PANEL TECHNOLOGY, BUILDING SYSTEM

CUTAWAY VIEW OF A HOUSE SHOWING THE USE OF THE SYSTEM FOR WALLS, SLABS AND ROOF

THE MOST VERSATILE AND FLEXIBLE BUILDING SYSTEM IN THE WORLD
WHAT IS THE PRE-FAB PANEL SYSTEM?

The system combines a high tech polystyrene foam and steel mesh panel core with a "skin" of high strength RCC applied by spraying.

The system was invented by an Italian engineer, Angelo Candiracci over 30 years ago. It has constantly been perfected to its present state as the world's most widespread anti-seismic building system.

It is light, very strong and cost effective.

It is highly resistant to heat, moisture, sound, and provides for the best comfort conditions in any climate.

It has been used mostly in developing countries in south East Asia, Latin America, Africa, and the middle east.

The entire building of walls, slabs, and roofs are made with this system, which is called sips, structural insulated panel system.

It is now been introduced to the U.S. As a green system to re-build housing in the vulnerable cyclone affected southern states.
TYPES OF CORE PANELS - Standard Panels

Single Panel:
This panel is perfect for walls, partitions, claddings, floors and roofing of buildings, both civil and industrial.

Used as a load-bearing structure, for four storey buildings, with application of structural plaster on both sides, for partitions and claddings in buildings, either new or to be renovated; as a curtain wall and partition in large-sized industrial and commercial buildings; as an insulating disposable form for roofing and floors of reduced span, prepared with or without pre-installed ribs.

Double Panel:
Insulating double panel, excellent for reinforced concrete walls such as load-bearing walls and retention walls.

The double panel consists of two basic panels, suitably shaped and joined one another by double horizontal connectors creating internally a space to be filled with concrete having suitable characteristics and strength. The thickness of the concrete casting inside the "double panel" as well as the characteristics of the concrete itself will be defined according to the structural needs.

Finally, the panel is finished with the application of the external plaster. The double panel, supplied with reinforcement certified by an Official Laboratory in conformity with the Law 5/11/1971 no.1086 - D.M. 9/1/1996, complies with the provisions concerning reinforced concrete structures according to the EUROCODE 2 (EC2)
TYPES OF CORE PANELS - Standard Panels

Floor Panel:
Panel for the realization of floors and roofing with r.c. joists, giving great advantages as to lightness, insulation and rapidity of assembling.
Using the Panel floor panel composed of a foam polystyrene shaped plate it is possible to realize floors and roofing of buildings with the addition of supplementary steel inside suitable joists and subsequent cast on site of concrete. In the photograph: panel equipped with reinforcements for the installation phase.

Stair Panel:
Panel for a lightweight, resistant staircase of rapid realization.
It is made up of a foam polystyrene block, shaped according to design requirements, coated with two layers of steel wire mesh assembled with electro-welded steel wires.
This panel, suitably reinforced and finished with casting on site in the proper spaces, is used for the realization of flight of stairs to be externally finished with traditional plaster, tiles or whatever material. The stairs panel is characterized by comfortable and rapid installation along with a special lightness and structural resistance.
TYPES OF CORE PANELS - Standard Panels

Landing Panel:

Panel for the realization of landings, floors and bi-directional reinforcements. It gives continuous insulation to the panel intrados.

The Panel landing panel is an excellent solution for the realization of landings positioned next to the stairs realized with the Panel stairs panel.

The landing panel can also be used for any plate or slab of r.c. to be reinforced in two directions, with the advantage of a weight smaller than a full slab and the presence of a continuous insulating material used also as a form.
TYPES OF CORE PANELS - Special Panels

Floor Panel (Moulded):

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Angular Double Panel:

Panel to be used in the combination with the double panel for the realization of the edges.

The angular panel completes the range of the double panels, with which load-bearing walls of reinforced concrete are realized.
TYPES OF CORE PANELS - Special Panels

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The Panel can be easily hand transported by one/two operators, even in the assembled way and when the dimensions exceed 4 m².

Afterwards, during the assembling phase, it can be worked and manually positioned just by one operator without the use of lifting equipment.

This facilitates and speeds up the installation of the panels in any situation. These operations do not demand any specialized labourers.
CONSTRUCTION PROCEDURE

The laying of the systems is easy, fast and clean, since it does not require any masonry work.

The chases in the polystyrene are carried out by means of a hot-air generator and the system canalizations are laid behind the metal mesh.

In case of rigid or semi-rigid pipes, the metal mesh is cut in the required length by using normal shears and then restored with portions of reinforcement plane meshes.
CONSTRUCTION PROCEDURE

Once the panels have been joined one another, the plumbing system has been completed, the concrete casting, in the case of double panels, has been done and once the pipes have been arranged, the plaster can be applied directly onto the panel.

Here again, if compared to other systems, the advantages of the Panel system are evident. The galvanizing of the support mesh does not prevent the use of different types of plaster. Moreover, the plaster, if applied on joined walls and if reinforced with metal meshes, will turn out to be monolithic, excluding any possible phenomenon of flaw due to mechanical and/or thermal strains.

What is more, since there are no patches of the system chases - that are, instead, always visible in the traditional systems - the plaster will turn out to be homogeneous and improved as for quality and even from an aesthetic point of view.
CONSTRUCTION OPTIONS

For low rise bungalows and apartments, the structure can be done in a month

Load bearing wall apartments upto 20 stories can be built without columns and beams

RCC / steel frames can also be integrated structurally with the panels for longer spans and higher buildings {20-50 stories}

Large span structures such as factories, I.T. Buildings, shopping malls can be built using composite /Panel structures in a very short time

Costs are lower than conventional buildings, but due to the thinner walls, effective floor area is higher, and generates more revenue in a given envelope.
ADVANTAGES

Lightness: The Panel are lightweight and sufficiently rigid at the same time, even before their finishing with spritz-beton, so that they turn out to be extremely manageable and easy to handle and to assemble even in the most uncomfortable operating conditions.

Rapid installation: Several experiences carried out in various conditions, in many countries of the world and using different labourers, have shown a remarkable shortening of the time of realization as for the constructions carried out with the Panel system if compared to those carried out with the traditional systems, thanks to the use of an industrial product which optimizes the assembling sequences and reduces the operations of the construction site personnel to a minimum.

Versatile: The Panel building system favours absolute design flexibility, since it is equipped with a full range of building elements: load-bearing walls, curtain walls, floors and stairs. Furthermore any kind of geometrical form, either plane or curve, is easily obtainable just by simply cutting the elements at the site.
ADVANTAGES

Inexpensive: The Panel panels represent a real advantage both for the final users and the firms since they permit to obtain better performances than the traditional products and at more reduced costs.

Energy Saving: The remarkable improvement of the heat comfort indoors the house built with the Panel system is guaranteed by the wide presence of polystyrene and by the very low thermal conductivity which, eliminating the thermal bridges, reduces the energy consumption and relevant costs dramatically. Thanks to the Panel building system one can realize high energy efficiency buildings thanks to continuous walls without thermal bridges and thanks to insulated canalizations inside the panels.

Load Resistance: Several laboratory tests carried out in different areas of the world as well as in Italy have put into evidence the high load resistance of the Panel panels. For example, compression tests with centred load carried out on a finished single panel, cm 270 high, have shown that the same panel can sustain a maximum load of 1530 kN/m.
ADVANTAGES

Cyclone Resistance: Buildings realized with the Panel system in areas with high risk of cyclones have proved, throughout the years, their capacity to withstand the passing of the most destroying cyclones, thus confirming the high resistance of the Panel buildings to the complex strains and thrusts of the force generated by cyclones.

Earthquake Resistance: Laboratory tests carried out on one of the Panel prototypes made up of two stairs in true scale have shown that the structure withstands, with no damages, strains greater than those calculated for a First Class Earthquake, that is the maximum provided for by the Italian Earthquake regulation. The results obtained during these tests represent the scientific confirmation of what has already been experimented in nature many times.

Fire Resistance: The quality of the foam polystyrene used for our panels is of the self-extinguishing type; moreover, the two concrete layers which coat the panel sides prevent its combustion. The fire resistance has been also verified in tests carried out at different laboratories, complying in full with the minimum requirements of the most demanding regulations. For example, a wall realized using the PSM80 panel has shown a fire resistance greater than REI120.
ADVANTAGES

Sound Proofing: The soundproofing of the Panel panels represents one of the advantages of the building system. The possible application of acoustic insulation materials onto the panel (such as cork, cocoa fibre, plasterboard, rock wool, etc…) optimizes the insulation of the walls in accordance with the hardest acoustic legislation.

Wide choice of finishing: As for their finishing, the walls realized with the Panel panels can be completed both with the application of a thickness covering directly on the raw plaster and, as an alternative or a traditional paint on the smoothened plaster. Finishing of any type are possible without any limitation.
The buildings are so strong that they can resist the strongest earthquakes!

They are in use for 25 years all over the world!

They are fireproof and can resist strongest cyclones.

Earthquake testing at Terni, Italy in November 1999 with full scale building was tested to 8.5 Richter without damage
I.T. SECTOR AND COMMERCIAL BUILDINGS

The Panel system is ideal for rapid construction of IT complexes for the following advantages:

Speed - IT buildings are always wanted "yesterday". Panel buildings can be made in 1/3 the time.

Insulation - all IT Buildings are air conditioned 24x7x365. So the initial tonnage cost of AC buildings can be reduced by 40%.

The energy costs for cooling can be reduced by 30% throughout the life of the building.

Total savings add up to significant figures.

Even at imported prices, Panel buildings are competitive for all buildings requiring 24x7 air conditioning.

This includes all offices, hotels, biotechnology factories, Electronic and other hi-tech industries.
Because the structure is truly monolithic, it can absorb seismic stresses more 8.5 on the Richter scale without damage. It is widely used in seismic regions such as Italy, Mexico, Chile, Philippines, etc.

It has been used for load-bearing walls in apartment buildings of 20 stories high in Chile and other Latin American locations.

Panel can be used in combination with steel and RCC frames if needed.

A test conducted at the university of Peruggia in 1999 on a full scale model showed that even the strongest seismic stresses could not damage the house.

As the structure is based on a polystyrene and steel core with a 35mm skin of m-30 RCC, the reduced thickness gives more usable area.

The great reduction in weight reduces the foundation cost, a significant factor in areas with low bearing capacity. The walls are also bulletproof.
# COMPARISON OF MOKUL WITH MONOLITHIC CONCRETE

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<tr>
<th>FEATURES</th>
<th>Panel</th>
<th>Poured Concrete</th>
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<tr>
<td>Strength</td>
<td>Very Strong</td>
<td>Very Strong</td>
</tr>
<tr>
<td>Speed</td>
<td>Very High</td>
<td>High</td>
</tr>
<tr>
<td>Steel Usage</td>
<td>Very low, all steel is contained in the system as Galvanized wire mesh FE-600</td>
<td>Normal, with site fabrication of normal steel.</td>
</tr>
<tr>
<td>Formwork</td>
<td>No formwork needed.</td>
<td>Expensive but re-usable aluminum formwork</td>
</tr>
<tr>
<td>Wall Thickness</td>
<td>About 140-150 mm.</td>
<td>Usually 100 mm.</td>
</tr>
<tr>
<td>Resistance to Heat, Moisture</td>
<td>Extremely Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Durability</td>
<td>Extremely Durable</td>
<td>Reasonably Durable</td>
</tr>
<tr>
<td>Site Machinery</td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cost</td>
<td>10-20% Less</td>
<td>Standard</td>
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SPECIAL BUILDINGS IN EXTREME CLIMATES

It is ideally suited for Himalayan regions, as the traditional material, wood is in short supply.

Photo of building under construction in Antarctica

These buildings bear extremely high snow and wind loads. Temperatures of -60°C and wind speeds of 160 kmph.

Panel buildings in extreme climates have proved their extreme adaptability.

Building at Saudi Arabia, Extremely hot 50°C temp by day

Building at Antarctica, Temp -60°C

Kedarnath - extreme cold and very heavy snow loads
Panel BUILDINGS IN INDIA

First Villa being constructed at Shantiniketan, West Bengal in Year 2000.

Presently several buildings have been constructed with the system in West Bengal, Maharashtra, Gujarat, and Uttaranchal, with panels imported from manila.

Photographs show construction in, Mumbai (10 storied apartment)-2004.

House for West Bengal housing board-2001,

Guest house at kedarnath-2005.

Several other buildings have been constructed in India using imported panels, from 2000 to the present date, to explore the possibilities of the system

Imported panels are relatively expensive due to the transportation and import duties

Once panels are produced in India, the structure costs are expected to be 10% to 18% cheaper than conventional RCC/masonry construction
The Panel system is ideal for large scale EWS projects because:

- Lower costs for stronger buildings - possible because of the simple and fast erection
- The system has been used very successfully for EWS type housing in many developing countries over the last 25 years
- Materials used are relatively inexpensive
- Time taken is far less than with a conventional system-saving interest costs
- Concrete used for structural plaster uses 5mm down aggregate
- Buildings are strong but lightweight, resulting in lower foundation costs
- Comfort conditions inside are far better than with RCC wall construction
Panel buildings work out less than conventional G+3 RCC framed buildings with masonry infill.

No columns or beams are needed for load bearing RCC wall construction up to 20 stories high.

Very little shuttering is needed for the slabs

Very little additional steel is needed, most of the steel is galvanized welded wires in the panel itself.

Very little labor is required for erection and spraying

Volume of concrete (M-25 and M-30) is comparatively small for buildings with single panels

No lifting machinery is needed, most operations are manual.

Installation of doors/windows and electrical/sanitary plumbing is fast and easy

Buildings are monolithic - absence of joints makes for lower maintenance
Panel AROUND THE WORLD

SOME BUILDINGS IN LATIN AMERICA, WHERE THE SYSTEM IS IN WIDESPREAD USE.

ROW HOUSING PROJECT - KOLKATA

20 STORIED APARTMENTS - MEXICO
BUILDINGS IN SOUTH-EAST ASIA

Photographs of Buildings with the Panel system in Malaysia and Philippines.
THANK YOU