An ACI Standard

Specification for Installation of Cementitious Grouting between Foundations and Equipment Bases

Reported by ACI Committee 351

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American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331
Phone: +1.248.848.3700
Fax: +1.248.848.3701

www.concrete.org

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David Kerins*, Chair

Mukti L. Das, Secretary

Omesh B. Abhat
Richard P. Bohan†
William L. Bounds
William D. Brant
Michael M. Chehab
Shu-Jin Fang
Fred R. Goodwin
Shraddhakar Harsh
Erick N. Larson
Robert R. McGlohn
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Richard O'Malley
Michael A. Paipal†
Ira W. Pearce
Charlie L. Rowan
William E. Rushing
Yasser Salem
Larry W. Schulze
Phillip A. Smith†
W[illegible]
J. Alan Wiley
Sheng-Chi Wu

Consulting Members
Navin N. Pandya
Shamsher Prakash
Robert L. Rowan Jr.

*Chair of Task Force 351.TG1.
†Members of Task Force 351.TG1 who prepared this specification.

This specification covers minimum requirements for cementitious grouting between foundations and equipment bases. Included are requirements for materials and placing.

Keywords: cement grout; cementitious grout; equipment grout; foundations; grout; hydraulic cement grout; machinery grout

CONTENTS

(*mandatory portion follows*)

PART 1—GENERAL

1.1—Scope

1.1.1 This specification covers minimum requirements for cementitious grouting between foundations and equipment and machinery bases.

1.1.2 This specification supplements the Contract Documents and provides requirements for the Contractor.

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1.1.3 This specification governs for construction within its scope, except the Contract Documents govern if there is a conflict.

1.1.4 This specification governs if there is a conflict with referenced material and testing standards.

1.1.5 The Contractor is permitted to submit written alternatives to any provision in this specification.

1.1.6 Do not use this specification in conjunction with ACI 301, ACI 350.5, or ACI 530.1 unless Contract Documents state that this specification governs for Work covered by 1.1.1.

1.1.7 Ignore provisions of this specification that are not applicable to the Work.

1.1.8 Values in this specification are stated in inch-pound units. A companion specification in SI units is also available.

1.1.9 The "Notes to specifiers" are not part of this specification.

1.2—Interpretation

Unless otherwise explicitly stated, this specification shall be interpreted using the following principles:

(a) Interpret this specification consistent with the plain meaning of the words and terms used.

(b) Definitions provided in this specification govern. Unless otherwise explicitly stated, this specification shall be interpreted using the following principles:

i. Its provisions are in harmony and do not conflict.

ii. Headings are part of this specification and are intended to identify the scope of the provisions or sections that follow. If there is a difference in meaning or implication between the text of a provision and a heading, the meaning of the text governs.

iii. Where a provision of this specification involves two or more items, conditions, requirements, or events connected by the conjunctions "and" or "or," interpret the conjunction as follows:

"and" indicates that all of the connected items, conditions, requirements, or events apply.
"or" indicates that the connected items, conditions, requirements, or events apply singularly.

iv. The use of the verbs "may" or "will" indicates that the specification provision is for information to the Contractor.

1.3—Definitions

1.3.1 The following definitions govern in this specification. For definitions not given herein, refer to "ACI Concrete Technology."

headbox—device for controlling the gravity flow of grout into the formwork.

unrestrained areas of grout—areas of grout that are not under or within 4 in. of the baseplate.

1.4—Referenced standards

Standards of ACI Spcited in this specification are listed by name and designation, including year.

1.4.1 *ACI standards*

ACI 117-10—Specification for Tolerances for Concrete Construction and Materials and Commentary

ACI 301-10—Specifications for Structural Concrete

1.5—Submittals

1.5.1 *General*—Provide to Architect/Engineer submittals required by this specification in accordance with Contract Documents.

1.5.2 *Quality control plan*—If required, submit a quality control plan showing means and methods to control the purchase, use, and placement of grout. Provide information related to quality control in accordance with 1.7.1.

1.5.2.1 Submit data on qualifications of proposed testing agency for acceptance. Use of testing services will not relieve Contractor of the responsibility to furnish materials and construction in compliance with Contract Documents

1.5.3 *Quality control procedures*

1.5.3.1 Submit the following to Architect/Engineer before the start of the work:

a) Experience record of supervisory personnel

b) List of equipment and procedures

c) Detailed procedures for grouting, including anchoring unrestrained areas of grout if required in Contract Documents

1.5.3.2 Submit the following to the Architect/Engineer during construction:

a) Notification to Architect/Engineer in time to permit in-place inspection of the foundation and formwork prior to placement of grout

b) Test results for samples taken in accordance with 1.7.4

c) Record set markup of drawings

d) Formwork and formwork accessories data

1.6—Delivery, storage, and handling

1.6.1 Grout shall be stored and handled in accordance with the manufacturer's written instructions and material safety data sheets.

1.7—Quality control procedures

1.7.1 *General*—Grout materials and operations may be tested and inspected by Owner as Work progresses. Failure to detect defective Work or material shall not prevent rejection for defects discovered later nor shall it obligate Architect/Engineer for final acceptance.

1.7.1.1 Testing agencies shall be accepted by Architect/Engineer before performing any Work. Field tests of grout required in 1.7.2 and 1.7.3 shall be performed by personnel trained in testing grouts.

1.7.2 *Testing responsibilities of Contractor*—Unless otherwise specified in Contract Documents, Contractor shall assume the following duties and responsibilities:

a) Qualify proposed materials

b) Allow access to the project site or to the source of materials and assist Owner's testing agency in obtaining and handling samples at the project site or at the source of materials

c) Advise Owner's testing agency at least 24 hours in advance of operations to allow for completion of quality tests and for assignment of personnel

d) Provide and maintain adequate facilities on the project site for safe and acceptable storage and initial curing of grout test specimens for the sole use of testing agency

1.7.3 *Quality control*—Quality control shall be performed to ensure the following in accordance with the grout material manufacturer's written instructions or as indicated in Contract Documents:

a) The grout has not exceeded its shelf life

b) The foundation and baseplate have been properly prepared

c) The formwork is fit for purposes

d) The required tests are performed at the specified frequency

e) The correct placing methods are used

f) Proper curing temperature is maintained for the required time

g) Shims, wedges, or leveling devices are removed unless otherwise specified after material has reached full cure.

h) Temperature of the baseplate, grouting materials, foundation, and air are within specified parameters.

1.7.4 Samples shall be taken every day and when any of the component batch numbers change during grout installation. Test samples for properties critical to the installation such as flow, wet density, bleed, and strength, using documented test methods appropriate to the type of grout, as cited in the contract documents and grout manufacturer's instructions. Record the amount of water and any admixtures used in mixing.

1.8—Acceptance of work

1.8.1 *General*—Completed grout shall conform to applicable requirements of this specification and Contract Documents

1.8.1.1. Grout that fails to meet one or more requirements of Contract Documents but subsequently is repaired to bring the grout into compliance will be accepted.

1.8.1.2 Grout that fails to meet one or more requirements of Contract Documents and cannot be brought into compliance is subject to rejection.

1.8.1.3 Repair rejected grout by removing and replacing or by additional construction to strengthen or otherwise satisfy project requirements as directed by Architect/Engineer. To bring rejected Work into compliance, use repair methods that meet applicable requirements for function, durability, dimensional tolerances, and appearance as determined by Architect/Engineer.

1.8.1.4 Submit proposed repair methods, materials, and modifications needed to repair the grout to meet the requirements of Contract Documents.

1.8.1.5 Contractor shall be responsible to bring grout into compliance with requirements of Contract Documents.

1.8.2 *Dimensional tolerances*

1.8.2.1 Unless otherwise specified, construction tolerances shall conform to ACI 117.

1.8.2.2 Formed surfaces resulting in grout with dimensions smaller than permitted by the tolerances of ACI 117 may be considered deficient in strength and subject to the provisions of 1.8.4.

1.8.2.3 Formed surfaces resulting in grout with dimensions larger than permitted by ACI 117 are subject to rejection. Remove excess materials when required by Architect/Engineer.

1.8.2.4 Inaccurately formed grout surfaces that exceed ACI 117 tolerances are subject to rejection.

1.8.3 *Appearance*

1.8.3.1 Grout surfaces not meeting the requirements of 3.2.7 or 3.2.12 shall be brought into compliance in accordance with 1.8.1.

1.8.4 *Strength*

1.8.4.1 *Criteria for determining potential strength deficiency*—Strength may be considered deficient and grout work is subject to rejection when the Work fails to comply with requirements that control the strength of the grout including, but not limited to, the conditions given in the following:

(a) Grout strength failing to comply with specified parameters

(b) Reinforcement size, quantity, grade, position, or arrangement at variance with the requirements of 3.1.4 or other Contract Documents

(c) Grout that differs from the required dimensions or location

(d) Curing not performed in accordance with Contract Documents

(e) Insufficient protection of grout from extreme temperature and other adverse environmental conditions during early stages of hardening and strength development

(f) Mechanical injury, construction fires, or premature removal of formwork resulting in deficient strength

1.8.4.2 *Action required when strength is potentially deficient*—When grout structural strength is considered potentially deficient, the actions given in the following may be required by Architect/Engineer:

(a) Structural analysis, additional testing, or both

(b) Core tests

(c) Load tests, which may be required if core testing is inconclusive or impractical or if structural analysis does not confirm the safety of the grout-supported equipment

(d) Strengthening with additional construction or replacement for grout work shown deficient by structural analysis or by results of a load test

(e) Submittal of documentation for repair work proposed to bring strength-deficient grout work into compliance with Contract Documents

1.8.5 *Durability*

1.8.5.1 *Criteria for determining potential durability deficiency*—Durability of grout may be considered deficient when it fails to comply with the requirements that control durability, including, but not limited to, the conditions given in the following.

(a) Grout strength failing to comply with specified parameters

(b) Materials for grout not conforming to the requirements in Contract Documents

(c) Curing not in accordance with Contract Documents requirements

(d) Insufficient protection of grout surfaces from detrimental environmental conditions as required by contract documents

1.8.5.2 *Action required when durability is potentially deficient*—When grout durability is considered potentially deficient, the actions given in the following may be required by Architect/Engineer.

(a) Obtain and test samples of the constituent materials used in the grout

(b) Obtain samples from the grout by coring, sawing, or other acceptable means

(c) Laboratory evaluation of grout and grout materials to assess the grout's resistance to weathering, chemical attack, abrasion, or other deterioration, and to protect reinforcement and metallic embedments from corrosion

(d) Repair or replace grout rejected for durability deficiency as directed by Architect/Engineer

(e) Document repair work to bring grout into compliance with Contract Documents and submit documentation for acceptance

PART 2—PRODUCTS

2.1—Grouts

Supply grout as specified in Contract Documents.

2.2—Joint and sealant material

Supply joint and sealant material as specified in Contract Documents.

2.3—Formwork

Supply forms and formwork, including accessories, as specified in ACI 301.

2.4—Water

Unless otherwise specified in Contract Documents, all water shall be potable.

PART 3—EXECUTION

3.1—Preparation

3.1.1 Prepare concrete surface on which grout will be placed to provide a minimum 0.5 in. peak-to-valley profile, remove all laitance and microcracking from the concrete, and expose coarse aggregate. Use only small hand tools or a small pneumatic hammer with 30 lb maximum weight with a bull or chisel point to generate the profile. Nail point tools, bush or bush head bits, large jack hammers, or pavement breakers shall not be used. The surface shall be thoroughly cleaned and protected from subsequent contamination. The concrete surface shall be saturated with water and maintained in a saturated condition for a minimum of 24 hours immediately before grouting.

3.1.2 Clear debris, dirt, and water from anchor bolt sleeves, shear key pockets, and other areas to receive grout using oil-free compressed air or vacuum.

3.1.3 For anchor bolt sleeves that are not specified to be grouted, clear debris, dirt, and water by oil-free compressed air or vacuum. Fill with nonbonding moldable materials as specified in Contract Documents.

3.1.4 Install pins, dowels, or other means of controlling shrinkage cracks, edge lifting, or both, in areas of unrestrained grout as specified in Contract Documents.

3.1.5 The equipment base shall be inspected to ensure that grout can be placed beneath the plate without trapping air in unvented corners. The inside of the base plate shall be inspected where possible for blind areas or obstruction of flow. Verify that a vent hole 1/4 to 1/2 in. in diameter is placed through the plate at the intersection of all crossing stiffeners and at each point where air may be trapped.

3.1.6 Verify that grout holes for placement are located so that grout does not travel more than approximately 48 in. The grout holes shall have been placed so that grouting can be started at one hole and progress to other holes to ensure that the grout flows under all areas of the plate. Verify that holes for pumping grout are 3/4 to 2 in. in diameter and threaded for standard pipe threads. Grout holes for gravity-assisted placement of grout should be 3 to 6 in. in diameter.

3.1.7 Verify that baseplate and other metal surfaces have been prepared in accordance with the manufacturers' requirements for grouting.

3.1.8 Inform Architect/Engineer immediately if equipment base would create issues with grout placement.

3.1.9 *Forms*—Forms shall be rigid and sealed with tape, caulk, or similar material to prevent leakage. Forms shall extend at least 1 in. above the highest elevation of the grout material under the grouted element and shall be built so that the grout can be placed as continuously and expeditiously as possible. Forms may also be provided to prevent grout from flowing over the top surface of the equipment base or baseplate.

3.1.10 *Form coating*—Forms shall be coated with compatible form oil or wax or lined with plastic or other suitable bond breaker or release agent. Do not allow formwork coating to contact underside of the equipment base or concrete surface.

3.1.11 *Gravity flow applications*—When grout is to be placed around the perimeter of a base, the forms shall be constructed so that a pressure head can be developed in a headbox on one side of the plate. The headbox shall begin 2 to 4 in. from the baseplate and slope away from the plate at approximately 45 degrees and provide a minimum grout head of 12 in. The box shall be sealed to the form to generate the head pressure required to get the grout to flow to the opposite side. The form on the opposite side shall be 2 to 4 in. from the plate edge and shall extend at least 1 in. above the bottom of the plate. On the side of the plate parallel to the direction of grout flow, the forms shall generally be less than 1 in. from the plate but still allow air to vent from beneath the plate during grout placement.