

# Cracking Matters

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ISSUE NO. 2

## A PARABLE FOR REPAIR

A friend, of a friend, who has a friend, etc. etc., who is a partner in a small Architectural practice in the City.

A few years ago, the 'friend' set out for himself the standards by which he would judge the success of his life. Given that this was during the heady days of the eighties, he no doubt committed these objectives to paper in that section of his filofax designated 'lifestyle objectives'.

One such measure of his success was that by the time he was forty, he should be the proud owner of a series 5 BMW, complete with all the sports additions and a personalised number plate. Another great objective was to gain the respect of his peers by the standard of his work. Happily, he achieved both with a couple of years to spare. Yet there was a flaw in this great scheme of things.

Whilst the BMW and its successors have all enjoyed a pampered lifestyle with the best of mechanical care, the same cannot be said of some of his construction projects. Like so many others, a man who would not dream of sending his car to a back street garage, is quite prepared to leave specialist construction work to the tender mercies of a general builder.

This is not a down on general builders; it is simply that specialised jobs require specialised knowledge and capability. Sometimes a lack of awareness of this fact can have serious consequences.

A while ago, at the conclusion of concrete repairs to some marine defences, a Contract Administrator reported that he was confident that the Main Contractor could carry out a recently discovered extra repair using general site labour. Against advice, they set to work. On the Monday morning, after a busy (not to say expensive!) week-end, the shuttering was struck on the newly repaired section of concrete.

The silence, as the repair slid gracefully from its rightful position and into the water, was broken only by the voice of the site comedian intoning the burial at sea service over the fast disappearing bubbles that were all that remained from the week-end's labours.

The Contract Administrator had made the classic mistake of failing to recognise the importance of using a specialist contractor - even for the smallest of repairs. The taunts of an unsympathetic workforce being the least of his problems when the cost of the



Concrete repair projects demand specialist capabilities

week-end debacle became apparent.

It is easy to be smug. There is a streak of cruel humour in most of us that enjoys the discomfiture of others, especially when they set themselves up for a fall as perfectly as in this case.

Consider, however, that this incident happened in an isolated location. The only thing that got hurt was one person's ego. In a different setting, for example with residents in-situ, the same mishap could have serious consequences. Twenty kilograms of concrete sliding six inches into the sea is one thing - the same block coming adrift ten floors high, in an inhabited area, is a rather different matter! You can paint as an alarming picture as you want, but no amount of talk about site safety procedures will gloss over the fact that a poorly

executed concrete repair can be expensive in more than just financial terms.

Well we would say that, wouldn't we. Because, lets face it, CRA contractor members have a vested interest in the point of view that concrete repairs should be the province of specialist contractors. Which brings us back to the friend's friend with the BMW.

The real reason for his insistence on a specialised mechanic looking after his car; and for not using a specialist contractor for his repair projects, was because he wants to maintain the conditions of the guarantee on his vehicle. What guarantee, he would argue, would he get from a specialist contractor?

A fair point. 'Guarantee' is the sort of word

that sends lawyers running for cover and with the possible exception of the NHBC certificate on new houses, it is not a word bandied about in the construction industry. Yet, almost uniquely among the repair and refurbishment fraternity, the concrete repair industry has set itself standards that provide a set of assurances to the specifier.

The Concrete Repair Association has moved on from simply being an industry pressure group. It now sets the benchmark standards for this specialist construction sector. Basic standards are imposed upon each member, with accreditation to BS EN ISO 9001/9002 an essential requirement. Further demands are made upon contractor members to train their personnel to a high standard, to comply with the CRA Codes of Practice and abide by current Health and Safety requirements.

In the final analysis, all specifiers need to appreciate that modern standards are demanding higher than ever levels of expertise. Where specialised skills exist, it is folly not to make full use of them. We live in a society that increasingly sees litigation as the answer to its problems. To fail to recognise the need to make sure that all potential angles are covered when specifying products and contractors is to court trouble.

To be blunt, the specifier may not see the need for a specialist contractor but, in the worst case scenario of legal action, no lawyer worth his fee is going to let the absence of experienced operatives go unexploited. Defending a claim, be it for property or injury, on the basis of 'we didn't use experienced personnel to save money' is never going to be successful and is hardly the image that any responsible company, or practice, would wish to cultivate.

So, the specifier owes it to himself to specify specialist companies for specialist work such as concrete repair. Or, to put it another way, to insist on the same standards for the project on his desk, as for the vehicle in his drive. After all, isn't his work as important as his car?

## FOOTNOTE:

*"When you buy on price, you can never be sure. It is unwise to pay too much, but it is worse to pay too little.*

*When you pay too much, you lose a little money - that's all. But when you pay too little, you sometimes lose everything, because the thing you bought is incapable of doing the thing it was bought to do.*

*The common law of business balance prohibits paying a little and getting a lot. It can't be done. If you deal with the lowest bidder, it is as well to add something for the risk you run, and if you do this, you will have enough to buy quality".*

Ruskin. Circa: 1895

THE JOURNAL OF THE  
CONCRETE REPAIR ASSOCIATION

THE  
CONCRETE  
REPAIR  
ASSOCIATION

# Business dip but optimism remains

The latest set of state of trade findings, produced by the Concrete Repair Association and relating to the U.K. concrete repair market for the six months - July to December 1997, show overall business volume down on 1996.

The figures, produced on a six-monthly basis, are compiled from returns supplied by the Association's contracting members, who, between them account for the majority of concrete repair work carried out in the U.K. Based upon the returns, the overall concrete repair market in the U.K. in 1997 was estimated to be worth in the region of £137m.

In comparison to 1996, the figures for the whole of 1997 reveal a decrease of almost 14% in the value of concrete repair work completed by CRA contractor members and a corresponding decrease in the number of contracts completed. This is a reversal of the previous four years figures, which had shown progressive growth in this sector.

Comparisons with the first half of the year show an increase of approximately 12% in contract values for building related work, but a decrease of 0.7% in civil engineering related work. During this period, however, the number of contracts won by CRA members (and currently being carried out) were significantly higher than in the first six months, but lower in value, indicating smaller value contracts being let. Concrete repair related work enquiries received were down in the building sector but significantly up on the civils side, which was a complete reversal of the first six months. During the period, no appreciable change in the intervals between concrete repair enquiries being received and work being let had been experienced.

Most contractor members reported that they continue to operate at less capacity than they would normally regard as a satisfactory workload, but the figures indicate a trend in an upward direction and optimism about work volume and value for the forthcoming twelve

months. Other findings showed that in all sectors about two-thirds of CRA members' total workload was accounted for by concrete repair work.

A second survey, carried out among the CRA's product manufacturer members, mirrors the contractor findings. Overall sales for the year were less than in 1996. The figures show a continuing increase in sales of flowable repair mortars, but decreases in the sales of all other categories of products in the second half of 1996. Manufacturer returns also indicate that whilst the vast majority foresee an increase in sales volume over the forthcoming twelve months, they anticipate sales value and margins to remain static.

Copies of the figures and trends, compiled since 1993, are available at a charge to approved organisations. Enquiries should be addressed to: The Secretary, Concrete Repair Association, Association House, 235 Ash Road, Aldershot, Hants GU12 4DD. Tel: (01252) 321302. Fax: (01252) 333901.

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The above questions are typically asked as part of the audit of an insurance inspector for insurance backed guarantees (IBG's).

## Insurance backed guarantees (IBG's)

IBG's evolved partially as a consequence of some failures of concrete repair projects undertaken in the early to late 1980's in particular to municipal work. Perhaps many of the failed schemes were based on the first of the 'recipes' listed above.

Many of the failed schemes were undertaken by contractors who have since ceased trading and hence the affected building owners have been left high and dry.

Typically, IBG's cover the cost of remedial work if it is evident that failure has occurred as a result of defective materials or workmanship. Each claim will be subject to a policy excess. The amount payable under the policy will reduce on a sliding scale to zero on expiry of the insurance. As with all forms of insurance, a premium (usually 5%) is payable at the start of the policy, added to this will be the fee of an independent insurance inspector.

The adoption of an IBG should be considered on merit. IBG's are probably best suited to projects where repairs are carried out under a design and build contract or where a leading specialist consultant has not been appointed. Certainly, an IBG would be less necessary if a first-class project team was involved (as in the second of the 'recipes' listed above).

## Overview

The concrete repair industry appears to be in good shape, however the market place has changed to one where environmental issues are becoming increasingly important. There is currently a trend away from 'bash it' and 'repair it' to the more ecologically friendly 'retain and treat'. As a result, the use of traditional repair material such as conventional repair mortars is declining whilst the use of conservation techniques such as the electrochemical based methods of realkalisation, desalination and cathodic protection, and the new breed of corrosion inhibitors are on the increase. Some of the leading concrete repair manufacturers have taken the initiative recognising the increasing demand for corrosion inhibitors, overcladding systems, insulated renders etc. It is fair to say that the leading contractors employ more technically qualified staff and offer a wider range of expertise than say ten years ago.

## The future

The CRA continues to strive to encourage higher standards within the concrete repair fraternity and shed the past image of the industry amateurism.

There is much wider understanding of the causes of concrete deterioration than there was say 10-15 years ago. Increased training of contractor's staff has enabled this understanding to percolate down to the workers at the 'cutting edge'. The BSI will soon be issuing the long awaited Eurocodes on concrete repair. This will mark another step towards standardisation and consistency within the legitimate sectors of the industry. In conjunction with all the exiting new developments coming from the leading manufacturers and contractors, this will represent the coming of age of the concrete repair industry.

ENQUIRY NO: 134



Mike Gibbs, CRA Chairman.

## MIKE GIBBS TAKES OVER THE REIGNS AT CRA

Mike Gibbs, of Pitchmastic PLC, previously Deputy Chairman of the Concrete Repair Association, has accepted the post of Chairman following the retirement of Pat McArdle. The change, occurring unusually in mid-year, has been brought about because of a career move on the part of the previous Chairman.

Bob Berry, of specialist contractor Yoldings Limited, has been elected as the Association's new Deputy Chairman and Allen Broad of specialist contractor

Alfred Bagnall & Sons (Restoration) Limited, has accepted an invitation to join the Executive Committee. The seven man CRA Executive Committee now consists of Mike Gibbs, Bob Berry and Allen Broad, Chris Martin of Concrete Repairs Limited, Mike Darby of Makers Industrial Limited, Glen Runagall of Fosroc Limited and Jimi Fadayomi of Sika Limited.



Bob Berry



Glen Runagall



Chris Martin



Mike Darby



Jimi Fadayomi



Allen Broad

## 'Consultant's Comments'

The Consultant Engineer's role in the process of concrete repair is, of course, critical. In this issue of 'Cracking Matters' we feature an article from Quest Technical Services Limited, which provides an alternative viewpoint of this specialist sector of the construction industry.

In future issues we intend to carry the observations, opinions, experiences and constructive criticisms of other Consultants in a special regular 'Consultant's Comments' section.

If you would like to contribute, please send you comments to The Editor, Cracking Matters, C/O: The Secretary, Concrete Repair Association, Association House, 235 Ash Road, Aldershot, Hants GU12 4DD. Email: john.fairley@btinternet.com

# News from CRA Members

For further information write the relevant enquiry number(s) on the Fax back

## TOTAL PACKAGE EXPERTISE

Traffic management in the centre of London is a political hot potato at both local and national level. Modern, well-maintained parking facilities are increasingly seen as part of the solution to the Capital's congestion problems. As part of Westminster City Council's upgrade of its stock of multi-storey car parks, specialist concrete repair contractor, BAGNALLS, has been working on the refurbishment of Chiltern Street car park in central London. By combining its specialist concrete repair skills with Main Contractor status, Bagnalls has been able to provide the client with a total package, including fire protection and electrical reinstatement, for the structure. Westminster Council benefits through the appointment of one specialist with Main Contractor status, thus dispensing with the management of a multitude of independent trades. This gives the Council the bonus of knowing that the line of communication from client to contractor is clear and concise, avoiding the pitfalls of protracted chains of control. With expertise covering all aspects of concrete repair and refurbishment, from car parks to tower blocks, Bagnalls is able to offer the total package of abilities to clients in both public and private sectors. Telephone: 0181 311 3910 ENQUIRY NO:120



## MULSIFIX THE ANSWER FOR JOHN SCURR HOUSE

Two years ago John Scurr House was a derelict five-storey shell. Extensive cracking, delamination and spalling had developed in most of the exposed concrete surfaces. Further damage had been caused by structural movement, mainly in and near the balconies and walkway parapets. The building was refurbished using SBD LIMITED's environmentally friendly Mulsifix Concrete Repair System. The external decorative and protective treatment was achieved using Mulsicoat Elastomeric; a flexible anti-carbonation coating which compensates for thermal movement and expansion in concrete structures. The SBD Mulsifix Concrete Repair System is BBA approved. More details available from: SBD Limited, tel: (01525) 718877. ENQUIRY NO: 121



## YOLDINGS WINDOWS '98

ISO 9002 Quality Assured accredited Specialist Contractor YOLDINGS LIMITED, recently completed a £650,000, Insurance Backed Guarantee contract to refurbish, repair and reseal the window joints of the external elevations of Unipart's Head Office in Cowley, Oxford. The six-storey office block comprises reinforced concrete beams, columns and ring beam frame structure with pre-cast concrete panels, all sand/cement rendered, with Lakeland slate spandrel pane below numerous window units. YOLDINGS repaired defective and spalled areas of with the BBA approved SBD Mulsifix Concrete Repair & Protection System. SBD Monocouche Architectural Rendering was used extensively to replace the existing rendering. Both the client and specifiers insisted on the use of a CRA contractor to accomplish the quality and architectural finish demanded. For further information contact: Bob Berry, Yoldings Ltd, Tel 01323 442288 ENQUIRY NO: 122



## BALCONIES RESIPATCHED !

Low rise accommodation blocks owned by Fareham Borough Council have been refurbished using EXCHEM'S BBA accredited Resipatch Concrete Repair System. Extensive concrete repair and protection was required and the ongoing refurbishment project is being undertaken by CRA Contractor Member, Yoldings Limited. The steel reinforcement was treated with Resipatch SP alkaline steel primer and the balcony edges repaired using Resipatch HB, a Lightweight high build repair mortar. Exposed surfaces were treated with two coats of Resicote WB2 elastomeric anti-carbonation coating. The Resipatch System is part of Exchem's extensive product portfolio which spans concrete protection materials, resin bonded anchors, flooring and coating systems all designed to comply with the highest standards demanded by today's material specifiers. Further information can be obtained by telephoning: 01773 540440. ENQUIRY NO: 125



## CONCRETE REPAIRS LIMITED LEADS THE WAY

Innovation has enabled CONCRETE REPAIRS LIMITED to stay at the forefront of the concrete repair industry for more than 40 years. A management board of professional engineers and a skilled workforce has established the company's reputation for quality work at competitive prices. Services include NDT inspections, carbon fibre plate bonding, cathodic protection, corrosion inhibitors and a patented gelAnode system for realisation and desalination. Concrete Repairs Limited leads the industry for others to follow. For information contact: John Drewett on 0181 288 4848. ENQUIRY NO: 123



## STRUCTURAL STRENGTHENING WITH SIKA

Specifiers have a limited number of options when faced with the need to strengthen a structure. Until recently, steel plate bonding was considered state-of-the-art. However, practical drawbacks include the need for numerous bolts, and difficulties around services. Sika has pioneered the introduction of an innovative alternative to steel plates. The Sika Carbodur System comprises carbon fibre reinforced polymer laminates, typically 1mm thick, bonded with a proven, durable, structural epoxy adhesive. Bolting requirements are minimised, positioning around services becomes simple and access for following trades is immediate. Moreover, the system is maintenance-free. Recently, it became necessary to increase the floor loadings at King's College Hospital, south London (see picture). Sika Carbodur was the only realistic alternative to demolition. For more information telephone (01707) 394444 ENQUIRY NO: 124



## WATER WONDERFUL WARD

Hospital staff and patients at Graigavon Hospital, Belfast have been delighted with the method used by LLEWELLYN STONECARE LIMITED to complete the concrete repairs on the occupied ward blocks. Break out of the concrete was successfully completed using precision hydra-cut LF20. Using only water, the system cuts out areas on concrete relatively quietly with no dust and no need to grit blast the steel afterwards - a real advantage in sensitive areas such as hospital environments. The use of this system enabled the hospital to function throughout the works (now in its fifth phase) with the minimum of disruption. For further information contact Brian Gardiner on: (01908) 679222. ENQUIRY NO: 126



Repair and protection of reinforced concrete



Systematic solutions developed for a new era

## SYSTEMATIC SOLUTIONS FROM FOSROC

With over 60 years expertise, Fosroc recognise the need for a fully integrated system for the repair and future protection of concrete. Fosroc offers customers advice and information on a range of solutions including traditional and electrochemical concrete refurbishment. This is backed up by comprehensive information which is aimed specifically at the refurbishment of all concrete structures. Service support for specifiers is also on hand, from planning to completion. This includes technical advice, customised specification, contractor selection, introductory seminars and on-site demonstrations. For more information telephone: 01827 262222. ENQUIRY NO: 127



## CONFEDERATION PUTS FEDERATION HOUSE IN ORDER

Specialist concrete repair and protection materials, manufactured by CEMENT TECHNOLOGY LIMITED (CEMTEC), a division of the Instarmac Group, have been used to refurbish the concrete framed exterior of Federation House, the National Federation of Builders Midlands Regional Business Centre, in Sheldon, Birmingham. Work was required to correct the problem of reinforcement corrosion and surface deterioration, caused as a result of carbonation of the concrete. Restoration was essential since the structure was fast becoming a safety hazard due to parts of the concrete delaminating and falling to the ground. Cembuild LW-25, a light weight, high build cementitious mortar, was used to reinstate the surface to its original profile and the entire concrete surface was treated with Cemcoat ACE, an elastomeric anti-carbonation coating. Further information can be obtained from: (01827) 872244. ENQUIRY NO: 128



## CONNAUGHT COMPLETE INSURANCE BACKED REPAIR

CONNAUGHT GROUP has recently completed the refurbishment of the Brentford County Court building. Constructed in the 1960's it had been suffering the effects of both carbonation and chloride attack. Since court business had to be maintained during the works, an essential pre-requisite was to keep noise and disturbance to a minimum. Following a full inspection and diagnostic survey, it was decided to repair the structure using products that are kind to the environment and to protect the reinforcement with the latest corrosion inhibiting technology. The treatment was applied after the reinstatement of cracked and spalled areas and prior to the application of an anti-carbonation coating. The works, completed in 14 weeks, and the first of its kind to qualify for an insurance backed guarantee, were independently supervised and inspected throughout. For further details contact Jackie Ducker on 0181 335 3110. ENQUIRY NO: 130



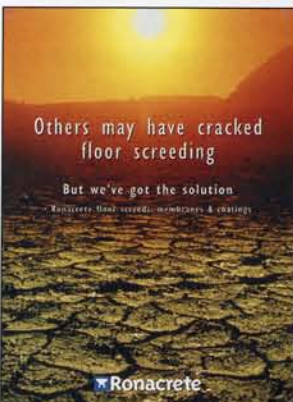
## FLEXCRETE RANGE SPANS THE BRIDGE

A range of high performance concrete repair materials from FLEXCRETE LIMITED has been chosen for the restoration of the Tay Bridge in Scotland. The project involved repairs to 85 defective concrete columns below the bridge deck, which had deteriorated as a result of the effects of carbonation and exposure to the aggressive climatic conditions. The re-bars were first treated with Flexcrete Steel Reinforcement Protector 841 before Flexcrete Monolite - a rapid hardening, low density, trowel applied waterproof mortar - was applied. Monolite incorporates the latest cement chemistry, microsilica, fibre and styrene acrylic copolymer technology and complies fully with the UK DoT Standard BD27/86 for the repair of highway structures. Its high build properties enable applications up to 100mm to be achieved in a single operation. Tel. (01772) 255039. ENQUIRY NO: 131



## MAKERS NEW CONCRETE REPAIR TOOLBOX

MAKERS INDUSTRIAL LIMITED has been repairing reinforced concrete for over 25 years. During that time, the company has devised innovative and cost-effective solutions to the benefit of its clients. The repair techniques featured in the Tool Box are all proven systems revolving around providing cost-effective, durable solutions to concrete problems. Makers offer a full service from diagnosis of the problem through to repair and future protection. Please contact Mike Darby at the Marketing Department for your copy of the new Tool Box brochure - telephone (01487) 832222. ENQUIRY NO: 129



## RONACRETE SCREEDING SOLUTIONS

RONACRETE LTD has floor screeds, membranes and coatings to suit every possible application from light domestic to heavy industrial situations. Our proven range of products offering long term performance, chemical resistance, waterproofing, flexibility and aesthetics includes: thin sections screeds and high strength toppings; rapid set one hour repairs; damp proof membranes; solvent and solvent-free coatings. Applications where we successfully supply solutions for specifiers, installers and end-users include: healthcare and educational establishments, offices, warehouses, airports and retail premises. For more details, telephone 0181 593 7621. ENQUIRY NO: 132

# EFFECTIVE CONCRETE REPAIR - A CONSULTANT'S PERSPECTIVE

By: Mark Creighton of Structural Engineers and Material Consultants - Quest Technical Services Ltd.

Would you let a doctor undertake major surgery on your body without having established the correct diagnosis from exploratory procedures such as keyhole surgery? Why then should our concrete structures be thought of any differently? Similarly, if the latest proven life-saving operation was available using 'state-of-the-art' technology which involved far less distress to the patient, why use a crude invasive procedure based on out of date technology?

Comparable analogies could be made with the use of specialist concrete repair procedures, or the employment of corrosion inhibitors and electrochemical techniques, as opposed to 'bash and replace' repairs.

This perspective on successful concrete repair is offered as opinion on past and current experience. It is intended as a source of guidance to newcomers to the science and hopefully does not offend the already 'converted'.

There have been many publications in recent years on concrete repairs, in particular from the BRE, but also from other learned bodies, individuals and the CRA. In addition much information is available on the causes of concrete deterioration, how to investigate and what remedies are available. We do not wish to dwell on these subjects for fear of being repetitious, but there are two recipes on the menu (tabled in the following columns) from which to choose. Which one appeals to you?

Each stage of the procurement route is important in the quest for successful repair

## The consultants role

The consultant's role should be one of an adviser. The advice may include recommendations concerning the need to investigate the scope of the repairs necessary to fulfil the objectives of the client, suitable type of contract and the procedure for selecting contractors.

The modern day consultant should be perceived as being a 'multi role professional'. Gone are the days where professionals were pigeon holed into one particular field. As a pre-requisite a consultant must be aware of safety in design and site practices and appreciate financial and commercial matters. The consultant should also keep up-to-date with the latest developments and processes in the industry.

The traditional onus on the consultant to act diligently with 'reasonable skill and care' remains unchanged. The consultant should act with impartiality to achieve best value for the client for a fair reward to the contractor.

The role of the consultant in the context of a concrete repair project is to identify, define and solve problems, design and specify remedies, administer the contract and achieve a safe, successfully completed and costed project. Such functions are usually fulfilled by an individual or specialist team. Seldom is there the luxury of a PQS or allied professional unless the scheme demands it.

## Recipe: 1

- Take a misinformed client.
- Omit the survey.
- Reproduce (or reheat) a mouldy specification with lean quantities.
- Issue to an alleged specialist repair contractor not previously tried and tested.
- Accept and add to the mix a lesser-known repair system.
- Site batch and apply by spade both repair mortar and coating.
- Sit back and let the contract simmer.
- Omit to taste a levelling mortar.
- Let contract boil over whilst unattended.
- Sign off in a hurry and walk away.
- Return to cauldron within a few years.
- Garnish with claim and counter claim if still in business.
- Abandon recipe and start again.

## Survey and testing

To obtain maximum benefit from an investigation it is essential to ask the right questions at the outset. Investigatory work should then be tailored to answer clearly defined questions. For instance, some concrete investigations undertaken within the industry are apparently conducted with tunnel vision, concentrating only on carbonation, cover and chlorides and not interaction with the surrounding building fabric, i.e. waterproofing, substrate movement, environmental conditions etc.

Investigations produce data that requires interpretation. Many contractor-led surveys produce adequate results, however some, especially those produced by non specialists, lack detailed interpretation and independent appraisal.

## Contract documentation

A main function of the contract document is to convey to the tendering contractor the scope of the repair scheme in a clear, concise and unambiguous manner. Ambiguity leads to misunderstanding, claims and dispute. The document later serves as central point of reference or clarification.

Specifications are often prepared with the assistance of a manufacturer but it should be noted that seldom does a contract exist between the client and manufacturer or consultant and manufacturer. Often direct copies of old schemes (second or even third generation specifications) are used. The danger here is that earlier mistakes could be replicated or product literature may be out-of-date.

Specifications should always be project specific and bear resemblance to the job in hand. A loose or poor specification invites 'wedges' to be driven through the contract. It is generally advantageous to use tried and tested contracts allied to project specific specifications.

It is often asked, 'How do you estimate the quantities for a repair project?' The answer is that there is no empirical formula or

## Recipe: 2

- Take a responsible client.
- Add an experienced consultant.
- Investigate thoroughly, investigate further (if required).
- Weigh up the options and costings.
- Allocate a realistic budget and contract period.
- Add to the mix a technically correct specification with detailed quantities.
- Introduce to the recipe a specialist contractor.
- Serve as a main contract on a bed of JCT Conditions.
- Garnish with BBA approved materials.
- Simmer the works and monitor with a well seasoned CA.
- Remeasure with fairness (or in a lump sum) to taste.
- Check the finished coating has achieved the recommended DFT.
- Serve with a successful completion once contract has matured.
- Continue to monitor in use and maintain as appropriate.
- Optional ingredient:- As an alternative have an IBG for those who lack confidence in the above ingredients.

equation. Much is down to the experience of the engineer and his ability to review and distil into a meaningful form all the data available. Evidently, reference to survey reports both qualitative and quantitative should offer some guidance on which to base a best estimate. Those undertaking quantitative surveys should not be fooled into reproducing the survey as a B of Q unless a firm lump sum price is invited from the contractors. Visual damage seldom equates to actual defects.

Estimating quantities of concrete repairs is an acquired skill and should be entrusted to those with the appropriate experience. Most concrete repair projects are undertaken on a re-measurement basis using an approximate B of Q. The CRA's 'Standard Method of Measurement' gives valued guidance but needs careful interpretation.

The ideal B of Q should encompass all the items that could be reasonably anticipated for the nature of the works and include realistic provisional sums for additional repairs or undefined work. Having received and analysed the tenders, the consultant should be capable of recognising errors and omissions in the tenders making valid comparisons between different tenders on which to base suitable recommendations to his client.

## Contractors

Contractors should be selected on the basis of their suitability for the works in hand with consideration given to their credentials, size, resources, track record, reputation, etc.

The selection of a tendering contractor inappropriate for the project will result in considerable wasted effort by all parties.

In our opinion a minimum pre-requisite for a tender shortlist is a full Contractor membership of the CRA, preferably with a commitment to Q.A. such as ISO 9002 or similar and if possible BBA accreditation.

## Materials

BBA approved materials are considered essential by many professional indemnity insurers and prudent clients. A commitment to BBA and Q.A. by the manufacturer speaks volumes for the system. It indicates that the manufacturer has a commitment to the quality of their products and ongoing product development.

Many of the manufacturers are firmly committed to R&D, product development, contractor training and improving manufacturing processes. In our experience failure of a material from a reputable manufacturer seldom occurs.

## Site supervision

Site supervision or quality monitoring is an essential ingredient. Ideally, each stage of the concrete repair process should be inspected by an employer's representative - at least on a sample basis. A responsible inspector should maintain accurate auditable records of such inspections. A simplified checklist should include for example the following questions:-

- Has the survey and testing been undertaken thoroughly and recorded for posterity?
- Has the surface which will receive the repair or coating been cleaned thoroughly?
- Is the extent of breakout complete or excessive and have feathered edges been avoided?
- Has the reinforcement been exposed beyond its corroded length?
- Has the reinforcement been cleaned to the specified quality eg SA2<sup>1/2</sup>?
- Has the reinforcement primer been applied correctly to the specified thickness?
- Has the surface been adequately pre-dampened?
- Has the appropriate repair material been used for type of repair?
- Have the repairs been appropriately cured?
- Has the application of a levelling mortar/fairing coat achieved the specified nominal thickness and finish on an adequately prepared and dampened substrate?
- Has the final coating been applied pinhole free in sufficient coats to achieve the correct DFT and is it of the desired opacity?
- Is the corrosion inhibitor present and has it been applied at the specified application rate?

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Second edition: 010798.