

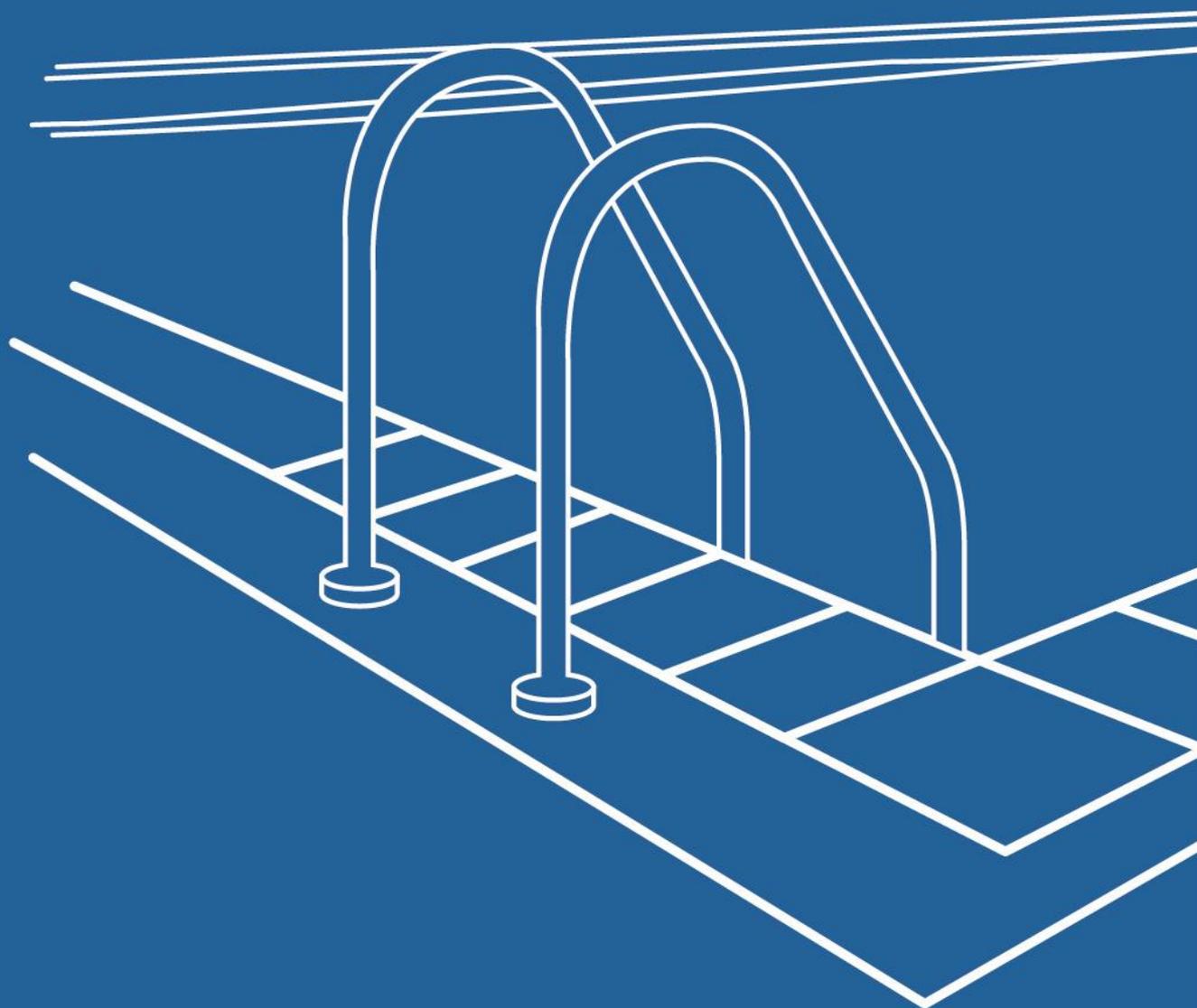
Informational Brochure

Izodom 2000 Polska



Guidelines for calculation
and construction of swimming pools
by means of the “Izodom 2000 Polska” system

No6



Guidelines for calculating and constructing a swimming pool's basin by means of the "Izodom 2000 Polska" system

The following study makes use of materials provided by members of the team at the Civil Engineering Faculty at the Łódź Technical University, composed of: dr hab. inż. Maria Kaminska (PhD Eng.), dr inż. Jan Kozicki (PhD Eng.), and mgr inż. Jacek Filipczak (M.Sc. Eng.)

November 2002

Łódź, Poland

Izodom 2000 Polska Spółka z o.o.

98-220 Zduńska Wola, ul. Ceramiczna 2
phone 043 823 23 68, fax. 043 823 41 88

www.izodom2000polska.com

e-mail: biuro@izodom2000polska.com

List of available Informational Brochures:

Informational Brochure No. 1: Basic information on materials and the construction system using "Izodom 2000 Polska" technology

Informational Brochure No. 2: Guidelines for calculating and constructing walls by means of the "Izodom 2000 Polska" system – "Richtlinien für die Berechnung und Konstruktion der Wände im system "Izodom 2000 Polska"; [German version of Informational Brochure No. 2, based on German standards]

Informational Brochure No. 3: Ceiling construction by means of the "Izodom 2000 Polska" system

Informational Brochure No. 4: Halls, refrigeration facilities, and storage facilities erected by means of the "Izodom 2000 Polska" system

Informational Brochure No. 5: Guidelines for calculating and constructing sand type concrete walls by means of the "Izodom 2000 Polska" system

Informational Brochure No. 6: Guidelines for calculation and construction of swimming pools by means of the "Izodom 2000 Polska" system

Informational Brochure No. 7: Construction of roofs by means of the "Izodom 2000 Polska" system

Informational Brochure No. 8: Construction of ground slabs by means of the "Izodom 2000 Polska" system

Informational Brochure No. 9: Application of "Izodom 2000 Polska" system walls in seismically active regions

Content

1.	General rules for forming swimming pool basins by means of the "IZODOM 2000 POLSKA" system.....	4
2.	Swimming pool walls	5
2.1.	Calculation considerations	5
2.2.	Nomograms for determining the necessary reinforcement for walls.....	5
2.3.	Structural requirements.....	6
3.	Base slab monolithically connected to the walls (type A construction).....	7
3.1.	Base slab thickness.....	7
3.2.	Base slab reinforcement	7
4.	Strip footing of swimming pool walls (type B construction)	8
4.1.	Strip footing dimensions.....	8
4.2.	Strip footing reinforcement	8
5.	Forming entry steps	9
6.	Integrity of the swimming pool basin	9
7.	External Insulation.....	10
8.	Technological requirements.....	10
8.1.	Concreting	10
8.2.	Concrete quality control.....	10

1. General rules for forming swimming pool basins by means of the "IZODOM 2000 POLSKA" system

A swimming pool basin can be formed in two ways in the "IZODOM POLSKA-2000" system (Fig. 1):

A - as a spatial structure consisting of walls monolithically connected to the base slab

B - as a set of retaining walls erected on strip footings, with a base slab separated from the walls by an expansion joint.

The first solution (Type A) is preferable in structural terms (the spatial rigidity of the swimming pool's basin) and in technological terms (no expansion joint seams), and in terms of utility, since it makes it easier to meet the condition concerning the swimming pool's integrity.

However, if the swimming pool has large dimensions in its plan view, such as an edge measuring several dozen metres, or where ground conditions are complicated, construction type B is preferred.

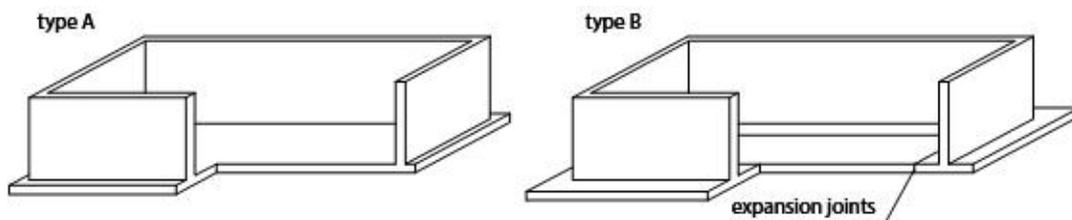


Fig. 1. Swimming pool basin construction drawings

Please note: In both cases, the highest level of the groundwater table may not extend above the level of the swimming pool's foundation. If this condition is not met, the structure of the swimming pool basin should be designed individually, taking into account the additional load of ground water displacement.

Swimming pool basins can be constructed by means of spot internal overflows or external overflows. In the first case the wall is simply brought to the surface level and in the second case special overflow profiles structurally connected to the wall must be used.

The solution with an external overflow requires the use of additional installation system collecting and removing water from the overflow. This means that the cost of building such a swimming pool is about 50% higher than for a swimming pool with internal overflows.

The swimming pool can be rectangular in shape in the plan, or by means of polystyrene profiles can be "hinged" – any polygon shape, which undoubtedly diversifies its form.

2. Swimming pool walls

2.1. Calculation considerations

It is assumed that the wall of the swimming pool is a support structure mounted in the base slab or strip footing. The most unfavourable horizontal load on the wall is in an empty swimming pool and is caused by the thrust of the surrounding earth and the load exerted by the backfill. The extent of these loads has been set on the basis of PN-88/B-02014 Loads on building structures. Soil loads. For two types of soil: non-cohesive and cohesive, assuming a soil volume weight of $\gamma = 20.0\text{kN/m}^3$ and $\gamma = 22.0\text{kN/m}^3$ respectively and a resting pressure rate of $K_0 = 0.5$ and $K_0 = 0.6$.

A characteristic backfill load to 10 kN/m^2 was adopted, also according to the standard quoted above. Two static and strength criteria were considered:

- the condition concerning bearing capacity for bending of the wall cross-section with the greatest load exerted,
- the condition of not exceeding the allowable displacement for the end of the support, with an assumed maximum allowable wall height deflection of $1/300$.

Calculations showed that the degree of wall reinforcement necessary depended on the second condition, i.e. the allowable deflection.

The required cross sectional area of wall reinforcement with a width of 1m was determined by adopting the following assumptions:

- compressed concrete is non-linear-elastic, and stretched concrete also transfers tension after its keying (the "tension stiffening" principle)
- reinforcing steel has elastic-plastic characteristics,
- reinforcement is arranged symmetrically on both sides of a wall, and its cross section is constant over the whole height of the wall,
- the partial material certainty factor is uniform for concrete and reinforcement and amounts to $\gamma_m=1.4$ (concerns the state of its bearing capacity)
- The concrete creep coefficient amounts to $\varphi_p=1.0$ (concerns the state of its displacement).

2.2. Nomograms for determining the necessary reinforcement for walls

The calculations adopted the following assumptions:

- Class of concrete B20
- Reinforcement using steel of the grade 34GS
- Wall height $\leq 2.0\text{m}$,
- Backfill load $\leq 10.0\text{kN/m}^2$
- Two types of soil
 - non-cohesive
 - cohesive

The results of the calculations are presented in the form of ZBA nomograms (non-cohesive soils) and

ZBB nomograms (cohesive soils). The nomogram is used as follows:

1. Adoption of wall height.
2. Adoption of a characteristic backfill load appropriate for the local conditions (location of the swimming pool, the possibility of nearby traffic, etc.).
3. Marking on the appropriate nomogram a point corresponding to the adopted wall height and backfill load; the size described by the nearest curve lying to the right of the designated point should be adopted as the reinforcement.

2.3. Structural requirements

Wall reinforcement should be formed as shown in Fig. K1. $\varnothing 6$ size 34GS steel rods arranged in each layer of blocks should be used as horizontal transverse reinforcement. Internal and external reinforcement must be connected by means of $\varnothing 6$ rods with no fewer than two pieces per 1 m² of wall surface.

Vertical load-bearing wall reinforcement is structurally connected to the ground slab and thanks to anchoring reinforcement, led out from that slab (see. P. 3.2).

Reinforcement of wall corners should be constructed as shown in Fig. K2.

Please note: The coping of the wall, i.e. its shape and the reinforcement must be individually designed and tailored to the adopted swimming pool equipment system.

3. Base slab monolithically connected to the walls (type A construction)

3.1. Base slab thickness

The thickness of the base slab "d" adopted should depend on the height of the walls of the swimming pool (pool depth):

$$H \leq 1.50\text{m} \quad d = 0.14\text{m},$$

$$1.50\text{m} \leq H \leq 2.00\text{m} \quad d = 0.18\text{m}.$$

The base slab should be extended about 200mm beyond the outer contour of the polystyrene profiles (Fig. 2).

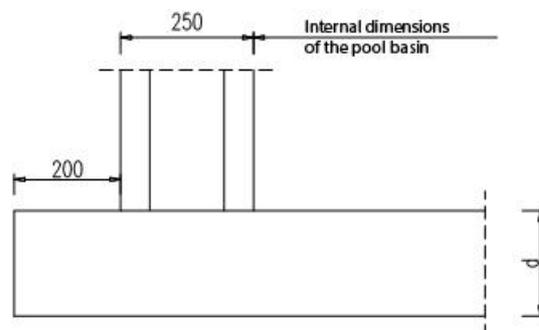


Fig. 2. Shaping the swimming pool's base slab in type A construction

3.2. Base slab reinforcement

The base slab of the swimming pool must be reinforced top and bottom by means of a mesh of $\varnothing 10$ ribbed steel reinforcing rods 34GS, spaced 150mm apart for a base slab thickness of 140mm or else with a mesh of $\varnothing 12$ ribbed steel reinforcing rods with the same spacing for a base slab thickness of $\varnothing 180\text{mm}$.

The upper mesh should be stabilized by means of shims of appropriate height and numbering four shims per 1 m^2 of base slab surface.

Along the entire perimeter of the base slab reinforcement should be placed in the shape of a "U" lying flat (Fig. K3). The diameter of the reinforcement rods and their spacing should be the same as for the vertical reinforcement of the wall.

In those places where the walls of the swimming pool connect, vertical reinforcement should be located in the base slab so as to project from it, according to the construction drawing K3. The purpose of this reinforcement is a structural connection between the ground slab and the walls of the swimming pool.

4. Strip footing of swimming pool walls (type B construction)

4.1. Strip footing dimensions

The width of strip footing B (Fig. 3) should be determined on the basis of nomogram ZBH.

This dimension is determined on the condition that in the empty swimming pool the resultant force from long-term loads is not outside the core of the foundation base (according to PN-81 /B-03020 "Direct foundation of buildings").

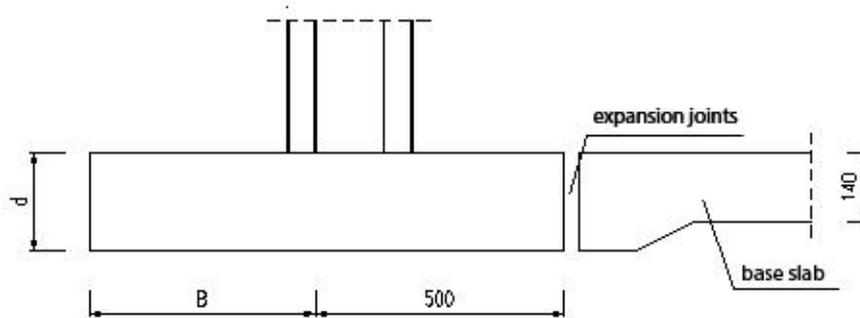


Fig. 3. Forming the strip footing of swimming pool walls in type B construction

The thickness of foundation strip footing "d" adopted should depend on the width of B:

$B \leq 0.80\text{m}$ $d = 0.20\text{m}$,

$B > 0.80\text{m}$ $d = 0.25\text{m}$.

The swimming pool base slab is in this case separated by expansion joints from the strip footing and its thickness does not depend on the dimensions of the swimming pool;

A thickness of 0.14m can be adopted

Please note:

In the case of a heterogeneous substrate, the base slab should be divided by means of expansion joints into smaller areas, depending on soil conditions.

4.2. Strip footing reinforcement

Strip footing must be reinforced in the direction perpendicular to the walls, top and bottom using $\varnothing 8$ steel rods 34GS spaced 150mm apart. Transverse reinforcement $\varnothing 8$ every 250mm should be used.

The upper reinforcement should be stabilized by means of shims of appropriate height and numbering four shims per 1 m² of strip footing surface.

Along the strip footing, where this connects with the walls of the swimming pool, reinforcement should be inserted in the strip footing according to construction drawing K4.

5. Forming entry steps

The swimming pool's walls and base slab must be designed so that entry steps are included in the basin of the swimming pool. Examples of solutions are presented in Fig. 4. The number of steps should be determined on an individual basis in consultation with the investor.

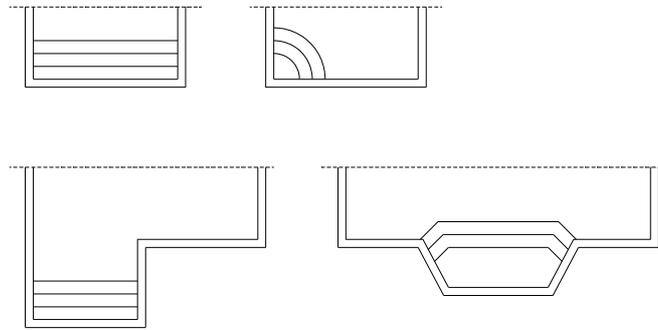


Fig. 4. Forming entry steps

Construction of entry steps should also be designed individually, depending on their adopted shape and the material chosen by the investor (reinforced concrete, steel, wood, plastic). The general principle should, however, be to locate the entry steps inside the basin of the swimming pool, due to the requirement of maintaining its integrity.

6. Integrity of the swimming pool basin

Due to discontinuity in the concrete walls where ties in polystyrene profiles occur, the integrity of the swimming pool basin must be ensured by the inner finishing layers.

In critical areas such as expansion joint seams, or where installations protrude through the walls, or where drains occur in the floor etc., system solutions ensuring the achievement of integrity should be used.

Example solutions by the Deitermann Company for filling the expansion joint seam are shown in Fig. 5.

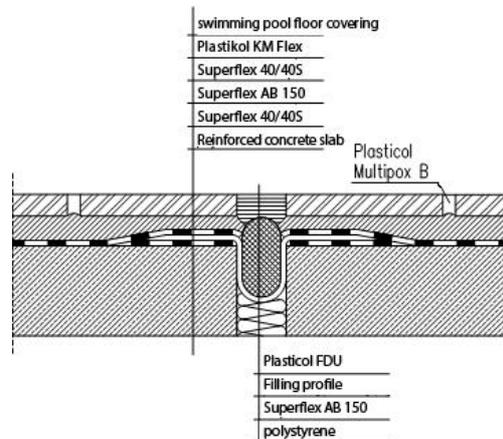


Fig. 5. Example solutions for filling the expansion joint seam

7. External Insulation

The walls of the swimming pool should be protected from the outside against rainwater. Lightweight insulation applied directly on styrofoam profiles can be used for this purpose.

8. Technological requirements

8.1. Concreting

Ground slab

The substrate beneath the ground slab should be prepared in the form of a layer of lean concrete or sand mixed with cement.

After laying the reinforcement and possibly insulating inserts in the places of future working contact between walls and the foundation, concrete must be poured and mechanically compacted.

Due to the large surface of the ground slab with a relatively small thickness, in order to reduce the effects of concrete shrinkage, it must be carefully protected against moisture loss.

Walls of the basin

The aggregate used must have a grain diameter not exceeding 8 mm. The concrete should be laid in layers with a height corresponding to three blocks and must be compacted by "rodding".

A tight styrofoam shuttering clearly limits the ability to drain excess water from the concrete, and so it is necessary to reduce the amount of water in the concrete mix. This can be achieved while maintaining a plastic consistency by use of a plasticizer in the mixture. This should be dispensed and used according to the manufacturer's instructions.

The requirements concerning the consistency of the concrete mix must be adhered to – a mixture with a liquid consistency must not be used, as the pressure and buoyancy of such concrete leads to deformation of the wall's polystyrene skeleton.

It is acceptable to use a concrete mix with a consistency of K2 or K3, i.e. dense-plastic or plastic, according to the recommendations of PN-88/B-06250 Ordinary concrete.

In the case of a wall formed by means of concrete layers, if the next layer of concrete is laid more than 6 hours after the previous pour, one must ensure fusion of the two layers. To do this, one must remove the "vitrified" cement milk layer from the previous concrete surface, and then thoroughly cleanse and dampen the surface.

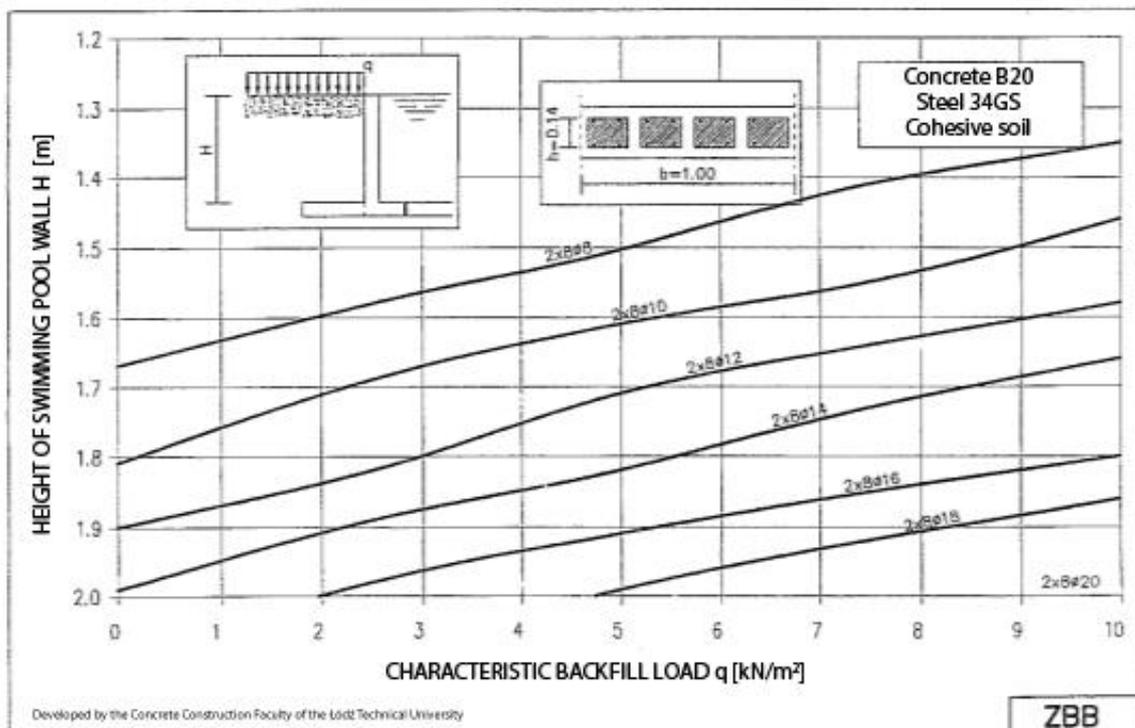
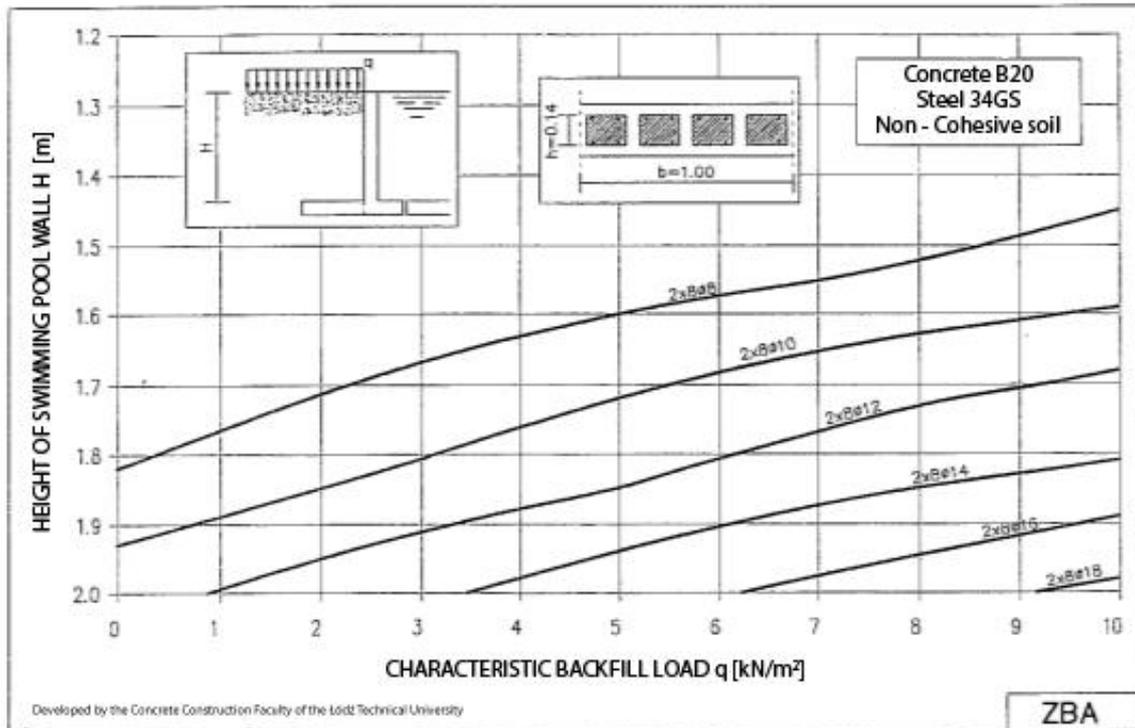
When concreting in layers one should also remember not to smooth the concrete surface of the next layers laid.

8.2. Concrete quality control

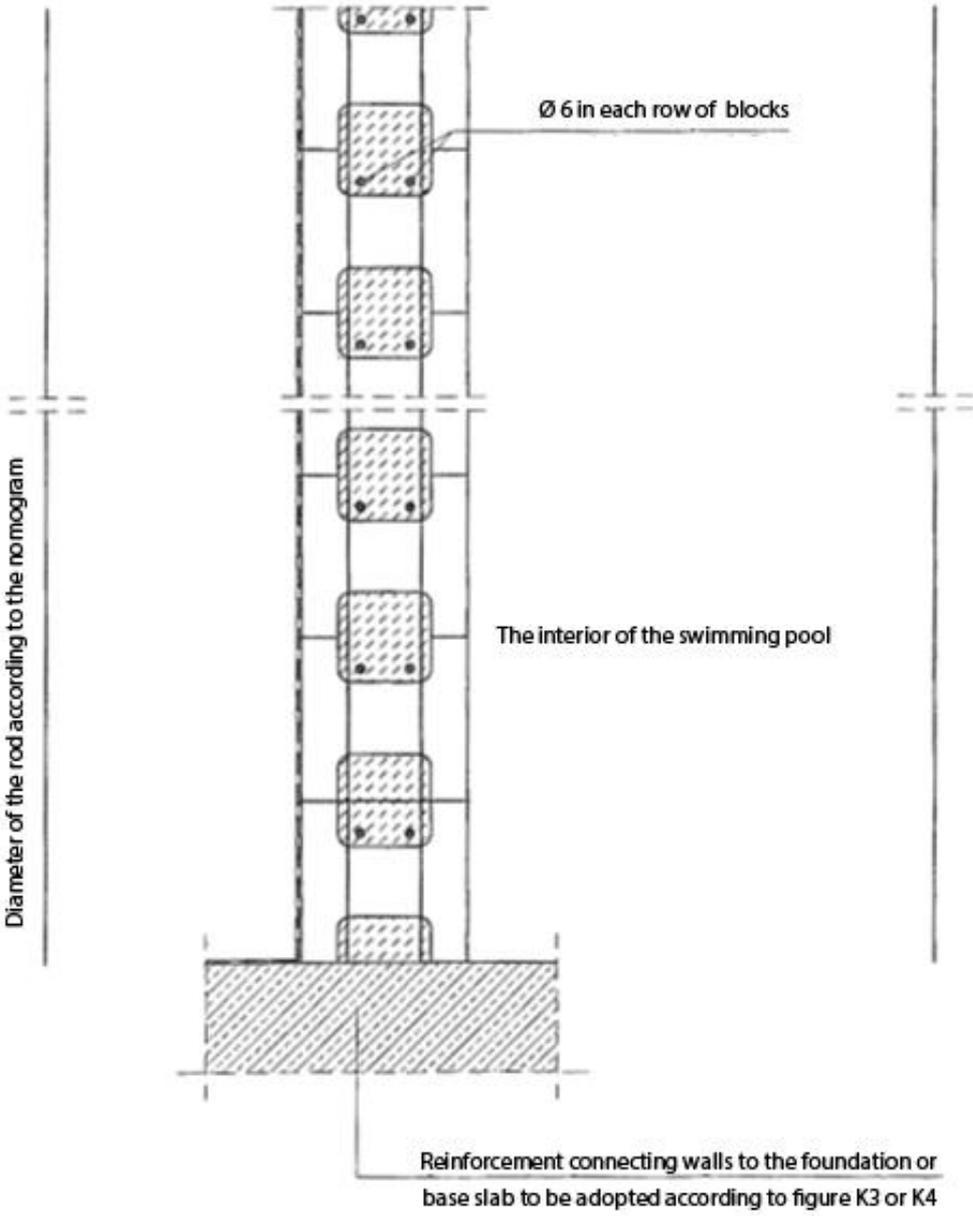
If the concrete mix is prepared on-site, in the course of concreting three samples of concrete per day must be collected during the concrete works. These samples should be examined by an authorized laboratory.

In the case of ready-mixed concrete, quality certificates must be attached to the Official Site Log.

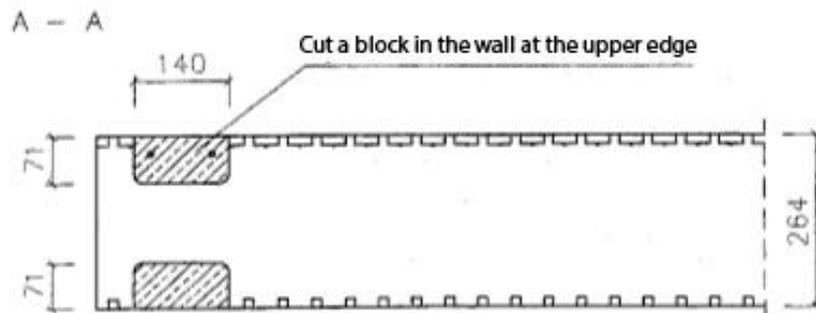
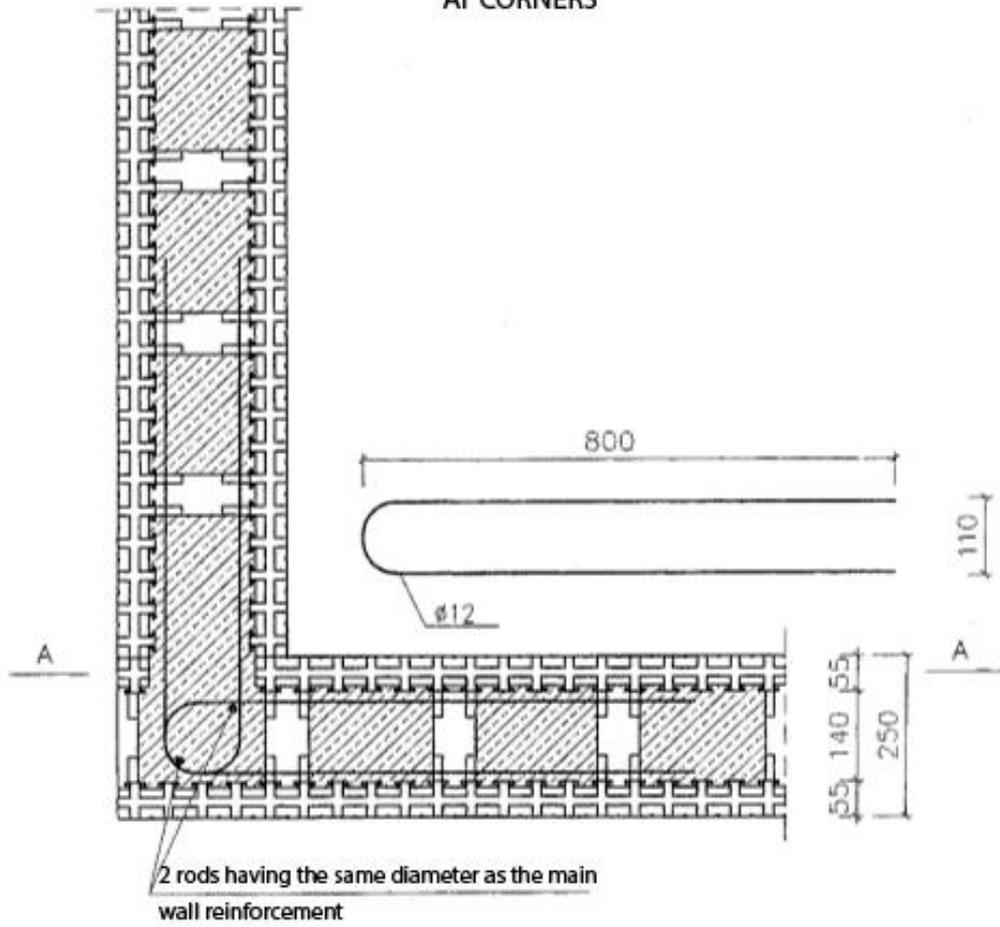
NOMOGRAMS FOR DETERMINING THE SWIMMING POOL WALL REINFORCEMENT



THE SWIMMING POOL WALL REINFORCEMENT

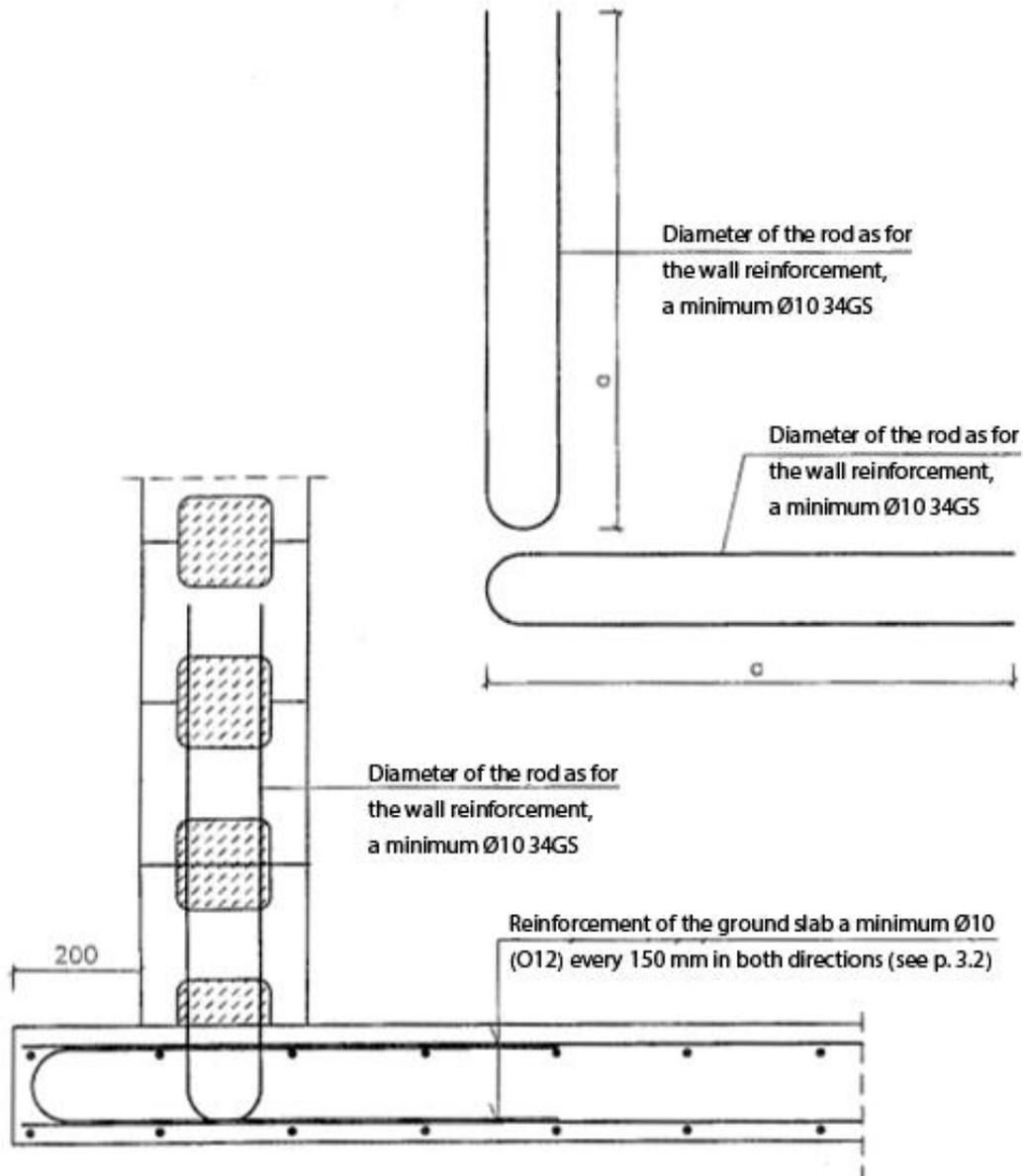


CONNECTION OF WALLS AT CORNERS



PLEASE NOTE: Reinforcement in the form of loops in each layer of blocks
Reinforcement of walls according to namograms and fig. K1

CONNECTION OF SWIMMING POOL WALL WITH THE FOUNDATION IN TYPE A CONSTRUCTION



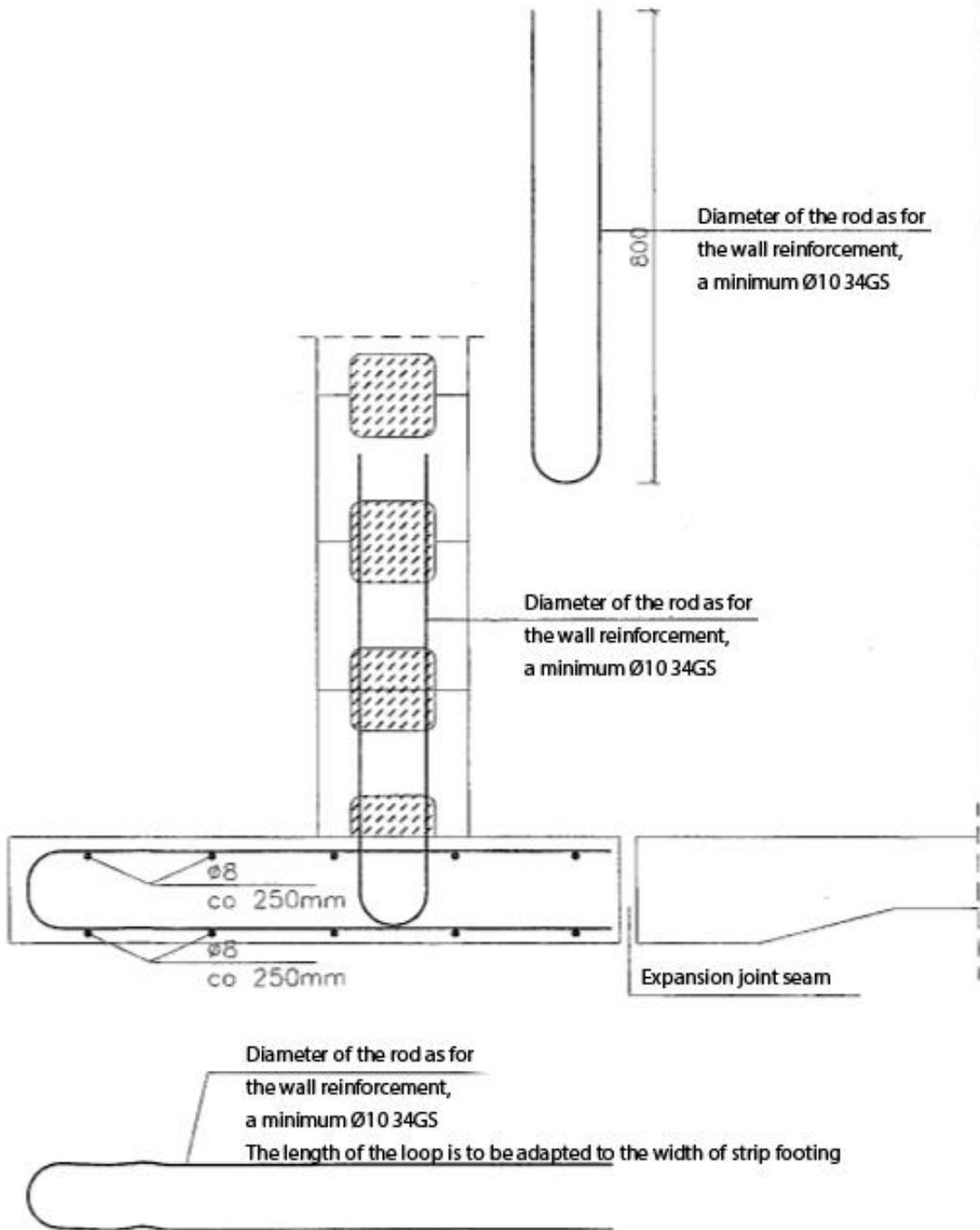
The length of the horizontal loop to be adapted to the width of the strip footing adopted

Ø10	a=0.80m
Ø12, Ø14	a=1.10m
Ø16, Ø18	a=1.40m

Developed by the Concrete Construction Faculty of the Lodz Technical University

K 3

CONNECTION OF SWIMMING POOL WALL WITH THE FOUNDATION IN TYPE B CONSTRUCTION



**NOMOGRAM FOR DETERMINING
THE WIDTH OF STRIP FOOTING
IN TYPE B CONSTRUCTION**

