Machines & Micropiles

TEI Manufacturing

Machining Centers

Todays Manufacturing is surrounded by a quick pace of production and precision machining that can take as little interruption as possible. Having to stop production of an entire facility to install the foundation of one machining center is huge financial “HIT” for any manufacturer and leaves production at a stand still.

The larger machining centers can weigh over 20 tons or more and require an independent foundation from the rest of the factory. In the past this was accomplished by cutting out the factory floor, digging down to set compacted gravel for a base of the new foundation, let this settle for ??? Weeks then set forms just to poor the concrete for a independent foundation. This is a very lengthy process that takes precious time away from production.

This is one of the great advantages of MICROPILES! where you have minimal impact on your production but also create a lasting, competent foundation for your machinery.

Four Different Scenarios

- MA-500H Horizontal Machining Center
  23,000kg setting on three points

- Multus B400 Multi spindle 5 axis Machining Center
  23,000kg setting on ten points

- MillAC-761VII Vertical Machining Center
  20,500kg sets on six points

- Hexagon Global CMM Computerized Measuring Machine
  3000kg sets on five points, needs complete isolation from the vibrations of all other equipment.

Horizontal Mill

This Okuma Machining center was to be placed on three micropiles with the design working capacity of 100 kips each.

Using the hollow bar system (IBO) we had 40/16 bar and a 100mm bit. This being our first large horizontal machining center we were looking to accomplish some certain parameters.

- Building the piles with smaller equipment to work inside the factory
- Installing the piles during manufacturing operations.
- Creating a foundation independent of the existing slab floor.

Horizontal Mill

The soil was mostly a gravel fill from the initial construction of the building, this went for 2m, then we had the expanding adobe clays common to our region to 12-13m. The finish length was drilled through competent shale.

The micropiles were drilled using a 100mm bit, all three piles reached a depth of 15m. Below we can see some of the finish grout being contained with silica sand.

Horizontal Mill

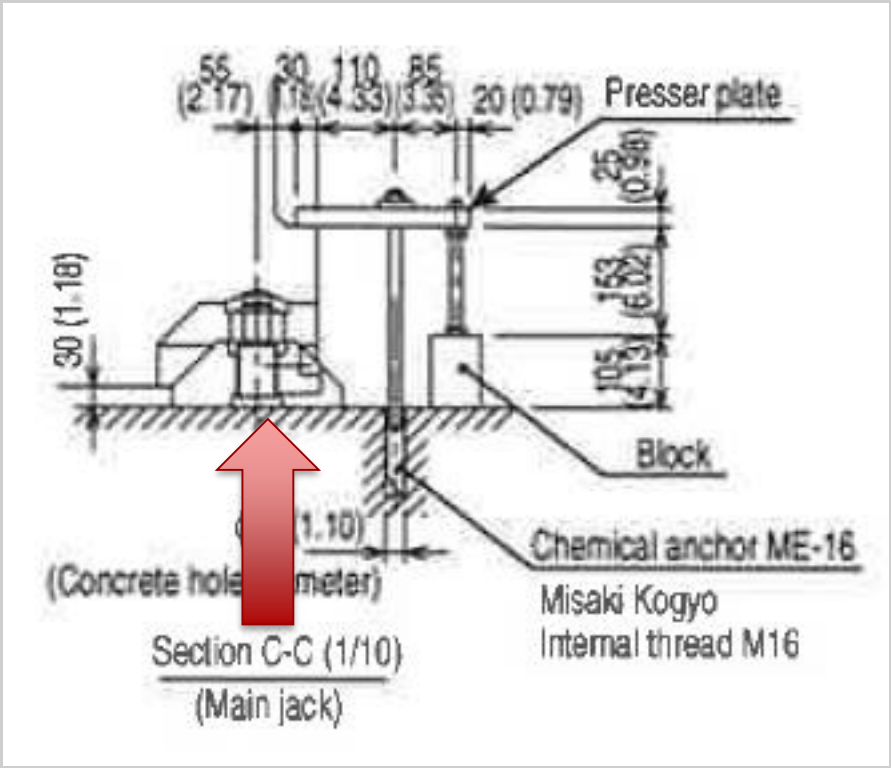
With the micropiles installed the clean up was easy with the grout plant located away from the work area and the finish grout contained for each pile.

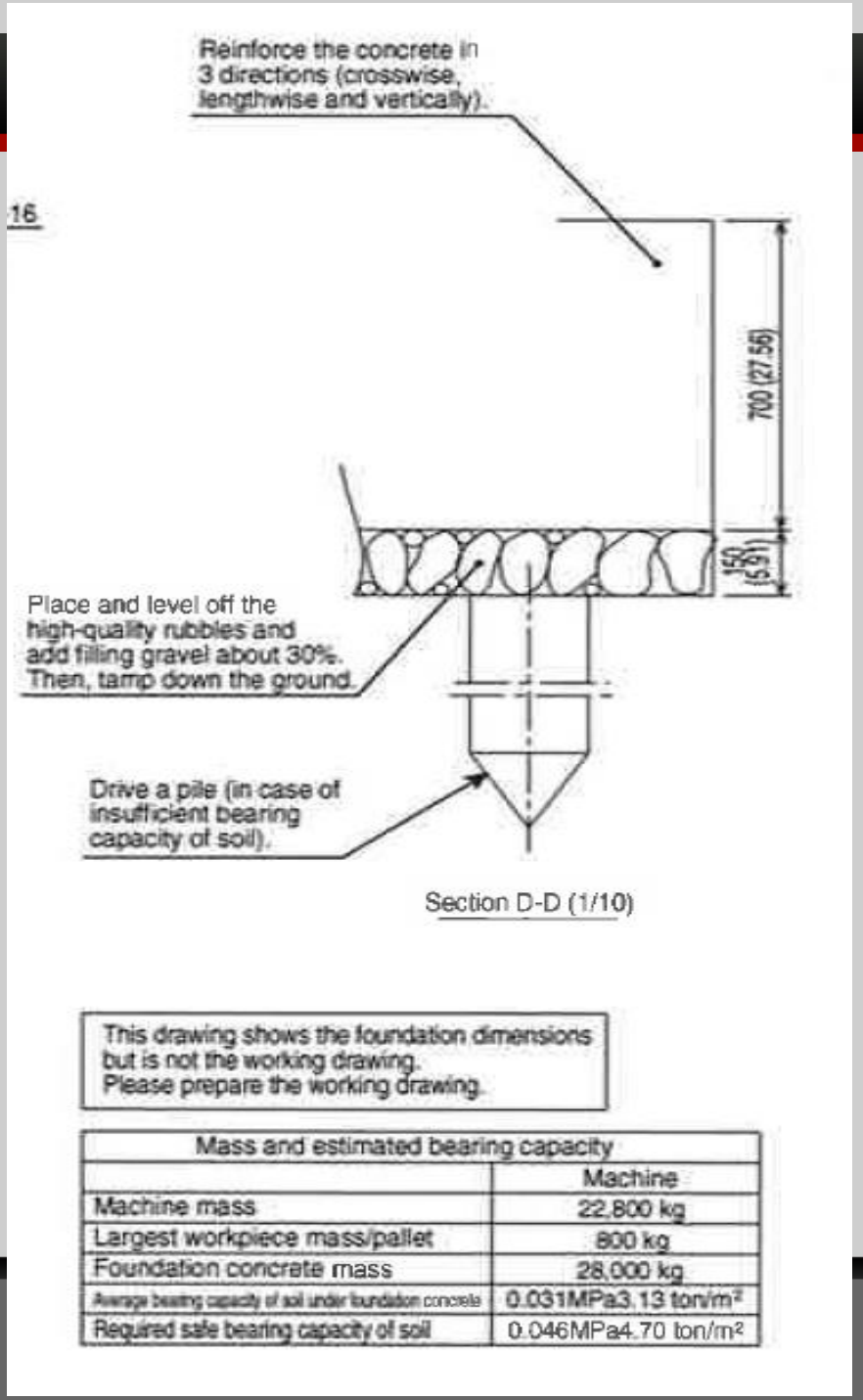
Horizontal Mill

A plate design was used, set at floor level to carry the machine footing on the micropile itself. This separated any load from the existing concrete foundation that was inconsistent in thickness.

Horizontal Mill

Some of the foundation requirements that are overcome with the use of micropiles. Our piles were installed in one working day, are isolated from the existing concrete pad and have a capacity of 100 kips in 48 hours.





Mass and estimated bearing capacity	
	Machine
Machine mass	22,800 kg
Largest workpiece mass/pallet	800 kg
Foundation concrete mass	28,000 kg
Average bearing capacity of soil under foundation concrete	0.031MPa3.13 ton/m²
Required safe bearing capacity of soil	0.046MPa4.70 ton/m²

Horizontal Mill

The delivery of the MA-500H machining center taking a full semi truck with a shipping weight of more than 30 tons was placed carefully in pieces with manufacturing still in operation.

Horizontal Mill

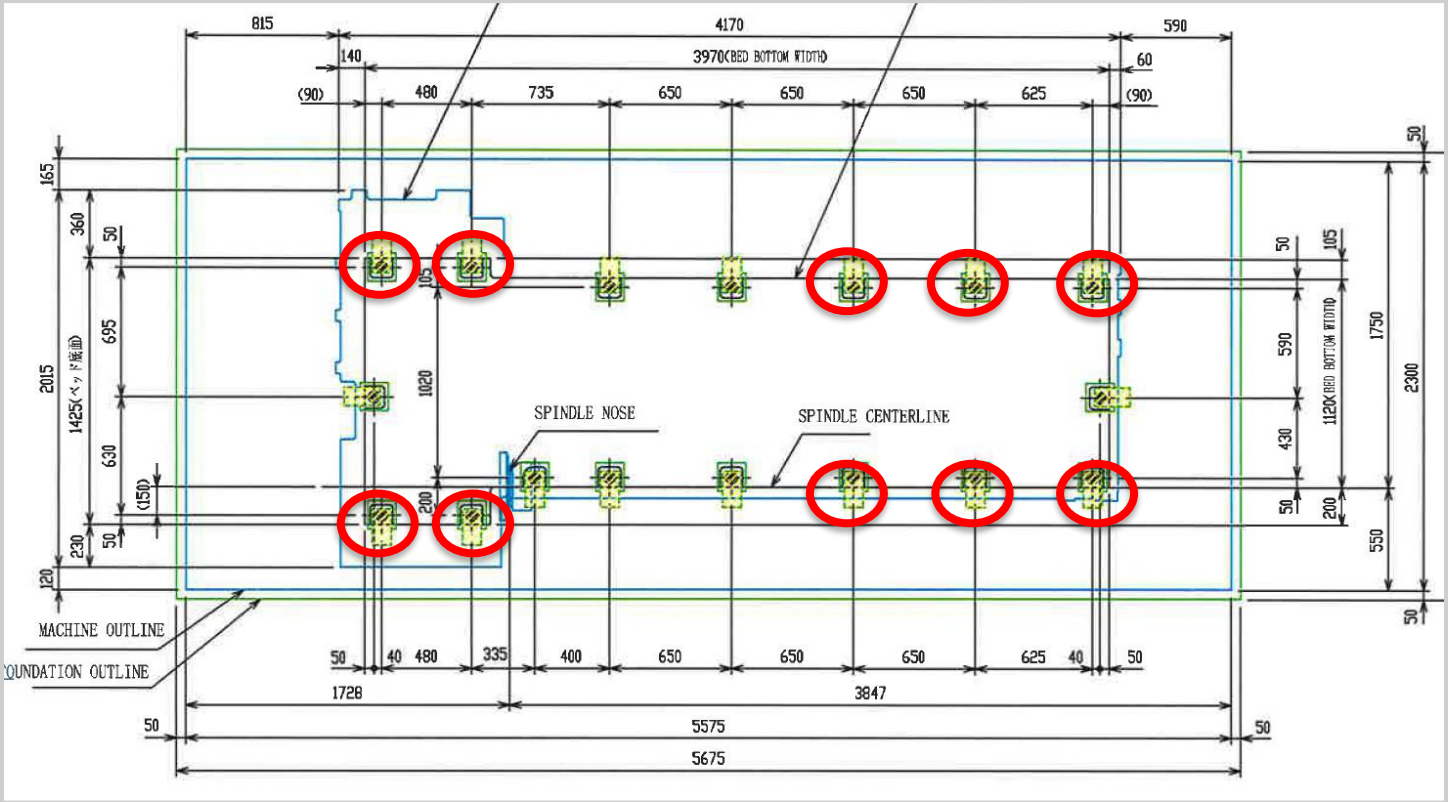
The machining was installed in 2009 and after 10 years of continual use has not needed any adjustment with the machine level. It is a very good testament to the quality of a micropile foundation, installed correctly and designed to the correct specifications.

Multus B400 multi axis machining center

The B400 is a multi axis machine that preforms both turning and milling functions. This machine is more than 25 tons with the added tooling center and has a shifting weight of the spindle of 2.5 tons. (depending on the tool used)

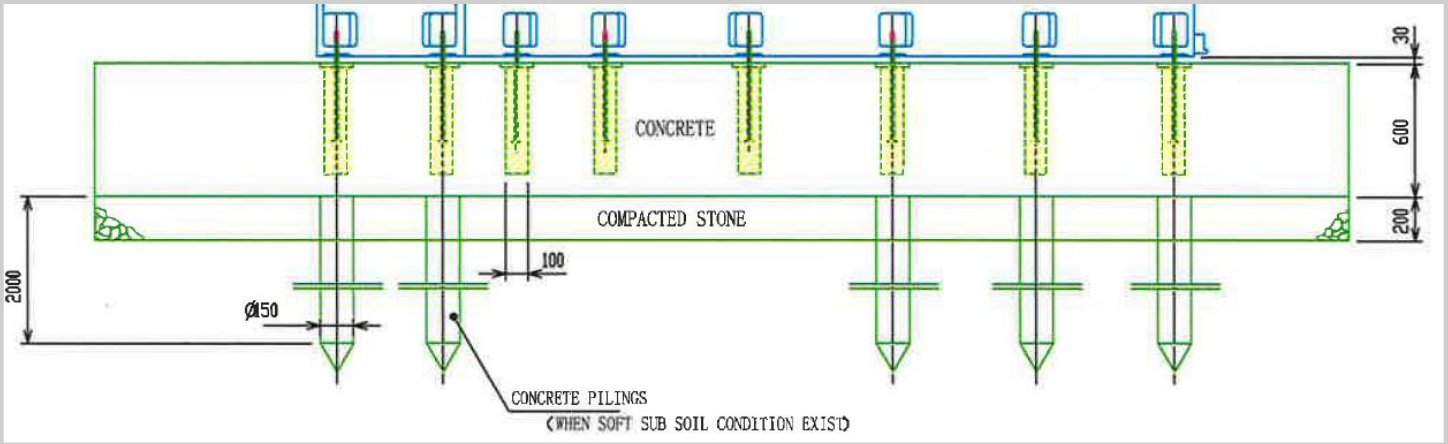
Multus B400 multi axis machining center

The foundation required 10 micropiles laid out over a 4m X 1.2m span, there are 17 mounting pads for this machine but in working with the machine manufacturers engineering we were able to carry the 50 kip loads for each micropile over 10 points. The challenge was to create a stable base so that the shifting weight and torque would not twist the machine.



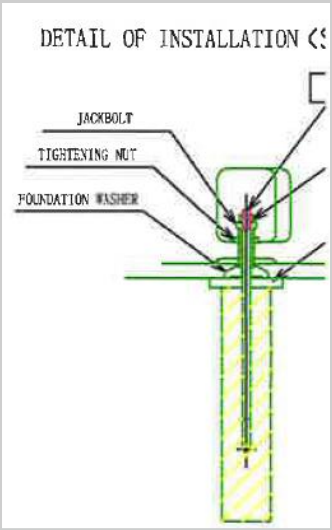
Multus B400 multi axis machining center

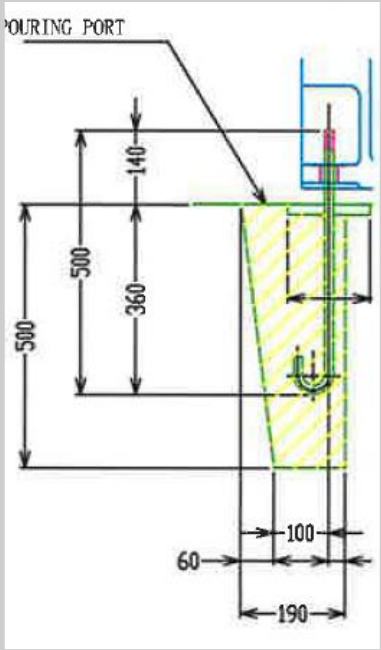
Here is a picture of the standard foundation base from the manufacturer before the micropile design.



Materials used for Micropiles;

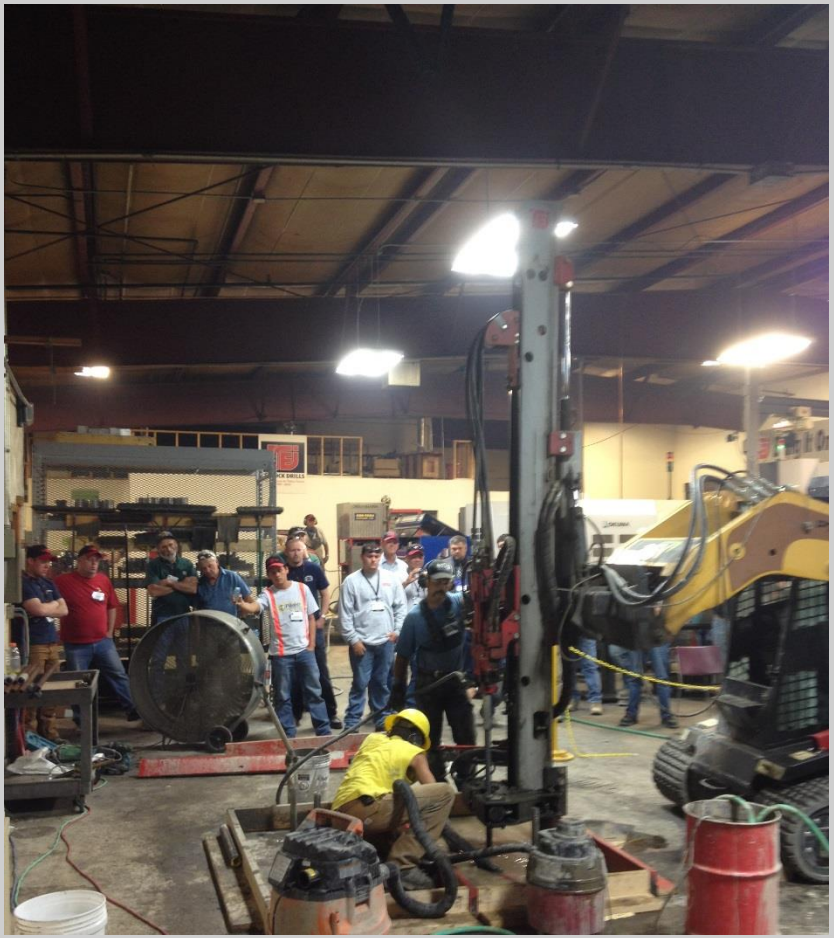
- Geo-drill injection anchor 38mm X 21mm, with a maximum ultimate strength 112 kips.
- 100mm carbide hex bit.
- 90mm pile cap design with the manufacturers coupler.





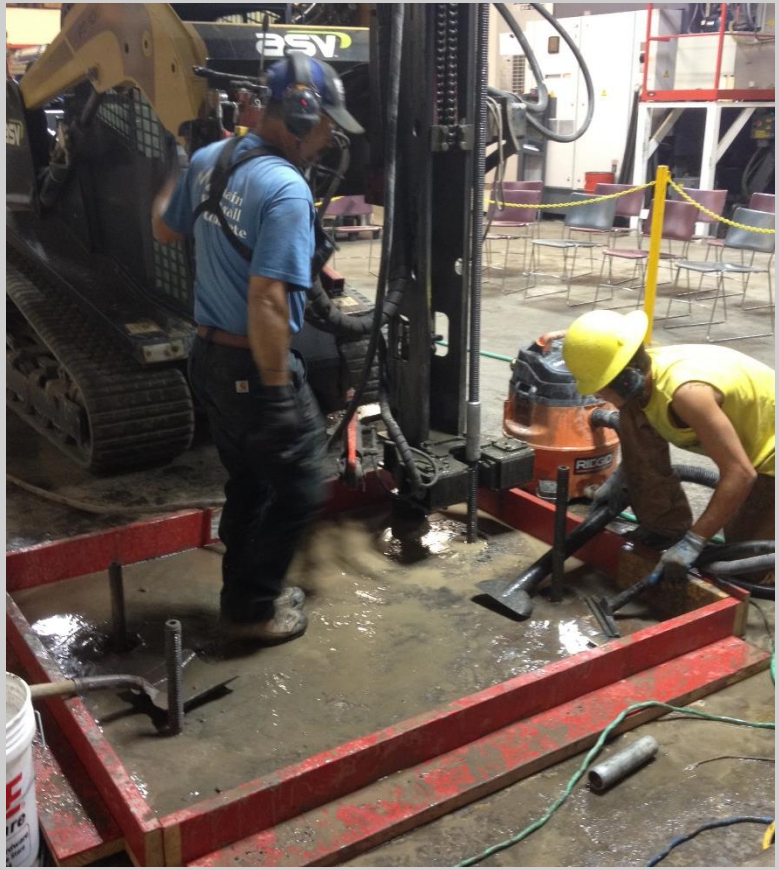
Multus B400 multi axis machining center

Once again the micropile installation process was done without interruption of the manufacturing, this installation was used as a class during our annual Drill School.



Multus B400 multi axis machining center

Using simple 1.2m X 2.2m wooden cribbing makeing it easy to contain the drill cuttings and grout.



Multus B400 multi axis machining center

Even with the large amount of shifting weight the hollow bar micropiles held the B400 in perfect alignment.

MillAC 761V II

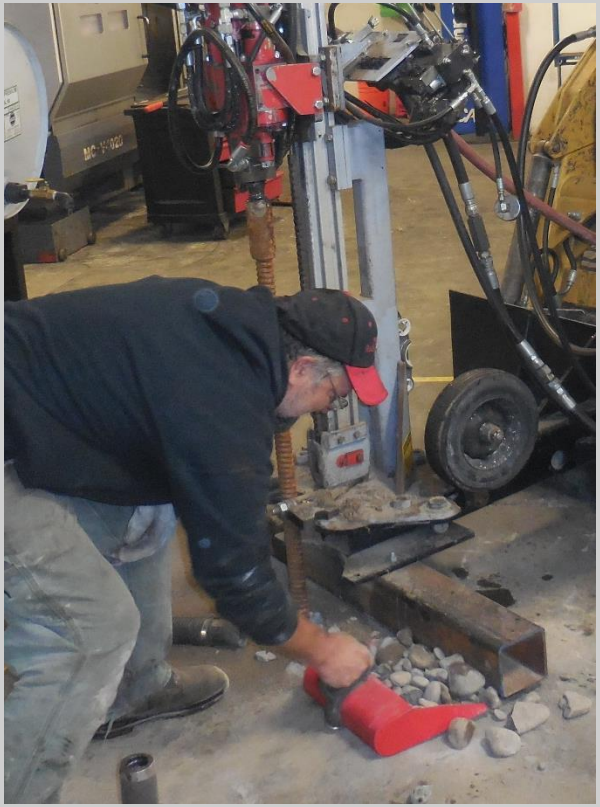
The MillAC is a large vertical machining center that also has rapid positioning of a heavy worktable. Without the proper foundation the machine can vibrate and move effecting the accuracy of your manufacturing.

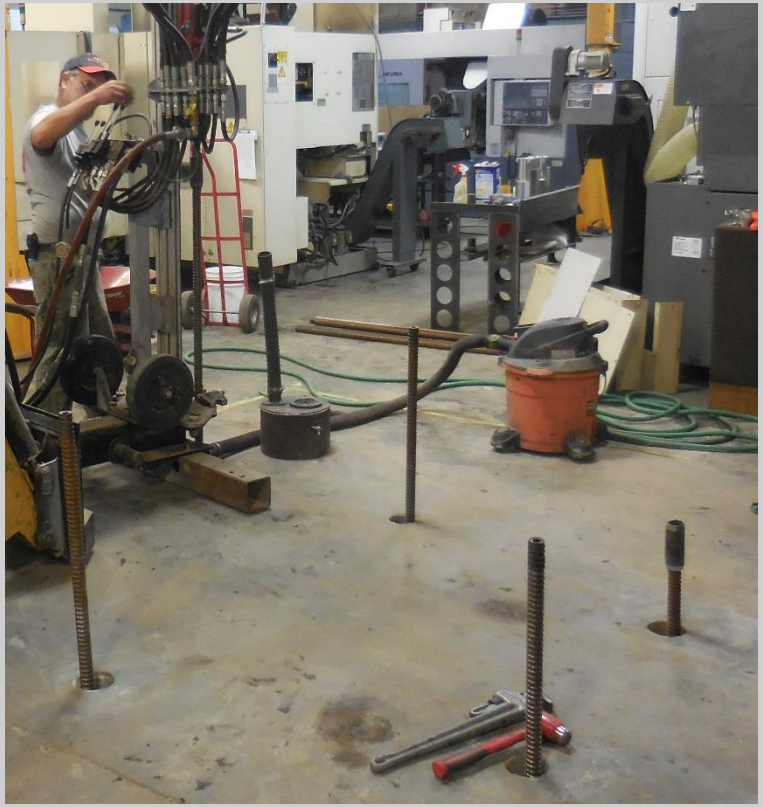
The foundation is designed for 6 piles to handle the 20 tons of machine and the moment of the moving table and parts.

A Picture showing the coring process of the concrete. 100mm holes were cored through the existing foundation to accommodate the 89mm cross bits used to install the micropiles.

MillAC 761V II

When the drilling started, we could see how the soil conditions changed. We were in an area that had been filled with gravel and cobbles, the picture below shows the drill cuttings. This required a thicker grout with the thin grout running off and not giving us cutting returns while drilling.





MillAC 761V II

The process we turned to was:

- Core the concrete for a uniform hole and so we would know the thickness of the pad to determine if we would need a short piece of casing for our lateral load. This was finished for all six holes before moving on to the next step.
- Drill the holes using air for our flushing, this allowed us to reach our depth (3m-6m) and not plug the rod or wash out the gravel around our pile.
- Run our finish grout using the drill rotation to mix the grout and cobles around the pile.

The left picture shows the vacuum can used for air flushing

The right picture is the pile cap used that the machine will be placed on.

MillAC 761V II

A proud group of drillers with the work and cleanup completed.

CMM Inspection Machine

Hexagon Global CMM inspection machine;

CMM Inspection Machine

This machine was the greatest challenge that we have had in our factory, not because of the weight but of the precision needed and its susceptibility to vibration. This foundation needed to not only be independent of the existing pad but had to be completely isolated from any vibration around it. With a full machine shop operating daily and the other equipment being used to move material to and from the machines this is where the challenge was.

I could not find a reference for this design, so we did some testing for the vibrations created from the machining centers and from the passing forklifts loaded with material. We found the forklift gave us the highest readings and we would need to base our final results from this action.

We found that a depth of 1.5m was sufficient to isolate the vibration from the forklift, by using Quick (Sono) tubes of 215mm to this depth it would give us the results needed for our foundation. We took the 40mm IBO bar 3m further in depth as a bond area to carry the load of the CMM machine.

To get away from the existing pad we cut out the concrete so there would be no chance of contact or transfer of any vibration. The holes were then drilled for the Quick tubes to be installed to depth, these were auger drilled and set in place one at a time.

CMM Inspection Machine

Cut out of concrete pad

Sono tubes installed

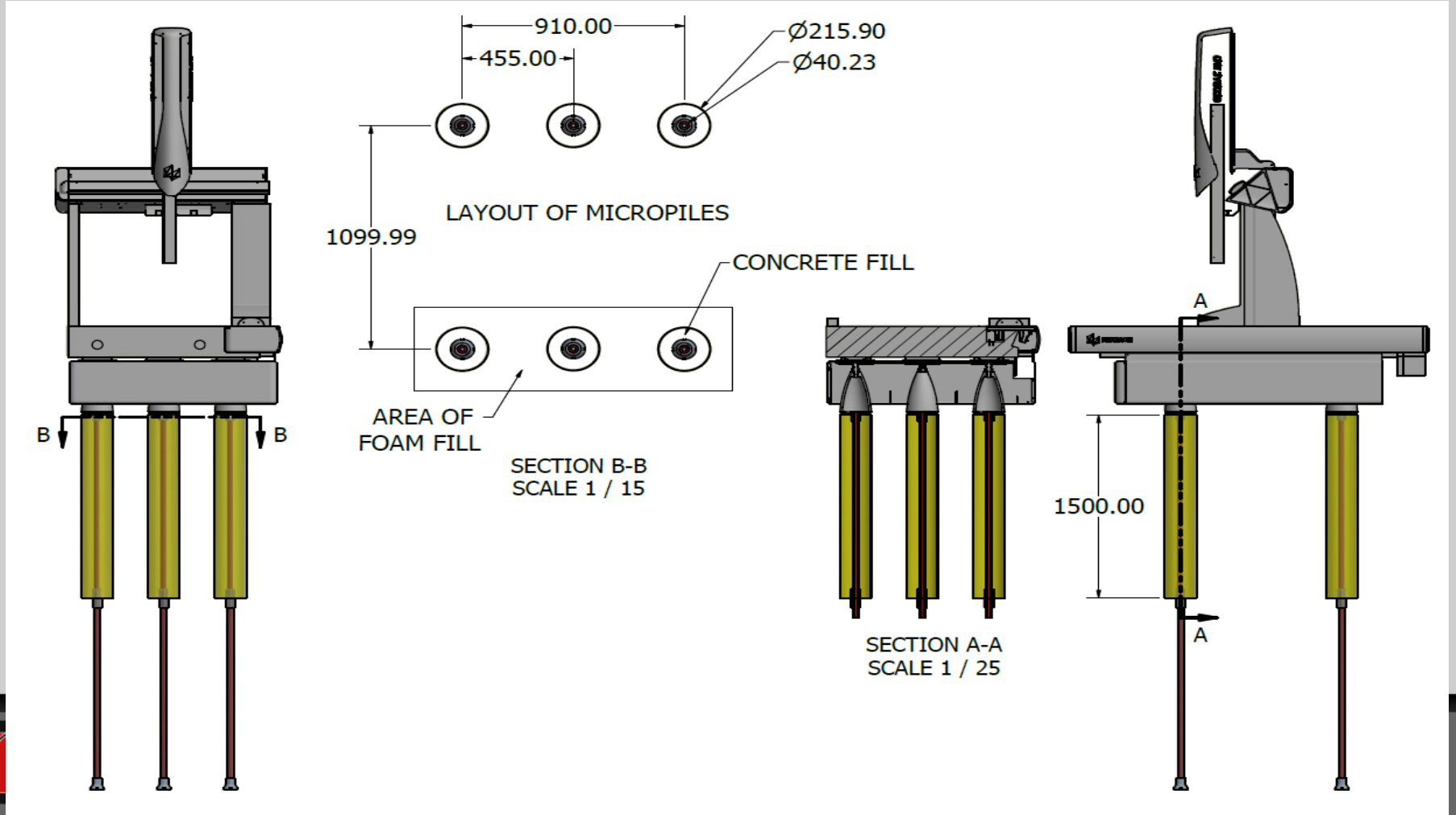
CMM Inspection Machine

The fill remained loose around the Quick tubes but we felt this would help to isolate the vibrations from the machinery and this is also a no bond area so this will not affect the load capabilities of the micropiles. The outer top of the tubes were encased with foam to help keep them in line but also to help with the isolation from the existing pad.

The hollow bars were installed to a 4-6m depth, after reaching our depth we used the finish grout to fill the Quick tubes. To centralize the bars we built a special fixture to keep the bars in line with the tubes and in place for the feet of the CMM.

CMM Inspection Machine

The design for this foundation came from internal discussions and using our experience with micropiles. The manufacturer of the CMM machine were very surprised and satisfied with the vibration measurements taken during commissioning.



ISM Seminar Astrualia 2019!

Glenn Patterson
TEI Rock Drills