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GLOSSARY OF TERMS RELATING TO CEMENT CONCRETE

PART IX STRUCTURAL ASPECTS

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GLOSSARY OF TERMS RELATING TO CEMENT CONCRETE

PART IX STRUCTURAL ASPECTS

0. FOREWORD

0.1 This Indian Standard (Part IX) was adopted by the Indian Standards Institution on 16 February 1973, after the draft finalized by the Cement and Concrete Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Cement concrete is one of the most versatile and extensively used building materials in all civil engineering constructions. There are a number of technical terms connected with the basic materials for concrete as well as the production and use of concrete which quite often require clarification to give precise meaning to the stipulations in the standard specifications, codes of practices and other technical documents. It has, therefore, become necessary to standardize the various terms and definitions used in cement and concrete technology and thus avoid ambiguity in their interpretations. The Sectional Committee has, therefore, decided to bring out a series of glossaries of terms relating to concrete and concrete materials.

0.3 For convenience of reference, this glossary of terms relating to cement concrete has been grouped into the following twelve parts:

Part I Concrete aggregates
Part II Materials (other than cement and aggregate)
Part III Concrete reinforcement
Part IV Types of concrete
Part V Formwork for concrete
Part VI Equipment, tools and plant
Part VII Mixing, laying, compaction, curing and other construction aspects
Part VIII Properties of concrete
Part IX Structural aspects
Part X Tests and testing apparatus
Part XI Prestressed concrete
Part XII Miscellaneous

0.3.1 In addition to the above, two separate standards have been brought out concerning terminology relating to hydraulic cement and pozzolanic materials. These standards are IS : 4845-1968* and IS : 4305-1967†.

0.4 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by deriving assistance from the following publications:

BS 2787 : 1956 Glossary of terms for concrete and reinforced concrete. British Standards Institution.

BS 4340 : 1968 Glossary of formwork of terms. British Standards Institution.

ASTM Designation : C. 125 Definitions of terms relating to concrete aggregate. American Society for Testing and Materials.

ACI No. SP-19 Cement and concrete terminology. American Concrete Institute.

ACI 617-1968 Recommended practice for concrete formwork. American Concrete Institute.

1. SCOPE

1.1 This standard (Part IX) covers definitions of terms relating to structural aspects.

2. DEFINITIONS

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Allowable Load — The ultimate load divided by factor of safety.

2.2 Allowable Stress — Maximum permissible stress used in design of members of a structure and based on a factor of safety against rupture or yielding of any type.

2.3 Average Bond Stress — The force in a bar divided by the product of its perimeter and its embedded length.

2.4 Balanced Load — Load capacity at simultaneous crushing of concrete and yielding of tension steel.

*Definitions and terminology relating to hydraulic cement.
†Glossary of terms relating to pozzolana.

2.5 Balanced Moment — Moment capacity at simultaneous crushing of concrete and yielding of tension steel.

2.6 Balanced Reinforcement — An amount and distribution of reinforcement in a flexural member such that in working stress design the allowable tensile stress in the steel and the allowable compressive stress in the steel and the allowable compressive stress in the concrete are attained simultaneously.

2.7 Beam — A structural member subjected primarily to flexure; also the graduated horizontal bar of a weighing scale on which the balancing poises ride.

2.8 Beam and Slab Floor — A reinforced concrete floor system in which the floor slab is supported by beams of reinforced concrete.

2.9 Beam Test — A method of measuring the flexural strength (modulus of rupture) of concrete by testing a standard unreinforced beam.

2.10 Bearing Capacity — The maximum unit pressure which a soil or other material will withstand without failure or without settlement to an amount detrimental to the integrity or the function of the structure.

2.11 Bond — Adhesion and grip of concrete or mortar to reinforcement or to other surfaces against which it is placed, including friction due to shrinkage and longitudinal shear in the concrete engaged by the bar deformations; the adhesion of cement paste to aggregate; adherence between plaster coats or between plaster and a substrate produced by adhesive or cohesive properties of plaster or supplemental materials; also the arrangement of units in concrete block or stone masonry and brickwork so that vertical joints are discontinuous.

2.12 Bond Area — The area of interface between two elements across which adhesion develops or may develop, as between concrete and reinforcing steel.

2.13 Bond Length — The length of grip of a reinforcing bar.

2.14 Bond Strength — Resistance to separation of mortar and concrete from reinforcing steel and other materials with which it is in contact; a collective expression for all which it is in contact; a collective expression for all forces, such as adhesion, friction due to shrinkage, and longitudinal shear in the concrete engaged by the bar deformations that resist separation.

2.15 Bond Stress — The force of adhesion per unit area of contact between two bonded surfaces, such as concrete and reinforcing steel or any

other material such as foundation rock; shear stress at the surface of a reinforcing bar, preventing relative movement between the bar and the surrounding concrete.

2.16 Brace — Any structural member used to support another; always designed for compression and sometimes for compression and sometimes for tension under special load condition.

2.17 Bracket — An overhanging member projecting from a wall or other body to support weight outside the wall, or similar piece to strengthen an angle.

2.18 Cellular Raft — A raft in which the intersecting beams form a number of cells.

2.19 Chord Modulus — *See* **2.117.**

2.20 Column

a) A compression member, the effective length of which exceeds 12 times its least radius of gyration (*see also* ' strut ').

NOTE — In the case of a rectangular section, column may be taken as a compression member, the effective length of which exceeds 3·46 times its least lateral dimension.

b) A strut (*see* **2.204**) whose longitudinal axis is vertical or nearly vertical.

2.21 Column, Combination — A column in which a structural steel member, designed to carry part of the load, is encased in concrete of such quality and in such manner that the remaining load may be allowed thereon.

2.22 Column Composite

a) A column in which a metal structural member is completely encased in concrete containing special and longitudinal reinforcement.

b) A concrete column with a core of structural steel or cast iron designed to carry a portion of the column load.

2.23 Column, Long

a) A column whose load capacity should be reduced because of its slenderness.

b) A column having a ratio of effective length to its least radius of gyration greater than 50.

NOTE — In the case of rectangular sections it is a ratio of effective length to its least lateral dimension not more than 14·4.

2.24 Column, Short

a) A column whose load capacity need not be reduced because of its slenderness.

b) A column having a ratio of effective length to its least radius of gyration not more than 50.

NOTE — In the case of rectangular sections, it is a column having a ratio of effective length to least lateral dimension not more than 14·4.

2.25 Column Capital — An enlargement of the end of a column designed and built to act as an integral unit with the column and flat slab and increase the shearing resistance.

2.26 Column Strip — The portion of a flat slab over the columns and consisting of the two adjacent quarter panels on each side of the column centre line.

2.27 Combination Column — *See* **2.21**.

2.28 Combined Footing — A structural unit or assembly of units supporting more than one column load.

2.29 Composite Column — *See* **2.22**.

2.30 Composite Pile — A pile made up of different materials, usually concrete and wood, or steel fastened together end to end, to form a single pile.

2.31 Compression Flange — The widened portion of an I, T, or similar cross-section beam which is shortened or compressed by bending under normal loads, such as the horizontal portion of the cross-section of a simple span T-beam.

2.32 Compression Reinforcement — Reinforcement designed to carry compressive stresses.

2.33 Compressive Strength — The measured maximum resistance of a concrete or mortar specimen to axial loading expressed as force per unit cross-sectional area.

2.34 Concrete Pile — A reinforced or prestressed concrete pile driven into the ground by a pile driver or otherwise placing.

2.35 Concrete, Structural — Concrete used to carry structural load or to form an integral part of a structure; concrete of a quality specified for structural use; concrete used solely for protective cover, fill, or insulation is not considered structural concrete.

2.36 Concrete, Structural Lightweight — Structural concrete made with lightweight aggregate; the unit weight usually is in the range of 1 440 to 1 850 kg/m^3.

2.37 Confined Concrete — Concrete containing closely spaced special transverse reinforcement which is provided to restrain the concrete in directions perpendicular to the applied stresses.

2.38 Construction Loads — The loads to which a permanent or temporary structure is subjected during construction.

2.39 Contact Pressure — Pressure acting at and perpendicular to the contact area between footing and soil, produced by the weight of the footing and all forces acting on it.

2.40 Continuous Beam — *See* **2.42**.

2.41 Continuous Footing — A combined footing of prismatic or truncated shape, supporting two or more columns in a row.

2.42 Continuous Slab or Beam — A slab or beam which extends as a unit over three or more supports in a given direction.

2.43 Continuously Reinforced Pavement — A pavement without transverse joints, except tied construction joints placed between successive days concreting, with sufficient longitudinal reinforcement, adequately lapped to develop tensile continuity, so that transverse cracks will be held tightly closed.

2.44 Conventional Design — Design procedure using moments or stresses determined by widely accepted methods.

2.45 Core

a) That portion of a reinforced concrete column inside the centre line of the principal reinforcement.

b) A cylindrical sample of hardened concrete or rock obtained by means of a core drill.

2.46 Corner Reinforcement

a) Reinforcement provided to strengthen the corners of a pavement slab against stresses caused by wheel loads especially over poor foundations.

b) Reinforcement provided in reinforced concrete slab for torsion at unrestrained corners.

c) Plaster reinforcement used at re-entrant or internal angles to provide continuity between two intersecting plaster planes.

2.47 Cracked Section — A section designed or analyzed on the assumption that concrete has no resistance to tensile stress.

2.48 Cracking Load — The load which causes tensile stress in a member to exceed the tensile strength of the concrete.

2.49 Creep — *See* **2.147.**

2.50 Dead Load — The weight of a structure of portion thereof.

2.51 Deflection — In general, an angular variation from an established direction or plane, usually measured as a linear deviation from an established plane rather than an angular variation.

2.52 Deformation — A change in dimensions or shape due to stress.

2.53 Design Compressive Strength — The load-bearing capacity of a member computed on the basis of the allowable stresses assumed in design; the assumed values for the strength of the concrete and the yield stress of the steel on whose basis the theoretical ultimate strength of a section is computed.

2.54 Diagonal Tension — The principal tensile stress resulting from the combination of vertical and horizontal stresses in a beam.

2.55 Double T-Beam — A member composed of two beams and a top slab projecting on both sides; also a flat slab panel with projecting stems.

2.56 Dowel Shear — The force applied in the plane of the cross-section of the dowel.

2.57 Drop-in-Beam — A simple beam, usually supported by cantilever arms, with joints so arranged that it is installed by lowering into position.

2.58 Drop Panel — The structural portion of a flat slab which is thickened throughout an area surrounding the column, column capital or bracket.

2.59 Dynamic Analysis — Analysis of stresses in framing as functions of displacement under transient loading.

2.60 Dynamic Load — A load which is variable, that is, not static, such as a moving live load, earthquake, or wind.

2.61 Dynamic Loading — Loading from units (particularly machinery) which, by virtue of their movement or vibration, impose stresses in excess of those imposed by their dead load.

2.62 Dynamic Modulus of Elasticity — The modulus of elasticity computed from the size, weight, shape, and fundamental frequency of a concrete test specimen, or from pulse velocity.

2.63 Edge Beam — A stiffening beam at the edge of a slab.

2.64 Effective Area of Concrete — Area of a section assumed to be active in resisting the applied stresses; the area of a section which lies between the centroid of the tension reinforcement and the compression face of the flexural member; for a cracked flexural member, the effective area of concrete is the area between the neutral axis and the compression face.

2.65 Effective Area of Reinforcement — The area obtained by multiplying the normal cross-sectional area of reinforcement by the cosine of the angle between the direction of the reinforcement and the direction in which the effectiveness is required.

2.66 Effective Area of Reinforcement in Diagonal Bends — The area obtained by multiplying the normal cross-sectional area of the reinforcement by the cosine of the angle at which the bend is inclined to the direction for which its effectiveness is considered.

2.67 Effective Depth — Depth of a beam or slab section measured from the compression face to the centroid of the tensile reinforcement.

2.68 Effective Flange Width — Width of slab adjoining a beam stem assumed to function as the flange element of a T-beam section.

2.69 Effective Length of Column — The distance between inflection points in a column when it bends.

2.70 Effective Modulus of Elasticity — Combination of elastic and plastic effects in an overall stress-strain relationship in the service structure; often expressed as:

$$E_{\text{eff}} = \frac{1}{1 + 0{\cdot}4\ (E_c/E_f)}\ E_c$$

where

E_{eff} = effective modulus of elasticity,

E_c = modulus of elasticity of concrete, and

E_f = modulus of elasticity of the foundation rock.

2.71 Effective Reinforcement — Reinforcement of a section assumed to be active in resisting the applied stresses.

2.72 Effective Span — The lesser of the two following distances:

a) the distance between centres of supports, and

b) the clear distance between supports plus the effective depth of the beam or slab.

2.73 Effective Stress — In prestressed concrete, the stress remaining in the tendons after all losses of the prestressing load have occurred.

2.74 Effective Width of Slab — That part of the width of a slab taken into account when designing T- or L-beams.

2.75 Elastic Design — A method of analysis in which the design of a member is based on a linear stress-strain relationship and corresponding limiting elastic properties of the material.

2.76 Elastic Limit — The limit of stress beyond which the strain is not wholly recoverable.

2.77 Elastic Loss — In pretensioned concrete, the reduction in prestressing load resulting from the elastic shortening of the member.

2.78 Elastic Modulus — *See* **2.117.**

2.79 Elasticity — That property of a material by virtue of which it tends to recover its original size and shape after deformation.

2.80 Equivalent Rectangular Stress Distribution — An assumption of uniform stress on compression side of neutral axis in a reinforced concrete section used in Whitney method of ultimate strength design to approximate actual conditions at ultimate bending load.

2.81 Exterior Panel — In a flat slab, a panel having at least one edge which is noncontinuous.

2.82 Extreme Compression Fibre — A fibre farthest removed from the neutral axis on the compression side of a member subjected to bending.

2.83 Factor of Safety — The ratio of the ultimate strength (or yield point) of a material to the working stress assumed in design (stress factor of safety); or the ratio of the ultimate load, moment, or shear of a structutal member to the working load, moment, or shear, respectively, assumed in design (load factor of safety).

2.84 Fatigue — The weakening of a material caused by repeated or alternating loads.

2.85 Fatigue Strength — The greatest stress which can be sustained for a given number of stress cycles without failure.

2.86 Flexural Moment — *See* **2.151.**

2.87 Flexural Rigidity — A measure of stiffness of a member, indicated by the product of modulus of elasticity and moment of inertia divided by the length of the member.

2.88 Flexural Strength — A property of a solid that indicates its ability to withstand bending.

2.89 Foundation — The material or materials through which the load of a structure is transmitted to the earth.

2.90 Four-Way Reinforcement — A system of reinforcement in flat slab construction comprising bands of bars parallel to two adjacent edges and also to both diagonals of a rectangular slab.

2.91 Frame or Panel — The principal prefabricated, welded structural unit in a scaffolding tower; also beam and column skeleton of a building.

2.92 Girder — Any heavy, strong, or principal, usually horizontal flexural member on which the weight of a floor, partition, or beam is carried.

2.93 Grade Beam — A reinforced concrete beam, usually at ground level, to form a foundation for the walls of a super-structure.

2.94 Grid Foundation — A combined footing formed by intersecting continuous footings, loaded at the intersection points and covering less than 75 percent of the total area within the outer limits of the assembly.

2.95 Hardy Cross Method — A method of distributing moments named after its inventor, a sign convention.

2.96 Haunch — The deepened portion of a beam that increases in depth toward the support.

2.97 Haunching

a) The increased depth of a beam or a slab near the supports, to increase its strength.
b) Concrete support to the sides of a drain or sewer pipe above the bedding.
c) Work done in strengthening or improving the outer strip of a roadway.

2.98 H/D Ratio — Ratio of height, H, to diameter, D.

2.99 Hinge Joint — Any joint which permits hinge action with no appreciable separation of the adjacent members.

2.100 Inelastic Behaviour — Deformation that does not disappear on removal of the force that produced it.

2.101 Initial Tangent Modulus — *See* **2.117**.

2.102 I-Section — Beam cross-section consisting of a top and bottom flanges connected by a vertical web.

2.103 Isotropy — The behaviour of a medium having the same properties in all directions.

2.104 Kern Area — The area located within the kern distance from the centroid of a footing as seen in plan.

2.105 L-Column — The portion of a precast concrete frame, composed of the column, the haunch, and part of the girder.

2.106 Lever Arm — In a structural member, the distance from the centre of the tensile reinforcement to the centre of action of the compression.

2.107 Lift Slab — A method of concrete construction in which floor and roof slabs are cast on or at ground level and hoistened into position by jacking; also a slab which is a component of such construction.

2.108 Limit Design — A method of proportioning reinforced concrete members based on calculations of their ultimate strength.

2.109 Load-Bearing Wall — A wall designed and built to carry superimposed vertical and shear loads as opposed to non-load-bearing walls.

2.110 Load Factor — The ratio of the collapse load to the working load on a structure or section.

2.111 Long Column — *See* **2.23**.

2.112 Mat Foundation — A continuous footing supporting an array of columns in several rows in each direction, having a slab-like shape with or without depressions or openings, covering an area at least 75 percent of the total area within the outer limits of the assembly (*see also* Grid foundation and Raft foundation).

2.113 Membrane Theory — A theory of design for thin shells, based on the premise that a shell cannot resist bending because it deflects; the only stresses that exist, therefore, in any section are shear stress and direct compression or tension.

2.114 Middle Strip — In flat slab framing, the slab portion which occupies the middle half of the span between columns (*see* **2.26**).

2.115 Modular Ratio — The ratio of modulus of elasticity of steel E_s to that of concrete E_c usually denoted by the symbol m.

2.116 Modulus of Deformation — A concept of modulus of elasticity expressed as a function of two time variables; strain in loaded concrete as a function of the age at which the load is initially applied and of the length of time the load is sustained.

2.117 Modulus of Elasticity — The ratio of normal stress to corresponding strain for tensile or compressive stresses below the proportional limit of the material; referred to as " elastic modulus ", " Young's modulus ", and " Young's modulus of elasticity "; denoted by the symbol E (*see also* **2.19**).

2.118 Modulus of Rigidity — The ratio of unit shearing stress to the corresponding unit shearing strain; referred to as 'shear modulus' and 'modulus of elasticity in shear'.

2.119 Modulus of Rupture — A measure of the ultimate load-carrying capacity of a beam and sometimes referred to as 'rupture modulus' or 'rupture strength'. It is calculated for apparent tensile stress in the extreme fibre of a transverse test specimen under the load which produces rupture.

NOTE — The actual stress in the extreme fibre is less than the apparent stress since the flexure formula employed in the calculation is valid only for stresses within the proportional limit of the material; nevertheless, the nominal rupture strength so obtained is considered the rupture modulus.

2.120 Mud Slab — A 5 to 15 cm layer of concrete below structural concrete floor or footing over soft, wet soil.

2.121 Negative Moment — A condition of flexure in which top fibres of a horizontally placed member, or external fibres of a vertically placed exterior member, are subjected to tensile stresses.

2.122 Neutral Axis — A line in the plane of a structural member subject to bending where the longitudinal stress is zero.

2.123 One-Way System — The arrangement of steel reinforcement within a slab that presumably bends in only one direction.

2.124 Overdesign — To require adherence to structural design requirements higher than service demands, as a means of compensating for statistical variation or for anticipated deficiencies or both.

2.125 Overturning — Result of any combination of forces tending to overcome stable equilibrium.

2.126 Panel — A concrete member, usually precast, rectangular in shape, and relatively thin with respect to other dimensions.

2.127 Panel Drop — *See* **2.58**.

2.128 Panel Strip — A strip used for design purposes extending across the length of width of a flat slab.

2.129 Pedestal — An upright compression member whose height does not exceed 3·46 times its average lateral dimension or whose effective length does not exceed twelve times its least radius of gyration, such as a short pier or plinth used as the base for a column.

2.130 Pedestal Pile — A cast-in-place concrete pile constructed so that concrete is forced out into a widened bulb or pedestal shape at the foot of the pipe which forms the pile.

2.131 Pier — Isolated foundation member of plain or reinforced concrete.

2.132 Pilaster — Column built within a wall, usually projecting beyond the wall.

2.133 Pilaster-Face — The form for the front surface of a pilaster parallel to the wall.

2.134 Pilaster Side — The form for the side surface of a pilaster perpendicular to the wall.

2.135 Pile — A long slender timber, concrete, or steel structural element, driven, jetted, or otherwise embedded on end in the ground for the purpose of supporting a load or of compacting the soil.

2.136 Pile Bent — Two or more piles driven in a row transverse to the long dimension of the structure and fastened together by capping and (sometimes) bracing.

2.137 Pile Cap

a) A structural member placed on, and usually fastened to, the top of a pile or a group of piles and used to transmit loads into the pile or group of piles and in the case of a group to connect them into a bent; also known as a rider cap or girder; also a masonry, timber, or concrete footing resting on a group of piles.

b) A metal cap or helmet temporarily fitted over the head of a precast pile to protect it during driving; some form of shock-absorbing material is often incorporated.

2.138 Pile Column — Column made of steel pipe; often filled with concrete.

2.139 Pipe Column, Concrete Filled — A metal pipe column filled with concrete, with or without reinforcement, designed to carry a portion of the column load.

2.140 Pipe Pile — A steel cylinder, usually between 250 and 600 mm in diameter, generally driven with open ends to firm bearing and then excavated and filled with concrete. This pile may consist of several sections from 1·5 to 8 m long joined by cast-steel sleeves or otherwise. Sometimes it is used with its lower end closed by a conical steel shoe.

2.141 Plane of Weakness — The plane along which a body under stress will tend to fracture; may exist by design, by accident, or because of the nature of the structure and its loading.

2.142 Plastic Centroid — Centroid of the resistance to load computed for the assumptions that the concrete is stressed uniformly to 0·85 its

design strength and the steel is stressed uniformly to its specified yield point.

2.143 Plastic Deformation — Deformation that does not disappear when the force causing the deformation is removed.

2.144 Plastic Design — *See* **2.227.**

2.145 Plastic Flow — *See* **2.49.**

2.146 Plasticity — A complex property of a material involving a combination of qualities of mobility and magnitude of yield value; that property of freshly mixed cement paste, concrete, or mortar which determines its resistance to deformation or ease of moulding.

2.147 Plastic Loss (Creep) — Time dependent deformation due to load.

2.148 Plate — In structural design; a member, the depth of which is substantially smaller than its length and width.

2.149 Point of Inflection — The point on the length of a structural member subjected to flexure at which the direction of curvature changes and at which the bending moment is zero; called also point of contraflexure; location of an abrupt bend in a plotted focus of points in a graph.

2.150 Poisson's Ratio — The ratio of transverse (lateral) strain to the corresponding axial (longitudinal) strain resulting from uniformly distributed axial stress below the proportional limit of the material; the value will average about 0·2 for concrete and 0·25 for most of the metals.

2.151 Positive Moment — In simple structures, flexural moment such as occurs in a simply supported beam under gravity loading; in complex and indeterminate structures, flexural moment of a sense determined by the particular sign convention (hardy cross or slope deflection) being used.

2.152 Precast Pile — A reinforced concrete pile manufactured in a casting plant or at the site but not in its final position.

2.153 Precompressed Zone — The area of a flexural member which is compressed by the prestressing tendons.

2.154 Proof Stress — The stress which is just sufficient to produce, under load, a non proportional elongation equal to a specified percentage of the original gauge length, conventionally the specified percentage is fixed at 0·1 or 0·2 percentage.

2.155 Proportional Limit — The greatest stress which a material is capable of developing without any deviation from proportionality of stress to strain (Hooke's Law).

2.156 Protected Corner — Corner of a slab with adequate provision for load transfer, such that at least 20 percent of the load from one slab corner to the corner of an adjacent slab is transferred by mechanical means or aggregate interlock.

2.157 Punching Shear

a) Shear stress calculated by dividing the load on a column by the product of its perimeter and the thickness of the base or cap or by the product of the perimeter taken at one-half the slab thickness away from the column and the thickness of the base or cap.

b) Failure of a base when a heavily loaded column punches a hole through it.

2.158 Raft Foundation — A continuous slab of concrete, usually reinforced, laid over soft ground or where heavy loads should be supported to form a foundation.

2.159 Resilience — The work done per unit volume of a material in producing strain.

2.160 Rib — One of a number of parallel structural members backing sheathing; the portion of a T-beam which projects below the slab; in deformed reinforcing bars, the deformations or the longitudinal parting ridge.

2.161 Ribbed Panel — A panel composed of a thin slab reinforced by a system of ribs in one or two directions, usually orthogonal.

2.162 Ribbed Slab — *See* **2.161.**

2.163 Rider Cap — *See* **2.137.**

2.164 Rigid Frame — A frame depending on moment in joints for stability.

2.165 Rigid Pavement — Pavement that will provide high bending resistance and distribute loads to foundation over a comparatively large area, for example, Portland cement concrete pavement, and bituminous brick, or stone-block pavement supported on Portland cement concrete base.

2.166 Secant Modulus — *See* **2.117.**

2.167 Secondary Moment — In statically indeterminate structures, the additional moments caused by deformation of the structure due to the applied forces.

2.168 Semiflexible Joint — A connection in which the reinforcement is arranged to permit some rotation of the joint.

2.169 Service Dead Load — The calculated dead weight supported by a member.

2.170 Service Live Load — The live load specified by the general building code, or the actual load applied in service.

2.171 Shear — An internal force tangential to the plane on which it acts.

2.172 Sheet Pile — A pile in the form of a plank driven in close contact with others to provide a tight wall to resist the lateral pressure of water, adjacent earth, or other materials; may be tongued and grooved if of timber or concrete and interlocking if made of metal.

2.173 Short Column — *See* **2.24.**

2.174 Shrinkage Reinforcement — Reinforcement designed to resist shrinkage stresses in concrete.

2.175 Simple Beam — A beam without restraint or continuity at its supports.

2.176 Slab — A flat, usually horizontal or nearly so, moulded layer of plain or reinforced concrete usually of uniform thickness, but sometimes of variable thickness, as the flat section of floor or roof either on the ground or supported by beams, columns, or other framework.

2.177 Slab Strip — *See* **2.114.**

2.178 Slenderness Ratio — The ratio of effective length or height of a wall or pier to effective thickness; or least radius of gyration used as a means of assessing the stability of a masonry wall or concrete panel or column.

2.179 Sloped Footing — A footing having sloping top or side faces.

2.180 Soil Pressure — *See* **2.39.**

2.181 Sonic Modulus — *See* **2.62.**

2.182 Span — The distance between supports of a flexural member.

2.183 Spandrel — A beam in the wall of a building.

2.184 Spirally Reinforced Column — A column in which the vertical bars are enveloped by spiral reinforcement; that is, closely spaced continuous hooping.

2.185 Splice — Connection of one reinforcing bar to another by overlapping, welding, mechanical end connectors, or other means.

2.186 Spread Footing — A generally rectangular prism of concrete larger in lateral dimensions than the column or wall it supports, to distribute the load of a column or wall to the subgrade.

2.187 Static Load — The weight of a single stationary body or the combined weights of all of the stationary bodies in a structure, such as the load of a stationary vehicle on a roadway; or, during construction, the weight of forms, stringers, joists, reinforcing bars, and the actual concrete to be placed.

2.188 Static Young's Modulus of Elasticity — The value of Young's modulus of elasticity obtained by arbitrary criteria from measured stress-strain relationships derived from other than dynamic loading.

2.189 Stepped Footing — A step-like support consisting of prisms of concrete of progressively diminishing lateral dimensions superimposed on each other to distribute the load of a column or wall to the subgrade.

2.190 Stiffness Factor — A measure of stiffness, indicated by the ratio of moment of inertia of the cross-section to the length of the member.

2.191 Straight-Line Theory — An assumption in reinforced-concrete analysis according to which the strains and stresses in a member under flexure are assumed to vary in proportion to the distance from the neutral axis.

2.192 Strain — Deformation of a material expressed as the ratio of linear unit deformation to the distance within which that deformation occurs.

2.193 Strength, Compressive — *See* **2.33.**

2.194 Strength, Creep — The stress that causes a given creep in a given time and at a specified temperature.

2.195 Strength, Fatigue — *See* **2.85.**

2.196 Strength, Shear — The maximum shearing stress which a material is capable of developing, based on the original area of cross-section.

2.197 Strength, Ultimate — *See* **2.226.**

2.198 Strength Yield — *See* **2.237.**

2.199 Stress — The intensity of the force developed per unit area within a body in resisting the forces acting on it; considered at a point within a plane passing through the body, stress may be divided into two components; normal stress acting perpendicular to the plane and shearing stress tangent to the plane.

2.200 Stress Corrosion — Corrosion of a metal accelerated by stress.

2.201 Stringer — A horizontal structural member supporting joists and resting on vertical supports.

2.202 Strip Footing — A combined continuous footing of prismatic or truncated shape supporting two columns in a row.

2.203 Strip Foundation — A continuous foundation of which the length considerably exceeds the breadth.

2.204 Strut — A member supporting an axial compressive load and having an effective length exceeding 12 times its least radius of gyration, or, if its cross-section is rectangular, 3·46 times its least lateral dimension (*see also* **2.20**).

2.205 Subgrade Reaction — *See* **2.39.**

2.206 Sustained Modulus of Elasticity — Term including elastic and inelastic effects in one expression to aid in visualizing net effects of stress-strain up to any given time; computed by dividing the unit sustained stress by the sum of the elastic and plastic deformations at that time.

2.207 Swaybrace — A diagonal brace used to resist wind or other lateral forces.

2.208 Tangent Modulus — *See* **2.117.**

2.209 T-Beam — A beam composed of a stem and a flange in the form of a 'T'.

2.210 Temperature Stress — Stress in a structure or a member due to changes or differentials in temperature in the structure or member.

2.211 Temporary Stress — A stress which may be produced in a precast concrete member or component of a precast concrete member during fabrication or erection, or in cast-in-place concrete structures due to construction or test loadings.

2.212 Tensile Strength — Maximum stress which a material is capable of resisting under axial tensile loading, based on the cross-sectional area of the specimen before loading.

2.213 Tensile Stress — Stress resulting from tension.

2.214 Test — A decisive trial, such as a controlled loading to failure of a specimen or a specified number of similar specimens.

2.215 T-Head — In precast framing a segment of girder crossing the top of an interior column; also the top of a shore formed with a braced horizontal member projecting on two sides forming a T-shaped assembly.

2.216 Thin-Shell Precast — Precast concrete characterized by thin slabs and web sections.

2.217 Tied Column — A column laterally reinforced with ties.

2.218 Tower — A composite structure of frames, braces, and accessories.

2.219 Transformed Section — A hypothetical section of one material arranged so as to have the same elastic properties as a section of two materials.

2.220 Transverse Strength — *See* **2.85** and **2.119.**

2.221 Two-Way Reinforced Footing — A footing having reinforcement in two directions generally perpendicular to each other.

2.222 Two-Way System — A system of reinforcement: bars, rods, or wires placed at right angles to each other in a slab and intended to resist stresses due to bending of the slab in two directions.

2.223 Ultimate Design Resisting Moment – The moment at which a section reaches its ultimate usable strength, most commonly the moment at which the tensile reinforcement reaches its specified yield strength.

2.224 Ultimate Load — The maximum load which may be placed on a structure before its failure due to buckling of column members or failure of some component; also the load at which a unit or structure fails.

2.225 Ultimate Shear Stress — The stress at a section which is loaded to its maximum in shear.

2.226 Ultimate Strength — The maximum resistance to load that a member or structure is capable of developing before failure occurs; or, with reference to cross-sections of members, the largest moment, axial force or shear a structural concrete cross-section will support.

2.227 Ultimate Strength Design — A method of proportioning structures of members for failure at a specified multiple of working loads, and assuming non-linear distribution of flexural stresses.

2.228 Unbraced Length of Column — Distance between adequate lateral supports.

2.229 Unprotected Corner — Corner of a slab with no adequate provision for load transfer, so that the corner should carry over 80 percent of the load.

2.230 Waffle — Square prefabricated pan form used in two-way concrete joist floor construction.

2.231 Wheel Load — The portion of the gross weight of a loaded vehicle transferred to a supporting structure under a given wheel of the vehicle.

2.232 Wing Pile — A bearing pile, usually of concrete, widened in the upper portion to form part of a sheet pile wall.

2.233 Working Stress — Maximum permissible design stress using working stress design methods.

2.234 Working Stress Design — A method of proportioning structures or members for prescribed working loads at stresses well below the ultimate, and assuming linear distribution of flexural stresses.

2.235 X-Brace — A pair of tension sway braces.

2.236 Yield Point — That point during increasing stress when the proportion of stress to strain becomes substantially less than it has been at smaller values of stress.

2.237 Yield Strength — The stress, less than the maximum attainable stress, at which the ratio of stress to strain has dropped well below it value at low stress, or at which a material exhibits a specified limitings deviation from the usually proportionality of stress to strain.

2.238 Yield Stress — Stress (that is, load per unit cross-sectional area) at which elongation first occurs in the test piece without increasing the load during tensile test. In the case of steels with no such definite yield point, the yield stress is the stress under the prescribed testing conditions at which the observed increase in the gauge length is 1/200 of the gauge length when the rate at which the load is applied is not more than 0·5 kg/mm^2/s when approaching the yield stress.

(*Continued from page* 2)

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