Centralized technical management system for expressway tunnels

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Nam-Goo Kim
Profile

Nam-Goo Kim
Tunnel Fire Safety Engineer

- Korea Expressway Corporation (1995 ~ ), Team Leader (HQ)
- PIARC TC D5 member (2008 ~ )
- Educational Background
  - B.S. on Building Equipment
  - M.S. on Architectural Environment
  - M.B.A., PhD(c) in Business Administration

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I. Introduction of KEC

1. Overview of S. Korea - location
I. Introduction of KEC

1. Overview of S.Korea - Key Figures

- AREA: 100,340km²
- POPULATION: 51.8 million
- TOTAL LENGTH OF ROAD: 110,091km
- VEHICLES REGISTERED: 22.5 million

(as of Dec. 2017)
I. Introduction of KEC

1. Overview of S. Korea — Total Road Network

<table>
<thead>
<tr>
<th>Type of Road</th>
<th>Authority</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expressway</strong></td>
<td>KEC (on behalf of MOLIT)</td>
<td>4,717</td>
</tr>
<tr>
<td><strong>National Highway</strong></td>
<td>MOLIT</td>
<td>13,983</td>
</tr>
<tr>
<td><strong>Special, Metropolitan City Road</strong></td>
<td>Special Metropolitan City Government</td>
<td>4,886</td>
</tr>
<tr>
<td><strong>Provincial Road</strong></td>
<td>Provincial Government</td>
<td>18,055</td>
</tr>
<tr>
<td><strong>City, County Road</strong></td>
<td>City / County Government</td>
<td>68,650</td>
</tr>
<tr>
<td>Total Length of Road Network</td>
<td><strong>(as of Dec. 2017)</strong></td>
<td>110,091</td>
</tr>
</tbody>
</table>

※ MOLIT: Ministry of Land, Infrastructure & Transport
I. Introduction of KEC

2. Expressway Network: 7V x 9H + 6 Ring

- 1969
- 2009: 3,496km
- 2017: 4,717km
- 2020: 5,131km

Under Construction
- New lines: 514km
- Expansion: 69km
I. Introduction of KEC

3. Roles of KEC

- Construction
- Operation & Maintenance of Facilities
- Traffic management
- Research & Development
- International Cooperation & Overseas Project

*KEC performs these missions on behalf of the Korean government*
I. Introduction of KEC

4. Organization

- **6HQ with 20 division**
- **8 Regional HQ, 8 R&D office, 14 Construction Office**
- **Total Staff : 6,076**

[Diagram showing the organizational structure of KEC with various departments and offices listed.]
I. Introduction of KEC

5. Tunnels & Bridges of Expressway

- **Tunnels : 532 (454km)**
  - No. of over 1km : 131 / 1.0-0.5km : 184 / under 0.5km : 217

- **Bridges : 9,334**
  - No. of over 1km : 62 / under 1km : 9,272
II. Background of Centralization

Increasing number of tunnels and staff

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2012</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No of tunnel</strong></td>
<td>232</td>
<td>316</td>
<td>479</td>
</tr>
<tr>
<td><em>(long tunnel)</em></td>
<td><em>(42)</em></td>
<td><em>(65)</em></td>
<td><em>(123)</em></td>
</tr>
<tr>
<td><strong>No. of Staff</strong></td>
<td>228</td>
<td>348</td>
<td>684</td>
</tr>
<tr>
<td><strong>Cost(USD)</strong></td>
<td>15.3mil</td>
<td>21.4mil</td>
<td>42.6mil</td>
</tr>
</tbody>
</table>

- To reduce increasing labor cost of operation staffs
- To increase the efficiency of tunnel O&M
II. Background of Centralization

History

- ~1999: Local control center & operation staffs for each tunnel
- 2000 ~: 1st Integrated Tunnel Operation Center [Daeguanryung]
  - O&M for 12 tunnels [including 5 long tunnels]
- 2009 ~: Adopt Centralized Management System
  - All systems of tunnels are connected by Fiber-optic network
  - Remote monitoring & control for group of tunnels
    at O&M office
III. Network & Zoning

Korea Expressway Corp. HQ and 8 Regional HQ
### III. Network & Zoning

#### Yangyang O&M Office

<table>
<thead>
<tr>
<th>No of tunnels</th>
<th>Total</th>
<th>&gt; 1km</th>
<th>1 ~ 0.5km</th>
<th>&lt; 0.5km</th>
<th>Longest TN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>32</td>
<td>13</td>
<td>4</td>
<td>15</td>
<td>Inje tunnel(10.9km)</td>
</tr>
</tbody>
</table>
IV. Systems and Operation

Tunnel Control Center
IV. Systems and Operation

Overview of centralized system

- Ventilation Control System
- Auto Fire-detection System
- Traffic management System (VMS/LCS)
- Electric Power Control System
IV. Systems and Operation

Overview of control center
IV. Systems and Operation

Ventilation control system
IV. Systems and Operation

FFFS and Mechanical control system
IV. Systems and Operation

Electrical power control system

Overview of Electrical Power System

Electrical Monitoring System
IV. Systems and Operation

Lighting control system

Dimming control system
IV. Systems and Operation

Fire detecting system

Fire Detecting System

Fire Detecting near the Vertical Shaft
IV. Systems and Operation

Traffic control system

Traffic Monitoring and VMS/LCS Control System
IV. Systems and Operation

Automatic Accident Detection System
IV. Systems and Operation

Overheated Vehicle Detection System

Over-heated Vehicle Monitoring and Control System
IV. Systems and Operation

Fire-accident response process

Fire Detecting

<Centrized control center>
① Call 119, 112 (Emergency service)
② Operating safety facilities
③ Spread-out the emergency situation

<Highway patrols>
① Move to the tunnel
② Rescue, evacuate
③ Small fire suppression

<O&M Office>
① Alert the Emergency Situation
② Support people start to the tunnel

+10min

<Police/Fire station>
① Rescue
② Fire suppression
③ Traffic control/vehicle detour

<Regional Control Center>
① Supporting (people, equipment, ...)
② Cooperate related agencies
③ Announcement and press control
V. Operational Issues & Lessons

- Too many kind of systems for tunnel operation
  - Need more education and drill for operators
  - Simple procedure for emergency situation

- Network capacity, speed & stability are very important
  - Ring network, Duplex server, Hacking prevention

- Accessibility & Quick response
  - Need very high level of availability of safety systems
  - Close cooperation between emergency services.
Thank you for your attention
Merci pour votre attention