



Sistema de suspensão rocker-bogie

PEF-3208 - Fundamentos em Mecânica das Estruturas

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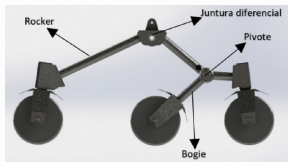
Introdução



SOBRE O SISTEMA ROCKER-BOGIE



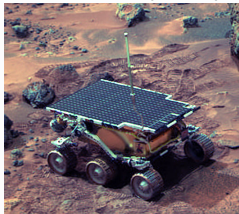
- ▶ Desenvolvido em 1988 para o uso da NASA na exploração de Marte.
- ▶ Usado para movimentar robôs de 6 rodas.



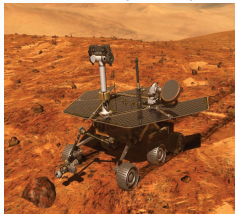
USO DO SISTEMA DE SUSPENSÃO



Sojourner (1996)



Spirit (2003)



Opportunity (2003)



Curiosity (2011)



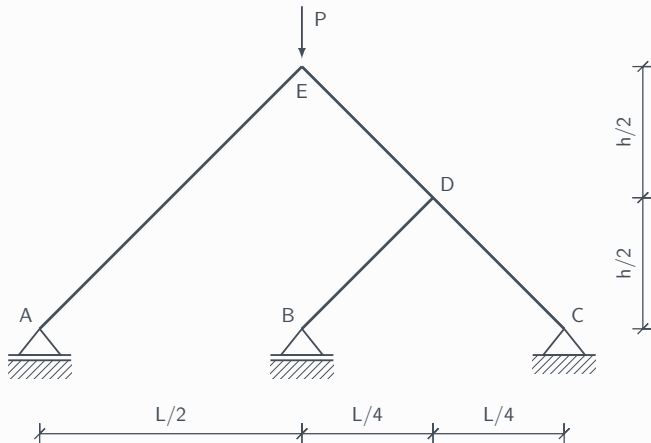
Perseverance (2020)



Análise da Estrutura



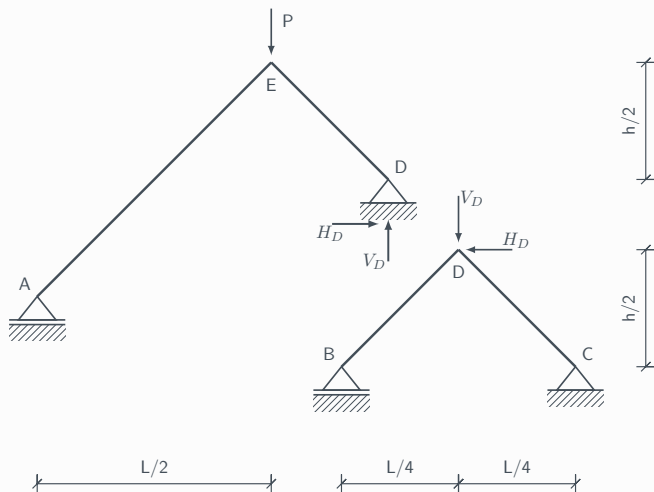
DIAGRAMA DA ESTRUTURA



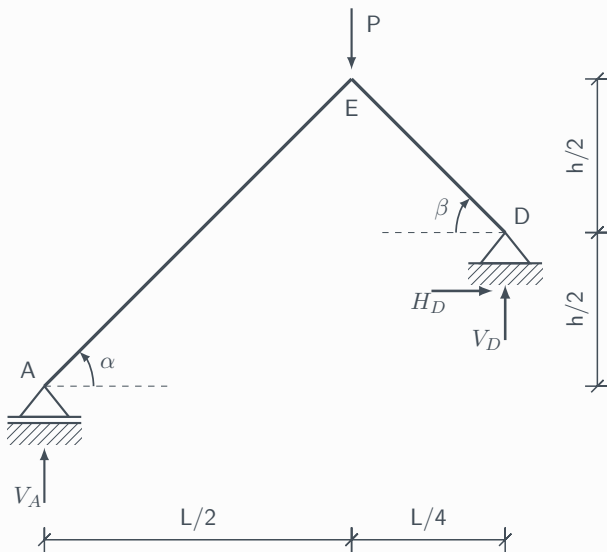
SIMPLIFICAÇÃO



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ANÁLISE DA PRIMEIRA ESTRUTURA





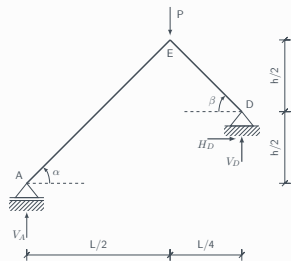
EQUAÇÕES DE EQUILÍBRIO

$$\begin{cases} \sum F_H = 0 \Rightarrow H_D = 0 \\ \sum F_V = 0 \Rightarrow V_A + V_D - P = 0 \\ \sum M_A = 0 \Rightarrow \left(\frac{L}{2} + \frac{L}{4}\right) V_D - \frac{L}{2} P - \frac{h}{2} H_D = 0 \\ \sum M_D = 0 \Rightarrow \left(\frac{L}{2} + \frac{L}{4}\right) V_A + \frac{L}{4} P = 0 \end{cases}$$

$$H_D = 0$$

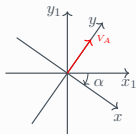
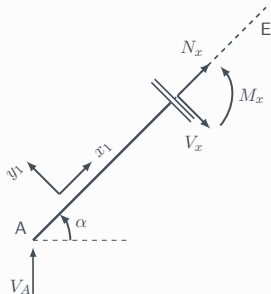
$$V_A = \frac{P}{3}$$

$$V_D = \frac{2P}{3}$$





TEOREMA DO CORTE: A-E



$$\begin{cases} \sum F_H = 0 \Rightarrow V_A \sin \alpha + N_x = 0 \\ \sum F_V = 0 \Rightarrow V_A \cos \alpha + V_x = 0 \\ \sum M_x = 0 \Rightarrow -V_A \cos(\alpha)x + M_x = 0 \end{cases}$$

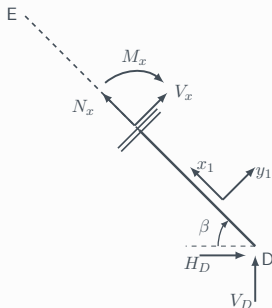
$$N_x = -\frac{P}{3} \sin \alpha$$

$$V_x = \frac{P}{3} \cos \alpha$$

$$M_x = \frac{P}{3} \cos(\alpha) x$$



TEOREMA DO CORTE: D-E



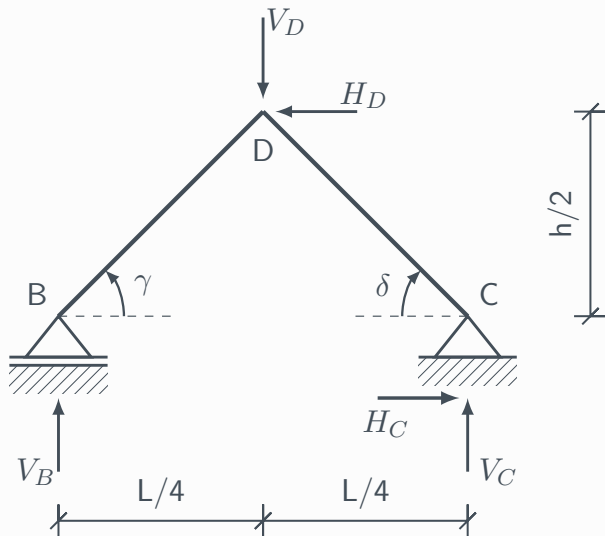
$$\begin{cases} \sum F_H = 0 \Rightarrow V_D \sin \beta - H_D \cos \beta + N_x = 0 \\ \sum F_V = 0 \Rightarrow V_D \cos \beta + H_D \sin \beta + V_x = 0 \\ \sum M_x = 0 \Rightarrow (V_D \cos \beta + H_D \sin \beta)x - M_x = 0 \end{cases}$$

$$N_x = -\frac{2P}{3} \sin \beta$$

$$V_x = -\frac{2P}{3} \cos \beta$$

$$M_x = \frac{2P}{3} \cos(\beta) x$$

ANÁLISE DA SEGUNDA ESTRUTURA





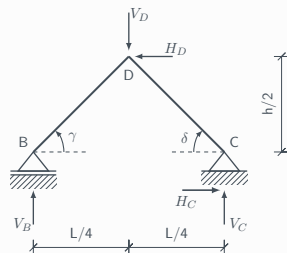
EQUAÇÕES DE EQUILÍBRIO

$$\left\{ \begin{array}{l} \sum F_H = 0 \Rightarrow -H_D + H_C = 0 \\ \sum F_V = 0 \Rightarrow V_B + V_C - V_D = 0 \\ \sum M_B = 0 \Rightarrow \frac{L}{2}V_C - \frac{L}{4}V_D = 0 \\ \sum M_C = 0 \Rightarrow -\frac{L}{2}V_B + \frac{L}{4}V_D = 0 \end{array} \right.$$

$$H_C = 0$$

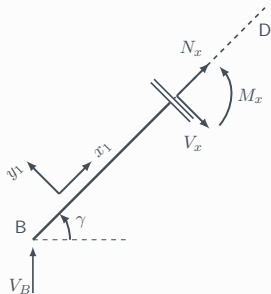
$$V_B = \frac{P}{3}$$

$$V_C = \frac{P}{3}$$





TEOREMA DO CORTE: B-D



$$\begin{cases} \sum F_H = 0 \Rightarrow V_B \sin \beta + N_x \\ \sum F_V = 0 \Rightarrow V_B \cos \beta - V_x \\ \sum M_x = 0 \Rightarrow -V_B \cos(\beta) x + M_x = 0 \end{cases}$$

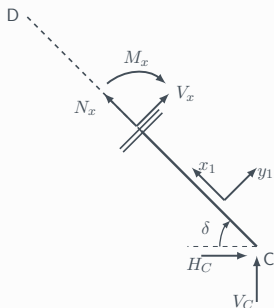
$$N_x = -\frac{P}{3} \sin \beta$$

$$V_x = \frac{P}{3} \cos \beta$$

$$M_x = \frac{P}{3} \cos(\beta) x$$



TEOREMA DO CORTE: C-D



$$\begin{cases} \sum F_H = 0 \Rightarrow V_C \sin \gamma - H_C \cos \gamma + N_x = 0 \\ \sum F_V = 0 \Rightarrow H_C \sin \gamma + V_C \cos \gamma + V_x = 0 \\ \sum M_x = 0 \Rightarrow (H_C \sin \gamma + V_C \cos \gamma)x - M_x = 0 \end{cases}$$

$$N_x = -\frac{P}{3} \sin \gamma$$

$$V_x = -\frac{P}{3} \sin \gamma$$

$$M_x = \frac{P}{3} \cos(\gamma) x$$

DIAGRAMA DA FORÇA NORMAL



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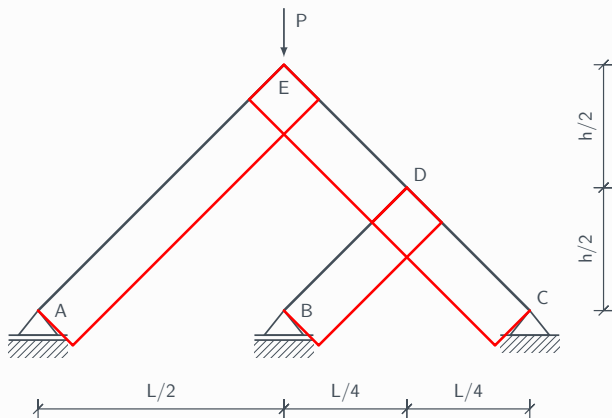


DIAGRAMA DA FORÇA CORTANTE

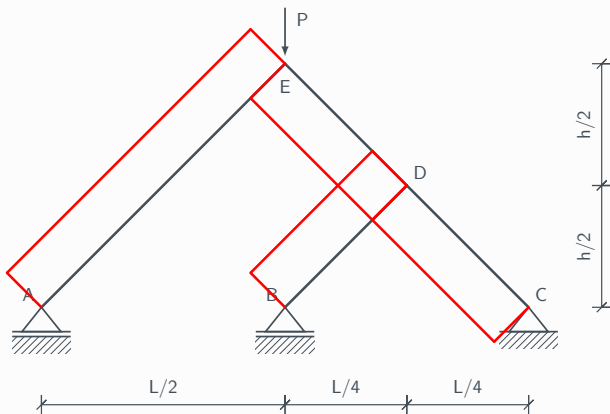
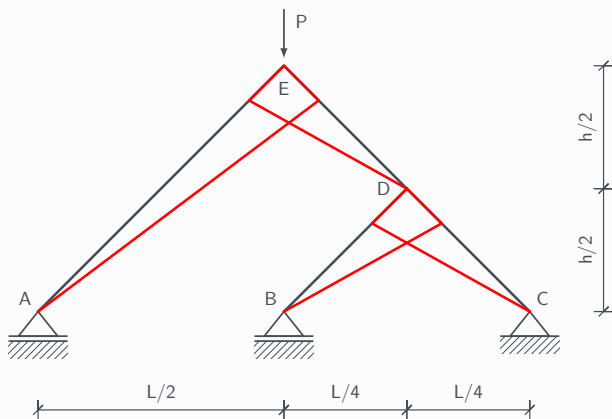


DIAGRAMA DO MOMENTO FLETOR



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A stylized, line-art profile of a person wearing a hat, rendered in a light blue color against a dark blue background. The person is facing right. The hat has a wide brim and a decorative band. The person's hair is short and styled. The overall aesthetic is modern and graphic.

Fim