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betterground
Engineered Ground Improvement

Betterground Equipment

Our history, our equipment

Betterground Equipment, owned by the Degen family, sells and rents specialty equipment for ground improvement of loose sand and soft silt and clay.

Betterground equipment has proven its worth on some of the world's most challenging projects, some of which are featured herein.

With support stations based in Munich, Dubai, Dallas, and Hong Kong and with long term area-licensed customers on all continents, Betterground Equipment is equipped and dedicated to support their clients around the world.

Besides equipment repairs, after sales services include site training by experienced staff with each over 10 years experience, as well as fundamental geotechnical advice on the capabilities and limits of the technology during tender stage and execution.

1900

Johann Degen bought the Johann Keller Company in 1900. After his early death in 1903, his wife managed the company through hard times until its transition to sons Johannes and Wilhelm in 1920.

1901 - 1970

Wilhelm L. Degen, son of Johann Degen, was Managing Director and Chief Engineer of Keller until his death in 1970. He owned numerous patents, including the depth vibrator for Vibro Compaction, and various Stone Column patents.

1938

Sergey Steuermann, co-inventor of the Vibroflot, left Germany and set up the Vibroflotation Foundation Company in Pittsburgh, PA, establishing Vibro Compaction in the USA.

1958

Wilhelm L. Degen invented the Stone Column method.

1974

Johannes Degen and the children of Wilhelm L. Degen sold their share in the Keller Group. Wilhelm. F. Degen (son of Wilhelm L. Degen) bought the Vibroflotation Foundation Company of Pittsburgh, PA, from Sergey Steuermann.

1978

Wilhelm F. Degen and Franz Elchkorn developed the first high performance electrical Vibroflots, which had unique penetration capacity. This enabled their machines to reach numerous world record depths .

1980

World record for deep vibro compaction by Vibroflotation at Jebba Dam, Nigeria

1986

Alexander M. Degen and Wilhelm S. Degen set up Vibroflotation AG and developed the Gravel Pump, the Vibro Stitcher and the Marine Gravel Pump together with designers Franz Eichkorn and Beda Kälin.

1990 - 1996

Licence agreements between Soletanche S.A., in France and Vibroflotation AG and a Joint venture between Vibroflotation AG and Bachy-Soletanche were established in Hong Kong.

1994 - 2001

Vibroflotation equipment dominated the Vibro Compaction market in Germany for lignite mining slope stability projects of over 70 m in depth, with a total volume of over 1 billion cubic meters.

2001 - 2009

Soletanche Bachy took a 70% share in The Vibroflotation Group and and in 2006 took over the company entirely. The relationship ended in a three year non competition undertaking by Wilhelm and Alexander Degen during which both brothers were consulting The Vibroflotation Group on numerous key international projects.

2009

Betterground Ltd. (Switzerland) was founded in early 2009 and was immediately joined by the most experienced technical experts in the world.

One of the first projects of Betterground equipment was the Palm Deira in Dubai, the largest Vibro Compaction project in history.

2012 - 2014

Betterground supported China Harbour Engineering Co. with low headroom offshore stone column equipment, site supervision and engineering support on the Hong Kong Boundary Crossing Facility project, which included over one million linear meters of marine Stone Columns. It is the largest project of its kind in history.

2014 - 2016

Today Betterground has license and JV agreements in place with geotechnical specialty contractors in over 20 countries. Partnerships through performance-based equipment rental or joint ventures now form an important part of Betterground's business. For this purpose, the selling of equipment has been split off into a separate firm called Betterground Equipment, while the project business remains under the name Betterground.

Using a modified version of the BC1 Bottom Feed Stone Column rig, Betterground installed the first Bottom Feed Sand Columns compacted by a Vibroflot.

Vibroflots, the centerpieces of compaction technology

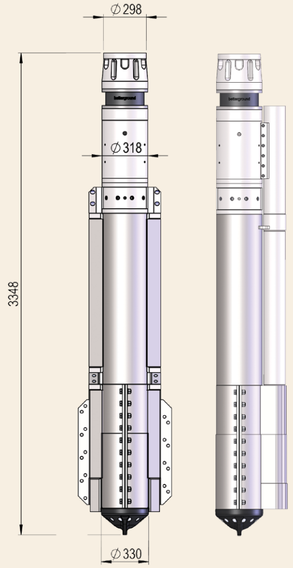
The Degen family has been involved since the first Vibroflot built in the late 1930's till today in pushing this equipment to new levels of performance and new applications.

Vibroflot performance is not only measured in nominal horsepower (or kW) but in the ability to reach the required working depth and the equally important ability to achieve great compaction results once such depth has been reached.

Betterground vibroflots are available in three sizes. The smallest are the B15 series machines. Operating in a range between 1800 and 3000RPM), they are installing stone columns in city environments, where disturbance from vibration shall be limited and when foundation sizes demand relatively small columns.

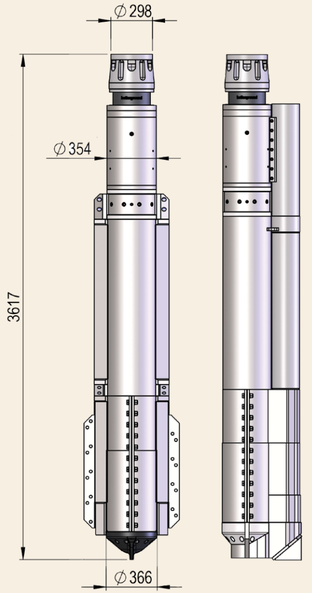
The B27 series is Betterground's general purpose machine. It most economically installs stone columns, but is also suitable for compaction of sand and gravel.

At the upper end of the scale in terms of size and performance stands the B41, the world's highest performance sand and gravel compacting machine.



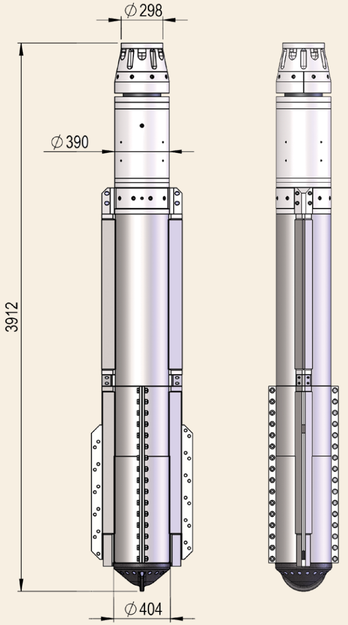
B15 data at max. speed

voltage:	420V
frequency:	100Hz
rotation speed:	3'000RPM
motor force:	82kW
eccentric force:	270kN
amplitude:	15mm
weight:	1700kg



B27 basic data

voltage:	440V
frequency:	60Hz
rotation speed:	1'800RPM
motor force:	130kW
eccentric force:	240kN
amplitude:	24mm
weight:	2'200kg



B41 basic data

voltage:	440V
frequency:	60Hz
rotation speed:	1'800RPM
motor force:	210kW
eccentric force:	450kN
amplitude:	32mm
weight:	2'800kg

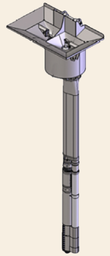
Equipped to improve all loose and soft soils

Betterground designs and manufactures the most reliable and highest performance vibroflots, but equally important are the attachments with which they achieve the soil improvement work in various ground conditions.

Over the years Betterground developed various attachments for gravel placement by bottom feed (B) and top feed (T) as well as such that work on excavator (E), lattice boom crawler crane (C), or from a drill rig with a set of vertical leads (L). In the development and evolution of these attachments Betterground benefitted greatly from having been involved in many projects as contracting partners to their equipment licensees.

Excavator based

BE1



TE1

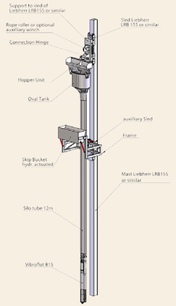
Crawler crane based

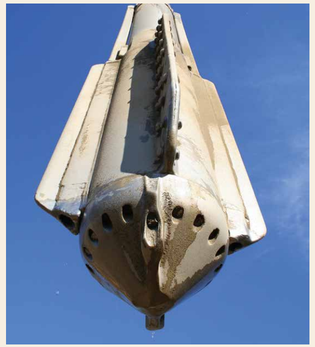
TC1

BC1

Drill rig based

BL1



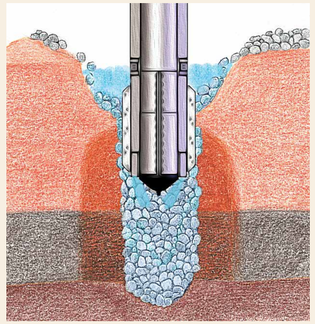


B41 vibroflot for compaction of sand and gravel

The B41 is the latest in the vibroflot evolution chain and is based on over 70 years of experience gained by the Degen family being at the forefront of depth vibrator development. The predecessors of the B41 were successfully used on many projects over the last few year, and mainly on some of the world's largest reclamation sites in Hong Kong, Singapore and Dubai.

Following on from this success the B41 now has a higher motor endurance and vibration performance. In addition the B41 has an advanced wear parts system that now leads to an increased period of use between service intervals.

In recent projects the B41 has been complemented with the patented Betterground Operator Guidance system. This is a network of devices that work together through data link. It takes the task off the crane operator to adapt the volume and pressure of water and air to the conditions in different soil layers. Adjustments are done automatically by a computerized valve controller, feeding back the information on flow rates and pressures to the central data logger. This data logger also serves as a sort of "auto pilot" for the operator to decide on the motions in the installation process, suggesting to the operator the necessary up and down movements at the right time and to the right distances. Having such a system in place allows an operator without special experience to build a stone column or compaction point better optimized to the ground improvement objective than a very experienced operator without such guidance system.



Compaction and reinforcement of silt and clay with stone columns

Stone Columns can be installed with the top feed method, where the stone is allowed to fall down to the tip of the vibroflot through an annular space created by flushing water as depicted in the above sketch. It is the disposal of process water that makes this otherwise fast and high quality method not usable in inner-cities or on sites with contaminated soil.

Although there are some inner city sites like the one on the left where top feed stone columns could be managed by reducing the flushing water volume to a minimum. Top Feed stone columns have been installed to a depth of up to 9 m with excavators, as shown above, or with lattice boom crawler cranes to depths over 30 m.

Attachments for bottom feed stone columns

BL3

Bottom feed stone columns are installed using the same B27 and B15 vibroflots as with top feed stone columns.
In order to feed the gravel to the tip of the vibroflot different attachments are used that all follow the same principle.

On the top there is a lifting head to suspend the unit on a crane (C) or excavator (E). Below the lifting head a hopper takes up the gravel filled either with the shovel of a telescopic loader (for BL1, BL3, BE1, BE2) or via a tilt bucket (for BC1 and BC2).

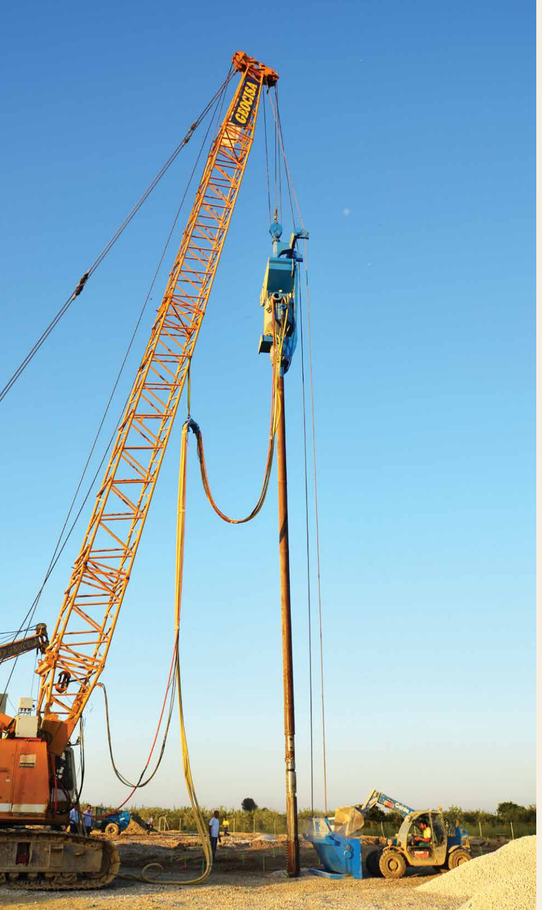
From the hopper the gravel falls through one or, in case of the BC2, two lock gates into so called silo tubes inside which the gravel falls to the tip of the vibroflot.

In the leader based BL1 rig in the below photo the gravel is transported by a bucket that travels along the mast. For short columns up to around 7.5 m depth an excavator in the 30 ton to 45 ton weight class can be used as a carrier.

BE1

BL1

BC2



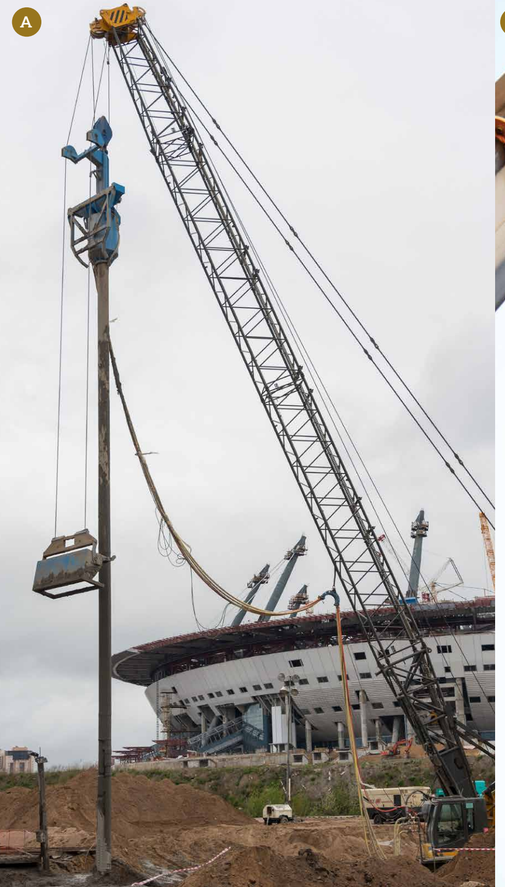
Bottom Feed Stone Columns for all size projects

Bottom feed stone columns are used in three fields of applications:
1) As foundation elements in replacement for concrete or timber piles to reduce foundation settlements.
2) To reduce the risk of soil liquefaction during earthquakes.
3) To reinforce slopes against landslides, be it due to earthquake liquefaction or purely static design.

For the foundation application stone columns are often installed in the depth range of 3m to 40m, with a majority in the range of less than 12m and a very large part less than 8m, which is suitable for the excavator based units.

For liquefaction mitigation a large number of projects require 15 m long columns, some of them recently reaching over 30 m depth.

For liquefaction mitigation any granular soil between columns requires compaction. In this instance the better compaction capability of a machine operating at 1800RPM over a machine running at higher RPM, suggests the use of the B27 for such applications.



BC1, BE1, and BL3 Bottom Feed Stone Column rigs

A
One of the total 3 BC1 rigs installing stone columns on a land reclamation in St.Petersburg, Russia, near the new football stadium.

B
BL3 rig mounted to a standard drill rig, installing bottom feed stone columns to 12m depth with a B27 vibroflot, feeding the gravel with a Bettergrund built trap door shovel.

C
A vibroflot cast alloy nose cone with bottom feed tremie pipe (left) and water jets (right)

D
A BE1 excavator based rig photographed from below. The nose cone with the tremie pipe is seen as well as the blue hopper above that receives the gravel from the telescopic loader.

E
BL3 rig mounted to a standard drill rig, with air compressor on the back.

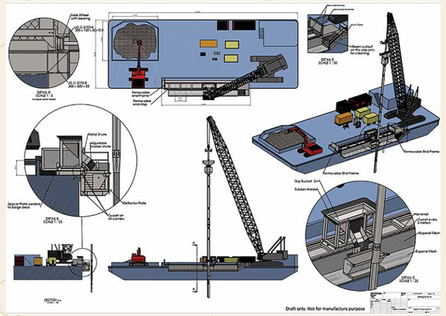
Teaching old drill rigs new tricks
...to install bottom feed stone columns

Betterground can provide adaption kits for many standard and non-standard hydraulic drill rigs that will enable these to be used for the installation of bottom feed stone columns.

These adaption kits allow for multi utilization of drill rigs during technology fluctuation changes and during periods of either low or high market intensity.

Betterground have so far successfully produced, and used, kits for machines such as those shown in the photographs in this page.

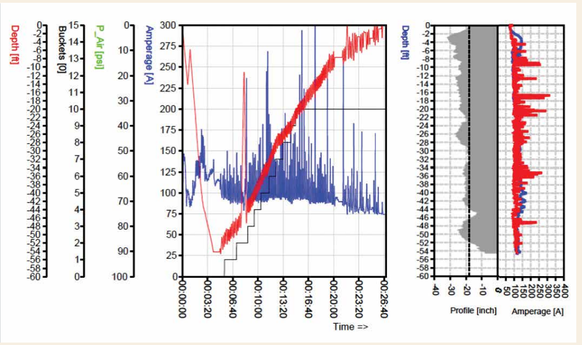
Where depths are in excess of 8m and working space is limited, a standard hydraulic drilling rig modified as shown may be more appropriate and efficient than the normal lattice boom crawler crane (BC1 or BC2) or the excavator based BE2.



BC2 offshore stone column rig

The BC2 rig in it's double lock variant can be used on land and offshore. This rig has been adapted to the marine conditions using Betterground's unsurpassed experience in offshore stone columns. The above 3D CAD drawing shows just one of many concepts that are deployed by Betterground for their customers worldwide. It is a large advantage that Betterground has all their design documents in 3D CAD and that their experienced mechanical and geotechnical engineers have a proven track record of successful implementation of such projects from joint concept development with the client, manufacturing, assembly on barge, guidance in the installation methods, as well as fast feedback from lessons learned on such projects into the manufacturing process.

Right page:
Stone Column installed by BC2 rigs into 31m diameter caissons to depths of over 20 m.



Quality Control, offshore and onshore

Quality control offshore (left page) is even more important than onshore, as offshore columns can not be visually inspected and are very cumbersome to load test. The left page shows the touch screen display for a BC2 with double lock. The installation process has been split into several phases that are shown on the bottom of the screen, with the next phase in orange and already done phases in green. This layout has lead to the pleasant side effect that operating this unit is done by most operators without ever consulting the manual.

On the top right output a column in silty sand is shown. At 46 ft (14m) depth a little mistake happened by pulling the rig once too high up. The grey column diameter plot picked this up, whereas without such diameter plot it may have been overlooked.

The bottom right plot shows a typical liquefaction design, with 1.6 m diameter columns in the upper (silty) layer versus only 0.8m in the lower (sandy) layer. The quality of columns shown here is only possible with the operator guidance system of Betterground.