



INFORMATION  
ABOUT  
VELOX BUILDING  
SYSTEMS

[www.velox.cz](http://www.velox.cz)

## *We build with nature*

*Lately, we have improved our attitude to nature. We would like to live in natural surroundings and our demands on our living are increasing. Main points of ecology are kept during the production of the basic element of VELOX building system - the timber-cement boards. Product technology uses natural material (wood, cement) that is not demanding on energy. There are not any exhalations or dangerous waste, that would have no load on environment. Waste from production from VELOX building system is by the company VELOX-WERK s. r. o. recycled and processed again. VELOX building system has very high thermal insulation without thermal bridge appearance, so it saves energy in the already performed building. Both of the characteristic meet ecological requirements to save energy sources. Used natural materials and clear ecological system are guarantee of healthy and satisfying living.*

## *Good atmosphere is source of good mood*

*Masive and stable construction from VELOX building system gives perfect connection of thermal insulation characteristic and heat accumulation parametres. Advantage of high thermal resistance of the outside part of the wall and heat accumulation of concrete core there is pleasant cool in summers and warm in winters in rooms. It has the ability to absorb noise from outside. High fire protection with above mentioned advantages generates comfortable living which will be valued by folowing generations.*

## *Time is money*

*Assembling of VELOX building system is easy and exact, easy manipulation (only 20 % of the total construction is manual work), using of mechanismus is minimalized, so the speed of building coresponds. It is possible to realize even under the temperature of -5°C. The speed is one of the most important characteristic when evaluating advantageges of this system, so using of this system pays off in the end.*

## *Who saves, earns more*

*Investments into VELOX building system will pay back many times not only during the construction itself because of low transportation costs, minimal needs of storage place and workers, great amount of plaster saved thanks to exactness of building, but also in finished building where you can save a lot on heating. Walls made of VELOX building system have very high thermal insulation although the thickness is 30 cm, which increases the usage of building area and means more living space.*

## *Be yourself*

*It is possible to process VELOX boards as wood - to cut, drill and join with nails, to screw without dowel, to mill. A house built according to VELOX technology can boost with originality as this system can realize all you imagine with no limit. An architect or a designer can use all their ideas when designing non-traditional construction.*

## *VELOX means complete service*

*Technical and advisory service of VELOX-WERK s. r. o. and their sales organisations will meet your demands including project documentation, special supervising, staff training, realisation of rough building, or construction "key" supply.*

**VELOX BUILDING SYSTEM SATISFIES:**

- **DESIGNERS** - variability of usage and function
- **INVESTORS** - economy, effectiveness, and building price
- **CONSTRUCTION ENGINEERS** - fast building and exactness of building
- **USERS** - low operational costs and comfort of ecological living.

### TIMBER-CEMENT BOARD VELOX AND ITS FEATURES

Basic element of universal usage of VELOX building system is timber-cement boards VELOX. Source raw material for its production is processed wood-cuts from needles trees wood so called "wood chips" - which is 90% of board.

Another components are - cement to secure strength and coherence of boards, and solution of water glass that stabilizes board against humidity and increases its resistance against moulds and mice.

VELOX boards take over the features of wood, so it is easy to work with them and process them - you can cut them, drill, join with nails, screw without dowel, mill them.

The surface is porous, so it ensures excellent connection with plaster and concrete and also decreases and absorbs the noise.

VELOX boards are hygienically convenient, their fire resistance is high (WSD - class A ingredients non-flammable, WS - class B ingredients hardly flammable).

Thermal insulating features of VELOX boards together with thermal insulating material (polystyren) are rapidly increasing.

VELOX boards are produced in wide range because of individual requirements for thermal and noise insulation of buildings.

Complexity of building systems is guaranteed by own production of timber-cement elements for ceilings and partitions, special building ties for construction of casing (panelling) and supplies of steel-space girder for reinforcement of ceilings. Products for special usage with noise protection barriers are included in the offer.

In the whole process of production the control is guaranteed, if the technology of production is kept, including outcoming control of measurement, strength and other standards for board production. Boards must be rectangular, the edges must not be crumbled away, their width, length and thickness must be in tolerance of standards. Verified technology of production with proper control guarantees high quality of boards and consequently good quality of construction work.

Technical and testing institut in Prague confirmed and certified VELOX boards and does controls at producer annually. Control is aimed at meeting standards that means supervising the certified product.



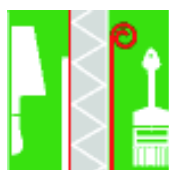
- Optimal thermal insulation features.



- Special stability of boards, mainly strength in pulling in bend.



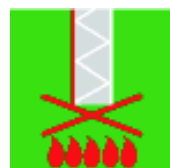
- Easy processing (machine) of boards
  - cutting,
  - milling,
  - drilling,
  - glueing.



- Excellent adhesiveness
  - plaster,
  - concrete,
  - cement (putty).



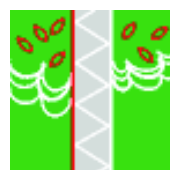
- Optimal sound insulating features.



- Good fire resistance - tests according to ČSN 73 0862 (classification of flammable level of building material - B hardly flammable).



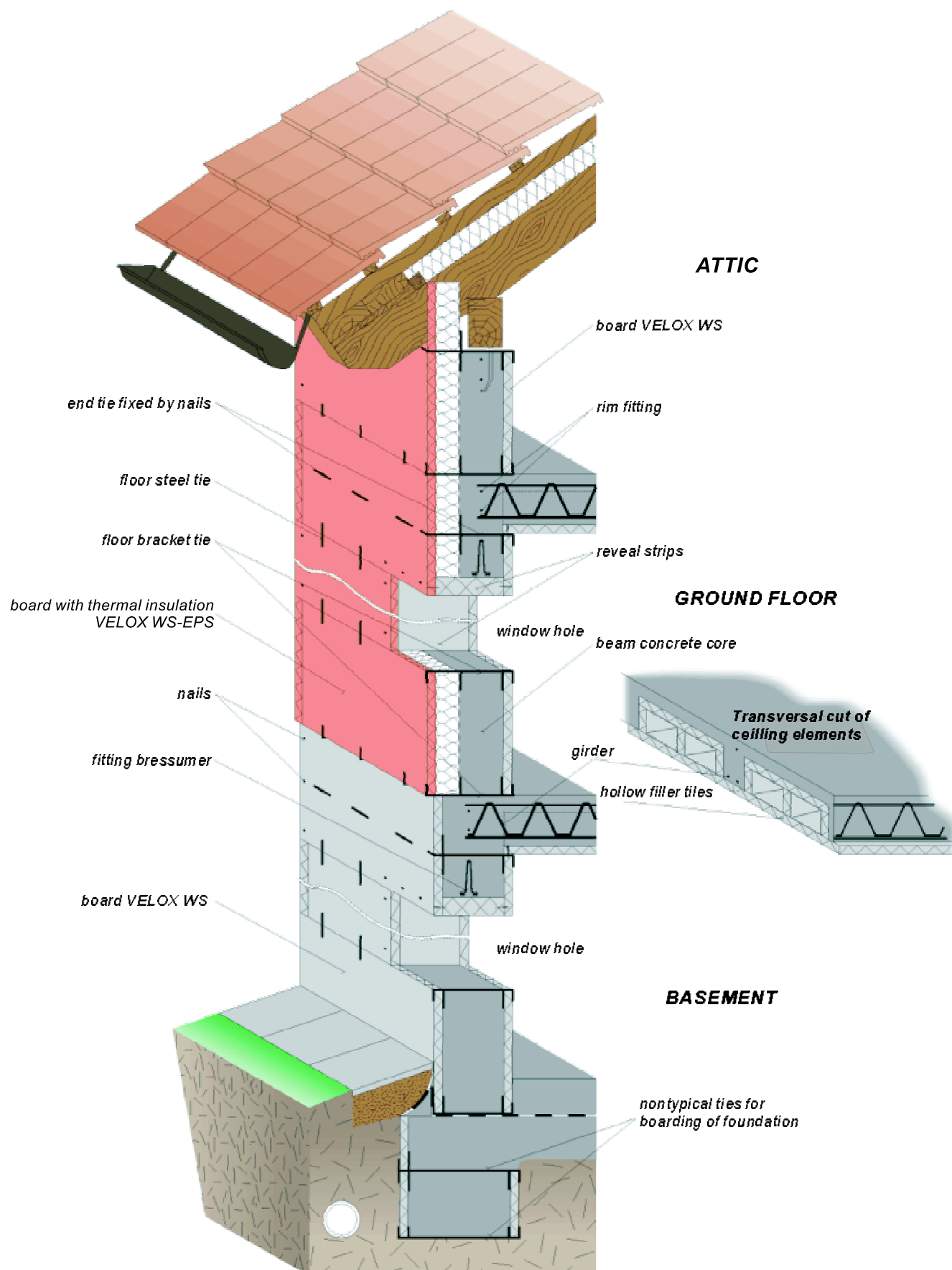
- Easy joining of boards
  - nails,
  - screws,
  - dowels,
  - glueing.



- Hygienic and health convenience
  - approved by authorised main hygienic in the Czech republic.

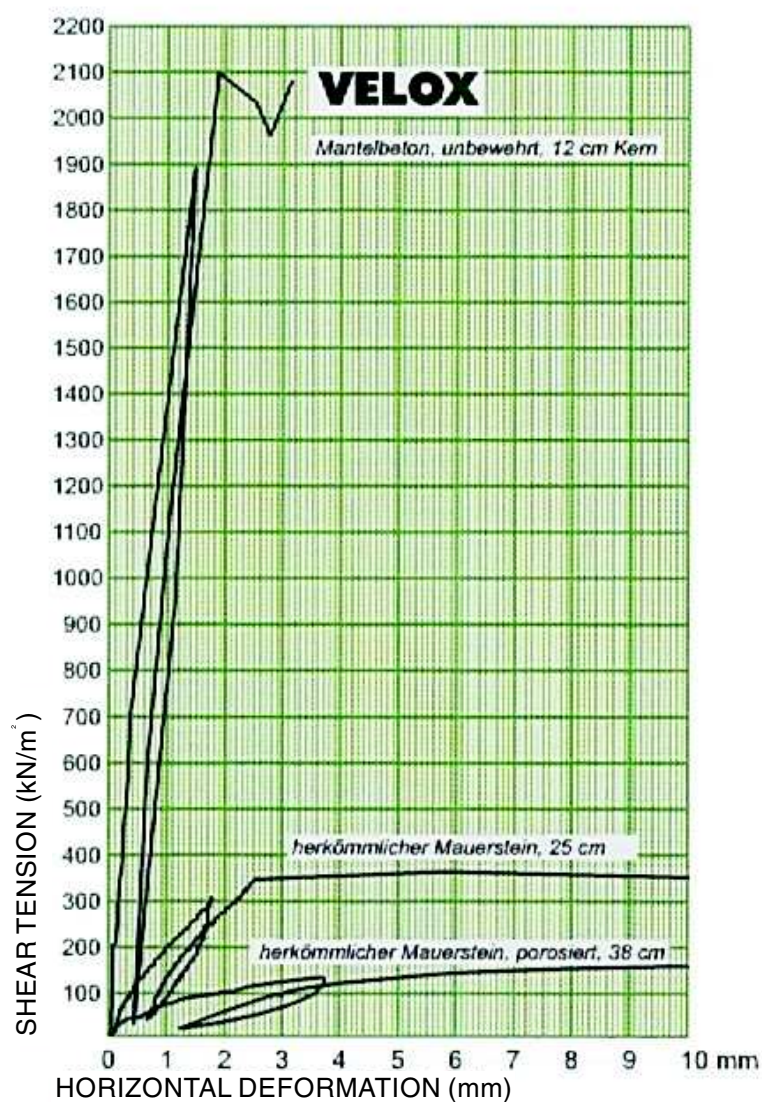
- Minimal absorption - minimal volume changes under influence of humidity.
- Good permeability.

- Exactness
- Resistance against fungus and mice (rodents).



According to shear tests in  
Technical testing institution  
for strength of building ma-  
terials in Graz (Austria).

Mantle load 1 000 kN/m<sup>2</sup>  
Shear tension 2 100 kN/m<sup>2</sup>







## **BOARDS VELOX WS**

***One-layer timber-cement boards to produce forms (boardings) carrying, peripheral of external and internal walls, without special demand on thermal or sound insulation.***

- good thermal and sound insulation
- high strength in pulling in bend
- excellent adhesiveness of concrete and plaster
- easy and strong joining the board with nails
- resistant against shaking from thickness 50 mm
- health and hygienically convenient
- well resistant against animal and plant pests (vermins)
- good fire resistance

TYPE OF BOARD ACCORDING TO MARKING AND THICKNESS "d"		VELOX WS		
		25 mm	35 mm*	50 mm
TECHNICAL FEATURES	Measurement, units	VALUES		
Standard measurement length l x width b	mm	2 000 x 500	2 000 x 500	2 000 x 500
Average volume mass	kg / m <sup>3</sup>	580	570	570
Coefficient of thermal conductivity $\lambda_k$ (with mass humidity $w_{mk} = 6\%$ )	W / mK	0,11	0,11	0,11
Factor of diffusive resistance $\mu$	-	13,7	13,7	13,7
Dynamic solidity s	MN / m <sup>2</sup>	8 000	8 000	8 000
Strength of pulling in bend	N / mm <sup>2</sup>	≥1,8	≥1,3	≥1,0
Requirements for health and hygienical convenience	-	Meet the criteria (approved by main authorised hyg. officer)		
Grade of flammability	-	B - hardly flammable does not increase fire loading		

*\* For outside casing of carying walls red board WSC supplied.*



## BOARDS VELOX WS-EPS

*Double-layer timber-cement boards, consisting of timber-cement boards VELOX WS - thickness 35 mm and foam polystyren board to create casing in supporting external walls, with high requirements for thermal insulation.*

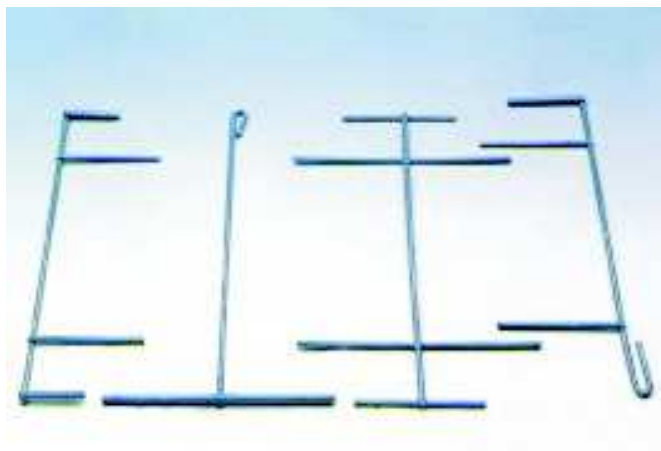
- excellent thermal and sound insulation features
- excellent adhesiveness of concrete and plaster
- easy and strong joining the board with nails, easy to make corners and linings
- resistant against shaking and vibration
- health and hygienically convenient
- well resistant against animal and plant pests (vermins)
- good fire resistance

TYPE OF BOARD ACCORDING TO MARKING AND THICKNESS "d"		VELOX WS-EPS			
		135	115	95	85
Thickness of cash layer of a board in mm	VELOX WS	35	35	35	35
	Foam polystyren	100	80	60	50
TECHNICAL FEATURES	Measurement, units	VALUES			
Standard measurement length l x width b	mm	2000 x 500	2000 x 500	2000 x 500	2000 x 500
Average area mass	kg / m <sup>2</sup>	30	30	29	29
Coefficient of thermal conductivity $\lambda_k$ of board VELOX WS 35 (with mass humidity $w_{mk} = 6\%$ )	W / mK	0,11	0,11	0,11	0,11
Coefficient of thermal conductivity $\lambda_k$ of foam polystyren board	W / mK	0,036	0,036	0,036	0,036
Factor of diffusive resistance $\mu$ of foam polystyren board	-	20-50	20-50	20-50	20-50
Strength of pulling in bend	MN / m <sup>2</sup>	$\geq 0,4$	$\geq 0,4$	$\geq 0,5$	$\geq 0,5$
Shear tension	N / mm <sup>2</sup>	0,04	0,04	0,04	0,04
Requirements for health and hygienical convenience	-	Meet the criteria (approved by main authorised hyg. officer)			
Grade of flammability	-	B - hardly flammable does not increase fire loading			

**NOTE:**

*Technical features of polystyren come out from  
atests of supplier.*

*On the basis of the order, it is possible to supply  
the board WS-EPS in combination with other  
board produced in another thickness from foam  
polystyren (WS-EPS 75, 105, 125, 155, 185).*



## **BUILDING TIES VELOX**

**Structure of fixing ties with welded distant crossbars ensures fixation of board position in outside and inside casing of walls, also serving to lay and join of each casing board on each other in vertical position of both coating.**

- are produced from tow wire made of steel 11 343, has round diameter 4 and 5 mm, with help of welding, fulfil the required strenght in tow 540 MPa
- standard surface treatment is assigned under the plaster
- the width of ties are various and depends on constitution of each layer of a wall
- in the case of usage without plaster, it is possible to paint surface with a special treatment

### **Sorts of ties according to shape and usage:**





**Oneside ties** - are usually laid in bottom part level of first layer of casing, in the level of ceiling is put on the inside of supporting wall and when window sill is built.

**Both-side ties** - are placed continuously when laying and tieing each board of wall casing in layers cracks.

**Ceilings ties** - are placed on the same level as ceiling is laid on peripheral, supporting wall, one end of a tie on inside casing and the other one on already drilled holes of peripheral continuing

boards where it is fixed on the end eye with nail in cross direction.

**Tow ties** - are lead through already drilled holes in the center of end eye of outside boards and inside boards of casing and in the end eye is fixed with nail in cross direction. In case of using VELOX WS boards it is recommended to use and place 2. and 3. rows of casing board when the strength of casing shall be encreased during concreting the whole floor at the same time.

SORT OF TIE	LENGTH OF TIE (mm) (thickness of wall)	COMSUMPTION		DRAWING OF TIES
		internal wall	external wall	
One-side tie	150 - 400	5 pcs / m* of wall	8 pcs / m** of wall	
Both-side tie	150 - 400	4 pcs / m of crack	4 pcs / m of crack	
Ceiling tie	150 - 400	4 pcs / m of wall	-	
Tow tie	150 - 400	1 - 2 pcs / m one layer casing	1 - 2 pcs / m one layer casing	

\*When calculating a consumption of ties, it is usually counted with 5 pcs / m of wall. Out of which 4 pcs / m are supposed to fix first row of boards on floor and 1 pce / m to finish window sills.

\*\*When calculating a consumption of ties, it is counted with 8 pcs / m of wall. Out of which 4 pcs / m are supposed to fix first row of boards on floor and 4 pcs / m to finish wall under ceiling.





## **HOLLOW FILLER TILES**

*Solves horizontal construction of building with method of lost casing generating iron - concrete monolithic rib's ceiling in axial distance of 500 (300) mm and width of rib is 120 mm. They are glued from cut sizes of board VELOX WS - thickness 25 mm and are in shape of hollow blocks with exceeds to make ribs, that standard plan width and length is set by production measures of boards, it means 500 (300) x 2 000 mm, height is from 170 upto 575 mm and its usage depends on range required by used loading of ceiling of building, concrete quality and content of reinforcement.*

- ceiling elements are produced in modulating heights 1830, 1660, 1500, 1330, 1000, 660, 500, 330 mm
- according to needs and statics requirements it is possible produce any type of the element (convenient usage during redevelopment works)
- ceiling construction is fast and easy

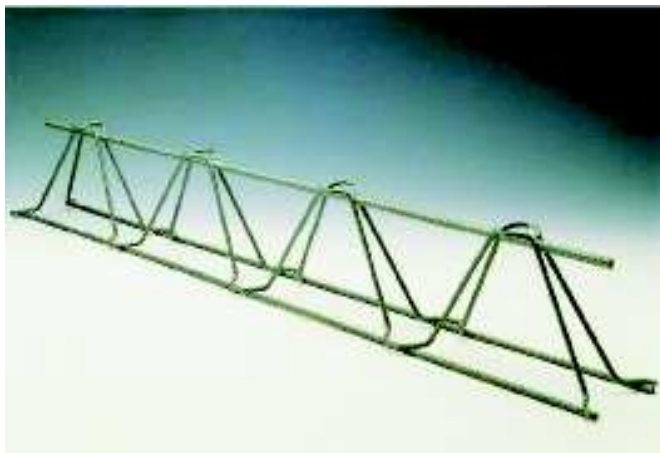
- ceiling elements have a low weight
- excellent adhesiveness of plaster mixture
- easy support when concreting moulds
- not plastered ceilings have very good sound absorption
- ceilings have good thermal insulation
- possibility to perform cassette ceilings into reinforce cross

OVERVIEW OF VELOX HOLLOW FILLER TILES (basic plan measurement 2 000 x 500 mm)

HEIGHT OF MOULD + CONCRETE LAYER (mm)	TOTAL HEIGHT OF CEILING (mm)	WEIGHT OF PANEL (kg)	CONSUMPTION OF CONCRETE (l / m <sup>2</sup> )	THERMAL RESISTANCE OF CEILINGS R* (m <sup>2</sup> K / W)
170 + 50	220	49	85	0,52
220 + 50	270	55	97	0,55
260 + 50	310	67	107	0,60
315 + 50	365	75	120	0,62
350 + 50	400	79	128	0,63
400 + 50	450	91	140	0,65
500 + 50	550	106	164	0,70
575 + 50	625	122	184	0,77

\* Values set up by calculation

Static parametres of ceiling (e.g.) chapter 3.4.2. - Dimensioning of vertical constructions.



## **SPACE GIRDERS**

- *to build ceiling construction, where casing is consisting of timber-cement VELOX ceiling elements (are put between each blocks for casing and thus create reinforcement of ceiling rib)*
- *to reinforce supporting over - door and over - windows lintels*
- diameter of rods of down strape reinforcement is set so that girder has all range (span) constant load - carrying capacity
- placing, diameters and class of steel reinforcement are stated in table 3 chapter 3.4.2
- steel R 10 505

## VERTICAL CONSTRUCTIONS

1.

Way of performing of wall easing with VELOX boards is easy. Onto already prepared basis of a construction real plan of construction is carried over and gradual building of casing wall boards, and usually it start in a corner of an object. First basic layer of casing is built in the whole range according to project design

### Creating a corner:

On an outside casing one-side tie is put in a way, that first is settled ( $t + \text{cca } 50 \text{ mm}$ ) from building corner and consequent ties are settled in regular distance calculating 4 pcs / m of wall (cca 250 mm), where  $t$  = total thickness of wall without plaster in mm. Last tie on board is settled cca 50 mm before the end. To create corner you cannot use board slights shorter than 1 m. Insulating material - polystyren - must be cut of exactly by the thickness of connecting board.

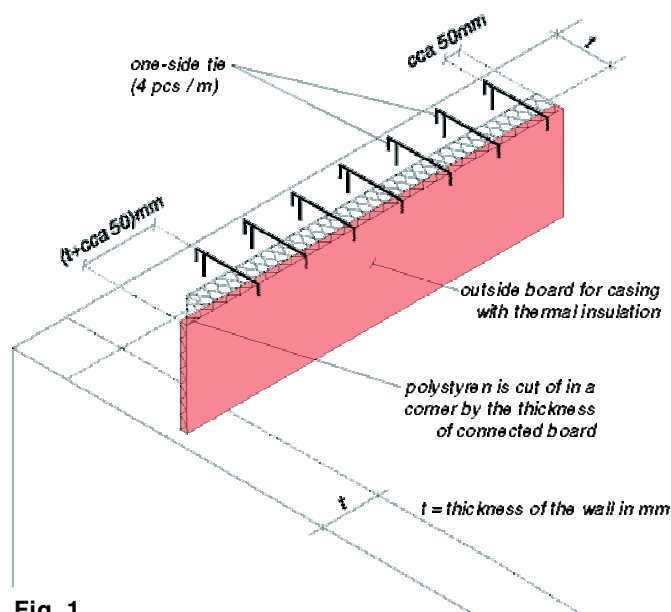


Fig. 1

NOTE: Into already prepared base construction it is recommended to place steel anchoring reinforcement for better joining of wall with the base.

2.

Board is turned by  $180^\circ$  and is put by ties on already drawn plan.

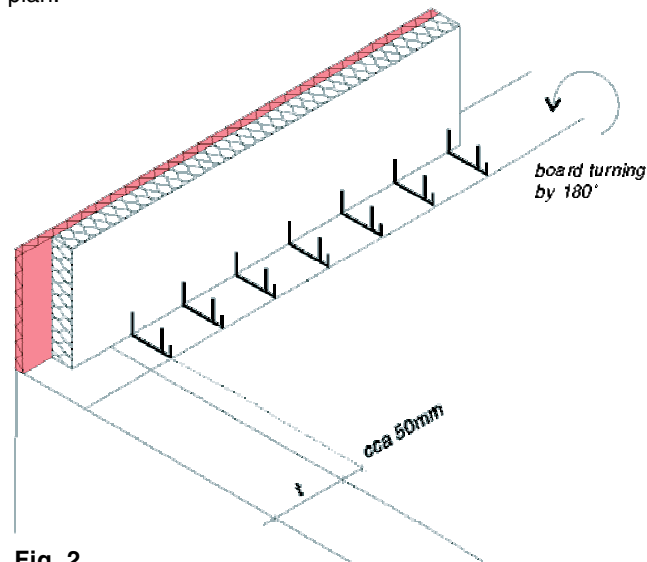


Fig. 2

2.

Before settling of inside board into one-side ties a tie must be place on an end.

Outside and inside casing boards must cover up each other at least by the wall thickness = " $t$ ". The best thing to do is to start with one whole board and one half board.

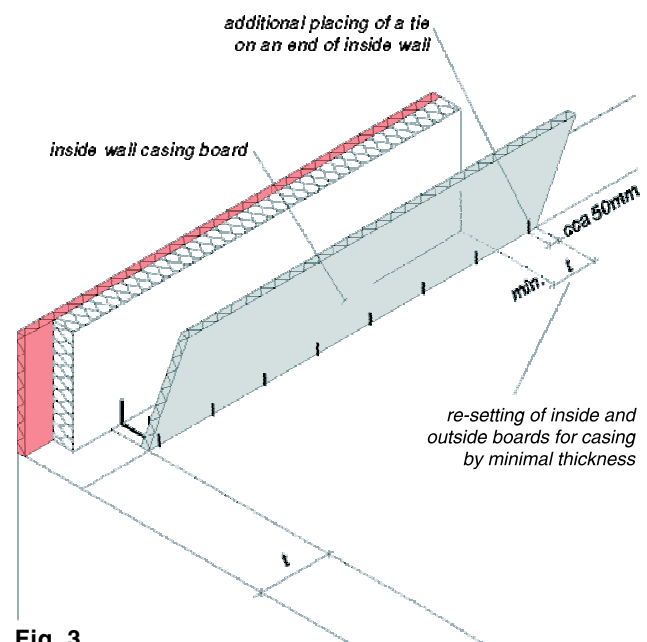


Fig. 3

### VERTICAL CONSTRUCTIONS

4.

Lining of windows and doors is done by reveal strips, that are classing wall from three sides. Reveal strips are nailed between wall and nails (min. 3 pcs on board width). Level of sill is left open for concreting. Under the sill there is concrete core into which it is recommended to put min. 2 pcs of rib concrete steel that conceal 750 mm into the following wall. Lintels are made with space steel girders or concrete steel. Before concreting, it is necessary to support upper part of lining of windows and doors.

EXAMPLE  
- INSIDE VIEW

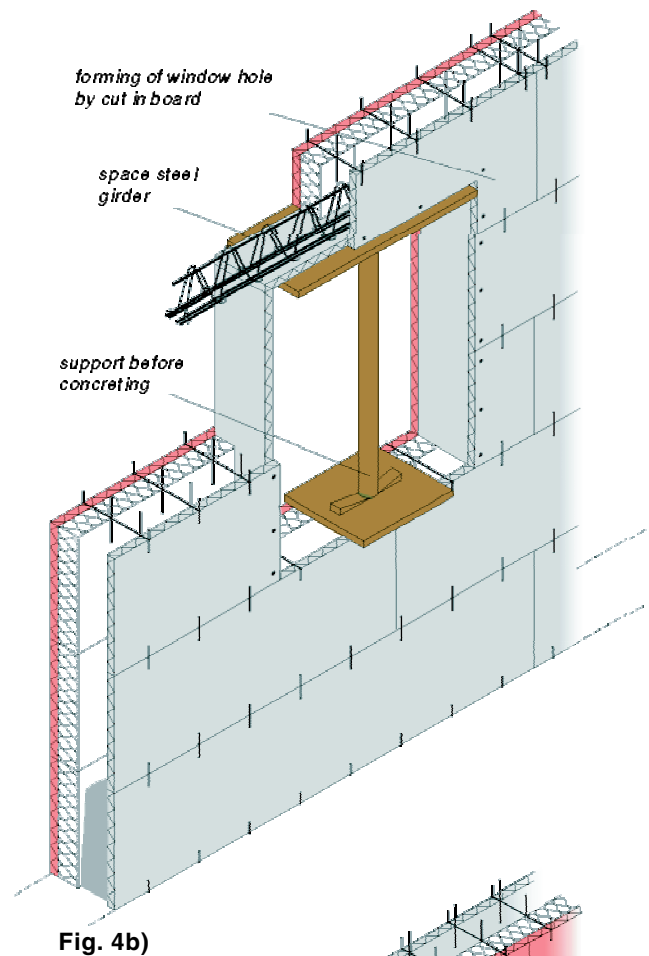
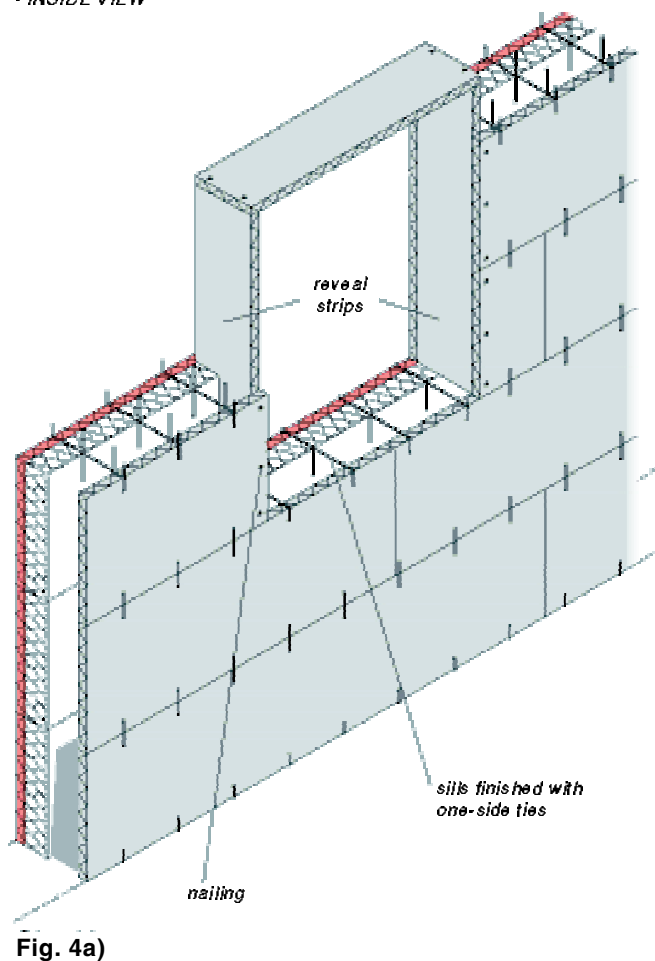


Fig. 4b)

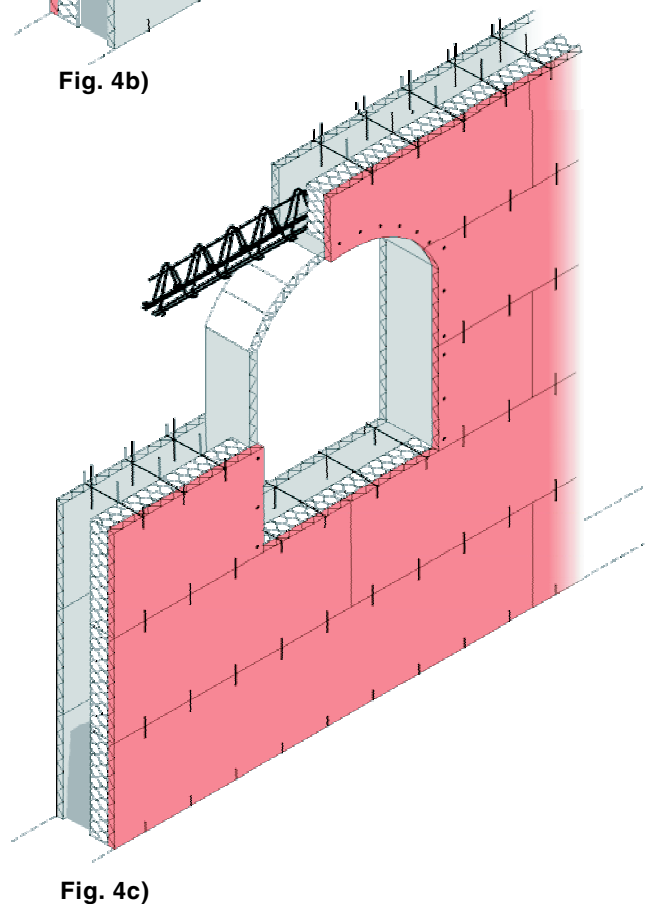


Fig. 4c)

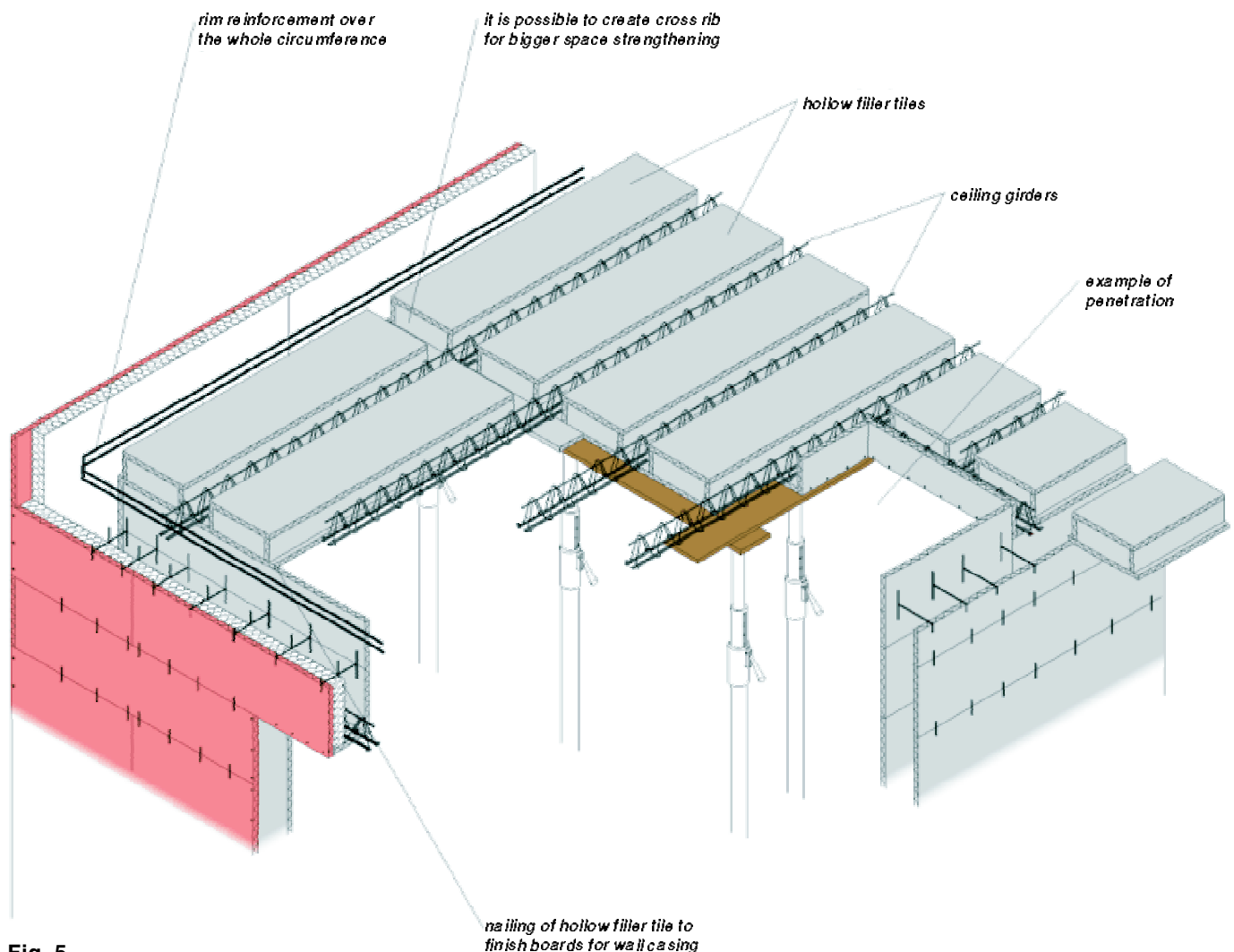
## **HORIZONTAL CONSTRUCTIONS IRON-CONCRETE MONOLITIC RIB (CASSETTE)**

**5.**

Hollow filler tiles are put onto carrying boards on wall circumference, nailed to inside casing boards (4 pcs of nails / m) and into gaps between moulds continuous ceiling girders are put, exceeding into carrying walls where rim reinforcement is tied up.

**ATTENTION:**

Console parts (balcony, fillet, oriel) and ceiling up of non-typical plans is necessary to prove with static calculations.



**Fig. 5**

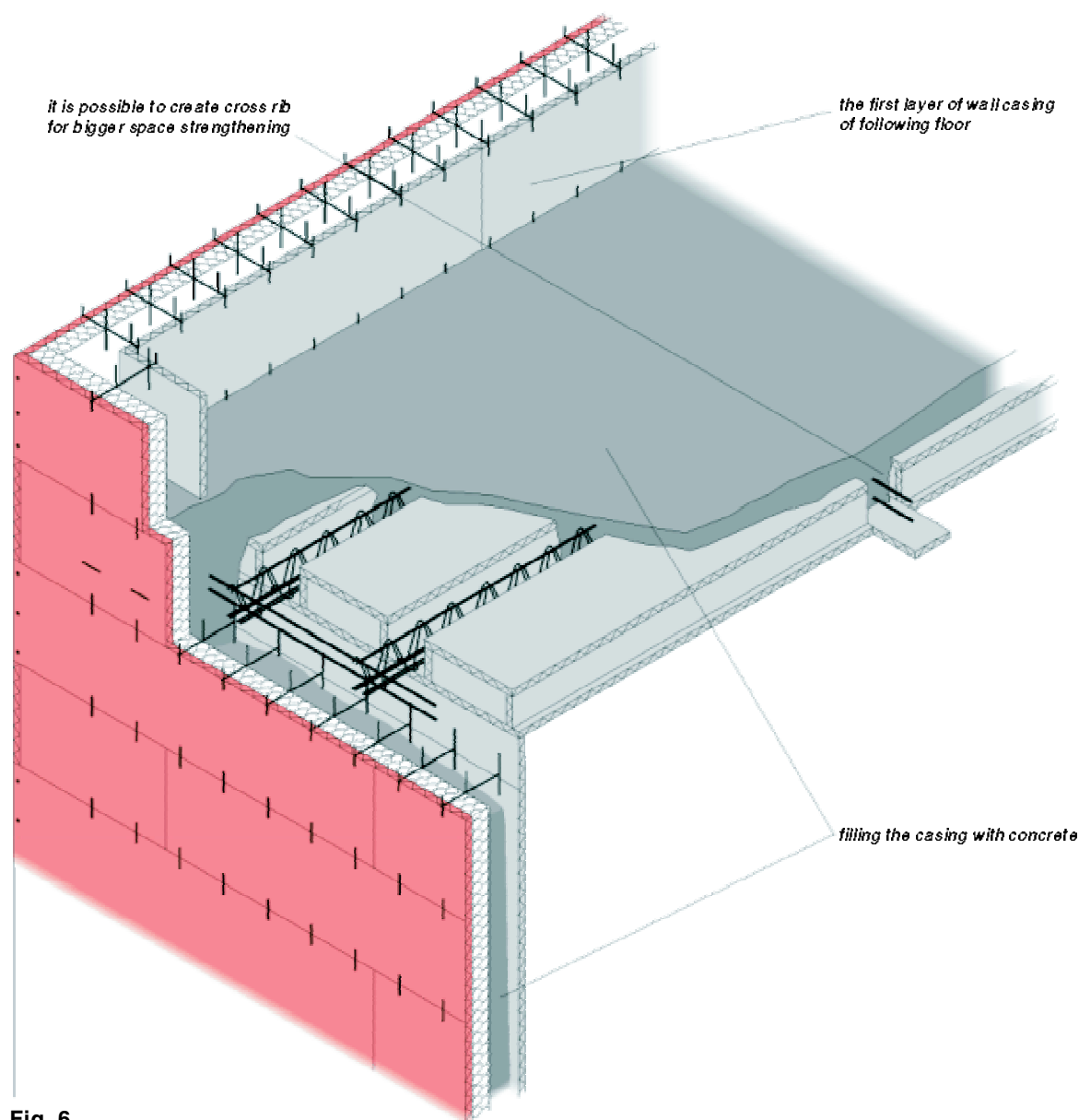


## **HORIZONTAL CONSTRUCTIONS IRON-CONCRETE MONOLITIC RIB (CASSETTE)**

**6.**

Built casing of walls and ceilings are filled with concrete mixture, including the last concreting of 50 mm concrete board over ceiling moulds.

On already generated floor you can continue building wall casing of following floor.



**Fig. 6**

## **INSTRUCTIONS FOR WALL CONCRETING**

- needed classes for concrete strength are set by designer and are stated in project
- for concreting is used concrete mixture of very soft consistence size of grain max. 16 mm
- transport of the concrete into casing is done by a pump or basket
- settling of concrete mixture goes on smoothly over the whole circumference of completely built casing in the same horizontal layer size cca 50 cm high. When settling concrete you must insist on proper filling of casing with concrete
- concrete mixture must be perfectly and constantly solid in each part of the construction
- concreting is performed (after concreting of the whole basic layer of casing) in range of one floor including ceiling, fulfilling the conditions that guarantees stronger casing:
  - 1) While wall casing with VELOX WS boards we recommend to use tow ties in 2. and 3. layer of the casing, good solidity is reached by puncturing
  - 2) While casing with WSD boards it is not necessary to use tow ties in 2. and 3. layer, good solidity is reached by immersing a vibrator max. 40 mm or intensive puncturing
- construction of supporting walls and following concreting can be done each by each layer when keeping up the position and treating the working crack
- working crack should be placed where the pressure of fresh concrete was in perpendicular direction on it. Its position in casing must be lower by 10 cm than loading crack of board. Working crack and loading crack CANNOT be on the same level.
- working crack you cannot avoid (appears when intercepting concreting for longer than 2 hours) is accompanied with sticking out rods, from steel for concreting - diameter 6 - 8 mm, minimal length 20 cm, into layer done before. Distance between rods is max. 50 cm
- during building casing it is necessary to keep up working cracks clean
- during remedy, settling, reaching good solidity and treating of concrete mixture you must act according to rules and standard regulations

## **ASSEMBLING AND CONCRETING OF CEILINGS**

- according to a plan for laying of ceiling a provisional temporary support construction will be built consisting of basic support and spread planks. Supports must be well-carrying and must be built on a strong basis and / or fixed well, distance between each support depends on thickness of spread planks. While assembling the construction which slender proportion (proportion of light span  $l_s$  to thickness  $H$  of ceiling construction) is bigger than 15, construction bank up is adjusted according to below mentioned chart
- when ceilings are built in more floors, the supports must stand perpendicularly above each other
- VELOX ceiling moulds are laid on assembly joint when assembling. In case you need to shorten the ceiling element cavities must be closed so that the concrete doesn't get in, on the element with cavities is put on assembling joint facing the previous element
- after laying the ceiling elements, into created ribs space steel reinforcement is laid exceeding into carrying walls. Required cover up of down reinforcement is ensured by distant ports. Girders with damaged latticing mustn't be used
- while manipulating with the material during assembling and during laying of concrete provisions must be set up so that space steel reinforcement is not damaged permanently
- total area assembling load of ceiling element before concreting into construction cannot exceed  $1,5 \text{ kN} / \text{m}^2$
- concrete mixture B 20 of soft consistency is used, max. grain size 16 mm
- while concreting, concreting cannot pile up on one place
- concreting of ceiling construction is done in stripes towards girders and at the same time ribs and concrete boards are concreted, that complete the ceiling to gain necessary height
- when laying concrete mixture reinforcement mustn't move or be damaged. Concreting of a stripe mustn't be interrupted. Working crack may appear only between girders in the middle of ceiling element
- concrete in ribs and around strengthening ribs is necessary to thicken properly. In case of using the immerse vibrator, the vibrating head diameter is max. 40 mm. Vibrations with the help of reinforcements is not allowed. Thickening can be done also by intensive puncturing
- after ceiling is made, it is necessary to keep the concrete moist till it get hard
- supports can be taken away when concrete reach standard strength according to regulations that are set up. The supports are taken away from top floor to ground floor
- while performing the support it is necessary to proceed according to valid standards and rules

Very important part of finishing work both inside and outside is plastering. Plaster protects construction against severe influence of surroundings, mechanic damage and increases good characteristics of building material, influence final appearance and architecture.

For construction of VELOX system of carrying walls there are technical recommendations for design preparation and building realisation of plaster related layers and final surface treatment.

Set of recommendations contests summary of performance of final plaster treatment.

Technical information ensuing from modern experience are general. These general information can't include specific conditions at site.

To use plaster mixture on construction of VELOX system there is set of technical advice from each producer of dry plaster and mortar mixtures.

When applying it is necessary to keep up the producers instructions.

### **BASE REQUIREMENTS AND PREPARATION FOR APPLICATION OF PLASTER**

Base for plaster at VELOX system is timber-cement board laid on binding. For out side of peripheral construction there will be, in most of the cases, used double-layer timber-cement board, e.g. VELOX WS-EPS.

To start with plaster it is necessary the concrete core matures and dries properly. Time for drying depends on climate and situation at site.

### **PREPARATIONS AND CONCERNING WORKS**

It means work that is needed to perform before start of plastering. The work mainly means protection against rain and others:

- finishing of roof construction
- settling hole fillings so that the plaster is not damaged afterwards
- covering sills with metal sheets or settling sills itself, covering of attic, window sills with metal sheets and other consols, handles etc.
- covering those parts of construction that shouldn't get dirty

(windows, doorstep, handles, furniture...)

- before inside plastering all installation means must be finished (water, gas, electricity, heating). If there is more pipelines next to each other. The whole hole must be filled in with mortar and covered with glass cotton or netting put in core layer; exceeds no more than 100 mm on both sides

### **BEFORE BEGINNING OF PLASTERING AND FINAL SURFACE TREATMENT WE RECOMMEND TO FOLLOW AND VERIFY THE FOLLOWING:**

- conditions and level of basis from timber-cement boards
- state of strength, homogeneity and cohesivity of timber-cement boards, in case VELOX boards are not enough joint with concrete core then must be anchored with suitable plate dowels
- performance of joining ties and exactness of performance of corners and so on
- condition of surface - whether is clean or dusty
- to verify whether the surface is not frozen
- to verify the humidity of timber-cement boards, base must be absolutely dry and if the surface is not dry it must get dry

When plastering inside the temperature of the surface and air cannot drop below + 5°C. This temperature must be for 2 or 3 days before plastering so that plastered surface reaches this temperature and must be kept for the time till the plaster gets hard (cca 7 days).

Fresh plaster made outside can't be exposed to big sun shine and severe drying wind. To prevent past drying of the plaster and to make easy its processing, specialist work in shadow part of the object. Fresh plaster is kept moist for about 3 days by spraying water on.

VELOX boards content also rest of back and bast but in very small amount. When we use plaster on gypsum basis parget for inside treatment these parts can generate brown spots, mainly when the surface is not dry sufficiently. When painting we shall use paints recommended by paint producers.

We recommend to perform three-layer plasters.

**Spraying** - serves as anchoring layer, enables better adhesiveness of core plaster onto base. Spray is made of cement and river sand in ratio 1:2, size of sand grain is 0 - 7 mm. Spray is laid by trowel sharply on the whole area and fills in all cracks between boards.

**Core layer** consists of cement-lime mortar (size of sand grain 0 - 7 mm), general requirements for thickness of inside core is 15 mm (min. 10 mm), outside core 20 mm (min. 15 mm). In case the core is thicker, is spread in two layers, when the second layer is spread after first one is board enough.

When spreading core layer, the glass cloth is pushed in the last third of outside part of peripheral walls, which serves as plaster reinforcement and risk of fissure is lowered. Glass cloth must be resistant against alkali. At the corners of buildings nettings are spread over by 20 cm, each stripe of cloth are covering up in join spots by 10 cm, in parts where tension is bigger - corners of window and door holes - we recommend to put there cloth diagonally cca 50 x 30 cm.

When spreading core layer of inside plaster in corners and places where materials are connected with various changes, the core is cut to base or the connection is spanned by reinforcing cloth.

With outside plastering a cut is made and filled in with plastic cement. Time for maturing of the plaster is 1 day/1 mm of plaster thickness.

**Last surface layer** - is final surface treatment and you can also use parget or various binds of decorating plasters whether it depends on structure or colour of plaster. The best thing to do is to use dry plaster mixtures to ensure constant quality of material.

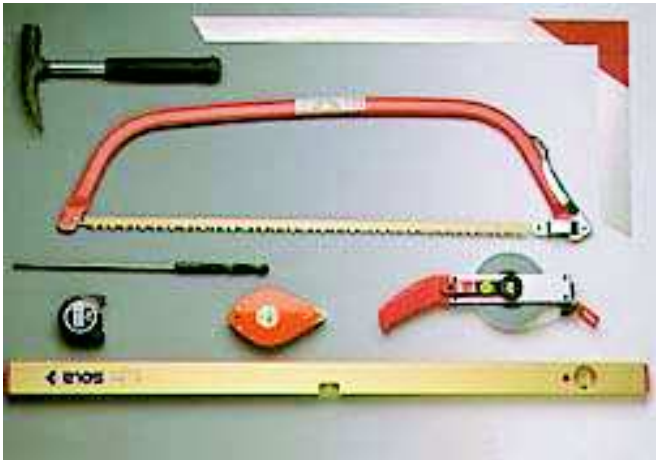
### **SURFACE TREATMENT OF CEILINGS**

For ceilings we recommend to use hardening mortar as basic layer together with laying reinforcing cloth over the whole area. As final surface treatment you can use parget or various kinds of decorative plasters. Surface treatment performed in such a way is necessary to understand as the whole system. For this reason we recommend to buy each component from one supplier or producer and follow his instructions for application.

Plaster-cartons can be used as surface treatment of inside walls and ceilings.



## APPROPRIATE EQUIPMENT AT CONSTRUCTION SITE



***Suitable and working tools is the base of perfect constructions. Tools for VELOX system is not very demanding:***

- circular saw with widia discs
- portable bow-frame saw min. 800 mm long
- electric portable circular saw with widia discs
- electrical drill + extension lead
- drill  $\varnothing 12$  mm, length min. 350 mm
- hammer
- assembling ladders
- spirit level, string
- immersing vibrator with head - with max. diameter 40 mm
- rolling-up meter
- steel or wooden supports for ceilings
- nails length - 100 / 3,15 mm to join boards
- nails length - 63 / 3,15 mm to join ceiling panels
- wooden wedges to rebalance the foundations when necessary



**VELOX-WERK s.r.o.**

Bělotínská cesta • 753 01 Hranice

tel.: +420 581 651 430 • fax: +420 581 651 530

e-mail: [velox@velox.cz](mailto:velox@velox.cz)

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**[www.velox.cz](http://www.velox.cz)**