CONSTRUCCIONES DEL PACÍFICO
Pacificonstruye S.A.

PT POST-TENSIONING SYSTEMS

Criterios de Diseño en Postensado

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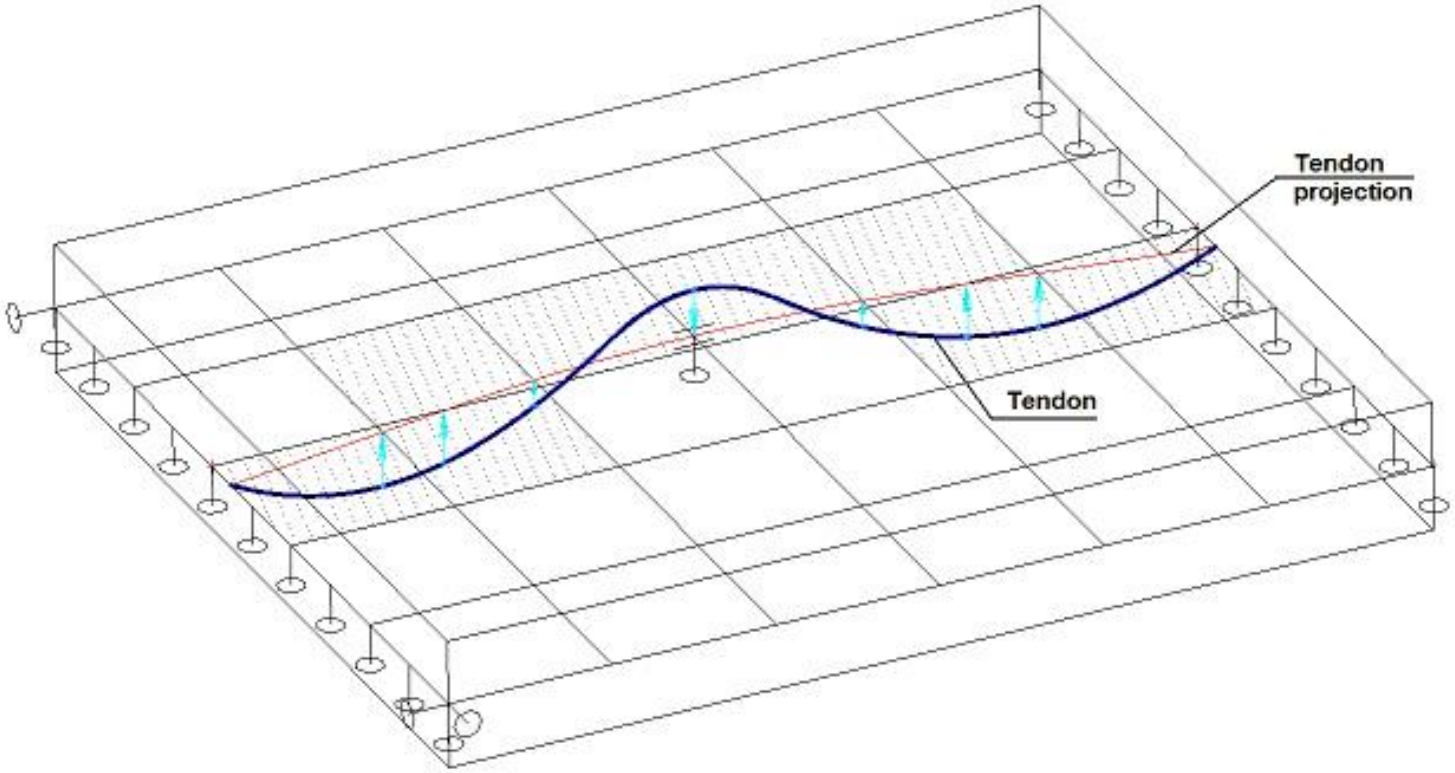
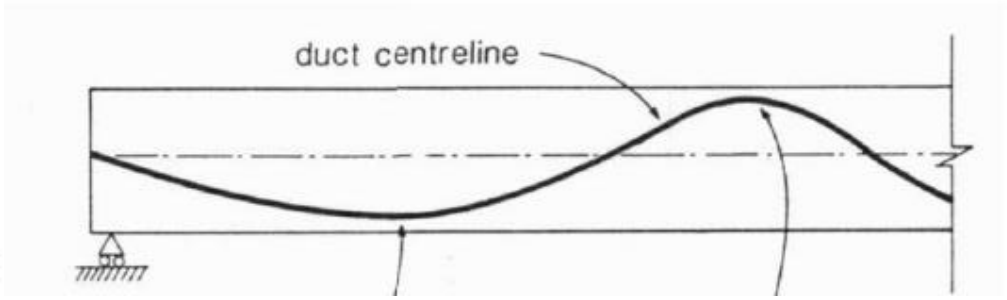
Master of Science in Structural Engineering

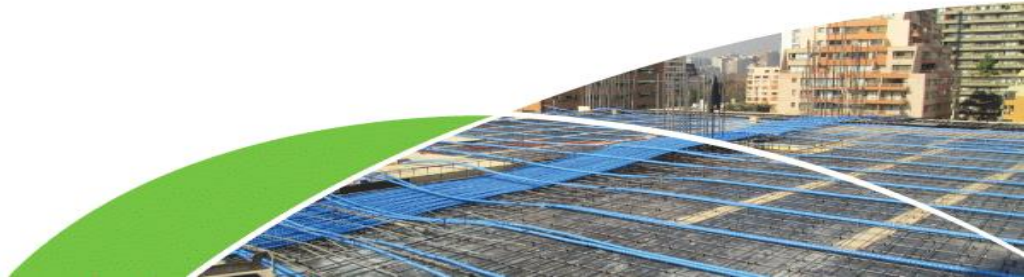
Fecha: 11 de Noviembre de 2017

Lugar: Cámara de la Industria de la Construcción -Desintecsa

El diseño se da por secciones

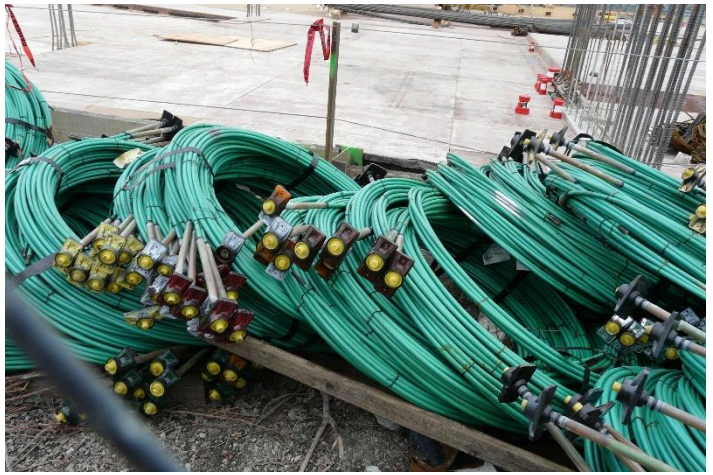


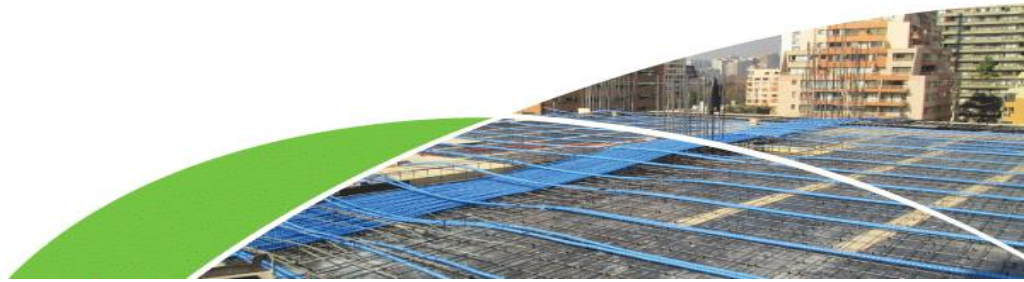




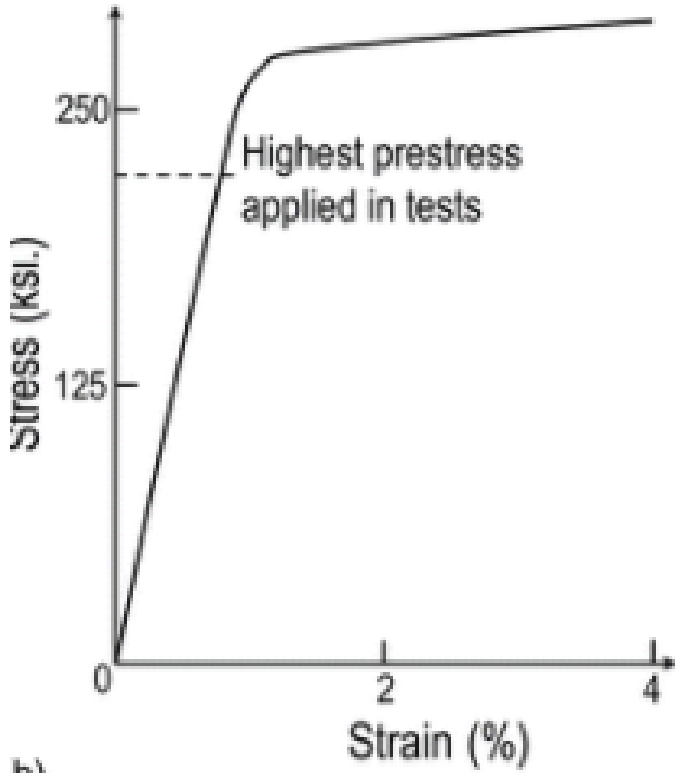
Dispositivos de Postensado

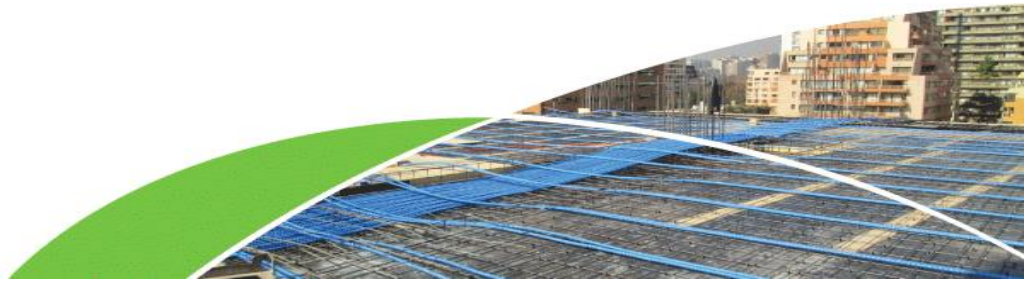
- Anclajes
- Cuñas
- Prestressing Steel
- Sillas





Prestressing Steel





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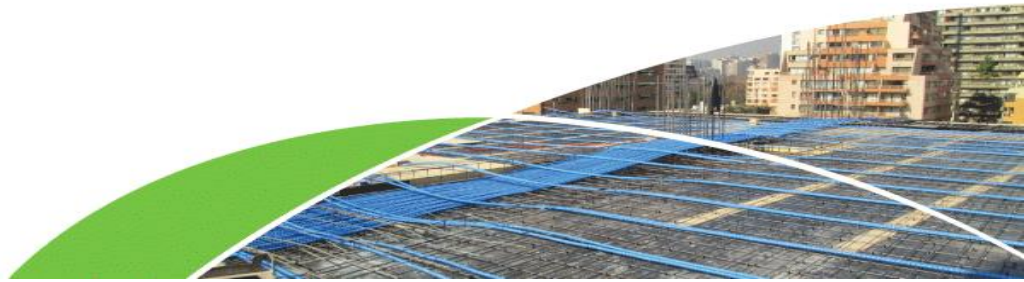
Equipos de Postensado



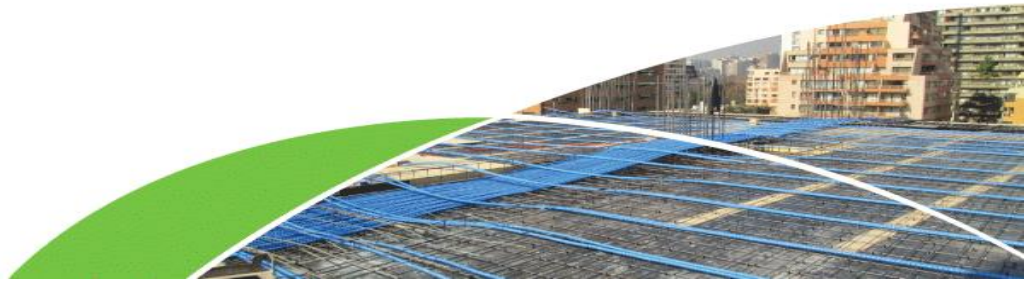
Pérdidas de Presfuerzo

- Transferencia y asentamiento de cuñas

Seating losses

- Acortamiento elástico del hormigón
- Creep
- Shrinkage
- Relajación del acero
- Pérdidas por fricción

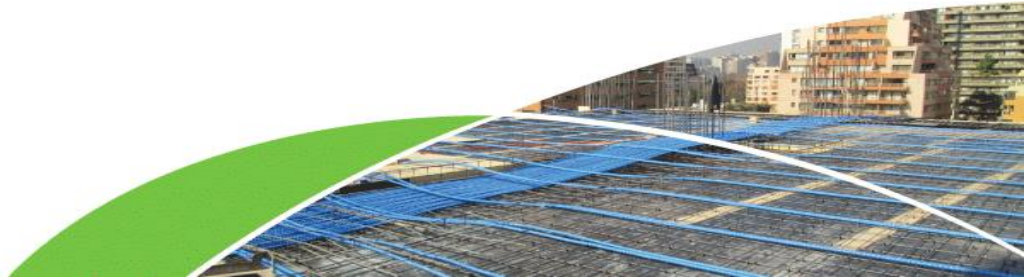
Effective



Diferencia con el hormigón armado Convencional

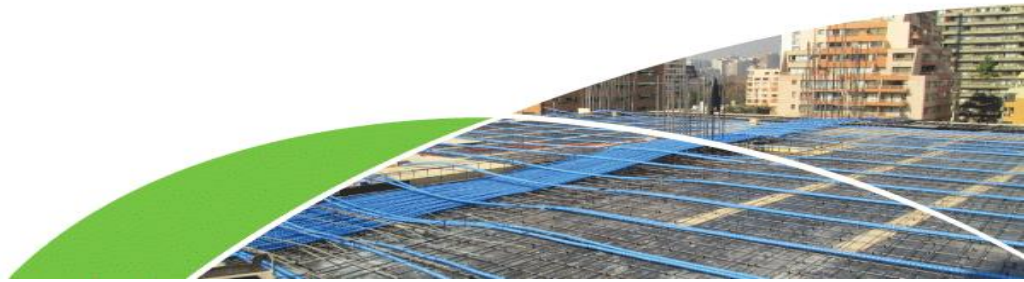
- Hormigón Armado: Se calcula As con una fórmula.

- Postensado: Proceso Iterativo. Algunos Parámetros deben cumplirse.

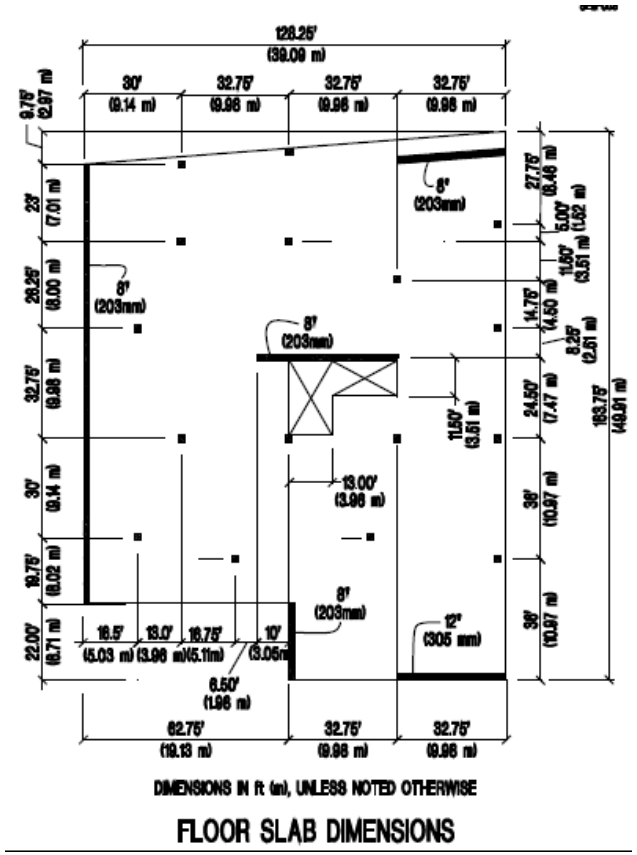


Pasos y etapas de diseño

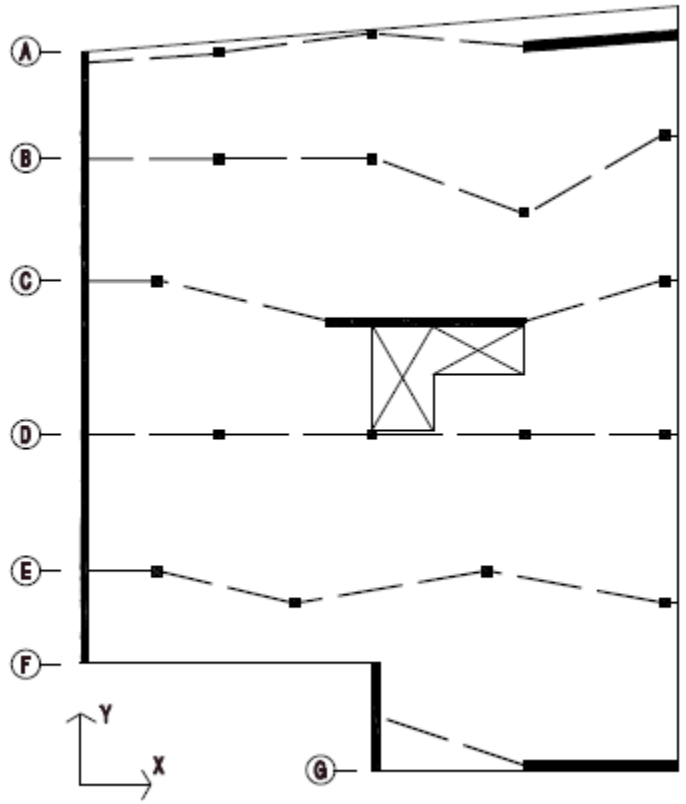
1. Geometría del sistema estructural (Boundary Conditions,material property)
2. Cargas
3. Parámetros de Diseño
4. Parámetros de Postensado
5. Revisión para servicio
6. Revisión para resistencia
7. Revisión para deflexiones
8. Planos



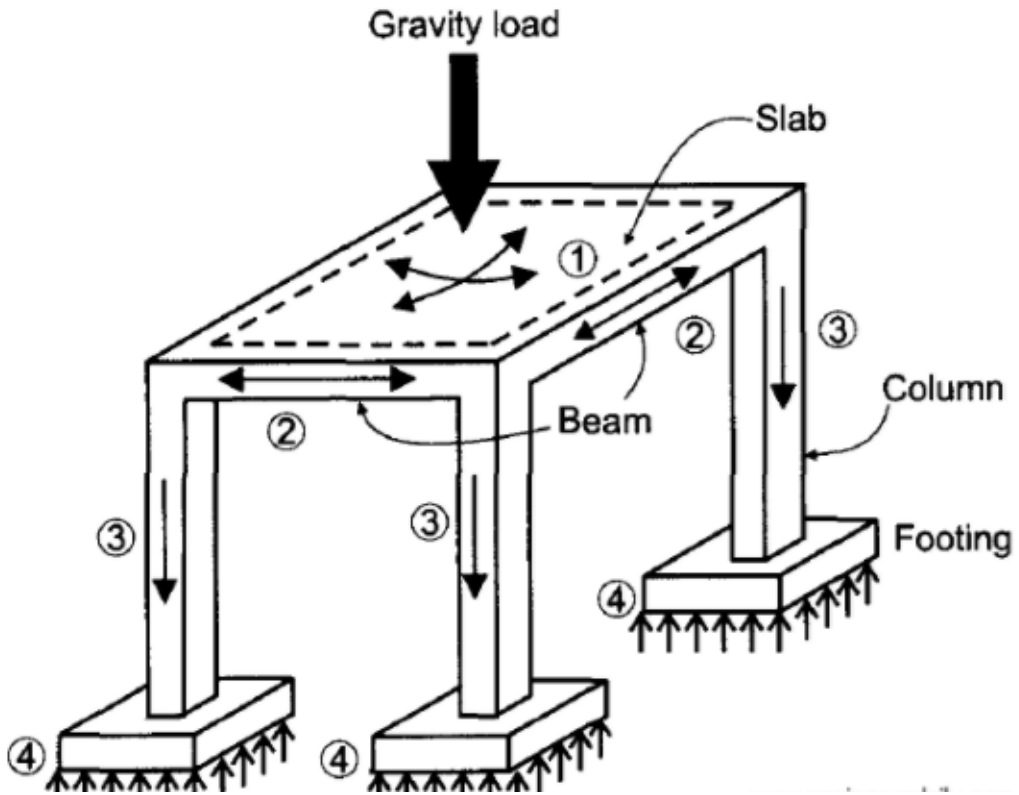
Geometry, Material Properties, Geometry



FLOOR SLAB DIMENSIONS



Cargas



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Parámetros :Normas requeridas

An ACI Standard and Report

Building Code Requirements for Structural Concrete (ACI 318-14)

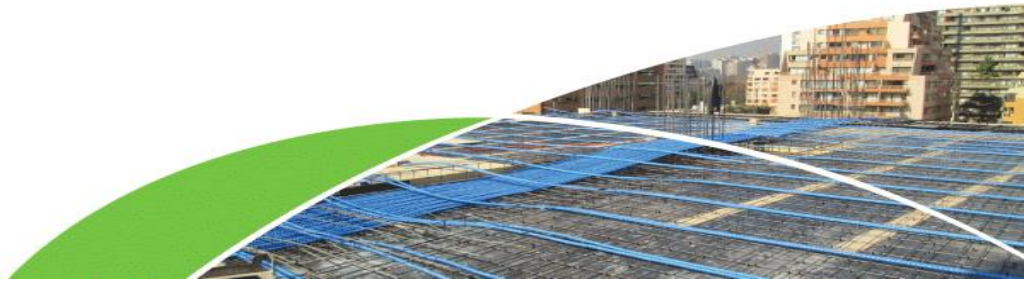
Commentary on Building Code Requirements for Structural Concrete (ACI 318R-14)

Reported by ACI Committee 318

ACI 423.3R-05

Recommendations for Concrete Members Prestressed with Unbonded Tendons

Reported by ACI Committee 423



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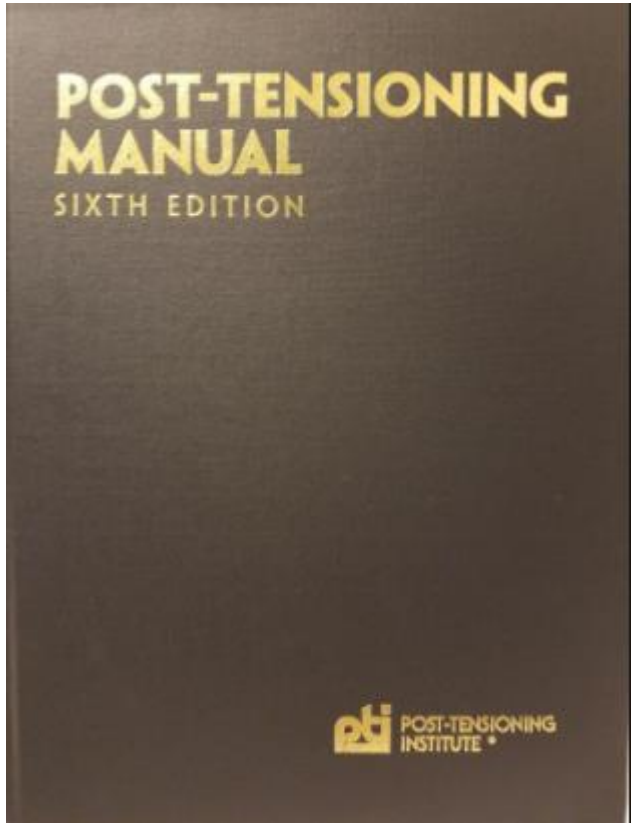
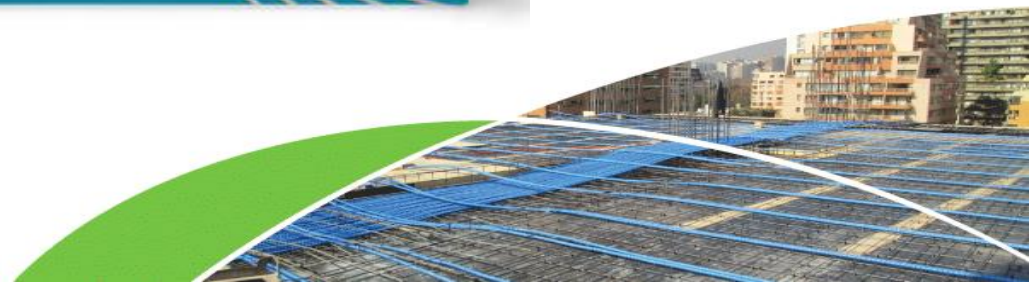
Soporte

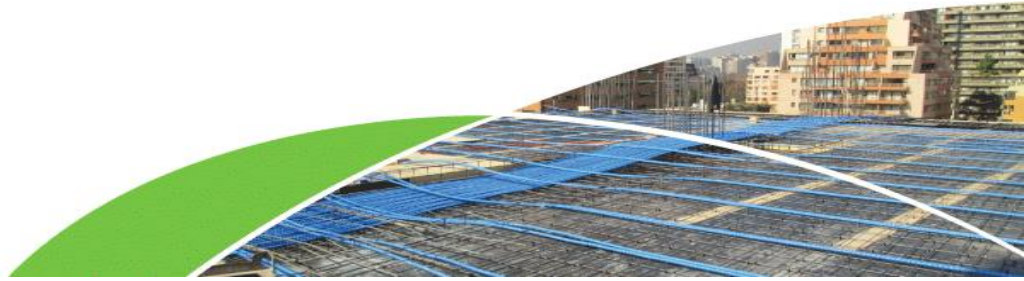




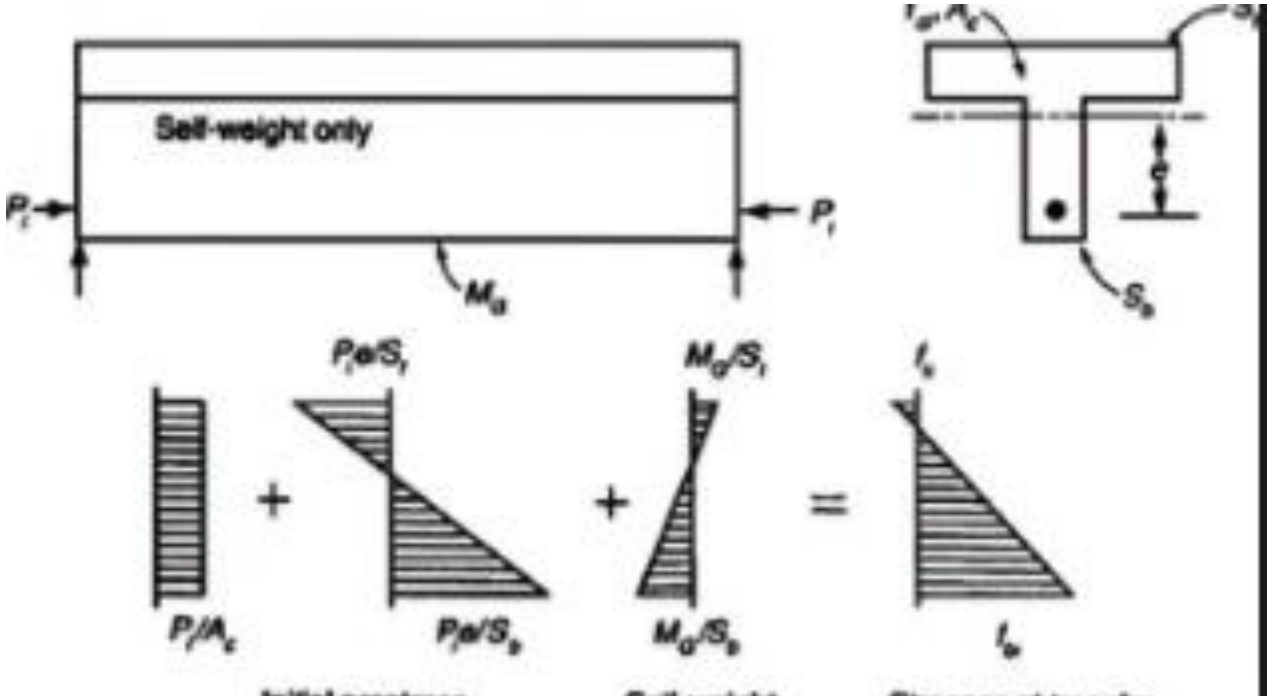
Etapas del revisión -Servicio

- Initial (Jacking Stress)
- Sustained
- Total

- Tomar en cuenta pérdidas



Cálculo de esfuerzos



$$\sigma = (M_D + M_L + M_{PT})/S + P/A$$

Esfuerzos -Initial Condition

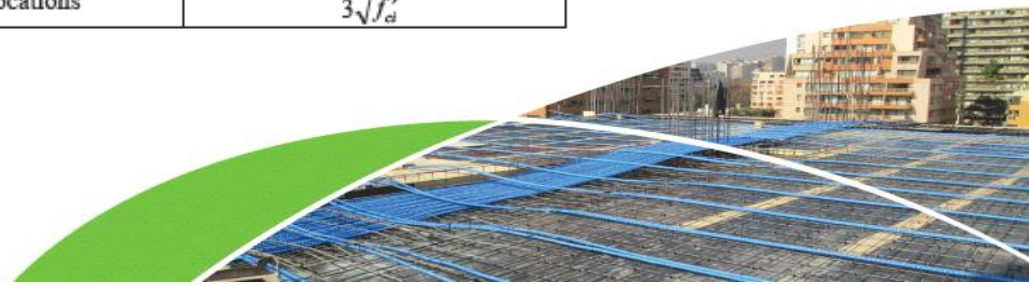
1.0*D+0.0*L+1.15PT

Table 24.5.3.1—Concrete compressive stress limits immediately after transfer of prestress

Location	Concrete compressive stress limits
End of simply-supported members	$0.70f_{ci}'$
All other locations	$0.60f_{ci}'$

Table 24.5.3.2—Concrete tensile stress limits immediately after transfer of prestress, without additional bonded reinforcement in tension zone

Location	Concrete tensile stress limits
Ends of simply-supported members	$6\sqrt{f_{ci}'}$
All other locations	$3\sqrt{f_{ci}'}$

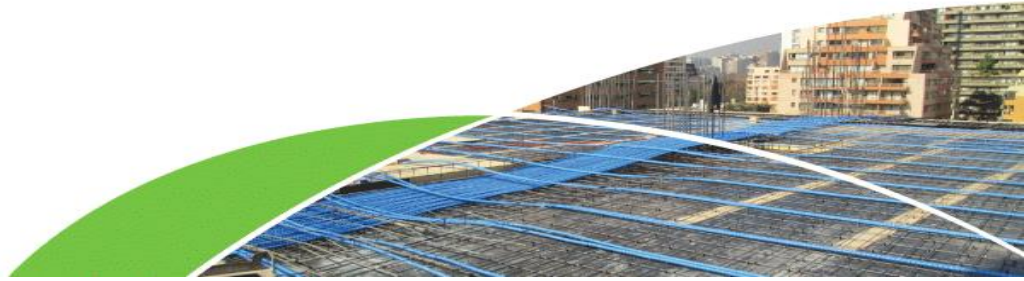


Esfuerzos -Sustained

1.0*D+0.3*L+1.0PT

Table 24.5.4.1—Concrete compressive stress limits at service loads

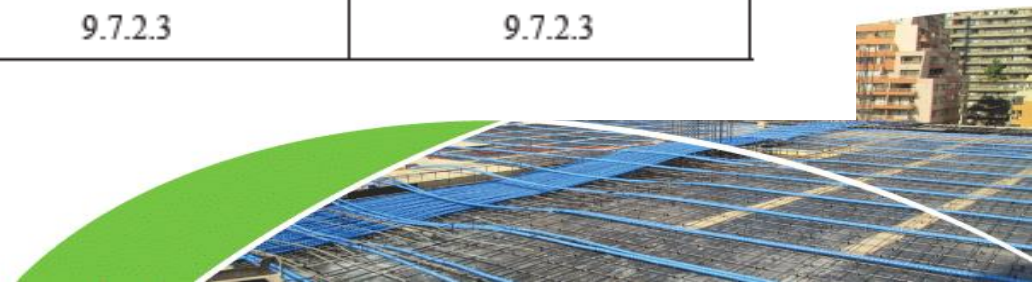
Load condition	Concrete compressive stress limits
Prestress plus sustained load	$0.45f_c'$
Prestress plus total load	$0.60f_c'$



Parámetros: Esfuerzos permitidos-Carga Total

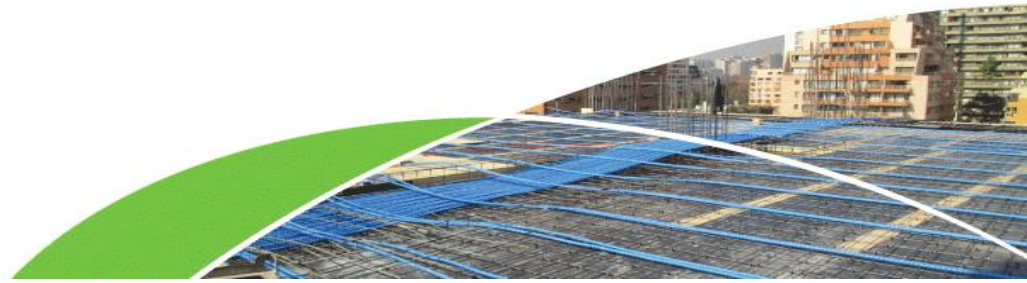
Table R24.5.2.1—Serviceability design requirements

	Prestressed			Nonprestressed
	Class U	Class T	Class C	
Assumed behavior	Uncracked	Transition between uncracked and cracked	Cracked	Cracked
Section properties for stress calculation at service loads	Gross section 24.5.2.2	Gross section 24.5.2.2	Cracked section 24.5.2.3	No requirement
Allowable stress at transfer	24.5.3	24.5.3	24.5.3	No requirement
Allowable compressive stress based on uncracked section properties	24.5.4	24.5.4	No requirement	No requirement
Tensile stress at service loads 24.5.2.1	$\leq 7.5\sqrt{f'_c}$	$7.5\sqrt{f'_c} < f_t \leq 12\sqrt{f'_c}$	No requirement	No requirement
Deflection calculation basis	24.2.3.8, 24.2.4.2 Gross section	24.2.3.9, 24.2.4.2 Cracked section, bilinear	24.2.3.9, 24.2.4.2 Cracked section, bilinear	24.2.3, 24.2.4.1 Effective moment of inertia
Crack control	No requirement	No requirement	24.3	24.3
Computation of Δf_{ps} or f_s for crack control	—	—	Cracked section analysis	$M/(A_s \times$ lever arm), or $2/3 f_y$
Side skin reinforcement	No requirement	No requirement	9.7.2.3	9.7.2.3



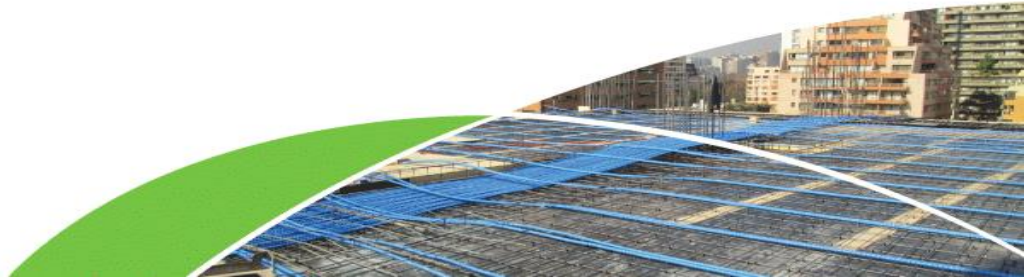
Esfuerzos –Carga total

ACI 318-02 requires that two-way prestressed slab systems be designed as Class U, with a maximum permissible concrete flexural tensile stress of $7.5\sqrt{f'_c}$ psi ($0.62\sqrt{f'_c}$ MPa) under service loads. Before ACI 318-02, two-way prestressed slab systems were limited to a maximum service load concrete stress of $6\sqrt{f'_c}$ psi ($0.5\sqrt{f'_c}$ MPa). Designers should carefully evaluate the ramifications of increased service load cracking at the tops of columns in two-way prestressed slabs that may result from this 25% increase in permissible flexural tensile stress. Because of limited experience with slabs designed for service load tensile stresses of $7.5\sqrt{f'_c}$ psi ($0.62\sqrt{f'_c}$ MPa), Joint ACI-ASCE Committee 423 recommends limiting this value to $6\sqrt{f'_c}$ psi ($0.5\sqrt{f'_c}$ MPa), except in cases where live loads are infrequently applied, unrealistically high, or both. In these cases, the increase in the permissible service load tensile stresses to $7.5\sqrt{f'_c}$ psi ($0.62\sqrt{f'_c}$ MPa) may be appropriate.



Parámetros de Postensado

1. Esfuerzo Efectivo
2. Average Precompression.
3. Porcentaje de Carga Balanceada.
4. Perfil del Tendón.



Esfuerzo Efectivo

- Se le considera después de todas las pérdidas

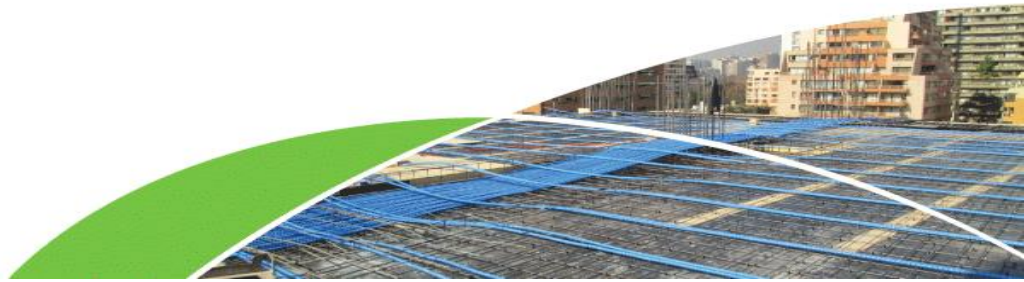
For unbonded tendons:

f_{se} =175 ksi (1206.59 MPa)

For unbonded tendons

Force per tendon = 175 ksi * 0.153 in^2 = 26.77 kips/tendon (119.08 kN/tendon)

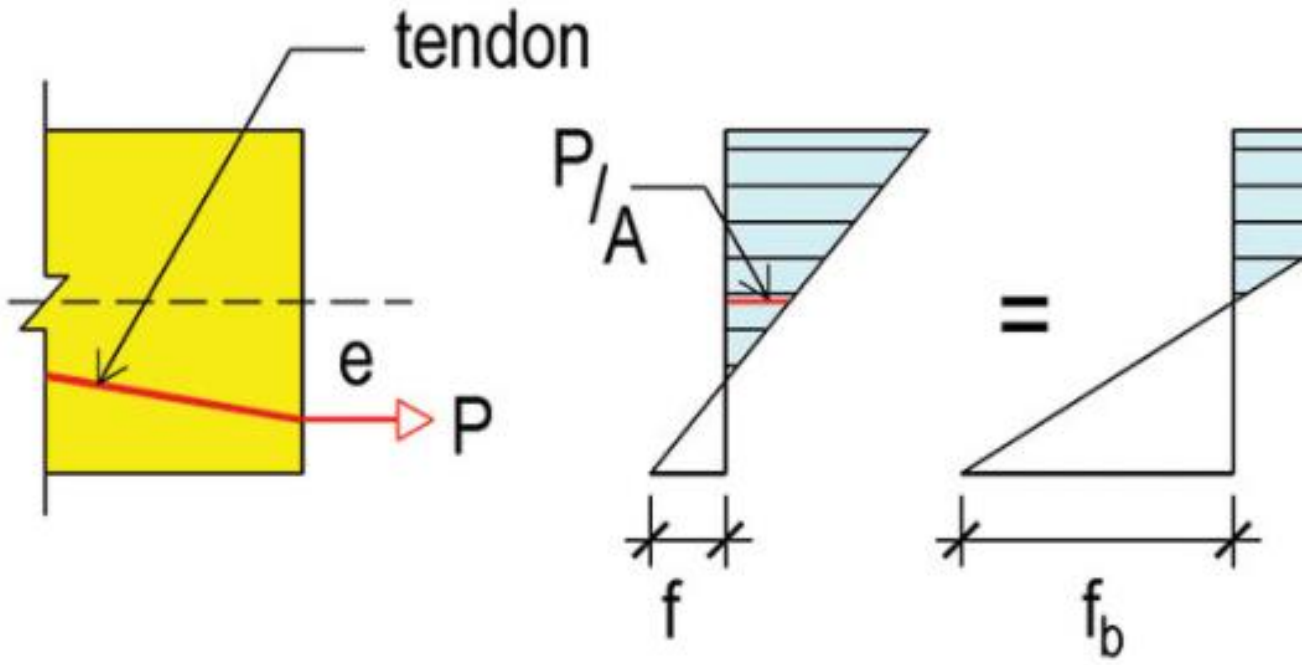
Use multiples of 26.77 kips (119.08 kN) when selecting the post-tensioning forces for design.



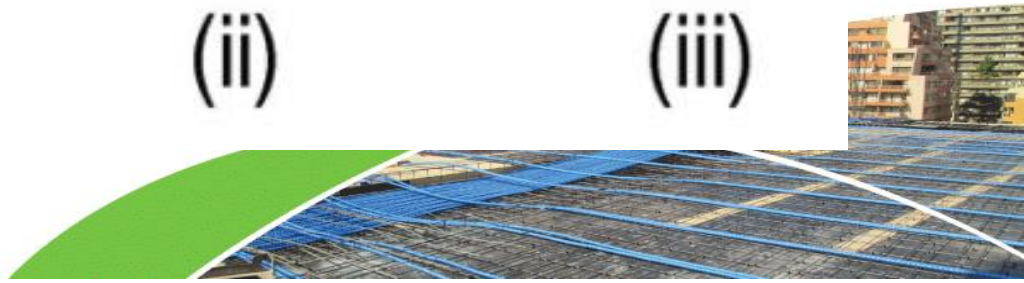
Precompresión Media

- Fuerza total dividido para el área perpendicular a la fuerza.

- **Máximo 275 psi(2.50 MPa)**

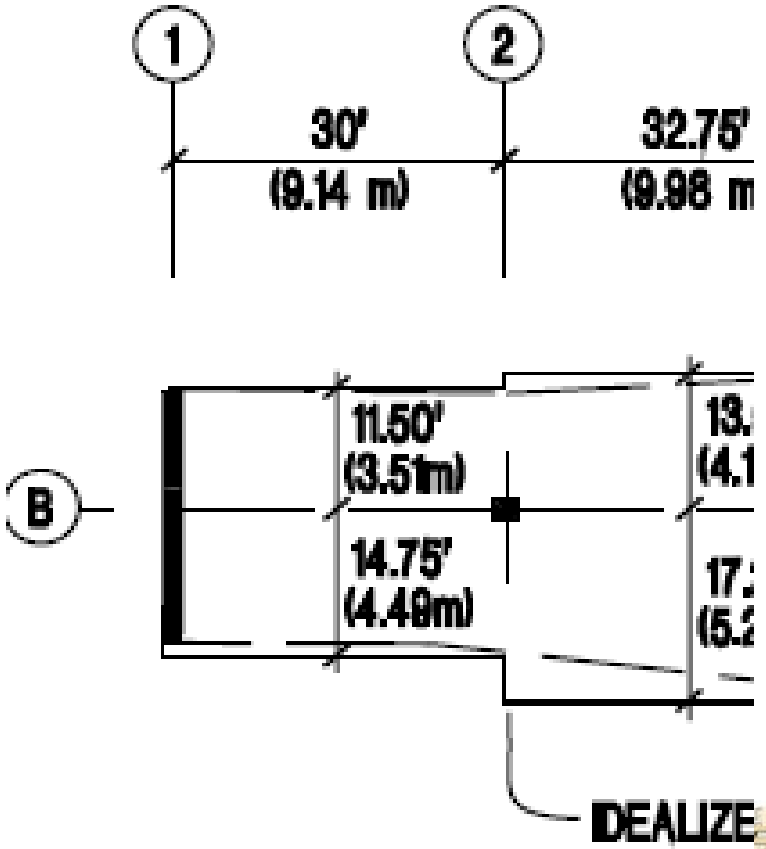


- **Mínimo 125 psi (0.85MPa)**

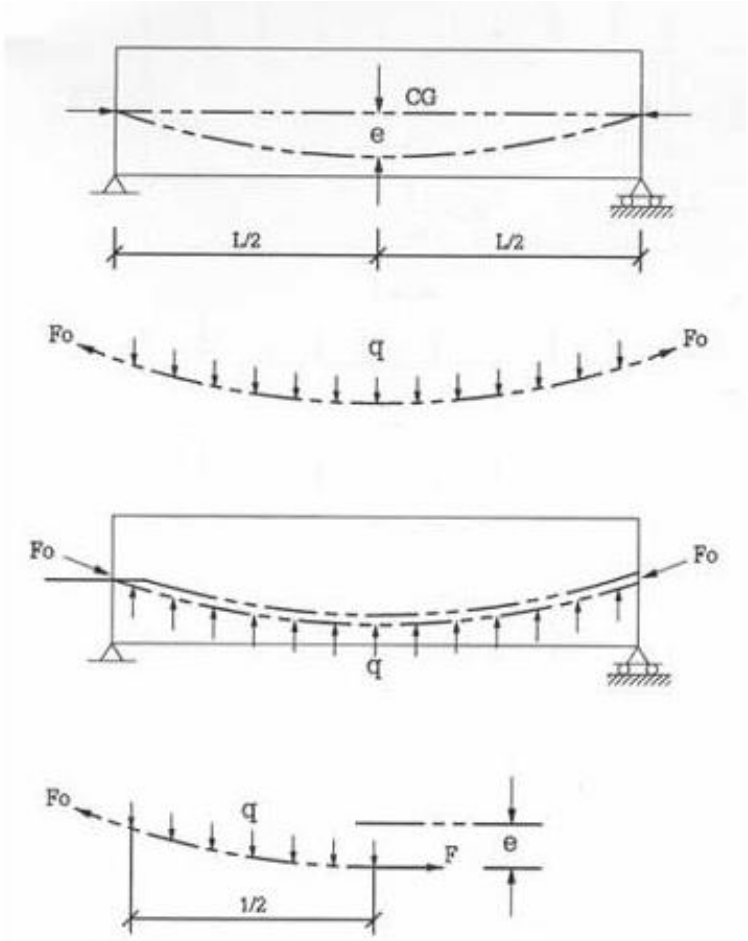


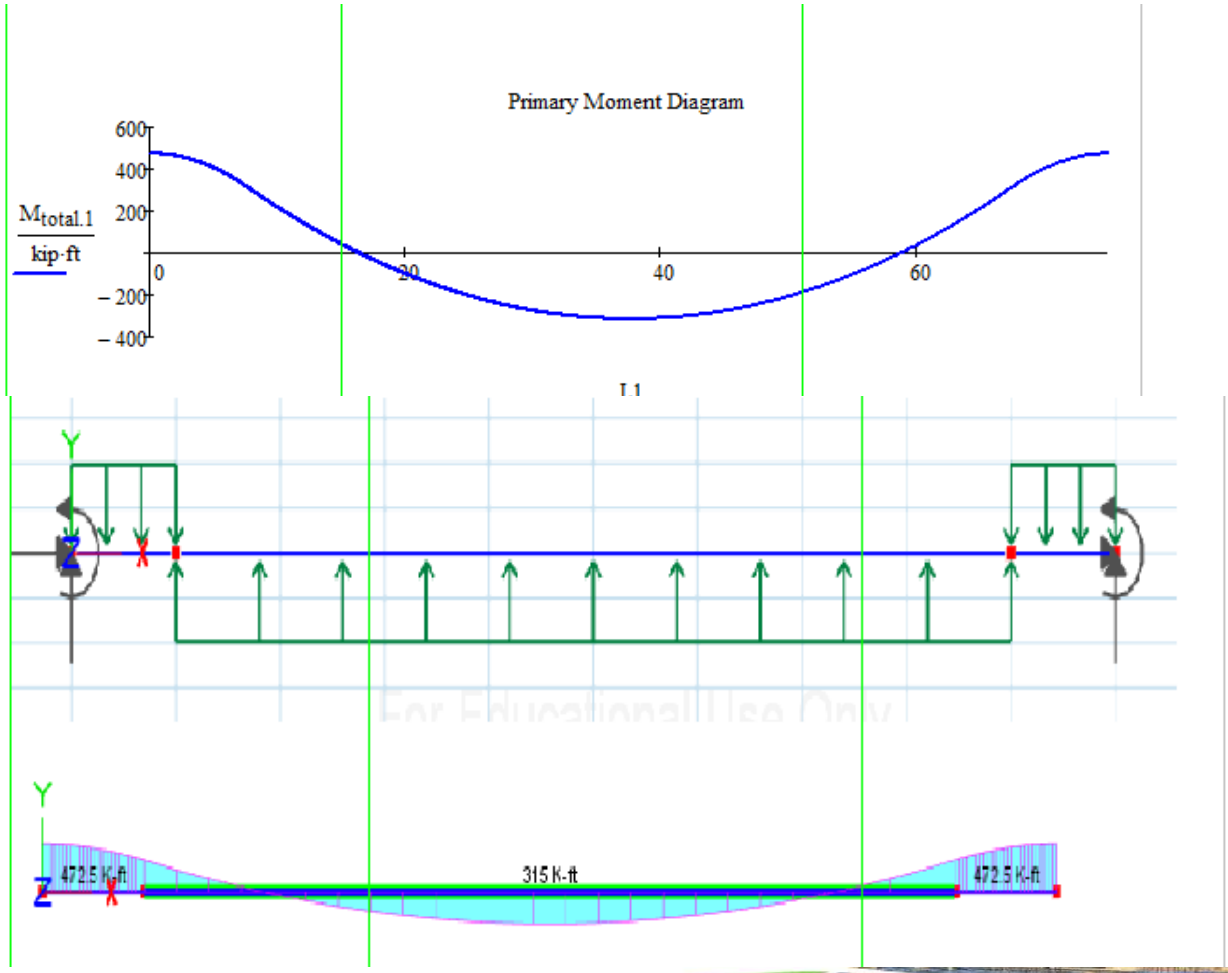
Ejemplo: Cálculo de Número de tendones

- Asumimos una precompresión: 150 psi
- Multiplicamos por el área de la sección transversal.Esa es la fuerza total.
- Fuerza total/ Fuerza de cada Tendon (26.77 kips)



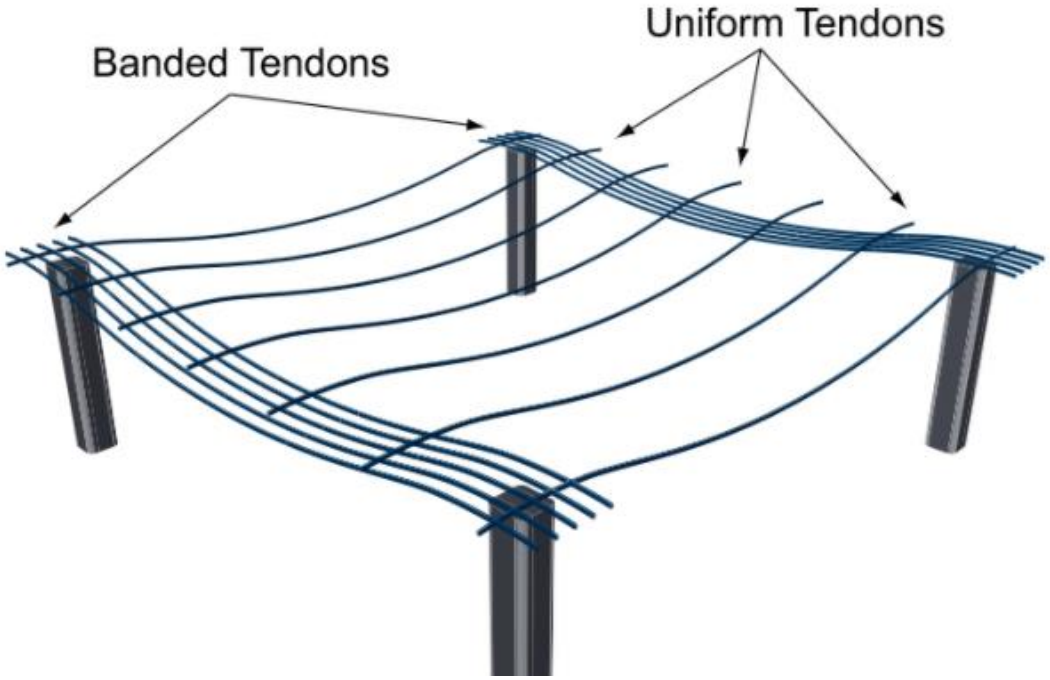
Porcentaje de Carga Balanceada

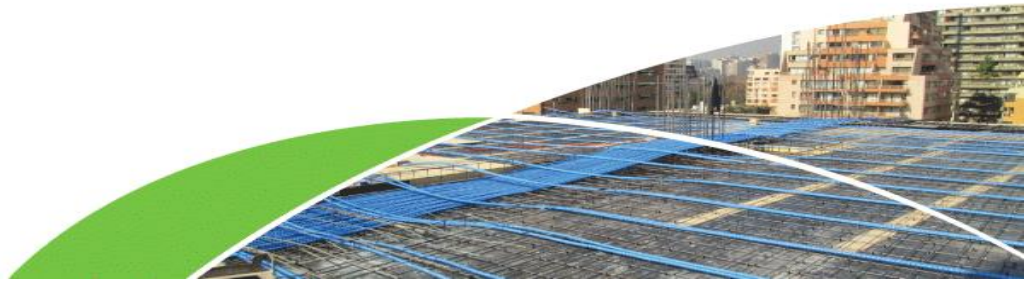




Porcentaje de Carga Balanceada

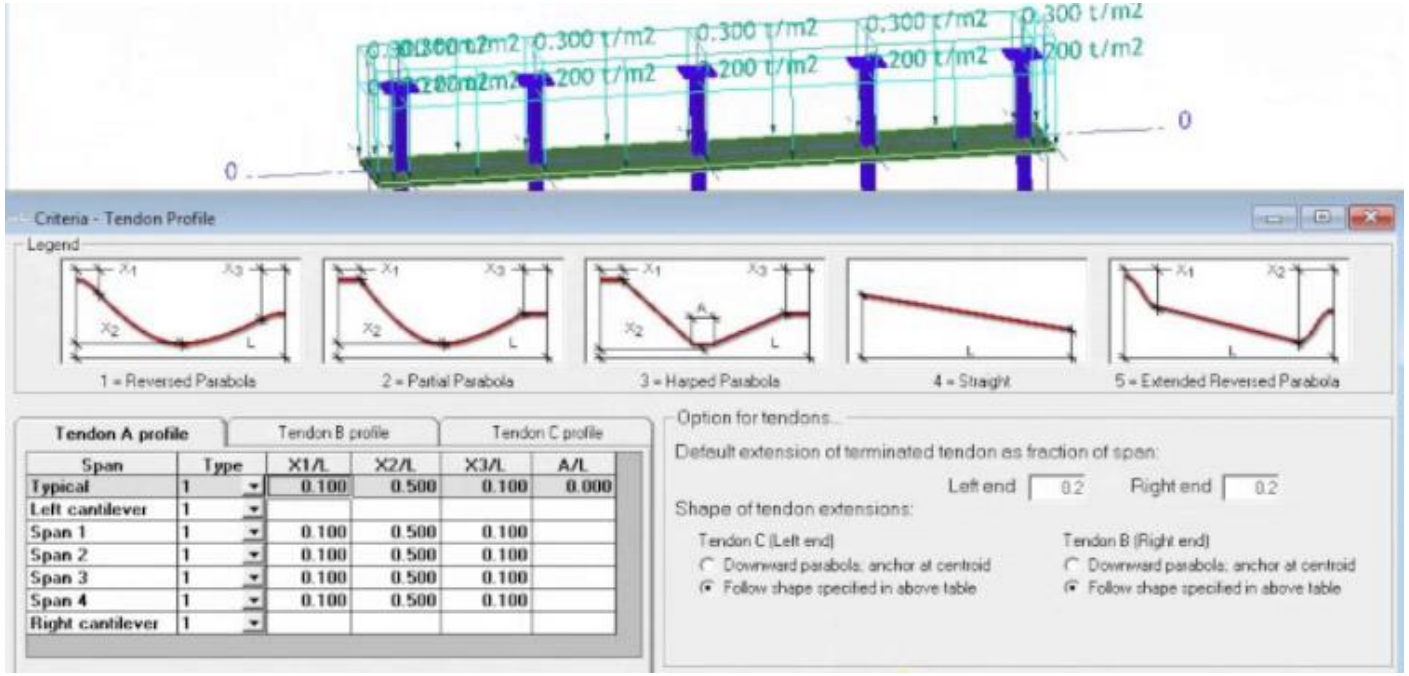
- Para losas es normal tener entre un 60% y un 80 % de balanceo.

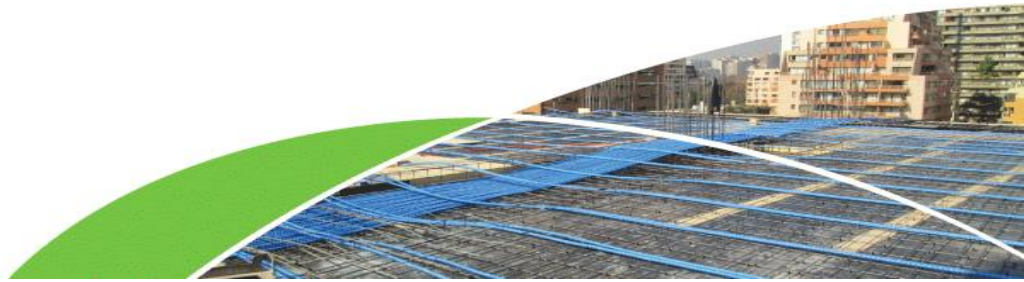




Perfil del Tendón

- L/10
- Eccentricidad





Resistencia Flexión

$$f_{ps}\,(\text{psi}) = f_{se} + 10{,}000 + \frac{f'_c}{300\rho_p} \le f_{se} + 30{,}000 \qquad (3\text{-}6)$$

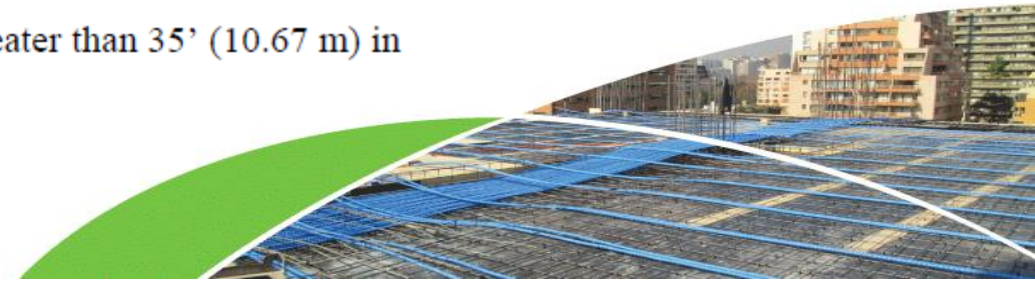
$$f_{ps}\,(\text{MPa}) = f_{se} + 70 + \frac{f'_c}{300\rho_p} \le f_{se} + 200 \qquad (3\text{-}6)\ \text{SI}$$

- f_{ps} is conservatively assumed to be 215 ksi (1482 MPa) if span is less than 35' (10.67 m) in slabs

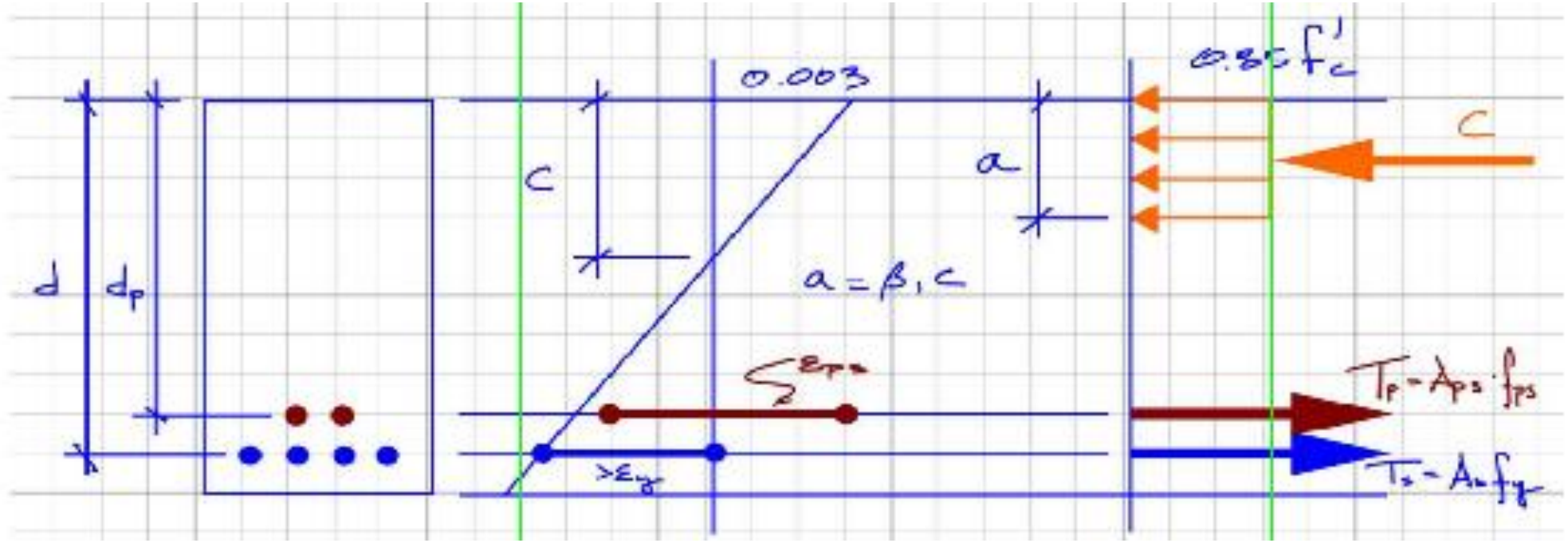
  f_{ps} is conservatively assumed to be 195 ksi (1344 MPa) if span is greater than 35' (10.67 m) in slabs

  f_{ps} is conservatively assumed to be 205 ksi (1413 MPa) if span is less than 35' (10.67 m) in beams

  f_{ps} is conservatively assumed to be 190 ksi (1310 MPa) if span is greater than 35' (10.67 m) in beams



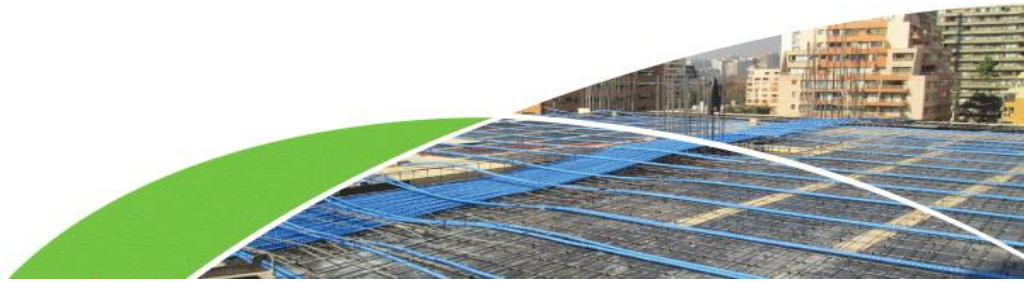
Resistencia Flexión



Fórmulas para Momento

$$a = \frac{f_{ps} \cdot A_{ps} + f_y \cdot A_s}{0.85 \cdot f'_c \cdot b} \quad ;$$

$$\phi Mn = 0.9\left[f_{ps} \cdot A_{ps} \cdot \left(d_p - \frac{a}{2} \right) + f_y \cdot A_s \cdot \left(d - \frac{a}{2} \right) \right]$$



Refuerzo Mínimo (Acero corrugado)

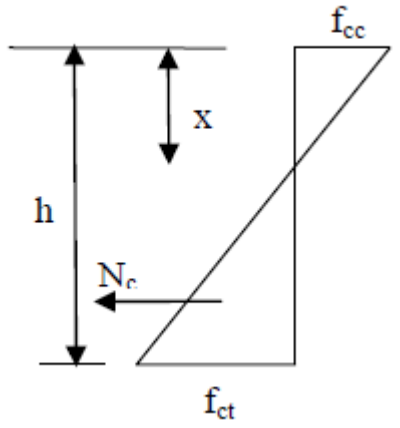
Momento Negativo

$A_s = 0.00075 * A_{cf}$

Where, A_{cf} is the larger gross cross-sectional area of the design strips of the two orthogonal slab frames intersecting at the column in question.

Momento Positivo

$A_s = N_c / (0.5 * f_y)$



Deformación

Total deflection from Quasi Permanent load combination - L/250

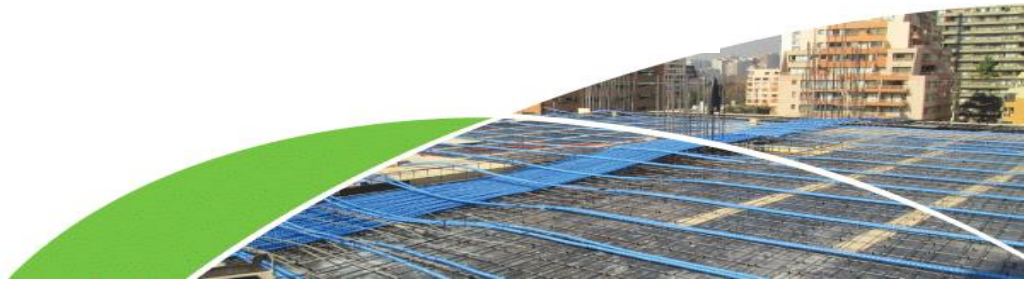
Where, L is the length of the span.

Deflection subsequent to installation of construction that can be damaged from load combination

Quasi-permanent L/500

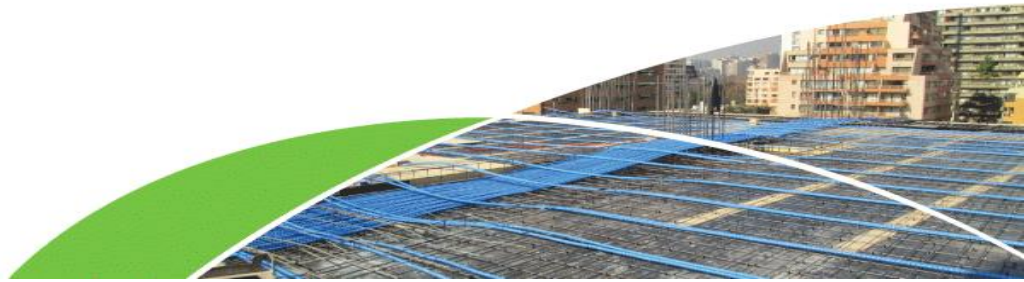
Brittle partitions are assumed to have been installed 60 days subsequent to date of casting the slab.

Deflection does not generally govern the design for members dimensioned within the limits of the recommended tables [PTI 1990] and balanced within the recommended range, and when subject to loading common in building construction. For such cases, deflections are practically always within the permissible code values.



Planos

- Plano Estructural
- Plano de tendones
- Plano de trayectorias
- Plano de acero de refuerzo fy:4200 kg/cm2
- Planos de detalles



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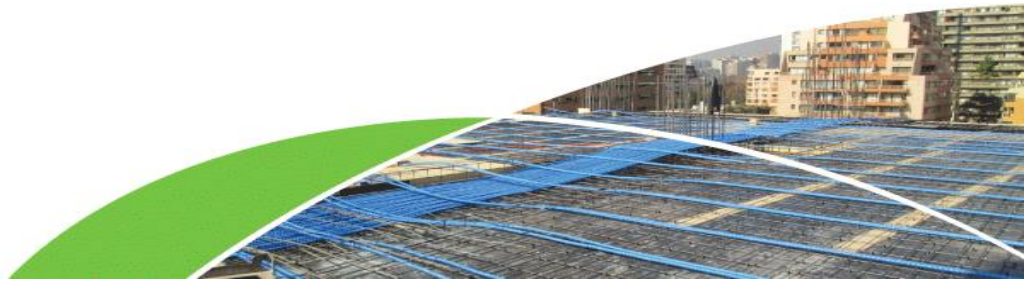
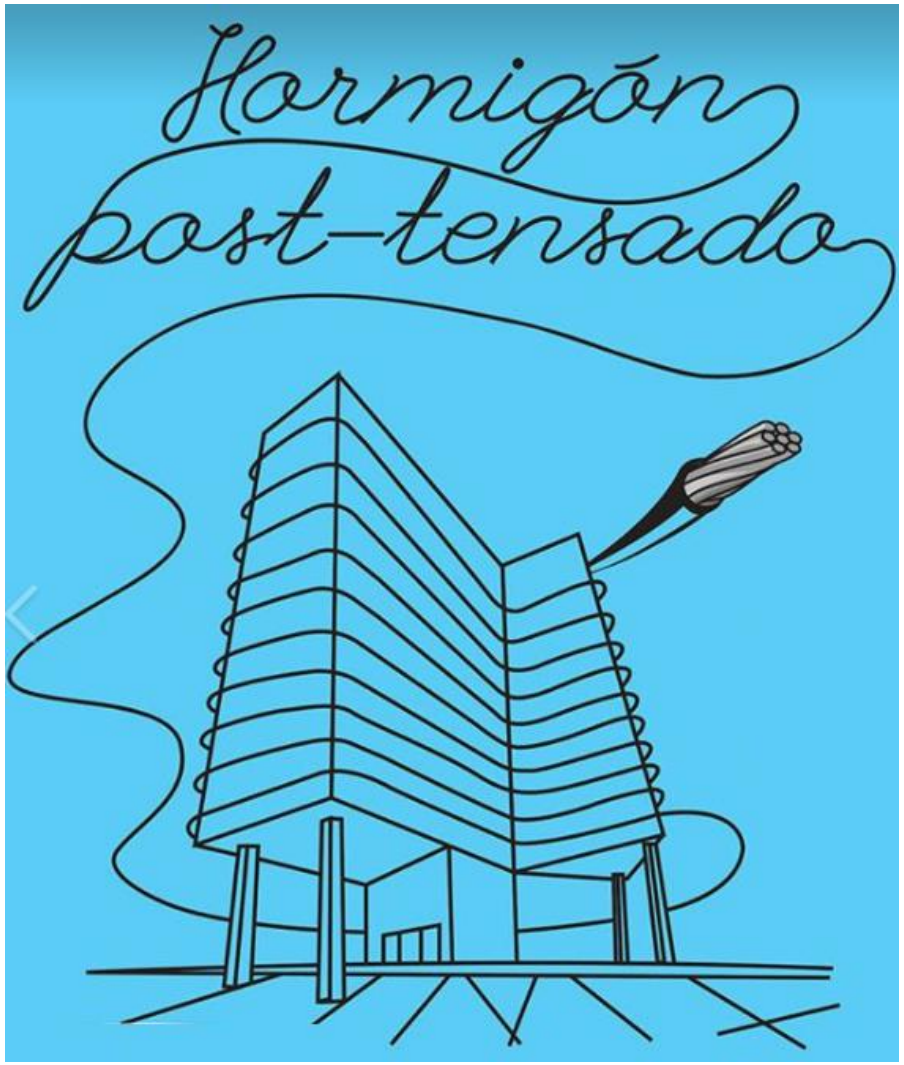


CONSTRUCCIONES DEL PACÍFICO
Pacificonstruye S.A.

PT POST-TENSIONING SYSTEMS



Gracias

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