付録 B 理解度測定試験

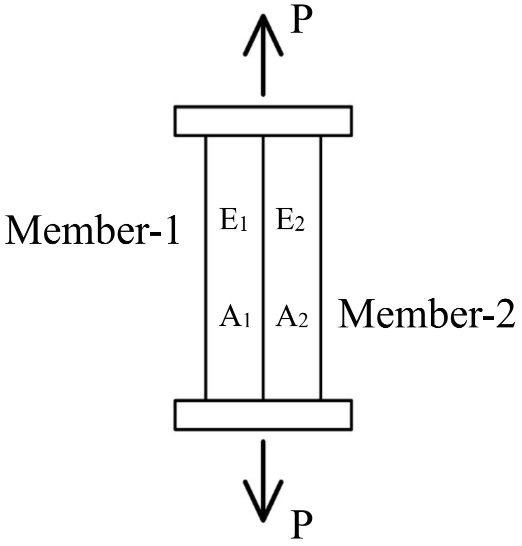
B-1 特別講義のプレテスト

Pre-Test (19th Oct. 2017)
Lecture : Special Lecture for Cable Stayed Bridge

Name :	Score :

Question 1.

Calculate the force at each member: P_1 and P_2

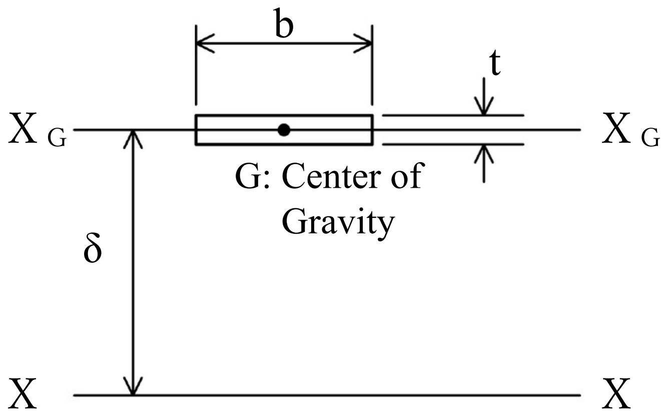


E_i: Young's Modulus of Elasticity
A_i: Cross Sectional Area

P_1: Force at Member-1 (E_1, A_1)
P_2: Force at Member-2 (E_2, A_2)

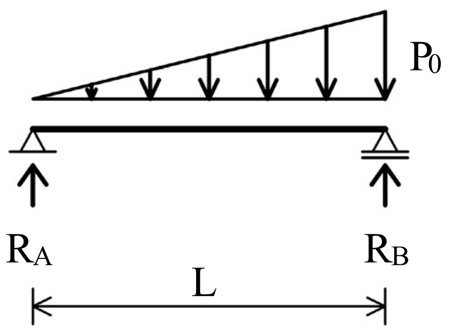
Question 2.

Calculate second moment of inertia about the X_G axis [I_{XG}] and X axis [I_X].



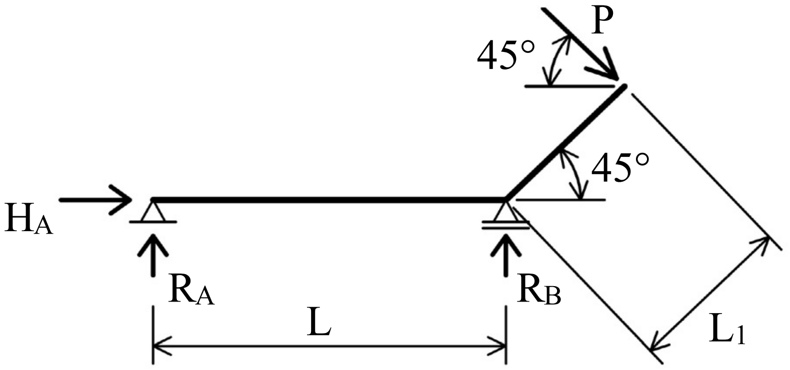
Question 3.

Calculate reaction force of R_A, R_B and H_A.



Question 4.

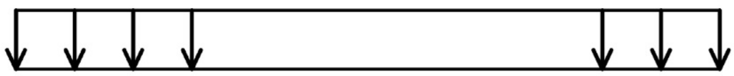
Calculate reaction force of R_A, R_B and H_A.



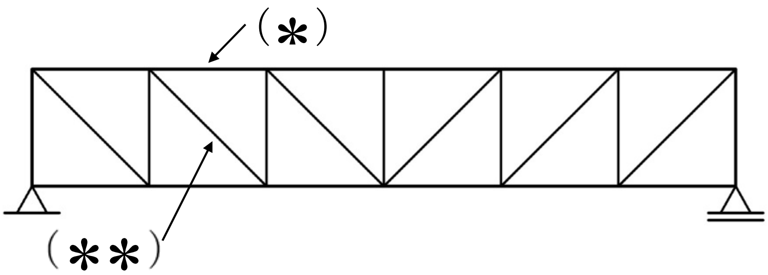
$\sin 45° = \cos 45° = 1/\sqrt{2}$

Question 5.

Identify the members (*, **) are subjected to tension or compression.



(1)



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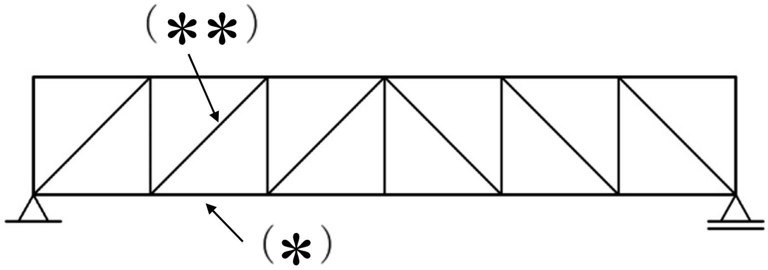


付録 B　　理解度測定試験

B-2　　上部工の設計概論（コンクリート橋）のプレテスト

Pre-Test
Lecture : Superstructure Design-1 (Concrete)

Name :	Score :

Question 1. Type of Bridges

Select the correct combination of bridge types from the following options A ~ E:


(1)


(2)


(3)

A. (1) Frame bridge (2) Girder bridge (3) Arch bridge
B. (1) Frame bridge (2) Arch bridge (3) Girder bridge
C. (1) Girder bridge (2) Frame bridge (3) Arch bridge
D. (1) Girder bridge (2) Arch bridge (3) Frame bridge
E. (1) Arch bridge (2) Frame bridge (3) Girder bridge

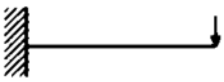
Question 2. Basic of Statics

A concentrated load is acting on the tip of a cantilever beam as shown in the right figure below.

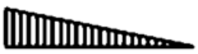
Q2-1. Choose the correct bending moment diagram from A ~ D. A2-1

Q2-2. Choose the shear force diagram from A ~ D. A2-2

A. 



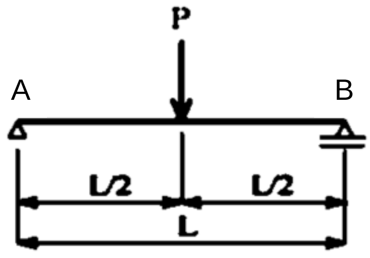
B. 

C. 

D. 

Question 3. Basic of Statics

A concentrated load P is acting at the center of a simply supported beam of length L.



Q3-1. Calculate the support reactions at A (left) and B (right).

Reaction at support A: ___________

Reaction at support B: ___________

Q3-2. Draw the bending moment diagram.

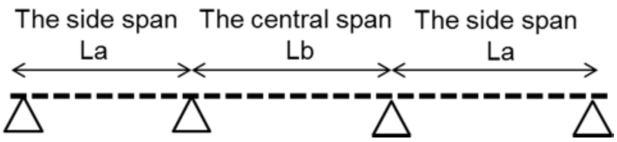
A _________________________________ B

Q3-3. Calculate the maximum bending moment.

Mmax = _____________________

Question 4. Consideration on Span Arrangement

Select the correct combination of span length ratio which is statically most ideal for three-span continuous girder among the following options (construction condition & erection method are ignored).



A. La : Lb = 1.0 : 1.0
B. La : Lb = 1.0 : 1.2
C. La : Lb = 1.0 : 1.25
D. La : Lb = 1.0 : 1.3
E. La : Lb = 1.0 : 1.5

Question 5. Erection Method of Concrete Girder Bridges

Select the name of erection method for concrete girder bridges from the options A ~ E which is described in the following.

[Erection method]

A Concrete girder is constructed symmetrically from pier tables block by block using form travelers.

A. Span-by-span erection method
B. Free Cantilever erection method
C. Incremental launching method
D. Crane erection method
E. Erection beam method

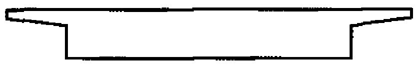
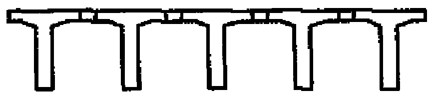
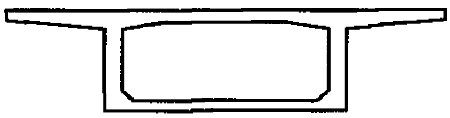
Question 6. Creep and Shrinkage of Concrete

Select the most appropriate description about creep and shrinkage of concrete from the followings.

A. Creep deformation is assumed to be proportional to the elastic displacement.
B. Deformation due to creep is finished in about one month.
C. Creep is caused only by self-weight.
D. Creep is a phenomenon to steel
E. Shrinkage strain is increased gradually after casting of concrete.

Question 7. Type of Girder Cross Section

Select the correct combination of cross sections of concrete girder bridge arranged in the order of practically applicable span lengths from longer to shorter.

 (1) Solid slab	 (2) T-girder
 (3) Box girder	 (4) Hollow slab

A. (1) – (2) – (3) – (4)
B. (1) – (4) – (2) – (3)
C. (2) – (3) – (1) – (4)
D. (3) – (4) – (2) – (1)
E. (3) – (2) – (4) – (1)

Question 8. Concrete bridges using precast elements

Describe advantages and disadvantages of applying precast elements to concrete bridges, compared to cast-in-place construction.

付録 B　理解度測定試験

B-3　基礎工・下部工の設計概論のプレテスト

Pre-Test
Lecture : Substructure Design

Name :	Score :

Question 1. [score 10]

Please select the suitable type of foundation under the conditions below from A. to D.

Conditions:

- There is gravel, size range from Dia.100 to Dia.150mm, in the middle layer.
- Bearing layer, soft rock, exists in 35m from ground surface.
- Extremely large amount of inflow water.
- Water depth is 1.5m.

A. Cast-in-Placed RC Pile Foundation by All Casing Method
B. Deep Foundation
C. Pneumatic Caisson Foundation
D. Diaphragm Wall Foundation

Answer:______________________

Question 2. [score 10]

Please select the most suitable type of foundation from A. to D. under the conditions below.

Conditions:

- Bearing layer, sand with N-value 50, exists over 60m depth from ground surface.
- There is high possibility that the position of the support layer is not same depth.
- Water depth is 3.0m.
- Vibration and noise control are required.

A. Steel Pipe Pile by percussion driving method
B. Steel Pipe Pile by vibratory hammer method
C. Rotation Steel Pile Method
D. SPSP

Answer:______________________

Question 3. [score 10]

Why Cast-in-placed RC Pile by All Casing Method is not applicable under the conditions that very soft layer in the middle layer or the vicinity of surface layer exist?

Answer:

Table: Referential Criteria of Applicability of Foundation Type

applied condition \ foundation type				spread foundation	Pile Foundation																Deep foundation		caisson foundation		steel pile sheet pile foundation	diaphragm wall foundation
					driving pile method			pile boring method						steel pipe pile soil cement piles	preboring method	cast-in-place piles method			Rotation Pile method							
					PHC piles ・SC piles	steel pipe piles		PHC piles ・ SC piles			steel pipe piles															
						percussion method	vibratory hammer method	final driving method	jetting and mixing method	concrete placement method	final driving method	jetting and mixing method	concrete placement method			all casing method	reverse circulation drill method	earth drill method		set pile deep foundation	columnar deep foundation	pneumatic	open		
ground condition	condition until bearing layer	There is a very soft layer in the middle layer or the vicinity of the surface layer			○	○	○	○	○	○	○	○	○	○	○	×	○	○	○	×	×	○	△	○	○
		There is a very hard layer in the intermediate layer			△	△	△	○	○	○	○	○	○	○	○	△	○	×	○	○	○	○	△	△	○
		There is gravel in the middle layer	gravel diameter less than or equal to 50mm		△	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
			gravel diameter 50～100mm		△	△	△	△	△	△	△	△	△	○	○	△	×	○	○	○	○	○	○	△	△
			gravel diameter 100～150mm		×	×	×	×	×	×	×	×	×	×	×	△	×	×	×	○	○	○	△	×	△
		There is a ground to liquefaction			○	○	○	○	○	○	○	○	○	○	○	○	○	○	○			○	○	○	○
	bearing layer condition	depth	less than 5m	○	○	×	×	×	×	×	×	×	×	×	×	×	×	×	×	○		×	×	×	×
			5～15m	△	○	○	○	○	○	○	○	○	○	○	○	○	△	○	○	○	○	○	○	△	△
			15～25m	×	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
			25～40m	×	○	○	○	○	○	○	○	○	○	○	○	○	○	△	○	△	△	○	○	○	○
			40～60m	×	△	○	○	△	△	△	○	○	○	○	○	△	○	×	○	×	×	△	○	○	○
			over 60m	×	×	△	△	×	×	×	×	×	×	△	△	×	△	×	○	×	×	×	△	△	△
		soil	sand ・ sand gravel (30≦N)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
			cohesive soil (20≦N)	○	○	○	○	○	△	×	○	△	×	△	△	○	○	○	△	○	○	△	△	○	○
			soft rock ・ hardpan	○	×	○	△	○	△	×	○	△	×	△	△	○	○	○	△	○	○	○	○	○	○
			hard rock	○	×	×	×	×	×	×	×	×	×	×	×	△	△	△	×	○	○	△	×	×	△
		There is high possibility that the position of the support layer is not same depth, including; slope is large, irregularities of surface layer is heavy, etc.,		△	△	△	△	△	△	△	△	△	△	△	△	○	○	○	○	○	○	△	×	○	○
	groundwater condition	Groundwater level is near the ground surface		△	○	○	○	○	○	○	○	○	○	○	○	△	△	△	○	△	△	○	○	○	△
		extremely large amount of inflow water		△	○	○	○	○	○	○	○	○	○	△	△	△	△	△	○	×	×	○	○	○	△
		there is artesian water that 2m deeper than the surface		×	○	○	○	×	×	×	×	×	×	×	×	×	×	×	○	×	×	△	△	○	×
		groundwater flow rate over 3m/min		×	○	○	○	○	×	×	○	×	×	×	×	×	×	×	○	×	×	○	△	○	×
type of support		bearing pile			○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○					
		friction pile			○	○	○	×	×	×	×	×	×	○	×	○	○	○	×						
construction condition	aquatic construction	water depth less than 5m		△	○	○	○	△	△	△	△	△	△	×	×	×	×	×	○			△	△	○	×
		water depth over 5m		×	△	○	○	△	△	△	△	△	△	×	×	×	×	×	○			△	△	○	×
	narrowness of work space			○	△	△	△	△	△	△	△	△	△	△	△	△	△	△	△	○	○	△	△	×	△
	construction of batter pile				○	○	○	×	×	×	×	×	×	×	×	×	×	×	○	×					
	effect of toxic gas				○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	×	×	×	○	○	○
	surrounding environment	vibration and noise control		○	×	×	△	△	○	○	△	○	○	○	○	○	○	○	○	○	○	○	○	×	○
		Effects on adjacent structures		○	×	△	△	△	○	○	△	○	○	○	○	○	○	○	○	△	△	△	△	△	○

Applicability O: high △: moderate X: low

Question 4. [score 10]

Does the following layer have a possibility to occur liquefaction?

- The groundwater level is in less than 5m from earth surface, and the saturation soil layer exists in a range from surface to 15m depth.
- D50 [50% particle diameter] is 7 mm and D10 [10% particle diameter] is 1 mm.
- Plasticity index (IP) is less than 12 and fine-grain fraction content (FC) is 38%.

A. Yes, it has possibility. So, further evaluation (calculation of F_L (resistivity to liquefaction)) is necessary for judgement.

B. No, it does not have possibility.

Answer:______________________

Question 5. [score 8 x 5 questions]

Does the Clayey Sand layer in 16m depth have a possibility to occur liquefaction? Please assess that layer based on the laboratory test result for sampling No.P14.

Question 5.1 Please read D50 [50% particle diameter] in the Grain Size Distribution Curve.

Answer:______________________

Question 5.2 Please read D10 [10% particle diameter] in the Grain Size Distribution Curve.

Answer:______________________

Question 5.3 Please read FC [fine-grain fraction content] in the Grain Size Distribution Curve.

**FC is the fraction of fine grains (<0.075mm) contained in the ground material (<75mm).*

Answer:______________________

Question 5.4 Please calculate IP (Plasticity index) from Atterberg's Limit Test Result.

Answer:______________________

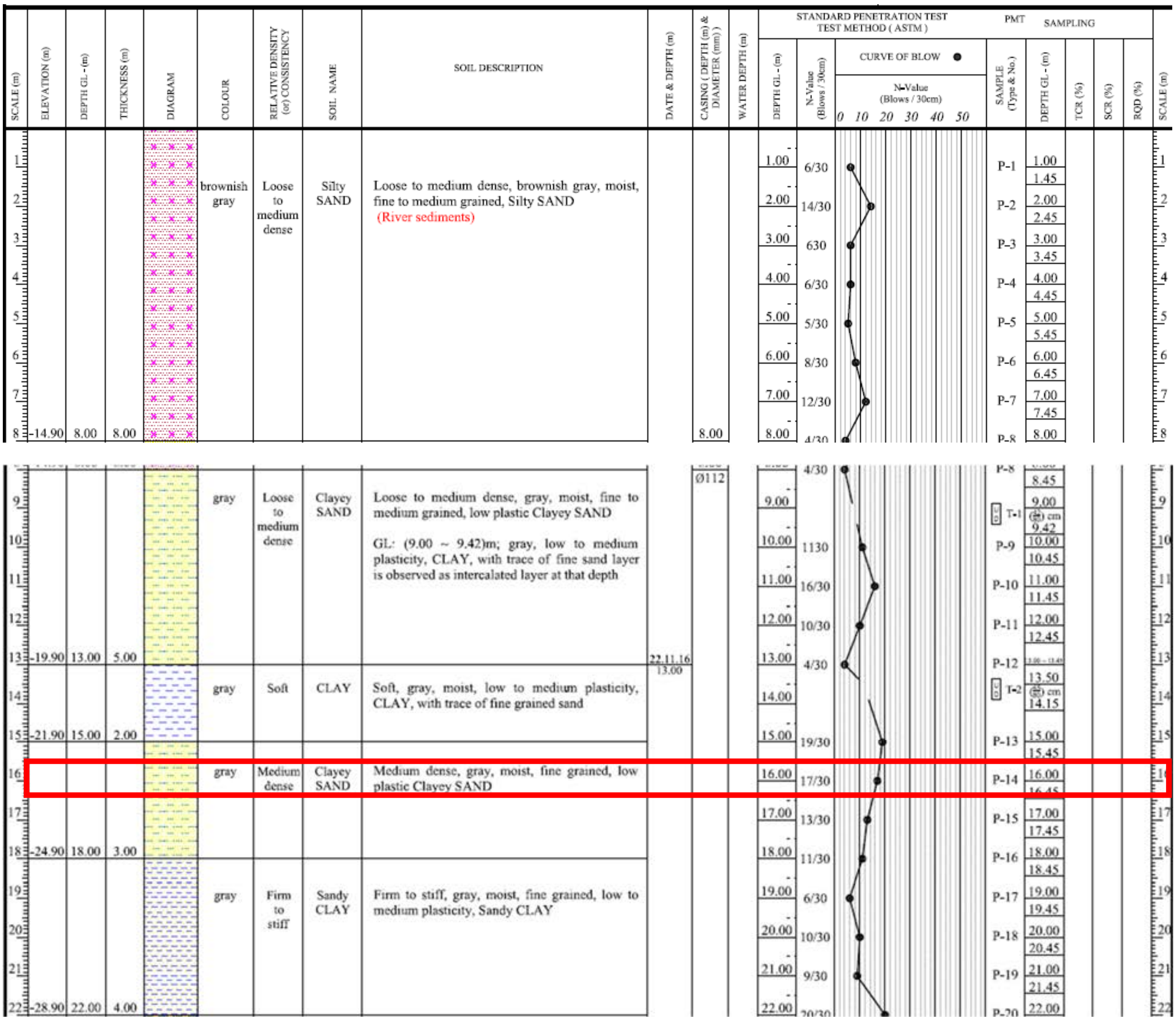
Question 5.5 Does this soil layer have a possibility to occur liquefaction?

A. Yes, it has possibility. So, further evaluation (calculation of F_L (resistivity to liquefaction)) is necessary for judgement.

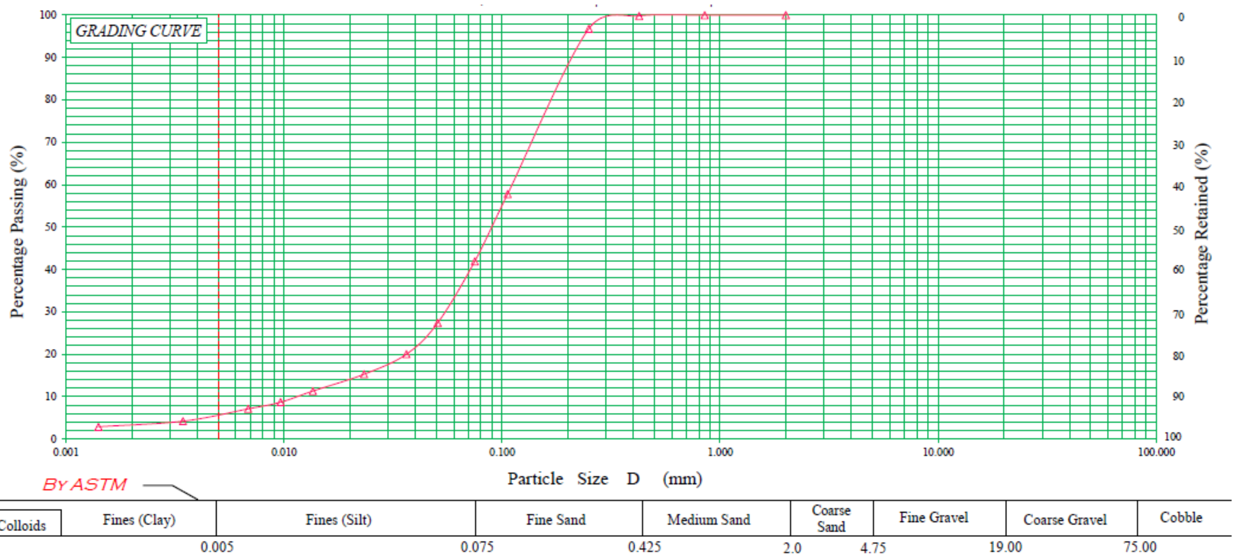
B. No, it does not have possibility.

Answer:______________________

<u>Boring Log (Bore Hole No.BH-BD-05 in the river, ground level EL-6.90m)</u>



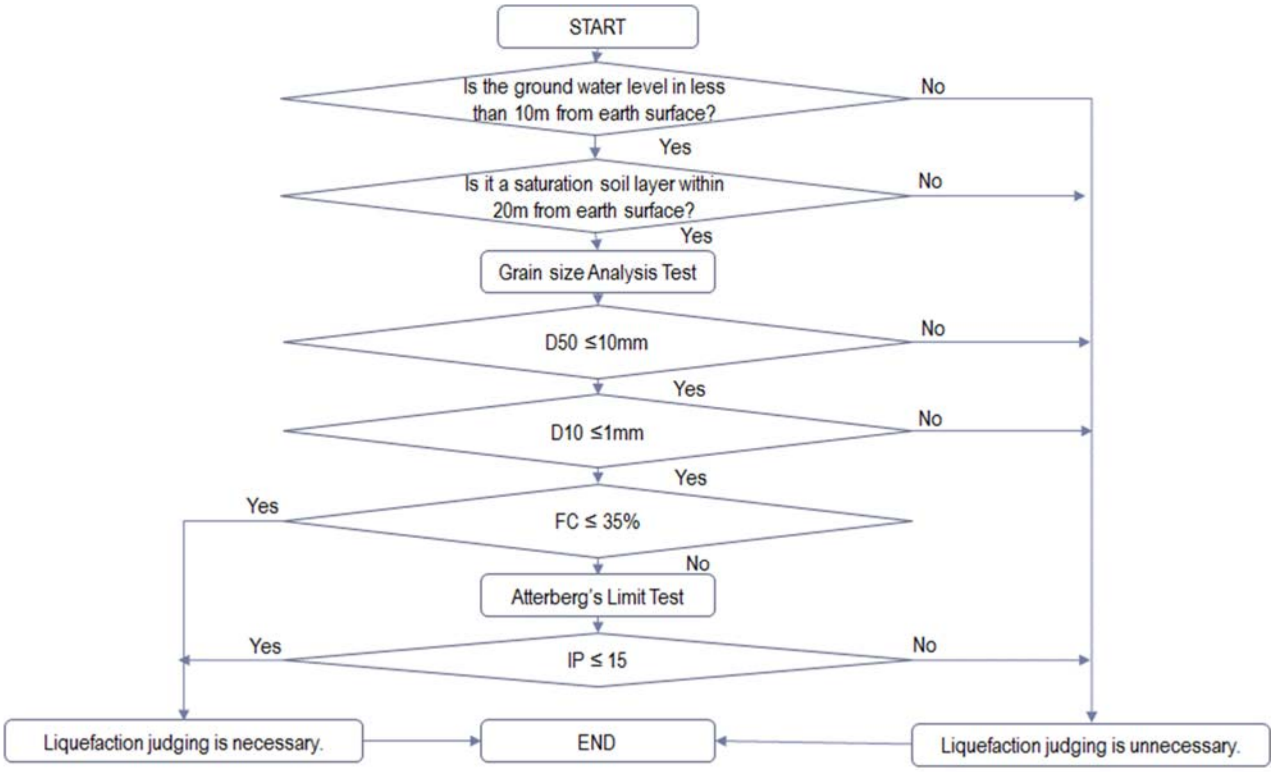
Particle Size Analysis Test (Grain Size Distribution Curve of Sample No.P-14)



Remarks: Gravel (%) = -	Silt (%) = 36.25	TEST BY:	E E W, M E P
Sand (%) = 58.05	Clay (%) = 5.70	CHECK BY:	T H

Laboratory Test Result (Atterberg's Limit)

Sample No.				P-11	P-12	T-2	P-13	P-14
Depth (m)				12.00 ~ 12.45	13.00 ~ 13.45	13.50 ~ 14.15	15.00 ~ 15.45	16.00 ~ 16.45
Moisture Content		w	%	22.57	33.18	34.98	27.56	28.25
Bulk Density		ρ_t	g/cm^3	- / -	- / -	1.726 / 1.734	- / -	- / -
Atterberg's Limit	Liquid Limit	WL	%	-	51.70	36.40	17.65	23.11
	Plastic Limit	WP	%	-	21.83	21.83	14.15	18.42

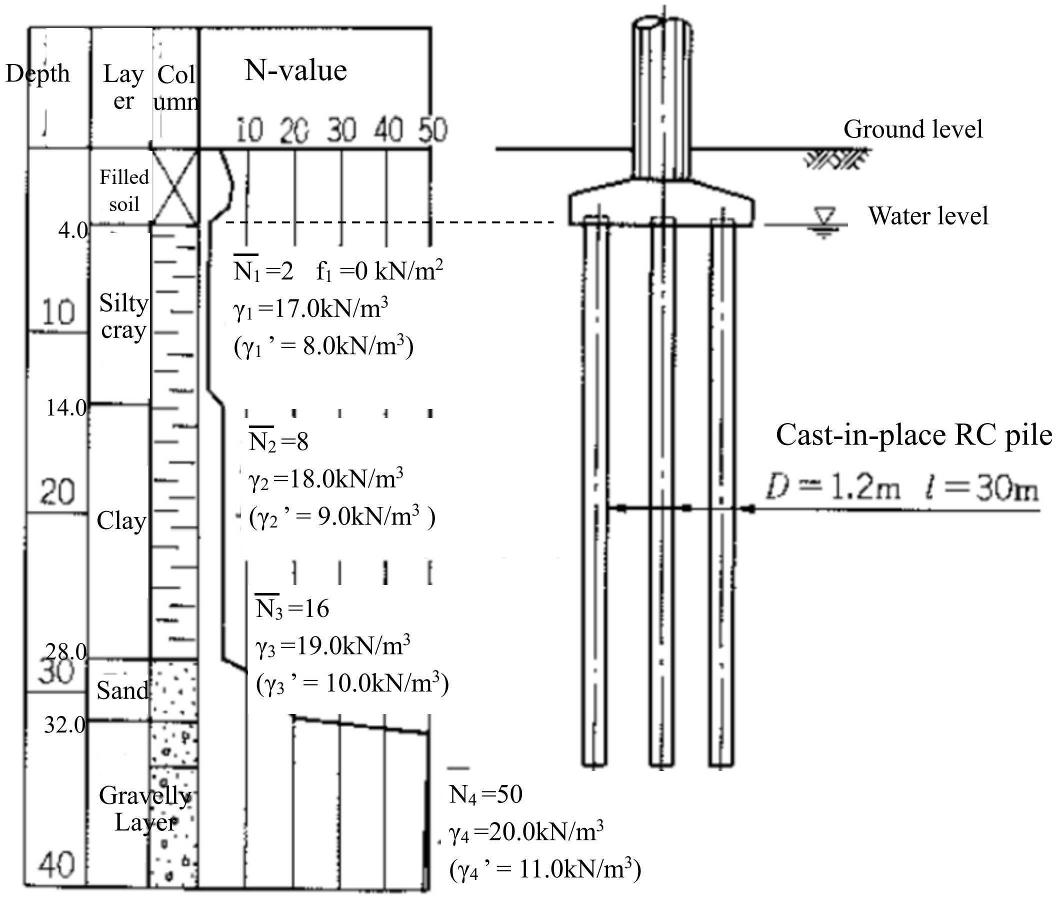


Flow Chart of Initial Assessment of Potential of Liquefaction

Question 6. [score 10 x 2 questions]

Calculation of Ultimate Bearing Capacity and Pull-Out Capacity of single CIP RC Pile with Diameter 1.2m and length 30m.

Geological Condition



Note)

The shaft resistance intensity for soft clay layer with small N value needs to to be estimated by appropriate soil tests. Here, the value of f_1 for silty clay layer is to be calculated as 0 kN/m^2 due to un-reliability.

Type of foundation

- Cast-in-place RC pile
- Pile diameter: D=1.2m
- Pile length: L=30.0m
- Unit weight of RC concrete: 24.5kN/m^3

Question 6.1 Calculate Ultimate Bearing Capacity of Pile (Ru) (kN)

$$Ru = qd \cdot Ap + U \cdot \Sigma(Li \cdot fi)$$

qd：ultimate end bearing capacity intensity per unit area (kN/m^2)

Table: qd for Cast-in place RC pile:

Ground Type	Ultimate Bearing Capacity End Bearing Intensity (kN/m^2)
Gravelly Layer and Sandy Layer (N≥30)	3,000
Sturdy Gravelly Layer (N≥50)	5,000
Hard Cohesive Soil Layer	$3q_u$

Notes) q_u : unconfined compressive strength (kN/m^2),
N : N value from the Standard Penetration Test (SPT)

(Source: JSHB)

Ap：area of pile tip (m^2)
U ：perimeter of pile (m)
Li：thickness of soil layer considering shaft resistance(m)
fi：maximum shaft resistance of soil layer considering pile shaft resistance (kN/m^2)

It is noted that shaft friction is not considered in the range of 1.0・D from the tip of pile for calculation of ultimate bearing capacity.

Table: maximum shaft resistance depending on pile installation method and soil type

Pile Installation Method \ Ground Type	Sandy Soil	Cohesive Soil
Driven Pile Method (including Vibro-hammer Method)	$2N$ (≤100)	c or 10 N (≤150)
Cast-in-place RC Pile Method	$5N$ (≤200)	c or 10 N (≤150)
Bored Pile Method	$2N$ (≤100)	0.8c or 8 N (≤100)
Pre bored Pile Method	$5N$ (≤150)	c or 10 N (≤100)
Steel Pipe Soil Cement Pile Method	$10N$ (≤200)	c or 10 N (≤200)

(Note) c: cohesion of ground (kN/m^2), N: N value from SPT.

i	Depth (m)	Thickness *li* (m)	Soil type	Averaged N-value	Shaft resistance intensity f_i (kN/m^2)	$li \cdot f_i$ (kN/m)
1	4.0-14.0	10.0	Silty clay	2	0	0
2	14.0-28.0	14.0	Clay			
3	28.0-32.0	4.0	Sand			
4	32.0-33.0	1.0	Gravel			
4	33.0-34.0	1.0	Gravel			
Total		30.0	-	-	-	

Answer:_______________________

Question 6.2 Calculate Ultimate Pull-Out Capacity Pu (kN)

$$Pu = U \times \Sigma li \times fi$$

Answer:______________________

付録 B　理解度測定試験

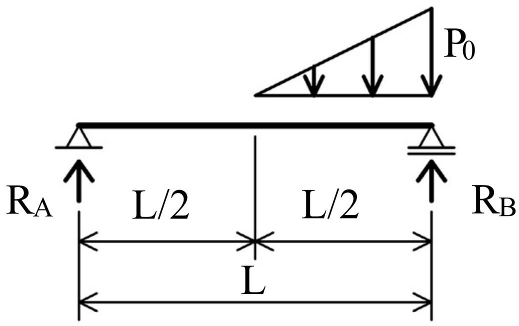
B-4　特別講義の中間試験

Examination (20^{th} Dec. 2017) 09:30~11:30 (2h)
Lecture: Special Lecture

Name:	Score:

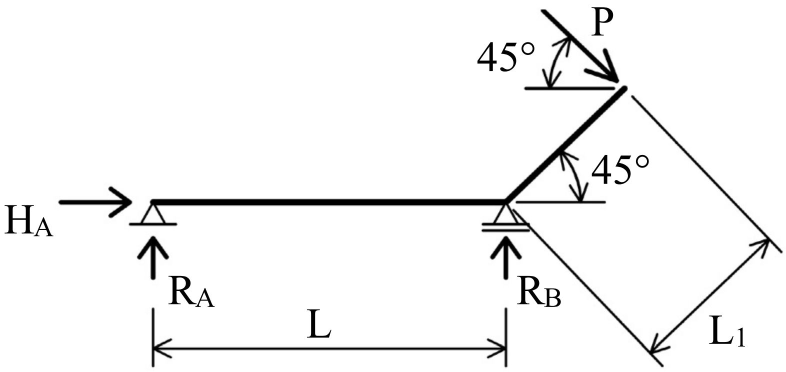
Question 1.

Calculate reaction force of R_A, R_B.



Question 2.

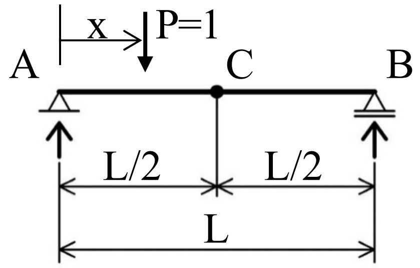
Calculate reaction force of R_A, R_B and H_A.



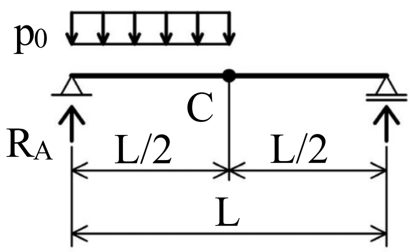
$\sin 45° = \cos 45° = 1/\sqrt{2}$

Question 3.

(1) Draw Influence line of Reaction at A, B (Ra, Rb), Moment at C (Mc) and Shear Force at C (Qc)

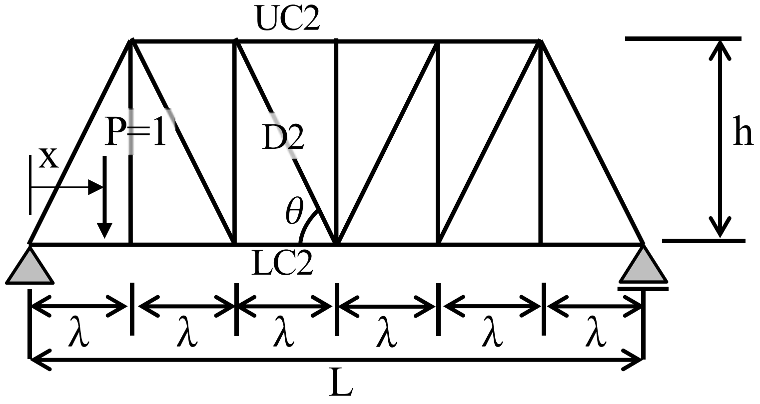


(2) Calculate Reaction Ra and Moment at C using Influence line.



Question 4.

Draw Influence Line of member force at upper chord (UC2), diagonal member (D2) and lower chord (LC2).

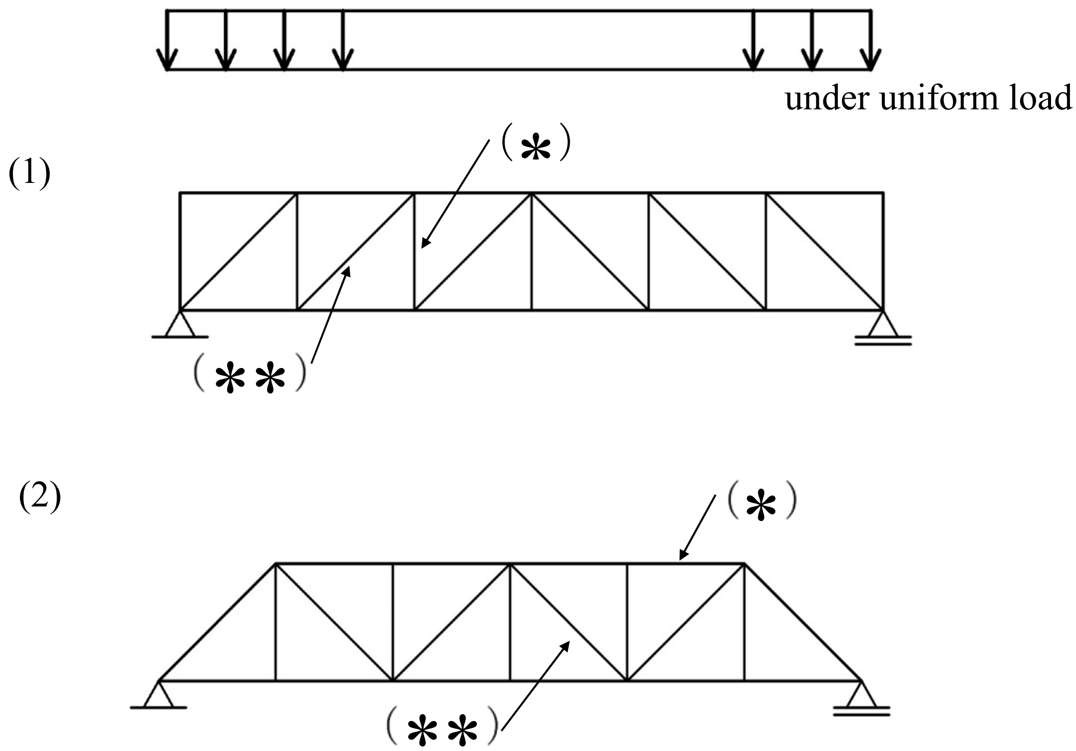


sin θ = s

cos θ = c

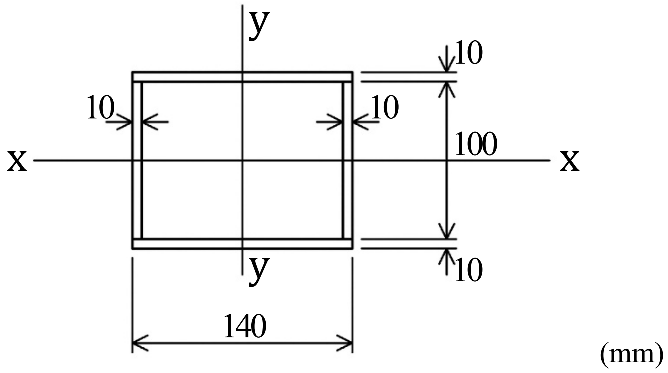
Question 5.

Identify the members (*, **) are subjected to tension or compression.



Question 6.

(1) Calculate Area (A), Second Moment of Inertia at x-axis (Ix) and y-axis (Iy).



(2) Calculate allowable buckling stress of column by JSHB. (Equations: Refer next page)

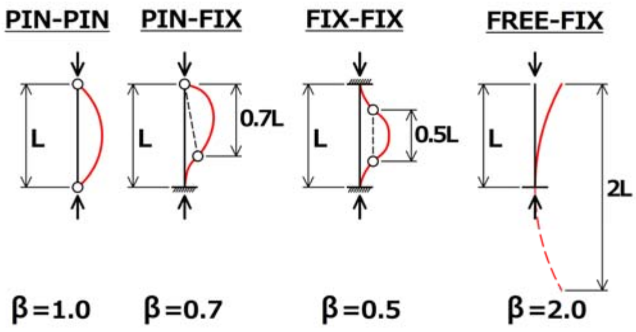
- Cross Section: Same with the section at (1)
- Length of Column L=5000mm
- Support Condition of Column: Fix-Fix
- Material: SM400

Allowable Buckling Stress of Column

<table>
<tr><th>Plate thickness (mm) \ Steel type</th><th>SS400
SM400
SMA400W</th><th>SM490</th><th>SM490Y
SM520
SMA490W</th><th>SM570
SMA570W</th></tr>
<tr><td>40 or less</td><td>$140: \frac{l}{r} \leqq 18$
$140-0.82\left(\frac{l}{r}-18\right): 18 < \frac{l}{r} \leqq 92$
$\frac{1,200,000}{6,700+\left(\frac{l}{r}\right)^2}: 92 < \frac{l}{r}$</td><td>$185: \frac{l}{r} \leqq 16$
$185-1.2\left(\frac{l}{r}-16\right): 16 < \frac{l}{r} \leqq 79$
$\frac{1,200,000}{5,000+\left(\frac{l}{r}\right)^2}: 79 < \frac{l}{r}$</td><td>$210: \frac{l}{r} \leqq 15$
$210-1.5\left(\frac{l}{r}-15\right): 15 < \frac{l}{r} \leqq 75$
$\frac{1,200,000}{4,400+\left(\frac{l}{r}\right)^2}: 75 < \frac{l}{r}$</td><td>$255: \frac{l}{r} \leqq 18$
$255-2.1\left(\frac{l}{r}-18\right): 18 < \frac{l}{r} \leqq 67$
$\frac{1,200,000}{3,500+\left(\frac{l}{r}\right)^2}: 67 < \frac{l}{r}$</td></tr>
<tr><td>More than 40 and up to 75</td><td rowspan="2">$125: \frac{l}{r} \leqq 19$
$125-0.68\left(\frac{l}{r}-19\right): 19 < \frac{l}{r} \leqq 96$
$\frac{1,200,000}{7,300+\left(\frac{l}{r}\right)^2}: 96 < \frac{l}{r}$</td><td rowspan="2">$175: \frac{l}{r} \leqq 16$
$175-1.1\left(\frac{l}{r}-16\right): 16 < \frac{l}{r} \leqq 82$
$\frac{1,200,000}{5,300+\left(\frac{l}{r}\right)^2}: 82 < \frac{l}{r}$</td><td>$195: \frac{l}{r} \leqq 15$
$195-1.3\left(\frac{l}{r}-15\right): 15 < \frac{l}{r} \leqq 77$
$\frac{1,200,000}{4,700+\left(\frac{l}{r}\right)^2}: 77 < \frac{l}{r}$</td><td>$245: \frac{l}{r} \leqq 17$
$245-2.0\left(\frac{l}{r}-17\right): 17 < \frac{l}{r} \leqq 69$
$\frac{1,200,000}{3,600+\left(\frac{l}{r}\right)^2}: 69 < \frac{l}{r}$</td></tr>
<tr><td>More than 75 and up to 100</td><td>$190: \frac{l}{r} \leqq 16$
$190-1.3\left(\frac{l}{r}-16\right): 16 < \frac{l}{r} \leqq 78$
$\frac{1,200,000}{4,800+\left(\frac{l}{r}\right)^2}: 78 < \frac{l}{r}$</td><td>$240: \frac{l}{r} \leqq 17$
$240-1.9\left(\frac{l}{r}-17\right): 17 < \frac{l}{r} \leqq 69$
$\frac{1,200,000}{3,700+\left(\frac{l}{r}\right)^2}: 69 < \frac{l}{r}$</td></tr>
<tr><td>Remarks</td><td colspan="4">l : Effective buckling length of member (mm)
r : Radius of gyration of gross section area of member (mm)</td></tr>
</table>

Le : Effective buckling length

β : Buckling coefficient (Le = β L)



Radius of gyration: r

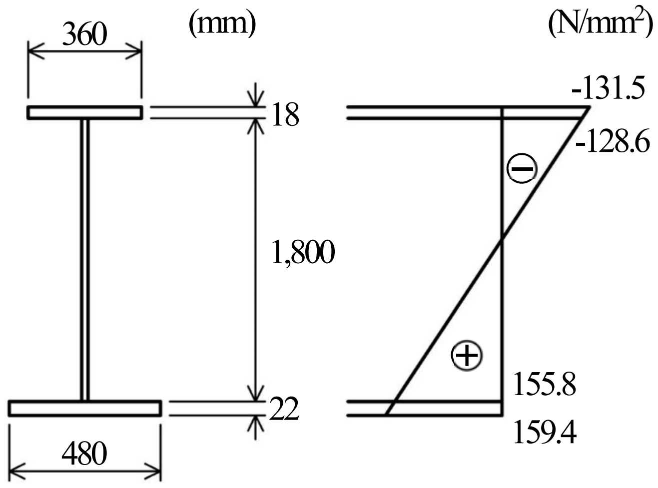
$$r = \sqrt{\frac{I}{A}}$$

I: Second Moment of Inertia

A: Area of Cross Section

Question 7.

Calculate required number of friction bolts at upper flange and lower flange.



[Design Conditions]

- Bolt: M22, F10T
- 2-plane friction
- Material Grade: SM490Y

(σa = 210 N/mm²)

[Calculation]

(1) Design Stress (σ_o)

σ_o = max. $\{\sigma_n, 0.75\sigma_{ca}\}$

σ_{ca} : allowable compressive/tensile stress

(2) Number of bolt ($n_{req.}$)

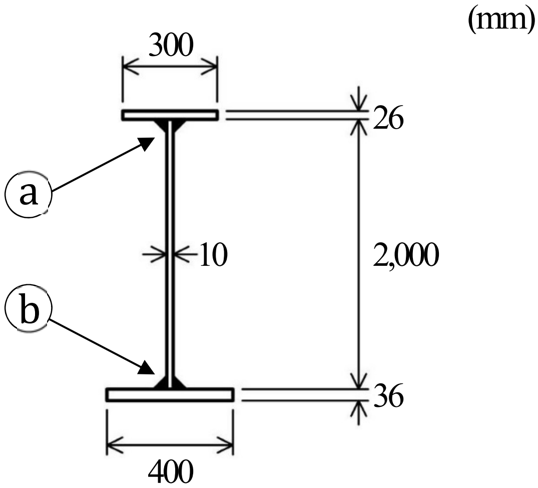
$n_{req.} > \frac{\sigma_o A_f}{\rho_a}$ A_f : Area of Flange

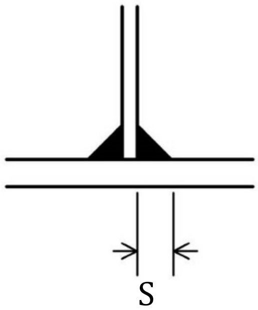
Allowable bolt force (ρ_a)

bolt grade	nominal designation of thread	γ	μ	α	σ_y (N/mm²)	A_e (mm²)	N (kN)	ρ_a (kN)
F8T	M20 M22 M24	1.7	0.4	0.85	640	245 303 353	133 165 192	31 39 45
F10T S10T	M20 M22 M24	1.7	0.4	0.75	900	245 303 353	165 205 238	39 48 56

Question 8.

Calculate <u>fillet welding size (s)</u> at a and b.





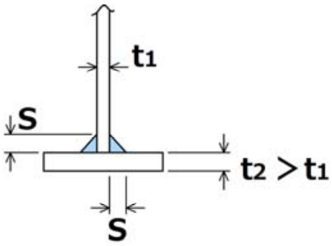
1）Size of fillet welding

$$t_1 > S > \sqrt{2t_2}$$

t_1 : thinner plate thickness

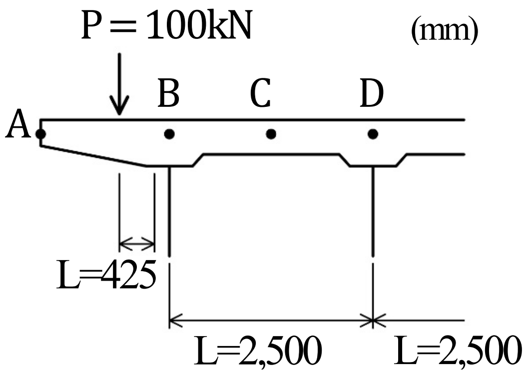
t_2 : thicker plate thickness

($S_{min.} > 6mm$)



Question 9.

Calculate <u>design moment of slab by live load</u> in main direction and distributing direction at A, B, C and D.



Design moment per unit length (1m) by T-load for RC slab

(kN·m/m)

		simple slab ($0 < L \leqq 4^m$)	continuous slab ($0 < L \leqq 4^m$)			cantilevered slab ($0 < L \leqq 1.5^m$)	
		at span center	at span center	at span center (end span)	at intermediate support	at support	at tip
dead load(*) (w)		$\frac{wL^2}{8}$	$\frac{wL^2}{14}$	$\frac{wL^2}{10}$	2-span $-\frac{wL^2}{8}$ 3-span more $-\frac{wL^2}{10}$	$-\frac{wL^2}{2}$	—
T-load	main reinforcement	$(0.12L + 0.07)\,p$ Ⓐ	0.8×Ⓐ	0.8×Ⓐ	−0.8×Ⓐ	$-\frac{PL}{1.30L+0.25}$	—
	distributing reinforcement	$(0.10L + 0.04)\,p$ Ⓑ	0.8×Ⓑ	0.8×Ⓑ	—	—	$(0.15L + 0.13)p$

付録 B　理解度測定試験

B-5　上部工の設計概論（コンクリート橋）の中間試験

Examination
Lecture : Superstructure Design (Concrete)

Name :	Score :

Question 1. Erection Methods of Prestressed Concrete Bridges

Select the correct combination of erection methods by which girders can be erected without using space under bridge from the following options A ~ E:

(1) Precast girders by crane erection
(2) Precast girders by erection girders
(3) Free cantilever erection
(4) Incremental launching erection
(5) All-staging erection by conventional falsework
(6) Movable falsework erection
(7) Span-by-span erection

A. (1) – (2) – (3) – (4) – (5)
B. (1) – (3) – (4) – (5) – (7)
C. (2) – (3) – (4) – (5) – (6)
D. (2) – (3) – (4) – (6) – (7)
E. (3) – (4) – (5) – (6) – (7)

Question 2. Bending moment diagram of PC BOX Cross Section

Select the proper diagram of bending moment generated on PC BOX Cross sections by each load case from the following figures :

(1) Self-weight (Dead Load) (1) ________ (2) ________

(2) Prestress (Due to eccentricity)

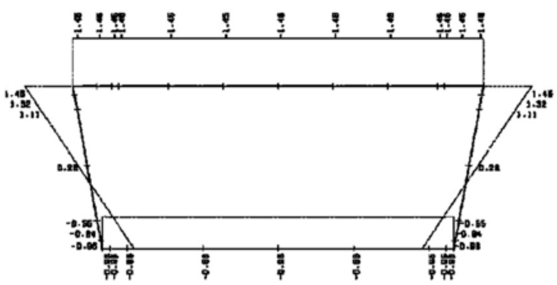
(3) Prestress (Due to eccentricity + elastic shortening) (3) ________ (4) ________

(4) Live Load (Loaded on left cantilever slab)

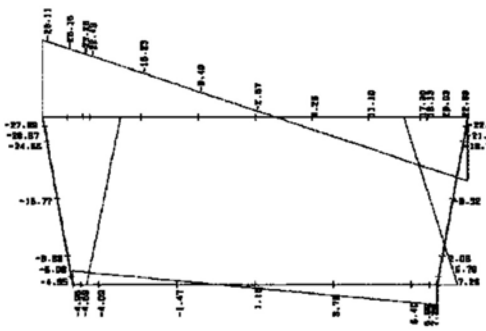
(5) Live Load (Loaded on box slab) (5) ________ (6) ________

(6) Temperature Gradient

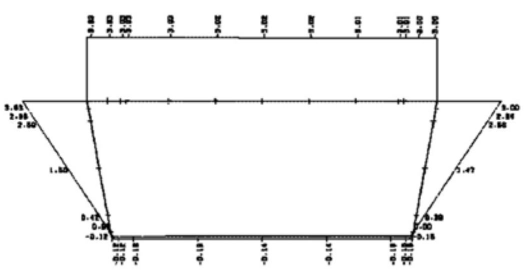
A.



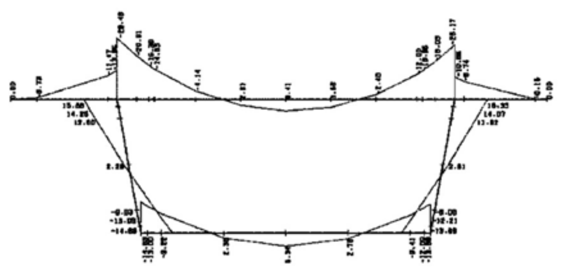
B.



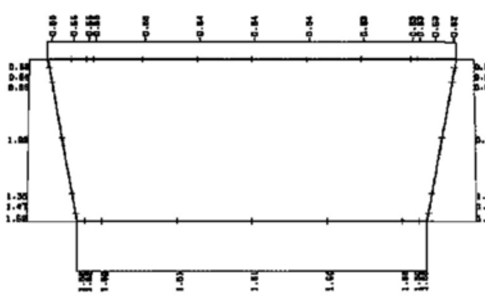
C.



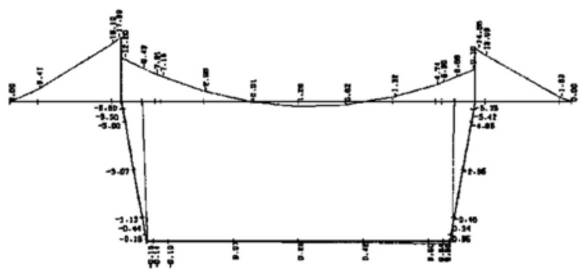
D.



E.



F.



Question 3. Concrete bridges using precast elements

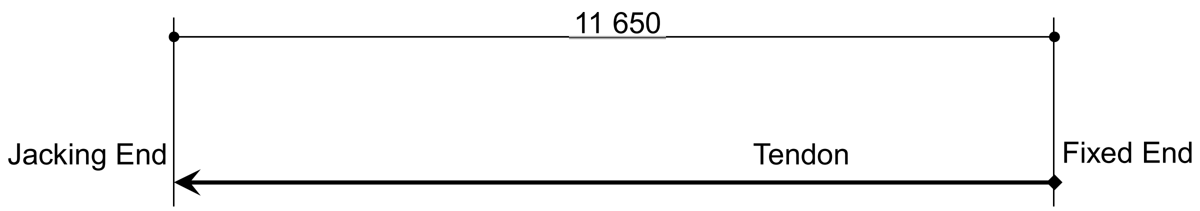
Describe advantages and disadvantages of applying precast elements to concrete bridges, compared to cast-in-place construction.

Question 4. Calculation of Prestress in deck slab (transverse prestressing)

Q3-1. Calculate the prestress immediately after anchor-set

a) Calculate the prestress after loss due to friction : σ_{pt}. = ______________ N/mm²

σ_{pt1}	: Tensile stress in prestressing steel at the section considered		
σ_{pt}	: Initial stress in prestressing steel at the jacking end	1 250.0	N/mm^2
λ	: Wobble friction coefficient per unit meter	0.004	/m
ℓ	: Distance from jacking end to the section considered	11.650	m
μ	: Friction coefficient due to change of angle of tendon	0.3	/rad
α	: Change of angle	0.0	rad

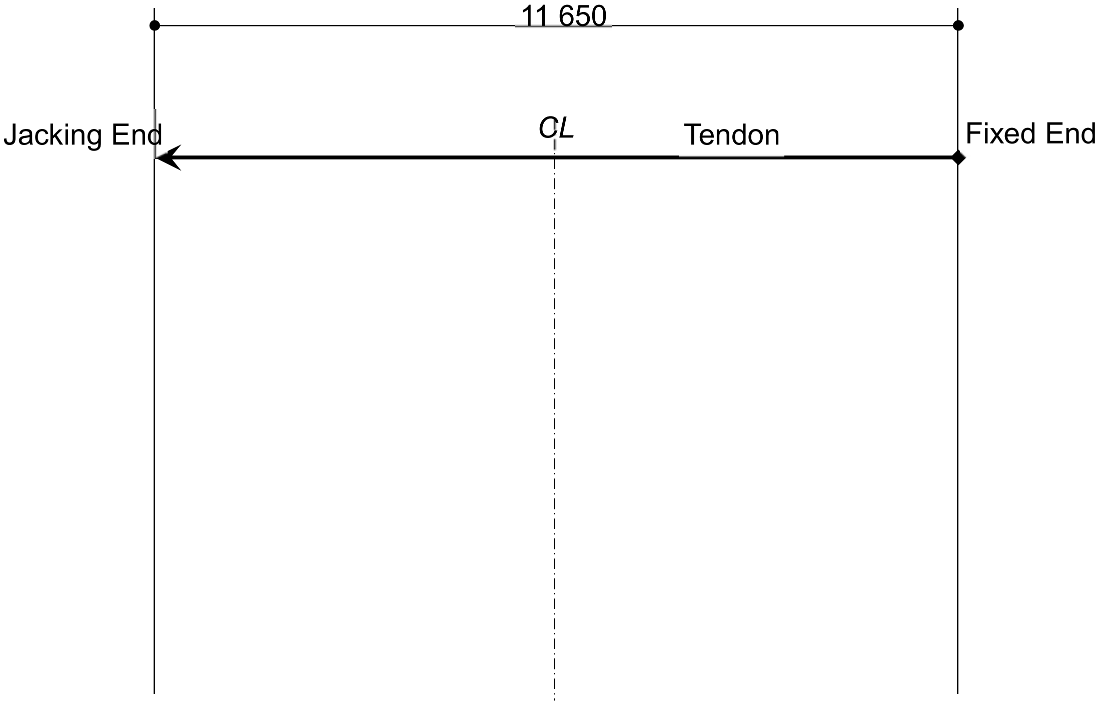


b) Calculate the prestress after loss due to pull-in of anchor wedges:

At fixed end : σ_{pt2} = ______________ N/mm^2

At jacking end : σ_{pt1}' = ______________ N/mm^2

$\Delta\sigma_{p1}$	: Loss of stress in prestressing steel due to pull-in of wedge		
ℓ	: Length of prestressing tendon	11.650	m
$\Delta\ell$	: Amount of pull-in of wedge	4.0	mm
E_p	: Modulus of elasticity of prestressing steel	$2.0\text{x}10^5$	N/mm^2

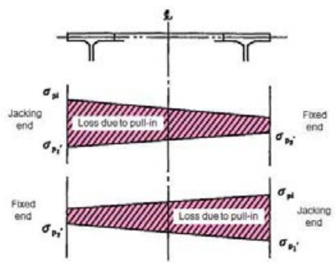


Stress diagram in prestressing steel

c) Calculate the prestress immediately after anchor-set

Elastic deformation is ignored.

Tendons are jacked at one side alternately.



σ_{p1}. = $(\sigma_{p1}' + \sigma_{pt2})$ /2 = ______________ N/mm^2

Q3-2. Calculate the effective prestress.

a) Calculate the loss of prestress due to creep and shrinkage. $\Delta\sigma_{\varphi}$ = ______________ N/mm²

$\Delta\sigma_{\varphi}$	: Loss of stress in prestressing steel due to creep and shrinkage of concrete	
Φ	: Creep coefficient of concrete	2.6
ε_s	: Shrinkage strain of concrete	20×10^{-5}
n	: Modular ratio E_p / E_c	7.143
E_p	: Modulus of elasticity of prestressing steel	2.0×10^{5} N/mm²
E_c	: Modulus of elasticity of cpncrete	2.8×10^{4} N/mm²
σ_{cp}	: Stress in concrete at the centroid of tendon due to self-weight of concrete and prestress immediately after anchor-set	2.405 N/mm²
σ_{pt}	: Stress in prestressing steel immediately after anchor-set (see Q3-1c)	
σ_{cpt}	: Stress in concrete immediately after anchor-set	2.405 N/mm²

b) Calculate the loss of prestress due to relaxation of steel. $\Delta\sigma_{p\gamma}$ = ______________ N/mm²

$\Delta\sigma_{p\gamma}$	: Loss of stress in prestressing steel due to relaxation	
γ	: Relaxation coefficient of prestressing steel	1.5 %
σ_{pt}	: Stress in prestressing steel Immediately after anchor-set (see Q3-1c)	

c) Calculate effective prestress in prestressing steel. σ_{pe} = ______________ N/mm²

d) Calculate effective coefficient. $\eta = \sigma_{pe} / \sigma_{pt}$ = ______________ N/mm²

付録 B　　理解度測定試験

B-6　　上部工の設計概論（鋼橋）の中間試験

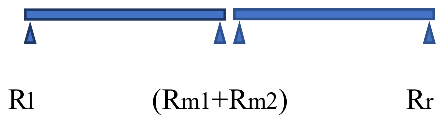
Examination
Lecture : Superstructure Design (Steel)

Name :	Score :

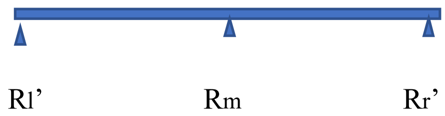
Q1 Select the proper relation between each support reactions subjected to two beam condition A and B as figured below.

Here, load and beam stiffness I is constant through the span and same for A and B.

A.



B.



a. Rm1=R1=R1' (Rm1+Rm2)=Rm Rm2=Rr=Rr'

b. R1 < R1' (Rm1+Rm2) > Rm Rr < Rr'

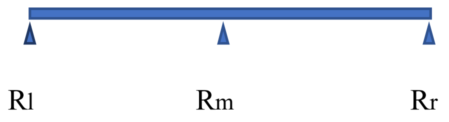
c. R1 > R1' (Rm1+Rm2) < Rm Rr > Rr'

d. R1 < R1' (Rm1+Rm2) < Rm Rr < Rr'

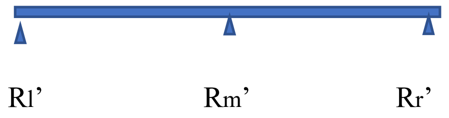
Q2 Select the proper relation between each support reactions subjected to two beam condition A and B as figured below.

Here, load is constant through the span and same for A and B. However, beam stiffness of A; Ia is larger than beam stiffness of B; Ib.

A.



B.



a.	Rl = Rl’	Rm=Rm’	Rr=Rr’
b.	Rl < Rl’	Rm>Rm’	Rr<Rr’
c.	Rl > Rl’	Rm<Rm’	Rr>Rr’
d.	Rl > Rl’	Rm>Rm’	Rr>Rr’

Q3 Select either of ○ (Correct) or ×(Wrong) about descriptions below.

a. Young's Modulus E is defined as the ratio of the elongation by its length between before/after loading.

b. Usually, Young's Modulus E is applied as $2.0 \times 10^5 (kn/m^2)$.

c. A moment of inertia for rectangular section which is a part of the combined section become larger, as the rotation axis of the whole combined section is more apart from the neutral axis of the rectangular section.

d. Polar geometrical Moment of Inertia Ip is described as $Ip=(Ix+Iy)^2$

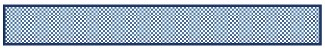
e. According to allowable stress against buckling, a bar of fulfil section is weaker than a pipe section in case that both area are same.

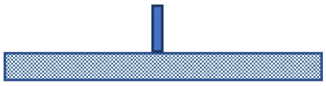
f. Euler's Buckling Phenomena is hypothesized that steel material elasticity is sustained till the steel stress comes to yield point.

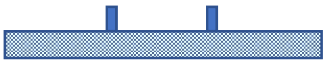
a________________ b________________ c________________

d________________ e________________ f________________

Q4 Select the proper relation of critical compression stress between section of A to C as figured below. Here, total sectional area of steel material is same in A to C.

A.  1-plate 2000x24

B.  1-plate 2000x20 1-stiffener 400x20

C.  1-plate 2000x20 2-stiffeners 200x20

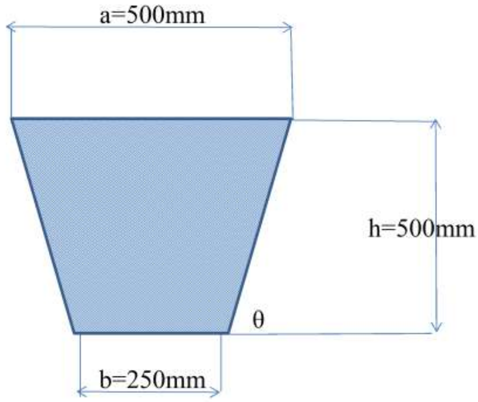
a. $\sigma_{cr}(A) = \sigma_{cr}(B) = \sigma_{cr}(C)$

b. $\sigma_{cr}(A) < \sigma_{cr}(B) = \sigma_{cr}(C)$

c. $\sigma_{cr}(A) < \sigma_{cr}(B) < \sigma_{cr}(C)$

d. $\sigma_{cr}(B) < \sigma_{cr}(A) < \sigma_{cr}(C)$

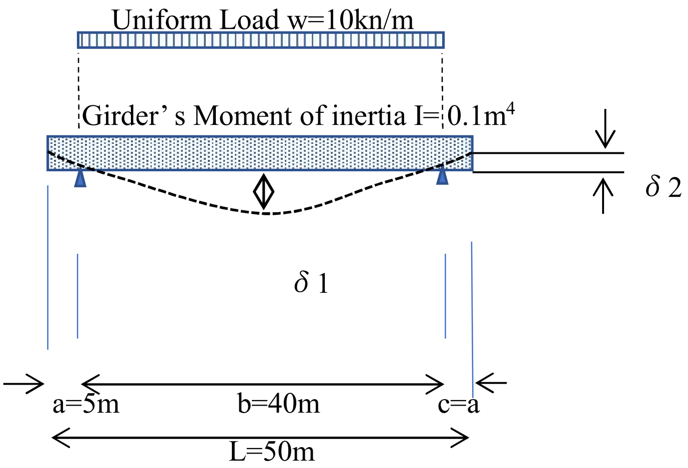
Q5 Calculate the moment of inertia ; I for trapezoidal section as figure below.



Q6 Consider a simple girder 40m length with 5m of cantilever beam at the both ends.

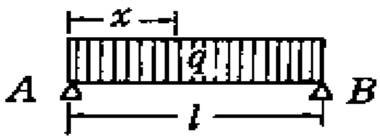
Here, calculate the deflection at the mid of span ; δ 1 and deflection at the end of cantilever ; δ 2.

Load is considered as uniform load distributed between supports only.



Supplemental explanation

Formula for bending moment; M and deflection; y of simple span beam with distributed load can be ;



$$M=\frac{ql^2}{2}\left(\frac{x}{l}-\frac{x^2}{l^2}\right)$$

$$M_{max}=\frac{ql^2}{8} \qquad y=\frac{ql^4}{24EI}\left(\frac{x}{l}-2\frac{x^3}{l^3}+\frac{x^4}{l^4}\right)$$

- Angle of deflection can be expressed as ;

  $dy/dx=\theta$

付録 B　理解度測定試験

B-7　基礎工・下部工の設計概論の中間試験

Examination
Lecture : Substructure Design

Name :	Score :

Q.1 Major verification for pile foundation

Describe the verifications to be satisfied for pile foundation design in terms of structural stability and stress verification of pile body.

A.1

Q.2 Assessment of Soil liquefaction

Describe the initial consideration for potential of liquefaction required for foundation design before calculation of FL (Liquefaction resistivity factor).

For an alluvial sandy layer having all of following three conditions, liquefaction assessment shall be judged by FL (Liquefaction resistivity factor).

1) The groundwater level is in less than _(a)__m from earth surface, and the saturation soil layer exists in the depth within _(b)_m from ground surface.

2) The soil layer whose fine-grain fraction content is less than _(c)_%, or the soil layer whose plasticity index is less than (d) even if fine-grain fraction content exceeds _(c)_%.

3) The soil layer which D(e)_ (_(e)_% particle diameter) is less than (f) mm and D(f)__((f)_ % particle diameter) is less than 1mm.

A.2

(a) ____________________ (b) ____________________ (c) ____________________

(d) ____________________ (e) ____________________ (f) ____________________

Q.3 Technical feature of Steel Pipe Sheet Pile

Describe details regarding follows for structural aspect of Steel Pipe Sheet Pile foundation.

(1) Provision of overall sectional stiffness

(2) Occurrence of residual stress on pipes

A.3

Q.4 Construction Step of Steel Pipe Sheet Pile Foundation

Arrange followings as construction steps of SPSP foundation in order of actual work flow.

a. Pier construction

b. Installation of guide piles and guide frames

c. Mortal filling in joint pipes, concrete filling in main pipes at neat top slab

d. Cutting and removal SPSP at cofferdam portion

e. Driving of steel pipe sheet piles

f. Support beam setting and dewatering inside cofferdam

g. Underwater excavation inside cofferdam

h. Temporary platform installation

i. Stud welding for pile head connection

j. Underwater concreting for bottom slab

k. Support beam setting and dewatering inside cofferdam completely

l. Casting concrete for top slab

A.4

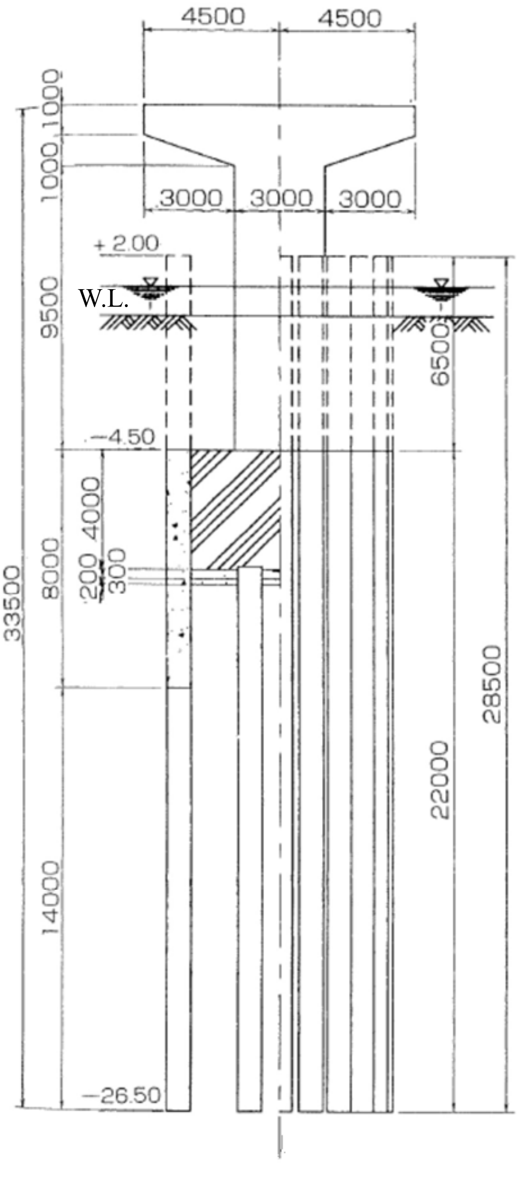
Q.5 Bearing Capacity and Pull-out Capacity of SPSP

Calculate “Allowable bearing capacity” and “Allowable pull-out capacity” of pile. Ordinary case and Seismic case shall be obtained, respectively.

<u>Foundation Type</u>

Steel Pipe Sheet Pile Foundation
Method: Driven pile method

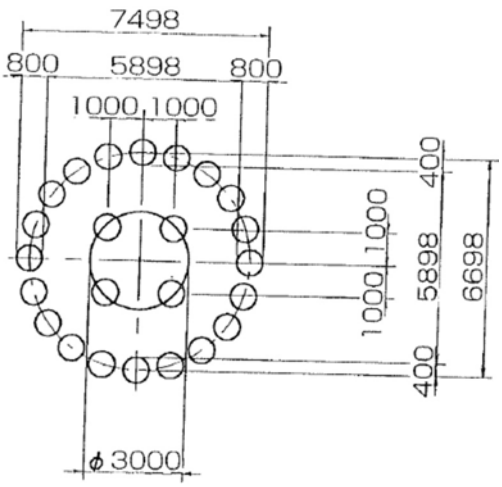
<u>Profile Outline</u>



Elevation (m)	Layer	SPT value (10 20 30 40)	Thickness (m)	Average N value	Soil unit weight γ (kN/m³)	Soil unit weight γ’ (kN/m³)	Friction angle φ(°)	Cohesion c(kN/m²)
+1.00 / ±0.00 to −3.50	Sand		3.50	1	17	8	20	–
−3.50 to −9.00	Sand		5.50	11	18	9	25	–
−9.00 to −15.00	Clay		6.00	15	16	7	–	90
−15.00 to −25.50	Sand		10.50	20	18	9	32	–
−25.50 to −28.50	Sand		3.00	45	20	11	40	–

Note) For obtaining a shaft resistance intensity for clay layer, apply cohesion C shown above table.

Sectional Detail



- Exterior wall : 20piles

  (L=22.0m at permanent portion, L=6.5m at temporary portion)

- Inner single piles : 4piles (L=18.0m)

  Pile diameter : 800mm, Enclosed area of pile : $0.503m^2$

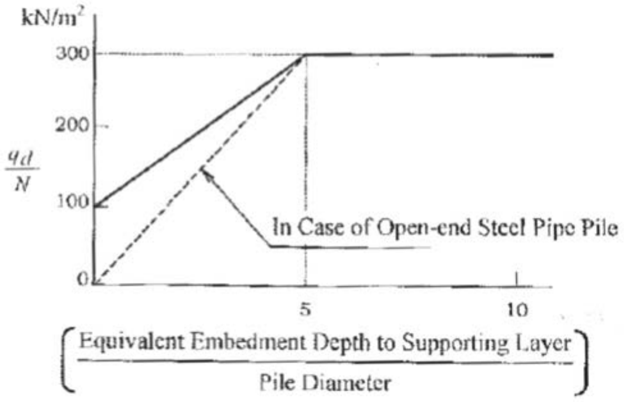
U1 : Peripheral lengths along the lines enveloping the outer periphery of the well part = 23.556m

U2 : Sum of peripheral lengths along the lines enveloping the inner peripheries = 28.582m

A: Enclosed area by well top slab = $30.2m^2$

<u>Supplemental Explanation</u>

- End bearing capacity for driving pile method



- Shaft resistance for driving pile method

Pile Installation Method \ Ground Type	Sandy Soil	Cohesive Soil
Driven Pile Method (including Vibro-hammer Method)	$2N$ (≤ 100)	c or $10N$ (≤ 150)

- Allowable bearing capacity of pile

$$R_a = \frac{1}{n} R_u$$

$$R_u = q_d A_i + \frac{1}{n_1 + n_2 + n_3} (U_1 \Sigma L_i f_i + U_2 \Sigma L_j f_j)$$

- Allowable pull-out force of pile

$$P_a = \frac{1}{n} P_u + W$$

$$P_u = \frac{1}{n_1 + n_2 + n_3} (U_1 \Sigma L_i f_i + U_2 \Sigma L_j f_j)$$

A.5

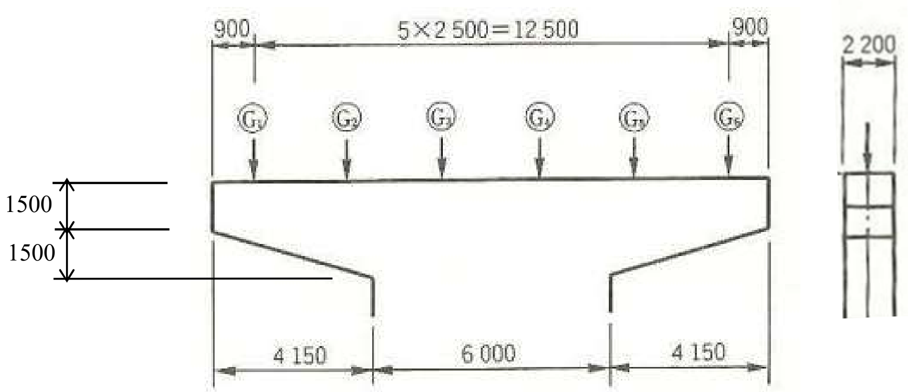
Q.6 Design of Beam of RC Pier

(1) Calculate bending moment worked at verification section of the beam for Vertical direction.
Here, load case is to be considered both of a) Dead+Live case and b) Dead only case

(2) Determine rebar arrangement of the beam at tension side by verification of bending stress of (a) and (b).

Supplemental Design Condition

Reaction force from girders to be applied for beam design is given as below.



	Dead load (kN)	Live load (kN)
Reaction force at G1 (G6)	1470	600
Reaction force at G2 (G5)	1470	600
Reaction force at G3 (G4)	1470	600

・Material properties

- Design standard concrete strength : σ_{ck}=24N/mm^2
- Type of reinforcement bar : SD345
- Diameter & Dimensions of bar :

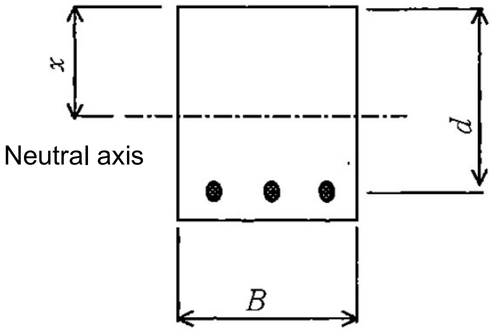
	Diameter (mm)	Dimension (mm^2/bar)
D19	19.1	286.5
D22	22.2	387.1
D25	25.4	506.7
D29	28.6	642.4
D32	31.8	794.2
D35	34.9	956.6

Table-4.3.1 Allowable Stresses of Reinforcing Bars (N/mm^2)

Type of Stress and Structural Member \ Type of Reinforcing Bar			SR235	SD295A SD295B	SD345
	1) In Cases of Principal Loads except Live Loads and Impacts (Beams, etc.)		80	100	100
Tensile Stress	Basic Values in Cases of Load Combinations without Collision or Seismic Effects	2) General Members	140	180	180
		3) Members in Water or Groundwater	140	160	160
	4) Basic Values in Cases of Load Combinations with Impacts or Seismic Effects		140	180	200
	5) Basic Values for Calculating Lap Joint Length or Anchoring Length of Reinforcing Bars		140	180	200
6) Compressive Stress			140	180	200

Supplemental Explanation

Formula of RC Section calculation



- Position of neutral axis

$$x = \frac{nA_s}{B}\left(-1 + \sqrt{1 + \frac{2Bd}{nA_s}}\right)$$

- Compressive stress of concrete

$$\sigma_c = \frac{2M}{Bx(d - \frac{x}{3})}$$

- Tensile stress of reinforcement

$$\sigma_s = \frac{M}{A_s(d - \frac{x}{3})} \quad \text{or} \quad \sigma_s = n \cdot \sigma_c \frac{d - x}{x}$$

A.6

付録 C　写真

C-1　講義及びセミナーの写真

橋梁設計特別講義：長井名誉教授（長岡技術科学大学）

橋梁設計特別講義：岩崎教授（長岡技術科学大学）

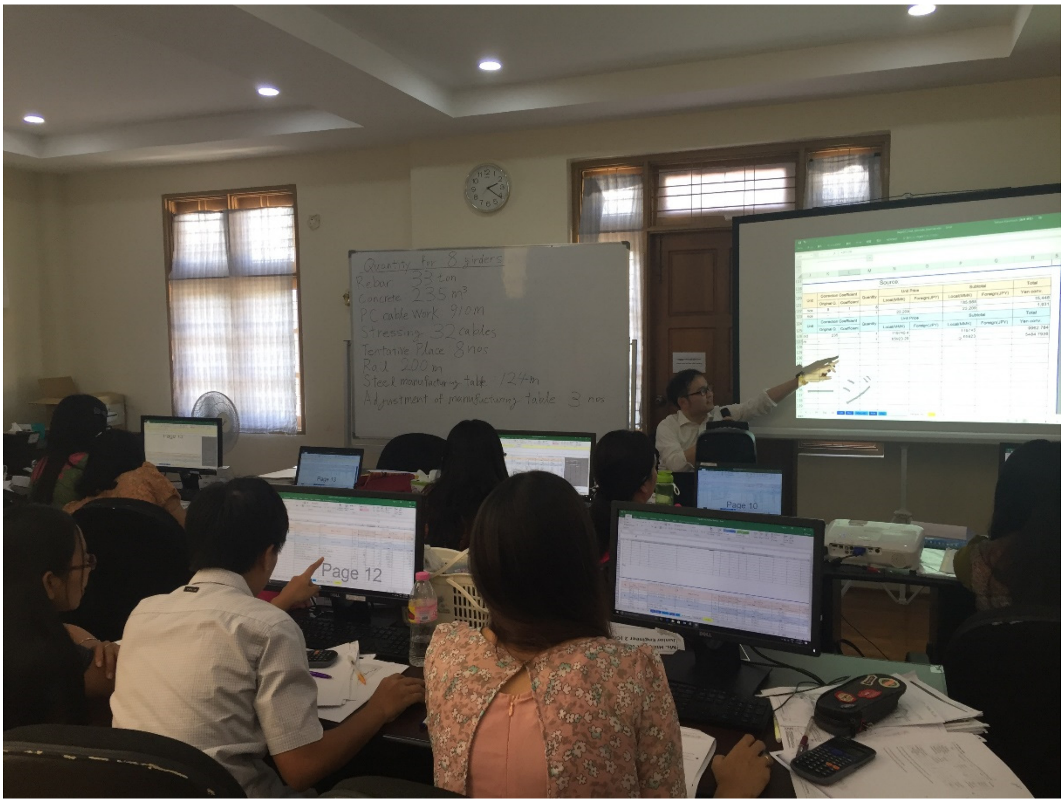
構造解析概論

上部工の設計概論（コンクリート橋）

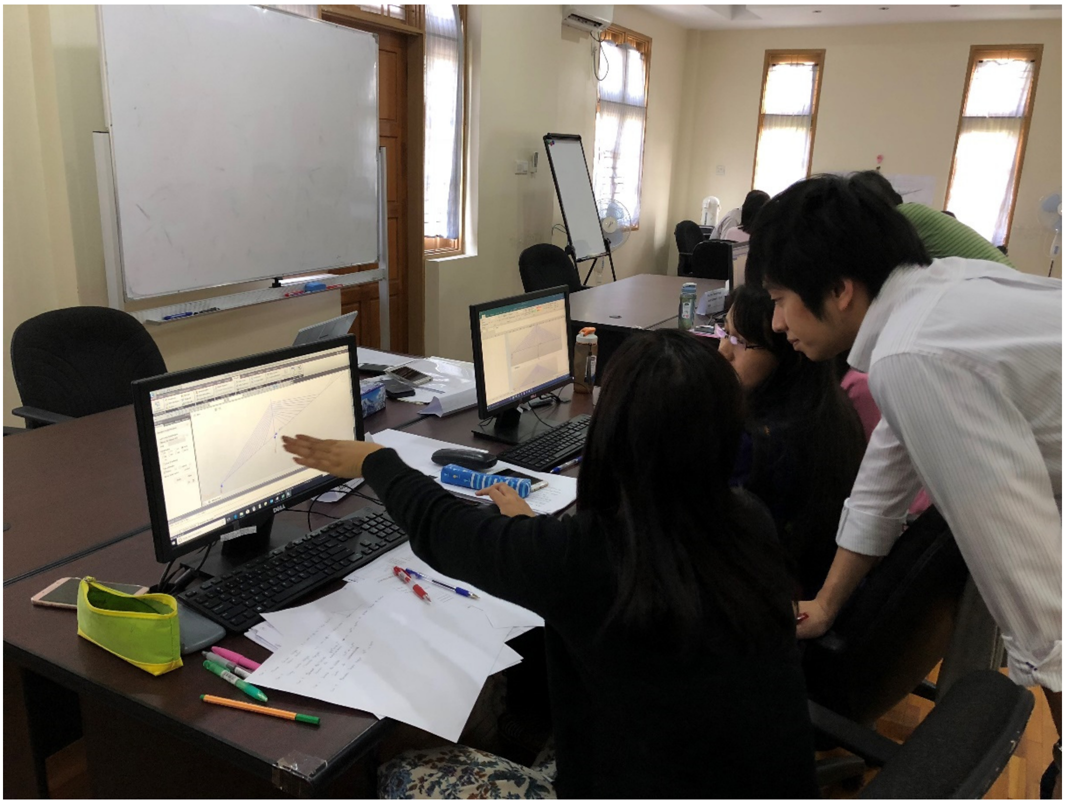
上部工の設計概論（鋼橋）：**J&M** 工場見学

基礎工・下部工の設計概論

風洞実験セミナー：白土教授（京都大学）

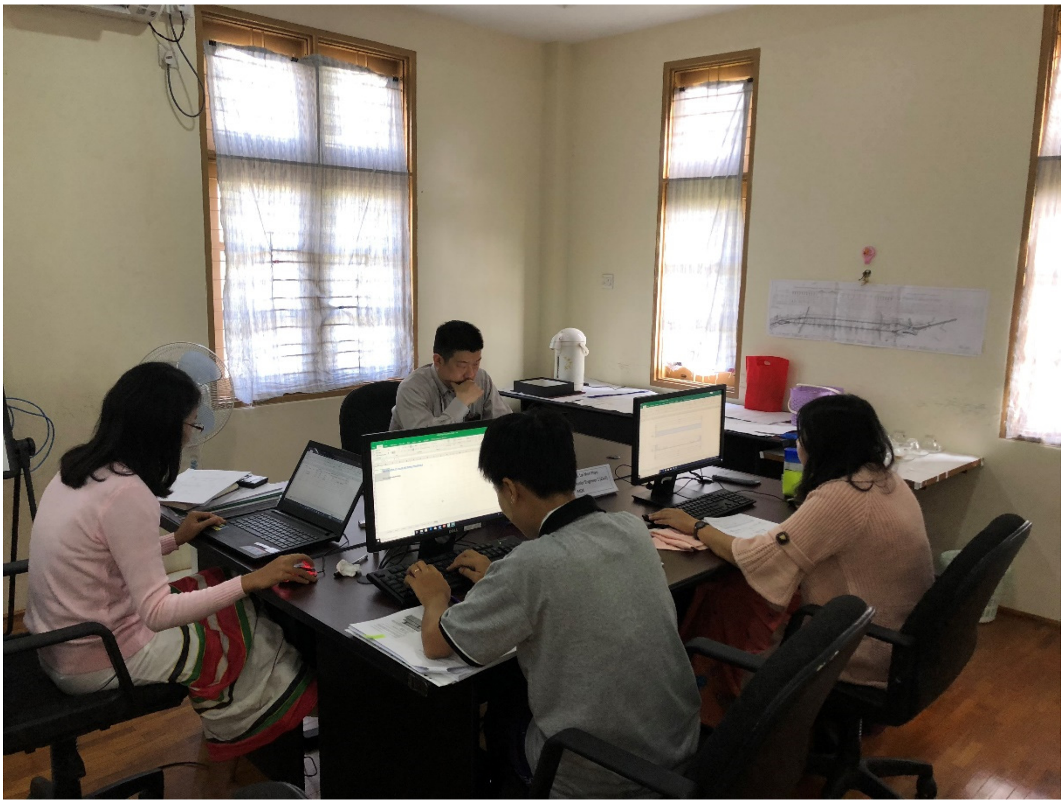


積算セミナー



鋼斜張橋の設計演習

鋼箱桁橋の設計演習



PC 箱桁橋の設計演習

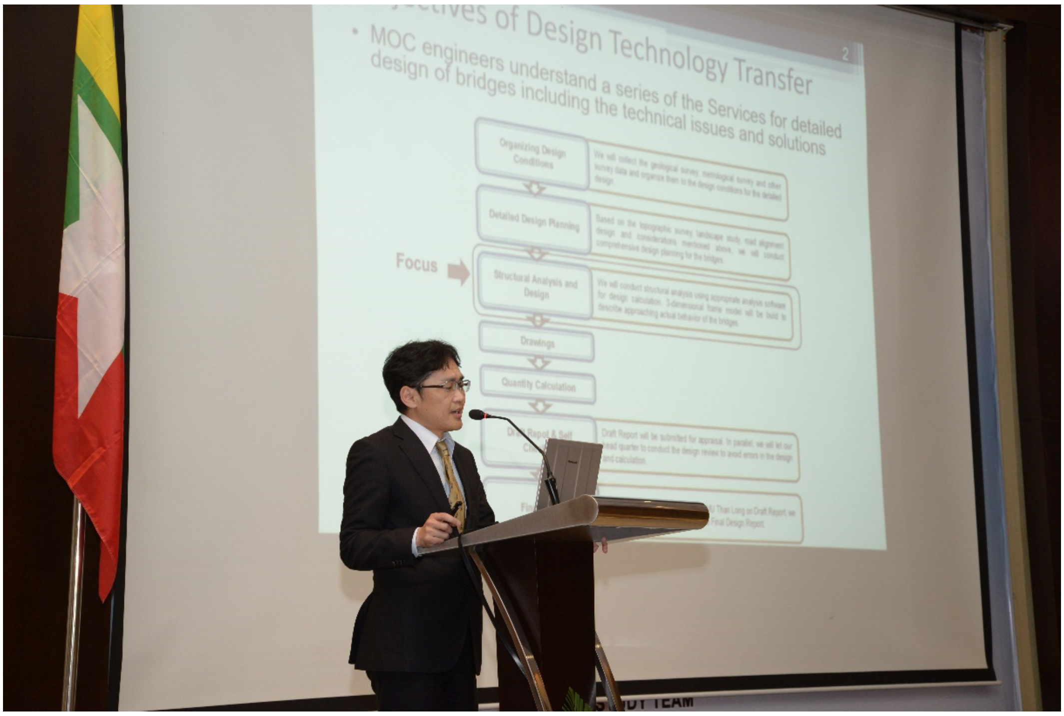
下部工・基礎工の設計演習

付録 C　写真

C-2　認定書授与式の写真

MOC 大臣 Mr. Han Zaw スピーチ

JICA ミャンマー事務所 西形康太郎次長スピーチ



JICA 調査団 佐野祐一総括スピーチ

長井正嗣名誉教授スピーチ（長岡技術科学大学）

研修生代表スピーチ（Ms. Ei Htwe San, Deputy Director (Civil) of MOC）

研修生代表スピーチ（ Ms. Nant Thar Hmwe, Deputy Director (Civil) of MOC）

認定書授与

MOC 橋梁局副局長 Mr. Nay Aung Ye Myint スピーチ


DETAILED DESIGN
ON
THE BAGO RIVER BRIDGE CONSTRUCTION PROJECT
JICA
DESIGN TECHNOLOGY TRANSFER
FEBRUARY 2018

記念品交換


DETAILED DESIGN
ON
THE BAGO RIVER BRIDGE CONSTRUCTION PROJECT
JICA
DESIGN TECHNOLOGY TRANSFER
FEBRUARY 2018

集合写真

付録 D　　出席表

Detailed Design Study on Bago River Bridge Construction Project

Design Technology Transfer

Attendance Record (1)

October ~ December , 2017

October

No.	Date / Lecture	16	17	19	20	23	24	25	26	27	30	31
	Lecture	Special Lecture										Seminar
1	Daw Ei Htwe San Deputy Director (Civil)	○	○	○	○	○	○	○	○	○	○	○
2	Daw Nant Tha Hmwe Assistant Director (Civil)	○	○	○	○	○	○	○	○	○	○	○
3	Daw San Phyu Phyu Saw Assistant Director (Civil)	○	○	○	○	○	○	○	○	○	○	○
4	Daw Yu Yu Naing Staff Officer (Civil)	○	○	○	○	○	○	○	○	○	○	○
5	Daw Lai Mon Phyo Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○
6	Daw Kyi Thar Soe Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○
7	Dr. Hay Man Myint Maung Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○
8	Daw Htet Tint Wai Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○
9	Daw Shwe Yamin Myat Junior Engineer (3) (Civil)	○	○	○	-	○	○	○	○	○	○	○
10	U Hein Zaw Junior Engineer (4) (Civil)	○	○	○	○	○	○	○	○	○	○	○
11	Daw Swe Hnin Aye Junior Engineer (1) (Civil)											
12	Daw Hnin Ei Ei Chaw Junior Engineer (2) (Civil)											
13	Dr. Khin Su Su Htwe Professor (YTU)	○	-	-	-	-	-	-	-	-	-	-
14	U Phyo Hein Kyaw Ph.D (Thesis) (YTU)	○	○	○	-	-	-	-	-	-	-	-
15	Daw Hnin Yadanar Kyaw Junior Engineer (1) (Civil)											○
16	Daw Htoo Eain Lwin Staff Officer (Civil)											○
17	Daw Swe Hnin Aye Junior Engineer (1) (Civil)											○
18	Daw Hnin Ei Ei Chow Junior Engineer (2) (Civil)											○

November

No.	Date / Lecture	1	6	7	8	9	10	14	15	16	17	20	21	22	23	24	27	28	29	30
	Lecture	Seminar										Special Lecture								
1	Daw Ei Htwe San Deputy Director (Civil)	○	○	○	○	○	-	○	○	○	○	○	○	○	○	○	○	○	○	○
2	Daw Nant Tha Hmwe Assistant Director (Civil)	○	○	○	○	○	-	○	○	○	○	○	○	○	○	○	○	○	○	○
3	Daw San Phyu Phyu Saw Assistant Director (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
4	Daw Yu Yu Naing Staff Officer (Civil)	○	○	○	○	○	-	○	○	○	○	○	○	○	○	○	○	○	○	○
5	Daw Lai Mon Phyo Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
6	Daw Kyi Thar Soe Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
7	Dr. Hay Man Myint Maung Junior Engineer (1) (Civil)	○	○	○	○	○	-	○	○	○	○	○	○	○	-	-	○	○	○	○
8	Daw Htet Tint Wai Junior Engineer (1) (Civil)	○	○	○	○	○	-	○	-	-	-	-	-	-	-	-	-	-	-	-
9	Daw Shwe Yamin Myat Junior Engineer (3) (Civil)	○	○	○	○	-	-	○	○	○	○	○	○	○	○	○	○	○	○	○
10	U Hein Zaw Junior Engineer (4) (Civil)	-	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
11	Daw Swe Hnin Aye Junior Engineer (1) (Civil)							○	○	○	○	○	○	○	○	○	○	○	○	○
12	Daw Hnin Ei Ei Chaw Junior Engineer (2) (Civil)							○	○	○	○	○	○	○	○	○	○	○	○	○
13	Dr. Khin Su Su Htwe Professor (YTU)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	U Phyo Hein Kyaw Ph.D (Thesis) (YTU)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	Daw Hnin Yadanar Kyaw Junior Engineer (1) (Civil)	○										○	○	○	○	○				
16	Daw Htoo Eain Lwin Staff Officer (Civil)	○										○	○	○	○	-				
17	Daw Swe Hnin Aye Junior Engineer (1) (Civil)	○																		
18	Daw Hnin Ei Ei Chow Junior Engineer (2) (Civil)	-																		

December

No.	Date / Lecture	1	4	5	6	7	8	11	12	13	13	15	19	20	21	22	Attendance Rate
	Lecture							Seminar	Special Lecture								
1	Daw Ei Htwe San Deputy Director (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	98%
2	Daw Nant Tha Hmwe Assistant Director (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	98%
3	Daw San Phyu Phyu Saw Assistant Director (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	100%
4	Daw Yu Yu Naing Staff Officer (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	98%
5	Daw Lai Mon Phyo Junior Engineer (1) (Civil)	○	-	○	○	○	○	○	○	○	○	○	○	○	○	○	98%
6	Daw Kyi Thar Soe Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	100%
7	Dr. Hay Man Myint Maung Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	93%
8	Daw Htet Tint Wai Junior Engineer (1) (Civil)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9	Daw Shwe Yamin Myat Junior Engineer (3) (Civil)	○	○	○	○	○	-	○	○	○	○	○	-	○	○	○	89%
10	U Hein Zaw Junior Engineer (4) (Civil)	-	○	○	○	○	○	○	○	○	○	○	-	○	○	○	93%
11	Daw Swe Hnin Aye Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	100%
12	Daw Hnin Ei Ei Chaw Junior Engineer (2) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	100%
13	Dr. Khin Su Su Htwe Professor (YTU)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
14	U Phyo Hein Kyaw Ph.D (Thesis) (YTU)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
15	Daw Hnin Yadanar Kyaw Junior Engineer (1) (Civil)							○	○	-	-	-	-				
16	Daw Htoo Eain Lwin Staff Officer (Civil)							-	-	-	-	-	-				
17	Daw Swe Hnin Aye Junior Engineer (1) (Civil)																
18	Daw Hnin Ei Ei Chow Junior Engineer (2) (Civil)																

Detailed Design Study on Bago River Bridge Construction Project

Design Technology Transfer

Attendance Record (2)

January ~ February , 2018

Date		January																		February																			Attendance Rate
		8	9	10	11	12	15	16	17	18	19	22	23	24	25	26	29	30	31	1	2	5	6	7	8	9	13	14	15	16	19	20	21	22	23	26	27	28	
Lecture									Special lecture																									Special lecture	Ceremony			Presentation	
Detailed Practice for Steel Cable Stayed Bridge																																							
1	Daw Ei Htwe San Deputy Director (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-	○	○	○	○	○	○	○	-	○	○	○	○	○	○	○	○	○	○	○	○	95%
2	Daw Nant Tha Hmwe Deputy Director (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-	○	○	○	○	○	○	○	-	○	○	○	○	○	○	○	○	○	○	○	○	95%
Detailed Practice for Steel Box Girder Bridge																																							
3	Dr. Hay Man Myint Maung Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	-	○	○	○	○	-	-	○	○	○	○	-	-	-	○	○	○	○	○	○	○	○	○	○	84%
4	Daw Shwe Yamin Myat Junior Engineer (3) (Civil)	○	○	○	○	○	○	-	○	○	○	○	○	○	-	○	○	○	○	-	-	-	○	○	○	○	○	○	○	○	-	-	○	○	○	○	○	○	81%
Detailed Practice for PC Box Girder Bridge																																							
5	Daw Lai Mon Phyo Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-	○	○	○	○	○	○	○	○	97%
6	Daw Kyi Thar Soe Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	100%
Detailed Practice for Foundation & Substructure																																							
7	Daw San Phyu Phyu Saw Assistant Director (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	100%
8	Daw Yu Yu Naing Staff Officer (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-	○	○	○	○	○	○	○	○	○	○	○	○	97%
9	Daw Swe Hnin Aye Junior Engineer (1) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	100%
10	Daw Hnin Ei Ei Chaw Junior Engineer (2) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	100%
11	U Hein Zaw Junior Engineer (4) (Civil)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	-	○	○	○	○	○	○	○	○	○	○	○	97%