



NATIONAL PETROCHEMICAL COMPANY
STANDARDS

CONSTRUCTION STANDARD FOR CONCRETE

NPCS-CS-ST-01

REVISION : 0

MAY 1992

THIS DOCUMENT IS THE PROPERTY OF N.P.C. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED. TO THE OWNER NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF N.P.C.



CONTENTS

1 GENERAL

1.1 SCOPE

1.2 REGULATIONS

1.3 CODES AND STANDARDS

2 PROPORTIONING

2.1 COMPRESSIVE STRENGTH OF CONCRETE

2.2 SLUMP

2.3 PROPORTIONING OF INGREDIENTS

3 FORMWORK

4 REINFORCEMENT

5 JOINTS AND EMBEDDED ITEMS

5.1 CONSTRUCTION JOINTS

5.2 EXPANSION JOINTS AND WATER STOPS

5.3 OTHER EMBEDDED ITEMS

5.4 PLACING EMBEDDED ITEMS

5.5 SLIDING SUPPORTS

6 MIXING

6.1 MEASURING AMOUNTS OF MATERIALS FOR MIXING

6.2 READY MIXED CONCRETE

6.3 BATCH MIXING AT SITE

6.4 RETEMPERING

6.5 HIGH TEMPERATURE PROTECTION FOR CONCRETE

THIS DOCUMENT IS THE PROPERTY OF N.P.C. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED, TO THE OWNER NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, SIGNED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF N.P.C.



THIS DOCUMENT IS THE PROPERTY OF N.P.C. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED. TO THE OWNER NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF N.P.C.

6.6 LOW TEMPERATURE PROTECTION FOR CONCRETE

7 PLACING

7.1 CONVEYING

7.2 DEPOSITING

1.3 BONDING

8 FINISHING OF FLAT WORK

9 YARD PAVING

9.1 GENERAL

9.2 HEAVY DUTY CONCRETE PAVING

9.3 LIGHT DUTY CONCRETE PAVING

9.4 PAVING JOINTS

9.5 EXECUTION

10 CURING

10.1 GENERAL

10.2 INITIAL CURING

10.3 FINAL CURING

10.4 FORMED SURFACE

11. GROUTING AND DRY PACKING

11.1 GENERAL

11.2 GROUTING

11.3 DRY PACKING

12 PRECAST CONCRETE

13 TESTING

14 INSPECTION



THIS DOCUMENT IS THE PROPERTY OF NPCC. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED. TO THE OWNER NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF NPCC.

1 GENERAL

1.1 SCOPE

This standard covers the requirements for the construction of concrete foundations and structures and miscellaneous concrete civil work.

1.2 REGULATIONS

1.2.1 The work shall be done in accordance with the national and local law and regulations.

1.2.2 For subjects not covered by regulations or specifications, the construction, shall be based on good engineering and working practice. The methods are subject to approval by owner.

1.3 CODES AND STANDARDS

All concrete work, except as specified herein including forms, mixing, conveying, curing, reinforcement, etc. shall conform to the latest edition of the following:

- a) American Concrete Institute ACI:
- ACI 318-89 Building Code Requirements for Reinforced Concrete.
 - ACI 211.1 Recommended Practice for Selecting Proportions for Normal and Heavy Weight Concrete.
 - ACI 301 Specifications for Structural Concrete for Buildings.
 - ACI 305 Hot Weather Concreting.
 - ACI 306 Cold Weather Concreting.
 - ACI 315 Details and Detailing of Concrete Reinforcement.
 - ACI 347 Recommended Practice for Concrete Formwork.
 - ACI 304 Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
 - ACI 311.4 Guide for Concrete Inspection.



- b) Portland Cement Association:
- Design and Control of Concrete Mixtures.
- c) American Society for Testing and Materials (ASTM):
- A185-85 Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - A615-87 Standard Specification for Deformed and Plain Billet-Steel Bar for Concrete Reinforcement.
 - C31-87a Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - C33-86 Standard Specification for Concrete Aggregates.
 - C39-86 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - C53 Quicklime and Hydrated Lime for Water Treatment.
 - C94-86b Standard Specification for Ready Mixed concrete.
 - C109-86 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - C143 Test for Slump of Portland-Cement Concrete.
 - C144-87 Standard Specification for Aggregate for Masonry Mortar.
 - C150 Specification for Portland Cement.
 - C171 Specification for Sheet Materials for Curing Concrete.
 - C172-82 Standard Method of Sampling Freshly Mixed Concrete.
 - C309 Specification for Liquid Membrane Forming Compounds for Curing Concrete.
 - E329 Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as used in Construction.

THIS DOCUMENT IS THE PROPERTY OF N.P.C. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED. TO THE OWNER NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR ANY MANS WITHOUT THE PRIOR WRITTEN CONSENT OF N.P.C.



2 PROPORTIONING

2.1 COMPRESSIVE STRENGTH OF CONCRETE

All concrete shall meet the requirements of quality specified in chapter 5 of the ACI, code 318-89 and shall meet the strength requirements for a minimum compressive strength f_c of 210 Kg/Cm² for all structural concrete, structural members, foundations, etc, except non structural items e.g. blinding where 175 Kg/Cm² may be used.

The specified compressive strength shall be obtained in 28 days unless high early strength cement is approved for use, in which case the required strength shall be obtained in 7 days. High strength concrete may be used for precast structural members and precast piles.

2.2 SLUMP

The concrete consistency as determined by the slump concrete test (ASTM C143) shall have the following range:

Table 1: Slump Limits

Type of Construction	Slump (*)			
	Maximum		Minimum	
	mm	inch	mm	inch
Reinforced foundation walls and footings	75	3	25	1
Reinforced slabs, beams columns and walls	100	4	25	1
Sidewalks, driveways and slabs on ground	75	3	25	1
Heavy mass Construction	75	3	25	1

(*) When mechanical vibrators are not used, these values may be increased by 25mm.

2.3 PROPORTIONING OF INGREDIENTS

The proportioning of concrete ingredients shall conform to ACI standard 211.1, Recommended Practice for Selecting Proportions for Normal and Heavy Weight Concrete.

THIS DOCUMENT IS THE PROPERTY OF N.P.C. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED. TO THE OWNER NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF N.P.C.



3 FORMWORK

- 3.1 The design and engineering of the formwork as well as its construction, shall be the responsibility of the contractor, but will be subject to the approval by the owner.

Typical drawings showing the proposed formwork shall be submitted by the contractor for approval by the owner before starting the construction. Concrete forms shall be square, plumb and adequately braced to prevent shifting during the placing of concrete.

The formwork shall be designed for the loads, lateral pressure and allowable stresses outlined in chapter I, design, of "Recommended Practice for Concrete Formwork" (ACI 347).

- 3.2 Selection of the materials for formworks should be consistent with safety and the quality required in the finished work. Lumber, plywood, steel and other materials can be used in formwork subject to the approval by the owner. For exposed concrete above grade, smooth faced material such as metal or plywood shall be used.
- 3.3 Temporary openings shall be provided at the base of column forms and wall forms and at other points when necessary to facilitate cleaning and observation immediately before concrete is deposited.
- 3.4 The external corners of columns, walls and foundations above grade shall be formed with 25 mm chamfer. In warehouse buildings where columns are likely to be damaged by forklift trucks, all the edges of columns shall be protected by insertion of steel angles into concrete up to a height of 2 m and brightly painted.
- 3.5 Forms shall be sufficiently tight to prevent leakage of grout or cement paste. Formwork shall be retained in position using patented, approved form ties. The use of wire ties to hold the forms together shall not be permitted.
- 3.6 Plywood and other wood surfaces shall be sealed against absorption of moisture from the concrete by a commercial form oil or sealer.

THIS DOCUMENT IS THE PROPERTY OF NPCC. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED. TO THE OWNER NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF NPCC.



- 3.7 Form release agents shall be applied to the form contact surfaces to prevent bond and facilitate stripping.
- 3.8 When forms are coated to prevent bond with concrete, the coating shall not be allowed to stand in puddles in the forms nor allowed to come in contact with concrete against which fresh concrete will be placed.
- 3.9 Templates of adequate structural strength shall be installed at top of slabs or foundation mats to firmly locate the column/pier starter bars before any concrete is cast for the slab or mat.
- 3.10 All form surfaces shall be cleaned and repaired before reuse.
- 3.11 Vertical forms shall be made in such a manner that they can be loosened or stripped to allow watering on vertical concrete surfaces for curing.
- 3.12 REMOVAL OF FORMS
- The period that should be passed before removing forms, shall be as per table 2.

THIS DOCUMENT IS THE PROPERTY OF N.P.C. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED. TO THE OWNER NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF N.P.C.



Table 2: Period Before Formwork Removal(Days)

	Ordinary	Portland	Cement	Concrete
Formwork	Cold weather (just above freezing) °C	Normal weather (10°C-27°C average 20°C	Any temperature (t) between 0°C and 32°C, for formulae use t=25 as maximum	
Beam sides/ walls/columns	6	2	-	
Slabs (sup- porting props left in place	8	4	<u>100 days</u> t + 10	
Beam soffits (supporting props left in place)	19	9	<u>250 days</u> t t 10	
Removal of props to slabs	19	9	<u>250 days</u> t t 10	
Removal of props to Seams	28	12	<u>360 days</u> t + 10	

Whenever the formwork is removed during the curing period the exposed concrete shall be cured by one of the methods of curing as described hereinafter. Damaged surfaces shall be repaired within 24 hours of form removal, but not before owner knowledge and approval.

3.13

TOLERANCES FOR FORMED SURFACES

Unless otherwise specified, formwork shall be constructed so that the concrete surfaces will conform to the following tolerance limits:



3.13.1 Variation from plumb:

- a) In the lines and surfaces of columns, piers, walls and in arises:

In any 5 m of length : 10 mm.
Maximum for the entire length : 25 mm.

- b) For exposed corner columns, control joint grooves and other conspicuous lines:

In any 5 m of length : 5 mm.
Maximum for the entire length : 12 mm.

3.13.2 Variation from the level or from the grades specified in the contract documents:

- a) In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores:

In any 5 m of length : 10 mm.
In any bay or in any 10 m length : 15 mm.
Maximum for the entire length : 19 mm.

- b) In exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines:

In any bay or in 5 m length : 5 mm.
Maximum for the entire length : 12 mm.

3.13.3 Variation of the liner building lines from established position in plan and related position of columns, walls and partitions:

In any bay : 12 mm.
In any 10 m of length : 15 mm.
Maximum for the entire length : 25 mm.

3.13.4 Variation in the sizes and location of sleeves, floor openings and wall openings : ± 6 mm

3.13.5 Variation in cross sectional dimensions of columns and beams and in the thickness of slabs and walls:

Minus : 6 mm.
Plus : 12 mm.

THIS DOCUMENT IS THE PROPERTY OF NPCC. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED. TO THE OWNER NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE DISCLOSED TO ANY THIRD PARTY. REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF NPCC.



3.13.6 Footings*

a) Variations in dimensions in plan:

Minus : 12 mm.
Plus : 25 mm.

b) Misplacement or eccentricity

2 percent of the footing width in the direction of
misplacement but not more than 25 mm.

c) Thickness:

Decrease in specified thickness : 5%
Increase in specified thickness : No limit.

3.13.7 Variation in steps:

a) In a flight of stairs:

Rise : ± 3 mm.
Tread : ± 6 mm.

b) In consecutive steps:

Rise : ± 1.5 mm.
Tread : ± 3 mm.

* Tolerances apply to concrete dimensions only, not to
positioning of vertical reinforcing steel, dowels,
anchor bolts and other embedded items.

THIS DOCUMENT IS THE PROPERTY OF N.P.C. IT IS CONFIDENTIAL AND ALL RIGHTS RESERVED TO THE OWNER. NEITHER THE WHOLE NOR ANY PART OF THIS DOCUMENT MAY BE
DISCLOSED TO ANY THIRD PARTY, REPRODUCED, STORED IN ANY RETRIEVAL SYSTEM OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE PRIOR WRITTEN CONSENT OF N.P.C.