

# Coordinates

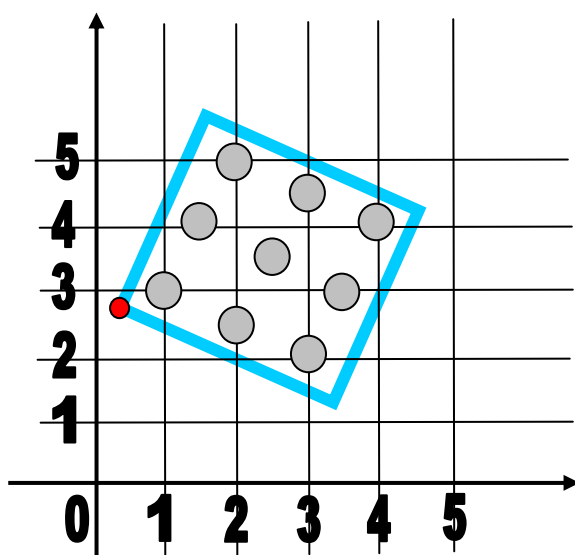
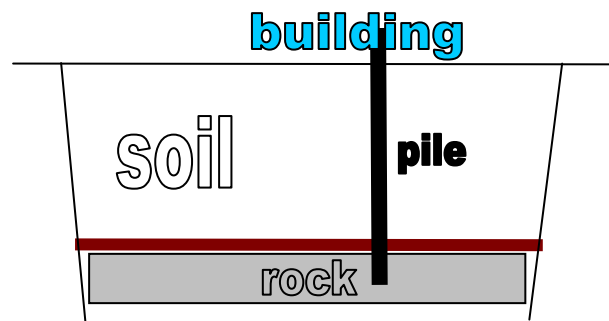
## How do you make sure buildings stay up?

If you're building a twenty floor skyscraper, you want to be completely sure it won't fall down. It's important to make sure that it has a proper foundation. Suppose that your building is in an area where there's a layer of rock about five metres down, but above that there's only poor quality soil that won't support the weight of the building. Then you need to put some **piles** in to support the building.

Piles are long and thin. They might have a cuboid or cylinder shape. They can be made of steel or timber or concrete and are pushed through the soil into the rock. The important thing is that they allow the building to be supported by them, and they stand on the firm rock below the soil.

When pushing (engineers call it **driving**) piles into the ground, you have to make sure that they're spaced out evenly.

Imagine that you're in a helicopter looking down on the building site. You could make a map of the site and put coordinates on it so that you can say where the piles should go.



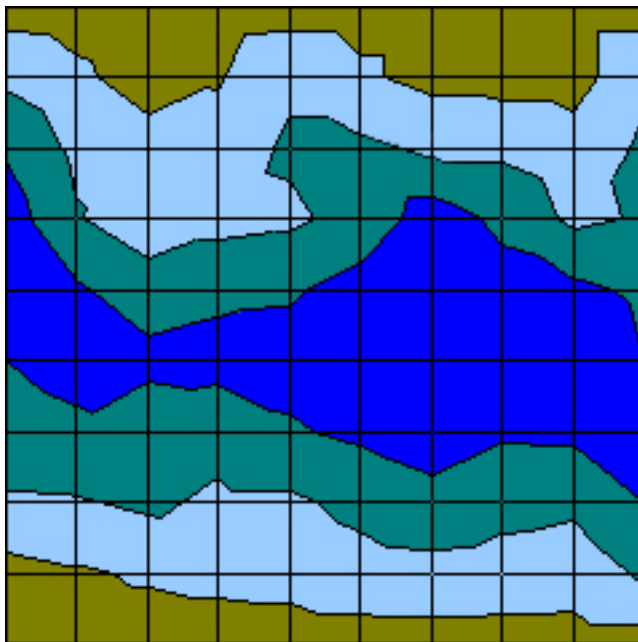
In the grid shown, there are nine positions where the piles are to go, marked with grey dots. Two of these positions are (1,3) and (2, 2.5). Where are the other seven positions?

The building is marked as a blue rectangle on the grid. If we made the building twice as long in each direction, keeping one corner fixed at the red dot, how many more piles would we need? Where should they be put?

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## Building bridges

An engineering company has been asked to build a bridge across the river shown. The grid can be given coordinates so that the bottom left hand corner is (0,0) and the top right hand corner is (9,9). The foundation piles for the bridge are to be placed at the following coordinates:



(1,0), (2,0), (3,0)  
(1,1), (2,1), (3,1)  
(1,2), (2,2), (3,2)  
(1,3), (2,3), (3,3)  
(1,4), (2,4), (3,4)  
(1,5), (2,5), (3,5)  
(1,6), (2,6), (3,6)  
(1,7), (2,7), (3,7)  
(1,8), (2,8), (3,8)  
(1,9), (2,9), (3,9)

1. Draw where the piles for the bridge should go.
2. The colour shows where land is, or the depth of the water. For example, there is:  
**Land** at (2,8)  
**Shallow water** at (2,7)  
**Deep water** at (2,5)  
**Very deep water** at (2,4)  
Suppose that it costs £2000 to drive a pile into land, £3500 to drive a pile into shallow water, £4500 to drive a pile into deep water, and £5500 to drive a pile into very deep water. How much will it cost to drive all of the piles for the bridge, in total?
3. An earlier suggestion had been to run the bridge from (5,0), (6,0) and (7,0) directly across to (5,9), (6,9) and (7,9). How much more expensive would it have been to drive the piles for this route?