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	Title	Speaker
Part -1	**Seminar on Study of Technology of Pre-tensioning Spun Pile in Myanmar**	May Pwint Phyu M.E (Civil) R.E-01934 Associate Asian Engineer (AAE5052)
Part -2	**Seminar on Study of Technology of Post-tensioning Segmental Girder in Myanmar**	Zaw Lwin Moe B.E (Civil) R.S.E-0459

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Seminar on Study of Technology of Pre-tensioning Spun Pile in Myanmar

Present by
May Pwint Phyu
M.E (Civil)
Associate Member of Asian Engineer

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Content

I. Introduction to Pre-stressed Precast Concrete Spun Pile Industry

In Japan, development of PC Spun Pile began in 1962, with the first large-scale use in bridge pier foundations for the Tokyo Metropolitan Expressway.

Over the 54 years since, PC Spun Pile has been used for all types of structures such as buildings and highway structures, and it is a widely recognized preferred foundation material along with cast-in-place pile and steel pipe pile.

In Myanmar, spun pile was started production on 2016 by I&H Engineering Co.ltd. Mainly use for foundation of buildings, bridges and jetty projects.

In this Seminar, a presentation will be made of the structure, advantages, and production method of PC Spun Pile.

II. Advantages of _Pre-cast Concrete Spun Pile

Centrifugal forming results in uniform and compact concrete

Number of joints can be small

Uniformity of property

Compact concrete increase corrosion resistance

Japan Quality System

Reduction of Construction Site Risk

Pre-Qualification on Product Before Installation

Providing of Product On Time in Construction Schedule,

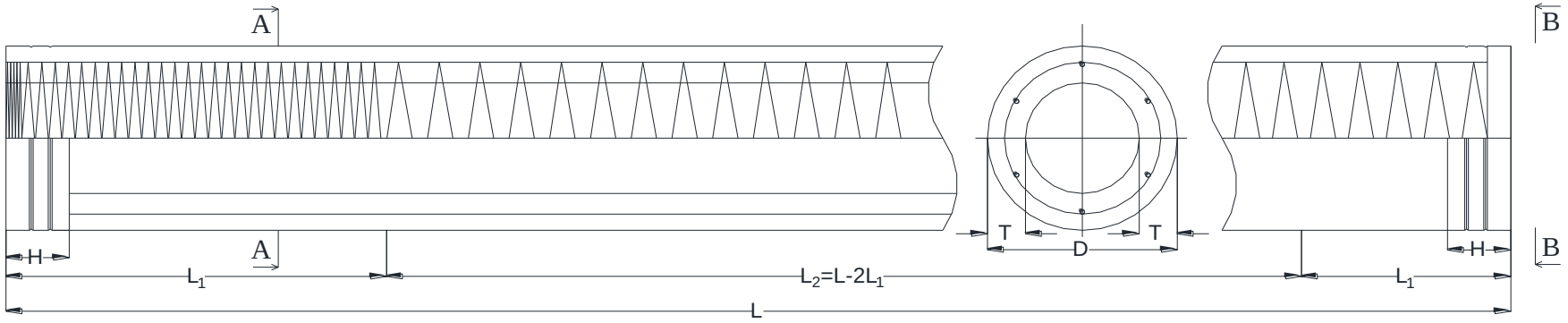
Against for Rainy Season

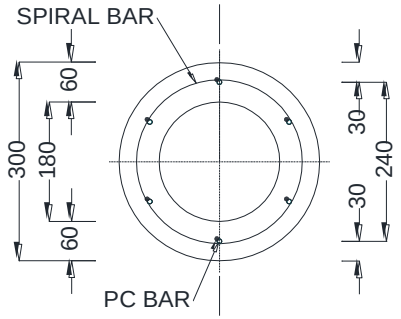
Reduction of Quality Control Work on Site

- Save Environmental Condition

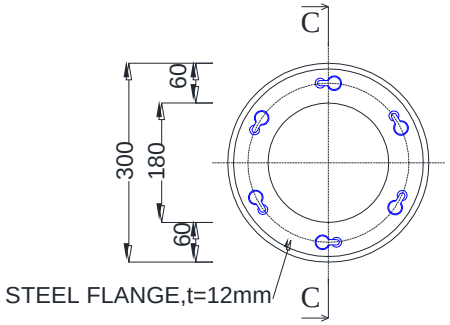
III. Structure of _Pre-cast Concrete Spun Pile

(Ref: I&H)

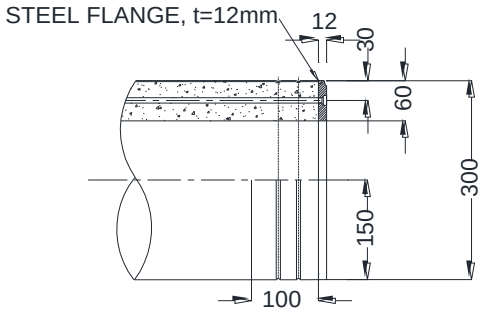




SECTION A-A



SECTION B-B



SECTION C-C

IV. Specification

JIS A5335 – Pretensioned Spun Concrete Piles

Diameter : 300mm, 350mm,400mm,450mm, 500mm, 600mm, 700mm, 800mm, 1000mm, 1200mm
Type : Type A , Type B , Type C (based on cracking moment by bending)
Concrete Strength : Grade Cylinder 50

JIS A5337 – Pretensioned Spun High Strength Concrete Piles

Diameter : 300mm, 350mm,400mm,450mm, 500mm, 600mm, 700mm, 800mm, 1000mm
Type : Type A , Type B , Type C (based on cracking moment by bending)
Concrete Strength : Grade Cylinder 80

Foundation for High Raise Building ,Warehouse , Factory , Bridge , Jetty , Oil Tank , Retaining wall and etc., JIS Japanese Standard , High Technology , to improve the infrastructure sector .

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V. Structural Capacity of _Pre-cast Concrete Spun Pile

Cylinder 50MPa (Ref: I&H)

No.	Dimension					PC-bar Dia. (mm)	No.of PC Bar (Nos)	Effective Pre-stress (N/mm2)	Crack Bending Moment (kN.m)	Break Bending Moment (kN.m)	Allowable Bearing Capacity		Allowable Shear Capacity		Allowable Tensile Capacity	
	Dia. (mm)	Thick-ness (mm)	Length (m)	Weight (ton/m)	Class						Per-manent (kN)	Tem-porary (kN)	Per-manent (kN)	Tem-porary (kN)	Per-manent (kN)	Tem-porary (kN)
1	300	60	6 ~ 13	0.118	A	7.1	6	4.4	24.6	40.2	706	1,059	51	64	251	297
					B	9.0	8	8.7	35.7	72.0	658	987	68	85	511	607
					C	10.0	8	10.3	40.1	82.8	640	960	74	92	619	740
2	350	65	6 ~ 15	0.151	A	7.1	7	4.0	36.4	56.6	914	1,371	62	79	298	358
					B	10.0	7	7.4	49.8	96.6	865	1,298	81	102	573	695
					C	10.7	9	10.3	61.9	127.6	824	1,236	94	117	797	952
3	400	75	6 ~ 15	0.199	A	7.1	10	4.3	56.2	90.9	1,197	1,795	82	105	416	495
					B	10.0	10	8.0	78.3	154.1	1,127	1,691	107	135	805	966
					C	10.7	11	9.7	88.9	181.9	1,095	1,643	117	146	995	1,198
4	450	80	6 ~ 15	0.242	A	9.0	7	4.0	75.8	117.2	1,460	2,190	99	127	476	571
					B	10.0	14	8.4	113.0	236.6	1,366	2,049	137	171	1,024	1,221
					C	10.7	14	10.1	127.3	260.8	1,321	1,981	149	185	1,251	1,499
5	500	90	6 ~ 15	0.301	A	9.0	9	4.1	105.7	166.3	1,818	2,727	125	159	606	725
					B	9.0	18	7.8	147.9	288.1	1,712	2,568	165	207	1,193	1,436
					C	10.7	18	10.4	179.2	367.5	1,637	2,456	188	234	1,600	1,910
6	600	100	6 ~ 15	0.408	A	9.0	12	4.1	176.2	270.5	2,462	3,693	168	215	821	982
					B	10.0	24	8.4	260.3	548.3	2,309	3,463	230	288	1,732	2,065
					C	10.7	24	10.2	295.4	604.5	2,227	3,341	251	313	2,132	2,552

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V. Structural Capacity of _Pre-cast Concrete Spun Pile

Cube 80MPa (Ref: I&H)

No.	Dimension					PC-bar Dia. (mm)	No.of PC Bar (Nos)	Effective Pre-stress (N/mm2)	Crack Bending Moment (kN.m)	Break Bending Moment (kN.m)	Allowable Bearing Capacity		Allowable Shear Capacity		Allowable Tensile Capacity	
	Dia. (mm)	Thick-ness (mm)	Length (m)	Weight (ton/m)	Class						Per-manent (kN)	Tem-porary (kN)	Per-manent (kN)	Tem-porary (kN)	Per-manent (kN)	Tem-porary (kN)
1	300	60	6 ~ 13	0.118	A	7.1	6	4.4	24.6	40.2	938	1,407	51	66	251	297
					B	9.0	8	8.7	35.7	72.0	897	1,346	69	87	511	607
					C	10.0	8	10.3	40.1	82.8	882	1,323	75	93	619	740
2	350	65	6 ~ 15	0.151	A	7.1	7	4.0	36.4	56.6	1,212	1,818	63	81	298	358
					B	10.0	7	7.4	49.8	96.6	1,170	1,755	82	103	573	695
					C	10.7	9	10.3	61.9	127.6	1,135	1,702	96	119	797	952
3	400	75	6 ~ 15	0.199	A	7.1	10	4.3	56.2	90.9	1,590	2,385	83	106	416	495
					B	10.0	10	8.0	78.3	154.1	1,530	2,294	109	137	805	966
					C	10.7	11	9.7	88.9	181.9	1,503	2,254	119	149	995	1,198
4	450	80	6 ~ 15	0.242	A	9.0	7	4.0	75.8	117.2	1,936	2,905	101	129	476	571
					B	10.0	14	8.4	113.0	236.6	1,858	2,787	139	174	1,024	1,221
					C	10.7	14	10.1	127.3	260.8	1,817	2,726	151	188	1,251	1,499
5	500	90	6 ~ 15	0.301	A	9.0	9	4.1	105.7	166.3	2,412	3,618	127	162	606	725
					B	9.0	18	7.8	147.9	288.1	2,320	3,480	167	210	1,193	1,436
					C	10.7	18	10.4	179.2	367.5	2,257	3,386	191	238	1,600	1,910
					A	9.0	12	4.1	176.2	270.5	3,267	4,900	171	219	821	982

V. Structural Capacity of _Pre-cast Concrete Spun Pile

Cylinder 80MPa (Ref: I&H)

No.	Dimension					PC-bar Dia. (mm)	No.of PC Bar (Nos)	Effective Pre-stress (N/mm2)	Crack Bending Moment (kN.m)	Break Bending Moment (kN.m)	Allowable Bearing Capacity		Allowable Shear Capacity		Allowable Tensile Capacity	
	Dia. (mm)	Thick-ness (mm)	Length (m)	Weight (ton/m)	Class						Per-manent (kN)	Tem-porary (kN)	Per-manent (kN)	Tem-porary (kN)	Per-manent (kN)	Tem-porary (kN)
1	300	60	6 ~ 13	0.118	A	7.1	6	4.2	27.7	42.0	1,173	1,760	60	77	241	288
					B	10.0	6	8.1	37.8	72.3	1,141	1,711	79	99	481	576
					C	10.0	8	10.3	43.8	89.9	1,124	1,686	87	110	619	740
2	350	65	6 ~ 15	0.151	A	7.1	7	4.0	41.8	58.7	1,510	2,265	75	97	298	358
					B	10.0	7	7.4	55.4	102.5	1,475	2,212	97	122	573	695
					C	10.0	9	9.2	62.9	124.6	1,457	2,185	106	134	722	877
3	400	75	6 ~ 15	0.199	A	7.1	10	4.3	64.4	94.7	1,983	2,974	99	128	416	495
					B	10.0	10	8.0	86.7	164.0	1,932	2,898	128	162	805	966
					C	10.0	11	8.7	91.0	176.7	1,923	2,884	133	167	906	1,108
4	450	80	6 ~ 15	0.242	A	9.0	7	4.0	87.2	121.5	2,413	3,619	120	155	476	571
					B	10.0	14	8.4	124.7	253.0	2,351	3,526	163	205	1,024	1,221
					C	10.0	14	9.0	129.4	253.8	2,331	3,496	168	211	1,133	1,379
5	500	90	6 ~ 15	0.301	A	9.0	9	4.1	121.4	172.6	3,006	4,509	151	195	606	725
					B	9.0	18	7.8	164.0	306.0	2,929	4,393	197	249	1,193	1,436
					C	10.0	18	9.3	182.0	358.9	2,898	4,348	212	267	1,451	1,759
					A	9.0	12	4.1	202.4	279.8	4,071	6,107	203	263	821	982

VI. Structural Calculation Formula for Spun Pile Product

- **Mcr = (Ie/ye) (σtu+σce+σN)**
- **Pap = (1/3) (σcu-σce) Ac**
- **Pat = (1/2) (σcu-σce) Ac**

Where:

- Mcr : Cracking moment
- Mu : Ultimate moment

Class A: Mu=1.5Mcr

Class B: Mu=1.8Mcr

Class C: Mu=2.0Mcr

- Pap : Permanent allowable bearing capacity of pile
- Pat : Temporary allowable bearing capacity of pile
- Ie : Moment of inertia
- ye : Length from centroid to tensile edge of concrete (D/2)
- Σcu : Compressive strength of concrete (σcu =50N/㎜2)
- Σtu : Flexural tensile strength of concrete (σtu = 6N/㎜2)
- Σce : Effective prestress
- σN : Axial compressive stress working on a pile (σN =0)
- Ac : Section area of pile

VI. Structural Calculation Formula for Spun Pile Product

Stress induced in concrete by bending moment and axial force

$$\sigma_c = \frac{N}{A} + \sigma_{ce} \pm \frac{M}{Z} \leq \sigma_{ca}$$

Where N: Axial force acting on pile

σc : Stress induced in concrete pile body

M: Bending moment acting on pile

σce : Effective prestress in pile body

A: Section area of pile

σca : Allowable stress of concrete

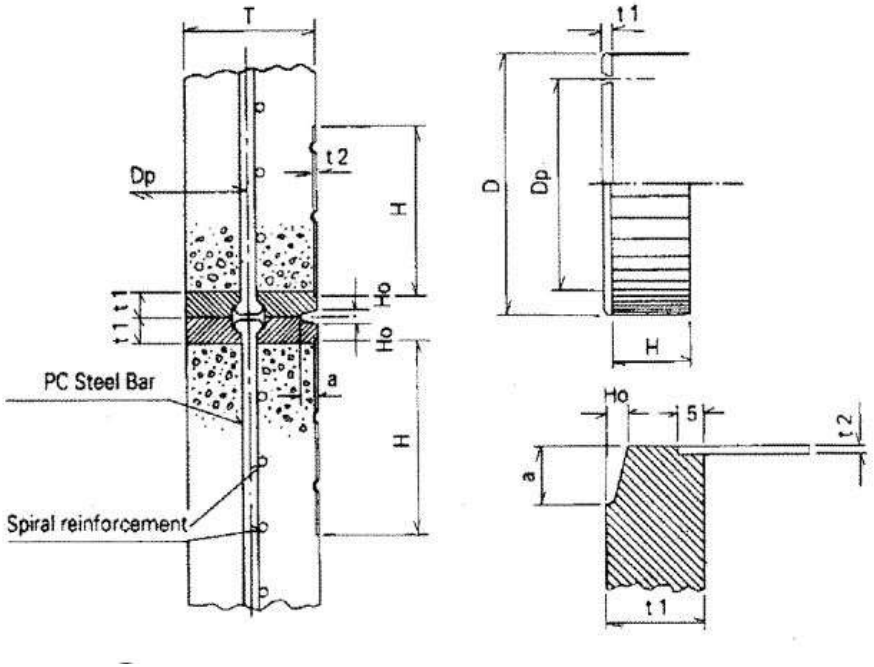
Z: Section modulus of pile

1) Allowable Capacity of pile (to be the minimum of:) allowable structural capacity allowable soil capacity
2) Bending moment and shear force from lateral load on pile to not exceed the pile's allowable bending moment and allowable shear force (include unit stress from vertical force). Unit stress induced in concrete to not exceed allowable unit stress
3) Displacement of pile head to not exceed the allowable displacement of the structure

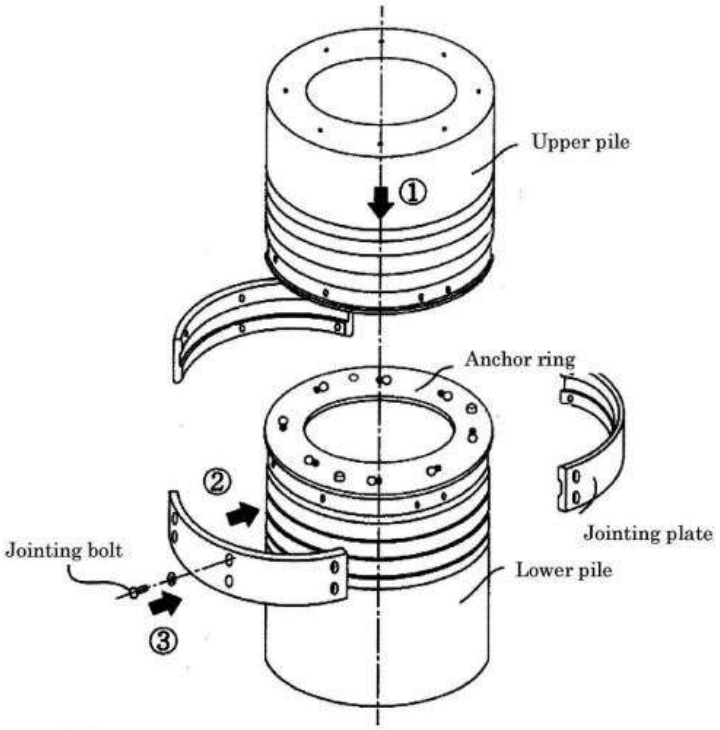
Pile head displacement is determined by lateral force on pile, stiffness of pile body, and strength of the soil.

VII. Connection Detail

VII.1 Joint of Spun Pile Product



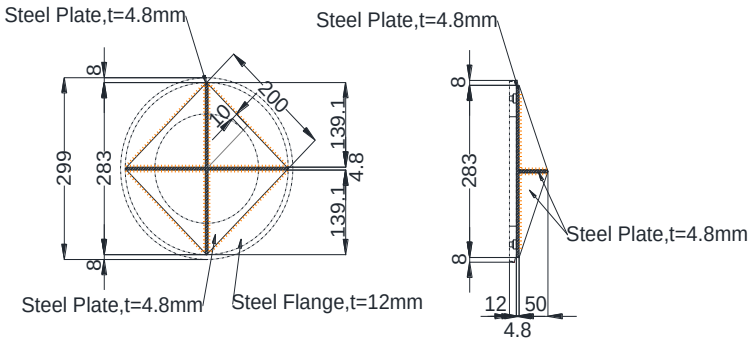
1. Welding Joint Between Two Piles (Standard)



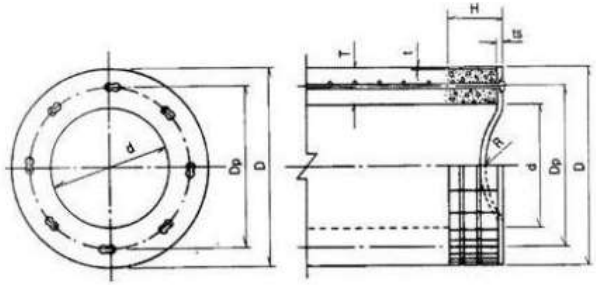
2. Mechanical Joint Between Two Piles (Example)

VII. Connection Detail

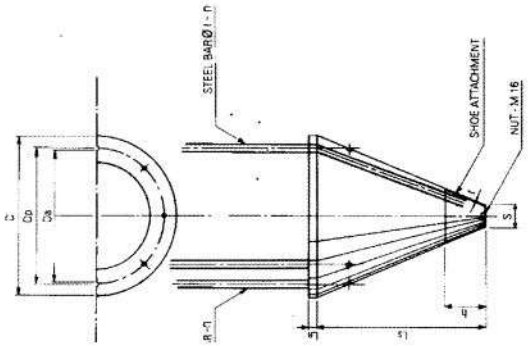
VII.2 Toe/Shoe of Spun Pile Product



1. Cross Shoe



2. Mamira Shoe (Concave-section shoe)



3. Pencil Shoe

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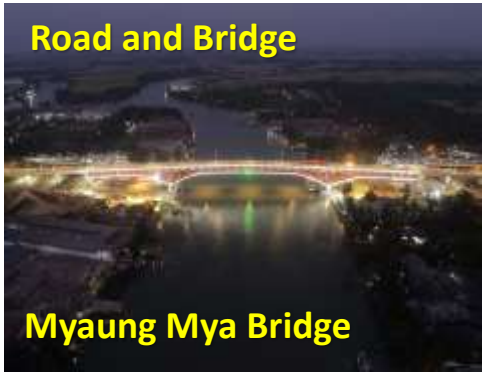
Reference Spun Pile Projects of I&H



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II.1. Pre-cast Concrete Spun Pile

II.1.4 Price Comparison between Spun Pile and other piles

Project name	Bored Pile Design					Spun Pile Counter Design				
	Pile Size	Length (M)	No.pile pts	Total M	Price (USD)	Pile Size	Length (M)	No .pile pts	Total M	Price (USD)
City Loft Project Phase 1 Star City , Thanlyin	Ø 800mm	30	6	180	559,000	Ø600mm	24	132	3,168	175,000
	Ø 800mm	35	11	385						
	Ø 1200mm	33	20	660						
	Ø 1200mm	36	24	864						
Construction Period	3 Month 2 points / day					1.5 Month 5 Points / day				

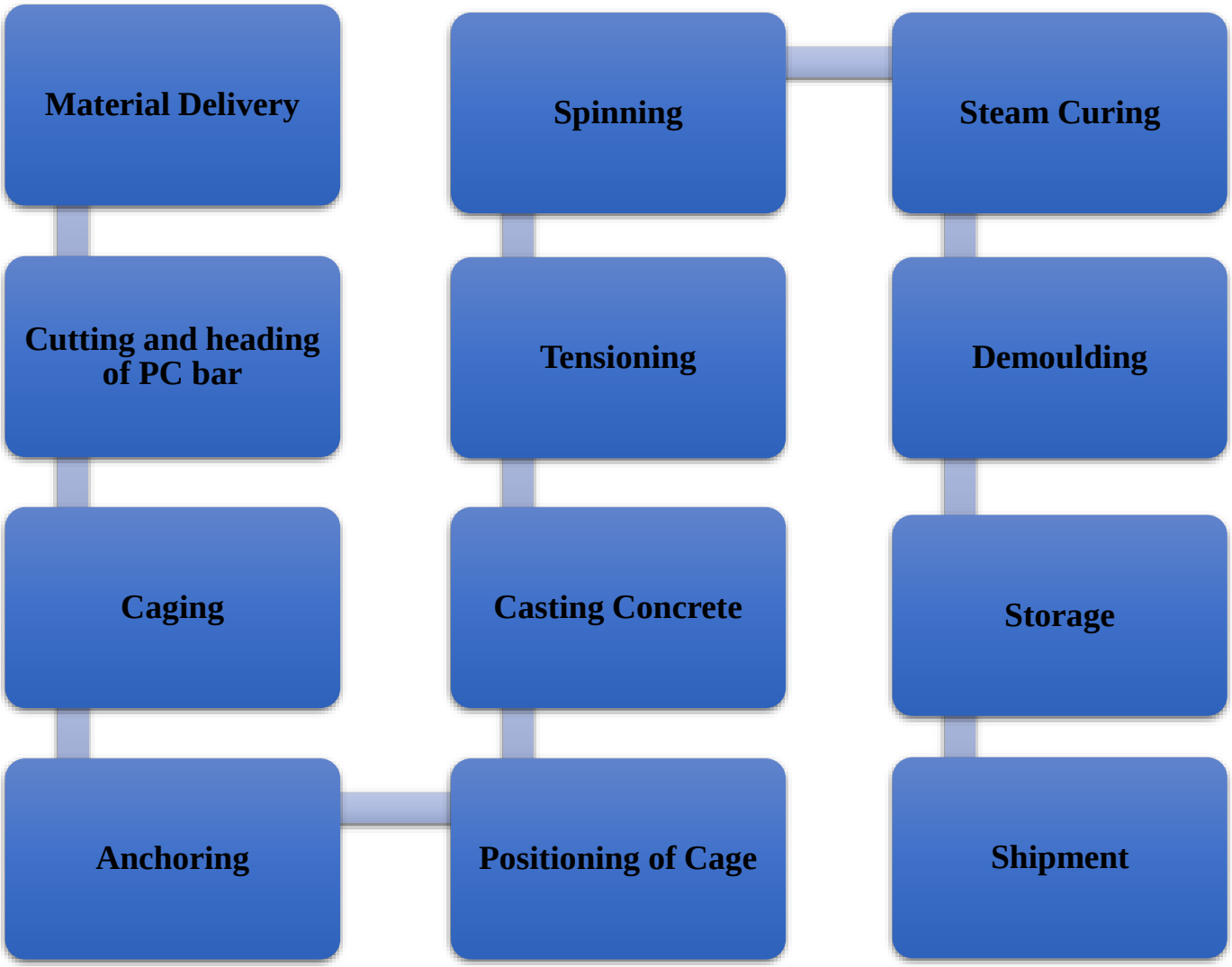
II.1. Pre-cast Concrete Spun Pile

II.1.4 Price Comparison between Spun Pile and other piles

	RC Pile Design					Spun Pile Counter Design				
Project name	Pile Size	Length (M)	No.pile pts	Total M	Price (USD)	Pile Size	Length (M)	No.pile pts	Total M	Price (USD)
Toyo Ink Factory PJ (Thilawa SEZ)	300mm x 300mm	12	420	5,040	90,720	Ø 300mm	18	248	4,464	71,424
FLP WareHouse (Thar kay Ta)	250mm x 250mm	24	971	23,304	256,344	Ø 300mm	30	345	10,350	165,600

 # High Quality can minimize quantities and save cost

VIII Workflow in Manufacturing Process of Spun Pile



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Cutting of PC Bar

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Heading of PC Bar

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Caging

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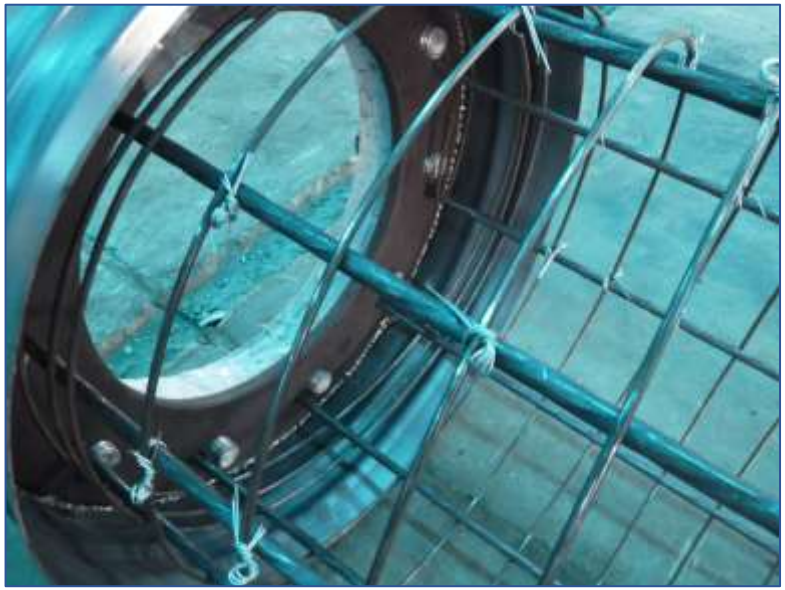
Anchoring



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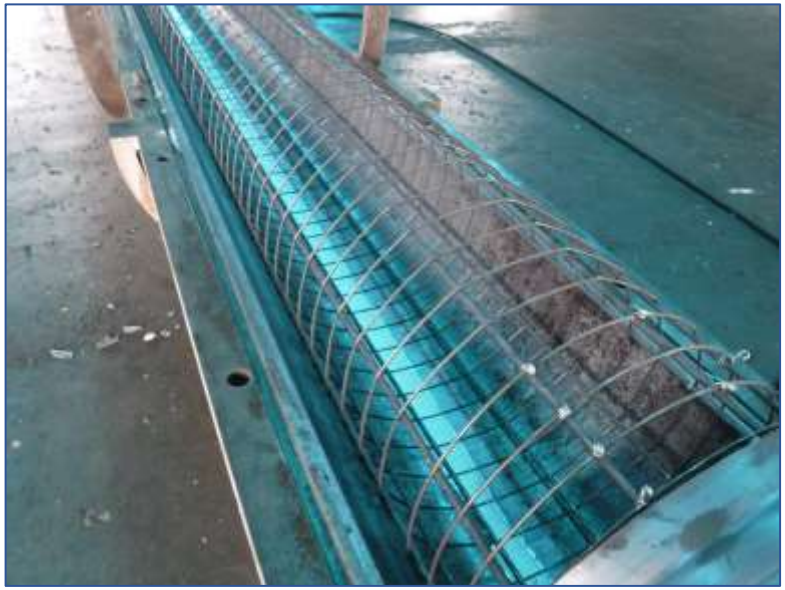
Positioning of Cage in Bottom Formwork



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Casting Concrete

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Upper Forming

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Tensioning

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Spinning

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Steam Curing

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Demoulding

IX. Workflow in Installation Process of Spun Pile

Delivery to Site

Material Receiving

Setting-up of Pile Machine

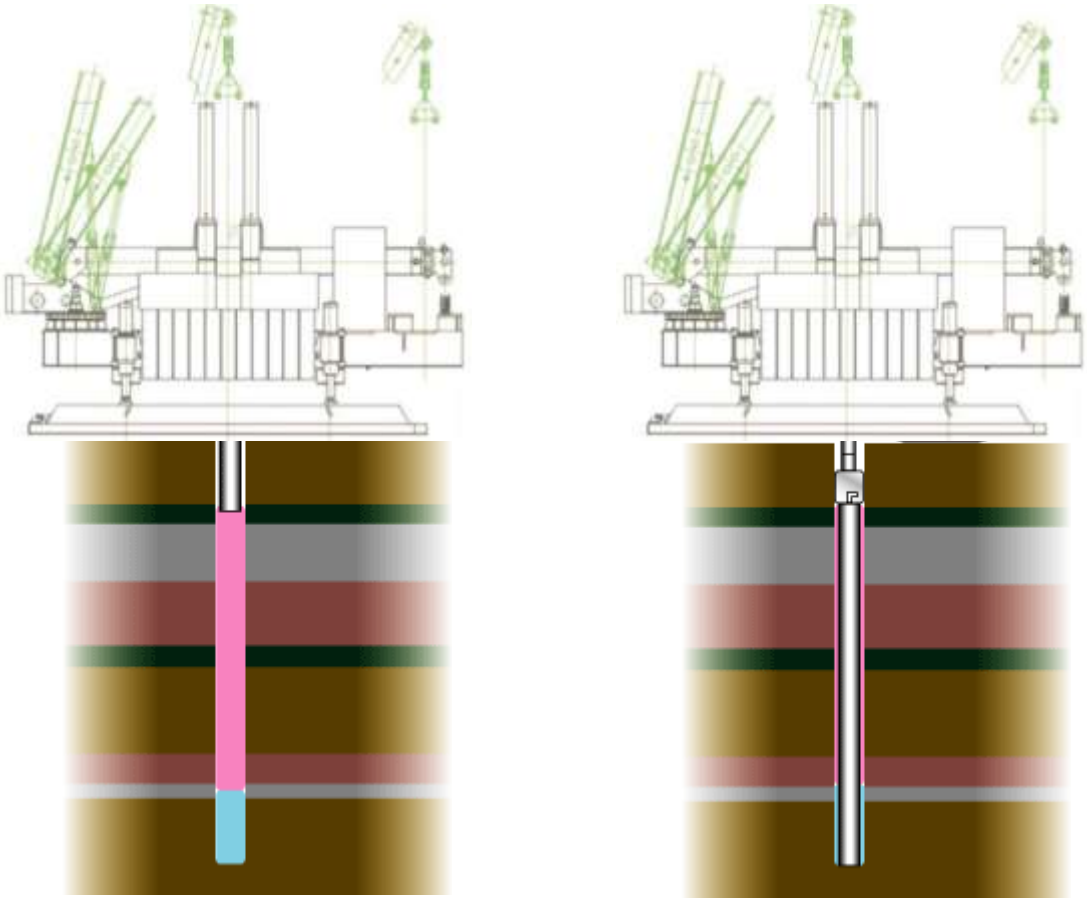
Installation of Jack-in-pile

Jointing by Welding

Testing Piling

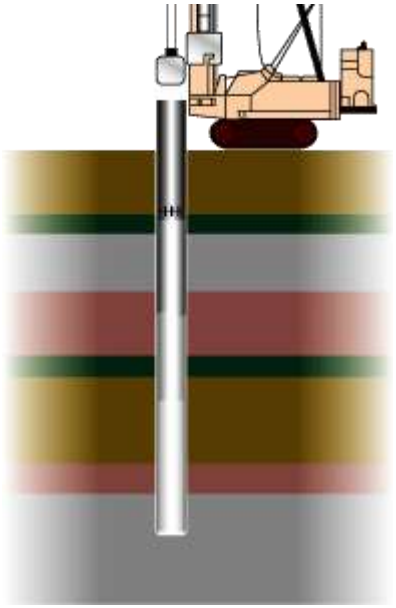
III.3. Construction Method for Spun Pile (currently)

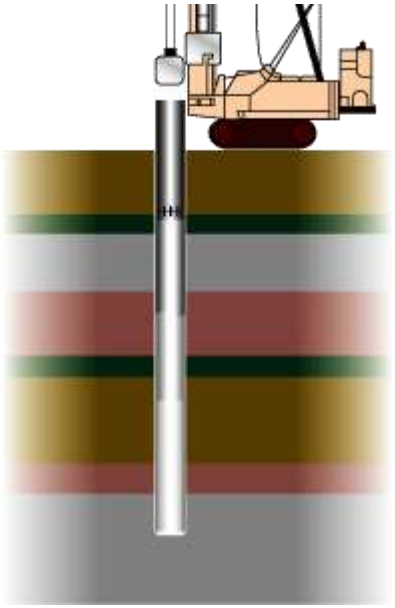
Pile Installation using Jack-in-Pile Method



III.3. Construction Method for Spun Pile (currently)

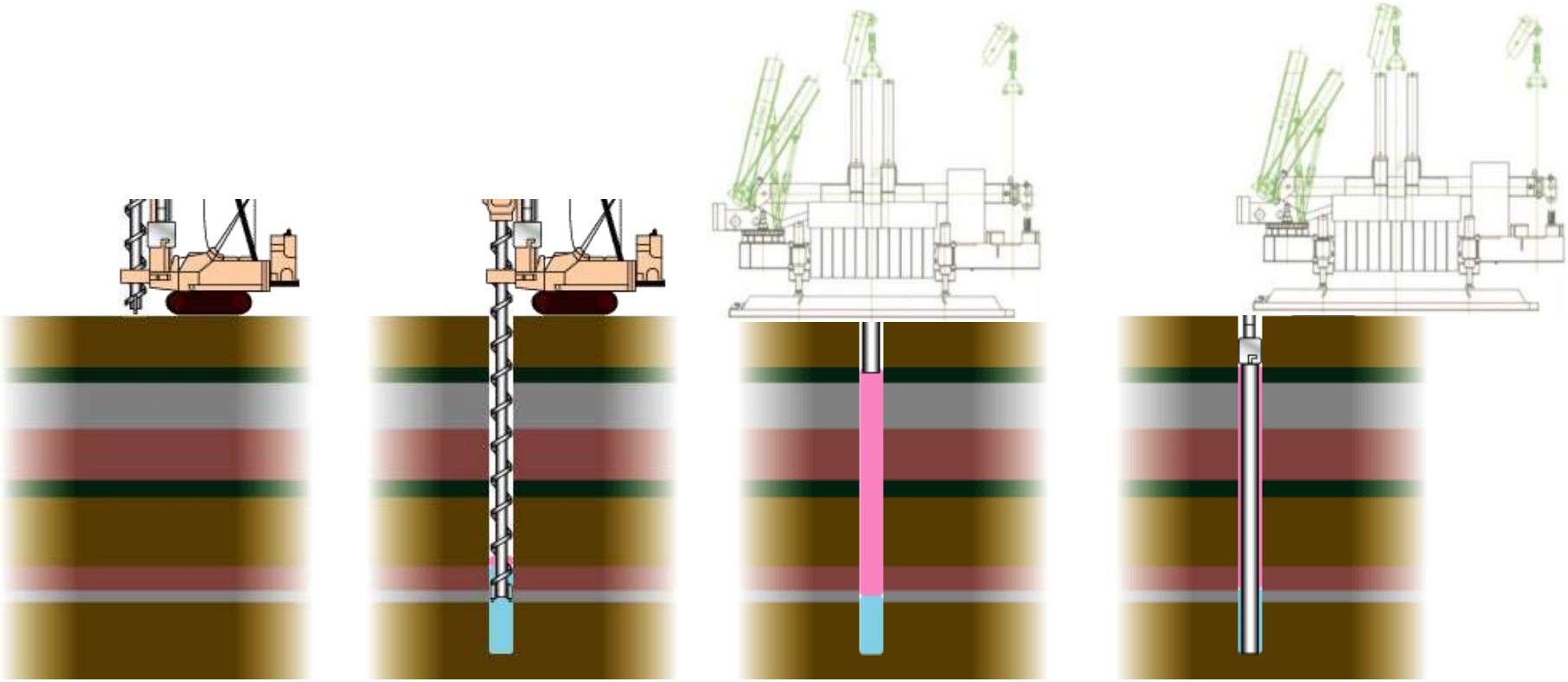
Pile Installation using Drop Hammering Method



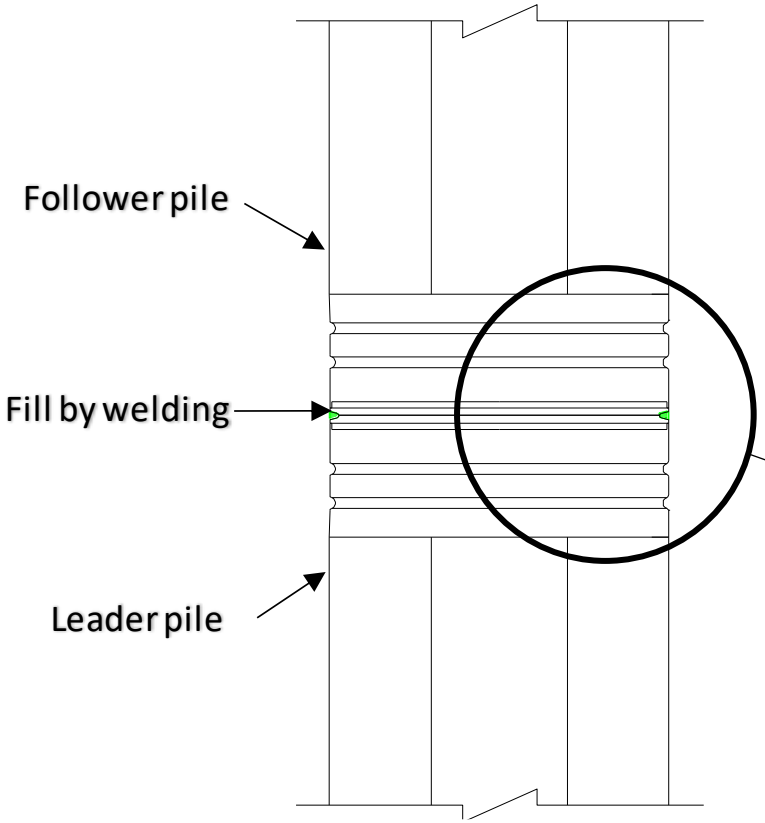


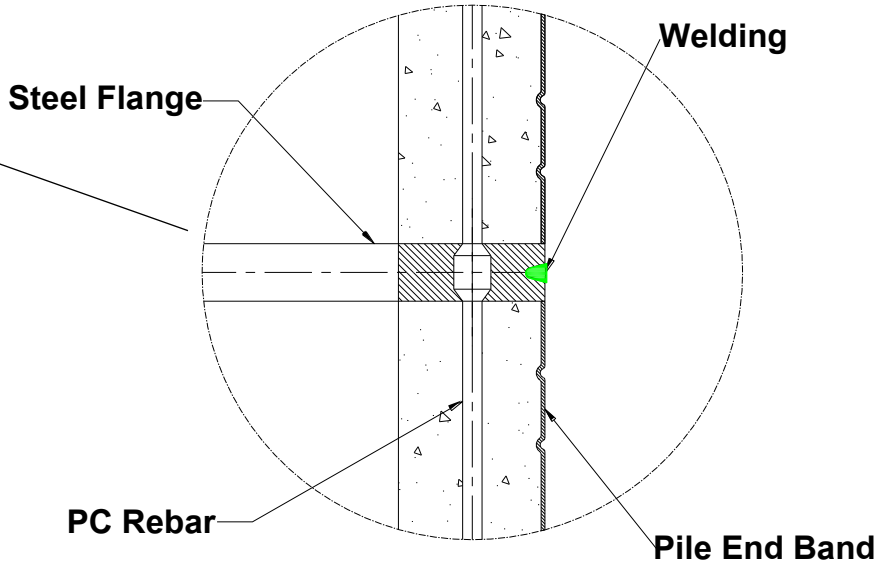
III.3. Construction Method for Spun Pile (currently)

Pile Installation using Pre-Boring with Jack-in-Pile Method

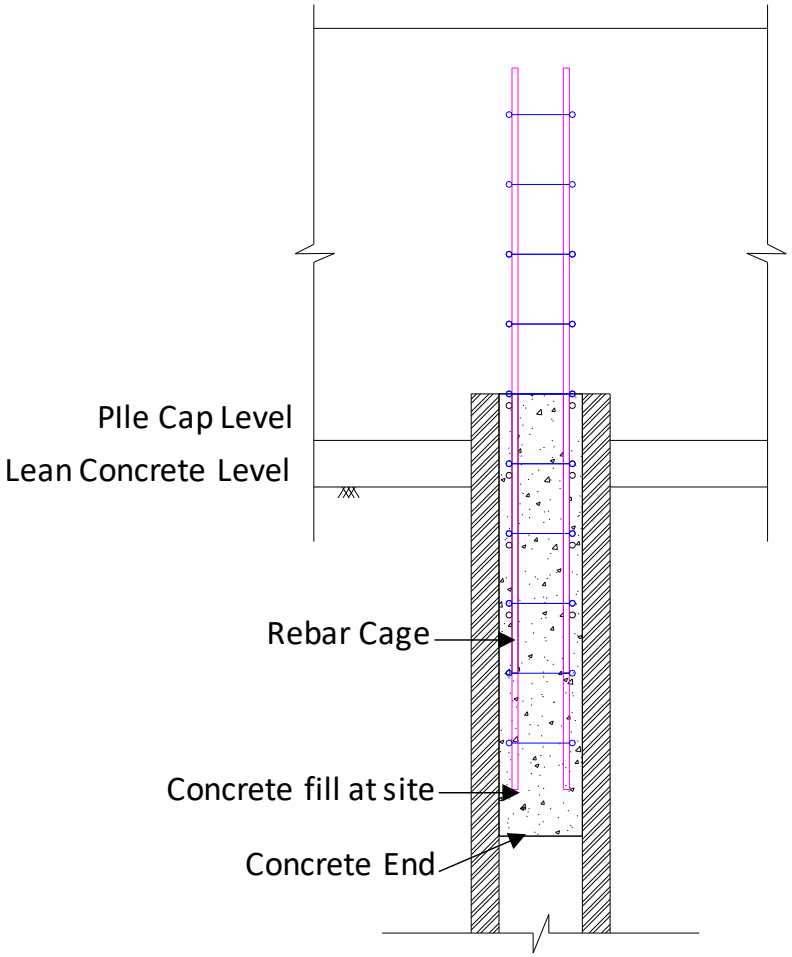


III.4. Spun Pile Jointing Method

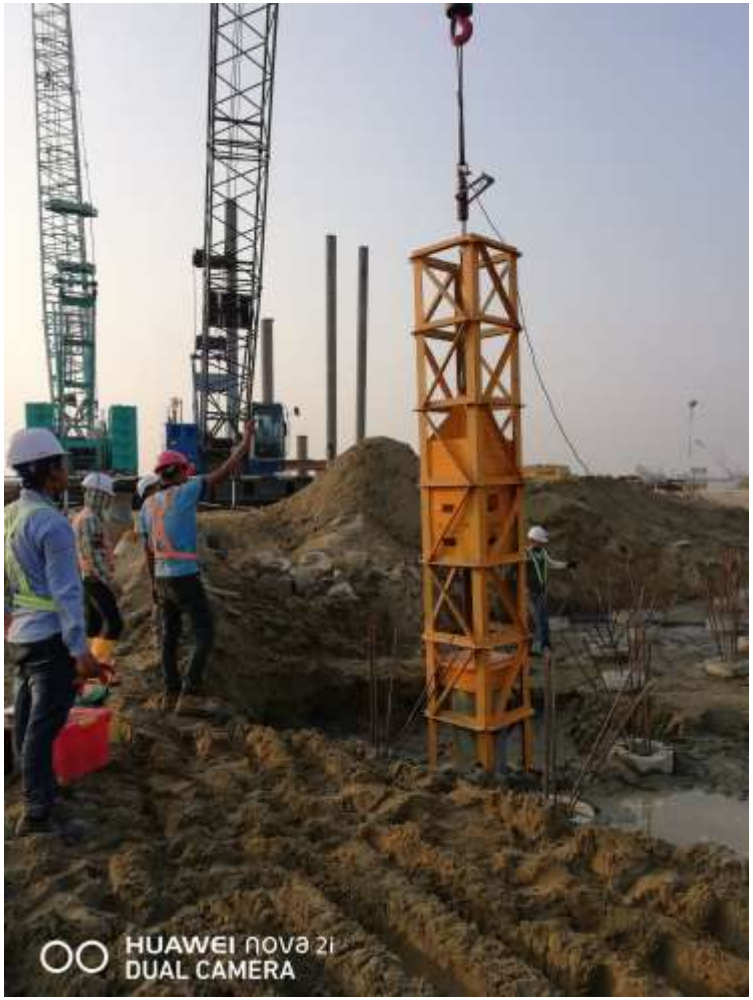


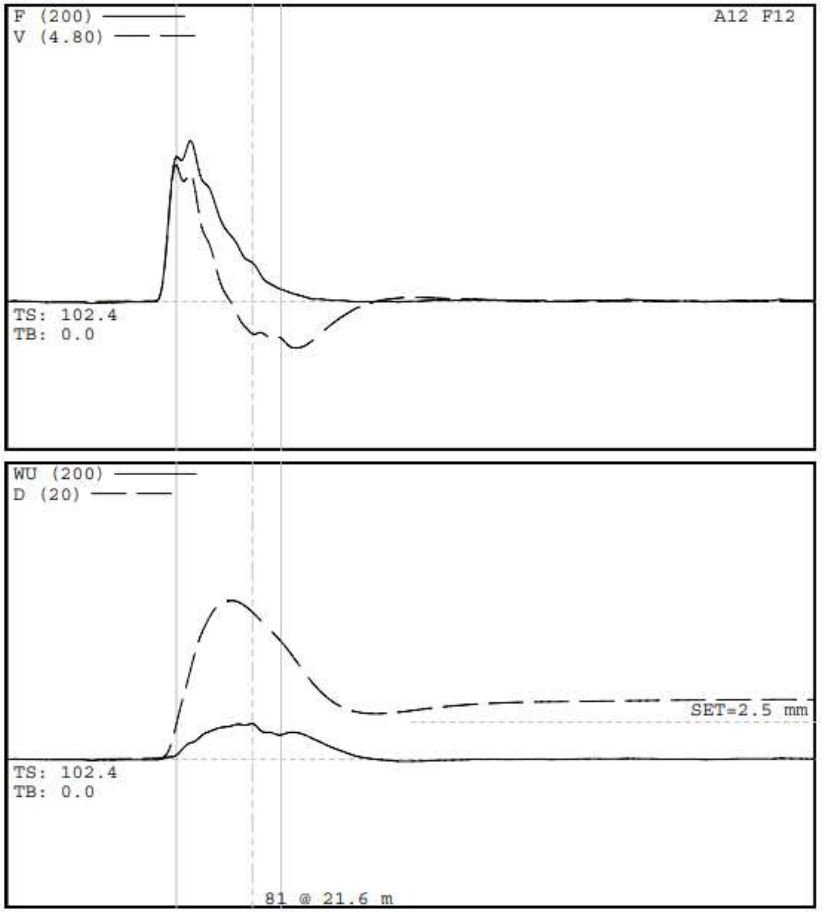


III.5. Spun Pile Head Treatment

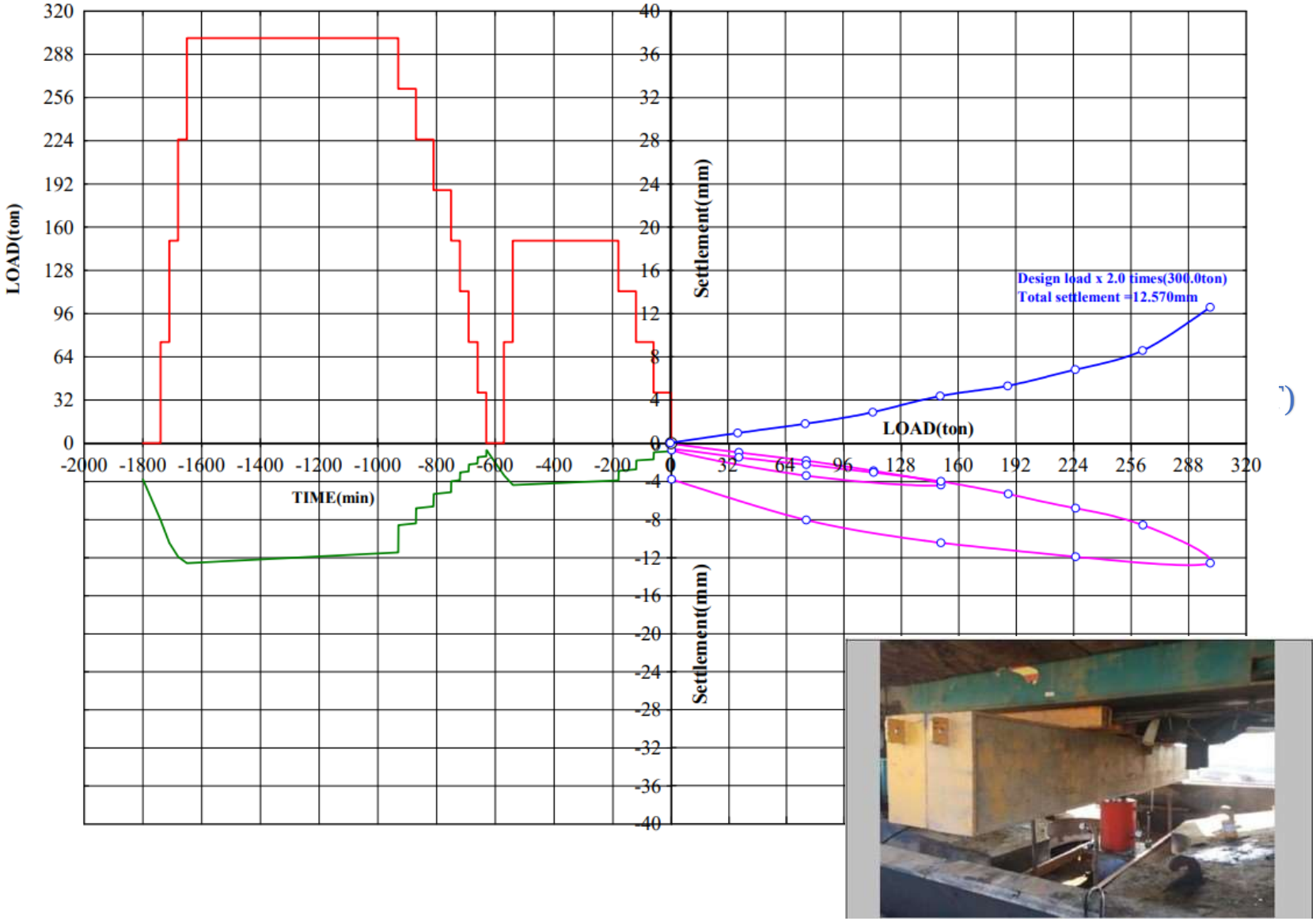


III.6. Testing of Pile , (Dynamic Load Test)

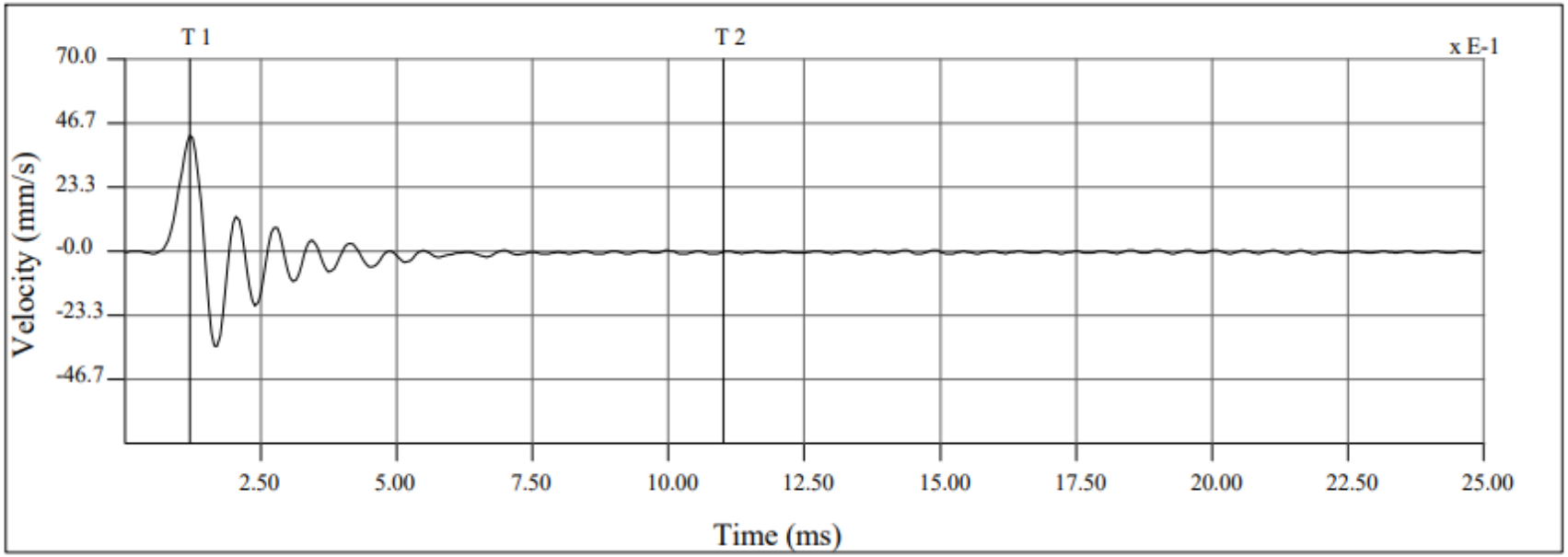




III.6. Testing of Pile , (Static Load Test)



III.6. Testing of Pile , (Pile Integrity Test)



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Seminar on Study of Technology of Post-tensioning Segmental Girder in Myanmar

Present by
Zaw Lwin Moe
B.E (Civil)

I. Introduction to Pre-cast Segmental Bridge Girder

- I.1. Advantages of Precast Post Tension Segmental Girder
- I.2. Reference Projects
- **II. Assembly of Girder, Execution on Site**
- **III. Production of Girder**

I. Introduction to Pre-cast and Post-tensioned Segmental Bridge Girder

I.1 Advantages of Precast Post Tension Segmental Girder

- High Quality can be maintained by manufacturing in the factory
- No concrete work in the site
- Minimize the work period and men power in the project site
- No interruption due to the rain
- Easily Transport by segmental girder to the erection points

I.2 Reference Project of Post tensioned Segmental Girder

New Myaing Mya Bridge Project under Ministry of Construction
(Completed in 2019)

Post Tensioned Segmental I Girder

Total Length	-	540 meter (Approach Bridge)
Client	-	Ministry of Construction

II. Assembly of Girder, Execution on Site

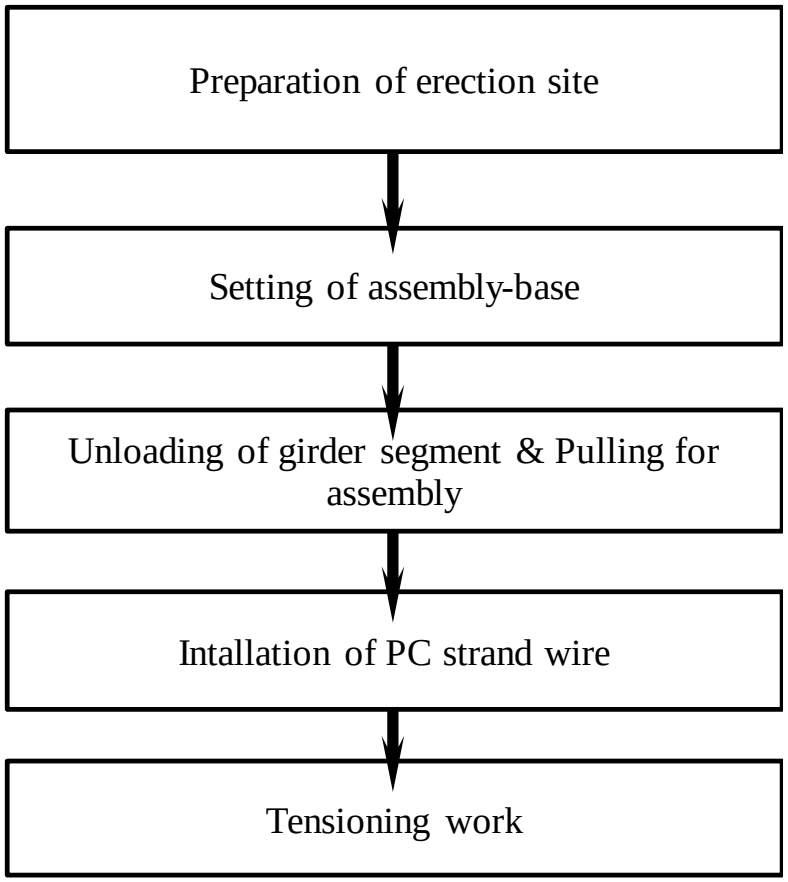
Flow Chart for Execution on Site

II. Assembly of Girder, Execution on Site

Transportation of girder segment

II. Assembly of Girder, Execution on Site

Assembly of girder segment

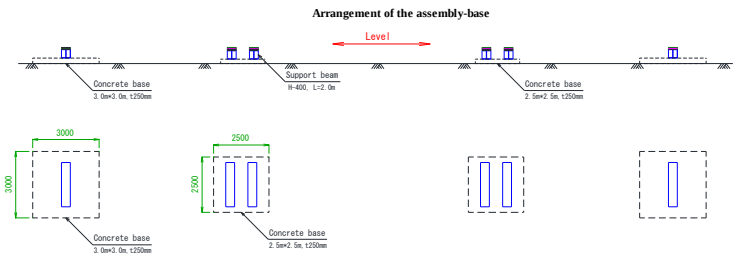


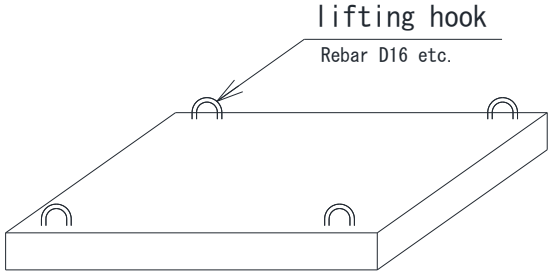
II. Assembly of Girder, Execution on Site

Preparation of erection site

II. Assembly of Girder, Execution on Site

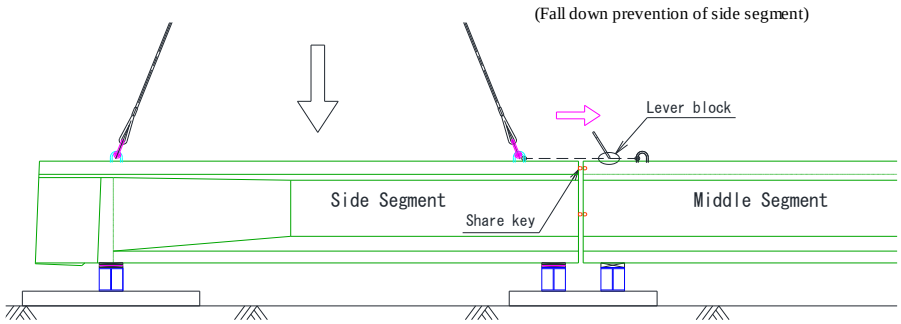
Setting of assembly-base





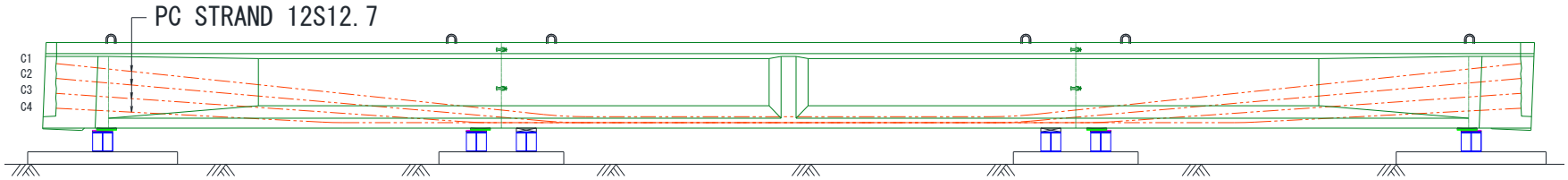
II. Assembly of Girder, Execution on Site

3) Unloading of girder segment & Pulling for assembly



II. Assembly of Girder, Execution on Site

4) Installation of PC strand wire

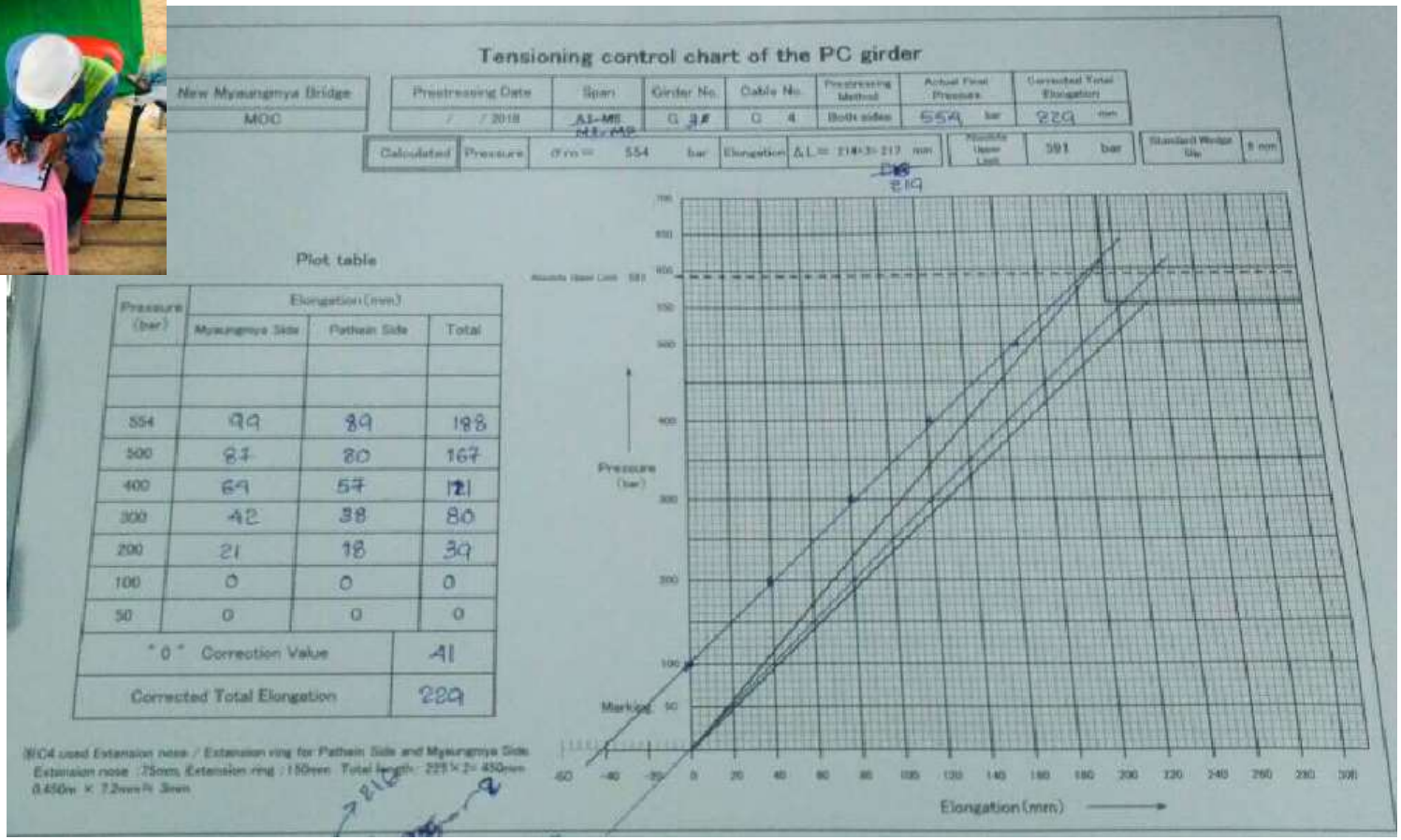


II. Assembly of Girder, Execution on Site

5) Tensioning work

II. Assembly of Girder, Execution on Site

5) Tensioning work



Tensioning control chart of the PC girder

New Myaungmya Bridge	Prestressing Date	Span	Girder No.	Cable No.	Prestressing Method	Actual Final Pressure	Corrected Total Elongation
MOC	/ / 2018	A1-M1 M1-M2	G 3F	C 4	Both sides	554 bar	229 mm

Calculated	Pressure	554 bar	Elongation	581 bar	Standard Wedge Slip	6 mm

Plot table

Pressure (bar)	Elongation (mm) Myaungmya Side	Pathein Side	Total
554	99	89	188
500	87	80	167
400	69	57	121
300	42	38	80
200	21	18	39
100	0	0	0
50	0	0	0
"0" Correction Value			41
Corrected Total Elongation			229

Pressure (bar)

Elongation (mm)

II. Assembly of Girder, Execution on Site

(1) Erection of girder

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II. Assembly of Girder, Execution on Site

(2) Grouting work for PC strand

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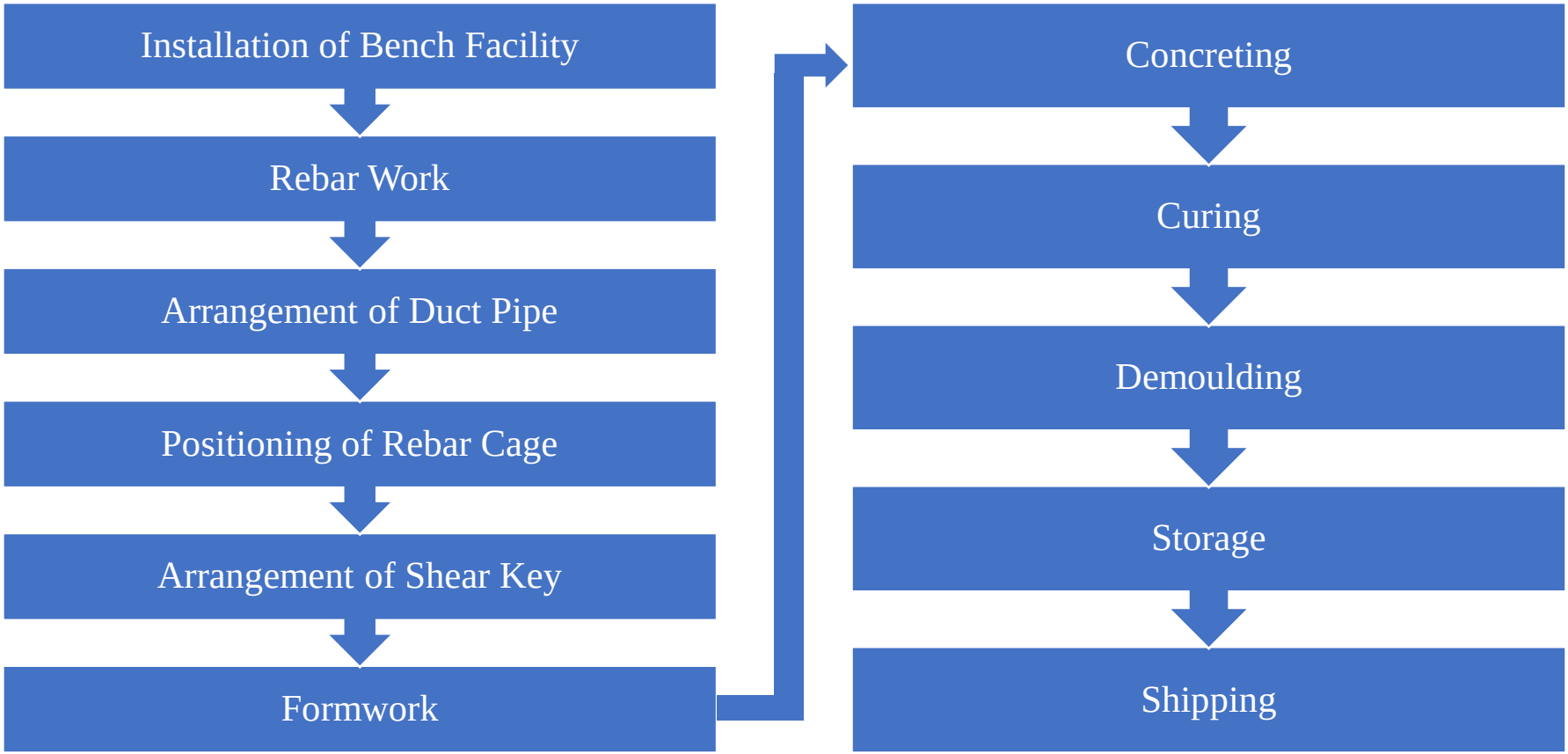
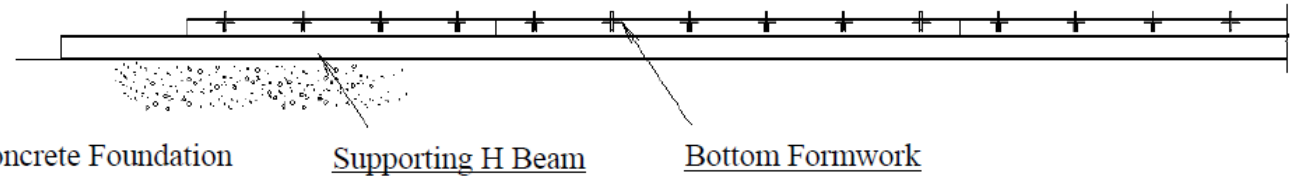
III. Girder Production Procedure

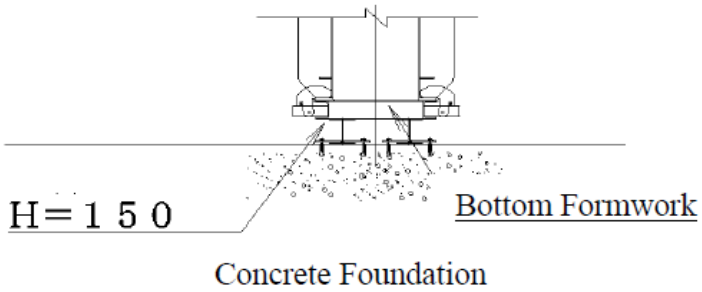
Flow Chart in Production



III. Girder Production Procedure

Installation of Bench Facility





III. Girder Production Procedure

Rebar Work

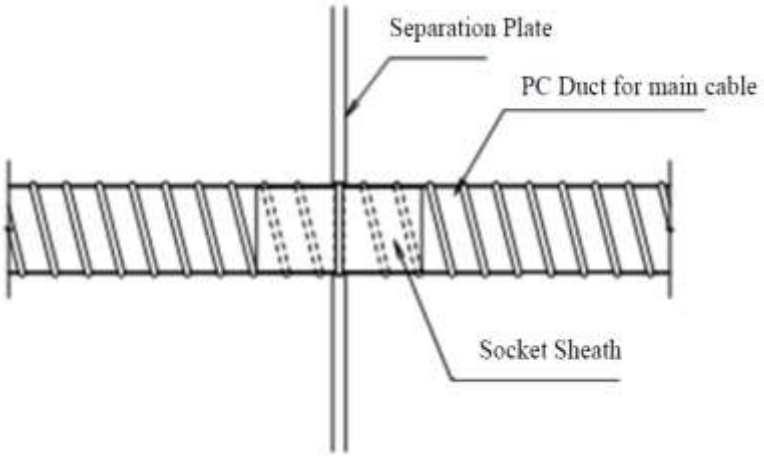
Cutting

Bending

Assembling

III. Girder Production Procedure

Arrangement of Duct Pipe



Partation Plate & PC Duct Connection

III. Girder Production Procedure

Positioning of Rebar Cage

III. Girder Production Procedure

Arrangement of Shear Key

Shear Key

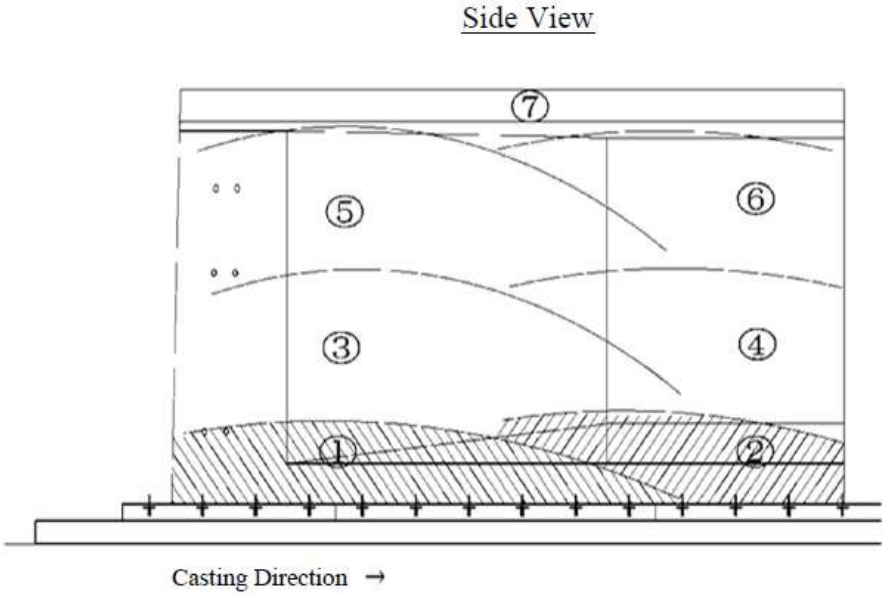
III. Girder Production Procedure

Formwork

Fixing Formworks

III.2. Girder Production Procedure

Concreting



Casting Sequence

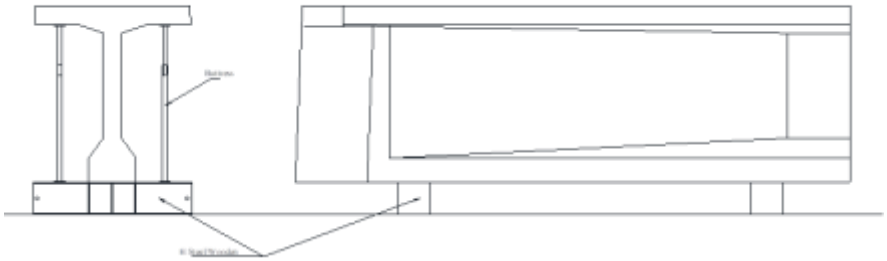
III. Girder Production Procedure

Curing

III. Girder Production Procedure
Demoulding

III. Girder Production Procedure

Storage



III. Girder Production Procedure

Shipping

IV. Quality Control

- Aggregate Sieve Analysis and Sand Moisture Test
- Test of Concrete Compressive Strength
- Checking of Concrete Slump and Temperature
- Inspection of Duct Pipe Location & Segment Length

1) Aggregate Sieve Analysis and Sand Moisture Test

Testing Standard:
Sieve Analysis (ASTM C33) and Sand Moisture (JIS A1111)

2) Test of Concrete Compressive Strength

Testing Standard:
Compressive Strength of Cylinder Concrete (ASTM C39)

3) Checking of Concrete Slump and Temperature

3) Inspection of Duct Pipe Location & Segment Length

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