Activities of Japan Prestressed Concrete Contractors Association

Les initiatives de l'Association japonaise de la construction en béton précontraint

Three Basic Policies of Japan Prestressed Concrete Contractors Association

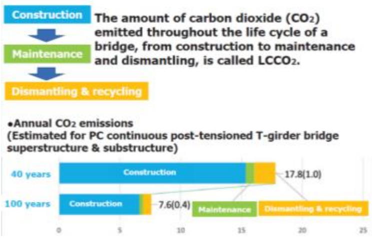
Carbon-neutral: Environmental conservation measures

Japan has declared that it will become carbon-neutral by 2050.
Japan Prestressed Concrete Contractors Association is actively working to promote the use of precast members, in addition to reducing CO_2 emissions with the construction of prestressed concrete structures and developing infrastructure associated with natural and renewable energy.

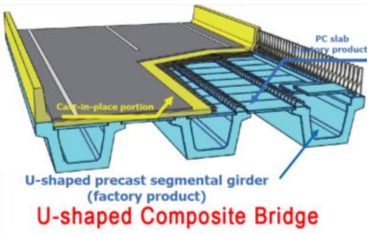
Measures associated with the reduction of CO_2 emissions

1. Reducing CO_2 emissions by extending the service life of prestressed concrete bridges

The longer a PC bridge is in common use, the lower the annual CO_2 emissions.



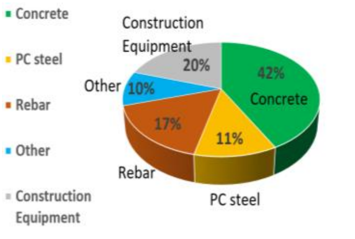
2. Promoting the use of precast members, which greatly contributes to the reduction of CO_2 emissions



We are promoting the use of precast members (factory products) to replace cast-in-place PC bridges such as hollow slab bridges and box girder bridges.

3. Further reduction of CO_2 emissions with the construction of the superstructures of prestressed concrete bridges

We will be working to further reduce CO_2 emissions from materials with high CO_2 emission rates.



CO_2 emission in construction of superstructure
(PC continuous box girder bridge with a span of 50 m)

Main types of prestressed concrete road bridges and the amount of CO_2 emissions

Type	PC simple pretension T-girder bridge	PC simple post-tensioned T-girder bridge	PC continuous post-tensioned T-girder bridge	PC continuous hollow slab bridge	PC continuous box girder bridge	PC rigid-frame box girder bridge
Type of structure						
Cross-sectional shape						
Characteristics	The cross section fabricated (prefabricated) by tensioning prestressing tendons before concreting is T-shaped.	The cross section fabricated (site-fabricated) by tensioning prestressing tendons before concreting is T-shaped.	Structure form by interconnecting post-tensioned T-girders using site-cast reinforced concrete on bridge piers	Bridge built with a beamless deck slab. Fabricated by embedding cylindrical hollow forms for the purpose of weight reduction.	A box girder cross section is used for weight reduction. Often adopted for bridges with relatively long spans.	The cross-sectional shape is similar to a continuous box girder bridge, and piers and girders are rigidly connected. Adopted for bridges in cases where tall piers are used.
Erection method	Truck crane erection	Launching girder erection	Launching girder erection	Ground-supported falsework erection	Ground-supported falsework erection	Cantilever erection
Span length (m)	20.0	25.0～45.0	3@25.0～3@45.0	4@25.0～4@35.0	4@30.0～4@50.0	36+60+36～54+90+54
CO_2 emissions per unit area of bridge surface (t-CO_2/m^2)	0.33	0.36～0.49	0.35～0.47	0.41～0.53	0.43～0.46	0.45～0.50
Effect of blast furnace slag powder 50% replacement	0.26	0.30～0.39	0.28～0.36	0.33～0.42	0.36～0.37	0.33～0.37
Effect of fly ash 20% replacement	0.31	0.34～0.44	0.32～0.42	0.38～0.48	0.40～0.42	0.39～0.43
Combined effect of both replacements	0.23	0.27～0.34	0.24～0.37	0.30～0.38	0.33～0.34	0.28～0.32

➢ The green numbers in the bottom 4 rows of the table represent the values for the superstructure only.

● CO_2 emission calculation method

Materials ■ Emissions due to manufacture of materials
CO_2 emissions (t-CO_2) (e.g., t, m^3) = Amount used × Quantity (t-CO_2/t, CO_2/m^3)

Construction equipment ■ Emissions due to fuel and electric power consumption for construction equipment operation (construction, direct)
CO_2 emissions (t-CO_2) = Total number of units used (e.g., units, days) × Emission per unit of fuel consumption (t-CO_2/unit-day)

■ Operation-time depreciation for emissions due to construction equipment production (construction, indirect)
CO_2 emissions (t-CO_2) = Total number of units (e.g., units, days) × Operation-time depreciation per unit (t-CO_2/unit-day)

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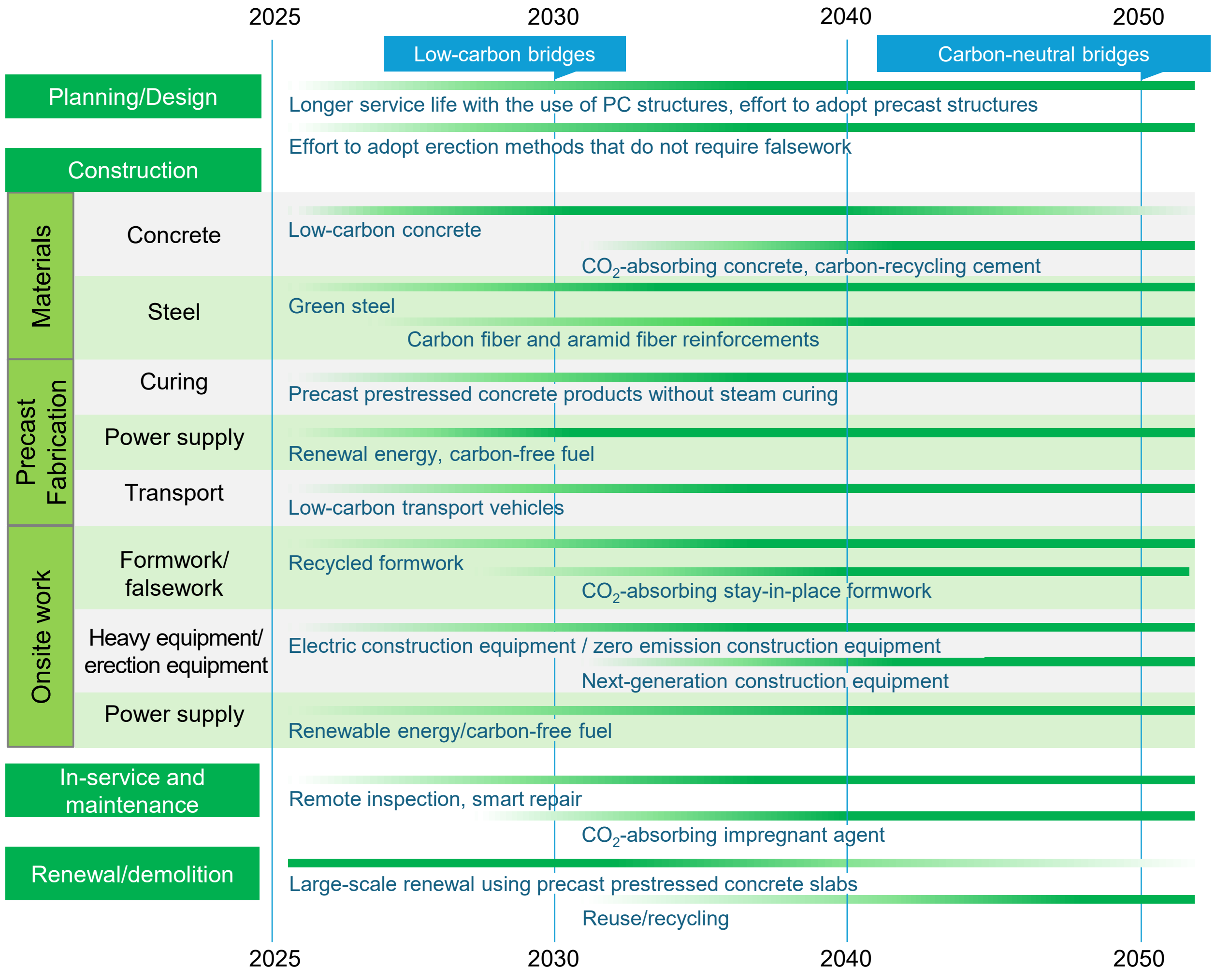
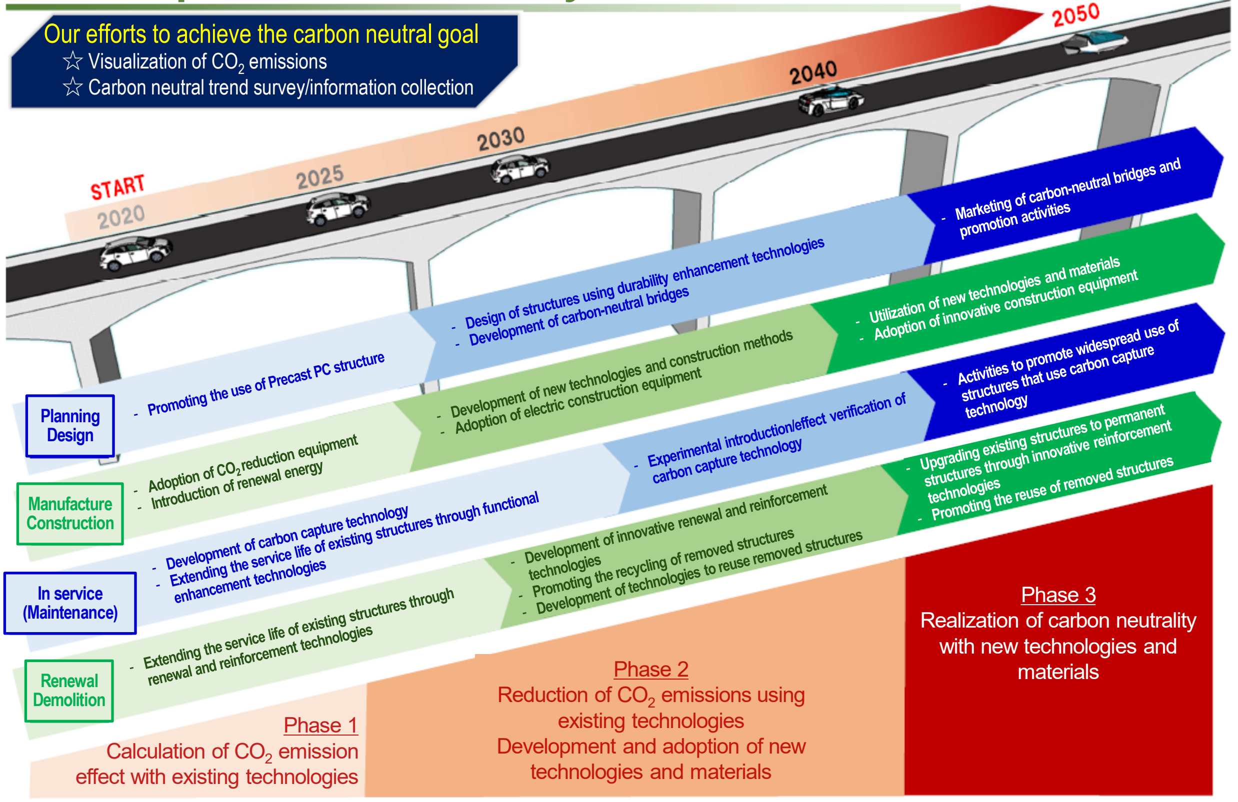
Technologies contributing to CO_2 reduction



Road map to carbon neutrality



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Enhancing resilience through reliable maintenance of arterial road networks using prestressed concrete technology

Large-scale renewal projects of expressways (e.g., deck slab replacement)

Deteriorated structural members causing functional decline are repaired promptly to ensure that expressway bridges remain functional as part of arterial transportation routes, not only under normal conditions, but also during emergencies, such as disasters.

Deck slab replacement using mobile cranes

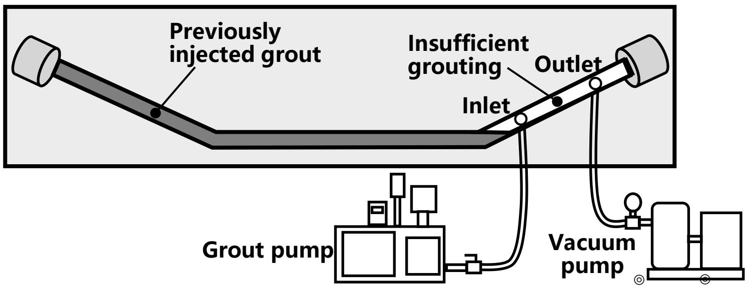
- Long-term durability is achieved by replacing the damaged RC deck slabs of steel bridges with PC deck slabs, which offer superior durability.
- Using precast members reduces traffic restriction periods.
- Optimal construction methods are selected according to the conditions of the bridge to be repaired, such as traffic volume, the number of lanes, detour route selection, and obstacles.

Half-slab replacement with one lane in service

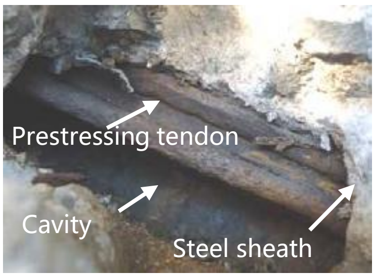
Deck slab replacement using deck slab erection equipment

PC grout re-injection

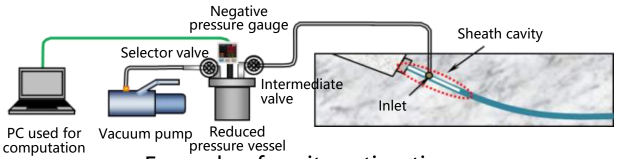
Bridges constructed in the past may contain prestressed concrete sections with insufficient grout. As a preventive maintenance measure, grout is injected into these insufficient section to prevent the corrosion and rupture of the prestressing tendons.



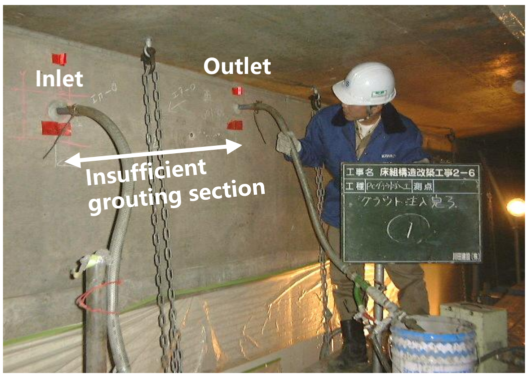
Re-injection of grout



Prestressing tendon at insufficient grouting location



Example of cavity estimation



Re-injection of grout

- Investigation of prestressing tendon locations by nondestructive testing
- Estimation of insufficient grouted section and cavity volume
- Drilling an inlet and an outlet at the ends of the insufficient grouted section so as not to damage the prestressing tendon.
- Prestressed concrete grout is re-injected by the gravity flow method, the vacuum pump assisted method, or the pressure grouting method.
- The inlet and outlet regions is repaired with mortar.

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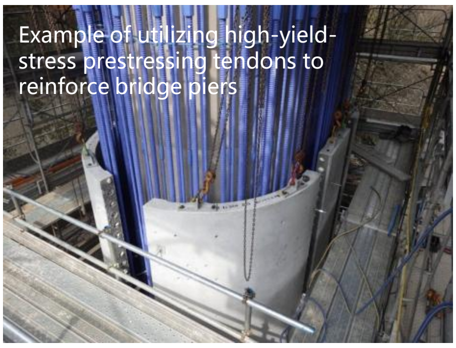
Enhancing resilience through preparedness for natural disasters using prestressed concrete technology

Preparedness for major earthquakes (seismic retrofitting)

In order to create and maintain a safe society, existing structures will be seismically retrofitted using prestressed concrete technology.
In the event of an earthquake, prestressed concrete engineers will take part in post-disaster restoration activities.



Seismic retrofit of bridge piers (prestressed concrete jacketing)

Restoration of a bridge damaged by a major earthquake

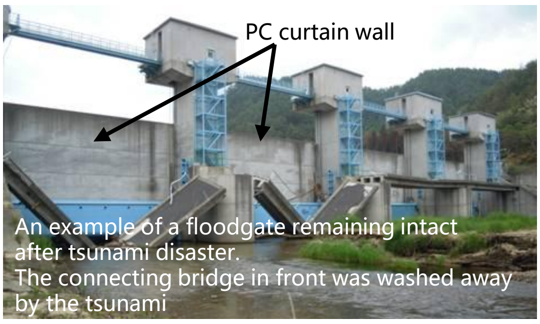
Adding seismic strengthening devices to an existing prestressed concrete bridge

Modifying a hinged rigid-frame bridge into a continuous structure and constructing an additional arch

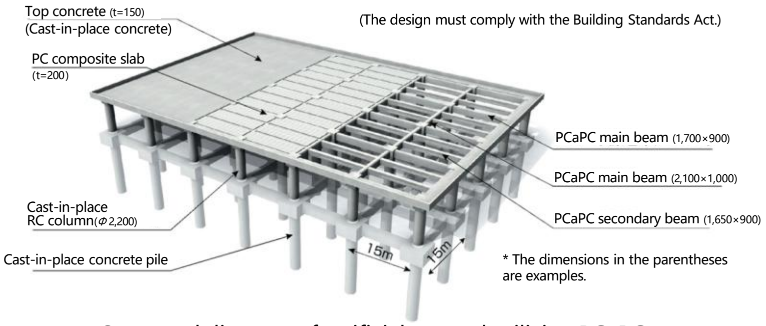
Preparedness for tsunamis

To realize a safe and secure society, promote the development of artificial ground and tsunami evacuation facilities using PCaPC technology, as well as the construction of tsunami floodgate systems using PC curtain walls.

Artificial ground constructed offshore



Tsunami floodgate curtain wall



Structural diagram of artificial ground utilizing PCaPC
* The use of precast members accelerates relocation to higher ground, as well.

Tsunami evacuation towers utilizing PCaPC technology

(Note) PC : prestressed concrete , PCa : precast , RC : reinforced concrete

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