



**XXIVth WORLD
ROAD CONGRESS**
Mexico City 2011

Large road bridges management, monitoring and maintenance

Thierry KRETZ

Sétra : Technical department for transport, roads and bridges - Ministry of ecology, Sustainable Development, transport and housing

thierry.kretz@developpement-durable.gouv.fr

Sétra



Ministère
de l'Écologie, de l'Énergie,
du Développement durable
et de l'Aménagement
du territoire

Introduction

Group 3 of TC D3 Road bridges has sent a questionnaire sent to large bridges managers in order to get information on :

- Organization of the management
- Monitoring systems used on large bridges
- Maintenance and rehabilitation works

We received ten answers concerning very different types of bridges



Large Road Bridges Management

Introduction



Australia Gateway
bridge



Large Road Bridges Management

Introduction



Canada Peace Bridge



Large Road Bridges Management

Introduction



Canada
Champlain viaduct



Large Road Bridges Management

Introduction



Denmark
Great belt link – East
bridge



Large Road Bridges Management

Introduction



France

Millau viaduct



Large Road Bridges Management

Introduction



Greece
Harilaos
Trikoupi
bridge



Large Road Bridges Management

Introduction



Japan
Akashi
Kaikyo
bridge



Large Road Bridges Management

Introduction



Sweden

Alvsborgsbron
bridge



Organization of the management

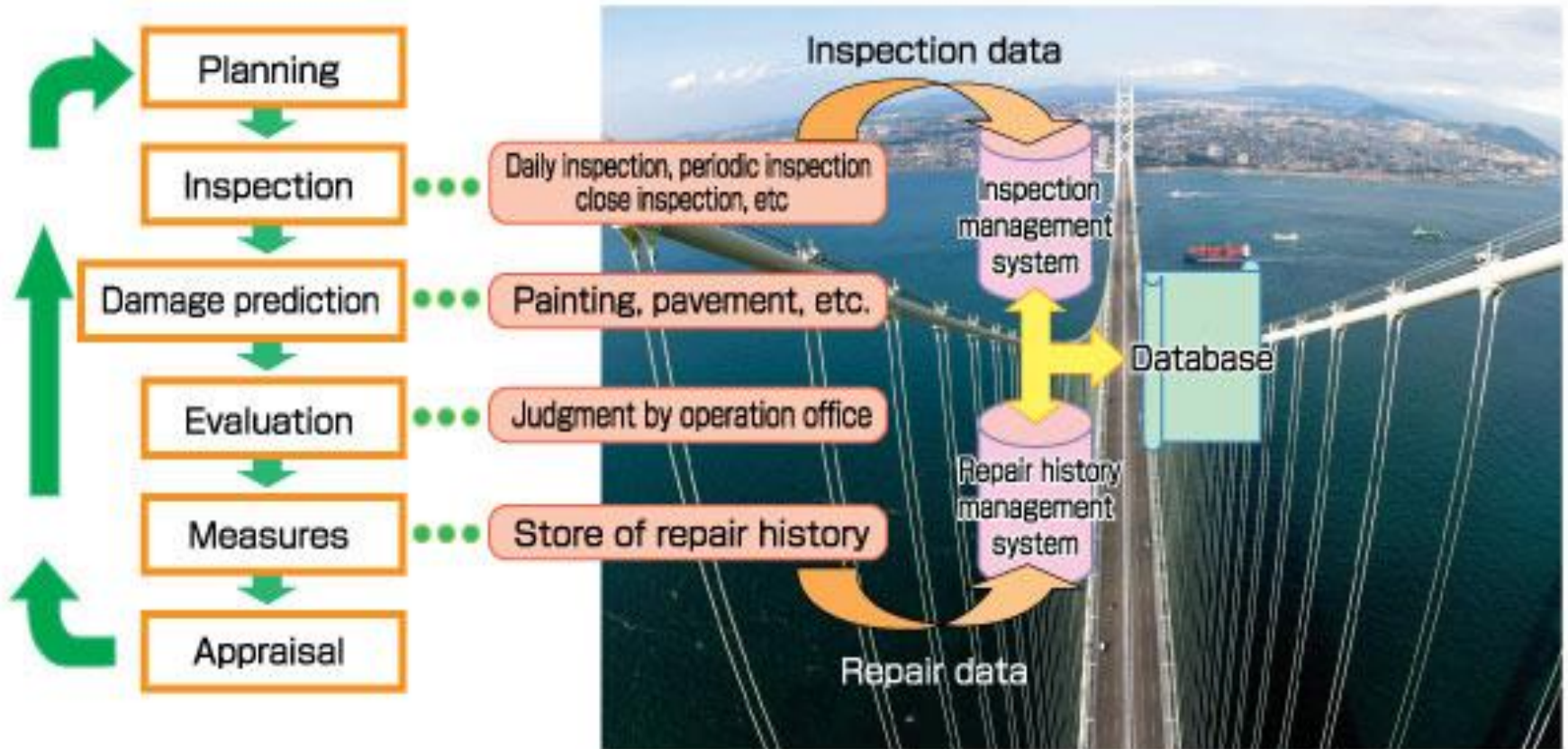
- Based on the Bridge Management System of the country
- Dedicated team in charge of very large bridges
- High objectives in terms of risk mitigation, durability, maintenance planning and costs
- Monitoring system to assess the bridge condition on very large bridges



Large Road Bridges Management

Organization of the management

- Akashi-Kaikyo : Preventive maintenance scheme



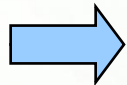
Organization of the management

Risk analysis = Hazard * Vulnerability* Consequences

- Analysis of potential hazards
- Assessment of material and structural vulnerability
- Mitigation :

Adequate design

Choice of materials



Monitoring

Accessibility and reparability

Maintenance actions



Monitoring of large bridges

Objectives

- Detect internal or external hazards
- Ensure that the structure behaves as expected
- Control material properties and durability
- Operational Control : weather station, trafic flow,..

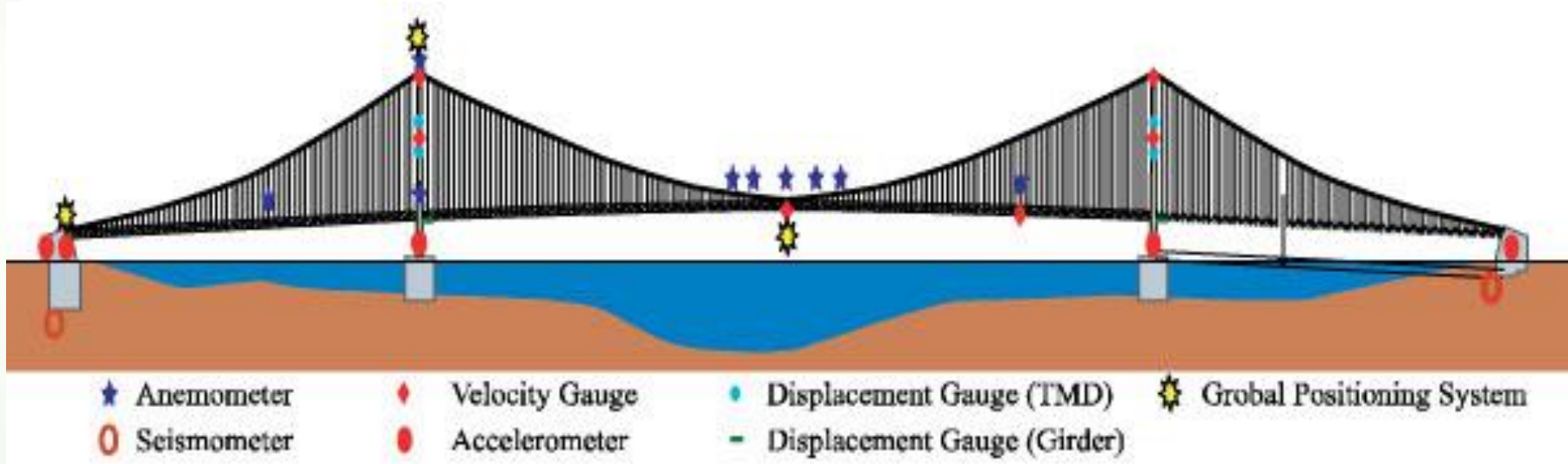
Cost of a monitoring system

- 0,1 % to 0,3% of construction cost



Monitoring of large bridges

Akashi Kaikyo : Monitoring of the dynamic behavior to check the design under extrem events (wind, earthquake)



Monitoring of large bridges

Great Belt link : 450 devices to monitor the bridge :

- Structural monitoring :

- Global : GPS, geometrical survey
- Local : mouvement of expansion joints, of hydraulic buffers, of bearings

- Material monitoring :

- steel fatigue : strain gauges
- concrete : embedded electrical probes (corrosion of reinforcement) + spare concrete blocks for testing

- Operational monitoring :

- weather station, trafic flow, icing of the road



Maintenance and rehabilitation

Monitoring  Conditional preventive maintenance

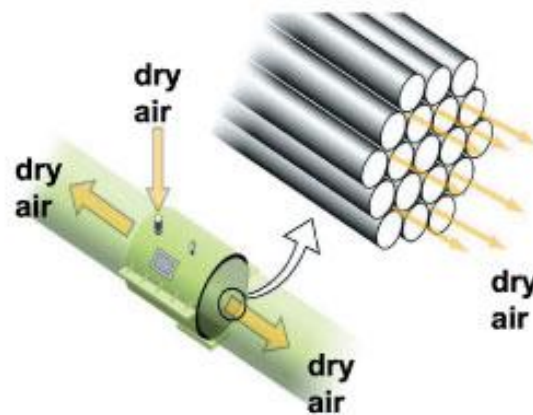
- Concrete protection before the carbonation front reaches the reinforcement
- Recoating of a steel bridge before deterioration of the second protective layer to avoid painting off



Maintenance and rehabilitation

Devices and actions for a very long durability

- Permanent electro-chemical protection of marine steel piers
- Dry air injection in main suspension cables of suspended bridges
- Dehumidification of steel box girders
- Dampers to reduce cable vibrations



Akashi-Kaikyo :
dry air injection

Conclusion

Large road bridges are built for a very long service life

- A careful maintenance is a condition of success
- A modern monitoring system provides accurate information on materials, components and structural health
- It facilitates a conditional preventive maintenance approach which is the most cost effective.

