

# Prestressed slabs developments in Europe

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# PRESTRESSED SLABS-DEVELOPMENTS IN EUROPE

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## RESEARCH

Development of prestressed concrete slabs  
 20 x 20 x 400 cm (8" x 8" x 16" - slab No. 1, 2nd Series)  
 Institute of Mechanical Engineering (Institute for  
 Technology (ETH), Zurich, 1977

### 20 x 20 cm SLAB (TESTING TWO PLATE STRIPS)

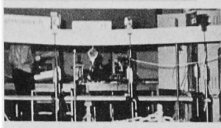


Fig. PS 4 - Test arrangement

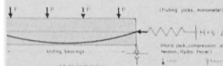


Fig. 1 - Test arrangement for plate strips

Slab No.	Thickness (cm)	Span (cm)	Load (kN)	Deflection (mm)	Crack width (mm)	σ (N/mm²)	ε (mm/mm)
1	20	20	2.0	1.0	0.1	10	0.001
2	20	20	4.0	2.0	0.2	20	0.002
3	20	20	6.0	3.0	0.3	30	0.003
4	20	20	8.0	4.0	0.4	40	0.004
5	20	20	10.0	5.0	0.5	50	0.005

Fig. 2 - Characteristics of test specimens



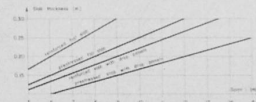
Fig. 3 - Results - Load-deflection curves for all plate strips

## DESIGN

### Scheme of load transfer by tendons



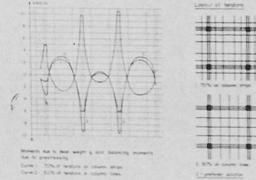
### Slenderness of slabs



### Punching mechanism

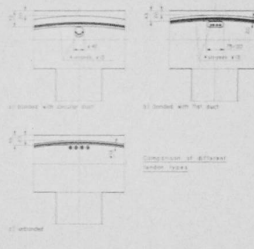


### Distribution of tendons



## CONSTRUCTION

### Excentricities



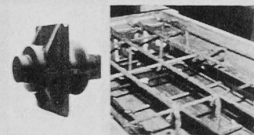
### Unbonded monostrand



### Extruding of unbonded monostrands



### Monostrand stressing anchorage



## EXAMPLES OF APPLICATION

### Multi-Storey Car Park, Saas-Fee, Switzerland

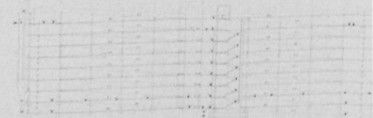
#### POST-TENSIONING WITH UNBONDED MONOSTRANDS

OWNER: Municipality of Saas-Fee  
 ENGINEER: Schmidwieser/Hubert  
 CONTRACTOR: Altmann & Hubertmann AG  
 PRESTRESSING: Spennacker AG Lyssach

Slab with 8 prestressed floors  
 22.2 x 24.4 m each, for parking of 300 cars

Span: 23.07 m  
 Thickness: 0.20 m  
 Loadless dead load: 2.0 kN/m²  
 Live load: 2.5 kN/m²  
 Prestressing steel: 3.5 kN/m²

#### LONGITUDINAL SECTION



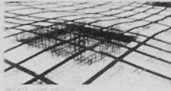
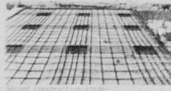
### Underground Garage, Housing Complex Oed XII, Linz, Austria

#### POST-TENSIONING WITH BONDED TENDONS (IN SLAB ON G)

OWNER: Austrian State of Upper Austria  
 ENGINEER: GPT, Graz, Austria  
 CONTRACTOR: Josef Stöckl & Sohn GmbH  
 PRESTRESSING: Spennacker AG, Wien

Prestressed garage slab with a total area of  
 200 m x 120 x 40 m

Span: 7.00 m  
 Thickness of slab: 0.18 m with 10%  
 Loadless dead load: 2.0 kN/m²  
 Live load: 2.5 kN/m²  
 Prestressing steel: 3.5 kN/m²





## PRESTRESSED SLABS DEVELOPMENTS IN EUROPE

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The development of prestressed slabs in Europe was delayed in comparison with the USA and Australia.

Main reason for that delay was the missing of suitable standards and simplified design methods. With the research done (specially in Germany and Switzerland), standards and design methods could be established.

Today, recommendations are available in the United Kingdom (1) and have also been published by FIP (2). In Germany (3), Switzerland (4) and the Netherlands these standards are under preparation and will be issued shortly.

Most of the questions during the poster-session at the congress did concerne bonded versus unbonded solution, e.g. protection against corrosion, fire and earthquake behaviour.

Following the advantages respectively of unbonded and bonded systems.

### Unbonded

- Maximum possible tendon drape
- No grouting required
- Corrosion protection of tendons also during transport, handling and placing
- Simple and fast placing of tendons
- Small friction losses
- Considerable dissipation of energy

### Bonded

- Increased ultimate moment
- Local failures of tendons have only localised effects (e.g. in the case of fire, explosion and earthquake)

Finally, a summary of advantages of prestressed slabs:

- . Economical
- . Increased span lengths and span/depth ratios
- . Reduced dead weights and building heights
- . Deflection and crack free under permanent loading
- . Improved punching shear resistance
- . Reduced construction time due to early stripping

### References:

1. Flat slabs in post-tensioned concrete with particular regard to the use of unbonded tendons—design recommendations.  
Concrete Society Technical report No. 17, published 1979 by C & CA, Wexham Springs, Slough SL3 6PL.
2. Recommendations for the design of flat slabs in post-tensioned concrete (using unbonded and bonded tendons), FIP/2/5, May 1980, published by C & CA, Wexham Springs, Slough SL3 6PL.
3. DIN 4227, Teil 6 "Bauteile mit Vorspannung ohne Verbund"
4. SIA 162, Arbeitsgruppe 5, "Bruchverhalten von Platten"