O'Quinn Marine Construction Inc.

Design Build Broad River Fishing Pier Rehabilitation

Beaufort, SC

RFP# 092314

Prepared By: O'Quinn Marine Construction Inc.

October 2, 2015

Broad River Fishing Pier Rehabilitation

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October 2, 2015

Mr. Robert McFee, P.E.
Director of Engineering and Infrastructure
Beaufort County Engineering Division
104 Industrial Village Road, Bldg #3
Beaufort, SC 29906

RE: Broad River Fishing Pier Rehabilitation
Stage I Inspection, Testing, Engineering and Recommendations
RFP 092314

Dear Mr. McFee:

The below listed have contributed to the compilation of the analysis and engineering for the Broad River Fishing Pier Rehabilitation project.

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Respectfully submitted,

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October 2, 2015

Mr. Robert McFee, P.E.
Director of Engineering and Infrastructure
Beaufort County Engineering Division
104 Industrial Village Road, Bldg #3
Beaufort, SC 29906

RE: Broad River Fishing Pier Rehabilitation
RFP 092314

Dear Mr. McFee:

The following is a summary of our evaluation, comprehensive inspection and analysis of the Broad River Fishing Pier. Robert O'Quinn of O'Quinn Marine Construction Inc., McSweeney Engineers and KCI Technologies Inc. put to this work together. Both McSweeney Engineers and KCI Technologies Inc. are registered engineering firms with the state of South Carolina.

I. Design Life Spans:

The typical lifespan for concrete bridges is 50 to 75 years. This structure, although no longer an in-service bridge is 61 years old and is well into the end of its usable life. I expect that if left in its current state localized failures may occur especially on the outer 9 spans within the next 5 to 7 years, possibly sooner if significant storm events are encountered. The first alternative includes repair and preservation work on spans 9 – 1 and reinforcement of piles at Bents 8 and 9. This option will require extensive concrete repair work on the concrete beams. In addition, in order to maintain/reestablish the bearing capacity at Bents 8 and9 extensive engineering and retrofitting construction would have to be performed. I anticipate that if extensive repairs are performed an additional 10-12 years of service life can be added to the structure if yearly maintenance is performed.

It must be noted that the outermost 10 spans represent approximately 30 percent of the total length of the fishing pier but would require at 65% - 70% of the work and cost. Furthermore, during the inspections it was observed that a majority of pier patrons tend to fish in the middle section of the pier. It is for these reasons that other options should be considered.

Another alternative includes removal or barricade of the outermost 9 spans and repair and preservation work on the innermost 22 spans only. The defects observed in the first 22 spans

were significantly less extensive that those on the outermost 9 spans. This option has the benefit of preserving over 1000 feet of the pier at a fraction of the cost represented in the first option. I anticipate an additional 12-15 years of service life added to this structure under the alternative. I suggest allocating a budget for ongoing maintenance activities after these repairs are completed.

II. Field Inspections:

1. Above Water Inspection – an above water inspection was conducted on June 9th and 10th, 2015 from a barge by McSweeney Engineers and KCI Technologies Inc. on a manlift. The results of this inspection revealed that the deterioration of the concrete beams was significantly more extensive than previous cursory inspections had indicated.

   Extensive spalling of the bottom of the pre-stressed concrete beams was observed. During the inspection a total of 179 defects with 535 exposed reinforcing or pre-stressing strands were noted. It should also be
   noted that approximately 80 percent of the encountered defects were located on the outmost 10 spans of the pier.

2. Underwater Inspection – An underwater inspection was conducted on May 26 through May 28, 2015 by McSweeney Engineers. The results of this inspection revealed that for the most part, the piles supporting the pier are in fair to satisfactory condition. Random minor defects consisting of vertical cracks within the splash zone and spalling of the pile faces were observed

   The most significant deficiency encountered was the undermining of foundation elements in two locations. Exposed H-Pile stingers at the bottom of concrete piles were discovered at Bents 8 and 9. At Bent 8, all of the pile stingers were exposed, with a maximum of 10 inches. At Bent 9, three piles exhibited exposed stingers with a maximum exposure of 4 inches. Furthermore, exposed stingers exhibited as much as 2 inches of heavy scale and rust nodules, 100 percent loss of protective coating, and 100 percent loss of section on the H-Pile flanges. A review of the design plans indicated that these stingers are approximately 3 feet long. This represents a significant deficiency in that these bents are being supported by substantially less bearing area and friction forces than specified in the original design.

III. Laboratory Testing:

During the above water inspection, four concrete core samples were taken for Petrographic and Compressive testing and analysis. The locations of these cores were as follows: Span 2 Beam D, Bent 3 Pile Cap, Span 10 Beam C, and Span 19 Beam C.

1. Petrographic Analysis – Petrographic analysis indicated that the concrete is in fair condition overall.

However, samples tested from a concrete beam exhibited high chloride content, estimated at 4.8 pcy or 1261 ppm. The generally accepted chloride concentration threshold for the initiation of corrosion of steel reinforcement is 500 ppm. This is an indication that the concrete is saturated with a high chloride content and corrosion of internal steel reinforcement is likely to continue throughout the structure regardless of the repair method chosen.

2. Compressive Strength Testing – Testing of concrete samples from beams at Span 2 and Span 19 resulted
in a compressive strength of 5100 psi and 6200 psi, respectively. These figures closely match the available design drawings, which indicate a final girder release strength of 5000 psi. Load Rating Analysis performed by McSweeney Engineers and KCI also used compressive strength values of 5000 psi.

IV. Load Rating:

Based on data acquired from field inspections and laboratory analysis, load rating was performed with the assistance of Bentley Systems LEAP CONSPAN software and a peer-review performed by KCI Technologies, Inc. After careful consideration of the pier's current use category and condition stated, a loading combination consisting of a 20,000 lb two-axle vehicle and 60 psf live load were selected for the analysis. From this analysis it was determined that the pre-streesed concrete beams can support this load case in their current condition. The previously stated load carrying capacity was based on analysis of the superstructure. The load rating did not consider the effects of reduced bearing capacity of the structure; i.e., Bents 8 and 9 where the H-Piles stingers were exposed. In addition, the load rating analysis assumed that only the lower row of pre-stress strands were broken. Given the high chloride ion concentration, it is possible that the remaining currently embedded (unexposed) pre-stress strands have some level of deterioration that can reduce the capacity of the superstructure. It is for this reason that we suggest reducing the vehicular load to a 15,000 lb vehicle, which is consistent with a Type I, ambulance currently employed by Beaufort County EMS.

In addition I have included in the more detailed report information from the Engineers addressing Bents 8 and 9. At Bent 8 all 8 piles supporting the bents had exposed steel stingers with a maximum exposure of 10-in. at Pile D-East. Steel stringers were exposed a maximum of 4-in at piles A,B and C west on Bent 9. It should be noted that the full load of each octagonal pile is being carried by their respective stingers. Each stinger exhibited a heavy 1 to 2-in thick layer of heavy scale and nodules, 100 percent loss of protective coating and up to 100 percent loss of section on the H-Pile flanges. The design plans indicate a stinger length of 3 feet. This is an indication there is approximately 26 to 32 in of pile stinger embedment at these locations

Due to the depth of the water (+/-45ft) I do not believe that underwater rehabilitation using divers will be reasonable. On a 50 ft diving schedule, it would take an extremely large diving team or saturation diving techniques in order to accomplish any work in a reasonable timeframe. Structural pile jackets and/or pile
stinger encapsulation would not be a prudent alternative. For structural jacket installation it is necessary to excavate 1 to 2 feet around the base of the pile.

Given the already shallow embedment length, this would not be possible. In addition, given the depth and strong currents, quality control of any underwater work would be extremely difficult.

It is for this reason that I propose designing and installing some type of retrofit that does not require the use of divers. I have attached a general schematic of this option to this letter. Although this is preliminary, we are able to quote a price to engineer and perform the work. The preliminary option is as follows:

V. Post Tension Pile Cap Footing Retrofit:

This includes a type of post-tensioned retrofit to Bents 8 and 9. This method is similar to the technique employed on the southbound lanes of US 17 over the Ashley River in Charleston and consists of installing a new pile cap/footing on each side of the existing bent and designing some form of post tension system to connect these pile cap footings to the existing bent.

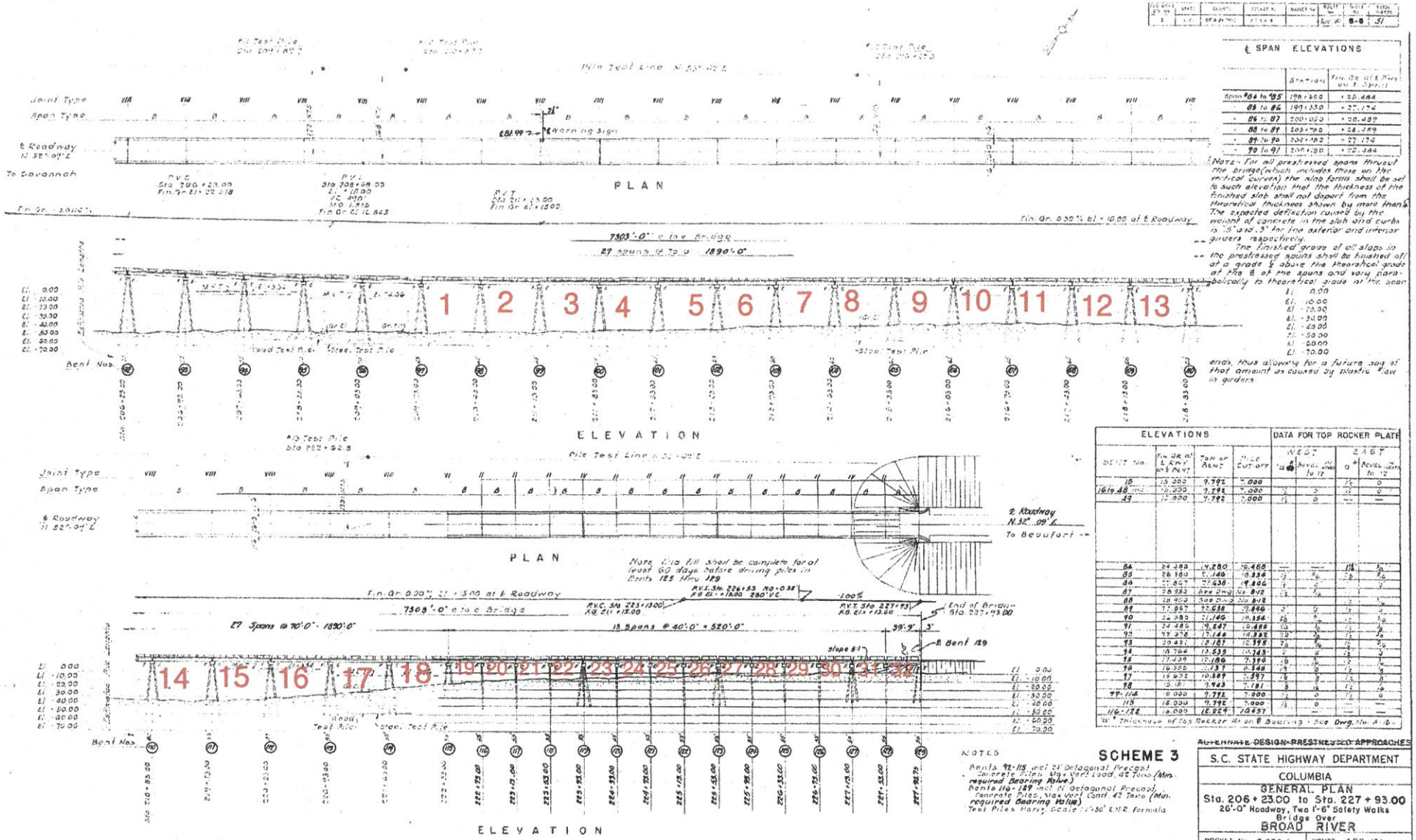
Enclosed you will find a Proposal to perform the necessary work to completely rehabilitate the fishing pier.

Respectfully submitted,

Robert D. O'Quinn, III
O'Quinn Marine Construction Inc.

RDOIII/nhl

Enclosure



℄ SPAN ELEVATIONS

	Bottom of Girder	Fin. Gr. at ℄ Roadway over ℄ Span
Span #84 to #85	198'-6.66"	+25.484
" 85 to 86	199'-1.30"	+25.174
" 86 to 87	200'-0.09"	+24.489
" 87 to 88	200'-7.80"	+24.389
" 89 to 90	204'-1.82"	+22.134
" 90 to 91	204'-7.86"	+22.344

Note:- For all prestressed spans thruout the bridge(which includes those on the vertical curves) the slab forms shall be set to such elevation that the thickness of the finished slab shall not depart from the theoretical thickness shown by more than ½. The expected deflection caused by the weight of concrete in the slab and curbs is .5" and .3" for the exterior and interior girders respectively.

The finished grade of all slabs on the prestressed spans shall be finished off at a grade ½ above the theoretical grade of the ℄ of the spans and vary parabolically to theoretical grade at the seat ends, thus allowing for a future sag of that amount as caused by plastic flow in girders.

Cl.	0.00
El.	-10.00
El.	-20.00
El.	-30.00
El.	-40.00
El.	-50.00
El.	-60.00
El.	-70.00

ELEVATIONS

Bent No.	Fin. Gr. at ℄ Rdwy. over ℄ Bent	Top of Bent	Pile Cut-off
15	15.000	9.792	7.000
16 to 48 inc.	10.000	9.792	7.000
49	12.800	9.792	7.000
84	24.489	14.280	10.488
85	24.189	13.980	10.334
86	23.863	13.638	9.806
87	23.553	See Dwg. No. B-12	
88	24.902	See Dwg. No. B-12	
89	27.863	22.638	20.846
90	24.383	21.140	18.356
91	24.483	19.647	18.488
92	22.276	17.146	14.382
93	20.481	15.181	12.195
94	18.764	13.533	10.743
95	17.439	12.186	9.378
96	16.382	11.137	8.348
97	15.602	10.369	7.397
98	15.18	9.943	7.181
99-114	15.000	9.792	7.000
115	15.000	9.792	7.000
116-128	15.000	12.929	10.137

"a" Thickness of Top Rocker Plate on ℄ Bearing - See Dwg. No. A-16.

DATA FOR TOP ROCKER PLATE

	WEST a	WEST Bevel in Inches	EAST a	EAST Bevel in Inches
15			15	0
16 to 48 inc.	15	0	15	0
49	15	0	—	—
84	—	—	15	0
85	15	0	15	0
86	15	0	15	0
87	15	0	15	0
88	15	0	15	0
89	15	0	15	0
90	15	0	15	0
91	15	0	15	0
92	15	0	15	0
93	15	0	15	0
94	15	0	15	0
95	15	0	15	0
96	15	0	15	0
97	15	0	15	0
98	15	0	15	0
99-114	15	0	15	0
115	15	0	—	—
116-128	—	—	—	—

SCHEME 3

NOTES

Bents 92-115 incl 24 Octagonal Precast Concrete Piles, 85 k Vert. Load, 42 Tons (Min. required Bearing Value)

Bents 116-129 incl 21 Octagonal Precast Concrete Piles, Max Vert. Load 42 Tons (Min. required Bearing Value)

Test Piles Vary, Scale 1"=50' E.N.R. formula

~~ALTERNATE DESIGN PRESTRESSED APPROACHES~~

S.C. STATE HIGHWAY DEPARTMENT

COLUMBIA

GENERAL PLAN

Sta. 206+23.00 to Sta. 227+93.00

26'-0" Roadway, Two 1'-6" Safety Walks

Bridge over

BROAD RIVER

DOCKET No. 7.238.4 | ROUTE ADD. 181

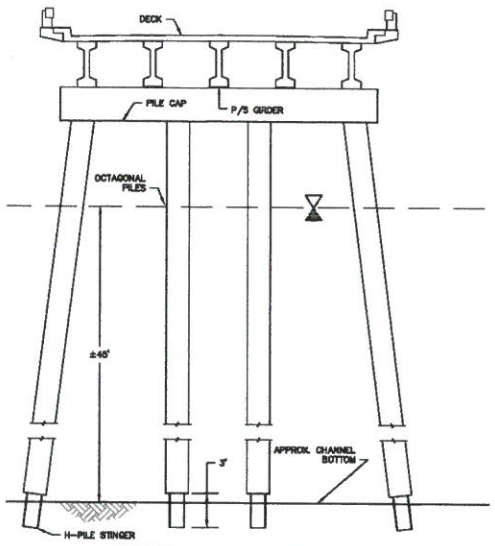
V. BARSTOW, Consulting Engineer, New York N.Y.

MADE C.D.S. | TRACED J.A.P. | CHECKED J.C. | COMPARED J.A.P.

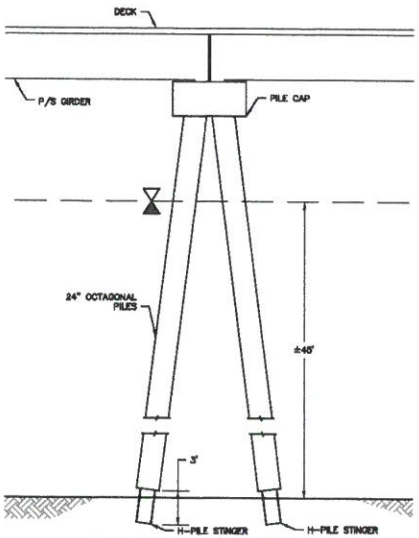
SCALE 1"=50' | DATE June 1959 | DWG. No. B-8

Rev. W.F.L. 9-21-55; Chd. D.H.P.

EXISTING



EXISTING BENT ELEVATION
SCALE: 3/16" = 1'



EXISTING CROSS SECTION
SCALE: 3/16" = 1'

McSweeney Engineers
123 Cannon Street
Charleston, SC 29403
(843) 974-0821
www.mcsweeneyengineers.com

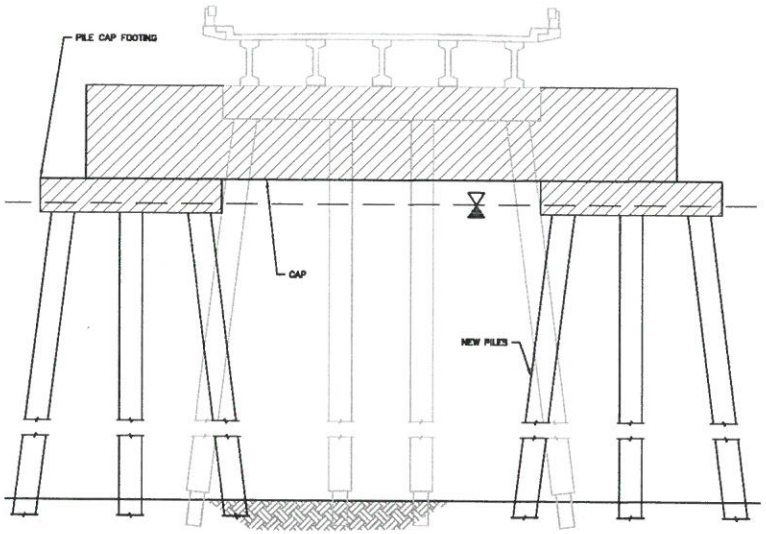
BENT 8 AND 9 RETROFIT

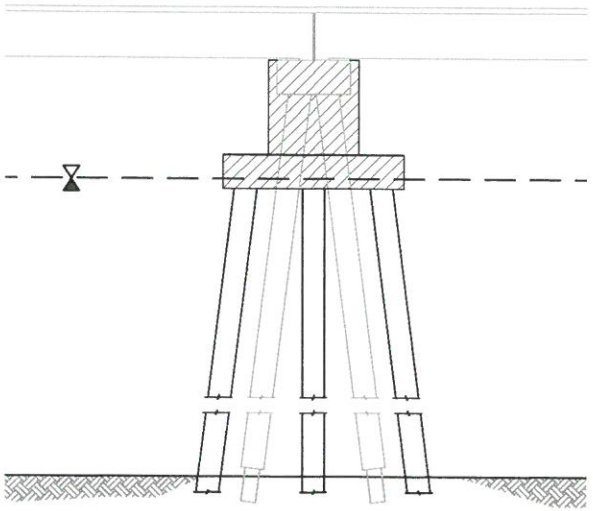
BROAD RIVER FISHING PIER

DESIGNED BY:	WDB
DRAWN BY:	WDB
CHECKED BY:	DBM
DATE:	9/7/15
REV. _ DATE:	——

A2
SHEET NUMBER

POST TENSION RETROFIT OPTION





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BENT 8 AND 9 RETROFIT

BROAD RIVER FISHING PIER

DESIGNED BY:	WDB
DRAWN BY:	WDB
CHECKED BY:	DBM
DATE:	9/7/15
REV. _ DATE:	___

A1

SHEET NUMBER

O'Quinn Marine Construction Inc.
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843-522-3138 (Fax)

PROPOSAL

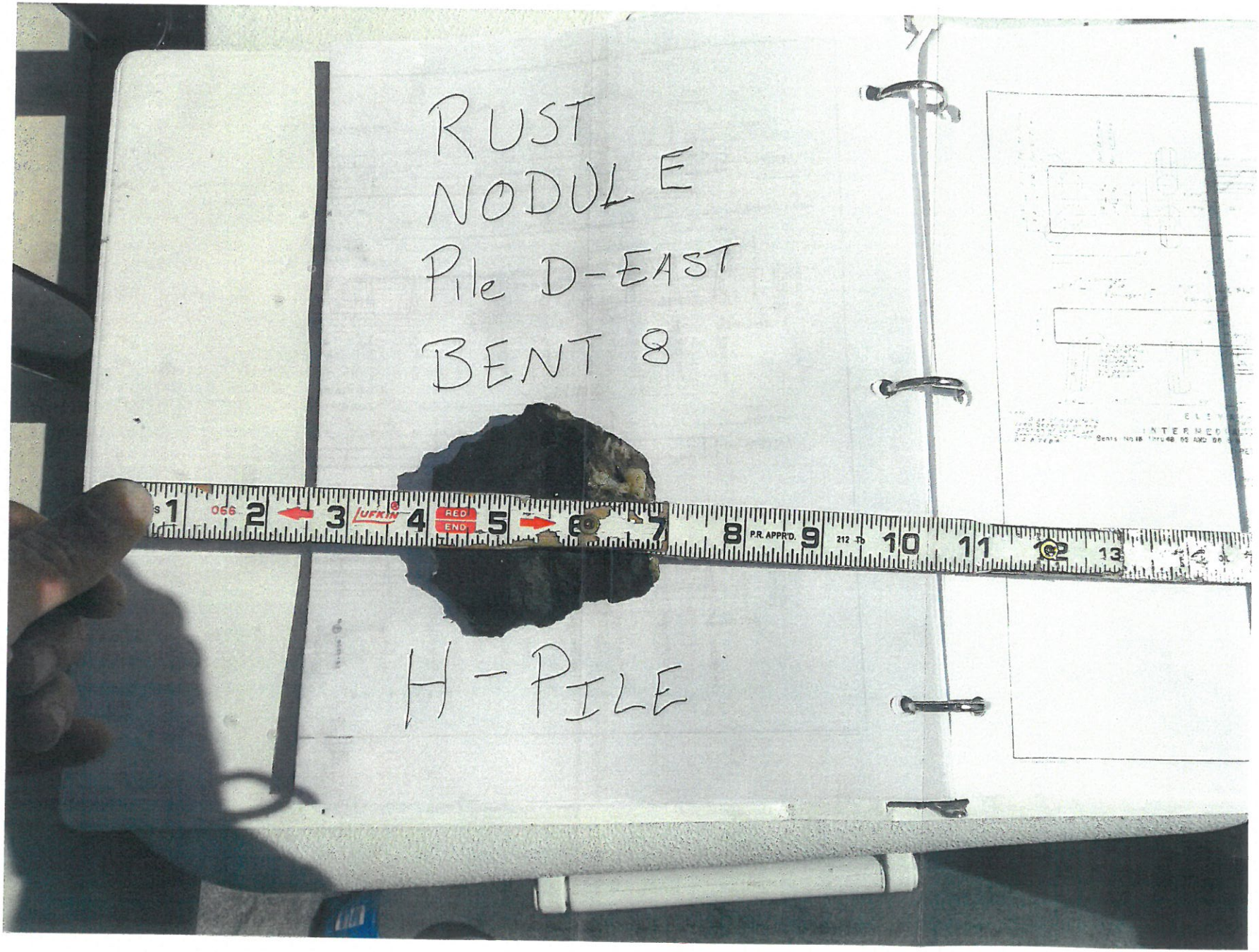
1. Repair spans 29-10 as in drawing prepared by McSweeney Engineers.
   Cost: $388,480.00

2. Furnish engineered repair plans (see sketch). Repair pile bents 8 and 9 with a post tension retrofit. **Cost: $885,000.00**

3. Repair spans 9-1 as in drawing prepared by McSweeney Engineers.
   Cost: $662,515.00

4. If no repair is done to pile bents 8 and 9, barricade the end of pier with a chain link fence and gate. **Cost: $13,650.00**

5. Remove and dispose of spans 9-1 and dispose of at near shore fish havens.
   Cost: $950,000.00


RUST
NODULE
Pile D-EAST
BENT 8
H-PILE
LUFKIN
RED END
P.R. APPR'D.