

# Estruturas na Arquitetura IV

## Projeto

FAU

EXERCÍCIO – Levantamento de cargas atuantes no sistema  
Laje-Viga-Pilar

PEF 2603

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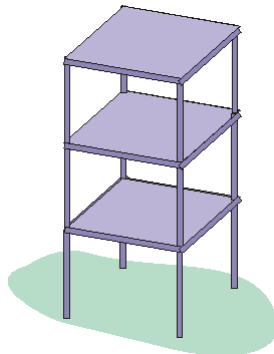


Departamento de Engenharia de  
Estruturas e Geotécnica  
Escola Politécnica



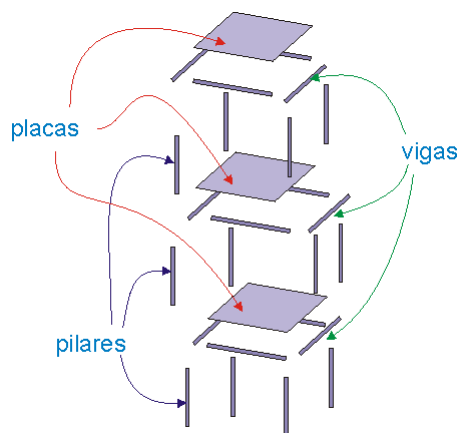
## Sistema Estrutural

- Edifício LVP

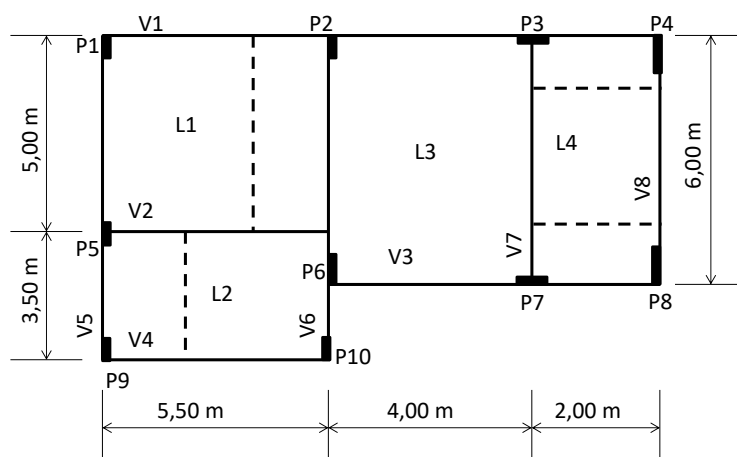


# Sistema Estrutural

- LVP



## Exercício – Edifício (LVP)



## Exercício – Edifício (LVP)

- **Dados:**

- ✓ **Espessura das lajes**  $e_{laje} = 8\text{cm}$
- ✓ **Seção transversal das vigas**  $b = 30\text{cm} \times h = 70\text{cm}$
- ✓ **Propriedades do Concreto**
  - Módulo de elasticidade*  $E_c = 25\text{GPa}$
  - Peso específico*  $\gamma_c = 25\text{kN/m}^3$
- ✓ **Revestimento**
  - Espessura*  $e_{rev} = 3\text{cm}$
  - Peso específico*  $\gamma_{rev} = 20\text{kN/m}^3$
- ✓ **Alvenaria (sobre todas as vigas)**
  - Espessura*  $e_{alv} = 15\text{cm}$
  - Altura*  $h_{alv} = 2,80\text{m}$
  - Peso específico*  $\gamma_{alv} = 13\text{kN/m}^3$
- ✓ **Sobrecarga (carga de utilização)**  $q = 2,5\text{kN/m}^2$

## Exercício – Edifício (LVP)

### a) Cargas atuantes sobre as lajes e vigas:

- **Laje L1**

$$\mathbf{g_1: \text{ peso próprio das lajes} = } e_{laje} \times \gamma_c = 0,08 \times 25 = 2,0\text{kN/m}^2$$

$$\mathbf{g_2: \text{ peso do revestimento} = } e_{rev} \times \gamma_{rev} = 0,03 \times 20 = 0,6\text{kN/m}^2$$

$$\mathbf{g_3: \text{ peso da alvenaria} = } \frac{l_{alv} \times e_{alv} \times h_{alv} \times \gamma_{alv}}{l_x \times l_y} = \frac{5 \times 0,15 \times 2,80 \times 13}{5,0 \times 5,50} = 1,0\text{kN/m}^2$$

$$\mathbf{g_T: \text{ carga permanente : } } g_1 + g_2 + g_3 = 3,60\text{kN/m}^2$$

$$\mathbf{Q_T: \text{ sobrecarga (carga de utilização):} = 2,50\text{kN/m}^2$$

$$\mathbf{p: \text{ carga total: } } g_T + q_T = 6,10\text{kN/m}^2$$

## Exercício – Edifício (LVP)

### a) Cargas atuantes sobre as lajes e vigas:

- Lajes

Tipo de carga	L1 (kN/m <sup>2</sup> )	L2 (kN/m <sup>2</sup> )	L3 (kN/m <sup>2</sup> )	L4 (kN/m <sup>2</sup> )
g <sub>1</sub>	2,0	2,0	2,0	2,0
g <sub>2</sub>	0,6	0,6	0,6	0,6
g <sub>3</sub>	1,0	1,0	-	1,82
g <sub>T</sub>	3,6	3,6	2,6	4,42
q <sub>T</sub>	2,5	2,5	2,5	2,5
p=g <sub>T</sub> +q <sub>T</sub>	6,10	6,10	5,10	6,92

**g<sub>1</sub>**: peso próprio das lajes

**q<sub>T</sub>**: sobrecarga (carga de utilização)

**g<sub>2</sub>**: peso do revestimento

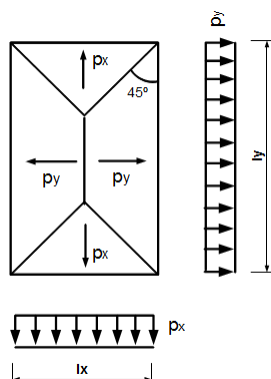
**p**: carga total

**g<sub>3</sub>**: peso da alvenaria

## Exercício – Edifício (LVP)

- Vigas

### Cargas devido às lajes:



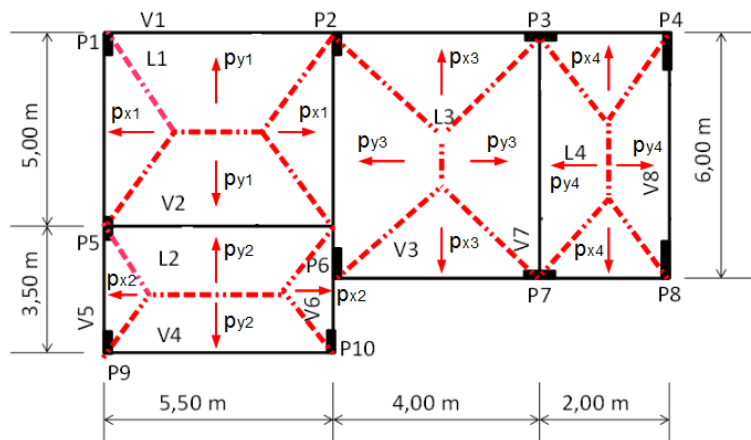
$$p_x = \frac{p \cdot l_x}{4}$$

$$p_y = p_x \left( 2 - \frac{l_x}{l_y} \right)$$

## Exercício – Edifício (LVP)

- Vigas

Cargas devido às lajes:



## Exercício – Edifício (LVP)

- Vigas

Cargas devido às lajes:

Laje	Lx (m)	Ly (m)	Lx/Ly	p (kN/m <sup>2</sup> )	px (kN/m)	py (kN/m)
L1	5,0	5,50	0,91	6,10	7,63	8,32
L2	3,50	5,50	0,64	6,10	5,34	7,26
L3	4,0	6,00	0,67	5,10	5,10	6,78
L4	2,0	6,00	0,33	6,92	3,46	5,78

## Exercício – Edifício (LVP)

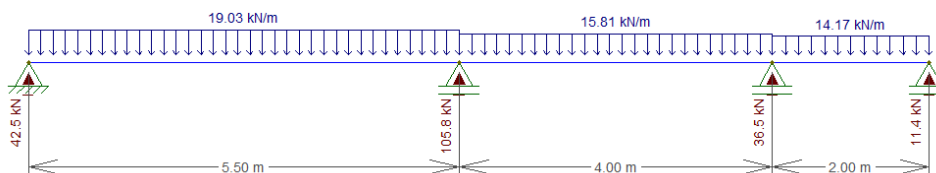
Cargas atuantes sobre vigas:

Viga	Trecho	b (m)	h (m)	pv (kN/m)	palv (kN/m)	plaje (kN/m)	pTv (kN/m)
1	1	0,30	0,70	5,25	5,46	8,32	19,03
	2					5,10	15,81
	3					3,46	14,17
2	1					8,32+7,26=15,58	26,29
3	1					5,10	15,81
	2					3,46	14,17
4	1					7,26	17,97
5	1					5,34	16,05
	2	7,63	18,34				
6	1	5,34	16,05				
	2	5,34+6,78 = 12,12	22,83				
	3	7,63+6,78 = 14,41	25,12				
7	1	6,78+5,78 = 12,56	23,27				
8	1	5,78	16,49				

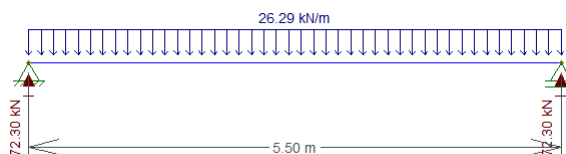
## Exercício – Edifício (LVP)

• Esquema estrutural das vigas

• V1



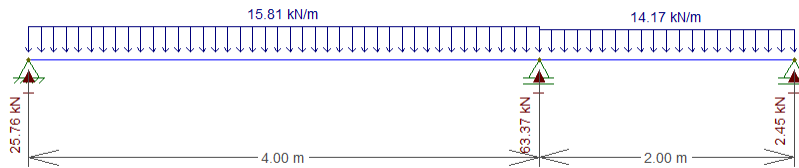
• V2



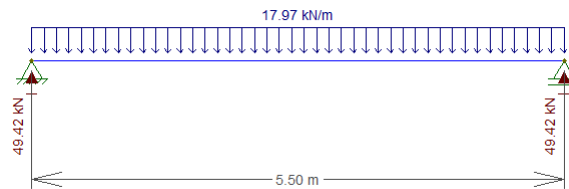
## Exercício – Edifício (LVP)

- Esquema estrutural das vigas

- V3



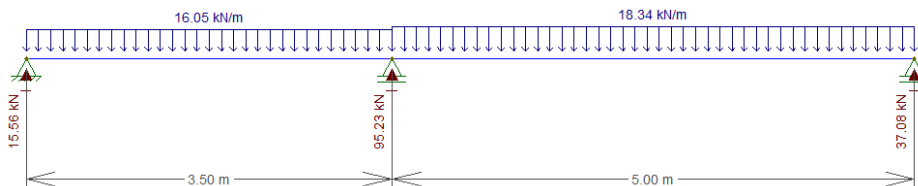
- V4



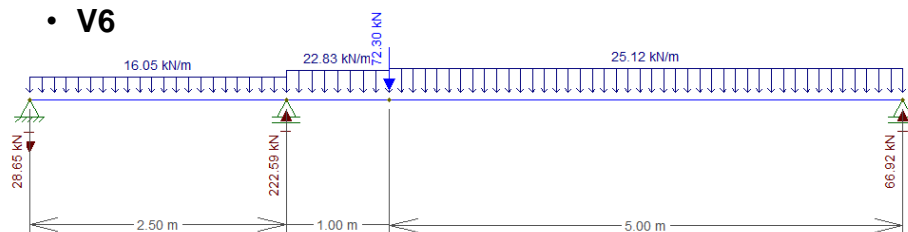
## Exercício – Edifício (LVP)

- Esquema estrutural das vigas

- V5



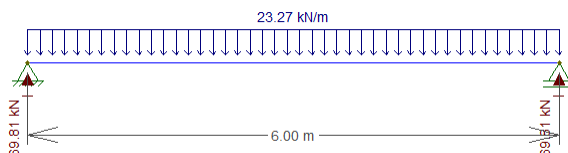
- V6



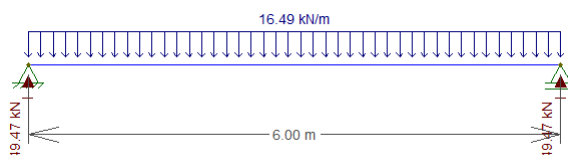
## Exercício – Edifício (LVP)

- Esquema estrutural das vigas

- V7



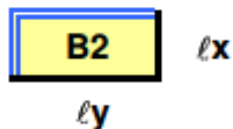
- V8



## Exercício – Edifício (LVP)

b) Momentos positivos e negativos e flechas das Lajes L1 e L2:  
utilizou-se tabela de Czerny com coeficiente de Poisson nulo

- Laje L1

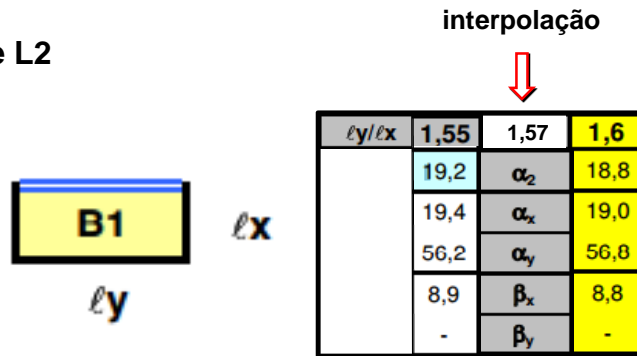


$l_y/l_x$	1,1
$\alpha_2$	33,1
$\alpha_x$	35,1
$\alpha_y$	42,0
$\beta_x$	12,7
$\beta_y$	13,6



## Exercício – Edifício (LVP)

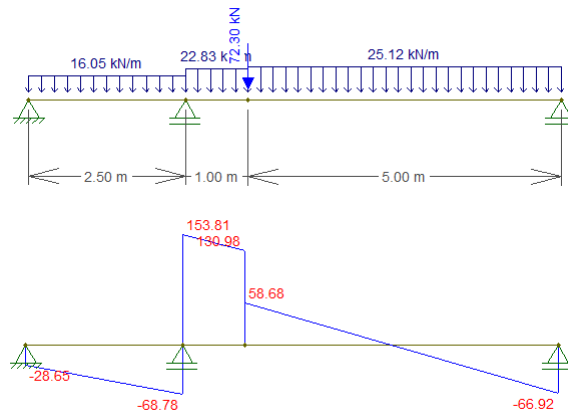
- Laje L2



## Exercício – Edifício (LVP)

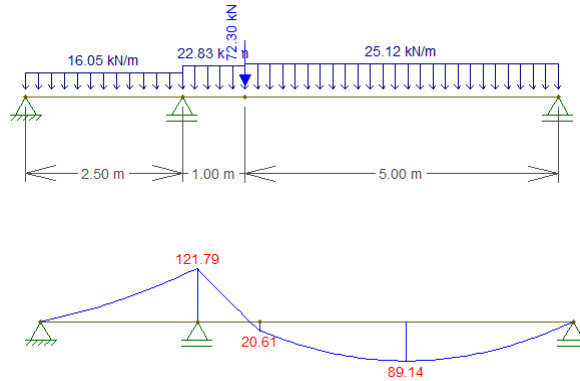
### c) Esforços Solicitantes

- Viga V6 – Esforço Cortante



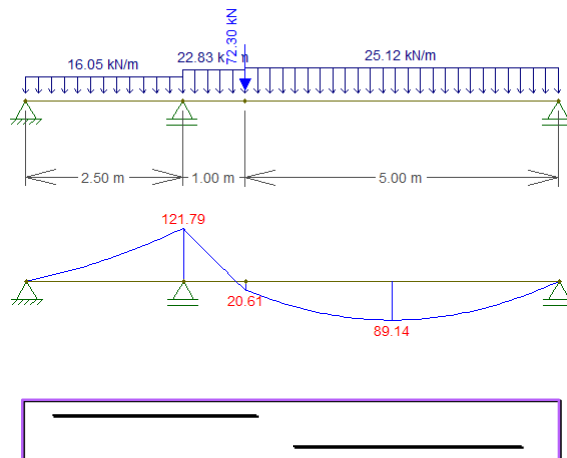
## Exercício – Edifício (LVP)

### • Viga V6 – Momento Fletor



## Exercício – Edifício (LVP)

### d) Distribuição da armadura longitudinal

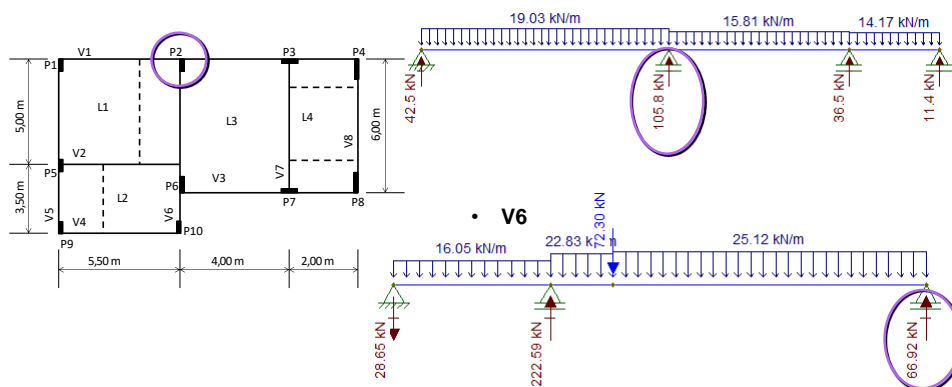


## Exercício – Edifício (LVP)

### e) Cargas verticais nos pilares P2, P6 e P10

- Pilar P2:  $P_{p2} = R_{v1} + R_{v6} = 105,80 + 66,92 = 172,72 \text{ kN}$

- V1

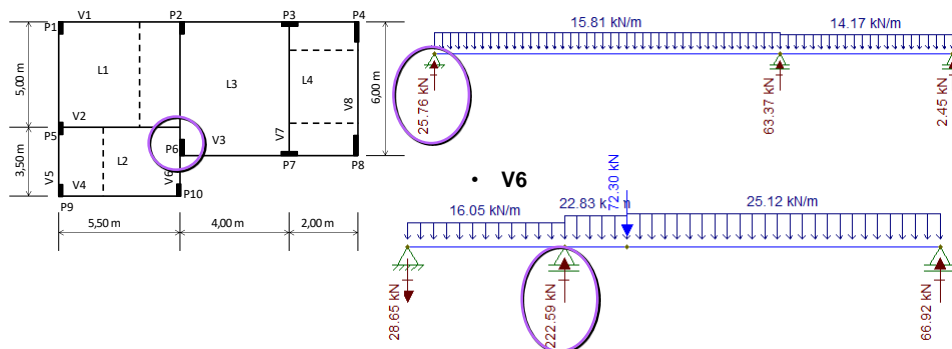


## Exercício – Edifício (LVP)

### e) Cargas verticais nos pilares P2, P6 e P10

- Pilar P6:  $P_{p6} = R_{v3} + R_{v6} = 25,76 + 222,59 = 248,35 \text{ kN}$

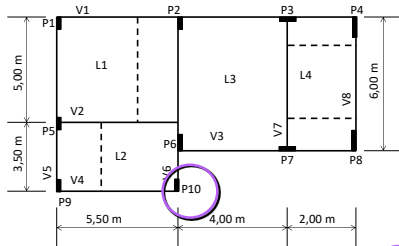
- V3



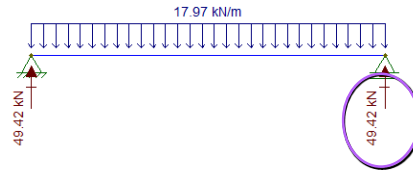
## Exercício – Edifício (LVP)

### e) Cargas verticais nos pilares P2, P6 e P10

- Pilar P10:  $P_{p10} = R_{v4} + R_{v6} = 49,42 - 28,65 = 20,77 \text{ kN}$



#### • V4



#### • V6

