



มหาวิทยาลัยสงขลานครินทร์  
คณะวิศวกรรมศาสตร์

การสอบปลายภาคประจำภาคการศึกษาที่ 2

ปีการศึกษา 2557

สอบวันที่ 15 พฤษภาคม 2558

เวลา 09:00 – 12:00 น.

วิชา: 220-484 การใช้คอมพิวเตอร์ช่วยในการเขียนแบบในงานวิศวกรรมโยธา

ห้อง Computer2

ชื่อ-สกุล.....รหัส.....

Instructions/Information

1. ข้อสอบมีทั้งหมด 4 ข้อ คะแนนรวม 60 คะแนน ดังแสดงในตารางด้านล่าง
2. ข้อสอบมีทั้งหมด 17 หน้า รวมปก
3. ให้ทำข้อ 1-3 ลงในข้อสอบ
4. ข้อ 4 ให้ใช้โปรแกรม SketchUp
5. อนุญาตให้ใช้ดินสอ หรือปากกาในการทำข้อสอบได้
6. ให้นักศึกษาเขียนชื่อ-สกุล และรหัส ทุกหน้าของข้อสอบ ไม่เขียนหัวหน้าละ 1 คะแนน
7. ห้ามนำเอกสารใดๆ เข้าห้องสอบ ทุจริตจะได้ E
8. ห้ามหยิบ หรือยืมของใดๆ ของผู้อื่นในห้องสอบ
9. ห้ามนำส่วนใดส่วนหนึ่งออกจากข้อสอบ
10. Good Luck

ตารางคะแนน

ข้อที่	คะแนนเต็ม	ได้
1	15	
2	10	
3	15	
4	20	
รวม	60	

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 2 ภาคการศึกษา

ผู้ออกข้อสอบ ดร.อรกมล วังอภิสิทธิ์

ชื่อ-สกุล.....รหัส.....

1. จากแบบ Standard Drawing of Department of Highway

“7.00 M. ROADWAY WIDTH SLAB BRIDGE”

โครงการก่อสร้าง สร้างสะพาน span 6.00 M. จงทำตารางวางแผนการตัดวัสดุ (Bar Cut List) ของ Bar Mark และสรุปรายการเหล็ก ของรายการเหล็กเสริมดังต่อไปนี้

(ข้อละ 5 คะแนน รวม 15 คะแนน)

1.1. C 101

1.2. ST 104

1.3. F 102

เขียนคำตอบในตารางหน้า 4 จาก 17

2. จากแบบ Standard Drawing of Department of Highway

“BUS STOP SHELTER TYPE A”

โครงการก่อสร้าง สร้างอาคารที่หยุดรถผู้โดยสาร จงทำตารางวางแผนการตัดวัสดุ (Bar Cut List) และสรุป รายการเหล็ก ของโครงสร้างต่อไปนี้ (รวม 10 คะแนน)

2.1. R.C. COLUMN AND R.C. FOOTING

เขียนคำตอบในตารางหน้า 5 จาก 17

ชื่อ-สกุล.....รหัส.....

3. จากแบบโครงการก่อสร้าง CHANA CCPP Block 2 จงตอบคำถามต่อไปนี้

(ข้อละ 3 คะแนน รวม 15 คะแนน)

3.1. แบบก่อสร้างนี้เป็นแบบก่อสร้างอะไร

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3.2. ก่อนเทคอนกรีตโครงสร้างจริง จะต้องทำ Reinforced Bedding Concrete หนาเท่าไร

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3.3. หลังจากมีการหล่อคอนกรีตแล้วเสร็จ โครงสร้างจะต้องมี Visible Concrete Edge ขนาดเท่าไร

3.4. จงบอกคุณสมบัติของคอนกรีตสำหรับทำ Basemat และ Lean concrete

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3.5. โครงสร้าง Turbine-Foundation ควรจะแยกออกจาก Foundation ของโครงสร้างอื่นๆ จงวาดภาพ และให้รายละเอียดของรอยต่อระหว่าง Turbine-Foundation และ Foundation ของโครงสร้างอื่น

4. จงใช้โปรแกรม SKETCH UP วาดภาพสามมิติ อาคารพักอาศัย 2 ชั้น โดยมีข้อกำหนดดังนี้ (รวม 20 คะแนน)

4.1. อาคารขนาด กว้าง 6 เมตร ยาว 18 เมตร

4.2. หลังคาทรงเพิงหมาแหงน

4.3. ชั้นบนมีระเบียงด้านหน้าอาคารระยะยื่น 1 เมตร

4.4. ประตูหน้าต่าง ทั้งด้านหน้า และด้านหลังของตัวอาคาร

ให้ save file เป็นไฟล์นามสกุล \*.pdf จัดเก็บใน share folder

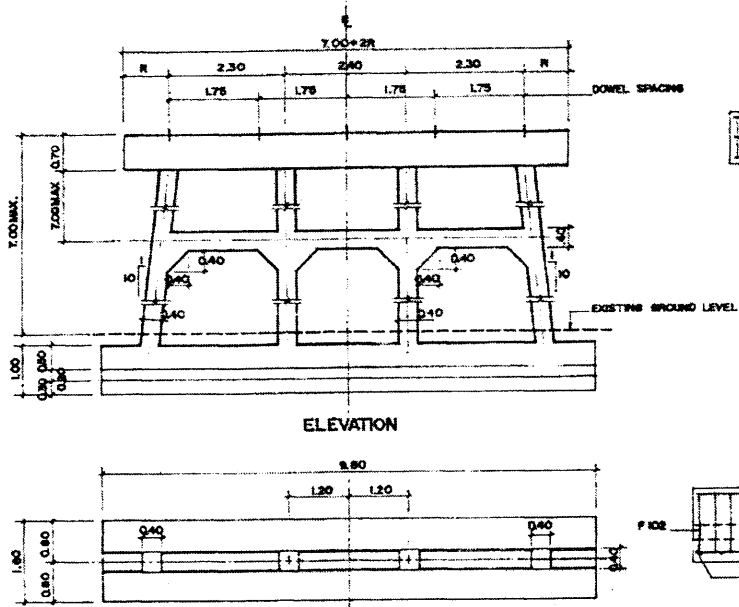
ชื่อไฟล์ รหัสนักศึกษา + ชื่อจริง

ชื่อ-สกุล.....รหัส.....

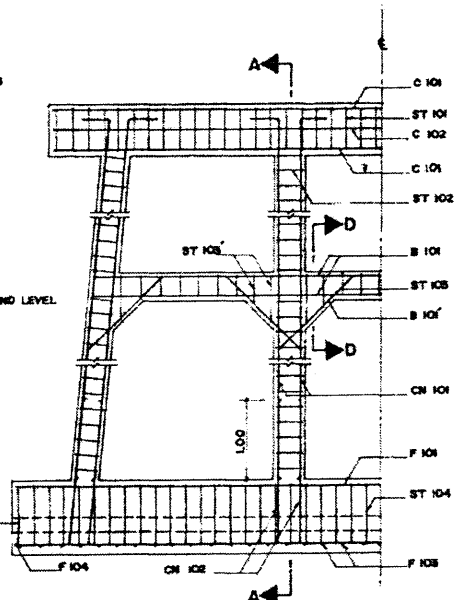
ตารางคำตอบข้อ 1													
Member	Bar mark	Bar size	Unit /Weight	A m.	B m.	C m.	D m.	E m.	F m.	Bending Length m.	No' of Bars	Total Weight	Bar Shape
สรุปรายการสั่งซื้อเหล็ก													

ชื่อ-สกุล.....รหัสนี้.....

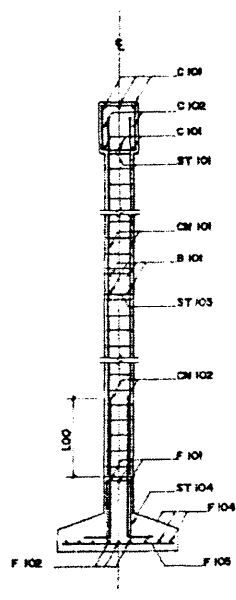
ตารางคำตอบข้อ 2													
Member	Bar mark	Bar size	Unit /Weight	A m.	B m.	C m.	D m.	E m.	F m.	Bending Length m.	No' of Bars	Total Weight	Bar Shape
สรุปรายการสั่งซื้อเหล็ก													



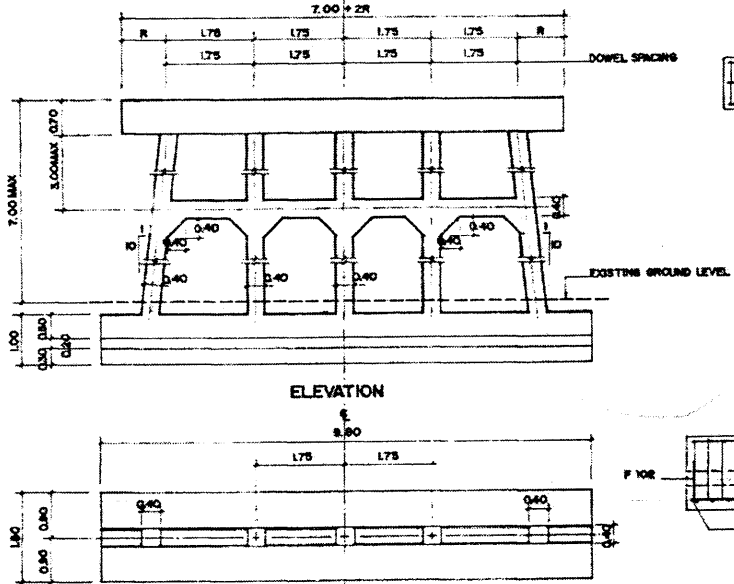
PIER DETAILS FOR 5.00-6.00 M. SPAN  
SCALE 1:75



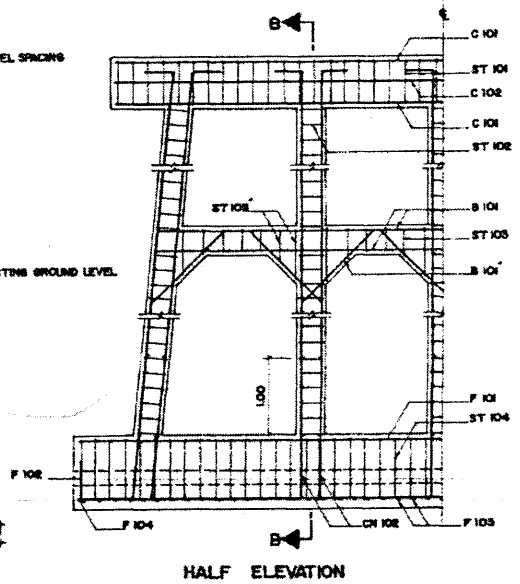
HALF ELEVATION  
REINFORCEMENT DETAILS FOR 5.00-6.00 M. SPAN  
SCALE 1:50



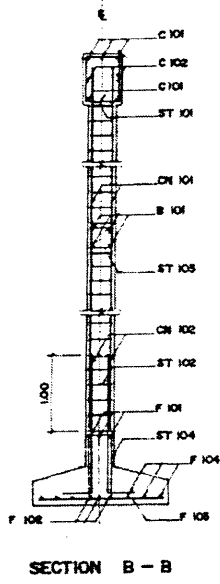
SECTION A - A



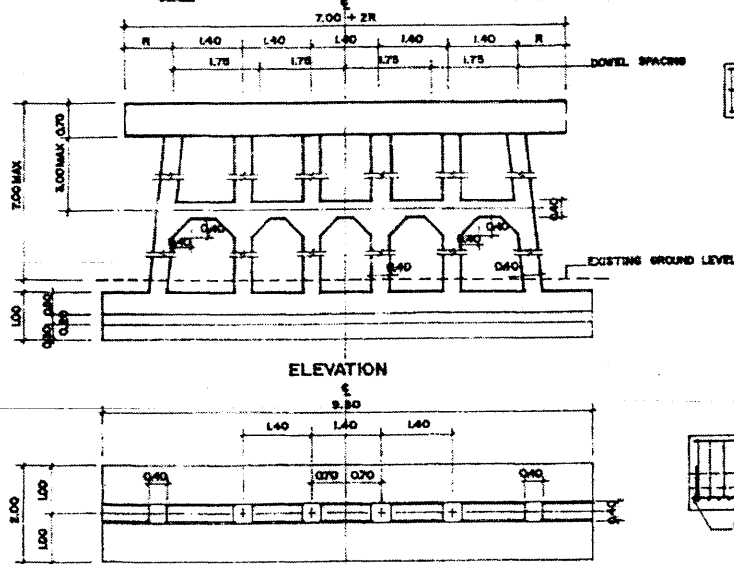
PIER DETAILS FOR 7.00-8.00 M. SPAN  
SCALE 1:75



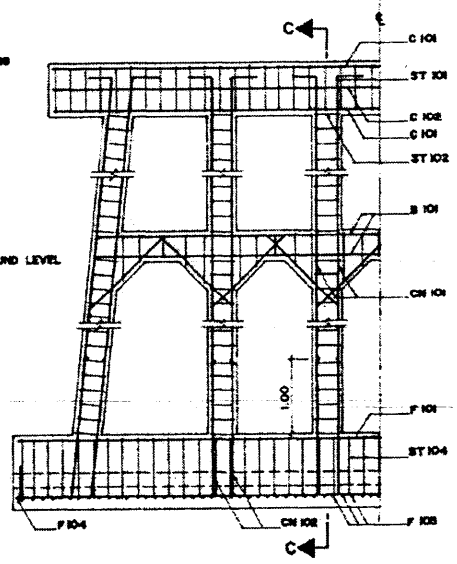
HALF ELEVATION  
REINFORCEMENT DETAILS FOR 7.00-8.00 M. SPAN  
SCALE 1:50



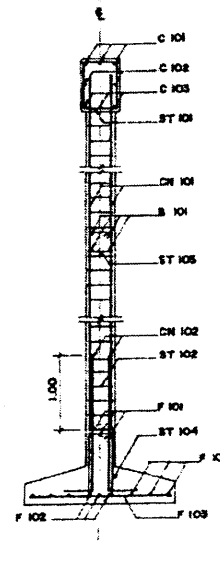
SECTION B - B



PIER DETAILS FOR 9.00-10.00 M. SPAN  
SCALE 1:75



HALF ELEVATION  
REINFORCEMENT DETAILS FOR 9.00-10.00 M. SPAN  
SCALE 1:50



SECTION C - C

TABLE OF REINFORCEMENT

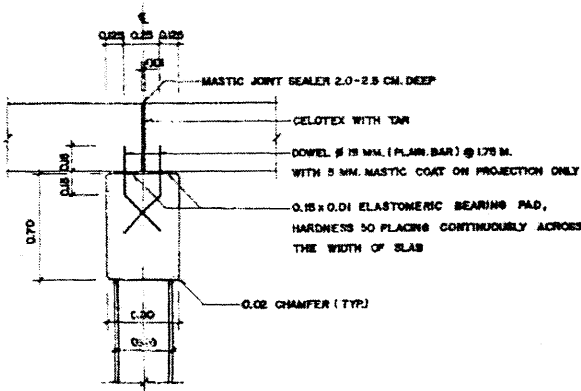
BAR BENDING DIAGRAMS	BAR MARK	SPAN 5.00 M.				SPAN 6.00 M.				SPAN 7.00 M.				SPAN 8.00 M.				SPAN 9.00 M.				SPAN 10.00 M.			
		NO.	L	NO.	L	NO.	L	NO.	L	NO.	L	NO.	L	NO.	L	NO.	L	NO.	L	NO.	L	NO.	L		
	C 101	8	—	8	—	8	—	8	—	8	—	8	—	8	—	8	—	8	—	8	—	8	—		
	C 102	4	—	2	—	4	—	2	—	4	—	2	—	4	—	2	—	4	—	2	—	4	—		
	CN 101	8	—	16	11.25	8	—	16	11.25	8	—	20	8.25	8	—	20	8.25	8	—	24	8.25	8	—	24	11.25
	CN 102	8	—	16	2.31	8	—	16	2.31	8	—	20	2.31	8	—	20	2.31	8	—	24	2.31	8	—	24	2.31
	ST 101	3	.20	—	2.36	3	.20	—	2.36	3	.20	—	2.36	3	.20	—	2.36	3	.20	—	2.36	3	.20	—	2.36
	ST 102	3	.20	192	1.98	3	.20	182	1.98	3	.20	240	1.98	3	.20	240	1.98	3	.20	298	1.98	3	.20	298	1.98
	ST 103	3	.28	36	1.35	3	.25	34	1.35	3	.25	28	1.35	3	.25	28	1.35	3	.25	18	1.35	3	.28	16	1.35
	ST 104	3	.28	24	—	3	.25	24	—	3	.25	32	—	3	.25	32	—	3	.25	40	—	3	.28	40	—
	B 101	8	—	8	—	8	—	8	—	8	—	8	—	8	—	8	—	8	—	16	—	8	—	8	—
	B 102	8	—	24	1.55	8	—	24	1.55	8	—	32	1.55	8	—	32	1.55	8	—	40	1.55	8	—	40	1.55
	F 101	8	—	3	9.70	8	—	3	9.70	8	—	3	9.70	8	—	3	9.70	8	—	3	9.70	8	—	3	9.70
	F 102	8	—	3	10.80	8	—	3	10.80	8	—	3	10.80	8	—	3	10.80	8	—	3	10.80	8	—	3	10.80
	F 103	4	.25	38	1.90	4	.25	38	1.90	4	.20	48	1.70	4	.20	48	1.70	4	.25	78	1.90	4	.25	78	1.90
	F 104	4	—	8	9.70	4	—	8	9.70	4	—	8	9.70	4	—	8	9.70	4	—	8	9.70	4	—	8	9.70

③ = 3/8" OR 9 MM., ④ = 1/2" OR 12 MM., ⑤ = 3/4" OR 20 MM., ⑥ = 1" OR 25 MM., NO = TOTAL AMOUNT OF BARS, L = TOTAL LENGTH OF EACH BARS.

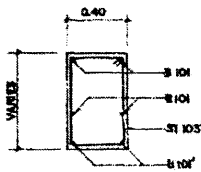
NOTES :

- THE BOTTOM OF A FOOTING SHALL BE EMBEDDED IN THE EXISTING GROUND AT THE LEVEL WHERE SCOUR WILL NOT AFFECT ITS CAPACITY BUT NOT LESS THAN 2.5 M. AFTER THE GROUND UNDER THE BOTTOM OF FOOTING HAS BEEN PREPARED, 10 CM. THICK OF LEAN CONCRETE SHALL BE POURED AT LEAST 10 CM. WIDER THAN THE FOOTING ALL AROUND. COMPOSITION OF LEAN CONCRETE SHALL BE 1:3:6 BY VOLUME.
- SOIL UNDER THE FOOTING SHALL HAVE A MINIMUM ALLOWABLE BEARING CAPACITY OF 20 TON/M<sup>2</sup>.
- HORIZONTAL CROSS BRACING BETWEEN COLUMNS SHALL BE PROVIDED IN THE FOLLOWING CIRCUMSTANCES :
  - IF THE DISTANCE FROM EXISTING GROUND LEVEL TO THE BOTTOM OF THE CAP BEAM EXCEED 3.0 M., A BRACING SHALL BE PLACED IN SUCH A WAY THAT THE DISTANCE FROM THE BOTTOM OF THE CAP BEAM TO THE CENTERLINE OF THE BRACING IS NOT MORE THAN 3.0 M., AND
  - IF THE DISTANCE BETWEEN THE CENTERLINE OF THE BRACING TO THE EXISTING GROUND LEVEL EXCEED 3.0 M., ADDITIONAL BRACING SHALL BE PROVIDED AT AN INTERVAL NOT MORE THAN 3.0 M.
- CLEAR CONCRETE COVER SHALL BE 3.0 CM. EXCEPT THE CAP BEAM, WHERE A CLEAR COVER OF 2.5 CM. SHALL BE PROVIDED.
- CONCRETE SHALL HAVE A MINIMUM CEMENT CONTENT OF 350 Kg/M<sup>3</sup> AND A MINIMUM ULTIMATE COMPRESSIVE STRENGTH OF 210 Kg/CM<sup>2</sup> FOR A 15x15x15 M. CUBE AT 28 DAYS. CEMENT SHALL BE TYPE I PORTLAND CEMENT. A SUGGESTED APPROXIMATE MIX DESIGN PER CUBIC METER IS AS FOLLOWS :
 

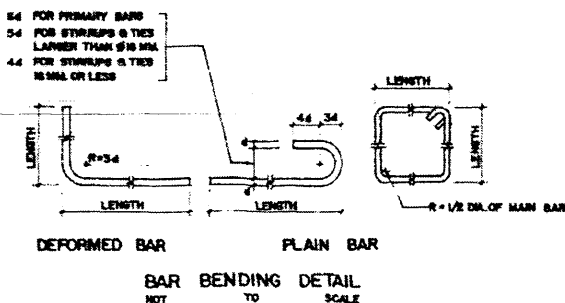
PORTLAND CEMENT	350	Kg
SAND	0.45	M <sup>3</sup>
CRUSHED ROCK OR GRAVEL	0.84	M <sup>3</sup>
CONCRETE SLUMP MIX	10	CM.
- REBARS # 4 OR LARGER SHALL BE TIS 24 GRADE 80 30 DEFORMED BARS OTHERS SHALL BE TIS 20 GRADE 8R 24 PLAIN BARS UNLESS OTHERWISE INDICATED.
- LOCATION OF LAP SPLICE OF REBARS SHALL BE APPROVED BY THE ENGINEER.
- LAP LENGTH SHALL NOT BE LESS THAN 40 DIAMETER OF BIGGER BAR FOR PLAIN BARS AND 24 DIAMETERS OF BIGGER BAR FOR DEFORMED BARS.
- IN CASE OF SALINE PROTECTION, HIGH SULPHATE RESISTANT PORTLAND CEMENT TYPE 5 CONFORMING TO TIS 15 SHALL BE USED AND ADDITIONAL CONCRETE COVER OF 2.5 CM. FROM NORMAL CASE ALL AROUND SHALL BE PROVIDED FOR THE CAP BEAM WITHOUT ALTERING THE LOCATION OF REBARS.
- THE MAXIMUM FREE HEIGHT OF PIER FROM EXISTING CANAL BED TO THE TOP OF CAP BEAM SHALL BE 7.0 M. PIER HIGHER THAN 7.0 M. SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.
- QUANTITIES OF REBARS SHOWN IN THE TABLE ARE BASED ON THE TOTAL PIER HEIGHT OF 12.0 M.
- ALL DIMENSIONS SHOWN ARE IN METERS UNLESS OTHERWISE INDICATED.
- THIS DRAWING IS ADAPTED FROM DOH DWG. NO. 3405-104-14/25.



CAP BEAM DETAILS SCALE 1:25



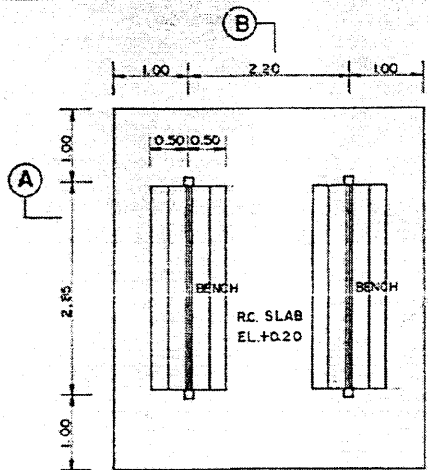
SECTION D - D SCALE 1:25



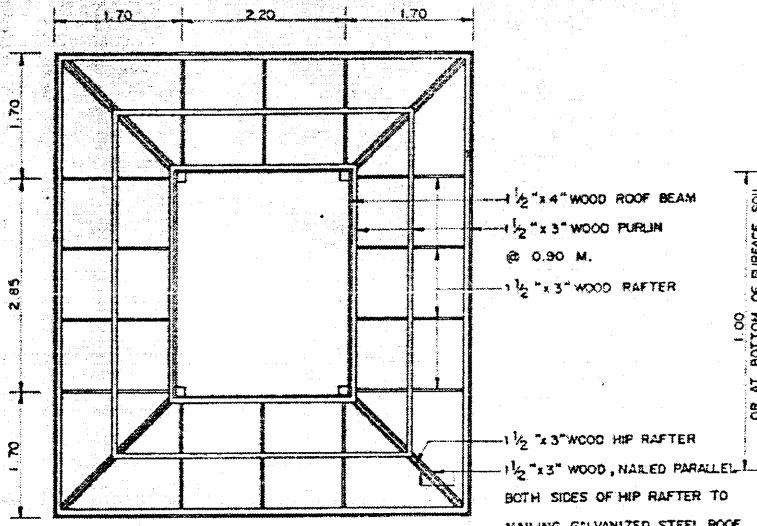
**KINGDOM OF THAILAND**  
**MINISTRY OF TRANSPORT AND COMMUNICATIONS**  
**DEPARTMENT OF HIGHWAYS**

STANDARD DRAWING  
**7.00 M. ROADWAY WIDTH SLAB BRIDGE**  
 SPREAD FOOTING PIER DETAILS

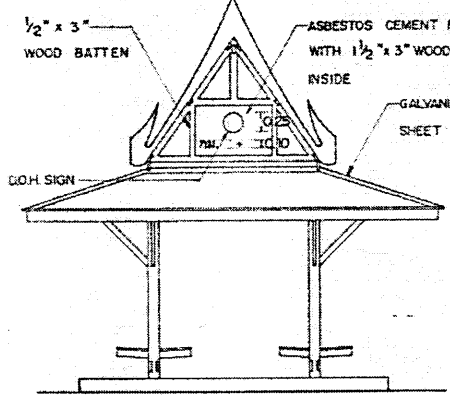
DESIGNED : DOM & CONSULTANTS	CHECKED : <i>Kot</i>	DATE JULY 1994
SUBMITTED : <i>P. Bumpayong</i>	SCALE AS SHOWN	
(DIRECTOR OF LOCATION & DESIGN DIVISION)		DWG. NO. ST-02



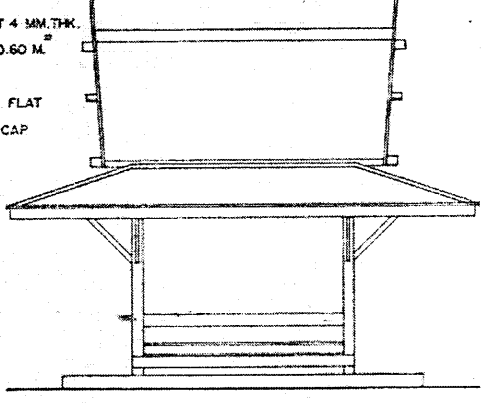
**PLAN**  
SCALE 1 : 50



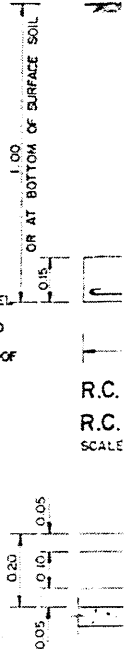
**ROOF FRAMING PLAN**  
SCALE 1 : 50



**FRONT ELEVATION**  
SCALE 1 : 50

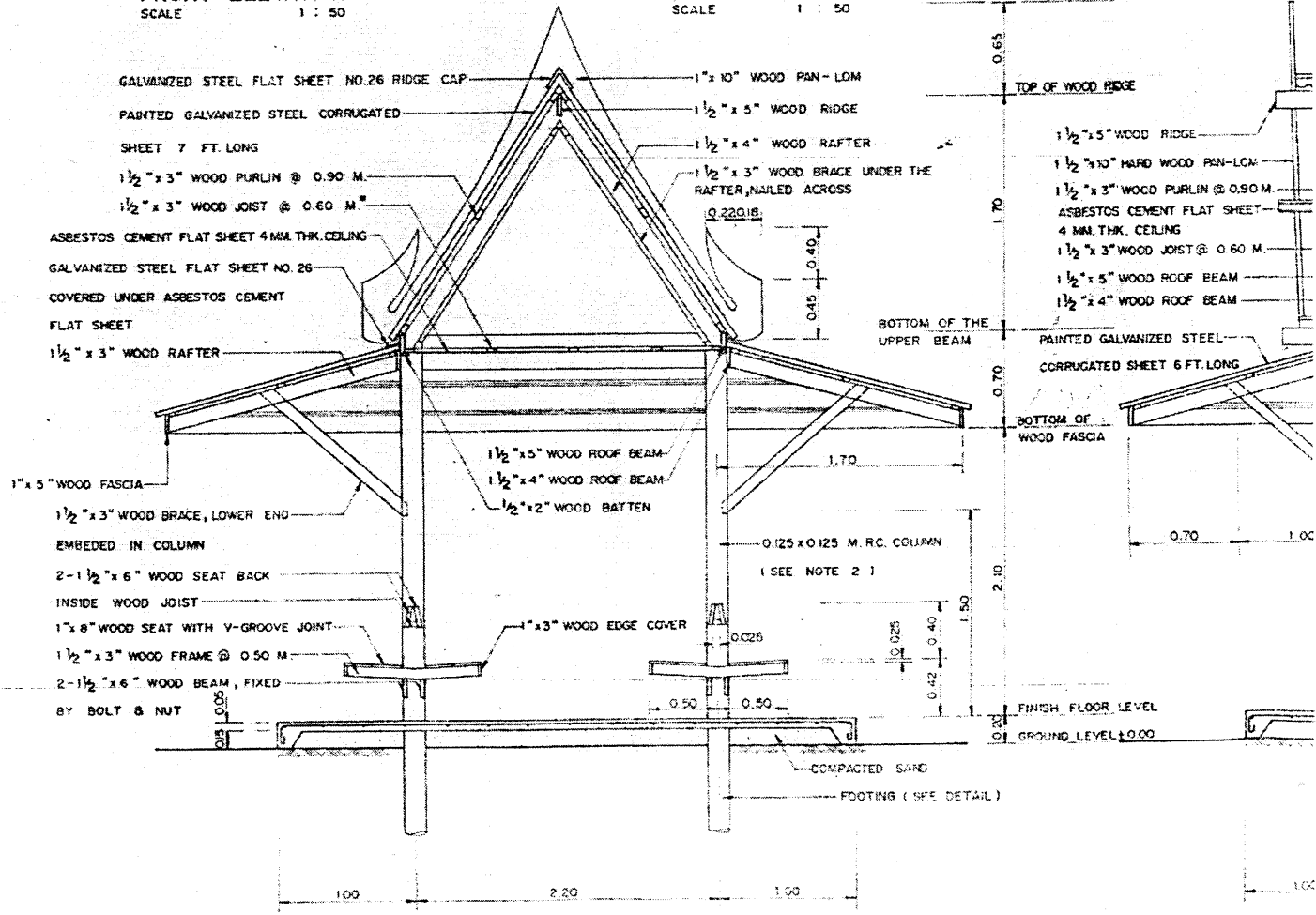


**SIDE ELEVATION**  
SCALE 1 : 50



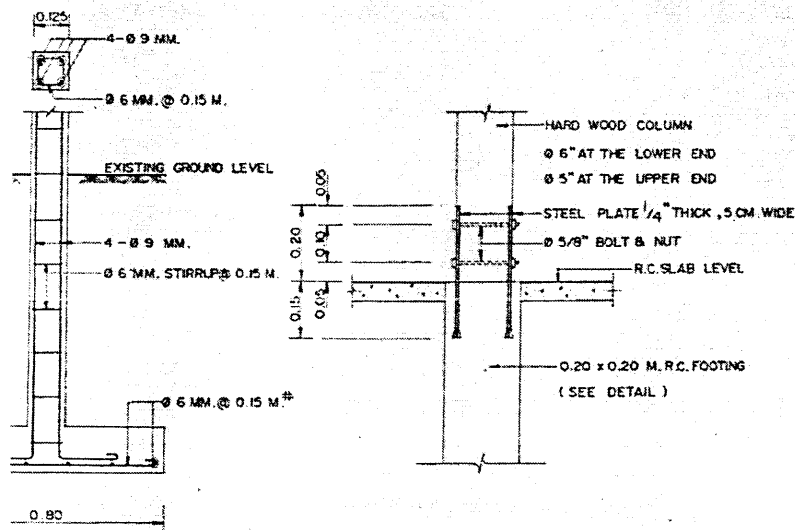
R.C.  
R.C.  
SCALE

**HARD WOOD**  
SCALE



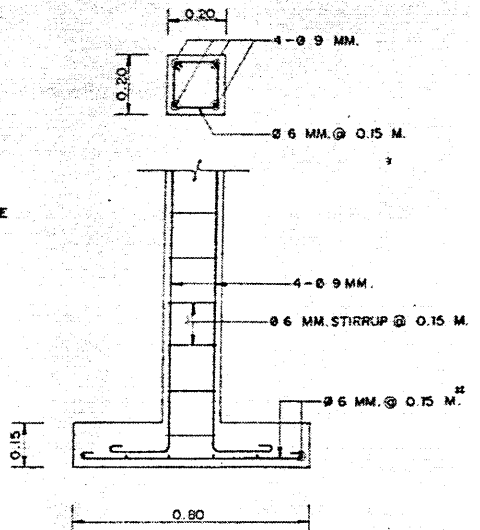
1.00 2.20 1.00



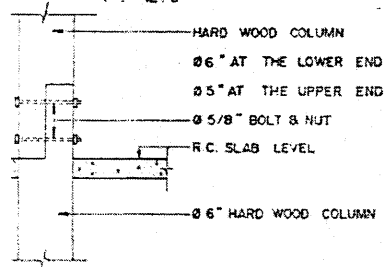


**COLUMN AND FOOTING DETAILS**  
SCALE 1 : 12.5

**HARD WOOD COLUMN AND R.C. FOOTING CONNECTION DETAILS**  
SCALE 1 : 10



**0.20x0.20 M. R.C. FOOTING DETAILS**  
SCALE 1 : 12.5

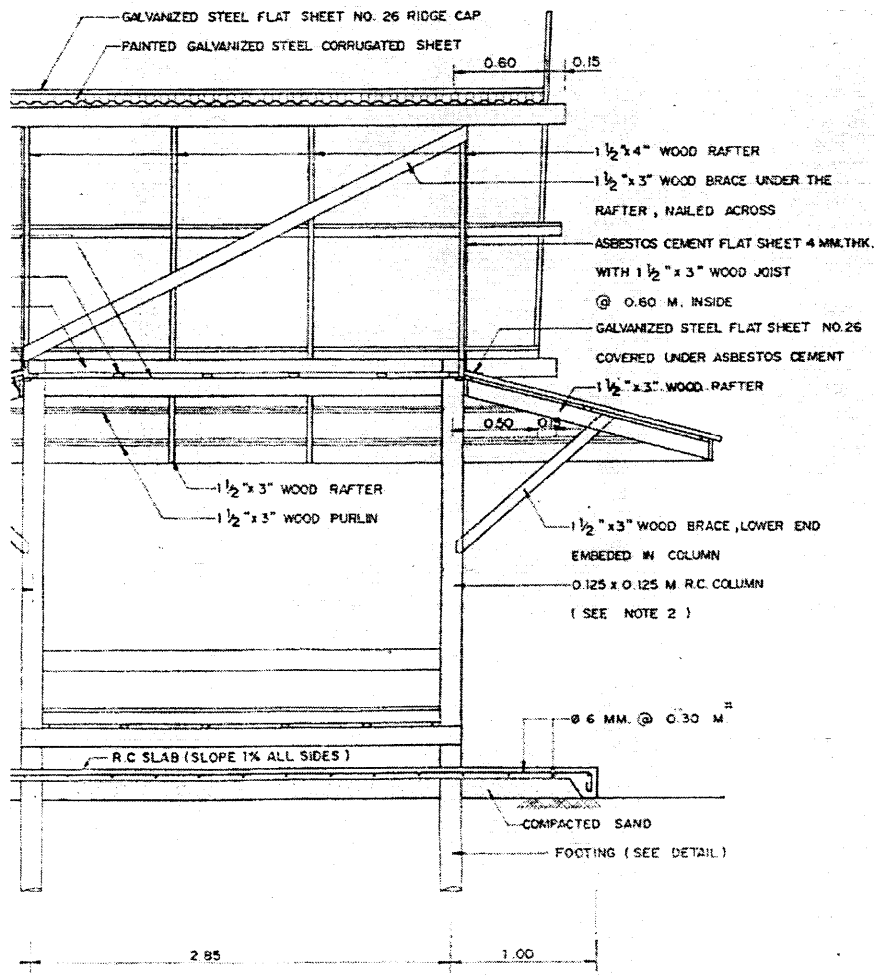


**COLUMNS CONNECTION DETAILS**  
SCALE 1 : 10

**NOTES :**

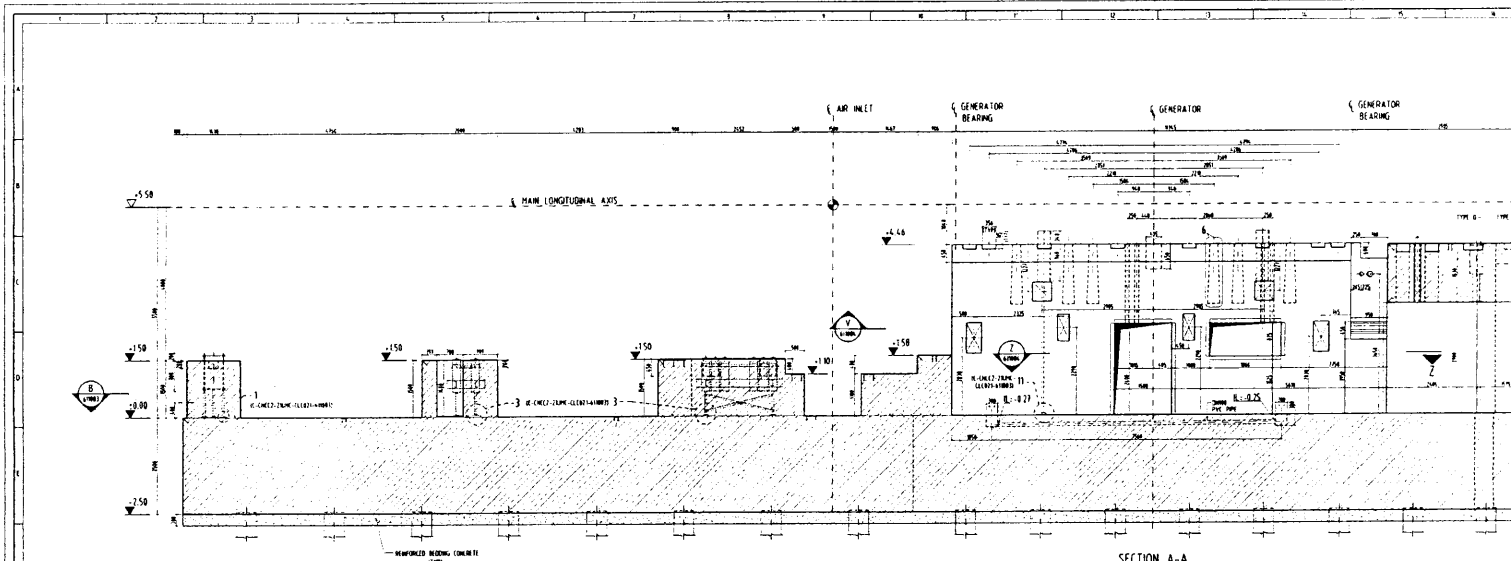
1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE INDICATED.
2. THE SPECIFIED COLUMNS FOR THIS BUS STOP SHELTER ARE AS FOLLOWS:
  - 2.1 WHERE USING THE 0.125x0.125 M. R.C. COLUMN WITH 0.15x0.80x0.60 M FOOTING, REACHES TO THE CEILING.
  - 2.2 HARD WOOD COLUMN Ø 6" AT THE LOWER END AND Ø 5" AT THE UPPER END MUST BE NON-DECAYABLE WITH MINIMUM OF 5 METERS DRIVEN IN THE GROUND.
  - 2.3 WHERE USING CONNECTED-COLUMNS SEE DETAILS AS SHOWN IN THIS DRAWING, THE HARD WOOD COLUMNS MUST BE TENG (Shorea obtusa), RUNG (Pentacme siamensis), DANG (Xylocarpus) OR ANY OTHER KIND OF HARD WOOD OF THE SAME QUALITY.
3. ELEVATION = 0.00 AS SHOWN IN THIS DRAWING, INDICATES THE ROADWAY SHOULDER ELEVATION.
4. CONNECTION JOINTS SHALL BE Ø 3/8" BOLTS AND NUTS WITH WASHERS UNLESS OTHERWISE SHOWN.
5. WOOD TEXTURE MUST BE PRESERVED AGAINST DECAY AND INSECT DAMAGE BY PROPER PRESERVATIVE PAINT.
6. A PATH TO THE SHELTER FROM SHOULDER EDGE SHALL BE PROVIDED BY 1.50 M. WIDE SAND-MORTAR AT ELEVATION OF +0.10 METERS.
7. GALVANIZED STEEL ROOF SHALL BE GREEN OR RED COLOR.
8. PAN - LOW, FASCIA AND CEILING SHALL BE PAINTED IN WHITE COLOR.
9. CONCRETE SHALL HAVE A MINIMUM ULTIMATE COMPRESSIVE STRENGTH OF 210 KSC. FOR 15x15x15 CM. CUBE AT 28 DAYS. AN APPROXIMATE MIX DESIGN PER CUBIC METER IS SUGGESTED AS FOLLOWS:
 

PORTLAND CEMENT TYPE I	350	KG. ( MIN. )
SAND	0.43	M <sup>3</sup>
CRUSHED ROCK OR GRAVEL	0.86	M <sup>3</sup>
CONCRETE SLUMP	10	CM. ( MAX. )
10. REINFORCING STEEL SHALL CONFORM TO TIS.20 GRADE SR 24.
11. IN CASE OF CONSTRUCTION BY THE DEPARTMENT OF HIGHWAYS AND NOT LOCATED IN MAIN ROUTE, LOCAL MATERIALS MAY BE USED BY REMAINING SHAPE AND STRUCTURES OF THIS BUS STOP SHELTER.

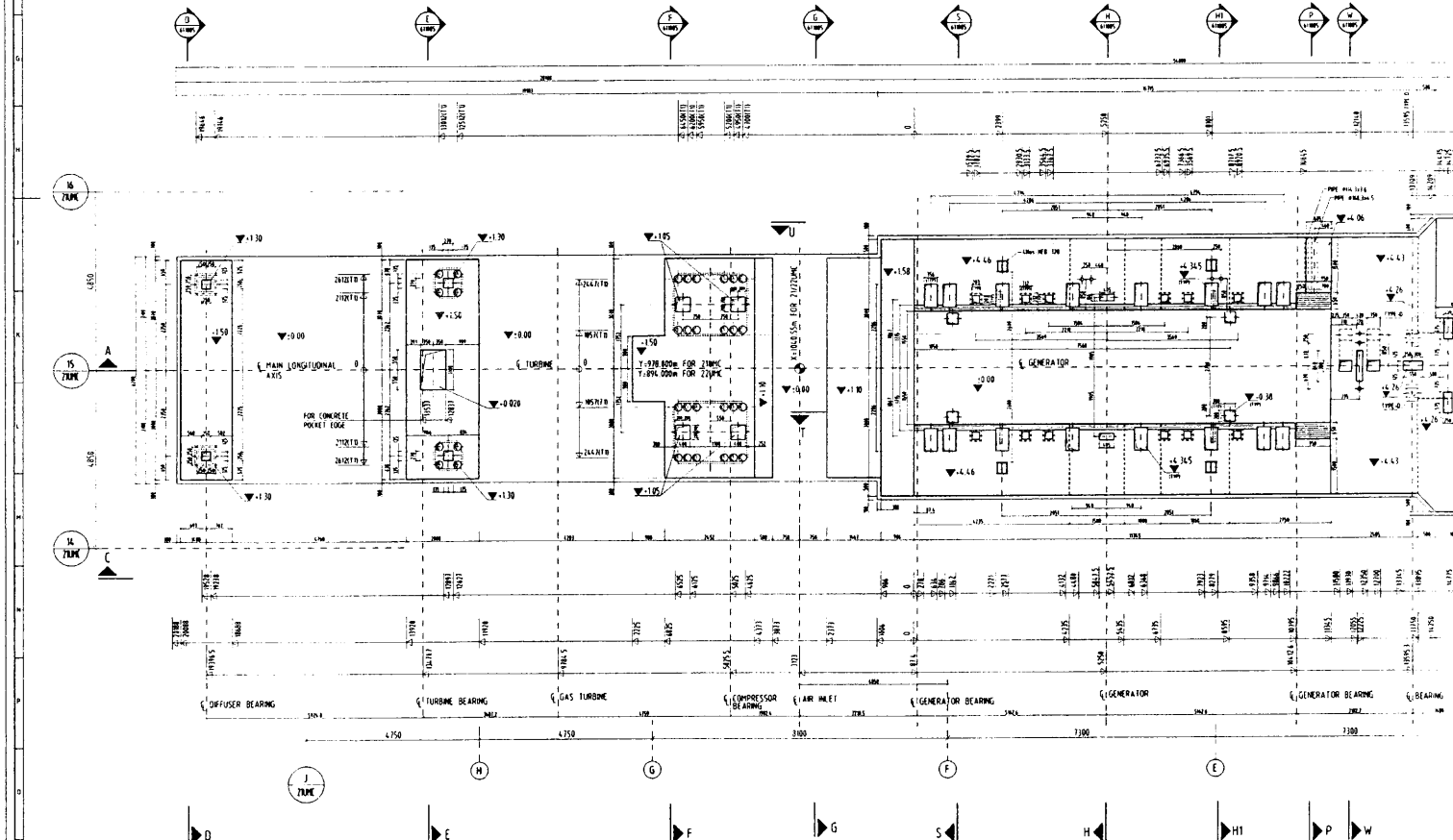


**SECTION (B) - (B)**

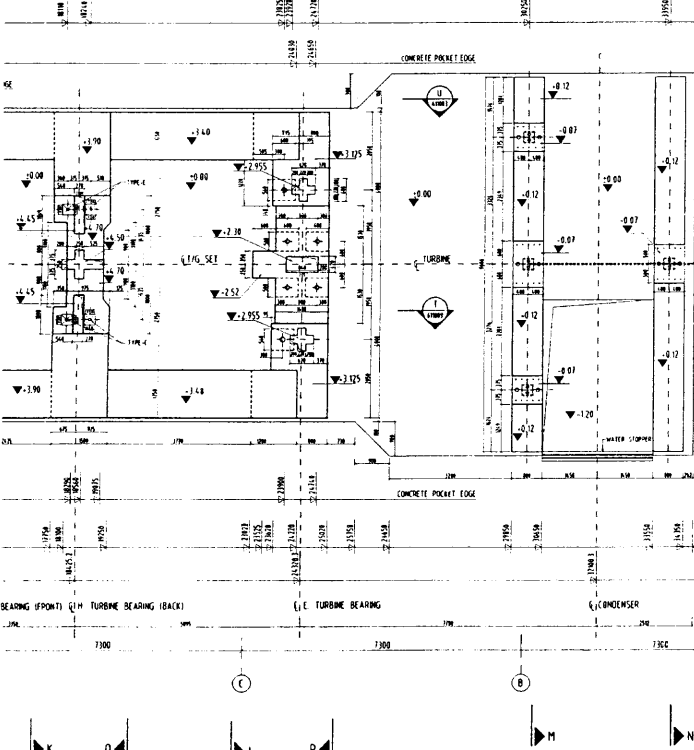
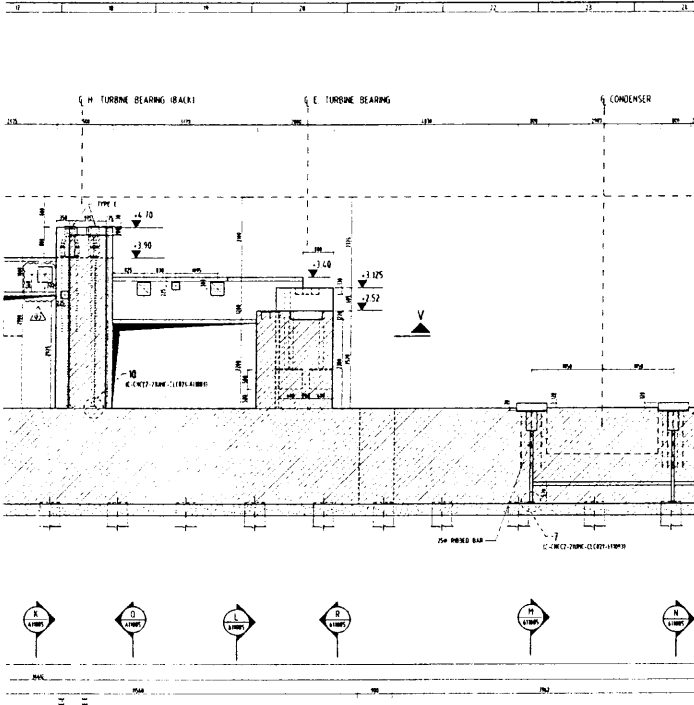
<b>KINGDOM OF THAILAND</b>		
MINISTRY OF TRANSPORT AND COMMUNICATIONS		
DEPARTMENT OF HIGHWAYS		
STANDARD DRAWING		
BUS STOP SHELTER TYPE A		
DESIGNED : D.O.H. & CONSULTANTS	CHECKED :	DATE JULY 1994
SUBMITTED :		SCALE AS SHOWN



SECTION A-A



PLAN VIEW OF TURBOSET FOUNDATION  
(INDICATING DIMENSION FOR CONCRETE EDGES AND MACHINE EMBEDDED PARTS)



**9. FOUNDATION CONCRETE POURING**  
The construction shall be carried out in the following concrete stages:  
STAGE 1: THE BASE MAT SHALL BE CAST OF CONCRETE WITHOUT FORMWORK COUSING.  
STAGE 2: THE WALLS ABOVE THE BASE MAT SHALL BE CAST WITHOUT CONSTRUCTION JOINTS.  
IN THE CONSTRUCTION JOINT AREA OF BEARING BEARING OR BEARING STAGE CONCRETE THE FOLLOWING SHALL BE TAKEN CARE OF: THE CONSTRUCTION JOINT AREA SHALL BE PROTECTED AND PROPERLY CURED WITH COMPRESSED AIR TO REMOVE ANY LOOSE AGGREGATES THE JOINT AREA SHALL BE CLEANED AND PROTECTED FROM WEATHERING.

**10. CONCRETE TEMPERATURE**  
THE MAXIMUM TEMPERATURE OF CONCRETE SHALL NOT EXCEED 40°C. THE TEMPERATURE DIFFERENCE BETWEEN THE TOP AND BOTTOM OF THE CONCRETE SHALL NOT EXCEED 25°C. THE TEMPERATURE DIFFERENCE BETWEEN THE TOP AND BOTTOM OF THE CONCRETE SHALL NOT EXCEED 15°C. THE TEMPERATURE DIFFERENCE BETWEEN THE TOP AND BOTTOM OF THE CONCRETE SHALL NOT EXCEED 10°C. THE TEMPERATURE DIFFERENCE BETWEEN THE TOP AND BOTTOM OF THE CONCRETE SHALL NOT EXCEED 5°C. THE TEMPERATURE DIFFERENCE BETWEEN THE TOP AND BOTTOM OF THE CONCRETE SHALL NOT EXCEED 2°C. THE TEMPERATURE DIFFERENCE BETWEEN THE TOP AND BOTTOM OF THE CONCRETE SHALL NOT EXCEED 1°C.

**11. SYMBOLS**

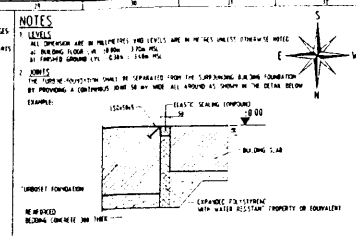
REINFORCED CONCRETE	ACCESS	OPENING	CONSTRAINT POINT
FORMED SIDE FINISH	CONCRETE LEVEL	CHANGING LEVEL	ENTER LINES AT INTERSECTION POINT
SQUARE PIPE FOR ANCHOR BOLT	LEAN CONCRETE	SLAB	PIPE FOR ANCHOR BOLT
FRESH LINE	NET - NOT TO SCALE		

**12. VISIBLE CONCRETE SURFACE**  
VISIBLE CONCRETE SURFACE SHALL BE CHAMFERED 25MM.

**13. THE CHAMFER IS FURTHER POINTED TO SEAL OFF AT PLAIN SATISFACTORY CONNECTION BETWEEN STRAIN AND SLAB FOUNDATION.**

**REFERENCE DRGS.**

DESCRIPTION	NO.
FOUNDATION PLAN	1
FOUNDATION PLAN (LOCAL ENGINEER)	2
FOUNDATION PLAN (LOCAL ENGINEER)	3
FOUNDATION PLAN (LOCAL ENGINEER)	4
FOUNDATION PLAN (LOCAL ENGINEER)	5
FOUNDATION PLAN (LOCAL ENGINEER)	6
FOUNDATION PLAN (LOCAL ENGINEER)	7
FOUNDATION PLAN (LOCAL ENGINEER)	8
FOUNDATION PLAN (LOCAL ENGINEER)	9
FOUNDATION PLAN (LOCAL ENGINEER)	10
FOUNDATION PLAN (LOCAL ENGINEER)	11
FOUNDATION PLAN (LOCAL ENGINEER)	12
FOUNDATION PLAN (LOCAL ENGINEER)	13
FOUNDATION PLAN (LOCAL ENGINEER)	14
FOUNDATION PLAN (LOCAL ENGINEER)	15
FOUNDATION PLAN (LOCAL ENGINEER)	16
FOUNDATION PLAN (LOCAL ENGINEER)	17
FOUNDATION PLAN (LOCAL ENGINEER)	18
FOUNDATION PLAN (LOCAL ENGINEER)	19
FOUNDATION PLAN (LOCAL ENGINEER)	20
FOUNDATION PLAN (LOCAL ENGINEER)	21
FOUNDATION PLAN (LOCAL ENGINEER)	22



**NOTES**

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.  
UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.  
ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.  
ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.

**1. FOUNDATION CONSTRUCTION**

**2. CONCRETE TEMPERATURE**

**3. REINFORCEMENT**

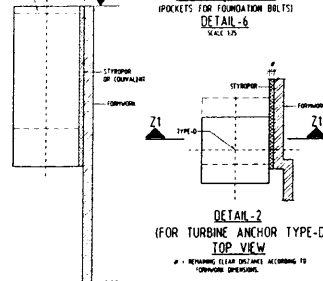
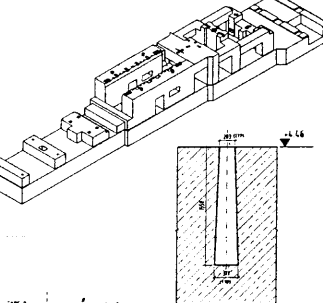
**4. ANCHOR BOLTS**

**5. DIMENSIONS / VARIATIONS**

**6. CONCRETE**

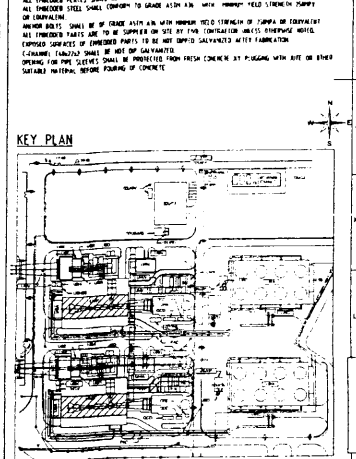
**7. REINFORCEMENT**

**8. EMBEDDED PARTS**



**RELEASED FOR EXECUTION**  
Siemens  
Date: 2012-01-17  
Sign: M. Abele sgd

**THIS DRAWING IS ALSO VALID FOR UNIT 22**



ELECTRICITY GENERATING AUTHORITY OF THAILAND  
CHANA COMBINED CYCLE POWER PLANT BLOCK 2  
THE CONSORTIUM OF SIEMENS AND INDUSTRIAL ENGINEERING CO., LTD. AND MAHABULAKULI CORPORATION

second submission to EGAT

CHANA CCPP Block 2

480050212

NO.	REV.	DATE	BY	CHKD.	APPV.	REVISION
01	01	2012-01-17	M. Abele	S. Sorn	S. Sorn	ISSUED FOR PERMIT
02	01	2012-01-17	M. Abele	S. Sorn	S. Sorn	ISSUED FOR PERMIT
03	01	2012-01-17	M. Abele	S. Sorn	S. Sorn	ISSUED FOR PERMIT
04	01	2012-01-17	M. Abele	S. Sorn	S. Sorn	ISSUED FOR PERMIT

TH1001  
72JUMC  
72JUMC

CLC021  
61082

GAS AND STEAM TURBINE FOUNDATION  
SG15-4000 AND TP909  
PLAN OF FURROSET FOUNDATION, SECTION A-A  
FORMWORK DRAWING PART 1/4

**SIEMENS** C-CCN2-2JUMC-CLC021-61082

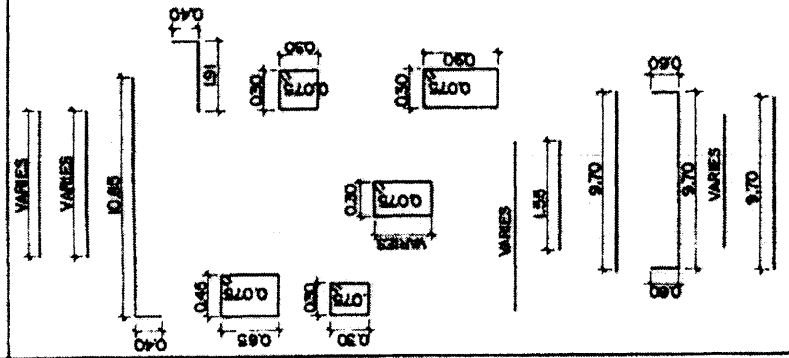
03

TABLE OF REINFORCEMENT

BAR MARK	SPAN 5.00 M.		SPAN 7.00 M.		SPAN 8.00 M.		SPAN 9.00 M.		SPAN 10.00 M.	
	NO.	L	NO.	L	NO.	L	NO.	L	NO.	L
C 101	6	-	6	-	6	-	6	-	6	-
C 102	4	-	4	-	4	-	4	-	4	-
CH 101	6	11.25	6	11.25	8	11.25	8	11.25	8	11.25
CH 102	8	2.31	8	2.31	8	2.31	8	2.31	8	2.31
ST 101	3	2.20	3	2.20	3	2.20	3	2.20	3	2.20
ST 102	3	2.0	3	2.0	3	2.0	3	2.0	3	2.0
ST 103	3	2.25	3	2.25	3	2.25	3	2.25	3	2.25
ST 104	3	2.0	3	2.0	3	2.0	3	2.0	3	2.0
B 101	6	-	6	-	6	-	6	-	6	-
B 101'	6	1.55	6	1.55	6	1.55	6	1.55	6	1.55
F 101	8	-	8	-	8	-	8	-	8	-
F 102	8	10.90	8	10.90	8	10.90	8	10.90	8	10.90
F 103	4	2.5	4	2.5	4	2.5	4	2.5	4	2.5
F 104	4	-	4	-	4	-	4	-	4	-

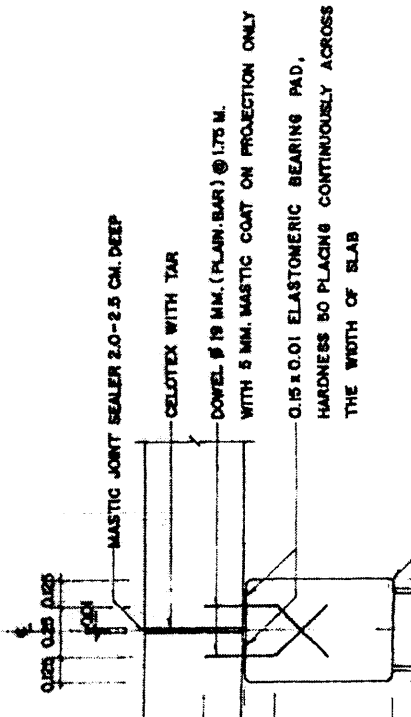
$\phi 3 = 3/8"$  OR 9 MM.,  $\phi 4 = 1/2"$  OR 12 MM.,  $\phi 6 = 3/4"$  OR 20 MM.,  $\phi 8 = 1"$  OR 25 MM., NO = TOTAL AMOUNT OF BARS, L = TOTAL LENGTH OF EACH BARS.

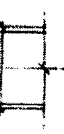
BAR BENDING DIAGRAMS



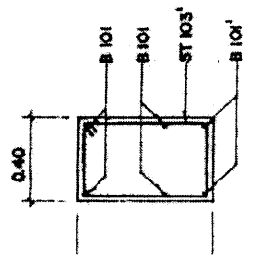
NOTES:

- THE BOTTOM OF A FOOTING SHALL BE EMBEDDED IN THE EXISTING GROUND AT THE LEVEL WHERE SCOUR WILL NOT AFFECT ITS CAPACITY BUT NOT LESS THAN 2.5 M. AFTER THE GROUND UNDER THE BOTTOM OF FOOTING HAS BEEN PREPARED, 10 CM. THICK OF LEAN CONCRETE SHALL BE POURED AT LEAST 10 CM. WIDER THAN THE FOOTING ALL AROUND. COMPOSITION OF LEAN CONCRETE SHALL BE 1:3:6 BY VOLUME.
- SOIL UNDER THE FOOTING SHALL HAVE A MINIMUM ALLOWABLE BEARING CAPACITY OF 50 TON/M<sup>2</sup>
- HORIZONTAL CROSS BRACINGS BETWEEN COLUMNS SHALL BE PROVIDED IN THE FOLLOWING CIRCUMSTANCES:
  - IF THE DISTANCE FROM EXISTING GROUND LEVEL TO THE BOTTOM OF THE CAP BEAN EXCEED 3.0 M., A BRACING SHALL BE PLACED IN SUCH A WAY THAT THE DISTANCE FROM THE BOTTOM

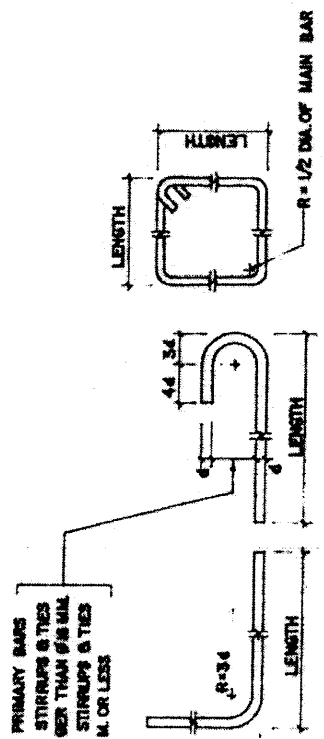




**BEAM DETAILS**  
1:25



**SECTION D - D**  
1:25



**FORMED BAR**  
**PLAIN BAR**  
**BAR BENDING DETAIL**  
TO SCALE

6) IF THE DISTANCE BETWEEN THE CENTERLINE OF THE BRACING TO THE EXISTING GROUND LEVEL EXCEED 3.0 M., ADDITION BRACING SHALL BE PROVIDED AT AN INTERVAL NOT MORE THAN 3.0 M.

4. CLEAR CONCRETE COVER SHALL BE 5.0 CM. EXCEPT THE CAP BEAM, WHERE A CLEAR COVER OF 2.5 CM SHALL BE PROVIDED.

5. CONCRETE SHALL HAVE A MINIMUM CEMENT CONTENT OF 350 KG/M<sup>3</sup> AND A MINIMUM ULTIMATE COMPRESSIVE STRENGTH OF 210 KG/CM<sup>2</sup>. FOR A 25.1.5X.15 M. CUBE AT 28 DAYS. CEMENT SHALL BE TIS 10 TYPE I PORTLAND CEMENT. A SUGGESTED APPROXIMATE MIX DESIGN PER CUBIC METER IS AS FOLLOWS:

PORTLAND CEMENT	350	KG.
SAND	0.46	M <sup>3</sup>
CRUSHED ROCK OR GRAVEL	0.86	M <sup>3</sup>
CONCRETE SLUMP MIX	10	CM.

6. REBARS # 4 OR LARGER SHALL BE TIS 24 GRADE SD 30 DEFORMED BARS OTHERS SHALL BE TIS 20 GRADE SR 24 PLAIN BARS UNLESS OTHERWISE INDICATED.

7. LOCATION OF LAP SPLICE OF REBARS SHALL BE APPROVED BY THE ENGINEER.

8. LAP LENGTH SHALL NOT BE LESS THAN 40 DIAMETER OF BIGGER BAR FOR PLAIN BARS AND 24 DIAMETERS OF BIGGER BAR FOR DEFORMED BARS.

9. IN CASE OF SALINE PROTECTION, HIGH SULPHATE RESISTANT PORTLAND CEMENT TYPE 5 CONFORMING TO TIS 15 SHALL BE USED AND ADDITIONAL CONCRETE COVER OF 2.5 CM. FROM NORMAL CASE ALL AROUND SHALL BE PROVIDED FOR THE CAP BEAM WITHOUT ALTERING THE LOCATION OF REBARS.

10. THE MAXIMUM FREE HEIGHT OF PIER FROM EXISTING CANAL BED TO THE TOP OF CAP BEAM SHALL BE 7.0 M. PIER HIGHER THAN 7.0 M. SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

11. QUANTITIES OF REBARS SHOWN IN THE TABLE ARE BASED ON THE TOTAL PIER HEIGHT OF 12.0 M.

12. ALL DIMENSIONS SHOWN ARE IN METERS UNLESS OTHERWISE INDICATED.

13. THIS DRAWING IS ADAPTED FROM DOH DWG. NO. 3405 - 106 - 14/23.

<b>KINGDOM OF THAILAND</b>			
<b>MINISTRY OF TRANSPORT AND COMMUNICATIONS</b>			
<b>DEPARTMENT OF HIGHWAYS</b>			
STANDARD DRAWING			
7.00 M. ROADWAY WIDTH SLAB BRIDGE			
SPREAD FOOTING PIER DETAILS			
DESIGNED : DOH & CONSULTANTS	CHECKED : <i>[Signature]</i>	DATE	JUL
SUBMITTED :	<i>[Signature]</i>	SCALE AS :	
(DIRECTOR OF LOCATION & DESIGN DIVISION)		DWG. NO. S	
APPROVED :	<i>[Signature]</i>	SHEET NO. 1	
MPL (DIRECTOR GENERAL)			

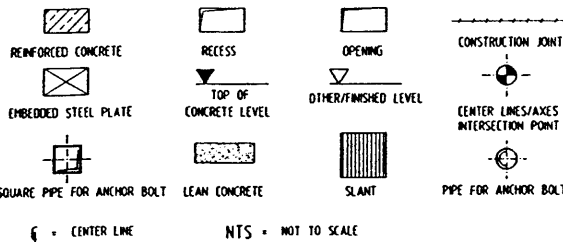
**9. IG - FOUNDATION CONCRETE POURING**

THE CONSTRUCTION JOINT GIVEN IN THE FORMWORK DRAWINGS IS NECESSARY FOR THE FOLLOWING CONCRETE STAGES:  
 STAGE 1: THE BASE MAT SHALL BE CAST IN CONCRETE WITHOUT CONSTRUCTION JOINTS.  
 STAGE 2: THE WALLS & PLINTHS ABOVE THE BASE MAT SHALL ALSO BE EXECUTED WITHOUT CONSTRUCTION JOINTS.  
 IN THE CONSTRUCTION JOINT AREA OR BEFORE BEGINNING OF SECOND STAGE CONCRETING, THE FOLLOWING SHALL BE TAKEN CARE OF - THE CONSTRUCTION JOINT AREA SHALL BE ROUGHENED AND THOROUGHLY CLEANED WITH COMPRESSED AIR TO REMOVE ANY LOOSE AGGREGATES. THE JOINT AREA SHALL BE SUITABLY PREPARED USING BONDING AGENT.

**10. CONCRETE TEMPERATURE**

THE PLANT-MIXED FRESH CONCRETE SHALL HAVE A TEMPERATURE BETWEEN +5°C AND +30°C. GENERALLY THE TEMPERATURE OF +30°C SHALL NOT BE EXCEEDED.  
 THE CONCRETE TEMPERATURE DUE TO HEAT OF HYDRATION MUST BE LIMITED TO 60°C. FOR CONCRETE MEMBERS WITHOUT ANY SPECIFIC REQUIREMENTS TO WATER TIGHTNESS (e.g. WALLS ETC.) THE DIFFERENCE BETWEEN CORE TEMPERATURE AND SURFACE TEMPERATURE MUST NOT EXCEED  $\Delta T = 20^\circ\text{C}$  AND FOR WATERTIGHT CONCRETE MEMBERS (e.g. BASEMAT WITH GROUND WATER INFLUENCE)  $\Delta T = 15^\circ\text{C}$ .  
 THE EXPECTED WEATHER CONDITION (HUMIDITY, TEMPERATURE) FOR THE DAY OF POURING SHALL BE CONSIDERED ACCORDINGLY.  
 THE THICKNESS OF A FRESHLY PLACED CONCRETE LAYER SHALL NOT EXCEED 40 cm. THE CONCRETE MUST BE VIBRATED SUFFICIENTLY IN ORDER TO BE ABLE TO ACHIEVE THE SPECIFIED COMPRESSIVE STRENGTH. THE FORMWORK SHALL BE SUFFICIENTLY TIGHT TO PREVENT LOSS OF GROUT.  
 CONCRETE SHALL BE PROTECTED FROM HARMFUL EFFECTS SUCH AS SEVERE HEATING OR COOLING, PREMATURE DRYING OUT (INCLUDING BY WIND), LEACHING OUT BY FALLING RAIN OR FLOWING WATER, CHEMICAL ATTACK OR VIBRATION AND IMPACT WHICH MAY DISRUPT THE CONCRETE OR INTERFERE WITH ITS BOND TO THE REINFORCEMENT.

**11. SYMBOLS**



**12. VISIBLE CONCRETE EDGES**

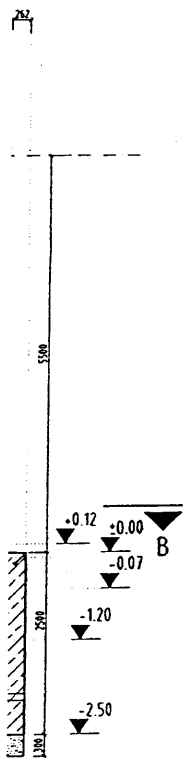
VISIBLE CONCRETE EDGES SHALL BE CHAMFERED 25/25 mm.



13. THE DRAIN PIPE IS FURTHER ROUTED TO SEAL OR PIT. PLAN SUITABLE FLEXIBLE CONNECTION BETWEEN DYNAMIC AND STATIC FOUNDATION.

**REFERENCE DRGS.**

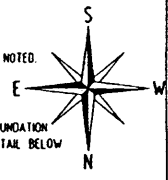
DESCRIPTION	DRG. NO.
1. FOUNDATION LOAD	12909-98015/D01 & 002
2. FOUNDATION PLAN	12909-98011/D01, 002 & 003
3. FOUNDATION PLAN & LOADS CONDENSER	12914-968500-MT010-300074
4. FOUNDATION EARTHING DRAWINGS	C-CMC2-21PMC-EL040-719021 & 719022
5. FORMWORK DRAWING PART 2/4	C-CMC2-21PMC-CL021-611083
6. FORMWORK DRAWING PART 3/4	C-CMC2-21PMC-CL021-611084
7. FORMWORK DRAWING PART 4/4	C-CMC2-21PMC-CL021-611085
8. NUMBERING OF EMBEDDED PARTS, PART 1/3	C-CMC2-21PMC-CL024-611086
9. NUMBERING OF EMBEDDED PARTS, PART 2/3	C-CMC2-21PMC-CL023-611087
10. NUMBERING OF EMBEDDED PARTS, PART 3/3	C-CMC2-21PMC-CL023-611088
11. CONTACT FACES FOR GROUT PLACEMENT	C-CMC2-21PMC-CL023-611089
12. SCHEDULE OF EMBEDDED PARTS, PART 1/3	C-CMC2-21PMC-CL024-611090
13. SCHEDULE OF EMBEDDED PARTS, PART 2/3	C-CMC2-21PMC-CL024-611091
14. SCHEDULE OF EMBEDDED PARTS, PART 3/3	C-CMC2-21PMC-CL024-611092
15. EMBEDDED PART TURBINE ANCHORING TYPE-D	C-CMC2-21PMC-CL024-611093
16. EMBEDDED PART TURBINE ANCHORING TYPE-E	C-CMC2-21PMC-CL024-611094
17. SCHEDULE OF TURBINE ANCHORING TYPE-DE	C-CMC2-21PMC-CL024-611095
18. EMBEDDED PART TURBINE ANCHORING TYPE-DE	C-CMC2-21PMC-CL024-611096
19. EMBEDDED PART TURBINE ANCHORING TYPE-D2	C-CMC2-21PMC-CL022-611097
20. REINFORCEMENT BASEMAT PART 1/3	E-CMC2-028AW-ELD040-250888
21. GROUNDING - TURBINE BUILDING AND GRSG	E-CMC2-028AW-ELD040-250888
22. GROUNDING - TURBINE BUILDING AND GRSG	E-CMC2-028AW-ELD040-250889



**NOTES**

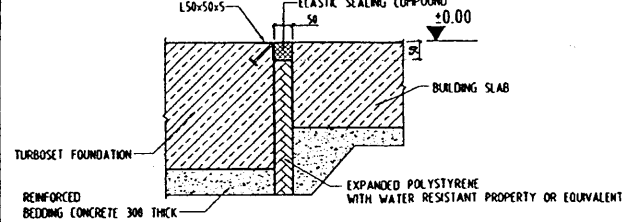
**1. LEVELS**

ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES UNLESS OTHERWISE NOTED.  
 a). BUILDING FLOOR LVL. +0.00m = 3.70m MSL  
 b). FINISHED GROUND LVL. -0.30m = 3.40m MSL



**2. JOINTS**

THE TURBINE-FOUNDATION SHALL BE SEPARATED FROM THE SURROUNDING BUILDING FOUNDATION BY PROVIDING A CONTINUOUS JOINT 50 mm WIDE. ALL AROUND AS SHOWN IN THE DETAIL BELOW  
 EXAMPLE:



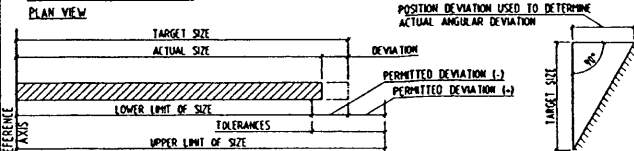
**3. REFERENCE AXES**

BEFORE THE CONSTRUCTION OPERATIONS, THE MAIN LONGITUDINAL AXIS AND THE MAIN TRANSVERSE AXES HAVE TO BE FIXED ON CONCRETE CLOSE TO THE FOUNDATION IN THE REGION OF THE POWER HOUSE - SLAB BY MEANS OF AXES BOLTS.  
 AFTER THE REMOVAL OF FOUNDATION FORMWORK, THE MAIN AXES HAVE TO BE MARKED PERMANENTLY ON THE TURBINE FOUNDATION ON IDENTIFIED PLATES.

**4. ANCHOR HOLES**

THE ANCHOR BOLTS, FIXINGS, SLEEVES AND POCKETS ARE TO BE INSTALLED IN SUCH A MANNER THAT THEIR VERTICAL POSITION IS SECURE DURING THE CONCRETING.

**5. TOLERANCES / VARIATIONS**



THE ALLOWABLE DEVIATIONS AND TOLERANCES WITH RESPECT TO THE REFERENCE AXIS IN PLAN VIEW ARE DEFINED AS FOLLOWS:

	PERMITTED DEVIATION	TOLERANCE
MINOR AXES WITH REFERENCE TO THE MAIN AXES	±1.0mm	2.0mm
FORMWORK OF STRUCTURAL MEMBERS, OPENING ETC.	±10.0mm	20.0mm
EMBEDDED PARTS OF MACHINE ANCHORING IN GENERAL	±10.0mm	20.0mm
SLEEVES OF MACHINE ANCHORING	±10.0mm	10.0mm
EMBEDDED PARTS OF GAS TURBINE ANCHORING [TI]	±5.0mm	10.0mm
EMBEDDED PARTS OF STEAM TURBINE ANCHORING [TYPE D, E]	±10.0mm	20.0mm
OTHER EMBEDDED PARTS, ANCHOR PLATES ETC.	±10.0mm	20.0mm
FLAT STEEL ANCHOR PLATES AT TOP SURFACE OF TURBINE FOUNDATION	±35.0mm	70.0mm

THE ALLOWABLE DEVIATIONS AND TOLERANCES OF ELEVATION WITH REFERENCE TO THE MACHINE AXIS OR THE LEVEL BENCHMARK ARE DEFINED AS FOLLOWS:

	PERMITTED DEVIATION	HEIGHT	ANGULARITY
FORMWORK AND SURFACES OF STRUCTURAL MEMBERS	±10.0mm		±1/300
EMBEDDED PARTS OF MACHINE ANCHORING IN GENERAL	±5.0mm		±1/300
SLEEVES OF MACHINE ANCHORING	±10.0mm		±1/300
EMBEDDED PARTS OF GAS TURBINE ANCHORING [TI]	±5.0mm		±1/300
EMBEDDED PARTS OF STEAM TURBINE ANCHORING [TYPE D, E]	±5.0mm		±1/300
OTHER EMBEDDED PARTS, ANCHOR PLATES ETC.	±10.0mm		±1/200

**6. CONCRETE**

CONCRETE GRADE FOR BASEMAT (STAGE:1 CONCRETE) AND PLINTHS (STAGE:2 CONCRETE) SHALL BE ACCORDING TO ACI 318 WITH MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF 1=280kg/cm² AT 28 DAYS WITH MEAN MODULUS OF ELASTICITY E=25000 MN/m².  
 LEAN CONCRETE GRADE SHALL BE WITH MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF 1=150kg/cm² AT 28 DAYS. CONCRETE TOP SURFACE SHALL BE FINISHED BY LEVELING AND POWER FLOAT FINISH APART FROM THE ONES GIVEN IN THE DRAWING NO. C-CMC2-21PMC-CL023-611089.

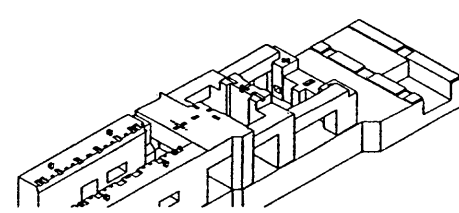
**7. REINFORCEMENT**

REINFORCEMENT SHALL BE S40 WITH MINIMUM YIELD STRENGTH 1yk=392 N/mm² ACCORDING TO THAI INDIVIDUAL STANDARD OR EQUIVALENT DUE TO LOCAL AVAILABILITY (e.g. ASTM A65) SHALL BE USED.

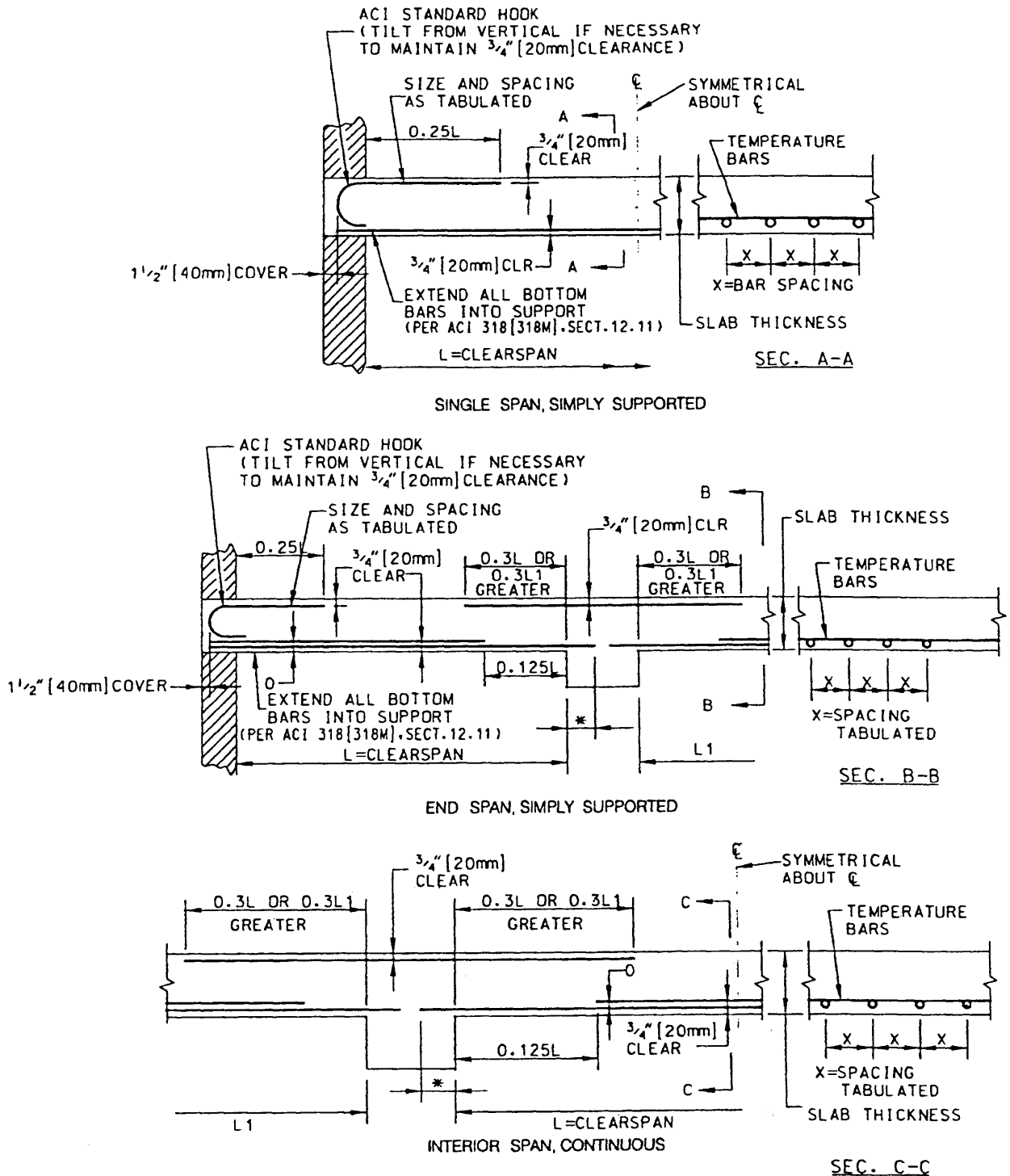
**8. EMBEDDED PARTS**

FOR DETAILS OF EMBEDDED PARTS, REFER DRG. NO. C-CMC2-21PMC-CL024-611090 TO 611092.  
 ALL EMBEDDED PLATES SHALL BE FLUSH WITH THE FACE OF CONCRETE, UNLESS OTHERWISE NOTED.  
 ALL EMBEDDED STEEL SHALL CONFORM TO GRADE ASTM A36 WITH MINIMUM YIELD STRENGTH 250MPa OR EQUIVALENT.  
 ANCHOR BOLTS SHALL BE OF GRADE ASTM A36 WITH MINIMUM YIELD STRENGTH OF 250MPa OR EQUIVALENT.  
 ALL EMBEDDED PARTS ARE TO BE SUPPLIED ON SITE BY CIVIL CONTRACTOR UNLESS OTHERWISE NOTED.  
 EXPOSED SURFACES OF EMBEDDED PARTS TO BE HOT DIPPED GALVANIZED AFTER FABRICATION.  
 C-CHANNEL C60x22x2 SHALL BE HOT DIP GALVANIZED.  
 OPENING FOR PIPE SLEEVES SHALL BE PROTECTED FROM FRESH CONCRETE BY PLUGGING WITH JUTE OR OTHER SUITABLE MATERIAL BEFORE POURING OF CONCRETE.

EMBEDDED PARTS



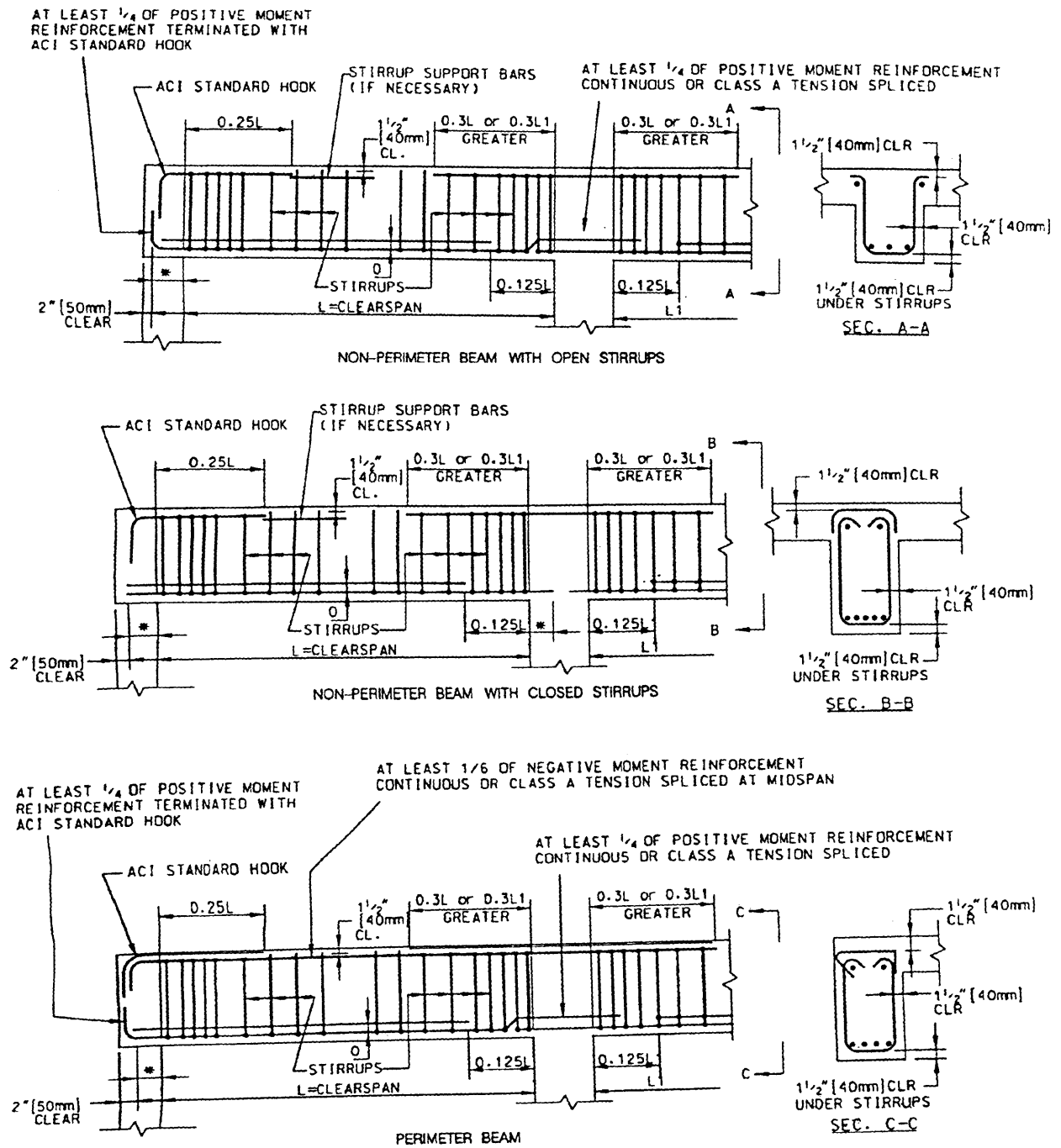
MANUAL OF CONCRETE PRACTICE  
PART C—FIGURES AND TABLES



\* MIN. 6" [150mm], UNLESS OTHERWISE SPECIFIED BY THE ARCHITECT/ENGINEER

Note: Unless noted otherwise, tables and figures are based on ACI 318 (318M). Concrete cover shown is minimum and should be increased for more severe conditions. Except for single span slabs where top steel is unlikely to receive construction traffic, top bars lighter than No. 4 at 12 in. (No. 13 at 300 mm) are not recommended. For a discussion of bar support spacing, see Section 5.4 of this standard. See also Chapter 12 of ACI 318 (318M). Bar cutoff details must be verified to provide required development of reinforcement.

Fig. 1—Typical details for one-way solid slabs.

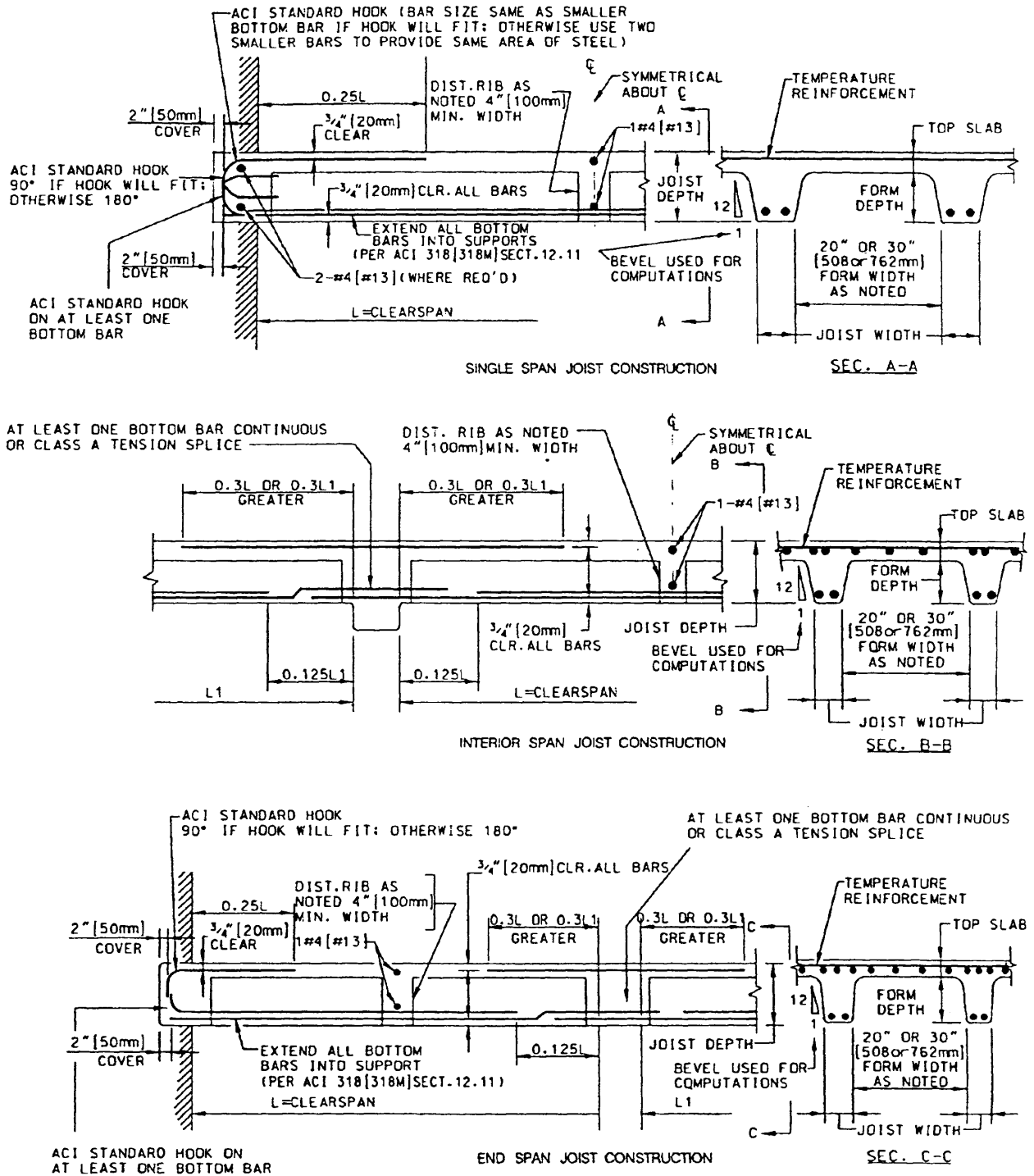


\* MIN. 6" [150mm], UNLESS OTHERWISE SPECIFIED BY THE ARCHITECT/ENGINEER

Note: Check available depth, top and bottom, for required cover on ACI standard hooks. At each end support, add top bar 0.25L in length to equal area of bars required. See also Chapter 12 and Chapter 21 of ACI 318 (318M). Bar cutoff details must be verified to provide required development of reinforcement.

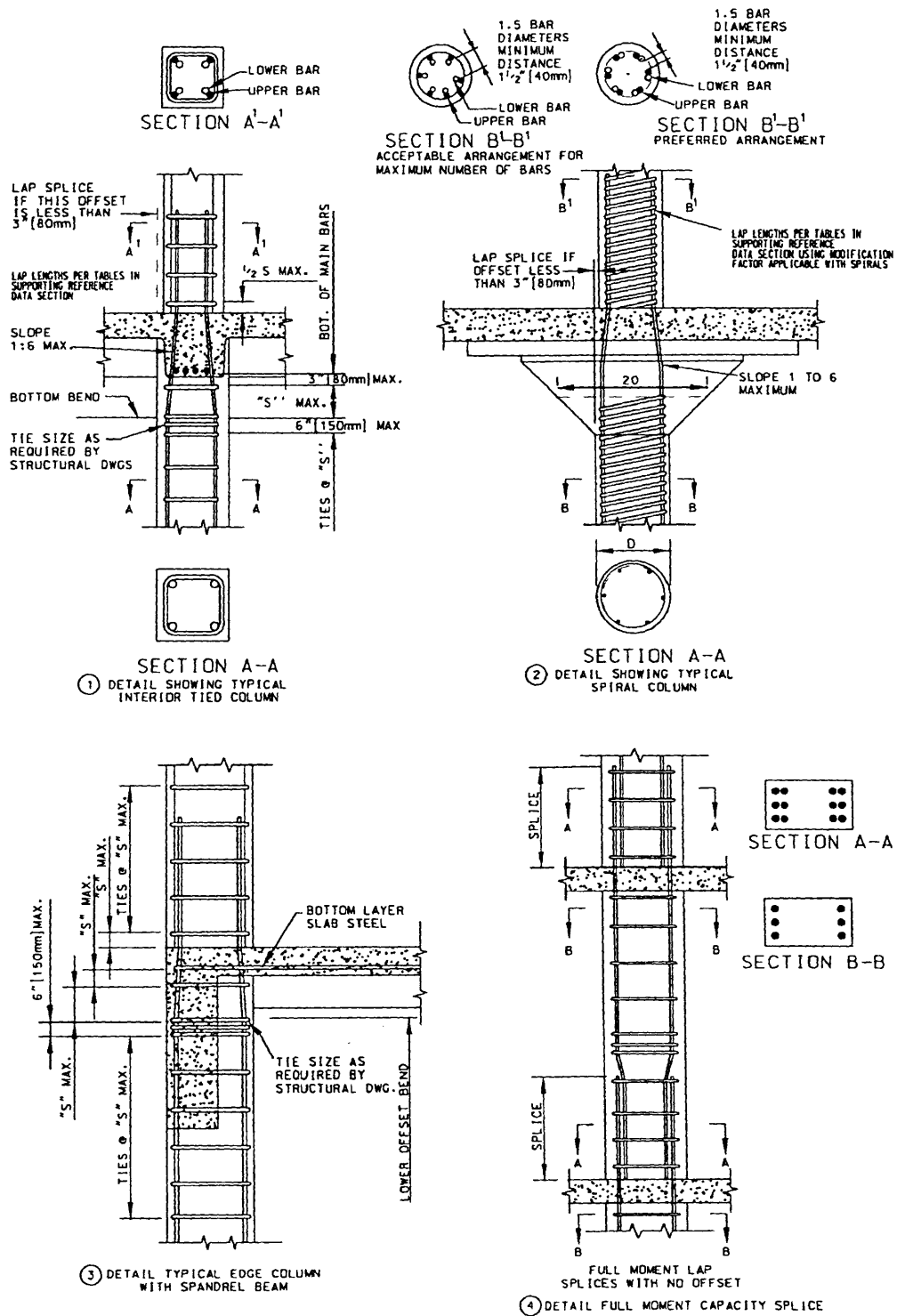
Fig. 2—Typical details for beams.





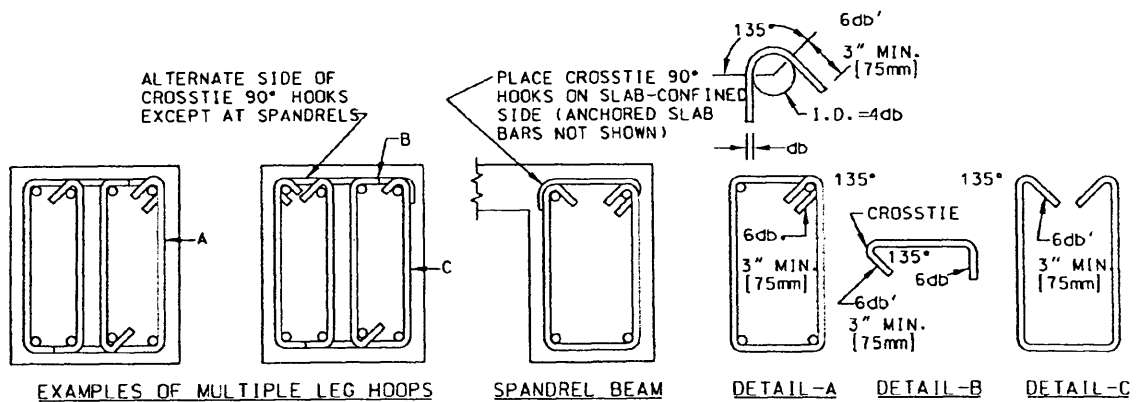
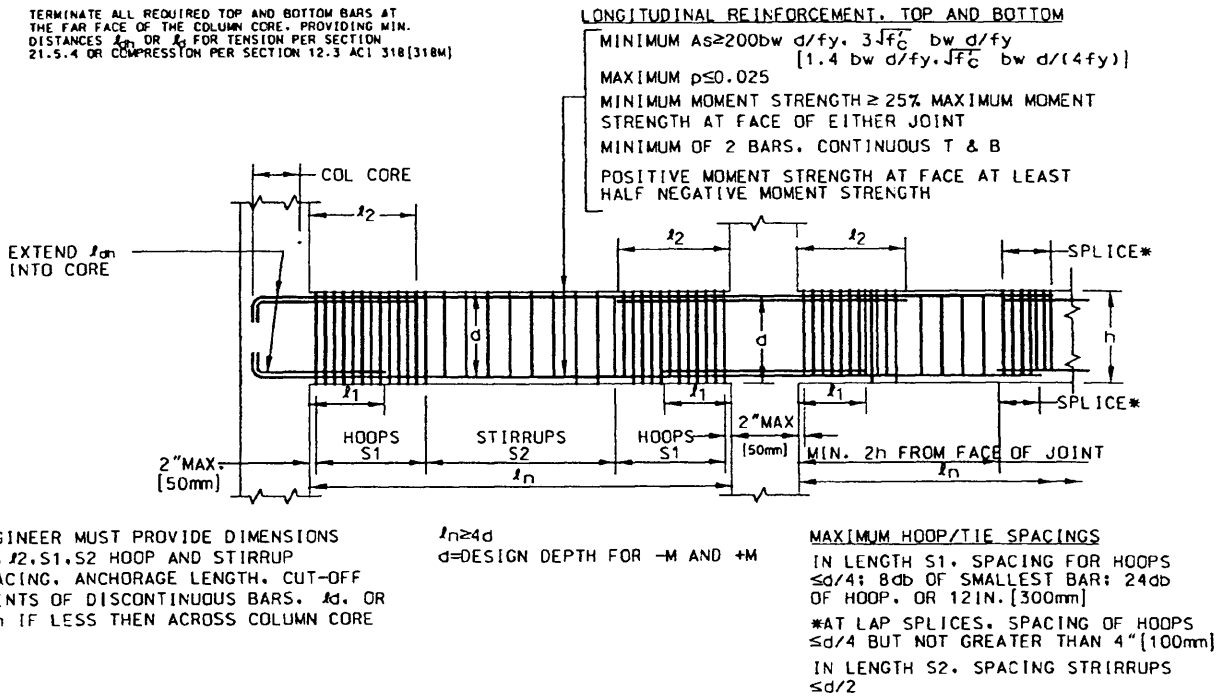
Note: See also Chapter 12 and Section 7.13 of ACI 318 (318M). Bar cutoff details must be verified to provide required development of reinforcement.

Fig. 3—Typical details for one-way joist construction.



Note: Where column size above is unchanged from below, "upside down" offset bars are effective in maintaining full moment capacity at end of column. In U.S. practice, this unusual detail is rare, and should be fully illustrated on structural drawings to avoid misunderstandings, whenever its use is deemed necessary. For maximum tie spacing, see table in Supporting Reference Data section.

Fig. 4—Column splice details.



STIRRUPS REQUIRED TO RESIST SHEAR SHALL BE HOOPS OVER LENGTH AS SPECIFIED IN ACI 21.3.3.5. THROUGHOUT THE LENGTH OF FLEXURAL MEMBERS WHERE HOOPS ARE NOT REQUIRED, STIRRUPS MUST BE SPACED AT NO MORE THAN  $d/2$

Fig. 5—Typical seismic-resistant details: flexural members.

## 4. ขนาด มวล และเกณฑ์ความคลาดเคลื่อน

4.1 ชื่อขนาด ขนาดระบุ และมวลระบุของเหล็กเส้นกลม ให้เป็นไปตามตารางที่ 1

ตารางที่ 1 ชื่อขนาด ขนาดระบุ และมวลระบุของเหล็กเส้นกลม  
(ข้อ 2.4 ข้อ 2.5 และข้อ 4.1)

ชื่อขนาด	ขนาดระบุ		มวลระบุ กิโลกรัมต่อเมตร
	เส้นผ่านศูนย์กลางระบุ มิลลิเมตร	พื้นที่ภาคตัดขวางระบุ ตารางมิลลิเมตร	
RB 6	6	28.3	0.222
RB 8	8	50.3	0.395
RB 9	9	63.6	0.499
RB 10	10	78.5	0.616
RB 12	12	110.1	0.888
RB 15	15	176.7	1.387
RB 19	19	283.5	2.226
RB 22	22	380.1	2.984
RB 25	25	490.9	3.853
RB 28	28	615.8	4.834
RB 34	34	907.9	7.127

หมายเหตุ 1. พื้นที่ภาคตัดขวางระบุ =  $3,1416 \left( \frac{\text{เส้นผ่านศูนย์กลางระบุ เป็นมิลลิเมตร}}{2} \right)^2$   
เป็นตารางมิลลิเมตร2. มวลระบุ =  $0.00785 \left( \frac{\text{พื้นที่ภาคตัดขวางระบุ เป็นตารางมิลลิเมตร}}{1000} \right)$   
เป็นกิโลกรัมต่อเมตร

## 4.2 มวลต่อเมตรของเหล็กเส้นกลม

4.2.1 มวลต่อเมตรของเหล็กเส้นกลมแต่ละเส้นจะคลาดเคลื่อนจากค่ามวลระบุได้ไม่เกินเกณฑ์ที่กำหนดในตารางที่ 2 สดมภ์ที่ 3

4.2.2 มวลต่อเมตรเฉลี่ย จะคลาดเคลื่อนจากค่ามวลระบุได้ไม่เกินเกณฑ์ที่กำหนดในตารางที่ 2 สดมภ์ที่ 4 การทดสอบให้ปฏิบัติตามข้อ 9.1

### 3. ชั้นคุณภาพ

3.1 เหล็กข้ออ้อยแบ่งตามส่วนประกอบทางเคมีและสมบัติทางกลออกเป็น 3 ชั้นคุณภาพ ตามตารางที่ 5 และ ตารางที่ 7 ได้แก่

- (1) ชั้นคุณภาพ SD 30
- (2) ชั้นคุณภาพ SD 40
- (3) ชั้นคุณภาพ SD 50

### 4. ขนาด มวล และโมเมนต์ความเฉื่อย

4.1 ชื่อขนาด ขนาดระบุ และมวลระบุของเหล็กข้ออ้อย ให้เป็นไปตามตารางที่ 1

ตารางที่ 1 ชื่อขนาด ขนาดระบุ และมวลระบุของเหล็กข้ออ้อย  
(ข้อ 2.5 ข้อ 2.7 และข้อ 4.1)

ชื่อขนาด	ขนาดระบุ		มวลระบุ (W <sub>N</sub> ) kg/m
	เส้นผ่านศูนย์กลางระบุ (d <sub>N</sub> ) mm	พื้นที่ภาคตัดขวางระบุ (S <sub>N</sub> ) mm <sup>2</sup>	
DB 6	6	28.3	0.222
DB 8	8	50.3	0.395
DB 10	10	78.5	0.616
DB 12	12	113.1	0.888
DB 16	16	201.1	1.578
DB 20	20	314.2	2.466
DB 22	22	380.1	2.984
DB 25	25	490.9	3.853
DB 28	28	615.8	4.834
DB 32	32	804.2	6.313
DB 36	36	1 017.9	7.990
DB 40	40	1 256.6	9.865

หมายเหตุ 1.  $S_N = \frac{3.1416 d_N^2}{4}$

2.  $W_N = 0.00785 S_N$