CBC goes DEEP for new Courtyard by Marriott at The University of Dayton

More Than Geotechnical Engineering

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CBC Engineers & Associates, Ltd. was involved in a major expansion of facilities at The University of Dayton in the mid 2000's. This expansion included a new baseball field, softball field and football practice field. It also included a Residence Hall, a Courtyard by Marriott and the expansion of The UD Arena where basketball is played. This case study will focus on the the Geotechnical Engineering provided by CBC to Concord Hospitality Enterprises Company who oversaw the building of the Courtyard by Marriott. Messer Construction was hired to build the facility. Deep Dynamic Compaction was the solution to improve the foundation for the new Hotel.

CBC Engineers and Associates, Ltd first did a Geotechnical Engineering Investigation (GEI) of the underlying soils at the proposed site in late 2003. It was known that the entire area being developed had once been a barrow pit for the construction of I-75 and then a construction debris land fill during the 1950's and 1960's so settlement and poor bearing was expended to be found. The fill material found in the borings was primarily "hard fill" comprised of primarily concrete, asphalt and brick, however some organics were found as well. The fill under the building footprint showed depths of fill of 6 feet to 32 feet. This type of fill was not conducive to support a spread footing foundation and slab construction to support the new Hotel. CBC recommended that in order to get a spread footing foundation to work that ten (10) feet of the construction debris material would have to be uncut and replaced with suitable material compacted to 95% Modified Proctor.

CBC went further to recommend that in lieu of a the massive undercut the foundation and slab could by supported by Driven H-Piles. The design called for 53 ton capacity HP14 x 73 lb. piles driven to 20 foot in depth. This deep foundation method would be difficult because of the all the large construction debris that lye below. CBC suggested that each pile would need to be drilled first in order to drive the piles to the 20 foot depth. This drove the cost up dramatically to perform this operation in addition to the driven piles.

Client Ready for a New Idea

Reaching DEEP into our bag of solutions, CBC thought that Deep Dynamic Compaction might be a feasible way to consolidate the underlying soils enough to allow a spread footing and slab to work properly. The name describes the act used to compact the underlying soil. From the surface the underlying soil must be made to compact well down form the surface using some "Dynamic" force.

Dynamic compaction is process whereby a heavy weight is repeatedly raised and dropped from a specific height to impact the ground surface, thereby transmitting high compaction energy into the soil mass. The depth of the compaction depends on the tonnage of the weight and the height of the fall. The degree of improvement of the soil to carry load depends on the amount of energy applied per unit area.

It was recommended by CBC that the Dynamic compaction be performed using a tamper with a minimum weight of 30,000 lbs. and a contact area of about 28 square feet (a little over 5 feet square). This weight was to be dropped from a crane capable of raising the weight at least 75 feet in the air. The area to be compacted was determined by adding 20 feet to the perimeter of the building and then laying it out in a 12 foot grid. So the weight will fall 12 feet center to center to each other creating a crater field. Each grid point was dropped seven (7) times on the first pass and then the weight was changed to 20,000 lbs and having a contact area of 100 square feet (10 feet square). This second pass with a lighter weight and larger contact area is called the "Ironing Pass".

The Ironing Pass also dropped the weight from a height of 20 feet. The drops did over lap by 2 feet at each grid point and only 2 drops were required during this final pass. This process was intended to improve the underlying material up to the depth of 40 feet. To complete the site improvement the site was proof rolled with a loaded tandem dump ruck to see if there was soft areas remaining. Should any had been found the Crane and the original tamper weight set up would have been required to improve those areas. This mine field on compaction holes was graded down and compacted using standard methods.

Deep Dynamic Compaction Results

The compaction process took from October 5th, 2005 until October 11th, 2005. On the 11th the compaction was completed and resulted in individual craters from 5 to 7 feet deep where the individual weights were dropped. The overall area subjected to the Dynamic compaction settled approximately two (2) whole feet during this process. CBC recommended that this took enough of the settlement out of the construction debris pile to build the new Hotel as planned on spread footing foundations and slab with some small rick of settlement still remaining. Once the Dynamic compaction was completed, CBC was able to give the foundation designers a bearing capacity of 4000 psf.

The final result was that the University of Dayton was able to take a difficult site and develop it for some much needed on Campus hotel space next to the UD Arena and new proposed Time Warner Baseball Field. Deep dynamic Compaction is not always the solution as the weight dropping does cause a lot a surrounding ground vibrations. But because we were far enough away from other buildings and structures this was accomplished saving Concord Hospitality Enterprises Company a lot of money on deep and difficult to construct foundations.

Should you have any questions about this project please contact our ***Director of Marketing*** - **Joe Dennis** @ 937-428-6150.