Pan American Health Organization  
DIPECHO-III

Report  
on the  
Comparison of Building “Codes” and Practices  
which are in use in the Caribbean  
(principally Bahamas, CUBiC, Dominican Republic, French Antilles, OECS)  
focussing on design and construction of healthcare facilities

May 2003

Prepared for the Pan American Health Organization  
under the  
Disaster Prevention, Mitigation and Preparedness Programme  
of the  
European Community Humanitarian Office

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Report on the Comparison of Building “Codes” and Practices which are in use in the Caribbean (Bahamas, CUBiC, Dominican Republic, French Antilles, OECS) focussing on design and construction of healthcare facilities by Tony Gibbs

1 CODES AND STANDARDS AND PRACTICES

Much confusion arises from the common usage of the words “code” and “standard”. In particular, the word “code” is commonly used in place of “standard”. For example the Caribbean Uniform Building Code (CUBiC) is principally a set of technical standards. It would be appropriate to distinguish clearly between the two words, at least for the purposes of this paper.

The word “code” has a legal connotation. Codes are often part of the law of a country enacted either by statute or under powers to legislate delegated to a minister of government. Codes are usually accompanied by “regulations” and often refer to technical “standards”.

As inferred above, “standard” usually refers to a set of technical recommendations set out in an orderly manner to guide the practitioner in executing the design, fabrication and construction of (in this case) building works.

Actual practices may vary from both codes and standards. In the case of codes, this may come about because of ineffective enforcement mechanisms. In the case of standards, this may come about because the standards may not be mandated by the laws and regulations of the relevant state.

2 BACKGROUND

The region is afflicted by many natural hazards. The principal natural hazards affecting the region are hurricanes, earthquakes, torrential rains, volcanic eruptions, tsunamis, sea waves and storm surge. For the purposes of the design of buildings the hazards of hurricanes, torrential rains and earthquakes are the critical ones.

Engineers in the Caribbean have been using “codes of practice” and standards for almost as long as they were available to engineers in the metropolitan countries. Because of the colonial presence, most of these standards in the Commonwealth Caribbean were from the United Kingdom and in the French Antilles from European France. However, standards from the United States of America and Canada were also in use. The use of standards was generally subjective, uncontrolled and lacking in uniformity. The Caribbean cannot afford disasters. Disasters must be avoided. Hence there is an urgent and overdue need for codification of the building industry.

In previous generations there was little conscious engineered attention to earthquake-resistant design in the Caribbean. Much more attention had been paid to designing against hurricane-force winds. Even at present there are still many significant structures, including hospitals, which are not subjected to conscious earthquake-resistant design techniques.
3 THE HAZARDS

3.1 Wind Loading and Earthquake-resistant Design

The work in the area of wind loading has been considerable. Indeed there is now heightened interest in this issue. There are in existence several regional documents: the BAPE/CCEO document “Wind Loads for Structural Design”, the CUBiC section on “Wind Loading” and the Dominican Republic “Reglamento para el Análisis por Viento de Estructuras”.

Earthquake-resistant design has taken up more time in debate and study than any other single issue in the development of regional building standards. Undoubtedly this debate will continue and (hopefully) so too will the research effort.

3.2 Other Hazards

Torrential rain is not dealt with in any building standard in the Caribbean. Yet the damage caused by this hazard is arguably greater (though less dramatic) than that caused by earthquakes and wind. Scientific guidance is available however. Lirios’ intensity-duration-frequency curves have been developed for several territories in the region and may be available through the Caribbean Institute for Meteorological and Hydrology in Barbados.

The complex phenomenon of storm surge is of interest for coastal sites. Computer models are available for developing storm-surge scenarios for coastlines. One such model is TAOS (The Arbiter of Storms) developed by C Watson and tailored for the Caribbean under the Caribbean Disaster Mitigation Project (CDMP) managed by the Organisation of American States (OAS) and funded by the United States Agency for International Development (USAID).

The tsunami phenomenon has received the attention of regional scientists particularly with respect to the submarine volcano, Kick ‘em Jenny, just north of Grenada.

Both of these marine hazards are highly specialised subjects for which expert advice should be sought for all low-lying, coastal developments. Codes and standards are unlikely to be able address these matters satisfactorily at this time.

4 THE HISTORY OF CARIBBEAN STANDARDS AND CODES

4.1 Bahamas Building Code

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1 BAPE = Barbados Association of Professional Engineers
   CCEO = Council of Caribbean Engineering Organisations

2 The latest edition of this document was funded by the Organisation of American States through the National Council of Science and Technology (Barbados) in 1981. It is a Barbados standard BNS CP28.


4 Prepared for Dirección General de Reglamentos y Sistemas, Secretaría de Estado de Obras Públicas y Comunicaciones by Grupo de Estabilidad Estructural in 1999
Bahamas was the first Commonwealth Caribbean country to have a mandatory building code incorporating modern standards. The Bahamas Building Code was implemented in the early 1970s and its use is mandatory for the design and construction of all buildings in that country.

The Code is administered by a special section of the Ministry responsible for planning. Building inspectors and qualified engineers are employed for the examination of building plans and for the inspection of construction.

The latest published edition of the Code is dated 1987. However, it is understood that the document is currently undergoing a significant revision. The standards in the Bahamas Building Code follow closely those of the South Florida Building Code.

The Ministry of Health is mentioned in the Foreword as a contributor to the development of the Code. Nine occupancy categories are defined covering almost every possible function. However, the Code does not include (specifically) hospitals, clinics or any other health-care facility in any of its occupancy groups. In the section on gravity loads (section 2002) there is no mention of hospitals, clinics or any other health-care facility. There is mention of laboratories. In the section on wind loads (section 2006) there is no requirement for additional safety levels for hospitals, clinics or any other health-care facility. Chapter 28 deals with exit facilities, corridors, stairs and the like. No specific mention is made of hospitals, clinics or any other health-care facility. Although section 3108.5(b) and (c) require compliance with impact tests for windows in hurricanes, the tests are not named in the Code.

4.2 The Council of Caribbean Engineering Organisations (CCEO)

The CCEO has been central to the development of technical standards in the Commonwealth Caribbean in the present generation. The development of building standards for the Commonwealth Caribbean has been in progress for over three decades. The mandate of the CCEO included the development of building standards and the co-ordination of such activities among its various constituent member organisations.

Regional seminars were held in Jamaica in 1970, 1971 and 1972 with the aim of developing and finalising a set of Caribbean building standards.

A major conference was held in Trinidad in 1978 devoted entirely to the seismicity of the Caribbean region and earthquake-resistant design practices therein.

4.3 The Caribbean Uniform Building Code (CUBiC)

In 1977 there was an abortive effort by the Trinidad & Tobago Bureau of Standards, with financial assistance from the Commonwealth Fund for Technical Cooperation, to develop a set of regional building standards.

In the 1980s the preparatory activities of the 1970s gelled into the development of CUBiC - the Caribbean Uniform Building Code. In 1982 the United States Agency for International Development (USAID) agreed to assist in financing the work required to develop the Code. The
project was executed by CARICOM\textsuperscript{5} with financing from USAID, the Caribbean Development Bank (CDB) and CCEO. In 1986 the Code was formally accepted by the CARICOM Council of Ministers of Health (the sponsors of the project).

The process of having the use of the standards detailed in CUBiC legislated by the CARICOM countries was not developed although all of the countries agreed to a CARICOM resolution which accepted the documents for use in the member states. To date only three Caribbean countries have made mandatory (through laws in their parliaments) the technical provisions of CUBiC. Another procedural problem not finalised in 1986 was arrangements for the distribution and sale of copies of CUBiC to Caribbean building professionals. This aspect of CUBiC’s use was not completely thought through with the result that many building professionals have found it difficult to access the documents. It was only in 1990 that copies of CUBiC became available for purchase by the general public. By agreement with CARICOM, CCEO has been given the authority to produce and sell copies of CUBiC.

There is, however, still the need to advertise the existence of CUBiC and to conduct more training exercises for building professionals in the use of the standards. It is also considered that updating of the standards must be considered a priority, in as much as CUBiC was developed over 15 years ago, and revisions which are a normal consequence of standards development have not been carried out.

In 1999, through CDMP\textsuperscript{6}, the CCEO prepared a project proposal on behalf of CARICOM for submission to the CDB for funding for the preparation of a new edition of CUBiC. Approval by CDB is expected in the very near future.

The document “CUBiC:Part-2:Section-2:Wind Load” makes no specific reference to hospitals and other health-care facilities. There are clauses providing guidance on adjusting wind pressures for different return periods and therefore for different levels of safety or different levels of importance of the building. However, nowhere is guidance given on the selection of safety levels for different categories of buildings.

The document “CUBiC:Part-2:Section-3:Earthquake Load” does make specific reference to hospitals in Clause 2.305.6. In that clause hospitals are categorised as “Class I Buildings” essential for use in the aftermath of a major earthquake. An “Importance Factor” of 1.5 is allocated to such buildings which effectively increases the design loads by 50% over those for “normal” buildings. No specific mention is made of hospital equipment nor furniture. There is no mention of base isolation or other non-traditional methods of earthquake-resistant design which may be appropriate for buildings required to be functional immediately after earthquakes.

4.4 Turks and Caicos Islands

The Physical Planning Ordinance now in force was approved by the Legislative Council of the Turks and Caicos Islands (TCI) in 1989 and Regulations (which included the TCI Building Code

\textsuperscript{5}Caribbean Community Secretariat

\textsuperscript{6}Caribbean Disaster Mitigation Project financed by USAID and managed by the OAS
and Building Guidelines) were approved by the Governor in 1990. The Ordinance and Building Code were developed through a 1984 Physical Planning Project financed by the United Nations Development Programme (UNDP) and the British Development Division in the Caribbean (BDD)\(^7\) and executed by United Nations Centre for Human Settlements (UNCHS or Habitat).

The Ordinance and its Regulations deal with the physical development of the TCI including such matters as development planning, environmental controls and building regulations. The Building Regulations mandate the use of the Turks and Caicos Islands Building Code and establish procedures for examining development applications. The Regulations also give authority to the Physical Planning Board and to the Director of Planning to refuse development permission where the application does not conform to the Regulations or to the Code.

The Building Code is administered by the staff of the Department of Planning which includes development control officers (building inspectors) who must examine all development applications and provide comments to the Director and to the Physical Planning Board. The Development Control Officers are also responsible for inspecting developments during construction to ensure that the requirements of the building and development regulations are maintained.

The process should work reasonably well as the Director of Planning and the Board are empowered by the Code to require the employment of Special Inspectors for the examination and inspection of projects which are technically beyond the training of the development control officers. This has been done so far with mixed results.

The Department of Planning has sold over hundred and fifty copies of the Code and Guidelines to developers and builders in TCI (population 19,900 in 2001).

The TCI Code adopts by reference CUBiC for both wind and earthquake loads. Therefore the last two paragraphs of Section 4.3 of this paper are relevant to this Section 4.4.

4.5 The United Nations International Decade for Natural Disaster Reduction

In the past decade the United Nations Centre for Human Settlements (UNCHS) provided considerable assistance to the Organisation of Eastern Caribbean States (OECS)\(^8\) to bring about formal, legally-binding building standards for member countries. This project built on the work of the CUBiC project and was not a duplication of CUBiC activities. Indeed, the OECS Codes depend for their technical basis on CUBiC. The OECS Codes are meant for formal, government enactment. This work by UNCHS was continued through projects managed by the OAS and

\(^7\)Now changed to Department for International Development (DFID)

\(^8\)Grenada, St Vincent & the Grenadines, St Lucia, Dominica, Montserrat, Antigua & Barbuda, St Kitts & Nevis, Anguilla. The OECS headquarters are in St Lucia. The OECS Code and Guidelines included the British Virgin Islands.
most recently through CIDA\(^9\) and IBRD\(^{10}\) programmes.

Documents were produced for each of the countries of the OECS and the British Virgin Islands and discussions were held with the builders and Government officials in several of these countries. Fifteen copies of the resultant documents (in 2 volumes) have been provided to each of the countries. The USAID/OAS Caribbean Disaster Mitigation Project (CDMP) joined forces with UNCHS and CARICOM to introduce the model code in three OECS countries. Antigua & Barbuda, the first among the three, passed the necessary legislation shortly after being hit by Hurricane Luis in 1995 to ensure that the Code would be used to guide reconstruction.

As of May 2003 Antigua & Barbuda, St Kitts & Nevis and Dominica have taken the vital step to give these documents the force of law. St Lucia, with some assistance from World Bank funding, is close to legislating the use of the Code. It is understood that Grenada is soon to follow.

As stated above, the UNDP/UNCHS on request from the OECS Secretariat has assisted in the development of Codes and illustrated Building Guidelines for the OECS Countries. The planning and building laws under which all of the British colonies operated before political independence or the attainment of “associated country” status were similar and concentrated on ensuring that all buildings conformed to the health laws of the countries. The sizes and heights of individual rooms and ventilation of all habitable spaces and toilets were the important criteria. The office responsible for the administration of the legislation had the authority to require the use of appropriate design and construction standards, but generally this was interpreted to mean spatial and siting standards.

The use of the Building Code and Guidelines developed in 1991 varies. Some countries such as Anguilla and Montserrat have been using the documents administratively from about 1994 by requiring architects, engineers and other building designers to ensure that the building designs are in accordance with the Building Code and Building Guidelines as may be applicable. Building inspectors are also employed to check construction and to guide the constructors of small buildings in the use of the Building Guidelines.

The responsible building and planning authorities in Anguilla (population 11,600 in 2001) and Montserrat (pre-Soufrière population 11,000) have each sold about one hundred copies of the Building Code and Building Guidelines to developers and to the building fraternity.

In 1996, the State of Antigua & Barbuda passed regulations to the 1974 Development Control Act mandating the use of the Antigua & Barbuda Building Code. The regulations give firm authority to the Development Control Authority to require all developments to be designed and constructed in accordance with the Building Code and Building Guidelines. In 2000 the parliament in St Kitts & Nevis mandated the use of the Building Code. It has been orally reported recently that similar action was taken in Dominica in May of 2002.

\(^9\) Canadian International Development Agency

\(^{10}\) International Bank for Reconstruction and Development (The World Bank)
The UNDP/UNCHS has financed follow-up missions to Anguilla, Antigua & Barbuda, Montserrat, Dominica and St Lucia. The OAS-managed, USAID-financed CDMP did likewise for Grenada. The missions have led to the use of the documents in Montserrat and Anguilla and as stated, to legislating the use of the documents in Antigua & Barbuda, St Kitts & Nevis and Dominica.

In spite of all that has been said in this section, the current practice in all OECS countries is far from that envisaged by the Code and the Guidelines. Design continues to be inconsistent. This problem stems from the universal lack of effective enforcement mechanisms in OECS countries.

As stated above, the OECS Code depends to a large extent for its technical basis on CUBiC. In addition to the references to hospitals, clinics and other healthcare facilities in CUBiC, the OECS Code has a few specific references to hospitals. Hospitals, asylums, infirmaries, old and handicapped persons homes and sanatoria are all listed in Occupancy Group B for Institutional Buildings requiring special attention.

4.6 The More Developed Countries (MDCs)

Trinidad & Tobago, Barbados and Jamaica are all close to concluding the necessary arrangements for mandatory building standards. These three countries are all relying on CUBiC as the technical basis for their “codes”.

In Barbados the National Building Code is a published, official document of the National Standards Institution (a largely Government agency). However the use of the Code has not yet been mandated. That action awaits the bringing into being of the Barbados Building Authority.

In Trinidad & Tobago a committee has been set up and the process of developing the necessary documentation for a set of mandatory national standards is underway.

Jamaica (at least in Kingston and St Andrews) has had an official requirement to comply with formally-articulated technical standards for several decades. However the situation is now in a state of flux while a thorough review is undertaken of proposed technical provisions for a national building “code”. The building fraternity in Jamaica has been discussing a draft Jamaica National Building Code for the past 15 years. Building developments are generally controlled by the individual parish councils who have building bylaws which authorize the councils to approve or reject building applications. Some of these bylaws provided some details of construction which must be observed. However a 1984 study carried out by the Pan Caribbean Disaster Preparedness and Prevention Project (PCD3P) found that enforcement of the bylaws was not carried out efficiently. The number of building inspectors in each parish was insufficient to carry out the inspections required.

Apart from the references in CUBiC, no specific attention is paid to hospitals and other healthcare facilities in the present standards and regulations for natural hazards in Trinidad & Tobago, Barbados and Jamaica.

4.7 Belize and The Cayman Islands

Both Belize and the Cayman Islands have had legislation for some time to ensure that buildings
are constructed in accordance with the spatial and health principles defined in the legislation.

The Belize City Building Ordinance was fairly specific about the minimum sizes of members required for the structures of small buildings, besides requiring adherence to the health and safety law of the country. In 1999 the OAS assisted the private sector in developing and publishing the Belize Building Standards and the Belize Residential Construction Standards as well as model laws and regulations for consideration by the government. The Standards rely on the technical provisions of CUBiC. So far the required legislation has not been put in place.

The Belize Standards adopt by reference CUBiC for both wind and earthquake loads. Therefore the last two paragraphs of Section 4.3 of this paper are relevant to this Section 4.7.

It is understood that the building authority in the Cayman Islands now require that buildings be designed and constructed in accordance with the standards of the Southern Building Code Congress International (SBCCI)\textsuperscript{11} as amended by a Cayman “application document”\textsuperscript{12}.

Clause 309.1 in the Cayman Islands Building Code describes Group I Unrestrained Occupancy as including buildings or portions thereof used for medical, surgical, psychiatric, nursing, or custodial care on a 24-hour basis of 6 or more persons who are not capable of self-preservation and shall include among others: detoxification facilities, hospitals, mental hospitals, nursing homes (both intermediate care facilities and skilled nursing facilities). Table 1606 in the Cayman Islands Building Code prescribes a “Use Factor” for hospitals and other medical facilities having surgery or emergency treatment areas of 1.15. This factor is to be applied to the pressure thus increasing the loads by 15% over those for “normal” buildings. Rather confusingly, in the earthquake loads section of the base code (SBCCI Standard Code) hospitals are categorised as Group III (essential facilities which are required for post-earthquake recovery). The process for determining earthquake loads differentiates clearly between such essential facilities (including health-care facilities) and “normal” buildings.

4.8 The French Antilles

In Martinique and Guadeloupe there are two standards documents in current use for earthquake-resistant design -- \textit{Règles Parasismique Applicables aux Bâtiments} (PS92) and wind (and snow) loads -- \textit{Neige et Vent} (NV65)\textsuperscript{13}. The numbers indicate the years of original publications. These standards are applicable to all classes of buildings. However, for small buildings of regular shape there is the CP-MI guide (\textit{Guide pour la Construction Parasismique des Maisons} 2000).

\textsuperscript{11}This is known as the Standard Code. No further editions will be published since the SBCCI is a member of the International Code Council (ICC) which publishes the International Building Code (IBC). (Neither the ICC nor the IBC are “international”. They are purely of the USA. Nevertheless the IBC may well come to dominate building standards in the Caribbean Basin.

\textsuperscript{12}Cayman Islands Building Code 1996

\textsuperscript{13}It is interesting to note that this document was referenced in the 1970 wind loads standard of the Barbados Association of Professional Engineers.
Individuelles aux Antilles)\textsuperscript{14}. It includes detailed recommendations and pre-calculated tables for masonry and reinforced concrete building elements but it is not valid for buildings with irregular geometry.

Eurocodes for earthquake-resistant design (EC8)\textsuperscript{15} and for wind loads (EC1 - Part 2.4)\textsuperscript{16} are likely to be introduced formally in the French Antilles along with their introduction in metropolitan France. EC8 is the only Eurocode dealing with existing buildings (strengthening and repair). It will eventually be compulsory to use the Eurocodes in public projects in the French Antilles.

In Eurocode 1: Part 2.4 (wind) no specific reference is made to hospitals, clinics or other healthcare facilities in its Section 1.1 “Scope”. In Section 7.3 “Annual Probabilities of Exceedance ......” a method of adjusting wind speeds to allow for more critical facilities is given. However, there is no specific reference is made to hospitals, clinics or other healthcare facilities.

In Eurocode 8 there is the requirement that “structures important for civil protection remain operational.” Although the words “hospital” and “clinic” are not articulated, healthcare facilities are inferred in that statement. In addition, hospitals are listed explicitly along with fire stations and power plants in “Importance Class I” which require the greatest level of protection. There is an important inclusion of “base isolation” in Section 10 of the document. This subject is dealt with in more than usual detail for a standards document. Base isolation is of particular importance for hospitals as a means of achieving the functioning of such facilities immediately following earthquakes and at acceptable costs.

4.9 Dominican Republic

The impetus for development of building standards documents and the enactment of laws and regulations governing the design of buildings in the Dominican Republic has usually come from disastrous results of natural hazard events. This is not much different from the experiences of most other countries.

Following Hurricane David in 1979 the Dominican Republic published two natural-hazard standards:

- Recomendaciones Provisionales para el Análisis Sísmico de Estructuras No.5/80
- Recomendaciones Provisionales para el Análisis por Viento de Estructuras No.9/80

Following the events of Hurricane Georges in 1998 the Dominican Republic embarked on a major reassessment of its standards for the design and construction of buildings. The wind-
loading standard, in particular, was found to be wanting. The immediate outcome of a review of the wind loading standard was the new document published in 1999 with funding from the Caribbean Disaster Mitigation Project and titled: “Reglamento para el Análisis por Viento de Estructuras”\textsuperscript{17.}

In 2001, with special funds from the World Bank and the Technical Secretariat of the Dominican Republic Presidency, a comprehensive set of building standards was commissioned. It is expected that this project will end its documentation stage later this year (2003). It consists of 3 main activities:

1. Preparation of the building standards documents
2. Introduction of the building standards documents to the construction industry
3. Vulnerability assessment of existing structures

The first activity (preparation of the building standards documents) is sub-divided into 7 main units:

1. Minimum Loads
2. Structural Analysis and Design
3. Electrical Installations
4. Sanitary and Mechanical Installations
5. Fire Protection Systems
6. General Construction Specifications
7. Architectural Specifications

The first unit (Minimum Loads) contains 3 titles or sections:

1. Load Combinations
2. Wind Load Standard
3. Seismic Standard

The second activity (introduction of the building standards documents to the construction industry) is sub-divided into 2 main units:

1. Workshops
2. Courses in Santo Domingo, Santiago, Puerto Plata, Barahona and San Pedro de Macoris

The third activity (vulnerability assessment of existing structures) is sub-divided into 2 main products:

1. Vulnerability Studies
2. Design Recommendations

\textsuperscript{17}This followed closely the American Society of Civil Engineers standard ASCE 7-98. The team included Daniel Comarazamy and José Manuel Diaz (Dominican Republic), Ricardo Lopez (Puerto Rico) with Tony Gibbs (Grenada/Barbados) as adviser.
Among the 8 facilities examined were 3 healthcare centres:

1. Santiago Regional Hospital
2. Maternity General Hospital in Santo Domingo
3. Children General Hospital in Santo Domingo

In the preparation of the new standards existing Dominican Republic standards were used as base documents, where these were reasonably comprehensive and up-to-date. Where this was not the case, the philosophy of the IBC2000\(^\text{18}\) was followed.

The special issues of hospital design and construction were dealt with in the wind and earthquake loads provisions by applying “importance factors” to those loads when analysing critical facilities. Clause 6.6 in the wind-load standard classifies hospitals or medical centres providing surgical and emergency services as Type-IV structures (essential services). The relevant coefficient of importance is 1.15 requiring 15% higher wind pressures than for “normal” buildings. In the earthquake loads standard hospitals are classified in Seismic Use Group III Structure – Structures shall be provided with the capacity to function, insofar as practical, during and after an earthquake. Such a classification affects the levels of design loads and the details of construction to provide greater security and reliability of performance.

5 LIMITATIONS OF STANDARDS

5.1 Maintenance of Standards

By their very nature, and due to the continuing development of scientific and technological knowledge, standards documents are always out-of-date. This does not mean that they are useless, however. What it does mean is that there needs to be a mechanism for the continual reviewing of such standards and the wherewithal for publishing regular revisions. This is clearly a big task, even for the Commonwealth Caribbean as a unitary body. It is obviously out of the question for any individual Commonwealth Caribbean state. In this, as in so many other aspects of life in this region, integration is a *sine qua non* for real and sustainable progress.

It can be seen from Section 4 of this paper that there are more sets of standards in the Caribbean than can reasonably be kept up-to-date with the limited resources available for the task.

5.2 Design and Construction

Emphasis in standards documents is usually placed on analysis and detailing. Very little, if anything, is said about (conceptual) design and not enough is said about construction. The middle is dealt with while the ends are given little attention. Economy depends largely on attention to conceptual design while overall success is often jeopardised by careless construction.

\(^{18}\)IBC2000 was the first edition of the International Building Code which is a wholly USA document published in the year 2000 by the International Codes Council, a USA model-code entity.
5.3 Non-structural Components

Non-structural components are the orphans of the building industry. No one pays proper attention to their safety. They include ceilings, windows, doors and external cladding and many other components of buildings. Non-structural components comprise 60 to 80 percent of the cost of a building. Since consulting engineers do not get paid for designing these elements they are not dealt with by this group. Since the training of architects does not equip them to address the strength and stability issues associated with these elements they leave these matters to the suppliers and contractors. Codes and standards are almost silent on these matters. The suppliers and contractors, seeing that no one is paying attention to strength and stability issues, concern themselves mainly with appearance and price. A high percentage of the losses in hurricanes and earthquakes is due to the failure of such non-structural elements.

It is understood that the structural design of non-structural components in Colombia is now becoming a clearly recognised function with a particular (an additional) member of the design team allocated task.

The non-structural components are particularly important for hospitals and other healthcare facilities since these are required to function during and immediately following hurricanes and earthquakes.

5.4 Minimum Standards

There are many facilities that warrant more than minimum standards. This is properly left to the judgement of the designer, sometimes prompted by the owner. Most commonly, however, the minimum requirements in codes and standards are interpreted as maximum standards. But, designing to the minimum standards in “codes” is equivalent to aiming to produce the worst building that the law would allow.

Designers, suppliers and contractors dare not go above the minima for fear of being uncompetitive. Even where devices such as the “importance factor” in earthquake standards and the “life-of-building factor” or “return-period factor” in wind standards point in the direction of more than the minima, such safer approaches are rare. But there is a limit to how much specific guidance can be incorporated in a standards document. At the end of the day the judgement of knowledgeable and experienced practitioners must be relied on. Beware of engineers who blindly follow codes of practice rather than seeking to take account of the laws of nature.

The damage and destruction of hospitals in hurricanes and earthquakes is a distressingly common occurrence. Clearly, no better than “code minima” standards are often used for these critical facilities. This is simply not good enough.

6 THE REGULATORY ENVIRONMENT

The existence of codes and standards and the enactment of laws are not enough to achieve
success. The checking of compliance is of paramount importance.

There is no need to wait for the setting up of elaborate inspectorates before implementing building codes. Indeed the region cannot afford large bureaucracies, which may not be effective anyway. The Singapore model, with modifications, could be a good guide. There is a considerable degree of self-regulation in Singapore with registered professional engineers having to certify, explicitly, that design and construction are in compliance with the specified standards.

There is also the French approach brought about by the *Code Napoleon* (which makes the contractor liable for design and construction faults). This led to decennial insurance which, in turn, led to the need for *bureaux de contrôle* (check consultants). Consideration should be given to this excellent method of quality assurance.

The Pan-American Health Organisation has initiated a process which could lead to routine independent checking of designs and construction quality control mechanisms for healthcare facilities in the Caribbean. There have already been a few projects subjected to this regime. Of course, healthcare facilities are all independently reviewed in Martinique, Guadeloupe and French Guyana.

7 THE WIDER CARIBBEAN

As the march towards the Free Trade Area of the Americas (FTAA) gains momentum it becomes increasingly inappropriate for the Commonwealth Caribbean to ignore what is happening in the French- and Spanish-speaking Caribbean. Cross fertilisation has started. The work in the Dominican Republic has already been described in Section 4.9 of this paper. In the recent standards development projects in the Dominican Republic there has been significant involvement of professionals from the Commonwealth Caribbean and from Puerto Rico. This was the case in the 1999, OAS-sponsored wind-loading standard for the Dominican Republic. This is also the case in the World-Bank-funded comprehensive set of building standards for the Dominican Republic. In this project the team leaders are from the DR and the Commonwealth Caribbean. As in the case of the wind-loading standard there is also some specialist input from Puerto Rico.

7.1 The ACS Project

The Association of Caribbean States is principally a political alliance. However it has embarked on a project which focusses on wind loads and earthquake loads for structural design. This is a regional project embracing mainly the Spanish- and English-speaking countries of the Caribbean Basin. The work is being done by a team of Costa Rican and Trinidadian engineers

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20 The team included Daniel Comarazamy and José Manuel Diaz (Dominican Republic), Ricardo Lopez (Puerto Rico) with Tony Gibbs (Grenada/Barbados) as adviser.

21 The work is being done by a joint venture of INTEC-GE and CEP International Ltd. The joint coordinators are Daniel Comarazamy and Tony Gibbs.
monitored by Italian engineers.²²

7.2 Consensus Conference on Technical Building Standards in the Caribbean (CCTBSC)

In 1999 the European Union’s DIPECHO²³ regional office located in the Dominican Republic started the promotion of a project aimed at bringing the building standards of the Caribbean Basin closer together. In the event the DIPECHO project did not obtain the required funding from Brussels. That project was called “Consensus Conference on Construction Codes for the Caribbean (CCCCC).

That initiative was revived in 2002 by Marcel Clodion²⁴ with French local-government financial assistance. The revived project has been renamed Consensus Conference on Technical Building Standards in the Caribbean (CCTBSC)²⁵. The first formal meeting of CCTBSC took place in Martinique in November 2002. The second meeting was held in Barbados in February 2003. Further planning meetings are scheduled for the near future. The climax for CCTBSC is scheduled for November 2003.

8 CONCLUSION

The march towards ensuring “safe” building was begun many years ago with the basic legislation of the colonies of the United Kingdom. However such legislation concentrated on ensuring that the health of the population was controlled and did not specifically examine the need to resist extreme natural events such as hurricanes, earthquakes and torrential rains. The damage caused by hurricanes in the past half century has forced a re-examination of the legislative requirements for building control and has led to a tightening up of some of the building regulations and to the development of building codes in some of the countries.

However there are still some countries in the region that have not taken full advantage of the assistance being offered by the international community for standards and code development and training and have not introduced mandatory building codes (incorporating modern technical standards) for the design and construction of new buildings. There is an identified need for all governments of the region to recognise that the very large losses incurred by the occurrence of earthquakes and hurricanes can be significantly reduced by putting in place the requisite legislation and by providing an effective mechanism for monitoring design and construction standards.

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²⁵ The project is being executed by Association Pour La Prévention des Risques Majeurs à la Martinique (APRM). This is headed by Didier Deris.
There has always been a fear that the legislating of building standards will lead to increases in building costs and may also lead to the cost of new homes becoming greater than could be afforded by the majority of the population. Studies have shown that any increase in cost due to the use of appropriate construction standards is rarely more than 3% of the cost of a building, and that the cost of small homes need not be increased when appropriate concepts are used.

The review of existing building standards and codes in the Caribbean has revealed an almost total lack attention to the specific needs of hospitals and other healthcare facilities. This demonstrates the need for specific hospital design guides to supplement the conventional standards and codes. Such a guide is being prepared as part of the DIPECHO-III project. It will be titled:

Design Manual for Health Services Facilities in the Caribbean
with particular reference to
Natural Hazards and Other Low-frequency Events

The Caribbean is located in an area of the world exposed to multiple hazards. If sustainable development is to be achieved, there is no other option but to counteract these natural hazards by designing and constructing resistant buildings. Widespread failure must not be tolerated. If success is to be achieved at affordable cost, appropriate conceptual designs must be adopted. This would be facilitated through the adoption and mandating of good standards and the continuing education of engineers and architects in the requirements of designing against earthquakes and hurricanes in particular. Most of all, support and encouragement must come from governments, financing agencies and the catastrophe insurance industry.

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²⁶This is the third project in a series funded by the Disaster Prevention, Mitigation and Preparedness Programme of the European Community Humanitarian Office.