IZOBLOK

CONSTRUCTION WALL PARTS

DIRECTIVE

FOR THE DESIGN AND PERFORMANCE OF WALLS CONCRETED FOR

IZOBLOK
WOOD-CEMENT BLOCKS

MFC MORFICO
creator of construction materials

1. General

1.1 Directive Validity

This directive applies to the designing and performing of walls concreted into the **IZOBLOK** wood-cement blocks. The design procedures, which are designated in these directives as simplified, can be used with buildings of ground structures with a maximum of six aboveground floors and the floor clearance $h < 3.50$ m, with ceiling span $L < 6.00$ m and with usable standard load $v_n < 5.00$ kN/m^2. Unless these conditions for simplified design procedures are met, it is needed to perform a more detailed assessment.

1.2 Others

Provisions not expressly stated in this directive are taken over from corresponding valid CSNs.

2. Block Classification and Designation

The IZOBLOK wood-cement blocks are classified according to the type as basic and corner, with a thermally insulating insert (for perimeter walls) or without it (for internal bearing walls and partitions).

The block designation is governed by the production programme of the company:

IZOBLOK wood-cement block width š / insulation thickness t / type

Dimension designation:	š	Block width [cm]
Insulation designation:	t	Thermally insulating insert thickness [cm]
Type designation:	Z	Basic
	R	Corner

Example:

- Wood-cement block of width 320 mm, basic, with a thermally insulating insert of thickness 110 mm for perimeter walls................32/11 /Z

- Wood-cement block of width 200 mm, corner, without a thermally insulating insert for internal bearing walls...............20/ 0/ R

3. Design Requirements

Walls concreted into wood-cement blocks are multi-layer tied walls consisting of:

- Blocks serving as sacrificial formwork and plaster carrier,

- Bearing core of plain or reinforced concrete,

- Possible thermal insulating insert.

The concrete of the bearing core of the wall must comply with the requirements of CSN 73 1201. The concrete class is determined by the designer. The required concrete class must be observed in the entire construction building, possibly in its certain part (individual floors), unless the designer determines a higher concrete class for some structural elements (piles, lintels, etc.).

When performing and checking the quality of concrete, it is necessary to observe the provision of CSN 73 2400.

3.1 Bearing Walling

3.1.1 Bearing Walls

With bearing walls concreted into the wood-cement blocks, the concrete core thickness should be $t > 120$ mm. The effective length L_{bz} of the bearing concrete core is the sum of the thicknesses b of individual bearing concrete columns, running across the entire floor height. Only such a column can be considered bearing, whose width b meets the condition of

$$90\text{ mm} \leq b_i \leq b_d,$$

Where b_d is the width of the concrete column, which can be considered with regard to the tying of the blocks and the shape of the column section[1] and which is connected in every block layer with adjacent columns with the concrete of the crossbeams and the height of at least 80 mm and section area $A_{pmin} = 50t$ [mm^2] in block rib cut-outs (Fig. 1).

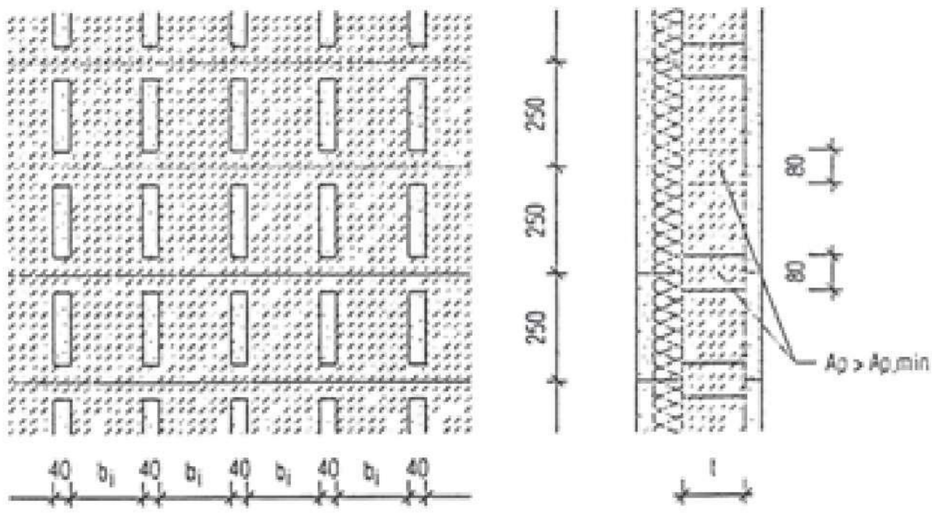

Fig. 1. Width of the concrete bearing column $b_!$ and crossbeam A_p

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*1) For example with blocks with an incorrectly performed or moving tie, the width of the concrete column b_d with regard to the overlap of the block ribs is smaller than the width of the block cavity, with blocks with a correctly performed tie, the width of the concrete column b_d is the same as the block cavity width, i.e. $b_d = 210$ mm.

The effective length of the bearing concrete core L_{bz} in a loaded section of the bearing wall of length L_z (Fig. 2) is thus equal to:

$$L_{bz} = \sum_{i=1}^{n} b_i \, .$$

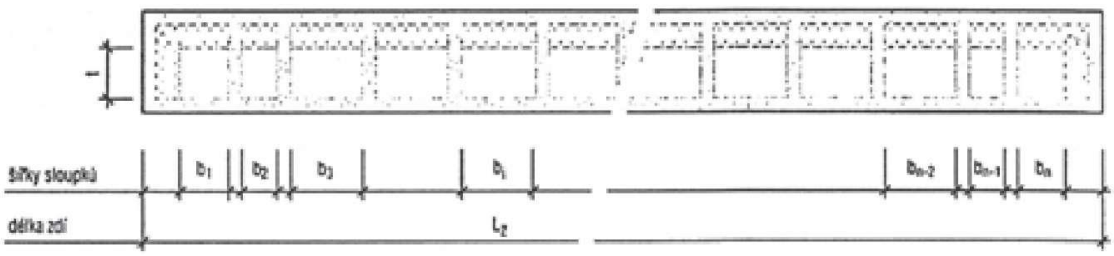


Fig. 2. Bearing wall of blocks 30/7

Example:

- Calculation of the effective length L_{bz} of a bearing wall of length 4.10 m of 2 pcs of blocks 30/7/R and 2 pcs of blocks 30/7/Z:

$$L_{bz} = \sum_{i=l}^{n} b_i = 2 \,.\, 150 + 2 \,.\, 105 + 13 \,.\, 210 = 3240 \text{ mm}$$

3.1.2 Piles

A vertical structural element concreted into the wood-cement blocks is considered a bearing pile (Fig. 3) only in case the effective length L_{bp} of the bearing concrete core of the pile complying with the provision of Claus 3.1.1 meets the condition:

$1.5 \,.\, b_d$ (min . 315 mm) $< L_{bp} \leq 4 \,.\, b_d$ (max. 840 mm),

Where b_d is the calculation width of the concrete column pursuant to Clause 3.1.1.

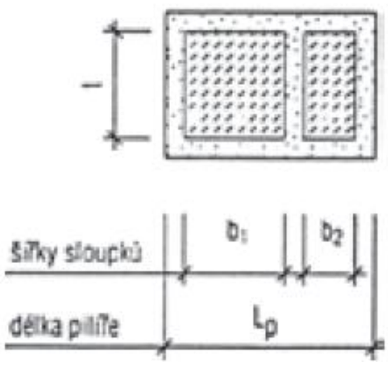


Fig. 3. Bearing pile of block 30/0/Z

3.1.3 Cellar Bearing Walls

The thickness of the concrete core should be t > 150 mm. During the wall design, it is needed to consider the ground pressure load. Water-tight insulation of the wood-cement blocks is required.

3.1.4 Maximum Lengths and Heights of Bearing Walls

To prevent the creation of cracks in the concrete, it is necessary to divide the construction building with running dilatation gaps into multiple units. The maximum length of the dilatation units is stated in CSN 73 1201, Appendix 6.

The maximum height of the bearing wall determined assuming the joint fastening of both ends and securing the immobility of nodes (by reinforcing the construction building pursuant to Sec. 3.2) is stated in Table 1.

Table 1: Maximum heights of bearing walls of wood-cement blocks

Concrete core thickness [mm]	Maximum bearing wall height [m] [1])	
	Of plain and weakly reinforced concrete	Of reinforced concrete [2])
270	6.25	8.55
240	5.55	7.60
220	5.10	7.00
180	4.15	5.75
160	3.70	5.10
150	3.50	4.75
130	3.00	4.10

Note:

(1) With partial fixing of the bearing wall into the ceiling structure (see Cl. 4.4.1), it is possible to increase the stated values by 10%.

(2) For bearing walls of reinforced concrete, the following applies: X_{max} = 110 and p = 1,00 (see CSN 73 1201/86 - Clauses 5.2.4.1 and 5.2.4.3).

3.2 Tie Walls

The thickness of the concrete core of tie walls concreted into the wood-cement blocks should be t > 90 mm. For masonry tie walls, CSN 73 1101 applies.

3.2.1 Construction Building Tying

The tying of the construction building does not need to be proven by calculation, if the maximum distance of tie walls pursuant to Sec. 3.2 is:

- 8.00 m with ceilings without lateral distribution (wooden ceilings, beam ceilings and ceilings of prefabricated sections without effective lateral connection),
- 12.00 m with ceilings with lateral distribution (ceilings of prefabricated sections with effective lateral connection, monolithic ceilings) and if the following conditions are met:
- The construction building does not have a height larger than double its width.
- The tie wall is tied into the tied wall with an effective length of the bearing concrete core L_{bz} > 1.00 m.
- The thinness of the tie wall of wood-cement blocks

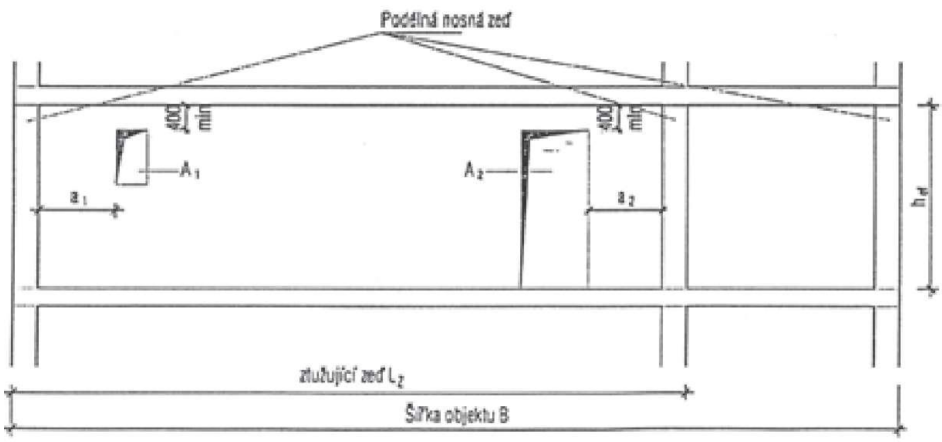
$$\lambda = \frac{l_e}{t_e}\sqrt{12} \leq 80 \text{ resp. } 110$$

For plain and weakly reinforced concrete or for reinforced concrete, where the height of the tie wall l_e is determined according to CSN 73 1201, Tab. 7 and the effective thickness of the concrete core is t = t [m], if the tie wall is considered bearing, possibly t = t + 0.04 [m], the tie wall is not considered bearing. For masonry tie walls, CSN 73 1101, Cl. 114 applies.

-The tie wall of wood-cement blocks is either concreted simultaneously with the tied wall or U-shape clamps are fitted into the tied wall, min. diam. V 6 every 250 mm, wrapping with the enclosed end in the tied wall 2 diam. V 10 and anchored with the open end into the tie wall in a length of min. 500 mm.

The openings in the tie wall do not have a combined area of more than 1/5 of the total area of the tie wall, the distance of the opening from the external face of the tied wall is larger than 1/5 of the wall height (however, minimally 500 mm) and between the opening and the ceiling, there is a band of masonry at least 400 mm tall.

Unless these conditions are met, it is needed to assess the tying of the construction building by calculation (see e.g. Cl. 3.2.2).



$$A1 + A2 = \frac{1}{5} \cdot L_z \cdot h_{ef} \qquad a_i \geq \frac{h_{ef}}{5}\text{, příp. } a_i \geq 500\ mm$$

Fig. 4. Example of a tie wall

3.2.2 Simplified design - tying of a construction building with ceilings with lateral distribution

For simplified assessment of the tying of individual floors (see Sec. 1.1), relation 2) can be used:

$$L_{pr} \leq L_{max} = 0{,}03\ (3 + o)\ (9 - n)\ (\sum L_z - 4i) + 2i,$$

While

$$o = R \cdot t_a^2 \cdot \gamma$$

Where

i is the number of tie walls considered in the calculation,

n is the number of floors - counted from the top,

R is the strength of the piece building materials (see CSN 73 1101, Cl. 31) of tie walls, possibly the guaranteed pressure strength of the concrete core of tie walls (MPa),

*2) see ONORM B 3350, Sec. 5.4.

t_a	is the average thickness of tie walls, possibly of the concrete core of tie walls [m],
γ	is the volumetric weight of tie walls [kN/m^3]
$\sum L_z$	is the sum of lengths [m] of the tie walls considered in the calculation, during the calculation, all tie walls, whose length $L_z > 2.00$ m can be considered. If the tie wall is effectively connected with the tied wall of effective length $L_{bz} > 1.00$ m, the length of the tie wall can be multiplied by the coefficient 1.2,
L_{max}	is the largest admissible length of the face [m] between external walls or dilatation gaps,
L_{pr}	is the actual length of the face [m] between external walls or dilatation gaps

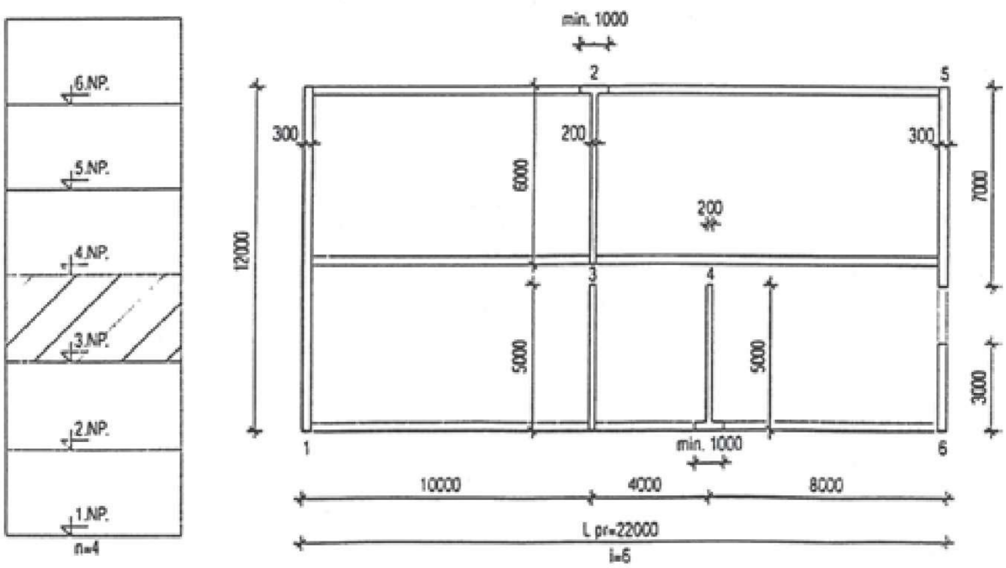


Fig. 5. Construction building with longitudinal bearing system and lateral tie walls

Example:

- *Assessment of the tying of the construction building (Fig. 5):*
- *Tie walls 1, 5, and 6 are of blocks 30/7*
- *Tie walls 2, 3, and 4 are of blocks 20/0*
- *Concrete of the core of Cl. B 12.5* $R = 12.5$ *MPa,* $\gamma = 23$ *kN/m*^{3}

$$\sum L_z = 12{,}00 + 1{,}2 \cdot 6{,}00 + 5{,}00 + 1{,}2 \cdot 5{,}00 + 7{,}00 + 3{,}00 = 40{,}20\ m$$

$$t_a = \frac{\sum(L_{zi} \cdot t_1)}{\sum L_z} = \frac{(12{,}00 + 7{,}00 + 3{,}00) \cdot 0{,}15 + (1{,}2 \cdot 6{,}00 + 1{,}2 \cdot 5{,}00 + 5{,}00) \cdot 0{,}13}{40{,}20} = 0{,}141\ m$$

$$o = 12{,}5 \cdot 0{,}141^2 \cdot 23 = 5{,}715$$

$$L_{max} = 0{,}03\ (3 + 5{,}715)\ (9 - 4)\ (40{,}20 - 4 \cdot 6) + 2 \cdot 6 = 33{,}17\ m > L_{pr}$$

Tying of the 3rd aboveground floor complies.

3.3 Bearing Masonry Penetrations

Without an assessment, it is possible to admit penetrations in the bearing walling up to an area of 625 cm^2 and up to the penetration side ratio no smaller than 1 : 1.5, if they do not weaken the bearing core section by more than 15 %.

3.4. Pockets and Grooves in Bearing Masonry

Without an assessment, it is possible to admit pockets and grooves in the bearing masonry while meeting the following requirements:

a) Vertical, additionally performed pockets and grooves:

Depth: $d \leq \frac{t}{10}$

Width: $b \leq \frac{0{,}03 \, . \, n \, . \, b_i \, . \, t}{d}$,

Where

n is the number of concrete columns of width b_i per 1.00 m of the bearing wall length,

t is the thickness of the bearing concrete core.

The aforementioned depth and width of the additionally performed pocket or groove is considered only in the bearing concrete core.

During additional performing of pockets and grooves, it is needed to secure that a breach of the surrounding concrete of the bearing core does not occur. Additionally performed pockets and grooves of depth d > t/10 are not permitted in the bearing masonry.

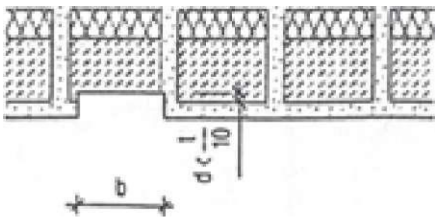


Fig. 6. Additionally performed groove in the bearing wall

Example:
- Bearing wall of blocks 30/7 (Fig. 6):

$t = 150 \text{ mm}, b_i = 210 \text{ mm}, n = 4$

$d = 15 \text{ mm} = \frac{t}{10}$

$b_{max} = \frac{0{,}03 \, . \, 4 \, . \, 210 \, . \, 150}{15} = 252 \text{ mm}$

$b = 200 \text{ mm} > b_{max}$

b) Vertical boarded pockets and grooves

Without reinforcement:
Depth: $d \leq t - 80$ mm
Width: $b \leq 250$ mm

With reinforcement:
Depth: $t - 80 \text{ mm} \leq t \leq t - 50$ mm
Width: $b \leq 250$ mm

In this case, it is necessary to insert a rod diam. V 8 at least into every second gap between the blocks (see Working Manual) and anchor it with hooks into two neighbouring bearing concrete columns. Pockets and grooves of depth d > t - 50 mm and width b > 250 mm must be assessed in the static calculation.

c) Skewed and horizontal grooves, either additionally performed or boarded, may weaken the area of the lateral section of the bearing concrete core maximally by 3%.

3.5 Termination of Walls under the Ceiling and Perimeter Collars

All bearing and tie walls must be either connected with the ceiling structure so that the moments of partial fixing of the ceiling structure are caught (Cl. 4.4.1 - d) or terminated so that deformation of the ceiling structure is allowed (Cl. 4.4.1 - a, b, c).
The perimeter collar can be performed in the width t of the bearing concrete core with reinforcement placement into the cut-outs in the block ribs (Fig. 7). The longitudinal reinforcement of the collar of min. 4 diam. V 10 must be placed,

- With beam ceilings into the layer of blocks below the beams.
- With prefabricated board ceilings into the layer of blocks under the ceiling panels.

The reinforcement of the perimeter collar may be contacted with an overlap to the contact length (it is recommended to alternate the contacts), or welding. The reinforcement of the perimeter collar in the corners of perimeter walls and in connections of tie walls is recommended to be contacted with L-shape liners.
With monolithic ceilings, the function of the perimeter collar is taken over by the additional reinforcement min. 4 diam. V 10, which is placed into the monolithic part of the ceiling above the masonry. The bearing core of the wall is anchored into the ceiling either with spindles min diam. V 8 every 500 mm or with a tensile reinforcement pursuant to Cl. 4.4.1 - d.

The provision of this section applies provided the conditions of Sec. 3.2 are met.

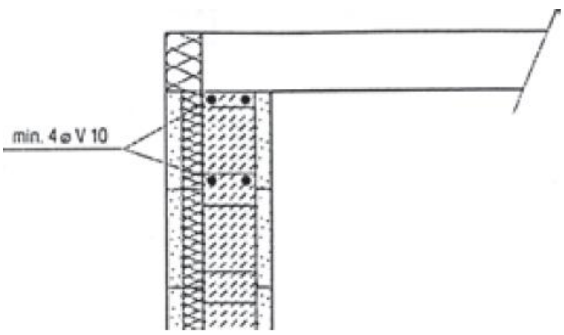


Fig. 7. Perimeter collar below the ceiling panel

3.6 Ceiling Placement

Unless stated otherwise by the ceiling structure manufacturer, the ceilings must be placed across the entire width t of the bearing concrete core of the wall. The placement of the ceiling must be considered during the load eccentricity calculation.

3.7 Lintels

Lintels may be created according to the rules stated in the Working Manual by reinforcing the blocks. The share of the load acting on the lintel is stated in the following examples (see Fig. 8 to 10). The manners of loads may be mutually combined.

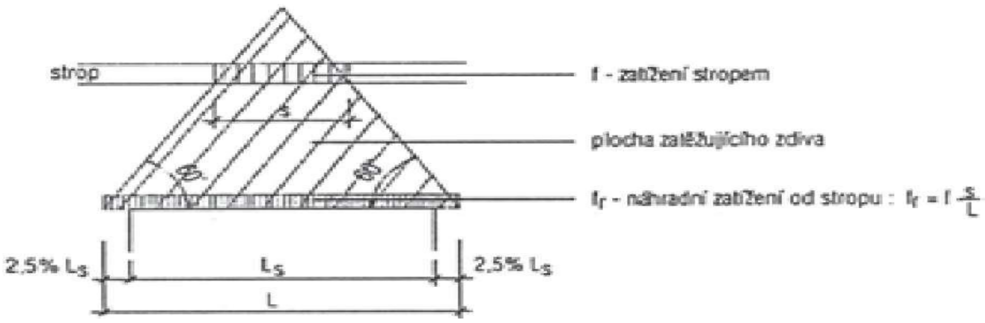


Fig. 8. Load by the well and the ceiling

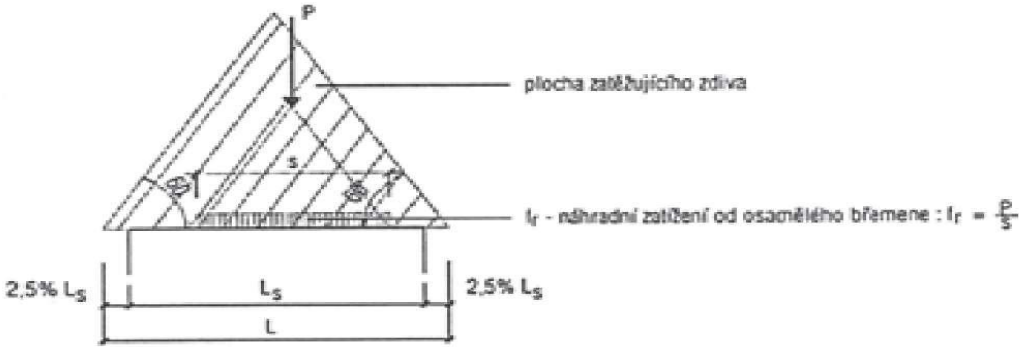


Fig. 9. Load by a lone burden in the loading triangle

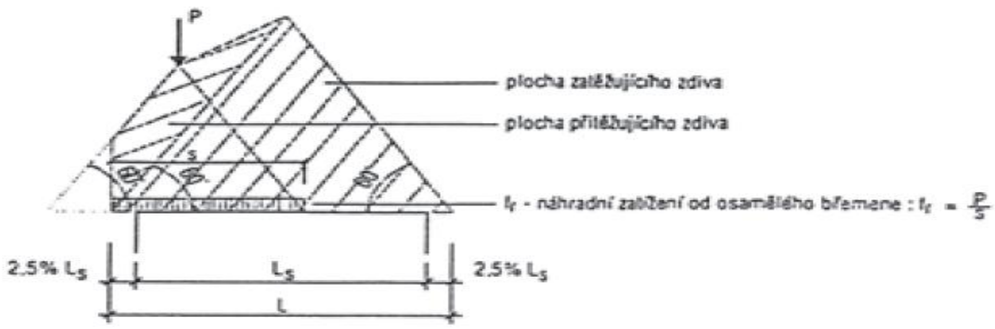


Fig. 10. Load by a lone burden outside the loading triangle

If is height of the lintel h < 0.5 L_S, the lintel is designed as a both-side partially fixed beam for bending moments of

$$M = \pm \frac{1}{16} f \cdot L^2,$$

Where L is the beam span;

f is the total beam load.

During the design of the longitudinal reinforcement, the height of the pushed part of the concrete section x_u may be maximally equal to the block rib cut-out height.

During the calculation of the breach limit by the shifting force, it is possible to consider a full rectangular section b . h for the calculation of Q_{bu} (Fig. 11),

Where **b** is the width of the pushed concrete (corresponds to the width of the cut-out in the block rib),
h is the height of the beam, depending on the number of rows of blocks between the opening and the ceiling.

The block ribs in the section, where $Q > Q_{bu}$, will be cut out.

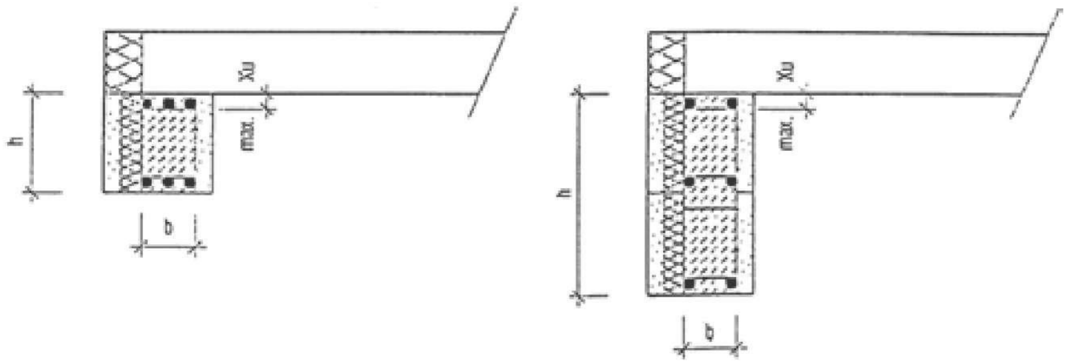
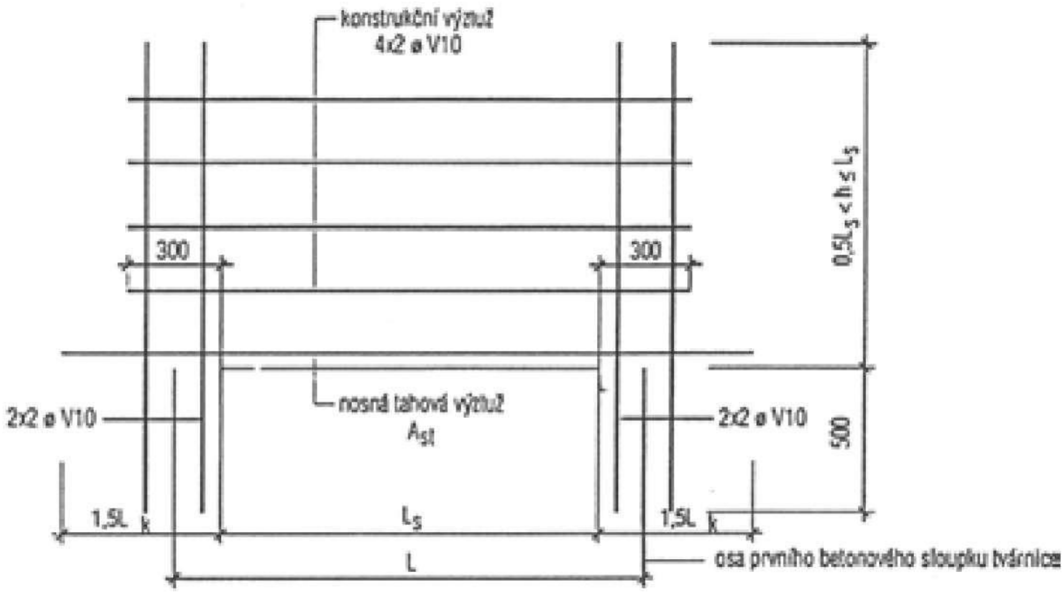


Fig. 11. Examples of Lintel Reinforcement

The upper reinforcement of the lintel must be anchored to the anchoring length, however, minimally 750 mm, into the concrete of the adjacent masonry beyond the opening face, the bottom reinforcement pulled minimally 300 mm into the concrete of the adjacent masonry beyond the opening face.
If the lintel height is h > 0.5 L_s, the lintel is designed as a wall beam simply placed for the bending moment of

$$M = \frac{1}{8} f \cdot L^2.$$

In this case, it is necessary to anchor the bottom reinforcement of the lintel for 1.5 times the anchoring length into the concrete of the adjacent masonry beyond the opening face. Into longitudinal grooves (created by cut-outs in the block ribs) of the lintel, a structural reinforcement min. 2 diam. V 10 is always inserted, intervening minimally 300 mm into the concrete of the adjacent masonry beyond the opening face. Into the first concrete column from the opening face, a vertical reinforcement 4 diam. V 10 is inserted for the lintel height and intervening for the length of 500 mm below the lower level of the lintel. The height of the lintel is considered maximally equal to the opening clearance.



$$A_{st} = \frac{N_{st}}{\gamma_u \cdot R_{sd}} \qquad kde \qquad N_{st} = \frac{M}{z_h}$$

$$z_b = 0,5\,h$$

Fig. 12. Example of Reinforcement in a Wall Lintel

4. Design

4.1. Geometric Shape

The lengths of the perimeter walls of the construction building of wood-cement blocks are recommended to be designed in a module network of IZOBLOK blocks, i.e. in multiples of module 500 mm between the inner faces of the perimeter walls. The design height is designed in multiples of module 250 mm. The dimensions of the openings in the walls are recommended to be designed in multiples of module 250 mm (see Fig. 13, p. 14).
In cases, where it is impossible to apply this rule for architectural or design reasons, the blocks can be modified by cutting directly at the site and thus create any plan and vertical shapes of walls (see the Working Manual).

4.2. Load

The load of the structure is determined pursuant to CSN 73 0035 with the following exceptions:

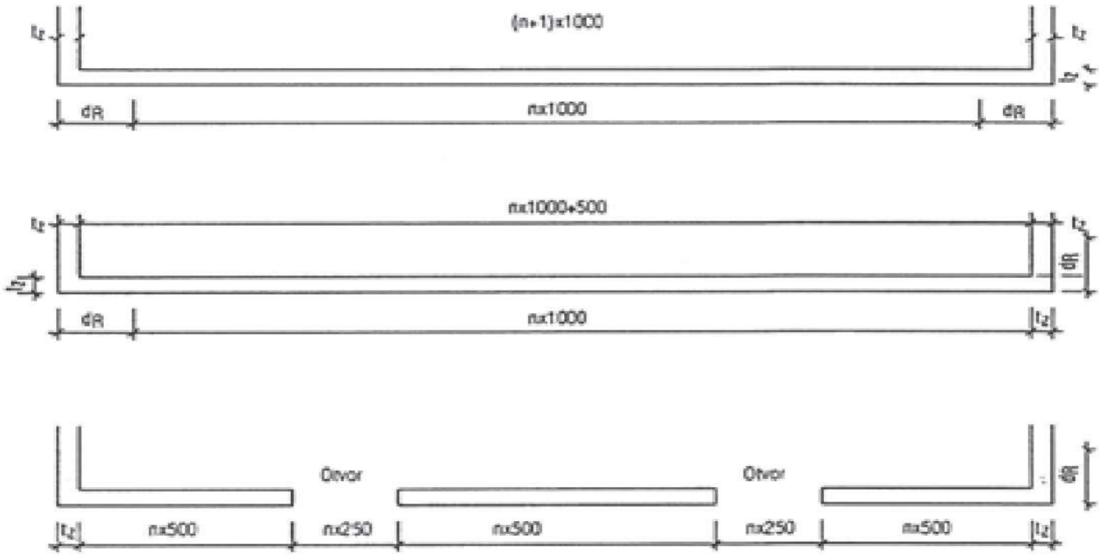
Wood-cement blocks:

- Standard load per 1 m^2 of the viewing area of the masonry is determined from the relationship

$g_{tn} = 4 \cdot gt_s$ [kN/m^2]

Where g_{ts} is the block weight [kN] according to the production programme

- Load coefficient $y_f = 1.2$ (0.8).



Where t_z is the thickness of the wall = thickness of the corner block

d_R is the length of the corner block

Fig. 13. Example of Designs of Plan Dimensions of a Wall of Th. 320 and 350 mm

Concrete core of the wall:
- Standard load per 1 m^2 of the viewable area of the masonry is determined from the relationship:

$$g_{2n} = V \cdot \gamma_b \; [kN/m^2]$$

Where

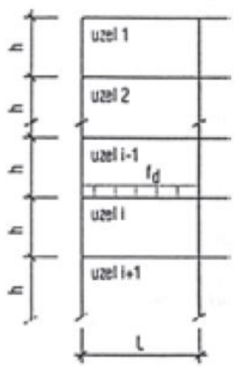
V is the volume of the concrete v the wall core [m^3/ m^2] according to the production programme

γ_b is the volumetric weight of the concrete (for a core of plain concrete with crushed or mined compact natural aggregate, $\mathbf{Y_t}$ = 23.00 kN/m^3)

- Load coefficient $\mathbf{Y_f}$ = 1.1 (0.9)

4.3 Calculation of Load in Walls and Nodes

Load of ceilings:

Operating	Calculation		Fig. 14. Example of the shape and load of the structure
Permanent load			
gs [kN / m^2]	g_d [kN / m^2]		
Random load			
V_S [kN / m^2]	v, [kN / m^2]		
Total load			
f_S [kN / m^2]	f_d [kN / m^2]		

Load by the ceiling per 1 m' of masonry:[2]

Permanent load

$$G_{s(d)} = \frac{g_{s(d)} \cdot L}{2} \quad [kN/m]$$

celkové zatížení

$$F_{s(d)} = \frac{f_{s(d)} \cdot L}{2} \quad [kN/m]$$

Total load

$$G_{0s(d)} \quad [kN/m]$$

Load by own weight of the wall (blocks, core, plaster) per 1 m' of the wall:

$$N_{gs(d)i} = \sum_{i}^{i} (G_{s(d)} + G_{0s(d)}) \quad [kN/m]$$

Normal force in node i:

Permanent load

$$N_{s(d)i} = \sum_{i}^{i} (F_{s(d)} + G_{0s(d)}) \quad [kN/m]$$

Total load

Fig. 15. Wall (pile) between windows

4.3.1 Increase of the Load in a Wall between Openings

$$N^P = \frac{N \cdot b}{b^P} \quad [kN/m]$$

$$M^P = \frac{M \cdot b}{b^P} \quad [kNm/m]$$

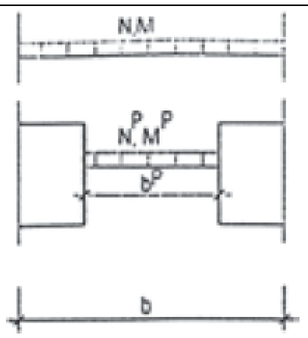


Fig. 15. Wall (pile) between windows

4.4 Wall Design

When designing walls concreted into the wood-cement blocks, CSN 73 1201 applies, to which all further references relate, however with these complements:

4.4.1 Node shape: perimeter wall - ceiling

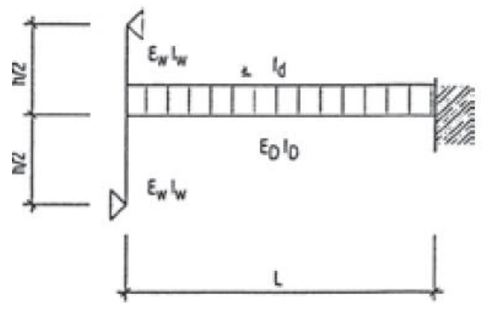
The largest possible moment of partial fixing M_m in the node perimeter wall - ceiling (see

3) Only the calculation of reactions for a plain beam is stated.

the static diagram in Fig. 16, p. 15) is determined by dividing the moments using the Cross method [4] [MD1]:

$$M_m = \frac{1}{m} \cdot f_d \cdot L^2 \qquad [kNm/m]$$

Fig. 16 Static diagram for determining the moment M_m



4 See KOMENTAR ÖNORM B3350 BEISPIELE, Sec. 6.2.:

Rigidity of rods per unit of length for dividing the moments according to the Cross method:

- Ceiling: $k_D = \frac{E_D . I_D}{L}$

- Wall: The length unit for calculation I_W is 2/3 of the length unit for calculation I_D

$$k_w = \frac{3}{4} \cdot \frac{E_w \cdot 2/3 \cdot I_w}{\frac{h}{2}} = \frac{E_w . I_w}{h}$$

- Moment, falling to both walls:

$$M = \frac{3}{4} \cdot \frac{f_d \cdot L^2}{12} \cdot \frac{\frac{2E_w I_w}{h}}{\frac{2E_w I_w}{h} + \frac{E_D I_D}{L}} = \frac{c}{8\,(2c+1)} \cdot f_d \cdot L^2 = \frac{1}{m} \cdot f_d \cdot L^2$$

kde:

$$m = \frac{8\,(2c+1)}{c}$$

$$c = \frac{L}{h} \cdot \frac{E_w . I_w}{E_D . I_D}$$

With the simplified design procedure (see Sec. 1.1), the safe value of coefficient m is determined from the graph (Fig. 17) depending on the thickness of the concrete core t:

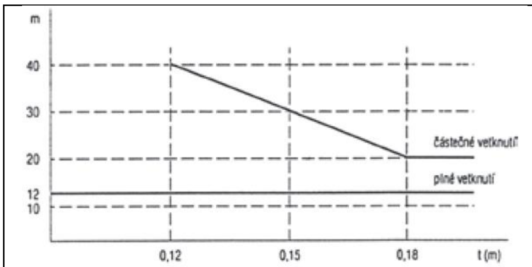


Fig. 17. Graph for determining the value of coefficient m

It is only possible to calculate using the stated partial fixing moment, if the wall clamps the ceiling structure sufficiently (Cl. 4.4.1 - a), and/or if it is possible to consider the node a frame nodal point (Cl. 4.4.1 - d). The aforementioned moment must of course transfer the ceiling section in the partial fixing point into the wall.

a) Partial fixing secured by clamping - board ceilings transferring the partial fixing moment (Fig. 18): Partial fixing moment:

$$M_m = \frac{1}{m} \cdot f_d \cdot L^2$$

Force necessary for activating moment M:

$$N_m = \frac{2 \cdot M_m}{t} \geq N_{gd}$$

Clamping moment in node i:

$$M_n = N_{gd} \cdot \frac{t}{2}$$

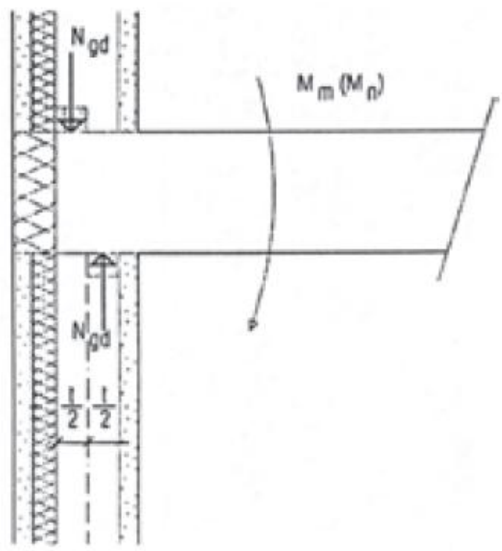


Fig. 18.
Ceiling board clamped by the walls

If there is force N , < N in node i, activation of moment M_m cannot occur, therefore it is impossible to consider partial fixing with value M and it is needed to consider clamping moment M_n. For an assessment of the partially fixed ceiling, moment M is thus always considered, which is the smaller of moments M_m or M_n. Calculation moment M_z for an assessment of the wall section is considered with value:

$$M_z = 0{,}5 \cdot M$$

b) Plain placement - board ceilings without backing (Fig. 19), ceilings not transferring the partial fixing moment:

$$M = 0$$

$$M_z = F_d \cdot \frac{t}{4}$$

Where F_d is a value determined for the corresponding ceiling pursuant to Sec. 4.3

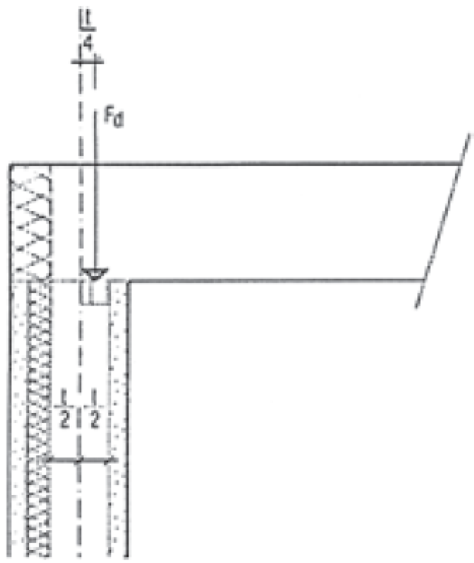


Fig. 19
Ceiling board plainly placed on a wall

c) Plain placement - beam ceilings into pockets (Fig. 20):

$$M = 0$$

$$M_z = F_d \cdot \frac{t}{4}$$

Where F_d is a beam reaction from the total load divided by the axial distance of the beams, possibly by the width of the load distribution in the wall footer, if it is smaller than the axial distance of the beams. Load distribution in the wall is considered at 60°.

With beam ceilings, it is also needed to consider the assessment of the core concrete for concentrated pressure according to CSN 73 1201, Cl. 5.5.2 to 5.5.5.

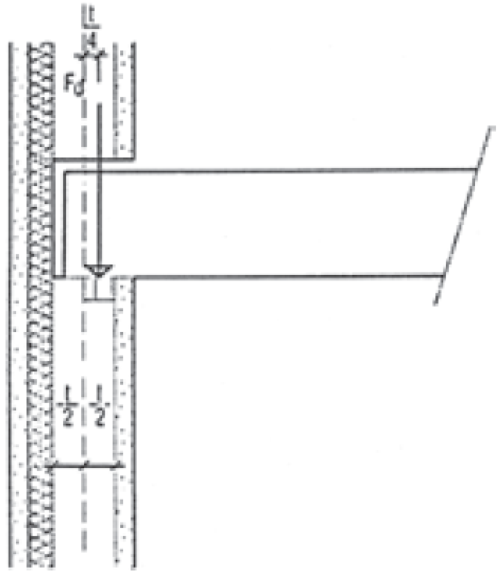


Fig. 20.
Beam plainly put into pockets on a wall

d) Partial fixing secured by reinforcing - monolithic ceilings (Fig. 21)
Partial fixing moment:

$$M_m = \frac{1}{m} \cdot f_d \cdot L^2$$

$$M_z = 0{,}5 \cdot M_m$$

Tensile force N_{st} in the concrete core of the wall must be transferred by the reinforcement of section area A_{st}:

$$A_{st} = \frac{N_{st}}{\gamma_u \cdot R_{sd}}$$

The tensile force N_{st} is determined by calculation.

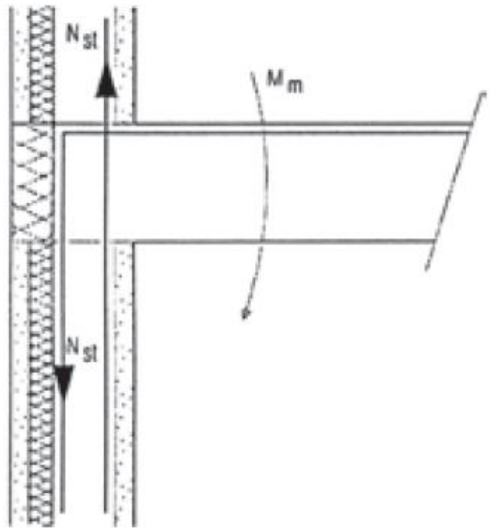


Fig. 21.
Placement of the tensile reinforcement in the node

4.4.2 Node shape: perimeter wall - ceiling with a console

During the strain of the wall by the ceiling field with a console, the moment in the wall is reduced.

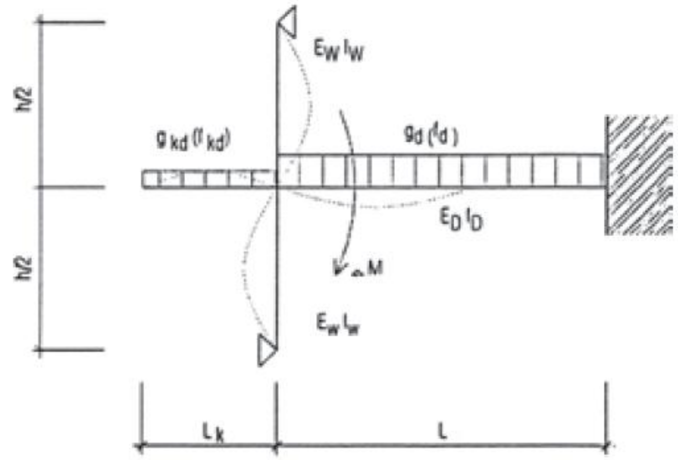


Fig. 22. Static Diagram for Determining Moment ΔM

Konzola: $M_{kg} = \frac{1}{2} \cdot g_{kd} \cdot L_k^2$, resp. $M_{kf} = \frac{1}{2} \cdot (g_{kd} + v_{kd}) \cdot L_k^2$,

pole: $M_f = \frac{1}{12} \cdot (g_d + v_d) \cdot L^2$, resp. $M_g = \frac{1}{12} \cdot g_d \cdot L^2$,

$$\Delta M = \frac{1}{12} [(g_d + v_d) \cdot L^2 - 6 \cdot g_{kd} \cdot L_k^2], \text{ resp. } ^{*5)}$$

$$\Delta M = \frac{1}{12} [g_d \cdot L^2 - 6 \cdot (g_{kd} + v_{kd}) \cdot L_k^2]$$

pak $M = \frac{3}{4} \cdot \Delta M \cdot \frac{2c}{2c+1} = \frac{12 \Delta M}{m} \leq M_m = \frac{1}{m} (g_d + v_d) \cdot L^2$

kde $c = \frac{L}{h} \cdot \frac{E_W . I_W}{E_D . I_D}$

The calculation moment M_z for assessment of the wall section is considered using value:

$$M_z = 0,5 \cdot M$$

4.4.3 Node Shape: Middle Wall - Ceiling

During the strain of the middle wall by continuous ceiling fields of approximately the same span, the moment in the middle wall is not considered. With a difference of the span of neighbouring fields of ceilings larger than 20% of the larger span field ($L_1 - L_2 > 0.2\ L_1$), it is needed to consider moment **Δ**M.

Při: $L_1 - L_2 > 0,2\ L_1$

$$\Delta M = \frac{1}{12} [(g_{1d} + v_{1d}) \cdot L_1^2 - g_{2d} \cdot L_2^2],$$

pak $M = \frac{3}{4} \cdot \Delta M \cdot \frac{2\bar{c}}{2\bar{c}+1} \leq M_m = \frac{1}{m} (g_{1d} + v_{1d}) \cdot L_1^2$

*5) The larger of both moments is considered.

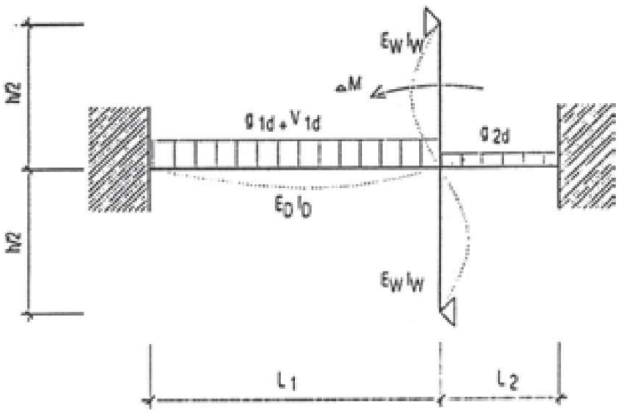


Fig. 23. Static Diagram for Determining Moment ΔM

kde $\bar{c} = \frac{L_1}{h} \cdot \frac{E_W \cdot I_W}{E_D \cdot I_D} \cdot \frac{1}{\left(1 + \frac{L_1}{L_2}\right)}$

Calculation moment M_z for an assessment of the wall section is considered with value:

$$M_z = 0{,}5 \cdot \Delta M$$

4.5 Assessment of Walls Concreted into the Wood-Cement Blocks

4.5.1. Assessment of Walls with Calculation according to CSN 73 1201

Bearing walls concreted into the wood-cement blocks are assessed pursuant to CSN 73 1201, Sec. 5.1 and 5.2 as an element (either of plain or reinforced concrete) of an area of the concrete part of the section:

$$A_b = L_{bz} \cdot t$$

Where

L_{bz} is the effective length of the bearing wall,

t is the thickness of the bearing concrete core.

During the assessment of the pile, area A_b is multiplied by coefficient **x**, from the graph in Fig. 24.

4.5.2. Graphs for Assessment of Walls

The graphs are processed for the design of a bearing wall of length L_z = 1,000 mm of effective length L_{bz} = 4 b_d = 840 mm pursuant to Cl. 3.1.1. The graphs may be used also for the design of piles pursuant to Cl. 3.1.2 provided the normal force N_d and the bending moment M_d, determined for a pile of effective length L_{bp} are multiplied by coefficient

$$\chi = \frac{L_{bz}}{\chi_1 \cdot L_{bp}},$$

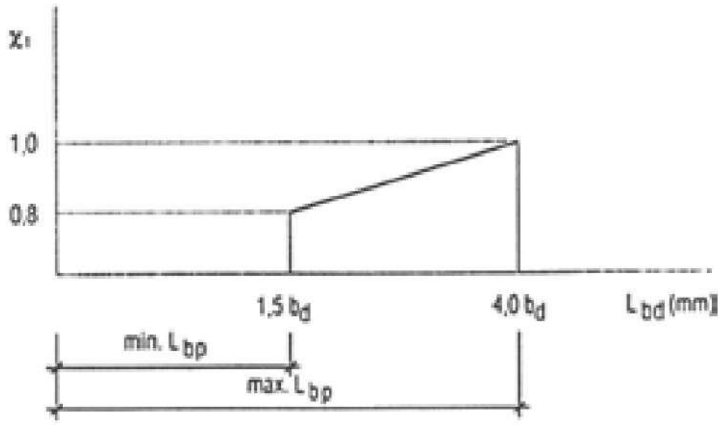


Fig. 24. Graph for determining the value of coefficient x,

5. Performing

Performing walls concreted into the wood-cement blocks is governed by the Working Manual and the following rules.

5.1. Block Tie

The blocks are put dry with a tie of 250 mm, possibly 500 mm. The bearing concrete core must create vertical running columns throughout the floor height, which are connected with the crossbeam concrete in the cut-outs of the block ribs in every block layer (see Cl. 3.1.1). This rule must be preserved especially with inter-window bearing walls. Deviations from the tie requirements are admissible only with:

- Piles, whose length L_p (Fig. 3) is not larger than the length of the entire block, where the blocks are put plainly on each other.
- Walls in an arch, which are formed by cutting segments of blocks. In this case, it is recommended to hammer the blocks together with nails of length about 100 mm.
- Unloaded walls or parapet walls, into which cut pieces of blocks may also be inserted.

The cut pieces of blocks may also be inserted into bearing walls, while preserving the conditions stated in Cl. 3.1.1, while the tie of these cut pieces must also be taken care of. It is not recommended to insert them to corners or wall edges.

5.2 Concreting

Concrete must be plastic enough that it safely fills all cavities in the masonry. Natural aggregate of maximum grain 16 mm is used for the mixture. The workability of the concrete mixture should range according to the compacting manner (with a submersible vibrator of maximum diameter 30 mm or perforation with a batten of section about 20 x 20 mm) between s = 50 or 80 mm of a cone sag according to Abrams. When laying the concrete mixture during its compacting, it is needed to pay attention that separation of the components of the concrete mixture does not take place, for the concreting manners etc. see the Working Manual.

5.3. Working Gaps

It is recommended to exclude the working gaps in the concrete for a height of one floor. If this is exceptionally impossible, it is necessary to secure the working gap with spindles of concreting reinforcement (min. diam. V 6), placed alternately along the external and internal surface of the wall. The mutual distance of the spindles must not be larger than 500 mm and their section area must be at least 0.0005 times (min. 2 diam. V 6) the area of the corresponding section of the connected concrete core of the wall. The spindles must intervene into the concrete core on both sides from the working gap for the anchoring length (min. however 200 mm).

The working gap in the concrete core of the wall is not considered, unless an interruption of the concreting takes place at least 100 mm below the placement area of the blocks and if concreting continues within 24 hours after the interruption. Before continuing with the concreting, it is however necessary to treat the contact gap of the concrete core pursuant to CSN 73 2400.

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