EXAMPLES OF PRECAST CONCRETE APPLICATIONS EXPERIENCES IN JAPAN

Splice Sleeve Japan, Ltd.
Asao Sakuda

Precast Concrete in Japan

Most common precast concrete methods:

W-PC　precast wall structure
R-PC　moment frame structure
Prestress concrete structure

Wall structure building

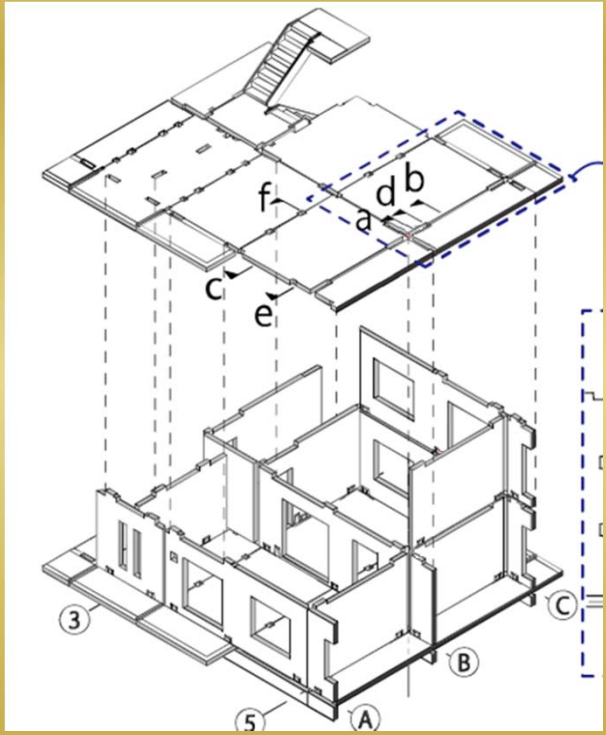
[Splice Sleeve Japan, Ltd. brochure]

Moment frame structure building

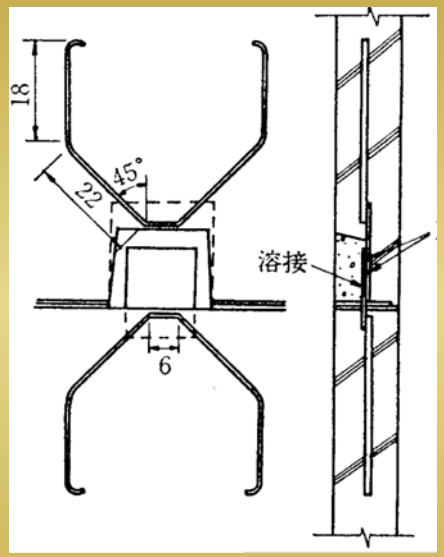
[Splice Sleeve Japan, Ltd. brochure]

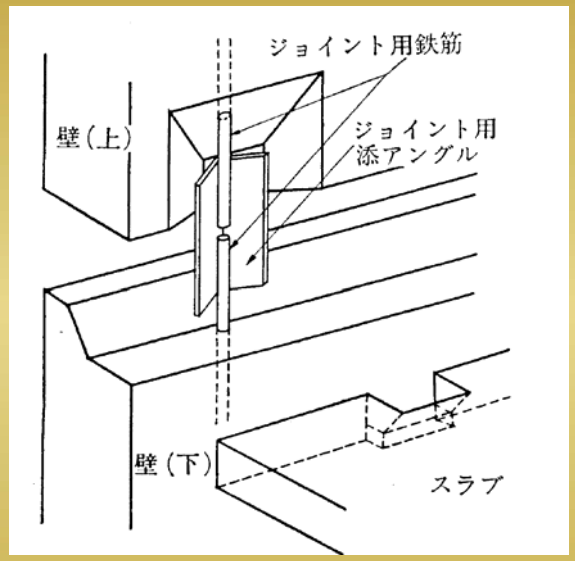
Precast Concrete in Japan

W-PC precast wall connections （1960 to 1975）



W-PC
[Tokyo Metropolitan University Architecture and Urban Studies Division 2011/8]

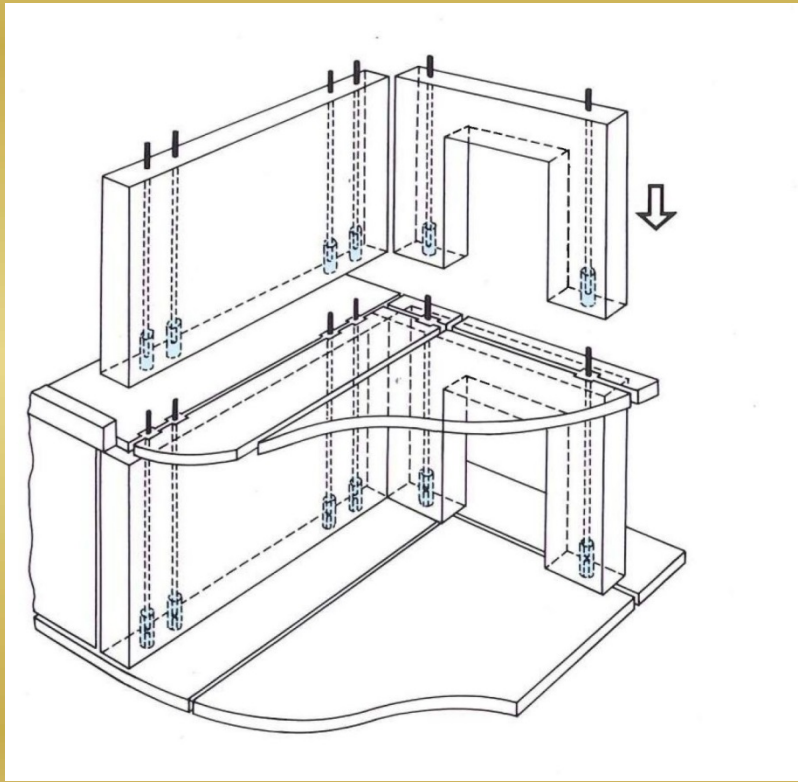




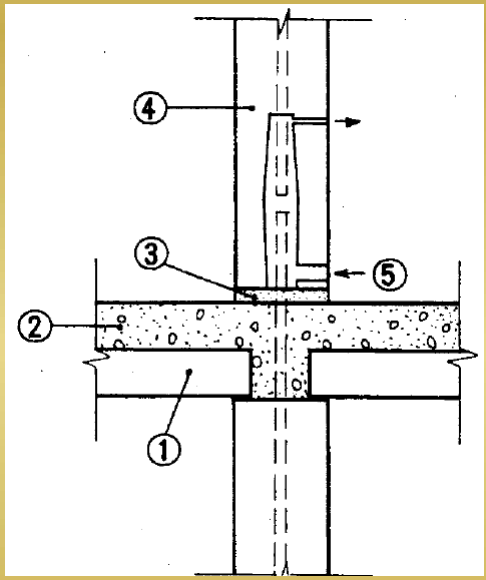
welding connections
[Concrete Journal July1974, Vol12, No7
Professor Suenaga of National University of Yokohama]

Precast Concrete in Japan

W-PC precast wall connections　(1975 to present time)



[Splice Sleeve Japan, Ltd. brochure]



Grouted couplers

[Splice Sleeve Japan, Ltd. brochure]

Precast Concrete in Japan

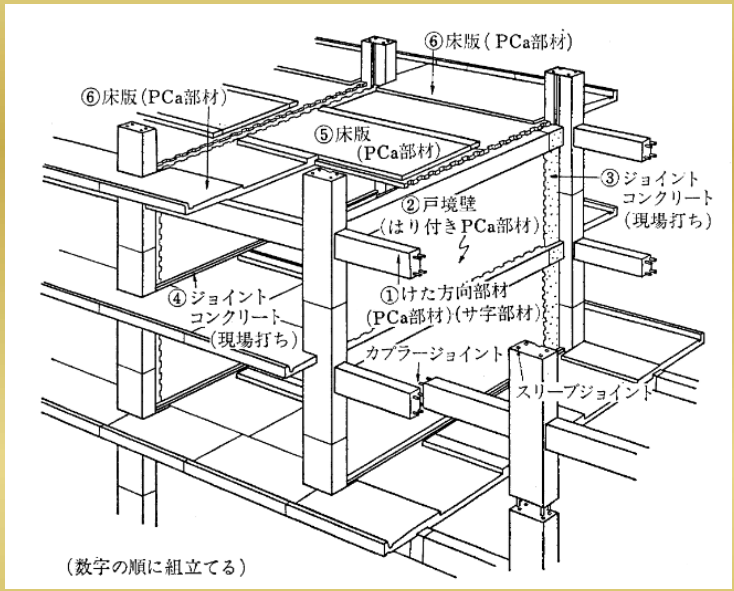
W-PC precast wall structure buildings (examples)

[Taisei U-Lec Co., Ltd. web site]

[Taisei U-Lec Co., Ltd. web site]

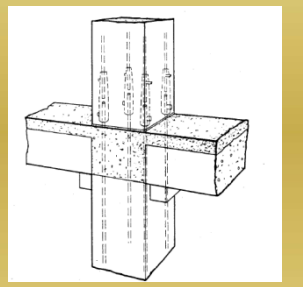
Precast Concrete in Japan

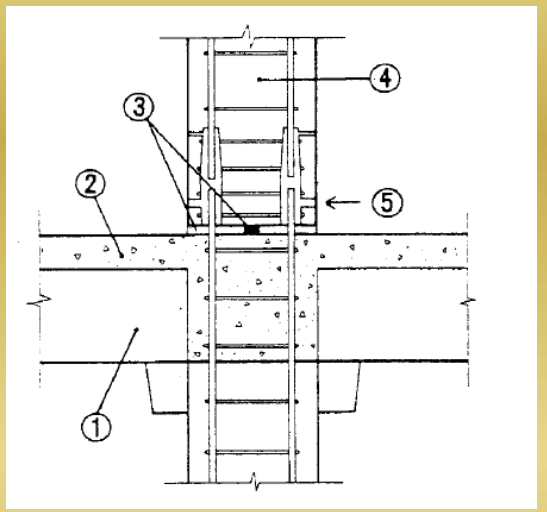
R-PC moment frame structure

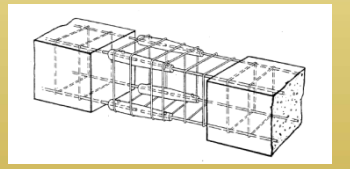


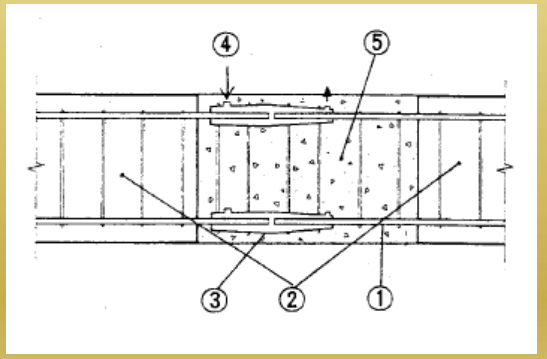
[JCI Concrete Journal March1987, Vol25]

[Splice Sleeve Japan, Ltd. brochure]









[Splice Sleeve Japan, Ltd. brochure]

Precast Concrete in Japan

R-PC buildings - examples

High rise building
56 stories, Tokyo

[Splice Sleeve Japan, Ltd. brochure]

High rise building
42 stories, Fukuoka

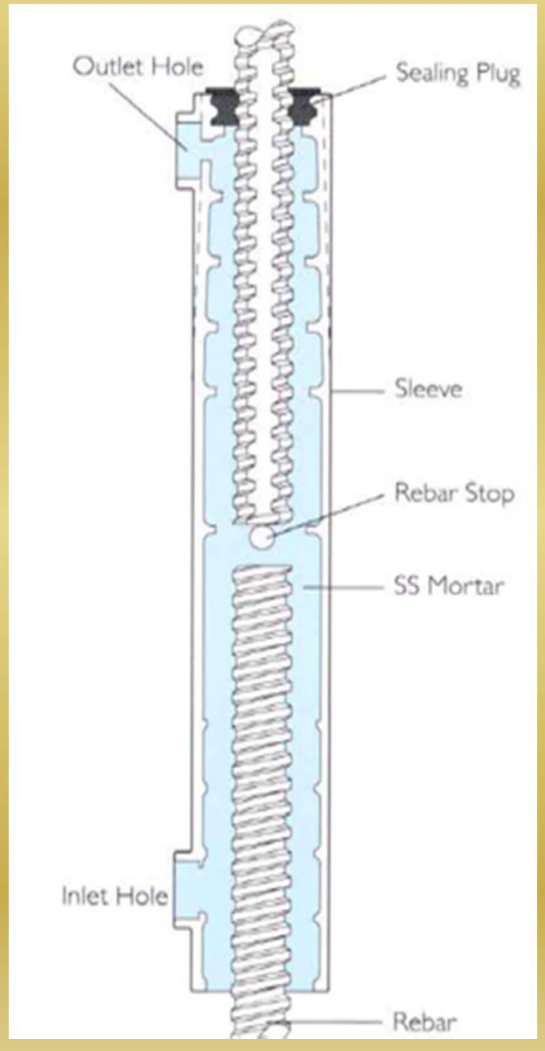
High rise building
53 stories, Tokyo

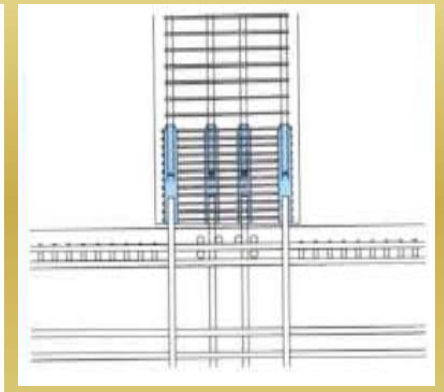
Precast Concrete in Japan

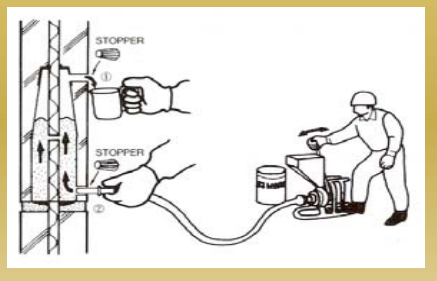
About grouted couplers

Introduced to the Japanese construction market in 1970's. Mock up tests were conducted in Yokohama National University. Test results showed that precast concrete structures that where grouted couplers are used are safe and reliable. Grouted couplers were adopted in the Public Housing Standard Design and since then it is widely used in precast concrete construction.

[Japan Prefabricated Construction Suppliers and Manufacturers Association]







[Splice Sleeve Japan, Ltd. brochure]

Precast Concrete in Japan

grouted coupler's performance – classified as class SA

Test methods and loading rules

Static tension test

$0 \rightarrow \sigma y_0 \rightarrow$ breaking

Repeated tension test

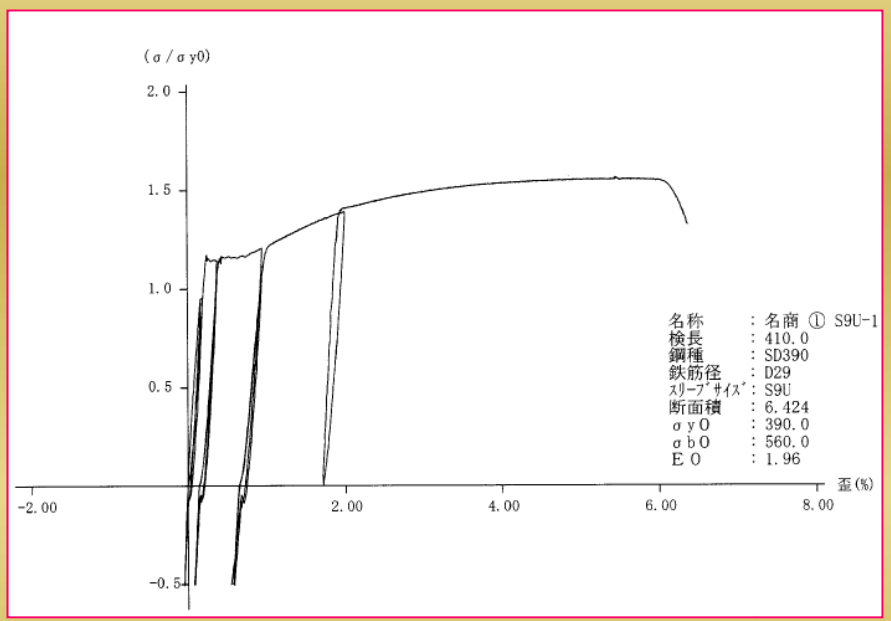
$0 \rightarrow (0.02\sigma y_0 \leftrightarrow -0.95\sigma y_0)$ 30 times$\rightarrow$ breaking

Cyclic tension and compression test

$0 \rightarrow (0.95\sigma_{y0} \leftrightarrow -0.5\sigma_{y0})$ 20 times$\rightarrow$ $(2\varepsilon_y \leftrightarrow -0.5\sigma_{y0})$ 4 times$\rightarrow$$(5\varepsilon_y \leftrightarrow -0.5\sigma_{y0})$ 4 times $\rightarrow$breaking

σy_0 : rebar's specified yield strength

ε_y : rebar's strain at actual yield stress



Class SA: The strength, rigidity and ductility are almost equivalent to those of the rebars to joint.

Class A: The strength and rigidity are almost equivalent, but the ductility is slightly inferior to the rebars to connect.

Class B: The strength and rigidity are almost equivalent, but other characteristics are inferior to the rebars to connect

Class C: The strength, rigidity etc. are inferior to the rebars to connect

Precast Concrete in Japan

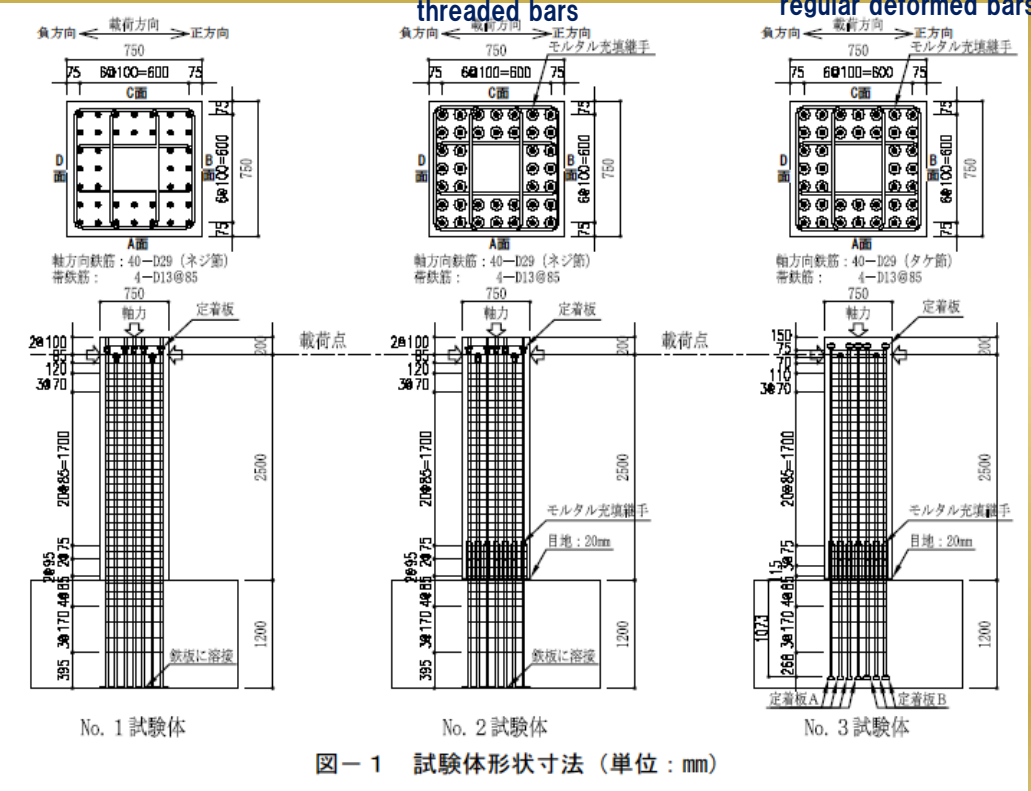
grouted coupler's performance – same as cast in place

Performance comparison test between precast concrete columns installed using grouted couplers and cast in place column

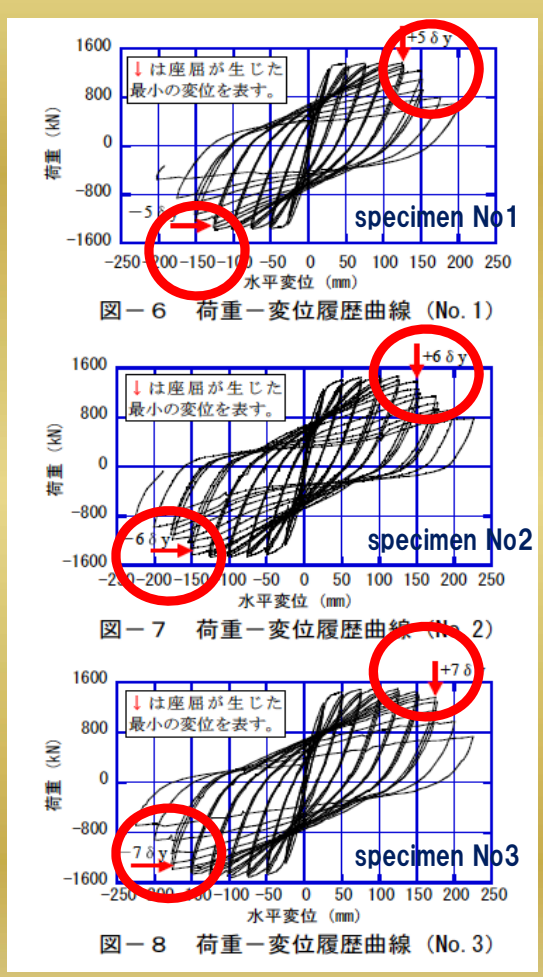
specimen No1
no mechanical couplers used

specimen No2
precast column grout coupler's connection
threaded bars

specimen No3
precast column grout coupler's connection
regular deformed bars



図－１　試験体形状寸法（単位：mm）



図－６　荷重－変位履歴曲線（No. 1）

図－７　荷重－変位履歴曲線（No. 2）

図－８　荷重－変位履歴曲線（No. 3）

[Reversed Cyclic Loading of Precast Concrete Rigid-frame Railway Viaduct Model Using Grout-filled Coupling Sleeves　Concrete Technology Annual Paper Vol. 27, No2, 2005
Mr. Hironobu Aida, Shimizu Corporation]

R-PC construction method example

TYPICAL R-PC BUILDING EXAMPLE

Project name: new development in Tokyo area (multistory condominium, private project)

Total period: September 1st, 2010～July 31, 2012

Structure: RC & S 23 stories, 1 underground story

1 penthouse condominium（201 flats）

B1～2G : cast in place

2F～23F・PH : precast

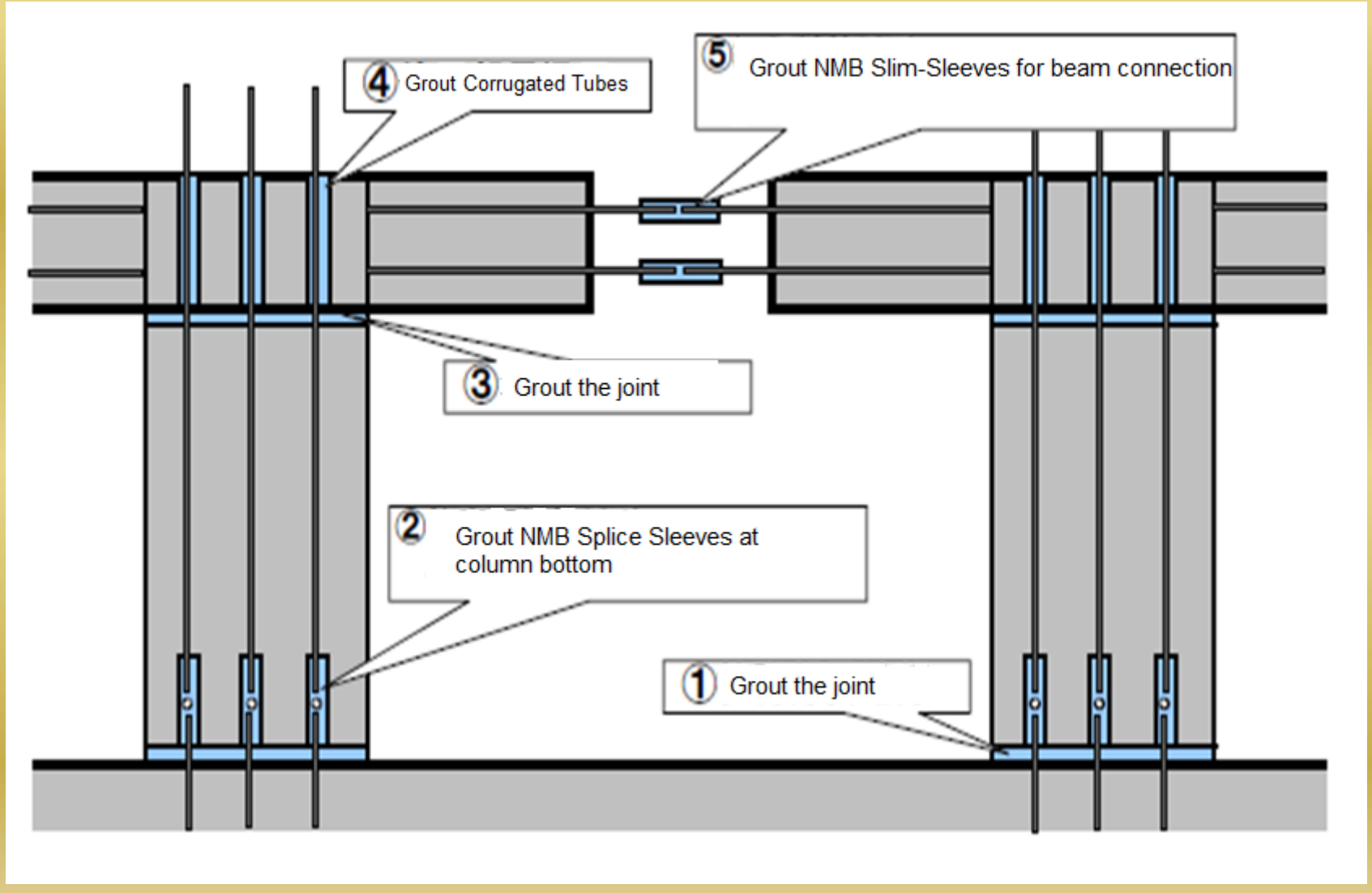
Building area: 2,940.37m^2

Total floor space: 20,258.11 m^2

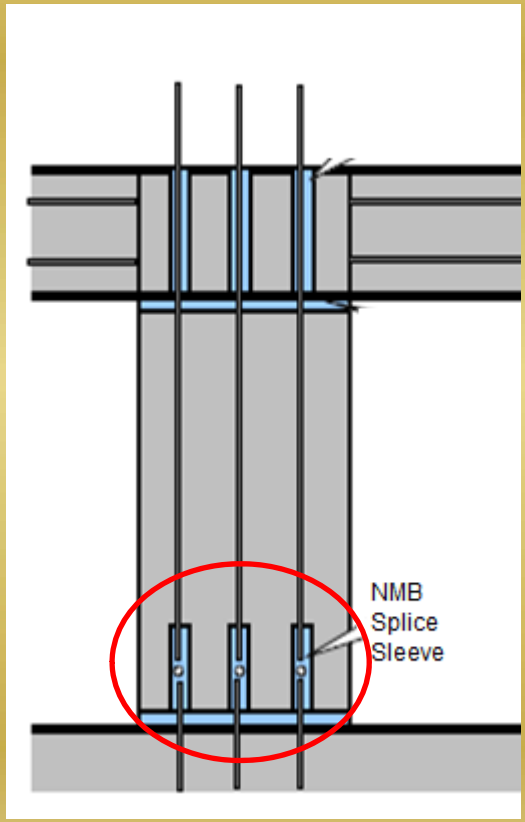
PRECAST CONCRETE COMPONENTS

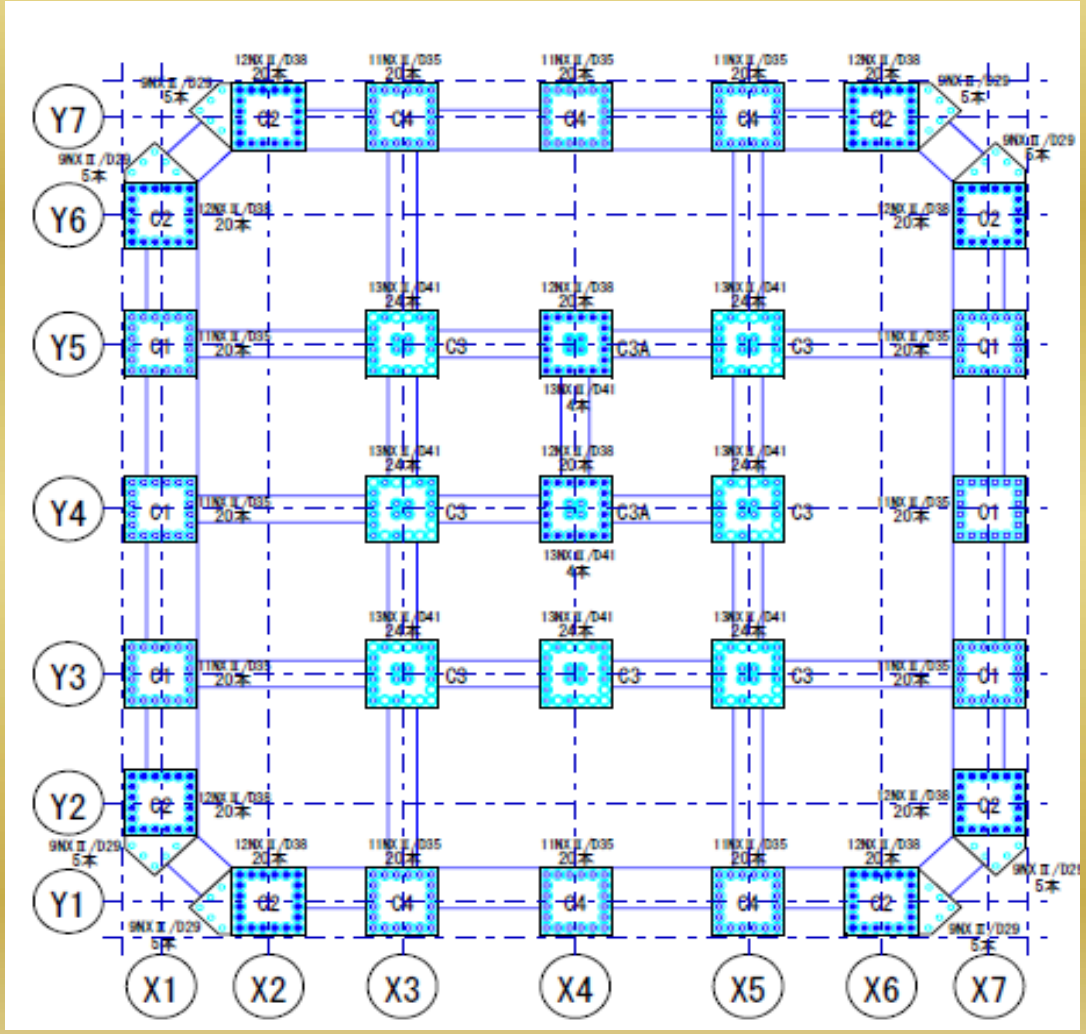
- Columns : Precast concrete
  installed using grouted couplers
- Beams : Precast concrete (beam/column combined member)
  connected using grouted couplers
  Beam/column connection area using
  corrugated tubes for rebars to go through
- Slabs : Half precast concrete

PRECAST CONCRETE COMPONENTS

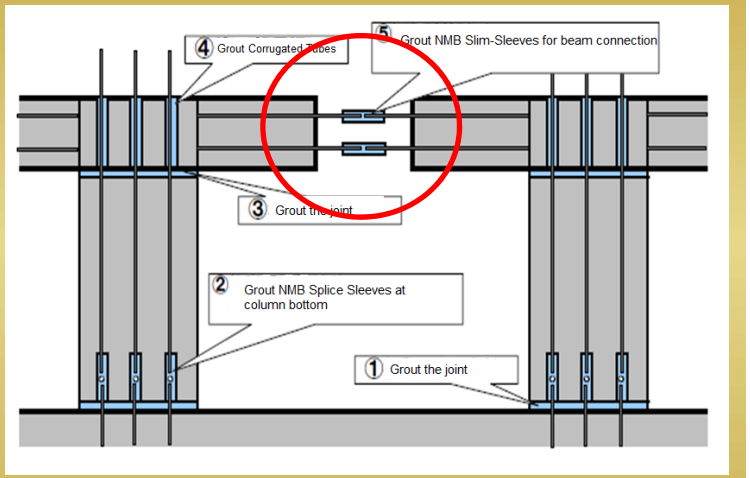


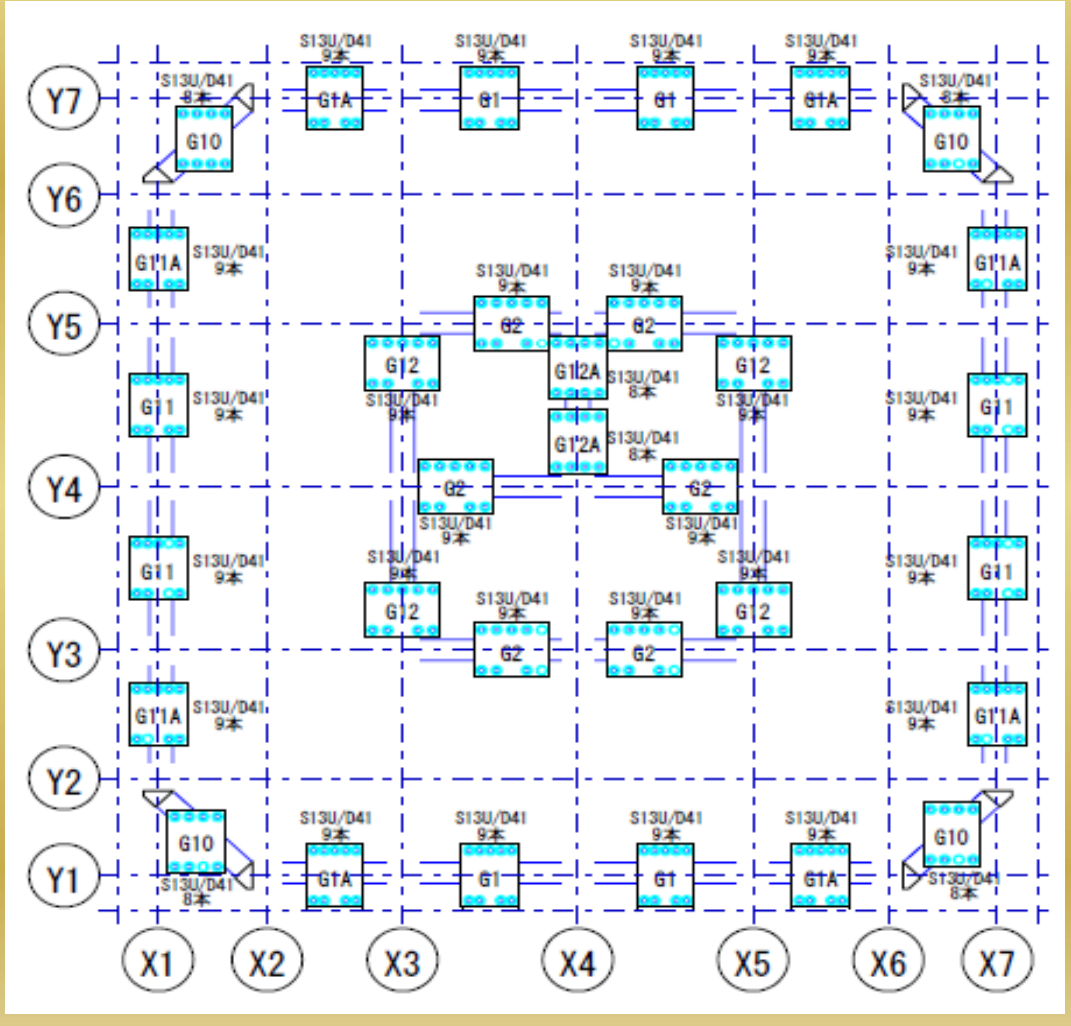
PRECAST COLUMN'S LOCATION



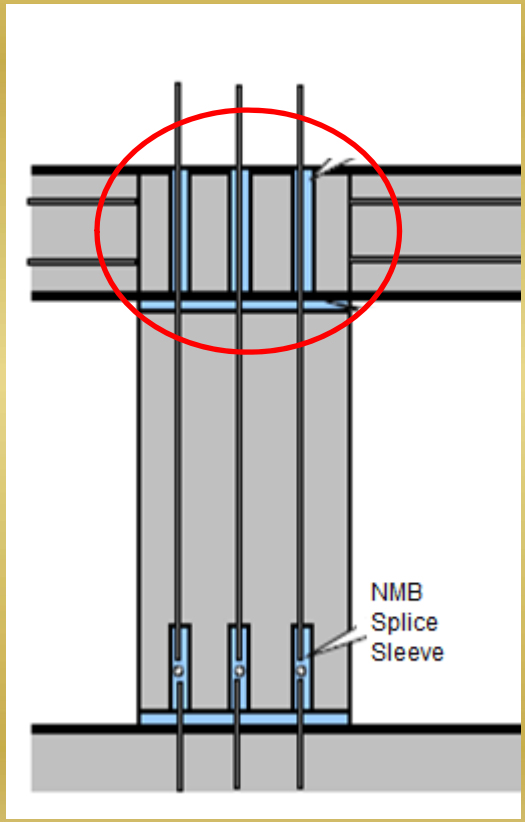


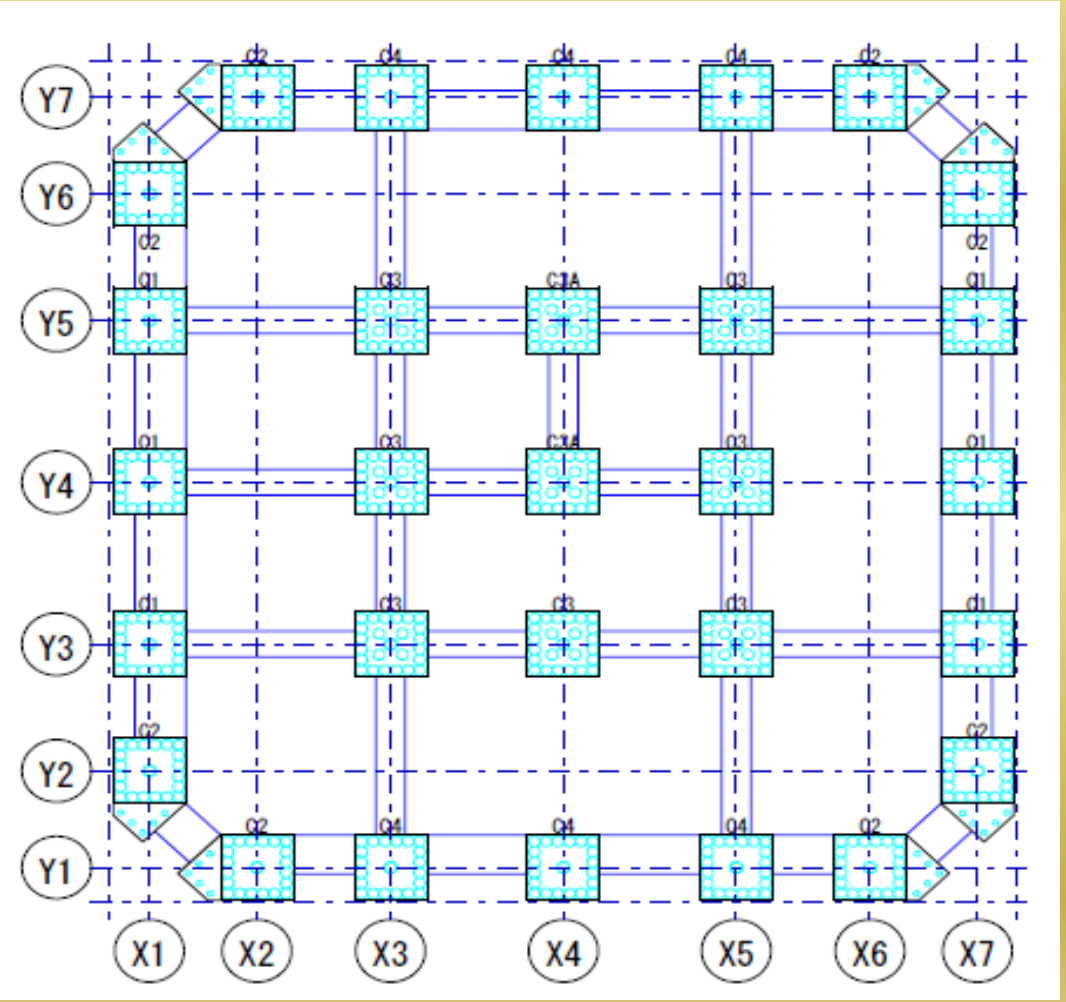
BEAM CONNECTION'S LOCATION





COLUMN-BEAM JOINT AREA

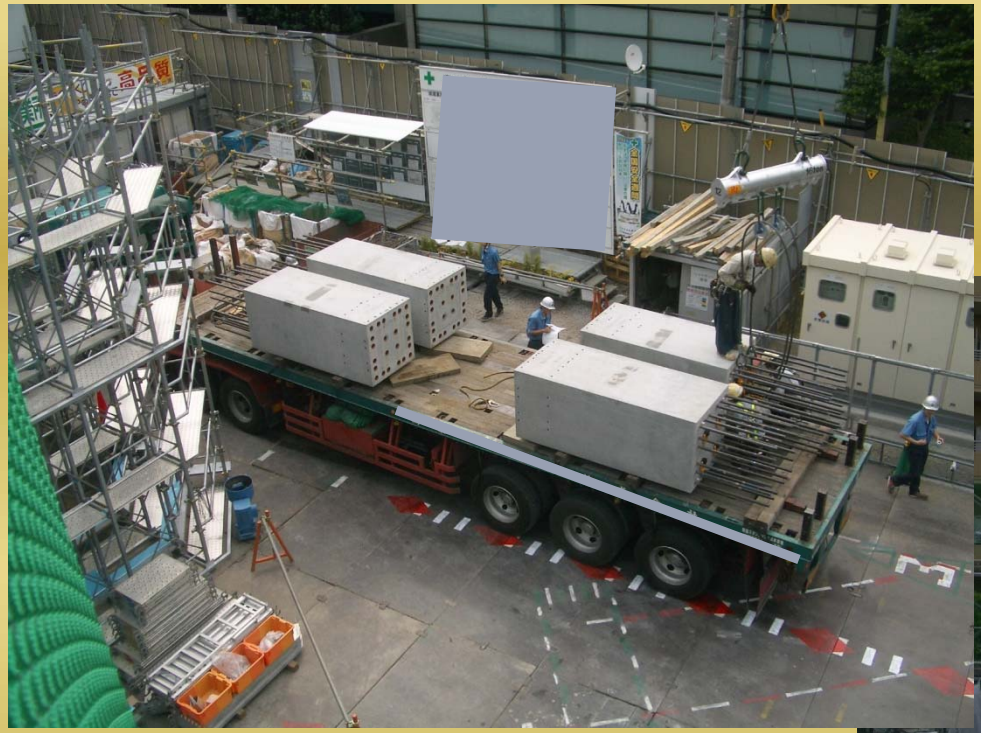




PRECAST INSTALLATION SCHEDULE

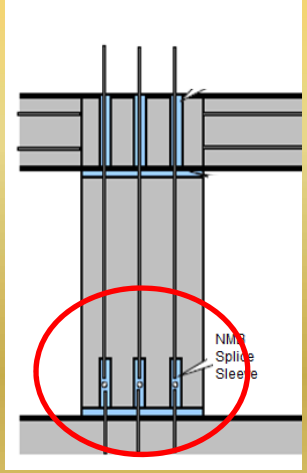
CONSTRUCTION SCHEDULE	DAY1	DAY2	DAY3	DAY4	DAY5
1. Concrete Pouring					
2. Erection of Outer Perimeter Beams	20P				
3. Slab Installation					
4. Column Top Joint Sealing		29P			
5. Grouting Slim Sleeves in Beam Connection		32P			
6. Grouting Column Top Joint			29P		
7. Erection of Precast Columns				29P	
8. Installing Air Tubes at Core Column Joint				9P	
9. Grouting Core Column Joint				9P	
10. Outer Perimeter Colulmn Joint Sealing				20P	
11. Outer Perimeter Column Sleeve Grouting					20P
12. Beam Erection for Cores					12P

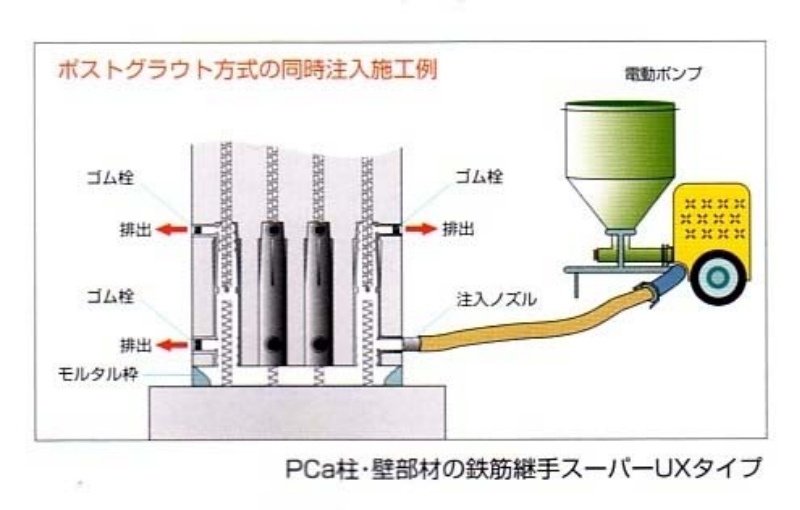
①PRECAST COLUMNS



delivered to the
site by truck

Erection of Column





Mass grouting

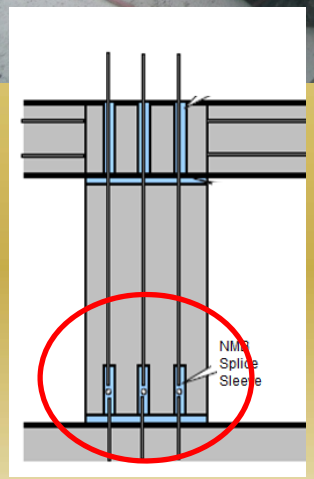
Pumping the grout through one splice sleeve to the joint area and other sleeves

Column/column joint sealing

The joint perimeter is sealed with the same grout that is used for the splice sleeve grouting, but of very low consistency. The splice sleeves will be grouted in the following day

Precast column connection: NMB Splice Sleeve

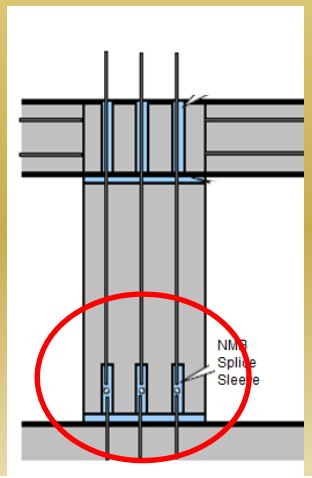
Filling grout material: SS Mortar 120N



Electric pump

Mass grouting

The filling grout is continuously pumped from the inlet hole of one splice sleeve to the joint area and also the rest of sleeves until all the plug indicators have moved to "filled" position



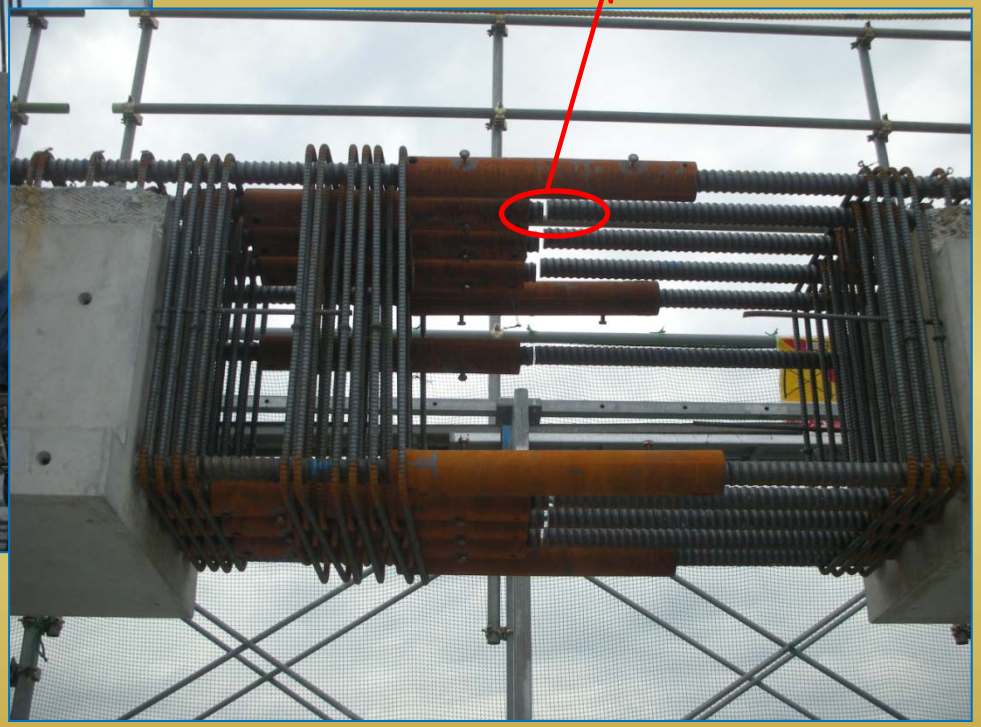
Grouting of outer precast columns

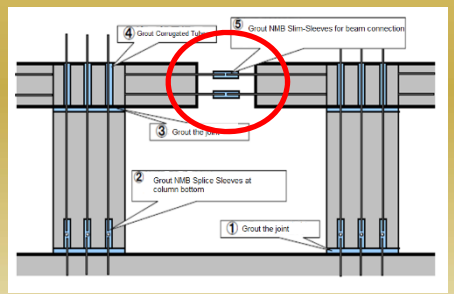
Confirmation of filling grout in the couplers by indicator-stoppers

②PRECAST BEAMS

precast beam installation

Tolerance: 3cm



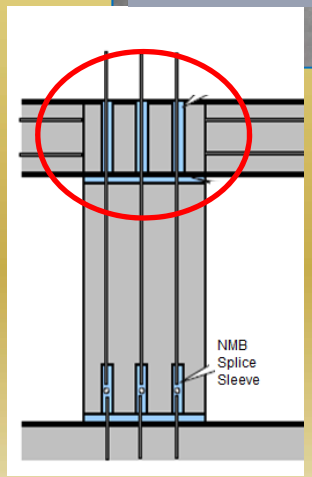


Connection beam/beam using grout couplers, NMB Slim-Sleeve

After grouting

Inspection after grouting

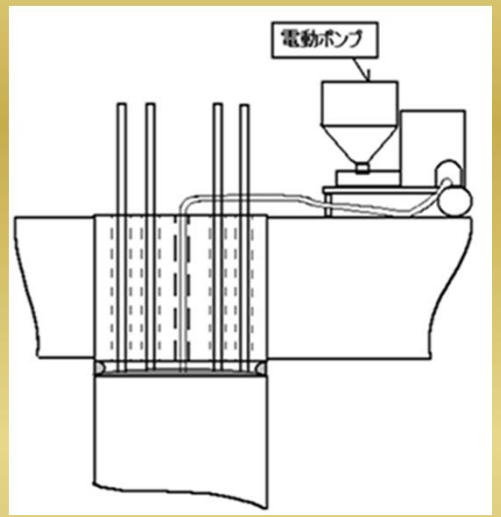
③COLUMN/BEAM CONNECTION

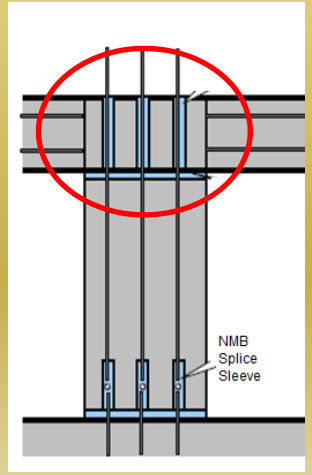


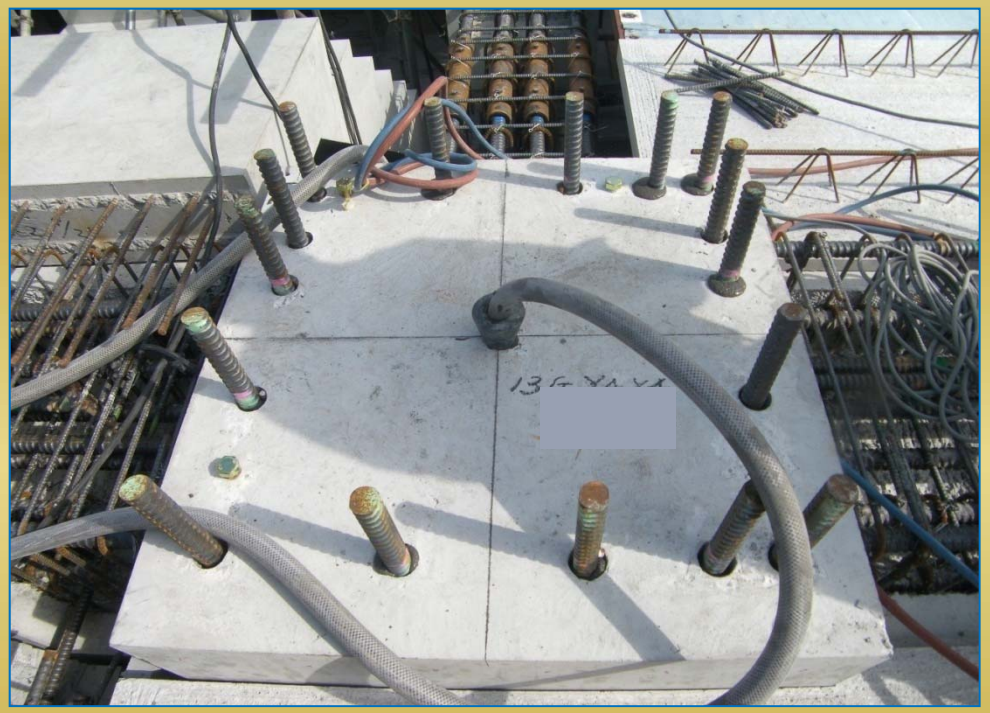
Column/column gap sealing

Hole for air escape

Column/beam connection grouting







THANK YOU FOR YOUR ATTENTION
ありがとうございました