Safety Management and Emergency Relief of Hangzhou Bay Bridge

--- Department of Communications of Zhejiang Province
• Zhejiang owns a great number of bridges. Till 2011, the number has been 45578, among which 196 bridges are super large bridges, such as Hangzhou Bay Bridge, Zhoushan Bridge, Jiashao Bridge (under construction), Xiangshanggang Bridge (under construction).
• The management system of the roads and bridges in Zhejiang consists of government leading, industry regulation and owner in-charge.
• Recently, Zhejiang Province is consistently exploring and practicing the Safety Management and Emergency Relief of super large bridges. Experiences will be introduced, taking Hangzhou Bay Bridge as an example.
Overview

- Length of 36 km
- Investment of 13.4 billion
- Highway
- Dual-direction, six-lane
Overview - Role in the Economy

Hangzhou Bay Bridge

Shorten by 120km

Shanghai

Hangzhou Bay Bridge

Ningbo
• Second Prize of National Science and Technology Progress Award, 2011.
• China Construction Luban Award, 2010-2011.
• Zhan Tianyou Award of China Civil Engineering, 2011.
• Construction Safety: Ten Billion RMB Output with Zero Death
Formulate the Regulating Rules of Hangzhou Bay Bridge
Set up the Administration Bureau of Hangzhou Bay Bridge (ABHBB)

Leader: Administration Bureau
Main body: Owner Corporation
Guarantee: Logistics departments
Supporter: Maintenance centers
Safety Management-Operational Condition

Large tide range, high speed flowing, deep scouring.

- **Average velocity**: 2.39 m/s
- **Maximum velocity**: 5.16 m/s
- **Maximum tide range**: 7.57 m
- **Average tide range**: 4.65 m

Small-range disastrous climate is common.

Mass fog happens frequently.
Safety Management-General Frame

Countermeasures

Equipment
- Traffic monitoring
- Sea monitoring
- Electronic patrol
- Distributed attendance
- VTS system
- 88 navigation aids
- Windbreak/fog lamp
- Cablecasting

Joint logistics
- Road patrol
- Stationary attendance

Maritime safety management
- Structure monitoring
- Integrated application
- AIS system
- Emergency tug
- Information board
- Structural safety

Related measures
Safety Management

- Full-coverage and intelligent monitoring
- Maritime safety
- Joint logistics
- Related measures
Full-coverage and intelligent monitoring

19 sets of equipments

Traffic safety of the bridge

Structural safety

Maritime safety

Integrated application

Bridge Monitoring and Control System
Bridge monitoring and control

- Weather monitoring system
- Orientation control system
- Emergency telephone and cable casting
- Health monitoring system
- 419 video cameras
- Lamps
杭州湾跨海大桥

Hangzhou Bay Bridge

Bridge monitoring and control

监测系统网络结构图

Monitoring system of Hangzhou Bay Bridge
Joint logistics

- Zone 1: south bank-platform
- Zone 2: platform-north bank
- Zone 3: north bank-platform
- Zone 4: platform-south bank

Scheme of the joint logistics

24 hours electronic patrol in the monitoring center

Stationary attendance

North bank

South bank

Ocean platform

24 hours patrol

Stand-by

Shanghai

Ningbo
### Achievement of the goals of joint logistics

<table>
<thead>
<tr>
<th>Main objective</th>
<th>Requirements</th>
<th>Implementation</th>
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<tbody>
<tr>
<td>Arrival time for accidents on-deck and obstacle clearing</td>
<td>Patrol car arrives in 20 minutes in daytime and 25 minutes at night. Heavy traffic arrives in 30 minutes. Large vehicle arrives in 50 minutes.</td>
<td>100% of the vehicles arrives in the specified time and half of them arrive in 10 minutes.</td>
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<tr>
<td>Incident detection rate of monitoring center</td>
<td>More than 65%, aim to 70%.</td>
<td>Average rate is more than 73%.</td>
</tr>
<tr>
<td>Safe operation and equipment soundness</td>
<td>Registration rate is up to 98%, prosecution rate is 95%, wind-up-case rate is 95%, repair rate is 100%.</td>
<td><strong>All the requirements are satisfied.</strong></td>
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Monitor and regulate the vessel within the bridge area using VTS and AIS

Monitoring center of vessel traffic service
Maritime safety

- Monitoring center and VTS, AIS
- Anti-collision boxes of non-navigable span
- 88 navigation aids
- Anti-collision boxes
- Emergency tug and patrol vessel
- Maritime safety management

Anti-collision boxes
Related countermeasures

- 1.5m-high windbreaks distributed along the north and south channel bridge

- Safe level of wind speed
  - Level 8
  - Level 10 or more

- Safe level of wind speed
Related countermeasures

1844 fog lamps along the road
Related countermeasures

- 10 information boards
- 27 lane controlling flags

Cablecasting
Detection and evaluation of the structure safety

Inspection items:
- bridge tower;
- channel bridge;
- girder;
- settlement of bridge piers;
- vibration.

Alarming of the structure safety:
- bridge deck
- concrete components
- steel box girder
- dynamic test
Safe, Unimpeded, Harmonious, Efficient

- No major traffic accident happens during the operation
- 0.33 accidents per ten thousand vehicles
Emergency plans of Hangzhou Bay Bridge

- Provincial plan of Zhejiang
- City plan of Ningbo
- Bureau plan of the administration bureau

- Predictive alarming
- Process of the emergency relief
- Post-disposal
- Pre-disposal
- Extended Relief
- Information report
- Graded response
Emergency relief

Major event (Ⅰ)
Large event (Ⅱ)
Usual event (Ⅲ)

Emergency plan of Hangzhou Bay Bridge

Natural disaster
Operational safety accident
Public health incident
Social security incident

Traffic accident
Incident of dangerous chemicals
Structural damage
Fog weather

22 emergency plans
Emergency relief

Emergency headquarter

Monitoring center

Highway police (organization, command)

Emergency departments

Clearing and Maintenance
Relief liquid caustic soda leaking incident

Countermeasures of caustic soda, alert of conservation and fire control

Alarm

Locate the incident using video cameras

Rescue and release information
Emergency relief

(Usual event)

Bureau headquarters
Bureau plan

report

municipal relief?

N

Y

Municipal headquarters
Municipal plan

( Large event )

Provincial headquarters
Provincial plan

(provincial relief)

N

Y

report

( Major event )
Emergency relief

- Fire drill
- Dangerous chemicals drill
- Preview of the plan
- Emergency tug drill
• Vehicle could turn around in the ocean platform to reduce the relief time
Emergency relief

- Rescuing drill of the helicopter in the platform

Helipad and dock
VTS monitoring center on the 2nd floor of the sightseeing tower
1. Difficulties in operation management caused by complex climate such as strong tide estuary.

Thank you for your attention!