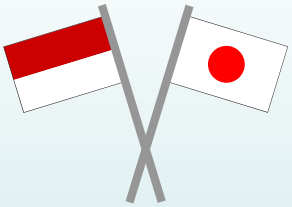
Steel Bridge Quality Management in Japan

Selamat sore



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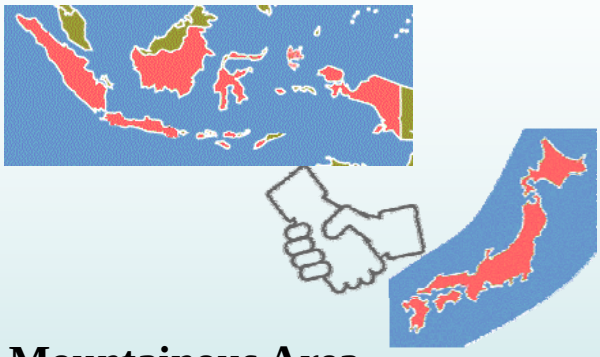
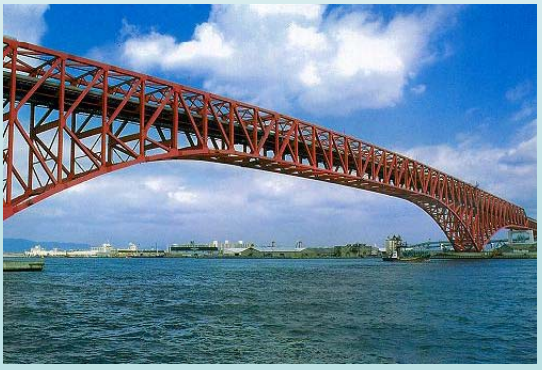
Variety of Bridges



Plain

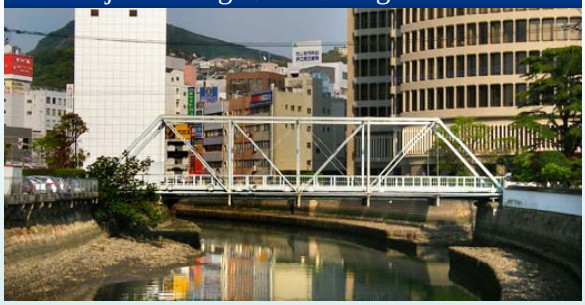
Mountainous Area

River & Strait



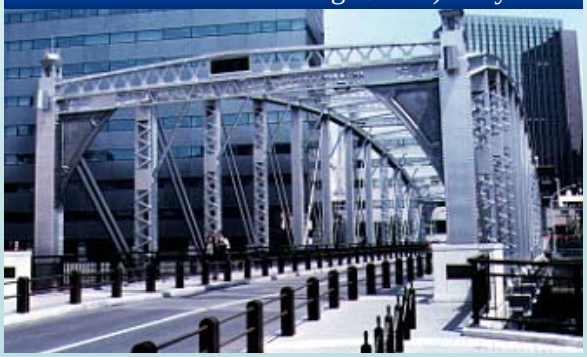
Over 100 years Bridges

Dejima Bridge（1890） Nagasaki Pref.



Mogamigawa Bridge（1886） Yamagata Pref.

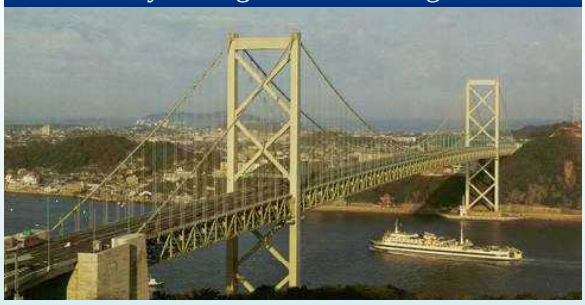
Minami-Takabasi Bridge（1904） Tokyo



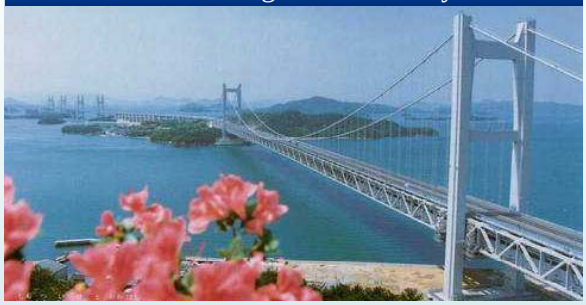
Hachiman Bridge（1878） Tokyo

Strait Crossing Bridges
(Over 20 years.)

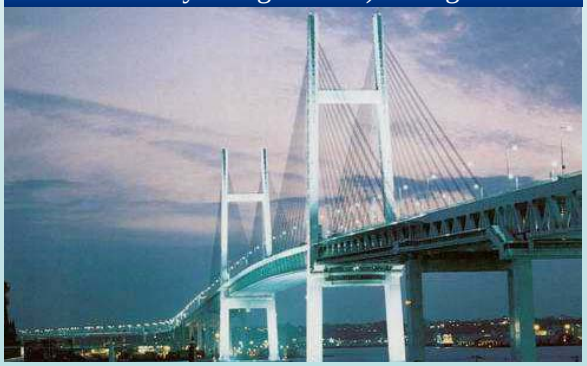
Kanmonkyo Bridge（1973） Yamaguchi Pref.



Shimotsui-Seto Bridge（1988） Okayama Pref.



Yokohama Bay Bridge（1989） Kanagawa Pref.



- Quality Control
  through Construction phase
  to Operation phase

- Record and maintain
  Result of Quality Control

- - Traceability - -

Work Flow of Construction

Full-Size Drawing

Material Procurement

Marking / Cutting

Assembly / Welding

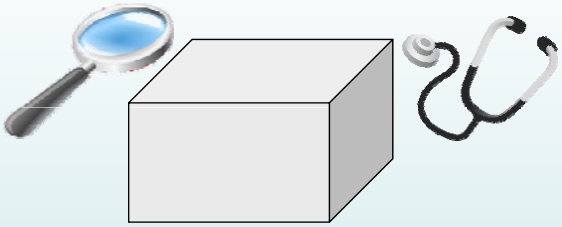
Temporary Erection

Shop Painting

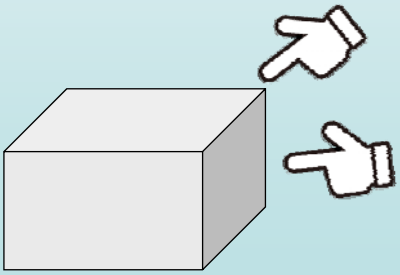
Erection

Inspection / Repair

Double check

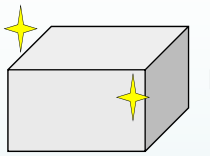


Mutual check

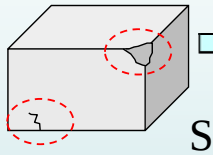


Work Flow of Construction

(Checking system)

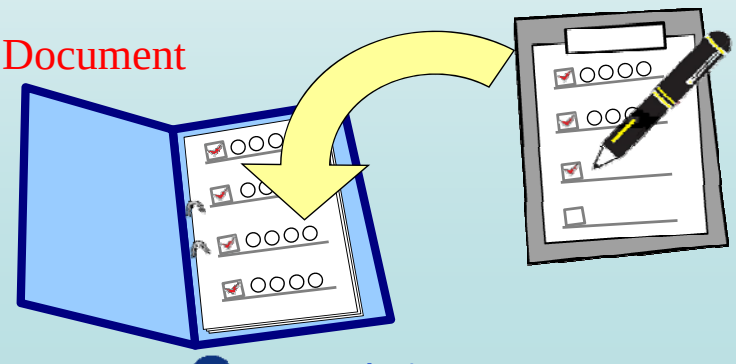


Next process



Supplier
Previous process

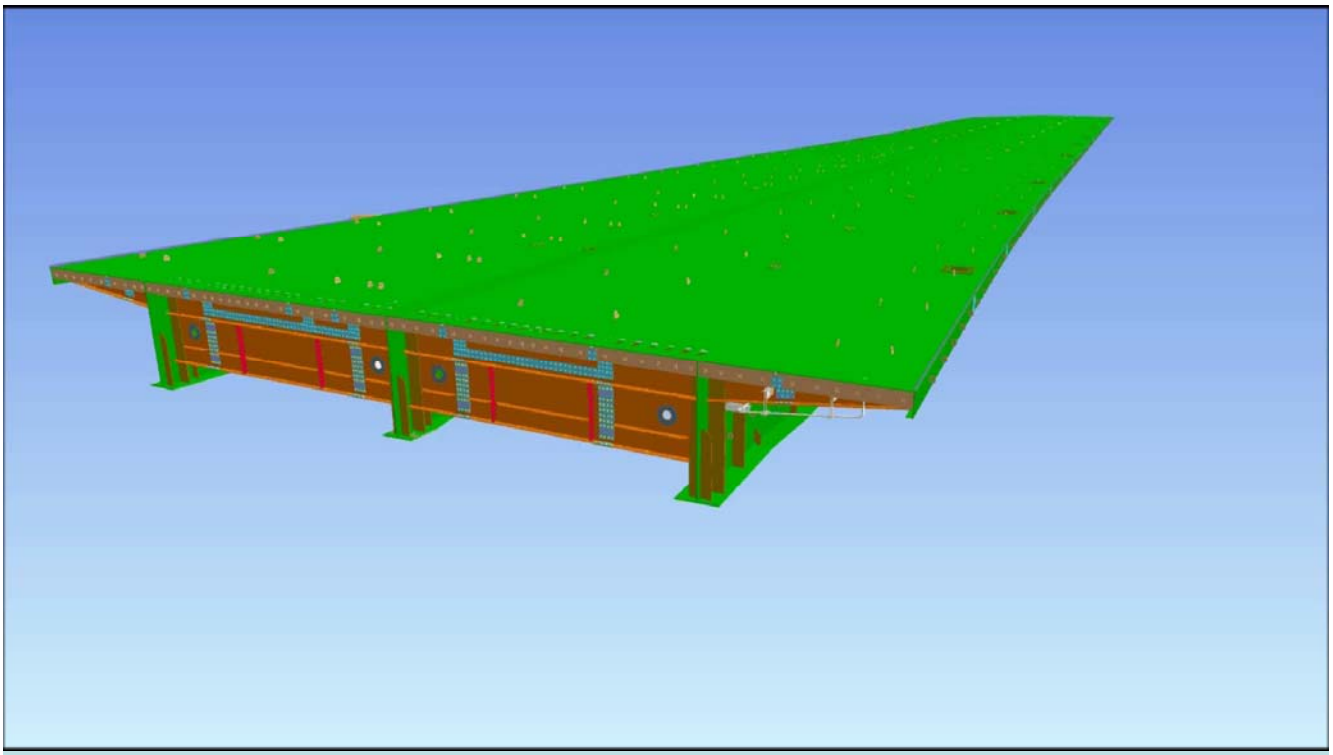
Record & Document



Full-Size Drawing

- developed from information presented on the contract drawings
- contains
  - basic bridge geometry
  - sub-structure locations
  - sizes of all material
  - weld and bolt sizes
  - basic connection information
  - etc.

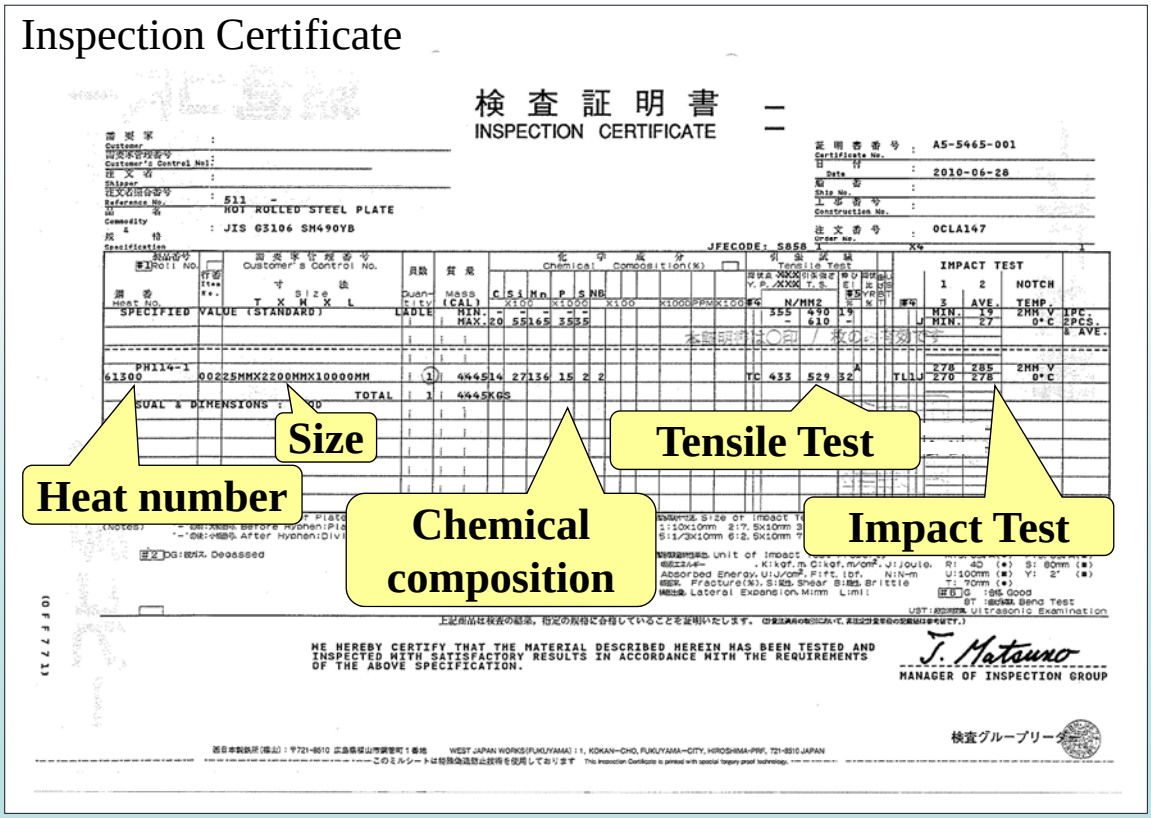
3D-computer generated model



Record and document the information

Material Procurement

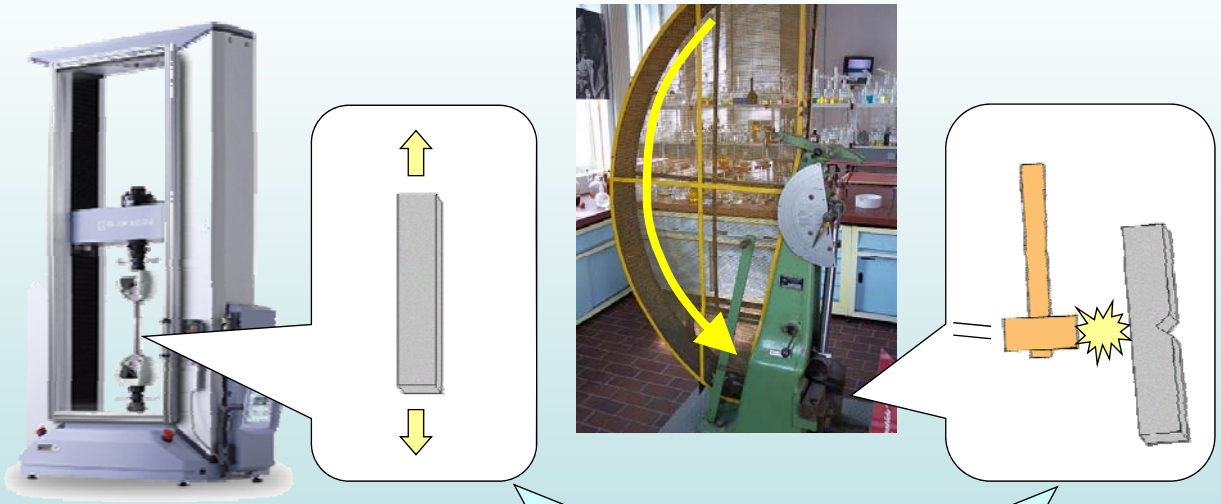
Inspection Certificate



Material Procurement

- Tensile Strength Testing -
measure Tensile Strength

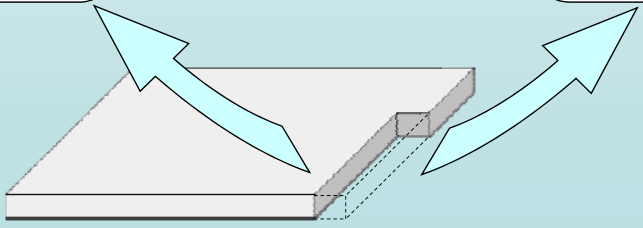
- V-Notch Testing -
measure brittle toughness



- Double-check -

Certificates

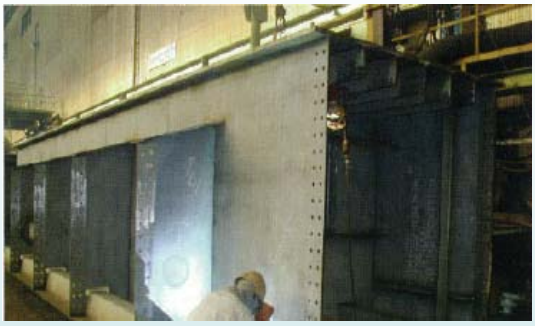
Actual testings



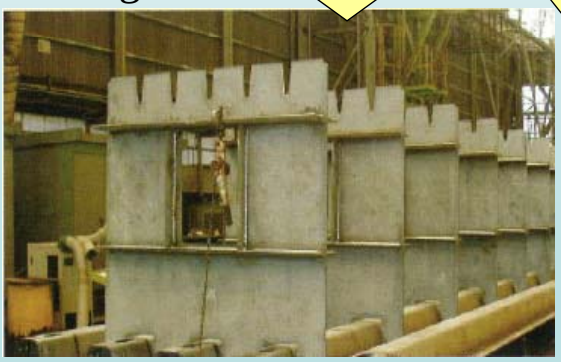
Welding

Individual Panel Assemblies

Assembled into Girder



Arrangement



Items factored in

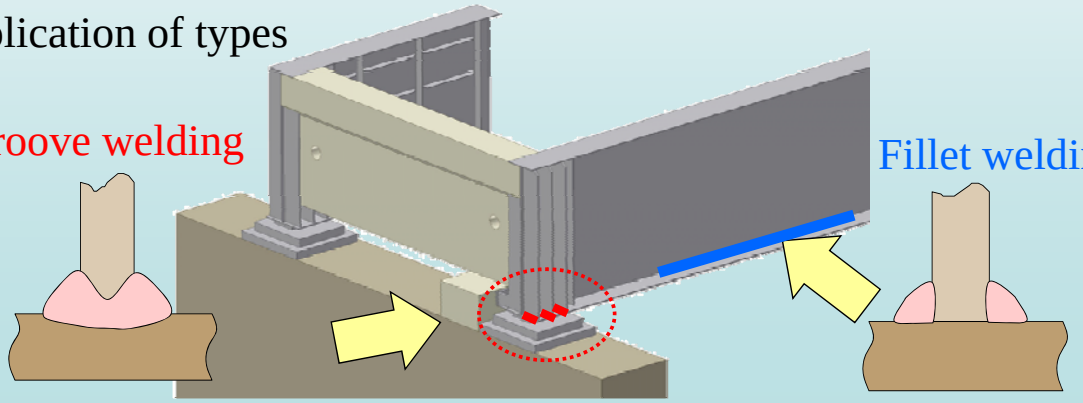
- Welding type
- Welding Processes, position
- Thickness of base material

Welding / Types

Fatigue (cycle) Testing

- to study
  Characteristics
  Durability
  of each welding types

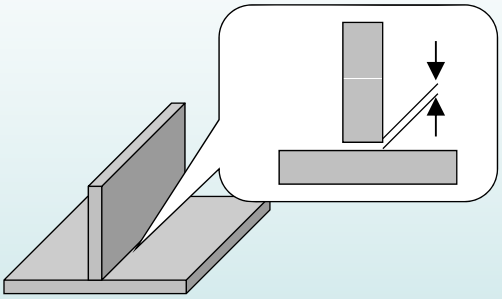
Application of types



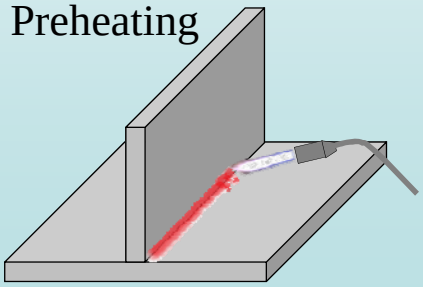
Welding / Operation

Preparation for Welding

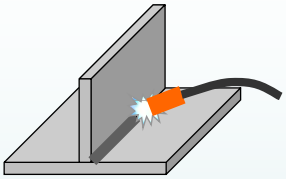
Checking gap



Preheating



During Welding



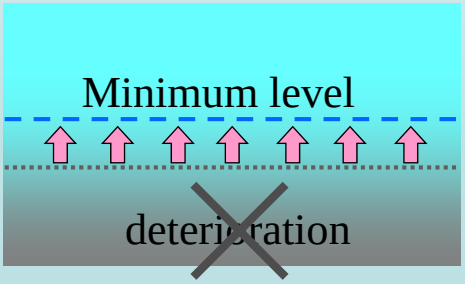
Observe and control
- Interpass temperature
to prevent cracking

- Heat input
to prevent getting brittle

Quality

better

worse



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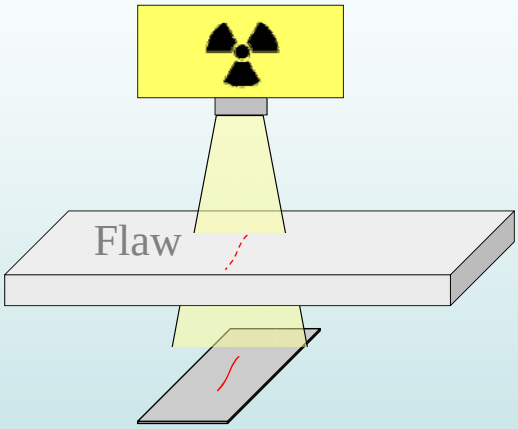
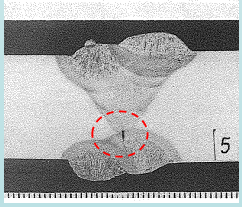
Nondestructive Testing (NDT)

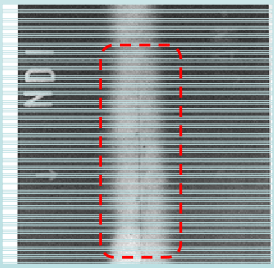
(Detect Embedded Flaws)

Radiographic Testing

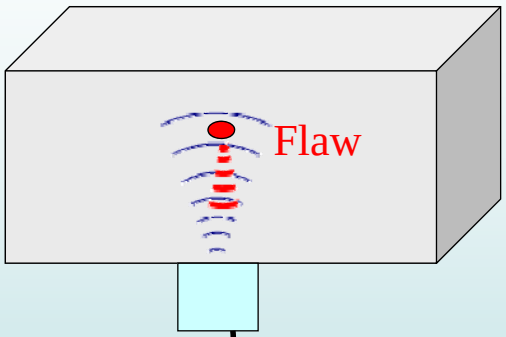


Flaw





Ultrasonic Testing



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Nondestructive Testing (NDT)

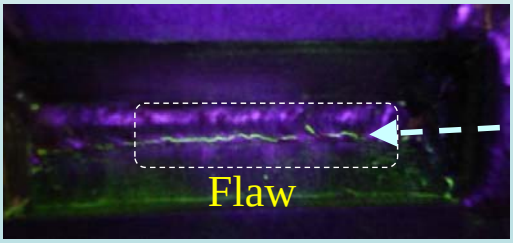
(Detect Flaws on the weld)

Magnetic Particle

invisible

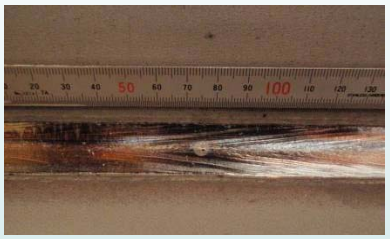
highlights

visible



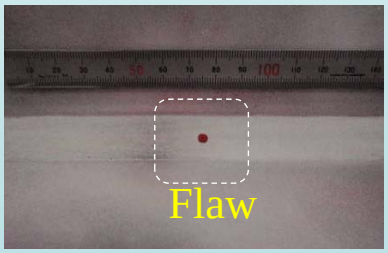
Dye Penetrant

invisible



highlights

visible



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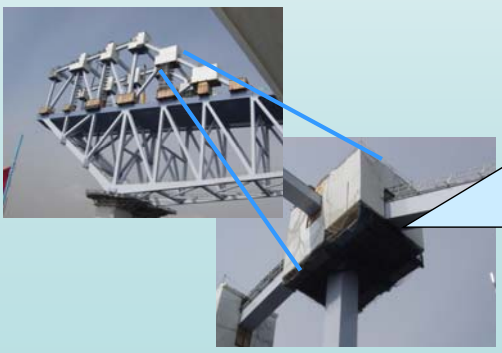
Tokyo Gate Bridge

High Durability & Smooth Exterior



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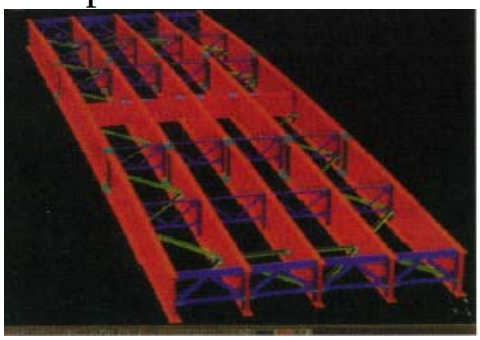
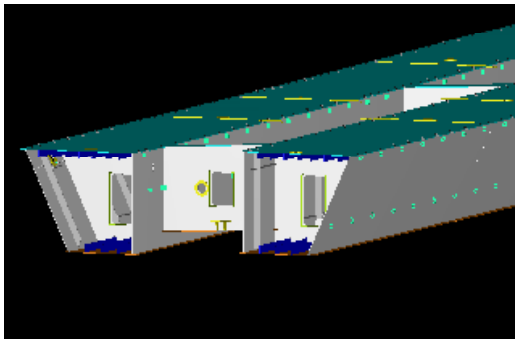
Temporary Erection

Conform with fabrication tolerance

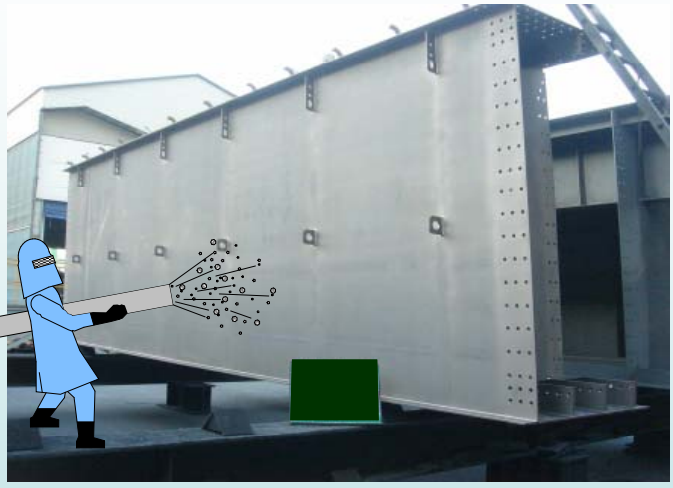
Computer Simulation





Shop Painting / Blast

Blast cleaning



- is to clean prior to painting
- is to shoot a mixture of steel particles

Specimen

Shop painting

Brush painting

- Narrow spaces
- Material edges

spray painting

- Fluorine resin paint material
  is generally used

40years Durability

Shop painting

Check
Temperature / Humidity

- Temperature affects
  Drying and Curing times

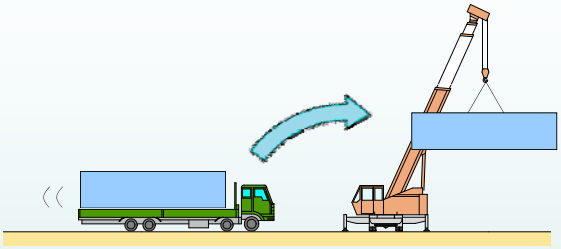
- Humidity affects
  Condensation

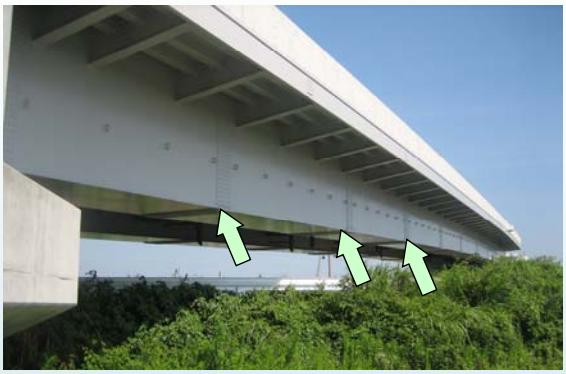
Measure Thickness

(Each coating ‘layer’)

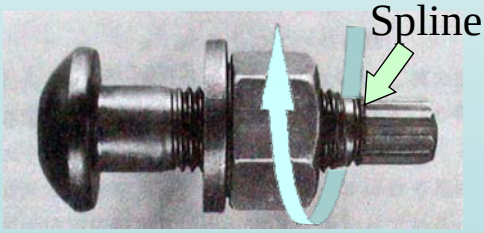
to obtain evenness of the paint

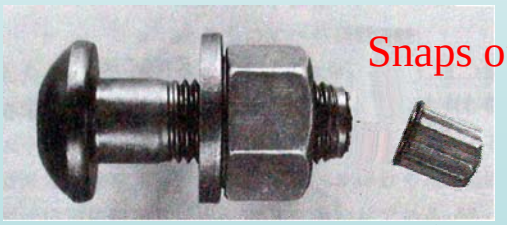
Site Joint / Torque control bolt





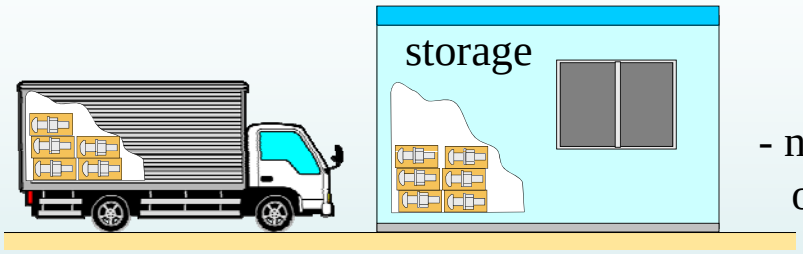
High strength bolt
- Torque control bolt





Appropriate tension force

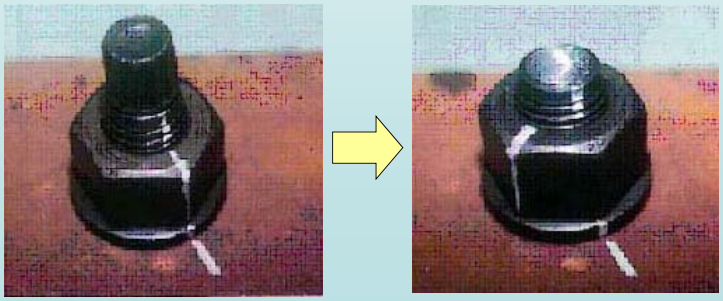
Site Joint / Torque control bolt



- must be used
  in as-received condition

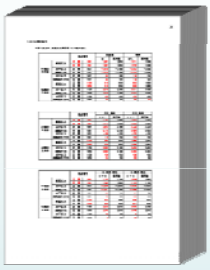
- needs special attention
  on cleanliness

100% Visual Inspection

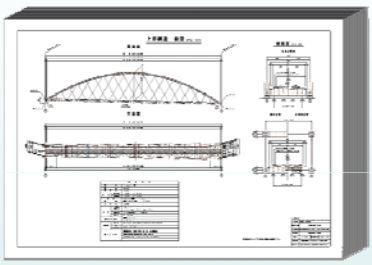


Storage of Information

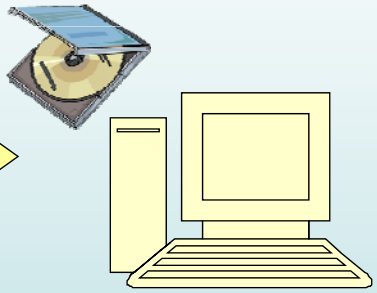
Design Reports



Drawings

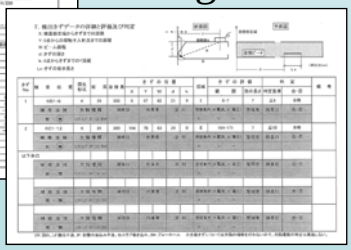


Electronic Files

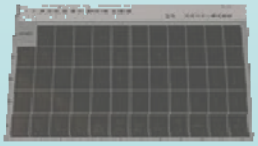


Fabrication Information

Testing Results



Microfilms



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Inspections

Inspection

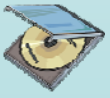
- Ordinary Inspection
- Periodical Inspection
- Intermediate Inspection
- Specific Inspection
- Inspection after Extreme Event such as Earthquake

Data → Future Inspections

Data → Repair works

Repair works → Data Storage

Data



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Summary

In Japan,

- Construction processes are operated under well controlled condition

- Results of operations are confirmed before going next step

- Reports are recorded and documented to secure the traceability

to guarantee the quality of the product at the time of completion
also
to keep infrastructures in proper condition



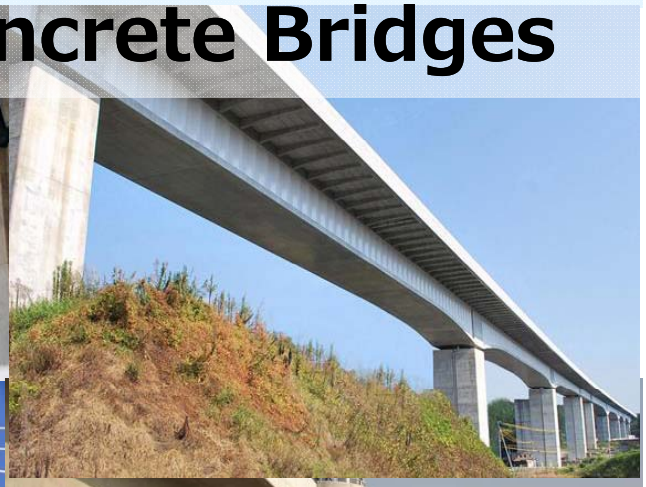
Terima kasih

Thank you

一般社団法人 日本橋梁建設協会
Japan Bridge Association

Japan Bridge Association

Accelerated Construction of Prestressed Concrete Bridges

Advantages of Accelerated construction

1. Accelerated construction in urban areas

- Reduction of traffic jam by early opening of a traffic network
- Load reduction on current road networks via fewer traffic controls at time of installation
- Reduction of loads on local residents by pre-casting

2. Accelerated construction in mountainous area

- Economic impact by maintaining road networks soon.
- Rise in convenience by introducing bypass roads soon.

3. Accelerated construction of large bridges

- Contributes to economic development by connecting soon to economics that are separated by strait, etc.

Advantages of rapid construction of elevated bridges in urban areas

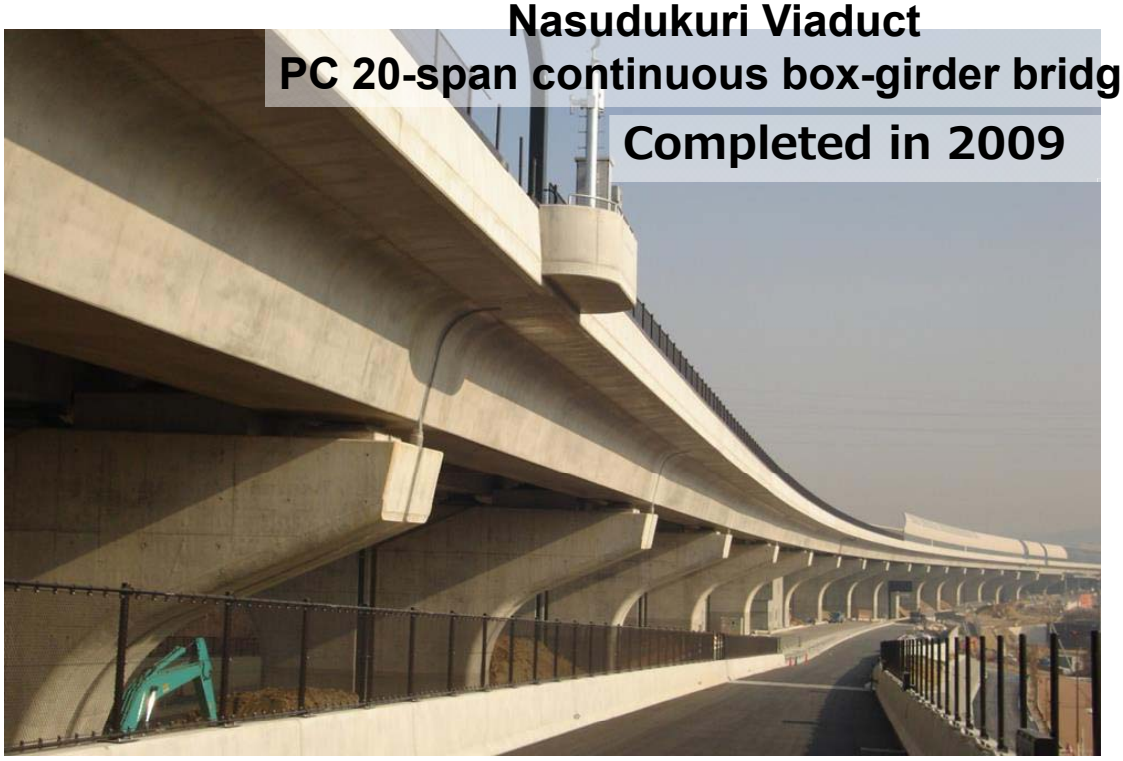
- ○ U-beam lifting erection method
- ○ Span-by-span construction method using U-shaped cross sections

<Effects>

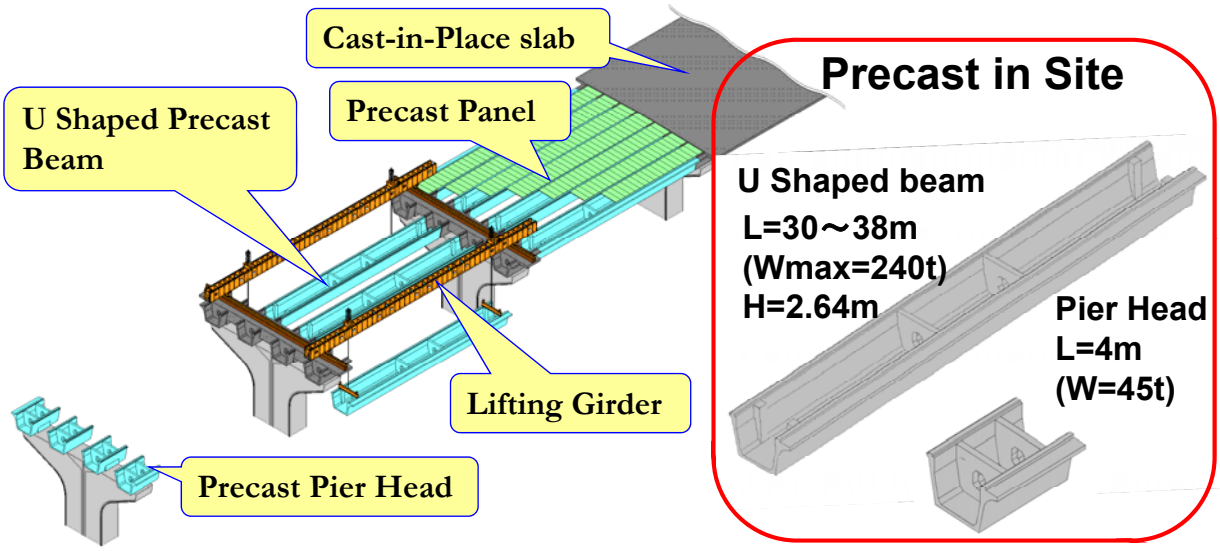
- Reduction of traffic jam by early opening of a traffic network.
- Load reduction on current road networks via fewer traffic controls at time of installation.
- Reduction of loads on local residents by pre-casting

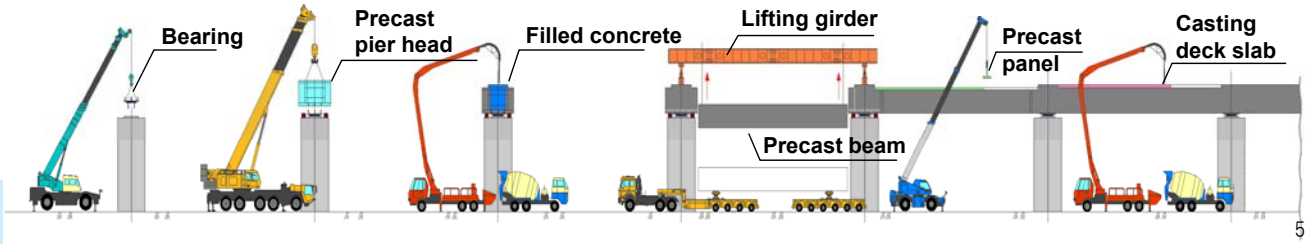
1. U-beam lifting erection method

Nasudukuri Viaduct
PC 20-span continuous box-girder bridge
Completed in 2009



Overview of U-girder lifting erection method

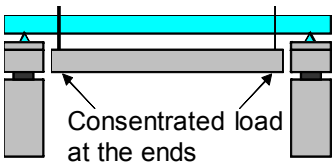
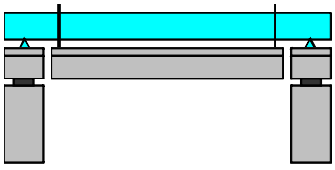
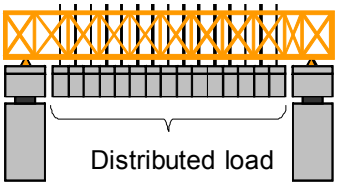
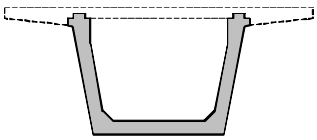
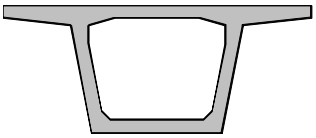
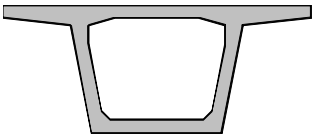




Onsite transportation of 2400kN weight beams

Lifting U-beam

Comparison to ordinary methods

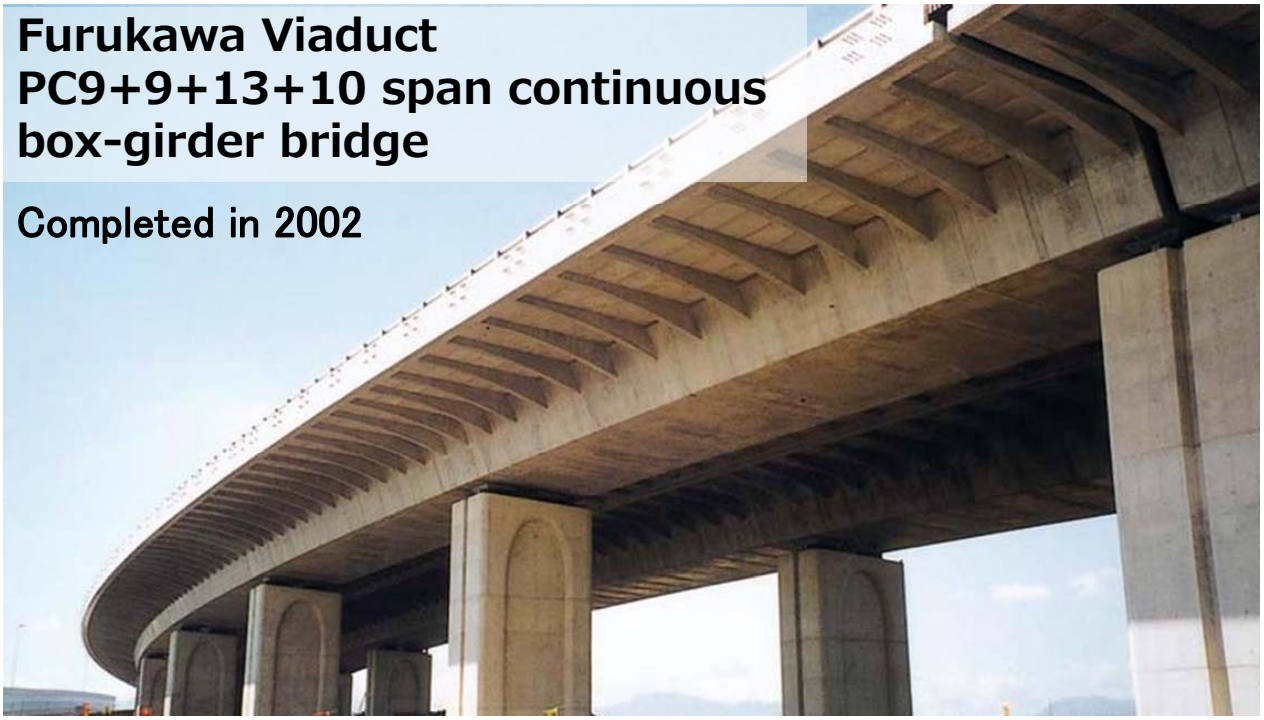
Construction method	U-Beam lifting	Ordinaly girder lifting	Span-by-span method
Condition	With fabrication yard of Precast beam on site		Without fabrication yard
Method Outline			
Cross Section	Composite Section (U Beam + Cast-in-place slab) 	Box Girder Section 	Box Girder Section 
Moment of the girder	18%	30%	100%
Design Method	Percially prestressed concrete	Percially prestressed concrete	Need to be Fully prestressed concrete

- **Construction period is 1/2 of ordinary span-by-span method**
- **Erected girder is 80% lighter → Cost reduction achieved**

2. Span-by-span erection method by U-shaped segments

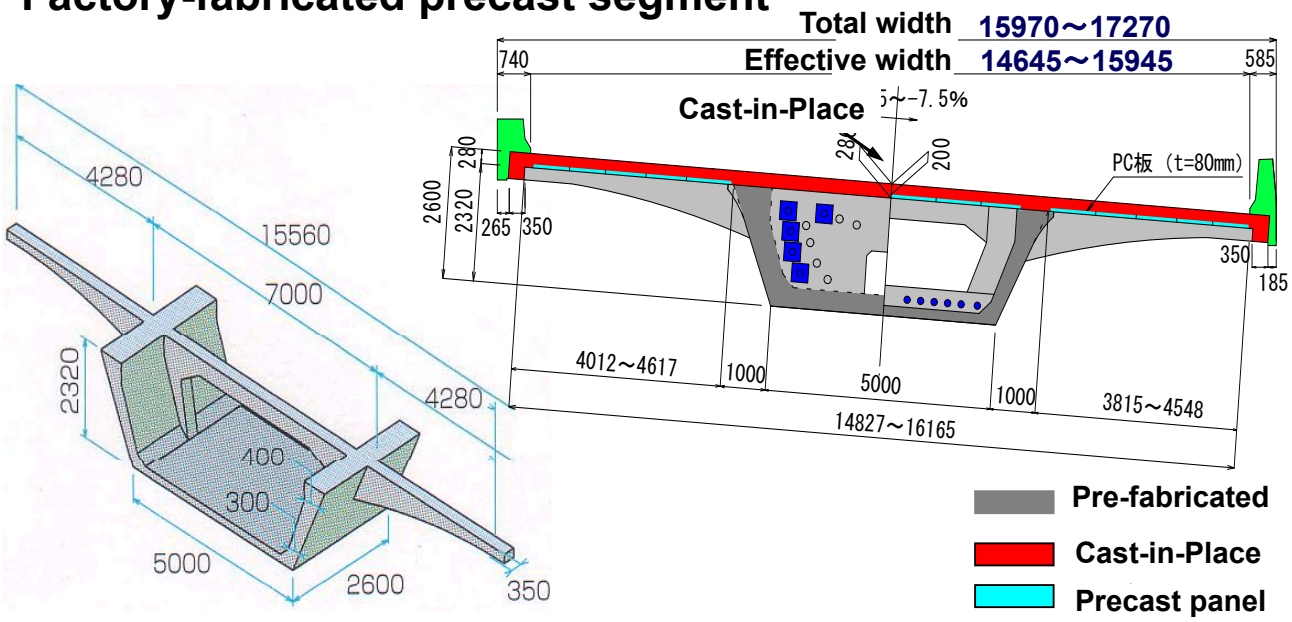
Furukawa Viaduct
PC9+9+13+10 span continuous box-girder bridge

Completed in 2002



Shape of segment

Factory-fabricated precast segment

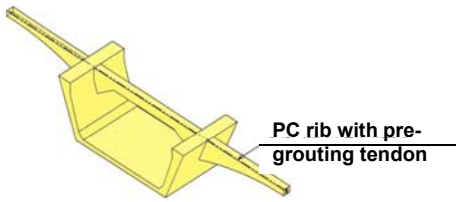


U-shape core segment with horizontal rib

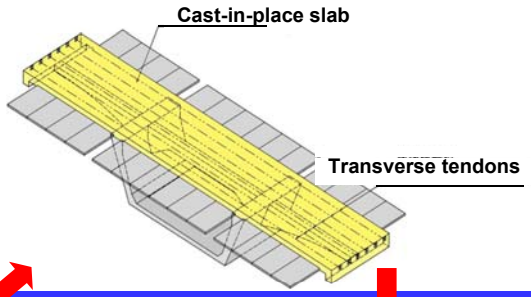
・Normally a 65% reduction in number of segments per span

Installation in steps

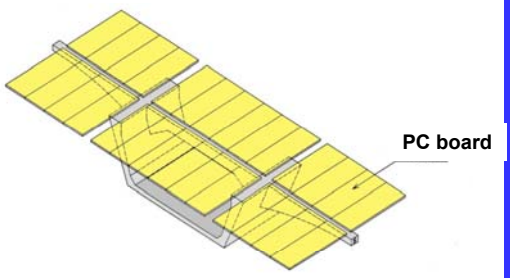
Segments fabrication
Transport and Install



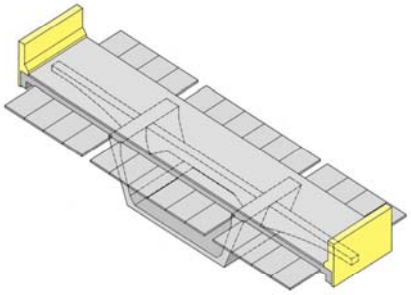
Case-in-place of deck slab



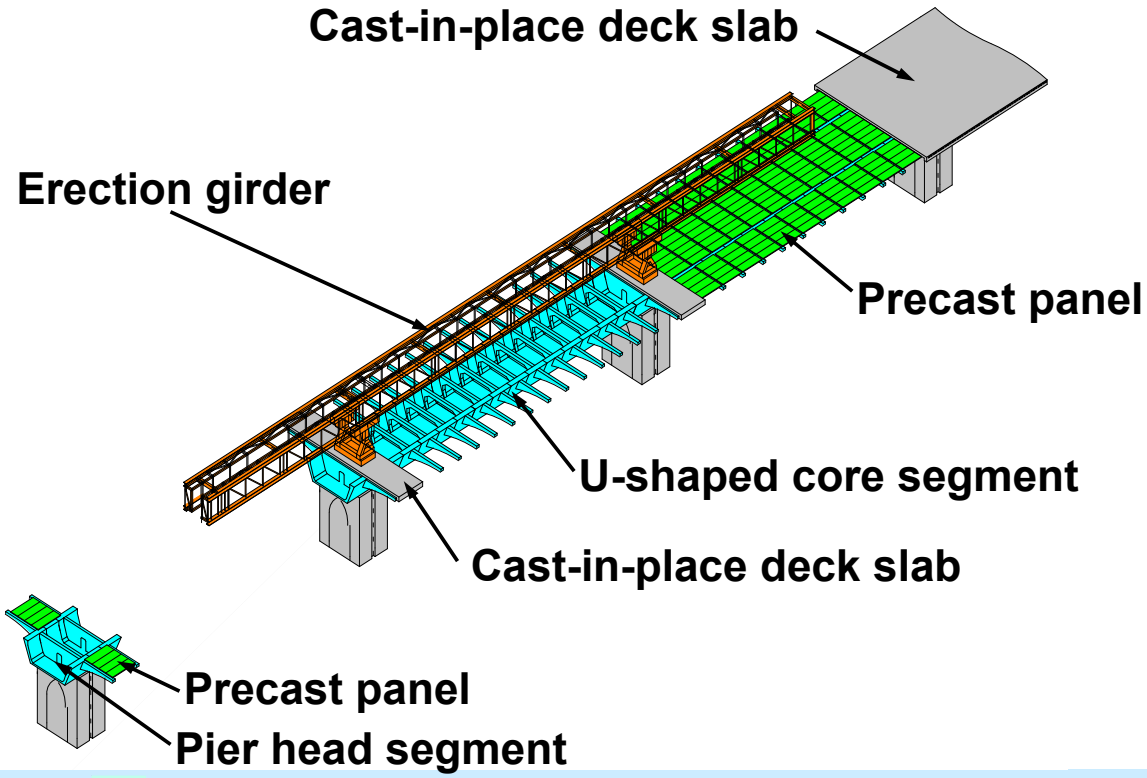
Lay down precast panel



Bridge face construction



Over view of Erection Method



Span-by-span erection

- 5 days for segment erection per span
- Erection girder weight was lightened by up to 60%
- 5 days also per span construction of add-on deck slab

→ Normal construction period reduced by 70%

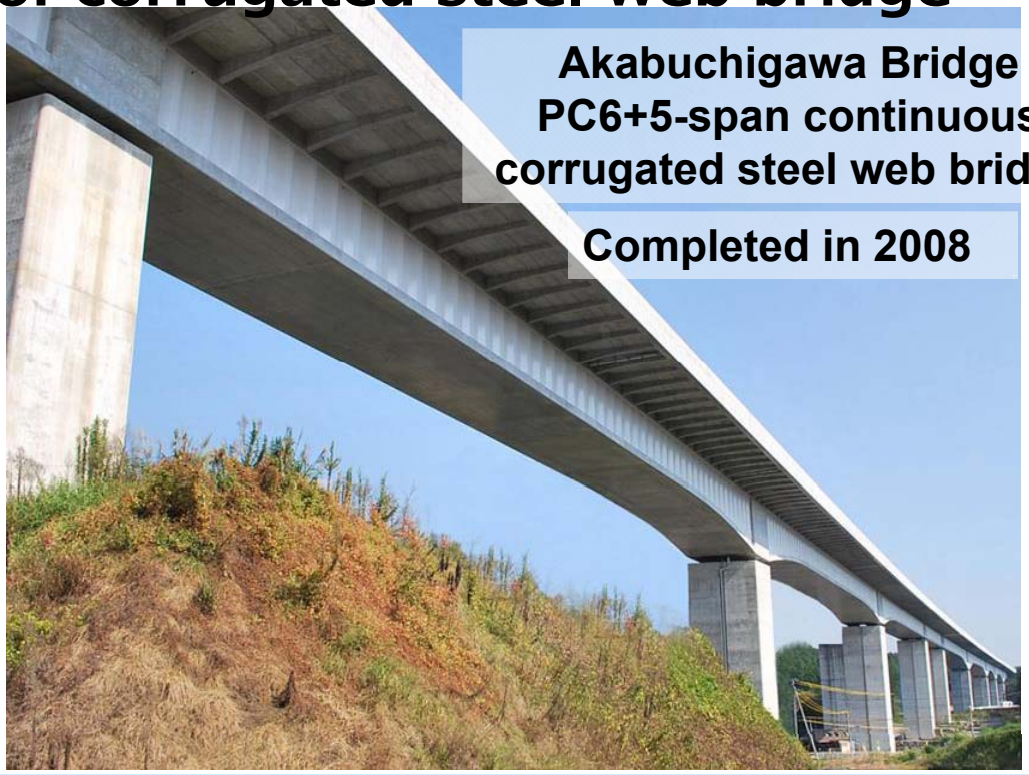
Accelerated construction of bridges in mountainous area

○ Streamlined construction method of corrugated steel web bridge

<Effects>

- Economic impact by maintaining road networks soon
- Rise in convenience by introducing bypass roads soon

3. Streamlined construction method of corrugated steel web bridge



Akabuchigawa Bridge
PC6+5-span continuous corrugated steel web bridge

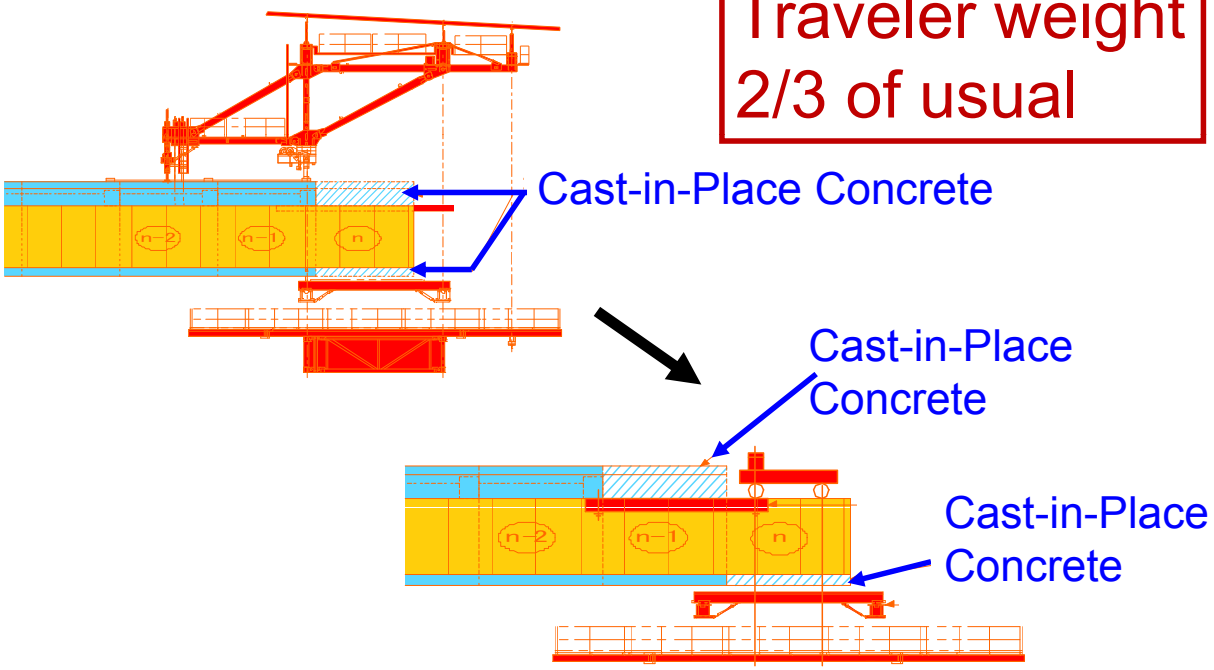
Completed in 2008

Construction method of C.S.W Bridge

Corrugated Steel Web Bridges are normally constructed by baranced cantilever construction method.

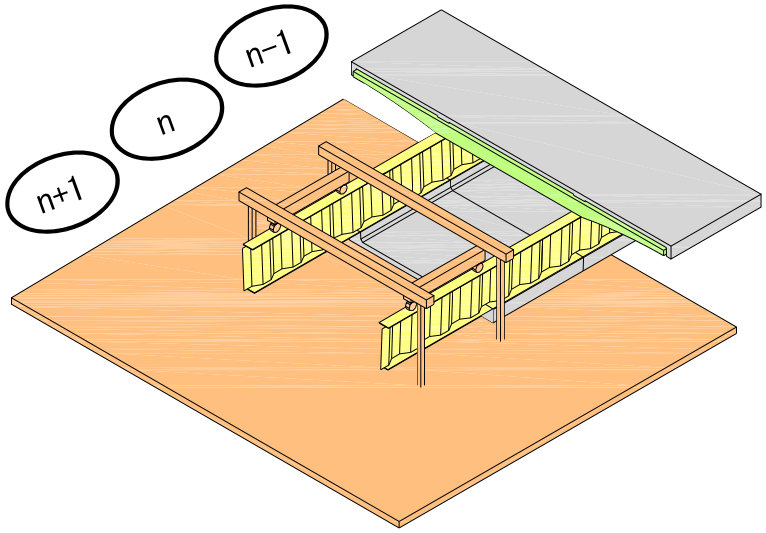
Rapid construction method using corrugated steel web

Traveler weight 2/3 of usual



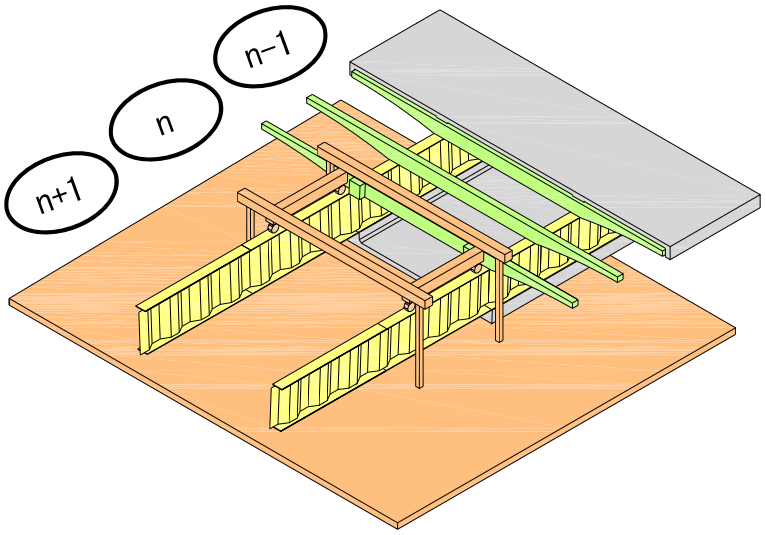
Rapid construction method for balanced cantilever erection

1. Movement of the form traveler



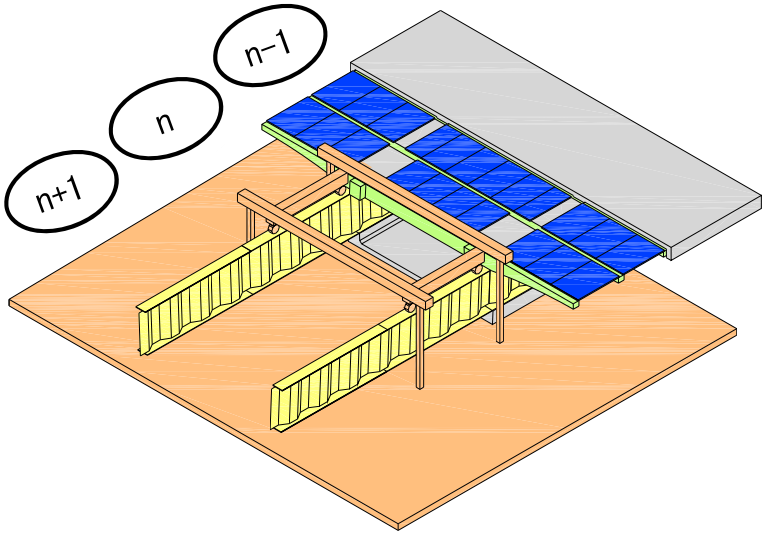
Rapid construction method for balanced cantilever erection

2. Corrugated steel paned erection Precast rib erection



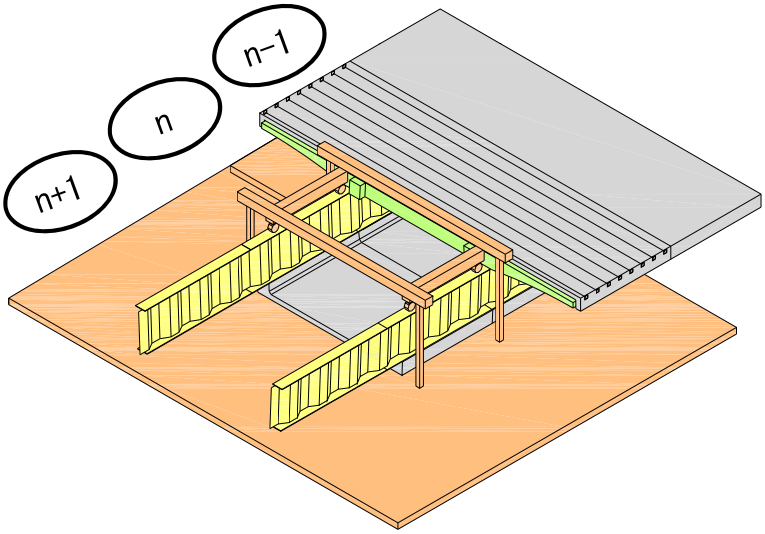
Rapid construction method for balanced cantilever erection

3. Precast panels setup, Re-bar and PC assembly



Rapid construction method for balanced cantilever erection

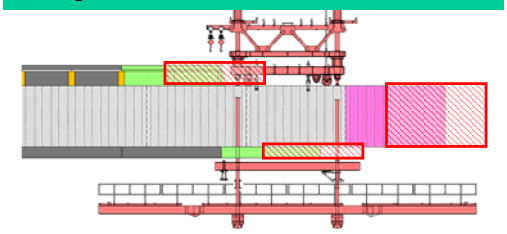
4. Casting concrete on upper and lower deck



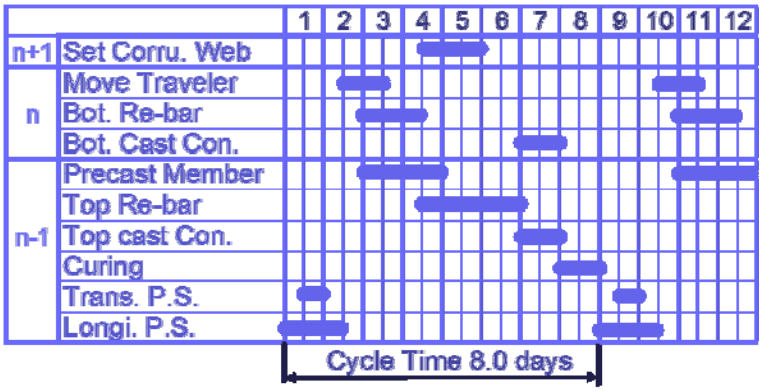
Comparison of overhangs erection speed

Cycle stages were cut by approx 40%

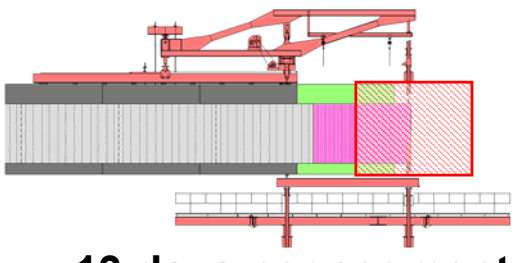
Rapid construction



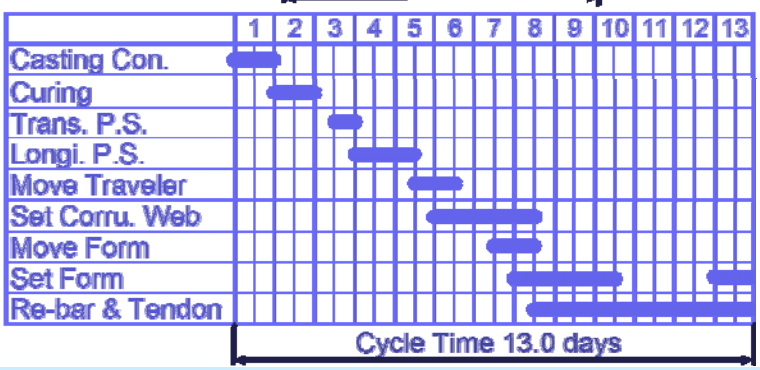
8 days per segment



Conventional construction



13 days per segment



Accelerated construction of long and large bridges

○Concrete-steel composite extradosed bridges

- ・Precast segmental method
- ・Steel-beam large-block erection method

<Effects>

- Contribution to economic development by early consolidation of economies separated by strait, etc

4. Steel concrete composite extradosed bridges

Ibi River Bridge / Kiso River Bridge
6 span (5span)-continuous
PC-Steel composite extradosed bridge

Completed in 2001

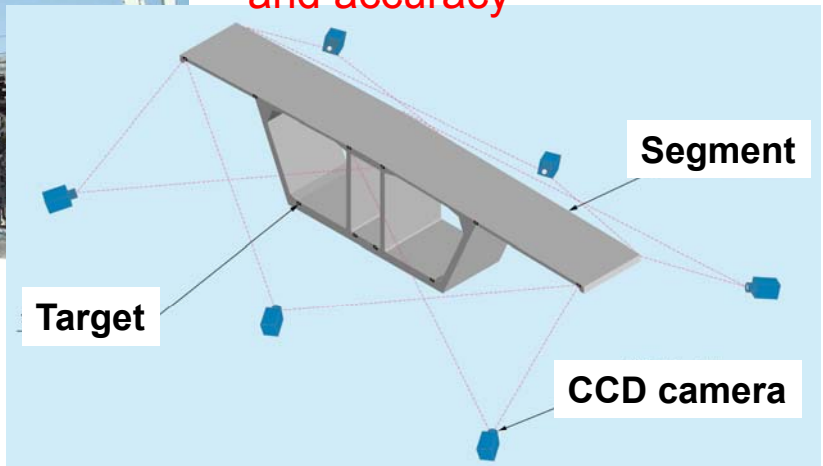
Fabricated by short-line and match-cast

- 357 segments, Maximum weight 4,000 kN
- Seaside yard and transported by barges
- Short-line match-cast

Labor saving in precast segment fabrication

Pre-assembling of re-bar cage for labor saving and rapidness

Final shape checking
by using CCD camera system
→labor saving, rapidness
and accuracy

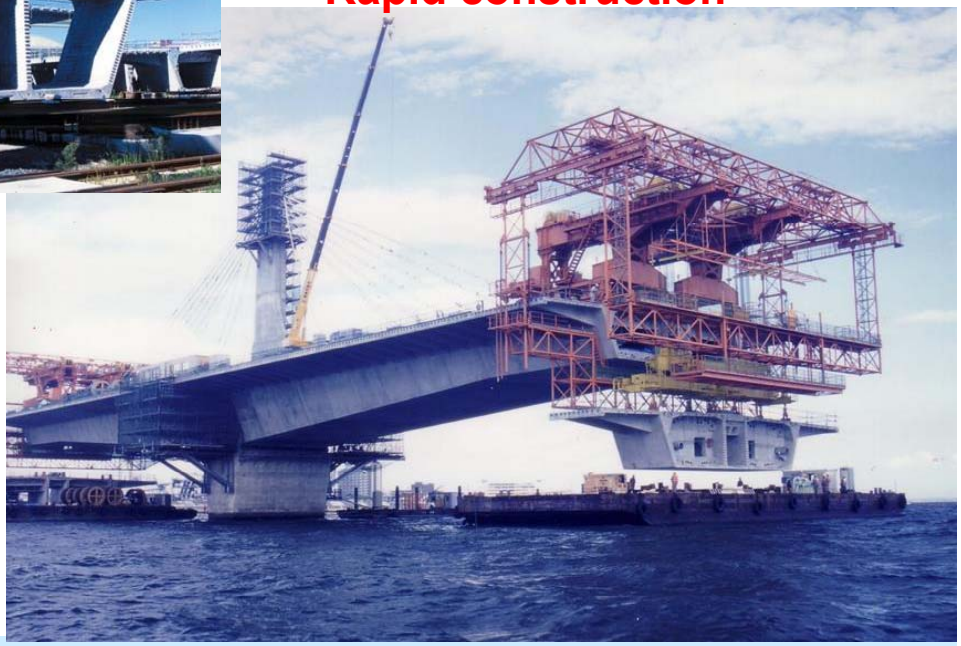


Erection using a large floating-crane

Erection of pier-head section segment using a large FC ship
→segmentation→Rapid const.

Rapid construction with precast segment

Precast for concrete section
→More durable,
Rapid construction



Rationalization for composite structure

- High compression area, near piers：Concrete structure
- High bending moment area, span centers：Steel structure

→Realized an extradosed structure with long multiple span

Construction period was 2 years 4 months

The technology about Accelerated Construction of PC Bridges will contribute the infrastructure supply

Overseas road PPP Council (March 14, 2014)

Technology of low carbon asphalt pavement and recycled asphalt pavement(RAP) in JAPAN

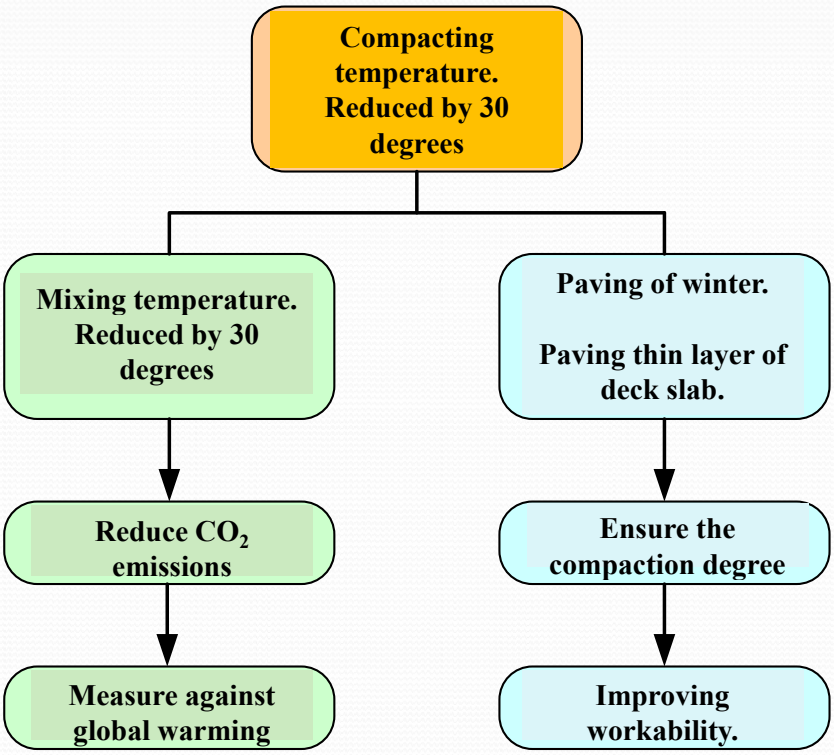
Japan Road Contractors Association

TOA ROAD CORPRATION, Technical Department
General Manager, Nagato ABE

Overview

- Low carbon asphalt pavement (Warm-mix) Technology overview and application
- Other pavement technology to reduce CO_2 emission Technology overview, etc.
- Recycled asphalt pavement(RAP) Technology overview and application

Outline of Warm-mix Technology



Outline of Warm-mix Technology

◆**Special additive：foaming, visco-elasticity adjustment, lubricant (surfactant)**

○**Foaming（generating and dispersing foam in asphalt mortar)**

Concept of foaming mechanism（**Compaction：bearing effect**）

・Added by plant-mix

（**fine foam like mousse**）

○ **Visco-elasticity (adjusting mixture consistency at high temperature)**

・Special additive：Similar composition of asphalt

Lowers consistency of mix during mixing and paving at high temperature

・ Added by plant-mix

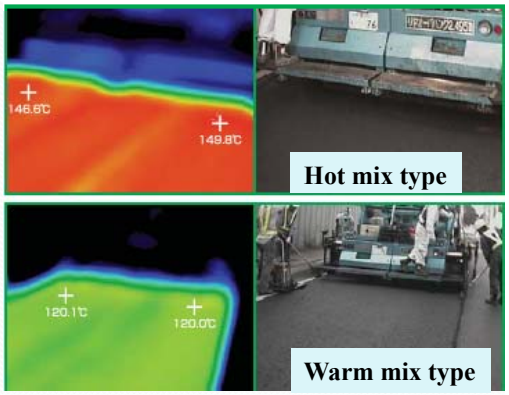
○**Lubricant or surfactant (improves lubrication of asphalt and aggregate interface)**

・ Added by premix or plant-mix

Reduction of compacting temperature (major effect)

- Initial compaction at 120℃

- Ensure compaction degree of thin layer mix
- Ensure compaction degree in winter
- Ensure compaction degree when paved manually



- Improving workability (ensuring quality)

(T.Hirato, M.Murayama: Development and Evaluation of surfactant for Warm-mix asphalt , Road Construction, July 2010)

Lowers Temperature at Compaction (secondary effect)

- Can be compacted at 120℃ at initial compaction
- No asphalt mix disposal caused by temperature decline
- Among 3R (Reduce, Reuse, Recycling) in recycling-based society, it contributes Reduce.
- Effective for environmental measure

Outline of Warm-mix Technology

○Application example: same as conventional asphalt paving

Asphalt mix is “smooth”, and easy to apply manually at beginning and end of section. →

Outline of Warm-mix Technology

2. Major effect by application

- Decreasing CO_2 emission
  - ・Decrease fuel consumption at mixing plant by manufacturing HMA at lower temperature.
  - ・Decrease fuel consumption of rolling equipment at usual manufacturing temperature.
- Earlier traffic opening
  - ・Lowering temperature shortens traffic control time at rehabilitation work. Restraining initial crack.
- Improving workability during cold season
  - ・ In case of usual manufacturing temperature, it gains higher compaction ability.
    It is effective to apply to bridge deck pavement or thin layer pavement where rapid temperature dropping is concerned.

Application Example

○ Reducing CO_2 emission at manufacturing HMA

・Example 1（Warm-mix: 30 – 50℃ lower than conventional）

Condition	Mixing temp. (℃)	Manufacturing quantity (t)	Fuel oil amount of consumption (ℓ/t)	CO_2 emission (kg-C/t)	CO_2 amount of reduction (%)
1	160	443	7.5	5.52	0.0
2	130	243	6.0	4.41	20.1
3	110	63	5.1	3.75	32.0

* : Aggregate moisture-ratio : 4.4% , CO_2 discharge basic unit of fuel oil : 0.7357 (kg-C/ℓ)

（Ichioka et al, “Development of asphalt mix with modified visco-elasticity and its application to Warm-mix”, Road Construction, 2001.8）

Effect: 20.1% at 30℃ reduction, 32.0% at 50℃ reduction.

・Example 2（Warm-mix: 30 ℃ lower than conventional）

Effect: 18%

Item		PMA type Ⅱ	PMA type Ⅱ + Warm-agent
A fuel oil amount of consumption	(ℓ/t)	7.7	6.3
Basic unit of A fuel oil	(kg-CO_2/ℓ)	2.71	
Basic unit of warm-agent	(kg-CO2/ℓ)	5.38	
The amount of the warm-agent	(kg/t)	0	1.3
CO_2 increase due warm-agent	(kg/t)	----	0.085
CO_2 emissions	(kg/t)	20.9	17.2

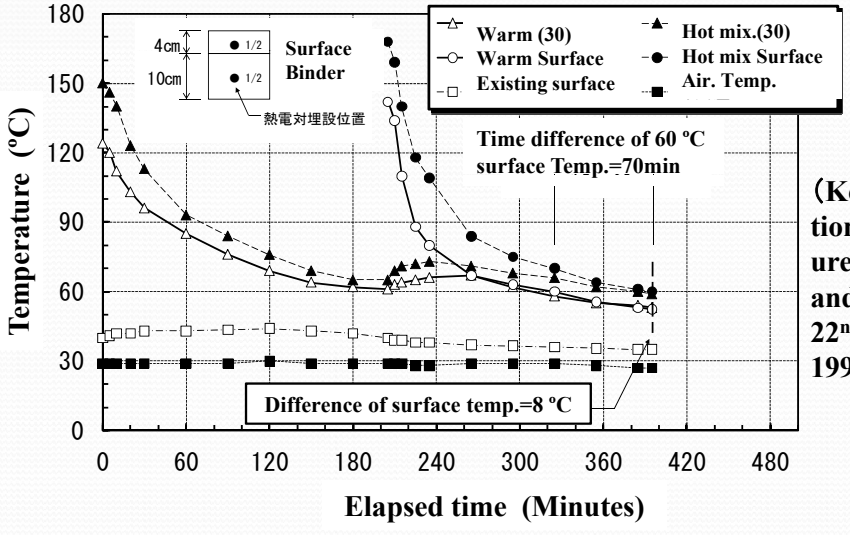
(Kato, et al. “Development and performance evaluation of lubricant warm-mix” 28th Japan Road Conference, 2009.10)

Application Example

2. Apply for earlier traffic opening

○ Rehabilitation work on pavement

・Warm-mix: 30℃ lower than conventional HMA



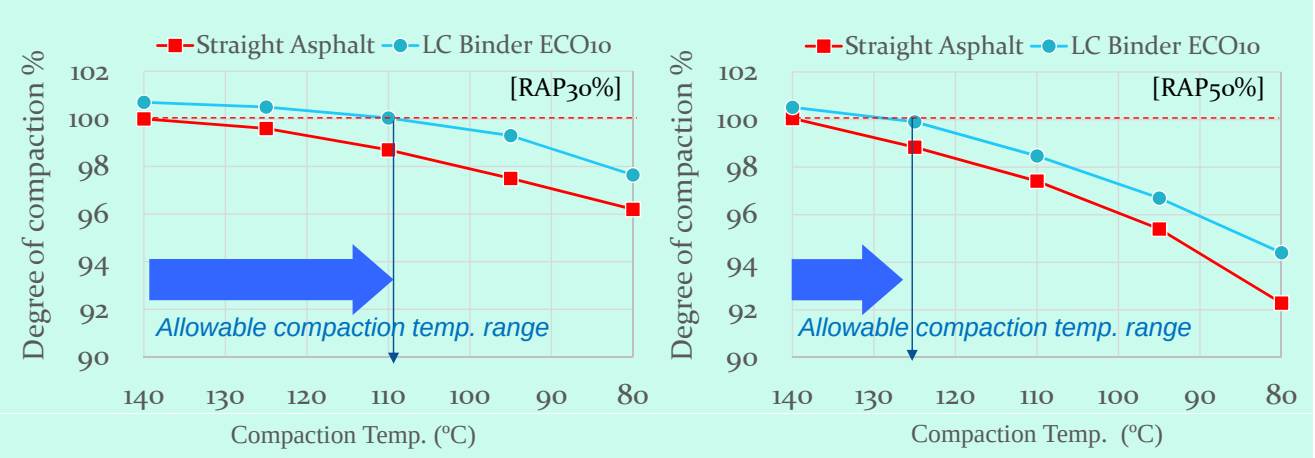
（Kobayashi, et al, “Examination on restraining temperature at traffic open by cutting and overlay” 22nd Japan Road Conference, 1997.10

Effect: Shorten 70 minutes until the internal temperature of surface layer falls to 60℃

Effect of Mixing Ratio of Recycled Aggregate

- Warm-mix binder (Straight Asphalt type) is different depends on mixing ratio of recycled aggregate. When the ratio of aged asphalt increase, it becomes difficult to decline the temperature.

- It declines temperature by 30℃ when using 30% of recycled aggregate. Using 50% of recycled aggregate, it declines the temperature by 15℃.



Difference in Price of Asphalt Mix

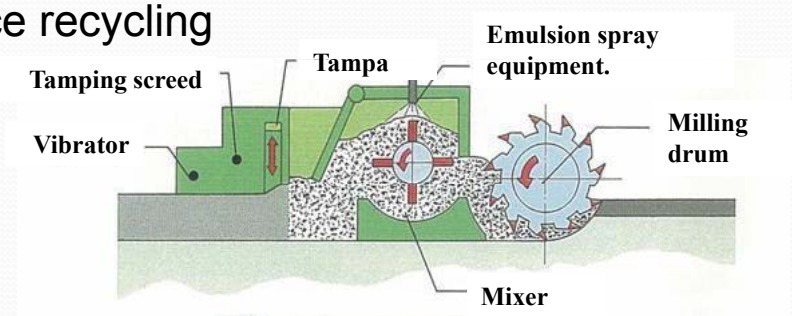
- **Asphalt content: 5.2～5.5%**
- **Rises JPY1,000～1,300/ton**
- **Future subject is to retain cost increase of mix by making effort on application as increase paving volume per day from earlier traffic open, and decreasing wasted mix (decreasing loss rate) .**

Other Technology to Reduce CO_2 Emission

○ **Existing technology of cold mix to reduce CO_2 emission**

- Chip seal (Seal coat, Armor coat)
- In-place base course recycling with cement and asphalt emulsion
- Cold in-place surface recycling

Applying seal coat



Cold in-place surface recycling

（Japan Emulsified Asphalt Association：Basics of asphalt emulsion and its app lication, 2006.2 ）

Other Technology to Reduce CO_2 Emission

○ **Other existing pavement technology to reduce CO_2 emission**

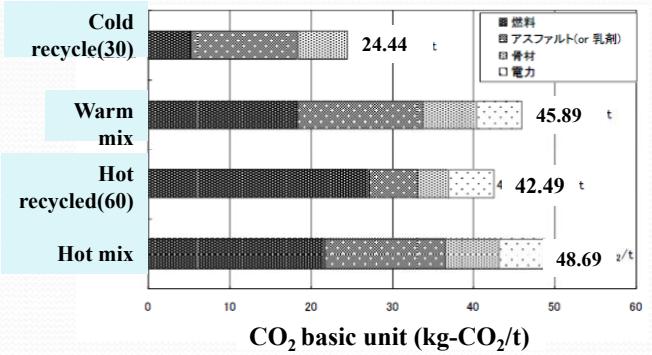
- **Cold Recycling Mix**

・Cold recycling mix can be manufactured easily with asphalt emulsion mix and it can be stored for long time.

・It can be applied in the place where is too far to deliver HMA from the plant.

・Using modified asphalt emulsion, it ensures equivalent strength as HMA.

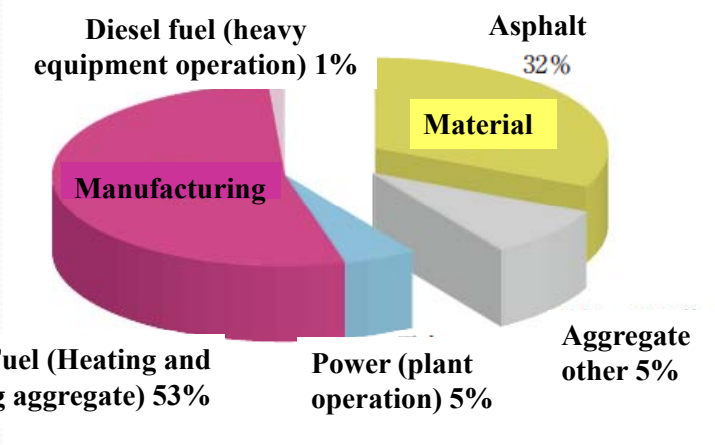
・The basic cost CO_2 is 50% of that of HMA, it is effective to low carbon.



（Kawaguchi, Yoshitake, “Development and application of recycled asphalt mix at ambient temperature ”, Road Construction, 2011）

CO_2 Emission in Hot Asphalt Mix Plant

- The breakdown of CO_2 basic unit in conventional HMA is shown below from material and manufacturing.
- 60% of CO_2 emission is at manufacturing, most of them are occurred from fuel at heating and drying aggregate.
- Saving energy and decrease CO_2 emission.
- Heating and drying aggregate.



Manufacturing Equipment of Asphalt Mix

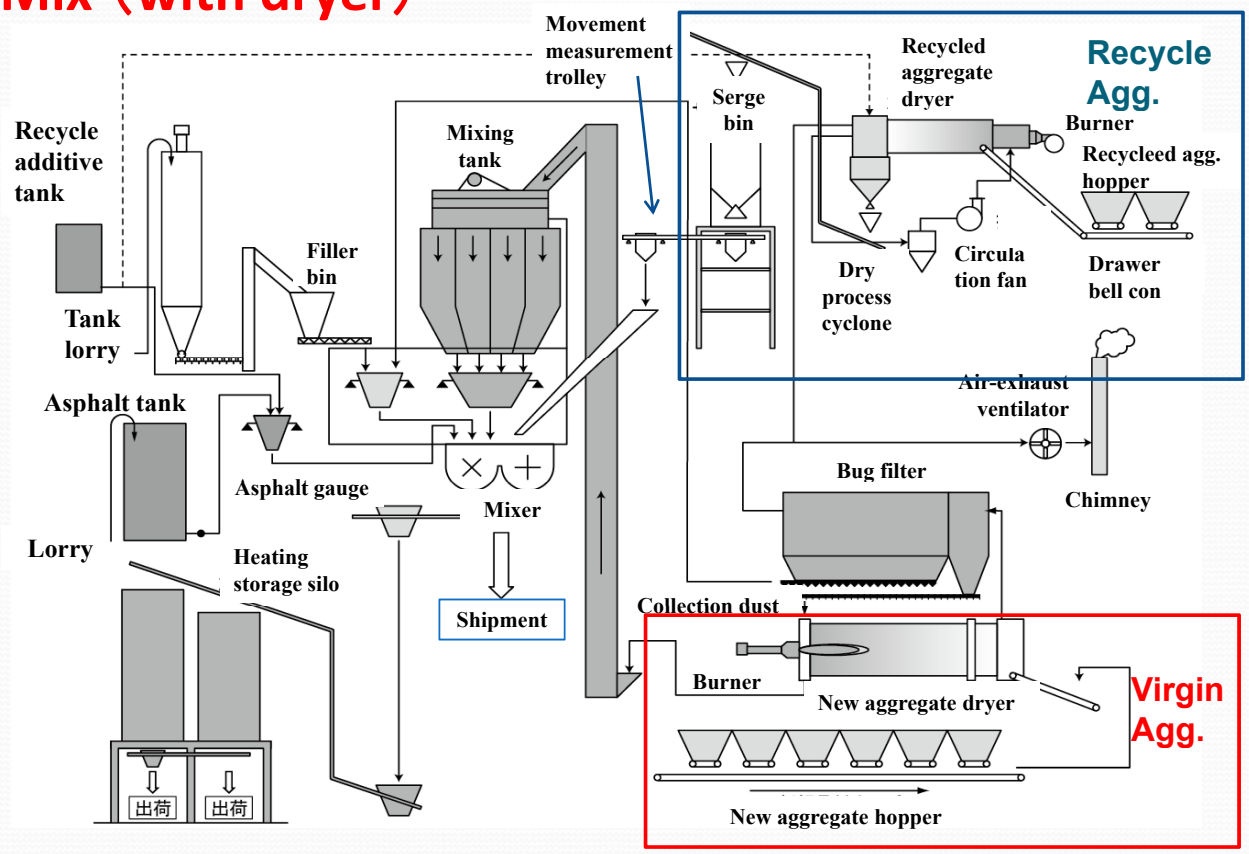
There are 3 categories in manufacturing recycled asphalt mix. The share of equipment and type in Japan is shown in the table.

Parallel hot mixing type (new plant with recycling dryer) is widely used.

Type of manufacturing equipment	Installed Ratio in Japan* (%)	Standard mix ratio of recycled aggregate (%)	Outline of Mixing Method	Characteristics
Parallel hot mixing type	69.2	20 - 60	Dryer for recycled aggregate is parallely installed with batch plant and manufacture the mixture	・Both new and recycled mixture can be manufactured. ・Larger capacity of drying and heating recycled aggregate ・Available to manufacture various types with small quantity
Indirect hot mixing type	19.8	30 or less	Recycled aggregate is feeded into heated new aggregate, then mixture is manufactured by heat exchange during mixing.	・Both new and recycled mixture can be manufactured. ・Inexpensive plant cost ・Available to manufacture various types with small quantity
Drum dryer mixing type	11.3	60 or more	New aggregate and recycled agggregate are mixed and heated in drum dryer to manufacture the mixture.	・larger propertion of recycled aggregate ・Inexpensive plant cost

* Questionarries by Japan Asphalt Mixutre Association, 2009

Manufacturing Equipment of Recycled Asphalt Mix（with dryer）



Recycled Aggregate Mix

- Wasted asphalt pavement from job site is crushed and arrange particle size to use as recycled aggregate.

- Old and aged asphalt adheres on recycled aggregate.
- Therefore, 1) adding recycling agent to soften, then mix with new aggregate and new asphalt. 2) mix recycled aggregate and new aggregate, using new asphalt with high penetration.

Removal of damaged pavement

Integrated into the As mixture plant.

Crush the lump.

Classified and stored.

Conclusion

Current situation and orientation of pavement technology

○Safety, comfortable, durable and economical pavement

・Service to vehicle, bicycle, pedestrians and ecological preservation

→basis of pavement technology to be developed

○Ecological road pavement

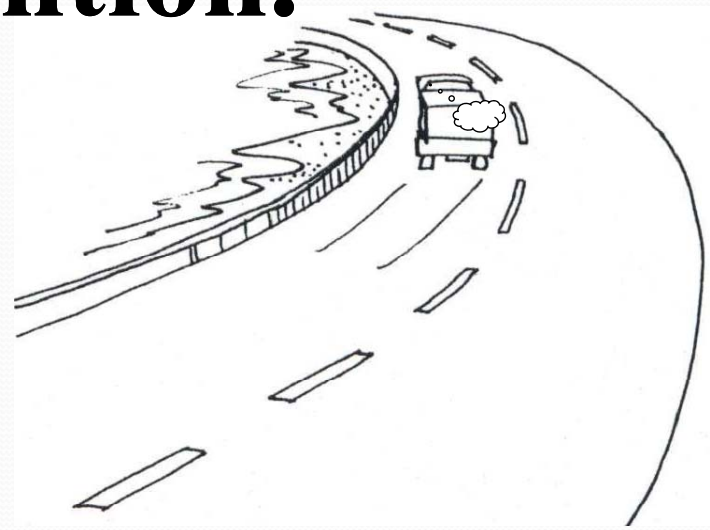
・Increase restraining against green house gas emission (decrease 25% from1990)

→develop and promotion of pavement materials and application metho of less CO_2 emission

→Expand WMA in manufacturing HMA: it can be expected decreasing 150,000t of CO_2 emission if applied to total HMA production (0.544 million ton in 2007)

→JRCA is promoting in Technical and Application WG-1 "Survey and follow of low carbon asphalt".

Thank you for your attention.



Deployment of ITS Infrastructure by PPP Approach

<Case Study> Electronic Toll Collection (ETC) System for Indonesia

March 2014

MITSUBISHI HEAVY INDUSTRIES, LTD.
Land Transportation Systems Division

MITSUBISHI HEAVY INDUSTRIES, LTD.
Our Technologies, Your Tomorrow

1 ETC system in Japan (1)

Japanese ETC is recognized as one of the most successful ETC system in practice.

ETC Usage Rate	89% (2013) since 2001
Number of On-board Unit	41million Users (2013)
Service Interoperability	Full interoperability among several operators and multi-suppliers
ETC Standard	International Open Standard (5.8GHz Microwave) as National Unified Standard
Communication Reliability	99.999%

Government's strong initiative to set national unified standard and utilization promotion are the key success factors.

National Unified Standard

Nation-wide Interoperability among multi suppliers

a single OBU supplied by any supplier can be used anywhere in the nation, regardless the difference between toll operators

Reliable System

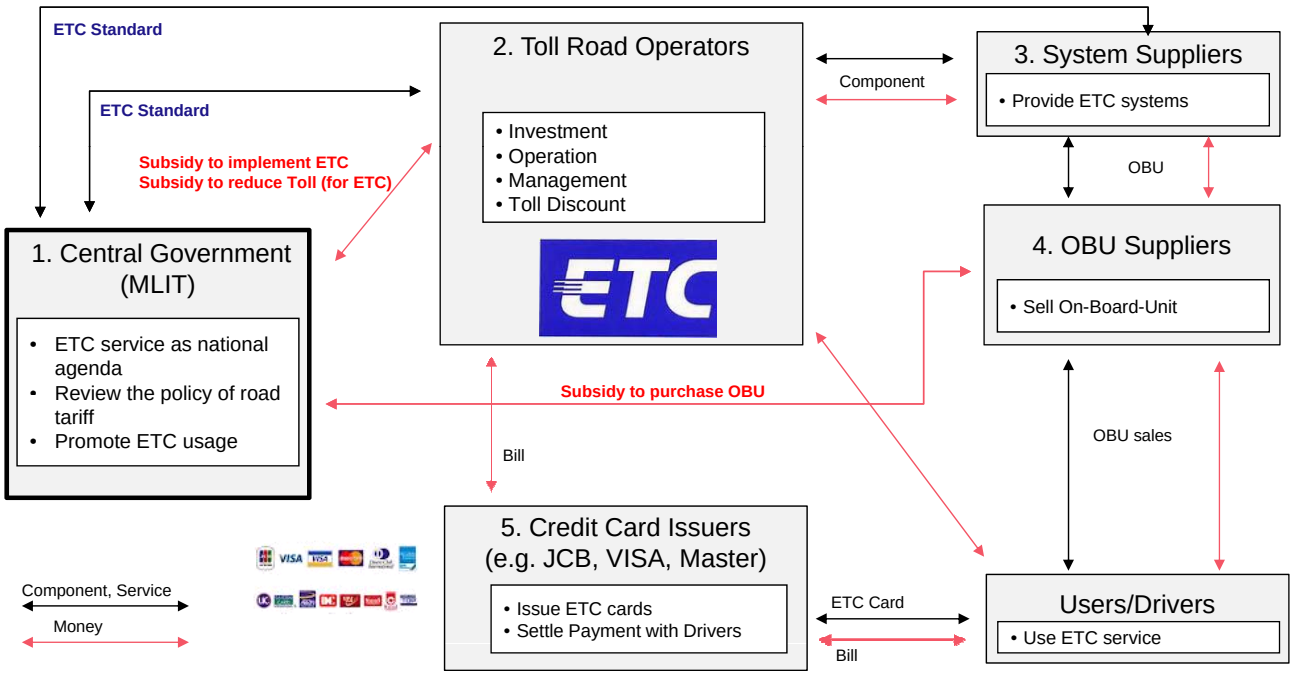
5.8GHz OBU

Utilization Promotion led by government

- ✓ Subsidy to purchase OBU for car users.
- ✓ Subsidy to implement ETC for Toll Operators
- ✓ Special Discount on ETC Toll fare up to 50%.

2 ETC system in Japan (2): Business Model

Close cooperation among government and private sector has realized wide spread usage of ETC in Japan. ETC has been one of national agenda led by government.

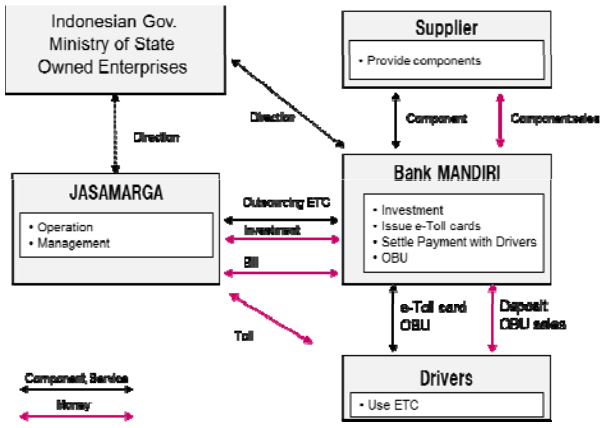


3 Study Result (1) Current ETC System in Indonesia

In year 2012, the Japanese Government conducted a study on reviewing “e-Toll Pass”, a current ETC system in Indonesia, which is yet to being popularized.

<Study Team>: Nomura Research Institute, NEXCO-West, Mitsubishi Heavy Industries

Current Business Model of “e-Toll pass” in Indonesia



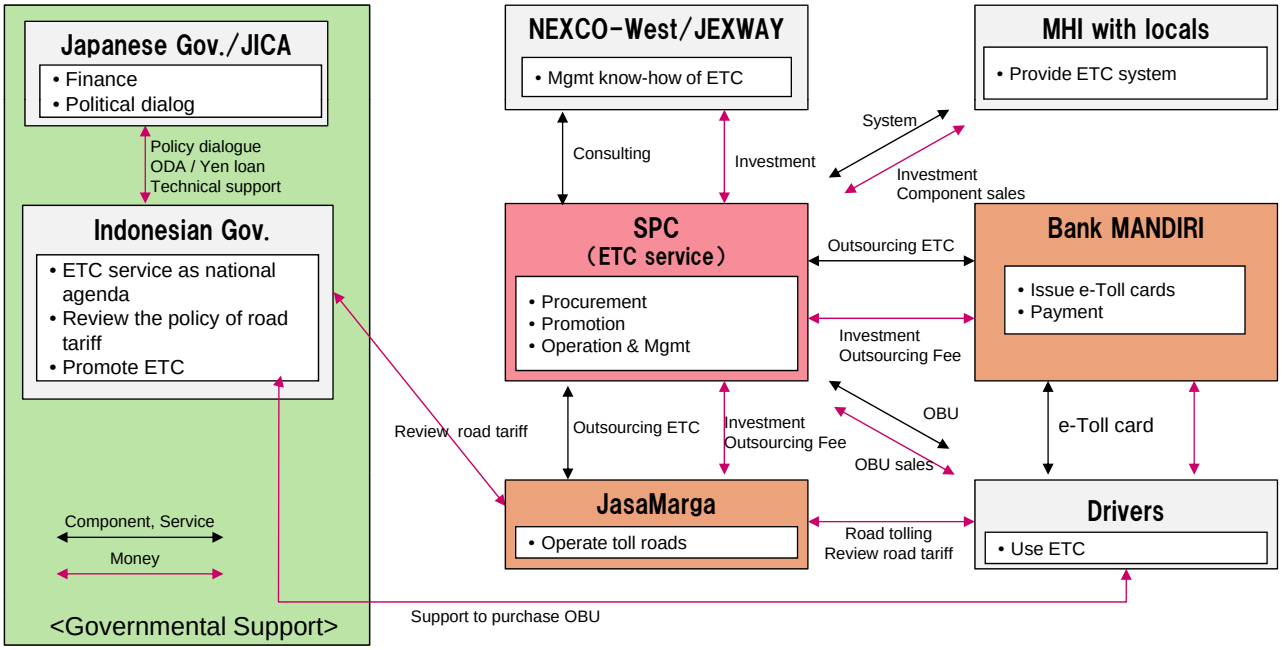
Technology of e-Toll Pass

e-Toll pass On Board Unit provided by Bank Mandiri is based on Malaysian National Standard

- ✓ ETC system in Indonesia, “e-Toll pass”, is managed under two different private entities, Bank Mandiri as investor of ETC and JasaMarga as road operator.
- ✓ There is no strong business incentive to invest in more ETC system in Indonesia.

4 Study Result (2) Proposed Business Model

- New independent SPC can enhance current business model in Indonesia.
- SPC dedicated for ETC service is established jointly by local companies and international companies those having knowledge and experience in successful ETC operation.
- Government' support to SPC is essential as national agenda to promote ETC system.



5 Study Result (3) Technical Demonstration

Demonstration show successfully that Japanese ETC (overseas specification version) can be operated by Bank Mandiri's e-toll card and existing ETC system provided by local manufactures in Indonesia.

Date	September 2012
Location	Jakarta, Indonesia
Attendees at demonstration	(Bank) Bank Mandiri (Cooperation) PT. Module Intracs Yasatama (Performer) Nomura Research Institute, Mitsubishi Heavy Industries
Card used	e-Toll card
System configuration	Using the Japanese on-board ETC equipment and ETC antenna modified for reading the e-Toll card
Expected results	To demonstrate that the e-Toll card can be used in the Japanese ETC system.
Results of technical evaluation	All items came out successfully.

Japanese OBU/e-Toll card
(Overseas Version)

Verification unit to check the e-Toll card balance
(Bank Mandiri)

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