
1 Portland Cement Concrete Pavement Supervision

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CHAPTER ONE:

PORTLAND CEMENT CONCRETE PAVEMENT SUPERVISION

The purpose of this course is to provide information on how to properly construct Portland Cement Concrete Pavement (PCCP). Emphasis will be on acquiring the skills and knowledge that a PCCP Field Supervisor will need to supervise and ensure construction of quality pavements in conformance with the plans and specifications. The construction of smooth, durable, and safe highways requires careful planning and continuous monitoring.

This manual is intended to provide the best practices for the Certified PCCP Field Supervisor. Many of the techniques, procedures, and methods provided are not applicable to all pavement circumstances, and other methods may be used to meet the requirements of the specifications. The manual is not to be considered part of the specifications or override the specifications or contract documents.

PREREQUISITES

A PCCP Field Supervisor should have knowledge of the following items prior to taking this course.

- 1) INDOT Standard Specifications
- 2) Indiana Test Method 803 (Appendix A)
- 3) PCCP paving processes and methods
- 4) Paving equipment operations
- 5) Pavement deficiencies and how to correct these problems
- 6) Plans and contract Special Provisions
- 7) Profilographs
- 8) OSHA 10 or OSHA 30 training course on traffic and safety
- 9) Certified Worksite Traffic Supervisor (CWTS) requirements

DUTIES

The general duties of a PCCP Field Supervisor are contained within **Sections 105, 305, and 500**. These duties may be designated to other personnel on the project. The duties are summarized as follows:

- 1) Provide all work and materials in reasonably close conformance with the plans and specifications (Section **105.03**)
- 2) For work conducted in accordance with Sections **305, and 500**, serve as the Contractors “competent superintendent” (Section **105.05**)
- 3) Be responsible to recognize and furnish acceptable materials and perform all work in accordance with the requirements of plans and specifications (Section **105.09**)
- 4) Keep the Project Engineer or Project Supervisor (PE/PS) informed as to the schedule of the work, the progress of the work and the manner in which the work is being performed (Sections **108.04, 108.05, 108.06 and 108.07**)
- 5) Be knowledgeable of the Construction Requirement Sections of **501, 502, 503, 504, 505, 506, 507, and 508**
- 6) Complete the Paving Quality Control Plan (QCP) in accordance with ITM 803 (See Appendix A) and perform the work in accordance with the QCP
- 7) Be knowledgeable of and implement the maintenance of traffic plan in accordance with Section **801.03** for the PCCP operations
- 8) Be responsible for constructing PCCP meeting the plans and specifications for the contract.

CHAIN OF COMMAND

Every organization has a number of management levels, each with their own assigned authority and responsibility. The chain of command within INDOT and the Contractor should be known and followed. Working through the chain usually minimizes problems and maintains cooperation.

INDOT PROJECT/DISTRICT LEVEL

The levels of management in the field include:

- 1) PCCP Technician/Inspector
- 2) Project Engineer/Project Supervisor
- 3) District Area Engineer
- 4) District Construction Engineer
- 5) District Deputy Commissioner

When there are major problems on the contract, such as equipment breakdown or non-routine questions or requests, the PE/PS is contacted. If the problem is urgent and the PE/PS is not available, the Area Engineer is contacted.

CENTRAL OFFICE

Each District Construction Director has a Central Office Construction Field Engineer to provide guidance concerning PCCP operations. The Field Engineers are each assigned a construction specialty and work in the Construction Management Division of INDOT.

CONTRACTOR

A typical Contractor organization may include:

- 1) The crafts -- operators, carpenters, laborers
- 2) Field Quality Control Technicians
- 3) Job Foremen/Paving Foremen

- 4) PCCP Field Supervisor. This position is responsible for communication occurring between the PCCP field operations and the PCCP plant in accordance with the QCP.
- 5) Job Superintendent
- 6) General Superintendent/Project Manager
- 7) Executive

SAFETY

The PCCP Field Supervisor is required to be concerned with the safety of the traveling public, INDOT employees, and the Contractor's work force, as well as their own safety. Although many safety devices and procedures have been established to provide a safe construction work zone, various hazards still exist. These hazards are required to be identified and the necessary safety precautions taken to prevent injuries and accidents.

HAZARDS

Safety hazards that are present every day for inspecting PCCP include:

Equipment

<u>Type of Equipment</u>	<u>Potential Hazard</u>
Trucks	Dump bed operation Climbing on side of bed to check concrete Overhead power lines
Pavers	Clothing catches causing injuries
Air hammers	Flying debris and dust
Hand tools	Long handles
Vehicle and Equipment fires	Burns

Materials

<u>Type of Material</u>	<u>Potential Hazard</u>
Fresh concrete	skin irritation and burns

Traffic

<u>Type of Traffic</u>	<u>Potential Hazard</u>
Traveling public through or adjacent to the work zone	Being hit
Construction traffic	Being hit

POSSIBLE INJURIES

Safety hazards may result in accidents which cause injuries or death. The possible injuries that may occur are:

<u>Part of Body</u>	<u>Possible Injury</u>
Eyes	Concrete splatter
Hands and arms	Cuts and lacerations Bruises and abrasions
Body	Falls Bruises Electrocution Serious, extensive and possibly fatal injuries if run over
Feet	Blisters Burns Bruises

SAFETY PRECAUTIONS

Dress

Clothing

Full-length trousers and shirts should be worn. Loose jackets, shirts, or pants are never worn because of the danger of getting caught in moving parts.

Shoes

Work type leather boots with non-skid soles and steel toes are required to be worn. Tennis shoes do not provide adequate foot protection and are not worn. When working with concrete, rubber boots should be worn.

Safety Vests

Type III Fluorescent vests, t shirts, and hardhats, are required to be worn at all times while engaged in operations upon or adjacent to a highway construction and public traffic.

Safety vests and caps are bright colored so that equipment operators and motorists are more likely to see them.

The vest may get caught on equipment and/or other projections, and should be properly adjusted to minimize snagging.

Safety Equipment

Hard Hats

Hardhats should be worn in accordance with OSHA and Contractor safety policies.

Specifically, hard hats are required to be worn when an employee is on any worksite where overhead equipment, such as cranes, backhoes, loaders, or other large equipment (as deemed necessary by the Supervisor), is considered a part of the worksite.

When bending over, the hard hat may fall off or get blown off. Care is taken in making any sudden movement to recover the hat as a safety hazard may exist. A hat strap may be attached to hold the hat on.

Seat Belts

All operators and occupants of Contractor and INDOT vehicles are required to wear the complete seat belt assembly of the vehicle.

Safety Glasses

Safety glasses are available and worn when there is any possibility of damaging the eyes.

Gloves

When climbing on the truck and conducting other similar tasks, gloves are worn.

Ear Plugs

Ear protection may be needed if jackhammers or other loud noises are prevalent.

Minimizing Exposure

The risk of having an accident that results in injury may be minimized by following these precautions:

- 1) When climbing onto a truck or equipment, use the steps and hand holds when they are available with the 3 contact mounting and dismounting method
- 2) Do not climb onto truck/equipment, unless absolutely necessary to do so
- 3) Inform the driver/operator before climbing on the truck/equipment
- 4) Be alert to changes in the conditions on the contract that affect safety hazards. One example is one-way traffic versus two-way traffic.
- 5) Park vehicles out of the way of the traffic

Pertinent Information

Fires

Fires on the contract or in the field office are not common, but may occur. Basic fire suppression, the locations of fire extinguishers, and how to operate the fire extinguishers is required to be known.

First Aid

The proper treatment of minor cuts and burns not only reduces the irritation but also reduces the chance of infection and more serious complications. Basic methods of treatment and the location of the first aid kit are required to be known.

Emergencies

Emergency situations may arise that require contacting aid. At the start of the contract, the location and phone number or best method to contact a medical facility, an ambulance, the fire department, and the State Police are required to be identified.

TERMS RELATED TO PCCP

AASHTO - American Association of State Highway and Transportation Officials

Absorption - The amount of water absorbed under specific conditions, usually expressed as a percentage of the dry weight of the material; the process by which the water is absorbed.

Accelerator - An admixture which, when added to concrete, mortar, or grout, increases the rate of hydration of hydraulic cement, shortens the time of set, or increases the rate of hardening or strength development.

ACI - American Concrete Institute

ACPA - American Concrete Pavement Association

Admixture - A material other than water, aggregates, and portland cement (including air-entraining portland cement, and portland blast furnace slag cement) that is used as an ingredient of concrete and is added to the batch before and during the mixing operation

Agitating Truck - A vehicle in which freshly mixed concrete can be conveyed from the point of mixing to that of placing; while being agitated, the truck body may either be stationary and contain an agitator or may be a drum rotated continuously so as to agitate the contents

Air Content - The amount of air in mortar or concrete, exclusive of pore space in the aggregate particles, usually expressed as a percentage of total volume of mortar or concrete

Air-Entraining Admixture - An addition for concrete which causes air, usually in small quantity, to be incorporated in the form of minute bubbles in the concrete during mixing, usually to increase its workability and frost resistance. An entrapped air void is characteristically 1 mm or more in width and irregular in shape whereas an entrained air void is typically between 10 and 1000 μm in diameter and spherical or nearly so

Air-Entrainment - The inclusion of air in the form of minute bubbles during the mixing of concrete or mortar

Alkali-Silica Reaction - The reaction between the alkalis (sodium and potassium) in portland cement binder and certain siliceous rocks or minerals, such as opaline chert, strained quartz, and acidic volcanic glass, present in some aggregates; the products of the reaction may cause abnormal expansion and cracking of concrete in service

ASTM - American Society for Testing and Materials

Backer Rod - Foam cord that inserts into a joint sealant reservoir and is used to shape a liquid joint sealant and prevent sealant from adhering to or flowing out of the bottom of the reservoir

Bag (of cement) - A quantity of cement; 42.6 kg in the United States; portland or air-entraining portland cement, or as indicated on the bag for other kinds of cement

Base Course - A layer of specified select material of planned thickness constructed on the subgrade or subbase below a pavement to serve one or more functions such as distributing loads, providing drainage, minimizing frost action, or facilitating pavement construction

Bleeding - The self-generated flow of mixing water within, or its emergence from, freshly placed concrete or mortar

Blistering - The irregular rising of a thin layer of placed mortar or concrete at the surface during or soon after completion of the finished operation

Bulk Specific Gravity - The ratio of the weight in air of a given volume of a permeable material (including both permeable and impermeable voids normal to the material) at a stated temperature to the weight in air of an equal volume of distilled water at the same temperature

Bulk Specific Gravity (Saturated Surface Dry (SSD)) – The ratio of the weight of a volume of a material including the weight of water within the pores in the material (but excluding the voids between particles) at a stated temperature, to the weight of an equal volume of distilled water at a stated temperature

Bull Float - A tool comprising a large, flat, rectangular piece of wood, aluminum, or magnesium usually 8 in. wide and 39 to 60 in. long, and a handle 1.1 to 5.5 yd in length used to smooth unformed surfaces of freshly placed concrete

Burlap - A coarse fabric of jute, hemp, or less commonly flax, for use as a water-retaining cover for curing concrete surfaces; also called Hessian

Burlap Drag - Surface texture achieved by trailing moistened coarse burlap from a device that allows control of the time and rate of texturing

California Profilograph - Rolling straight edge tool used for evaluating pavement profile (smoothness) consisting of a 25-ft frame with a sensing wheel located at the center of the frame that senses and records bumps and dips on graph paper or in a computer

Cement, Blended - A hydraulic cement consisting essentially of an intimate and uniform blend of granulated blast-furnace slag and hydrated lime; or an intimate and uniform blend of portland cement and granulated blast-furnace slag cement and pozzolan, produced by intergrinding Portland cement clinker with the other materials or by blending Portland cement with the other materials, or a combination of intergrinding and blending

Cement, High Early-Strength - Cement characterized by producing earlier strength in mortar or concrete than regular cement, referred to in as Type III.

Cementitious Materials - Substances that have hydraulic cementing properties (set and harden in the presence of water); includes ground, granulated blast-furnace slag, natural cement, hydraulic hydrated lime, and combinations of these and other materials

Central Mixer - A stationary concrete mixer from which the fresh concrete is transported to the work

Certified Material - An aggregate product produced in accordance with the Certified Aggregate Producer Program (CAPP) for INDOT use

Certified Aggregate Producer - A Plant/Redistribution Terminal that meets the requirements of ITM 211, continues to be under the same ownership, and is approved by INDOT

Coarse Aggregate - Aggregate that has a minimum of 20 percent retained on the No. 4 (4.75 mm) sieve

Cohesiveness - The property of a concrete mix which enables the aggregate particles and cement paste matrix therein to remain in contact with each other during mixing, handling, and placing operations; the “stick-togetherness” of the concrete at a given slump

Compressive Strength - The measured resistance of a concrete or mortar specimen to axial loading; expressed as pounds per square inch (psi) of cross-sectional area

Consistency - The relative mobility or ability of fresh concrete or mortar to flow. The usual measures of consistency are slump or ball penetration for concrete and flow for mortar

Construction Joint - The junction of two successive placements of concrete, typically with a keyway or reinforcement across the joint

Continuously Reinforced Pavement - A pavement with continuous longitudinal steel reinforcement and no intermediate transverse expansion or contraction joints

Contraction Joint - A plane, usually vertical, separating concrete in a pavement, at a designated location such as to prevent formation of objectionable shrinkage cracks elsewhere in the concrete. Reinforcing steel is discontinuous.

Crack Saw - Small three-wheeled specialty saw useful for tracing the wandering nature of a transverse or longitudinal crack; usually contains a pivot wheel and requires a small diameter crack sawing blade.

CRC Pavement (CRCP) - Continuously reinforced concrete pavement

Curing - The maintenance of a satisfactory moisture content and temperature in concrete during its early stages so that desired properties may develop

Curing Blanket - A built-up covering of sacks, matting, Hessian, straw, waterproof paper, or other suitable material placed over freshly finished concrete

Curing Compound - A liquid that can be applied as a coating to the surface of newly placed concrete to retard the loss of water

D-Cracking – a series of cracks near to and roughly parallel to features such as joints, edges, and structural cracks

DTE – District Testing Engineer

Deformed Bar - A reinforcing bar with a manufactured pattern of surface ridges that provide a locking anchorage with surrounding concrete

Diamond Grinding - The process used to remove the upper surface of a concrete pavement to remove bumps and restore pavement rideability

Dispersing Agent - admixtures capable of increasing the fluidity of pastes, mortar or concretes by reduction of inter-particle attraction

Dowel:

- 1) A load transfer device, commonly a plain round steel bar, which extends into two adjoining portions of a concrete construction, as at a joint in a pavement slab, so as to transfer shear loads
- 2) A deformed reinforcing bar intended to transmit tension, compression, or shear through a construction joint.

Durability - The ability of concrete to remain unchanged while in service; resistance to weathering action, chemical attack, and abrasion

Early Strength - Strength of concrete developed soon after placement, usually during the first 72 hours

Efflorescence - Deposit of calcium carbonate (or other salts), usually white in color, appearing upon the surface or found within the near-surface pores of concrete. The salts deposit on concrete upon evaporation of water that carries the dissolved salts through the concrete toward exposed surfaces.

Entrained Air - Round, uniformly distributed, microscopic, non-coalescing air bubbles entrained by the use of air-entraining agents; usually less than 1 mm (.04 in.) in size

Entrapped Air - air in concrete that is not purposely entrained. Entrapped air is generally considered to be large voids (larger than .04 in.)

Equivalent Single Axle Load (ESAL) – The effect on pavement performance of any combination of axle loads of varying magnitude equated to the number of 80-kN (18,000-lb.) single-axle loads that are required to produce an equivalent effect

Faulting - Differential vertical displacement of a slab or other member adjacent to a joint or crack

Fine Aggregate - Aggregate that is 100 percent passing the 3/8 in. (9.5 mm) sieve and a minimum of 80 percent passing the No. 4 (4.75 mm) sieve

Fineness Modulus – a factor obtained by adding the percentages of material in the sample that is coarser than each of the following sieves (cumulative percentages retained), and dividing the sum by 100: No. 100, No. 50, No. 30, No. 16, No. 8, No.4, 3/8 in., 3/4 in., 1 ½ in., and 3 in.

Flexural Strength - A property of a material or structural member that indicates the ability to resist failure in bending

Float - A tool usually of wood, aluminum, or magnesium, used in finishing operations to impart a relatively even but still open texture to an unformed fresh concrete surface

Fly Ash - The finely divided residue resulting from the combustion of ground or powdered coal and which is transported from the fire box through the boiler by flu gasses; used as mineral admixture in concrete mixtures

Grooving - The process used to cut slots into a concrete pavement surface to provide channels for water to escape beneath tires and to promote skid resistance

Hairline Cracking - Barely visible cracks in random pattern in an exposed concrete surface which do not extend to the full depth or thickness of the concrete, and which are due primarily to drying shrinkage

Hardening - When portland cement is mixed with enough water to form a paste, the compounds of the cement react with water to form cementitious products that adhere to each other and to the intermixed sand and stone particles and become very hard. As long as moisture is present, the reaction may continue for years, adding continually to the strength of the mixture.

Harshness - Deficient workability and cohesiveness caused by insufficient sand or cement, or by improperly graded aggregate

Header - A transverse construction joint installed at the end of a paving operation or other placement interruptions. To a Contractor, a header is the location at which paving will resume on the next day.

Heat of Hydration - Heat evolved by chemical reactions of a substance with water, such as that evolved during the setting and hardening of portland cement

High Early-Strength Concrete - Concrete that, through the use of high-early-strength cement or admixtures, is capable of attaining specified strength at an earlier age than normal concrete

Honeycomb - Concrete that, due to lack of the proper amount of fines or vibration, contains abundant interconnected large voids or cavities; concrete that contains honeycombs was improperly consolidated.

Hydration - The chemical reaction between cement and water which causes concrete to harden

Jointed Plain Concrete Pavement (JPCP) - Pavement containing enough joints to control all natural cracks expected in the concrete; steel tiebars are generally used at longitudinal joints to prevent joint opening, and dowel bars may be used to enhance load transfer at transverse contraction joints depending upon the expected traffic.

Jointed Reinforced Concrete Pavement (JRCP) - Pavement containing some joints and embedded steel mesh reinforcement to control expected cracks; steel mesh is discontinued at transverse joint locations.

Keyway - A recess or groove in one lift or placement of concrete, which is filled with concrete of the next lift, giving shear strength to the joint

Load-Transfer Assembly - Most commonly, the basket or carriage designed to support or link dowel bars during concreting operations so as to hold them in place, in the desired alignment

Longitudinal Joint - A joint parallel to the long dimension of a structure or pavement

Map Cracking:

- 1) Intersecting cracks that extend below the surface of hardened concrete; caused by shrinkage of the drying surface concrete which is restrained by concrete at greater depths where either little or no shrinkage occurs; vary in width from fine and barely visible to open and well-defined

2) The chief symptom of chemical reaction between alkalis in cement and mineral constituents in aggregate within hardened concrete; due to differential rate of volume change in different portions of the concrete; cracking is usually random and on a fairly large scale, and in severe instances the cracks may reach a width of ½-in.

Maturity – The extent of the development of a property of a cementitious mixture. Maturity is usually used to describe the extent of relative strength development of concrete. The term may also be applied to the evolution of other properties which are dependent on the chemical reactions which occur in cementitious materials. At any age, maturity is dependent on the curing history.

Maximum Particle Size - The sieve on which 100 percent of the material will pass

Membrane Curing - A process that involves either liquid sealing compound or non-liquid protective coating (e.g., sheet plastics or “waterproof” paper), both of which types function as films to restrict evaporation of mixing water from the fresh concrete surface

Mixing Time - The period during which the mixer is combining the ingredients for a batch of concrete. For stationary mixers, the time is measured from the completion of batching cement and aggregate until the beginning of discharge. For truck mixers, mixing is given in terms of the number of revolutions of the drum at mixing speed.

Modulus of Rupture - A measure of the ultimate load-carrying capacity of a beam, sometimes referred to as “rupture modulus” or “rupture strength.” This value is calculated for apparent tensile stress in the extreme fiber of a transverse test specimen under the load that produces rupture.

Moist - Slightly damp but not quite dry to the touch; the term “wet” implies visible free water, “damp” implies less wetness than “wet,” and “moist” implies not quite dry

Mortar - Concrete with essentially no aggregate larger than about 3/16 in.

NCHRP - National Cooperative Highway Research Program

NHI - National Highway Institute

NRMCA - National Ready Mixed Concrete Association

Nominal Maximum Particle Size - The smallest sieve opening through which the entire amount of the aggregate is permitted to pass

Open-Graded Subbase - Unstabilized layer consisting of crushed aggregates with a reduced amount of fines to promote drainage

PCA - Portland Cement Association

PCC - Portland Cement Concrete

Pitting - A localized disintegration taking the form of cavities at the surface of concrete.

Plastic Shrinkage Cracking - Cracks, usually parallel and only a few inches deep and several feet long, in the surface of concrete pavement that are the result of rapid moisture loss through evaporation

Popout - Pit or crater in the surface of concrete resulting from cracking of the mortar due to expansive forces associated with a particle of unsound aggregate or a contaminating material, such as wood or glass

Portland Cement - A commercial product which when mixed with water alone or in combination with sand, stone, or similar materials, has the property of combining with water, slowly, to form a hard solid mass. Physically, portland cement is a finely pulverized clinker produced by burning mixtures containing lime, iron, alumina, and silica at high temperature and in definite proportions, and then intergrinding gypsum to give the properties desired.

Pozzolan - A siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties

Process Control - Those quality assurance actions and considerations necessary to assess production and construction processes so as to control the level of quality being produced in the end product. This includes sampling and testing to monitor the process but usually does not include acceptance sampling and testing.

Pumping - The forceful displacement of a mixture of soil and water that occurs under slab joints, cracks and pavement edges which are depressed and released quickly by high-speed heavy vehicle loads; occurs when concrete pavements are placed directly on fine-grained, plastic soils or erodible subbase materials

Quality Assurance - Planned and systematic actions by an owner or his representative to provide confidence that a product or facility meet applicable standards of good practice. This involves continued evaluation of design, plan and specification development, contract advertisement and award, construction, and maintenance, and the interaction of these activities.

Quality Assurance/Quality Control Specification - Statistically based specification that is a combination of end result and material and method specifications. The Contractor is responsible for quality control (process control), and the highway agency is responsible for acceptance of the product.

Quality Control - Actions taken by a Producer or Contractor to provide control over what is being done and what is being provided so that the applicable standards of good practice for the work are followed

Quality Control Plan (QCP) - A document written by the Contractor that is contract-specific and includes the policies, and procedures used by the Contractor

Qualified Technician - An individual who has successfully completed the written and proficiency testing requirements of the Department Qualified Laboratory and Technician Program

Raveling - Displacement of aggregate or paste near the slab surface from sawing; normally indicates that concrete strength is too low for sawing

Release Agent - Material used to prevent bonding of concrete to a surface

Retardation - Reduction in the rate of hardening or strength development of fresh concrete, mortar, or grout; i.e., an increase in the time required to reach initial and final set

Saturated Surface-Dry - Condition of an aggregate particle or other porous solid when the permeable voids are filled with water but there is no water on the exposed surface

Sawed Joint - A joint cut in hardened concrete, generally not to the full depth of the member, by means of special equipment

Sawing - Cutting of joints in hardened concrete by means of special equipment utilizing diamond or silicon carbide blades or discs; cut goes only part way through the slab

Scaling - Flaking or peeling away of the near-surface portion of hydraulic cement concrete or mortar

Screed:

- 1) To strike off concrete lying above the desired plane or shape
- 2) A tool for striking off the concrete surface, sometimes referred to as a Strikeoff

Segregation - The tendency, as concrete is caused to flow laterally, for coarse aggregate and drier material to remain behind and for mortar and wetter material to flow ahead. This also occurs in a vertical direction when wet concrete is over-vibrated, the mortar and wetter material rising to the top. In the vertical direction, segregation may also be called Stratification.

Shrinkage Crack - Crack from restraint of volume reduction due to shrinkage or temperature contraction; usually occurring within the first few days after placement.

Slump - A measure of consistency of freshly mixed concrete, equal to the subsidence measured to the nearest 1/4-in. of the molded specimen immediately after removal of the slump cone

Soundness - In the case of cement, freedom from large expansion after setting. In the case of aggregate, the ability to withstand aggressive conditions to which concrete containing the aggregate might be exposed, particularly those due to weather.

Spalling, Surface - Cracking, breaking, chipping, or fraying of slab surface; usually within a confined area less than 0.5 square meters

Specific Gravity - The ratio of the weight in air of a given volume of material at a stated temperature to the weight in air of an equal volume of distilled water at the same temperature

Stratification - The separation of over-wet or over-vibrated concrete into horizontal layers with increasingly lighter material toward the top; water, laitance, mortar, and coarse aggregate will tend to occupy successively lower positions (in that order)

Subbase - A layer in a pavement system between the subgrade and base course or between the subgrade and a portland cement concrete pavement.

Subgrade - The soil prepared to support a pavement structure or a pavement system. The subgrade is the foundation of the pavement structure.

Structural Backfill - Suitable sand, gravel, crushed stone, air-cooled blast furnace slag, or granulated blast furnace slag used to fill designated areas excavated for structures that are not occupied by permanent work

Transit-Mixed Concrete - Concrete, the mixing of which is wholly or principally accomplished in a truck mixer

Water-Cementitious Materials Ratio - The ratio of the amount of water, exclusive only of that absorbed by the aggregates, to the amount of portland cement and other cementitious material (fly ash, pozzolan, etc.) in a concrete or mortar mixture; preferably stated as a decimal by weight

Water-Reducing Admixture - A material that either increases slump of freshly mixed mortar or concrete without increasing water content or maintains a workability with a reduced amount of water, the effect being due to factors other than air entrainment; also know as water reducer

Water-Reducing Admixture (High Range) - A water-reducing admixture capable of producing large water or great flowability without causing undue set retardation or entrainment of air in mortar or concrete

Workability - The property of freshly mixed concrete or mortar which determines the ease and homogeneity with which concrete may be mixed, placed, compacted, and finished

Yield - The volume of fresh concrete produced from a known quantity of ingredients; the total weight of ingredients divided by the unit weight of the freshly mixed concrete

PAVEMENT DESCRIPTION

A rigid pavement such as PCCP is designed to resist bending and not crack under the traffic load. The strength of the pavement structure or soil conditions under the rigid surface are usually of lesser concern because a surface rigid enough to prevent deflection will adequately distribute loads to the existing soil (Figure 1-1).

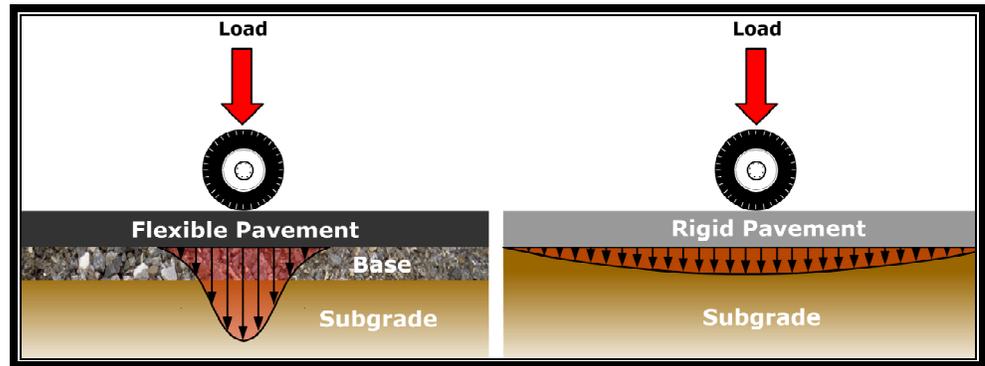


Figure 1-1. Load Distribution

PCCP is composed of Portland cement concrete and, when specified, reinforcing steel and various joint materials. The basic components of a concrete pavement are illustrated in Figure 1-2

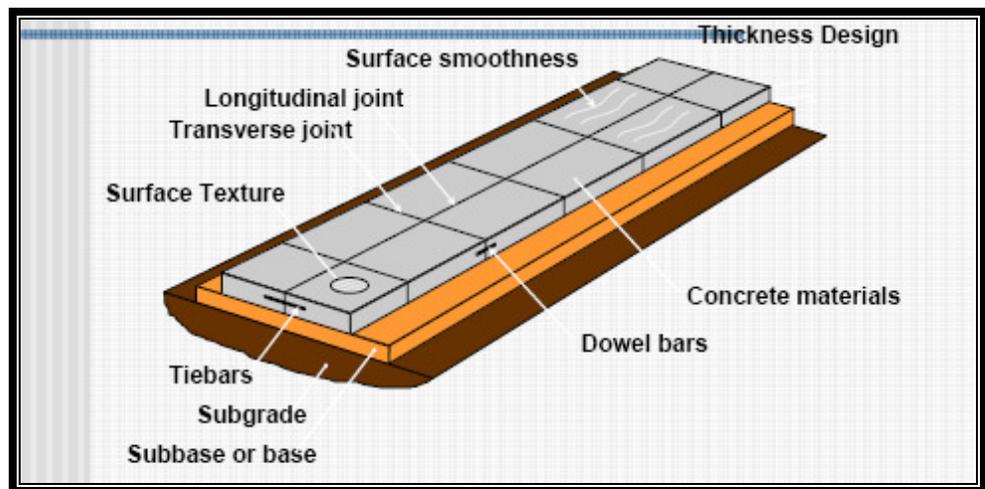


Figure 1-2. Basic Components of Concrete Pavement

Concrete pavement is placed at the thickness specified in the plans or proposal and is constructed on a prepared subgrade and subbase course. The pavement is placed in reasonably close conformance to the lines, grades, and typical cross-sections shown in the plans.

Concrete basically consists of Portland cement, water, and fine and coarse aggregates. The curing of the concrete is a chemical reaction of the Portland cement and water, which causes the concrete to shrink and crack. To control the cracking, transverse joints and longitudinal joints are constructed in the pavement. All pavements require transverse joints to control transverse cracking. These are sometimes known as contraction joints. Pavements wider than 16 ft require longitudinal joints to control longitudinal cracking. Pavements with transverse joints are referred to as pavements with joints or jointed pavements. There are several types of concrete pavements and requirements for their corresponding contraction joints.

TYPES OF CONCRETE PAVEMENT

PLAIN CONCRETE PAVEMENT

Plain concrete pavement is constructed of only concrete with no reinforcement or joints and is used mainly for base widening of an existing pavement. This pavement is used in conjunction with a Hot Mix Asphalt (HMA) overlay. Uncontrolled random cracking as shown in Figure 1-3, occurs in this type of pavement.

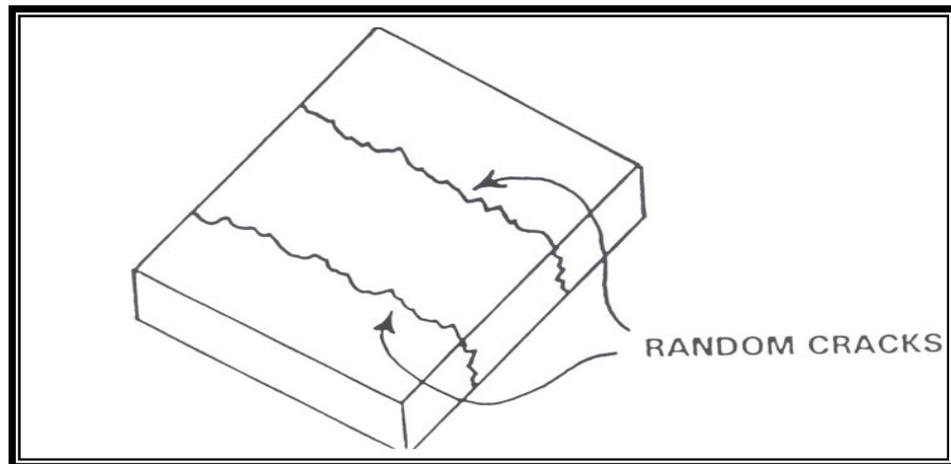


Figure 1-3. Random Cracks in Plain Concrete Pavement

PLAIN CONCRETE PAVEMENT WITH JOINTS

Plain concrete pavement with joints has no reinforcing steel but is constructed with various transverse joint spacing (joints from edge of pavement to edge of pavement). The types of joints used in plain concrete are shown in Figure 1-4. Nearly all of the concrete pavements constructed by INDOT are of this type.

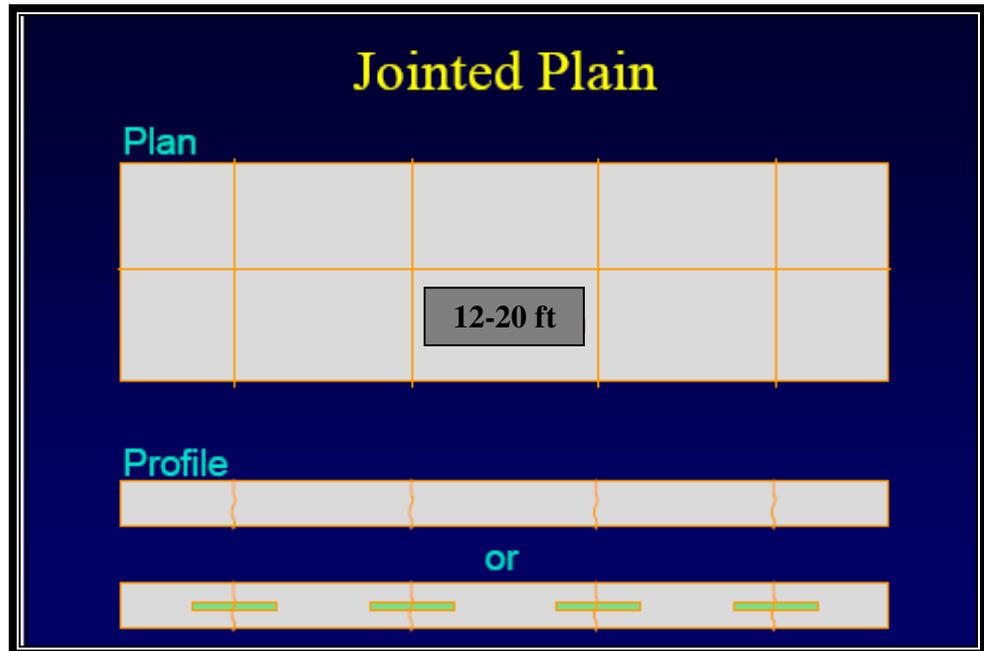


Figure 1-4. Plain Concrete Pavement with Joints

REINFORCED CONCRETE PAVEMENT WITH JOINTS

Reinforced concrete pavement with joints (Figure 1-5) is pavement reinforced with steel mesh and is built with transverse joint spacing of 40 ft.

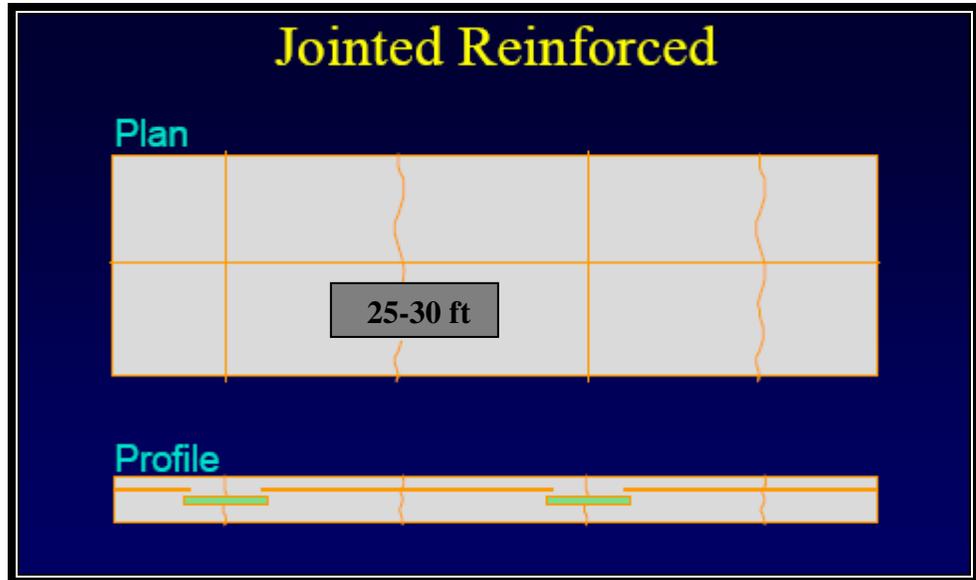


Figure 1-5. Reinforced Concrete Pavement with Joints

CONTINUOUSLY REINFORCED CONCRETE PAVEMENT

Continuously reinforced concrete (CRC) pavement (Figure 1-6) is reinforced with a large amount of longitudinal steel (No. 5 bars, 6 inches on center) and only longitudinal joints as required. There are no transverse joints in this type of pavement.

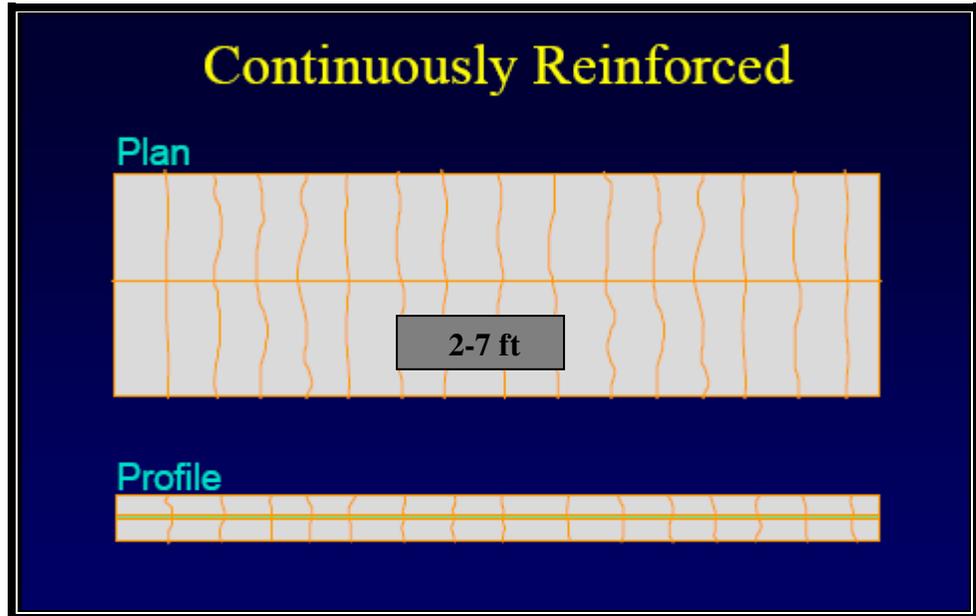


Figure 1-6. Continuously Reinforced Concrete Pavement