The Moorings Condominiums
Building 5
366 - 372 Moorings Cove Drive
Tarpon Springs, FL 34689
B.A.S.I.C. File No.: B2020-018

March 17th, 2021

FINAL REPORT

BASIC ENGINEERING

Bay Area Sinkhole Investigation & Civil Engineering
2601 E. 7th Avenue, Tampa, FL 33605
Ph: (813) 885-4144 | Fx: (813) 885-4166
www.basic-engineering.com

BAY AREA SINKHOLE INVESTIGATION & CIVIL ENGINEERING

2601 East 7th Avenue • Tampa, Florida 33605
Ph: 813-885-4144 • Fx: 813-885-4166

To: The Moorings Condominiums Association
Attn: Karen Cleary, President
450 Moorings Cove Drive
Tarpon Springs, FL 34689

Date: 03/17/2021
Project # B2020-018

Subject: Injection Pin Pile, Compaction and Chemical Grouting
The Moorings Condominiums | Building 5
366 – 372 Moorings Cove Drive, Tarpon Springs, FL 34689

Dear Ms. Cleary,

We have reviewed a Structural Damage Evaluation and Subsidence Investigation report by SDII Global, (SDII), dated April 6th, 2018, a Geologic/Geotechnical Testing and Evaluation report by Applied Engineering & Geosciences (AEG), dated September 22nd, 2018, a Sinkhole Loss Determination report by Structural Engineering and Inspections, Inc, (SEI), dated November 28th, 2018, a Peer Review report by SDII Global, (SDII), dated January 11th, 2019, a Neutral Evaluation report by Andreyev Engineering, Inc., (AEI), dated March 16th, 2020 and field work and engineering design performed by B.A.S.I.C. Engineering.

Based on the aforementioned reports, you have asked us to recommend and monitor a remediation program. B.A.S.I.C. Engineering recommended utilizing a combination of injection pin piles, compaction grouting and chemical grouting points. We have provided you with a Site Plan indicating the location of the injection pin piles, compaction grout and chemical grouting points and their estimated depths of installation. However, we were unable to accurately predict the amount of grout that would be required prior to actual field installation.

Injection Pin Piles are recommended in similar situations whereby the property requires lifting or other foundation support in addition to sealing off the limestone interface to prevent future sinkhole activity from occurring. The installation of the Injection Pin Piles is a process whereby high carbon steel pilings are hydraulically driven into the ground until a predetermined pressure reading is attained, or refusal occurs where lifting of the structure takes place. The Injection Pin Piles are then grouted through a patented process allowing grout to be pumped directly at the limestone interface.

In addition to the installation of the Injection Pin Piles, a high slump pressure grouting program is recommended as a means of sealing deep openings into underlying cavernous zones, fill in void zones, consolidate/densify the loose soils, prevent downward migration of soil particles and also to provide greater lateral stability to the steel pilings. A 4-6 inch slump grout is recommended by B.A.S.I.C. Engineering so that it may be accurately pumped below the structure and it may flow through the grout holes and densify soil voids with greatest efficiency.

Compaction grouting is the injection of grout into the soil to improve bearing capacity. This is accomplished by using a very viscous (low-mobility), aggregate under high pressure to form grout bulbs, which displace and densify the surrounding soils in a controlled manner through an injection pipe. The upward component of force causing heaving at the surface during compaction grouting usually limits the degree which soil can be compacted, making compaction grouting ineffective for stabilizing upper level soils (approximately the top 15 feet). Therefore, in order to stabilize the uppermost subsurface soils, chemical grouting has also been recommended.

Chemical grouting is a process whereupon a polyurethane grout is injected to fill void spaces and improve the strength of granular soils. Chemical grout behaves like a fluid but reacts with an agent and water and within sixty seconds forms a solid, expanding to compact the soils similarly to standard compaction grouting but in a more controlled manner.

MONITORING

As requested, we have completed the monitoring of the subsurface injection pin piles, compaction grouting and chemical grouting operations as conducted by Helicon Foundation Repair Systems, Inc., (Helicon). This work was completed utilizing the TMG Injection Pier System, Compaction Grouting and Chemical Grouting. The remediation was started on January 27th, 2021 and completed on March 12th, 2021. A technician from our firm was present during the remediation operations to monitor operations and perform applicable grout slump tests.

Helicon installed a total of 42 injection pin piles around the property as per our site plan recommendations, as shown in figure 5a. Due to the site conditions, one (1) point was omitted from our original recommendations. (Injection Pin Pile Number 41). The depths of installation ranged from a low of 32 feet to a high of 121 feet below grade. Each pin pile was hydraulically driven into the soil until enough pressure was reached for refusal. The hydraulic gauge reading (psi) was recorded for each injection pin pile along with the installed depth (Figure 5a). The contractor then accepted delivery of a 1500-psi pressure grout from Pasco Ready Mix. The grout was a high slump 4-6 inch pressure grout. A grout gun was connected to each of the 42 injection pin piles pumped by Helicon, utilizing a TK-40 pump. The grout was pumped until a pressure gauge reading of up to 400-psi was reached on the in-line gauge. The amount of grout pumped for each injection pin pile was recorded (Figure 5a). A total of 42.5 cubic yards of grout was pumped in various quantities through 42 injection pin piles points.

Helicon then staked the compaction grout point locations as shown in Figure 5c in accordance with B.A.S.I.C. Engineering's recommendations. Angled compaction grout points were installed to refusal (hard limestone bedrock) at depths ranging from 62 to 76 feet below existing grade. A total of 271 feet of grout casing was installed at the 4 compaction grout points. After the grout casing was installed, a TK-40 pump was used to inject a mixture of cement, fly ash, sand, water, and other admixtures into the loose soils and voids in the limestone and overlying sand strata. Pumping continued until a grout pressure of 200 to 400 psi was achieved (over that required to initiate grout take) or lifting of the structure was observed (via a surveyor's level). The grout casing was then extracted upward four to five feet and pumping resumed. A total of 48.5 cubic yards of grout was pumped in various quantities through 4 compaction grout points on the subject property, ranging from a minimum of 4.43 cubic yards on point #1 to a maximum of 19.25 cubic yards on point #3.

Lastly, a total of 305.2 lbs. of chemical grout was injected through 4 chemical grout points by Helicon as shown in Figures 5d. Angled points were pumped at depth ranges between 12', 10', 8', 6', 4' and 2 feet below ground surface until lift of the slab/ground refusal was achieved.

It is our opinion that the injection pin piles, compaction grout and chemical grout were installed in accordance with industry standards and are an effective method to fill voids, cracks, fractures and cavities and to stabilize granular material, thus improving the physical properties of soil and rock at The Moorings Condominiums | Building #5. The proven technology utilized by the pier manufacturer and the ability to solve foundation settlement problems using a combination of injection pin piles, compaction grout and chemical grout, has demonstrated success without additional settlement. This report is not a guarantee that sinkhole activity will not continue to exist at the subject property but rather a summary and certification of the work completed by Helicon Foundation Repair Systems, Inc.

We thank you for the opportunity to provide the services to you on this project. We trust that the information provided in this letter is satisfactory. Should you have any questions, or require additional assistance, please do not hesitate to call.

Sincerely,

03/17/21

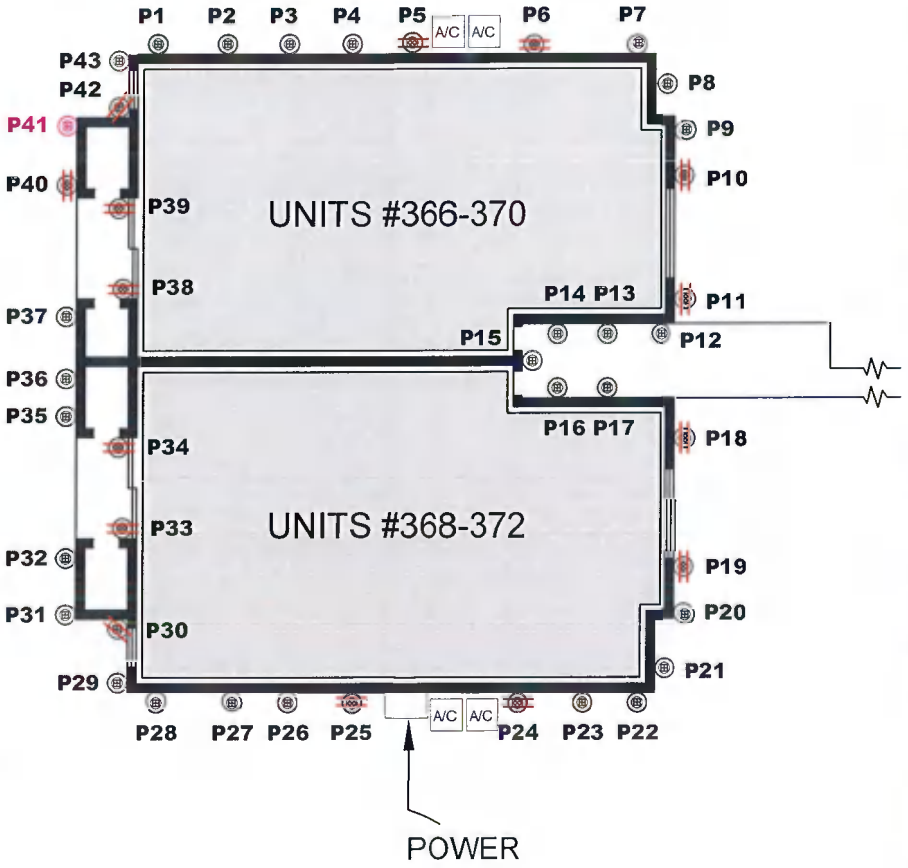
Justin D. James, P.E.
Florida P.E. # 60886
C.O.A. # 25869
Attachments

TECHNICAL NOTES:

- ⊛ - INJECTION PIN PILE
- ⊛ - SPREADER BEAM
- ⊛ - POINTS OMITTED
- SEE FIGURE 5b FOR PIN PILE DETAIL
- NOT FOR PERMITTING

Points #	PSI	Depth (ft)	Strokes	Actual Grout (cy)
1	2500	90.0	5	0.09
2	2600	45.0	207	3.64
3	2800	105.0	3	0.05
4	2700	80.0	4	0.07
5	2700	111.0	8	0.14
6	2700	80.0	9	0.16
7	2600	55.0	41	0.72
8	2700	55.0	3	0.05
9	2600	55.0	2	0.04
10	2800	55.0	108	1.90
11	2600	41.0	6	0.11
12	2700	44.0	51	0.90
13	2700	46.0	111	1.95
14	2700	113.0	3	0.05
15	2600	45.0	2	0.04
16	2700	40.0	10	0.18
17	2600	45.0	68	1.21
18	2600	45.0	51	0.90
19	2600	32.0	22	0.39
20	2700	43.0	24	0.42
21	2600	36.0	21	0.37
22	2600	43.0	30	0.53
23	2700	46.0	5	0.09
24	2700	37.0	91	1.60
25	2800	40.0	75	1.32
26	2700	40.0	325	6.26
27	2800	32.0	191	3.69
28	2700	41.0	7	0.14
29	2500	49.0	240	4.77
30	2600	43.0	143	2.84
31	2400	53.0	3	0.06
32	2500	61.0	3	0.06
33	2400	121.0	8	0.14
34	2500	110.0	7	0.12
35	2500	52.0	3	0.05
36	2400	46.0	252	4.30
37	3000	47.0	132	2.42
38	2700	47.0	11	0.20
39	2700	76.0	5	0.09
40	2700	79.0	11	0.20
41	-	-	-	-
42	2500	65.0	7	0.13
43	2400	70.0	8	0.15
	TOTALS:	**2459.0**	**2316.0**	**42.5**

TWO STORY WOOD FRAME BUILDING #5



Approximate Scale
1" = 15'

0 7.5 15

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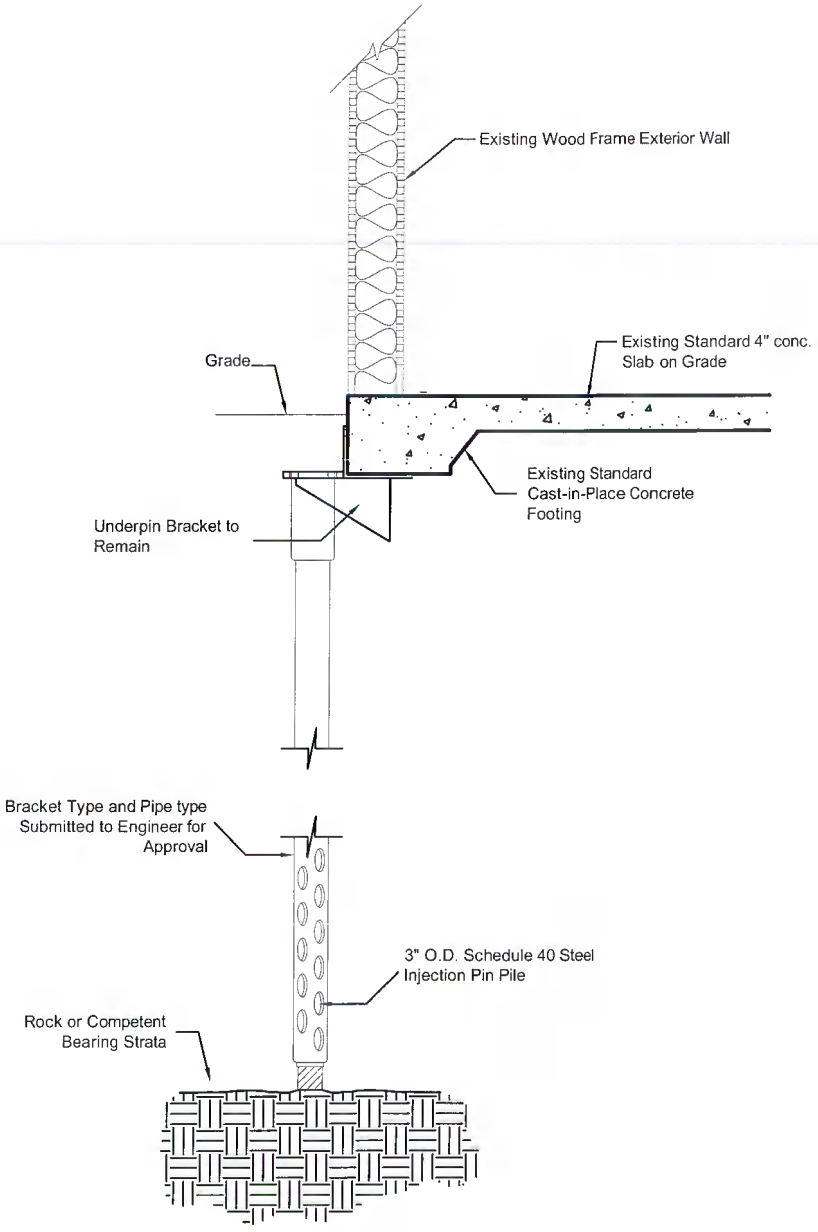
PINELLAS COUNTY

CONSTRUCTION INJECTION PLAN

FIGURE NO.: 5a
FILE NO.: B2020-018
DATE: 03/17/2021
CHECKED BY: JJ

Wood Frame on Spread Footer:

Injection Pin Pile Detail
(Not for Permitting)



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INJECTION PIN PILE DETAIL PLAN

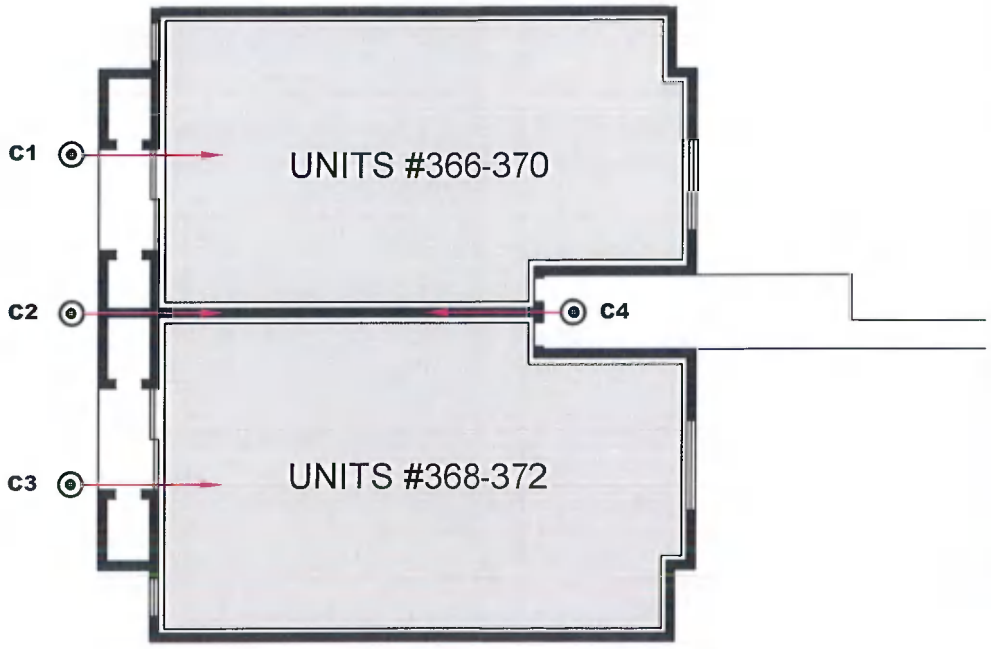
FIGURE NO.: 5b
FILE NO.: B2020-018
DATE: 03/17/2021
CHECKED BY: JJ

TECHNICAL NOTES:

- INSTALLED DEPTHS: 62' - 76'
- = ANGLED COMPACTION GROUT POINT
- NOT FOR PERMITTING

Points #	Depth (ft)	Strokes	Actual Grout (cy)
1	64	260	4.43
2	62	664	11.76
3	76	1,045	19.25
4	69	734	13.04
Total:	**271**	**Total:**	**48.5**

TWO STORY
WOOD FRAME
BUILDING #5



Approximate Scale
1" = 15'
0 7.5 15

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COMPACTION GROUT PLAN

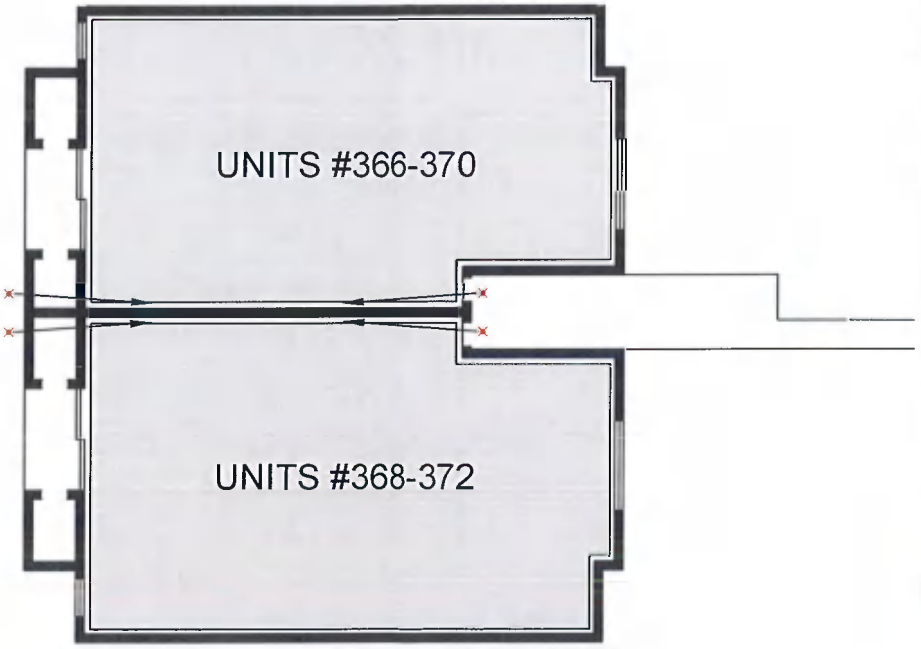
FIGURE NO.: 5c
FILE NO.: B2020-018
DATE: 03/17/2021
CHECKED BY: JJ

TECHNICAL NOTES:

- INSTALLED DEPTHS: 12', 10', 8', 6', 4' & 2' BGS
- = INSTALLED CHEMICAL GROUT POINTS = 4
- INSTALLED CHEMICAL QUANTITY = 305.2
- NOT FOR PERMITTING

Point #s	Depth (ft)	PSI	Lbs.
1	12	1200	6.0
	10	-	-
	8	-	-
	6	1200	14.8
	4	-	-
	2	-	-
2	12	1200	45.1
	10	-	-
	8	-	-
	6	1200	15.1
	4	1200	7.0
	2	1200	2.8
3	12	1200	50.0
	10	1200	29.9
	8	1200	16.9
	6	1200	7.7
	4	-	-
	2	-	-
4	12	1200	50.0
	10	1200	29.9
	8	1200	20.1
	6	1200	9.9
	4	-	-
	2	-	-
		Total:	**305.2**

TWO STORY
WOOD FRAME
BUILDING #5



Approximate Scale
1" = 15'
0 7.5 15

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CHEMICAL GROUT PLAN

FIGURE NO.: 5d
FILE NO.: B2020-018
DATE: 03/17/2021
CHECKED BY: JJ