HOW SAFE IS MY HOUSE?

Self-check for Earthquake Safety of Concrete Hollow Block (CHB) Houses in the Philippines

The integrity and safety of a house depends on how it was made.

DOST

JICA

JST

ASEP

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OBJECTIVE OF THE TEST

This “House self-check” serves to understand and evaluate the integrity of your house and its vulnerability to strong earthquakes. The initial result will verify whether your house was properly built and have followed appropriate construction procedures and recommended measures or if it will require necessary strengthening.

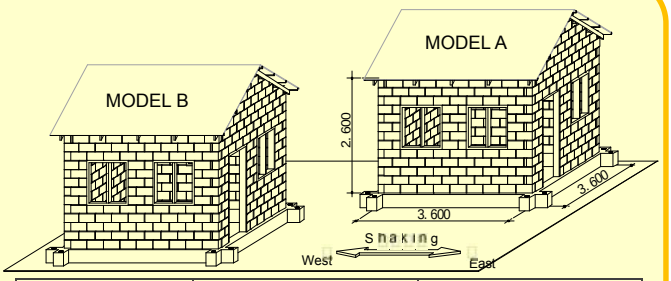
TARGET USERS / HOUSE TYPE

This evaluation is initially intended for 1 to 2-storey Concrete Hollow Block (CHB) houses, including those residences with small shops, offices, garages and the like. It will help the house owners of this type to evaluate their houses by themselves and to understand the likely behavior of their houses during a strong earthquake.

Full scale shaking table test of CHB Houses

A full-scale shaking table experiment on CHB masonry structures was conducted in Japan to showcase two types of CHB houses. One model represented a code-compliant CHB house (Model A) and the other represented the more common residential CHB house (Model B) in the Philippines. The aim of the test was to better understand the vulnerability of its different parts and sections, the failure pattern and the overall behavior of similar structures during large earthquakes.

For the Philippine CHB houses, the application of mortar is another crucial construction activity that should be given equal importance as with appropriate reinforcements. Mortar should be properly applied and compacted requiring proper mixing, pouring and curing to produce homogeneous fill and bond.



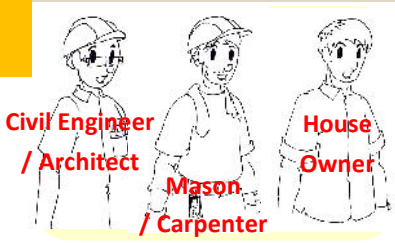
Specification	Model A	Model B
CHB Wall	6” (400x200x150 mm)	4” (400x200x100 mm)
Vertical Steel Bars	10 millimeter diameter spaced at 40 centimeter	6 millimeter diameter spaced 90 centimeter
Horizontal Steel Bars	10 millimeter diameter spaced at 60 centimeter or laid every 3 layers	6 millimeter diameter spaced at 60 centimeter or laid every 3 layers
Mortar Mix (Cement : Sand)	1:4 Compacted	1:4 Not compacted
Roof Frame / Roofing	Wood / G.I. Sheets	Wood / G.I. Sheets

Request and notes to those who distribute this material.

This method in evaluating CHB Houses was developed as an easy and manageable test for laymen to promote inexpensive yet practical performance evaluation of residential houses against earthquakes and to subsequently disseminate information and strategies for strengthening. It aims to help the house owners enhance their awareness and acquire relevant information by doing the evaluation themselves. This test shall lead to a more detailed assessment with assistance from building experts for what the house owners need to know about their house, allay their fears and confusion and learn what to do thereafter.

This earthquake disaster awareness material was prepared by the Philippine Institute of Volcanology and Seismology (PHIVOLCS) of the Department of Science and Technology (DOST) in collaboration with the Association of Structural Engineers of the Philippines (ASEP) under the Japan International Cooperation Agency (JICA) - Japan Science and Technology (JST) Project on the “ Enhancement of Earthquake and Volcano Monitoring and Effective Utilization of Disaster Mitigation Information in the Philippines”.

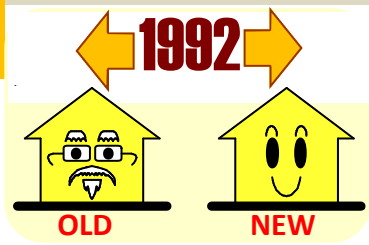
QUESTION 1 — Who built or designed my house?



Items		point
A: Built or designed by a licensed civil engineer/architect.	-	1
B: Not built by a licensed civil engineer/architect.	-	0
C: It is not clear or unknown.	-	0

This question refers to the person who supervised the building of the house.

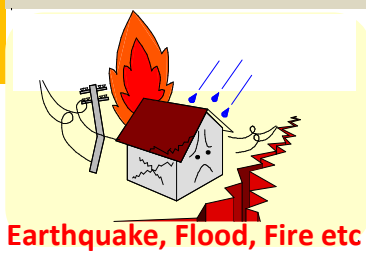
QUESTION 2 — How old is my house?



Items		point
A: Built in or after 1992.	-	1
B: Built before 1992.	-	0
C: It is not clear or unknown.	-	0

This checks if your house was built under more recent earthquake-resistant building standards.

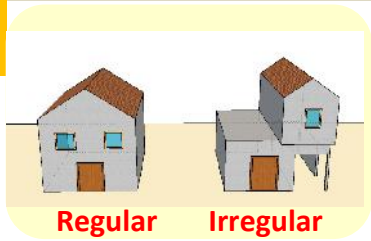
QUESTION 3 — Has my house been damaged by past earthquakes or other disasters ?



Items		point
A: NO or YES but repaired.	-	1
B: YES but not yet repaired.	-	0
C: It is not clear or unknown.	-	0

This checks if the house sustained structural damage and had undergone repair works.

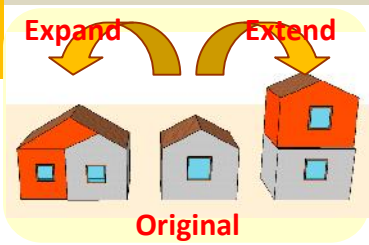
QUESTION 4 — What is the shape of my house?



Items		point
A: Regular (symmetrical, rectangular, box-type, simple)	-	1
B: Irregular/Complicated.	-	0
C: It is not clear or unknown.	-	0

This checks the shape of your house which influences behavior during strong ground shaking. .

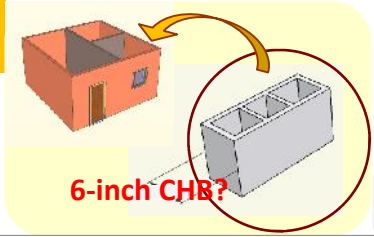
QUESTION 5 — Has my house been extended or expanded?



Items		point
A: NO or YES but supervised by a civil engineer/architect.	-	1
B: YES, but not supervised by a civil engineer/architect.	-	0
C: It is not clear or unknown.	-	0

This checks if additional construction was properly executed and correctly attached to the original structure.

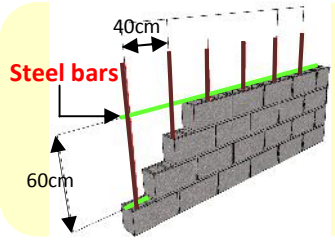
QUESTION 6 — Are the external walls of my house 6-inch (150mm) thick CHB?



Items		point
A: YES, it is 6-inch	-	1
B: NO, it is thinner than 6-inch.	-	0
C: It is not clear or unknown.	-	0

This checks if the standard size of at least 6" thick CHB was used.

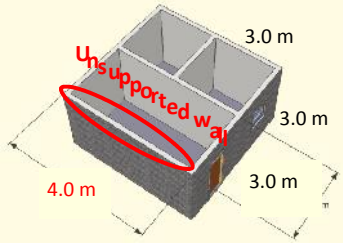
QUESTION 7 — Are steel bars of standard size and spacing used in walls ?



Items		point
A: YES (10mm diameter, tied and spaced correctly) .	-	1
B: NO, fewer and smaller than 10mm.	-	0
C: None or Unknown.	-	0

This checks if standard size and spacing of steel bars were used as reinforcement.

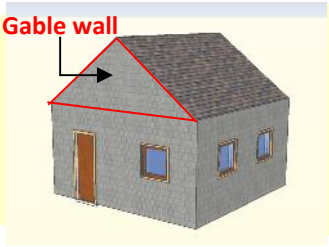
QUESTION 8 — Are there unsupported walls more than 3 meters wide?



Items		point
A: NONE, all unsupported walls are less than 3m wide.	-	1
B: YES, at least one unsupported wall is more than 3m wide.	-	0
C: It is not clear or Unknown.	-	0

This checks if the wall is properly supported from falling down.

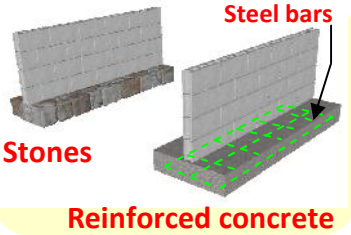
QUESTION 9 — What is the gable wall of my house made of ?



Items		point
A: Light materials, properly anchored CHBs, no gable wall.	-	1
B: Not properly anchored CHBs, Bricks, Stone.	-	0
C: It is not clear or Unknown.	-	0

This checks if the gable wall is properly supported by sufficient steel bars or by a lintel beam.

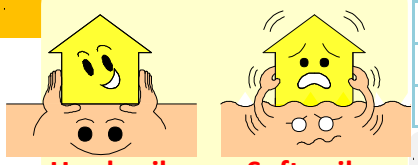
QUESTION 10 — What is the foundation of my house?



Items		point
A: Reinforced concrete.	-	1
B: Stones or unreinforced concrete.	-	0
C: It is not clear or Unknown.	-	0

This checks if the foundation is properly constructed to support the walls.

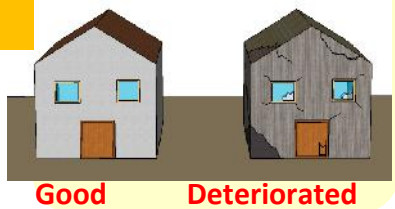
QUESTION 11 — What is the soil condition under my house?



Items		point
A: Hard (rock or stiff soil).	-	1
B: Soft (muddy or reclaimed) .	-	0
C: It is not clear or Unknown.	-	0

This checks if the house was built over a stable or stabilized ground.

QUESTION 12 — What is the overall condition of my house?



Items		point
A: Good condition.	-	1
B: Poor condition.	-	0
C: It is not clear or Unknown.	-	0

This describes the overall physical state of the house and checks defect or any deterioration.

Your information .

Name: Address: .

Score

Please sum up the points of question 1 to 12.

Total	Evaluation and Next steps
11 - 12 points	Though this seems safe for now, please consult experts for confirmation.
8 - 10 points	This requires strengthening, please consult experts.
0 - 7 points	This is disturbing! Please consult experts soon.

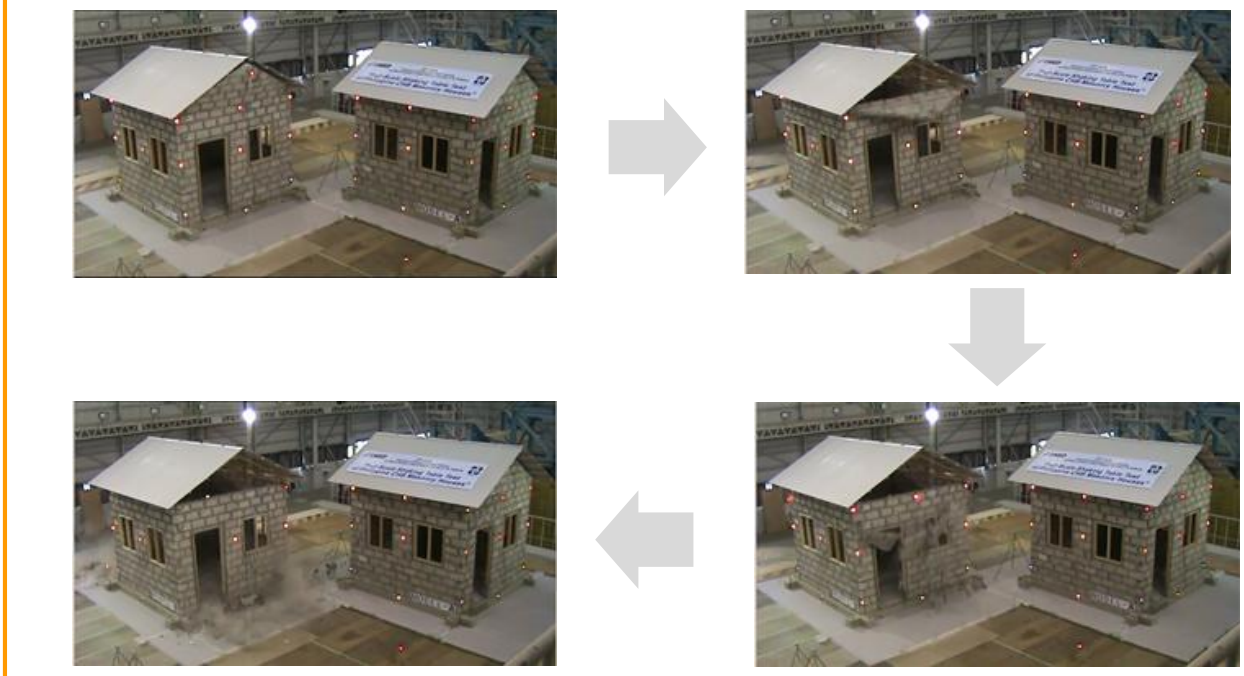
COMMENTARY AND RECOMMENDATION FOR SAFER CHB HOUSES

The National Building Code, the National Structural Code of the Philippines and the Full Scale Shaking Table Test for CHB Houses emphasizes adherence to design standards and proper construction implementation for CHB type of structures in the Philippines. The walls of CHB houses play a vital function as the main support of the structure. The code prescribes the use of at least 6" (150mm) thick CHB reinforced with vertical and horizontal steel bars with a minimum diameter of 10 millimeters spaced at 40 centimeters and 60 centimeters on center respectively. It also highly recommends that all CHB cells and joints are filled and compacted with mortar using the correct mix of 1 part of cement to 4 parts (1:4) of washed river sand.

This safety evaluation tool intends to provide more understanding and guidance whether your CHB house conformed with the minimum construction standard.

- It is assumed that building construction standards were most likely observed if authorized people took charge of the construction.
- It rates the chance that your house was built compliant to the recent earthquake-resistant building standards similar to special seismic detailing introduced in 1992.
- If damaged by previous earthquakes and disasters and not repaired, the structure is weakened making it vulnerable to a partial or total collapse during a strong ground shaking.
- The shape of the house influences its behavior during strong ground shaking. Box-type or rectangular-shaped houses behave better than those with irregular or unsymmetrical configurations.
- It is assumed that supervised expansion or extension leads to safer and stronger structures.
- The use of standard 6" CHB for external walls produces more stable and stronger structures. This was realized in the Full Scale Shaking Table Test conducted for CHB houses on two models on Feb 2011 in Tsukuba, Japan. Avoid using sand and gravel taken from the shorelines and beaches as materials for CHB, mortar, plaster and concrete mix for foundation for they are known to corrode the steel bars over time resulting to thinner diameter and loss of bond.
- Steel bars embedded in CHB walls, concrete columns, floors and foundation resist the impact of ground shaking. The use of the standard 10 millimeters diameter steel bars spaced at 40 centimeters from side to side and properly connected and tied to steel bars laid every 3 layers of CHB (~60 centimeters) prevent collapse of walls during earthquakes.
- Walls wider than 3 meters span without any perpendicular walls or supports are susceptible to collapse in a strong ground shaking.
- The shaking table test for CHB Houses exhibited that the unanchored gable part of the wall show larger horizontal movement during strong ground shaking. It is recommended that well-reinforced and well-anchored CHBs or light materials be used for the gable wall.
- Reinforced concrete wall foundation resists shaking, slipping and tilting better than stone-foundations.
- Rock or stiff-soil provides better support. Soft soils usually amplify strong ground shaking and tend to spread and subside the ground which may worsen damage to structure. For houses on slopes, tie beams or continues wall foundation prevent uneven settlement during strong ground shaking.
- It is important to observe the state of our house over time. Regular house maintenance must be done to prevent deteriorations like sagging roof, chipped-off plasters and cracks on walls.

Full Scale Shaking Table Test of CHB Houses, February 2011 in NIED Tsukuba, Japan



Pictures show the eventual collapse of the gable wall of Model B

Picture shows the collapsed gable part of the back wall of model B

It is highly recommended however, that the state of your house must be consulted to the proper authorities. The Engineers/Experts of your Local Government Unit may have recommended methods using affordable or low-cost materials to strengthen your house (specifically its walls) in order to protect it from collapse, and to minimize possible falling debris during strong earthquake ground shaking.

DOST

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