

# Build Aid

## HAITI

**“A DISASTER MANY YEARS IN THE MAKING”**



**An initial evaluation report on the damage in Port au Prince and surrounding areas following the 12 January earthquake**

## INTRODUCTION

BuildAid a UK registered construction charity undertook an evaluation of the conditions in Haiti following the earthquake of 12 January 2010.

The inspection was undertaken by the authors of this report, structural engineer William Keane and Chartered Building Surveyor Robert Muir. Both have extensive knowledge in building failures following natural disasters and conflict.

The geographical area covered was from Port au Prince in the east, travelling west through Carrefour, Cressier and finishing near to the earthquake epicentre at Leogane.

Various use types of buildings were inspected including hospitals, schools, retail, industrial, commercial and residential. The buildings varied in size from single to four storeys in height.

The buildings also varied in age from an indeterminate 30 to 50 years to newly constructed and in some cases still under construction.

Although a vast majority of the subject buildings were of reinforced concrete construction, other technologies inspected included timber and metal frame, traditional load-bearing and ad-hoc shanty type buildings.

The evaluation was to determine the type of construction, the condition post earthquake, how it performed structurally under the seismic conditions, the quality of the engineering design, materials and workmanship.

Having collated the above information it was possible to reach a preliminary conclusion as to why the earthquake had such a devastating effect on the building stock and caused the consequential loss of life and injuries to their inhabitants.

A partially collapsed building in Port au Prince



## **FINDINGS**

Some of the more important problems identified during our recent evaluation visit and ongoing feasibility studies to address them are listed below:

### **Inherent constructional defects in the building stock nationwide caused by the absence of an engineered structural design, poor quality primary materials and the workmanship generally**

This relates to virtually every building in the country, whereby the vast majority has not been constructed to withstand the prevailing seismic risks from earthquakes and meteorological effects such as hurricanes and storm surges. To counter this, we recommend that any sub-standard buildings, even those superficially not affected, should be demolished and cleared to create open sites. These sites can then be used for transitional purposes until replacement buildings can be constructed. This is the only way to ensure that the current situation with many partially collapsed and unsafe structures still in situ does not result in further uncontrolled collapses of unstable buildings.

To commence reconstruction with inadequate or non-existent geo-technical site specific information and the application of engineering solutions in the construction to mitigate their possible effects would significantly increase the chances of future building failures particularly by virtue of liquefaction and ground amplification in vulnerable areas in the event of another earthquake. Before any rebuilding is considered, detailed site investigations should be undertaken so an appropriate foundation and superstructure design can be properly engineered taking into account the geo-technical requirements of the particular sites; in the meantime there should be a moratorium on all but essential building. The demolition would have to be phased over an extended period, with a programme being prioritised to deal with the most vulnerable/dangerous buildings first and giving due consideration to creating sites for urgently needed "lifeline" and socio-economic priorities.

### **The absence of mandatory building codes and their enforcement which would ensure all buildings comply with adequate safety standards**

There are currently many initiatives and recommendations to introduce building codes to Haiti. The imposition of an existing prescribed code adopted from another country would not be the correct way to do this. Whereas both building and planning regulations would be necessary to ensure all buildings erected are safe and appropriate to an integrated plan, they should be directly contextual to the particular requirements in Haiti and implemented only after extensive consideration via consultation has been undertaken to ascertain the particular requirements of individual areas.

The regulations should be phased in over a period of time commencing with the most urgent sections (i.e. structure, fire and sanitation). This would allow for comprehensive training programmes for contractors, consultants and enforcement officers to run alongside their phased introduction. At the same time, there would be time for the creation of a government regulatory body to control the whole process.

Pending creation of the regulatory body and its staffing, duly qualified consultants, contractors and developers could be licensed so they could self-certify compliance with an agreed international standard; this would need to be warranted in some form which itself would have to be covered by an insured guarantee.

**The absence of government control measures and the unregulated construction of substantial buildings by unqualified and inexperienced stakeholders (including some NGOs) have resulted in the construction of many poorly engineered and constructed buildings.**

The current situation in Haiti has been many years in the making and is the result of a combination of non-related but ultimately catastrophic factors which, when compounded, resulted in the disaster triggered by the January earthquake. The consequential loss of life, the manifold injuries and hardships to the population, the loss of livelihoods and property and the damage to the economy and infra-structure are the ultimate consequences of the failure to plan and regulate in the past.

It is the responsibility of the Haitian Government and the Haitian people themselves (with assistance) to make sure that extensive measures are now put in place to reduce, mitigate and ideally eliminate the risks involved with destructive natural events to prevent them becoming disasters. This can only be done by developing a comprehensive strategy to address all the identified risks.

The process should begin with the introduction of a comprehensively considered town planning and development strategy but only after an extensive consultation with **all** stakeholders, not just the UN and donor organisations; this is essential if there are not to be lost opportunities. The plan could be kept relatively generic in the first instance to facilitate the reconstruction of lifeline buildings without delay which will provide hospitals, schools, government buildings and essential enabling infrastructure for subsequent regeneration; this will include the docks and airfields.

It will be difficult to take the established building owners on this journey, especially if they have no independent financial support. They will likely prefer to continue as before and rebuild to the old established methodologies, unless of course they are provided with incentives to "Build Back Better".

Damaged building showing collapse of the lower storeys



**Haiti's geographical location and the risks presented from earthquake, hurricane, storm surge and tsunami are exacerbated by the differing and sometimes conflicting construction requirements to combat such natural hazards.**

Nothing can be done about Haiti's geographical location and its geological configuration. However, due consideration should be given to these very important factors. For example, all current discussions regarding reconstruction concentrate on seismic resistance, but there are also significant risks from hurricanes, storm surges and possible tsunamis emanating from adjacent faults under the sea. Alongside the sensible inclusion of measures to combat seismic activity on the land, there should also be warning systems for hurricanes and tsunamis with comprehensively publicized strategies to mitigate their effects. This generally involves placing refugees in designated safe areas such as high ground or lifeline buildings.

**The lack of alternative construction material resources such as timber, steel or composites which would perform better under extreme climatic conditions**

The historic and extensive use of cast in-situ reinforced concrete technology in Haiti's building stock has contributed significantly to this current disaster. This is an inappropriate technology to employ in a seismically active area such as Haiti but has been used extensively owing to the availability of local materials and skills.

The problems caused by its use are exacerbated by the poor standards of structural design and workmanship in the building stock. This can be seen in the poorly or non-connected elements of the primary structures which, when combined with the very heavy loads of the roof and floor slabs, inadequate sizing and poor quality concrete has caused the vast majority of the structural failures, the consequential building collapses and the extensive fatalities.

The use of alternative technologies such as timber or steel frame or well-anchored lightweight pre-fabricated structures would be far better suited to the prevailing conditions in the Caribbean. Feasibility studies into how the adoption of alternative technologies could be sustainably achieved should be undertaken as a priority. This could be done by creating a manufacturing capability in Haiti, together with the requisite training programmes for their manufacture and installation.

This could be achieved in the short term with external investment and long-term product development, engaging native stakeholders, ethical investments and grant-making trusts and banks.

**The extensive collateral damage sustained by the January earthquake and the quantity of displaced persons and the effect on the economy**

The middle income bracket of the population has been the worst affected by this disaster in terms of loss of life, loss of businesses and damage to property and wealth. This will continue to impact on the economy via unemployment, loss of services and a delayed recovery. This sector will need extensive assistance to recover.

Historically, NGOs have quite rightly concentrated their aid on the poorer and marginalized groups within the community, but in this case, although those elements will continue to need ongoing support, there can be no sustainable recovery until normal society is resumed and this can only be achieved when the whole community is fully functional.

It is vital that any recovery plan consultations should include all stakeholders, particularly those in the business and commercial sectors, so that a coherent and inclusive plan can be developed which coordinates the efforts of all parties. This could then be extended to the wider investment community or the B2B organisations worldwide, as well as the usual humanitarian funding streams.

### **The lack of indigenous skills and specialist prefabrication manufacturing capability to create alternative solutions internally**

The continuing and essential aid effort to provide transitional shelters and relief will clearly continue for some time, but there is already considerable pressure mounting to commence the permanent reconstruction programme.

This should not start in earnest until the government has in place either suitable development controls or transitional measures to ensure that any reconstruction is undertaken in a safe and sustainable way. During this interim period local capacities should be created for manufacturing quality materials and a range of prefabricated components, providing temporary and permanent infrastructures to facilitate the long term reconstruction process and initiate comprehensive trade and professional training programmes to ensure local resources are available in perpetuity.

This will only be achieved with partner organisations working together under a national plan and substantial funding from external donor organisations, grants from supporting countries and maybe the World and other Development Banks.

### **The logistics in undertaking the reconstruction programme with a large internally displaced population occupying the open spaces in the cities**

It is not feasible and would not be welcome to close businesses or displace native populations for long periods to carry out reconstruction projects on a large scale; it could also have a devastating effect on the economy.

Whereas the phased reconstruction of large areas of the cities would be preferable over an extended period of time for expediency, the extended delay would not be advisable as the ongoing risk of further natural disaster events with the multiplier effect of the many retained poor quality buildings would result in a significant and increased risk to their occupants and the population generally.

The challenge is to deliver the regeneration without causing unmanageable social disquiet or disrupting the social cohesion, at the same time dealing with possible politically driven agendas. The implementation of a successful recovery strategy would leave a legacy creating a society that has the knowledge and resilience to deal with the constraints imposed by its geographical location and its inherent hazards, but at the same time capitalising on the geopolitical benefits.

It should be noted, however, that to secure and retain maximum primary stakeholder interest it will be necessary to define the expected timelines, how infrastructure inadequacies will be reconciled and how a reliable supply chain will be developed and maintained. This will relate primarily to the public, private, business and community sectors and will need detailed plans addressing the particular constraints and involvement of each sector.

## CONCLUSION

The recent disaster in Haiti is due to the culmination of different but interrelated factors which all have built up over an extended period but nevertheless have all contributed to the current disaster. They include the demographic shift from the rural to the urban areas resulting in a large number of people living and working in a confined space and the proliferation of poorly designed and constructed buildings unable to withstand the extreme conditions imposed by the geo-meteorological conditions in the area.

The main cause of injury and deaths was the high incidence of structural failure and the consequential uncontrolled collapse of buildings. The buildings were generally under-engineered and definitely not designed to withstand an earthquake of even minor proportions. The quality of materials used in construction and the workmanship employed was also substandard in comparison to modern buildings in the city.

There are still a very large number of damaged buildings in danger of collapse and these should be demolished immediately to prevent further injuries and possible loss of life. The whole building stock should be inspected for structural stability and any found lacking or not suitable for retro-fitting or strengthening should also be demolished.

The process of reconstruction should be delayed in virtually all cases until suitable controls are in place for the government to regulate and enforce all building on the island. A moratorium on all but essential lifeline buildings should be put in place to prevent the repair or rebuilding of dangerous structures.

The use of alternative technologies better suited to the prevailing geological and meteorological conditions should be urgently considered to prevent similar disasters in the future. These would include steel and timber frame, well anchored lightweight structures, pre-fabricated and composite structures. In all cases the buildings should be professionally designed by qualified engineers and constructed in a robust and workmanlike way with quality assured materials. Alongside the introduction of these technologies will have to be extensive training programmes to teach the people of Haiti how to manufacture, install and maintain the differing products.

Finally, the programme for recovery should now be devised which will chronologically need to address, the remainder of the emergency response to provide urgent medical treatment and food distribution to the internally displaced population, transitional housing, schooling and municipal buildings, enabling reconstruction to allow business and supply chain development, long term reconstruction of the towns and cities.

The programme for recovery should follow a fully integrated regeneration brief prepared after extensive consultation with all the stakeholders but particularly with the Haitian people at all levels. A successful plan will need to include the user groups, the business, finance and commercial sectors, internal and external investment organisations and the government, aid agencies and the UN organisations representing foreign government donors.

## What Next?

We are currently putting together a consortium of potential partners to address these issues and are undertaking ongoing feasibility studies on how to fund, manage and deliver the urgently needed facilities, training and of course lifeline and community buildings. We would reiterate that it is vital that we engage the native business and investment sectors in Haiti during the early feasibility stages or we will have little local knowledge, no input from the ultimate user groups and no one to take ownership and operate the finished facilities.

**We are very keen to develop these ideas further either operationally or strategically with any interested organisations and would welcome any constructive advice or criticism.**

**NEVER AGAIN**



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## The Authors

### Bill Keane, Structural Engineer

Bill has over 16 years specialist knowledge on Blast and Risk Assessment, Disaster Recovery/Prevention buildings resulting from extensive involvement in the damage assessment of the London St. Mary's Axe, Bishopsgate and Ealing Broadway and Manchester terrorist bombings and more recently the Buncefield oil depot vapour cloud explosion. Bill has given numerous presentations on such matters and has technical papers published on the structural assessment of bomb damaged buildings. He advised Lambeth Council on the effects a gas explosion had on one of their residential tower blocks, Kerrin Point, and is principal point of contact for the strategic assessment and disaster recovery of damaged buildings within the Clarke Bond Group.

He has recently been working pro-bono with BuildAid on a number of projects including the Jimma University specialist burns and plastic surgery unit in Ethiopia.

### Robert Muir, Chartered Building Surveyor and Engineer

Robert is a trustee of BuildAid and following extensive deployment to South East Asia has extensive knowledge on post event disaster management and response. He has worked on educational and medical projects extensively in Russia, Sri Lanka, Nepal, Ethiopia and now in Haiti. Robert has presented to the UN on sustainable urbanisation, the RICS on disaster response and is currently undertaking doctoral research at Salford University on the preparation of design briefs post-disaster.

He has worked pro-bono for BuildAid since founding the charity in 2005 and is currently working on the Leprosy Treatment Centre in Lalghadh Nepal and with Bill on the Jimma comprehensive medical centre in Ethiopia.

Damaged concrete structure Port au Prince

