



The Moorings Condominiums
Building 3

334 - 348 Moorings Cove Drive
Tarpon Springs, FL 34689
B.A.S.I.C. File No.: B2020-018

April 22nd, 2021



FINAL REPORT



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

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

Date: 04/22/2021
Project # B2020-018

Subject: Injection Pin Pile, Compaction and Chemical Grouting
The Moorings Condominiums | Building 3
334 – 348 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 February 11th, 2021 and completed on April 19th, 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 73 injection pin piles around the property as per our site plan recommendations, as shown in figure 3a. Due to the site conditions, four (4) points were omitted from our original recommendations. (Injection Pin Pile Numbers 38, 60, 65 and 73). The depths of installation ranged from a low of 19 feet to a high of 80 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 3b). 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 73 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 3b). A total of 107.8 cubic yards of grout was pumped in various quantities through 73 injection pin piles.

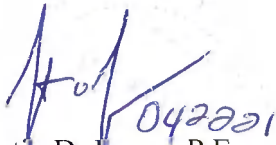
Helicon then staked the compaction grout point locations as shown in Figure 3d in accordance with B.A.S.I.C. Engineering's recommendations. Angled compaction grout points were installed to refusal (hard limestone bedrock) at depths ranging from 31 to 65 feet below existing grade. A total of 351 feet of grout casing was installed at the 10 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 69.6 cubic yards of grout was pumped in various quantities through 10 compaction grout points on the subject property, ranging from a minimum of .39 cubic yards on point #7 to a maximum of 19.40 cubic yards on point #3.

Lastly, a total of 812.4 lbs. of chemical grout was injected through 12 chemical grout points by Helicon as shown in Figures 3e. Angled points were pumped at depth ranges between 12', 10', 8', 6' and 4' 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 #3. 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,



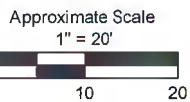
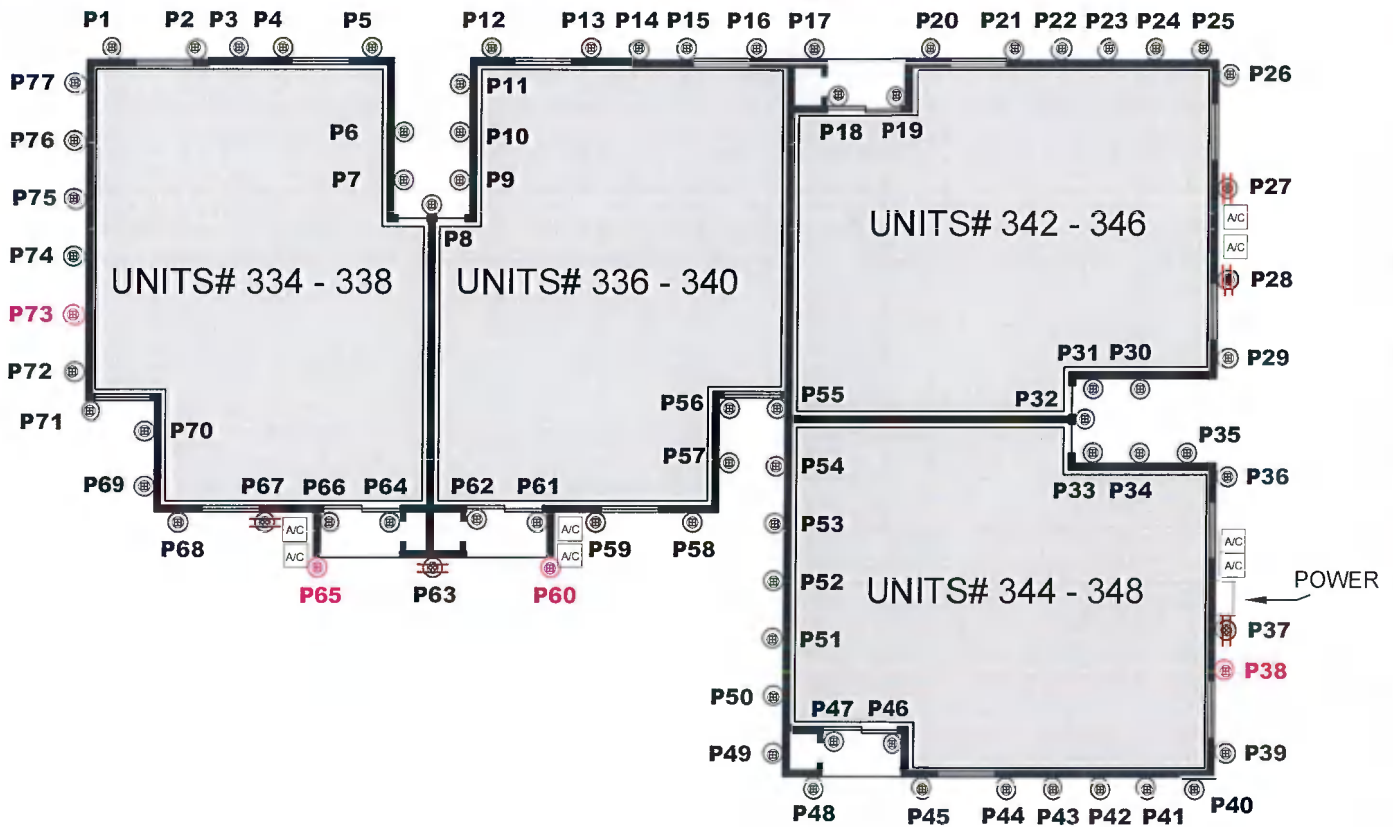
Justin D. James, P.E.
Florida P.E. # 60886
C.O.A. # 25869
Attachments

TECHNICAL NOTES:

- ⊗ - INJECTION PIN PILE
- ⊗ - SPREADER BEAM
- ⊗ - INJECTION PIN PILE
- SEE FIGURE 3c FOR INJECTION PIN PILE DETAIL
- NOT FOR PERMITTING



TWO STORY WOOD FRAME BUILDING #3



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CONSTRUCTION INJECTION PIN PILE PLAN

FIGURE NO.: 3a

FILE NO.: B2020-018

DATE: 04/22/2021

CHECKED BY: JJ

TECHNICAL NOTES:

- INJECTION PIN PILE SUMMARY POINTS

Points #	PSI	Depth (ft)	Strokes	Actual Grout (cy)
1	2600	30.0	50	0.83
2	2700	30.0	205	3.40
3	2500	50.0	4	0.07
4	2600	45.0	307	5.62
5	2600	32.0	467	8.69
6	2800	23.0	36	0.68
7	2600	22.0	4	0.08
8	2700	22.0	3	0.06
9	2800	23.0	121	2.29
10	2700	24.0	135	2.56
11	2500	35.0	48	0.81
12	2700	23.0	2	0.03
13	2500	26.0	123	2.06
14	2600	23.0	72	1.20
15	2700	30.0	213	3.87
16	2600	39.0	4	0.07
17	2500	33.0	386	7.08
18	2600	23.0	5	0.10
19	2600	30.0	65	1.28
20	2500	30.0	11	0.22
21	2700	45.0	180	3.54
22	2700	43.0	117	2.30
23	2700	51.0	443	8.18
24	2500	34.0	187	3.40
25	2400	25.0	5	0.09
26	2300	80.0	3	0.05
27	2500	40.0	47	0.83
28	2600	44.0	11	0.19
29	2600	50.0	4	0.07
30	2700	25.0	2	0.04
31	2600	40.0	3	0.05
32	2700	27.0	3	0.05
33	2600	35.0	469	8.24
34	2200	75.0	4	0.07
35	2500	60.0	26	0.46
36	2400	55.0	4	0.07
37	2600	35.0	7	0.13
38	-	-	-	-
39	2600	40.0	63	1.13

Points #	PSI	Depth (ft)	Strokes	Actual Grout (cy)
40	2200	70.0	9	0.16
41	1900	65.0	2	0.04
42	200	65.0	3	0.05
43	2000	65.0	2	0.04
44	2000	70.0	460	8.25
45	2200	40.0	4	0.06
46	2700	36.0	208	3.23
47	2600	34.0	294	4.60
48	1800	23.0	22	0.36
49	1900	33.0	1	0.02
50	2100	29.0	2	0.03
51	2000	25.0	51	0.83
52	2100	30.0	249	4.04
53	2100	48.0	4	0.06
54	2500	25.0	1	0.02
55	2800	65.0	2	0.03
56	2700	29.0	34	0.55
57	2600	27.0	69	1.12
58	2600	30.0	159	2.57
59	2300	20.0	5	0.08
60	-	-	-	-
61	2700	23.0	19	0.29
62	2600	30.0	16	0.25
63	2800	40.0	3	0.05
64	2600	32.0	57	0.96
65	-	-	-	-
66	2500	20.0	19	0.32
67	2600	30.0	190	3.20
68	2700	40.0	6	0.10
69	2600	19.0	32	0.54
70	2800	48.0	3	0.05
71	2300	30.0	2	0.03
72	2500	30.0	169	2.80
73	-	-	-	-
74	2700	23.0	23	0.38
75	2600	23.0	13	0.22
76	2700	31.0	136	2.25
77	2500	35.0	23	0.38
TOTALS:	2680.0	6131.0	6131.0	107.8



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INJECTION PIN PILE SUMMARY POINTS

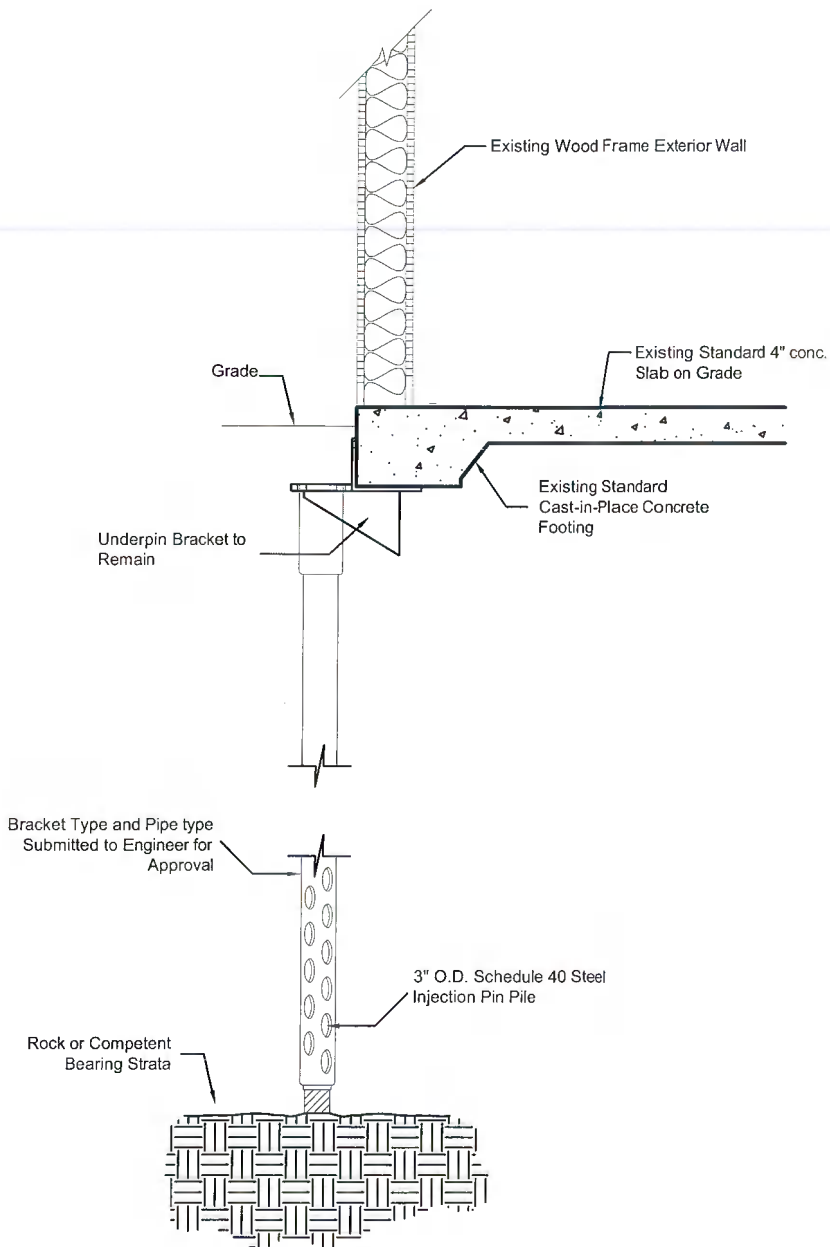
FIGURE NO.: 3b

FILE NO.: B2020-018

DATE: 04/22/2021

CHECKED BY: JJ

Wood Frame on Spread Footer:
Injection Pin Pile Detail
(Not for Permitting)



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INJECTION PIN PILE PLAN

FIGURE NO.: 3c

FILE NO.: B2020-018

DATE: 04/22/2021

CHECKED BY: JJ

TECHNICAL NOTES:

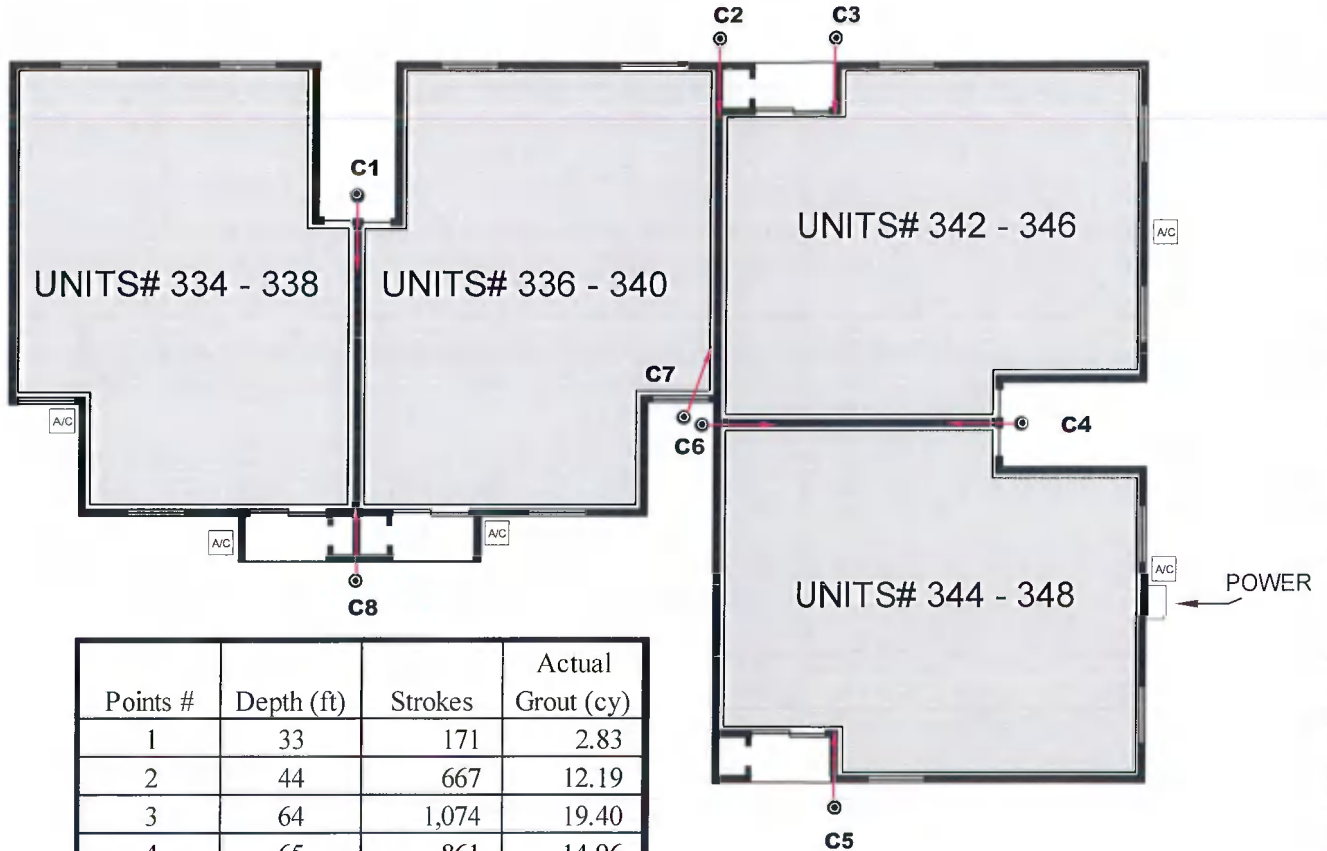
- INSTALLED POINTS DEPTHS: 31' - 65'

⊙ = ANGLED COMPACTION GROUT POINT

- NOT FOR PERMITTING



TWO STORY WOOD FRAME BUILDING #3



Points #	Depth (ft)	Strokes	Actual Grout (cy)
1	33	171	2.83
2	44	667	12.19
3	64	1,074	19.40
4	65	861	14.96
5	40	684	11.77
6	34	134	2.08
7	40	25	0.39
8	31	351	5.96
Total:	351	Total:	69.6

Approximate Scale
1" = 20'



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COMPACTION GROUT PLAN

FIGURE NO.: 3d

FILE NO.: B2020-018

DATE: 04/22/2021

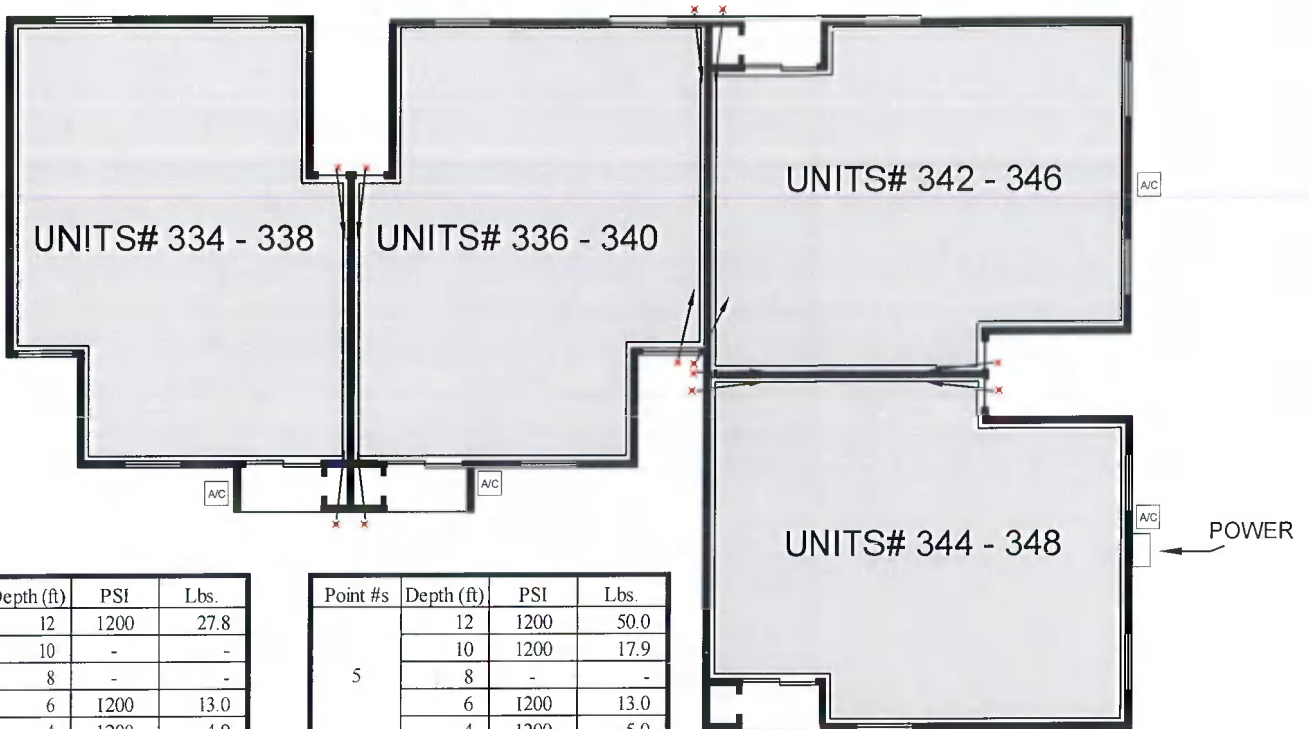
CHECKED BY: JJ

TECHNICAL NOTES:

- ✘ - INSTALLED DEPTH: 12', 10', 8', 6', 4' & 2' BGS
- INSTALLED CHEMICAL GROUT POINTS = 12
- INSTALLED CHEMICAL GROUT QUANTITY = 812.4 LBS
- NOT FOR PERMITTING



TWO STORY WOOD FRAME BUILDING #3



Point #s	Depth (ft)	PSI	Lbs.
1	12	1200	27.8
	10	-	-
	8	-	-
	6	1200	13.0
2	4	1200	4.9
	12	1200	36.6
	10	-	-
	8	-	-
3	6	1200	12.7
	4	1200	-
	12	1200	44.0
	10	-	-
4	8	-	-
	6	1200	13.0
	4	1200	7.0
	12	1200	50.0
5	10	1200	35.2
	8	1200	18.6
	6	1200	13.0
	4	1200	4.9

Point #s	Depth (ft)	PSI	Lbs.
5	12	1200	50.0
	10	1200	17.9
	8	-	-
	6	1200	13.0
6	4	1200	5.0
	12	1200	50.0
	10	1200	21.5
	8	-	-
7	6	1200	13.0
	4	1200	3.9
	12	1200	40.8
	10	-	-
8	8	-	-
	6	1200	13.0
	4	1200	0.7
	12	1200	45.4
9	10	-	-
	8	-	-
	6	1200	13.0
	4	1200	0.7
10	12	1200	50.0
	10	-	-
	8	-	-
	6	1200	13.0
11	4	1200	7.0
	12	1200	39.4
	10	-	-
	8	-	-
12	6	1200	6.3
	4	-	-
	12	1200	50.0
	10	1200	1.4
13	8	-	-
	6	1200	13.0
	4	1200	7.0
	Total:		

Point #s	Depth (ft)	PSI	Lbs.
9	12	1200	50.0
	10	1200	5.6
	8	-	-
	6	1200	11.6
10	4	-	-
	12	1200	37.0
	10	-	-
	8	-	-
11	6	1200	13.0
	4	1200	7.0
	12	1200	39.4
	10	-	-
12	8	-	-
	6	1200	6.3
	4	-	-
	12	1200	50.0
13	10	1200	1.4
	8	-	-
	6	1200	13.0
	4	1200	7.0
Total:			812.4

Approximate Scale
1" = 20'



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CHEMICAL GROUT PLAN

FIGURE NO.: 3e

FILE NO.: B2020-018

DATE: 04/22/2021

CHECKED BY: JJ