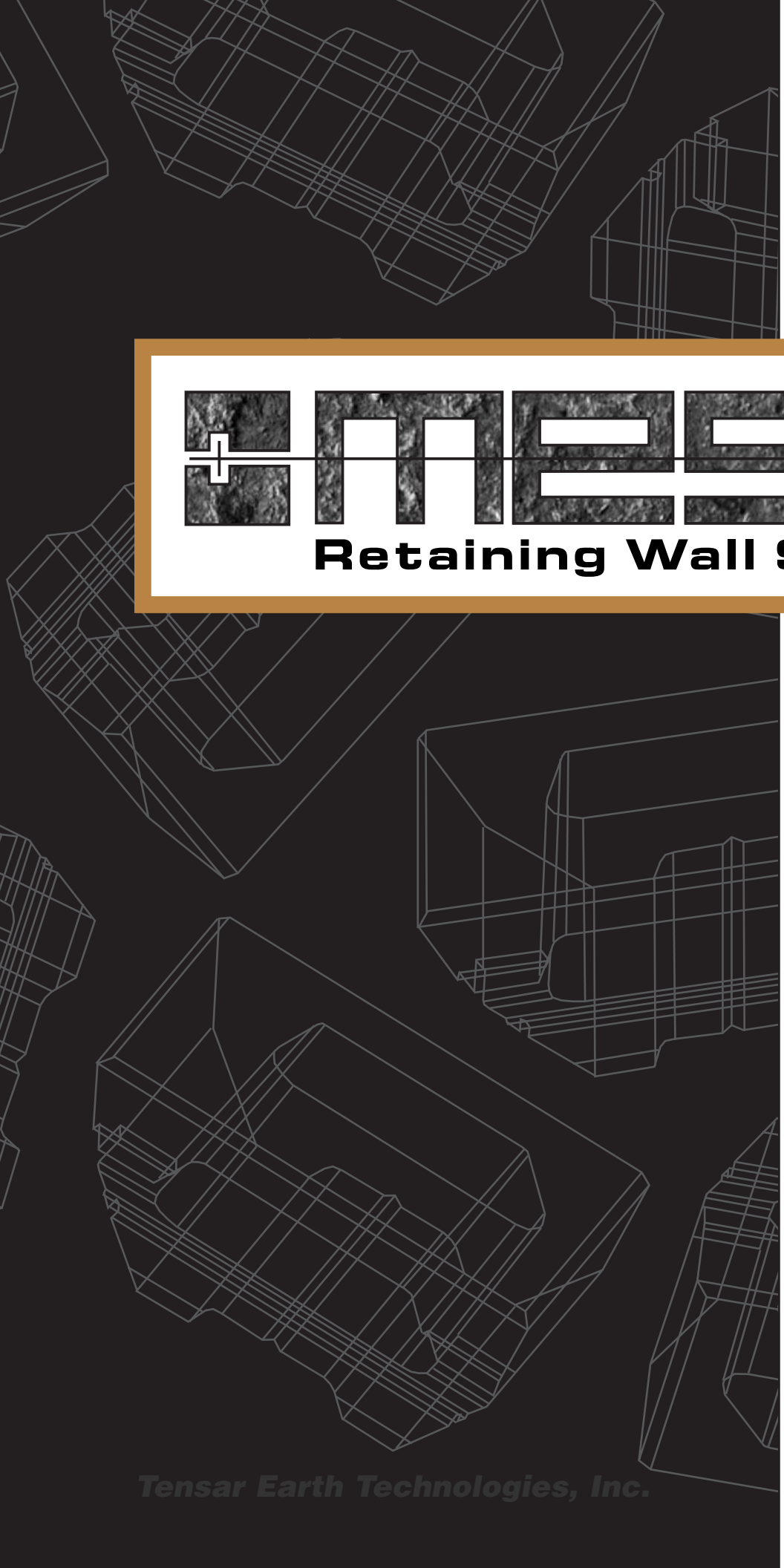


mesa®

Retaining Wall Systems

Construction & Quality Control Manual

Tensar Earth Technologies, Inc.

CONSTRUCTION & QUALITY CONTROL

This manual provides general guidelines for construction and quality control of the installation. This section shall be provided to the owner's Engineer, the Construction Quality Assurance Inspector, and the Contractor. This manual's contents provide general guidelines and examples. Specific construction details and procedures depend on individual site conditions and other considerations which are the responsibility of the Owner and the Engineer.

All installation instructions shall apply to the Mesa Standard Unit, the Mesa XL Unit, and the Mesa Landscape Unit, except where otherwise noted.

1.1 Responsibilities for Construction Compliance

- The Contractor must provide construction in accordance with the contract documents, plans, and specifications. The Contractor is also responsible for the verification of line, grade, and other physical features, as well as surface water drainage control.

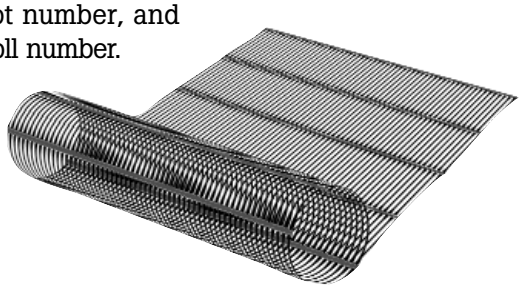
1.2 Materials and Handling

MATERIALS SUPPLIED

- Mesa Segmental Concrete Facing Units and Mesa Connectors
- Mesa Cap Units (where required)
- Tensar® Uniaxial (UX) and Biaxial (BX) Geogrids
- Drainage composite and piping (where required)
- Geotextile filter materials (where required)

HANDLING WALL MATERIALS

- The concrete facing units are delivered on pallets and off-loaded by the Contractor. Transporting equipment must have firm ground and a stable, level area to off-load. A forklift is normally used to handle pallets. If pallets are the property of the block manufacturer, they must be stored by the Contractor for pickup. The Contractor must provide protection from staining or discoloration of the units, such as by using wood dunnage and polyethylene sheet film.
- The Mesa Connectors are shipped in cartons and shall be stored in a secure and dry location.
- The Tensar Geogrids are shipped in roll form with the Contractor responsible for off-loading.
- Rolls should be stored in a secure area. Each roll will be labeled as to its type, its lot number, and its roll number.



- Standard roll sizes of Tensar UX Geogrid are 4.36 feet wide by 200 or 250 feet long. Rolls weigh between 87 and 170 pounds depending on type. Before labels have been removed, it is suggested that rolls be color-coded with spray paint to identify geogrid type.
- It is the Contractor's responsibility to verify the quantities shipped and condition of the materials. The Contractor will inventory materials supplied to assure sufficient quantities have been delivered.

- The Contractor will be allowed a limited amount of time to off-load materials.
- If certifications are required, the Contractor must provide a written request prior to shipment of the material. The Contractor will ensure that all information, including product type, roll/lot number, etc., is furnished to the Engineer.

CONTRACTOR SUPPLIED MATERIALS

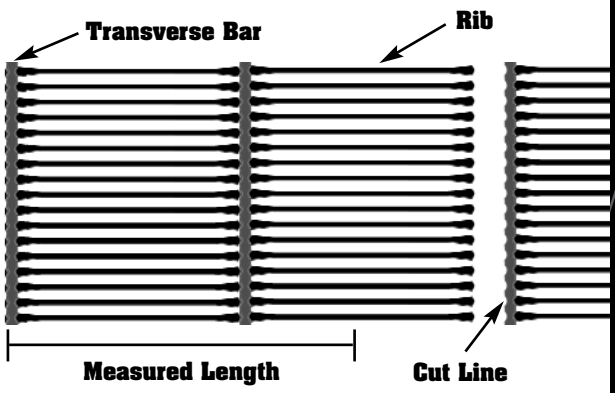
- Dead blow hammer
- 2-foot or 4-foot levels
- Utility saw and/or grinder
- Masonry string and chalk line
- Pitchfork (optional to remove slack from Tensar Geogrid)
- All cast-in-place concrete and structural components
- Stone filter medium
- Reinforced or select fill
- Stakes and/or rods used to remove the slack from the geogrid unless pitchfork is used
- All labor, equipment, and supervision necessary to perform the total Mesa Wall construction

1.3 Preparatory Work for Wall Construction

- Verify approval of Mesa Units, Tensar Geogrid, and the specific reinforced fill
- Review drawings to plan Tensar Geogrid layout
- Review drawings and site plans to consider surface water drainage control both during and after construction.
- Prepare subgrade by excavating vertically to plan elevation and horizontally to design geogrid lengths. If a rock face is shown, it is the responsibility of the Engineer to determine the competency of the rock at the limits of excavation shown on those plans.

Any deviation in the location of the rock face with respect to the face of the retaining wall may require an adjustment to the Tensar Geogrid design and the designer of record must be notified by the contractor prior to proceeding with the wall construction.

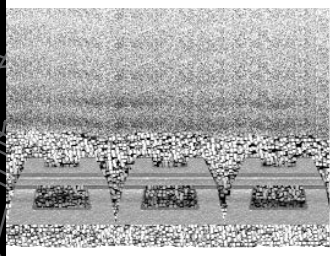
- The subgrade shall be approved before proceeding with wall construction. Any foundation soils found unsuitable by the Engineer shall be treated in a manner approved by the Engineer.
- On larger projects it is suggested that Tensar Geogrid be cut in advance to speed wall construction.
- Cut geogrid flush at the nearest transverse bar beyond measured length as is illustrated below or in front of the transverse bar to provide "finger shims" (as illustrated in Figure 2 on page 8).



LEVELING PAD CONSTRUCTION

- The leveling pad must be flat and level to assure that the first course of Mesa Units will provide uniform support to the courses above it. Non-uniform support will induce tensile stresses and shear stresses in the Mesa Units above the first course that can result in cracking.

- The leveling pad may be constructed with unreinforced concrete or compacted, 3/4–inch minus, well–graded aggregate. It is typically 12 inches wider than the Mesa Units, providing 6 inches in front of and behind the Mesa Unit, allowing for wall curvature and minor alignment adjustments. It is generally 6 inches deep. For unreinforced concrete leveling pads, steel or wood forms are required to assure that the top of the leveling pad is flat and level. For aggregate leveling pads, the aggregate is generally overfilled, compacted, and then carefully trimmed down to near plan elevation. The Mesa Units are then seated into the aggregate with a rubber mallet to the plan elevation, and leveled front to back and side to side.



- Steps in the leveling pad are required to change elevation. It is important that the height of the step is equal to the height of the number of Mesa Unit courses. In practice, the steps may be slightly more or less due to the thickness of the Tensar Geogrid reinforcement connected between courses and to the normal dimensional tolerances of the units. Where a concrete step is not at the same elevation of the adjacent courses, shimming or grinding will be required to match the elevation and provide a flat and level bearing surface for the next course of units. As shown in the figure below, such grinding or shimming will be required over some distance (5 feet min.) from the step to assure that the top surface of the entire course of Mesa Units placed on the stepped section of the leveling pad is flat and level. Ribs or transverse bars of the Tensar Geogrid may be used as shims if their thickness is correct.

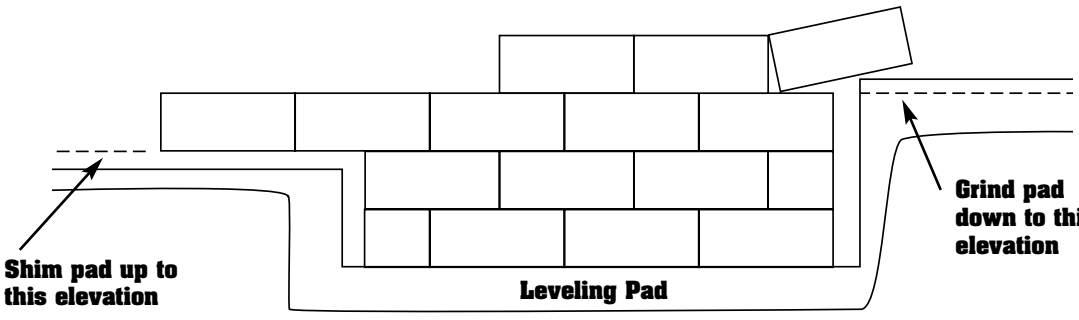
- If contract documents indicate the wall has a battered face, the Contractor shall ensure that the 5/8–inch setback is accounted for at each leveling pad step. It is recommended that the elevation changed of the leveling pad does not exceed four courses.

- The top of the Mesa Units should be adjusted as required to be leveled. Shimming and/or grinding may be required (see "Shimming Mesa Units" section on pages 7 to 8 for instructions).

1.4 Wall Construction

- Wall line shall be established using a chalk or string line. Chalk line should be placed on the concrete pad along the tails of the Mesa Units. A string line can be used in lieu of a chalk line and will be necessary where leveling pad consists of aggregate. (Alignment based on the split faced Mesa Units may render an uneven wall face.)

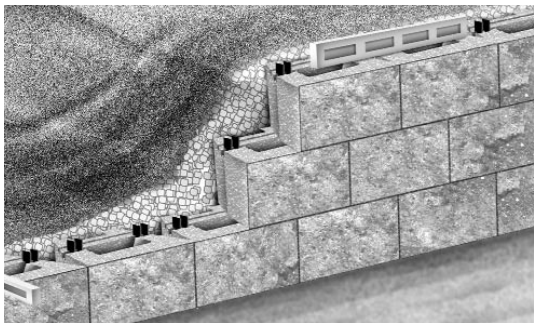
- Once the leveling pad is complete, the first course can be installed. Place the Mesa Unit with the sides touching and the textured face outward. The first course must be accurately placed, carefully spaced, and leveled to facilitate construction and to enhance the appearance of the wall.



- Prior to the installation of the second course and each successive course, the tops of the Units on which the course is to be placed must be swept clean. Failure to do this will result in problems with seating and leveling the Mesa Units and increase the likelihood of cracks developing in the units due to load concentrations as additional courses are set.

- The Mesa Units are stacked in a running bond fashion, similar to standard masonry wall construction. A limit for the shift from a perfect running bond is needed. On straight wall sections, it should be a 1/2 inch to assure all standard connector teeth are squarely in the slots. The units, once placed, shall be advanced forward toward the face of the wall until they make contact with the Mesa Connector. The connectors do allow for the units to slide from side to side, therefore, the vertical joint alignment should be checked frequently (max. 20 units) to ensure that a running bond pattern is maintained within the limits stated above.

- Drainage fill is placed to the limits shown on the drawings. Drainage and/or core fill may not be required for structural walls (refer to the Definitions section under "Drainage Fill" and "Core Fill"). Proper installation of drainage materials is critical to overall wall performance. Drainage materials must be installed properly and protected during construction.

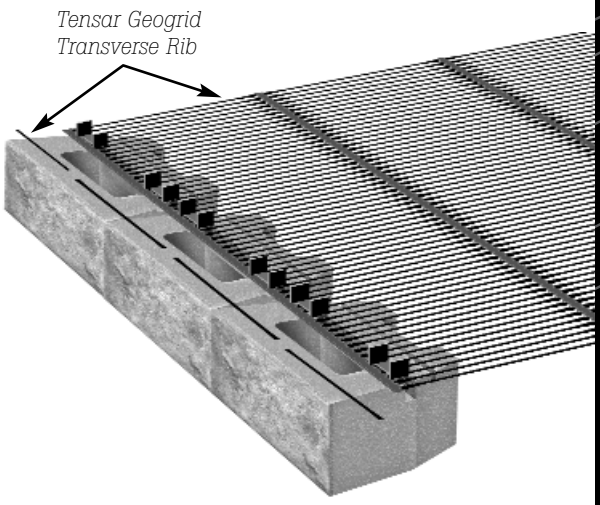


As subsequent courses of Mesa Units are placed, it is important that the units remain level from front to back and side to side. This level should be checked as each course is placed. If the units are more than 1/8-inch out of level from front to back or side to side, or if the units are not level from back to front, they should be brought to level by grinding and/or shimming (see Figure 1 to the right and Figure 2 on page 8).

SHIMMING MESA UNITS

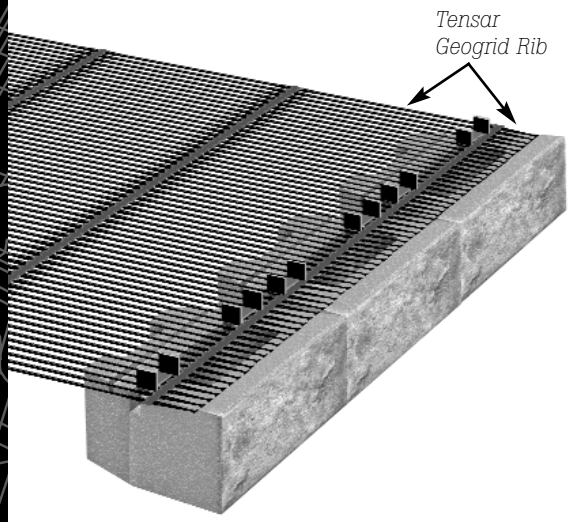
- It is important that the courses of Mesa Units are level front to back and side to side. To achieve this in the front to back plane, it may be necessary to grind the units or use shims between some of the courses to correct for:
  1. the thickness of the Tensar Geogrid reinforcement ribs that cross the tails of the units, or
  2. for slight differences in the height at the front and back of the units.

Figure 1: Geogrid Rib Shim



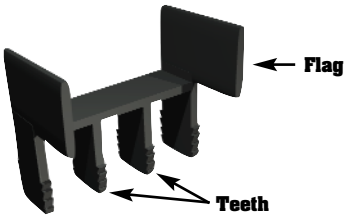
- For courses placed on a geogrid elevation, shims may be required on the front face shell of the Mesa Unit below. The shims should be the same thickness of the geogrid rib. The shim material can be a rib trimmed from the same roll of Tensar Geogrid that is placed on top of the front face shell of the Unit. An alternative is to cut the geogrid so that the ribs extend approximately 1 inch onto the front face shell. These methods are shown in the drawing above and on the drawing on the next page.

Figure 2: Geogrid Finger Shim



- To correct for slight differences in unit heights, a geogrid rib may be cut and placed on successive courses to bring the face and/or tail back to level. As shown in Figure 1 (page 7) and Figure 2 (above), the "Rib Shim" and "Finger Shim" should be positioned on the inside of the front face shell of the unit, generally within a 1/2 inch of the core. This results in less stress on the underlying block than would exist if the shim is placed near the front face of the unit.
- The Tensar Geogrid may be draped over the upper courses of the wall until the reinforced fill reaches the level of the Tensar Geogrid. To ensure the Mesa Wall's geometry is being maintained, a string line should be pulled after each course has been set. The string can be referenced from the connector slot or tail of the Mesa Unit.

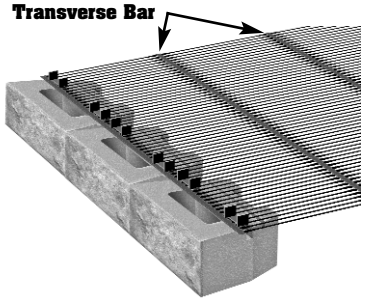
NOTE: To ensure proper installation, the geogrid transverse bar must be pulled to contact with the teeth of the Mesa Connector.



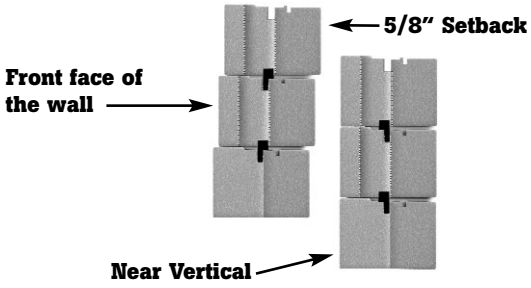
1.5 Geogrid & Connector Placement

The following section covers the installation for both geogrids and connectors based on use of the Standard, XL, and/or Landscape Units.

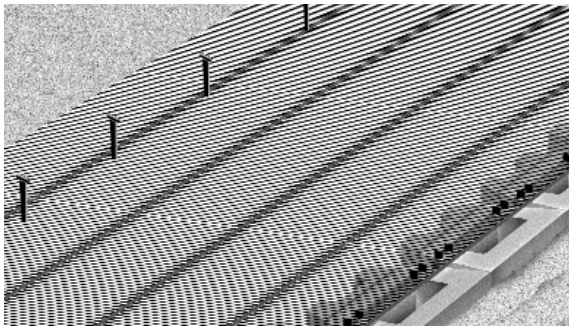
- *At the end of each day, the Contractor shall ensure the reinforced backfill is graded to drain water away from the face of the wall. Berms and/or ditches must also be in place and functioning to prevent the entrance of runoff into the wall construction site. Delays in wall construction during rainy periods should be avoided to minimize the likelihood of saturation of the backfill.*
- At the location and elevation shown on the plans, install the Tensar Geogrid of the type and length specified, ensuring the transverse bar of the Tensar UX Geogrid is in the location indicated in the illustration. The teeth of the Mesa Standard Connector must penetrate through the Tensar Geogrid apertures into the Connector slot on each side of the top of the Mesa Units. On courses that receive geogrid and on courses that do not receive geogrid, a Mesa Standard Connector shall be placed in each of the connector slots on top of the units. All four teeth of the connectors should be positioned in the slots. Where necessary, to align standard connectors over slots, the transverse bar of the geogrid may be cut midway between the connectors. The transverse bar should be snug against the connector teeth before final seating of the connector.



- Flags on top of the Mesa Connector must be oriented in the proper direction for a "battered" or "near vertical" wall as per the contract documents. Placement of the connector with flags forward (toward the face of the wall) will render a near vertical wall. Placing the connectors with the flags pointed away from the wall face will provide a 5/8–inch setback.



- The fill on which the geogrid is placed must meet specification and must be compacted to the required density (see compaction requirements on this page) and graded reasonably smooth. On courses that require geogrid, the reinforced fill must be at the same elevation as the top of the course for a distance of three feet before the fill



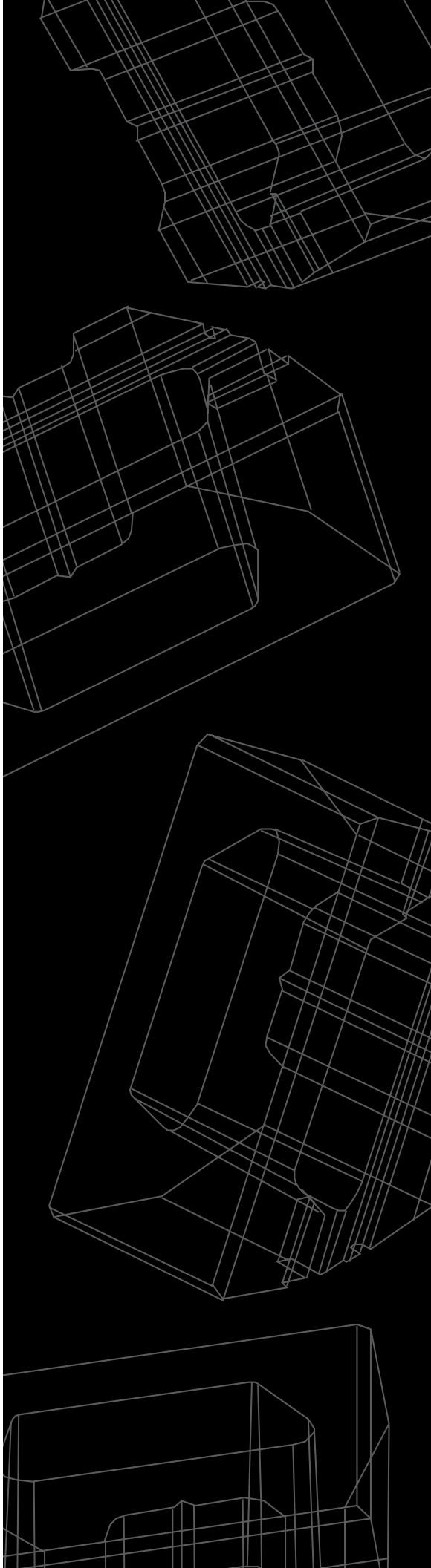
can be gradually sloped. Remove slack from the geogrid by pulling it taut, and then anchor it using stakes and/or rods. The stakes used to position the tail of the geogrid can be withdrawn once the fill has been placed and then reused on subsequent lifts. Optionally, a pitchfork can be inserted at the tail of the geogrid and slack removed by prying until the fill has been placed on the geogrid. The removal of the slack from the geogrid prior to fill placement will help prevent any movement of the wall face due to translation of the slack toward the wall face.

- Fill placement shall be performed to minimize development of slack in the geogrid. The fill should meet specification and be spread in a direction away from or parallel to the face of the wall. By doing this, any slack that does develop will tend to be pushed toward the free (unconnected) end of the geogrid. Unless the contract documents are more stringent, the loose lifts of the reinforced fill shall not exceed 6 inches where hand compaction equipment is used, or 10 inches where heavy compaction equipment is used. These thicknesses may vary depending on the approved project specific soil types used. The fill shall be compacted to 95% of ASTM D–698 or as required by the contract documents, whichever is more stringent. Only hand–operated compaction equipment shall be used within 3 feet of the tail of the unit.

- Heavy equipment shall not be used within 3 feet of the back of the facing units. Tracked construction equipment shall not be operated directly on the geogrid. Rubber tired equipment may be operated on the geogrid providing the subgrade is not pumping or rutting. Turning of tired equipment shall be minimized to prevent dislocation or damage to the geogrid or facing units. The equipment must travel slowly and with sufficient care to avoid dislocating the geogrid or the facing units.

- The Cap Units, if required, are installed by attaching them to the units below using an approved exterior concrete adhesive. The Cap Units may be placed such that a nominal 1 inch overhang is achieved or flush with the face of the wall.

- Wall penetrations may be accommodated by cutting the Mesa Units to fit using a utility saw and a mason's hammer. The small voids, less than 1 inch, can then be closed with a cement and sand mix or other methods that have been approved by the Engineer.



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IG-MESA-2.04