



Pekabex[®] System

Residential Buildings



Design Instructions

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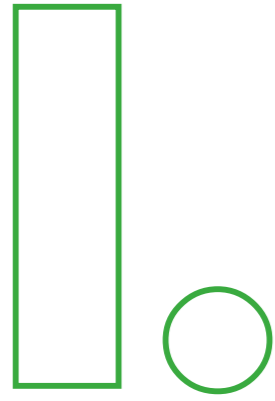
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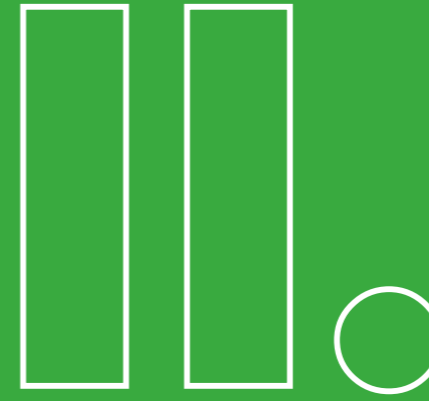
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Preliminary Notes

This manual is a set of guidelines and recommendations for architectural and structural designers if they wish to design a building or part thereof using the prefabrication technology and the Pekabex System. In particular, it discusses issues affecting the possibility of final production, transport or assembly of individual elements.

The manual does not touch upon general and applicable design principles. This means that this document should be treated as a supplement to the knowledge and it is subordinate to the commonly known regulations contained in the Construction Law, Construction Standards, technical and construction studies and others.

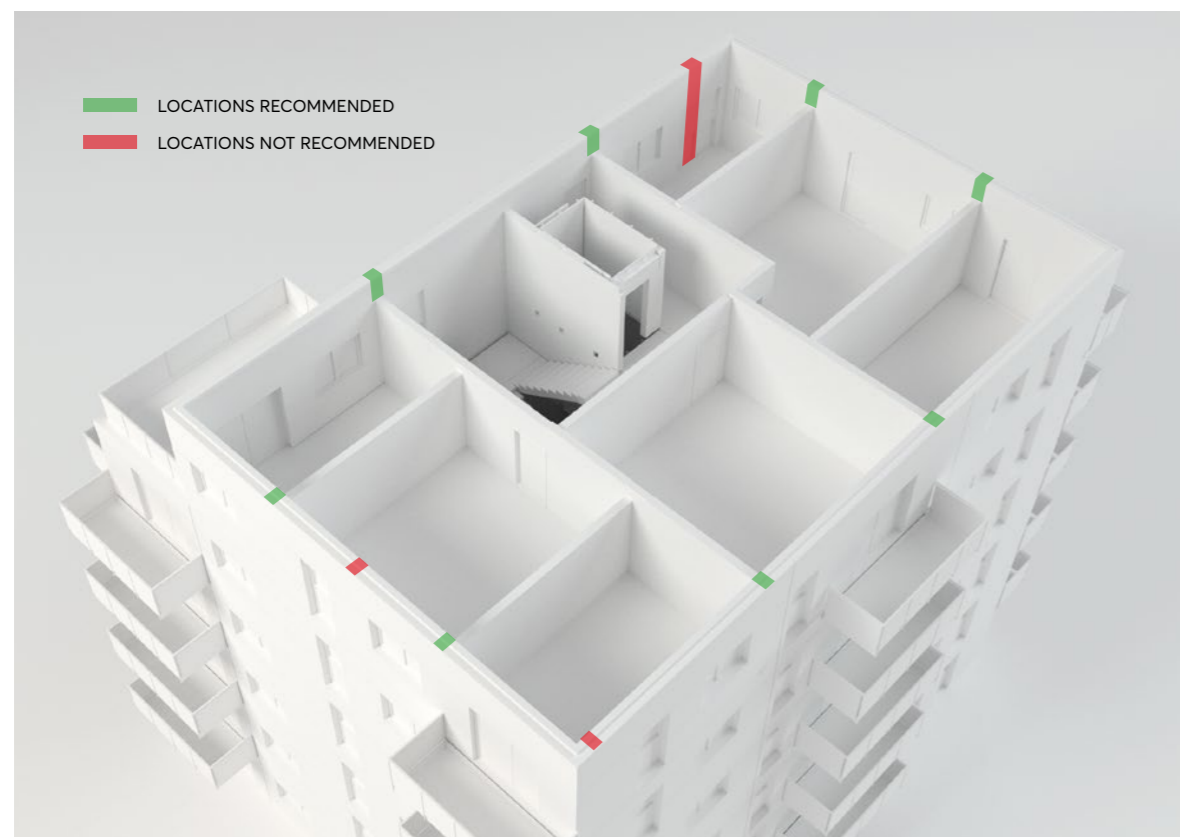


General design principles

Floor plan

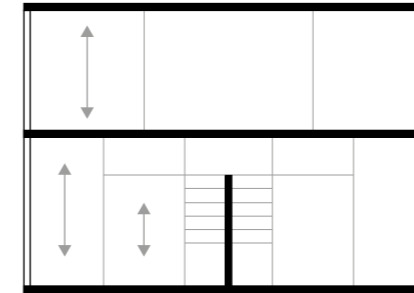
Recommendations:

- use rectangular or square shaped modules in the plan;
- design the basement floor on the basis of the plan of higher floors – facade and load-bearing walls brought down to the foundation level;
- use flat roofs, with a minimum pitch, or traditional roof slabs;
- use repeatable dimensions;
- avoid sharp angles in module corners;
- avoid overhangs on structures and transfer elements;
- avoid facade irregularities such as pilasters, joint faultings, supports, etc.;
- consolidate kitchen and bathroom service risers;
- place service risers in the corners of rooms;
- use a maximum of 2-3 different thicknesses for the external wall construction layer;
- use a maximum of 2-3 different thicknesses for the internal wall construction layer;
- use repeatable elements;
- avoid corner balconies;
- place balconies in the same spot on each floor;
- for balconies, rest the floor slab perpendicularly to the balcony slab;
- avoid loggias;
- strive to conceal vertical joints of external walls where there are perpendicular walls.

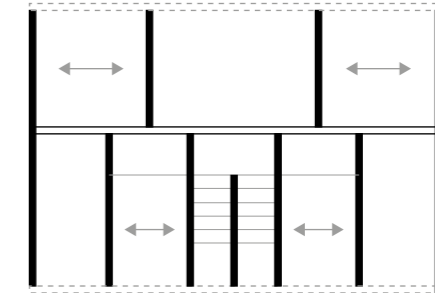


Constructional layout

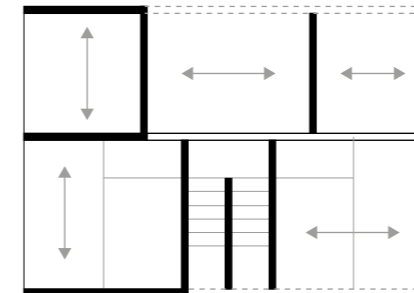
Residential buildings are designed in the prefabrication technology most often as wall structures or wall-slab structures, where the structural walls of the building are the load-bearing walls. The are following different constructional layouts:



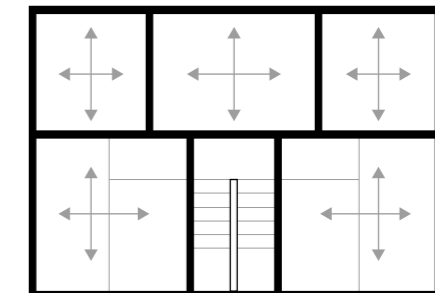
longitudinal – recommended for designing low structures with an extended and uncomplicated plan;



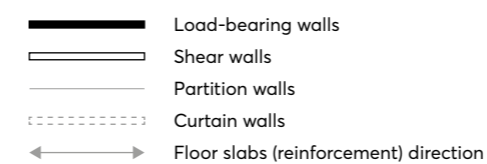
transverse – the best for residential buildings with the wall structure, it enables the separation of structural walls from insulating walls;



mixed – not recommended, structure has both longitudinal and transverse layouts;



two-way – popular in residential buildings, but usually used in high buildings, with expected high utility loads or exposed to seismic influences.



Stability

As a general and obligatory rule, multi-storey buildings, as well as buildings with a jointed frame structure, use shear walls to ensure spatial rigidity. These walls are designed to absorb all the horizontal forces acting on the structure and should have high bending stiffness in their plane. The remaining structural elements of the building can then only be dimensioned for vertical loads.

Horizontal forces can act from different directions, so it is necessary to place shear walls in both longitudinal and transverse directions. It is possible to combine them and create spatial units that are rigid in both directions.

Prefabricated elements

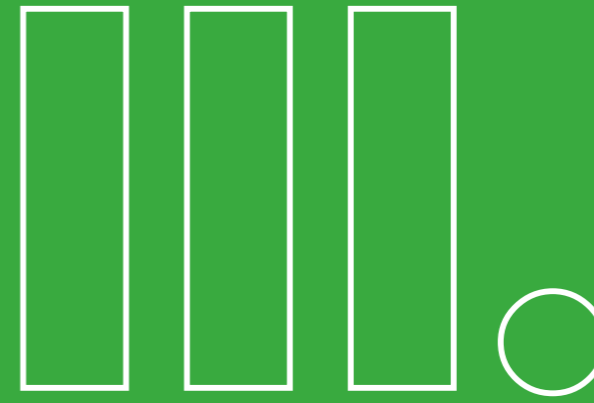
When designing and selecting prefabricated elements, remember the following:

- use the products according to their intended use and approval, i.e. only in the relevant human risk category, building height group and fire resistance class (see Chapter III.);
- take into account the maximum and economic dimensions of the products concerned already at the stage of designing the basic functional and structural layout of the building (see Chapter IV.);
- do not exceed the recommended assembly weight of a single pre-fabricated element (1.15 * dead weight), i.e. 12 tons;
- minimum thickness of the structural layer in terms of the fire resistance (see Chapter V.);
- pay attention to how the balconies are anchored to the floor slab;
- include the guidelines for the installation of sockets and boxes (see Table A.3) in the electrical system documentation;
- Design a system of blind joints when using external or internal three-layer walls with a concrete facade.

Table A.1 gives schematic sections of the prefabricated elements to illustrate which layers are inserted into each element.

Table A.2 gives guidelines for making holes in the Pekabex System's HC hollow core slabs.

Examples of architectural and constructional details can be found in the Pekabex System – Residential Buildings, Technical Details Catalogue.



System Products – application

Exterior walls

- 1 - Three-layer with concrete facade 2 - Three-layer with texture 3 - Three-layer with cladding
4 - Double-layer 5 - Single-layer

Building	ZL I	ZL II	ZL III	ZL IV	ZL V
Low (L)	B 1,2,4,5	B 1,2,4,5	C 1,2,4,5	D 1,2,3*,4,5	C 1,2,4,5
Medium-high (MH)	B 1,2,4,5	B 1,2,4,5	B 1,2,4,5	C 1,2,4,5	B 1,2,4,5
high (H)	B 4,5	B 4,5	B 4,5	B 4,5	B 4,5
high-rise (HR)	A 4,5	A 4,5	A 4,5	B 4,5	A 4,5

*produkt dostępny na rynek zagraniczny

Interior walls

- 1 - Three-layered 2 - Composite 3 - Single-layer

Fire resistance class of building elements	A	B	C	D	E
main frame	R240 3	R120 1,2,3	R60 1,2,3	R30 1,2,3	(-) 1,2,3
interior wall	EI60 3	EI30 1,2,3	EI15 1,2,3	(-) 1,2,3	(-) 1,2,3

Floor slabs

- 1 - HC slabs 2 - Reinforced solid slabs 3 - Prestressed solid slabs
4 - Reinforced filigree slabs 5 - Prestressed filigree slabs

Fire resistance class of building elements	A	B	C	D	E
main frame	R240 2,4	R120 1,2,3,4,5	R60 1,2,3,4,5	R30 1,2,3,4,5	(-) 1,2,3,4,5
roof structure	R30 1,2,3,4,5	R30 1,2,3,4,5	R15 1,2,3,4,5	(-) 1,2,3,4,5	(-) 1,2,3,4,5
floor slab	REI120 1,2,3,4,5	REI60 1,2,3,4,5	REI60 1,2,3,4,5	REI30 1,2,3,4,5	(-) 1,2,3,4,5



System Products – design principles

Exterior walls

Interior walls

Floor slabs

Staircases

Balconies

Exterior walls

Outline dimensions

Recommendations:

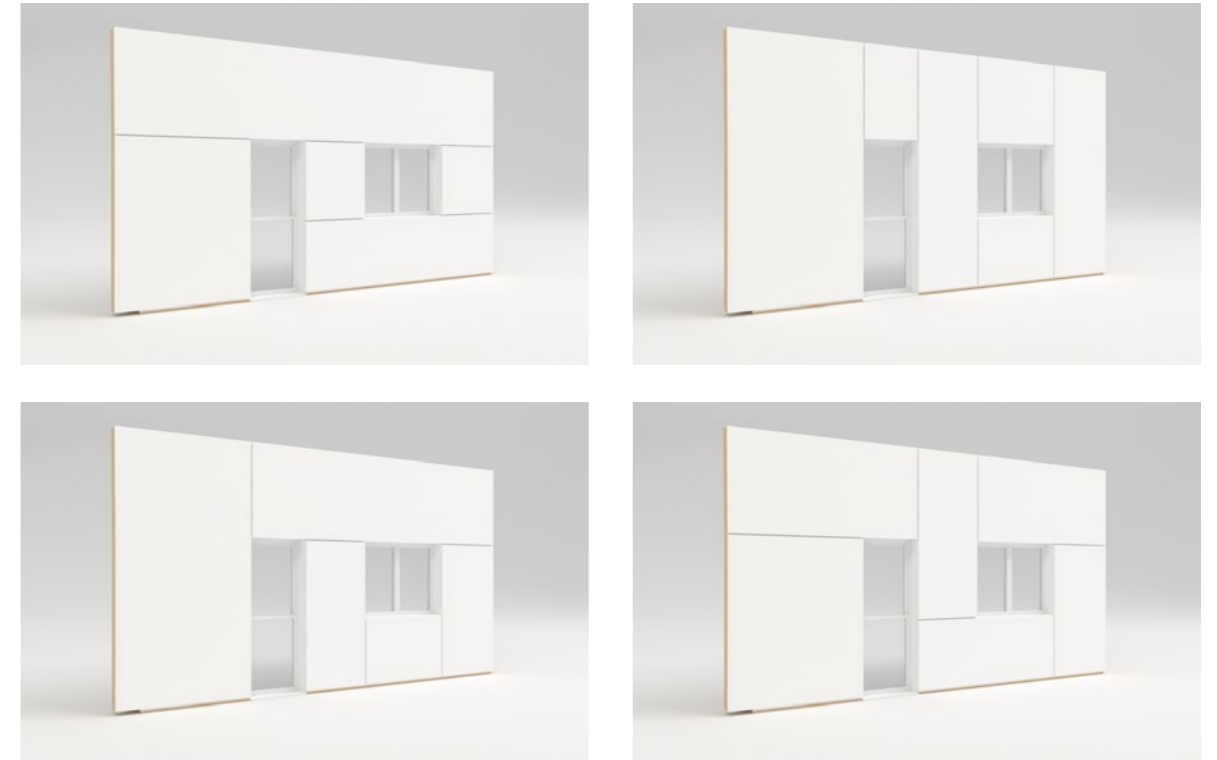
- overall length: economical 4–6 m, maximum up to about 12 m;
- overall height: economical 2.85–3.05 m, maximum up to about 4 m;
- surface backing thickness: avoid dimensions that are indivisible by 2 or 3;
- element weight: assembly weight (1.15 * element weight) up to 12 tons;
- pilaster dimensions:



Specific requirements

Blind joints

Three-layer walls with a concrete facade shall be constructed with blind joints in such a way that they form smaller, rectangular elements with a side ratio not exceeding 1:6. Example:



Interior walls

Outline dimensions

The same rules are recommended as for the external walls.

Specific requirements

Blind joints

The same rules are recommended for the internal three-layer walls as in case of the external three-layer walls with a concrete facade.

Designing the systems

Do not use sockets/boxes etc. in the cross-section of the wall on both sides.

Sound requirements

In partitions where the sound reduction index appropriate for internal partitions is minimum 50 dB, the thickness of the structural layer shall not be less than 180 mm.

Floor slabs

Outline dimensions

HC slabs	<ul style="list-style-type: none"> — overall length: economical 6–8 m, maximum: <ul style="list-style-type: none"> • HC150 – up to 7.5 m • HC200 – up to 11.5 m • HC265 – up to 12 m • HC320 – up to 14 m • HC400 – up to 16 m • HC500 – up to 18 m — maximum width: 1.2 m; — available widths of tapered slabs: 										
	Type of section	Available widths of tapered slabs [mm]									
	HC 150	300	400	500	600	700	800	900	1000	1100	
	HC 200		400	500	600	700	800	900	1000	1100	
	HC 265			510		690		870		1050	
	HC 320			510		690		870		1050	
	HC 400					690		870		1050	
	HC 500							870		1050	
Reinforced solid slabs	<ul style="list-style-type: none"> — overall length: economical 6–8 m, maximum up to about 13 m; — width: economical 2.4 m. 										
Solid prestressed slabs	<ul style="list-style-type: none"> — overall length: economical 6–8 m, maximum up to about 11 m; — width: economical 2.4 m. 										
Reinforced filigree slabs	<ul style="list-style-type: none"> — overall length: economical up to 7 m, maximum up to about 12 m; — width: economical up to 2.4 m, maximum up to about 3.3 m; — thickness: 50 mm, 60 mm, 70 mm. 										
Prestressed filigree slabs	<ul style="list-style-type: none"> — overall length: economical up to 7 m, maximum up to about 12 m; — width: economical up to 2.4 m, maximum up to about 4m; — thickness: 75–200 mm. 										



Specific requirements

HC slabs	<ul style="list-style-type: none"> — due to the bending of the slabs after compression, the indicated finishing layers with concrete screed (not to be confused with the structural concrete overlay); — designing the systems: under or over the floor slab
Reinforced solid slabs	— designing the systems: under or within the floor slab (in the structural layers of the floor slab) under the main reinforcement.
Solid prestressed slabs	— designing the systems: under or within the floor slab (in the structural layers of the floor slab) along the compression rods.
Reinforced filigree slabs	— designing the systems: under the floor slab or over the filigree slab (in the structural layers of the floor slab).
Prestressed filigree slabs	— designing the systems: under the floor slab or over the filigree slab (in the structural layers of the floor slab).



Staircases

Outline dimensions

Stair flights	<ul style="list-style-type: none">— overall length: economical 3–6 m;— width: economical 2.4 m.
Landings	<ul style="list-style-type: none">— overall length: economical up to 5 m;— width: economical 2.4 m.

Specific requirements

Stair flights	<ul style="list-style-type: none">— installation of railings recommended from the side.
Landings	<ul style="list-style-type: none">— installation of railings recommended from the front.



Balconies

Outline dimensions

Recommendations:

- overall length: economical 4–6 m;
- width: economical up to 2.4 m (including length of connectors);
- surface backing thickness: economical up to 0.21 m.

Specific requirements

- installation of railings recommended from the front;
- anchoring balconies to HC slabs is only possible after applying a layer of concrete overlay to the floor slab.





V. System Products – basic parameters

Minimum thickness of the structural layer at a given fire resistance class [mm]

	(-)	R30	R60	R120	R240
Exterior walls					
Three-layer with concrete facade	100	100	120	150	-
Three-layer with texture	100	100	120	150	-
Three-layer with brick	100	100	120	150	-
Double-layer	100	100	120	150	240
Single-layer	100	100	120	150	240
Interior walls					
Three-layer	100	100	110	150	-
Composite	180	180	180	180	-
Single-layer	120	120	120	160	240
Floor slabs					
HC slabs	HC150	HC150	HC150	-	-
	HC200	HC200	HC200	HC200	-
	HC265	HC265	HC265	HC265	-
	HC320	HC320	HC320	HC320	-
	HC400	HC400	HC400	HC400	-
	HC500	HC500	HC500	HC500	-
Reinforced solid slabs	60	60	80	120	175
Solid prestressed slabs	60	60	80	120	175
Reinforced filigree slabs	50 (150)*	50 (150)*	50 (200)*	50 (200)*	50 (200)*
Prestressed filigree slabs	100 (100)*	100 (100)*	100 (100)*	100 (100)*	100 (100)*
Staircases					
Stair flights	150	150	150	150	175
Landings	200	200	200	200	200
Balconies					
Balconies	180	180	180	180	180

*the value in parentheses is the thickness of the structural layer with concrete overlay



Annexes

Table A.1 Cross-sections of system products

Exterior walls	
Three-layer with concrete facade	
Three-layer with texture	
Three-layer with brick	
Double-layer	
Single-layer	
Interior walls	
Three-layer	
Composite	

Single-layer	
Floor slabs	
HC150	
HC200	
HC265	
HC320	
HC400	
HC500	

Reinforced solid slabs	
Solid prestressed slabs	
Reinforced filigree slabs	
Prestressed filigree slabs	
Staircases	
Stair flights	
Landings	
Balconies	
Balconies	

Table A.2 Guidelines for making holes in HC floor slabs

There are two types of holes:

Type I – a small cut-out that does not cut through the slab ribs:

Type of section	Maximum hole diameter
	[mm]
HC 150	50
HC 200	50
HC 265	90
HC 320	90
HC 400	90
HC 500	90

Assuming the maximum diameter of the hole, it should be placed in the axis of the channel.

It is possible to make several interlocking round holes to obtain a cut-out with an elongated shape.

Type II – these are larger holes created by cutting out one or more slab ribs.

Type of section	IIA type hole in the centre of the element		IIB type hole at the side edge		IIC type hole at the front edge		IID type hole in the corner	
	L	B	L	B	L	B	L	B
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
HC 150	1000	400	1000	400	600	400	600	400
HC 200	1000	400	1000	400	600	400	600	400
HC 265	1000	400	1000	330	600	400	600	330
HC 320	1000	400	1000	330	600	400	600	330
HC 400	1000	400	1000	330	600	400	600	330
HC 500	1000	400	1000	330	600	400	600 <td 330	

NOTE! When planning the layout and size of the holes in the slab, it is important to note that the hole eliminates the compression strings, thus reducing the slab's load-bearing capacity.

18 cm thick prefabricated reinforced concrete walls meet the sound conditions for the unit-to-unit walls and have REI 120, which was confirmed in field tests. The wall thickness should be chosen according to the necessary support.

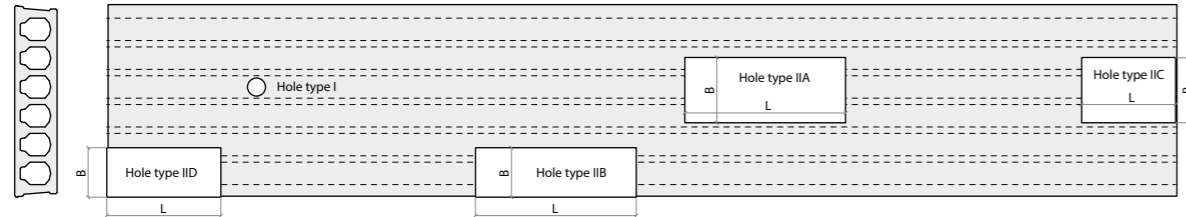


Table A.3 Sample list of design guidelines – sockets and boxes

