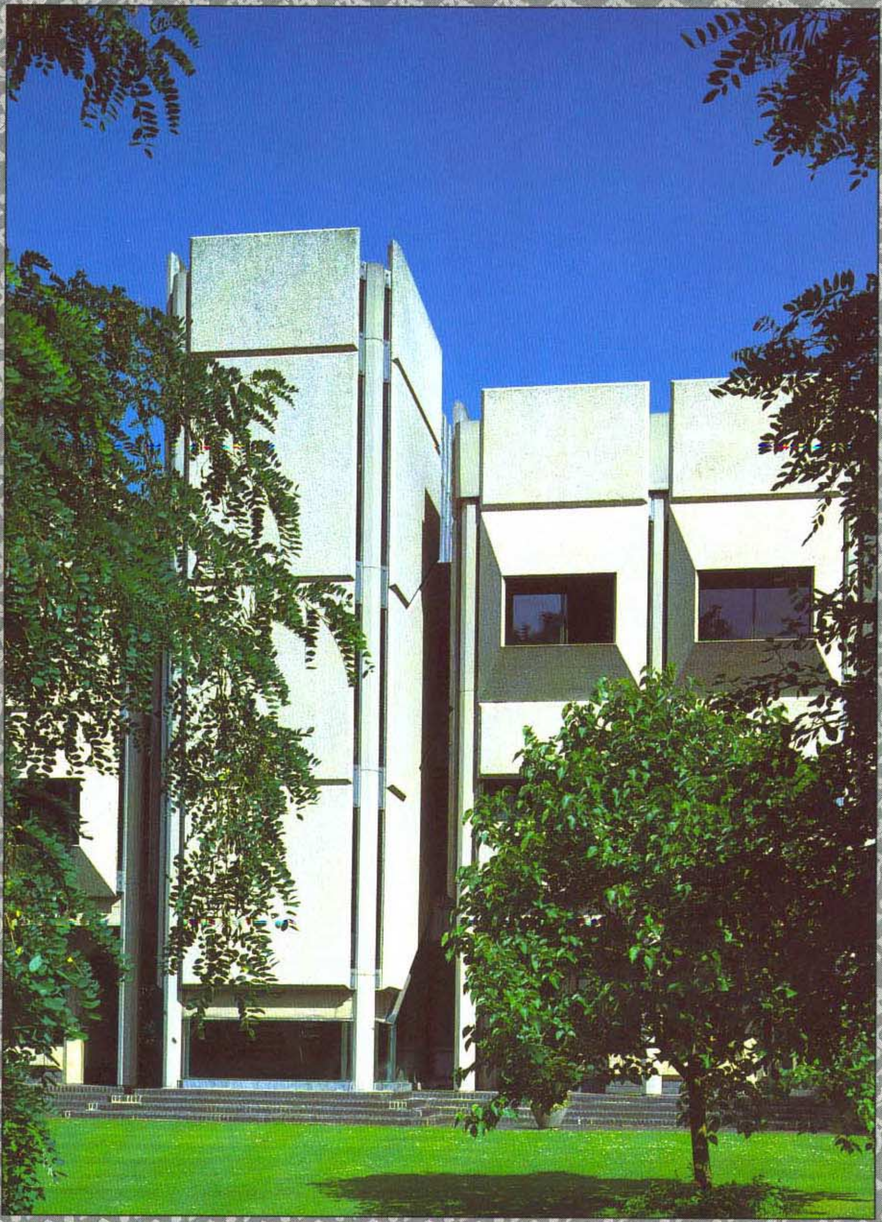
AUTUMN 1992

CONCRETE QUARTERLY



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Frontispiece
The Hilda Besse Building at St. Antony's College was an early exercise in the control of weathering (Revisit, p16). Photograph – Jonathan Farmer

BCA

Invited contributors to *Concrete Quarterly* are encouraged to express their own opinions; these do not, of course, always reflect the views of the British Cement Association.

Front cover
Subtle variations in texture, and superb craftsmanship at Fitzwilliam College Chapel (p20). Photograph – Martin Charles

EXPRESSION OF QUALITY

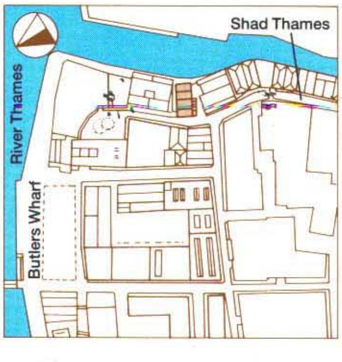
John Pringle
AADipl, RIBA

John Pringle trained at Architectural Association. He joined Michael Hopkins & Partners in 1978 and became a partner in 1981. He was responsible for Schlumberger Laboratories, stands at Lord's Cricket Ground, Bracken House and David Mellor Buildings.

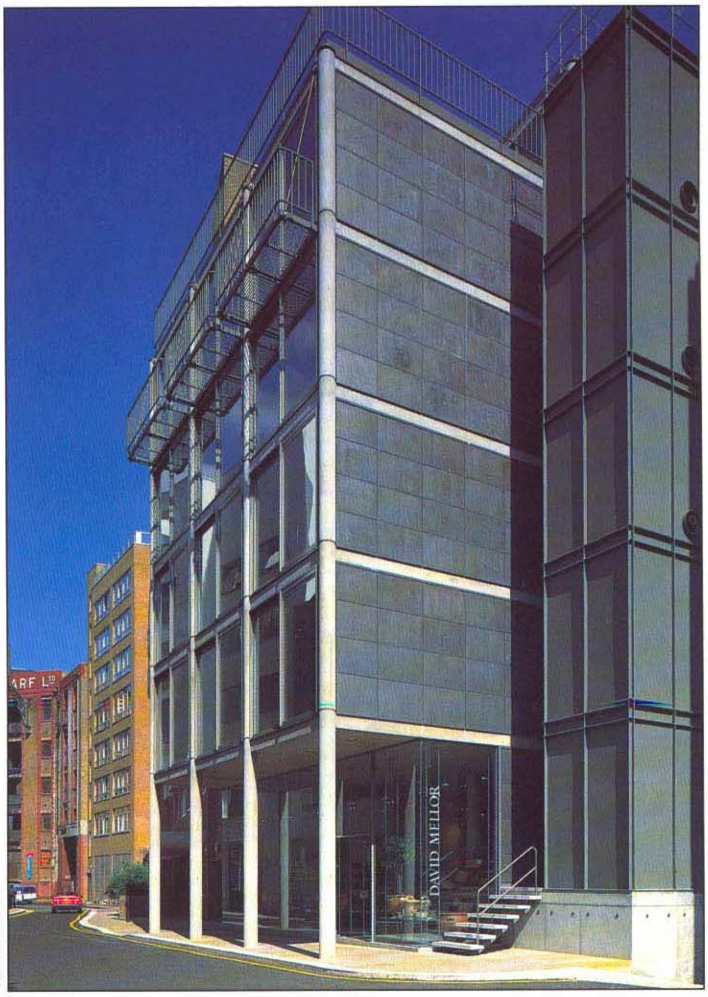
From the beginning there was never much doubt that the new David Mellor building, at Butler's Wharf in London, would be built in concrete, lead and glass. We had briefly considered the idea of stainless steel and concrete, like Louis Kahn's Yale Art Gallery, but during development of the design we gained confidence in lead, as a result of our earlier building for David Mellor at Hathersage in Derbyshire. Concrete was appropriate to the tough context of surrounding warehouses and its inherent fire resistance made it a natural choice for this multi-storey, multi-use building.

The site in Shad Thames was a tight one, facing onto St Saviour's Dock close to Tower Bridge on the south bank of the river, and developed jointly with the neighbouring building on the site of former warehouses.

The brief revolved around David Mellor's business. He designs and manufactures cutlery and has three shops which sell his products and other kitchen goods. He has always lived next to his business and this building was to be no exception. It is designed to accommodate a variety of uses: a workshop (later showroom) on the ground floor, three floors of offices, a two-storey apartment on the top floor with a double-height hall in the middle, a terrace on the roof and parking in the basement.



The concrete structure is intended to be a theme which links all these diverse functions into a neutral framework, as well as providing for other unknown activities in the future. The idea was to build a robust and flexible structure which should prove as adaptable to re-use as many of the nearby Victorian dock buildings in London Docklands.



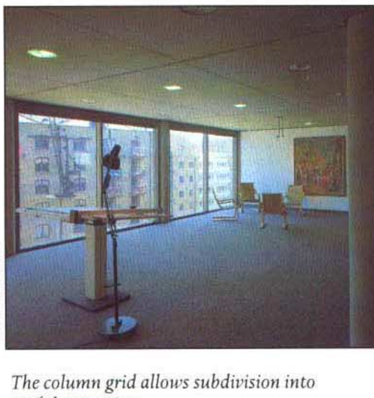
MARTIN CHARLES

We had an unusual arrangement in that the client was also going to be involved in constructing the building, as he had been the year before when we designed his cutlery factory at Hathersage. We had learned then that he was a perfectionist, bringing a combination of the precision of production engineering and the art of the silversmith to the construction industry: he shared our usual preoccupation with bringing out the quality of materials used in building.

Refined simplicity

The structural format was very simple: a reinforced concrete in-situ flat slab on a grid of columns whose spacing would allow the space to be subdivided into useful room sizes. A grid of 6 x 3.85 m was chosen, mainly to suit the apartment which is the most demanding area in terms of subdivision, and this is expressed in a series of room-sized cells in the external walls of the building. The overall building size is 24 x 12 m with 3 m storey heights.

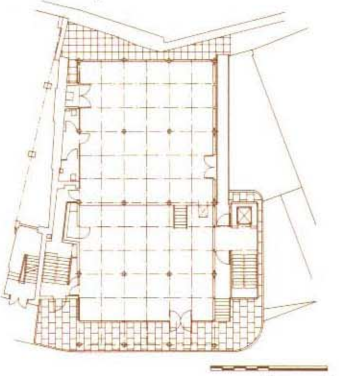
Having established this grid, the different activities express themselves in the treatment of the different floors of the building. The showroom has plate glass walls, the offices have full-height horizontal sliding windows in aluminium frames and the apartment floors have the same glazing system but with projecting



MARTIN CHARLES

The column grid allows subdivision into useful room sizes steel balconies. The lifts and stairs are separated from the main structure in a free-standing shaft of structural plate steel, linked by glazed bridges, standing in front of the flank wall of the building. Service areas – including escape stairs, floor-by-floor boiler rooms, lavatories, kitchens, service risers – are squashed into the wedge-shaped left-over space between the main frame and the party wall of the next-door building.

Ground floor plan



The building is consciously made up of few elements and the aim was to refine their details as much as possible and express the construction of each component as fully as possible. The frame is fair-faced concrete, the front and back walls are fully glazed and the flank walls are mainly lead-faced panels with a small area of glazing in the middle bays. All the external walling is in the same plane as the structure and the concrete columns and slab edges are expressed in the elevation. The whole structure sits on a concrete plinth of retaining walls which enclose the basement garage.

Bringing out the best

For our practice concrete was, at the time, a relatively little-used material and not a familiar part of our architectural vocabulary. During this period we were also designing the concrete frame at Bracken House (CQ Spring 1991) and the composite steel and concrete structures of Compton & Edrich Stands at Lord's Cricket Ground and developing our knowledge of the material. We had done only one concrete structure previously, which was the production facility for Solid State Logic at Oxford. Lessons learnt from one job were transferred to the others and we gradually built up the basis of our design techniques for concrete structures.

Concrete has qualities which we liked, and tried to exploit.

We wanted it to look like concrete and not like plaster or stone or something else it wasn't.

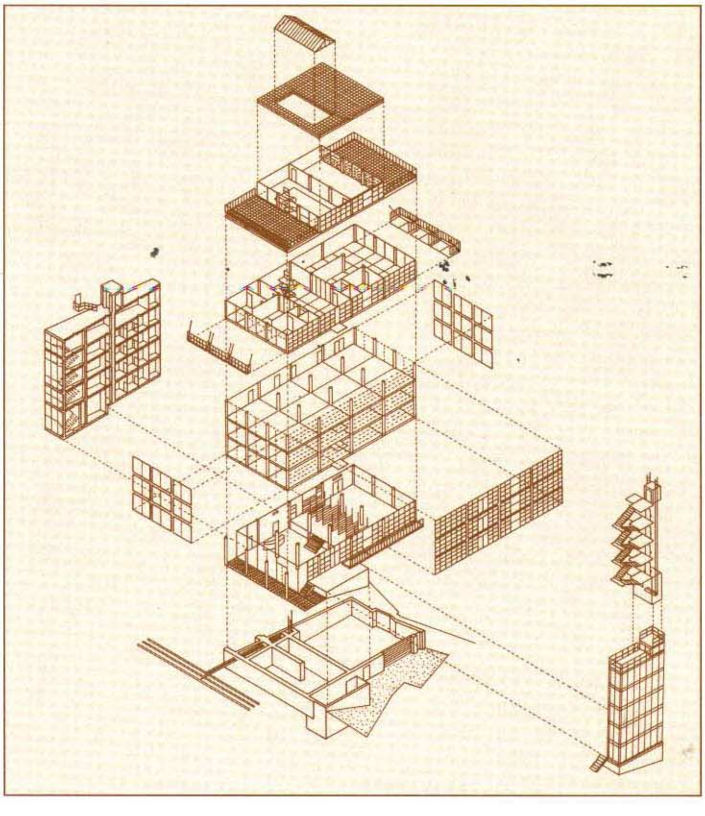
We wanted it to look like a moulded material which had been poured. We wanted to see the profiles of the mould and were anxious not to obliterate them with heavy surface treatments.

The structure had to be designed in a way that was sympathetic to the fluid nature of the material. One element should merge with the next in a seamless way: it shouldn't look like a steel post-and-beam structure converted into concrete. Slabs should be integral with beams and columns – an approach which was perhaps even more evident on our Lord's structures.

The structure could be moulded to provide, in an effortless way at the outset, profiles for services, lighting and perhaps glazing; they should not be screwed onto the structural frame as an afterthought.

MARTIN CHARLES

We wanted it to look like a moulded material



The visible structure can contribute to the internal environment: its thermal mass exposed to the room can be used as a heat store to damp out extremes of summer and winter temperatures and reduce reliance on mechanical systems – in the same way that traditional massive structures provide a relatively stable internal environment.

It seemed to us that a visible, well-made, massive, monolithic structure should reveal a performance and qualities in concrete that are normally suppressed under layers of curtain walling, suspended ceilings and internal cladding.

Lost skills

In adopting this approach we had not bargained for the appalling widespread de-skilling of the concrete industry during the 1980s – at least in terms of providing self-finished fair-faced concrete. The industry had become very good at constructing frames very quickly with sophisticated fast-track techniques, but to the complete detriment of visual appearance. The skills needed for a high-quality finish were simply not there any more – at least without a real struggle. We were fortunate to find a contractor who was prepared to relearn those techniques. ▶

The thermal mass of the structure damps out temperature extremes

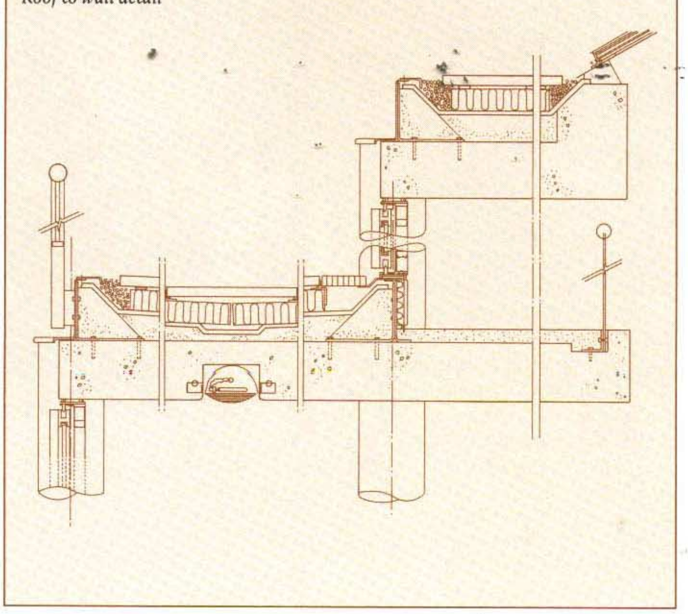
EXPRESSION OF QUALITY


MARTIN CHARLES

The aim was to express each component as fully as possible

We attributed this trend to the American construction techniques which had been adopted by major developers during the 1980s. The philosophy was that the structural frame should be put up very quickly, as a skeleton that will never been seen and which can be as rough as you like. It didn't much matter whether it was in steel or concrete, as you would never know it was there. Thereafter, a succession of cosmetic layers are applied both inside and out and the visual quality of the concrete frame just isn't important.

Roof to wall detail



We often wonder why the industry chose to import only the most philistine element of American construction technology. What had happened to the superb workmanship found in the buildings of Louis Kahn, I M Pei and Paul Rudolph, where we really did have something to learn from the Americans? It seemed as though no one had asked for architectural concrete in this country since the days of the brutalist buildings of the 1960s or the National Theatre in the 1970s.

When we went around precasters' yards they couldn't produce a single sample of fair-faced plain grey concrete mixes from their samples libraries: they were all faced with revolting bits of stone, marble tiles or terrazzo, destined for large, storey-height precast cladding panels for city office blocks. It was as if they were almost ashamed of concrete, the mainstay of their business. Ironically, the last bastion of fine concrete workmanship seemed to be the civil engineering industry where the concrete of bridges and viaducts is still visible and needs to look good.

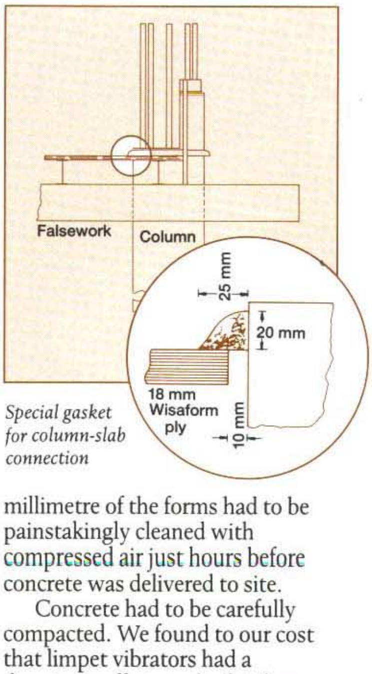
Learning from scratch

On each of our projects we were learning the techniques from scratch, with the help of some patient and committed contractors. We found that we had to work everything out from first principles.

Formwork isn't just temporary rough carpentry to be nailed together and discarded. We learnt that it had to be a beautiful piece of joinery, as good to look at as the finished product: it is, after all, the mirror image of the finished product. In this case David Mellor manufactured it himself in his workshops. Panels of Wisaform ply were used, with chamfered edges to produce a projecting vee in the finished concrete – a successful detail which produced much consternation at the outset. A special aluminium extrusion was produced for the construction joints on grid lines and special gaskets were produced for the column/slab connection. Columns were constructed in circular steel forms.

We needed to think about how to support steel reinforcement, as conventional spacers would create an unsightly pattern on the soffit. We hit on the idea of using the light fittings, which are cast into the slab, as reinforcement supports fixed to the formwork. Electrical conduits had to be fixed at the same time as the steel reinforcement as they were buried in the middle of the slab.

The forms had to be scrupulously cleaned before pours and every particle of rust from reinforcement removed to avoid staining. During steel fixing, the forms had to be treated with extreme care and protected from any stray pieces of metal or swarf. Every square



Special gasket for column-slab connection

millimetre of the forms had to be painstakingly cleaned with compressed air just hours before concrete was delivered to site.

Concrete had to be carefully compacted. We found to our cost that limpet vibrators had a disastrous effect on the finish – revibrating the concrete and stripping the surface of all the formwork fine detailing. After a visit to Japan, I asked our Japanese colleagues from Obayashi who were working on the Bracken House project how they got such a good finish on their concrete buildings. Their answer was: no pokers, not even robots, just lots of men shoulder-to-shoulder with bamboo poles, working very hard. This was too much for our contractor! – we settled for conventional pokers.

And how did the Japanese get such a good surface texture? Tadao Ando told me that his secret was that he got all the young architects out of his office and gave them all a sheet of sandpaper to sand down the entire surface by hand. This was too much for us! However,

Cast-in light fittings supported the reinforcement

David Mellor – initially sceptical – took this up and actually did just that. It gives an incomparable finish: the well compacted dense surface is left intact (unlike with grit blasting) and the laitence is removed, revealing a smooth surface of mainly sand and cement.

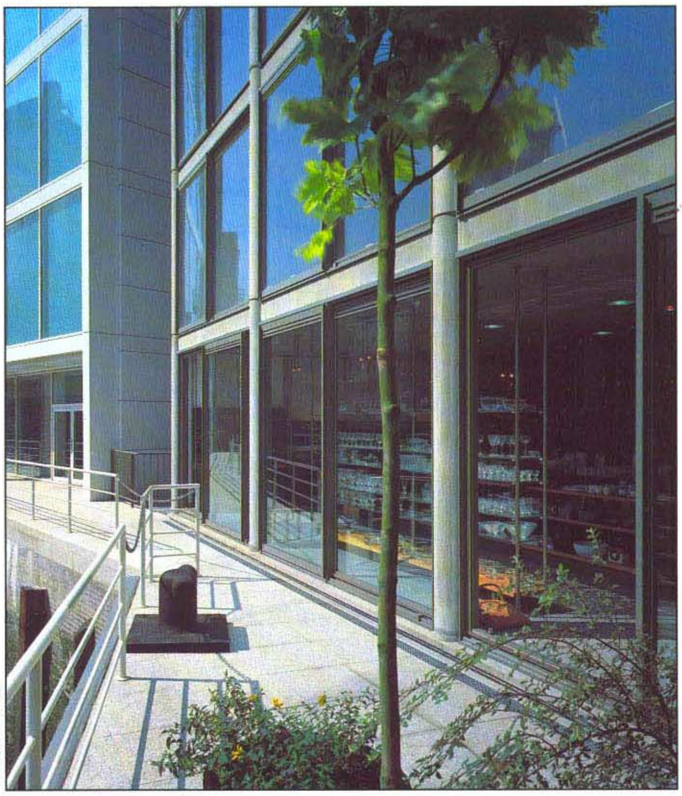
How do you specify good-quality concrete? Somehow there were no industry-standard clauses which fitted the bill: they all assumed a fairly basic level of competence. The normal specification for the highest quality finish assumes that the contractor can make good the surface – which would ruin its appearance as a cast material. We did not want what was effectively a rendered or filled surface, we wanted cast concrete. In fact, we preferred a finish which included small blow holes – within reason – rather than the Tipp-Ex speckling of filler (albeit matching) all over the surface. In the end, we forbade the contractor to make good the surface and left it to someone with a decorator's eye to carry out the final finishing.

And what about the mix? Do we have to put up with whatever ready-mix material the supplier happens to have in his yard at the time, to meet the requirements of British Standard cube tests and little else. We were keen to use the river sands that the Japanese use, or the two-sand mixes that the Americans specify for high quality work, or the sparkle that micaceous sands can give to the surface. With the potentially enormous geological recipe book available, why do we always have to put up with take-it-or-leave-it ready-mix that the industry offers as standard? On this job the cost penalty for a special mix was too high for the client and we reluctantly ended up with standard concrete.

Despite the construction of a sample panel using the special formwork system before work started on site, the first storey was still the most agonizing: after building and demolishing half a dozen columns, building and demolishing about 6 m of retaining wall, teething problems with the support of formwork, problems of grout-loss at the joints, trial and error using a tremie for column work, we finally worked it out, and the finish got better and better as we progressed up the building. By the end of the project the contractors were producing the highest quality concrete with ease.

Client involvement

David Mellor and his son Corin were on site from the beginning as part-contractor, part-clerk of works and part-client. By the end of the job they probably knew as much about manufacturing formwork, pouring and finishing high quality architectural concrete, as many contractors in the building industry. Much of the rest of the building was built by them and their work-force, including the precisely-made lead-faced wall panels, the steel lift tower and all the metalwork. ■



MARTIN CHARLES

After teething problems, concrete of the highest quality was produced

PETER COOK

CLIENT
■ David Mellor Design Ltd

ARCHITECT
■ Michael Hopkins & Partners

ENGINEER
■ Buro Happold

MANAGEMENT CONTRACTOR
■ Sir Robert McAlpine Management Contracting Ltd

CONCRETE CONTRACTOR
■ Silver Construction Ltd

TIME AND TIDE

Peter Clutterbuck

BSc, CEng, MICE

Peter Clutterbuck, Managing Director of Hydrocore Ltd, has extensive experience of maritime civil engineering projects as client, designer and constructor.

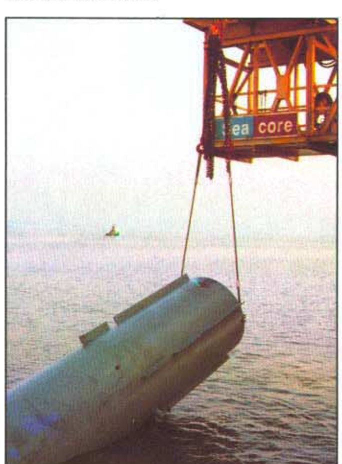
Can you build a lighthouse in a fortnight? More specifically, can you build a set of four lighthouses – or beacons – in the two months 7 August to 6 October to meet once-a-year Spring tide dates and times which would allow dry construction techniques to be used at low water? This, we decided, was the essential conundrum which had to be solved if a cost-effective method was to be developed for the construction of the Severn Navigation Beacons.

These lighthouses are not quite in the Eddystone Light class, but they are substantial structures, located in waters with the second highest tidal range in the world creating challenging navigation and operational conditions.

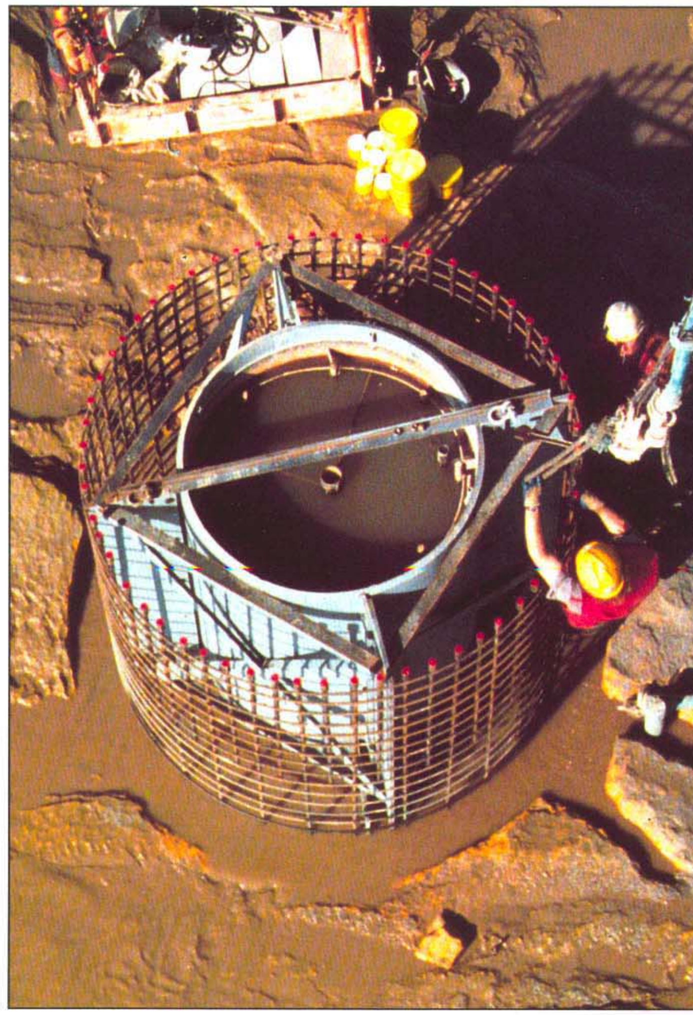
When the construction of the Second Severn Crossing over the 'English Stones' reefs of the Severn estuary was announced, the responsible river authority, Gloucester Harbour Trustees, required an upgrading of the navigation aids to mark the Shoots Channel under the main span of the new bridge. It was decided that four new beacons were needed, to mark the north and south entrance to the channel. The extreme tidal range exposed the rock seabed at one location on every tide, but only the highest spring tides exposed the seabed for brief periods at the other three locations.

Jack-up at low water with drill-string suspended from the cantilevered drill

A pile is lifted into position for lowering into the rock socket



Photographs – Peter Clutterbuck

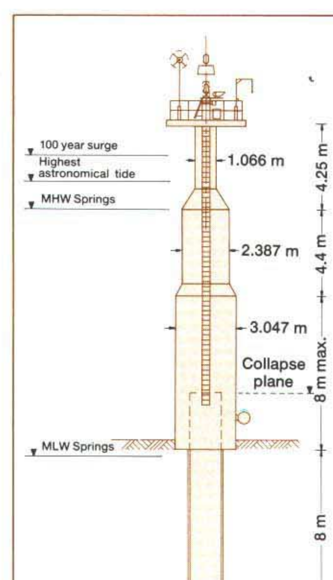


Pile-cap reinforcement fitted to the pile at low water

Design

The beacons are 15-20m high overall and a solid 3m in diameter at the base to resist vortex-shedding vibrations and provide a clear daymark. To cater for 10 000 tonne ship impact, the beacon tower structure incorporates a weak plane to permit tower failure without damage to the expensive pile foundations in the ultimate collision situation. The high intensity sector and omni-directional lights at each beacon are powered by a battery pack, recharged by solar panels, which in turn are backed up by a wind generator. On two beacons, additional experimental current generators were fitted – it is believed that this is the first application of tidal power to navigation aid illumination.

With the assistance of specialist geotechnical consultant Applied Geology, Hydrocore developed an alternative drilled



Typical elevation

Fixing reinforcement from the working platform

foundation construction technique which, with critical minor modifications to the beacon structure design, allowed all works to be carried out in sequence from a jack-up platform positioned at the four beacon locations in turn. This would allow for the key programme requirement to construct each beacon in a 14 day period, so that the jack-up could be moved at high water to the next beacon and be on location for the critical spring tides which expose the seabed at low water for two hours.

Construction

The stable jack-up platform allowed a powerful hydraulic drill to quickly sink 8m deep by 1.7m diameter rock sockets and then to open out this socket into a 3m diameter surface seat (a minimum of 0.5m deep) for the beacon. A capped, thick-wall steel pile was floated out at high water, lifted by the jack-up cranage and lowered into the open rock socket at low water to be grouted into position. A pre-assembled pile cap reinforcement cage was then lowered over the pile and bolted into position, and the first permanent shutter precast concrete manhole ring lowered over the cage. Further manhole rings were then added with an epoxy grout joint. These rings were temporarily held in place by a top frame with tensioned anchor bars. After placing in-situ concrete in the pile cap, the beacon was built up in stages with further sets of concrete rings, and the reinforcement cage extended with threaded Lenton couplers. The change of beacon section was achieved with a special tapered precast unit, while the top section and taper was fabricated in steel, with a bolted connection to the galvanized steel top platform which accommodates the navigation aids and power generation systems.

This form of construction allowed a rhythm to be developed with materials supply and preparation at high water, and construction at low water. Preplanning and organization were essential. Daily adjustments to materials transfer schedules ensured that the prefabricated steel pile floated out on time and that the flow of precast concrete rings, grout, cement, aggregate and water met each shift's requirements without overloading the jack-up. Traditional Cornish seamanship and mining skills were a prerequisite for the five-man crews, who performed all necessary activities, working continuous shifts to make the best of the tidal opportunities.

Many systems of concrete production were researched, including ready-mix, skipped to site by helicopter. The method adopted, with a 21/14 mixer mounted on the jack-up, and fed with bagged cement and big-bag, pre-weighed aggregate, worked well, producing a consistent quality superplasticised class 50 concrete.

So, yes, rapid marine concrete construction is possible. This project was completed last autumn to programme and budget in a total period of only 15 months from initial feasibility study to final beacon construction. ■

A precast ring is lowered onto the epoxy joint

A completed beacon at low water revealing the tidal current generator

CLIENT
■ Gloucester Harbour Trustees

ENGINEER
■ M R M Partnership

CONTRACTOR
■ Hydrocore Ltd

GEOTECHNICAL CONSULTANT
■ Applied Geology Ltd

PRECAST CONCRETE UNITS
■ Hughes Concrete Ltd

NAVIGATION AIDS
■ A B Pharos Marine Ltd

CONCRETE and THE ENVIRONMENT

Jim Stevenson
and
David Spooner
BSc, PhD, CPhys, MInstP

Some people would be surprised to learn that concrete is one of the most environmentally-friendly building materials available. This article explains why, and will be followed in the Winter issue by a second feature on concrete <u>in</u> the environment.

Jim Stevenson's career began in manufacturing, and later marketing, in the engineering sector. He was Managing Director of Plessey Opto Electronics, and latterly of Renishaw Metrology, before joining the British Cement Association as Chief Executive in January 1989.

David Spooner is Director of Materials and Standards at BCA. He is a physicist whose publications have included work on concrete properties, testing thermal performance and energy use, and environment in buildings. An active member of BSI and European Committees, he is currently convenor of a European Standards task group on concrete.

To most people involved in construction the term 'green' refers to an early stage in concrete's life, when it has set but not yet gained significant strength. With the growing interest in environmental matters, it is increasingly recognised that concrete is not only green for a few days, but that it is 'green' in the wider sense throughout its life. In the words of former RIBA president, Max Hutchinson, 'concrete really is the ultimate green building material'.

Concrete is directly derived from natural materials. Water, sand, and gravel or crushed rock are mixed with naturally occurring minerals, which have been heated and ground, to produce a manufactured 'stone'. It consumes less energy in its manufacture than most building materials. It contributes to energy saving in a variety of ways – for example in its light-weight form, using low density aggregate or with a high proportion of voids, it provides high insulation values for walls, floors and roofs. Given that construction is vital to economic and social development, concrete is as environmentally friendly as any other building material.

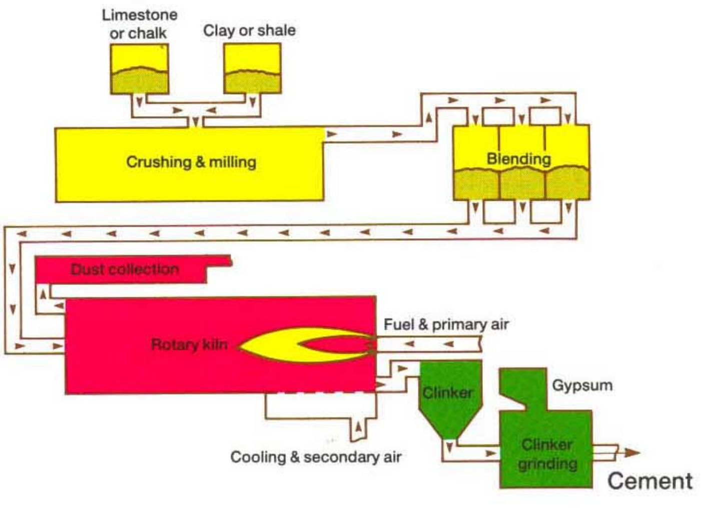
TREVOR JONES

Concrete is directly derived from natural materials

The concrete industry is one of the world's largest by volume of output – water being the first. Concrete's role is equally vital, and that goes as much for Britain as for the rest of the world.

In whatever form, concrete consists of hydrated cement, water, sand and gravel or crushed rock. A range of admixtures may be used to make the concrete more convenient to handle – for instance, delaying the set or improving workability. Concrete is strong in compression, while reinforcing steel is incorporated when needed to enhance its tensile and bending strength. The production of all these component materials involves the consumption of fuel and electricity and, of necessity, mineral extraction. While the latter inevitably involves changing the landscape, if only temporarily, the former leads to the generation of by-products. The simple fact is that concrete can be produced at far less environmental cost than most building materials. To illustrate this point it is instructive to look at each stage in the process of producing concrete.

The cement manufacturing process



Cement making

The manufacture of cement should be seen as one of the early stages in the production of concrete. By itself, cement is of no practical use, but then neither, on the whole, are reinforcement, concrete aggregates or admixtures. Cement makes up 10-20% of the mass of a typical concrete mix and is by far its most energy-intensive component. However, it is the total environmental balance of the finished structure in use, and over its lifetime, that is the only valid basis for comparing concrete with alternative materials.

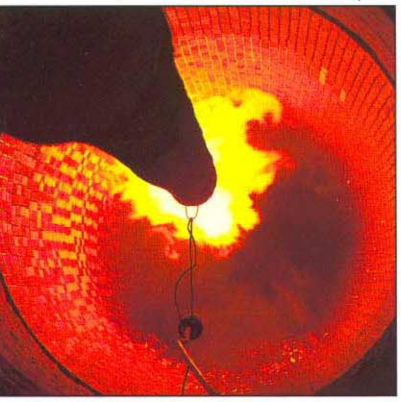
In essence, cement is manufactured by heating limestone or chalk with clay to produce hard nodules of clinker which are then ground together with a little gypsum to produce cement. To achieve the necessary chemical reaction requires a high temperature – about 1450°C – and inevitably involves consumption of significant quantities of fuel, the cost of which has always been a major consideration.

Fuel conservation has, therefore, been a fundamental industry objective for many years. Over the last thirty years the fuel used in cement making has been reduced by 35% per tonne, with a consequent reduction in atmospheric emissions such as CO_2. In 1980 there was a major audit and review by the former Department of Energy into energy use in the British cement industry. Partially as a result of the take-up of its recommendations there now remains limited scope for further increases in fuel energy efficiency, but measures are being continually investigated.

With regard to emissions, there is another source of CO_2 in cement making about which, frankly, little can be done with current technology. Carbon dioxide evolves as a by-product of the decarbonisation of limestone ($CaCO_3$) to produce calcium oxide (CaO) during the clinker making process and is roughly equal to the amount produced by combustion of the kiln fuel. This 'process CO_2' has been recognized by the EC as unalterable in the discussions that have led to a voluntary agreement on CO_2 reduction by the turn of the century. There is no visible means of capturing the gas – which is an inevitable by-product of cement manufacture

To put this into perspective, primary steel making releases about 60 times as much carbon dioxide per tonne as concrete, and paint about 100 times. Cement manufacture accounts directly for around 1.2% of the CO_2 emissions in Britain (about the same, incidentally, as that breathed out by the whole population). This amounts to around 250 kg per person per year compared, for example, to 1540 kg from road vehicles and 2750 kg from coal-fired power stations.

A high temperature is needed to achieve the necessary chemical reaction



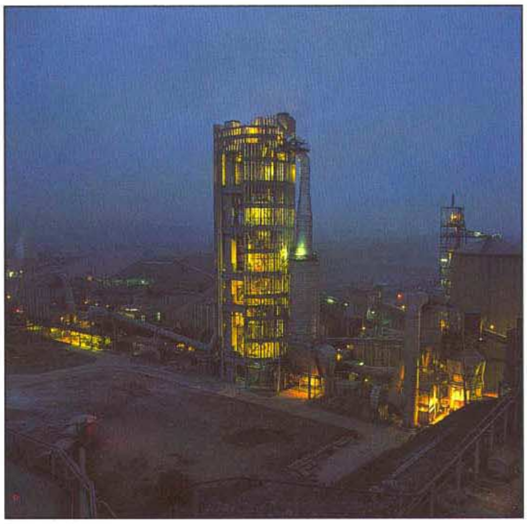
Emissions of other gases, particularly nitrogen and sulphur oxides (NO_X and SO_X), are within the established British regulatory requirements. In the case of sulphur, one of the effects of the way that fuel is burned in cement kilns is that most of the sulphur gases released from the fuel are trapped in the cement clinker, so little SO_X gas can escape. Nitrous oxides are not 'locked in' in the same way but are minimized by careful combustion control.

Similarly, the cement makers have made great strides in reducing the amount of fugitive dust from their plants. Unlike many industries, where such dust is largely composed of unburnt fuel particles, the dust from cement plants is mostly the finest portion of the ground material. The installation of covers, windbreaks, enclosed storage facilities and improved arrestment plants have greatly reduced the problem, and again British cement plants operate well within established statutory dust requirements.

The cement grinding process involves the use of electrical power. This is generally done at night which helps power stations operate more efficiently by spreading their load more evenly and brings the benefit of off-peak rates.

Cleaner use of fuel

Fuels used in cement manufacture are chosen on economic, environmental and technical grounds and in Britain the majority of heat energy currently comes from burning coal. Because of the very high temperatures in the kilns, even comparatively dirty – high ash – coal burns quite cleanly. Higher sulphur coals can be burned as the sulphur combines chemically with the clinker. Moreover, the potential to use alternative fuels offers very real environmental benefits. For example, the use of petroleum coke as a fuel provides a useful application for what would otherwise be a waste by-product. Experience around the world has shown that other waste products, such as scrap tyres, domestic refuse, and even sewage sludge, can be burned quite efficiently in cement kilns. Hazardous waste can be efficiently destroyed in the high temperature environment. Trials at a cement factory in Wiltshire have shown that refuse can be effectively destroyed in a kiln while reducing the need for coal utilization. Cement plants are located adjacent to quarries, some of which are being landfilled concurrently with extraction. Methane, produced by the degradation of landfill waste, can now be economically captured,



Night-time cement grinding helps to spread power station load

rather than escaping as a damaging greenhouse gas with a far more serious effect than CO_2. This 'green' energy source offers further potential for future exploitation.

Using waste products

There are other ways that cement making can be of benefit to other industries by using their problematic waste products. For many years, waste ash from power stations, pulverised-fuel ash (pfa), has been used as a component of Portland pfa cement, and volumes are increasing. Similarly, the slag waste from blast-furnaces is ground to produce a useful blended cement. Like pfa, slag can also be added at the concrete plant. In the future, gypsum will be the waste by-product of the desulphurization process being installed at key coal-fired power stations as part of the acid-rain reduction programme. This may well be used as a substitute for mined gypsum in cement making.

Quarrying

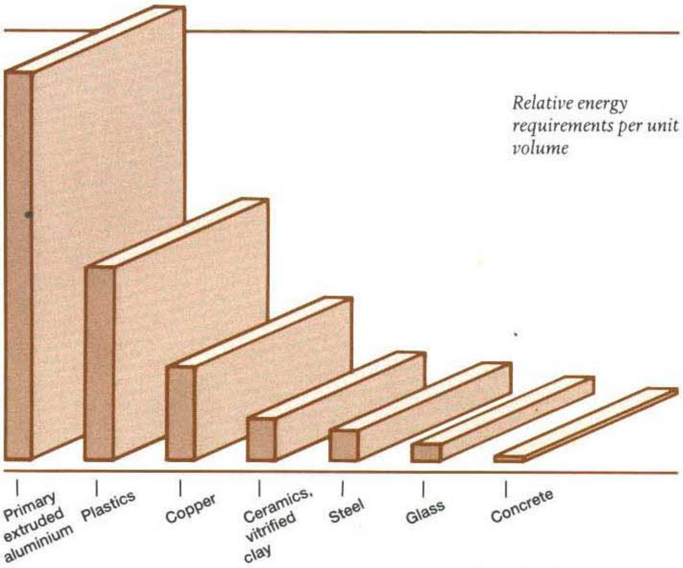
The main component of concrete, about three-quarters by volume, is the fine and coarse aggregate – sand, gravel and crushed rock – won from pits, quarries and the sea-bed. The environmental impact of these operations and of the cement industry's own quarries is carefully weighed against the country's need for minerals by local and national planners. Working practice and restoration are covered by planning conditions, local agreements, voluntary codes of practice and national guidelines. There are many examples of successful restoration of pits and quarries to agriculture, nature reserves and water parks. Moreover, restoration by infill provides a vital means for the efficient disposal of refuse. ▶

The environmental impact of quarrying is carefully weighed against national needs

Although the great majority of concreting aggegate will continue to be won from these sources, there will be a growing contribution from recycling.

There is no great technical reason why old concrete cannot be crushed and re-used as aggregate. It has already happened to many of the old wartime airfields in eastern England, and buildings, roads and other structures which have outlived their usefulness will now become an increasing source of aggregate.

Recycling of concrete is nothing new. During the war, bombsite rubble and cement made a satisfactory concrete – 'blitzcrete' – to use John Outram's term. The Romans, pioneers in the use of concrete, used crushed statues, (rejects or unfavoured heroes) as an aggregate source. Machinery manufacturers have introduced small mobile crushing plants which can be used on site to turn waste rubble into useable aggregate.



Relative energy requirements per unit volume

TARMAC

About half the concrete produced in Britain is supplied by local ready-mixed plants

Other materials

Water is the third key component of concrete – around 10 million tonnes a year is used to hydrate the cement and assist mixing and workability. The amount is not really significant in national terms, even in the light of current concern over water supply. While it takes under a tonne of water to make a tonne of concrete, 300 tonnes of water are needed to produce a tonne of structural steel.

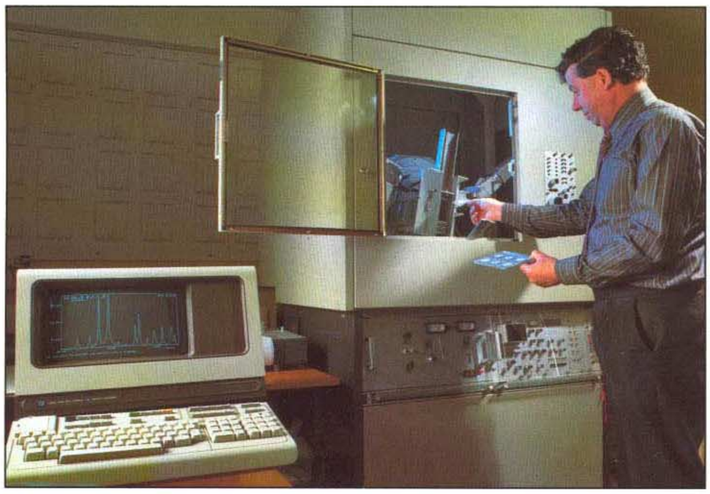
Virtually all concrete which fulfils a structural role is reinforced with steel. Surprisingly, it is not widely recognised that over 99% of British reinforcing steel is recycled from scrap – from cars and washing machines – an outstanding example of recycled waste materials being used to produce a high-performance, quality-assured product. Like concrete, reinforcement itself can be reclaimed from demolition sites. In the USA and continental Europe whole buildings have been successfully recycled, a trend that has now come to Britain.

Apart from the environmentally sound use of ground granulated blastfurnace slag and pfa, a number of other materials are used in concrete – lightweight aggregate, for example, often using pfa and slag as its raw materials or produced from pumice. The Hekla volcano in Iceland, a source of pumice aggregate for some years now, is a very visible sustainable resource!

Concrete in production

We have looked at the environmental effect of concrete's constituent parts, but what about its production? About half the concrete produced in Britain is manufactured in local ready-mixed concrete plants at some 1300 locations. The great majority, 95%, are quality assured. Most building sites are within a few miles of their local concrete plant. Journeys to site are therefore normally short, minimizing the energy used in

Restoration and landscaping of a former chalk quarry



Research at BCA to enhance the performance and competitiveness of concrete

transportation. Ready-mixed concrete needs no packaging and no pallets and occupies no storage space.

A typical truckmixer will carry 15 tonnes of concrete at a time making several daily deliveries. At the end of the day, a residue of around 200 kilogrammes of cement, sand and stone remain in the truck to be washed out into settling tanks. In the past, the solid part of the residue was treated as waste, but the water recycled. However, the value of the residue is now widely recognized and the cost of dumping has escalated significantly. These twin effects have led to the introduction of total recovery systems, a trend that seems sure to grow.

About a quarter of cement goes straight to concrete product factories producing a wide range of products from bricks, blocks and pavers to huge beams and panels.

NORDBERG

Crushing old concrete will become an increasing source of aggregate

There has, since the 1970s, been a significant move to energy-efficient curing facilities. Wastage has been minimized, originally by better quality procedures and now by the crushing and re-use of reject products. Many precast products such as paving units and tiles can be used again and attention is being given to potential for recycling larger products and systems.

Concrete in use

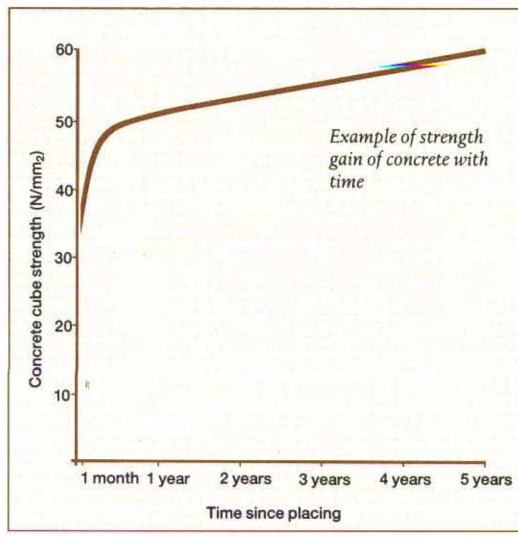
In buildings and structures, concrete is a genuinely environmentally sound material. It produces no emissions, needs no toxic preservatives and, because of its inherent fire resistance, needs no additional applied protection. It can give efficient acoustic insulation and in its lightweight form possesses excellent thermal properties. Moreover its thermal capacity – the ability to store and re-radiate heat – makes control of internal climates far easier and can reduce or even eliminate the need for expensive air-conditioning – so reducing energy consumption and CFC emissions.

In Britain there is a great shortage of 'quality' building land, but land which has previously been considered marginal and undesirable can be improved by cement stabilization. The process is straightforward, involving little more than mixing the existing earth with cement, but the benefits are great. Roads are often constructed over poor ground in this way – saving time and money. Even when the existing ground is contaminated by previous industrial processes on the site, the contaminants can be effectively locked into a cement-stabilized zone.

Unlike other materials, concrete continues to gain strength after placing. It is durable, has low lifetime maintenance costs and is easily repairable.

Concrete really comes into its own in its applications. The practical contribution it makes to the environment through its properties and the functions it performs will be considered in a second article.

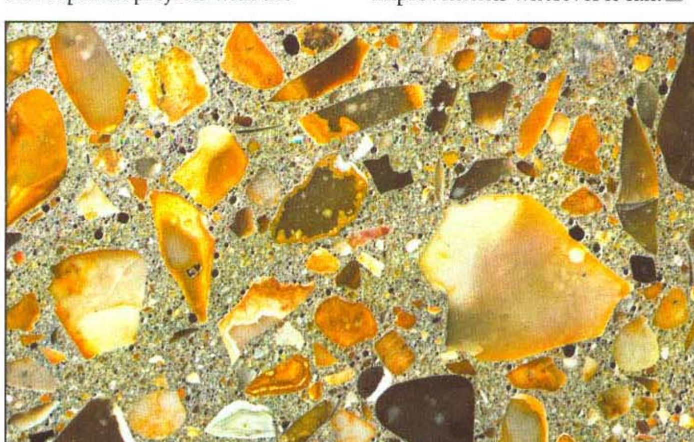
Using the expertise and resources of the BCA, the British cement makers have commissioned a range of research and development projects with the objective of enhancing the performance and competitiveness of concrete. This vital work has resulted both in a lowering of cement content in mixes, without sacrificing concrete quality, and in the more efficient application of



Example of strength gain of concrete with time

concrete in structures. This has also led to a further consequent benefit in the resultant lowering of energy consumption and CO_2 emissions.

Environmentally, the industry has achieved a great deal and it is committed to making further improvements wherever it can. ■



VIEW FROM THE PARK

Karin Möllfors
MArch(ETH), SIA

Karin Möllfors was born in Stockholm and studied anthropology at the University of Zurich and architecture at ETH. Since 1988 she has been working as an architect with the Campi and Pessina practice in Lugano.

In the Ticino village of Vico Morcote a new car park, with a roof-top terrace overlooking the Lake of Lugano, reflects the cultural influences which have shaped the region's architecture.

The Ticino Valley is the Italian-speaking region of Switzerland, located at its southern border with Italy. Lying to the south of the Alps, it enjoys a near-Mediterranean climate and attracts huge numbers of tourists.

Though politically federated to Switzerland in 1803, the region has for centuries been culturally influenced by Italy. So the Ticino has always been closer to Lombardy than to the French – and German speaking parts of Switzerland, from which it is separated by the formidable cultural and natural barrier of the Alps.

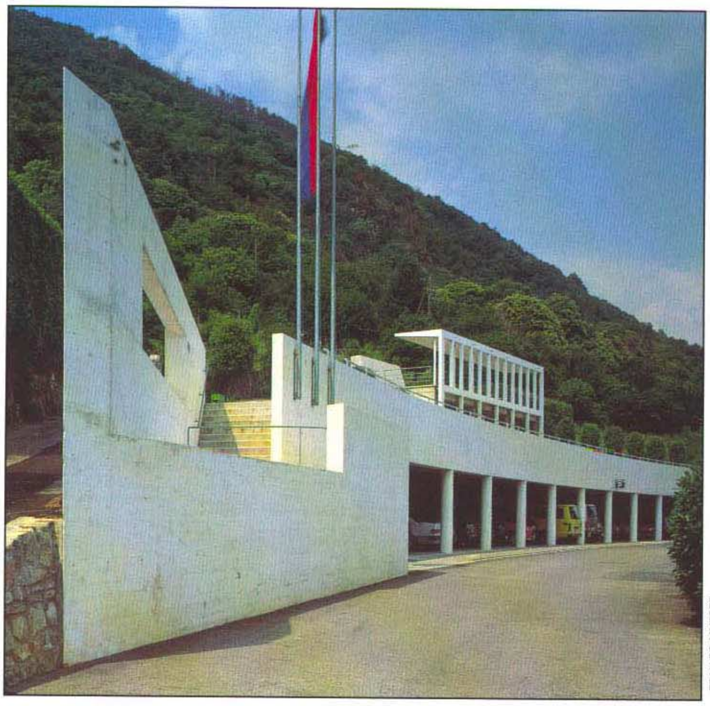
Over the years the Ticinese, feeling neither truly Italian nor Swiss, have developed a fierce regional pride in the face of rejection by their northern and southern neighbours.

Architectural roots

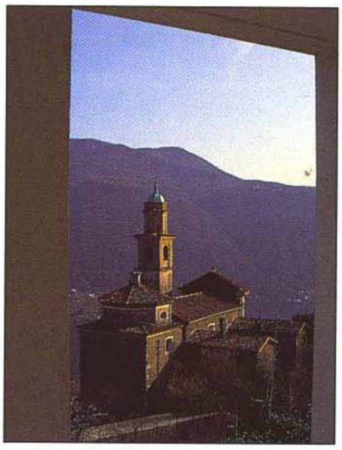
Until relatively recent times the Ticino was desperately poor and underdeveloped, and lacked the resources to support its population. Emigration was the inevitable consequence. During the Renaissance young men left their villages around the Lake of Lugano to work first as stonemasons and later as architects on some of Rome's most notable buildings. Those who followed this path included Domenico Fontana, architect to Pope Sixtus V (who left in 1543), his nephew Carlo Maderno, who became architect to Pope Clemence Aldobrandini, and Francesco Borromini who was perhaps the greatest of these emigrés.

In later centuries, as the economy gradually improved, architects were increasingly able to stay and work in their homeland. The flow of commissions grew steadily after 1803 as Ticino began to develop into a modern society.

Imbued with a strong sense of craft and functional responsiveness



EDUARD HUEBER



KARIN MÖLLFORS

View from the belvedere above the new car park at Vico Morcote

This, and the growth of tourism – destined to become its major industry – generated an increasing demand not only for hotels but also for a wide range of public buildings. So it was that local architects like Ferla, Chiattone, Bordonzotti and Rino Tami – the father of modern Ticinese architecture – were able to establish their reputations.

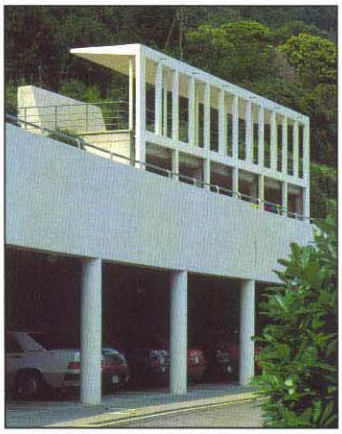
This brief historical resumé illustrates how Mario Campi and Franco Pessina, in common with other architects practising in Ticino today, can draw on a rich vein of local historical precedents giving linear continuity to the tradition of high-quality building design and construction. It also helps to explain why the area is so significant in the history of 20th century architecture. One could say that a direct axis runs from Lugano to Como and Milan, the birthplace of Italian rationalism in the 1920s.

The Swiss dimension

While the architecture of Ticino is spiritually and artistically inspired by Neo-Rationalism, the very fact that the buildings are in Switzerland distinguishes them noticeably from their Italian neighbours. Because of the social stability and density of its population, Switzerland has been able to maintain an extraordinarily high quality of construction and a sense of permanence in its building tradition.

Most architects in Ticino trained at ETH (the Eidgenössische Technische Hochschule) in Zurich so they are imbued with a strong sense of craft and of functional responsiveness. While Campi and Pessina's early schemes demonstrated innovation and inventiveness, they are nevertheless strongly aligned with the Swiss tradition. In the mid-1970s their work underwent a major change of direction, coinciding with the growing international recognition of the Neo-Rationalists. Campi and Pessina have worked together for 30 years, but their more recent schemes display a particular concern for precise building types, filtered through a Swiss-modernist formal sensibility, a hallmark of current Ticinese achitecture. (Their Chapel of the Madonna of Fatima, at Giova, was illustrated on the cover of *CQ* Summer 1991.

Campi, who has taught at Harvard and Cornell Universities in the USA, and is a Professor at ETH, offers a deceptively simple design philosophy 'a good, simple plan with excellent detailing makes a good building'. So it is hardly surprising that the firm makes extensive use of 'custom' detailing



EDUARD HUEBER

White concrete was the natural choice for the structure

which is still an affordable luxury in a country where the tradition of craftsmanship shows little sign of decline. After years of producing relatively small buildings the practice has now moved on to larger schemes including the IBM headquarters and a new ETH Chemistry Faculty building, both in Zurich, and social housing in Lugano.

Village car park

One of Campi and Pessina's most recently completed projects is a car park in Vico Morcote, a typical Ticino village with winding streets and picturesque old buildings. The scheme is the first phase of an 'urban plan' for the linear street village which overlooks the Lake of Lugano. The church and houses are ranged alongside the main street which leads up the hill from the lake to the next village, Carona.

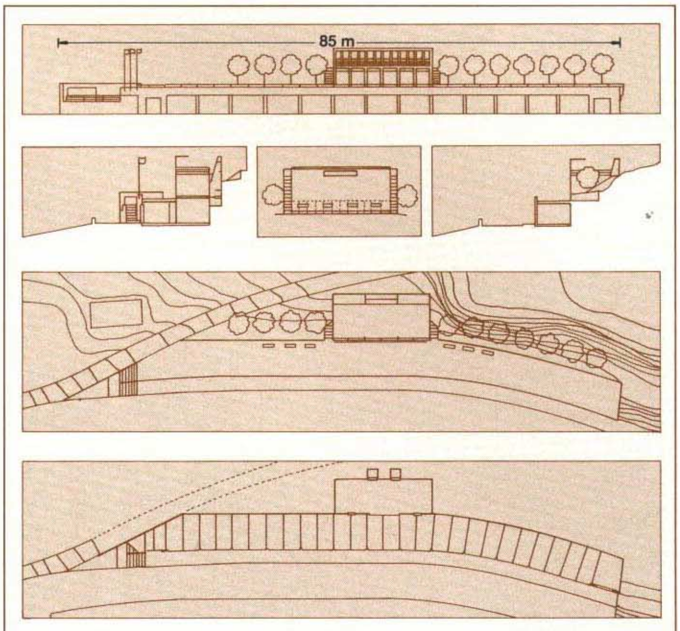
For years the community has lacked its own public open space and also parking facilities both for the villagers and for students attending lectures at SCI-ARCH (the outstation of the Southern California Institute of Architecture).

The architects have therefore sought not only to cater for the practical needs, but also to create a positive addition to the fabric and character of the village.

The new building, set into the hillside to its west, is built alongside Vico Morcote's main street, following and emphasizing its gentle curve.

The 85 m long linear structure provides 26 covered parking spaces at street level, a pedestrian terrace on its roof, and the central portion is extended back into the hillside to house municipal and communal facilities and topped by a belvedere. The main elements of its concrete structure are the retaining wall to the hillside, the deck over the car park supported on the street frontage by circular columns, and the facilities block.

The parking bays are at right angles to the street, with direct access over dropped kerbs and the footway; public lavatories and phone booths are also provided at this level. A large store behind the central parking bay accommodates street cleaning and maintenance plant and tools. The terrace formed by the roof overlooks the lake and provides a much-needed safe children's play area and a location for village festivities, with a covered area and open fireplace over the plant store. Its roof, in turn, serves as a belvedere with a stunning panoramic view of the lake, the village and the surrounding mountains; the

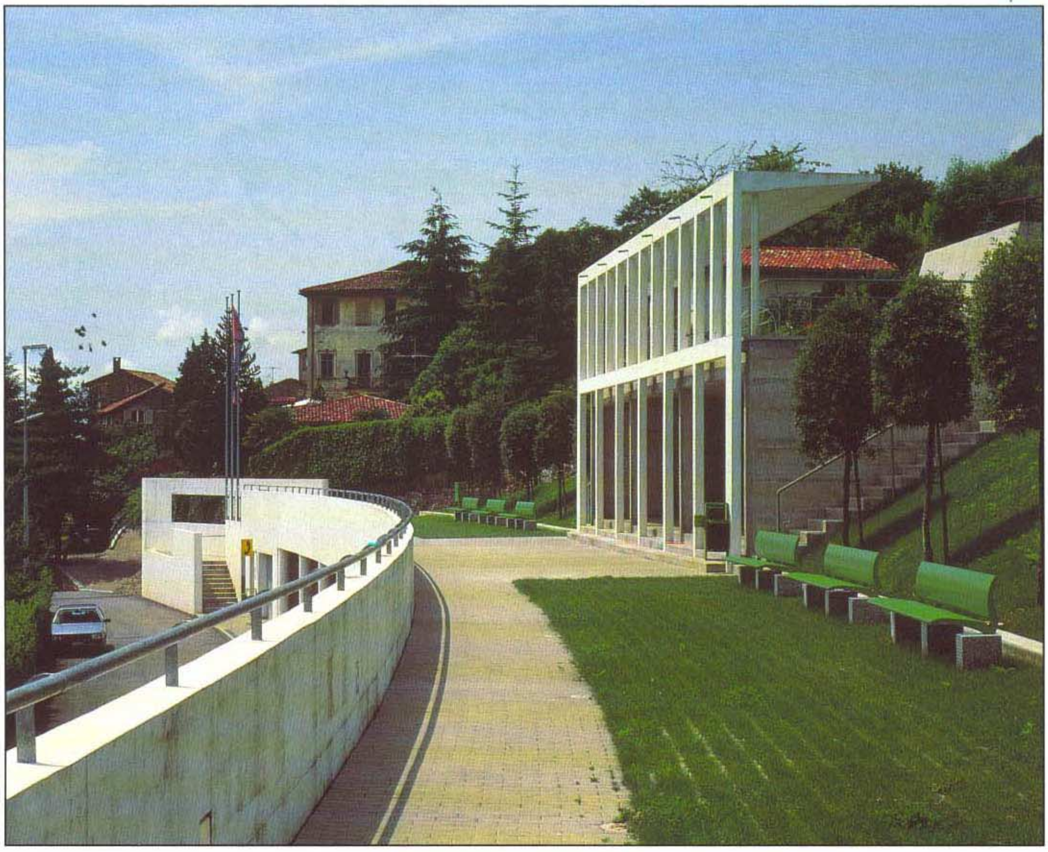


Elevation, sections and plans

modular façade screen which rises from terrace level, forms a series of 'windows' and supports a small cantilevered concrete roof.

Concrete – white on all significant exposed parts, including the huge communal fireplace – was the natural choice for the structure. The material is ideally suited to express the architectural quality of the design. ■

The terrace formed by the car park roof is used as a safe play area and for village festivities



EDUARD HUEBER

ERIK PELHAM (PAVERPRINT)

UPDATE ON PATTERN-IMPRINTED PAVING

Tony Roeder

CChem, FRSC, FICT, FIQ, FGS

Tony Roeder is Principal Concrete Technologist in the BCA Marketing Division

Pattern imprinting of concrete can combine a finished appearance of brick, tile or cobblestone with the advantages of in-situ slab construction. The technique offers yet another practical way of harnessing the versatility of concrete. While the material in its own right offers a broad range of attractive surface finishes such as exposed-aggregate, integral colouring, bush hammering – or plain – there will always be a demand for concrete that does not look like concrete.

Design preferences and the need for compatibility with a particular environment are major considerations in the selection of surface texture and appearance, so the scope for creating paved areas with the appearance of 'traditional' materials, but with the durability of concrete, is made possible by the technique of imprinting.

'Patterned', 'stamped', 'imprinted' and 'embossed' are all terms which are used to mean the same thing – the creation of a surface pattern and texture in concrete paving constructed in situ, similar to that of natural stone, brick and other manufactured paving materials.

The technique has been in use for nearly forty years, particularly in the United States, New Zealand and Australia and is growing in Japan, continental Europe and the United Kingdom. Many UK specialist imprinted paving contractors operate under US and New Zealand franchises.

Base and slab

As with any paving operation, the preparation of the sub-base is important. It should be of suitable depth, taking into account the ground conditions and the anticipated loadings. Blinding layers and damp-proof membranes may be necessary in some circumstances.

Slab thickness will depend on the traffic loading. For pedestrian use a slab 75 to 100 mm thick may be adequate while for industrial use a thickness of 200 mm or more may be required.

Once the side forms have been fixed to line and level, and any necessary steel reinforcement supported, the concrete is placed, fully compacted and screeded. The mix used must be designed to ensure adequate strength and durability. Many contractors use a Grade 30 concrete with a slump of about 50 mm. Maximum aggregate size is 10 mm (to facilitate forming the pattern) and the concrete is air entrained to overcome the possible effects of frost and de-icing salts. With the introduction of Designated Mixes in BS 5328 : Part 2 : 1991, the most suitable mix to be specified is PAV 1. This will produce a strong and durable concrete, and one which the ready-mixed concrete supplier can easily provide. In some instances the contractor will incorporate fibres – usually polypropylene – into the concrete to control cracking and improve impact resistance. They may also assist in the formation and retention of the pattern.

Colour and pattern

The colour is applied to the surface in the form of a 'colour hardener' which is sprinkled evenly by a dry-shake hand method in two operations. The first shake uses about 60% of the total recommended dosage, never less

Ideal for commercial and domestic applications

TREVOR JONES (BOMANITE)

than 3 kg/m^2. The concrete is thoroughly floated after each treatment and finally steel-trowelled to give a hard wearing and impervious surface.

PATTERNED CONCRETE (SW)

In-situ concrete with the appearance of traditional paving

Colour hardeners are usually blends of pigment, cement, fine hard aggregates, and admixtures which help the dispersion of the colour hardener and condition the surface to receive the imprinting tools.

When the concrete is sufficiently hard – firm to finger pressure – the imprinting tools or mats are placed on the surface and pressed into the concrete to form the required pattern. The imprinting tools or mats vary in size and, depending on the area to be treated, several tools may be fixed together.

Tools and mats have shapes in the configuration of, for example, granite setts, herringbone brick, random stone, cobble-stone and ashlar slate. By the use of combinations of tools and mats the variety of patterns is almost limitless. Furthermore, the colour range and surface texture which can be achieved in pattern-imprinted concrete is extensive.

When patterns are produced with a plastic texture mat the surface of the concrete must be treated with a pigmented release agent to assist in the formation of the surface texture. Thin polythene sheeting is often introduced between the tool and the concrete to help form a more rounded pattern, such as for cobble-stones, and also aids the release of the texture mats.

Curing and joints

After the imprinting operation, the concrete is protected from the weather. The use of plastic sheeting, waterproof paper or curing membranes is not recommended, and water curing can adversely affect the colour of the concrete. After a few days the excess pigmented release agent used on textured surfaces is removed by washing.

The final operation is the sealing of the surface using a wax or acrylic type material. This sealer not only completes the curing operation but helps to protect the surface against discoloration. It also increases the durability of the surface and makes it impervious, so facilitating cleaning to remove oil and other dirty materials.

One very important aspect of pavement design and construction is the need for movement joints, and this applies equally to imprinted concrete. The joints may be sawn in the hardened concrete, formed in the plastic concrete or created as a construction joint. They can become part of a feature where there is a change of colour or pattern and are thus easily disguised. The type and spacing of joints depends on the specification and the application. Poorly formed joints can affect the appearance and performance of the paving.

In situations where the surface may become damaged, integral pigmentation of the concrete may be necessary, but repair and reinstatement is possible. Cutting out and replacement of affected areas is claimed to be a relatively simple operation.

CRETEPRINT

The range of patterns and textures is almost limitless

Imprinted concrete can also be used as a thin topping over existing sound slabs, although the materials and techniques used are slightly different.

Pattern imprinting is an alternative way to construct concrete paving which is both functional and decorative. The wide range of colours, textures and patterns are suitable for applications ranging from a garden path or garage drive, to a leisure facility or petrol filling-station forecourt. As with any other paving system the end result will reflect the quality of the materials and the skill and knowledge of the construction team. ■

PAVERPRINT

ST. ANTONY'S COLLEGE

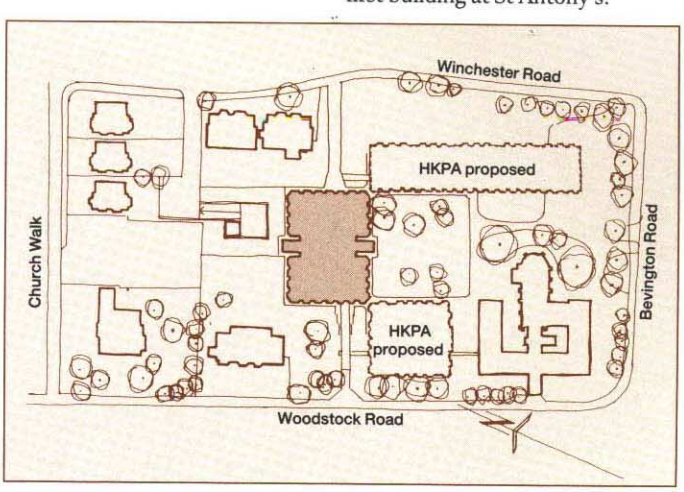
REVISIT

Frank Hawes
DipArch, RIBA

Frank Hawes is a specialist in the architectural use of concrete and design to control long-term appearance, and is a regular contributor to CQ.

This article looks closely at an early exercise in the control of weathering. I have tried to ignore the rosy hue which my glasses might bestow on one of my favourite buildings.

In the early 1960s, Howell, Killick, Partridge and Amis (HKPA) were commissioned to design developments for two Oxford Colleges. The development plan for St Antony's was first onto the drawing board and received RFAC approval in 1962, but Phase One of St Anne's was under construction before the practice was commissioned to get on with the first building at St Antony's.



On both schemes, HKPA developed their particular interest in separating the structure of a building from its skin and in using the skin to modulate the way light enters a building. Their buildings were usually informally grouped to create places of character between and around them and express their principal or 'served' spaces separately from service spaces. They tend to do this by giving each principal space its own visible structure.

Layout

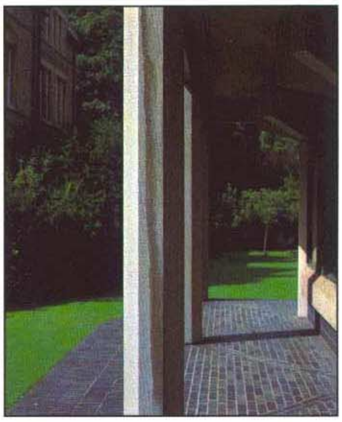
The site covered a complete block on the Woodstock Road and contained a Victorian convent and several typical large north Oxford houses. The initial brief envisaged a completely new college with all existing buildings removed but, by the time the detailed design was underway, this had been modified to retain all the existing buildings. In 1966 a group of three new blocks – teaching, residential, and dining/common room – was approved which, together with the former convent would surround a garden/quadrangle in the centre of the site.

Only the last of the proposed new blocks was built before Oscar Niemeyer offered to design the next phase free of charge. By the time the College had discovered just how much this was actually going to cost them, the whole financial climate had changed. Now, more than 20 years on, a further block is under construction financed by a Japanese company but designed by different architects.

The Hilda Besse Building

The Hilda Besse Building, as the HKPA block is known after the wife of its French benefactor, has three floors and a basement. Service access is via a ramp to the basement, allowing the building to sit very comfortably into the garden. The ground floor is recessed behind a complete peristyle of neat octagonal concrete columns so that the principal spaces at first and second floor

West elevation with at least two repaired panels



In cleaning the concrete, college staff have sensibly not attempted to remove all signs of weathering (octagonal column)

levels dominate the composition. The west side is occupied by the double-storey dining hall, while the east side has the kitchens on the first floor and two common rooms on the second. These 'served' spaces east and west are separated by a taller service bay containing the staircases and lift.

The walkway behind the ground floor columns was to be repeated on the other buildings, making a covered way all round the garden/quad, but the staircases at the ends of the service bay project and interrupt it on the north and south faces of the Besse Building. Perhaps this is intended to give a subtle nudge towards the entrances on the east and west sides.

These entrances plunge deep into the heart of the ground floor, meeting at a columned entry hall which has quite a medieval feel. It is interesting how the simple and traditional expedient of offsetting the two accesses makes this a place rather than a thoroughfare.

Internally the building has the clarity of structure and plan that one would expect of these architects, though the severe finishes are not entirely liked by its present users.

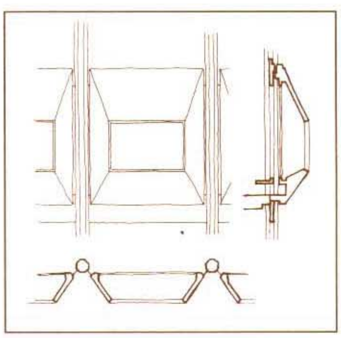
The logic of the building's structure and detailing all springs from the 6″ faces of the octagonal columns which form neat junctions with windows, partitions and structural members either at right angles or on the diagonals. The roof structures are diagrids spanning clear over the largest spaces and containing lighting and rooflights, and wooden panelling to control sound. The lower structural floors are supported on a wealth of columns with boldly detailed diagonal cruciform heads.

Detail design

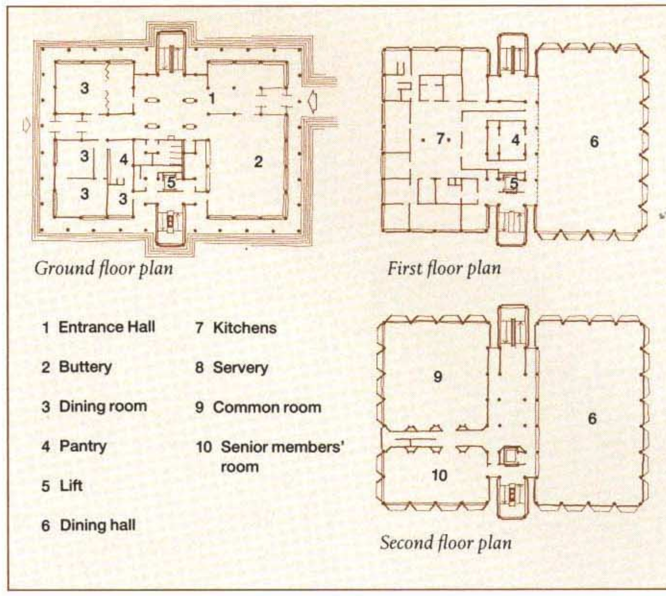
John Partridge was one of the first architects to demonstrate an interest in regulating the flow of water on the façades of buildings. This, together with HKPA's interest in using the skin to control the way light enters, led to the development of characteristic panels which for want of a simpler name I shall call 'hooded window surrounds' which deserve detailed discussion. While they have not, perhaps, achieved in practical terms all that was hoped of them, there is no doubt that they give a particular character to the building; because they are used only for the dining hall and the two common rooms they permit the clear external expression of these spaces.

The non-load-bearing character of the panels and window hoods is shown by keeping them separated from the columns – by a narrow glass strip where the units are of storey height and by a lead-faced strip where there are spandrels and lintel panels.

Diagrammatic elevation, plan and section through hooded window surround



On St Anne's College the storey-height hooded surrounds form the east and west elevations of the residential buildings and, with their sloping tops and soffits nearer horizontal than on St Antony's, they make shallow balconies for the students' rooms.

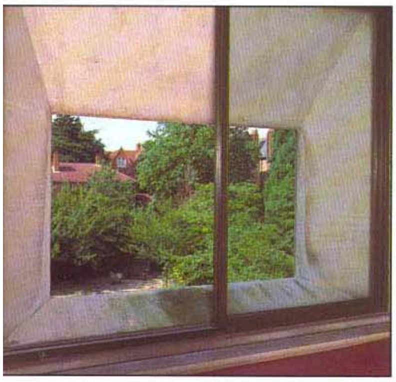


Here, their practical functions seem to be to modulate the daylight entering the rooms, to control the flow of water on the façades and, perhaps, to give a sense of privacy to the rooms.

Controlling light

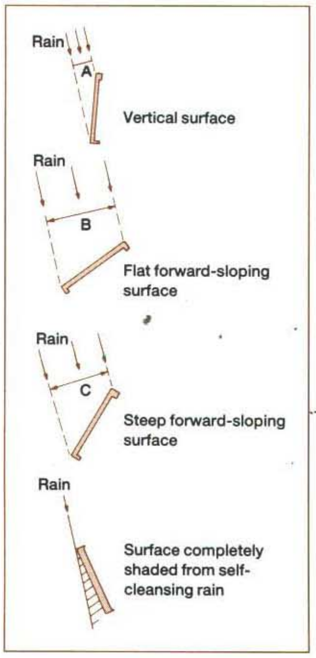
The walls of modern buildings are thin when compared to those of past centuries, with the result that it is difficult to detail window frames and jambs to avoid glare. The splayed shutter boxes at the jambs of Georgian windows, on the other hand, seem to do this pretty well and to reflect daylight into the room. HKPA were presumably aiming for a similar effect, but some of the rooms in this deep-plan building seem now to need more artificial light than one would wish, even though there is also light coming through the diagrid roof. In the smaller common room ▶

The columned entry hall has quite a medieval feeling



Dull surface of inner face of a hooded window surround disfigured by uncontrolled water

Diagram from CPS 27 – lengths A B and C are directly related to first-contact rain



this may be because the windows face east and north, and there is a standard solution for all elevations, but I am not aware of 18th century details varying from one aspect to another. Maybe the natural illumination worked better when the building was new and the inner faces of the hoods were as white as the outside. But now, after some 20 years, very little light is reflected in from the jambs.

These must have been the top faces when the units were cast – it looks as though they have a wood float finish – so maybe it would not be unreasonable for them now to be given a little help in reflecting light.

Controlling water

John Partridge taught many of us to consider the way in which rain would affect our buildings and the form of these surrounds either arose from, or gave rise to, a diagram that is familiar to those who heard or read his views at that time. We all expected a direct relationship between the amount of water we would get directly onto the surface and its subsequent cleanliness. His Concrete Society Current Practice Sheet* on the subject highlights the importance of controlling the concrete's surface absorption but none of us really appreciated its interdependence with both inclination and aspect.

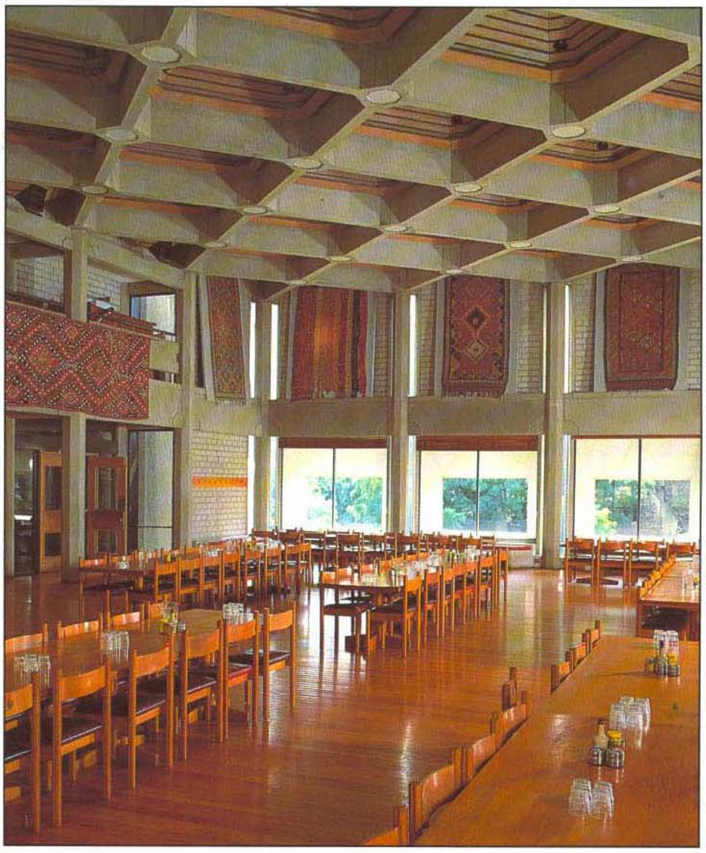
He mentioned balancing the inclination of a surface in order to collect water against its consequent increased likelihood of its collecting and holding dirt. I doubt that the latter is often a problem in our climate, where dirt rarely remains undisturbed by rain for long, but the inclination does make the imperviousness of the surface very important.

Elsewhere in Oxford, the British Council Centre, with which I was involved a few years earlier, has in-situ concrete surfaces which are inclined both up and down, facing all four points of the compass. As one would now predict, there are slight differences between elevations and the upward-facing surfaces are different from those protected from rain, but it is the protected ones that look cleaner because the upper faces are heavily colonized with lichen and moss.

The precast, exposed aggregate, inclined surfaces on St Antony's were much denser and I do not remember seeing any signs of either dirt or colonization on them, although the sloping soffits below the sills did become soiled and streaky. Sadly from the point of view of this study, the Hilda Besse Building has been cleaned twice in the last ten years or so – first on the initiative of the maintenance manager, and then again a couple of years ago to facilitate an inspection by engineers brought in specially by the college, Moore, Vaughan and McClean. On both occasions the cleaning was undertaken by the college maintenance staff using just water and a hand brush. After the first cleaning the surfaces were treated with a proprietary fungicide and after the second, and following repairs to the corners of some of the panels, these areas were sprayed with silicone – again by the staff.

While I would not have recommended this treatment – the aggregate is a mixture of Luxulyan granite and Derbyshire spar – on my recent visit I could see no sign of the stickiness problems that silicone is said to produce on such non-absorbent aggregates.

How useful it would be if we had photographs of these units just before each of the cleaning operations. From those I took in April 1979 it can be seen that, carefully as the weathering details had been considered, they did not all work quite as expected. I would not, though, have expected the building to have desperately needed cleaning within two or three years of that visit – nor, however, would I ever want to dissuade a building owner from good housekeeping!

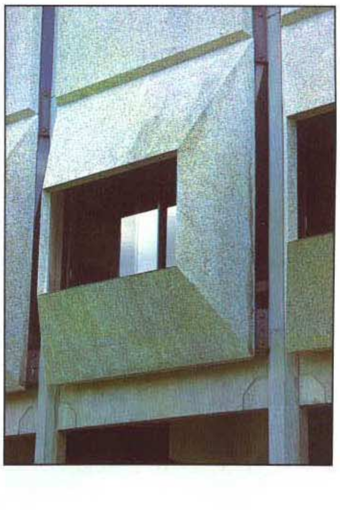


The roof structures are diagrids spanning the largest spaces

A hooded window surround in 1979…

FRANK HAWES

… and re-photographed in 1992



* PARTRIDGE, J. *Current Practice Sheet No 27. Weathering: design of concrete buildings. Concrete* Vol. 9 No. 11, November 1975

I noted two points particularly at that time. The sill detail was not bold enough to prevent streaking on the sloping soffits, and there was some staining on the east elevation which was not repeated in a similar situation on the more exposed south side. John Partridge now feels that the inclination of the soffit was not right, and certainly the St Anne's units are more decisive. Nevertheless, even if the angle were different I would opt for a bolder detail at the sill.

It will be seen from the detail sketch that water is collected in a gutter at the back of the sill. This is led, via what John Partridge termed 'elevational plumbing', to discharge from neat outlets in the leadwork which closes the narrow gap between the column and the hooded surround. While most of the water responsible for the staining on the soffit must, therefore, have come from the narrow outward sloping concrete edge, there would probably also have been some coming via the outer flanks and edges of the hood surround.

Water flowing down the head of the unit also needs more control. At the moment there is a tendency for some of it to run down the jambs and get onto the inner faces of the flanks, so causing stains which are conspicuous from the principal rooms of the building. A detail to control this might at the same time provide a useful stop to some form of cladding or applied finish to improve the light reflectance of the inner surfaces.

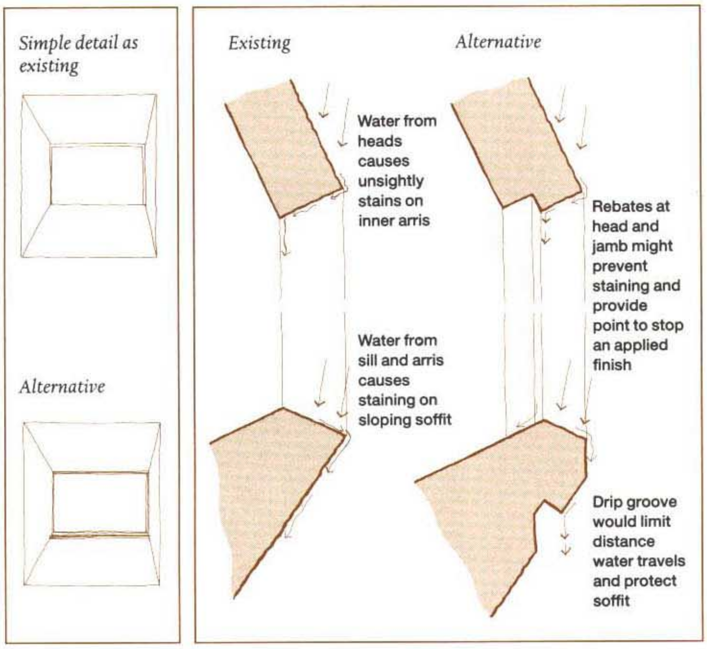
To control all this would have required some very bold detailing – quite probably bolder than the thickness of the units would permit, and so making the cladding look heavier than HKPA would have wished. It would also have been more expensive, but the whole building including basement access ramp and external works cost only £361,852 – less than £150/m²! If only we had known then how costs would spiral through the subsequent decades.

Precast concrete in the nineties

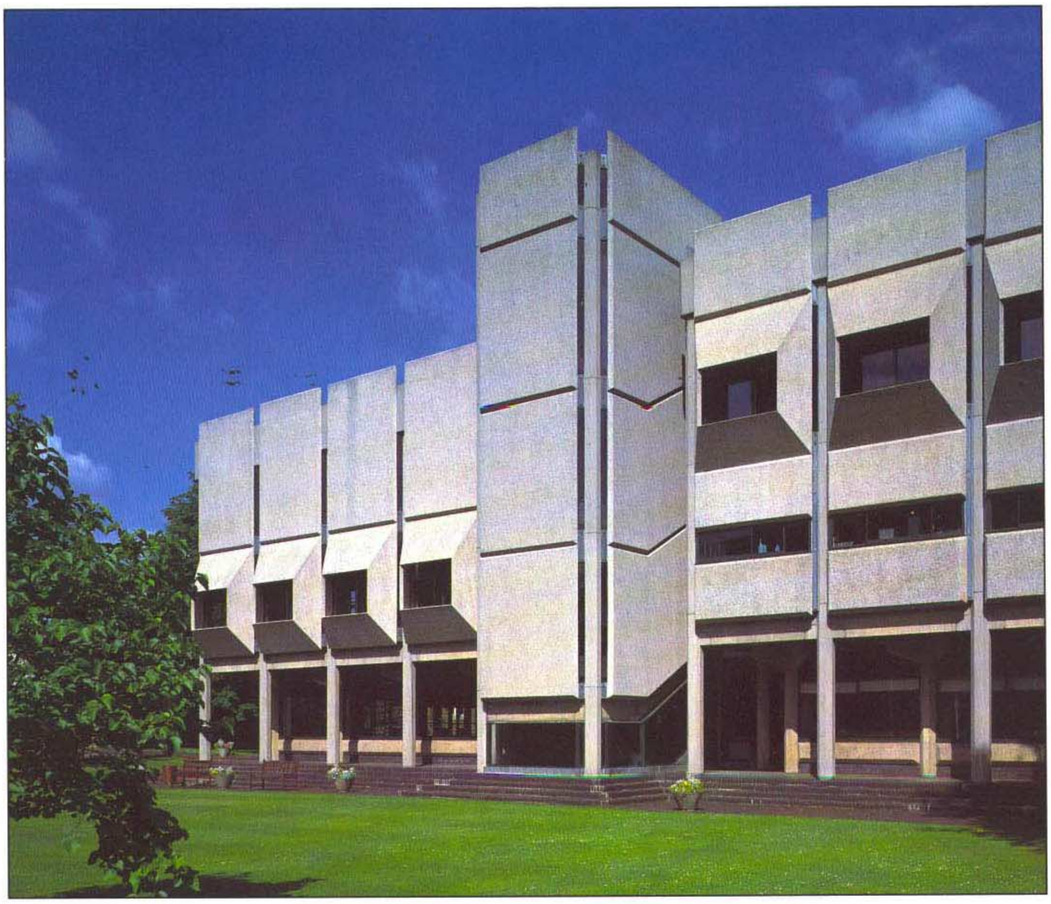
One of the biggest differences between the way such a commission would be tackled now, and how it was done then, lies in our fear of making mistakes. HKPA designed and detailed the entire system with the close co-operation of the engineers, Harris and Sutherland, and then obtained tenders from a number of precasters. Apart perhaps from getting some modest changes to the mixes to suit their standard practices, Trent Concrete, who won the contract would have had only to price the job and cast, deliver and probably erect the precast units.

Today the precaster would be required to provide a complete package from much less detailed information and would usually expect to supply and fix the windows and carry out all the jointing. As an architect I may be biased, but I believe this probably means there is less innovation and originality of design but I can see too that it should mean fewer problems during and after construction.

HKPA, and John Partridge in particular, led the way in addressing the challenge of designing for successful weathering. The technical expertise of the precast industry available to designers today was honed on buildings like St Antony's. By the same token, there are lessons on the control of weathering still to be learned by designers from these buildings.



Photographs (taken in July 1992) – Jonathan Farmer



South elevation

Essay in CONCRETE

Dorian Wisjniewski
BArch, DipArch

The role of the architect, to respond to the instances of the site, was exploited in the siting of a new chapel within the context of the proposed master plan for Fitzwilliam College, Cambridge.

Dorian Wisjniewski graduated from the Mackintosh School of Architecture in 1985, joined MacCormac Jamieson Prichard in 1988, and is currently Principal Project Architect for the new telecommunications college for the Cable and Wireless Group.

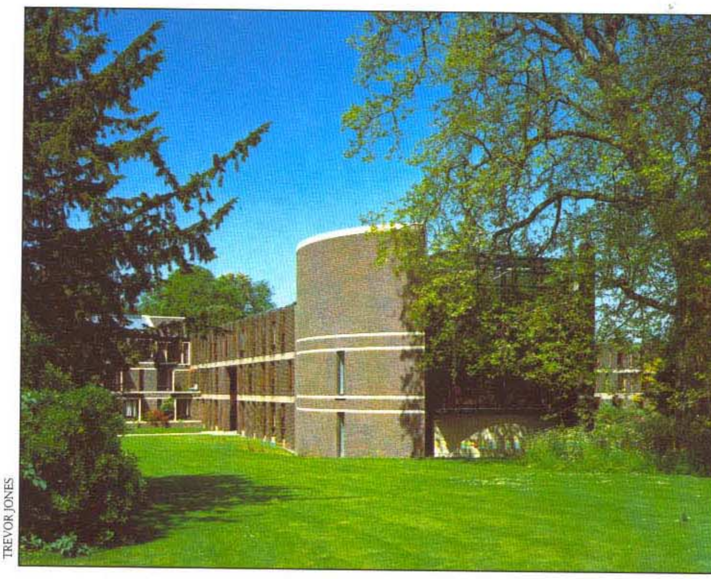
The implicit special qualities of the existing Grove Garden's 'idealized nature' were to be contained by a square cloister (sketch 1). The cloistered garden was to provide the setting for the College's future communal buildings.

The chapel sits against the truncated wing of residences towards the middle of the College grounds. Its spiritual importance is heightened by the place of worship being set within the Grove Garden, focused on the giant plane tree at the garden's heart.

Metaphor and geometry

The volume offered by the height of the residential wing allowed for an elevated place of worship (2). The metaphor of the ship accentuates the notion of the chapel floating amidst this special landscape. The ship's deck is the chapel floor and its under-belly the roof to the semi-subterranean crypt space.

The ship, constructed in oak, bridges the cloistered route to become the ceiling of the cloister at the point of entry to the chapel.



TREVOR JONES

Set in Grove Garden at the end of a truncated residential wing

The chapel space is defined by two arced, in-situ concrete cusps, the place of worship further defined by an inset cubic frame of precast concrete (3 and 4). The pure geometric forms of the cube within the cylinder, which in turn sits within the square cloister, speak of more abstract ideas of Platonic significance.

The chapel's prinicpal elements are simple, yet they encounter the age-old problem of how to resolve the interfaces of the differing geometries of the circle and the square. In the resolution of this, light is used as the mediating and reconciling element. It has been fretted by the modulated tracery of mullions and transoms, which wraps back on itself to contain the light as a measured volume of its own.

Colour and texture

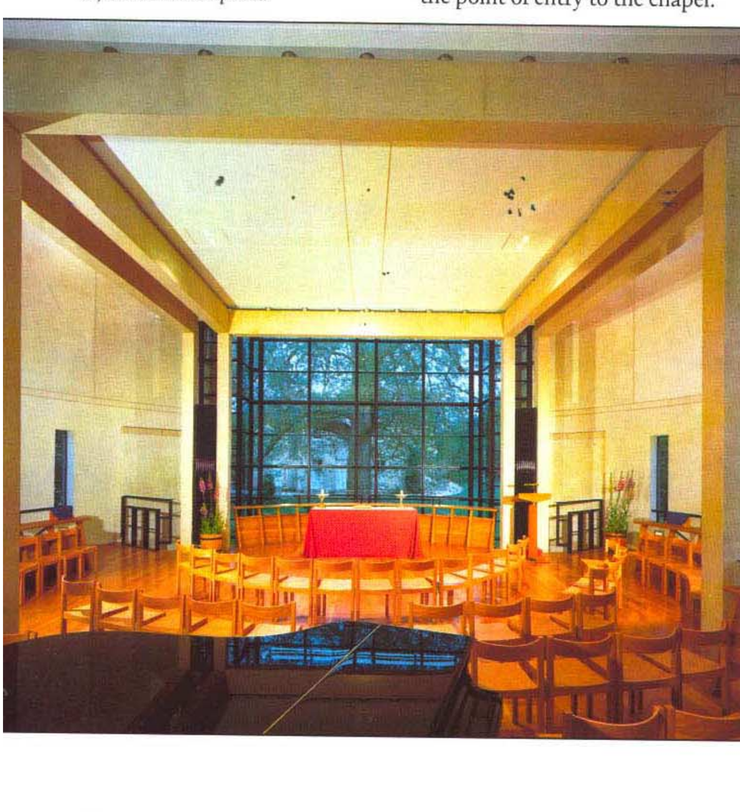
The materials which constitute each element were chosen for their innate qualities. The natural colours and textures were considered and exploited in the choice of construction and finishing processes.

The ship is constructed in American Oak. Oak is a timber traditionally used in wooden shipbuilding. The tracery is metal, used for its efficiency of section size and darkened to emphasize its modulation of the light.

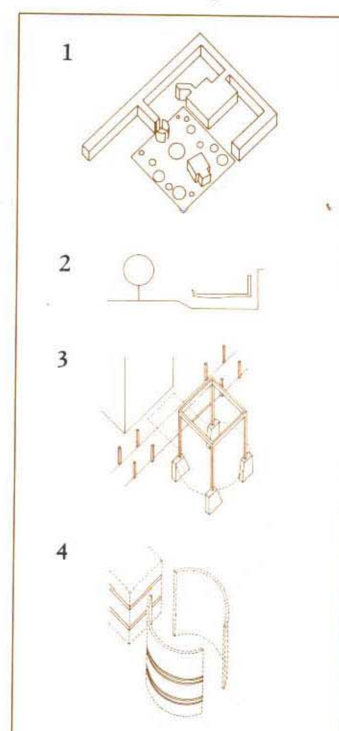
The curved cusps are cast in situ with grey concrete. They are rendered internally, using a mix based on white cement and the fines of the white concrete, with lime added for ease of handling. It took no fewer than eight one metre square samples to find a suitable match for the white concrete.

The crypt is encircled by an inner ring of rendered block walls, with four heavily textured in-situ white concrete piers orientated in pairs to the east and west. The walls and plinths emerge from a bed of dense white concrete screed which moulds to form steps at the points of ingress and egress to the crypt, and around to define a well of aqueous green carpet.

A cubic precast concrete frame defines the worship area



TREVOR JONES

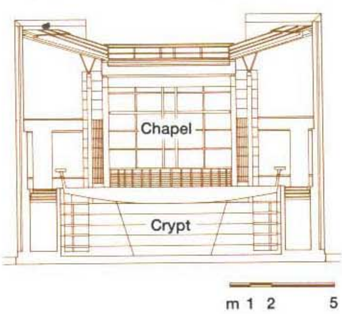


The render is white, like that on the curved cusps, and is striated in horizontal bands, suggestive of geological strata. This gives the impression of an excavated quality to the crypt, evocative of ancient precedents.

The screed, made with white cement and similar aggregates to the concrete, is treated as a terrazzo, but less highly polished, and finished in a durable, semi-gloss sealing lacquer.

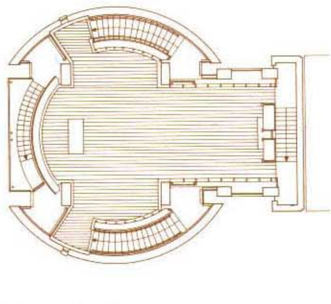
The in-situ plinths are cantilevered foundations and, as such, do much of the support work for the structures above. As an emphatic gesture representative of the forces exerted on them, they have been cast with a batter, and display the same stratification as the rendered block. They have been heavily point tooled to reveal their larger Gloucestershire limestone aggregate.

On beginning to ascend to the chapel, one steps onto oak treads let into a fissure between the layer of the crypt walls and the outer cusps, which are finished alike.



Aligning with the deck of the chapel, the cusps set back coincidentally with the top of the crypt walls to reveal string courses of finely tooled white precast concrete coping stones. These use the same constituent materials as

Suggestive of geological strata, the plinths and rendered walls of the crypt are striated



Plan at chapel level

the in-situ concrete, but with finer aggregates. The cusps set back again at higher level, revealing further string courses which, together with the considered modulation of the daywork joints in the render, reinforce the idea of stratification.

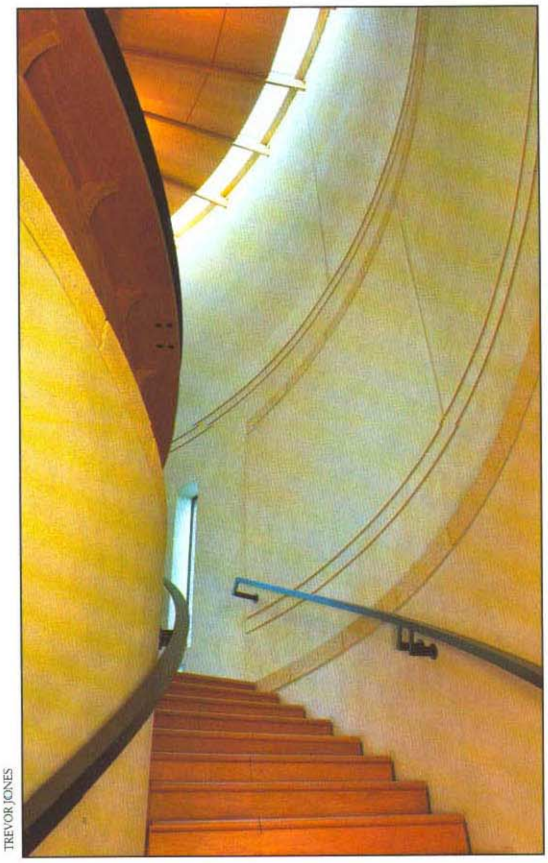
The precast white concrete frame of columns and beams is supported on the in-situ concrete plinths. The frame, made with the same mix as the precast copings, was finished by grinding and polishing. The same parent material as that of the plinths has here undergone a sort of metamorphosis, ossifying the Gloucestershire limestone into more precious Purbeck-like qualities, appropriate to the importance of the place of worship.

In the outer skin of brick cladding the string courses stand out in contrast, as precious veins within a broader seam of dark brickwork (4). They give contextual acknowledgement by delineating a dimensional and level relationship with the concrete bands in the existing residential building.

Hierarchy of materials

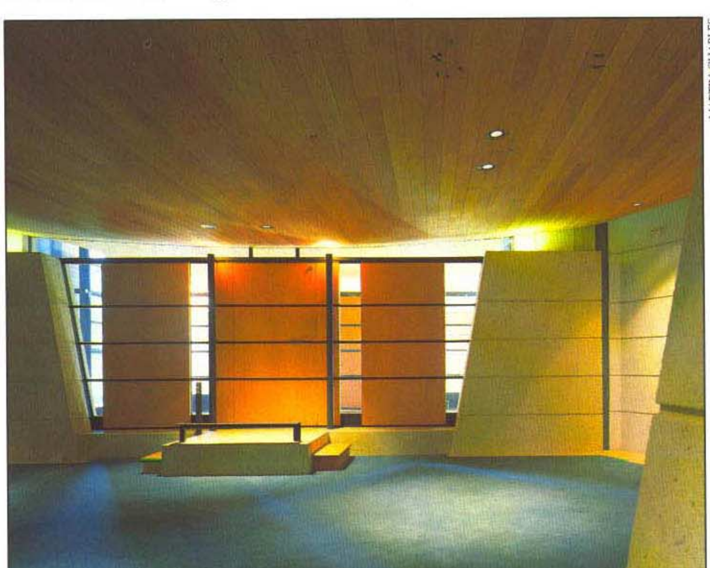
The chapel uses concrete in many different ways. The forms created have relied on the plastic nature of concrete. Indeed, the flat roof, in its tasks to stabilize the structure of the frame to the cusps and reconcile the geometries, could not easily have been constructed in any other material.

The variety of textures and finishes achievable in concrete has enabled us, in this instance, to explore a hierarchy of materials in relation to a narrative of metaphor.



TREVOR JONES

Great care was taken to match the render to the white concrete



MARTIN CHARLES

Arriving at the finishes required a continual process of sample preparation. The goodwill and understanding of the builders was essential to enable this experimentation to take place. It was carried out with mutual enthusiasm for the product.

The finished building displays the excellent craftsmanship exercised at all times throughout the construction process by the builder.

In awarding the chapel a High Commendation in this year's Concrete Society Awards, the Judges commented 'This sophisticated solution to one of the oldest building problems has largely been expressed in different forms of concrete. Every part of the chapel has been detailed and built with an intense striving for perfection by the architect and builder: in particular, the rendering and concrete work are to a high standard. The idea of using concrete as a high quality interior material, executed in the manner of a cabinet maker, is to be commended'. ■

CLIENT
- Fitzwilliam College

ARCHITECT
- MacCormac Jamieson Prichard

STRUCTURAL AND SERVICES ENGINEER
- Ove Arup & Partners

QUANTITY SURVEYOR
- Dearle and Henderson

CONTRACTOR
- Johnson and Bailey Ltd

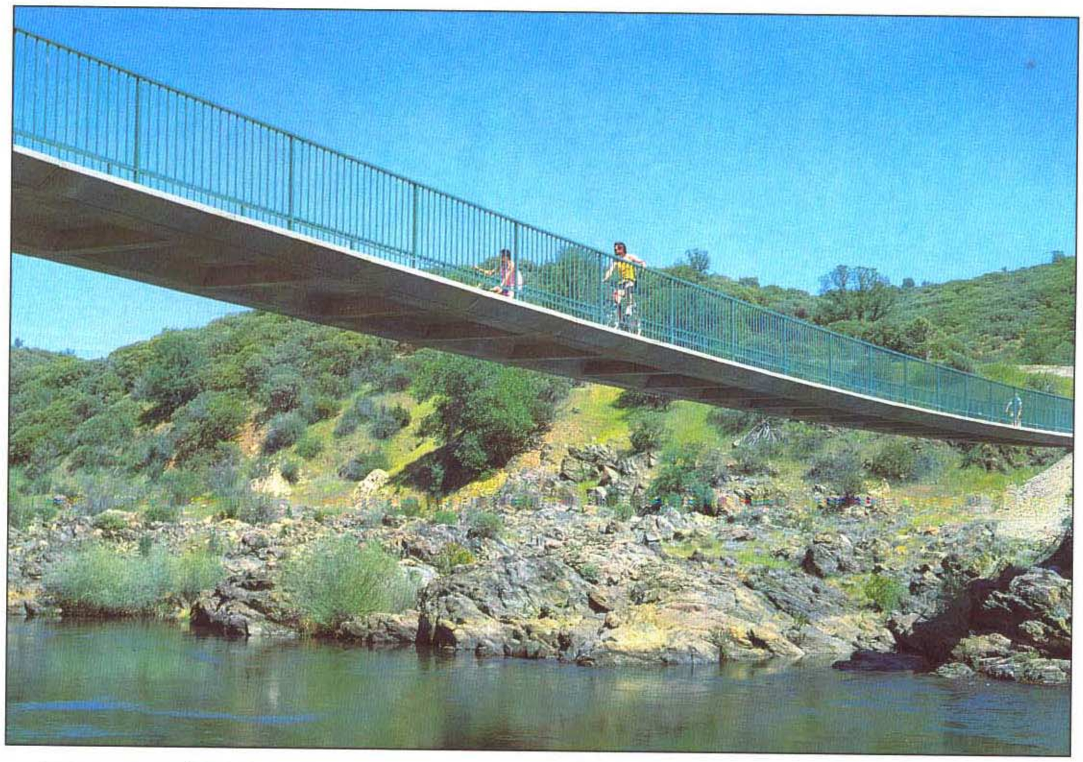
SUB-CONTRACTORS
- Histon Concrete Products Ltd (precast concrete)
- Johnson and Bailey Ltd (in-situ concrete)

SACRAMENTO RIBBON

Charles Redfield
and
Jiří Stráský

Charles Redfield is a consulting engineer in Mill Valley, California. He has been involved with concrete bridge design for over 30 years, working in the United States and in Switzerland and Brazil.

Dr Jiří Stráský is a consulting engineer from Brno, in Czechoslovakia where he has designed innovative bridges including nine stressed ribbon footbridges. Dr Stráský is currently working at T.Y. Lin International, San Francisco.



For many years the citizens of the City of Redding in Northern California have enjoyed a parkland along the Sacramento River stretching upstream to Keswick Dam. Apart from an old historical arch bridge at the city limits, the pedestrians were confined to 4 km trails on each bank without access across the river. In the autumn of 1987 a decision was taken to build a bridge that would link the upper end of the park, turning the previously separated trails into an 8 km loop.

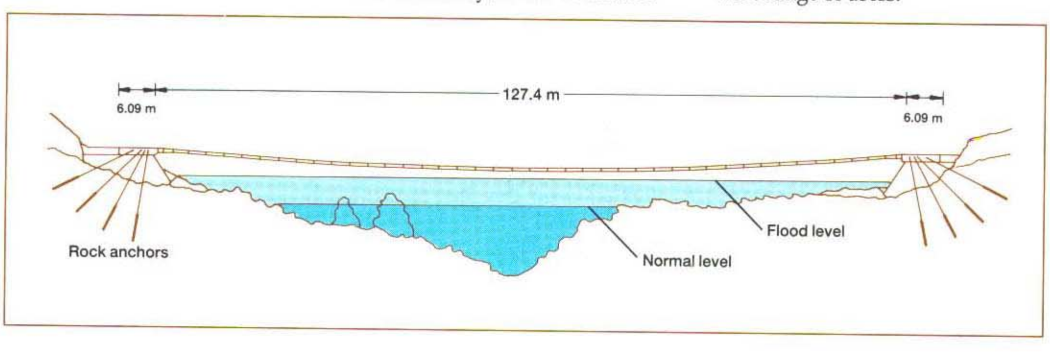
Because of the dam's presence, the banks of the river directly downstream have extensive rock outcropping, adding dramatically to the beauty of the river basin. The existence of this natural setting, coupled with the bridge's intended recreational use, dictated a strong aesthetic concern in its design. Geotechnically, it was concluded that the metamorphic bedrock condition gave a satisfactory foundation on both banks. In respect to hydraulic considerations, the dam upstream also assures the intermediate regional flood level at +156.9, compared to an elevation of +161.3 for the abandoned railroad bed which forms the trail along one bank.

Design challenge

Any design would have to accommodate changing hydraulic conditions and allow adequate freeboard below the superstructure. The popularity of jogging and occasional running races in the area presented an additional special challenge in the design, requiring a capacity to sustain the vibration of different pace frequencies. At the same time, the general recreational use of park trails for family walks and exercise required that the structure maintain slopes amenable to a wide range of users.

Conventional short-span alternatives involving truss and strutted frame bridges were considered during preliminary design, but eventually eliminated because of the high cost of extensive earth fill or piers on each side of the river, which would result in unsatisfactory hydraulic performance of the river, and finally for aesthetic reasons, as the fill would damage the beauty of the rock outcropping and drastically disrupt the valley setting.

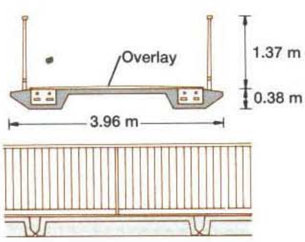
A light bridge of a stress ribbon design, with a single span, presented the advantage of requiring no construction within the river basin. Another advantage of the stressed ribbon was the assurance of a 0.91 m minimum freeboard across the whole flood plain without interruption. By keeping the two abutments at the same elevation, with a minimal drape at the centre, the slope at the ends could be held to an acceptable 9%. This design would require considerable prestressing material in the superstructure and large rock anchors embedded deeply into the hillside at both ends. Still, estimates suggested that it would prove an economical as well as an aesthetically elegant solution. On the basis of these considerations it was recommended to pursue the final design as a single-span stressed ribbon structure.



Design layout

The design called for a free-span stressed ribbon length of 127.4 m and a total bridge length of 137.42 m, with a deck width between the railings of 3.42 m. During use of the bridge, the sag at mid-span was calculated to vary from 3.35 m, early in its life under full live load and maximum temperature, to 2.71 m after long term creep and shrinkage and minimal temperature. Because the bridge would be used by cyclists, the height of the railing was set by code at 1.37 m.

Apart from a short distance at each end abutment, the constant depth of the deck was only 381 mm, corresponding to the static behaviour of the prestressed concrete band. The bending stresses of point loads along the span were determined to have minor structural consequences, while the stresses at the supports due to the effects of prestress, temperature drop and shrinkage of the concrete were decisive.



Typical section and elevation

This effect was mitigated by strengthening the deck with a short haunch transition at each end. The stress ribbon entailed 40 precast segments 3.05 m long, suspended on bearing cables during erection and shifted along them into position. Prestressing, introduced by a second set of cables after casting the joints between the members, secures sufficient rigidity into the structure. Thirty six of the segments were identical, with a double-T cross section designed to house the longitudinal cables in two troughs, and stiffened by diaphragms at each transverse joint.

Abutments founded in unweathered bedrock served to anchor both bearing and prestressing cables. The large horizontal pull of the longitudinal cables is transferred to the underlying rock by 12 double-protected rock anchors, spaced in a symmetrical splayed pattern around longitudinal superstructure cables along the top of the abutment blocks.

Apart from pedestrian loads, the bridge was designed for an emergency or maintenance vehicle of 120 kN gross weight. Careful consideration was given to bridge vibration studies for a wide range of pace frequencies, and even to the remote possibility of vandals attempting to physically excite the bridge. Because the structure would be extremely shallow and of long span over a channelized valley, an aeroelastic study was necessary to check the stability of the bridge under dynamic wind loads. A wind tunnel test in Prague verified that the bridge would be stable for the maximum possible wind intensities it could experience.

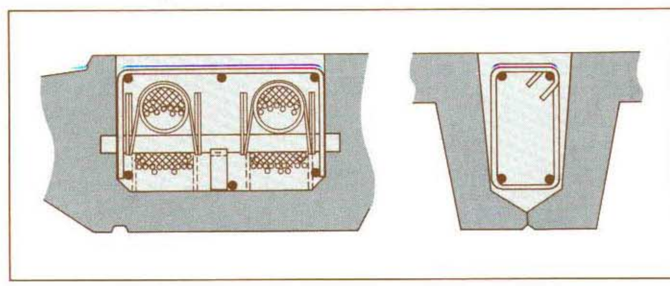
Concrete forms were used to cast the 40 segments

Construction

In March 1989 construction at each abutment began. After inspection of the exposed rock, the first massive lift of the concrete abutment was cast using cooling water directly from the river.

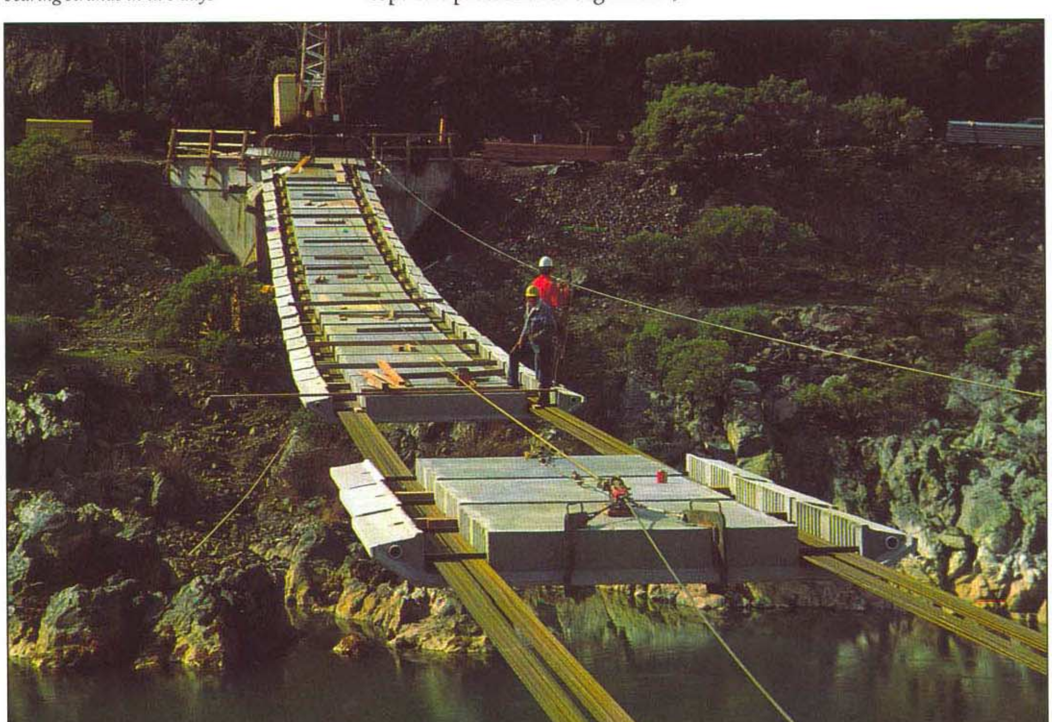
The drilling rig then proceeded to drill out holes, through preset PVC sleeve guides, a minimum of 17 m into sound rock. After approval of the drilled holes, fully prepared permanent strand anchors were inserted, stressed, tested and grouted.

The contractor chose to fabricate his segments using concrete forms. He first constructed an exact wood form with the typical segment exterior shape, using cabinet-quality plywood and many coats of fibreglass with intermediate sanding operations. From this master he fabricated four negative concrete forms for the segment production. Steel bulkheads and trough forming were bolted into place onto these concrete form bases. Production of the reinforcement cages, casting, curing and stockpiling for the 40 segments was done at the contractor's yard 20 km away from the site. The segments were stored from 5 to 6 months before delivery, greatly mitigating concrete shrinkage effects.



Detail – trough and joint

At the bridge site, the bearing cables were strung across the river strand by strand with the help of tuggers so as to keep the steel out of the water. The strands were then stressed to a level at which the drape would assume the designed profile sag when the concrete segments were placed on top. The precast deck segments ▶



All the segments were positioned on the bearing strands in two days

SACRAMENTO RIBBON

were brought in by truck directly below and next to the east abutment and lifted onto the bearing strands. The segments were then pulled across the river with a tow line sliding on the smooth bearing cable strands. Placing of the segments took two working days.

Casting of the troughs the full length of the bridge was done with a plasticizer and a retarder so that the mix remained plastic during the complete casting operation. The pour duration extended several hours into the cool evening and capitalized on the following day's temperature rise as the concrete attained set, adding a favourable stress situation similar to that of prestressing.

Load testing

The following day a nominal force was applied to two of the prestressing tendons. When design strength was reached in the in-situ concrete, the remaining tendons for the cross section were placed and stressed. Once the tendons were grouted and set, the structure served the contractor for passage of his equpment to complete the railing and the rest of the bridge.

Because this was an unusual type of structure, it was considered prudent to load test the bridge. The test was conducted using twenty four vehicles belonging to City personnel, spaced over the whole length of the structure. Tests were also conducted for one half of the bridge asymmetrically loaded, and for a concentrated group of six cars in the middle.

Conclusion

Opening day was celebrated on 14 April 1990 with an inaugural 10 km race to the City of Redding and back around the completed loop along both sides of the river. Crowds of people passed over the bridge at various times during the festivities, providing an informal confirmation of the previous load tests. The bridge responded well in all respects.

Because it incorporated an innovative principle of stress ribbon design for the first time in the United States, the realization of this bridge took considerable courage on the part of the community of Redding and their governing body. The willing participation of eminent professional engineers and professors who contributed much of their time cannot be understated. It is seldom in our profession that so many were involved in a relatively small project where financial rewards were not a prime concern. This bridge, exemplified by its slender beauty, is a tribute to all who unselfishly helped bring about its realization. ■

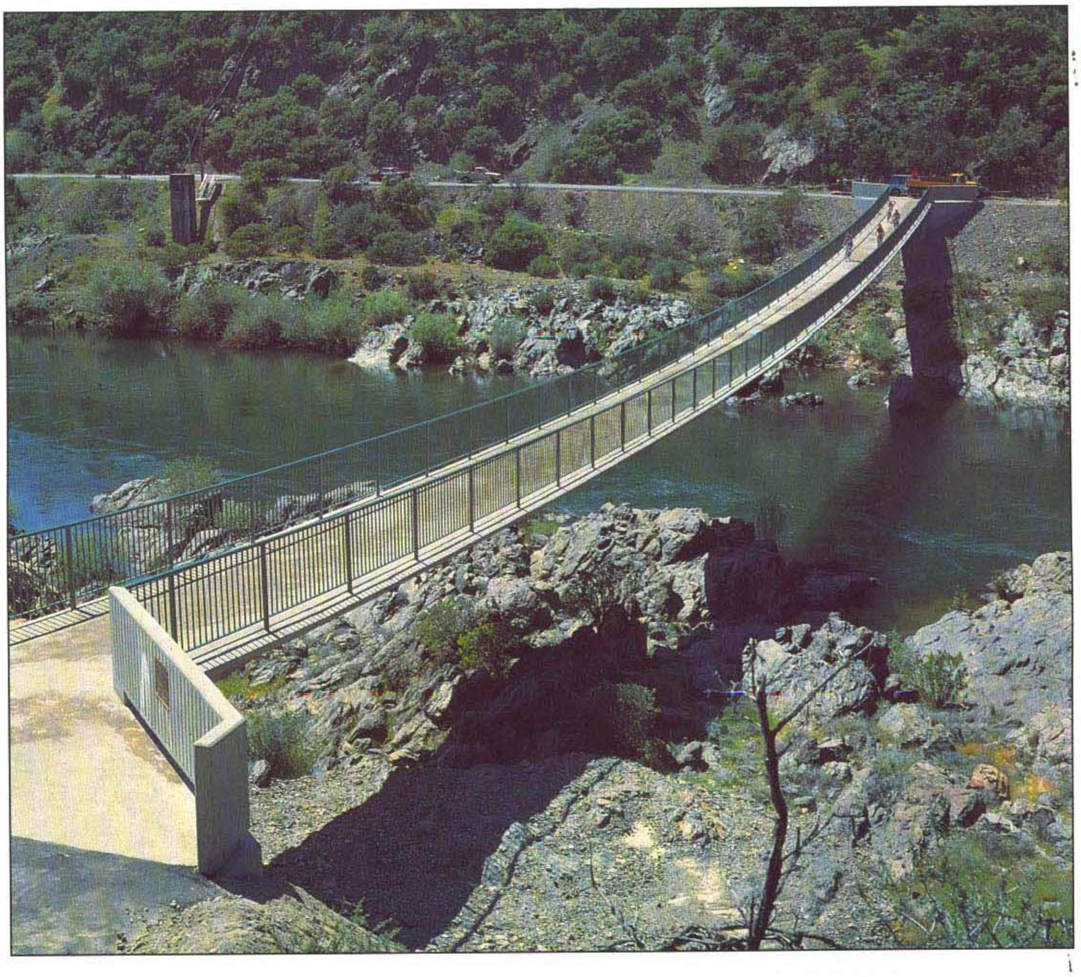
CLIENT
- City of Redding, California
  Fred Mathis, City Engineer
  Terry Hanson, City Planner

ENGINEERS
- Charles Redfield, Mill Valley
  Tomás Kompfner, Project Engineer
  Converse Consultants, San Francisco
  Dr Jiří Strásky, Brno, Czechoslovakia

CONSULTANTS
- Dr Miroš Pirner, Prague
  Dr Marie Studničková, Prague
  Prof Charles Scheffey, Virginia
  Prof Ray Clough, Berkeley
  Prof Alex Scordelis, Berkeley

CONTRACTOR
- Shasta Constructors, Redding

PRESTRESSING SUBCONTRACTOR
- AVAR Systems, Campbell



The bridge has a free span of over 127 m between abutments

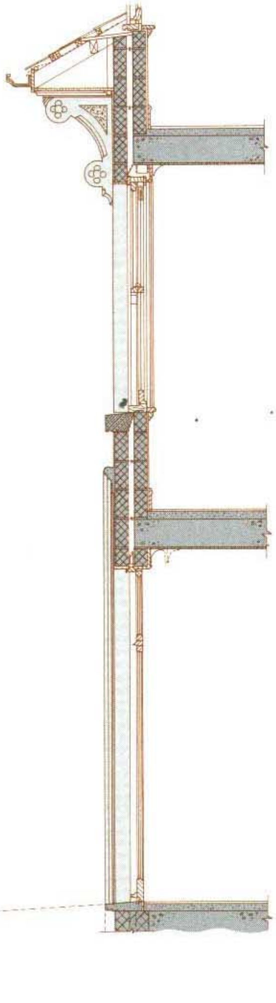
CAREFUL MATCH

Anthony Kyrke-Smith
BA, AADipl, RIBA

Major extensions to Galsworthy House, a Victorian building now used as a nursing home, show how concrete products can be extensively and effectively used in a way which is wholly sympathetic to the original structure.

Situated on Kingston Hill and overlooking Richmond Park, the original house was built in 1860 for the father of John Galsworthy, author of *The Forsyte Saga*. Originally called Parkside, its name was changed earlier this century to Galsworthy House to commemorate the author's birth there in 1867.

Sixty five bedrooms were created as a result of a scheme made up of 80% new-build and 20% refurbishment. This involved the demolition of earlier insensitive additions to this Listed 'Curiosity', and the addition of major extensions in a more appropriate style.



Whilst the property is situated high on Kingston Hill, trial holes revealed that the water table was relatively high, being about 700 mm below ground level. The engineers therefore had to design foundations that were wide and shallow rather than of great depth, and de-watering was needed for their construction. This situation has subsequently been turned to advantage by installing a pump in the large, interconnected concrete ring soakaways located around the building for surface water drainage, thus enabling them to serve as a permanent reservoir for garden watering.

In order to achieve good sound insulation, and also solidity and ease of construction, composite concrete floor construction was adopted, consisting of precast concrete planks with projecting reinforcement as structural shuttering for the floor slabs which were finished with a conventional screed.

At each level, the floor slabs are supported on dense blockwork walls. Although it might have been possible to use single-skin construction, the cavity option was preferred, with dense blockwork inner and outer leaves and insulation within the cavities. Block thickness in the inner leaf, and partition walls, varies up to 140 mm to suit structural requirements.

Expansion joints in the length of the building were 'lost' by incorporating a series of double-skin walls across the building. Wall expansion joints tie in with corners of rooms and externally with the rhythm of the design, rather than at maximum intervals.

The rendering, which had given a Bath Stone appearance to the original brick-built house, had become weathered and damaged with the passage of time. It was thought that it would be difficult to match in any repairs and the client was in favour of painting the house so that new and old would blend. However, as the architects, we together with English Heritage were keen to keep the original appearance.

First, the existing render was cleaned and any loose or defective materials removed. The rendering specialist then carried out various trial areas and, after a suitable drying out period, the correct mix to achieve a reasonable match was agreed.

CLOUD NINE PHOTOGRAPHY

The new blockwork received a basic two-coat render before precast details for the various architraves, arches and roundels were fixed. These were precast off site with the same mix, using the dry cast method in which a slightly damp mortar is compressed into the mould and then turned onto a board. The cast is sprayed to keep it damp until initial hardening has taken place, and then submerged in water for 28 days. After these units had been fixed, using both mechanical and chemical methods, the render finishing coat incorporating a silver sand was applied, and coursing lines added.

Other details such as the string course and cills were also precast in a reconstructed Bath Stone mix but built in during construction. Similarly formed, a new grand 'stone' staircase was incorporated within the atrium area created in the rear of the old building to link the old and new levels. Two new reconstructed stone porticos, made to measure but to a standard design, were also added.

The nursing home now stands as an imposing structure, with the new wings complementing the original central portion. Their traditional construction has taken full advantage of concrete products both to reduce costs and also to achieve the best possible sound and thermal insulation qualities so important in a building housing the frail and elderly.

The contract value of the scheme, which was opened by HRH Princess Alexandra in September 1991, was £1.65 million. ■

Anthony Kyrke-Smith is principal of South East London based Kyrke-Smith Architects. His classical approach to architecture has involved the practice in period restoration, specialist repair, refurbishment and extension of many Listed buildings.

CLIENT
- South London Nursing Homes

ARCHITECT
- Kyrke-Smith Architects

STRUCTURAL ENGINEER
- Kenneth Rowe Associates

CONTRACTOR
- Biltone Construction

CONCRETE SUPPLIERS
- Blockcrete Floors Ltd (precast floor design and manufacture)
- Tarundel (external and internal mouldings)
- Sandhurst Stone, Yorktown Joinery (cills, string course and stairs)
- Slough Plastering Co Ltd (external render, internal plaster)
- Haddonstone Ltd (porticos and statuary)

Great West Plantation in Tring, Hertfordshire, is the home of Alan Tye and his family as well as being the office of Alan Tye Design RDI Ltd. Originally trained as an architect, he designed the existing house and offices, which received an RIBA Commendation in the 1970s. Alan is now primarily engaged in product design. In 1989 he approached me to provide additional accommodation – mainly offices – to his existing group of buildings.

ANDREW STROUD

The new office wing abuts the existing building at right angles

HEALTHY BUILDING

Paul Collinge

ATP, RIBA, MSCD

Paul Collinge joined Aldington Craig + Collinge in 1971, became a Partner in 1980, and Principal of the practice in 1986. He studied architecture part-time at Thames Polytechnic, graduating with Distinction in Design. He is also a qualified interior designer.

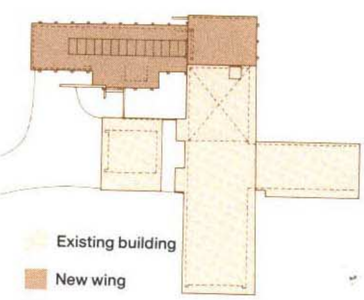
In our practice we have always strongly believed that a thorough brief is essential to the production of good buildings. John Craig, a former partner, undertook the briefing for this project. In the brief, Alan Tye says 'Real things cannot be conveyed by talk', implying that words are diagrams which other people interpret through the filter of their own opinions, so that the meaning is likely to be changed during the process. In the Chinese language, meaning is represented by pictorial characters, allowing more information to be conveyed about real things. He goes on to say 'It is important to understand this feeling, and the belief that real communications will be with drawings of three dimensional objects'.

Alan Tye Design is a small practice, three to four strong, which is centrifugal in nature, with Alan himself as the focus. To quote from the brief again: 'The aim of Alan Tye Design is not towards the highest achievements of fashion or opinion, but towards achieving a product created by the brief acting through the ambition of the designer, to make it function as simply and as economically as possible, as if it were a natural thing'. This is a very clear and potent expression of what good design should be about.

A further powerful part of this philosophy is exemplified in Alan's wish that the building should present no inherent danger to health. 'It should be a healthy building, with no toxic chemicals or preservatives, one which uses natural materials like wood, leather, stone, fired clay and concrete'.

The design

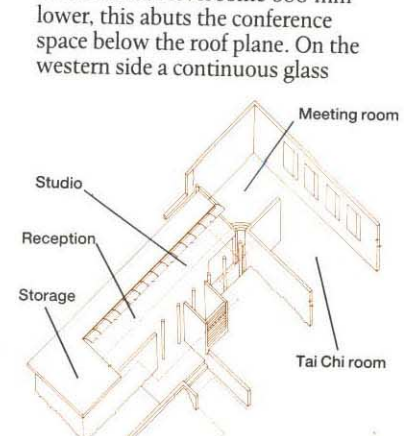
The existing building was of open-ended box construction; rendered, insulated block walls, inside and out, topped with a timber lid supported on clear-spanning telegraph poles. The



concept is austere yet pure. The basic components, or 'phrases', of the design language are easily comprehended. In adding to the building we believed it was necessary first to understand them and then to recompose a new language using the original components and adding new 'interjections', to explore a wider variety of three-dimensional relationships.

To develop the original language of load-bearing walls supporting telegraph poles, the first new 'phrase' was to discard, in some areas, the planar support given by walls and replace it with natural concrete columns, and the associated solid surfaces with the transparency of glass. The other major new 'phrase' introduced is continuous top lighting to the centre of the drawing office space. A long polycarbonate-glazed barrel, white and opaque rather than clear, not only admits simple natural light but also acts as a reflector for internal artificial light.

With the addition of the new extension, the existing house, T-shaped on plan, is turned into an elongated Z. Alan Tye is an exponent of Tai Chi, and a room was to be formed to cater for this activity. The original office lent itself to this use which could become an ideal interface between home and work. To this has been added a large informal conference space where relaxed meetings can be held. It continues the language of the existing buildings, developing it slightly at the north eastern end where the final beam is supported on a single column. The glazed wall at this point looks onto a tranquil landscaped courtyard with trickling water, also seen from Alan's own office in the new wing. With its floor level some 600 mm lower, this abuts the conference space below the roof plane. On the western side a continuous glass



plane, some 6 m wide, holds the existing building away from its new addition and overlooks a new 12 x 7 m planter. With alpine plants set in shingle, this arid interjection is in marked contrast with the green treed surroundings. The planter, and other landscaping was designed by Peter Aldington, a former partner in our practice.

The entrance to the new offices, again of frameless glazing, is situated beyond an interview area, a solid enclosure which directs the visitor to the entrance. The roofs are well overhung at this point.

Within the new offices the materials are simple, clean and meticulously executed. The floor is of white ceramic tiles with the blockwork walls rendered and painted white. The telegraph poles are stained, as in the existing house, but the European redwood boarding and kerbs to the new rooflight are left in their natural state.

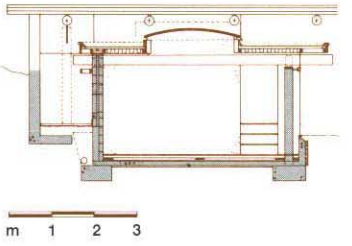
A principle of our practice philosophy is to eliminate unnecessary elements, especially at junctions between floor and wall, wall and roof, and glass and wall. There is a conscious aim to remove the frame, thus visually simplifying junctions and allowing the basic planes and three-dimensional form to be easily read.

Telegraph poles have a natural taper; with their underside laid flat they form a monopitch slope on the top surface. This slope gives a very shallow fall to the roof plane so that a good quality, flat-roof single-skin covering is needed to ensure that the roof surface performs adequately.

The in-situ concrete columns used to prop the telegraph poles were simply cast in plastic drainpipes, which were carefully cut away to leave a glazed and marbled finish to the concrete. These columns, of 200 mm diameter, were designed to be of minimal dimensions. A steel T-shaped plate connector, with welded lugs, sits on to the columns to support the telegraph poles. The engineers devised this simple, straightforward mechanism which displays a clear 'truth' in detail.

The well-insulated ground floor slab incorporates water under-floor heating pipes, thus concealing the system and maintaining visual simplicity.

For a successful result, thorough and detailed collaboration is required between client and architect. In this case the combination of Aldington Craig + Collinge and Alan Tye created an interesting and potentially volatile mix of opinions that had to be brought together.



The briefing method employed, together with a closeness of philosophy between both parties, has allowed this project to be fulfilled in full understanding of one another's desires.

CRISPIN BOYLE

Where glazing replaces solid walls, the roof is supported on circular concrete columns

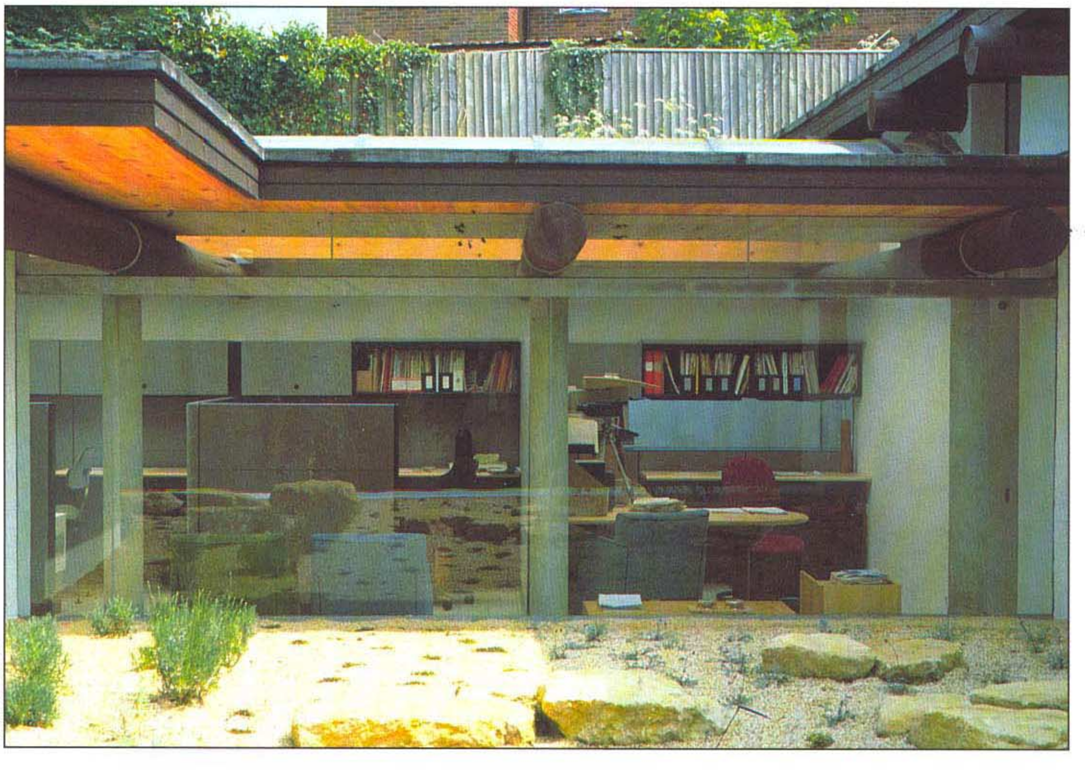
Alan Tye has commented: The concrete columns were to be untreated and, by good fortune, this structural necessity had a very happy result. The columns were cast in plastic pipe which was cut off with a router. This was economical compared with the original idea of matched steel moulds (which would, in any case, have left a joint witness like a plastic moulding) and, above all, achieved a quietly refined and beautiful appearance. The surface is naturally swirled during the pouring which means that every part is different, just as it is in, say, travertine which is made by nature using a similar process! This varied and natural beauty is the most exciting and significant point about these columns.

CLIENT
- Alan Tye Design RDI Ltd

ARCHITECT
- Aldington Craig + Collinge

ENGINEER
- Whitby and Bird

CONTRACTOR
- Basil Wyatt and Sons Ltd



ANDREW STROUD

Looking across the alpine planting into the office area

Screeding Off

Where have all the people gone?

A (nearly) true story

Once upon a time I set the camera up beside a kids' playground. I can't remember where – it was probably Milton Keynes. It was generally Milton Keynes in those days. I backed out from under the black cloth to find I was being solemnly watched by a small grubby boy. Standing with him was his slightly bigger sister.

"That's an old camera," he said.

I looked at a thousand pounds' worth sitting on the tripod. "Not that old," I said.

"Can I have a look?" said his sister. I lifted her up and covered both our heads with the black cloth.

"What can you see?" I asked her.

"It's upside down," she complained. "I can see my house and swings and the roundabout and the children."

I put her down. "Can I take a picture?" she asked.

I had already taken the photograph, but I put in a Polaroid and let her press the cable release.

I peeled apart the black packet, and showed her.

"There – now what can you see?"

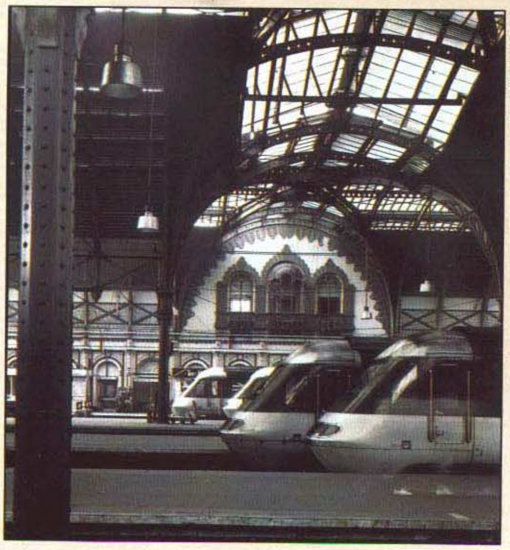
She looked at the unrecognisable swirls and blurs of the playing children.

"Why aren't there any people?" she asked.

Which is the perennial question.

It is in the nature of architectural photography to emphasise composition. A normal camera in which the position of the lens is fixed in relation to the film provides only a central axis, an unvarying symmetry both vertically and horizontally. Composition may require the axis to be shifted away from the centre. To do that one has to move the lens in relation to the film.

This photograph of Paddington station exhibits just such movement. The image has been shifted to

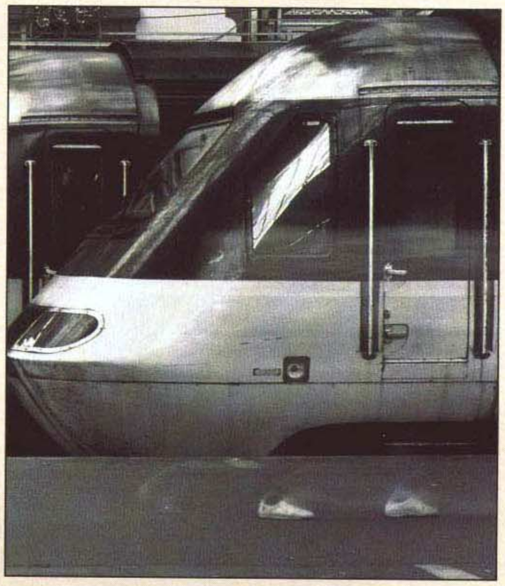


MARTIN CHARLES

the right, as shown by the perspective of the rafters at the top. And the camera, being at normal eye level, includes considerably more above than below.

To be able to move the lens requires a larger camera than normal, and therefore lenses of greater focal length. And a greater focal length means less depth of focus, which in turn implies 'stopping down' if overall focus is to be maintained. The end result is a long exposure. Couple that with slowish films, and all the filtering required by modern mixes of light sources, and no wonder architectural photographs do curious things to people who appear in them.

Such as, if you look closely…



… disembodied feet. Paddington was not nearly as deserted as it appears. Passengers were hurrying for the train, and one happened to be wearing bright white trainers. Since the feet remain still under a moving body, they appear unnervingly on their own.

The picture was taken on a bright day and on fast black and white film. Even so the exposure must have been about a second. Working indoors in colour, exposures can stretch into minutes. There is no way such photographs can be inhabited naturally. Maybe better no people at all than the strained face clamped to a silent telephone to keep it still.

Efforts are periodically made to break away from the restrictions of the large format camera, but the compositional demands of architectural photography inevitably reassert themselves. So the people may well be there – it's just that you can't see them.

The girl and her little brother ran off. When a safe distance away the boy turned back to look at me standing with the black cloth draped round my shoulders.

"Huh!" he shouted disdainfully. "Batman!"

Martin Charles
Architectural photographer

FORTHCOMING EVENTS

Brief details of some of the BCA events planned into 1993 follow.

Durable reinforcement for aggressive environments
Coventry – 5 November

New ways of providing reinforcement for concrete in aggressive environments are always being sought. BCA has conducted a study of cathodic protection, epoxy-coated rebars and new synthetic materials and this seminar examines the potential for producing high quality reinforced concrete suitable for aggressive environments.

Architectural in-situ concrete – site practice and specification
Slough – 12 November

For clerks of works, architects, construction supervisors and specialist concrete contractors. Techniques for producing high quality in-situ concrete finishes to walls, columns and flat work will be demonstrated. Topics will include formwork and liners, release agents, curing and minimizing efflorescence and colour variation of finished surfaces.

Housing – an update on developments in traditional design and construction
Altrincham – 17 November
Crowthorne – 18 February

Will update architects, house-builders and structural engineers on improvements in the quality and cost-effectiveness of design options involving traditional brick and block construction. These events will examine changing customer priorities in areas such as construction quality, space utilization, and thermal and sound insulation.

External rendering – right first time
Southampton – 2 December
Exeter – 2 March

Rendering is a traditional craft that has suffered from lack of experience, and poor understanding of the properties of the materials involved. These courses will update specifiers and users on the technology of mortars and renderings.

Economical assembly of reinforcement
Leeds – 3 February

Will update engineers and construction managers on prefabricated assemblies for beams, slabs, walls and columns and explain how they are far quicker to install than traditional loose or single bar fixing. Will show how to obtain the maximum benefit from design and construction scheduling with rapid rebar assemblies.

Calatrava exhibition
London – 20 October to 14 November

BCA is pleased to be sponsoring a major exhibition on the work of Santiago Calatrava at the RIBA in London. Calatrava will lecture on 20 October. Details and exhibition catalogue are available from BCA Communications Department on Fulmer (0753) 660454.

WIST THORPE/OBSERVER MAGAZINE

Rooted in time
Described as 'imaginative and sexy' by Stephen Gardiner in The Observer Magazine, *Cocteau's concrete sculpture of a tree in the grounds of Chateau de Clavary, Grasse, home of the late Sir Peter Wilson, former Chairman of Sotheby's.*

Student lecture meetings
Eight UK venues
October-December

BCA has arranged a new series of student lecture meetings on concrete in the built environment, covering architecture, structural engineering and construction. Entitled 'Concrete: Back to the future in three hours', these events are designed to be of special interest and relevance to students in all construction-related disciplines. The speakers, well known to *CQ* readers, will be George Perkin, Frank Hawes and David Bennett. For details of your nearest venue, contact BCA Communications Department on Fulmer (0753) 660454.

For details and *Programme of Events* phone Events Department, Fulmer (0753) 660428. American Express/Access/Visa holders may book by phone.

NEW PUBLICATIONS

The following new publications are now available.

BCA Bulletin No. 14
Free. 10 pp.

Topics include Europe and design for concrete durability, the new Kitemark scheme for cement, information on ASR, and a progress report on EC2.

The diagnosis of alkali-silica reaction
Report of a working party
Ref. 45.042. £14.00. 48 pp.

Fully revised and updated, this second edition puts greater emphasis on the examination of finely ground surfaces of concrete samples and on the interpretation of crack patterns revealed by this technique; it upgrades the method of testing core expansion, and gives new guidance on the petrographic examination of hardened concrete.

For *BCA Catalogue* and orders, phone Publication Sales, Fulmer (0753) 660440. American Express/Access/Visa holders may order by phone.

New year move for BCA From 1 January 1993 the new address of the British Cement Association will be:
Telford Avenue, Crowthorne, Berkshire RG11 6YS. Telephone (0344) 762676. Fax (0344) 761214