University of Debrecen

Design of a Carport for more Cars

Thesis Defense

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OVERVIEW

- *Objectives*
- *Design Procedure*
- *Structural Failures*
- *Vehicle*
- *Parameters and Geometry*
- *Load Cases*
- *Snow Load*
- *Wind Load*
- *Utilization*
- *Conclusion*

OBJECTIVES

- To design a commercial duopitch carport that can host up to 30 vehicles.
- To follow a defined and systematic approach in the design procedure of the carport.
- To discuss different aspects pertaining to the carport and common structural failures including the comparison between tilt angle among different canopy roof types.
- To make use of computer-aided design and finite element analysis using AxisVM and FEM to scrutinize the structure under various load cases and load combination

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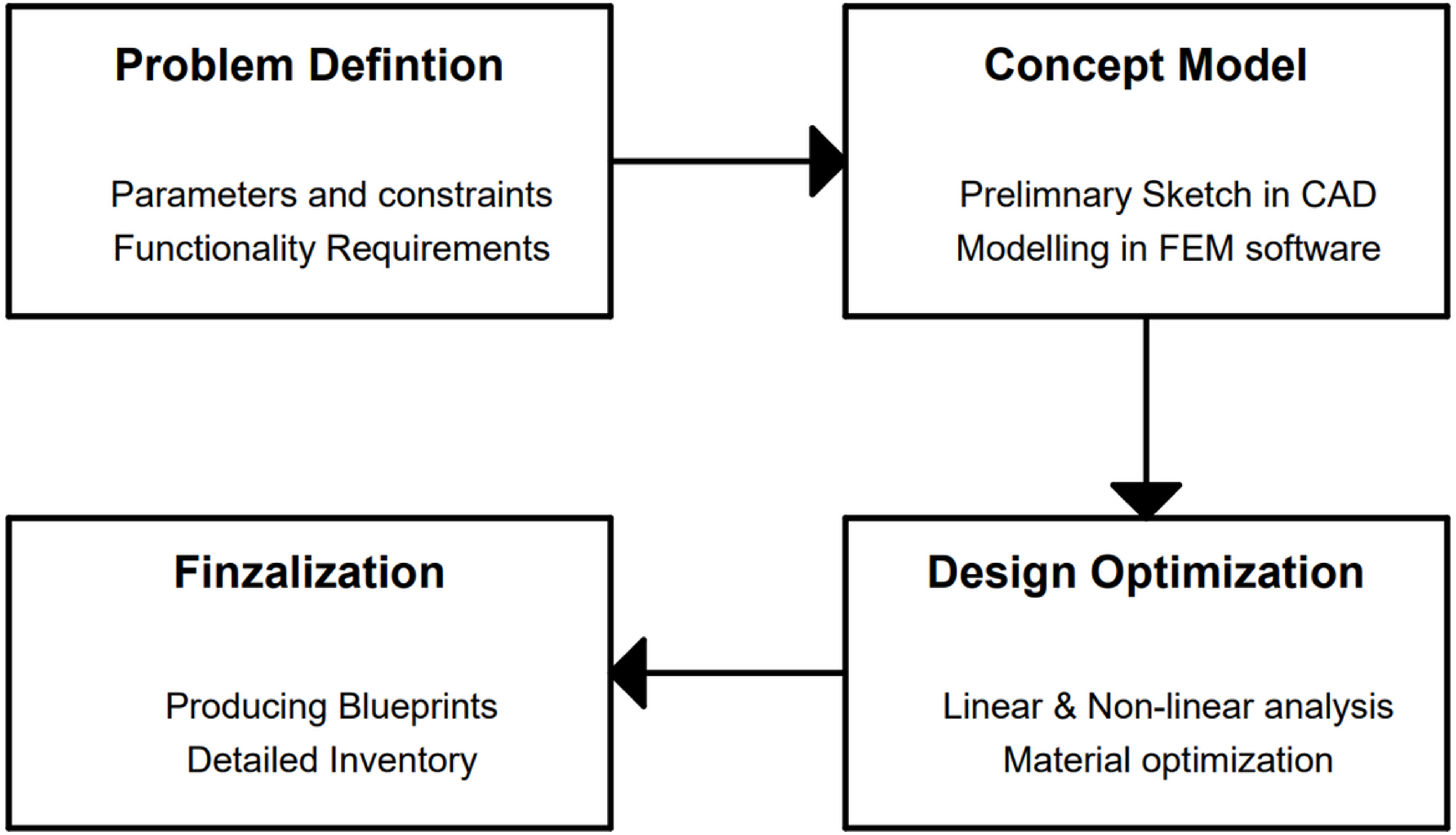
DESIGN PROCEDURE



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STRUCTURAL FAILURES

Snow is one of many factors that may cause damage to carports over time but it usually does so in small increments rather than all at once as earthquakes or hurricanes do. Snow will gradually pile onto roofs until they eventually give way from the pressure – causing everything inside them to fall out as well!

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STRUCTURAL FAILURES

High **wind** pressures can collapse carports, rip off roofing, and create prying force on the base joints. Roof overhangs and other features that tend to trap air beneath them, resulting in high uplift forces, are particularly susceptible to damage.

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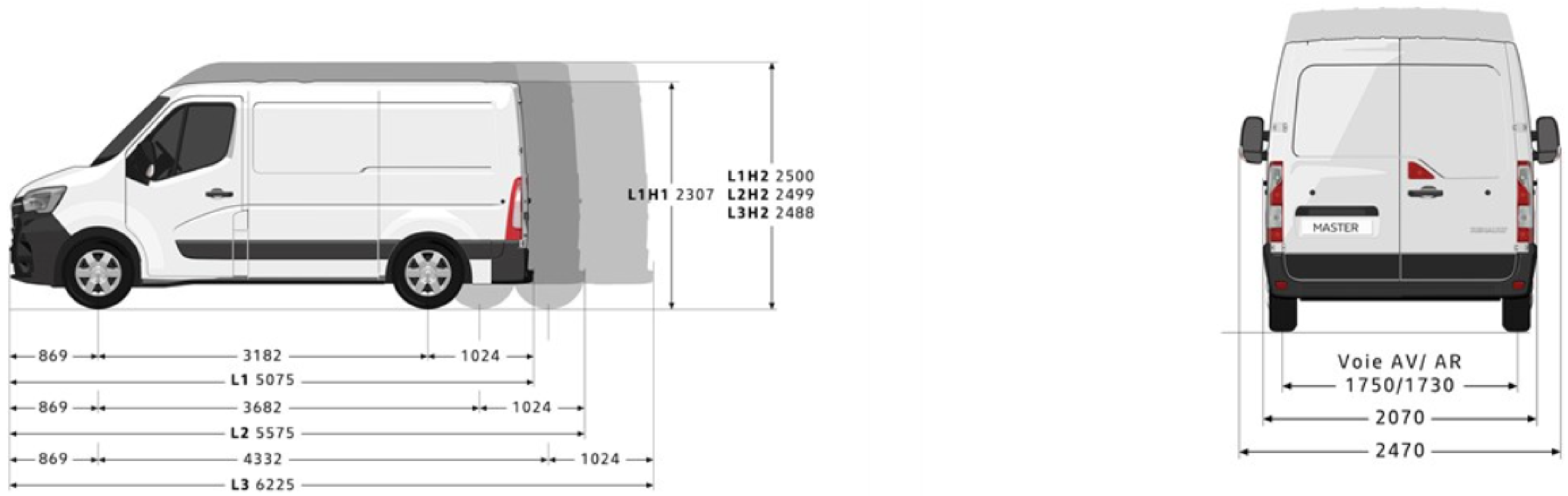
VEHICLE

NEW MASTER Z.E. : ITS DIMENSIONS

VAN DIMENSIONS (MM)



The right sample vehicle is a pickup or cargo truck with dimensions bigger than that of conventional consumer vehicles. This ensures that vehicles of smaller dimensions can comfortably be hosted by the carport of the project.

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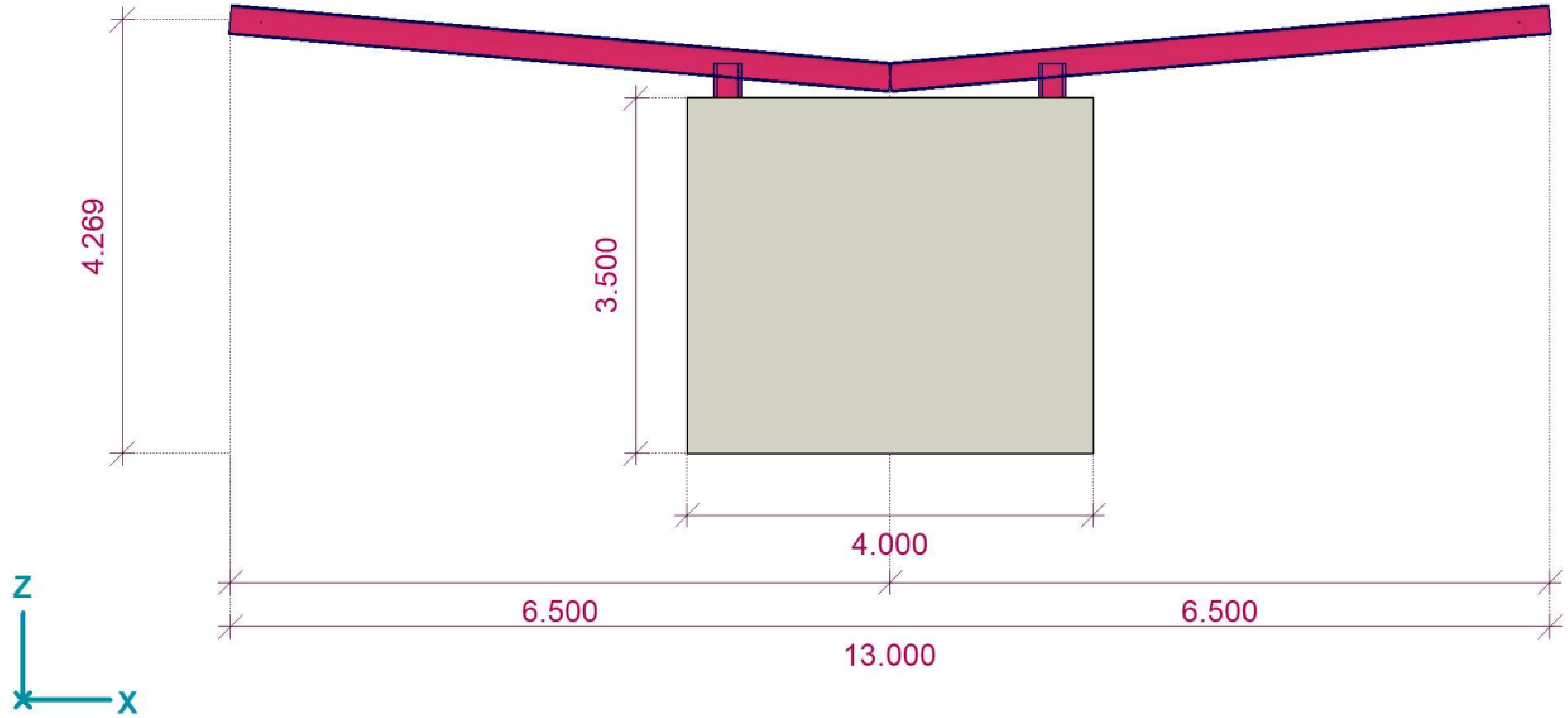
PARAMETERS AND GEOMETRY



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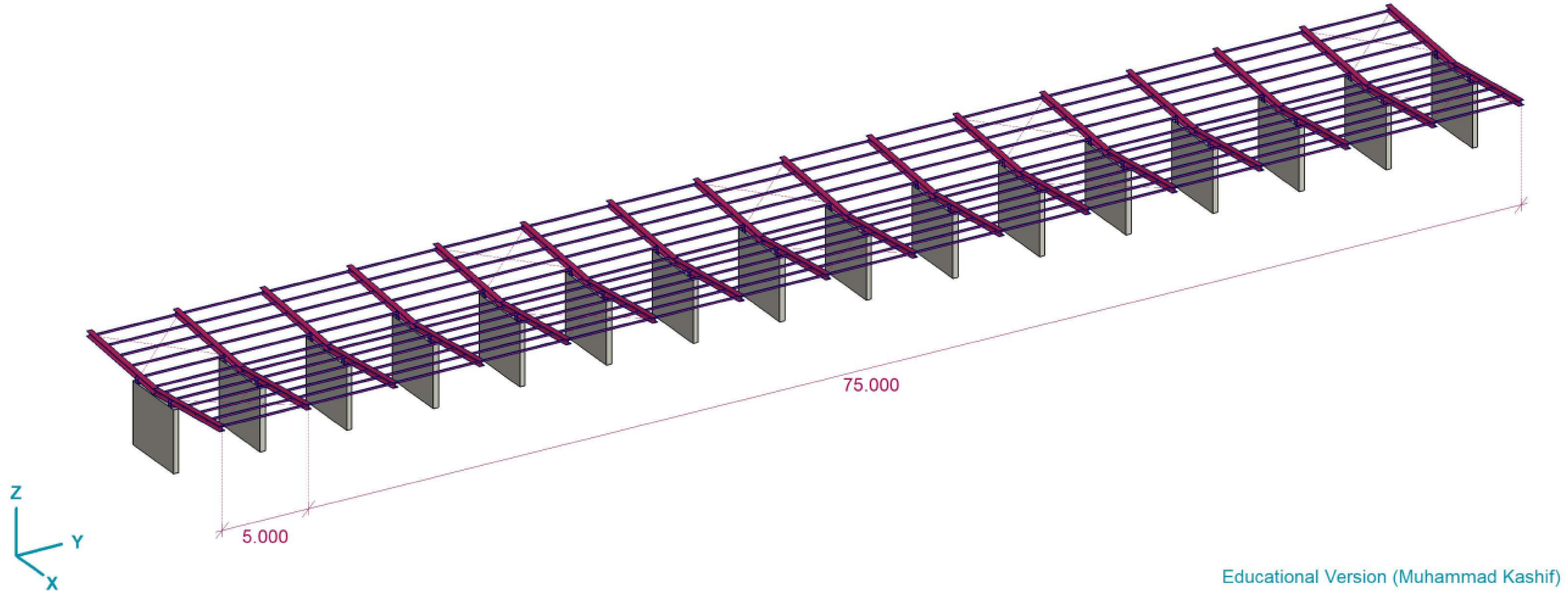

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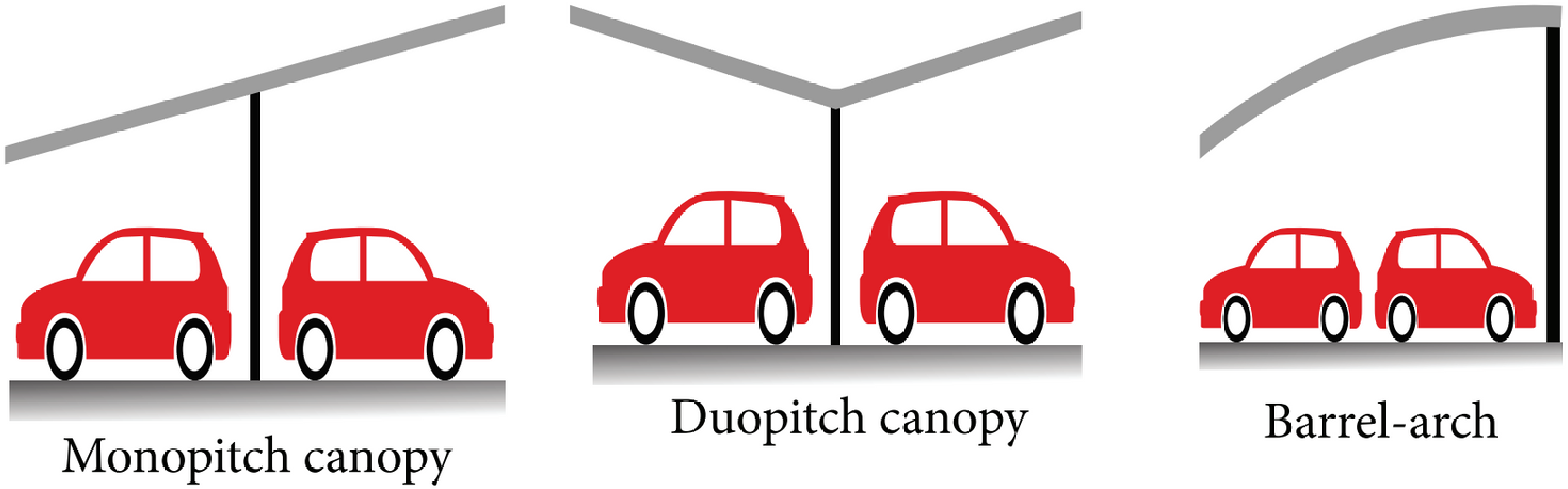

(a) Monopitch canopy (b) Duopitch canopy (c) Barrel-arch canopy

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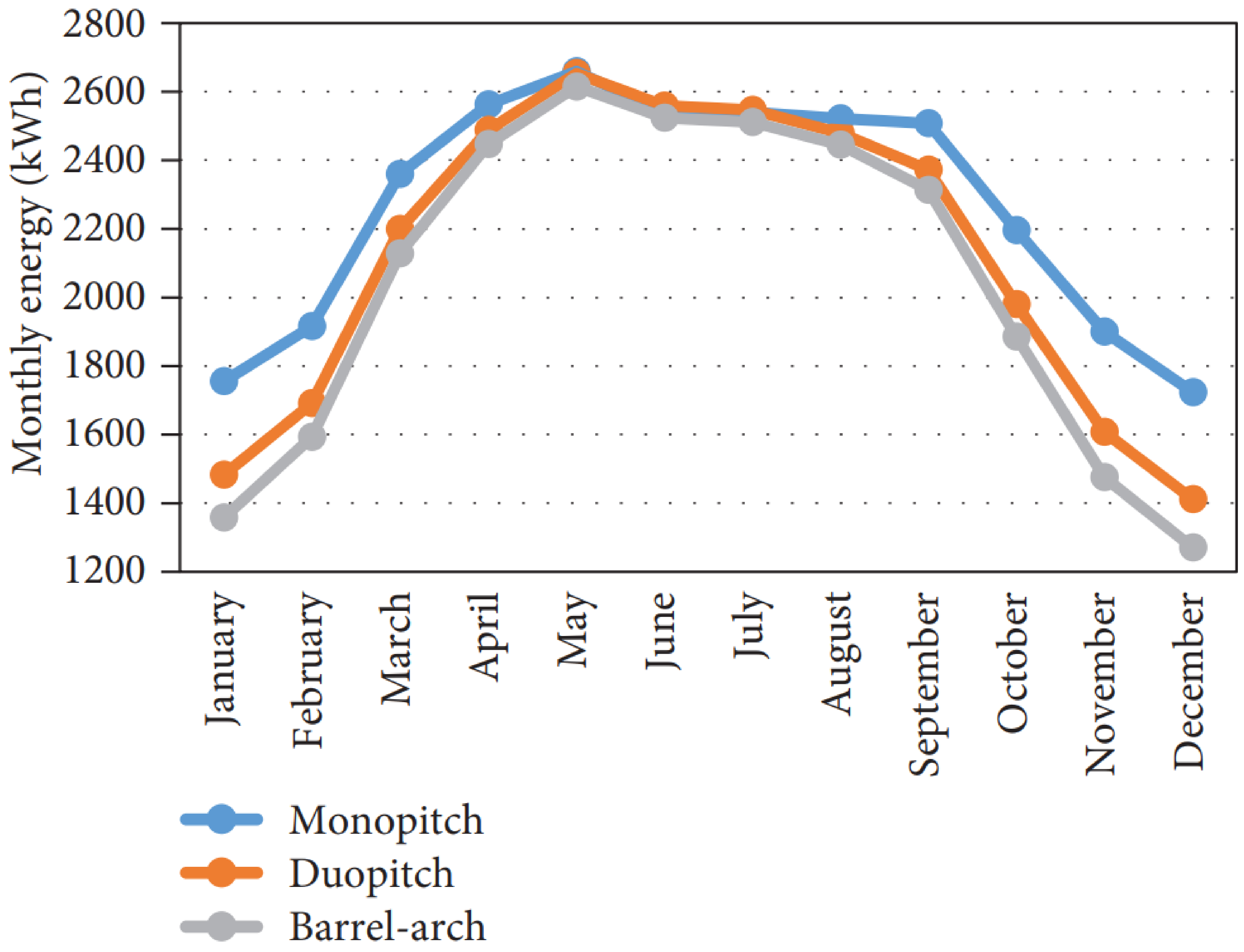
PARAMETERS AND GEOMETRY



Comparison of PV generation of monopitch, duopitch, and barrel-arch canopies.

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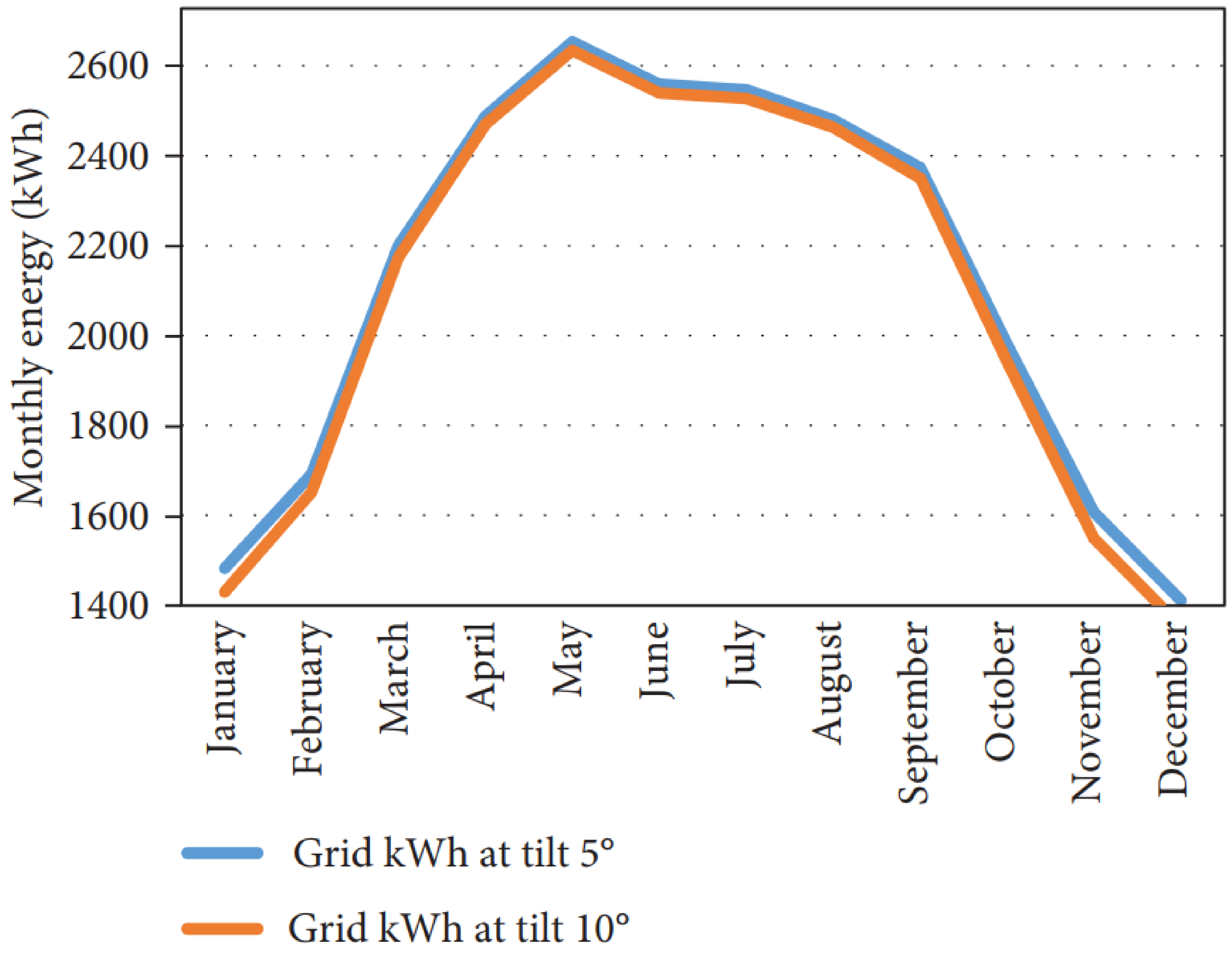
PARAMETERS AND GEOMETRY



Comparison of duopitch monthly PV generation at tilt angle 5° and 10°. A 5° angle tilt fetches 25.47 MWh while a 10° angle tilt fetches 25 MWh.

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LOAD CASES

Load cases

	Name	Group	Group type
1	Dead Load	Dead Load	Permanent
2	Snow Load	Snow Load	Variable
3	Snow Right	Snow Load	Variable
4	Snow Left	Snow Load	Variable
5	Acc Snow Load	Accidental Snow	Accidental
6	Acc Snow Right	Accidental Snow	Accidental
7	Acc Snow Left	Accidental Snow	Accidental
8	Wind Load 1	Wind Load	Variable
9	Wind Load 2	Wind Load	Variable

	Name	Group	Group type
10	Wind Load 3	Wind Load	Variable
11	Wind Load 4	Wind Load	Variable
12	Wind Load 5	Wind Load	Variable
13	Wind Load 6	Wind Load	Variable
14	Wind_Y	Wind Load	Variable
15	Wind_Y_Pressure	Wind Load	Variable
16	Wind_Y_Suction	Wind Load	Variable
17	+25	Temperature	Variable
18	-25	Temperature	Variable

Name: Load case name; **Group:** Load group; **Group type:** Load group type;

Educational Version

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SNOW LOAD

- Snow load on the ground - characteristic value: $s_k := 1.25\ \frac{kN}{m^2}$ (A<400 m)
- Slope of the roof: $\alpha := 5\ °$
- Roof shape coefficient: $\mu_1 := 0.8$ 0°<α<30°
- Snow load on the roof - characteristic value:

$C_e := 1.0$ Exposure coefficient.

$C_t := 1.0$ Thermal coefficient.

$$s := C_e \cdot C_t \cdot \mu_1 \cdot s_k = 1\ \frac{kN}{m^2}$$

- Snow load on the beams:

$$q_{s1} := s \cdot t_{b1} = 1.91\ \frac{kN}{m}$$

$$q_{s2} := s \cdot t_{b2} = 5.76\ \frac{kN}{m}$$

$$q_{s3} := s \cdot t_{b3} = 4.78\ \frac{kN}{m}$$

$$q_{s4} := s \cdot t_{b4} = 5.06\ \frac{kN}{m}$$

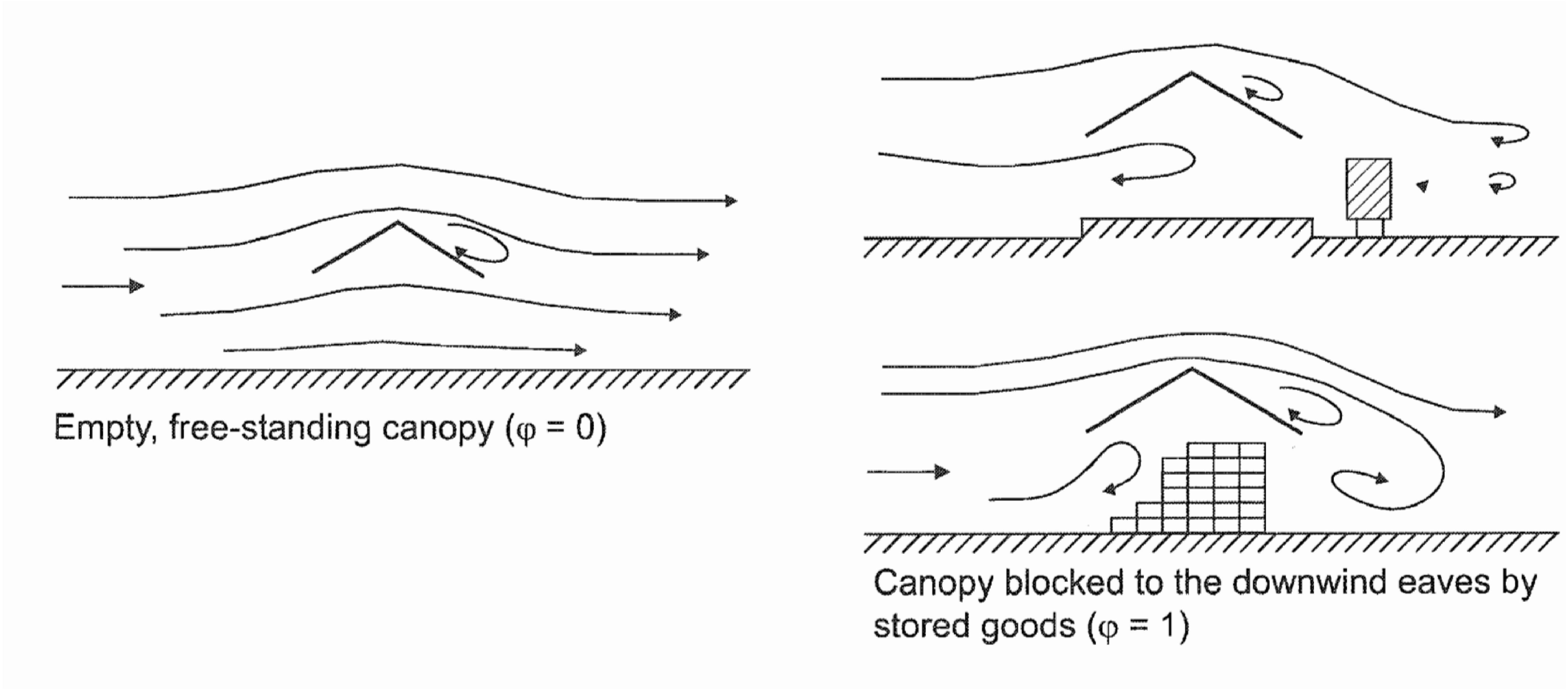
$$q_{s5} := s \cdot t_{b5} = 4.98\ \frac{kN}{m}$$

$$q_{s6} := s \cdot t_{b6} = 5.01\ \frac{kN}{m}$$

$$q_{s7} := s \cdot t_{b7} = 5\ \frac{kN}{m}$$

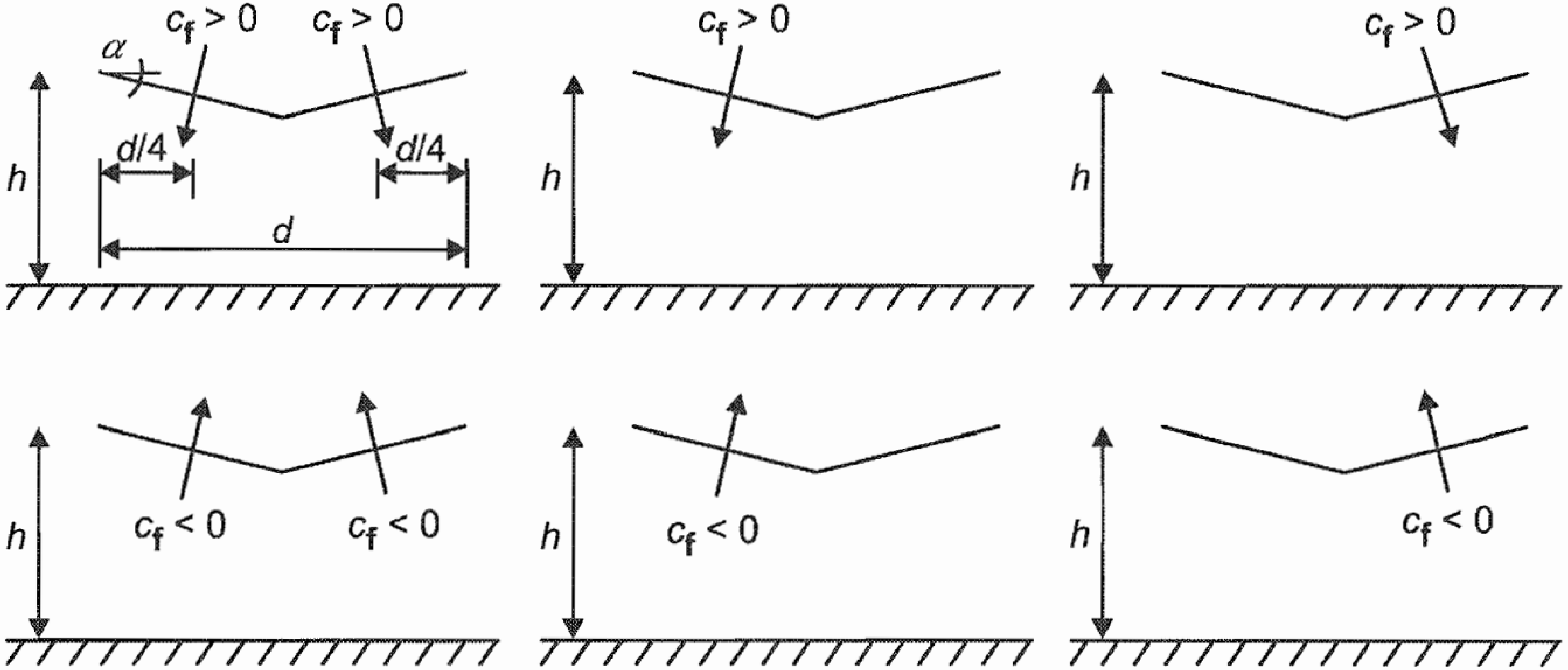
$$q_{s8} := s \cdot t_{b8} = 5\ \frac{kN}{m}$$

WIND LOAD



The degree of blockage under a canopy roof according to EN 1994-1-4 (2005) Part 1-4

WIND LOAD



Arrangement of loads obtained from force coefficients for duopitch canopies according to EN 1994-1-4 (2005) Part 1-4

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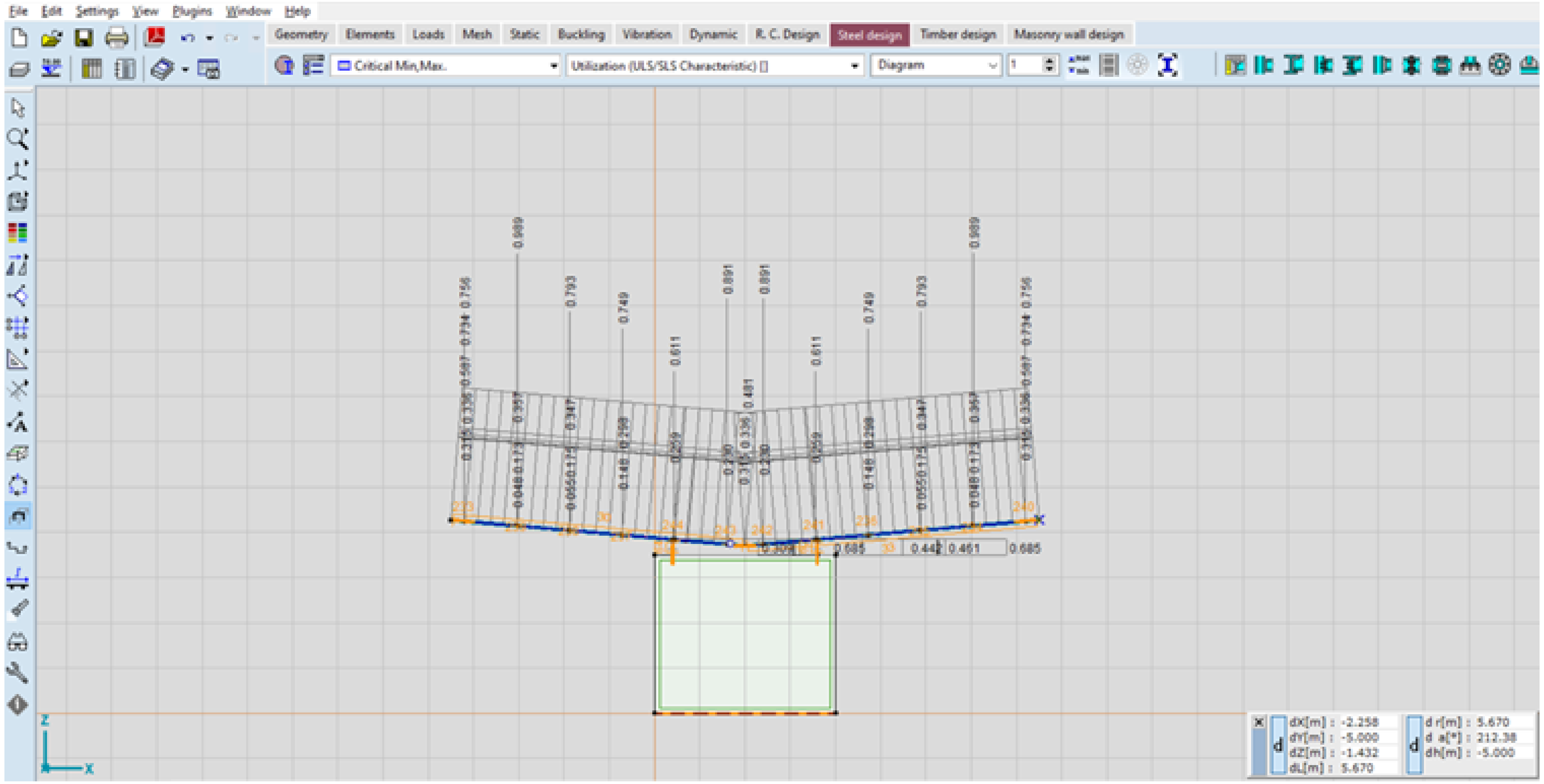
UTILIZATION



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CONCLUSION

By the help of FEM and CAD software modules in this four-staged design process, a designer can efficiently and accurately produce blueprints of an assigned project. It makes it significantly easier to coincide different aspects of a project for better flow and integration of information from within.

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THANK YOU