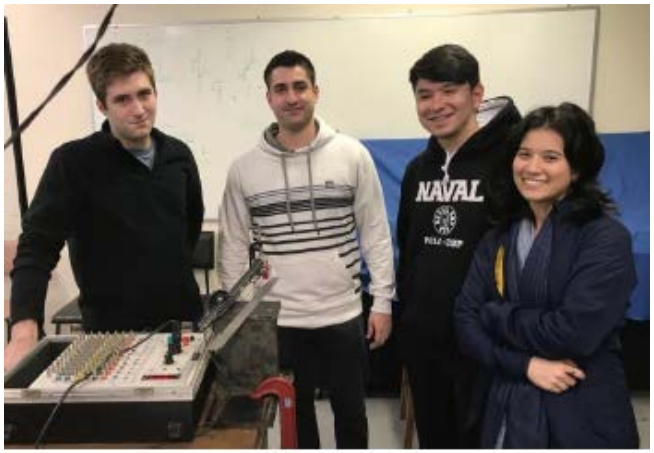
DEPARTAMENTO DE ENGEHARIA NAVAL E OCEÂNICA
ESCOLA POLITÉCNICA DA USP

Análise Experimental de Vigas

PNV 3212 – Mecânica Dos Sólidos I

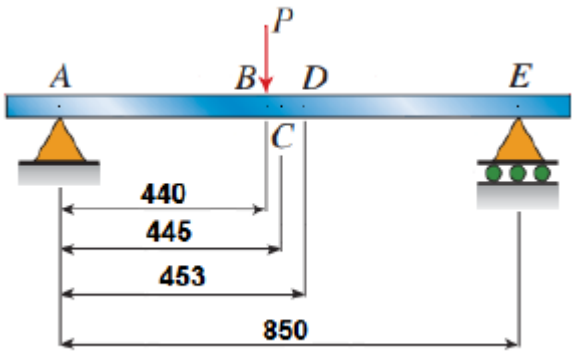
2019

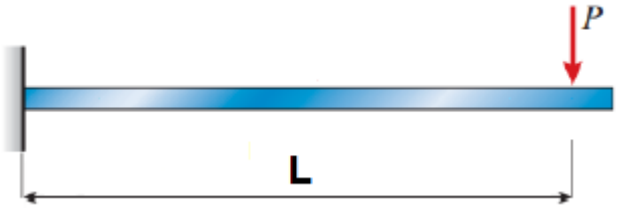

ALLDREN


NAVAL

Experimento

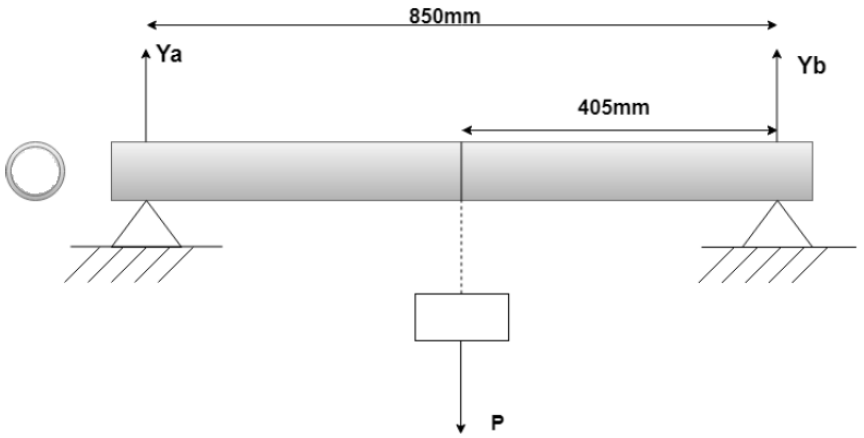
- Configurações





Experimento

- Configurações

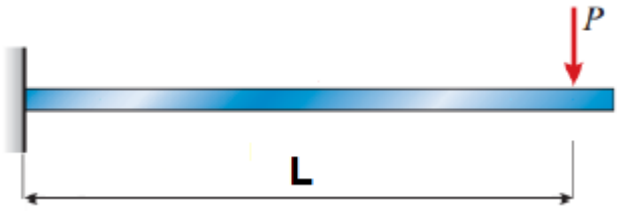


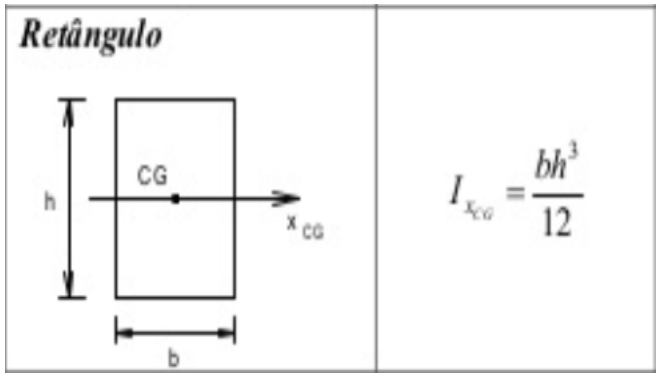
d_e[mm]	15,75
d_i[mm]	12,6
b [mm]	410
L [mm]	850
$E\ [MPa] = \left[\frac{N}{mm^2}\right]$	$210 \cdot 10^3$
$I[mm]^4$	1.783,36

Tabela 2.1 - Parâmetros da viga bi apoiada.

Experimento

- Configurações

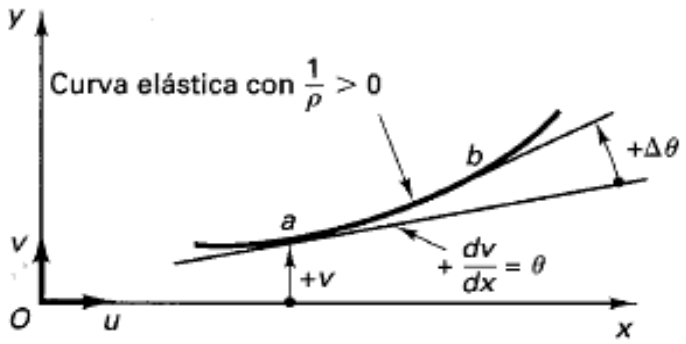




b[mm]	42
h[mm]	3
L[m]	330
$E\ [GPa] = \left[\frac{N}{mm^2}\right]$	$210 \cdot 10^3$
$I[mm]^4$	94,5

Tabela 2.2 - Parâmetros da viga engastada.

Teoria



$$\frac{dv}{dx} = \theta$$

$$\frac{1}{\rho} = \frac{\frac{d^2v}{dx^2}}{\left[1 + \left(\frac{dv}{dx}\right)^2\right]^{3/2}}$$

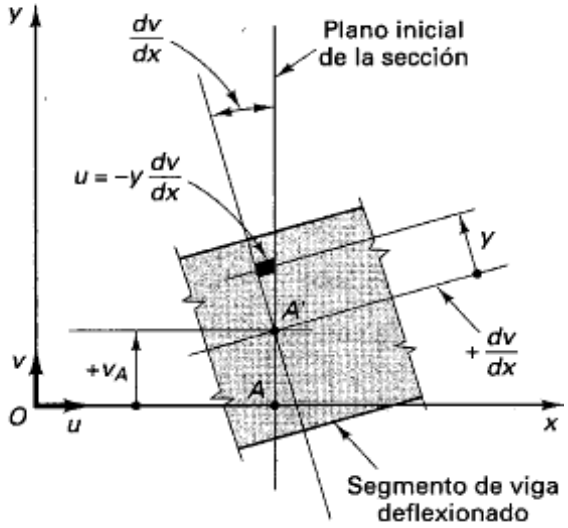


Fig. 14-4 Desplazamientos longitudinales en una viga debido a la rotación de una sección plana.

$$u = -y\frac{dv}{dx}$$

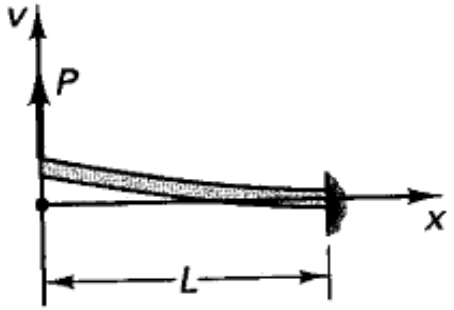
$$\varepsilon_x = -y\, d^2v/dx^2$$

$$\varepsilon_x = -My/EI$$

Resultados

- Viga em balanço

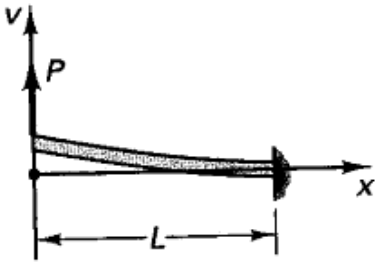
Carga	Deslocamento		Geometria deformada		Deformação			
P	u	v	dv / dx	d^2v / dx^2	$1/\rho$	ε_x	ε_y	υ
[kg]	[mm]	[mm]				mm/mm	mm/mm	---
0	0.00	0.00	0	0.00E+00	0	0	0	0.3
0.25	0.01	1.90	0.012893779	5.15E-05	19399	75	-22	0.3
0.5	0.03	3.80	0.025787557	1.03E-04	9699	149	-45	0.3
0.75	0.04	5.70	0.038681336	1.55E-04	6466	224	-67	0.3
1	0.05	7.59	0.051575114	2.06E-04	4850	299	-90	0.3
1.25	0.06	9.49	0.064468893	2.58E-04	3880	374	-112	0.3
1.5	0.08	11.39	0.077362671	3.09E-04	3233	448	-135	0.3
1.75	0.09	13.29	0.09025645	3.61E-04	2771	523	-157	0.3
2	0.10	15.19	0.103150228	4.12E-04	2425	598	-179	0.3
2.25	0.12	17.09	0.116044007	4.64E-04	2155	673	-202	0.3
2.5	0.13	18.99	0.128937786	5.15E-04	1940	747	-224	0.3



$$v = \frac{P}{6EI}(2L^3 - 3L^2x + x^3)$$

$$v_{máx} = v(0) = \frac{PL^3}{3EI}$$

Resultados



$$v = \frac{P}{6EI}(2L^3 - 3L^2x + x^3)$$

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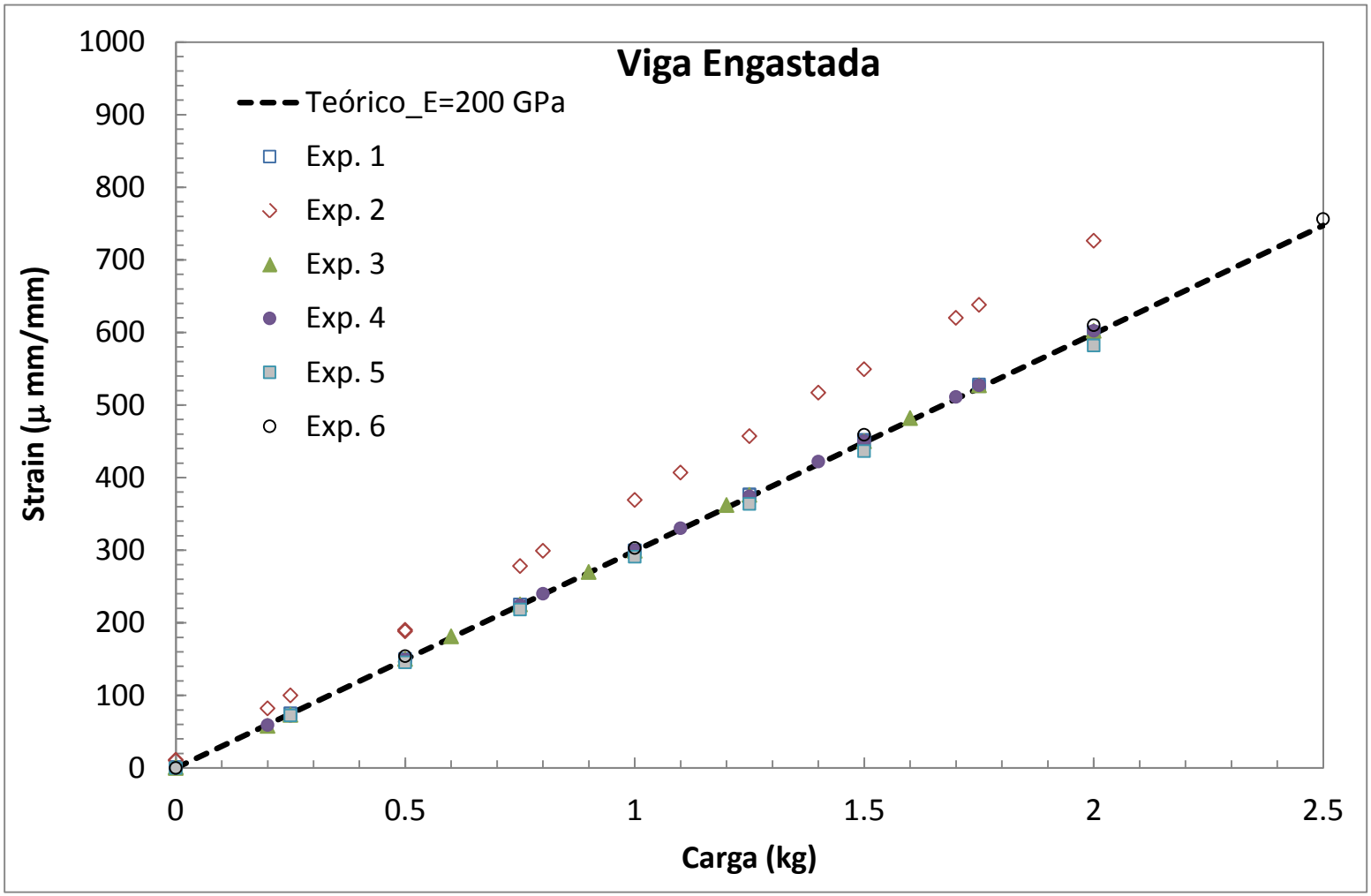
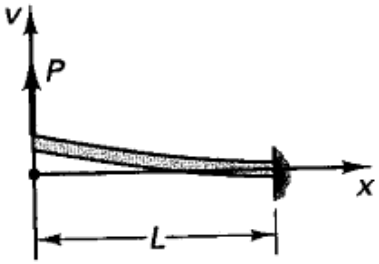
- Viga em balanço – Deformações (μ mm/mm)



Resultados



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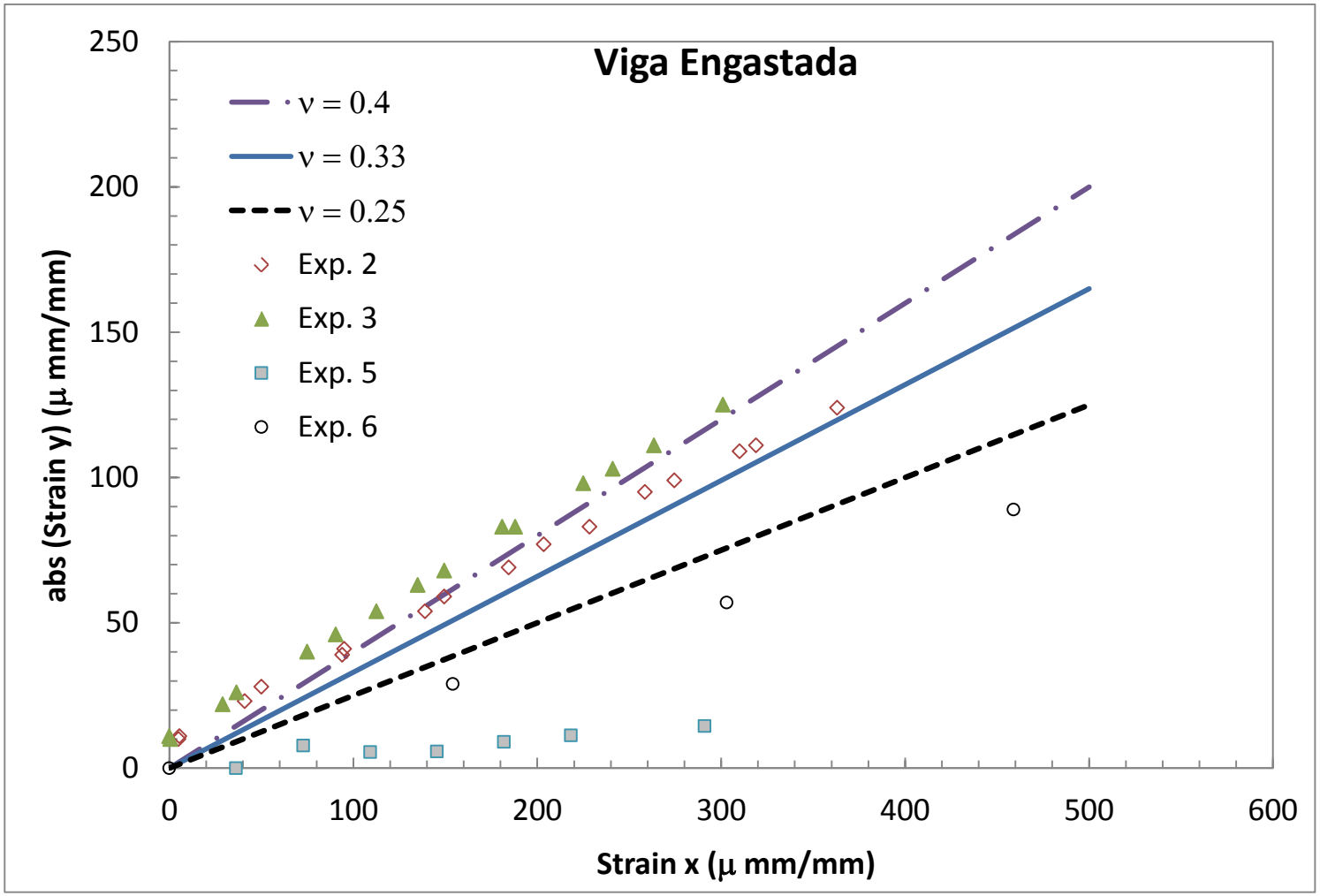
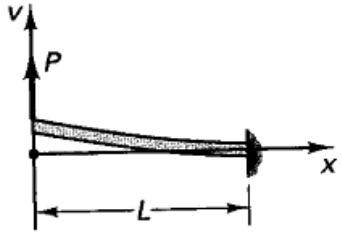


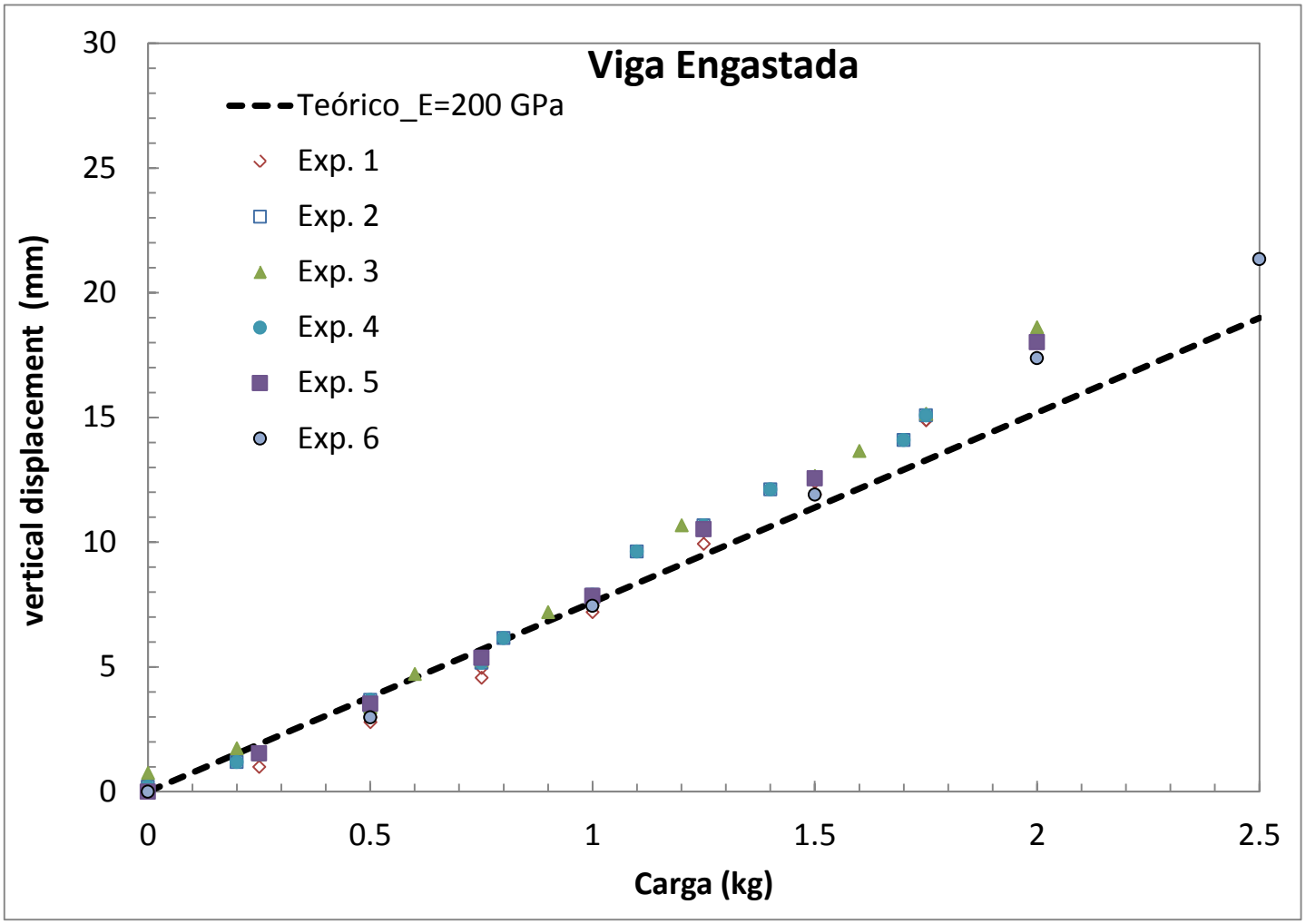
Resultados



$$v = \frac{P}{6EI}(2L^3 - 3L^2x + x^3)$$

$$v_{máx} = v(0) = \frac{PL^3}{3EI}$$

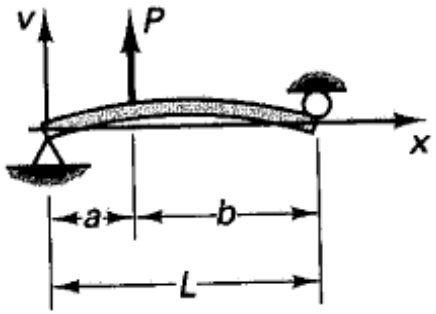
- Viga em balanço – Deflexões (mm)



Resultados

- Viga biapoiada

Carga	Deslocamento		Geometria deformada			Deformação		
P	u	v	dv / dx	d^2v / dx^2	$1/\rho$	ε_x	ε_y	υ
[kg]	[mm]	[mm]				mm/mm	mm/mm	---
0	0.00	0.00	0	0.00E+00	0	0	0	0.33
1	0.06	0.35	0.000119522	5.84E-06	171271	46	-15	0.33
2	0.11	0.70	0.000239043	1.17E-05	85635	92	-30	0.33
3	0.17	1.05	0.000358565	1.75E-05	57090	138	-46	0.33
4	0.23	1.40	0.000478087	2.34E-05	42818	184	-61	0.33
5	0.28	1.75	0.000597609	2.92E-05	34254	230	-76	0.33
6	0.34	2.10	0.00071713	3.50E-05	28545	276	-91	0.33



Cuando $0 \leq x \leq a$, entonces

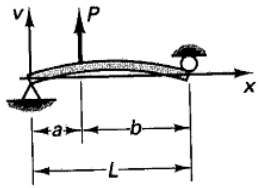
$$v = \frac{Pbx}{6EIL}(L^2 - b^2 - x^2)$$

Cuando $a = b = \frac{L}{2}$, entonces

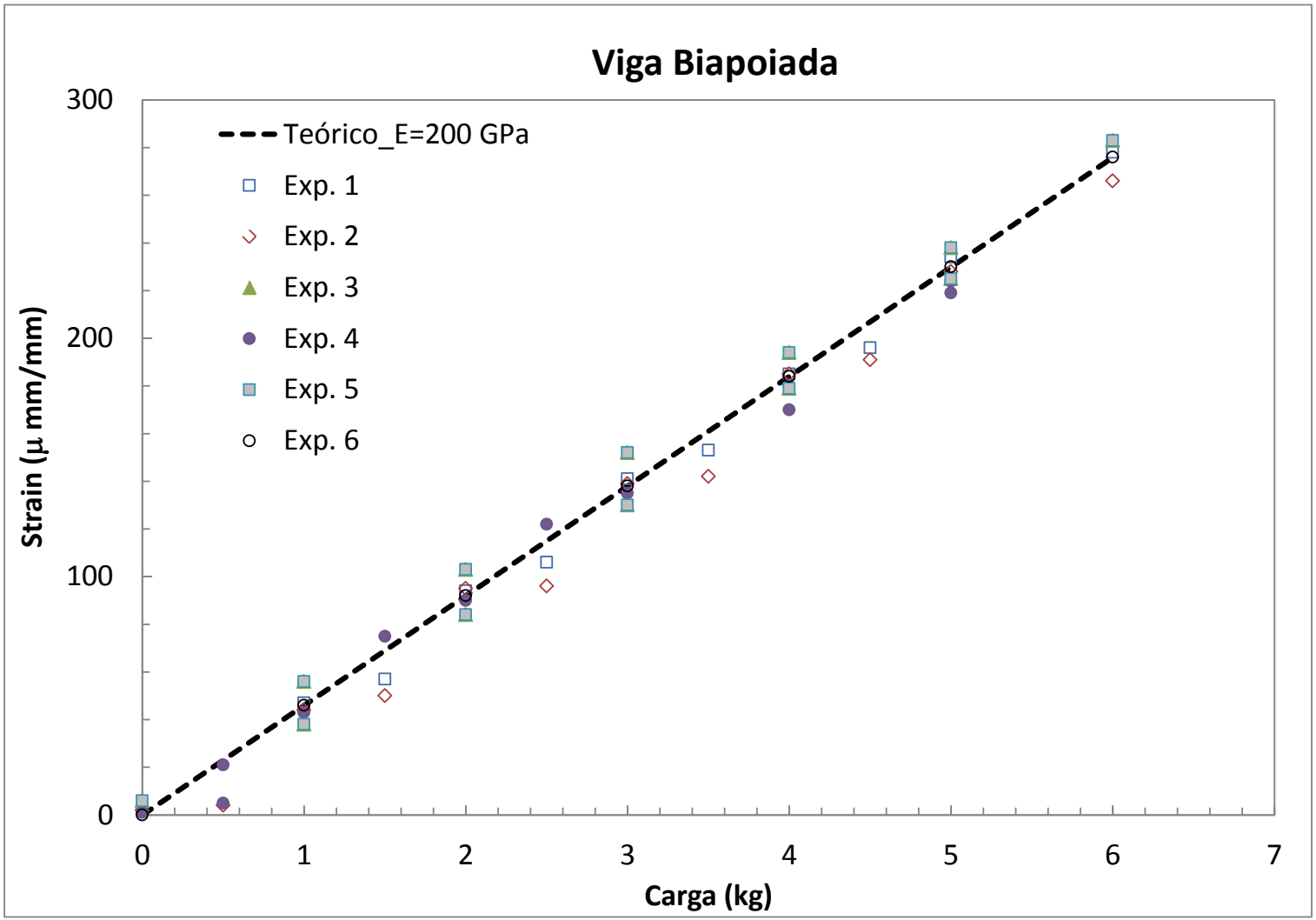
$$v = \frac{Px}{48EI}(3L^2 - 4x^2)$$

$$v_{máx} = v(L/2) = \frac{PL^3}{48EI}$$

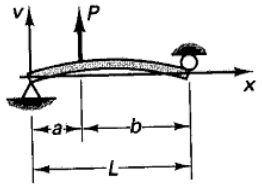
Resultados



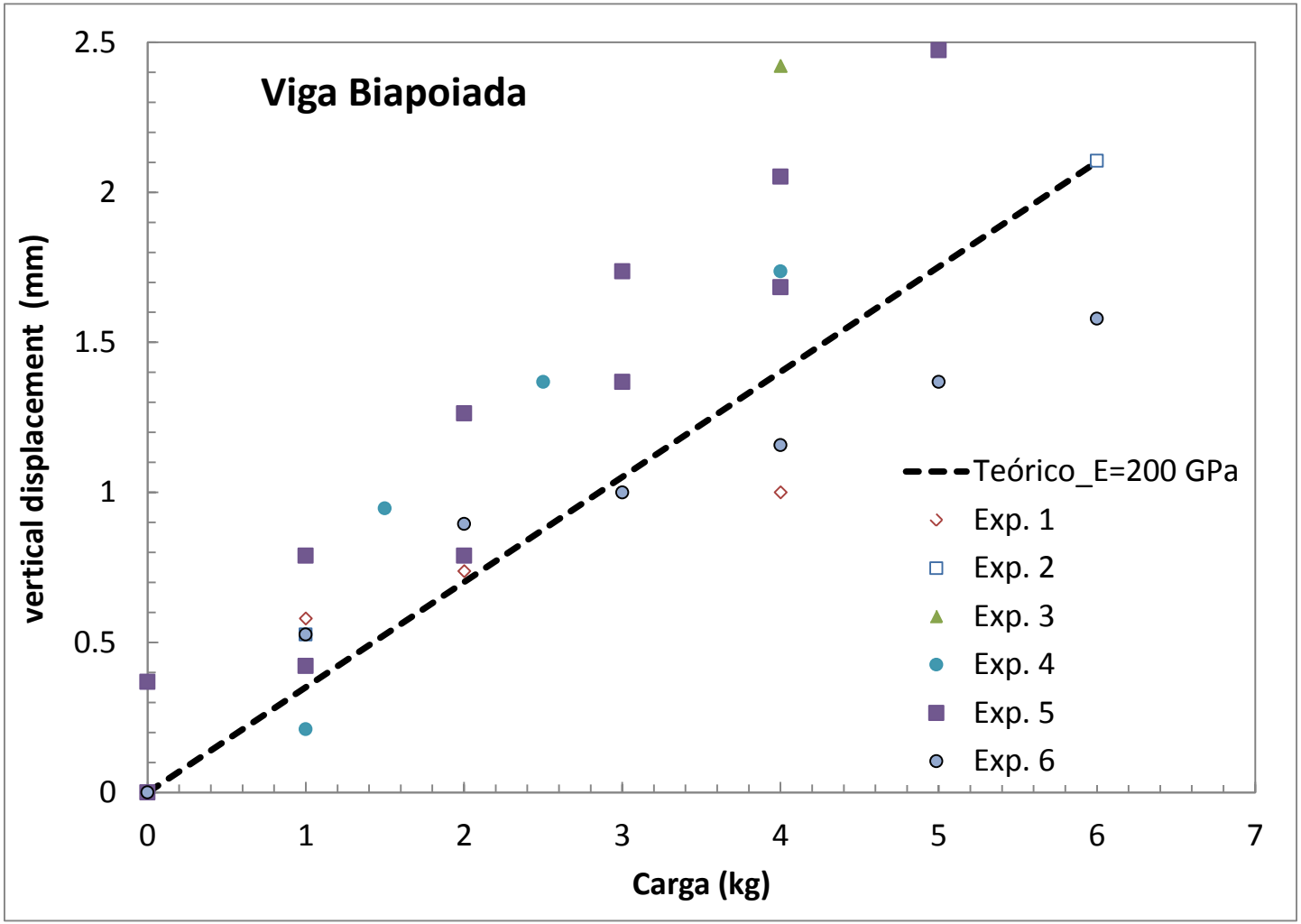
- Viga biapoiada– Deformações (μ mm/mm)



Resultados



- Viga biapoiada – Deflexões (mm)



Conclusões

- Valida da teoria simples de viga
  - Viga em balanço
    - Deformações experimentais e teóricas com boa correlação
    - Deflexões experimentais e teóricas com aceitável correlação até 600 μ mm/mm
  - Viga biapoiada
    - Excelente correlação entre resultados de deformações experimentais e teóricas
    - Deflexões experimentais com elevado ruído nas medições experimentais. Uso de outro equipamento de medição é necessário para verificar a resposta.