You can help keep your families safe from earthquakes!

屋顶 Roof

小心！不能使用预制板！
CAUTION! Do not use precast concrete planks for your roof!

在四川省的震区内使用预制板是很危险的
用预制板建造的屋顶是很危险的，是因为预制板的过重和板与板之间搭接过弱。用预制板建造的屋顶在地震时会很容易倒塌而伤害家人。木屋顶与现浇楼板会
为更安全。

Precast concrete planks are not safe to use in earthquake-prone areas

Using precast concrete planks for your roof is dangerous because they are too heavy and the connection between each plank is not strong. During a strong earthquake, it is likely that roofs made from precast concrete planks will collapse causing serious injury or death to anyone inside the home. A much safer roof option is to use a timber roof or a cast-in-place reinforced concrete roof.

选择1：使用现浇钢筋混凝土
Option 1: Use cast-in-place reinforced concrete

优点：
• 抗震性好
• 屋面可以利用
• 现浇混凝土屋面板

更牢固

Advantages:
• Resists earthquake well
• Roof surface can be used
• Properly make roof will

last a long time

缺点：
• 施工难度高，如加固不够也
可在地震中倒塌
• 排水慢，易积水。一定要

做屋顶防水

Challenges:
• Requires more care to construct.
If not reinforced properly it can
collapse in an earthquake.
• Be sure to waterproof roof slab.
Cast in place roof is more likely
to leak.

选择2：使用铺瓦的木质梁架
Option 2: Use timber truss with clay tiles

优点：
• 轻
• 便宜
• 排水快
• 冬暖夏凉
• 施工难度小

Advantages:
• Light
• Cheap
• Sheds water quickly
• Warm in winter, cool in summer
• Simple construction

缺点：
• 木架容易腐朽，所以

必须做防腐处理

Challenges:
• Wood may rot easily, it must be

treated with preservative.

X

木屋架：透雨的山墙形状为三角

形，山墙可用水泥或粘土做，最好用

木屋架，水泥能控制裂纹

Wooden truss: A gable wall is the triangle

formed by a sloping roof. Gable wall can be

made of wood or brick. The best practice is
to use a wood gable wall because they are

tighter and lasts.

X

不要使用砖或木墙，砖或木墙位置

过高且没有处架支撑，容易产生新

建和老旧部分，需使用木制山墙或

现浇混凝土。

Masonry gable walls can be used but are not

recommended because the height will lack

of bracing can cause them to crack easily

and collapse during an earthquake.

X

如采用钢和木墙，一定要用钢筋

混凝土楼板连接（见上图）所示位置

If a masonry gable wall is used, then the sloping

part of the masonry must be connected by a

reinforced concrete beam.

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抗震户型 Earthquake Resistant Building Configuration

简单、方正和对称的农房户型是房屋的抗震性的关键点
Simple, square, symmetric layout is critical to good performance during earthquakes

房屋外形 Shape Of The House
比较其他不规则类型的房屋，正方形最利于抗震。长度应该小于宽度的4倍。避免L型的房屋。
Square is the best shape for earthquake resistance. Length should be less than four times the width. Avoid L-shaped buildings.

墙体密度要对称 Sufficient Symmetric Wall Density
• 南 - 北、东 - 西两个走向应分别至少有两段结构墙
  Use a minimum of two structural shear walls in each direction
• 在平面图中尽可能使结构墙近似对称布置
  Structural walls should be approximately symmetric in plan

构造柱位 Tie Column Locations
建议：构造柱必须设置在：
RECOMMENDATION: Tie columns should be located at:
- 每个外墙与外墙连接处
  Every exterior corner
- 每个内墙与外墙连接处
  Every intersection between interior and exterior wall
- 每个内墙与内墙连接处
  Every intersection between interior walls
- 宽度大于1.5m的门洞两边
  Door openings larger than 1.5m long should have columns at both sides
- 隔墙的端部
  The end of a partition wall
- 横墙超过6m加设构造柱
  Column in walls longer than 6 meters

门窗洞口 Openings
• 每道墙体上尽量只设一个门洞或窗洞
• 如果开间临近结构墙，洞口两边应设置构造柱
• Maximum one opening per wall panel
• If opening is adjacent to a structural shear wall, the opening should be confined by tie columns at both sides
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砌体结构条形基础 Masonry Strip Footing

修筑毛石混凝土基础时要保证混凝土能够填满所有毛石间的空隙

When building the stone masonry for the foundation, it is important to fill all the gaps between the stones.

旧址重建时，若挖出旧基础，松土，大树根，井或沼气池等应妥善处理，否则会引起新的地基沉降。应该先把它们清理掉，再用小颗粒细石混凝土回填。

Loose soils, leftover foundations, tree roots, or underground tanks will not support the foundation properly. They should be excavated and filled with pea gravel (small gravel with diameter 1cm or less).

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建议用于一层或两层的砖混结构

Recommendation for 1 or 2 story confined masonry house

在构造柱处，砖石基础应设大马镫。构造柱中钢筋应延伸至砖石基础底部，端部弯钩长度至少为36cm。The long bars from the column should extend to the base of the foundation and terminate with anchors that are at least 36cm long.

毛石不应直接接触基槽侧壁的混凝土。Stones should not touch the walls of the foundation trench.

Inadequate space between stones, spaces not completely filled with mortar.

毛石之间不要互相接触，要留10cm的间距。毛石间的空隙要灌满混凝土。Stones should not be touching each other. Leave at least 10cm space between each stone and fill the gap completely with concrete.

配置混凝土时不能使用连砂石。When mixing the concrete for the foundation, do not use gravel that is already mixed with sand. Instead, use clean sand and gravel.

应使用振捣棒振捣，帮助混凝土流到毛石之间的缝隙里去。Use a concrete vibrator to fill the gaps between stones completely with concrete.

在构造柱处，砖石基础应设大马镫。构造柱中钢筋应延伸至砖石基础底部，端部弯钩长度至少为36cm。The long bars from the column should extend to the base of the foundation and terminate with anchors that are at least 36cm long.

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**Recommendations for Good Quality Materials**

### 石头 Stone

**RECOMMENDATION:**
Use HARD, ANGULAR STONE (not weathered or rounded) for foundation.

### 砂 Sand

**RECOMMENDATION:**
Use CLEAN SAND for mortar and concrete. The requirement is less than 5% mud content.

### 石子 Gravel

**RECOMMENDATION:**
Use CRUSHED GRAVEL for concrete (not rounded).

### 钢筋 Steel

**RECOMMENDATION:**
RIBBED STEEL is best for reinforcing confined masonry homes.

### 砖 Bricks

**RECOMMENDATION:**
How to check brick quality:
- No cracks or chips, No visible unmixed portions or divots.
- Brick is square, not warped or curved.
- When hit together, they make a clink sound, not a dull thud.
- Dimensions are consistent, length does not vary by more than 8mm, width and height 6mm.

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Use FULLY FIRED BRICKS that don't crumble or break.

Using recycled bricks is acceptable, but do not use cracked or broken bricks.
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混凝土 Concrete

C15 混凝土，用于毛石混凝土层

1 袋50公斤的水泥
   bag of 50kg cement
1 小推车砂
   wheelbarrow sand
2 小推车石子
   wheelbarrows gravel

C20 混凝土，用于地梁和构造柱

2 袋50公斤的水泥
   bags of 50kg cement
1.5 小推车砂
   wheelbarrows sand
3.5 小推车石子
   wheelbarrows gravel

C25 混凝土，用于上圈梁和屋面板

1 袋50公斤的水泥
   bag of 50kg cement
0.5 小推车砂
   wheelbarrows sand
1.5 小推车石子
   wheelbarrows gravel

小心，别加太多的水！
Caution! Do not use too much water!

混凝土拿在手上时，水不应流出手掌。
Water should not be running down your hand, with concrete mixture in hand.

混凝土浇筑 Concrete Pouring

使用混凝土垫块隔离模板与钢筋。
Use concrete spacer to ensure adequate cover over steel.

在浇筑前要湿润模板与钢筋。
Pour water on formwork and steel before pouring concrete.

混凝土浇筑混凝土使其密实。
Compact concrete by ramming with rod or tapping formwork with hammer.

在地梁上做拉毛，使其与砖墙结合得更好。
Recommendation: Scarcify the top of the foundation beam for good contact with masonry.

混凝土养护7天左右，拆模后检查有无钢筋暴露，混凝土开裂。
Cure the concrete for about 7 days and check for exposed steel and cracks after removing formwork.

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International Federation of Red Cross and Red Crescent Societies
You can help keep your families safe from earthquakes!

Building Good Quality Masonry is one of the most important things you can do to help ensure your confined masonry house doesn’t collapse in the next earthquake.

**Good Practice**

1. Lay Bricks one course at a time using line and deadman

2. Fill joints completely with mortar at the time bricks are laid

3. Joint spacing between bricks should be consistent and between 0.8cm and 1.2cm

4. Stagger vertical joints and do not use broken or half bricks

**Bad Practice**

5. Don’t leave joints more than 1.2cm thick. Joints that are too thick will weaken the wall.

6. In the day before building the walls, clean the bricks and water them for 20 minutes. Then let them rest.

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**Tips for Good Quality Masonry**

1. 砌砖时一次一层并使用准线和皮数尺
   
   **Lay Bricks one course at a time using line and deadman**

2. 砌砖时砂浆填满饱和
   
   **Fill joints completely with mortar at the time bricks are laid**

3. 灰缝厚度应是0.8cm到1.2cm，厚度要一致
   
   **Joint spacing between bricks should be consistent and between 0.8cm and 1.2cm**

4. 错缝竖缝且不要使用坏砖
   
   **Stagger vertical joints and do not use broken or half bricks**
搭接钢筋时要保证有足够的锚固长度与有足够的箍筋在加密区里。Because the tie columns and bond beams together, care must be taken to ensure adequate anchor length and additional stirrups near every joint.

柱的钢筋至少要高于墙顶0.56m，用于搭接上圈梁。

Steel reinforcement in the tie column should extend at least 0.56m above the top of the wall to have enough anchor length.

钢筋直径为6mm大，箍筋直径可为12mm，长并向45度弯曲。

Use 6mm diameter bars for stirrups with hooks at least 6cm long, turned inward at a 45 degree angle.

搭接长度过短。依据四川省农村住房抗震设计技术指南（2008修订版）规定，直径12mm的热轧螺纹钢筋搭接长度为0.57m，直径14mm的热轧螺纹钢筋搭接长度为0.66m。

Overlap is too short. In Sichuan the splice length must be at least 0.57m for 12mm diameter ribbed steel and 0.66m for 14mm diameter ribbed steel bars to meet requirements.
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构造柱与墙体的结构 Tie Column and Wall Connection

墙与构造柱之间需要用马牙槎和拉接筋来防止构造柱与墙体在地震中分裂。

Tie column toothings and horizontal steel reinforcements in the masonry bed joint are needed to prevent separation of the walls from the tie columns during earthquakes.

马牙槎
Tie Column Toorthing

马牙槎高不大于30cm（5匹砖厚），凹进宽度不要小于6cm。

Tie Column toothings height should not be higher than 30cm (every 5 courses of bricks), and the width no less than 6cm.

L形转角
L-Shape Corner

T形墙
T-Shape Wall

最好是在每个转角处都设置构造柱。若有未设置构造柱的转角，也应每隔50cm（每8匹砖）高设置转角拉结筋。

It is better to use a tie column at every corner and wall intersection, but if there is no tie column, make sure to put the same steel reinforcement in the horizontal bed joint of the masonry at every 50cm (every 8 courses of bricks).

Images of wall separation from China Academy of Building Science

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门窗过梁 Doors, Windows and Lintel Beams

过梁是建筑上的横梁，用于支持窗户或门上的砖块重量。如不用过梁的话，窗门上的墙与屋頂会很容易在地震中倒塌。最常见的过梁有两种，预制过梁和现浇过梁。在修建一層两层的砖混结构民房时，门窗洞口上可用预制过梁。但如果门窗过大，洞口之间距离太近，或洞口离柱距离太近时应该使用使用现浇过梁。

Lintels are horizontal beams used in construction. They usually support masonry above a window or door. If lintels are not used, walls and roof over the doors and windows will easily collapse from an impact such as an earthquake. The most common type of lintel in Sichuan is Pre-Cast and Cast-In-Place Lintel. For one and two story confined masonry buildings, Pre-Cast Lintels can be used on the openings for the windows and doors, but when the openings are too large or if the openings are too close together, or when any of the openings are located close to the column, a cast-in-place lintel should be used.

单个门窗洞口 Single Opening

预制过梁 Pre-Cast Lintels

在门窗洞口宽度小于1.5m时，可以选用预制过梁。过梁两端至少要伸入墙里24cm（一砖长的长度）。

If single openings are 1.5m or smaller, a pre-cast lintel beam may be used. The lintel beam must extend into the wall at least 24cm (length of a brick) on both sides.

现浇过梁 Cast-in-Place Lintels

门窗洞口宽度最好少于1.5m，在宽度大于1.5m时，必须使用现浇过梁。过梁两端至少要伸入墙里24cm（一砖长的长度），并把过梁钢筋锚固到两边的柱内。

The best practice is to have single openings that are 1.5m or smaller. If a single opening is larger than 1.5m, then a cast-in-place lintel beam must be used. The cast-in-place lintel beam must extend into the wall at least 24cm (length of a brick) on both sides with its rebars tied into the column on both sides.

两个门窗洞口 Double Openings

预制过梁 Pre-Cast Lintels

若两个门窗洞口之间的距离超过0.8m，可以分别使用预制过梁。过梁两端至少要伸入墙里24cm（一砖长的长度）。

If doors and windows are 0.8m or more away from each other, then a pre-cast lintel beam may be used. The lintel beam must extend into the wall at least 24cm (length of a brick) on both sides.

现浇过梁 Cast-in-Place Lintels

两个门窗洞口之间的距离最好少于0.8m。在距离少于0.8m时，必须使用现浇过梁。过梁两端至少要伸入墙里24cm（一砖长的长度），并把过梁钢筋锚固到两边的柱内。

The best practice is to have doors and windows 0.8m or more away from each other. If they are closer than 0.8m to each other, then a cast-in-place lintel beam must be used. The cast-in-place lintel beam must extend into the wall at least 24cm (length of a brick) on both sides with its rebars tied into the column on both sides.

门窗洞口在柱旁 Openings Next to Columns

预制过梁 Pre-Cast Lintels

在门窗洞口离构造柱的距离超过0.8m时，可以选用预制过梁。过梁两端至少要伸入墙里24cm（一砖长的长度）。

If doors and windows are 0.8m or more away from the column, than a pre-cast lintel beam may be used. The lintel beam must extend into the wall at least 24cm (length of a brick) on both sides.

现浇过梁 Cast-in-Place Lintels

门窗洞口离构造柱最好少于0.8m。在距离少于0.8m时，必须使用现浇过梁。过梁两端至少要伸入墙里24cm（一砖长的长度），并把过梁钢筋锚固到两边的柱内。

The best practice is to have doors and windows 0.8m or more away from the column. If they are closer than 0.8m to the column, then a cast-in-place lintel beam must be used. The cast-in-place lintel beam must extend into the wall at least 24cm (length of a brick) on both sides with its rebars tied into the column on both sides.