

## Disaster Prevention Measures for Building Safety Communities: Using the Collapse of the Weiguan Jinlong Residential Complex from the 0206 Tainan Earthquake as an Example

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### Abstract

Residential buildings in communities are the fundamental spaces and environments for human dwelling. However, natural and human-made disasters can threaten the safety of these buildings, and thus communities. This study integrated the current concepts and practices of different types of communities into the concept of safety communities. In addition, it used the collapse of seven complex buildings. Weiguan Jinlong residential complex in Tainan, caused by a magnitude 6.4 earthquake on February 6, 2016 as an example to systematically examine and analyze the current concepts and practices of the aforementioned community types. In addition, by focusing on how natural environments are relevant to buildings in communities, this study proposed suggestions for the following policies and initiatives related to site planning: environmental measures on safety from geographic features, guidelines for national land use, architectural management for communities in cities, initiatives on national land conservation managed by specific institutions, and the Disaster Prevention and Response Act.

**Keywords:** Safety community; Disaster-prevention community; Safe community; Sustainable community; Ecological community; Site planning

### Introduction

Houses are sanctuaries for human dwelling, and make up communities where families, the elderly, and infirm can live and rest. When natural and human-made disasters occur, they can destroy these fundamental spaces for human dwelling, thus disrupting safe living conditions, causing deaths and casualties, and wrenching families apart.

Taiwan is at risk of many types of natural disasters such as earthquakes, typhoons, rainstorms, debris flows, floods, and soil liquefaction, all of which are threats to the safety of residents in Taiwan. Few areas in Taiwan are suitable for residential use and the residential buildings in communities would be unsafe should any of the following incidents or factors occur: inadequate selection of the base for construction; inappropriate planning by builders, architects, technicians, and construction personnel; lack of information regarding the relevant natural environment; inappropriate planning and design; and architectural structures not being built in accordance with related construction codes.

This study integrated the current concepts and practices of common community types to develop the concept and practices of a safety community. Furthermore, it used the collapse of the aforementioned building in Tainan that was caused by soil liquefaction induced by the magnitude 6.4 earthquake that struck on February 6, 2016 (hereinafter referred to as the 0206 earthquake) (Figure 1) as an example to systematically examine and analyze the insufficiency of the current theories and practices regarding the safety of residential communities. In addition, by focusing on how natural environments are relevant to residential buildings in communities, this study proposed suggestions for policies and initiatives related to site planning.

### Literature Review

#### Safety community

**Definition of safety community:** A safety community refers to

a community in which its residents can dwell safely. The term “dwell safely” originates from the promises of the God in Judaism to the Israelites [1], including promises that the Israelites can plant vineyards (works), build houses, and dwell in places where they are free from chaos and human-made disasters and are not required to wander from place to place and can keep their families together.

**Aspects of a safety community:** With the occurrences of extreme climate and global environmental changes, the concept and practices of conventional community development emphasizing building landscapes and industries and promoting population growth can no longer meet the requirements for building a safety community. A safety community must integrate the concepts and practices of the following types of communities: disaster-prevention communities, safe communities, sustainable communities, and ecological communities [2].

To build a safety community, site planning of the bases for residential buildings as well as the following factors associated with the life cycle (Magic School of green Technologies), of residential buildings are imperative: the planning and design, substantive examination, supervision, construction, and management of residential buildings.

#### Disaster-prevention community

According to the definition proposed by the Soil and Water Conservation Bureau of the Council of Agriculture of Executive

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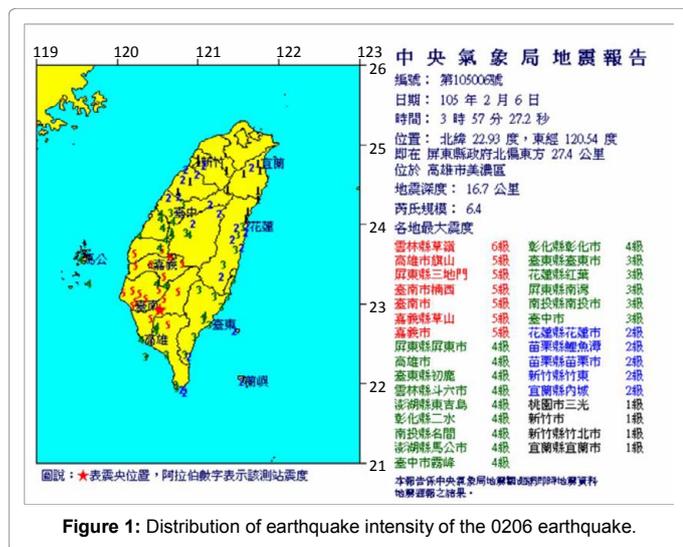


Figure 1: Distribution of earthquake intensity of the 0206 earthquake.

Yuan, a disaster-prevention community is a community capable of disaster management; that is, a community that can reduce the disaster-causing factors before disasters occur, implement emergency responses during disasters, perform mutual assistance and aid, and rapidly restore and rebuild the community after disasters occur. Every resident in a disaster-prevention community hopes to dwell in a safe and comfortable environment, and the goal of such a community is to build a safe and secure community. A disaster-prevention community incorporates the following three abilities:

1. To reduce the occurrence of disasters;
2. To endure the impacts of disasters, to respond to disasters instantly, and to reduce the loss caused by disasters;
3. To rapidly restore and rebuild the community, and sustainably develop the community after disasters occur.

A disaster-prevention community can form a community consensus through community empowerment and reduce disasters from occurring through disaster reduction and prevention measures. Should disasters occur, the residents can prevent disasters from spreading, reduce the loss caused by disasters, and rapidly promote initiatives to restore and rebuild the community.

Self-examination checklist for a disaster-prevention community:

1. Geographical Location and Basic Attributes

- (1) Whether the community is located in potential debris flow areas.
- (2) Whether the environment of the community is prone to disasters.
  - A. Whether the streams and rivers in the surrounding areas have accumulated debris;
  - B. Whether the bridges and culverts are blocked;
  - X. Whether debris accumulation at check dams is severe;
  - Δ. Whether excessive reclamation, excessive deforestation, and overbuilding on hillsides and other behaviors destructive to forest structures have been performed;
  - E. Whether the soil and rocks on hillsides are abnormally loose.

- (3) Whether the community has experienced previous debris flow disasters.

2. Autonomy of the Community

- (1) Whether the community is cohesive;
- (2) Whether the community residents actively engage in initiatives of disaster prevention;
- (3) Whether the community has already developed its own disaster prevention and relief organizations (e.g., volunteer police and firefighters, Neighborhood Rescue Team, and Phoenix Professional Volunteers Team);
- (4) Whether the mobility of the disaster prevention and relief organizations in the community is adequate.

3. Awareness of Disaster Prevention

- (1) Whether the residents' understanding of the community is sufficient;
- (2) Whether the residents' understanding of debris flows and debris flow disasters is sufficient;
- (3) Whether the residents participate in bilateral communication activities, picture-based activities for disaster prevention advocacy, and disaster prevention forums;
- (4) Whether the residents participate in the community-based drills and professional training for disaster prevention and relief;
- (5) Whether the residents' knowledge of disaster prevention as well as their crisis awareness of and response ability to disasters are sufficient.

4. Resources for Disaster Prevention and Relief

- (1) Whether the community is equipped with sufficient facilities for disaster prevention and relief (e.g., medical resources, first aid equipment, destruction equipment, and electric generators);
- (2) Whether the community has a sufficient back up of daily essentials;
- (3) Whether the community has well-established alarm and reporting systems;
- (4) Whether the community maintains unobstructed communications with the relevant civil organizations or nongovernmental teams.

Safe community

According to the definition proposed by the Health Promotion Administration of the Ministry of Health and Welfare [3], a safe community refers to a community that, according to a consensus of the residents, can combine all the community resources to jointly strive toward preventing various types of accidents and intentional injuries from occurring; building relatively safe environments; promoting interpersonal harmony; and enhancing each person's comfortableness in physical, psychological, and social states. A safe community does not refer to a community that has attained a safe and secure state; rather, it refers to a community that meets the following criteria:

1. A safe community must incorporate an interdisciplinary group responsible for promoting and leading fundamental

initiatives of community safety that is developed on the basis of partnership and cooperation;

2. The plan developed for a safe community must be a long-term and sustainable plan.
3. That considers residents of all genders and ages as well as all the relevant environments and conditions;
4. A safe community must have plans that consider high-risk groups and environments and focus on safety promotion aimed at groups that are prone to injuries;
5. A safe community must incorporate a mechanism that can analyze and apply the records regarding the frequency and causes of local accidents and injuries;
6. A safe community must be capable of assessing the processes of implementing project aspects and the effects of improved projects;
7. A safe community must be able to continuously participate

in domestic and international activities regarding safe communities.

### Sustainable community

Lee [4] defined a sustainable community as a community that satisfies the various requirements of its current and future residents, their offspring, and others; in addition, it promotes a high quality of life and provides opportunities and choices to the community residents. Residents develop a sustainable community through the following methods: effective use of natural resources, improvement of community environments, promotion of community awareness and development, and enhancement of economic prosperity. A sustainable community can be divided into the following three types: a general community, a community with advanced community buildings, and an environmentally sensitive community. Table 1 presents the criteria for defining sustainable communities.

### Ecological community

According to the definition proposed by Lee [4], an ecological

General community	Community with advanced community buildings	Environmentally sensitive community
Establishes safe environments and security mechanisms in the community to elevate the quality of life.	Establishes safe environments as well as security management and protection mechanisms in the community and offers extensive care to the disadvantaged groups in the community. Develops a human-centered community and implements the related concepts and creates alleys for students to use to go to schools safely and streets that are safe for pedestrians	Implements the protection and management of environmentally sensitive areas; establishes a model for environmental protection; maintains the vital functions for different types of ecosystems; and enhances the foundation for the development of local industry.
Applies environmental planning designs and uses public facilities and construction to elevate the interpersonal relationships among community residents.	Applies environmental planning design and uses public facilities and constructions to enhance the interpersonal relationships among community residents.	Analyzes the environmental receptivity that serves as the basis for community development management. Integrates intergenerational perspectives to propose the visions and strategies for community development with an aim to plan, design, operate, and manage the development and characteristics of community environments.
Constructs open and visible community spaces to prevent crimes and enhance mutual assistance among community residents.		
Strategically applies external supports to strengthen limited community resources.	Reinforces the environmental protection measures for recycling and energy saving	Promotes garbage waste minimization, and organic waste recycling and reuse. Investigates and evaluates possible renewable energy that can be used by the community to promote the use of such energy.
	Develops a mechanism for community conventions, and advocates the responsibilities, rights and obligations of community residents to engage in relevant activities.	On the basis of community conventions and other regulations, develops community consensus and strategies for resource development, usage, and management to elevate the efficiency of resource use and prevent leisure, recreation, and industry development activities from destroying the environments of environmentally sensitive areas.
		Promotes the application of green building technology and ecological engineering to reduce the destruction of environments.
	Develops local markets and the regional economy to establish community industries, and to gradually progress to green production and green consumption.	Constructs the basis for and improves the technique of ecological agriculture development to promote the economic values of relevant industries.
Promotes the publication of community information to enable all residents to gain equal opportunity for participation.	Provides a platform for community information exchange and establishes a community supervisory mechanism.	
Establishes a community cooperation network and promotes community development through external support.	Develops a community cooperation network to exchange experiences.	
Provides and improves public facilities and community spaces to enhance residents' identification with their community.	Develops an image for the community and a symbol for community identification, and enhances residents' identification with the community.	

**Table 1:** Criteria for the different types of sustainable communities.

community is one in which the community residents, organizations, and interested parties give the community the following ecological characteristics through proper resource and environment management, reasonable consultation and decision-making processes, and satisfactory communication and operation methods:

1. Natural ecology: biodiversity
2. Human ecology: cultural diversity
3. Ecological building: a building that provides a well-off ecological environment that focuses on energy saving, water saving, greening, and beautification that is harmless, healthy, convenient, and practical and that prioritizes waste recycling and renewable energy usage;
4. Ecological transportation: develops ecological transportation networks, transportation tools, and transportation means that are human-centered, highly efficient, and generate low impacts on environments;
5. Ecological production/consumption: reduces the destruction of and influences on environments and reduces the consumption of energy regarding production and consumption.

The idea of sustainable development is the basis of ecological community development; the idea of a human-nature harmony and symbiosis is the theme of ecological community development; and ecological buildings involve techniques that can guarantee the fulfillment of an ecological community (Table 2).

Table 3 displays the planning, design, construction, management concepts, and implications of a safety community:

### Compilation of the Causes and Effects of the 0206 Earthquake and the Collapse of the Weiguan Jinlong Residential Complex in Tainan

#### Conditions of the buildings in Tainan and Kaohsiung regions damaged by the 0206 earthquake

Conditions of the buildings in Tainan and Kaohsiung regions damaged by the 0206 earthquake are given in Table 4.

#### Damages to the Weiguan Jinlong residential complex caused by the 0206 earthquake

The collapse of the Weiguan Jinlong residential- commercial mixed-use community building complex occurred at 03:37 am on February 6, 2016. The complex shook up-and-down and then left-and-right during the earthquake. After 7 to 8 seconds, the building stopped shaking; shortly after, the entire complex, located at the intersection of

Sec. 2 Yong-Da Road and Guoguang 5th Street, emitted a loud sound and collapsed (comprising buildings A, B, C, D, E, F, G, H, and

I) toward the direction of Sec. 2 Yong-Da Road and lay flat on the road. After days of continually searching through the ruins, a total of 115 people were confirmed dead and 175 were rescued (among the survivors, 96 were injured) on February 18, 2016. The number of casualties at the Weiguan Jinlong residential complex exceeded that at Taipei City's Tunghsing Building (87 deaths) caused by the 921 earthquake in 1999 and is the most severe in Taiwan caused by a collapsed building [5].

The Weiguan Jinlong residential complex contained nine buildings (buildings A, B, C, D, E, F, G, H, and I) before it collapsed. The first three floors were rented to the Tsann Kuen Enterprise Co., LTD (Yongkang store), an ophthalmology clinic, and an otolaryngology clinic; the fourth floor and above were for residential use; and one floor served as the basement. The residential-commercial mixed-use complex was U-shaped, and held 90 households, housing a total of approximately 200 people. The complex faced west and tilted from west to east when the earthquake occurred; subsequently, the complex collapsed onto Yong-Da Road. A third of the complex fell flat on the ground and approximately two-thirds of it sank to the ground or was damaged. After the disaster, no deaths were reported in buildings C and I; the casualties in buildings G, A, and F were the most severe (Figures 2 and 3).

#### Planning, design, and construction of the Weiguan Jinlong residential complex

The Weiguan Jinlong residential complex was constructed by the Weiguan Construction Company, which was registered with the Tainan County Government in 1989. The company obtained the construction permit for the Weiguan Jinlong residential complex in 1992 and subsequently proposed changes to the complex design in 1994, in which five households were combined into one by removing the walls. The building occupation permit was obtained in November 1994. However, the Weiguan Construction Company was dismissed not long after the Weiguan Jinlong residential complex was completed, a suspicious act that has been associated with the buildings not being built in accordance with related construction codes and a scheme to avoid responsibilities should accidents occur in the future.

In addition, according to the reports released by the media, the following factors have been associated with the collapse of the Weiguan Jinlong residential complex:

1. According to an ancient map, the location of the Weiguan Jinlong residential complex was situated on the great lake that was once inhabited by tilapias, thus indicating that the complex was located on an area prone to soil liquefaction (geological drilling and improvement were not performed) (Figure 4).

Dimension	Index item	Suggestion for the assessed content
Natural environment (ecology)	Natural ecological environment	Emphasizes a symbiosis with the natural environment and considers matters on environmental pollution, biodiversity, and ecological habitat.
Human-made (living)	Energy cycle and management	Environmental resource management serves as the basis for assessment, in which the following are involved: resource recycling and regeneration, organizational mechanism for environmental management maintenance, disposal rate of polluted water and wastes from the community, and water resource recycling.
	Built environment	Considers the amount of green buildings, green transportation, water permeability, and green cover rate, as well as disaster relief planning, barrier-free space, building coverage rate, height ratio, and plot ratio.
	Community building/ Local identity	Local organizations, local activities, and cultural assets.
Human-made environment	Note: The dimension of production at the current stage is not incorporated into the category for assessing an ecological	

Table 2: Criteria for assessing an ecological community.

Conditions for composing a safety community	Natural environment	Human-made building	Type of Community
	Geographical location and basic attributes:		Disaster-prevention community
	1. Whether the community is located in potential debris flow areas		
Site planning	2. Whether the community environment is prone to disasters.		
	(1) Whether the streams and rivers in the surrounding areas have accumulated debris;		
	(2) Whether the bridges and culverts are blocked;		
	(3) Whether debris accumulation at check dams is severe;		
	(4) Whether excessive reclamation, excessive deforestation, and overbuilding on hillsides and other destructive behaviors on forest structures have been performed;		
	(5) Whether the soil and rocks on hillsides are abnormally loose.		
	3. Whether the community has experienced previous debris flow disasters.		
	1. The plan developed for a safe community must be a long-term and sustainable plan that considers all the relevant environments;	A safe community must incorporate a mechanism that can analyze and apply the records regarding the frequency and causes of local accidents and injuries.	
	2. A plan that considers high-risk environments must be developed. Analyzes the environmental receptivity that serves as the basis for community development management.		
	Plans for disaster relief.	Barrier-free space and building coverage	Sustainable community
	Height ratio and plot ratio.	Green buildings, water permeability, and green cover rate.	
		Promotes the application of green building techniques and ecological engineering to reduce destruction of environments.	Sustainable community (environmentally sensitive community)
Architectural design			
Substantive examination	Ecological building: a building that provides a well-off ecological environment that focuses on energy saving, water saving, greening, and beautification, and that is harmless, healthy, convenient, and practical.		
Supervision Construction Management	Awareness of disaster prevention:		Disaster-prevention community
	1.Understanding of community environment;		
	2.Understanding of debris flows and debris flow disasters;		
	3.Participation in bilateral communication activities, picture-based activities for disaster prevention advocacy, and disaster prevention forums;		Sustainable community
	4. Participation in the community-based drills and professional training in disaster prevention and relief;		
	5. Elevation of knowledge in disaster prevention as well as the crisis awareness of and response ability to disasters.		

Table 3: Planning, design, construction, management concepts, and implications of a safety community

City and County	Total reported number	Unassessed	Assessed				
	Subtotal	Subtotal	Red	Yellow	No	Data	Subtotal
			danger	danger			
			sign	sign			
Tainan	462	59	62	60	235	46	403

Table 4: Statistical assessment of dangerous buildings (until 2016.02.13).

- The U-shaped Weiguan Jinlong residential building (Figure 5).
- The architectural design and construction of the Weiguan Jinlong residential complex was inappropriate in the following ways: substantive examinations of the building structure by external parties (below 50 meters) were avoided, inappropriate changes in architectural design were made and some floors lacked sufficient diaphragm walls (only one floor had mat foundation), as well as insufficient earthquake-proof building

regulations, low values of the seismic resistance coefficient, an inadequate steel bar binding method (the difference between 90 and 135 degrees), and an insufficient amount of cement and concrete were all applied (Figures 2-8).

### Relief measures and improvement items implemented by the construction and planning agency of the ministry of the interiors

Table 5 displays the relief measures and improvement items

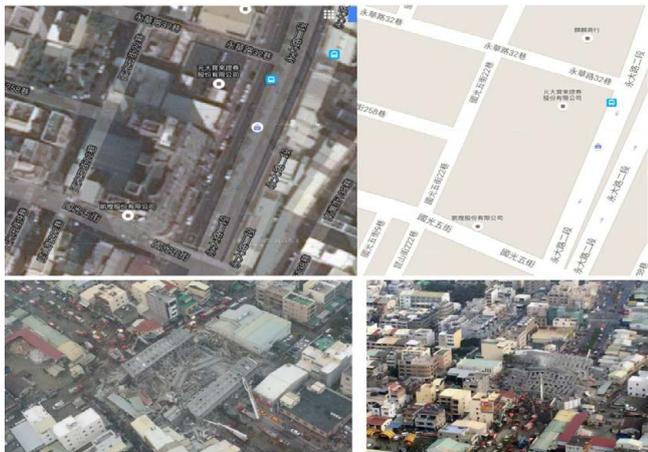


Figure 2: Aerial photographs of the collapse of the Weiguan Jinlong residential complex.



Figure 5: Image of the original Weiguan Jinlong residential complex.

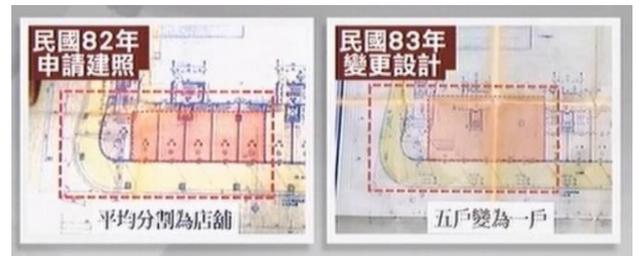


Figure 6: Inappropriate changes to the architectural design.



Figure 3: Configuration of the residential complex, and conditions of the collapsed buildings and trapped residents.



Figure 7: Lack of substantive examination of building structures by external parties and fractures of reinforcing steel.



Figure 4: According to an ancient map, the Weiguan Jinlong residential complex was located on the great lake that was once inhabited by tilapias.

implemented by the Construction and Planning Agency of the Ministry of the Interiors onto the Central Emergency Operation Center of the Executive Yuan.

Review of the aforementioned relief measures and improvement items:

- (1) The relief measures only provided relief and assistance to buildings and households that were damaged and affected by the 0206 earthquake;
- (2) In the short-term, the improvement items merely focused on

strengthening the regulations regarding aseismic design standards as well as building construction and management; and in the long-term, the improvement items merely offered subsidies for safety inspection, renewing building plan and design, and performing reinforced engineering on old buildings;

(3) Architecture, environments, and site planning for the community were lacking; therefore, conditions for designating residential areas in urban planning and restrictions regarding the intensity of land use should be proposed.

**Disaster-inducing factors causing a community to be unsafe and the possible remedial measures implemented by the government**

Table 6 presents the corresponding comparisons between the elements that a safe community should contain and the relief measures

Relief measure	Improvement item
Urgent assessment of dangerous buildings.	Promotion of safety inspections for old buildings (preliminary and detailed assessments of buildings' aseismic capacities).
Housing rental assistance:	Subsidies for renewing the plan of and design for old buildings.
1. Rent subsidies	
Rent relief	
Loans for rebuilding, repurchasing, or repairing houses.	Subsidies for aseismic retrofitting buildings that require it.
Sustain the balance of loans for earthquake-damaged buildings.	Review the building management laws.
Assistance for rebuilding or repurchasing houses.	Review of whether the standard of aseismic design for buildings should be elevated.
Subsidies for renewing the plan of and design for earthquake-damaged buildings.	
Subsidies for aseismic retrofitting earthquake-damaged buildings.	
Subsidies for rebuilding earthquake-damaged collective houses	
Subsidies for rebuilding earthquake- damaged single houses	

**Table 5:** Relief measures and improvement items implemented by the construction and planning agency.

Conditions for a safety community	Disaster-inducing factors causing the community to be unsafe for dwelling	Corresponding measures implemented by the government
Site planning	<i>Earthquake-induced soil liquefaction regions being designated as residential during urban planning</i>	
	The bases and the geology of community architectures being undrilled and unimproved, respectively.	
	Poor configuration of the buildings causing the building structures to pull and drag each other.	
	Architects lend out their licenses and their assistants, rather than the architects, illustrate the <i>design</i> layout;	Review the law of building administration and strengthen the construction management of buildings;
	The architectural design does not adhere to the safety regulations;	Review whether the aseismic design standard for buildings should be elevated;
	False examination of the architectural design is performed by external parties;	Subsidize renewing the plan and design of earthquake-damaged buildings;
	Regulations regarding the different number of floors, underground floors, and diaphragm walls for different geological environments are not implemented	Subsidize renewing the plan and design of old buildings.
	Inadequate seismic resistance coefficients are used;	
	Steel beam contacts are located in the floor on the ground level and thus are different from the general location of the contacts, which are located in the middle of steel beams;	
	Inadequate regulations of relevant methods;	
Supervision	Technicians specializing in earth, civil engineering, water retention, structural, and drilling measurements do not participate in examining the architecture design.	
	Architects also serve as the construction supervisors;	Perform urgent assessments of dangerous buildings;
	False architecture supervision.	Promote safety inspections for old buildings (preliminary and detailed assessments of buildings' aseismic capacity).
	Construction does not follow the design layout;	Subsidize aseismic retrofitting to old buildings;
	Construction is not performed in accordance with related construction codes;	Subsidizing aseismic retrofitting.
	The construction company lacks professional competence;	
	Frequent replacement of site managers and dereliction of duty committed by them;	
Management	Nonpublic architectural engineering lacking the 3-level quality management system which is implemented on public architecture.	
	Lack of geological monitoring;	Offer housing rental assistance (rent subsidies and rent relief);
	Indifference to residents' feedback and public opinion toward the construction company and architectural quality.	Offer loans for rebuilding, repurchasing, or repairing
	The construction company declares bankruptcy after the construction case is sold, and another company promotes the construction case.	Sustain the balance of loans for earthquake-damaged buildings; Assist rebuilding or repurchasing houses; Subsidize rebuilding earthquake-damaged collective and single houses.

**Table 6:** Disaster-inducing factors causing a community to be unsafe for dwelling and the Possible remedial measures implemented by the government.

and improvement items implemented by the Construction and Planning Agency [6,7].

The aforementioned measures implemented by the Construction and Planning Agency prevented not fully ensure the concept of a safety

community and its practices are fulfilled. Therefore, the following policies and initiatives must also be incorporated.

### Strengthen the disaster prevention of national lands

1. Re-examine and comprehensively review the urban planning



Figure 8: Ground floor lacked diaphragm walls or foundation piles.

specifications and maps, and subsequently exclude the following disaster-prone areas, potential soil liquefaction areas, or areas that require geological improvements from being designated as construction areas: a certain size of land area adjacent to fault zones, potential debris flow areas, flood-prone areas, lake areas as are indicated on ancient maps, wetlands, areas that have flooded in the recent century, tidal lands, sandy mud areas, consequent slopes, and areas adjacent to water ditches, rivers, and streams.

2. Comprehensively examine and improve building constructions and old residential buildings with low values of seismic resistance coefficients.

(1) Execute substantive examinations on building structures above 50 meters, buildings below 11-stories that have not received structural design examinations, and buildings that are easily influenced by the resonant frequency of earthquakes.

(2) To save costs on digging diaphragm walls, the construction company of the Weiguan Jinlong complex merely constructed mat foundations for the buildings, without implementing geological improvement and constructing three floors of diaphragm walls.

2. Measures for subsidizing and reducing the mortgages of earthquake-damaged houses:

(1) Consult the unified approaches implemented by financial institutions regarding transferring mortgages of earthquake-damaged houses to bad debts or requesting reevaluated insurance claims;

(2) Consult relevant organizations regarding the large donations assigned to be used for mortgages;

(3) The institution responsible for donation management (e.g., earthquake relief foundation) appropriates a certain amount of money to subsidize and reduce the mortgages for earthquake-damaged houses.

3. Legal regulations for earthquake damage avoidance

(1) Elevate the seismic resistance coefficient of buildings;

(2) Regulate that buildings containing different stories should incorporate different ground floor structures, and that

geological improvement, foundation pile, and mat foundation must be implemented and constructed.

### Develop measures to improve national land safety from environmental features

1. Install warning systems along river basins to monitor rainstorms and floods;
2. Develop evacuation methods for residents living in flood-prone areas (under the flood level and along the evacuation route);
3. Develop evacuation methods for residents living in potential debris flow areas (areas of debris flows and rainfall, and along the evacuation route);
4. Install warning signs along fault zones (100 meters along periphery and planned evacuation route) and develop evacuation methods for residents living near these zones;
5. Implement specific monitoring of creek rivers before flood season and clean the silt from the rivers;
6. Implement disaster-prevention measures in parks and disaster prevention drills.

### Adjust the guidelines for national land use

1. Implement structural adjustment plans for urban and rural land use;
2. Implement structural adjustment plans and enforce the related rights, obligations, and feedback, and implement a compensation act regarding land use;
3. Strictly control the use of prime farmlands and certain agricultural areas;
4. Allow countryside villas to be built and developed in nonspecific agricultural lands;
5. Transform the designated but undeveloped urban residential areas into green spaces, and allow detached countryside villas (not row houses) requiring a small construction base to be built;
6. Incorporate old-type-C building lands into urban planning to ensure that all statutory open spaces and public facilities of the old-type-C building lands are designated by detailed plans as community green spaces;
7. Rezone all the land designated for general expropriation and urban land consolidation into zone expropriation zones;
8. Review the detailed plans in urban planning and ensure that parks and green spaces are evenly provided in residential areas;
9. Establish multifunctional community plazas in residential communities and develop green space courtyards among residential buildings;
10. Shorten long lanes, redistrict lanes with different widths, and establish connections among lanes.

### Architectural management of communities in urban areas

1. Uniformly transform residential areas into residential-commercial mixed-use areas to reduce building coverage rates;
2. Subsidize newly-built buildings to dig two additional

underground floors to serve as the areas for stagnant flood water where temporary parking is usually offered. However, parking would be forbidden to be held here;

3. Allow low-rise single buildings to be built on hillsides; however, monitor the construction of high-rise buildings and buildings requiring a large construction base at such areas;
4. Implement architectural safety demonstrations to aboriginal peoples on the mountains;
5. Subsidize households to clean the external walls of buildings and subsidize each township to establish teams that can be entrusted to clean the external walls of buildings;
6. Subsidize fees for safety inspection and repairs of houses and residential buildings (renovate the external walls and install water resistant external walls) and subsidize each township to develop repair teams that can be entrusted to perform repair tasks.

### **Institutions specifically responsible for implementing the environmental safety of national lands**

1. Develop teams specifically responsible for national land planning, development, and conservation (to expand the organizational structure of the Urban and Rural Development Branch of the Construction and Planning Agency, and to focus not only on urban planning and development but also on water resource and transportation developments);
2. Establish teams specifically responsible for urgent repair of machine tools and for providing emergency relief across the nation (For example, these teams would contribute toward restoring the Former Bureau of Housing and Urban Development of Taiwan Province rather than focusing merely on urban engineering);
3. The initiatives regarding river basins (involving mountains, rivers, national parks, national forest recreation areas, the areas reclaimed by the Veterans Affairs Council, reservoirs, watersheds, polluted water, and river terraces) and coastal managements must be executed by a single institution. The standard act for the relevant laws and rules as well as the relevant administrative operations do not require being operated by the same ministry and administration; instead, the operations and acts should be independent from each other yet must remain in horizontal coordination.

### **Revision of the disaster prevention and protection act**

1. Expand the range of areas that qualify for assistance incorporated in the Disaster Prevention and Protection Act: soil liquefaction pertains to earthquake disasters and thus areas associated with soil liquefaction or natural disasters (flood-prone areas, potential debris flow areas, houses by the sea or on sand, and houses contaminated by radioactivity) should be incorporated into the range of areas that qualify for assistance by the Act.

2. Mortgage forgiveness for damaged houses: for houses that are made uninhabitable by natural disasters, the original mortgages should be compensated by the government;
3. Safety inspection on and specific reinforcement of old buildings located in natural disaster areas: subsidies should be provided for safety inspections of buildings located in soil liquefaction, flood-prone, and potential debris flow areas; of houses that are contaminated with radioactivity or that are built by the sea or on sand; and of old buildings with low values of seismic resistance coefficients that were built before the 921 earthquake. In addition, architectural reinforcement techniques should be developed to support relevant teams to manage the reinforcement, repair, and maintenance of old buildings and houses.

### **Conclusion**

A comprehensive integration of the concepts and practices of a safety community, which were taken from disaster-prevention, safe, sustainable, and ecological communities, revealed that the typical community still lacks the proper establishment of the safety community. Regarding the current remedial measures implemented by the government, the emphasis on natural environments relevant to community architecture, its special focus on site planning, and its planning, design, and construction of residential buildings all reveal that the following current professional acts still have not been comprehensively implemented: The Building Act, Architects Act, Professional Engineers Act, Regulations on Construction Industry Management, and Company Act. Shortcomings still exist in these and other relevant acts, with improvement and perfection required. Therefore, the government must comprehensively examine and reinforce the relevant acts and systems.

### **Acknowledgements**

1. The Bible (Old Testament), Ezekiel 28:26: They will live in it securely; and they will build houses, plant vineyards and live securely when I execute judgments upon all who scorn them round about them. Then they will know that I am the LORD their God. See Hsiao, J. H. (1995). *Ancient Hebrews' Social Ideals and Practices of Properties*. In J. H. Hsiao (1997), *How to Have Large Houses to Accommodate the Poor* (pp. 79–92). Taipei: Tonsan Publications.

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