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Standard**

ISO 37179

**Smart community infrastructures —
Disaster risk reduction — Basic
framework for implementation**

*Infrastructures urbaines intelligentes — Réduction du risque de
catastrophe — Cadre général pour la mise en œuvre*

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principles	3
4.1 General	3
4.2 Stakeholder inclusiveness	4
4.3 Optimized resource allocation for operations	4
4.4 Harmonization and dissemination of technology for DRR	5
4.5 Robustness and redundancy	5
4.6 Science-based approach	5
4.7 Critical function focus	5
4.8 Structural and non-structural measures	5
4.9 Investment in advance	6
4.10 Response preparedness	6
4.11 Continuous improvement	6
5 General requirements	6
5.1 General	6
5.2 Stakeholder inclusiveness	6
5.3 Optimized resource allocation for operations	7
5.4 Harmonization and dissemination of technology for DRR	7
5.5 Robustness and redundancy	7
5.6 Science-based approach	8
5.7 Critical function focus	8
5.8 Structural and non-structural measures	8
5.9 Investment in advance	8
5.10 Response preparedness	9
5.11 Continuous improvement	9
Bibliography	10

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 268, *Sustainable cities and communities*, Subcommittee SC 1, *Smart community infrastructures*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Disaster risk reduction (DRR) is a systematic approach in identifying, assessing and reducing the risks of disaster. It aims to reduce socio-economic vulnerabilities to disasters as well as to address geophysical, hydrometeorological, environmental and other hazards that trigger them. For example, with regards to hydrometeorological and environmental hazards, climate change is often the multiplier of disaster risk, as climate change is projected to exacerbate existing risks through increased frequency or intensity. For this reason, it is essential for smart communities to design DRR measures that allow communities to adapt to climate change and become sustainable and resilient. This approach is essential for both developing economies as well as developed economies.

Among the many ways to implement DRR in communities, infrastructures are one of the most fundamental. Smart community infrastructures are primarily designed, constructed and operated to serve the needs of ordinary situations; however, it is also essential to plan, build, utilize, maintain and improve community infrastructures taking into consideration DRR. Such infrastructure can be utilized alongside existing community infrastructure and supplemented by nature-based solutions.

The United Nations Sendai Framework for Disaster Risk Reduction (SFDRR) [7] identifies several key areas on how infrastructure can be used for DRR and strengthened to reduce disaster risk and enhance community resilience to shocks caused by natural hazards that can lead to disruptions in infrastructure services. This includes infrastructure and technologies that can identify hazard risks, investing in DRR and technologies that can facilitate the sharing of information, which can support life-saving services.

Smart community infrastructures are planned, implemented and operated with the collaboration of multiple stakeholders, including the public and private sectors and integration of funding for investment, cooperation and coordination.

This document provides ten principles as described in 4.1 with general requirements for each principle. These contribute to the realization of the four priorities for action of the SFDRR, with regards to community infrastructure. The principles include four overarching principles and six focus area principles for the continuous improvement of DRR. Together, these ten principles provide community stakeholders a framework to implement DRR and enhance community resilience by using smart community infrastructure. This document is intended to be used by stakeholders relevant to smart community infrastructure, including community managers, planners, funders, providers and administrators, who wish to reduce disaster risk and enhance the resilience of communities and their infrastructures.

NOTE The four priority areas from the SFDRR are:

1. understanding disaster risk;
2. strengthening disaster risk governance to manage disaster risk;
3. investing in disaster risk reduction for resilience;
4. enhancing disaster preparedness for effective response.

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Smart community infrastructures — Disaster risk reduction — Basic framework for implementation

1 Scope

This document specifies the principles and general requirements for the implementation of smart community infrastructures contributing to disaster risk reduction (DRR).

It is intended to be used by stakeholders relevant to smart community infrastructures, including community managers, planners, funders, and providers or administrators of community infrastructure services who aim to reduce disaster risk and enhance the resilience of communities and their infrastructures.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 community

group of people with an arrangement of responsibilities, activities and relationships

Note 1 to entry: In many, but not all, contexts, a community has a defined geographical boundary.

Note 2 to entry: A city is a type of community.

[SOURCE: ISO 37120:2018, 3.3]

3.2 community infrastructure

system of facilities, equipment and services that support the operations and activities of communities

Note 1 to entry: Such community infrastructure includes, but is not limited to, energy, water, transportation, waste and information and communication technologies (ICT).

Note 2 to entry: Community infrastructure can include basic physical and organizational structures to design, operate and maintain infrastructure services.

[SOURCE: ISO 37151:2024, 3.2, modified — Note 2 to entry is added.]

3.3 critical function

function that, if lost or degraded, or as a result of incorrect or inadvertent operation, would result in catastrophic or critical consequences

[SOURCE: ISO 14620-1:2018, 3.1.17, modified — the term "safety critical function" has changed to "critical function".]

3.4 disaster

serious disruption to a city or *community* (3.1) due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to human, material, social, economic and environmental losses and impacts

Note 1 to entry: Disasters can be frequent or infrequent, depending on the probability of occurrence of the relevant *hazard* (3.6). A slow-onset disaster is one that emerges gradually over time, for example through drought, desertification, sea level rise, subsidence or epidemic disease. A sudden-onset disaster is one triggered by a hazardous event that emerges quickly or unexpectedly, often associated with earthquakes, volcanic eruptions, flash floods, chemical explosions, *critical function* (3.3) failures or transport accidents.

[SOURCE: ISO 37123:2019, 3.2, modified — “social,” is added to the definition; “and/or” is replaced by “and” at the end of the definition; “and the return period” is deleted from Note 1 to entry.]

3.5 disaster risk reduction DRR

policy aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development

[SOURCE: ISO 22300:2021, 3.1.74]

3.6 hazard

phenomenon, human activity or process that can cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation

Note 1 to entry: Hazards include biological, environmental, geological, hydrometeorological and technological processes and phenomena. Biological hazards include pathogenic microorganisms, toxins and bioactive substances (e.g. bacteria, viruses, parasites, venomous wildlife and insects, poisonous plants, mosquitoes carrying disease-causing agents). Environmental hazards can be chemical, natural, radiological or biological, and are created by environmental degradation, physical or chemical pollution in the air, water and soil. However, many of the processes and phenomena that fall into this category can be “drivers” of hazard and risk rather than hazards themselves (e.g. soil degradation, deforestation, biodiversity loss, sea level rise). With respect to drinking water, “hazard” can be understood as a microbiological, chemical, physical or radiological agent that causes harm to human health. Geological or geophysical hazards originate from internal earth processes (e.g. earthquakes, volcanic activity, landslides, rockslides, mud flows, or tsunamis). Hydrometeorological hazards are of atmospheric, hydrological or oceanographic origin (e.g. tropical cyclones, floods, drought, heatwaves, cold spells, and coastal storm surges). Hydrometeorological conditions can also be a factor in other hazards such as landslides, wildland fires and epidemics. Technological hazards originate from industrial or technological conditions, dangerous procedures, infrastructure failures or specific human activities (e.g. industrial pollution, nuclear radiation, toxic waste, dam failures, transport accidents, factory explosions, fires, chemical spills).

[SOURCE: ISO 37123:2019, 3.3, modified — In Note 1 to entry, “tsunamis” and “tropical cyclones” is added, and “cyclones, typhoons, hurricanes” are deleted.]

3.7 non-structural measures

measures not involving physical construction which use knowledge, practice or agreement to reduce disaster risks and impacts, in particular through policies and laws, public awareness raising, training and education

Note 1 to entry: Common non-structural measures for DRR (3.5) include building codes, land-use planning laws and their enforcement, research and assessment, information resources and public awareness programmes.

[SOURCE: United Nations Office for Disaster Risk Reduction, 2017]

3.8

resilience

ability to absorb and adapt in a changing environment

Note 1 to entry: In the context of urban resilience the ability to absorb and adapt to a changing environment is determined by the collective capacity to anticipate, prepare and respond to threats and opportunities by each individual component of an urban system.

[SOURCE: ISO 22300:2021, 3.1.206]

3.9

smart community infrastructure

community infrastructure (3.2) with enhanced technological performance that is designed, operated and maintained to contribute to sustainable development and *resilience* (3.8) of the *community* (3.1)

[SOURCE: ISO 37151:2024 3.3, modified — Notes 1 and 2 to entry have been removed.]

3.10

structural measures

physical construction to reduce or avoid possible impacts of hazards, or the application of engineering techniques or technology to achieve hazard resistance and *resilience* (3.8) in structures or systems

Note 1 to entry: Common structural measures for *DRR* (3.5) include dams, flood levies, ocean wave barriers, earthquake-resistant construction and evacuation shelters.

[SOURCE: United Nations Office for Disaster Risk Reduction, 2017]

4 Principles

4.1 General

In this clause, ten principles for implementing the concept of DRR with community infrastructures are introduced. The goal of each principle is to enable continuous improvements of community infrastructures for DRR and enhancing community resilience. Together, the consideration of all ten principles is intended to promote the continuity of critical functions and services during a disaster event, and to reduce potential disruptions, allowing for communities to quickly recover and rebuild utilizing lessons from past disasters and threats.

The ten principles include four overarching principles and six core principles. The four overarching principles are: stakeholder inclusiveness, optimized resource allocation for operations, harmonization and dissemination of technology for disaster risk reduction, robustness and redundancy. The six core principles are: science-based approach, critical function focus, structural and non-structural measures, investment in advance, response preparedness and continuous improvement.

[Figure 1](#) illustrates the systemic relationship between the ten principles. There are four overarching principles and six principles related to focus areas for continuous improvement of disaster risk reduction. The focus areas illustrated at the bottom of [Figure 1](#) are identified in consideration of the Sendai Framework for Disaster Risk Reduction's [7] four priorities for action, to be used across sectors at the local, national, regional, and global levels.

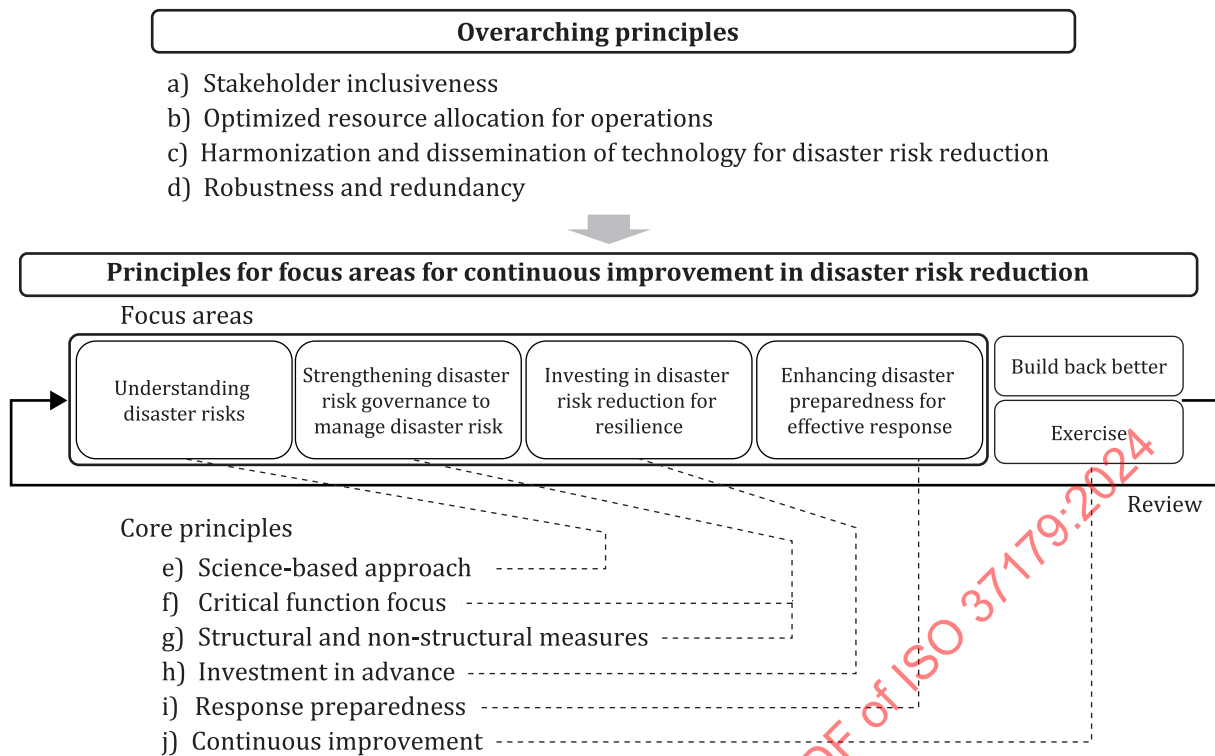


Figure 1 — Systemic relationship between the ten principles

4.2 Stakeholder inclusiveness

Natural hazard events can impact multiple community stakeholders. Due to their wide-ranging effects, development, planning and operations should be inclusive and people-centred. Inclusive infrastructure shall ensure access to valuable services for all individuals in a community, with special attention given to people disproportionately affected by disasters such as vulnerable groups. Identifying, consulting and engaging with multiple community stakeholder groups with diverse characteristics and capabilities can lead to reductions in exposure and vulnerability to hazards, and strengthen preparedness for response and recovery. Inclusivity can also foster a sense of shared ownership and vision, leading to greater acceptance of infrastructure planning.

4.3 Optimized resource allocation for operations

Resources are utilized to support the operation of various infrastructures that are essential for maintaining the community. Under normal circumstances, the resources required for infrastructure operations, such as human, technical, financial, and material resources, are sufficient.

However, during a disaster event, resource availability can become limited or unavailable, leading to disruptions in basic services. Additionally, resources can also be required following a disaster event, as communities recover and begin to build back better, depending on the scale of necessary resources based on local vulnerabilities.

In order to minimize the impacts on the community, it is important to optimize operations on a priority basis and to provide a system for sharing necessary resources. Operations essential to sustain communities should be prioritized throughout a disaster event. Operations essential for the response and recovery phases should also be prioritized.

In order to reduce potential disruptions of critical services, community stakeholders should identify which operations to prioritize and the necessary resources required.

Identifying and assessing the necessary resources to be used for each operation can lead to an efficient and early recovery from a disaster event or other unanticipated scenarios.

4.4 Harmonization and dissemination of technology for DRR

Technology is essential for enabling the implementation and operation of DRR in community infrastructure. Technology (such as early warning systems) can be used in identifying and monitoring future disaster risk, allowing community stakeholders to respond effectively.

As natural hazards impact a wide area beyond local administrative jurisdictions, harmonization of technologies is essential for wider area collaboration and implementation of DRR.

Also, achieving economies of scale is crucial to lower the price of technologies and make them affordable for the world, especially in developing countries. To this end, dissemination of technologies through standardization is important.

Lastly, implementation of technologies in society requires close and efficient communication and collaboration between multiple stakeholders. A harmonized protocol or vocabulary is essential to facilitate communication and collaboration.

4.5 Robustness and redundancy

Communities can be highly reliant on the continued functioning of community infrastructures, which have critical functions, such as energy, transportation, waste and water systems, information and communications technologies (ICT), and built structures such as health and educational facilities. Additionally, human resources are essential in the operation of this critical function.

This dependency can be highlighted during a crisis or disaster event, as disruptions or failures can occur, affecting functionality and services for communities. It is necessary to devise ways to optimize the use of existing infrastructure functions, societal systems, and resources to cope with such disasters.

For this reason, community infrastructure shall be designed to be robust in order to withstand higher thresholds for stress and disaster risk, as well as to provide redundancy, allowing infrastructures to have alternative options or substitutions, which can allow for continued functionality during and after a disaster event.

4.6 Science-based approach

Local hazard risks are dependent on the geophysical and hydrometeorological features of the area as well as the human-made systems present that consider local perspectives on hazard risk management.

Therefore, it is essential to adopt science-based approaches to understand and assess the local hazard risks and the anticipated cascading effect of hazards and systemic risks in a particular area, rather than relying on phenomena observed during recent hazards.

4.7 Critical function focus

In order to reduce disaster risk and enhance community resilience by using smart community infrastructures, it is important to identify vulnerable people and assets. Addressing vulnerability to natural hazards requires identifying and investing in critical functions and resources within the community infrastructure and social system. To do this, it is necessary to be aware of the needs and expectations of relevant stakeholders. In order for critical functions to work properly, the development of human resources is essential. This includes education and training. Additionally, in order to reduce disaster risk and enhance community resilience by using smart community infrastructures, structural measures should be combined with non-structural measures, such as securing evacuation routes and developing rules and guidelines in the case of an emergency.

4.8 Structural and non-structural measures

When considering disaster risk management planning, particularly during the implementation of prevention measures to mitigate risk, it is important to consider the optimal implementation of risk-informed structural and non-structural measures.

Excessive reliance on structural measures can be insufficient and should be supplemented with non-structural measures.

Each community has its own unique set of stakeholders, hazard exposure and vulnerabilities. For this reason, each community should explore and identify a combination of structural and non-structural measures to implement based on local circumstances that can strengthen a community's coping capacity.

NOTE 1 Structural measures can include, but are not limited to, elevated houses, seismometer systems, dams, flood gates, sensors to measure bodies of water, early warning systems, and drone swarms, as identified in ISO/TR 6030.

NOTE 2 Non-structural measures can include, but are not limited to, stockpiling of supplies such as food and nutritional supplements, land use zoning, evacuation planning, risk financing schemes, and multi-stakeholder dialogue/collaboration, as identified in ISO/TR 6030.

4.9 Investment in advance

While it is important to minimize damages and casualties during and after a disaster event, it is also important to proactively invest in structural and non-structural measures to mitigate or reduce disaster risk in the first place.

As economies develop, supply chains and relationships between stakeholders become more closely intertwined, resulting in an increasing tendency for a single natural event to escalate into a major economic disaster. Therefore, prioritizing the mainstreaming of disaster resilience measures into new infrastructure, or retrofitting existing infrastructure, can contribute to resilient and sustainable development. Anticipatory investments can be significantly more cost-effective than focusing on rehabilitation costs.

4.10 Response preparedness

In the context of community infrastructures that have critical functions, it is essential to maintain and monitor measures after implementation in order to keep them in good condition, so that they can continue to operate as designed in the event of a disaster. To ensure the proper operation of infrastructure, it is necessary to train personnel and strengthen the system to operate it, in order to minimize mistakes during normal operations. In addition, during disruptions caused by a disaster event, it is important to minimize the spread of damage by taking appropriate measures. For this purpose, it is essential to regularly review and enhance operator capabilities, rules, and systems through exercises and education. It is also important to prepare stockpiles of food and other necessary materials for emergency activities.

4.11 Continuous improvement

Disaster events can also provide an opportunity to learn from past and current experiences and utilize them for future actions and prediction. This allows communities to modify and adapt their infrastructure accordingly to better anticipate future disaster risks and other unanticipated events, which leads to strengthened resilience of communities. Lessons learned from past disaster events, such as during the response and re-building phases, can provide feedback for future mitigation and preparedness planning, further reducing vulnerabilities. While it is impossible to completely prevent damages and losses from a disaster, continued feedback can contribute to strengthened resilience of communities over time.

5 General requirements

5.1 General

In this clause, the general requirements for community infrastructures that contribute to DRR, in line with the principles identified in [Clause 4](#), are specified.

5.2 Stakeholder inclusiveness

Community infrastructures shall be designed taking into consideration the diverse needs of relevant stakeholders.

Relevant stakeholders to infrastructure design and operations include, but are not limited to, the following groups:

- citizens and other people who use community infrastructures;
- industry or enterprises;
- various levels of governments such as central and local governments;
- infrastructure operators;
- product, service and solution providers;
- financial institutions and investors;
- scientific and technical organizations.

NOTE 1 The stakeholders mentioned in 5.2 for community infrastructure are also listed as the stakeholders to be considered for the selection of performance metrics for community infrastructures in ISO 37151:2024, 5.4.

NOTE 2 Special attention is given to stakeholders including, but not limited to, women, children and youth, persons with disabilities, older persons, indigenous peoples and migrants (See Reference [7]).

5.3 Optimized resource allocation for operations

Community infrastructures shall be designed considering the resource allocation and prioritization at the time of disaster and prepared from the perspective of overall optimization. The approach to plan resource allocation and prioritization should include the following:

- prioritize infrastructure to maintain the operation and recovery, responding to changing conditions caused by hazards;
- enhance the capacity to anticipate future conditions;
- mobilize human, financial and physical resources;
- utilize natural resources, such as materials and energy, efficiently;
- conduct robust post-disaster needs assessment to assess the impact on assets and services and to provide estimates for recovery and reconstruction financing needs;
- utilize the ability, infrastructure and resources of other stakeholders, when necessary.

5.4 Harmonization and dissemination of technology for DRR

In the design of community infrastructure, harmonized structures such as international standards, reference architecture, communication protocol, applied technologies, shall be identified and adopted to the extent that meet local needs to achieve interoperability between stakeholders, infrastructures and communities.

5.5 Robustness and redundancy

Community infrastructures shall be designed to incorporate the following features:

- redundant functions which include multiple or alternative methods to achieve a particular function in the event of a failure, which can facilitate rapid recovery;
- redundant functions which include spare capacity, such as in its power supply and ability to communicate, which could accommodate potential disruptions;
- robust functions which include the ability to resist the effects of hazards, based on an analysis of its hazard exposure in the area in which they are to be implemented;
- robust infrastructure which should be able to adapt and evolve in response to changing situations.

5.6 Science-based approach

Community infrastructures shall be planned, designed, and invested, considering the implementation of a science-based approach to understand local hazard risks. Such a science-based approach includes the following features:

- understanding geophysical and hydrometeorological data, from the past and present as well as future projections;
- simulating the consequences of disaster events including its cascading effects;
- taking into consideration the social, economic, physical and environmental factors that can influence community vulnerability to natural hazards;
- developing a mechanism to collect, monitor and disseminate various types of data for multiple situations, including scenarios of normal operations and uncertainty;
- updating risk assessment regularly to incorporate changes and the latest scientific information.

5.7 Critical function focus

Community infrastructures shall be planned, designed, and invested to incorporate the process to identify factors such as:

- supporting community infrastructures that have critical functions;
- the time frame within which the impacts of inoperable critical functions would become unacceptable to the community infrastructure;
- resources that are needed to support critical functions;
- the interdependencies between critical functions.

5.8 Structural and non-structural measures

Community infrastructures shall be designed to take into consideration an optimal combination of structural and non-structural measures, before and after the disruption of services. Consideration should include the features such as:

- protecting and strengthening critical functions and supporting resources by reducing either the likelihood or the impact of disruptions, or both;
- mitigating the impact of disruptive events, including action plans and capacity building for community infrastructure;
- the impact and benefits of combining both structural and non-structural measures;
- the use of natural structures to supplement structural measures, where applicable.

Cost, effectiveness, feasibility of implementation and urgency should be taken into account when considering measures.

5.9 Investment in advance

Investing in community infrastructure shall be determined based on various factors such as:

- measures to reduce the likelihood of disasters occurrence;
- measures to minimize impact of disasters when they occur;
- an appropriate combination of structural and non-structural measures;