Studies on maintenance of aged steel bridges

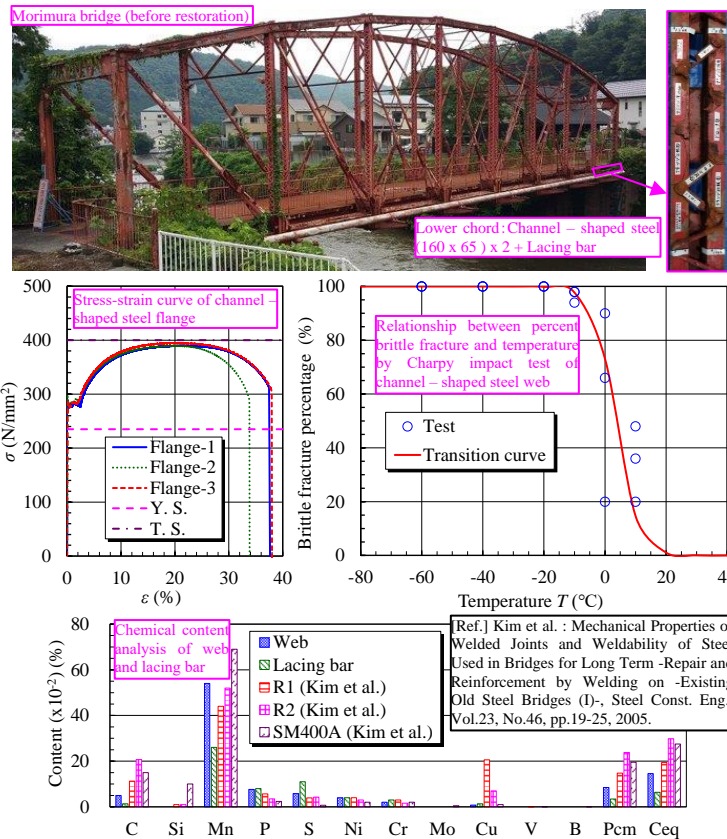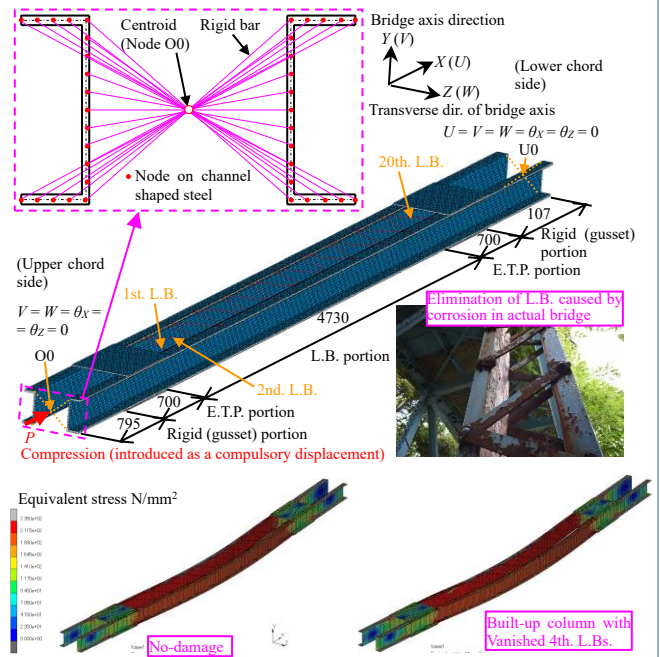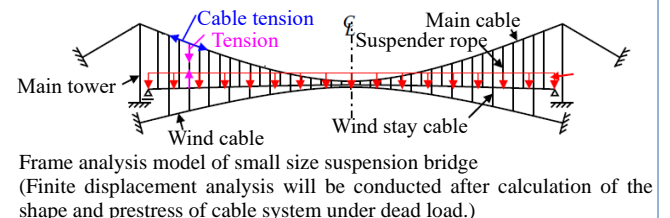| Name	MIYOSHI Takao	E-mail	miyoshi@akashi.ac.jp
Status	Associate Professor		
Affiliations	JSCE (Japan Society of Civil Engineers), JSSC (Japanese Society of Steel Construction), JSME (The Japan Society of Mechanical Engineers)		
Keywords	aged steel, material properties, built-up member, small size suspension bridge, ultimate strength, finite element method		
Technical Support Skills	Material properties of aged steel and its investigation Ultimate strength evaluation and repair method of built-up members with damage caused by corrosion Ultimate strength evaluation of steel members with thinning and crack caused by corrosion An effect of cable system deterioration on mechanical behavior of small size suspension bridge		

Research Contents

(1) Investigation on material properties of aged steel removed from actual bridge

(2) A study on load carrying capacity of built-up column with vanished lacing bar

(3) A study on load carrying capacity and deformation properties of small size suspension bridge with deteriorated cable system

Morimura bridge (before restoration)

Lower chord：Channel – shaped steel (160 x 65) x 2 + Lacing bar

Stress-strain curve of channel – shaped steel flange

Flange-1
Flange-2
Flange-3
Y. S.
T. S.

Relationship between percent brittle fracture and temperature by Charpy impact test of channel – shaped steel web

○ Test
— Transition curve

Chemical content analysis of web and lacing bar

Web
Lacing bar
R1 (Kim et al.)
R2 (Kim et al.)
SM400A (Kim et al.)

[Ref.] Kim et al. : Mechanical Properties of Welded Joints and Weldability of Steel Used in Bridges for Long Term -Repair and Reinforcement by Welding on -Existing Old Steel Bridges (I)-, Steel Const. Eng., Vol.23, No.46, pp.19-25, 2005.

Several material test results of removed member from Morimura bridge (completed in 1906)

(Tensile strength of removed member is lower than its minimum proof value (400 N/mm^2). Percent brittle fracture of removed member shows 100% below -20 degrees Celsius. Carbon content of removed member is low compared to that of current steel. Contents of phosphorus and sulfur are high as well.)

Centroid (Node O0)   Rigid bar

Node on channel shaped steel

Bridge axis direction
$Y(V)$
$X(U)$
$Z(W)$ (Lower chord side)

Transverse dir. of bridge axis
$U = V = W = \theta_X = \theta_Z = 0$
U0

20th. L.B.
107
Rigid (gusset) portion
700
E.T.P. portion

(Upper chord side)
$V = W = \theta_X = \theta_Z = 0$
O0
P
Compression (introduced as a compulsory displacement)
1st. L.B.
2nd. L.B.
795
700
Rigid (gusset) portion
E.T.P. portion
L.B. portion
4730

Elimination of L.B. caused by corrosion in actual bridge

Equivalent stress N/mm^2

No-damage

Built-up column with Vanished 4th. L.Bs.

Numerical investigation on the ultimate strength of built-up member with vanished lacing bars (L.B.)
(Vanishment of fourth lacing bars does not give significant effect on the load carrying capacity.)

Cable tension
Tension
Main cable
Suspender rope
Main tower
Wind cable
Wind stay cable

Frame analysis model of small size suspension bridge
(Finite displacement analysis will be conducted after calculation of the shape and prestress of cable system under dead load.)

Available Facilities and Equipment

Universal hydraulic testing machine (2000kN capacity)	General purpose finite element analysis program MSC Marc/Mentat
Personal computer (Dell Precision 3640)	Self-made non-linear finite element analysis program
Personal computer (Be-Clia)	Exterior digital caliper gauge (TECLOCK GMD-1J)
Fortran compiler (Intel)	Digital point micrometer (Niigata Seiki MCD232-25P)
General purpose pre and post processor GiD	Portable Data Logger (TML TDS-150)