Proceeding of International Workshop on Disaster Management for Roads

ORGANIZED BY PIARC TC E.3, REAAA, JRA and Hanshin expressway

Tokyo, JAPAN, May 31, 2017,

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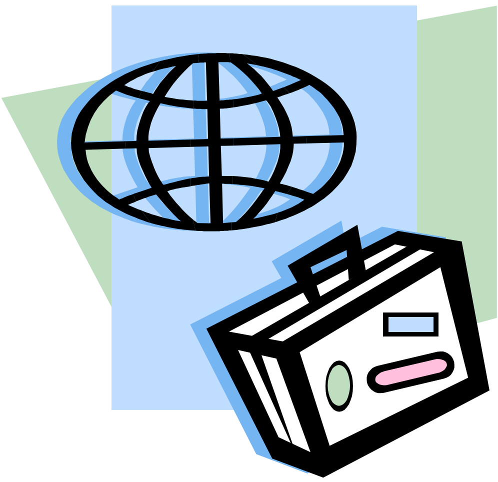


1. Workshop Program

(1) OUTLINE OF THE WORKSHOP

Workshop Theme:	International Workshop on Disaster Management for Roads
Co-organized by:	PIARC TC E.3 "Disaster Management" REAAA JRA
Supported by:	Hanshin Expressway
Date:	May. 31, 2017
Venue:	Iidabashi Rainbow building, Tokyo, JAPAN
Workshop schedule	May 31, 2017 Oral presentations and discussions June 1 and 2, 2017 Technical Visit

(2) FINAL PROGRAM

Time	Activity
10:00 – 10:30	**Opening Remarks – Moderated by ADACHI, Y** (Hanshin expressway - JPN) • Welcome Address - **TANIGUCHI, H.**, President, JARA • Welcome Address - **KIKUKAWA, S.**, Vice President, PIARC • Welcome Address - **HASHIBA, K.**, Vice President, REAAA • Opening Remarks - **TAMURA, K.**, Chair, TC E.3, PIARC
10:30 – 11:45	**Session #1 – Moderator: GRUBER, J.** (Department of Transportation - CZE) • **KIYASU, K.** (National Institute for Land and Infrastructure Management - JPN) **-** " Efforts for Recovery of Roads from the 2016 Kumamoto Earthquake" • **LISSADE, H.** (Caltrans - USA) **–** " Emergency Management and Resilience in Transportation " • **MORI, M.** (JICA -JPN) **–** " Japan International Cooperation Agency Technical Assistance on Road Disaster Risk - Management to the Government of El Salvador "
11:45 – 13:15	**Lunch**
13:15 – 14:05	**Keynote Session – Moderator: TAMURA, K.** (Kyoto University - JPN) • **OKADA, N.** (Kwansei-Gakuin University - JPN) **–** " The Age of Mega Disaster and Risk Governance - Thinking Creative for Road and Other Infrastructures "
14:05 – 15:20	**Session #2 – Moderator: Moore, K.** (Moore Associates - AUS) • **GRUBER, J.** (DOT, - CZE) **-** "Strategy of the Use of Temporary Bridges in Crisis Situations" • **ADACHI, Y.** (Hanshin expressway - JPN) **–** "Disaster Management Using GIS Technology" • **ZHANG, J.** (Changsha University of Science and Technology - CHN) **–** "Prediction and Enhancement of Resistance of RC Bridge during Service"
15:20 – 15:40	**Coffee break**
15:40 – 17:20	**Session #3 – Moderator: Moore, K.** (Moore Associates - AUS) • **ONISHI, M.** (Kyoto University, - JPN) **-** "A Methodology for Emergency Response Decision-Makings with the Consideration of the Unexpected Contingencies" • **GUSYEV, M.** (ICHARM, MLIT - UKR) **–** "ICHARM's Practices of Flood Hazard and Risk Assessment" • **UNO, T.** (Hanshin Expressway - JPN) **–** "Web-based Risk Management Manual" • **ELLIOTT, J.** (Elliott asset management - UK) **–** "'Future Ready' Impacts and What They Mean to Our Highway Networks"
17:20 – 17:30	**Closing session** • Closing Remarks - **SEKIMOTO, H.** (Executive Director, Hanshin Expressway) • Closing Remarks - **TAMURA, K.**, Chair, TC E.3, PIARC

(3) PHOTO ALBUM

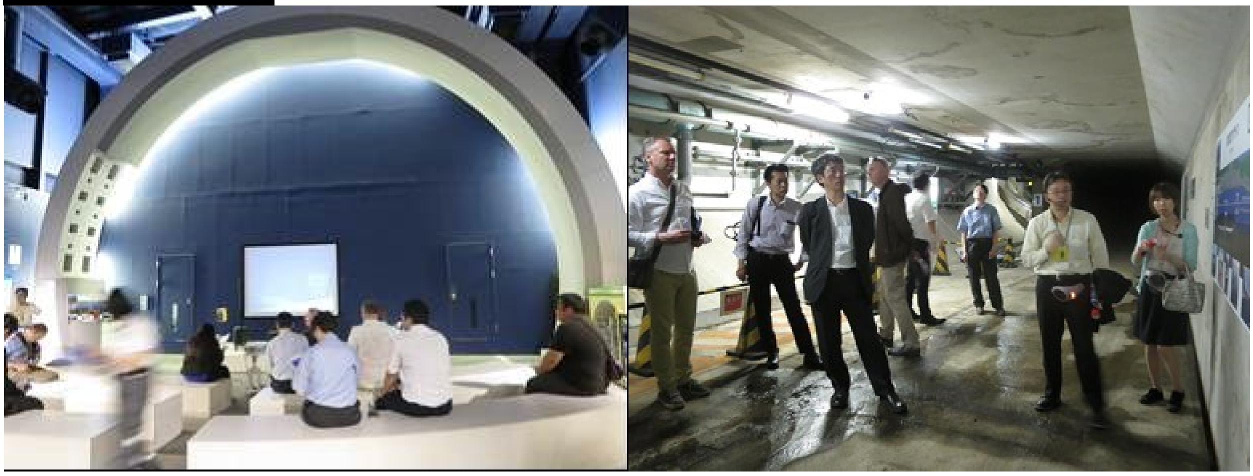
WORKSHOP

Workshop venue

Opening Session

Plenary Photo

TECHNICAL VISIT



Visit to Tokyo Aqua Line Tunnel (pressured TBM tunnel)

Visit to Kumamoto earthquake disaster site

Kumamoto Castle

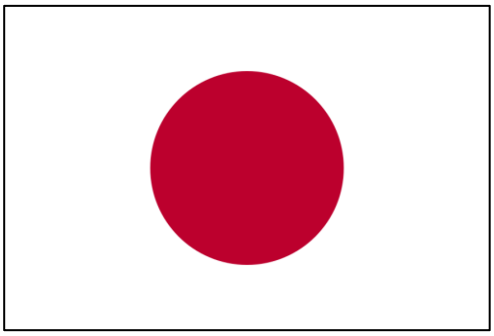
Welcome and Opening Remarks

TANIGUCHI, Hiroaki	President, Japan Road Association
KIKUKAWA, Shigeru	Vice president, PIARC
HASHIBA, Katsuji	Vice president, REAAA
TAMURA, Keiichi	Chairman, TC E.3 PIARC Adjunct Professor, Kyoto University,

Efforts for Recovery of Roads from the 2016 Kumamoto Earthquake

KIYASU, Kazuhide

NILIM, Ministry of Land, Infrastructure, transport and tourism
JAPAN



Efforts for Recovery of Roads from the 2016 Kumamoto Earthquake

May 31, 2017

Kazuhide KIYASU
Research Coordinator for Construction Management
Research Center for Infrastructure Management
National Institute for Land and Infrastructure Management
Ministry of Land, Infrastructure, Transport and Tourism

NILIM SUPPORT FOR DISASTER RESPONSE

国土交通省

- The National Institute for Land and Infrastructure Management is the only national research organization in the housing and public capital field.
- “Disaster response support” is one of the major roles of NILIM.
- NILIM have sent experts to many areas affected by disasters including the Great East Japan Earthquake, to support restoration, in cooperation with the Public Works Research Institute.

1

Overview

国土交通省

◆Overview of the Kumamoto Earthquakes and the damage

◆Disaster response by MLIT

◆The efforts to restore roads

2

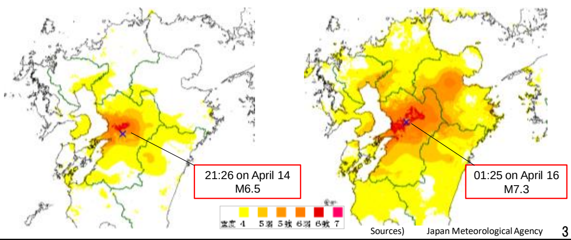
Occurrence of the Kumamoto Earthquake

国土交通省

- From April 14 to 16, 2016, a series of earthquakes ranging from M6.5 to M7.3 struck the Kumamoto Area.

Foreshock
Date/time: 21:26 on April 14
Epicenter: Kumamoto region of Kumamoto Prefecture
(North 32° 44' and East 130° 48')
Epicenter depth: 11km
Scale of earthquake: Magnitude 6.5

Main shock
Date/time: 01:25 on April 16
Epicenter: Kumamoto region of Kumamoto Prefecture
(North 32° 45' and East 130° 45')
Epicenter depth: 12km
Scale of earthquake: Magnitude 7.3



Sources) Japan Meteorological Agency

3

Damage caused by the Kumamoto Earthquake

国土交通省

- 50 deaths were caused directly by building collapse and sediment disasters. About 200,000 buildings were damaged.
- Roads, railways, water supply and sewage systems, electric power and other public services were severely damaged.

Sources) Kokusai Kogyou Co., Ltd./Pasco Corp.
Sources) Kyushu Regional Development Bureau

Setting up of Disaster Countermeasure Headquarters

国土交通省

- Immediately after the earthquake on April 14, the Kyushu Regional Development Bureau set up the disaster countermeasure headquarters.
- At 23:00 on the same day, it held a TV conference with MLIT and shared information with the Minister.

Sources) Kyushu Regional Development Bureau

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Sending liaisons and TEC-FORCE

国土交通省

○ On April 14, at the same time as the Kyushu Bureau set up the Disaster Countermeasure Headquarters, liaisons were sent to Kumamoto Prefecture, Kumamoto City, Mashiki Town, etc. The liaisons collected information, supported the disaster area.
○ The first 14-member TEC-FORCE was sent to Mashiki Town at 1:25 on April 15.

▲ Situation immediately after the disaster reported by the Mashiki Town Liaison
▲ State of evacuation reported by the Mashiki Town Liaison
▲ Meeting prior to departure of TEC-FORCE
▲ Dispatch of 1ST TEC-FORCE Team to Mashiki Town

Sources) Kyushu Regional Development Bureau 6

Sending equipment and materials

国土交通省

○ On April 15, Disaster countermeasure vehicles such as lighting vehicles and information gathering vehicles were deployed to support various activities.

▲ Disaster countermeasure vehicles gathered
▲ Lighting vehicles were sent to city hall
▲ Deployment of disaster countermeasure vehicles
▲ Gathering information in a vehicle

Sources) Kyushu Regional Development Bureau 7

Surveying by a helicopter (April 15)

国土交通省

○ On the Morning of April 15, The Kyushu Bureau started to survey the damage using their own helicopter.

Sunken road surface (Kyushu Expressway)
Road cut off by land slide
Collapsed homes
Damage to Kumamoto Castle

Sources) Kyushu Regional Development Bureau 8

Surveying by a helicopter (April 16)

国土交通省

○ On the day of the main shock, the Kyushu Bureau started to survey the damage and the opening of roads using the helicopter.

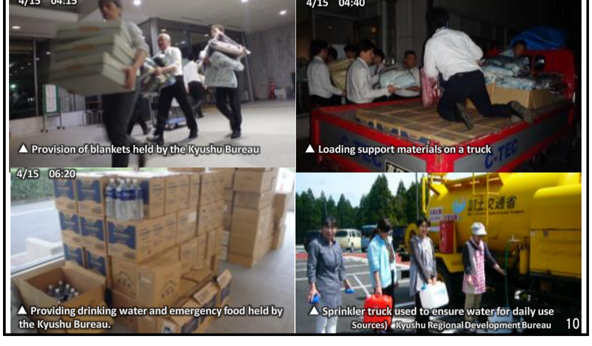
Land slide cut off a road and caused the Aso bridge to fall.
Survey of opening roads where road surfaces were cracked
Land slide at portal of the Tawarayama Tunnel
Damaged bridge (Choyo Bridge)

Sources) Kyushu Regional Development Bureau 9

Assisting evacuees

国土交通省

○ On April 15, drinking water, emergency food, blankets, etc. which had been held by the Kyushu Bureau were provided as emergency supplies to local governments in the disaster area.



▲ Provision of blankets held by the Kyushu Bureau
▲ Loading support materials on a truck
▲ Providing drinking water and emergency food held by the Kyushu Bureau.
▲ Sprinkler truck used to ensure water for daily use

Sources) Kyushu Regional Development Bureau 10

Activities of TEC-FORCE

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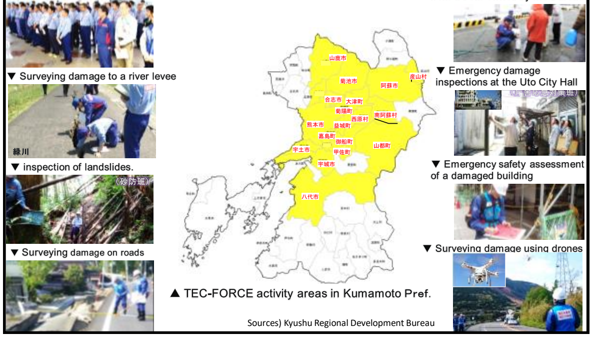
○ In addition to TEC-FORCE of the Kyushu Bureau, up to about 440 TEC-FORCE members gathered from all over Japan.
○ TEC-FORCE conducted surveys on the damage situation etc. of infrastructure facilities.



from a boat owned by the Bureau
▼ Surveying damage to a river levee
▼ inspection of landslides.
▼ Surveying damage on roads
▼ Emergency damage inspections at the Uto City Hall
▼ Emergency safety assessment of a damaged building
▼ Surveying damage using drones
▲ TEC-FORCE activity areas in Kumamoto Pref.

Sources) Kyushu Regional Development Bureau

TEC-FORCE(Road-opening team)

国土交通省

○ The TEC-FORCE road-opening team surveyed the state of damage to national roads, prefectural roads, etc.
○ They also helped with early restoration, such as road opening work in response to requests.

【 National Route 443 opened on April 20】 【Prefectural Route 149 opened on April 17】

Sources) Kyushu Regional Development Bureau 12

Technological Support by NILIM and PWRI

国土交通省

○ Immediately after the earthquake, NILIM also set up a Disaster Countermeasure Headquarters and sent experts to Kumamoto as TEC-FORCE.
○ TEC-FORCE of NILIM and PWRI gave advanced technological support with damage surveys and emergency restoration.

NILIM Disaster Countermeasure Headquarters meeting

Explaining the results of an emergency inspection to a self-governing body

Surveying state of damage on the scene

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Damage on Expressways

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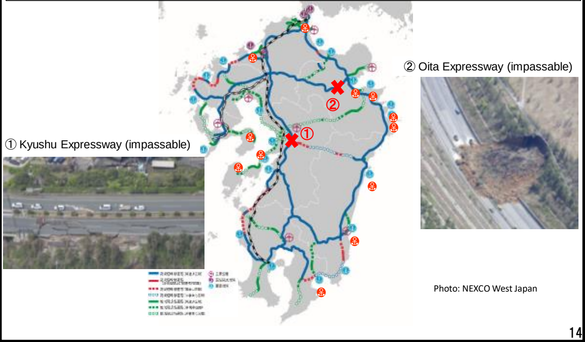
○ Up to 507km of expressways in Kyushu were closed under the effects of the earthquake.
○ On the Kyushu Expressway and Oita Expressway, bridges and slope faces were seriously damaged.



① Kyushu Expressway (impassable)

② Oita Expressway (impassable)

Photo: NEXCO West Japan

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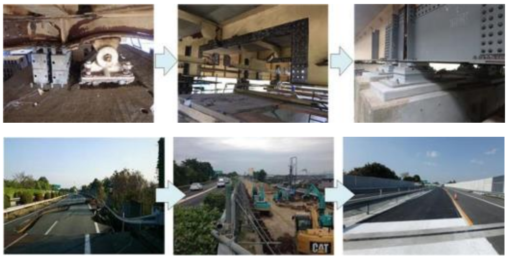
Restoration of Expressways

国土交通省

○ NEXCO West Japan performed emergency restoration, and opened all expressways by May 9,2016.
○ In part of the Kyushu Crossing Expressway in Kumamoto district, traffic was opened in 2 lanes out of 4, but all 4 lanes were completely restored and opened on April 28, 2017.



Immediately after earthquake | During restoration work | Present time

Photo: NEXCO West Japan

15

Damage to Trunk Roads around the Aso area

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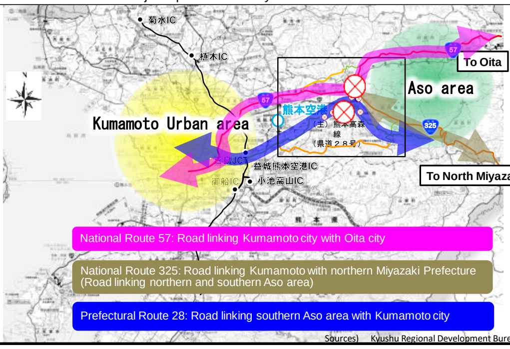
○ Between Kumamoto urban area and Aso area, roads were seriously damaged.
○ National Route 57 and 325, Prefectural Route 28 were cut off traffic on these routes.
○ These disasters had a major impact on inter-city traffic.



Sources) Kyushu Regional Development Bureau 16

Ensuring detours

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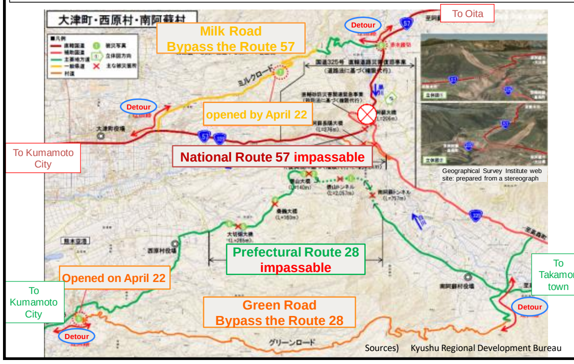
○TEC-FORCE helped open the Prefectural Milk Road and the Green Road on April 22 in 2016.
○By these, detours on National Route 57 and Prefectural Route 28 were secured.

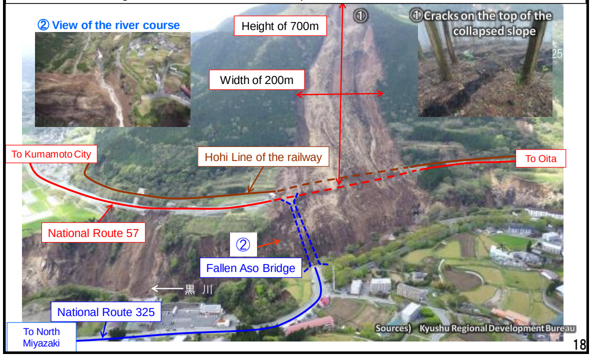


Sources) Kyushu Regional Development Bureau 17

Cut Off National Route 57 and 325

国土交通省

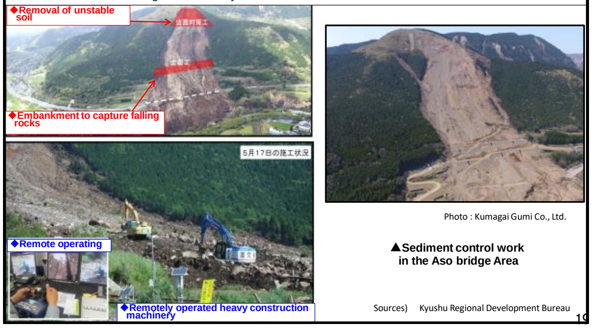
○ A land slide occurred in the area where National Route 57 and 325 meet. This cut off National Route 57 and the Hohi Line of the railway those link Kumamoto city with Oita.
○Also the Aso bridge on National Route 325 collapsed.



Sediment disaster prevention in the Aso bridge area

国土交通省

○ To prevent the collapse of unstable soil from causing secondary disasters, the Kyushu Bureau began sediment disaster prevention works in May 2016.
○ To ensure the safety of this work, it was done using construction machinery that can be remotely controlled.
○ Manned execution began in January 2017.



New bypass of National Route 57

国土交通省

○ To restore the functions of National Route 57 that was cut off in the Aso Bridge area, the Japanese government decided to construct a new bypass on the north side of the existing road.
○ The Kyushu Bureau is executing the work with opening the bypass in 2021 as its goal.

Improvement of the Milk Road

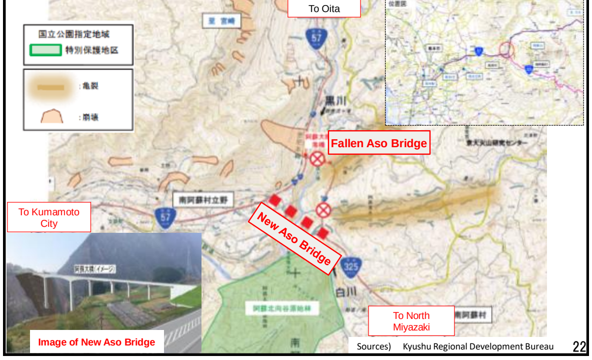
国土交通省

○ The Kyushu Bureau, in cooperation with Kumamoto Prefecture, improved the Prefectural Milk Road by December 2016, so it could serve as the detour around National Route 57.

Restoration of the Aso bridge on the Route 325

国土交通省

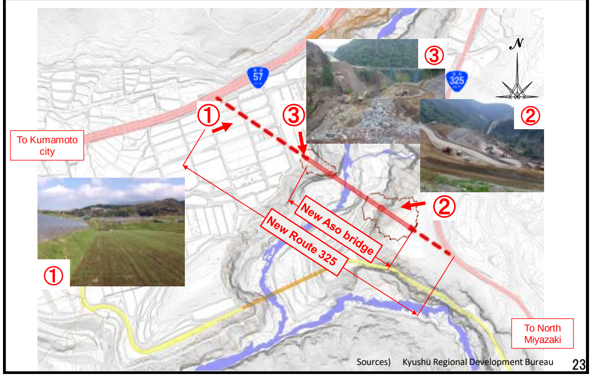
○ Restoration of the Aso bridge on the Route 325 required advanced technology, so the Japanese government decided to implement the disaster restoration project as a direct project.



Replacement work of the Aso bridge

国土交通省

○ The Kyushu Bureau is undertaking the work with the aim of replacing the bridge by 2021.



Damage to a Village Road near the Aso Bridge

○ A Minamiaso village road near the Aso Bridge was also became impassable due to disasters.
○ Following the request of the village mayor, the Japanese government decided to restore it directly on behalf of the village under the Large Disaster Restoration Law.

Sources) Kyushu Regional Development Bureau 24

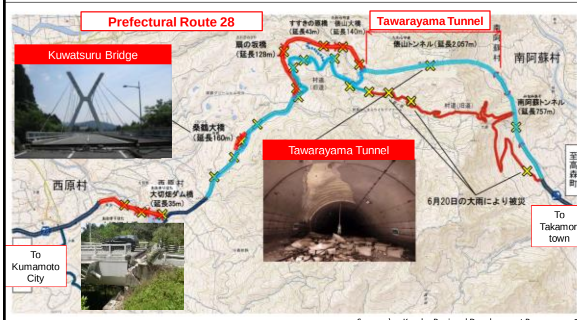
Restoration work of the Village Road

○ The Kyushu Bureau is undertaking restoration work with the aim of restoring the road in the summer of 2017.

Sources) Kyushu Regional Development Bureau 25

Damage to Prefectural Route 28

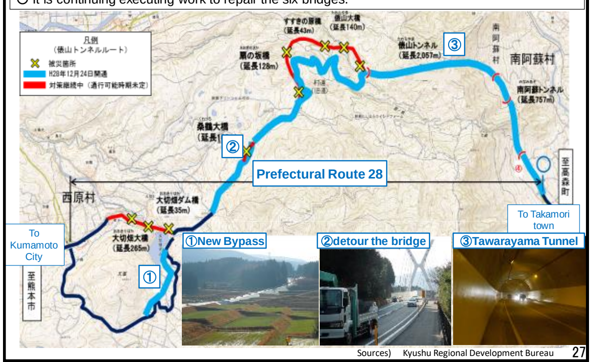
○ Prefectural Route 28 was impassable because 6 bridges and 2 tunnels were seriously damaged.
○ Following the request by the Kumamoto prefectural governor, the national government decided to restore it directly on behalf of the prefecture under the Law.



Sources) Kyushu Regional Development Bureau 26

Provisionary Opened Prefectural Route 28

○ The Kyushu Bureau repaired the tunnels and improved old roads to detour the bridges, provisionally opened it on December 24, 2016.
○ It is continuing executing work to repair the six bridges.



Sources) Kyushu Regional Development Bureau 27

Technological Support by NILIM and PWRI

○ Advanced expertise is required for restoration of these roads and sediment control work, the Kyushu Bureau has established technical committees.
○ Experts on sediment control, bridges, etc. from the NILIM and PWRI also join these committees, and survey at the disaster site to give technical advice on restoration methods etc.

Technical Committees

□Technical Committee for Restoration in Aso Bridge area
□Technical Committee for Restoration of National Route 325
□Technical Support Team for Restoration of Prefectural and Village Roads


Technical Committee for Restoration in Aso Bridge area


Technical Committee for Restoration of National Route 325


Survey at the disaster site

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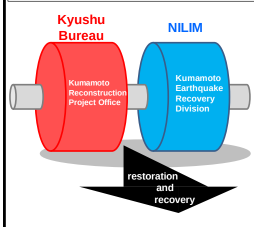
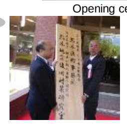
Opening the Restoration Office and the Recovery Division in Kumamoto

○ In July 2016, the Kyushu Bureau opened the Kumamoto Earthquake Disaster Countermeasure Promotion Office. Six experts from NILIM also participated as the Promotion Office members.
○ In April 2017, the Kyushu Bureau opened the Kumamoto Reconstruction Project Office in Mimani-Aso Village in Kumamoto Prefecture. NILIM also opened the Kumamoto Earthquake Recovery Division in the same building as the Project Office.
○ The two organizations will work together to promote the restoration and recovery from the Kumamoto Earthquake.




Opening ceremony (April 24, 2017)


Name plate


Project Office & Division

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国土交通省

Thank you very much for your kind attention

Opening Ceremony the Kumamoto Prefectural Route 28 on December 24,2016

Photo： Kyushu Regional Development Bureau

http://www.nilim.go.jp/english/hottopics/index.htm

Emergency Management and Resilience in Transportation

LISSADE, Herby

Department of Transportation, State of California
U.S.A.

Emergency Management and Resilience



INTERNATIONAL WORKSHOP ON DISASTER MANAGEMENT FOR ROADS – TOKYO JAPAN

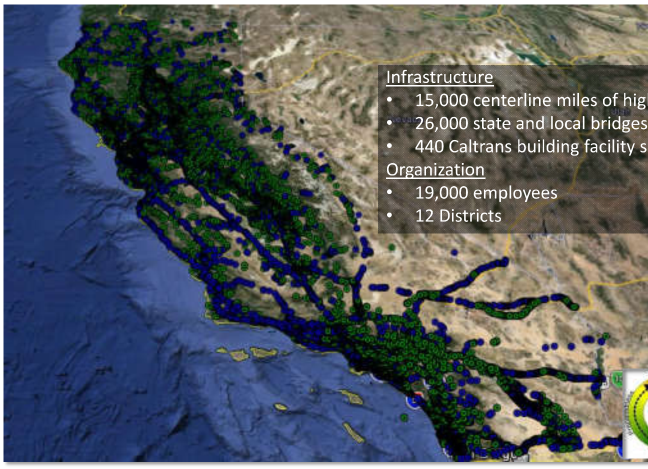
World Roadway Association
May 2017

Herby G. Lissade, P.E.

Chief, Office of Emergency Management and Infrastructure Protection
California Department of Transportation (Caltrans)

President – Haiti Engineering, INC.

Caltrans Organizational Profile



Infrastructure
- 15,000 centerline miles of highway
- 26,000 state and local bridges
- 440 Caltrans building facility sites

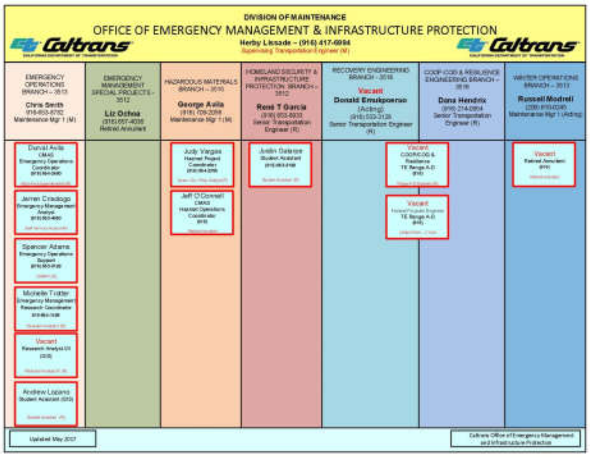
Organization
- 19,000 employees
- 12 Districts

Caltrans 12 Districts

Caltrans Resourced Based Response to Emergencies

- 19,047 Department Employees (thousands of engineers and field personnel)
- 7,750 Pieces of equipment
- 2 Aircraft
- 50,679 Lane miles of road
- 12,747 Bridges
- 330 Maintenance stations
- 713 Changeable Message Signs (CMS)
- 87 Safety roadside rests
- 364 Vista points
- 309 Park and Ride Lots
- 25,000 Acres of Landscaping
- 310 Pumping plants
- Tunnels and tubes
- 1703 Closed Circuit TV Cameras (CCTV)
- 87 Safety roadside rests
- 323 Park and Ride Lots (P&R) and 87 Safety Roadside Rest Areas
- 143 Highway Advisory Radio stations (HAR)
- 4,000 handheld radios
- 1,000's of mobile radios
- Signals
- Safety barrier systems
- Drainage systems
- Electrical systems
- Ferries

Caltrans Office of Emergency Management & Infrastructure Protection



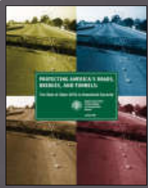
Caltrans Capabilities

- Architectural and Engineering Services
- Maintenance Field Operations
- Telecommunications
- Procurement and Warehousing
- Traffic Management
- Right of Way – Real Estate Assets
- Aeronautics
- Construction Management/Engineering
- Planning
- Human Capitol



State DOT's Major Responsibilities

- Highways
- Transit
- Freight and Passenger Rail
- Ports and Ferries
- General and Commercial Aviation Facilities
- Bike/Pedestrian
- Motor Carrier/Motor Vehicle Services
- State Patrol



Source: Protecting America's Roads, Bridges, & Tunnels: The Role of State DOTs in Homeland Security, AASHTO, 2006.

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State DOT's - Guardians of Nation's Transportation Network

DOT's own & operate 1.8 million lane miles & 273,200 bridges

5 billion daily vehicle miles (DVMT) traveled on DOT's roads and bridges, or 65% of total DVMT

$92 billion/year needed just to preserve system without extra security

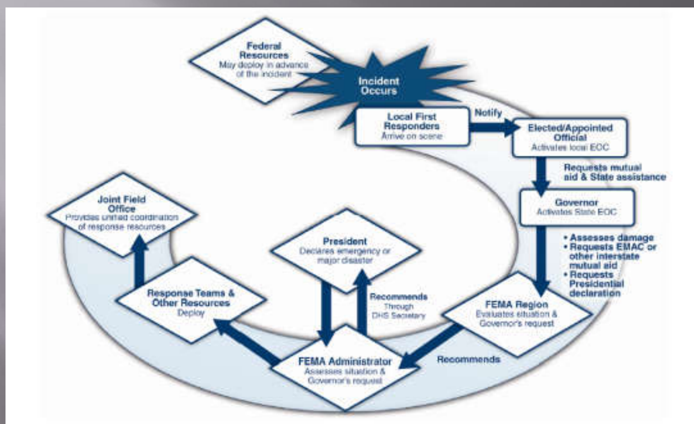
Source: Protecting America's Roads, Bridges, & Tunnels: The Role of State DOTs in Homeland Security, AASHTO, 2006.

Governance

Government, control, or authority

9

Stafford Act Support to States



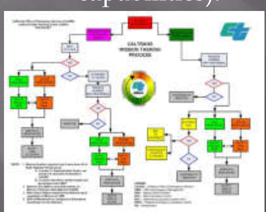
http://www.fema.gov/pdf/emergency/nrf/nrf-stafford.pdf

10

Caltrans Emergency Response in Assisting Other Government Agencies

In response to Emergencies/Disasters, through CalOES, Caltrans will assist other agencies and local authorities with the restoration of function and mobility to affected city and county critical infrastructure.

Caltrans will also carry out "Mission Tasking" through CalOES, in areas not related to the transportation system (based on capabilities).



11

Definition and Context for Resilience

12

California Emergency Functions CA – EF's

1. Transportation
2. Communications
3. Construction & Engineeri
4. Fire and Rescue
5. Management
6. Care and Shelter
7. Resources
8. Public Health & Medical
9. Search & Rescue
10. Hazardous Materials
11. Food & Agriculture
12. Utilities
13. Law Enforcement
14. Long-Term Recovery
15. Public Information
16. Volunteer & Donations Management
17. Cybersecurity

California State Emergency Plan

FEMA Recognized Typed of Disasters

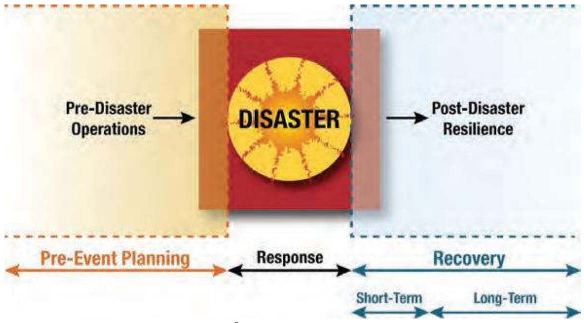
1. Chemical Emergencies
2. Dam Failure
3. Earthquake
4. Fire or Wildfire
5. Flood
6. Hazardous Material
7. Heat
8. Hurricane
9. Landslide
10. Nuclear Power Plant Emergency
11. Terrorism
12. Thunderstorm
13. Tornado
14. Tsunami
15. Volcano
16. Wildfire
17. Winter Storm

All Hazards Planning Fundamentals

- **Prevention:** Capabilities necessary to avoid, prevent, or stop a threatened or actual act of terrorism.
- **Protection:** Capabilities necessary to secure against acts of terrorism and manmade or natural disasters.
- **Mitigation:** Capabilities necessary to reduce loss of life and property by lessening the impact of disasters.
- **Response:** Capabilities necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred.
- **Recovery:** Capabilities necessary to assist communities affected by an incident to recover effectively.

Source: AASHTO. Fundamentals of Effective All Hazards Security and Resilience for State DOTs, 2015.

Pre-Event Recovery Planning For Transportation Infrastructure



Why is Pre-Event Recovery Planning
For Transportation Infrastructure recovery important?

- Effective and efficient Transportation Systems helps drive a nation's economy
- Pre-Event planning helps to accelerate the response and recovery of the Transportation System
- Opportunity to build back better
- Adds to the overall Resiliency of the Transportation System

Basic Principles

Recovery Efforts are executed better when:

- Resources are prepositioned
- Contractors are pre-approved
- Alternate Facilities are identified

- Recovery Is Different from Response
- Response Can Impact Recovery
- Short-Term Approaches Have Impact on Long-Term Recovery
- Rebuilding Is an Opportunity to Improve Infrastructure and Incorporate Resilience
- Economic Impact Is a Part of Recovery
- Take a Collaborative Approach
- Take a Regional Approach
- Establish Priorities in Advance
- Organize Roles and Responsibilities
- Be Aware of Funding Realities
- Link the Pre-Event Recovery Planning to Other Plans
- Incorporate Flexibility and Identify Alternatives

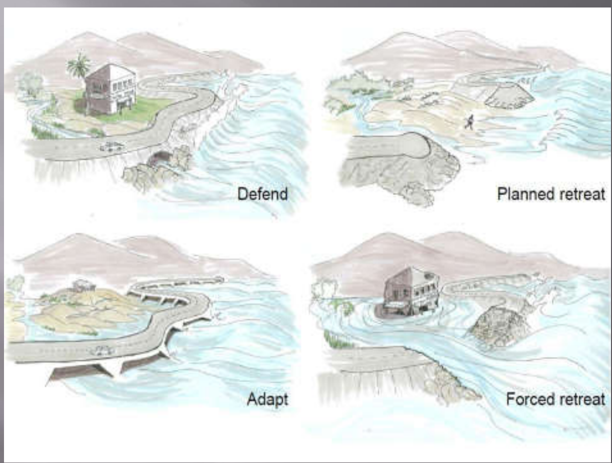
19

Assessing Disaster Risk

- Vulnerability Assessments
- Threat and Hazard Identification and Risk Assessment (THIRA)
- California MULTI-HAZARD MITIGATION PLAN
- Assessing Disaster Risk - Economic Studies
- Plans
- Human Behavior
- Hazard Mapping
- Exercise and Training
- Caltrans Division of Research, Innovation and System Information Hazard Assessment and Response Tools
- RRAP & HayWired
- Implementation of New Technology
- Transportation Research Board
- Haiti Engineering, Inc.

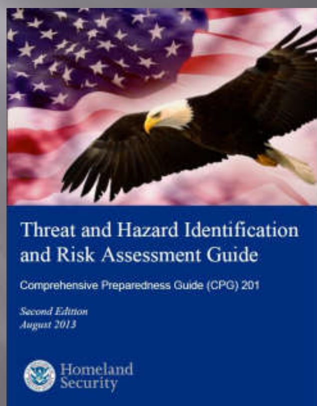
20

Statewide Vulnerability Assessments



Sea Level Rise Adaptation Options

Threat and Hazard Identification and Risk Assessment (THIRA)


Threat and Hazard Identification and Risk Assessment Guide

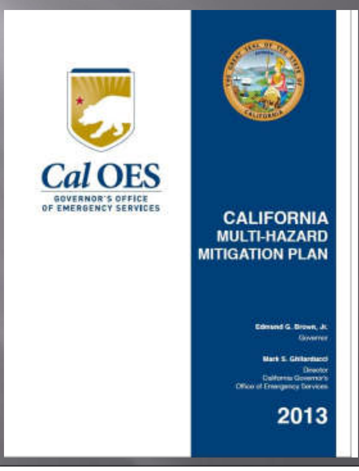
Comprehensive Preparedness Guide (CPG) 201

Second Edition
August 2013

Homeland Security

22

2013 STATE OF CALIFORNIA MULTI-HAZARD MITIGATION PLAN


Cal OES
GOVERNOR'S OFFICE OF EMERGENCY SERVICES

CALIFORNIA MULTI-HAZARD MITIGATION PLAN

Edmund G. Brown, Jr.
Governor

Mark S. Ghilarducci
Director
California Governor's Office of Emergency Services

2013

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Plans

- State Hazard Mitigation Plan
- Emergency Operations Plan
- Continuity of Operations/Continuity of Government
- Pandemic Plan
- All Hazards Infrastructure Protection Plan
- Security Plan
- Recovery Plans
- I T Recovery Plan

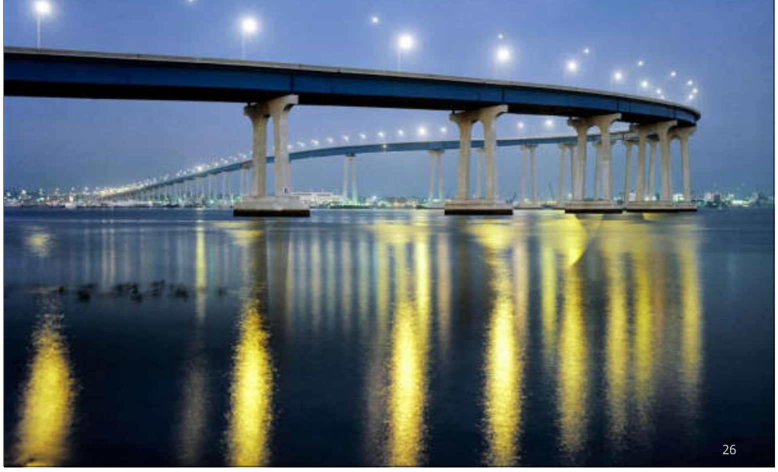
24

Human Behavior & Emergency Management Planning

- How do people actually react & why during emergencies?
- Accept what is, not what we want to believe.
- What we plan, and what people actually do are increasingly different.
- Design systems to support what people actually do.
- Engage Law enforcement in Planning and Response

25

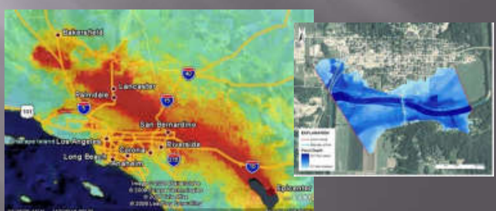
HAZARD MAPPING



26

PREPARATION

- The effective use of Hazard Maps decreases the magnitude of disasters
- Hazard Maps provide information on the range of possible damage and disaster prevention activities



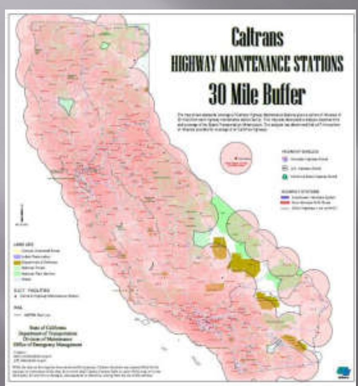
27

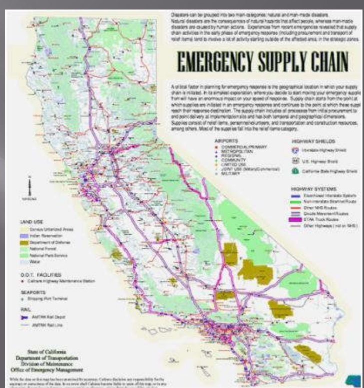
CALTRANS MAPS

Earthquake + Fire Maps
Flood + Landslide Maps
Supply Chain Maps
Traffic Flow Maps

28

HIGHWAY MAINTENANCE STATIONS & Emergency Supply Chains





30 Mile Buffer – Assess for response time
Along Emergency Lifeline Routes and NHS

Exercises and Training

30

Training Videos

Fire

Flood

Earthquake

31

Caltrans Division of Research, Innovation and System Information (DRISI) Hazard Assessment and Response Tools

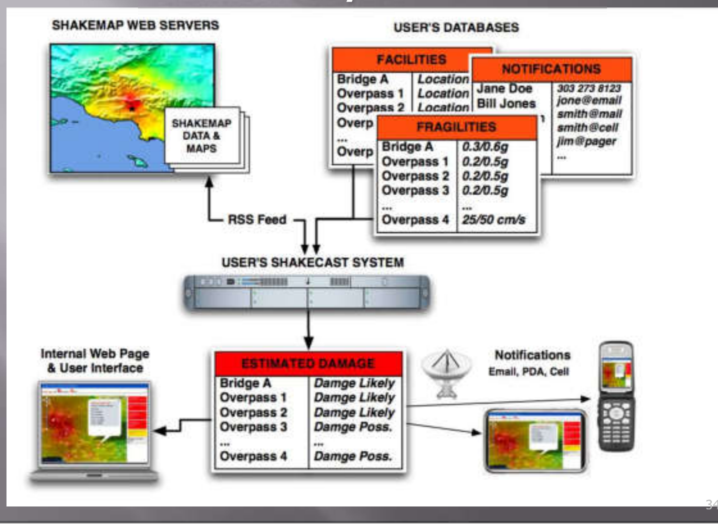
- ShakeCast
- FloodCast
- FireCast
- SnowCast
- Avalanche Path Atlas Map

32

What is ShakeCast?

33

ShakeCast System Overview



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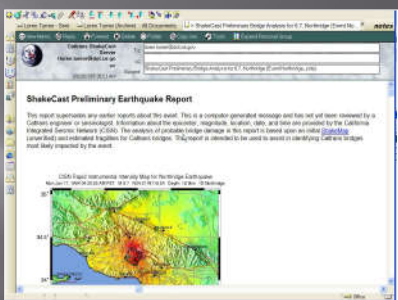
ShakeCast at Caltrans

- Automatic delivery of ShakeMap products to Caltrans.
- Automatic analysis of potential bridge damage state based on Basoz & Mander methodology using ShakeMap peak spectral accelerations.
- Email/Page bridge inspection prioritization lists.



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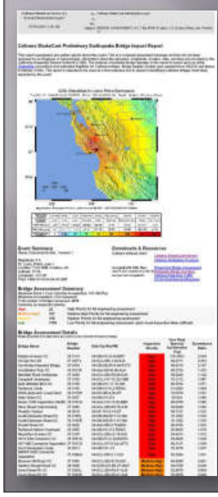
Inspection Prioritization



Bridge Assessment Summary

Maximum Peak 1.0 sec Spectral Acceleration: 188.76%g
Maximum Acceleration: (not measured)
Total number of bridges assessed: **3133**
Summary by inspection priority:

High	119	High Priority for full engineering assessment
Medium-High	156	Medium-High Priority for full engineering assessment
Medium	152	Medium Priority for full engineering assessment
Low	2706	Low Priority for full engineering assessment; quick visual inspection likely sufficient.

Bridge Assessment Details

Bridges presented in the table below are sorted in order of severity of impact to bridges.

Bridge Name	Bridge Number	Dist-Cty-Rte-PM	Inspection Priority	1sec Peak Spectral Acceleration (%g)	Exceedance Ratio
Ralston Avenue OC	35 0114	04-SM-101-9.55-BMT	High	105.3903	2.934
Via Del Oro OH	37 0477L	04-SCL-085-1.22-SJS	High	49.2711	2.472
San Mateo-Hayward Bridge	35 0054	04-SM-092-R14.44-FSTC	High	49.6514	2.167
Constitution Way OC	33 0513K	04-ALA-260-R.86-ALA	High	68.2755	1.415
Meridian Road Underpass	37 0258	04-SCL-280-R3.89-SJS	High	59.9229	1.122
Campbell Underpass	37 0135	04-SCL-017-12.22-CMB	High	70.2112	1.087
East Hillsdale Blvd OC	35 0138	04-SM-101-11.15-SM	High	68.3762	1.071
Redwood Creek	35 0145	04-SM-101-6.2-RDWC	High	61.0924	1.064
Sfobb-Approach Lower Deck	34 0118R	04-SF-080-4.95-SF	High	33.2578	1.057
Holly Street OC	35 0037	04-SM-101-8.4	High	65.904	1.048
Route 13/80 Separation (North)	33 0191G	04-ALA-013-13.92-BER	High	66.6766	1.046
Race Street Overcrossing	37 0260	04-SCL-280-R3.76-SJS	High	59.9229	1.045
Presidio Viaduct	34 0019	04-SF-101-9.14-SF	High	68.3123	1.035
South Delaware Street UC	35 0158L	04-SM-092-R11.61-SM	High	35.1822	1.030
South Delaware Street UC	35 0158R	04-SM-092-R11.61-SM	High	35.1822	1.030
Powell Street UC	33 0020	04-ALA-080-3.79-EMV	High	66.6766	1.020
Redwood Harbor Overhead	35 0065	04-SM-101-5.5-RDWC	High	56.8606	1.018
Macarthur Avenue OC	37 0100	04-SCL-280-L5.18-SJS	High	54.4613	1.012
N101-S84 Connector OC	35 0081G	04-SM-101-5.39-RDWC	High	56.8606	1.009
N17-N85 Connector Separation	37 0515G	04-SCL-017-9.24-LGTS	High	86.2137	1.008
San Francisquito Creek	35 0013	04-SM-101-.01	High	55.3678	1.007
N&S87-S280 Connector Separation	37 0396H	04-SCL-087-5.1-SJS	High	50.5564	1.001
Blossom Hill Road OC	37 0345	04-SCL-082-R.35-SJS	Medium-High	49.4998	0.951
Harkins Slough Road OC	36 0089	05-SCR-001-R2.27-WAT	Medium-High	56.0768	0.938
Sunol Street Rr UC	37 0263L	04-SCL-280-R3.41-SJS	Medium-High	52.8878	0.909
Sunol Street Rr UC	37 0263R	04-SCL-280-R3.41-SJS	Medium-High	52.8878	0.909
Winchester Boulevard OC	37 0195	04-SCL-280-4.57-SJS	Medium-High	55.327	0.898
Lincoln Avenue UC	37 0262L	04-SCL-280-R3.51-SJS	Medium-High	52.8878	0.896
South Gilroy OH	37 0305L	04-SCL-101-R5.1	Medium-High	43.2728	0.896

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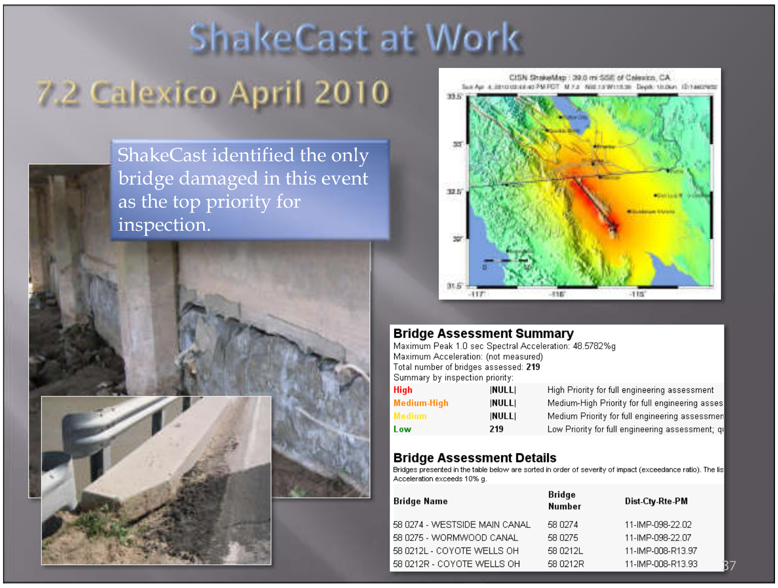
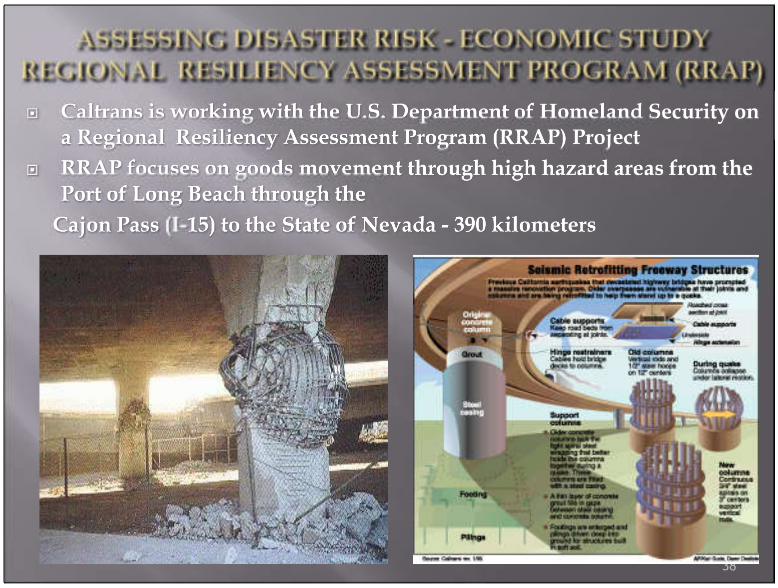
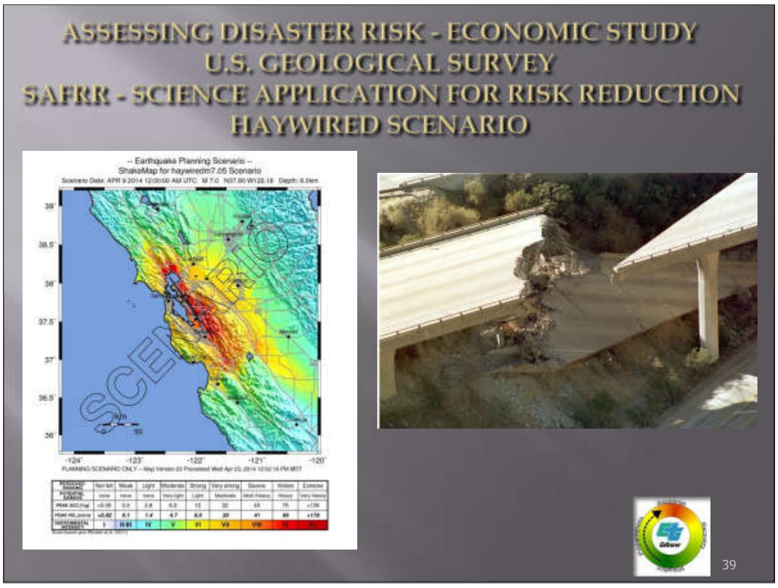
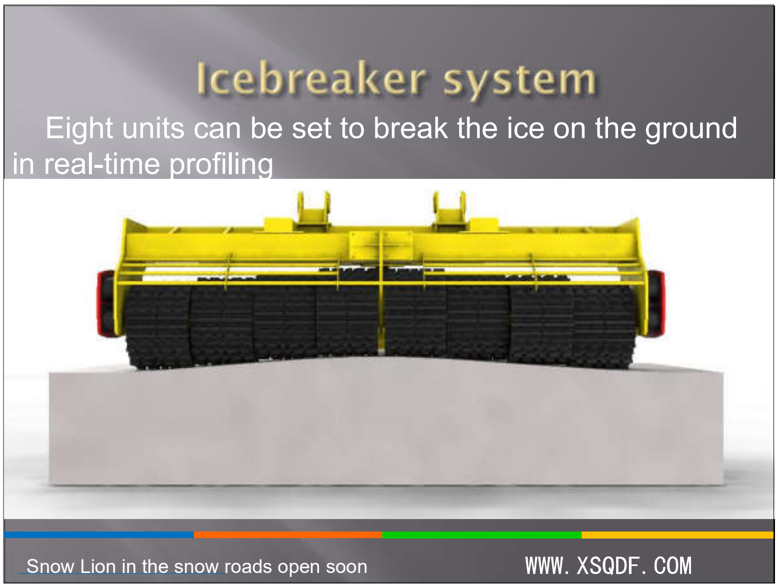

ShakeCast at Work
7.2 Calexico April 2010
ShakeCast identified the only bridge damaged in this event as the top priority for inspection.
CISN ShakeMap : 39.0 mi SSE of Calexico, CA
Bridge Assessment Summary
Maximum Peak 1.0 sec Spectral Acceleration: 48.5782%g
Maximum Acceleration: (not measured)
Total number of bridges assessed: 219
Summary by inspection priority:
High |NULL| High Priority for full engineering assessment
Medium-High |NULL| Medium-High Priority for full engineering asses
Medium |NULL| Medium Priority for full engineering assessmen
Low 219 Low Priority for full engineering assessment;
Bridge Assessment Details
Bridges presented in the table below are sorted in order of severity of impact (exceedance ratio).
Acceleration exceeds 10% g.
Bridge Name | Bridge Number | Dist-Cty-Rte-PM
58 0274 - WESTSIDE MAIN CANAL | 58 0274 | 11-IMP-098-22.02
58 0275 - WORMWOOD CANAL | 58 0275 | 11-IMP-098-22.07
58 0212L - COYOTE WELLS OH | 58 0212L | 11-IMP-008-R13.97
58 0212R - COYOTE WELLS OH | 58 0212R | 11-IMP-008-R13.93
37


ASSESSING DISASTER RISK - ECONOMIC STUDY
REGIONAL RESILIENCY ASSESSMENT PROGRAM (RRAP)
Caltrans is working with the U.S. Department of Homeland Security on a Regional Resiliency Assessment Program (RRAP) Project
RRAP focuses on goods movement through high hazard areas from the Port of Long Beach through the
Cajon Pass (I-15) to the State of Nevada - 390 kilometers
Seismic Retrofitting Freeway Structures
38

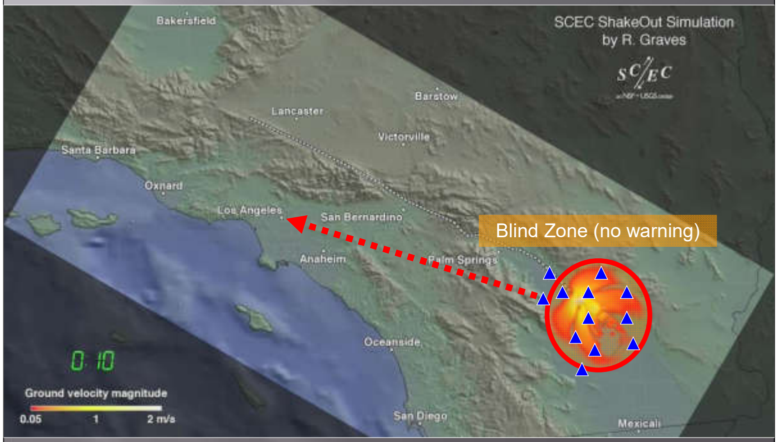

ASSESSING DISASTER RISK - ECONOMIC STUDY
U.S. GEOLOGICAL SURVEY
SAFRR - SCIENCE APPLICATION FOR RISK REDUCTION
HAYWIRED SCENARIO
-- Earthquake Planning Scenario --
ShakeMap for haywiredm7.05 Scenario
SCENARIO
39


Implementation of New Technology
Earthquake Early Warning System
Sustainable Snow and Ice Removal
40


Mechanical Ice-breaking


Icebreaker system
Eight units can be set to break the ice on the ground in real-time profiling
Snow Lion in the snow roads open soon
WWW. XSQDF. COM

Earthquake Early Warning



Up to 90 sec warning depending on distance.

43

Haiti Engineering, Inc.
www.HaitiEngineering.org

- Caltrans Engineers and other Professionals giving back
- Lessons learned applied to skill set and BMPs/SOPs

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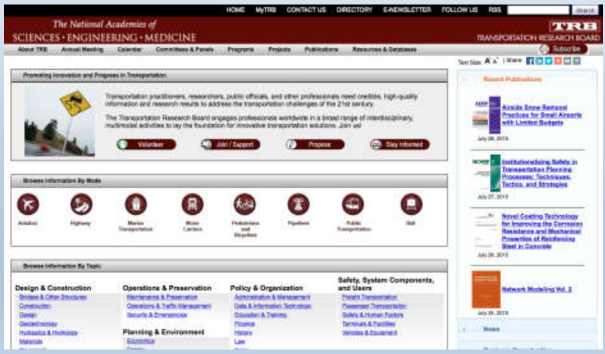
Transportation Research Board (TRB)

Promoting Innovation and Progress in Transportation

trb.org



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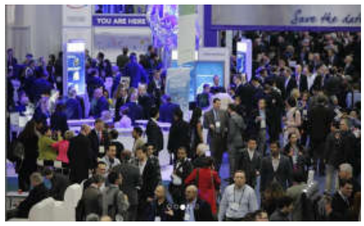
TRB Brings People Together

- Manage Research
- Deliver Policy Analysis & Advice
- Information Exchange: Meetings, Publications, Website, Dissemination, Outreach



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Identification of R&D Gaps & Needs

1. TRB Committee on Critical Transportation Infrastructure Protection shares research results from all sources & identifies research needs

↕

2. AASHTO Special Committee on Transportation Security & Emergency Management (SCOTSEM) identifies and refers research needs

Sources (arrows to/from Committee 1):
- 50+ other technical meetings
- TRB Annual State Visits to DOTs, Universities, MPOs, Transit Agencies, Ports, Airports & other agency reps
- State/Local Government
- Non-Government Organizations
- Federal Agencies
- Private Sector

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TRB "Professional Society" Functions

- 200 Standing Technical Committees – about 4,000+ people
- Constitute communities of interest
- Identify research needs
- Sponsor sessions, conferences, and meetings – 50+ events in addition to Annual Meeting
- Review and publish papers and reports
- Share information

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TRB Sponsors

- American Public Transportation Association
- Association of American Railroads
- State Departments of Transportation (All)
- South Coast Air Quality Management District
- U.S. Army Corps of Engineers
- U.S. Air Force Civil Engineering Center
- U.S. Coast Guard
- U.S. DOT: OST, FHWA, FTA, FRA, FMCSA, FAA

APTA AMERICAN PUBLIC TRANSPORTATION ASSOCIATION

ASSOCIATION OF AMERICAN RAILROADS

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TRB Hot Topic: Transformational Technologies

Transformational, or "disruptive" technologies, are those that can be expected to completely displace the status quo, forever changing the way we live and work.

- General examples: internet, personal computer, email, smartphone, GPS, big data
- Transportation: Connected/automated vehicles, shared vehicles, advanced versions of on-demand shared ride and micro-transit services, NextGen, cog in "internet-of-things"

TRB Hot Topic: Resilience

Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.

- Natural disasters: blizzards, tornadoes, floods, hurricanes, wildfires, heat waves, earthquakes, and other natural hazards
- Human-induced disasters: acts of terrorism, financial crises, social unrest, cyber attacks

TRB Work in Resilience

Disaster Resilience: A National Imperative (2012)

This report by the National Research Council defines "national resilience," describes the state of knowledge about resilience to hazards and disasters, and frames the main issues related to increasing resilience in the United States.

52

Resilience at The National Academies (2015)

53

TRB Key Products

Research Management

Cooperative Research Programs

- Highway
- Transit
- Airport
- Freight
- Hazardous Materials
- Rail

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NCHRP Report 753
A Pre-Event Recovery Planning Guide for Transportation
July 2013

Objective : to develop a guide that provides pre-event recovery planning principles, processes, tools, and appended resource materials for use by planners and decision makers in pre-event planning to support transportation infrastructure recovery.

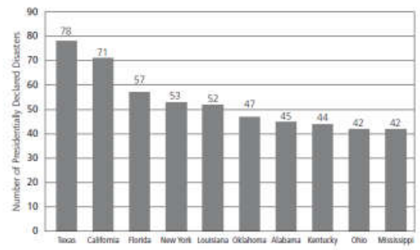

FIGURE 2-2
Presidentially declared disasters, top 10 states, 1953–2007.
Note: Declared disasters in these 10 states represent 32 percent of all disasters.
(Source: Federal Emergency Management Agency, U.S. Department of Homeland Security, www.fema.gov/news/disaster_totals_annual.fema.)

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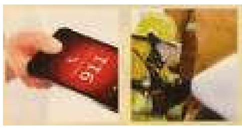
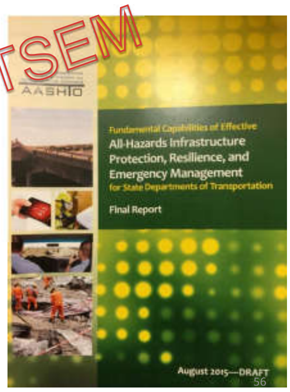
NCHRP Project 20-59(14B)
Fundamental Capabilities of Effective All-Hazards Infrastructure Protection, Resilience, and Emergency Management for State Departments of Transportation
2015

Adopted by SCOTSEM





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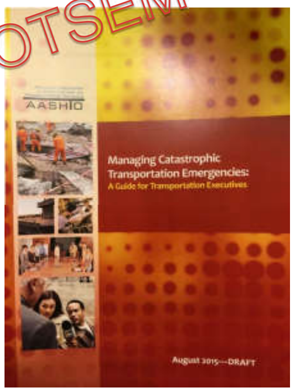
NCHRP Project 20-59(36)
Managing Catastrophic Transportation Emergencies: A Guide for Transportation Executives
2015

Adopted by SCOTSEM



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NCHRP Project 20-59(30)
Incident Command System (ICS) Training for Field Level Transportation Supervisors and Staff
December 2015

NIMS/ICS: Perform Reliably & Effectively

- Goal of NIMS/ICS: Reliable and effective response to an event, emphasizing safety of DOT staff
- Achieved through
  - Safety
    - Check-in, check out, demobilization
  - Personnel accountability
    - Food, shelter, family contacts
  - Reimbursement
    - The job you save may be your own
    - MAP-21 changes, debris removal reimbursement

Check-In, Check-Out, and Demobilization at ICP

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TRB Projects in Development

Security, Emergency Management and Infrastructure Protection-related

1. Integrating Climate Risk into Airport Management Systems
2. Emergency Management Training for Airport Critical Incidents
3. Airport Emergency Operations Centers Design Guide
4. Forum on Airport Roles in Reducing Communicable Diseases Transmission
5. Improving Freight Transportation Resilience in Response to Supply Chain Disruptions
6. Incorporating Freight, Transit, and Incident Response Stakeholders into Integrated Corridor Management (ICM): Processes and Strategies for Implementation
7. A Contracting Strategies Guidebook for Administration of Concurrent Regional Emergencies
8. Proposed Guidelines for Performance-Based Seismic Bridge Design
9. Proposed New AASHTO Load Rating Provisions for Implements of Husbandry
10. Applying and Adapting Climate Change Models to Hydraulic Design Procedures
11. Leveraging Big Data to Improve Traffic Incident Management
12. Update of *A Pre-Event Recovery Planning Guide for Transportation*
13. Research on Enhancing Transportation System Resilience
14. Voice and Data Interoperability for Transportation
15. Command–Level Decision Making
16. Research Support for Implementing Security, Emergency Management, and Infrastructure Protection at State Transportation Agencies
17. Impacts of Connected/Automated Vehicles on State and Local Transportation Agencies
18. A Guide to Ensure Access to the Publications and Data of Federally Funded Transportation-Related Research
19. Clear-Water and Live-Bed Scour in Long Contractions
20. Deploying Transportation Security Practices in State DOTs
21. Emergency Management in State Transportation Agencies
22. Deploying Transportation Resilience Practices in State DOTs

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Institute of Medicine

THE NATIONAL ACADEMIES PRESS

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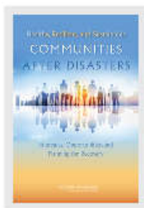

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ISBN 978-0-309-31619-4 | DOI 10.17226/18996

AUTHORS

Committee on Post-Disaster Recovery of a Community's Public Health, Medical, and Social Services; Board on Health Sciences Policy; Institute of Medicine

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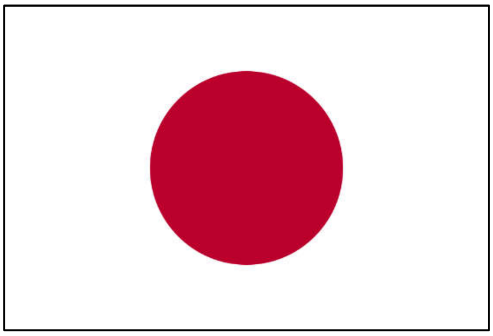
Herby G. Lissade, P.E.
Caltrans – Herby.Lissade@dot.ca.gov
Haiti Engineering – Herby.Lissade@HaitiEngineering.org
Response
Recovery
Mitigation
Preparedness
Caltrans
61

INTERNATIONAL WORKSHOP ON DISASTER MANAGEMENT FOR ROADS

MORI, Mikihiro

Nippon Koei Co., Ltd.
JAPAN



INTERNATIONAL WORKSHOP ON DISASTER MANAGEMENT FOR ROADS
May 31, 2017, Tokyo, JAPAN
organized by PIARC TC E.3, REAAA, JARA

Japan International Cooperation Agency Technical Assistance on Road Disaster Risk Management to the Government of El Salvador:
-Risk estimation and cost-benefit analysis for road locations for both non-seismic and seismic events -
Mikihiro MORI, Japan

Landslide on Pan-American Highway in San Salvador Metropolitan with vegetation of vetiver grass

Subsurface drainage works

1

1. Evaluation Procedure based on the Draft Manual Public Works Research Institute Japan, 2003

- The tool was formulated based on the Draft Manual for Risk Analysis and Risk Management Support of Road Slope Disaster (in Japanese), proposed by the [Public Works Research Institute Japan, 2003] (hereafter referred to as" [PWRI_JP 2003]"), for the risk reduction measures of road geohazards damage.

2

2. Non-seismic and Seismic Road Geohazard Events occurring at same road location

- Non-seismic road geohazard events
  - Mostly due to storms, and also non-hydrological events such as rockfall.
  - Higher probability and lower economic loss of road damage.
- Seismic road geohazard events
  - Rockfall, soil collapse on road, road foundation collapse, bridge collapse.
  - Lower probability and higher economic loss of road damage.

3

3. "Integrated analysis of non-seismic and seismic road damage events" increase accountability for the investment of the road geohazard risk reduction

- Most structural measures for road geohazard are valid for both non-seismic and seismic caused events such as groundwater drainage for landslide or road embankment slope stabilization.
- Total risk of potential annual losses and annual average benefits of risk reduction can be summed up as the non-seismic and seismic risks and benefits.

4

4. Flow of Risk Estimation and Cost-Benefit Analysis of a Road Location

(1) Annual exceedance probabilities (%/year) or occurrence probability in years (year) of different extents of road geohazard events

(2) Economic loss (US$) of different extents of road geohazard events

(3) Potential annual loss (US$/year)
= Integral computation of sets of annual exceedance probabilities and economic losses of road geohazard events

(4) Risk reduction target in annual exceedance probability (%/year) or occurrence probability in years

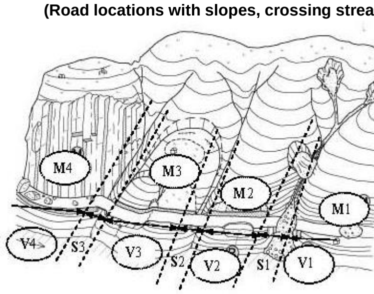
(5) Annual risk reduction benefits (US$/year)

(6) Cost (US$) of risk reduction measures Annual maintenance cost (US$/year)

(7) Cost benefit analysis indicators:
Cost-benefit ratio, Net present value (US$), Economic internal rate of return (%)

5

5. Geohazard Prone Road Locations to be Evaluated (Road locations with slopes, crossing streams)

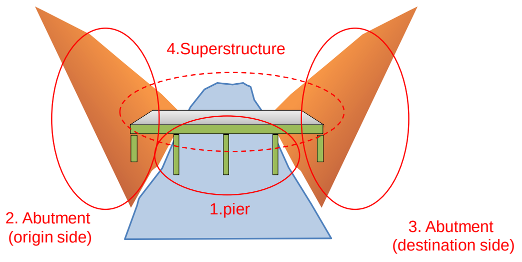


A geohazard prone road location is referred to a geographically distinguishable portion of road (normally, less than 1 kilometer)
M: mountainside slope, V: valley side slope, S: Stream Crossing

6

6. Bridge (river bridge and overpass on road) to be evaluated

Risk evaluation is done by four parts of a bridge



7

7. Proceduer of Evaluation/Estimation
7.1 Annual exceedance probabilities (%) or occurance probability in years of different extents of road geohazards events

- Rating checklist of occurrence probability in years for a non-seismic event; and critical horizontal seismic acceleration for a seismic event, which is converted to the occurrence probability according to the return period of the seismic magnitude at the evaluation location.
- A rating checklist with check item and their categories can provide the evaluation results of both for non-seismic and seismic road geohazard events. An example of an item is 'roadside slope angle, ' and its category is 'steeper than 40 degree'

8

Example of Rating Checklist of the Occurrence Probability of Road Geohazard Event

Check items and their categories for occurrence probability in years of a road geohazard event	Input '1' only for one applicable category	Non-Seismic Hazard Score of occurrence probability in years: YpS of road damage event (year) roadside only	one lane closing	two lanes closing	Seismic Hazard Score for critical horizontal seismic acceleration (gal)
(1) Extension along road of hazardous road location: E					
E ≥ 300 m		0.5	1.0	2.0	5
300 m > E ≥ 200 m	1	1.0	2.0	4.0	10
200 m > E		3.0	6.0	8.0	20
Score of occurrence probability in years for the selected category 1: SYp1		**1.0**	**2.0**	**4.0**	**10**
(3) Whole height of mountainside slope: WH					
WH ≥ 200 m		0.5	1.0	2.0	5
200 m > WH ≥ 100 m	1	1.0	2.0	4.0	10
100 m > WH		3.0	6.0	9.0	30
Score of occurrence probability in years for the selected category 3: SYp3		**1.0**	**2.0**	**4.0**	**10**

9

Factor items and their categories of rating checklist of road location with mountainside slope

Items	Categories
Topographical situations (selection of most appropriate category)	
Factor item 1: Length of survey slope along infrastructure: L	1. L ≥ 300 m 2. 300 m > L ≥ 200 m 3. 200 m > L ≥ 100 m 4. 100 m > L
Factor item 2: Slope inclination of infrastructure side slope up to inclination change point	1. SI ≥ 45^{O} 2. 45^{O} > SI ≥ 30^{O} 3. 30^{O} > SI ≥ 15^{O} 4. 15^{O} > SI
Factor items 3 - 6 are omitted.	
Surface and subsurface situation (selection of most appropriate category)	
Factor item 7: Dominant materials of slope surface	1. silt, clay 2. sand 3. gravels 4. cobbles, boulders 5. fractured rock Categories 6 - 8 are omitted.
Factor item 8: Dominant geology	Recent: 1. alluvium; 2. lava Holocene or Pleistocene: 3. white volcanic materials; Categories 4 - 7 are omitted. Categories of Pliocene and those of older geological age are omitted.
Factor item 9: Dominant geology Apparent inclination of dominant discontinuity against slope surface: AI	1. AI ≥ 60^{O} 2. 60^{O} > AI ≥ 20^{O} 3. 20^{O} > AI ≥ 10^{O} 4. 10^{O} > AI ≥ 0^{O} 5. 0^{O} > AI ≥ - 10^{O} 6. -10^{O} > AI ≥ - 20^{O} 7. -20^{O} > AI 8. no discontinuity
9. Factor items 10 - 18 are omitted.	
Predictor (category applicability check)	
Factor item 17: Predictor	1. minor collapse/fall 2. continuous cracks (more than 5 m) on slope 3. fallen/inclined trees Categories 4 - 15 are omitted.
Existing counter measure (selection of most appropriate category)	
Factor item 18: Main slope surface protection	1. mortal/concrete crib works 2. shotcrete or pitching works Categories 3 - 6 are omitted.
Factor item 19: Main retaining works	1. anchored wall 2. reinforced earth Categories 3-7 are omitted.
Factor items 20 and 21 are omitted.	

10

- Each category (selection or identification of applicable category) assigns scores of occurrence probability in years or critical horizontal seismic acceleration. The rating is adding all scores selected or identified category.
- Each rating score is initially set by engineering judgment, calibrated by multivariate statistic analysis, searching the most suitable regression model by minimizing residual sum of squares of actual – calculated occurrence probability in years or critical seismic acceleration of road geohazard events. Actual values are returned period of rainfall index or seismic acceleration of the historical road geohazard events, a recurrent period of frequently occurred road geohazard events, and determined by numerical model calculation.

11

- Due to the difficulty to determine road damage levels and lack of historical events for the rating tool calibration, the rating for road damage levels is only for 1-3 levels as next table.

12

Rating checklist for road location	Rating for Road Damage Levels	
	Non-seismic events	Seismic events
With Mountainside slope With Valley side slope With Stream crossing	Roadside only' 'one-lane closing,' and 'two-lane closing.'	Rating is determined only for critical horizontal acceleration of road location damage. Road damage extent is determined by engineering judgment or numerical calculation.
A set of Bridge piers Bridge abutment (origin side) Bridge abutment (destination side) Superstructure	Rating is determined only for critical occurrence probability in years of bridge. Bridge damage extent is determined by engineering judgment or numerical calculation.	Rating is determined only for critical horizontal acceleration of bridge. Bridge damage extent is determined by engineering judgment or numerical calculation.

13

- If existing measures are on the location, an effect on the occurrence probability in years (Eyp_EM) of existing measures is replaced the rating results. Eyp_EM is target return period designed or occurrence probability in years. Eyp_EM shall be modified to smaller if road or measures structures are damaged. Next table proposes Eyp_EM for the effect of slope stability measures by design safety factor.

14

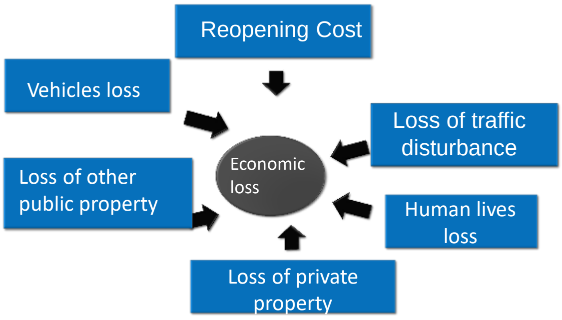
Proposed Values for the Effect of Slope Stability Measures on the Occurrence Probability in Years for Road Damage Events due to Geohazards

Note: "Slope failure" is a term used to cover slope fall, collapse, or slide.

Effect on the occurrence probability in years on a road location (years)	Design safety factor of slope stability (resistance force against slope failure force)
100	1.20
80	1.15
50	1.12
30	1.10

15

7.2 Economic Loss



16

7.3 Potential Annual Loss

- The risk index of potential annual loss = integral computation of sets of annual exceedance probability and economic loss of road geohazard events.
- To understand the risk index of potential annual loss, a risk curve as shown in the Figure in next slide would be useful.
- The risk curve is derived from the plots of annual exceedance probability of disaster occurrence on the vertical axis and potential economic loss of road geohazard event on the horizontal axis.

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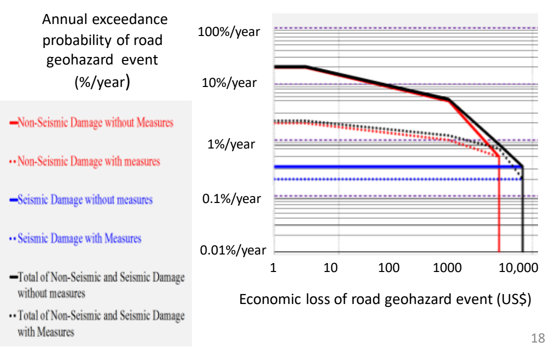
Risk Curve for Geohazard on a Road Location



18

7.4 Risk Reduction Target in Annual Exceedance Probability (%/year) or Occurrence Probability in Years

Risk reduction target occurrence probability in years for a road location (unit: years): This is the target-occurrence probability in years of no geohazard damage-causing events on a road location when road geohazard risk reduction measures are in place.

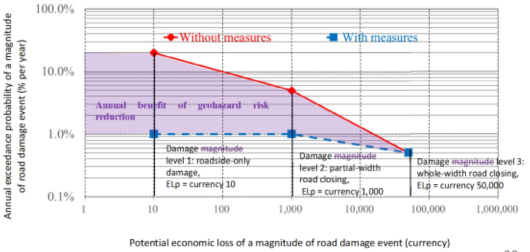
Proposed Risk Reduction Target of Occurrence Probability in years for road geohazard damage events
Note: "Slope failure" is a term used to cover slope fall, collapse, or slide.

Proposed risk reduction target of occurrence probability in years on a road location (years)	Design safety factor of slope stability (resistance force against slope failure force)
100	1.20
80	1.15
50	1.12
30	1.10

19

7.5 Annual Risk Reduction Benefits

Annual risk reduction benefits are the potential annual economic loss with measures minus potential annual economic loss without measures. The risk curb shows as the area of risk curbs of without/with measures and axis of the chart.



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7.6 Cost of Risk Reduction Measures, Annual Maintenance Cost

- Investment cost for road geohazard risk reduction (unit: currency): The planners of road geohazard risk reduction measures (experts in engineering geology and civil engineering) prepare a conceptual design with a rough cost estimation to meet the design target occurrence probability in years.
- Annual maintenance cost for measures installed (unit: currency per year): The planners of the risk reduction measures of road geohazard also estimate the annual maintenance costs, such as the costs to repair or replace structure materials or to remove sediments from flood or debris control dams.

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7.7 Cost Benefit Analysis Indicators

Inputs items are annual risk reduction benefit, cost of risk reduction investment, annual cost, and discount rate (%)
Output are economic feasibility indexes such as benefit/cost ratio (BCR), net present value (NPV) and economic internal rate of return (EIRR) of risk reduction projects of road geohazard.

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8. Conclusions

It is aware of the limitations of this procedure and requirement of further improvement as follows.

The accuracy of evaluation results depends on the quality of data entered for road geohazard event and rainfall, seismic acceleration, which needs further improvement.

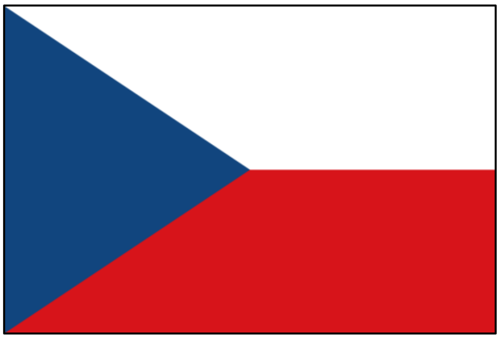
The accurate disaster records (occurrence time, magnitude, damage assessment including economic loss estimate), dense distribution of rainfall stations, and automatic recording of the definite period of rainfall amount are essential to improving the accuracy of the assessment results. Numerical geohazard model calculation should be conducted to compensate for a shortage of actual geohazard data.

23

Strategy and practical use of temporary bridges and supporting structures

GRUBER, Jan

Department of Transportation
Czech Republic



The Age of Mega Disaster and Risk Governance - Thinking Creative for Road and Other Infrastructures

Norio OKADA
Professor Emeritus, Kyoto University, Japan
Senior Fellow, IASS, Potsdam, Germany
Adviser, IDiRRG, Kwansei Gakuin University, Japan
International Workshop on Disaster Management for Roads
@ Iidabashi Rainbow Building, Tokyo, Japan May 31, 2017

Plan of my talk (1)

Prelude: Sendai Framework for Action

0. Self-introduction
1. Seemingly different, two challenging issues which I predicted we would face, right after March 11, 2011 Eastern Japan Earthquake
2. Challenge I (local)
   Geo-spatial integration over time
   Adaptive design for smart governance makes difference
3. Challenge II (global)
   Geo-focused, Issue-based integration over time
   Adaptive design for smart governance makes difference

2

Plan of my talk (2)

4. Major message summarized:
i) Mega-disasters challenge infrastructure : more creative thinking and communication (two competing process dynamics needed: top-down and bottom-up)

ii) Integrated disaster management, especially governance

5. Conclusion
◆Further ahead (from reactive to proactive)
◆Anticipating Nankai Trough Earthquake in the Western Pacific Coast of Japan
◆Climate change

3

Prelude

ISDR's Sendai Framework for Action 2016-2025

4

Preamble

- a) To adopt a concise, focused, forward-looking and action-oriented post 2015 framework for disaster risk reduction;
- (b) To complete the assessment and review of the implementation of the Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters;
- (c) To consider the experience gained through the regional and national strategies/ institutions and plans for disaster risk reduction and their recommendations, as well as relevant regional agreements for the implementation of the Hyogo Framework for Action;
- (d) To identify modalities of cooperation based on commitments to implement a post 2015 framework for disaster risk reduction;
- (e) To determine modalities for the periodic review of the implementation of a post 2015 framework for disaster risk reduction.

5

To attain the expected outcome, the following goal must be pursued:

- Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures } *sectoral*
  that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience. } *Disaster manage-ment cycle*

6

Priorities for action

- Priority 1: Understanding disaster risk.
- Priority 2: Strengthening disaster risk governance to manage disaster risk.

Geo-spatial integration over time

Adaptive design for smart governance makes difference !

- Priority 3: Investing in disaster risk reduction for resilience.
- Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

7

- (a) To reaffirm that developing countries need enhanced provision of coordinated, sustained and adequate international support for disaster risk reduction, in particular for the least developed countries, small island developing States, landlocked developing countries and African countries, as well as middle-income countries facing specific challenges, through bilateral and multilateral channels, including through enhanced technical and financial support and technology transfer on concessional and preferential terms, as mutually agreed, for the development and strengthening of their capacities;
- (b) To enhance access of States, in particular developing countries, to finance, environmentally sound technology, science and inclusive innovation, as well as knowledge and information sharing through existing mechanisms, namely bilateral, regional and multilateral collaborative arrangements, including the United Nations and other relevant bodies;

8

Means of implementation (continued)

- (c) To promote the use and expansion of thematic platforms of cooperation, such as global technology pools and global systems to share know-how, innovation and research and ensure access to technology and information on disaster risk reduction;

Geo-spatial integration over time

Adaptive design for smart governance makes difference !

- (d) To incorporate disaster risk reduction measures into multilateral and bilateral development assistance programmes within and across all sectors, as appropriate, related to poverty reduction, sustainable development, natural resource management, the environment, urban development and adaptation to climate change.

9

Follow-up actions

- The Conference invites the General Assembly, at its seventieth session, to consider the possibility of including the review of the global progress in the implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030 as part of its integrated and coordinated follow-up processes to United Nations conferences and summits, aligned with the Economic and Social Council, the High-level Political Forum for Sustainable Development and the quadrennial comprehensive policy review cycles, as appropriate, taking into account the contributions of the Global Platform for Disaster Risk Reduction and regional platforms for disaster risk reduction and the Hyogo Framework for Action Monitor system.

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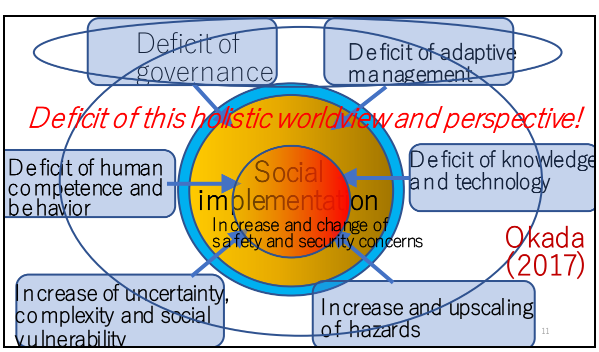

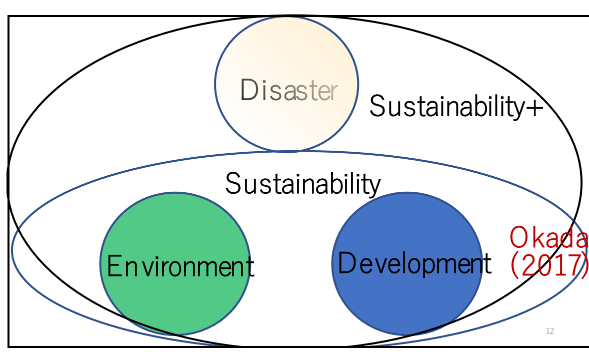

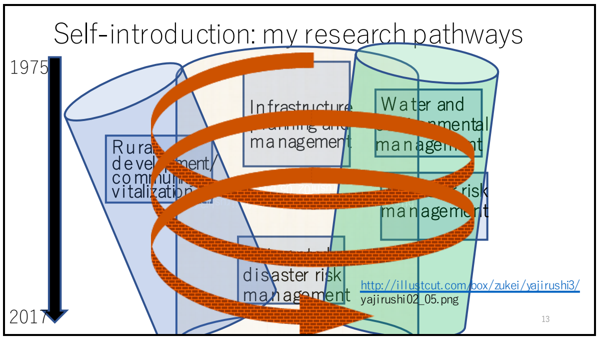

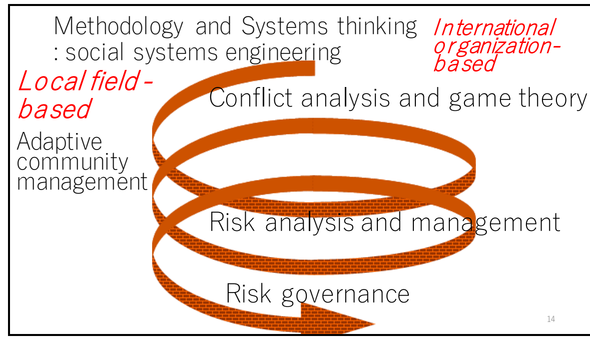

The age of mega disasters

- Mega hazards x Vulnerable Communities X Interconnected societies = Local-to-regional-to-global impacts ⇒short of structural change or into structural change
- Here and there sequential mega and other disasters (eg. In Japan)
- Un-thinkables, Un-imaginables? Yet-unidentified gaps/holes in the conventional, existing social systems
  ⇒governance deficits
- Sometimes social innovations and emergence of new self-organization and leadership

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1. Seemingly different, two challenging issues which I predicted we would face, right after March 11, 2011 Eastern Japan Earthquake

- Evidence-based adaptive knowledge-action development approach
- Two different angles
- Both addressing needs for “adaptive management for smart governance”
- Common platform for communication and collaborative action development

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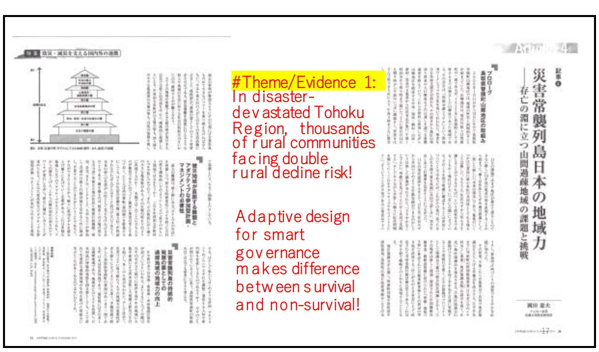

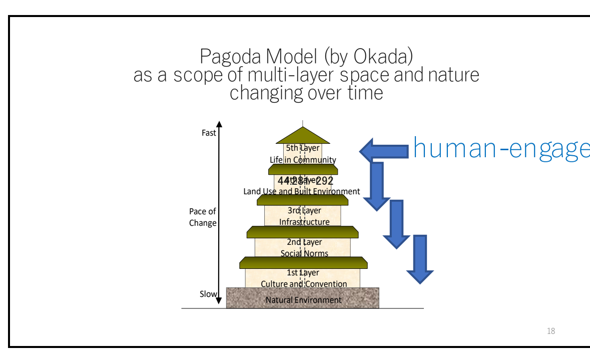


各国横断のリスク管理を
京都大学防災研究所長・岡田憲夫教授

#2 Theme/Evidence
Systemic risk: A new risk governance needed

(Nikkei Veritas, March 27, 2011)

◆Cascading effects of mega disaster across countries
◆Complex systems of supply chains
◆Networks of networks of transportations and logistical systems (global critical infrastructure)

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Systemic risks and their risk governance
O. Renn (2017 etc) x N. Okada (2016)

- Interconnected world
- Networks of networks, Systems of systems
- Science of Complexity
- Emergence
- Cascading (Domino) effects
- Slowly developing risks ⇒Catastrophe
- Structural change and transformation
- Breakthrough-making leading to innovation
- Breakdown of society and/or economy and survival failure
- Challenge for infrastructure: Super (-geo)-spatial risk governance over long period of time

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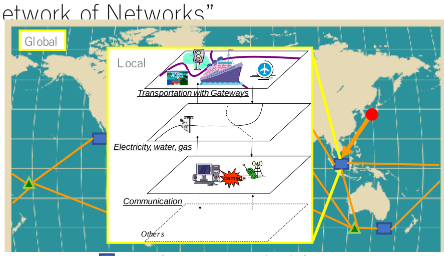
Global Infrastructure as a "Network of Networks"



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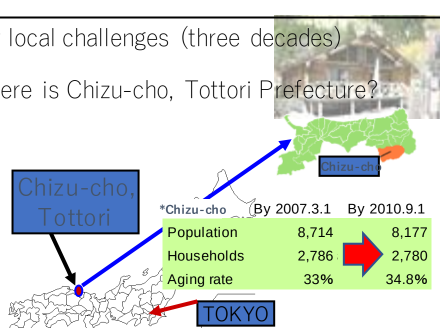
2. Challenge I (local)

Geo-spatial integration over time
Adaptive design for smart governance makes difference

22

My local challenges (three decades)

Where is Chizu-cho, Tottori Prefecture?



*Chizu-cho	By 2007.3.1	By 2010.9.1
Population	8,714	8,177
Households	2,786	2,780
Aging rate	33%	34.8%

http://www1.town.chizu.tottori.jp/dd.aspx?menuid=1

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Three decade-long local community initiatives ("machizukuri") in Chizu, Tottori, Japan

- Decade I (1985-1995)
  warming-up phase
- Decade II (1995-2005)
  "zero-to-one movement" version1 (village community unit level)
- Decade III (2005-2015)
  "zero-to-one movement" version2 (valley community group level)
- Decade IV (2015-)
  more self-developing process, open community, new challenges by new and old residents

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The role of Local Champion

- Atsushi Teratani, (63), the Postmaster of Nagi Post Office, also in Chizu, is one of the main founders of vitalization of the area.
- He and the residents are still in the process of activities, including the zero-ichi Community Vitalization Movement, aiming to build a lively community.

1.Local Communicator (Between local area and outside area)

2.Local Leader

3.Local Knowledge (Guiding for Outside Partner)

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What is 0-to-1 Community Vitalization Movement? (Zero-ichi Movement)

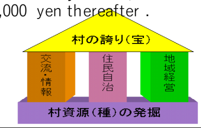
- Rediscover something valuable but almost diminishing"0" (zero) and recreate it to "1" (one).
- Residents themselves should design ten-year processes of actualizing it together.
- Make smart changes implemented.
- Compete each other among communities.
- Every selected community gets each year 200,000 yen per year till 5th year. 100,000 yen thereafter .

■ 3 Pillars of 0-to-1 Movement

1.Exchanging /Information

2.Local Autonomy

3.Local Management



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Report of Zero-ichi Movement in Chizu-cho (Every March)

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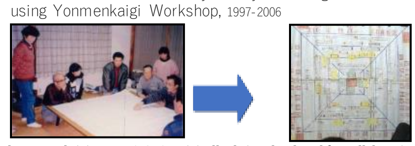
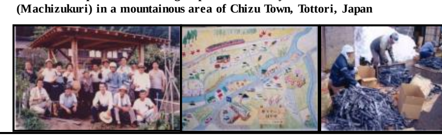
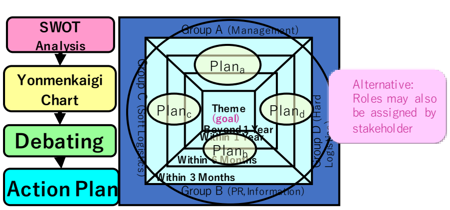
Zero-Ichi Movement Activity of Hayase Village using Yonmenkaigi Workshop, 1997-2006



The Yonmenkaigi system (YSM), originally designed and used for collaborative action development for small groups in community-citizen vitalization initiatives (Machizukuri) in a mountainous area of Chizu Town, Tottori, Japan

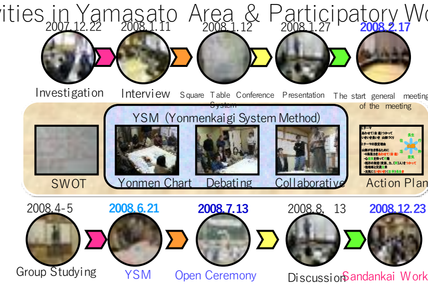


The Yonmenkaigi System Method(YSM)



The action components for each role are compartmentalized in a time frame. Participants share information and knowledge among them, then make action plan to achieve a goal by using Yonmenkaigi system.

The Zero-to-one Version 2: Activities in Yamasato Area & Participatory Workshops



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Implementation of YSM-based action plans
(Open Ceremony of Yamasato Area, Chizu in 13,July,2008)

Yamasato Open Ceremony in 13,July,2008

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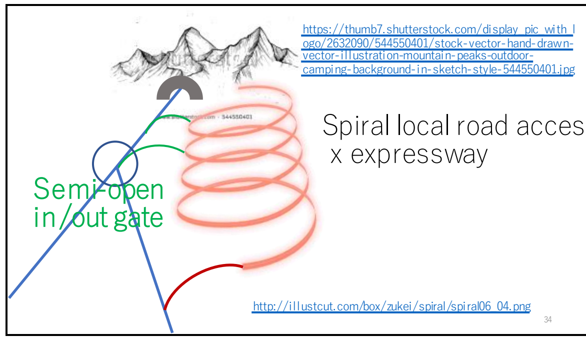

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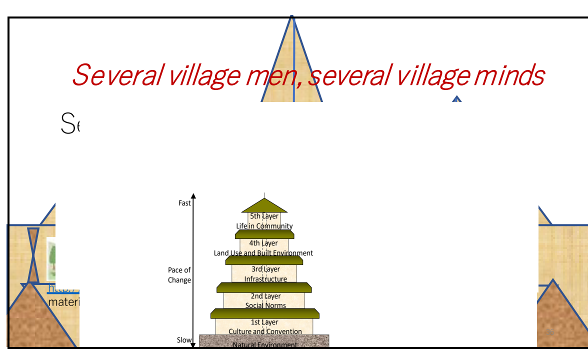
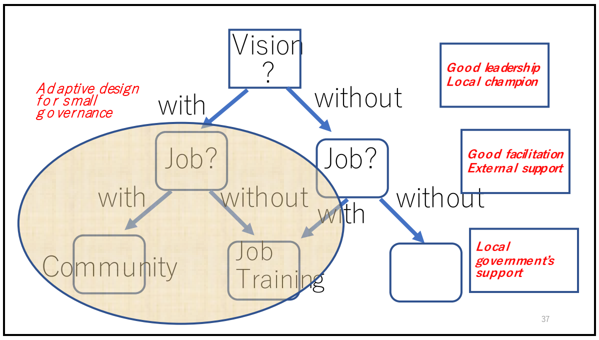
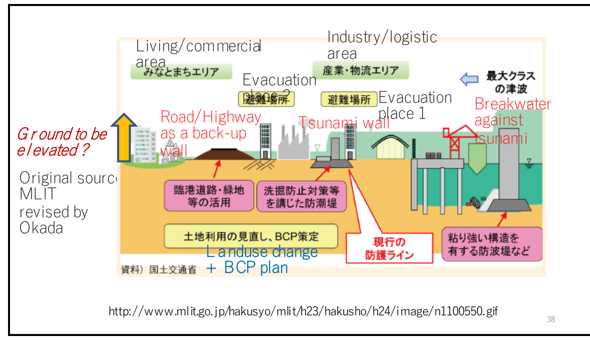
What and how to build back better devastated Eastern Japan Region?

35

Several village men, several village minds

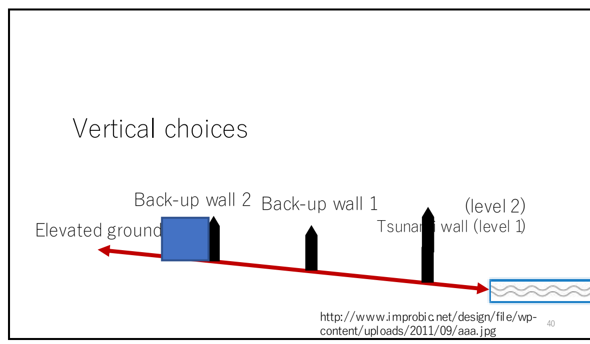


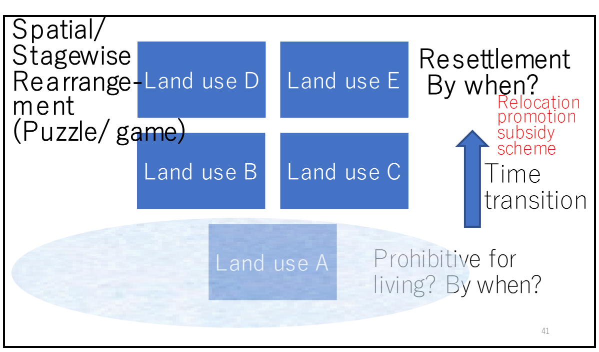




Interregional highway routing from a longer-term perspective but local section finetuning might work effectively for a limited period of time latitude?

39





Neighborhood community 2

Neighborhood community 1

Industry and shops

42

Neighborhood community 3 (plus New?

Neighborhood community 1+2

Communities successfully undivided

Industry 1 and shops

Fishery industry

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Taro, Miyako City, Iwate

A tsunami devastated town

research outlet developed by Prof. Masaaki Taro, Iwate University

Taro Village, Miyako, Iwate, Japan
Fighting to recover and restore their community,
Step by Step
by way of adaptive management.

Researchers are there to help them!

45

Mr. Shigeatsu Hatakeyama's initiative

http://goethe.nikkei.co.jp/images/human/121106/ph10.jpg

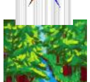
Supported by Louis Vuitton

http://jp.louisvuitton.com/jpn-jp/articles/activities-of-louis-vuitton

46

https://cdn.pixabay.com/photo/2016/08/02/21/19/budgies-1565033_1280.jpg

NGO "Moriwa Koibioto":
"The forest is longing for the sea".



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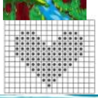
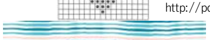


http://pds.exblog.jp/pds/1/201112/08/23/c0180023_22214178.jpg



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http://livedoor.4.blogimg.jp/himasoku123/imgs/a/4/a4f6d8e0.jpg

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Recovery of Coastal Fauna after the 2011 Tsunami in Japan as Determined by Bimonthly Underwater Visual Censuses Conducted over Five Years

- Reiji Masuda ,
- Makoto Hatakeyama,
- Katsuhide Yokoyama,
- Masaru Tanaka
- Published: December 12, 2016
- https://doi.org/10.1371/journal.pone.0168261

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Geo-spatial integration over time

Adaptive design for smart governance makes difference

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Where scientists find their roles ?

- Theories and models
- Art of facilitation and communication
- Systematic documentation and archives
- Process design of adaptive management
- Workshop methods

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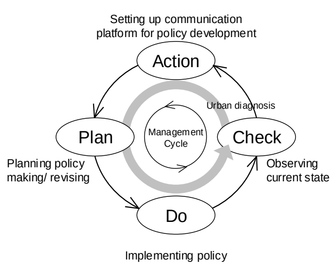
Plan-Do-Action-Plan Process
Small but Complete by Adaptive Management



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3. Challenge II (global)

Geo-focused, Issue-based integration over time
Adaptive design for smart governance makes difference

52

Systemic risk governance of mega disasters

- Mega hazards x Interconnected societies = Local-to-regional-to-global impacts ⇒short of structural change or into structural change
- Here and there sequential mega and other disasters (eg. In Japan)
- Unthinkables, Unimaginables? Yet-unidentified gaps/holes in the conventional, existing social systems
  ⇒governance deficits
- Sometimes social innovations and emergence of new self-organization and leadership

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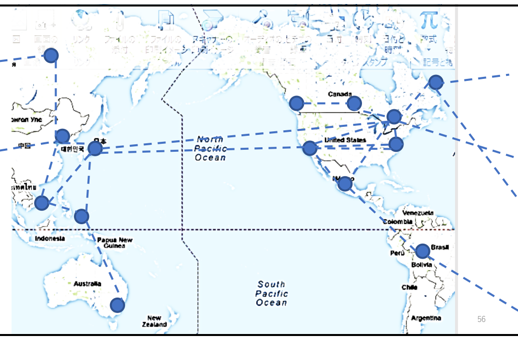
Risk Governance of Infrastructure needs more creative and imaginative

- "Critical infrastructure"
- Physical objects vs. Situation-dependent, Perception-dependent subjects/issues ?
- Infrastructure potentially turns "critical mode", and more "cascading" to become "globally-critical mode" under systemic disaster risks
- Depends on how we perceive, how we scope the problem complex and what /how we wish to govern
- Systemic disaster risks make mega-disaster globally impacting disasters

54

Evidence-based adaptive knowledge-action development approach

55

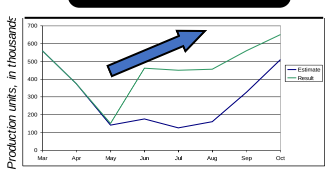


56

Impact on Production in North America

*Production Volume: Estimate & Actual**

- *Initial loss estimate: 500,000 units*
- *Total lost production volume: 242,200 units*
- *Improvement: 257,800 units*



*Courtesy: Toyota Motor Manufacturing Canada

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Eastern Japan Earthquake (March 11, 2011): Top Five Factors Affecting the Restart of Production at Toyota in Canada*

- The extensive, widespread damage.
- The damage to second-, third-, fourth- and fifth-tier suppliers.
- Semiconductor plants located in the Tohoku Region were impacted.
- Damage to industrial complexes in Japan.
- Effects of nuclear plant crisis.

*Courtesy: Toyota Motor Manufacturing Canada

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What We Did During the Downturn*

*Courtesy: Toyota Motor Manufacturing Canada

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Renesas Electronics Corporation, Tohoku, Japan

(reported by Kimura, Nikkei Electronics)

April 10,2011

March 21,2011

2500 volunteers/day from other areas and companies to repair the damages

http://www.nikkeibp.co.jp/article/reb/20110613/273768/

60

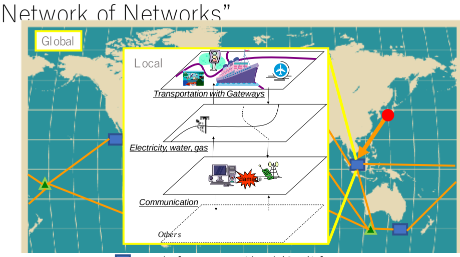
Collaborative survival rules tentatively developed

- Rival companies joined rescue and recovery
- And revised when next and next mega disasters occurred

- If we can promote this more strategically
- Adaptive design to ferment
  communicative space over time
  for smart governance
- New rules and collective behaviors implemented

61

Global Infrastructure as a "Network of Networks"



62

Risk Governance of Infrastructure needs more creative and imaginative

- "Critical infrastructure"
- Physical objects vs. Situation-dependent, Perception-dependent subjects/issues ?
- Infrastructure potentially turns "critical mode", and more "cascading" to become "globally-critical mode" under systemic disaster risks
- Depends on how we perceive, how we scope the problem complex and what /how we wish to govern
- Systemic disaster risks make mega-disaster globally impacting disasters

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Maritime Interconnected (Potentially Critical) Infrastructure in Global Risk Governance Perspective
Straits of Malacca and Singapore
(Policy Dialogue Workshop by IRGC and Kyoto U, 2010)

- Ship Collisions
- Haze
- Oil Leaks (e.g. BP)
  (Hinterland Critical Infrastructure)
- Piracy
- Terrorism (Raymond, 2006)
- Cyber Attack
  (Security issues)

2009/9

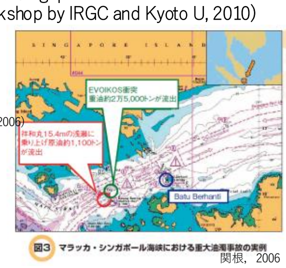

図3 マラッカ・シンガポール海峡における重大油濁事故の実例
関根, 2006

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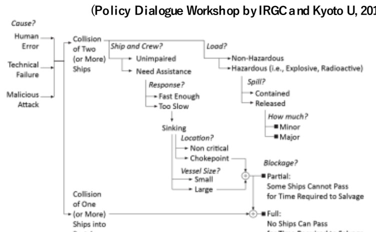
Collision scenarios:

(Policy Dialogue Workshop by IRGC and Kyoto U, 2010)



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Significant volcanic ash events

- Eyjafjallajökull, Iceland, 2010. The eruption's ash plume drifted eastward, reaching as far as the United Kingdom and parts of Western Europe. Air travel over western and northern Europe was disrupted for six days because of the amount of ash ejected into the atmosphere and the forecast that the ash would reach some areas of very high air traffic volume. The contingency plans and procedures for airspace control during this event were not adequately defined or understood, resulting in significant disruption to European and North Atlantic air traffic.

66

FOURTH MEETING OF THE INTERNATIONAL VOLCANIC ASH TASK FORCE (IVATF/4) (Montréal, Canada, 13 to 15 June 2012)

- **Recommendation 4/1 —**
- In the context of ground-based lidar capabilities for volcanic ash detection in support of the ational Airways Volcano Watch (IAVW), ICAO be invited to encourage the World Meteorological Organization (WMO) to continue its efforts to include volcanic ash in its programme of the Global Atmosphere Watch (GAW), recognizing that

the GAW provides a strong framework for improving the use of lidar techniques and networks for the detection and characterization of volcanic ash in the atmosphere.

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Adaptive design for smart governance

Geo-focused, Issue-based integration over time

- Meeting together and repeat
- A seed of a rule/practice is adaptively brought forth.
- Make it a tentative(seed) rule/practice, and ferment it over time.
- Small to start, repeat step-by-step with incremental knowledge development, and networking
- Adaptive design for smart governance
- The modest rule to start with is to meet again with small homework
- Research initiatives joined/endorsed by multiple stakeholders

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4. Major message summarized

i) Mega-disaster challenges infrastructure : more creative thinking and communication (top-down and bottom-up)

ii) Integrated disaster management, especially governance

http://www.idrim.org/

iii) Risk governance: Perspective, Methodology and Process Design of Communication Platform

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IRGC Risk Governance Framework

- Originally proposed by Ortwin Renn, professor of sociology, University of Karlsruhe, Germany
- Refined, reexamined and evolved by IRGC S&TC members and other reviewers
- Now published as the first of the series of IRGC Whitepapers.
- Implementation trials made for many different projects

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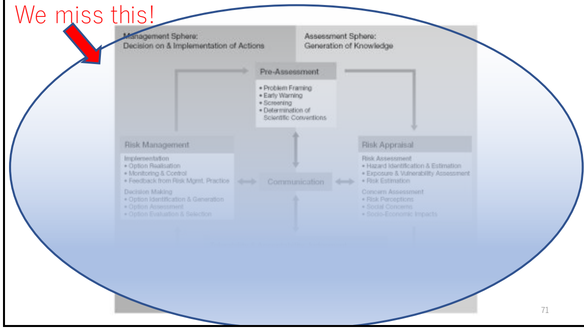
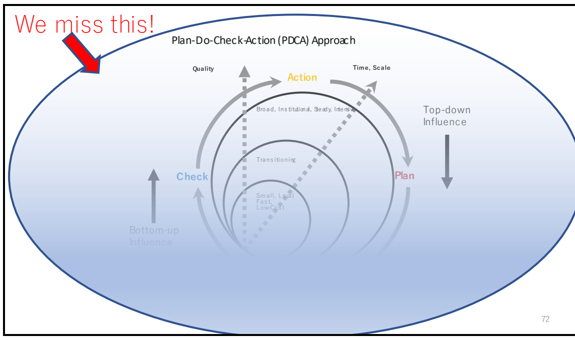
We miss this!



71

We miss this!



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Thank you for your kind attention!

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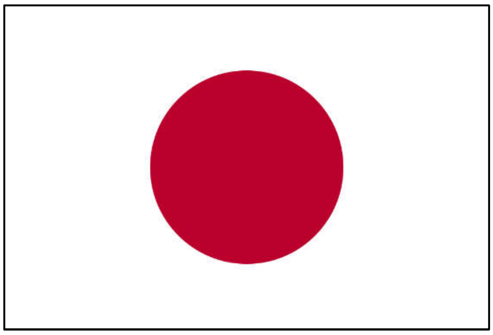
Disaster Management Technologies in Hanshin Expressway

ADACHI, Yukio

Hanshin Expressway
JAPAN



Ministerstvo dopravy

Strategy and practical use of temporary bridges and supporting structures

Presented by:
Jan Gruber

Ministry of Transport of the Czech Republic
Security Department,
Crisis Management Division

1

Contents

- Transport infrastructure
- Resilience
- Basic technological procedures for bridge renewal
- Emergency reserves for Recovery
- Training, research and development
- Other resources
- Atypical use of railway temporary constructions
- Practical experience of using temporary bridges
- Conclusions

2

Ministerstvo dopravy

Transport infrastructure

3

Road and motorway network of the Czech Republic

4

Road Transport Infrastructure

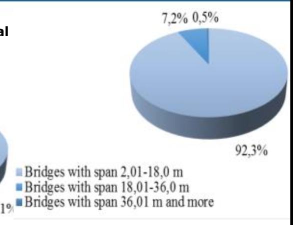
Total length of road network (km)	
Motorways	691
1st class roads	6 210
2nd class roads	14 592
3rd class roads	34 161
Total length	**55 654**

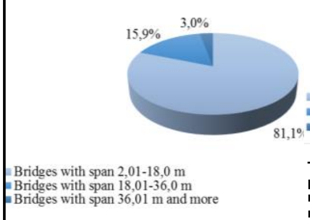
	Bridges	Underpasses	Railway Crossings	Tunnels
	number	number	number	number
Motorways	843	530	0	8
1st class	3548	1181	220	11
2nd class	4467	536	685	1
3rd class	8042	842	1678	2
Total	**16900**	**3089**	**2583**	**22**

5

Percentual ratio of bridges

The statistic shows the percentual ratio of single-pole bridges with maximal span 18,0 m is 92,3%.





The statistic also shows the percentual ratio of both single and multiple-pole bridges with maximal span 18,0 m is 81,1%.

Based on this research - two economical version of footbridge with maximal span 18 m and 36 m were set up.

6

Natural Disaster - Floods

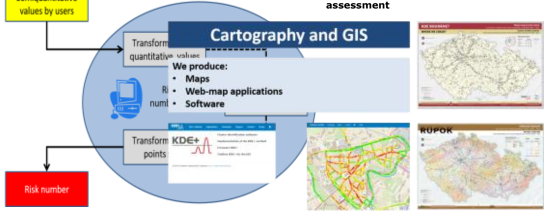
7

Resilience

8

Support tools for planning

Cartographic materials, web applications, and software applications with risk assessment



software applications CritInfo is based on risk analysis procedures processed into a methodological framework risk assessment of transport infrastructure.

Ouput – 1 value (risk R)

9

National Traffic Information Center

Team of operators works on 24/7 basis

The center receives traffic information and traffic data from highways and expressways, evaluates traffic situation, and verifies generated traffic information. It receives traffic information about current traffic situation from many subjects including the police, firefighter departments, rescue teams, and traffic correspondents.

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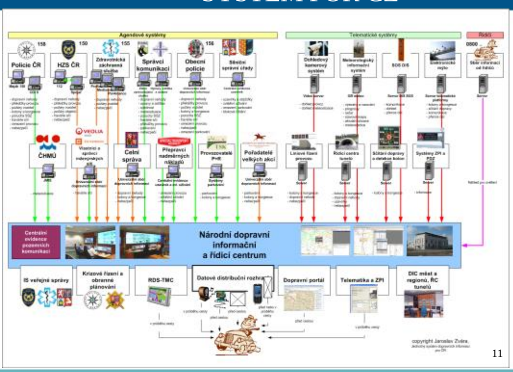
INTEGRATED TRAFFIC INFORMATION SYSTEM FOR CZ



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Regulatory measures in road transport

A part of a system of economic measures for crisis situations:

- provide services in accordance with the emergency plan
- special legislation (Act No. 13/1997 Coll., On roads)
- Act No. 241/2000 Coll., On economic measures for crisis situations

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The main task of resilience

In order to maintain the mobility of transport infrastructure and to ensure the functionality and transport service, bridges are particularly critical.

The Ministry of Transport directs its efforts to ensure the repair of damaged or destroyed bridges in crisis situations by replacing them with temporary bridge constructions.

Sources of these materials are available to business entities or stored in standby stocks of the State Material Reserves Administration.

Ministerstvo dopravy 13

Emergency reserves

- materials and products to ensure the needs of the population and for operations of emergency services
- generated in the case when materials and products are not available

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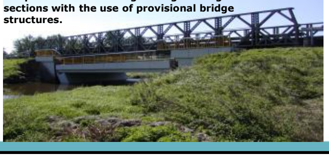
Renewal of the road infrastructure


In order to renew the operation of road transport as quickly as possible, it was decided to resolve the problem of renewing damaged bridges or road sections with the use of provisional bridge structures.

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Management of the Provisional Bridges under Crisis Situations

Leader: Ministry of Transport

Partners: Ministry of Defence
University of Defence Brno
Administration of State Material Reserves
Road and Motorway Directorate
Technical Schools
Private Businesses

Users: Bridge Owners (Stricken Regions, Municipalities, Infrastructure Managers)

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Road Infrastructure Recovery

Floods Situations	Type of bridge				Total	
	MS		TMS		Number	Length
	Number	Length	Number	Length		
July 1997	14	384	6	219	**20**	603
July 1998	4	99	1	27	**5**	126
August 2002	39	798	13	606	**52**	1.404
March 2006	2	48	0	0	**2**	48
June 2009	15	294	1	27	**16**	321
August 2010	19	393	1	66	**20**	459
June 2013	5	96	1	15	**6**	111
TOTAL	**98**	**2.112**	**23**	**960**	**121**	**3.072**

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Basic technological procedures for bridge renewal

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Use of temporary bridges in crisis situations

Types and degrees of damage to bridge objects:

- Light damage to bridge structure without impact on load capacity
- Damage to the load bearing structure of the bridge with bearing capacity
- Destruction of the bridge object
- Damage or destruction of the access road

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Summary of measures to restore transport infrastructure

A summary of measures to restore transport infrastructure includes :

- Planning,
- Construction and technical measures,
- Provision of resources and their preparation,
- Preparation of activation of forces and resources,
- Own recovery, which is divided into:
  - site survey
  - designing
  - construction work.

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Implementation of building temporary bridge

Construction preparation

•Ensuring building permits, Depositing of debris, Landscaping, Disconnection of utility networks, Ensuring site space, Securing auxiliary building materials - road panels, aggregates, construction timber)

Construction realization:

•Moving of building materials and technology; Focus and positioning of the runway, positioning of the bridge and pillars; Positioning of the crane; Construction of the runway; Construction of the individual parts of the bridge; Ejection of the bridge; Stacking of the bridge and construction of ramps on the bridge; Facilities (eg barriers, pedestrian walkways, traffic signs); handover of the bridge to the traffic controller

Operation and maintenance:

•Performing regular inspections and prescribed Technical Conditions maintenance

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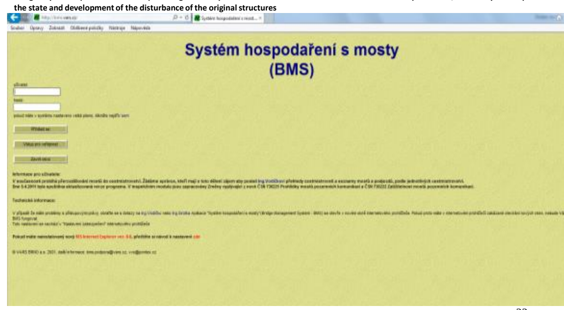
Information system BMS Vars for management of bridges

Information system for management of bridges BMS Vars (http://bms.vars.cz/) possibility to be used for conducting main inspections on local bridges by municipalities as well as providing necessary information in the framework of submission of requirements; Possibility of comparison of the state and development of the disturbance of the original structures



Support for the implementation of reconstruction/recovery of transport infrastructure 22

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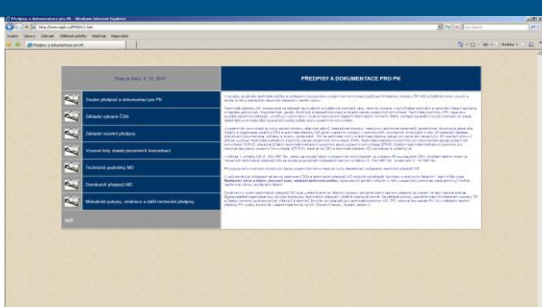
Technical Conditions MoT



The regulations and documentation for roads

23

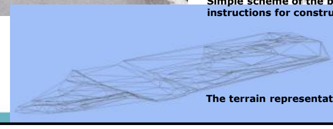
23

Survey and geodetic focus

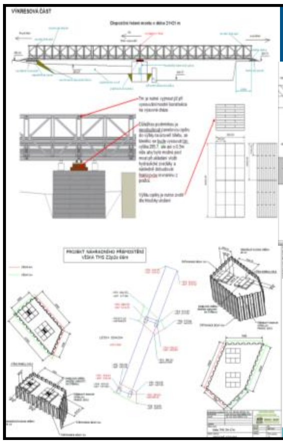
The main task of the reconnaissance team is to survey and perform the geodetic focus of the area where bridge construction is planned. The team is primarily composed of geodetters and experts in the TMS and MS bridging facilities.

The elements to be removed

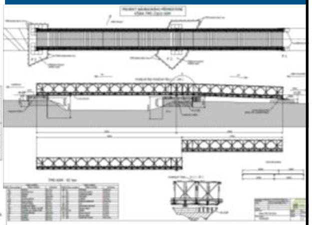
Simple scheme of the bridge location with instructions for construction and site preparation



The terrain representation in the 3D model 24



Designing



Shortened project documentation:
- Technical report (text part of the project documentation),

- Bridge layout and bridge situation (bridge crossing bridge 1:25, longitudinal section bridge 1:50 or 1: 100 - by length of bridge),

- Scheme of assembly and dismantling of temporary bridge construction,

- Extract part of bridge temporary bridge kits, including assembly tools

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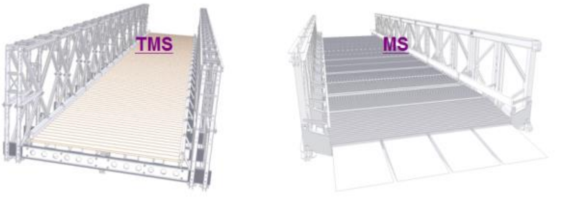
Support for designers

PROJEKTOVÁNÍ A STAVBA PROVIZORNÍCH MOSTŮ ZE SOUPRAV

Design and construction of temporary bridges MS and TMS



More detailed information on the website.
The websites are published and regularly updated site with fairly extensive additional information to aid in the design process

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Emergency reserves for Recovery

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Warehouses of emergency reserves

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Provisional Bridges in the Emergency Reserves

- Heavy bridge set – TMS
- Bridge Set – MS
- Pontoon bridge set – PMS
- Bridge Piers – PIZMO

BRIDGE TYPE	BRIDGE NUMBERS	TOTAL BRIDGE LENGHT
TMS	30	4581 m
MS	52	1056 m
PMS	11	802 m

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Heavy bridge set - TMS

- These are steel framework structures, assembled from individually pre-manufactured components
- Depending on the load, they are built as one-storey, one-wall or two-storey constructions with two walls and reinforced

30

Bridge Set - MS

- The structure is composed of full bridges parts of length 3 m.
- The bridge is approved for civilian traffic.
- MS is characterized by rapid and simple construction and low-carrying capacity.


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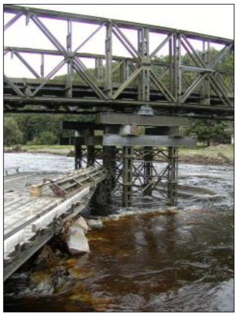
Pontoon bridge set - PMS

- It is a standardized folding bridge structure on floating supports
- The material of the set may be used to assemble bridges of floating supports with load-bearing capacity from 20 to 170 tons


32

Bridge Piers - PIZMO

- It is a steel framework dismountable structure, which may be easily adapted to the load, and height and load-bearing capacity of the ground foundation
- Serves as a support for both railway and road bridges



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Training, research and development

Ministerstvo dopravy

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Training and Education

Security Department organizes professional courses to prepare participants to be able in crisis situations in transport to ensure the implementation of measure, particularly in the case of the destruction of bridges.

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Training and Education

Course participants:
• Private construction companies,
• Organizations that provide planning,
• Employees emergency departments of municipalities, regions and companies with a focus on road transport,
•Organizations and companies that protect temporary bridge structure and ensure their removal for the purposes of restoring bridges,
• Students civilian and military universities and colleges aimed at building bridges (such as the practice of theoretical training provided by the second subsystem).

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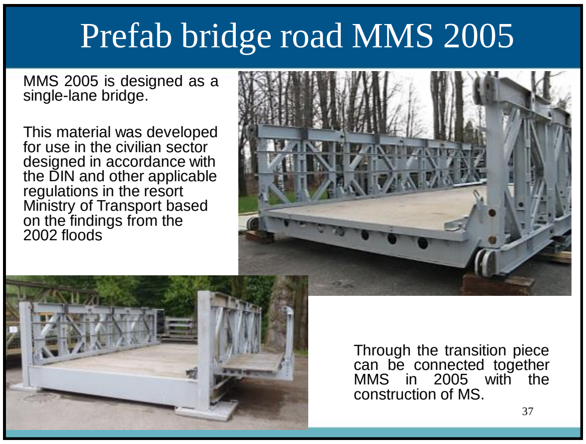
Prefab bridge road MMS 2005
MMS 2005 is designed as a single-lane bridge.
This material was developed for use in the civilian sector designed in accordance with the DIN and other applicable regulations in the resort Ministry of Transport based on the findings from the 2002 floods
Through the transition piece can be connected together MMS in 2005 with the construction of MS.
37


Temporary bridges for pedestrian and bicycle traffic range of 3-18 m (the small bridge)
Modular footbridge with variable span from 3,0 m up to 18,0 m was designed as steel panel truss construction with modulus 3,0 m.
38


Temporary bridges for pedestrian and bicycle traffic range of 3-36 m (the big bridge)
Modular footbridge with variable span from 3,0 m up to 36,0 was also designed as steel panel truss construction with modulus 3,0 m with headroom 2,50 m
39


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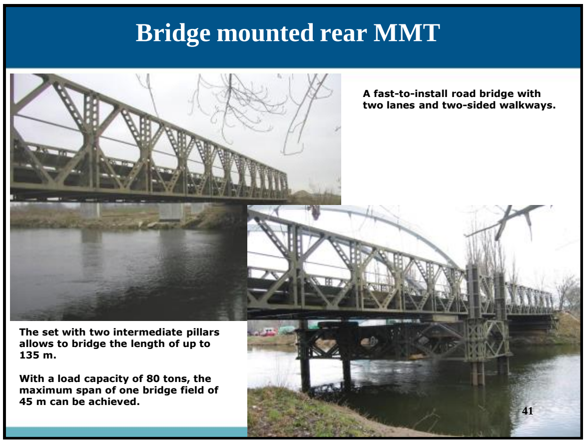
Other resources
40


Bridge mounted rear MMT
A fast-to-install road bridge with two lanes and two-sided walkways.
The set with two intermediate pillars allows to bridge the length of up to 135 m.
With a load capacity of 80 tons, the maximum span of one bridge field of 45 m can be achieved.
41

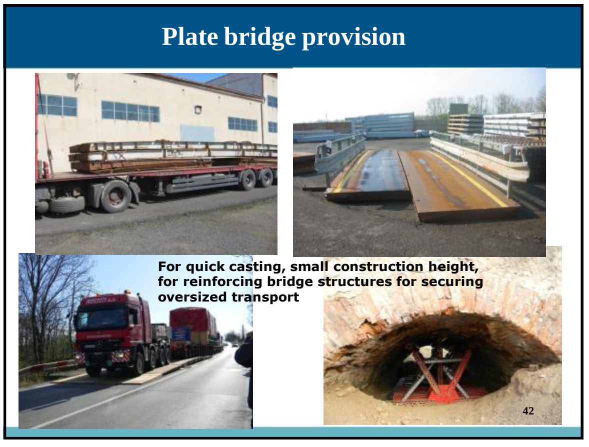


Plate bridge provision
For quick casting, small construction height, for reinforcing bridge structures for securing oversized transport
42

Bridges mobile AM-50

Bridges mobile:
Two types of mobile bridge constructions:
Rail or full bridge

Bridge with a full bridge used in the AM-50 bridge car

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Bridges mobile MT-55A

Rail bridge, the transport of which is ensured by the MT 55A bridge tank

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Ministerstvo dopravy

Atypical use of railway temporary constructions

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Sets of beams IP

Different sizes and lengths:

IP 60	– 12, 14, 16
IP 75	– 14, 16, 18, 20
IP 100	– 18, 20, 22, 24, 26

For road bridges, the beams can be longitudinally joined

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Atypical use of railway temporary constructions

Temporary railway bridge ŽM-16
for road traffic

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Atypical use of railway temporary constructions

Supporting road bridges "Transport"

Supporting railway bridges
During their reconstruction

48

Atypical use of railway temporary constructions

Supporting statically disturbed buildings

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Atypical use of railway temporary constructions

Vertical and horizontal shifting of structures

50

Atypical use of railway temporary constructions

Use of the PIŽMO structure for the lifting of a permanent bridge construction

The stroke of three parts of the arch of a permanent bridge construction up to 20 m high, with the maximum weight of individual parts 680 - 720 t using 5 auxiliary pillars PIŽMO

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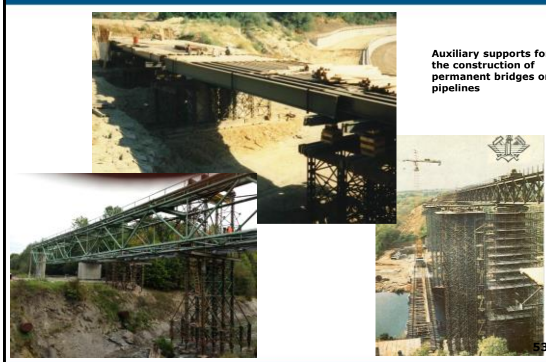
Atypical use of railway temporary constructions

Floating support and Installation of technological equipment

52

Atypical use of railway temporary constructions



Auxiliary supports for the construction of permanent bridges or pipelines

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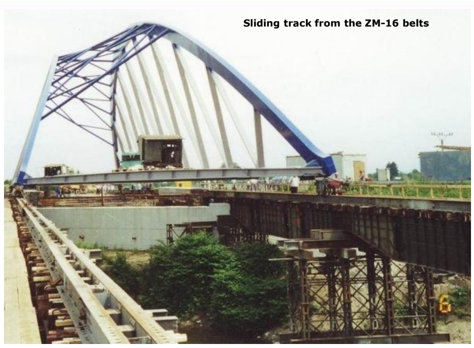
Atypical use of railway temporary constructions



Sliding track from the ZM-16 belts

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Practical experience of using temporary bridges

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Practical experience of using temporrary bridges

Noise of old structures and their inappropriateness for intravilan use and
Insufficient pedestrian protection

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Practical experience of using temporrary bridges

We have in the reserves only of the former military structures that need to be equipped with provisional technical modifications to meet the requirements for civilian operation in times of peace - after crisis

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Practical experience of using temporrary bridges

Mistakes in the design and placement of traffic signs:
Incorrectly placed TS (TS combination on one pillar, TS position, etc.)

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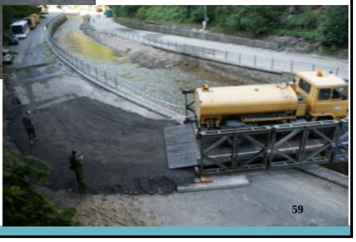
Practical experience of using temporrary bridges

Incorrectly made entry wedges (the incoming wedges)

Need practical verification of the functionality of the bridge temporaries before commissioning



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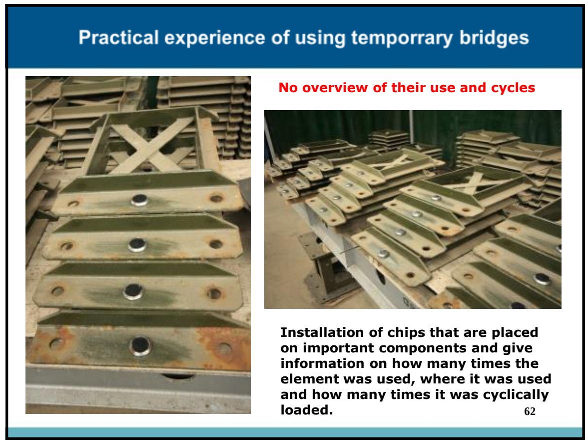
Practical experience of using temporrary bridges

Insufficient maintenance and control of bridges during long-term use

60


Practical experience of using temporrary bridges
The need for timely response to further potential floods and the provision of a bridge against the negative effects of natural threats.
61
61


Practical experience of using temporrary bridges
No overview of their use and cycles
Installation of chips that are placed on important components and give information on how many times the element was used, where it was used and how many times it was cyclically loaded.
62


Ministerstvo dopravy
Conclusions
63
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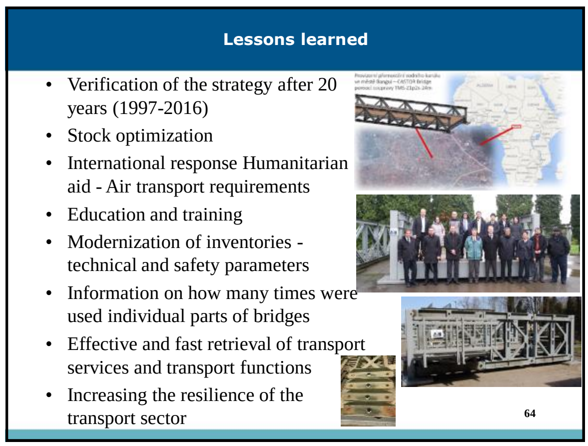
Lessons learned
• Verification of the strategy after 20 years (1997-2016)
• Stock optimization
• International response Humanitarian aid - Air transport requirements
• Education and training
• Modernization of inventories - technical and safety parameters
• Information on how many times were used individual parts of bridges
• Effective and fast retrieval of transport services and transport functions
• Increasing the resilience of the transport sector
64


PRAGUE
CZECH REPUBLIC
Candidate city to host the
WRC2023
XXVII World Road Congress 2023
MINISTRY OF TRANSPORT
OF THE CZECH REPUBLIC
www.mdcr.cz

Prediction and Enhancement of Resistance of RC Bridge during Service

ZHANG, Jianren

Changsha University of Science and Technology
CHINA

Disaster Management Technologies in Hanshin Expressway

Yukio ADACHI*, Masato OKAYAMA*,
Nobuhiro ARIMA** and Takayuki ARAKAWA**

HANSHIN EXPRESSWAY COMPANY LIMITED

Challenge for the Innovation! ...and Create the Future.
Hanshin Expressway R&D Company Limited

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Highway network in Japan and Hanshin expressway

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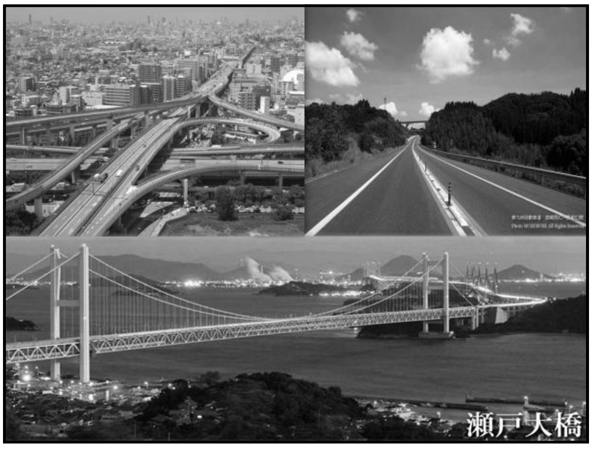
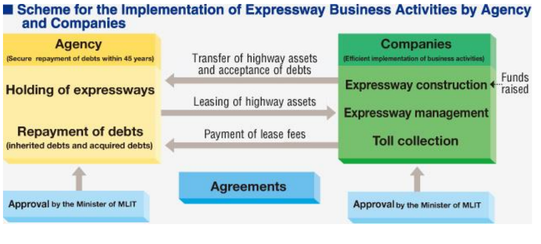


Current Highway system in Japan



NEXCO EAST, NEXCO CENTRAL, NEXCO WEST, shutoko, Hanshin Expressway, Honshu-Shikoku Bridge Expressway Company Limited

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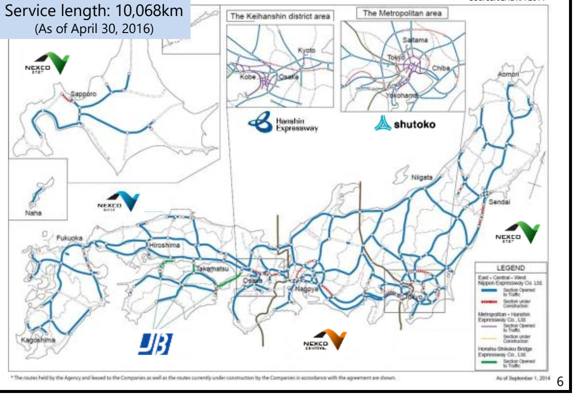
Highway Network in Japan



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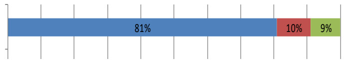
Hanshin expressway network

Structural feature of Hanshin expressway

Bridge	Tunnel	Earthwork
209km (81%)	28km (10%)	22km (9%)



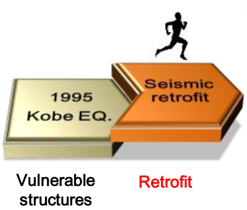
Lessons learned from previous earthquakes in Japan

Lessons learned from previous earthquakes

Collapse of bridges and viaducts

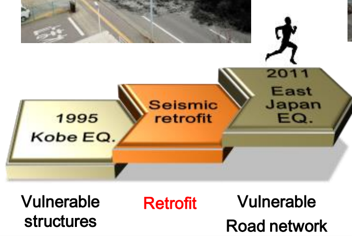
Lessons learned from previous earthquakes

Seismic improvement to bridges and viaducts



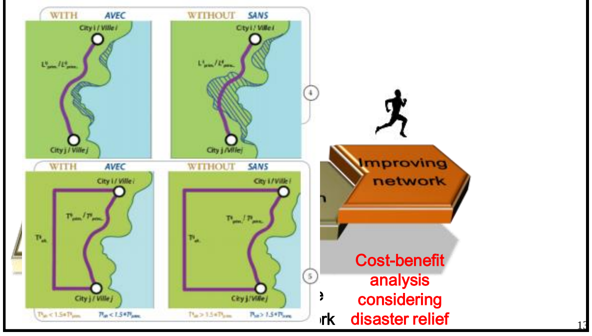
Lessons learned from previous earthquakes

2011 East Japan earthquake



Lessons learned from previous earthquakes

Road network considering disaster resilience



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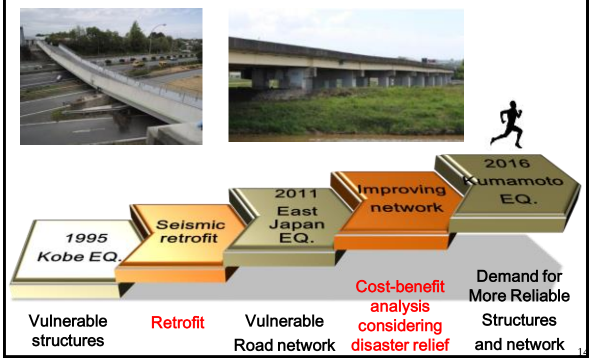
Lessons learned from previous earthquakes

2016 Kumamoto earthquake



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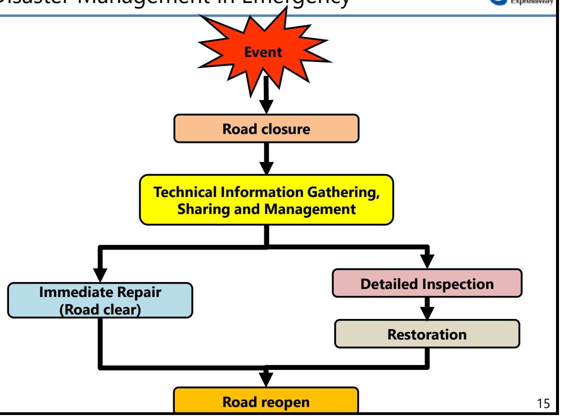
Disaster Management in Emergency



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Disaster Information management system using GIS technology

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Disaster management system

The Lessons of 1995 Kobe earthquake

The measures for information sharing was too bad.

1999～2011

Development of Disaster Information Management System

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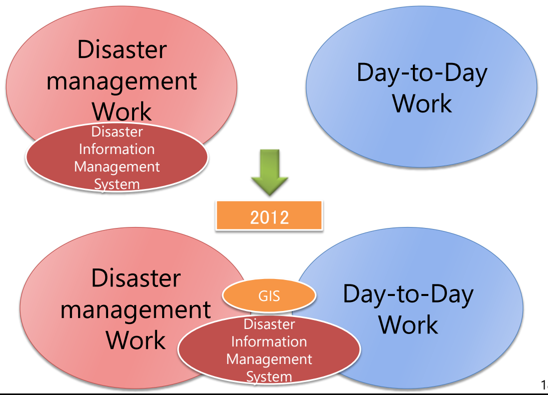
Disaster management system using GIS



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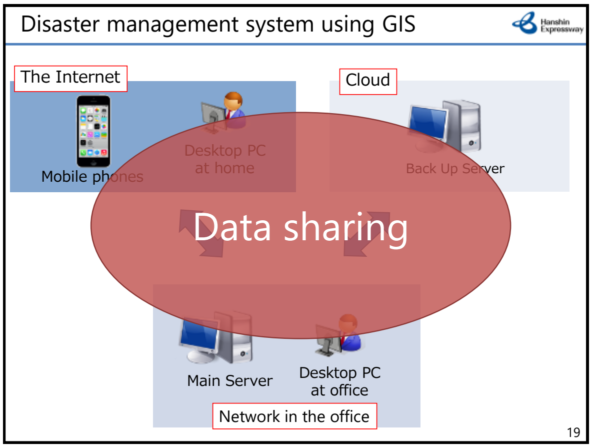
Disaster management system using GIS
The Internet
Cloud
Mobile phones
Desktop PC at home
Back Up Server
Data sharing
Main Server
Desktop PC at office
Network in the office
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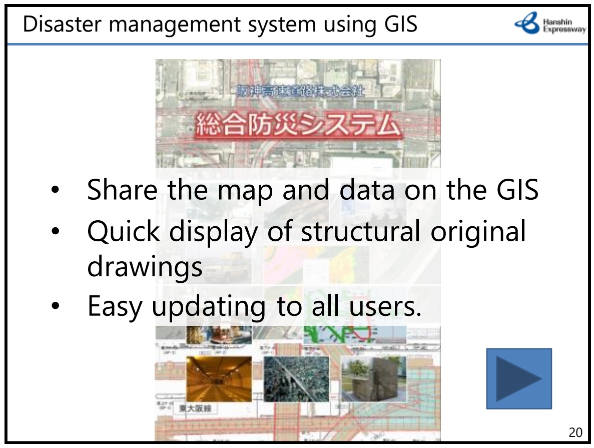
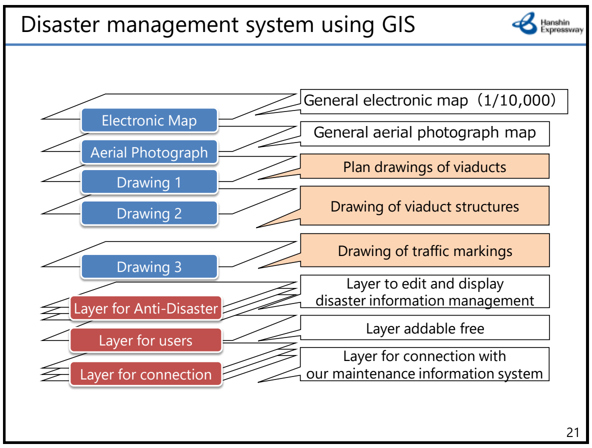

Disaster management system using GIS
総合防災システム
• Share the map and data on the GIS
• Quick display of structural original drawings
• Easy updating to all users.
20


Disaster management system using GIS
Electronic Map
Aerial Photograph
Drawing 1
Drawing 2
Drawing 3
Layer for Anti-Disaster
Layer for users
Layer for connection
General electronic map（1/10,000）
General aerial photograph map
Plan drawings of viaducts
Drawing of viaduct structures
Drawing of traffic markings
Layer to edit and display disaster information management
Layer addable free
Layer for connection with our maintenance information system
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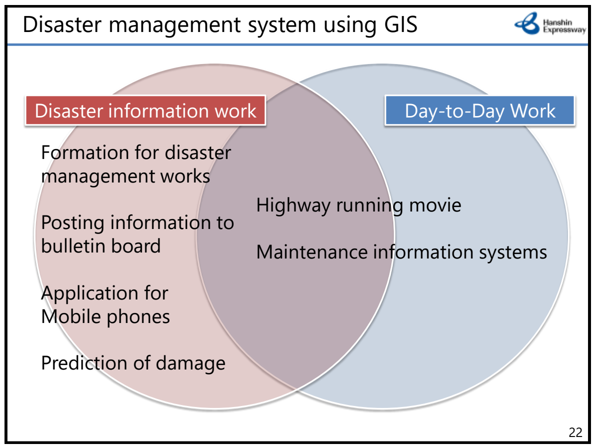
Disaster management system using GIS
Disaster information work
Day-to-Day Work
Formation for disaster management works
Posting information to bulletin board
Application for Mobile phones
Prediction of damage
Highway running movie
Maintenance information systems
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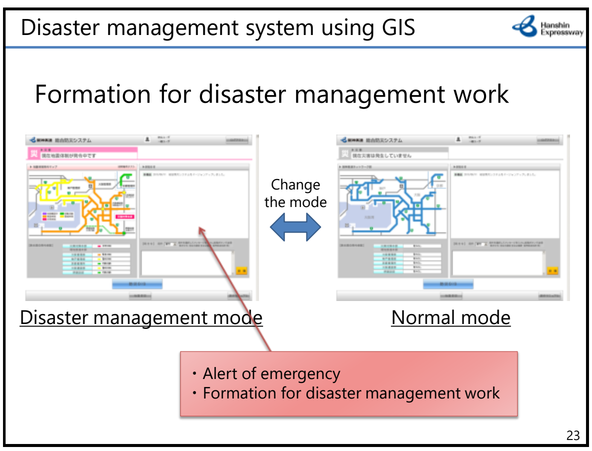
Disaster management system using GIS
Formation for disaster management work
Change the mode
Disaster management mode
Normal mode
・Alert of emergency
・Formation for disaster management work
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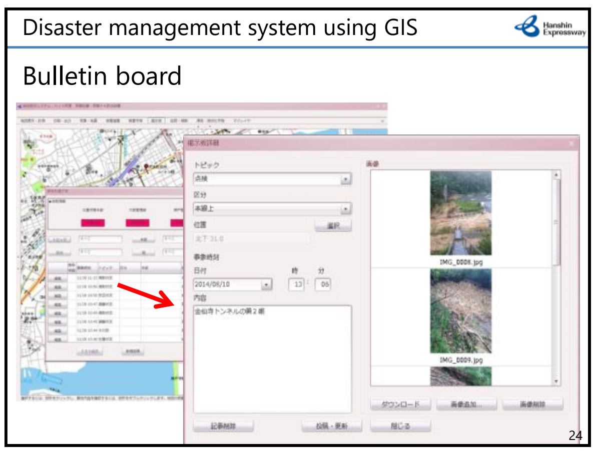
Disaster management system using GIS
Bulletin board
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Disaster management system using GIS

Application for Mobile phones

Mobile phone

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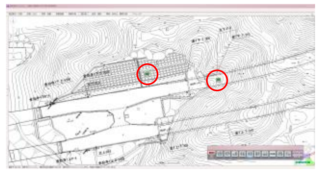
Disaster management system using GIS

Application for Mobile phones



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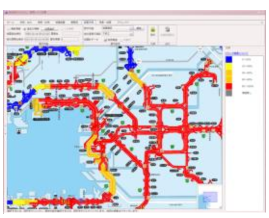
Disaster management system using GIS

Prediction of damage



Decision of priority route for inspection

Information of
・seismic waves
・location

Input ← Own Seismometers

Input ← Japan Meteorological Agency

・seismic intensity
・Location

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Disaster management system using GIS

Link to driver's_view.mpg

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Disaster management system using GIS

Link to maintenance information system

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Disaster management system using GIS

Link to vehicle counter system

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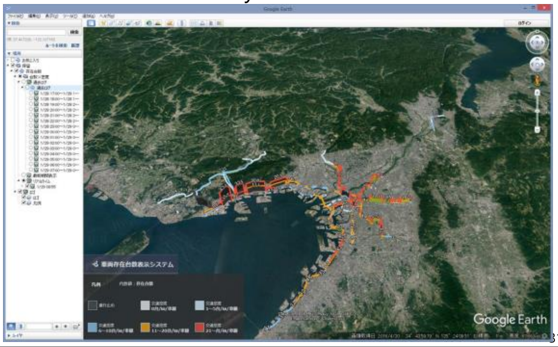
Disaster management system using GIS

Link to vehicle counter system



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Recent study for earthquake disaster mitigation

Improve preparedness

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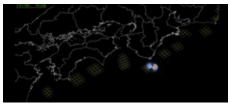
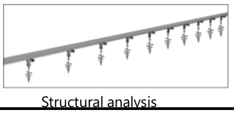
Recent study for earthquake disaster mitigation

- Upgrade disaster mitigation strategy toward keeping road function anytime in post event phase

- Demand of network-wide seismic behavior analysis



Seismic wave simulation



Structural analysis

Network simulation in the earthquake event

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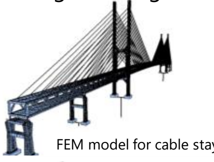
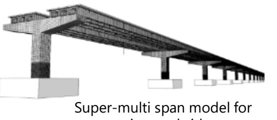
Recent study for earthquake disaster mitigation

- Start network-wide simulation using super-computer resource available in Kobe
- Use finite element models in original design

Super computer "KEI"



FEM model for cable stayed bridge



Super-multi span model for continuous bridges

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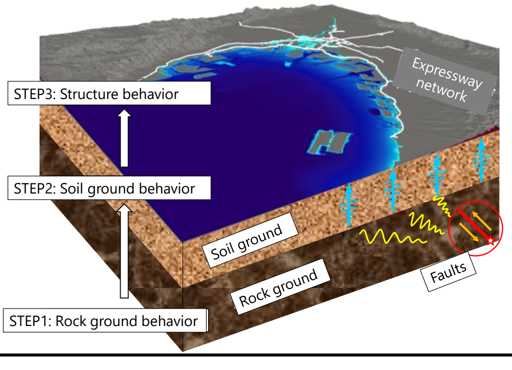
Recent study for earthquake disaster mitigation

- Ground modeling



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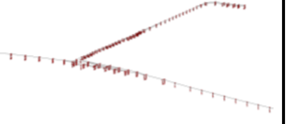
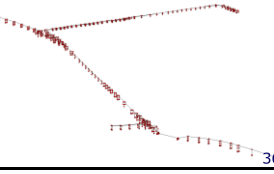
Recent study for earthquake disaster mitigation

- Structure modeling





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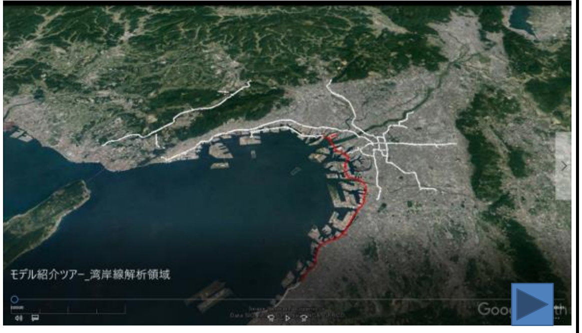
Recent study for earthquake disaster mitigation

- Structure modeling



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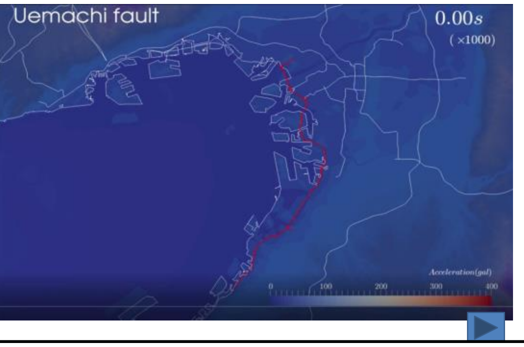
Recent study for earthquake disaster mitigation

- Fault rupture and structure behavior simulation



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Recent study for earthquake disaster mitigation

- Predicting the post event situation of viaduct road through combination study of earthquake simulation and driving simulation.

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Conclusion

- Disaster Management Technologies in Hanshin Expressway is presented here by introducing soft management measures.
- In addition to soft management measures, hard management measures especially for tsunami disaster is also going.
- Continuing seismic retrofit program is also going to raise up the performance level from “not-collapse” to “keep road function”.

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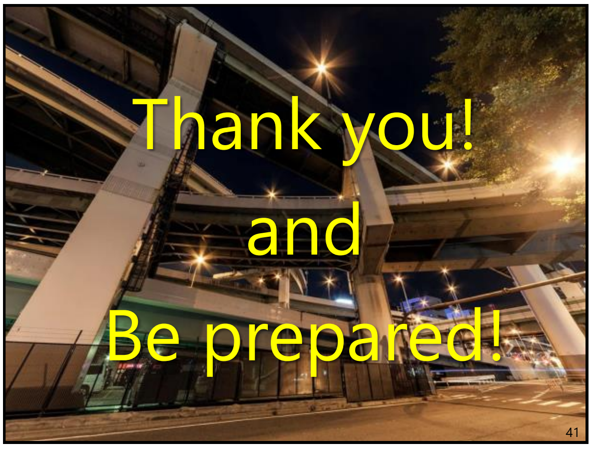

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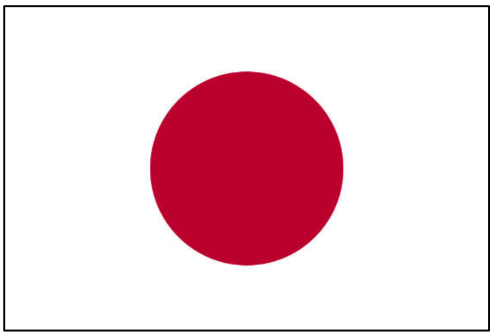
A Methodology for Emergency Response DecisionMakings with the Consideration of Unexpected Contingencies

ONISHI, Masamitsu

Kyoto University
JAPAN



Prediction and Enhancement of Resistance of RC Bridge during Service

Prof. Jianren Zhang

Changsha University of Science and Technology, China

Outlines

- Introduction
- Experimental Research for Resistance Deterioration
- Structural Resistance Degradation Prediction and Updating
- The Theory and Method for Resistance Enhancement
- Achievements Application

1 Introduction

Present situation of bridges in China

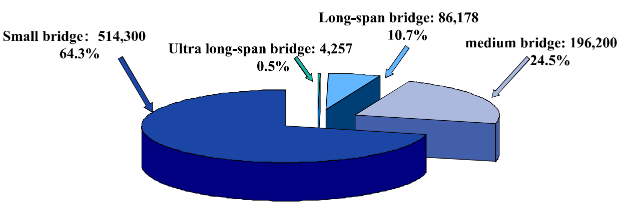
4,696,300 km of roads length, more than 800,000 bridges and the total length of the bridges is 49,170 km (2016)

Number of bridges at each province

Jiangsu: 27,239
Shandong: 26,534
Guangdong: 25,948
Liaoning: 24,771
……
Hunan: 26,449

Present situation of bridges in China

Statistical bulletin of highway and waterway transportation department in 2016



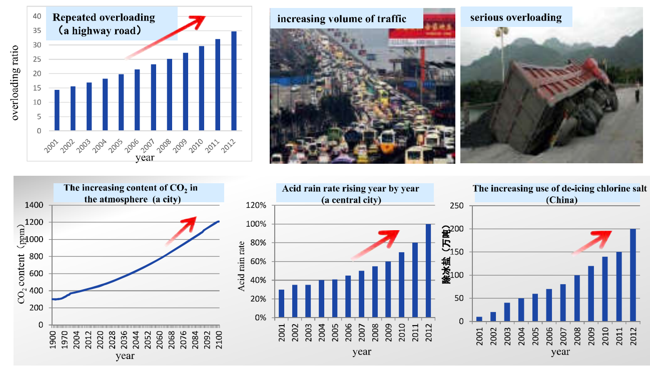
The number of concrete bridges is more than 90% of the 800,000 bridges

■ : Ultra long-span bridge: 4,257 L > 1000m; L_k > 150m	■ : medium bridge: 196,200 30m< L < 100m; 20m< L_k<40m
■ : Long-span bridge: 86,178 100m < L < 1000m; 40m< L_k<150m	■ : small bridge: 514,300 8m< L < 30m; 5m< L_k<20m

L: total length

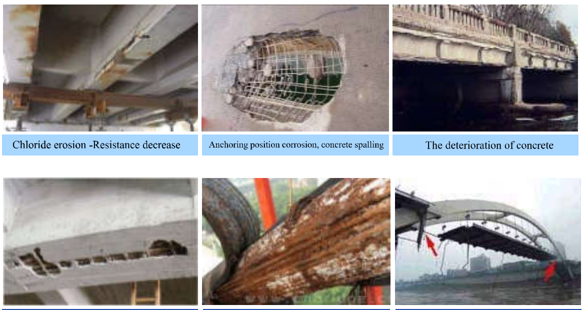
L_K : the largest span

Service conditions deterioration seriously jeopardize safety of bridges



（Data sources: http://news.xinmin.cn/rollnews/2009/09/16/2575554.html http://www.doc88.com/p-38373911663.html

Representative engineering diseases, serious degradation of resistance



Chloride erosion -Resistance decrease | Anchoring position corrosion, concrete spalling | The deterioration of concrete

Surface holes of concrete | Corrosion damage of cable | Corrosion fatigue of hanger rod

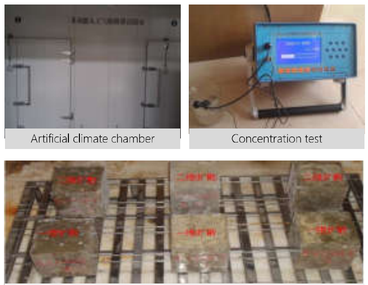
More attention to safety assessment of service bridges

- At present, performance degradation issues of material - components – structure of bridges has become increasingly prominent under couple of adverse environmental and load effect
- Federal highway administration (FHA) has implemented " Long-term bridge performance (LTBP) " research project from 2008 to 2028, that will collect bridges' data of the key nodes of the road network to improve the understanding of performance deterioration of the bridge, and develop predictive models of deterioration
- China' s Ministry of Transport is preparing to carry out a 20-year "long-term bridge performance plan" to improve service level and safety operations of bridges from 2014 to 2034

2 Experimental Research for Resistance Deterioration

Material property testing

Chloride diffusion test

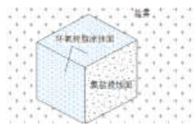


Artificial climate chamber | Concentration test

112 specimens were designed to consider the effect of temperature and humidity

Diffusion Test

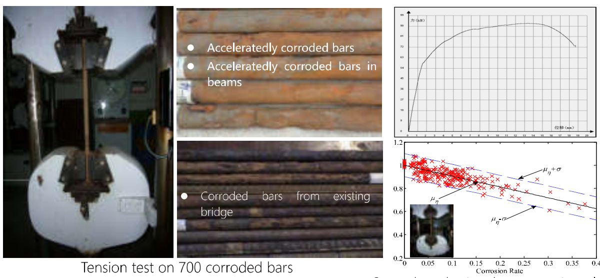
- Built Artificial climate chamber (Invention NO. 201210203012.5)
- Accelerated reinforcement corrosion test and concrete diffusion test under complicated circumstances
- Established the dynamical diffusion coefficient mode
- diffusion coefficient increases with increasing diffusion depth
- The consideration of spatial variability enhanced the corrosion initiation probability about 13.1% to 18.5%



Representative paper : *Experimental Study on Chloride Ion Diffusion Coefficient in Concrete and Probabilistic Analysis of Its Influence on Deterioration Performance of RC Structures, China Journal of Highway and Transport, 2014, 27(6):77-83*

Material property testing

Mechanics test on corroded bars



Tension test on 700 corroded bars

Strength reduction has approximately a linear relationship with corrosion loss

Failure mode of corroded bars

Ductile failure : $M_{corr} \le M_{limit}$

Brittle failure : $M_{corr} \ge M_{limit}$

where M_{limit} is random variable, Mean=22.5% · COV=0.2

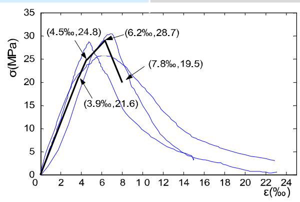
$$f_y(t) = f_{y0}\left[1-\left(0.86 \cdot \frac{\Delta A_{st}(t)}{A_{stnom}}\right)\right]$$

Representative paper : *Probabilistic analysis of corrosion of reinforcement in RC bridge considering fuzziness and randomness. ASCE' Journal of Structural Engineering, 2013, 139(9): 1529-1540*

Material property testing

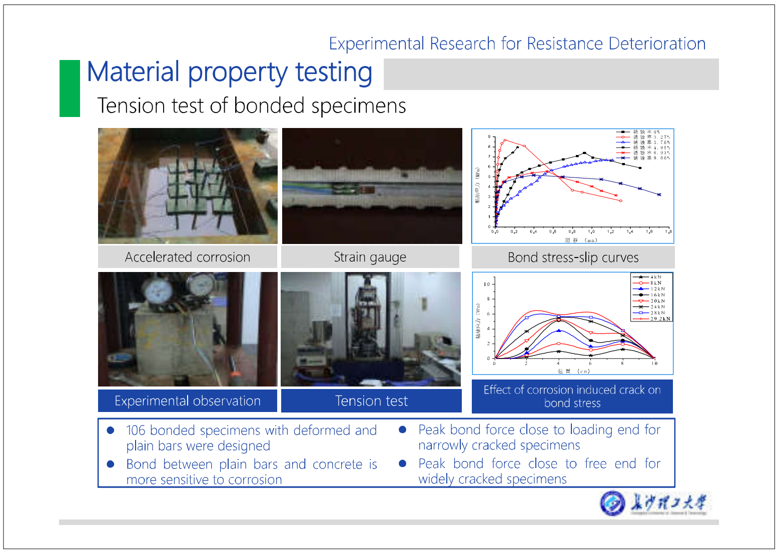
Mechanics test on deteriorated concrete

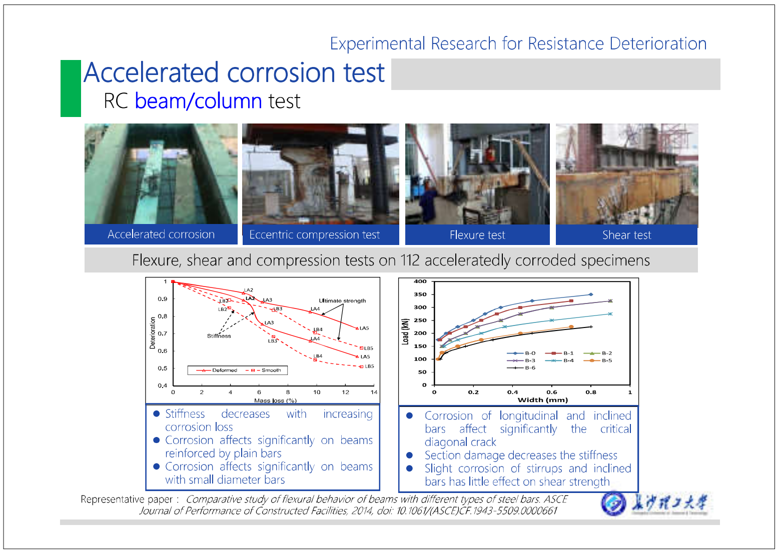
Sample of deteriorated concrete | Concrete cores from existed bridge | Mechanics test on 226 deteriorated concrete cores

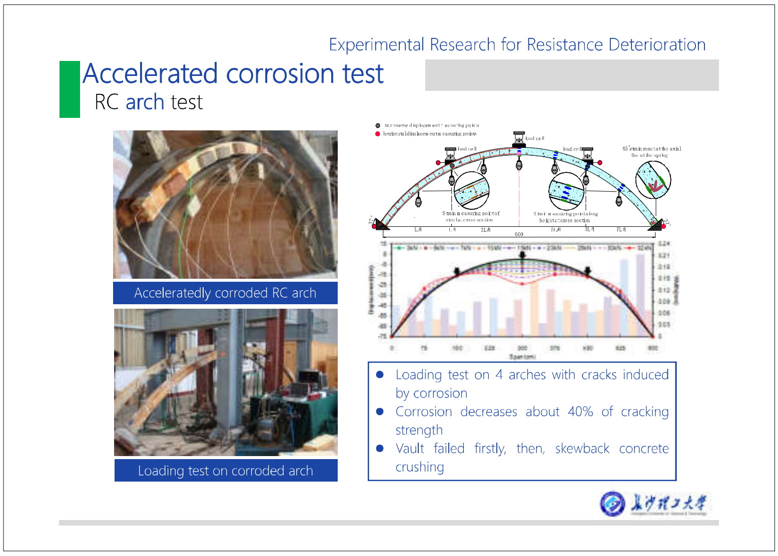


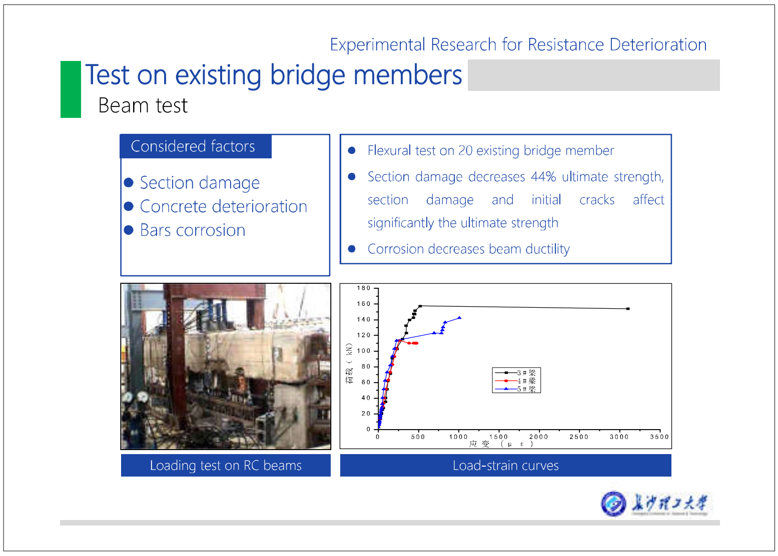
Constitutive law of deteriorated concrete

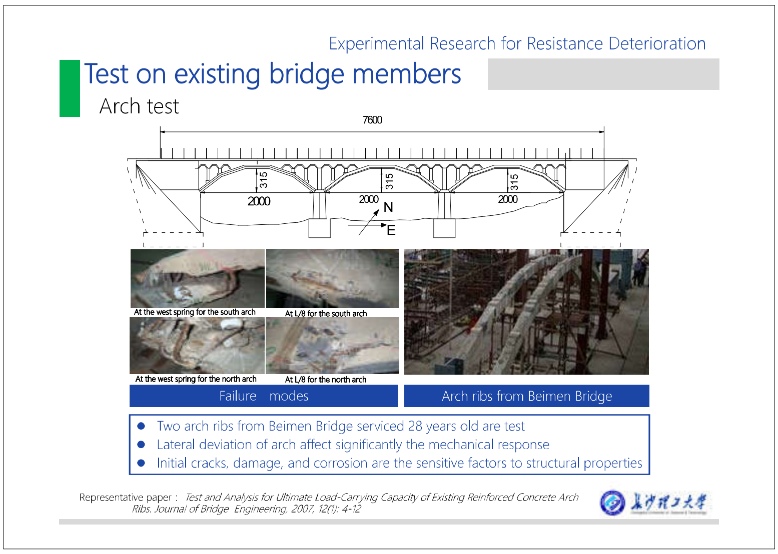
- Strong nonlinearity exhibits at the initial loading test
- Reduction of the ultimate strength and elastic modulus
- Increase of the strain corresponding to peak stress

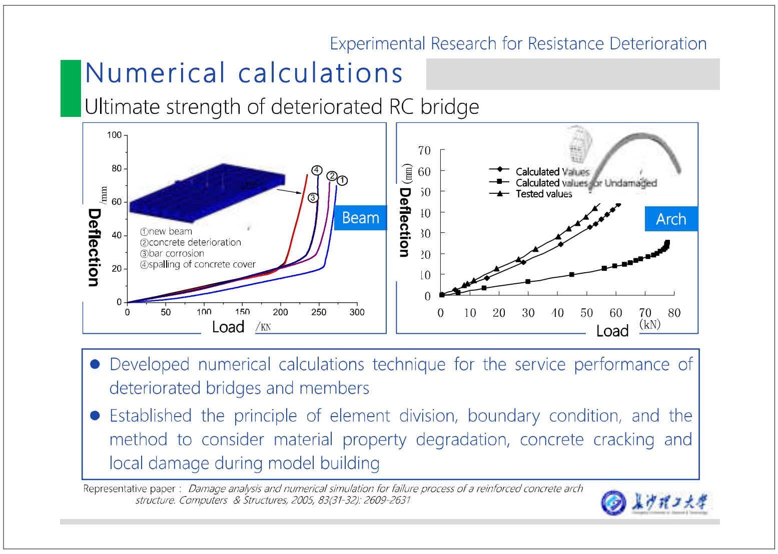

Experimental Research for Resistance Deterioration
Material property testing
Tension test of bonded specimens
Accelerated corrosion
Strain gauge
Bond stress-slip curves
Experimental observation
Tension test
Effect of corrosion induced crack on bond stress
106 bonded specimens with deformed and plain bars were designed
Bond between plain bars and concrete is more sensitive to corrosion
Peak bond force close to loading end for narrowly cracked specimens
Peak bond force close to free end for widely cracked specimens


Experimental Research for Resistance Deterioration
Accelerated corrosion test
RC beam/column test
Accelerated corrosion
Eccentric compression test
Flexure test
Shear test
Flexure, shear and compression tests on 112 accelerated corroded specimens
Stiffness decreases with increasing corrosion loss
Corrosion affects significantly on beams reinforced by plain bars
Corrosion affects significantly on beams with small diameter bars
Corrosion of longitudinal and inclined bars affect significantly the critical diagonal crack
Section damage decreases the stiffness
Slight corrosion of stirrups and inclined bars has little effect on shear strength
Representative paper： Comparative study of flexural behavior of beams with different types of steel bars. ASCE Journal of Performance of Constructed Facilities. 2014, doi: 10.1061/(ASCE)CF.1943-5509.0000661


Experimental Research for Resistance Deterioration
Accelerated corrosion test
RC arch test
Acceleratedly corroded RC arch
Loading test on corroded arch
Loading test on 4 arches with cracks induced by corrosion
Corrosion decreases about 40% of cracking strength
Vault failed firstly, then, skewback concrete crushing


Experimental Research for Resistance Deterioration
Test on existing bridge members
Beam test
Considered factors
Section damage
Concrete deterioration
Bars corrosion
Flexural test on 20 existing bridge member
Section damage decreases 44% ultimate strength, section damage and initial cracks affect significantly the ultimate strength
Corrosion decreases beam ductility
Loading test on RC beams
Load-strain curves

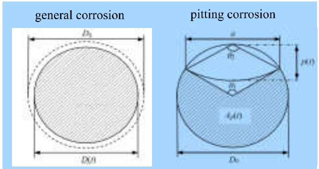

Experimental Research for Resistance Deterioration
Test on existing bridge members
Arch test
7600
2000
2000
2000
At the west spring for the south arch
At L/8 for the south arch
At the west spring for the north arch
At L/8 for the north arch
Failure modes
Arch ribs from Beimen Bridge
Two arch ribs from Beimen Bridge serviced 28 years old are test
Lateral deviation of arch affect significantly the mechanical response
Initial cracks, damage, and corrosion are the sensitive factors to structural properties
Representative paper： Test and Analysis for Ultimate Load-Carrying Capacity of Existing Reinforced Concrete Arch Ribs. Journal of Bridge Engineering. 2007, 12(1): 4-12


Experimental Research for Resistance Deterioration
Numerical calculations
Ultimate strength of deteriorated RC bridge
Deflection
Load
Beam
①new beam
②concrete deterioration
③bar corrosion
④spalling of concrete cover
Arch
Calculated Values
Calculated values for Undamaged
Tested values
Developed numerical calculations technique for the service performance of deteriorated bridges and members
Established the principle of element division, boundary condition, and the method to consider material property degradation, concrete cracking and local damage during model building
Representative paper： Damage analysis and numerical simulation for failure process of a reinforced concrete arch structure. Computers & Structures, 2005, 83(31-32): 2609-2631

3 Structural Resistance Degradation Prediction and Updating

Probabilistic resistance model

Corrosion loss



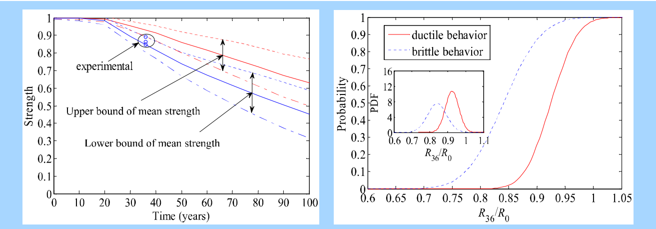
- Aggressive environment changes corrosion type in concrete bridge
- General corrosion and pitting corrosion may occur simultaneously or separately in practical engineering, which increases the model uncertainty
- The likelihood of different corrosion types is important for corrosion loss prediction

$$D(t) = D_0 - 0.0232(t - T_i)\, i_{corr}(t) \qquad p(t) = 0.0116(t - T_i)\, i_{corr}(t) R$$

Considering the probability of general corrosion and pitting corrosion model, the corrosion loss can be written as

$$\rho_{corr}(t) = P(M_1)\rho_g(t) + P(M_2)\rho_p(t)$$

Probabilistic strength model



Strength model:

$$R(t) = \sum_{i=1}^{n} k_p \cdot k_{si} \cdot A_i(t) \cdot f_{i,y}(t) \left(h_0 - \frac{f_{i,y}(t) \cdot A_i(t)}{2 f_c b} \right)$$

Brittle: $r(t) = \max\left[n r_1(t), (n-1) r_2(t), \cdots, 2 r_{n-1}(t), r_n(t) \right]$, $r_1(t) < r_2(t) < \cdots < r_{n-1}(t) < r_n(t)$

Ductile: $r(t) = \sum_{i=1}^{n} r_i(t)$

- The model considers corrosion area loss, the strength loss of rebars, failure modes of rebars, bond degradation and model error, etc.

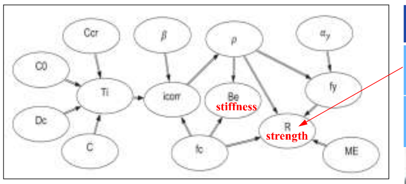
Published paper: Probabilistic prediction with Bayesian updating for strength degradation of RC bridge beams. Structural Safety, 2013, 44: 102-109

Load testing-Bayesian network

- Load testing is an efficient method for bridge assessment , but this method can not directly reflect structural strength
- Traditional Bayesian method can update model and parameters using observed data
- There is a crucial need to develop a updating method involving intermediate or smaller module calculations, e.g. using deflection data to predict structural strength
- Bayesian network is a type of statistical model and is one of the most useful methods for uncertainty expression and information fusion

---

Bayesian network updating method

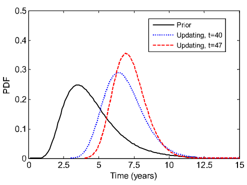


Time	Loading conditions	Flexural bending, kN·m	Deflection, mm
40 years	Test Ⅰ	81.42	1.1
		158.36	2.1
	Test Ⅱ	212.57	2.9
		359.43	4.3
47 years	Test Ⅰ	76.6	1.2
		147.2	2.4
	Test Ⅱ	196.98	2.7
		378.48	5.0

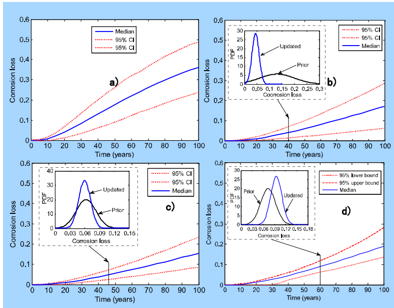
- Load testing directly represents structural stiffness
- Structural strength and stiffness, corrosion initial time, corrosion loss and other influencing factors can be regarded as the nodes in a network
- Bridge strength prediction method integrating the Bayesian network and load testing is proposed, and a Markov Chain Monte Carlo method is developed to implement the calculation process
- All the nodes can be updated given an observation for one node

---

Corrosion parameters updating



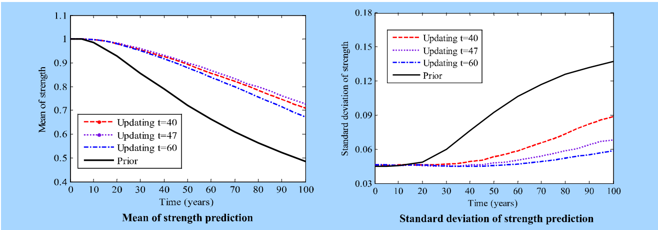
Updating results of the node *Ti* (corrosion initial time)



The node ρ (corrosion loss): a) prior ; b) 40 years; c) 47 years; d) 60 years

- The posterior mean of the corrosion initiation time increases from 4.62 years to 7.4 years
- The 95% confidence bounds and the variability are decreased

Structural strength updating



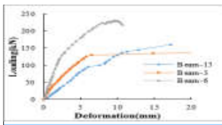
- A stable posterior mean strength prediction is obtained by the updating method
- The standard deviation decrease 34%, 49% and 53% with increasing updating times

Published paper: *Bridge remaining strength prediction integrated with Bayesian network and in-situ load testing. ASCE Journal of Bridge Engineering, 2014, doi: 10.1061/(ASCE)BE.1943-5592.0000611.*

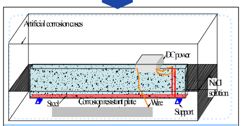
4 The theory and method of resistance enhancement

The experimental research of resistance enhancement

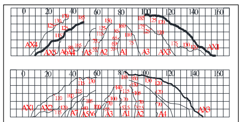
Strengthened using steel plate anchored with stud



Load-deflection curve



Corrosion after strengthening



Distribution of cracks

- The experimental research of 48 RC beams were carried out, the beams included strengthened beams after being corroded and corroded beams after being strengthened
- The influence of parameters such as concrete strength, plate thickness and cover thickness on resistance deterioration of tested beams was analyzed

The Theory and Method of Resistance Enhancement

Indirect cost model for resistance enhancement

Cost model of driver

$$E(C_{user,driver})=\sum_{i=1}^{N}\left[\sum_{h=1}^{H} w_h k_{hm} t_w l\left(\frac{1}{n_{hi}}-\frac{1}{n_h}\right)\right]\times\frac{1}{(1+r_d)^{t_i}}$$

Cost model of fuel consumption

$$E[C_{user,toll}]=\sum_{i=1}^{N}\left[\sum_{h=1}^{H}\frac{L_n m_h k_{hm} t_w (n_h-n_{hi})}{n_h}\right]\times\frac{1}{(1+r_d)^{t_i}}$$

Cost model of society

$$E(C_{society,acc})=\sum_{i=1}^{N}\left[\sum_{h=1}^{H} C_{ha} t_w (A_{ha}-A_h)\right]\times\frac{1}{(1+r_d)^{t_i}}$$

Technical features

- Different vehicle models
- Toll standard
- Traffic simulation

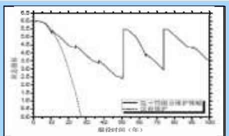
Cost constitute

- Toll loss
- Fuel cost
- Labor charge
- Traffic accident

- Optimized indirect cost models for toll loss, fuel cost, etc due to bridge resistance enhancement actions ;
- The influence of types of vehicle and drivers was considered

The Theory and Method of Resistance Enhancement

Probabilistic timing for reasonable resistance enhancement



Time and performance-controlled enhancement strategy

$$F_T(t)=P\left[\left(\beta(t)\le\beta_{target}\right)\cup\left(C(t)\le C_{target}\right)\right]$$

Probabilistic timing for resistance enhancement

Grouting treatment
Repairing concrete
Section enlargement method
Bonding steel plate

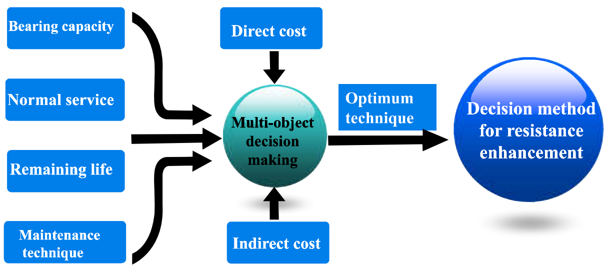
Enhancement technologies

Devices for enhancement

- Probabilistic method for resistance enhancement was developed
- Developing the resistance enhancement devices

The Theory and Method of Resistance Enhancement

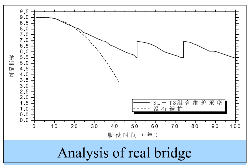
Multi-objective decision method for resistance enhancement

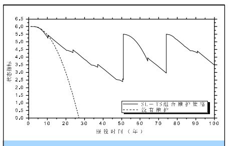


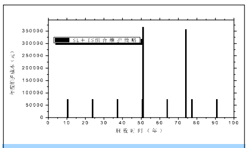
- Multi-object optimum decision method for resistance improvement was developed;
- An integral enhancement system of bridge performance-cost-enhancement action

The resistance enhancement of real bridge


Strengthening of real bridge


Analysis of real bridge


Analysis of condition index


Analysis of annual enhancement cost

5 Achievement Application

Popularization and application

Achievements application

- More than 50 papers were published at Journal of Structural Engineering , Structural Safety, Computers & Structures, Journal of Bridge Engineering, etc .
- Achievements have been widely applied for safety assessment and maintenance of more than 700 service bridges in Hunan province, and has reduced the removal bridge of more than 100 old bridges


Shuiduhe bridge in Changsha


Yuanjiazhong bridge in Guangxi


Zhangjiawan bridge in Yueyang

Main achievements

- "Concrete bridge service performance and residual life assessment method and its application ", hosted to get reward of second prize of the 2011 National Prize for Progress in Science and Technology
- "Evaluation of durability of concrete bridges theory and its applications", hosted to get reward of first prize of the 2010 Hunan Prize for Progress in Science and Technology
- "Time-dependent reliability analysis of existing reinforced concrete bridges and Study on Bearing Capacity evaluation", hosted to get reward of second prize of the 2004 Hunan Prize for Progress in Science and Technology
- "Structural reliability theory and its application in highway engineering", hosted to get reward of second prize of the 1999 Hunan Prize for Progress in Science and Technology

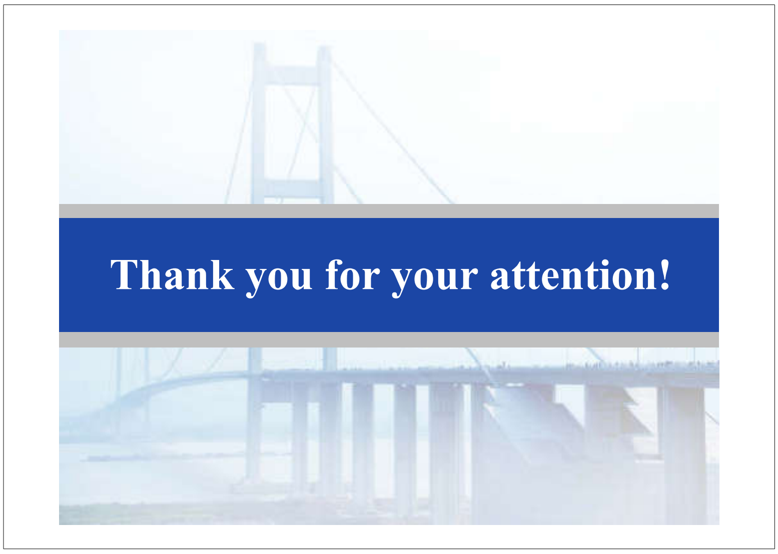
Acknowledgements

Supported by the following Grants

Project	Name
National Natural Science Foundation of China	Influence of repair strategy on the effect of time-dependent reliability of RC beam bridge (51178060)
National Natural Science Foundation of China	Degradation model of shear performance of existing RC bridge component and its reliability (50878031)
National Natural Science Foundation of China	Time - dependent reliability of existing reinforced concrete bridges (50478032)
National Natural Science Foundation of China	Dynamic reliability of long - span concrete cable-stayed bridge during construction (50178011)
National Natural Science Foundation of China	Mechanism and reliability assessment of bridge cable damage under Corrosion fatigue coupling (51478050)
Key basic research project of Ministry of Transportation	wind, rain monitoring and simulation of long-span bridge (2011318824140)
Western research projects of Ministry of Transportation	Residual life prediction method of concrete bridge(200631800019)
Basic application research projects of Ministry of Transportation	Probabilistic model of resistance deterioration of existing concrete bridge components (200431982514)
Basic application research projects of Hunan province	Evaluation of durability for concrete bridges (06FJ2008)

Conclusion

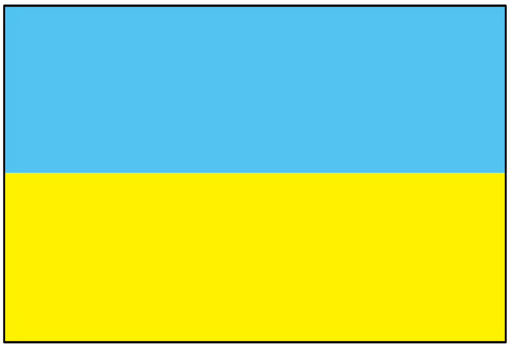
Research group of safety and durability assessment of bridge at Changsha University of Science and Technology has worked on structural deterioration of bridges, Assessment of time-dependent reliability and optimization of resistance Enhancement, and carried out a large number of experiments and theoretical analysis in the field. We hope that we can work with bridge mates from overall the world to protect the safety of deteriorating bridges together !


Thank you for your attention!

ICHARM's Practices of Flood Hazard and Risk Assessment

GUSYEV, Maksym

ICHARM, Public Works Research Institute, MLIT, JAPAN
UKRANE



INTERNATIONAL WORKSHOP ON DISASTER MANAGEMENT FOR ROADS
May 31, 2017@Tokyo

A Methodology for Emergency Response Decision-Makings with the Consideration of Unexpected Contingencies

Masamitsu Onishi
Disaster Prevention Research Institute, Kyoto University
&
Katsumi Seki, Katsumi Wakigawa, Kiyoshi Kobayashi

1

はじめに Introduction

東日本大震災を受けての
土木学会長・地盤工学会長・日本都市計画学会長
共同緊急声明

今回の震災は、古今未曾有であり、想定外であると言われる。われわれが想定外という言葉を使うとき、専門家としての言い訳や弁解であってはならない。このような巨大地震に対しては、先人がなされたように、自然の脅威に畏れの念を持ち、ハード(防災施設)のみならずソフトも組み合せた対応という視点が重要であることを、あらためて確認すべきである。

Joint Statement by the Presidents of JSCE, JGS and CPIJ after the Great East Japan Earthquake

This earthquake disaster is said to be unprecedented and beyond expectation. However, when we use the term 'beyond expectation', it must not mean an excuse as professionals. For such a catastrophic disaster, we should reconfirm the importance of soft policy as well as hard policy (e.g. building facilities), holding awe for nature as our ancestors did.

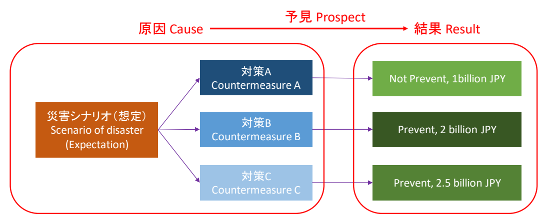
2

想定の必要性
Why an expectation is needed?

- 公共的意思決定としての災害対策
  Disaster countermeasures as public decision-making
- 公共的意思決定に求められる説明責任
  Accountability required for public decision-making
- 因果関係に基づく近代合理主義
  Modern rationalism based on causality relationship

3

予見に基づく対策案の選択
Selection of Countermeasure Based on Prospect



4

想定の要件
Requirements for Expectation

- 災害現象に関する専門家の分析
  Analysis by professionals on disasters' physical phenomena
- 経験を踏まえた社会による受容可能性
  Acceptability by society based on experience
  - 想定として既往最大がしばしば用いられる
    The maximum experienced level is often employed as an expectation.
- 社会的合意としての想定
  Expectation as a social consensus

5

認識としての想定
Expectation as a Recognition

6

想定の壁
A Wall of Expectation

想定の外　Outside of Expectation

7

防災から減災へ
From Disaster Prevention to Disaster Reduction

- 想定内の災害シナリオに対しては，完全に防御できる.
  Disaster scenario with in the expectation can be prevented.
- 安全神話
  A myth of safety
- 想定外リスクの可能性は排除できない.
  Risk of beyond expectation cannot be excluded.
- 完全には防御できないことを前提にどうすべきか？→**減災**
  On the premise that we cannot protect from disaster perfectly, how should we do?
  →**Disaster Reduction**

8

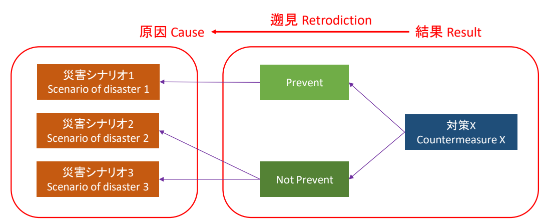
減災計画論に向けて
Toward the Disaster Reduction Approach

選択された対策（基本対策）は，想定外のいかなるシナリオまで対応できるのか？
What disaster scenarios of outside the expectation can be dealt with by a selected basic countermeasure?

対応できないシナリオに対しては，どのような対策案があり得るのか？
What alternatives are available to deal with scenarios which the basic scenario cannot cope with?

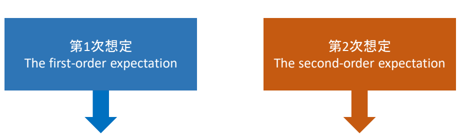
9

災害対策の能力評価
Capability Assessment of Basic Countermeasure



10

重層的防御
Multi-layered Countermeasures

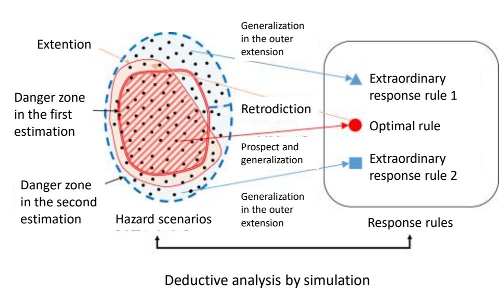


基本対策検討のための想定
Expectation for selecting a basic countermeasure

非常時対策検討のための想定
Expectation for selecting emergency countermeasures

11

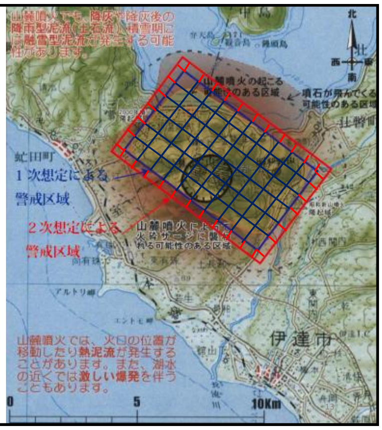
Identification of Extention by Retrodiction and Generalization



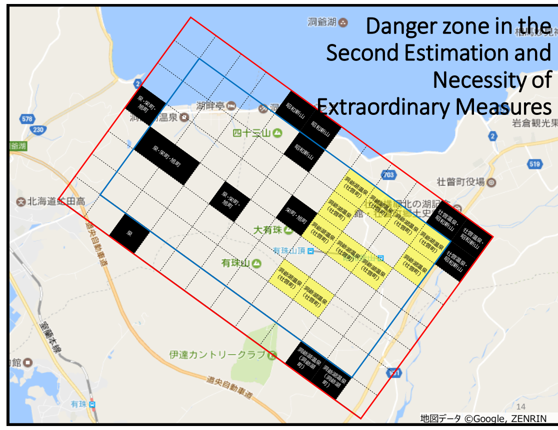
12

Split the danger zone in the first estimation into 60 meshes

Set the danger zone in the second estimation around the one in the first estimation



Danger zone in the Second Estimation and Necessity of Extraordinary Measures



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おわりに
Conclusion

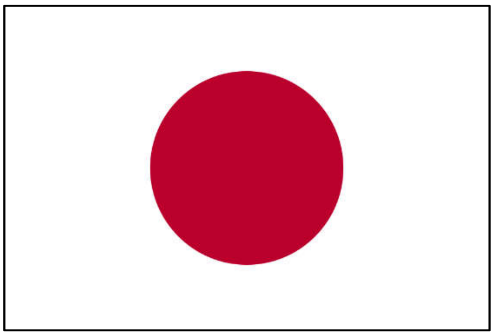
- 想定は基本対策のための社会的コンセンサス（＝第1次想定）
  Expectation is a social consensus for selecting a basic countermeasure (=the first-order expectation)
- 第2次想定まで含めた第1次想定を超える基本対策で対応できない災害シナリオ（想定外リスク事象）と対応する非常時対策の検討
  By extending to the second-order expectation, identifying disaster scenarios that a basic countermeasure cannot cope with (i.e., the risk of unexpected) and consideration of emergency countermeasures.
- 重層的対応システムの必要性
  Necessity of multi-layered countermeasure system

15

Development of the Web-based Disaster Management Manual

UNO, Takumi

Hanshin Expressway
JAPAN



ICHARM's Practices of Flood Hazard and Risk Assessment

International Workshop
on Disaster Management for Roads

M. Gusyev, Y. Tokunaga and K. Miyake
International Centre for Water Hazard and Risk Management (ICHARM) under auspices of UNESCO, Public Works Research Institute (PWRI)

31st May 2017
Tokyo

ICHARM 1

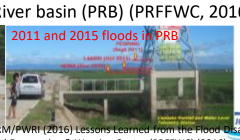
Outline

ICHARM 2

Flood disasters overview

Floods are devastating disasters causing major economic damages and losses of lives:

- *Australia:* Dec 2010-Jan 2011 flood in Brisbane;
- *Thailand*: Sep-Dec 2011 flood with about $40 billion in economic damage due to 5 typhoons from June to October (ICHARM/PWRI, 2016);
- *Pakistan*: July 2010 and August 2013 floods;
- *Russia and China*: August 2013 flood in the Amur River basin flooding major cities (SHI,2017);
- *Myanmar*: July – September 2015 flood;
- *Philippines*: Sep 2011, & Nov and Dec 2015 floods in Pampanga River basin (PRB) (PRFFWC, 2016).



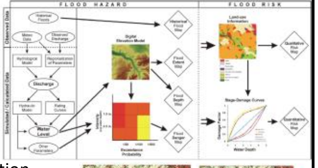
Reference: Russian State Hydrological Institute (SHI) (2017); ICHARM/PWRI (2016) Lessons Learned from the Flood Disaster in Industrial Estates/Parks/Zones in Thailand; Pampanga River Flood Forecasting & Warning Centre (PRFFWC) (2016)

ICHARM 3

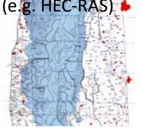
Flood hazard and risk mapping in US and EU

- Community based
- Past Event : display past flood event (e.g. remote sensing)
- Simulation model based

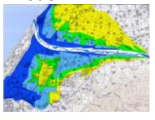
2D hydraulic model for diffusive-type inundation

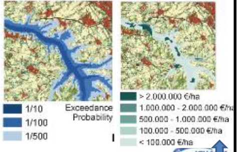


1D hydraulic model (e.g. HEC-RAS)



+ 2D inundation model





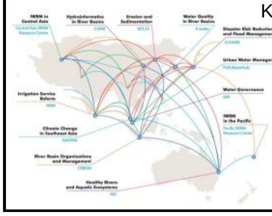
Reference: Moel, *et al.* 2009

ICHARM 4

ICHARM as a regional knowledge hub

- In 2006, ICHARM was established as UNSECO Category 2 Center.
- In 2007, ICHARM acted as Lead Organization for priority theme "Water-related Disaster Management" in the 1st Asia-Pacific Water (APWS) Summit and Regional Knowledge Hubs established.

Regional Knowledge Hubs

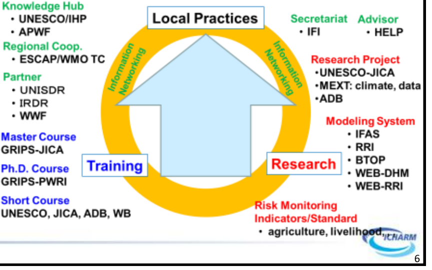


ICHARM 5

ICHARM's activities and challenges

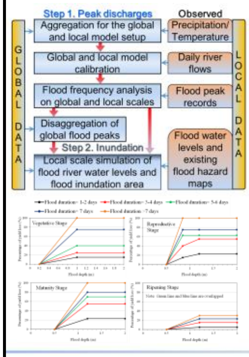
ICHARM's Challenge: **Localism**

Delivering best available knowledge to local practices



ICHARM 6

Flood hazard and risk assessment



Risk = Hazard x Vulnerability

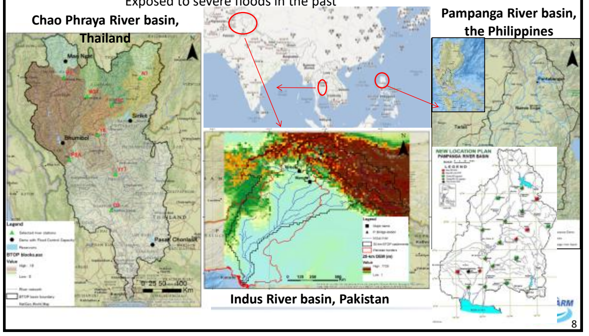
- Local data are usually unavailable.
- Models are constructed with globally available datasets such as satellite based topography and rainfall and inundation simulations are compared with satellite images of flood extent.
- Flood river discharge and inundation depth are calibrated with local data collected during field surveys to include road planning and design of road facilities, embankment, etc.
- Vulnerability (or fragility) curves are developed using collected damage data of past floods.

Reference: Gusyev, *et al.* 2016; Shrestha et al. 2016

7

Examples of ICHARM's flood assessment

Common features: Dam infrastructure is main source of water supply
Agriculture is a main economic activity during dry/wet seasons
Exposed to severe floods in the past



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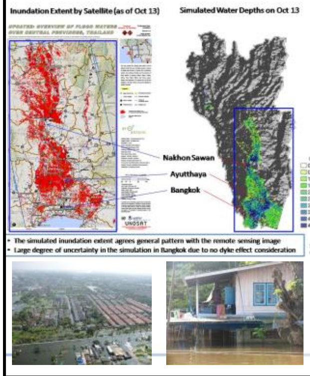
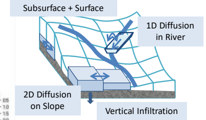
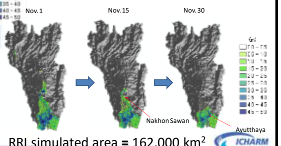
2011 Thailand flood hazard simulations



Flood discharge and inundation simulations with Rainfall-Runoff-Inundation (RRI) model

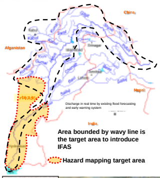




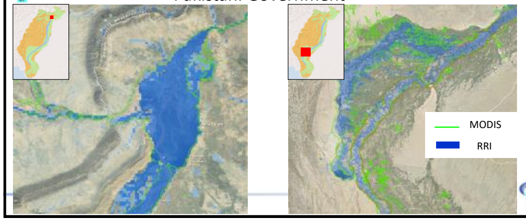
RRI simulated area = 162,000 km^2

9

2010 Pakistan flood hazard simulation



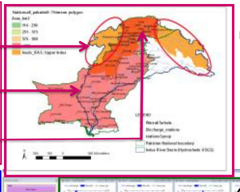
- 2010 flood damages of about 40 billion USD
- Infrastructure damages of 1.1 billion USD with about 25,000 km of roads and 1,600 railroads
- Preparation of hazard map using satellite data
- Cover flooded area in Lower Indus
- Developed Indus-IFAS with collaborating Pakistani Government



10

Indus-IFAS for UNESCO-Pakistan project

INPUT DATA CHALLENGES:
- *Lack of transboundary data*
- *Null-Low rain gauges network density*
- *Uncertainty on snowmelt*



SUPARCO

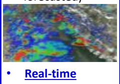
Inundation area by RRI

FLOOD HAZARD MAPPING

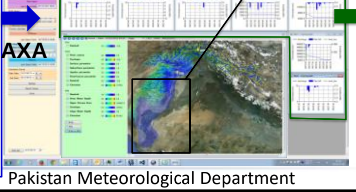
OUTPUT DATA:
- Rainfall distribution maps
- Hydro-graphs at specified locations
- Inundation extents in mid-low Indus

INPUT DATA :
- Rainfall data (ground- gauges, GSMaP, forecasted)

JAXA



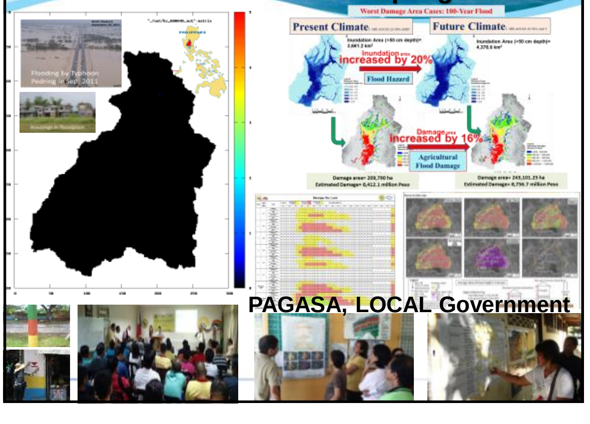
- Real-time observed discharges



Pakistan Meteorological Department

11

Flood Risk Assessment in Pampanga Basin



PAGASA, LOCAL Government


Thank you very much for your attention!
Mt. Tsukuba and ICHARM

Development of the Web-based Disaster Management Manual

May 31st, 2017
Tokyo, JAPAN
TCE.3, PIARC

Shinjuro KOMATA

Nippon Koei Co., Ltd. JAPAN

Contents

1. What's Risk Management Manual?

1) Objective (1)

RM - Manual:

The knowledge database designed to introduce and share the risk management techniques, and their practices among PIARC countries :

1) Objective (2)

- ***Introduction of RM techniques to the road sector systematically***
- ***Popularization of the road RM technology in developing countries***
- ***Utilization of RM-Manual as a common property of PIARC***

2) System of Web-based RM-Manual

/ *Designed by* ***Web-application****: Drupal, mySQL Database*

/ version : Easy PHP 5.3.5.0
/ Web server: Apache 2.2.17
/ language: PHP 5.3.5
/ database: MySQL 5.1.54
/ content management system : Drupal 7

/ *Using a Web-application provides an* ***easy, centralized always accessible****, and* ***uncomplicated method***

for PIARC TC members** to **contribute *risk management techniques and examples to the database*

2. Characteristics of Web-based RM-Manual

1) *Point and click directly:*

/**To show components** in the RM-Manual database such as Toolbox with Inventory sheets and Archives **by point and click directly.**

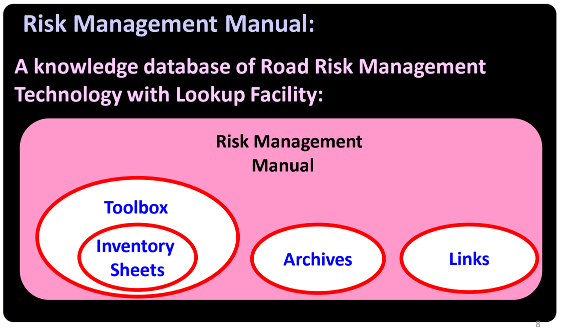
2) Search function:

/**To search subjects both in the RM-manual and in other external Websites** to link to a searchable risk management database such as technical standards, technical papers, etc.

3) Building continually:

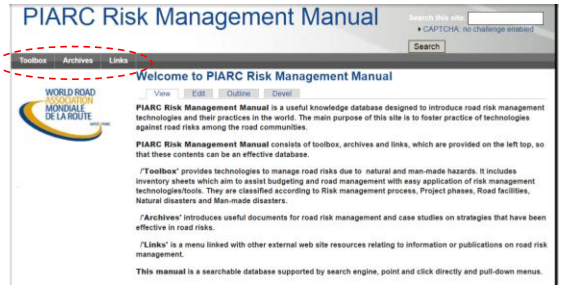
/**To continue building a vibrant Website** for road communities.

3. Components of RM- Manual



3. Components of RM- Manual

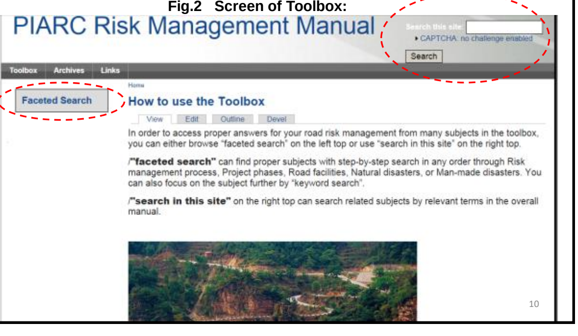
Fig.1 Start screen of Risk Management Manual:



4. Functions of Components

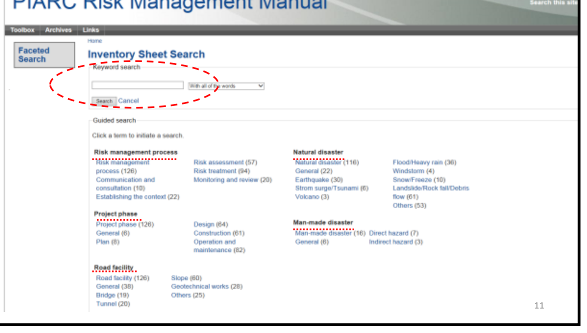
1) Toolbox(1)

Fig.2 Screen of Toolbox:

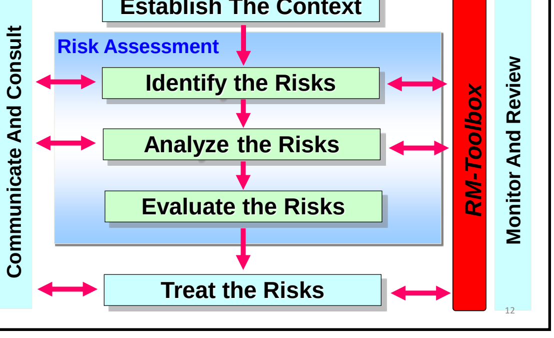


1) Toolbox(2): Faceted Search

Fig.3 Screen of Faceted Search:



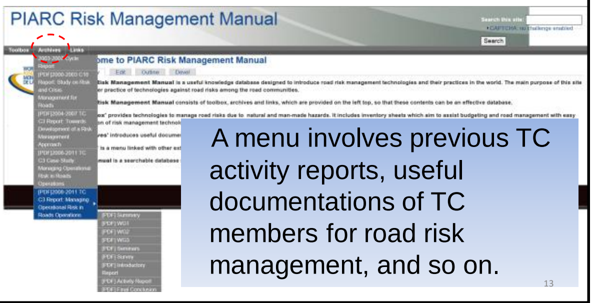
Relation RM Process/Toolbox



4. Functions of Components

2) Archives

Fig.4 Screen of Archives:

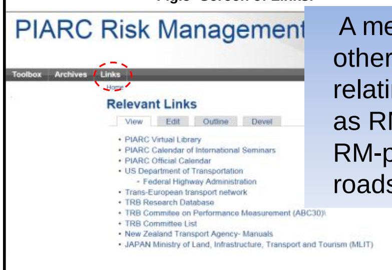


A menu involves previous TC activity reports, useful documentations of TC members for road risk management, and so on.

4. Functions of Components

3) Links

Fig.5 Screen of Links:



A menu linked with other web sites relating to RM such as RM-manuals and RM-publications for roads.

5. Inventory Sheets in Toolbox

- Easy application of RM technologies/tools to assist budgeting and road management
- The participating countries can use it as common property
- To promote individual technologies/tools of RM in developing countries

Inventory sheets *include 126 contents/elements*

Natural disaster Inventory Sheets

Natural events:

Earthquake, Storm surge/tsunami, Volcano, Flood/Heavy rain, Windstorm, Snow/Freeze, Landslide/Rock fall/Debris flow, and Others

Man-made disaster Inventory Sheets

Probability of Road accidents:

（Example: Traffic accident, dangerous goods transport, overloading vehicles, Tunnel fire etc）

Other events:

（Example: Closure of road due to explosion in the factories near road, fire, effect of nuclear accident, terrorism, war etc)

Example of Risk Inventory Sheet

Fig.6 Road disaster prevention hazard map using GIS.

Inventory Sheet 3

Technology/Method	Road disaster hazard map
Risk management process	Risk assessment
Project phase	Plan/operation and maintenance
Road facility	Slope/Geotechnical works
Natural disaster	general
Man-made disaster	-

Technical summary

Road disaster hazard maps summarize road disaster potential along roads. The locations, frequencies and stricken areas of various kinds of disaster along the road must be indicated on the map. The map forms the basis of risk management for road disaster reduction. It is advisable that the map be prepared to cover earthquakes, heavy rainfall, and landslides.

Effect

Road disaster hazard maps are widely available for crisis management, such as for the minimization of disaster damages related to transportation. Information on the maps about potential disaster spots helps administrators apply effective management. Above all, the maps facilitate timely treatment and restoration of roads following disasters.

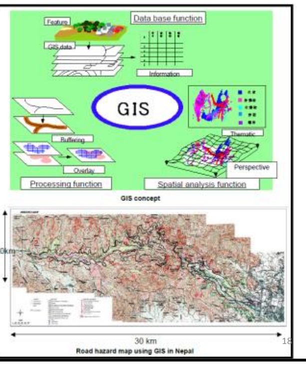
Considerations

Risk evaluation must be based on the damage and probability of road disaster for each of a range of disaster phenomena. Risk factors must be considered in the preparation of road disaster hazard map. GIS applications for the preparation and updating of hazard are particularly useful for sharing management knowledge on road disaster reduction.

Cost/resources 300 km2 each

Productivity (M/M)	Snr Enginee	Engineers	Staff
Site investigation	0.5	0.5	
Aerial photo observation	1.0	1.0	
Data inputting			1.0
Total	1.5	1.5	1.0

Basis of productivity:With the result in Japan calculation.



Example of Risk Inventory Sheet

Fig.7 Interpretation of aerial photographs.

Inventory Sheet 16

Technology/Method	Interpretation of aerial photographs
Risk management process	Establishing the context/Risk assessment
Project phase	Plan/Operation and maintenance
Road facility	General/Slope
Natural disaster	Volcano/Slide/Others(faults, soft ground)
Man-made disaster	-

Technical summary

Interpretation of aerial photographs is a survey method in which partly overlapping aerial photographs are viewed with a stereoscope and interpreted. Without going to the site, much topographical information can be obtained, and locations along the road that are danger points for rock and soil avalanches can be identified. The viewpoint can be from several hundred to several km in the air, so topography that can cause road disasters or lineaments that cannot be verified from the ground and other macroscopic features can be observed.

Effect

If interpretation of aerial photographs is done in conjunction with interpretation of topographical maps, vegetation and soil use can be read also, and the overall topographical condition and changes with time can be interpreted in a short time.
The range of application of interpretation of aerial photographs is wide, including the interpretation or inference of landslips, slope collapse, landslides, and other topographical features, to faults, folds, soil distribution, old water courses, and other microtopography.

Considerations

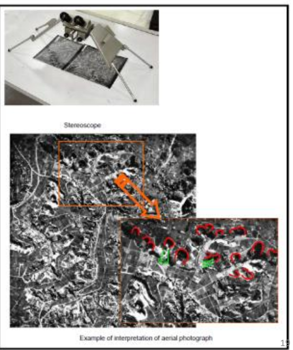
It is important to pay attention to the scale and quality of the photograph with reference to the purpose of the interpretation. Also, the quality of the results of the interpretation are greatly dependant upon the skill of the interpreter, so it is important that experienced interpreters carry out the interpretation. In order to minimize this error, the AHP method has recently been introduced.

Cost/resources

	Chief engineer	Engineer	Technician	Total	Unit
Interpretation	3.0	5.0	-	8.0	Person.day
Total	3.0	5.0	0.0	8.0	Person.day

* Unit price per 10km using package software
* Varies depending upon the complexity of the model

Cost basis: Derived by reference to "All-Japan Standard Cost Estimating Data", Japan Geotechnical Consultants Association



Example of Risk Inventory Sheet

Fig.8 Measurement of surface movement amount.

Inventory Sheet 39

Technology/Method	Measurement of surface movement amount
Risk management process	Risk assessment/Risk treatment
Project phase	Operation and maintenance
Road facility	Slope/Geotechnical works/Others(retaining wall, etc)
Natural disaster	Slide/Others(settlement, displacement)
Man-made disaster	-

Technical summary

This is the measurement of the amount of surface movement caused by cracks in road slopes or natural slopes. Measurement of the amount of surface movement is done by installing movement/displacement piles on either side of the crack, and monitoring the distance between the 2 points with time. Piano or invar wire is used for the measurement. The measurement results are plotted on a graph with displacement amount on the vertical axis and time on the horizontal axis. With this method, an extensometer is frequently used to measure the amount of landslip movement. Also, when it is necessary to simply determine the condition of movement of a soil mass, a measurement method using a brace board is used.

Effect

The measurement principle is simple, installation of the measurement equipment is easy, and the measurements can be made at relatively low cost and rapidly. Also, it can be used for large displacements. These monitoring results can be used for determining the mechanisms of slope movement and to set criteria for road operation such as road closures and road re-opening, etc.

Considerations

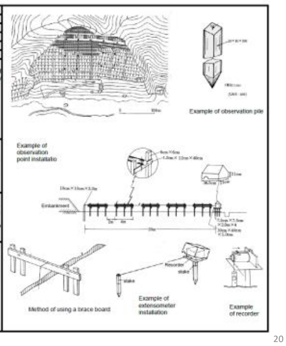
It is desirable that the distance between measurements is about 10 m. For distances greater than this it is desirable that an electronic distance meter be used. By setting the distance between measurements at about 10 m, the measurement results can be used for the strain rate. For measuring distances greater than 10 m it is necessary to install several piles in series.

Cost/resources

	Chief engineer	Engineer	Technician	Total	Units
Installation	0.0	0.5	2.0	2.5	Person.day
Measurement	0.0	0.5	0.5	1.0	Person.day
Total	0.0	1.0	2.5	3.5	Person.day

* Per 1 measurement line

Cost basis: Derived by reference to "All-Japan Standard Cost Estimating Data", Japan Geotechnical



Example of Risk Inventory Sheet

Fig.9 Earth removal work.

Inventory Sheet 72

Technology/Method	Earth removal work
Risk management process	Risk treatment
Project phase	Design/Construction
Road facility	Slope
Natural disaster	Earthquake/Heavy rain/Slide
Man-made disaster	-

Technical summary

When soil is removed from the top of an unstable soil mass in a landslip or unstable slope, the factor of safety increases. This is because normally the top part of an unstable soil mass makes a big contribution to starting a slip, but its contribution to the resisting force is almost negligible.

Effect

The stability of the slope is increased greatly with only earthworks.

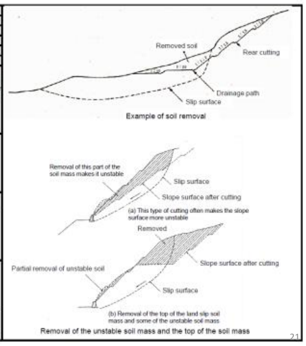
Considerations

Negotiations are needed to buy the land for the cutting. Also, when there are flowing foundation slopes or other structural causes, a cutting can cause another unstable soil mass, so it is necessary to study this in advance.

Cost/resources

Per 1m3 1000～2000 yen

Cost basis: Calculated by reference to Civil engineering cost estimating criteria manual, Kensetsu Bukka Chousa Kai



Example of Risk Inventory Sheet

Fig.10 Slope framework.

Inventory Sheet 68

Technology/Method	Slope framework
Risk management process	Risk treatment
Project phase	Design/Construction
Road facility	Slope
Natural disaster	Heavy rain/Windstorm/Snow/Slide/Others(erosion)
Man-made disaster	-

Technical summary

Slope framework construction is applicable to slopes for which vegetation is unsuitable or for which vegetation cannot assure long term stability. The shape is normally rectangular frames, so precast, in-situ poured concrete, or in-situ sprayed construction methods are used.

Effect

By changing the shape of a slope, slope framework has various uses, such as forming a foundation for vegetation, construction to restrain surface layer collapse, anchor pressure plates, etc. Slope framework generally does not have resistance to soil pressure, but those with large cross-section and weight or used with anchors can provide resistance to earth pressure. This method has great resistance to erosion, and if sprayed on site, can be constructed on unshaped slopes and has the advantage that slope drainage is not prevented.

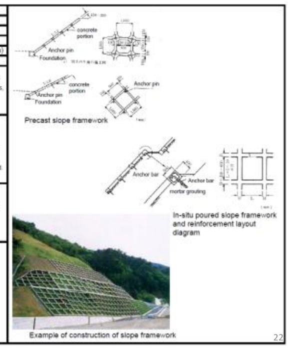
Considerations

For slope framework construction it is necessary to understand the characteristics of the construction location, and to consider the optimum construction method. The precasting, in-situ poured concrete, and in-situ sprayed methods each have their advantages and disadvantages. Also, it should be noted that when combined with drainage construction, vegetation, anchors, etc., their effect and range of application changes.

Cost/resources In-situ spraying 1,000m3

				Units
Framework	Slope cleaning, lath lining		1000	m2
	Lay slope framework		600.0	m
	Main anchors	D19×1.0m	60.0	No.
	10 - 20 million yen per location	Mortar spray	150.0	m3
Anchors	Excavation	115.0	900.0	m
	Insert & tension anchors and packing		40	No.
	Pouring concrete		30	m3
Temporary works			1	Set

Cost basis: Calculated based upon results within



Example of Risk Inventory Sheet

Fig.11 Daily visual inspection.

Inventory Sheet 6

Technology/Method	Daily visual inspection
Risk management process	Risk assessment/Risk treatment
Project phase	Operation and maintenance
Road facility	general
Natural disaster	general
Man-made disaster	-

Technical summary

The most effective monitoring method for road disaster management is visual inspection by daily patrol. The road manager's patrol car periodically circulates, and when precursor events that could lead to a disaster are discovered they take emergency action so that the disaster does not occur, thereby maintaining the traffic flow and realizing effective road disaster prevention measures. Also, if volunteer NPOs or road users participate in patrols, more detailed information can be obtained.

Effect

Slope disasters such as slope failure and settlement of embankments are often preceded by small deformations that act as signals. By the patrolmen detecting these warning symptoms, damage to road traffic is maintained to a minimum, and by taking suitable measures before collapse occurs, more economical and efficient measures can be taken.

Considerations

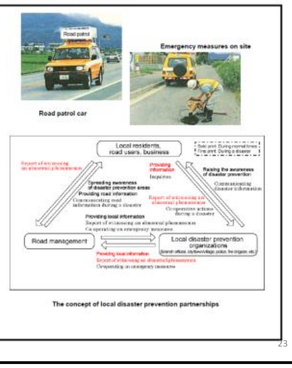
It is necessary that the patrol personnel have a wide range of knowledge of the road and disasters to perform visual inspection in the daily patrols. Therefore it is very important to introduce an education and training system for road disaster prevention for the patrol personnel. Also, the information provided by ordinary road users is important, so a structure to suit the road characteristics should be created.

Cost/resources

	(Patrol personnel)	(Total)	(Unit)
Patrol	2.0	2.0	Person days
Total	2.0	2.0	

2 persons, 1 group, 30km/day

Cost basis: Derived by reference to "Standard Cost Estimating Data for Design Work", Ministry of Land, Infrastructure and Transport



Example of Risk Inventory Sheet

Fig.12 Visual observation of structure surface.

Inventory Sheet 34

Technology/Method	Visual observation of structure surface
Risk management process	Risk assessment/Risk treatment
Project phase	Operation and maintenance
Road facility	Bridge/tunnel/Others(retaining wall, etc)
Natural disaster	Slide/Others(deformation, degradation, etc)
Man-made disaster	-

Technical summary

In road disaster prevention management, the symptoms of large scale landslides often appear in retaining walls and other existing structures. Visual observation is the most fundamental structural survey, and is the most simple survey for detecting the total picture of structural deformation and degradation. Surface degradation, corrosion, cracking, water leakage, deformation, change of color, etc., can be confirmed by visual observation. Hence crack scale gauges are provided for the engineer on site.

Effect

Visual inspection by an experienced engineer is effective for detecting the symptoms that can lead to a major collapse. The cost of countermeasures against collapse can be kept very low if implemented before failure. From the distribution of deformation or the appearance of a structure, the cause and nature of deformation or degradation can be inferred.

Considerations

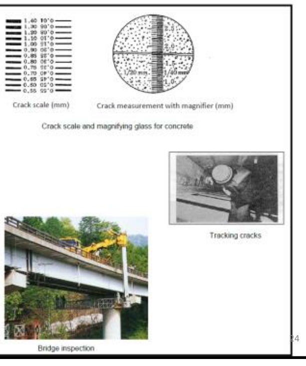
Visual observation is only capable of detecting deformation that appears on the surface. In visual inspection, cracking and other changes with time can be detected, and it is important to evaluate such changes in relation to rainfall amount etc.

Cost/resources

	Chief engineer	Engineer	Technician	Total	Units
Bridge inspection	0.0	0.5	0.5	1.0	Person.day
Tunnel inspection	0.0	0.5	0.5	1.0	Person.day
Retaining wall	0.0	0.3	0.3	0.6	Person.day

* Per 100 m length

Cost basis: Calculated based upon the results from within Japan



Example of Risk Inventory Sheet

Fig.13 Tunnel inspection using a laser scanner.

Inventory Sheet 35

Technology/Method	Optical scanning of structure surface
Risk management process	Risk assessment/Risk treatment
Project phase	Operation and maintenance
Road facility	Tunnel
Natural disaster	Slide/Others(deformation, degradation, etc)
Man-made disaster	-

Technical summary

Optical scanning is carried out in tunnels and other structures important for road disaster prevention management to detect surface degradation and deformation in the structure by optically scanning the concrete surface.

Effect

As this is a non-destructive method, it does not harm the structure and can be easily carried out.

Considerations

The equipment for scanning can be expensive. Also, there is a limit to the depth that degradation can be detected, so it is necessary to combine it with other inspection methods.

Cost/resources

	Chief engineer	Engineer	Technician	Total	Units
On site	0.0	1.0	1.0	2.0	Person.day
Reporting	0.0	1.0	1.0	2.0	Person.day
Total	0.0	2.0	2.0	4.0	Person.day

* Per 100㎡

Cost basis: Calculated based upon the results from within Japan

Inspection within a tunnel using a laser scanner

Inspection of road surface by laser scanner and scan image

Example of Risk Inventory Sheet

Fig.14 Evacuation guidance to mitigate tsunami disaster.

Inventory Sheet 61

Technology/Method	Evacuation guidance to mitigate tsunami disasters
Risk management process	Communication and consultation/Risk assessment/Risk treatment
Project phase	Operation and maintenance
Road facility	General
Natural disaster	Storm surge and tsunami
Man-made disaster	-

Technical summary

Whenever earthquake, tsunami, volcano, or other wide area disaster occurs, it is important to evacuate and provide guidance to those affected. If an evacuation and guidance system is prepared in advance the damage can be reduced and more certain evacuation is possible.

Effect

If the evacuation and guidance system is electronic it is more effective.

Considerations

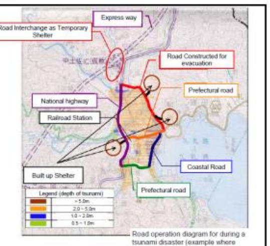
In areas where disasters are common, it is important to secure the refuge location in advance.

Cost/resources

Guidance for people: 100,000 - 1,000,000 yen
Evacuation and guidance system: 5 - 10 million yen

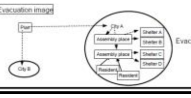
Cost basis: Calculated based on results within

Cost basis: Calculated by reference to Monthly cost estimating document, Keizai Chousa Kai Monthly construction costs, Kensetsu Bukka Chousa Kai Civil engineering cost estimating criteria manual, Kensetsu Bukka Chousa Kai Japan Roads Public Corporation Ccivil engineering cost estimating manual, Edited by Japan Roads Public Corporation
Design work standard cost estimating manual, Ministry of Land, Infrastructure and Transport All-Japan Standard Cost Estimating Data, Japan Geotechnical Consultants Association



Road operation diagram for during a tsunami disaster (example where tsunami damage is predicted)

Evacuation image



Evacuation, guidance image

Example of Risk Inventory Sheet

Fig.15 Tsunami signal planning.

Inventory Sheet 105

Technology/Method	Tsunami signal planning
Risk management process	Communication and consultation/Risk treatment
Project phase	Operation and maintenance
Road facility	General
Natural disaster	Storm surge and tsunami
Man-made disaster	-

Technical summary

Installation of 3 signposts to show the information about tsunami and the directions for escape in case of danger.
The same design is adopted for all the shelter places where there are no other guiding signposts.

Effect

It can lead people to safe shelter place fast.

Considerations

Uniform design is adopted for all the place.
Signposts need to be installed only after sufficient investigation for the proper place.

Cost/resources

Signs related to tsunami

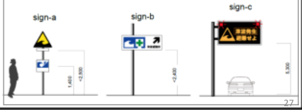
Tsunami — Shelter place — Place with high risk of tsunami

3 Signs for escaping Tsunami

a)Signpost showing danger
Able to sho characteristic of tidal wave and represent danger.

b)Signpost showing shelter
Should be able to convey the existence of shelter and the way to reach there.

c)Signpost showing the arrival of tsunami.
It should have the ability to communicate about the arrival of tsunami as early as possible.



Example of Risk Inventory Sheet

Fig.16 Bridge beam protective structures.

Inventory Sheet m9

Technology/Method	Bridge impact prevention measures
Risk management process	Risk treatment
Project phase	Operation and maintenance
Road facility	Bridge
Natural disaster	-
Man-made disaster	Indirect hazard

Technical summary

In locations where it is necessary to protect bridge beams from vehicles or similar due to insufficient clearance beneath the bridge deck, danger signs or bridge beam protective structures are installed to provide warning of the danger or to avoid direct impact with the deck.

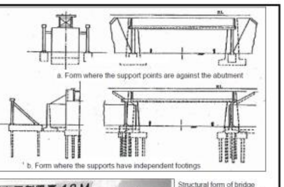
Effect

During design, bridges are normally designed to be safe against horizontal loads such as vehicle loads, earthquakes, and wind, but sideways vehicle impact is not considered. To protect bridge beams from such forces the height limit underneath the bridge is displayed to prevent direct impact with the bridge.

Considerations

• The closer the vehicle impact position is to the supports, the larger the load acting on the supports. Therefore the supports should be positioned so that the impact point is as near the center of the protective beam as possible.
• Support forms include types where the support point is positioned against the abutment, and where the support is supported on an independent footing (see the diagram to the right).

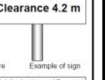
Risk optimization



a. Form where the support points are against the abutment

b. Form where the supports have independent footings

Structural form of bridge beam protective structures



Example of installation of bridge deck protective structure — Example of sign

Supervising editor: The Railways Bureau, Ministry of Land, Infrastructure and Transport

Example of Risk Inventory Sheet

Fig.17 Information Provision.

Technology/Method	Information Provision
Risk management process	Risk Treatment/Communication and Consultation
Project phase	Operation and maintenance
Road facility	General
Natural disaster	General
Man-made disaster	General

Technical summary

•Information dissemination at the time of disaster (Traffic restriction and traffic regulation information) directs the road user to the appropriate detour and prevents from needless trip.
•For metropolitan area with heavy traffic volume, provision of disaster information is inevitable in order to reduce the possible secondary disaster due to congestion. This type of information will reduce the overall traffic disaster.

Effect

•Prevention of secondary disaster due to information dissemination
•Alleviation of traffic congestion by reducing the non-emergency traffic and backtracking traffic.

Considerations

•Information collected from road administrator patrol, camera, and various sensor information are considered as means of collection of disaster information.
•Because the accuracy of information is not guaranteed, the report from the road user requires further investigation.
•The information board set up on the road, home and office internet, cellular phone and radio are considered as the dissemination of disaster information.

Cost/resources — note: approximate cost

•Center server:¥1,000,000
•Development cost for information provision software: ¥1,000,000
•WWW server:¥100,000 per month

Conceptual diagram of information provision

Example of information provision in case of disaster in Japan

Shiribeshi Area(Hokkaido) winter road information
*Snow damage information
*Weather warming
*Live camera information
*Road regulation information etc.

National Road #19 information
*Operated by nonprofit organization
*Message board style
*Information is available and writable on mobile phone and PC.

Usage Example: In case of slope failure

Establish The Context

1. Define the basic parameters.
2. Consideration must be given to the objectives, stakeholder expectations.

- Site Location
- Natural Event
- Risk Criteria

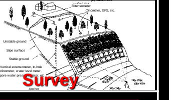
Search keywords

Disaster slope failure inspection

Relation RM Process/ Toolbox 31/37

Identify the Risk

Data/Information Collection	Disaster history, Weather Information Inspection ･･･ Visual inspection, etc･･･
Source Identification	Measurement management system, etc…
Identify the Risk	



Number	No.1	No.2
Name	R15 Site A	R15 Site B
Described	Rock fall	Landslide
Status	Emerging	Live

31

Relation RM Process/ Toolbox 25/37

Analyse Risks

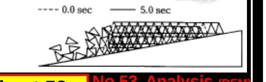
Rating the Likelihood

Likelihood	No.1	No.2
Threat	Rating 5	Rating 1
Opportunity	Rating 1	Rating 4

Inventory Sheet 3,15･･･

Rating the Consequence

Consequence	No.1	No.2
Threat	Rating 100	Rating -10
Opportunity	Rating 10	Rating -70



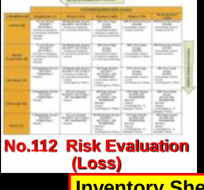
Inventory Sheet 53…

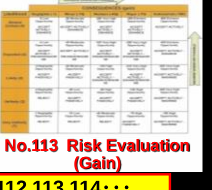
32

Relation RM Process/ Toolbox 33/37

Evaluating the Risks

		No.1	No.2
Threat	Risk Score	500	10
	Risk Category	Extreme	High
	Risk Ranking	1	2
Opportunity	Risk Score	-10	-280
	Risk Category	Low	Very High
	Risk Ranking	2	1


No.112 Risk Evaluation (Loss)


No.113 Risk Evaluation (Gain)

Inventory Sheet 112,113,114･･･

33

Relation RM Process/ Toolbox 34/37

Treat the Risks

1. The selection of a treatment type
2. The identification of treatment actions


No.68 Slope countermeasure

No.108 Bypass Tunnel

Inventory Sheet 68,108 ･･･

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6. Towards RM-Manual Completion 35/37

6. Towards RM-Manual Completion

1) Goal:
/ PIARC association's web-based knowledge data base
/ Release to PIARC web-site by the end of current cycle, 2019

2) TCE.3 member's contribution useful contents to the RM-Manual continually:
/ RM information, topics, and articles
/ Inventory sheet, / RM manual,
/ Case studies on techniques for managing risks of natural/man-made hazards including adaptation to the climate change effects.

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Summary 36/37

Summary

1. What's Risk Management Manual ?
2. Characteristics of Web-based RM-Manual
3. Components of RM-Manual
4. Functions of Components (Toolbox, Archives, and Links)
5. Inventory Sheets in Toolbox
6. Conclusion

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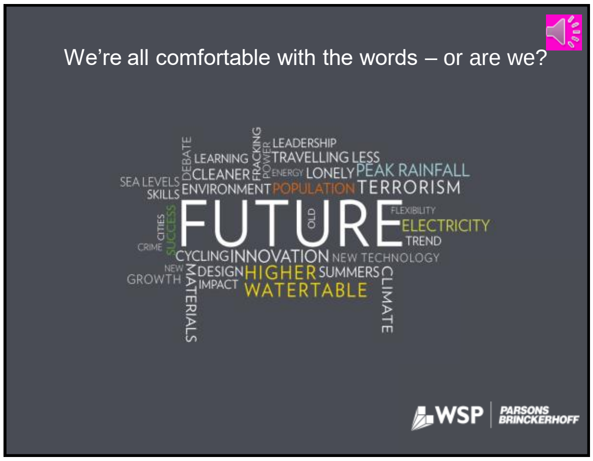
Thank you !

‘Future Ready’ impacts and what they mean to our Highway Networks

ELLIOTT, James

ELLIOTT ASSETT MANAGEMENT
U.K.


'Future Ready' impacts and what they mean to our Highway Networks
James Elliott, Director
Elliott Asset Management
United Kingdom
WRA Conference
May 2017
WSP | PARSONS BRINCKERHOFF


We're all comfortable with the words – or are we?
FUTURE
LEADERSHIP
LEARNING
TRAVELLING LESS
CLEANER
ENERGY
LONELY
PEAK RAINFALL
SEA LEVELS
SKILLS
ENVIRONMENT
POPULATION
TERRORISM
DEBATE
FRACKING
POWER
FLEXIBILITY
ELECTRICITY
TREND
CITIES
SUCCESS
OLD
CRIME
CYCLING
INNOVATION
NEW TECHNOLOGY
NEW
GROWTH
DESIGN
HIGHER
SUMMERS
IMPACT
WATERTABLE
MATERIALS
CLIMATE
WSP | PARSONS BRINCKERHOFF


FORECAST FUTURE TRENDS – BY 2050
Peak rainfall
20%
by 2050
Watertable
Rising
Locally?
Sea Levels
30cm
by 2050
Summers
Security
Higher risk of terrorism, less crime
Technology
More, Flexibility
WSP | PARSONS BRINCKERHOFF


Glasgow University
GLOBAL
KEY TREND
Weather
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Drought
Hot dry spell
Snow and low temperatures
Strong winds
Heavy rainfall / flooding
Unprecedented weather and network risks
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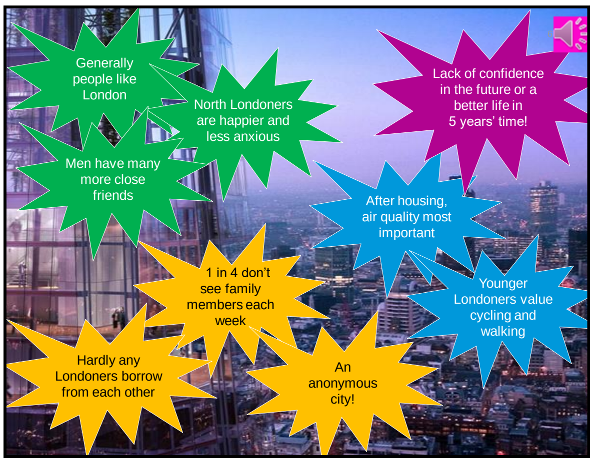
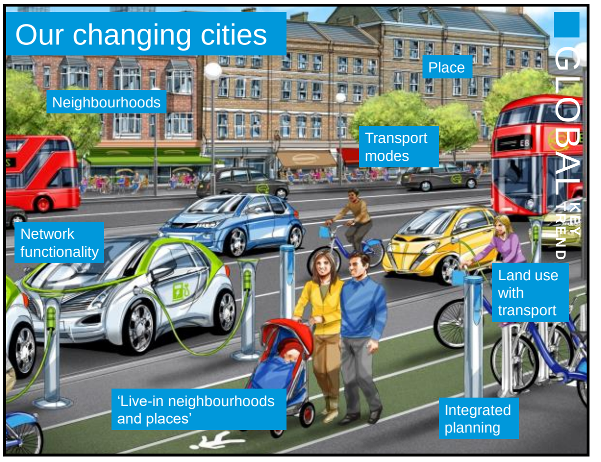
GLOBAL
KEY TREND
It's all about PEOPLE
• Demographics
• Mobility
• Lifestyle
• Loneliness
• Future Generations


Generally people like London
North Londoners are happier and less anxious
Men have many more close friends
Lack of confidence in the future or a better life in 5 years' time!
After housing, air quality most important
1 in 4 don't see family members each week
Younger Londoners value cycling and walking
Hardly any Londoners borrow from each other
An anonymous city!

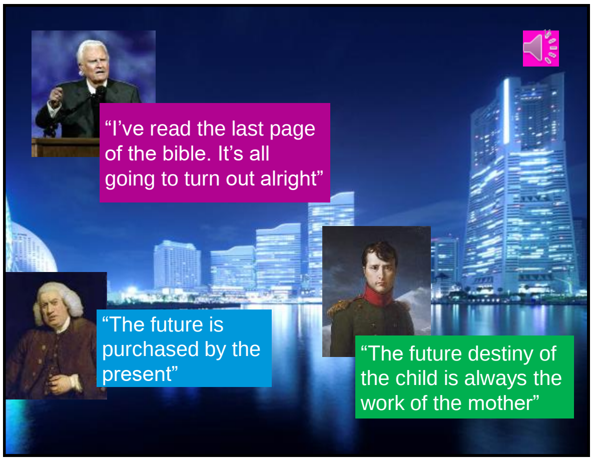


CONCLUSION – WHAT SHOULD WE BE DOING

- Understand the future: not just for us but for future generations
- Understand the impacts arising from Society, Technology, Resources and Climate
- Have a clear and consistent view about what our future world will look like. Engagement is critical
- With this understanding our challenge is to design our networks to both current code and our future world

WHAT ELSE SHOULD WE BE DOING

- Everyone should have a 'Future Ready' change programme
- Use your data and if it isn't good enough commission more data but share it to predict the impacts
- Make Future Ready a key focus for highway infrastructure
- In particular understand 'people' changes and impacts to our networks



ARE YOU READY FOR FUTURE READY?

james@elliottassetmanagement.com


Future Ready
https://youtu.be/W72tRlBB6hk
WSP PARSONS BRINCKERHOFF
@WSP_PB_UK

Closing Remarks

SEKIMOTO, Hiroshi	Executive director, Hanshin expressway
TAMURA, Keiichi	Chairman, TC E.3 PIARC Adjunct Professor, Kyoto University,

3. SEMINAR DISCUSSIONS

Opening Session 10:00-10:30

Session1 10:30-11:45

Efforts for Recovery of Roads from the 2016 Kumamoto Earthquake

Kazuhide Kiyasu, Japan

Q1

In my country (Czech Republic) we usually use temporary bridges to detour to avoid damaged bridges across the river. Do you use temporary bridges in Japan?

A1

In Japan we also use temporary bridges in some cases, but in Kumamoto case we decided to use the alternative road because the damaged area was quite wide. As for Aso-Bridge, it was not appropriate to use temporary bridges because of the bridge length and we decided to fully

Emergency Management and Resilience in Transportation

Herby Lissade, USA

Q1

In the case of disaster, it is necessary to recover the function of highway network quickly. At the same time we need to pay attention to bid rigging in procurement. Bid rigging would help procurement process to be shortened but it would not be the reason why bid rigging is justified in the disaster situation.

In Cartrans do you have any counter-measure to make public procurement quick and fair

A1

We've just checked how to make an emergency contract. We prepare $ 1.2 billion for an emergency contract for recovery works. We calculate the appropriate price with 20 – 30 % markup and confirm contractors in advance.

Federal Government also supervise the procurement process in order to prevent bid rigging. We can compare the price of the emergency contracts with that of past ordinary contracts.

Q2

Is it possible to share the assessment results using your evaluation tools?

A2

The tools which is produced by TRB are published for free via the website.

Japan International Cooperation Agency Technical Assistance on Road Disaster Risk Management to the Government of El Salvador

Milihiro Mori, Japan

Q1

The delay of recovery also causes the economic loss. In your method how do you consider the duration time for recovery works?

A1

I refer to research results by PWRI on days required for recovery works depending on the scale of slope damage. In my method economic loss per day is calculated based on traffic volume and detour and standby losses. Then I can calculate total economic loss by multiplying daily economic loss derived from my method by the duration of road closure.

Keynote Presentation 13:20-14:05

The Age of Mega Disaster and Risk Governance – Thinking Creative for Road and Other Infrastructures

Norio Okada, Japan

Session2 14:05-15:20

Strategy of the Use of Temporary Bridges in Crisis Situations

Jan Gruber, Czech Republic

Q&A NO

Disaster Management Using GIS Technology

Yukio Adachi, Japan et. al.

Q&A No

Prediction and Enhancement of resistance of RC Bridge during Service

Jianren Zhang, China

Q&A No

Session3 15:40-17:20

A Methodology for Emergency Response Decision-Makings with the Consideration of the

Unexpected Contingencies

Masamitsu Onishi, Japan et. al.

Q1

How do you expect and define the valuation of disaster.

A1

We need academic evidence for disaster expectation because it is really difficult to define it. Therefore risk communication between experts and public is important.

ICHARM's Practices of Flood Hazard and Risk Assessment

Maksym Gusyev, Ukraine et. al.

Q1

Is this method expensive?

A1

This is not expensive but it depends on the resolution of data.

Web-based Disaster Management Manual

Takumi Uno, Japan et. al.

Q&A No

Closing Session 17:20-17:30

4. Workshop Summary Sheet

1	PIARC Technical Committee	PIARC TC E.3 Disaster Management
2	Host country	Japan
3	Seminar title	International Workshop for Disaster Management for Roads
4	Seminar venue	Iidabashi Rainbow Building, Tokyo, Japan
5	Seminar dates	May 31, June 1-3, 2017
6	Number of speakers from lower middle income and low income countries	1 (UKR)
7	Number of speakers from upper middle income countries	1 (CHN)
8	Number of speakers from high income countries	9 (CZE-1, JPN-6, UK-1, USA-1)
9	Number of participants (exclusive speakers) from lower middle income and low income countries	1 (LAO)
10	Number of participants (exclusive speakers) from upper middle income countries	1 (MEX-1)
11	Number of participants (exclusive speakers) from high income countries	107 (CZE-1, KOR-1, JPN-105)
12	Total participants (sum of Q6-Q11)	120
13	Total participants from host country	111
14	Number of lower middle income and low income countries represented	2
15	Number of upper middle income countries represented	2
16	Number of high income countries represented.	5
17	Was a PIARC Technical Committee meeting held the same week?	YES (2.0 day meeting)
18	Was the seminar held in connection with another non-PIARC event? If yes, which event and organization?	JRA, REAAA & Hanshin expressway
19	Duration of the seminar, incl. field visit. Was a field visit organized?	YES (Tokyo Aqua Line and Kumamoto earthquake disaster area)
20	Registration fees – (Currency)	€ 0

5. Evaluation Summary of the International Workshop For TCE.3 Tokyo (JAPAN) 31th May 2017

1. General Information

General information is tabulated below.

Relevant organizations	PIARC TC E.3 JRA, REAAA, Hanshin expressway
Number of participants	120
Number of countries involved	9
Number of answers for questionnaire	48
Theme of workshop	International Workshop for Disaster Management for Roads
Technical visits	Tokyo Aqua Line Kumamoto earthquake disaster area

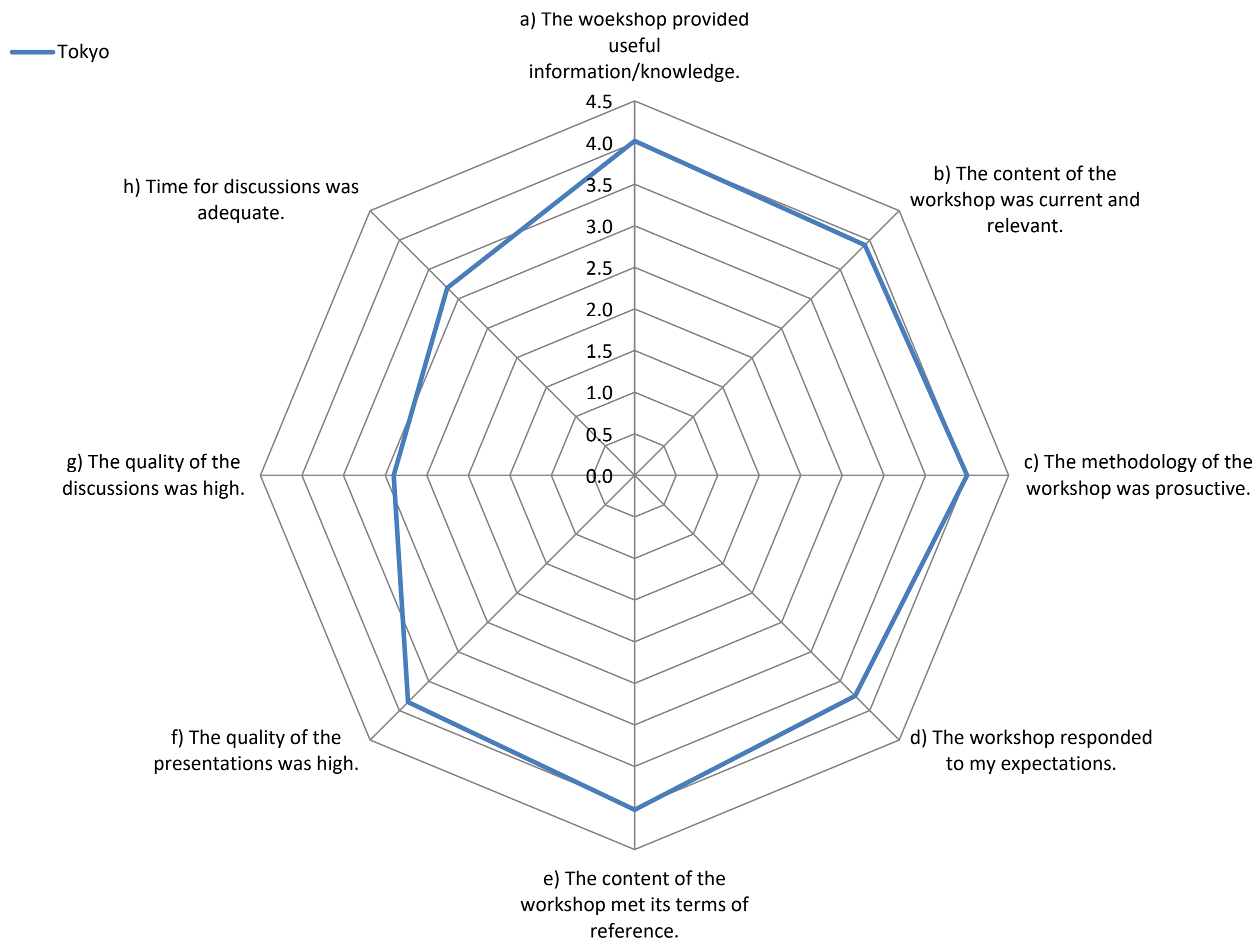
2. Synthesis of answers

Average satisfactory rating of each answer is shown below.

Item	Strongly agree (5 pts)	Agree (4 pts)	Neutral (3 pts)	Disagree (2 pts)	Strongly disagree (1 pt)	Average score
a) The seminar provided useful information/knowledge.	9	32	6	1	0	4.0
b) The content of the seminar was current and relevant.	9	27	11	1	0	3.9
c) The methodology of the seminar was productive.	9	31	7	1	0	4.0
d) The seminar responded to my expectations.	9	20	17	2	0	3.8
e) The content of the seminar met its terms of reference.	11	28	8	1	0	3.9
f) The quality of the presentations was high.	8	26	13	1	0	3.9
g) The quality of the discussions was high.	3	7	20	18	0	2.9
h) Time for discussions was adequate.	5	10	23	9	1	3.2

3. Comments and opinions to be noticed

- The workshop covers wide variety topics
- Information sharing of foreign and current case studies.
- Do it annualy
- The presentaiton that covers PIARC activites is expected.
- We expect handouts for clear understanding of the presentations.
- Presented materials should have been downloaded from website in advance
- Few question and no interactive discussion


Tokyo
a) The woekshop provided useful information/knowledge.
b) The content of the workshop was current and relevant.
c) The methodology of the workshop was prosuctive.
d) The workshop responded to my expectations.
e) The content of the workshop met its terms of reference.
f) The quality of the presentations was high.
g) The quality of the discussions was high.
h) Time for discussions was adequate.
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0