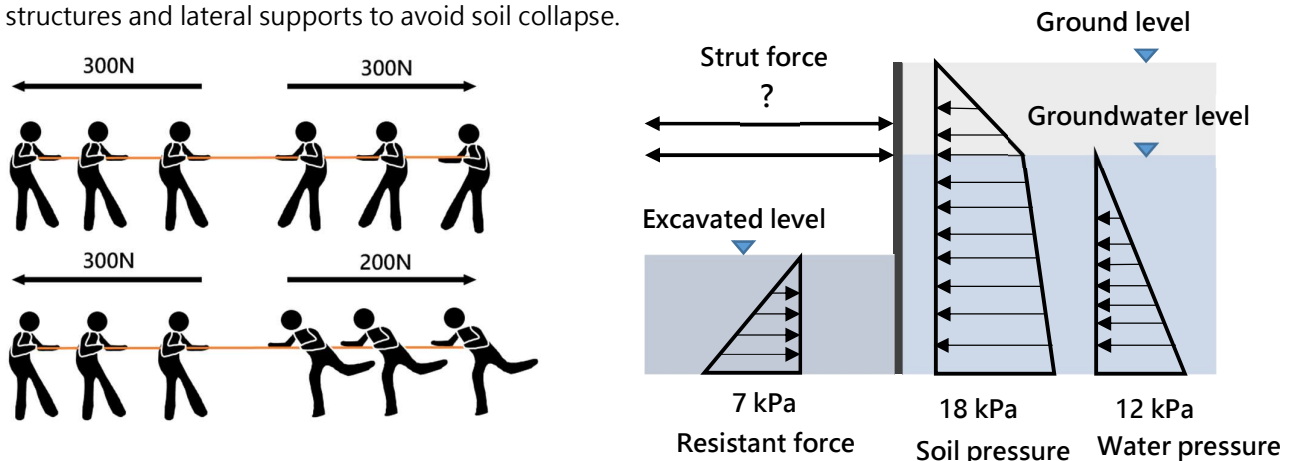
Briefly describe the causes of settlement based on the set-up diagram on page 1 and the diagrams below.



(Suggested answer) The ELS works are equipped with water pumps to withdraw water from the soil within the excavation area and reduce soil moisture for excavation work. After the removal of water, the water potential energy in the soil within the excavation area decreases, and potential energy difference is formed between the water in the soil outside the area. As water flows from a state of higher potential energy to one of lower potential energy, part of the water in the soil outside the excavation area will flow into the excavation area, lowering the groundwater level and reducing the voids between soil particles, thus causing the ground settlement.

### Works Characteristics – Lateral Support

Excavation works will cause a difference in ground level inside and outside the excavation area, resulting in a higher soil pressure outside the excavation area. Therefore, it is necessary to install vertical retaining structures and lateral supports to avoid soil collapse.



Please circle the struts (more than one answer) to be installed according to the figure above.

5 kPa

9 kPa

6 kPa

12 kPa

8 kPa

18 kPa

Since 23kPa is required to achieve the balance, possible answers are: (i) 6+8+9 or (ii) 5+6+12.