PREPARE

URBAN DISASTER RESILIENCY AND PREPAREDNESS IN TRINIDAD + TOBAGO

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A ROAD MAP FOR SEISMIC RISK MANAGEMENT IN TRINIDAD AND TOBAGO

2022

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Urban Disaster Resiliency and Preparedness in Trinidad and Tobago (PREPARE TT)

The goal of PREPARE TT is to provide a clearer picture of the probable impact of an urban earthquake disaster and facilitate advocacy and planning initiatives around strengthening seismic disaster risk reduction and preparedness measures in Trinidad and Tobago; to reduce the lives lost, people injured, internally displaced persons, and social and economic disruption.

The U.S. Agency for International Development (USAID)

The U.S. Agency for International Development is an independent U.S. federal agency responsible for planning and administering economic and humanitarian assistance worldwide.

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The Bureau for Humanitarian Assistance provides life-saving humanitarian assistance—food, water, shelter, emergency healthcare, sanitation and hygiene, and critical nutrition services— to the world's most vulnerable and hardest-to-reach people. BHA is the lead federal coordinator for international disaster assistance, harnessing the expertise and unique capacities of other U.S. government entities to effectively respond to natural disasters and complex crises around the world.

BHA takes a holistic look at humanitarian aid, helping before, during and after a crisis—from readiness and response to relief and recovery. This includes non-emergency programming that is foundational to linking humanitarian assistance to long-term development and the journey to self-reliance.

Miyamoto International, Inc.

Miyamoto International is a global structural engineering and disaster risk management reduction firm providing resiliency expertise that sustains industries and safeguards communities around the world.

Acknowledgement

The road map presents an opportunity to better address and implement national disaster risk reduction, preparedness, response, and recovery needs, which were identified by the stakeholders at a meeting on November 24, 2020. Participants included authorities from national and municipal-level governments, academic institutions, and private sector partners. The objective was to understand some of the concerns and solutions needed to effect improved seismic risk reduction and preparedness, linked to the PREPARE TT program. From the discussions, policy development and legislation, risk knowledge, mitigation, retrofitting and response assistance and public awareness all featured. This document also contains some notes on risk management actions after the November meeting.

Appreciation is expressed to the agencies, institutions and partners for their valuable time and participation, especially in the face of the difficulties presented by the COVID 19 pandemic. We look forward to working with them to strengthen seismic risk reduction and preparedness in T&T.

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ACRONYMS AND NOTATIONS

ASCE	American Society of Civil Engineers
APETT	Association Professional Engineers of T&T
ARISE	Private Sector Alliance for Disaster Resilient Societies
BOETT	Board of Engineers of Trinidad and Tobago
C3I	Command, control, communications and intelligence
CDEMA	Caribbean Disaster Emergency Management Agency
CDB	Caribbean Development Bank
DPC	Government of Haiti, the Directorate of Civil Protection
GoRTT	Government of the Republic of Trinidad and Tobago
HDC	Housing Development Corporation
IDB	Inter-American Development Bank
IDPs	Internally displaced persons
MNS	Ministry of National Security
MOWT	Ministry of Works and Transport
MPD	Ministry of Planning and Development
MRDLG	Ministry of Rural Development and Local Government
MTS	Material structural testing systems
NHIA	National hazard impact assessments
ODPM	Office of Disaster Preparedness and Management
POS	Port of Spain
SIDS	Small island developing states
T&T	Trinidad and Tobago
TTIA	Trinidad and Tobago Institute of Architects
T&CPD	Town and Country Planning Division
THA	Tobago House of Assembly
TTBS	Trinidad and Tobago Bureau of Standards
TTCA	Trinidad and Tobago Contractors Association
UNDP	United Nations Development Programme
UNDRR	United Nations Office of Disaster Risk Reduction
USAID BHA	United States Agency for International Development, Bureau of Humanitarian Assistance (formerly USAID OFDA)
USAID OFDA	United States Agency for International Development, Office of Foreign Disaster Assistance
UWI-SRC	University of the West Indies Seismic Research Centre
WB	The World Bank

CONTENTS

1. INTRODUCTION I

1.1 Context 1

1.2 PREPARE TT and *Regional Roadmap for Seismic Risk* 3

1.3 Disaster Resilience in the Caribbean 3

2. SCOPE OF WORK 5

2.1 Goal 5

2.2 Objectives 5

2.3 Benefits of a Road Map 5

2.4 Scope 5

2.5 Challenges & Opportunities 6

3. DISCUSSION ON THE ISSUES SURROUNDING SEISMIC RISK MANAGEMENT IN T&T 7

3.1 Risk Governance 7

3.2 Mitigation and Preparedness 11

3.2.1 Mitigation 11

3.2.2 Preparedness 12

3.3 Public Awareness and Education 12

3.4 Response, Recovery and Reconstruction 13

3.5 Risk Financing and Business Continuity Planning 14

3.6 Conclusion 14

4. THE WAY FORWARD - ROAD MAP FOR SEISMIC DISASTER RISK MANAGEMENT IN TRINIDAD AND TOBAGO 16

REFERENCES 35

ANNEXES 36

Annex I. Regional Roadmap: Urban Seismic Risk Management in the Caribbean 2016 36

Annex II. Key Stakeholders 37

Annex III. Current Policy, Legislation and Agreements regarding seismic risk management 39

1. INTRODUCTION

1.1 Context

Trinidad and Tobago (T&T) is exposed to significant earthquake risks, as the country is positioned on and along faults in a seismically active zone (Robertson et al., 2011); see Figure 1. For more than 50 years the country had not been impacted by a large magnitude earthquake (M 6.9-7). When such an event did occur, in August 2018, the peak ground acceleration was well below the design curves used by engineers (Latchman et al 2020, 8). Such earthquake experiences have led to a certain level of complacency by the population, despite the existing exposure and vulnerability. Increased urbanization (72%), discretionary construction standards and high levels of housing informality, put T&T's building stock and population at high risk. National development must address low-frequency, high-impact seismic risk if it is to be sustainable.

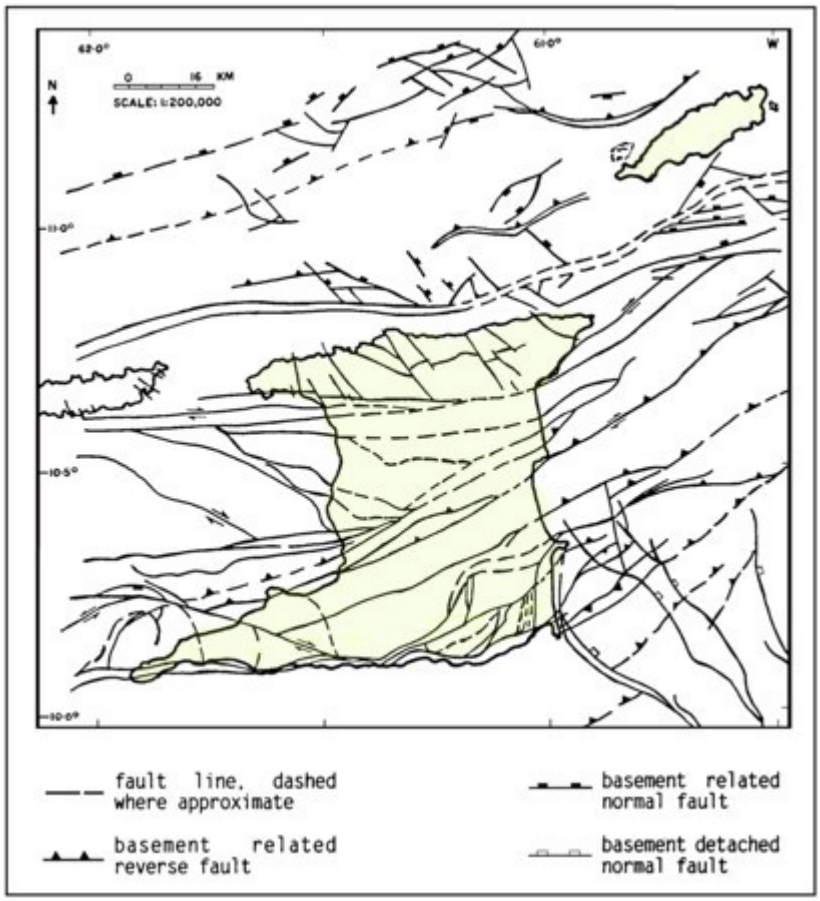


Figure 1. Fault Lines across T&T (adapted from Robertson et al., 2011)

Initiatives are being implemented to reduce seismic risk to the built environment, for example:

- Ministry of Works and Transport (MOWT) standards for public buildings;
- The *DevelopTT* planning and automated building permit digital platform;

- Urban seismic microzonation research through the University of the West Indies Seismic Research Centre (UWI-SRC) and the Ministry of Planning and Development (MPD)
- Response and recovery planning through the Office of Disaster Preparedness and Management (ODPM)
- The continued civil engineering education, research and solutions offered through the Faculty of Engineering of the University of the West Indies St. Augustine and the University of T&T
- Professional development training offered through the Board of Engineering of T&T
- Development of comprehensive disaster management policy disaster legislation by ODPM and Ministry of National Security together with the United National Development Program, the T&T Red Cross and International Federation of Red Cross and Red Crescent Societies.
- The reconstituting of the national building code committee through the Ministry of Planning and Development
- The updating of the Trinidad and Tobago Bureau of Standards *Guide to the Design and Construction of Small Buildings* (TTBS 599: 2006)
- Design data. UWI SRC updated probabilistic seismic hazard assessment and maps for Trinidad and Tobago http://uwiseismic.com/seishaz.aspx
- Scenario development: *Probabilistic Seismic Risk Assessment for Port of Spain* ODPM, Miyamoto 2021.
- The National Disaster Preparedness Risk Assessment NDPRA and five-year work program being developed by ODPM in collaboration with the Pacific Disaster Center
- ODPM's Tsunami-ready program and community awareness and training
- Business continuity planning training and support through the private sector e.g. AMCHAM TT

The building industry professional associations have also individually lobbied for policy and legislative improvement for building codes and for improved professional registration/accountability. UWI-SRC and the ODPM promote awareness and regularly warn the public of seismic risks to encourage preparedness.

Nevertheless, there is still work to be done. The country remains without modern, disaster risk management policy and legislation. Without comprehensive disaster management statutes, the existing disaster risk management systems are vulnerable. Risk mitigation initiatives, such as a mandatory national construction code and widespread awareness of the small building guide, are incomplete and implementations of construction best practice remain voluntary. The institutional framework for encouraging the use of the land and building approval processes and oversight needs further improvement. Seismic disaster/emergency response plans are being updated but these plans need greater ownership by the tactical and strategic organizations involved.

Earlier risk reduction efforts notwithstanding, perhaps a more comprehensive and strategic approach may be required. The development of the road map was proposed out of a multi-stakeholder online meeting held on June 18, 2020. This remote event was a necessary precaution due to the COVID 19 pandemic. A socially distanced in-person meeting of stakeholders was also held November 24, 2020. These meetings convened authorities from national and municipal-level governments, academic institutions, and private sector partners. The discussions were to understand some of the concerns and solutions needed to effect improved seismic risk reduction and preparedness linked to the PREPARE TT program. From the discussions, policy development and legislation, risk knowledge, mitigation, retrofitting and response assistance and public awareness all featured. The road map presents an opportunity to better address

and implement national disaster risk reduction, preparedness, response, and recovery needs identified by the stakeholders at the meetings. This document also contains some notes on risk management actions after the November meeting.

This road map has harnessed national stakeholder involvement to identify and assist with the implementation of the priorities examined in the *Road Map for Seismic Risk Management in T&T* (henceforth "road map" or alternatively, "T&T Road Map").

1.2 PREPARE TT and *Regional Roadmap for Seismic Risk*

In January 2020, the Cabinet of the Government of the Republic of Trinidad and Tobago (GoRTT) gave approval for the ODPM to partner with Miyamoto International, Inc. (Miyamoto) to implement the *Urban Disaster Resiliency and Preparedness in Trinidad and Tobago* (PREPARE TT) program. This program developed a probabilistic seismic risk assessment for Port of Spain (POS) through scientific support from the University of the West Indies Seismic Research Centre (UWI-SRC). This and other deliverables of PREPARE TT provide data to inform decision-making and advocacy by stakeholders in the construction sector to improve plans, policies and protocols to reduce seismic risk across T&T. The road map for Seismic Risk Management in Trinidad and Tobago aligns with these intensions.

Work has already been completed at the regional level to create a strategic road map to reduce seismic risk. The T&T Road Map follows on the *Regional Roadmap: Urban Seismic Risk Management in the Caribbean 2016*. The latter represents a collaborative effort organized by the Government of Haiti, the Directorate of Civil Protection (DPC), the United Nations Office for Disaster Risk Reduction (UNISDR), the UN Development Programme (UNDP) in Haiti, the World Bank (WB), and others. Guidance for the regional roadmap was also provided by the Caribbean Disaster Emergency Management Agency (CDEMA), UWI-SRC, and funding for the forum was provided by European organizations and the United States Agency for International Development (USAID) Office of Foreign Disaster Assistance (OFDA). The document (see Annex I) is structured around six priorities that have been used to guide discussion for the T&T Road Map:

i. Risk governance
ii. Understanding urban seismic risk
iii. Mitigation and preparedness
iv. Response, recovery and reconstruction
v. Risk financing and transfer and business continuity planning
vi. Communication, awareness and education, advocacy

1.3 Disaster Resilience in the Caribbean

After the 2017 devastation of the multi-island hurricane impact season, the goal of resilience gained further national importance. The Heads of Government of the Caribbean Community (CARICOM) asked the Caribbean Disaster Emergency Management Agency (CDEMA) to revisit the resilience agenda for acceleration, monitoring and advancement through institutional programming.

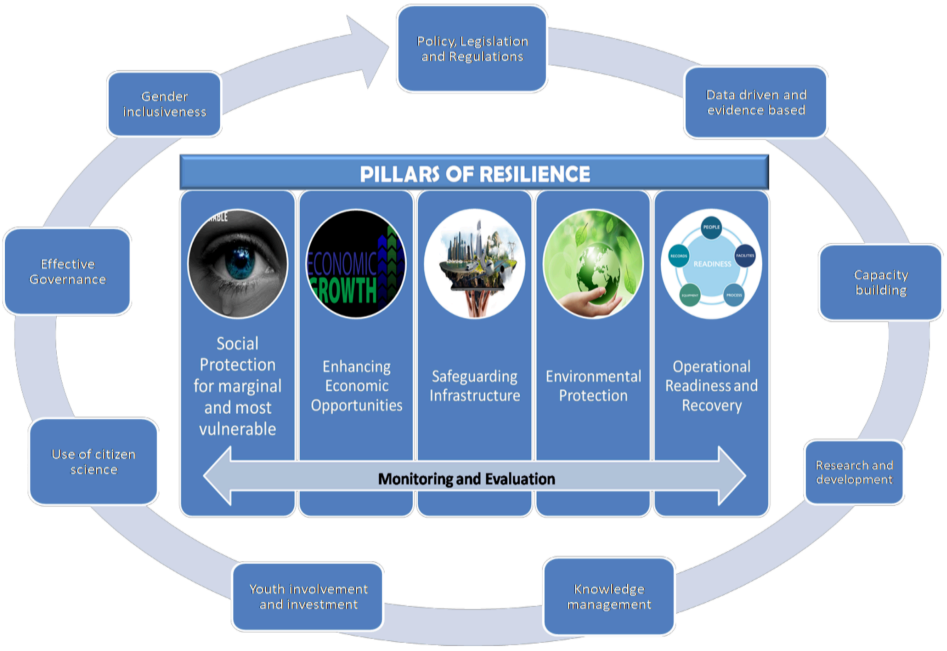


Figure 2 The Resilience Framework CDEMA CU & Participating States CDEMA 2018, 4

Figure 2 illustrates the regional resilience framework. Building on the UNISDR definition of resilience as the ability to resist, absorb and timely recovery from the hazard. The framework called for transformation, not business as usual.

The nine elements of the resilience framework are in harmony with and strengthen (through gender, youth cognizance) the six priority areas of the regional road map. The five pillars of resilience in the Caribbean provide the context and framework within which each priority should operate and be evaluated.

In support of the T&T Road Map there is an initial list of key stakeholders (Annex II), the relevant legislation policies and agreements (Annex III) and a draft discussion of some of the key issues of seismic risk management relevant to T&T (Chapter 3). The content of these documents is by no means exhaustive, but it is intended to lay the foundation for discussion on issues to determine which could be prioritized for action in the road map.

2. SCOPE OF WORK

The road map for seismic risk management is defined by the following:

2.1 Goal

The goal of the road map is to reduce the risks of seismic events in T&T through endorsement and support by the Government, and other key stakeholders, to support implementation.

This is a comprehensive goal, which should positively impact policy, legislation, regulations, programs, plans and procedures in multiple sectors. Demonstration of political will is essential if the elements of this road map are to be achieved.

2.2 Objectives

One objective is that national stakeholders and decision-makers identify and address priority risk-reduction actions for implementation along complimentary and cumulative timelines. These actions would reduce injury, mortality, property damage, loss and socio-economic disruption that would result from an earthquake in T&T. Priority items determined by stakeholders will filter implementation into more manageable actions.

Another objective is that stakeholders develop a strategy and implement actions to advocate for the Government and other stakeholder support of road map priorities within the agreed timelines. Stakeholders will need to champion the priority actions with diverse communication strategies to ensure that the common objective receives political support and the financial resources needed.

2.3 Benefits of a Road Map

The T&T Road Map offers another opportunity to resolve many long, outstanding seismic risk management issues. Although the focus is on seismic risks, it is noted that risk reduction efforts (e.g., for construction standards) often improve resilience to other hazards. Therefore the road map for seismic risk management is a multi-hazard strategy.

It provides a platform through which diverse stakeholders can participate with the common purpose to protect persons from seismic events. At the same time, properties and the economy will be better able to resist damage, disruption and destruction.

A safer environment can improve national resilience and sustainable development.

2.4 Scope

Seismic risks include both earthquakes and tsunami events.

The scope comprehensive and includes policy, legislation and disaster preparedness (e.g., plans), awareness and knowledge building, mitigation (e.g., development planning and building construction framework issues), business continuity and risk financing, response and recovery systems.

This road map is national in scope. It follows up on the recommendations of the *Regional Roadmap: Urban Seismic Risk Management in the Caribbean 2016* guide and focuses on the needs particular to the national disaster risk management system and the built environment of T&T.

It targets development in both urban and rural communities. The former has a greater seismic risks exposure due to a greater concentration of buildings and multi-occupancy structures. Rural areas,

although less densely occupied, are vulnerable to many secondary hazards (land slides) and due to their distance from established services. Decisions need to consider the circumstances of rural and urban stakeholders.

Any building construction discussions should include new buildings, alterations and retrofitting. The discussions pertain to small buildings [1] and multi-story structures, including schools, as well as infrastructure and special-purpose facilities e.g., utility or industrial facilities.

2.5 Challenges & Opportunities

There may be challenges in successful development and implementation of the T&T Road Map:

- Overcoming apathy and exhaustion by those who have tried for decades to implement change
- The change-management process: Government organizations and professionals reluctant to change (questions like "what's in it for me?"). Ensuring institutional frameworks, knowledge and skill sets can support the changes proposed.
- Maintaining momentum for actions which usually take some time, e.g. legislation, standards, etc.
- Introducing an improved seismic risk regulatory framework while minimizing bureaucracy – national improvements to the ease-of-doing-business.
- Securing resources to implement priorities

Opportunities for intervention currently exists including:

- Earthquake awareness. The recent memory of the magnitude 6.9 earthquake in 2018 and the continuous occurrence of multiple tremors, including six shallow (3-48km) events of M4.9 -5.5 between April and October 2020 (www.uwiseismic.com)
- Policy & statute development: Intentions of the government regarding policy for the construction sector stated in the budget (GORTT 2020 October, 17). The Planning and Facilitation Development Act 2014, already passed in Parliament, but not fully assented to can improve urban planning strategy, process and building codes.
- Current, ODPM, UNDP, IFRC, TTRC, policy and legislative improvements on comprehensive disaster management and the reconstituting of the national building code committee under the Ministry of Planning and Development.
- Improved data. The seismic risk assessment for POS being undertaken by UWI SRC and Miyamoto under the PREPARE TT program; the seismic microzonation of POS, San Fernando and Scarborough commissioned by Town and Country Planning Division and retrofitting solutions available through UWI's engineering faculty. Also the ODPM's National Disaster Preparedness Risk Assessment and Five Year Plan, facilitated by the Pacific Disaster Center
- Time: Recent elections allow a few years to implement change.
- Available resources under the PREPARE TT program can support stakeholder discussions and decision-making.

[1] Not more than two stories in height with a floor area of three hundred square meters or less.

3. DISCUSSION ON THE ISSUES SURROUNDING SEISMIC RISK MANAGEMENT IN T&T

3.1 Risk Governance

The need for comprehensive disaster risk management policy, legislation and regulatory framework to counter seismic risks

The level of acceptable seismic risk in Trinidad and Tobago is unclear, so it is difficult to mitigate this risk. This is not surprising, as the country is still developing its comprehensive disaster risk management policy and legislation. Indeed, T&T is one of just six countries in the Caribbean without disaster legislation (Haiti, Dominica, Grenada, Guyana, and Suriname represent the other five). The current *Disaster Measures Act* is an elaboration of the emergency powers of the Constitution.

The existing disaster offices are established by GoRTT Cabinet Notes. These organizations include the ODPM and the Disaster Management Office of the Ministry of Rural Development and Local Government (MRDLG), which manages the 14 municipal Disaster Management Units. The Tobago Emergency Management Agency (TEMA) is also similarly established through the Tobago House of Assembly (THA). Without legislation, the responsibilities of command, control, communication and intelligence-sharing are nebulous, and many disaster risk management obligations of other government ministries and bodies can be viewed as discretionary. The ODPM is currently working with the United Nations Development Programme (UNDP) and the T&T Red Cross to complete functional draft disaster risk management legislation. Political will is required to enact this legislation.

The current policy instruments that guide the building regulatory framework[2] and establish the levels of acceptable risk in T&T are incomplete and need to be developed or updated. In the construction environment, many planning policies need integrating and updating. For example, the national land-use planning policy document is decades old and the recent *Planning and Facilitation of Development Act 2014* and *2019* amendments[3] have been only partially proclaimed and implemented.

The planning approval and building permit process can be challenging to the individual developer. Geographic risk information and hazard risk mapping is generally unavailable to aid decision-making. The process itself is cumbersome. Land development and building permit approvals require 16 different procedures and the approvals process can take at least 257 days to complete (GoRTT, 2020, p.8). Applicants at times can prolong the process by using untrained draftsmen and working without an engineer or architect, to document their plans. Often the AutoCAD[4] documentation submitted is not useful/applicable for decision-making by the authorities.

With the land and construction approval processes separately managed by the T&CPD and the local government, safe construction design based on localized risks can be missed. It is noted that the Ministry of Planning and Development's digital application platform, www.developtt.gov.tt, seeks to simplify this prolonged applications process and close the gaps.

In addition, the costs of applications for land, building and compliance approvals (document preparation, conveyance and other fees) as well as ambiguities in the local building inspection system discourage

[2] The Planning and Facilitation of Development Act, Municipal Corporations, T&CP Acts and the Municipal Corporations amendment Bill.
[3] The National Spatial Development Strategy has many useful intentions, though unfulfilled.
[4] Persons proficient in the use of AutoCAD software, but who are not trained draftsmen working with engineers and architects, often miss the construction design details.

people from applying. It is common to find that people in the lowest income group, or those who possess the funds for construction, to build informally without land and building approval. Cease and desist legislation to stop this practice is slow to implement, by which time the structures are erected. The municipalities and Tobago House of Assembly (THA), responsible for including land development monitoring and control as well as building permit, inspection and compliance processes, have capacity and overtasking issues, which make it difficult to fulfill their roles. Attempts to use private sector engineers to add capacity have been stymied by a lack of transparency (World Bank, 2015) and the lack of mandatory building codes. The shortcomings of the local building inspection system process are well documented (JSC, 2019). Institutional capacity building needs to be improved through transparency, technology and better policy and legislation.

Immediate housing shortages, leading to housing informality, have taken priority over structural construction safety. T&T's high land and house prices as well as conservative bank policies[5] create a home ownership backlog. Many families turn to informally building homes themselves and/or occupying marginal land. These homes are built to voluntary/unknown standards and may cause potential life-threatening risks to their habitants. Ministry of Housing online documents include limited discussion on building safety (Housing Act 1962; http://www.housing.gov.tt). The need to fill the housing gap prioritizes affordability and developing self-sufficiency. Safety is discussed only in regard to low-income rentals (ibid). However, in 2016, the Housing Development Corporation (HDC) introduced a 22-point quality inspection program to mitigate poor workmanship. Small grants to enhance regularized squatter settlements and build homes are disbursed, but accompanying conditional risk reduction terms are not mentioned. Perhaps with technical support, cash transfers, conditional on meeting improved safety standards, could be articulated. Cash grants can also be incorporated into learning-by-doing (cash for work applied post-disaster) where construction and retrofitting best practice is demonstrated, learned and applied (Miyamoto 2021).

The initial license and registration system for roofing contractors, plumbers and wiremen, introduced through the Trinidad and Tobago Bureau of Standards (TTBS), is a positive step, but currently includes proportionally few practitioners. Many tradesmen/artisans have no formal training and a registration system[6] would need to find a solution to ensure self-employed tradespeople are not excluded in the new regulations, which could lead to raising unemployment. The T&T Contractors Association (TTCA) has been lobbying for the licensing of contractors for over a decade. The Board of Engineers of T&T (BOETT) has similarly identified gaps in the *Engineering Professions Act 1985* and has been advocating for over two decades for amendments to the Act. For example, despite the Act, engineers are not legally required to register to practice, nor are Architects[7]. Accountability is unclear. Questions remain on whether building inspectors (as well as engineers, architects, urban planners) approving compliance/designs can be held accountable for failed structures up to a limited period of time. The French system places the liability with the engineers and architects for up to five years after construction and the oversight is with the insurance companies, where the professionals' liability risk is transferred. The T&T professional association statutes (engineers and architects) do have some contingencies for accountability, but their ability to enforce this accountability needs strengthening.

In T&T, there is no mandatory national construction code. Engineers apply various international codes to their designs. The country continues to build structures with discretionary adherence to risk reduction

[5] Young professionals are often denied mortgages, although the rents they are paying are in excess of mortgage payments.
[6] E.g. a Prior Learning and Assessment Recognition PLAR process with different levels.
[7] The architect registration process does require some experience and an exam.

codes. Oversight requires standards, and a lack of transparency of the building requirements and process is an opportunity for manipulation of the regulatory process. The Trinidad and Tobago Bureau of Standards has available a *Guide to the Design and Construction of Small Buildings* (TTBS 599: 2006) at a cost. The Guide is not enforced and does not form a mandatory code.

High occupancy and multi-story buildings (schools, hospitals, cinemas, stadiums, etc.) warrant careful design and construction practice. The Ministry of Health has worked with the Pan American Health Organisation (PAHO) to address structural risk. As the population grew, from the 1970s onward saw an increase in multi-story school structures. 50% of primary schools are now over 50 years old and in need of repair (MoEdu, 2017). Attention to ensure safe structures in the Education Act is summarized by the phrase use of "*Architects and Users Briefs*" to guide all construction and repair. The discussion has centered more on efficiency and cost effectiveness in providing facilities to meet demand. Another concern for the structural integrity of schools (and community centers) is the fact that many are listed as emergency shelters to house the displaced post-disaster.

In the last decade, the Ministry of Works and Transport (MOWT) has adopted the following as national requirements aimed at reducing the vulnerability of public buildings.

- International Building Code IBC 2009
- American Society of Civil Engineers ASCE 7 (Earthquake Loads)
- American Society of Civil Engineers ASCE 7-05 (Wind Loads)
- American Concrete Institute ACI 318-05 (Reinforced concrete designs)

However, not all designs for public buildings pass through the MOWT. Many building designs are implemented through special purpose government bodies without referral to the MOWT. Documentation on building design is also an issue. For buildings that are privately owned and offered for rent to the government, the MOWT (Francois, 2011) is often challenged to find and review the building design and other documentation.

Different government administrations have recognized the gap in codes/construction risk and have given support for building code committees to be assembled. In 2019, the GoRTT Cabinet gave similar approval, to assemble another code committee, to the Ministry of Planning and Development. The status of the committee is unclear.

The current discussion on a national building code centers on adopting aspects of existing international building codes. Though it has many advantages (well researched, regularly updated), the practicality of small island developing states (SIDS) adopting an international code and standards comes with challenges (World Bank, 2015). Direct code importation may ignore longstanding local practice (vernacular construction, e.g. adobe, wattle, tapia).

International codes of current best practice (even the current TTBS small building code) may price construction beyond middle and low-income households, encouraging families to revert to constructing unsafe informal housing. It is estimated that attention to code practice can costs 5-10% of the construction expenditure (ibid). Many families build incrementally, as money becomes available. The codes (and construction permitting system) should allow for this incremental approach.

Adoption of international codes must be cognizant of the availability of design input data, local materials available and the capacity to undertake testing during construction. There is also an international move to performance standards, rather than set standards, in order not to stifle innovation/new techniques.

Retrofitting techniques to strengthen existing localized small building construction have been developed for T&T and should be included.

In applying to adopt an existing international code, T&T may take the Jamaican approach and include in the code application document (CAD) considerations relevant to the national construction environment. A process to institutionalize the continuous maintenance of local parameters would still be needed.

The national policy for resilient construction is under development in the Ministry of Planning and Development. It is therefore timely to identify priority actions to support this policy.

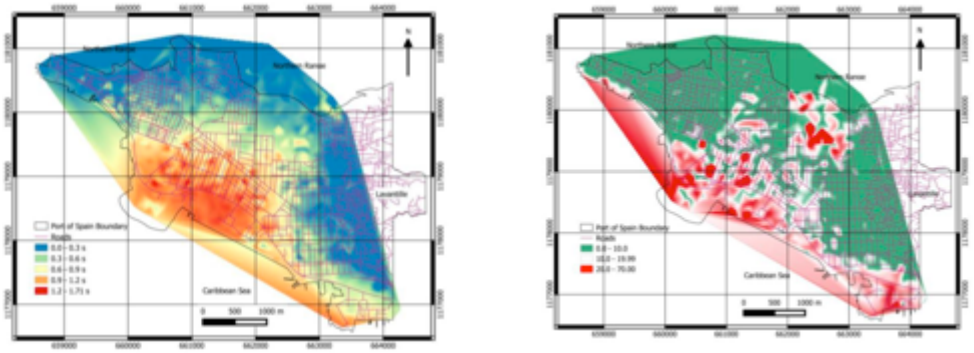
Knowledge Management – Understanding Urban Seismic Risk

Knowledge management will remain a continuous issue in T&T. Seismic risk assessment is ongoing and needs further development. To ensure codes and standards are adequate and adhered to, research, data and testing capacity are required. More publicly available and localized hazard and risk maps, data, local information on geology, soil, water table, slope, fault and seismic (ground motion) information for designs are needed. Challenges with data sharing[8] among the public and private sectors inhibit progress.

Data support programs continue to add to the existing body of knowledge:

a) The Seismic Microzonation Studies Project of the Town and Country Planning Division, Ministry of Planning and Development and the UWI-SRC and is funded by the Government of Trinidad and Tobago. The Port of Spain (POS) study is complete (see Figure 3). Studies for San Fernando and Scarborough are underway.

b)



a. Microzonation Map - POS *b. Potential Liquefaction Map - POS*

Figure 3. a and b Seismic Microzonation Program output map samples

c) The Urban Disaster Resiliency and Preparedness in Trinidad and Tobago (PREPARE TT). Miyamoto is implementing this program in partnership with UWI-SRC, ODPM, and the Ministry of National Security (MNS), and it is funded by the USAID Bureau of Humanitarian Assistance. The program will provide a clearer picture of the probable impact of an urban earthquake disaster to facilitate advocacy and planning for strengthening seismic disaster risk reduction and preparedness in T&T. The outputs will include probabilistic seismic impact maps of Port of Spain and associated data,

[8]E.g. multiple national agencies have GIS capability but often the base shape files are not the same requiring further manipulation before the data can be shared/compared/integrated. Many agencies are independently capturing building data and therefore duplicating efforts e.g. Building inspectors, insurance, Valuations Division, Land and building Tax, ODPM, TEMA, CSO, universities

such as the proportion of building damage, internally displaced persons (IDPs), deaths and injuries and debris volumes to be managed (see Table 1 for an illustrative example).

Table 1. Expected result categories of the Seismic Risk Assessment of POS

Structural Damage		Daytime				Nighttime				IDPs		Buildings				Debris Volume
		Fatalities		Injuries		Fatalities		Injuries				Yellow Tagged		Red Tagged		
%	Area km^2	%	No	%	No	%	No	%	No	%	No	%	No	%	No	(10^6) m^3

Despite existing and emerging seismic data, gaps still remain. For example, more localized microzonation and liquefaction studies are required to inform building design. Risk maps would need to be developed/updated to support the adoption of the mandatory code[9] of the country. UWI SRC has updated the probabilistic seismic hazard assessment and maps for Trinidad and Tobago http://uwiseismic.com/seishaz.aspx. There is a near urgent need for bathymetry maps/charts[10] for T&T and the North and Eastern Caribbean in order to address tsunami risks likely to be generated from shallow earthquakes in the Gulf of Paria and epicenters in the North and Eastern Caribbean.

For construction and engineering, quality assurance and control is a core issue for standards and testing. National laboratory testing capacity and accreditation is limited. The process is maintained by the T&T Bureau of Standards (TTBS), which currently has accredited a few laboratories (TTBS, 2020). Confidence in the testing oversight process will need to be enhanced (Quality and Standards Policy, 2013-2030, p.13). Civil and other engineering labs within universities enhance the national testing capacity and offer opportunities for innovation. However, the maintenance and upgrading of equipment, e.g. material structural testing systems (MTS), remains a challenge.

The T&T Road Map builds upon existing research programs and seeks to strengthen seismic risk knowledge management in the country.

3.2 Mitigation and Preparedness

3.2.1 Mitigation

Reducing seismic risks for new and existing buildings is necessary to save lives, and to protect national assets and the economy. The declaration of highly vulnerable areas through national hazard impact assessments (NHIA) is a requirement within T&T's commitment to the *Agreement between Member States to the Association of Caribbean States*. Incorporating the scientific, structural, critical facilities, response and financial/insurance studies for the 2018 earthquake could be a useful NHIA to inform seismic mitigation in urban/development planning and legislation.

Much has already been said about the built environment. The GoRTT intends to increase spending in the construction sector in 2020/21 (GoRTT MPD, 2020, p.61) as part of its COVID-19 economic recovery. This initiative is an entry-point for improved risk management. The discussions herein demonstrate the effort being made by T&T Ministries (MPD, MNS, MOWT, MRDLG) to implement risk-informed urban development. As shared in the various sections, mitigating seismic risk in T&T will require establishing and

[9] For example, seismic hazard maps are required for the International Building Code adopted by the Council of Caribbean Engineering Organisations Regional Road Map for Seismic Risk Management in the Caribbean PG13

[10] Bathymetry charts for this risk would also facilitate storm surge and sea level rise risk mapping – urban planning setbacks and engineering design.

enforcing building codes, a supporting institutional framework, available seismic and other risk data, capacity building, developing retrofitting incentives and sourcing financial support for maintenance of the building stock as it ages. This list is not exhaustive.

3.2.1.1 Retrofitting standards

Retrofitting incentives are necessary to ensure the safety of existing buildings. Approximately 60% of homes built between 1980-1990 were built without planning permission[11] and likely need retrofitting. The World Bank estimates that retrofitting costs 10-50% of construction costs and suggests that retrofitting programs should be incremental (WB, 2015, p.79). It is noted that building applications for upgrades are opportunities to encourage retrofitting. The University of the West Indies Department of Civil Engineering has shared retrofit technology for small buildings (http://www.ideascaribbean.com/hurri/), but these tools are not widely available and there is little awareness about their applicability. Policies and programs to incentivize structural retrofitting are needed.

3.2.2 Preparedness

A destructive earthquake is inevitable. Preparedness is key. Through the ODPM, the previous *National Earthquake Plan* has been updated to provide strategic and tactical actions, coordinated with the municipalities/THA and sectors. The revised plan takes into consideration the earthquake risk probability scenario for POS being developed by the PREPARE TT program. Post-earthquake, the expected surge in need for urban search and rescue (USAR) teams will likely exceed the capacity of the T&T Fire Service and TTDF[12] personnel trained in this area. Local public and private sector engineers will need to be engaged and the protocols for collaboration will need to be developed, tested and understood. If necessary, protocols to surge and engage additional regional USAR teams and equipment, should be reviewed, developed, tested and resourced.

Other resources from the private sector will be necessary to aid the response and recovery. Private sector businesses would need to have developed and tested their business continuity plans to be available to support the national response.

Among other matters, harmonized damage and needs assessment (DANA) forms and data sharing are central issues, as are relief resources, including cash transfer programs and shelter management for internally displaced persons (IDPs).

Fundamental to response and recovery from a destructive seismic event is the timely assessment of the structural integrity of buildings and bridges. This will require a common structural assessment instrument (basic and detailed), a nationally agreed-upon tagging system and familiarization with the processes to avoid confusion, conflicts and delays. After the 2018 earthquake in T&T, stakeholders convened to establish such an instrument, which was used to assess schools. This initiative should be developed further. It could be useful to integrate this tool (with training and protocols) into the ongoing building monitoring and inspection systems to ensure its availability for an emergency.

3.3 Public Awareness and Education

In T&T, public perception of disaster risk is low. This is due to the rarity of destructive seismic (and hurricane) events. A complacency associated with the "*God is a Trini*"[13] risk perception permeates.

[11] Conversation Prof. Michelle Mycoo, UWI Geometrics/Planning June 18 2020 PREPARE TT Online Stakeholder Update

[12] As an aide to civil authority.

[13] Tobagonians having a living memory of Hurricane Flora and the Tobago earthquake swarm of 1997 are more risk conscious. Nevertheless, the residents also experience loss from earthquakes and fierce winds.

Nevertheless, the country faces high seismic risk exposure and must increase public education and awareness to change the perception. Communicating seismic risk to technical and non-technical audiences, to improve risk perception, remains a target to be achieved.

The guidelines, codes and standards that do exist (TTBS, 2006) are not familiar to many contractors and tradespeople in the sector, as well as property owners. Efforts are being made by the TTBS to make the *Guide to the Design and Construction of Small Buildings* (TTBS 599: 2006), more readily available online and through bookstores. Property owners are generally unaware of the guidelines and depend on the contractors. However, most tradespeople and contractors are unaware of the recommended methods in the *Guide* having been "grandfathered" into the trade.

An institutionalized system of public awareness and professional development, with incentives, is needed. A culture of encouragement rather than compliance needs to be fostered. Training courses on the TTBS small building guide awareness/recommendations for tradespeople have been offered, but not on a continuous basis or with a certification incentive attached. The Professional Associations (APETT, BOETT) do occasionally offer professional development courses, often through the University of the West Indies Engineering Department. Incentives are required to encourage training and demand.

Communication program resources are usually inadequate for the promotion/awareness of standards and codes as well as for changing perception of risks. Risk awareness, preparedness and mitigation programs are often underfunded in favor of more immediate competing priorities. Communication-program follow-through, after the development of hazard research, codes and plans etc., needs strengthening. Awareness programs appear to cease once documents are published.

There are many good intentions surrounding the building regulatory framework, but in the last two decades, few were realized. This is probably the result of fragmented advocacy efforts and political will distracted by multiple competing issues. Consensus on the road map and priority actions, should also be complimented by a shared advocacy strategy to support implementation. The road map will seek to identify measures to increase public awareness and advocacy about earthquake risk.

3.4 Response, Recovery and Reconstruction

The responsibility to respond to a destructive seismic event is divided between multiple authorities, each with their own Cabinet note/legislation and reporting lines. The country does not have comprehensive disaster risk management policy or legislation. With no obligation to collaborate independent action, bureaucracy, duplication of effort, mixed messages, delays and gaps can occur. Such an environment is at risk to haphazard priorities, rather than assessed need.

Facilitating the response and recovery will require the removal, reduction and safe disposal of millions of cubic meters of debris. The T&T *Draft Disaster Debris Management Plan 2016* is to be improved and updated through the ODPM in collaboration with municipal corporations/THA, the Solid Waste Management Company (SWMCOL) MOWT etc. Issues such as clarifying public sector roles and support to households, temporary processing sites, vegetative waste, environmental concerns and recycling are among a few to be resolved.

Response and recovery planning for a seismic event will require strategic planning for a greater housing crisis and the surge in emergency-shelter dependency from internally displaced persons (IDPs). But disasters are also opportunities to implement resilient development plans. An updated national *Physical Development Policy* would be an essential guide. Care must be taken not to rebuild seismic risk while

addressing the housing crisis. Long-term structurally safe infrastructure and transitional housing policies can be planned before the event to protect against high-risk rushed rehabilitation.

Building on this preliminary research, the road map would support T&T in adopting build-back-better practices for response and recovery after an earthquake occurs.

3.5 Risk Financing and Business Continuity Planning

Critical to risk reduction is the expansion of business continuity planning (BCP) in the private and public sector to ensure services and goods are available post-earthquake. Public-sector BCP should be guided by the national *Business Continuity Management Policy for the Public Service* (GoRTT MPA, 2015), but widespread adoption and implementation of this policy is yet to take effect. Continuity of operations with minimal loss of service and rapid recovery is at the heart of the *Critical Facilities Protection Policy Framework ODPM 2010*. The framework needs to be updated and many of the policy's intentions are yet to be completed. There are lessons[14] to be applied from hazard impacts on critical facilities in the Caribbean in the last decade.

The COVID-19 pandemic has also exposed the vulnerability of the private sector, particularly micro, small, and medium enterprises[15] (MSME). The United Nations Office for Disaster Risk Reduction's *Private Sector Alliance for Disaster Resilient Societies* (UNDRR ARISE) offers a platform to advocate for and implement business continuity plans for MSME as well as other needs.

The government self-insures most of its capital assets, while the private sector is often underinsured. Despite every effort, mitigation and preparedness may not be enough. The Caribbean Catastrophic Risk Insurance Facility (CCRIF) may be useful to generate immediate liquidity after an event, but these releases are insufficient to support the recovery. With increases in debt-to-GDP ratios over the last decade, a review of risk financing options may be necessary to ensure the country can bridge the gap to facilitate successful recovery.

3.6 Conclusion

There are a myriad of issues surrounding the need to improve seismic risk management in T&T. Many are interlinked. The national road map is guided by the *Regional Roadmap: Urban Seismic Risk Management in the Caribbean 2016* and builds on previous ground made by national stakeholders. The actions are aligned to the themes:

i. Risk governance
ii. Knowledge management -Understanding seismic risks
iii. Mitigation and preparedness
iv. Public awareness and education
v. Response, recovery and reconstruction
vi. Risk financing and business continuity planning

A focus on seismic risk is not exclusive of other hazards. It is foreseen that actions implemented to reduce seismic risk would also benefit the risk management of other hazards.

The road map has the opportunity to contribute to the national building construction framework under development at the Ministry of Planning and Development. For seismic risks, the road map would make

[14] E.g. COVID-19 supply chain issues. The water distribution disruptions. The vulnerability of the telecommunications network to hurricanes in the eastern Caribbean.

[15] MSME account for c.14% of the employment in the manufacturing sector and c. 30% of the distribution sector (GORTT, 2020)

use of the current PREPARE TT program, using the probabilistic seismic risk assessment and stakeholder knowledge/data to inform data-driven decision-making. The perspectives of the scientific, professional and technical partners, as well as individual households across a variety of incomes, will need to be considered. An intended outcome of this process is to prioritize specific risk management solutions that can be implemented to reduce seismic risk in T&T. Below is the matrix of the way forward from which the priority actions can be determined.

4. THE WAY FORWARD - ROAD MAP FOR SEISMIC DISASTER RISK MANAGEMENT IN TRINIDAD AND TOBAGO

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
		1.0 Risk Governance			
1.1 A combined policy and legislative agenda	A CDM policy framework was developed by the ODPM but the CDM policy is still to be completed. Many existing related national policies need to be considered and referenced in drafting the national CDM policy	Complete the national CDM policy Elaborate a risk management framework (institutional arrangements) linked to fiscal policy	c.2-3 yrs. *ODPM Draft CDM Policy with CDEMA June 2022*	Tbc.	ODPM, Min. Nat Security, Include Ministry of Planning and Development & Min of Finance
	For about two decades many useful risk management Bills of legislation remain in different stages of development. Many were drafted independently by their professional bodies[1]. Government also has important legislation/Bills pending e.g. full proclamation Planning and Facilitation Act, the Bill to amend the Municipal Corporations Act	Review and integrate the current government legislation and bills with efforts of professional bodies and advocated for inclusion as a package in the government's legislative agenda. In completing the bills seek to minimize bureaucracy and maximize ease of doing business	c. 2-4yrs *Legislative Bill revision with ODPM & IFRC completed Aug 2022*	Tbc.	ODPM & Seismic Risk Management Road Map Stakeholders Include Ministry of Planning and Development Chief Parliamentary Council Gov't Chief Whip in charge of legislative agenda
		Creation of more partnerships between scientist, institutions,	Tbc.	PREPARE TT USAID BHA 2019-21 Other….	Road Map stakeholders

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
		1.0 Risk Governance			
		policy makers and citizens.			
1.2 Institutional Framework	Municipal authorities tasked with the building permit process and oversight do not all have civil engineers to support the institutional process. Additionally, the capacity of the building inspection units in the municipalities and the THA is stretched to achieve its monitoring, enforcement and oversight functions. Expanding the public service employment may not be the only solution.	Surge the capacity of the municipalities by engaging the private sector engineers (similar to the French system). Establish a framework to enlist services on demand, ensuring affordable fees to homeowners, transparency, independence, and accountability.	2-4yrs	Possibly CDB, World Bank, IDB, or other – previous effort	Min. Rural Development and Local Government BOETT, APETT
	Legislative initiatives by professional bodies seek to improve accountability of registered members.	Tbc. In addition to 1.2. Explore and adopt a modified French model of enforcement for building construction - linking professional accountability, oversight and liability through the insurance sector.	Tbc. *Registrar of BOETT met the Minister MOWT in August 2021*	Tbc.	Tbc. BOETT, APETT, ATTIC, Fr. Embassy/EU
	Many construction practitioners/contractors were 'grandfathered" into the sector without formal training. The knowledge and skills of various	Establish a multi-level knowledge and skills system of training and certification of contractors through establishes technical-	Tbc. 2 -10yrs	Tbc.	UWI, UTT, NIHERST/COSATT, UTT, MIC, Nat. Energy Skills Center. MUST, YTEPP, Min Comm Dev. National Training

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
		1.0 Risk Governance			
	contractors is unclear outside of those formally educated at tertiary facilities. The capacity to surge vocational training in the construction sector exists nationally. The licensing of sanitation contractors and electricians has begun.	vocational and tertiary institutions Provide awareness and an incentive program to allow/encourage practitioners to be part of the certification system.			Agency. Min of Planning and Development. Min Edu. TTBS

1. *Independent professional associations have drafted legislation- BOETT, Contractors Association, Institute of Urban Planners, Institute of Architects of T&T*

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
		2. Understanding Urban Seismic Risk			
2.1 Seismic monitoring of T&T – GPS – Weak motion – Strong motion – Background noise – Risk assessments	The Ministry of Planning and Development together with UWI SRC are completing the microzonation studies for POS, SFdo, SW Tobago.	A system, with financial support, to maintain and expand the national network for seismic monitoring inclusive of for the micro-zonation studies of T&T	3 yrs. *UWI SRC & MinPD completed microzonation (POS San Fernando, Tobago, Diego Martin, Barataria-San Juan) 2019-2021.*	Tbc.	UWI SRC, Ministry of Planning and Development (MPD)
2.2 Geologic and soils inventory for design and decision making	Some areas have been mapped moderately in terms of soils and geology and some areas require new mapping. Some data is proprietary residing in various engineering houses/ministries.	Evaluate the status of geologic and soils maps for urban seismic risks. Develop mechanism/ protocol for data sharing of existing proprietary data/maps e.g. http://uwiseismic.com/Maps.aspx	Tbc.	Tbc.	Ministries of Agriculture, Lands and Fisheries. Energy and Energy Industries BOETT, UWI

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
		2. Understanding Urban Seismic Risk			
		Develop a system to maintain current data sets			
2.3 Seismic hazard mapping	Seismic hazard and risks maps need regular updating. Regional institutions may not have the full expertize to carry out major assessments. The Council of Caribbean Engineering Organisations (CCEO) adopted the IBC.	Develop and maintain risk targeted seismic maps closely in sync with the updates of IBC and ASCE. Accept interim probabilistic seismic hazard assessment (PSHA) and develop risk targeted seismic maps (to support current codes) Establish a standing mechanism to ensure regular updating of seismic maps hazards http://uwiseismic.com/Maps.aspx	2021 onward	Tbc. Proposed donor and USGS partner initially, GORTT MOWT subsequently Or World Bank GFDRR	Tbc. UWI SRC, Engineering & Geomatics, Miyamoto, TAG – UWI SRC, UWI Eng. BOETT, APETT, TTBS ODPM & T&CPD, UTT
	Geospatial data (DEM etc.) Challenges accessing available geospatial data (e.g. geographic maps, aerial photographs, satellite imagery, LIDAR etc.). No national shape file. Multiple agencies using different shape files. Some current map scales do not allow for effective planning and decision making at the local level	Establish minimum useful geospatial databases of useful scales with protocols and procedures for ease of access for decision making.	1-3 yrs	Tbc.	Central Statistical Office, CSO, Lands and surveys Division -MPD, Min. Agriculture, Municipalities, Public utilities UWI Geomatics

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
		2. Understanding Urban Seismic Risk			
2.4 Fault Inventory (onshore and offshore)	Status unclear Regionally does not exist	National and regional entities to generate inventories	1-3 yrs	Tbc.	ODPM, UWI Seismic
2.6 Vulnerability and Risk Assessments	Risk and vulnerability assessments for earthquake risks are inadequate as they stand. IADB, WB and EU funded a few investigations and some training in the region but a much greater effort is needed. The SRC in collaboration with GEN tried to establish a regional program, but due to lack of funding this initiative was not sustained. (Regionally) The most extensive work done has been done through PAHO during the past 30 years in this area. Previous hazard risk assessment for T&T studies were also completed by the IDB	Undertake risk and vulnerability of seismic hazards in all major urban areas in the region. Establish a standard mechanism/methodology for undertaking seismic risks assessments Support for institutions undertaking risk and vulnerability assessment (training, modeling socio-economic losses to guide prevention policies and prioritize mitigation actions, retrofitting of existing buildings Generalization of assessment diagnostics of structural vulnerability of critical buildings (hospitals, administrations, schools, places of worship, retirement homes, hotels, etc.) to earthquakes. (Possible use of) applications done in Haiti (North) and Santo Domingo (capital) as a basis. Public access to general risk assessments/maps to assist home	Extending over 5 years 5 year review	Tbc.	ODPM, Miyamoto & UWI SRC, Ministry of Planning and Development (MPD), OSH

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
		2. Understanding Urban Seismic Risk			
	and CCRIF and its SPHERA model.	owners and developers with decision making			
2.6 Vulnerability and Risk Assessments cont'd	ODPM, Miyamoto, UWISRC/ are completing the seismic risk assessment of POS funded by USAID BHA is a useful pilot for reducing risks by informing policy, protocols, response, and recovery plans.		2019-2021	PREPARE TT USAID BHA 2020-21	ODPM, Miyamoto & UWI SRC, Ministry of Planning and Development (MPD)
2.6 Vulnerability and Risk Assessments cont'd	Urban and rural planners have insufficient risk management information and recommended guidance to inform the approvals process (with required conditions). There is a lot of information and maps residing in task specific studies in various ministries and government bodies, which could be useful.	A seismic risk-mapping module of the national hazard impact assessment (NHIA), which provides guidelines for decision-making and (construction safety) recommendations for the Town and Country Planning Division's land approval and municipal/THA building permit processes. A standard methodology of qualification and mapping of hazards at the regional level and a means of operationalizing and integrating this knowledge into urban planning: The methodological guide of risk	Tbc.	Tbc.	ODPM, UWI Seismic, T&CPD, BOETT, APETT, ACS (agreement), EMA (HIA process) ….and

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
		2. Understanding Urban Seismic Risk			
		reduction in Haiti could serve as a basis Review planning legislation to incorporate National Hazard Impact Assessment NHIA in the planning approval process. Public access to general risk assessments/maps (NHIA) to assist homeowners and developers with pre-application/purchasing decision-making. (See 4.1)			

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
		3. Mitigation and Preparedness			
3.1 Risks sensitive planning information	See 2 above				
3.2 Building codes and standards guided by earthquake engineering standards	The MOWT advocates for the IBC 09 and ASCE 07 as the public sector standard. The GoRTT Cabinet, in 2019, directed Min Planning & Development to reconstitute the National Building code Committee. The committee is working	Establish national building standards /codes and a supporting institutional framework	2-3 years to develop. 10 years to implement	GoRTT	Ministry of Planning and Development, T&T Bureau of Standards, and University of T&T
		Major banks to require building standards in their lending requirements	Tbc.	Tbc.	ODPM (Mitigation) Bankers Association of T&T BATT, Credit Unions, Min. Rural

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
3. Mitigation and Preparedness					
	with UTT to develop the update national construction standards. Similarly the TTBS was instructed to update the small building code guide through UTT. The Council of Caribbean Engineering Organisations (CCEO) has adopted the use if the IBC as the basis for its Code Application Document since 2000. T&T has attempted to develop its own AD and make the use of the IBC legally enforceable but so far unsuccessful- a very early stage of the program				Development and Local Government
		Tbc. French model of enforcement of building codes (through liability and insurance) should be reviewed for possible adaption and adoption in T&T	3-5 yrs	Tbc.	Board of Engineers BOATT , Institute of Architects, Association of Insurance Companies ATTIC, BATT
3.3 Seismic Retrofit and earthquake engineering	Many residential (as much as 60-80%) built in the last 40 years were constructed without approvals and oversight. Others were constructed to older codes and standards. These residential properties are vulnerable to seismic risks.	Adopt financial and other incentives to encourage seismic retrofitting of homes and buildings in T&T. This process is expected to be incremental Raise awareness and educate construction practitioners in retrofitting recommendations	Incremental change; Decades	Tbc.	Min. of Finance, Min of Housing. Municipalities and THA, Bankers Assoc; Credit Unions, , UWI Engineering APETT BOETT, Inst. of Architects, TTCA

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
3. Mitigation and Preparedness					
	50% of all schools are over 50 years old. Community centers and places of worship are of similar vintage. Many of these facilities are expected to become the emergency shelters for the internally displaced persons subsequent to a disaster The Ministry of Health is replacing the Central Block of the POS General hospital due to seismic vulnerability in line with the MOH & PAHO *Safe Hospital Index Report* 2009.	Structural assessments of schools/community centers /other designated emergency shelters with retrofitting guidelines Implement UNDRR Comprehensive Schools Safety and PAHO Safe Hospitals initiatives. Include high –level advocacy for this approach Replicate the initiatives in the health sector in the social and infrastructure sectors. Identify funding for implementation of retrofitting of high occupancy and critical facilities/services	1-10 year	Tbc.	Min. Education, Education Facilities Co. Ltd. (EFCL) BOETT/APETT, Inst Arch. TTCA, OSH Other critical facility sector stakeholders
		Aid and lending agencies through the monitoring and evaluation of their projects, need to ensure that the projects are built to manage seismic risk	Immediate		CDB, WB, EU, bi-lateral funding e.g. USAID, DfiD, AusAid, CIDCA, JICA, GAC etc.

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
4. Public Awareness and Education					
4.1 Public Awareness and Education	The UWI SRC and ODPM public information on seismic events, the M6.9 earthquake 2018 and subsequent, regularly occurring, tremors help to maintain seismic risk awareness. Nevertheless, seismic risk perception is still intermittent usually associated with tremor events. (Climate change awareness information, education, advocacy and funding tend to dominate hazard awareness).	Additional approaches and resources to increase seismic risk management communication and advocacy Use the probabilistic seismic risk assessment to target higher risk communities with information on earthquake and tsunami risks.	Tbc. 1-5 yrs. *City-wide Earthquake Risk Assessment for POS 2021. USAID BHA PREPARE TT program led by ODPM & implemented by Miyamoto International Inc. with support from UWISRC*	Tbc.	UWI SRC, ODPM, POSCC
	Risk information is generally unavailable or not available in sufficient detail to allow land, home owners and developers to make informed decision See 2.6	NHIA developed (see 2.6) and an open source platform for NHIA available publically. Public awareness campaign of this resource	Tbc.	Tbc.	ODPM, Min. Planning and Development UWI Seismic

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
4. Public Awareness and Education					
4.1 cont'd Public Awareness and Education	The public remains generally unaware of the planning approval and building permit processes; making unauthorized renovations, which work to their disadvantage when attempting to re-sell/publically rent properties. (Insufficient municipal personnel for construction oversight is part of this gap -See. 1.2)	Continue to encourage as well as enforce compliance. Greater resources for public information on planning approvals, building regulation and sources of advice	1-10 yrs	Tbc.	Min. of Communication, Min. PD, RD&LG, THA, professional associations and financial (mortgage/lending) institutions
	Although in existence since 2006, the public and practitioners are generally unaware of the recommendations in the *Guide to the Design and Construction of Small Buildings* (TTBS 599: 2006) – currently being updated (see 3.2). Homeowners presume their contractors are knowledgeable in current construction best practice.	Improve awareness and accessibility of current and updated small building code (see also 1.2)	1-10 yrs & cont'd	Tbc.	TTBS, UTT & tertiary education institutions. Min. RDLG, Communication and Min. Planning and Development. Professional Associations BOETT, TTCA, Inst Arch.
	To sustain initiatives in seismic risk management, the	Multi-stakeholder advocacy at the national level	Tbc	Tbc.	Road map Stakeholders

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
4. Public Awareness and Education					
	political will must be maintained and sustained through current and subsequent administrations				

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
5. Response Recovery and Reconstruction					
5.1 Seismic response	T&T earthquake response plan is under review. ODPM. Miyamoto UWI SRC are developing the impact probability data, wider awareness and testing will be needed. Regional surge protocols have been developed through CDEMA and among other regional organisations e.g., UN, CCOFC, CARILEC, CTU, IFRC	Test and complete the national earthquake plan. Raise awareness among public and private service function enterprises. Establish regular testing and updating system	Est. 2 yrs.	PREPARED TT USAID BHA	ODPM, SRC, Miyamoto MRDLG, POSCC, MoHealth, MOWT,
		Develop local surge capacity protocols integrated into regional, bilateral, and multi-lateral resources: – Mass Casualty* Management – Shelter IDP – Disaster Debris management**	Est. 2 yrs. *Draft MCMP with MOH* *Draft DDMP 2022w ODPM*	* PAHO	ODPM, SRC, Miyamoto MRDLG, POSCC, MoHealth, MOWT,
	Local capacity (public as well as private sector) exists for quick post-assessment “building triaging” in the aftermath	Develop national standards, protocols, methodology and procedures for common rapid building	1-4 yrs	PREPARED TT USAID BHA (Basic)	ODPM, BOETT, APETT, TTIA, MRDLG Building inspection Units, TTBS

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
5. Response Recovery and Reconstruction					
	of a seismic event. However, there is no accepted common standard (see 1.2 and 3.2 above) for rapid assessment and tagging (red, yellow, green), which may lead to conflicting results, signage, and loss of public confidence.	assessment (basic and detailed)			
		Develop capacities to conduct training in rapid damage assessments or 'building triage" in the immediate			Professional Associations and tertiary education institutions
	Given the probable widespread impact of a destructive earthquake in T&T, there will be limited existing capacities for seismic response	Build SAR and specialized emergency response capacities of emergency response teams (including community emergency response teams who also serve as first responders) through training and resourcing. Promote the establishment of multiple trained and adequately resourced SAR teams in country	9 months *TTFS has USAR capacity and continues to train*	Possibly USAID - previous support and course	ODPM, TTFS, CDEMA, CCOFC, INSARAG
5.1 Cont'd Seismic response		Develop protocols and procedures for surging national capacity through regional USAR assistance	9 months		ODPM, Miyamoto, CDEMA, TTFS, TTDF, Ministry of Foreign and CARICOM Affairs, Customs; Immigration, Port Health, key embassies and civil

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
5. Response Recovery and Reconstruction					
					society organisations that offer this surge capacity
		Promote the development of crisis communications strategies for the dissemination of credible information to the public in the aftermath of seismic events. Establish information sharing platform for dissemination off accurate/reliable information	1-3 yrs	GoRTT	ODPM, THA, OPM, MNS, Min RDLG
5.2 Rehabilitation and Reconstruction	Often times temporary/quick fixes are offered during the rehabilitation/recovery stages which inevitably remain as permanent solutions	Plan for the national rehabilitation and reconstruction post-earthquake e.g. make use of the PREPARE TT probability seismic risk assessment of POS and other. Promote rehabilitation and reconstruction activities in keeping with existing codes in the aftermath of a disaster.	3-7yrs	Tbc.	ODPM, Ministry of Planning and Development. Min. RDLG, THA

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
5. Response Recovery and Reconstruction					
		Design buildings to be earthquake resistant Promote seismic retrofitting of existing buildings			

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
6. Risk Financing and Business Continuity Planning					
6.1 Risk Financing and Transfer	More businesses than homes have property insurance. Yet 60-80% of the buildings are homes. Fewer still have content insurance. Properties with insurance are often underinsured for the present value. Renters' insurance is rare.	An incentive programme to encourage households to use insurance instruments as a supplement to manage risks	2-10 yrs	Tbc.	Min. of Finance
	The GoRTT subscribes to the Caribbean Catastrophic Risk Insurance Facility CCRIF	Review, and where necessary, strengthen the existing risk financing mechanisms given the probability of seismic impact e.g. ODPM, Miyamoto & UWI SRC Seismic Risk Assessment for POS	Tbc.	Tbc.	Min. of Finance
	Financial risk management. When a	Examine the national level catastrophe/disaster	2-5yrs	Tbc.	Ministry of Finance and National Security

Thematic Area	Status	Recommendations	Timelines	Funding Opportunities	Follow up Lead Organisation
6. Risk Financing and Business Continuity Planning					
	disaster is declared there is no automatic release of a established set of funds to support response and recovery	funds approach used by countries e.g. Mexico of FONDEN and FIPREDEN and New Zealand's earthquake Commission cover			
6.2 Business Continuity planning	Regionally countries in the region are in the early stages of BCP. The various chambers of commerce in T&T (Energy Chamber, AMCHAM TT, T&T CoC) have hosted BCP workshops for their members during the COVID 19 crisis.	Apply existing or develop a BCP toolkit, evaluation methodology and implementation approach for SMEs, NGOs	1 yr	Identify vested stakeholders banking, insurance, corporate entities, government, aid agencies, chambers of commerce	Chambers of Commerce
	GORTT approved the Business Continuity Management Policy for the Public Service in August 2015. In April2020 a Manager BC&P was recruited.	Provide incentives to encourage BCP in the public and private sector and strengthen public and private sector risk financing mechanisms An institutional structure in each ministry and government body to implement risk management and BCM	2-10yrs 2-7	GoRTT & ….	Ministry of Public Administration and Digital Transformation &….

Action Plan *to be elaborated subsequent to way forward strategy*

Thematic Area	Recommendation	Tasks	Indicators	Timelines	Funding	Follow up Lead Organisation
		1.0 Risk Governance				
1.1 A combined policy and legislative agenda	Complete the national Comprehensive disaster management CDM policy Elaborate a risk management framework (institutional arrangements) linked to fiscal policy	• Policy consultant • Draft national Policy (see also CDEMA Draft CDM Policy) • Cabinet approval for public consultations • Redraft final version	Cabinet adopts policy	Tbc. -2yrs	Tbc.	Tbc. ODPM, Min. Nat Security, Include Ministry of Planning and Development & Min of finance
	Gather, integrate, and complete the various bills. Advocacy for inclusion of the package of bills on the parliamentary agenda.	• Consultant(s): Policy and legislative drafting specialist(s) • Workshops • Legislative drafting • Internal and public consultation • Redrafting • Advocacy	• Bills[1] supporting risk management passed in Parliament • Planning and Facilitation Act full ascension completed	Tbc -4 yrs	Tbc.	ODPM & Seismic Risk Management Road Map Stakeholders Include Ministry of Planning and Development Chief Parliamentary Council Gov't Chief Whip in charge of legislative agenda
1.2 Institutional Framework	Surge the capacity of the municipalities by engaging the engineers (similar to the French system). Establish a	• Amendment to the Municipal Corporations Act? • Building permit regulations?				

Thematic Area	Recommendation	Tasks	Indicators	Timelines	Funding	Follow up Lead Organisation
	framework to enlist services on demand, ensuring affordable fees to homeowners, transparency, independence, and accountability	• Establish a transparent system to recruit/engage private civil/structural engineers • Set building inspection evaluation benchmarks (codes) and accountable processes • Establish a budget to support process				
		2. Understanding Urban Seismic Risk				
2.1 Seismic **monitoring of T&T** – **GPS** – **Weak motion** – **Strong motion** – **Background noise** – **Risk assessments**	A system, with financial support, to maintain and expand networks for the micro-zonation studies of T&T The development of seismic risk assessment for other urban concentrations in T&T	Tbc.	Tbc. Current seismic microzonation data for x% of T&T's urban and industrial concentrations Probabilistic seismic risk assessment for X urban concentrations in T&T	2021-2024	Tbc. Possibly USAID BHA	ODPM, Miyamoto & UWI SRC, Ministry of Planning and Development (MPD)
		6.0 Risks Financing & Business Continuity Planning				

Thematic Area	Recommendation	Tasks	Indicators	Timelines	Funding	Follow up Lead Organisation
Risk Financing and Transfer	Review, and where necessary, strengthen the existing risk financing mechanisms given the probability of seismic impact e.g. ODPM, Miyamoto & UWI SRC Seismic Risk Assessment for POS					
	Examine the approach used by Mexico of FODEN and FIPREDEN as well as national level catastrophe/disaster funds					
Business Continuity planning	Apply existing or develop a BCP toolkit, evaluation methodology and implementation approach for SMEs, NGOs	AMCHAM TT as part of its UNDP ARISE initiative is hosting a BCP mentoring interactive course	X# SMEs initiated their BCP plans	6 months development delivery Jan-Feb 2021	AMCHAM TT, Sponsors, participants	AMCHAM TT, ANSA McAL, Atlantic LNG, Guardian Group, National Gas Company, PODS Marketing Mix, Miyamoto International

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ANNEXES

Annex I. Regional Roadmap: Urban Seismic Risk Management in the Caribbean 2016

This document provides a framework for guiding regional actions on urban seismic risk management in the Caribbean. The document was developed based on inputs from experts in the Caribbean during the Regional Urban Seismic Risk Forum held in Haiti from 18-21 September, 2016.

Regional Road Map for Urban Seismic Risk Management in the Caribbean, 2016

https://www.undrr.org/publication/regional-road-map-urban-seismic-risk-management-caribbean

Annex II. Key Stakeholders

Association of Professional Engineers (APETT)

Association of T&T Insurance Companies (ATTIC)

Bankers Association of T&T (BATT) (Financial Incentive and advocacy)

Board of Engineers of T&T (BOETT)

Commissioner of State Lands

Habitat for Humanity

Housing Development Corporation (HDC)

Joint Consultative Association (JCA)

Land Settlement Agency (LSA)

Ministry of Education (School construction and maintenance)

Ministry of Housing & Urban Development (MHUD)

Ministry of National Security (MNS)

Ministry of Planning and Development (MPD)

Ministry of Rural Development and Local Government (MRDLG)

Ministry of Works and Transport (MOWT)- Construction Division

Miyamoto International, Inc. (Miyamoto)

National Infrastructure Development Company (NIDCO)

Office of Disaster Preparedness and Management (ODPM)

Port of Spain City Corporation (POSCC) Building Inspectorate, Disaster Management Unit

T&T American Chamber of Commerce (AMCHAM TT) - Arise Committee

T&T Bureau of Standards (TTBS)

T&T Chamber of Commerce - Facilities Development and Management

T&T Contractors Association (TTCA)

T&T Institute of Architects (TTIA)

T&T Manufacturers' Association – (TTMA) Construction

T&T Society of Planners

Tobago Emergency Management Agency (TEMA)

Tobago House of Assembly (THA) Building Inspectorate

Town and Country Planning Division (T&CPD)

Urban Development Corporation of T&T (UDECOTT)

University of the West Indies (UWI) Department of Civil Engineering

UWI Department of Geomatics - Urban Planning

UWI Seismic Research Centre (UWI-SRC)

Valuations Division

OTHER:

Caribbean Development Bank (CDB)

Caribbean Catastrophic Risk Insurance Fund (CCRIF SPC)

Inter-American Development Bank (IDB)

Embassy of China (Ministry of Housing sub-contractor)

Annex III. Current Policy, Legislation and Agreements regarding seismic risk management

Trinidad and Tobago has many policies and laws dealing with seismic risks, but these documents/statutes do not comprehensively address risk management. At the same time, other policy and legislation await Cabinet consideration and approval, remain as parliamentary bills, or are Acts that are not yet fully proclaimed. Critical policy documents, e.g. Vision 2030, missed the opportunity to outline how multi-billion dollar national capital investments and development plans will be protected from high impact hazards like earthquakes and tsunamis. Other than emergency powers acts, there is no legislation that comprehensively articulates national management of disaster response and recovery. A preliminary assessment using the World Bank's *Building Regulatory Capacity Assessment* (World Bank, 2017) indicates that work and investment is still needed to strengthen legislation and policy for seismic risk management. Below is a list of key policy, legislation and agreements regarding seismic risk management. The list is not exhaustive. For a comprehensive review please see IDB IGOPP 2020.

Policy	
National Development Strategy 2016 -2030 (Vision 2030)	Developing a building code is intended. Improved infrastructure at education facilities –does not indicate if this is a safety improvement. Protect all citizens from disasters natural and manmade. DM strategy is not well elaborated – CSO improvements are instead targeted. A disaster risk management policy will be developed 4.5 & draft a national disaster management plan. The National Spatial Development Strategy 2013/14 is to be reviewed
Building construction approval - Draft Policy on Local Government Reform 08-03-17	Proposed combining location and building construction approval with local government. "*the devolution of land use planning to local government – Planning and Building Inspectorate*
National Physical Development Plan 1984	Original national planning document. Under the T&CP Act this was supposed to be updated every 5 years
National Spatial Development Strategy Core and Regional 2013-2014	Concept to replace the national Physical Development Plan. To guide localized planning decisions. Requires detailed hazard risk assessments for areas. This is to be reviewed under Vision 2030.
Building code -Construction Division, Ministry of Works and Transport	*Structural Guidelines for T&T, Designs Engineering Branch, Construction Division, MOWT 2017*. The Chief Designs Engineer MOWT, applies the following codes as national standards aimed at reducing the vulnerability of public buildings e.g.: 1. International Building Code IBC 2009 2. American Society of Civil Engineers ASCE 7 (Earthquake Loads) 3. American Society of Civil Engineers ASCE 7-05 (Wind Loads) 4. American Concrete Institute ACI 318-05 (Reinforced concrete designs) These codes are adopted by the MOWT in conjunction with the Board of Engineering of T&T
Urban Upgrade and Renewal	East POS Development Company is responsible for infrastructure development in east POS. Risk management of the built environment is not mentioned Urban Upgrading and Revitalization Program IDB loan Tt-I1056 &57 (2020) US$30 m– the document does not mention how building construction risk reduction will be incorporated in the 3500 household grants or Mall revitalization

Quality and Standards Policy 2018-2023	Building codes and material standards *Today, public laboratories are rarely accredited, and there is a lack of commitment from the competent authorities to demonstrate technical capabilities using accreditation.* Pg22
Business Continuity Management Policy for the Public Service Aug 2015	*To ensure a timely and effective business continuity, disaster preparedness, response and total business recovery*. Implement a BCM programme, which *minimize exposure to risk, the adverse impact on employees and reputation… providing for continuity of operation*. Approved by Cabinet Minute No. 2224 27 Aug 20215
Critical Facilities Policy Framework Feb 2010	To protect critical facilities from all hazards and to assess the disaster risk implications of new major infrastructure proposals.
T&T Contractors association Cabinet note on the license of contractors c. 2009	To be included Does it include small contractors/tradesmen?
Risk financing -	Caribbean Catastrophic Risk Insurance Facility (CCRIF SPC) Risk Financing CCRIF SPC Annual Report 2015-2016 pg. 17 T&T had tropical cyclone and earthquake policies. The government paid a premium of $TT23,625,000 for this facility (Draft Estimates Recurrent for the financial year 2016-2017). Financial institutions usually require property insurance to support mortgages and depend on the national land and construction approval/permit system for a construction standard. The informal sector self-insures.
Housing	The last published housing policy document, publicly available, was 2002. *Showing T&T New Way Home*. Current policy 2016 onward, from speeches, Housing Construction Incentive Programme (HCIP), mortgages valued as much as $1.5M or as low as $750,000 and less. Low interest rates through TTMF. *Public Private Partnership model* income tax relief for developers of newly constructed affordable multi-family developments *and the Aided Self-Help Housing Programme, (upgrade regularized squatters),* Home Village Improvement Programme (HVIP) infrastructure works, *and construction grants for land owners*, *use of micro and small contractors playing a greater role in the Public Housing Construction Programme.* **Introduced a 22 Point Certification Quality Management Programme in 2016** to guarantee improved quality of its construction projects. There is sign off and approval of work at every stage of the construction process, to mitigate against shoddy workmanship and make the contractors accountable for delivering the highest and best quality standards. The demand for affordable housing. There are over 180,000 applications for housing with the Ministry.
Critical Facilities Protection Policy Framework for T&T Cabinet approved 2010	Vision A resilient critical facilities network whose continuous protection from existing and emerging threats is integrated into routine public and private sector business practice. Goal: 1 A long term program to protect critical facilities from all hazards; 2 procedures to assess disaster risk implications of new major infrastructure project proposals. Includes development of a knowledge-management platform and a critical facility asset register. Identifies legislation, regulation, standards, codes, license and inspections as essential to the legal and regulatory framework,
School's policy	Demand and repair priority. Intend to use Architect and User Briefs in construction and repair. MoEdu 2017. Draft Education Policy 2017-2022.

	https://www.moe.gov.tt/educational-facilities-planning-and-procurement-division-efppd/;
Legislation & Regulation	
The Constitution of the Republic Act #4 of 1976	Part II 4 a the right of the individual to life, liberty, security of the person and enjoyment of property and the right not to be deprived thereof except by due process of law
The Planning and Facilitation of Development Act 10 of 2014, and Act No1 of 2019	Partly proclaimed by Legal Notice 151 July 29, 2015. Part II 4 (f) *provide for structural and fire safety of buildings and the safety, health and general welfare of persons occupying buildings or using land in proximity thereto*; Includes provision for a National Spatial Development Strategy for T&T, requires Hazard Risk Assessments to inform planning but it is not specific about needing post-disaster updates. Part VI 61 (1) The Minister may make regulations providing for a building code for T&T…. (3) (a) codes of retrofit standards designed to provide acceptable levels of …safety… (3) (c) codes, standards and practice in relation to infrastructure and engineering works… 2019 3. Defines "simple development" no CEC required, *gross floor area of <500m^2 or…plots range of 465m^2 and 800m^2 inclusive* Section 15 – establishes a *Chief Building Officer.., National Planning Authority…* and*.. a Chief Enforcement Officer..*
Town and Country Planning Act 29 of 1960, Ch. 35:01 LRO updated to December 31, 2015	Control of development of land – *permission shall be required*. Guided by the National Physical Development Plan 1984 (see above). Final approval lies with the planning Minister. The Minister shall… The Minister may… grant or revoke permission.
Education Act 1996	The physical safety of the students is the responsibility of the Principals (27.) The Minister's(/Ministry) role is the promotion of education and establishment of education systems. Although safety can be addressed through policy development
The Engineering Profession Act, Ch.90:01, Act 34 of 1985, Authorised by L.R.O An amendment has been developed	Article 3., established that "A registered engineer— (a) shall have proper regard for the safety, health and welfare of the public in the performance of his professional duties; (b) shall notify the proper authorities of any situation which he considers, on the basis of his professional knowledge, to be a danger to public safety or health; and (c) shall complete, sign or stamp only those plans or specifications which reflect proper regard for the safety and health of the public". Registration is not obligatory
Architecture Professional Act 1992	For the registration of architects and the regulation of practice. The board is appointed by the Minister – can it be politicized? Registration is not obligatory
Urban and Regional Planners Professional *Bill* 2 of 2019	For the regulation of the profession
Housing Act of 1962 Ch. 33:01	To establish the Housing Development Corporation, speaks to the construction of dwelling houses and home ownership but addresses safety only in low rental housing projects. In the latter the standard of construction is approved by the Minister (46).
The Municipal Corporations Act 21 of 1990 LRO 2006. Updated to December 31, 2012	Building Regulations (unstated.. *the Minister may make*) and the authority for building permitting and oversight
Bill to Amend the Municipal Corporations Act and others	35A (1) *Each Corporation shall establish administrative decisions with the following responsibilities (g) spatial planning and building inspectorate; (k) infrastructure development and maintenance; (l) disaster management*

Tobago House of Assembly (THA)	The approval process is centralized to T&CPB
The Housing Act Ch.33:01 #3 of 1963 LRO 2014,	Section 63 mandates a Home Improvement Insurance Fund, it does not specify that these funds are specific to disaster recovery.
Land Settlement Agency Act 25 of 1998	Protect squatters from being ejected, facilitate acquisition of leasehold titles and establish land settlement areas. There are over 250 squatter settlements in T&T
State Land Act	Works in conjunction with the Land Settlement Agency regarding squatters
Occupational Safety and Health Act #1 of 2004 LRO 2014 Ch.88:08	Construction or renovation of a warehouse, plant or factory requires approval from the Chief Inspector Part XI (59)
Regional and International Agreements	
CDEMA Comprehensive Disaster Management Strategy 2014-2024	Safer more resilient and sustainable CDEMA Participating States. Enhance the application of knowledge management for fact-based decision making; Enhance disaster resilience within key sectors of the economy,; Improving operational readiness..; Outcome 2: Increased and sustained knowledge management and learning…; 3.2 Hazard information integrated into sectorial development planning and programming; 4.1 Standards for safe communities developed, agreed and applied
Agreement between Member States to the Association of Caribbean States	Declare within their territories … *Highly vulnerable areas: zones, parts of the territory or territories where there are elements which are highly susceptible to suffering severe, large scale damage, caused by one or more natural or anthropogenous phenomena and that require special attention in the sphere of cooperation among the parties.* … with a view to developing plans for co-operation in the prevention and management of natural disasters
UN Sendai Framework 2015-2030	Expected Outcome: The substantial reduction in disaster risk and losses in lives, livelihoods and health in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries. Goal Prevent new and reduce existing disaster risk…*Priorities 1: Understand disaster risk; 2 Strengthen disaster risk governance..; 3 Invest in disaster risk reduction for resilience; 4 Enhancing disaster preparedness for effective response and to build back better in recovery rehabilitation and recovery*
UN 2015 Sustainable Development Goals (2030 agenda)	*Goal 9 Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation* *Goal 11 Make cities and human settlements inclusive, safe, resilient and sustainable.*

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ROAD MAP FOR SEISMIC RISK MANAGEMENT IN TRINIDAD AND TOBAGO 2021