Weathering Steel Bridges and Bridge High-performance Steel

JISF Southeast Asia Steel Construction Seminar

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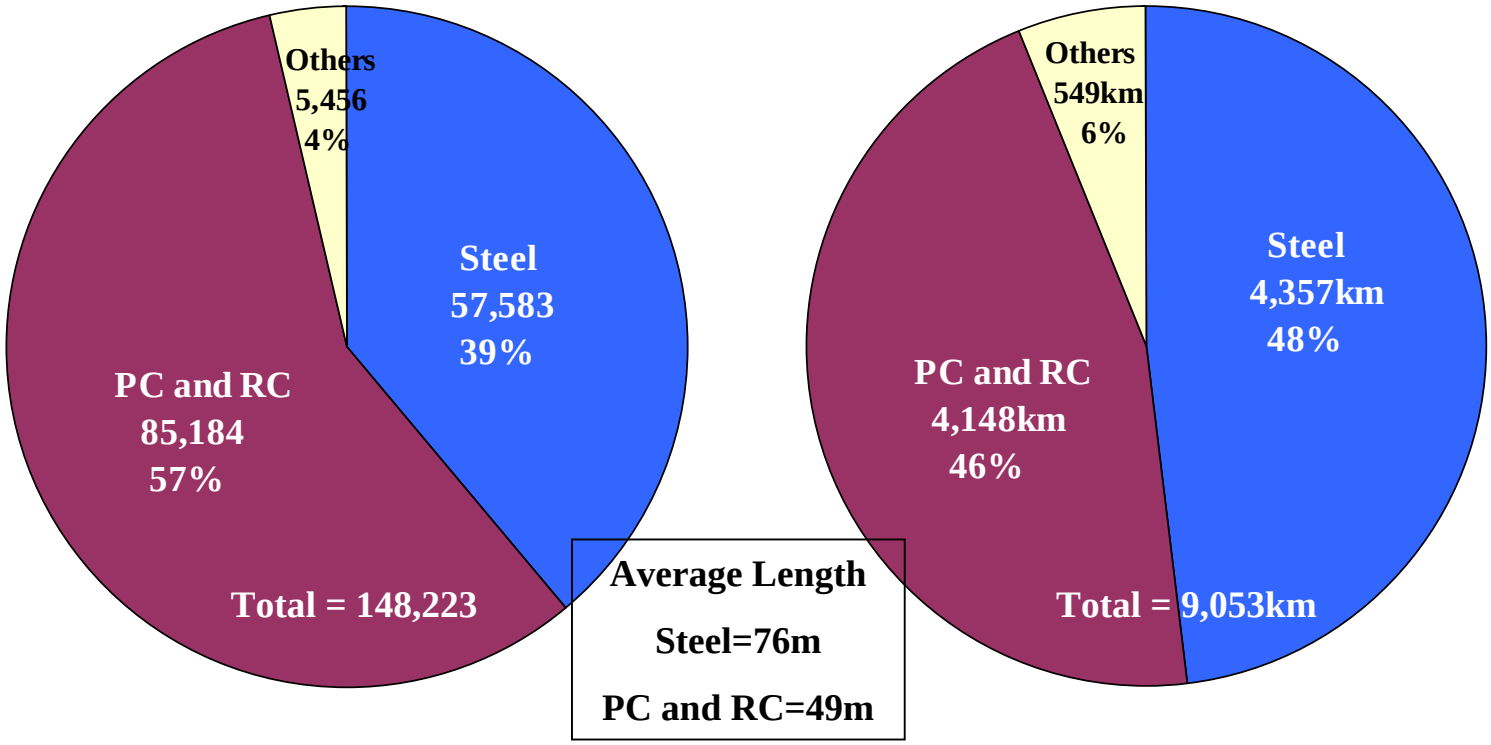
Outline of bridges in Japan



Accumulated Bridge Number in 2006

(Bridge length ≧ 15m)

Accumulated Bridge Length in 2006

(Bridge length ≧ 15m)

Design Specifications

Specifications for Highway Bridges

Japan Road Association, 2002

- Part 1: Common
- Part 2: Steel Bridges
- Part 3: Concrete Bridges
- Part 4: Substructures
- Part 5: Seismic Design

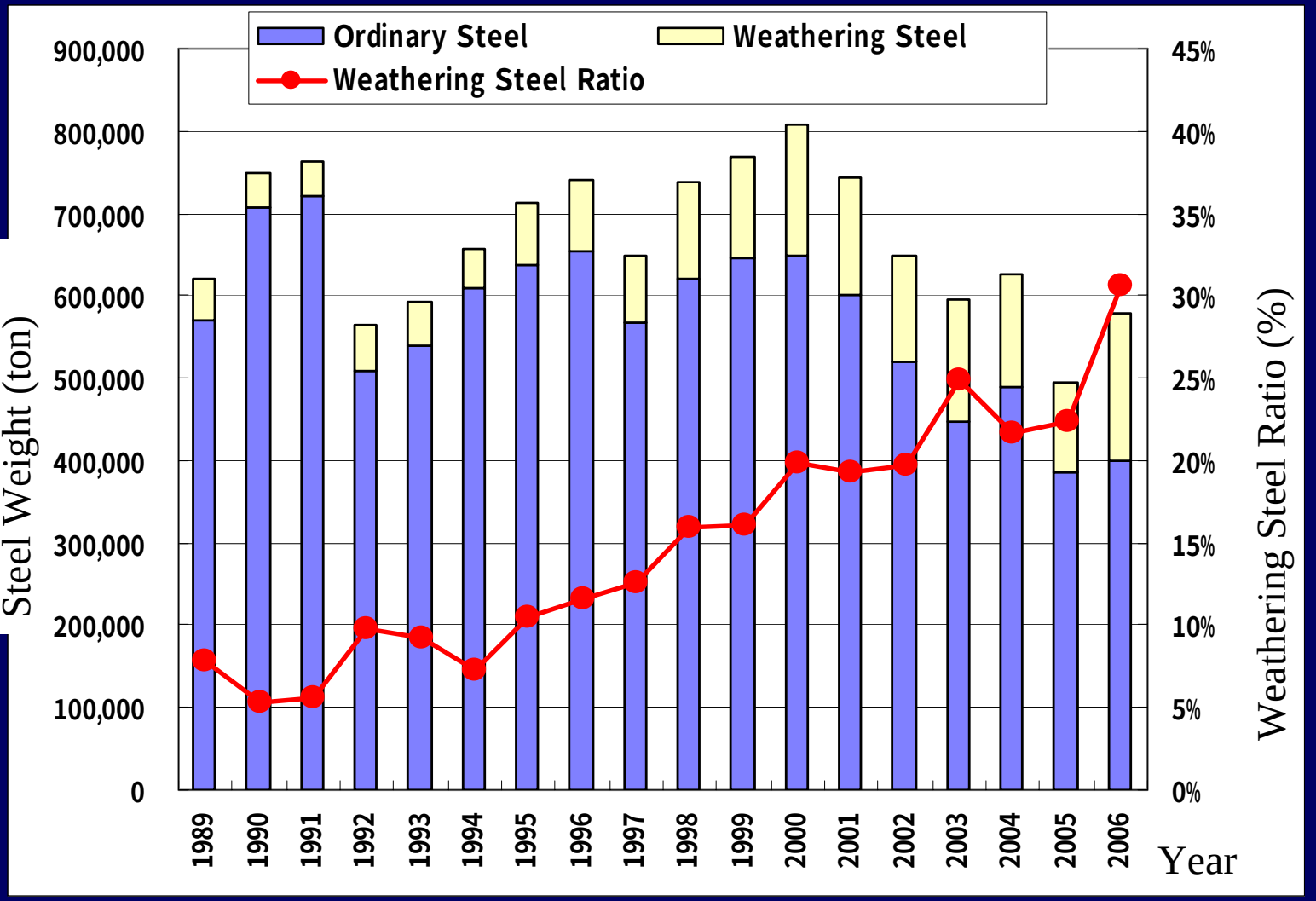
Clear indication of bridge performance

Allowable Stress Design Method

They are planed to be revised in 2009.

Partial Factors Design Method

Weathering Steel Bridges in Japan



Bridge Examples

Change of the surface

1)

2)

3)

1) After 1 month, 1982.2
2) After 13 months, 1983.3
3) After 17 years, 1999.1

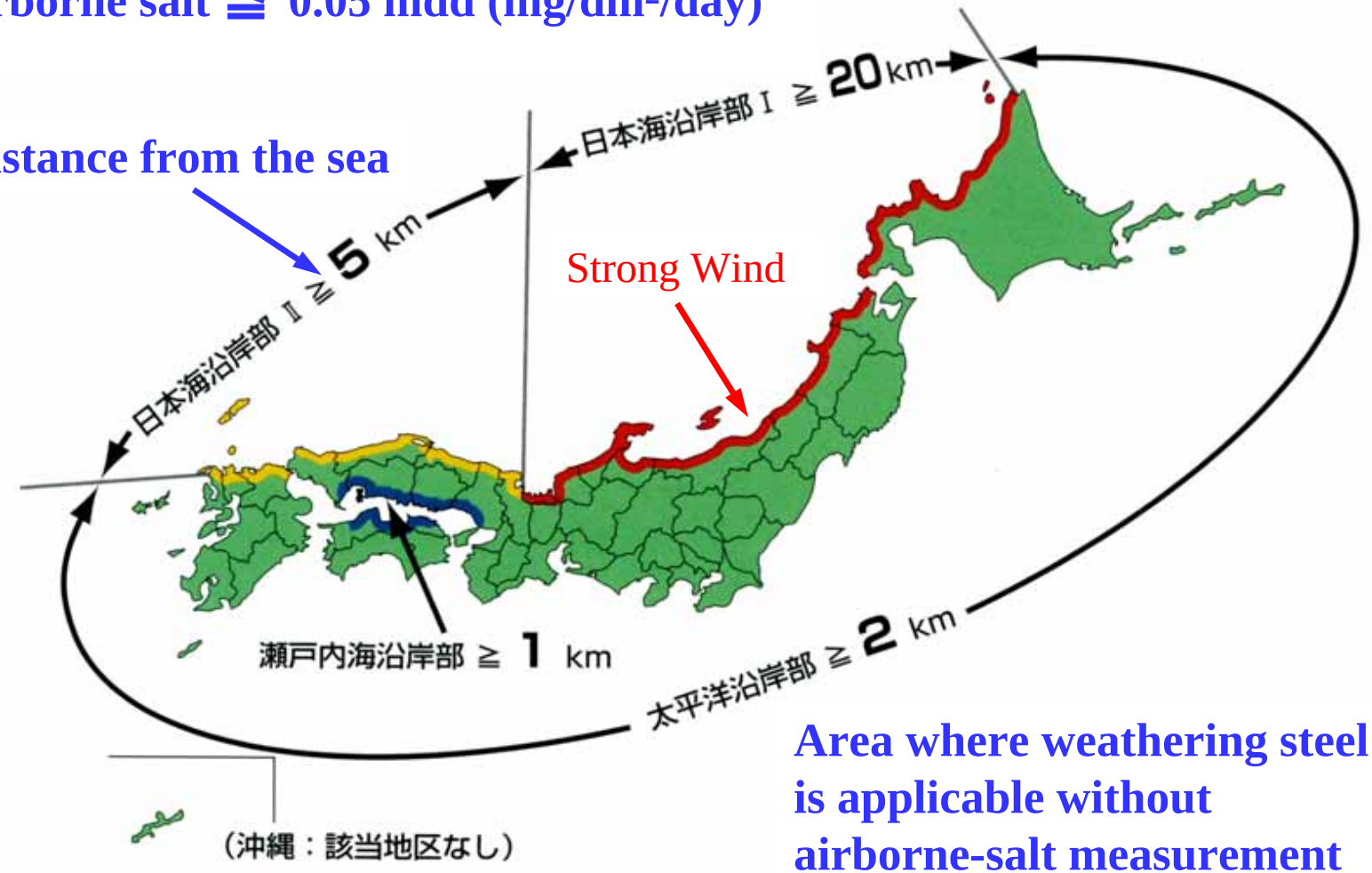
Arch Bridge

Girder Bridge

Truss Bridge

Specifications for Highway Bridges

Airborne salt ≦ 0.05 mdd (mg/dm²/day)



Area where weathering steel is applicable without airborne-salt measurement

Planning

Airborne-salt ≦ 0.05mdd (mg/dm^2/day)

⇒ Applicable

1) Area on the front map → Applicable without airborne-salt measurement

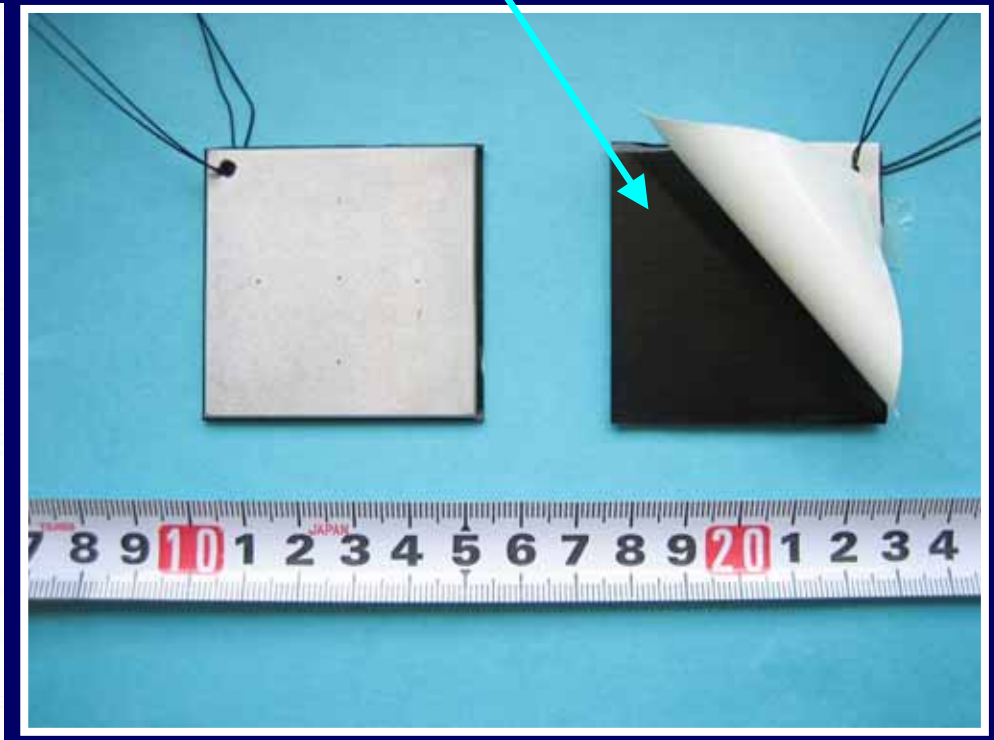
2) Airborne-salt measurement → Evaluate

3) Exposure test of specimens → Evaluate from a lot of exposure test data : 41 Bridges in the whole area in Japan for 18 years

Exposure Test

Specimens on a test stand
(former method)

Reverse: both-side adhesive tape



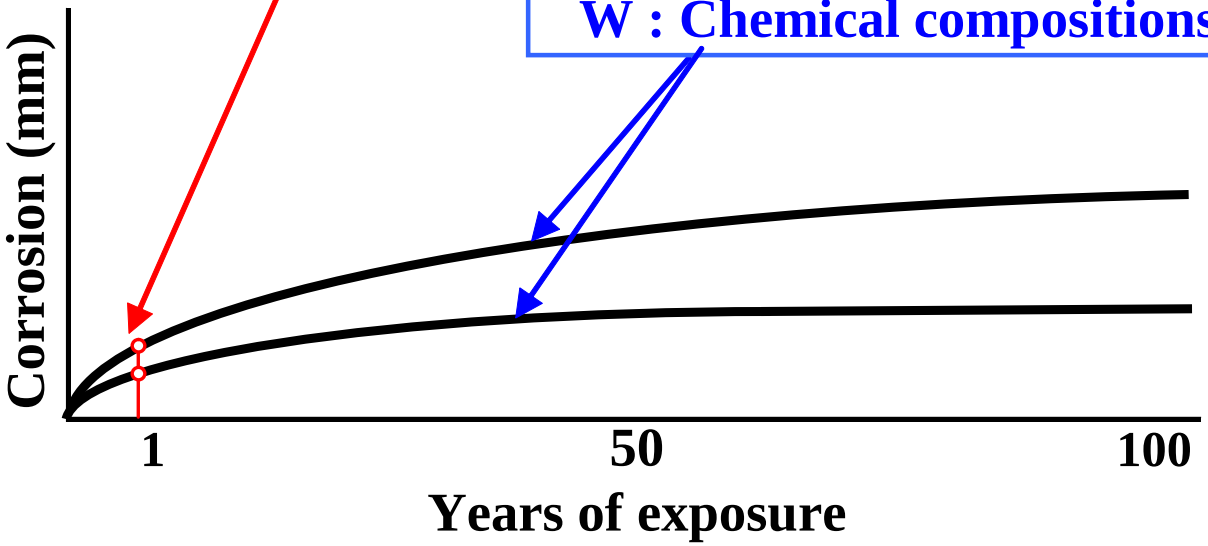
Button-test specimen with
both-side adhesive tape
(new method)

Prediction of corrosion in the future

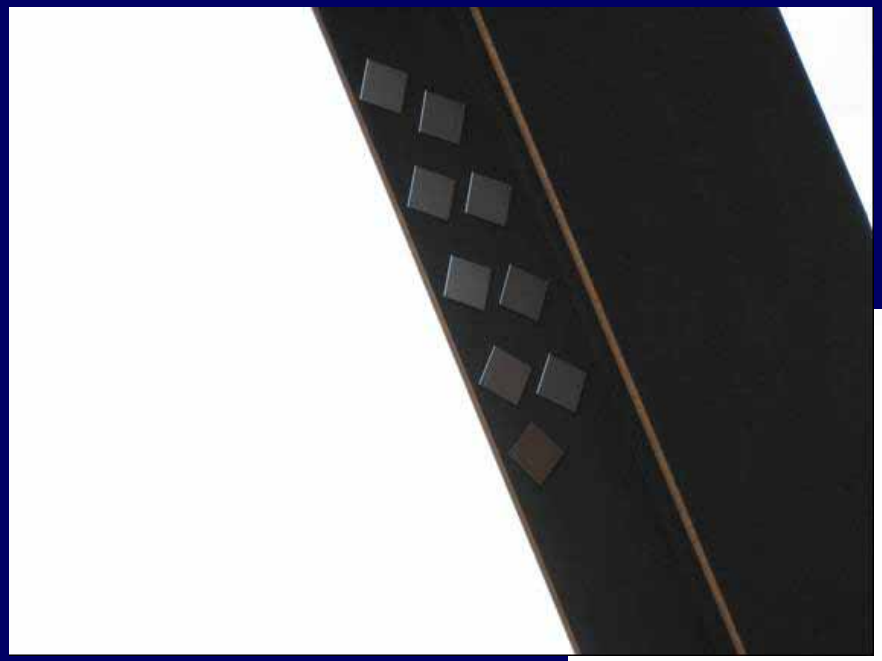
from a lot of exposure test data ; 41 Bridges
in the whole area in Japan for 18 years

Corrosion can be predicted from the exposure test data for 1 year

Corrosion = f (Cl, T, H, etc., W and Time)
- Cl : Airborne-salt
- T : Temperature
- H : Humidity
- W : Chemical compositions/Cu,Cr,Ni etc.



Button-test specimen



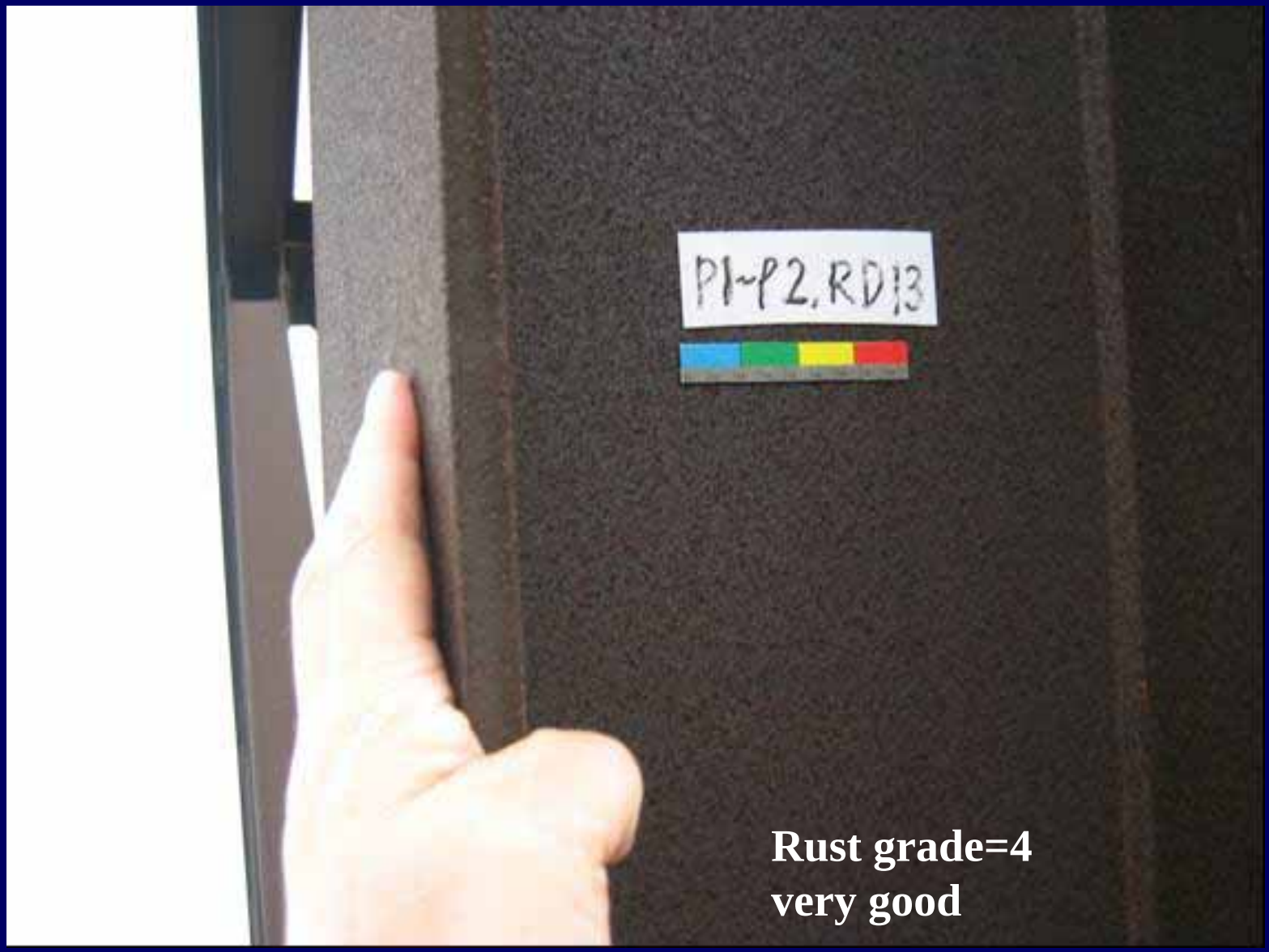
Maintenance

Standard Photos of Rust

Grade	5	4	3
Pictures			
Condition	very good	very good	good
Rust thickness	less than 200 μm or so	less than 400 μm or so	less than 400 μm or so
Action	nothing special	nothing special	nothing special

Standard Photos of Rust

Grade	2	1
Pictures		
Condition	caution	no good
Rust thickness	less than 800 μm or so	more than 800 μm or so
Action	continue to observe	repair (painting etc.)



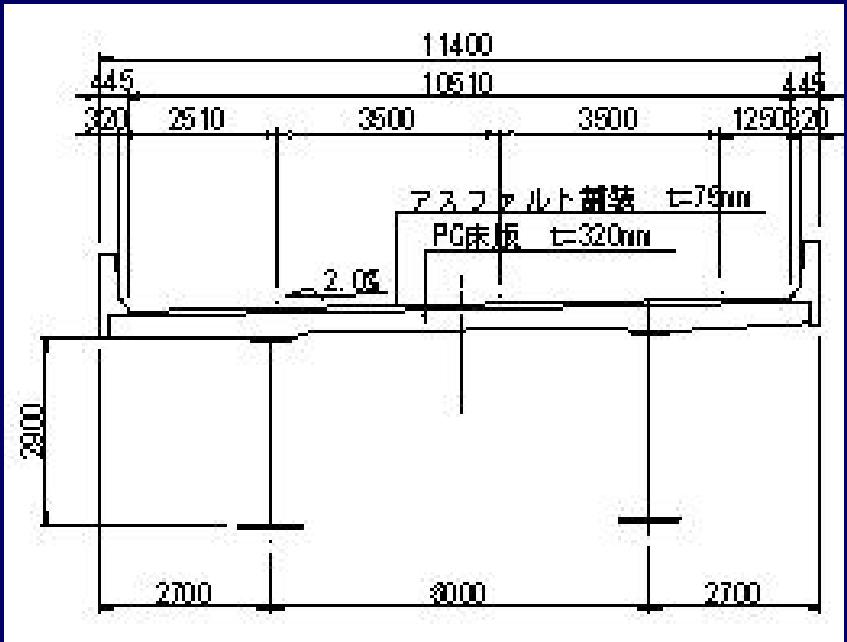
BHS : Bridge High-performance Steel

Higher strength and better weldability than conventional steel. ⇒ Reduce Steel Weight and Fabrication Cost

Steel Grade / Properties	570MPa		780MPa	
	BHS500(W)	Conventional SM570	BHS700W	Conventional HT780
min. Yield Strength (t = 50mm)	500 MPa	430 MPa	700 MPa	685 MPa
min. Yield Strength (t = 100mm)	500 MPa	420 MPa	700 MPa	665 MPa
Tensile Strength (Mpa)	570～720	570-720	780～970	780
max. Charpy Imapct Energy	100J	47J	100J	47J
max. Carbon Content	0.11%	0.18%	0.14%	0.18%
max. Pcm	0.20%	0.27%	0.32%	not specified
min. Preheating Temperature	Free	80 ℃	50 ℃	100 ℃

Pcm: Weld Crack Parameter = C+Mn/20+Si/30+Cu/20;Ni/60+Cr/20+Mo/15+V/10+5B (%)

Trial Design



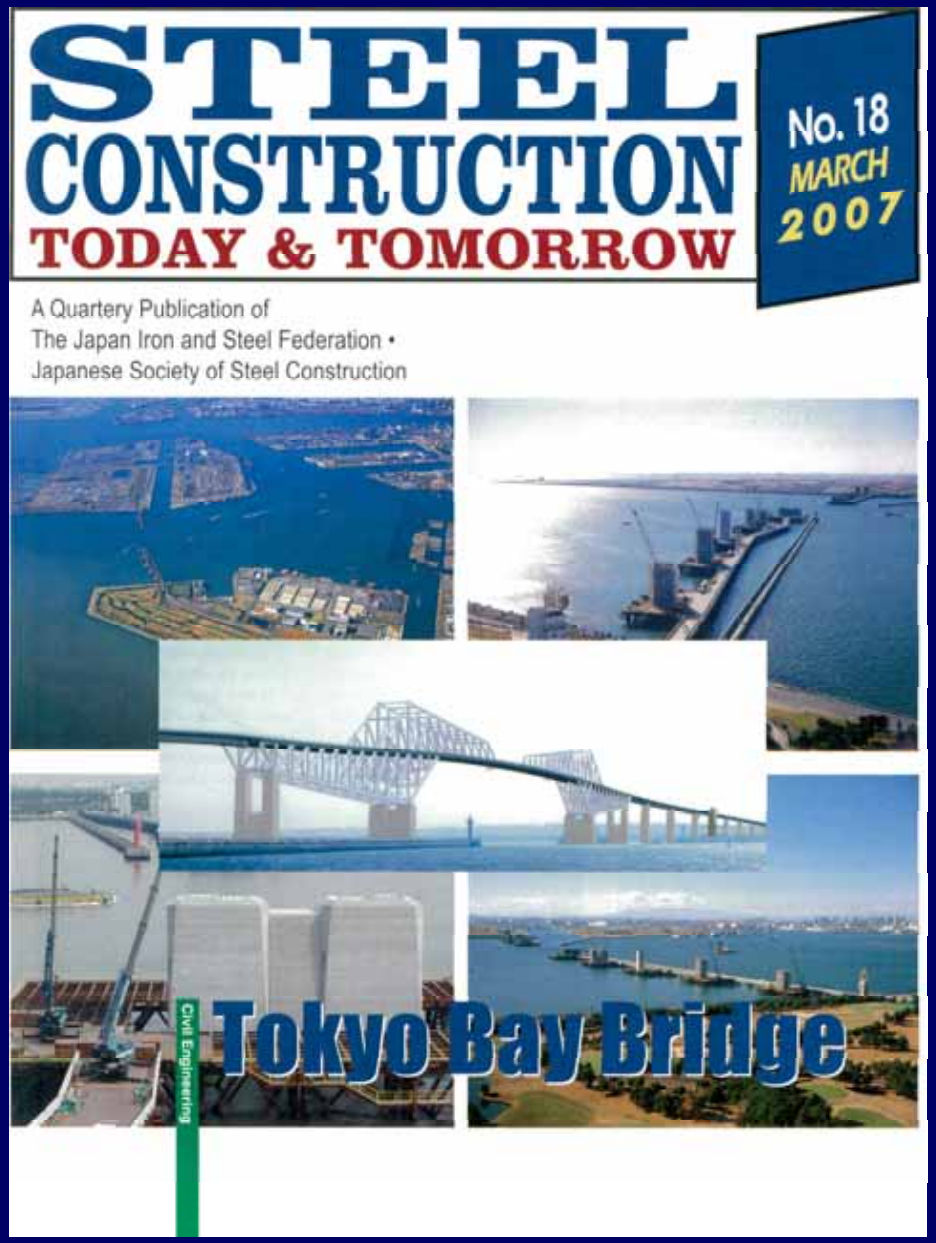
Continuous Composite

2-I Girder Bridge

Length = 3@60m= 180m

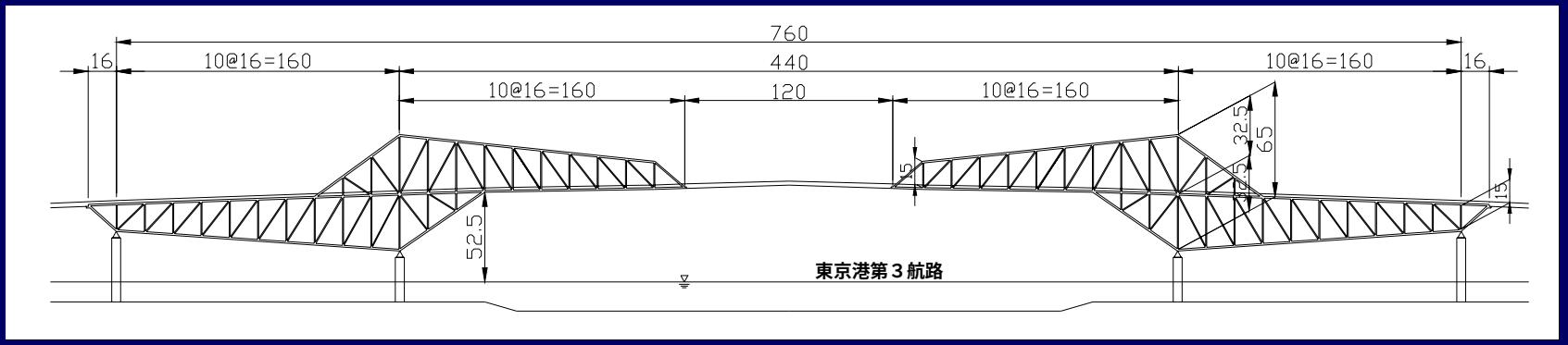
Comparison between ordinary steel and BHS

	SM570 (YP=450MPa)	BHS500 (YP=500MPa)	BHS700 (YP=700MPa)
Steel Weight Ratio	1.00	0.93	0.85
Total Construction Cost	1.00	0.90	0.99



Japan Iron and steel federation

The 1st long-span bridge BHS is applied to.



Steel Weight = 20,250 t included BHS500 =10,250t

Reduction in Total Cost = 12%

Thank you very much for your Kind Attention