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## THE NEW RUSSIAN DIRECTIVE FOR REINFORCED CONCRETE FINISHED PARTS

Prof Max [illegible]
Society of [illegible]

/Diagrams referred to herein are not reproduced./

Attempts at utilizing technical innovations are more energetic in [illegible] today than anywhere else. The use of finished parts in reinforced concrete construction has been expanded and localized. The outcome of experience in this field are found in the 90-page "Directive."

It is required that, in every planned reinforced concrete project, the non-use of finished parts be confirmed.

The possibilities of using finished parts such as wall sections, inserted floors, skylights, etc., in construction are to be investigated.

Chief uses of finished parts are: every single-story factory building, multistory structures built uniformly, military buildings; warehouses, bridges, etc., if they must be fire-resistant.

Still in need of development is the use of finished parts in multistory buildings, and in buildings which are dismantled and moved; e.g., in mining, after excavation of the deposits.

The independence of the building parts from each other must be considered in the plan; e.g., standard procedure is favored when the walls are carried outside the perimeter columns, when skylights are not connected to the framework, etc.

The style with independent columns (Diagram 1) is required for one-story halls. Thereby, crane tracks out of finished parts can be put in as indicated in Diagram 1 right. Here, roof construction should provide longitudinal rigidity and end-frames or the setting of the column bases for lateral rigidity.



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For large halls, finished columns (up to 20 plus meters in length) and crane-track units are joined with wooden [illegible] and the side sections made of finished parts, and the center section covered over with wood.

Multistory skeletons should utilize finished parts as much as possible, including wall sections, both in framework and supporting walls. Horizontal parts are to be projected beyond junctions to the C-point of moments.

Minimum wall thickness is 2-1.5 centimeters for lightly strained parts (tension zone of beams), otherwise, 3-2.5 centimeters.

Facilitation of concreting and removal of forms is important. For open, hollow beams with transverse panel, cross section is to be as shown in Diagram 3, not as in Diagram 2.

In reinforcing, the calculation requisite can be obtained through lateral welding of reinforcements and branches. The correct layout of the iron can be easily secured so that stirrups, which would serve only this purpose, can be left out.

Columns with cantilevers on either side, as in Diagram 1, when set up, are loaded on one side and tested for bending.

Concrete used for filling is to be calculated for greater strength and more rapid attaining thereof than the concrete in the finished part itself. From the standpoint of construction procedure, a fill without molding the joint is preferable.

Rigid fills are necessary if the stability of the building depends upon it and in event of vibrations (crane tracks) and earthquakes; they also present the advantages of continuous and connected constructions.

In measuring for the finished part, proper room for play is to be left for the connecting points (see Diagram 4).

In calculating, there is to be a distinction between loads before and after the making of the rigid connections; e.g., ordinary crane beams are to be calculated for specific weight as freely supported, for live load, as continuous.

Permissible stresses in finished parts increase 15 percent for concrete, 5 percent for iron. Contraction stresses are not to be included in calculation for structures out of finished parts. With consideration for wind and heat, the permissible bending-pressure stress for the three better grades of concrete are 103, 138, and 167 kilograms per square centimeter, and 1,630 kilograms per square centimeter for iron.

For fills made on the spot, no stress increase applies and better concrete is to be used.

For finished beams for inserted floors, laid end to end, a span of 2.5-7 meters is usable. Concreting the area between up to the full height of the beam gives a good connection. The parts of the beam strained by pressure or tension are mostly 4-5, but at least 2.5 centimeters thick, the other parts, 1.5-2. centimeters. Cross ribs are important for a rigid unit. In all-form cross section, they must be at 1- to 1.5 meter intervals and at the ends. Pressure slabs of up to 50 centimeters in width may be nonreinforced and no less than 3.5 centimeters thick.

Local reinforcement and continuous floor construction is easily attained by inserting iron in the joints to be filled. The joints must be 2 centimeters wider than the insert. The concrete in the fill may then be calculated as a section of pressure.



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Beams in buildings of industrial nature, and in buildings in earthquake areas, are required to have at least three cross-ribs (including the ends) and their joints must be concrete the full height of the beam. This also applies where the floor is to have a rigidifying effect upon the building.

A good beam junction can be made with projecting rod ends. The rods must extend over 30 d, have hooks on the ends and be wound with wire.

Stirrup ends must project from the recesses in the concrete, and be closed for interlacing. (Diagram 5.) Stirrup interval, 10 centimeters; diameter, 6 - 8 millimeters.

The best method of joining reinforcements is welding. Where possible, the iron should be bent as in Diagram 6 for axial transmission of tension. Diagram 7 shows the plan for possible extra reinforcement made of small angle irons or iron strips, cross section no smaller than the rod, and welded on. The length of the welded joint as in Diagram 6 must be 12 centimeters with a diameter of 20-25, and 9 centimeters with a diameter of 14-18. Strip thickness is 8 millimeter in the former instance and 6 millimeters in the latter instance.

A satisfactory connection may be achieved by using a 10-centimeter-long tube section as in Diagram 8.

Reinforced concrete sleeves are termed "rational in many cases" for the beam junctions. Reinforcements are used "on the ends" of the sleeves to secure the connection. The sleeves must be 9 centimeters longer than 60 d of the thickest rod and have stirrups 6-10 millimeters every 10 centimeters. Under these conditions, the beam may be considered continuous.

With ⊓-shaped beams, the upper slab is to be omitted for the length of the sleeve and the entire area in between concreted.

Projecting iron staples of greatest possible diameter are also required; interval between staples, 2-2.5 centimeters.

For crane beams in which positive bending moments may occur even over the supports, the junction is to be as illustrated in Diagram 9.

Joint connections with iron are not required, but may be advantageous in winter and under certain building circumstances. Least disadvantages are found in the arrangement in Diagram 10 (top view above, side view below).

Reinforced concrete columns not touched by reinforced concrete beams should consist of a single unit with rigid connection to the foundation. They should be cast in one unit with cantilevers, if any, when this will not impede their transport too much.

Cantilevers must be strongly reinforced at the joints.

Level bottoms on columns for jointed connection to the floor are not advisable because placing the column in wet mortar makes adjustment difficult; but subsequent underfilling easily leads to hollows and bursting out of the corners. Ball-shaped, rounded column ends should show a difference in height of ½-1 centimeter and must be transversely reinforced to a height equal to twice the width. A notable requirement is that compressive stress in the vicinity of the joint, without consideration of the transverse reinforcement, may not exceed 30 percent of the project strength, whereas, under concentric pressure, the stress on the concrete may amount to 40 percent. The curved surfaces should be made by means of



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plaster of Paris or rich mortar forms. For centering such joints, a rod is inserted and a hole dug out, both centered and vertical.

A rigid column foot can be attained by welding the overlapping longitudinal rods (or joining them with sections of tubing), with the concrete core projecting to the bottom; 8-millimeter stirrups are then wound around and the mortar applied. This arrangement is permitted only with light, vertical loads because of inequalities in pressure transmission.

A similar arrangement, without the concrete core with the columns resting on wedges during the welding and until the application of the concrete is deemed better. Here, the space in between is cast under pressure. Prior to concreting, the longitudinal rods must absorb all pressure with the generally permissible tension of 1250 kilograms per square centimeter, and must also be computed for buckling according to their slenderness.

Because of its usable cross section and better connecting, the double pile, with transverse rods, is particularly emphasized. Its parts may be produced separately.

If floor slabs or beams are to be laid on lateral projections of the support, the projections must be at least 7 centimeters wide; height is to be according to calculation for shearing, but at least 7 centimeters. If, as in Diagram 11, a connecting reinforcement is to be used, the floor surface is to be 2 - 2.5 centimeters higher than the top of the column.

With beams joining columns with a rigid connection by welding the iron, preliminary support should be used in the form of projections, projecting angles, or U-iron.

In multistory structures, interruption of column lines by horizontal building members is to be avoided.

Crane beams must have a rigid connection to the columns.

Column foundations can be made with a raised core when the column has a T-form or is made in two parts; however, the simplest is the cup form in the floor. The side walls of the cup-shaped hole must be somewhat slanting so that every opening is 4-5 centimeters wide at the top and 2-2.5 centimeters wide at the bottom. The whole must be well cast. Further securing (concrete pins) is not necessary. The columns should be enclosed at least to a height equal to their larger side width; the cup walls should be at least 15 centimeters thick and the bottoms 10 centimeters thick.

For stairs without notchboards, the form in Diagram 12 is to be avoided. The ordinary stairs in Diagram 13 should be supported by the riser on their free end. With this arrangement, dwelling stairs (1.20 wide, 2.70 long) may be calculated as secured on one side for half the load. The stair casing must be strong enough to absorb this moment.

For stairs with notchboards, the landing beams are to have projections (concrete appendage, iron bar) for receiving the notchboards.

The forms (for finished parts) must be tight and durable with smooth inner surfaces. The values must be tested with templates and steel measuring tapes.

Diagram 14 shows a form for curve beams with the reinforcements lying perpendicular to the sides of the form. This facilitates the use of coarser and stiffer concrete and saves forms and space.

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Side forms are to be removed after 7. hours, cores, after 8 - 10 hours.

The vibration method is used for thickening concrete; acceleration of hardening by steaming saves space and lightens winter operations. The vibration period must be carefully determined and maintained (according to dimensions of the part and quality of the concrete, 3 - 15 minutes).

Internal vibration with electric or compressed air vibrator is preferred when possible.

When steaming the part, the temperature in the steam chamber must be 70 - 80 degrees centigrade. Over 100 degrees can be damaging to the strength of the concrete. The total steaming time takes 8-48 hours. Average conditions (volume:upper surface of the part= 10 centimeters, 1:6 Portland cement) take 24-30 hours. Between steam period r (hours) with the heat level T and equivalent hardening time b (days), the following relation is set up for ordinary conditions:

$$^{10}\lg b = [T + 2(r - 6)]:150.$$

Two to four hours are allowed for cooling. In winter, the part must first dry 3 - 4 hours at 25 - 35 degrees centigrade. Because of evaporation, wetting after steaming is important.

Concrete 1:6 steamed 12 hours under 8 at (atmosphaeren uberdruck - gage pressure in atmospheres) has the same strength as 1:4-concrete after 28 days normal hardening.

The concreting of fills, when using finished parts in construction, is to be done with high-grade cement, and as soon as possible after everything is set up.

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