SECTION 3

RESULTS

Incorporation of disaster mitigation in the design and construction of new health care facilities

It was found that 100% of the architects and engineers reported that it is easy to incorporate mitigation measures in the design and construction of new health care facilities by the use of up to date standards and specifications.

A part of the training of architects and engineers is based on the use of codes and practices as stipulated by a variety of building codes.

The following codes are used in Trinidad and Tobago:-

(a) "Recommended Lateral Force Requirements & Commentary" of the Seismology Committee of Structural Engineers Association of California.

(b) The Caribbean Uniform Building Code (CUBiC)

(c) The Barbados Association of Professional Engineers' code "Wind Loads for Structural Design".

(d) The British codes and standards

(e) Other American codes

It was found that the two most commonly used in Trinidad and Tobago were the California and Caribbean Uniform Building Codes. Some aspects of the others listed may be used depending on the era in which the contractor was qualified.

It was reported that the building codes used by engineers do not specify precautions necessary for disaster mitigation in the construction of health care facilities such as the specifications for the strapping of roofs or the use of shutters instead of glass windows.

Many personnel involved in disaster mitigation reported that the use of mitigation guidelines have not been incorporated in its entirety in the design and construction of many of the new health care facilities.

System of approval for construction of new health care facilities

It has been emphasized by twelve(12) of the seventeen (17) interviewees that the approval for constructing new health care facilities is dependant on many agencies. Planning permission is the responsibility of Town and Country,

Department of the Ministry of Planning. Structural approval is given by the Ministry of Works for commercial buildings and any building over two levels high.

Various agencies such as the Fire Services Department, Water and Sewage Authority (WASA) and the Ministry of Health have responsibilities for approval at different stages of the construction cycle. On completion of the building a completion certificate is given by the Regional Corporation.

All interviewees reported that there is no agency at any point in the approval cycle directly responsible for ensuring that disaster mitigation is implemented.

Supervision and monitoring of construction of new health care facilities

The role of supervision and monitoring during construction is also given to many agencies. If the contract was given to a large construction firm then this firm is also given the supervisory and monitoring functions. If the work is being done through inter agency collaboration the Ministry of Works will have the responsibility for construction and supervision.

It is the experience of personnel that the process for approval and granting of completion certificates is not always adhered to resulting in difficulties in obtaining the completion certificate.

Further there is no supervisory or monitoring agency responsible for ensuring that disaster mitigation measures are incorporated in the construction phase.

Most personnel identified supervision and monitoring as critical to the implementation of disaster mitigation in the health sector when new facilities are designed and constructed.

Other experiences shared were that briefs from the Ministry of Health for constructing, refurbishing or purchasing of equipment for health care facilities do not state requirements for disaster mitigation. Engineers are left to use their initiative to identify and incorporate mitigation measures.

Disaster mitigation measures in existing health care facilities

This question seeks to determine what mitigation measures are present in existing Health Care Facilities.

It was reported that a certain level of raised redundancies that is factors to reduce the vulnerability of the building

are added whenever existing health care facilities are refurbished. This is done in keeping with latest technological development. This can be seen in plumbing systems, design for increasing the storage capacity of drugs and supplies, waste disposal of human parts and upgrading of electrical capability.

As recently as four years ago soil movement in a part of the Port of Spain general hospital resulted in damage to the building. Repairs were undertaken and in some areas prefabricated walls were instituted. This is reported to increase the vulnerability of the building in the event of a hurricane.

Oxygen storage in banks as reported by hospital personnel does not meet disaster mitigation levels as shown in example in Fig 5. The oxygen bank shown supplies the main operating theatre.

The mitigation measures which are being taken are only those measures which are calculated to be of immediate severe risk to the occupants. Vulnerability assessment is considered too costly and is not being undertaken at this point.

Some measures such as the changing of glass louvers to aluminum louvers on the Central Block of the Port of Spain General Hospital have been undertaken. Glass window panes are still used in this hospital making the building vulnerable in the event of a hurricane or earthquake. These can be seen in the example in Fig 4.

The Central block of the Port of Spain General Hospital and other parts of the hospital have certain inherent hazards that it can be described as a disaster zone for some of the following reasons as shown in Fig 4 and 5:-

1. Water tanks are housed on the top of very high structures.

2. The corridor linking the main theatre to the hospital is a glass structure without supportive steel.

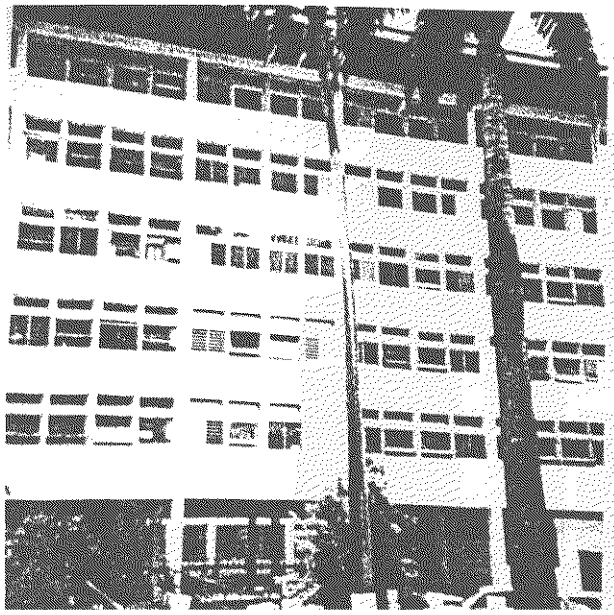
3. Whenever there is heavy rainfall the East Dry River over flows into the hospital compound causing flood into one of the boiler rooms.

4. The #1 boiler house roof is made of zinc sheets and not securely anchored (Fig 5).

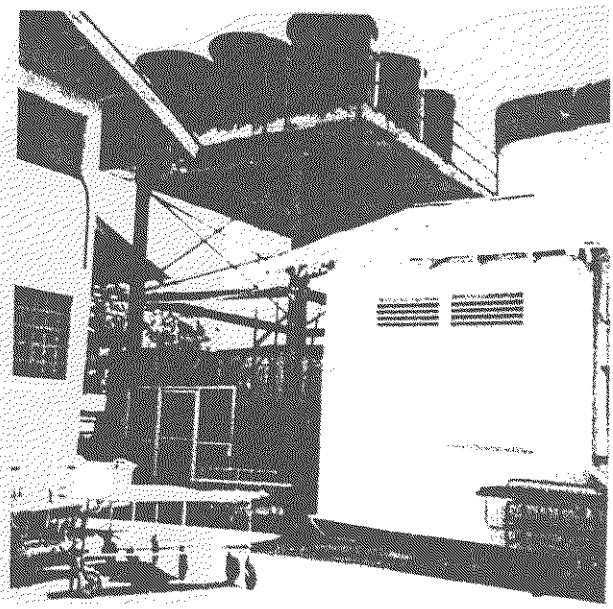
5. The walls of the bank of oxygen and nitrous oxide for the operating theatre can collapse causing malfunctioning of the theatre or fires to the building (Fig 4).

6. Free standing nitrous oxide, compressed air and oxygen are stored on the ground floor of the central block.

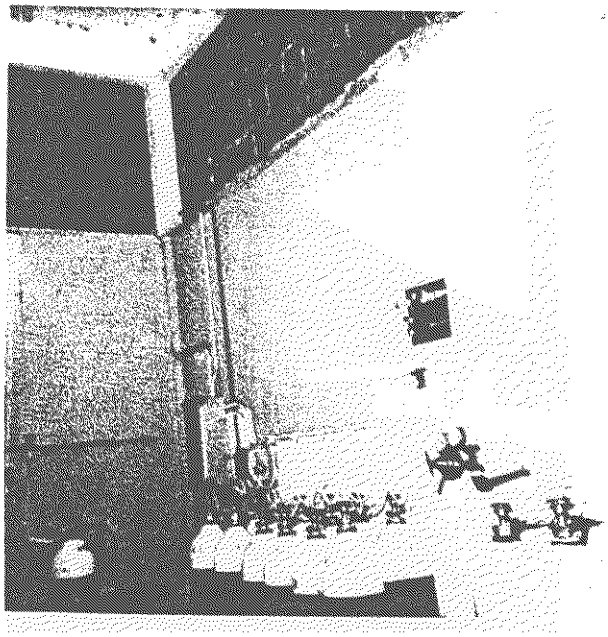
7. Large over hanging trees on the part Northern Elevation which can be uprooted in the event of a storm (Fig 4).



Part Northern elevation of Central Block of Port of Spain General Hospital

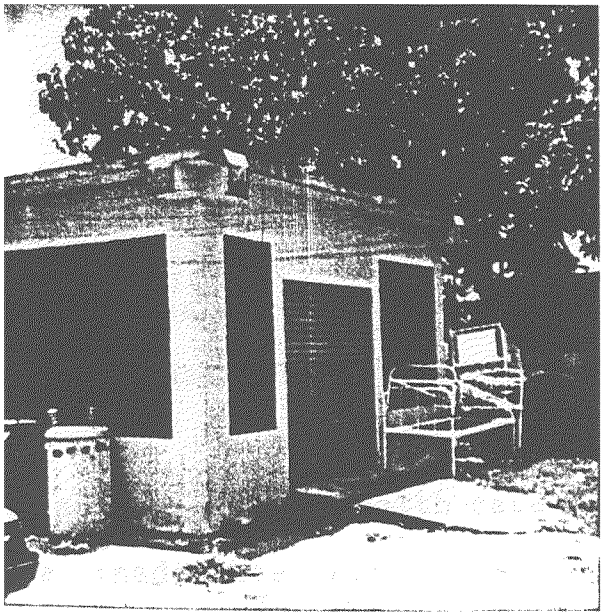


Water Storage Tanks to Laundry of Port of Spain General Hospital

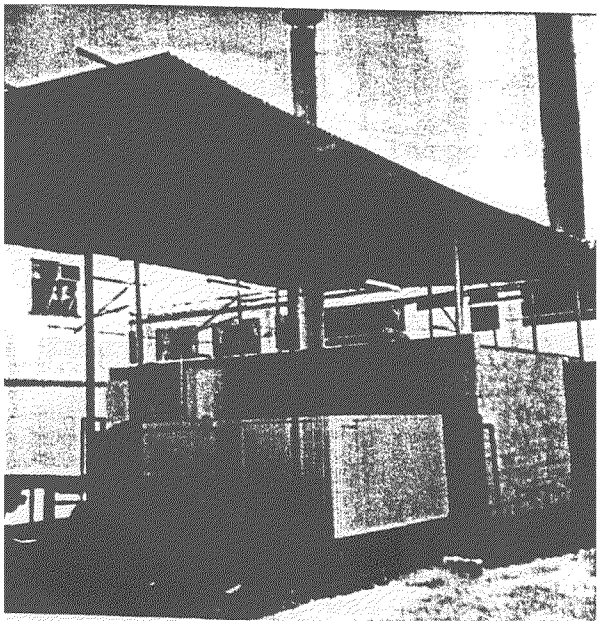


Oxygen Bank of Main Operating Theatre of Port of Spain General Hospital

Fig. 4 The Central Block, Water Storage and Oxygen Bank of the Port of Spain General Hospital.



Newly built Generator House



#1 Boiler House

Fig. 5 The Generator House and #1 Boiler House of the Port of Spain General Hospital

In the La Romain Health Centre soil erosion has made the entire building so unsafe for staff and clients that the new building which was constructed had to be evacuated.

The electricity supply to most health care facilities has been reported to be inadequate and must be included in the vulnerability assessment of any health care facility. In one case new electrical equipment were installed to international standards but housed in a building that can be vulnerable in the event of disasters.

In the San Fernando General Hospital the water storage capacity have been increased from 18,00 gallons to 120,000 gallons. This would provide a large supply of water in the event of a disaster.

The National Emergency Management Agency (NEMA) in their efforts to implement disaster mitigation have set up a committee to examine all critical facilities in Trinidad and Tobago with a view to recommend retrofitting where necessary. A hazard assessment project was recently completed. In this project the paths of previous hurricanes, areas prone to earthquakes and floods were mapped.

The Telecommunications Services of Trinidad and Tobago (TSTT), Water and Sewage Authority (WASA) and Trinidad and Tobago Electricity commission have submitted maps of their facilities showing vulnerable areas of critical care facilities to NEMA.

It is hoped that by overlaying these maps on the hazard map that vulnerable facilities can be identified. This is expected to be used in conjunction with the inventory of health care facilities.

Difficulties which exist in retrofitting existing health care facilities

The difficulties which arose where the facility was already constructed were reported to be in the following areas:-

(a) Disaster mitigation measures were not a part of the considerations of architects before 1990. Buildings constructed before this period catered for provision of service during normal conditions. Added safety factors have been used in the construction of hospitals.

(b) Although stringent building practices exist for building above two stories high and added safety factors have been used, time lapse can cause problems in the following ways:

(i) changes taking place in the design of health facilities.

(ii) Standards which were acceptable over thirty years are no longer so.

(iii) Technological changes in manufacturing standards of construction materials have also changed. A survey done on buildings in the city of port of spain revealed the building materials used have deteriorated with time.

(iv) Changes in construction practice in the areas of quality control and quality assurance have also impacted on the construction industry.

(v) New equipment, increase in occupancy, overload on utility systems have produce

stresses to the building which had not factored in capacity for increase load.

Assessment of health care facilities

It has been reported that architects and engineers were asked for vulnerability assessments of certain hospitals but to date they have not been done due to the cost involved. For example, the estimated cost for a vulnerability assessment of the Central Block Structure of the Port of Spain General Hospital was reported to be $265,000 TT.

Structural assessments have not been conducted because of the structural damage which may ensue if load is added to the building being tested. Visual inspections were undertaken on certain buildings to provide information for decision makers.

It is the experience of personnel that Nurses and Doctors working in the various health care facilities forward complaints to the Permanent Secretary concerning deficiencies in the buildings which hamper the delivery of health care.

Based on these complaints an overview is obtained on structural deficiencies and submitted to the decision makers in the Ministry of Health. Decisions are then taken when funds are available as to what areas will be refurbished, when and at what cost.

Disaster mitigation in preventive maintenance

All the personnel directly responsible for this aspect of work reported that it has been their experience that there is an absolute lack of preventive maintenance on health sector infrastructure. This is due to the lack of manpower and materials which they expressed is a constant feature in their work.

Disaster mitigation activities in a recently refurbished health care facility

It has been reported that the ares in which the Morvant Health Centre had been constructed can be described as a basin. Severe flooding of the facility resulted in damage to equipment. The facility had to be closed for a period of three years.

As a disaster mitigation measure a large deep drain had to be constructed at the front of the building. A new bridge was also constructed to allow access to and from the facility. The floor of the facility was elevated to prevent flood waters from entering the building. In spite of these measures heavy rain following Tropical Storm Bret, on the 6th August 1993, caused the entire premises to be flooded.

A Disaster Management Plan of St George Central, Ministry of Health (1980) was viewed and Sec. 17 states that it is the responsibility of designated officials to ensure that all legal documents and registers are protected and secured to ensure continuity of operational capabilities and confidentiality in the event of a disaster.

Boxes of records are stored on the floor in an unoccupied room due to lack of adequate storage facility. This creates a problem for staff when there is unusually heavy rainfall causing the facility to flood.

Intersectoral collaboration in disaster mitigation of health care facilities

This question attempts to investigate whether collaboration of various sectors such as the Private, Public and International Organisations are working together to implement disaster mitigation measures in Trinidad and Tobago.

Reports from many agencies also revealed that there is limited collaboration between Private Firms, Government agencies and International Organisations on disaster mitigation. It was expressed by all interviewees that there is no involvement with insurance companies.

It was reported that involvement with Pan American Health Organisation (PAHO) was one of technical cooperation and training. A workshop on vulnerability assessment of health care facilities was conducted in 1991 by the Faculty of Engineering, University of the West Indies (UWI). This workshop was organised in conjunction with PAHO, National Emergency Management Agency (NEMA) and the Ministry of Health.

It was reported by all interviewees that more workshops and training programmes on vulnerability assessment and other aspects of disaster mitigation are needed for architects, engineers and health service managers.

Objective of the Ministry when refurbishing health care facilities

It was stated that the objective of the Ministry of Health when constructing new and retrofitting existing health care facilities does not include mitigation measures against

disasters as a priority. At present, making health care facilities comfortable for staff and clientele is the prime focus in the delivery of care.

Mitigation measures which should be undertaken when constructing and retrofitting health care facilities

It was reported that as part of the mitigation measures against disasters, the possibility of constructing bus shelters in Trinidad and Tobago is being investigated. This is hoped to provide occupancy in the event of a disaster.

The construction industry has plans to demonstrate the proper method of connecting buildings from foundation to roof using standardised material. Guidelines for nailing of pearlings to rafters, connecting rafters to plates to ring beams and then bolting the entire structure when constructing new facilities should be used. All the above stated should be well connected with steel, concrete and block walls and tied to the foundation.

In constructing new health facilities the topography of the land chosen will be such that it allows for adequate natural drainage in unusual rainfall. The Port of Spain Hospital has

been sited in an area in which water is impounded by Broadway, South Quay and The Dry River resulting in flooding to some areas of the hospital. The siting of future health care facilities must be carefully selected.

Soil testing will be done in an attempt to ensure that the facility to be constructed will not have structural damage from land erosion and inadequate subsoil drainage. For example it has been reported that the foundation of the La Romain health centre failed because soil testing was not performed. There was subsequent land movement and the health centre which was newly built had to be evacuated.

Another consideration is to adequately design catering for projected disasters such as fires. The construction of fire exits, water sprinklers and the use of materials which are not flammable or toxic if set on fire must be a standard criteria in disaster mitigation.

The general construction of health care facilities should protect occupants from flying objects. In Fig 4 it can be observed that should a hurricane occur large overhanging trees could be uprooted and cause serious damage to lives or property.

Disaster mitigation measures will also be taken to promote the safety of occupants from lightening and ingress of storm waters. Lightening rods will be used to earth off the building.

On one of the sites visited, St James Medical Complex it was observed that due to poor maintenance the windows were unable to close. Also other sites visited had glass windows instead of storm shutters. There were in some areas long overhanging eaves which can make the building vulnerable in the event of a hurricane. These will be avoided when constructing or retrofitting health care facilities.

Stabilization of furniture and equipment have been reported important in the event of earthquake. Oxygen should be piped and there should be several shut off points to prevent fires. The quantity stored in banks will be carefully monitored and the areas of storage should be away from the main building.

The internal systems will be taken into account to provide for the following:-

1. Adequate water storage systems;

2. Separate electricity power units with properly protected and located stand by generators, transformers increase battery capability;

3. Properly installed steam generator for cooking;

4. A well equipped kitchen with an adequately protected storage area.

An example, was reported of the Arima Health Facility which is being constructed with mitigation measures against earthquakes and hurricanes in the design. The construction is in blocks of four units linked by streets. Columns on twelve foot modules are used. The building is tied to prevent fractures. Reinforced concrete frames are used instead of prefabricated walls and there are beams above door level.

To further reinforce the building the roof will be strapped. Folding roofs made from timber gables are being used to prevent lifting in high velocity winds.

An environmental impact assessment was done covering a three to four mile radius. Impact factors of dust and oil were also taken into account.

Two other examples were given where the dredging of rivers in the Diego Martin area is undertaken to reduce the risks of flooding to the health care facility in that area . The

other, ~~is~~ reafrostation is being considered by the Forestry division particularly of cane field areas as a disaster mitigation measure against flooding.

In the construction of health care facilities drainage design is given high consideration. It is based on the judgement of the level of rainfall or flood levels. This may be calculated 1:5, 1:10 or as long as 1:50 years. With this level of uncertainty created planning is made difficult.

It was expressed that flooding may only occur 1:50 years. Therefore, creating underground drainage to accommodate a flood which will occur so infrequently may not be cost effective.

The health care facility may have all the drainage infrastructure and may be constructed to accommodate a flood 1:25 years. If the other structures on which this drainage dependent are designed for a flood 1:5 years it is evident that in 25 years the facility will experience five floods attributed to the poor backup systems.

The integrity of the original structure of the San Fernando Hospital had been so designed and constructed to provide natural ventilation and in the process was reported to be able

to withstand winds of high intensity. It was built in 1948 and catered for a much lower occupancy. Over time the population has increased resulting in greater usage of the building. This situation as exists in many of the health care facilities had attributed to the vulnerability of the facility to disasters.

Disaster Mitigation Guidelines in the construction and refurbishment of health care facilities

It had been expressed by all of the personnel interviewed that the building codes are used by architects and engineers. However, building codes do not specify precautions to be taken against disaster mitigation. As such, they do not provide specifications for strapping of roofs or the nailing of pearlings to rafters.

Of all the personnel interviewed seven (7) were familiar with the disaster mitigation guidelines for hospitals and other health care facilities published by PAHO. Of the eleven (11) architects and engineers interviewed four(4) were familiar with the publication the other seven (7) were unaware of its existence. Of the four (4) who were familiar with the publication two (2) felt that the disaster mitigation

guidelines for hospital and other health care facilities although fairly well documented is not Law and as such is not compulsory for use in the design, construction and maintenance of health care facilities.

All the architects and engineers interviewed indicated that the building code is the tool used in construction practice. Ten (10) persons in this group think that it is adequate for dealing with earthquake and hurricane risks. As such it was felt that disaster mitigation guidelines are of limited use in the practice of architects and engineers working on large projects.

The practicing architects and engineers who were not familiar with the disaster mitigation guidelines for hospitals and other health care facilities were unable to make a contribution to its usefulness.

Engineers and other personnel involved in disaster mitigation who worked in agencies other than the Ministry of Health were not aware of the existence of such a document. Some personnel working in the Ministry of Health were sensitized to its usefulness and have found it helpful and cost effective for small internal projects as is illustrated in Fig 5 with the construction of the power house in the Port of Spain General Hospital.

It has been pointed out that the use of disaster mitigation guidelines can be effectively utilized when designing and constructing new health care facilities. It is easy to incorporate the recommendations in new constructions and the design could be done in such a way as to made the process very cost effective.

It has been reported that there was not much consciousness about disaster mitigation when the existing facilities were constructed prior to 1990. This has made all buildings constructed before that period in need of vulnerability assessments.

This has presented a serious problem of cost if existing facilities is to factor in retrofitting measures using the disaster mitigation guidelines.