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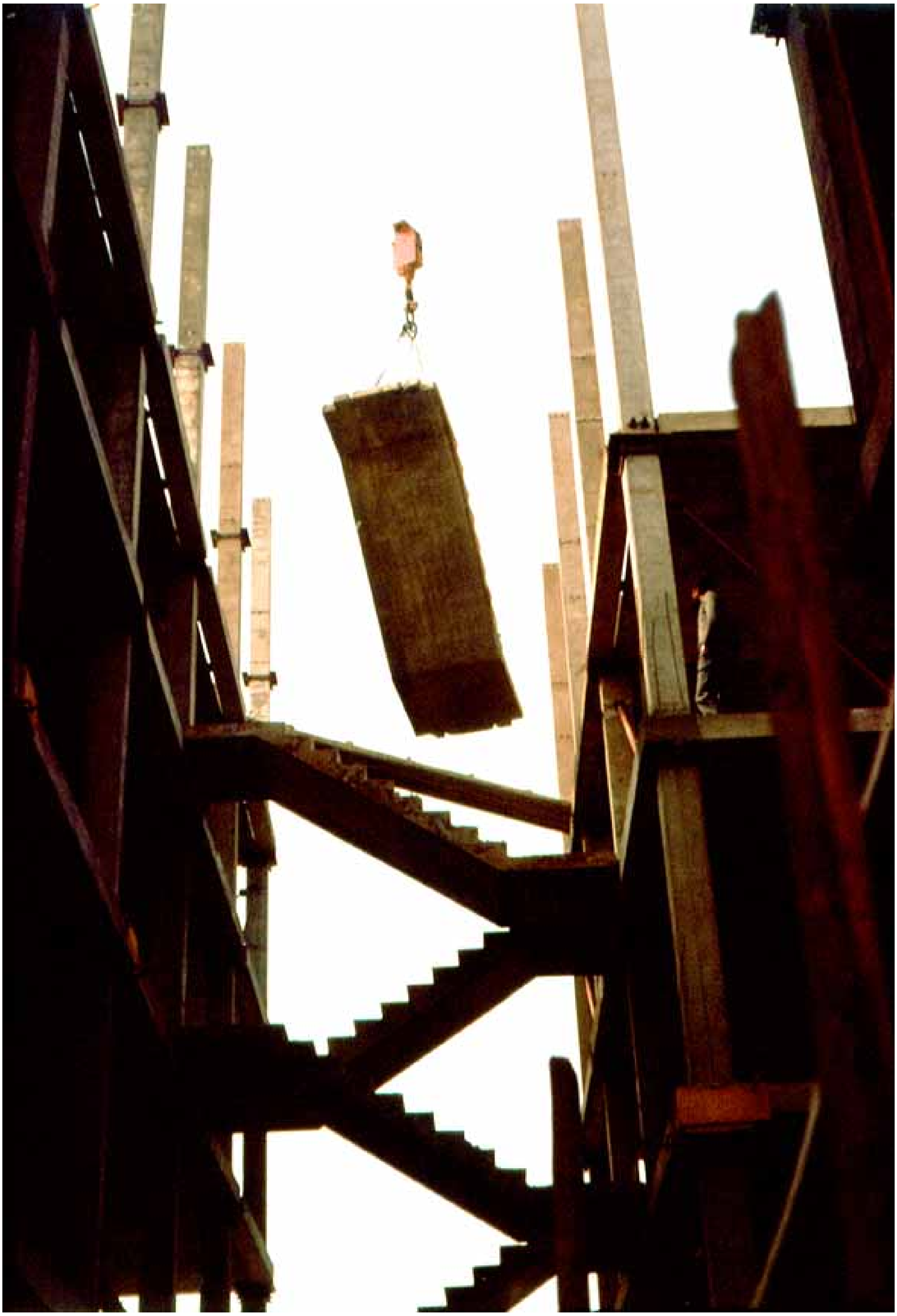
IMS BUILDING TECHNOLOGY

Precast Prestressed Concrete Skeleton in Contemporary Building



metals and equipment
roads and geomechanics
materials and building physics
structures and building technologies

Presentation

Edited by

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IMS BUILDING TECHNOLOGY

IMS building technology is an advanced system for accelerated construction with precasted elements of the skeleton. This unique system based on the prestressed connection of the structure elements was developed by prof. Branko Zezelj at the IMS Institute in Belgrade. It was first implemented in 1957 and is since constantly being upgraded.

Numerous buildings and apartment factories have been built – more than 150.000 apartments in former Yugoslavia, Italy, Angola, Philippines, Egypt, Ethiopia, Cuba, Hungary, Russia, Georgia, Ukraine, Bulgaria etc.

Prefabricated prestressed skeleton has been tested in theory and experimentally, under all kinds of possible loads (static, dynamic, seismic, impact, fire..) and it always showed, without exception, high safety coefficients. Verification and attesting of elements, joints and structure, as a whole, have been realized in former Yugoslavia, Hungary, Italy, Austria, Russia, Uzbekistan, Cuba, China and USA. The research results are verified on numerous international congresses of specialized experts and scientific organizations.

IMS Building Technology is used for virtually any type of buildings: residential, office, industrial, school, hospitals, houses, garages etc.

Benefits

- Significantly reduces building costs and accelerates investment turn over time.
- Enables flexible solutions, greater space-planning capabilities and wider range of possibilities for building interior design.
- Prestressed construction dissipates kinetic energy caused by seismic activity and resists to earthquakes up to 9 degrees of Richter’s scale.
- Enables extraordinary architectural solutions, increased technical performance and efficient organization.
- Minimizes the use of concrete and steel.
- Accelerates building and diminishes construction time.
- Increases building durability and reduces building envelope repairs.
- IMS building technology is a high return investment.
- Local materials or procedures can be applied on façades, roofing and interior surfaces, in order to obtain sustainable, energy-efficient and cost-efficient housing.

How does the innovation solve a particular problem?

In the early 1950's, former Yugoslavia had a great problem of housing space deficit, which represented a challenge for the great constructor Branko Zezelj and his team, first of all the engineer Bosko Petrovic, with whom he developed and applied, at the time, a new building material – prestressed concrete. Designing bridges and halls unique in the World, he got a great idea to apply the material and technology of prestressed concrete in the field of building houses.

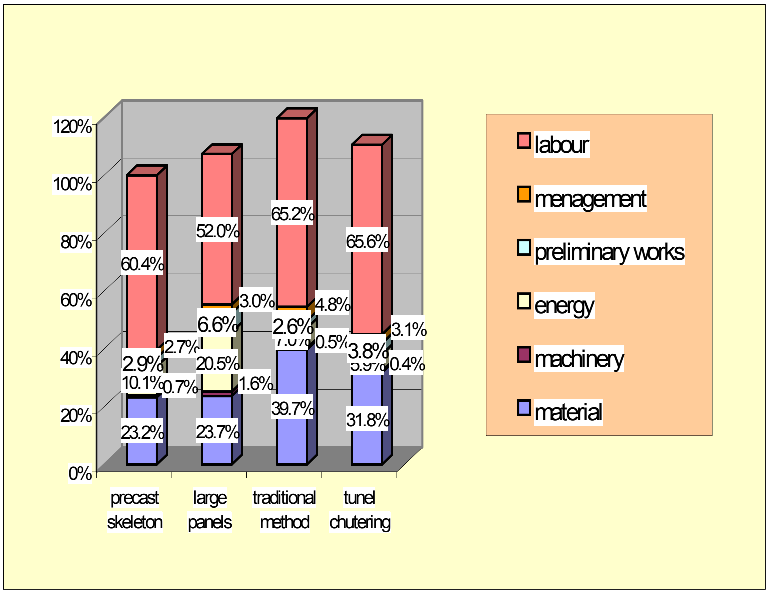

Diagram - Comparative analysis of different construction type expenses

Traditional building system
Tunnel form system
Large panel system
Prefabricated prestressed concrete skeleton.

Market price of building material
Labour price
Machinery and section power price
Preliminary work price
Management-expert service price
Total price of a building

The idea was simple – to build standard buildings by use of standard elements, as children do with Lego bricks. The toughest problem – the connecting of the elements of the concrete frame, made of prefabricated columns and slabs, was resolved through the application of steel cables aimed for the post-tensioning process. In was a revolutionary idea that required numerous researches and proofs, first of all, in the field of durability and stability and the in the field of architectural design and possibilities to be justified in practice as a universal technology for all kinds of high-rise structures.

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The IMS system holds the certificates of various institutions worldwide, such as:

- Ministry of Public Works, Italy
- Ministry of Construction, Cuba
- TbilZNIIEP Institute, Georgia
- EMI, Hungary
- Central Scientific – Research and design – Experimental Institute for the Construction of Complex Building Structures, Russia
- Building Research Institute, Ministry of Construction, China

During its 50 years of application all around the World, locations, where the buildings were constructed, were unfortunately exposed to natural and other catastrophes: earthquakes up to 8 Richter degrees (Banja Luka, Bosnia & Herzegovina), hurricanes (Havana, Cuba and Manila, Philippines), wars, bombings (Sarajevo, Mostar, Bosnia & Herzegovina, Osijek, Croatia), fires, accidents... In all those conditions buildings with prefabricated prestressed skeleton remained stable, as a whole, without significant damages, so that, after cosmetic remedial works, they are now in use again.

IMS apartment factories

In former Yugoslavia:

Nis, Leskovac, Smederevo, Kragujevac, Pancevo, Novi Sad, Belgrade, Pozarevac (Serbia), Zvornik, Banja Luka, Tuzla (Bosnia & Herzegovina), Osijek (Croatia).

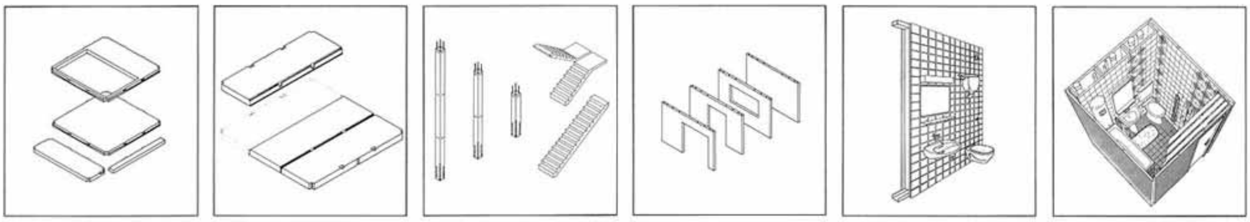
Worldwide:

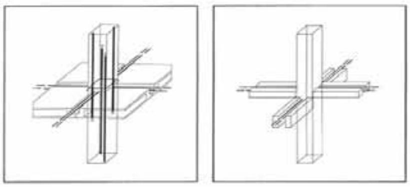
Angola, Egypt, Ethiopia, Philippines, Georgia, Italy, China, Cuba (three factories), Hungary, Russia (three factories).

IMS building Technology in practice

Basic IMS system elements

IMS building technology is based on reinforced concrete prefabricated skeleton, composed by basic reinforced concrete elements of the IMS system:





Columns (concrete grade M 40), continual through maximum 3 stories (depends on their cross-sections and storey height or possibilities of the crane used for erection), possessing square cross-section – dimensions: 30 x 30 – 60 x 60 cm.

Floor slabs (M 40) cover space between columns and can be manufactured with or without concrete ceiling, as one-piece (spans until 3.6 x 4.8 m) or multi-pieces aiming to adapt dimension for transportation and erection (ceilings made for the span 9.0 x 9.0 m are constructed from nine standard elements); the marginal girder and waffle web height is 20-40 cm (depending on column span between which space is covered), floor slab depth between coffer webs is 4-6 cm, and the ceiling one is 3cm.

Cantilever floor slabs (M 40), which replace edge beams in architectural solutions where balconies, loggias or other housing space out of column span are required and which are connected only to two columns (as a cantilever) and their height and length correspond to floor slabs near which they are erected, while their maximal width is limited on 1/3 of the longitudinal span. They are waffled and can be with or without concrete ceiling.

Edge girders (M 40) have a boundary position in order to form frame beams and facade construction. Their lengths and depth are the same as at corresponding floor slabs with which they form a frame beam and their width is chosen according to architectural requirements for the adequate type of facade walls.

Stiffening walls (M 40) are reinforced concrete panels (minimal depth – 15 cm), which stiffen the frame. They are positioned, by the rule, in the axis of two adjacent columns, having a function to form, together with columns, a structural element from foundations to the roof, ready to receive required intensity horizontal forces (in practice, those elements are often set in concrete in situ, especially at larger spans for the reasons of huge dimension, weight and slow frame erection).

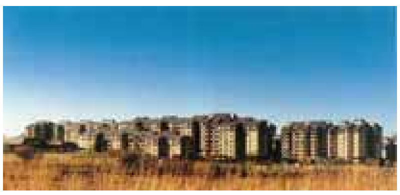
Elevator manholes – in practice those elements are set in concrete in situ, because of non-rational series (small number of elements in constructing building in relation with the mould price for manufacturing within the own section), which, by the rule serve for the acceptance of horizontal forces together with stiffening walls.

Stair elements for one-flight, double-flight or triple-flight stairs, with monolith or prefabricated steps.

The envelope of the building – façades and roofing, as well as interior walls and surfaces, installations and equipment are not standardized. That means that any type of local material or procedure can be applied in order to obtain sustainable, energy-efficient and cost-efficient housing.

Production of skeleton elements

Connection of elements – prestressing



A large housing estate built using the IMS System

What are the results?

Numerous buildings and apartment factories have been built – more than 150.000 apartments in former Yugoslavia, Italy, Angola, Philippines, Egypt, Ethiopia, Cuba, Hungary, Russia, Georgia, Ukraine, Bulgaria etc.

IMS building technology has successfully been implemented in the production of high, medium and low-standard housing, in Europe as well as in developing countries, for small individual houses and skyscrapers, for residential estates and commercial or public edifices and industry.

Benefits

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International interest

IMS Building Technology is today used on all continents.

Low-cost residential buildings,
Havana (Cuba)

Low-cost residential buildings,
Cairo, Egypt

A skyscraper in Pecz (Hungary)

Experimental building in Angola

Exclusive commercial and residential
complex in Manila, Philippines

To use IMS Building Technology in other countries

Apartment plants in Cuba and Ethiopia

Services provided by the IMS Institute:

- Design for the apartment plant
- Delivery of necessary equipment
- Training of local staff for design, production and assembly of skeleton elements
- Supervision of construction works for the first building
- Architectural and Structural designs for buildings

Transport of structure elements

A school in Hungary

Selection of papers

Apartment house built in the IMS skeleton system. Tbilisi: TbilZNIIEP Institute, 1981 (in Russian).

Certificato d'idoneita delle strutture realizzate secondo il sistema IMS. Roma: Ministerio dei lavori pubblici, 1964.

Dimitrijevic, Radovan and Gavrilovic, Branka. *Precast prestressed concrete skeleton in contemporary building - IMS system*. Belgrade: IMS Institute, 2000.

Dimitrijevic, Radovan. "Prestressing technology in housing – Yugoslav experience", XII FIP Congress, IMS Institute Proceedings, 2 (Vol. XXI, 1994), Belgrade.

Dimitrijevic, Radovan. "Researches of the column – slab joint in the IMS skeleton system", IMS Institute Proceedings, 1 (Vol. XXI, 1994), Belgrade.

Markarov, N.A. and Filaretov, M.N. "Structural and technological characteristics of the skeleton – panel buildings with stressed reinforcements at the building site in USSR", Concrete and prestressed concrete, 4 (April 1990), Moscow (in Russian).

Report on expert commission on testing and bearing control of floor – slab module in the plant of Allami Epitoipari Vallalat, Baranya. Budapest: EMI, 1981 (in Hungarian).

Report on the scientific-technical testing and testing of results of a three-storey segment of the sixteen-storey experimental building in Taskent. Moscow: Central scientific – research and design – experimental institute for the construction of complex building structures, 1991 (in Russian).

Static testing of the IMS system – column and slab load bearing characteristics. Beijing: Building research institute of The state administration of building construction, 1979 (in Chinese).

Testing report on bearing characteristics of joints for duna – tesit (IMS) structures and the possibilities for their strengthening. Budapest: EMI, 1990. (in Hungarian).

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