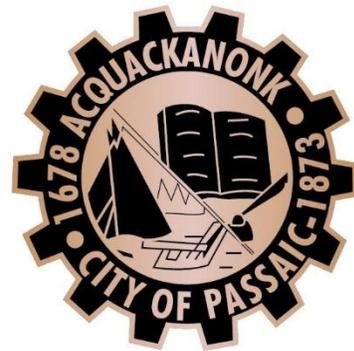


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CITY OF PASSAIC  
ENGINEERING  
DIVISION



# Cold Weather Concrete Policy

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WINTER MORATORIUM  
PERIOD



# CITY OF PASSAIC ENGINEERING DIVISION

## COLD WEATHER CONCRETE POLICY

### INTRODUCTION AND SCOPE

Construction of concrete structures are a daily occurrence in the City of Passaic, and the Municipality expects a durable, long-term product. In addition, other attributes of good concrete structures include safety to the public and appearance, not only at the end of the construction period, but also for the intended service life. Municipal staff, consultants, contractors, and concrete suppliers must work collectively to provide exterior concrete flatwork that is both aesthetically pleasing and durable when the optimal concrete performance mix is ordered, handled placed, finished, cured, and protected meeting the Municipality specifications. Every aspect of the work must be carefully constructed to ensure that the hardened concrete, will be resilient and visually appealing.

Since the concrete's durability and service life will be tested by weathering action, chemical attack, abrasion and a variety of different types of loading, it becomes imperative that proper specifications are followed, and appropriate construction practices are observed. If proper care is not taken, surface and structural defects such as scaling, mortar flaking, pop-outs, cracking and heaving may occur which all will impact the service life of the concrete works, and will lead to a safety issue as the concrete work(s) will become to a tripping hazard(s).

ACI 306 R-16 (Guide to Cold Weather Concreting) defines the objectives of cold weather concreting practices to be:

- To prevent damage to concrete due to freezing at early ages.
- To ensure that the concrete develops the recommended strength for safe removal of forms.
- To maintain curing conditions that foster normal strength development.
- To limit rapid temperature changes.
- To provide protection consistent with intended serviceability of the structure.

The following cold weather policy will be in effect and enforced within the City of Passaic for all Street/Road Openings during the Winter Moratorium Period. The Winter Moratorium Period is defined as beginning on November 15<sup>th</sup> and ending on March 31<sup>st</sup>.

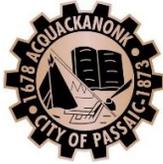
The intent of this policy is to provide a reliable resource in order to regulate the placement of concrete during cold weather by providing minimum standards. This policy shall apply to all concrete work (new or replacement) that is placed during the Winter Moratorium Period; and shall be used as basis for the acceptance or rejection of any residential concrete inspection in the City of Passaic; and it may be amended and/or supplemented from time to time without notice and at the sole discretion of the City Engineer.



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# CITY OF PASSAIC ENGINEERING DIVISION

## COLD WEATHER CONCRETE POLICY

# CHAPTER I – DEFINITIONS

## DEFINITIONS

### ACCELERATING ADMIXTURE

An admixture that causes an increase in the rate of hydration of the hydraulic cement and thus shortens the time of setting, increases the rate of strength development, or both.

### ACCELERATION

Increase in rate of natural progress of setting or hardening of concrete (See also accelerating admixture).

### ADDITIVE

A substance added to another in relatively small amounts to impart or improve desirable properties or suppress undesirable properties.

### ADMIXTURE

A material other than water, aggregates, cementitious materials, and fiber reinforcement, used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing.

### AIR ENTRAINING / AIR ENTRAINMENT

The capability of a material or process to develop a system of microscopic bubbles of air in cement paste, mortar, or concrete during the mixing.

### CEMENTITIOUS

Having cementing properties.

### CEMENTITIOUS MIXTURE

A mixture (mortar, concrete or grout) containing hydraulic cement.

### COLD STRENGTH

The compressive or flexural strength of refractory concrete determined before drying or firing.

### COLD WEATHER

A period when air temperature has fallen to, or is expected to fall below, 40 degrees Fahrenheit (40° F/ 4° C) during the protection period.

When temperatures above 50°F (10°C) occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.

### CONCRETE ADMIXTURE

A material other than water, aggregates, cementitious materials, and fiber reinforcement used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing.

### CURING

Action taken to maintain moisture and temperature conditions in a freshly placed cementitious mixture to allow hydraulic cement hydration and (if applicable) pozzolanic reactions to occur so that the potential properties of the mixture may develop.

### DURABILITY

The ability of a material to resist weathering action, chemical attack, abrasion, and other conditions of service.

### **EARLY AGE (OF CONCRETE)**

Period after final setting during which properties are changing rapidly.

### **FINAL CURING**

Action taken between the final finishing and termination of curing to reduce the loss of water from the surface of the concrete and control the temperature of the concrete.

### **FREEZING**

The development of solid water ice within the paste that disrupts the paste, causing frost lenses to develop in the paste.

### **HIGH-EARLY-STRENGTH CEMENT**

Portland cement characterized by attaining a given level of strength in mortar or concrete earlier than does normal Portland cement (referred to as ASTM C150 Type III)

### **HIGH-EARLY-STRENGTH CONCRETE**

Concrete that, through the use of additional cement, high-early-strength cement, or admixtures, has accelerated early-age strength development. Designed for use in cold weather.

### **MATURITY TESTING**

Tests performed to estimate in-place concrete strength using in-place concrete temperature history and strength-versus-temperature history functions derived from tests of concrete with comparable mixture proportions.

### **PLACEMENT**

- (1) The process of placing and consolidating concrete;
- (2) A quantity of concrete placed and finished during a continuous operation (often inappropriately referred as pouring).

### **PLACING**

The deposition, distribution, and consolidation of freshly mixed concrete in the place where it is to harden (often inappropriately referred to as pouring).

### **PORTLAND CEMENT**

A hydraulic cement produced by pulverizing portland-cement clinker and usually with addition of calcium sulfate to control setting.

### **POURING (OF CONCRETE)**

See placement and placing.

### **PROTECTION**

The materials and environmental conditions in place to prevent concrete from being affected by exposure to cold weather.

### **PROTECTION PERIOD**

The amount of time recommended to prevent concrete from being adversely affected by exposure to cold weather during construction.

### **RUTTING**

Creation of troughs in the soil support system in response to applied wheel loads.

### **SETTING**

A chemical process that results in a gradual development of rigidity of a cementitious mixture, adhesive or resin.

### **SLUMP**

A measure of consistency of freshly mixed concrete, mortar, or stucco equal to the subsidence measured to the nearest 1/4 in. (5 mm.) of the molded specimen.

### **STREET**

Any road, highway, public way, public alley, easement or other right-of-way accepted or maintained by the City as a public street, as well as any state or county road or highway over which the City has acquired jurisdiction by agreement.

### **SUBGRADE**

The soil prepared and compacted to support a structure or a pavement system.



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**CITY OF PASSAIC**  
**ENGINEERING DIVISION**

COLD WEATHER CONCRETE POLICY

## **CHAPTER 2 – PREPARATION BEFORE CONCRETE PLACEMENT**

### **ENVIRONMENTAL REQUIREMENTS**

- Before placing concrete, debris shall be removed from the space to be occupied by the new concrete. The forms and all concrete surfaces shall be thoroughly wetted. Concrete shall be placed on a damp but not wet or muddy subgrade.
- Concrete shall not be placed on compacted select crushed base and/or compacted subgrade material that is in a frozen state or contains any ice, snow, standing water or frost. All surfaces shall be protected by approved protection methods to prevent concrete placement on frozen or frost-covered material. Contractor must insure that concrete is not placed on frozen subgrade.
- Subgrade shall be thoroughly compacted. The surface shall be smooth with no humps or depressions and to the final grade on which the concrete will be placed.
- Base, subbase and subgrades on which concrete is to be placed shall be thawed and heated to at least 40 degrees Fahrenheit (40° F). The method by which the base, subbase or subgrade is to be heated shall be indicated in the contractor's cold weather concreting plan and must be submitted to the Engineering Division with the application for the Cold Weather Permit Application.
- Frozen materials or materials containing ice shall not be used.
- Prepare the base course before placing the concrete. Repair and re-compact rutted or disturbed base resulting from hauling or paving operations.
- Prior to placing concrete, contractor shall have a contingency plan and provisions in place to quickly and adequately address sudden temperature changes below those forecasted during the curing period.



# CITY OF PASSAIC ENGINEERING DIVISION

## COLD WEATHER CONCRETE POLICY

### CHAPTER 3 – CONCRETE COLD WEATHER REQUIREMENTS

- All concrete construction shall comply with the requirements of the American Concrete Institute's ACI-318 as the standard to follow. As it relates to cold weather concreting, ACI-318 references the ACI 306-16 standard for cold weather concreting requirements to be met.
- Concrete shall not be placed on frozen subgrade. It may be possible to thaw a few inches of frost using heat or blankets, or remove the frost and regrade with appropriate compacted subgrade material.
- Where proper precautions are taken, accelerating admixtures, Type III cement (high-early-strength), or additional cement can be used to shorten the time needed to accelerate time of set and strength development.
- Concrete shall be placed and compacted so that it is free from honeycomb and free of pockets of segregated aggregate. Sections of segregation or honeycomb revealed by removal of the forms shall be removed and replaced or otherwise repaired as approved by the Passaic City Engineer.
- Concrete shall not be placed when the temperature is predicted to drop below twenty-five (25) degrees Fahrenheit (25° F) during following 24 hours without prior approval from the City Engineer.
- Minimum twenty eight (28) day comprehensive strength of concrete shall be 4,500 psi; total air content for concrete (percent by volume of concrete) shall not be less than 4% or greater than 7%, and the maximum slump shall be 5 inches (5").
- The use of ready-mixed concrete shall in no way relieve the contractor or developer of the responsibility for proportion, mix, delivery, or placement of concrete. All ready-mixed concrete shall comply with ASTM C94.
- Dry calcium chloride shall not be field added to ready mix concrete. Calcium chloride and any other admixture shall be used according to manufactures' specifications and guidelines.
- All concrete shall be compacted by internal vibration using mechanical vibrating equipment. Concrete in floor slabs, sidewalks, or curb and gutter which is not placed against form linings shall be either tamped or vibrated. Care shall be taken to vibrate only long enough to bring a continuous film of mortar to the surface. Vibration shall stop before any segregation occurs. Mechanical vibrators shall be an approved type as specified in ACI 309, Chapter 5. Vibrators shall not be used to move or spread the concrete.

- The temperature of each batch of concrete shall be recorded as soon as it arrives at the construction site, and contractor shall comply with the following temperature requirements for concrete placement according to the latest version of the ACI 306-16 standards (Chapter 5.1 – Placement Temperature):

**Table 5.1—Recommended concrete temperatures**

		Section size, minimum dimension			
		< 12 in. (300 mm)	12 to 36 in. (300 to 900 mm)	36 to 72 in. (900 to 1800 mm)	> 72 in. (1800 mm)
Line	Air temperature	Minimum concrete temperature as placed and maintained			
1	—	55°F (13°C)	50°F (10°C)	45°F (7°C)	40°F (5°C)
		Minimum concrete temperature as mixed for indicated air temperature*			
2	Above 30°F (–1°C)	60°F (16°C)	55°F (13°C)	50°F (10°C)	45°F (7°C)
3	0 to 30°F (–18 to –1°C)	65°F (18°C)	60°F (16°C)	55°F (13°C)	50°F (10°C)
4	Below 0°F (–18°C)	70°F (21°C)	65°F (18°C)	60°F (16°C)	55°F (13°C)
5	—	Maximum allowable gradual temperature drop in first 24 hours after end of protection			
		50°F (28°C)	40° (22°C)	30°F (17°C)	20°F (11°C)

\*For colder weather, a greater margin in temperature is provided between concrete as mixed and required minimum temperature of fresh concrete in place.

Note 1: For Line 1, maximum placement temperature is minimum temperature in the table plus 20°F (11°C).

Note 2: For Lines 2-4, maximum temperature is minimum temperature in the table plus 15°F (9°C).

- Check concrete temperatures before leaving for the day to determine if additional protection measures are needed when overnight temperatures are forecasted to drop below 35 degrees Fahrenheit (35° F).
- Testing of all materials and construction shall be in conformance with the appropriate AASHTO, ASTM, ACI and NJDOT standards and specifications.



## CITY OF PASSAIC ENGINEERING DIVISION

COLD WEATHER CONCRETE POLICY

# CHAPTER 4 – CONCRETE PROTECTION & CURING MEASURES

## CONCRETE PROTECTION

Low temperatures during the placement and curing of concrete work can affect the ultimate strength and durability of concrete both temporarily and permanently. Concrete cures slower in cold temperatures and develops ultimate strengths over longer periods of time. Exposure of fresh concrete to temperatures significantly below freezing may actually stop the curing (hydration) process.

Small structures and/or slabs shall be protected from freezing as soon as practicable after placement, consolidation, and finishing without marring or damaging the finished surface.

- Concrete placed in cold weather shall be protected from extreme temperatures as follows:
  - ↪ When pouring concrete during wet cold weather conditions, it is critical to maintain concrete temperatures protected from freezing and must be maintained at a minimum of 50 Fahrenheit degrees (50° F) for at least the first seventy-two (72) hours (3 days) depending on the concrete mix, or until it reaches a compressive strength of 3,500 PSI.
  - ↪ After the first seventy-two (72) hours (3 days) and until the concrete is seven (7) days old, it shall be protected from freezing temperatures.
  - ↪ Concrete adjacent to heating devices shall be insulated from direct heat of the unit that may dry it out prior to being properly cured.
  - ↪ Temperatures shall be measured by maximum and minimum thermometers furnished by the Contractor and installed adjacent to the concrete.

Methods and/or Measures of Protection listed below are acceptable by the Passaic Engineering Division:

- ✓ Polyethylene Sheeting (8-mil or heavier)
- ✓ R-5.1 Commercial Grade Insulation Blankets
- ✓ Urethane Foam with Weather Resistant Enamel
- ✓ Polypropylene Sheeting (8-mil or heavier)
- ✓ Accelerating Admixtures for Concrete

The following requirements apply for concrete admixtures:

- A. Contractor shall use air-entraining admixtures for all surfaces of exposed concrete. Air entraining admixtures shall comply with ASTM C260.
- B. Type C and Type E water reducing, and accelerating chemical admixtures shall meet ASTM C494.

C. When concrete is to be used with reinforcing steel, a non-chloride/ non-corrosive admixture shall be used.

- If permit holder desires to utilize an alternate cold weather protection measure rather than one of the above-mentioned alternatives, a proposed measure must be submitted for the review and approval of the Passaic City Engineer in advance of the placing of the concrete.
- The American Concrete Institute (ACI) does **not** recommend using straw, as it is flammable, bulky and ineffective when wet, and may be blown out of space.
- The use of salt or other additives to prevent concrete from freezing is **not** allowed.
- The length of protection period of the placed concrete shall comply with the following day(s) requirements for concrete placement according to the latest version of the ACI 306-16 standards (Chapter 7.4, Table 7.2 – Length of Protection Period for Concrete Placing during Cold Weather):

PROTECTION PERIOD LENGTH FOR CONCRETE DURING COLD WEATHER		
CATEGORY	CONCRETE TYPE	DAYS
NO LOAD, NOT EXPOSED  (Not subject to early load prior to curing and below grade)	I OR II (Normal-Set Concrete)	2
	III (Accelerated-Set Concrete)	1
NO LOAD, EXPOSED  (Surfaced exposed to freezing, wind and weather but no early load requirements)	I OR II (Normal-Set Concrete)	3
	III (Accelerated-Set Concrete)	2
PARTIAL LOAD, EXPOSED  (Exposed to the weather and partial early loading)	I OR II (Normal-Set Concrete)	6
	III (Accelerated-Set Concrete)	4

CEMENT CHARACTERISTICS	
TYPE I	GENERAL USE
TYPE II	GENERAL USE; MODERATE HEAT OF HYDRATION AND MODERATE SULFATE RESISTANCE
TYPE III	HIGH-EARLY-STRENGTH

- It shall be the Permittee’s responsibility to provide proof of temperature and strength compliance through the use of maturity meters or with surface temperature recording devices, as certified (by a P.E. and) by a testing laboratory. The maximum frequency for recording temperatures shall be one (1) hour intervals.
- Adequate materials and equipment shall be provided for protection during cold weather. These must be on-site at the time of inspection.
- When pouring concrete during dry cold weather conditions, the concrete shall be protected from freezing for at least 72 hours (3 days), and concrete temperatures must be maintained at a minimum of 50 Fahrenheit degrees (50° F) for at least 4 days depending on the concrete mix, or until it reaches a compressive strength of 500 PSI.
- When pouring concrete utilizing approved accelerators, Type III Portland Cement, or where the cement ratio is increased 100 lbs. per cubic yard; the concrete shall be protected from freezing for at least 48 hours (2 days).
- Concrete protection shall comply with the following day(s) requirements for standard-cured 28-day strength concrete according to the latest version of the ACI 306-16 standards (Chapter 8.8, Table 8.8 - Duration of Recommended Protection for Percentage of Standard-Cured 28-Day Strength):

**Table 8.8—Duration of recommended protection for percentage of standard-cured 28-day strength\***

Percentage of standard-cured 28-day strength	At 50°F (10°C), days			At 70°F (21°C), days		
	Type of cement			Type of cement		
	I	II	III	I	II	III
50	6	9	3	4	6	3
65	11	14	5	8	10	4
85	21	28	16	16	18	12
95	29	35	26	23	24	20

\*The data in this table were derived from concretes with strengths from 3000 to 5000 psi (20.7 to 34.4 MPa) after 28 days of curing at 70 ± 3°F (21 ± 1.7°C), and did not contain fly ash. The 28-day strength for each type of cement was considered as 100 percent in determining the times to reach various percentages of this strength for curing at 50 and 70°F (10 and 21°C). These times are only approximate, and specific values should be obtained for the concrete used on the job.

- Wind protection is required when ambient air temperatures are below thirty-five (35) Fahrenheit degrees (35° F); or if wind is fifteen (15) MPH or greater.
- Protection is required when the average daily temperature is at the following:

30 - 25° F	Weather resistive membrane for 3 days minimum
25 - 20° F	Insulation blankets for 3 days minimum
< 20° F	Provide supplemental heat under the weather resistive membrane or insulation blankets for 3 days minimum

- Contractor must provide triple thickness of insulation at corners and edges; and insulation must be kept in close contact with the concrete or the form surface.
- If the permit holder desires to utilize an alternate cold weather protection measure rather than one of those mentioned above, that proposed measure must be previously approved by the Passaic City Engineer in advance of the pour.
- Contractor must specify in detail, the method of concrete placement and protection to be utilized and the duration of compliance on any site during cold weather in accordance with Chapter 7 of the ACI 306R-16.
- Monitoring of the concrete placement shall include verification of the temperatures of air; subgrade; forms; and concrete at the time of placement.
- At the end of the protection period, concrete should be cooled gradually to reduce crack-inducing differential strains between the interior and exterior of the structure.
- For further information, please refer to ACI 318, ACI 306 and ASTM Standards.

#### **PROTECTION AGAINST VANDALISM**

- It shall be the responsibility of the Contractor to protect all concrete work against damage or vandalism. When required, a guard shall be stationed over fresh work until the concrete is sufficiently set to prevent damage at the Contractor's expense. Concrete damaged in any way by vandals shall be removed and replaced at the Contractor's expense.

## CURING PROCEDURES

Fresh concrete shall be adequately protected from weather damage and mechanical injury during curing periods to avoid surface desiccation so that hydration can continue to occur. Measures should be taken to inhibit evaporation of moisture from concrete. Freshly placed concrete is vulnerable to freezing when it is critically saturated. Therefore, concrete should be allowed to undergo some drying before being exposed to temperatures below 32° F or 0° C (ACI 306-16, Chapter 10.1). The selected curing process shall be started as soon as it can be performed without injury to the concrete surface. The use of a membrane curing compound is recommended.

- Curing and temperature of protection should be continuous and uninterrupted. The cured surface shall be cleaned to remove any residual materials.
- Contractor must perform follow-up inspections to monitor temperatures during the curing process and shall provide a report of inspections to the Passaic Engineering Division, including the temperature records.
- When concrete warmer than sixty (60) Fahrenheit degrees (60° F) is exposed to air fifty (50) Fahrenheit degrees (50° F) or higher, contractor must take measures to inhibit surface desiccation. The preferred technique is to use steam for heating and inhibiting evaporation because it introduces additional moisture to the surface along with additional heat.
- Water curing is not recommended during periods when temperatures are below thirty-two (32) Fahrenheit degrees (32° F) due to potential surface freezing, unless additional protection measures are employed. Where water or steam curing are used, terminate the curing twelve (12) hours before the end of the temperature protection period. Allow the concrete to dry naturally for 12 hours prior to and during the gradual adjustment to ambient conditions.
  
- Following removal of temperature protection, it is usually unnecessary to provide measures to prevent surface desiccation as long as the air temperature remains below fifty (50) Fahrenheit degrees (50° F), and the relative humidity is greater than forty percent (40 %).
- When air temperature within the enclosure falls to fifty (50) Fahrenheit degrees (50° F), the concrete can be exposed to the air, provided the relative humidity is not less than forty percent (40 %). If the humidity is less than forty percent (40 %) inside the enclosure, it is necessary to add moisture to the air to maintain at least forty percent (40 %) relative humidity, and inhibit desiccation of the exposed surface.



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**CITY OF PASSAIC**  
**ENGINEERING DIVISION**

COLD WEATHER CONCRETE POLICY

## **CHAPTER 5 – COLD WEATHER INSPECTION PRACTICES**

All street and/or road opening work must be inspected by the City Engineer, or a designated agent, and must be done to the entire satisfaction of the City Engineer, or such inspector. It is the responsibility of the contractor to give advanced notice to the Engineering Division to inspect the forms a minimum of one (1) full working day (24 hours) prior to concrete placing.

The City Engineer, or such inspector, shall at all times have direct supervision over the construction and repairing of all street/road openings, and may at any time, have authority to order the contractor to suspend work thereon until such construction conform in all aspects with the specifications set forth in this policy and must be done to the entire satisfaction of the City Engineer.

- The air temperature shall be at least twenty-five (25) Fahrenheit degrees (25° F) and rising for an inspection of concrete related construction.
- The assigned inspector(s) will verify the sub-grade is not frozen prior to concrete placement.
- Inspector(s) will verify that adequate protection components are on-site at the time of inspection.
- Concrete must be poured the same day of the inspection approval.
- If there is cause to believe that the concrete has not been properly protected during cold weather conditions as described above or per another approved method, the City Inspector(s) will require the concrete to be tested in order to ensure that proper strength of the concrete has been developed.



# CITY OF PASSAIC ENGINEERING DIVISION

## COLD WEATHER CONCRETE POLICY

### CHAPTER 6 – REFERENCES

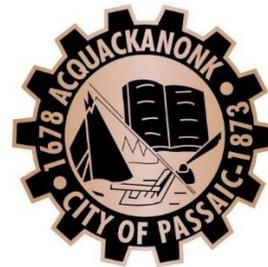
- American Concrete Institute (ACI) 306R-16 - Guide to Cold Weather Concreting.
- Construction Standards & Specifications, Section 800 - Concrete Mix Design and Construction, Elbert County, Colorado.
- Cold Weather Concrete Work Requirements, City of Aurora, Illinois.
- Douglas County Roadway Design and Technical Criteria Manual, Chapter 8 - Roadway Inspection and Testing Procedures and Construction Guidelines, Douglas County, Colorado.
- Cold Weather Concreting, Warren County Building Inspection, Warren County, Ohio.
- Section 32 13 13 - Concrete Walks, Curbs, and Miscellaneous Flatwork, Denver, Colorado.
- Policy Memorandum (Aeronautics) 2001-1 - Requirements for Cold Weather Concreting (2020), Illinois Department of transportation (IDOT), Division of Aeronautics, State of Illinois.
- Ames Cold Weather Concrete Policy (October 2019), City of Ames, Iowa.
- Cold Weather Concrete Policy, Building Codes Department, City of Prairie Village, Kansas.
- 2005-02 - Cold Weather Concrete Requirements, Standard Operating Procedures, Building Department, City of Coeur D'Alene, Idaho.
- Municipal Exterior Flatwork Construction Best practices Guide - Sidewalks and Curbs, Ontario Good Road Association (OGRA), Canada.

ENGINEERING DIVISION

Passaic  
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## COLD WEATHER CONCRETE POLICY

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