CEP

CONSULTING ENGINEERS PARTNERSHIP LTD

CONCEPT
DAYRELLS ROAD
CHRIST CHURCH
BARBADOS W I
TEL (246) 426-5830
FAX (246) 426-5835
P O BOX 715, BRIDGETOWN
E-Mail: CONCEPT@caribsurf.com

DIRECTORS

A E HUTCHINSON, BEng MASc FICE MStructE MIHT, MCSCE*
P T SOBERS, MSc DIC, MICE, MStructE, MASCE*
A C T FARRELL MSc, FICE, FIStructE

CONSULTANTS

TONY GIBBS BSc DCT (Lond) FICE, FIStructE FASCE, MConsE, FRSA*
K M JOHNSON, OBE, BSc FICE, FIWEM*
H E BROWNE BSc(Eng), MSc MS MICE AIStructE*

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Pan American Health Organisation
Emergency Preparedness & Disaster Relief Programme
Dayrell's Road
CHRIST CHURCH

Attention: Dr Dana van Alphen

Dear Mesdames/Sirs,

Victoria Hospital, St Lucia

In accordance with your instructions, we have carried out a Vulnerability Survey of the Hospital in Castries. The Assessment included field surveys, interviews with various members of the hospital staff and the Ministry of Health, and desk studies. This was a follow-up exercise to the Vulnerability Assessment undertaken in 1993.

Some action has been taken on the recommendations in the 1993 Report but much remains to be done. Some of the facilities are currently being reconstructed. However, insufficient is being done during reconstruction to reduce the vulnerability to natural hazards. Further encouragement to those involved with mitigation issues is warranted.

If the premises are retrofitted and the renovations executed in accordance with the general guidance in our report, the Hospital should perform satisfactorily in future hazardous events such as earthquakes, hurricanes and torrential rains. The short-term retrofitting measures have been estimated to cost approximately E$650,000.00. Medium- and long-term measures have also been recommended for action at the Hospital.

Of particular concern is the inadequacy of maintenance and housekeeping at the Hospital. Because of this we have placed emphasis on this "tool for mitigating damage" in section 6 of this report.

The need for greater involvement of non-technical personnel in promoting and monitoring natural-hazard damage mitigation is manifest. Because of this, section 7 of the report directly addresses administrators, permanent secretaries and ministers.

Most of the field surveys were undertaken by Engineer Stephen Sandiford of CEP. Considerable assistance was provided by Eng Alwyn Wason in the preparation of the maintenance section of our report.

We wish to acknowledge the assistance of Mr Aloysius Barthelmy (Permanent Secretary), Mr Husbands (Health Planner), Mr Augustine Compton (Project Officer), Mr Cosmos Andrew (Hospital Maintenance Manager) and Eng Cromwell Goodridge (Consultant to the Ministry of Health). The support of Dr van Alphen and other PAHO staff members was also important to us in carrying out the exercise.

Yours faithfully,
CONSULTING ENGINEERS PARTNERSHIP LTD

Tony Gibbs

TG/acc

Pan American Health Organisation
Emergency Preparedness & Disaster Relief Programme

Ministry of Health
Saint Lucia

Vulnerability Survey
of
Victoria Hospital
Castries
Saint Lucia

September 1996

Tony Gibbs
Consulting Engineers Partnership Ltd, Barbados

Vulnerability Survey of Victoria Hospital at Castries, Saint Lucia

CONTENTS

1 INTRODUCTION

1.1 Background

In 1993 the Pan American Health Organisation's Emergency Preparedness & Disaster Relief Programme office in Barbados (PAHO-EP&DRP) commissioned a Vulnerability Assessment of the Victoria Hospital (VH) in St Lucia. That study was undertaken by Eng Tony Gibbs of Consulting Engineers Partnership Ltd (CEP). At that time work was in progress on renovations to the Baron Wing and the eastern leg of the L-Block.

The 1993 Report detailed the natural hazards affecting St Lucia. Reference should therefore be made to that Report since the hazard information will not be repeated in the current report.

An important event took place a year after the 1993 Report was issued when Tropical Storm Debbie struck St Lucia on 09/10 September of 1994. Damage was done to the Paediatric Ward during that event. Fortunately the Ward had been evacuated (because, ironically, of lack of water) so that no injuries were suffered. Nevertheless, as recommended in the 1993 Report, the demolition and replacement of that building should be scheduled.

In July of this year (1996) the St Lucia Ministry of Health (MoH) requested assistance from PAHO-EP&DRP to carry out a follow-up study of the vulnerability of the Victoria Hospital. PAHO-EP&DRP commissioned CEP to undertake the exercise through Eng Tony Gibbs, who was to be assisted by members of the CEP staff. This report responds to that commission.

1.2 Terms of Reference

The principal elements of the Terms of Reference are:

- Review the Report prepared in 1993, revise and/or reiterate the medium and long-term measures proposed for the hospital, taking into account the changes since 1993.

- Review the construction work undertaken at the hospital during the last 3 years.

- Provide sufficient information to permit implementation of the short-term recommendations made in 1993 which may not yet have been implemented.

- Provide sufficient information to permit implementation of such additional mitigation measures with respect to hurricanes which can reasonably be implemented in the short term.

As a part of this exercise Eng Gibbs was to transfer knowledge on natural-hazard damage mitigation to other Caribbean professionals.

The full Terms of Reference are reproduced in Appendix A.1.

1.3 Site Visits and Meetings

1.3.1 MoH Permanent Secretary and Health Planner

On 23 August Eng Gibbs met with the Permanent Secretary (Mr Aloysius Barthelmy) and the Health Planner (Mr Husbands) at the Ministry of Health. The budget for maintenance was looked at in the Estimates document for the current financial year. The details were insufficient to identify where the money was to be spent. For those details Eng Gibbs was referred to the Victoria Hospital staff.

The major, new, development project was delayed. The services of the original French consultants had been terminated and new consultants are to be appointed.

The present construction project at the Victoria Hospital has the following involved persons and organisations:

Health Planner (MoH)	Mr Husbands
Project Manager	Mr Poyotte (Min of Planning)
Structural Engineer	Mr Cromwell Goodridge
Architectural Assistant	Ms Jennifer Auguste (MoP)
Elec/Mech Engineer	Mr John Charlery (Impact Services)
Quantity Surveyor	Ms Barbara Clerfond (MoP)
Medical Gases Consultant	M Naplaz (from Martinique)

The current project is for EC$2.6 million. (EC$2.70 = US$1.00)

EC$2.3 million was recently spent on other works at the Victoria Hospital (including a new operating theatre, change rooms and a ward).

The Victoria Hospital currently has 156 beds.

1.3.2 MoH Project Officer

The Ministry's Project Officer is Mr Augustine Compton. He has attended several seminars, workshops and conferences related to the protection of health-care facilities in the face of natural hazards.

Mr Compton met with CEP engineer, Stephen Sandiford, on 31 July when he provided a copy of his "National Report on the Disaster Mitigation Situation in Health Facilities - St Lucia" presented to the PAHO conference in Mexico in February 1996. Discussions were also held on the current construction project and future projects *eg* the accident/emergency wing and the water tank on the hill outside of the hospital compound. Eng Gibbs met again, briefly, with Mr Compton on 23 August. Mr Compton accompanied Eng Gibbs to the hospital and introduced him to Mr Cosmos Andrew, the Hospital Maintenance Manager.

1.3.3 Hospital Maintenance Manager and Assistant Accountant

The Hospital Accountant, Mrs Jeanette Hyacinthe, keeps the details of the maintenance budget. Regrettably Mrs Hyacinthe was ill at the time of Eng Gibbs' visit. In her absence Mr Anthony Philgence (the Assistant Accountant at the VH) attended the meeting.

The maintenance budget in the current Estimates is as follows:

o	Staff emoluments	EC$ 161,000
o	Operating and maintenance	EC$ 375,000
o	Professional and consultant services	EC$ 55,000

This, however, is not the full extent of the sums allocated to maintenance.

A proposal has recently been submitted for the maintenance of biomedical equipment, X-ray equipment, the intensive care unit and the laboratories. The quotation is US$156,000 (= EC$421,200) per year.

The "operations and maintenance" figure in the Estimates includes for vehicles as well as the fixed facilities.

The complement of maintenance staff at the VH includes:

- 3 carpenters
- 1 plumber
- 1 electrician
- 1 painter

For the quarter April to June 1996 the following was spent:

o	Materials	EC$ 18,000
o	Equipment	EC$ 51,000

Mr Andrew accompanied Eng Gibbs on a tour of the works in progress. This was the reconstruction of the north leg of the L-Block which had suffered fire damage in November 1995. Brief discussions were held with MoP's quantity surveyors and the contractor on the construction site:

- Strengthening of the existing masonry walls was by means of reinforced plaster on the inside surfaces only. This was to preserve the appearance of the original stone masonry on the outside.

- A new ring beam is to be installed over the existing walls prior to replacement of the roof structure.

Mr Andrew had met earlier, on 01 August, with Eng Sandiford of CEP. Discussions took place, principally with respect to maintenance of the facilities.

1.3.4 Government Architect

The Government Architect is Mr Douglas McFarlane.

1.3.5 Consulting Engineer

The Consulting Engineer for the current reconstruction project of the L-Block is Eng Cromwell Goodridge of Goodridge & Associates.

Stephen Sandiford met with Eng Goodridge on 01 August. At that time

Eng Goodridge afforded Eng Sandiford the opportunity to review the drawings for the reconstruction work now underway at the north leg of the L-Block.

Eng Gibbs had arranged a meeting with Eng Goodridge for 23 August but it did not materialise. Eng Goodridge was out of Castries on another assignment. Instead Eng Gibbs met with one of his technicians, Mr Conrad Emmanuel, at the office of Goodridge & Associates.

Six sketches of proposed retrofitting measures prepared by CEP were reviewed. Copies of the sketches and a Memorandum were left at the office for Eng Goodridge. A copy of the Memorandum is in Appendix A.1. The sketches are reproduced in Appendix 2.

2 REVIEW OF THE 1993 VULNERABILITY ASSESSMENT

2.1 Re-assessments

The 1993 Report (sections 3.4, 3.5, 3.6 & 3.7) provided descriptions and evaluations of the 9 principal buildings, services, utilities and external works at the hospital. Our reassessments, where appropriate, are given in the following sub-sections.

2.1.1 Paediatric & X-ray (Duke of Edinburgh Wing)

The 1993 Report recommended the demolition of this building in the medium term.

The doctors and nurses complain of poor ventilation in the children's ward on the upper floor.

The proprietary "SB" floor near the X-ray at first-storey level suffered partial collapse during Tropical Storm Debbie in 1994. Small dropouts of the hollow, clay, filler blocks have occurred in other areas. The damage may have been accelerated by water seeping into a poorly-sealed, vertical movement joint on the east face of building. A new timber ceiling, with supporting timber columns, has been installed under all of the SB floor and roof slabs to protect the occupants.

It is planned to demolish this building during phase 3[1] of the re-development of the hospital. Paediatrics will move into the Administration Block. X-ray will be transferred to a new wing (to be built) on the north side of the site.

2.1.2 The L-Block

About 70% of the building was destroyed in a fire in November 95. Work is in progress on concrete slabs in the north leg of the L-Block. A new operating theatre is being built at the north-east corner of L-Block.

There are no positive hold-down devices on the existing trusses (see photo 3). The masonry wall was simply built around the timber beam.

No ring beam was placed on top of the walls in the previously-renovated (1993/94) eastern section of the building. This had been recommended in the 1993 Report. Apparently the architect vetoed this proposal on the grounds that it might cause damage to the walls and there was no need for it since "the walls have stood for years". Eng Goodridge, the consulting engineer, has written letters indicating his opposition to this view and an alternative, involving a metal strap belt around the outside of the building, was mooted but never implemented.

Cyclone washers have been used in fixing the new roofing sheets so far. Although no attempt was made to rectify the hold-down inadequacies in the previously renovated (1993/94) section, the engineer's plans for the section currently under construction show the addition of mild steel plates to fix the trusses to the masonry walls and indicate the addition of a reinforced concrete beam (about 22 inches deep) on top of the existing walls.

2.1.3 The Baron Wing and the Link Block

The roof of the link between the L-Block and Baron Wing still lacks adequate hold-down connections at the eaves.

The Baron Wing itself has been renovated and is in use. Investigations

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[1] Phase 3 will consist of a new access road and a new entrance to the hospital, an accident/emergency ward; a paediatric ward; X-ray facility; administration block; pharmacy and other relocations within existing structures

into the balcony slab revealed that no reinforcing bars were present in slab. The slab has been strengthened with steel I-beams and the cracks have been repaired (see photo 22).

The upper balcony roof still does not have adequate hold-down details (see photos 20 & 21). The balcony railings and posts have been changed to steel members.

2.1.4 Former Nurses Home

Infill blockwalls have been added around the perimeter at the lowest floor. Some cracking is present in these walls under the pre-existing reinforced-concrete beams. These walls are not tied into the existing structure, but are not clearly separated from it.

The water tank has been moved from the roof. However, two small rubber tanks (600 gallons each) now sit on the roof without any hold-down devices.

2.1.5 Administration & Laboratory Buildings

There has been no change to the Administration Building. The roof pitch is very shallow (almost flat). This has led to problems with leaks and some repairs were being carried out. The shallow pitch is also a potential problem for security in hurricanes.

The administration functions and the pharmacy are to be moved to a new building in phase 3.

2.1.6 Formerly the Doctor's Residence (now the Geriatric Ward)

The building has been renovated (mostly non-structural items). Minor leaks have been repaired, but nothing has been done to the roof sheeting, the roof structure or the foundations. This building is still earmarked for demolition. The Geriatric Ward is to be re-located to the L-block on completion of work now in progress there.

2.1.7 Boiler House and Standby Generator Buildings

These two structures remain as they were in 1993.

The run of hot water pipe has been shortened (see photo 15) since the autoclave has been moved out of the L-block into its own separate building. The new autoclave building is vulnerable to wind damage with a shallow pitch to its roof and no hurricane straps in evidence.

A new standby generator has been placed to the west of the entrance to the hospital to supplement the older one. It could not be determined if the emergency power supply was now adequate to cater for all of the critical functions of the hospital.

2.1.8 Kitchen

The kitchen is in the same condition as in 1993. It is to be moved to the Administration Block in phase 3.

2.1.9 The Chest Wing

Minor repairs have been carried out. The asbestos sheeting remains in place and there are still problems with water ponding near the entrance.

2.1.10 Electrical Power

The new standby generator enclosure appears to have more positive eaves fixings than the older building. The timber rafters are encased in concrete at the eaves but it is not known how they are tied down.

Reference should also be made to section 2.1.7 above.

2.1.11 Water Supply

During Tropical Storm Debbie in 1994 it was found that the old water tank at the hospital could only supply about a day's requirement of water. (After Debbie water had to be brought in to the hospital using Hess Oil tankers.) The water storage has been supplemented recently by the addition of a number of 600-gallon rubber tanks. These have been placed on the roof of the water tank and on various buildings, including the Administration Building and the former Nurses Home (see photos 23, 26 & 31). These tanks are not anchored to the structures.

The old water tank has been patched to stop leaks.

It is estimated that the hospital now has storage for a 2-day supply of water. This is still inadequate since 5 days is minimum desirable for water storage at the Victoria Hospital. It is planned to build a new water tank on the hill above the hospital in the medium-to-long term.

2.1.12 Boilers

The general situation is unchanged from 1993. There are no flexible joints in the pipework. The boiler only supplies hot water to the autoclave and laundry. See also the comments in section 2.1.7.

2.1.13 Sewerage and Solid-waste Disposal

The problems remain the same as in 1993. Special hospital waste is burnt on site but the facilities are inadequate. Government has plans to build an incinerator which will handle hospital and other waste. It will not be located at Victoria.

There are no plans to build a dedicated treatment plant for other sewage at the Victoria Hospital. The hospital is to be tied in to the sewage treatment facility in Castries. Designs have been done for this but financing is unavailable at present. The implementation of this activity will probably take place during phase 3. The design capacity of the Castries treatment facility is not known.

2.1.14 Miscellaneous Items

Nothing has been done about securing the shelving in the pharmacy against toppling in an earthquake.

2.1.15 Communications

There is now a radio link between the hospital and the national Emergency Operations Centre (EOC) and the police. The location of the radio was not determined during Eng Sandiford's visit. It goes without saying that its location should be in a building likely to survive a major natural hazard event without significant damage.

Some utility cables have already been buried (see photo 25).

Covered walkways remain essentially the same as in 1993.

2.1.16 External Works

It is planned to access the hospital from the north side of the site to alleviate the congestion at the existing entrance. A new building is to be built there which will also house the accident and emergency department. Nothing has been done about poorly-performing external works. The stormwater outfall problem on the east side of the compound may have been exacerbated by the construction of a boundary wall (see photo 24).

2.1.17 The Princess Margaret Maternity Ward

This facility was not specifically examined during the 1993 study. It was very new at that time. It is still in much better condition than most other parts of the hospital. The main features and comments are:

- The walls are of reinforced concrete.
- The roofing material is profiled steel sheeting secured with fasteners incorporating French cyclone washers.
- It was indicated by Mr Augustine Compton that the design consciously addressed the hazards of earthquakes as well as hurricanes. (Eng Gibbs had learnt that there was a *bureau de contrôle* from Martinique who reviewed the design of this facility.)
- No hurricane shutters are available on site for the windows.
- The building is in relatively good condition save for a few shrinkage cracks and some cosmetic distress caused by slamming doors.

2.2 Short-term Measures Outstanding

The following items from the 1993 Report *(repeated in italics)* are still to be implemented in whole or in part:

(i) *Installation of appropriate hurricane straps and fixings for timber roof structures, (holding-down bolts should be given careful attention).*
This is still to be done.

(ii) *Rusting corrugated metal sheets should be replaced with newer sheeting of at least 24-gauge thickness.*
This has been done in some, but not all, cases.

(iii) *Fixings for roof sheeting should be of the cyclone washer type as used on the new maternity wing.*
This is being implemented for new works.

(iv) *Further investigation and repair/replacement of the balcony slabs on the Baron Wing.*
Retrofitting has been implemented and, so far, there is no sign of distress in the new ceramic tile flooring.

(v) *A reinforced concrete ring beam should be installed at eaves level in the **L**-Block. This would not only improve the uplift resistance of the roof, but would also improve the ability of the entire structure to resist lateral loads.*
This was not implemented for the eastern leg but is being done on the northern leg.

2.3 Medium-term Measures

The following items from the 1993 Report *(repeated in italics)* are still to be implemented in whole or in part:

(vi) *The demolition of the following buildings:*
1. All derelict structures on the site
2. The Boiler House
3. The Standby Generator building - The equipment currently housed in these buildings should be transferred to more secure areas.

These are still to be done.

(vii) *Walkways connecting buildings should be permanent structures protected from the elements. The concrete link between the Baron Wing and the **L**-Block, and that joining the Laboratory and Administration buildings, should be detached at one or both ends and constructed with an appropriate joint to allow for earthquake movements.*
Apparently there is no separation joint in the link walls for the

Baron Wing. The other bridges remain the same. Work on these items should be scheduled.

(viii) Communications and utility lines should be placed underground.
This process is in progress and should be continued to completion.

(ix) Existing pipework should be replaced by pipes with bends and flexible joints.
This is still to be done.

(x) Protection in the form of shutters should be provided for all windows. External doors should be secured by bolts.
Generally not done. No shutters are kept on the site. Mr Compton suggested that plywood may have to be installed when there is a hurricane warning or watch.

(xi) A regular maintenance programme should be created to oversee drainage and sewerage works and general cleaning of the compound.
It is not known what programme exists. Maintenance appears to be sporadic.

(xii) An external wireless link to the local EOC to be installed.
This has been done.

(xiii) Regular weekly testing of backup facilities such as the water tank and the standby generator should be instituted. This could be done as part of an overall emergency preparedness programme.
This is not done at present.

In addition to the above items the demolition of the Duke of Edinburgh Wing should be scheduled.

2.4 Long-term Measures

The following items from the 1993 Report *(repeated in italics)* are still to be implemented in whole or in part:

(xiv) The existing sewerage and waste disposal systems should be upgraded. The hospital should be provided with its own treatment and disposal plants.

Designs have been done. Implementation of these capital works projects should be scheduled.

(xv) *The Paediatrics wing should be demolished. It is understood that this is to be undertaken in phase 2 of the refurbishment plan.* It is not intended to implement this action until phase 3.

In addition to the above items the following should be addressed:

- The building of a new water tank with adequate capacity
- The provision of adequate vehicular access to the hospital to cater for large-scale emergencies
- The review and upgrading of external drainage works

3 REVIEW OF THE CONSTRUCTION WORK (1993 TO 1996)

3.1 The 1993-94 Project

The 1993/94 project comprised:

- the east leg of the L-Block;
- the Baron Wing;
- the link between these two facilities.

Some of the recommendations in the 1993 Report dealt specifically with the above-listed facilities. Designs were already well advanced at the time of the 1993 study and, indeed, some demolition work had already started. Thus the implementation of new recommendations was made more difficult. Nevertheless there were some successes.

The main disappointments were:

- the omission of a concrete belt beam from the tops of the original walls of the L-Block;
- the lack of attention to the structural separation of the link;
- the continuing inadequacy of hold-down devices for the balcony roofs of the Baron Wing.

3.2 Implementation of the 1993 Recommendations

Reference should be made to sections 2.2, 2.3 and 2.4 of this report for those items from the 1993 Report which are still outstanding.

3.3 Temporary Buildings

Following the fire at the **L**-Block in November 1995 two temporary buildings were erected:

- A storage facility and ward no 6 has been located near the entrance to the hospital. Unfortunately this has created even more congestion of the already-inadequate parking area. (See site layout plan.)

- A "non-perishable items" store near the north-west corner of the site. (See site layout plan.)

These buildings are intended for use only until the completion of reconstruction of the **L**-Block. They lack basic hold-down connections at roof and floor levels (see photo 13).

3.4 Standby Generator Building

The 1993 Report had identified this facility as being vulnerable to damage by earthquakes and hurricanes. This facility is still in use but a new, additional one has been constructed to the west of the entrance to the hospital.

3.5 The Reconstruction following the 1995 Fire

Eng Sandiford was able to review the structural drawings for the **L**-Block with the agreement of Eng Goodridge. He also visited the works in progress at the site. The principal features noted were:

- Timber floors are being replaced by reinforced concrete (RC) slabs supported by RC columns.

- Most of the masonry walls (16 to 18 inches thick) will remain (except for the gable-end wall of the old operating theatre). Stiffener columns will be placed in some areas. (This was a site

decision taken during Eng Sandiford's visit.)

- Inspection of the existing walls revealed that they were very variable. Some appeared to be solid stone. Others were rubble walls with stone or brick faces. The quality of stone varied considerably from very soft to very hard. The mortar had deteriorated to an almost powdery consistency in some instances.

- No details were seen for the dormer windows.

- Details were shown for straps and connections for the main roof trusses and purlins, but not for timber members at the balconies and not for other (smaller) areas of the roof.

4 PROPOSALS FOR SHORT-TERM MITIGATION MEASURES

4.1 Unfinished Issues from 1993

Reference should be made to section 2.2 of this report for those items from the 1993 Report which are still outstanding.

4.2 Additional Measures

a There is the need for additional hurricane straps, clips or other appropriate anchorages in the following areas:

Balcony of the **L**-Block
Timber purlins on the new roof to the **L**-Block
Link Corridor between the **L**-Block and the Baron Wing
Balcony of the Baron Wing
Roof and foundations of the temporary ward
Roof and foundations of the Geriatric Ward

b Repairs are required to the concrete stub columns of the foundations of the Geriatric Ward.

c Demolition and replacement of the old standby generator building

d Demolition and replacement of the boiler building

e Introduction of a regular maintenance programme for electrical and mechanical equipment (including the generators)

f Provision of window shutters and bolts for external doors

g Securing of shelving in the pharmacy and other areas where important and/or dangerous items are stored

Sketches illustrating recommendations for short-term mitigation measures are reproduced in Appendix 2.

4.3 Cost Estimates

Estimates are given in the following table for those measures which can be carried out in the short term. They include all of the unfinished items from the 1993 Report.

Item Ref No	Description of Item	Cost Estimate (EC$)
4.1	All unfinished items from the 1993 Report (see section 2.2 of the present report)	500,000
4.2 a	additional hurricane straps, clips or other appropriate anchorages	8,000
4.2 b	Repairs to the concrete stub columns of the foundations of the Geriatric Ward	2,000
4.2 c	Demolition and replacement of the old standby generator building	50,000
4.2 d	Demolition and replacement of the boiler building	75,000
4.2 e	Introduction of a regular maintenance programme	Not costed
4.2 f	Provision of window shutters and bolts for external doors	20,000
4.2 g	Securing of shelving in the pharmacy and other areas	2,000
4	**Total**	**657,000**