


ESCOLA Politécnica UNISINOS  
Somos infinitas possibilidades

**Especialização em Patologia e Perícia das Construções**

**Acidente. Miami. Lições**  
*Horário: Sexta-feira das 18h45 às 22h45*



**Paulo Helene**  
*Diretor PhD Engenharia  
Presidente e Conselheiro Permanente IBRACON  
Prof. Titular Universidade de São Paulo  
Gestor e Ex-Presidente ALCONPAT Internacional  
Member fib(CEB-FIP) Model Code for Service Life Design  
Conselheiro da CNTU e SEESP*

UNISINOS 30 de julho de 2021 São Paulo/SP

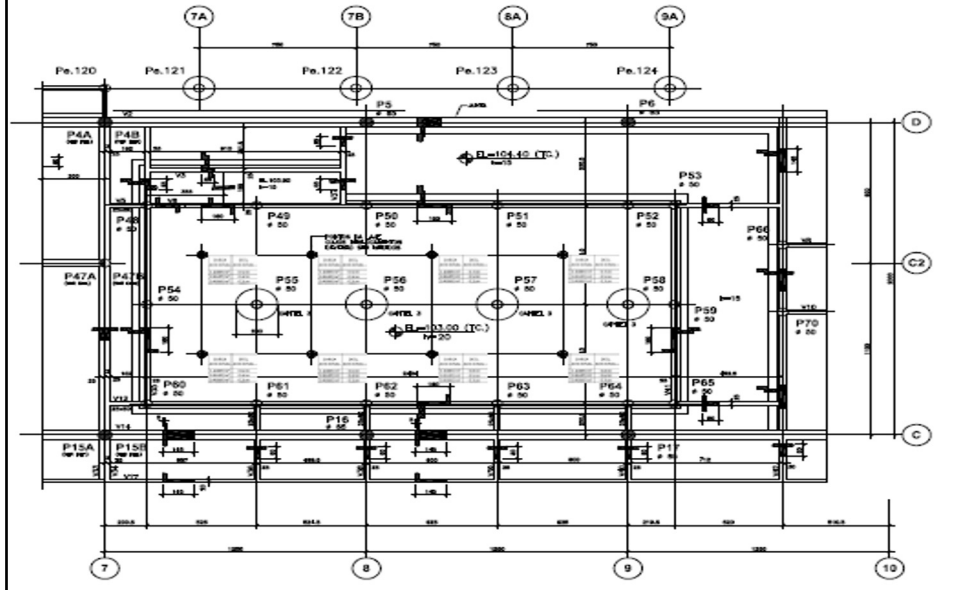
1



2

## **Pileta Centro Esportivo**

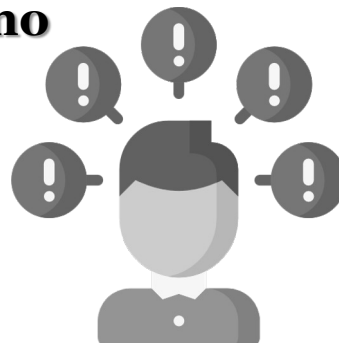
### **Prueba de Carga realizada en junio de 2017**



3

## **Problema**

**La revisión del diseño estructural, ATP (análise técnica de projeto) apuntó que hay problemas de cálculo en la losa de fondo. Projectista no concordó y decidimos una prueba de carga realizada en junio de 2017.**



4



5



6



7



8



9



10

Paulo Helene

**MANUAL**

**PARA REPARO,**

**REFORÇO E**

**PROTEÇÃO DE**

**ESTRUTURAS**

**DE CONCRETO**

**Punção**

**Manifestação Típica**



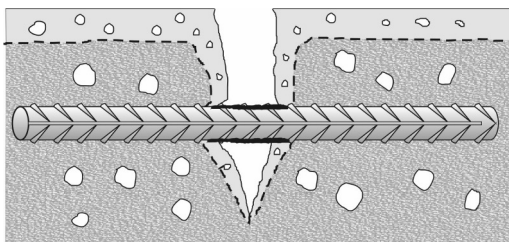
Projeto de Divulgação Tecnológica

PINI

FOSROC

11

**Fissuração y Carbonatación y Cloruro**



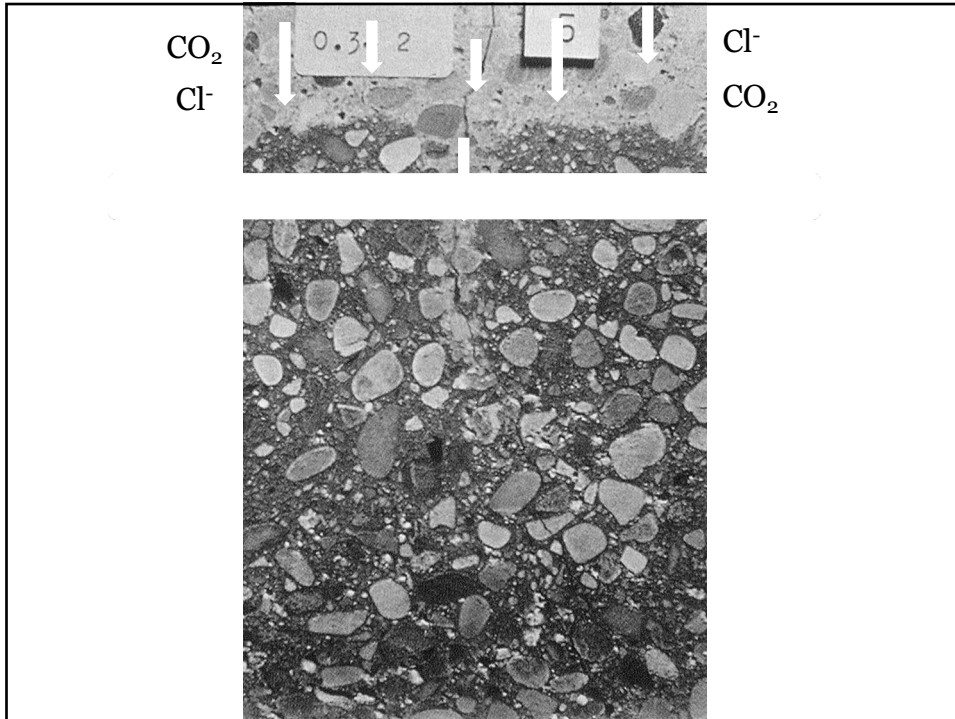
espesura carbonatada

$w_k$  piezas a flexion  $\gamma_F = 1$

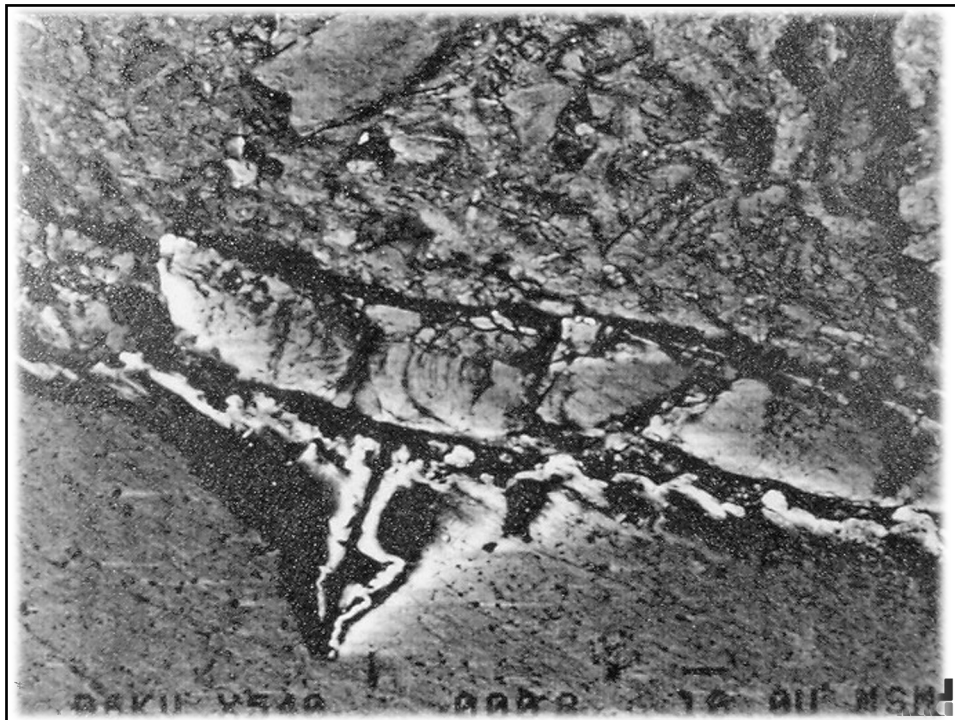
0,1 , 0,2 , 0,3 y 0,40 mm

→ vida útil  $\geq 50$  años!

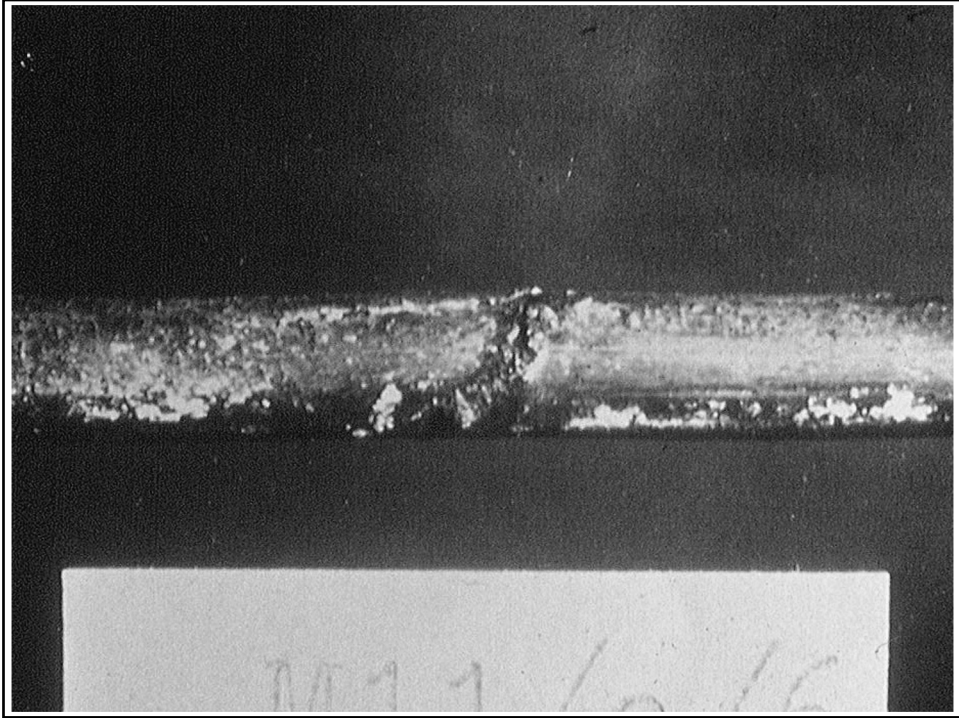
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18



19

19/07/2016 09h49 - Atualizado em 19/07/2016 19h32

**Área de lazer em condomínio de luxo desaba e porteiro é achado morto**

Drone mostra o estrago no Grand Parc, na Enseada do Suá, em Vitória. Suspeita é de vazamento de gás, segundo Corpo de Bombeiros.

Viviane Machado e Victoria Varejão  
Do G1 ES

FACEBOOK TWITTER G+ PINTEREST



As torres do condomínio de luxo Grand Parc Residencial Resort, na Enseada do Suá, em Vitória, foram esvaziadas após toda a **área de lazer desabar, na manhã desta terça-feira (19)**. Quatro pessoas ficaram feridas e **um porteiro ficou desaparecido até as 17h. Ele foi encontrado morto**. O desabamento aconteceu por volta de 3h.

20

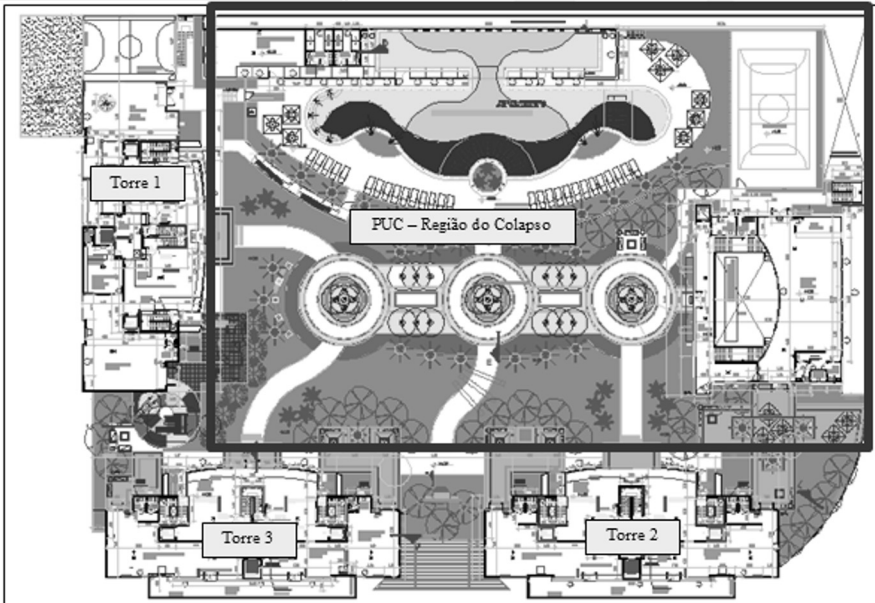


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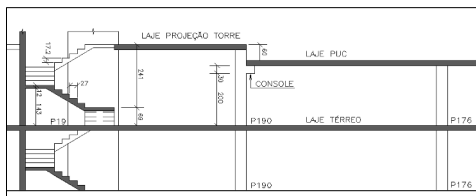
22

- Data: 19/07/2016 (03 h;
- 6 años de edad



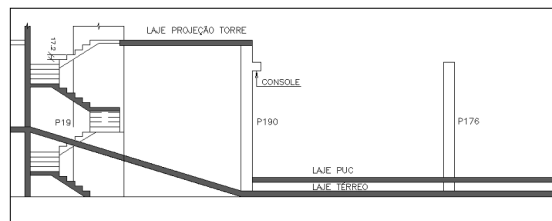
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## COLAPSO ESTRUTURAL



Situação antes do colapso

Situação após colapso



24



25



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27



28



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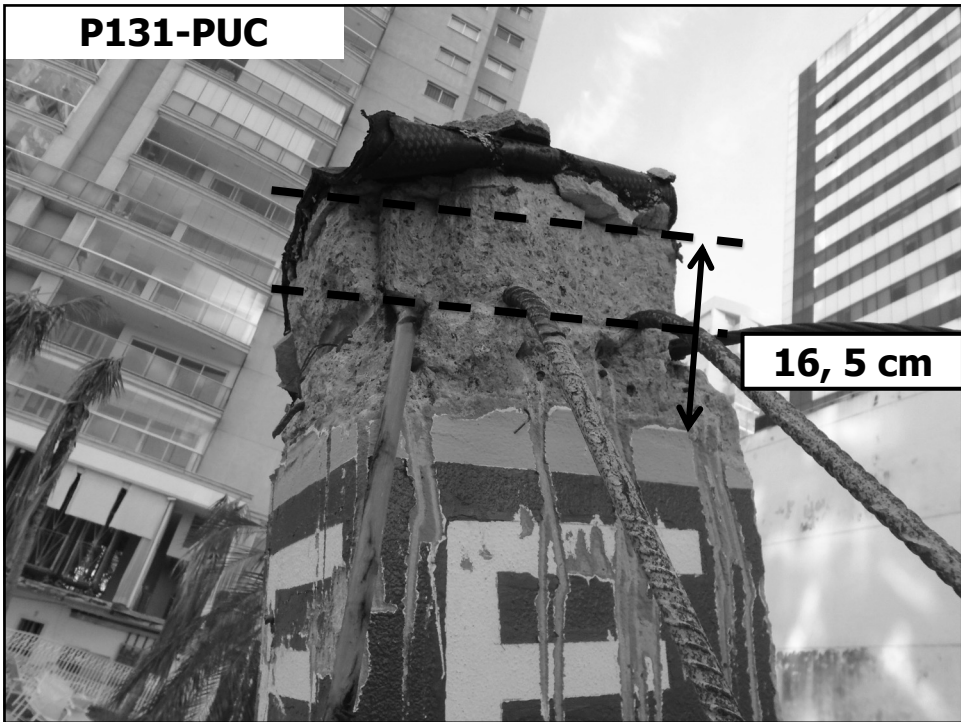
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**P118-PUC**

35



**P133-PUC**

36



37



38



39



40



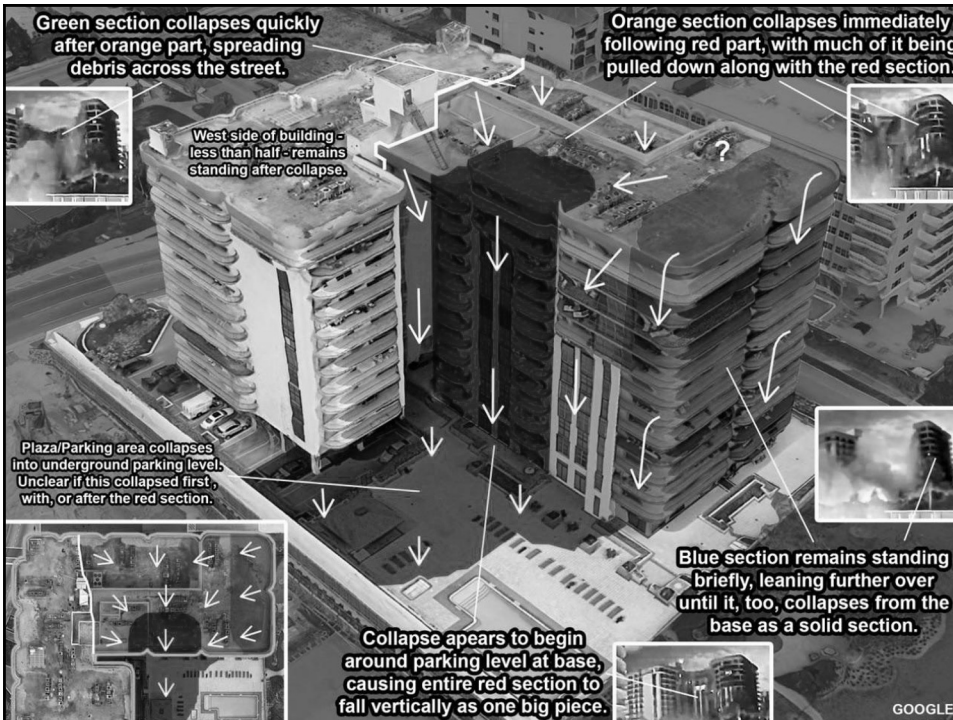
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46



47




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7/1/2021 40 Year Building Recertification Miami | Florida Inspections Unlimited

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## 40 Year Building Recertification Miami

If you own old property in Miami chances are you've heard about 40 year building recertification. The ordinance was enforced in 1975 and then it was replaced in 2001 by the Florida Building Code. The recertification decree applies to buildings within counties in Florida with the exception of small structures, duplexes, and single family homes. Forms are issued by the county and normally sent to individuals along with notice for inspection.

**How does it work?**

40 year recertification requires that buildings in Florida be re-certified for electrical and structural safety every 40 years. Upon expiration of 40 years, the county or city building authority will send out a "Notice

### REQUEST A QUOTE

49



October 8, 2018

Champlain Towers South  
8777 Collins Avenue  
Surfside, FL 33154

Attention: Ms. Maggie Manrara  
Treasurer

**Re: Champlain Towers South Condominium  
Structural Field Survey Report  
MC Job# 18217**

Dear Ms. Manrara:

Morabito Consultants, Inc. (MC) is pleased to submit this structural engineering report of the Field Survey completed at the existing Champlain Towers South Condominium Complex (CTS) in Surfside, FL. The scope of this project includes a review of the existing 12 story plus penthouse 136-unit residential building, below-grade parking garage and at-grade exterior entrance drive, pool and recreation area. MC reviewed a representative sample of ~68 condominium units (half of the total units found in the building) along with the roof, exterior facade (observed from the balconies surveyed), parking garage,

50

O RELATÓRIO DA INSPEÇÃO DA FIRMA "MORABITO CONSULTANTS" DE 2018

DÁ ALGUMAS CLARAS INFORMAÇÕES SOBRE ESSE ITEM

VER NO LINK

[https://www.townofsuffsidefl.gov/docs/default-source/default-document-library/town-clerk-documents/champlain-towers-south-public-records/8777-collins-ave---structural-field-survey-report.pdf?sfvrsn=882a1194\\_2](https://www.townofsuffsidefl.gov/docs/default-source/default-document-library/town-clerk-documents/champlain-towers-south-public-records/8777-collins-ave---structural-field-survey-report.pdf?sfvrsn=882a1194_2)

" The Pool Deck and Entrance Drive areas were reviewed ....

...

Many of the existing pavers on the pool deck are cracked

...

The joint sealant was observed to be beyond its useful life and are in need to complete replacement

...

The failed waterproofing is causing major structural damage to the concrete structural slab below these areas "

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**SU SLAB DEPTH REPAIR**

**SF SLAB FULL-DEPTH REPAIR**

**SE SLAB FULL-DEPTH DECK EDGE REPAIR**

**ST SLAB TOP SURFACE REPAIR**

**CS COLUMN SPALL REPAIR**

**BT BONDED TOPPING TERMINATION**

**EB STRUCTURAL CRACK REPAIR (EPOXY INJECTION)**

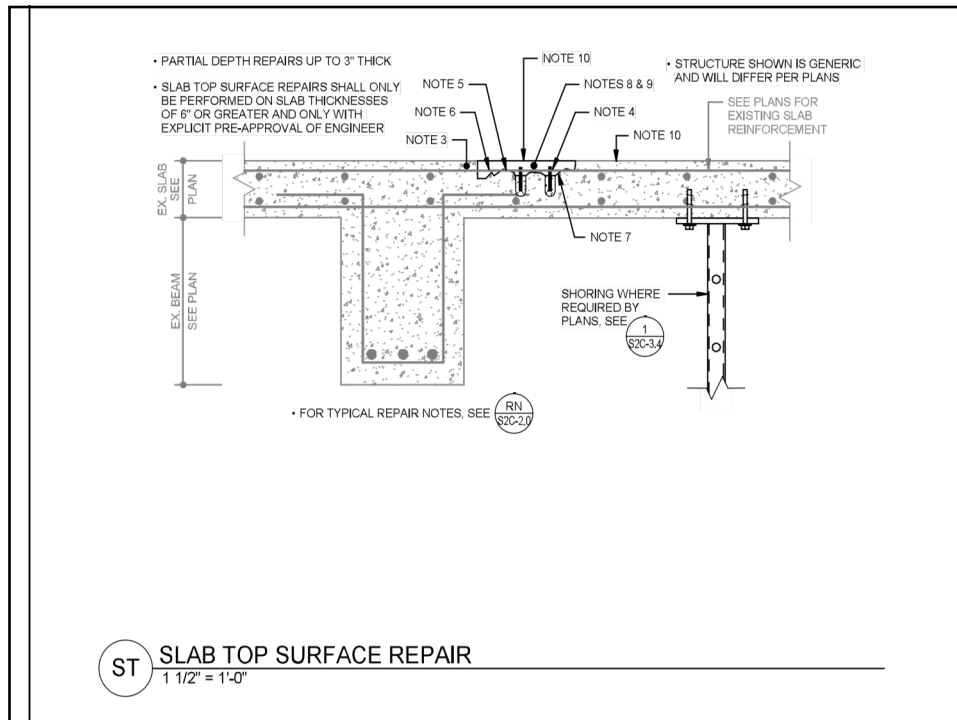
**JS NON-STRUCTURAL CRACK REPAIR (CRACK SEALANT)**

**CHAMPLAIN TOWERS SOUTH CONDOMINIUM REPAIR AND RESTORATION**

**morabito consultants**

Project No. 1807  
 Date: 06/2018  
 Scale: 1/8" = 1'-0"  
 Drawing Title: CONCRETE REPAIR DETAILS  
 Sheet No.: S2C-2.1

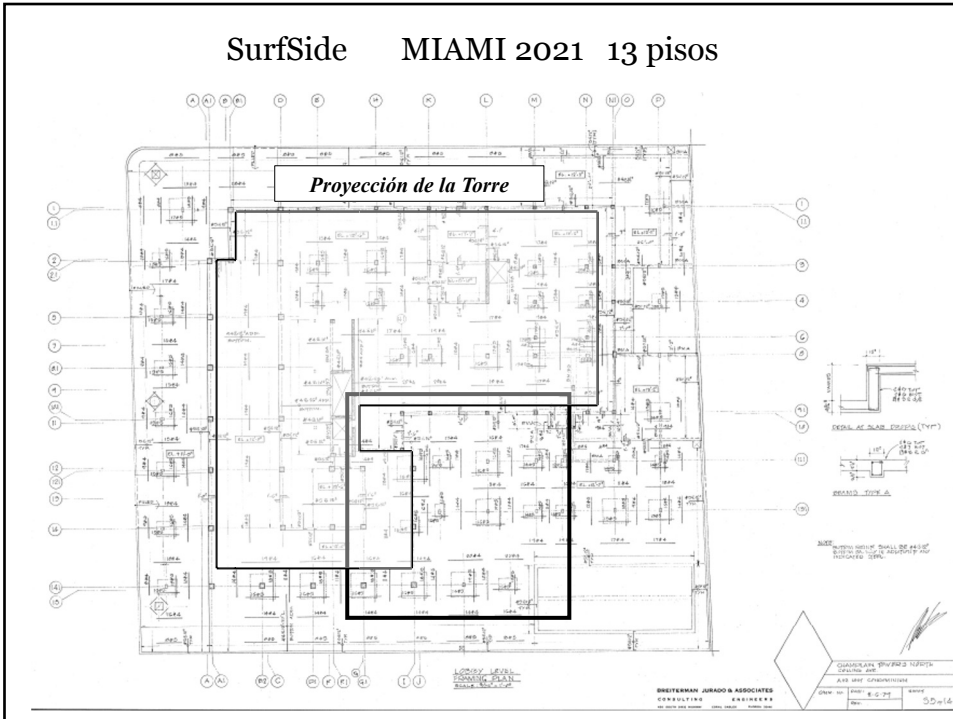
52



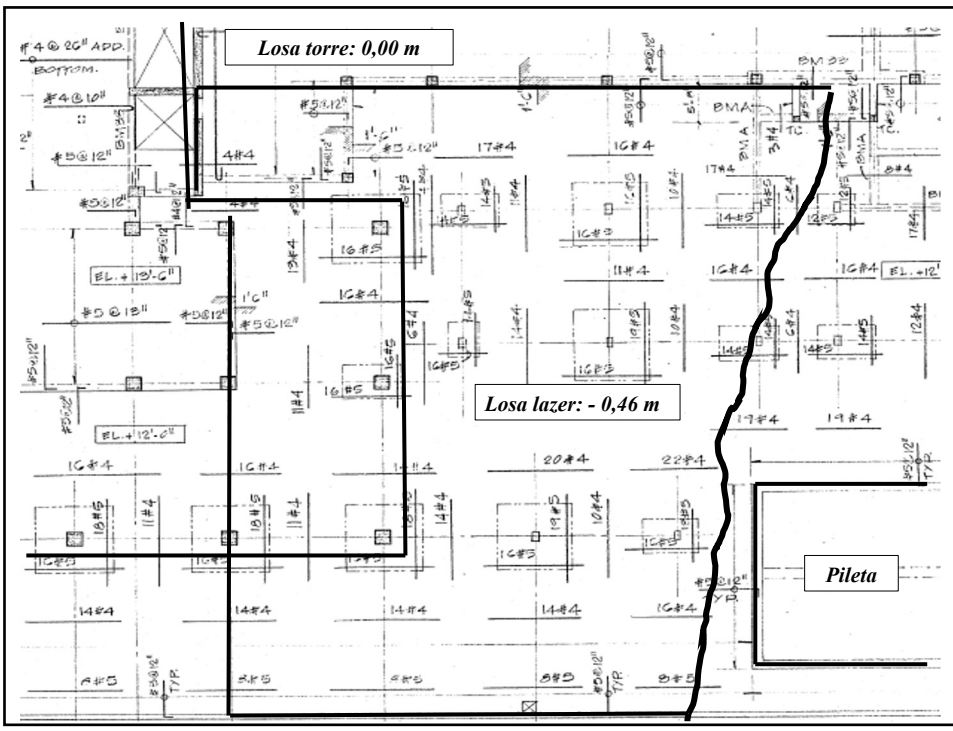
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- ❖ Pacometría - posición de los refuerzos
- ❖ Esclerometria - dureza superficial
- ❖ Ultrasonido - nidos de hormigonado
- ❖ Testigos -  $f_c$  concretos
- ❖ Espesor de la cubierta
- ❖ Espesor de carbonatación
- ❖ Presencia o perfil de cloruros
- ❖ Diseño de grietas
- ❖ Identificación de áreas problemáticas

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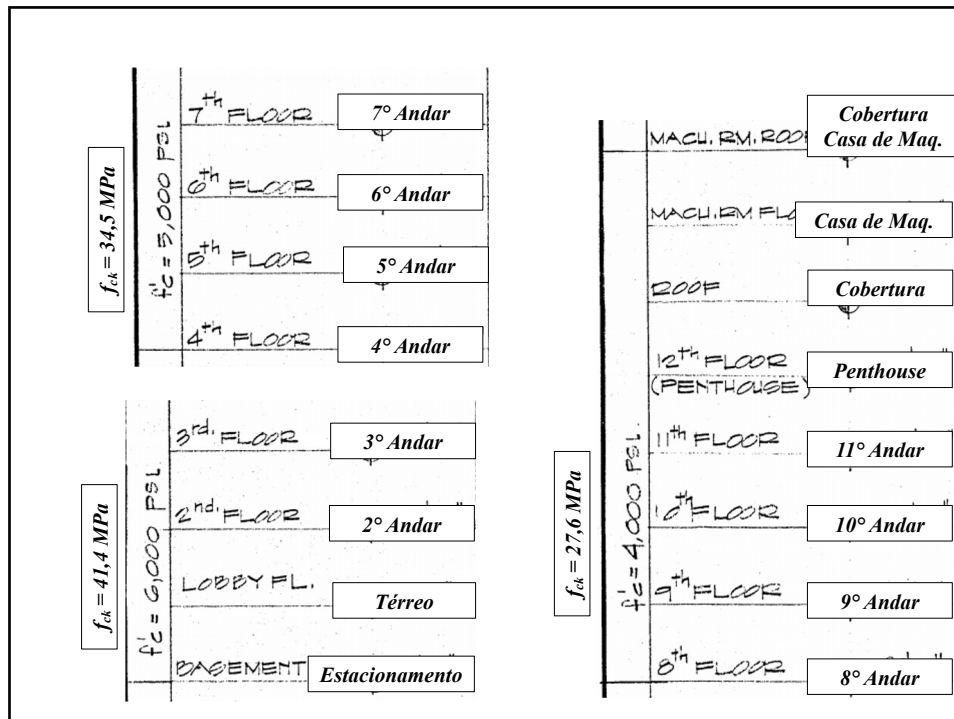
55



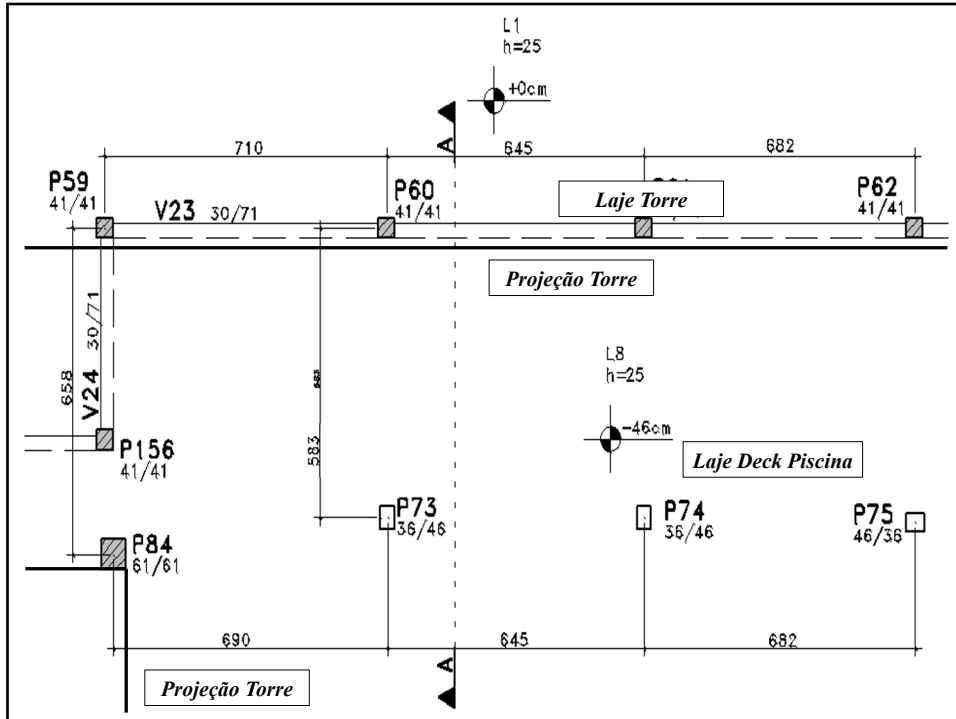
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- ✓ Concreto pilares da garagem até o terceiro andar: 6000psi (41,4 MPa)
  - ✓ Concreto lajes até o 8 andar: 4000psi (27,6 MPa)
  - ✓ Armadura pilar 61x61cm : 12Ø32 →  $A_s=98,28\text{cm}^2$   
→ $\rho=2,64\%$
  - ✓ Armadura pilar 41x41 cm : 8Ø36 →  $A_s=80,48\text{cm}^2$   
→ $\rho=4,79\%$
- ✓ Armadura pilar 36x46 cm: 10Ø32→ $A_s=81,9\text{cm}^2$  → $\rho=4,95\%$ 
  - ✓ Espessura lajes: 25cm (Terreo), 20cm (Tipo)
- ✓ Armadura inferior lajes: Ø12,7 C/30cm→  $\rho=0,17\%$  (Térreo),  
0,19% (Tipo)
- ✓ Não foi encontrado em projeto detalhe de armadura de punção

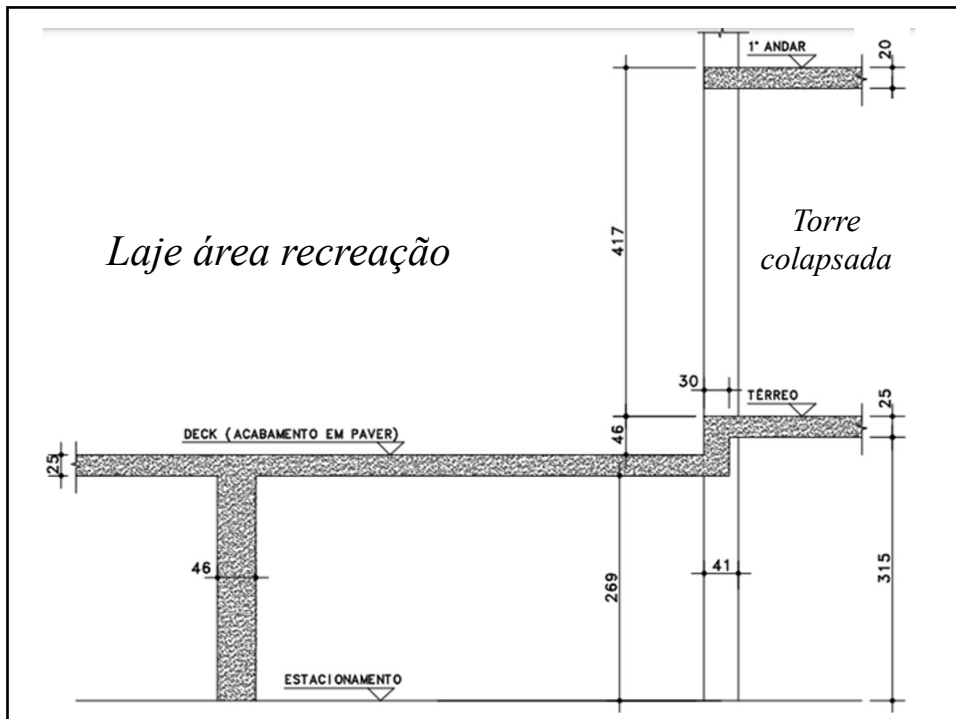
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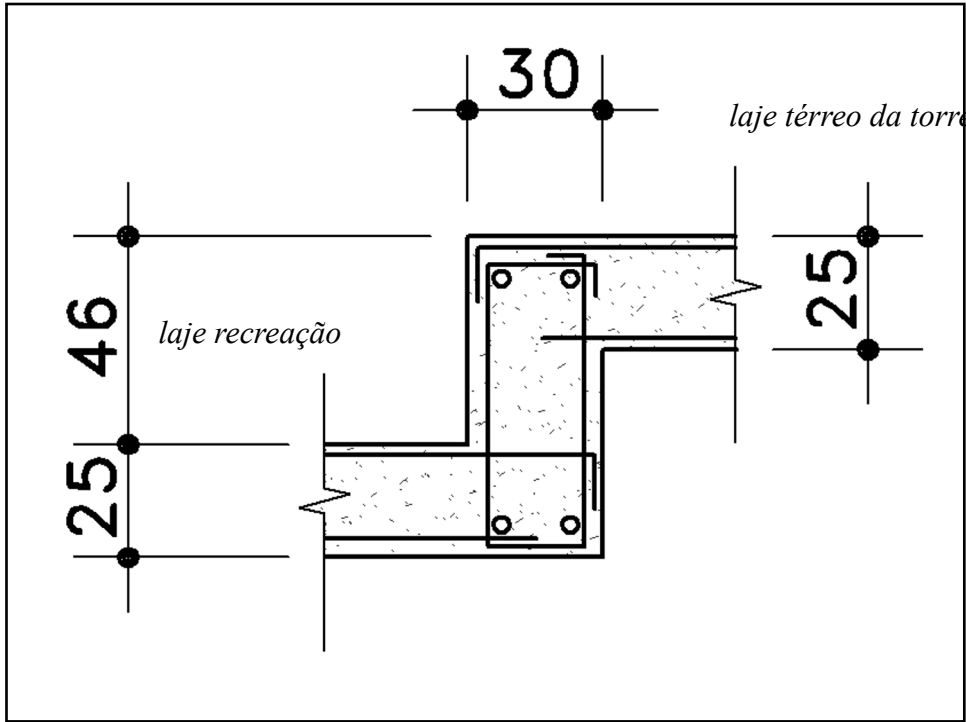
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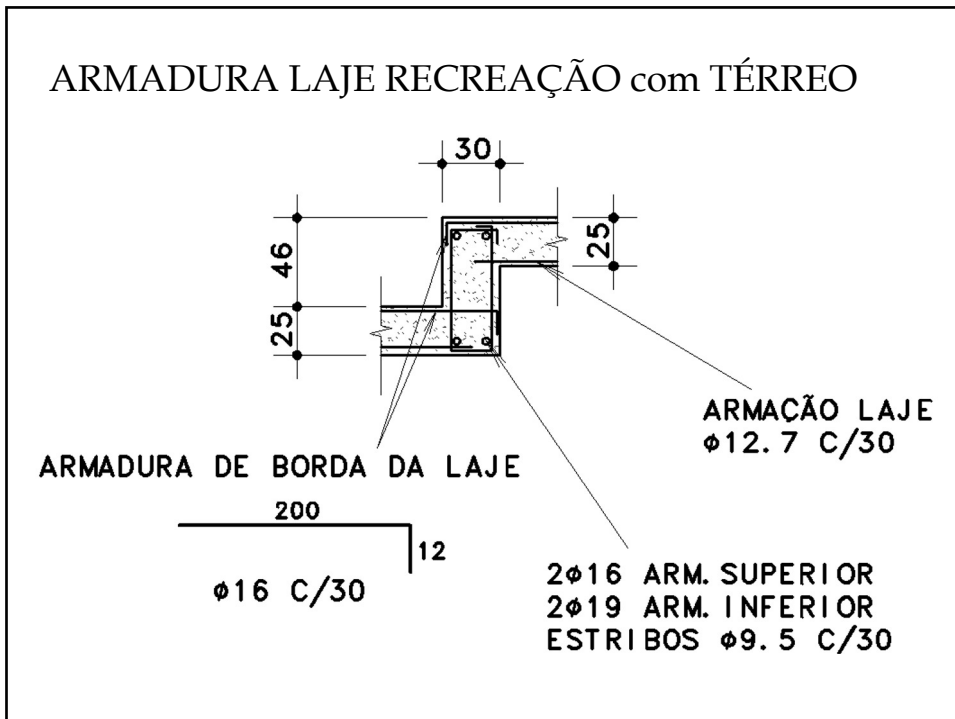
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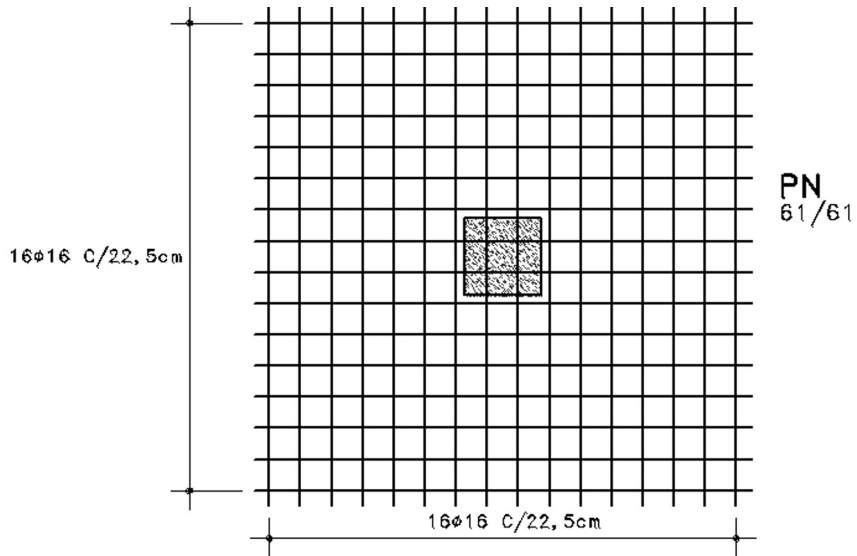
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### ARMADURA SUPERIOR PILAR 61x61 cm

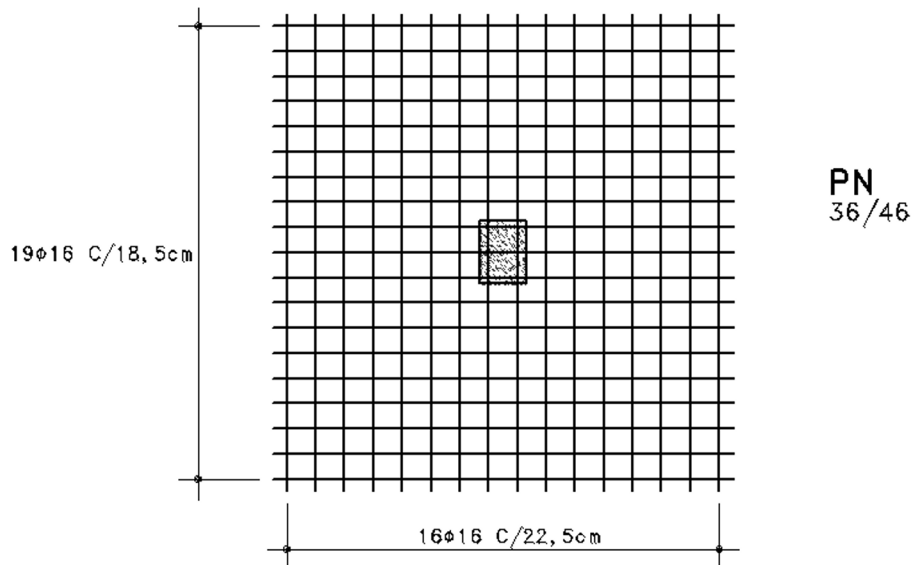
Laje recreação sob torre que não colapsou mas laje colapsou



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### Refuerzo SUPERIOR columnas 36x46 cm

Losa área lazer, plana, sin capitel



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## apartado 20.12

### “Punzonamiento”

pág. 418 a 422

#### *Hormigón Armado*

14<sup>o</sup> Edición

Basada en la EHE

Publicada em 2000

Pedro Jiménez Montoya

Álvaro García Meseguer

Francisco Morán Cabre



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## Losa Lazer Pileta → Punzionamiento

$e_{\text{nominal}} = 25 \text{ cm} \rightarrow \text{canto} \rightarrow d = 22 \text{ cm}$

Carga peso próprio =  $625 \text{ kgf/m}^2$

Carga Permanente =  $450 \text{ kgf/m}^2$

Total :  $1300 \text{ kgf/m}^2$

Carga Acidental =  $225 \text{ kgf/m}^2$

Columnas  $36 \text{ cm} \times 46 \text{ cm}$  a cada  $6,5 \text{ m}$  por  $7,0 \text{ m}$

Superfície crítica →  $2,5 \text{ m}^2$  → carga en la columna =  $55000 \text{ kgf}$

$f_{ck} = 27,6 \text{ MPa (N/mm}^2\text{)}$

Cuantía =  $0,01$  coeficiente  $\beta = 1,15$

Normal solicitante →  $F_{sd} = 550 * \gamma_F$  (kN)

Perímetro crítico →  $\mu_1 = 440 \text{ cm}$

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Losa Lazer Pileta → Punzionamiento

$$\tau_{rd} = 0,12 * (1 + \sqrt{\frac{200}{d}}) * \sqrt[3]{(100 * \rho_l * f_{ck})}$$

$$\tau_{sd} = \frac{\beta * Fsd}{\mu_1 * d}$$

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Losa Lazer Pileta → Punzionamiento

$$\tau_{sd} = \tau_{rd}$$

$$\tau_{rd} = 0,70 \text{ N/mm}^2 \text{ (MPa)}$$

$$\tau_{sd} = 0,65 * \gamma_F$$

$$(1,4 ?!)$$

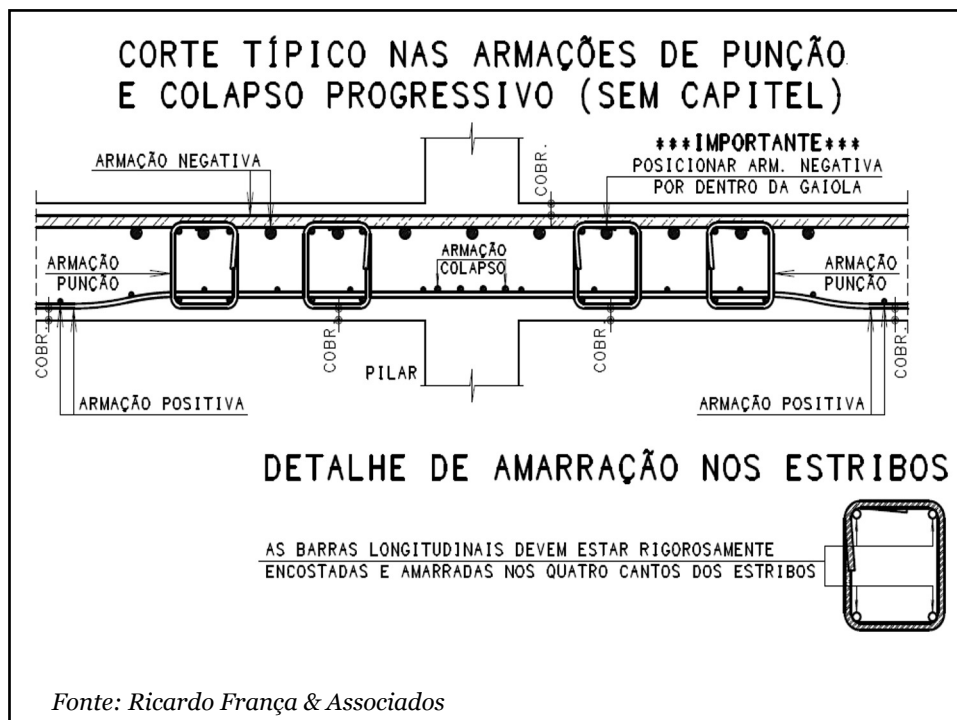
$$\gamma_F = 1,08$$

$$(1,5 ?!)$$

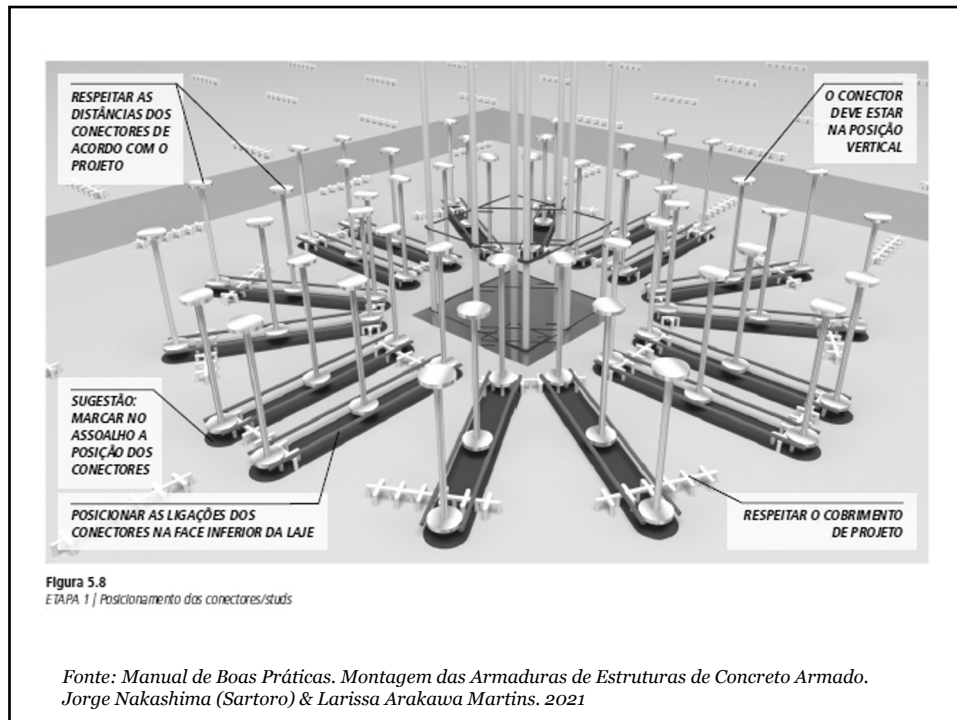
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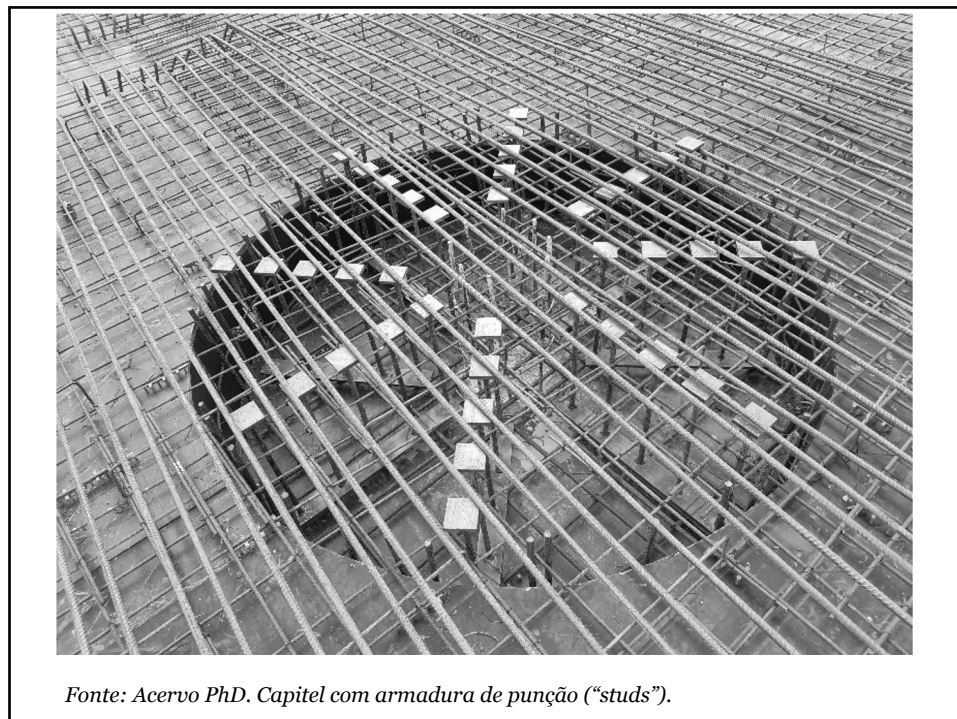
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## Lecciones

- ❖ Nuestras condolencias y solidaridad con las familias afectadas
- ❖ ATP (revisión del diseño estructural por pares)
- ❖ ATO (control tecnológico de estructuras por pares)
- ❖ ATU (inspección periódica)
- ❖ Mantenimiento (obras)
- ❖ ¡Cuidado con el agua! Nunca menospreciar corrosión!
- ❖ Los edificios no son eternos
- ❖ Elegir profesionales bien preparados (Certificación)
- ❖ El último ingeniero universal fue Leonardo da Vinci

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