

RSK Environment Ltd

Materials & Structures

Building surveying, structural investigation and assessment

Multidisciplinary scientific and engineering services

An independent consultancy including UKAS-accredited testing services

Provision of expert witness services and scientific materials evidence



"We are committed to providing our clients with tailored, pragmatic and environmentally sound engineering and scientific services and solutions that are delivered effectively and efficiently."

RSK
www.rsk.co.uk/stats

Consultancy with allied technical services

RSK Materials & Structures is a professional evaluative consultancy with allied technical services that are relevant to all stages in the life cycles of buildings and civil engineering structures

Our engineers, surveyors, technicians and materials scientists can provide comprehensive and cost-efficient solutions to the everyday needs associated with the design, inspection, maintenance and redevelopment of the built environment, as well as resourcing and evaluation of all structural, constituent, fixing and finishing materials.

We undertake commissions from a wide variety of clients, including architects, institutional investors, consulting engineers, building surveyors, house builders, property owners/agents, contractors, manufacturers, solicitors and government bodies.

Our staff are trained to work on the railway network, in confined spaces and at height from elevating work platforms and scaffolds, and by rope access.

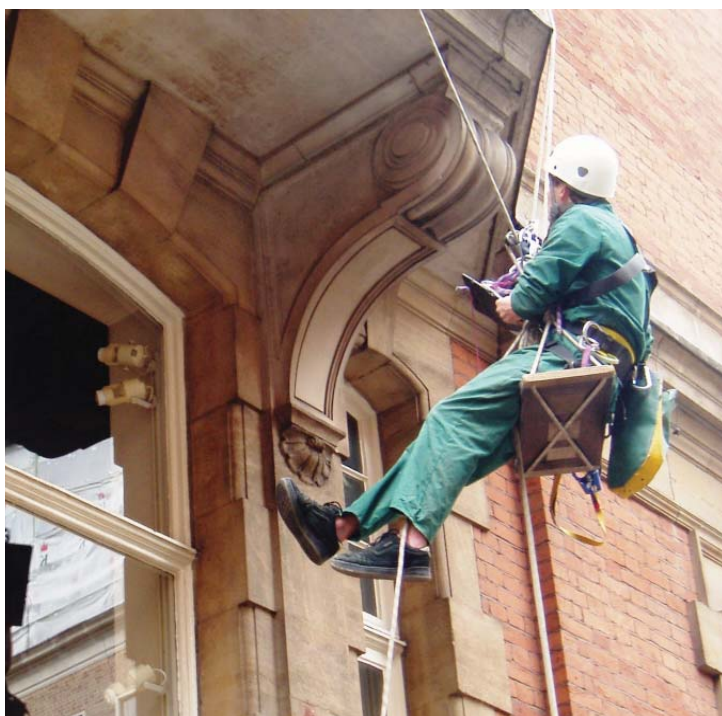
Our strengths lie in a combination of:

- Consultancy-led approach.
- Extensive experience in traditional and innovative materials, structural investigations and other related fields in over 60 countries worldwide.
- Broad, multidisciplinary skills base.
- Ability to perform both consultancy and contracting roles to give a one-stop shop for physical investigation, inspection, testing, assessment and interpretative reporting.
- ISO 9001/14001/18001 certification for quality, environmental and health and safety management.
- United Kingdom Accreditation Service (UKAS) accredited analytical and testing laboratories.

With each client, we agree an investigation outline and a fee structure at the outset, so that we can provide the information required within a set timescale at a competitive cost.

RSK prides itself on providing authoritative impartial information, opinions and advice.

In summary, RSK has the ability to design, manage and undertake routine and innovative specialist inspection, testing and monitoring of buildings, structures and structural components, and to specify and arrange any necessary repair and remedial works.



Materials in Construction and Expert Witness Services

Resource and product evaluation

As many types of construction materials comprise either selected and processed natural soils and rock strata, or constituents derived from quarried or mined deposits, effective geological evaluation is critical to understanding and predicting material availability, properties and behaviour.

Utilising specialist expertise in the selection of materials at the project feasibility and design stages can yield substantial cost savings, improve quality assurance and extend operational life.

RSK brings an independent, scientifically rigorous perspective to value engineering for materials and their related construction processes. We also advise on the scope, test methods and choice of acceptance criteria for materials specifications.

Stone and slate technology team

After 30 years of providing consultancy and testing services for stone and slate producers, traders, designers, contractors and building owners and investors,

RSK has consolidated these services into a dedicated skills team and facility, the Stone and Slate Technology team at STATS (SST@STATS).

SST@STATS provides a comprehensive service for all aspects of the selection, use and performance of natural stone and slate products in the built environment.

Off-site materials laboratory service

RSK's in-house laboratories provide full compliance testing, including the identification and analysis of construction materials and expert analysis of condition and performance assessments.

An experienced, multidisciplinary team of chemists, engineers and geologists provides expert analysis and interpretation from our fully UKAS-accredited facilities.

We offer a client-focused, cost-effective service for innovative solutions to the whole spectrum of problems and challenges encountered across the construction industry.

Expert witness services

Successful resolution of civil disputes or reliable conclusions in criminal cases is often aided by expert scientific opinion regarding the identification and comparison of materials and their properties and provenance. The credibility of the chosen expert in such cases is enhanced when qualifications are allied with practical experience and thorough understanding of the range and application of the specialist laboratory techniques used.

RSK team members act as expert witnesses for both claimants and defendants in civil litigation or arbitration, as single joint experts and, occasionally, in criminal cases.

A multidisciplinary team of highly qualified scientists and engineers carries out our materials consultancy services. This team's collective experience covers the full range of construction materials and their use in building and civil engineering works. An extensive panel of eminent specialist consultants is also available to support our full-time consultancy staff.



Heritage Buildings and Sensitive Sites



RSK recognises that special consideration is warranted for investigation of heritage buildings and when working on sites of sensitive public or commercial interest.

Non-Destructive Testing (NDT)

By adopting a range of non-destructive test methods we can evaluate the properties of a material, component or system without causing damage. Common methods include electromagnetic (cover-meter) surveys, Rebound Hammer (strength evaluation), Ultrasonics (homogeneity) and Geophysical (RADAR) for reinforced concrete structures; with Magnetic Particle Inspection (MPI) and Eddy Current techniques utilised for structural steelwork applications.

By working closely with the site owners/occupiers and the designers we are able to advise on the various NDT techniques available and on any limitations that may be expected using these methods, so that, where necessary, consideration can also be given to selection of individual sites for physical testing or material sampling.

Intrusive investigation

In certain cases, only intrusive survey methods will be able to provide the level of information required by the designer to assess the condition, material properties and hence load carrying capacity of a structural building component.

Our full-time professional staff have extensive experience in intrusive and semi-intrusive investigation methods. They have the training and engineering background required to understand the precise level of information that is required and thus are able to make informed judgement on the extent of any intrusive work necessary. This enables the client to be assured that the minimum level of disruption will be afforded to the building or its occupier.

By adopting the above methodologies, RSK has successfully undertaken investigation works within a variety of sensitive sites where particular care was needed to protect both the building fabric and its contents. These have included museums, Grade I or II Listed buildings, hospitals, pharmaceutical works, food production areas and many more.

We take pride in our ability to design working arrangements that ensure appropriate safety and security considerations are fully implemented. We explain clearly and honestly what disruption may be practically expected and programme our operations fully around the client's specific requirements.



Condition and Performance of Buildings & Structures

Asset management

RSK offers independent, professional inspection and investigation services, together with detailed materials surveys of historical structures and heritage sites, including existing building envelopes, structural elements, fixings and internal finishes.

The information gathered can be used for investment due diligence purposes and as part of planned or emergency maintenance operations.

For due diligence, the scope of surveys tends to encompass deleterious and hazardous materials as well as actual or incipient defects.

Broadcast masts and towers

For broadcast masts and towers, RSK can provide statutory and routine structural inspections, condition registers for civil engineering asset managers and we can conduct more-specific performance investigations into parameters such as integrity and type of coatings, including corrosion assessment of underlying steelwork.

Our site teams also undertake intrusive investigation of foundations to confirm their material properties and overall dimensions to aid an engineer's mast or tower stability assessment.

Multi-storey car parks

Many car parks were built before the industry's current understanding of design and specification of materials for long-term durability.

RSK can provide independent consultancy and testing to identify problem areas and provide practical solutions. We can also offer inspection and appraisal of edge containment barriers to ensure the protection of car park users.

Structural integrity

RSK monitors the long-term movement of buildings and bridges caused by cracking, settlement or vibration using

devices such as strain gauges, crack meters, electro-levels and accelerometers. Data loggers collect the results to enable remote access to the information.

Quality assurance in construction

Achieving consistency and high quality levels in any major construction project requires a combination of many factors, including implementing effective quality management systems and obtaining test data from which to monitor trends and substantiate quality compliance. RSK can provide three key elements to achieving high-quality projects:

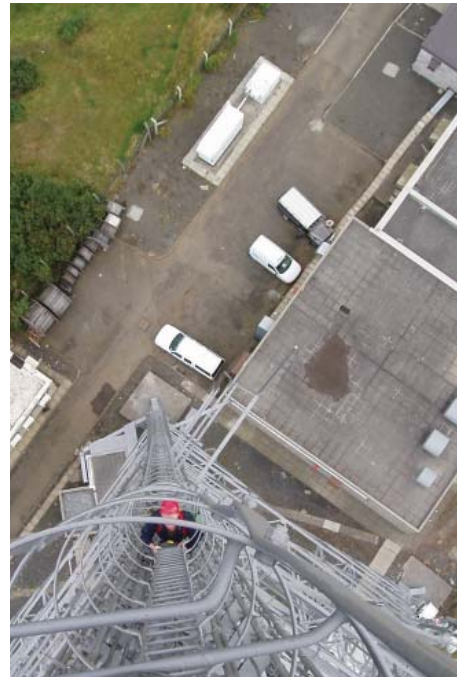
- Preparation or independent auditing of quality assurance and control documentation on policies, plans, procedures and methods.
- Quality statements through independent vendor assessment, including inspection and non-destructive testing both of off-site manufacturing and fabrication together with on-site erection and coating and finishing.
- Independent sampling and UKAS-accredited testing, including dedicated site laboratories and experienced construction materials engineers.

Building envelopes

A building envelope is the separation between the interior and the exterior environments of a building. It serves as the outer shell to protect the indoor environment and to facilitate its climate control.

RSK has extensive experience in assessing the physical components of the envelope including the foundation, the roof, the walls, the cladding systems, the doors and the windows to provide information on:

- Structural integrity.
- Moisture control.
- Temperature control.
- Control of air pressure boundaries.



Case Studies

Overheating in the desert

A construction company in Saudi Arabia built a 70m high concrete structure that showed extensive cracking and delamination on completion. This caused a dispute between the construction manager and the contractor, who claimed that the cracking was the result of alkali–aggregate reactivity (AAR). The construction manager asked RSK to investigate and to advise on possible remediation methods.



An RSK team with combined experience in structural engineering and AAR together with concreting in hot climates visited the site. After making arrangements for drilling of core samples and inspecting the aggregate sources at local quarries, a full materials investigation then took place at RSK's UK laboratory.

Petrographic examination found evidence of interaction between the carbonate aggregate and cement, but it was not causing the cracking. RSK concluded that the concrete temperature had been insufficiently controlled during construction work in the hot climate of Saudi Arabia. This led to thermal expansion of the CEM I concrete, followed by contraction cracking as the material gradually cooled after hydration and setting.

Managing alkali–silica reaction

Reinforced concrete beams supporting a road viaduct were exhibiting severe cracking. Initial investigations had concluded that the concrete was susceptible to alkali–silica reaction (ASR) but further investigation was required to determine longer-term serviceability management of the structure.

RSK comprehensively investigated the as-built details and the material properties of the concrete beams. This work included detailed surface crack mapping, Ferroskan cover meter surveys and half-cell potential mapping. Concrete core samples were also extracted for complementary examination and testing in RSK's materials laboratory.

Using various techniques, including accelerated expansion testing, RSK was able to evaluate the compositional characteristics, existing condition, strength and long-term durability of the concrete.

Consideration of the as-built details, coupled with petrographic examination and analysis of the mix characteristics, suggested there were several factors within the structure's form of construction and its constituent materials that could have contributed to initial early-age cracking of the concrete. The relatively severe environmental exposure of the structure was also deemed a factor in exacerbating any initial cracking.

RSK's initial commission for the laboratory-testing programme was then extended to enable long-term accelerated expansion testing to be conducted.



Inspection and movement monitoring of historic structures

A 25-m high, disused, masonry water tower built in 1867 required condition inspection. Owing to the nature of the building and restricted site access, RSK inspected the tower using rope-access techniques.

A close visual examination by our engineers revealed cracks towards the top of the tower wall where it supported an ornamental projecting turret. Historic records indicated some alterations to the tower roof structure had been carried out within the last 20–30 years. It was concluded that this could have caused redistribution of the working stresses in the structure and initiated structural cracking.



RSK was then commissioned to monitor further movement at the existing crack positions over a 12-month period. Inspection engineers using rope-access techniques installed several fixed reference points positioned to indicate vertical and horizontal movements at the critical locations. The data enabled RSK to advise the client on the extent of further movement and to recommend appropriate remedial techniques.

The foundations of power

In June 2005, a Japanese contractor asked a multidisciplinary team from RSK to examine the foundations of three gas turbines at a gas power plant in Algeria. The client was concerned that the concrete pours cast within the foundations of the three units would debond as a result of differential forces from the soon-to-be commissioned rotating turbines.



RSK used tensile testing and petrographic examination techniques to study the foundations. Several vertical cores were drilled through the foundations to depths of 2.5 m. A load cell and a tensile test rig were then attached to the individual cores to determine the force and the location at which failure would occur.

After the cores were retrieved, a concrete petrography specialist investigated the nature and quality of the interface between the concrete layers and the induced fractures.

RSK also carried out a full structural analysis and load check, and provided accurate information to the client on whether the foundations would withstand the forces exerted on them by the gas turbines once they were fully commissioned.

Bridge gantries assessment

The two main maintenance gantries beneath a major bridge structure near Plymouth, UK, needed substantial repair work. RSK was commissioned to manage this nine month project.

In order to undertake the inspection and repair work, the gantries had to be lowered to the ground. Following refurbishment of the diesel generators and the suspension/drive mechanism, the gantries were load tested whilst suspended from a purpose built steel frame. Weld integrity testing of these aluminium structures was then conducted in addition to undertaking any necessary repairs.



The complex sequence of operations concluded with the gantries being re-erected on the bridge, then electrically commissioned and driven across the bridge by RSK's engineers in a fully laden condition prior to being handed over to the client.

Stress-induced failure

When a sewage processing tank owned by a regional water authority failed catastrophically only 18 months after construction, RSK was asked to comment on this and investigate cracking to similar constructions on the site.

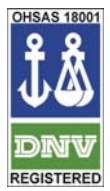


The tall, circular tank comprised a series of 7m high, 2.1m wide, reinforced-concrete panels with vertical prestressing and 20 horizontal post-tensioning cables. The inspection revealed that stress-induced failure of the post-tensioning system resulting from corrosion had caused the tank failure. A 10m exclusion zone was placed around similarly designed tanks while investigation work continued.

On completion, RSK was able to advise the client of the precautions to be taken for structures that rely on post tensioning cables for their stability. It was also made possible through a series of laboratory examinations, to provide the client with relative age and causal information associated with cracking to adjacent structures.

RSK Materials & Structures (formerly STATS Limited, founded 1974) is a specialist department of engineering and materials consultants within the RSK Group of companies. The group encompasses a wide range of professional engineers, scientists and technologists, with extensive experience in litigation, arbitration and other forms of dispute resolution on a wide range of civil, structural, and geotechnical engineering topics, building technology, building and construction materials and environmental issues.

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