

Sydney Gateway -  
Sydney, NSW, Australia.

DISCIPLINE BROCHURE

# Materials & Durability

OPPORTUNITIES  
THROUGH  
EXCELLENCE  
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BG  
&E



# Introduction

**BG&E is a globally renowned civil and structural engineering consultancy celebrated for its innovative, cost-effective, and award-winning designs.**

With a dynamic team spanning 15 offices worldwide - including Australia, New Zealand, South East Asia, the United Kingdom and Middle East - we unite local and international professionals to deliver practical solutions with a strong focus on constructability.

Our Clients consistently return to us, attesting to our exceptional service, responsiveness, and track record for delivering tailored solutions for technically challenging projects. The quantity and scope of engineering awards we've received acknowledge our diverse industry contributions and the exceptional quality of the services we deliver across a host of regions, disciplines, and sectors.







*The Doulton –  
London, United Kingdom.*

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## Materials & Durability

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BG&E Materials comprises professional civil, structural and chemical engineers, materials scientists, durability experts, and tradespeople who are experienced in delivering cutting edge design and construction staged services for our Clients around the world.

While technical excellence underpins our business, we also strive to provide responsive service, practical solutions, innovative ideas, and effective communication. These are the core values of our team, and we pride ourselves on bridging the gap between technicality and commercial practicality.

As leaders in our field, we encourage strong links to academia and value our industry partnerships. We have built our team with the vision that an amalgamation of all industry sectors, from academia to trades, genuinely offers a more professional and tailored service to our Clients.

SERVICES:

# Sustainability

BG&E has extensive expertise in implementing carbon reduction strategies across building and infrastructure projects.



*Quay Quarter Tower –  
Sydney, NSW, Australia.*

Our team excels in both engineering design and materials selection, encompassing concrete, structural steel, and timber. We have expertise in establishing project benchmarks and addressing potential shortcomings in methodologies.

From a structural and architectural standpoint, BG&E routinely reviews and determines the upfront embodied carbon of the structure. The scope of the calculation can include finishes and other construction materials, and the results of the carbon calculations can be analysed to identify the highest embodied carbon contributors and to set a baseline for improvement.





Requirements on projects can often be complex and conflicting, resulting from the need to have assets with long design lives that are both cost-effective to construct and low in carbon.

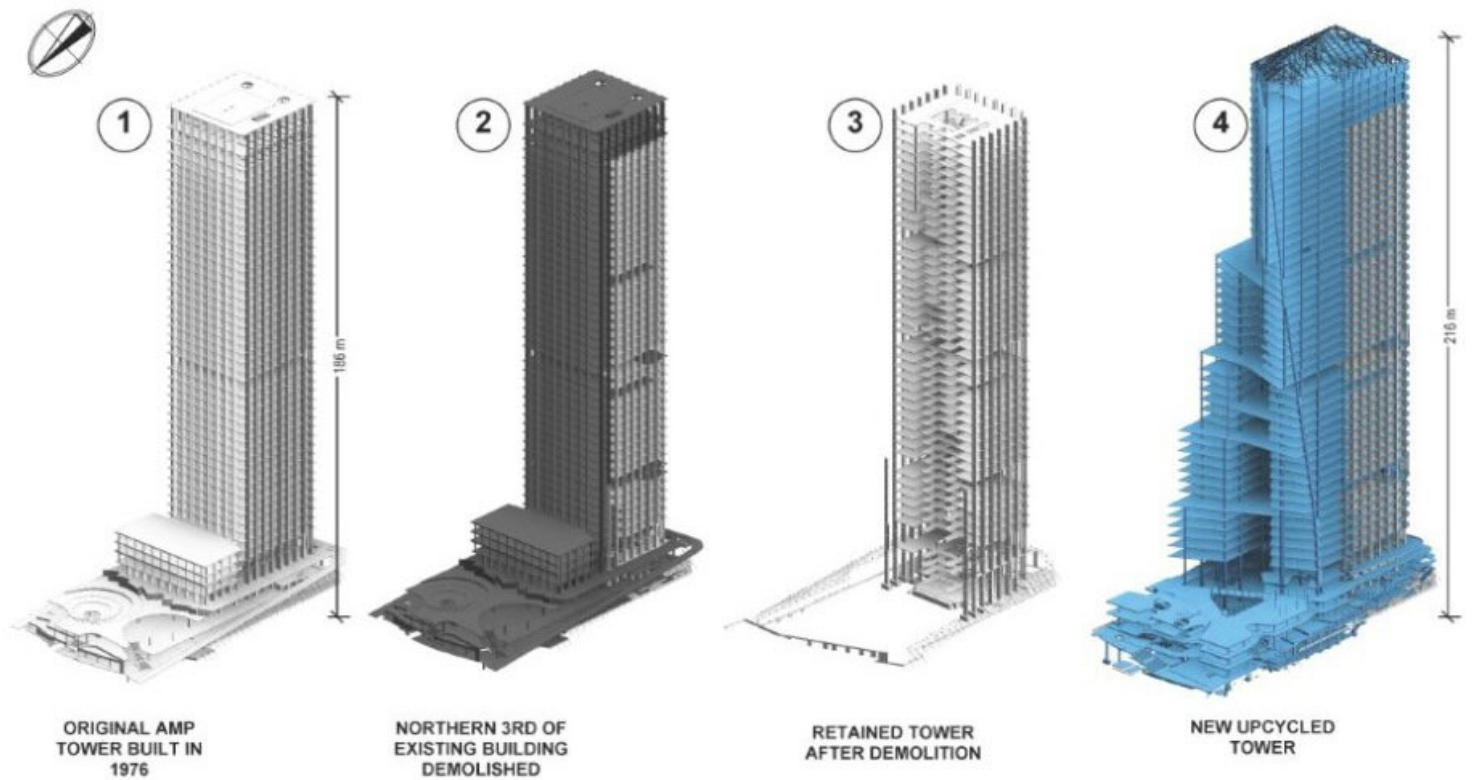
While current methods focus on material embodied carbon, we recognise the limitation of this approach and actively seek opportunities for value engineering and achieving lower carbon outcomes. For instance, we explore alternatives such as column grid spacing adjustments to minimise additional concrete depth for set-down flexibility.

BG&E are specialists in materials and opportunities for materials used in construction. We have done extensive work on concrete, component materials, binders, supplementary cementitious materials (SCM), and a large range of recycled materials.

Our work for Clients has involved using SCM product streams (fly ash and ground granulated iron blast furnace slag) as well as potential new products such as lithium residues, amorphous silicas, geopolymers, and nickel slag binders.

We leverage our expertise in materials decarbonisation by applying this knowledge to key project components and structural elements, reviewing specifications and standards covering design, construction and materials, and developing critical performance criteria and links between carbon in materials and structures.





*Quay Quarter Tower – Sydney,  
NSW, Australia.*

#### SERVICES:

## Adaptive Reuse

Adaptive reuse is the single most effective way to both reduce embodied carbon in construction and to adapt our built environment to changing demands.

With the building and construction sector currently accounting for nearly 40% of the world's greenhouse gas emissions, it is no wonder countries are turning to adaptive reuse in the race to fulfil net zero goals and sustainability pledges.

Our team is at the forefront of adaptive reuse, having been the lead Materials Specialist for numerous projects including the Quay Quarter Tower project in Sydney, which is widely considered to be the tallest and largest adaptive reuse project globally ever achieved.

Our adaptive reuse services include:

- Dilapidation assessment.
- Site investigation and condition assessment.
- Extension of life recommendations.
- Material property analysis and assessment.
- Repair and specification.
- Construction phase supervision.



SERVICES:

# Durability

BG&E's team of Materials Specialists have been instrumental in the durability planning of numerous asset types - including metro tunnels, stations, bridges, rail, and water infrastructure.



*Sydney Gateway Viaduct -  
Sydney, NSW, Australia.*

The aggressiveness of the local environment and climatic conditions directly impact the durability performance of a structure and its components. Our team is familiar with the whole life cycle of a project, having been involved throughout the tendering, detailed design, and construction phase delivery stages of numerous projects.

## DURABILITY PLANNING

Key features of our durability planning services include:

- Analysis of atmospheric and below ground environments to ensure appropriate durability measures for the project.
- Assessment of soil contamination and material selection within contaminated sites.
- Selection of the most appropriate material, i.e. concrete, steel or stainless steel for





*Sydney Gateway -  
Sydney, NSW, Australia.*

the application to best meet durability and maintenance requirements.

- Determination of corrosion allowances for buried and atmospherically exposed steel work, with protective coatings provided to further increase design life.
- Nomination of appropriate crack widths and concrete covers ensuring a durable structure with the ability to achieve its nominated design life.
- Concrete mix design review and optimisation to achieve sustainability outcomes without impacting the durability of a structure.

## DURABILITY MODELLING

Durability modelling is another key tool BG&E has expertise in which is used to confirm the adequacy of the nominated design properties and to ensure the design life can be achieved. Our services include:

- Development of concrete thermal control plans to ensure heat of hydration and concrete differential limits are achieved.
- Crack control and crack width modelling.
- Carbonation modelling considering the implications of future climates.
- Chloride diffusion modelling.
- Atmospheric corrosion modelling. durability of a structure.



SERVICES:

## Construction Materials

Construction materials like concrete, steel, quarry products, cement, timber, admixtures, and repair products are vital for efficient and sustainable construction. However, they're often overlooked, relying on outdated specifications that may not deliver the most efficient or durable results.



*Fitzroy River Bridge – Kimberly Region,  
WA, Australia.*

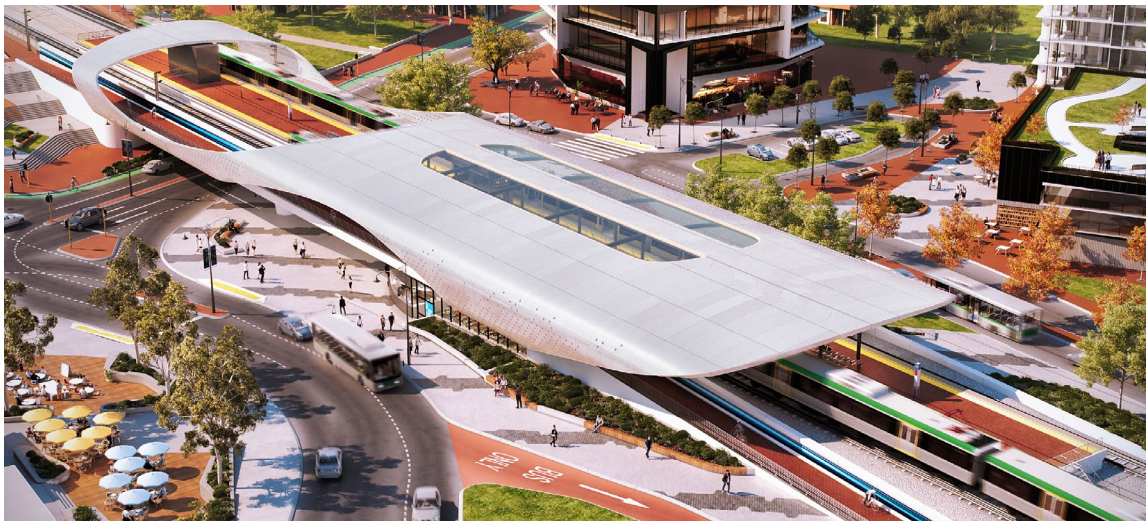
Often a project will have aesthetic requirements (such as concrete colour or steel coatings) that require pre-planning and careful specification to ensure reasonable constructability. Material costs fluctuate across markets, meaning the most cost-effective approach to achieving quality outcomes may differ from one location to another.

BG&E Materials Specialists hail from a wide variety of industries, which enables us to deliver cost-effective, durable and aesthetically sound solutions to our Clients across the globe.

We have seen many occasions where “compliant” concrete mix designs caused honeycombing because they were not optimised for placement with tight reinforcement when there was less than perfect vibration.

Our strength in construction materials has been demonstrated in the following solutions we provided:

- **Fitzroy River Bridge:** modified concrete mixes using local aggregates and high slag content for reduced heat of hydration and admixtures to assist pumpability.
- **Bayswater Station:** modified concrete mix aggregate grading to facilitate surface finishing and compaction with very tight reinforcement spacing.
- **Onslow Iron Project:** assisted with review and direction of concrete mix trials in Vietnam for high durability marine precast concrete.
- **Yanchep Rail Extension:** suggested shotcrete mix changes to improve early strength and reduce slumping on the wall on some rail retaining walls.



*Metronet, Bayswater Station –  
Perth, WA, Australia.*



SERVICES:

# Quality Assurance & Monitoring

Quality assurance (QA) and monitoring are critical elements of construction projects to ensure the durability, strength, and safety of structures.



*Nebo Rail Maintenance Facility –  
Mackay, QLD, Australia.*

Our team can provide a range of QA and monitoring services throughout the construction process - including on-site monitoring through inspections or testing and post-construction inspections to ensure elements have been built to meet the standards and requirements for each project.

We have been involved in projects from a wide variety of Clients including:

- Concrete suppliers (Boral, Holcim, Hanson, etc.).
- Tier 1 and 2 contractors (CPB, John Holland, Richard Crookes, etc).
- Local councils.
- Governing bodies (TfNSW, Sydney Water, etc).

Our Materials Specialists have undertaken a variety of projects, including concrete placement inspections, post-construction inspections of concrete culvert and pipe units, and assessments of concrete structures for defects. We have been trained in and utilise a variety of testing equipment to assist with inspections.

SERVICES:

# Asset Inspection & Remaining Life Assessment

Our Materials Specialists conduct thorough inspections to determine the remaining life assessments of assets, which is essential for maintaining asset integrity.



*Culvert - Cairns, QLD, Australia.*

Durability testing, including chloride and carbonation testing, is integral to this assessment process. To carry out chloride and carbonation testing, we extract dust or core samples from the concrete elements. Chloride testing is undertaken to determine the degree of chloride ingress in the concrete. Cores or dust samples are tested at NATA accredited laboratories. The results of lab testing are used to conduct chloride modelling to aid in the estimation of remaining asset service life.

Carbonation testing is undertaken to determine the degree of carbon dioxide ingress into the concrete. A phenolphthalein indicator is sprayed onto each concrete core sample to determine the carbonation depth. This data is then applied to a carbonation model to estimate the time until carbonation-induced corrosion of the reinforcement elements.

The combination of carbonation and chloride results is necessary to predict the remaining service life of the assets.



## SERVICES:

# Testing Services

BG&E Materials Specialists have accumulated a wide range of tools that we frequently use to obtain objective data for our Clients, whether it be for determining the pull-off strength of a newly bonded concrete, or the remaining thickness of a corroded steel sections.



*Pullout testing.*

Residual life modelling, corrosion monitoring, strength assessment, and integrity testing would not be possible without our extensive range of tools and equipment.

With the ever-improving nature of battery-operated equipment, digital data recording, and innovative technology, we ensure that our Clients are reaping the rewards of the latest available equipment, particularly in remote areas. This includes the use of ultrasonic

testing, photogrammetry, and reality modelling, petrographic analysis, digital crack mapping, concrete void assessment, and thermal imaging.

We ensure that proper training is conducted, accreditation received, and equipment certification and calibration obtained on all our equipment whether owned and operated by BG&E or hired from our reliable subcontractors.

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SERVICES:

# Remediation

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With a proven track record of success in this specialised field, our team bring a deep understanding of the unique challenges and intricacies involved in supporting Clients undertaking remedial construction projects.

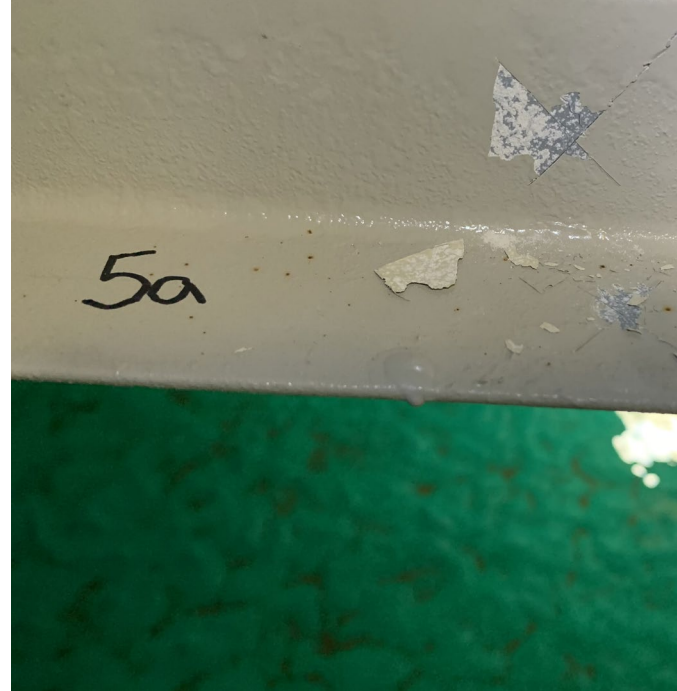
From identifying structural deficiencies to implementing effective remediation strategies, we offer comprehensive support every step of the way.

Our multidisciplinary team comprises seasoned professionals, including engineers, materials specialists, and project managers, who collaborate seamlessly to deliver tailored solutions that address our Clients' specific needs.

We prioritise clear communication and transparency, ensuring Clients are fully informed and involved throughout the process. Furthermore, our commitment to quality and compliance means that we adhere rigorously to industry standards and regulations, providing peace of mind to our Clients.

Whether it's addressing structural weaknesses, mitigating risks, or optimising project timelines, our team is dedicated to delivering results that exceed expectations and restore confidence in every aspect of the construction project.





*Community Water Tanks –  
Kimberly, WA, Australia.*

## SERVICES:

# Coatings & Treatments

BG&E's Materials Specialists have extensive knowledge and experience in coatings, their properties, preparation and application, and performance on metals, concrete, and other substrates. This includes protective coatings, powder coatings, protective tapes, and metallic coatings (such as galvanising, electroplating, thermal metal sprays, etc.) for steel and other metals used in construction and manufacturing. In addition to coatings, we have experience in surface treatments including anodising of aluminium and chemical passivation of metals.

Our previous experience includes:

- Selection and specification of protective and metallic coatings and/or surface treatments for steel and metals based on exposure conditions, surface preparation, site or workshop application, and aesthetic and durability requirements.
- Investigations and testing of existing coatings for identification and assessment of their condition.
- Development of Inspection & Testing Plans for the preparation, application, and testing of coatings for quality assurance.
- Inspection and testing services for preparation and application of protective coatings.
- Review of coating specification and Inspection & Test Plans to confirm durability and suitability of the proposed systems and conformance to project specifications and relevant industry and national or international standards.
- Undertaking failure investigations of coatings and coating corrosion failures to identify the cause/s of the failure and develop maintenance plans and repair requirements.
- Design and detailing of metal fabrications to optimise the durability and performance of the coatings that are to be applied.
- Durability planning for metals and coatings.



*Assessment of steel rakers for  
recladding works for Central  
Park – Sydney, NSW, Australia.*

## SERVICES:

# Metallurgy

BG&E Materials Specialists have extensive experience in steel and other metals used in construction and manufacturing - including structural and low alloy carbon steels, stainless steels, non-ferrous metals, and metallic coatings.

Our previous experience includes:

- Selection and specification of metals for durability, quality, and structural requirements.
- Metallurgical investigations and testing to identify steel grades and metal alloys.
- Mechanical properties testing to confirm steel grades or properties of other metals.
- Testing and assessment of existing steel or metal structures as part of structural investigations and determining remediation requirements. This includes testing and assessment of historical structural steelwork.
- Development of Inspection & Testing Plans for the quality assurance of metals, coatings, and welding. This includes the development of testing and inspection plans to ensure steel manufactured to non-Australian Standards complies with the requirements of AS 4100 and AS/NZS 5131.
- Review of mill certificates and testing to confirm conformance of structural steelwork to specifications, and Australian or international standards.
- Undertake failure and corrosion investigations of metals to identify the cause/s of the failure and repair requirements.
- Design and detailing of metal fabrications for durability and quality.
- Specification, testing, and analysis of metallic coatings and finishes including, galvanising, aluminium/zinc alloy type coatings, electroplating, passivation treatments, and anodising.
- Review of welding procedures for structural steelwork, stainless steel, reinforcement steel, and studs.
- Durability planning for metals and coatings.



SERVICES:

# Risk Assessment & Auditing



Our Materials team consists of Chartered professional engineers with backgrounds in civil and structural engineering. This expertise, combined with our knowledge of construction materials, offers a robust perspective when assessing asset risk - whether it be from defects, residual life, temporary, or safety in design.

Our team frequently audit concrete plants, quarries, mines, and other assets that pose risk from a work health safety (WHS) or commercial perspective. We have also had the opportunity to design risk management and auditing systems for our Clients so that their on-site personnel can easily determine risks and associate strategies to mitigate risks from their own inspections.

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SERVICES:

## Expert Witness

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**BG&E undertake extensive work with legal matters, particularly in relation to use of construction materials, including concrete and structural steel, on projects (“back end” work).**

We are experienced with legal processes where experts and expert reports are required and are often engaged as experts on matters where our expertise is required. We have extensive experience producing legal reports and working with lawyers and barristers. We have a good understanding of issues faced by parties in construction disputes, knowledge of mediation, expert conclaves and attending court. Finally, we have acted as technical referees on specific matters, working for both parties collectively.

Examples of work we have been involved with include:

- Durability of concrete in marine environments – issue of concrete design, construction, and materials.
- Cracking of concrete in slabs – apportioning technically who is responsible.
- Assessment of existing concrete for use in modified projects.
- Durability of steel fibre reinforced shotcrete and concrete, and concrete shrinkage and movement – disputes arising from incorrect design, construction, and materials.



# Why Work With Us

## KEY BENEFITS



**RESPONSIVENESS &  
AVAILABILITY**



**STRONG INDUSTRY  
RELATIONSHIPS  
(INC. EQUIPMENT,  
SUPPLIERS, &  
LABORATORIES)**



**EFFECTIVE &  
PROFESSIONAL  
COMMUNICATION**



**PRACTICAL  
SOLUTIONS**



**LICENSES,  
ACCREDITATION,  
& TRAINING**



**WIDE RANGE OF  
EQUIPMENT & TOOLS**



*Focus Apartments –  
Gold Coast, QLD, Australia.*

## Training & Development

The BG&E Materials team not only demonstrates advanced technical skill and resourcefulness - we also encourage a knowledge-sharing philosophy within the industry.

Our commitment to training and development is demonstrated through:

- Participation in roundtable or forum discussions.
- Provision of training sessions for construction teams.
- Engagement in partner and Client-focused industry presentations.
- Individual involvement in Australia Standard committees and university think tanks.
- Collaboration with industry partners to draft best-practice guidelines.



# Testing Equipment



## Borescope

A borescope is used to get into those hard to reach cavities and provide images of the condition. For example, behind masonry cavity walls.



## Concrete Scanner

Concrete scanners are used to assess the depth and location of embedded reinforcement and sometimes the depth of concrete elements.



## Concrete Scanner (Mobile)

The mobile version of a concrete scanner allows assessment of embedded reinforcement in smaller elements such as beams or slender columns.



## Inspection Camera System

Inspection cameras are a fantastic tool to assess pipes or cavities at longer distances where physical inspections cannot be completed.



## Moisture Meter

Moisture meters measure the percentage of water in a given substance, usually timber, but also masonry and concrete.



## Pull Out Tester

Pull out testers assess the strength and durability of a bond between two materials. For example, the bond between tiles and the concrete substrate.



### Rebound Hammer

A rebound hammer measures the surface hardness of a material. It is often used to confirm consistency of a material or to correlate to a strength.



### Thermal Camera

Thermal cameras are great tools to understand moisture conditions and heat maps for concrete placements. They are useful at detecting voids.



### Thermal Camera (Mobile)

The mobile version of a thermal camera connects to any smart phone and is great for quick assessments of moisture and heat mapping.



### UAV

Reality modelling and efficient inspections are possible with UAV's. Both fly and underwater drones allow access and visibility to places not easily accessed.



### Ultrasonic Integrity Tester

The ultrasonic pulse velocity tester uses dry point contact to determine an indirect UPV measurement. Ultrasonic pulse velocity (UPV) test is a non-destructive popular test used to examine the homogeneity, quality, cracks, cavities, and defects in concrete.



### Ultrasonic Thickness Gauge

Ultrasonic thickness gauging is a widely used non-destructive test technique for measuring the thickness of a material from one side.



# Industry Partners

BG&E Materials is proud to maintain strong relationships with and provide ongoing service to repeat Clients in various sectors.



**materials@bgeeng.com**

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At BG&E, we are united by a common purpose – we believe that truly great engineering takes curiosity, bravery and trust, and is the key to creating extraordinary built environments.

Our team of more than 1100 highly skilled people, in 15 offices across Australia, New Zealand, Singapore, the United Kingdom and Middle East, design and deliver engineering solutions for Clients in the Property, Transport, Ports and Marine, Water, Defence, Energy and Resources sectors.

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