

# Bulkhead Anchor Conditions Evaluation

# Morgan Creek Harbor Association Isle of Palms, South Carolina

December 12, 2019 Terracon Project No. 73055027

# **Prepared for:**

Morgan Creek Harbor Association c/o Property Management Services 1340-G Ben Sawyer Blvd. Mt. Pleasant, South Carolina

#### **Prepared by:**

Terracon Consultants, Inc. Columbia, South Carolina

📒 Geotechnical

December 12, 2019



Morgan Creek Harbor Association c/o Property Management Services 1340-G Ben Sawyer Boulevard Mt. Pleasant, South Carolina 29464

- Attn: Ms. Laurie Schueler Ph: (843) 881-5459 laurie@charlestonpms.com
- Re: Bulkhead Anchor Conditions Evaluation Report Morgan Creek Harbor-Steel Bulkhead Isle of Palms, South Carolina Terracon Project No.: 73055027

Dear Ms. Schueler:

Terracon Consultants, Inc. (Terracon) is pleased to provide the attached engineering report for the referenced project. These services were conducted as described in our revised proposal dated September 30, 2019. This report contains the anchor pull test data, tie rod observations, and our conclusions based on the observations.

Should any questions arise from the provided information, we would be pleased to address them with you. Terracon appreciates the opportunity to serve as your geotechnical and materials testing consultant on this project and we look forward to our continued involvement at Morgan Creek Harbor.

Sincerely, Terracon Consultants, Inc.

Robert McLeod, P.E. Senior Project Manager SC Registration No. 10333 Kevin Sohrabnia, P.E. Senior Principal SC Registration No. 16603



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# **Bulkhead Anchor Conditions Report**

# Morgan Creek Harbor Association Isle of Palms, South Carolina Terracon Project No. 73055027 December 12, 2019

# 1.0 INTRODUCTION

Terracon has observed and documented the condition of backfill, tie rod and check anchor load pullout test program performed by TIC at the Morgan Creek Harbor in Isle of Palms, South Carolina. The scope of our services included:

- Observing test pit excavation at 4 locations to document the condition of backfill, tie rod, and also measure the thickness of tie rod to check for any apparent cross section loss.
- Observe and record pull testing of anchors by TIC. TIC provided the testing equipment and performed the pull test at each location.
- Visual observation of backfilling and compaction of each excavation.

This report presents our observations, the results of the anchor pullout testing, the results of the tendon observation, and our conclusions based on the observed conditions. Representative photo graphs have also been included.

# 2.0 PROJECT INFORMATION

ITEM	DESCRIPTION
Location	Morgan Creek Harbor, Isle of Palms, South Carolina.
Existing Improvements	Steel bulkhead wall totaling approximately 6,000 linear feet. The sheet piles range in length from 45 to 50 feet, with exposed height of above mudline of about 8 to 10 feet. The exposed section of wall is supported by series of screw anchor tie-back anchors installed on alternating 4 and 8-foot centers at Elevation +/- 4' MSL and 0'+/- MSL.
Background Information	The tie-backs were installed during late 90's and early 2000 as part of repairs of sheet pile system. It consists of tie rods and an AB Chance helical anchor coupled together with



ITEM	DESCRIPTION
	threaded bar adaptors. The anchor lengths vary depending on soil conditions and wall height. The initial 5-foot section of tie rod immediately behind the wall is encased in grease filled, 4- inch diameter SCH40 PVC sleeve to protect it from the environment.
	The tie rods are connected to the sheet piles with a nut and bearing plate assemblage on the water side and pre- tensioned to lock-off loads as per project manual. See diagrams below from original design plans.

# 3.0 ANCHOR PULLOUT LOAD TESTS

# 3.1 General Information

The purpose of the pullout load test is to verify the tension load capacity of the installed bulkhead anchors. Construction documents indicated a design proof load capacity of 20 tons for the Chance helical anchors and bulkhead connections as installed. The design documents (circa 1998) required a proof load of 20 tons with a hold period of 10 minutes.

Each load test included a cyclic load and unload, with load applied in steps of .25, .50, .75 and 1.0 x the proof load of 20 tons. The anchor pullout tests were performed by representatives of TIC, Inc. of Savannah, GA under contract to Morgan Creek Harbor Association (MCHA). Load test locations were selected jointly by Terracon, MCHA, and TIC. The selection of test locations was based on reasonable access to the work area. A total of four (4) load test locations were selected as detailed below:

- #1, 59+80: Morgan Creek Marina/41 Morgan Cove Drive
- #2, 28+00: 17 Morgan Creek Drive/ 16<sup>th</sup> tee
- #3, 03+58: 50 Waterway Island Drive
- #4, 21+58: 35 Waterway Island Drive

See attached test location sketch for additional location information.

#### 3.2 Anchor Pullout Load Test Procedures

At each test location, TIC representatives established a work platform in front of the bulkhead wall and deployed floating absorbent collars around the platform. The purpose of the floating collars was to define the work area for safety purposes, and to contain any incidental debris or liquids that may fall from the work area.

The exposed end of each anchor is a nominal #8 Dywidag bar. The end of each anchor rod was cleaned of rust and/or marine growth with a power grinder to expose the threads. TIC used a steel



coupler to connect the exposed end to another threaded Dywidag bar. A hydraulic center pull jack with a custom load frame was next positioned over the threaded bar, and steel fittings used to connect the jack to the treaded rod. The hydraulic jack was rated for 60 tons capacity (Photos #12, #13, #14).

TIC used a separate metal rod, attached to the steel bulkhead with magnetic bases, to independently support a dial gauge on the exterior steel fittings. The dial gauge measured movement of the threaded rod as the incremental loads were applied. The dial gauge was capable of measuring movements in increments of 0.001 inches.

The anchor pullout tests were conducted on November 25, 2019. The load measured at the exposed anchor rod is based on the ram and pump. The calibration data for the ram and pump were provided to us by TIC and is included in the Appendix.

Each test was performed in general accordance with the quick load method as described in the 1998 project manual. Briefly, the quick load method consists of applying load to the pile in 25 percent increments of proof load and holding the proof load for a period of 10 minutes. The load increments were increased until a total load on each anchor reached the proof load of 20 tons. The load was held for 10 minutes, then released in 25 percent intervals.

# 3.3 Test Results

Data obtained during the load test are shown graphically in Figures A, B, C, and D in the Appendix. The loads shown were measured at the steel fitting on the free end of the anchor rod, based on the contractor's ram and pump. At the proof load (20 tons), the recorded deflection was about 1/2 inch for each anchor. Once the proof load was removed, the permanent deflection at the steel fitting was about 0.2 inches for Anchors at locations #2, #3, and #4; for Anchor #1, the permanent deflection was less than 0.1 inches.

At location #2, TIC attempted load tests on three exposed anchors in the vicinity of station 28+00. At the first two locations, the degree of corrosion on the exposed bar threads was such that the threaded coupler pulled off the bar under load. The third attempt at station 27+58 resulted in a complete test.

# 4.0 TEST PITS/TIE ROD OBSERVATION

# 4.1 Tie Rod Observation Methods

At each pullout test location, TIC removed the bulkhead wall backfill to expose a tie rod for visual examination and direct measurements. The excavations were made with a tracked hydraulic miniexcavator except location #1, where the excavation was made using hand tools. The excavations extended down through the backfill until a tie rod was exposed, then the excavations were sloped



to allow access to the tie rod. TIC performed the tie rod excavations on November 20 and 21, 2019. (Photos #1 - #11)

The tie rod excavations were typically located horizontally about 3 to 5 feet behind the bulkhead. At location #2, the excavation began immediately behind the bulkhead, and the excavator slightly damaged the fabric wrapped stone drain located immediately behind the bulkhead. The stone and fabric thus disturbed were replaced by TIC using bagged landscaping stone of similar size. The tie rod excavations extended from 4 to 6 feet below the existing ground surface.

# 4.2 Tie Rod Observation Data

The soils encountered in the tie rod excavations typically consisted of tan and brown slightly silty fine to medium sand. At each location except location #2, wet conditions and some water seepage were observed in the bottom of the excavation.

At each excavation, a segment of the tie rod approximately two to three feet long was exposed for viewing. Once exposed, the tie rod was wiped clean of soil, photographed, and the diameter measured using a set of dial calipers. The dial calipers were capable of measuring to 0.001 inches. Diameter measurements were made at three to four locations on each tie rod, and the measurements averaged to provide the data presented below. The following tie rod sizes were recorded:

Test Location	Tie Rod Diameter (inches)	Remarks
#1 / 59+80	1.00	Black grease coating on tie rod; rectangular plate nominal ½ x 3 inches partially exposed & welded to tie rod. Photos 1,2,3
#2 / 28+00	1.11	Black grease coating on tie rod. Photos 4, 5
# 3 / 3+58	1.17	Black plastic coating on tie rod. Photos 6,7,8
#4 / 21+58	1.17	Black plastic coating on tie rod; rectangular plate nominal <sup>1</sup> / <sub>2</sub> x 4 inches partially exposed & welded to tie rod. Photos 9,10,11

After tie rod observations were complete, TIC personnel replaced the excavated soil in thin lifts, and compacted each lift using a vibratory plate tamp. Excavated sod was replaced when backfill was complete. The tie rod excavation at location #1 was begun at a slight depression in the ground surface and was backfilled as much as possible. A slight depression in the ground surface remained after backfilling at location #1



# **5.0 DISCUSSION**

Based on the available data from the test pits, and from the results of the anchor pullout tests, our opinion is that the buried tie rods at locations observed have suffered minimal loss of section due to corrosion. The results of pullout tests indicate that anchors in place can likely provide resistance equal to proof load of 20 tons assumed to be in the range anticipated in the original design.

The exposed Dywidag bars (waterside) are experiencing some loss of cross section due to exposure to the tidal conditions, but this loss was noticeable (i.e. unable to attach threaded coupler for pullout test) at only one of the four locations tested.

# 6.0 GENERAL COMMENTS

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted engineering practices. No warranties, either expressed or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon Consultants, Inc. reviews the changes and either verifies or modifies the conclusions of this report in writing.

Bulkhead Anchor Conditions Evaluation Report Morgan Creek Harbor-Steel Bulkhead Isle of Palms, South Carolina December 12, 2019 Terracon Project No. 73055027



# **APPENDIX**

Figure 1 – Load Test Location Plan Figure 2 – Pullout Load vs Deflection Curves Calibration Data for Load Hydraulic Ram Photographs

Appendix



Exhibit









RICHARD DUDGEON, INC. 24 Swift Place 24 Swift Place 25 06710	email:APPLICATIONS@DUDGEONJACKS.COM WWW.DUDGEONJACKS.COM
PRESSURE GAUGE	CERTIFICATION
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GAUGE SERIAL NO.	CAPACITY 10,000 PSI 6" Dia
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Photo #4 Location #2, station 28+00 . Access to test location with mini-excavator



#### Photo #5 rod





**Photo #6** Location #3, prior to excavation. Notebook on wall is station 3+50, mini-excavator at upper left in photo.





Photo #7 exposed. Location #3, tie rod



**Photo #8** Location #3, tie rod exposed. Plastic/polymer coating visible. Water seeping into excavation at time of photo.



**Photo #9** 21+58

Location #4, station





**Photo #10** Location #4, tie rod exposed. Plate visible at left in photo.



**Photo #12** Anchor pullout test, Location #2. Typical access for installing test equipment





**Photo #13** Location #1, Typical pullout test equipment setup. Arrow points to jack

