

Important Properties of Concrete

There are several important properties of concrete that an inspector should know and understand. Some of these properties are measurable and used in the acceptance process, while others are not measurable but are used in the decision-making process during construction.

Note that some specifications described in the following content may not be the same as the specifications followed by your agency. Always check with your State agency's standards and specifications when using these guidelines.

Sections

- **Strength**
- **Air Content**
- **Slump**
- **Water/Cement (W/C) Ratio**
- **Unit Weight**
- **Temperature**
- **Workability**

Strength

- Many factors affect strength:**
 - W/C ratio
 - Curing time and curing temperature
 - Air content
 - Types and sources of cementitious material

Introduction to Paving Inspection – Portland Cement Concrete Paving Materials and Properties AT-TC3CN004-18-T1-JA02

- Admixtures
- Aggregate size, shape, grading, texture, strength
- Compressive strength is measured through the testing of cylinders or cores**
- Flexural strength can be determined by either a center-point loading or a third-point loading testing device**

Air Content

- The air system within the concrete will determine its ability to resist freeze/thaw deterioration**
 - Therefore, ensuring adequate air content is of paramount importance
- Air content is checked in the field using a pressure meter, which is a test that determines the total air in the concrete**
 - While this does not tell if the air system is adequate to protect the concrete, normally it is the best test available, and it is most commonly used

Slump

- Slump is an old test of concrete that was commonly used to give an indication of water content in the mixture**
- Slump testing is normally used to indicate a change in the mix rather than an identifying measure of water content**

Water/Cement (W/C) Ratio

- Water/cement ratio is an important property of concrete**

Introduction to Paving Inspection – Portland Cement Concrete Paving Materials and Properties AT-TC3CN004-18-T1-JA02



- ❑ **The relationship of how much water is present in the mixture relative to the amount of cement will have a great effect on the ultimate strength of the concrete**
 - The more water particles in the concrete, the farther apart the cement particles are held
 - The cement particle's ability to bind to each other, and thereby produce strength in the concrete, is then reduced

Unit Weight

- ❑ **When a mixture is designed, normally the unit weight (mass) is one of the properties that is determined and becomes part of the parameters of the mixture**
- ❑ **When concrete is measured in the field, the unit weight (mass) will tell if the mixture produced is similar to the mix design**
- ❑ **Producers know exactly how much one cubic yard (or cubic meter) of each of their mixes weighs**
- ❑ **If a producer knows the exact weight (mass) of the materials that were batched into a truck, he can calculate exactly how much volume that concrete will fill when placed**
 - This is the “weight (mass) versus volume” or “unit weight (mass)” relationship

Temperature

- ❑ **The temperature of the concrete is important for a number of reasons:**
 - When the weather is cold, it is important that the concrete mix temperature be warm enough for the hydration process to take place
 - When the concrete is very hot, the mix can set too quickly and not allow time for proper placement or finishing

**Introduction to Paving Inspection –
Portland Cement Concrete Paving Materials and Properties
AT-TC3CN004-18-T1-JA02**

- Hydration reaction doubles with an increase of 20° Fahrenheit
- The hydration reaction is cut in half with a decrease of 20° Fahrenheit

Workability

- Workability is a characteristic of concrete that describes how well the concrete can be moved, molded, and shaped to the proper dimensions
- Workability is variable between mixtures and can change with time within a given mixture
- There is no specification regarding workability
- Workability is a characteristic of the concrete and is affected by water/cement ratio, aggregate gradation, and characteristics of the cementitious materials
- The inspector should watch how the concrete moves through the paver and discuss the workability with the contractor and the mix designer