Mathematics Day for Lower Secondary 2019

Design a parking garage!

MATHEMATICS DAY FOR LOWER SECONDARY 2019

During the day you will be working on a major open problem with a group of three to four students. The intention is that by the end of the day you will have written a paper as a result of your work. Below, you find a checklist with issues to keep in mind.

Method	*Check*
First read the entire assignment and consider the following: - Approach - Division of tasks - Availability computer - Time planning (make one!)	
Work together: regularly discuss whether you are still on the right path and whether your planning is still accurate; do not forget to plan in some time at the end of the day to write a coherent report.	
Do not be satisfied too easily. Try different variants/ methods/ strategies within the assignments and include these in your report.	
Always justify your choices with arguments and describe your work method.	
Write a real report, not merely a list of answers to the questions; ensure that it is a logical entity.	
Make sure that your report can be read as an independent entity without the jury needing to look at the assignments. The report consists of the map of the parking garage, including an explanation to the decisions made and in the APPENDIX the approaches and results of the investigations.	
Remember to number the pages.	
Mention the names of the team members and the school on the cover sheet.	

The assessment

This assignment is not about the “one correct answer”; there isn‘t merely one.
In the assessment the following aspects are taken into account:

- whether your work method has been described clearly;
- whether the choices and results have been substantiated;
- how you have dealt with the assignment, whether you have worked systematically, and whether the use of math and calculations is correct, useful and clear;
- how the final assignment have been executed and whether the results of the investigations are incorporated in the map;
- whether the report/paper is a coherent entity that can be read as an independent piece without the use of the assignment;
- whether you used your creativity.

Have fun and good luck!

PREFACE

A local authority wants to create extra parking space in the city by building a parking garage under an apartment building that has yet to be built.

This parking garage must meet a number of conditions:

- there must be enough space for the cars (for turning, if necessary for passing, for parking)
- there must be two parking places for disabled people
- there must be two parking places for electric cars
- there must be six parking spaces for motorcycles
- there must be a stairwell
- there must be a good slope for the cars, for entering and leaving the parking garage.

In the appendices you can see the floor plan of the basement.
You are the architect team that gets this assignment from the local authority!

To design a parking garage that people want to use, it is important to examine a number of things well before you start designing.
In any case, you should investigate:
- the size of the turning circle of a car
- the steepness of the slope(s)
- the size and layout of the stairwell.

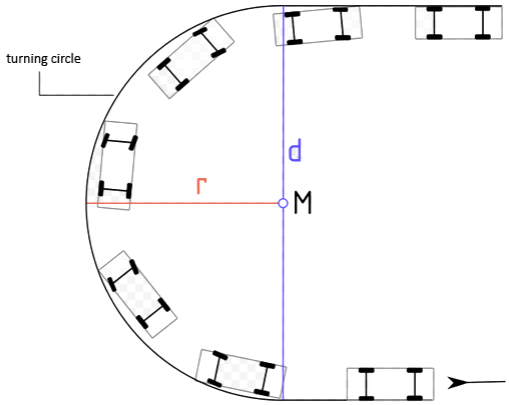
Next to that, you may do extra investigations, if you think this is necessary.

Below, we give a number of instructions for conducting the various investigations. The most important thing in every investigation is that you make clear how you conducted the research, with photos, drawings, materials, calculations, etcetera.

Investigating the TURNING CIRCLE

To get into a parking garage and to be able to park in it, you have to have space to turn the car.
The turning circle is the smallest possible circle that a car can make in one movement.
For a video on a turning circle of a car, see:
https://www.youtube.com/watch?v=3HTbSDcvmWk

The size of a turning circle is often indicated by the length of the diameter (d) of the turning circle. Below, you see half of the turning circle (r is the radius of the circle):

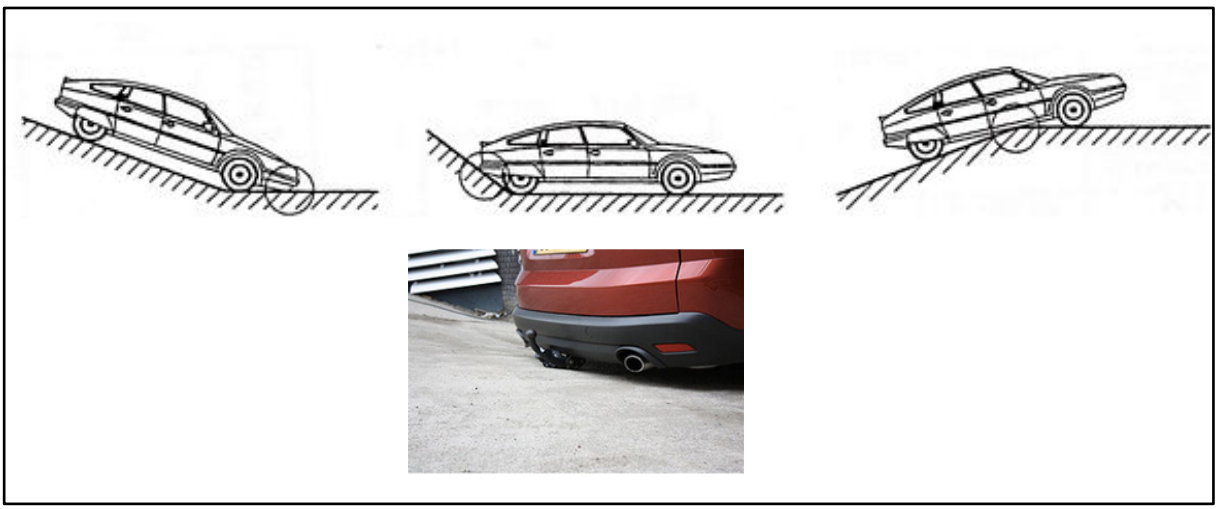


Investigate, using the tools you think you need, how much space you need for a car that has to make a turn.
Tools you might need are, for example, toy cars, Lego, bicycle ....
You will probably need to do some measurements and calculations before you can draw conclusions about the turning circle of a car.
Clearly indicate, using pictures, drawings, calculations, measurements, how you come to your conclusion(s).

Investigating THE SLOPE

The parking garage will be built in a basement. The cars will have to drive down from the road.
In the appendix, you see a ground plan of the terrain, where you can see where the parking garage is situated. The terrain around it can be used freely to create access to the basement. This access then connects to the road, or the roads, that run around the grounds (the lot).
Your investigation focuses on how steep and long the slope should be. You can work with percentages or with degrees; a tool for that is https://www.geogebra.org/m/t3zp5mjf

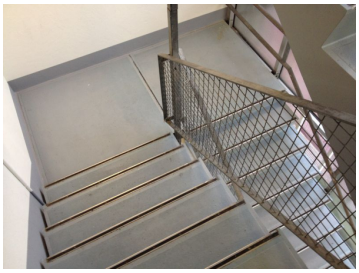
This should of course never happen!



Investigate, using everything you think you need, what the slope will look like! Explain well, using photos, drawings, scale models, calculations, measurements and so on, how you came up with your final slope.
A tool that you can also use can be found here:
https://www.geogebra.org/m/fphad38a

Investigate THE STAIRWELL

The people who park their cars don't use the same routing as the cars do. There is a stairwell for pedestrians. You set up this stairwell yourself. You make decisions about the location of the stairwell and how much space there is for the stairwell (the height and width of the stairs). You explain all those decisions, using calculations, drawings, photographs, and so on.



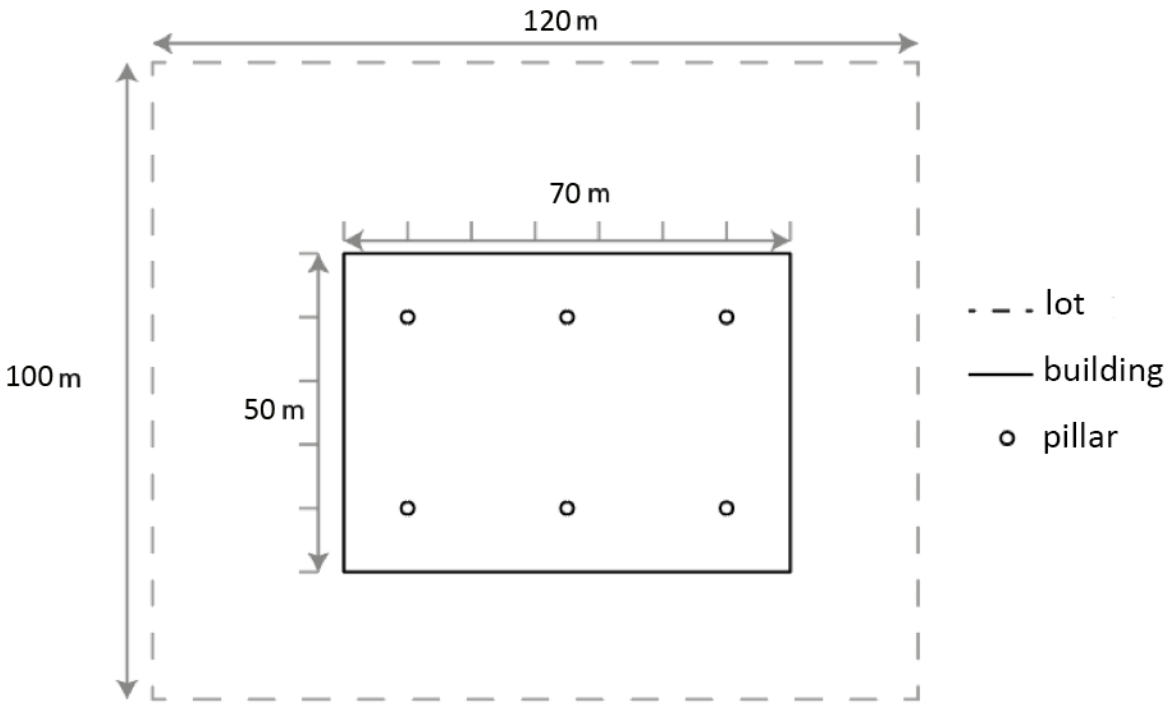
More investigations?

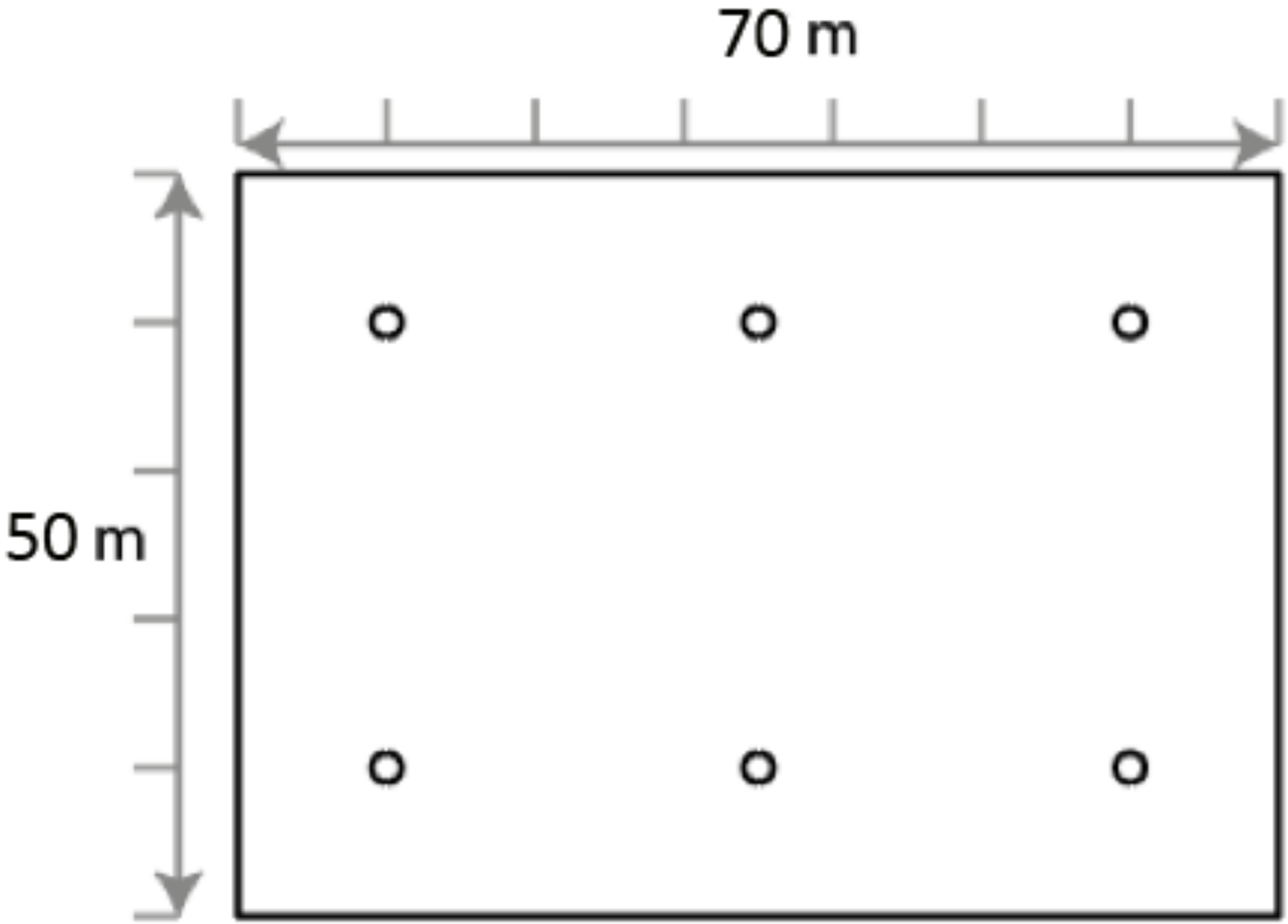
Do you have enough information now to design the parking garage? Or are other investigations still necessary?
Indicate what else you need to know and why. Carry out the investigation and explain how you got your information.
Incorporate all in your report.

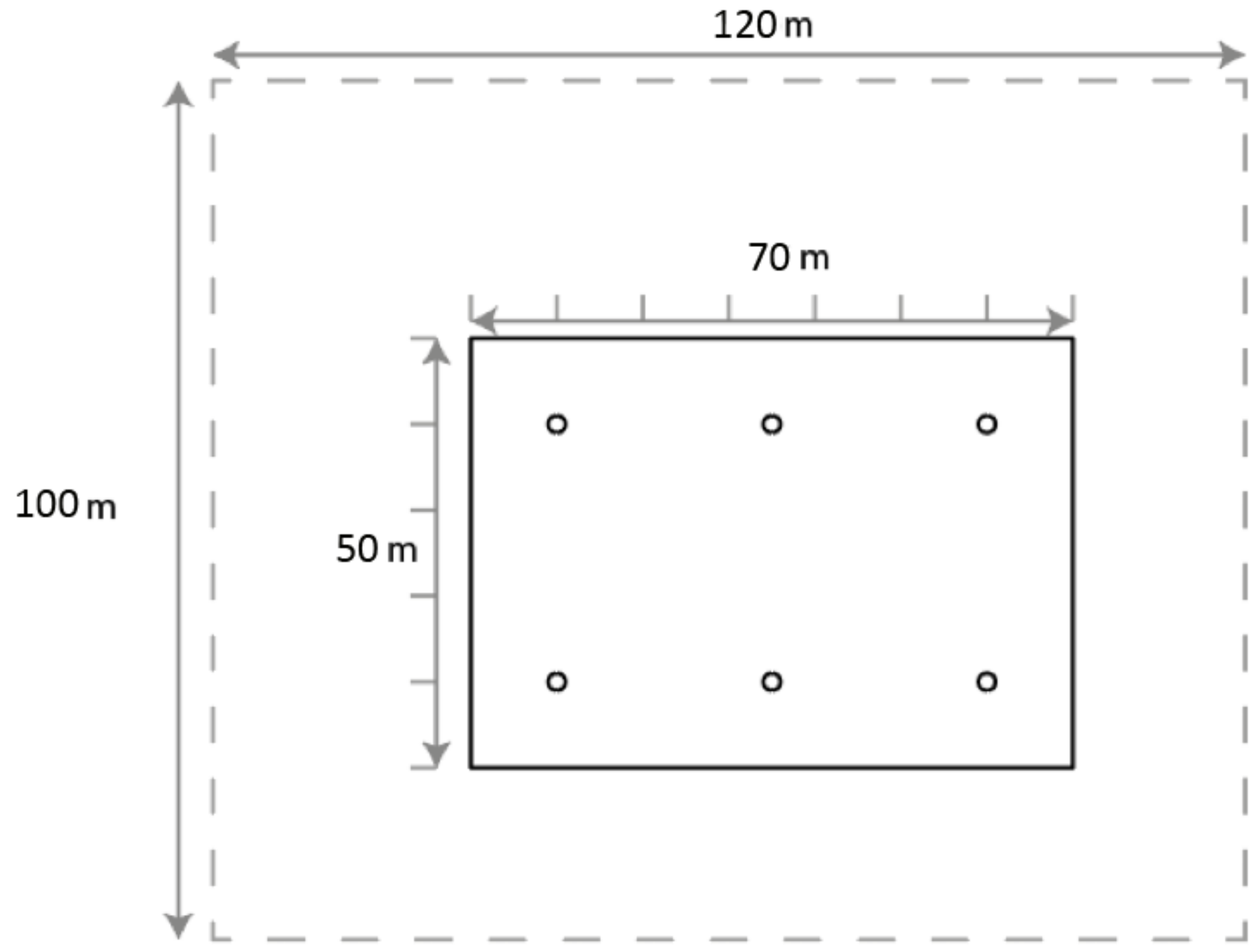
FINAL TASK

The client (the local authority) would like to have a lot of parking space, but the local authority also wants parking in the parking garage to be pleasant and easy.
As a team of architects, you provide a clear, completed floor plan, (including the slope) to scale. Make sure you meet the requirements set by the municipality. Also provide an explanation of all the choices made.
The approaches and results of the investigations are included in the report that you provide with the floor plan.

APPENDIX - small




70 m
50 m


120 m
70 m
100 m
50 m