



Fill and Backfill for Foundations *Specification Provisions*

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3. SPECIFICATION PROVISIONS

3.1 GENERAL

3.1.1 THE PLANS AND SPECIFICATIONS define the project in detail and show how it is to be constructed. They are the basis of the contractor's estimate and of the construction contract itself. The drawings show the physical characteristics of the structure, and the specifications cover the quality of materials, workmanship, and technical requirements. Together they form the guide and standard of performance that will be required in the construction of the project. Once the contract is let, the plans and specifications are binding on both the Owner and the contractor and are changed only by written agreement. For this reason, it is essential that the contractor and the Owner's representative anticipate and resolve differences that may arise in interpreting the intent and requirements of the specifications. The ease with which this can be accomplished will depend on the clarity of the specifications and the training and experience of the individuals concerned. Understanding of requirements and working coordination can be improved if unusual requirements are brought to the attention of prospective bidders and meetings for discussion are held prior to construction. Situations will undoubtedly arise that are not covered by the specifications, or conditions may occur that are different from those anticipated. Close cooperation is required between the contractor and the inspection personnel in resolving situations of this nature; if necessary, to be fair to both parties a change order should be issued.

3.1.2 PREPARATION OF CONTRACT SPECIFICATIONS is easier if an outline of general requirements is available to the specification writer. However, it would be virtually impossible to prepare a guide specification that anticipates all problems that may occur on all projects. Therefore, contract specifications must be written to satisfy the specific requirement of each project. Some alternate specification requirements that

might be considered for some projects are discussed below.

Soil Group	Soil Types	Degree of Compaction	Fill and Backfill				Field Control	
			Equipment	Typical Equipment and Procedures for Compaction No. of Passes or Coverages	Comp. Lift Thick., in.	Placement Water Content		
Pervious (Free-Draining)	CV CP SV SP	90 to 95% of CE 55 maximum density 75 to 85% of relative density	Vibratory rollers and compactors	Indefinite	Indefinite	Saturate by flooding	Control tests at intervals to de- termine degree of compaction or relative density	
			Rubber-tired roller ^b	2-3 coverages	12			
			Crawler-type tractor ^c	2-3 coverages	8			
			Power hand tamper ^d	Indefinite	6			
		Semi-compacted	85 to 90% of CE 55 maximum density 65 to 75% of relative density	Rubber-tired roller ^b	2-3 coverages	14	Saturate by flooding	Control tests as noted above, if needed
	Crawler-type tractor ^c			1-2 coverages	10			
Power hand tamper ^d	Indefinite			8				
		Controlled routing of construction equipment	Indefinite	8-10				
Semi-pervious and Impervious	GM GC SM SC ML CL OL	90 to 95% of CE 55 maximum density	Rubber-tired roller ^b	2-3 coverages	8	Optimum water content	Control tests at intervals to de- termine degree of compaction	
			Sheepsfoot roller ^e	4-8 passes	6			
			Power hand tamper ^d	Indefinite	4			
		Semi-compacted	85 to 90% of CE 55 maximum density	Rubber-tired roller ^b	2-4 coverages	10	(A) Optimum water content (B) By observation; wet side-maximum water content at which material can satisfactorily op- erate, dry side- minimum water content required to bond particles and which will not re- sult in voids or nonuniform material	(A) Control tests as noted above, if needed (B) Field con- trol exercised by visual in- spection in specimen of action of compacting equipment
	Sheepsfoot roller ^e			4-8 passes	8			
	Crawler-type tractor ^c			3 coverages	6			
	Power hand tamper ^d			Indefinite	4			
			Controlled routing of construction equipment	Indefinite	8-8			

Note: The above requirements will be adequate in relation to most construction. In special cases where tolerable settlements are unusually small, it may be necessary to employ additional compaction equivalent to 95 to 100% of compaction effort. A coverage consists of one application of the wheel of a rubber-tired roller or the threads of a crawler-type tractor over each point in the area being compacted. For a sheepsfoot roller, one pass consists of one movement of a sheepsfoot roller drum over the area being compacted.

^a From TM 5-818-1.

^b Rubber-tired rollers having a wheel load between 19,000 and 25,000 lb and a tire pressure between 80 and 100 psi.

^c Crawler-type tractors weighing not less than 20,000 lb and exerting a foot pressure not less than 6-1/2 psi.

^d Power hand tampers weighing more than 100 lb; pneumatic or operated by gasoline engine.

^e Sheepsfoot rollers having a foot pressure between 250 and 500 psi and tamping foot 7 to 10 in. in length with a face area between 7 and 16 sq in.

Table 3-1

Summary of compaction criteria

3.2 EXCAVATION. The section of the specifications dealing with excavation contains information on drainage, shoring and bracing, removal and stockpiling, and other items, and refers to the plans for grade requirements and slope lines to be followed in excavating overburden soils and rock.

3.2.1 DRAINAGE. For some projects the specifications will require the contractor to submit a plan of his excavation operations to the Owner for review. The plans and specifications will require that the excavation and subsequent construction and backfill be carried out in the dry. To meet this requirement, a dewatering system based on the results of groundwater studies may be included in the plans. Also, for some projects the specifications may require the contractor to submit his plan for controlling groundwater conditions. The specifications should likewise indicate the possibility of groundwater conditions being different from those shown in the subsurface investigation report due to seasonal or unusual variations or insufficient information, since the contractor will be held responsible for controlling the groundwater flow into the excavation regardless of the amount. To this end, the specifications should provide for requiring the contractor to submit a revised dewatering plan for review where the original dewatering plan is found to be inadequate.

3.2.2 SHORING AND BRACING. The specifications either will require the contractor to submit for review his plans for the shoring and bracing required for excavation or will specify shoring and bracing required by subsurface and groundwater conditions and details of the lines and grades of the excavation. In the latter case, the contractor may be given the option to submit alternate plans for shoring and bracing for review by the Owner. The plans will present the necessary information for the design of such a system if the contractor is allowed this option.

3.2.3 STOCKPILING. Provisions for stockpiling materials from required excavation according to type of backfill may or may not be included in the specifications. Generally, procedures for stockpiling are left to the discretion of the contractor, and a thorough

study should be made to substantiate the need for stockpiling before such procedures are specified. There are several conditions under which inclusion of stockpiling procedures in the specifications would be desirable and justified. Two such conditions are discussed in the following paragraphs.

3.2.3.1 UNDER CERTAIN CONDITIONS, such as those that existed in the early stages of missile base construction where time was an important factor, it may be necessary or desirable to award contracts for the work in phases. As a result, one contractor may do the excavating and another place the backfill. It is probable that the excavation contractor will have little or no interest in stockpiling the excavated materials in a manner conducive to good backfilling procedures. When such a situation can be foreseen, the specifications should set forth stockpiling procedures. The justification for such requirements would be economy and optimum use of materials available from required excavation as backfill.

3.2.3.2 THE SPECIFICATIONS will contain provisions for removing, segregating, and stockpiling or disposing of material from the excavation and will refer to the plans for locations of the stockpiles. The subsoil conditions and engineering characteristics requirements may state that the specifications must be quite definite concerning segregation and stockpiling procedures so that the excavated materials can be used most advantageously in the backfill. The specification may require that water be added to the material or the material be aerated as it is stockpiled to approximate optimum water content, that the stockpile be shaped to drain and be sealed from accumulation of excess water, and that the end dumping of material on the stockpile be prohibited to prevent segregation of material size or type along the length of the stockpile.

3.2.3.3 AN ALTERNATIVE to this latter action would be to specify the various classes of backfill required and leave the procedure for stockpiling the materials by type to the discretion of the contractor. In this case, the contractor should be required to submit a detailed plan for excavating and stockpiling the material. The plan should indicate the

location of stockpiles for various classes of backfill so that the material can be tested for compliance with the specifications. The contractor may elect to obtain backfill material from borrow or commercial sources rather than to separate and process excavated materials. Then the specifications should require that stockpiles of the various classes of needed backfill be established at the construction site in sufficient quantity and far enough in advance of their use to allow for the necessary testing for approval unless conditions are such that approval of the supplier's stockpile or borrow source can be given.

3.3 FOUNDATION PREPARATION. The provisions for preparation for structures will generally not be grouped together in the specifications but will appear throughout the earthwork section of the specifications under paragraphs on excavation, protection of foundation materials, backfill construction, and concrete placement. When a structure is to be founded on rock, the specifications will require that the rock be firm, unshattered by blasting operations, and not deteriorated from exposure to the weather. The contractor will be required to remove shattered or weathered rock and to fill the space with concrete.

3.3.1 SPECIFICATIONS FOR STRUCTURES FOUNDED ON SOIL require the removal of all loose material and all unsuitable material, such as organic clay or silt, below the foundation grade. When doubt exists as to the suitability of the foundation materials, a soils engineer should inspect the area and his recommendations should be followed. When removal of rock material below the planned foundation level is required, the overexcavation will usually require filling with concrete. The specifications also require dewatering to the extent that no backfill or structural foundation is placed in the wet.

3.3.2 SPECIFICATIONS FOR PREPARATION OF THE SOIL FOUNDATION to receive backfill require removing all debris and foreign matter, making the area generally level, and scarifying, moistening, and compacting the foundation to a specified depth,

generally 12 inches. Specific provisions may or may not be given with respect to leveling procedures.

3.4 BACKFILL OPERATIONS. The specifications define the type or types of material to be used for backfill construction and provide specific instructions as to where these materials will be used in the backfill, The percentage of CE 55 maximum dry density to be obtained, determined by a designated standard laboratory compaction procedure, will be specified for the various zones of backfill. The maximum loose-lift thickness for placement will also be specified. Because of the shape of the compaction curve, the degree of compaction specified can be achieved only within a certain range of water contents for a particular compaction effort. Though not generally specified, the range of water contents is an important factor affecting compaction.

3.4.1 THE SPECIFICATIONS SOMETIMES STIPULATE the characteristics and general type of compaction equipment to be used for each of the various types of backfill. Sheepsfoot or rubber-tired rollers, rammer or impact compactors, or other suitable equipment are specified for fine-grained, plastic materials. Noncohesive, freedraining materials are specified to be compacted by saturating the material and operating crawler-type tractor, surface or internal vibrators, vibratory compactors, or other similar suitable equipment. The specifications generally will prohibit the use of rock or rock-soil mixtures as backfill in this type of construction. However, when the use of backfill containing rock is permitted, the maximum size of the rock is given in the specifications along with maximum lift thickness, loading, hauling, dumping, and spreading procedures, type of compaction equipment, and method of equipment operation. The specifications should protect areas where heavy equipment cannot operate. Rock-soil mixtures having greater than 8 to 10 percent binder should be prohibited in all areas. In the case of backfill containing rock, the density is not generally specified. Obtaining adequate density is usually achieved by specifying the compaction procedures. The specifications may require that these procedures be developed in field test sections.

3.4.2 SPECIFICATIONS MAY ALSO REQUIRE specific equipment and procedures to ensure adequate bedding for round-bottom structures such as tunnels, culverts, conduits, and tanks.

3.4.3 THE SPECIFICATIONS will state when backfill may be placed against permanent concrete construction with respect to the time after completion; this time period is usually from 7 to 14 days. To provide adequate protection of the structures during backfill construction, the specifications require that the backfill be built up symmetrically on all sides and that the area of operation of heavy equipment adjacent to a structure be limited. Also, the minimum thickness of compacted materials to be placed over the structures by small compact compaction equipment, such as vibratory plate or rammer type, will be specified before heavy equipment is allowed to operate over the structure. The specifications require that the surface of the backfill be sloped to drain at all times when necessary to prevent ponding of water on the fill. The specifications also provide for groundwater control, so that all compacted backfill will be constructed in the dry. Where select, freedraining, cohesionless soils of high permeability are required in areas where compaction is critical, the specifications list gradation requirements. Gradation requirements are also specified for materials used for drains and filters.

3.4.4 UNUSUALLY SEVERE SPECIFICATION REQUIREMENTS may be necessary for backfill operations in confined areas. The requirements may include strict backfill material type limitation, placement procedures, and compaction equipment.

3.4.5 IT IS SUGGESTED it should not be the policy of the Owner to inform the contractor of ways to accomplish the necessary protection from freezing temperatures. However, to ensure that adequate protection is provided, it may be necessary to specify that the contractor submit detailed plans for review for such protection.

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