Present Status and Applications of Railroad Disaster Prevention System in Korea

Lee, Chang-Ho Korean National Railroad (KNR)
Shin, Min-Ho Korea Railroad Research Institute (KRRI)

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Present Status of Railroad Disasters and Future Plan

Lee, Chang-Ho Korean National Railroad (KNR)

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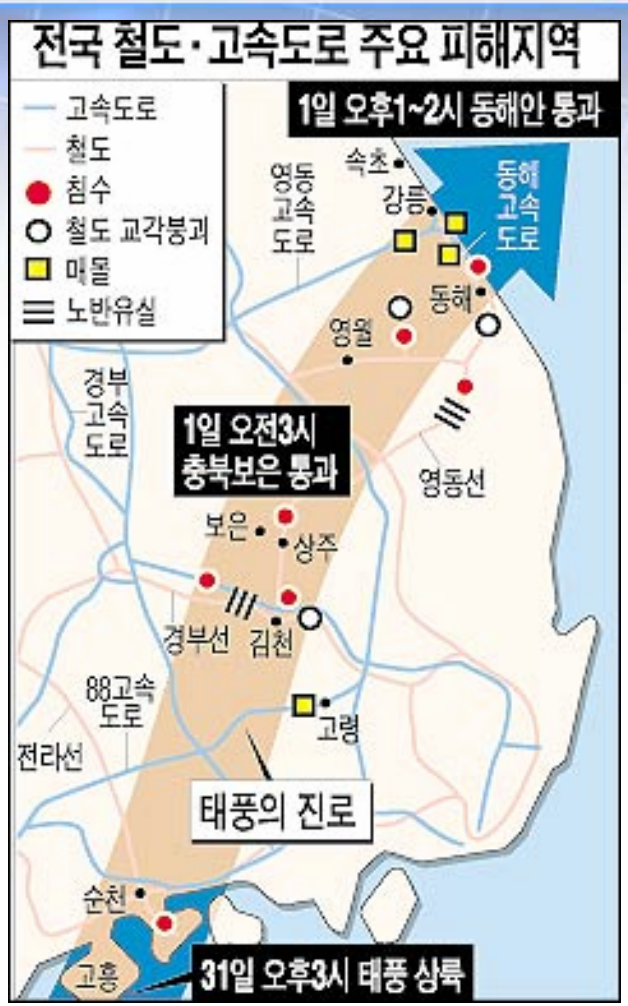
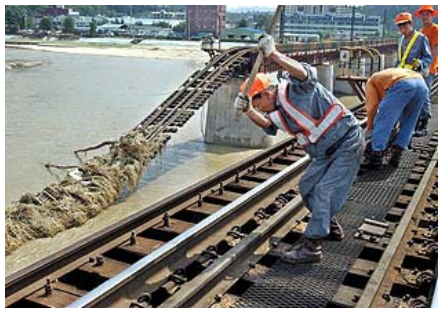
Railroad Damage by Typhoon, RUSA('02)





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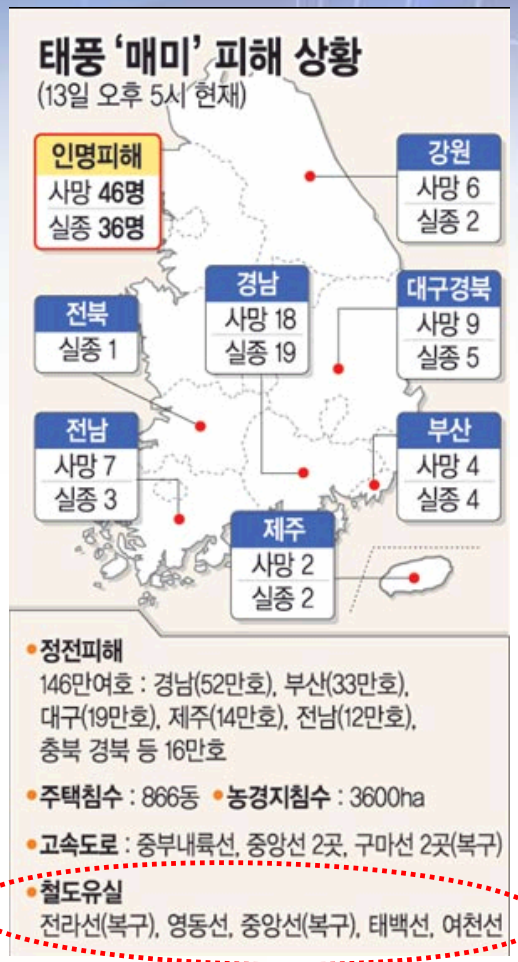
Railroad Damage by Typhoon, MAEMI('03)



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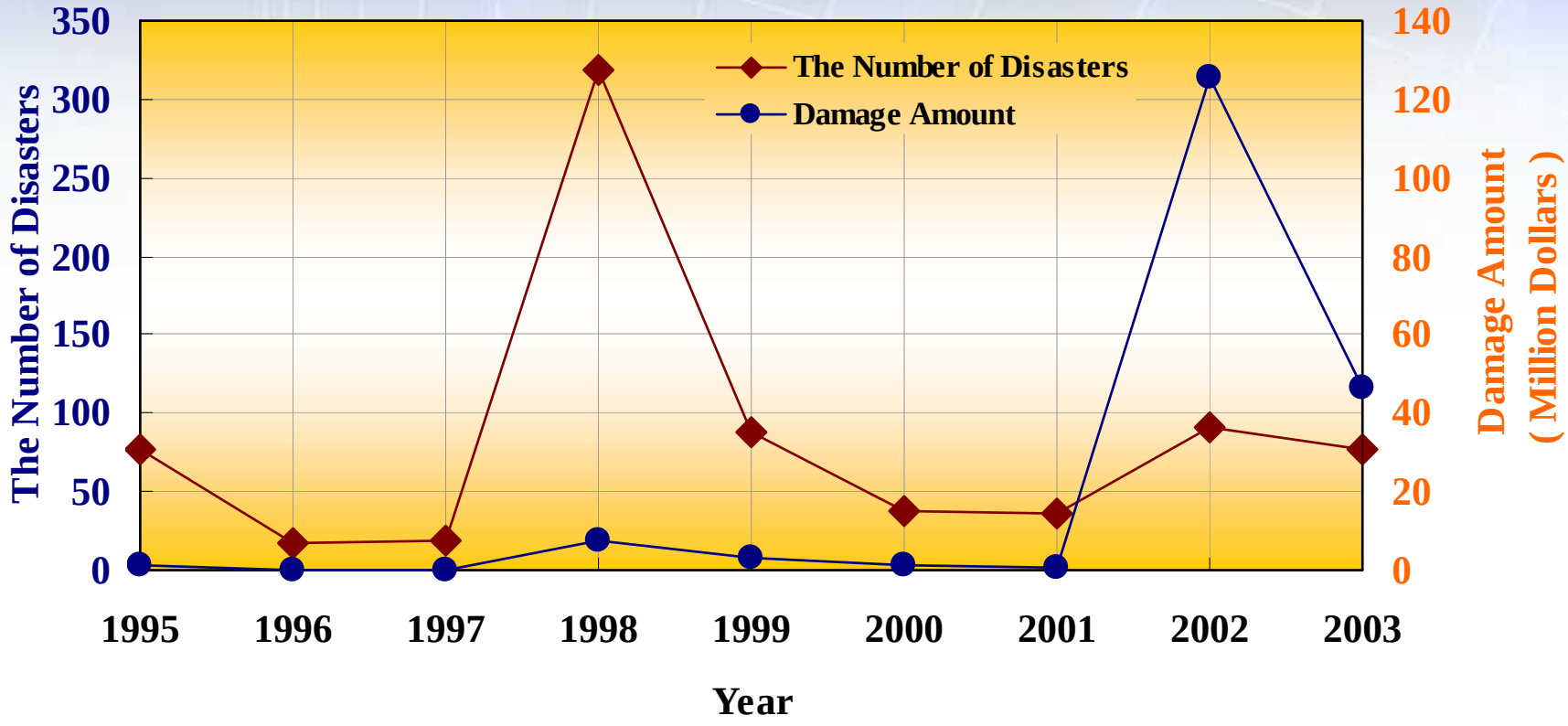
Subway Fire Damage ('03)

- Location : Jung-Ang Station, Dae-Gu (Feb. 18, 2003)
- Death & Injury : **337 persons (Death : 191 persons)**
- Cause and Result : Total Destruction of 2 Cars by Arson

Present Status of Railroad Damage by Natural Disasters for 9 *Years* (’95~’03)



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Problem Statement (1)

Technical Aspect

- Difficulty in monitoring by human
  - ☞ Average monitoring distance and time : 3.32km, 4.5 hours
- Insufficiency of Train Operation Regulation Criteria

Economic/Industrial Aspect

- Rehabilitation Cost : About $20 million per year
  - ☞ Total Rehabilitation Expense for last 8 years(’95-’03) : $186 million
  - ☞ Rehabilitation Cost by RUSA (’02.8.31~’02.9.1) : $125 million
  - ☞ Rehabilitation Cost by MAMI (’03.9.12~’03.9.13) : $46.5 million

Problem Statement (2)

Social/Cultural Aspect

- **Worldwide Abnormal Temperature and Frequent Occurrence of Disasters**
  - ☞ **Frequent Heavy Local Rainfall by Global Warming**
- **Increment of Safety Threatening Factors**
  - **as Rolling Stocks are Getting Speedier and Lighter**

Railroad Disaster Prevention System is Needed
for *Absolutely Safe Operation of Train*

Governmental Efforts to Prevent Railroad Damage

Railroad Facility Improvement Project ('01~'05) : $ 574 million

- Prevention is needed through improvement of railroad facility
  - Establishment of annual plan to spend money
  - Improvement of bridges having water flow section shortage
  - Installation of retaining walls and drainage ducts at disaster-worried sites
  - Installation of tunnel and fence at rock-fall worried sites
  - Foundation reinforcement to the scouring of piers and riverbed

● Amount of money and Objects (Except for flood rehabilitation)

Unit : Hundred Million Won

Division	Main Objects		Financial (2003)		Financial (2004)		After 2005
	Amount	Site	Amount	Site	Amount	Site	
Total	**688,748**	**1,362**	**11,450**	**18**	**15,000**	**24**	**1,302**
Bridge	385,517	72	7,485	4	10,000	4	57
Sub-Pier	90,140	204	485	1	3,000	10	185
Drainage	10,319	126	700	5	500	5	109
Landslide	38,042	66	590	3	1,000	2	59
Retaining Wall	119,624	615	2,190	5	500	3	604
Roadbed	45,106	279	-	-	-	-	279

Direction of Drive for Railroad Disaster Prevention

- **Prevention**
  - Enforcement of facility management
- **Establishment of Disaster Prevention System**
  - Enforcement of control function to train operation and Effective management of works for preventing disasters
  - Thorough coping with railroad disasters
- **Positive Propulsion of Prevention Project**
  - Enforcement of monitoring of disaster-worried sites and training
- **Rapid restoration upon railroad disasters**

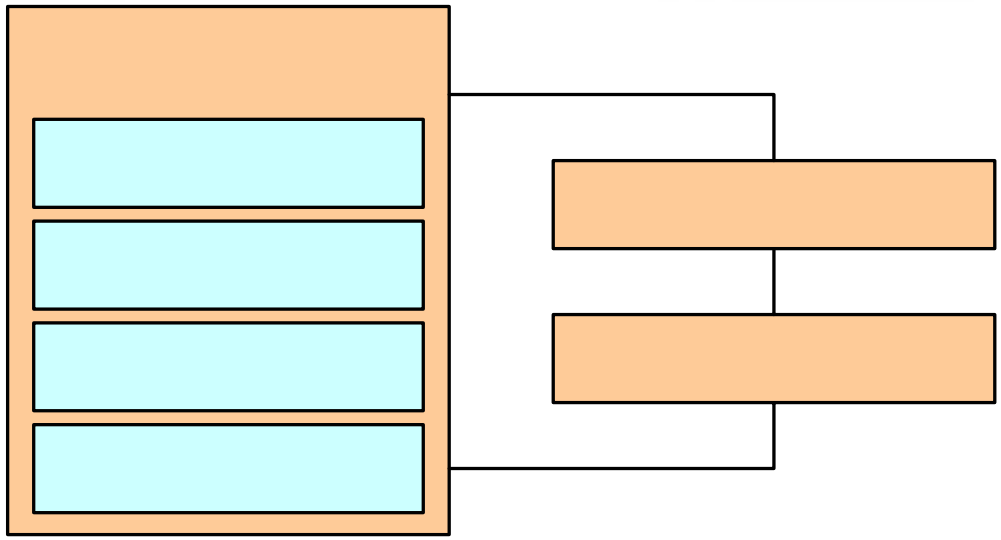
General Countermeasure for Disaster Management (KNR)

- **Preparation Stage**
  - **Maintenance and Examination of Equipments or Structures**
  - **Systematic Training**
- **Countermove Stage**
  - **Disaster Measure Headquarter**
  - **Minimization of Railroad Disaster through Rapid Countermove**
- **Restoration Stage**
  - **Execution of Permanent Restoration of Damaged Area**
  - **Enforcement of Investigation and Feed-Back Function**

Railroad Disaster Investigation Committee (RDIC) is working

- **Optimal measures will be made**
- **Systematic support and deployment of resources and manpower will be made**

by RDIC



Future Plan of KNR

Establishment of Railroad Disaster Prevention System(RDPS)

Technological Development and Application of Railroad Disaster Prevention System

Shin, Min-Ho Korea Railroad Research Institute (KRRI)

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Technological Development of Railroad Disaster Prevention System

The Present Status of the Researches in Railroad Disaster Prevention

- The Study for the Database Construction of Falling Rocks/Landslide nearby Railroad (1999-2000)
  - Numerical Topographical Map, Plane Figure of Railroad Station, Plane Figure of Station Building, Database of Falling Rocks/Landslide
- The Stability Development Technology of Railway Facilities (1999.9-2003.9)
  - Construction of Disaster Prevention System for Railway Earthwork Facilities
  - Suggestion of Standard for the Assessment of Slope Stability
  - Railway Slope & Falling Rocks Area Monitoring System

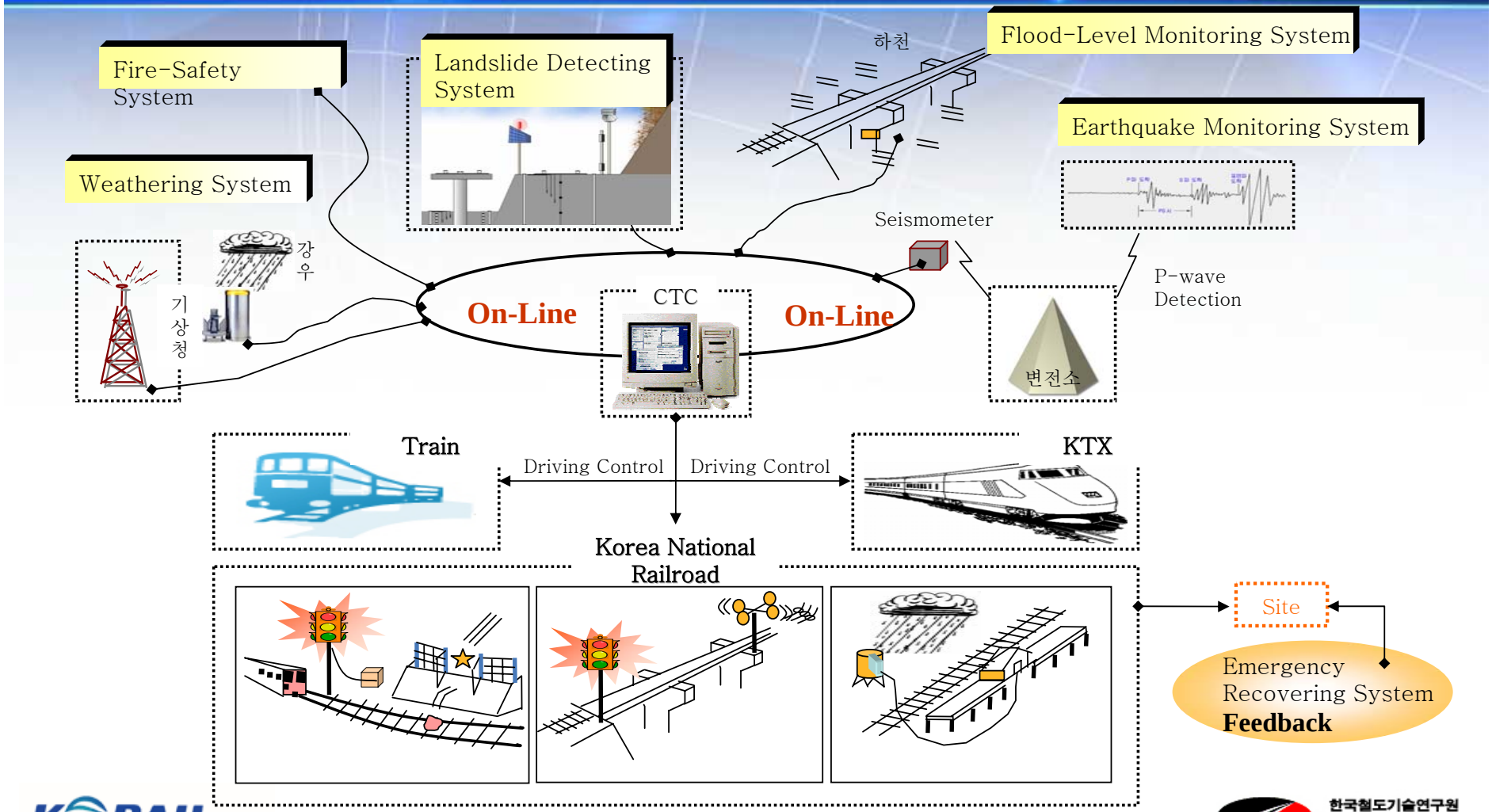
- Development of Auto Rainfall Warning Equipment (2001-2002)
  - KRRI's Projects
  - Suggestion of Rail-Transport Operation Control
  - Development of Auto Rainfall Observation System based on Proto-type Web
- Research of Observation System for Water Level of Flood (2003-2004)
  - Important Transportation Technology Project

- Railroad Slope Stability Assessment and Alternatives (2003.11-2004.12), KNR
  - Investigation of Slope (90places), Close Investigation (40places)
  - Evaluation of Unstable Slopes and Establishment of Reinforcement Methods
- The Construction for Railway Rainfall Disaster Prevention System (2003.12-2004.12), KNR
  - Construction of Auto Rainfall Warning System (209national places)
  - Establishment of Roadmap for construction of Railway Rainfall Disaster Prevention System

Major Factors for preventing Railroad Disasters

- **Risk Assessment** for Vulnerable Structure
- **Reinforcement** of Railway Structure
- **Rail-Transport Operation Control**
- **Information Network** for Disaster Prevention
- **Emergency Recovery System**

Outline of Railroad Disaster Prevention System



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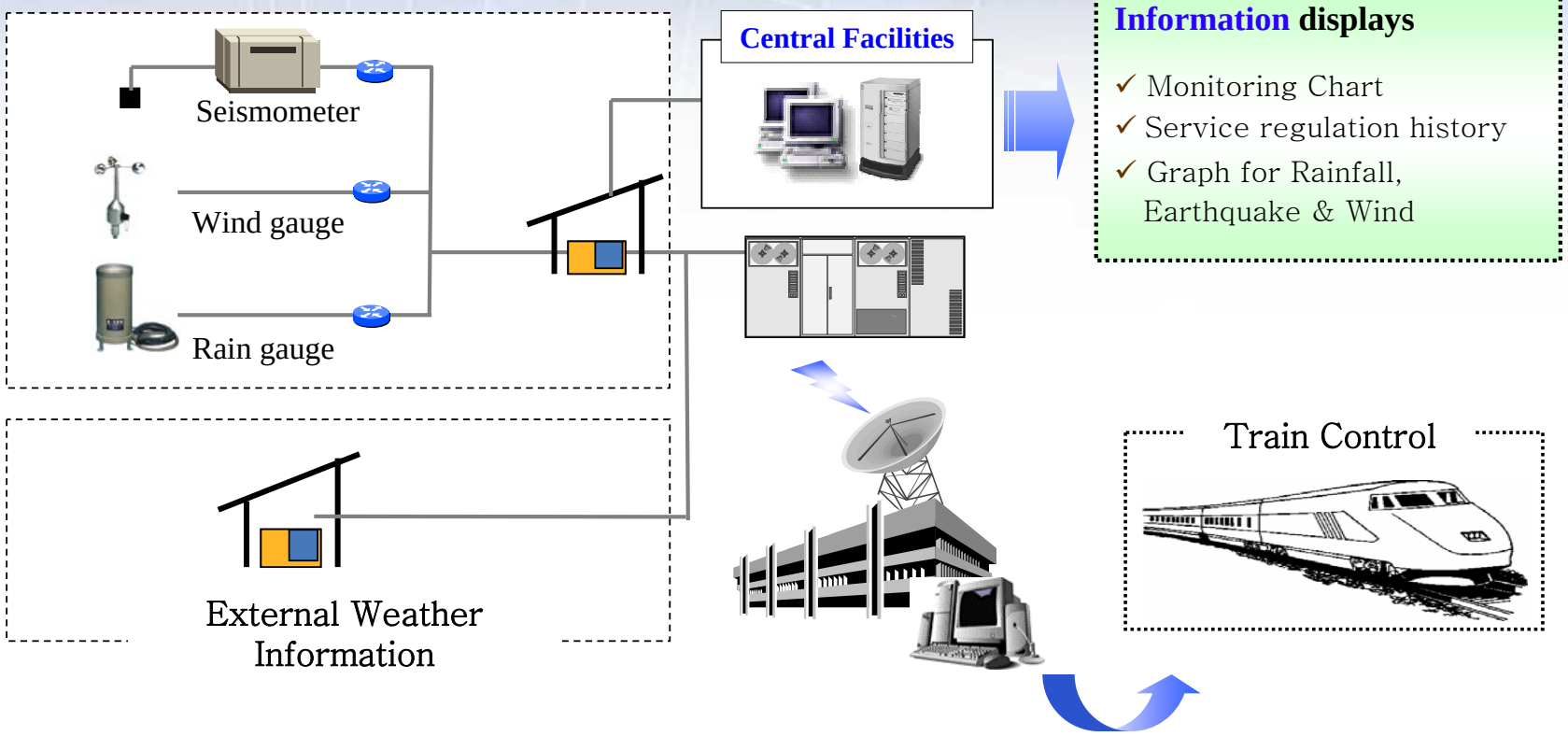
Disaster Prevention System for Korea Train eXpress

Automatic Weather System of KTX



Safety & Disaster Prevention System of KTX

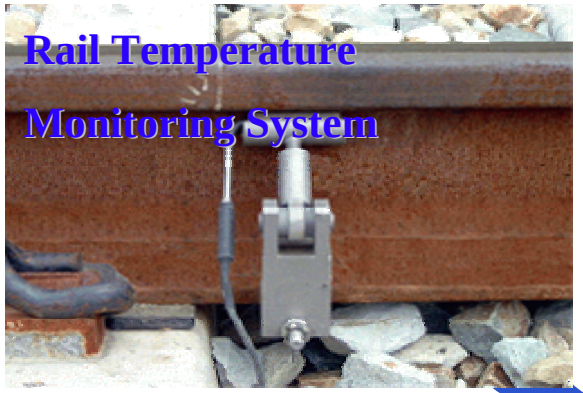
Overheat Detecting System

Fence Detecting System

Train Access Warning Equipment

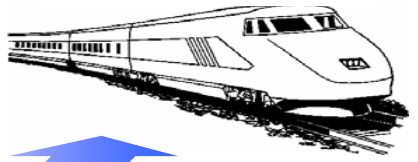
Tunnel Warning Equipment

Rail Temperature Monitoring System



Trail Detecting System

Safety Insurance of KTX



Disaster Prevention System for Railroad Roadbed

Monitoring System using Wireless Data Communication

In Situ Test (38km Kyung-Chun Line)

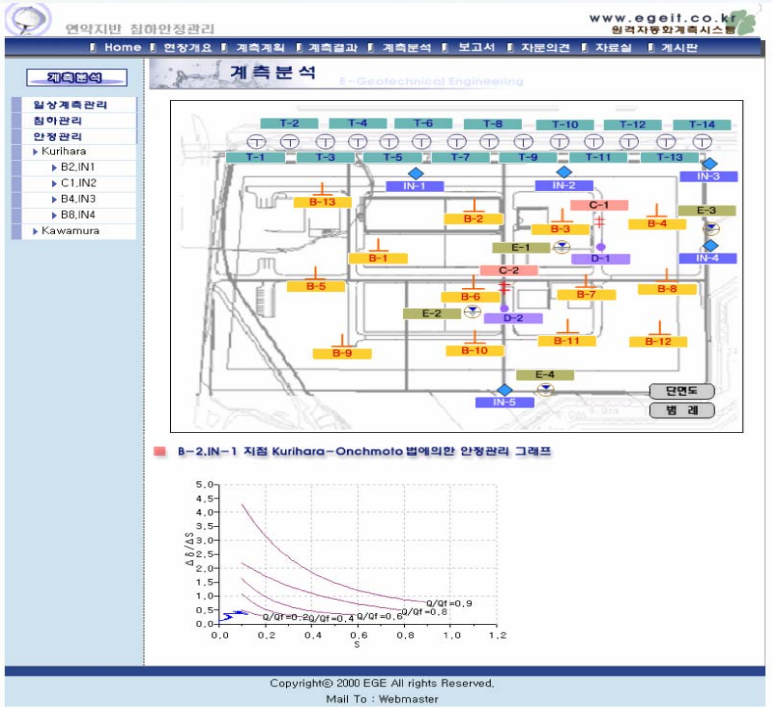
Data Input/Output System based on WEB

Construction Management (Illo-DaeBul)

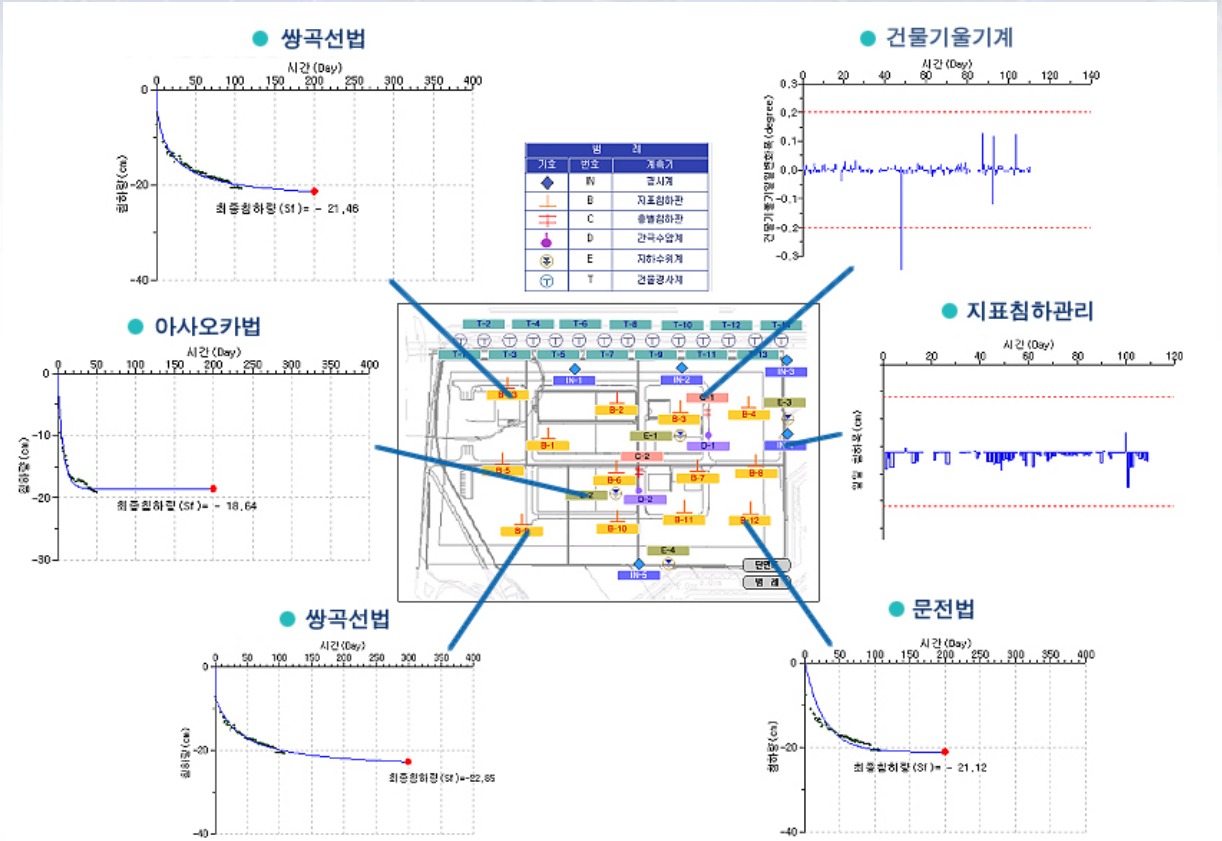
Disaster Prevention System for Railroad Structures

Railroad Bridge Monitoring System

KwangYang Harbor Line

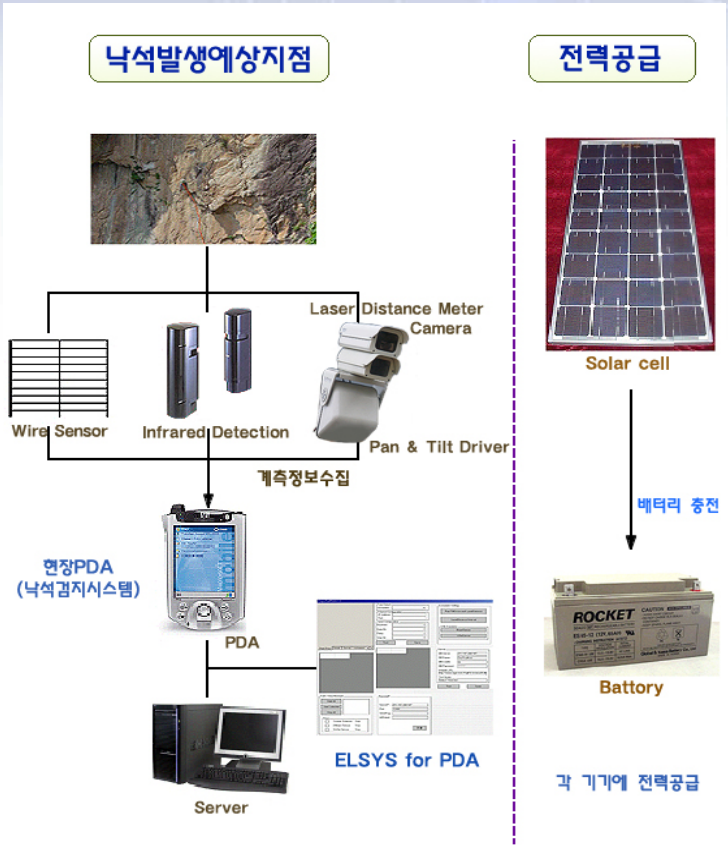


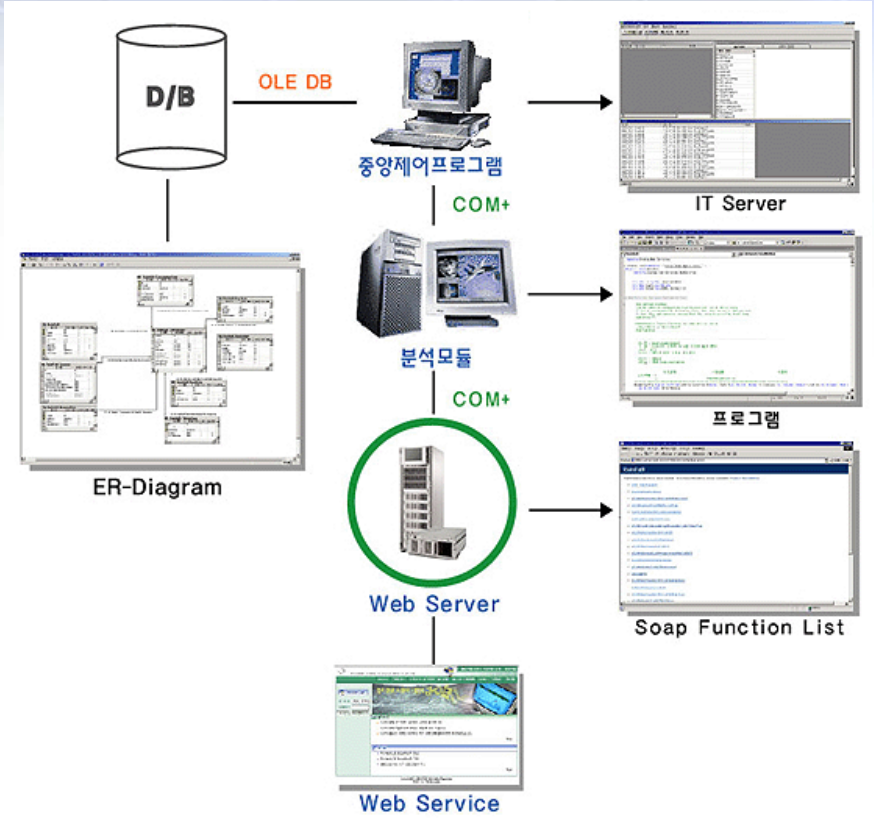
Stability Management of Vulnerable Structure on Internet



Rock-fall Monitoring System

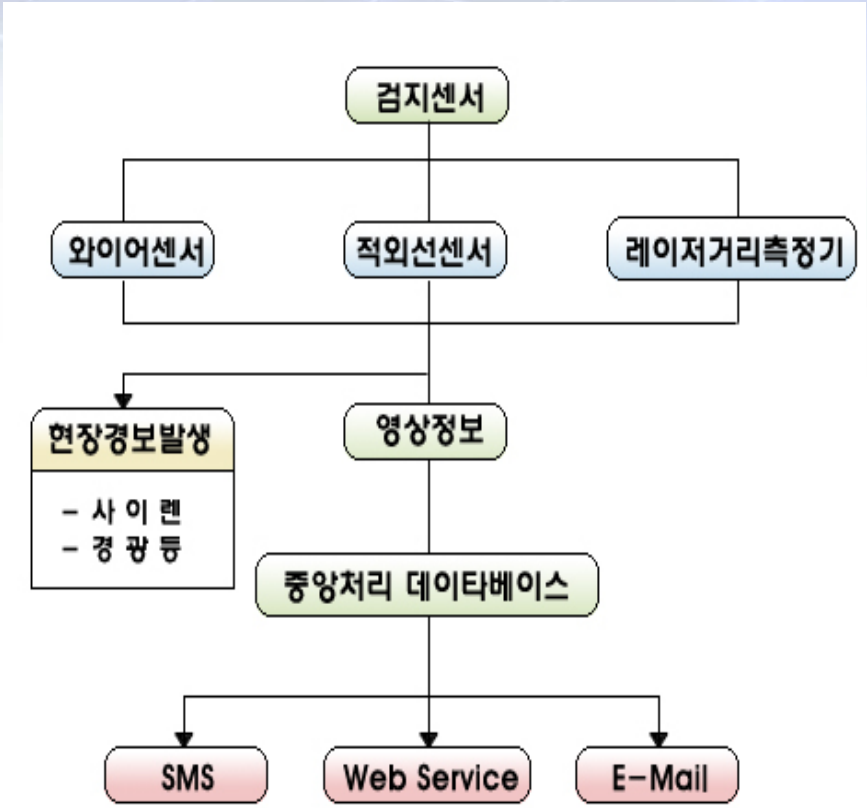
Constitution & Internet Program





Field Test of Rockfall Detecting System

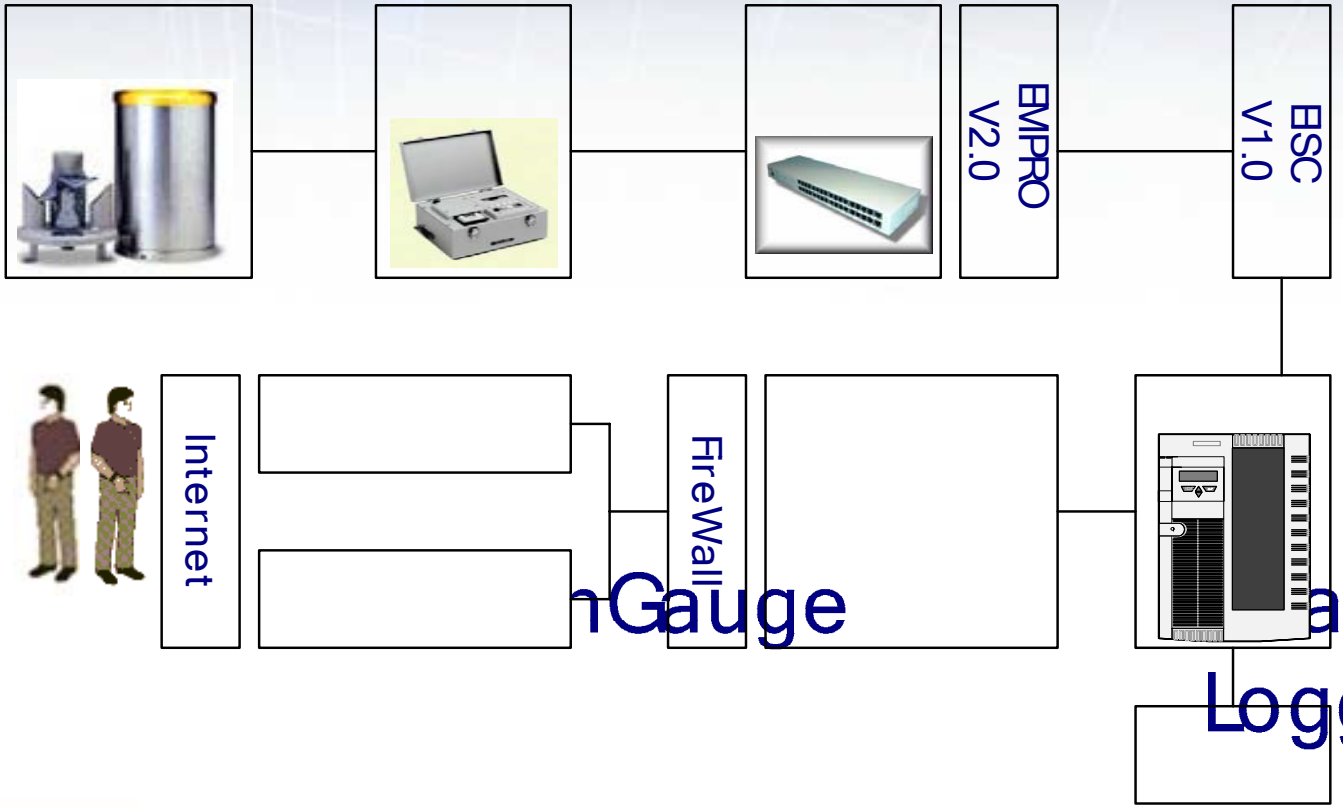
- **In Situ Emergency Warning**
  - Siren & Warning Lights
- **Warning for Train & Manager**
  - Siren & Warning Lights
  - Short Massage Service (SMS)
- **Warning for Site Manager & CTC**
  - E-Mail & WEB Service
  - Short Massage Service (SMS)



Rainfall Automatic Warning System

Continued

Auto Rainfall Data Collecting System on WEB
Establish Dangerous Degree of Rainfall



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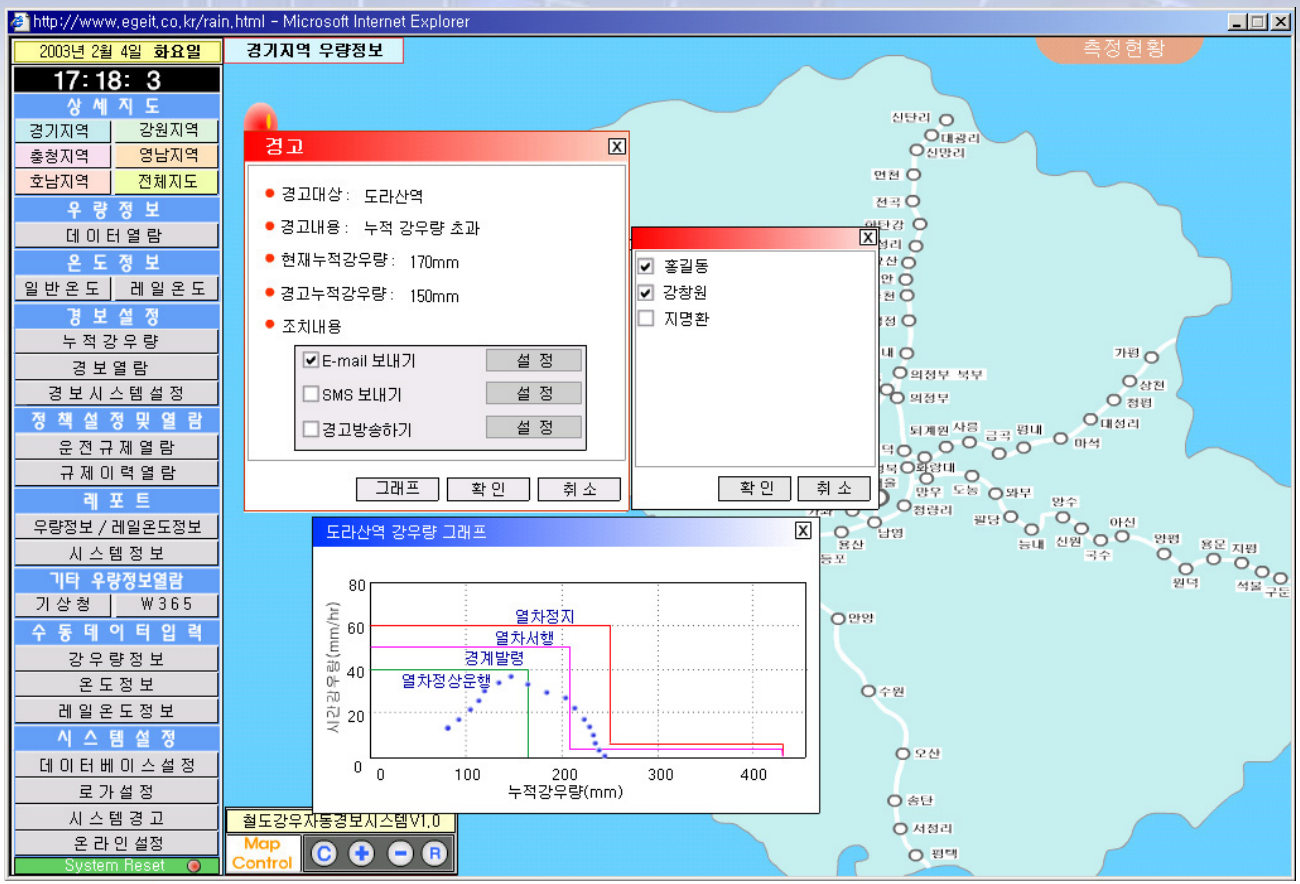
Automatic Rainfall Monitoring Program



Flood-level Monitoring System for Railroad Bridges

Composition of System

Immersion Level Transmitter

☞ Easy to install and use widely

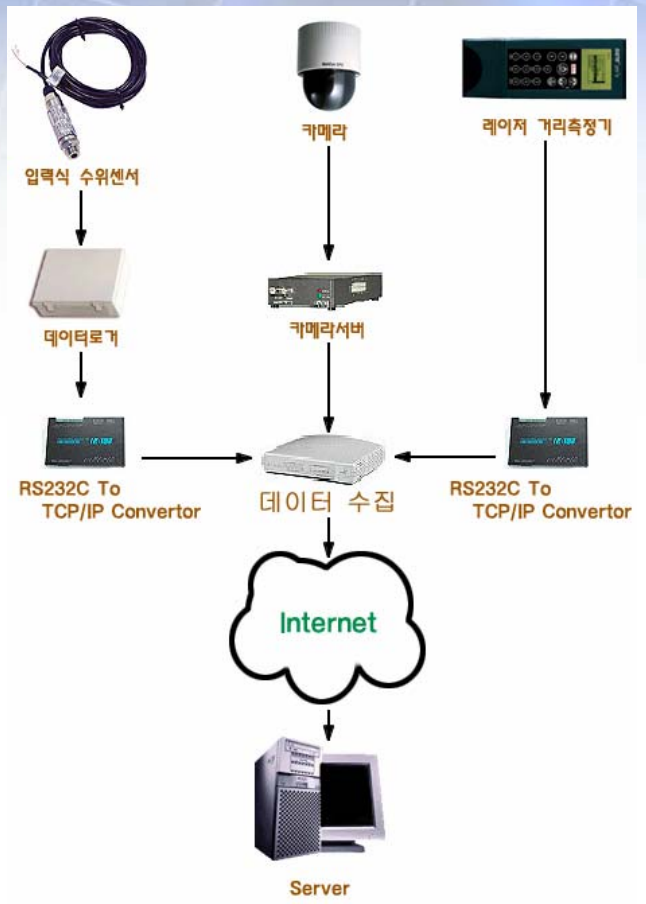
Laser Distance Measuring Instrument (LDMI)

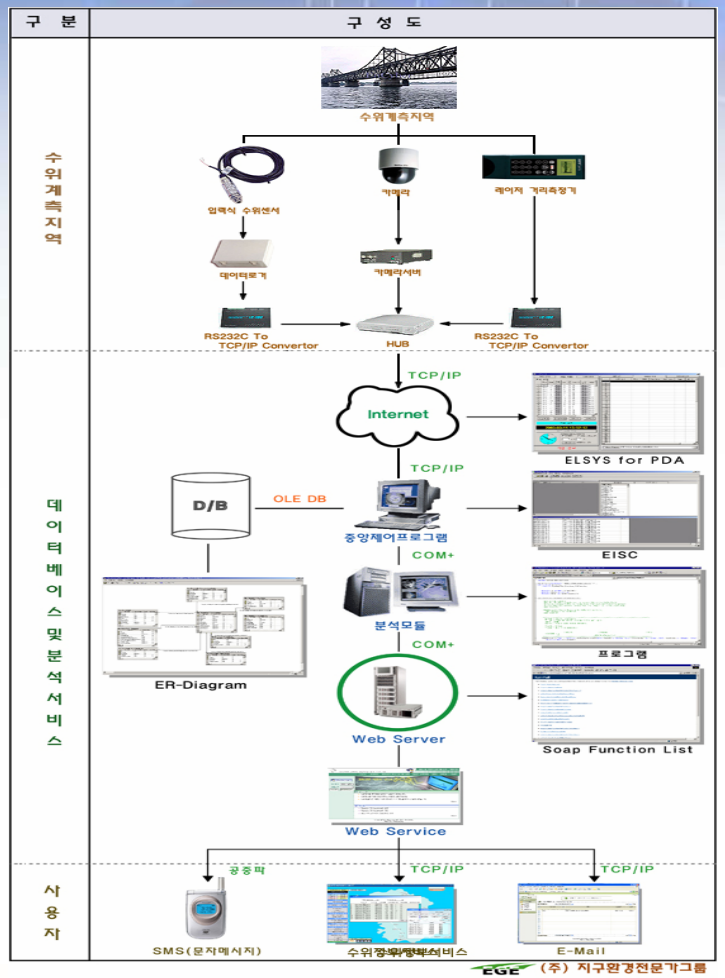
☞ Measure water-level using LDMI

☞ Possibility of precise measurement

CCTV System

☞ Measure water-level through image analysis





Data Acquisition & Analysis System

☞ Central Control Program

- Collection and Analysis of Data
- Possible to process High Capacity Data

Internet Service of Water-Level Information

☞ Easy to access to information through web page

☞ Supply the convenient visual interface

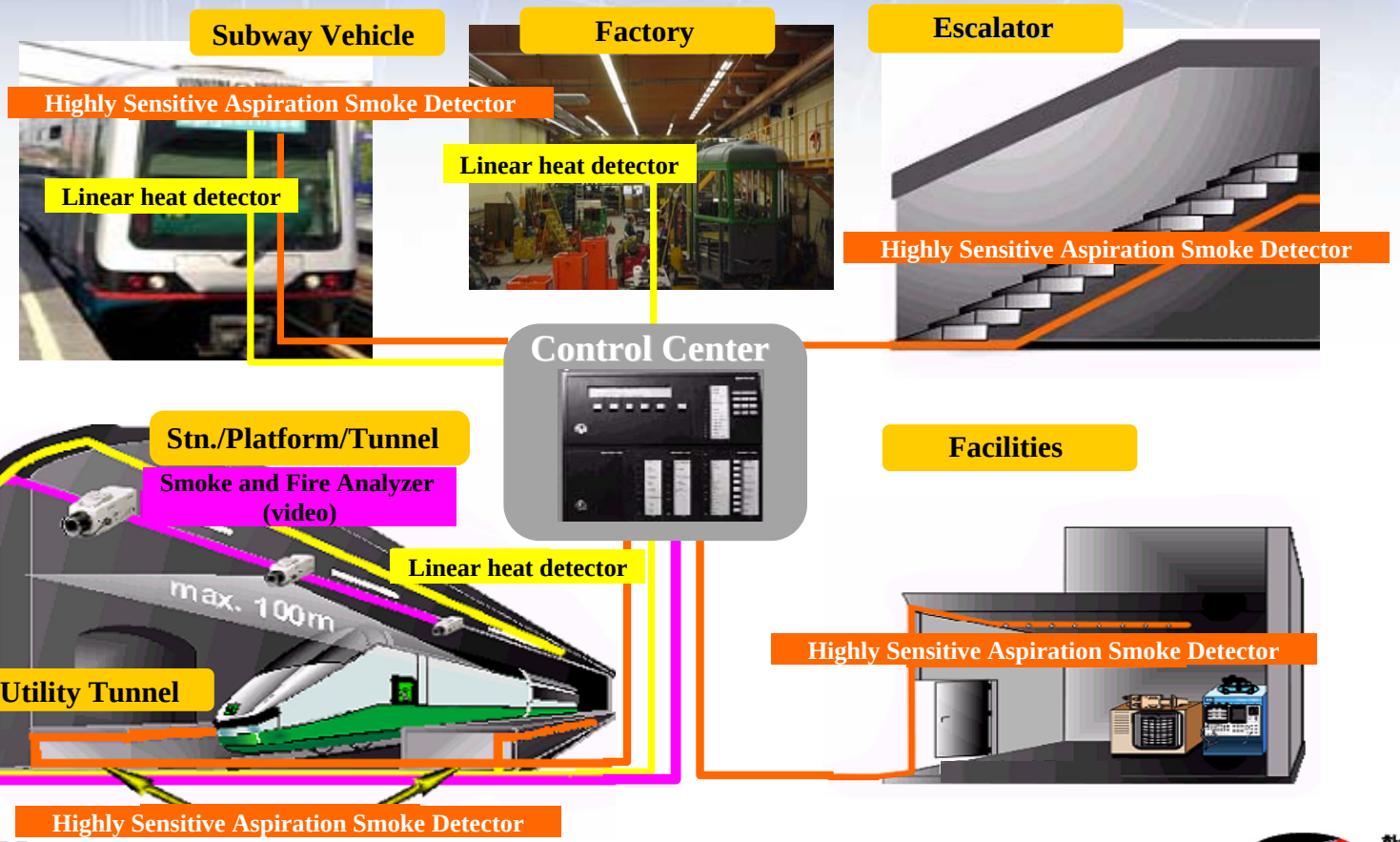
Real-time Warning Service

☞ Short Message Service of mobile phone

☞ Warning Service of E-mail

Railroad Fire Monitoring System

Fire detection system for subway stations and tunnels



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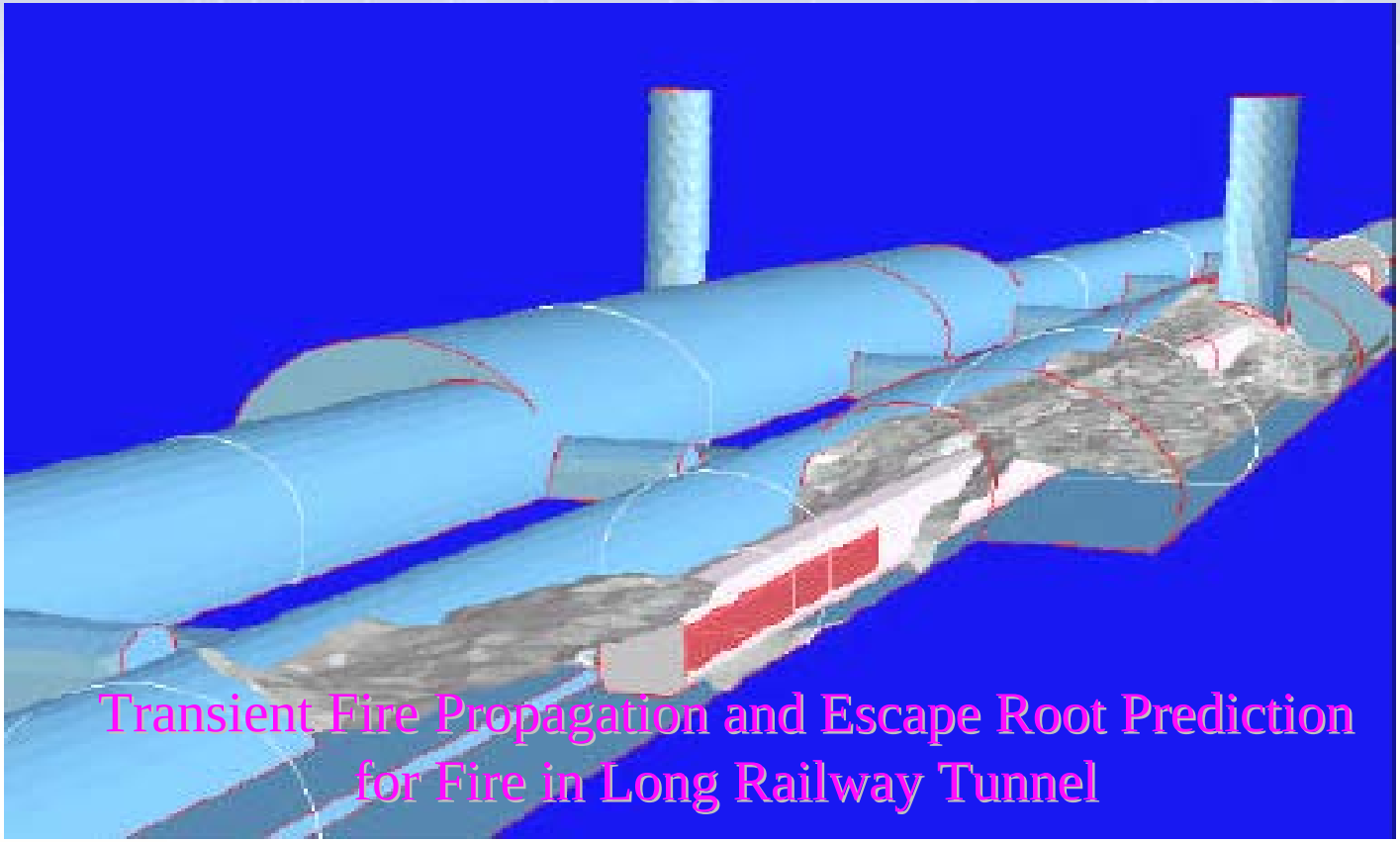
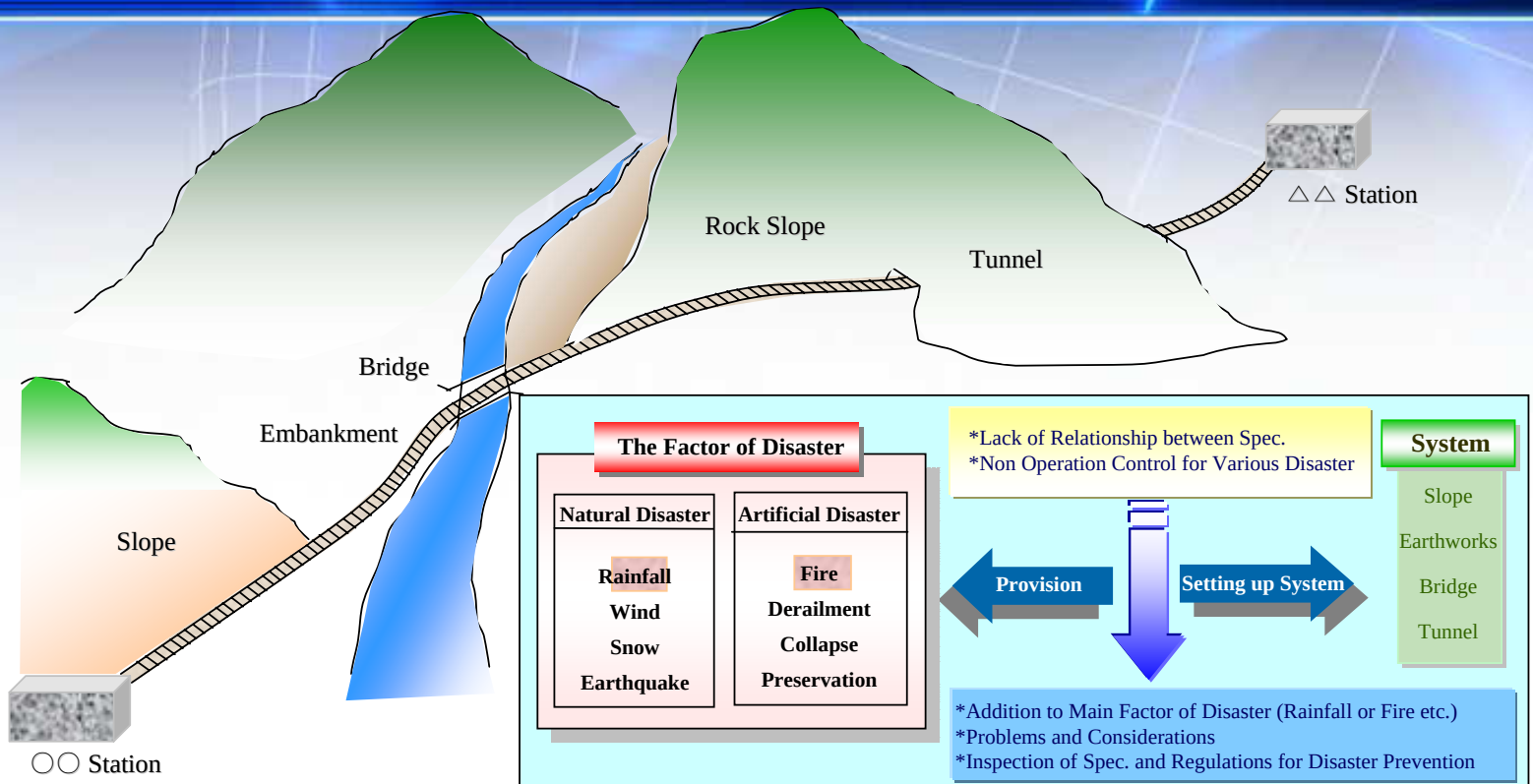
Development of Fire Propagation Prediction & Monitoring System



Transient Fire Propagation and Escape Root Prediction for Fire in Long Railway Tunnel

Application of Railroad Disaster Prevention System



Earth Structure Monitoring & Maintenance System | **Water Level of Flood Monitoring System** | **Rockfall Detecting System** | **Tunnel Monitoring System**

Railroad Disaster Prevention System (○○ Station-△△ Station)

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Conclusion and Suggestion

- The Fundamental Effort for Disaster Prevention must be Made by the KNR
- Effort to minimize the Disaster through the Construction of the Integrated Disaster Prevention
- KRRI have Studied & tried the Development of Disaster Prevention before Railway Disaster became an issue
- Development of many Kinds of System with IT has been a Good Help to Railway Disaster Prevention

- The Planning & Securing of an ample budget is Required for the Construction of Long/Short Term Integrated Disaster Prevention System
- Improvement of all Sorts of Regulation and Existing System is Required for the Construction of Integrated Disaster Prevention System


Thank You for Your Attention
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