Types of Concrete Pavements

The first concrete road was built in 1893 in Bellefontaine, OH and it is still in service today. Since that pioneering project, concrete pavements have been refined into five primary types:

- Jointed plain concrete pavement (JPCP)
- Jointed reinforced concrete pavement (JRCP)
- Continuously reinforced concrete pavement (CRCP)
- Pervious concrete pavement
- Roller-compacted concrete (RCC) pavement

The one item that distinguishes between JPCP, JRCP, and CRCP is the jointing system used to control crack development. Pervious concrete pavement and RCC use different materials and construction methods than pervious concrete pavement and RCC, and pervious concrete pavement offer stormwater management benefits.

JPCP, the type of new concrete pavement that can be designed using StreetPave, is the most concrete pavement type specified by highway agencies in the U.S. and Canada (Figure 1).

Figure 1. Percent of new concrete pavement construction by state agencies that is JPCP, JRCP, or CRCP (ACPA 2005 Survey of State Agencies http://apps.acpa.org/apps/APDPass.aspx).
Controlling Cracking and Providing Load Transfer

Crack development in concrete pavements is a complex subject. It is important to know that, for various reasons, concrete shrinks, contracts and expands, and bends from applied and environmental loads; these actions can induce cracks. It is equally important to know that this natural cracking can be easily controlled by the appropriate use of joints and/or reinforcing steel and load transfer devices within the pavement.

*Jointed plain concrete pavements (JPCP)* contain enough joints to control the location all of the expected natural cracks. All necessary cracking occurs at joints and not elsewhere in the slabs. JPCP do not contain any steel reinforcement. However, there may be load transfer devices (e.g., dowel bars) at transverse joints and deformed steel bars (e.g., tiebars) at longitudinal joints. The spacing between transverse joints is typically about 15 feet for slabs 7-12 inches thick.

*Jointed reinforced concrete pavements (JRCP)* contain steel mesh reinforcement (sometimes called distributed steel). In JRCP, designers intentionally increase the joint spacing and include reinforcing steel to hold together mid-panel cracks. The spacing between transverse joints is typically 30 feet or more. Because of performance issues caused by the embedded steel being incapable of holding together mid-panel cracking and the resultant erosion/faulting of such cracks that include no load transfer devices and other joint-related issues, only a handful of agencies still employ JPCP designs.
**Continuously reinforced concrete pavements (CRCP)** do not require any transverse contraction joints. Transverse cracks are expected in the slab, usually at intervals of 3-5 feet. CRCP is designed with enough steel (approximately 0.6-0.7% by cross-sectional area) so that cracks are held together tightly. Determining an appropriate spacing between the cracks is part of the design process for this type of pavement. CRCP designs generally cost more than JPCP or JRCP designs initially due to increased quantities of steel. However, they can demonstrate superior long-term performance and cost-effectiveness. A number of agencies choose to use CRCP designs in their heavy urban traffic corridors.

![Overhead View](image)

*Cracks 1.5 - 6.0 ft apart*

*Controlled Cracks*

*Reinforcing Steel (Embedded)*

**Pervious concrete pavements** include no embedded steel or load transfer devices; such pavements do not fail by erosion/faulting (see this PDF for more details on pervious concrete design theories: [http://www.acpa.org/PerviousPave/About%20PerviousPave.pdf](http://www.acpa.org/PerviousPave/About%20PerviousPave.pdf)). Joints may or may not be formed into the concrete before it has set or cracks may be allowed to develop naturally.

**Roller compacted concrete (RCC) pavements** also do not include embedded steel or load transfer devices and typically are not jointed. Load transfer is provided in an RCC pavement by way of enhanced aggregate interlocked developed due to the compaction of the fresh concrete.

**Concrete Overlays**

With the exception of pervious concrete pavement, which relies on drainage through its subbase and into the subgrade to function properly, all types of concrete pavements can be used as overlays of existing concrete, asphalt, or composite pavements. Even though the first concrete overlays date back to the early 1910s and at least 375 concrete overlays had been constructed by 1981, the use of concrete overlays did not become a nationally accepted practice until the mid-2000s. Tightening budgets and increases in the cost and volatility of asphalt led engineers to look for a long-term cost-effective and sustainable solution, which they found in the form of concrete overlays; concrete overlays can be designed for service lives of 5-30+years and such increases in remaining service life of the roadway section are accomplished without costly reconstruction of the section. As of 2004, the total square yards of concrete overlays thinner than 6 inches in the United States was approximately 1.2 million. Due largely to a sustained education and implementation effort by industry and FHWA, the widespread adoption of thin concrete overlay technologies across the country led to over 8 million square yards of concrete overlays thinner than 6 inches having been constructed in 2009 and 2010 (Figure 2).
Concrete Pavement Basics

Concrete Pavement and Overlay Design Software

ACPA offers a variety of concrete pavement and overlay thickness design software, including:

- StreetPave (streets, roads, highways): JPCP; JPCP Overlays
- AirPave (airfields, industrial): JPCP
- WinPAS (roads, highways; based on AASHTO 93 Method): JPCP; JPCP Overlays
- PerviousPave: Pervious concrete pavement
- apps.acpa.org: Bonded Concrete Overlay on Asphalt (BCOA) Calculator

Other commercially available concrete pavement and overlay thickness design methods and software include the 1993 AASHTO Guide (JPCP; JRCP; CRCP; JPCP, JRCP, and CRCP Overlays), AASHTO’s DARWinME™ (JPCP; CRCP; JPCP and CRCP Overlays), and PCA’s RCCPave (RCC) and Hydrological Design Software (pervious concrete pavement). Several state agencies also have customized design methods or software for the various types of concrete pavements.

Additional Resources

Many other ACPA and third-party design, analysis, and construction tools are available at:

http://apps.acpa.org/

ACPA software and publications are available at: http://acpa.org/bookstore/

Other organizations that offer tools and publications useful in the design, analysis and construction of concrete pavements include:

- American Association of State Highway and Transportation Officials (AASHTO): http://www.transportation.org/
- American Concrete Institute (ACI): http://www.concrete.org
- International Grooving and Grinding Association (IGGA): http://igga.net/
- National Ready Mixed Concrete Association: http://nrmca.org/
- National Concrete Pavement Technology (CP Tech) Center: http://www.cptechcenter.org/
- Portland Cement Association (PCA): http://www.cement.org/