



**PETRAFLEX**<sup>TM</sup>  
**THE NATURAL SOLUTION!**



*'The Unfair Advantage'*

**Articulated Concrete Revetment System**

**With Manta Ray Engineered Earth Anchor Systems**



**UNDER CONSTRUCTION**



**6 MONTHS LATER**

## SECTION 1: PETRAFLEX AND MANTA RAY – THE UNFAIR ADVANTAGE

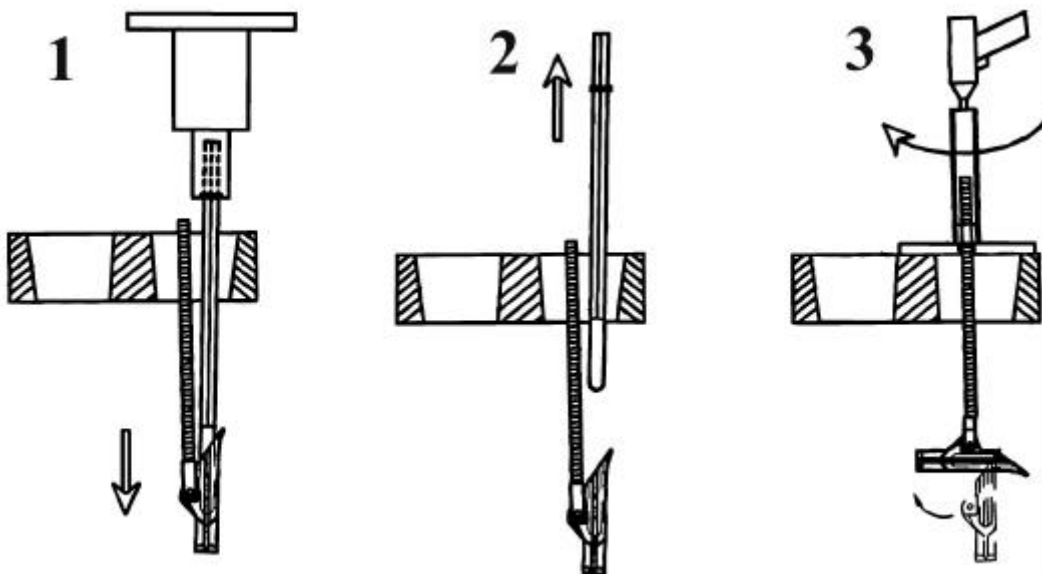
The Unfair Advantage of the **Petraflex Revetment System with Manta Ray Anchors** is the ease, speed and flexibility of installation and the effectiveness of the anchor. Manta Ray Anchors are easily installed through the holes in open blocks so they can be used in the middle of the mat. There is no need to remove and replace blocks with cement or grout as with other anchor systems. With the Manta Ray anchors, the mat is actually “clamped” to the soil at the anchor locations. Manta Ray Anchors are driven into the soil, with no excavation thus no holes, no digging, nor expensive restoration is required. Each anchor is individually tensioned during the installation process and can be easily proof loaded to ensure that the required capacity is met. **INSTALLATION AND TENSIONING ARE SIMULTANEOUS.**

### THE MANTA RAY ANCHOR ADVANTAGE:

- \*Environmentally friendly
- \*Fast, simple installation saves money
- \*Simultaneous installation and tensioning ensures capacity
- \*Anchors in the middle of mats are easily installed

### HOW THEY WORK: EASY AS 1-2-3!

- 1) Drive the anchor with the jackhammer
- 2) Remove the Drive steel
- 3) Place the plate & nut, Tension with Locking Socket



1.2: Petraflex – Manta Ray System – Typical Section Detail

**BASIC INSTALLATION PROCEDURE**

- 1) DRIVE ANCHOR, USING PDS8818-60 DRIVE STEEL THROUGH HOLE IN REVETMENT BLOCK UNTIL ANCHOR ROD IS 1" ABOVE FLUSH WITH TOP OF BLOCK.
- 2) INSTALL SPREADER PLATE, AND HEX NUT.
- 3) USE DRILL WITH LS16-15 LOCKING SOCKET TO TURN NUT UNTIL ANCHOR ROD HAS BEEN DRAWN BACK 6" OR A TORQUE OF 5 FT-LBS (60 INCH-LBS) IS ACHIEVED. THIS RESULTS IN A CLAMPING LOAD OF APPROXIMATELY 500 LBS.
- 4) CUT OFF ANY EXCESS ANCHOR ROD FLUSH WITH TOP OF NUT

**REQUIRED INSTALLATION TOOLS**

COMMONLY AVAILABLE TOOLS SUPPLIED BY CONTRACTOR:

- 65 LB PNEUMATIC PAVEMENT BREAKER WITH 1 1/8" X 6" CHUCK
- 1/2" PNEUMATIC DRILL
- COMPRESSOR, HOSES AND FITTINGS FOR BREAKER AND DRILL
- SAWSALL WITH METAL CUTTING BLADE, OR 1/2" BOLT CUTTERS

SPECIFIC TOOLS AVAILABLE FROM FORESIGHT PRODUCTS:

- PDS8818-60 DRIVE STEEL FOR MR88 ANCHOR (FORESIGHT #50212)
- LS16-15 LOCKING SOCKET (FORESIGHT #50202)

3 FT. MIN. AFTER TENSIONING

A	7/14 2000	TJ	CORRECTED ULT STR REVISED LAYOUT	DESCRIPTION
<b>FORESIGHT PRODUCTS inc</b> (303) 286-8955				
MR88 ANCHORS FOR PETRAFLEX REVETMENT				
title				rev
S20346				A
number				rev

3C: \FOR SIGHT\SKETCHES\S20346A

MANTA RAY MR88-RA4 ASSEMBLY INCLUDES: ANCHOR WITH 4 FT. STEEL THREADED ANCHOR ROD, SPREADER PLATE AND NUT. ALL COMPONENTS ZINC COATED FOR CORROSION RESISTANCE.

ULTIMATE STRENGTH OF ANCHOR : 10000 LBS.  
 EXPECTED HOLDING CAPACITY : 3000 - 4000 LBS  
 CAUTION: HOLDING CAPACITY IS SOIL DEPENDANT!

## SECTION 2: MANTA RAY MR88-RA4 REVETMENT ANCHORS

The Manta Ray model MR88-RA4 is the most popular anchor used for revetment mat applications. It is composed of the Manta Ray MR-88 anchor equipped with a 4 foot long 1/2" diameter anchor rod, a spreader plate, washer and nut. All of the components are zinc coated for corrosion resistance. Actual component specifications are:

### Anchor Head:

Anchor width: 1.75inches  
Anchor length: 6.25inches  
Bearing area: 10.0 square inches  
Anchor weight 2.2 pounds  
Ultimate Strength: 10,000 pounds  
Yield strength: 7500 pounds  
Typical Holding Capacity: 3000 to 4000 pounds in Medium Dense Sandy Gravel or Very Stiff to Hard Silts and Clays with Blow count (N) from 24 – 40

### Anchor Rod:

Anchor Rod Thread: 1/2" 13 UNC  
Anchor Rod, Nut Material: Grade 2  
Anchor Rod Length: 4 feet

### Spreader Plate:

Spreader Plate Material: Steel ASTM A-36 (minimum)  
Spreader Plate Size: 6" x 4" x 3/16" thick with 9/16" hole



All of the components of the MR88-RA4 anchor assembly are available as spare parts if necessary:

Anchor Head:	#20118	MR-88 Anchor
Anchor Rod:	#00024	AT-16-Z48 Rod
Spreader Plate:	#20064	AT-16-P Spreader Plate
Washer:	#00056	FW-16-Z Flat Washer
Nut:	#00064	NUT-16-Z Hex Nut

### SECTION 3: MANTA RAY MR88-RA4 HOLDING CAPACITY CHART

The table below lists the predicted holding capacity of the MR88-RA4 anchor assembly in different soils. This chart should be used as a guideline for establishing the required number of anchors and spacing for each particular project.

Also listed in the chart is the next larger size Manta ray anchor, the MR-4. This anchor is sometimes substituted in place of the MR-88 anchor head in cases where greater holding capacity or depth greater than 4 feet is necessary. The MR-4 anchor requires slightly different drive steel and should only be used in cases where the MR-88 anchor will not suffice. The MR-4 anchor can be equipped with the same anchor rod and spreader plate as the MR88-RA4 (Order MR-4-16G anchors) or it can be equipped with anchor rods up to 3/4" and appropriate spreader plates. Please contact Foresight Products at 303 286-8955 if this situation arises.

**ULTIMATE HOLDING CAPACITIES IN Kips (1Kip = 1000 pounds)**  
**(Numbers in parentheses refer to notes at bottom of chart)**

Soil Description	Blow count (N)	MR-88 Ultimate= 10 kips	MR-4 Ultimate= 16 kips
Dense fine compacted sands, very hard silts or clays	45-60	6 - 10 (2,3,4)	9 - 16 (2,3,4)
Dense Clays, Sands and gravels, hard silts and clays	35-50	4 - 6 (2,4)	6 - 9 (2,4)
Medium dense sandy gravel, stiff to hard silts and clays	24-40	3 - 4 (4)	4.5 - 5.5 (4)
Medium Dense Coarse sand and sandy gravel, Stiff to Very stiff silts and Clays	14-25	2 - 3 (4)	3.5 - 4.5 (4)
Loose to Medium dense Fine to Coarse sand: firm to Stiff Clays and Silts	7-14	1.5 - 2.5 (4)	2.5 - 4 (4)
Loose Fine Sand, Alluvium, Soft Clays, Fine saturated Silty Sand	4-8	0.9 - 1.5 (4,6)	1.5 - 2.5 (4,6)

- Notes:**
- 1) Drilled pilot hole required for efficient installation
  - 2) Ease of installation may be improved by drilling a pilot hole
  - 3) Holding capacity limited by ultimate strength of anchors
  - 4) Holding capacity limited by soil failure
  - 5) Not recommended in these soils
  - 6) Wide variation in soil properties reduces prediction accuracy. Pre construction field test is highly recommended.



MR-88



MR-4

## SECTION 4: MANTA RAY INSTALLATION EQUIPMENT AND TIPS

### 4.1 Complete Hydraulic Installation equipment package available from Foresight:



1	#50364	HB90-14 CE Anchor Hammer	(1 1/4" x 6" chuck)
1	#50076	DL-08550 Hydraulic Drill	(1/2" hydraulic drill)
1	#50382	GPU18-8 CE Power Unit	(8 gpm/2000psi hyd. power)
2	#50087	HC-16-25 Hydraulic hoses	(25 feet long)
1	#50211	PDS8814-60 Power drive steel	(1 1/4" x 6" shank)
1	#50202	LS16-15 Locking Socket	

The distance from the power unit can be extended up to a total maximum of 50 feet by the addition of another pair of HC-16-25 hoses.

### 4.2 Pneumatic, Gasoline, Electric Installation equipment:

Manta Ray MR88-RA4 anchors can be driven with pneumatic, gasoline or electric hammers. Historically, the order of anchor driving performance from best to worst has been: 90 pound hydraulic, 65 lb hydraulic, 90 pound pneumatic, 65 pound pneumatic, 60 pound gasoline, 60 pound electric. There are other considerations such as soil hardness, anchor depth, site accessibility, distance from power unit to hammer and many others which affect the choice of which hammer is the best choice. Hydraulic hammers have historically provided the best anchor driving performance, Pneumatic and Electric Hammers are typically the most readily available from rental yards, and Gasoline hammers are very "handy" because they require no power unit or hoses. **Be sure to match the drive steel shank size to the chuck size of the hammer. 1 1/8" hex x 6" or 1 1/4" hex x 6" are the most common.** Hammers with smaller chuck sizes are typically too small to drive the MR88-RA4 anchors. Small demolition or chipping hammers are too small.

#### The following hammers have been successfully used:

Pneumatic: Any manufacturer, 65 pound is a practical minimum typically has 1 1/8" chuck.

Gasoline: Atlas Copco Berema FB60-S available with 1 1/8" or 1 1/4" chuck.

Atlas Copco Berema Cobra mk1 available with 1 1/8" or 1 1/8-4" chuck.

Electric: Atas Copco Berema Kango 2500 Big Breaker available with 1 1/8" or 1 1/4" chuck

Bosch Brute Breaker Hammer Model 11304 1 1/8" chuck.

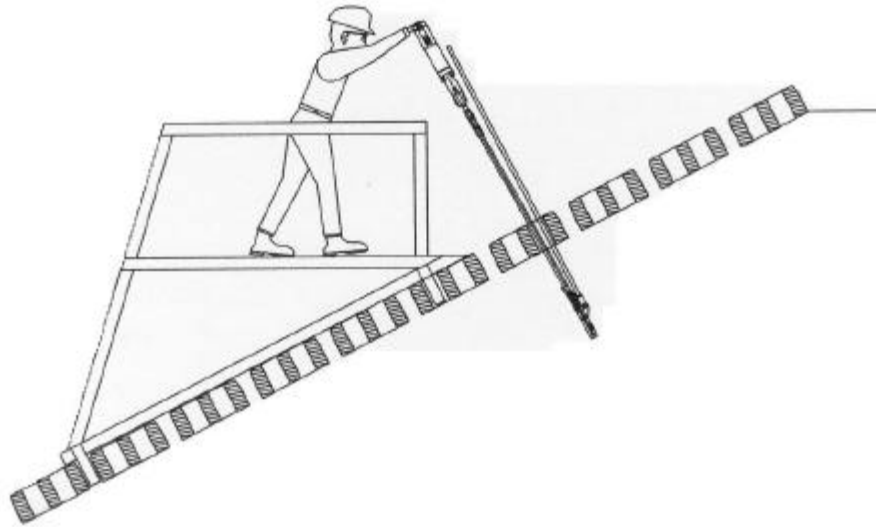
#### Available from Foresight Products:

#50211	PDS8814-60 Power drive steel (1 1/4" x 6" shank size)
#50212	PDS8818-60 Power drive steel (1 1/8" x 6" shank size)
#50202	LS16-15 Locking Socket

### 4.3 Hand driving tips:

- 1) Care must be taken to maintain proper alignment during driving and to support the weight of the hammer so it does not side load and bind the drive steel. If proper alignment is not maintained, then premature drive steel will occur.
- 2) Ease of hand installation on a slope can be greatly improved by building a simple, portable construction lumber platform for the installers to stand on.
- 3) Remember that Manta ray anchors pull back approximately 1 – 2 lengths of the anchor during tensioning. Be sure to drive the anchors deep enough to account for this pull back, but not so deep that the anchor rod will not pass through the spreader plate. After tensioning, cut off any excess anchor rod with “Sawsall” or bolt cutters.
- 4) In some hard soils anchor driving can be very slow. In these cases pre drilling a 2” diameter pilot hole with Foresight’s LB-1 Earth Auger can reduce installation time significantly without loss of holding power. The LB-1 Earth Auger is powered by the same hydraulic power unit as the Hydraulic Hammer and the Hydraulic Drill. The following is a list of equipment required for this operation:

1	#50093	LB-1 Earth Auger
2	#50109	LB9061-C2H Carbide Tip 2” Hex
2	#50098	LB2x36 HSL 2” Hex Auger Extension
1	#50119	LB9061-H2 Snap-On / Hex Adapter
2	#50113	LB9041-2 Retainer Pin 2” Hex



Hand driving MR88-RA4 anchors from Platform

#### **4.4 Tensioning tips:**

- 1) Manta Ray anchors must be load locked by pulling backward on the anchor rod to rotate the anchor from its drive position to its load locked position. This can be accomplished in several ways (pulling back on the anchor rod with a back hoe, skid steer, fork lift, etc), but it is our experience that the locking socket in a 1/ 2” drill is the most effective. The Locking Socket is custom made to lock the anchors quickly and effectively with a ½” drill.
- 2) Some projects require a formal proof test of a certain quantity of anchors. If this is required, then the #50172 LL-2 Manual load locker is good choice. It is a manually operated proof tester with a direct reading gage that indicates the capacity of each anchor tested. It is a self-contained unit and requires no external power. Another way is to use a backhoe, skid steer or fork lift and a dynamometer or crane scale.
- 3) In some very soft soils as much as 6” – 12” of pullback will be required. In general, if the anchor has pulled back 12” without achieving the required load, then the soil is too soft and a larger anchor should be used, or a different installation angle or length should be used to get the anchor into more competent soil.
- 4) If the required proof test load is not achieved, use the LL-2 load locker (or other method) to determine the actual holding capacity of the anchor. Determine the maximum the anchor will hold without movement, and contact the project engineer. Use this tested capacity and the holding capacity chart to adjust the number of anchors and spacing to achieve the required capacity for the entire mat. Alternately, the tested capacity can be used to estimate the capacity of the larger MR-4-16G anchor which can be substituted. If the MR-4-16G anchor is substituted, then slightly different drive steel will also be required. Please contact Foresight Products at 303-286-8955 for assistance.

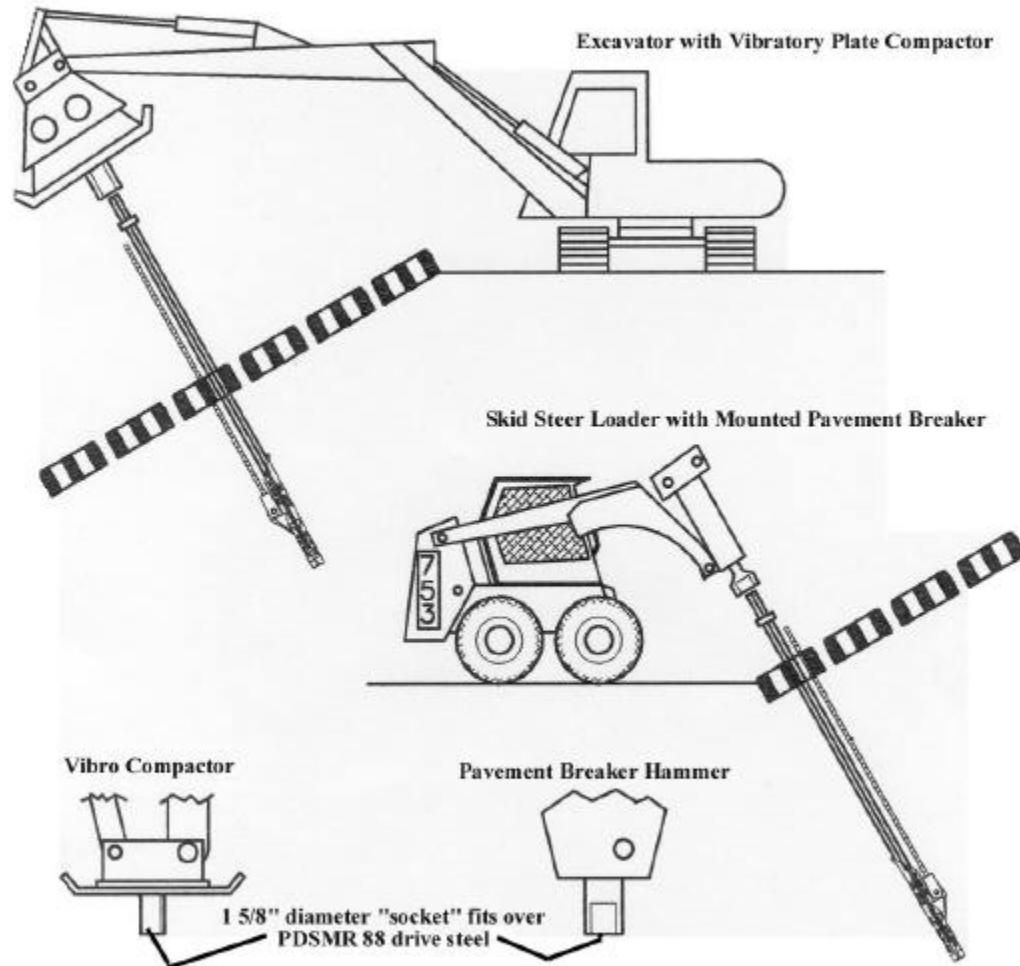
#### **4.5 Mechanized Driving Methods and Tips:**

Vehicle mounted pavement breakers and vibratory plate compactors are very effective tools for driving Manta Ray anchors, but a bit more care is required to maintain alignment of the drive steel during installation. It is easy to be misaligned which causes premature drive steel failure and difficult drive steel removal.

- 1) When using vehicle mounted tools, a Socket style tool similar to a pipe driver is used in the hammer. Foresight can provide tools for some mounted hammers. Please call for availability. These are not normally stock items and may require a significant lead time. The socket slips directly over the drive steel. Some contractors remove the concrete Breaking tool from the hammer and have it “bored out” to a loose slip fit over the PDSMR88 Drive steel. Do not weld on the concrete breaking tool this will damage the heat treat and the welds will break. See sketch (next page) for details.
- 2) The maximum recommended size for pavement breakers and Manta Ray MR88 anchors is the 250 ft. – lb. class. If larger sizes are used then the warranties on the drive steel may be voided. Please consult directly with Foresight Products or your Manta Ray Distributor.
- 3) When using a Vibratory plate compactor, a socket is welded onto the bottom of the vibro. This socket “captures” the drive steel to keep it from sliding off the plate. See sketch (next page) for details.
- 4) In general a rubber tired Backhoe loader or a tracked small excavator provides the most versatility for mechanized installation.

#### 4.5 Mechanized Driving Methods and tips – cont'd:

### Mechanized Driving of MR88 Anchors



Vibro Compactor

Pavement Breaker Hammer

1 5/8" diameter "socket" fits over PDSMR 88 drive steel

Weld pipe or tube to bottom of plate. Foresight has had best results with socket centered in plate. Some installers prefer the socket in a corner to improve operator visibility when placing over drive steel

Remove tool from hammer  
Have a machine shop bore out the socket.  
Do not weld on the tool!

## **SECTION 5: RELATED PRODUCTS**

The following related products are available from Foresight products. They all use the same installation equipment at the MR88-RA4.

**#20091 MR8808G042HD Anchor/wr assembly.** MR-88 anchor head with 42" of ¼" wire rope with a heavy duty thimbleye. This anchor is very useful in cases where a flexible wire rope tendon is more appropriate than a solid steel rod.

**#20657 MR8808S042HD A Anchor/wr assembly.** MR-88 anchor head with 42" of ¼" Stainless Steel wire rope with heavy duty galvanized thimbleye.

**#20119 MR88-RA1 Anchor / hdwe assembly.** MR-88 anchor with 3foot long x ½" anchor rod with a nut and washer. Similar to M88-RA4 except it is only 3feet long and has no spreader plate.

**#20284 EN-16G Eyenut:** ½" eyenut can be used on any MR88 with ½" rod. It is useful for attaching revetment mat cables to MR-88 anchor rods.

## **SECTION 6: FOR MORE INFORMATION:**

Contact: Foresight Products, LLC  
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