



# Engineering Standard

SAES-Q-009

28 September 2008

## Concrete Retaining Walls

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## Saudi Aramco DeskTop Standards

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## 1 Scope

This Standard covers mandatory requirements governing the design and specifications for construction of reinforced concrete retaining walls. Where materials other than reinforced concrete are required, refer to [SAES-M-100](#), "Saudi Aramco Building Code".

## 2 Conflicts and Deviations

- 2.1 Any conflicts between this standard and other applicable Saudi Aramco Engineering Standards (SAESs), Materials System Specifications (SAMSSs), Standard Drawings (SASDs), or industry standards, codes, and forms shall be resolved in writing by the company or buyer representative through the Manager, Consulting Services Department of Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from this standard in writing to the company or buyer 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.

### ➤ 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-112</a>	<i>Meteorological and Seismic Design Data</i>
<a href="#">SAES-A-113</a>	<i>Geotechnical Engineering Requirements</i>
<a href="#">SAES-A-114</a>	<i>Excavation and Backfill</i>
<a href="#">SAES-M-100</a>	<i>Saudi Aramco Building Code</i>
<a href="#">SAES-Q-001</a>	<i>Criteria for Design and Construction of Concrete Structures</i>

## 4 Design

The design and specifications for construction of reinforced concrete retaining walls shall be adequate for the structures intended use in accordance with commonly accepted engineering practice, Saudi Aramco Engineering Standard [SAES-Q-001](#), and the requirements specified in the following paragraphs.

### 4.1 Soils Analysis

- 4.1.1 A soils analysis shall be made which shall specify soils characteristics including the stratigraphy of subsurface materials, the maximum allowable soil bearing pressure, the recommended depth of bottom of footing, unit soil weight, internal friction angles, soil shearing capacity, groundwater location, and other provisions as described in paragraph 11, Appendix A of Saudi Aramco Engineering Standard [SAES-A-113](#).
- 4.1.2 For minor retaining walls in remote locations or for all retaining walls where data exist for soils adjacent to the proposed location, a detailed soils analysis may be waived with the concurrence of the Supervisor, Civil Engineering Unit, Rotating Equipment & Civil Engineering Division, Consulting Services Department. In such instances, allowable soil characteristics for design shall be established and documented by the design.

### 4.2 Retaining Wall Stability

- 4.2.1 The bottom of the footing shall be at least 600 mm below the finished grade surface of the ground in front of the footing, unless a detailed soils investigation indicates otherwise.
- 4.2.2 Retaining walls shall be designed for anticipated loads such as surcharge loads, wheel loads, earthquake/seismic loads as noted in Saudi Aramco Engineering Standard [SAES-A-112](#), construction loads, lateral pressures from water filled cracks in the backfill, and any other loads arising from special circumstances.
- 4.2.3 The retaining wall shall be designed to withstand full active soil pressure. Adequate drainage facilities shall be provided to effectively drain fill material behind the retaining wall. Fill material shall be drained using weepholes with crushed rock or coarse gravel french drains, placed at suitable intervals, or longitudinal drains placed behind the wall with outlets at the ends of the wall. Alternatively, commercial drainage/filter materials designed for this purpose may be used to drain the fill material behind the retaining wall. If crushed rock or coarse

gravel is used for weepholes or French drains, it shall satisfy the following criteria:

$$\frac{D15 \text{ (of filter)}}{D85 \text{ (of soil)}} < 4 \text{ to } 5 < \frac{D15 \text{ (of filter)}}{D15 \text{ (of soil)}} \quad (1)$$

$$\frac{D85 \text{ (Size of filter material)}}{\text{Hole width or Diameter of Weephole}} > 1 \text{ to } 2 \quad (2)$$

- 4.2.4 In counterfort walls there shall be at least two drains for each pocket formed by the counterforts.
- 4.2.5 All retaining wall footings subject to water pressure shall be designed to resist a uniformly distributed uplift equal to the full hydrostatic pressure.
- 4.2.6 The minimum safety factor against overturning about the toe and sliding shall be 1.5. The weight of soil or passive earth pressure for the first top two feet from backfill in front of the retaining wall shall not be considered in computing these safety factors. A combination of both friction resistance and passive pressure may be used to determine the resistance to sliding. Where sliding resistance is low, a key may be provided to increase the sliding resistance to meet the minimum factor of safety.
- 4.2.7 For retaining walls constructed on or at the base of slopes, a general slope stability analysis should be performed. A minimum factor of safety for long-term stability of 1.25 is required.
- 4.2.8 In areas of soft soils or potentially liquefiable soils, retaining walls may be supported on piles or stone columns.

#### 4.3 Specifications for Construction

The design shall specify vertical V-notch type contraction joints spaced no more than 9 m apart horizontally and vertical expansion-type joints spaced no more than 27 m apart horizontally.

Backfill shall be specified to be completed both in front and behind the retaining wall to the same finished level before additional material is placed behind the wall.

## 5 Installation

All concrete retaining walls shall be fabricated and constructed to Saudi Aramco Engineering Standard [SAES-Q-001](#) and this Standard. Standards, specifications and special requirements for construction shall be specified by the design.

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## 6 Inspection and Testing

All concrete, reinforcement, backfill and drainage materials, fabrication, construction and acceptance shall conform to Saudi Aramco Engineering Standards [SAES-Q-001](#), [SAES-A-114](#) and this Standard. Inspection and testing standards, specifications and special requirements shall be specified by the design.

### Revision Summary

28 September 2008	Revised the "Next Planned Update". Reaffirmed the contents of the document, and reissued with editorial revisions.
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