



EXCAVATION & JOBSITE PREP REQUIREMENTS - 2022

IVI-GOLF / Sandtrapper 5 Pine Camp Dr. Binghamton, NY 13904 888-970-5111



JOBSITE REQUIREMENTS

GENERAL SPECIFICATIONS

Proper use and construction of the PermaEdge Bunker System (referred to as “the System”) involves unique and specialized requirements that conform with patented and patent-pending processes. Beyond the simple concept of synthetic turf, the System employs the use of re-purposed synthetic turf that meets specific compositional, dimensional, preparatory, construction, and safety requirements. It is the precise steps and combination of these requirements that form the System. At its core, the System is a method of constructing a retaining wall from recycled, sand-impregnated synthetic turf; supplied as multi-dimensional tiles; site-prepared and built employing a stacked, alternating layer approach; additionally secured with a compacted, dry-mixed, Portland Modified Soil back fill.

Reference Figure 1 for Typical PermaEdge Profile and Specification Notes

WORKSITE/BUNKER PREPARATIONS

Prep work will vary depending on the nature of the project. If renovation or restyling, project bunkers should be stripped of surround grass (minimum 2 rows) to define the work area. Excavation of the bunker faces/slopes should follow design intent, with the desired angle of the finished revetted face translated to the excavated face angle. Target slope angles should range between 55-65 degrees for fairway bunkers and 65-75 degrees for greenside bunkers.

Prior to any wall building, it is critical to properly define and prepare the foundation (referred to as “The Bench”). For traditional revettments, the Bench should be level from side to side and front to back. It is strongly advisable to use a laser level for better accuracy. For flashed bunkers where the goal is to follow the contours of the bunker edge, the Bench should be level from front to back. A third method is called a “Stepped Bench” which is used when the design intent requires level, horizontal layers yet the sand is heavily flashed.

The bench/foundation needs to be compacted. Local ground conditions will effect the amount of compactive effort needed. Hand tampers/rammers or mechanical plate compactors may be used to achieve this result – a firm, smooth surface. The necessary width of the bench/foundation is approximately 1’ (.30 meters). Many smaller compactor models have plate sizes that are between 12-14 inches (.3-.36 meters), which is acceptable. Plate sizes of 15” (.38 meters) inches or larger are too large for this application.

Reference Figure 2 for Bunker Excavation & Prep

MODIFIED SOIL SPECIFICATION

The System will be comprised of Portland Modified Soil (referred to as “PMS”) backfill. Typically the PMS backfill will take the form of Portland modified soil/aggregate, using contaminated sand from existing bunker surrounds (less than 35% of material passing a no. 200 Sieve) 5% minimum to 10% by volume (10:1) of PMS will be ordinary Portland cement (OPC - complying with AASHTO M85), dry mixed on site either manually or by mechanical mixer to produce a uniform distribution. Approximately .65 cubic feet of backfill is needed for every square foot (face) of PermaEdge being constructed. In metric, this is 0.2 cubic meters per square meter of face. Approximately 3 lbs OPC is needed for every square foot (face) of PermaEdge being constructed. Approximately 15 kg per square meter (face) of PermaEdge being constructed.

Where soil/aggregate is not sourced from contaminated bunker sand, any other combination of gravel, stone, sand, silt, slag, sandshell, ash, waste, aggregate, crushed stone or crushed bitumen provided that organic content does not exceed 20% by dry weight and 100% passes a 1½ U.S. Sieve and a minimum 60% passes a #4 U.S. Sieve.

Compaction of PMS backfill by 40 lb. (20kg) hand tamper/rammer, in layers no thicker than 2.5 inches (60mm) producing dry density of 90%. Compaction of dry backfill can be accelerated by application of small quantities of water applied at a rate of approximately 8 oz / sq. Ft. (2 liters/sq. m). This is equivalent to a rainfall of .07 inches (2mm) and can be simulated by one pass of a “watering can”.

CONSTRUCTION MATERIALS ESTIMATING

Determining material needs for PermaEdge construction requires an assessment of equipment on hand, sand/soil access, and OPC amounts. Many facilities and contractors will commonly have the equipment and supplies necessary. Some of the smaller supplies are typically purchased.

Equipment	Basic Materials	Supplemental Materials
Mini Excavator w/ Knuckle Bucket	Rakes & Shovels	Work Gloves
Equipment w/ high flotation turf tires	Inclinometer	Cutting Knives/Blades
Gas-Powered Plate Compactor (12-14")	5 gal. Buckets	Cutting Table
9-12 cu ft Gas Concrete Mixer	Plywood	8" x 8" Hand Tamper
Forklift (to unload material)	Water Hose	Saw Horses
	Ordinary Portland Cement (OPC)	



JOBSITE REQUIREMENTS

Typically, one piece a facility will need to access is the portable gas concrete mixer (9-12 cu ft) which is normally available from a local equipment rental firm (approx. \$300/wk).

OPC required is 3-6 lbs. per square foot of face (approx. 15-30 kg per square meter) . More simply put, OPC required is approximately 180-360 lbs. per PermaEdge pallet (62.5 sq. ft). OPC typically comes in 90 lb. bags, so conservatively speaking, a single 90 lb. bag will cover a quarter of a pallet.

These estimating considerations are exclusive of turf reinstatement materials. The turf reinstatement measures use small amounts common materials (topsoil, wetting agents, growth regulators) and natural turf to complete the project. If a renovation, stripped material can be reserved for use in reinstatement detail, with top turf layer being purchased or cut from on-site nursery.

Reference Figure 3 - Turf Reinstatement

MOBILIZATION NOTES

Excavation equipment needs will vary depending on the nature and scope of the project. Larger bunkers and larger projects would benefit from heavier excavation equipment yet require tighter control to properly define excavated slope, bench, and base. Depending on excavation requirements, additional hauling equipment may be needed to remove excess, excavated material.

PMS mixing is achieved at the bunker with a small portable mixer. A larger mixing effort can be established away from the working bunker, but is advisable only in specialized settings where new material is used versus excavated, reserved bunker sand/material.

Having a ready supply of cutting blades is critical. Blades should be replaced often to speed turf cutting/slicing/notching. Knee Pads are essential for the worker fitting turf to work for any extended stretches. Cutting table can be constructed out of a stack of pallets with plywood if saw horse aren't an option. The 10' canopy is useful in hot weather, to keep material damp when cutting and stacking.

PRODUCT HANDLING REQUIREMENTS

This Tiles in the System are intended to remain in its shrink-wrapped condition until installed. Should the pallet wrapping be removed, the sand infill will loose its moisture. Handling the material in a dry state is not advised. During handling and slicing/cutting, material must remain in a wet/damp condition or sand can exit the profile. Handle with care. Pallets can be sprayed with water at the worksite to maintain proper moisture content. Reference Figure 3 for Pallet and Handling Specification

LABOR EXPECATIONS

Labor requirements are build on training a 5-person team. The 5-person team is set-up with 2 persons that will be trained to a high skill level. The remaining 3 persons are defined more as basic skilled. As a group, however, each person is important is creating a continual "production pipeline". One person faltering in a basic labor task impacts productivity directly for the group as a whole.

At the beginning, training establishes the base skills and team roles. For the first series of bunkers (5-6) that are built, it is typical to have the team reach approximately 70-80 square feet (6.5-7.5 square meters) of face per day. Subsequent bunkers will see the productivity grow where the productivity rate increase is driven by team cohesion and adherence to known PermaEdge methods.

Beyond quality and aesthetics, a trained team will install PermaEdge much faster than an untrained team. Our studies prove this. On a large project of approximately 10,750 sq ft (1,000 sq m), a trained team will complete work roughly 250 man-days less than an untrained team. Even on very small projects of approximately 1,000 sq ft (93 sq m), a trained team will complete work roughly 20 man days less.

TECHNICAL SUPPORT & TRAINING

The PermaEdge Technical Advisor role will be to train staff and manage construction of the first 2-3 bunkers, depending upon size, and set the high quality benchmark for the remainder. Beyond the start-up process, we can provide supplemental, long-term support, if desired.

We do not want to make the process overly complicated, but we hope that all golf clubs will understand that PermaEdge Bunker System relies very heavily on the quality of installation to retain its integrity. We all want the same thing: beautiful, low maintenance bunkers which contribute to better golf courses and higher member satisfaction.

ON-SITE ORGANIZATION & SET UP

For greatest productivity, it is recommended that all materials needed for bunker construction are brought to the bunker. Once a bunker is complete, tools and materials can be transferred to the next bunker. This includes all cutting and mixing.

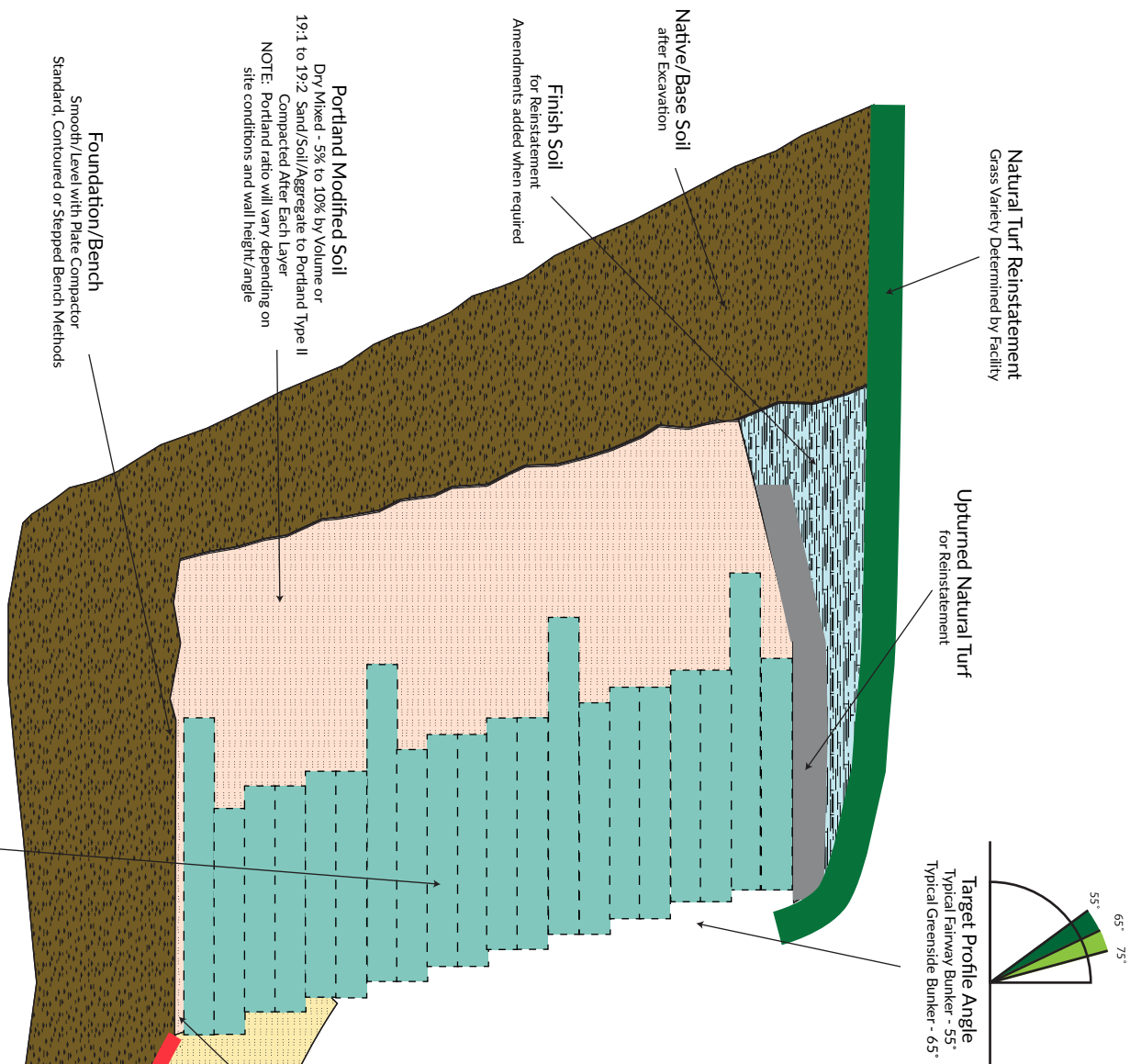
When the PermaEdge Technical Advisor is on-site, team members will be instructed, in detail, on proper set-up routines and guidelines that will streamline work and improve productivity. We always stress that an organized, clean and tidy work area produces great results and the least disturbance to the area.

PermaEdge Design Specification









FIGURE 1

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Typical PermaEdge Profile



Legend - Notes

-  **Base Soil / Excavated Soil**
Compacted Level Bench/Foundation w/ Angle of Excavated Slope Equal to Target Profile Slope Angle.
-  **PMS - Portland Modified Soil**
5% Type II Portland by Weight in a 1:1.0 Ratio w/ Sand/Soil/Aggregate, Compacted by Layer.
-  **Synthetic Turf Profile**
Alternating Layers of Anchor Tiles and Fascia Tiles to a 1:1.5 Ratio.
-  **Bunker Sand**
-  **Natural Turf Reinstatement**
Upturned layer of Natural Turf as Intermediate Layer Prior to Finish Soil and Final Turf Layer.
-  **Finish Soil - Natural Turf Reinstatement**
Topsoil as Amended to Include Wetting Agent for Improved Turf Establishment.
-  **Natural Turf Reinstatement**
Final Turf Layer - Placed to Overhang the Synthetic Turf Profile until Established, then Trimmed to Final Edge
-  **Optional - Bunker Liner**
For Additional Protection, a Fabric Liner such as Sandtrapper or alternative hardscap

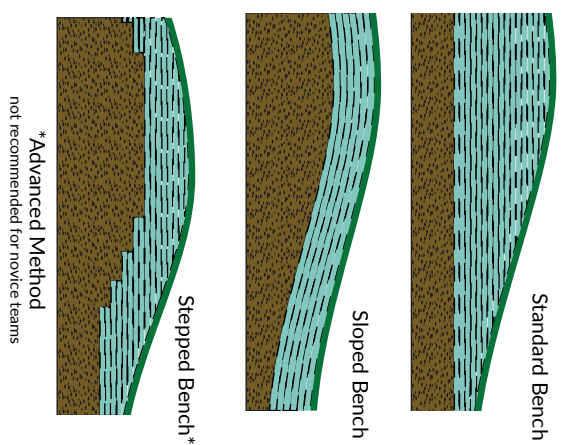
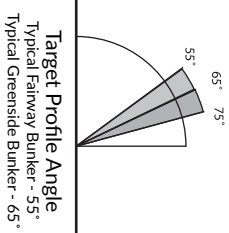
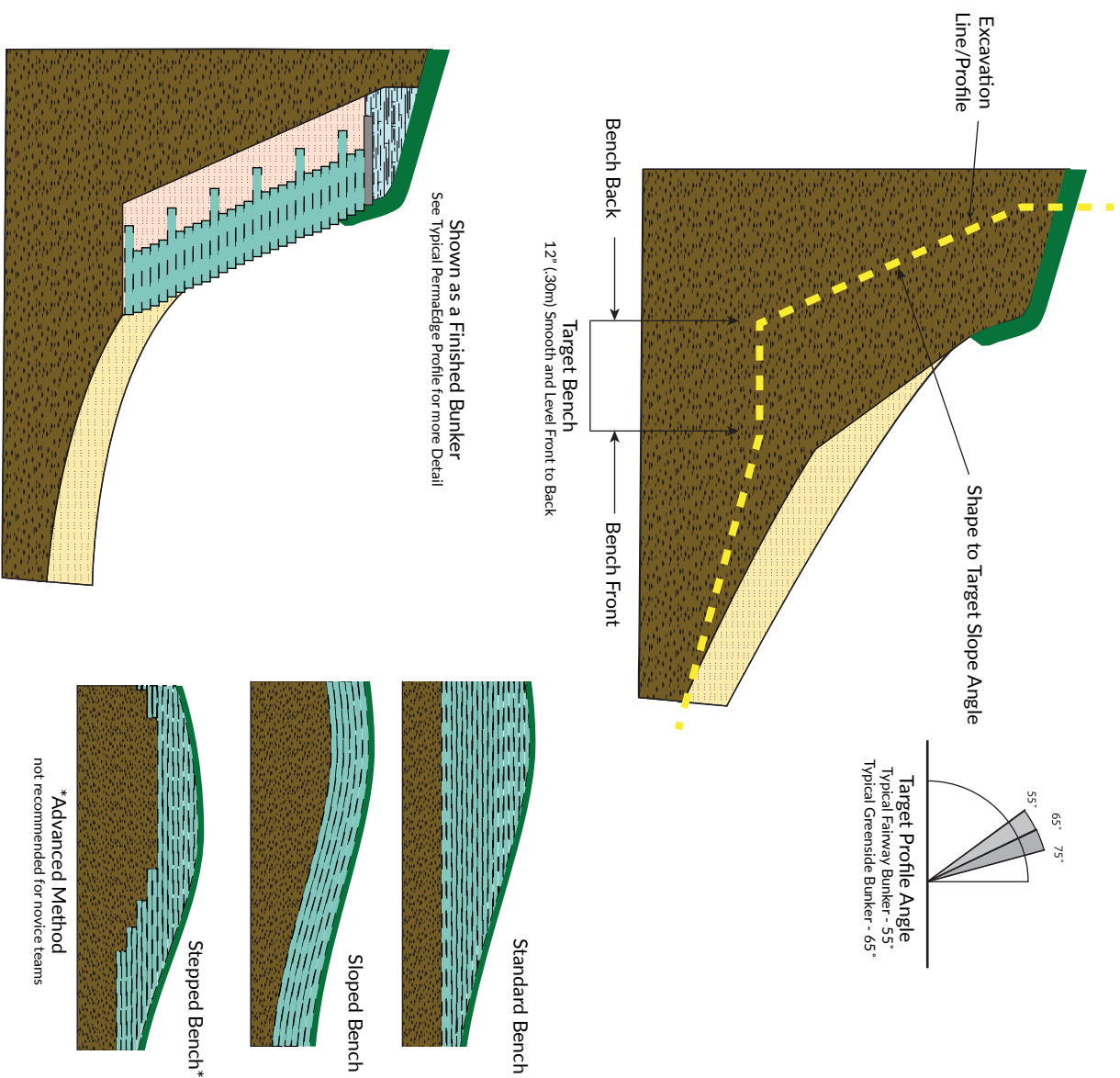








PermaEdge Design Specification

FIGURE 2

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Bunker Excavation & Prep Specification



-  **Base Soil to be Excavated**
Mini-Excavator w/ Knuckle Bucket to Excavate. Reserve Soil for use in PMS backfill. Restyling may require heavy equipment.
-  **Bunker Sand**
Excavate and reserve for use in PMS backfill
-  **Natural Turf Surround**
2-3 Strips removed for Work Area. Can be reserved for use in Finishing/Natural Turf Reinstatement Spec.
-  **Excavation Target**
Upturned layer of Natural Turf as Intermediate Layer Prior to Finish Soil and Final Turf Layer.
-  **PMS - Portland Modified Soil**
5% Type II Portland by Weight in a 1:1.9 Ratio
-  **Finish Soil - Natural Turf Reinstatement**
Topsoil as Amended to Include Wetting Agent

Notes

Prep work will vary depending on the nature of the project. If renovation or restyling, project bunkers should be striped of surround grass (minimum 2-3 rows) to define the work area.

Excavation of the bunker faces/slopes should follow design intent, with the desired angle of the finished reverted face translated to the excavated face angle. Target slope angles should range between 55-65 degrees for fairway bunkers and 65-75 degrees for greenside bunkers.

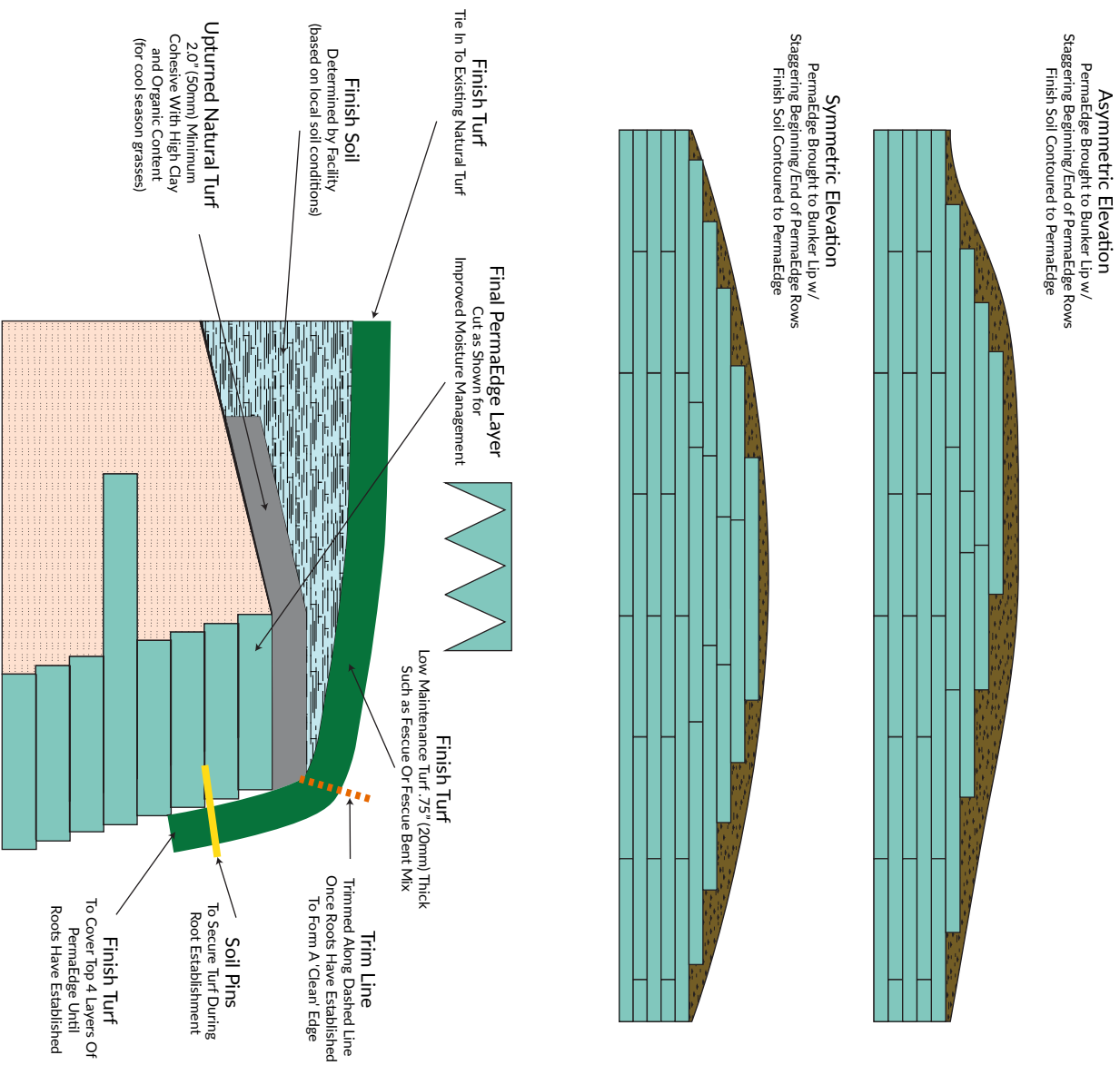
Prior to any wall building, it is critical to properly define and prepare the foundation (referred to as "The Bench"). For traditional reverts, the "Standard Bench" should be level from side to side and front to back. It is strongly advisable to use a laser level for better accuracy.

For flashed bunkers it common to use a "Sloped Bench" where the goal is to follow the contours of the bunker edge, the Bench should be level from front to back. A third method is called a "Stepped Bench" which is used when the design intent requires level, horizontal layers yet the sand is heavily flashed.

The bench/foundation needs to be compacted with a plate compactor. The necessary width of the bench/foundation is approximately 1' (.30 meters), so the plate compactor should be sized accordingly. Many smaller compactor models have plate sizes that are between 12-14 inches (.3-.36 meters), which is acceptable. Plate sizes of 15" (.38 meters) inches or larger are too large for this application.









Finishing - Final Turf Layers & Turf Reinstatement



Asymmetric Elevation
 PermaEdge Brought to Bunker Lip w/
 Staggering Beginning/End of PermaEdge Rows
 Finish Soil Contoured to PermaEdge

Symmetric Elevation
 PermaEdge Brought to Bunker Lip w/
 Staggering Beginning/End of PermaEdge Rows
 Finish Soil Contoured to PermaEdge

-  PermaEdge Profile
-  Portland Modified Soil
-  Upturned Natural Turf
-  Base Soil
-  Finish Soil Topsoil as Amended
-  Finish Turf

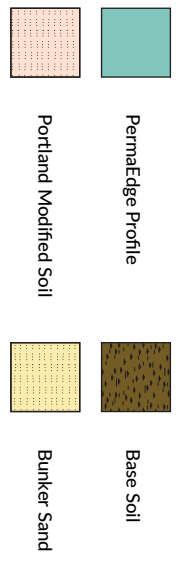
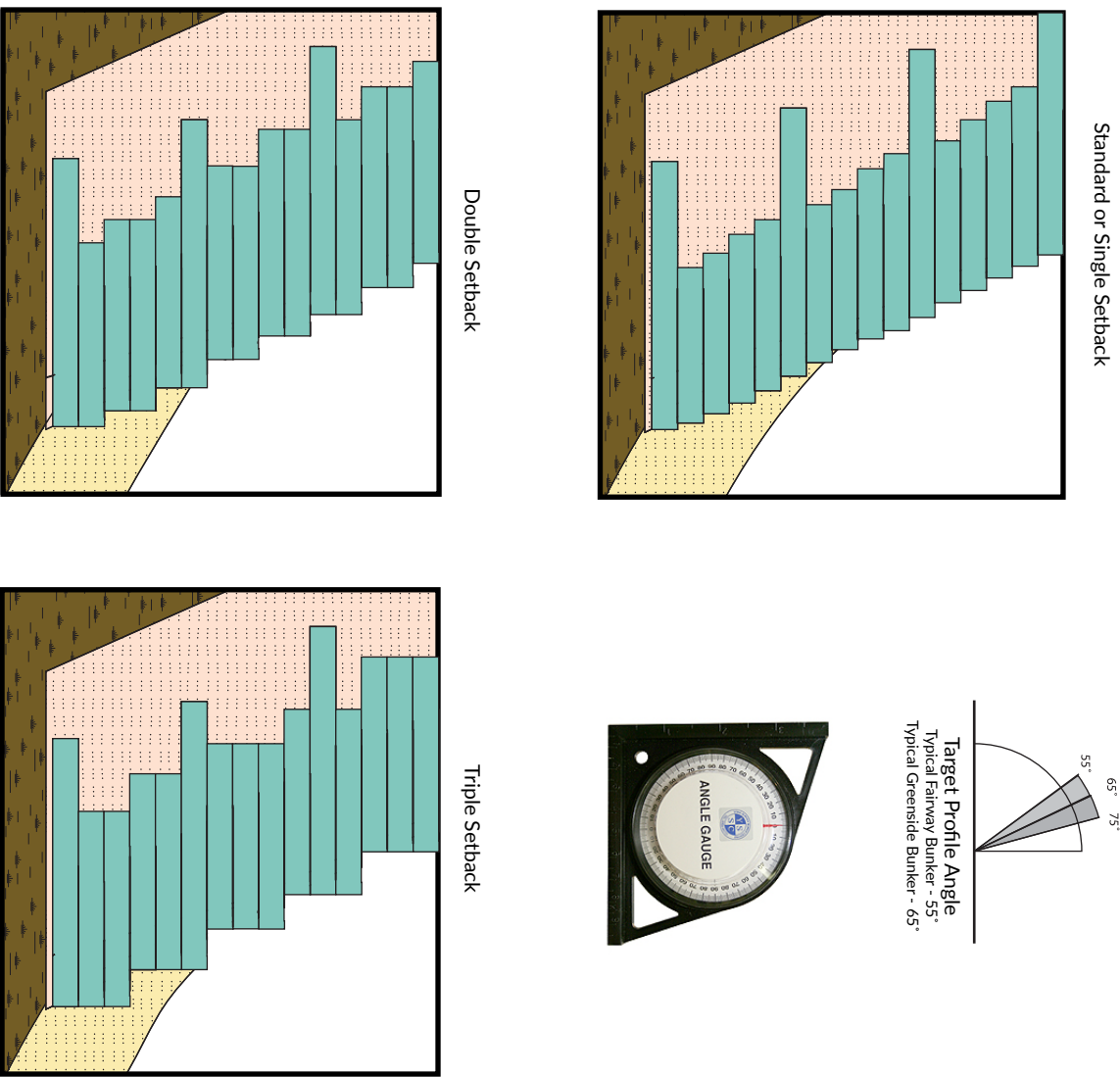
Notes

Afterscare is essential, during natural turf establishment and will vary according to weather.
 Turf must not be allowed to dry completely.
 Wetting agent (spray applied) and growth regulator (i.e. Primo Maxx) to be applied as required.
 Alternative detail should be used in hot climates where creeping grasses (E.G. Bermuda) dominate.



PermaEdge Design Specification

Construction Specs & Notes



Notes

The System of building the retaining wall begins with a small, skim coat or bunding layer of PMS approximately .25" (5mm) thick. This layer should be smoothed to an even, level layer. The first Tile layer to be placed is the Anchor Tile. This layer should be placed on top of the bunding layer and carefully fit to follow the desired bunker contours. Tiles should be placed tightly together. Bunker curvatures should be transitioned smoothly. After placing of the first layer, fit should be checked and corrected prior to the addition of new layers. PMS should then be placed behind the Anchor Tile layer, smoothed and compacted.

Following the Anchor Tile layer, 4 layers of Fascia Tiles will be placed individually, with the placing, smoothing and compaction of PMS after each layer. After 4 layers of Fascia Tiles, another layer of Anchor Tiles are placed, again, followed with placing, smoothing and compacting of PMS after the layer. Subsequent layers of Fascia Tiles and Anchor Tiles in a 4:1 ratio to build the wall to the desired height. Each layer of Tiles placed should always be followed with placing, smoothing and compacting of PMS.

In order to meet the specific angle or slope requirement of the wall, single or multiple layers are setback in varying distances to meet the 55-75 degree slope. Single layers (referred to as "Single Stacked or Single Setback") can be placed one at a time and placed a slight distance back from the previous layer to define the slope. Multiple layers (referred to as Double Setback and Triple Setback") can be placed two or three at the same spacing from the previous layers, with each set of two or three layers placed a slight distance from the previous set of two or three layers to define the slope.





9-12 Cu Ft Gas Mixer



12-14" Plate Compactor



Utility Knives & Blades



Water Hose & Nozzle



Work Gloves



Hand Tampers



OPC - Type 1 or 2



4x8 Sheet Plywood



Saw Horses



Wheel Barrows



Flat Shovels



Pointed Shovels



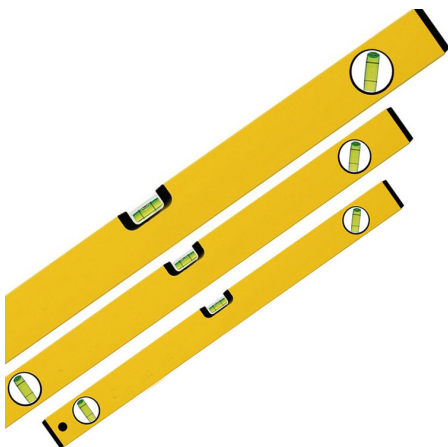
Water Hose & Nozzle



Finish Trowel



5 Gallon Buckets



Straight Edge / Level

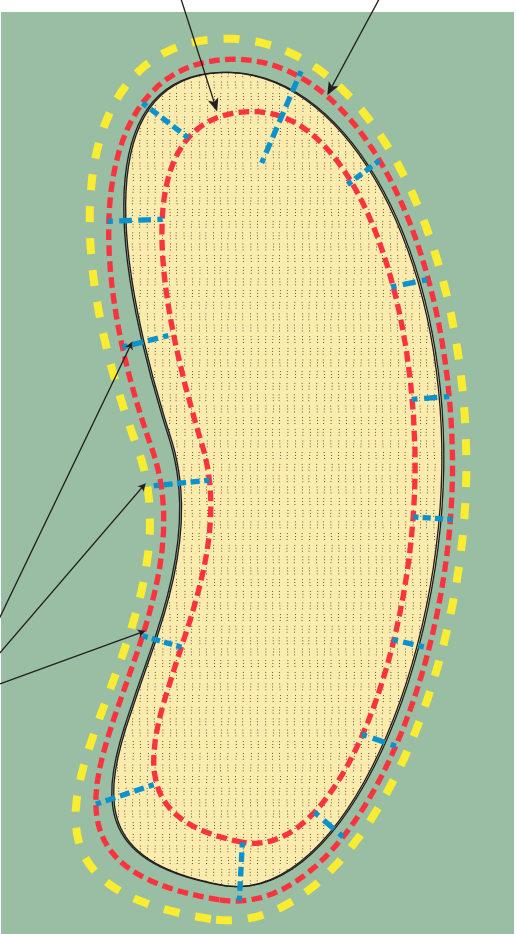
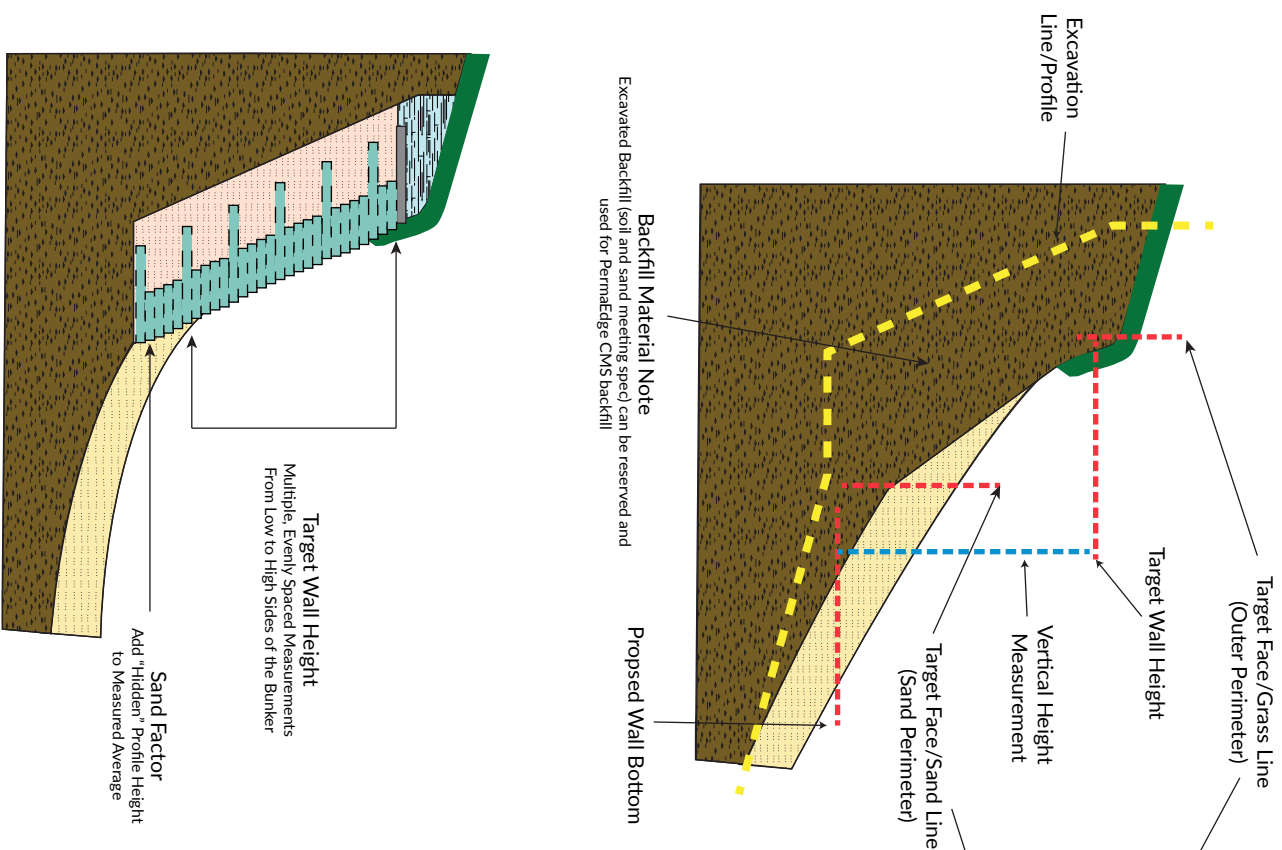


3-inch deck screws



Cordless Screwdriver

Estimating Material Requirements



Basic PermaEdge Calculations

Material - Outer Perimeter (ft) x Target Wall Height (ft) = Bunker Face Area (sq ft)
 Pallet Quantities - Add all bunker areas (sq ft) ÷ 62.5 = Number of Pallets (round up to next integer)

PMS Backfill Calculations

Excavated Soil/Sand - .65 cubic feet per square foot face of PermaEdge estimate
 OPC - 3 pounds per square foot face of PermaEdge estimate

Labor Calculations (5 Man Team)

New Construction Team - Approximately 70-80 square feet per 8 hour day
 Experienced Construction Team - Approximately 120 square feet per 8 hour day
 Highly Skilled Team - Approximately 150 square feet per 8 hour day

In order to determine material requirements, a perimeter measurement and average wall height are calculated. For improved accuracy, a perimeter measurement at the desired face/grass line (outer perimeter) is made along with a perimeter measurement at the sand perimeter. These can be averaged to yield a single perimeter figure. In practice, the outer perimeter measurement yields a figure suitable for most projects.

Determining wall height can be more involved depending on the size and shape of the bunker. Small round bunkers can use two simple measurements, a high side and low side averaged, to create the single figure. If bunkers have multiple peaks and dips (taller and shorter walls), more measurements should be employed. Spacing measurements equally around the perimeter is recommended.

1. Measure outer perimeters and sand perimeters in feet and calculate average.
2. Basic height average - measure max height and min height and calculate average
3. Accurate height average - measure at 6 or 8 equally spaced locations and calculate average
4. Sand adjustment (+4 inches) add to height average
5. Multiply average perimeter with adjusted average height
6. Calculate for each bunker in the project