BIG HOLE DRILLING WITH BULROC DTH HAMMERS
In today’s foundation drilling industry the need for faster and more accurate methods of producing large diameter cased and no cased holes has resulted in the development of Bulroc’s Big Hole range of DTH percussive rock drilling products capable of drilling holes larger than 1m in all rock conditions.

The Bulroc range of DTH hammers now include the Hyper 181, Hyper 241, Hyper 301S which when used with Bulroc’s extensive range of continuous casing systems, will give one of the world’s fastest cased pile drilling systems capable of penetrating all types of ground conditions whilst still being able to produce a cased rock socket in excess of 1m in diameter.

Prior to the availability of these large diameter DTH products, bored pile holes were common place but due to varying ground conditions their slow penetration rates were measured in hr/m. Using the Bulroc Big Hole range of equipment, penetration rates can now be measured in m/hr, providing huge savings in both time and money.

The greatly improved production rates mean fewer rigs are required to produce a given number of piles in a specific time period and consequently, plant costs are also drastically reduced.

Bulroc realised very early in the development of their Big Hole range that existing bored pile contractors would not always be prepared to invest in expensive purpose made drill rigs that would allow them to change to DTH percussive equipment. For this reason, Bulroc has developed relatively inexpensive methods of converting both hammered pile and bored pile rigs into DTH rigs allowing the contractor to experience these greatly improved penetration rates with minimal outlay for new plant.

Bulroc’s Big Hole range can be used on just about any drill rig with a top drive rotation head that has sufficient torque and pull down (weight on bit). These factors will vary depending on the size of the hole to be drilled but as a guide, a 610mm diameter hole will ideally require a rotation unit of 2.5 to 3.0Tm torque at rotation speeds down to 4 rpm. The drill rig should have the capability of applying and maintaining a “weight on bit” of 5.5T. This means that the drill rig needs to have the ability to apply this 5.5T pull down when drilling commences but also has the capability of holding back the additional weight that will be applied as more cased drill pipes are added.

The Big Hole range can also be used on Kelly bar machines by simply fitting a suitable hexagon connection to the bottom of the Kelly, providing there is sufficient height below the Kelly to accept the hammer and drill bit.
The Bulroc Hyper 181, Hyper 241 and the new Hyper 241S are all valveless hammers and are all basically similar in their design and construction. High quality materials and carefully controlled heat treatment come as standard.

These three hammers have a through bore wearsleeve with no inner cylinders and no internal porting to ensure maximum strength.

The piston is the only moving part and its cycle is determined by the sturdy control tube.

The Hyper 181, Hyper 241 and Hyper 241S are all large hammers and whilst economical for their size, they do require a substantial volume of compressed air for their efficient operation. Consequently, the exhaust air is generally sufficient for effective hole cleaning.

When setting up the drill string for Big Hole drilling, care is taken to ensure that the drill pipe, and usually also the hammer are correctly sleeved or cased to ensure efficient hole cleaning with the exhaust air available.

However, in certain particular circumstances where the hammer exhaust air alone is not sufficient and extra flushing is required to maintain efficient flushing, a hole may be drilled in the base of the control tube to allow additional high pressure air straight through the hammer to supplement the exhaust air.

All Bulroc Big Hole hammers are supplied as standard with a check valve arrangement that helps maintain pressure in the hammer when the air is turned off and so prevent the ingress of water and cuttings from entering the hammer which could cause potential problems.

The chucks on all three hammers are designed to house replaceable nylon drive plates which eliminate spline wear when correctly maintained and consequently prolong the life of both chuck and bit.

The trapezoidal twin start thread of both chuck and backhead minimize the force necessary to break open these components for bit replacement or servicing. If a suitable hydraulic break out tool is not available or if the drill rig does not have an adequate break out arrangement, then the thick breakout washers can be cut through to release the thread connection.

The Hyper 181 hammer has an 8 5/8” API reg pin backhead and a chuck to suit Numa 180 shanked bits. However, this hammer can also be supplied with a chuck arrangement to suit Mission SD18 shanked bits. In this instance, the drive plates are replaced with drive rods.

The Hyper 241 is supplied as standard with an 8 5/8” API reg box backhead but can also be supplied with an 8 5/8” API reg pin if preferred. This should be specified at the time of ordering. The chuck is designed for Numa 240 shanked bits.

The Hyper 241S has a 10” BECO pin thread backhead but can be supplied with an 8 5/8” API reg box if preferred. The chuck is designed for Mission XL24/XL32 shanked bits.

As with all DTH hammers, a constant supply of the correct type and quantity of rock drill oil is extremely important. These costly products can be irreparably damaged in seconds if the lubrication supply fails. A well lubricated hammer is generally a trouble free hammer.

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A typical Big Hole drilling arrangement

1. Shock absorber - The 'out of hole' shock absorber is optional and will depend on the ability of the rotation head to accept a reasonable level of vibration from the hammer. Burro propose the out of hole option since much of the vibration from the hammer will be absorbed by the drill string and so extend the life of the shock absorber. By positioning the shock absorber beneath the rotary head, it eliminates a potential loss of expensive equipment in the event of a connection failure should the shock absorber be positioned behind the hammer.

2. Air inlet swivel - Generally these rigs may not have the facility to pass the necessary volume of compressed air through the rotation head and in such cases, an air inlet swivel is required. This needs to be of a size and design that will pass large volumes of air with minimum restrictions. At this point it is important to emphasize that an air receiver must be positioned between the several compressors, that will be required to produce the necessary air volume, and a suitable oil lubricator before connecting to the air inlet swivel.

A simple manifold system is no substitute for an air receiver and will only result in a throttling effect of the weakest compressor, which will effectively reduce the availability of the total air package with a corresponding reduction in the performance of the DTH hammer.

3. Sleeveed drill pipe - On 'Big Hole' drilling, sleeveed drill pipe now replace the former threaded type. The drill pipes will generally be sleeveed out to a particular diameter to provide for the most effective hole cleaning or 'pipe hole velocity' relative to the diameter of the drill bit. Reinforced holes through the sleeve allow 'rebar' or similar steel bar to be inserted to hold and support the drill string when adding or removing drill pipe. No more spotters, no holding tools, no greasing, a fast efficient way of handling large diameter drill.

4. Saver sub - The hammer is connected to the hexagon drive drill pipe by way of a thread to hexagon saver sub, although a hammer with a direct hexagon connection can be supplied on request.

5. Sleeveed DTH hammer - The DTH hammer is sleeveed to the same diameter as the drill pipe to provide an even flow for more efficient hole cleaning. There are different designs of hammer sleeves, the one shown in the illustration is a bolt on design, but Burro can offer other designs.
In most cases, the pile will be drilling in overburden and unconsolidated ground until solid rock is reached where the socket can be formed. Whether the socket is required to be cased or uncased, it will still be necessary to use a continuous casing system such as the Bulroc CDS-R.

The Bulroc CDS-R is a concentric overburden drilling system specifically designed for the continuous casing of large diameter holes down to and into solid rock. The specification of the pile and depth of socket will determine the practicality of producing the complete socket with the CDS-R, or closing and removing the system once bedrock is reached, and then completing the socket with a conventional drill bit.

When drilling commences, the cutting segments are extended to cut a hole slightly larger than the casing diameter. Depending on ground conditions, it may be necessary to inject water through the air system to lubricate the hole and keep the cutting segments free. When bedrock is reached, the cutting segments can be closed by rotating the CDS-R anti-clockwise against the solid base of the hole or by pulling up against the casing shoe, and rotating anti-clockwise. The complete drill string, hammer and CDS-R can be removed from the hole leaving the casing in place.

The STABLE-X builds on the proven design of Bulroc's CDS and CDS-R Overburden Drilling Systems and is recommended for drilling in ground conditions where minimum disruption to sub structures and existing foundations is essential. The STABLE-X features patented Bulroc Airflow technology.

Both systems feature easy to replace rings and segments.

Alternatively, and in certain ground conditions or particular pile requirements, the Bulring system may be more suitable. Thick bands of small size cobbles or extreme bands of inclined boulders are typical examples. Where holes are required to be fully cased into particularly deep sockets, the Bulring system would be more cost effective than the CDS. If the pile design requires that the casing is to form part of the pile, the Bulring system with a sacrificial ring bit can be a more suitable alternative.

The Bulring system is a “Full Face” concentric overburden system for continuous casing and comprises a ring bit and a one piece pilot bit /driver.

The ring bit can be of a single use, sacrificial design or a heavy duty multi use design. In either case, the ring bit is attached to the casing shoe that in turn is welded to the casing. When bedrock is reached and the socket has been drilled, the drill string can be rotated anticlockwise releasing the driver from the ring bit / casing. At this point, the ring bit / casing can either be left in the hole if it is to form part of the pile or the ring bit / casing can be extracted as the pile is formed to be reused.
Bulroc Systems are capable of producing horizontal holes once broken through the ring bit can be salvaged and reused. The casing shoe can be ground/burnt off.

In addition to the developments in vertical Big Hole drilling, there is now an ever increasing market for Big Hole horizontal drilling and as with the vertical systems; Bulroc has developed equipment capable of drilling horizontal holes greater than 1m in diameter in a single pass. This is a cost effective system of driving straight holes with high penetration rates through solid rock and rocky ground conditions where conventional augers cannot operate. In some instances, being able to produce this diameter of horizontal hole through all ground conditions has resulted in project costs being reduced to a fraction of those costs incurred when producing multiple small diameter horizontal holes.

Having the capability of drilling large diameter horizontal holes cost effectively has led to new designs in drainage systems and reduced the need for separate underground structures normally produced for electricity, cable, telephone services etc.

The set up is similar to that for drilling vertical holes using the Bulroc Bulring system except that since the ring bit can now always be recovered and re-used, a heavy duty multi use ring bit is the standard design.

A heavy duty launching base is required, such as is used in large diameter conventional auger boring, with upwards of 5Tm torque rotation unit and a pushing force of over 8T. An air inlet swivel is needed to introduce the compressed air needed to power the DTH hammer. As mentioned earlier in the vertical drilling section, the several compressors necessary to deliver the required air volume must each be fed into a receiver and from the receiver, through a single outlet to an oil lubricator before feeding into the air inlet swivel.

As in the case of Big Hole vertical drilling, it may be necessary to sleeve the DTH hammer to the diameter of the hollow stem augers. The sleeve diameter will be determined by the size of the hammer and the diameter of the ring bit. In certain ground conditions, it may be advantageous to weld a spiral vane over the length of the hammer sleeve to assist in the transfer of drilling debris from the drilling head to the start of the hollow stem augers.

In most instances, a cased hole will be necessary. A casing shoe will then be welded inside. The front of the lead length of casing will be passed over the sleeved DTH hammer and will locate against the shoulder of the driver. This will now leave the front face of the driver to accept the heavy duty ring bit which is locked on to the pilot bit by a bayonet arrangement. The complete system is now ready to drill. Constant feed is required and continuous clockwise rotation must be maintained to prevent loss of the ring bit. When the system breaks through the other end of the drive, the ring bit can be rotated and lifted off the driver ready for the next job. The hammer and driver can now be withdrawn back through the casing leaving the protruding casing shoe which can be cut or burnt off leaving the casing supporting the drive.
A major development during the period in which Bulroc have been working on their Big Hole range was the introduction of hexagon drive drill pipe. This is a feature that allows the drill string to be quickly assembled and disassembled without either the worry of cross threading or the need for large, heavy and cumbersome spanners that can present potential dangers to the operators using them.

They also eliminate the need for hydraulic clamps and retaining forks to support the drill-string during pipe changes and of course, no thread greasing.

Hexagon drill pipe are connected and disconnected through the offset locking pins and the ‘O’ rings between the connections minimise the potential air loss.

By using Bulroc's hexagon drive drill pipe, the retrieval time of the drilling equipment from the hole is reduced to a fraction of the time it takes when using conventional taper threaded connections. This in itself is a big cost saving feature when drilling cased holes that require an uncased rock socket.

With conventional threaded connections, it may take longer to retract the drill string and then return down the hole with a conventional drill bit than it does to cut the rock socket. With hexagon connecting drill pipe, the removal and re-assembly of the string is done quickly and safely with only the need for one rig operator and two helpers. Reinforced holes through the sleeve allow for rebar or similar steel bar to be inserted to hold and support the drill string during adding or removing drill pipe.

No more spanners, no holding forks, no greasing. A fast, efficient and safer way of handling large diameter drill pipe.