Quality Assurance Inspection Report

Building 5 Foundation Stabilization

5100 Village View Way

Missoula, Montana

Project: 16001

August 10, 2017

Prepared for:

The Village at Elk Hills Home Owners Association

Attn: Cory Gangle Law Firm, PC

P.O. Box 16356

Missoula, MT 59808

Prepared by:

Michael Remboldt, P.E., G.E.

K & A Engineering, Inc.

Coburg, Oregon

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August 10, 2017 **Project: 16001**

The Village at Elk Hills Home Owners Association
Attn: Cory Gangle Law Firm, PC
P.O. Box 16356
Missoula, MT 59808

Subject: Quality Assurance Construction Observation Summary
Foundation Stabilization – Building 5
Village View Way, Missoula, Montana

BACKGROUND

This report summarizes work that was completed to stabilize the foundation and floor slabs-on-grade of the subject building.

Building 5 was the second of four buildings constructed on the north, and final, phase of the Elk Hills development, the west-most building. In the north row of buildings, building 5 is first from the west. Soon after completion of construction (est. between 2006 and 2008), indications of differential foundation settlement were observed.

K & A Engineering, Inc. was retained in 2013 to determine the nature, cause, and extent of the differential settlement and to make recommendations for the estimated cost of repairs as part of a claim for damages by the Home Owners Association ("HOA"). We reported our findings in our Geotechnical Report dated May 8, 2013. In that report, we summarized our findings that the building had been constructed on undocumented fills that had been placed in a gully.

Pursuant to the resolution of their claim for damages, the HOA asked K & A Engineering, Inc. to assist in selecting a foundation stabilization alternative. The HOA selected *compaction grouting* as their preferred repair alternative.

At the HOA's request, K & A Engineering, Inc. completed detailed geotechnical investigation of the site in March 2016 for the purpose of developing a foundation stabilization repair plan utilizing compaction grouting. In this investigation, we found that undocumented fills ranged in depth under building 6 from approximately 7 to 49-feet below the top of the main level floor. The undocumented fill included large zones of coarse woody debris, construction debris, and organic-laden soils.

Subsequently, K & A Engineering, Inc. issued a geotechnical report with a design for compaction grouting of soils supporting Building 5, dated July 1, 2016.

Hayward Baker, Inc. ("HBI"), of Denver, Colorado, was selected to construct the specified compaction grouting system. Construction commenced on or about November 4, 2006 and was completed on or

about December 20, 2016. Due to the fact that the construction involved ground improvement and not construction of structural elements, no building permit was required.

PURPOSE AND SCOPE OF QUALITY ASSURANCE INSPECTIONS

The purpose of our inspections was to ensure that foundation stabilization was made in accordance with recommendations made in our repair plan[1] and to address changed conditions discovered during construction.

The scope of our services for quality assurance included:

- Site Inspections to ensure quality construction as per the 2016 Geotechnical Recommendations and to make sure that the project objectives were met,
- On-site recommendations to address construction issues in a timely manner while keeping our engineering costs to a minimum,
- Recommendations for finish work to be done after foundation stabilization was completed, and
- This written report.

GENERAL COMPACTION GROUTING DESCRIPTION

Ground improvement with compaction grouting was selected as the preferred foundation stabilization method because no structural modifications were required, required disturbance to finishes were minimal. Advantages of compaction grouting include:

- **Ground Improvement:** Grout injection fills voids and densifies the soil by through grout displacement, thus increasing relative soil density, shear strength, and load-bearing capacity.
- **Foundation Underpinning:** Grout columns extending from firm native soils to the bottom of spread footings or slabs-on-grade transfer structural and service loads to competent native soil, eliminating further settlement, and
- **Lifting:** Footings and slabs-on-grade can be lifted to a more level condition during grouting. This improves functionality within the living spaces and improve long-term serviceability to the structure.

Compaction grouting for this project consisted of constructing grout columns that extend from the foundation and slabs-on-grade to several feet into native stiff sandy-clay soils. A low-mobility grout (LMG) mix design was developed by the contractor for this project, which consisted of ¾" – 0 well-graded crushed aggregate, silty-sand, Portland cement, and water.

[1] "Geotechnical Recommendations – Foundation Support and Ground Improvement – Building 5 – Elk Village Home Owners Association, Village View Way, Missoula, Montana," dated July 1, 2016.

Grout columns were formed by injecting the LMG mix, under pressure (approximately 140 to 400-psi) in 1-foot vertical increments, starting at the base of the column (in native soils). The average grout take[2] was approximately 3.4-ft^3/vertical-ft. Grout column spacing averaged approximately 7-feet O.C.

CONSTRUCTION OBSERVATIONS

GROUTING PROCEDURES

General Remarks

The general procedures for installing low-mobility grout (LMG) columns and stabilizing perimeter were conducted in four steps:

1. **Concrete/Pavement Coring:** Holes are cut through existing concrete slabs, asphalt pavement, and concrete footings to provide access to underlying soils;
2. **Driving Casing:** hollow 2-inch I.D. steel casing is driven through access holes through (unsuitable) fill soils and into firm, stable native soils;
3. **Grout Injection:** Low Mobility Grout (LMG) is injected, from the bottom (native soils) upward using a concrete pump to form grout columns (see Grout Injection Procedures), and
4. **Lifting:** Selected areas of foundations and slabs-on-grade are lifted by injecting additional grout (see Lifting Procedures).

Grouting

The injection LMG was done using a *Bottom-Up* procedure in which:

- Grout is pumped into the casing starting at the bottom of the column (in stable native soils) to the desired grout take,
- The casing is pulled upward (advanced) 1-foot, and
- Grouting continues in 1-foot increments upward, terminating at either the existing slab-on-grade or footing.

Grouting pressures were generally limited to 400-psi to achieve the desired grout take, or limited as required to minimize lifting.

Lifting

In areas requiring lifting, LMG column are initially completed from the native soils upward to a depth of approximately 15-feet. The injected grout is given time to set, creating a platform against which additional pressurized grout can lift the foundation. Once the grout has set, casing is installed to near the top of the completed grout column and grout is injected to continue forming the grout column upward. Lift is achieved as the column approaches the foundation.

[2] "Grout take" is the grout injection rate in terms of cubic feet per vertical foot.

CREWS, EQUIPMENT, AND MATERIALS

Crews

During construction, Hayward Baker, Inc. used up to two crews to install LMG columns. Each crew generally consisted of:

- Crew foreman, and
- Four to six laborers.

Additionally, a professional geotechnical engineer (working for the Contractor) was on-site to provide guidance during the initial phases of grouting.

Equipment

Equipment to pneumatically drive casing:

- Water-rotary drill with 4" diameter diamond bit to pre-drill through interior slabs-on-grade,
- Air compressor
- Pneumatic casing advancer
- Casing adapter to support casing advancer on top of casing
- 2-inch casing (3-foot lengths) and sacrificial cone tips

Equipment required to drill casing:

- Water-rotary drill with 4" diameter diamond bit to pre-drill through interior slabs-on-grade,
- Percussive air-rotary TEI Rock Drill (Model WB50) used for drilling through underlying construction debris (in fill soils), asphalt, and perimeter footings (typically at an angle),
- Air compressor
- 2-inch casing (3-foot lengths) and sacrificial bits

Equipment used to inject grout included:

- "Mudder" trucks to supply Portland cement, crushed aggregate, sandy-silt, and water in metered quantities to the concrete mixer/pump,
- Concrete mixer and pump (mounted on a trailer) with remote control,
- Hoses and injection manifolds connected to casing (with pressure gages),
- Hydraulic jacks to lift and remove casing while injecting grout.

Other miscellaneous equipment used in construction were:

- Laser levels to monitor slab and foundation movement, and
- ZipLevel[3] to develop floor elevation surveys.

[3] Technidea Corp. See http://ziplevel.com/

Materials

Low mobility Grout (LMG) consisted of a mixture of Portland cement, crushed aggregate[4], "top soil[5]," and water. The mix design was designed by the Contractor based on past experience with grouting. Design quantities were metered and mixed on site using conveyor/hopper systems on the mudder trucks and concrete mixer.

CONSTRUCTION EXECUTION

General Discussion

120 LMG grout columns (8 holes were removed due to utilities) were completed with a total grout volume of approximately 336-yd^3. Table 1 summarizes some project production statistics, comparing design quantities from the 2016 Geotechnical Recommendation Report and the actual as-built quantities.

See the Appendix A and B for specific grouting details including grout column locations, as-built grout takes and orientation.

In general, our estimates for average column depth and total grout volume was very close (less than 5%) to the actual quantities achieved during construction. Average grout take was greater than anticipated due to unusually large percentage of voids in the undocumented fill in the general location of the center of the building.

Table 1 - LMG Production Summary

Description	Design	As-Built
Total Number of LMG Columns	121	120
Average LMG Column Depth[6]	25.8-ft	24.3-ft (22.4-ft)
Average LMG Grout "Take" per Linear Foot[7]	3.14-ft^3/ft	3.13-ft^3/ft
Average LMG Column Diameter[5]	2.0-ft	2.0-ft
Total Grout Volume	349-yd^3 [8]	336-yd^3
Construction Time	3-weeks	17-days
Average Number LMG Columns/day	No estimate	7.8

[4] ¾" – 0 well-graded crushed aggregate passing the ¾" sieve.
[5] A non-organic silty-sand and sandy-silt from local sources.
[6] On average, steel casing was installed a depth 24.3-feet (2,891-feet of steel casing) below the slab surface. However, on average, only 22.4-feet (2,684-feet) was grouted. Typically, the top 1 to 2-feet were not grouted to limit unnecessary slab movement.
[7] Based on total length of installed casing (2,891-feet).
[8] This is was our original un-factored design estimate.

Overall, the total length of the LMG columns (both interior and exterior) compared well with the lengths predicted in the 2016 Geotechnical Recommendations Report. The small discrepancy between these two values is either due to the fill being slightly deeper than anticipated or the grout casing being installed several feet beneath the native, firm ground.

Our prediction for grout volume and column diameter compared remarkably well, varying less than 5% from measured quantities. In our 2016 report, we recommended total grout volume be estimated with a factor of safety of 2 to account for any issues that could result greater grout take (i.e. factored LMG volume was estimated to be 698-yd^3). This factor of safety, however, substantially overpredicted actual grout quantities.

Lifting

Prior to stabilization, the differential settlement of Building 5 was moderate with elevation difference on the main slab-on-grade floor (in the living area) ranging from 0.6-inches in unit 5-3 to 2.4-inches at the east end of units 5-1 and 5-2. See the attached drawing "2013 Floor Topography – Building 5." The 2013 survey did not include attached garages.

Lifting was attempted at two locations:

- The west perimeter foundation of unit 5-3
- The east ends of units 5-1 and 5-2.

Attempts at lifting the west perimeter foundation of unit 5-3 was not successful. Grouting to lift in this area started the footing and stem wall to rotate (the top of the stem wall moving west), which increased the existing gap between the slab-on-grade and the stem wall. The cause was likely due to the fact that the footing/stem wall was not plumb prior to grouting (due to uneven ground subsidence along the edge of the footing) and adding pressure to the bottom of the footing initiated further sliding and rotation before any lifting occurred. Upon observation of the movement, grout injection take was immediately reduced to avoid further displacement, and the columns under this footing were completed.

Lifting the area of greatest floor slope in the building - at the east end of units 5-1 and 5-2 - was successful, resulting in reduction of floor slope, closing wall cracks, and making doors operable in jambs.

Post-grouting floor topography for building 5 was not measured.

Building Finishes

The pre-stabilization settlement had resulted in damage to interior and exterior finishes such as wall cracking, sticking doors, and a gap between the west edge of the slab-on-grade and perimeter stem wall in unit 5-3. This damage was documented in previous geotechnical reports related to the legal claim for damages.

Long term differential settlement of framed structures usually causes structural creep of in framing members and structural connections. Additionally, it is typical for damage caused by differential settlement, such as drywall cracks or out-of-square door openings, to have been repaired prior to any foundation stabilization.

Grouting in building 5 resulted in some new damage including:

- Increased gap between the slab-on-grade floor and the west perimeter stem wall in unit 5-3.
- Heaving of the slab-on-grade floor in the west bedroom of unit 5-3 – the heaved area was approximately 7-feet x 12-feet in size.
- Interference of the sliding door in the door frame located in the west perimeter wall of unit 5-3,
- Minor diagonal cracking in wall finishes.

After grouting was completed, the Home Owner's Association hired a finish contractor to repair damage to interior finishes. Our scope of work did not include observation of these repairs. We understand that a portion of the slab-on-grade in unit 5-3 was sawcut, removed, and replaced to eliminate the excessive heaving and gap.

Schedule

Hayward Baker began installing casing on November 4, 2016 throughout building 6 in preparation of constructing low-mobility grout (LMG) columns, which began subsequently on November 5. These initial columns were constructed to verify subsurface conditions and grout volumes. Construction on building 5 began after the completion of building 6 on November 29. The coring of concrete slab, driving of casing, and injection of LMG continued concurrently until the completion of the last column on December 20, taking less than 4 weeks to complete. Figure 1 below summarizes the quantity of grout injected by date.

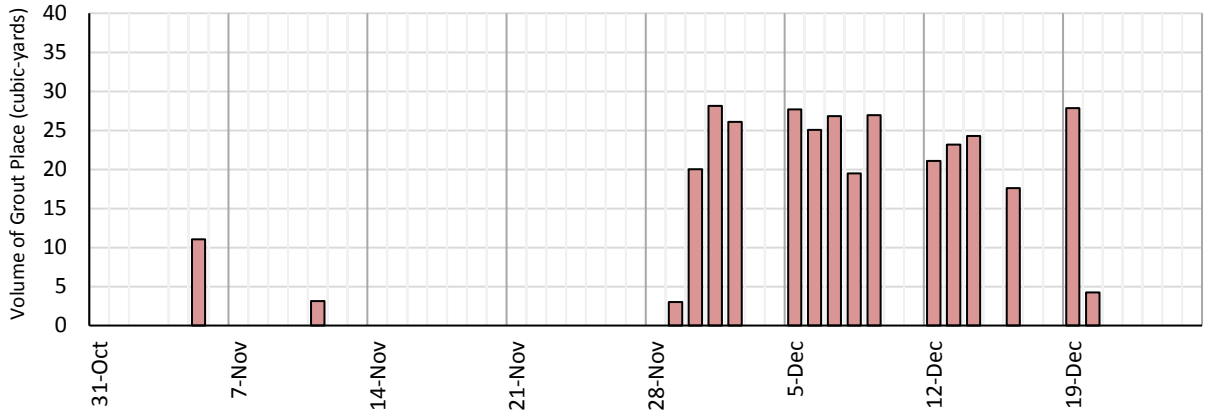

Figure 1 - Summary of LMG Column Production

SUMMARY AND RECOMMENDATIONS

Approximately 336-yd^3 of grout were injected into 120 grout columns to stabilize Building 5. These quantities are very close to those estimated in our repair plan.

In our opinion, the grouting materials and methodology of construction used for this project meets current state-of-the-art standards, based on our review of extensive documentation of the development of compaction grouting in professional journals and conferences.[9]

We recommend that the grouting completed for Building 5 meets the intent of the design recommendations developed by K & A Engineering, Inc. for the project and that the foundation has been adequately stabilized.

Thank you for the opportunity to be of service. Please do not hesitate to call me if you have any questions.
Sincerely,

Michael Remboldt, P.E., G.E.
K & A Engineering, Inc.

[9] James Warner and Michael Byle, "Limited Mobility Grouting – Past, Present, and Future," Proceedings of the 4th International Conference on Grouting and Deep Mixing, Special Publication No. 228, American Society of Civil Engineers Geotechnical Institute. 2012

Appendix A

Initial Floor Topography and

Grout Column Location Drawings

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Missoula, Montana

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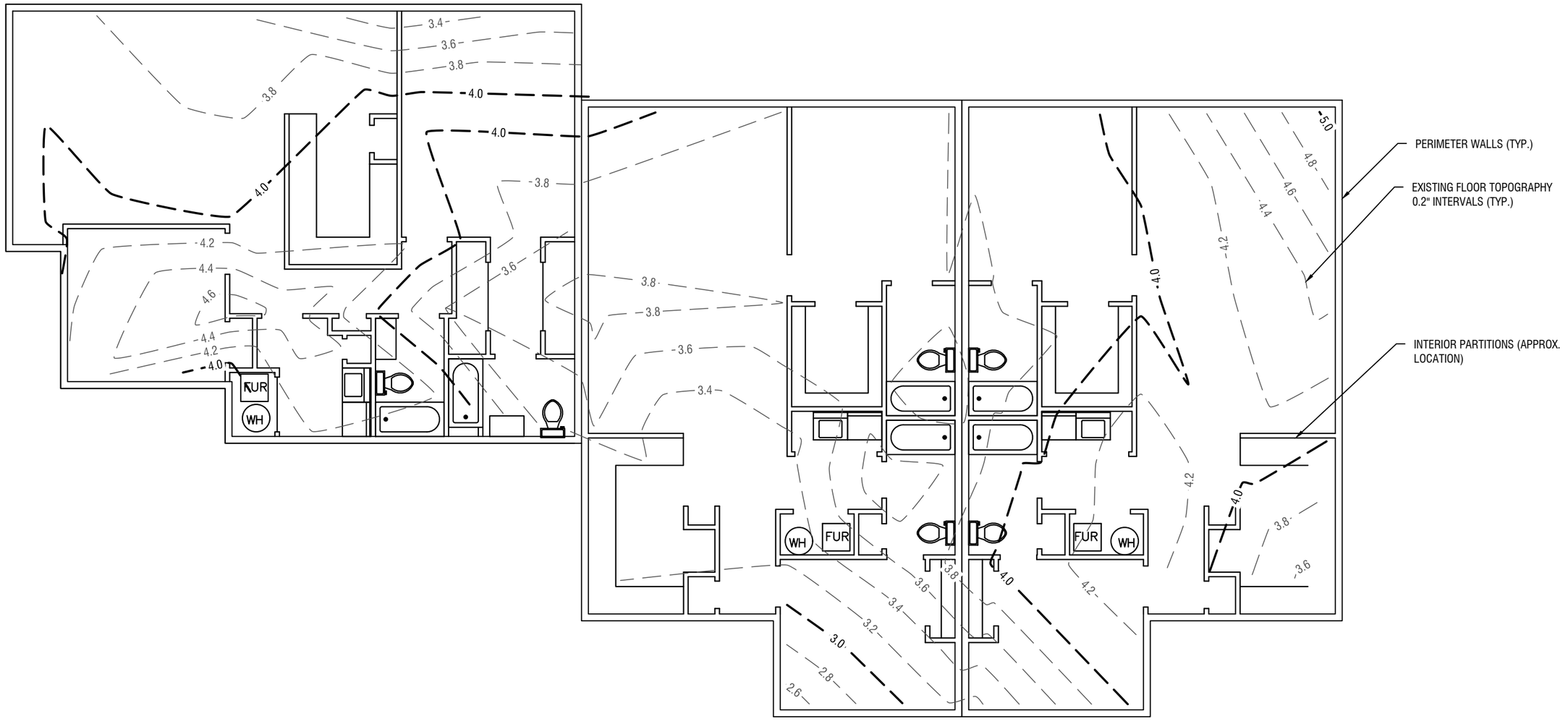
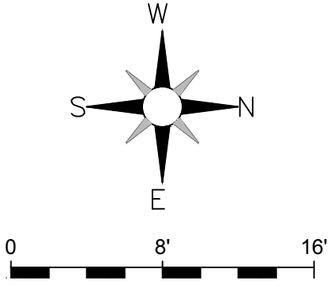


1/2 **INITIAL FLOOR TOPOGRAPHY - BUILDING 5**

1/8" = 1'-0"



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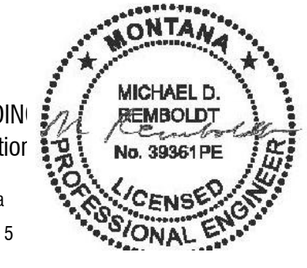
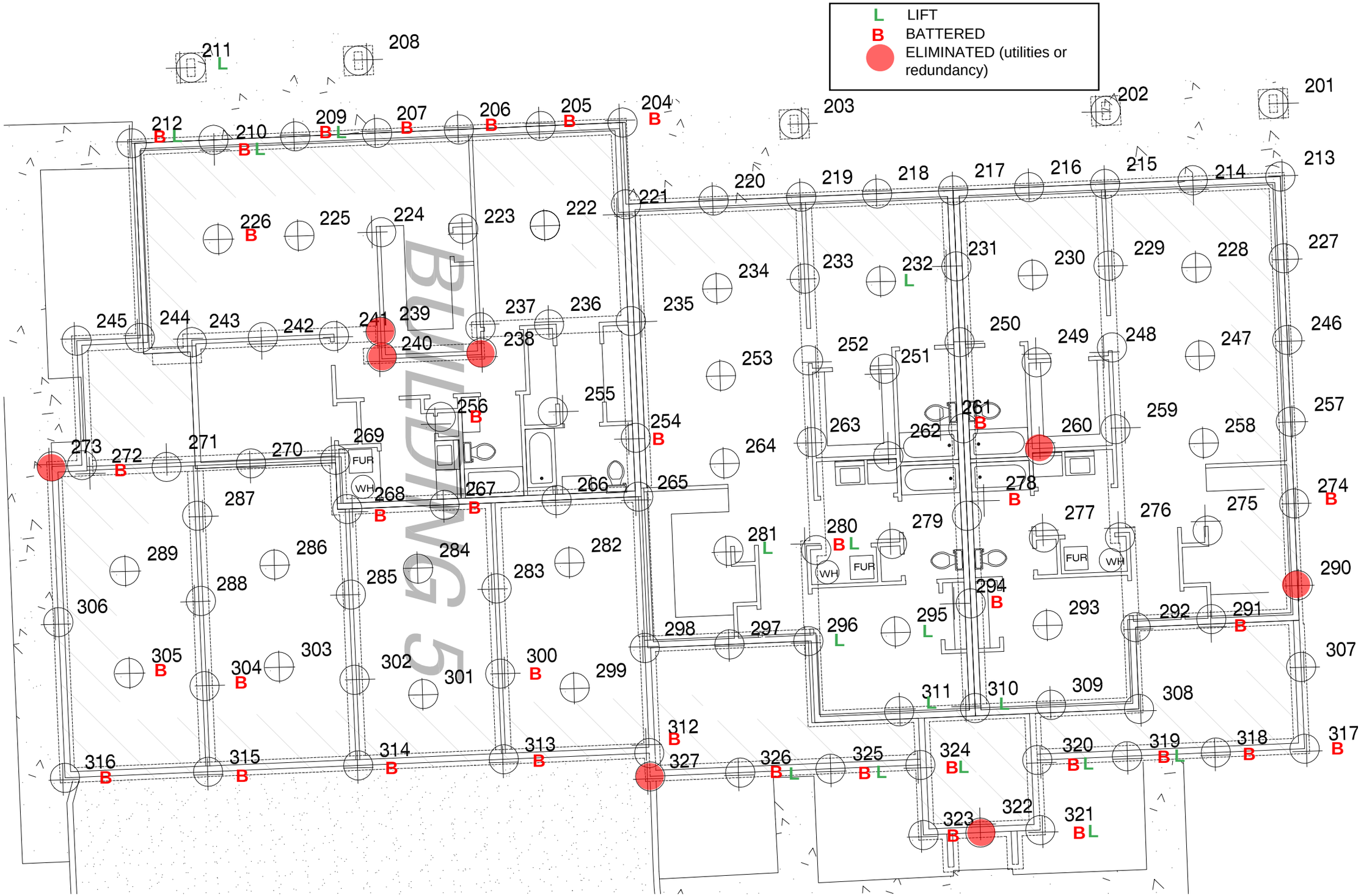
k·a engineering

2013 FLOOR TOPOGRAPHY - BUILDIN(
Geotechnical Foundation Investigatior
Village at Elk Hills Homeowner's Assoc.
5100 Village View Way, Missoula, Montana
05 02 13 Project: 13009 Drawing 2 / 5




L LIFT
B BATTERED
ELIMINATED (utilities or redundancy)
BUILDING 5
FUR
WH

Appendix B

Master Grouting Log

Quality Assurance Inspection Report

Building 5 Foundation Stabilization

5100 Village View Way

Missoula, Montana

Project: 16001

August 4, 2017

Prepared for:

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Building 5 Master Grouting Log

Hole ID	Installation Date	Casing Batter Angle	Casing Batter Azimuth	Install Depth (ft)	Length Pumped (ft)	No. of Strokes	Total Grout Take (ft^3)	Lifting Required (?)	Pumping Stage	Comments
200	12/11/2016	0	0	33	32	340	85.00	No	Bottom-Up	
201	12/13/2016	0	12	12	11	160	40.00	No	Bottom-Up	
202	12/14/2016	0	0	21	20	312	78.00	No	Bottom-Up	
203	12/19/2016	0	0	16	13	160	40.00	No	Bottom-Up	
204	12/19/2016	15	50	18	17	210	52.50	No	Bottom-Up	
205	12/19/2016	13	50	25	23	346	86.50	No	Bottom-Up	
206	12/16/2016	14	135	23	21	250	62.50	No	Bottom-Up	
207	12/16/2016	15	135	23	21	278	69.50	No	Bottom-Up	
208	12/19/2016	15	170	26	24	370	92.50	No	Bottom-Up	
209	12/14/2016	13	250	28	27	443	110.75	No	Bottom-Up	Some lifting observed
210	12/14/2016	11	250	24	22	334	83.50	No	Bottom-Up	Some lifting observed
211	12/16/2016	15	0	23	20	168	42.00	No	Bottom-Up	Some lifting observed
212	12/19/2016	14	45	20	18	238	59.50	No	Bottom-Up	Some lifting observed
213	12/13/2016	0	62	15	14	188	47.00	No	Bottom-Up	
214	12/7/2016	0	12	21	20	232	58.00	No	Bottom-Up	
215	12/14/2016	0	12	27	26	280	70.00	No	Bottom-Up	
216	12/14/2016	0	210	24	23	242	60.50	No	Bottom-Up	
217	12/14/2016	0	210	16	15	154	38.50	No	Bottom-Up	
218	12/14/2016	0	0	18	17	232	58.00	No	Bottom-Up	
219	12/14/2016	0	200	18	17	224	56.00	No	Bottom-Up	
220	12/6/2016	0	112	42	41	690	172.50	No	Bottom-Up	
221	12/6/2016	0	0	32	30	406	101.50	No	Bottom-Up	
222	12/6/2016	0	0	18	17	232	58.00	No	Bottom-Up	
223	12/5/2016	0	0	31	29	418	104.50	No	Bottom-Up	
224	12/5/2016	0	0	25	23	356	89.00	No	Bottom-Up	
225	12/5/2016	0	0	27	24	290	72.50	No	Bottom-Up	
226	11/5/2016	2	120	21	19	236	59.00	No	Bottom-Up	Low take at bottom of hole
227	12/13/2016	0	0	10	8	132	33.00	No	Bottom-Up	
228	12/8/2016	0	111	34	33	395	98.75	No	Bottom-Up	
229	12/7/2016	0	0	34	33	412	103.00	No	Bottom-Up	
230	12/8/2016	0	0	21	20	236	59.00	No	Bottom-Up	
231	12/5/2016	0	57	24	23	324	81.00	No	Bottom-Up	
232	12/2/2016	0	196	36	21	490	122.50	Yes	Bottom-Up	
233	12/5/2016	0	220	27	25	242	60.50	No	Bottom-Up	
234	12/2/2016	0	220	29	28	390	97.50	No	Bottom-Up	
235	12/1/2016	0	220	39	38	670	167.50	No	Bottom-Up	High grout take, very soft
236	12/7/2016	0	0	32	30	454	113.50	No	Bottom-Up	
237	12/7/2016	0	0	30	28	344	86.00	No	Bottom-Up	
238										Removed due to utilities
239										Removed due to utilities
240										Removed due to utilities
241	12/6/2016	0	0	21	19	260	65.00	No	Bottom-Up	
242	12/6/2016	0	0	22	20	198	49.50	No	Bottom-Up	
243	12/6/2016	0	0	19	17	145	36.25	No	Bottom-Up	
244	12/14/2016	0	0	12	10	96	24.00	No	Bottom-Up	
245	12/14/2016	0	0	12	10	92	23.00	No	Bottom-Up	
246	12/13/2016	0	16	15	7	140	35.00	No	Bottom-Up	Pulled hole at 8 feet due to sewer line
247	12/7/2016	0	0	21	20	312	78.00	No	Bottom-Up	

Building 5 Master Grouting Log

Hole ID	Installation Date	Casing Batter Angle	Casing Batter Azimuth	Install Depth (ft)	Length Pumped (ft)	No. of Strokes	Total Grout Take (ft^3)	Lifting Required (?)	Pumping Stage	Comments
248	12/9/2016	0	220	18	16	176	44.00	No	Bottom-Up	
249	12/9/2016	0	2	24	23	196	49.00	No	Bottom-Up	
250	12/9/2016	0	121	18	17	144	36.00	No	Bottom-Up	Next to sewer, pulled when observed movement
251	12/6/2016	0	210	27	26	328	82.00	No	Bottom-Up	Bottom up hole
252	11/30/2016	0	0	42	39	772	193.00	No	Bottom-Up	
253	12/5/2016	0	212	15	14	144	36.00	No	Bottom-Up	
254	12/7/2016	15	45	15	13	154	38.50	No	Bottom-Up	
255	12/7/2016	0	0	15	13	146	36.50	No	Bottom-Up	
256	12/16/2016	10	327	26	23	340	85.00	No	Bottom-Up	
257	12/13/2016	0	12	12	11	136	34.00	No	Bottom-Up	
258	12/8/2016	0	12	21	20	280	70.00	No	Bottom-Up	
259	12/7/2016	0	14	12	11	88	22.00	No	Bottom-Up	
260										Removed due to utilities
261	12/9/2016	35	116	25	18	324	81.00	No	Bottom-Up	
262	12/6/2016	0	0	33	32	446	111.50	No	Bottom-Up	
263	12/5/2016	0	112	42	41	716	179.00	No	Bottom-Up	
264	11/5/2016	0	0	33	32	443	110.75	No	Bottom-Up	
265	12/2/2016	5	325	36	34	582	145.50	No	Bottom-Up	
266	12/1/2016	0	0	26	24	368	92.00	No	Bottom-Up	
267	12/1/2016	5	160	27	25	412	103.00	No	Bottom-Up	
268	12/1/2016	10	5	21	19	226	56.50	No	Bottom-Up	
269	12/14/2016	0	0	15	13	148	37.00	No	Bottom-Up	
270	11/30/2016	0	0	19	17	122	30.50	No	Bottom-Up	
271	11/29/2016	0	0	16	14	116	29.00	No	Bottom-Up	
272	12/14/2016	14	52	12	10	64	16.00	No	Bottom-Up	
273										Removed due to utilities
274	12/16/2016	5	150	9	8	100	25.00	No	Bottom-Up	
275	12/7/2016	0	200	18	17	232	58.00	No	Bottom-Up	
276	12/8/2016	0	0	21	19	316	79.00	No	Bottom-Up	
277	12/19/2016	0	12	16	15	212	53.00	No	Bottom-Up	
278	12/8/2016	30	175	30	23	352	88.00	No	Bottom-Up	
279	12/13/2016	0	0	36	34	490	122.50	No	Bottom-Up	
280	11/30/2016	9	79	42	18	486	121.50	Yes	Bottom-Up	Will restart for lifting
281	12/1/2016	0	120	42	41	574	143.50	Yes	Bottom-Up	Will restart for lifting
282	12/2/2016	0	0	30	27	472	118.00	No	Bottom-Up	
283	12/1/2016	0	0	24	23	278	69.50	No	Bottom-Up	
284	12/1/2016	0	0	27	26	312	78.00	No	Bottom-Up	
285	11/30/2016	0	0	26	24	162	40.50	No	Bottom-Up	
286	11/30/2016	0	0	21	19	72	18.00	No	Bottom-Up	
287	11/30/2016	0	0	18	17	70	17.50	No	Bottom-Up	
288	11/29/2016	0	0	18	16	118	29.50	No	Bottom-Up	
289	11/29/2016	0	0	18	16	90	22.50	No	Bottom-Up	
290										Removed due to utilities
291	12/9/2016	7	267	12	10	112	28.00	No	Bottom-Up	
292	12/9/2016	0	0	15	14	182	45.50	No	Bottom-Up	
293	11/5/2016	0	0	24	23	392	98.00	No	Bottom-Up	
294	12/20/2016	18	148	28	27	155	38.75	No	Bottom-Up	Some lifting observed
295	12/9/2016	0	0	36	24	520	130.00	Yes	Bottom-Up	Will restart for lifting

Building 5 Master Grouting Log

Hole ID	Installation Date	Casing Batter Angle	Casing Batter Azimuth	Install Depth (ft)	Length Pumped (ft)	No. of Strokes	Total Grout Take (ft^3)	Lifting Required (?)	Pumping Stage	Comments
296	12/8/2016	0	0	44	29	524	131.00	Yes	Bottom-Up	Will restart for lifting
297	12/19/2016	0	0	33	32	326	81.50	No	Bottom-Up	
298	12/2/2016	0	0	37	35	508	130.00	No	Bottom-Up	
299	12/5/2016	0	0	33	31	500	125.00	No	Bottom-Up	
300	12/2/2016	10	10	25	23	362	90.50	No	Bottom-Up	
301	11/30/2016	0	0	24	22	144	36.00	No	Bottom-Up	
302	12/1/2016	0	0	24	22	200	50.00	No	Bottom-Up	
303	11/30/2016	0	0	22	20	102	25.50	No	Bottom-Up	
304	11/30/2016	10	92	18	16	101	25.25	No	Bottom-Up	
305	11/5/2016	2	201	14	13	120	30.00	No	Bottom-Up	Quickly observed movement in first garage
306	11/30/2016	0	0	18	16	132	33.00	No	Bottom-Up	
307	12/19/2016	0	0	15	14	168	42.00	No	Bottom-Up	
308	12/12/2016	0	0	21	20	308	77.00	No	Bottom-Up	
309	12/9/2016	0	0	25	24	358	89.50	No	Bottom-Up	
310	12/20/2016	0	0	21	20	218	54.50	No	Bottom-Up	Some lifting observed
311	12/9/2016	0	0	42	27	580	145.00	Yes	Bottom-Up	Will restart for lifting
312	12/7/2016	15	310	38	26	524	131.00	Yes	Bottom-Up	Will restart for lifting
313	12/13/2016	10	10	30	28	404	101.00	No	Bottom-Up	
314	12/13/2016	10	286	18	16	252	63.00	No	Bottom-Up	
315	12/13/2016	16	10	16	14	188	47.00	No	Bottom-Up	
316	12/13/2016	14	290	14	12	130	32.50	No	Bottom-Up	
317	12/13/2016	12	220	9	8	112	28.00	No	Bottom-Up	
318	12/13/2016	12	270	15	14	172	43.00	No	Bottom-Up	
319	12/12/2016	16	220	19	8	160	40.00	Yes	Bottom-Up	Will restart for lifting
320	12/12/2016	16	210	27	12	240	60.00	Yes	Bottom-Up	Will restart for lifting
321	12/12/2016	16	256	25	10	200	50.00	Yes	Bottom-Up	Will restart for lifting
322										Removed due to utilities
323	12/12/2016	10	287	31	18	348	87.00	Yes	Bottom-Up	Will restart for lifting
324	12/9/2016	10	225	31	15	320	80.00	Yes	Bottom-Up	Will restart for lifting
325	12/12/2016	10	265	36	22	440	110.00	Yes	Bottom-Up	Will restart for lifting
326	12/12/2016	10	280	40	27	580	145.00	Yes	Bottom-Up	Will restart for lifting
327										Removed due to utilities
232 R1	12/16/2016	16	240	15	14	65	16.25		Lifting	Lifting and completion of BU column
280 R1	12/19/2016	9	79	24	23	384	96.00		Lifting	Lifting and completion of BU column
281 R1	12/19/2016	0	0	12	11	115	28.75		Lifting	Lifting and completion of BU column
295 R1	12/19/2016	0	0	15	14	188	47.00		Lifting	Lifting and completion of BU column
296 R1	12/19/2016	0	0	15	14	148	37.00		Lifting	Lifting and completion of BU column
311 R1	12/19/2016	0	0	15	14	142	35.50		Lifting	Lifting and completion of BU column
319 R1	12/16/2016	16	240	15	13	128	32.00		Lifting	Lifting and completion of BU column
320 R1	12/16/2016	16	220	15	14	203	50.75		Lifting	Lifting and completion of BU column
321 R1	12/16/2016	16	240	15	14	53	13.25		Lifting	Lifting and completion of BU column
324 R1	12/16/2016	11	235	16	14	93	23.25		Lifting	Lifting and completion of BU column
325 R1	12/16/2016	9	250	15	14	225	56.25		Lifting	Lifting and completion of BU column
326 R1	12/20/2016	10	280	13	11	76	21.00		Lifting	Lifting and completion of BU column