Natural Hazards and Hazard Management
in the Greater Caribbean
and Latin America
Raff Ahmad (Editor)

Publication No. 3, pp. 96 to 106, 1997
Unit for Disaster Studies
The University of the West Indies
Mona, Kingston, Jamaica
ISBN 976-41-0115-1

13 PROPOSED REVISIONS TO THE NATIONAL BUILDING CODE OF JAMAICA

Wayne D. Adams

SMADA Consultants Ltd.
8 Hope Road, Kingston 10, Jamaica

ABSTRACT

Revisions to the earthquake loading provisions of the National Building Code of Jamaica have been slated since 1992. The effects of the M 5.4 earthquake event of January 13, 1993, despite its modest magnitude, brought to the attention of the design industry information regarding:-

Source fault location,
Behaviour of non-structural elements notably infill walls,
Load bearing masonry reinforcement, and
Irregularity.

The Code changes proposed will include:-

- *A revised equivalent static lateral force procedure (SEAOC 1988 format),*
- *Recommendations for irregularities of buildings, and*
- *Revisions to the zone factor Z for different regions of Jamaica.*

This paper discusses the recommended code changes and their expected applications.

INTRODUCTION

For centuries, Jamaica has been aware of the possibility of the occurrence of a major earthquake, a legacy of the famous 1692 earthquake at Port Royal and other significant seismic events (Tomblin and Robson, 1977).

The earthquake of January 13, 1993 though not of magnitude comparable to the great earthquakes of 1692 and 1907 was nonetheless of sufficient magnitude to perform an impromptu load test of sorts on some engineered structures. The first section of this paper reviews the behaviour of some structures under the earthquake loading highlighting common types of structural failures observed during the 1993 event.

The Jamaican Bureau of Standards is the governmental organization responsible for implementing revisions to the National Building Code. To achieve this a sub-committee mandated to review the existing building code provisions for earthquakes was formed and has developed a draft of the Earthquake Loads Section 3 of the National Building Code of Jamaica.

In the second section of the paper some of the major changes to the earthquake load provisions for Jamaica proposed in the draft Earthquake Loads Section 3 National Building Code (NBCJ) document are discussed.

JANUARY 13, 1993 EARTHQUAKE

Seismic Considerations

The January 13, 1993 earthquake produced seismological data (Wiggins-Grandison, 1996) of significance to engineers:-

(i) Magnitude 5.4 defined as moderate,
(ii) Epicentre was located in the Blue Mountain Structural Block less than 40 km from the city of Kingston,
(iii) Peak ground accelerations estimated to be the order of 0.1g based on intensity data.

The extent of damage to many engineered structures due to the earthquake was of some concern to engineers.

With code design forces corresponding to an effective peak acceleration of 0.3g and detailing provisions to absorb and dissipate energy inputs as great as a magnitude 7.0 earthquake, minimal or non-existent structural damage was expected. The incidents of structural damage following the 1993 earthquake were seen to be results of structural deficiencies of design, detailing or construction.

Review of Building Practice and Damage

Adams (1993, 1996) has described the following modes of failure in the engineered structures in Jamaica following the 1993 event. This review is limited to cases of structural interaction of infill walls.

Infill Partitions

Reinforced concrete block masonry walls are customarily used as partitions in commercial and office buildings of reinforced concrete frames.

The inherent stiffness of these block panels had attracted loads leading to damage of the panels after which the structural frame would be free to perform as designed. Damage was limited to infill panels.

Sill Walls

Another mode of infill block work-structure interaction which in cases caused severe structural damage was partial height infill walls mainly in exterior beam column frames of structural buildings. This led to premature failure of the columns in an undesirable shear mode. Essentially the natural ductile behaviour of the columns and structures were 'short circuited' by infill walls of this configuration.

The sill wall appears to be a logical architectural solution for external walls of bathrooms, school classrooms and car park basements. The high wall provides privacy and retaining of earth while the clerestory windows give light and ventilation.

The structural problem that sill walls create highlights the importance of early structural engineering input in the planning stages of buildings. Some solutions to the short column irregularity which may be implemented on a case by case basis are:-

(i) Increase of column sizes thereby increasing columns overall shear strength,
(ii) Additional shear reinforcement (links) to suppress the non-ductile shear failure,
(iii) Introduction of a shear wall in the frame line to reduce load on the 'captured' column, and
(iv) Combinations of the above.

Load Bearing Masonry Walls

A number of cases of failure in load bearing blockwork occurred. Load bearing concrete block masonry is traditionally used in residential construction, for both engineered and non-engineered buildings.

The presence of a number of openings for doors and windows and other building services without compensating structural improvements resulted in structural walls of inadequate structural resistance against forces of even the moderate earthquake experienced.

The structural details which were found lacking in many of these cases of load bearing masonry were:-

(a) unfilled block pockets, and
(b) absence of horizontal reinforcement.

It may be possible that the block material used was of inadequate quality, however, no evidence is available to confirm this.

There appears to be potential for increase in vulnerability of the building stock. There has been a proliferation, within the last few years, of multi-storey residential structures in Jamaica. These load bearing masonry structures over three storeys are in many cases being built with what appears to be the traditional load bearing blockwork technology, which in many cases may be inadequate for multi-storey structures.

PROPOSED NBCJ EARTHQUAKE LOADS REVISION

The earthquake loading provisions as stated in NBCJ 1983 currently refers users to the latest version of SEAOC.

The foreword of the Earthquake Loads section 3 of the National Building Code of Jamaica 1993 presents in detailed fashion the background developments to the current version of the code.

In summary, a Sub-Committee for Earthquake Loads adopted the provisions of CUBiC (1985) but with the use of specific portions of the SEAOC Code 1988 introduced to reflect some of the latest thinking of researchers since the 1985 CUBiC.

These revisions are summarized as:-

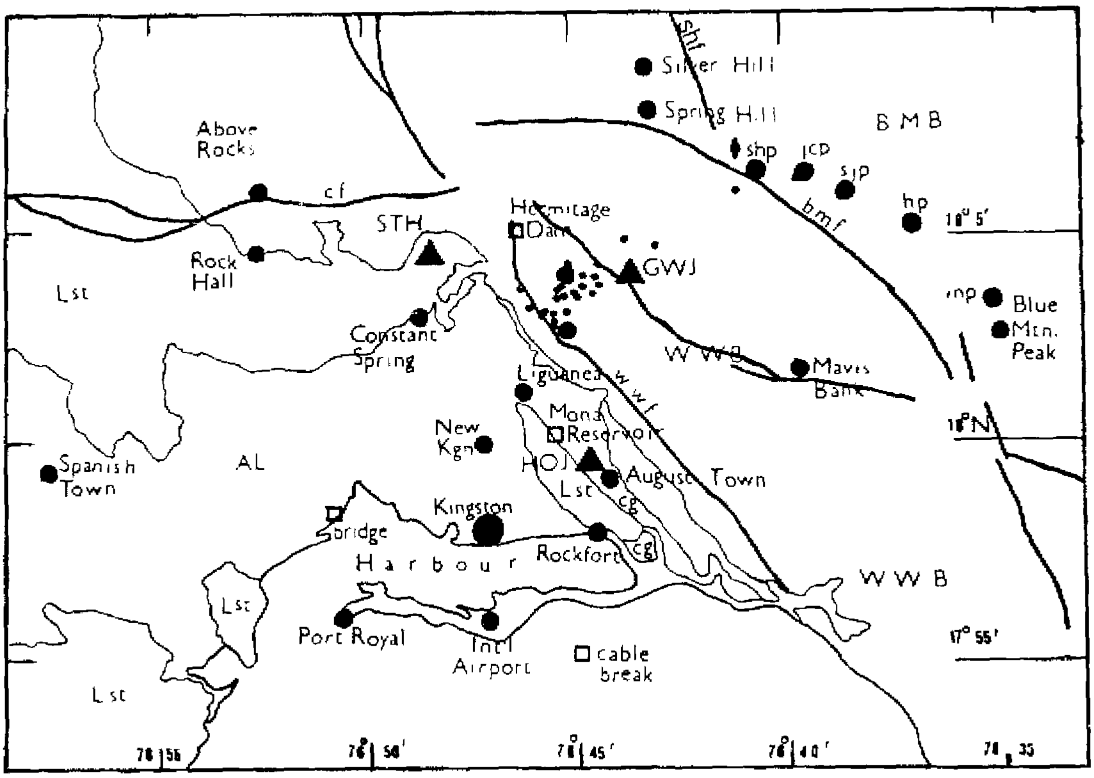
	Code Reference
Zone Factor	Table 1-A
Equivalent Static Lateral Force Equation	3 305
Irregularity Clauses	3.304 2
Increase in loading on concrete block masonry for allowable working stress design	3.307.19

It should be pointed out that the proposed code is limited to structures of maximum six (6) storey's or a height of 19.8 metres.

Zone Factor

Wiggins-Grandison (1996) has proposed that the Wagwater Belt may be part of a fault system capable of producing an earthquake of magnitude 6.0 or greater. As far as the earthquake hazard is concerned Grandison (1996) stated that the January 13, 1993 event "has illustrated the potential of faults associated with the Wagwater Belt and the Blue Mountain Block to produce earthquakes with damaging intensities,....."

Figure 1 shows the major faults in Eastern Jamaica. The foregoing has influenced the proposed Zone factor revision discussed later.



Heavy lines = faults; 'shf' = SilverHill Fault; 'bmf' = Blue Mountain Fault; 'wwf' = Wagwater Fault; 'cf' = Cavaliers Fault; (from Geological Structure Series Map 92.21. Gregory Geoscience Ltd 1992).

Medium lines – coastline.

Light lines = surface geological boundaries: 'BMB' = Blue Mountain (Structural) Block, 'WWB' = Wagwater Belt/Trough, 'AL' = alluvium, 'Lst' = limestone, 'cg' = Coastal Group formation; (from Jamaica Geology, Mines and Geology Div, 1977).

Diamond = epicentre, very small dots = aftershocks; larger solid circles = towns and city centres; triangles = seismograph stations; squares = other sites; 'shp' = Silver Hill Peak, 'jcp' = John Crow Peak, 'sjp' = Sir John's Peak, 'hp' High Peak, 'mp' = Middle Peak. These form part of the Grand Ridge of the Blue Mountains (Jamaica Topography, Survey Dept., 1972).

Fig 1. Major faults in Eastern Jamaica and the epicentres of the main shock and aftershocks for the earthquake of January 13, 1993, from Wiggins-Grandison (1996). Reproduced with the permission of the Geological Society of Jamaica.

Equivalent Static Lateral Force Equation

The equivalent static lateral force equation prior to the 1993 revision corresponded to the equation used in the 1983 version of the SEAOC code.

$$V = ZICSKW \ldots\ldots\ldots (1)$$

Where:

V – Base Shear. The total earthquake force to be applied to the structure for design.

Z – Seismic Zone factor. A factor depending on the seismicity of the site based on its proximity to faults.
Zone 4 of greatest seismicity was 1.0, Jamaica had adopted a value of 0.75.
Zone 4 represented sites within 24km of a fault capable of producing earthquake between 6.0 & 7.0 Richter Magnitude or within 40km of an earthquake capable of magnitude 7 or greater.

I – Occupancy Importance Factor.
I = 1.5 Essential Facilities.
I = 1.0 Other.

C – Dynamic Response Modification Factor.
A factor accounting for the increased effect of loading based on dynamic behaviour compared to the static effects.

S – Site Coefficient.
A factor representing the structural effect of the dynamic response of the ground supporting the structure.

CS being limited to a maximum of 0.14.

K – This factor represented mainly the non-linear effects of structural behaviour. Some measure of energy is dissipated from the structure by yielding under cycles of loading. Values ranged from 1.33 for Stiff Bearing Wall type structure expected to behave elastically, but with low ductility to 0.67 for High ductility structures capable of large deformations without significant loss of strength eg. specially detailed concrete frame buildings.

It has been recommended that the equivalent lateral force equation for the NBCJ 1993 code be changed to:

$$V = ZICW/R_w \ldots\ldots\ldots (2)$$

This is the equivalent static lateral force equation used by the SEAOC code from its 1988 edition to present.

The recommended factors are defined as follows:

Z – is now expressed directly in terms of the effective peak rock acceleration. Table 1 compares the existing and the proposed zone factors.

Figure 2 (a) shows Table 1-A of NBCJ 1993. Figure 2 (b) is a schematic diagram (from Ahmad, 1996) showing the Wagwater belt and Blue Mountain Block in relation to the eastern parish boundaries.

I – The factor for Occupancy Importance has been redefined as:
I = 1.5 for essential facilities during post disaster functions eg. hospitals, police stations, fire stations, schools etc.
I = 1.2 High Occupancy structures eg. schools, theatres, auditoria.
I = 1.0 Ordinary structures.

C – A numerical coefficient representing both soil amplification effect and dynamic response where $C = 1.25\, S / T^{2/3}$
The upper limit of C being 2.75.

T – The approximate fundamental period of the structure defined by empirical equations.

S – The Site Coefficient determines the equivalent static effects of the dynamic amplification by the underlying soil as shown in Fig. 3.

R_w – A system quality factor based on the ductility of the structural system which reduces forces from the equation to a design strength level.

Table 1 Comparison of Existing and Proposed NBCJ Zone Factor Values

Parish	Z Value	
	Existing	Proposed
Kingston, St. Andrew, St. Catherine, St. Mary, Portland and St. Thomas	0.75	0.4g
Remaining Parishes	0.75	0.3g

Z VALUES

Territory		Z Value
Jamaica –	East, ie. Portland, St. Thomas, St. Mary, St. Andrew & St. Catherine	0.4
Jamaica –	West – Remaining Parishes	0.3

Fig. 2(a). Proposed NBCJ Earthquake Loads Section 3, Table 1-A Z Values, from NBCJ, 1993

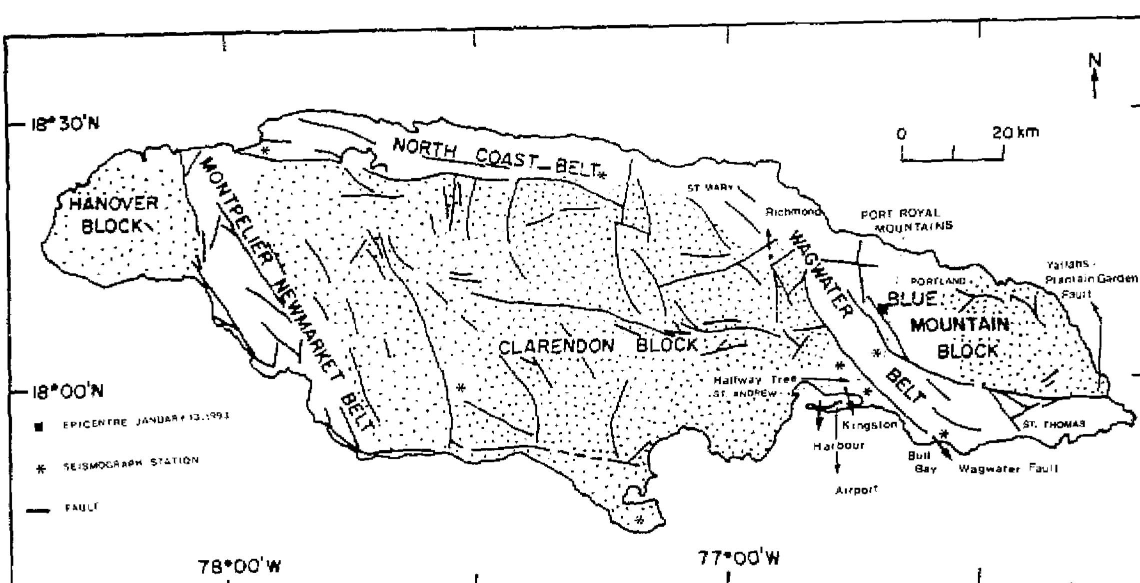


Fig. 2 (b). Major faults in eastern parishes of Jamaica: Portland, St. Thomas, Kingston and St. Andrew, St. Mary. From Ahmad (1996), reproduced with the permission of the Geological Society of Jamaica.

R compares with the K value in the previous equation but now has values which increase with increasing ductility, resulting in decreasing forces. Engineers should be better able to relate the R factor to degrees of ductility and its effect on forces.
Figure 4 shows the R_w factor as Table 1-G, of the proposed NBCJ document.

S Coefficients for Soil - Structure Amplifications

According to SEAOC (1988), in the earthquake of Mexico City 1985, the deep lake bed of clayey deposits created dynamic force amplifications, compared to rock sites in excess of 4. In Jamaica. The Liguanea Plain including Kingston is underlain with Quaternary alluvium to thicknesses in excess of 100m in some areas (Geol. Surv. Div., 1974). Definitive work of the soil dynamic properties of this area is still awaited, but Shepherd & Aspinall (1980) stated: "Preliminary estimates indicate that bedrock accelerations could be amplified by a factor of 3 - 4 by the Liguanea formation under favourable conditions."

To cater for any such effects of soil-structure dynamic amplification in the design static equation, the soil types S1 to S4 shown in Fig 3 (Table 1 - B NBCJ) has values ranging from 1.0 to 2.0 respectively for S, Site Coefficients.

TABLE 1 - B
SITE COEFFICIENT (S)

Type	Description	S Factor
S_1	A soil profile with either: (a) A rock-like material characterized by a shear-wave velocity greater than 762 metres per second or by other suitable means of classification. or (b) stiff or dense soil condition where the soil depth is less than 61 metres.	1.0
S_2	A soil profile with dense or stiff soil conditions, where the soil depth exceeds 61 metres or more.	1.2
S_3	A soil profile 12 metres or more in depth and containing more than 6 metres of soft to medium stiff clay but not more than 12 metres of soft clay	1.5
S_4	A soil profile containing more than 12 metres of clay	2.0

1. The site factor shall be established from properly substantiated geo-technical data. In locations where the soil properties are not known in sufficient detail to determine the soil profile type, soil profile S_3 shall be used. Soil profile S_4 need not be used unless the Building Official determines that soil profile S_4 is established by geo-technical data, in which case soil profile S_4 will be used.

Fig. 3. Proposed NBCJ Earthquake Loads Section 3 Table 1-B Site Coefficients, from NBCJ, 1993.

TABLE 1 - G
STRUCTURAL SYSTEMS
R_w Factor

Basic Structural System	Lateral Load Resisting System - Description		R_w [5]	H[2]
A. Bearing Wall System	1.	Light Frames Walls with Shear Panels		
		a. Plywood Walls for Structures 3-storeys or less	8	19.8
		b. All other Light Frames Walls	6	19.8
	2.	Shear Walls		
		a. Concrete	6	49
		b. Masonry	6	36.0
	3.	Light Steel Framed Bearing Walls with Tension-Only Bracing		
	4.	Braced Frames where Bracing carries Gravity Loads		
		a. Steel	6	49
		b. Concrete	4	
		c. Heavy Timber	4	19.8
B Building Frame System	1.	Steel Eccentric Braced (EBF)	10	73
	2.	Light Framed Walls with Shear Panels		
		a. Plywood Walls for Structures 3-storey or less	9	19.8
		b. All other Light Frames Walls	7	19.8
	3.	Shear Walls		
		a. Concrete	8	73
		b. Masonry	8	49
	4.	Concrete Braced Frames		
		a. Steel	8	49
		b. Concrete	8	
		c. Heavy Timber	8	19.8
C. Moment Resisting Frame	1.	Special Moment Resisting Space Frames (SMRSF)		
		a. Steel	12	N.L. [4]
		b. Concrete	12	N.L.
	2.	Intermediate Moment Resisting Frames		
		a. Steel	12	49
		b. Concrete	5	
D Dual System	1.	Shear Walls		
		a. Concrete with SMRSF	12	N.L.
		b. Concrete with Concrete IMRSF	9	49
		c. Masonry with SMRSF	8	49
		d. Masonry with Concrete IMRSF	7	
	2.	Steel EBF with Steel SMRSF	12	

NOTES:

(1) Basic Structural System are defined in Section 3.302
(2) H = Height Limit applicable to Seismic Zones 3 and 4 (*i.e.* Z = 0.3 or 0.4)
(3) Prohibited in Seismic Zones 3 and 4
(4) N.L. = No Limit

Fig. 4. Proposed NBCJ Earthquake Loads Section 3 Table 1-G (after NBCJ, 1993).

Intent and Limitation of Equivalent Lateral Force Equation

The design earthquake loads from the equivalent lateral force is based on non-catastrophic damage to structural members dissipating the energy received. The proposed code lateral forces will actually be less than those expected from an earthquake of similar magnitude, due to this.

This reduced force approach is implemented using the R_w factor in equation 2. The survival of the building in an earthquake will therefore depend on the structural elements being designed and constructed to justify the R_w factor used.

Irregularities

Irregular structures have been categorized as shown in Figs. 5 & 6 which are Tables 1-E and 1-F of the proposed NBCJ code. Adams (1993) gave diagrammatic examples of the irregular structures classified in the proposed code revisions. Irregular structures cannot justify the R_w ratings in Fig. 4. The penalty for irregularity adopted from the SEAOC of 1988 requires an increase of force level by $3R_w/8$. This would result in a force factor of 3 for a typical building frame type of structure common to Jamaica. This would in turn result in greater building costs.

Of particular significance is the system limitation (prohibition) of the Vertical Strength irregularity due to its record of documented collapses in past earthquakes. The 'short column' effect created by sill walls would fall within this classification.

According to the code, this mode of irregularity is prohibited unless the structure is no greater than 2 storeys, 9.2 m high or is made of timber.

The fact that many of these structural deficiencies can be assessed visually e.g. geometry, weight, re-entrant corners, non-parallel systems, can be an important factor in realizing success in educating lay persons in the identification of irregularities in earthquake resistant construction. Structural Engineers on the other hand, should seek to incorporate technical assessment procedures for irregularities less common to earthquake resistant design practice e.g. drift, stiffness, and strength irregularity checks.

Increase in Forces on Concrete Block Masonry

Concrete block masonry is used extensively in Jamaica, but its performance depends on the quality of the materials and the workmanship. In comparison to reinforced concrete, block masonry does not enjoy the same degree of quality control in Jamaica. The proposed NBCJ 1993 proposes the adoption from SEAOC 1988 of a factor of 1.5 to loads when using the working stress method of design for reinforced hollow concrete block work. The rationale for this factor is the relatively limited knowledge of the system performance of reinforced concrete masonry from past earthquakes.

CONCLUSIONS

Based on the review of building structure performance during the January 13, 1993 earthquake, the relative stiffness of infill walls to the structural members appears to warrant consideration, by designers of the contribution of these walls to the structural behaviour of framed buildings.

Openings and cuttings for services in load bearing blockwork masonry can have a major weakening effect on system performance. Sill Walls create an irregular condition in beam-column framed structures that can lead to collapse if not addressed. Treatment involves implementing loading code provisions and specific design or detailing remedies.

The proposed 1993 revisions to the National Building Code of Jamaica has made changes to the equivalent static lateral force equation. Resulting, should be forces for regular structures similar to the SEAOC 1988 equation but with coefficients more transparent to users. Departures are however:-

- An increase of 33% in design forces for Eastern Jamaica,
- A force increase of the order of 200% for irregular structures depending on the structural system quality factor R_w,
- An increase of 50% in force on reinforced block masonry in structures if they are to be used as structural elements.

NBCJ 1993 is in its draft stage and draft copies will be available shortly for evaluation and comment.

ACKNOWLEDGEMENTS

The author would like to thank Rafi Ahmad, UWI, Mona for his suggestions to improve the manuscript, Margaret Wiggins-Grandison for information on the seismology of the 1993 earthquake, and Alfrico Adams for information on structural damage from the 1993 earthquake.

TABLE 1 - E
VERTICAL STRUCTURAL IRREGULARITIES (1)

Irregularities Type and Definitions

a. Stiffness Irregularity - Soft Storey A soft storey is one in which the lateral stiffness is less than 70 percent of that in the storey immediately above or less than 40 percent of the combined stiffness of the three storeys above.	Exception: Storey drift ratio less than 1.3 drift ratio of the storey above 3.304.2b (1)
B. Weight (mass) Irregularity Mass irregularity shall be considered to exist where the effective mass of any storey is more than 150 percent of the effective mass of an adjacent storey. a roof which is lighter than the floor below need not be considered a mass irregularity.	3.304.2b (1)
C. Vertical Geometric Irregularity shall be considered to exist where the horizontal dimension of the lateral force resisting system in any storey is more than 130 percent of that in an adjacent storey. One storey penthouses need not be considered.	3.304.5 (a)
D. In-Plane Discontinuity in Vertical Lateral Force Resisting Element.	
E. Discontinuity in Capacity - Weak Storey a week storey is one in which the storey's strength is less than 80 percent of that in the storey above. The storey strength is the total strength of all seismic resisting elements sharing the storey shear for the direction under consideration	3.304 5(a)
F. Non-parallel Systems The vertical lateral load resisting elements are not parallel to nor symmetric about the major orthogonal axes of the lateral force resisting system.	

Fig. 5. Proposed NBCJ Earthquake Loads Section 3 Vertical Structural Irregularities, Table 1-E, from NBCJ, 1993.

TABLE 1 - F
PLAN STRUCTURAL IRREGULARITIES (1)

Irregularities Type and Definitions	Reference Section
a. **Torsional irregularity, to be considered when diaphragms are not flexible.** Torsional irregularity shall be considered to exist when the maximum storey drift computed, including accidental torsion, at one end of the structure transverse to an axis is more than 1.2 times the average of the storey drifts of the two ends of the structure.	3.305.10
B. Re-entrant Corners Plan configurations of a structure and its lateral force resisting system contain re-entrant corners where both projections of the structure beyond a re-entrant corner are greater than 15 percent of the plan dimension of the structure in the given direction.	
C. Diaphragm Discontinuity Diaphragm with abrupt discontinuities or variations in stiffness, including those having cut-out or open areas greater than 50 percent of the gross enclosed area of the diaphragm.	
D. Out of Plane Offsets Discontinuities in the lateral force path, such as out-of-plane off- sets of the vertical element shall be avoided.	
E. Non-parallel System The vertical lateral load resisting elements are not parallel to nor symmetric about the major orthogonal axes of the lateral force resisting system.	

NOTES: Structures having irregularities beyond the limits described above and outside the exceptions in clauses 3.304.26 and 3.305 will not be permitted under this Code, except by use of dynamic analysis procedure. However, where additional provisions as defined by the SEAOC Code are adhered to, such designs may be deemed to be acceptable.

Fig. 6. Proposed NBCJ Earthquake Loads Section 3, Table 1-F, Plan Structural Irregularities, from NBCJ, 1993.

REFERENCES

Adams, A., 1993. Implications for Building Codes & Practices. Proceedings of Jamaica Institution of Engineers Seminar on Lessons from the Jamaica Earthquake of January 13, 1993.

Adams, A., 1996. A Review of the Effects of the January 13, 1993 Earthquake and Building Code Provisions. The Journal of the Geological Society of Jamaica, Vol. 30, pp. 41-48.

Ahmad, Rafi, 1996. The Jamaica earthquake of January 13, 1993: geology and geotechnical aspects. The Journal of the Geological Society of Jamaica, Vol. 30, pp. 15-31.

Caribbean Uniform Building Code (CUBiC), 1985 Edition, Structural Design Requirements Earthquake Load, Part 2 Section 3.

Geological Survey Department, 1974. Geological Sheet No. 25, Kingston 1:50.000. Jamaica Geological Survey Department, Kingston.

Jamaican Bureau of Standard, National Building Code of Jamaica, Earthquake Loads 1993.

Jamaican Bureau of Standards, JS35:1975, Jamaican Standard.

National Building Code of Jamaica 1983. The Standing Review Committee on the Building Code, Ministry of Finance, Government of Jamaica, Kingston.

Shepherd, J, and Aspinall, W., 1980. Seismicity and seismic intensities in Jamaica, West Indies: A problem in risk assessment. Earthquake Engineering and Structural Dynamics, Vol. 8, pp. 315-335.

Structural Engineers Association of California. (SEAOC), 1988. Recommended Lateral Force Requirements & Commentary.

Tomblin, J.M. and Robson, G.R., 1977. A Catalogue of Felt Earthquakes for Jamaica with reference to other islands in the Greater Antilles. Mines and Geology Division, Ministry of Mining and Natural Resources, Jamaica, Special Publication No. 2.

Wiggins-Grandison, Margaret, D., 1996. Seismology of the January 1993 Earthquake. The Journal of the Geological Society of Jamaica, Vol. 30, pp. 1-14.

Natural Hazards and Hazard Management
in the Greater Caribbean
and Latin America
Rafi Ahmad (Editor)

Publication No. 3, pp. 107 to 111, 1997
Unit for Disaster Studies
The University of the West Indies
Mona, Kingston, Jamaica
ISBN 976-41-0115-1

14 CARIBBEAN DISASTER MITIGATION PROJECT:

MAKING INROADS INTO THE DEVELOPMENT PROCESS

Jennifer Worrell-Campbell

USAID/Office of Foreign Disaster Assistance
Caribbean Regional Programme
USAID, 2 Haining Road
Kingston, Jamaica

ABSTRACT

At the mid-way mark of the Caribbean Disaster Mitigation project (CDMP), project activities have begun to positively and effectively impact on the future sustainability of the development process in the Caribbean region. As a result of the initiative of the CDMP, The Caribben Development Bank (CDB) which is the largest development financing institution in the Caribbean with a membership over 20 countries, has placed a disaster mitigation conditionality on the hurricane reconstruction loan package for the Commonwealth of Dominica. The Bank has also begun to request that borrowing countries refer to the Caribbean Uniform Building Code (CUBiC) for large development projects. The Vice Presiden of the CDB, in a recently held CDMP/CDB Natural Hazards Training Workshop for project development staff, spoke of the need for an improvement in the low productivity of investment in the Caribbean region and cited the non-use of natural hazard information in the decision making process for developmnet projects as one of the majour reasons for this. He applauded the efforts of the CDMP in promoting the systematic use of natural hazard information amoung development financing institutions like the CDB and reconfirmed the Banks commitment to working with the project to promote mitigation activities in the region. The project has developed simple apppropriate technology for the strengthening of low-income Caribbean homes against hurricane and tropical storms. This technology was recently tested during the 1995 hurricane season when homes retrofitted withstood the ravages of the season and resulted in a reduction of losses from hurricanes in the Commonwealth of Dominica. The recently accepted National Land Policy of Jamaica, made reference to the use of hazard maps produced by the CDMP by the Town and Country Planning Department in the development approval process and lifeline loss reduction audits are being used to develop optimal designs and mitigation standards for the electrical utilities of the region.

BACKGROUND

The Caribbean Disaster Mitigation Project is a 5 year, US$5 million dollar project which is funded by the USAID Office of Foreign Disaster Assistance (OFDA) and implemented by the Organization of American States (OAS). The project is presently being managed by the Caribbean Regional Programme (CRP) which was recently formulated and operates out of the USAID Mission in Kingston Jamaica. The CRP Office has a mandate to function in areas of disaster mitigation, trade and the environment and will handle only projects of a regional nature.

The CDMP is dedicated to helping Caribbean countries establish a suitable combination of public and private seector mechanisms to achieve a more disaster resistant environment and seeks to strengthen the linkage between disaster mitigation and development. To this end, the project activities reduce vulnerability to natural hazards in existing and planned developments, enhance public awareness of natural hazards, strengthen local preparation for disasters, map hazard prone areas, and improve the insurancce industry capacity to manage risk.

The CDMP and the Caribbean Development Bank

The project initiated an activity with the Caribbean Development Bank shortly after its inception in 1993 for the purpose of influencing the lending policy of the Bank to include more considerations for natural hazard assessments when developing criteria for loan qualifications. The CDMP has so far conducted two workshops for the project development staff of the bank and has introduced a methodology for the inclusion of natural hazard information in the project cycle to a total of 48 professionals of the project development staff of the bank. After the first workshop a policy decision was made at the CDB to amend its existing environmental impact assessment procedures to include considerations for natural hazard reviews. A major achievement for the CDMP occurred recently when the CDB demonstrated a commitment to his process, by placing a natural hazard mitigation conditionality on the loan package for the reconstruction of the damaged sea wall in the Commonwealth of Dominica. This sea defense structure was destroyed by hurricanes Luis and Marilyn during the 1995 hurricane season. To go a step further, the Bank defined this conditionality by insisting that storm surge maps produced by the CDMP (which give an indication of projected surges to be expected in coastal areas from hurricanes of certain intensities) be used by the coastal engineers when developing the design parameters for the reconstruction of this sea defense.

Establishment of Mitigation Standards Building Codes

The CDB, in the wake of hurricane Luis and again on the initiative of the CDMP began requesting from borrowing countries on a pilot basis the use of the Caribbean Uniform Building Code (CUBiC) as the minimum standard for large construction projects. In focusing on the disaster/development linkage in the Caribbean, the CDMP is working at improving the quality of construction in the built environment and therefore has designed activities to address this problem in both the formal and informal construction sector. The move by the bank to insist on these standards is a demonstration of the impacts the CDMP is beginning to have on the formal construction sector. The project is not only working with the CDB on this but it has joined forces with the United Nations Center for Human Settlements (UNCHS) in a move to produce national building codes which refer to the CUBiC standards. This is being done on a pilot basis for Antigua, Dominica and St. Lucia. The code for Antigua has been completed and is presently undergoing cabinet review before formally adopted by that country.

Informal Housing Sector

The CDMP is involved in the retrofitting or strengthening of low income houses in selected vulnerable Caribbean communities against hurricanes and tropical storms. One of the more interesting features of this activity is that it utilizes simple, appropriate technology, developed in the Caribbean region from the lessons learned from past hurricanes like Gilbert and Hugo, which devastated the region in the 1980s. For sustainability, this activity has a training component which trains local artisans and builders in hurricane retrofitting techniques and develops curricula for these training modules to be included in the construction courses offered by local technical colleges. With the use of Caribbean architects, the project has also developed standard hurricane resistant designs for new low income houses. Persons in the project areas who participate in this activity receive low interest loans from the National Development Foundations (NDFs) in the respective countries. This activity is being implemented by the Cooperative Housing Foundation (CHF). Since the inception of this housing retrofit component, over 200 houses have been retrofitted in two Caribbean countries and over 150 artisans trained in the retrofitting techniques.

A major plus for the project which again demonstrated the kind of impact the CDMP is having occurred as recently in 1995, when the homes retrofitted in the Carib Territory in the Commonwealth of Dominica, survived Hurricane Luis and remained intact amidst their un-retrofitted neighbours who lost their roofs and in some cases their foundations. This has given our retrofit activities a boost among the locals in the community who began affixing hurricane straps to their roofs on their own after seeing their neighbours homes withstand the hurricane. One of the retrofitted homes was also used as a hurricane shelter for victims of Hurricane Luis. In Dominica, Barbados and Jamaica, the retrofit concept was introduced to insurance companies three of which have elected so far to provide premium cost reduction to clients using retrofitting techniques to strengthen their homes against hurricanes and wind storms.

Since the initiation of this activity in St. Lucia and Dominica, the Antiguan National Development Foundation (NDF) has requested the assistance of the CDMP in setting up a similar activity for Antigua in the wake of hurricanes Luis and Marilyn and have so far obligated $600,000 Eastern Caribbean (EC) dollars of their own money for this. In addition, after hurricane Luis, the CDMP, under the post-disaster technical assistance activity, provided a series of workshops to train builders and artisans of affected communities in Antigua, St. Kitts and Nevis. Persons trained by the project activity in Dominica have participated in the training of the Antiguan builders and played a major role in the reconstruction of low income houses damaged by the hurricane. In tracking the impact of this training, the project has learned that many of these trained artisans are now utilizing the acquired retrofitting techniques in construction associated with their regular jobs. Following these training workshops, the Antiguan Development Control Authority (DCA) modified the job description of one of their technical staff members for the purpose of ensuring that continuous training in retrofitting techniques will be provided to local builders. In keeping with this, the DCA organized a workshop for 25 participants from the public works department, private sector construction companies and local builders in safe construction techniques.

The CDMP project will share the lessons learned from the safe roof retrofitting activity with the rest of the Caribbean in a regional lessons learnt workshop in October of this year. This workshop will coincide with worldwide activities to commemorate the observance of the United Nations International Day for Natural Disaster Reduction (INDNR) on October 9, 1996.

Generation and use of Natural Hazard Information

The CDMP is in the process of helping Caribbean countries to develop a capability to map hazard prone areas, develop a Caribbean-wide system for coping with wind storm and storm hazards and to assist the Caribbean insurance industry to establish a pricing system which links premiums to risk. The Arbiter of Storms (TAOS) was used to produce storm surge maps for Montego Bay and Kingston in Jamaica, the Dominican Republic, Belize, the Commonwealth of Domina and Parham Harbour in Antigua. These maps give an estimate of the surge heights to be expected from storms of different intensities along statistically recurrent paths. The Kingston Multi-Hazard Assessment activity is presently producing, in addition to surge maps, seismic micro-zonation maps, landslide hazard maps and flood hazard maps for Kingston. The storm surge and flood hazard maps have been completed and the landslide and seismic hazards are being done by the Geology Department, Earthquake Unit and Seismic Research Unit of the University of the West Indies.

Development of Mitigation Policies

A major success for the Kingston Multi-Hazard Assessment activity has been the recent provision for the use of hazard maps produced by the CDMP in the National Land Policy of Jamaica. This policy was recently accepted by cabinet in July of 1996 and under this new policy, government technical agencies will continue the mapping activities started by the project and the planning agencies will use these maps as an input for the development approval process. The Jamaican National Land Policy refers to the rising cost of capital and insurance development purposes and cites this as a trend which requires proper site analysis to be conducted for major development projects. It also cites the growing pressures for settlement in high risk areas, and the depletion of international financial resources for disaster/recovery and rehabilitation as major issues justifying the present policy. The policy calls for the incorporation of mitigation measures in the design and execution of development projects. The policy specifically refers to the hazard maps produced by the CDMP and to the continuation of this mapping exercise for other areas in Jamaica and specifically states that once these maps have been prepared they will be incorporated in the development approval process of the Town and Country Planning Department.

The National Land Policy of Jamaica also recommends that the government, at the end of the CDMP, should continue to collect data on the effects of natural hazards and work toward preparing a national plan for hazard management based on prevention and mitigation where possible. Since this decision was taken, the government of Jamaica has assembled a national committee to draft a national policy on hazard mitigation and to develop a national mitigation plan for the country. The OAS and USAID CDMP project staff sit on this committee. So far, a draft of mitigation policy has been submitted for comment and priority areas for disaster mitigation have been identified.

Community Participation in Disaster Mitigation

One of the greatest impacts of the CDMP in the Dominican Republic so far has been its success in spearheading the involvement of the private sector and the NGO community in assuming a joint responsibility with the government of the Dominican Republic for the implementation of a multi-sectoral, participatory system for disaster preparedness and mitigation and establishment of a communication and coordination mechanism for this system. This was done largely through the election of a permanent board of advisors comprising members from the private sector, NGO community and the public sector. This board established five strategic areas for project activities and works with the project implementation unit in developing work plans for each of these areas. Since the inception of the permanent board of advisors in 1994, the Dominican Republic has founded its own NGO known as the Dominica Disaster Mitigation Committee which is presently implementing an affiliation campaign with the CDMP.

The work of the CDMP in the Dominican Republic has resulted in the mobilization of local support through the CDMP bulletin and other press-related activities from more than 500 businesses, NGO and CBO organizations which have contributed so far the equivalent of over 1,200 work days in personnel and volunteer time; over 320 minutes of free television time; 80 minutes of free radio time and free newspaper space for a CDMP workshops. The information element of the project has published and distributed over 5,000 hurricane posters and 10,000 hurricane and earthquake brochures. The training programme which began in collaboration with the OFDA/LAC Disaster Management Training and the Dominican Red Cross has trained a core of 53 instructors who in turn trained over 1,700 persons. Since July of 1996 all training courses are financed by the participants and their companies and have been generating income for the NGO.

As a result of this training and increased level of awareness, participants have gone back to their communities and have begun setting up community disaster preparedness organizations. The organizations identify community risks and vulnerabilities, identify local capabilities, prepare community disaster plans and assign responsibilities for response actions. In identifying community vulnerability and risk reduction, these organizations also design projects for the implementation of vulnerability reduction projects. The CDMP will consider funding projects for communities willing to contribute labour and technical assistance for their mitigation projects.

Lifeline Loss Reduction

This activity is focussed on helping the participating countries reduce vulnerability of basic infrastructure and critical public facilities. The CDMP has concentrated its attention to date on vulnerability reduction in electrical utilities, in close association with the Caribbean Electrical Utilities Services Cooperation (CARILEC). A vulnerability audit of the LUCILEC facilities in St. Lucia covered the thermal power plant and transmission and distribution systems, while the Dominican vulnerability audit concerned DOMELIECs hydroelectric facility. Based on these two audits the project published a training manual, "Mitigation of Damage caused by Natural Hazards," which is presently being introduced to member countries as a guide to conducting vulnerability assessments and for integrating loss reduction practices into standard preventative maintenance. A damage assessment of the Antigua and Barbuda electrical utility was directed at deriving lessons learned from the experience and a risk analysis of the St. Vincent and Dominica electrical utility made use of techniques documented in the St. Lucia and Dominica pilot audits to produce optimal designs and mitigation standards for the utility's transmission and distribution system.

CDMP Insurance Initiative

One of the problems being addressed by the project is the inability of the insurance industry to adequately assess catastrophic risk due to natural hazards and make reasonably priced property insurance widely available throughout the region. The CDMP has so far conducted three national workshops in Jamaica, Belize and the Dominican Republic for senior insurance executives on underwriting and probable maximum loss estimation. In early 1995 the CDMP agreed to support the CARICOM Working Party on Insurance and Reinsurance. This Working Party was formed by the heads of government of Caribbean countries to study critical insurance issues against the background of increased frequency of destructive hurricanes in the region. The CDMP, in collaboration with the World Bank, prepared a working paper on catastrophe protection in the Caribbean which serves to guide the deliberations of the CARICOM working party. The working paper outlines mechanisms for strengthening the regional insurance industry, for reducing the risk exposure and vulnerability to natural perils as well as for increasing the availability of affordable insurance.

CONCLUSIONS

The Caribbean Disaster Mitigation Project is effecting the kinds of impacts the project was designed to create, and is getting the support and attention from the participating governments and regional financial institutions. This is demonstrated by a serious commitment of regional resources and policy adjustments required for the achievement of project impacts. The private and public sector is therefore responding to the initiative of the CDMP in the participating countries and creating the partnerships this project needs for the establishment of sustainable private/public sector mechanisms, which measurably lessen loss of life, reduce the potential for physical and economic damage and shorten the disaster recovery period.