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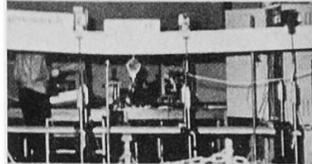
# PRESTRESSED SLABS-DEVELOPMENTS IN EUROPE

P. Schlub  
LOSINGER LTD  
Berne - Switzerland

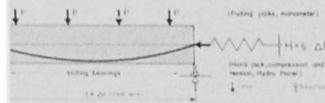
## RESEARCH

1986 Supervisor of prestressed concrete slabs  
STAL 26, P. 8112, FOST. Gr. 5, 750 (beam)  
P.O. of Mechanical Engineering (Berne/Fabriz)  
P.O. of Technology (1976), 1976, 1977

IN A FOUR-PLY (INLAND) PISE-PLATE STRIPS  
POST-TENSIONED WITH UNBONDED TENDONS



Strip PS 4 - Test arrangement



Example of test arrangement for plate strips

Number	Span (m)	Span length (m)				
1	3.00	3.00	3.00	3.00	3.00	3.00
2	3.00	3.00	3.00	3.00	3.00	3.00
3	3.00	3.00	3.00	3.00	3.00	3.00
4	3.00	3.00	3.00	3.00	3.00	3.00
5	3.00	3.00	3.00	3.00	3.00	3.00
6	3.00	3.00	3.00	3.00	3.00	3.00
7	3.00	3.00	3.00	3.00	3.00	3.00
8	3.00	3.00	3.00	3.00	3.00	3.00
9	3.00	3.00	3.00	3.00	3.00	3.00
10	3.00	3.00	3.00	3.00	3.00	3.00
11	3.00	3.00	3.00	3.00	3.00	3.00
12	3.00	3.00	3.00	3.00	3.00	3.00
13	3.00	3.00	3.00	3.00	3.00	3.00
14	3.00	3.00	3.00	3.00	3.00	3.00
15	3.00	3.00	3.00	3.00	3.00	3.00
16	3.00	3.00	3.00	3.00	3.00	3.00
17	3.00	3.00	3.00	3.00	3.00	3.00
18	3.00	3.00	3.00	3.00	3.00	3.00
19	3.00	3.00	3.00	3.00	3.00	3.00
20	3.00	3.00	3.00	3.00	3.00	3.00
21	3.00	3.00	3.00	3.00	3.00	3.00
22	3.00	3.00	3.00	3.00	3.00	3.00
23	3.00	3.00	3.00	3.00	3.00	3.00
24	3.00	3.00	3.00	3.00	3.00	3.00
25	3.00	3.00	3.00	3.00	3.00	3.00
26	3.00	3.00	3.00	3.00	3.00	3.00
27	3.00	3.00	3.00	3.00	3.00	3.00
28	3.00	3.00	3.00	3.00	3.00	3.00
29	3.00	3.00	3.00	3.00	3.00	3.00
30	3.00	3.00	3.00	3.00	3.00	3.00
31	3.00	3.00	3.00	3.00	3.00	3.00
32	3.00	3.00	3.00	3.00	3.00	3.00
33	3.00	3.00	3.00	3.00	3.00	3.00
34	3.00	3.00	3.00	3.00	3.00	3.00
35	3.00	3.00	3.00	3.00	3.00	3.00
36	3.00	3.00	3.00	3.00	3.00	3.00
37	3.00	3.00	3.00	3.00	3.00	3.00
38	3.00	3.00	3.00	3.00	3.00	3.00
39	3.00	3.00	3.00	3.00	3.00	3.00
40	3.00	3.00	3.00	3.00	3.00	3.00
41	3.00	3.00	3.00	3.00	3.00	3.00
42	3.00	3.00	3.00	3.00	3.00	3.00
43	3.00	3.00	3.00	3.00	3.00	3.00
44	3.00	3.00	3.00	3.00	3.00	3.00
45	3.00	3.00	3.00	3.00	3.00	3.00
46	3.00	3.00	3.00	3.00	3.00	3.00
47	3.00	3.00	3.00	3.00	3.00	3.00
48	3.00	3.00	3.00	3.00	3.00	3.00
49	3.00	3.00	3.00	3.00	3.00	3.00
50	3.00	3.00	3.00	3.00	3.00	3.00

Characteristics of test specimens



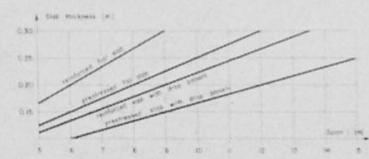
Results - Load-deflection curves for all plate strips

## DESIGN

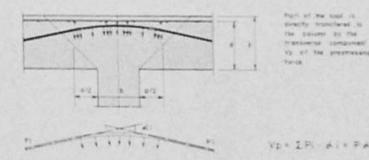
### Scheme of load transfer by tendons



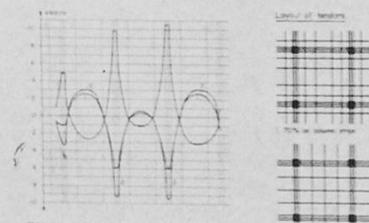
### Slenderness of slabs



### Punching mechanism



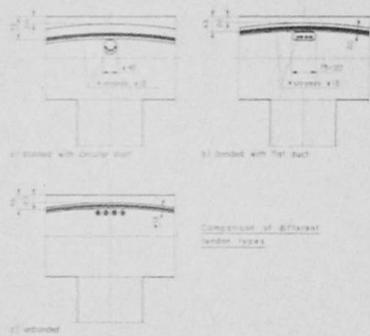
### Distribution of tendons



Minimum slab to beam weight is 400 kg/m². Spacing of tendons is 100 mm. Curve 1: 70% of tendons in column zone. Curve 2: 50% of tendons in column zone. 1: prefabrication.

## CONSTRUCTION

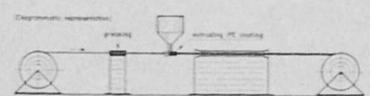
### Excentricities



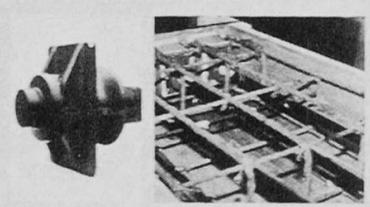
### Unbonded monostrand



### Extruding of unbonded monostrands



### Monostrand stressing anchorage



## EXAMPLES OF APPLICATION

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

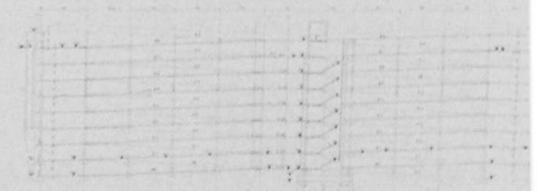
#### POST-TENSIONING WITH UNBONDED MONOSTRANDS

OWNER: Municipality of Saas-Fee  
ENGINEER: Schuelter-Koch/Balder+Ritz  
CONTRACTOR: Altmann & Kallenberg AG  
PRESTRESSING: Spannteam AG Lyssach

Structure with 8 prestressed floors, 32.3 x 34.4 m each, for parking of 950 cars  
Spans: 7.50/7.60 m  
Thickness: 0.20 m  
Loadings: dead load 2.0 kN/m²  
Free load 7.0 kN/m²  
Prestressing steel: 3.7 kN/m²

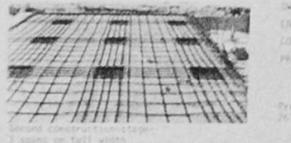


#### CONDIGIONAL SECTION



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

#### POST-TENSIONING WITH BONDED TENDONS IN FLAT SLABS



OWNER: Wohnbau Oed XII  
ENGINEER: Sigl, Ing. B. Preussner & Partner  
CONTRACTOR: Josef Pröll & Georg Ebert  
PRESTRESSING: Sinterbau Oed, Wien  
Prestressed garage roof with a total area of 26.0 sq. m (29 x 90 m)  
Spans: 7.50/8.00 m  
Thickness of slab: 0.30 m with drop  
Loadings: dead load 7.5 kN/m²  
Free load 4.0 kN/m²  
Total: 11.5 kN/m²  
Prestressing steel: 4.0 kN/m² tendons with 4.0 mm dia. 10



## PRESTRESSED SLABS DEVELOPMENTS IN EUROPE

Peter Schlub  
 Project Engineer  
 Losinger Ltd.,  
 Berne, Switzerland

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"