Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

RESTRICTED

INFORMATION REPORT

STAT

COUNTRY USSR

SUBJECT Building Construction

DATE DISTR. 6 February 1948

NO. OF PAGES 15

NO. OF ENCLS. (LISTED BELOW)

STAT

PLACE ACQUIRED

DATE ACQUIRED

SUPPLEMENT TO REPORT NO.

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE ACT 50 U.S.C., 31 AND 32, AS AMENDED. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW. REPRODUCTION OF THIS FORM IS PROHIBITED. HANDLE THIS INFORMATION CONTAINED HEREIN IN THE MANNER THAT WILL FULFILL THE PURPOSES OF THE RESEARCH AS DEEMED NECESSARY BY THE RESEARCH ANALYSTS.

THIS IS UNEVALUATED INFORMATION FOR THE RESEARCH USE OF TRAINED INTELLIGENCE ANALYSTS

STAT

DESCRIPTION OF THE NEW RUSSIAN PROVISIONS FOR CONCRETE AND REINFORCED CONCRETE AS OF 1931

Prof Max Mayer, D Eng
Moskva
1931

[Sketches referred to herein are not reproduced]

By the order of the Chief National Economic Office (VSNKh) of the Soviet Federation of States, the provisions herein are in force as of 1 June 1931, superseding various former directives and plans.

The first section deals with general aspects and economic considerations. While for almost a year "commercial-business procedure" in rough form has been practiced in all state services and has been exhibiting destructive consequences, national economic foresight appears here in the provision that economic judgement on construction projects must originate not from the narrow aspects of the cost estimate, but must be based on state interests in general. Wood-reinforced concrete and caissons were designated as acceptable for engineering projects of minor importance which, from practical experience, appear justified. Finished parts of reinforced concrete are ordered for the purpose of industrialization, year-round operation, and saving of forms, though upon condition of accurate construction of connections and reliable equipment for production, shipping, and assembling. Long, heavy frames of reinforced concrete (which the theorists unreasonably preferred) are to be avoided. For conservation of forms a number of measures are ordered, among which is the construction of piling inside of facework.

CLASSIFICATION RESTRICTED

STATE	X	NAVY	X	NSRB	DISTRIBUTION					
ARMY	X	AIR	X							

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

The desire for simple calculation should not influence the choice of construction; rather, after the economic solution of the problem presented, that method of calculation should be chosen which gives a sufficiently accurate picture of the modus operandi of the construction with a minimum of effort. I maintain it completely erroneous to require exact estimates of size and location of live loads, machinery, and equipment, and to require consideration of every possible simplification (stiffening effect of brickwork and the like), because far-sighted work with little additional expense is of much more value, particularly in reinforced concrete construction.

The second section deals with the calculation of stress, proportioning, and formation. As formerly, more distinctions are made in the quality of the concrete than is the case with us. The conception of the "concrete type" is now coupled with two prerequisites, i.e., the cubic strength, and the consistency, without the significance of this tie-in having been made clear. With ordinary cement the cubic strength is conclusive after 28 days; when one of the two types of high-grade cement is used to speed up construction, only 7 days are needed. For this, the term "project strength" has been adopted in the trade. The consistency is measured by the settling measurement of the cone or the angle of inclination of the testing table. The concrete types are designated with the strength figures. Types 90, 110, and 130 are generally used; 45 and 65 are used for non-reinforced concrete only; types 170 and 210 only when their use would entail not-too-heavy reinforcement, i.e., in heavily loaded columns as well as for weight conservation in long-span bridges and headers (Binders) when there is danger of earthquake, and for finished parts. The minimum content of cement is reduced to 250 kilograms per cubic meter for exposed parts, and a 220-kilograms-per-cubic-meter minimum for all reinforced concrete. The general minimum-reinforcement principle may be of little significance, since there must naturally be an exception for partially reinforced concrete. The transverse expansion figure is set at 1.6, the heat conduction figure, much too superficial an estimate, at 1.0. Temperature changes may remain out of consideration in ordinary structures; for engineering projects there are tables applying which give, for example, at the January isothermal line, minus 19 degrees an axis temperature (Achstemperatur) of minus 15 degrees when a wall is 80 centimeters thick, or minus 5.8 degrees when a wall is 5 meters thick, and minus 17.7 degrees or minus 9.1 degrees respectively when a column has the same dimensions in square. In concrete construction, expansion joints are required every 10 to 20 meters; in reinforced concrete construction, every 40 meters. With greater intervals, the expansion and shrinkage must be tested. In watertight container walls the reinforcement must take up the total tensile force; however, with the five concrete types 210, 170, 130, 110, 90 it may not comprise more than 2.6, 2.1, 1.5, 1.2, 1.0 percent of the concrete cross-section. The ends of the reinforcing rods should be anchored in pressed concrete. Complete relinquishing of the round hooks on the rod ends, as was first attempted under American influence, was given up after disastrous experiences; after long consideration, however, it was agreed that since the rods are anchored, they need no hooks. If a rod is welded at a place where its tension amounts to more than 70 percent of the permissible value, additional rods must absorb 30 percent of its tension. As a finishing layer, 1 centimeter is required for slabs, 2 centimeters for beams and columns, but only 1 centimeter over their stirrups; however, at least one additional centimeter is required with weather factors. For permis-

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

sible tensions, tables are given prescribing the following percentages of the project strength (mostly 28-day cubic strength), and giving the following specifications, with deviations up to 3 percent:

Axial pressure, with l:h<14	40 percent
Bending pressure, base value	45
Bending pressure, with wind or heat	55
Bending pressure, with wind and heat	65
Bending pressure, with wind, heat, contraction and other influences	70
With slabs on the face, i.e., in arches (Vouten), increase of	10
Shear protection not required if shear stress (facing - load - tension) (Haupt - Zug - Spannung) is under	4
Shear stress limit	10
Concrete share of shear stress over the entire beam length	2.0
Shear stress between the ribs and the lateral pressure wings (Druckflugeln) of the T-shaped beam (Plattenbalkens)	6
Gripping force with round rods	4-5
Direct shearing off	7
Tensile stress in the axis of tank walls	12

For concrete structures

Pressure and bending pressure, base value	35
Pressure and bending pressure, with wind or heat	42
Pressure and bending pressure, with wind and heat	49
Pressure and bending pressure, with wind, heat and other influences	56
Bending stress in the same four cases	4, 5, 6, 7
Shear stress (facing - load - tension)	4

All data apply to second-class structures, e.g., dwellings, schools, hospitals, with a life span of over 40 years. For class 3 structures, that is, the same structures in simplified building procedure for a life span of less than 40 years, the above-mentioned permissible stresses may be increased 10 percent. However, there is the condition that 70 percent of the project strength may never be exceeded. Thus, the permissible stress (for bending pressure taking into consideration all influences) indicated for concrete type 210 at 145 kilograms per square centimeter remains the greatest value for reinforced concrete; for our next concrete type, 130, 52 kilograms per square centimeter applies for columns; for bending pressure, 60, 70, 85, 90 kilograms per square centimeter; with concrete, 95 x 1.1 = 104.5 kilograms per square centimeter can be considered for type 170.

Permissible tensile stress for iron is 1,250 kilograms per square centimeter; with consideration of wind or heat, 1400; with wind and heat, 1,500; with wind, heat, contraction, and others, 1,600 kilograms per square centimeter. These values are also permissible with ordinary iron types as long as they do not exceed 50 percent of the tensile strength. On the other hand, a base stress of 1,650 (1,850) kilograms per square centimeter is permitted for high-grade carbon steel (for silicon steel) with 3,000 (3,600) yield point.

The calculated stresses should not depart by more than 5 percent from the permissible value; if they remain any lower, there must be an economic reason.

Because of the danger of buckling, concrete pillars are permissible

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

only when their length does not exceed 12 times the minimum thickness in the case of pillars of circular or octagonal cross section, or 14 times the minimum thickness with other types. The buckling factor, to be computed as 1:(0.4 / 1.73 or 24:1), first reaches this limit at 1.84, and thus is much less than when figured according to German estimates. With reinforced-concrete columns, buckling is not to be considered up to the specified slenderness 12 to 14; for cases beyond that, there is a table also based on reinforcement percentage, which gives for slenderness 17.3 (round) or 20 (square), buckling figures of 1.35 (at 0.5 percent) to 1.25 (at 3 percent); and for slenderness 26 or 30, buckling figures of 2.14 to 1.99. The reinforcement in columns should make up at least 0.5 percent, and 0.2 percent in unnecessarily thick columns. The longitudinal reinforcements should be between 12 and 40 millimeters thick, and in centrally loaded columns, should be separated by at least 15 centimeters. The least interval of the column stirrups is 15 times the diameter of the longitudinal rods and 10 times at their joint (Stoss). In columns of over 35 centimeters with more than four longitudinal rods, as many additional links are required as are necessary to prevent the breaking out of the intermediate rods. For columns reinforced with spiral binding, there is, in addition to data in the German directives, the provision that the core cross section comprise at least two-thirds of the total cross section of the column, and that the proportion of longitudinal reinforcement to spiral reinforcement must be between 1:1 and 1:2. There is a computation form prescribed also for transverse reinforcement of rectangular lattice work of 1- to 10-millimeter wire; strangely enough, it is required that the vertical distance between the mesh be equal to the horizontal interval between the rods and no greater than one-third the minimum width of the column. The "iron hair" method of transverse reinforcement is the result of mixing wire of 0.5 millimeters maximum in pieces of at least 40 d length with the concrete. (The computation forms for this transverse reinforcement and for hooped (umschnurtes) cast iron, and all other details can be provided if required.)

For slabs, the rods in the middle of the span must number between 5 and 14 per meter. That is an advancement insofar as the reinforcement can accordingly be formed from stronger rods and set more precisely. At least one-third of the lower reinforcements and at least three rods per meter must be carried out to a point above the supports. The repartition rods must amount to 10 to 20 percent of the tension rods, with 20 percent for use with concentrated loads, and must be set at intervals of 30 centimeters maximum. The slab reinforcements need receive no hooks when they terminate in the zone of pressure. Minimum thickness so for slabs with reinforcement in one direction area for roofs, 6 centimeters; dwelling floors, 7 centimeters; floors for industrial buildings, 8 centimeters; under thoroughfares, 10 centimeters. With crossing reinforcement, at least 8 centimeters are necessary. The ratio of the slab thickness to the width of the span is unlimited. Slabs supported on all sides are subdivided according to the quarter lines; the outer quarter strips are to be reinforced one-half as heavily as the center strips.

In addition to the German requirements for T-shaped beams (Plattenbalken), it is stated that the sum of the slab thickness and arch (Voute) height must amount to at least one-tenth of the beam height. If there are no arches, the slab thickness must be at least one-tenth of the beam height if it is to be included in the computations as a slab. It is strange that the width of the zone of pressure for the main joists may not be calculated any greater than the distance between

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

the axes of the secondary joists. If the reinforcement in [illegible] lar-beam cross sections is strained less than would be permissible, then, (according to Swiss style) the concrete's compressive [illegible] may be increased about one-twentieth of that difference.

For eccentrically loaded columns, the zone of tension of the concrete may be included in computation until the permissible [illegible] tensile stresses according to the table above are reached; that is, scarcely up to one-tenth of the permissible compressive stress; the German directives permit one-fifth in this case. In [illegible] attention is paid to the exact formulas pertinent to the [illegible]

Forty percent of the shear stresses may be placed upon the concrete; at most, the permissible value of the shear stress (1 [illegible] of the project strength) may be placed on the concrete. [illegible] percent must be taken up by stirrups and mainly through [illegible] reinforcements. For shear stresses in columns and frame members, [illegible] given which requires further clarification. Stirrups of [illegible] millimeters thickness must always be set in beams at intervals [illegible] of the beam depth, maximum 50 centimeters; the stirrups may not [illegible] brace more than five successive tension rods or three successive compression rods. Closed stirrups are not recommended when there is no consideration of compression reinforcement. The inclined [illegible] must be arranged in slope between 1:2 and 2:1 so that every [illegible] cross section is cut by at least one of them. Floating [illegible] reinforcements are forbidden. With T-shaped beams, the shear [illegible] also be tested at the junction of the compression flange with the [illegible] 0.3 percent of the slab cross section adjoining the upper [illegible] web must be set with reinforcements of at least eight [illegible] there is no longitudinal slab reinforcement running through [illegible] this. The chief significance of this reinforcement in relation [illegible] fixing of the slab is not touched on here, regardless of whether [illegible] statistician has considered it or not.

The chapter "Torsion" (TN: of the "Provisions") gives a table [illegible] De Saint-Venant for the factors-of-resistance moment of the rectangle relative thereto. The tension to be computed from this, with the [illegible] dition of the prevailing shear stress, may not exceed 16 percent of the project strength. Otherwise, the concrete cross section must be [illegible] larged. The part of the torsional moment amounting to more than the permissible shear stress (4 percent of the project strength) is to be divided by the double surface of the core cross section and the permissible tensile stress of the reinforcement; the quotient stands for the additional reinforcement to be put in per centimeter of core circumference, and simultaneously the cross section area of the additional stirrups to be set in per centimeter of rod length.

In finished parts, which are fabricated under strict supervision, 15 percent greater concrete stress and 5 percent greater reinforcement stress is permissible. However, this does not apply to connecting parts which are made only on the spot. The connection must insure the volumetric stability of the structure. The joining of iron members fastened to the ends of the concrete parts is, strangely enough, designated as insufficient, and only permitted in statically determined systems; in statically undetermined systems, it is permitted only in the area of the zero point of moments. For prevention of damage in transit, the sections must be sufficiently rigid in every respect; the points to be supported when unloading, and the points to be lifted when unloading must be indicated. For computing the stress in transit the specific weight of single units is to be multiplied by 1.5.

The value of foreign influence is to be noted, particularly in

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

RESTRICTED

the concluding chapter of this section and the sketches concerned. The requirement of sufficient figures in diagrams and the careful checking of these and all figures is never a superfluous stipulation. In the scales, which are standardized according to the series 1, 2, 5, 10, 20, etc., a numerical error remained. The scale 1:40 proposed by a commission member as a specification for reinforcement diagrams, was not accepted. The diagrams must include class of structure, type of concrete, composition and loading pattern, concrete volume and quantity of reinforcement, content of reinforcement per cubic meter, and also diagrams of moments and shearing forces for important parts. The reinforcing rods in the diagram and the lists of reinforcements should be included on a special sheet, separate from the construction diagram.

The third section of the provisions concerns the execution of the work. In preparation, time is required for setting up an operational plan consisting of the following: time patterns for the individual operations on the individual structural members, the movement of main construction materials, labor; general plan, i.e., ground plan of the building site with all auxiliary structures, supply lines, storage areas, construction machinery, all explanatory reports and "list of construction procedures"; operating calculations with payroll; financial plan; printed forms for current work of operations supervisors. The substance of operational projection is expressed here in the principles of smooth-running, uninterrupted work and industrialization of construction procedure, i.e., the greatest possible use of finished parts and intermediate products from individual factories and lumber yards.

All matters pertaining to this purpose are submitted to extensive examination and amplification in the National Research Institute for the Construction Industry, founded in August 1931.

The operational project and its requirements are to be discussed thoroughly in meetings of all construction personnel concerned. Prior to start of work, every worker group should receive a definite assignment, with information as to quantity, time, and payment, in such form that the group itself can formulate a counterplan, i.e., a promise of even higher output.

The work diagrams, even those of the forms, should arrive at the building site, as a rule, 20 days before start of the work, so that the division of the structures into stories or other work sections can be synchronized between the project office and the building site. Upon arrival at the building site, the diagrams are to be examined for inclusion of designation of building part, all details of reinforcement, concrete volume, and layout of joints. All alterations in procedure must be entered on a record copy of the diagrams.

Only concrete work of less than 500 cubic meters may be carried out directly, provided this is economically justified. With more than 2,000 cubic meters, and in important cases with an even lesser quantity, the field laboratory is to be organized, receiving its assignments from the construction management; its methods, however, are to be supervised by the permanent laboratory.

In reference to the building materials, it is required that the cement be used in the order of its arrival. The floor of the cement shed must be at least 30 cm above the ground; the bags may not lie against the wall.

Sea water may be used for concrete except in the construction of dwellings.

RESTRICTED

RESTRICTED

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

RESTRICTED

Stone from rock of less than 300-kg-per-sq-cm compressive strength may be used when no resistance to frost is required and if the concrete made from it proves of sufficient strength.

Ordinary commercial iron may be used without laboratory examination if the cold bending test to 180 degrees around a bar of diameter 2 d results in no cracks whatsoever.

The order requiring that the forms be constructed according to certain diagrams, proportions, and calculations, and that the engineers devote particular attention to them is explained by the lack of capable workers and foremen for such advanced task, and is also to be regarded as evidence of an energetic effort toward scientific operational management. The form parts should be made as uniform as possible and treated as permanent inventory of the enterprise. Main types of forms are:

1. The collapsible and convertible form, whose parts are to be prepared in workshops and used as often as possible. Set-up and removal methods are to be given in the form diagrams; methods must be as simple as possible and must conserve the parts. Here, standard inventory parts (column stirrups, props with heads, extension props, bolts, etc.) are to be utilized extensively. This type of form is to be used in all homogeneous structures, and is also to be used many times in succession through suitable subdivision within large building sites.

2. The single-use form, of which only the wood is again used as building material. This may be used only in exceptional cases, in structures such as bridges and domes.

3. Slide forms, about whose use here much is already published (see "Concrete and Iron" 1930, Book 13; "Civil Engineering", 1931, Book 3). For normal conditions and ordinary cement, daily progress is given as 2 meters.

In addition, attention is called to convertible forms for longer structures (walls, canals, tunnels), iron forms, those forms which comprise a part of the structure itself, and the factory equipment for finished parts (pipes, window frames, stair parts, etc.)

The requirements of raw materials and the construction of the forms is to be determined from the "form turnover" to be determined from the form-removal time.

For side parts, this amounts to the length of time necessary for attaining 25 percent of the project strength.

For horizontal slabs with spans up to 2.5 meters, the time factor is based on 50 percent of the project strength.

For everything else, the time factor is based on 70 percent of the project strength.

In cases of particularly great span widths, inordinate factors of specific weight and live load, application of load shortly after removal of forms, etc., the periods are to be lengthened. The actual interval should be determined practically through duplicate (control) samples (cubes or beams), produced and maintained under the same conditions as the actual structural members. Following are the minimum intervals, given favorable conditions:

The project strength is based on a concrete maturity of 28 days and 7 days.

	28 days (Ordinary Portland Cement)		7 days (High-grade Cement)		
Mean air temperature over 24 hours	>15°	10-15°	>15°	10-15°	5-10°

RESTRICTED

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

RESTRICTED

Side surfaces of beams, columns, etc.	3	4	6	2	3	4 days
Slabs with under 2.5-meter span	7	10	14	4	5	6 days
Other members	14	18	24	5	7	9 days

Shorter intervals are permissible only upon careful proving through experiments.

The forms for the next story may be set up only after the preceding floor has attained 25 percent of the project strength. Boards are to be laid under the walkways and under the props; it is also required that the props of the various stories lie in single vertical lines above one another.

A slope of 1:4 and surface pressure of not over 20 kilograms per square centimeter is required for the wedge beneath the prop.

Three tables are given for the dimensions of wood in the forms. A six-part table gives the interval of the cross pieces and height for slab forms, whereby thicknesses are set at 19 and 25 millimeters for form boards; 25, 35, and 50 millimeters for upright boards; 6 - 12 centimeters for slabs; and slab widths at 1.4 - 2.4 meters. The second table gives the stirrup interval for column forms - depending on whether plastic or cast concrete is used - for form-board thicknesses of 19, 22, 25 and 40 millimeters, and for columns 20, 40, 70, 100, and 150 centimeters square; the intervals for the column stirrups apply for the horizontal members of wall forms with upright boards, whereby the wall thicknesses correspond to one-half the column thicknesses. The third table gives the permissible loads for round and square props of 8-, 10-, 12-, and 15- centimeters thickness, and for clear heights of 3 - 6 meters.

In addition, however, the integral bases for the calculation of the form would be given. The give of the form under the fresh concrete may not exceed 1:400 of the span width, but before the concrete is poured may be greater.

Freshly laid concrete is to be reckoned at 2.5 tons per cubic meter, reinforced concrete at 2.6 tons per cubic meter. Lateral pressure is to be calculated according to the general bulk-material formula (earth-pressure formula), and is to be rated at 1.1 h for plastic concrete, 1.5 h for cast concrete. However, in narrower cross sections, it is (as in silo cells) reduced to 10 r (plastic) or 17 r (cast concrete), where r stands for the quotients, area of the cross section by its circumference or the half of the wall thickness. The dynamic effect of trampling and car tipping can be compensated for by an additional load of 250 kg per sq meter. In regard to the concrete's starting to set, in no case is it necessary to assume more than six times the hourly height-advance for the pressure level of the concrete.

The following permissible tensions apply for the calculation of the form:

	Kg per Sq Cm Fir	Pine
Equal stress	135	150
Equal pressure - longitudinal	120	135
Equal pressure crosswise (with height < width)	18	20
Equal shearing stress - longitudinal (with length of the shear section < 6 x binding)	14.5	16
Equal shearing stress - crosswise (with length of the shear section < 4 x binding)	7	8

RESTRICTED

RESTRICTED

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

RESTRICTED

	Fir	Pine
Bending	135	150
Bending thrust, maximum tension	27	30
Pressure from cross-cut timber to cross-cut timber	97	110
Swelling pressure crosswise to the grain, over the entire width and maximum 1/3 the length	30	34
Same with maximum 5-cm width	35	40
Swelling pressure crosswise to the grain, with area of pressure maximum 1/3 the width and maximum 1/2 the length	42	47
Iron in stress, pressure and bending	1,700	-
Elasticity count of the wood to be taken as	100,000	-

A nail of "1" centimeter length (from 5 to 12-5 centimeters) may be strained in every section with a shearing force of 10-"1" kilograms. Continuous boards loaded equally or with stress concentrated are to be calculated for a moment of /10 or /5 respectively and a deflection of /126 or /77.

The formulae for the permissible buckling load of the wood props read for the various slenderness grades (length/radius of gyration):

$5 < R < 100$ $\quad P = F\delta\,(1 - 0.007\lambda)$

$R > 100$ $\quad P = 330{,}000\,F : \lambda^2$

In these formulas the length for calculation, with fixed members, is to be taken as 0.8 times the distance between the joints; otherwise, as the full board length.

The joints of the reinforcing rods must be welded and the wire netting for columns, beams, etc., should be made in the workshop. Before placing the reinforcement, the concrete insulating course should be secured by laying in concrete blocks; pieces of iron may not be used for this purpose, but they may be used to separate correctly two layers of iron from each other.

The composition of the concrete must comply with the laboratory-tested requirement; at the mixing site the raw material quantities for one batch must be noted on a table in their actual units of measurement. The water should be measured automatically and the cement weighed. Minimum mixing time in the machine is one minute. Addition of water thereafter is not allowed. When mixing by hand, the cement should first be dry-mixed with the sand three times.

Decomposition of the concrete while moving is to be prevented. In particularly bad cases, it is to be remixed without the addition of water.

For moving the concrete in a cart, etc., paths are to be arranged so that no one need tread upon and damage the reinforcement.

The carrying vessels for the concrete must be fully leakproof.

When pouring the concrete, the forms must not only be cleaned, but must be soaked to the point of saturation. The joints of the forms are to be thoroughly closed. (It is practical to employ cheap female labor to caulk up most of the joints with oakum.)

Tamped concrete is permitted only when experienced workers are available and sufficient tamping is assured (with compressed air tampers or hand tampers of 12-16 kilograms). Each freshly tamped layer (maximum 15 centimeters high) is to be roughened immediately with brooms or rakes.

Plastic concrete should be used ordinarily. For cast concrete, the economy must be proved (in regard to the much higher quantity of cement used for the same strength)

RESTRICTED

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

Columns of up to 5 meters without internal reinforcement are concreted from the top in one operation. The concreting of columns with transverse reinforcement or stirrups is done by layers from one or two sides and with extendible form attachments.

When concreting the columns during the tamping-in, the form must always be struck with mauls. The lower 20 centimeters should be made of mortar (like that contained in the concrete) without coarse aggregate. The covering of beams should also be formed from this mortar.

When concreting is done in the direction of the main joists, the expansion joint should be situated in the center section of the main joist between the secondary joists (Sketch 1). If concreting is done in the direction of the secondary joists, the expansion joint is to be laid through them (Sketch 2). A form is always to be set up at the expansion joint so that the concrete does not diverge and slant off.

With cast concrete, the free drop at the end of the trough may not be greater than 2 meters.

For concreting under water, plastic concrete with a special 10-percent supplement of cement is to be used. Free falling of the concrete through the water is not permissible; it must be poured by means of tightly-closed boxes or sacks, or in an even stream through funnel pipes. The successive layers up to 40 centimeters in depth are to be poured crosswise to each other. While the concrete is setting, no flowing water may act upon it. Pumping out the construction pit before sufficient hardening has taken place is not allowed. For concreting bulky bodies a previous time plan must be set up and a connection (by means of hooks, short iron rods, hollows) provided for.

In caring for the concrete, it must be kept wet for at least 7 days, and it may be necessary to cover it with matting. Subsequently knocking holes in concrete and reinforced concrete is, as a rule, forbidden. If it is unavoidable, the holes may be bored only according to a special pattern. If this is also excepted, holes may be chiseled only from bottom to top or from both sides in.

For continuous control of the concrete, the field laboratory must maintain:

1. A stiffness test at least twice in every working shift
2. A test of concrete composition (dosage) at least once per shift
3. A test of raw materials (cement and aggregates) at least once every 5 days, and upon every alteration in raw material quality
4. The strength test, by making a batch test cube for every 100-200 cubic meters of reinforced concrete, and for every 250-500 cubic meters of non-reinforced concrete, each according to the importance of the construction.

With concrete and reinforced-concrete work of over 250 cubic meters, and with less in the case of important structures, there must be a construction log containing daily entries on the quantity laid, composition and rigidity of the concrete, the activity (standard strength) of the cement, cement consumption, temperature, and later also cube information, and time of removal of forms, etc. A log of the field laboratory is also to be kept.

The fourth section, which comprises the major part of the provisions, deals with the choice of concrete composition and with the control of concrete in construction.

To obtain a uniform concrete of the desired properties, five prerequisites are specified: proper choice of raw materials (both technically and economically); correct choice of mixing ratio; control of mixing proportions; control of mixing and pouring; care of the laid

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

concrete. These measures, planned and executed, constitute a chain, each link of which is indispensable if the desired result is to be attained. To this end, a responsible person must be stationed at the building site to supervise the concrete work. The construction laboratory must also be available to this person.

The prime theorem in the science of concrete is that strength depends "almost entirely" upon the quality of the cement and upon the water-cement ratio, i.e., the weight proportion of water to cement, given satisfactory aggregates and normal hardening conditions. If the quality of the cement alone is changed, the strength of the concrete can be taken as proportional to the strength of the cement through the standard test (called "activity"). The quantity of aggregate to the specified cement paste (cement plus water) is not influenced by the strength as long as the substance remains plastic.

Thus, the water-cement ratio is to be ascertained from the strength required, and the composition and quantity of aggregate from the required consistency. The gradation of grain sizes of the aggregate has much to do with the consistency and must therefore be chosen carefully so that the required consistency is maintained with the greatest quantity of aggregate possible.

The cement must be examined at the work site for normal stiffness, setting time, constancy of volume, and standard strength. Samples are to be taken from each lot, at least one sample every 500 barrels. Vicat's needle or, in case of necessity, the "streak method", and 28 percent by weight of water is to be used for the first two tests. A 4-hour heating test is directed for constancy of volume. The testing of cement strength, with standard sand 1:3 after 28 days, may be undertaken on small beams 4 x 4 x 25 or 2 x 3 x 25 centimeters instead of on 50-square centimeter cubes. In that case, however, the proportion of the strengths to each other must be predetermined in a larger laboratory.

Strangely enough, it is required that in all calculations and experiments, the volume weight of all cements is to be taken uniformly as 1300 kilograms per cubic meter. The water may not contain above 0.3 percent sulphur anhydride, nor above 1 percent sodium chloride or magnesium chloride.

The sand may not contain more than 2 percent by weight of loam. The total content of dressy, pulverulent, and loamy constituents may not amount to over 5 percent by weight in the sand, and not over 1 percent by weight in the coarse aggregate. If large amounts are present, the material must be washed.

In the color test, 130 cubic meters of sand are made up with caustic soda (NaOH) solution to 200 cubic meters, strongly agitated and left standing 24 hours. If this test shows up a dark yellow or brown-red color, the sand either is useless or will have to be proven through strength tests - exhibiting results comparable to standard sand in a 1:3 mortar. Washing does not always help against organic impurity.

For the gradation of grain size of the sand, it is required that the following weight-percentages pass through:

Sifter Openings (Inside Diameter)	
10 mm	up to 100 percent
5 mm	95 - 100
1.2 mm	45 - 80
0.3 mm	5 - 30
0.15 mm	0 - 5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

The maximum diameter of the coarse aggregate is designated as the measurement of the openings through which at least 95 percent will pass; 40 to 70 percent should pass through openings half this size; and 0 to 10 percent should pass through a sifter with openings of 5 millimeters. The largest size may not exceed one-fourth of the measurement of the smallest structural member, nor may it be greater than the least interval of the iron reinforcements.

Exceeding these limits of gradation necessitates the use of a larger quantity of cement.

In contrast to these unobjectionable estimates and the sufficiently conclusive data, very important as practical guides, it must be evident that the first paragraphs repeat the old conception of the "coarseness modulus". This is defined as the hundredth part of the sum of all percentages remaining on a definite series of sifters (square holes of 0.15, 0.3, 0.6, 1.2 millimeters width, and round holes with 2.5, 5, 10, 20, 40, 80 millimeters width). It must also be striking that the concept that the larger the "coarseness modulus" of the gravelly sand, the better is its specification, is irrational and in complete contradiction to the foregoing.

The best values of the coarseness modulus for sand lie between 2.5 and 3.5. The minimum value is 1.5 and for the coarse aggregate, between 6.5 and 8.5, and at least 6.0. To further complicate matters, the product from the coarseness modulus and from (50-V) is designated as a measurement for the quality of the sand, "V" being the percentage pore area of the loose sand.

Importance is attached to the determination of the water content in the aggregates, and its consideration in determining the amount of water to be added. The proportion of the weights of a definite quantity of sand before and after drying amounts to 1.1 for moderate moisture, 1.2 for medium moisture, between 1.25 and 1.3 for heavy moisture.

The use of high-grade cement comes under consideration: (1) with hurried construction (quick stripping of forms, early application of loads, sliding forms); (2) at low temperatures; (3) when particularly great strength is required. It may be less practical to recommend the use of high-grade cement in order to compensate for the poor qualities of cheap local aggregates. It is also impractical to recommend the use of high-grade cement where it is to be partially replaced by cheap, local binders(such as brass).

The basis for the pattern of concrete is the dependence of the strength upon the type of cement and the water-cement ratio. Water-cement ratios are given in the following table.

Concrete Strength (Kg Per Sq Cm)	Standard Test Strength of Cement					
	7 Days	28 Days	7 Days	28 Days	7 Days	28 Days
	160 kg/sq cm		275 kg/sq cm		420 kg/sq cm	
210	-	0.41	0.43	0.65	[illegible]	0.92 [illegible]
170	-	0.47	0.49	0.75	0.64	-
130	0.37	0.56	0.58	0.90	0.74	-
110	0.42	0.62	0.63	1.00	0.82	-
90	0.49	0.70	0.71	-	0.93	-
65	0.63	0.90	0.90	-	-	-
45	0.78	-	-	-	-	-

The figures in this table originated from Leningrad experiments with gravel and sea sand at plus 15 degrees; for the same sand with riv-

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

er gravel, the strengths are to be set at 15 percent less; with the use of nothing but sharp-edged aggregate, the figures are 10 percent higher. If the above strengths are designated as 100, the following applies during hardening at other temperatures.

Strength	20°	15°	10°	0°
After 7 Days	110	100	85	70
After 28 Days	105	100	90	80

The stiffness of the concrete is to be so chosen that the concrete is suitable for transport and pouring so that the mixture does not decompose. The following points apply in the choice of stiffness:

	Settling Measurement on Abrams Cone	Inclination on Skrautvef Table
Moist: Mass unit with little reinforcement	2 to 7 cm	33 to 25°
Soft: Ordinary reinforced concrete with medium density of reinforcement	7 to 12 cm	25 to 20°
Fluid: Thin structural members or dense reinforcement	12 - 18 cm	20 to 15°

The proportion of crushed rock or gravel to sand is to be chosen according to the following table.

	When 2/3 of the Sand Measures Over 0.6 mm	Under 0.6 mm
When 2/3 of the Rock (gravel) measures		
Over 20 mm	1-1.5-2	1.5-2-2.5
Under 20 mm	1.5-2-2.5	2-2.5-3

Stiffness tests are to be made with the corresponding three proportions, and from the results, the economic mixture is to be computed in accordance with the local prices.

The provisions further deal with the influence of the "coarseness modulus" on the proportion of the aggregates.

For computing quantities, the yield, i.e., the concrete volume divided by the sum of the volumes of cement and aggregates, is taken as 0.6.

For orientation, particularly in cost estimates, the following table gives the kilograms of cement necessary for 1 cubic meter of finished concrete.

Cube Strength After							
28 days		210	170	-	130	110	90
7 days		130	110	90	-	-	60
Consistency	Cement Type						
1 to 3 cm	0		320	300	280	250	230
	00	270	250	240/250	220/250	-	-
	000	220/250	-	-	-	-	-
7 to 10 cm	0	-	350	320	300	275	250
	00	300	270	250	240/250	-	-
	000	250	220/250	-	-	-	-
15 to 18 cm	0	-	-	-	330	310	290
	00	320	300	280	260	220/250	-
	000	270	240/250	220/250	-	-	-

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

250 kilograms per square centimeter represents the prescribed minimum content for rust protection for exterior members, 220 the same for interior members.

Russian designations of cement types are as follows:

0 - ordinary Portland cement
00 - improved Portland cement
000 - high-grade cement

If the concrete is to be waterproof, weatherproof, and frostproof, the water-cement factor may not be greater than 0.65 to 0.70, and the grain sizes must be finely graduated. In hydraulic works, and for frost-free structural members, at least 280 kilograms of cement per cubic meter of concrete must be used. For road construction, settling should amount to 1 to 4 centimeters.

Control at the building site is to be concerned with the following five points:

1. Raw Materials

The cement must be tested according to details preceding; in addition, the aggregates must be tested for gradation of grain size at every change in lot, and at least once for every 500 cubic meters. The moisture in the aggregates must be determined at least once every 24 hours and the water addition to the concrete altered accordingly. The properties of the water must be tested after every rainfall, at high water, in dry spells, and at least once a month.

2. Concrete Composition

The quantity of water may not be changed without the knowledge of the person in control; the measuring in of the water is to be automatic or it must be efficiently watched over. The same applies in the case of the cement, which should be measured in according to weight. The stiffness of the concrete must be tested at least twice a day at the mixing site.

3. The shortest mixing time of one minute, measured from the point when all materials have been added, must be controlled through an automatic gauge or a sand glass. In transporting the concrete, damaging stops are to be avoided. Pouring of the concrete is to be watched for complete filling in, particularly in all narrow places. Addition of water (thinning) when pouring is strictly forbidden.

Points 4 and 5, strength testing and care of the finished concrete, have been previously treated.

Concerning the notes on testing, it should be noted that in the case of cement the strength test on the aforementioned beams should be multiplied by 10 in order to estimate the cube strength when both strengths are based on 7 days, or both on 20 days; but it is to be multiplied by 15 to determine a 28-day cube from a 7-day beam. The loam content of the sand is determined from the growth of its volume after the addition of calcium chloride, the content of clayey and pulverulent constituents is determined by washing them out. For a rapid test of crushed rock or gravel for weather durability, a saturated solution of sodium sulphate (Na_2SO_4) at 21 degrees C is used five times.

With the coarse gravel, a strength test is directed in which 1 kilogram of gravel is to be divided into three portions of various grain sizes. Each stone is to be subjected to static pressure between iron plates at least 5 millimeters thick. Pressure is to be applied as follows: for stones one-half to 1 centimeter, 16 kilograms; 1 to 2 centimeters, 26 kilograms; over 2 centimeters, 34 kilograms. Stones which do not sustain this pressure may not comprise more than 5 percent of the lot.

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

In order to establish the dependence of strength upon the water-cement ratio, 18 cubes are to be tested; each group of three equal cubes to have three different mixtures and two different water-cement ratios. If it is desired that the strengths be known after 7 days as well as after 28 days, 36 cubes are necessary. The 28-day test is to be expected to be 1.6 times the 7-day test.

If the block press is not available, concrete beams 15 x 15 x 120 centimeters may be used. Pressure resistance at 28 days is then to be assumed as nine times the bending strength after 7 days, or as 6 times the bending strength after 7 days with ordinary cement. For higher-grade cement, the 7-day pressure resistance is nine times the 7-day bending strength.

Cubes for testing aggregate of not over 5 centimeters are required to have a 20-centimeter edge length, otherwise, a 30-centimeter edge length.

The list of equipment for the building-site laboratory numbers 50 items from the sets of sieves and the scales through measuring vessels and block forms to chemicals. In addition, there are listed column headings for the daily records of the construction superintendents and the laboratory experiments. Pertinent cement standards, etc., are also included.

A special supplement consists of 7-pages of instruction for test loading of structures in which no overloading occurs contrary to the static calculations, and in which the permanent deflection may amount to no more than one-third of the total deflection. There is also a 13-page directive for winter work which, however, is overlapped by a very complete 300-page special directive for winter work (to be published in February 1932).

Thanks to the careful treatment of all foreign and domestic research, a very high level is reached with these provisions - excepting certain imperfections - as this concise extract may have shown. Furthermore, because of the special national economic significance of the directives, they are ultimately a scientific opus worthy of attention.

A SUPPLEMENT TO THE CHAPTER "FOUNDATION FLANGES" FROM "REINFORCED CONCRETE CONSTRUCTION" BOOK II, PART 1, BY MOERSCH

In this work, Professor Moersch poses a visual method for determining the distribution of pressure on the building ground by taking into consideration the bending of the foundation flange. He first hypothesizes the rigidity of the foundation, determines the ground pressures, and then the changes of form y of the foundation flange. As a result of the proportionality of pressing and sinking $p = Cy$, the original tension distribution line must be altered so that its lower limit is proportional to the y-line. "Here, by experimenting, the chord must be plotted so that the conditions of external balance are satisfied, the sum of all ground pressures equaling the total load R, and so that its resultant coincides with R."

This very tedious experimentation can easily be avoided, as is shown below. The resultants do not change in size or location if we annex two equal but opposed forces. Therefore, we determine the area of the Cy line and ascertain the center of gravity by means of a polygon of forces and a funicular polygon.

Now we calculate sides a and b of a trapezoid which has an area equal

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5

STAT

to the C·y area and whose center of gravity lies on the same perpendicular.

Referring to the adjoining diagram we evolve the following basic equations:

(1) $\frac{a + b}{2} \cdot l = F$ (F being the C·y area)

(2) $a' = \frac{1}{3} \cdot \frac{2a + b}{a + b}$

There follow from these:

$a = \frac{2F}{l^2} (3a' - 1)$, and the analogous equation:

$b = \frac{2F}{l^2} (3a - 1)$.

By plotting a and b we immediately find the chord wanted since we have altered nothing in the size and position of the resultant through the addition of the trapezoid with the sides a and b, and the subtraction of the C·y area.

- 26 -

Sanitized Copy Approved for Release 2011/06/09 : CIA-RDP80-00809A000600130011-5