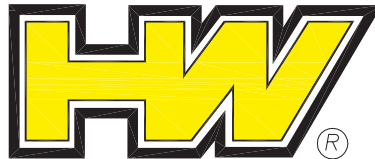


**WELDED WIRE (WWW) and
EUREKA REINFORCED SOIL (ERS)
M.S.E RETAINING WALLS**

Construction Guide



HILFIKER RETAINING WALLS

1902 Hilfiker Lane

Eureka, California 95503-5711

Local 707.443.5093 Fax 707.443.2891

Toll-Free 800.762.8962

Web: <http://www.hilfiker.com> email: info@hilfiker.com



Hilfiker M.S.E. Systems are covered by the following patents:

Patent no. 4,117,686; 4,329,089; 4,505,621 and others

HILFIKER MSE WALL SYSTEMS

Welded Wire Wall and Eureka Reinforced Soil (E.R.S.)

The Hilfiker MSE System is a composite mechanically stabilized earth structure, designed for strength, durability and ease of construction. The welded wire mats reinforce the backfill, providing the tensile strength to make the compacted soil a stable structure. The superior pullout resistance of the wire mesh potentially allows a wide range of backfill soils. Properly installed, the Hilfiker MSE System is exceptionally strong, resilient and economical.

Backfill should preferably be select granular material with a high frictional strength.

ALWAYS FOLLOW YOUR PROJECT SPECIFICATIONS!

Compaction of the backfill is very important to prevent unanticipated settlement of the wall. Ninety to ninety-five percent compaction is recommended for walls supporting paved roadways, railroads, buildings, mining equipment and other significant loads. If the backfill is not compacted as recommended, settlement will occur, and may distort the wall face.

In addition, the moisture content of

the backfill prior to and during construction shall be uniformly distributed throughout each lift.

The contractor must provide positive drainage and encapsulation of the backfill to insure that it is not saturated with surface and sub-surface moisture. If rain is expected, protect the backfill from getting wet. If it does get wet, remove the wet portion and replace it with dry backfill.

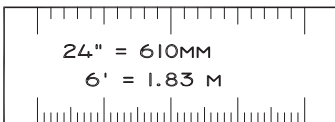
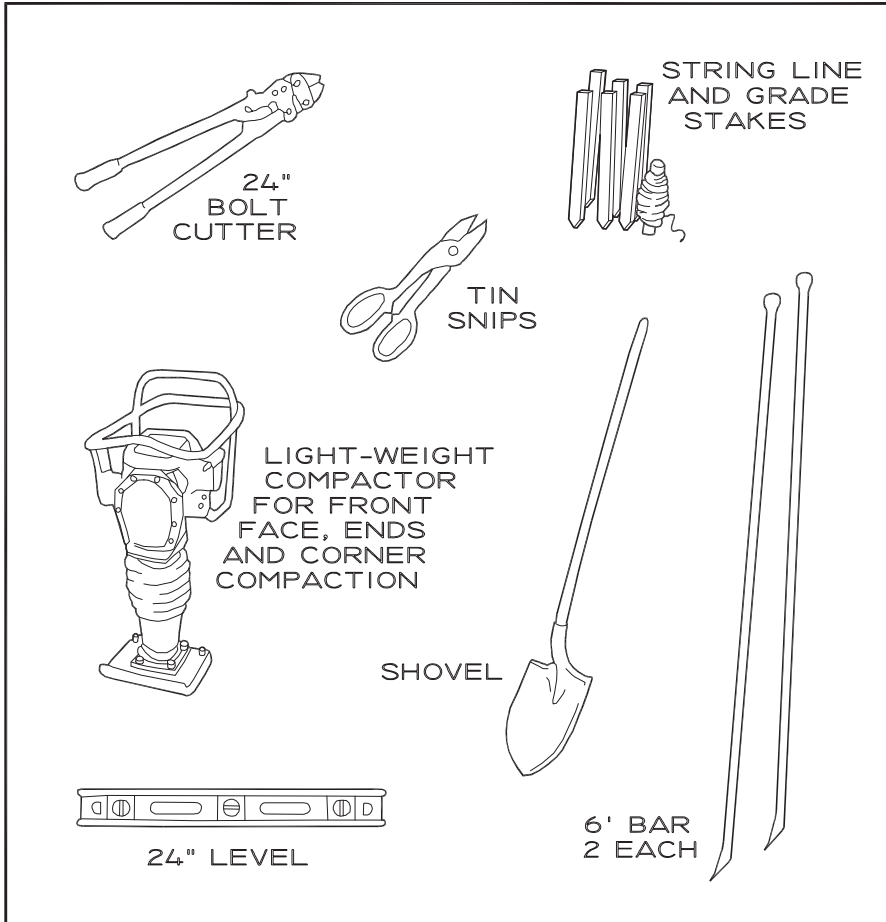
Under no circumstances should the use of saturated backfill ever be permitted within the M.S.E. structure. This includes the placement of future landscape irrigation.

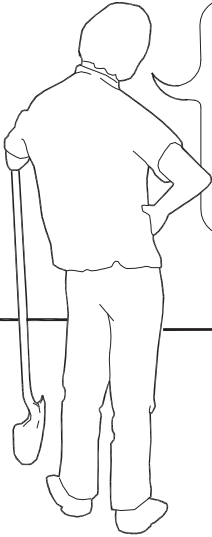
Hilfiker MSE Systems can be designed as battered, vertical or cantilever structures. The welded wire mats are easily trimmed or bent, adapting to curves, angles and steps. A Welded Wire Wall can be designed to fit nearly any special site application.

If you have any questions about design, construction or suitability of application, contact Hilfiker Retaining Walls. We will be happy to answer your questions, or design a retaining wall for your project.

ABOVE ALL, PLEASE REMEMBER, THIS BOOKLET IS A GUIDE ONLY. FIELD CONDITIONS NATURALLY VARY. THE OWNER'S DISCRETION AND EXPERIENCE MAY NECESSITATE MODIFICATIONS WITHIN REASON. HILFIKER ASSUMES NO LIABILITY FOR COMPLIANCE, OR LACK THEREOF.

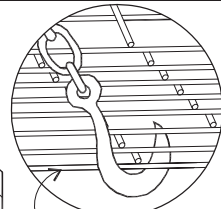
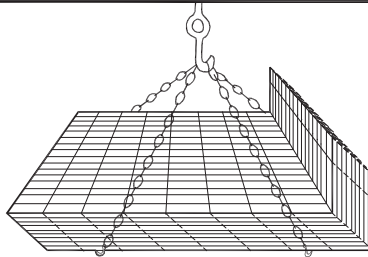
HAND TOOLS NECESSARY
TO BUILD YOUR WALL
(NOT PART OF HILFIKER SUPPLIED COMPONENTS)





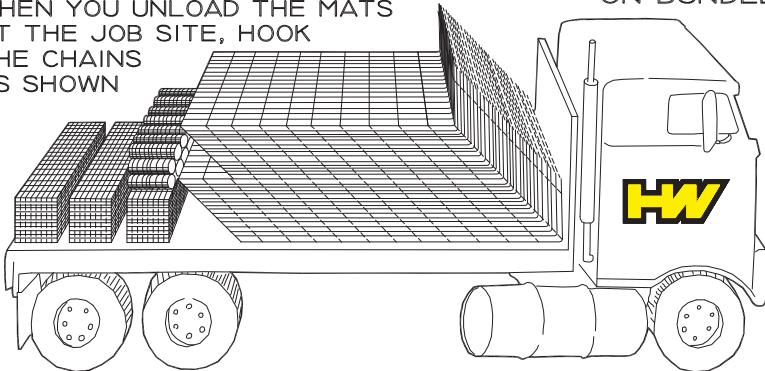
I THINK YOU'LL FIND HILFIKER'S WALL SYSTEMS TO BE THE EASIEST RETAINING WALLS YOU'LL EVER BUILD. THE WIRE MATS ARE DESIGNED TO GIVE THE PROPER STRENGTH. IT'S UP TO YOU TO MAKE THE BACKFILL STRONG. BE SURE IT'S THE RIGHT DENSITY AND COMPACTION. KEEP IT DRY! QUESTIONS? JUST CALL US!

SUGGESTED UNLOADING PROCEDURE



BOTTOM WIRE ON BUNDLE

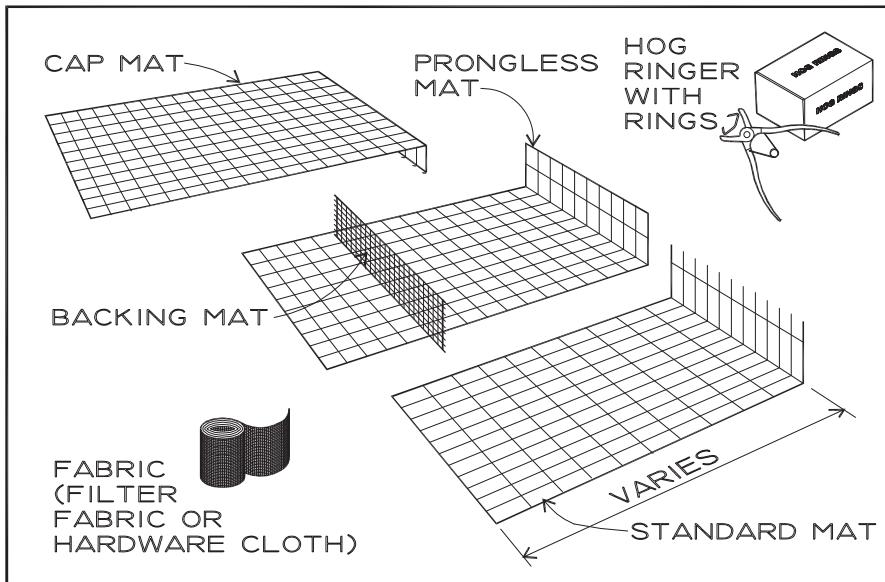
WHEN YOU UNLOAD THE MATS AT THE JOB SITE, HOOK THE CHAINS AS SHOWN



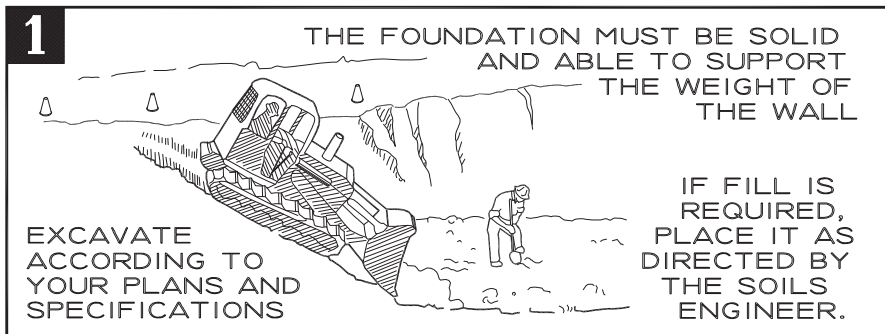
IMPORTANT!

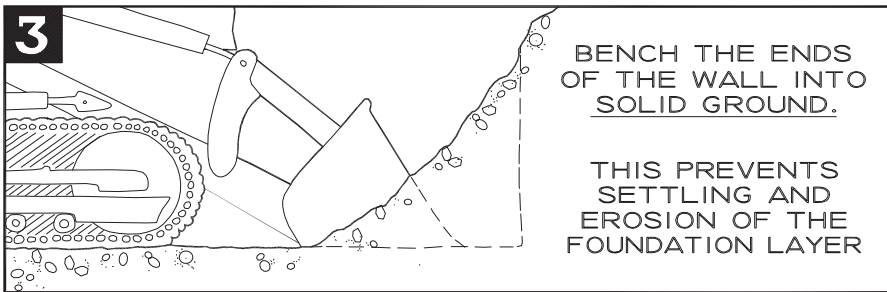
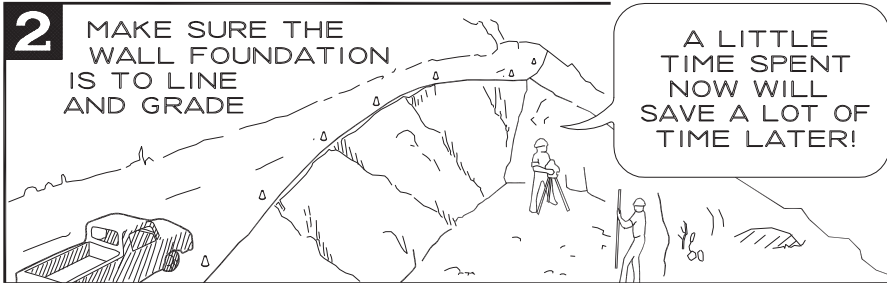
CHECK OFF "WALL PARTS" FROM YOUR BILL OF LADING AS YOU UNLOAD.

SUPPLIED WALL PARTS

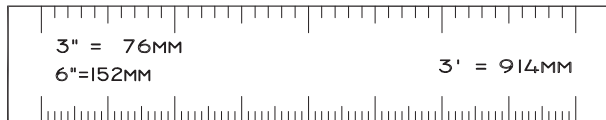
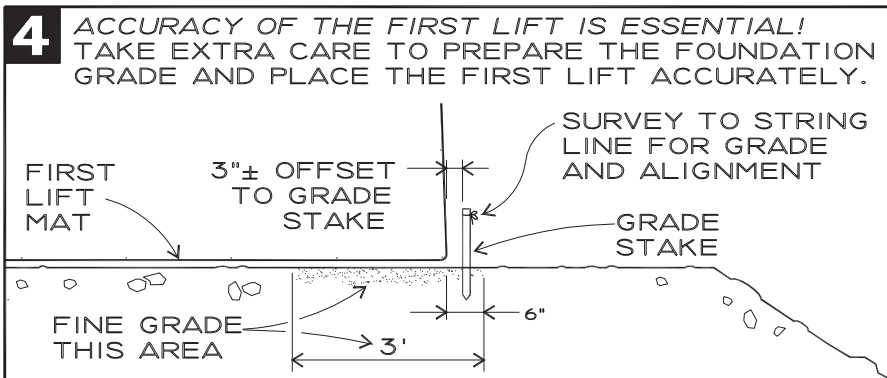


EXCAVATION





START YOUR WALL!



5 BE SURE YOU HAVE THE REQUIRED BERM IN FRONT OF THE WALL. SEE YOUR PROJECT PLANS FOR THE MINIMUM WIDTH. IF FIELD CONDITIONS DO NOT GIVE YOU THE MINIMUM WIDTH, CONTACT THE PROJECT ENGINEER.

BERM WIDTH

6 *YOU MAY CUT THE MATS TO FIT YOUR EXCAVATION IF NEEDED.

DO NOT SHORTEN THE BASE DEPTH

CUT TRANSVERSE WIRES ONLY!

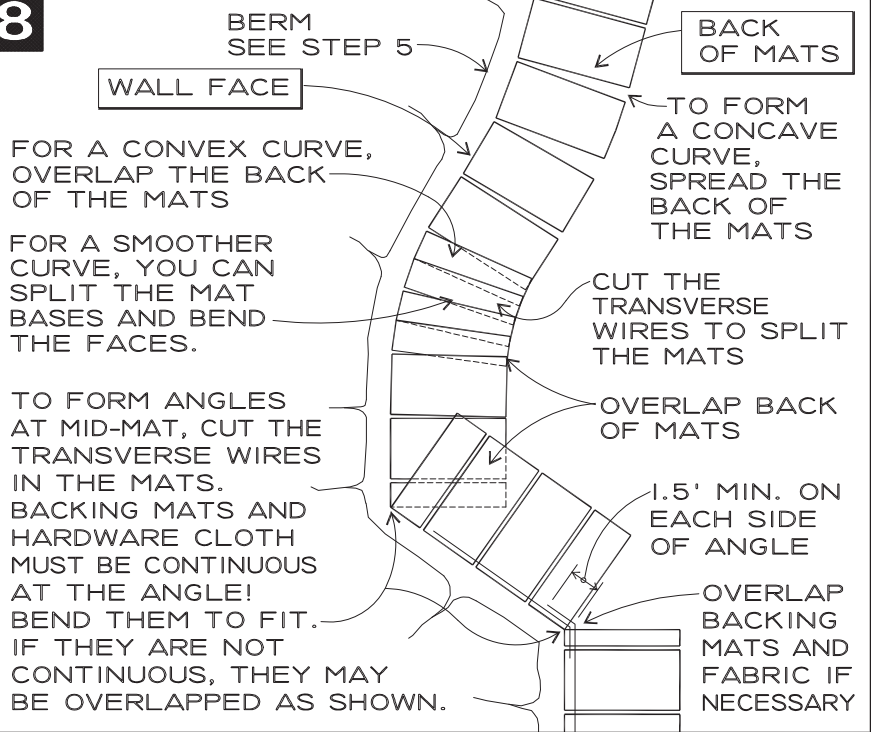
7 FOLLOW YOUR PLANS CAREFULLY FOR LOCATING THE THE MATS BY BASE DEPTHS AND WIRE SIZES. EACH MAT BUNDLE WILL BE TAGGED!

THE SPACE BETWEEN THE MATS SHALL EQUAL THE SPACE BETWEEN THE LONGITUDINAL WIRES.

EQUAL

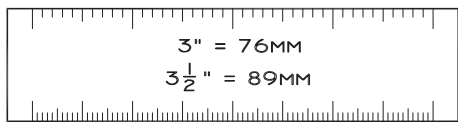
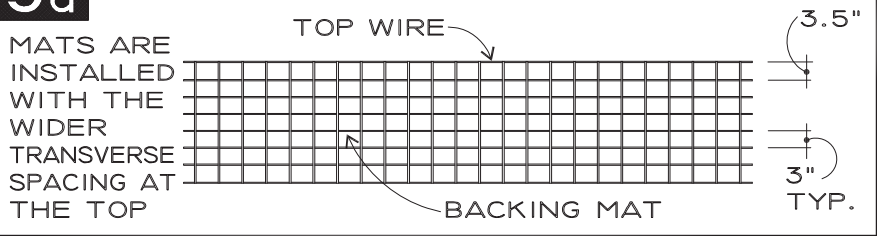
*Do not scrap the trimmed portion until the wall is complete.
 Save remaining trimmed portion, in case it can be used elsewhere in the MSE wall.

8



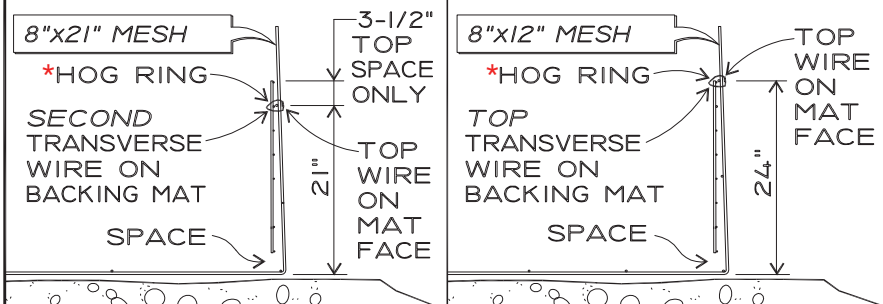
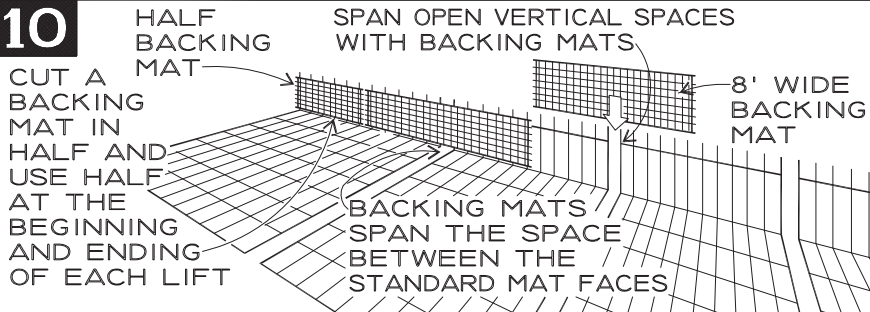
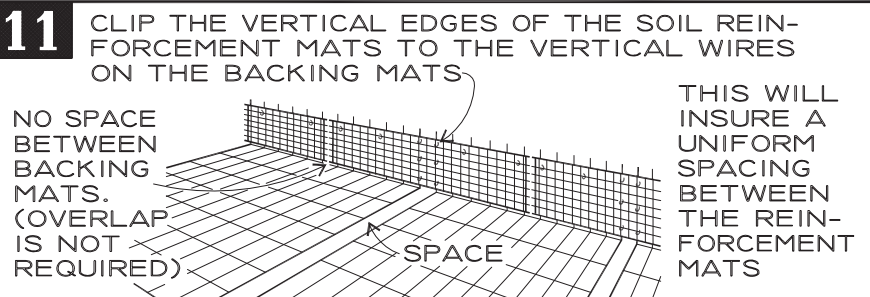
9a

BEGIN BACKING MAT INSTALLATION.



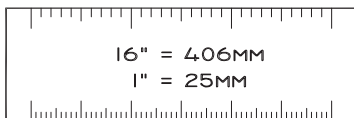
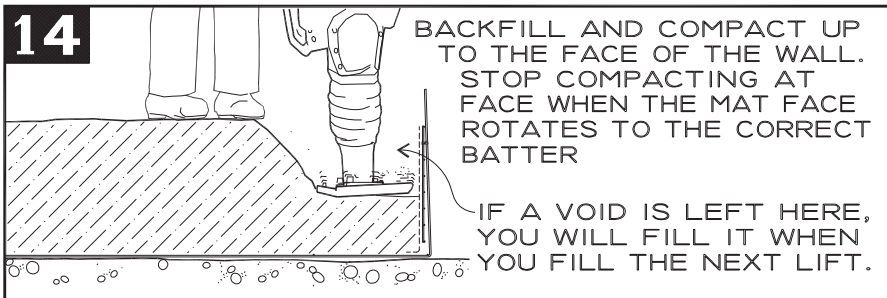
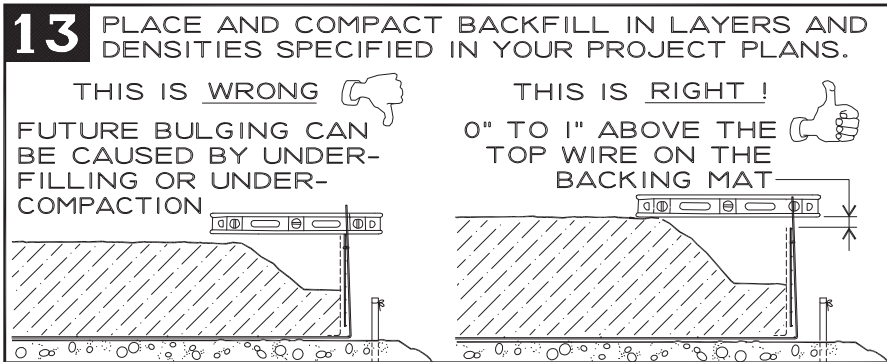
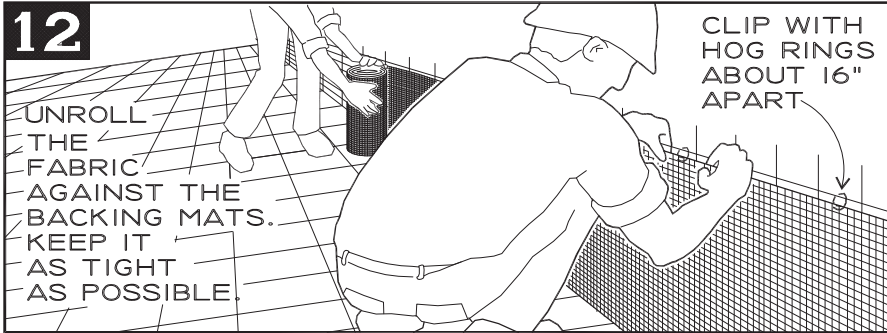
9

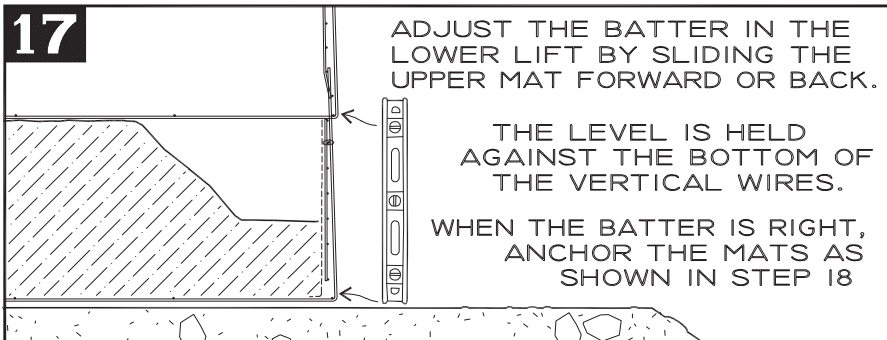
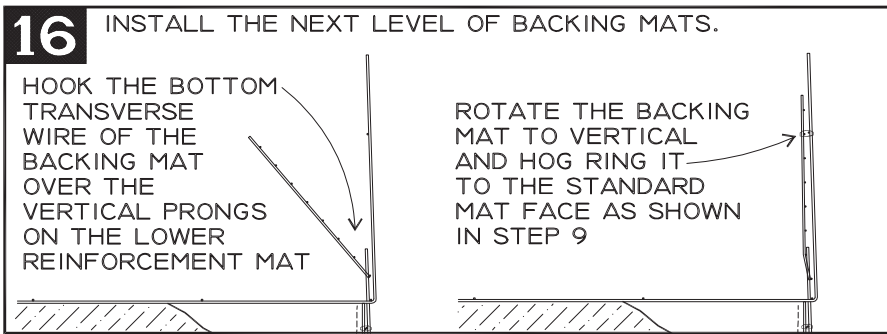
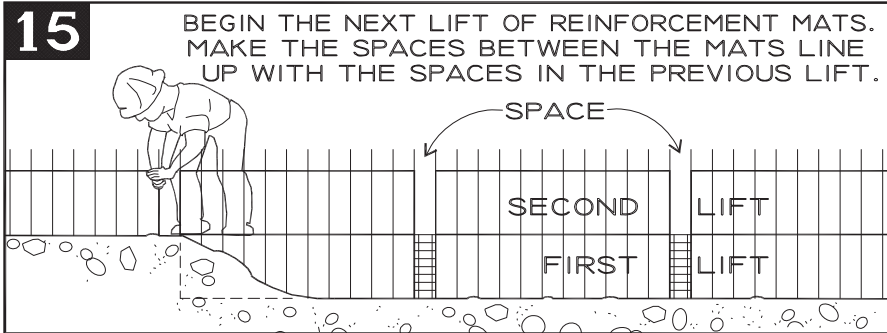
INSTALL THE BACKING MATS INSIDE THE FIRST LIFT
IMPORTANT! CHECK STANDARD MAT MESH SIZE!

**10****11**

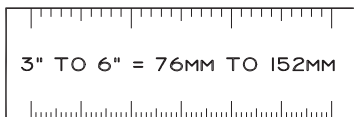
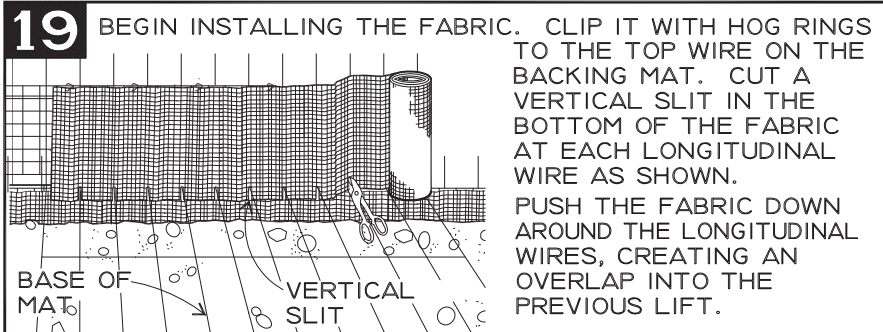
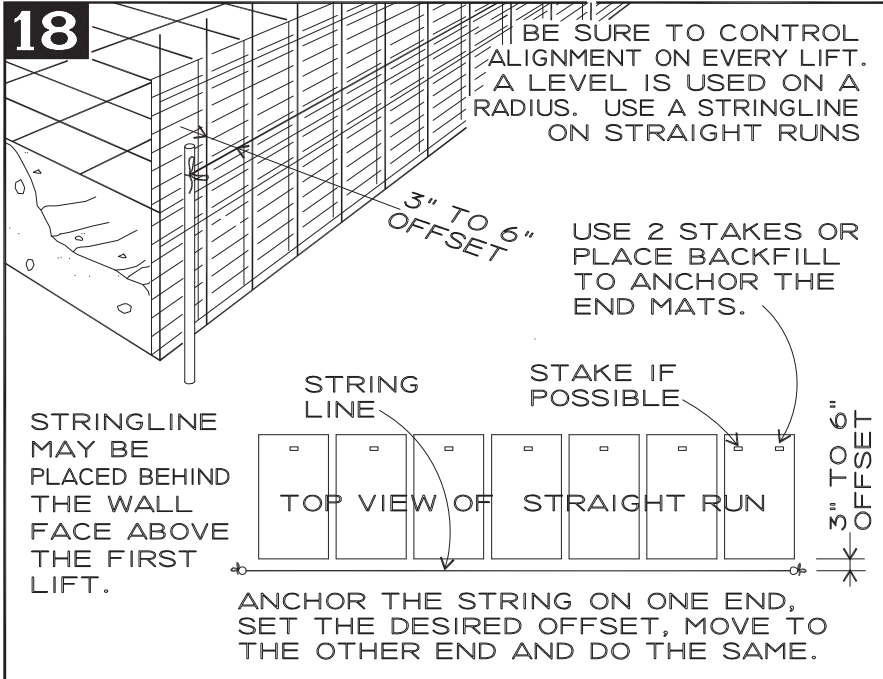
$3\frac{1}{2}" = 89\text{MM}$	$8" = 203\text{MM}$
$12" = 305\text{MM}$	$24" = 610\text{MM}$
	$8' = 2.438\text{M}$

*The use of pneumatic hog rings (or c-rings) are not recommended for the backing mat installation.



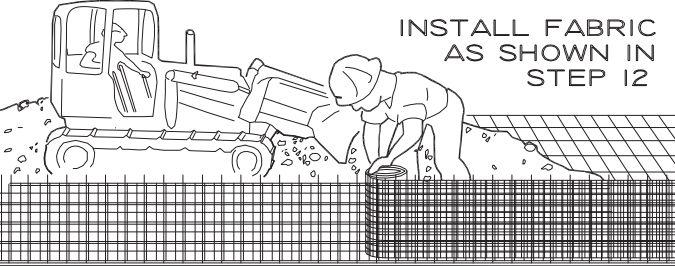


1:4.8 = 1/4 INCH PER VERTICAL FOOT
 1:10 = 1.2 INCH PER VERTICAL FOOT
 1:6 = 2 INCHES PER VERTICAL FOOT



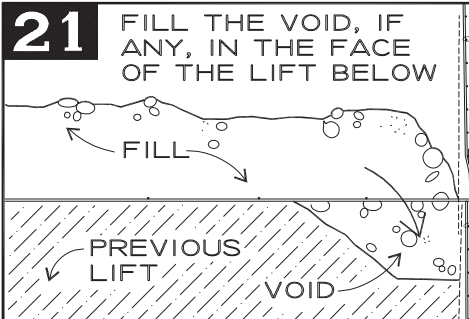
20 BEGIN BACKFILLING AGAIN. *DO NOT* OPERATE HEAVY EQUIPMENT ON THE BARE WIRE!

WHEN THE MATS ARE WEIGHTED WITH FILL, YOU CAN REMOVE THE STAKES.



INSTALL FABRIC AS SHOWN IN STEP 12

21 FILL THE VOID, IF ANY, IN THE FACE OF THE LIFT BELOW

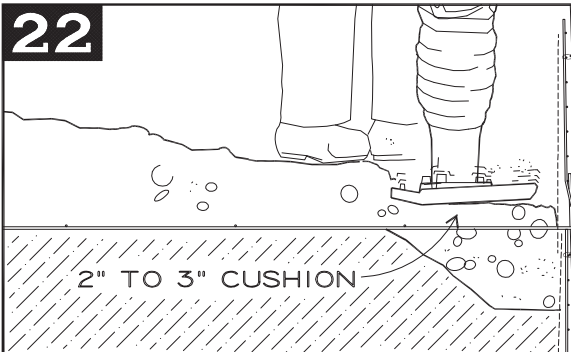


FACE OF WALL

PLACE THE FILL SO FALLS THROUGH THE BASE WIRES INTO THE VOID BELOW.

USE FILL THAT WILL PASS THROUGH THE MESH.

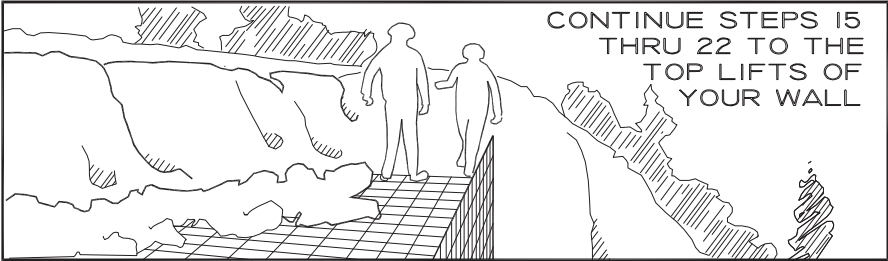
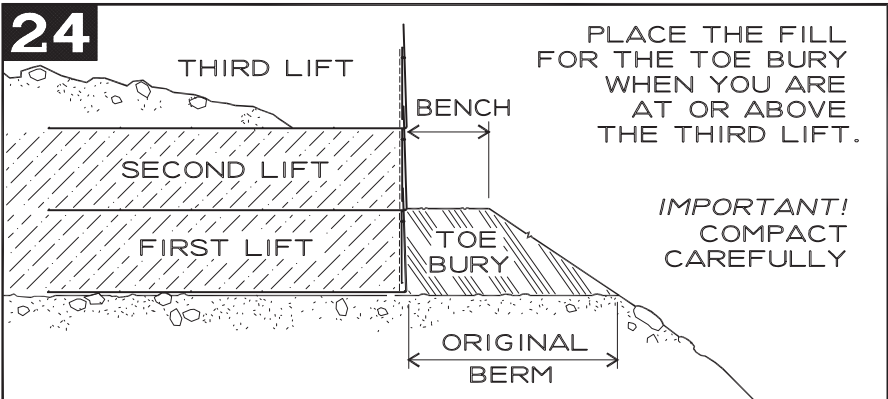
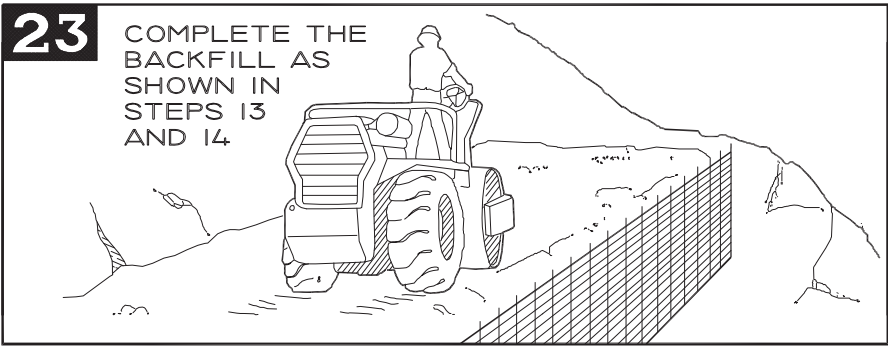
22



USE A HAND COMPACTOR TO COMPACT THE FILL IN THE FACE OF THE WALL

KEEP A 2" TO 3" CUSHION OF FILL UNDER THE TAMPER TO PROTECT THE WIRE.

2" TO 3" = 51MM TO 76MM



TOP OF WALL DETAILS

25 THE ENDS OF THE TOP LIFTS NEED RETURN BACKING MATS TO CONTAIN THE FILL.

MAKE A RETURN BACKING MAT BY BENDING AN 8' BACKING MAT IN HALF AS SHOWN.

IMPORTANT!
IN THE 8"X12" LIFTS ONLY, HOG RING THE TOP WIRE ON THE BACKING MAT TO THE TOP WIRE ON THE PRONGLESS MAT. (SEE STEP 9, SIMILAR)

ROLL FABRIC AGAINST BACKING MAT

HOG RING TO END LONGITUDINAL WIRE

PRONGLESS (TOP LIFT) MAT

26 IF YOUR WALL STEPS AT THE TOP, USE A RETURN BACKING MAT TO CLOSE THE END OF EACH STEP.

RETURN BACKING MAT

CONTINUOUS FABRIC

8" = 203MM	4' = 1.22M
12" = 305MM	8' = 2.44M

2 BACKFILL TO THE TOP OF THE TOP LIFT. BEFORE YOU PUT THE CAP ON, COMPACT AND ALIGN THE PRONGLESS MAT.

THIS LAYER IS *IMPORTANT!* THIS IS THE FINAL MAT LAYER, AND WILL BE THE TOP OF THE WALL

Diagram description: A cross-section of a wall under construction. The top surface is being prepared. A layer of material is being compacted, indicated by a double-headed arrow labeled 'COMPACT'. To the right, a vertical line represents the wall, with an arrow pointing to it labeled 'ALIGN THE PRONGLESS MAT'. The top surface is filled with small circles representing aggregate or gravel.

28 COMPLETE THE FINAL LIFT. TILT THE CAP AND CATCH THE FRONT HOOK UNDER THE MIDDLE WIRE ON THE PRONGLESS MAT

LAY THE CAP ONTO THE FILL. CHECK THE ALIGNMENT, SET THE BATTER, AND ANCHOR. BEGIN THE COVER BACKFILL

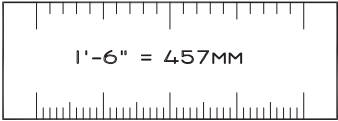
Diagram description: Two workers are shown from behind, pushing a large rectangular cap onto the top of the wall. An inset circular diagram shows a close-up of the cap's front edge, which has a hook that is being inserted under a wire of the prongless mat. The cap is being tilted as it is placed.

29 FILL THE VOID, IF ANY, IN THE FACE OF THE LIFT BELOW

COMPACT THE BACKFILL AS SHOWN IN STEPS 21 AND 22.

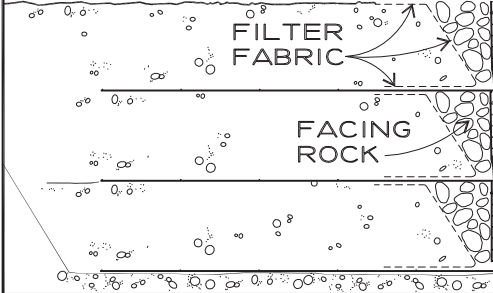
BACKFILL TO THE TOP OF THE FINAL GRADE PER YOUR PROJECT PLANS.

Diagram description: A 3D perspective view of the wall. A tractor is shown filling a gap (void) behind the wall. A worker is standing on the ground behind the wall, using a tool to compact the backfill. Labels include '1'-6" MINIMUM COVER' with a vertical arrow, 'CAP' pointing to the top of the wall, and 'FILL VOID' pointing to the gap behind the wall. A small inset diagram shows a cross-section of the backfill being compacted.



PROJECT-SPECIFIC DETAILS ROCK FACING INSIDE THE WALL FACE

30 SOME PROJECTS CALL FOR ROCK FACING. IN THESE APPLICATIONS, THE HARDWARE CLOTH IS OMITTED. ROCK LARGER THAN THE OPENINGS IN THE BACKING MAT MESH IS PLACED AT THE FACE OF THE WALL



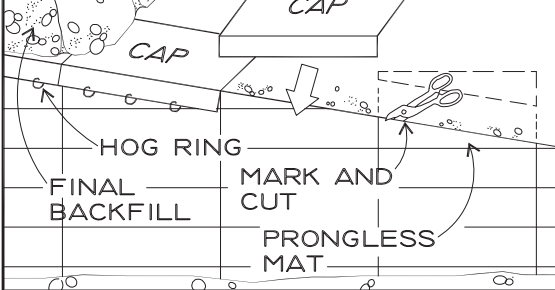
FILTER FABRIC MAY BE INSTALLED DIRECTLY BEHIND THE ROCK.

THIS ENCAPSULATES THE BACKFILL AND PREVENTS ANY FINES FROM MIGRATING INTO THE ROCK ZONE.

SLOPED CAP ON TOP OF WALL

31 SOME WALLS REQUIRE A SLOPED CAP TO MAINTAIN A MINIMUM SHOULDER WIDTH ABOVE THE WALL.

INSTALL THE BACKING MAT AND FABRIC IN THE TOP LIFT. PLACE AND COMPACT THE BACKFILL ON SLOPE TO THE LEVEL OF THE TOP OF THE WALL SHOWN IN YOUR PLANS.



MARK THE PRONGLESS MATS AND BACKING MATS, AND CUT THEM TO FOLLOW THE SLOPE. INSTALL THE CAP MATS AND HOG RING TO THE FACE.

PLACE AND COMPACT THE FINAL LAYER OF FILL.

WOOD GUARDRAIL PENETRATION

32 IF THE PLANS CALL FOR GUARDRAIL POSTS NEAR THE FACE OF THE WALL, IT MAY BE NECESSARY TO CUT HOLES IN THE CAP MATS.

FUTURE GUARDRAIL POST

"A"

MARK THE MAT AT THE PROPER SPACING ALONG THE FACE OF THE WALL. CHECK AND MARK THE OFFSET TO THE FACE OF THE WALL.

MARK FOR FUTURE POST LOCATION

IF DISTANCE "A" IS LESS THAN 5', CUT A HOLE IN THE CAP MAT FOR POST PENETRATION

CAP MAT

PRONGLESS MAT

CULVERT THROUGH WALL

33 IF A CULVERT OR LARGE PIPE PASSES THROUGH THE FACE OF THE WALL, THE MATS ARE CUT TO FIT AROUND IT.

AT THE LOWER SURFACE OF THE CULVERT, CUT THE TRANSVERSE WIRES ON THE MAT FACE, THEN BEND THE LONGITUDINAL WIRES BACK TO FIT AGAINST THE CULVERT.

CUT THE BACKING MAT AND FABRIC TO FIT SNUGLY AGAINST THE CULVERT

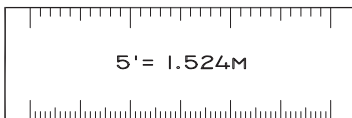
CULVERT

CUT THE BACKING MAT AND FABRIC TO FIT SNUGLY AGAINST THE CULVERT

LONGITUDINAL WIRE

TRANSVERSE WIRE

BASE OF MAT (DO NOT CUT)



CULVERT THROUGH WALL (CONTINUED)

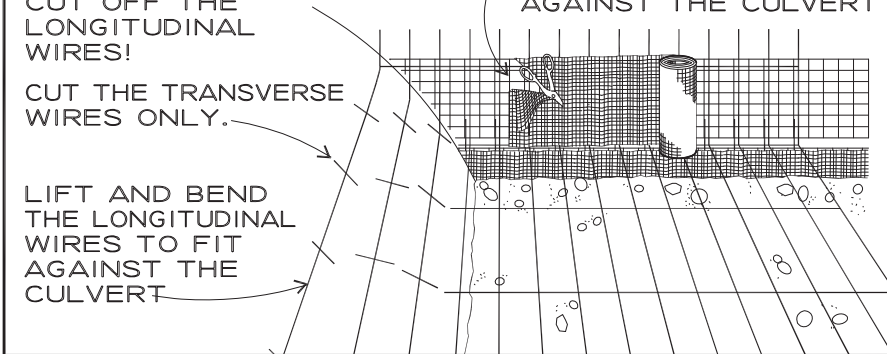
34 AT THE UPPER SURFACE OF THE CULVERT, THE TRANSVERSE WIRES IN THE BASE OF THE MATS ARE CUT AND BENT AGAINST THE CULVERT AS SHOWN.

DO NOT
CUT OFF THE
LONGITUDINAL
WIRES!

CUT THE TRANSVERSE
WIRES ONLY.

LIFT AND BEND
THE LONGITUDINAL
WIRES TO FIT
AGAINST THE
CULVERT

CUT THE BACKING MAT
AND FABRIC TO FIT
AGAINST THE CULVERT



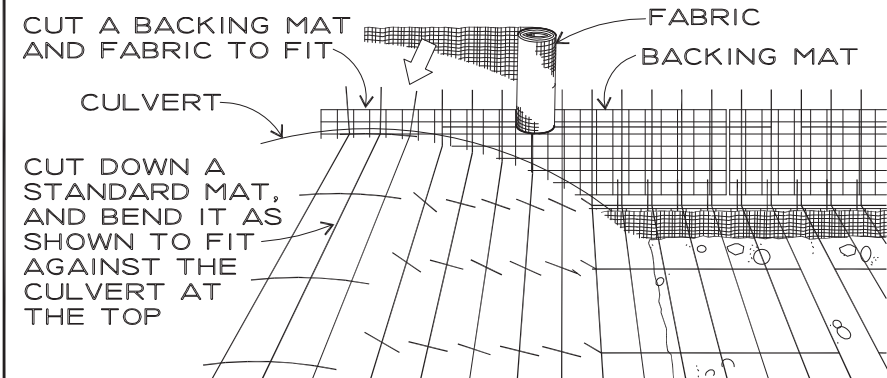
35 THERE MAY BE A LARGE GAP IN THE FACE OF THE WALL AT THE TOP OF THE CULVERT.

CUT A BACKING MAT
AND FABRIC TO FIT

FABRIC
BACKING MAT

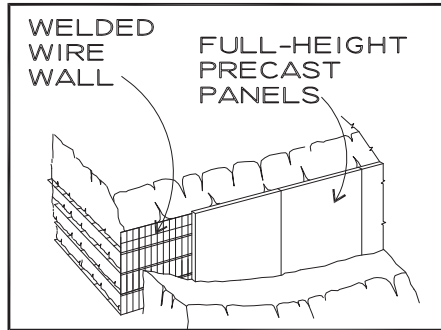
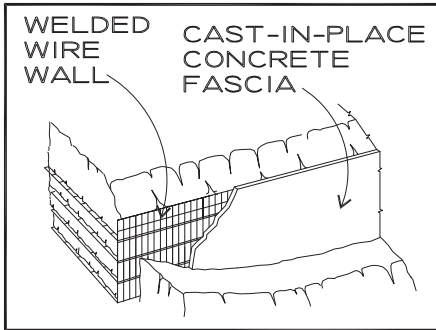
CULVERT

CUT DOWN A
STANDARD MAT,
AND BEND IT AS
SHOWN TO FIT
AGAINST THE
CULVERT AT
THE TOP

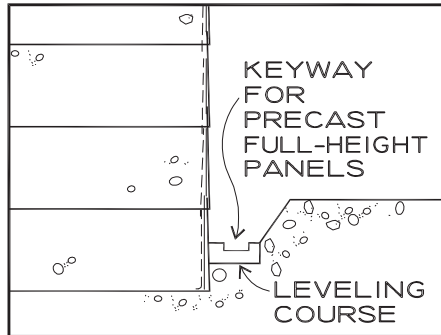
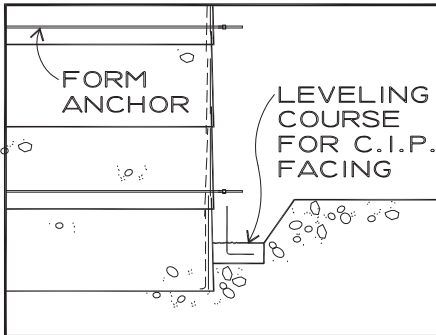


EUREKA REINFORCED SOIL M.S.E. WALL DETAILS

THE HILFIKER E.R.S. WALL BEGINS AS A WELDED WIRE WALL. AFTER COMPLETION AND ANY POTENTIAL SETTLEMENT, PERMANENT FACING IS INSTALLED. THIS MAY CONSIST OF CAST-IN-PLACE CONCRETE, OR FULL-HEIGHT PRECAST CONCRETE PANELS. THE PROJECT CONSTRUCTION PLANS WILL GIVE MORE SPECIFIC DETAILS.

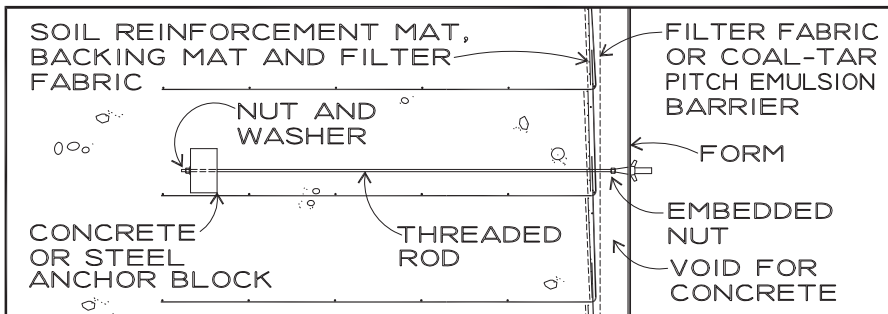


A LEVELING COURSE IS CAST AGAINST THE TOE OF THE WELDED WIRE WALL. THIS WILL SERVE TO SUPPORT AND ALIGN THE FORMS FOR THE C.I.P. FACING, OR WILL HAVE A KEYWAY FOR ALIGNMENT AND CONTROL OF THE TOE OF THE PRECAST FULL-HEIGHT PANELS.



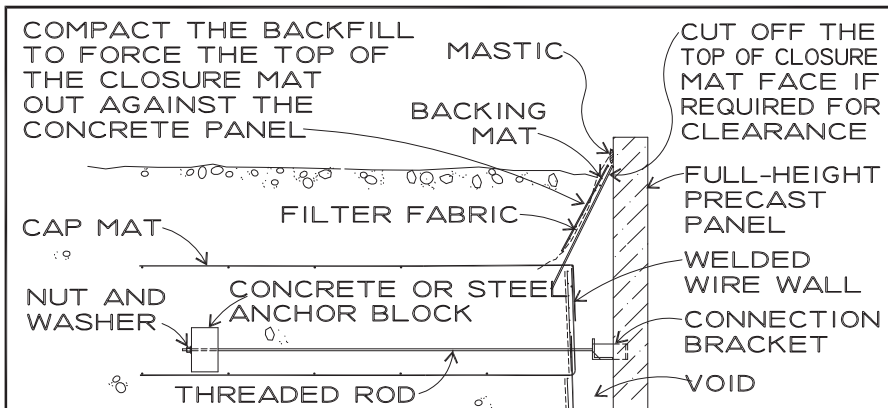
ANCHORS FOR C.I.P. FORMS

ANCHORAGE BOLTS ARE INSTALLED AS THE WELDED WIRE WALL IS BUILT. THE DESIGN MAY VARY FROM THAT SHOWN HERE. SPACING, SIZE AND PROJECT-SPECIFIC DETAILS OF THE ANCHORS WILL BE SHOWN IN THE CONSTRUCTION PLANS.

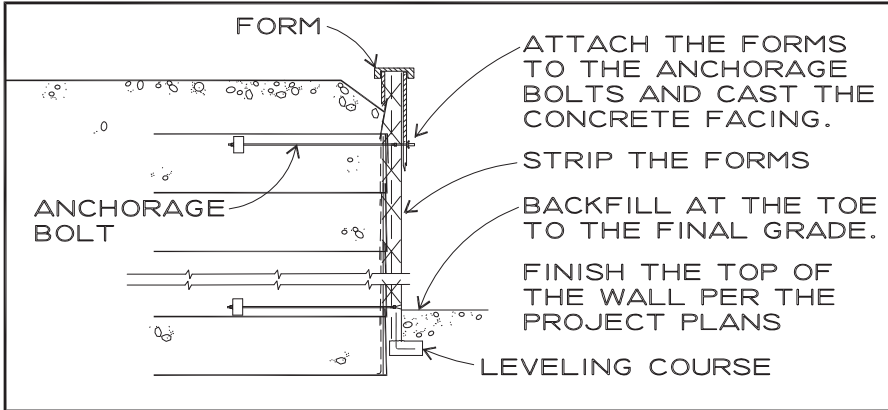


ANCHORS FOR FULL-HEIGHT PRECAST PANELS

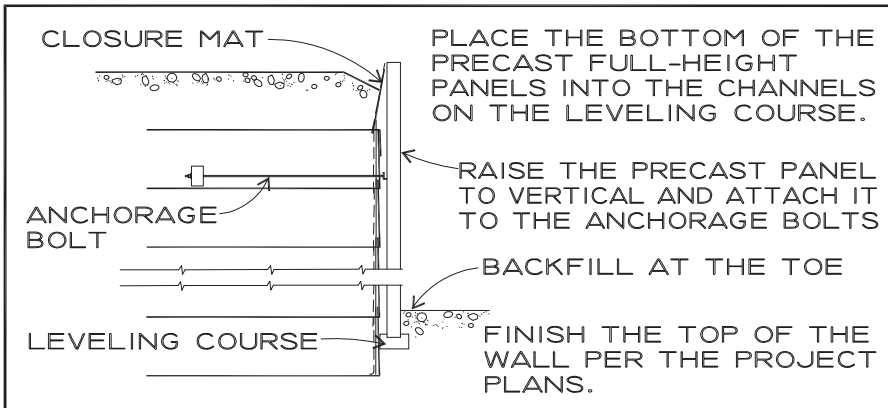
ANCHORAGE BOLTS ARE INSTALLED ONLY NEAR THE TOP OF THE WALL. THE DESIGN MAY VARY FROM THAT SHOWN HERE. SPACING, SIZE AND PROJECT-SPECIFIC DETAILS OF THE ANCHORS WILL BE SHOWN IN THE CONSTRUCTION PLANS.



FINISHING THE E.R.S. C.I.P. FACING



FINISHING THE E.R.S. PRECAST FACING



STAND BACK AND ADMIRE YOUR WORK OF ART! SEND PHOTOGRAPHS TO HILFIKER RETAINING WALLS FOR POTENTIAL PUBLICATION (WITH YOUR APPROVAL, OF COURSE!)

WIRE SIZE COMPARISON TABLE

"W" SIZE NUMBER	NOMINAL DIAMETER (INCHES)	NOMINAL DIAMETER (MM)
W12.0	.391	9.9
W9.5	.348	8.8
W7.0	.299	7.6
W4.5	.239	6.1
W4.0	.226	5.7
W3.5	.211	5.4

WIRE SPECIFICATIONS

ASTM SPECIFICATION	AASHTO STANDARD	TITLE
A 82	M 32	COLD-DRAWN STEEL WIRE FOR CONCRETE REINFORCEMENT
A 185	M 55	WELDED STEEL WIRE FABRIC FOR CONCRETE REINFORCEMENT
A 123	M III	ZINC (HOT DIP GALVANIZED) COATINGS ON IRON AND STEEL PRODUCTS

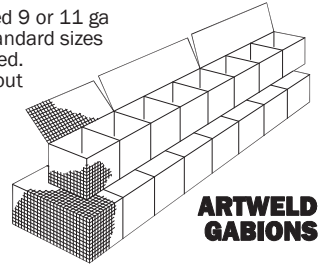
WELDED SMOOTH WIRE FABRIC ASTM A 185

WIRE SIZE	TENSILE STRENGTH PSI	YIELD STRENGTH PSI	WELD SHEAR STRENGTH
W1.2 & OVER	75,000 (520 MPA)	65,000 (450 MPA)	35,000 (240 MPA)

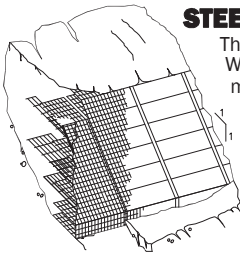
FOR MORE INFORMATION ON WELDED WIRE REINFORCEMENT (WWR) CHECK THE WEBSITE FOR THE WIRE REINFORCEMENT INSTITUTE:
[HTTP://WWW.WIREREINFORCEMENTINSTITUTE.ORG/](http://www.wirereinforcementinstitute.org/)

OTHER HILFIKER PRODUCTS

ArtWeld Gabions are factory-assembled of galvanized 9 or 11 ga Welded Wire Mesh, and are shipped folded flat. Standard sizes are available, and non-standard sizes can be supplied. The mesh can be field-cut to any size or shape without losing structural strength. In comparison to conventional gabions, the larger wire diameter and welded grid gives greater strength, longer life and easier installation. "Spiral" binders, used in field assembly of the gabion edges, and preformed stiffeners, are fast and simple to install.



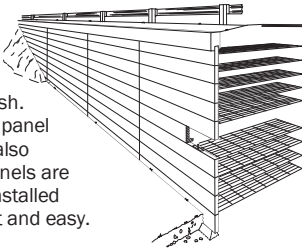
STEEPENED SLOPE



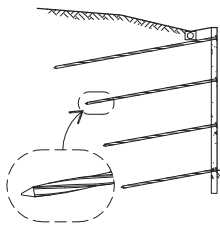
The Hilfiker Steepened slope system is composed of Welded Wire Fabric components. The flat primary soil reinforcement mats are interlocked with bent facing mats, prefabricated to a 1:1 slope. The slope may be flattened, if desired, by stepping each layer back. Behind the facing mats are Welded Wire Fabric backing mats incorporated with erosion mat or sod. Virtually any type of sod or vegetation that will best suit the environment may be used with this system. Low-growth, maintenance-free vegetation is typically specified.

REINFORCED SOIL EMBANKMENT (SMOOTH FACE)

The R.S.E. Smooth Face Retaining Wall retains most of the advantages of the Welded Wire Wall, while providing the additional durability of precast face panels. Panels can be cast to match a variety of architectural treatments, as well as a smooth finish. In most structures, the simple 12.5' x 2.5' standard panel is used, making all the panels interchangeable. We also manufacture special panel sizes when required. Panels are cast with a cantilever footing at the back, and pre-installed reinforcement mat anchors, making installation fast and easy.



SPIRALNAIL WALL SYSTEM



The Spiralnail system was originally designed to replace conventional soil nailing systems. Spiralnails are driven directly into the soil, eliminating time-consuming "drill and grout". They can be used in a variety of projects, including retaining walls, slope stabilization, tie-backs for cast-in-place or precast concrete panels, repair of existing retaining structures, and can be designed to act as soil drains. They can also be faced with welded wire, gabions, and "spider" slope reinforcing.