Making Holes

Until we had steel, making holes was hard work. Time was a little cheaper than it is now so, a man could sit down and hack at a piece of timber for a few days with some flint and produce a hole. If you needed 20 holes – 20 men would sit down. Making holes in stone was not to be contemplated.

One Day a Diamond Driller was Born

On that day his father handed him a drill rig and a bunch of drill bits tipped with diamonds. He drove away in his white van and was immediately asked if he could drill a bit faster, a bit longer, more accurately. Since then the quest has never lessened – boundaries are still being stretched.

Diamond drilling was seen as an embarrassment saver. “I forgot to leave a pocket in the concrete slab for the drain!” – “call in the diamond driller”. Within a blink of an eyelid there were diamond drilling companies everywhere. I know, I was that man

Technology

From an engineering standpoint the technology of cutting stone and concrete efficiently with diamonds fascinated me, it was so fast. Could I make it faster? Speed the motor up, make it more powerful. I started to record the “cause and effects” of what I did, the science became more interesting. That was 44 years ago and I am still doing the same today. It seems the only way to stay in business is to constantly develop new and more efficient methods and products. In the early years diamond drill bits were all the same, now we have different compounds available for all minerals.

Anchoring

To keep ahead of the pack, I looked for different applications for the drilling technology I was keen to promote. Anchoring seemed to be an interesting route to pursue. Anchors in buildings that required stabilising or strengthening interested me because there were likely to be more holes required at one address rather than drilling one hole for a tumble drier.

I researched the anchor manufacturers and was introduced to a company called Cintec. We introduced ourselves as innovative problem solvers. Around twenty years later we still have the same title and the projects become more exciting and challenging.

Subjects Covered

Long Hole Drilling
Accurate Drilling
Drilling with Water
Drilling with Air
Drilling with Foam
Drilling with CO_2
Drilling very Hard Materials
Drilling very Soft Materials
Silent Drilling
Tapping up
Steering

Long Hole Drilling

Drill bits were available in two standard lengths. 350mm for ½"BSP and 450mm for 1 ¼" back ends. If a hole had to be longer, the drilling had to stop the drill bit cleared, an extension rod added and start again. Sometimes more time could be spent clearing holes and drill bits than drilling. It is now possible buy drill bits four times longer if required. New methods allow drill bits to be manufactured and delivered next day.

If very long holes are needed, mining barrel, a scaled down version of oil drilling technology has been adapted for hand held and rig mounted machines. Mining barrel is a tube that is internally and externally threaded at opposite ends. Lengths of tube can be added to each other without withdrawing the drill bit. When the correct length has been achieved the drill bit can be withdrawn with the spoil that has been retained within it.

Another great benefit of mining barrel is because it has a constant thickness its straight line drilling ability is increased.

Accurate Drilling

As length ability increased, greater accuracy was required. This advent saw the use of steady bearings, laser beams and digital spirit levels and fluxgate compasses.

Cintec posed some drilling in a mosque in Cairo where anchor holes had to be drilled from inside the building along a wall that was only visible from outside. Heights had to be determined with a water level (probably very similar to the one used when the building was constructed 1,000 years before.) Angles of the wall were measured from outside using a hand held digital compass. These bearings were then used to align the drill bit on the inside of the mosque. A digital level was used to ensure a precise vertical angle was maintained. Lasers were used internally to transfer levels from one wall to another. There was only one other complication, we were not allowed to use water to flush the spoil from the limestone drilling. We had to rely on Egyptian compressors. Although these compressors came with two 24 hour attendants, they still regularly broke down, ran out of fuel or overheated. Despite these challenges our anchor holes were accurately drilled and the contract completed ahead of time.

Drilling with Water

To the uninitiated, diamond drilling looks easy. Turn a switch, twist a handle, turn on a tap, anybody can do that!

Water is used in diamond drilling to cool the drill bit and flush away the drilling spoil. Water passes down through the centre of the drill bit and up the outside. The volume of water is so important. Anybody can drill a hole but can they do it efficiently? The drilling engineer has a duty to promote long drill bit life with high production. The physics behind accurate water control is simple but it requires vigilance and experience.

The drilling engineer must constantly analyse the drilling spoil and adjust water flow to suit. The correct amount of water should produce a constant coloured drilling spoil. If the water starts to flow clearly the water flow should be reduced to allow some of the cuttings to sharpen the cutting head. When the coloured water returns the water can be increased a little until a balance is reached. The basic rules are too little water will cause spoil to accumulate and wear away the cobalt compound exposing the diamonds so quickly that they will fall out before their useful life has been achieved. Too much water will prevent the diamonds becoming exposed and the drill bit will become glazed and fail to cut efficiently. The experienced driller will notice a ring of iron filings around the exhausted water and automatically adjust the force on the cranking handle and the flow of water to suit.

There are however a few problems with water. Water can damage a structure when it is no longer a liquid! Trying to drill with water in freezing climates is uncomfortable for the operator and can become an inexpensive form of demolition for the client. Do we have other substitutes that will not have detrimental side effects? We can't use an oil based liquid because of the detrimental effect if using the hole for anchoring. So it has to be solvent free, non combustible and readily available – air fulfils all of those requirements!

Drilling with Air

In some historic buildings drilling with water could wash away lime mortar. If this occurred, the strengthening works could cause the building to become more frail. Air is substituted for water. Compressed air is used to perform the same functions as water and it is monitored and adjusted in a similar fashion.

It is essential to know that air drilling is required before the start of a contract to ensure that air drilling drill bits with the correct grade of compound are ordered. Generally air flush drill bits are of a harder compound than water flush bits. This is because water acts as a lubricant.

Again the skill of the drilling engineer affects the performance. Inexperienced drillers will find that drilling soft material is fast so they turn the cranking handle quickly until the core jams inside the bit and the drill has to be taken out of the wall and cleaned. This is particularly annoying if you have drilled 10M or more. The secret is to watch the drilling spoil quantity, if it slows, back off with the cranking pressure and allow the drill string to clear before resuming.

Drilling with Foam

Foam drilling has been popular with the geotechnical drilling fraternity for a long time. Auguring through clay or percussion drilling through rock, the soap content makes the clay slippery and not stick to the rotating auger or in rock it helps float the spoil to the surface without causing clouds of dust. The scales are vastly different from diamond drilling so the geotechnical equipment was not suitable for anchor drilling.

Some situations that we encounter in historic buildings pose a dilemma where foam drilling could ease the problem. For example, flint filled limestone walls – the limestone is easy to drill the flint is more difficult particularly if the request has been for dry drilling and the flint is held in soft lime mortar. The flint has to stay still to be drilled; the water washes away the mortar securing the flint, the flint become mobile and impossible to drill. Foam drilling could be the answer. We manufacture

a small completely self contained foam pump for diamond drilling. The principle is simple pump a small volume of concentrated liquid into a fast moving stream of air. When the mixture reaches the cutting tips it turns to foam and flushes the spoil to the surface. The foam can be collected with a vacuum cleaner and re-used. The amount of fluid does not affect the lime mortar. There is no dust produced, the moist air retains it. The same pump can be used with diluted glycol to allow drilling in sub zero temperatures.

Drilling with CO2

This does sound unusual but is invaluable in certain circumstances. CO2 used straight from the bottle, well through a regulator, cools the cutting segments like nothing else. We use it primarily where compressed air is not feasible. Depending on the hole size, you can drill for hours on a single bottle. It is not expensive and is available throughout the world.

Too much gas is to be avoided as the cutting segments may freeze, if this happens the compound can become very brittle.

Very Hard Materials

There are a couple of suggestions here. The most important is the best segment compound. The compound must be “soft” to allow diamonds to become exposed. Too “soft” and the diamonds will be forced below the surface causing a glazed cutting surface. The optimum rotational speed is essential, consult your speed recommendation chart. Too much cranking force will have the same effect as a bond that is too “soft”. The answer here is let the drill bit do the work and don’t try to speed up by forcing it because you will be slowed down by constantly sharpening up your drill bit.

My tip is to use two auto feed drills at the same time. Set up one machine, set it to go, then set up another and set that to go. Now all you have to do is watch and listen. The micro processor will regulate your cranking speed automatically for you.

Very Soft Materials

Nearly as hard as drilling very hard materials. Again the correct compound is essential but this time very hard to prevent premature wearing.

As mentioned above soft materials will make you feel that you can crank the handle quickly. Restraint is the answer to prevent cutting spoil causing a problem.

Silent Drilling

Drilling with hydraulics produces almost no drilling noise. This is ideal for occupied premises. The motive power comes from a power pack, this can be a remote petrol or diesel unit or for true quietness a 3 phase unit can be used.

Hydraulic drills are also ideal when drilling up-hill, overhead or indeed under water.

Petro-chemical installations often insist on spark free operations, hydraulics are an ideal solution.

Tapping Up

Tapping up or sharpening of diamond bits is sometimes required. There are two ways of achieving this. The first by running a grinding disc lightly over the dull cutting segments. This method removes a layer of the compound that the diamonds are held in and exposes fresh diamonds. The second method is to turn the drill bit upside down and tap the segments with an old file. The effect is to create a rough surface and uncover buried diamonds.

Steering

Directional drilling is possible when drilling deep geotechnical holes. The same method can't be used for diamond drilling, but it is possible to gain some steerage.

When drilling very long holes down a narrow wall it may be necessary to guide the drill bit to keep it on target. This can be achieved by pre-drilling holes at right angles to the main hole and inserting steel rods for the main drill to glide across. It is possible to steer around objects within a wall.

If you have any challenges relating to anchor hole drilling, that you need solutions for, I would be delighted to assist, just give me a call.

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