
RUSSTECHNICAL NOTES

FREEZE-RESISTANT CONCRETE

OVERVIEW:

The main objective for cold weather concrete placement is to produce concrete that is durable and will perform as though it had been placed at 50 to 70 F (Fahrenheit) rather than in cold weather conditions.

Two main problems occur in concrete placed in sub-freezing weather:

- *Freezing at early ages:* If fresh concrete does not reach adequate strength (at least 500 psi) prior to initial freezing it may be damaged permanently and may never reach its required strength.
- *Extended setting times:* Ambient temperatures below 32 F significantly extend the initial set time of the concrete, often causing poor finished surfaces due to over finishing, carbonation, and bleeding. Labor, protection, and heating costs for these types of placements can be astronomical.

ACI 306 “Standard Specification for Cold Weather Concrete” addresses the requirements necessary to produce satisfactory concrete during cold weather to avoid the above mentioned problems. Two specific requirements in ACI 306 are protection to prevent early age freezing and length of protection time required to keep the environment around the concrete above 50 F for three days after placement. This often can cost a contractor up to \$50/yard or possibly more to accomplish!

Concrete incorporating proper dosages of **LCNC-166**, non-chloride accelerator and water reducing admixture, accelerates the early compressive strength to 500 psi as quickly as possible. This allows placement of concrete in sub-freezing temperatures as low as 20 F without risk of freezing at early ages in the plastic state. **LCNC-166** may reduce or eliminate the need for some of the protection requirements set forth in ACI 306 “Standard Specification for Cold Weather Concrete” and overcomes the extended setting times by acceleration.

ADVANTAGES:

- Accelerated setting times, initial set time 4 to 6 hours *in sub-freezing ambient temperatures*
- May reduce or eliminate the need for heated enclosures and extended protection times normally required by ACI 306 “Standard Specification for Cold Weather Concrete”
- Increases rate at which heat is generated during hydration- promotes earlier setting, finishing, and strength gain
- Increases early and ultimate compressive and flexural strengths
- Provides superior finishability on all flatwork and pre-cast surfaces
- Earlier use of structural concrete
- Reduces construction loan interest expense per day by completing projects sooner
- Labor savings due to accelerated initial set times and reduced finishing time

APPLICATIONS:

- Sub-freezing concrete placements, particularly on elevated slabs where protection, normally from above and below, may be reduced or eliminated
- Placements in cold storage or freezers where high early compressive strengths are desired
- Projects with penalty clauses which need to be completed on time or possibly earlier

SPECIFICATIONS:

Conforms to ASTM C 494 Types C and E
AASHTO M 194 Types C and E
CRD C 87 Types C and E
All other Federal and State specifications

MIX PERFORMANCE DATA:

517 lbs. (307 kg) of Type I cement per cubic yard (cubic meter)

Slump 5.5 inches (140 mm)

Ambient Temperature 20 F (-7 C)

Concrete Temperature 40 F (4.4 C)

Air Content 5.5%

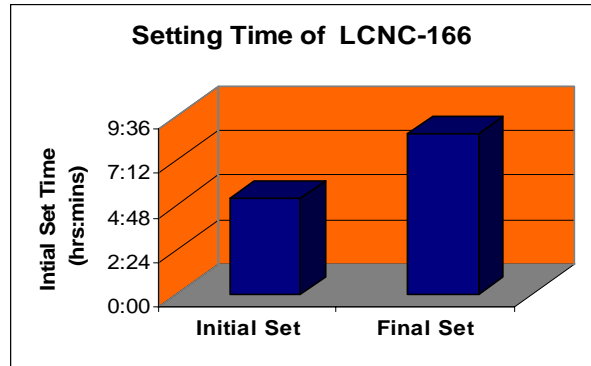
LCNC-166 at 80 ounces per 100 pounds (5218 mL per 100kg) cement

Water adjustment is approximately 14% lower

Set Times:

Compressive Strength:

Mix Age	psi	MPa
3 Day	1200	8.3
7 Day	2790	19.2
28 Day	5010	34.5



SUB-FREEZING DOSAGE CHART:

Concrete with LCNC-166 admixture at the recommended dosages can be placed in sub-freezing ambient temperatures and may reduce or eliminate the need for some of the protection requirements set forth in ACI 306 "Standard Specification for Cold Weather Concrete" and overcomes the extended setting times by acceleration. It is recommended that the concrete's heat of hydration be conserved through the use of insulating blankets.

Concrete Temperature	Ambient Temperature Until Initial Set Is Reached			
	20 F - 24 F	25 F - 29 F	30 F - 34 F	35 F - 40 F
	(All Dosages Are Ounces Per 100 pounds of Cement)			
40 F - 44 F	90	75	60	55
45 F - 49 F	80	70	55	50
50 F - 54 F	75	60	50	45
55 F - 60 F	70	55	45	40

REQUIREMENTS FOR SUB-FREEZING PLACEMENTS:

1. Ambient temperature should be 20 F and rising
2. Minimum cement factor should be 517 lbs./cubic yard
3. Do not incorporate flyash into the mix design
4. Use the recommended dosage for LCNC-166 from the dosage chart
5. Use insulating blankets to conserve concrete's heat of hydration
6. Prevent ingress of water from rain or snow into newly placed concrete that could freeze by sealing the surface with a membrane forming Cure and Seal
7. Maximum slump of concrete placed should never exceed 6 inches



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