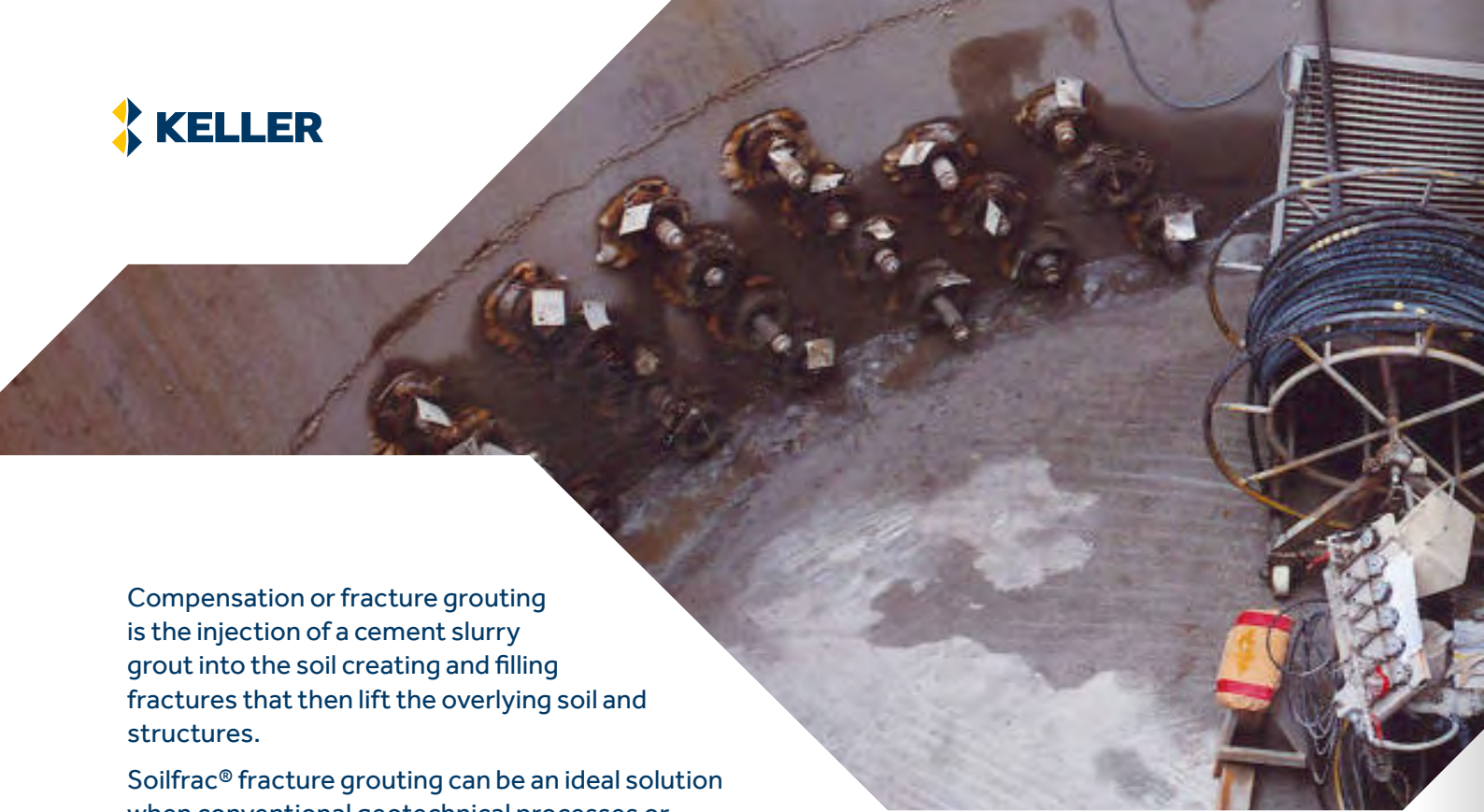




Soilfrac® and Compensation grouting

An advanced solution for building
protection and settlement
remediation

Geotechnical solutions for the construction industry



Compensation or fracture grouting is the injection of a cement slurry grout into the soil creating and filling fractures that then lift the overlying soil and structures.

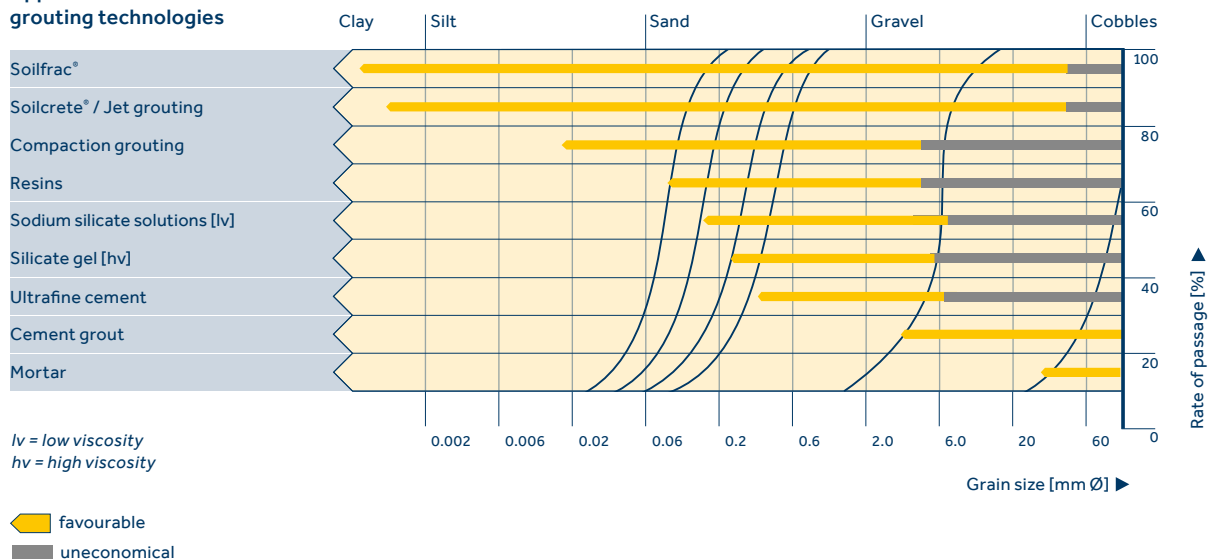
Soilfrac® fracture grouting can be an ideal solution when conventional geotechnical processes or structural remediation are not suitable.

Using advanced grouting technology combined with instrumentation and monitoring, it's possible to elevate structures by several decimetres in a controlled manner to the correct level. In many cases, Soilfrac® compensation grouting can be applied without interrupting the operation of the affected buildings.

Originally the soil fracturing process was used in the oil industry to create fractures in the soil as paths for the oil to flow towards oil wells. Since the 1980s, Keller engineers have been developing the process for a broad range of applications in civil engineering.

Keller has brought compensation grouting to maturity

Application limits for grouting technologies

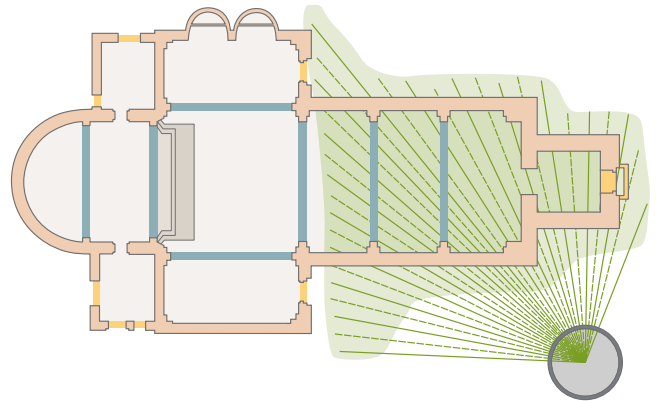




Applications

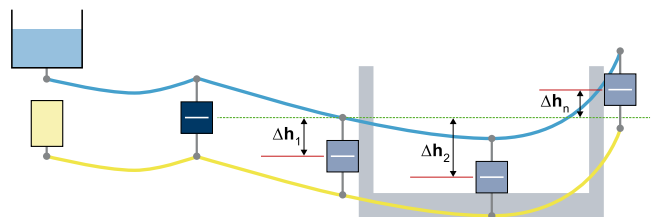
Remediation

Footings and subsoils are both part of the foundation structure. Over time both may fail for a number of reasons, and this frequently happens with historic buildings. In some applications, the bearing capacity has to be increased to transfer additional loads. In these cases, Soilfrac® can be an appropriate reconnect the structure and competent soil formations and provide the required bearing capacity.



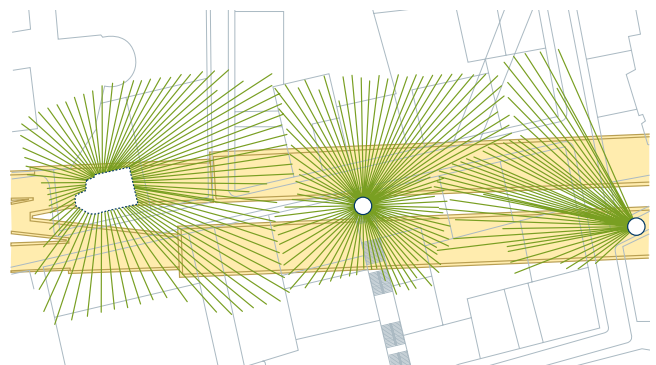
Relevelling of structures

Settlement of structures can be restored by Soilfrac®. The lifting process is designed and adjusted according to the status of the building and the soil properties. Precise partial displacements of only a few millimetres each ensure controlled lifting of building structures in the range of several decimeters. Soilfrac® is also a proven technology to straighten leaning buildings.



Protection of structures

Soilfrac® compensation grouting is the technology of choice to protect structures against settlement during tunneling works. The change of stress state during tunnelling works inevitably causes settlements. Keller Soilfrac® can compensate the settlements fully or partially according to the established lifting targets. Grouting is then controlled by the monitoring system. A quick response to any deformation that occurs is a clear advantage of Soilfrac® compared to other technical solutions.



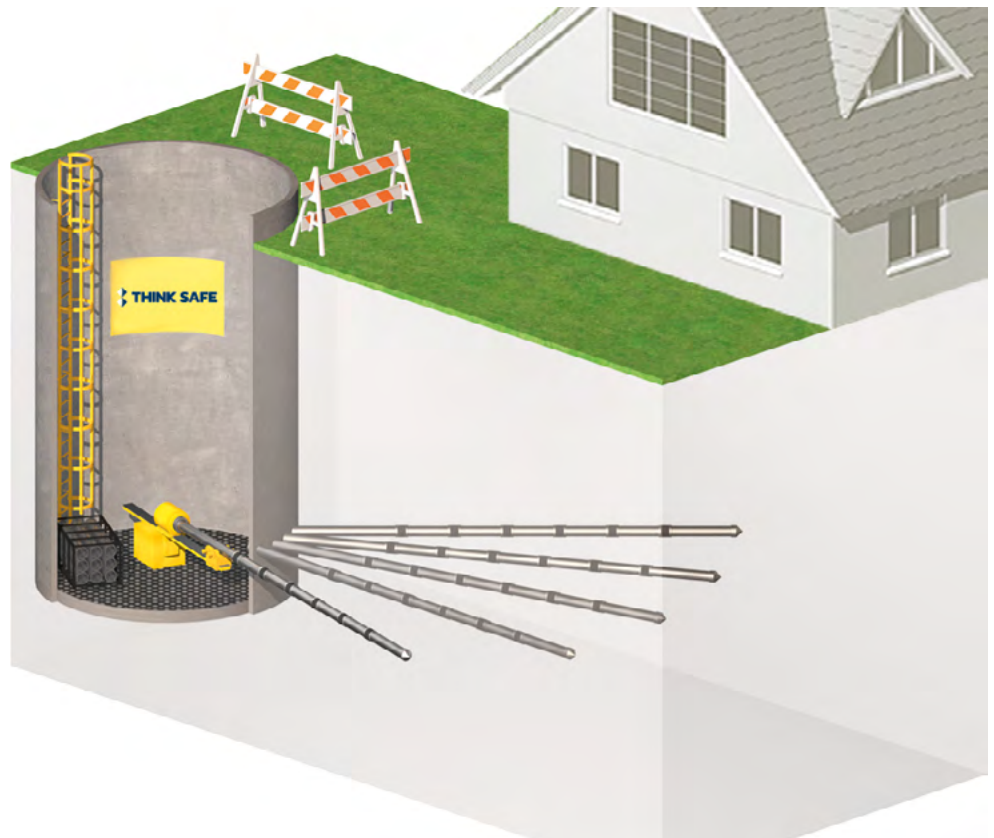
An advanced process for challenging foundation problems



1 Sleeve pipe installation

A sleeve port pipe is grouted into a pre-drilled hole beneath a structure and grout injected under pressure at strategic locations through the ports.

Once the hydrofracture pressure of the soil is exceeded, fractures open in the soil and are immediately expanded by the influx of grout. This results in the controlled heave of the overlying soils and structures.



Technical highlights

- Suitable for a variety of soils from gravel to clay, including organic soils
- Affected buildings can operate without interruption where access from outside the building is granted
- A very precise and proven technology to relevel buildings that experience undue settlement
- Leaning high rise buildings can be brought back to an upright position



2 Soil fracturing

For the injection of the Soilfrac® grout, a hose with a double packer at its tip is inserted into the sleeve pipe. The double packer closes the sleeve pipe on either side of the sleeve, allowing the grouting of individual sleeves in the area to be treated. The grout mix is specially designed for each project.

3 Multiple grouting

The sleeves along the grout pipe might be used only once or several times according to the technical requirements. The grout parameters and sequence are strictly met according to the given specifications. Sleeve pipes can be kept operational for a long period. A monitoring system is used to control the grouting process.



Soilfrac®

Project example



Crossrail C300/C400 London, UK

The largest rail project in Europe, Crossrail involves the construction of 42km of tunnel and new stations beneath Central London.

As the project involved the construction of twin tunnels, cross passages and a number of new station excavations beneath some of the UK's highest value and critical real estate, settlement was a big concern.

Keller provided a compensation grouting scheme to re-level structures which settled as the tunnelling machines advanced along with an instrumentation system to monitor structural movement.

A total of 45,000m of Tube à Manchette pipes were installed from numerous shafts beneath around 50,000m² of buildings. Where settlement was detected, grout was injected through the tubes to re-level the structures to within millimetres of original level.

Soilfrac®

Project example

Cityringen Metro Copenhagen, Denmark

The Cityringenmetro project is a new 15.5km-long metro line in Copenhagen. The new line comprises two 5.78m diameter tubes passing through the Copenhagen and Frederiksberg municipalities and a total of 17 new underground stations.

It was a complex situation at one of the new underground stations. The new tunnels pass above the existing metro tunnels and very close, down to 4.5m, to the foundations of the old landmarked buildings above. Studies confirmed the need for remedial measures to mitigate any settlement caused as the tunnel boring machines (TBM) advanced.



Keller Group Plc

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