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# VIETNAM; A GUIDE TO STRENGTHEN YOUR HOME AGAINST STORMS AND FLOODS

A CATALOGUE OF TECHNICAL SUGGESTIONS FOR HOUSEHOLDS TO IMPROVE THE STRENGTH OF YOUR HOMES

# Preparing for the storm and flood

Before the typhoon season or when you receive information about strong wind or rain approaching, households are encouraged to carry out the following to their own abilities;

- Watch and listen out for early warning messages before, during and after the disaster season from loudspeakers, on the radio, TV and other information sources.
- Know where you will evacuate to, e.g. Evacuation center, evacuation holes or strong houses within the community, if the condition becomes severe.
- Be prepared and store enough materials such as rope, sand bags, tape for the window glass and poles to fix doors to prepare your home for the typhoon or flood. Ensure household assets are fixed and stored safely, toilets and water sources secured and safe.
- Prune tree branches to avoid house damage from falling trees.
- Strengthen your house as recommended in this guide.

## Using this guide

This guide offers advice for strengthening homes. It is organized according to the level of resources which may be available to each household. Main techniques include preparing for the storm and flood, strengthening house with Little, Medium and High resources. For each technique, the orange box demonstrated as below offers an indication of the level of resources required to execute the works, it offers estimates for labor, skill level, material needs and costs in Vietnamese Dong estimated for an average house size of 5.5m x 7.5m.

Example;

|                  |     |   |   |   |      |
|------------------|-----|---|---|---|------|
| Labour in days   | 1   | 2 | 3 | 4 | 5+   |
| Skill level      | Low |   |   |   | High |
| Materials needed | Low |   |   |   | High |



Resources required for typical house of 5.5 m x 7.5 m

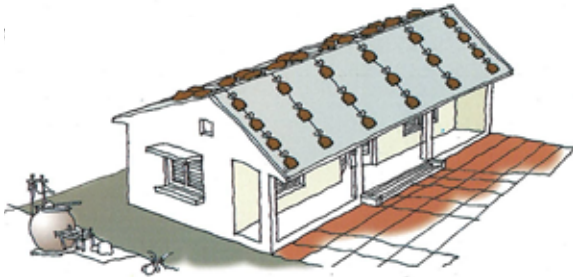
Costs (VND)

|      |         |         |           |      |
|------|---------|---------|-----------|------|
| 0-1m | 1m – 3m | 3m –15m | 15m – 30m | >30m |
|------|---------|---------|-----------|------|

# Preparing for the storm and flood

For the following recommendations all materials and tools required to execute works should be prepared in advance. In addition to works to the house in the case of a flood all belongings should be raised up to shelves or within attics.

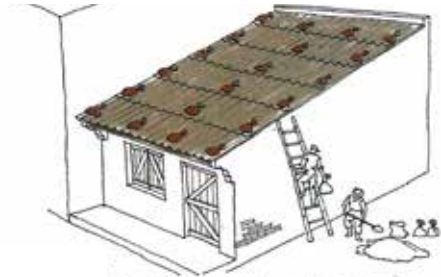
## P1 . Fix your roof against strong winds



Sand bags or aqua bags tied together with rope can be used to add weight to the roof to prevent it from wind uplift

Check roof structure if it is strong enough to carry extra load.

Sand bags or aqua bags should be placed immediately above the purlins .



Sand bags or aqua bags individually fixed to sections of separate roof sheets

|                  |  |   |  |  |  |  |  |
|------------------|--|---|--|--|--|--|--|
| Labour in days   | <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5+ |  | Typical house of 5.5 m x 7.5 m requires 48 bags of sand/water roughly 10-15kg each |  |  |  |  |
| Skill level      | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> High                            |   | Costs (VND)  | <input type="checkbox"/> 0-1m <input type="checkbox"/> 1m – 3m <input type="checkbox"/> 3m –15m <input type="checkbox"/> 15m – 30m <input type="checkbox"/> >30m |  |  |  |
| Materials needed | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> High                            |   |  |  |  |  |  |

## P2 . Fix your roof against strong winds using ropes and anchors



Timber structure fixed to top of roof finish to restrain sheeting in high winds

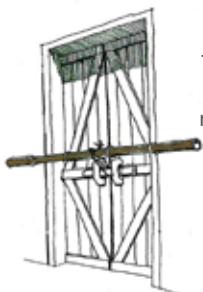


Roof structure tied back to the ground with rope anchored with 10cm diameter wood sticks or bamboo with min depth of 50cm into the ground.

If using plastic rope, use min 10mm diameter. If using zinc wire 4mm diameter double weave.

|                  |  |   |   |  |  |  |  |
|------------------|--|---|---|--|--|--|--|
| Labour in days   | <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5+ |  | Typical house of 5.5 m x 7.5 m requires 10 anchors, approx . 25x3m poles and 80m rope |  |  |  |  |
| Skill level      | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> High                            |   | Costs (VND)   | <input type="checkbox"/> 0-1m <input type="checkbox"/> 1m – 3m <input type="checkbox"/> 3m –15m <input type="checkbox"/> 15m – 30m <input type="checkbox"/> >30m |  |  |  |
| Materials needed | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> High                            |   |   |  |  |  |  |

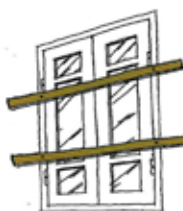
## P3 . Fix the window and door against strong winds



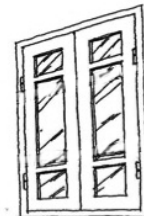
Timber pole used as a restraint bar



Reinforcement tape added to window panes



Timber strapping added to openings and fixed to frames and walls



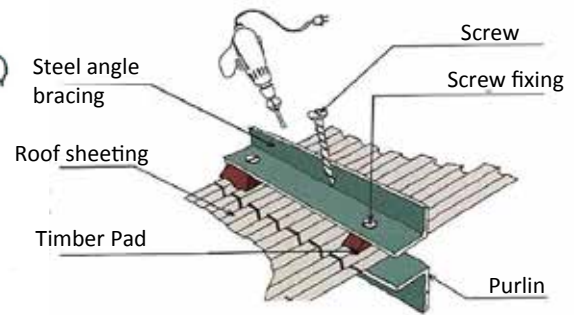
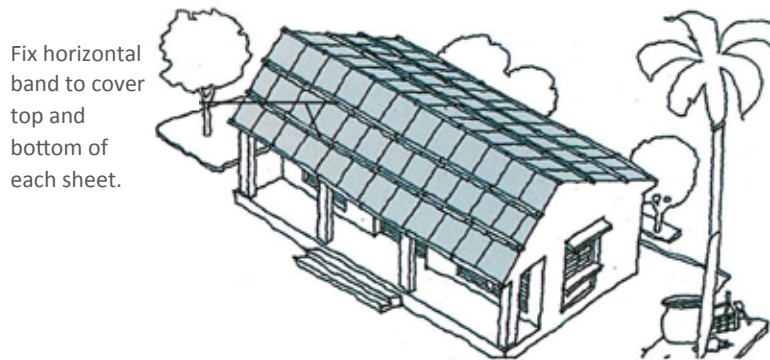
Add shutters if window opening are not covered

|                  |  |   |  |  |  |  |  |
|------------------|--|---|--|--|--|--|--|
| Labour in days   | <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5+ |  | Typical house of 5.5 m x 7.5 m requires enough material for 6-8 openings |  |  |  |  |
| Skill level      | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> High                            |   | Costs (VND)  | <input type="checkbox"/> 0-1m <input type="checkbox"/> 1m – 3m <input type="checkbox"/> 3m –15m <input type="checkbox"/> 15m – 30m <input type="checkbox"/> >30m |  |  |  |
| Materials needed | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> High                            |   |  |  |  |  |  |

# Strengthening your house with little resources (< 3 million Dong)

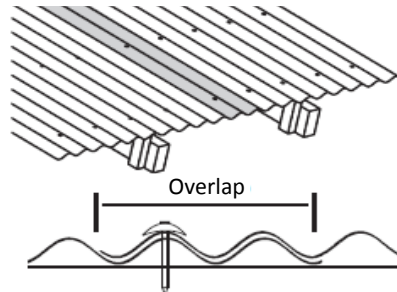
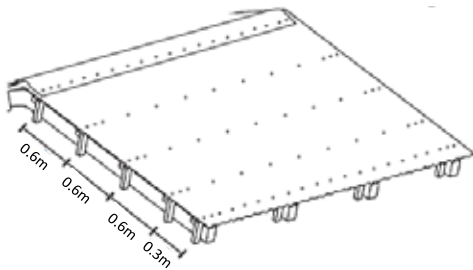
## L1. Tie down roof cover (sheet roofing)

Steel angle tied to purlin at sheet joint



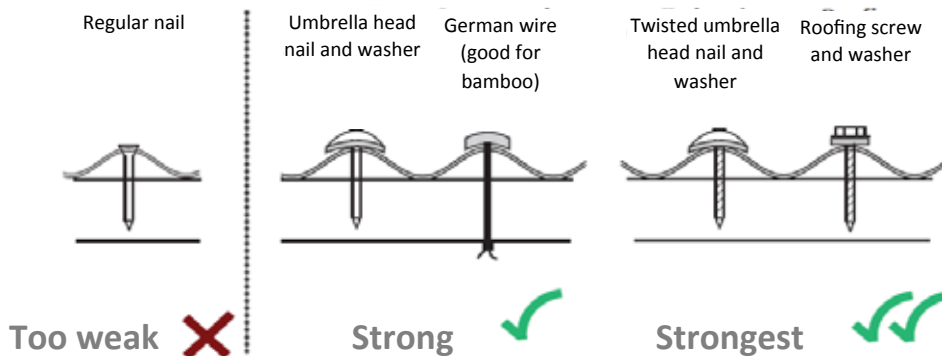
|                  |  |   |   |   |  |  |  |
|------------------|--|---|---|---|--|--|--|
| Labour in days   | <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5+ |  | Typical house of 5.5 m x 7.5 m requires Approx. 36 m length of steel angles |   |  |  |  |
| Skill level      | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> High   |   | Costs (VND)   | <input type="checkbox"/> 0-1m <input checked="" type="checkbox"/> 1m – 3m <input type="checkbox"/> 3m –15m <input type="checkbox"/> 15m – 30m <input type="checkbox"/> >30m |  |  |  |
| Materials needed | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> High   |   |   |   |  |  |  |

## L2. Tie down roof cover (fixing sheet roofing)



Overlap roof sheets with at least two troughs to strengthen joints and avoid leaking

## L3 . Roof fixings techniques (nails and screws)



Fix nails and screws to the top of the trough to avoid leakage

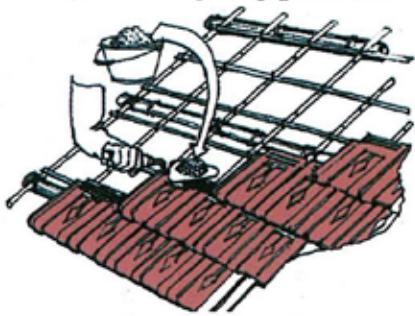
|                             |  |   |  |   |  |  |  |
|-----------------------------|--|---|--|---|--|--|--|
| <b>L2+L3</b> Labour in days | <input type="checkbox"/> 1 <input checked="" type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5+ |  | Typical house 5.5 m x 7.5 m requires fixtures for roof area of approx. 60 sqm, 10-12 nails per sqm |   |  |  |  |
| Skill level                 | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> High   |   | Costs (VND)  | <input type="checkbox"/> 0-1m <input checked="" type="checkbox"/> 1m – 3m <input type="checkbox"/> 3m –15m <input type="checkbox"/> 15m – 30m <input type="checkbox"/> >30m |  |  |  |
| Materials needed            | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> High   |   |  |   |  |  |  |

# Strengthening your house with little resources (< 3 million Dong)

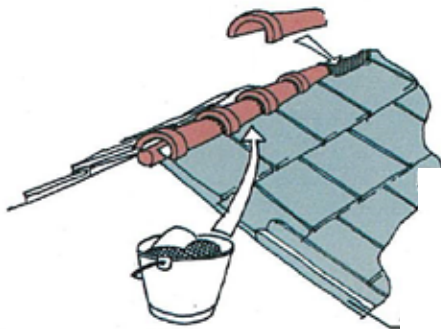
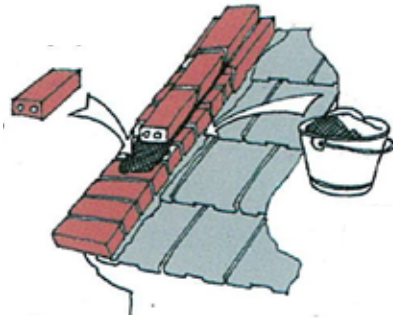
## L4. Roof fixing techniques (Tiles)

Before fixing the roof, household should clean the roof and scrub off algae.

**A.** Use a mortar bed to fix each tile. (Consider this technique when building a new house).

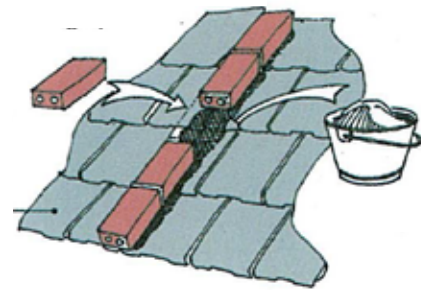


**B.** Lay brick bands on a mortar bed over gable ends



**C.** Use a mortar bed for the ridge tiles. (Consider this technique when building a new house).

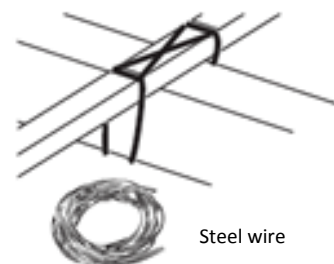
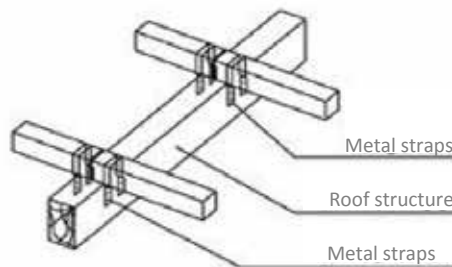
**D.** Lay brick band on a mortar bed over clay tiles



|                  |  |                                  |                                   |                                    |  |  |
|------------------|--|----------------------------------|-----------------------------------|------------------------------------|--|--|
| Labour in days   | <input type="checkbox"/> 1               | <input type="checkbox"/> 2       | <input type="checkbox"/> 3        | <input type="checkbox"/> 4         | <input checked="" type="checkbox"/> 5+ |  Typical house 5.5 x 7.5 m requires 400 unit of 10cm wide bricks + 1 cement bag |
| Skill level      | <input checked="" type="checkbox"/> Low  | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High          |  |
| Materials needed | <input checked="" type="checkbox"/> Low  | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High          |  |
| Costs (VND)      | <input checked="" type="checkbox"/> 0-1m | <input type="checkbox"/> 1m - 3m | <input type="checkbox"/> 3m - 15m | <input type="checkbox"/> 15m - 30m | <input type="checkbox"/> >30m          |  |

## L5 . Fixing roof structure together and to the wall

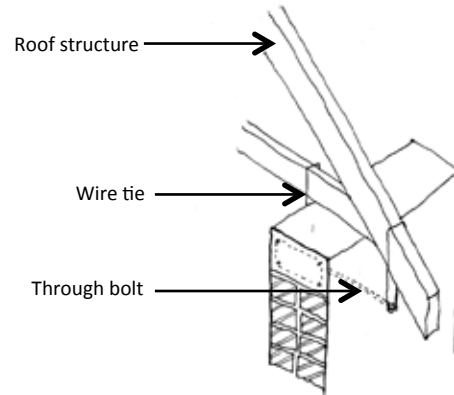
(Consider applying this technique when building a new house).



|                  |  |                                       |                                   |                                    |                               |   |
|------------------|--|---------------------------------------|-----------------------------------|------------------------------------|-------------------------------|---|
| Labour in days   | <input type="checkbox"/> 1               | <input checked="" type="checkbox"/> 2 | <input type="checkbox"/> 3        | <input type="checkbox"/> 4         | <input type="checkbox"/> 5+   |  Typical house 5.5m x 7.5 m requires 4-6kg of steel wire |
| Skill level      | <input checked="" type="checkbox"/> Low  | <input type="checkbox"/>              | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High |   |
| Materials needed | <input checked="" type="checkbox"/> Low  | <input type="checkbox"/>              | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High |   |
| Costs (VND)      | <input checked="" type="checkbox"/> 0-1m | <input type="checkbox"/> 1m - 3m      | <input type="checkbox"/> 3m - 15m | <input type="checkbox"/> 15m - 30m | <input type="checkbox"/> >30m |   |

# Strengthening your house with little resources (< 3 million Dong)

## L6 . Fixing roof structure to the wall

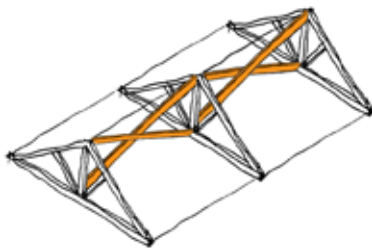


|                  |                              |                                       |                            |                            |                               |
|------------------|------------------------------|---------------------------------------|----------------------------|----------------------------|-------------------------------|
| Labour in days   | <input type="checkbox"/> 1   | <input checked="" type="checkbox"/> 2 | <input type="checkbox"/> 3 | <input type="checkbox"/> 4 | <input type="checkbox"/> 5+   |
| Skill level      | <input type="checkbox"/> Low | <input checked="" type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/> High |
| Materials needed | <input type="checkbox"/> Low | <input type="checkbox"/>              | <input type="checkbox"/>   | <input type="checkbox"/>   | <input type="checkbox"/> High |

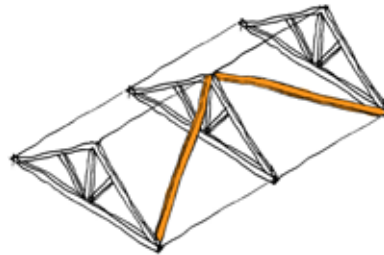
Typical house 5.5m x 7.5 m requires 4-5kg of steel wire and 30 bolts

|             |  |                                  |                                   |                                    |                               |
|-------------|--|----------------------------------|-----------------------------------|------------------------------------|-------------------------------|
| Costs (VND) | <input checked="" type="checkbox"/> 0-1m | <input type="checkbox"/> 1m - 3m | <input type="checkbox"/> 3m - 15m | <input type="checkbox"/> 15m - 30m | <input type="checkbox"/> >30m |
|-------------|--|----------------------------------|-----------------------------------|------------------------------------|-------------------------------|

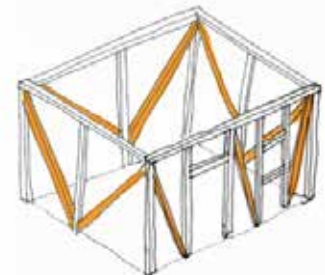
## L7 . Strengthen timber structures (bracing)



1. Cross bracing (bamboo, wood) can be between trusses.



2. Cross bracing can be added to roof pitch (Consider applying this technique when building a new house).



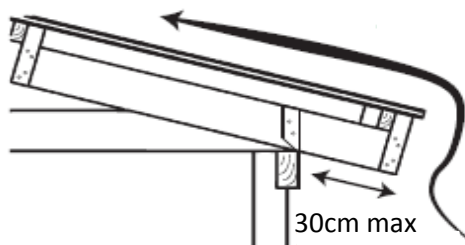
3. Introduce diagonal bracing to timber frame structures.

|                  |                              |                                       |                                     |                                     |                               |
|------------------|------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|-------------------------------|
| Labour in days   | <input type="checkbox"/> 1   | <input checked="" type="checkbox"/> 2 | <input type="checkbox"/> 3          | <input type="checkbox"/> 4          | <input type="checkbox"/> 5+   |
| Skill level      | <input type="checkbox"/> Low | <input type="checkbox"/>              | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> High |
| Materials needed | <input type="checkbox"/> Low | <input type="checkbox"/>              | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> High |

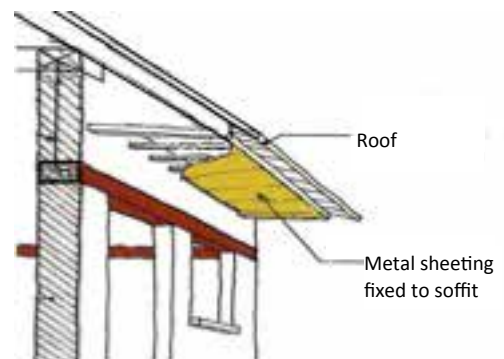
Typical house 5.5m x 7.5 m  
Cost for bamboo bracing: ~ 500 thousand  
Cost for wood bracing: 1 - 3 million

|             |                               |   |                                   |                                    |                               |
|-------------|-------------------------------|---|-----------------------------------|------------------------------------|-------------------------------|
| Costs (VND) | <input type="checkbox"/> 0-1m | <input checked="" type="checkbox"/> 1m - 3m | <input type="checkbox"/> 3m - 15m | <input type="checkbox"/> 15m - 30m | <input type="checkbox"/> >30m |
|-------------|-------------------------------|---|-----------------------------------|------------------------------------|-------------------------------|

## L8 . Roof overhang design



Overhangs should not exceed 30cm



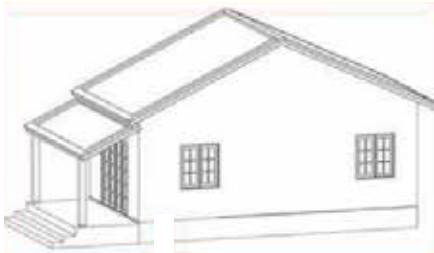
|                  |                              |                            |                                       |                                     |                               |
|------------------|------------------------------|----------------------------|---------------------------------------|-------------------------------------|-------------------------------|
| Labour in days   | <input type="checkbox"/> 1   | <input type="checkbox"/> 2 | <input checked="" type="checkbox"/> 3 | <input type="checkbox"/> 4          | <input type="checkbox"/> 5+   |
| Skill level      | <input type="checkbox"/> Low | <input type="checkbox"/>   | <input type="checkbox"/>              | <input checked="" type="checkbox"/> | <input type="checkbox"/> High |
| Materials needed | <input type="checkbox"/> Low | <input type="checkbox"/>   | <input checked="" type="checkbox"/>   | <input type="checkbox"/>            | <input type="checkbox"/> High |

Typical house of 5.5m x 7.5 m requires 3-6 sqm sheet metal for eave soffit

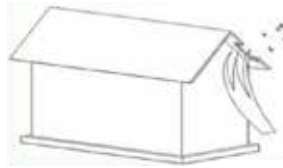
|             |                               |   |                                   |                                    |                               |
|-------------|-------------------------------|---|-----------------------------------|------------------------------------|-------------------------------|
| Costs (VND) | <input type="checkbox"/> 0-1m | <input checked="" type="checkbox"/> 1m - 3m | <input type="checkbox"/> 3m - 15m | <input type="checkbox"/> 15m - 30m | <input type="checkbox"/> >30m |
|-------------|-------------------------------|---|-----------------------------------|------------------------------------|-------------------------------|

# Strengthening your house with medium resources (15 -30 million dong)

## M1. Separate veranda structure

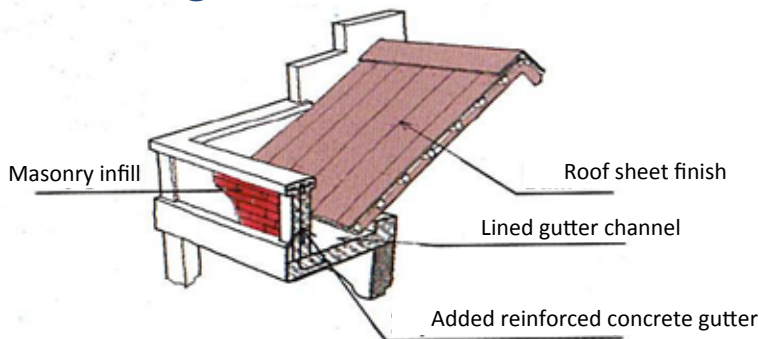


For sheet metal roofs cut extra redundant part of the eave and hem the eave with sheet metal



Avoid wide roof overhangs; separate the veranda structure from the house. Introduce a parapet around the eaves

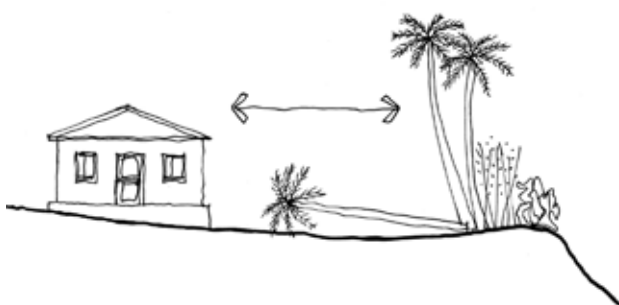
## M2. Protecting the eaves



Introduce a parapet detail to the perimeter of the edges of the roof. (Consider applying this technique when building a new house).

|                  |         |         |           |      |      |  |      |         |         |           |      |
|------------------|---------|---------|-----------|------|------|--|------|---------|---------|-----------|------|
| Labour in days   | 1       | 2       | 3         | 4    | 5+   |  Typical house of 5.5m x 7.5 m requires 8-16m of concrete guttering |      |         |         |           |      |
| Skill level      | Low     |         |           |      | High |  |      |         |         |           |      |
| Materials needed | Low     |         |           |      | High |  |      |         |         |           |      |
|                  |         |         |           |      |      | Costs (VND) <table border="1"> <tr> <td>0-1m</td> <td>1m – 3m</td> <td>3m –15m</td> <td>15m – 30m</td> <td>&gt;30m</td> </tr> </table>                 | 0-1m | 1m – 3m | 3m –15m | 15m – 30m | >30m |
| 0-1m             | 1m – 3m | 3m –15m | 15m – 30m | >30m |      |  |      |         |         |           |      |

## M3. Roof pitch



Site houses adequately far enough away from trees



Construct wind breaks around structures, layer 1 is made up of low shrubs, layer 2 of bamboo and layer 3 of tall trees (often Jackfruit)

|                  |     |   |   |   |      |   |
|------------------|-----|---|---|---|------|---|
| Labour in days   | 1   | 2 | 3 | 4 | 5+   |  Construct fence, or grow vegetation |
| Skill level      | Low |   |   |   | High |   |
| Materials needed | Low |   |   |   | High |   |
|                  |     |   |   |   |      | Costs (VND): No construction cost estimate  |

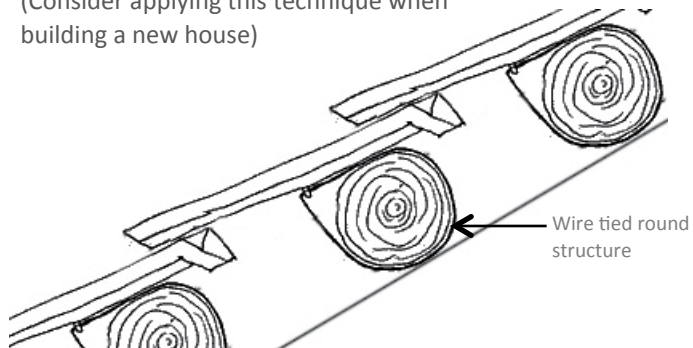
# Strengthening your house with medium resources (15 -30 million dong)

## M4. Tie down roof cover

The tile has a hole located on the underside, which allows wire to be tied to the roof structure or batten. Tie every two/three tiles.



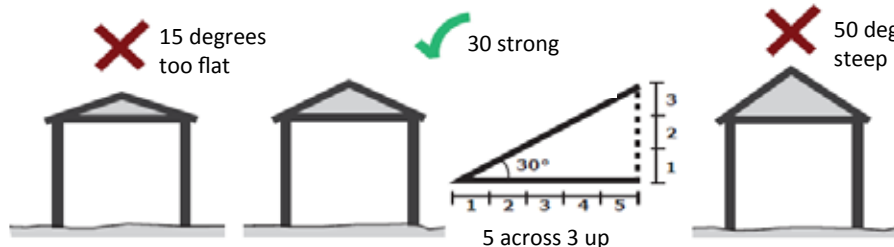
(Consider applying this technique when building a new house)



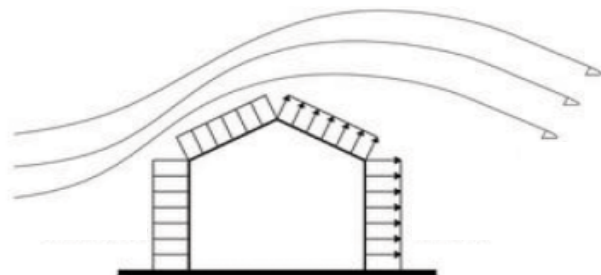
|                  |  |   |  |   |  |  |  |
|------------------|--|---|--|---|--|--|--|
| Labour in days   | <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input checked="" type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5+ |  | Typical house of 5.5m x 7.5 m requires approx 1,400 clay tiles |   |  |  |  |
| Skill level      | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> High   |   | Costs (VND)  | <input type="checkbox"/> 0-1m <input type="checkbox"/> 1m - 3m <input type="checkbox"/> 3m -15m <input checked="" type="checkbox"/> 15m - 30m <input type="checkbox"/> >30m |  |  |  |
| Materials needed | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> High   |   |  |   |  |  |  |

# Strengthening your house with high resources (> 30 million Dong)


## H1. Roof pitch



Advisable roof form and pitch  
(Consider applying this technique when building a new house).



Wind can cause pressure differences to pull walls and roofs apart

|                  |  |   |   |   |  |  |  |
|------------------|--|---|---|---|--|--|--|
| Labour in days   | <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input checked="" type="checkbox"/> 5+ |  | Take roof cover and structure off, remodel roof pitch and cover roof again.<br>Cost of sheet metal roof: 20-25 million<br>Cost of tiled roof: 30-35 million |   |  |  |  |
| Skill level      | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> High   |   | Costs (VND)   | <input type="checkbox"/> 0-1m <input type="checkbox"/> 1m - 3m <input type="checkbox"/> 3m -15m <input type="checkbox"/> 15m - 30m <input checked="" type="checkbox"/> >30m |  |  |  |
| Materials needed | <input type="checkbox"/> Low <input checked="" type="checkbox"/> <input type="checkbox"/> High   |   |   |   |  |  |  |

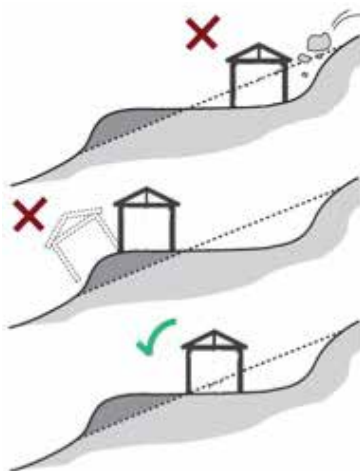
# Strengthening your house with high resources (> 30 million Dong)

The following recommendations should be considered when building a new house.

## H2. Relocate house to safer location



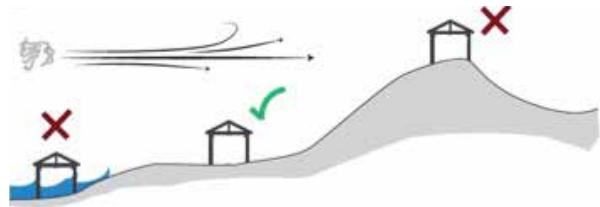
**A.** Plant trees and build mounds to help dissipate wind strength and storm surge



**C.** Don't build too close to edges or too close to slope where land slides might occur.



**B.** When siting houses, provide space between units so trees can be planted to deflect the wind



**D.** Select sites for your house away from flood prone areas and away from places with high winds.

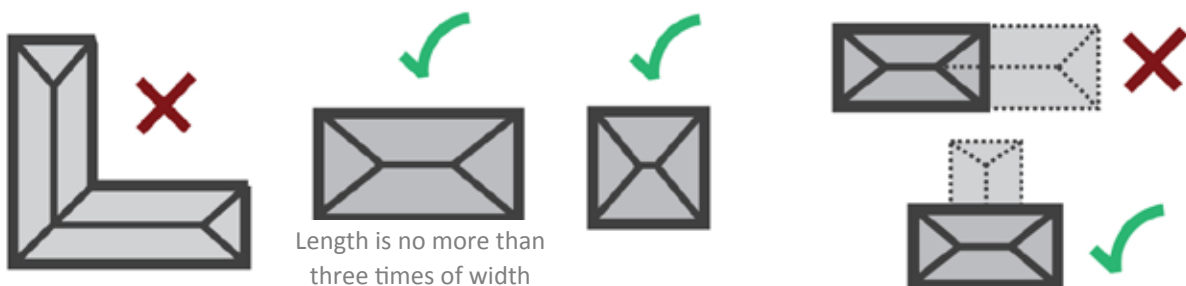


**E.** When selecting housing location, check water level indicator to see how high the flood can reach to built house or increase the platform to higher position.

|                  |   |                                  |                                   |                                    |  |  |
|------------------|---|----------------------------------|-----------------------------------|------------------------------------|--|--|
| Labour in days   | <input type="checkbox"/> 1              | <input type="checkbox"/> 2       | <input type="checkbox"/> 3        | <input type="checkbox"/> 4         | <input checked="" type="checkbox"/> 5+   |  Households need to find safe land and negotiate relocation lots and to rebuild houses. |
| Skill level      | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High            |  |
| Materials needed | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High            |  |
| Costs (VND)      | <input type="checkbox"/> 0-1m           | <input type="checkbox"/> 1m - 3m | <input type="checkbox"/> 3m - 15m | <input type="checkbox"/> 15m - 30m | <input checked="" type="checkbox"/> >30m |  |

## H3. Rebuild house with simple shape

Simple, compact shapes are the safest



|                  |   |                                  |                                   |                                    |  |   |
|------------------|---|----------------------------------|-----------------------------------|------------------------------------|--|---|
| Labour in days   | <input type="checkbox"/> 1              | <input type="checkbox"/> 2       | <input type="checkbox"/> 3        | <input type="checkbox"/> 4         | <input checked="" type="checkbox"/> 5+   |  Households need remodel and reconstruct parts of the house. |
| Skill level      | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High            |   |
| Materials needed | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High            |   |
| Costs (VND)      | <input type="checkbox"/> 0-1m           | <input type="checkbox"/> 1m - 3m | <input type="checkbox"/> 3m - 15m | <input type="checkbox"/> 15m - 30m | <input checked="" type="checkbox"/> >30m |   |

# Strengthening your house with high resources (> 30 million Dong)

The following recommendations should be considered when building a new house.

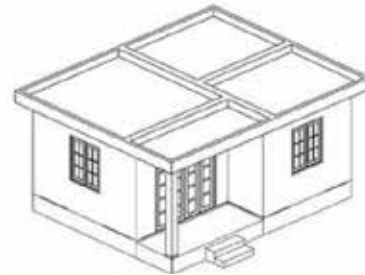
## H4. Improve roof shape



Use appropriate slope and fix edges of the roof



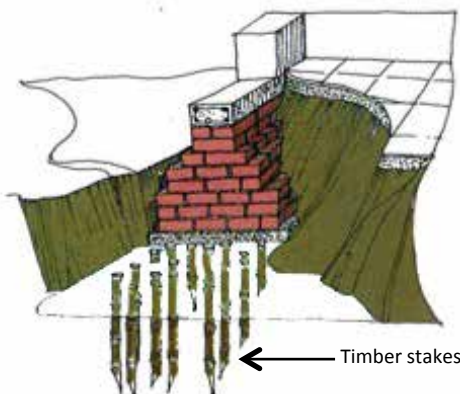
Use roof with four slopes (hipped roof)



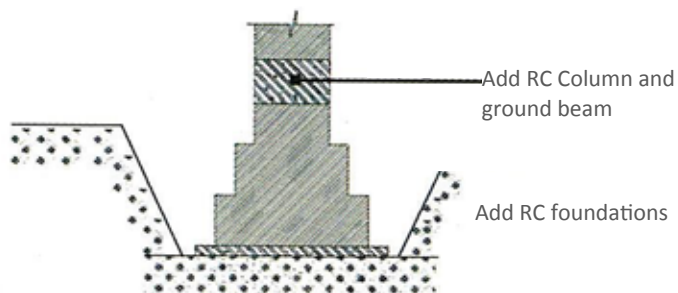
Convert to reinforced concrete (RC) roof

|                  |   |                                  |                                   |                                    |  |  |
|------------------|---|----------------------------------|-----------------------------------|------------------------------------|--|--|
| Labour in days   | <input type="checkbox"/> 1              | <input type="checkbox"/> 2       | <input type="checkbox"/> 3        | <input type="checkbox"/> 4         | <input checked="" type="checkbox"/> 5+   |  Households will need to remove existing roof off and construct new roof structure. |
| Skill level      | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High            |  |
| Materials needed | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>           | <input type="checkbox"/> High            |  |
| Costs (VND)      | <input type="checkbox"/> 0-1m           | <input type="checkbox"/> 1m - 3m | <input type="checkbox"/> 3m - 15m | <input type="checkbox"/> 15m - 30m | <input checked="" type="checkbox"/> >30m |  |

## H5. Improve Foundations



Use a perimeter reinforced concrete capping beam on a stepped brick base foundation.



Stepped foundations are strongest

|                  |   |                                  |  |                                    |  |  |
|------------------|---|----------------------------------|--|------------------------------------|--|--|
| Labour in days   | <input type="checkbox"/> 1              | <input type="checkbox"/> 2       | <input type="checkbox"/> 3                   | <input type="checkbox"/> 4         | <input checked="" type="checkbox"/> 5+ |  Typical house 5.5m x 7.5 m requires a foundation upgrade of 28 linear meters |
| Skill level      | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>                     | <input type="checkbox"/>           | <input type="checkbox"/> High          |  |
| Materials needed | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>                     | <input type="checkbox"/>           | <input type="checkbox"/> High          |  |
| Costs (VND)      | <input type="checkbox"/> 0-1m           | <input type="checkbox"/> 1m - 3m | <input checked="" type="checkbox"/> 3m - 15m | <input type="checkbox"/> 15m - 30m | <input type="checkbox"/> >30m          |  |

## H5. Strengthening walls

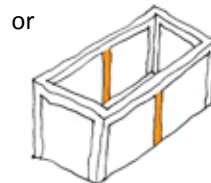


Walls with no RC column or structure with long spans are weak, walls should be plastered to enhance stiffness

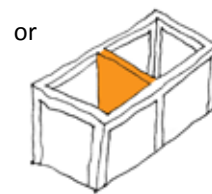
To strengthen



Adding pilasters to the walls



Additional columns



Adding internal walls

|                  |   |                                  |                                   |   |  |  |
|------------------|---|----------------------------------|-----------------------------------|---|--|--|
| Labour in days   | <input type="checkbox"/> 1              | <input type="checkbox"/> 2       | <input type="checkbox"/> 3        | <input type="checkbox"/> 4                    | <input checked="" type="checkbox"/> 5+ |  Typical house 5.5m x 7.5 m requires 2 additional columns, 30-35m of bracing if an RC bracing system is applied |
| Skill level      | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>                      | <input type="checkbox"/> High          |  |
| Materials needed | <input checked="" type="checkbox"/> Low | <input type="checkbox"/>         | <input type="checkbox"/>          | <input type="checkbox"/>                      | <input type="checkbox"/> High          |  |
| Costs (VND)      | <input type="checkbox"/> 0-1m           | <input type="checkbox"/> 1m - 3m | <input type="checkbox"/> 3m - 15m | <input checked="" type="checkbox"/> 15m - 30m | <input type="checkbox"/> >30m          |  |

# Preparing for the storm and flood

## Additional recommendations

### P4 . Build a mezzanine within the house.

|                  |   |   |  |
|------------------|---|---|--|
| Labour in days   | <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input checked="" type="checkbox"/> 5+                          |  | Typical house of 5.5 m x 7.5 m, a mezzanine could be 4x2 m in area |
| Skill level      | <input type="checkbox"/> Low <input checked="" type="checkbox"/> High   |   |  |
| Materials needed | <input type="checkbox"/> Low <input checked="" type="checkbox"/> High   |   |  |
| Costs (VND)      | <input type="checkbox"/> 0-1m <input type="checkbox"/> 1m – 3m <input type="checkbox"/> 3m –15m <input type="checkbox"/> 15m – 30m <input checked="" type="checkbox"/> >30m |   |  |

### P5 . Raise the floor of the house.

|                  |   |   |                                |
|------------------|---|---|--------------------------------|
| Labour in days   | <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input checked="" type="checkbox"/> 4 <input type="checkbox"/> 5+                          |  | Typical house of 5.5 m x 7.5 m |
| Skill level      | <input type="checkbox"/> Low <input checked="" type="checkbox"/> High   |   |                                |
| Materials needed | <input type="checkbox"/> Low <input checked="" type="checkbox"/> High   |   |                                |
| Costs (VND)      | <input type="checkbox"/> 0-1m <input type="checkbox"/> 1m – 3m <input type="checkbox"/> 3m –15m <input checked="" type="checkbox"/> 15m – 30m <input type="checkbox"/> >30m |   |                                |

## House Designs



For specific designs the Ministry of Construction has many proposals for different contexts and budgets “Supporting the poor to construct storm/flood resistant housing in the Central of Vietnam”, Decision 48/2014/QĐ-TTg.

