



TECHNICAL SPECIFICATIONS FOR HILFIKER M. S. E. SYSTEM Reinforced Soil Embankment (Hot Dipped Galvanized Wire)

1.0 DESCRIPTION

This work shall consist of **Reinforced Soil Embankment** retaining walls constructed in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions shown on the plans or established by the Owner's Engineer.

2.0 MATERIALS

Unless otherwise stated in the contract documents, the Contractor shall make his own arrangements to purchase all **Reinforced Soil Embankment** retaining wall materials, including concrete panels, welded wire reinforcement mats, fasteners, joint materials, and all necessary incidentals from Hilfiker Retaining Walls, 1902 Hilfiker Lane, Eureka, CA 95503-5711, ph. 707/443-5093; www.hilfiker.com; info@hilfiker.com.

2.1 Concrete Facing Panels

Cement shall be Types I, II, III, or V (10, 20, 30, or 50), and shall conform to the requirements of ASTM C 150 (CAN/CSA-A5-M88). Concrete shall have a compressive strength at 28 days in accordance with Section 2.1.7. - Compressive Strength. Retarding or accelerating agents or any additive containing chloride shall not be used without approval of the Owner's Engineer

Panel anchors, alignment pins and sleeves and lifting devices shall be set in place to the dimensions and tolerances shown on the plans prior to casting.

2.1.1 Testing And Inspection

Acceptability of the precast unit will be determined on the basis of comprehensive strength tests and visual inspection. The precast units shall be considered acceptable regardless of curing age when compressive test results indicate that the compressive strength will conform to 28-day requirements. The Contractor or his/her supplier shall furnish facilities and perform all necessary sampling and testing in an expeditious and satisfactory manner. Panels utilizing Type I, II or V (10, 20 or 50) cement shall be considered acceptable for placement in the wall when 7 day initial strengths exceed 85% of 28-day requirements. Panels utilizing Type III (30) cement shall be considered acceptable for placement in the wall prior to 28 days only when compressive strength test results indicate that the strength exceeds the 28-day specification.

2.1.2 Casting

The panels shall be cast on a flat area, the front face of the form at the bottom, the back face at the upper part. The concrete in each unit shall be placed without interruption and shall be consolidated by the use of an approved vibrator, supplemented by such hand-tamping as may be necessary to force the concrete into the corners of the forms and prevent the formation of stone pockets or cleavage planes. Clear form oil of the same manufacture shall be used throughout the casting operation.



2.1.3 Curing

The units shall be cured for a sufficient length of time so that the concrete will develop the specified compressive strength.

2.1.4 Removal of Forms

The forms shall remain in place until they can be removed without damage to the unit.

2.1.5 Concrete Finish and Tolerances

Unless otherwise indicated on the plans or elsewhere in the specifications, concrete surface for the front face shall have an ordinary surface finish and for the rear face an unformed surface finish. Rear face of the panel shall be roughly screeded to eliminate open pockets of aggregate and surface distortions in excess of 1/4 inch (6.35 mm).

2.1.6 Tolerances

All units shall be manufactured within the following tolerances:

(a) Panel Dimensions

Lateral position of panel anchors - within 1/2 inch (12.7 mm). All other dimensions - within 3/16 inch (4.76 mm).

(b) Panel Squareness

Squareness, as determined by the difference between the two diagonals, shall not exceed 1/2 inch (12.7 mm).

(c) Panel Surface Finish

Surface defects on smooth formed surfaces measured on a length of 5 feet (1500 mm) shall not exceed 1/8 inch (3.18 mm). Surface defects on textured-finished surfaces measured on a length of 5 feet (1500 mm) shall not exceed 5/16 inch (7.94 mm).

2.1.7 Compressive Strength

Acceptance of the concrete panels with respect to compressive strength will be determined on the basis of production lots. A production lot is defined as a group of panels that will be represented by a single compressive strength sample and will consist of either 40 panels or a single days production, whichever is less. During the production of the concrete panels, the manufacturer will randomly sample the concrete in accordance with ASTM C 172. A single compressive strength sample, consisting of a minimum of four cylinders, will be randomly selected for every production lot.

Cylinders for compressive strength tests shall be prepared in accordance with ASTM C 31 (CSA Test Method M23.2-M90, Section 3C) on 6-inch by 12-inch (152.4 mm by 305 mm) specimens. For every compressive strength sample, a minimum of two cylinders will be cured in the same manner as the panels and tested at approximately 7 days. The average compressive strength of these cylinders, when tested in accordance with ASTM C 39 (CSA Test Method A23.2-M90, Section 9C), will provide a test result which will determine the initial strength of the concrete. In addition, two cylinders shall be cured in accordance with ASTM C 31 (CSA Test Method A23.2-M90, Section 3C) and tested at 28 days. The average compressive strength of these two cylinders, when tested in accordance with ASTM C 39 (CSA Test Method A23.2-M90,



Section 9C), will provide a compressive strength test result which will determine the compressive strength of the production lot.

If the initial strength test results indicate a compressive strength in excess of 4,000 pounds per square inch (30 MPa), then these test results will be utilized as the compressive strength test result for that production lot and the requirement for testing at 28 days will be waived for that particular production lot.

Acceptance of a production lot will be made if the compressive strength test result is greater than or equal to 4,000 pounds per square inch (30 MPa). If the compressive strength test result is less than 4,000 pounds per square inch (30 MPa) (277.4KG/cm²), the acceptance of the production lot will be based on its meeting the following criteria in its entirety:

- (a) 90% of the compressive strength test results for the overall production shall exceed 4,000 pounds per square inch (30 MPa).
- (b) The average of any six consecutive compressive strength test results shall exceed 4,000 pounds per square inch (30 MPa).
- (c) No individual compressive strength test result shall fall below 3,600 pounds per square inch (25 MPa).

In the event that a production lot fails to meet the specified compressive strength requirements, the production lot shall be rejected. Such rejection shall prevail unless the manufacturer, at his/her own expense, obtains and submits evidence of a type acceptable to the Owner's Engineer that the strength and quality of the concrete placed within the panels of the production lot is acceptable. If such evidence consists of tests made on cores taken from the panels within the production lot, the cores shall be obtained and tested in accordance with the specifications of ASTM C 42.

2.1.8 Rejection

Units shall be subject to rejection because of failure to meet any of the requirements specified above. In addition, any or all of the following defects shall be sufficient cause for rejection:

- Defects that indicate imperfect molding.
- Defects indicating honeycombed or open texture concrete.
- Defects in the physical characteristics of the concrete, such as broken or excessively chipped concrete.

2.1.9 Marking

The date of manufacture, the production lot number and the piece-mark, shall be clearly scribed on the rear face of each panel.

2.1.10 Handling, Storage, and Shipping

All units shall be handled, stored, and shipped in such a manner as to eliminate the danger of chipping, cracks, fractures, and excessive bending stresses. Panels in storage shall be supported on firm blocking located immediately adjacent to panel anchors to avoid bending the panel anchors.



2.2 Wire Reinforcement and Panel Anchors

Wire mesh for soil reinforcement shall have a prebent tie to allow connection to the concrete facing panels. The reinforcing mats shall be shop fabricated of cold drawn steel wire and shall be welded into the finished mesh fabric conforming to the minimum requirements of ASTM A-1064. The panel anchors shall be shop fabricated of cold drawn steel wire conforming to the minimum requirements of ASTM A-1064. All wire material exposed to the soil for the Reinforced Soil Embankment wall shall be per project specifications, and will be hot dip galvanized (2.0 oz./sf - ASTM A-123) [CSA Specification G164-M1981]. Any damage done to the mesh galvanization prior to installation shall be repaired in an acceptable manner and in a galvanized coating comparable to that provided.

2.3 Connection Pins

Connecting pins shall be as shown on the plans. Coatings shall conform to the same requirements as paragraph 2.2.

2.4 Bearing Pads

Bearing pads shall be a type and grade recommended by Hilfiker Retaining Walls Company.

3.0 SELECT GRANULAR BACKFILL MATERIALS

As shown on the plans, select granular backfill materials for the **Reinforced Soil Embankment** wall structure shall be reasonably free from organic and otherwise deleterious materials and shall conform to the following gradation limits as determined by ASTM D-422:

Sieve Designation	Percent by Weight Passing Standard Sieves (AASHTO T 27 & T 11)
6 inches (152.4 mm)	100
3 inches (76.2 mm)	100 - 75
No. 200 (75 µm)	0 - 15

The backfill shall conform to all of the following additional requirements:

- A. The Plasticity Index (P.I.), as determined by ASTM D-4318 (AASHTO T 90), shall not exceed 6.
- B. The fraction finer than 15 microns (0.015 mm), as determined by ASTM D-422 (AASHTO T-88) shall not exceed 15 percent.
- C. The material shall exhibit an angle of internal friction of not less than 34 degrees, as determined by the standard direct shear test ASTM D-3080-72 (AASHTO T-236), utilizing a sample of the material compacted to 90% percent of ASTM D-1557-92. No testing is required for backfill where 80 percent of the material is greater than ¾ inch (19mm). Before construction begins, the borrow selected shall be subject to show conformance with this frictional requirement.

In addition, backfill materials shall also meet the following corrosion requirements:

Resistivity	≥ 3000 OHM-cm (min)	AASHTO T 288
pH	5.0 to 10.0, inclusive	AASHTO T 289
Chlorides	≤ 100 mg/kg (ppm)	AASHTO T 291
Sulfates	≤ 200 mg/kg (ppm)	AASHTO T 290
Organic Content	<1%	AASHTO T267-86

If the resistivity is greater than or equal to 5,000 ohm-cm, the chlorides and sulfates requirements may be waived.





3.1 Acceptance of Material

The Contractor shall furnish to the Owner’s Engineer a Certificate of Compliance certifying that the select granular backfill material complies with this section of the specifications. A copy of all test results performed by the Contractor, which are necessary to assure compliance with the specifications, shall also be furnished to the Owner’s Engineer and the MSE supplier.

The frequency of sampling of Select Granular Backfill necessary to assure the above-mentioned requirements shall be directed by the Owner’s Engineer.

Backfill not conforming to this specification shall not be used without written consent of the Engineer.

3.2 Free Draining, Permeable Backfill

If the M. S. E. will be subject to water inundation, the following permeable, free-draining backfill material shall be used:

Sieve Designation	Percent by Weight Passing Standard Sieves (AASHTO T 11 and T 27)
6” (76 mm)	100
¾” (19 mm)	50 - 90
No. 4 (4.75 mm)	20 - 50
No. 200 (75 µm)	0 - 2

4.0 CONSTRUCTION REQUIREMENTS

4.1 Wall Excavation

Excavation shall be in accordance with the requirements of all applicable specifications and in reasonably close conformity with the limits and construction stages shown on the plans.

4.2 Foundation Preparation

The foundation for the structure shall be graded level for a width equal to or exceeding the length of the reinforcement mat or as shown on the plans. Prior to wall construction, the foundation, if not in rock, shall be compacted, as directed by the Owner’s Engineer. Any foundation soils found to be unsuitable shall be removed and replaced, as directed by the Owner’s Engineer.

At each panel foundation level, at the Contractor's option, an unreinforced cast in place concrete leveling pad shall be provided as indicated on the plans. The leveling pad shall be cured a minimum of 12 hours before placement of wall panels. At the Contractor's option, and as approved by the Owner’s Engineer, the leveling pad may be precast concrete units. Levelness of leveling pads shall be within 1/8 inch (3.18 mm) per pad or per 100 feet (30.48 m), whichever is longer. Vertical alignment of leveling pads shall be within 1/8 inch (3.18 mm) per 100 feet (30.48 m).

4.3 Wall Erection

Precast concrete panels shall be placed vertically with the aid of mechanical lifting equipment. For erection, panels are handled by means of a lifting device set into the upper edge of the panels. Panels should be placed in successive horizontal lifts in the sequence shown on the plans as backfill placement proceeds. Vertical tolerances (plumbness) and horizontal alignment tolerances shall not exceed 3/4 inch (19.05 mm) when measured on a 10 foot (3000 mm) straight edge. The maximum allowable offset in any panel joint shall be 3/4 inch (19.05 mm). The overall vertical tolerance of the wall (plumbness from top to bottom) shall not exceed 1/2 inch (12.7 mm) deviation from true plumb per 10 feet (3000 mm) of wall height.





4.4 Backfill Placement

Backfill placement shall closely follow erection of each course of panels. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials or misalignment of the facing panels. Any wall materials, which become damaged or disturbed during backfill placement, shall be either removed and replaced at the Contractor's expense or corrected, as directed by the Owner's Engineer.

Backfill shall be compacted to a minimum 90% of the optimum laboratory density as determined by ASTM D 1557 (95% of the Lab Maximum Dry Density as per ASTM D-698, Method D).

The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. Backfill material shall have a placement moisture content slightly less than or equal to the optimum moisture content. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift. The optimum moisture content shall be determined in accordance with ASTM D 1557.

Backfill shall be placed in complete horizontal lifts. The maximum lift thickness after compaction shall not exceed ten (10) inches (254 mm). The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density.

Compaction within 3'-0" (.914 m) of the backface of the wall facing shall be achieved by at least three (3) passes of a lightweight mechanical tamper, roller or vibratory system.

At the end of each day's operation, the Contractor shall slope the last level of backfill away from the wall facing to rapidly direct run-off of rainwater away from the wall face. In addition, the Contractor shall not allow surface area run-off from adjacent areas to enter the wall construction area.

5.0 METHOD OF MEASUREMENT

5.1 Concrete Facing Panels

The unit of measurement for furnishing and fabricating all materials for the walls, including concrete panels, wire mesh reinforcement mats, panel anchors and connection pins, joint material and other incidentals will be the square foot of wall surface area.

The quantity to be paid for shall be measured on the basis of wall surface area supplied.

Measurement and payment for excavation and backfill performed during **Reinforced Soil Embankment** wall construction will be in accordance with the applicable sections of the contract specifications.

5.2 Wall Erection

The unit of measurement for wall erection will be the square foot of wall surface area complete and in place. The quantity to be paid for will be the actual quantity erected in place at the site. Payment shall include compensation for all labor and materials required to prepare the wall foundation, place the reinforcement mats, and erect the facing panels to the lines and grade.

5.3 Concrete Leveling Pad

The unit of measurement for the concrete leveling pad will be the number of linear feet, complete in place and accepted, measured along the line and grade of the leveling pad.



HILFIKER RETAINING WALLS

Welded Wire Wall • Eureka Reinforced Soil
Gabion Faced M.S.E. • Reinforced Soil Embankment
ArtWeld Gabions • Spiralnail • Steepened Slope • Trinity Wall

• End of Section •

This information is proprietary to Hilfiker Retaining Walls, 1902 Hilfiker Lane, Eureka, CA 95503-5711, Telephone: 707-443-5093, Email: info@hilfiker.com.

HILFIKER RETAINING WALLS ARE COVERED BY ONE OR MORE OF THE FOLLOWING PATENTS:

3,631,682	4,068,482	4,329,089	3,922,864	4,117,686	4,324,508	243,697
4,051,570	4,343,572	243,613	4,266,890	4,391,557	4,154,554	4,260,296
4,505,621	OTHER PATENTS PENDING					

Revision Date: June 8, 2012

w:\product info\3. specifications\product specs\rse\rse-hotdipped spec updated 6-7-12.doc

