ACECC TC28 2nd Meeting on 27th Sep 2023

For a Better Quality of Life

http://www.acecc-world.org/

Outline

No.	Time	Contents	Presenter
1	13:00 – 13:05	Opening	Chair
2	13:05 – 13:10	Self Introduction by New Members	New Members
3	13:10 – 13:15	Brief Explanation on All Chapters of the Guideline	Nakano (JSCE)
4	13:15 – 13:25	Explanation on Chapter1 of the Guideline	Nakano (JSCE)
5	13:25 – 13:45	Result of the Questionnaire (VFCEA, KSCE, JSCE)	Goda (JSCE)
6	13:45 – 13:55	Discussion on the Result of the Questionnaire	ALL
7	13:55 – 14:05	Future Work of TC28	Goda (JSCE)
8	14:05 – 14:15	Free Discussion	ALL
9	14:15 – 14:20	Closing	Chair

1. Opening

1. Opening

Chair of TC28 (also, Japanese Representative of ACECC)

Name:	**Prof. Eiki YAMAGUCHI**
Affiliation:	**Department of Civil Engineering, Kyushu Institute of Technology**

2. Self Introduction

For a Better Quality of Life

http://www.acecc-world.org/

2. Self Introduction (TC Members)

<Representative List for TC28>

As of 2023.9.7

Organization	(1) Name	(2) Affiliation	(3) Position	(4) Specified field	(5)Contact Address	(6)E-mail address
ASCE (US)	Dr. Lian Duan	California Department of Transportation, USA	Senior Bridge Engineering, Steel Committee Chair	Seismic Design, Structural Stability, Bridge Design	1801 30th Street, DES MS-9/1H, California Department of Transportation, Sacrameto, CA 95816, USA	lduanbeh@gmail.com
	Dr. Chungwook Sim	University of Nebraska at Lincoln	Assistant Professor	Structural Engineering	1110 South 67^th St. (Office: PKI 203B), Omaha, Nebraska 68022, USA	csim@unl.edu
CICHE (Taiwan)	Dr.Tzu-Kang Lin	University of Yanming-Chiaotung, Taiwan	Professor	structural identification and monitoring of bridges.	-	tklin@nycu.edu.tw
EA (Australia)	Dr.Shane Scriven	Engineers Australia's Asset Management Council	Maintenance & Reliability Special Interest Group Chair	Maintenance & Reliability	Managing Director | SAS Asset Management | M +61 4 363 55137	Shane.Scriven@SASAssetManagement.com
IEB (Bangladesh)	Dr. A.F.M.Saiful Amin	Bangladesh University of Engineering and Technology (BUET)	Professor	Monitoring of bridge piers and foundations; Monitoring of corrosion, Vibration based monitoring	-	samin@ce.buet.ac.bd aminsaiful71@gmail.com
IEP (Pakistan)	Dr. Shamsoon Fareed	NED University of Engineering & Technology, Karachi-Pakistan	Associate Professor	Structures	Department of Civil Engineering, NED UET, University Road, Karachi-Pakistan	sfareed@neduet.edu.pk
	Mr. Wajahat Nassar	Remco Center	General Manager incl. Inventories/Warehousing	Inventrory Management, Construction Management	-	wajahat.nassar@gmail.com
KSCE (Korea)	Dr.Chang-Su Shim	School of Civil and Environmental Engineering, Urban Design and Studies, Chung-Ang University	Professor	-	Tel: 82-(0)2-820-5895, Fax: 82-(0)2-812-6397, Cell: 82-(0)10-4102-9151	csshim@cau.ac.kr
	Dr. Robin Eunju Kim	Department of Civil & Environmental Engineering Hanyang University	Assistant Professor	-	Office) 82-2-2220-0413 Fax) 82-2-2220-0399	robinekim@hanyang.ac.kr
PICE (Philippine)	Dr. Benito M. PACHECO	University of the Philippines Diliman	Professor	Structural Engineering; Environmental & Energy Engineering; Civil Engineering Education	Institute of Civil Engineering, UP Diliman, Quezon City 1108, Philippines Cell No. +639175332500	riskguide101@up.edu.ph
VFCEA (Vietnam)	Dr. Pham Hoang Kien	Faculty of Engineering Department of Automation and Design of Roads, University of Transport and Communication	Associate Professor	Automation of Bridge and Road Design	tel: 0975474828	phkien@utc.edu.vn
	Dr. Le Thanh Binh	Anglia Ruskin University, UK (Ho Chi Minh city University of Transport, Vietnam)	Senior Lecturer, UK (Visiting Lecturer, Vietnam)	Geotechnical Engineering, Image analysis technology	UK: Bishop Hall lane, Chelmsford, Essex, UK. Postcode: CM1 1SQ. (Vietnam: Ho Chi Minh city University of Transport, 2 Vo Oanh, Binh Thanh district, Ho Chi Minh city, Vietnam.)	binh.le@ut.edu.vn binh.le@aru.ac.uk
JSCE (Japan)	Dr. Masaaki NAKANO	Research & Development Center, Nippon Koei Co., Ltd.	General Manager, Center for Advanced Research	Structures, Maintenance	TEL:+81-29-871-2119	a4753@n-koei.co.jp
	Mr. Tetsuro GODA	Research & Development Center, Nippon Koei Co., Ltd.	Engineer, Center for Advanced Research	Structures, Maintenance	Tel:+81-90-2637-8228	goda-tt@n-koei.jp

New Member

2. Self Introduction (Japanese National Committee)

<Japanese National Commission for TC28>

As of 2023.9.7

Organization	(1) Name	(2) Affiliation	(3) Position	(4) Specified field	(5)Contact Address	(6)E-mail address
JSCE (Chair)	Dr. Eiki Yamaguchi	Department of Civil Engineering, Kyushu Institute of Technology	Professor	Bridge, Structures	Tobata, Kitakyushu 804-8550, Japan Phone: +81-93-884-3110	yamaguch@civil.kyutech.ac.jp
JSCE (Executive secretary)	Dr. Masaaki NAKANO	Nippon Koei Co., Ltd.	General Manager	Structures, Maintenance	Nippon Koei Co., Ltd. 2304 Inarihara, Tsukuba, Ibaraki 300-1259 JAPAN Tel: +81-29-871-2119 (Mobile)	a4753@n-koei.co.jp
JSCE (Secretary)	Mr. Tetsuro GODA	Nippon Koei Co., Ltd.	Engineer	Structures, Maintenance	Nippon Koei Co., Ltd. 2304 Inarihara, Tsukuba, Ibaraki 300-1259 JAPAN Tel: +81-90-2637-8228 (Mobile)	goda-tt@n-koei.jp
JSCE	Kimitoshi MATSUYAMA	Nippon Koei Co., Ltd.	(Not asked yet)	(Not asked yet)	5-4 Kojimachi, Chiyoda-ku, Tokyo 102-8539 JAPAN Tel: +81-3-3238-8377	a4043@n-koei.co.jp
JSCE	Masaki MIYAMURA	FUKUYAMA CONSULTANTS Co., Ltd.	(Not asked yet)	(Not asked yet)	Tokyo, Chiyoda City, Kanda Iwamotochō, 4-14 4F, 101-0033 Tel: +81-3-5296-9406	m.miyamura@fukuyamaconsul.co.jp
JSCE	Hiroshi DOBASHI	Technology Center of Metropolitan Expressway	(Not asked yet)	(Not asked yet)	Tokyo, Minato City,Toranomon, 3-chōme-10-11, 105-0001 Tel: +81-3-3578-5750	dobashi@tecmex.or.jp
JSCE	Manabu KASAHARA	East Nippon Expressway Company Limited	(Not asked yet)	(Not asked yet)	Akita, Yokoteshi, Ekinishi, 2-3-22, 013-0049 Tel: +182-23-6702	m.kasahara.aa@e-nexco.co.jp
JSCE	Motoharu KAWANISHI	Oki Electric Industry Company, Limited	(Not asked yet)	(Not asked yet)	-	kawanishi381@oki.com
JSCE	Takashi HARADA	Oki Electric Industry Company, Limited	(Not asked yet)	(Not asked yet)	-	harada655@oki.com

Member changed

New Members from OKI

Photo Session

Could you please turn your camera on?

(We will use ‘together mode’ of Microsoft Teams.)

3. Brief Explanation on All Chapters of the Guideline

For a Better Quality of Life

http://www.acecc-world.org/

Background of TC Establishment

- Infrastructure is critical for economic prosperity, economic growth and sustainable development. While many countries invest heavily in infrastructure construction, much less attention has been paid to maintenance work, which could generate a serious bottleneck to economic growth and public services in the long run.
- Utilizing new technologies for systematic infrastructure management is essential for both preventing accident and minimizing life-cycle-cost.

Air-borne salt from sea

Deteriorated beam

Objectives

- **Civil Infrastructures have been constructed across the Asian region; however, maintenance has already become a big issue.**
- **Although a lot of monitoring technologies and products are developed, the administrators are struggling to choose technologies since the practical specifications are not standardized.**

- **The TC is to prepare the guidelines on the scheme for the maintenance of infrastructure; by making good use of monitoring technology, the maintenance work would be made sophisticated and efficient.**

JSCE Recommendations (Draft)

- [Draft of Recommendations for Utilization of Monitoring Technology in Japan](JSCE) was published in June, 2022
- The TC will share the contents and discuss developing and reconstructing as the ACECC guidelines.

Table of Contents of JSCE Recommendations

4. Explanation on Chapter1 of the Guideline

Chapter 1 General Provisions

- 1.1 Scope
- 1.2 Positioning of Monitoring
- 1.3 Monitoring plan
- 1.4 Definition of Terms

1.1 Scope of Application

The Guidelines for Utilization of Monitoring Technology (hereafter referred to as the Guidelines) apply to the monitoring of general road structures.

1.2 Objective of Monitoring

(1) Basically, the maintenance of structures is carried out in a cycle of [inspection→ diagnosis → measures (repair, reinforcement, etc.) → record]. When monitoring is utilized in the cycle of maintenance, the following objectives should be clarified and implemented.

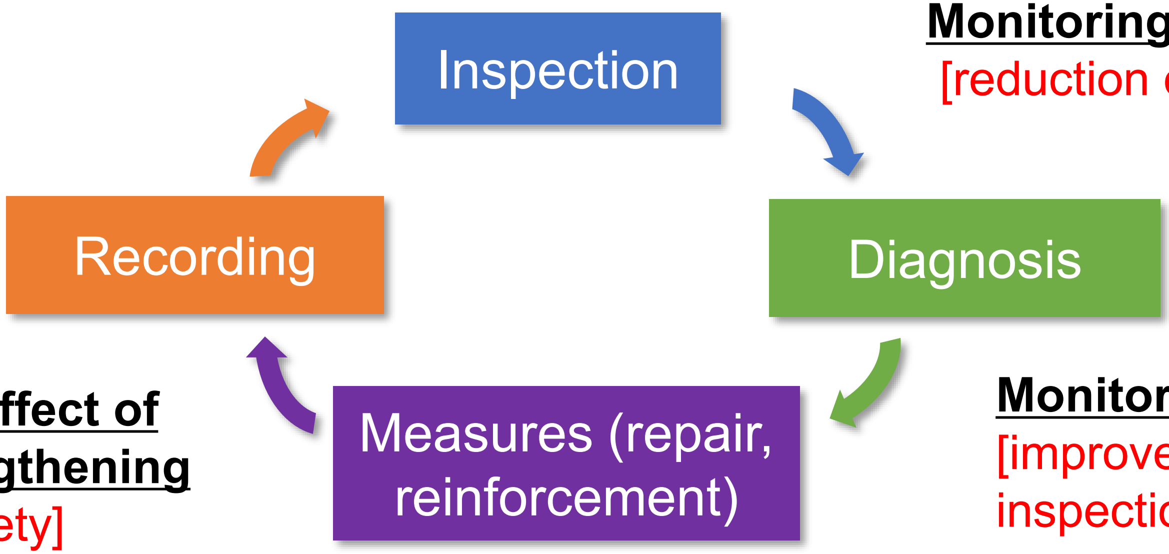
[1]Monitoring to assist inspection
[2]Monitoring to assist diagnosis
[3]Monitoring to confirm effectiveness of repair and strengthening
[4]Monitoring to assist emergency response

(2) Monitoring should be conducted in accordance with the purpose as well as the maintenance and management policy of the manager of the structure, with more specific specific positioning clarified according to the type of structure, the state of deformation, environmental conditions, etc.

Maintenance Cycle & Monitoring of Infrastructures

Monitoring to assist emergency response
[improvement of efficiency, rationality, and safety]

Monitoring to assist inspection
[reduction of inspection cost]



Monitoring the effect of repair and strengthening
[evaluation of safety]

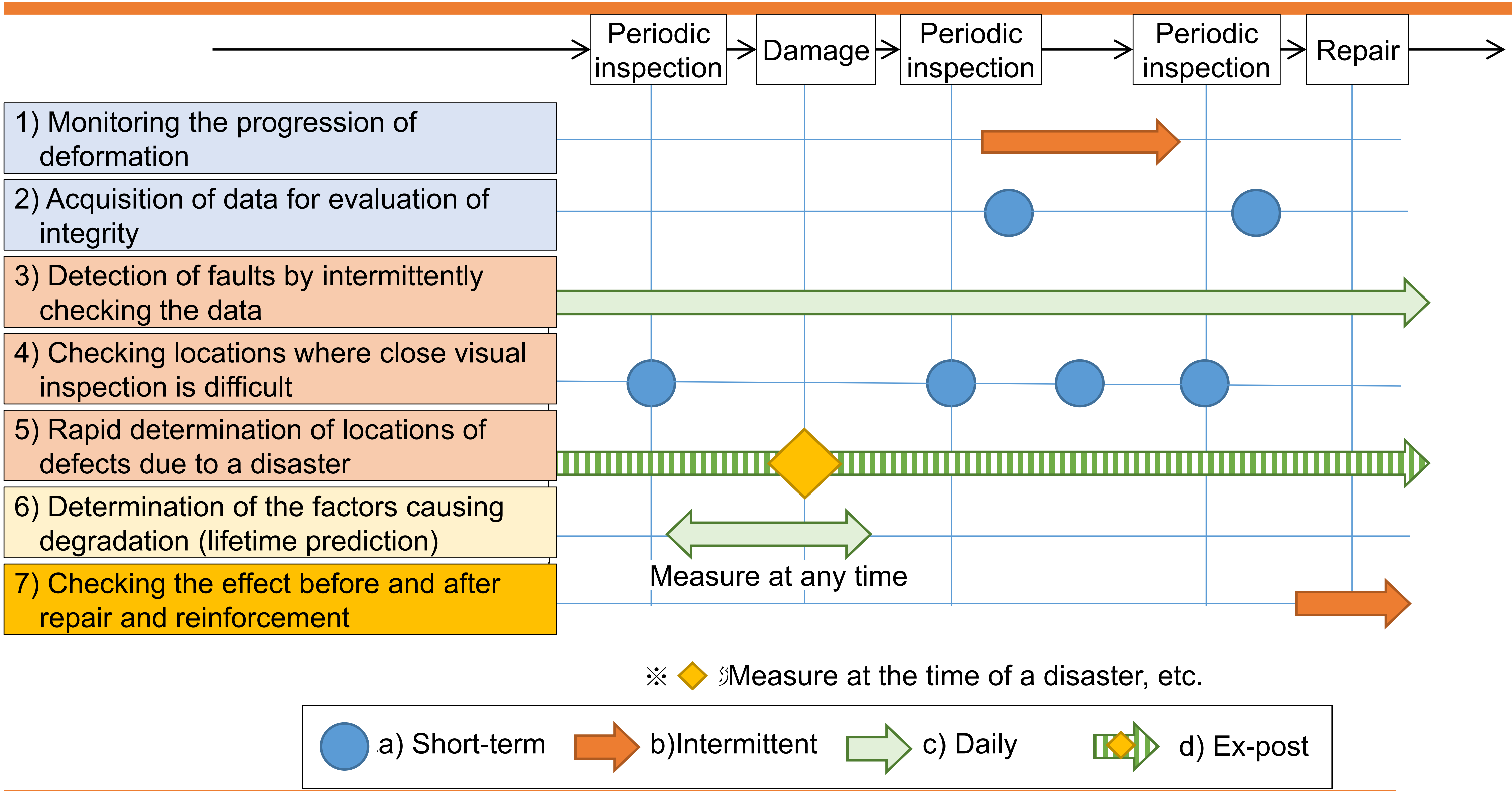
Monitoring to assist diagnosis
[improvement of reliability of inspection and diagnosis]

Inspection	Normal Inspection; Interim Inspection; Specific Inspection; Periodic Inspection; Abnormal Inspection
Diagnosis	Estimation of degradation mechanism/ Evaluation of performance; Diagnosis of soundness; Determination of whether action is required
Actions	Repair/ Reinforcement; Emergency; Surveillance; Traffic control; Detailed investigation/ Follow-up investigation
Record	Recording; Utilization (monitoring and analysis)

Needs and Objectives of Monitoring (examples)

Purpose of Monitorin g	Management Needs	Specific Objectives
(1) Assist with inspections	Reduce the number of missed deformities during normal inspections.	To determine the location of any deformities.
	Reduce inspection time and cost by narrowing the scope of periodic inspections.	To determine the healthy range or the range that needs to be monitored.
(2) Assistance in diagnosis	Prevent the progression of deterioration through the implementation of preventive maintenance.	Obtain the information necessary to determine the implementation of preventive maintenance.
	Prioritization of measures.	Obtain and compare quantitative data.
	Improve the accuracy of the soundness assessment.	Obtain qualitative and quantitative data for health assessment.
	Maintain in-service condition.	Confirm that conditions that should limit or close traffic have not been reached.
		Check the condition of the building until repair/reinforcement or other measures are taken.
(3) Confirmation of effect of repair/reinforcement	Confirm the adequacy of the countermeasures.	Confirm the effectiveness and sustainability of the countermeasures.
(4) Assist in emergency response	Early identification of traffic hazards.	Identify the locations where bridges are expected to fall or other hazards are anticipated.
	Shorten the time it takes to open to traffic.	

Concept of implementation of monitoring



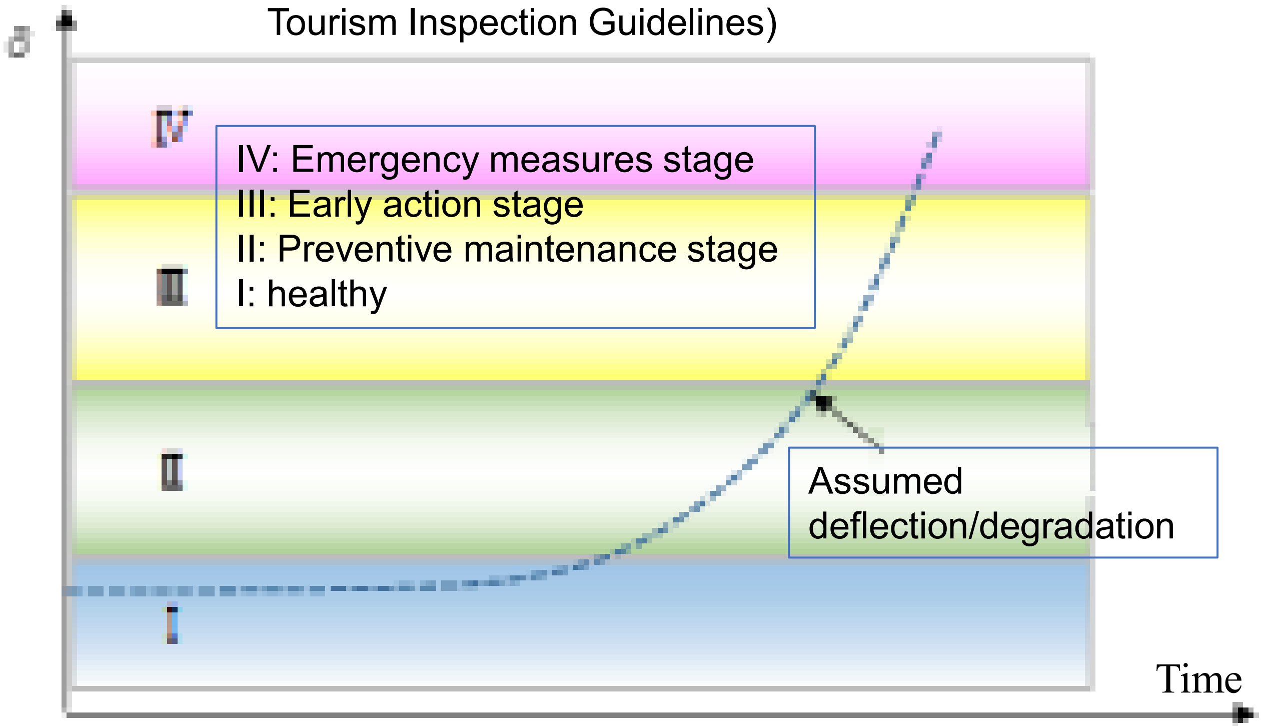
1.3 Monitoring Plan

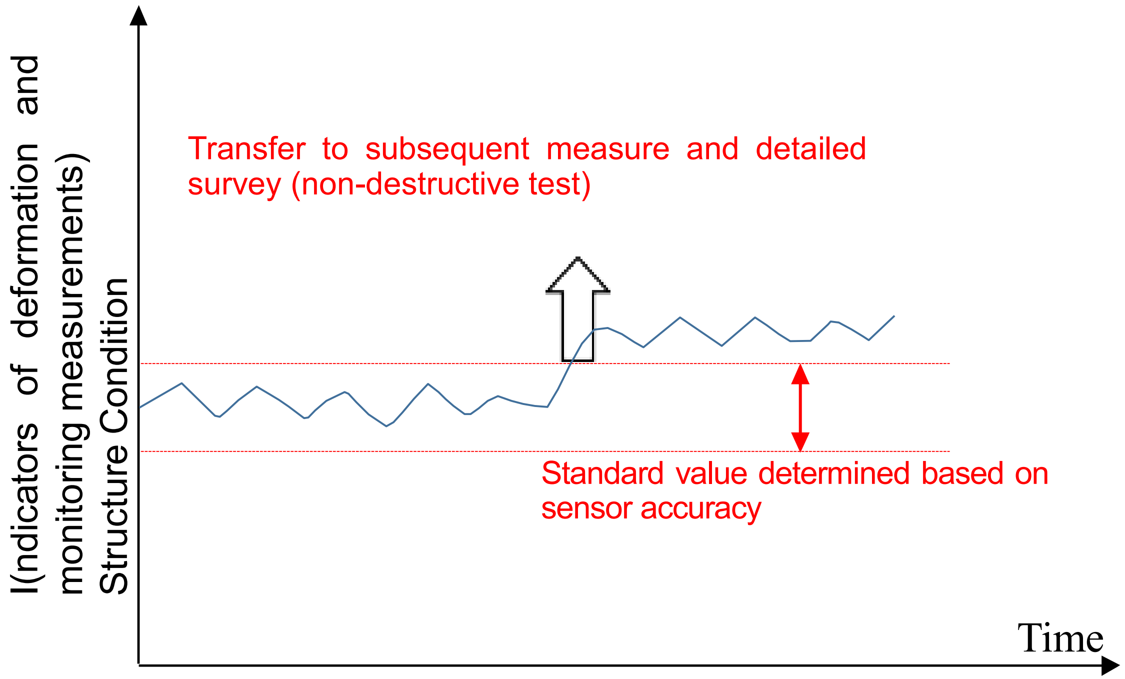
(1) Monitoring should be planned by clarifying its position and purpose in the maintenance cycle of the target structure.
(2) In selecting a monitoring system, the appropriate combination and specifications should be selected to suit the monitoring position, purpose, and local conditions. Policies for collection, storage, and utilization of acquired data must be fully considered at the planning stage, as they affect the cost, system scale, and long-term maintenance plan.
(3) Setting of control standards
In principle, the evaluation and determination of monitoring measurements shall be made with control standards set in advance.

- ✓ Monitoring is conducted to assess the condition of a structure, which is conventionally done by humans in the maintenance cycle, to improve efficiency, reliability (accuracy), and safety (urgency), etc. In planning, it is necessary to clarify its position and purpose.
- ✓ Monitoring systems can be roughly classified into acquisition and utilization of monitoring data on structures, as well as storing and utilizing monitoring data
- ✓ In selecting a monitoring system, it is necessary to select an appropriate combination and specifications based on cost and long-term maintenance plans. Costs related to monitoring are:
  1.Advance work cost, 2.Measurement cost, 3.Data compilation costs, 4.Other costs

Image of Control Standard Values

Judgment category of soundness
(Ministry of Land, Infrastructure, Transport and Tourism Inspection Guidelines)





- ✓ Clarify the relationship between load-bearing capacity and deflection of structures by analysis, etc., and establish control standard values.

Examples of Control Standard Values

case	Monitoring Technology	Indicators to be evaluated
a)	Observation of cracks in floor slab by image	Crack density, crack width
	Image-based girder deformation monitoring	Crack width, water leakage
	Monitoring of painted surfaces by image	Amount of rust
	Measuring the amount of salt adhered by a salt detector	Salt content of flying salt
	Measuring Natural Potential in Concrete with a Collimating Electrode	Natural potential (corrosive environment of rebar)
b)	Fiber optic floor slab fallout monitoring	Steps on underside of floor slab
	Deflection measurement of floor slab by displacement transducer	Amount of deflection
	Pca floor slab joint monitoring with fiber optic	Cracks, joint openings
	Vibration characteristics of slab by acceleration sensor	Comparison of vibration modes and degree of damage
	Floating and spalling of concrete by thermal imaging camera	Presence and extent of floating and delamination
	Vibration characteristics of a girder by acceleration sensor	Natural frequency, damping constant, vibration mode, deflection angle
	Abnormality detection of girder ends by displacement transducer	Displacement of girder end
	Measurement of girder deflection using images, optical fibers, etc.	Deflection, stiffness of girder
	Measurement of girder displacement by displacement transducer	Movable condition of bearing
	Natural frequency measurement of pier foundation by accelerometer (wash) (Amount of digging)	Natural frequencies of foundations (amount of scour and stability)
c)	Measuring displacement of slopes and slopes with inclinometers	Amount of time variation of tilt angle
	Displacement measurement of slopes and slopes by satellite positioning	Displacement velocity of ground surface
	Determination of rockfall risk by vibrometer	Difference in vibration characteristics between base and rock mass

1.4 Definition of Terms

Monitoring: The condition of structures and materials is monitored constantly or multiple times by installing sensors or other means.(always/timely/irregularly, at least at two points in time) to objectively grasp changes over time in the state of the system.
Monitoring technology: Technology to perform monitoring.
Monitoring system: In addition to monitoring technology, this system combines technologies for collecting and transmitting data, storing and accumulating the data, and monitoring, analyzing, and predicting deterioration (Figure 1.3.1).
Monitoring measurements: values of displacement, acceleration, crack width, etc. obtained by monitoring.
Inspection: To understand the state of deformation of a structure. In the case of road structures, the basic method is close visual inspection, but in addition to close visual inspection, sound percussion, palpation, and other non-destructive testing may be used to determine the condition Including understanding.
Diagnosis: The act of making a judgment on the necessity and method of measures by estimating the deterioration mechanism and evaluating the performance based on the inspection results.
Measures: Measures to maintain or restore the function, durability, etc. of a structure, such as repair or reinforcement. measures: measures taken to remove the structure, to monitor it periodically or constantly, or when emergency measures cannot be taken, e.g., traffic control or road closure. Includes no measures.
Deformation: A condition that, due to some cause, should not be present.
Damage: An alteration that may interfere with the function of a structure.
Deterioration: An alteration that may interfere with the function of a structure. Deterioration: Deformation that progresses over time.
Management standard: An operational policy for implementing the maintenance and management of structures.
Management standard value: The limit value specified for implementing maintenance and management of a structure.

5. Result of the Questionnaire (VFCEA, KSCE, JSCE)

For a Better Quality of Life

http://www.acecc-world.org/

Result of Questionnaire

- **Questions regarding the state of maintenance and monitoring in each country**

No	Question	VFCEA	KSCE	JSCE
1	Are there any technical standards or regulations regarding “maintenance and management” of road and bridges in your country?	Yes In Vietnam: https://vanban.chinhphu.vn/default.aspx?pageid=27160&docid=194253	Yes	Yes
2	Are there any technical standards or regulations on “infrastructure monitoring” for road and bridges in your country?	Yes In Vietnam: https://vanban.chinhphu.vn/default.aspx?pageid=27160&docid=187774	Yes	Yes

Result of Questionnaire

Definition of Monitoring…
The monitoring is the act of periodically acquiring data and comparing them to understand the occurrence and progression of abnormalities over time.

- **Differences among countries regarding Chapter 1 General Provisions**

No	Question	VFCEA	KSCE	JSCE
3	Please provide any additional information or suggestions for revision regarding the maintenance management cycle in Figures 1.1.1 and 1.1.2 based on the actual situation and issues in your country.	Figure 1.1.1: it should have a starting point which can be Inspection Figure 1.1.2: No comment	Definition of the monitoring is needed. As-built information is very important at the beginning of the maintenance. So, it will be better to add the information delivery from project information to maintenance.	“Monitoring to assist in emergency response” in Figure 1.1.1 is not related to the maintenance cycle.
4	Regarding "Positioning of Monitoring" in 1.2, there are 4types of monitoring in Japan. Please provide any additional information or suggestions for revision based on the actual situation and issues in your country.	No further suggestions.	Recently, digital twin models are actively developed for the life-cycle maintenance. So, we need to focus on KPI(key performance indicator) according to different structural types. Especially, time-depended performance needs to be monitored to update the analysis model. (ref. IBASE TG.5)	-

Figure 1.1.1 Maintenance Cycle and Monitoring

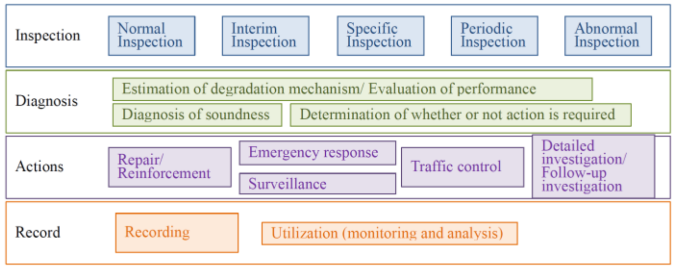


Figure 1.1.2 Cycle of maintenance management

1.2 Positioning of Monitoring

(1) Basically, the maintenance of structures is carried out in a cycle of [inspection→ diagnosis → measures (repair, reinforcement, etc.) → record]. When monitoring is utilized in the cycle of maintenance, the following objectives should be clarified and implemented.

① Monitoring to assist inspections

② Monitoring to aid diagnosis

③ Monitoring to confirm effectiveness of repair/reinforcement

④ Monitoring to assist in emergency response

(2) Monitoring should be conducted in accordance with the purpose as well as the maintenance and management policy of the manager of the structure, with more specific positioning clarified according to the type of structure, the state of deformation, environmental conditions, etc.

Result of Questionnaire

- **Differences among countries regarding Chapter 1 General Provisions**

No	Question	VFCEA	KSCE	JSCE
5	As stated in 1.2(2), there are 4cases where monitoring is implemented. Please provide any additional information or suggestions for revision based on the actual situation and issues in your country.	No further suggestions.	Fatigue and Corrosion are critical issues and difficult to monitor. For assessment to judge the service life of existing bridges, it is necessary to monitor the response for some period.	-

(2) There are a wide variety of situations in which monitoring is utilized, and it is important to employ it appropriately according to the type of structure, the state of deformation, and environmental conditions, in accordance with the maintenance and management policy of the manager of the structure.

To help you visualize the use of monitoring in the cycle of maintenance and management, the following figures show the cases in which monitoring is introduced according to the maintenance and management scenario (Figure 1.2.2).

- Monitoring to be performed after the alteration is confirmed.

When structural deformation is identified during normal inspections, it is effective to conduct monitoring to obtain information necessary for diagnosis and to monitor the progress of the deformation.

1) Monitoring of deformation progression

A typical example is continuous displacement monitoring of RC slabs when salt or fatigue damage has progressed and deflection and vibration caused by traffic loads are significant. This monitoring is effective for measuring the amount of deflection due to traffic loads to determine the progress of deterioration, and for making decisions on traffic control measures when the increase in deflection becomes significant. When cracks are detected in the concrete, the progression of the cracks can be checked from images taken periodically, and the width of the cracks can be continuously measured using gauges.

2) Gathering information to assess soundness

When cracking, lifting, or delamination of concrete is evident and there is concern that the rigidity of the structure may deteriorate, it is effective to monitor the natural frequencies and vibration modes using accelerometers. This case also includes monitoring the corrosion environment inside the concrete by measuring the electrical potential of the steel material, assuming salt damage. Monitoring techniques have also been developed to evaluate the soundness of bridge foundations when piers in rivers are scoured.

- Monitoring for early detection of deformities

In ordinary inspections, the range of proximity is limited and the detection of deformations may be delayed due to the timing of the inspection cycle. Monitoring can be used to supplement this process, thereby improving the sophistication and efficiency of maintenance management.

3) Detecting deformities through continuous data confirmation

It is a monitoring method that periodically collects data from a healthy state and conducts a detailed investigation when changes in the data appear, in order to detect abnormalities at an early stage. It is similar to the method in which a human body temperature and blood pressure are measured from normal conditions to check the state of health. MonitAoring data includes displacement, natural frequencies, natural potentials, and image comparisons. Monitoring techniques have also been developed to detect signs of slope failure and slope failure.

4) Confirmation of difficult-to-see areas in close proximity

In principle, inspections should be conducted visually at close range, but in actual work sites, there are some locations, such as high places and narrow areas, where it is difficult to get close. However, there are some areas that are difficult to inspect in close proximity, such as high or narrow areas, and it is effective to supplement the inspection of such areas with monitoring using sensors. This includes comparing images taken by a telephoto camera or drone, and measuring strain at stress concentrations. Measurement of salt permeation in concrete also falls into this category.

5) Early identification of deformed areas in the event of a disaster

In order to efficiently inspect a large number of structures, it is extremely effective to determine the priority of inspection if damaged structures can be sorted out at an early stage using information from sensors and other sources.

However, since a large number of sensors must be installed at all times, sufficient consideration must be given to the selection method of the target structure, the deformation to be monitored, and the technology to be used, including the cost and maintenance of the equipment.

- Monitoring to predict deterioration

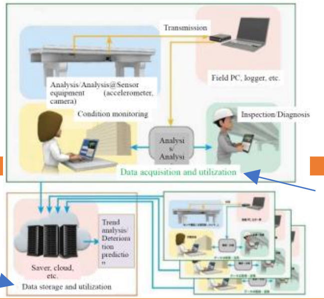
6) Identification of deterioration factors

When deterioration is anticipated, the condition of the deterioration factors is assessed in order to predict the service life and to plan the timing of preventive maintenance measures. An example of this is to measure the amount of salt that is blown into the building and assume the risk of salt damage.

- Monitoring to confirm the effectiveness ofrepair/reinforcement

7) Confirmation of effectiveness before and after repair/reinforcement

In the maintenance of structures, it is useful to monitor the condition and behavior of the structure to confirm that the effects of the design have been achieved when the structure is covered with concrete for preventive maintenance or repaired or reinforced at the point of deformation. This can be reflected in the revision of deterioration forecasts and in the improvement of repair and reinforcement methods.



Result of Questionnaire

- **Differences among countries regarding Chapter 1 General Provisions**

No	Question	VFCEA	KSCE	JSCE
6	In 1.3(2), monitoring systems are mainly classified into acquisition/utilization and storage/utilization of structural monitoring data. Please provide any additional information or suggestions for revision based on the actual situation and issues in your country.	No further suggestions.	For common bridges, it is not easy to install the monitoring system for long period. Recently, wireless and detachable sensor systems are utilized in several bridges. Vision-based sensing system is useful for the monitoring of deformation of bridges.	-
7	In 1.3(3), control criteria are established to estimate the condition of structures based on measurements obtained from monitoring and to move to the next action according to changes in condition. Please provide any additional information or suggestions for revision based on the actual situation and issues in your country.	This section is important but in practice, it is difficult to determine such control criteria due to the uncertainty regarding the current health of the structures. For example, before installation of the monitoring instrumentation, the structures could have deformed which may not known and any control criteria can not consider those prior deformations.	We need to define indicators for the control criteria. The indicators need to be derived from the baseline model. For cable-supported bridges, it is common to define upper and lower bound of the sensing data considering design conditions and environmental conditions.	-

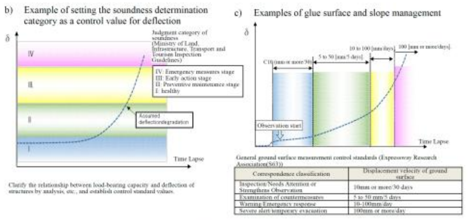


Figure 1.3.2 Image of control standard values

Result of Questionnaire

- **Differences among countries regarding Chapter 1 General Provisions**

No	Question	VFCEA	KSCE	JSCE
8	Please provide any other examples of standards you have applied regarding the examples of setting control standard values in Table 1.3.1.	Restriction on the tunnel lining displacements due to nearby construction activities Code of Practice for RAILWAY PROTECTION October2004 Edition (Singapore LTA)	-	-
9	Please provide any other questions or comments regarding Chapter 1 General Provisions.	No questions	Is the guideline for all the common bridges? Or for the special cases such as severe deterioration or natural hazards?	-

Table 1.3.1 Examples of setting control standard values

case	Monitoring Technology	Indicators to be evaluated
a)	Observation of cracks in floor slab by image	Crack density, crack width
	Image-based girder deformation monitoring	Crack width, water leakage
	Monitoring of painted surfaces by image	Amount of rust
	Measuring the amount of salt adhered by a salt detector	Salt content of flying salt
	Measuring Natural Potential in Concrete with a Collimating Electrode	Natural potential (corrosive environment of rebar)
b)	Fiber optic floor slab fallout monitoring	Steps on underside of floor slab
	Deflection measurement of floor slab by displacement transducer	Amount of deflection
	Pca floor slab joint monitoring with fiber optic	Cracks, joint openings
	Vibration characteristics of slab by acceleration sensor	Comparison of vibration modes and degree of damage
	Floating and spalling of concrete by thermal imaging camera	Presence and extent of floating and delamination
	Vibration characteristics of a girder by acceleration sensor	Natural frequency, damping constant, vibration mode, deflection angle
	Abnormality detection of girder ends by displacement transducer	Displacement of girder end
	Measurement of girder deflection using images, optical fibers, etc.	Deflection, stiffness of girder
	Measurement of girder displacement by displacement transducer	Movable condition of bearing
	Natural frequency measurement of pier foundation by accelerometer (wash) (Amount of digging)	Natural frequencies of foundations (amount of scour and stability)
c)	Measuring displacement of slopes and slopes with inclinometers	Amount of time variation of tilt angle
	Displacement measurement of slopes and slopes by satellite positioning	Displacement velocity of ground surface
	Determination of rockfall risk by vibrometer	Difference in vibration characteristics between base and rock mass

Result of Questionnaire

- **Questions regarding current state, challenges, and objectives of monitoring in each country**

No	Question	VFCEA	KSCE	JSCE
10	What is the biggest challenge in your country in the maintenance cycle of inspection, diagnosis, action and record? (Multiple answers are acceptable.) Please also indicate the reasons for your answer.	The current practice is highly laborious, the quality of the data can be questionable.	- Invisible damage detection - Decision making of severely deteriorated bridges - Reliability of data from inspection reports for existing bridges (for ML training)	Damage of structures are recorded well. However, evaluation of soundness is not sufficiently done based on structural analysis. It should be done from the structural point of view.
11	Regarding the position of monitoring, there are mainly monitoring to assist inspection, to aid diagnosis, to confirm effectiveness of repair/reinforcement, and to assist in emergency response. What do you consider the most important in your country? (Multiple answers are acceptable.) Please also indicate the reasons for your answer.	Aid diagnosis and continuous monitoring for structure health. That helps ensure the structures safe for operation.	For common bridges, monitoring can be done for bridges with serious problems or critical decision issues. There are regular maintenance process and regulations. So, the monitoring should be defined as special tasks with additional budget.	Amount of budget and the number of engineers especially in rural area are not enough to manage all degraded bridges. So, monitoring to assist inspection and to aid diagnosis are important to easily know defects of structure.

Result of Questionnaire

- **Questions regarding current state, challenges, and objectives of monitoring in each country**

No	Question	VFCEA	KSCE	JSCE
12	Are there any road and bridge structures in your country that you are focusing on for monitoring? For example, urban highways or long-span bridges. Please also tell us why you are focusing on them.	Personally, I am not focusing on bridge..	For psc bridges with corrosion issues. For steel bridges with fatigue cracks or possibility of cracks due to their long service life.	Monitoring is usually carried out for important expressway and special bridges.
13	Please provide any good examples of monitoring that has been done in your country. We are interested in any road and bridge structures including a special bridge or a small bridge.	Personally, I am not focusing on bridge.	In Korea, we have a loading test for all bridges every 5 years. Sensors are installed during the test. HSM is only for special bridges such as cable-supported bridges. Recently, Government started to support for the development of digital twin models using HSM data.	Expressway companies adopted many types of monitoring including digital technology for managing their assets.

Result of Questionnaire

- **Questions regarding current state, challenges, and objectives of monitoring in each country**

No	Question	VFCEA	KSCE	JSCE
14	Small bridges located in rural areas do not tend to be well-maintained using monitoring technology in any country. Is there a strong need to actively promote monitoring for such objects? Please also indicate the reasons for your answer.	Accidents/collapses occasionally happen to small bridges and monitoring can help reducing the consequences. With the advance in IoT BIM Digital Twin, the monitoring can be done with a reasonable cost.	Some bridges already passed the design life. So, bridge owners should decide the new policy to manage the old and deteriorated bridges. Budget limit is a critical issue for the government or local government due to fast increase of demand.	Due to insufficient budgets and shortage of engineers, there is a strong need to set labor-saving systems for maintaining structures in rural areas.
15	What are the obstacles for applying various monitoring techniques to manage road structures in your country? For example, lack of budget, lack of engineers, etc. Please share your thoughts on what is needed to remove these obstacles.	Lack of budget, approval procedure can be long and complicated. Workshops to raise the awareness of the authority on the importance of the monitoring scheme.	No regulations of monitoring systems for common bridges. We need to define when the monitoring system should be installed. If the owner want to expand the service life, the monitoring system is essential to guarantee the safety.	Additional cost need to be paid to install monitoring technologies, but B/C is not calculated well. Monitoring technologies would be adopted more if we know the B/C correctly.

Result of Questionnaire

- **Table of contents of the guideline**

No	Question	VFCEA	KSCE	JSCE
16	This guideline is composed 9chapters in the table of contents. Please let us know if you have any suggestions regarding the table of contents. For example, some items to be added or focused.	We should push for IoT digital twin and BIM in monitoring and maintenance purposes.	Data on public infrastructures have security issue. So, the collection of data and accumulation needs de-identification process. In Korea, we are trying to persuade the government to build a data pipeline for the data accumulation. When the maintenance tasks are submitted to the system, automatic data transfer can be done through the pipeline without identification of the structure, only with meta data.	Good examples of installation of monitoring technologies in ACECC countries as an appendix

Result of Questionnaire

- **Expectations of this TC**

No	Question	VFCEA	KSCE	JSCE
17	What are your expectations for TC28 regarding infrastructure monitoring? For example, there are the introduction of advanced technologies, technical guidance, multilingualization of guidelines, and sharing of how to handle big data collected from sensors, etc.	To be discussed in the meeting.	Collaboration of data for the development of prediction models such as deterioration, damage progress and structural capacity.	To clarify and summarize the common issues and current state on maintenance and monitoring in ACECC countries. Establishment of the guideline which can be adopted in ACECC countries including some good examples of installation of monitoring technologies.

6. Discussion on the Result of the Questionnaire

For a Better Quality of Life

http://www.acecc-world.org/

Discussion

<Topic>

- **Any comments or opinions regarding the result of the questionnaire or Chapter1 of the guideline**

13:45 – 13:55 in JST

7. Future Work of TC28

For a Better Quality of Life

http://www.acecc-world.org/

Remaining Chapters to be Discussed

- **There are still 8chapters (Chapter2-9) to be discussed.**
- **We will make some questionnaire and share it with the TC members as we did for Chapter1 at this time.**

Chapter 1	General provisions
Chapter 2	Monitoring of concrete slabs
Chapter 3	Monitoring of concrete girders
Chapter 4	Monitoring of steel girders
Chapter 5	Monitoring in salt-affected environments
Chapter 6	Monitoring of piers and foundations
Chapter 7	Monitoring of glide surfaces and slopes
Chapter 8	Collection of monitoring data
Chapter 9	Data storage and utilization

Meeting Schedule

- **We may have 4meetings/seminars in future.**

No	Date	Title	Contents
1	2023.09	2nd TC Meeting	Discussion on chapter1(General provisions)
2	2024.03	ECM@Manila	Seminar(Tentative contents: introduction of good examples of monitoring technology for concrete slabs, concrete girders, or steel girders.)
3	2024.04	3rd TC Meeting	Discussion on chapter2(Monitoring of concrete slabs), chapter3(Monitoring of concrete girders), and chapter4(Monitoring of steel girders)
4	2024.09	4th TC Meeting	Discussion on chapter6(Monitoring of piers and foundations), chapter8(Collection of monitoring data), and chapter9(Data storage and utilization) (※Brief discussion on chapter5 and 7)
5	2025.10	CECAR10@Korea	Accomplishment Report of TC28

Confirmation

- **Tentative contents of ECM@Manila is on introduction of good examples of monitoring technology for concrete slabs, concrete girders, or steel girders.**
- **These topics are too specific for you? We will consider to add some other topics if the number of presenters are less than 4 or 5.**

No	Date	Title	Contents
1	2023.09	2nd TC Meeting	Discussion on chapter1(General provisions)
2	2024.03	ECM@Manila	Seminar(Tentative contents: introduction of good examples of monitoring technology for concrete slabs, concrete girders, or steel girders.)
3	2024.04	3rd TC Meeting	Discussion on chapter2(Monitoring of concrete slabs), chapter3(Monitoring of concrete girders), and chapter4(Monitoring of steel girders)

8. Free Discussion

For a Better Quality of Life

http://www.acecc-world.org/

Discussion

<Topic>

- **Any comments or suggestions for this TC**

14:05 – 14:15 in JST

9. Closing

For a Better Quality of Life

6. Closing

Thank you for your kind attention!