



3 CARREGAMENTOS DAS VIGAS DO PAVIMENTO-TIPO

3.1 AÇÕES

3.1.1 CLASSIFICAÇÃO DAS AÇÕES



NBR 6118:2003/11.2

AÇÕES PERMANENTES

DIRETAS: peso próprio, peso elementos construtivos fixos e instalações permanentes ...

INDIRETAS: retração, fluência, recalque de apoio, imperfeições geométricas, protensões ...

AÇÕES VARIÁVEIS

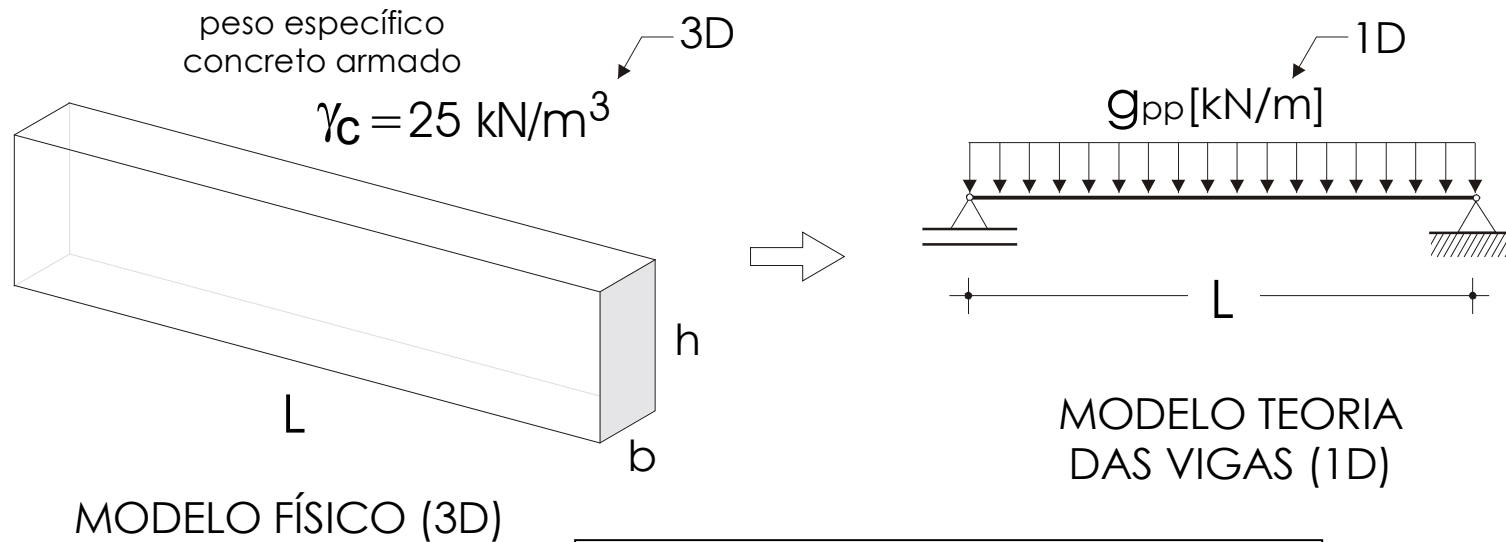
DIRETAS: sobrecargas de utilização e construção, vento, água ...

INDIRETAS: variações de temperatura, cargas dinâmicas ...

3.1.2 PESO PRÓPRIO



NBR 6118:2003/8.2.2



$$g_{pp} = \gamma_c \cdot b \cdot h = 25 \cdot b \cdot h [\text{kN/m}]$$

3.1.2 PAREDES



NBR 6120:1980/Tabela 1

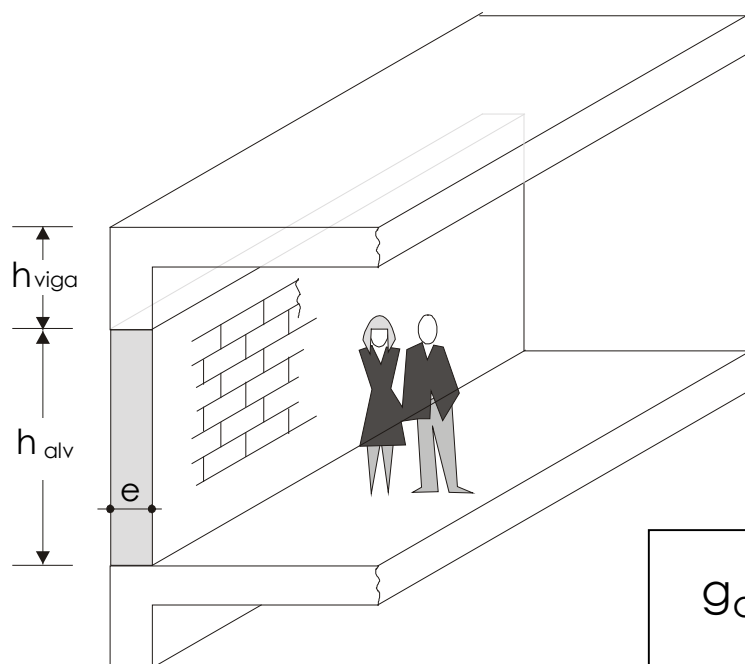
PESO ESPECÍFICO DOS MATERIAIS γ_{alv}

- Tijolos furados 13,0 kN/m³;
- Tijolos maciços 18,0 kN/m³;
- Tijolos sílico-calcáreos 20,0 kN/m³;
- Blocos de argamassa 22,0 kN/m³;
- Blocos de concreto celular 5,5 kN/m³;

NOTAS:

- 1) Desprezar aberturas (portas, janelas...) e revestimentos (azulejos, argamassa de assentamento...);
- 2) Adotar a espessura da parede igual à largura da viga (compatibilidade arquitetônica);

3.1.2 PAREDES (cont...)



$$h_{alv} = L_{sup} - h_{viga}$$

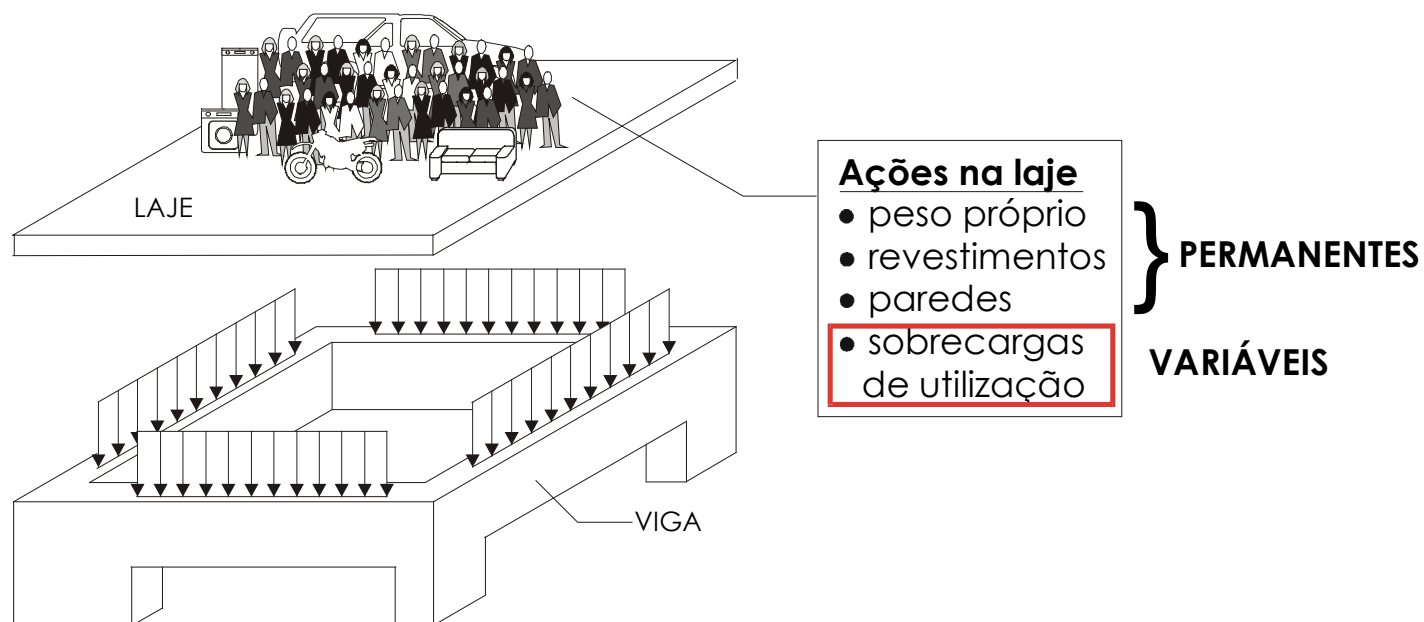
sendo:

L_{sup} : pé-direito estrutural
(piso a piso)

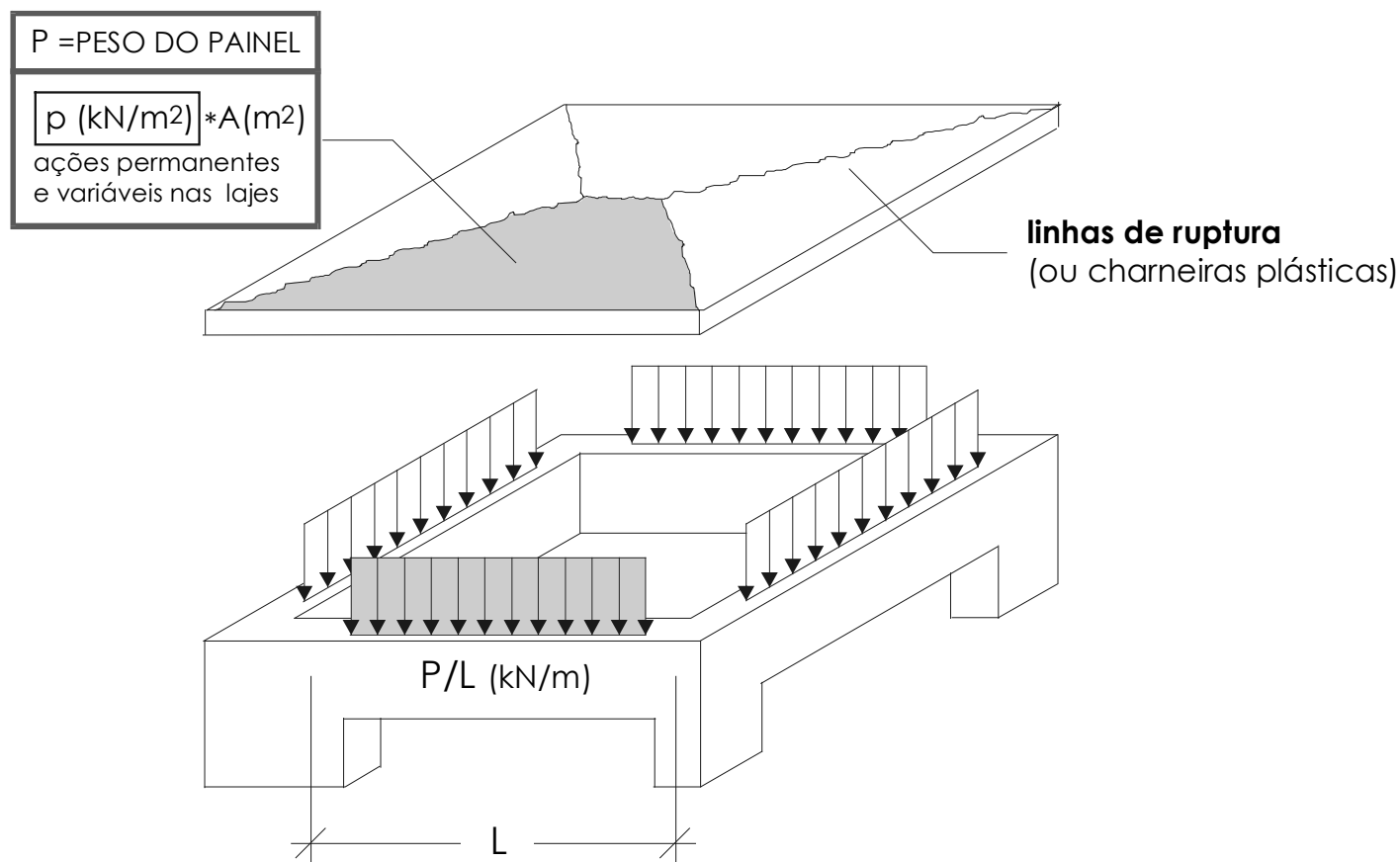
$$g_{alv} = \gamma_{alv} \cdot e \cdot h_{alv} \text{ [kN/m]}$$

3.1.3 REAÇÃO DAS LAJES

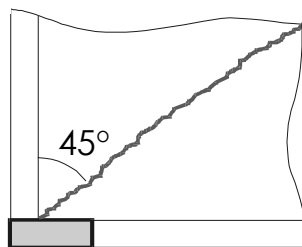
 **NBR 6118:2003/14.7.6.1**



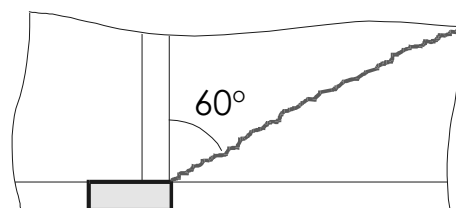
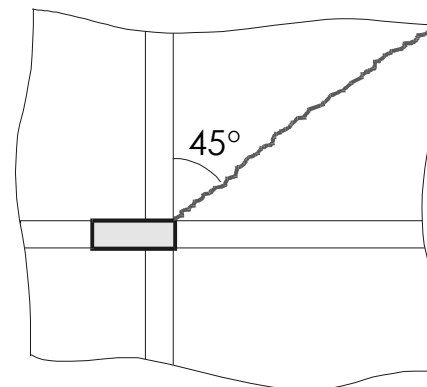
3.1.3 REAÇÃO DAS LAJES (cont...)



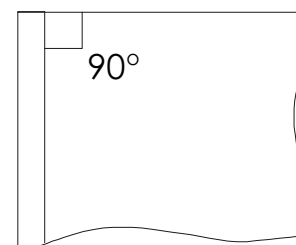
3.1.3 REAÇÃO DAS LAJES (cont...)



canto entre dois apoios
de mesmo tipo

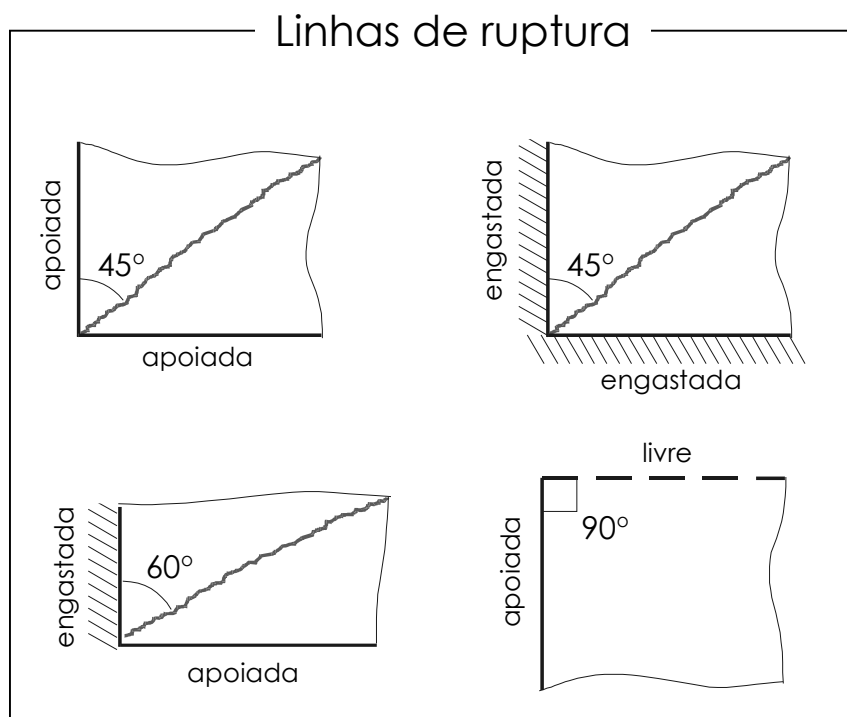


canto entre apoios engastado
e simplesmente apoiado



canto entre apoio
e borda livre

3.1.3 REAÇÃO DAS LAJES (cont...)



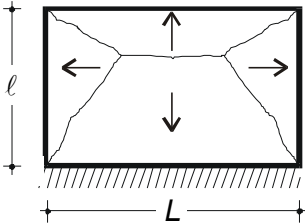
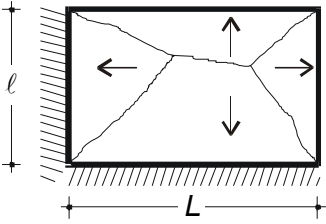
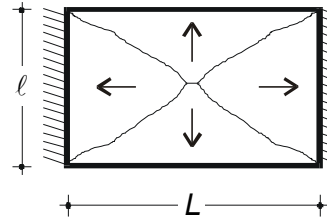
Simbologia

| | |
|--------|-----------------------------------|
| p | carregamento na laje (perm.+var.) |
| L | lado maior |
| ℓ | lado menor |
| R_A | reação na borda maior apoiada |
| R_E | reação na borda maior engastada |
| r_A | reação na borda menor apoiada |
| r_E | reação na borda menor engastada |

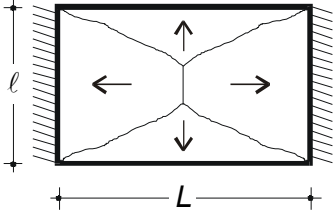
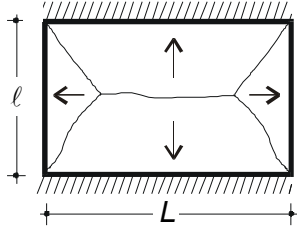
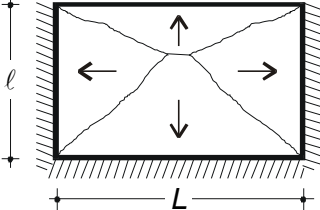
3.1.3 REAÇÃO DAS LAJES (cont...)

| TIPO 1 | TIPO 2A | TIPO 2B |
|---|---|--|
| | | |
| $r_A = \frac{p\ell}{4}$ $R_A = r_A \cdot \left(2 - \frac{\ell}{L}\right)$ | $\frac{\ell}{L} < 0,732:$ $r_A = \frac{p\ell}{4}$ $r_E = 1,732 \cdot r_A$ $R_A = r_A \cdot \left(2 - 1,366 \cdot \frac{\ell}{L}\right)$ | $\frac{\ell}{L} > 0,732:$ $R_A = 0,732 \cdot \frac{pL}{4}$ $r_A = R_A \cdot \left(2 - 0,732 \cdot \frac{L}{\ell}\right)$ $r_E = 1,732 \cdot r_A$ |

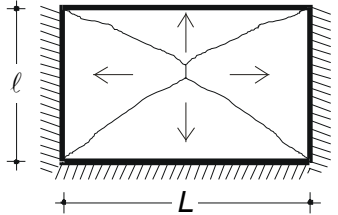
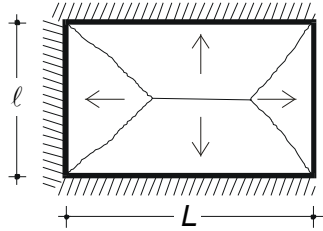
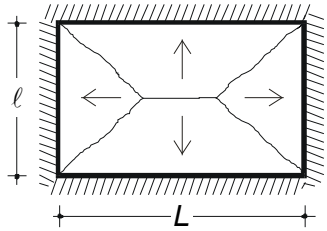
3.1.3 REAÇÃO DAS LAJES (cont...)

| TIPO 2C | TIPO 3 | TIPO 4A |
|---|--|--|
|  $r_A = 0,732 \cdot \frac{p\ell}{4}$ $R_A = r_A \cdot \left(2 - 0,732 \cdot \frac{\ell}{L}\right)$ $R_E = 1,732 \cdot R_A$ |  $r_A = 0,732 \cdot \frac{p\ell}{4}$ $r_E = 1,732 \cdot r_A$ $R_A = r_A \cdot \left(2 - \frac{\ell}{L}\right)$ $R_E = 1,732 \cdot R_A$ |  $\frac{\ell}{L} < 0,577 :$ $r_E = 1,732 \cdot \frac{p\ell}{4}$ $R_A = \frac{p\ell}{4} \cdot \left(2 - 1,732 \cdot \frac{\ell}{L}\right)$ |

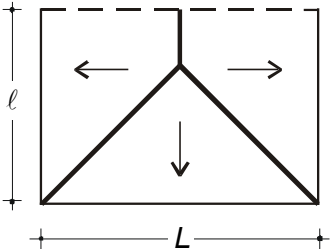
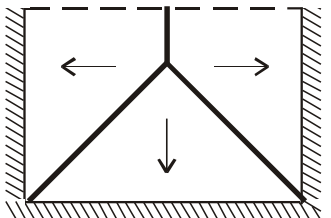
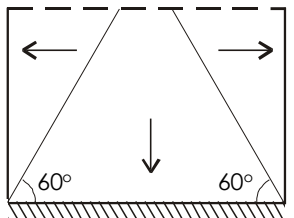
3.1.3 REAÇÃO DAS LAJES (cont...)

| TIPO 4B | TIPO 4C | TIPO 5A |
|---|--|---|
|  <p style="text-align: center;">$\frac{\ell}{L} > 0,577 :$</p> $R_A = 0,577 \cdot \frac{pL}{4}$ $r_E = \frac{pL}{4} \cdot \left(2 - 0,577 \cdot \frac{L}{\ell} \right)$ |  <p style="text-align: center;">$r_A = 0,577 \cdot \frac{p\ell}{4}$</p> $R_E = \frac{p\ell}{4} \cdot \left(2 - 0,577 \cdot \frac{\ell}{L} \right)$ |  <p style="text-align: center;">$\frac{\ell}{L} < 0,789 :$</p> $r_E = 1,268 \cdot \frac{p\ell}{4}$ $R_E = r_E \cdot \left(2 - 1,268 \cdot \frac{\ell}{L} \right)$ $R_A = 0,577 \cdot R_E$ |

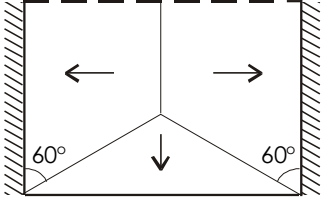
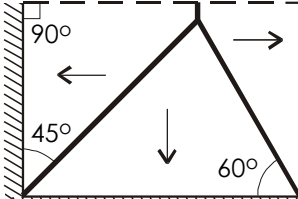
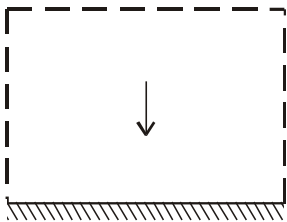
3.1.3 REAÇÃO DAS LAJES (cont...)

| TIPO 5B | TIPO 5C | TIPO 6 |
|---|--|---|
|  <p style="text-align: center;">$\frac{\ell}{L} > 0,789:$</p> $R_E = \frac{pL}{4}$ $R_A = 0,577 \cdot R_E$ $r_E = R_E \cdot \left(2 - 0,789 \cdot \frac{L}{\ell}\right)$ |  $r_E = \frac{p\ell}{4}$ $r_A = 0,577 \cdot r_E$ $R_E = r_E \cdot \left(2 - 0,789 \cdot \frac{\ell}{L}\right)$ |  $r_E = \frac{p\ell}{4}$ $R_E = r_E \cdot \left(2 - \frac{\ell}{L}\right)$ |

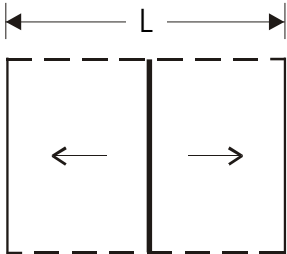
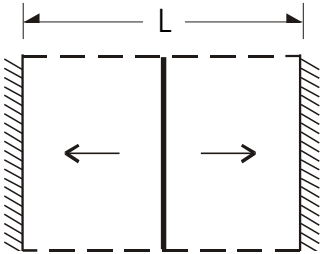
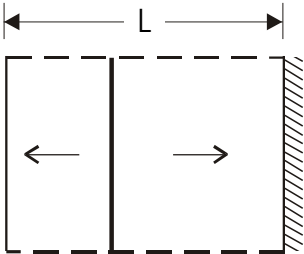
3.1.3 REAÇÃO DAS LAJES (cont...)

| TIPO 7 | TIPO 8 | TIPO 9 |
|--|---|---|
|  $r_A = \frac{pL}{2} \cdot \left(1 - 0,25 \frac{L}{\ell}\right)$ $R_A = \frac{pL}{4}$ |  $r_E = \frac{pL}{2} \cdot \left(1 - 0,25 \frac{L}{\ell}\right)$ $R_E = \frac{pL}{4}$ |  $r_A = 0,289 p \ell$ $R_E = p \ell \cdot \left(1 - 0,577 \frac{\ell}{L}\right)$ |

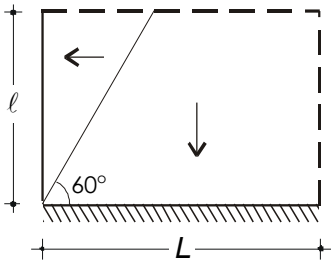
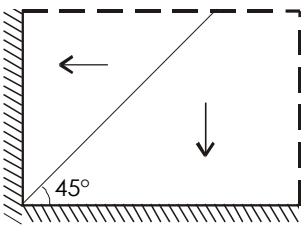
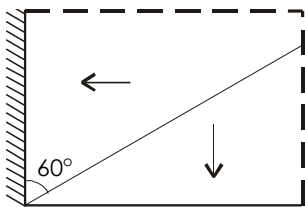
3.1.3 REAÇÃO DAS LAJES (cont...)

| TIPO 10 | TIPO 11 | TIPO 12 |
|---|--|---|
|  $r_E = \frac{pL}{2} \cdot \left(1 - 0,289 \frac{L}{\ell}\right)$ $R_A = 0,289 pL$ |  $\frac{\ell}{L} > 0,634 :$ $r_A = 0,366 pL \cdot \left(1 - 0,317 \frac{L}{\ell}\right)$ $r_E = 0,634 pL \cdot \left(1 - 0,317 \frac{L}{\ell}\right)$ $R_E = 0,317 pL$ |  $R_E = p\ell$ |

3.1.3 REAÇÃO DAS LAJES (cont...)

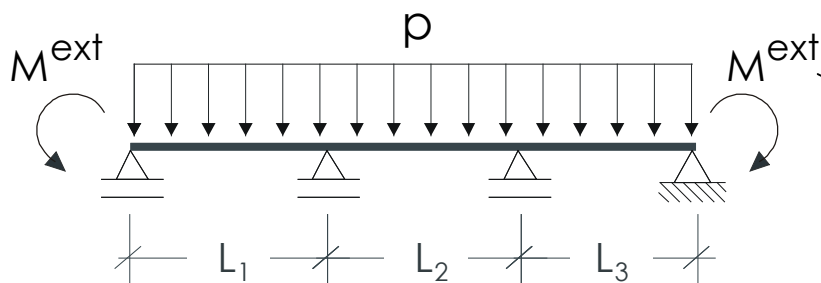
| TIPO 13 | TIPO 14 | TIPO 15 |
|--|---|---|
|  $r_A = \frac{pL}{2}$ |  $r_E = \frac{pL}{2}$ |  $r_A = \frac{3pL}{8}$ $r_E = \frac{5pL}{8}$ |

3.1.3 REAÇÃO DAS LAJES (cont...)

| TIPO 16 | TIPO 17 | TIPO 18 |
|---|--|---|
|  $r_A = 0,289 p \ell$ $R_E = p \ell \cdot \left(1 - 0,289 \frac{\ell}{L}\right)$ |  $r_E = \frac{p \ell}{2}$ $R_E = p \ell \cdot \left(1 - 0,5 \frac{\ell}{L}\right)$ |  $r_E = p L \cdot \left(1 - 0,289 \frac{L}{\ell}\right)$ $R_A = 0,289 p L$ |

3.1.4 MOMENTO DE EXTREMIDADE

NBR 6118:2003/14.6.7.1



simulação da influência da ligação pilar-viga no comportamento da viga

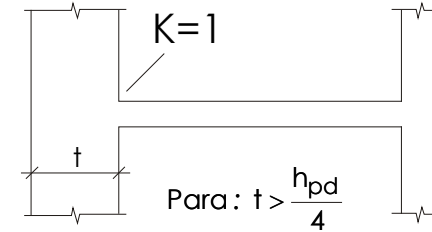
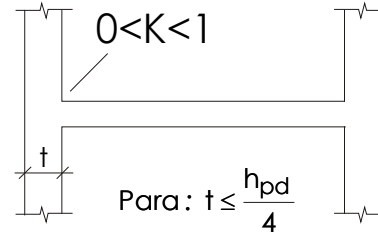
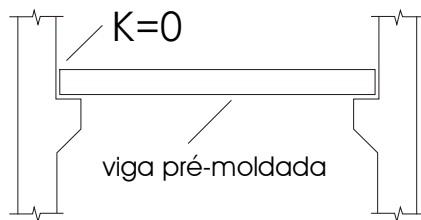
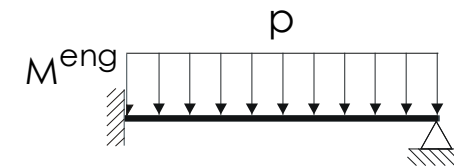
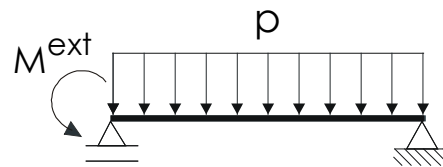
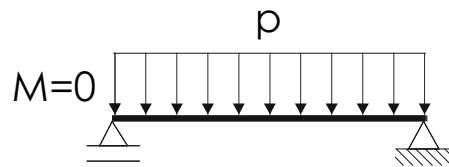
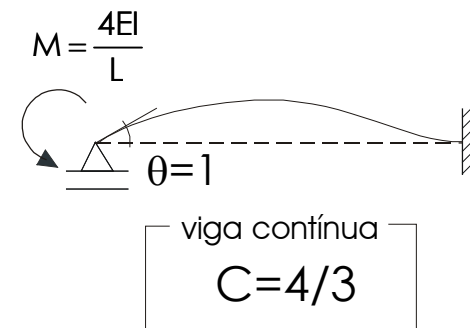
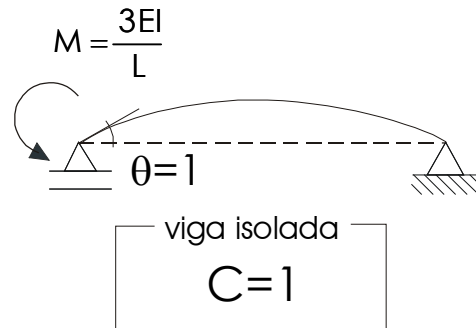
$$M^{ext} \left[\frac{(I/L)^{inf} + (I/L)^{sup}}{(I/L)^{inf} + (I/L)^{sup} + C \cdot (I/L)^{viga}} \right] \frac{pL^2}{12} = K \cdot \frac{pL^2}{12}$$

momento de engastamento perfeito

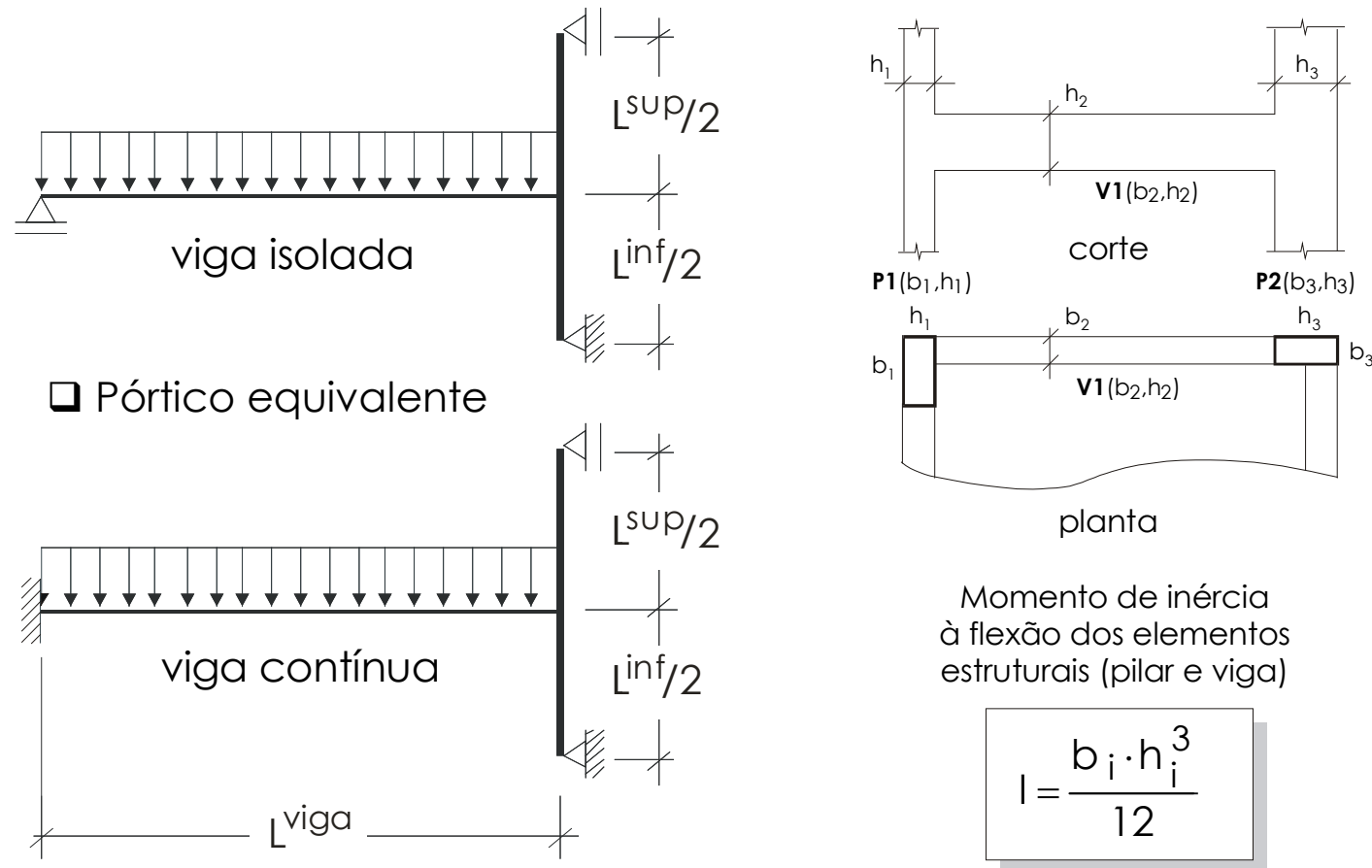
K = coeficiente de engastamento parcial

- Viga equivalente engastamento parcial produzido por momento de extremidade

3.1.4 MOMENTO DE EXTREMIDADE (cont...)



3.1.4 MOMENTO DE EXTREMIDADE (cont...)



3.1.4 MOMENTO DE EXTREMIDADE (cont...)

