Preparing Activity: USACE Superseding
UFGS-32 01 29.62 (August 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 32 01 29.62

CONCRETE PAVEMENT RAISING
11/18

NOTE: This guide specification covers the requirements for slabjacking of rigid pavements for roads, streets, parking areas, airfield and other general applications.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

1.1 UNIT PRICES

NOTE: Delete paragraphs MEASUREMENT and PAYMENT when lump sum bidding is used.

1.1.1 Measurement

Accurately measure the dry materials by weight or volume if delivered in bulk or packaged in uniform volume sacks. Batch the water through a meter or scale with a totalizer for the day's consumption. Make these measurements in the presence of the Contracting Officer. Submit weigh bills for cement and sand after slabjacking operations are completed to

validate mix proportions used.

1.1.1.1 Quantity of Portland Cement Grout

The quantity of portland cement grout to be paid for will be that actually used in the accepted work.

1.1.1.2 Quantity of Portland Cement

The quantity of portland cement to be paid for will be accurately measured by weight.

1.1.1.3 Number of Holes

The quantity of holes to be paid for will be the number of holes actually drilled to accomplish the work specified and as shown on the drawings.

1.1.1.4 Broken Slabs

Repair or replacement of concrete slabs broken due to jacking will not be measured for payment. Furnish all labor, equipment, tools, and materials necessary to repair or replace broken concrete pavement at no cost to the Government.

1.1.2 Payment

1.1.2.1 Portland Cement Unit Price

The quantity of portland cement, measured as specified, will be paid for at the contract unit price for portland cement. The unit price for portland cement will include full compensation for furnishing labor, grout materials, and tools and equipment; for furnishing, loading and unloading, storing, hauling and handling grout ingredients; for mixing and pumping grout; and for furnishing of manufacturer's test report for each lot of cement. All of the above will be considered in the unit price per kg hundred weight of portland cement.

1.1.2.2 Drilled Holes

The quantity of holes determined as specified, will be paid for at the contract unit price for Drilled Holes, which will include full compensation for furnishing all labor, equipment, tools, materials, and for filling of holes.

1.2 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature

to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C31/C31M	(2022) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C142/C142M	(2017) Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C150/C150M	(2022) Standard Specification for Portland Cement
ASTM C266	(2020) Standard Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles
ASTM C494/C494M	(2019; E 2022) Standard Specification for Chemical Admixtures for Concrete
ASTM C618	(2023; E 2023) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C937	(2016) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C939/C939M	(2022) Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C940	(2022) Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C953	(2017) Standard Test Method for Time of Setting of Grouts for Preplaced-Aggregate

	Concrete in the Laboratory
ASTM C1602/C1602M	(2022) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM D75/D75M	(2019) Standard Practice for Sampling Aggregates

1.3 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.
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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Weigh Bills; G[, [_____]]

Equipment; G[, [_____]]

SD-05 Design Data

Grout Mixture; G[, [_____]]

SD-06 Test Reports

Production Sampling and Testing

Tests, Inspections, and Verifications

SD-07 Certificates

Cement

Grout Mixture

1.4 QUALITY CONTROL

1.4.1 Bench Marks

Determine, establish, and maintain elevations of bench marks for grade control.

1.4.2 Testing Facilities

Perform sampling and testing using a commerical testing laboratory approved in accordance with Section 01 45 00 QUALITY CONTROL 01 45 00.00 40 QUALITY CONTROL. Work requiring testing will not be permitted until the facilities have been inspected and approved. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory validation is not allowed. The laboratory is to maintain this certification for the duration of the project. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.4.3 Cement

Do not use cement until its test report is approved by the Contracting Officer. Sample cement at the mill or shipping point and at the work site. If tests prove that a cement that has been delivered is unsatisfactory, promptly remove it from the work site. Retest cement that has not been used within 6 months after testing when directed by the Contracting Officer. Cement will be rejected if test results are not satisfactory.

1.4.4 Aggregate

Sample aggregates in the presence of the Contracting Officer. Obtain samples in accordance with ASTM D75/D75M that are representative of the materials to be used for the project. Perform all aggregate tests no earlier than [30] [_____] days prior to starting grouting operations. Conduct aggregate testing in a laboratory approved by the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Provisions for Cement

Deliver and store all cementitious materials at a temperature not exceeding 65 degrees C 150 degrees F. Furnish cement in bulk or in suitable bags used for packaging cement. Plainly mark the bags with the manufacturer's name, brand, and lot number. Furnish cement that is dry and free from lumps and caking when delivered. Check shipments of bagged cement for weight when delivered. Provide accurate scales and labor for checking the weight of bagged cement. Approximately 1 percent of each shipment will be selected at random and checked for weight except that additional weight checks will be made to determine compliance with the cement specification when deficiencies in weight are found. Deliver bulk cement, if used, in weathertight carriers and unload it into the storage facilities by means of weathertight conveyors or other suitable means that will completely protect the cement from moisture. Storage facilities are subject to approval. Provide storage facilities that permit easy access for inspection and identification. Store and use different brands of cement separately so that a complete record will be available of the grade of cement used in all batches of grout mixes.

1.5.2 Provisions for Aggregates

Handle and store aggregates at the site so that segregation, intermixing between stockpiles, or contamination by foreign materials does not occur. Prepare and maintain sites for stockpiles to prevent the inclusion of foreign materials with the aggregate. Segregated aggregate is not permitted. Discard aggregate when segregation is apparent at no cost to the Government.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not perform pavement slabjacking when the ambient temperature at the bottom of the pavement slab is less than 5 degrees C 40 degrees F or when the subgrade or aggregate base is frozen.

PART 2 PRODUCTS

2.1 EQUIPMENT

Furnish all equipment, tools, and other apparatus necessary for the proper construction and acceptable completion of the work specified under this contract. The equipment must be approved by the Contracting Officer prior to starting the work. Maintain equipment in good working condition during the progress of the work. Submit list of proposed equipment to be used in performance of construction work including descriptive data.

2.1.1 Grout Plant

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NOTE: When the use of limestone dust grouts is approved, a paddle type mixer may be substituted for the high speed colloidal mixer.

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Provide a grout plant consisting of a positive displacement grout injection pump capable of applying up to 1.72 MPa 250 psi pressure, a high speed colloidal mixing machine, and a grout return system. Produce the

colloidal grout by mixing in a colloidal mill connected to the cone-shaped bottom of a cylindrical drum. Operate the colloidal mill between 800 and 2,000 RPM, creating a high shearing action and subsequent pressure release to make a homogeneous mixture. Provide an injection system capable of continuously pumping grout at rates as low as 5.68 liters 1-1/2 gallons per minute and equipped with pressure monitoring devices and a quick action valving system that can be closed instantly and provide for the grout to be recirculated through the system.

2.1.2 Water Tanker

If water tanks and metered pumps are not an integral part of the plant, provide a water truck equipped with a metered pump for delivery to the grout plant.

2.1.3 Drilling

Provide an air compressor and rock drill or other device capable of drilling the grout injection holes through the pavement and base material. Keep the equipment in good condition. Provide injection holes that are vertical and round. Do not exceed a down-feed pressure of 1.38 MPa 200 psi whether by hand or mechanical means.

2.1.4 Flow Cone

Provide a flow cone with necessary components in accordance with ASTM C939/C939M so that the consistency of the mixture can be determined.

2.1.5 Miscellaneous

Provide all necessary hoses; valving, valve manifolds, and positive cut-off and bypass provisions to control pressure and volume; pressure gauges with gauge protectors; expanding packers for positive seal grout injection; wood plugs; hole washing tools; and drill steel and bits.

2.2 MATERIALS

2.2.1 Portland Cement

Provide portland cement Type [_____] meeting the requirements of ASTM C150/C150M. Do not use cement salvaged by cleaning bags mechanically or otherwise, or from discarded bags of cement. Use cement that has been stored at the site for 60 days or more before using cement of lesser age.

2.2.2 Pozzolans and Fly Ash

Provide pozzolans and fly ash meeting the requirements of ASTM C618.

2.2.3 Mineral Aggregate

Provide aggregate to be used for slabjacking consisting of natural sand, manufactured sand, or a combination of natural and manufactured sand and limestone dust. If the aggregate is a combination of separately processed sizes from the same or different sources, or a blend of different materials, batch the different components separately or blend under approved conditions prior to delivery to the batching plant.

2.2.3.1 Particle Shape

Provide particles of the aggregate that are generally spherical or cubical in shape. Aggregates containing flat platelet grains or rhombohedral grains will not be approved.

2.2.3.2 Grading

Provide aggregate conforming to the following gradation when tested in accordance with ASTM C136/C136M and ASTM C117.

Sieve designation U.S. Standard square mesh	Percentage by weight passing
2.36 mmNo. 8	100
1.18 mmNo. 16	80-95
0.30 mmNo. 50	50-70
0.075 mmNo. 200	25-45

2.2.3.3 Deleterious Materials

Do not exceed the following limits for deleterious materials in the aggregate when tested in accordance with ASTM C142/C142M.

Material	Percentage by Weight
Clay lumps	2.0
Coal and lignite	1.0

2.2.4 Chemical Admixtures

Provide chemical admixtures that are proposed to be used to assist in pumping grouts or to compensate for climatic conditions conforming to ASTM C494/C494M and ASTM C937.

2.2.5 Water

Provide water for mixing and curing that is fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water, or water from concrete production operations may be used if it meets the requirements of ASTM C1602/C1602M.

2.3 MIXES

2.3.1 Proportioning of Materials

Proportion the grout mixture to be used for slabjacking as follows:

a. One part (by volume) portland cement.

b. Three parts (by volume) aggregates or a mixture of aggregates and pozzolans or fly ash.

c. Water to achieve fluidity.

d. Additives (when approved), high range water reducers, water reducers, fluidifiers.

2.3.2 Grout Mixture

Submit certified mix designs by an approved commerical laboratory for each type of concrete, grout, or blended material including a complete list of ingredients, admixtures, and set time. Include certificates for cement, cementitious materials, and admixtures. Proportion and test a mix design to meet the specification requirements. Provide portland cement grout mixture used for slabjacking consisting of portland cement, pozzolan or fly ash, limestone dust, sand, and water. The use of accelerators, high range water reducers and fluidifiers are subject to the approval of the Contracting Officer. Do not produce grout until the mix design has been approved.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Submit certified copies of test reports for aggregates, cement, and fly ash not less than [30] [_____] days before the material is required in the work and daily during construction. Provide certified reports of inspections and laboratory tests including analysis and interpretation of test results. Properly identify each report by contract number, location, quantity of material placed, and timed events of milestones. Describe test methods used and compliance with specified standards.

2.4.1 Daily Report

Provide daily mixture test results of the materials and additives used in the mixture including aggregate gradation, flow cone times, shrinkage and expansion observed, time of initial set, and 1-day, 3-day, and 7-day strengths of previous day's placements.

2.4.2 Compressive Strength

Provide a minimum 7-day strength not less than 4 MPa 600 psi as determined by tests made in accordance with ASTM C39/C39M. Fabricate test specimens from the materials being used on the project including water and admixtures. Make, cure, and test specimens as described in paragraph FIELD TEST SPECIMENS in PART 3.

2.4.3 Expansion

Determine the expansion in accordance with ASTM C940 at the beginning of the job and whenever the mix proportions are changed.

2.4.4 Set Time

Determine the time of initial set in accordance with ASTM C266 or ASTM C953 at the beginning of the job and when a different lot of cement is used.

2.4.5 Fluidity

Test the fluidity of each batch of grout slurry in accordance with

ASTM C939/C939M. Provide time of efflux (fluidity) for pozzolanic grouts that range from 16 to 26 seconds. Provide time of efflux for limestone dust grouts that range from 22 to 32 seconds. A flow cone time of efflux of 9 to 15 seconds can be used during the initial injection at each hole.

PART 3 EXECUTION

3.1 PAVEMENT INSPECTION

Closely examine the slabs for any existing cracks prior to jacking any pavements. Perform this investigation with the Contracting Officer. Both parties must agree regarding the existing condition of the pavement with existing cracks noted and marked.

3.2 DRILLING HOLES FOR GROUT INJECTION

Drill grout injection holes in a pattern as shown on the drawings. Drill grout injection holesto a maximum diameter of 50 mm 2 inches. Drill holes vertically to a depth sufficient to penetrate through any chemically stabilized base, but not more than 75 mm 3 inches into the subgrade. Drill holes so that breakout does not occur at the bottom of the slab.

3.3 WASH HOLES

Subject to the Contracting Officer's approval, holes may be washed or air blown to create a small cavity to allow the initial spread of grout.

3.4 JACKING

Erect string lines that will be blocked up from the pavement high points to monitor movement prior to jacking operations. Lower into the holes an expanding rubber packer or other approved device providing a positive seal and connected to the discharge hose on the grout plant. Do not extend the discharge end of the packer or hose below the lower surface of the concrete pavement. Pump in a pattern and in the amount required to raise the pavement to string line grade. Continuous pressures up to 1.38 MPa 200 psi are permitted. Pressures within the range of 1.38 MPa 200 psi to 2.07 MPa 300 psi are allowed only for short periods. In the event the pavement is bonded to the aggregate base, brief pressure rises (10 seconds or less) up to 4.14 MPa 600 psi are allowed. Loss of grout through cracks, joints, other injection holes, or from back pressure in the hose or in the shoulder area is not permitted. Do not use grout for jacking that is held for more than 1 hour in the mixer or in the injection pump or hose.

3.5 RAISING OF SLABS

Do not raise the slabs more than 5 mm 1/4 inch when pumping in any one hole at any time. Do not raise any part of a slab so that it leads any other part of the slab or any adjacent slab more than 5 mm 1/4 inch at any time. Keep the entire slab and all adjacent slabs on the same plane at all times within the 5 mm 1/4 inch tolerance. Make observations to ensure that when pumping from one hole, the grout flows to adjacent holes filling all voids. Slabs can be cut to prevent breakage when it is bound against an adjoining slab. If the temperature is 27 degrees C 80 degrees F or higher during the jacking operation, moisten the slabs sufficiently to prevent expansion of the slabs.

3.6 SEALING OF INJECTION HOLES

Immediately remove the packer and plug the hole temporarily with a tapered wooden plug after jacking has been completed at any one hole. Do not remove the temporary wooden plugs until the grout has set sufficiently so that back pressure will not force it through the hole. Permanently seal each hole flush with the pavement surface with a fast setting sand/cement or other patch material approved by the Contracting Officer. Provide patch material having a minimum thickness of 75 mm 3 inches.

3.7 PLAN GRADE REQUIREMENTS

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NOTE: The designer will evaluate which procedure, i.e., grinding or raising the adjacent pavement, should be used to correct for overjacking. If the slabjacking is to be accomplished adjacent to a fixed structure it will be necessary to grind or remove the overjacked pavement. The 3 mm 1/8 inch tolerance is appropriate for airfield and high-speed roadway pavements. For low-speed roadways and parking areas a tolerance of 6 mm 1/4 inch should be specified.

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Provide qualified personnel and equipment for determining the proper elevations required to conform to the plan elevations. Perform jacking operations so that all slabs within the work area present an even grade at each joint and that do not vary from the plan grade elevations by more than [3] [6] mm [1/8] [1/4] inch. If slabs are found that are lower than the specified tolerance from the plan grade, continue jacking these slabs until the tolerance is met. [If slabs are found that are higher than the specified tolerance, raise the grade of the surrounding pavement to a newly established grade as determined by the Contracting Officer.] [Grind individual sections of pavement that are raised above the specified tolerances.] Should the overjacking be greater than 5 mm 1/4 inch the Contracting Officer has the option to require removal and replacement of the pavement. Perform repairs to jacked slabs at no additional cost to the Government.

3.8 REPLACING AND REPAIR OF DAMAGED PAVEMENT

Replace or repair any slabs broken due to jacking as determined by the Contracting Officer. Cracks emanating radially from the grout injection holes will be presumed to be caused by improper injection techniques. For each 1.5 m 5 feet of such crack measured, the pay quantity will be reduced by 0.03 cubic meters 1 cubic foot of grout. In the event that transverse cracks develop between adjacent grout injection holes, repair these cracks by an epoxy injection method to the satisfaction of the Contracting Officer. The Contracting Officer may require the removal and replacement of the entire slab or a portion of the slab damaged by radial or transverse cracks at no cost to the Government. Replace the pavement in accordance with Section 32 13 14.13 CONCRETE PAVING FOR AIRFIELDS AND OTHER HEAVY DUTY PAVEMENTS.

3.9 PRODUCTION SAMPLING AND TESTING

3.9.1 Aggregates

Sample aggregates delivered to the mixer during slabjacking operations to determine compliance with specifications. Test aggregate gradation daily.

3.9.2 Field Test Specimens

Take samples of grout in the field from mixtures used for jacking to determine the adequacy of control of materials and the proportioning, consistency, and mixing of the grout. Take three sets of three cylinders from each day's operation or when the mixture proportions are changed. Make and cure the test cylinders in accordance with ASTM C31/C31M and test them in accordance with ASTM C39/C39M for strength. Additional sets of test cylinders will be required at the start of jacking operations and when the aggregate source, aggregate characteristics, or mix design is changed until the Contracting Officer is satisfied that the grout mixture being used complies with the strength requirements specified. Use an approved commerical laboratory to cure and test specimens for compressive strength. The test result will be the average of the strength of the 3 cylinders. If the average strength of cylinders falls below the specified strength, the Contracting Officer may require changes in the mix proportions.

3.10 PROTECTION OF PAVEMENT

Do not permit traffic on the pavement slab until the grout has obtained a minimum set. Include the minimum set time in the grout mixture submittal. Adjust the minimum set time daily to account for variations in temperature.

3.11 ACCEPTANCE OF WORK

Prior to acceptance, remove loose concrete, joint filler, or grout spilled on the surface or shoulder. Remove waste construction material and leave the surrounding areas in a neat and orderly condition prior to opening to traffic or final acceptance.

-- End of Section --