ICOMOS Methodology for Building Assessment and Mitigation
following the January 12, 2010 Haiti Earthquake
11 April 2010

INTRODUCTION

Haiti officially the **Republic of Haiti** (*République d'Haïti* ; *Repiblik Ayiti*) is a Caribbean country. Along with the Dominican Republic, it occupies the island of Hispaniola, in the Greater Antillean archipelago. The total area of Haiti is 27,750 square kilometers (10,714 sq mi) and its capital is Port-au-Prince. Haitian Creole and French are the official languages.

Haiti was the first independent nation in Latin America and the first black-led republic in the world when it gained independence. Haiti is the only predominantly Francophone independent nation in the Americas.

The **2010 Haiti earthquake** was a catastrophic magnitude 7.0 Mw earthquake that occurred on 12 January. Its epicenter was near the town of Léogâne, approximately 25 km west of Port-au-

Prince. As of February 12, the Haitian Government reports that between 217,000 and 230,000 people had been identified as dead, an estimated 300,000 injured, and an estimated 1,000,000 homeless. They also estimated that 250,000 residences and 30,000 commercial buildings had either collapsed or were severely damaged.

The earthquake caused major damage to Port-au-Prince, Jacmel, and other settlements in the region. Many notable landmark buildings were significantly damaged or destroyed, including the Presidential Palace, the National Assembly building, and the Port-au-Prince Cathedral.

The purpose of this methodology is to establish background information; set up an informed and standardized methodology to perform condition assessments of historic buildings damaged by the earthquake; and to aid in development of emergency mitigation strategies so that historic buildings and sites can be stabilized for future restoration rather than demolition.

This methodology is divided into five parts with acknowledgements at the end:

Part 1 - Assessment Methodology presents the goals of the assessment, discusses what types of damage to look for, describes how to establish assessment teams, presents an assessment methodology, lists essential tools and supplies to have along with during the assessment, and delineates how to fill out the ICOMOS Post-Earthquake Damage Assessment Forms.

Part 2 - Emergency Mitigation Strategies presents immediate and short term strategies to address observed conditions.

Part 3 - Heritage Building Types provides a discussion of possible building types tha may be encountered during the survey and gives a brief account of the origins of building materials used.

Part 4 - Contextual History of Haiti is a summary of the history of Haiti.

Part 5 - Technical Description of the Earthquake is a summary of the details of the 2010 earthquake that struck near Port-au-Prince.

PART 1: ASSESSMENT METHODOLOGY

Work on an ICOMOS Assessment team will be a volunteer effort. If you are a member of an ICOMOS Assessment team you must accept that this volunteer effort will not end when you leave the field. There will be follow up work (data compiling, reporting, consultations, etc.) that will be ongoing and required. This follow up work is just as important as work in the field and failure to carry out this responsibility may lead to failure of the mission.

With an assessment that involves both a collection of different buildings and sites and team members of varying expertise, experience and ability; it is of the utmost importance that an approach be taken to assure that the assessments be uniform. In this manner a consistent and high quality result can be obtained. This standardized assessment must also be compliant with preservation charters and other doctrinal texts such as those that are administered by ICOMOS.

Standard methodologies can be adopted on the ground when the typical patterns of distress are better understood. These patterns of distress should be documented relative to building types and materials. ***ICOMOS Building and Site Assessment*** forms should be used. These forms will be used to enter the collected data into a data base.. The completion of these forms is essential but should in no way hinder the creative use of the skills and knowledge of the practitioner. Copies of these Assessment forms in English and French are attached to the end of the Methodology.

Assessment reports that include the data and descriptive text can then serve as an effective tool for the transfer of technology and for communication between various teams and other disciplines. Text should be brief so that differences in language (French, English, and Spanish) will not be as much of an issue in distributing the information.

It is important that the assessment achieve the following objectives:

- identify any weakened parts and unstable components that will have to be safeguarded as soon as possible.
- Prepare the necessary safeguards and drawing up a list of requirements of personnel and equipment.
- Give the authorities more exact information concerning the damage done by the earthquake.

Types of Damage to Look For

The following types of damage can be expected to be observed and should be looked for:

Subsurface failure is failure of the soil systems in and around buildings that would included liquefaction of the soil, land slides on sloped inclines, and spreading of the soils beneath

Foundation failure would include buildings shifting on or falling from their foundations and "soft story" failure.

Shear and out of plane damage to building walls which would include cracking of masonry walls, racking of wood frame walls, masonry wall collapses, masonry veneer collapses, and cracking and collapse at building corners.

Failure of individual columns or beams in frame structures

Collapse of non-structural elements such as chimneys, parapets, cornices, or other architectural decoration.

Development of Teams for the Assessment

It is suggested that squads of 7 to 9 persons be employed on a weekly basis. This squad should break up into 3 to 4 teams of two persons each with one person serving as the leader of the entire squad.

Squad members should reflect various disciplines such as architects, engineers, and conservators. Squad members may also reflect a variance in experience and ability. It is up to the squad and squad leader to correctly match up the correct teams and modify these teams as often as possible to meet circumstances on the ground.

Safety and communications are important. At no time should any assessment be done by a sole practitioner. In addition it is suggested that all team members and leader be in constant *walkie talkie* communication with each other during the assessment work. Please remember that buildings being assessed are structurally compromised and the decision to enter a building should be determined with proper gravity.

The assessment should begin with the entire squad performing an assessment of one to two structures together. In this manner, the assessment format can become standardized and questions of the group can be discussed and answered in the presence of all. Then the squad can break up into 3 to for teams. With two persons per team, one can do the assessment while the other can be the recorder and photographer. It is advisable that these partners share these responsibilities so that the process can benefit from the opinions and visual inspections of all members. Time should be allotted on a daily basis for the squad to compare notes and discuss patterns of distress and conditions that have arisen in the field that may be significant.

Essential Supplies for each Squad

- Potable water (approx. 2 liters per person per day)
- Food
- First Aid kit
- Maps
- Walkie talkies/mobile (please check if network connection works in the area)
- Sunscreen and insect repellant
- Hat
- Appropriate attire (including but not limited to work boots, hard hats, safety glasses, gloves, etc)

Tools that will be required for the assessment

- Digital camera (please use the date stamp function)
- Binoculars
- Handheld GPS device
- Metric measuring tape
- Sounding hammer
- Flashlight
- Extra batteries for all electrical equipment
- ICOMOS Building and Site Assessment forms
- Clipboard
- Assessment Forms
- Paper and writing utensils
- Materials for marking the buildings that are assessed: chalk/paint
- Field bag or other method of carrying and access equipment to not impede the use of both hands.

The Assessment Methodology

The methodology for assessment ranges from basic to sophisticated techniques. Assessment techniques should always begin with the most basic and work towards the more sophisticated techniques as they become necessary. The range of techniques would span from historical research, visual survey, close up inspection, creation of inspection openings, sample removal for laboratory analysis, *in situ* testing, and long term monitoring. For the ICOMOS assessment the techniques should focus only on non-intrusive techniques (research and visual assessment). The seismic event will have already created ample opportunities to look within the building construction due to collapse.

Archival Research

This methodology is meant to serve a s a basic primer for research and a starting point only. You should collect any maps, historic documents, photographs, books, records of previous damages and repairs and restorations done in the past (regardless of text language) and provide copies of these to the ICOMOS Haiti Steering Committee for distribution along with any comments on their interpretation. Such information found in Haiti may not be available elsewhere.

Visual Survey

It is important to obtain an indication of the extent of the distress through a visual survey. Distress that is observed during the visual survey should be recorded with labeled digital photography. The visual survey should determine the overall condition of the building. Global behavior and patterns should be assessment such as overall stability, displacements and areas of significant distress.

Close-up Inspection

Based on the results of the visual survey, representative locations with typical representative distress conditions or specific unique conditions are selected for further evaluation through close-up inspection. During the close-up inspection, some hands-on investigative work may be performed. Sometimes tapping or "sounding" a wall with a small hammer can provide an indication of delamination or loosening of masonry. Specific measurements may be made to quantify cracks, displacements, out-of-plumb building components.

In order to reduce the risk of unsupervised demolition, it is useful to put a notice on the historic buildings stating that these are heritage buildings and should not be demolished.

Completing the ICOMOS Post-Earthquake Damage Assessment Form

As stated previously, it is recommended that the entire squad performing assessments begin by assessing one to two structures together. All teams are required to completely fill out and submit their assessment forms (one form per property) at the end of each day. It is recommended that all forms be backed up as a digital photograph. A copy of the assessment forms follows this report.

Overall and detailed digital photographs of each property are required and should be dated and properly labeled. The following labeling protocol is required: yyyy.mm.dd-location name-photographer initials-chronological number (example: 2010.05.14 Jacmel SJK 27.jpg). All survey sheets, notes and photo files must be provided to the ICOMOS Haiti Steering Committee.

Inspection summary

An important part of the completion of the assessment forms for each building is establishing a summary damage. This is at the top of the first page so that anyone can immediately see the conclusion at a glance. However, it is filled in at the end of the assessment after the building has been inspected. The categories are as follows:

- ***Category 0 - No Damage.***
- ***Category 1 – Building is serviceable.*** The building is intact (no damage at all) or is only slightly damaged.
- ***Category 2 – Building is temporarily unserviceable.*** The building has suffered serious structural damage (seriousness to be defined visually e.g. wide cracks in load-bearing walls) but can be quickly brought back in to service
- ***Category 3 – Building is not reusable without major structural repairs.*** Significant structural dislocation e.g. structural components are seriously damaged or dislocated or walls are split and separated.
- ***Category 4 - The building is destroyed and is beyond repair.*** Partial or complete destruction of the building.

Previous Tag

This refers to any damage status assigned to the building prior to this assessment. Often the initial survey (also called usability, safety, or windshield survey) has been completed in the first few days or weeks after the event, and is done by local officials. This initial survey usually results in a three-part distinction between safe, unsafe, and restricted use. Our assessment should be more detailed and may change the damage status.

Building Identification

This information is essential for accurately locating the building later and for assuring proper dissemination of the findings. The physical address can be difficult to obtain in a disaster zone, so always include the latitude and longitude.

Inspection Accuracy
This is the level of access to the building by the surveyor. Less access means lower accuracy.

Relation to other Buildings
The position of the subject building relative to adjacent structures is an important consideration in determining structural vulnerability. It also helps others in locating the building.

Map Reference
Identify the grid or cell of the base map being used by the team. This is preferably an already-established map in general use. For specially made maps with arbitrary grids, keep a copy of the reference map on file at the field office and provide one to each team.

Sketch and Notes of Building and Site
Draw a simple sketch and annotate as necessary to convey the general sense of proportion, number of stories, roof shape, etc. Use a different color to mark damage locations on the sketch.

Architectural Style
Try to identify the style of the building. Mention the dominant and earliest style if style varies through additions and alterations. Use locally recognized names for the styles.

Metrical Data
List the basic metrics for the building, including number of floors, etc. Estimate the age by listing an approximate year (e.g. c. 1870, or pre 1900) as closely as possible. If more than one major building campaign, try to list the major eras of work. State whether the building is occupied at the time of the assessment.

Soil and Foundation
Characterize the gross site morphology (shape of the land), and list any visible damage or suspected risk from ground subsidence (settlement), fissures, tilting, sliding etc.

Roof
Characterize the roof structure first as thrusting or non-thrusting (gable framing without cross-ties is thrusting, a truss with intact bottom chord is non-thrusting). Next, identify the construction type.

Building Shape
This is the plan regularity (or lack thereof) and is important for seismic behavior.

Building structure types *(Exterior, Interior, Floors)*
These boxes allow choices for basic types of construction. It is expected that more than one choice will be made. Mark as many as appropriate for the main structure. Cross out or write in different selections as needed.

Adequacy of Tying

Evaluate the extent and condition of lateral ties at floor-to-wall connections, across vaults and arches, etc.

Further Actions

Recommend detailed evaluation if needed, barricades, shoring, bracing for safety.

Damage to Structural Elements & Existing Measures

Mark all boxes that apply. The matrix combines damage level and extent, and the boxes are shaded to indicate vulnerability. Existing measures are those already in place at the time of the survey. If none, strike through this box with a diagonal line, or write "none."

PART 2: EMERGENCY MITIGATION STRATEGIES

These strategies could be immediate or short term.

Immediate mitigation measures

1. Putting up notice/marking the building stating that it is heritage building and should not be demolished. Any signage should be coordinated with ISPAN.
2. Gutters or drain pipes might be clogged with debris. It will be necessary to clear them, or perhaps to make temporary arrangements to drain off the water.
3. Temporary covering with light covering material like plastic sheets fastened through ropes, nails/anchoring hooks would be helpful in preventing further damage especially during rains.
4. The vulnerability of the damaged building may significantly increase over time especially after series of aftershocks. Therefore where possible, it is useful to put monitoring equipments like telltale to monitor the cracks.
5. Salvage of movable architectural fragments or collections to safe places would help in preventing further damage. This should be supplemented by identification and securing of temporary storage and access to laboratory for immediate conservation treatment.
6. It is important to take measures for protection against looting of architectural fragments/collections.

Short Term Mitigation Strategies

There are numerous strategies that can be used to mitigate damage to the building. The strategies discussed below are not utilized in isolation but are used as a complement to one another as dictated by specific circumstances.

Shoring consists of numerous timber or steel members leaning diagonally against a vertical wall to counteract the overturning action. It is relatively easy to assemble and typically does not require lifting equipment. The following disadvantages are noted:

- Requires considerable quantities of timber, steel, or other shoring materials
- Depending on the complexity, shoring may require a significant amount of time for assembly
- Can hinder circulation around the street and building
- Can constitute additional mass against the building which can be dynamically activated by aftershock tremors

Shoring of the façade of Santa Giusta church in Bazzano from “Protection of the cultural heritage in the post-earthquake emergency” by C. Modena and L. Binda.

Contrast system is a type of shoring that consists of bracing one building against another using timber. This offers similar advantages to shoring with less materials but must be engineered to ensure proper load distribution and path. It may also be designed to provide better circulation around the building as compared to shoring.

Example of the contrast system used in L'Aquila from "Protection of the cultural heritage in the post-earthquake emergency" by C. Modena and L. Binda.

The following disadvantages are noted:

- Can constitute additional mass against the building which can be dynamically activated by aftershock tremors.
- The legal aspect may be an obstacle as it would involve more than one owner.

The strapping (or belting) system acts as a corset to prevent the damaged walls from collapsing outward. Straps used have traditionally been steel cables. In the recent L'Aquila earthquake polyester straps were used and are the same as those used in ports to handled heavy packages. The use of the ratchet allows for securing the strap at the appropriate strain. The layout of the straps must be done with great care using various timber sections to distribute the load on the walls. Whenever possible, it is very useful to bind the building together at the most critical levels, which are the tops of walls and the floor levels. Polyester straps are superior to steel cable which lacks flexibility in the corners. Several layers of straps can be used to build additional tensile capacity.

Example of the polyester strapping system on L'Aquila from "Protection of the cultural heritage in the post-earthquake emergency" by C. Modena and L. Binda.

The cage system is the most elaborate interim structural protection system. It is essentially a more rigid version of the strapping system using steel/timber frame to box in the exterior walls and connecting these exterior frames to one another by interior cables or other members. It is used in special instances when the reliability and stability of the damaged structure must be maintained.

Reconstruction of collapsed structural elements. In the event of partial collapse, it will often be necessary to restore the physical continuity of the wall before the straps are fitted. This is done by either filling the gaps or replacing collapsed parts with braces or horizontal shores or by temporarily rebuilding the ruined wall.

Bracing or walling the openings. Openings are weak points in a structure even during normal times. After the earthquake, cracks around them become a potential factor for collapse. Therefore to supplement other mitigation strategies, such as strapping, openings should be braced with timber balks in order to make the walls as homogenous as possible. Alternatively, it might be simpler to wall up all the openings systematically with bricks bound by weak mortar in lime or with low percentage cement.

Dismantling and safe keeping. Fragile structures which have been severely shaken, especially small-scale decorative features, will often have to be dismantled and the materials stored in a safe place. The operation should be amply covered by photography; the dismantled components (building stones in particular) should be numbered in indelible paint before removal and the numbers recorded in a notebook. The components should be stored in a logical order to facilitate reassembly. Dismantling such structures is more difficult where the masonry is of brick, especially if the bricks are covered with plaster moulding or sculpture. The aim should be to remove components as nearly as possible in one piece, consisting of several bricks still bonded by their mortar.

Protection of the building using tarpaulins. Tarpaulins and rope are typically used to protect building interiors from rainwater after hurricane damage. Such a mitigation strategy must be used only with the greatest caution as tarpaulins can act as a sail and cause further damage during high winds when used in conjunction with a structure that has already been structurally compromised.

Protection of non-movable objects. Temporary protection must sometimes be provided for non-movable objects of heritage value like altars, group of sculptures etc. In the initial phase, sand bag protection may be considered. Thereafter effective protection against falls of overhanging masonry may be provided by a shelter stoutly built of timber or metal with adequate bracing and designed to resist crushing.

Removal and sorting of debris. Once the damaged buildings have been temporarily stabilized, it becomes much less dangerous to enter them or work near them. Only afterwards, debris of the collapsed upper parts should be sorted. However this work can be started earlier in case of heritage buildings that have been completely destroyed and wherever the structures still standing presented no danger to the workers or, conversely, where accumulated debris placed the monument at risk.

In all cases, the debris should be sorted as it is removed. Space should be set aside for the storage of each category: rubble, rough stone, whole bricks, dressed stone, reusable roofing materials, beams, joists and structural timbers, joinery, valuable small items e.g. bits of plaster with mural painting which it may be thought possible to reassemble later on, hardware, art objects and collectors' items to be salvaged to temporary storage.

PART 3: HERITAGE BUILDING TYPES

Historical Overview of the Built Heritage of Haiti

Better known for its land and sea, the Caribbean is also home to a wealth of historic buildings sites and urban areas. Haiti is an island nation colonized by Spanish and French settlers, and its built heritage reflects these European colonial influences. Its buildings are also testimony to a history of slavery and constant immigration, and their construction reveal the legacy of European, African, and North American techniques. The wealth of the island's sugar plantations has left behind industrial heritage, mansions, religious works and French ironwork market buildings and balconies.

Available Construction Materials

Wood

Haiti was once a lush tropical island, replete with pines and broad leaf trees such as walnut and mahogany. Much of this building material was exploited and sent to Europe and North America. Much of the forests were decimated by the late 19th Century. By 1988 only about 2 percent of the country had tree cover remaining. Haiti depends on the felling of trees for the production of charcoal. Similarly, many rural and provincial small businesses that have no access to electricity use wood as a fuel in powering their operations. Wood for building construction is no longer locally available but must be imported mainly from South America.

Traditional Mortars

Lime was a necessary ingredient for the manufacture of sugar and must have once been readily available. We know from archaeological research that lime kilns were constructed on Martinique and Jamaica. Reportedly there are lime deposits found on the slopes of some hills that have been further exposed due to deforestation and consequent erosion from rainstorms. In addition, kalk lime must have been readily available by burning corals and shells. Contemporary mining in Haiti was limited to clays and limestone for cement manufacture (a leading industry in 2002), marble, and sand and gravel.

Brick

Bricks were scarce until the late 19th Century and were brought from Europe as ballast on ships. The first Caribbean brick kiln was established in Martinique in 1690 where bricks and tiles were made. Brick was frequently used in buildings at the beginning of the 20th Century. Reportedly bricks are no longer manufactured.

Iron

Iron work was imported from Europe and England and can be seen on buildings use for ornamental iron railings, balconies, and brackets dating from the 1870s onward. It became popular because of its resilience to hurricane winds and earthquakes.

Concrete Construction

The use of reinforced concrete was probably introduced into Haiti during the US occupation that began in 1915. Some monumental buildings of the 1920s-30s used reinforced concrete including the Notre Dame Cathedral (1912) and the Palais National (1918). After the middle of the 20th century reinforced concrete became prevalent. Many of the reinforced concrete buildings were built in stages as funds became available and there is little or no standard of concrete construction from one phase of building to another even within the structures.

Distinct Building Periods

Pre-Columbian

Taíno Indians, a subgroup of the Arawakan Indians, inhabited the Greater Antilles in the Caribbean Sea at the time when Christopher Columbus' arrived to the New World. Chiefs lived in rectangular huts, called *caneyes*, located in the center of the village. The people lived in round huts, called *bohios*. The construction of both types of building was the same: wooden frames, topped by straw, with earthen floor. Today there are no easily discerned traces of the Taíno peoples except for some archaeological remains, but some of these building traditions remain outside of Port au Prince.

Colonial

The Spanish and French colonial periods have left little built heritage of monumental scale. There are ruins of industrial heritage from the years of refining sugar. Much of the colonial period constructions of Cap-Haïtien were destroyed in the earthquake of 1842 and were subsequently reconstructed. Port au Prince has had numerous fires and no buildings remain that predate the 19th century.

Post-Revolutionary

19th Century building types feature wood frame, brick, rubble stone, and half timber (colombage) buildings with infill or brick and mortar, rubble stone and clay, and other materials. It is common for timber frame gingerbread buildings to have mixed original construction methods, often with heavier colombage on the first floor, and timber or light wood frame with no masonry infill on the second.

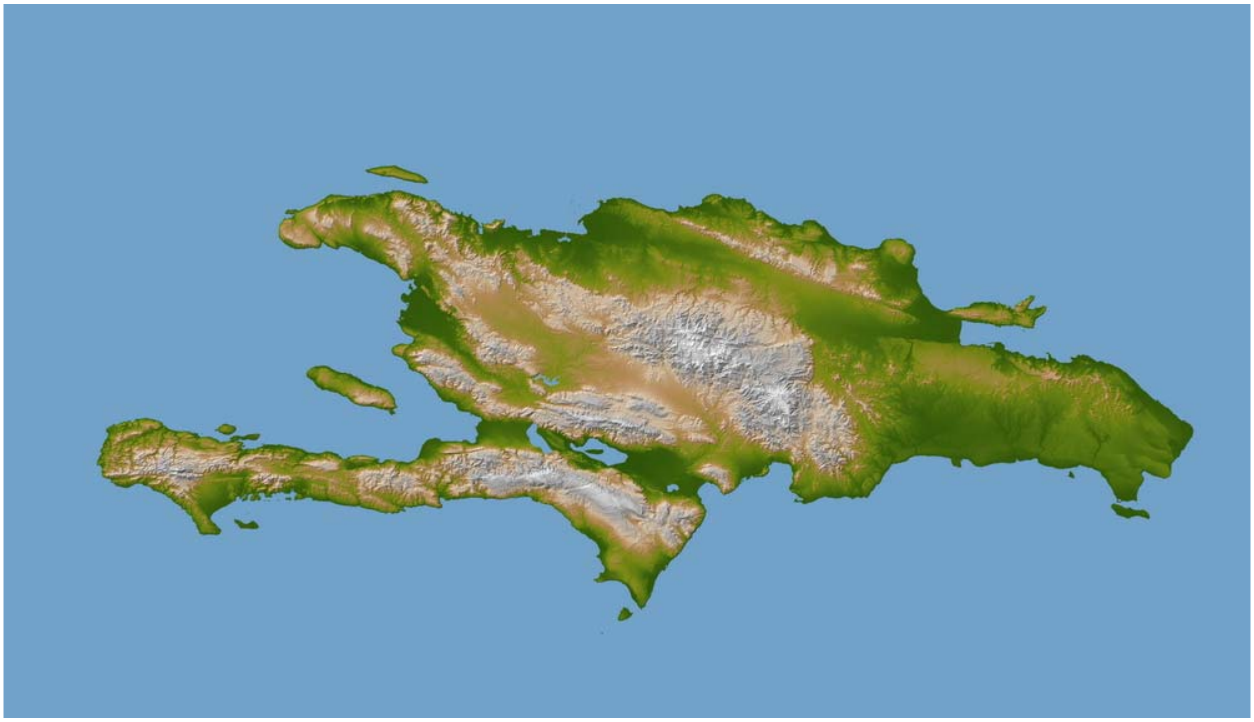
Architectural styles of the period that are unique to Haiti include the gingerbread districts of Port-au-Prince and Jacmel. These gingerbread residences with intricate gingerbread details, ridge boards and door and window trim can utilize any of the previously listed building types. Some residences feature steep spires and turrets - another architectural flourish indigenous to Haiti.

Also during this period iron assemblies were imported from France that were used for the construction *marches en fer* in Port-au-Prince and Jacmel and also the construction of multistory balconies around houses. These iron constructions were also utilized in New Orleans USA.

Introduction of Reinforced Concrete

From the 1970s onward, the construction industry boomed and concentrated on infrastructure developments, industrial structures, and extravagant residential housing in Port-au-Prince and its exclusive suburb, Pétionville. The growing demand for construction caused cement output to increase from 150,000 tons a year in 1975 to 220,000 tons a year by 1985.

PART 4: CONTEXTUAL HISTORY OF HAITI



The recorded **history of Haiti** began on December 5, 1492 when the European navigator Christopher Columbus happened upon the large island. It was inhabited by the Taíno indigenous peoples, who variously called their island *Ayiti*, *Bohio*, or *Kiskeya*. Columbus claimed the island for the Spanish Crown, and renamed it *La Isla Española* or *Hispañola*.

Spanish Hispaniola

Columbus claimed the whole island for Spain, and left his brother, Bartolomeo, to found a new settlement. Following the arrival of Europeans, Haiti's indigenous population suffered near-extinction, in possibly the worst case of depopulation in the Americas. Spanish interest in Hispaniola began to wane in the 1520s, as more lucrative gold and silver deposits were found in Mexico and South America.

French Saint-Domingue

In 1664, the newly established French West India Company took control over the colony, which it named Saint-Domingue, and France formally claimed control of the western portion of the island of Hispaniola in what is now Haiti. The southern part of the island had become a haven for French pirates based on nearby Tortuga. In 1670 the French established the first permanent French settlement, Cap François (now Cap-Haïtien) on the north coast. Under the 1697 Treaty of Ryswick, Spain officially ceded the western third of Hispaniola to France. France established a slave-based plantation economy and, with the encouragement of Louis XIV, settlers had begun to grow tobacco, indigo, cotton, and cacao on the fertile northern plain, thus prompting the importation of African slaves.

The economy of Saint-Domingue gradually expanded, with sugar and, later, coffee becoming important export crops. By the 1780s, Saint-Domingue produced about 40 percent of all the sugar and 60 percent of all the coffee consumed in Europe; and became known as the "Pearl of the Antilles" – one of the richest colonies in the 18th century French Empire

From 1787 onward, the colony received more than 40,000 slaves a year. However, the inability to maintain slave numbers without constant resupply from Africa meant the slave population, by 1789, totaled 500,000, ruled over by a white population that, by 1789, numbered only 32,000. To regularize slavery, in 1685 Louis XIV enacted the *Code Noir*, which, while granting certain human rights to slaves and responsibilities to the master, allowed a system of cruelty that was fully enacted. Saint-Domingue also had the largest and wealthiest free population of color in the Caribbean, the mulattos or *gens de couleur*.

As numbers of *gens de couleur* grew, the French colonial government enacted discriminatory laws. However, these regulations did not restrict their purchase of land, and many accumulated substantial holdings and became slave-owners. By 1789, *gens de couleur* owned one-third of the plantation property and one-quarter of the slaves of Saint-Domingue. The largest concentration of *gens de couleur* was in the southern peninsula, the last region of the colony to be settled, owing to its distance from Atlantic shipping lanes and its formidable terrain, with the highest mountain range in the Caribbean.

Founding of Jacmel

The city of Jacmel was founded in 1698 as the capital of the south eastern part of the French colony of Saint-Dominigue. The area was Taíno territory and the French renamed Yaquimel as Jacmel.

The city has not changed much since the late 19th century when the town was inhabited by wealthy coffee merchants, who lived in gracious mansions that adorned the town. These mansions would later come to influence the residential types of much of New Orleans; the architecture of the city boasted cast iron pillars and balconies purchased in France. In recent years, efforts have been made to revitalize the once flourishing cigar and coffee industries. The town has also been a popular tourist destination in Haiti due to its relative tranquility and distance from the political turmoil that plagues Port-au-Prince.

Founding of Port-au-Prince

Under Spanish rule a settlement had founded not far from present day Port-au-Prince named *Santa Maria del Puerto* was founded. The latter was burned by French explorers in 1535 and then by the English in 1592. The Spanish colonial administration decided to abandon the region in 1606. For more than 50 years, the area that is today Port-au-Prince saw its population drop off drastically, and French pirates from Tortuga began to use it as a base. Around 1650, the pirates established a colony in the area.

The Spanish government signed the *Treaty of Ryswick* in 1697 renouncing their claim to Saint-

Domingue. Around this time, the French also established bases at Ester (part of Petite-Rivière) and Gonaïves. Following a great fire in 1711, Ester was abandoned, and the new city of Léogane was founded just west of what would be Port-au-Prince.

The French colonial administration began to worry about the continual presence of pirates. In order to protect the area, in 1706 a captain named de Saint-André sailed into the bay just below the recently vacated pirate setlement, in a ship named *Le Prince*. It is said that M. de Saint-André named the area Port-au-Prince.

The colonial administration was convinced that a capital needed to be chosen, in order better to control the French portion of Hispaniola. In 1749 a new city of Port-au-Prince was built to serve as the capital. In 1770, Port-au-Prince replaced Cap-Haïtien as capital of the colony of Saint-Domingue and in 1804, it became the capital of newly independent Haiti.

Revolutionary Period

The outbreak of the French Revolution in 1789 had a powerful effect on the colony. While the French settlers debated how new revolutionary laws would apply to Saint-Domingue, civil war broke out in 1790 when the *gens de couleur* claimed they too were French citizens under the terms of the *Declaration of the Rights of Man and the Citizen*.

In 1790 the newly formed French National Assembly granted full civic rights to the *gens de couleur*, but these rights were refused by the royal governor of Saint-Domingue. This would lead to the Haitian Revolution on August 22, 1791 when slaves in the northern region of the colony staged a revolt.

The Haitian Revolution was quite complex with competing agendas of white colonists, *gens de*

General François-Dominique Toussaint L'Ouverture, leader of the Haitian Revolution.

General Jean-Jacques Dessalines, a leader in the Haitian Revolution and first ruler of independent Haiti

couleur, African slaves, and the British Empire. The rebel slaves under the leadership of François-Dominique Toussaint L'Ouverture would eventually emerge as a powerful military force that by 1798 would be the *defacto* ruler of the colony.

By 1801, L'Ouverture was in control of the entire island, after conquering Spanish Santo Domingo. In 1802, Napoleon Bonaparte sent an invasion force and brought the eastern part of the island of Hispaniola under the direct control of France. After a French betrayal L'Ouverture was captured and sent to a French prison where he died of pneumonia in 1803. Napoleon strove to maintain slavery where it had not disappeared, and further edicts stripped the *gens de couleur* of their newly won civil rights. As the tide of the war turned toward the former slaves, Napoleon abandoned his dreams of restoring France's New World Empire. In 1803, Napoleon signed the Louisiana Purchase selling France's North American possessions to the United States. The Haitian army defeated the French army that same year. On January 1, 1804 declared independence, reclaiming the indigenous Taíno name of Haiti ("land of mountains") for the new nation.

Despite the Haitian victory, France refused to recognize the newly independent country's sovereignty until 1825, in exchange for 150 million gold francs. This fee, demanded as retribution for the "lost property,"—slaves, land, equipment etc.—of the former colonialists, was later reduced to 90 million. Haiti agreed to pay the price to lift a crippling embargo imposed by France, Britain, and the United States, but to do so the Haitian government had to take out high interest loans. The debt was not repaid in full until the 1940s.

Independent republic

Dessalines proclaimed himself Emperor Jacques I. He was assassinated in a coup d'état in 1806 and the two main conspirators divided the country into rival regimes. The countries history for the next era was that of instability and frequent turnovers of power. From 1824 to 1826 witnessed significant free-Black immigration from the US in which more than 6,000 immigrants settled in different parts of the island. By 1840, Haiti had ceased to export sugar entirely, although large amounts continued to be grown for local consumption. However, Haiti continued to export coffee, which required little cultivation and grew semi-wild.

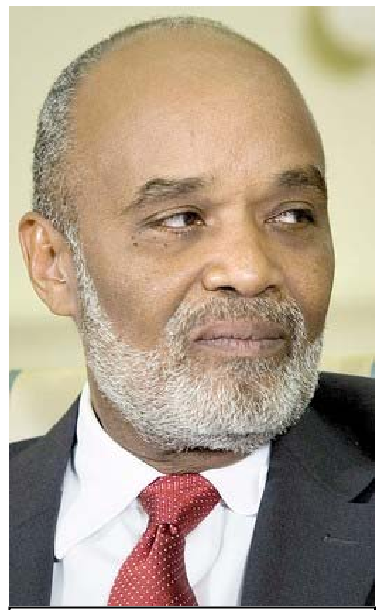
The Constitution of 1867 saw peaceful and progressive transitions in government that did much to improve the economy and stability of the Haitian nation and the condition of its people. The development of industrial sugar and rum industries near Port-au-Prince made Haiti, for a while, a model for economic growth in Latin American countries. The last two decades of the 19th century were also marked by the development of Haitian intellectual culture. This period of relative stability and prosperity ended in 1911, when revolution broke out, and the country slid again into instability.

Foreign intervention

The United States was apprehensive about the role of the economically powerful German community in Haiti in the years leading up to the World War. In an effort to limit German influence, in 1910-11, the US State Department backed a consortium of American investors in acquiring control of the Banque National d'Haïti, the government treasury.

Responding to complaints from American banks to which Haiti was deeply in debt, American forces occupied the country in 1915. During this time the currency was reformed and the debt stabilized. Corruption was reduced, although never eradicated. Public health, education, and agricultural development were greatly improved. The US Marines initiated an extensive road-building program to enhance their military effectiveness and open the country to US investment. Lacking any source of adequate funds, they revived a semi-feudal system, known as corvée (similar to slavery) which required peasants to perform labor on local roads in lieu of paying a road tax. By 1918, more than 760 km (470 miles) of road had been built or repaired.

In 1922, a puppet dictator was put in place who ruled without a legislature until 1930. This dictatorship oversaw the expansion of the economy, building over 1,600 km (1,000 miles) of road, establishing an automatic telephone exchange, modernizing the nation's port facilities, and establishing a public health service.



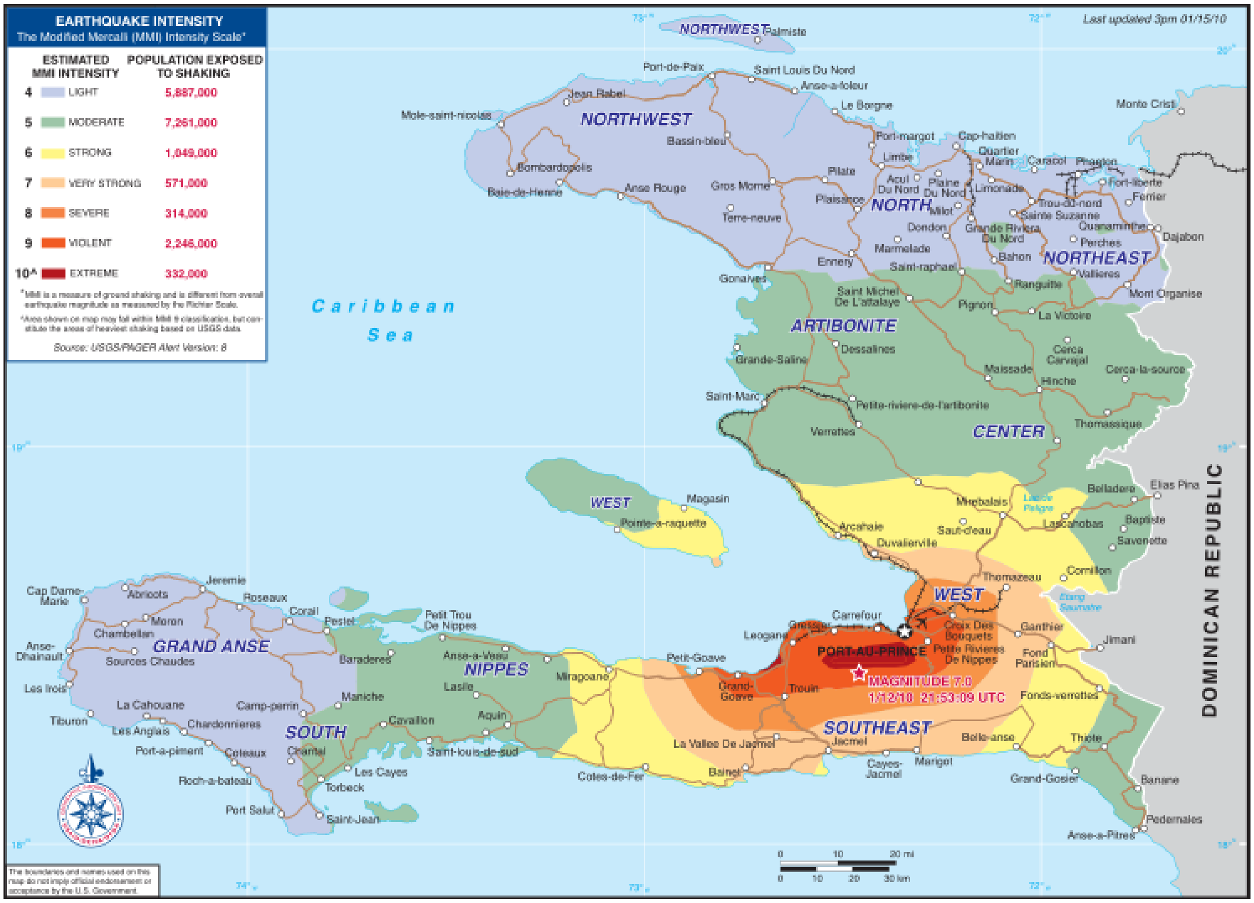
Réne Garcia Préval, the President of Haiti since 2006.

In 1930, Sténio Vincent, a long-time critic of the occupation, was elected President, and the US completed the withdrawal of its forces by 1934. By 1946 the brief period of democracy came to a close when economic difficulties lead to a military coup followed by brutal dictatorships and brief periods of democratic government.

In 2000, the government was taken over by Supreme Court Chief Boniface Alexandre who petitioned the UN Security Council for the intervention of an international peacekeeping force. The force would ultimately be formed of troops from the US, Canada, France, Brazil and Chile. Elections were held in 2006 and were won by Réne Garcia Préval. Préval took office in May 2006 and is the current president of Haiti.

PART 5: TECHNICAL DESCRIPTION OF THE EARTHQUAKE

The island of Hispaniola, shared by Haiti and the Dominican Republic, is seismically active and has a history of destructive earthquakes. During Haiti's time as a French colony, an earthquake was recorded in 1751, that left "only one masonry building [that] had not collapsed" in Port-au-Prince. In addition it was reported that the "whole city collapsed" in the 1770 Port-au-Prince earthquake. Cap-Haïtien and other towns in the north of Haiti and the Dominican Republic were destroyed during an earthquake in 1842. A magnitude 8.0 earthquake struck the Dominican Republic and shook Haiti I 1946, producing a tsunami that killed 1,790 people. Haiti is no stranger to natural disasters; in addition to earthquakes, it has been struck frequently by hurricanes, which have caused flooding and widespread damage.



The magnitude 7.0 M_w earthquake occurred inland, on 12 January 2010 at 16:53 (21:53 Greenwich mean time), approximately 25 kilometers (16 mi) WSW from Port-au-Prince at a depth of 13 kilometers (8.1 mi) on the Enriquillo-Plantain Garden fault system. Strong shaking associated with intensity IX on the Modified Mercalli scale (MM) was recorded in Port-au-Prince and its suburbs. It was also felt in several surrounding countries and regions, including Cuba (MM III in Guantanamo), Jamaica (MM II in Kingston), Venezuela (MM II in Caracas), Puerto Rico (MM II–III in San Juan), and the bordering Dominican Republic (MM III in Santo Domingo). According to estimates from the United States Geological Survey (USGS), approximately 3.5 million people lived in the area that experienced shaking intensity of MM VII to X, a range that can cause moderate to very heavy damage even to earthquake-resistant structures.

The quake occurred in the vicinity of the northern boundary where the Caribbean tectonic plate shifts eastwards by about 20 millimeters (0.79 in) per year in relation to the North American plate. The strike-slip fault system in the region has two branches in Haiti, the Septentrional-Orient fault in the north and the Enriquillo-Plaintain Garden fault in the south; both its location and focal mechanism suggest that the January 2010 quake was caused by a rupture of the Enriquillo-Plaintain Garden fault, which had been locked for 250 years, gathering stress. The rupture was roughly 65 kilometers (40 mi) long with mean slip of 1.8 meters (5.9 ft). Preliminary analysis of the slip distribution found amplitudes of up to about 4 meters (13 ft) using ground motion records from all over the world.

Aftershocks

The USGS recorded eight aftershocks in the two hours after the main earthquake, with magnitudes between 4.3 and 5.9. Within the first nine hours 32 aftershocks of magnitude 4.2 or greater were recorded, 12 of which measured magnitude 5.0 or greater, and on January 24 USGS reported that there had been 52 aftershocks measuring 4.5 or greater since the January 12 quake.

On 20 January at 6:03 local time the strongest aftershock since the earthquake, measuring magnitude 5.9, struck Haiti. USGS reported its epicenter was about 56 kilometers (35 miles) WSW of Port-au-Prince, which would place it almost exactly under the coastal town of Petit-Goâve. A UN representative reported that the aftershock collapsed seven buildings in the town. According to staff of the International Committee of the Red Cross, who reached Petit-Goâve the day before the aftershock, the town was estimated to have lost 15% of its buildings.

Casualties

The earthquake struck in the most populated area of the country. The International Federation of Red Cross and Red Crescent Societies estimates that as many as 3 million people had been affected by the quake. On 10 February the Haitian government gave a confirmed death toll of 230,000. Haitian authorities also estimated that 300,000 had been injured and as many as one million Haitians were left homeless. Experts have questioned the validity of these numbers warning that casualty estimates could only be an estimate. Edmund Mulet, UN Assistant Secretary-General for Peacekeeping Operations, said, "I do not think we will ever know what the death toll is from this earthquake."

Infrastructure Damage

Among the widespread devastation and damage throughout Port-au-Prince and elsewhere, vital infrastructure necessary to respond to the disaster was severely damaged or destroyed. This included all hospitals in the capital; transport facilities; and communication systems.

The quake affected the three Médicins Sans Frontières medical facilities around Port-au-Prince, causing one to collapse completely. A hospital in Pétionville, a suburb of Port-au-Prince, also collapsed, as did the St. Michel District Hospital in the southern town of Jacmel, which was the largest referral hospital in south-east Haiti.

Roads were blocked with road debris or the surfaces broken. The main road linking Port-au-Prince with Jacmel remained blocked ten days after the earthquake, hampering delivery of aid to Jacmel. There was considerable damage to communications infrastructure. The public telephone system was damaged, and two of Haiti's largest cellular telephone providers, Digicel and Comcel Haiti, both reported that their services had been affected by the earthquake.

In February 2010 Prime Minister Jean-Max Bellerive estimated that 250,000 homes and 30,000 commercial structures were severely damaged and needed to be demolished. The deputy mayor of Léogâne reported that 90% of the town's buildings had been destroyed. Many government and public buildings were damaged or destroyed including the Palace of Justice, he National Assembly, the Supreme Court, and the Port-au-Prince Cathedral The National Palace was severely damaged. Most of Port-au-Prince's municipal buildings were destroyed or heavily damaged, including the City Hall.

Minister of Education Joel Jean-Pierre stated that the education system had "totally collapsed". About half the nation's schools and the three main universities in Port-au-Prince were affected. The Haitian art world suffered great losses; artworks were destroyed, and museums and art galleries were extensively damaged, among them Port-au-Prince's Centre d’Art, Collage Saint Pierre, and Holy Trinity Cathedral.

ACKNOWLEDGEMENTS

The principal author of the Methodology is Stephen Kelley, member of ICOMOS, co-President of the International Scientific Committee on the Analysis and Restoration of Structures of Architectural Heritage (ISCARSAH) and Officer on the Scientific Council. The Principal author of the Assessment forms is S. Patrick Sparks, member of ICOMOS and member of ISCARSAH.

The Methodology and evaluation forms reflect the collaboration, hard work of work, and expertise of persons on the Haïti ICOMOS / Comité de pilotage - Steering Committee, ISCARSAH, and the International Committee on Risk Preparedness (ICORP). For the Methodology we would like to acknowledge and thank the critically important contributions of ICORP President Rohit Jigyasu; ICORP members Ritva Laurila, Sue Cole, and Richard Hughes; ISCARSAH co-President Claudio Modena; ISCARSAH members Lyne Fontaine, Patrick Sparks, Randolph Langenbach, and Luigia Binda.

For the Assessment forms we would like to thank Rohit Jigyasu, Randolph Langenbach, and Olsen Jean Julien of the Fondation Connaissance et Liberté (FOKAL).

I sincerely hope that we have not inadvertently forgotten anyone.

Address	Surveyor:	Date:
Location	Affiliation:	*day/month/year*

ICOMOS POST-EARTHQUAKE DAMAGE ASSESSMENT – HAITI 2010

Category of Damage	**0** UNDAMAGED	**1** MINOR DAMAGE USABLE	**2** MODERATE DAMAGE REPAIRABLE	**3** SEVERE DAMAGE REPAIRABLE	**4** DESTROYED
PREVIOUS TAG					

BUILDING IDENTIFICATION

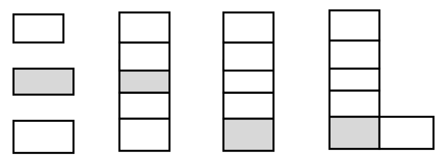
Address	
District	
Municipality	
Province	
Building name	
Owner name	
Latitude	**Longitude**

INSPECTION ACCURACY

From Outside Only **Complete** **Not Inspected**

Reason:

RELATION TO OTHER BUILDINGS



Isolated **Internal** **End** **Corner**

MAP REFERENCE

SKETCH and NOTES of BUILDING and SITE

Architectural Style:

3 GEOMETRICAL DATA

Total Stories	**Floor-to-floor height (*m*)**		**Floor Area (*m*)**		**Age**	**Use**		**Occupied?**	
	1		**1**			**Dwelling**			
	2		**2**			**Business**			
	3		**3**			**Assembly**			
	4		**4**			**Industrial**			
	5+ (avg)		**5+ (avg)**			**Other**			

Address	Surveyor:	Date:
Location	Affiliation:	*day/month/year*

SOIL & FOUNDATION							
Site Morphology				**Damage (present or possible)** __landslide __liquefaction __Fissures			
Peak	**High Slope**	**Mild slope**	**Level**	**Absent**	**Produced by earthquake**	**Worsened**	**Pre-existent**

ROOF	**Thrusting**	**Non-thrusting**	**Framing Type:** *describe*
Heavy			
Light			

BUILDING SHAPE		**Elevation**	
Plan		**Irregular**	**Regular**
1	**Irregular**		
2	**Regular**		

EXTERIOR STRUCTURE *mark all that apply*

Masonry walls	Stone	Brick	Block/tile
Concrete Frame	Infill: *brick tile stone block other*		
Light Wood frame	Horizontal sheathing	Diagonal sheathing	Metal sheathing
	Braced/unbraced		
Timber Frame	Colombage: *brick stone other*		
Iron/steel frame	Metal sheathing	Wood sheathing	Other
Other			

INTERIOR STRUCTURE *mark all that apply*

Masonry walls	Stone	Brick	Block/tile
Concrete Frame	Columns	Infill:	
Light Wood frame	Plaster	Wood covering	Drywall
Timber Frame	Columns	Sheathed	Other
Iron/steel frame	Columns	Braced	Other
Other			

FLOOR TYPE	**FRAMING**		
DIAPHRAGM	**Timber**	**Iron**	**Concrete**
Concrete			
Wood planks			
Vaults *corrugated or brick*			
Other			

ADEQUACY OF TYING *describe*

FURTHER ACTIONS:

Detailed Evaluation:

Barricades

Vertical shoring

Lateral Bracing

Banding

DAMAGE TO STRUCTURAL ELEMENTS

Damage level and extent / Structural Component		DAMAGE: Severe			Moderate			Minor			Null
		> 2/3	1/3 – 2/3	< 1/3	> 2/3	1/3 – 2/3	< 1/3	> 2/3	1/3 – 2/3	< 1/3	
		A	B	C	D	E	F	G	H	J	K
1	Vertical Structure										
2	Horizontal Structure										
3	Roof										
4	Cladding										
5	Stairs										
6	Pre-existing damage										

EXISTING EMERGENCY MEASURES

None	**Removal**	**Ties**	**Repairs**	**Shoring**	**Barricades**
A	**B**	**C**	**D**	**E**	**F**

Adresse	Inspecteur:	Date:
Emplacement	Affiliation:	*jour/mois/année*

ICOMOS ÉVALUATION DES DOMMAGES APRÈS SÉISME – HAITI 2010

CATÉGORIE DES DOMMAGES	**0** EN BON ÉTAT	**1** DOMMAGES MINEURS/UTILISABLE	**2** DOMMAGES MODERES REPARABLES	**3** DOMMAGES GRAVES RÉPARABLES	**4** DETRUIT
MARQUAGE PRECEDENT					

IDENTIFICATION DU BÂTIMENT	
Adresse	
Quartier	
Municipalité	
Province	
Nom du bâtiment	
Propriétaire	
Latitude	**Longitude**

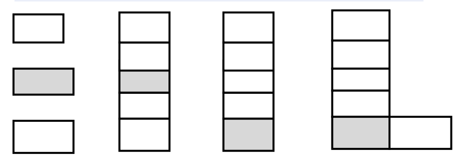
PRECISION DE L'INSPECTION

Extérieur seulement **Complet**

Non inspecté

Raison:

RAPPORT AUX AUTRE BÂTIMENTS



Isolé **Enclavé** **Extrémité** **En angle**

CARTE DE RÉFÉRENCE

DESSINS ET COMMENTAIRES DU BÂTIMENT ET DU SITE

Style Architectural:

3 DONNEES GEOMETRIQUES

Total des étages	**Hauteur d'un étage à l'autre (*m*)**		**Surface de plancher (*m²*)**		**Âge**	**Usage/destination**		**Occupé?**	
	1		**1**			**Domicile**			
	2		**2**			**Bureau**			
	3		**3**			**Assemblée**			
	4		**4**			**Industriel**			
	5+		**5+**			**Autre**			

Adresse	Inspecteur:	Date:
Emplacement	Affiliation:	*jour/mois/année*

SOLS ET FONDATIONS							
Morphologie du site				**Dommages (présents ou possibles) - glissement - liquéfaction - fissures**			
Sommet	**Pente forte**	**Pente douce**	**Niveau**	**Absent**	**Dû au séisme**	**Aggravée**	**Préexistant**

TOITURE	**Instable**	**Stable**	**Charpente du toit**: *à décrire*
Lourd			
Léger			

FORME BÂTIMENT		**Façade**	
	Plan	**Irrégulier**	**Régulier**
1	**Irrégulier**		
2	**Régulier**		

STRUCTURE EXTERIEURE			
Maçonnerie	Pierres	Briques	Tuiles
Ossature béton	Remplissage: briques tuiles pierres parpaings autre		
Ossature légère bois	Bardage horizontale	Bardage diagonale	Bardage métallique
	Contreventée/non contreventée		
Charpente bois	Colombage: *briques pierres terre*		
Ossature métallique	Revêtement métallique	Revêtement bois	Autre

STRUCTURE INTERIEURE			
Maçonnerie	Pierres	Briques	Tuiles
Ossature béton	Poteaux	Remplissage :	
Ossature légère bois	Plâtre	Couverture bois	Murs secs
Charpente bois	Poteaux	Revêtement	Autre
Ossature métallique	Poteaux	Contreventée	Autre
Autre			

TYPE DE PLANCHER	**OSSATURE**		
RAIDISSEUR	**Bois**	**Métal**	**Béton**
Béton			
Planches de bois			
Voûtes *tôle ou briques*			
Autre			

ACTIONS A PREVOIR:

Inspection détaillée:

Barricades

Etaiement vertical

Etaiement latéral

Cerclage

ADEQUATION DES LIAISONS *décrire*

DOMMAGES AUX ELEMENTS STRUCTURELS											
Niveau des dommages et étendue / **Composants structurels**	**DOMMAGES**										
	Sévères			**Modérés**			**Mineurs**			**Nuls**
	> 2/3	1/3 – 2/3	< 1/3	> 2/3	1/3 – 2/3	< 1/3	> 2/3	1/3 – 2/3	< 1/3	
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	K
1 Structure verticale										
2 Structure horizontale										
3 Toiture										
4 Bardage/façades										
5 Escaliers										
6 Dégâts préexistants										

MESURES D'URGENCE EXISTANTES					
Aucune	**Enlèvement/ nettoyage**	**Tirants**	**Réparations**	**Etaiement**	**Barricades**
A	**B**	**C**	**D**	**E**	**F**

ICOMOS FICHE D'EVALUATION DES DOMMAGES APRES SEISME – HAITI 2010