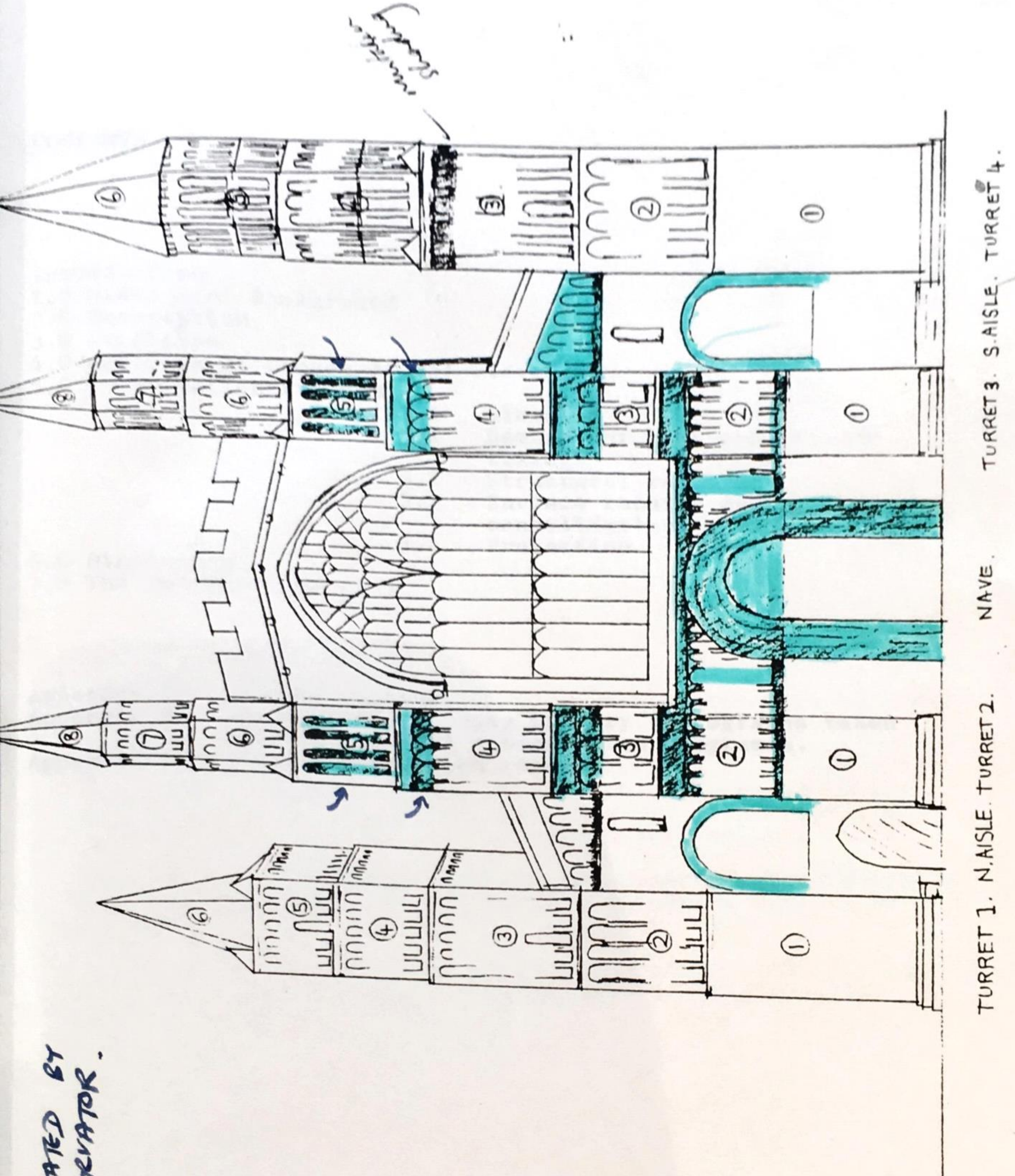
ROCHESTER CATHEDRAL: THE WEST FRONT

REPORT ON THE CONSERVATION OF THE 12th CENTURY STONEWORK OF THE WEST FRONT

Nicholas Durnan
Broadacres
Old Way
Ilton
Ilminster
Somerset TA19 9EA

Tel 0460 54046

25th November 1991



- AREA TREATED BY THE CONSERVATOR.

ROCHESTER CATHEDRAL:
WEST FRONT ZONES.

date JAN. 91. scale N.T.S. number 99

Caroe & Martin Architects

90 Eversholt Street London NW1 1BT 01 387 0477
Penniless Porch Market Place
Wells Somerset BA5 2RB 0749 77561

CONTENTS

INTRODUCTION

Between May 1991 and August 1991, the West Front was cleaned and repaired. For the purposes of the contract the work was divided into two parts. All the 12th century decorative stonework was treated by the Conservator (Nicholas Durnan), all the remaining stonework was treated by the main contractor (The Canterbury Cathedral Co. Ltd.).

The specification for the conservation of the 12th century decorative stonework was drawn up by the Surveyor of the Fabric, Martin Caroe with the assistance of the Conservator, Nicholas Durnan. Parallel to the conservation work, the Cathedral Consultant Archaeologist, Tim Tatton-Brown made a study of the stonework to increase historical knowledge of the structure. His assistant John Atherton Bowen produced stone by stone scale drawings from a photogrammetric survey carried out by Atkins AMC, which as well as providing an excellent record of the detailing and geology of the existing structure, have formed the basis for documenting the conservation work. Professor Donovan studied the geology of the west front, in particular the identification of Pearson's (restoration of 1889-94 replacement stone.

The general conservation principals governing the work were as follows:

All 12th century stonework was to be preserved as it recorded all the original detail of the west front. All losses to the form and surface this stonework was regarded as part of its history and therefore no restoration was carried out.

All 19th century replacement was to be preserved where possible but areas of severe decay and unstable stonework were to be replaced with new stone.

As the structure was built of various limestones, all fixing, re-pointing, mortar repair and protective coating was lime based.(1)

1.0 HISTORICAL BACKGROUND

CHRONOLOGY

1077-1108	Gundulf rebuilt the cathedral in Ragstone rubble and Tufa for quoins. He may also have used some Caen stone.
1115-25	Ernulf rebuilt claustral buildings (Dorter, Chapter House and Frater)in Ragstone rubble with mainly Caen stone quoins. A shelly oolitic limestone was used for the en delit shafts (eg. in the Chapter House upper windows)
1137	Fire in which the city and monastery were burnt.
c.1160	Nave and west front faced with Caen stone ashlar with onyx marble shafts.
1179	Fire in which the city and monastery (including cathedral) were burnt, extent of damage to west front uncertain (no fire marks on existing 12th century stone) but fire marks visible in the nave work and at the Chapter House.
1327	West door of north aisle inserted - Caen stone
C.15th	North nave turret destroyed and rebuilt - probably Kentish rag stone.
1763	Upper part of the west wall of the north aisle was rebuilt with the adjoining turret. Stone type unknown - ?Portland and brick.
1825-6	Cottingham renewed the perpendicular west window in Bath stone and replaced adjacent 12th century decorated ashlar in spandrels with plain Bath stone ashlar.
1889-94	Pearson's restoration using Thompsons of Peterborough - nave aisle turrets and north nave turret rebuilt, plus much other replacement in Weldon stone. (Identified by Professor Donovan in 1991)

1967 Cleaning - under Emil Godfrey (Surveyor to the Fabric). Methods unknown.

1984 M.B.Caroe's conservation of west doorway, Conservation work by Wells Conservation Centre (Hebe Alexander and David Hill).

1991 M.B.Caroe's conservation of west front. Conservation of 12th century stone by team directed by Nicholas Durnan. Cleaning and replacement masonry of 19th century stone by Canterbury Cathedral Co. Ltd.

For more detailed analysis of the history of the west front, the reader is directed to Livett(2), St.John Hope(3), McAleer(4) and Kahn(5).

2.0 DESCRIPTION

Historians in the past have suggested various dates for the west front and the west doorway. Following the cleaning of the facade in 1967, Zarnecki recognised that the work was of one date, probably about 1160. Subsequent authors have followed this view.

The west front has been previously described in the following extracts by Kahn(5) and St.John Hope(3). Firstly Kahn:

> The west front is a balanced work of elegant proportions. The internal structure of the church is marked on the facade: the position of the nave and the aisles are indicated by turrets at their outer angles, and the end aisle walls are slightly recessed. The arrangement is made complete with a pair of outer turrets. The facade is embellished with a rhythmic series of blind arches and with patterned stones, but the main sculpture is concentrated on the central doorway. This has a tympanum with Christ in Majesty, five richly sculpted archivolts and supporting columns with carved imposts, capitals, annulets and a pair of column-figures.....

W.H.St. John Hope:

> The great west doorway is a very rich work with five elaborately carved orders and hood mould, wrought with leaf-work and monsters. The jamb shafts have sculpted capitals and mediaeval bands, and out of the two of them, one on each side, are carved the figures of a king and queen, probably Henry I and his consort Matilda [More likely Henry II with later dating, but ?Old Testament Kings - T.T-B.]. These are among the most ancient statues now remaining in this country. The tympanum of the doorway contains a (now headless) figure of Our Lord in majesty, supported by two angels, and surrounded by two emblems of the four Evangelists. The horizontal lintel is composed of eight stones curiously joggled together, and carved with twelve figures, probably of the Apostles.
>
> The stage in which the doorway is set is plain in its lower half, with a deep recess on each side, but the upper part is covered with a wall arcade. From this stage rise the broad flanking pilasters of the gable, ornamented with tiers of arcading, and terminating originally in octagonal pinnacles. Of these only the southern one remains; the northern was destroyed in the fifteenth century, and replaced by a small octagonal turret in the style then in fashion. The south aisle retains its original end. Below the window the wall space is covered with opus

recticulatum, or an ashlar facing of square stones set lozenge-wise. Over the window, above the wall passage light, is a row of graduated arches that follows the old rake of the aisle roof. The upper part of the north aisle was rebuilt with the adjoining turret in 1763. The labels of both aisle windows furnish us with a very early instance of true dog tooth moulding.[Not so with the later dating]

The turrets that flanked the front were, according to old prints, carried up nearly to the same height as the nave pinnacles, and terminated in a similar manner. Except in the lowest stage, which was plain ashlar, they were ornamented with tiers of arcading.

Detailed description

For the purposes of the contract the west front was divided horizontally into zones (1-8) and vertically into turrets (1-4), aisles (N & S) and nave area (see illustration 1).

Apart from the west door, virtually all the surviving 12th century work is contained within zones 1-5 on turrets 2 & 3 and nave areas. Most of the N & S aisle areas are also predominantly mid 12th century stonework. The conservator's work was confined to the carved and ornamented areas (see shaded areas of illustration 1) as follows:

a) The west door
b) North and south aisle windows
c) 1st tier of arcading (zone 2)
d) 2nd tier of arcading (zone 3)
e) 3rd tier of arcading (zone 4)
f) 4th tier of arcading (zone 5)

The conservator also treated an area of mid 12th century string course on the exterior north wall of the nave immediately east of the west front.

g) North wall string course

The description of these areas is as follows:

a) The west door

Great west door of the Cathedral. Five columns either side od door supporting tympanum and orders. All capitals of tympanum carve. Two figures (headless) on second out from door on each side. Six orders of carving outside tympanum with a roll moulding betrween the first and second orders of carving. The orders are made up of foliate motifs, figures and mythical beasts.

The tympanum depicts Christ in Majesty (headless) with two supporting angels supporting mandola. To either side are the four symbols of the evangelists.

There has been some 19th century replacement to the outer orders (see West Door Conservation Report by H.Alexander and D.Hill 1984 for detailed analysis).

b) North and south aisle windows

Comprising of an inner and outer arrangement. The inner being a chevron decorated round arched head springing at either side from a single capital,shaft and base. The outer arrangement having orders decorated with dog tooth ornament, The orders again springing at either side from a single capital, elongated shaft and base. The label moulds terminate in small heads.

All original stone apart from some of the hood mould.

c) 1st tier of arcading (zone 2)

A blind arcade supported by a richly decorated string course. The bases take the form of carved corbel heads. The shafts (where the originals survive) are alternately plain and barley twist. The capitals are carved in variations of the scalloped and ionic type. The arches are decorated with floral motifs. Above the arches the ashlar is decorated with a medallion type ornament.

Within the two wide bays immediately adjacent to the west door are the 19th century figures of Gundulf and .

Capitals: 11 north of doorway, 6 original, 4 replacement, 1 mixture.
10 south of doorway, 5 original, 5 replacement,

Arches: 11 north of doorway, 3 original, 7 replacement, 1 mixture.
10 south of doorway, 4 original, 5 replacement, 1 mixture.

Medallions: Mixture of original and replacement, mostly replacement.

d) 2nd tier of arcading (zone 3)

Blind arcade, traversed between capital and arch by a string course boldly decorated with zigzag. This string supports a richly carved typanum within each arch. The bases and shafts are plain, the capitals carved as on the 1st tier. The arches

are decorated with chevron and floral motifs. Above the arches is a double course of bold diagonal lattice work.

Tympana (all original) on turret 2 from north to south:

Tympanum 1: Two birds facing each other with smaller central bird? in their beaks.
Tympanum 2: Male figure with legs splayed and interlaced with arms, fish are held up to man's ears.
Tympanum 3: A bird standing over a serpent biting it.

Tympana (all original) on turret 3 from north to south:

Tympanum 4: Spiraling, interlacing stems and leaves

Tympanum 5: Very weathered, possibly two beasts one biting the other, one a bull?

Tympanum 6: Another variation on spiraling, interlacing stems and leaves.

e) 3rd tier of arcading (zone 4)

Blind arcade, plain bases and shafts rise from a lozenge decorated string course. The capitals are all 19th replacement so the original form is unknown. The arches are decorated with chevron. Above the arches is billeted interlacing archwork. Above this a plain band of ashlar.

All moulded and decorated work is replacement, the ashlar in mostly original.

f) 4th tier of arcading (zone 5)

From a billeted string course rise plain bases and shafts alternating with chevron and tongue decorated pilasters which support similarly decorated arches. This stonework and the capitals are all 19th century replacement so the original form is unknown. The ashlar between the shafts and pilasters is mostly original and decorated with lozenge ornament on turret 2 (north) and with an encircled floral motif on turret 3 (south). Above this is an embattled string course all 19th century replacement.

g) North wall string course

This is all original and is semi-circular in section and decorated with beaded and moulded lozenges.

are decorated with chevron and floral motifs. Above the arches is a double course of bold diagonal lattice work.

Tympana (all original) on turret 2 from north to south:

Tympanum 1: Two birds facing each other with smaller central bird? in their beaks.
Tympanum 2: Male figure with legs splayed and interlaced with arms, fish are held up to man's ears.
Tympanum 3: A bird standing over a serpent biting it.

Tympana (all original) on turret 3 from north to south:

Tympanum 4: Spiraling, interlacing stems and leaves

Tympanum 5: Very weathered, possibly two beasts one biting the other, one a bull?

Tympanum 6: Another variation on spiraling, interlacing stems and leaves.

e) 3rd tier of arcading (zone 4)

Blind arcade, plain bases and shafts rise from a lozenge decorated string course. The capitals are all 19th replacement so the original form is unknown. The arches are decorated with chevron. Above the arches is billeted interlacing archwork. Above this a plain band of ashlar.

All moulded and decorated work is replacement, the ashlar in mostly original.

f) 4th tier of arcading (zone 5)

From a billeted string course rise plain bases and shafts alternating with chevron and tongue decorated pilasters which support similarly decorated arches. This stonework and the capitals are all 19th century replacement so the original form is unknown. The ashlar between the shafts and pilasters is mostly original and decorated with lozenge ornament on turret 2 (north) and with an encircled floral motif on turret 3 (south). Above this is an embattled string course all 19th century replacement.

g) North wall string course

This is all original and is semi-circular in section and decorated with beaded and moulded lozenges.

3.0 CONDITION

Photographs of the west front dating from before Pearson's restoration (1889-94) show that he replaced all the severely decayed 12th century stonework on the front.

The 12th century stones he did not replace appear to be in excellent condition in photographs taken soon after his work was complete c.1900. Many of these stones have deteriorated rapidly since that date.

The speed of this decay probably owes much to the use of very hard dense cement mortars by Pearson for both fixing new stones adjacent to original ones and the proud re-pointing of the existing original work.

Cleaning is known to have been carried out in 1967 and a post 1967 photograph shows that the areas cleaned were the west door and zones 1,2 & 3 of the nave and turrets 2 & 3. (see Illustration 1). This is consistent with the scoured/scratched surfaces found in parts of these areas.

Detailed condition

a) The west door Superficial loose dirt on stone surface which had collected since the conservation work of 1984 (6). Sheltercoat intact in sheltered areas but lost on more exposed areas of outer orders of arch. In three areas water has run over over the outer order onto the inner ones making the original surfaces here friable. There is some slight breakup of some of the 1984 mortars, tending to be the ones on severly decayed stones. Iron ties in the southern jamb figure are causing cracks in adjacent stone.

b) North and south aisle windows Generally sound with soot crust on sheltered surfaces. The surviving original stones in the hood mould are severly eroded and friable. Hard cement pointing abounds.

c) 1st tier of arcading (zone 2) Alges/lichen encountered on the projecting corbels causing break up of stone matrix. Thick soot crusts on corbels especially undercut areas. Surviving original corbels severly eroded beyond recognition. Other surviving original work: capitals/arches/medallions are suffering from exfoliation and blistering and cracks have been filled with cement, but much less than on string course and corbels.

d) 2nd tier of arcading (zone 3) Algea/lichen found on upper surfaces of corbels and arches, causing breakdown os stone matrix. More exfoliation/blistering encountered on 12th century stone here than on zone 2. Generally the surface of the stone is sound, but the underside of original lintels shows greater friability, with some flaking and laminating. Severe cracks in all typana, possibly caused during Pearsons restoration whilst fixing adjacent new stonework.

e) 3rd tier of arcading (zone 4) The surviving 12th century work is generally sound with some blistering and exfoliation. The soot crust is thinner than in the lower zones.

f) 4th tier of arcading (zone 5) The surviving 12th century work is generally sound with some blistering and exfoliation. The stone is in better condition than on zone 4 due to it being well sheltered between the shafts.

g) North wall string course A good deal of the original surface has survived, but it is in an extremely delicate condition. Exfoliation and loss of binding (cohesion) has led to large areas becoming loose. Original design exists on approx. 60% of the surface.

4.0 ANALYSIS OF CAUSES OF DETERIORATION

The deterioration of the Caen stone in all areas of the west front is consistent with the effect of atmospheric sulphur dioxide gas(SO_2). This gas is very soluble in water and reacts with it to form sulphurous acid (H_2SO_3). This in turn combines with oxygen in the air to produce sulphuric acid (H_2SO_4. The following then takes place:

a) The limestone ($CaCO_3$) reacts with sulphuric acid to give calcium sulphate ($CaSO_4$ and water (H_2O). The calcium sulphate then takes up the water as it crystallizes as the mineral gypsum ($CaSO_4.2H_2O$).

b) The limestone is then being physically damaged by salt crystallization stresses through wetting and drying cycles. This damage takes the form of blistering, exfoliation and powdering of the stone surface.

The degree of weathering depends of the position of the stone. The process is as follows:

A gypsum skin or coating is formed on the stone surface which slows up the attack.

In exposed positions this skin is dissolved and washed away by rain water.

In sheltered positions the skin remains, thickens and collects a soot crust above it.

In sheltered/semi-sheltered positions when conditions allow for continuous wetting/drying warming/cooling cycles, the sulphate skin blisters by thermal expansion of the gypsum (5 times that of calcite). Eventually the blistered surface falls away and the process is repeated.

Some stones are deteriorating much more than others in similar positions. This is probably due to differences in pore size distribution and other textural properties of the stones themselves. Where larger losses exist e.g. labels and strings this may be due to face bedding of the stone.

The use of hard impervious cement mortar during Pearson's restoration for both the setting of new stones, the re-beding of 12th century stones and the re-pointing of 12th century stones has had the effect of accelerating the decay. This decay is caused by:

a) Salts from the cement migrating into adjacent stonework
b) Thermal expansion of the cement being greater than that of limestone has created cracks between cement and stone thus allowing ingress of water through capillary action.
c) As the stone weathers back further than the cement, water traps are created.
d) Salt crystallisation often occurs behing the cement thus causing in depth break down of the stone.

The cleaning methods used during the 1960s programme are unknown but some Caen stone surfaces show signs of being scoured and scratched, indicating wire or very hard brushes were used. It is possible that the was much surface loss during this cleaning operation.

5.0 CONSERVATION PROGRAMME

The purposes of the conservation work were as follows:

c) To remove dirt,sulphation, hard cement and oxidising ironwork from the stone.

d) To consolidate and protect the stone where necessary using porous and permeable lime mortars. To pin the stone where necessary with stainless steel rod and polyester resin.

5.1 CLEANING

Since 1986 I have been developing ammonium carbonate poultices as a cheap and user friendly method of cleaning sulphated limestone. At Canterbury Cathedral (1986-88) the poultice medium was sepiolite. For the conservation work to the Chapter House at Rochester Cathedral in 1989 carboxy methyl cellulose (polycell) and starch (Rex paste) were used. For the conservation of the dorter doorway paper pulp was used for its ease of application and removal. This has proved the best poultice media to date. The expense of the pulp is far outweighed by time saved through ease of application and removal.

This method of cleaning was used for all the surfaces treated by the conservator with the exception of the West Door which was lightly water washed.

Water washing

All stone surfaces were gently cleaned to remove loose superficial dirt using portable pressurised sprays (killaspray type) and soft bristle brushes. This cleaning revealed the areas which had collected the more tenacious black sulphate crust.

Poulticing

All sulphated areas of both sculptural and architectural stonework were cleaned using the following poultice recipe and technique:

a) A 2.5% w/v solution of ammonium carbonate in tap water with a few drops of non-ionic detergent was made up.

b) To this was added a small amount of sepiolite

c) To this mixture was added enough paper pulp to make a slightly crumbly dough.

d) The stone surface to be cleaned was well wetted

e) The pulp dough was gently pressed into position to a thickness of 12-25mm.

f) After about 24 hours the poultice was removed and the surface rinsed with water several times to remove all residues.

g) For thickly sulphated areas a second application was required.

5.2 REMOVAL OF PAST REPAIRS AND FIXINGS

Cement

Areas of cement were removed by first drilling several holes into them with masonry bits of various sizes. The cement was then carefully cut away using sharp chisels. See drawings for position of cement that was removed.

Iron

The lead covered iron dowels set into the jamb figures of the west door were inspected for oxidation. Several dowels in the south figure had caused damage or were cracking adjacent stone. Where oxidation was apparent the dowels were removed, labelled and stored, and replaced with 6mm diametre ss dowels. The safest way to remove the original dowels was to drill closely beside them with a narrow masonry drill bit. See drawings for position of iron.

5.2 STRUCTURAL REPAIRS

Dowelling and pinning

This was carried out using round section stainless steel (grade 316) which was degreased and keyed and set in polyester resin. The dowels were 'secret' (recessed 25mm from stone surface and the hole packed with repair mortar. (see drawing for position of dowels).

5.3 SURFACE REPAIRS AND CONSOLIDATION

Lime mortar repairs The approach adopted was to remove all friable stone where this formed no part of surviving original surface or recognisable form however weathered. The reason for this is that these friable areas are rich in sulphates thus it is a way of removing these salts from the stone. It is also inadvisable to make a mortar repair on anything but a well

keyed sound surface as the salts below may in time push the repair off.

All exfoliating edges were supported with mortar. Blisters, hollow areas and cracks were similarly filled. The repair mortar comprising of Totternhoe lime, crushed Bath stone, washed Charing sand and yellow brickdust and HTI (see Appendix 1 for recipes), was a suitable colour match for most areas. Where a colour adjustment was necessary, coloured stonedust/brickdust were added. The mortar ratio was 1 part lime to 2½ well graded aggregate.

Re-pointing All open joints were packed with Totterhoe lime/Charing sand in a ratio of 1:2½ (see Appendix 1 for recipe). The aggregate size was varied to suit the size of joint. The mortar was brushed back slightly to reveal the aggregate.

Limewater 40 coats of limewater were applied to all the Caen stone. Some 'tightening up' of powdery surfaces was observed on powdery surfaces.. The limewater was applied using portable pressurised sprays (killaspray type) the excess being removed with a clean sponge.

5.4 PROTECTION

Sheltercoat

The sheltercoat mix applied was similar to that used for the Chapter House in 1989 and Dorter Doorway in 1990. The main difference was the use Bath stone instead of Caen as this could not be obtained in large quantity. The mix comprised of Totterhoe lime/Bath stonedust/Slate dust/Hornton brown stonedust, thinned with 50/50 skimmed milk and water. (see Appendix 1 for recipes)

The conservation team tested various colours until a shade between the yellowest and greyest Caen stone was obtained. The main contractor then made up a large quantity for treating the whole west front (Caen, Weldon and Bath stone) which was used by both the conservation team and the main contractor.

Lead dressings

Code 5 lead 'eyelids' were fitted to protect the labels of the aisle windows and the west door. To the ends of the lead over the central door were added ss wire 'drip clips' to stop uplift and throw water clear.

.0 DISCOVERIES

he main discoveries were:

. The extent of the 19th century replacement stonework
. The speed of decay of 12th century stones adjecent to 19th century stones which were apparently sound directly after Pearson's restoration.

These discoveries are shown in the coloured up 1:20 scale drawing and in photographs of the cleaned stonework (before sheltercoat) taken by Dr. Linday Grant of the Conway Library, Courtauld Institute of Art. (see Appendix 2 for a selection of these)

See site documentation records for other discoveries (Appendix 3)

7.0 THE CONSERVATION TEAM

Colin Schlapobersky (site foreman)
Peter Martindale (site foreman)
Louise Bradshaw
Nigel Hobbins
Keiran Elliott
Steven Conway
Robert Lugg
Nicholas Durnan

Thanks are also due to Tim Tatton-Brown for his assistance in compiling this report, to Steve Hopkins (the contractors foreman) for his continuous help to the team on site and to the three 1991 William Morris Fellows for their contribution to the work on the west front.

References

(1) The cleaning and treatment of limestone by the lime method: John Ashurst in The Conservation of Building and Decorative Stone pp 169-76. Butterworths 1991.

(2) Foundations of the Saxon Cathedral Church at Rochester Arch Cant Vol 18 1889: Rev. Grevile Livett.

(3) The Cathedral Church and Monastery of St. Andrew at Rochester Arch Cant Vol 23 1898: W.H.St. John Hope

(4) The Significance of the West Front of Rochester Cathedral Arch Cant Vol 1983: J. Philip McAleer

(5) The West Doorway of Rochester Cathedral: Deborah Kahn from Romanesque and Gothic: Essays for George Zarnecki (Boydell + Brewer 1987) ed N. Stratford et al.

(6) Conservators report on the conservation of the West Door: H. Alexander and D. Hill of Wells Conservation Centre 1984. (copy in Cathedral Library)