



## MATERIAL & DESIGN SPECIFICATIONS - 2017

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

## 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

## BASIC PHYSICAL SPECIFICATION

The System begins with used/recycled synthetic turf which meets approximate height, width, and length tolerances. The System requires the use of synthetic turf with a perforated SBR latex backing. The System does not use turf with a foam, Hessian, or other backing systems.

The System uses re-purposed synthetic turf that comes from a wide range of sports fields, so that the green color of the synthetic turf may vary slightly from field to field. The System defines that the synthetic turf is pre-impregnated with sand into the entire turf profile. The sand, prior to impregnation, is kiln-dried. The result is a material that is inert and void of harmful organic and microbiological matter so that it passes all safety tests for international trade.

The System defines that the turf height is approximately .75” (20mm). The System requires the use of two different sized pieces (referred to as “Tiles”) that form the retaining wall. Type 1 Tiles (referred to as “Anchor Tiles”) are approximately 19.5” (500mm) in length and 8” (200mm) in width. Type 2 Tiles (referred to as “Fascia Tiles”) are approximately 19.5” (500mm) in length and 4” (100mm) in width.

Reference Figure 2 for Basic Physical Specification and Specification Notes

## PALLET PACKAGING SPECIFICATION

The System defines each pallet to be loaded with both Anchor Tiles and Fascia Tiles in 1:4 proportion to build 62.5 square feet (5.8 square meters) of wall face. Each pallet will be approximately 25” (640mm) in height, 48” (1200mm) in length, and 40” (1000mm) in width. Each pallet should weigh approximately 2100-2300 lbs. (950-1050kg) depending on moisture content.

Each pallet of turf that is provided will be packaged with an identifying label that includes Product Information/Coding, Order Number, Lot Number, and Quality Control Marks. The Lot Number, which defines a unique number for each field the synthetic turf was sourced. The Lot Number allows for better management of any possible color variation from bunker to bunker.

Reference Figure 3 for Pallet and Handling Specification

## PRODUCT HANDLING REQUIREMENTS

The Tiles in the System are intended to remain in their shrink-wrapped condition until installed. Should the wrapping be removed, the sand infill will lose 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

## TILE PREPARATION SPECIFICATION

Each Tile in the System, requires special preparation prior to use in wall construction. All bunkers are made up of varying convex and concave shapes. Depending on these contours, each tile will require several slices/cuts so that each tile can be contoured to fit the desired curvature. Prior to preparation, the tiles should be in a damp or moist state. If proper moisture is not maintained, sand can exit the profile. Handle with care.

For concave bunker curvatures, two slits or cuts are required beginning approximately .375” (10mm) from the facing edge, creating a “termination”. The cut is made through the remainder of the depth axis (see figure 4). The cuts are made to the SBR backer using a utility knife. They should be evenly spaced to create three approximately sized segments tied together by the termination. Tight bunker curvatures may require three slit cuts.

For convex bunker curvatures, two notch cuts are required beginning approximately .375” (10mm) from the facing edge, creating a “termination”. The cut is made through the remainder of the depth axis (see figure 4). As above, the cuts are made to the SBR backer using a utility knife. They should be evenly spaced to create two approximately sized segments tied together by the termination. Tight bunker curvatures may require three notch cuts.

Reference Figure 4 for Tile Preparation Specification

## 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 5 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% by volume (19:1) 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 SPECIFICATION

The System of building the retaining wall begins with a small, skim coat or blinding 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 blinding layer and carefully fit to follow the desired bunker contours. Tiles should be placed tightly together. Bunker curvatures should be transitioned smoothly. After placement of the first layer, fit should be checked and corrected prior to the addition of new layers. This is very important. Alignment errors at this stage are very difficult to correct later. 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.

It is important to set the angle within the first several rows, frequently checked with an inclinometer. As the wall grows, layer by layer, continual verification of angle in addition to the smoothness of the curvatures is critical.

Reference Figure 6 for Construction Specs & Notes

## FINISHING - FINAL LAYERS & TURF REINSTATEMENT

Once the edge/face is constructed, the completion of the bunker requires detailed finishing methods. Plans for final shaping of the surround, securing the top layer, prepping for turf, soil additives, and grow-in can be discussed with the PermaEdge Technical Advisor during on-site training, if needed.

Reference Figure 7 - Finishing & Turf Reinstatement

## MOBILIZATION - EQUIPMENT, MATERIALS, AND SUPPLIES SPECIFICATION

Equipment	Basic Materials	Supplemental Materials
Mini Excavator w/ Knuckle Bucket	Rakes & Shovels	Blades, Blades, Blades
Equipment w/ high flotation turf tires	Inclinometer	Knee Pads
Gas-Powered Plate Compactor (12-14")	5 gal. Buckets	10' x 10' Canopy
9-12 cu ft Gas Concrete Mixer	Plywood	Tarps
Forklift (to unload material)	Water Hose	6 foot poles (or old flag sticks)
	Ordinary Portland Cement (OPC)	

Excavation equipment needs will vary depending on the nature and scope of the project. Smaller renovation projects can often be completed using primarily hand tools, but 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 highly advisable 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 and also improve working conditions for personnel.

## OPTIONAL SPECIFICATIONS - PROFILE COLORIZATION

As shown in Figure 1, Typical PermaEdge Profile, some facilities opt for a specific bunker look, where the prevailing design intent is to have a face color different than the green color of the raw PermaEdge face. Typically this is defined with a indigenous soil color or brown-spectrum color. The colorization material is a latex-based, paint with adhesion promoter (primer). The colorization option can be applied using a common spray unit.

## OPTIONAL SPECIFICATIONS - BUNKER LINER

The PermaEdge Bunker System is commonly utilized along with a barrier product. Either a fabric liner, such as Sandtrapper, or with a bunker hardscape, PermaEdge installation is easily coordinated. Different methods are employed, depending on preference. PermaEdge can be built prior to bunker liner install or, depending on material, on top of the selected liner.

## PRODUCT ESTIMATING

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 desired face/sand line (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 essential.

All wall heights should factor in planned sand depths. This can be achieved by adding 4" (100mm) or .33" to the average.

Estimating aides such as diagrams, worksheets, and calculators are available. Reference Figure 8, Measuring Face Area.

## CONSTRUCTION ESTIMATING

Determining construction costs requires an understanding of mobilization (and equipment needed), PMS materials and the labor needed to construct the PermaEdge Bunker System. Many facilities and contractors will have the equipment and supplies necessary. Some of the smaller supplies are typically purchased. These estimating considerations are exclusive of excavation/shaping and turf reinstatement.

The PMS (Portland modified soil) used for the project typically comes from material excavated and reserved from the bunker along with purchased OPC (ordinary Portland cement). The amount of excavated sand/soil mixture needed per square foot of face is approximately 0.65 cubic feet. Each square meter of face built requires the same ratio, or 0.2 cubic meters of material. OPC required is 3 lbs. per square foot of face (approx. 15 kg per square meter). More simply put, OPC required is approximately 180 lbs. per PermaEdge pallet (62.5 sq. ft).

Labor requirements are calculated based on a 5-person team for larger projects. Smaller projects can be calculated with a smaller team, but the productivity rate falls. A well trained team can reach approximately 120 square feet (11 square meters) of face built per day. Experienced teams, with substantial history with the PermaEdge Bunker System can reach higher targets.

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.

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 in creating a continual "production pipeline". One person faltering in a basic labor task impacts productivity directly.

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.

## TECHNICAL SUPPORT & TRAINING

At IVI-GOLF/Sandtrapper/PermaEdge, we recognize that many golf clubs who wish to use the PermaEdge Bunker System on their courses choose to either use their own, internal staff or hire external contractors to perform the project work. We recognize that in either case, there are skilled and motivated personnel who need to learn how to install the product under license.

At the beginning of every PermaEdge project, we require the use of a PermaEdge Technical Advisor, regardless of whether a contractor or internal staff is used. This is usually a 4-day process with a minimum of a 3-days. IVI-GOLF requires this so there is adequate supervision, training and support at the startup of installation.

The Technical Advisor's 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. In building these first several bunkers, facility staff and/or the preferred contractor will be trained in the unique skills needed to construct PermaEdge Bunker System to the highest quality standard. 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.

The better personnel is trained, the better the project result. Training covers the basics of installation, face/wall building, maintaining angles, team mechanics, productivity, and finishing. Advanced training includes design concepts, convex/concave shaping detail, project planning.

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.

## 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.

It is possible to spool up greater efficiencies through multiple teams and different materials handling. However, managing more than one team does have some drawbacks. More detailed discussions should be undertaken if more than one team is desired.



**TRAINING REQUIREMENTS**

At IVI-GOLF/Sandtrapper/PermaEdge we recognize that many golf clubs who wish to use the PermaEdge Bunker System on their courses choose to either use their own, internal staff or hire external contractors to perform the project work. We recognize that in either case, there are skilled and motivated personnel who need to learn how to install the product under license.

We support these efforts by requiring all initial projects to have an On-Site Technical Advisor to provide the necessary training. Our Technical Advisors serve as trainers, construction managers, and product support for the PermaEdge Bunker System.

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.

We implement a three stage approach, but this approach can be flexible, particularly where we are dealing with clubs that have been revetting for many years, and understand many of the basic principles. The three stage approach is outline below.

<b>LEVEL 1 (under supervision)</b>	<b>LEVEL 2 (reduced supervision)</b>	<b>LEVEL 3 (unsupervised)</b>
Skill/Ability	Skill/Ability	Skill/Ability
Understanding various health and safety procedures	Lay turf to consistent layers and at varying gradients	Ability to shape bunkers to blend into design contours
Handling and cutting PermaEdge correctly	Correct use of inclinometer (or similar) for consistency	Speed: Minimum of 120 sq ft per day by 5 man team
Laying turf correctly in consistent layers	Forming concave and convex shapes	Ability to plan, organize and manage a project
Backfilling and compaction with suitable material	Understanding natural turf reinstatement detail	
Preparation of bunker, particularly benching	Speed: Minimum of 70-80 sq ft per day by 5 man team	

For bunker projects where the requirement is edge stabilization and there is a small PermaEdge face (6-8 inches) with little to no reveal, a modified training and guidance regimen is provided.

**INTELLECTUAL PROPERTY & LICENSING**

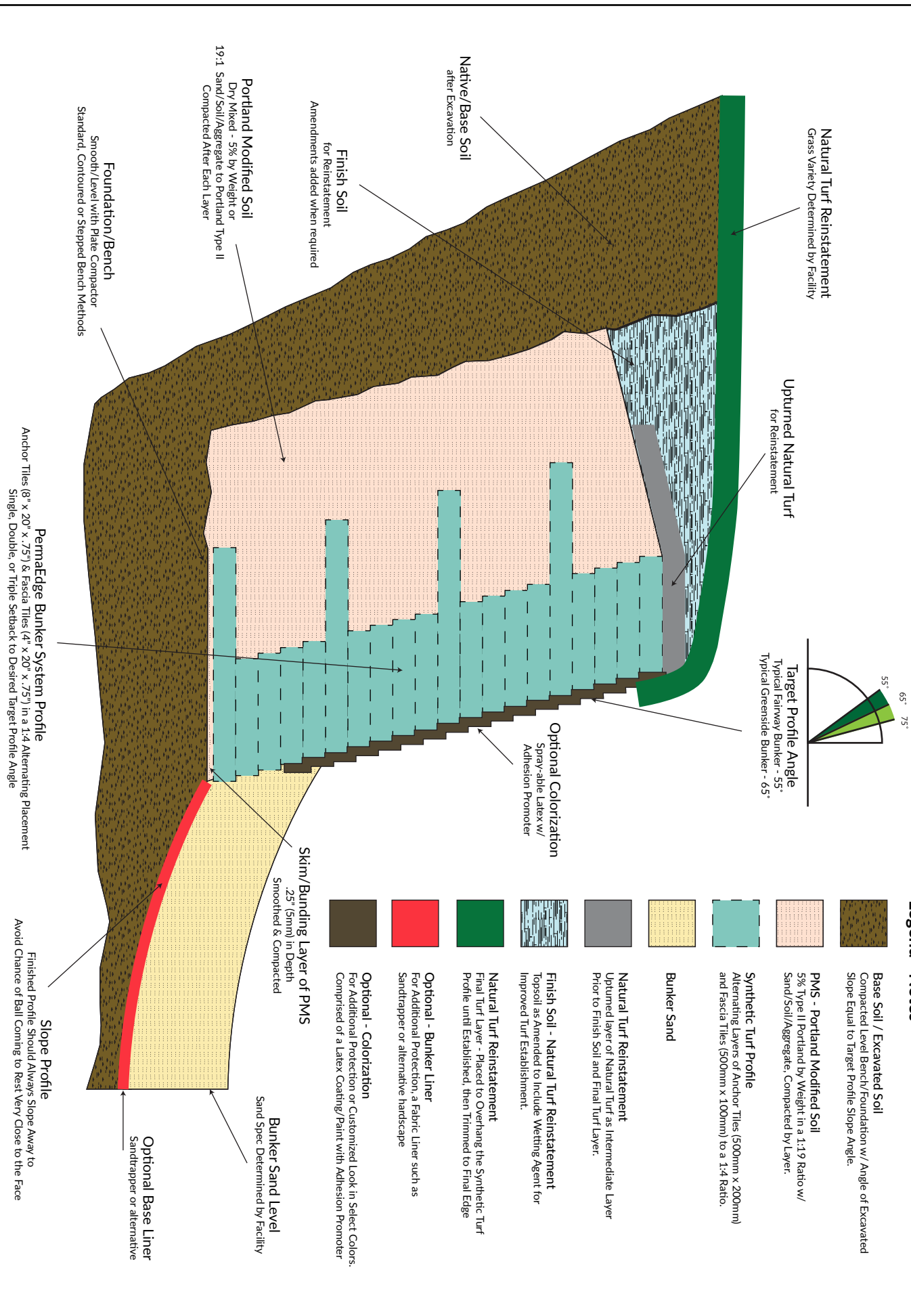
The PermaEdge Bunker System is protected by international patents. The System is licensed for use to the facility for each product order. Assignment of the System License is granted, pursuant to scheduled PermaEdge Bunker System Training by IVI-GOLF/PermaEdge personnel.

# PermaEdge Design Specification

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FIGURE 1

## 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 1:1.9 Ratio w/  
Sand/Soil/Aggregate, Compacted by Layer.

**Synthetic Turf Profile**  
Alternating Layers of Anchor Tiles (500mm x 200mm)  
and Fascia Tiles (500mm x 100mm) to a 1:4 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 Appended 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

**Optional - Colorization**  
For Additional Protection or Customized Look in Select Colors.  
Comprised of a Latex Coating/Paint with Adhesion Promoter

**Skim/Bundling Layer of PMS**  
0.25" (5mm) in Depth  
Smoothed & Compacted

**Bunker Sand Level**  
Sand Spec Determined by Facility

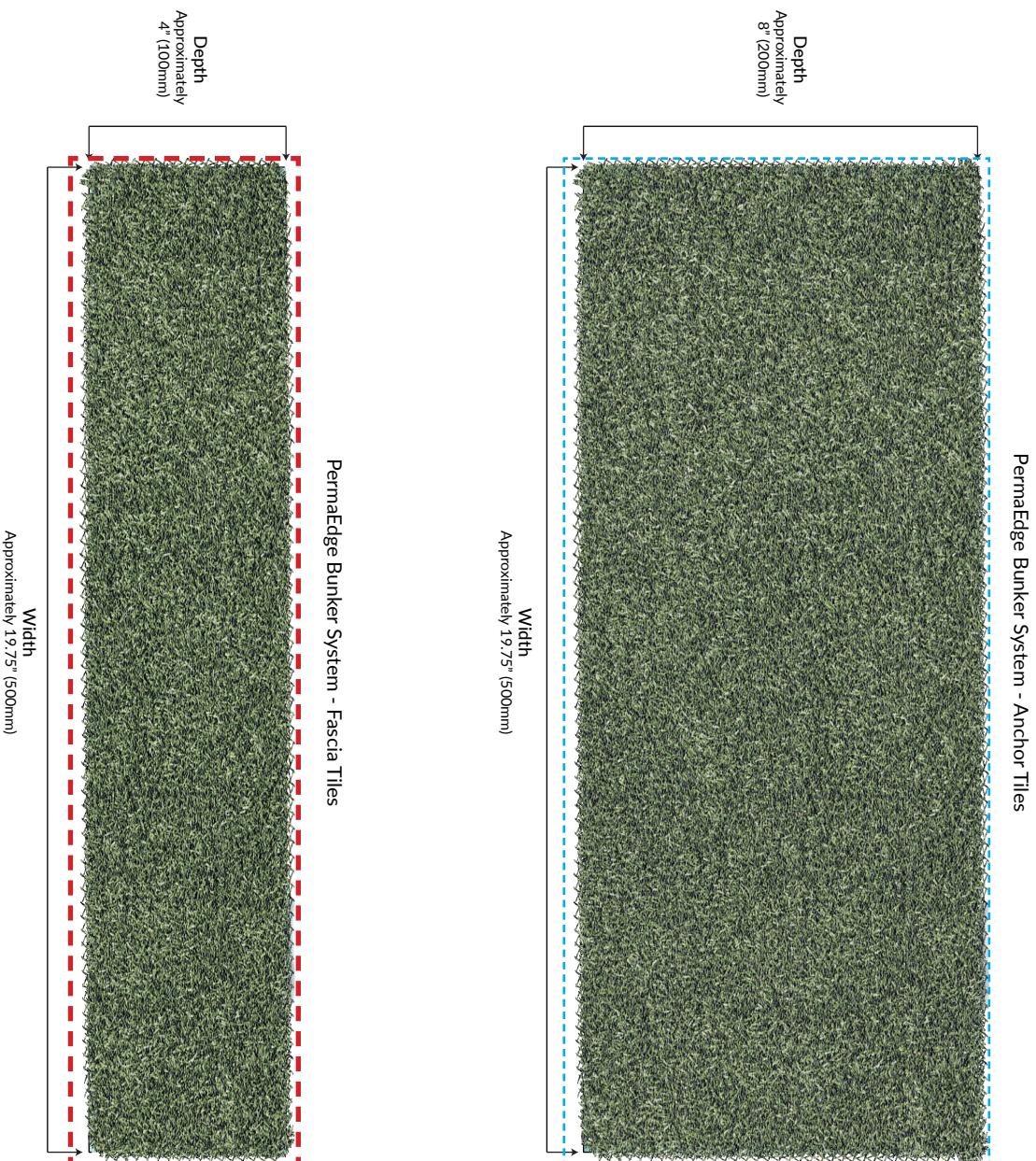
**Optional Base Liner**  
Sandtrapper or alternative

**Slope Profile**

Finished Profile Should Always Slope Away to  
Avoid Chance of Ball Coming to Rest Very Close to the Face

# PermaEdge Design Specification

## Basic Physical Specification



**Anchor Tile**  
Approximately 19.75" (500mm) x 8" (200mm)



**Fascia Tile**  
Approximately 19.75" (500mm) x 4" (100mm)

**Notes:**

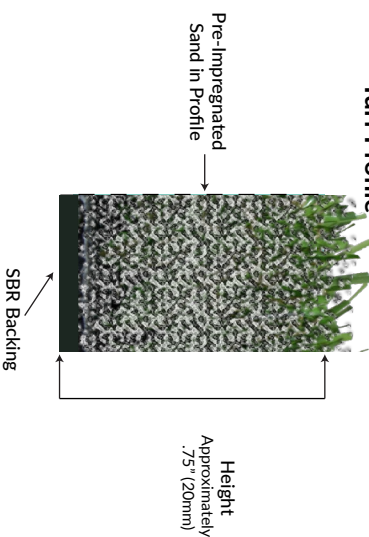
Individual Tiles are fabricated from large segments of used or recycled/repurposed synthetic turf and converted to meet the PermaEdge specification. The above dimensions are approximate and if individual Tiles are greater or less than these dimensions by 15-20% they are still acceptable within the System.

The System uses repurposed synthetic turf that comes from a wide range of sports fields, so that the green color of the synthetic turf may vary slightly from field to field.

The System relies on Tiles that are shipped in a damp/wet state. They are intended to remain in their palletized, shrink-wrapped state until used. Should the wrapping be removed, the sand infill will lose its moisture.

Handling the material in a dry state is not advised. During handling and preparation, material must remain in a wet/damp condition or sand can exit the profile. Handle with care.

**Turf Profile**



**Notes:**

The System requires the use of synthetic turf with a perforated SBR latex backing. The System does not use turf with a foam, Hessian, or other backing systems.

The above dimensions are approximate and if individual Tiles are greater or less than these dimensions by 15-20% they are still acceptable within the System.

The System defines that the synthetic turf is pre-impregnated with sand into the entire turf profile. The sand, prior to impregnation, is kiln-dried. The result is a material that is inert and void of harmful organic and microbiological matter so that it passes all safety tests for international trade.





## Pallet & Handling Specification

### PermaEdge Bunker System - Pallet Dimensions



**Pallet Weight**  
Approximately 2100-2300 lbs. (950-1050kg)  
depending on moisture content.

## Handling

The System relies on Tiles that are shipped in a damp/wet state. They are intended to remain in their palletized, shrink-wrapped state until used. Should the wrapping be removed, the sand infill will loose its moisture.

Handling the material in a dry state is not advised. During handling and preparation, material must remain in a wet/damp condition or sand can exit the profile.

Pallets can be sprayed with water at the worksite to maintain proper moisture content. Handle with care.

## Pallet Identification

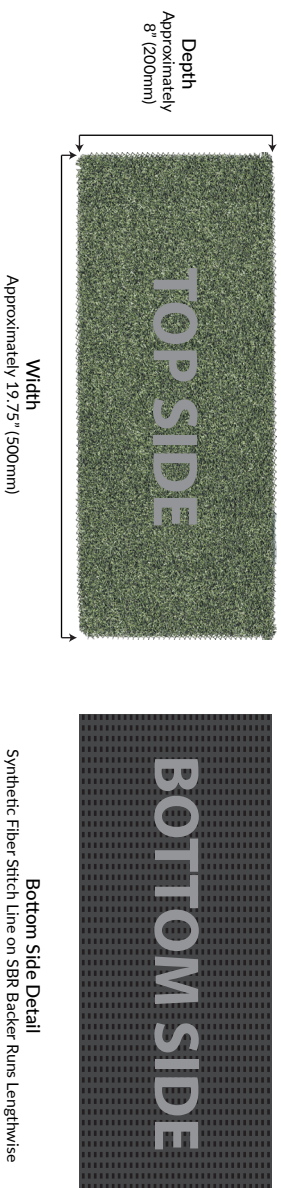
PermaEdge	PRODUCT NOTICE
<p>The product is intended to remain in its shrink wrapped condition until installed. Should the wrapping be removed, the sand infill will lose its moisture. Handling this product in a dry state is not advised. During handling and preparation, material must remain in a wet/damp condition or sand can exit the profile.</p> <p>Please reference PermaEdge Construction Methods Information for a complete understanding of the PermaEdge Bunker System, its handling and methods.</p>	
IVI-GOLF NUMBER _____	
PRODUCT CODE - LOT NUMBER _____	
QUALITY CONTROL CHECK _____	
SPECIAL ORDER INFO _____	
<p>IVI-GOLF / Sandtrapper / PermaEdge - 5 Pine Camp Dr. Binghamton, NY 13904 888-970-5111 permaedgebunker.com</p>	

Each pallet of turf that is provided will be packaged with an identifying label that includes Product Information/Coding, Order Number, Lot Number, and Quality Control Marks.

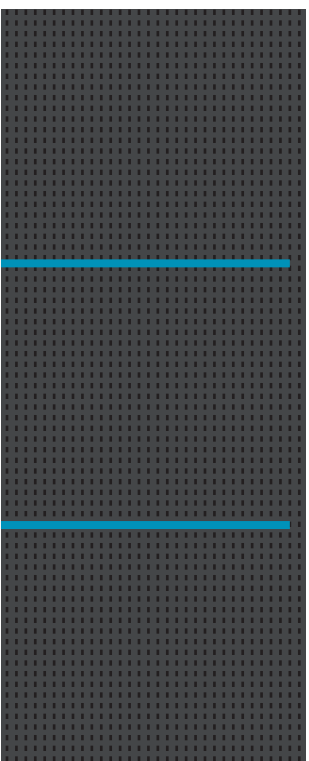
The Lot Number, which defines a unique number for each field the synthetic turf was sourced. The Lot Number allows for better management of any possible color variation from bunker to bunker.

## Tile Preparation Specification

**Example: Anchor Tiles Prepared**  
(same procedure for Fascia Tiles)

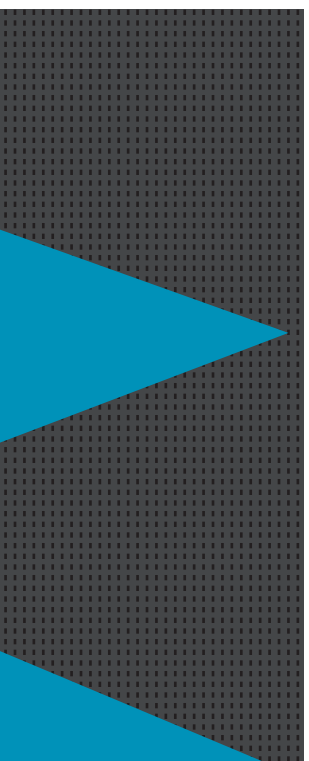


**Slit Cut Termination**  
Approximately .375" (10mm)



**Standard Slit Cuts - For Use With Concave Bunker Curvatures**  
Evenly Spaced to Create Three Segments Tied Together by the Termination  
Tight Bunker Curvatures May Require Three Slit Cuts

**Notch Cut Termination**  
Approximately .375" (10mm)



**Standard Notch Cuts - For Use With Convex Bunker Curvatures**  
Evenly Spaced to Create Two Segments Tied Together by the Termination  
Tight Bunker Curvatures May Require Three Notch Cuts

**Fascia/Anchor Tiles**  
This method is the same for both Tile Types

### Tile Prep Notes

Tiles are arranged on pallets, top side facing upwards. Tiles should be placed onto the working surface with the bottom side upwards.

When handling Tiles, it is recommended to move individual tiles in multiples (4-5 pieces).

Handle Tiles carefully from pallet to working surface and working surface to wall and do not aggressively drop tiles onto work surface or at worksite/wall.

When cutting Tiles (on the Bottom Side), one should always use sharp utility knife blades. Replace regularly to maintain fast, easy cuts.

Tiles are then placed top side down near the wall area being constructed.

### Moisture Control

The System relies on Tiles that are shipped in a damp/wet state. They are intended to remain in their palletized, shrink-wrapped state until used.

Should the wrapping be removed, the sand infill will loose its moisture.

Handling the material in a dry state is not advised. During handling and preparation, material must remain in a wet/damp condition or sand can exit the profile.

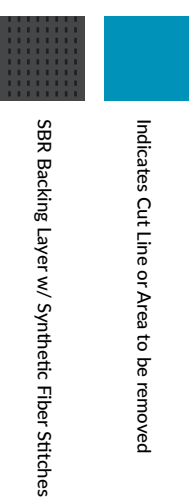
Pallets can be sprayed with water at the worksite to maintain proper moisture content. Handle with care.

### Worksite Organization

At each bunker, a cutting table should be defined that is close to the bunker edge as this minimizes steps to wall.

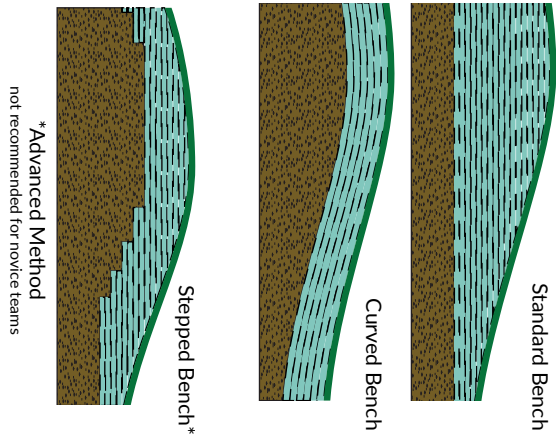
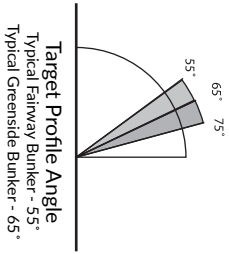
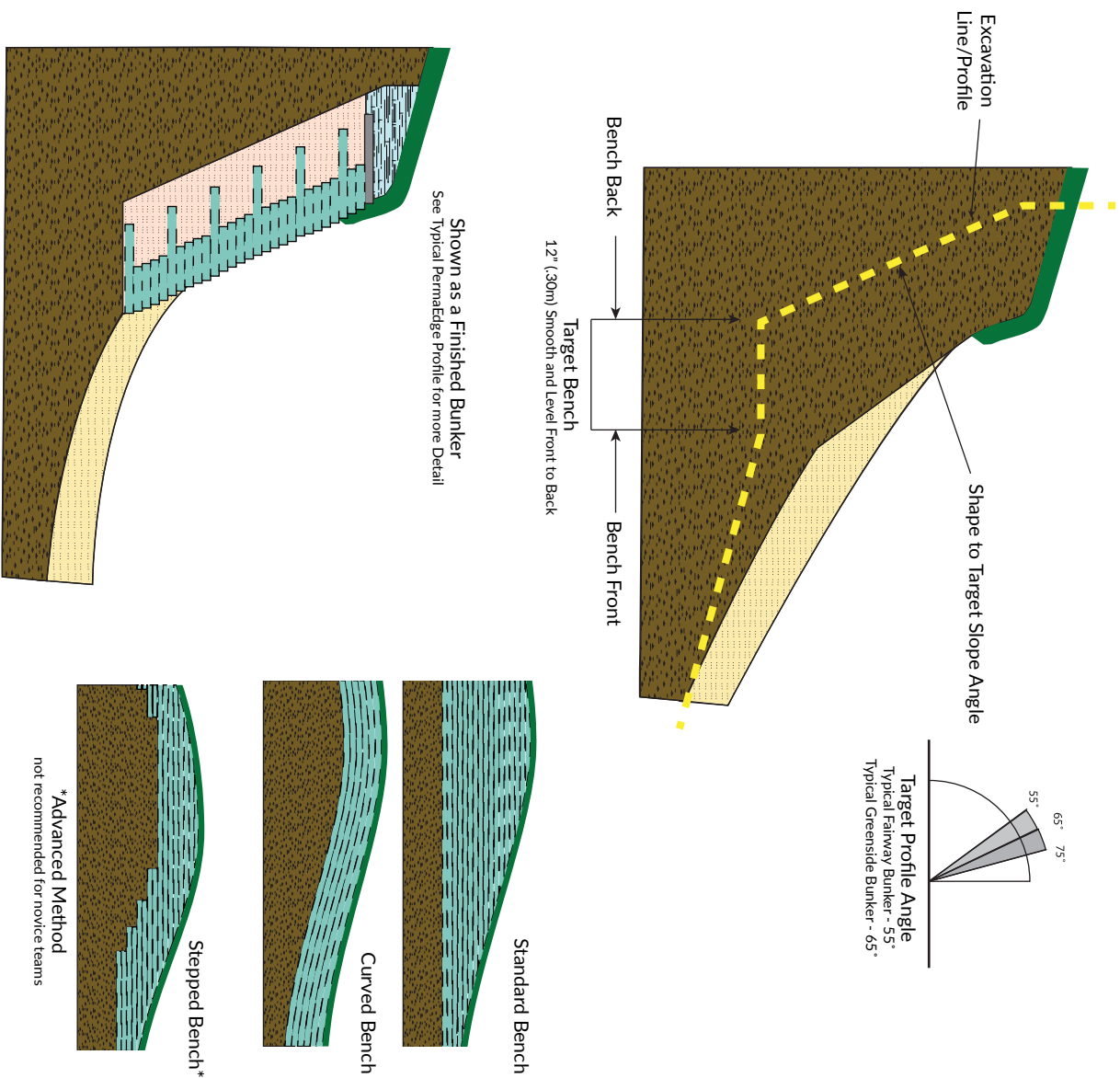
PermaEdge pallets should be placed near the cutting table. Table should be of proper height so workers do not hunch over to cut.

A water supply should be made available adjacent to the cutting table and pallets to maintain PermaEdge Tile moisture content.









# PermaEdge Design Specification

## Bunker Excavation & Prep Specification



\*Advanced Method not recommended for novice teams

-  **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 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 revetments, 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 "Curved 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.

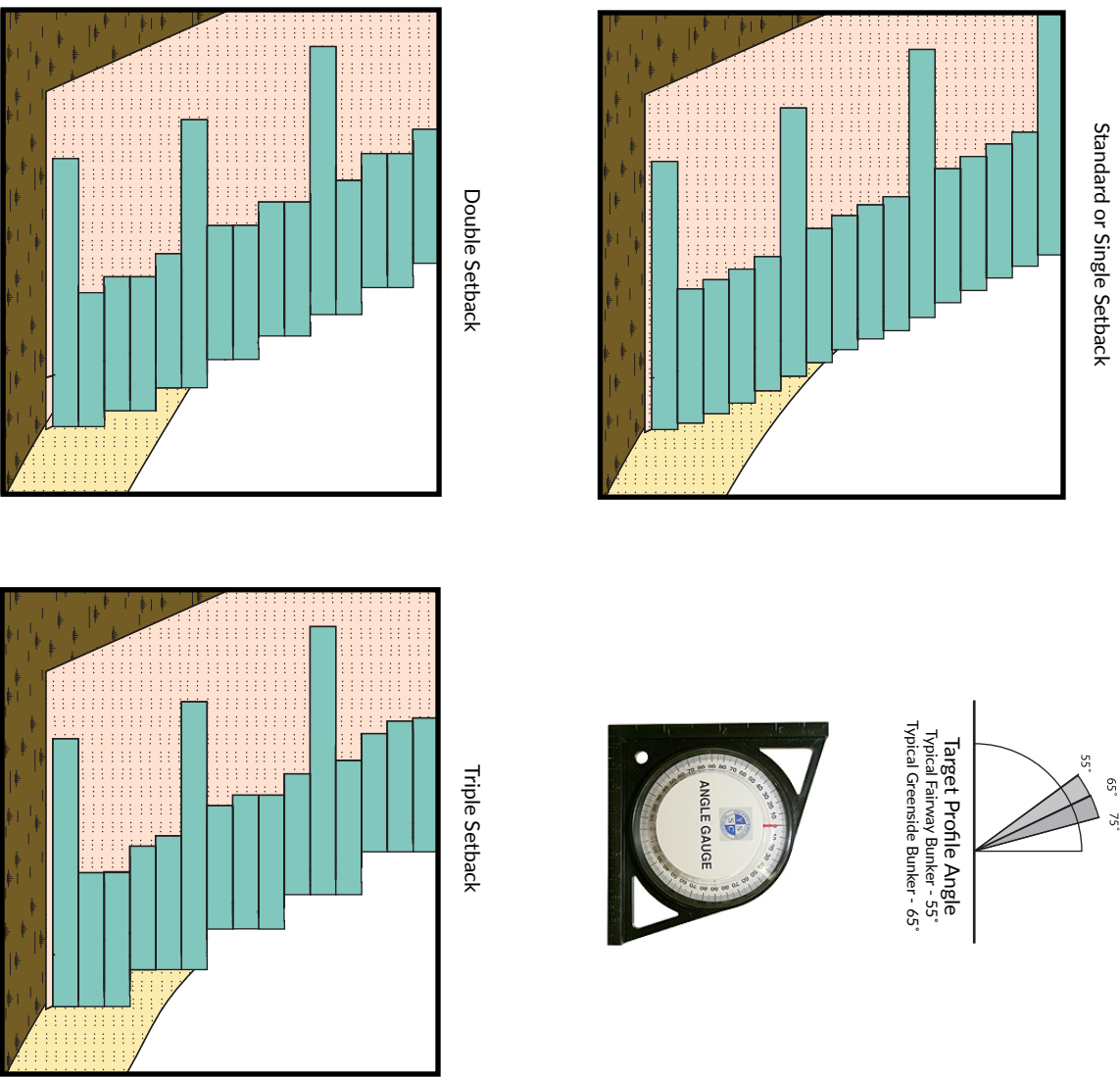
The bench/foundation needs to be compacted with a plate compactor. The necessary width of the bench/foundation is approximately 1' (.30 meters), so the plate compactor should be sized accordingly. Many smaller compactor models have plate sizes that are between 12-14 inches (.3-.36 meters), which is acceptable.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

Shown as a Finished Bunker  
See Typical PermaEdge Profile for more Detail



# PermaEdge Design Specification

## Construction Specs & Notes



### Notes

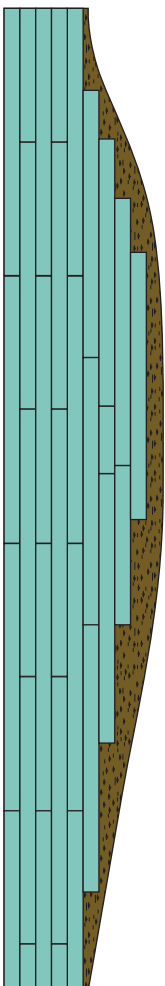
The System of building the retaining wall begins with a small, skim coat or bunding layer of PMS approximately .25" (5mm) thick. This layer should be smoothed to an even, level layer. The first Tile layer to be placed is the Anchor Tile. This layer should be placed on top of the bunding layer and carefully 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.

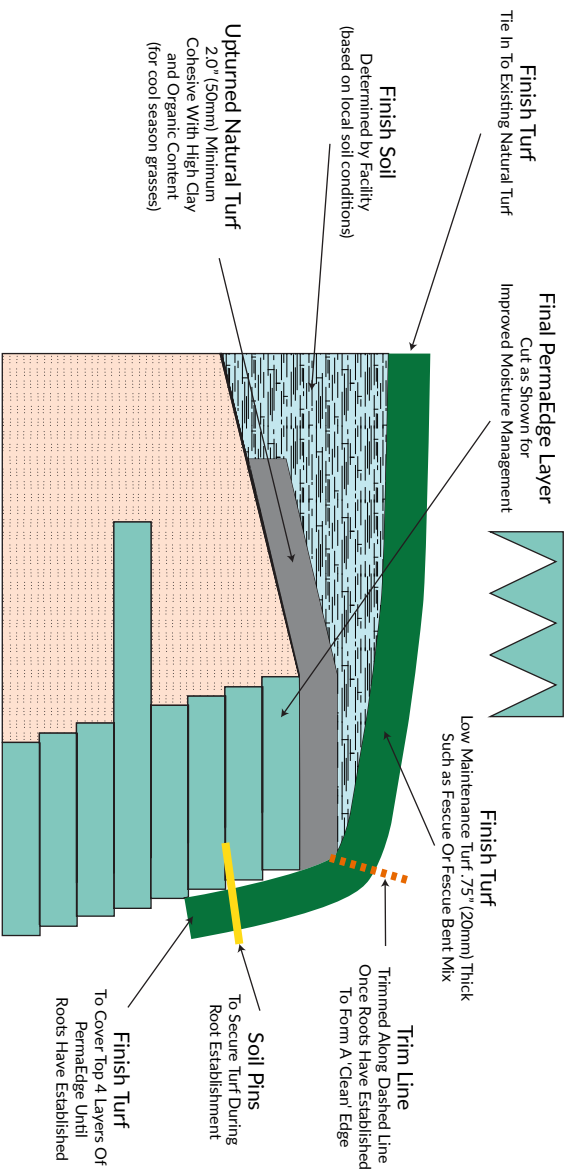
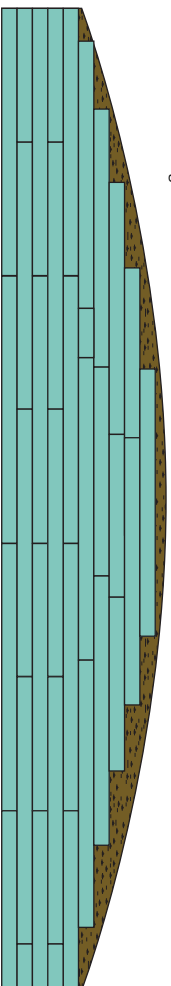
In order to meet the specific angle or slope requirement of the wall, single or multiple layers are setback in varying distances to meet the 55-75 degree slope. Single layers (referred to as "Single Stacked or Single Setback") can be placed one at a time and placed a slight distance back from the previous 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.







## 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



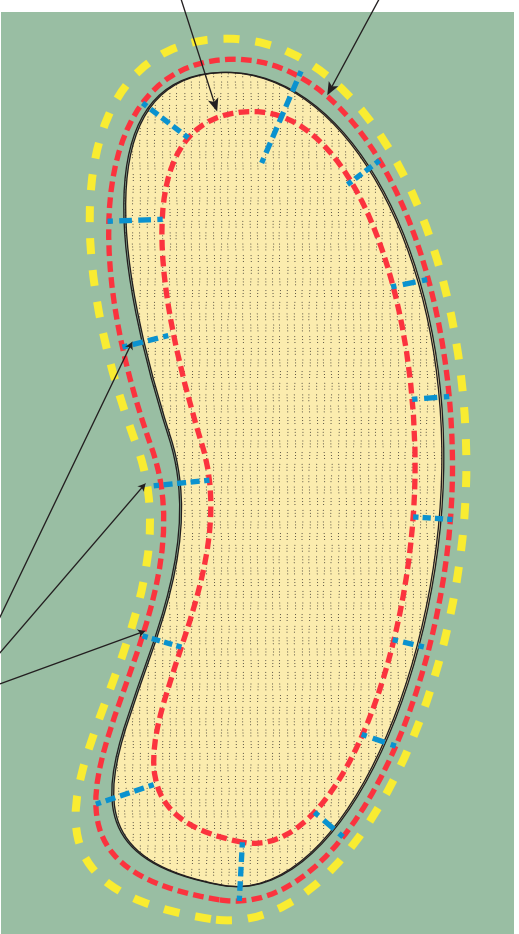
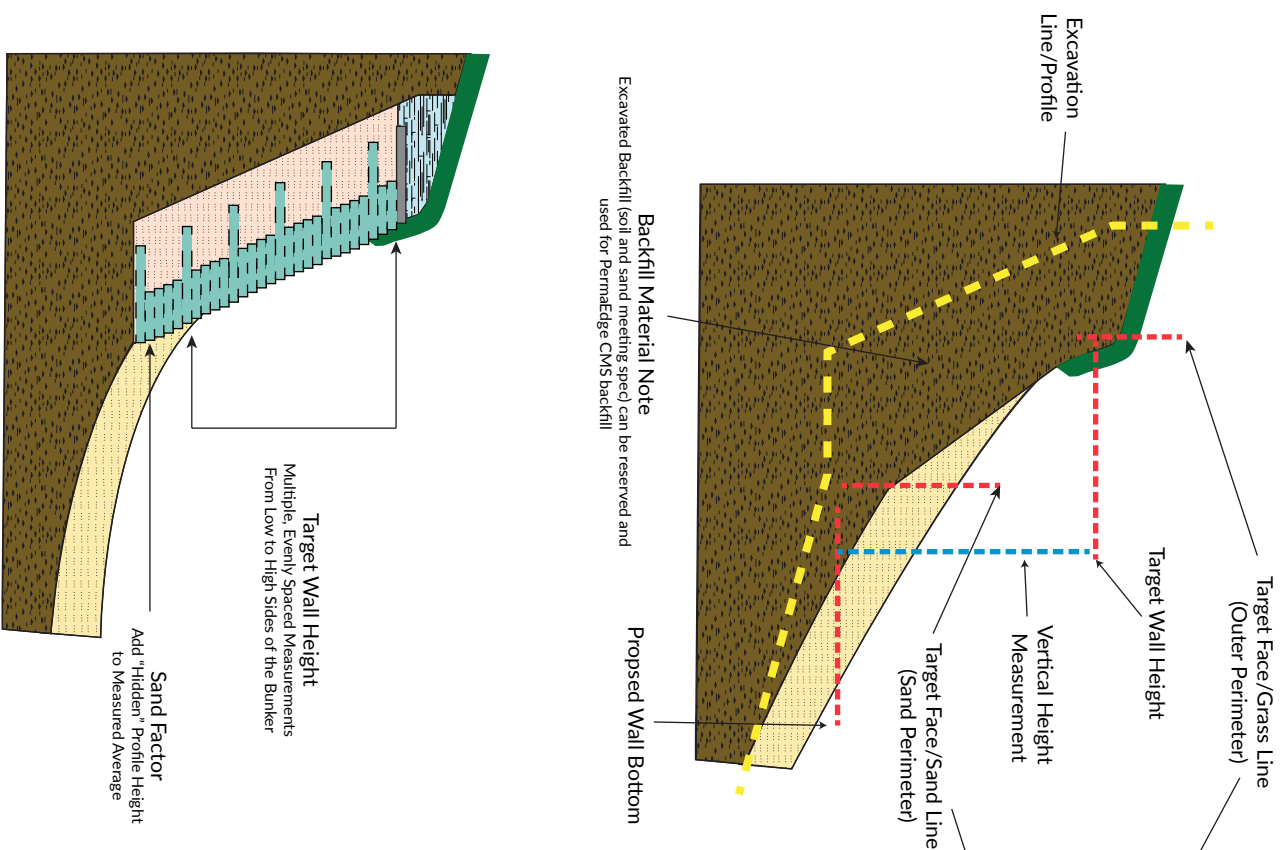
-  PermaEdge Profile
-  Portland Modified Soil
-  Upturned Natural Turf
-  Base Soil
-  Finish Soil Topsoil as Amended
-  Finish Turf

### 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.



## 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 desired face/sand line (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