

# Engineering Standard

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SAES-A-114

28 April, 2004

## Excavation and Backfill

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## Saudi Aramco DeskTop Standards

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## 1 Scope

This Engineering Standard defines the requirements for excavation, placement, inspection, and management of earth and rock materials during construction and/or maintenance.

## 2 Conflicts and Deviations

- 2.1 Any conflicts between this Specification and other applicable Saudi Aramco Materials System Specifications (SAMSSs), Engineering Standards (SAESs), Standard Drawings (SASDs) or industry standards, codes, and forms shall be resolved in writing by the Company through the Manager, Consulting Services Department.
- 2.2 Direct all requests to deviate from this Specification in writing to the Company Representative, who shall follow internal company procedure [SAEP-302](#) and forward such requests to the Manager, Consulting Services Department of Saudi Aramco, Dhahran.

## 3 References

The selection of material and equipment, and the design, construction, maintenance, and repair of equipment and facilities covered by this Standard shall comply with the latest edition of the references listed below, unless otherwise noted.

### 3.1 Saudi Aramco References

#### Saudi Aramco Engineering Procedure

<a href="#">SAEP-302</a>	<i>Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement</i>
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#### Saudi Aramco Engineering Standards

<a href="#">SAES-A-111</a>	<i>Borrow Pit Requirements</i>
<a href="#">SAES-L-450</a>	<i>Construction of on-Land and Near-Shore Pipelines</i>
<a href="#">SAES-L-460</a>	<i>Pipeline Crossings Under Roads and Railroads</i>
<a href="#">SAES-Q-001</a>	<i>Criteria for Design and Construction of Concrete Structures</i>
<a href="#">SAES-Q-006</a>	<i>Asphalt Concrete Paving</i>
<a href="#">SAES-Q-007</a>	<i>Foundations and Supporting Structures for Heavy Machinery</i>

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[SAES-S-070](#)

*Installation of Utility Piping Systems*

Saudi Aramco General Instructions

*GI-0002.100*

*Work Permit System*

*GI-1021.000*

*Street and Road Closure: Excavation,  
Reinstatement and Traffic Controls*

Saudi Aramco Manuals

Saudi Aramco Construction Safety Manual

Saudi Aramco Blasting Services Manual

Inspection document "Schedule Q"

3.2 Industry Codes and Standards

American Society for Testing and Materials

*ASTM C136*

*Sieve Analysis of Fine and Coarse Aggregates*

*ASTM D422*

*Particle-Size Analysis of Soils*

*ASTM D1140*

*Standard Test Methods for Amount of Material in  
Soils Finer Than the No. 200 (75-um) Sieve*

*ASTM D1556*

*Standard Test Method for Density and Unit  
Weight of Soil in Place by the Sand-Cone  
Method*

*ASTM D1557*

*Laboratory Compaction Characteristics of Soil  
Using Modified Effort 56,000 ft-lbf/ft<sup>3</sup> (2700  
KN- M/M<sup>3</sup>)*

*ASTM D2167*

*Standard Test Method for Density and Unit  
Weight of Soil in Place by the Rubber Balloon  
Method*

*ASTM D2487*

*Classification of Soils for Engineering Purposes*

*ASTM D2922*

*Standard Test Methods for Density of Soils and  
Soil-Aggregate in Place by Nuclear Methods  
(Shallow Depth)*

*ASTM D2937*

*Standard Test Method for Density of Soil in Place  
by the Drive-Cylinder Method*

*ASTM D4253*

*Maximum Index Density and Unit Weight of Soils  
Using a Vibratory Table*

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*ASTM D4254*                      *Minimum Index Density and Unit Weight of Soils  
and Calculation of Relative Density*

*ASTM D4318*                      *Liquid Limit, Plastic Limit and Plasticity Index of  
Soils*

Process Industry Practices

*PIP CVS02100*                      *Site Preparation, Excavation, and Backfill  
Specification*

#### 4 Definitions

**Brackish Water:** Water with Total Dissolved Solids of 10,000 ppm or more.

**Clean Sand:** Soil meeting the following gradation containing less than 3% weight of organic material or clay:

Sieve Size	Percent Passing
¼ in (6.25 mm)	100
No. 10 (2.00 mm)	90 - 100
No. 200 (0.075 mm)	10 or less

**Company Representative:** Saudi Aramco's authorized representative with overall authority and responsibility for the project.

**Contract or Contract Documents:** Any and all documents, including design drawings, which Saudi Aramco has transmitted or otherwise communicated, either by incorporation or by reference, and made part of the legal contract or purchase order agreement between Saudi Aramco and the Contractor.

**Contractor:** The party responsible for performing excavation and backfill, including work executed through the use of sub-contractors

**Dune Sand:** is wind-deposited sand consisting of relatively single-sized particles generally passing the No. 16 sieve (1.18 mm) and usually containing less than 10% soil particles passing the No. 200 sieve (0.074 mm).

**Fill Material:** see section 6.2.1.

**Hard Rock:** see Rock Excavation, section 7.5.

**Marl:** is a wide variety of calcareous soil materials found in Saudi Arabia which may vary from clay to gravel sizes and often include cobble and boulder sized pieces.

**Rocks:** have various hardness and engineering properties. "Rock" may refer to anything from boulder-size individual pieces to hard, intact bedrock. See section 7.5 for classification of rock by excavation methods.

**Sabkha:** is a saline (generally coastal) deposit generally consisting of saturated, loose silty sand and possibly clay.

**Select Fill Material:** see section 6.2.2

**Soft Rock:** see Normal Excavation, section 7.5.

## 5 General

### 5.1 Quality Control

The Contractor shall institute a quality control program that will verify or ensure that the work performed under the contract meets the requirements of this Standard and the design drawings as per Inspection document "Schedule Q". Saudi Aramco shall have access to all facilities and records of the Contractor for the purpose of conducting performance inspection/audits. During the audit, any inspection, test reports, and/or engineering analyses and calculations associated with the scope of work shall be furnished upon request.

#### Inspection & Testing Agency

5.1.1 The Contractor's quality control testing requirements shall be performed by either a Saudi Aramco-approved independent testing agency or by the Contractor's own laboratory, approved by the Saudi Aramco Inspection Department.

5.1.2 All required laboratory and field acceptance tests required in Section 6.3.3 and all seismic refraction testing required in Section 7.5 shall be performed by a Saudi Aramco-approved independent testing agency.

5.1.3 If testing and/or inspection is done by Saudi Aramco, this does not relieve the Contractor of the responsibility to meet all requirements of this Standard. Should it be later found that some work has been completed not in compliance with this Standard, it shall remain the Contractor's responsibility to repair or reconstruct deficient work until specifications are met at no cost to Saudi Aramco.

### 5.2 Submittals

The Contractor shall be responsible for transmitting the following submittals to the Saudi Aramco Company Representative:

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- 5.2.1 Bi-weekly reports including all test logs and comments. These reports include density and moisture content test logs indicating location by coordinates and elevation. A complete record of all test logs and comments, compiled at earthwork completion, for permanent project records, shall also be submitted.
- 5.2.2 Borrow (Fill) Materials and Water. Sources and test results of all borrow materials and compaction water used for fill prior to beginning fill operations.
- 5.2.3 Excavation Plan, submitted to Loss Prevention as per the Construction Safety Manual, Part II, Section 2.1. All shoring and sheeting materials and systems will meet the minimum requirements established within the Construction Safety Manual, Part II, Section 2. If excavation bracing is required, the Contractor shall:
  - a) Describe the materials and shoring system to be used.
  - b) Indicate whether or not any components will remain after filling or backfilling.
  - c) Provide plans, sketches, and/or detail along with calculations prepared by Saudi Aramco or a licensed engineering establishment.
  - d) Indicate the sequence and method of shoring installation and removal.
- 5.2.4 Dewatering. If dewatering of an excavation is required, the Contractor shall submit proposed methods and details to the Saudi Aramco Company Representative for review, before beginning dewatering and excavation.

### 5.3 Environmental

#### 5.3.1 Contaminated Soils

Known contaminated soils within the construction limits shall be managed in accordance with a contaminated soil management plan provided by Saudi Aramco prior to the start of excavation. If unexpected soil contamination is encountered during the work, the Contractor shall stop work and notify the Saudi Aramco Company Representative immediately.

#### 5.3.2 Erosion/Sediment Control

The Contractor shall ensure that all areas shall be maintained using temporary erosion and sediment control measures during construction or

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until relieved by the Saudi Aramco Company Representative or until permanent measures are completed and functioning in a satisfactory manner.

#### 5.3.3 Dust Control

The Contractor shall employ dust control measures during construction. The adequacy of the dust control shall be determined by the Saudi Aramco Company Representative.

### 5.4 Drainage and Dewatering

5.4.1 All temporary drainage and dewatering methods and disposal of water are subject to approval by Saudi Aramco.

5.4.2 The Contractor shall employ temporary drainage measures during construction. Ponding of water on placed fill or within excavations shall not be allowed.

5.4.3 Surface water shall be prevented from flowing into excavations by ditching, trenching, forming protective swales, pumping, or other approved measures.

5.4.4 If required in the contract documents, prior to excavation, an approved dewatering system shall be installed and operated when necessary to lower the groundwater.

5.4.5 All diverted and pumped water shall flow to specified collection areas and shall be disposed of as directed by the Saudi Aramco Company Representative. Excavations for foundations and other underground installations shall not be used as temporary drainage ditches.

### 5.5 Safety and Protection

All excavation and trenching shall be done in accordance with all Saudi Aramco safety requirements including, but not limited to, the Saudi Aramco Construction Safety Manual Part II, Section 2.

#### 5.5.1 Required Permits

All necessary permits must be obtained from Saudi Aramco prior to performing any earthwork. One or more of the following permits are required as applicable:

- Saudi Aramco Form "Work Permit" (GI-0002.100)
  - Saudi Aramco Form "Borrow Pit Permit" ([SAES-A-111](#))
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- Saudi Aramco Form "Land Use Permit"
- Saudi Aramco Form "Site and Drainage Permit"
- Other applicable Saudi Aramco Permits as specified in the Project Execution Plan.

## 5.5.2 Safety

- 5.5.2.1 The Contractor shall place and maintain in good condition temporary fences, guardrails, barricades, lights, shoring, bracing, and other protective measures required for the safety of personnel and the premises as described in the Saudi Aramco Construction Safety Manual.
- 5.5.2.2 Any construction or maintenance work which restricts the full use of a pedestrian or vehicular roadway shall comply with GI-1021.000, Street and Road Closure: Excavation, Reinstatement and Traffic Controls.
- 5.5.2.3 A clear space of at least 0.6 m (2 ft) shall be maintained on all sides of an excavation or trench. When any excavation or trench reaches a depth of 1.2 m (4 ft) or when soil banks are greater than 1.5 m (5 ft), shoring shall be installed or the sides shall be sloped or benched and the trench treated as a confined space in accordance with the Saudi Aramco Construction Safety Manual. A safe means of entry and exit shall be provided for all excavations and trenches every 7.5m.
- 5.5.2.4 Excavations shall be inspected daily by the Contractor for possible cave-ins, failures of protective systems and equipment, hazardous atmospheres or other hazardous conditions. Inspection shall also be done after rains and blasting. If there is an unsafe condition, workers shall not be allowed to enter the excavation.
- 5.4.2.5 Unless otherwise specified, all known utilities within the project limits will be located and marked by Saudi Aramco or noted in the contract documents prior to earthwork. In addition, the Contractor shall contact all Saudi Aramco utilities departments to determine the locations of underground utilities. Other utility locations may become evident as earthwork progresses which may necessitate work to stop until utilities are identified and specific direction is provided by Saudi Aramco. Whenever the presence of underground utilities is known or suspected or the excavation is around or near
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electrical substations, mechanical excavators shall not be used until all underground utilities have been exposed by hand excavation.

### 5.5.3 Protection

- 5.5.3.1 No excavation is permitted under existing foundations. Excavations are not allowed to intersect a 45 degree plane extending downward from the bottom edge of existing foundations unless an engineered support system is in place prior to the start of work or the excavation is in stable rock.
- 5.5.3.2 Excavations adjacent to existing underground installations (e.g., piping, manholes, electrical and duct banks) or sidewalks shall use bracing and shoring to protect those installations during construction.
- 5.5.3.3 All reference points, property markers, bench marks, etc., will be carefully maintained during excavation, backfilling, compaction and earthwork. Unless otherwise specified, damage to a reference point by the Contractor during performance of the work shall be repaired or replaced by the Contractor to the satisfaction of the Saudi Aramco Company Representative at no cost to Saudi Aramco.
- 5.5.3.4 The Contractor shall be responsible for preserving and avoiding damage to trees, shrubs, and all other vegetation in the areas beyond the designated excavation area.

### 5.5.4 Rock Blasting

All rock blasting shall follow the procedures in the Saudi Aramco Blasting Services Manual.

### 5.5.5 Hazards

Whenever Saudi Aramco determines that any excavation or embankment or fill on Saudi Aramco property which was created by a Contractor and which is a hazard to life and limb, or endangers property, or adversely affects the safety, use or stability of a roadway or drainage channel, the responsible contractor, upon receipt of a notice in writing from Saudi Aramco, shall immediately repair or eliminate such excavation or embankment so as to eliminate the hazard.

## 6 Fill and Backfill

### 6.1 General

Fill and backfill materials shall be from either on-site excavation, designated borrow areas, or off-site sources conforming to the following criteria or as recommended by a geotechnical report. All borrow material and its source of supply shall be approved by Saudi Aramco. Stockpiles of cohesive soil shall be protected from freezing.

### 6.2 Fill and Backfill Materials

Fill or backfill materials shall meet the requirements given in Sections 6.2.1 or 6.2.2 below. Other fill materials may be used with the approval of the Supervisor, Civil Engineering Unit, Mechanical & Civil Engineering Division, Consulting Services Department.

'Fill Material' shall be used for all fills except where 'Select Fill Material' is specified. As a minimum, 'Select Fill Material' shall be used within 0.6 m (2 ft) of the bottom elevation of foundations, spread footings, or slabs-on-grade when fill is required to achieve final grade. 'Select Fill Material' shall also be specified for backfill which will be in contact with concrete or steel structures.

#### *Commentary Note:*

*Foundations may be constructed directly on undisturbed soil. Excavation of undisturbed soil and replacement with Select Fill Material should not be performed except as noted in 7.2.2 or as recommended in a geotechnical report.*

Soils shall be classified per ASTM D2487.

#### 6.2.1 Fill Material

Fill material shall consist of gravel, sand and/or marl. The maximum size of the fill material shall be one-half the lift thickness or 75 mm (3 inches), whichever is less. Fill material shall be free of frozen lumps, organic matter, trash, chunks of highly plastic clay or other unsatisfactory material.

#### 6.2.2 Select Fill Material

Select fill shall be composed only of inorganic material and shall have 100% passing the 5 cm (2 in) sieve and from 0 to 20% passing the No. 200 sieve. That portion of the material passing the No. 40 sieve shall have a maximum liquid limit of 35 and a maximum plasticity index of 12 per ASTM D4318. Liquid limit and plastic limit tests are not required for select fill material with less than 15% passing the No. 200 sieve.

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### 6.2.3 Compaction Water

Water used for compaction of fill material shall be reasonably free of salts, oil, acid, alkalis, organic matter, or other deleterious substances. Use of water with a TDS in excess of 10,000 ppm such as brackish water, seawater or water obtained from ground pits such as subkha water is not allowed unless it is proven and verified by the Company Representative and the Project Inspection Representative that there is no other source of water available within 20km and all concrete to be supported by or buried within the fill is designed for either Exposure Type II or III as defined in [SAES-Q-001](#) Table 1.

## 6.3 Performance Requirements

### 6.3.1 Site Preparation of Areas to Receive Fill, Pavement or Loads

6.3.1.1 Areas to receive fill, foundations, or pavement or areas to be used in the future to support structural loads shall be prepared in accordance with PIP CVS02100, Section 4.3.1, and shall be free of roots, trash, snow, ice or other foreign material, and shall not be frozen. Stripping, clearing and grubbing shall be completed in accordance with PIP CVS02100, Sections 6.1.1 and 6.1.2.

6.3.1.2 All areas to receive fill, foundations, or pavement or areas to be used in the future to support structural loads shall have the in-situ soil proof rolled and inspected, after clearing and grubbing, for soft spots or loose zones. Proof roll may be defined as crossing the area with a heavy (minimum 10-ton weight) rubber-tire or steel-wheel roller.

6.3.1.3 All observed soft spots or loose zones shall be compacted in-place or excavated to firm soil and replaced with properly compacted fill.

6.3.1.4 The top 6 inches (150 mm) of any area to receive fill, foundations, pavement or areas to be used in the future to support structural loads shall be scarified and recompacted. The density of the top 6 inches (150 mm) in these areas shall not be less than that required in paragraph 6.3.2.5 at the time that the fill, foundation, pavement, or concrete is applied.

### 6.3.2 Fill Placement and Compaction

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- 6.3.2.1 Compacting shall begin only after the fill or backfill has been properly placed and the material to be compacted is at the proper moisture content. Compaction shall be performed with equipment compatible with soil type.
- 6.3.2.2 Fill material shall be placed in lifts not exceeding 200 mm (8 in) in loose depth. Fill materials shall be placed in lifts not exceeding 100 mm (4 in) in loose depth for hand-operated compaction. Other lift thicknesses may be approved by the appropriate Saudi Aramco Inspection Representative based on a field test section using the intended compaction equipment.
- 6.3.2.3 Fill and backfill adjacent to structures such as retaining walls, pits, and basements shall not be compacted with heavy equipment, but shall be compacted with hand-operated equipment to a distance of 1.2 meters (4 feet) or greater beyond the sides of the structures. Every effort shall be made to place backfill materials symmetrically and in uniform layers to prevent unnecessary eccentric loading on a structure or foundation.
- 6.3.2.4 Bedding and backfill for pipeline and utility trenches shall conform to [SAES-L-450](#), [SAES-L-460](#), or [SAES-S-070](#) as appropriate.
- 6.3.2.5 Fill or backfill placed beneath footings, grade beams, mats, buildings, and process areas shall be compacted to at least 90% of the maximum Modified Proctor density as determined by ASTM D1557. For cohesionless free draining soils, 70% relative density as determined by ASTM D4253 and ASTM D4254 shall be used.

For foundation static loads over 320 kPa (6500 psf) and foundations for vibrating or heavy machinery as defined in [SAES-Q-007](#), and for asphalt and concrete pavement subgrades, fill shall be compacted to 85% relative density for cohesionless soils or 95% of the maximum density as determined by ASTM D1557 for cohesive materials.

When the backfill material cannot clearly be classified as cohesive or cohesionless both relative density and Proctor density tests must be performed per the above paragraph. The backfill shall then be compacted to the greater density.

- 6.3.2.6 All other fill shall be compacted to a density equal to that shown on the drawings or equal to that of the adjacent in-situ material as appropriate.
- 6.3.2.7 The moisture content of the material being compacted shall be within 3%, plus or minus, of the optimum moisture content as determined by ASTM D1557. However, when ASTM D4253/ASTM D4254 are the appropriate test procedures, there is no applicable optimum moisture content.
- 6.3.2.8 Compaction by water jetting or flooding is not permitted for most fill material. However, flooding may be used if the fill material is cohesionless freely draining sand.
- 6.3.2.9 In no case shall compaction be allowed on slopes greater than 1 (V) to 5 (H) (20% slope). A series of horizontal benches, steps, or terraces, at least 10 feet (3048 mm) wide, should be cut into existing and natural slopes prior to adding new fill.

Construction of new slopes shall be accomplished by compacting horizontal fill layers at least 1 roller width beyond the design edge of the slope and then trimming back to achieve the final slope dimensions.

- 6.3.2.10 If clean sand or dune sand is used for fill, surface protection will be required. A cap layer of compacted cohesive material 150 to 300 mm (6 to 12 in) in thickness will generally be sufficient. Capping material shall have a maximum size of one-half lift thickness or 75 mm (3 in), whichever is less, and shall have between 11-35% passing the No. 200 sieve. The capping material shall have a maximum liquid limit of 35 and a maximum plasticity index of 12, per ASTM D4318. Final slopes shall be protected from erosion.
- 6.3.2.11 Compacted surfaces of fill and backfill shall be finish graded to the cross sections, lines, grades, and elevations as indicated on the drawings.

### 6.3.3 Testing

- 6.3.3.1 Gradation, density, and moisture content control tests shall be performed at the following minimum frequencies: one standard sieve analysis (ASTM C136, ASTM D422 or ASTM D1140) and one Modified Proctor Test per ASTM D1557 with corresponding Proctor curve performed for each type of fill
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material or where there is a change in the type or the source of material. For cohesionless free draining soils, ASTM D4253 Maximum Index Density and Unit Weight of Soils Using a Vibratory Table and ASTM D4254 Minimum Index Density and Unit Weight of Soil and Calculation of Relative Density shall also be performed.

- 6.3.3.2 In-place density and moisture content of soils shall be determined by the sand-cone method per ASTM D1556, nuclear method per ASTM D2922, the rubber balloon method per ASTM D2167, or the drive-cylinder method per ASTM D2937. Acceptance testing of in-place density and moisture content (field density testing) on compacted fill will be performed at the following rates:
1. Under all foundations - one test every 1000 ft<sup>2</sup> (90 m<sup>2</sup>) of each lift.
  2. Under area paving - one test every 2000 ft<sup>2</sup> (180 m<sup>2</sup>) of each lift.
  3. Road base and sub-base - one test every 2000 ft<sup>2</sup> (180 m<sup>2</sup>) of base or sub-base.
  4. Backfill of trenches - one test for every 50 linear ft (15 m) of each lift.
  5. General fill - one test every 5000 ft<sup>2</sup> (460 m<sup>2</sup>) of each lift.
- 6.3.3.3 As a minimum, at least one in-place density test must be performed on every lift of fill and further placement shall not be allowed until the required density has been achieved.

The number of tests shall be increased if a visual inspection determines that the moisture content is not uniform or if the compacting effort is variable and not considered sufficient to attain the specified density.

The Project Inspection Representative may approve a decrease in the number of tests once a compaction procedure has proven to meet compaction requirements.

#### 6.4 Base Course

The base course for roads, parking areas, and other areas to be surfaced shall be prepared in accordance with [SAES-Q-006](#).

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## 7 Excavation

### 7.1 General Excavation

General excavation shall be performed after clearing and grubbing has been completed in accordance with PIP CVS02100, Section 6.

### 7.2 Structural Excavation

Structural excavation shall include excavations for footings, grade beams, pits, basements, retaining walls, man holes, catch basins, pipeline thrust anchors, etc.

7.2.1 Excavation shall be performed as required by the design drawings to the dimensions, grades, and elevations as noted and as required for formwork and allowance for compaction equipment.

7.2.2 When soft and compressible soil is encountered at footing grades as shown on the drawings, such soil shall be removed and replaced with compacted fill or backfill as specified in Sections 6.2 and 6.3.2 or lean (2000 psi minimum 28-day compressive strength) concrete.

7.2.3 Over-excavation at footings shall be backfilled with compacted fill or backfill as specified in Sections 6.2 and 6.3.2 or lean (2000 psi minimum 28-day compressive strength) concrete.

### 7.3 Earthen Structures

Earthen structures include permanent work items such as ponds, canals, ditches, etc. Excavation for such work shall be made to the lines, grades, and cross sections as shown on the drawings.

7.3.1 Side slopes of excavations shall be cut true and straight and shall be graded to the proper cross section. Unstable soil in the slopes shall be removed and the slopes properly prepared. The bottoms of excavations shall be graded to the elevations and configurations as shown on the drawings.

7.3.2 Over excavation shall be backfilled with suitable material and compacted in accordance with Section 6.3.2.

### 7.4 Trenching

Trenching for pipelines and underground utilities shall conform to [SAES-L-450](#), [SAES-L-460](#), or [SAES-S-070](#) as appropriate.

## 7.5 Rock Excavation

Seismic velocities will be the sole factor in determining the appropriate category for the excavation of rock. Excavation of rock will fall into the following categories, based on the seismic velocities measured in the field by refraction seismic testing.

### 7.5.1 Normal Excavation

Normal Excavation is excavation that can be accomplished using rippers (defined as soils and rock falling within the CAT D9N "rippable" range of seismic velocities as shown in the Caterpillar Handbook of Ripping, latest edition) and/or heavy backhoes (for trenches and isolated small excavations, defined as soils or rock with seismic velocities of 1530 mps or less) operated in accordance with good construction practice. Normal excavation includes all soils and also includes soft, weathered and/or fractured rock that does not require blasting or pneumatic rock breakers to facilitate excavation.

### 7.5.2 Rock Excavation

Rock Excavation is excavation that cannot be accomplished using rippers (defined as soils and rock falling outside the CAT D9N "rippable" range of seismic velocities as shown in the Caterpillar Handbook of Ripping, latest edition) and/or heavy backhoes (for trenches and isolated small excavations, defined as rock having seismic velocities greater than 1530 mps) and which requires blasting or pneumatic rock breakers to facilitate excavation.

## 7.6 Disposal of Materials

All excavated materials that are unsatisfactory for use as fill or backfill or that are surplus to that needed for backfilling shall immediately be disposed of at a location designated by the Saudi Aramco Company Representative.

28 April, 2004

**Revision Summary**  
Major revision.