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FACOLTA' di INGEGNERIA
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viale Japigia, 182 Bari (Italy)

TRIALS ON BEAMS IN METAL TRESTLE BURIED IN CONCRETE
G. DONATONE - G. FRADDOSIO - A. SOLLAZZO



UPN65-42

Sec. beams
06 1 and 2

-10x80
II
9

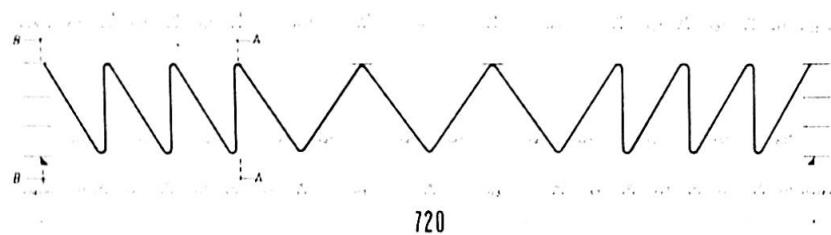


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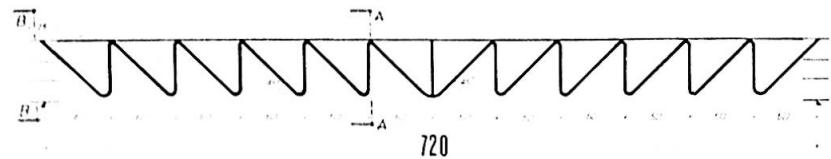
Sec. beams
09 3 and 4

-45x10
II
9

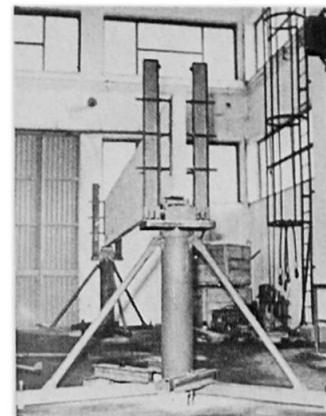
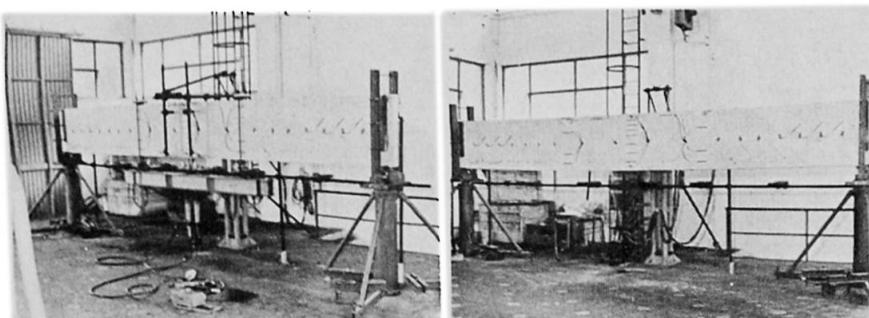
TRESTLE OF THE BEAMS 1-2



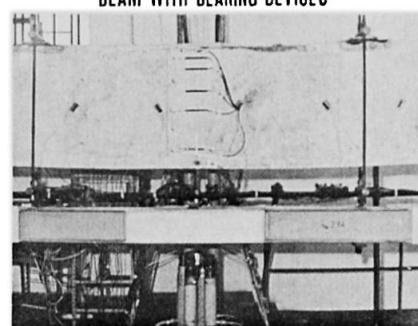
TRESTLE OF THE BEAMS 3-4



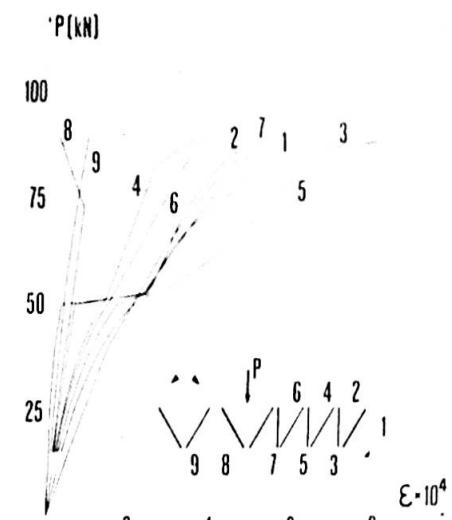
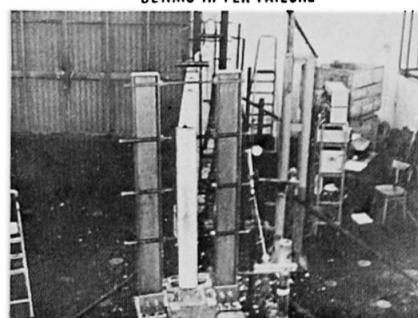
LOAD DEVICES AND BEAM AFTER CRACKING



BEAM WITH BEARING DEVICES



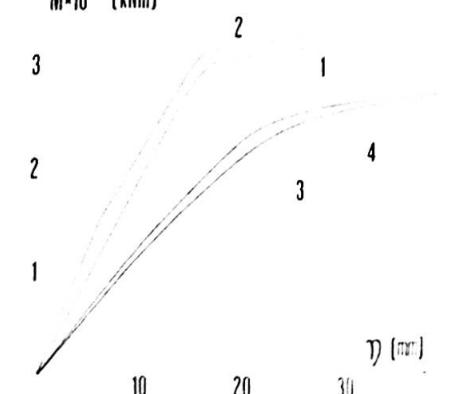
BEAMS AFTER FAILURE



STRAINS IN VERTICAL RODS AND DIAGONALS

OF THE TRESTLE OF THE BEAM 1

$\cdot M \cdot 10^{-2} (\text{kNm})$



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 hidraulic 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.

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- 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

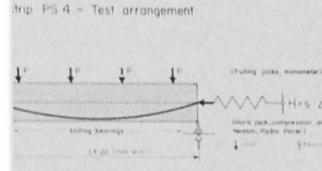
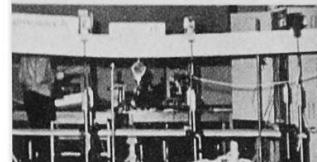
PRESTRESSED SLABS-DEVELOPMENTS IN EUROPE

P Schlub
LOSINGER LTD
Berne - Switzerland

SEARCH

THE DEVELOPMENT OF PRESTRESSED CONCRETE SLABS
D.M.A., 26. 11. 1972, Inst. Dr. S. Thüringens
Inst. für Strukturalk Engineering Gesellschaft
für Technologie (IfStG), Darmstadt, 1972

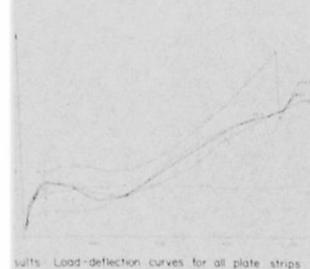
W. A. JOURNAL PLATE TEST AND PLATE STRIPS
POST-TENSIONING WITH UNBONDED TENDONS



Example of test arrangement for plate strips

Slab No.	Plates, mm	Plate strip thickness, mm, width, 50 mm
P 1	8.40 x 3.60	P 1.1 P 1.2 P 1.3 P 1.4 P 1.5
P 2	8.40 x 3.60	8.40 8.40 8.40 8.40 8.40
P 3	8.40 x 3.60	0.15 0.15 0.15 0.15 0.15
P 4	8.40 x 3.60	0.15 0.15 0.15 0.15 0.15
P 5	8.40 x 3.60	0.15 0.15 0.15 0.15 0.15
P 6	8.40 x 3.60	0.15 0.15 0.15 0.15 0.15
P 7	8.40 x 3.60	0.15 0.15 0.15 0.15 0.15
P 8	8.40 x 3.60	0.15 0.15 0.15 0.15 0.15
P 9	8.40 x 3.60	0.15 0.15 0.15 0.15 0.15
P 10	8.40 x 3.60	0.15 0.15 0.15 0.15 0.15

Characteristics of test specimens



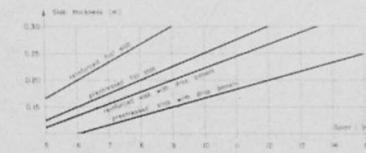
Results: Load-deflection curves for all plate strips

DESIGN

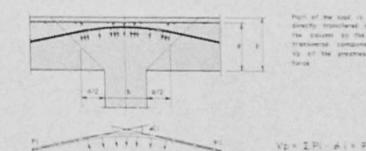
Scheme of load transfer by tendons



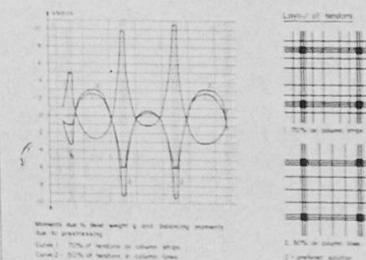
Slenderness of slabs



Punching mechanism

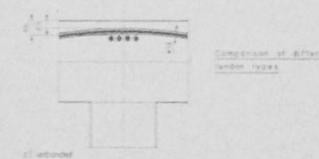
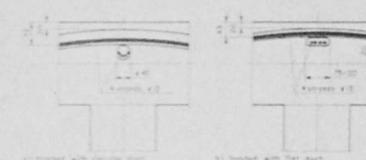


Distribution of tendons



CONSTRUCTION

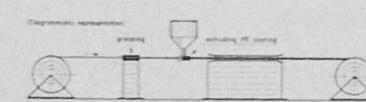
Excentricities



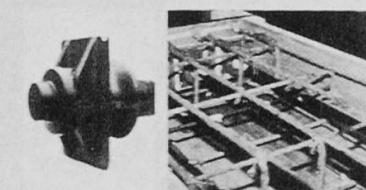
Unbonded monostrand



Extruding of unbonded monostrands



Monostrand stressing anchorage



EXAMPLES OF APPLICATION

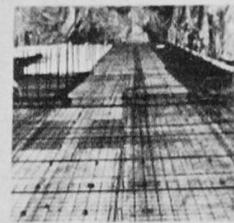
Multi-Storey Car Park, Saas-Fee, Switzerland

POST-TENSIONING WITH UNBONDED MONOSTRANDS

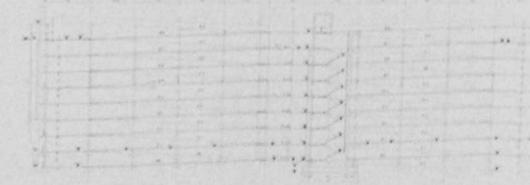
OWNER: Municipality of Saas-Fee
ENGINEER: Schmidleitner & Partner AG
CONTRACTOR: Ateliers de la Chaux-de-Fonds AG
PRESTRESSING: Spannerton AG Lyssach

Structure with 8 prestressed floors,
32.3 x 34.4 m each, for parking of 910 cars

Span: 7.50/7.60 m
Thickness: 0.20 m
Loadings: dead load 2.0 kNm/m
live load 7.0 kNm/m
Prestressing load: 3.7 kNm



LONGITUDINAL SECTION



Underground Garage, Housing Complex Oed XII, Linz, Austria

POST-TENSIONING WITH BONDED TENDONS IN FLAT DUCTS

OWNER: Wohnungs- und Immobilienamt
ENGINEER: Dipl. Ing. R. Heesemann
CONTRACTOR: Josef Prill & Sohn Linz
PRESTRESSING: Sonderbau GmbH, Linz

Prestressed garage roof with a total area of
2610 sq. m. (79 x 90 m)

Span: 7.50/8.00 m
Thickness of slab: 0.30 m with drop
loadings: dead load with cover 15.0 kNm/m
live load 15.0 kNm/m
total load 22.5 kNm/m
Prestressing steel: 8-groove strands with 40.000 daN tensile force



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

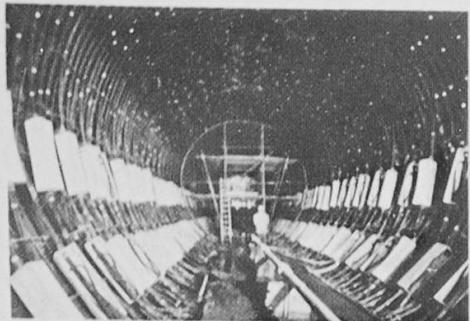
References:

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"



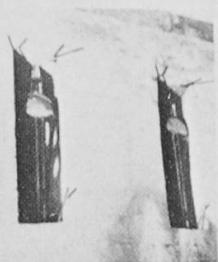
PRESTRESSED PRESSURE TUNNELS AND SHAFTS

I. Uherkovich, F. Fink
LOSINGER LTD
Berne - Switzerland



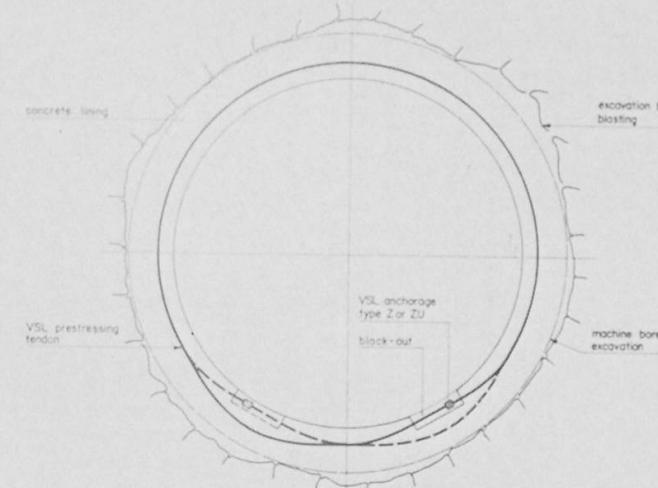
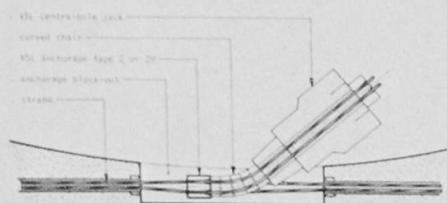
Prestressed concrete lining under construction. Pumped storage scheme, Oberaar-Grimsel, Switzerland. (Photo: Dampfwerk Unterwerke AG, Berne)

Stressing Anchorage

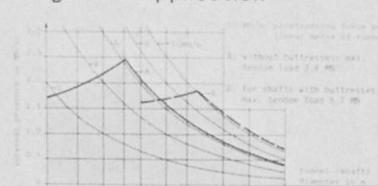


- VSL stressing anchorage type Z and ZU in block-out
- No anchorages inside the tunnel.
- Hydraulic profile maintained

Stressing Principle



Range of Application

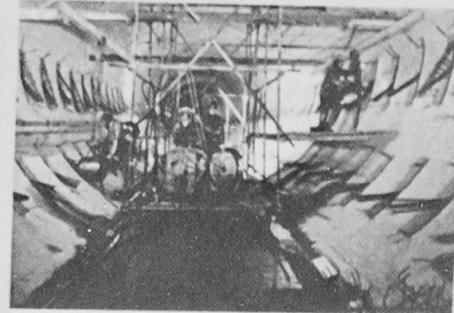
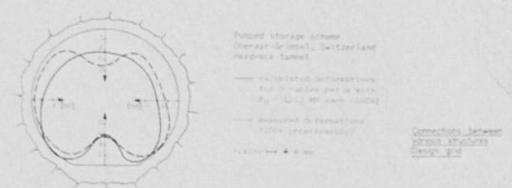


Prestressed Tunnel and Shaft Connections

Pumped storage scheme, Chelles-Piastre, Italy



Calculated / Measured Deformations



(Photo: Dampfwerk Unterwerke AG, Berne)

Representative Projects

PRESSURE TUNNELS

PIASTRA-ANDOVA, ITALY 1973/78

Length: 10,000 m, section: 12.5 m, Max. internal pressure: 100 bar



TALORD, SARDINA, ITALY 1975/78

Length: 10,000 m, section: 12.5 m, Max. internal pressure: 100 bar



OBERAAR GRIMSEL, SWITZERLAND 1977

Length: 10,000 m, section: 12.5 m, Max. internal pressure: 100 bar



CHIOTAS-PIASTRE, ITALY 1979/81

Length: 10,000 m, section: 12.5 m, Max. internal pressure: 100 bar



SURGE SHAFTS

BRASSTONE, ITALY 1973/74

Height of shaft: 100 m, section: 12.5 m, Max. internal pressure: 100 bar



TALORD, SARDINA, ITALY 1975/78

Height of shaft: 100 m, section: 12.5 m, Max. internal pressure: 100 bar



CHIOTAS-PIASTRE, ITALY 1979/81

Height of shaft: 100 m, section: 12.5 m, Max. internal pressure: 100 bar





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.

ASTM

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



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.

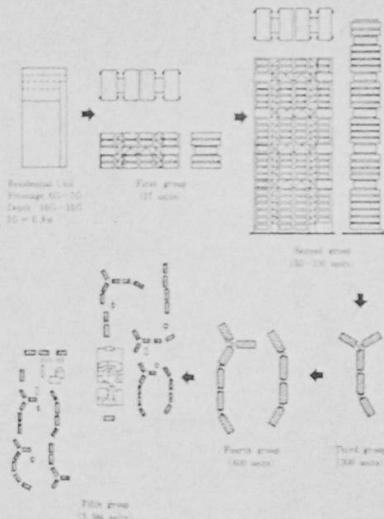


Fig. 1 System of High-Rise
Residential Buildings

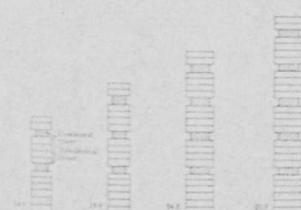


Fig. 2 Composition of Stories

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

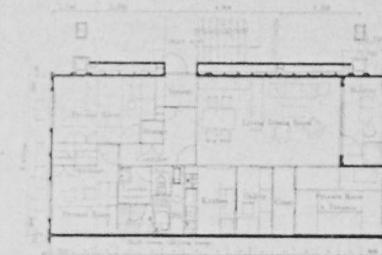


Fig. 3 Plan of A Residential Unit

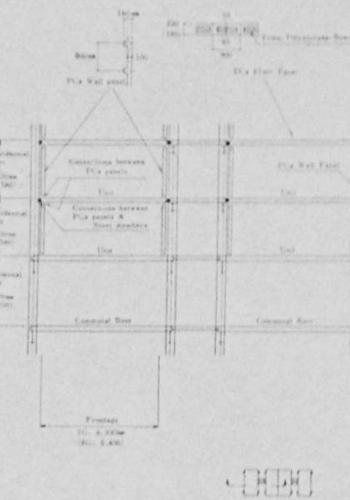


Fig. 5 Structure of Residential Units

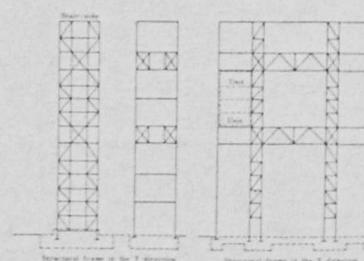
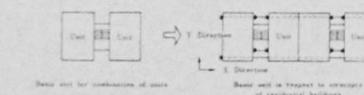


Fig. 6 Deformation of
Residential Units

* 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.

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

MICHELIN & CIE
VILLE DE MECHELEN
AUTEUR DU PROJET
PROF. DR. IR. F. MORTELMANS
K.U. LEUVEN

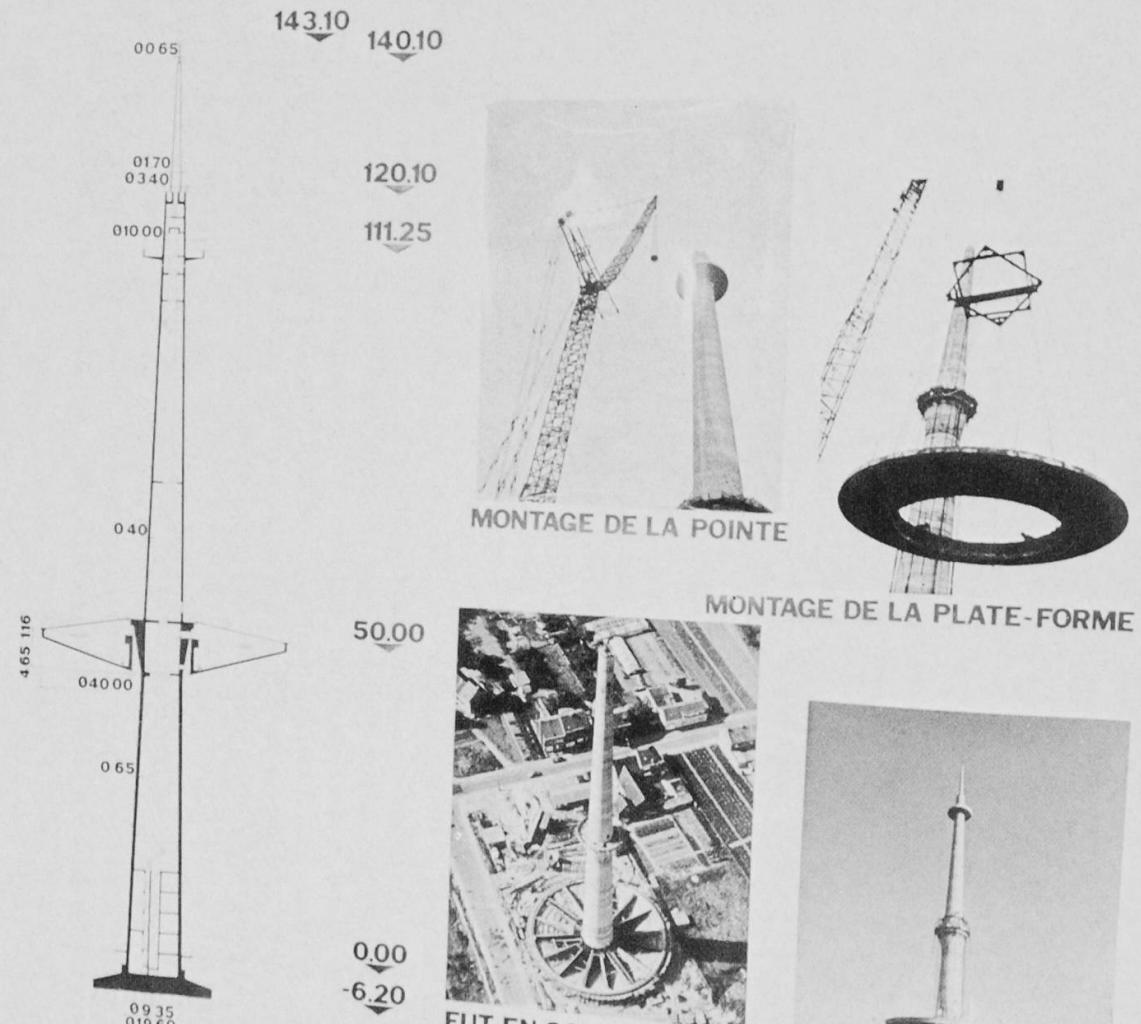
INGÉNIEURS CONSEILS
OMNIMIX TECHNIQUE DE
LA CONSTRUCTION LTD.
BRUXELLES

ENTREPRENEUR
VAN HOUT VOSSelaar
PRECONTRAINTE V.S.L.
CAPACITE DU RESERVOIR: 2300m³
COÛT TOTAL DE LA CONSTRUCTION:
15.000.000 FR

DATE DE MISE EN SERVICE:
15.09.1979



DETAILS DE LA PRECONTRAINTE DU RESERVOIR





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 m³ 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 récep-trices de la radio- et télédistribution de la ville,
- d'un mât en acier inoxydable de 20 m de hauteur et qui couronne la construc-tion 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 com-posée 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 a 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/ flèche en acier inoxydable.

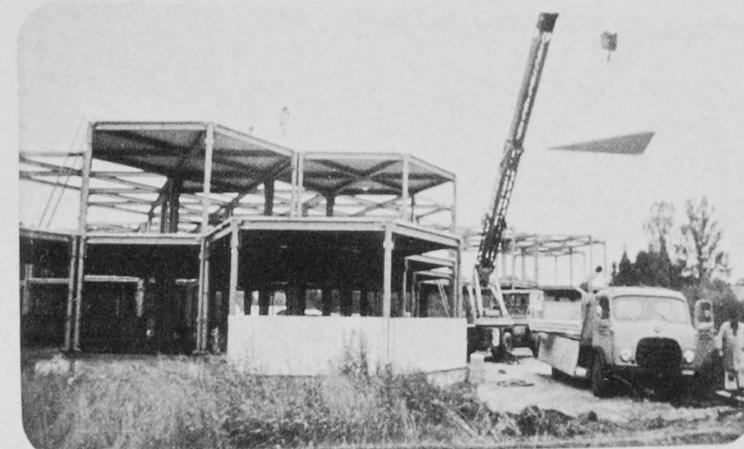
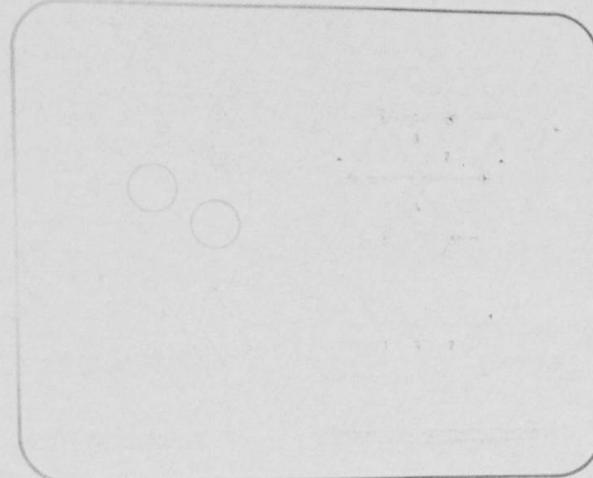
Maître de l'ouvrage : La Ville de Mechelen
Auteur du projet : Prof.dr.ir. F. Mortelmans
Bureau d'Ingénieurs Conseils : I.T.H. Bruxelles
Système de précontrainte et de levage : V.S.L.
Pieux des fondations : Soc. Pieux Franck
Entrepreneur : Soc. Van Hout à Vosselaar (Belgique)
Coût des travaux : 80.000.000,-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

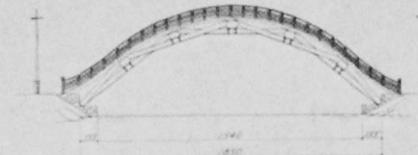
TWO SPECIAL CHINESE TIMBER BRIDGES

TANG HUAN CHENG

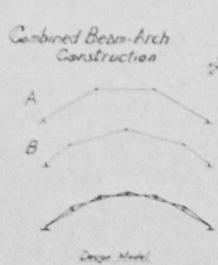


Rainbow
Bridge

This is a Chinese national art treasure, the Sung painting "River Side Scenery at the Qing Ming Festival". The bridge was constructed in year 1052, and was first noticed and analyzed by author in year 1953.



Dimensions of the bridge, as estimated from studies of writings by different authors in Sung dynasty are shown on picture. Calculated by electronic computer, the timber arch segment is about 30 cm in diameter. The total material required is 0.423 m^3 , including hand rails and deck plants.



The bridge structure consists of two basic systems, system A and B. Both systems are unstable structures, as they are held together by non-connection with timber strips.

The structure is designed as two hinged arch, but each segment is acted as a thrusted beam. It's named it "Combined Beam-Arch Construction" or similar names.



Bow Bow
Bridge

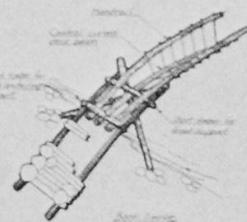
In the North-west of China, crossing the mountain river Yangtze, there are some interesting timber bridges constructed by native in the winter. The bridge have a bow shape. People call them "Bow-Bow" bridges.

Span length
12-20 M

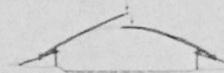


The bridge will mainly constructed with three curved beams connected with wooden rods members. The whole bridge looks like a new moon in the front view, and triangular shape in the cross section.

Bow Bow bridge is a spaced structure.



The construction of the bridge is shown on the picture. Longitudinal beams are installed in the riverbed on each bank, and connected out to the river. The gap between two longitudinal beams is then connected by another beam. During the connection beams, connecting main truss firmly with timber strips, the Bow Bow bridge is finally completed.



The Bow-Bow bridge though is not true arch action. It is a Pre-stressed Lateral beam construction.

Conclusion

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

prof. dr kruno
TONKOVIC

4 STRUCTURES EN BOIS ◦ WOOD ◦ HOLZ ◦

JUGOSLAVIJA

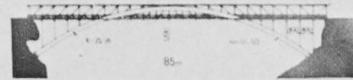
zagreb - jugoslavija
gradevinski institut

IVBH
IABSE
AIPC

1980



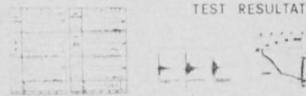
85m



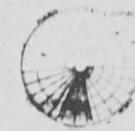
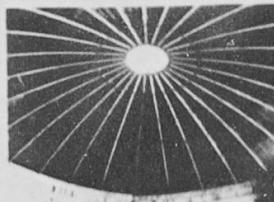
S. Dimnik: Pasarela - Kokra - Kranj - Jugoslavija 1938



L = 39 m



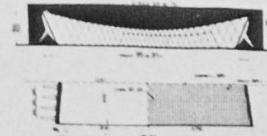
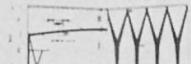
TEST RESULTATS



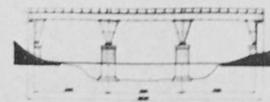
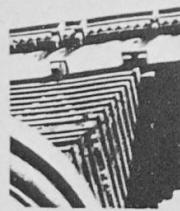
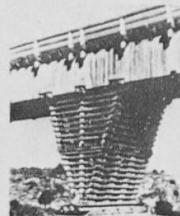
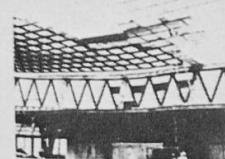
K. Tonković: Kupola brodarski institut - Zagreb - 1954

K. Tonković: hala velesajam - Zagreb

1955



L = 95 m



K. Tonković: most Budak - Lika 1952

HARTL
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