照査　田中　洋

仁川大橋大ブロック工法の架設方法と解析

内容

1. 仁川大橋の大ブロック架設

1.1 架設STEP

1.2 ベント反力の比較

2. 此花大橋の大ブロック架設

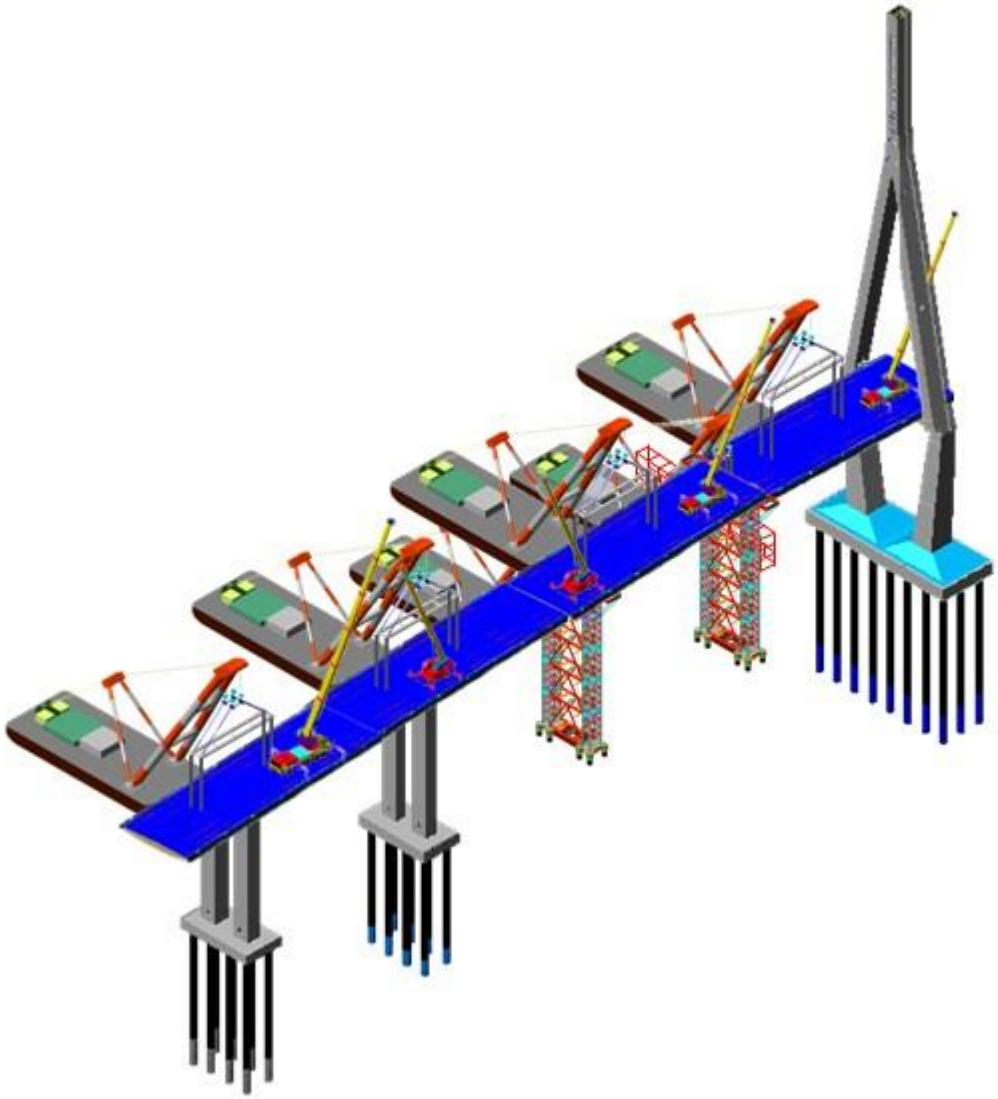
2.1 此花大橋の概要

2.2 誤差解析の概要

2.3 まとめ

1. 仁川大橋の大ブロック架設（側径間はベント工法）

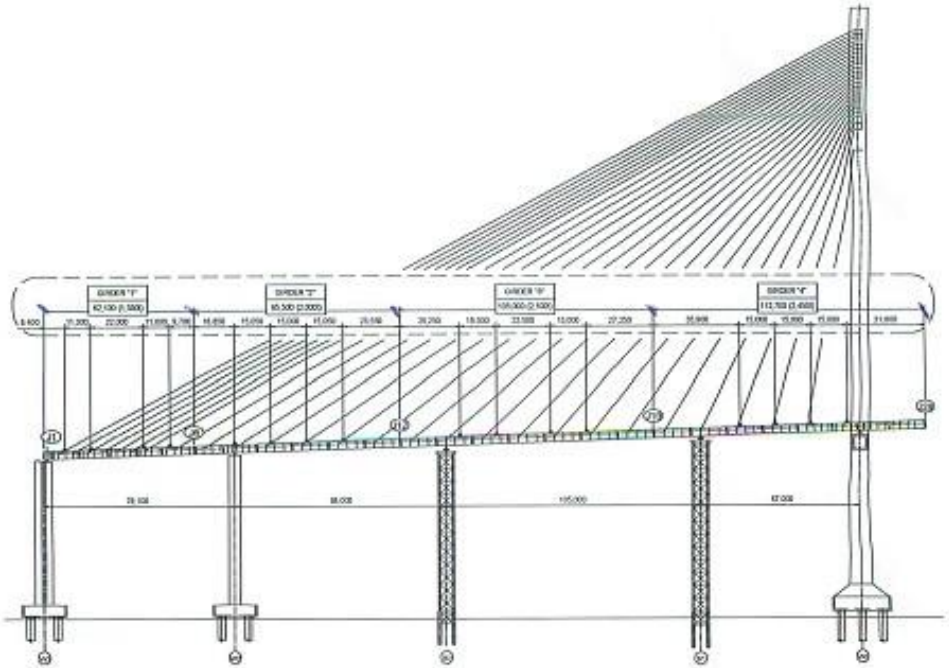
1.1 架設STEP



1. 仁川大橋の大ブロック架設

1.1 架設STEP

- 架設は Girder4(BB-4)から始まり Girder1(BB-1)で終了する。

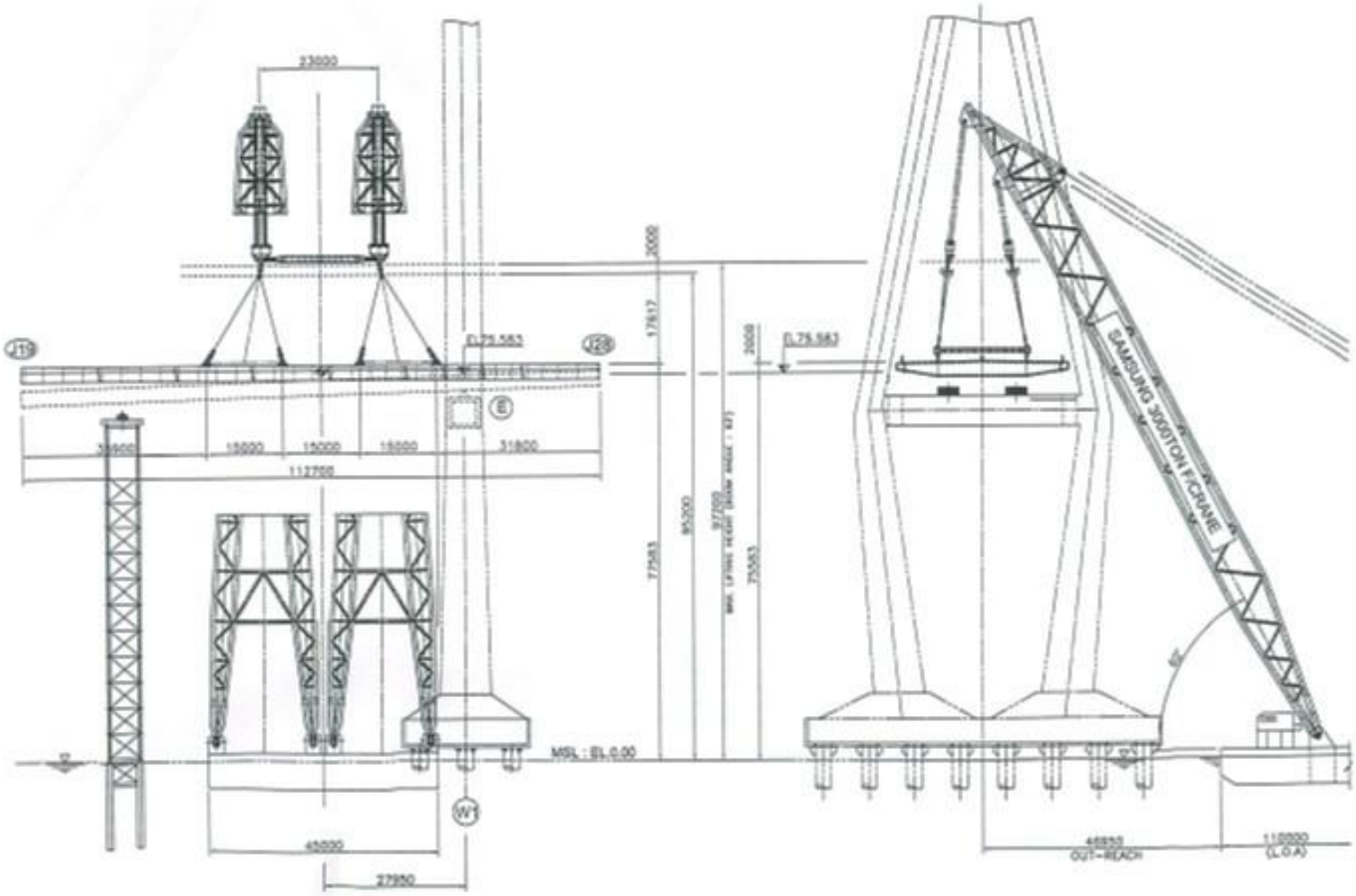


Description	Length (m)	Breadth (m)	Depth (m)	Weight (kN)
Girder "1"	62.1	35.8	3.0	13238.9
Girder "2"	85.5	35.8	3.0	19613.2
Girder "3"	105.0	35.8	3.0	20593.9
Girder "4"	112.7	35.8	3.0	24026.2

1. 仁川大橋の大ブロック架設

1.1 架設STEP

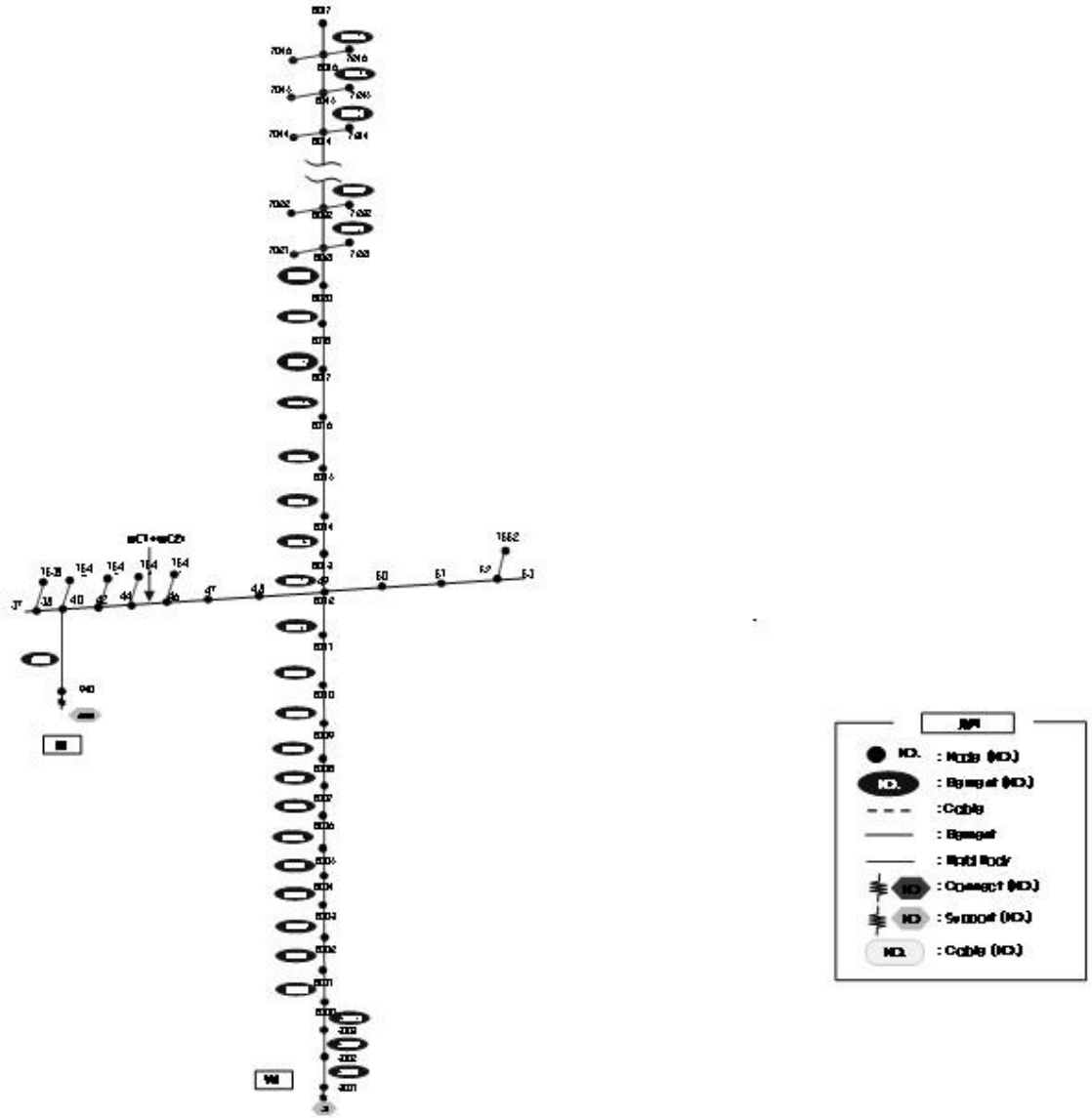
- BB-4の架設



1. 仁川大橋の大ブロック架設

1.1 架設STEP

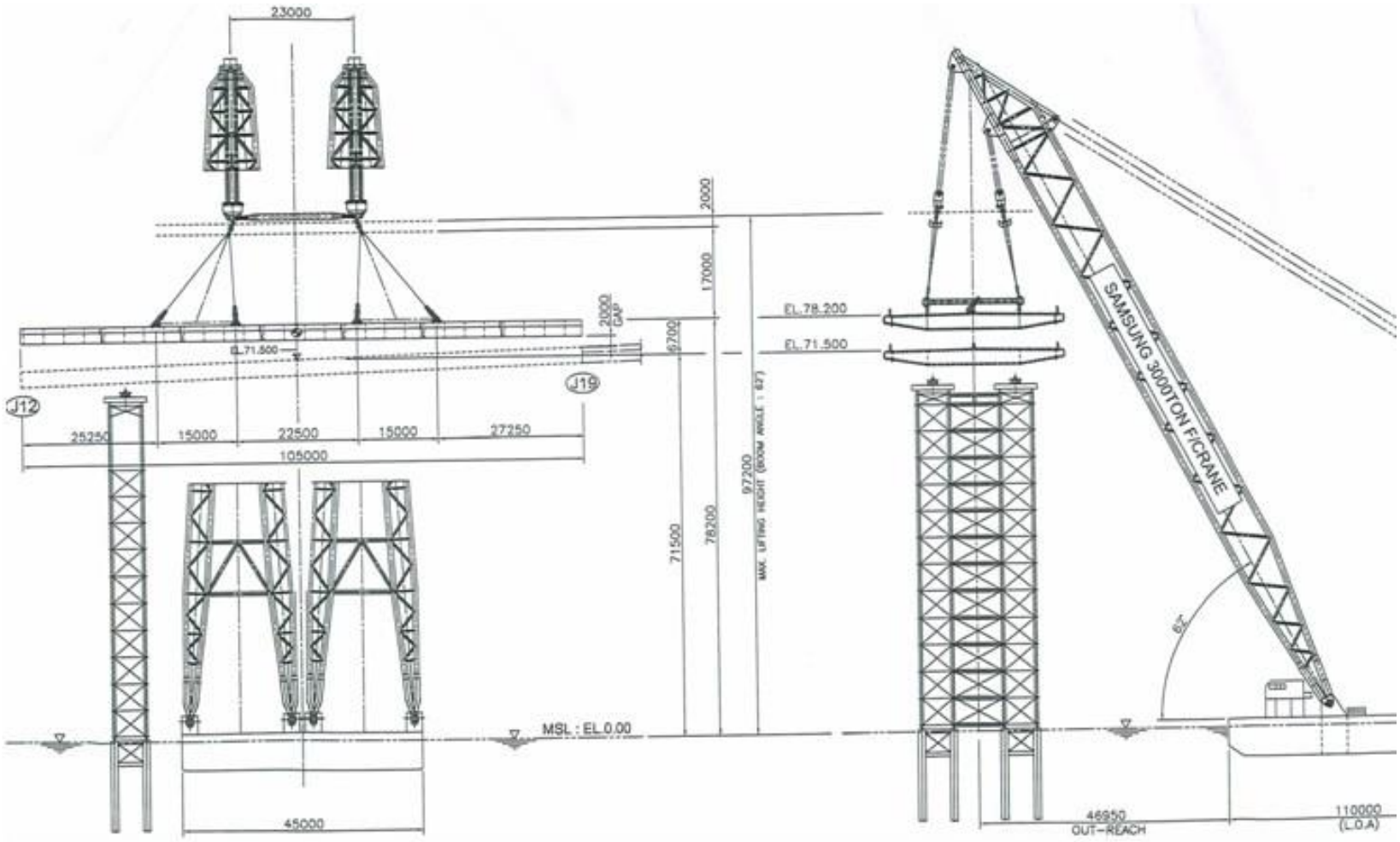
- STEP-2



1. 仁川大橋の大ブロック架設

1.1 架設STEP

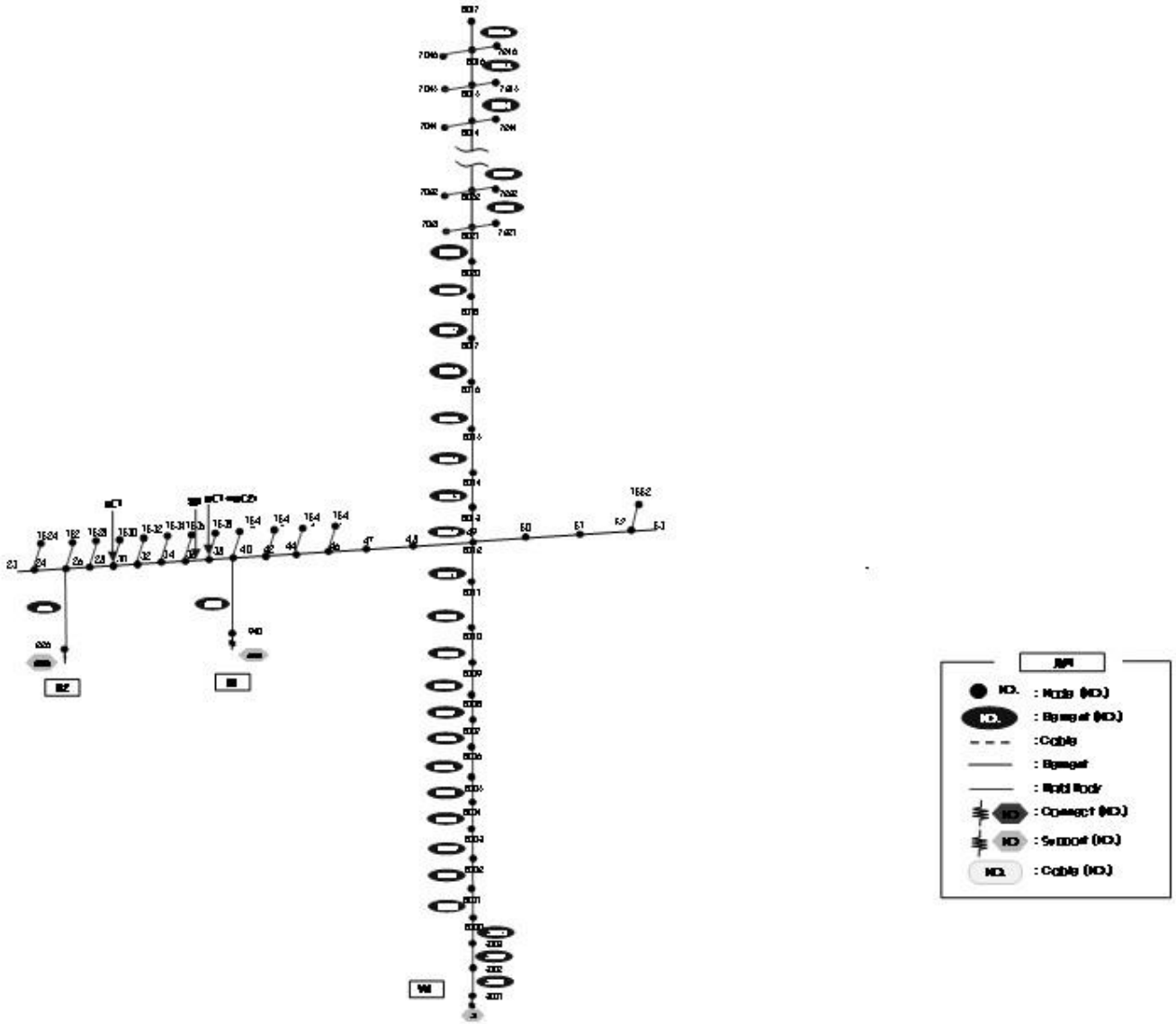
- BB-3の架設



1. 仁川大橋の大ブロック架設

1.1 架設STEP

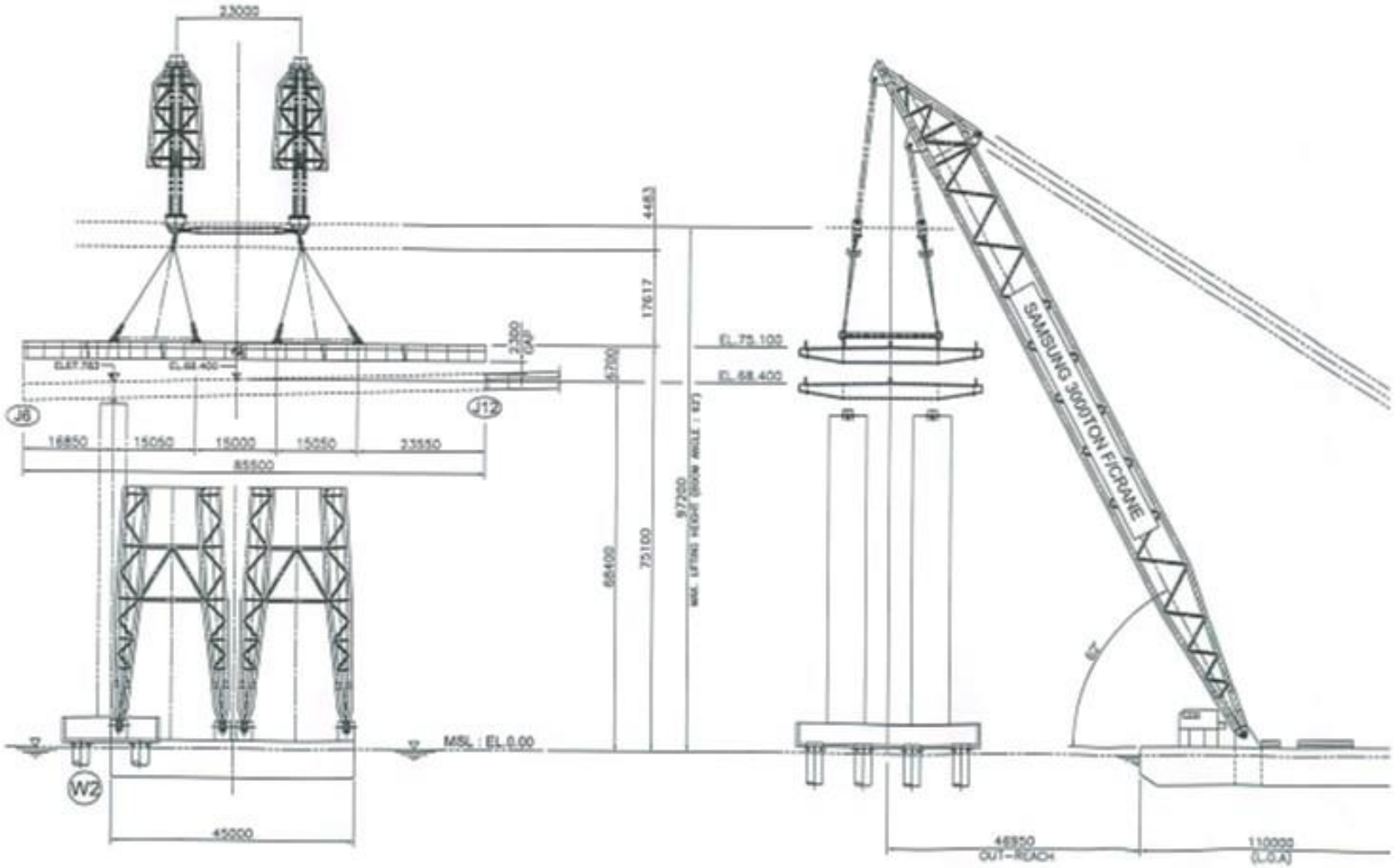
- STEP-3



1. 仁川大橋の大ブロック架設

1.1 架設STEP

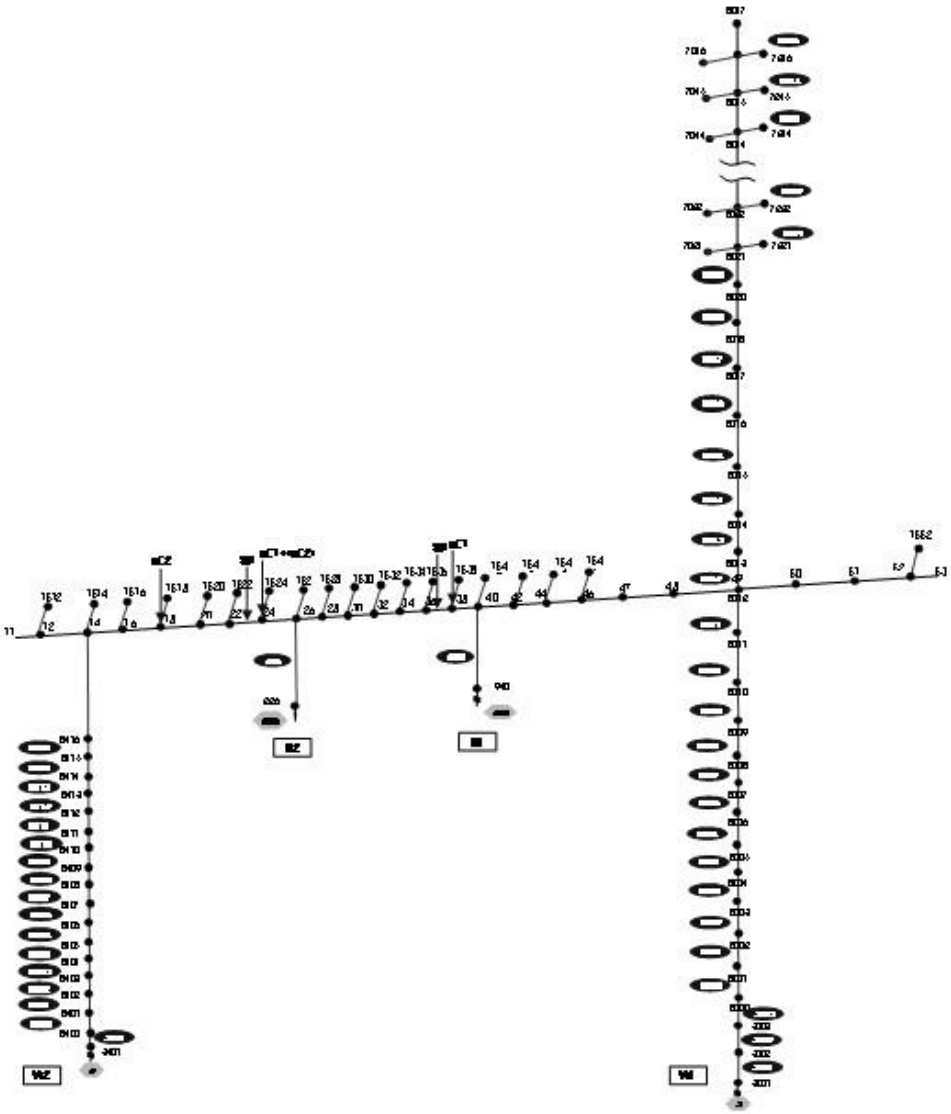
- BB-2の架設

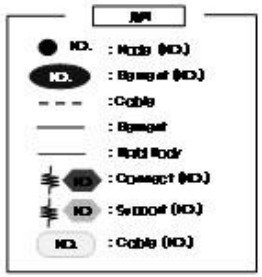


1. 仁川大橋の大ブロック架設

1.1 架設STEP

- STEP-4

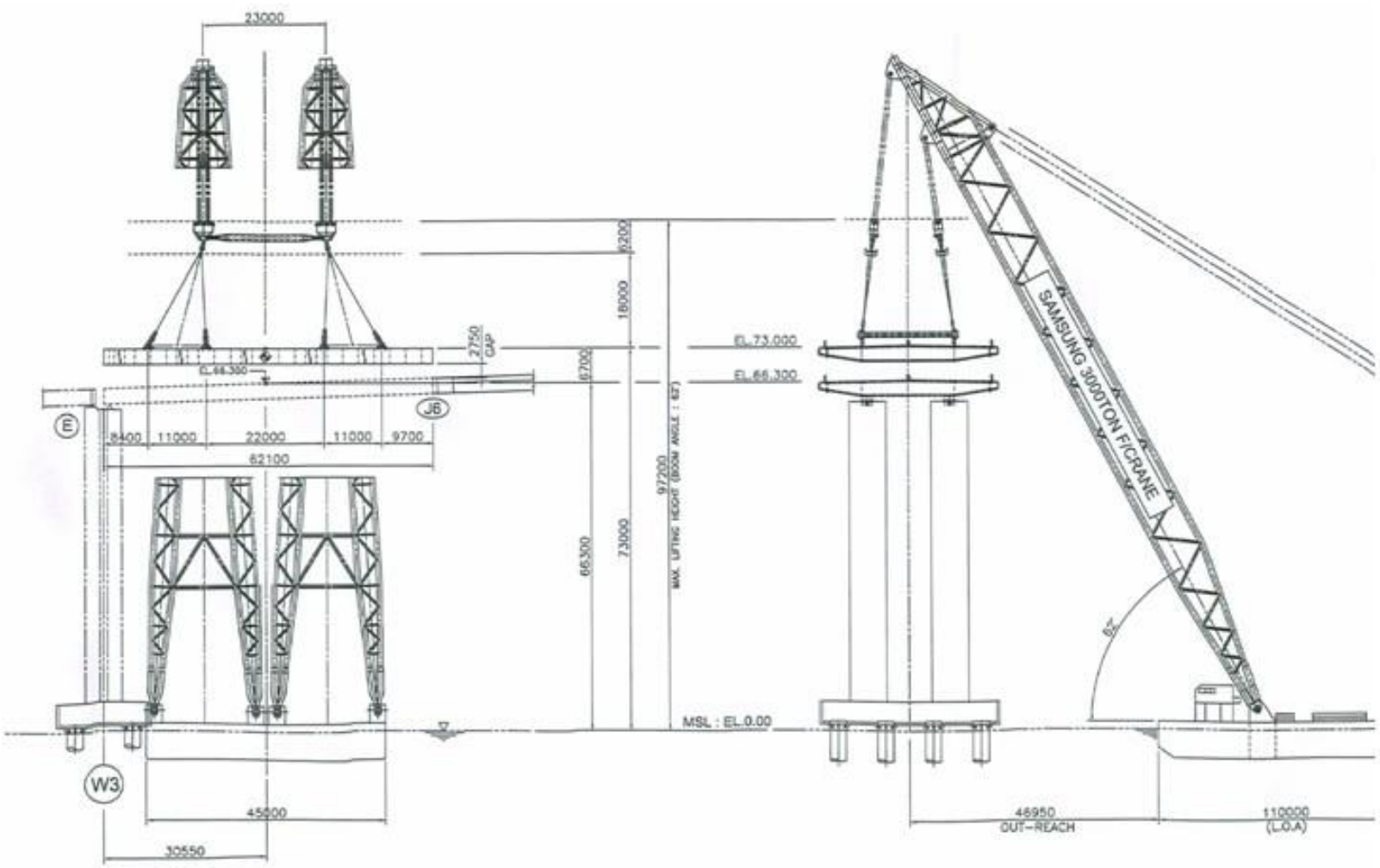




1. 仁川大橋の大ブロック架設

1.1 架設STEP

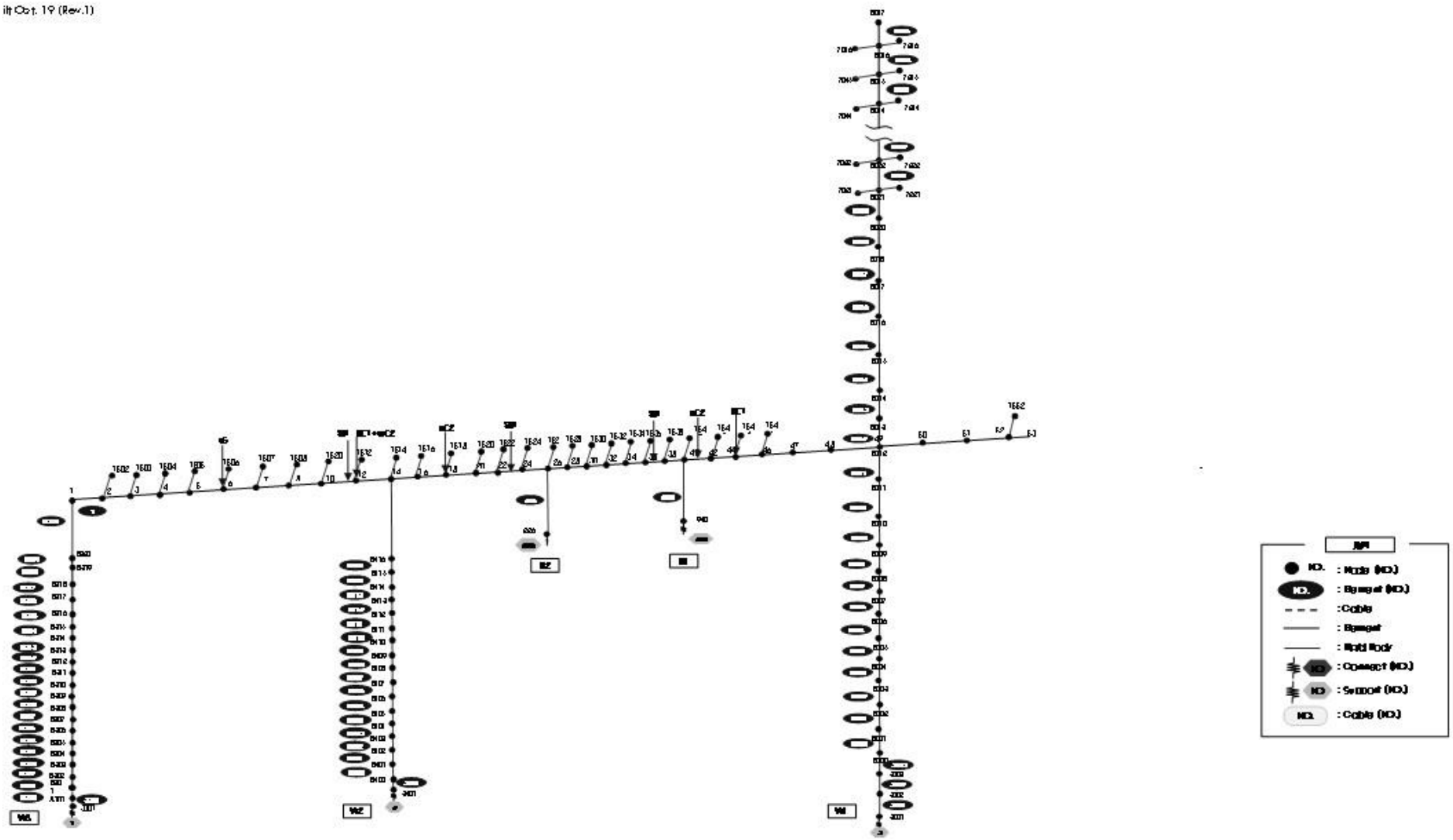
- BB-1の架設



1. 仁川大橋の大ブロック架設

1.1 架設STEP

- STEP-5



1. 仁川大橋の大ブロック架設

1.1 架設STEP

■ 3000トン海上クレーン

-Floating Crane Name : “SAMSUNG 3000”ton

-Length over All(L.O.A) : 110.00m

-Breadth(Mld.) : 45.00m

-Depth(Mld.) : 7.00

メインフックの引上げ能力

-Max Lifting Capacity : 3000.00ton(750 x 4)

-Max Lifting height (Fore) : 109.40m(Boom Angle 62deg)

-Max Lifting height (Aft) : 97.20m(Boom Angle 62deg)

-Out-Reach (Fore) : 50.20m (Boom Angle 62deg)

-Out-Reach (Mean) : 46.95m (Boom Angle 62deg)

-Out-Reach (Aft) : 43.70m (Boom Angle 62deg)

-Draft(Fore) : 5.50m ((Boom Angle 62deg)

-Draft(Mean) : 3.10m ((Boom Angle 62deg)

-Draft(Aft) : 4.60m ((Boom Angle 62deg)

1. 仁川大橋の大ブロック架設

1.1 ベント反力の比較

- 結論) コンサルタントCOWIの仮定荷重による反力は田中の精算荷重より大きく安全である。

Comparison of Reaction Force of Bents					
STEP	Bent 1 (kN)		Bent 2 (kN)		Remark
	COWI	Tanaka	COWI	Tanaka	
STEP-2	13,962	10,152			OK
STEP-3	22,966	21,962	18,284	12,637	OK
STEP-4	20,830	17,879	24,900	22,867	OK
STEP-5	21,272	19,334	23,038	18,988	OK

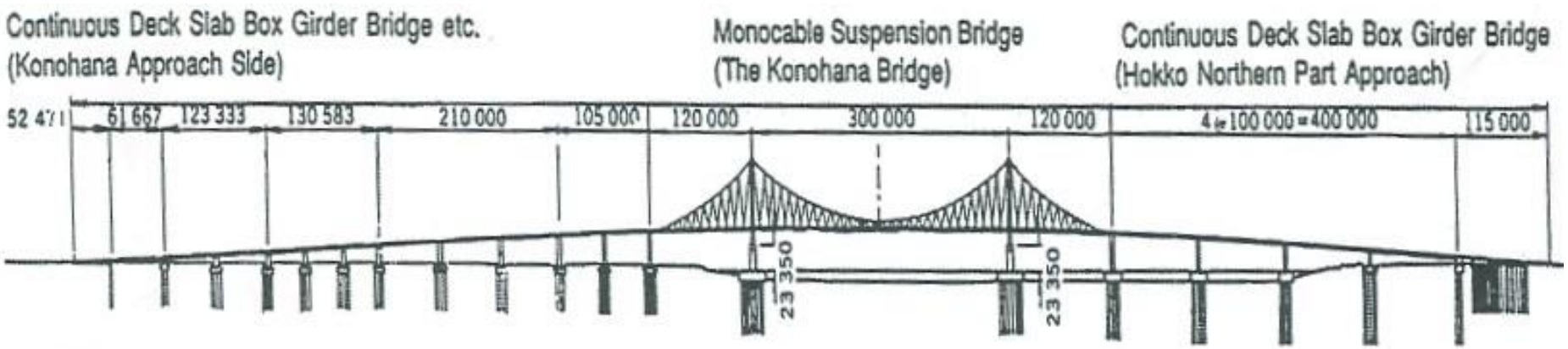
2. 此花大橋の大ブロック架設

■ 日本此花大橋の全景

2. 此花大橋の大ブロック架設

2.1 此花大橋の概要

- スパン構成

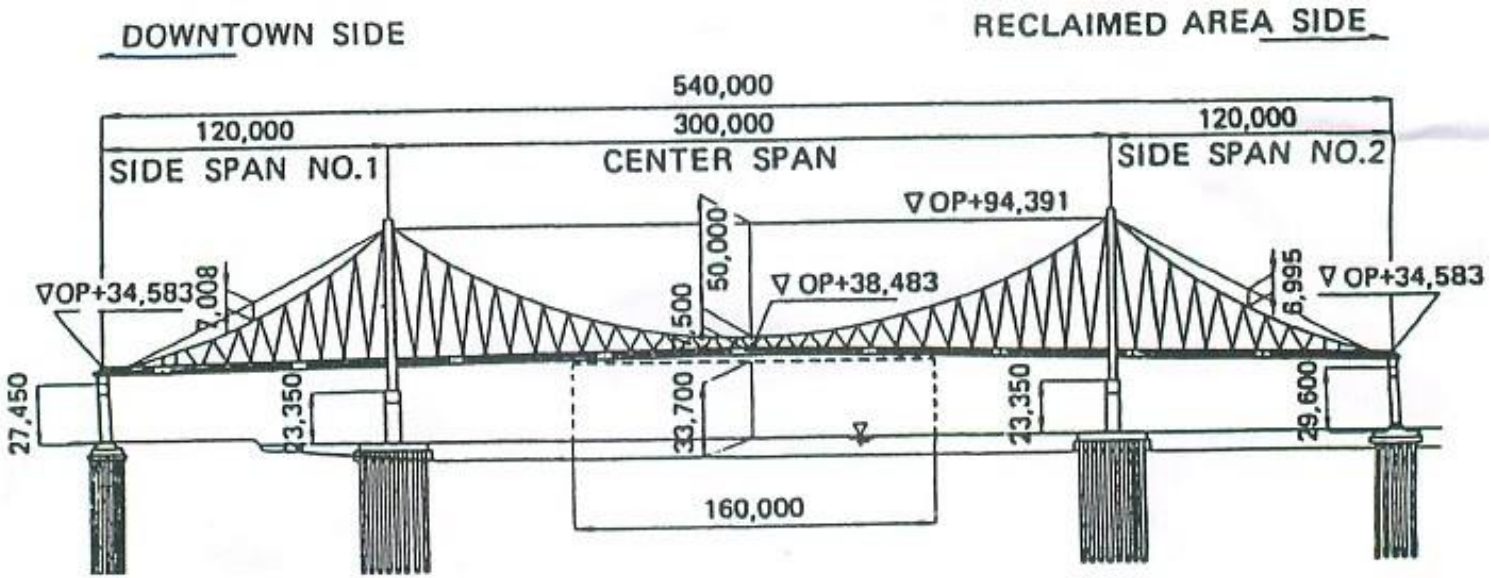


General view of Konohana Bridge

2. 此花大橋の大ブロック架設

2.1 此花大橋の概要

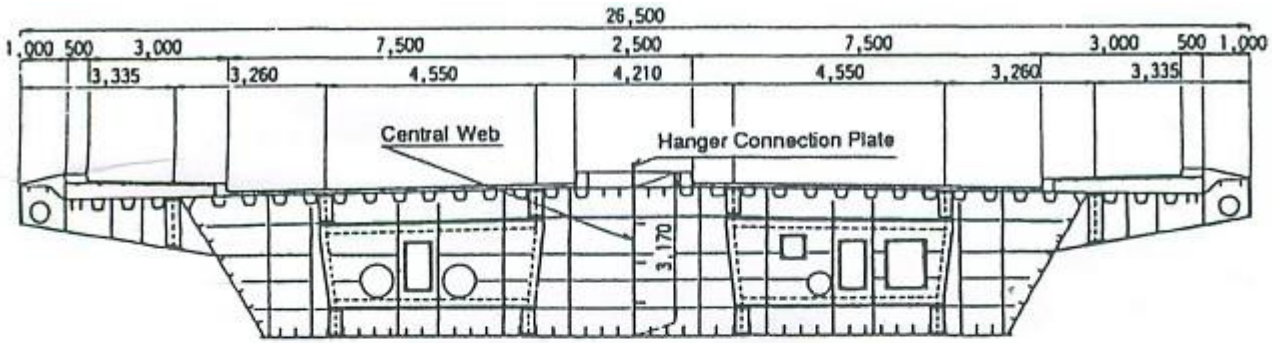
■ 自定式吊橋部(1)

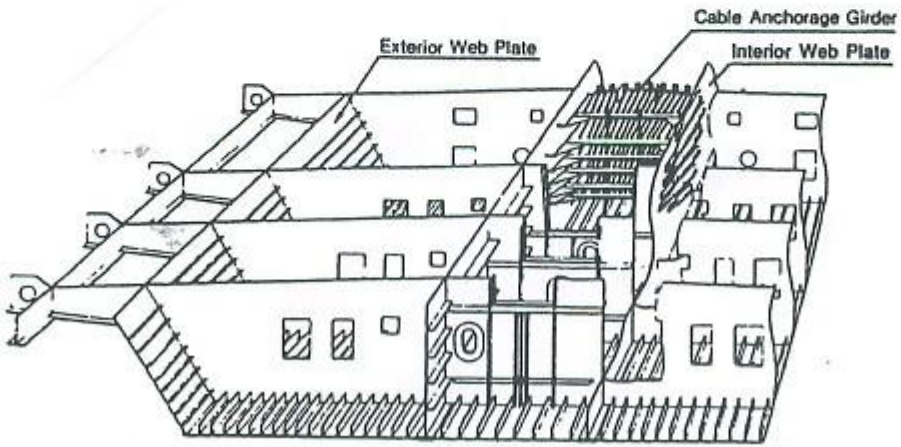


2. 此花大橋の大ブロック架設

2.1 此花大橋の概要

- 自定式吊橋部(2)

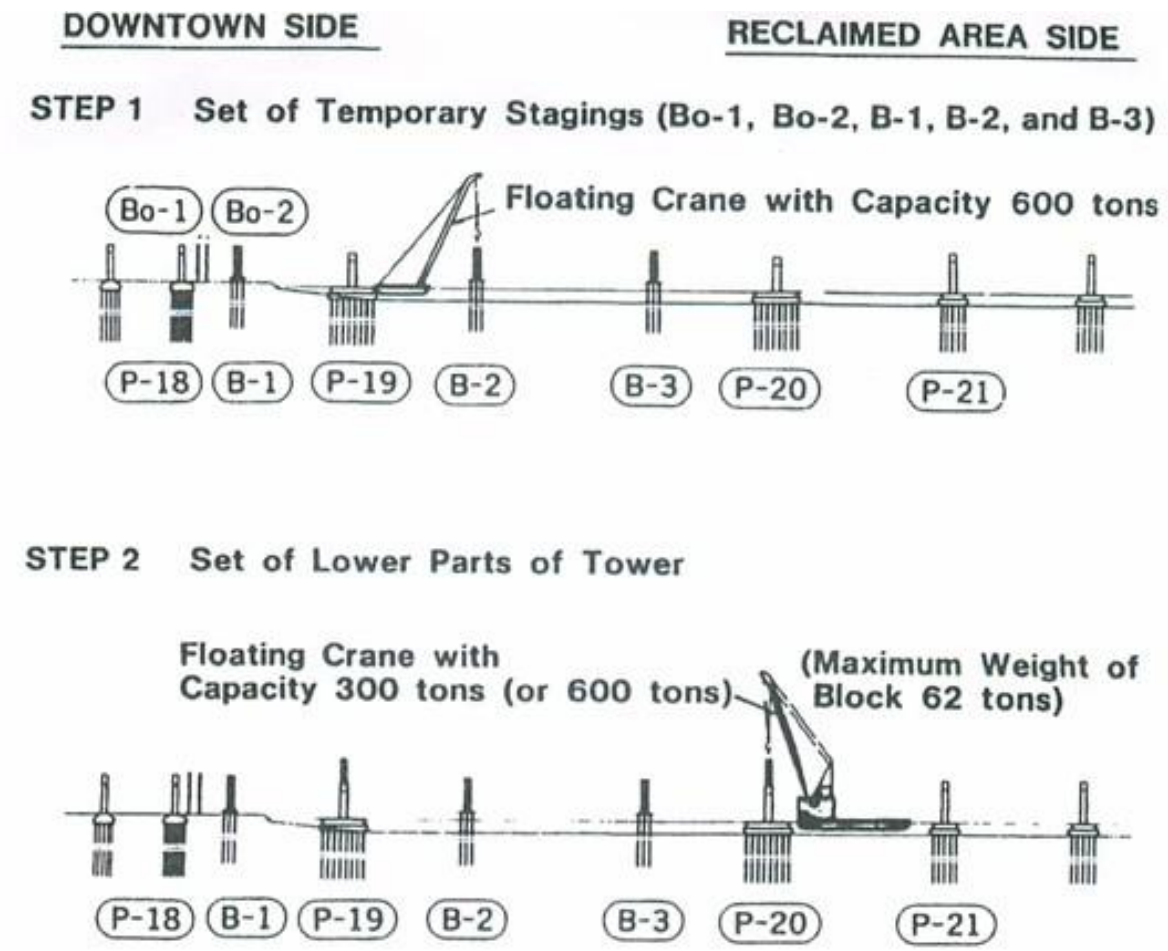




2. 此花大橋の大ブロック架設

2.1 此花大橋の概要

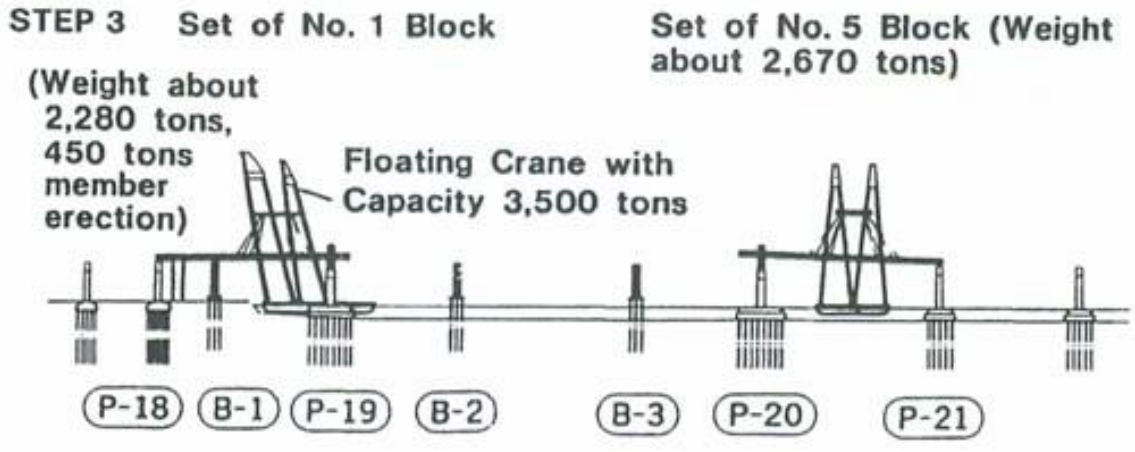
■ 架設STEP

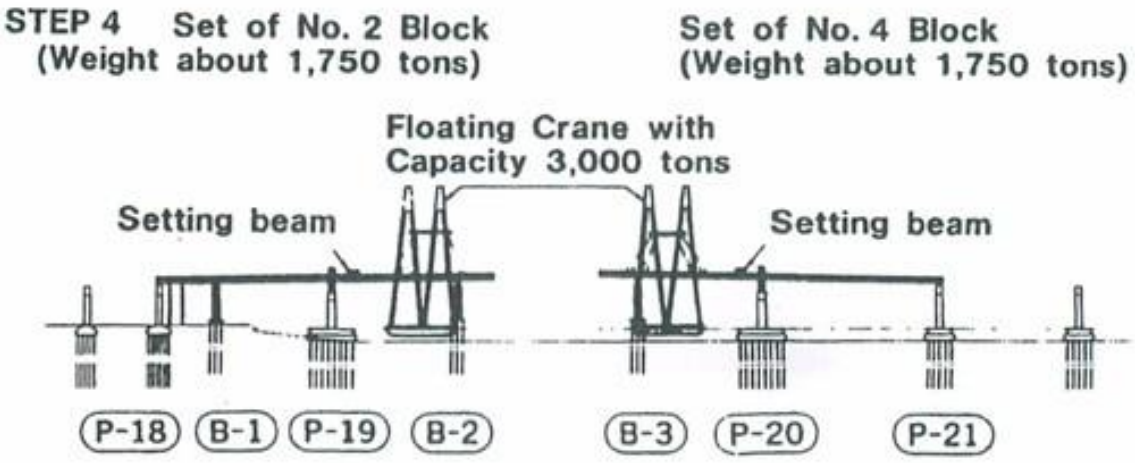


2. 此花大橋の大ブロック架設

2.1 此花大橋の概要

■ 架設STEP

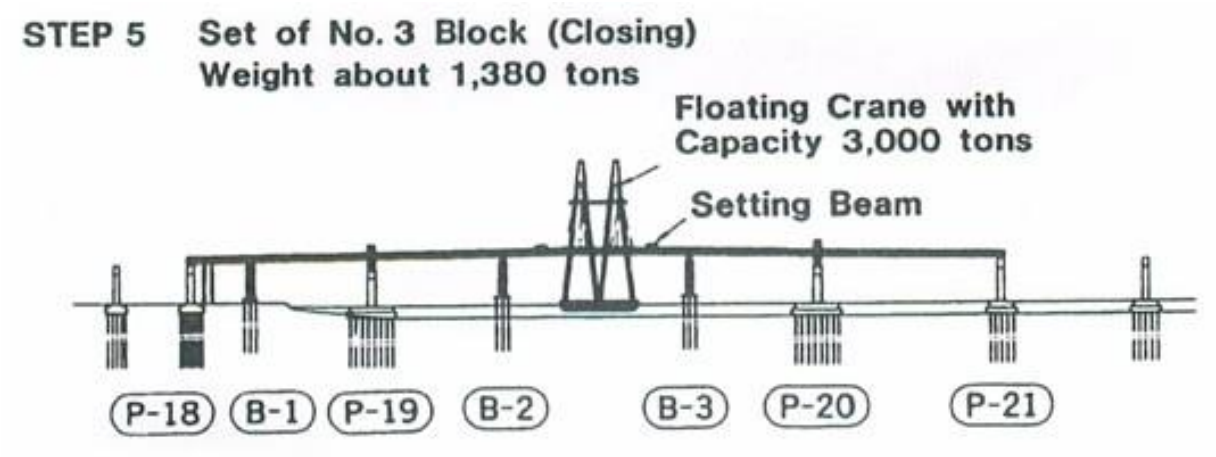


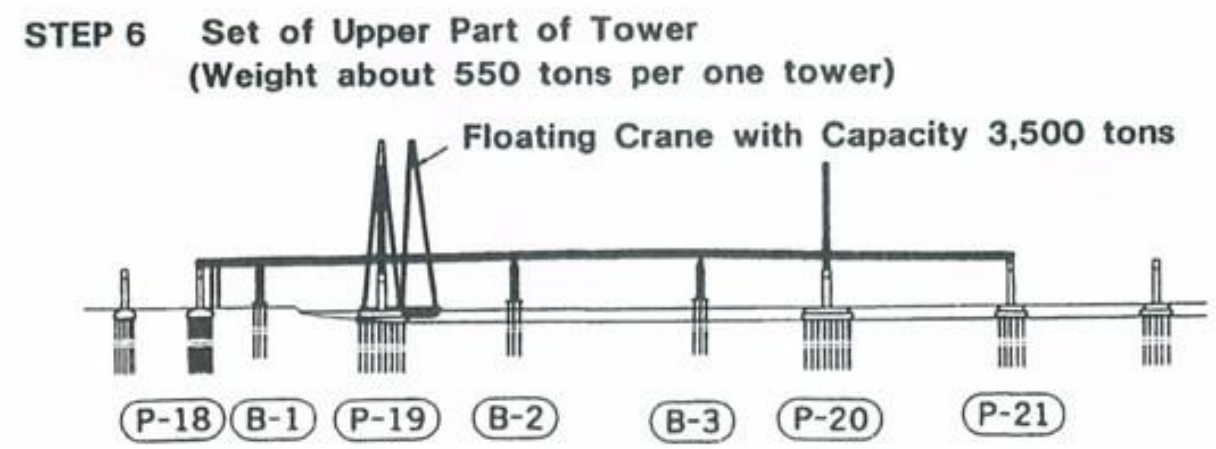


2. 此花大橋の大ブロック架設

2.1 此花大橋の概要

■ 架設STEP



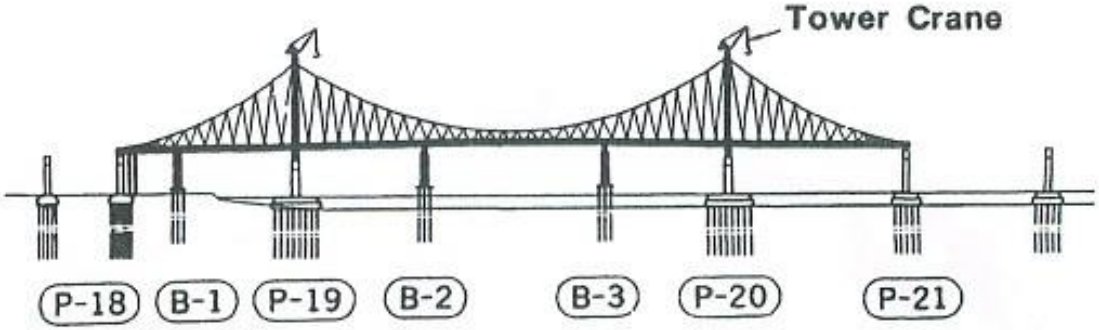


2. 此花大橋の大ブロック架設

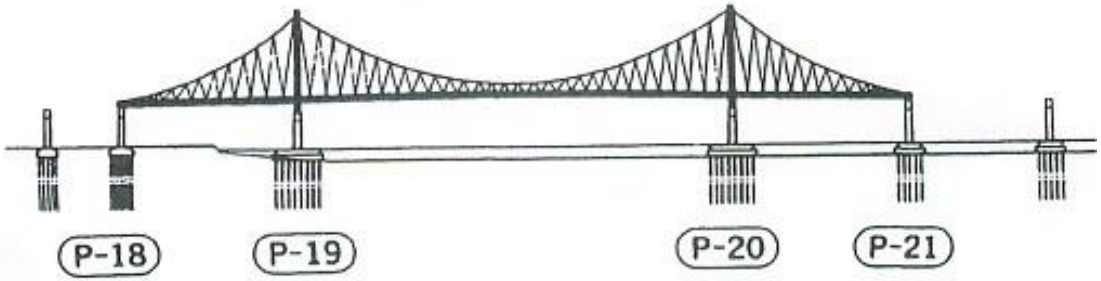
2.1 此花大橋の概要

■ 架設STEP

STEP 7 Erection of Cables and Hangers



STEP 8 Jacking down of Main Girder at Temporary Stagings
Removal of Temporary Stagings and Adjustment
of Tensile Force in Hangers



2. 此花大橋の大ブロック架設

2.1 此花大橋の概要

- 架設写真

2.2 誤差要因の概要

誤差要因

Structural Analysis Errors

-errors in material properties (Young's modules, etc.)

-wrong dead load estimation

-wrong stiffness estimation (moment of inertia, section area, etc.)

-assumption of improper boundary condition

-numerical error in computation

-wrong camber estimation

Construction Errors

-defective installation (wrong location)

-improper field joint by welding

-improper fixed joint by bolts

Fabrication Errors

-mistake in size (cable, girder, tower)

-defects in joint details

$$\{Z\} = \sum_{i=1}^{n} \alpha_i \{F_i\}$$ ($\{F_i\}$: Error mode)

2.2 誤差要因の概要

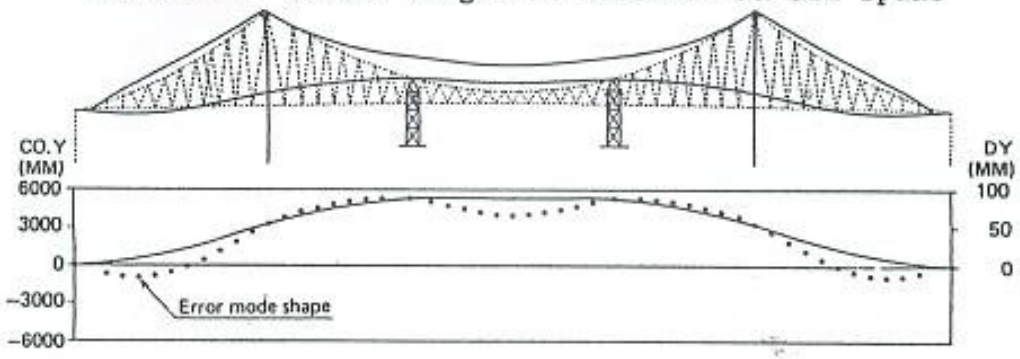
■ 誤差要因の抽出

Error mode No.	Error factor	Contents
1	Dead load of girder	Girder weight 0.08 t/m increase in side span No.1
2	"	Girder weight 0.08 t/m increase in center span
3	"	Girder weight 0.08 t/m increase in side span No.2
4	Cable length in non-tensile force	Cable length 0.010 m decrease in side span No.1
5	"	Cable length 0.020 m decrease in center span
6	"	Cable length 0.010 m decrease in side span No.2
7	Girder section stiffness	Moment of inertia 3 % decrease in each side span
8	"	Moment of inertia 3 % decrease in center span
9	Non-stress girder camber	Temperature difference 3°C between an upper deck and a bottom of a girder in block No. 1
10	"	Temperature difference 3°C between an upper deck and a bottom of a girder in block No. 2
11	"	Temperature difference 3°C between an upper deck and a bottom of a girder in block No. 3
12	"	Temperature difference 3°C between an upper deck and a bottom of a girder in block No. 4
13	"	Temperature difference 3°C between an upper deck and a bottom of a girder in block No. 5
14	Cable Young's modulus	Young's modulus 3 % decrease in all cables
15	Girder position	Forced displacement of a girder-0.05 m in X-direction

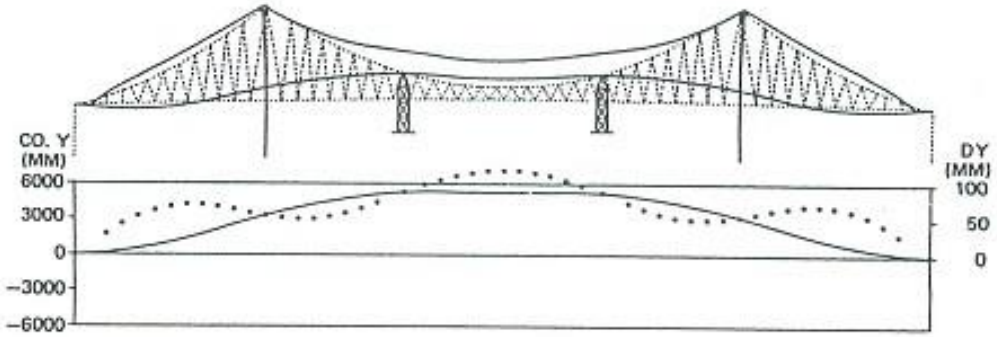
2.2 誤差要因の概要

■ 誤差要因による桁の変形例

Gase 1 --- Girder weight 5% increase in all spans



Gase 2 --- Temperature difference -2°C in all girders



Note) Co.Y --- Co-ordinate of Y
DY --- Displacement of Y co-ordinate by error mode shape. The abscissa expresses the scale length to the displacement.

2. 此花大橋の大ブロック架設

2.2 誤差要因の概要

- 現場計測に基づく入力値

Table 2 Examples of input values Unit (m)

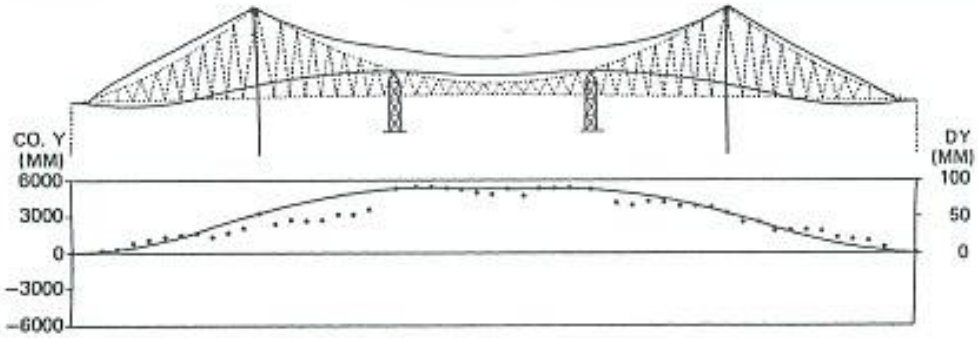
Nodal point No.	Calculated value with no error system(Y1)	Field measured value(Y2)	Y1-Y2
8	5.523 (Sag length)	5.486 (Sag length)	0.037
28	46.840 (Sag length)	46.758 (Sag length)	0.082
47	5.545 (Sag length)	5.666 (Sag length)	0.121
103	0.159	0.129	0.030
107	0.956	0.904	0.052
110	1.999	1.955	0.044
116	4.092	4.061	0.031
119	4.764	4.730	0.034
123	5.192	5.198	-0.006
128	5.155	5.160	-0.005
133	5.193	5.196	-0.003
137	4.761	4.743	0.018
140	4.084	4.079	0.005
146	1.995	1.959	0.036
149	0.961	0.918	0.043
153	0.146	0.121	0.025

2.2 誤差要因の概要

■ 誤差要因の寄与度

Table 3 Calculated results for an error contribution rate

Error mode No.	Error contribution rate :(α)	Assumed value	Calculated value
1	3.644	+0.080 t/m	+0.292 t/m
2	0.403	+0.080 t/m	+0.032 t/m
3	-2.548	+0.080 t/m	-0.204 t/m
4	-2.023	-0.010 m	+0.020 m
5	4.089	-0.020 m	-0.082 m
6	-2.002	-0.010 m	+0.020 m
7	4.478	-3 %	-13.4 %
8	5.001	-3 %	-15.0 %
9	-3.841	3°C	-11.5°C
10	6.341	3°C	+19.0°C
11	-2.105	3°C	-6.3°C
12	1.483	3°C	+4.4°C
13	-3.208	3°C	-9.6°C
14	-0.007	-3 %	+0.02 %
15	0.432	-0.050 m	-0.022 m



2. 此花大橋の大ブロック架設

2.3 まとめ

- 架設STEPを解析でBACK UPすることは非常に大切である。
- その時、桁の変形、桁の支点移動、桁の断面力に注意する必要がある。
- 構造物の計測結果と解析結果を比較してその誤差の要因を知っておくことが重要である。

誤差解析はそのための手法である。

ありがとうございました。