DEPARTMENT OF ARCHITECTURE. STUDY AND CALCULATION OF SPATIAL BLOCKS WITH A CYLINDRICAL COATING SHELL

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https://doi.org/10.5281/zenodo.8433696

Annotatsion: In construction, coatings in the form of solid single-span floorings from spatial blocks with a cylindrical shell are successfully used. The cylindrical shell in the space block has a small rise. Therefore, the forces acting in its middle surface are close in value to their projections on the base of the shell.

Keywords: Cylindrical shells, flat, thin-walled spatial, aperture, span, polynomial, eccentricity.

In construction, coatings in the form of solid single-span floorings from spatial blocks with a cylindrical shell are successfully used. Due to this, it is possible to make blocks of a sloping cylindrical shell from two diaphragms of a segmental outline and with a very short one. Such blocks with the KZhS brand (short reinforced concrete vault) can be made with nominal dimensions in terms of: 3 m wide and 12 span; 18; 24 m (Fig. 1). Diaphragms of blocks - thick-walled, 40 mm thick in the span, 50 mm - on the support areas; variable height, the largest value of which in the middle of the span is 1/20 .... 1/15 l. Diaphragms must be provided with stiffeners, which are placed in increments of 1.5 ...... 1.6 m. The cylindrical shell is also thin-walled, at least 30 mm thick; smooth (without transverse ribs), with haunches near diaphragms.

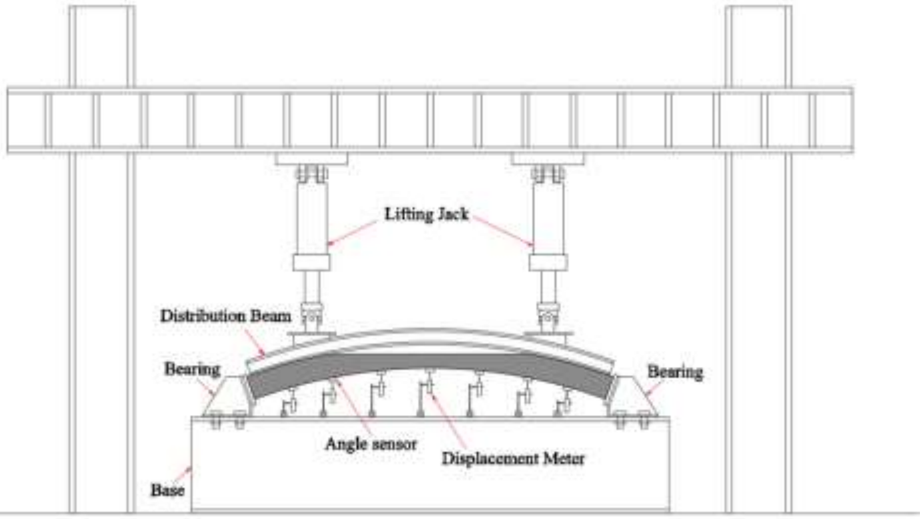


Fig. 1. Such blocks with the KZhS brand (short reinforced concrete vault) can be made with nominal dimensions in terms of: 3 m wide and 12 span; 18; 24 m

In cross section, KZhS blocks have a U-shaped shape; take the curvilinear outline of the shell along a square parabola; the supporting sections of the shell will be strengthened (see Fig. 1, d, f). Arrange protrusions along the upper outline of the diaphragms from the outside. The shape of their cross-section is such that grooves are formed between adjacent blocks of the KZhS, filled with a solution at the installation.

The main calculated longitudinal reinforcement of the blocks should be placed in the lower part of the diaphragms, which is thickened according to the design and design conditions. These rebars can be single or paired prestressed rebars made of high strength steel. At the ends (on the supports), the elements of the longitudinal reinforcement should be provided with external anchors resting against the concrete of the diaphragms along their ends.

The walls of the diaphragms are reinforced with meshes, their ribs are reinforced with frames. Reinforce the cylindrical shell according to the calculation with a single welded mesh, its haunches - with an additional bottom mesh. The cross-sectional area of the reinforcement in the entire shell, except for its support part, should be taken not less than: transverse - 0.3%, longitudinal - 0.2%. It is expedient to produce concrete for KZhS blocks at factories, as fully as possible, with insulation and a roofing roll.

In a three-dimensional block with a cylindrical shell, the internal forces and moments under the action of external loads can be determined taking into account the joint deformation of the diaphragms and the shell. This principle should be observed for any type of load: continuous distributed over the shell, or concentrated, applied to the ribs.

In a U-shaped block with a cylindrical shell loaded with a load P_0 uniformly distributed over the surface (Fig. 2), the diaphragms and the shell work together. At the same time, tangential forces S are formed along the lines of their contacts, developing at the level of the middle surface of the shell. To determine them, the shell is separated from the diaphragms. The contact forces of interaction on the shell and diaphragms have the opposite direction.

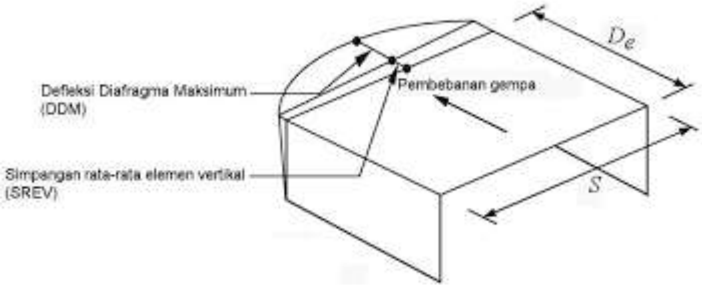
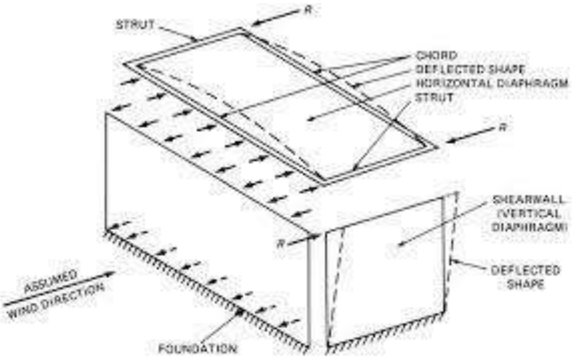


Fig. 2. To determine them, the shell is separated from the diaphragms.

The diaphragm is a flat thin-walled beam with a span l_1=2b, of variable height, loaded in its plane with a transverse load P= P_(0)(b_n/2) distributed along the span, as well as with unevenly distributed forces S applied to the diaphragm at the level of the middle surface cylindrical shell.

The action on the load diaphragm R. in fig. Figure 3 shows the geometric and design diagrams of the diaphragm with a transverse linear load P distributed along the span. The bending moments in the diaphragm are determined by the formula M_x=0,5p(a^2-x^2)



IBAST | Volume 3, Issue 10, October

Figure 3. The action on the load diaphragm R.

Torque value at individual points

$M_{x=0}$ = 0,5 pa^2; $M_{x=0,5a}$= 0,375$_{pa^2}$; $M_{x=0,707a}$= 0,25$_{pa^2}$

Deflection of the diaphragm, taking into account its variable stiffness. Over the span B_((x)), as well as the symmetry of the structure and load, are determined from the dependence $f_{p(x)}$= $\iint \frac{M(x)}{B(x)} d^2$x + c , where the moment function is calculated from the expression. The reciprocal of the aperture stiffness $1/B_x = B_x^{-1}$, variable along the length of the beam. It can be represented as a power polynomial with even exponents:

$B^{-1}(x) = A_1 + A_2x^2 + A_3^{x^4}$, where constant coefficients take into account the variability of the diaphragm cross section in the span.

The above dependences and the characteristic of the stress-strain state of the KZhS blocks are used to calculate the dimensions of the cross-sections of diaphragms, shells, haunches, as well as to calculate their reinforcement in terms of strength, deformability, crack resistance in accordance with the instructions of the regulatory documentation for the design of reinforced concrete structures.

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