Guildford Cathedral. *(Photo: Nikhilesh Haval.)*

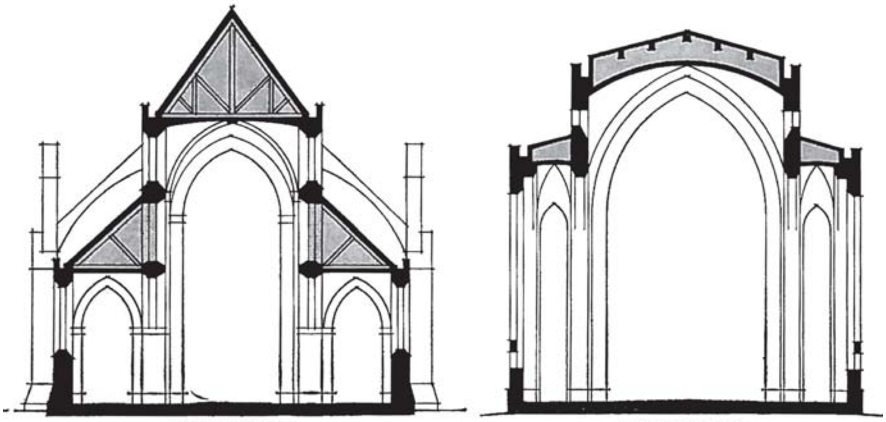
Concrete and the People's Cathedral

The Cathedral Church of the Holy Spirit in Guildford, Surrey is the last Church of England cathedral consecrated on a new site (in 1961) and one of only three CofE cathedrals built in the 20th Century. Constructed in a large part with reinforced concrete, the Grade II listed building recently underwent a major refurbishment project.* ***Concrete*** *report.*

In his article from the June 1952 edition of *Concrete & Constructional Engineering*[1], the consulting engineer Burnard Geen described concrete surface finishes at Guildford Cathedral thus, "Walls above ground will be plastered to a certain height, above which the walls and ceiling will be sprayed with acoustic plaster."

Little was Geen to know then just how significant those last few words would be.

More than 50 years later, the asbestos-reinforced acoustic plaster caused a major problem for the cathedral, as a spalling issue raised health and safety concerns, revealing the need for urgent building repairs. It saw the creation of a major refurbishment and community engagement project, which was finally completed last year and drew upon the history and heritage of the cathedral.



Design differences between Lichfield – here taken as a typical medieval cathedral – and Guildford. At Lichfield, flying buttresses are necessary to support the nave arches, whereas at Guildford clearly no buttresses are required. Though both cathedrals are of the same width and height, in section, Guildford has a third more internal space.

Construction

Guildford Cathedral was built – to a design by Sir Edward Maufe – over a period of 30 years in total, from the laying of the foundation stone in 1936 to the completion of the north garth in 1966.

The intervention of World War II put a stop to all construction and understandable post-war funding issues saw the building completed in a series of stages over the superseding years, with work on the nave not starting until 1955.

It took one of the first examples of mass crowdsourcing to will the cathedral into being. Through a 'Buy a Brick' scheme, 200,000 ordinary people paid 2s 6d for a brick to help complete the cathedral. By May 1961, it was consecrated and ready to be opened to the public.

The exterior is of brick design with some interior sections, including the tower and nave piers, having load-bearing capability and so Lingfield Engineering structural brickwork was specified.

The foundations and a large part of the superstructure were built using reinforced concrete. Some 778 precast piles were driven 20ft (6m) into the clay ground and the foundations overall used 4830yd^3 (3690m^3) of concrete. The first contract for the cast-in-situ vaults (not including nave) required 1500yd^3 (1150m^3) of concrete. The below-ground concrete interior and service corridors/areas in the tower have a mix of bush-hammered, exposed aggregate and board-marked finishes, whereas above ground, aside from the ashlar stone used for nave piers, arches, windows, pulpit, lectern, etc, the concrete was plastered and painted.

Concrete design

Maufe's design is a "modified gothic style with arts and crafts influences", according to Pevsner[2]. "It uses a cruciform plan around a central crossing tower with half-octagonal end to the Lady Chapel at the east flanked by a sacristy and chapter house, with an aisled nave to the west with projecting garths to north and south sides of the west end. Narrow high-vaulted aisles are supported on piers without capitals, transverse arches crossing the vaults. An ambulatory is beyond the crossing with knife point arches."

Indeed, through Maufe's design and use of concrete vaults in particular, the interior volume of the cathedral was vastly increased (see page 42 and bottom left photo) as Geen noted, "The general appearance of the building is extremely simple, free from buttresses and an impression of loftiness is obtained. This is made possible by the construction adopted, the curved beams throughout being designed as simple free beams thereby eliminating arch thrust. This is evidenced by the simple lines of the interior and the four main tower piers convey the same impression of slenderness, simplicity and functionalism.

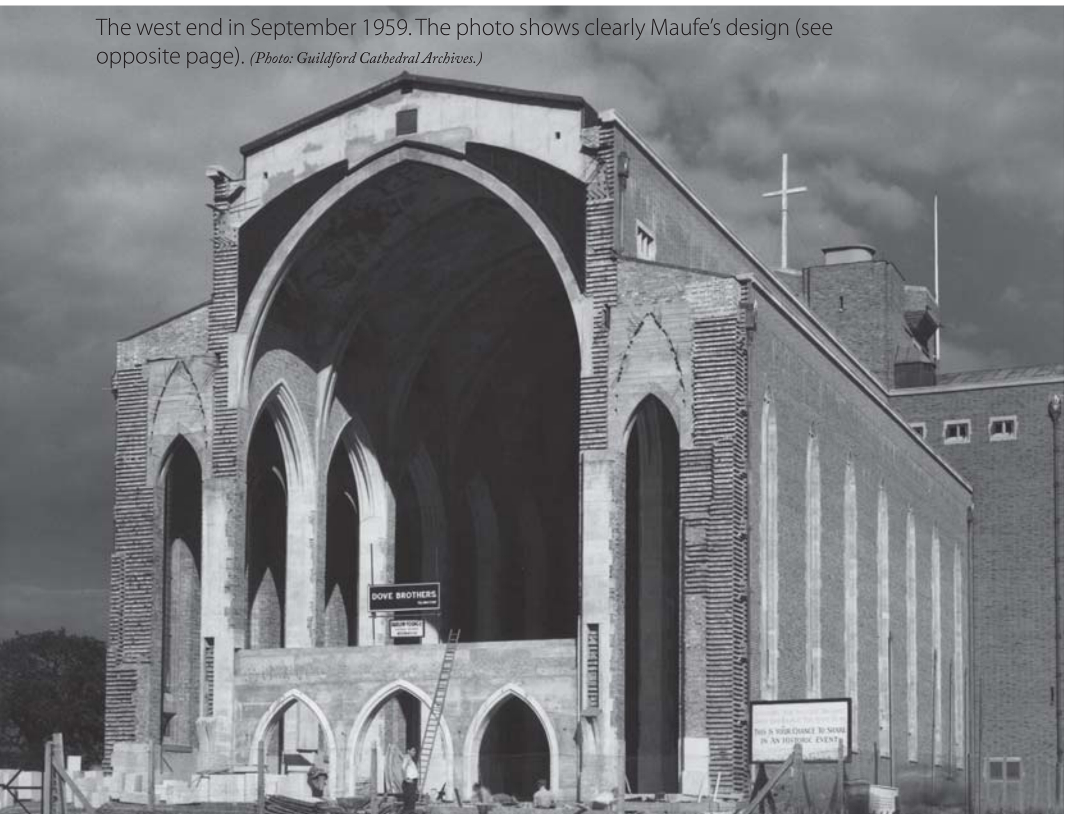
"The many varieties of shape in the vaulted roofs of aisles, transepts, Lady Chapel, and porches avoid monotony and provide great interest, and show how very suitable reinforced concrete is to such conditions."

Refurbishment

In 2012, Guildford Cathedral set out to secure funding from the Heritage Lottery Fund (HLF) to transform the site of modern heritage and secure the long-term future of the Grade II* listed building.

'Make your Mark' contributions from ordinary people – amounting to £1.3 million – enabled the cathedral to apply for a £4.6m HLF grant.

> "The cathedral has been returned to its former glory and the sheer volume of the interior is breathtaking. It is once again a beautiful, tranquil space."



The west end in September 1959. The photo shows clearly Maufe's design (see opposite page). *(Photo: Guildford Cathedral Archives.)*

Access passage and stairs within the tower, showing a variety of original concrete finishes.

Creating formwork for the chancel arches in 1939. *(Photo: Guildford Cathedral Archives.)*

Crossing and quire ceilings after plaster removal.

The removal of asbestos and refurbishment was undertaken by main contractor Buxton Building, with Thomas Ford & Partners as conservation architect and structural engineer Adrian Cox Associates. As a concrete structure of pre-war design, defect issues arose that are characteristic of design from this period. Some related to the external building envelope but of over-riding importance was the safe removal of asbestos-reinforced acoustic plaster.

Adding to a complex operation was the condition that the cathedral had to remain open throughout the works. This placed certain constraints on logistics and the design structure of scaffolding to enable asbestos removal.

The first constraint was that no significant load could be placed on the floor. The Travertine marble stone floor finish is very thin and not well bedded, with a copper pipe underfloor heating system immediately below the slabs. The pipework has joints within the floor and so works needed to avoid causing any damage. The whole floor had to be protected by plywood during the contract.

The high-level temporary platform allowing removal of the acoustic plaster from the nave ceiling was to be 12m above nave floor level. Therefore the deck required attachment to the structure, allowing it to span across the width of the nave.

The vaulted slabs forming the nave soffits were supported by reinforced concrete beams spanning the width of the nave at column positions and midway between columns. These were supported by stone-faced masonry forming the arcades.

Fixing into the masonry would have necessitated typically 50 separate resin anchors in to a single plate. A similar capacity was to be achievable by core drilling and grouting in a single 163mm-diameter tube to form a socket in the wall. Vertical hangers with 140mm-diameter tubes were fabricated to fit into the sockets. The hangers then supported temporary beams along the walls. On completion, the hangers were removed, allowing the sockets to be capped and plastered over.

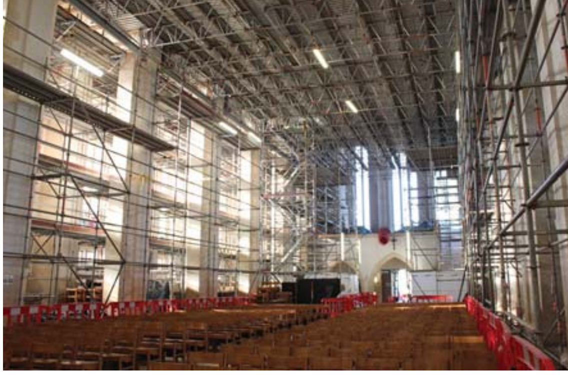
Having defined the support system at the arcades, the contractor was then free to use aluminium trusses to span 12m across the nave and the 21m necessary to span north–south across the crossing. In order to support this crossing scaffolding, large steel beams had to be installed spanning the transepts. Each weighed 4 tonnes and had to come into the cathedral in sections, before being bolted together and hoisted 15m into the air.

Once installed, the additional support and the airtight compartments were completed, allowing asbestos-containing materials to be removed during the week and services to continue uninterrupted at the weekends.

To remove the asbestos, any abrasive method or anything that impacted or vibrated the concrete vaults had to be avoided as the covering is only 3 inches (75mm) thick in places, with light fabric reinforcement. The sprayed acoustic plaster did not possess a very strong bond to the vaults so a water-based liquid including other chemicals was injected through the plaster – which varied between 25 and 70mm in thickness – that released any bonding. The material was then scrapped off

Completed cathedral following repairs, showing the sheer scale and volume of the interior.

Fixing reinforcement for roof slab.
(Photo: Guildford Cathedral Archives.)



Asbestos removal in a sealed cabinet under the west gallery, May 2016.

Top: The nave showing the extensive scaffolding, in November 2016.
(Photos: Bob Ellison.)

the vaults, bagged and removed from site. All the removal work had to take place in sealed sections, one stage at a time, to avoid any contamination.

Condition of concrete

The east end vaults (quire and quire aisles), completed before World War II were seen to be cast to the highest quality with zero defects. The concrete vaults were formed with softwood boards beautifully put together on temporary formwork and the concrete has been well compacted with the pattern of the boarding showing through. This work is excellent and the boarding marks provide a rich texture to the vault finishes. It is understood that Maufe always wished to see this type of finish.

The transept and crossing vaults were cast between 1947 and 1954. Again, softwood timber boarding was used but the quality of compaction was not as good. The surface was very random with patchy areas of honeycombing and several bad day joints. Reinforcement spacer blocks were evident in the surface in places. Significant areas here had to be plastered to fill the holes; just decorating the vaults would have been visually problematic.

The nave and nave aisles were cast as per the east end with narrow softwood boards and the quality was generally very good, with decoration only carried out. However, the main nave vault, vaults to the baptistry, north-west staircase, under the gallery and the chapter house were not as good. Large plywood sheets were used for the formwork and the concrete was generally not well compacted. In places, small concrete spacers and the reinforcement tie wires were visible. These vaults had to be replastered, as to leave them just painted would have given a poor aesthetic.

Once the asbestos had been removed the concrete was painted with an approved elastic paint finish to seal in any fibres that may have remained. This means that should the building move, the material will not fail. This was then coloured to match the overall colour scheme in the cathedral. Where a plaster finish over this was needed, a bonding agent was used that would stick to the elastic paint with the modern plaster then applied. A stain-block sealer was needed to some vaults where a bitumen coating on the concrete was encountered.

Decoration of the existing lime plaster walls was undertaken, with cleaning of the existing ashlar stonework at the same time. New sound and lighting systems were subsequently installed to bring these facilities up to date. There has been a change to the acoustic performance of the cathedral, with average reverberation time being extended by around 1.5 seconds.

Tranquil

The works were completed and scaffolding removed in 2017. The cathedral has been returned to its former glory and the sheer volume of the interior is breathtaking. It is once again a beautiful, tranquil space.

The People's Cathedral project was an ambitious 30-month initiative combining the repairs with a community engagement programme to capture and reveal the rich heritage and history behind the 20th Century building. The visitor experience too has been enriched by improving facilities, accessibility, audibility and interpretation. ■

References:

1. GEEN, B. Guildford Cathedral. Reinforced concrete foundation and roof. *Concrete & Constructional Engineering*, Volume 47, June 1952.
2. PEVSNER, N. and NAIRN, I. *The Buildings of England. Surrey*. Second edition (revised by B. Cherry), Yale University Press, London, 1971, pp.269–270.

Acknowledgement:

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Guildford Cathedral, Surrey

Client	The Cathedral Church of The Holy Spirit
Architect	Thomas Ford & Partners
Structural engineer	Adrian Cox Associates
Main contractor	Buxton Building
Quantity surveyor	Pierce Hill Consulting
Scaffolding	TONE Scaffolding Services
Asbestos removal	Keltbray