



7º SEMINÁRIO INTERNACIONAL ABCIC
INOVAÇÃO E OUSADIA PARA VENCER OS ATUAIS
DESAFIOS E GERENCIAR O FUTURO

PRECAST CONSTRUCTION IN JAPAN

SAO PAULO 22/SEP/2016

AKIO KASUGA / SUMITOMO MITSUI CONSTRUCTION

1. Bridges

1-1 U-Shaped Girder Segment

1-2 Large Size Girder Segment

1-3 Butterfly Web U-Shaped Girder Segment

1-4 Segment Construction for Piers

2. Buildings

SPECIAL CONDITIONS | JAPAN

- ✓ Strict transportation regulation (Up to 30 tons in public roads)
- ✓ Construction Company who has own precast factory
(SMCC: 80,000m³ to 200,000m³/ year)
- ✓ Seismic Code



1. Bridges

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1-4 Segment Construction for Piers

2. Buildings

FURUKAWA VIADUCT (2002)



ORDIAL SEGMENT



(W=80t)

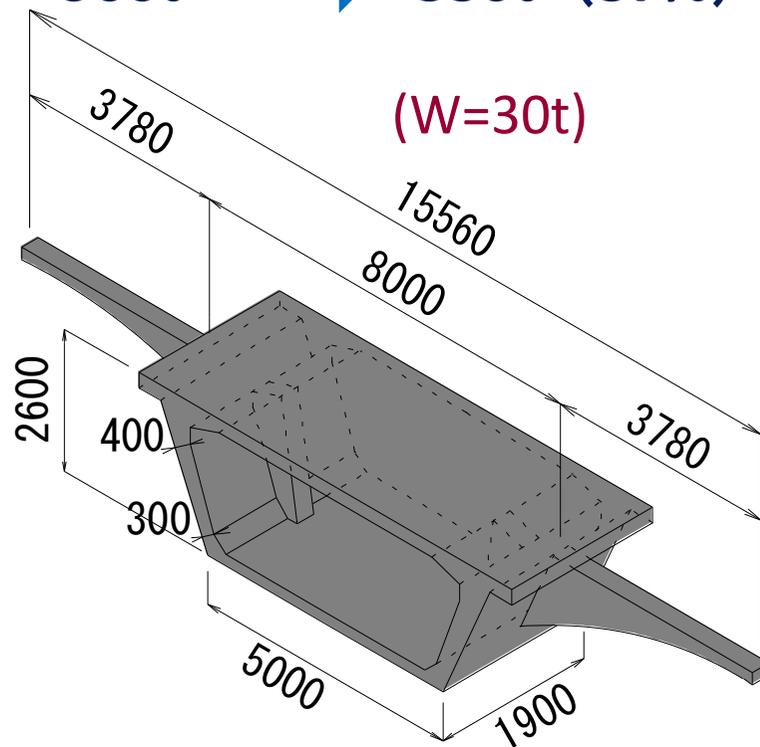
U-SHAPED SEGMENT

➤ Reduction of Segments = Reduction of Transportation Cost

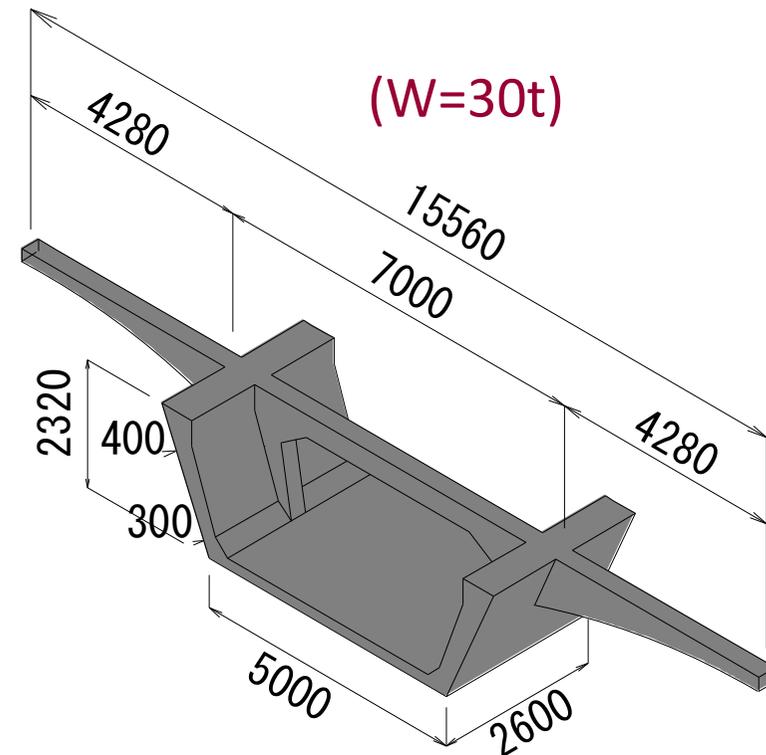
1900 Segments ➔ 1300 Segments (72%)

➤ Reduction of Erection Girder Weight = Reduction of Erection Cost

900t ➔ 330t (37%)

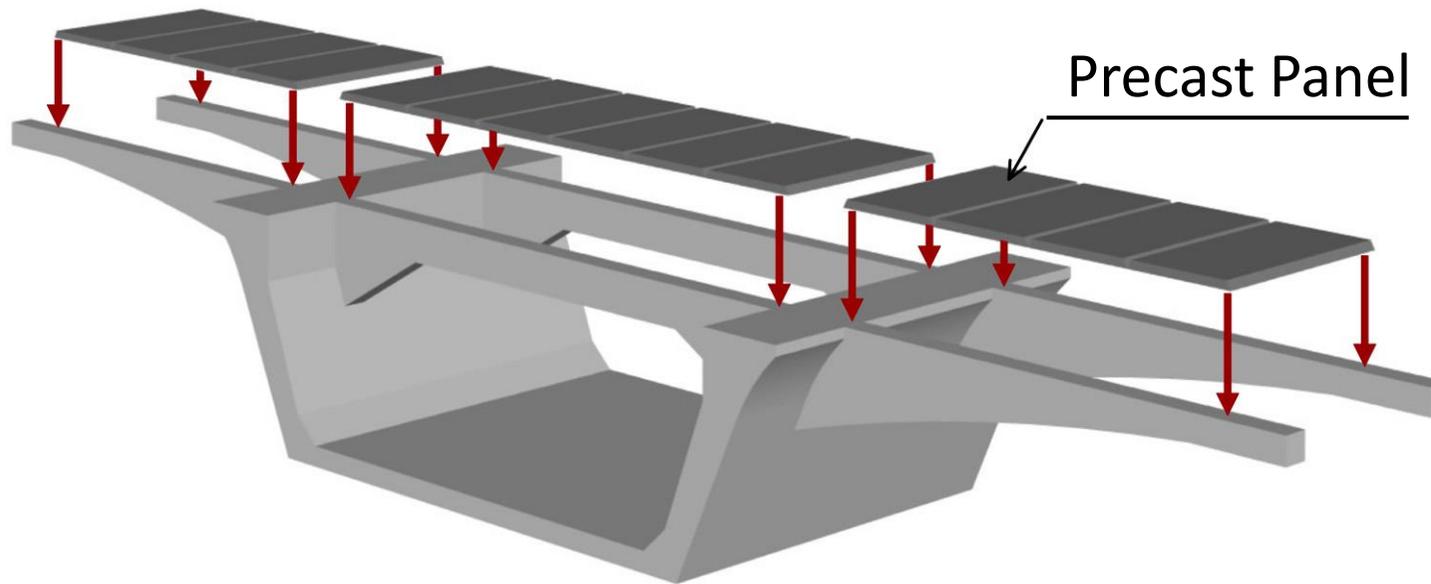


Basic Design



Detail Design

U-SHAPED SEGMENT CONSTRUCTION



FABRICATION OF U-SHAPED SEGMENT

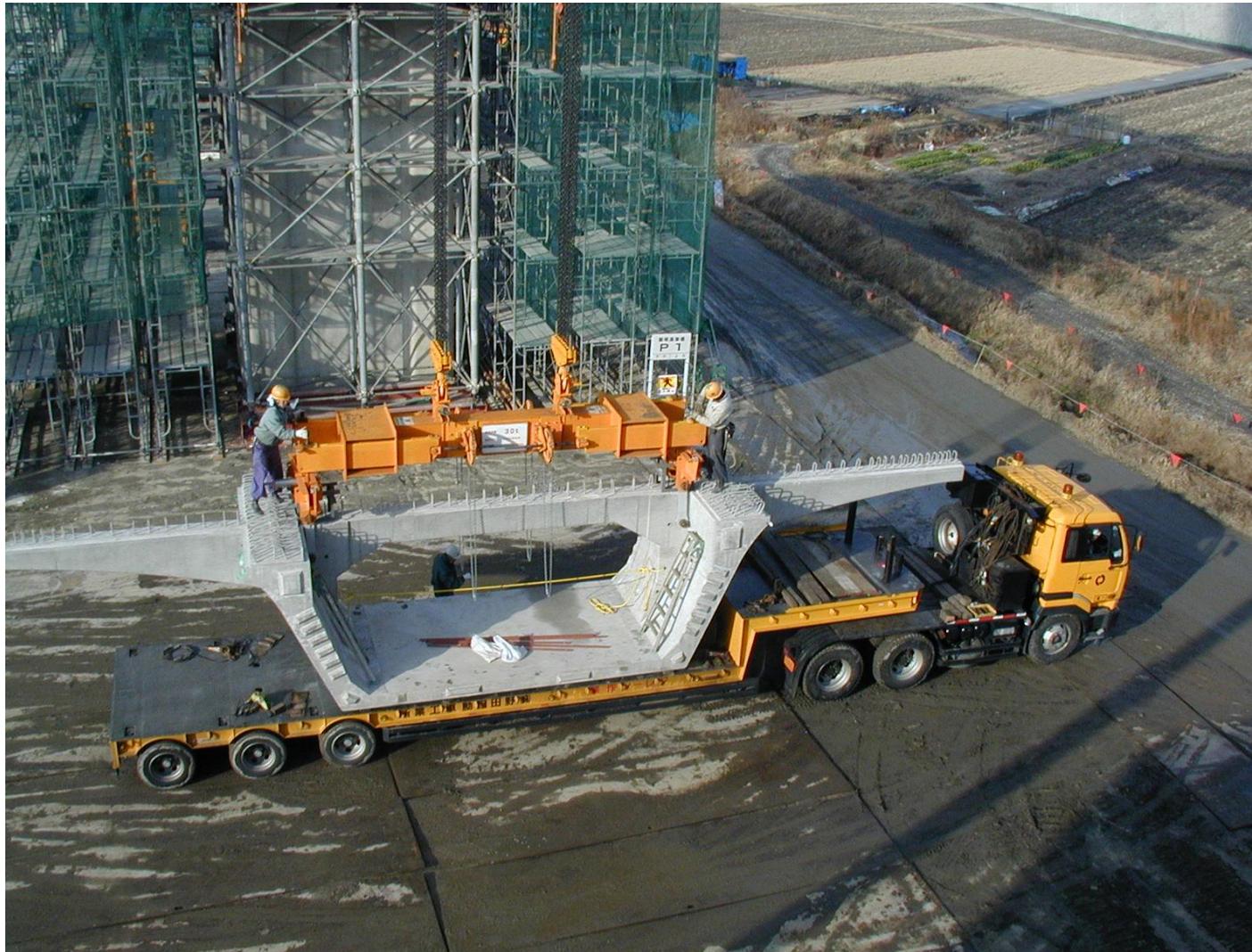
Fabrication in SMCC's Factory



SEGMENT STOCK YARD



TRANSPORTATION OF SEGMENT



ERECTION OF SEGMENT



PRECAST PANEL FOR DECK SLAB



CASTING OF DECK SLAB CONCRETE



1. Bridges

1-1 U-Shaped Girder Segment

1-2 Large Size Girder Segment

1-3 Butterfly Web U-Shaped Girder Segment

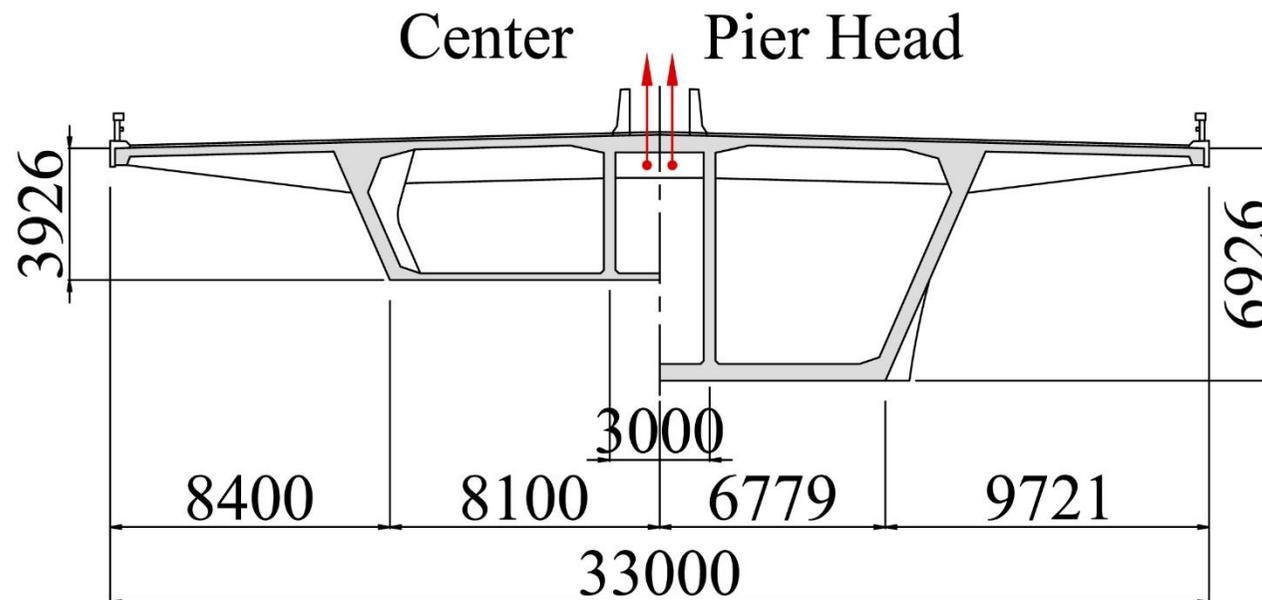
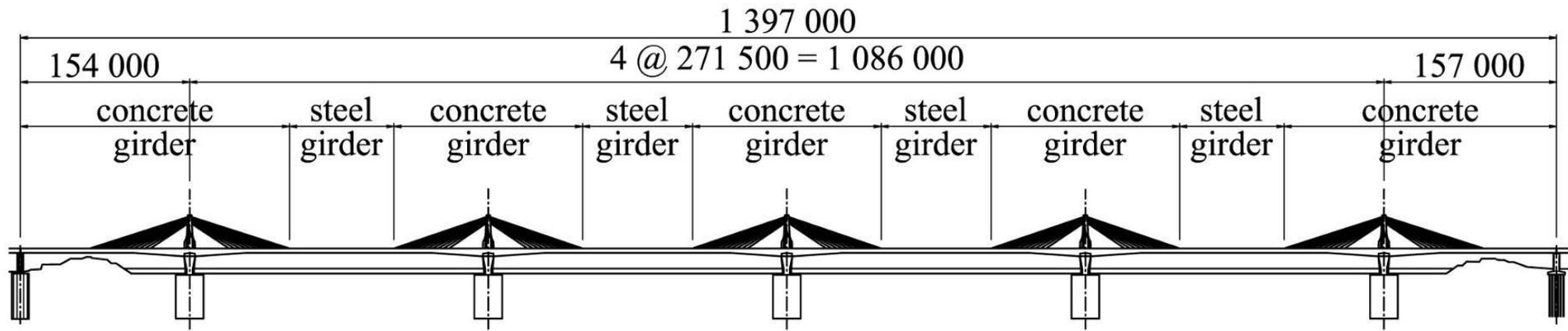
1-4 Segment Construction for Piers

2. Buildings

IBIGAWA BRIDGE (2001)



GENERAL VIEW



400 TONS SEGMENT



PREFABRICATION YARD



400-TON CRANE



LIFTING EQUIPMENTS



2000 tons Steel Girder



400 tons Concrete Segment

1. Bridges

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1-3 Butterfly Web U-Shaped Girder Segment

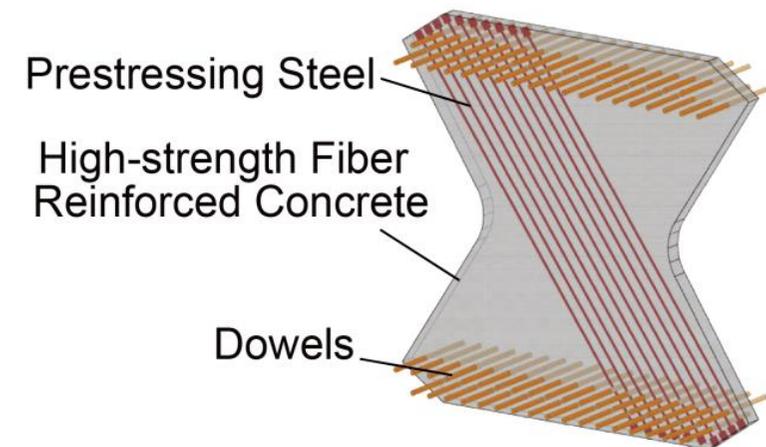
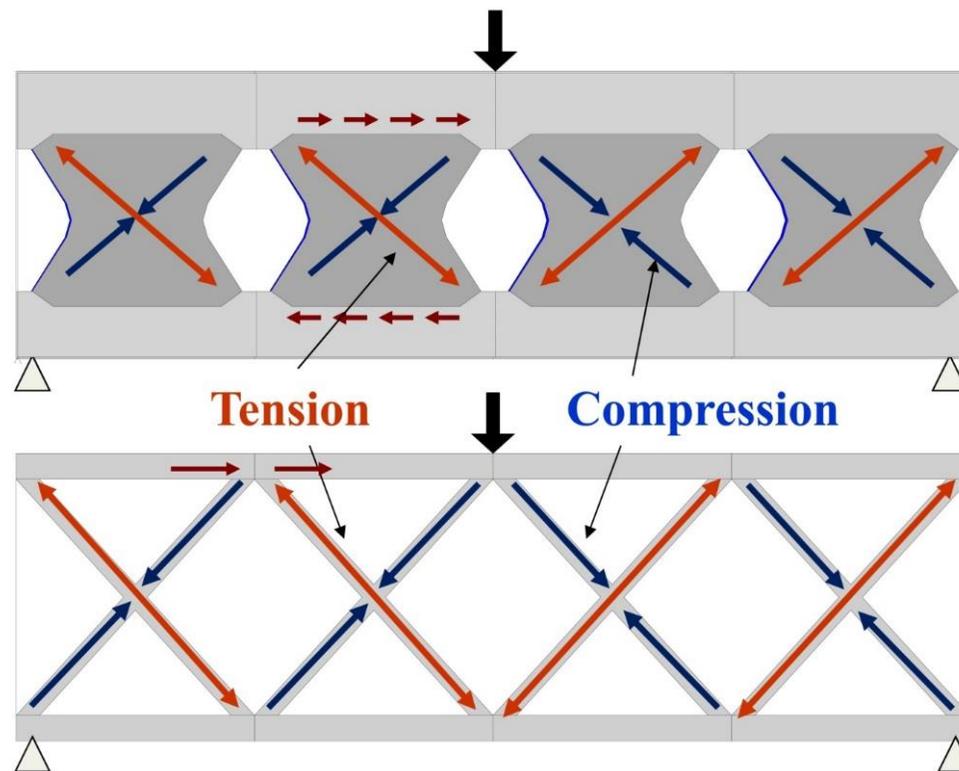
1-4 Segment Construction for Piers

2. Buildings

OKEGAWA VIADUCT (2013)

Bridge deck area : 35,000 m² = 18 months



BUTTERFLY WEB CONCEPT**Structural Behavior of Butterfly Web Bridge**

**Structural Behavior of Butterfly Web
= Double Warren Truss**

MATERIALS FOR BUTTERFLY WEB

High Strength Fiber Reinforced Concrete

$$f_{ck} = 80\text{MPa} \text{ Concrete Base}$$

- More than 2000N/mm² tensile strength steel
- 0.5% content in volume
- D = 0.2mm, L = 22mm steel fiber



Name	Steel Fiber		Slump (cm)	W/B (%)	Content (kg/m ³)				
	sort	volume			W	C	SF	S	G
SW	SW	0.50%	20±2.0cm	25	175	630	70	408	596

PREFABRICATION OF SEGMENTS

Fabrication in SMCC's Factory



R-Bar Cage



U-Shape Segment

BUTTERFLY WEB FABRICATION AT SMCC'S FACTRY



BUTTERFLY WEB PANEL



- 80MPa concrete
- 150mm thickness
- Reinforced by prestressing strands
- No re-bar

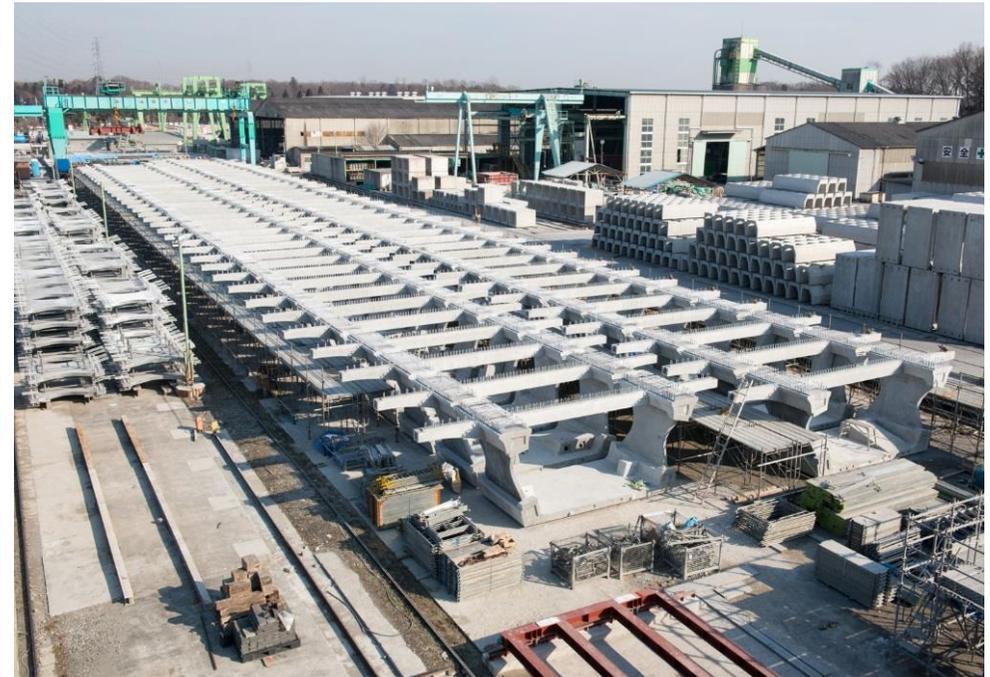
STOCK YARD

Butterfly Panel



Number of panels : **2372**

Segment



Number of segments : **1036**

TRANSPORTATION TO CONSTRUCTION SITE



Lifting of Segment

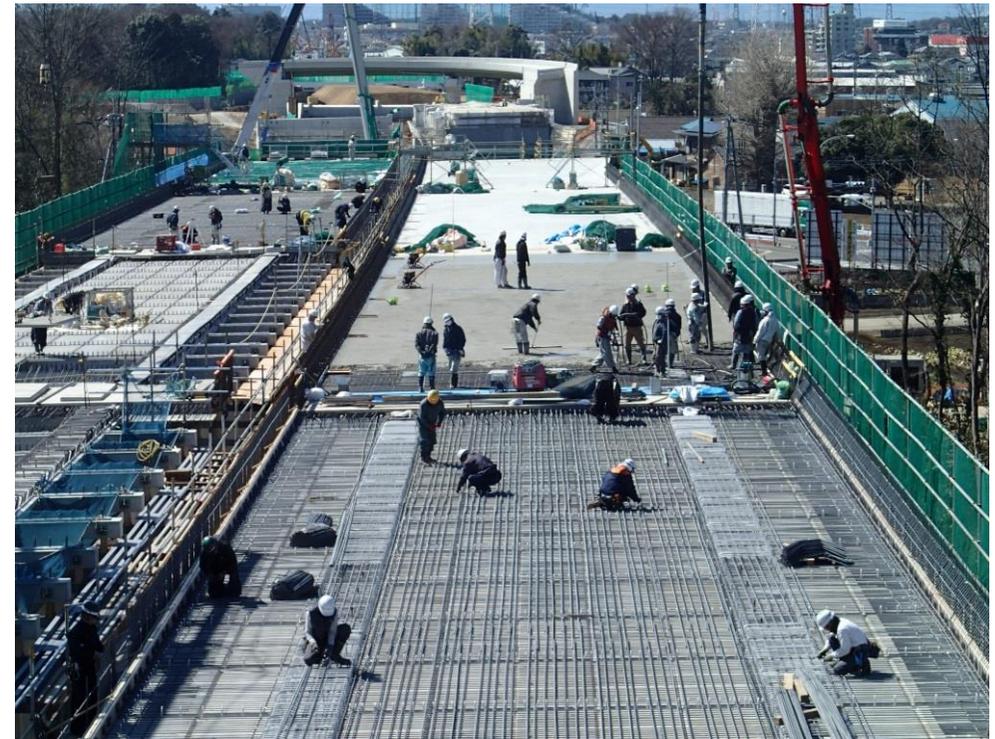


Transportation by Ttrailer

CONSTRUCTION OF DECK SLAB



Precast Panel



Casting of Deck Slab

EXTERNAL TENDONS



Easy Maintenance!

BRIDGE OF NEXT GENERATION (DURA-BRIDGE)

Paradigm Shift from 150-year Old RC



Aramid Fiber

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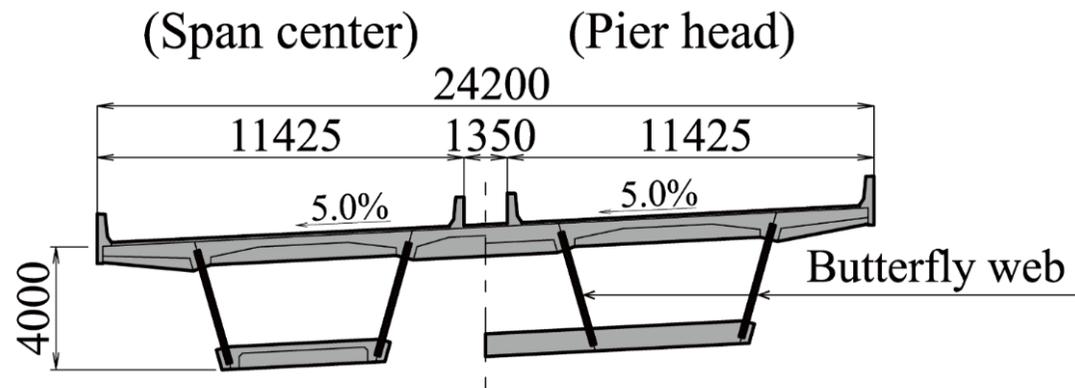
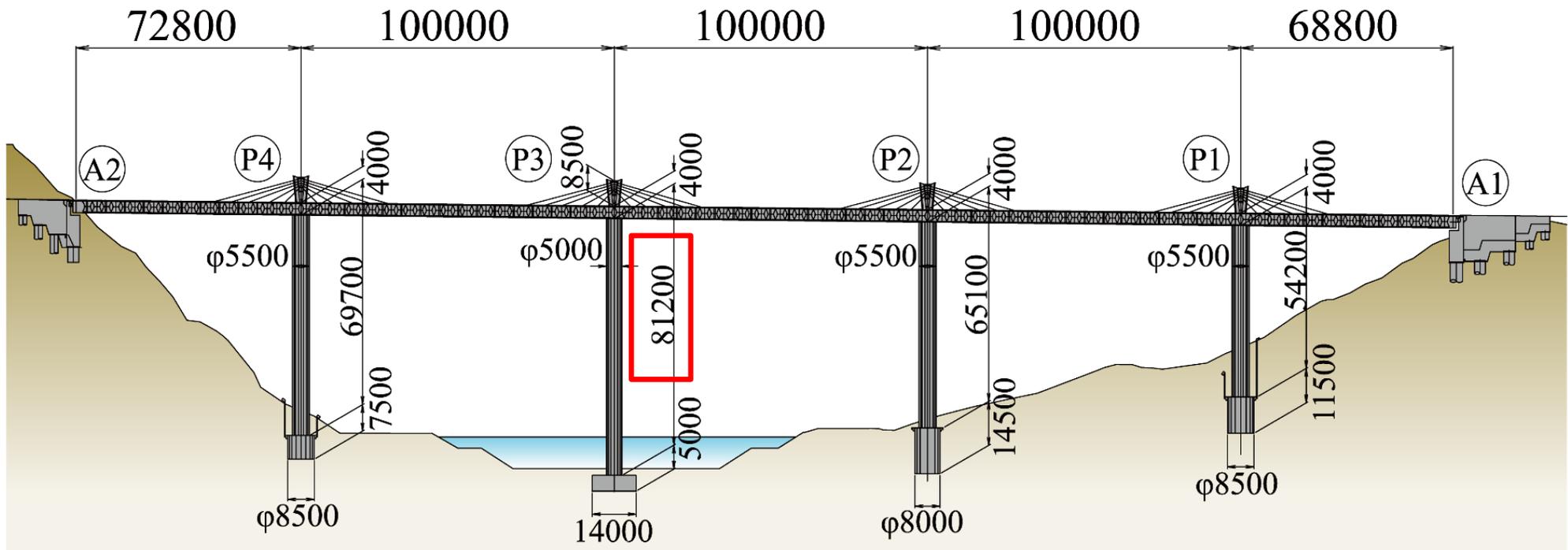
1-4 Segment Construction for Piers

2. Buildings

MIKOGAWA BRIDGE (2016)

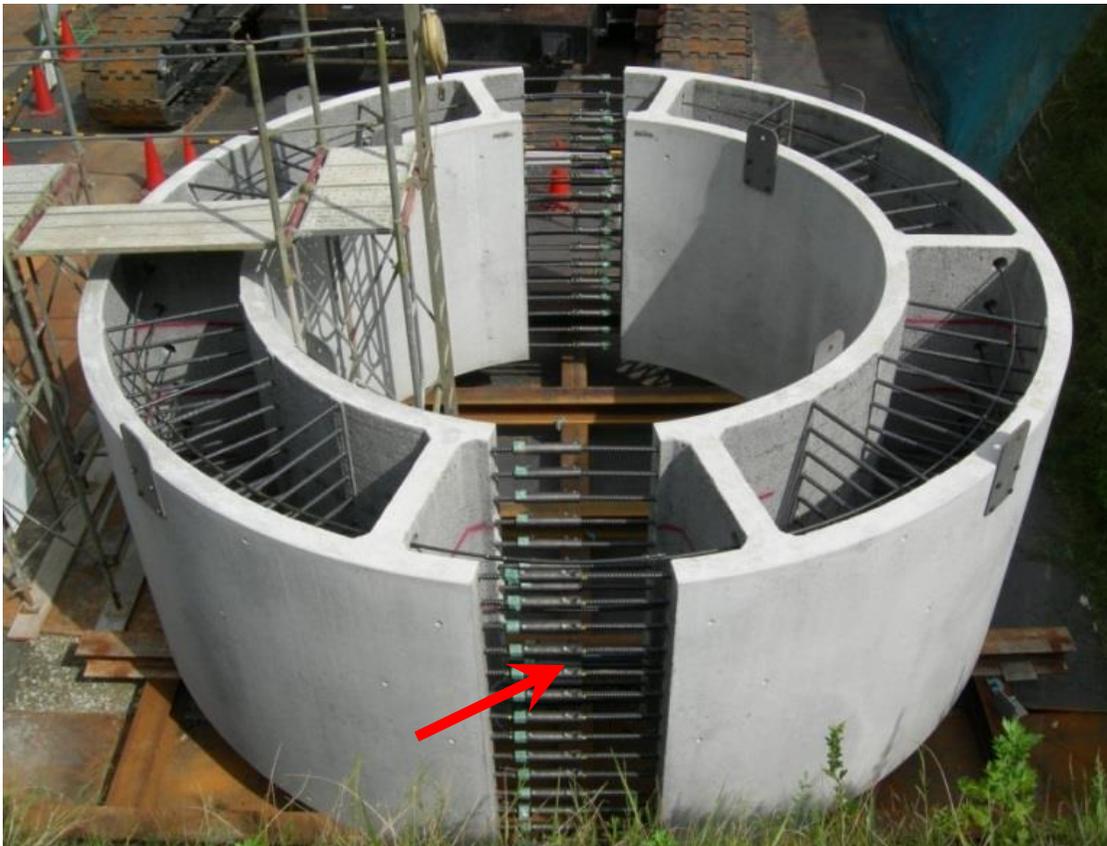


GENERAL VIEW



PIER SEGMENT

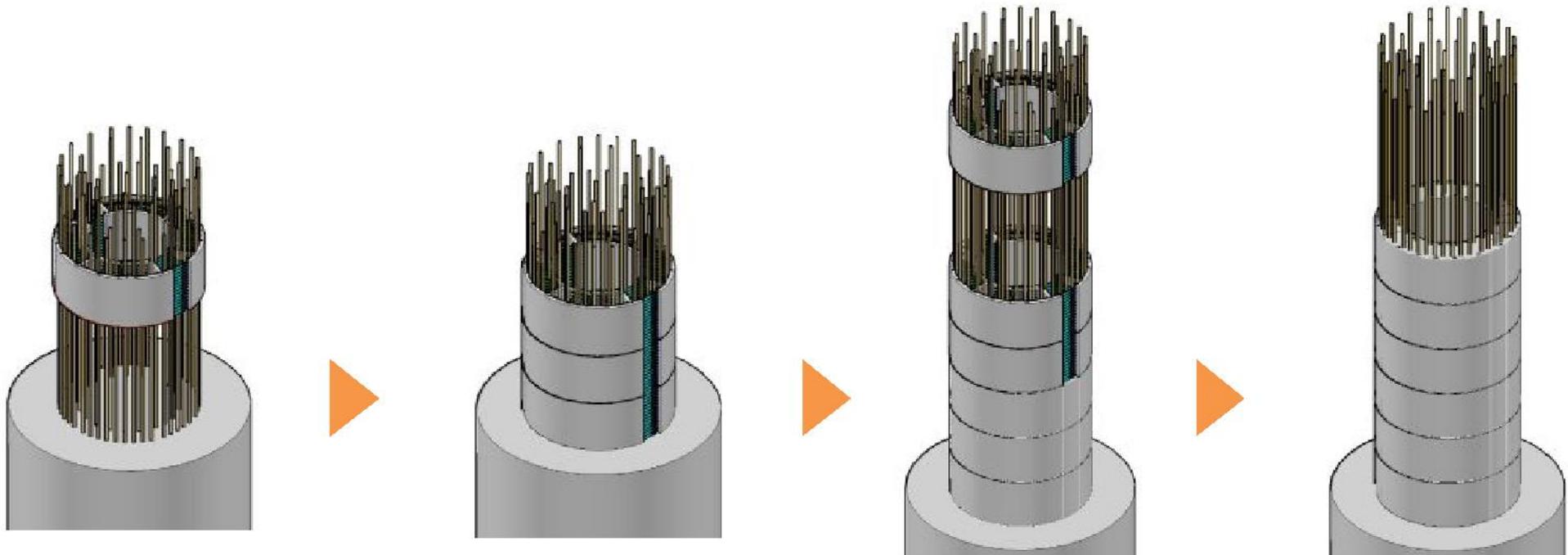
Fabrication in SMCC's Factory



- ✓ Horizontal Re-bars are set in the precast members.

CONSTRUCTION OF PIERS

Construction speed = 1m/day

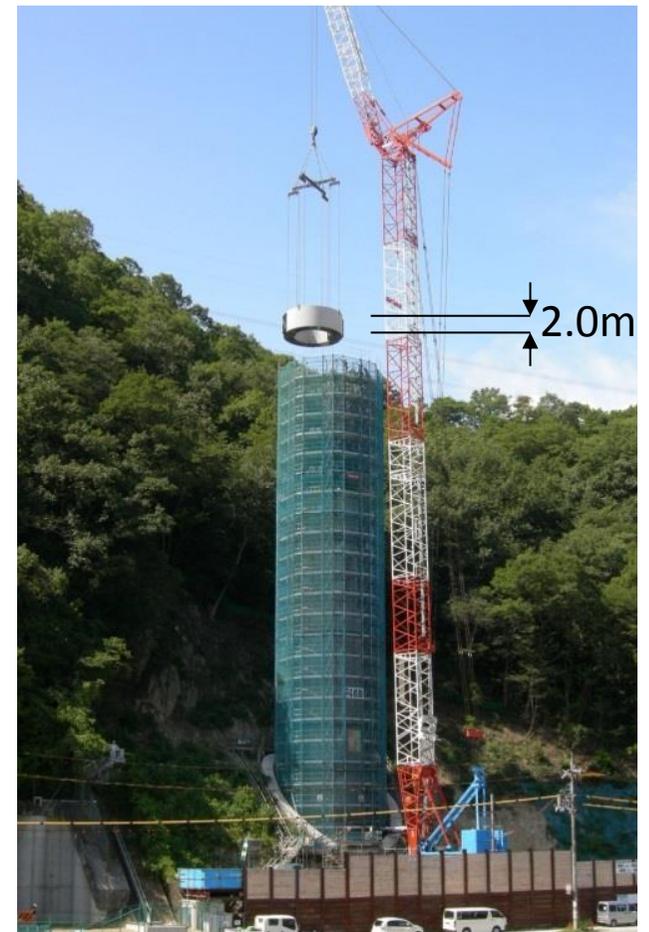


3 Segments/Lot
&
Casting Concrete

D51 Re-bar
(SD490)

CONSTRUCTION OF PIERS

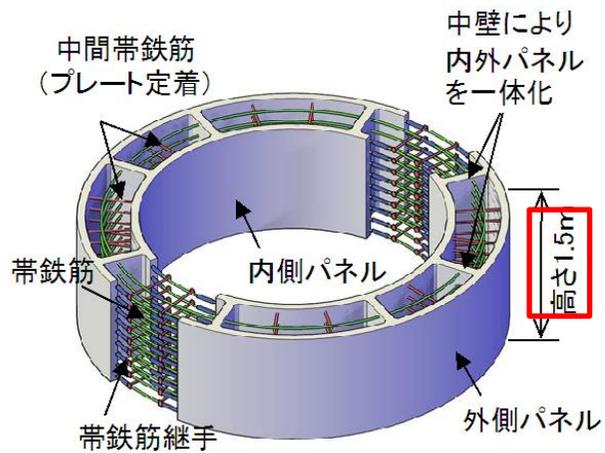
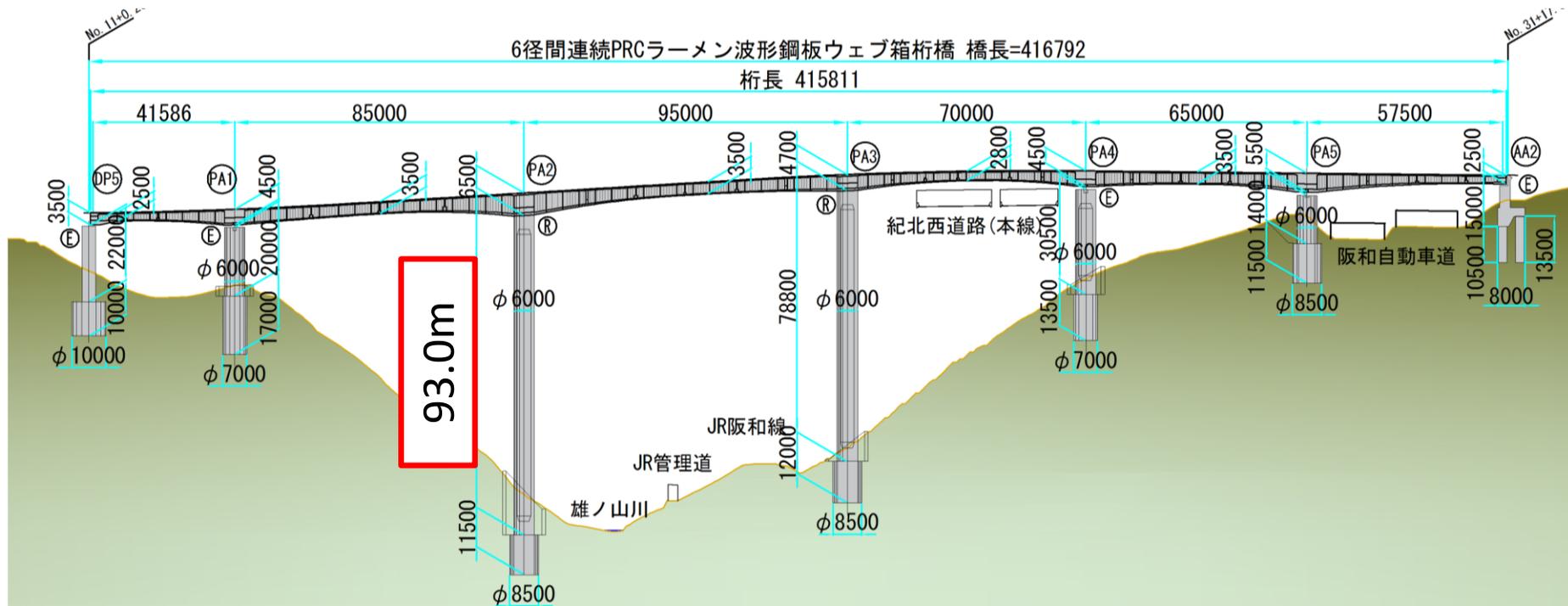
50 MPa Concrete



CONSTRUCTION OF PIERS



WAKAYAMA JCT BRIDGE (UNDER CONSTRUCTION)



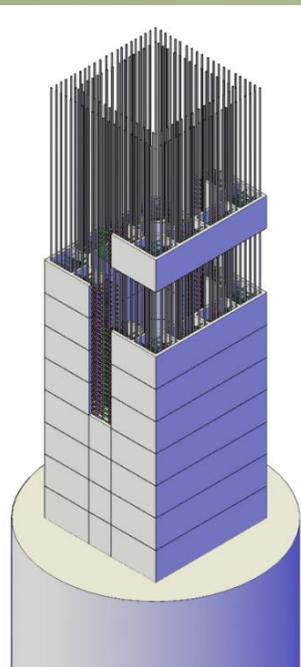
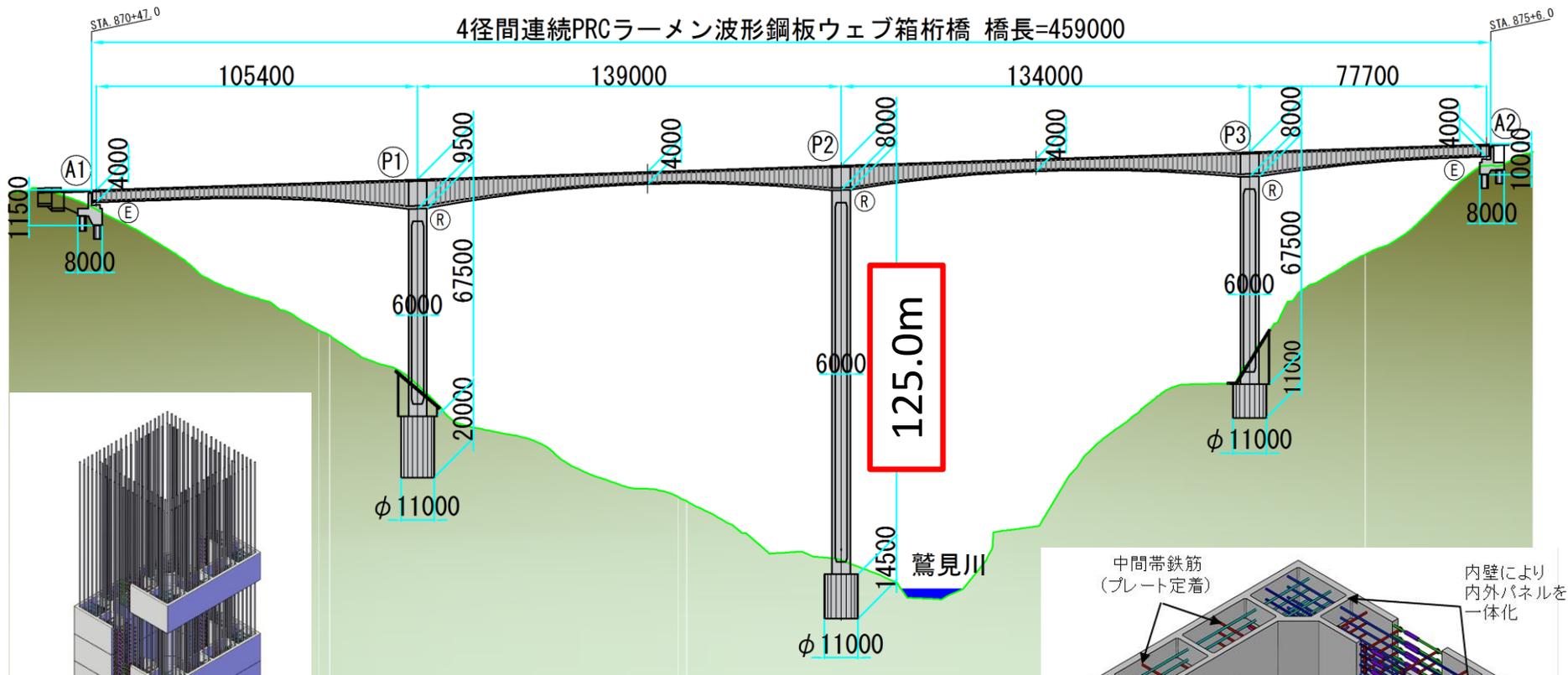
CONSTRUCTION OF PIERS



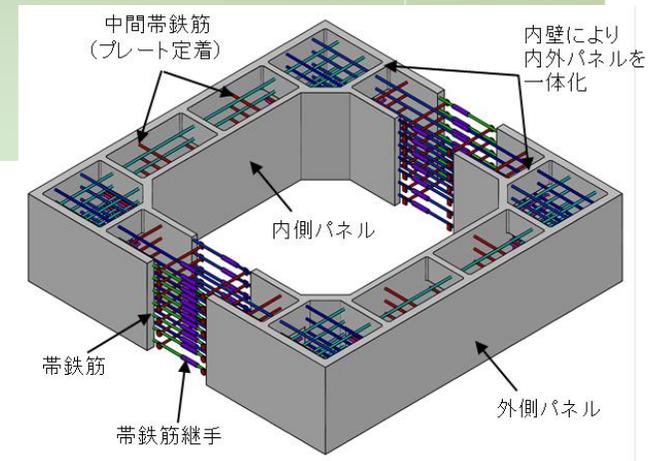
CONSTRUCTION OF PIERS



WASHIMI BRIDGE (UNDER CONSTRUCTION)



The highest pier in Japan



WASHIMI BRIDGE (UNDER CONSTRUCTION)



CONSTRUCTION OF PIERS



CONSTRUCTION OF PIERS



CONSTRUCTION OF PIERS

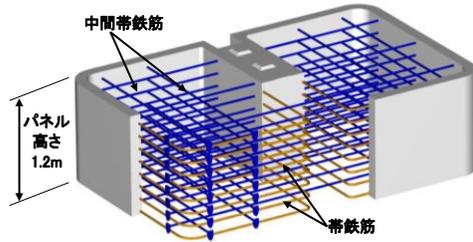


CONSTRUCTION OF PIERS

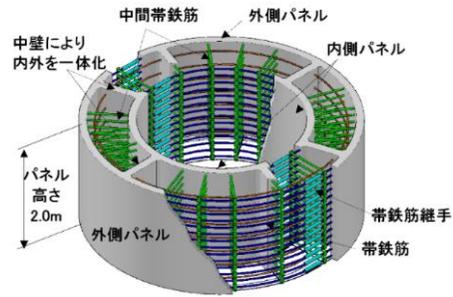


SPER METHOD

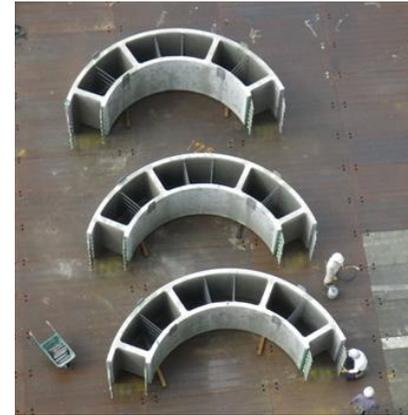
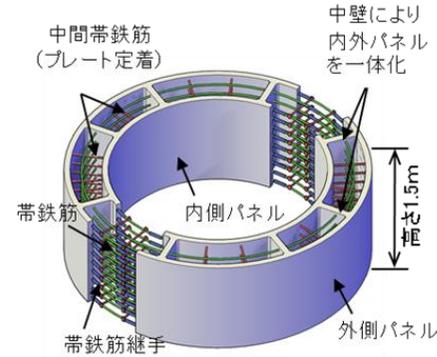
Aoyama Viaduct
2.5mx4.0m



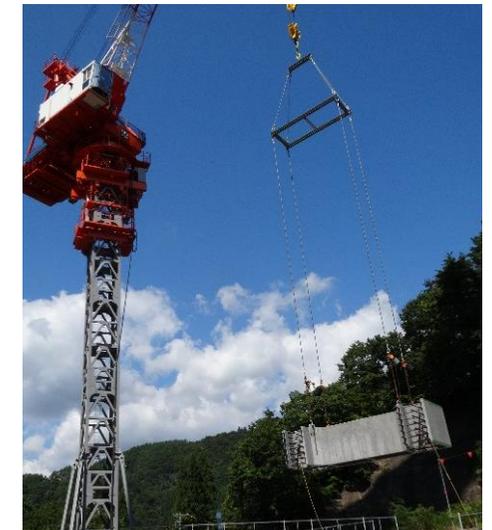
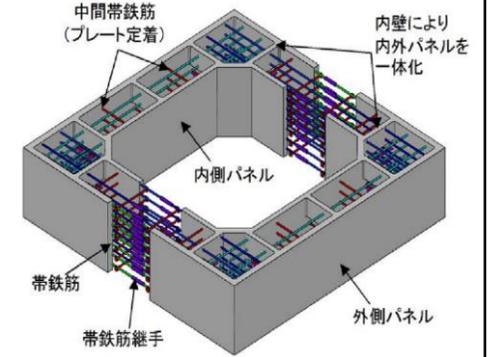
Mukogawa Bridge
φ5.0m, φ5.5m



Wakayama JCT
φ6.0m



Washimi Bridge
6.0mx6.0m



1. Bridges

1-1 U-Shaped Girder Segment

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SQRIM & SQRIM-H METHOD

SQRIM = Sumitomo Mitsui Quick RC Integration

SQRIM-H METHOD
Sumitomo Mitsui Quick Rc Integration – Horizontal system

Complete Precast Concrete Method with High Productivity & Versatility

SQRIM-H

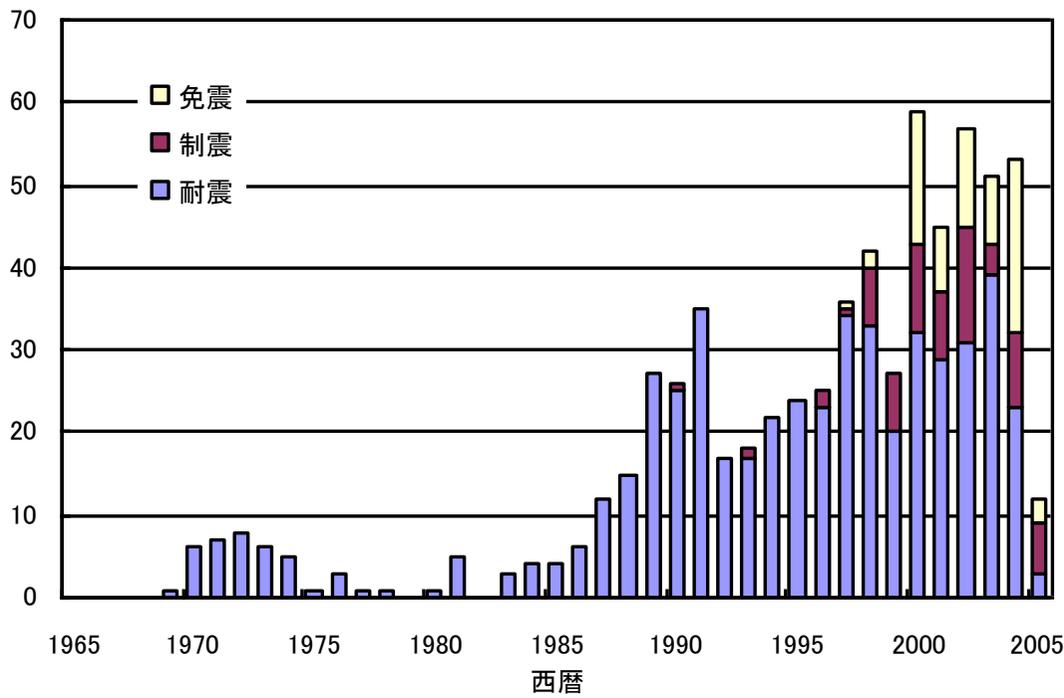
■ Contact to ✉ kenchikutoiawase@smcon.co.jp

 **SUMITOMO MITSUI CONSTRUCTION CO.,LTD.** Public Relations Office
2-1-6 Tsukuda, Chuo-ku, Tokyo
104-0051 Japan
TEL. 03-4582-3015 FAX. 03-4582-3204
<http://www.smcon.co.jp/english>

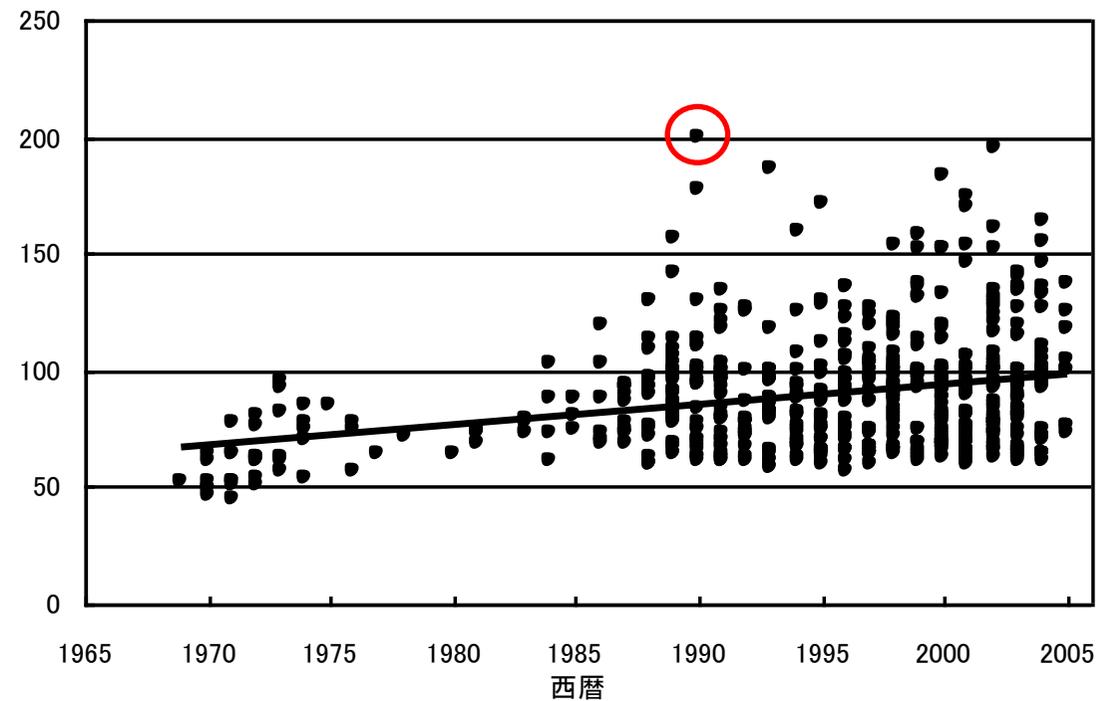
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ACHIEVEMENT OF PRECAST HIGH-RISE BUILDING

✓ High-rise residential building demand in Metropolitan Area



NUMBER



HEIGHT

EXAMPLES BY SQRIM METHOD

2005
YOKAOHAMA(27F)



2006
TOKYO (31F)



2008
TOKYO(52F) height 178m



2008
TOKYO(35F)



2009
TOKYO(33F)



2011
TOKYO(31F)



2011
TOKYO (32F)



2015
TOKYO(51F) height 177m



2011
TOKYO(35F)



2014
TOKYO(35F)



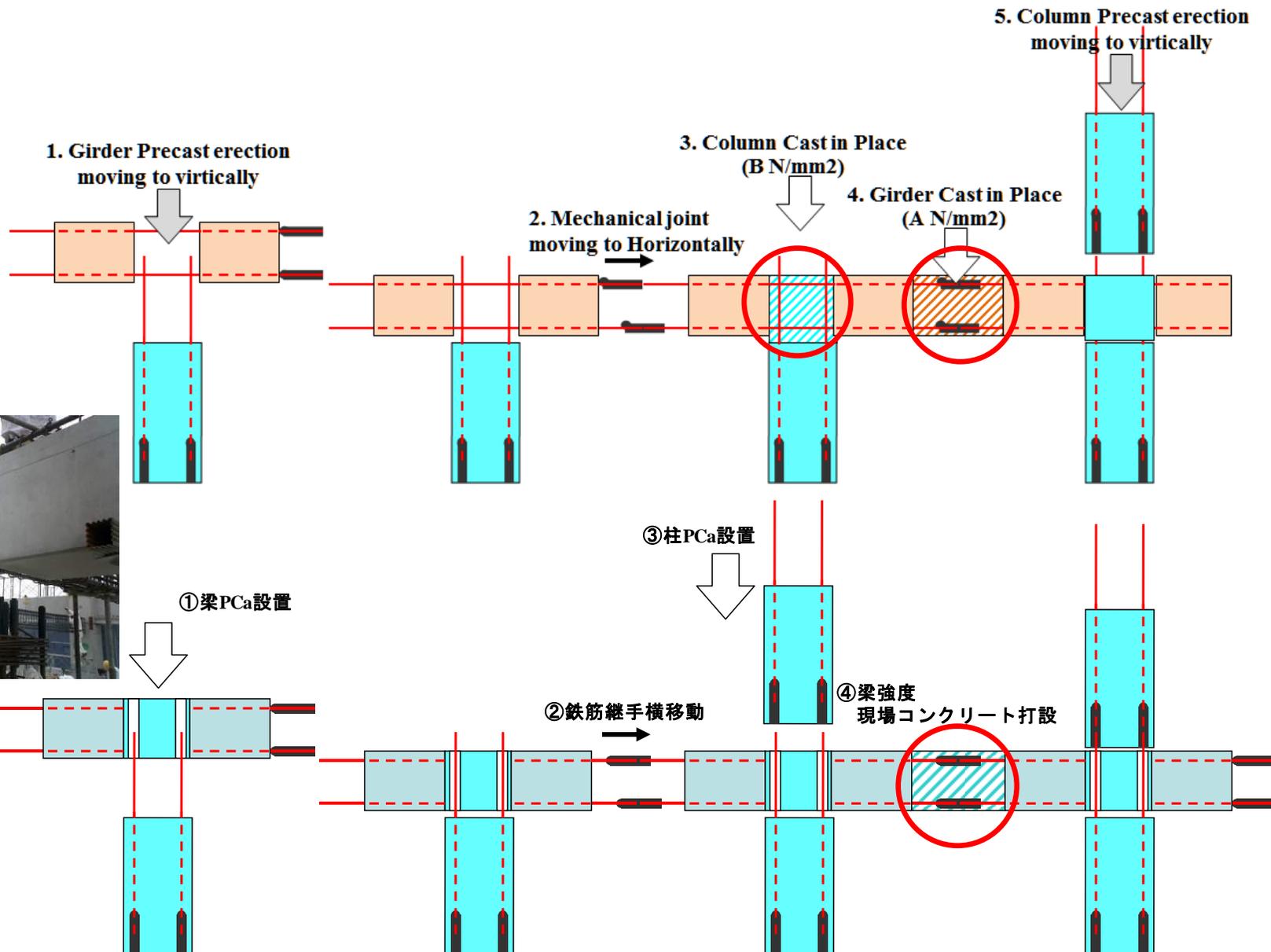
Since 2003, 38 buildings (1,523,434m²)

SQRIM METHOD (SINCE 2003)

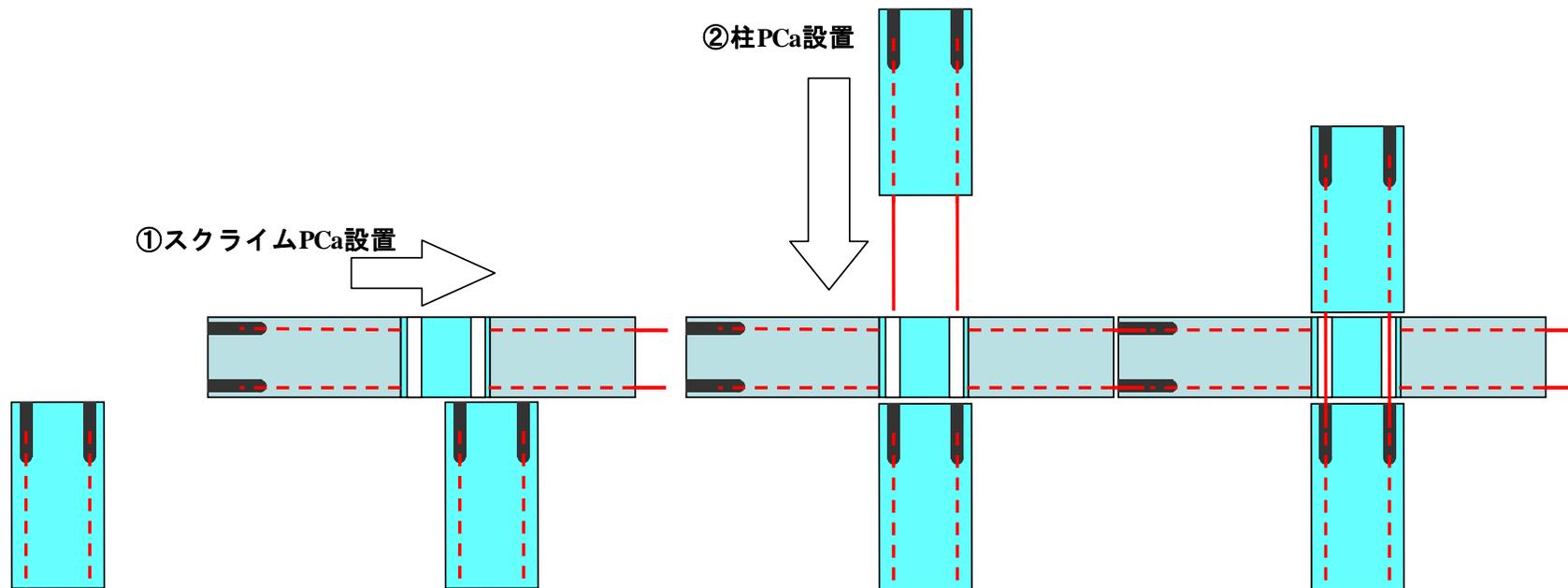


- ✓ Complete precast is applied for mains structure frame
- ✓ First applied to the project in 2003 as SQRIM Method.

CONVENTIONAL PRECAST METHOD



SQRIM METHOD



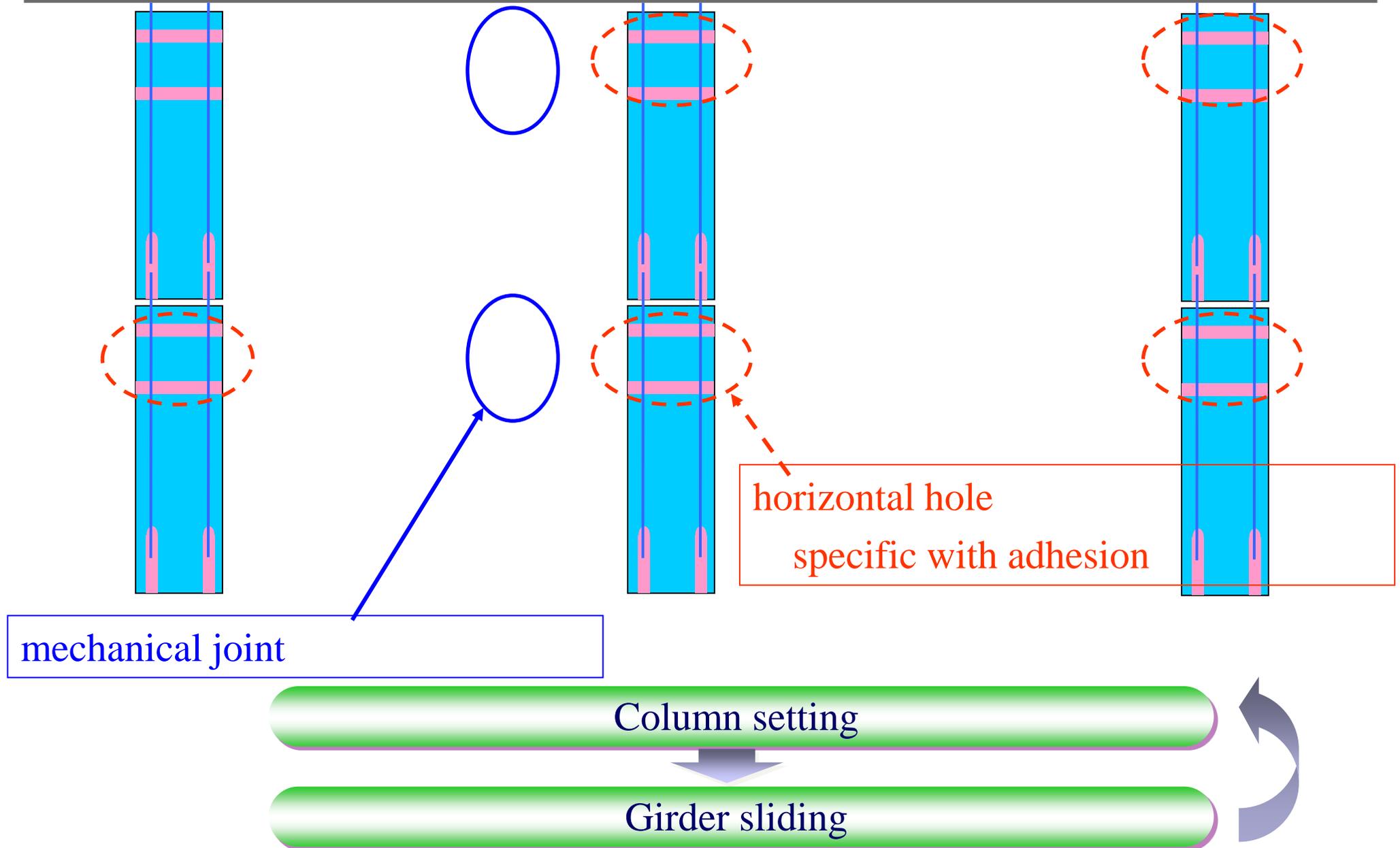
No cast-in-situ concrete joint!

SQRIM-H METHOD (SINCE 2008)



- ✓ SQRIM-H Method can build one floor per 3 days.
- ✓ SMCC has applied and under construction for 4 buildings with 3 project as of October, 2009

SQRIM-H METHOD PROCEDURE



SQRIM-H METHOD



PERFORMANCE TEST OF MECHANICAL JOINT

NMB SPLICE SLEEVE SYSTEM



DIVISION: 03 00 00—CONCRETE
SECTION: 03 21 00—REINFORCING STEEL

REPORT HOLDER:

SPLICE SLEEVE JAPAN, LTD.

17-1 NIHONBASHI
HAKOZAKI-CHO, 103-0015
CHUO-KU TOKYO

EVALUATION SUBJECT:

NMB SPLICE SLEEVE® UX (SA), NMB SLIM-SLEEVE™ AND NMB SPLICE SLEEVE®
UX (SA) SD590 SYSTEMS FOR CONNECTING STEEL REINFORCING BARS



Look for the trusted marks of Conformity!

"2014 Recipient of Prestigious Western States Seismic Policy Council
(WSSPC) Award in Excellence"

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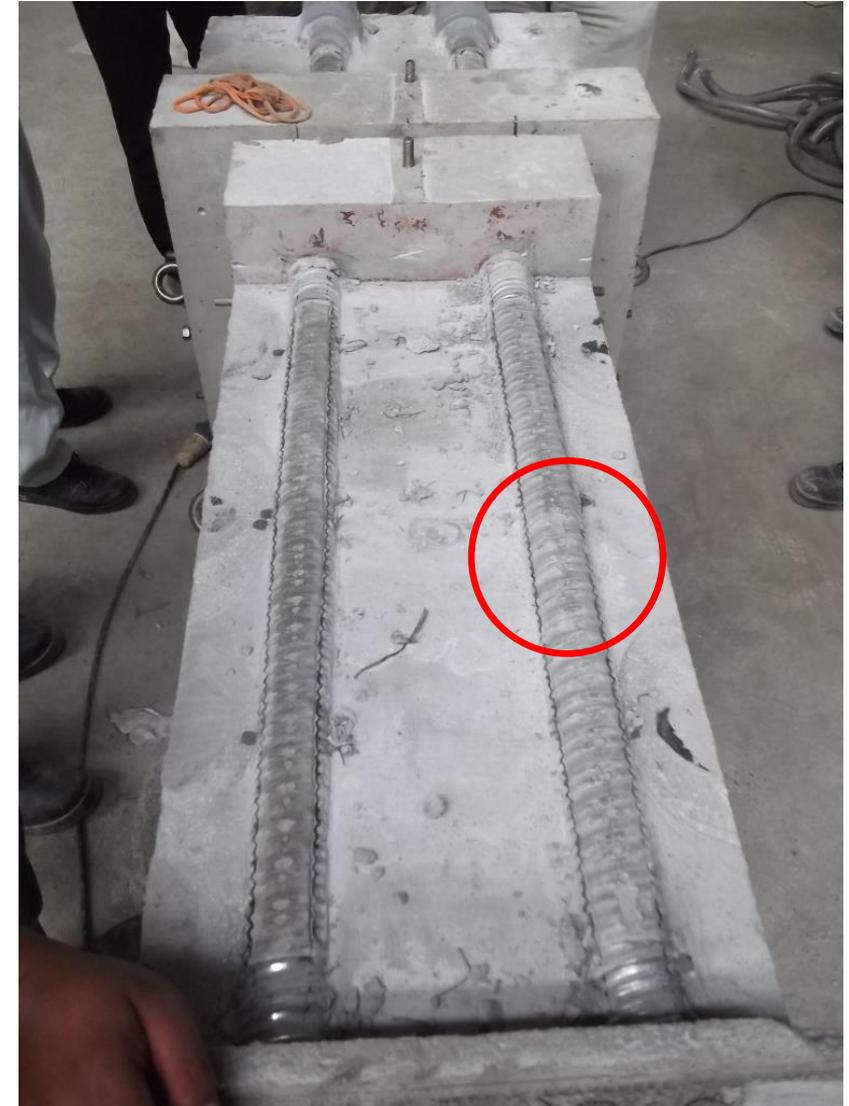


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INTERNATIONAL
CODE COUNCIL



GROUT INJECTION MOCKUP TEST

- ✓ Injection performance in the precast are is also important.



STRUCTURAL PERFORMANCE TEST AT SMCC R&D CENTER

- ✓ The same behavior as monolithic construction should be guaranteed.



CONCLUSIONS

1. Own concrete factory is useful for special precast construction.
2. Unique precast bridge construction methods have been applied in Japan.
3. New material is used in precast bridge construction.
4. Half precast method is useful for rapid construction of piers in the seismic area.
5. Precast construction for high-rise building is widely used.
6. Rapid construction for structural frame without cast-in-situ concrete is developed in Japan.



Thank you for your attention