Study of a work platform

Figure 1 shows a picture of a scissors platform. The platform can accommodate up to 2 people and be raised to about 6m. The movement of the carriage and the elevation can be controlled from the platform by means of a control console. To avoid too complex calculations, we study the geometry Figure 2 deliberately simplified. The problem will be considered plane (Oxy):

- 2 wheels (S_1) and (S_2) are of negligible mass;
- the carriage (S_3) has a mass m_3 and a center of mass G_3;
- 4 identical and homogeneous bars (S_4) to (S_7) have a length 2L of negligible mass;
- the platform elevation is set by the α angle;
- platform (S_8) is of negligible mass.
- user (S_9) (considered as a solid) has a mass m_9 and a center of mass G_9.

It is assumed that the parking brake acts on the set S_1.

Data: m_3=200 kg, m_9=100 kg, L=1.5 m, h_3=0.5 m, maximum elevation of G_9 H_{max}=8 m.

Figure n° 1 - Scissor lift platform (*nacelle élévatrice à ciseaux*)

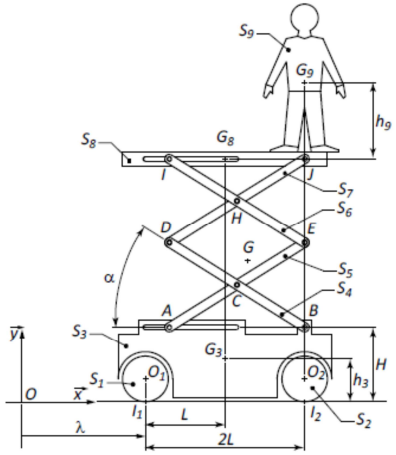

Figure n° 2 – Simplified geometry

1 - Failover of the nacelle

1. Calculate the reactions of the ground on the wheels I_1 and I_2 in the case of a horizontal placement.
2. The carriage is now inclined of an angle γ compared to the horizontal (slope). Give the condition of non tilting of the platform by calculating the maximum tilt angle as a function of various parameters. Do numerical application.

2 - Force calculation of the actuator

It is possible to place the linear actuator on BH or AB bonds. We want to compare these two positionings in order to minimize the effort of the actuator. The angle α varies between values of 5 and 60 °.

1. Give the expression of lengths x=AB and y=BJ depending on the angle α. Complete graph Figure n° 3 with x and y function of α.
2. Applying the theorem of virtual work and for the configuration AB, determine the expression of the force F_{AB} required to lift the mass m_9 (which is assumed centered with G_8 in this case) in function of α ? Complete Figure n° 4 with F_{AB}.
3. Similarly, calculate the configuration BH.
4. What is your conclusion on the choice of the positioning of the actuator?

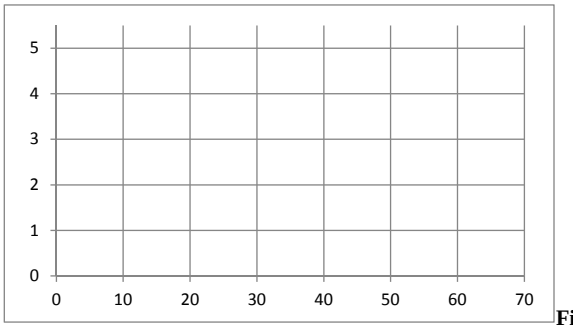

Figure n° 3

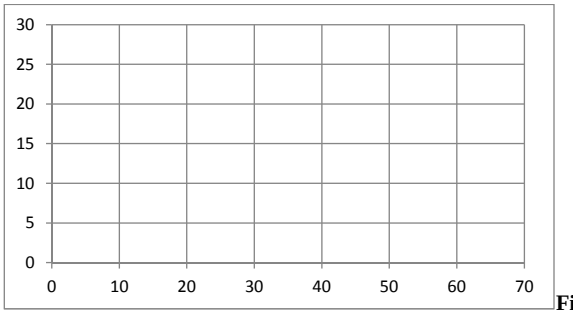

Figure n° 4