

ANSI/ASAE S289.2 FEB1998 (R2013)
Concrete Slip-Form Canal Linings



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Concrete Slip-Form Canal Linings

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1 Purpose and Scope

1.1 The growing demand for water in the world increases the need for conserving the available water supply. In open conveyance systems, conservation of irrigation water and reduced maintenance costs through control of weeds and seepage losses can best be accomplished by providing a dependable impervious lining. Non-reinforced concrete lining, which has a high hydraulic efficiency, is a dependable means of water control and seepage reduction in canals. The purpose of this Standard is to provide standards and specifications for the installation of concrete slip-form canal linings in the interest of reducing costs and assuring quality control.

1.2 The use of continuous excavating, trimming and lining equipment is the most economical method for construction of concrete-lined, trapezoidal canals. Available equipment permits construction to practical tolerances in alignment, grade and concrete thickness. The universal acceptance and use of standard trapezoidal canal sections will enable manufacturers to standardize excavating and lining equipment. This will permit a reduction in special engineering and equipment manufacturing costs, will make replacement and service parts readily available, and will result in a net reduction in the cost of completed linings.

1.3 This standard is restricted to irrigation canals that have a bottom width less than 1.8 m (72 in.), and a total depth of lined section not greater than 2.1 m (84 in.). Linings for larger canals usually involve more complex engineering and economic considerations; and they may require special criteria and construction requirements for the canal section, as well as for the lining.

1.4 The wide variance in design requirements by those involved in designing irrigation works prohibits developing criteria for establishing freeboard or foundation treatment. The scope is limited to establishing standard dimensions and shape of the canal section.

2 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Standards organizations maintain registers of currently valid standards.

ACI 305, Placing and Curing for Hot Weather Concreting

ACI 306, Placing and Curing for Cold Weather Concreting

ACI 318, Building Code Requirements for Reinforced Concrete

ASTM C31, Making and Curing Concrete Test Specimens in the Field

ASTM C33, Specifications for Concrete Aggregates

ASTM C39, Test for Compression Strength of Cylindrical Concrete Specimens

ASTM C94, Specification for Ready-Mix Concrete

ASTM C150, Specification for Portland Cement

ASTM C172, Sampling Fresh Concrete

ASTM C260, Specifications for Air-Entraining Admixtures for Concrete

ASTM C309, Specifications for Liquid Membrane-Forming Compounds for Curing Concrete

ASTM D1850, Specifications for Concrete Joint Sealer, Cold-Application Type

Fed. Spec. SS-S-1401B, Sealing Compound, Hot Applied for Concrete and Asphalt Pavements

3 General Definitions

3.1 concrete. A designed mixture of Portland cement, well graded aggregate and water. Admixtures may be used to replace a portion of the cement.

4 Basic Concepts

4.1 Minimum thicknesses for concrete lining, Table 1, are required. These thicknesses are based on the assumption that concrete and placement meet specifications in Annex A. Concrete shall be placed on a moist, firm, unyielding subgrade, and shall be protected against external hydrostatic pressure, uplift caused by expansive clays, and frost heave. Provisions for underdrainage to relieve uplift and to minimize frost damage, treatment of foundations involving expansive clays, and determining the design of the concrete mix are design considerations not included in this Standard.

Table 1 – Minimum required nominal thickness for slip-form concrete linings¹⁾

Design Velocity ²⁾ m/s (ft/s)	Minimum Thickness, mm (in.)	
	Warm Climate ³⁾	Cold Climate ³⁾
Less than 2.7 (9.0)	38 (1.5)	50 (2.0)
2.7 – 3.6 (9.0 – 12.0)	50 (2.0)	63 (2.5)
3.6 – 4.5 (12.0 – 15.0)	63 (2.5)	75 (3.0)
¹⁾ Velocities in short chute sections shall not be considered design velocities. ²⁾ For canals that have a bottom width not greater than 1.8 m (72 in.), design capacity not greater than 2.8 m ³ /s (100 ft ³ /s), and a maximum velocity of 4.5 m/s (15 ft/s). ³⁾ Warm = mean monthly midwinter temperature is 4.4 °C (40 °F) and above; cold = mean monthly midwinter temperature is less than 4.4 °C (40 °F).		

4.2 Lining thickness, alignment, and grade shall conform to the following tolerances.

Available excavating and lining equipment will permit construction of linings within the above tolerances. Abrupt deviations from design grade or horizontal alignment shall not be permitted. Local experience may indicate that in severe cold climates, minimum thickness shown in Table 1 must be increased.

4.3 Standard subgrade dimensions shall be maintained to meet the design dimensions of the lined ditch, Figure 1a. Any deviations from standard lining thickness shall be made by modifying the inside dimensions of the lining. Modifications made in this manner can be more economically accomplished than by changing subgrade dimensions.

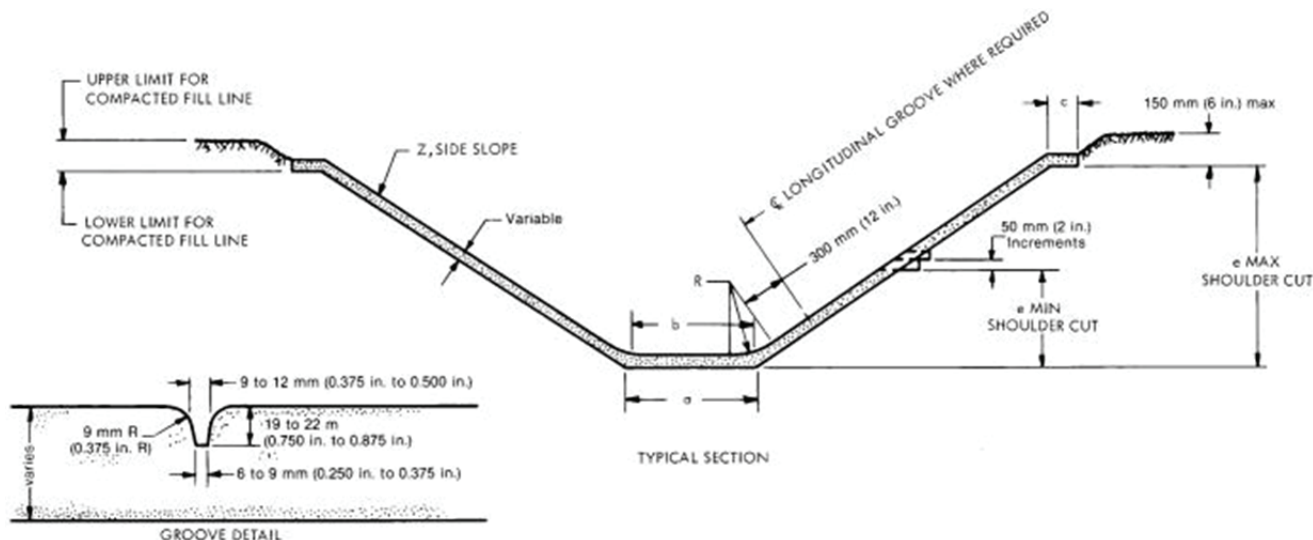


Figure 1(a) – Standard trapezoidal canal section

4.4 Contraction joints shall be provided to control cracking caused by shrinkage and temperature change. Transverse grooves shall be uniformly spaced at intervals of 2.5 to 4.5 m (8 to 15 ft) as a function of canal width and lining thickness. Where depth of section exceeds 1.2 m (4 ft), provide longitudinal grooves on each side as shown in Figure 1a. The groove dimensions specified will provide adequate space for placing common mastic sealing compounds.

4.5 Standard canal sections are based on subgrade dimensions to provide standardized excavation and slip-form equipment to permit economical construction.

4.6 Moisture content of the subgrade prior to placement of concrete shall be sufficient to prevent water migration from the concrete mix to the subgrade soil throughout the curing process.

5 Standard Cross Sections

5.1 The recommended standard cross sections, as shown in Table 2, consist of three sections with 1:1 side slopes, three sections with 1.25:1 side slopes, and five sections with 1.5:1 side slopes. The dimensional details of these standard sections are shown in Figure 1a, and Table 2. The underneath bottom width ("a"), shown in Figure 1a, is a function of lining thickness and determined as shown in Figure 1b. Minimum recommended thickness is presented in Table 1.

$$a = b + 2d$$

where:

a is underneath bottom width, using sharp corners;