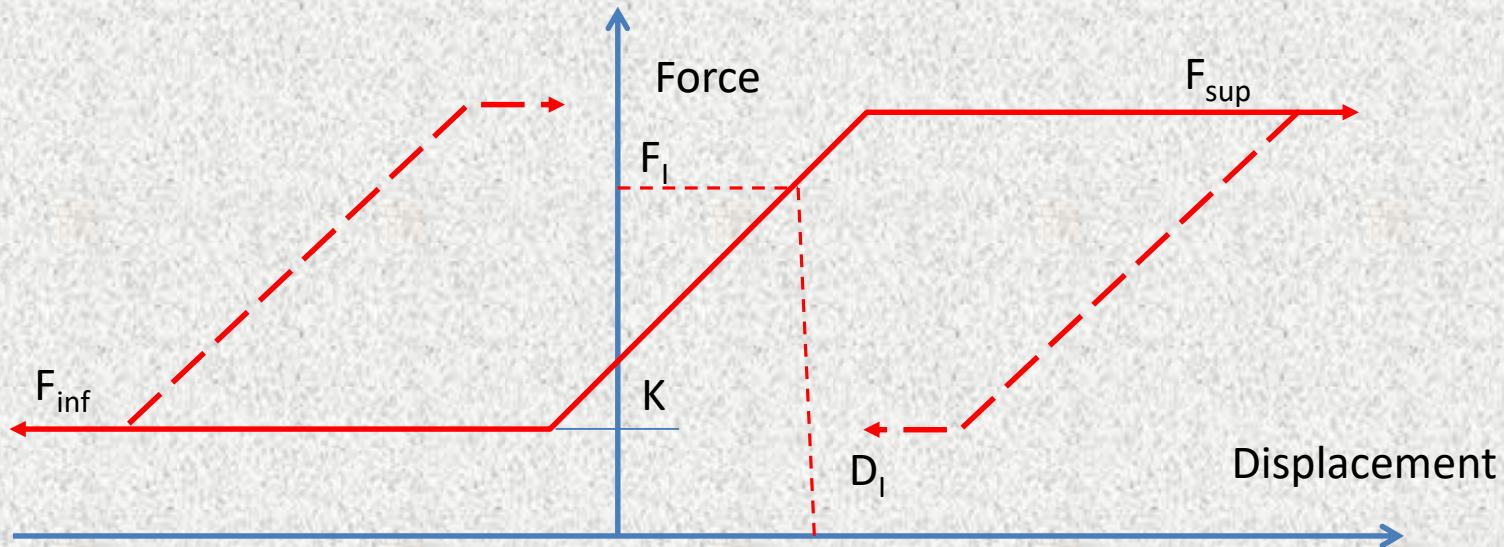


6) Spring finite element

This element:

- is attached to one single node (the other virtual extremity of the element is the foundation);
- is characterized by a direction (in 2D or in 3D);
- has a particular « Displacement–Force » behaviour (both in the defined direction)

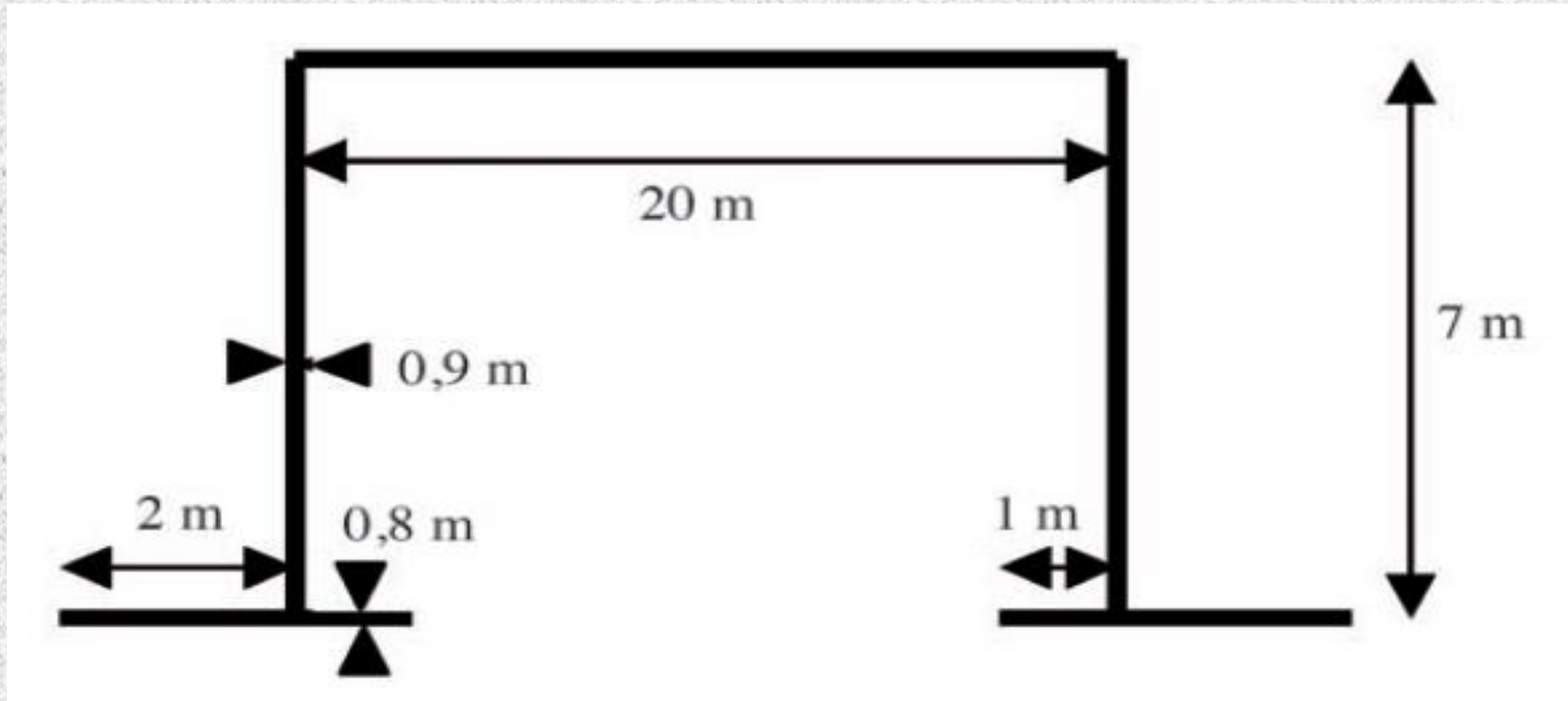


Input parameters are:

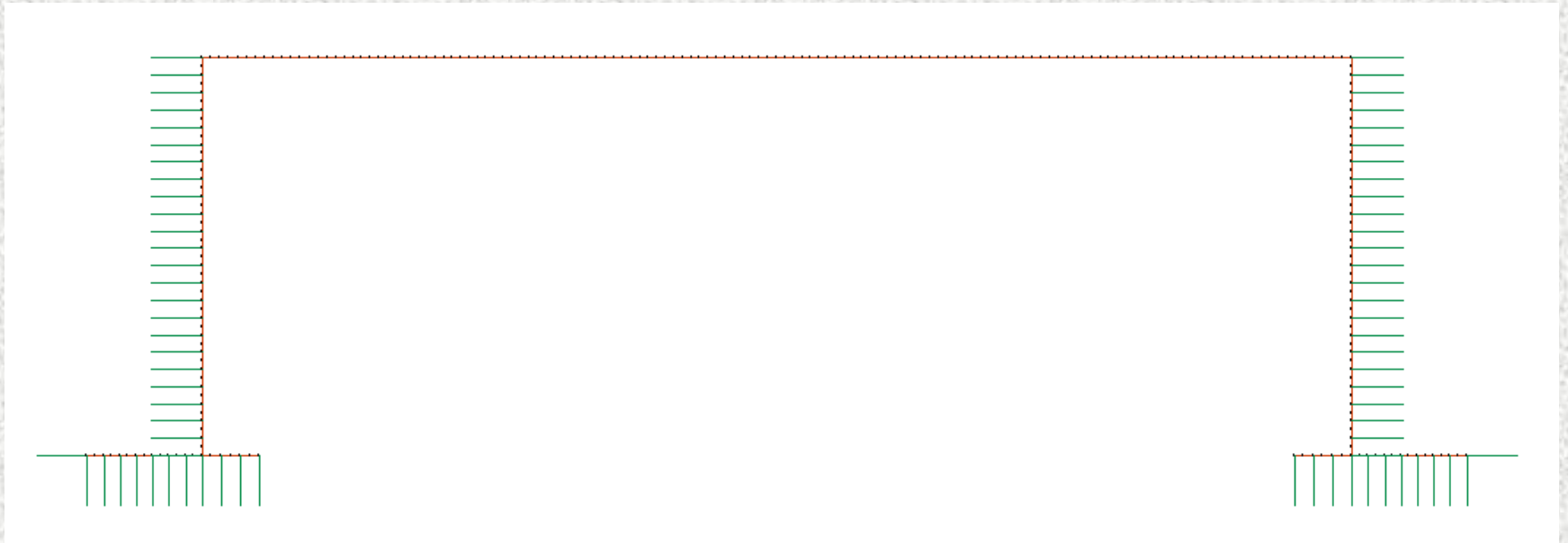
NSPR:	Number of the element.
NNODE:	Node where this element is attached.
CX:	Cosinus of the angle between X axis and this element.
CY:	Cosinus of the angle between Y axis and this element.
CZ:	Cosinus of the angle between Z axis and this element.
F_s	Superior limit of the load.
F_{inf}	Inferior limit of the load.
K	Stiffness of the element for elastic loading or unloading.
A	Area of influence (all forces are multiplied by A).
D_i	Displacement in the configuration of reference (time $t = 0$).
F_i	Force in the configuration of reference (time $t = 0$).

Application example

Cut and cover tunnel (Guide d'application from « CETU »)



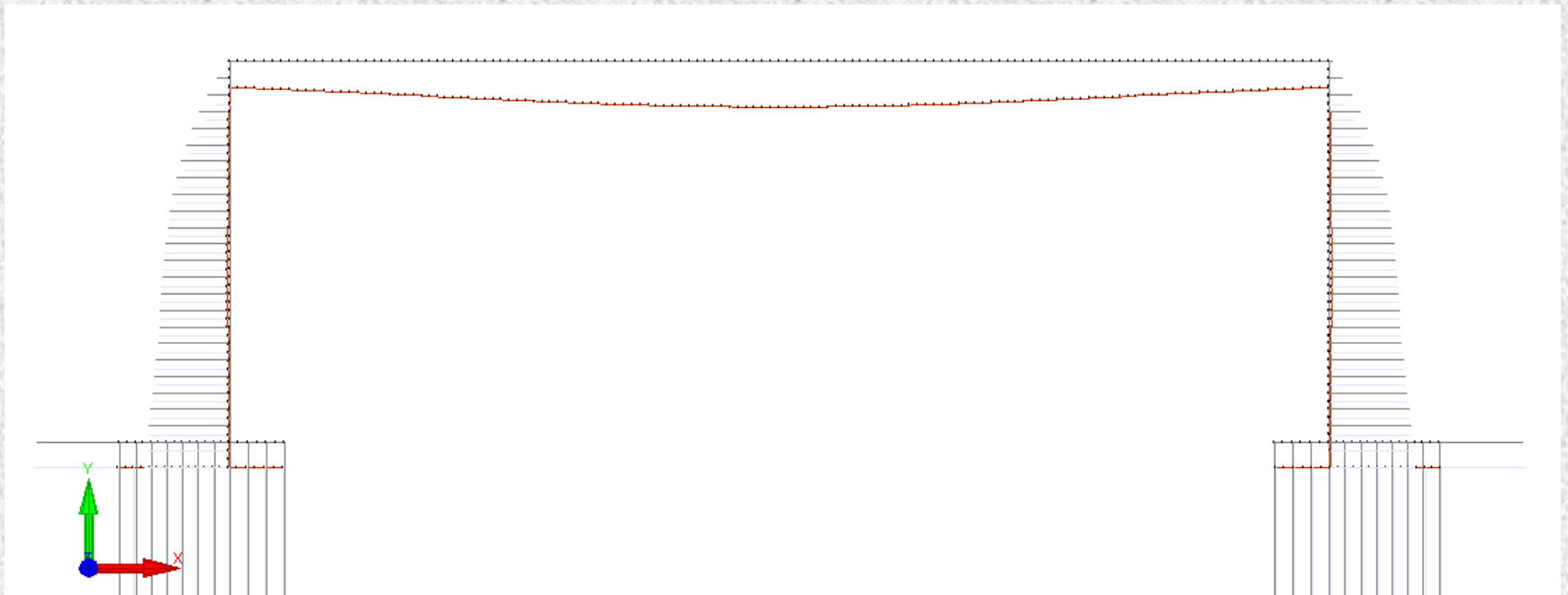
2D model with beam F.E. and spring F.E.



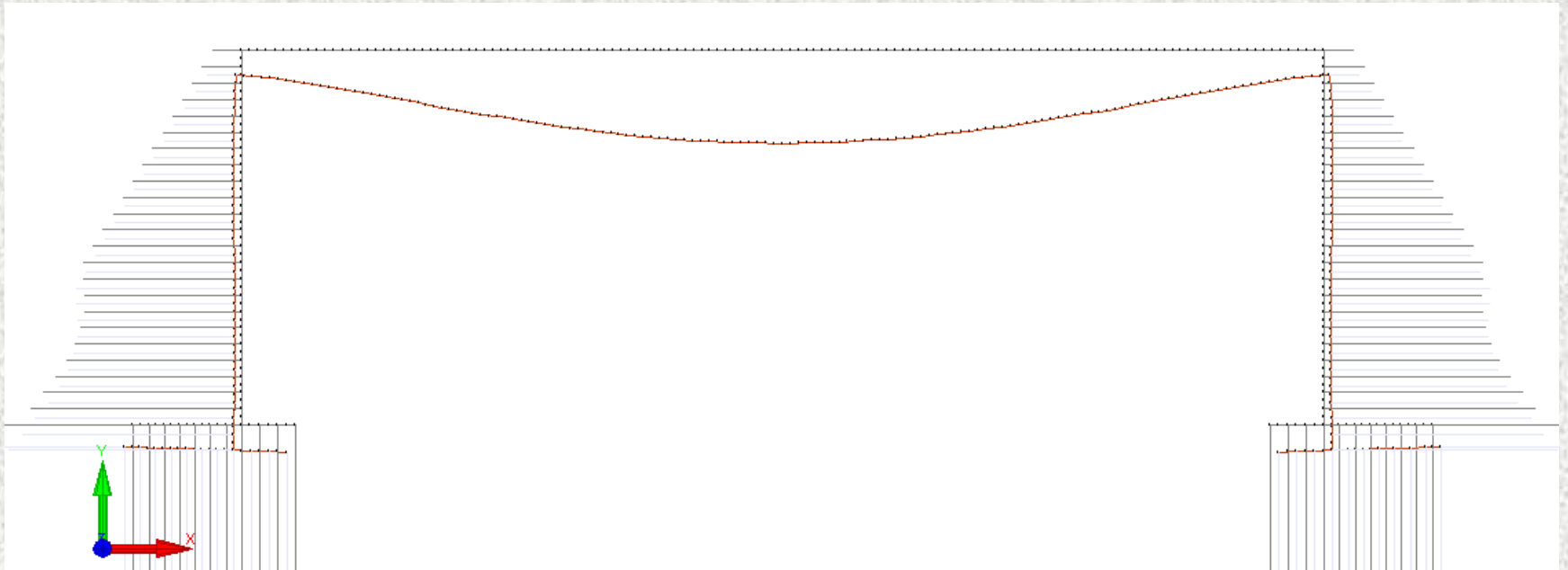
- No restrain
- Trapezoidal loads on the walls replaced by spring F.E.

Deformed shape and soil pressures at $t = 60$ s

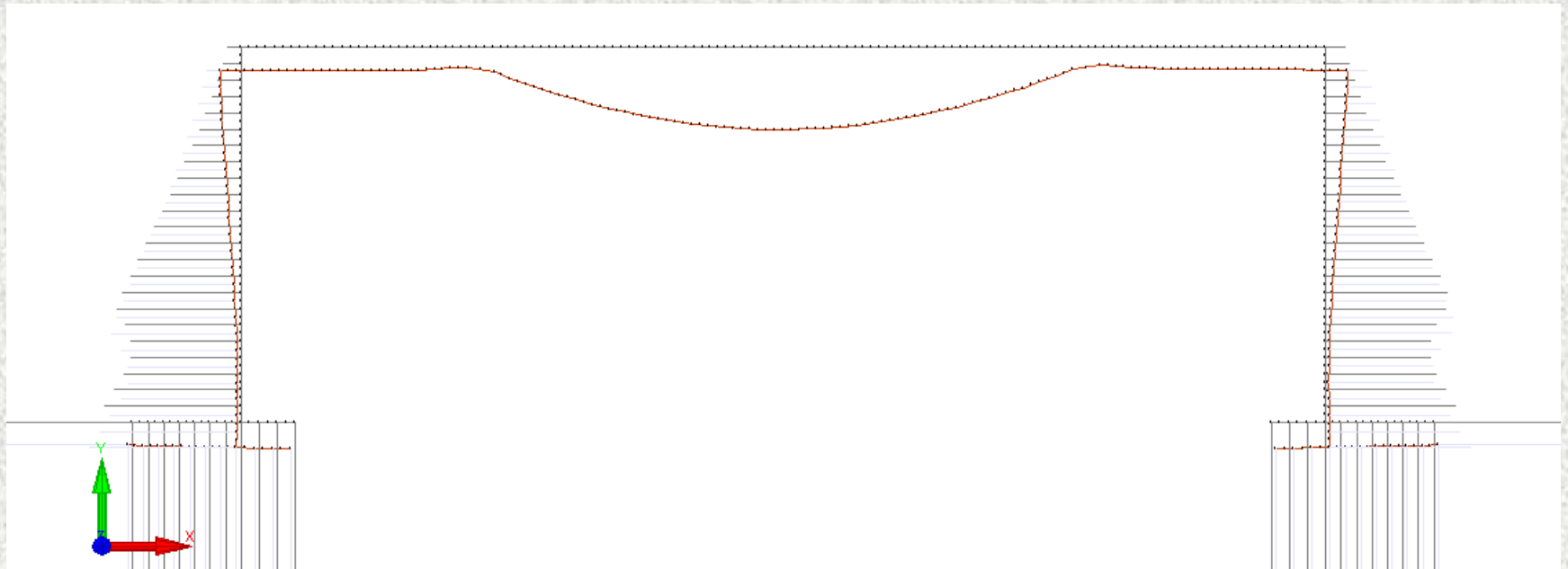
Note: Diamond can plot the loads F or the pressure F/A in the spring elements



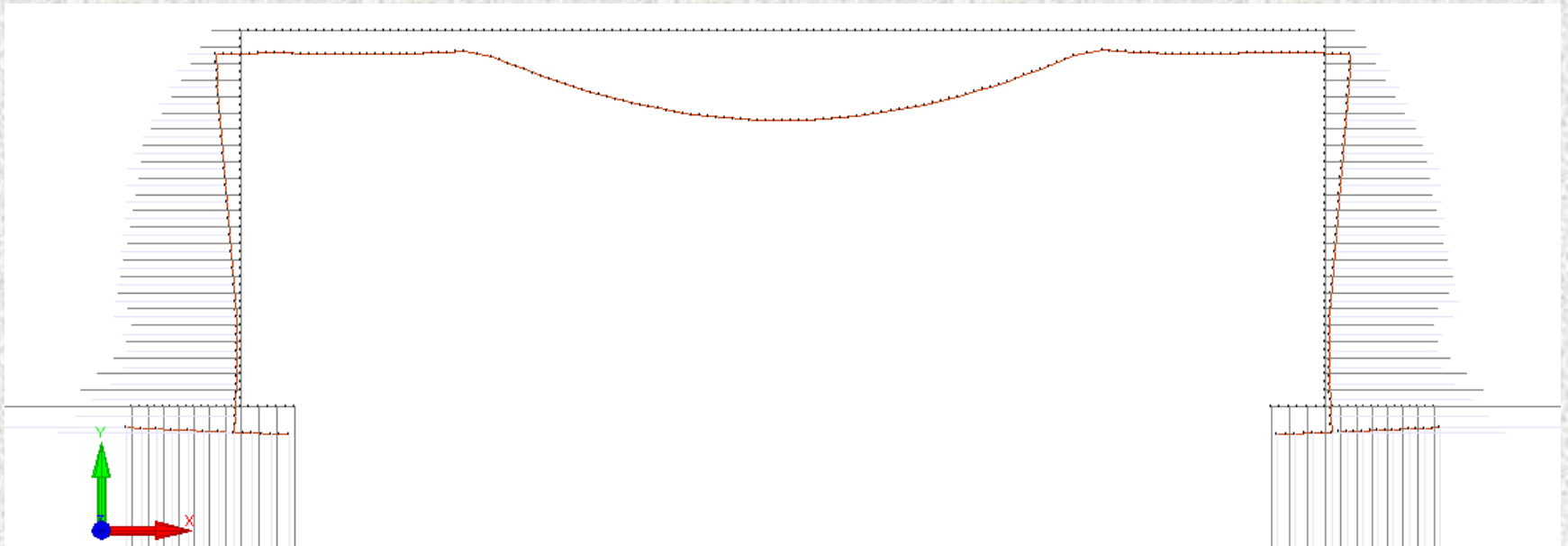
Deformed shape and soil pressures at $t = 3\,720\text{ s}$
(just before plastic hinges appear)



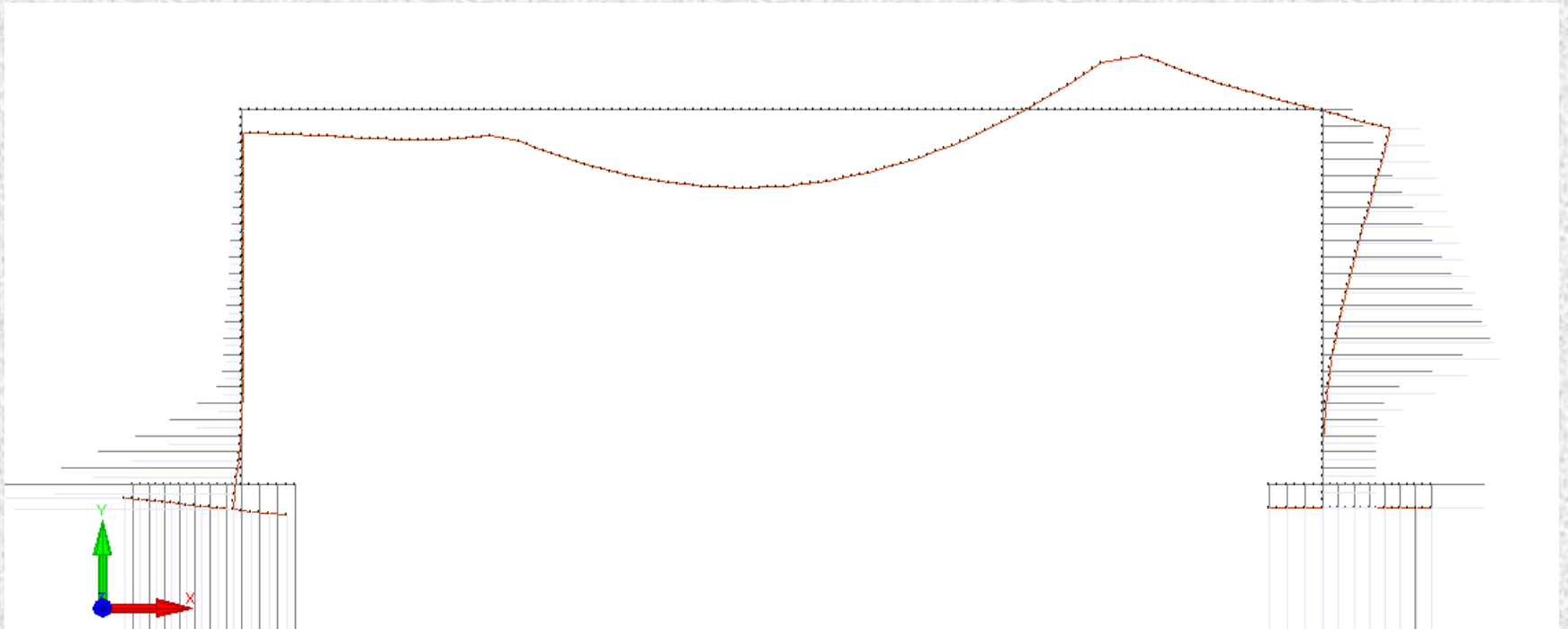
Deformed shape and soil pressures at $t = 3\,800\text{ s}$
(just after plastic hinges appear)



Deformed shape and soil pressures at $t = 5\,135\text{ s}$
(just before failure)



Deformed shape and soil pressures after failure



3D model

