



Advanced Ground
and Asset
Technologies
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JOG COMPUTER- CONTROLLED GROUTING

Non-invasive Re-levelling
and Stabilising of Large and
Complex Structures

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A unique re-levelling process by multi-point cementitious injection under computer control

Damage to the ground beneath large buildings and other structures can have costly and dangerous consequences. Unstable soils or those affected by seismic activity, floods, drought or nearby construction can cause foundations to subside, compromising structural integrity.

This can put building occupants at risk or render buildings uninhabitable, often bringing operations to an expensive standstill. Correcting subsidence of large and complex structures requires proven, engineered solutions. As an alternative to costly demolition or major underpinning works, Mainmark offers JOG Computer-Controlled Grouting (also known as Integrated Computer Grouting).

JOG is an extremely precise method for improving ground bearing capacity; raising and re-levelling large sunken structures, to deliver specific, engineered outcomes, regardless of complexity. It is an advanced and award-winning technology.

JOG was initially developed in Japan to correct the effects of earthquake induced liquefaction. It has since been used extensively in other seismic regions, such as Christchurch, New Zealand, to correct and re-level entire buildings, or large sections of structures, that have subsided.

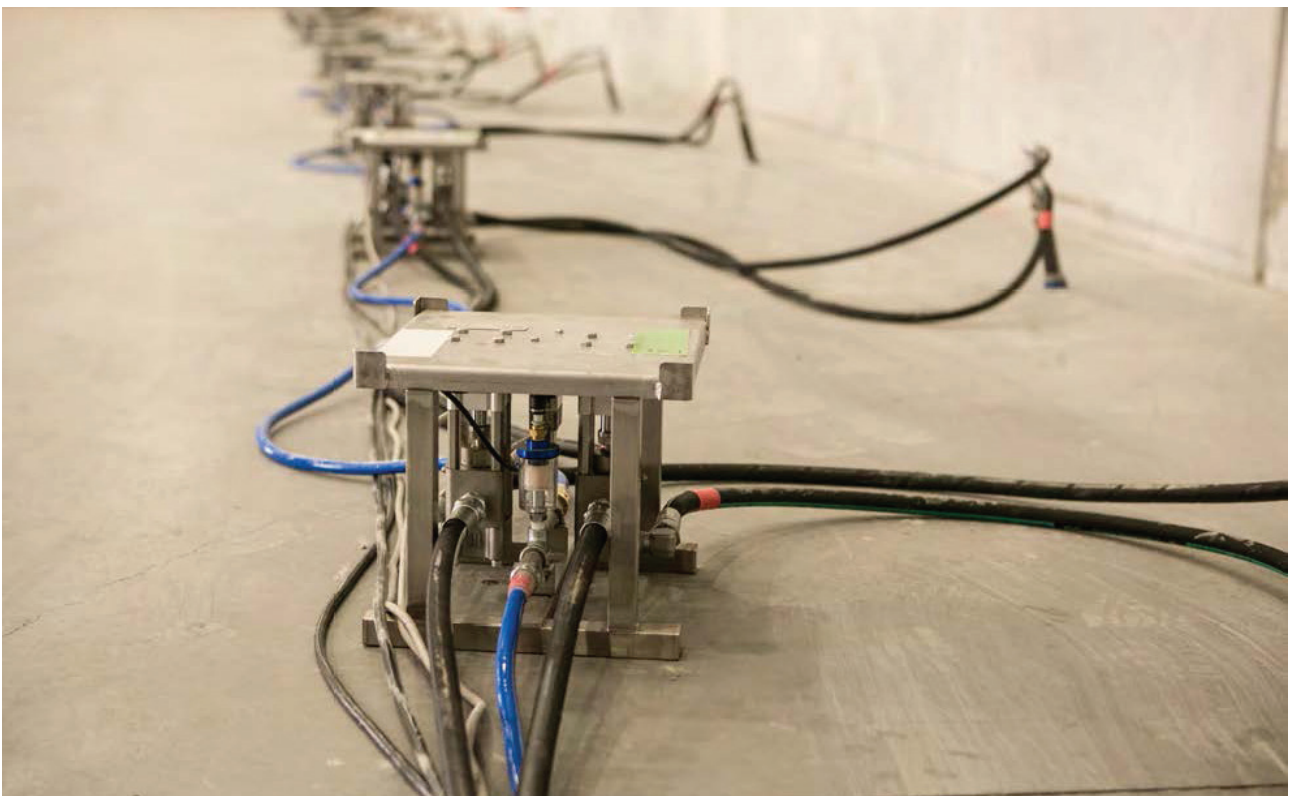
Mainmark's team draws on decades of experience and close collaboration with independent expert consultants, to interpret geotechnical information and complete risk assessments specific to a site's ground conditions. Using these insights, Mainmark develops an engineered solution that meets specific site requirements.

Mainmark can save you time, money and inconvenience, while re-levelling your structure.

FEATURES

BENEFITS

JOG uses a computer-controlled system of synchronised grout injections	<ul style="list-style-type: none">• Lifting and re-levelling is controlled to the millimetre and there is no undue stress on any part of the structure as it is raised back to level.
Grout is delivered via small injection points that are precisely and discreetly placed around the structure	<ul style="list-style-type: none">• Provides a proven and cost-effective alternative to piles, jacks and other expensive, invasive foundation repair processes.
Up to 128 injection points controlled by a single computer and computers can be banked together, enabling hundreds of injection locations if required	<ul style="list-style-type: none">• Large sections - or even entire structures - can be gently brought back to level in this synchronised process.
JOG is likened to 'keyhole surgery', using non-invasive equipment and techniques	<ul style="list-style-type: none">• Little or no excavation is required, which means little or no mess, noise or vibration. Premises don't usually need to be vacated. Neighbouring properties remain unaffected.
JOG uses cementitious grout	<ul style="list-style-type: none">• The environmentally inert grout won't contaminate soil or groundwater.



Re-levelling and stabilising large and complex structures

Multi-Storey



Re-levelled in just 1 week



Re-levelled, varying lift from 16mm to 32mm

Commercial/Retail



Commercial offices re-levelled while occupied



Supermarket re-levelled 180mm

Heritage



Gently re-levelled 110mm



1833 building re-levelled 240mm

Residential



Home re-levelled while occupied



Entire home re-levelled 175mm

Warehouse



No operational interruption

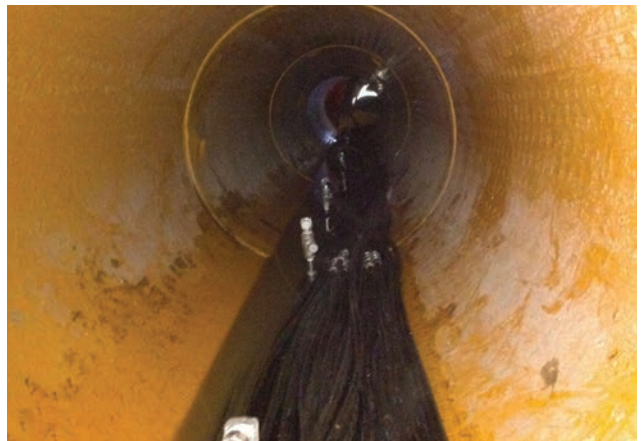


Re-levelled 165mm

Infrastructure/Pipeline



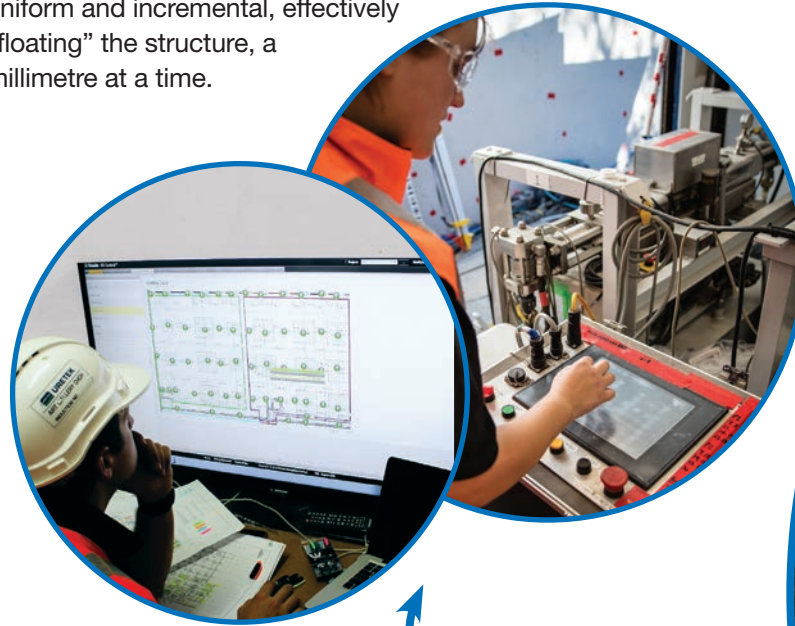
Underground pipeline/culvert raised



Manhole chamber and pipeline raised 35mm

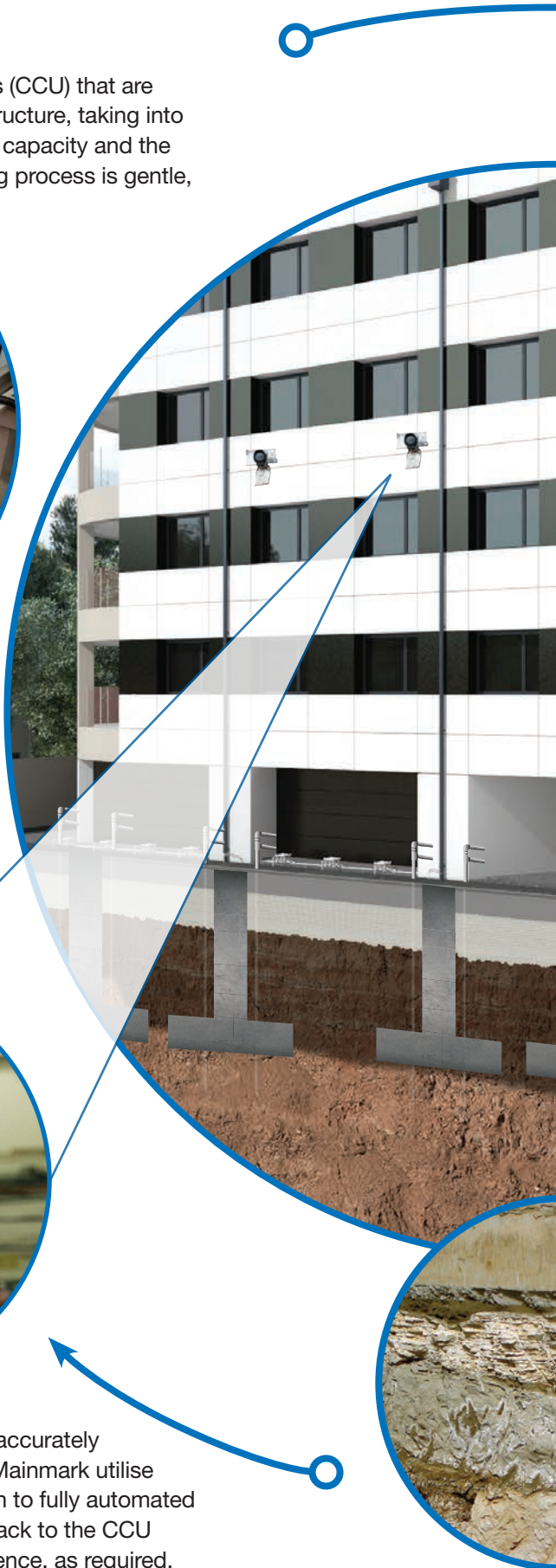
How the JOG system works: Computer-Controlled

The re-levelling process is co-ordinated with Computer Control Units (CCU) that are programmed with an “injection sequence” designed for the target structure, taking into consideration the structure’s current contour and position, structural capacity and the amount and rate of lift required. This helps ensure that the re-levelling process is gentle, uniform and incremental, effectively “floating” the structure, a millimetre at a time.



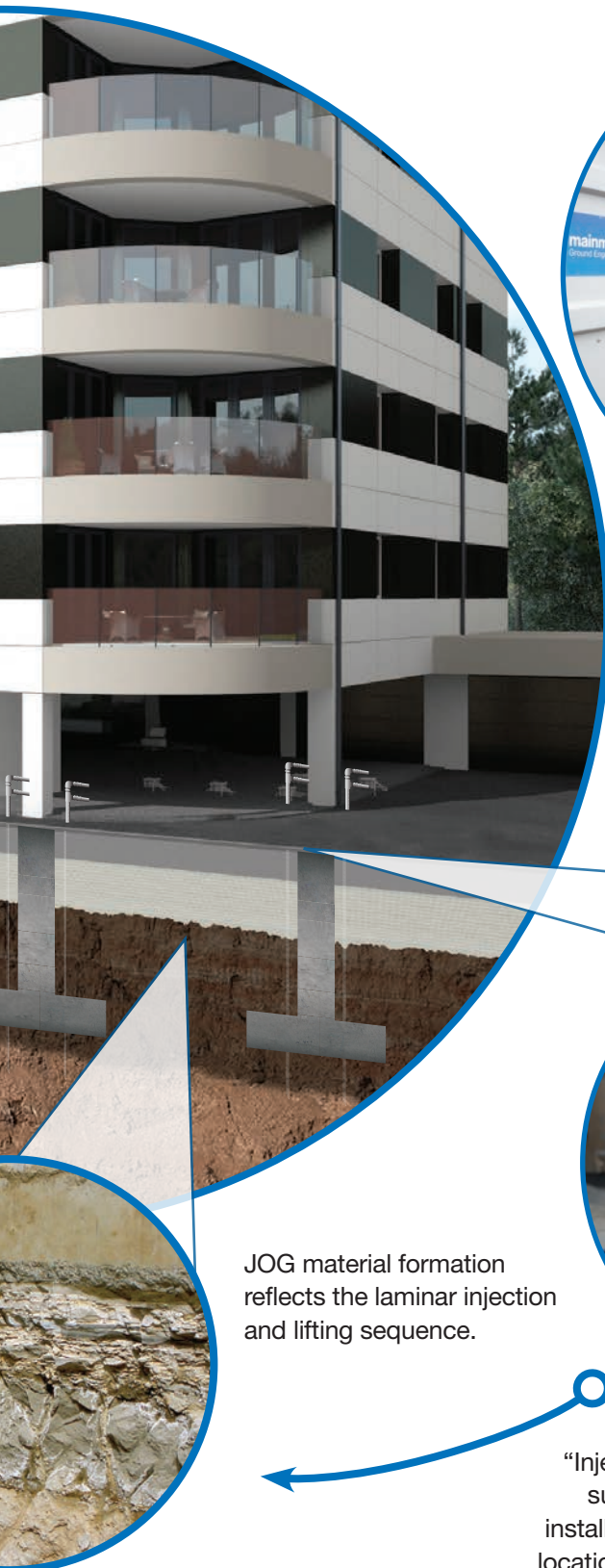
Monitoring and Surveying

Critical to every re-levelling project is the ability to continuously and accurately monitor the building’s response throughout the correction process. Mainmark utilise systems and equipment that range from traditional surveying through to fully automated robotic stations and 3D virtual models. The monitoring data is fed, back to the CCU where the information is processed to manipulate the injection sequence, as required, completing the circuit of the JOG process.



Plant and Equipment

JOG equipment is designed to be compact, self-contained and mobile to ensure that various project requirements can be easily accommodated. Automated containerised units are easily segmented when required to facilitate difficult site access. All production plant and materials can be established within an area as small as 40m². These can readily be transported to remote locations, including between countries.



JOG material formation reflects the laminar injection and lifting sequence.

Androids and Injectors

“Injectors” are strategically positioned across the target structure and are surgical by nature as they are only 25 to 40mm in diameter, and can be installed to 10 metres or more. “Androids” actuate each individual injection location according to the CCU injection sequence and can be positioned at every injection location or banked together remotely from the injection point.

The award-winning resurrection of the Christchurch Art Gallery

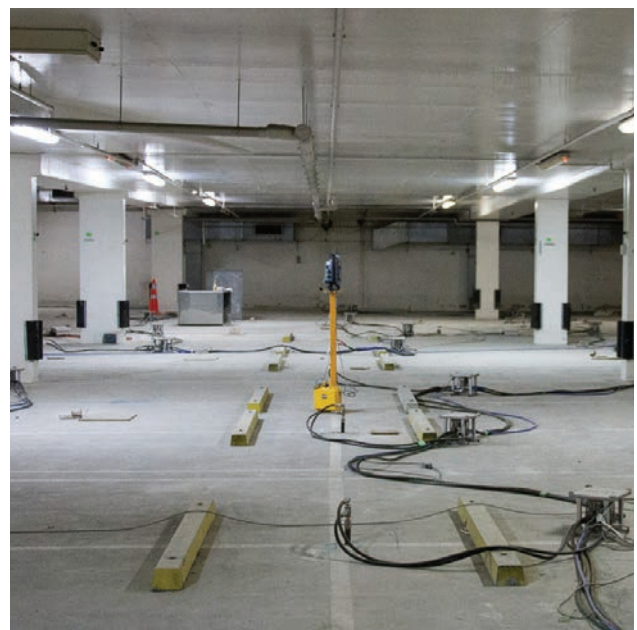


Mainmark won the International Project of the Year Award at the 2016 Ground Engineering Awards in London UK, for its use of JOG Computer-Controlled Grouting to re-support and re-level the 33,000-tonne Christchurch Art Gallery. During the earthquakes of 2010 and 2011, the foundation soils suffered severe liquefaction, creating differential settlement from 50 to 182mm across its 6,500m² footprint.

The landmark project demanded that Mainmark work closely with the project engineering team from design through to the delivery to ensure the best possible project results.

Working from within the basement, Mainmark re-levelled the four-storey gallery in just 44 days using JOG Computer-Controlled Grouting while the building remained occupied by staff and priceless artworks. Total lifts of up to 182mm were achieved, with the average daily lift being 2mm, ensuring a gentle and controlled correction. Critical to the success of lifting a building of this size, was the ability to continuously monitor the gallery's position at any given time.

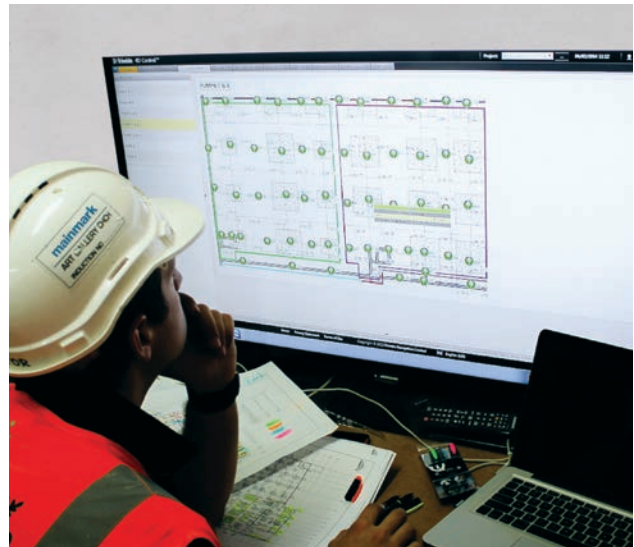
Mainmark developed an automated surveying system consisting of several robotic stations and hundreds of prisms positioned throughout the building.



The captured data was processed wirelessly back to the monitoring station in the temporary control room on site, as well as enabling remote client viewer access. The control room utilised the information to manipulate the injection sequence programming of the Computer Control Units, all effectively in real-time.

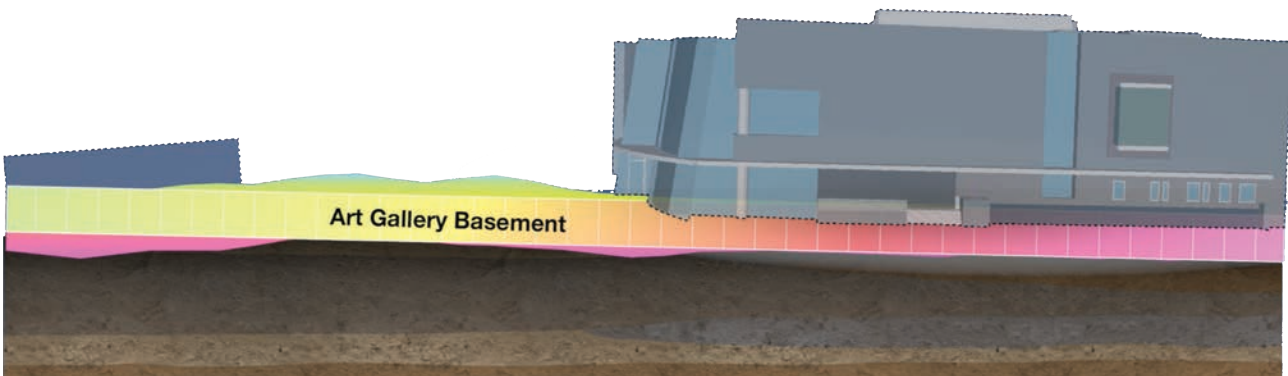
The monitoring system included a traffic-light alarm system to provide a simple visualisation of how the building was responding as it was re-levelled. All monitoring locations would display green if differential tolerances were maintained within the design set limits (2mm of one another). An amber alert would be activated if these tolerances were exceeded, requiring an immediate investigation of the area and adjustment to the injection sequence. A red alert would demand injection within the immediate area to cease until a visual inspection and check was completed, the injection system/sequence reset to correct the lead/lag before injection was permitted to recommence.

The re-levelling of the Christchurch Art Gallery set a new benchmark in re-levelling of large-scale buildings.

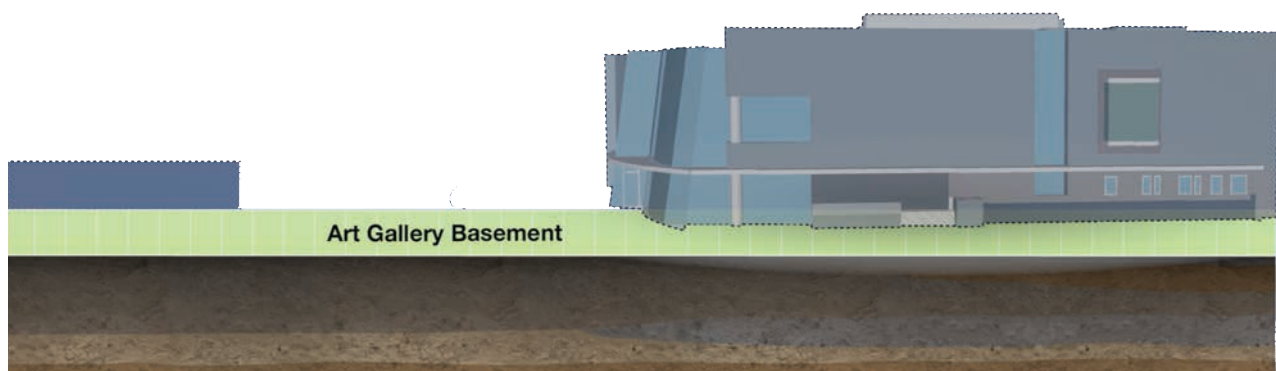


Remotely monitoring the data

Model representation of the differential settlement



Before re-levelling



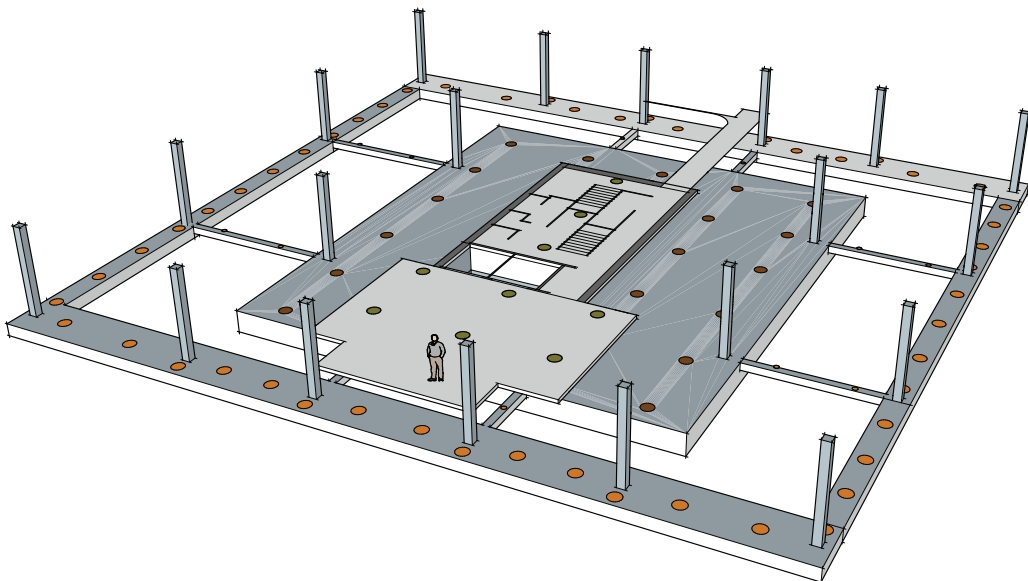
After re-levelling

Multi storey building re-levelled by JOG



A five-storey reinforced concrete building had been damaged during a series of earthquakes. The rigid structure had suffered differential settlement across the footprint by up to 160mm from SE corner to the NW corner. Mainmark's solution incorporated up to 100 injection locations strategically distributed across the footprint of the slab and surrounding foundations. All injectors were connected to the central Computer Control unit, where the operator individually controlled and manipulated the quantity of grout supplied and cure times to individual injection locations.

During the lift procedure the building was continuously monitored with automated monitoring system and automated robotic stations. This provided the precise data required to gently raise the building back to the desired target levels within a 33 day period from start to finish. Other trades were able to continue working on site while Mainmark raised the building and no additional damage was added as a result of the lift.



Design of the JOG injector placement

Commercial building re-levelled



A commercial property in the outer Melbourne suburb of Caroline Springs showed signs of significant foundation damage and needed to be stabilised. The property consists of two separate commercial structures, Building A and Building B, which were both showing signs of subsidence.

A combination of JOG Computer-Controlled grouting and Teretek® resin injection was able to re-support both buildings, prevent any further damage and allow the owners and occupants to continue using the buildings as intended.

The works at Building A were completed over six days with a maximum of 16mm lift achieved at an average of 3.5mm over the building's footprint.

All injection works at Building B were completed over eight days with a maximum of 32mm lift was achieved at an average of 18mm over the footprint of the structure.

Overall, the planning and execution of this project was completed successfully with both buildings responding well. Due to the complexity of the project, there were several challenges that the Mainmark team successfully navigated due to the unexpected thickness and extreme drilling depths required for some of the injection points. The Mainmark team of seven worked six days per week to successfully complete the entire project in less than five weeks.

About Mainmark

The Mainmark group of companies are leaders in advanced ground engineering and asset preservation technologies. For more than 20 years, Mainmark has led the world in offering unique, innovative solutions for foundation repair, and rectifying problems in residential, industrial, commercial, civil engineering and mining situations.

In Australasia, the Mainmark group of companies has been in operation since 1995, with seven offices throughout Australia and New Zealand. Since 2001, we have also operated wholly-owned subsidiaries in Japan and more recently in the UK. We are a privately-owned company with highly-trained technicians and state-of-the-art equipment. Our solutions are all non-toxic, inert, and environmentally neutral. All of our works are planned, supervised, and executed by our own experienced personnel. We guarantee our products.

Companies of the Mainmark group present creative, effective solutions to many types of ground engineering problems in a wide range of sectors: industrial; commercial; civil; and mining. Some of the companies offer related solutions in the building and construction areas. Many of these solutions are unique to Mainmark and its associates.



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