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Smart community infrastructures — Disaster risk reduction — Guidance for implementing seismometer systems

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Contents

Page

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ISO 37174:2024
https://standards.iteh.ai/catalog/standards/iso/e168009d-d3f7-4f0b-9ee2-071f953abdcb/iso-37174-2024

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Foreword

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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.

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(https://standards.iteh.ai)
Document Preview
ISO 37174:2024
https://standards.iteh.ai/catalog/standards/iso/e168009d-d3f7-4f0b-9ee2-071f953abdcb/iso-37174-2024

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Introduction

Earthquakes are one of the most devastating of all natural hazards. To achieve the goal set by the Sendai Framework for Disaster Risk Reduction 2015–2030,[19] it is necessary for relevant stakeholders in communities to prevent and reduce damage caused by earthquakes and maintain the level of services and quality of life in the community after an earthquake. Effective use of a seismometer system contributes to these objectives by enabling more informed emergency responses. Data from seismometer systems also helps to improve understanding and modelling of ground motion and structural behaviour, leading to improved seismic design regulations and improved seismic risk modelling.

In some seismically active countries, the damage caused by earthquakes has also been mitigated by installing appropriate seismometers and by effectively utilizing the data obtained. These data can be utilized for:

- land use control;
- the structural design of buildings and other facilities;
- emergency responses;
- evacuation guidance;

The data also help organizations to develop business continuity plans to help them to respond, recover and return to a pre-defined level of operation following the disruption.

However, the effectiveness of seismometer systems as one of the tools for seismic risk reduction has not been recognized globally due to a lack of systematic knowledge sharing. In countries or regions with rapid urbanization and significant earthquake risk, the lack of knowledge has resulted in the underutilization of seismometer systems. This makes the communities in these places less resilient.

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This document aims to assist relevant stakeholders of communities, such as various levels of governments, planners, developers and operators, in optimizing their investment in urban development by deploying and utilizing seismometer systems as a tool for the disaster risk reduction of earthquakes. This document also describes a categorization of the purposes of seismometer systems for achieving disaster risk reduction, as well as the specifications of seismometer systems required for this specific purpose, as part of the smart community infrastructures described in ISO/TR 6030.

ISO 37174:2024

Analysis of the data obtained from seismometer systems provides information for managing risk and reducing the impact on people, organizations, infrastructures and livelihoods. It also provides information for planning preventive measures and emergency responses after an earthquake. For these reasons, effective utilization of data will enable communities to enhance their resilience to earthquakes.

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Document Preview

ISO 37174:2024
https://standards.iteh.ai/catalog/standards/iso/e168009d-d3f7-4f0b-9ee2-071f953abdcb/iso-37174-2024

Smart community infrastructures — Disaster risk reduction — Guidance for implementing seismometer systems

1 Scope

This document provides guidance for developing, implementing and maintaining seismometer systems as a part of the infrastructure for disaster risk reduction in smart communities. The seismometer systems in this document can be used for the observation of seismic activity, such as earthquakes, micro-seismic motion and volcanic tremors, especially in seismically active areas.

This document gives examples of how different types of seismometers can fulfil the needs and expectations of users and help planners, developers and community operators to effectively use seismometers and related data for disaster risk reduction.

This document is not applicable to the following:

— drop-ball type and pendulum type seismometers;

— how to design and develop seismometer systems (e.g. seismometers installed in railway systems).

The features of the seismometer systems in this document are not intended for the measurement of vibrations caused by landslides.

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2 Normative references

There are no normative references in this document.

ISO 37174:2024
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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
hazard map
map developed to illuminate areas that are affected or vulnerable to a particular hazard (e.g. earthquakes, landslides, rockslides)

[SOURCE: ISO 37123:2019, 3.4]

3.2
earthquake focus
point inside the Earth where an earthquake originates, the fault rupture starts, and the seismic waves are generated

3.3
seismic intensity
degree of ground shaking at a given location, resulting from an earthquake

Note 1 to entry: The criteria for seismic intensity levels vary from country to country.

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3.4
magnitude
number that characterizes the relative size of an earthquake

3.5
disaster
situation where widespread human, material, economic or environmental losses have occurred that exceeded the ability of the affected organization, community or society to respond and recover using its own resources

[SOURCE: ISO 22300:2021, 3.1.73]

3.6
P-wave
primary wave
elastic body wave in which the particle motion is in the direction of propagation

[SOURCE: ISO 19901-10:2021, 3.73]

4 Value, purpose and structure of the system

4.1 General

Seismometer systems should be selected according to their purpose and specifications for data acquisition (see 4.3 and 4.4). When developing and implementing seismometer systems, planners, developers and operators of communities should define the purpose and specifications for data acquisition and the structure of the system.

NOTE A flowchart that can be used for determining the appropriate seismometer systems for specific purposes is provided in Annex A.

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4.2 Value of utilizing seismometer systems

Examples of values achieved by effective use of seismometer systems are as follows:

a) from the perspective of stakeholders:

1) reducing negative consequences and protecting lives, property, and the environment;

2) recovering quickly from damage;

3) meeting stakeholder expectations;

4) taking quick protective actions following earthquakes;

b) from the perspective of community operations:

1) improving the ability to maintain functions immediately after an earthquake and other seismic activity;

2) taking proactive actions in an effective and efficient manner;

3) fostering communities that are resilient, sustainable, liveable and smarter;

4) providing an effective response strategy to emergencies and disasters;

c) from the economic perspective:

1) reducing legal and financial burdens;

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2) reducing costs incurred by earthquakes;

d) from the business perspective:

1) strengthening resilience;

2) maintaining and improving reputation and credibility;

3) strengthening sustainability;

e) for research and the professional community:

1) improving the understanding of natural phenomena (e.g. earthquakes and volcanos);

2) improving the understanding of vibrations on the ground and in structures due to natural phenomena (e.g. earthquakes and volcanos);

3) improving design regulations and structural design.

By effectively utilizing seismometer systems, planners, developers and operators of communities can contribute to achieving the United Nations Sustainable Development Goals 3, 8, 9 and 11.

4.3 Purpose of use

Planners, developers and operators of communities should define the purposes for using seismometer systems. Examples of purposes include:

— assessing the exposure to hazards in the area;

— early detection and warning;

— evacuation alerts;

— controlling devices and systems.

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Further details on the purposes of use are described in 6.1 and 6.2.

ISO 37174:2024
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4.4 Data specifications

Seismometer data is time-series data for vibrations. The specifications for data acquisition should include:

— variables (e.g. acceleration, velocity and displacement);

— accuracy of location and time;

— real-time acquisition capability;

— data format.

4.5 Structure of the system

Seismometer systems can include the following components, as shown in Figure 1:

— seismometers for measuring environmental vibrations (e.g. seismic motion or volcanic ground motion);

— data obtained by seismometer;

— processing components;

— other peripheral equipment (e.g. communication infrastructure, power supply facilities, fixing devices).

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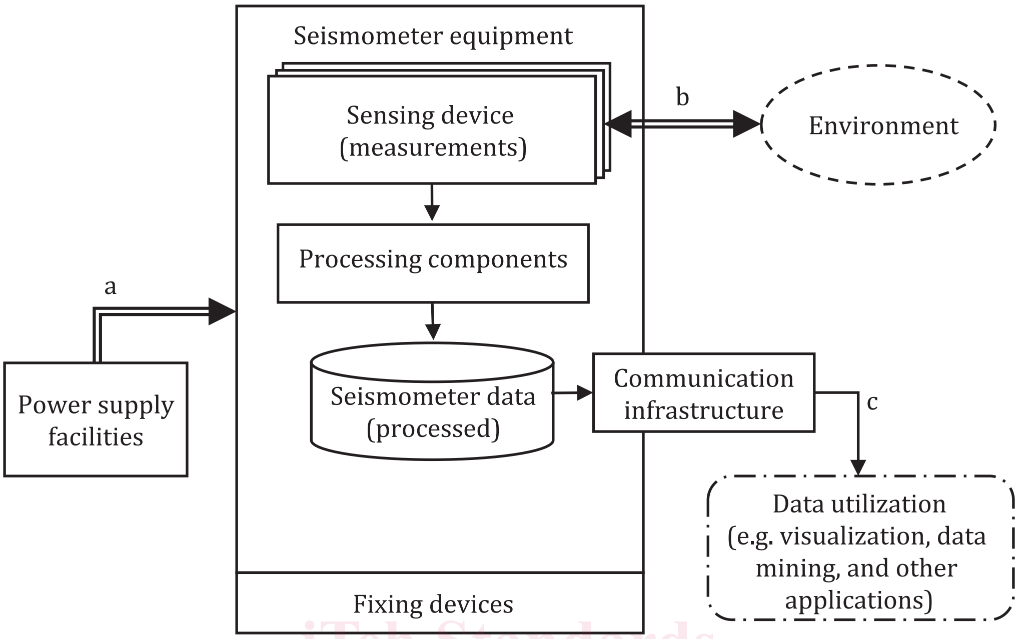
When performing seismic observations at multiple points using the communication infrastructure, the following factors should be considered:

— the observation environments that are likely to impact the performance of seismometer systems;

— the spatial distribution of seismometer systems, including location, density and network.



Key

a Electric power.

b Vibration caused by seismic motion or volcanic ground motion.

c Data.

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Figure 1 — Example of a seismometer system and interactions

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