

**Zeitschrift:** IABSE congress report = Rapport du congrès AIPC = IVBH  
Kongressbericht

**Band:** 11 (1980)

**Rubrik:** Posters

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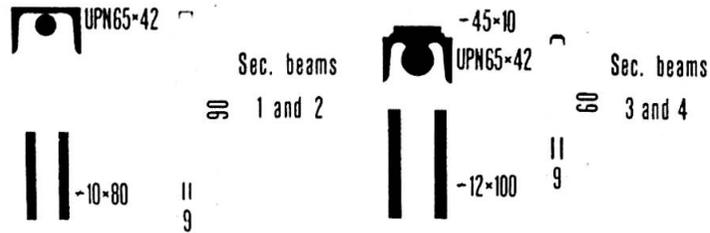
UNIVERSITA' degli  
STUDI di BARI

FACOLTA' di INGEGNERIA  
ISTITUTO  
di  
SCIENZA delle COSTRUZIONI

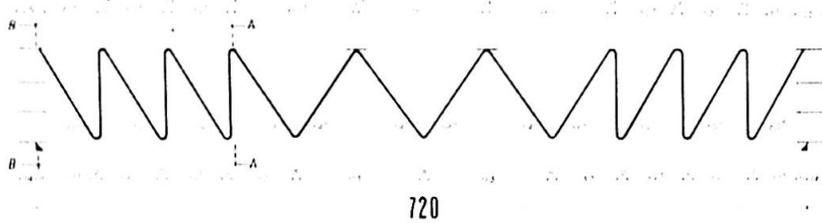
viale Japigia, 182 Bari (Italy)

TRIALS ON BEAMS IN METAL TRESTLE BURIED IN CONCRETE

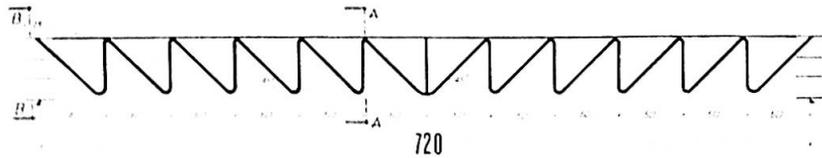
G. DONATONE - G. FRADDOSIO - A. SOLLAZZO



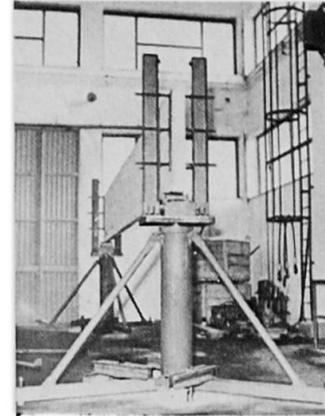
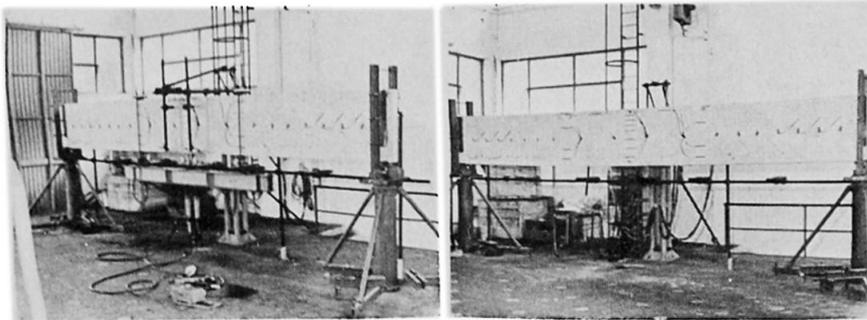
TRESTLE OF THE BEAMS 1-2



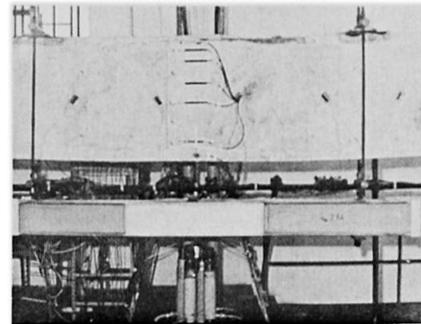
TRESTLE OF THE BEAMS 3-4



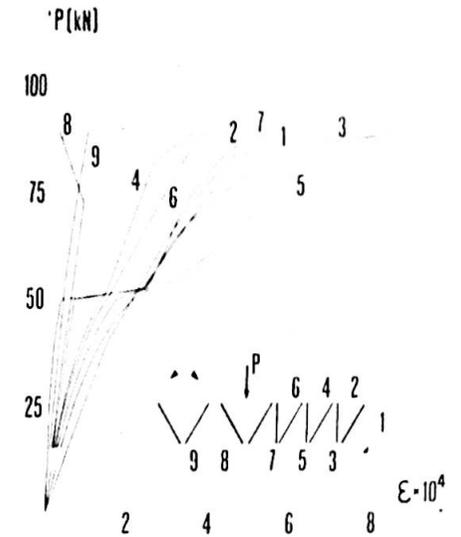
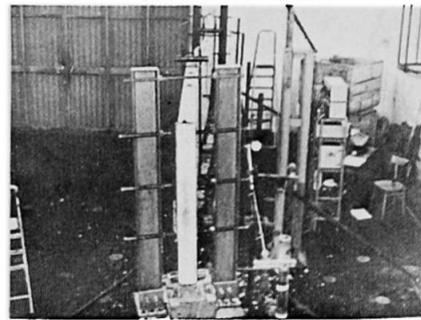
LOAD DEVICES AND BEAM AFTER CRACKING



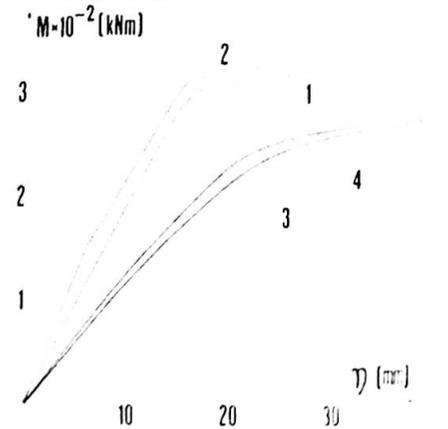
BEAM WITH BEARING DEVICES



BEAMS AFTER FAILURE



STRAINS IN VERTICAL RODS AND DIAGONALS  
OF THE TRESTLE OF THE BEAM 1



DIAG. MOMENTS - DEFLECTIONS FOR THE BEAMS 1 2 3 4

TRIALS ON BEAMS IN METAL TRESTLE BURIED IN CONCRETE

Giovanni DONATONE - Giuseppe FRADDOSIO - Alfredo SOLLAZZO

Istituto di Scienza delle Costruzioni - Facoltà d'Ingegneria

Università degli Studi di Bari - (Italy)

SUMMARY

The research aims to investigate in theoretical and experimental way the behaviour of beams, with rectangular cross section, made by a welded metal trestle buried in concrete.

Have been tested four beams on a span of 7,20 m; the first two (n.1 and n.2) have a cross section of 9x90 cm while the other two (n.3 and n.4) have a cross section of 9x90 cm. Such beams must be considered as the webs of structural elements to complete during the installation by means of an upper slab in such way to give them a T section. They are to be used for a particular prefabrication system of multistoried buildings in which beam and partition are made by an only prefabricated block.

In the poster are shown the construction details of the prototypes, the load and bearing devices and the beams after failure.

Special "diapason" bearings have been designed to prevent only the beam rotation around its longitudinal axis and loads have been applied by means of previously calibrated hydraulic jacks.

Experimental results obtained point out that the considered beams have a behaviour very near to that of reinforced concrete beams, both under exercise loads and up to the rupture. In fact, as it is possible to see from the diagram shown in the poster for the beam 1, not only the diagonals near bearings, but also the vertical rods have resulted stretched; besides stresses in the former have always been higher than in the latter, as commonly happens for bended bars and stirrups. Rupture experimental moments, besides, are near enough to the theoretical ones valued by means of limit design theory for reinforced concrete beams, with deviations respectively of 1,5% and 7,5 for the beams n.1 and n.2 and of 5% for the beams n. 3 and n.4. Also compression strains in concrete and steel have been near enough to the theoretical ones. Failure announced by the appearance of many cracks, manifested itself through a sudden lateral buckling of structures under loads lightly higher than those for which strains in stretched steel, corresponding to yield point, had been measured. Thus it is to think that collapse happened just for reaching, in center line, of theoretical crisis situation and that only consequently, because of beams slenderness, lateral buckling occurred with contemporary instability of compressed stringer.

REFERENCES

- 1 - G. DONATONE - G. FRADDOSIO - A. SOLLAZZO: Risultati di esperienze su prototipi di travi a traliccio metallico immerso nel conglomerato cementizio. Atti dell' Istituto di Scienza delle Costruzioni dell'Università di Bari, n. 126; 1979.
- 2 - G. DONATONE - G. FRADDOSIO - N. SCATTARELLI: In tema di sperimentazione su travi a traliccio metallico immerso nel conglomerato cementizio. Atti dell'Istituto di Scienza delle Costruzioni dell'Università di Bari, n. 130, 1980

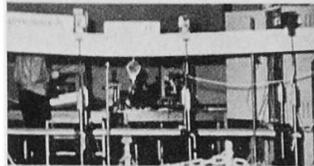
# PRESTRESSED SLABS-DEVELOPMENTS IN EUROPE

P. Schlub  
LOSINGER LTD  
Berne - Switzerland

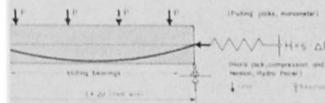
## RESEARCH

1986 Supervisor of prestressed concrete slabs  
STAL 26, P. 8112, FOST. Gr. 5, 750 (beam)  
P.O. of Mechanical Engineering (Berne/Fabrizi)  
P.O. of Technology (ETH, Zurich, 1987)

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	Plate thickness (mm)	Plate strip thickness (mm, with 12 mm)	Span (m)	Load (kN)	Deflection (mm)	Crack width (mm)
1	80	100	10	10	10	0.15
2	100	120	10	10	10	0.15
3	120	140	10	10	10	0.15
4	140	160	10	10	10	0.15
5	160	180	10	10	10	0.15
6	180	200	10	10	10	0.15
7	200	220	10	10	10	0.15
8	220	240	10	10	10	0.15
9	240	260	10	10	10	0.15
10	260	280	10	10	10	0.15
11	280	300	10	10	10	0.15
12	300	320	10	10	10	0.15
13	320	340	10	10	10	0.15
14	340	360	10	10	10	0.15
15	360	380	10	10	10	0.15
16	380	400	10	10	10	0.15
17	400	420	10	10	10	0.15
18	420	440	10	10	10	0.15
19	440	460	10	10	10	0.15
20	460	480	10	10	10	0.15
21	480	500	10	10	10	0.15
22	500	520	10	10	10	0.15
23	520	540	10	10	10	0.15
24	540	560	10	10	10	0.15
25	560	580	10	10	10	0.15
26	580	600	10	10	10	0.15
27	600	620	10	10	10	0.15
28	620	640	10	10	10	0.15
29	640	660	10	10	10	0.15
30	660	680	10	10	10	0.15
31	680	700	10	10	10	0.15
32	700	720	10	10	10	0.15
33	720	740	10	10	10	0.15
34	740	760	10	10	10	0.15
35	760	780	10	10	10	0.15
36	780	800	10	10	10	0.15
37	800	820	10	10	10	0.15
38	820	840	10	10	10	0.15
39	840	860	10	10	10	0.15
40	860	880	10	10	10	0.15
41	880	900	10	10	10	0.15
42	900	920	10	10	10	0.15
43	920	940	10	10	10	0.15
44	940	960	10	10	10	0.15
45	960	980	10	10	10	0.15
46	980	1000	10	10	10	0.15

Characteristics of test specimens



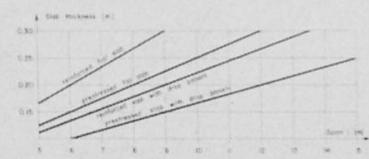
Results - Load-deflection curves for all plate strips

## DESIGN

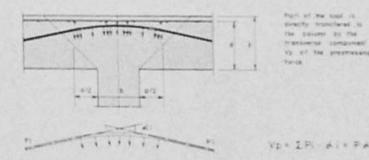
### Scheme of load transfer by tendons



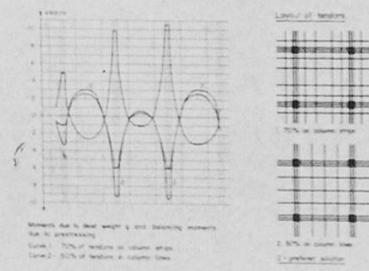
### Slenderness of slabs



### Punching mechanism

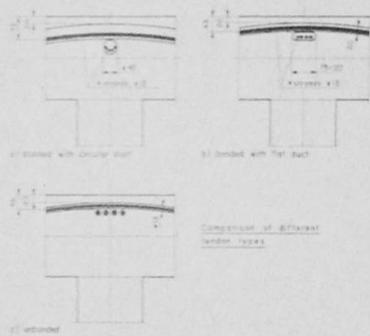


### Distribution of tendons



## CONSTRUCTION

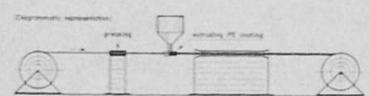
### Excentricities



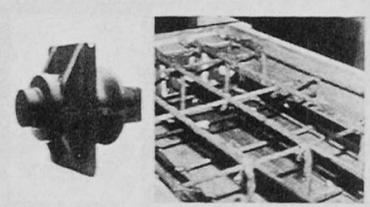
### Unbonded monostrand



### Extruding of unbonded monostrands



### Monostrand stressing anchorage



## EXAMPLES OF APPLICATION

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

#### POST-TENSIONING WITH UNBONDED MONOSTRANDS

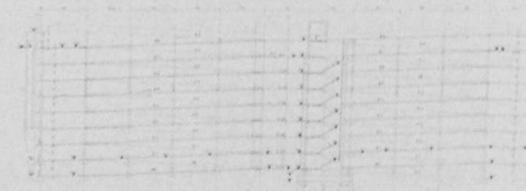
OWNER: Municipality of Saas-Fee  
 ENGINEER: Schuelter-Kocher-Halter+Kistler  
 CONTRACTOR: Altmann & Kallenberg AG  
 PRESTRESSING: Spannteam AG Lyssach

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/m<sup>2</sup>  
 Free load 7.0 kN/m<sup>2</sup>  
 Prestressing steel: 3.7 kN/m<sup>2</sup>



#### CONDIGIONAL SECTION



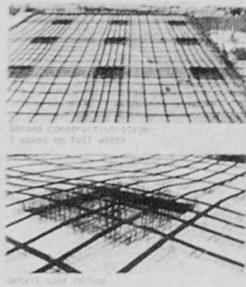
### Underground Garage, Housing Complex Oed XII, Linz, Austria

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

OWNER: Wohnbau Oed XII (Linz)  
 ENGINEER: Dipl.-Ing. R. Preissinger & Partner  
 CONTRACTOR: Josef Pröll & Georg Eberhart  
 PRESTRESSING: Sinterbau GmbH, 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: 0.20 m with drop  
 Loadings: dead load 2.5 kN/m<sup>2</sup>  
 Free load 7.0 kN/m<sup>2</sup>  
 Prestressing steel: 4.0 kN/m<sup>2</sup> tendons with 4.0 mm dia. steel





## 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"





## PRESTRESSED PRESSURE TUNNELS AND SHAFTS

Igor Uherkovich, Francis Fink  
LOSINGER LTD., VSL International

Where in tunnels and shafts the lack of sufficient overburden does not permit the rock to accept the internal pressure, or where this pressure is so high that the watertightness is in doubt although the stability of the tunnel shell is not in question, the structure is usually provided with a steel lining. Very often, however, transportation to remote sites as well as difficult installation condition make such a lining very expensive. The idea was to use the already existing concrete backfill as an autonomous lining without the need of a steel shell. This is possible with the help of the prestressing technique, using annular tendons acting like barrel hoops. To avoid the need of buttresses to anchor the tendons a special "floating" type of anchorage and the relevant stressing equipment as shown on the opposite page have been developed.

Many problems in the structural design and the construction had to be solved since in view of the often unpredictable behaviour and embedment the design and construction of underground constructions cannot entirely be carried out on the basis of the principles applied for open-air structures. Prestressed tunnel linings subject to high water pressures require a special treatment of the contact surface between rock and concrete. After pressing the resulting gap between rock and concrete has to be filled using the traditional grouting techniques. Also important is the use of a suitable formwork construction to ensure a complete concrete filling.

The proposed solution is not only limited to straight cylindrical sections of tunnels and shafts but can also be applied economically for tunnel and shaft connections, by-passes, etc.

A number of prestressed pressure shaft and surge chamber projects have been carried out successfully using this method. Noticeable reductions in construction time and cost savings were achieved. Although all completed projects were done in highly developed countries, still further advantages can be expected by using this solution in developing countries.

## A unique system of High-Rise Residential Buildings by Large Steel Structural Framework

Toshiharu Hisatoku\*  
Ryoji Tamura\*\*  
Yuzo Kato\*\*\*



This project is a plan for constructing residential buildings higher than 14 stories with a total of some 3,400 residential units by different owners on the reclaimed land off the coast (see, Fig. 1). They are 14, 19, 24 and 29 stories and the variations of 11 in the type (see, Fig. 2). Fig. 3 shows an example of the plans of the residential units.

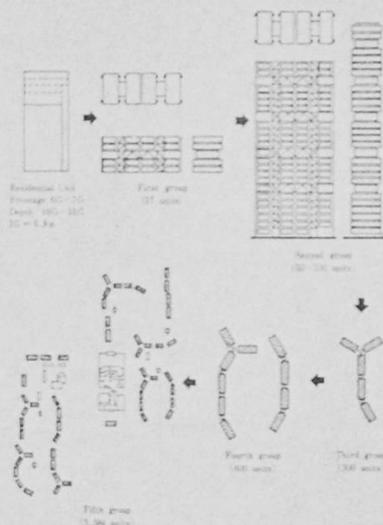


Fig. 1 System of High-Rise Residential Buildings

\* Chief Structural Engineer, Dr. Eng., Division of Structural Design, Takenaka Komuten Co., Ltd.

\*\* Chief Structural Engineer, Division of Structural Design, Nippon Steel Corporation

\*\*\* Chief Structural Engineer, Division of Structural Design, Takenaka Komuten Co., Ltd.



Fig. 2 Composition of Stories

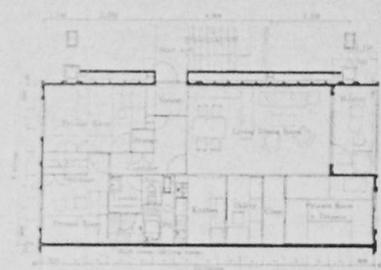


Fig. 3 Plan of A Residential Unit

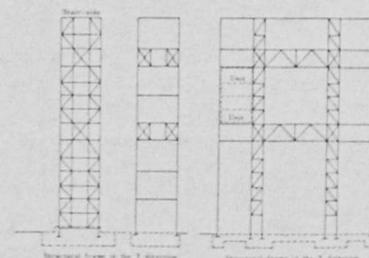
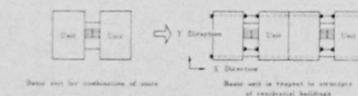


Fig. 4 Structural Framework

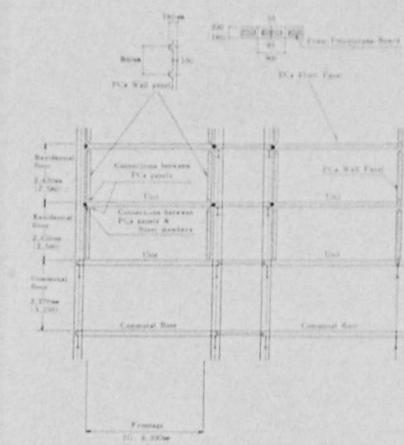


Fig. 5 Structure of Residential Units

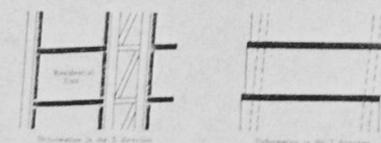


Fig. 6 Deformation of Residential Units



## A Unique System of High-Rise Residential Buildings by Large Steel Structural Framework

T. HISATOKU, Dr. Eng.                      R. TAMURA                                      Y. KATO  
Chief Structural Engineer, Chief Structural Engineer, Chief Structural Engineer,  
Takenaka Komuten Co., Ltd. Nippon Steel Corporation. Takenaka Komuten Co., Ltd.  
Osaka, Japan                                      Tokyo, Japan                                      Osaka, Japan

### 1. THE OUTLINE OF PROJECT

This project (about 3,400 Residential units in 52 buildings) was completed in July, 1979. The name "ASTM" is the combination of the first letters of Ashiyahama, (name of the city where these buildings were built) and the five participating companies in Japan.

The plan submitted by the ASTM won the first prize for its unique system utilizing prefabrication and industrialization in August 1973 in the competition for High-Rise Housing Complex at Ashiyahama.

This project is a plan for constructing residential buildings higher than 14 stories with a total of some 3,400 residential units by different owners on the reclaimed land off the coast (see, Fig. 1). They are 14, 19, 24 and 29 stories and the variations of 11 in the type (see, Fig. 2). Fig. 3 shows an example of the plans of the residential units.

### 2. THE OUTLINE OF THE STRUCTURAL DESIGN

#### 2.1 The Structural Frame

The structural frame of the residential buildings are shown in Fig. 4. The basic unit concerning the structure is four residential units per floor as shown in the figure. In the X direction (see Fig. 4) in order to create the free space for residential units, structural frame consist of two large rigid frames making the core with the stair column and the communal floors beams. In the Y direction (see Fig. 4), structural frame consists of four rigid joint truss frames situated at the both sides of the stairs.

#### 2.2 The Structure of the Residential Unit

Fig. 5 shows the outline of the structure of the residential unit. The residential unit is composed of PCa panels (that is precast concrete panels), and the four stories residential units lie on the beam which is located on the upper floor of the communal floor, except the lowest part of the building. The PCa panels and the PCa wall panels bear the vertical load, and the load is transmitted from the PCa floor panels to the PCa wall panels, and the vertical load of the four stories is eventually supported by the beam of the upper floor of the communal floor. These PCa panels are not participated against wind or earthquake.

#### 2.3 The Relationship between the Residential Unit and the Structural Framework

The walls and the floors of the residential unit are not only required to bear the vertical load but also to comply with deformation of the structural framework when horizontal loads are exerted on the structural framework. Taking these requirements into consideration, the design has been made about each of the directions as shown by Fig. 6. For this purpose, tetrafluoroethylene resins are placed on top of the walls of every story to slide bearing materials.

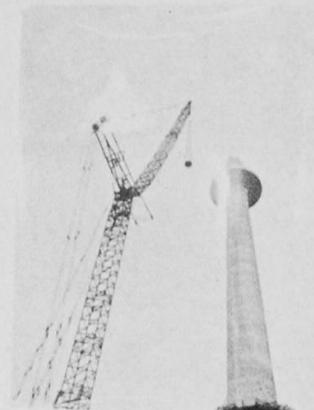
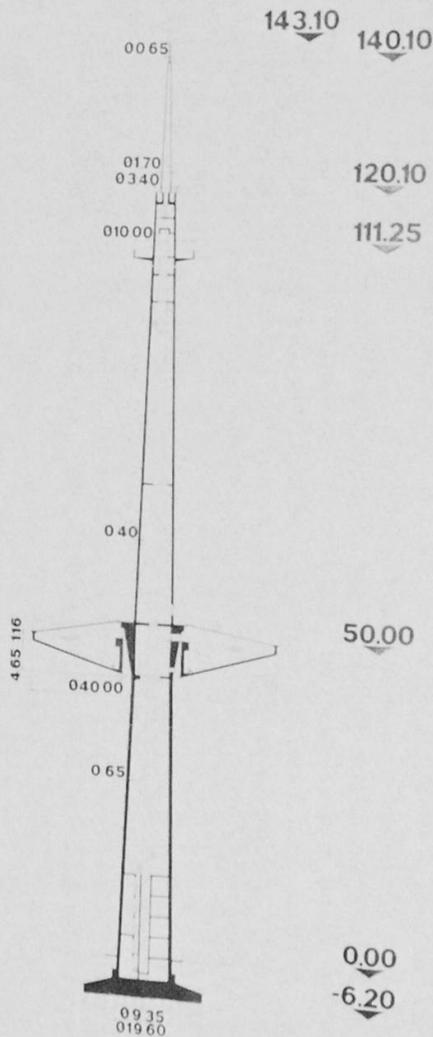
# CHATEAU D'EAU ET MAT D'ANTENNES A MECHELEN

PROF. DR. IR. F. MORTELMANS

MOTRI 12 11 1978  
 VILLE DE MECHELEN  
 AUTEUR DU PROJET  
 PROF. DR. IR. F. MORTELMANS  
 KULLEUVEN  
 INGENIEURS CONSEILS  
 OMNIM. TECHNOL. DE  
 LA CONSTRUCTION S.T.H.  
 BRUXELLES  
 ENTREPRENEUR  
 VAN HOUT, VOSSELAAR  
 PRECONTRAINTE V.S.L.  
 CAPACITE DU RESERVOIR 2500M<sup>3</sup>  
 COUT TOTAL DE LA CONSTRUCTION  
 8000000 FR.  
 DATE DE MISE EN SERVICE  
 15 09 1979



DETAILS DE LA PRECONTRAINTE DU RESERVOIR



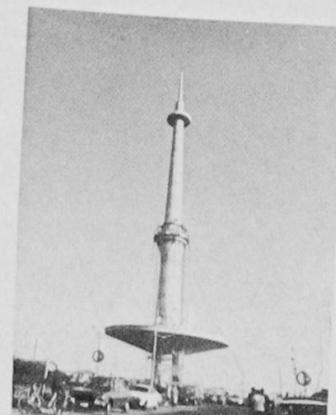
MONTAGE DE LA POINTE



MONTAGE DE LA PLATE-FORME



FUT EN CONSTRUCTION





CHÂTEAU D'EAU ET TOUR DE TELECOMMUNICATIONS  
EDIFIE A MECHELEN EN BELGIQUE

Fernand MORTELMANS  
Professeur Ordinaire  
à la Katholieke Universiteit Leuven  
Leuven-Heverlee, Belgique

La construction est composée :

- d'un réservoir d'une capacité de 2.500 m<sup>3</sup> à un niveau d'eau maximum de + 50 m par rapport au sol,
- de l'emplacement de trois antennes paraboliques au niveau de la toiture du réservoir (+ 55 m),
- d'une plate-forme à + 110 m et sur laquelle sont montées les antennes réceptrices de la radio- et télédistribution de la ville,
- d'un mât en acier inoxydable de 20 m de hauteur et qui couronne la construction entière,
- d'un paratonnerre extensible de 4 m de hauteur au sommet du mât.

La gaine centrale en béton armé et de 120 m de hauteur fût réalisée par procédé de coffrage glissant. Le réservoir consiste d'un fond conique renforcé de 16 parois radiales en béton précontraint, une paroi intérieure, une paroi extérieure de 40 m de diamètre, également précontraintes. Le tout est couvert par une toiture en forme de coque mince conique reposant sur la paroi extérieure du réservoir. Après leur parachèvement sur le sol, le réservoir et la toiture ont été hissés vers une console de suspension et ancrés définitivement.

La plate-forme des antennes fût également construite sur le sol. Elle est composée de trois anneaux préfabriqués en béton léger, solidarisés par coulage d'une couche de béton après leur mise en place par une grue de 160 m de hauteur de levage. Le mât en acier inoxydable, mis en place par la même grue, n'a qu'une fonction purement esthétique.

Il était surtout la façon d'exécution de cet ouvrage d'art qui à suscité l'intérêt du public.

Apparemment les opinions sont unanimes sur le fait que les qualités esthétiques de cette construction peuvent être attribuées à l'élégance et la simplicité des lignes, le choix des matériaux et leur mise en oeuvre comme les combinaisons de béton lis et rugueux et l'acier inoxydable.

Finalement apparaît la double dualité réservoir/plate-forme et gaine en béton/flêche en acier inoxydable.

Maître de l'ouvrage : La Ville de Mechelen  
Auteur du projet : Prof.dr.ir. F. Mortelmans  
Bureau d'Ingénieurs Conseils : I.T.H. Bruxelles  
Système de précontrainte et de levage : V.S.L.  
Pieux des fondations : Soc. Pieux Franck'i  
Entrepreneur : Soc. Van Hout à Vosselaar (Belgique)  
Coût des travaux : 80.000.000,- FB  
Délai d'exécution des travaux : 200 jours ouvrables



Elementierter  
Stahl-Hochbau  
mit hohem  
industriellen  
Vorfertigungs-  
grad.

In- und  
Auslands-  
patente

## 6D-Bauverfahren · Doubrava KG · Attmang · Austria



BAUEN OHNE GERÜST

Die Entwicklung des 6D-Bauverfahrens stand unter dem Protektorat der Österr. Forschungs-Förderung und gründet auf der exakten Auswertung der Erkenntnisse weltweiter Bauforschung

### 6D-Charakteristik:

- Gestaltungsvielfalt durch freie Addierbarkeit der selbsttragenden 6D-Raumeinheiten in allen 3 Dimensionen (bis 21 Etagen).
- Bleibende Flexibilität gegenüber beliebigen Raumgrößenveränderungen (keine tragenden Wände!).
- Hohe Wärme- und Kälteschutzwerte durch optimale bauphysikalische Detaillösungen. Alle geforderten Brandschutz-, Wärme- und Schall-Dämmwerte sind erfüllbar.
- Keine Gerüstung, keine Materialverluste auf der Baustelle.
- Kurze Bauzeit und daher Fixpreis.
- Erdbebensicher, Ideal exportfähig.



150-BETTEN-HOTEL MIT RESTAURANT

# TWO SPECIAL CHINESE TIMBER BRIDGES

TANG HUAN CHENG



Rainbow Bridge

This is a Chinese national art treasure, the Song painting "River Side Scene at the Qing Ming Festival". The bridge was constructed in year 1032, and was first repaired and enlarged by another in year 1853.



Dimensions of the bridge as estimated from sketches of writings by different authors in Song dynasty are shown on pictures. Calculated by electronic computer, the timber arch segment is about 30 cm in diameter. The total material required is 6000 m<sup>3</sup> for, including about 1500 steel deck planks.

## Combined Beam-Arch Construction



Design Model



The bridge structure consists of two A-B type systems. System A and B. Both systems are similar structures, so they are fixed together by the construction with similar design. The structure is designed as two A-B type and, but each system is acted as a structure beam. It is named as "Combined Beam-Arch" construction, or shorter named it.



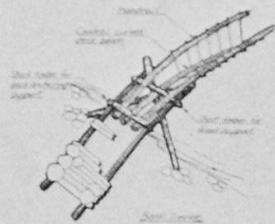
Bow-Bow Bridge

In the North part of the Sichuan province, China, crossing the mountain river gorges, there are some interesting timber bridges constructed by natural in the woods. All made with tree trunks. (Some call them "Bow-Bow" bridge).

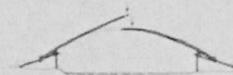
Span length 12-20 M



The bridge was naturally constructed with three curved beams connected with V-shaped steel members. The whole bridge looks like a new man in the front view, and triangular shape in the side view. Bow-Bow bridge is a special structure.



The construction of the bridge is shown on the picture. (Integrated) beams are joined in the piers on each bank, and connected out to the river. The pier between two cantilevers is then connected by another beam. During the construction, before connecting main steel, simply with similar design, the Bow-Bow bridge is finally completed.



The Bow-Bow bridge length is 12-20 m, but the arch span is 10 m. It is a pre-stressed beam construction.

## Conclusion

These two interesting special Chinese timber bridges are structurally reasonable, esthetical in form, simple, economical and easy to erect. Their structural principles may be utilized in new bridge design with new materials and techniques for new functional purposes.

prof. dr kruno  
TONKOVIĆ

4 STRUCTURES EN BOIS ◦ WOOD ◦ HOLZ ◦ ◦

JUGOSLAVIJA

Zagreb - jugoslavija  
gradevinski institut

IVBH  
IABSE  
AIPC

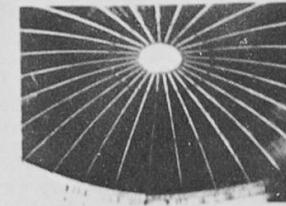
1980



85m



S. Dimnik: Pasarela-Kokra - Kranj - Jugoslavija 1938



L = 39m

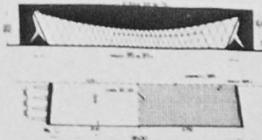
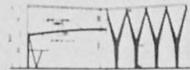


TEST RESULTATS

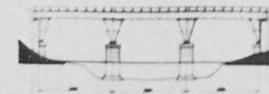
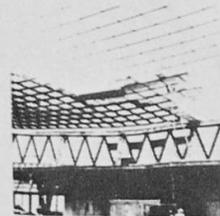
K. Tonković: Kupola brodarski institut - Zagreb - 1954

K. Tonković: hala velesajam - Zagreb

1955



L = 95m



K. Tonković: most Budak - Lika 1952

HARTL  
HOLZKONSTRUKTIONEN  
GESELLSCHAFT M.B.H.

1190 WIEN, SEIFERINGER STRASSE 2 · POSTFACH 46  
TELEFON: 0222/32 25 55 · FERNSCHREIBER: 0714/333  
3754 RUFRIITZ, NIEDERÖSTERREICH  
TELEFON: 02986/237

