dlc consulting
PRECAST SYSTEMS DESIGN AND TECHNOLOGY

Precast system for tertiary

PANDAL®

PANDAL® SYSTEM

- PANDAL® is an innovative precast system for tertiary

- Realizes frame structures or mixed wall-frame structures

- The elements are joined with dry connections that provide high speed of assembly

- It can be used to build:
  commercial buildings
  multifunctional centers
  office buildings
  schools
  barracks
  hospitals
  multilevel parking
  etc.

- The system is characterized by a low ratio m3 of concrete per m2 of construction

PANDAL® is the latest and most advanced precast concrete system for tertiary buildings developed by DLC consulting. The PANDAL® system allows the construction of multi-storey frame buildings using entirely precast pre-stressed R.C. slabs (Pandal® slabs) spaced by trussed R.C. plates, single hollow core Pandal® or inverted T beams in pre-stressed R.C., R.C. columns with corbels and foundation footings. In the most typical version slabs, beams and column corbels are in the thickness of the slab. The cladding is made with R.C. panels, typically arranged in horizontal, but it is compatible with different façade systems. The frame structure can be stiffened with the flexural connection of beams and pillars or used in combination with precast load-bearing lightened walls (Master® walls), so to obtain coupled wall-frame structures. All elements are connected with dry mechanical devices that provide high speed of assemblage.

The system, due to its high freedom in composition, allows the realisation of a wide range of tertiary buildings, such as malls or multifunctional centres, office buildings, schools, stations, hospitals, car parks.

The structural optimisation of the system has led to the attainment of a m^3 of concrete per m^2 ratio referred to the complete structure equal to only 0,16 for the frame structure and to 0,20 for the coupled wall-frame structure.

The PANDAL® system is set with a dual technology solution based on the maximum module span:

- PANDAL (frame): 10 x 16 m
- PANDAL+DOMUS (coupled wall-frame): up to 12 x 12 m

- Great lightness

- Slabs with floors and ceilings flats

- Arrangement for the plant engineering passages inside the voids of slabs

- Long span

- High fire resistance

PANDAL® SLAB

The Pandal® slab is an element in pre-stressed R.C. with lower flange having a standard width of 2,4 m. Its shape allows for high flexural and torsional stiffness and resistance with reduced thickness and consequent high lightness. Normally it is used to create decks with flat soffit and floor with elements spaced by trussed plates with a maximum inter-axis of 5 m, closed at the bottom with accessible ceiling. The slabs can also be placed in adjacency (in this case the slab is called Domus®).

R.C. trussed plates bear on special recesses left on the upper edges of the slab elements, closing the floor. An in-situ pouring of a completing screed may be executed, especially in case of distanced slab elements.

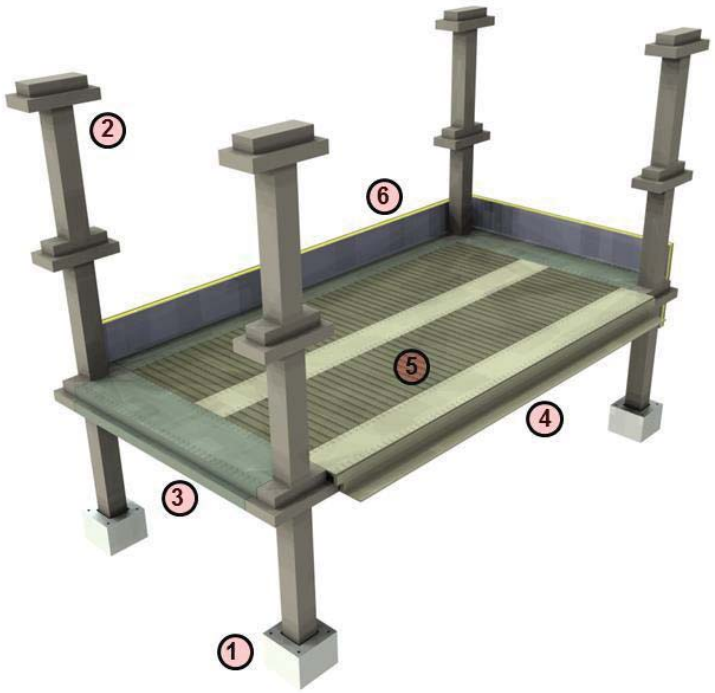
the Pandal® slab is produced with 350, 500 and 600 mm depth and the edges can be provided with corbels.

Its low weight allows to cover spans of up to 16 m.

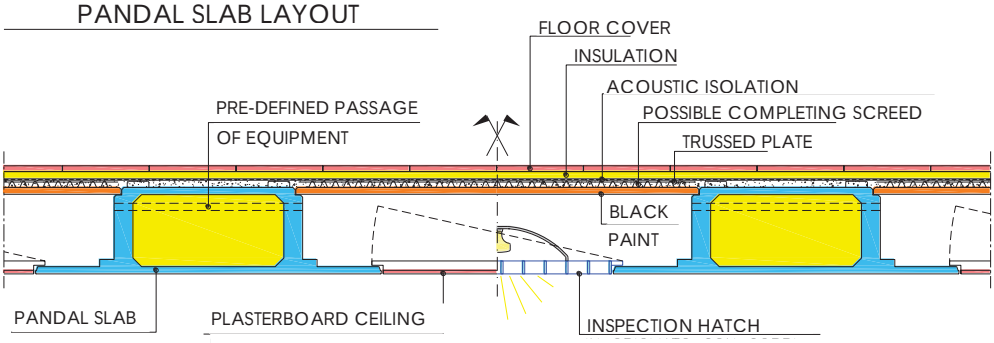
The positioning of the pre-stressing strands ensures high fire resistance.

LEGEND

1) Foundation footing
2) Column with corbels
3) Hollow core PANDAL beam
4) Hollow core PANDAL slab
5) Trussed interposed plates
6) Horizontal cladding panel



PANDAL SLAB LAYOUT



- Beams with box section or inverted T

- The beam can be in the slab thickness with saddle support

- A special reinforced slab, called tragolo, joints the pillars in orthogonal direction

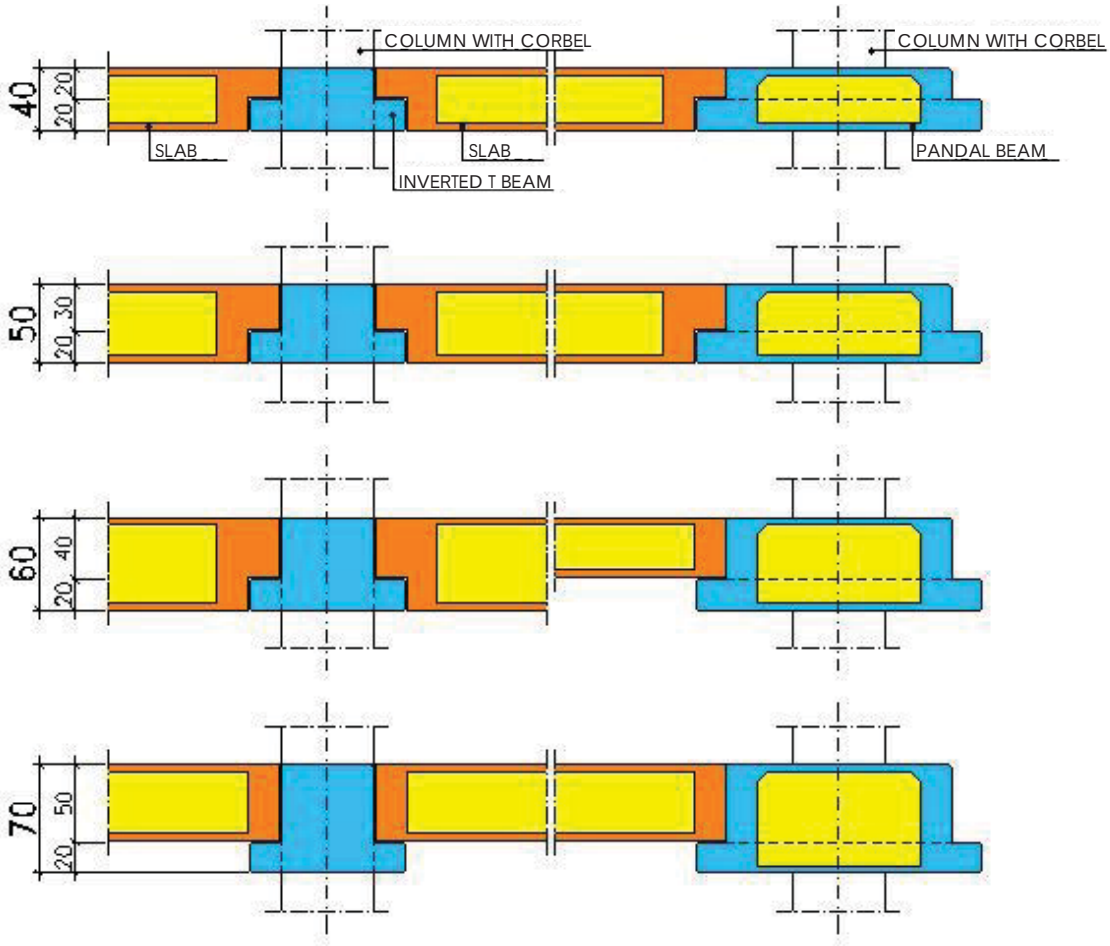
PANDAL® and inverted-T beam

The beams in r.c.p. supporting the beams have Pandal® box section (Pandal® beam) or inverted T.

The box beams, having a maximum width of 2.5 m, can greatly reduce the span by optimizing the structure of the floor.

The terminal part may be provided with saddle for the support on the capital of the pillar in the slab thickness.

A special reinforced slab, called Tragolo functions as a connecting beam between the columns in a orthogonal direction to the main beams and supports the curtain perimeter where there is no edge beam.



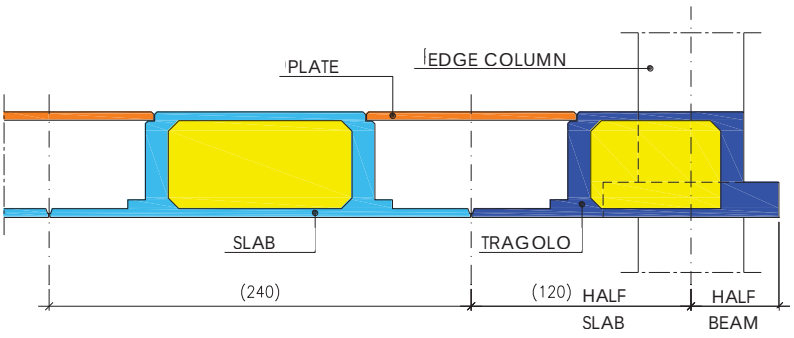
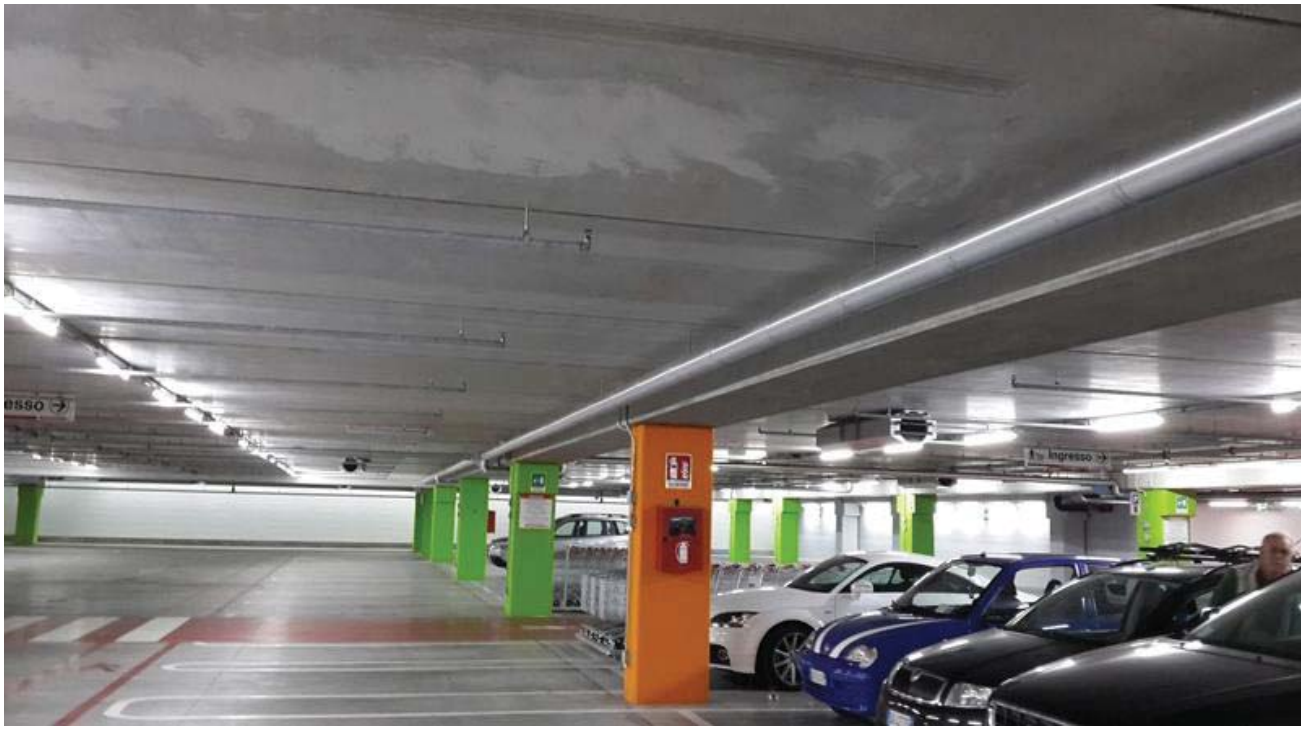


PLATE
EDGE COLUMN
SLAB
TRAGOLO
(240)
(120)
HALF
SLAB
HALF
BEAM



- Columns with square or rectangular section with corbels at each floor

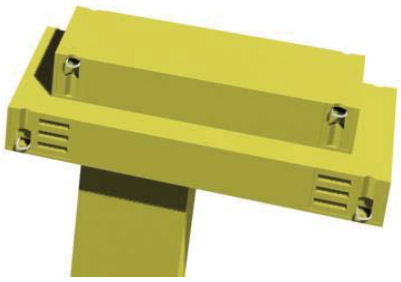
- Easy building expansion

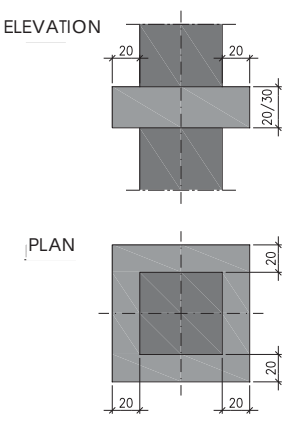
COLUMNS AND FOUNDATIONS

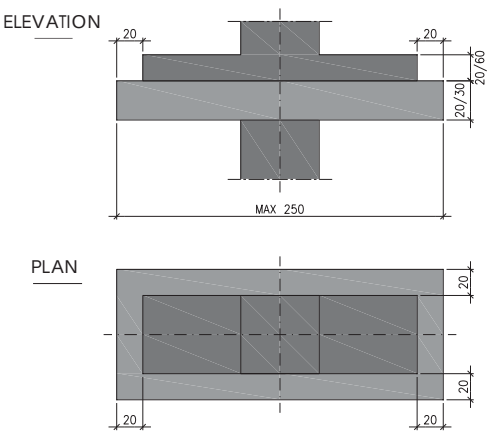
The columns usually have square cross section. They are provided with corbels sustaining PANDAL® or reverse-T beams. The corbel can also be asymmetrical.

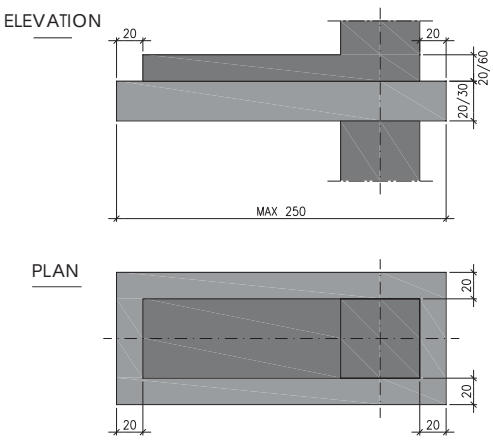
For ease of production, the lateral and corner columns may be geometrically identical to the central one and having the same reinforcement. This eases future expansion of the building.

Foundations are typically made with precast pockets completed in-situ with concrete pouring of the footing base. Mechanical connections are used for installation of the columns and for the joints between columns.










elsa

- Double screed panels with continuous thermal insulation
- A natural ventilation chamber can be left
- High energetic performances with low transmittance
- Multiple dry finishes techniques for different aesthetic solutions

Cladding panel

R.C. sandwich cladding panels with continuous thermal insulation placed in between the inner grid screed and the outer suspended screed are the standard cladding. Both horizontal and vertical panels are connected to the column corbels, the beams or the tragolos. Any other type of cladding can be alternatively applied.

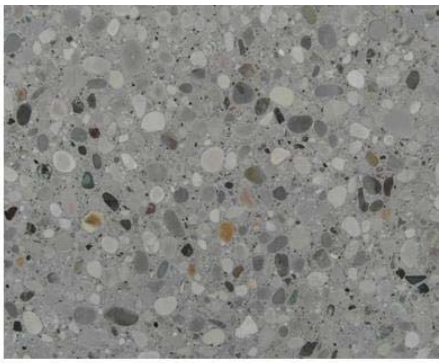
In between the two concrete layers a natural ventilation chamber can be left.

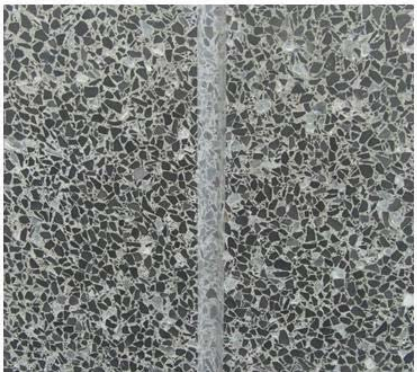
The panels and their connections are energetically optimised so to get a total envelope transmittance U down to 0,18 W/m^{2}K.

Several finishes techniques can be mechanically applied to the outer surface of the panels, also in combination, among which:

- bush-hammering
- polishing
- washing
- matrix patterns








PRECAST STRUCTURES WITH ADAPTABLE RESTRAINTS

- The frames can be clamped after the assembage with the activation of mechanical beam-column connections

- Increased frame stiffness and enhanced seismic performance due to the ductility of the joints

- Optimised stress distribution in the beams

The frames of PANDAL® system offer the possibility to clamp after assemblage selected beam-column joints by activating the Kaptor® connection and grouting the interface with special mortar.

With proper design, the rotation of the beam edges is prevented and the frame it is stiffened increasing its energy dissipation properties and consequently improving its seismic performance.

The use of pre-stressing for the control of the deformation and the activation of the joint at the edges of the beams leaving the dead carried in simple support leads to structural optimisation of the distribution of stresses in the elements, resulting in substantial savings.

PANDAL® + DOMUS DRY®

- PANDAL® + DOMUS DRY® for coupled wall-frame structures

- Master® walls may be combined to form bracing cores

- The wall elements are connected with mechanical devices

- The walls may also be placed along the perimeter of the building

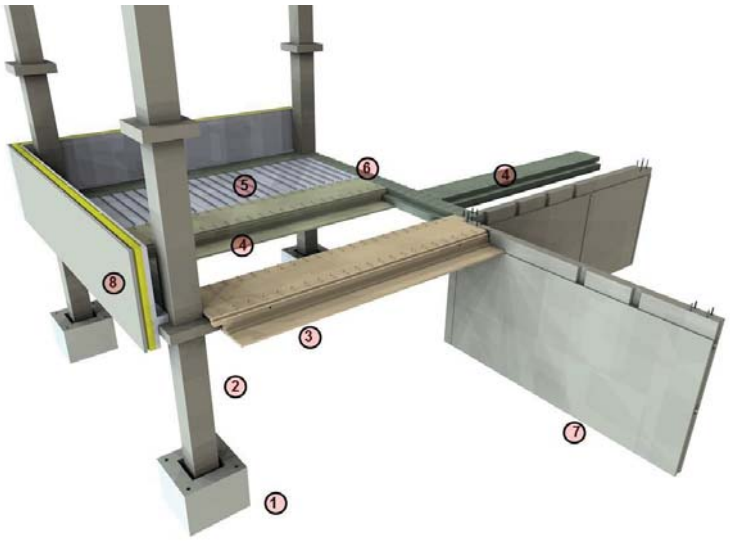
For all buildings where walls are required, for example tower buildings, the PANDAL® system may be used in combination with the DOMUS DRY® system to obtain a coupled wall-frame structure.

The walls are made with fully precast light-weighted Master® elements, each of them having the inter-storey height and length up to 12 m.

The Master® wall elements, produced in high-precision moulds with extractable lightening cores, are connected in vertical with the Kaptor® system and may be connected horizontally through rigid or dissipative devices to form bracing cores.

The walls may also be placed along the perimeter of the building, and in this case they are provided with a suspended screed having the same insulation features of that of the cladding panel.

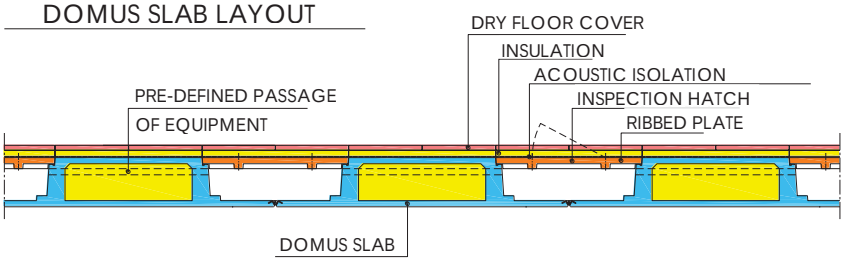
The floor may be made by spaced Pandal® elements or by adjacent Domus® elements.



LEGEND

1) Foundation footing
2) Column
3) Tragolo
4) Pandal/Domus slab
5) Ribbed or trussed plates
6) Hollow-core or inverted-T beam
7) Master wall
8) Horizontal cladding panel

DOMUS SLAB LAYOUT



- The PANDAL® and PANDAL® + DOMUS DRY® systems were selected as innovative structure in the frame of the Safecast project

- The largest precast structure ever built for scientific purposes has been subjected to a seismic experimental campaign at the ELSA/JRC laboratory

Interviews and more information on:

Experimentation

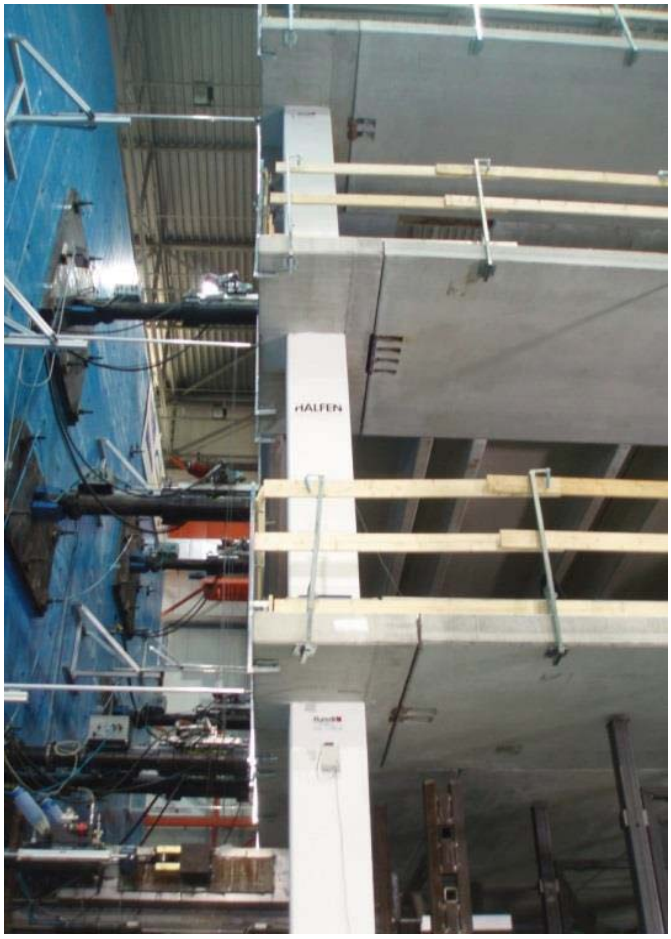
The PANDAL® and the mixed PANDAL® + DOMUS DRY® systems were selected as innovative structures in the frame of the Safecast research project funded by the European Commission.

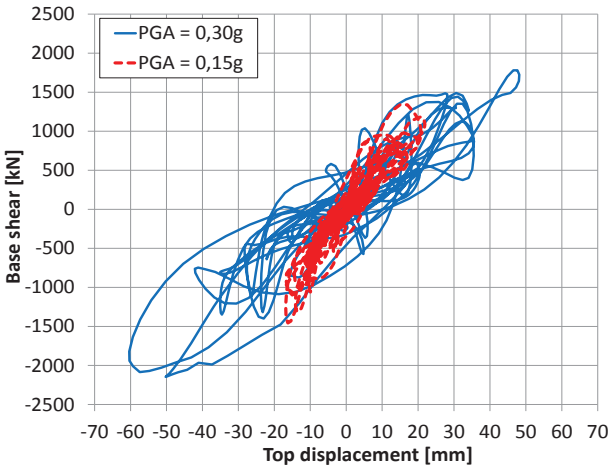
A full-scale precast prototype of a multi-storey building assembled with this system and tested in the standard PANDAL®, PANDAL® with adaptable restraint and mixed PANDAL® + DOMUS DRY® versions has been subjected to a seismic experimental campaign at the ELSA laboratory of the Joint Research Centre of Ispra (Italy).

It is the largest precast structure ever built for scientific purposes.

Watch the video interviews and find out more about the Safecast research project and its results:

http://elsa.jrc.ec.europa.eu/showproject.php?id=21





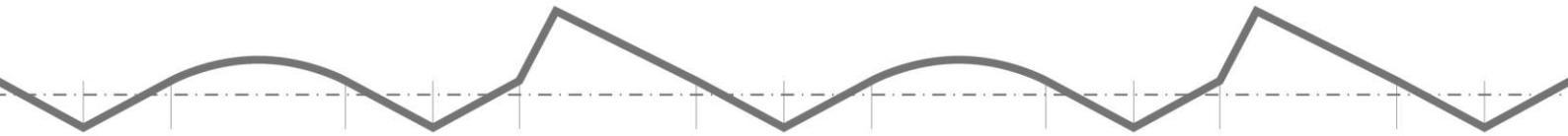
OUR REFERENCES

Realisations with Pandal system and Pandal + Domus systems

SME mall	Pordenone (PN)
Despar mall	Padova (PD)
Pilati Industries	Cles (TN)
Safilo	Padova (PD)
Corazza Industries	Padova (PD)
Menz & Gasser jams	Trento (TN)
Parma's trade fair	Parma (PR)
"La Martinella" mall	Langhirano (PR)
Multi-storey structure for seismic testing	Ispra (VA) - demolished

more details? design quotations?

info@dlc-consulting.it



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