ASA

ALAN H. SPRY & ASSOCIATES
Consultants on Stone Problems · Historic and Modern Buildings

Jan Stevens

512 Kensington Road,
Wattle Park 5066
South Australia
Telephone (08) 31 3397

JOINT HOUSE DEPARTMENT

PARLIAMENT HOUSE

CANBERRA ACT 2601

Attention: Mr A Guilfoyle

PARLIAMENT HOUSE, CANBERRA

STONEWORK CONDITION REPORT

JULY 1990

REPORT NO. C 179

DR ALAN H SPRY

1. INTRODUCTION

1.1 ADMINISTRATION

Consultant Dr Alan H Spry was commissioned to investigate the condition of the stonework of the new Parliament House, to comment on causes of any deterioration and recommend appropriate repair or maintenance.

The investigation took place on 10 and 11 July 1990, under work order EWO 33653.

1.2 BACKGROUND

Dr Alan H Spry provided consulting advice on matters pertaining to the stonework of the House during the design (for Mitchell, Giurgola and Thorp 1987), and construction (for the Parliament House Construction Authority 1983-1987) and operation (for the Joint House Department in 1988).

The data bank on test-work and other investigations extending over a period of seven years provides a background to an understanding of potential problems which were anticipated during design and construction. Reference is made to numbered Consultant Memoranda from Amdel produced between March 1983 (No. 1) and March 1986 (No. 18).

1.3 PROGRAM

An exhaustive examination of all stones in the building was beyond the scope of this investigation which was limited to a visual examination taking 2 days. The stonework was divided into the following groups, all of which were examined in varying detail depending on problems which either presented themselves or were anticipated.

(1) Carmina Granite of the curved wall.

(2) Issorie Verde green marble of the 4 niches in the curved wall and minor other applications.

(3) White Carmina marble of the Forecourt.

(4) Black (Belgian) white (Carrara) and red (Atlantico) marbles of the foyer floor.

(5) Miscellaneous paving of granite (Calca, Black Imperial, Black Grandee, Christmas Bush), sandstone (Linden) and marble (Travertino Romano and others).

(6) Miscellaneous ornamentation, furniture, pools, fountains, walls, etc. in granite (Calca, Christmas Bush, Black Imperial, Black Grandee and others) and marble (Carrara Statuario, Atlantide Rosa, Cipollino, Pentelikon and others).

2. CONDITION OF THE STONEWORK

2.1 General

It is now nearly 7 years since the first stone was applied to the northern end of the eastern curved wall and 2 years since completion of the whole. In general the stonework is in sound condition, much of it unaffected by service and no major failures were found. However several problems are developing and require attention.

2.2 Carmina Granite of the Curved Wall

2.2.1 Background

The Carmina Granite of the curved wall is sound and generally has not deteriorated in any way with use. The joints are even, no sign of relative movement of the panels, sagging, or failure of fixings was found. Although the rubber gasket in the joints was not a matter for this report, no evidence of failure was found with cursory examination. Slight-brown staining near joints may be related to the gasket.

Matters affecting quality were investigated in detail in 1983 and various possible problem anticipated as follows:

(1) Microcracks (Consultant Memo No. 9, June 1984)
The prominent microcrack system is a potential defect and it was thought possible that the cracks could open up with weathering, particularly with frost attack and that microcracks almost parallel to the surface might release chips. No sign of these was found.

(2) Small cracks (Consultant Memo No. 9, June 1984; No. 15, June 1985 and separate Amdel Report, Feb. 1984).
Single cracks several tens of mm long, particularly through the light-coloured inclusions, have the potential to extend or propagate. No sign of this was found.

(3) Pyrite (Consultant Memo No. 6, Nov. 1983; No. 7, Feb. 1984; No. 9, June 1984)
The brassy iron sulphide mineral pyrite, a common accessory in the granite, has the potential to oxidise with weathering and produce rusty spots or streaks. The pyrite now is tarnished but no evidence of rust was sighted.

(4) Warping (Consultant Memo No. 9, June, 1984; Separate Amdel Report)
At one time it was claimed that some granite panels warped after processing and although this was disproven (Amdel Report) the possibility of warping in service was investigated. No evidence of such behaviour was found.

CONCLUSION

It would appear that the rigorous inspection procedures during processing and construction were successful.

2.2.2 Damp at Base of the Curved Wall

Many polished granite panels at the base are dark due to the presence of moisture over much of the curved wall (Plates 1 and 2)., Damp extends from the bottom margin up to as high as 600 mm on some panels but is commonly between 200 and 400 mm.

The cause is not clear and is discussed below, however such damp will eventually cause discolouration of the granite and then deterioration of the surface.

The characteristics of the damp are as follows:

(1) It is not evenly developed throughout both surfaces of both curved walls: It is uncommon on the inner surfaces and most strongly developed at the southern ends of the outer surfaces of the walls. Distribution is shown in Figure 1.

The intensity depends on the location within the structure, being most prominent:

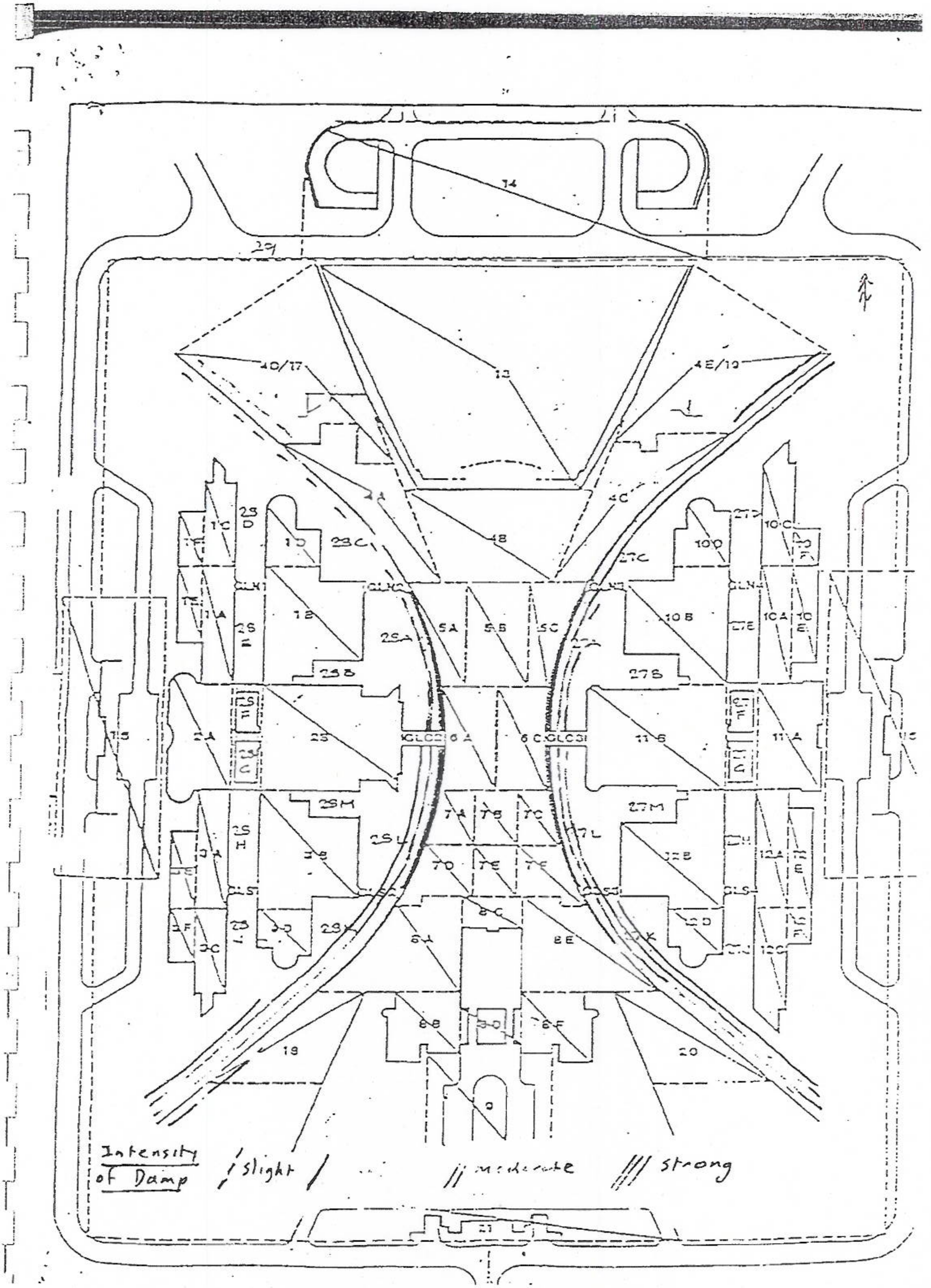
(i) on the outer face of the wall where lawns on deep soil are adjacent as against the inner face where the soil cover is thin or non-existent over structure below.

(ii) on the southern ends of the walls, however not depending on simple exposure, e.g. it is worse on north-east facing area 27K and least on north-east facing 4D.

(2) The intensity varies from panel to panel being often higher in the central panel of three on the faces of columns, being present on the outer panels of returns but not on the inner most panels.

(3) The intensity is not related to the presence of paving adjacent to the base of the wall as it is present on paved central sections 27A and 28A as well as unpaved 27K and 28K (although worse in the latter).

(4) The cavity was designed as being drained by omitting the lowest 100 mm of tasket in the vertical joints of the panels. These gaps exist but a knife passed through the opening meets an obstruction instead of an open joint. No line staining indicative of moisture flow out of these gaps was seen.


14
29
4D/17
13
4E/10
4A
4C
4B
1C
1D
23C
27C
10D
10C
1A
1B
25A
5A
5B
5C
10B
27E
10A
25B
27B
2A
11B
11A
6A
6C
25M
27M
7A
7B
7C
7L
25L
12B
12A
7D
7E
7F
8C
8E
8A
12D
12C
8B
8F
19
20
Intensity of Damp
/ slight
// moderate
/// strong

The pattern resembles that of rising damp which is common in masonry in contact with damp soil. However it is not common in granite which has very low porosity (Carmina is 0.30% by weight), particularly in panels which are hollow-fixed and resting on a massive concrete footing.

The source of moisture in such situations may be:

(a) rising damp from moist soil, from lawn sprinklers or from hosing down the base and adjacent paving.

(b) falling damp:

(i) due to rain penetrating open joints above or leaking plumbing.

(ii) due to run-down of condensation within the cavity.

(c) Irrigation sprays ??

POSSIBLE EXPLANATION

The final movement of moisture is a rise but the moisture may be derived from above by penetration, leakage or condensation within the cavity. It is suspected that the bottom of the cavity is filled with absorbent debris (e.g. powder from drilling fixing holes in the concrete backing wall above) and that this filling is holding moisture which penetrates through the granite panel from the rear.

It is possible that the lowest part of the panels were deliberately 'solid-fixed' by pouring mortar behind as this is common practice to make the lowest panel more resistant to impact.

INVESTIGATION

It is essential to determine the cause of the problem in order to devise a cure, therefore it is necessary to investigate the construction of the rear of the base of the panels. This will require some penetration of the panel. The simplest method would be to core-drill (say 50 mm) several holes through the base and insert a light and a mirror to view. The core plugs could be re-fixed to repair the holes. Alternatively the whole base could be removed by sawing a strip, say 200 mm high across the base. This could be repaired easily.

2.2.3 Physical Damage to Carmina Granite

Heavy impact has broken a panel in an alcove on the top of the eastern wall (area 7C on roof), as shown in Plate 2, No. 1. This should be repaired.

A small chip of granite lies on a window sill in the stair well in area 8A2 (Plate 2, No. 2). This appears to have fallen from the corner of a soffit panel of the window recess but no reason for the fracture could be seen (the joints appear open and the granite panels not in contact). It is possible that it remains from an original accident during construction.

There are tiny fragments on many of the wide sills on the first and second floors. Some appear to be of granite but most are gravel, dirt, bird droppings, insects, leaves and pieces of construction material (plastic membrane and metal packers), some left over from the construction period but very little possibly due to failure of the granite.

The joints in the granite generally show no sign of movement but compression is indicated by displacement of the joint material at the junction of the outer soffit panel and the vertical stone in a second floor window on the eastern side (area 5.2.E, 6th window south of GLN3).

2.2.4 Moisture Passage in the Upper Part of the Wall

Two indications were found, one currently operating, the other possibly of long duration.

(1) Drips of water were seen falling from the joint between the outer soffit panel and the vertical wall panel on a window on the second floor east (area 5.2.E, 1st window south of GLN3).

Lime joint-staining occurs on the soffits of windows just north of GLN3. The pointing mortar is cracked, possibly with slight displacement on the 2nd and 3rd windows north of GLN2, members' dining room.

(2) Vertical lime run-down staining is visible (Plate 3, No. 1) from the base of the course below the coping, particularly at the northern end of both curved walls. This had been observed as long ago as October 1985 (Consultant Memo No. 16) when the cause was recognised and treatments outlined (letter Amdel 2/88/1; C7333 of 18/1/86). It is not known whether the existing staining is original or has developed recently. It is unsightly and could result in damage to the granite; it should be removed.

2.2.5 Moisture Passage in Black Granite Flooring of Window Returns

White lime staining along the joints in the black granite paving in some window returns of the curved wall, and in the plinth to the western wall of the Senate Building indicates movement of moisture, leaching of cement mortar and deposition of lime. This is not yet a significant problem.

2.3 ISSORIE VERDE MARBLE

2.3.1 Background

The Italian Serpentine marble which is green with brecciated structure and abundant white carbonate veins was used as polished panels, mainly in the

four niches of the curved walls (2 east, 2 west on outer face, area 6A and 6C, immediately north and south of GLC2 and 3), but also in minor amounts externally (e.g. over the glassed links, door surrounds to area 11B, and minor decorative features) also internally, particularly in the glassed links as shown in Plates 4, 5 and 6.

The marble was known at the time of section to be fragile and prone to cracking and bleaching (Consultant Memo No. 5, 1983). When it arrived in 1985, many panels were found to be cracked (Consultant Memos 13, 14, 15 and 17 of 1984 and 1985). Remedial treatment consisting of careful inspection and insertion of metal reinforcement in the rear of panels across major cracks, followed by the application of a polymer textile plus adhesive backing before attachment to the wall (Amdel letter 2/88/1 of 29/1/85).

The completed northern niche on the western wall was inspected in December 1985 and various defects noted (report attached to Memo No. 17).

2.3.2 Condition of Niche in July 1990

The niche mentioned immediately above is the most exposed to sunlight and most susceptible to weathering. It was inspected from ground to second floor level from a mobile hoist and the defects seen in December 1985 examined.

In general the marble is structurally sound and no evidence of significant deterioration or failure was observed in any of the areas of application (including all four niches). However, comparison of the exposed marble of the niches with that in protected areas (particularly the soffit of the same niches and interiors of the glassed links) showed that some deterioration has occurred as follows:

(1) loss of polish of the previously highly polished panels,
(2) lightening of colour (bleaching) to a paler shade of green; this becomes more prominent with height.
(3) widening of some cracks at the stone surface (but no loss of significant chips or fragments),

(4) crazing and yellowing of the polymer filler of wide cracks and cavities.

The Consultant Memo No. 17 predicted that possibly within 10 years, the marble would have deteriorated to an unacceptable degree with cracks opening up, fragments detached and patches fallen out. After 5 years' service, that opinion is now believed to be over-pessimistic but the long term durability of the marble is still suspect and periodic inspections are required. Deterioration is only cosmetic at this stage.

The use of a protective coating to counteract the bleaching, improve the polish, reduce water penetration and increase durability should still be regarded as an option worth considering.

2.4 White Carrara Marble of the Forecourt - Great Verandah

2.4.1 Background

The carefully selected Staturio grade marble cladding to the columns and wing walls in the forecourt was anticipated to have the potential for problems, particularly defacement by graffiti. A test program was reported by Amdel Report 2/8//4, M7868 of April 1987.

The damp discussed below was recognised in 1988 (report by Alan H Spry to the Joint House Department, C 108 of April 1988).

2.4.2 Condition

The marble of the forecourt is sound and not decayed but the damp at the base of the panels, recorded in 1988 is not only still present (Plates 6 and 7), but has matured to the stage where yellow iron staining is developing at the upper margin (Plate 7, No. 2).

The pattern (and possible cause) may be related to that of the rising damp in the Carmina Granite (Section 2.2.2).

The approximate heights to which the damp has risen in the columns of the forecourt are indicated in Table 1, where columns are numbered from east to west.

Relevant observations are as follows:

(1) The damp appears on all columns and wing walls.

(2) The upper level of damp ranges from 0 to 800 mm above the base but is variable both across the whole structure, around each column and even on an individual panel.

(3) The intensity of darkening due to the damp is variable within each column, the damp on rear (inner) panels appearing fainter in darkening but commonly greater in height.

(4) Yellow iron staining has developed on 7 panels, mainly on rear (southern) panels but also on west facing panels of the western wing wall, a northern facing panel on column 2 and on eastern facing panel on column 21.

(5) Damp is developed on all columns, in both the straight and curved sections of the Great Verandah.

(6) Damp does not occur at ground level on the rear of the side columns (Nos. 1 to 5, 18 to 22) where the marble extends below ground level down the stairwell space.

(7) Some joints in the marble cladding of the columns above ground level appeared damp.

(8) Damp was visible on the columns and wing wall in April 1988 (Alan H Spry Report C 108) and on the Christmas Bush Granite base of the wall of the building. It was not visible in July 1990 on the granite.

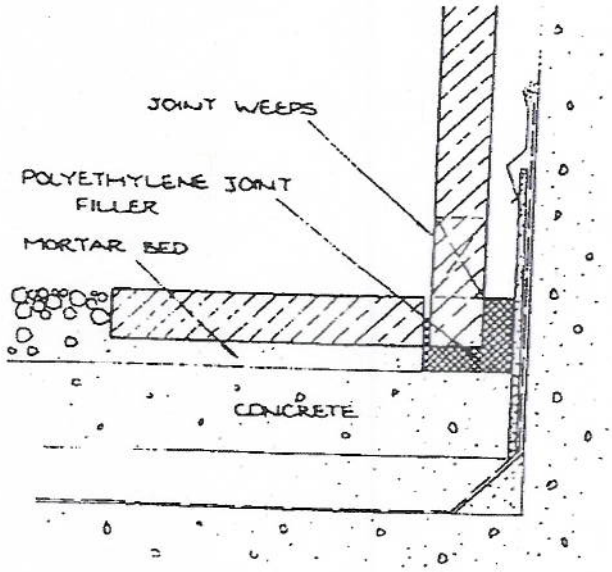
(9) It is noted that white Carrara marble cladding to external walls on the House of Representatives and Senate Buildings do not show this damp, presumably because they have a base block of black granite.

TABLE I APPROXIMATE HEIGHTS OF DAMP, FORECOURT MARBLE

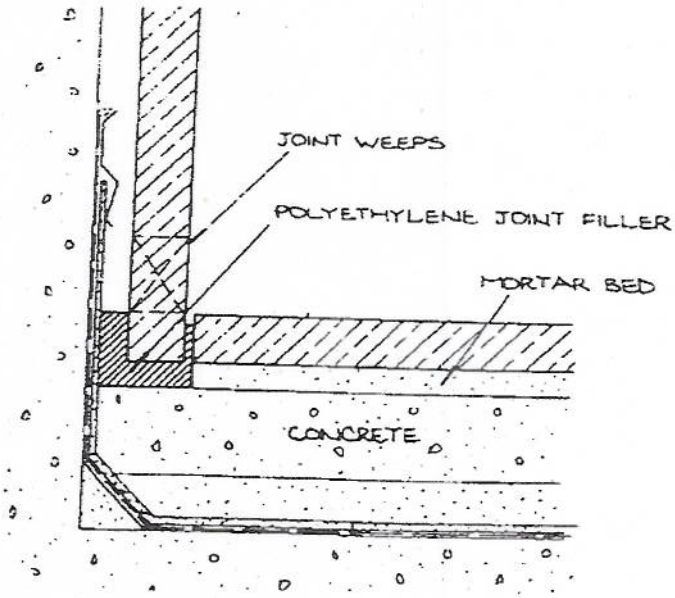
Structure	Column No.	Height of Damp in Each Face (mm) North	East	South	West
Eastern Wing Wall		0-150	400,500	0	0,500,200
			600,700-800		300
	1	120-250	0	0	0
	2	200 S	0	0	0
	3	100-250	100-300	0	0
	4	300	150-300	?	?
	5	300-400	300-400	?	?
	6	0-100	200 F	400	100-200
	7	150	200-300	300 F	250-300
	8	150-250	220-330	400 F	400
	9	200-270	330	400 F	100-200
	10	160-350	250-290	300 F	160
	11	210	0-160	300 F	80
	12	420	200	400 F	300 S
	13	150-250	110	400 F	200
	14	110-150	250-350	400-500 F	120
	15	200-320	130	500 F	240
	16	220-250	350	450 F	150-270
	17	0-400	100-270	0-430 S	0
	18	260-290	350	500 S	250-340 F
	19	270	?	600 S	460 F
	20	270-380	0	0	F
	21	230-260	320 S	0	270 F
	22	220	F	0	F
Western Wing Wall		270	120 S, 300 S, 170,200 190, F	0	330,380 450,450

F = Faint, S = Stain, ? = Not clearly visible.

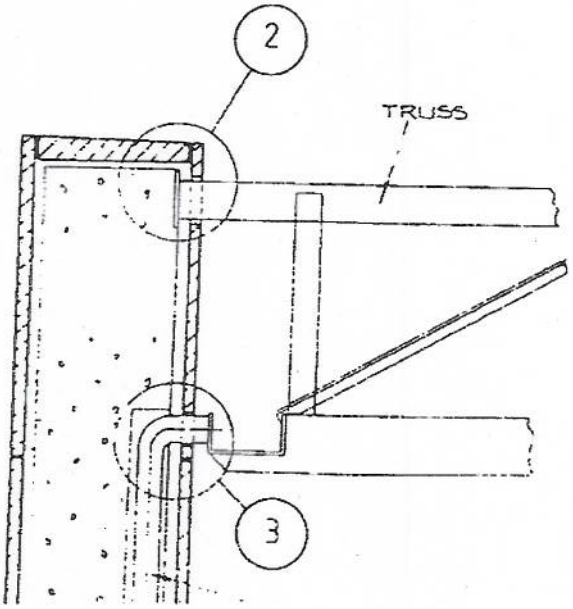
Figure 1.



1. Outer base of marble columns



2. Inner base of marble columns



3. Downpipe at top of marble columns, passes down through columns

TABLE 3 SUMMARY OF HEIGHTS OF DAMP (mm)

Column Numbers	N	E	S	W	(N,E,S,W) Average
1-5	430	200	0	0	160
6-17	200	220	370	200	250
18-22	280	130	220	220	210

No significant pattern of distribution has been recognised, relating to the whole problem.

CONCLUSION

The course of the damp is not known. The pattern is that of damp rising from the base but the source of the damp is not clear. Normal rising damp is ruled out because the columns are well above soil level with concrete, a car park or similar space beneath.

Possible sources of damp are suggested to be as follows:

(a) Moisture penetrating beneath the base of the lower-most panel from rainwater run-off or hosing of the paved area.

(b) The structure of the base, as originally designed (drawing W32-044271-310 of 17.3.86, hence not necessarily the final design or the actual construction) is shown in Figure 2. The area marked 'polyethylene joint' is critical as it is a potential leak path. The supposedly open joint above is also important as moisture could be held behind the panel if the cavity has been filled, intentionally with mortar as 'solid-fix' or accidentally with rubbish.

(c) Falling damp from open joints above or leakage from the rainwater draining downpipe (Figure 2) which passes down many columns.

RECOMMENDATION

The damp has been present for at least 2 years and is not improving, in fact, it is now developing unsightly brown staining which will increase with time. Actual deterioration of the marble will follow. The yellow staining should be removable (see Section 2.5.2.) but would probably return. It is essential to determine the source of the moisture so that this can be corrected. This should first involve an examination of the uppermost parts of the structure, looking for possible entry points for rain, of the joint, gaskets and of any seals around the base, plus any plumbing. Further investigation should be similar to that proposed in Section 2.2.2 for the similar problem of the granite on the curved walls. Removal of a panel may be necessary.

Ultimately it may be necessary to modify the base of the columns, for example, by removing the lower-most section to a height of 200 mm or so, and replacing it in black granite as for the precast walls of the Senate and House of Representatives buildings.

2.5 BLACK AND WHITE MARBLES OF MAIN FOYER (AREA 4 B.G. 834)

2.5.1 Background

The foyer is paved with a patterned combination of a black and a white marble (Belgian Black and Carrara White) with polished finish. The floor is in remarkably good condition considering the amount (5,000 - 6.000 people per day) and type (public access and social functions with food and drink) of use.

Matters of concern are as follows:

(1) yellow staining of some white marble slabs,
(2) lightening in colour of black marble slabs,
(3) staining of black marble slabs,
(4) general loss of polish, scratching, bruise marks, etc.

Possible problems of wear and loss of polish were mentioned in Consultant Memo No. 13 of February 1985 together with a recommendation for consideration of maintenance methods.

2.5.2 Yellow Staining

The yellowing is not yet particularly prominent but appears to be slowly increasing in intensity. Such staining is common in white Carrara marble used as flooring and is due to the precipitation from solution of iron compounds at the surface. Such iron may be derived from within the stone itself (as it contains trace iron carbonate) or from the screed beneath (if grey cement mortar was used). Mobilisation of the iron requires the presence of moisture which may be derived from the screed below or from regular cleaning liquids.

Information obtained from Mr Greg Leach, House Manager, indicates that only clean warm water has been used for cleaning the marble. The maintenance procedure, consisting of regular sweeping and daily mopping with clean water containing no detergents or other cleaning chemicals, is as gentle a process as available. The staining is not attributable to maintenance, and the only suggestion for improving the procedure would be to use a very little non-ionic liquid detergent such as the I.C.I. Lissapol (not a commercial floor cleaner) in the water, to use as little water as possible and to swab the floor dry after mopping.

The source (iron) is present within (or beneath) the stone and is concentrated within the surface. It is generally found that the stain can be removed (temporarily, if not permanently) by the following methods:

(1) use of a chemical solution, either rubbed on with a cloth, then washed off, or by means of a poultice (applied as a paste and allowed to dry). Possible solutions which could be tested on small areas are as follows (from gentlest first to most aggressive last):

(a) sodium citrate, 1:7, in water.

(b) paste of:

EDTA	2.5%
sodium bicarbonate	5%
Ammonium bicarbonate	2%, in water wallpaper paste to thicken.

(c) sodium thiosulphate and EDTA, 5% each in water.

(2) By means of abrasion. The whole surface can be repolished by machine or spotted by hand using a mild soft abrasive.

(3) By a combination of abrasion and chemical action. The so-called ' crystallisation process' involves repolishing in conjunction with oxalic acid.

Of these methods, a careful chemical approach is favoured. Abrasion of the whole floor would wear the surface down, abrasion on limited areas would cause patchiness in appearance, and any abrasive method would produce temporary results only.

2.5.3 Lightening in Colour of Black Marble

All polished black paving stones, both marble and granite, become lighter in colour as they show wear and lose their polish. The Belgian Black marble has performed reasonably well and no unacceptable variation in colour, tracking, etc. was noticed. It must be accepted that unless the stone is repolished or coated, it will lighten ultimately from the original very dark grey to a dark grey.

2.5.4 Staining of Black Marble

Maintenance staff pointed out faint staining of the black marble in several places in the foyer (these are perceptible only with difficulty) due to small-scale spillage of drinks, and extensive staining in Bar No. 2 (area 5G 862) where there has been large scale spillage. The acid in wine and fruit juice will etch and stain polished marble.

The former is so slight that it scarcely requires correction (except as discussed in Section 2.5.5) but the latter requires repolishing of the floor and regular maintenance with a wax polish or polymer coating to protect it.

2.5.5 General Loss of Polish, Scratching, Bruising, etc.

The marble flooring, in many places, has lost its polish, is scratched, shows percussion marks (bruises from Stiletto heels) and has lost body due to wear.

In view of the heavy traffic, the wear on the foyer floor and treads of the stairs (areas 4.1 and 4.2) are not excessive at this stage. However as the area has had only 2 years' service, it might be desired at some stage to consider some treatment to reduce wear. Treatments were discussed in detail in the report by Alan H Spry (C 108, April 1989) but the following are the methods commonly used:

(a) Regular application of a wax polish. This would protect the surface from stains, reduce the wear, increase the shine and darken the black marble. However it is an on-going maintenance procedure, would require periodic stripping to remove wax build-up and has the potential to produce slipperiness.

(b) Application of a satin to glossy polymer coating is now standard practice throughout the world for marble floors in heavily used areas (such as hotel foyers, shopping centres, etc.). A coating would prevent staining and wear, increase the shine and darken the black marble. However, the coating would need to be carefully selected, would require periodic replacement and might not produce an appearance which is acceptable.

2.5.5 Marble Floor of the Members' Hall

The beige marble of the Members' Hall has retained its polish and is in good condition. It was predicted in Consultant Memo No. 9 of June 1984 (also

Spry Report C 108, April 1988) that unfilled travertine can become worn, stained and unsightly in heavily used areas. However this area is only lightly used and apart from a rather unsightly accumulation of grime in the large pores of the travertine (Plate 7, No. 1) little or no deterioration was observed.

No treatment is recommended.

2.6 MISCELLANEOUS STONE PAVING

Granite has been widely used as paving in external areas. Types include Carmina, Black Hill, Grandee and Calca, in finishes such as honed, block sawn, gang sawn and exfoliated and as slabs or sets. The stone is generally in excellent condition apart from some slight joint staining in places and substantial staining in the covered courtyard (2 BG).

There is some problem with the performance of the red granite (Christmas Bush) laid as polished slabs extending from the front entrance into the foyer (Plate 10, No. 1). Where exposed externally it has lost its polish due to wear and is badly pitted (mostly original). Maintenance staff observed that the granite was very slippery when wet (particularly when stepping from the rough, non-slip surface at the adjacent black granite). Rain penetrating through openings above the verandah might well be preventing thus reducing the slipperiness.

Problems were anticipated (Alan H Spry Report C 108 of April 1988) with the Linden Sandstone paving to the Speaker's and President's Gardens. As predicted the stone has become soiled due to dropped food and drink however it has not yet begun to deteriorate. The growth of moss and algae in damp places (Plate 10, No. 2) is unsightly and, with damp, promotes decay. The sandstone base to a sculpture in the President's Garden is slightly damaged and has unsightly repair.

2.7 MISCELLANEOUS ORNAMENTATION

Stone has been widely used as external and internal wall decorations (Plate 11) for example granites (Calca, Black Imperial, Carmina, Black Grandee, Christmas Bush) and marbles (Verde Issore, Carrara Statuario, Cipolino Atlantide Rosa). No problems were observed.

Slight lime staining occurs on some granite (Plate 3, No. 2) and in joints of Black Grandee Granite of the pond and fountain.

3. RECOMMENDATIONS

The following require attention as soon as possible:

3.1 Damp at the base of the granite of the Curved Wall (Section 2.4).

3.2 Damp at the base of the white marble of the forecourt (Section 2.5).

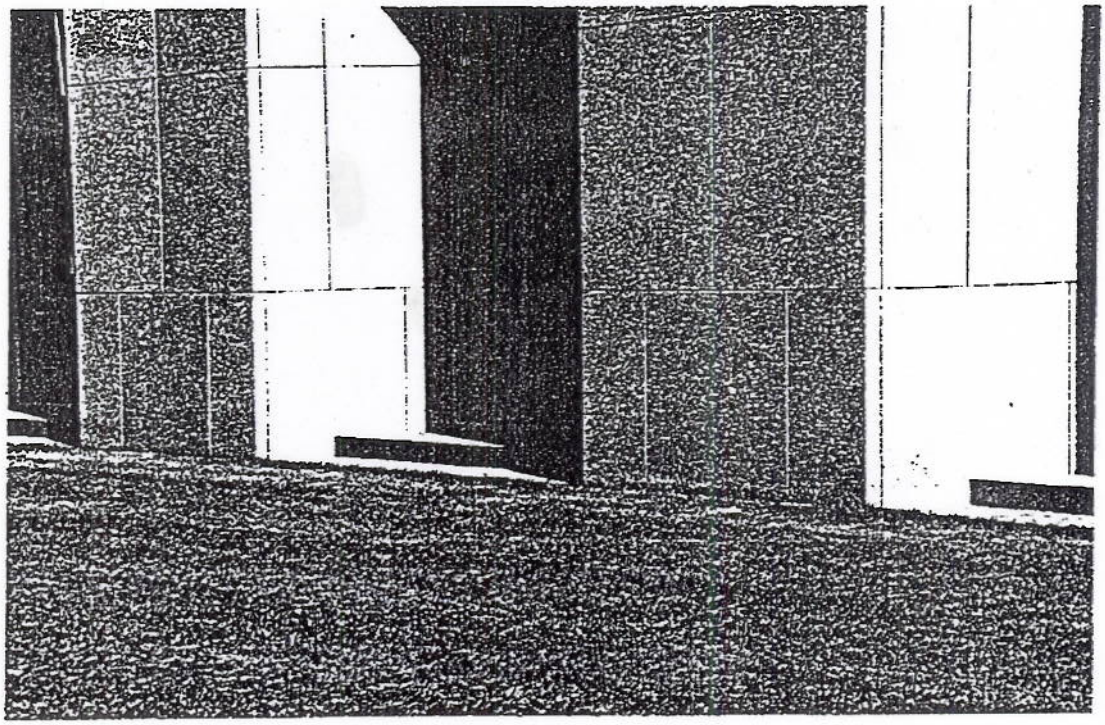
3.3 Moisture movement through the upper part of the Curved Wall (coping and panels below), Section 2.4.

3.4 Marble floor of the bar area (Section 2.4).

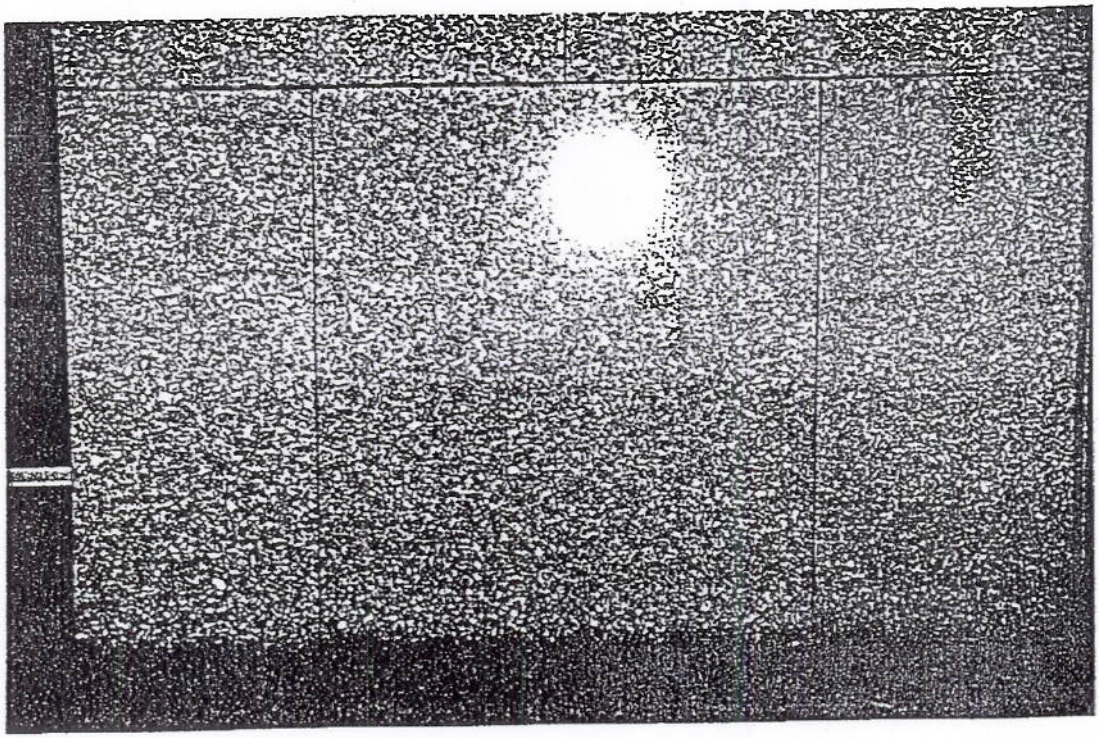
PLATE I DAMP AT THE BASE OF CARMINA GRANITE PANELS OF THE CURVED WALL.

NO I The damp is visible as the irregular dark band at the base of these columns on the outer surface, southern end, eastern wall, area 27K. The lighter grey panels are on the reveals to the columns.

NO 2 The upper limit of damp differs from panel to panel, here being higher in the central panel; location as for I above.



1



2