

タイ王国

タイ国鉄道橋梁改良計画

調査報告書

付録Ⅰ 1・2橋の補修、補強工事基本設計図

昭和52年1月

国際協力事業団

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タイ王国

タイ国鉄道橋梁改良計画

調査報告書

付録Ⅴ 12橋の補修、補強工事基本設計図

昭和52年1月

国際協力事業団

國際協力事業団	
設立 日 '84. 8. 24	122
	61.6
登録No. 13876	SDS

## 付 録 IX

### 12橋の補修・補強工事・基本設計図

No.	支 間 長	型 式	路 線	位 置	製 作 会 社	ペ ー ジ
(1)	20.0	T.P.	S-Line	1122 +255	Cleveland	3
(2)	25.0	T.T.	S-Line	897 +174	Cleveland	7
(3)	30.0	T.T.	S-Line	929 +903	Cleveland	13
(4)	30.0	T.T.	N-Line	263 +335	Daydé	18
(5)	30.0	D.T.	N-Line	577 +622		24
(6)	35.0	T.T.	S-Line	403 +257	Cleveland	32
(7)	40.0	T.T.	N-Line	311 +599	Daydé	37
(8)	45.0	T.T.	S-Line	672 +874	Cleveland	43
(9)	50.0	T.T.	S-Line	1063 +810	Cleveland	48
(10)	60.0	T.T.	S-Line	930 +931	Cleveland	54
(11)	70.0	T.T.	S-Line	297 +063	Cleveland	61
(12)	80.0	T.T.	NE-Line	479 +741	Daydé	69

## ま え が き

調査を実施した214スパンの中から代表的な12橋について補修・補強工事の基本設計図を作成し、各型式の橋梁について現場施工時の注意事項を記述する。

図面の適用に関して

これら12橋の詳細補強補修図の作成にあたっては、全で一橋一橋特別に詳細な調査を行ったものではなく、且つ詳細図を作成することを目的にして現地調査したものでもない。

あくまでも詳細設計図に対するアプローチの一手段に過ぎず、サンプルを呈示しているに留まっている。

従って、これら12橋の詳細補強補修図と謳っている図面が即製作図にはならない。

これらの橋梁の詳細図は、あくまでタイ国にて次に述べる事項等を再度調査して作成されるものである。

1. 架橋位置条件等の確認
2. 補強部材の確認
3. 補強、補修に関連のある全ての部材寸法(リベットピッチ等も含む)
4. 腐食、変状等の状態、位置、寸法の確認
5. 弛緩リベットの確認

等が必要である。

またある橋梁の補強、補修の詳細図作成及びその製作、施工にあたっては、今回作成した標準設計図、本文のⅥ章、Ⅶ章、12橋の詳細図、設計示方書、製作示方書、工事示様書等の真意を充分汲んで実行されねばならない。

# GENERAL DIAGRAM

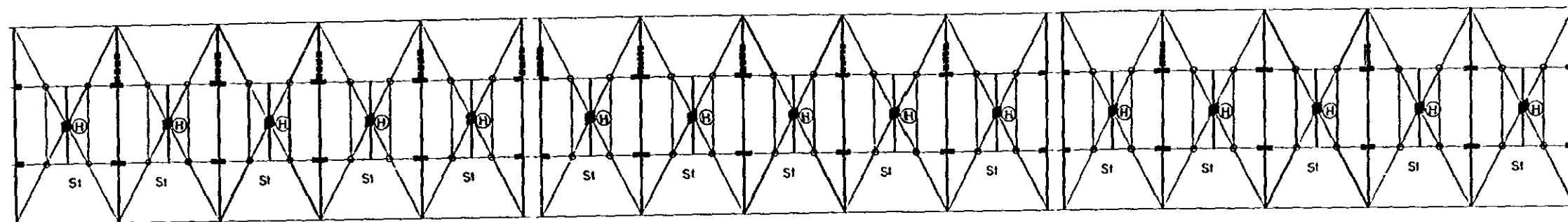
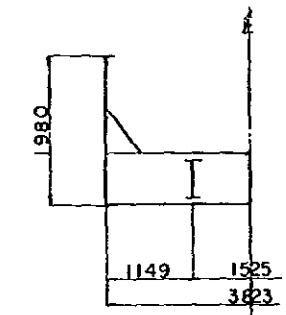
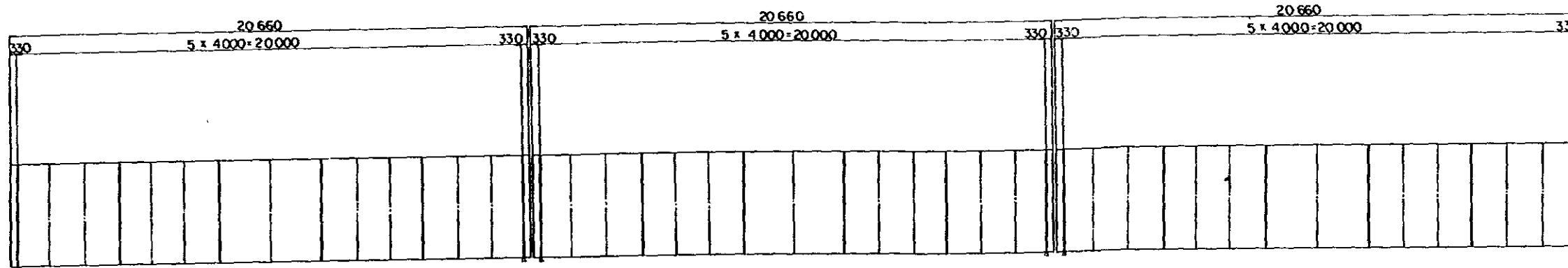
BRIDGE NO. 1

BRIDGE NO. 2

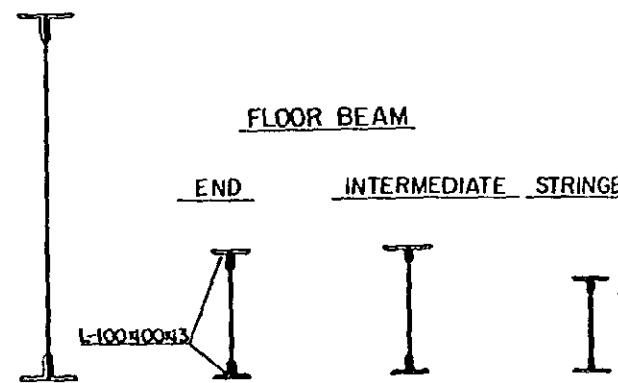
BRIDGE NO. 3

Sungai kolok

Bangkok



## MAIN GIRDER



END	INTERMEDIATE	STRINGER
M=290.3	M=30.7	M=33.2
$\sigma_c = 1128$	$\sigma_c = 913$	$\sigma_c = 985$
$\sigma_t = 1155$	$\sigma_t = 1034$	$\sigma_t = 1116$
$\sigma_{ca} = 1119$	$\sigma_{ca} = 1183$	$\sigma_{ca} = 1183$
$\sigma_{ta} = 1300$	$\sigma_{ta} = 1300$	$\sigma_{ta} = 1300$

**Note :**

- 1) ■ : Excessive stressed rivets to be strengthened
- 2) ◆ : Gusset plates to be improved
- 3) ○ : Defective hanger to be removed.
- 4) St : New strut to be added.
- 5)  $\frac{1}{2}$  : Web plates to be repaired.
- 6) ⊕ : Hanger to be added.

**General Notes :**

- 1) Weak drawings show the original members  
Deep drawings show the members to be improved

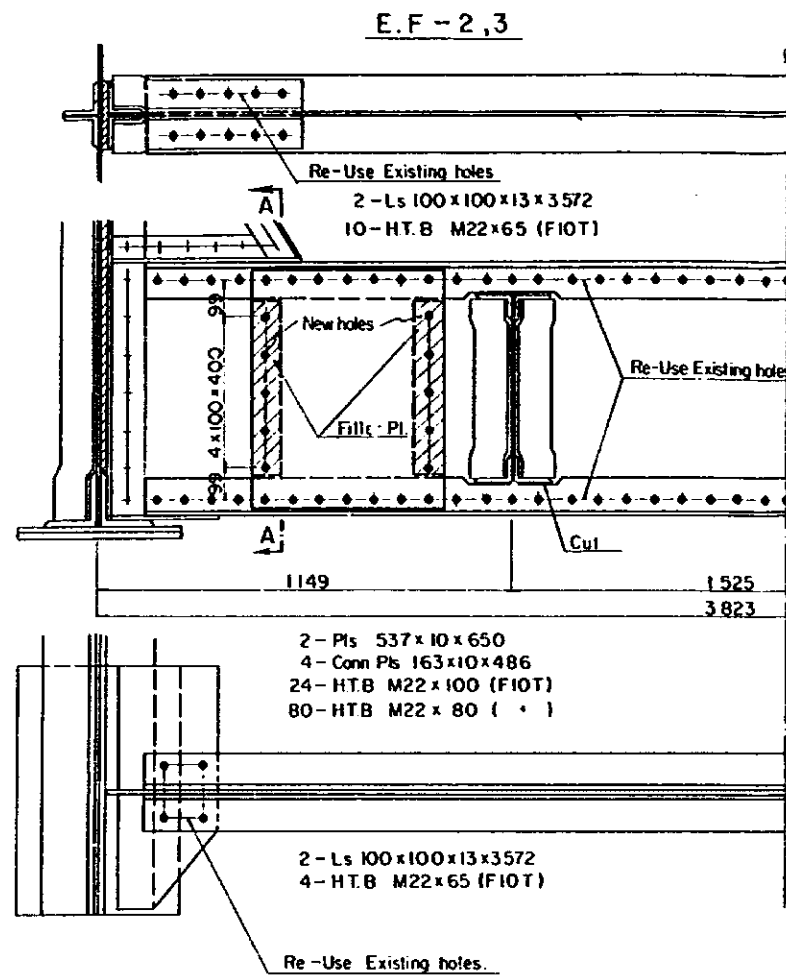
2) Actual stresses are based on DL-15 loading

3) Marks

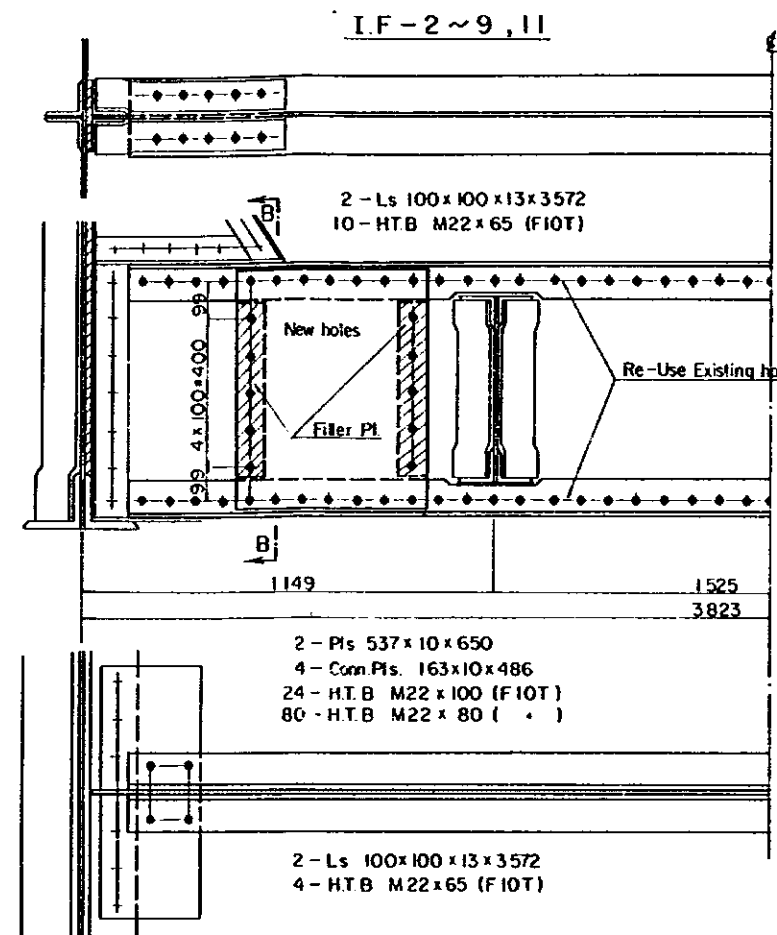
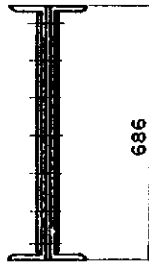
- M : Bending moment (t.m)
- $\sigma$  : Actual stress (kg/cm<sup>2</sup>)
- $\sigma_a$  : Allowable stress (kg/cm<sup>2</sup>)

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL-15 loading	
200 T.T	GENERAL DIAGRAM	Unit	Scale
		mm	
K. M.	1122 + 255	Designed by	_____
DISTRICT	Yala	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	_____

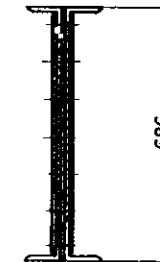
FLOOR SYSTEM (NO.1) s=1/10



SECTION A - A



SECTION B - B



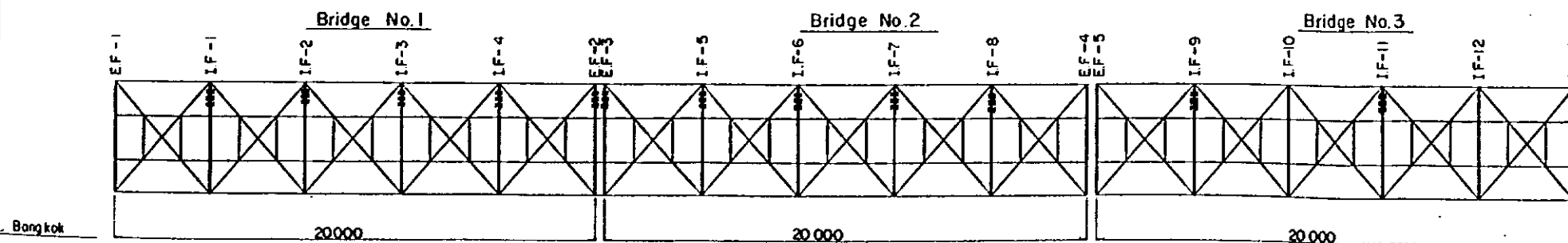
Note  
E.F-1 is only Lower Flange

Note:  
I.F-1 is only Web Plate.

General Notes :

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent
- 2) All high-strength bolts (HTB) are M22 (Φ XFIOT), and assumed frictional coefficient of contact surface (f) as follows.
  - i) for connection 1/204
  - ii) for stitch 1/203
- 3) All dimensions to be checked in the field.

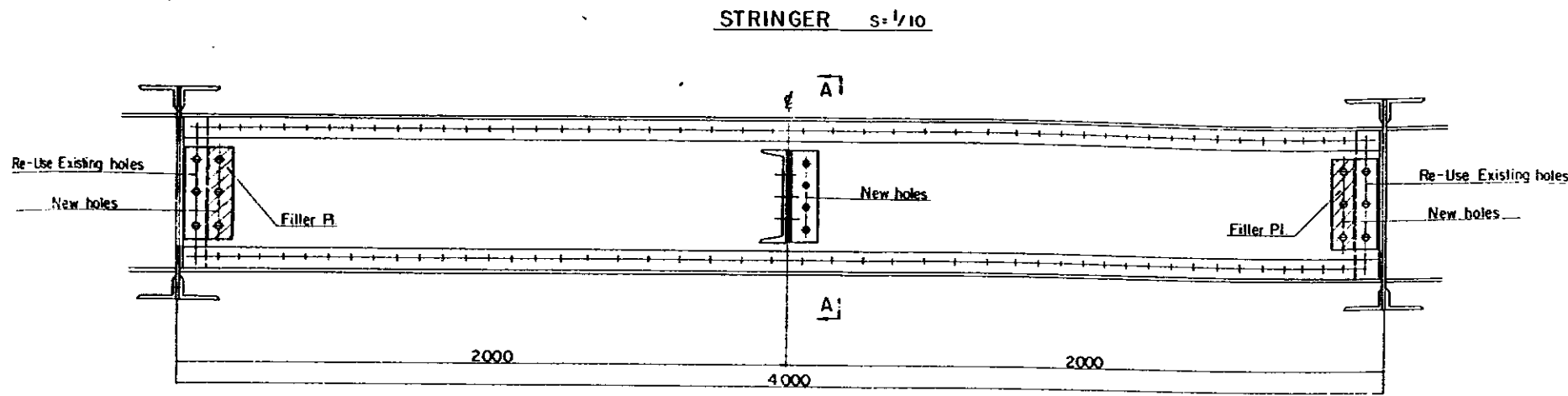
MARKING DIAGRAMS



THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members FLOOR SYSTEM (NO.1)	DL 15 loading	
20.0 T.T		Unit	Scale
		mm	1/10
K M	1122 + 255	Designed by	_____
DISTRICT	Yala	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

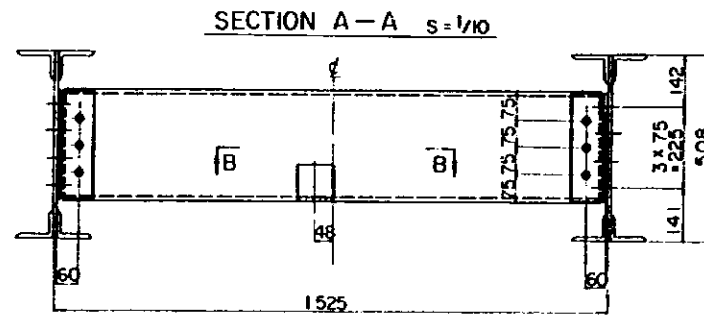


# FLOOR SYSTEM (NO.2)

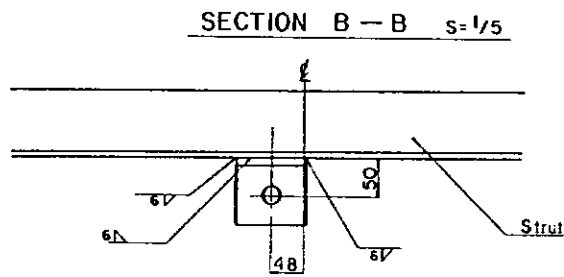


- (2 - Connection)
- 4 - Pls 148 x 10 x 236
- 4 - Fill Pls 74 x 10 x 296
- 12 - Rivets 22<sup>#</sup>

## STRUT OF STRINGER (S1)



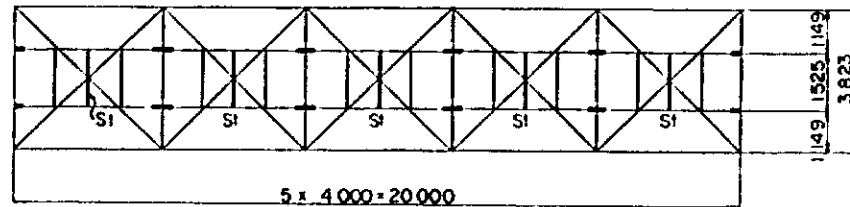
- 1 - C 300 x 90 x 10 x 1475
- 2 - Ls 100 x 100 x 10 x 290
- 14 - HTB M22 x 60 (F10T)



1 - L 100 x 100 x 10 x 100

## MARKING DIAGRAMS

Bridge No. 1, 2, 3



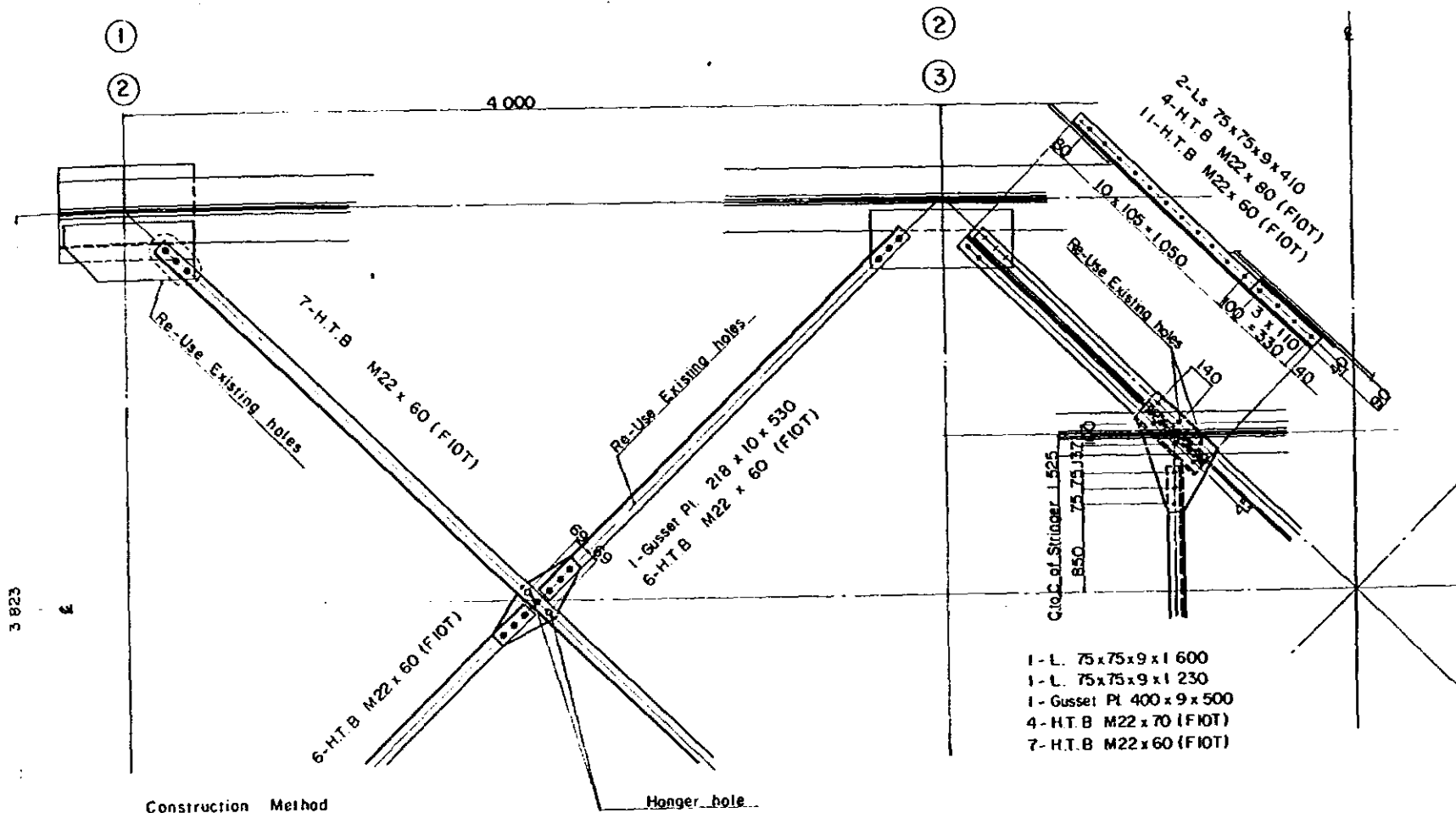
- Note :
- : Strengthening of connection.
  - S1 : Installation of new strut.

### General Notes :

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (F10T), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22<sup>#</sup> (F), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	FLOOR SYSTEM	DL 15 loading
			Unit Scale
200 T.P			mm 1/10, 1/5
K.M.	1125 + 255	Designed by	_____
DISTRICT	Yala	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	5742

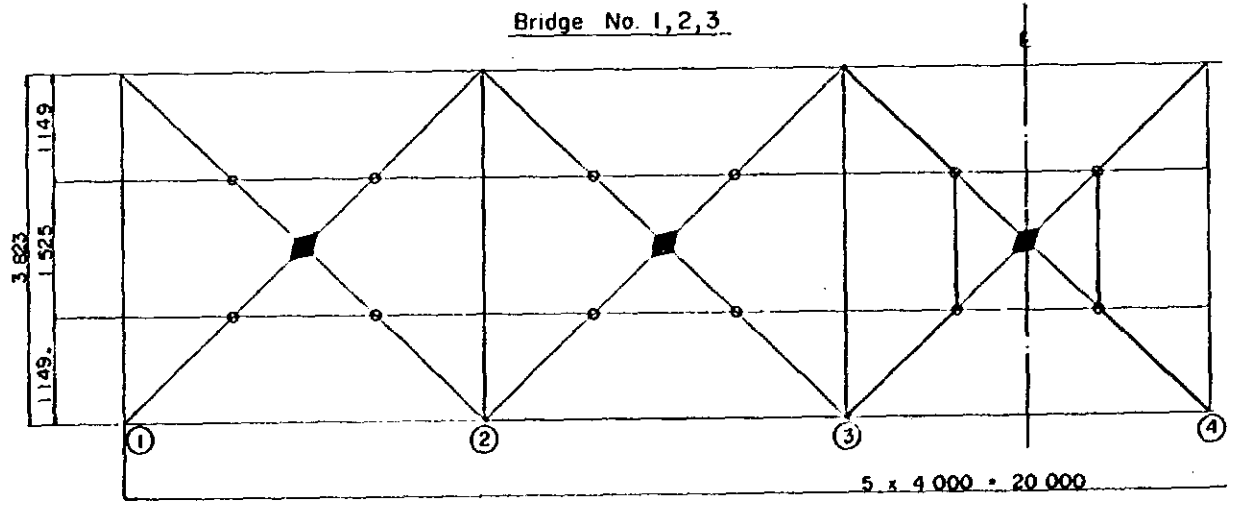
LOWER LATERAL BRACING s=1/15



- Construction Method**
- 1) Cut off rivets of originals.
  - 2) Drill new bolt holes.
  - 3) Clean surface between original and new members.
  - 4) Attach new connection plate.
  - 5) Tighten H.T. Bolts

**MARKING DIAGRAMS**

Bridge No. 1, 2, 3

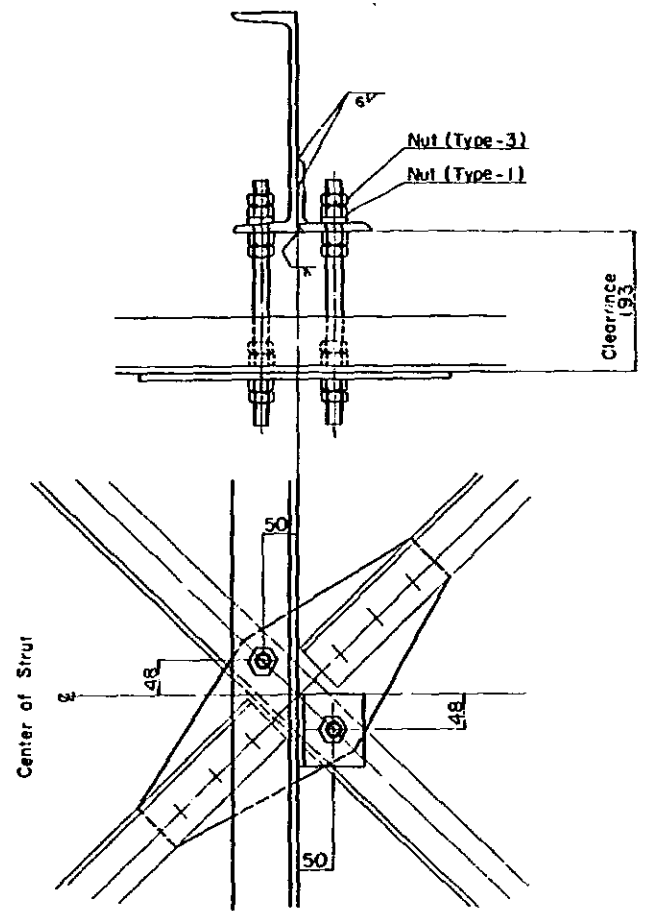


- Note :**
- 1)  $\blacklozenge$  : Strengthening Connection and Hanger
  - 2)  $\circ$  : Replacement of connection.

**General Notes**

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22( $\blacklozenge$ )(FIOT), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field

**HANGER s=1/5**



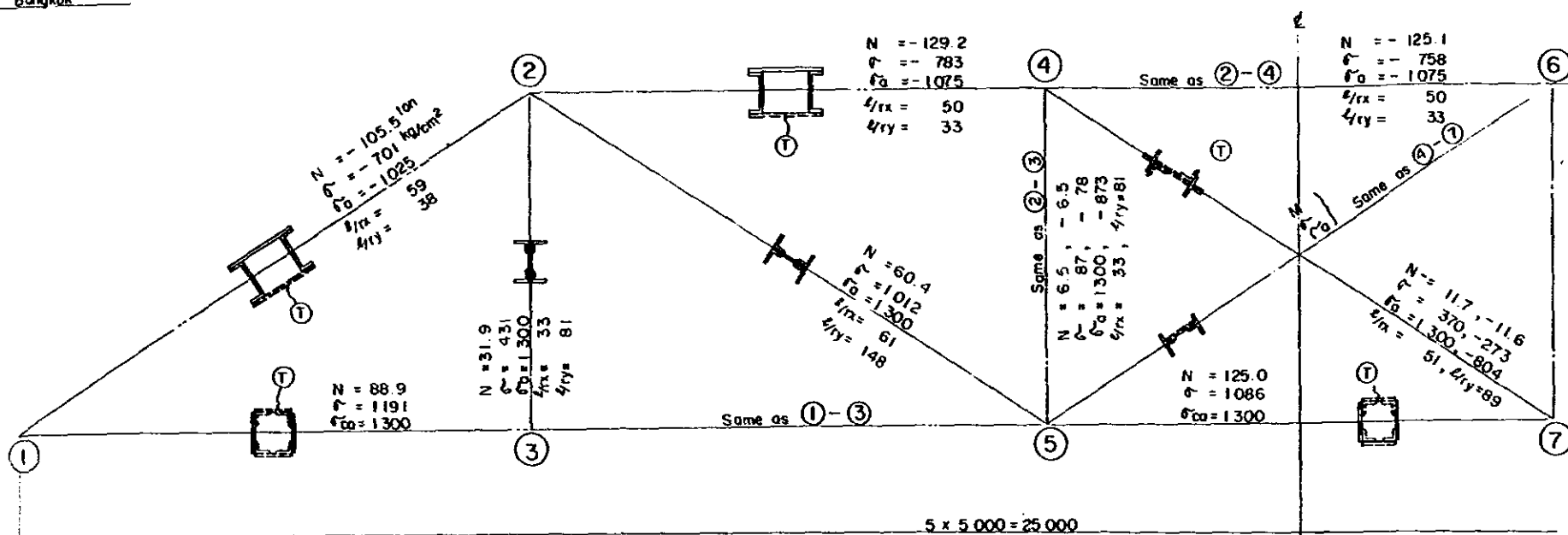
- 2 - Round Bar 22<sup>ø</sup> x 330
- 8 - Nut M22 (Type - 1)
- 8 - Nut M22 (Type - 3)
- 8 - Washer M22

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	LOWER LATERAL BRACING	D.L. 15 loading
200 T.P			Unit Scale
			mm 1/15, 1/5
K.M	1122 + 255		Designed by
DISTRICT	Yala		Checked by
LINE	Southern Line		Checked by
Remarks			Checked by
			Checked by
			Checked by
DATE		DRAWING NO.	5742

Bangkok

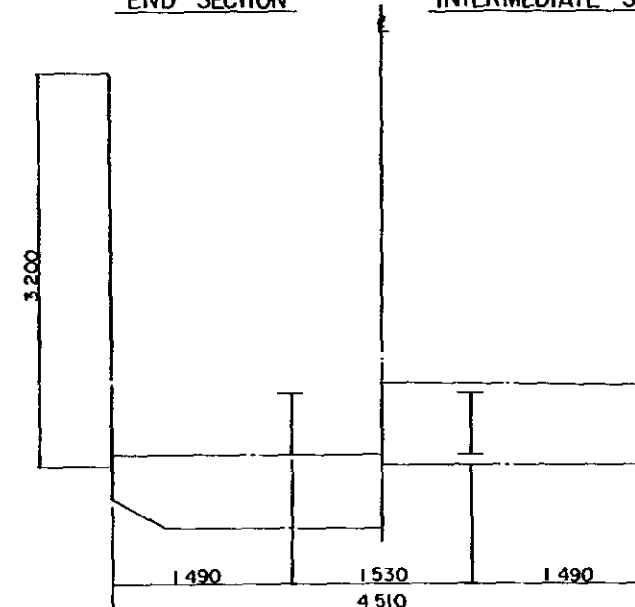
MAIN TRUSS

Hai Yai



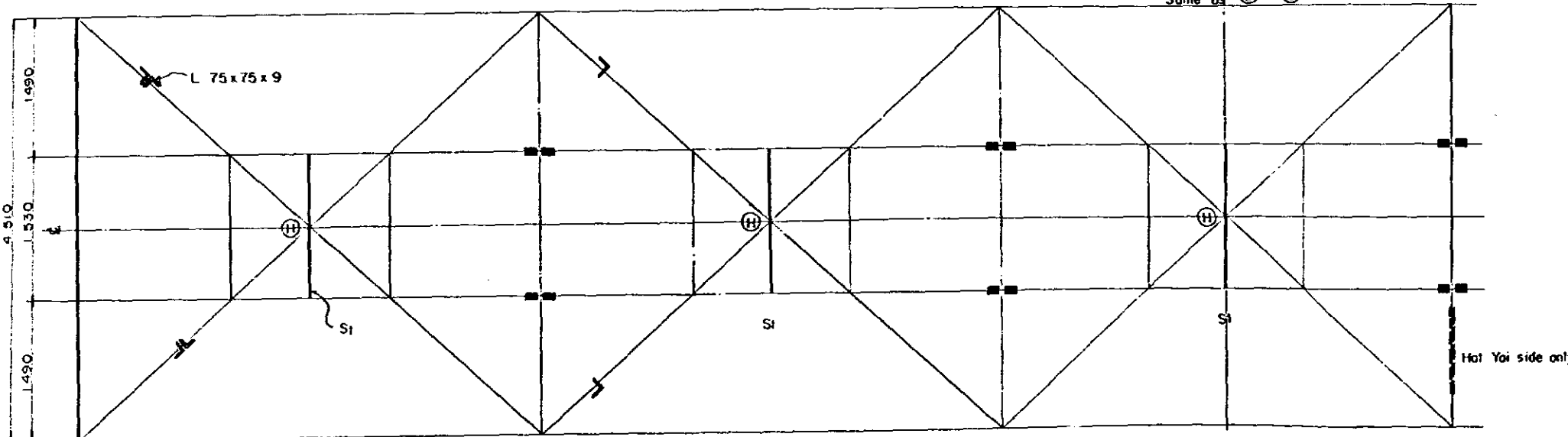
END SECTION

INTERMEDIATE SECTION



FLOOR SYSTEM & LOWER LATERAL

Same as 3-5

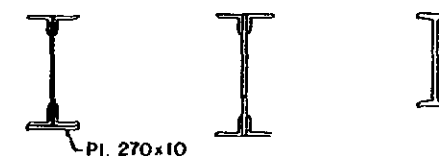


FLOOR BEAM

STRINGER

END

INTERMEDIATE



M = 43.5	M = 47.3	M = 26.8
$\sigma_c = -1139$	$\sigma_c = -1080$	$\sigma_c = -1122$
$\sigma_t = -913$	$\sigma_t = 1176$	$\sigma_t = 1122$
$\sigma_{ca} = -1184$	$\sigma_{ca} = -1188$	$\sigma_{ca} = -1078$
$\sigma_{ta} = 1300$	$\sigma_{ta} = 1300$	$\sigma_{ta} = 1300$

General Notes

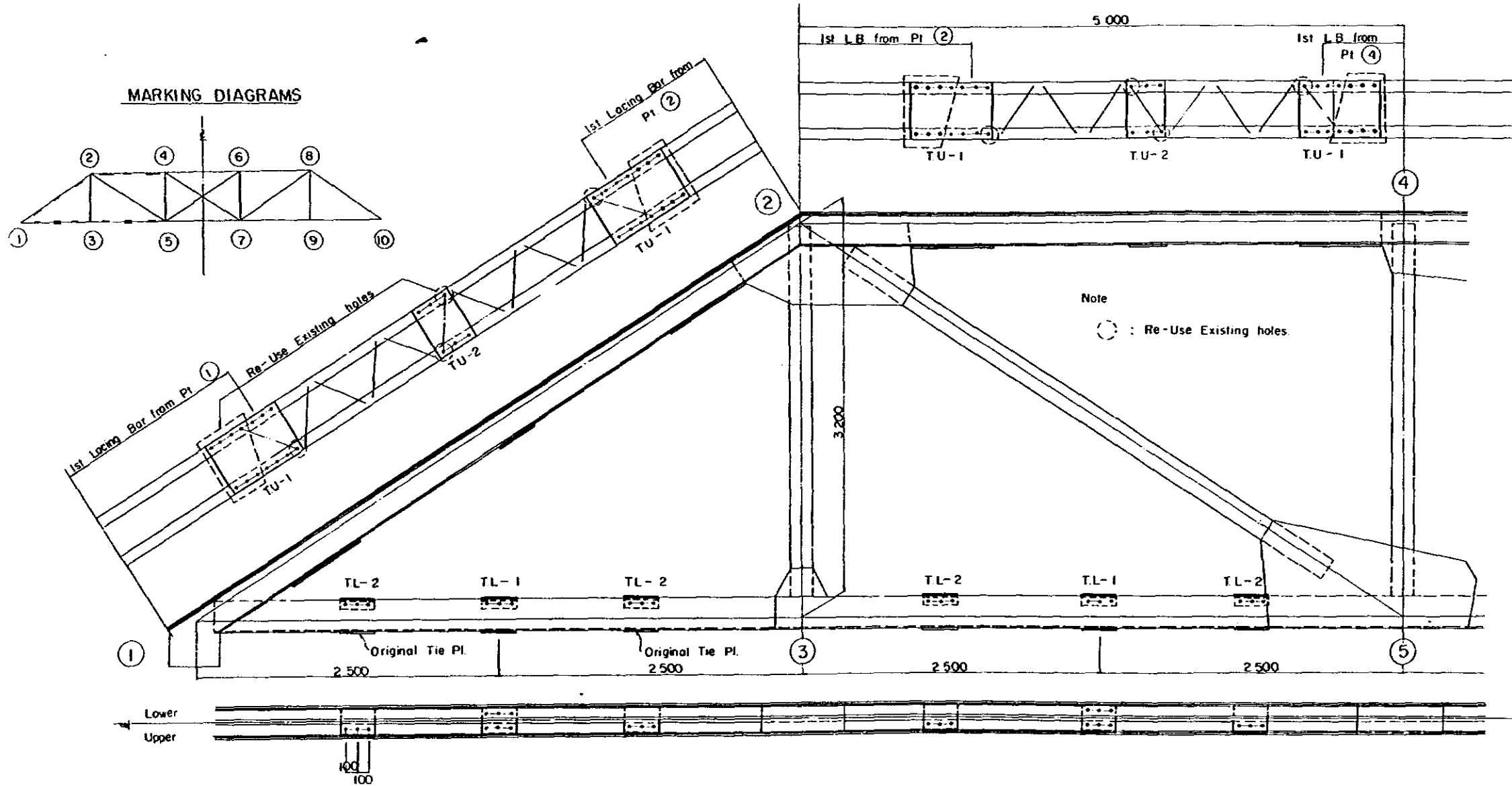
- Weak drawings show the original members. Deep drawings show the members to be improved.
- Actual stress are based on DL-15 loading.
- Marks:
  - M : Bending moment (tm)
  - N : Axial force (t)
  - l : Length of member (cm)
  - $r_x, r_y$  : Radius of gyration of sectional area for x or y axis (cm)
  - $l/r$  : Slenderness ratio.
  - $\sigma$  : Actual stress (kg/cm<sup>2</sup>)
  - $\sigma_a$  : Allowable stress (kg/cm<sup>2</sup>)

Legends :

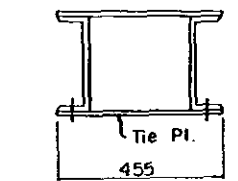
- Excessive stressed rivets to be strengthened
- Hanger to be added
- Tie plates to be strengthened
- New strut to be added.
- Web plates to be repaired.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	GENERAL DIAGRAM	DL-15 loading
25.0 FT			Unit Scale
			mm
K M	897 + 174	Designed by	
DISTRICT	Hai Yai	Checked by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

MAIN TRUSS MEMBERS (NO.1) s=1/20



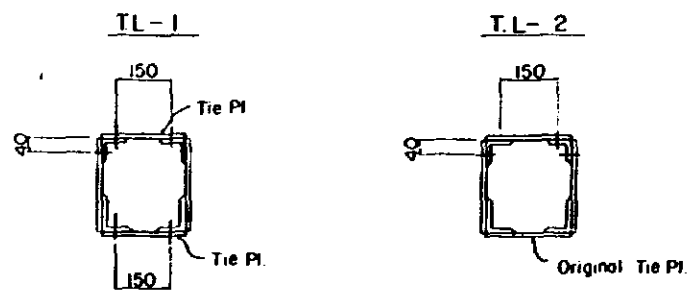
DETAIL T.U s=1/10



1-Tie Pl 455x10xL  
n-HTB M22x65 (FIOT)

	TU-1	TU-2
L	680	330
n	14	6

DETAIL T.L s=1/10



2-Tie Pls 230x10x280  
2-Ls 75x75x9x280  
1B-HTB M22x60(FIOT)

1-Tie Pl. 230x10x280  
2-Ls 75x75x9x280  
2-HTB M22x60(FIOT)

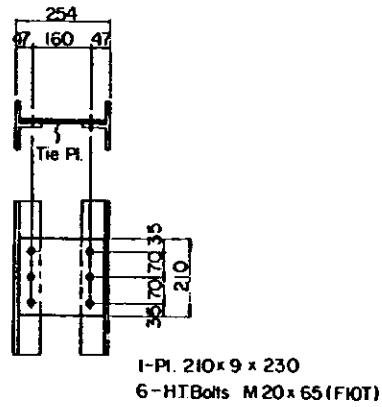
General Notes

- All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- All high-strength bolts (HTB) are M22 (F10T), and assumed frictional coefficient of contact surface as follows:
  - for connection 0.4
  - for steel 0.3
- All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
250 T.T	MAIN TRUSS MEMBERS (NO.1)	Unit	Scale
K.M	897 + 174	mm	1/20, 1/10
DISTRICT	Hof Yai	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

MAIN TRUSS MEMBERS (NO.2)  $s = 1/20$

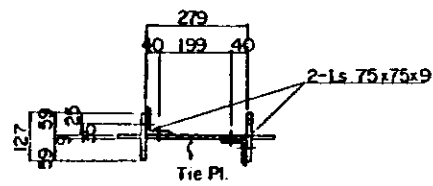
SECTION A - A  $s = 1/10$



Construction Methods

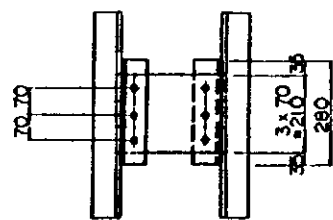
- 1) Drill new bolt holes
- 2) Clean surface between original and additional members.
- 3) Add new Tie Plates and tighten HT Bolts

SECTION B - B  $s = 1/10$

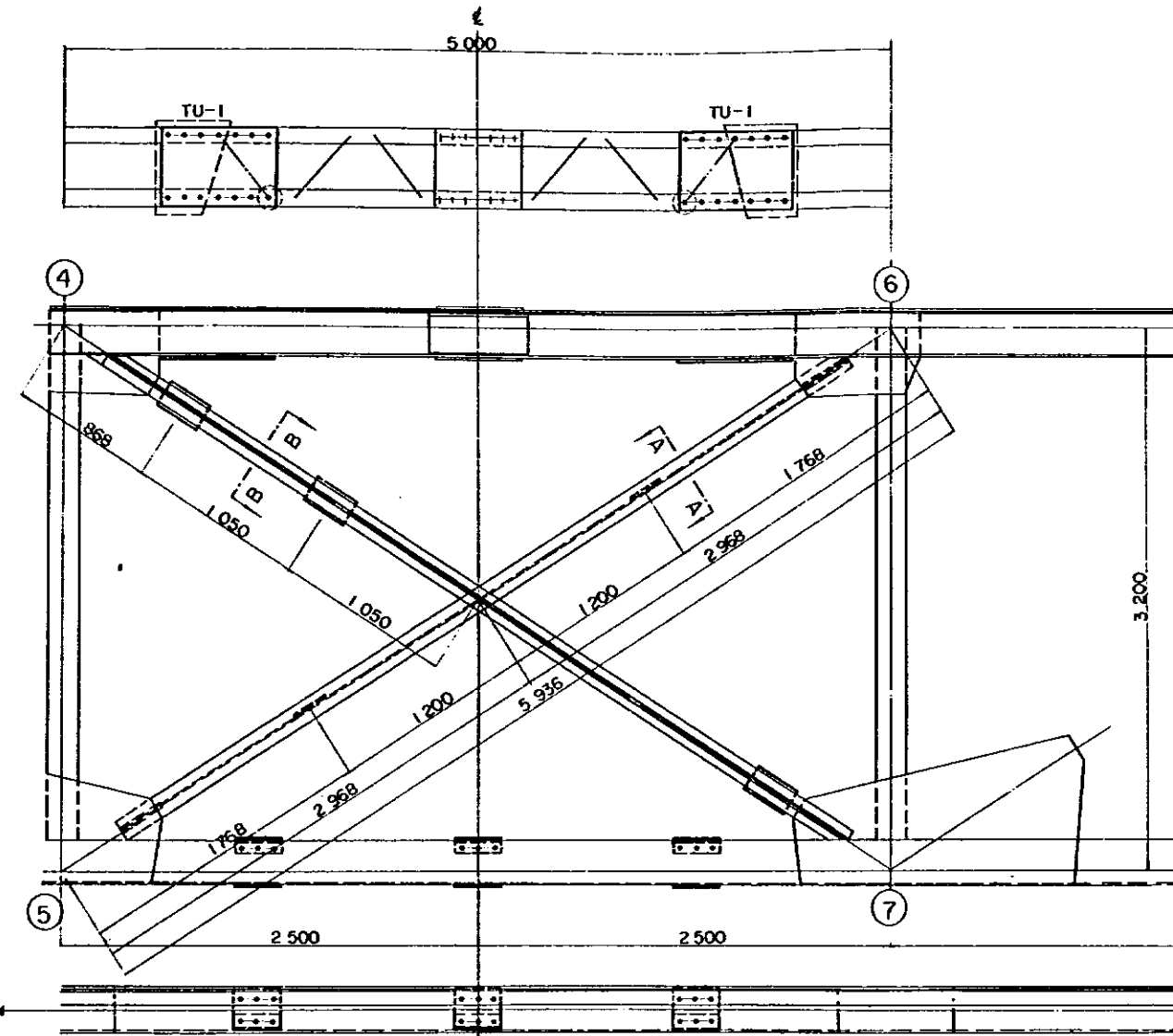


Construction Methods

- 1) Drill new bolt holes
- 2) Clean surface between original and additional members.
- 3) Add new angles and tighten HT Bolts
- 4) Add new Tie Plates and tighten HTBolts.

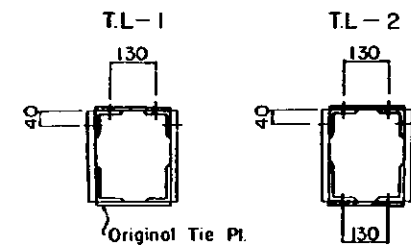


1-Pl 210x9x279  
2-Ls 75x75x9x280  
4-HT.B M20x65(FIOT)



Note: Re-Use Existing holes.

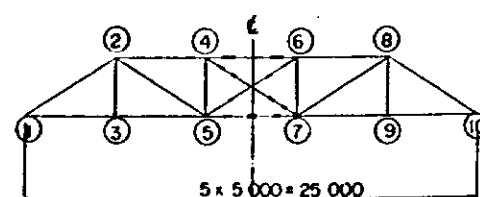
DETAIL T.L  $s = 1/10$



1-Tie Pl 210x10x280  
2-Ls 75x75x9x280  
6-HT.B M22x70(FIOT)  
6-HT.B M22 60(FIOT)

2-Tie Pl 210x10x280  
2-Ls 75x75x9x280  
12-HTB M22x70(FIOT)  
6-HTB M22x60(FIOT)

MARKING DIAGRAMS



General Notes

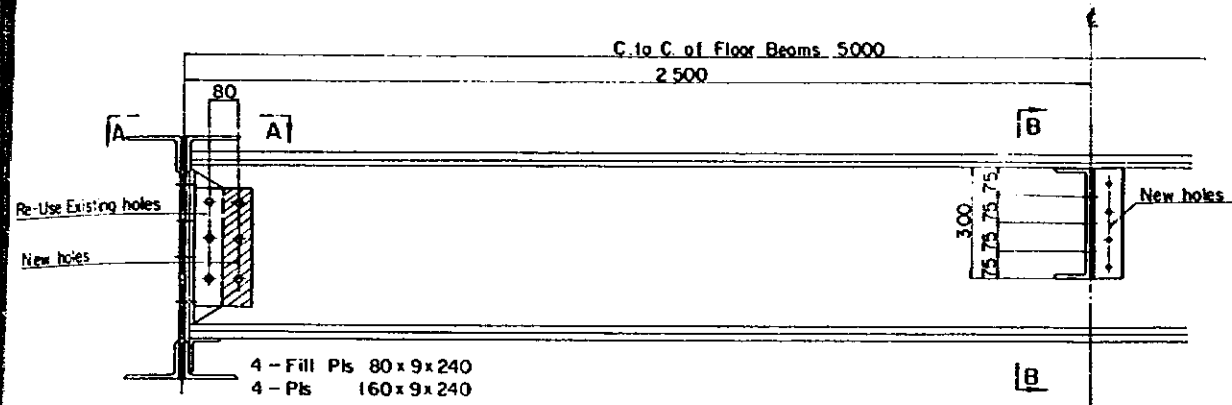
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22(+) (FIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for slitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field

THE STATE RAILWAY OF THAILAND

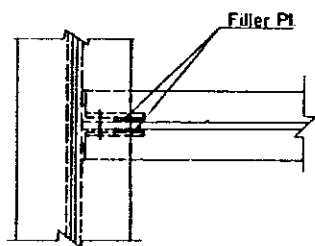
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members MAIN TRUSS (NO.2)	DL 15 Loading	
250 T.T		Unit	Scale
		mm	1/20, 1/10
K.M	897 + 174	Designed by	_____
DISTRICT	Hot Yai	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	_____

FLOOR SYSTEM S=1/10

STRINGER



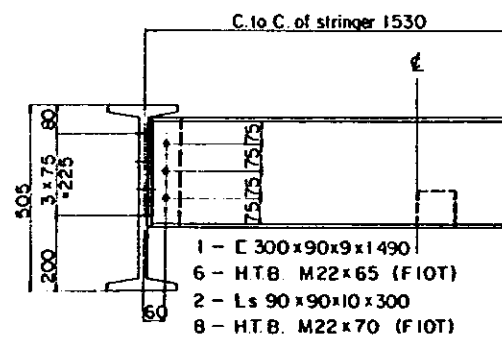
SECTION A - A



Construction Method for Connection

- 1) Drill new rivet holes to follow with original interval.
- 2) Take off connection rivets.
- 3) Add filler plates and connection plates.
- 4) Riveting

STRUT OF STRINGER (S1)

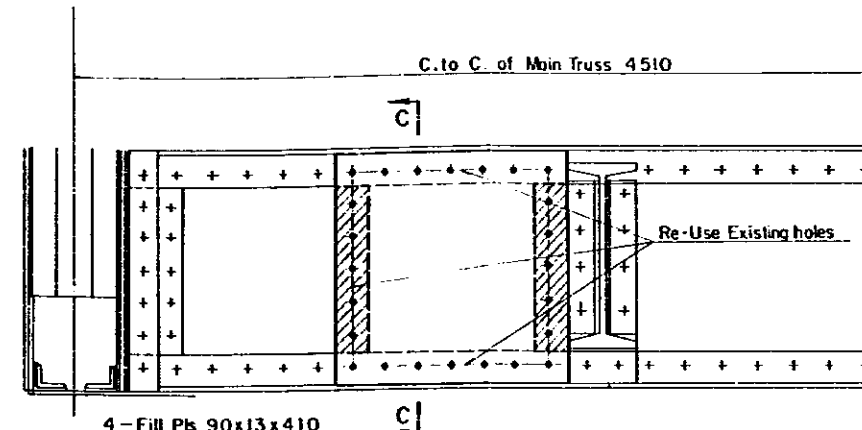


Construction Method for Stringer Strut

- Before construction, it is important point that hanger bolts in stringer must be set up to meet bolt holes in lateral. Therefore, pre-investigation is to be done for detail scale.
- 1) Drill new bolt holes.
  - 2) Clean surface between stringer and angles for attachment, and tighten HT.Bolts.
  - 3) Clean surface between stringer strut and angles for attachment, and tighten HT.Bolts.

SECTION B - B

INTER FLOOR BEAM (I.F-3)

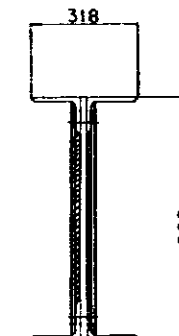


- 4 - Fill Pls 90x13x410  
2 - Pls 630x10x650  
24 - HT.B. M22x100 (FIOT)

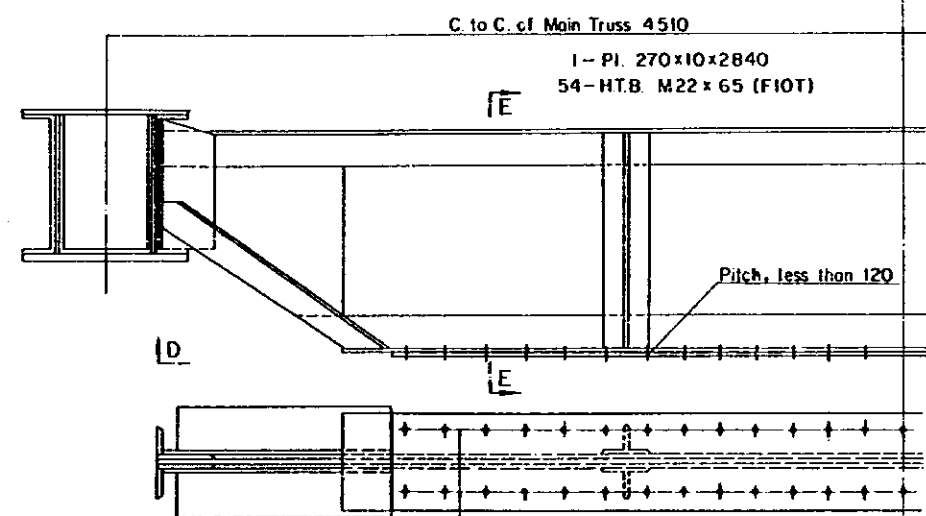
Construction Method for Corroded Plates

- 1) Take off rivets and plates.
- 2) Add filler plates and repair plates.
- 3) Tighten HT Bolts

SECTION C - C



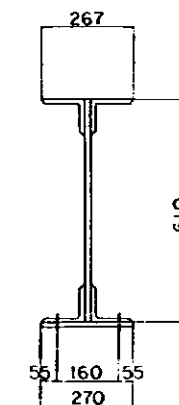
END FLOOR BEAM (E.F-1,2)



SECTION D - D

New holes

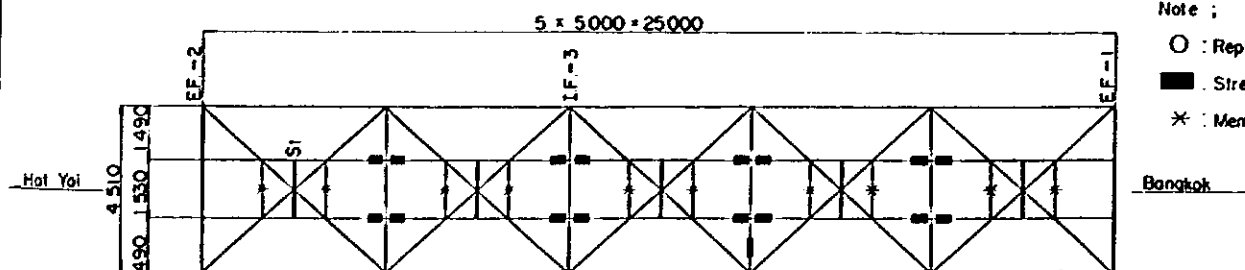
SECTION E - E



Construction Method

- 1) Drill new bolt holes.
- 2) Clean surface between original and new members
- 3) Add cover plate and tighten HT.Bolts.

MARKING DIAGRAMS



Note :

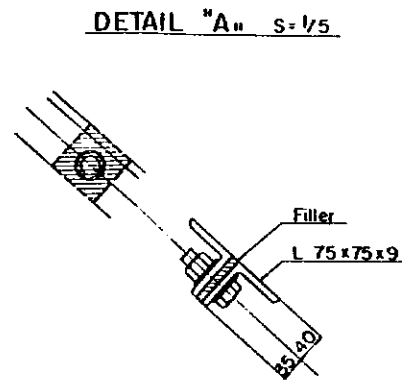
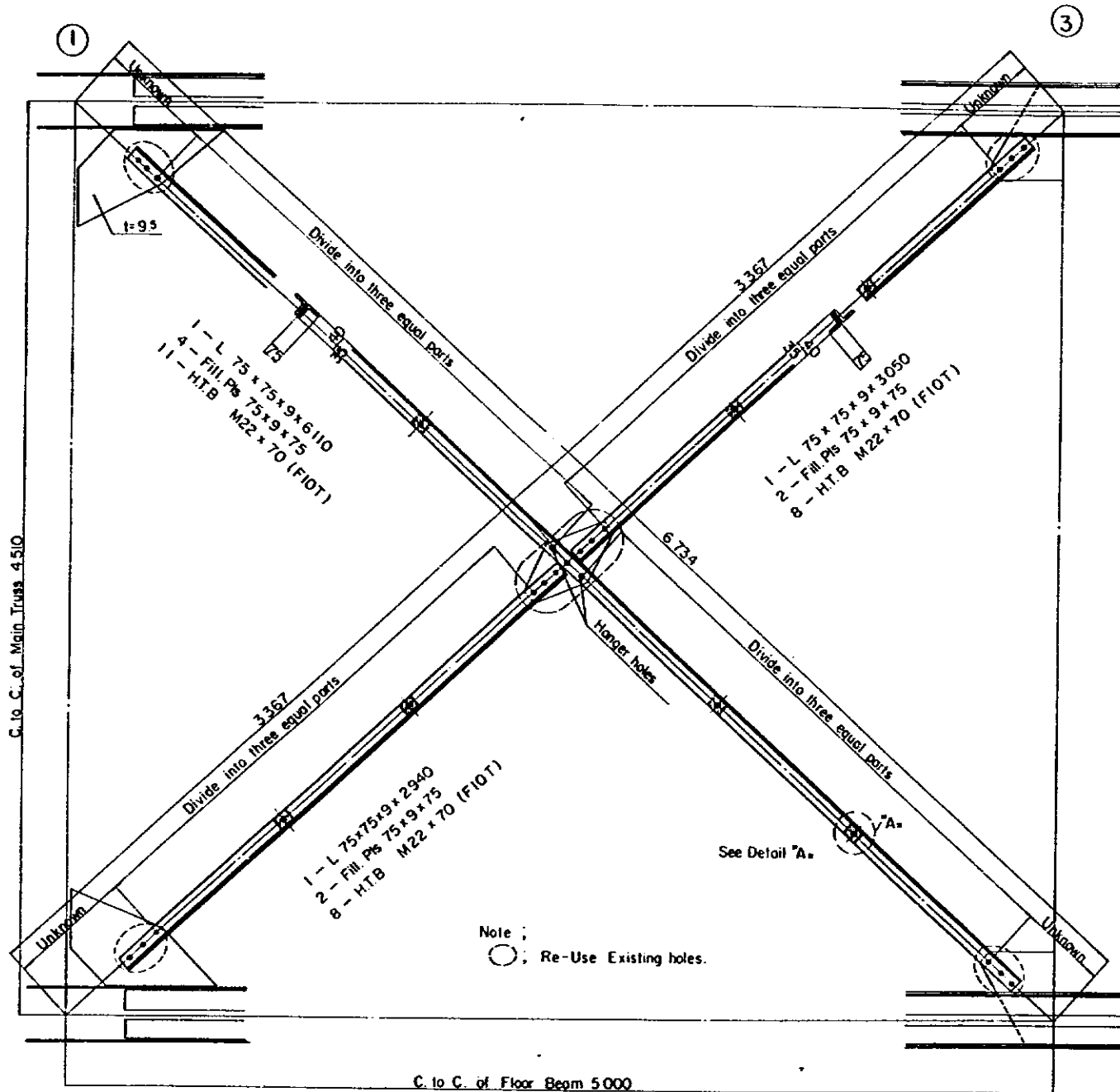
- : Replacement of loose rivets.
- : Strengthening of connection.
- \* : Member to be taken off.

General Notes:

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HT.B) are M22 (Φ)(FIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $\geq 0.4$
  - ii) for stitch  $\geq 0.3$
- 3) All rivets are .22<sup>φ</sup> (Φ), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field

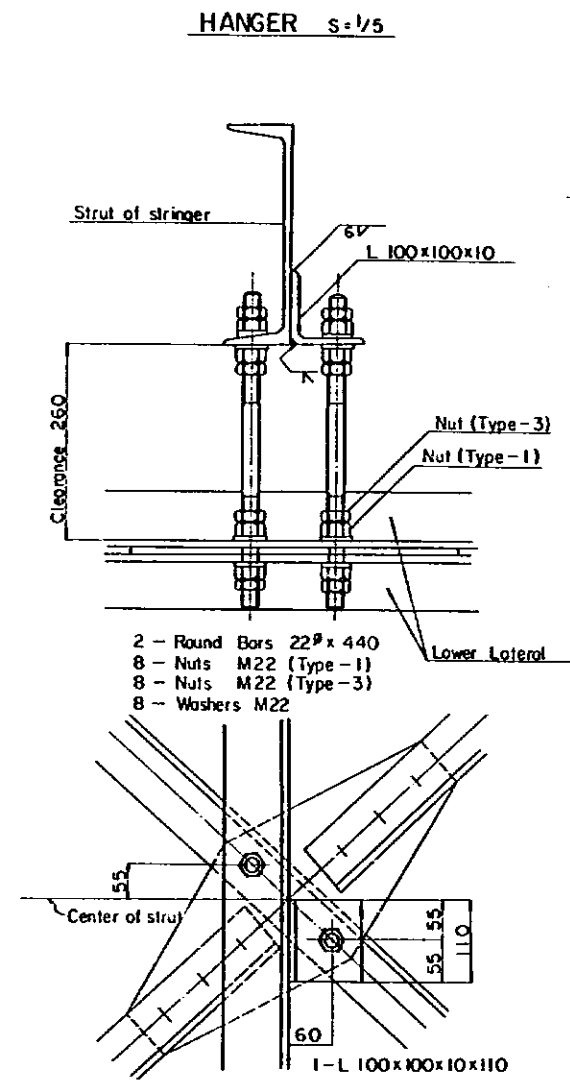
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 Loading	
25.0 T.T	FLOOR SYSTEM	Unit	Scale
K.M.	897 + 174	mm	1/10
DISTRICT	Hat Yoi	Designed by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

LOWER LATERAL BRACING (NO.1) s=1/5



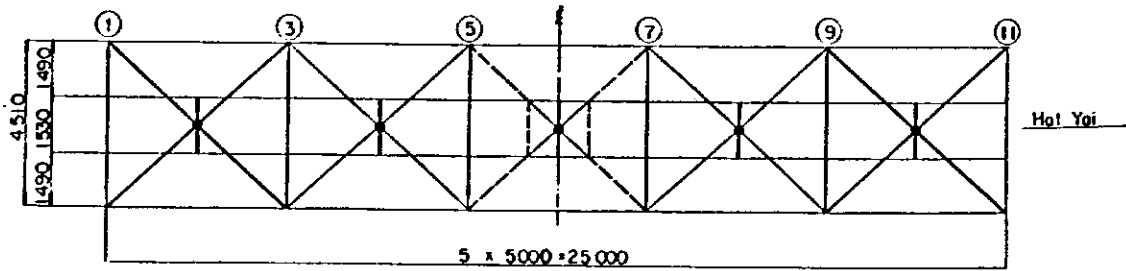
- Construction Method**
- 1) Cut off rivet of original members.
  - 2) Take off original members.
  - 3) Drill new bolt holes.
  - 4) Clean surface between original and new members
  - 5) Set up original and new members
  - 6) Tighten HTBolts.

**Notes:**  
 We referred to Field Drawing, as it is, we can't determine detail values.  
 Therefore, we have not noted a certain value, such as rivet's interval, member length, and connection of hanger.  
 But drawing scale referred to those estimated values.  
 Therefore, pay attention to the value of existing bridge.



**Note:**  
 All Nuts M22 JIS B1156 or materials of equivalent.

MARKING DIAGRAMS

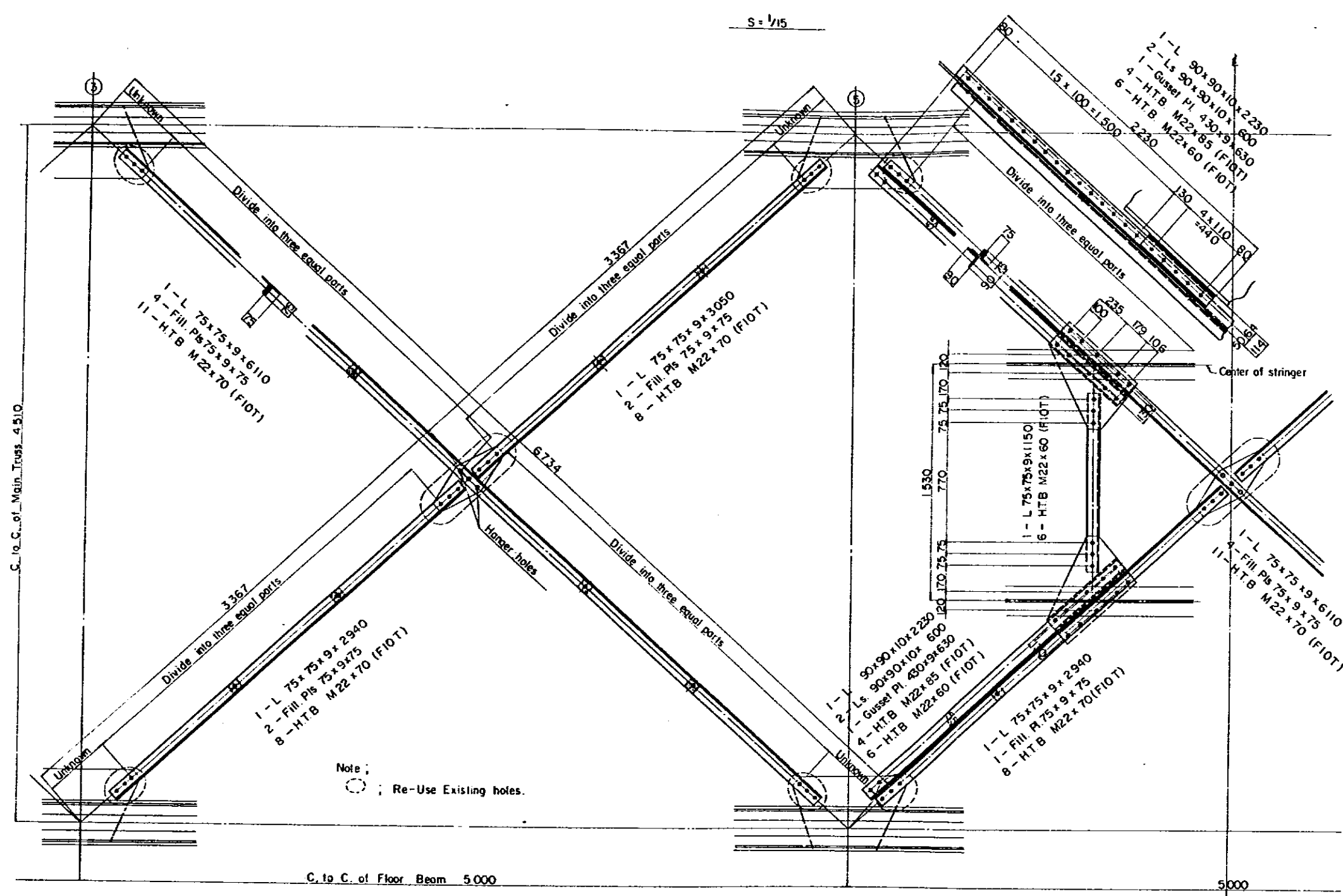


General Noted

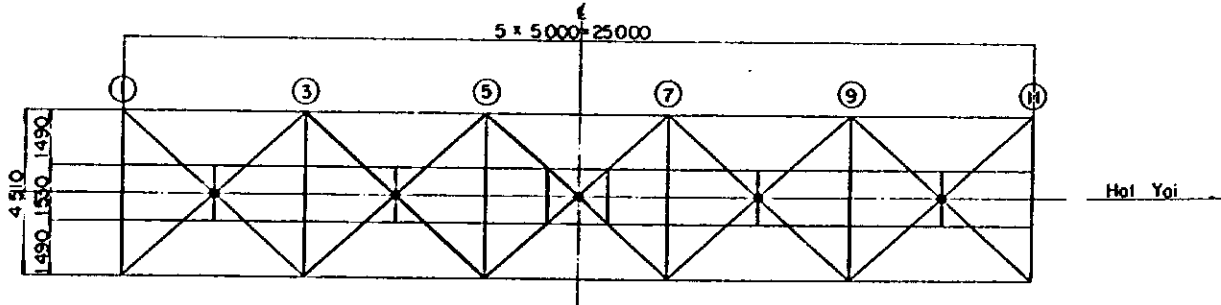
- 1) All materials are to be JIS G301 SS41 rolled steel for general structure or materials of equivalent
- 2) All high-strength bolts (HTB) are M22 (φ X F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for slitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field

THE STATE RAILWAY OF THAILAND				
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING				
Span Type	Members	LOWER LATERAL BRACING (NO.1)	D.L. 15 loading	
250 T.T			Unit	Scale
K M	897 + 174		mm	1/5
DISTRICT	Hat Yai		Designed by	_____
LINE	Southern Line		Checked by	_____
Remarks			Checked by	_____
			Checked by	_____
			Checked by	_____
			Checked by	_____
DATE			DRAWING NO.	_____

# LOWER LATERAL BRACING (NO.2) AND BRAKE TRUSS



### MARKING DIAGRAMS



Note ; • Strengthening of hunger

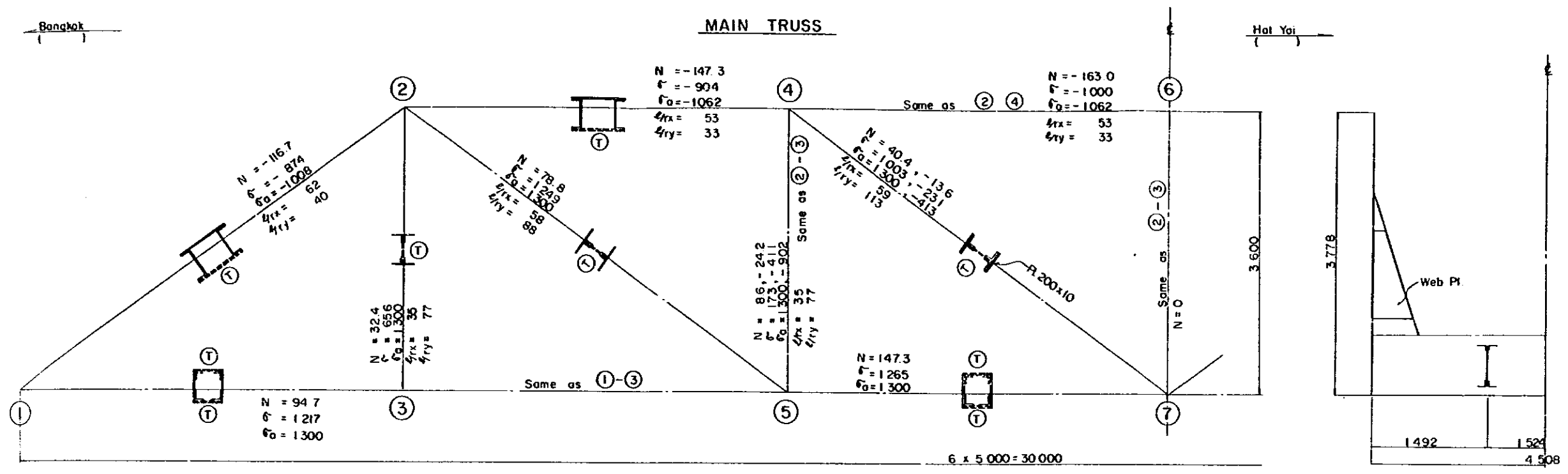
### General Notes;

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (F10T), and assumed frictional coefficient of contact surface (f) as follows
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

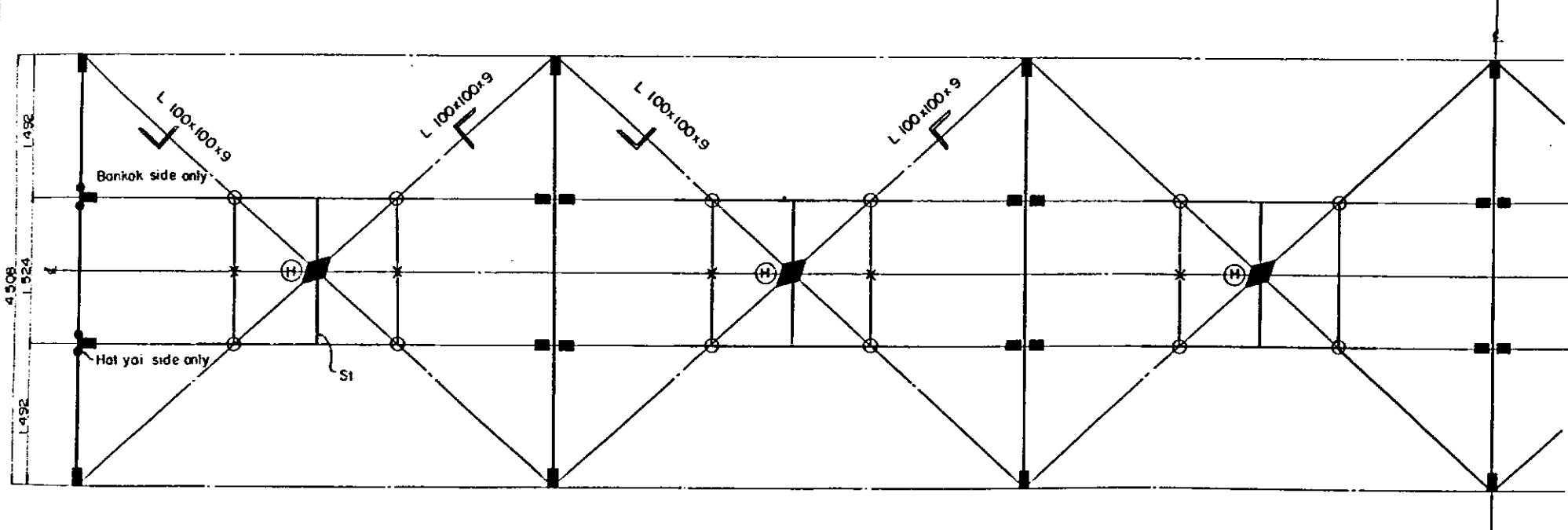
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
250 TT	LOWER LATERAL BRACING AND BRAKE TRUSS	Unit mm	Scale 1/15
K M.	897 + 174	Designed by	_____
DISTRICT	Hot Yai	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	



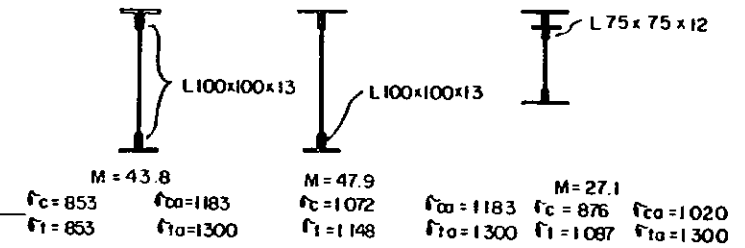
# GENERAL DIAGRAM



## FLOOR SYSTEM & LOWER LATETAL



## END FLOOR INT. FLOOR STRINGER



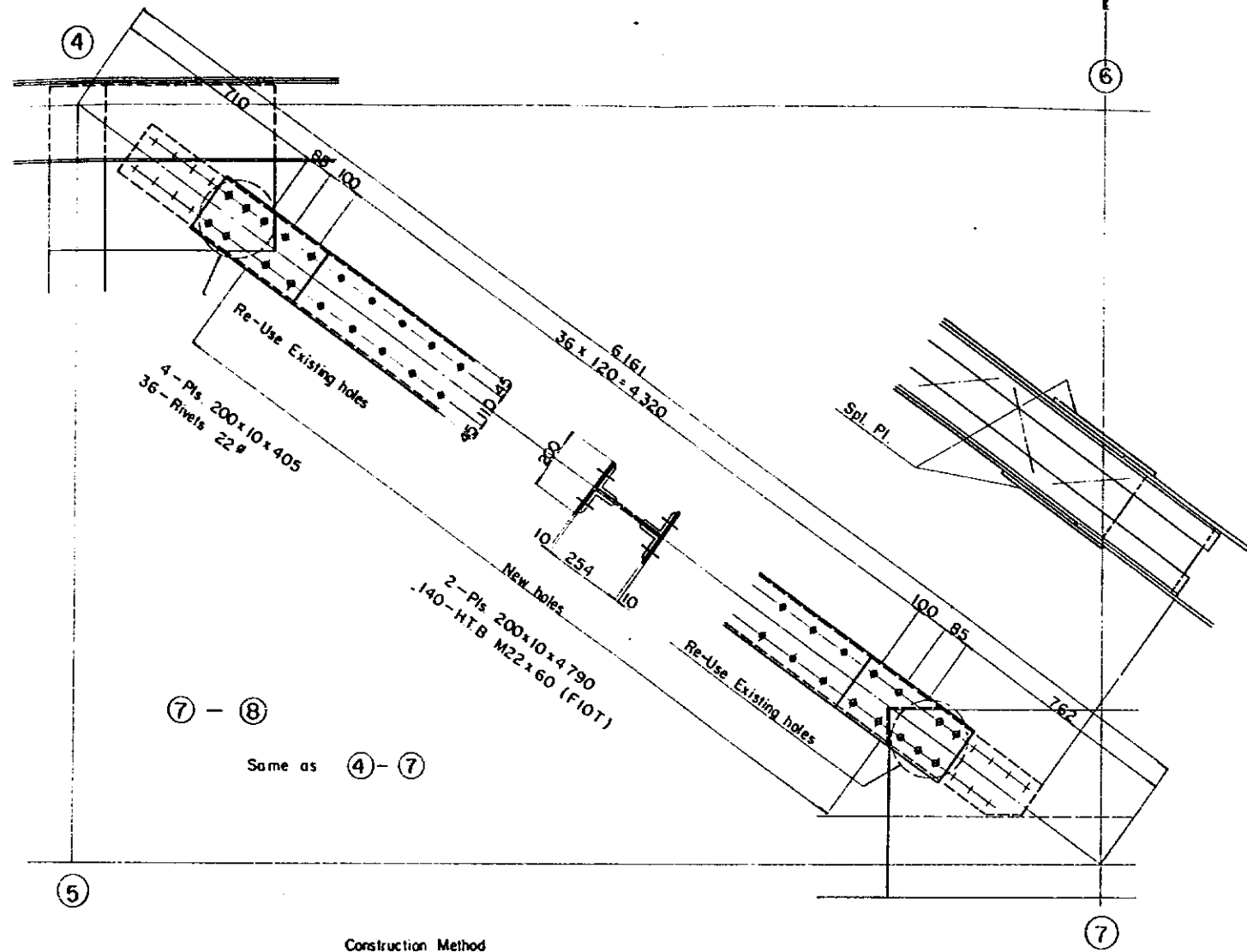
- Legends:**
- 1) ● : Loose rivets to be replaced
  - 2) ■ : Excessive stressed rivets to be strengthened
  - 3) ◆ : Gusset plates to be improved
  - 4) ○ : Defective hanger to be removed
  - 5) ✖ : Defective member to be removed
  - 6) ⊕ : Tie plates to be strengthened
  - 7) ⊕ : Hanger to be added.
  - 8) St : New strut to be added.

- General Notes:**
- 1) Weak drawings show the original members. Deep drawings show the members to be improved.
  - 2) Actual stresses are based on DL-15 loading.
  - 3) Marks
    - M : Bending moment (tm)
    - N : Axial force (t)
    - l : Length of member (cm)
    - $r_x, r_y$  : Radius of gyration of sectional area for x or y axis (cm)
    - $r_r$  : Slenderness ratio
    - $\sigma$  : Actual stress (kg/cm<sup>2</sup>)
    - $\sigma_a$  : Allowable stress (kg/cm<sup>2</sup>)

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
300 T.T	GENERAL DIAGRAM	Unit	Scale
		mm	
K.M	929 + 903	Designed by	
DISTRICT	Hat Yai	Checked by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

# MAIN TRUSS (NO.1)

DIAGONAL MEMBER  $s=1/10$

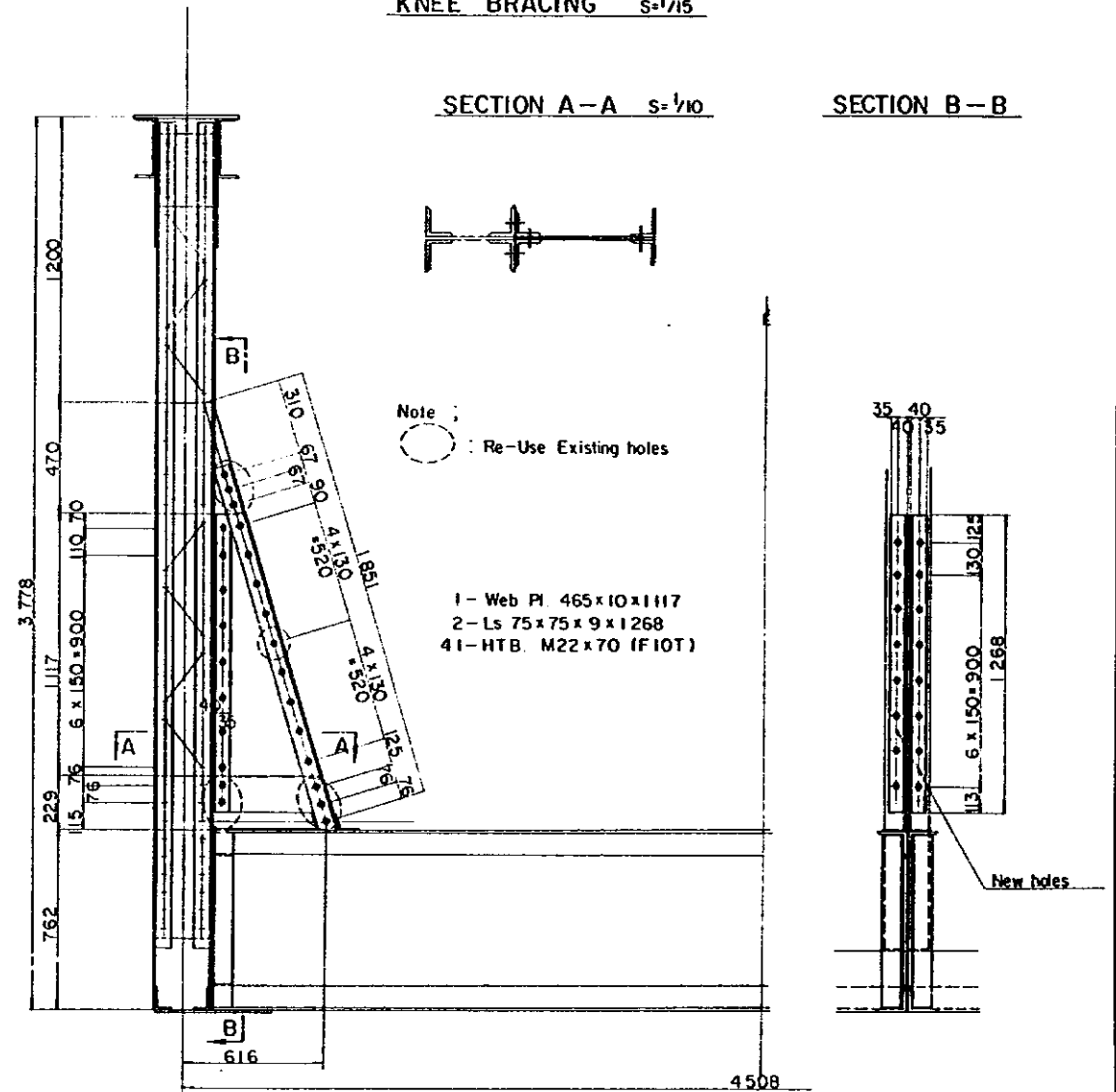


⑦ - ⑧  
Same as ④ - ⑦

**Construction Method**

- 1) Drill new bolt and rivet holes.
- 2) Cut off rivets of original members.
- 3) Clean surface between original and new members.
- 4) Add new plates and tighten HT Bolts.
- 5) Add splice plate and riveting.

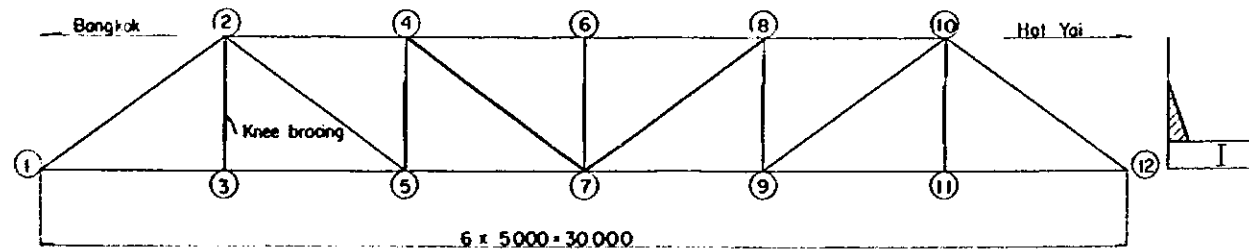
KNEE BRACING  $s=1/15$



**Construction Method**

- 1) Cut off rivet of original knee members.
- 2) Take off original knee Angles.
- 3) Drill new bolt holes.
- 4) Clean surface between original and new members.
- 5) Add new Angles and knee plate.
- 6) Tighten HT Bolts.

**MARKING DIAGRAMS**



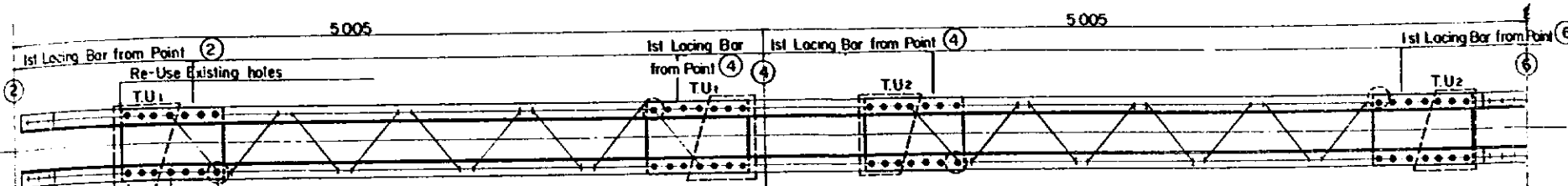
**General Notes:**

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (φ F10T), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22φ, and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.

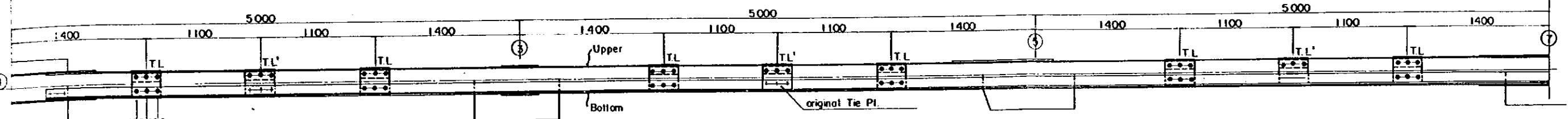
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
300 T.Y.	MAIN TRUSS (NO.1)	Unit	Scale
K M	929 + 903	mm	1/15, 1/10
DISTRICT	Hot Yai	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

MAIN TRUSS (NO.2) s=1/20

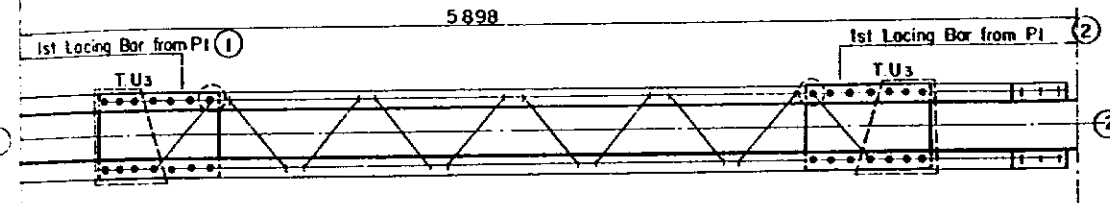
UPPER CHORD MEMBER



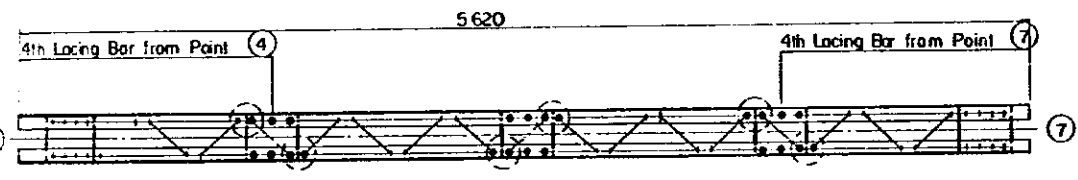
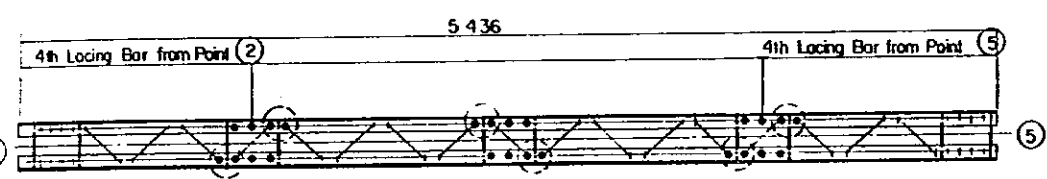
LOWER CHORD MEMBER



END POST

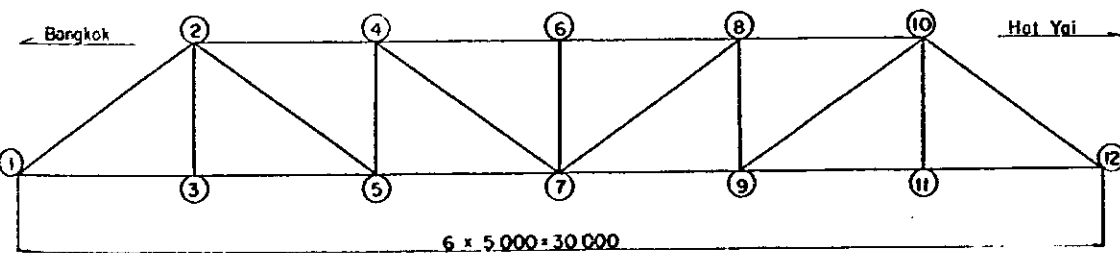


DIAGONAL MEMBER

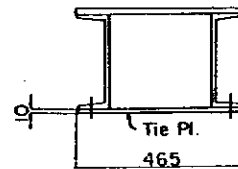


Note :  
 : Re-Use Existing holes.

MARKING DIAGRAMS



DETAIL T.U s=1/10



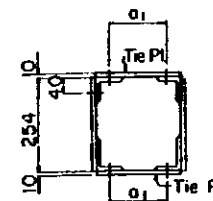
(12-Req'd)  
 1 - Tie Pl. 465x10xL  
 14 - HTB M22x65 (F10T)

T.U	T.U1	T.U2	T.U3
L	665	640	670

Construction Method (T.U1-3)

- 1) Cut off original rivets.
- 2) Take off original tie plates and lacing bar.
- 3) Drill new bolt holes.
- 4) Clean surface between original and new members.
- 5) Attach new tie plates and tighten H.T. Bolts.

DETAIL T.L s=1/10



Upper Tie Pl. (18-Req'd)  
 1 - Tie Pl. 02x10x280  
 2 - Ls 75x75x9x280  
 6 - HTB M22x65 (F10T)  
 Lower Tie Pl. (12-Req'd)  
 1 - Tie Pl. 02x10x280  
 6 - HTB M22x65 (F10T)

Construction Method (T.L or T.L')

- 1) Drill new bolt holes.
- 2) Clean surface between original and new members.
- 3) Attach new tie plates or angles and tighten H.T. Bolts.

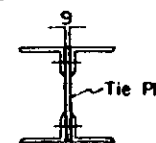
Note :

T.L : Add tie plates at upper and bottom side.

T.L' : Add tie plates at only upper side.

	(1)-(3)	(3)-(5)	(5)-(7)
a1	150	150	130
a2	230	230	210

DETAIL T.D s=1/10



(12-Req'd)  
 1 - Tie Pl. 255x9x280  
 6 - HTB M22x70 (F10T)

Construction Method (T.D)

- 1) Cut off original rivets.
- 2) Take off original tie plates or lacing bars.
- 3) Drill new bolt holes.
- 4) Clean surface between original and new members.
- 5) Attach new tie plates and tighten H.T. Bolts.

General Notes :

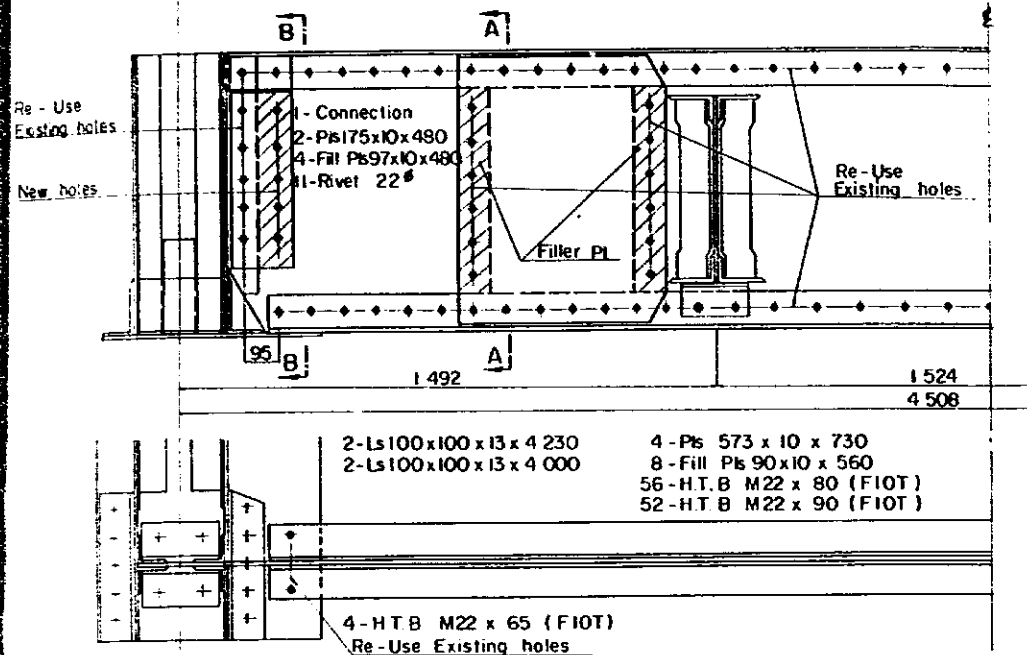
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection f2.04
  - ii) for stitch f2.03
- 3) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
		Unit	Scale
300 TT	MAIN TRUSS (NO.2)	mm	1/20, 1/10
K M	929 + 903	Designed by	_____
DISTRICT	Hot Yai	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

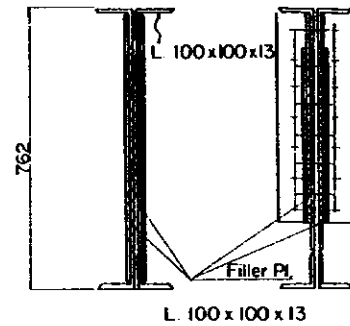
FLOOR SYSTEM S=1/10

FLOOR BEAM

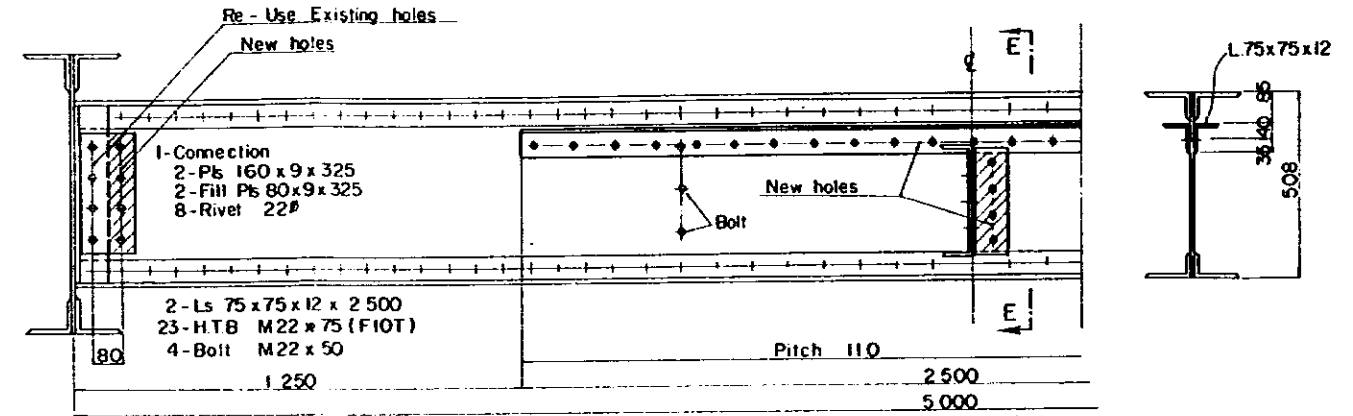
E.F-1,2



Section A-A Section B-B



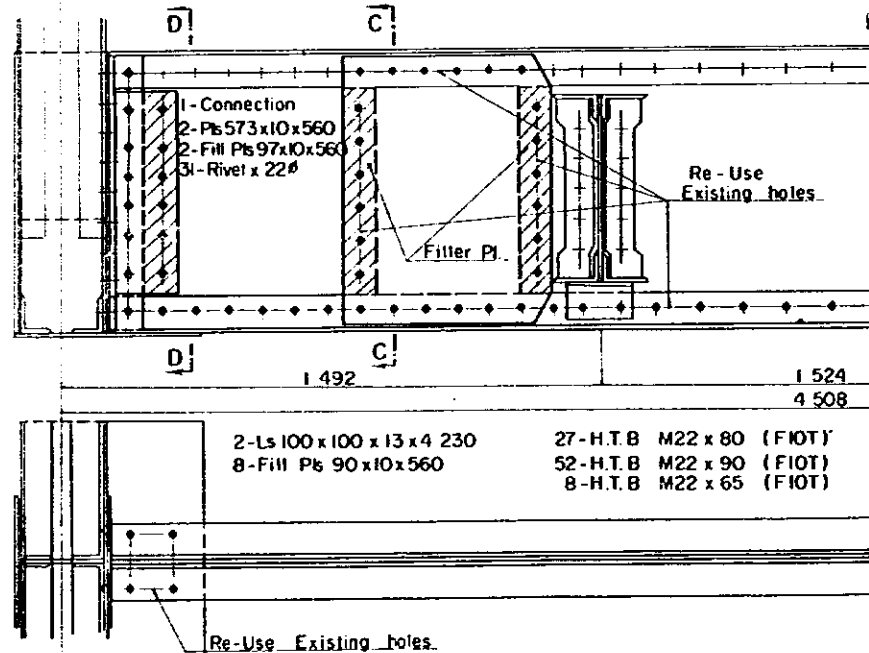
STRINGER



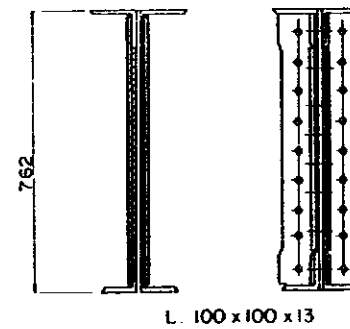
Construction Method

- 1) Drill new bolt holes.
- 2) Clean surface between original members and new angles.
- 3) Attach new angles and tighten HT Bolts
- 4) Strengthen Strut of Stringer.

I.F-1-5

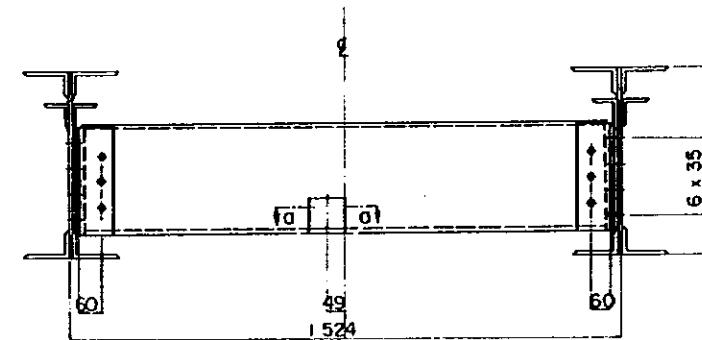


Section C-C Section D-D

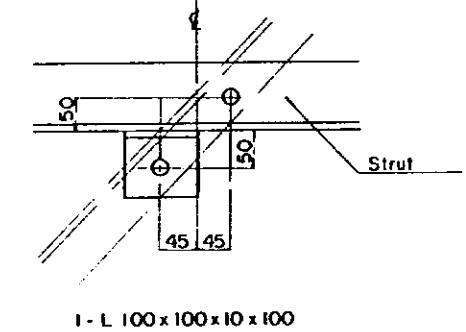


STRUT OF STRINGER (St)

Section E-E

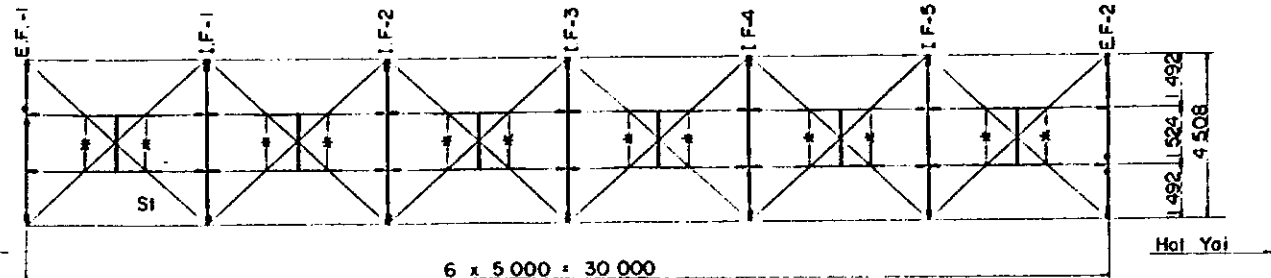


SECTION a-a S=1/5



MARKING DIAGRAMS

- Note:
- Replacement of Loose Rivets
  - Strengthening of Connection
  - \* Members to be taken off

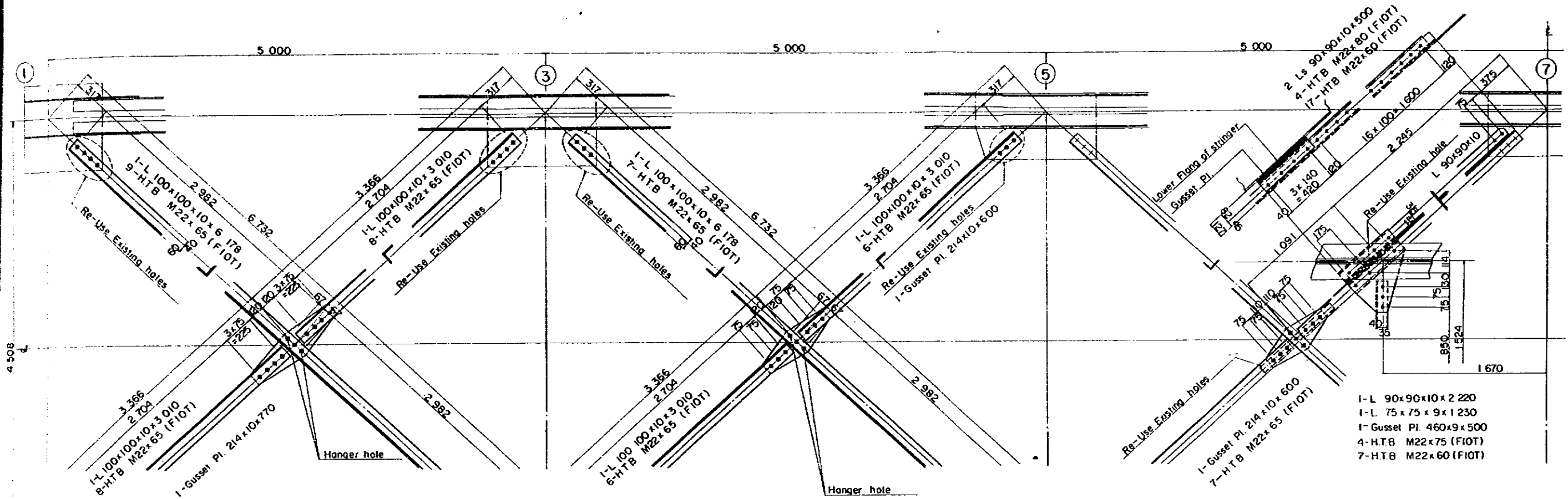


General Notes:

- 1) All materials are to be JISG3101 SS41 rolled steel for general structure or materials of equivalent
- 2) All high-strength bolts (HTB) are M22 (φ) (FIOT), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22<sup>#</sup> (φ), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent
- 4) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
		Unit	Scale
300 T.T	FLOOR SYSTEM	mm	1/10, 1/5
K M	929 + 903	Designed by	
DISTRICT	Hal Yai	Checked by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

LOWER LATERAL BRACING  $s = 1/15$



CONSTRUCTION METHOD

① - ③, ③ - ⑤

- 1) Cut off rivet of original members
- 2) Take off original members.
- 3) Drill new bolt holes.
- 4) Clean surface between original and new members.
- 5) Attach new angles.
- 6) Tighten HTBolts

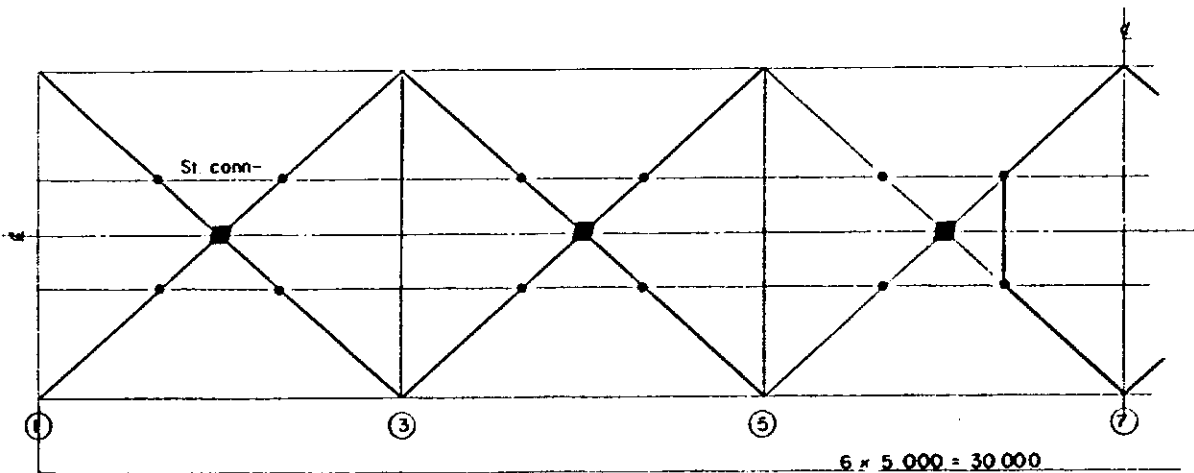
⑤ - ⑦

- 1) Cut off rivet of original members
- 2) Drill new bolt holes
- 3) Clean surface between original and new members
- 4) Attach new connection plate.
- 5) Tighten HTBolts.

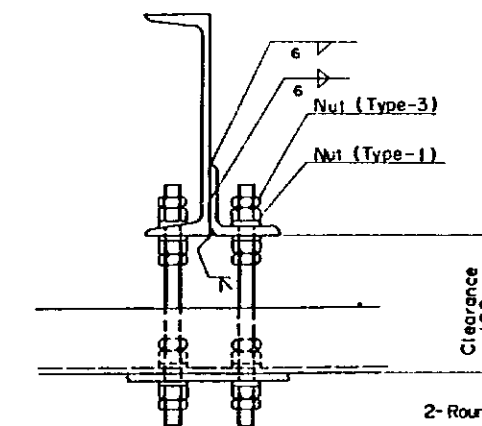
Note

- 1) : Strengthening connection and attaching hanger
- 2) : Original hanger to be taken off

MARKING DIAGRAMS



HANGER  $s = 1/5$



- 2-Round Bar 22<sup>#</sup>x330
- 8-Nut M22 (Type-1)
- 8-Nut M22 (Type-3)
- 8-Washer M22

Note

All Nut M22 (JIS B-1156) or materials of equivalent.

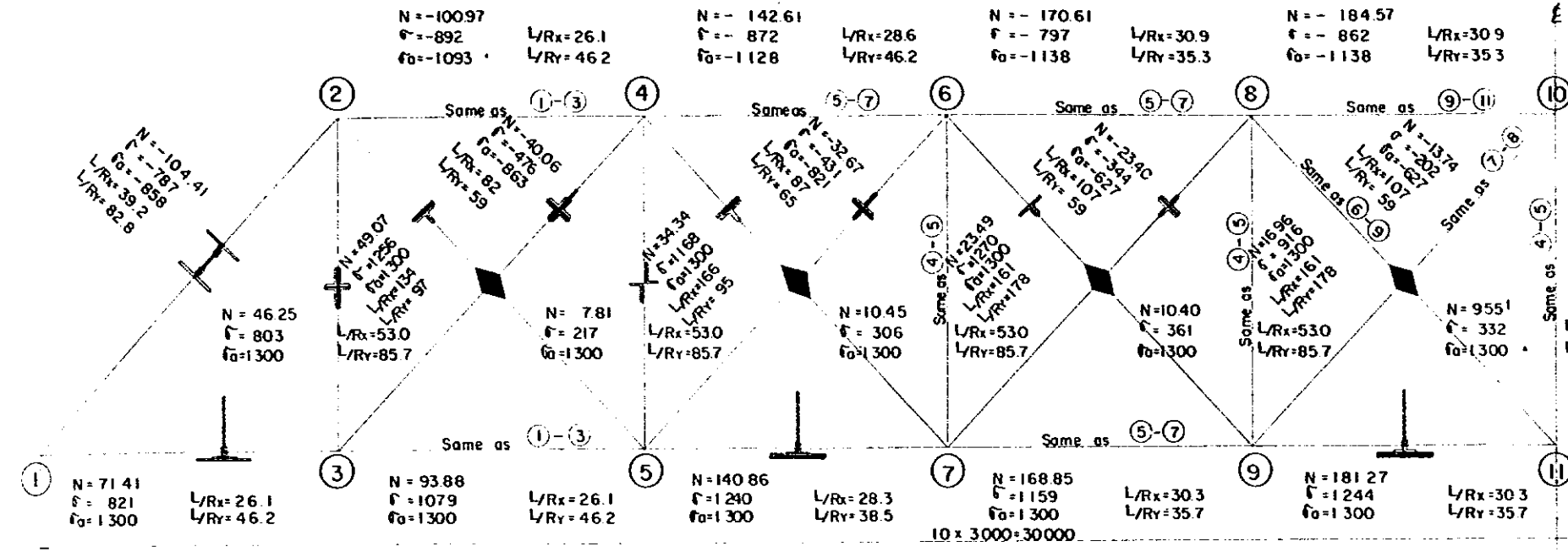
General Note:

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolt (HTB) are M22 (F10T), and assumed frictional coefficient of contact surface (f) as follows
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

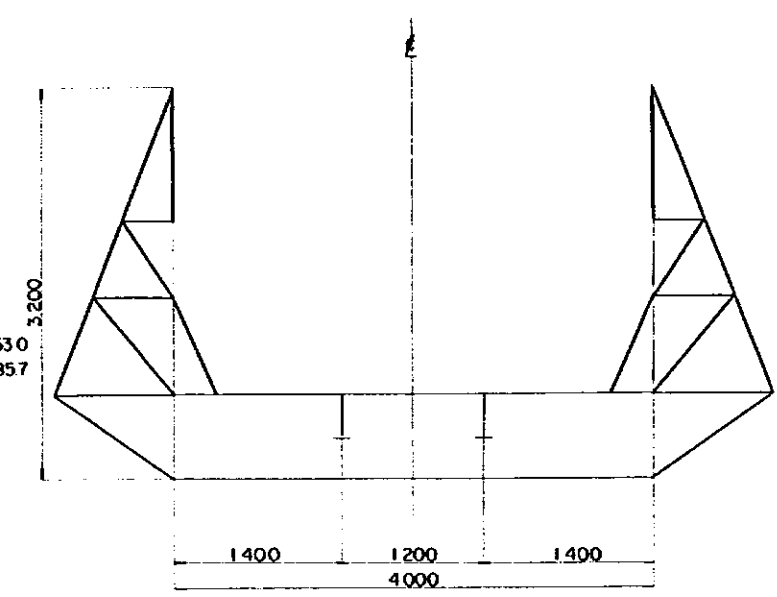
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
300 T.T	LOWER LATERAL BRACING	Unit	Scale
K M	929 + 903	mm	1/15, 1/5
DISTRICT	Hal Yai	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

# GENERAL DIAGRAM

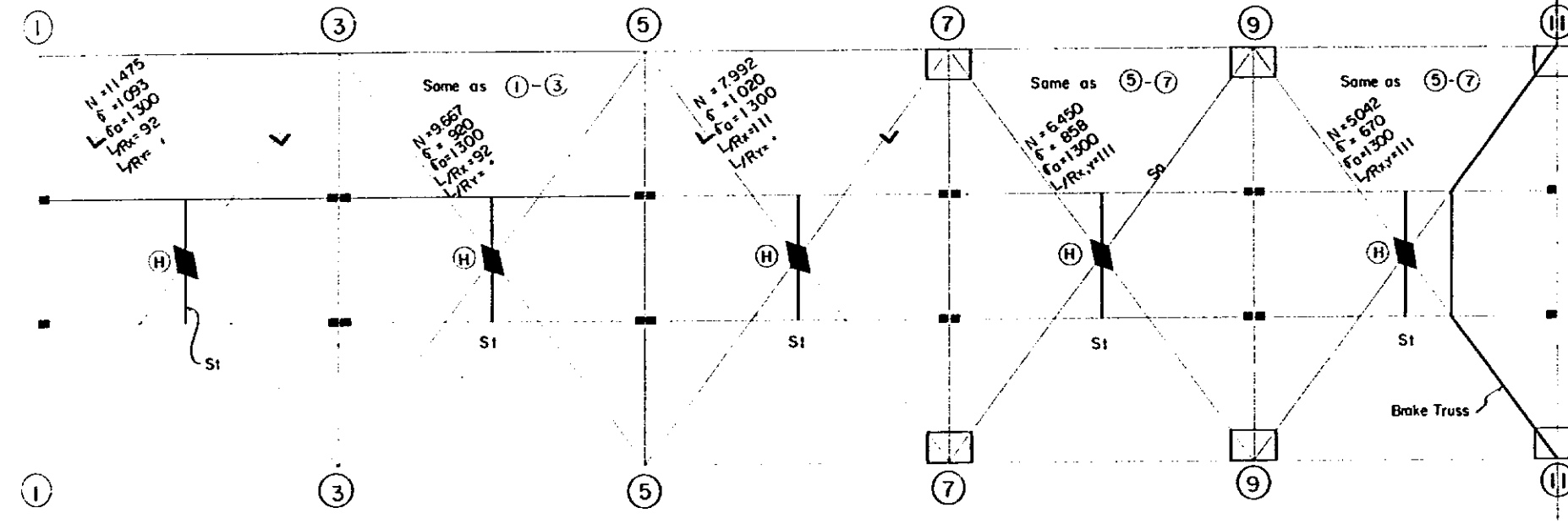
## MAIN TRUSS



## KNEE BRACING



## FLOOR SYSTEM & LOWER LATERAL



### END FLOOR    INT FLOOR    STRINGER

M = 31.4	M = 34.6	M = 9.9
f <sub>c</sub> = - 726	f <sub>c</sub> = - 802	f <sub>c</sub> = - 831
f <sub>t</sub> = 869	f <sub>t</sub> = 960	f <sub>t</sub> = 831
f <sub>ax</sub> = -1188	f <sub>ax</sub> = -1188	f <sub>ax</sub> = - 980
f <sub>ay</sub> = 1300	f <sub>ay</sub> = 1300	f <sub>ay</sub> = 1300

### Legends

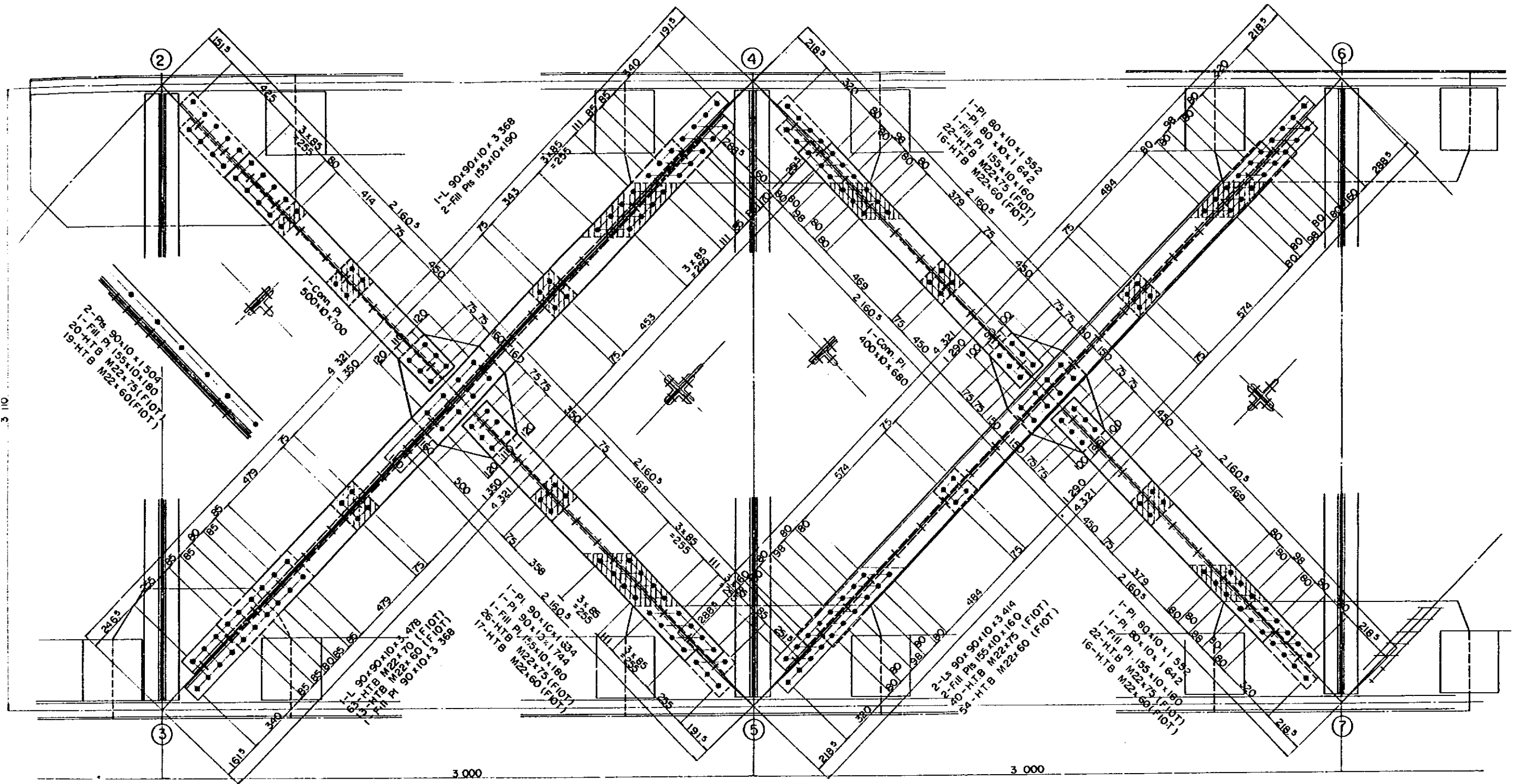
- 1) ■ : Excessive stressed rivets to be strengthened
- 2) ◆ : Gusset plates to be improved.
- 3) (H) : Hanger to be added.
- 4) □ : New gusset plates to be changed.
- 5) St : New strut to be added.

### General Notes

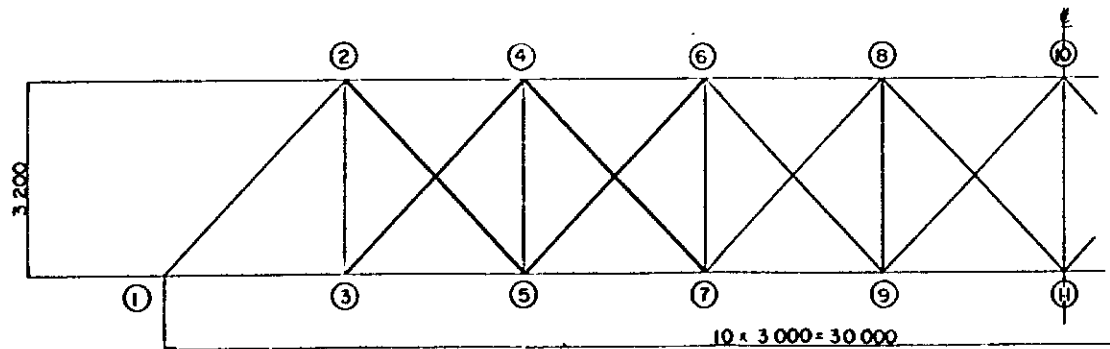
- 1) Weak drawings show the original members.  
Deep drawings show the members to be improved.
- 2) Actual stresses are based on DL-15 loading.
- 3) Marks  
 M : Bending moment (t-m)      L/R : Slenderness ratio  
 N : Axial force (t)              f : Actual stress (kg/cm<sup>2</sup>)  
 L : Length of member (cm)      fa : Allowable stress (kg/cm<sup>2</sup>)  
 Rx, Ry : Radius of gyration of sectional area  
 for x or y axis (cm)

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	GENERAL DIAGRAM	DL 15 loading Unit Scale
30.0 T.T			mm
K. M	263 + 335	Designed by	
DISTRICT	Nakhon Sawan	Checked by	
LINE	Northern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO	

MAIN TRUSS (NO. 1) S=1/10



MARKING DIAGRAMS

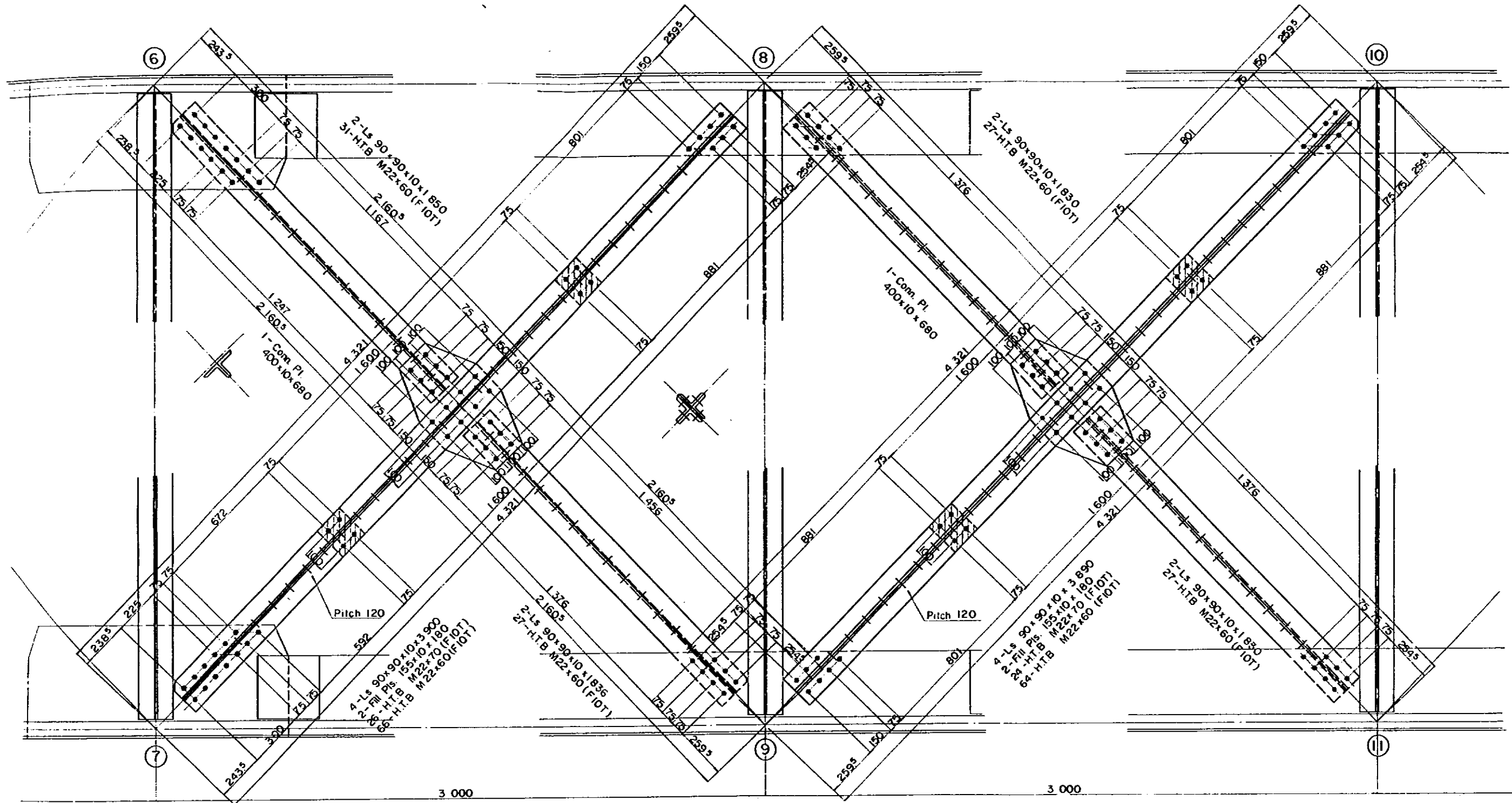


General Notes:

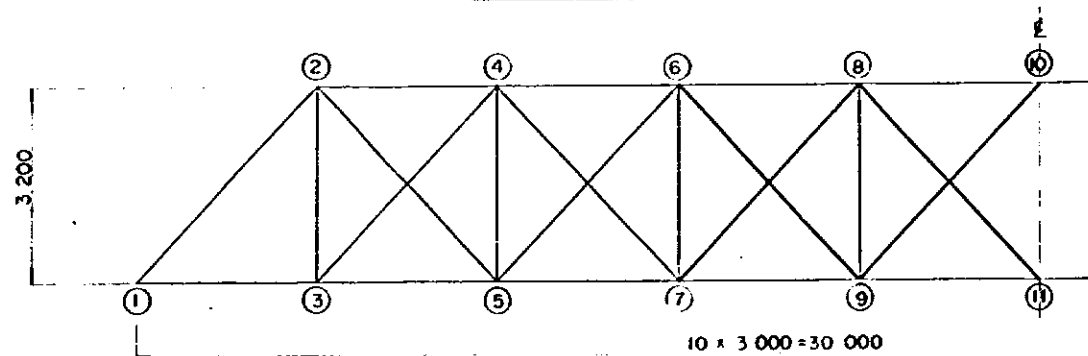
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22(♦)(F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
		Unit	Scale
300 T T	MAIN TRUSS (NO. 1)	mm	1/10
K. M	263 + 335	Designed by	_____
DISTRICT	Nakhon Sawan	Checked by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	_____

MAIN TRUSS (NO. 2) S=1/10



MARKING DIAGRAMS



General Notes :

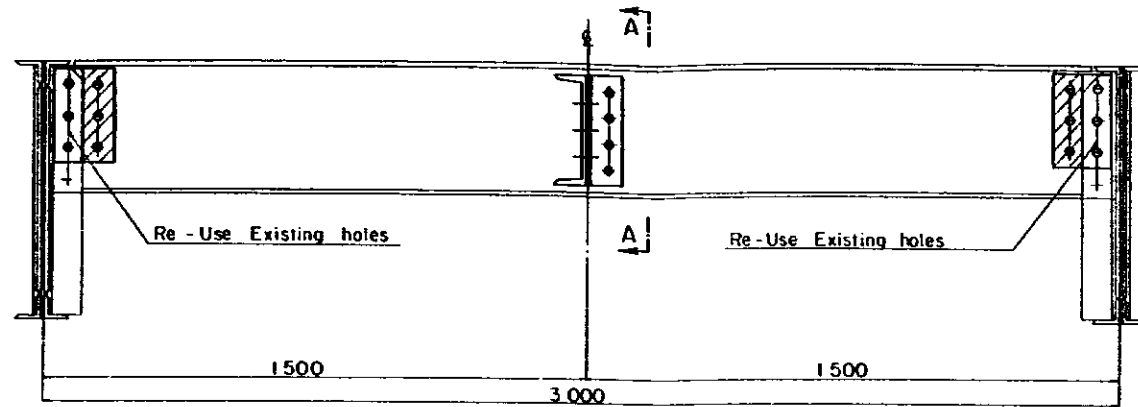
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HT.B) are M22 (♦)(F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
300 TT	MAIN TRUSS (NO. 2)	Unit mm	Scale 1/10
K. M.	263 + 335	Designed by	_____
DISTRICT	Nakhon Sawan	Checked by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	4498



# FLOOR SYSTEM & KNEE BRACING

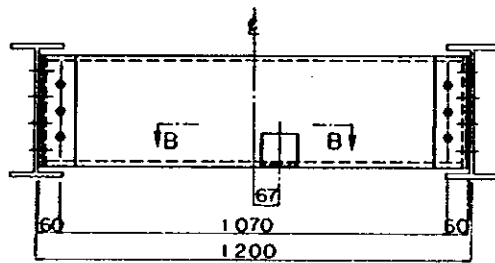
**STRINGER**  $s=1/10$



- (2-Connection)  
 4-Pls 160 x 10 x 253  
 4-Fill Pls 80 x 10 x 253  
 12-Rivets 22#

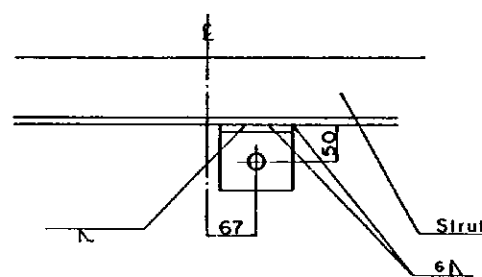
**STRUT**

**SECTION A - A**  $s=1/10$



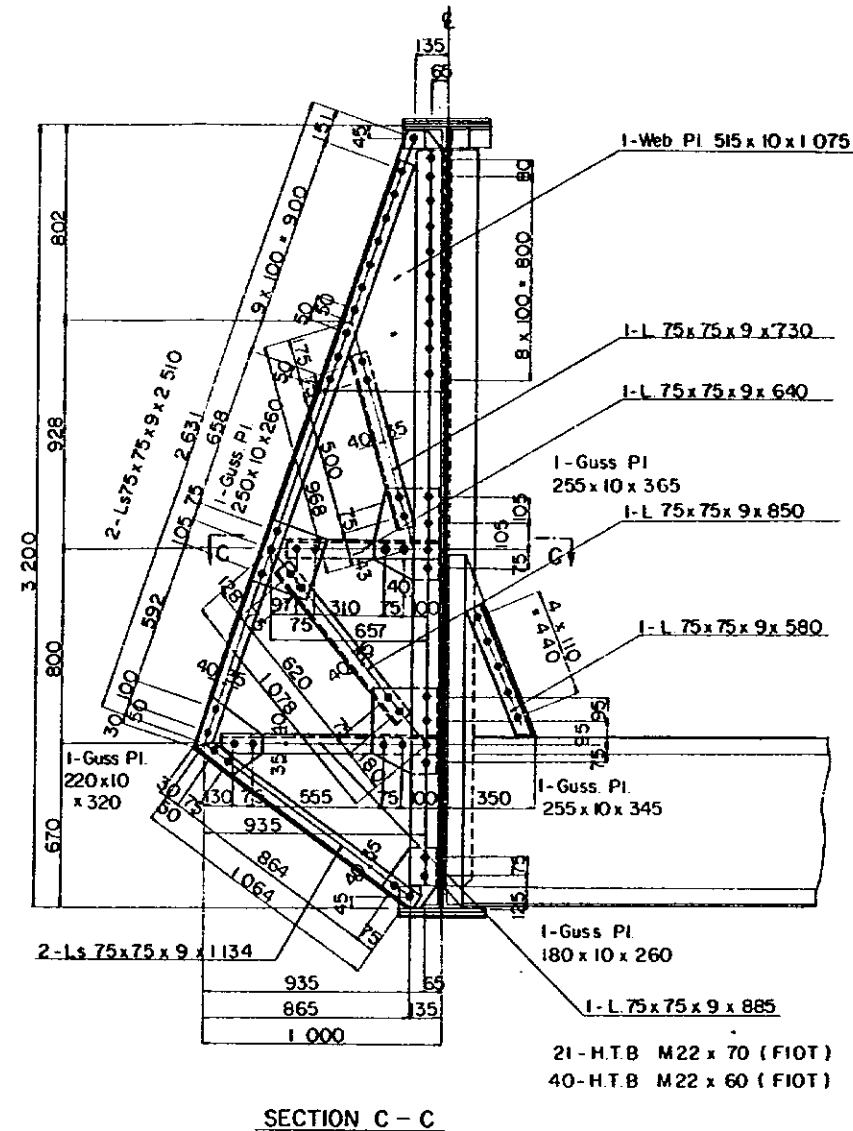
- 1-C 300 x 90 x 10 x 1150  
 2-Ls 100 x 100 x 10 x 290  
 14-HTB M22 x 60 (FIOT)

**SECTION B - B**  $s=1/5$



- 1-L 90 x 90 x 13 x 100

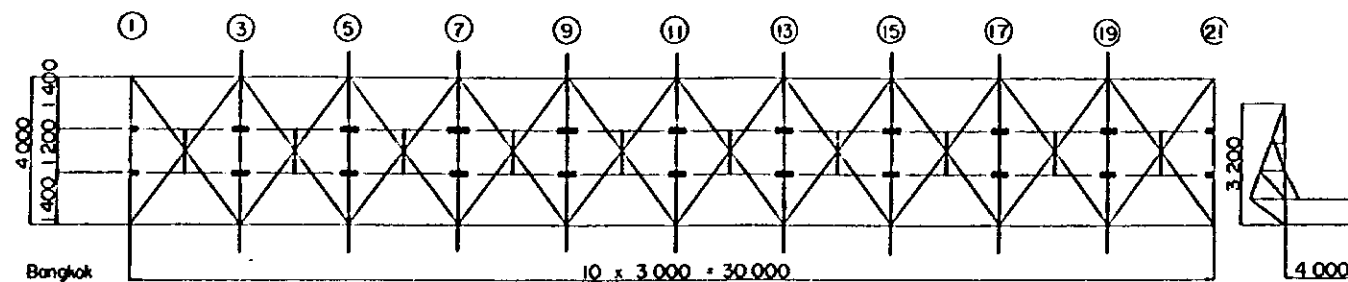
**KNEE BRACING**  $s=1/15$



**Construction Method**

- 1) Drill new bolt holes of original Vertical member.
- 2) Cut off rivets of original members.
- 3) Take off original gusset plate.
- 4) Clean surface between original and new added members.
- 5) Add new members and tighten HT.Balls.

**MARKING DIAGRAMS**

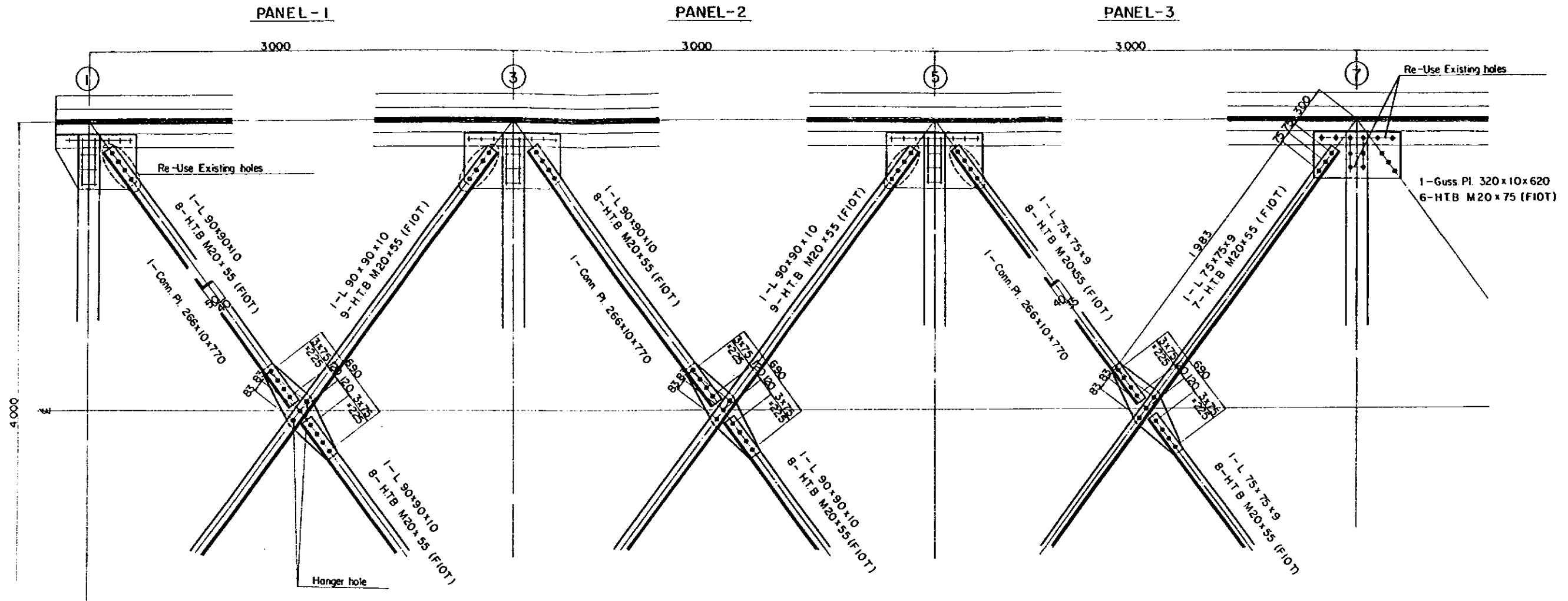


**General Notes:**

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (●) (FIOT), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22 (♣), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
300 TT	FLOOR SYSTEM & KNEE BRACING	Unit	Scale
K.M	263 + 335	mm	1/5, 1/10, 1/5
DISTRICT	Nakhon Sawan	Designed by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	4498

LOWER LATERAL BRACING (NO.1) S=1/15

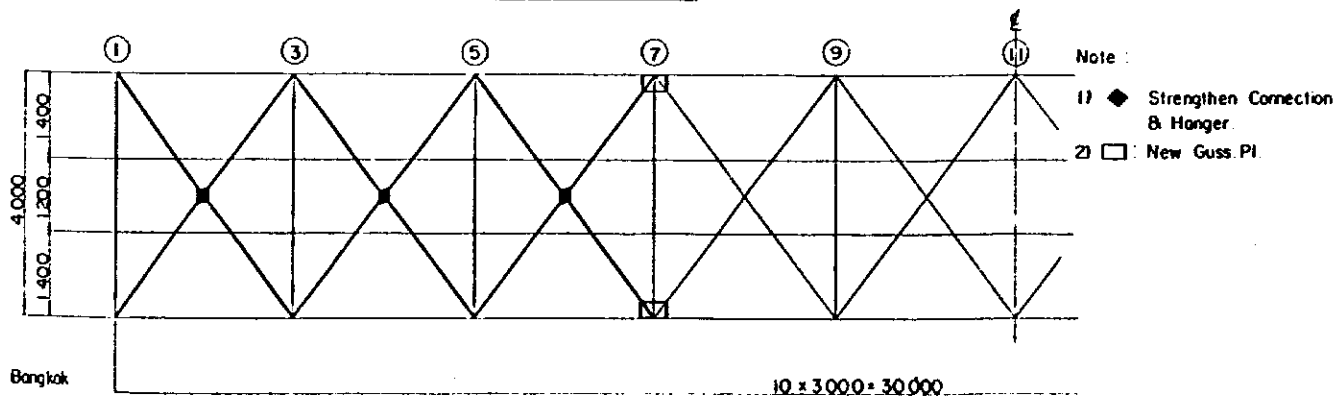


Note : Re-Use Existing holes.

Construction Method

- 1) Cut off original Rivets.
- 2) Take off original Members and Gusset Plate.
- 3) Clean surface between original and new members.
- 4) Attach new Angles and Gusset Plate.
- 5) Tighten HT.Bolts.

MARKING DIAGRAMS

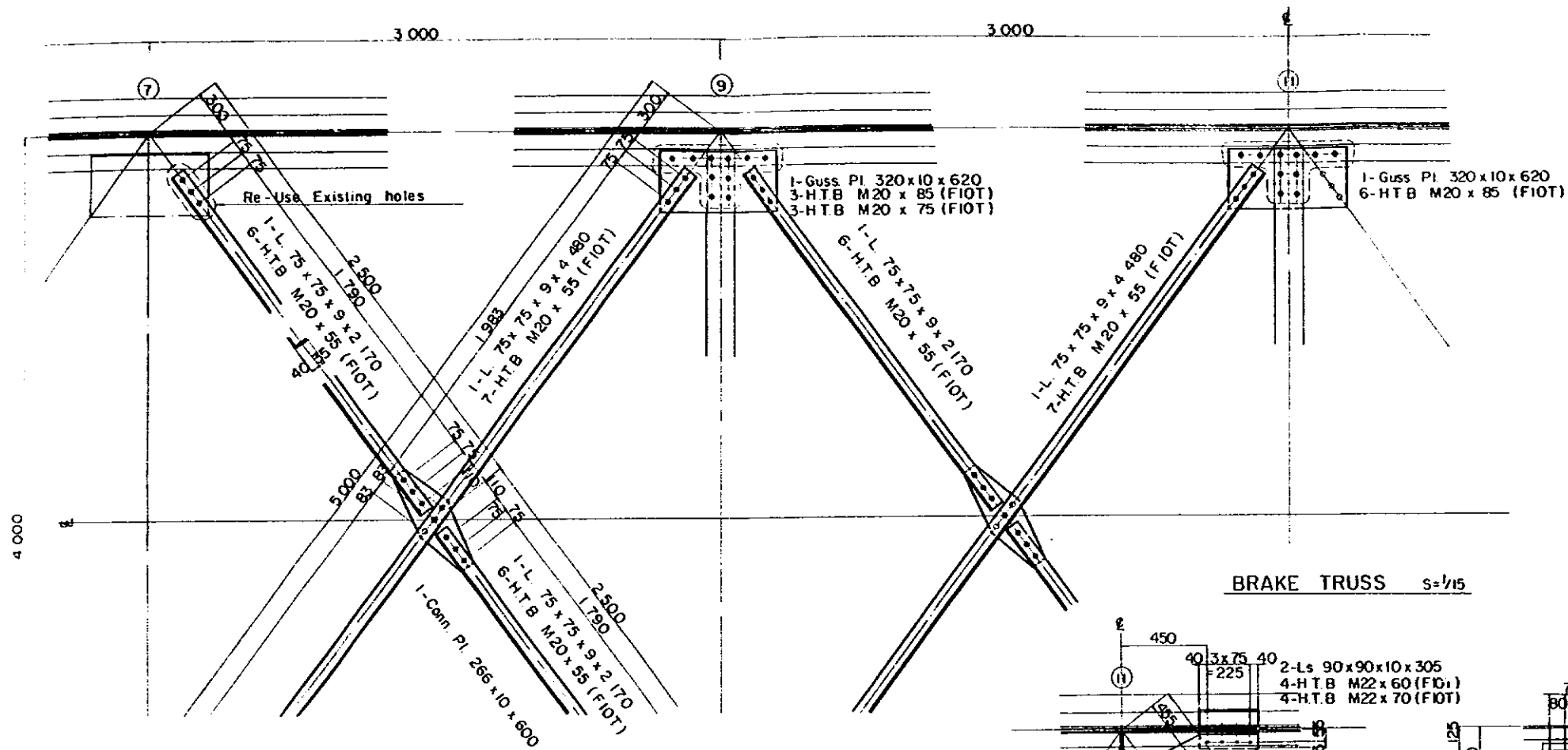


General Notes

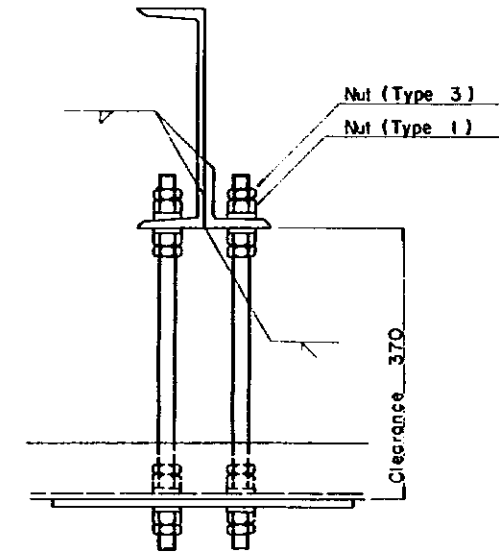
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M20 (Φ) (FIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field

THE STATE RAILWAY OF THAILAND				
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING				
Span Type	Members	LOWER LATERAL BRACING (NO.1)		DL 15 loading
300 T.T		Unit	Scale	
		mm	1/15	
K.M	263 + 335	Designed by		
DISTRICT	Nakhon Sawan	Checked by		
LINE	Northern Line	Checked by		
Remarks		Checked by		
		Checked by		
		Checked by		
DATE		DRAWING NO	4498	

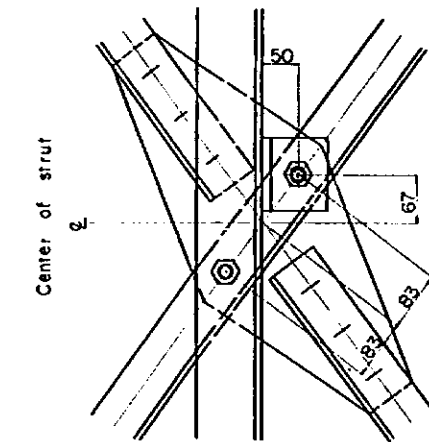
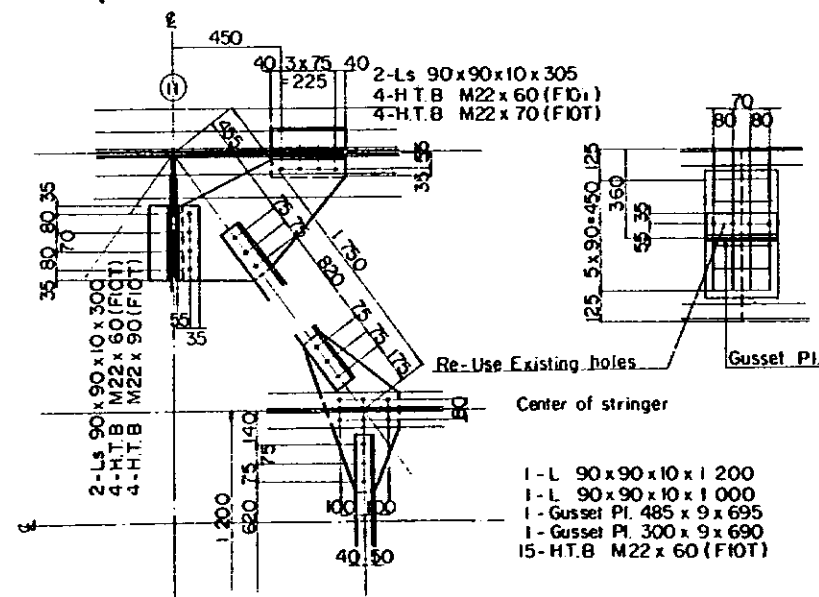
LOWER LATERAL BRACING (NO.2) s=1/15



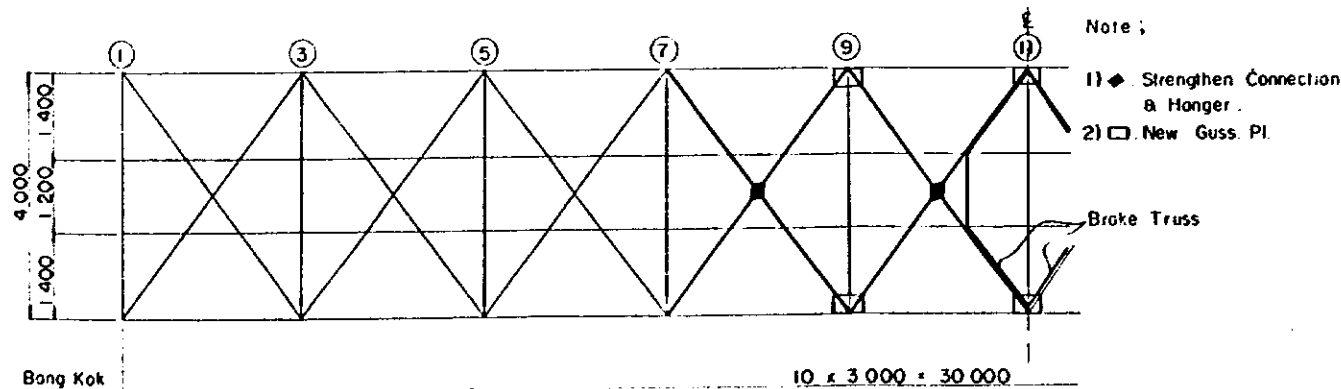
HANGER s=1/5



BRAKE TRUSS s=1/15



MARKING DIAGRAMS



General Notes:

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (φ) (FIOT), and assumed frictional coefficient of contact surface (f) as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND				
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING				
Span Type	Members	DL 15 loading		
		Unit	Scale	
300T		mm	1/15, 1/5	
K M	263 + 335	Designed by		
DISTRICT	Nakhon Sawan	Checked by		
LINE	Northern Line	Checked by		
Remarks		Checked by		
		Checked by		
		Checked by		
DATE		DRAWING NO	4498	

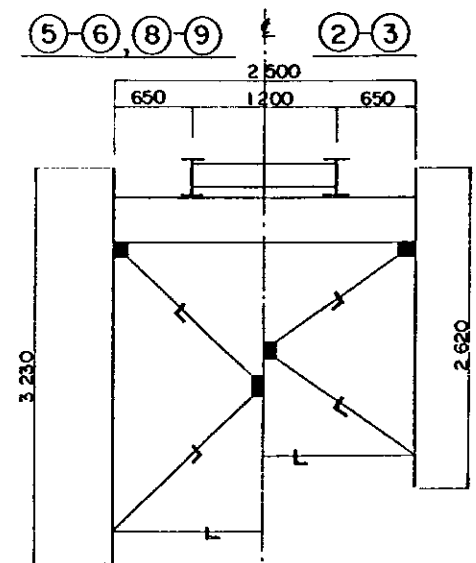
# GENERAL DIAGRAM

## FLOOR SYSTEM & UPPER LATERAL

## SWAY BRACING

Bangkok (Mov)

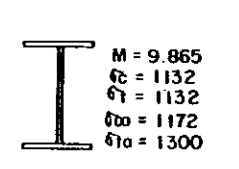
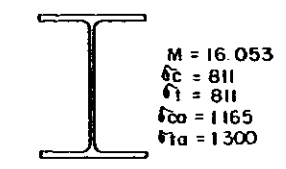
- Note
- 1) (F): New floor beam and connection
  - 2) (S): New stringer and connection
  - 3) (S): New strut of stringer
  - 4) (L): New lateral bracing
  - 5) (B): New brake truss
  - 6) ■: Strengthen Gusset Plates



Note: ■: Strengthen Gusset Plates

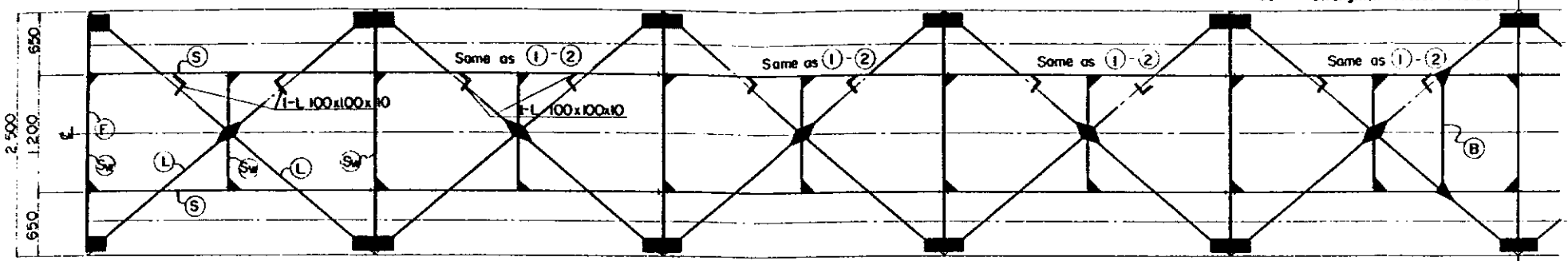
## FLOOR BEAM

## STRINGER

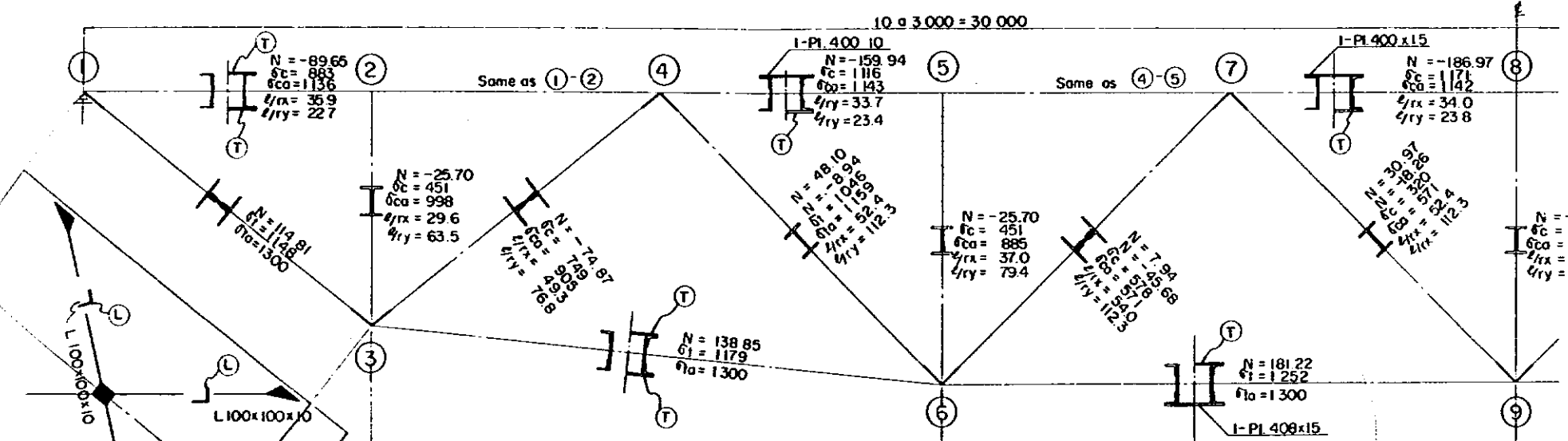


- General Note:
- 1) Weak drawings show the original members  
Deep drawings show the members to be improved.
  - 2) Actual stresses are based on DL-15 loading.
  - 3) Marks  
M: Bending moment (t.m)     $\sigma_c$ : Slenderness Ratio  
N: Axial force (t)          $\sigma_t$ : Actual stress ( $\text{kg/cm}^2$ )  
Length of member (cm)      $\sigma_{ca}$ : Allowable stress  
 $\sigma_x, \sigma_y$ : Radius gyration of sectional area ( $\text{kg/cm}^2$ )  
for x or y axis (cm)

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	GENERAL DIAGRAM	DL-15 Loading
300 D.T			Unit: mm Scale:
K.M	577 + 622	Designed by	_____
DISTRICT	Lampang	Checked by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	



MAIN TRUSS

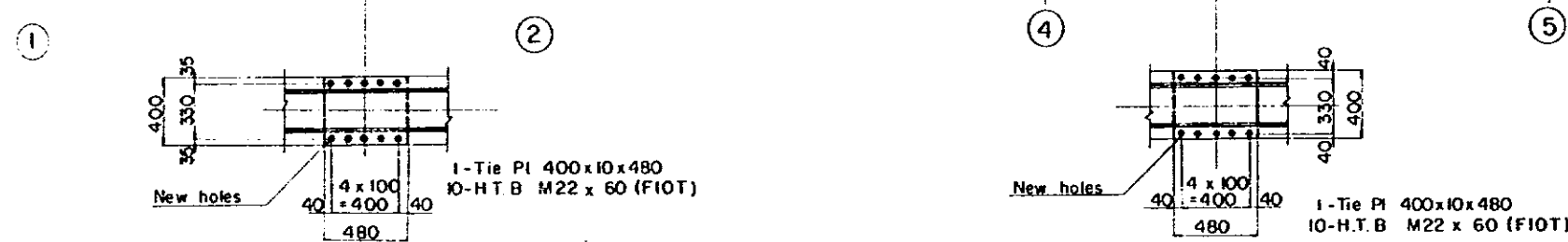
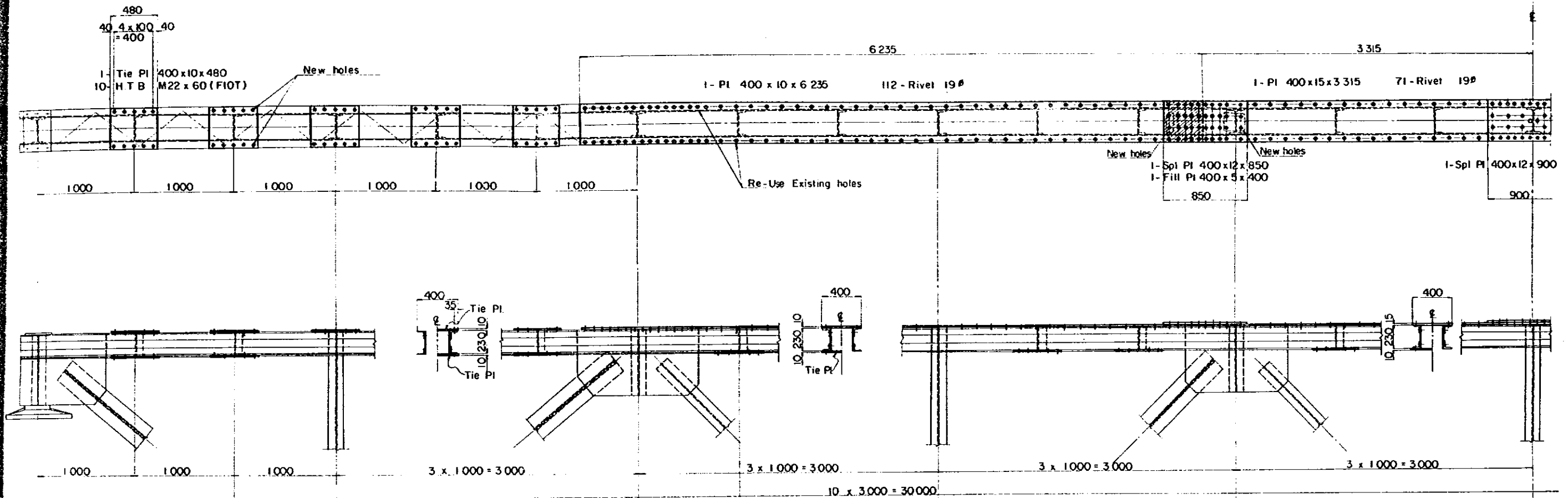


LOWER LATERAL

- Note
- 1) (L): New lateral bracing
  - 2) ■: New Gusset Plates.

# MAIN TRUSS (NO. 1)

UPPER CHORD MEMBER  $s=1/20$

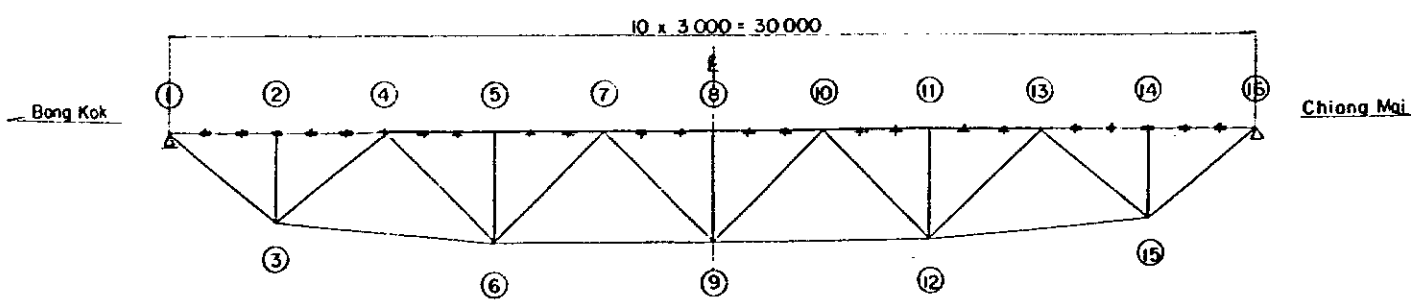


MARKING DIAGRAMS

- Construction Method**
- 1) Cut off original rivets
  - 2) Take off original Lacing Bar & Cover Plates
  - 3) Drill new bolt holes
  - 4) Clean surface between original members and additional plates
  - 5) Attach new tieplates and tighten HTBolts
  - 6) Add new cover plates and rivetting

- Note**
- 1) : Re-Use Existing holes
  - 2) : Take off original lacing bar.

- General Notes :**
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
  - 2) All high-strength bolts (HTB) are M22 (F10T), and assumed frictional coefficient of contact surface as follows
    - i) for connection  $f \geq 0.4$
    - ii) for stitch  $f \geq 0.3$
  - 3) All rivets are 19# (F), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
  - 4) All dimensions to be checked in the field

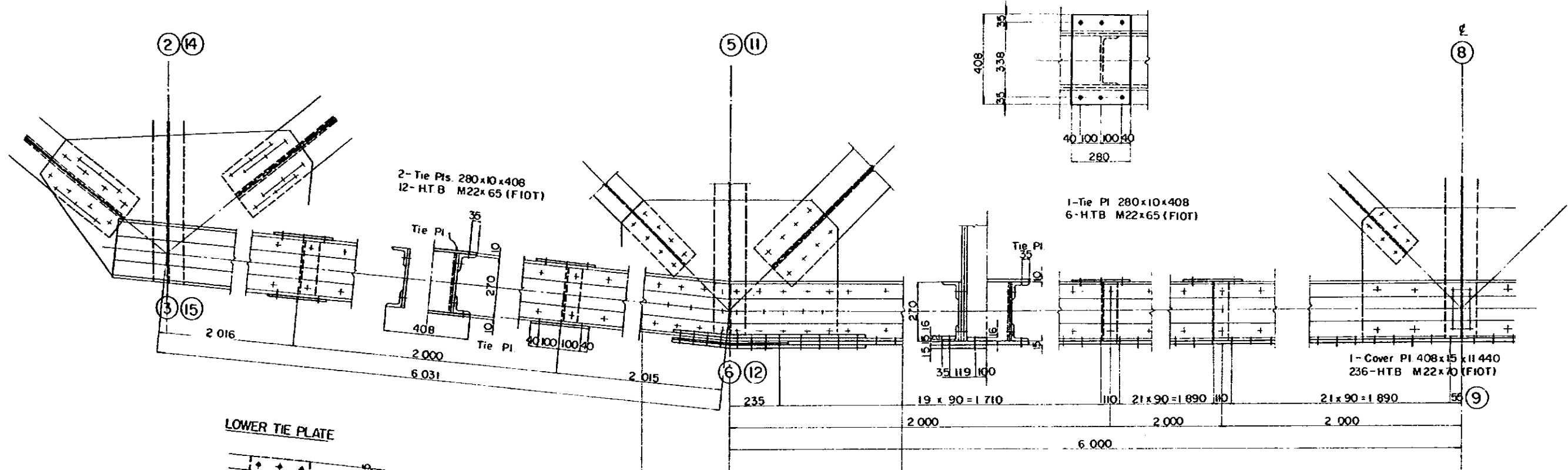


THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 Loading	
300 D T	MAIN TRUSS (NO. 1)	Unit	Scale
K M	577 + 622	mm	1/20
DISTRICT	Lampang	Designed by	
LINE	Northern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO	

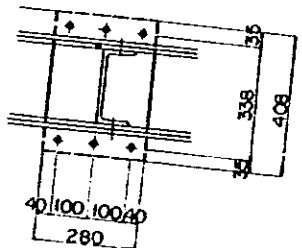
# MAIN TRUSS (NO. 2)

LOWER CHORD MEMBER s=1/10

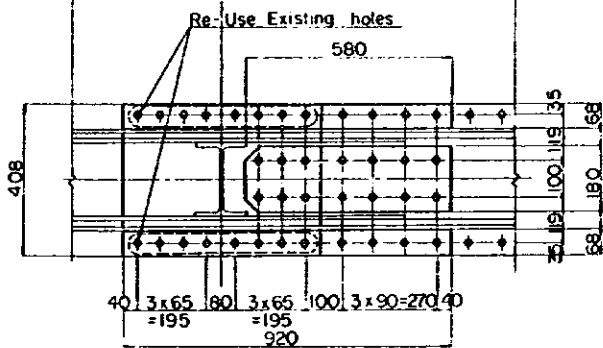
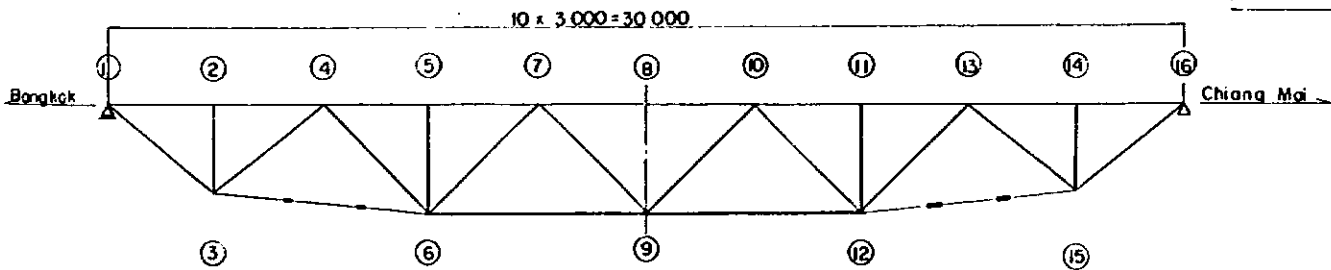
UPPER TIE PLATE



LOWER TIE PLATE



MARKING DIAGRAMS



- 2-Spl. Pls 68 x 16 x 920
- 1-Spl. Pl. 180 x 16 x 580
- 1-Spl. Pl. 408 x 15 x 920
- 2-Fill Pls 408 x 5 x 550
- 16-Rivets 22<sup>φ</sup>
- 22-Rivets 19<sup>φ</sup>

- General Notes:**
- 1) All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
  - 2) All high strength bolts (HTB) are M22(-Φ-)(FIOT), and assumed frictional coefficient of contact surface as follows:
    - i) for connection  $f \geq 0.4$
    - ii) for stitch  $f \geq 0.3$
  - 3) All rivets are 22<sup>φ</sup> and 19<sup>φ</sup> (-Φ-), and to be rolled steel for SV 34 (JIS G 3104) or materials of equivalent.
  - 4) All dimensions to be checked in the field.

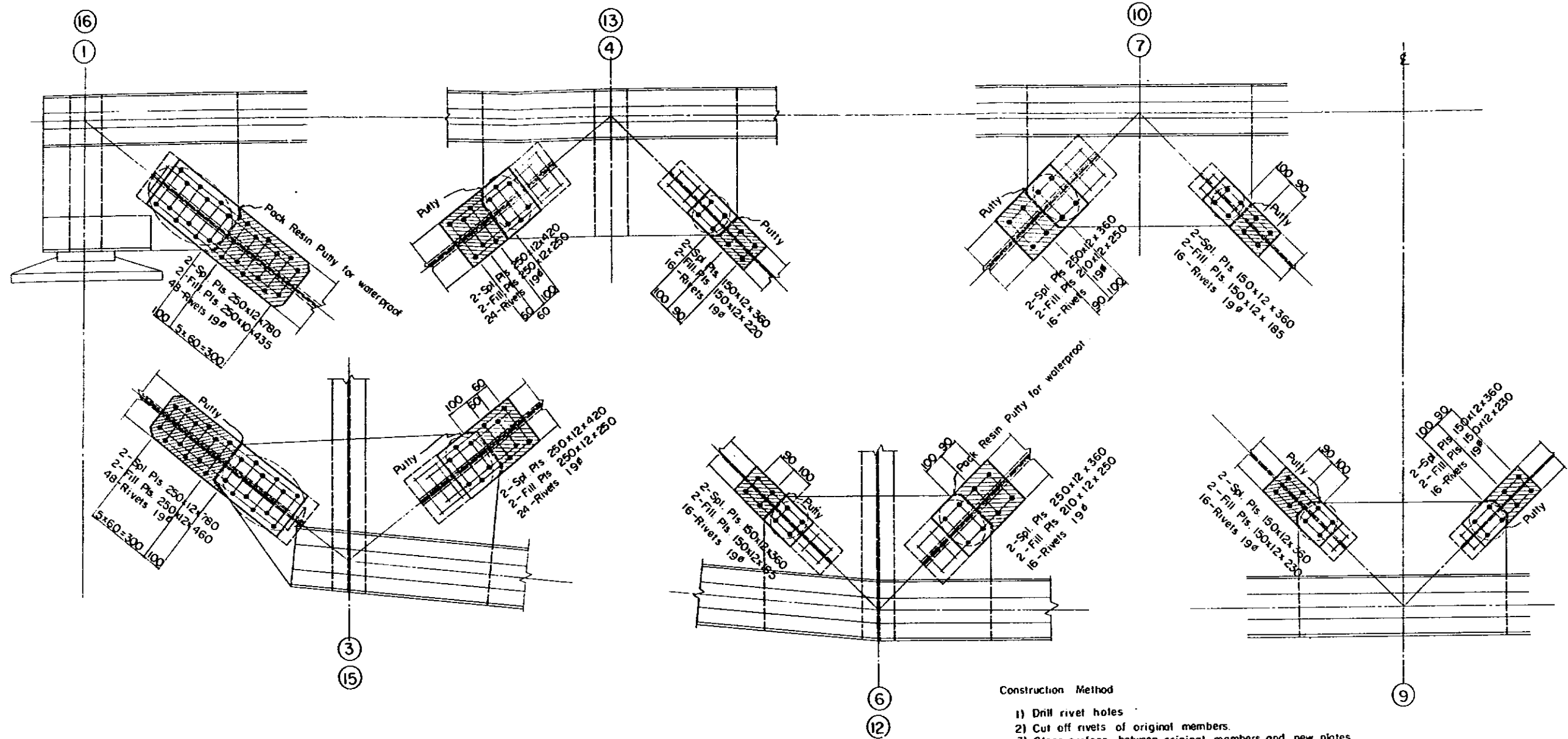
- Construction Method**
- 1) Drill new bolt holes
  - 2) Cut off original rivets
  - 3) Clean surface between original members and additional plates.
  - 4) Attach new Tie Plate and tighten HTBolts
  - 5) Add new Cover Plate and tighten HTBolts or riveting

**Note**  
 ; Re-Use Existing holes

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
30.0 D.T	MAIN TRUSS (NO. 2)	Unit	Scale
		mm	1/10
K.M.	577 + 622	Designed by	_____
DISTRICT	Lampang	Checked by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

MAIN TRUSS (NO.3)

DIAGONAL CONNECTION S=1/10



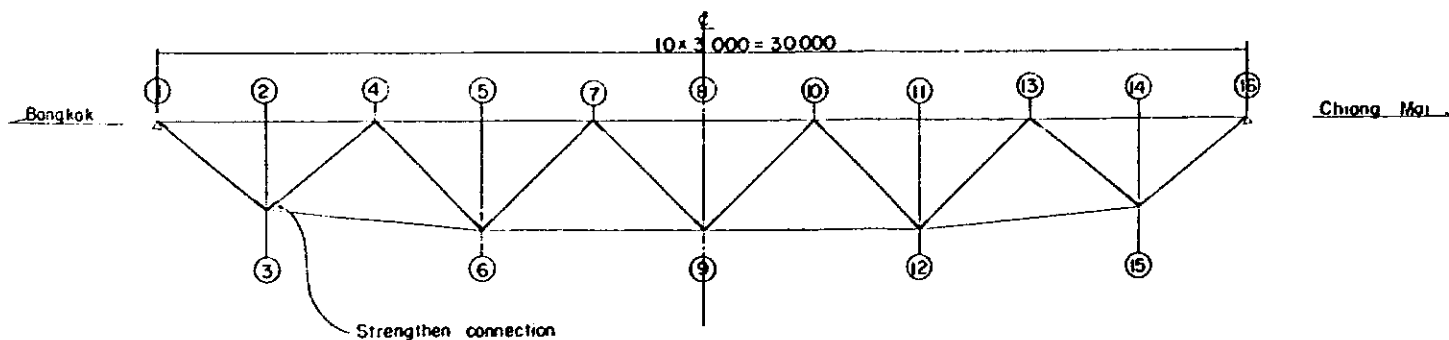
MARKING DIAGRAMS

Construction Method

- 1) Drill rivet holes
- 2) Cut off rivets of original members.
- 3) Clean surface between original members and new plates.
- 4) Add splice Plate, Fill Plate and rivetting

Note

⊘ : Re-Use Existing holes



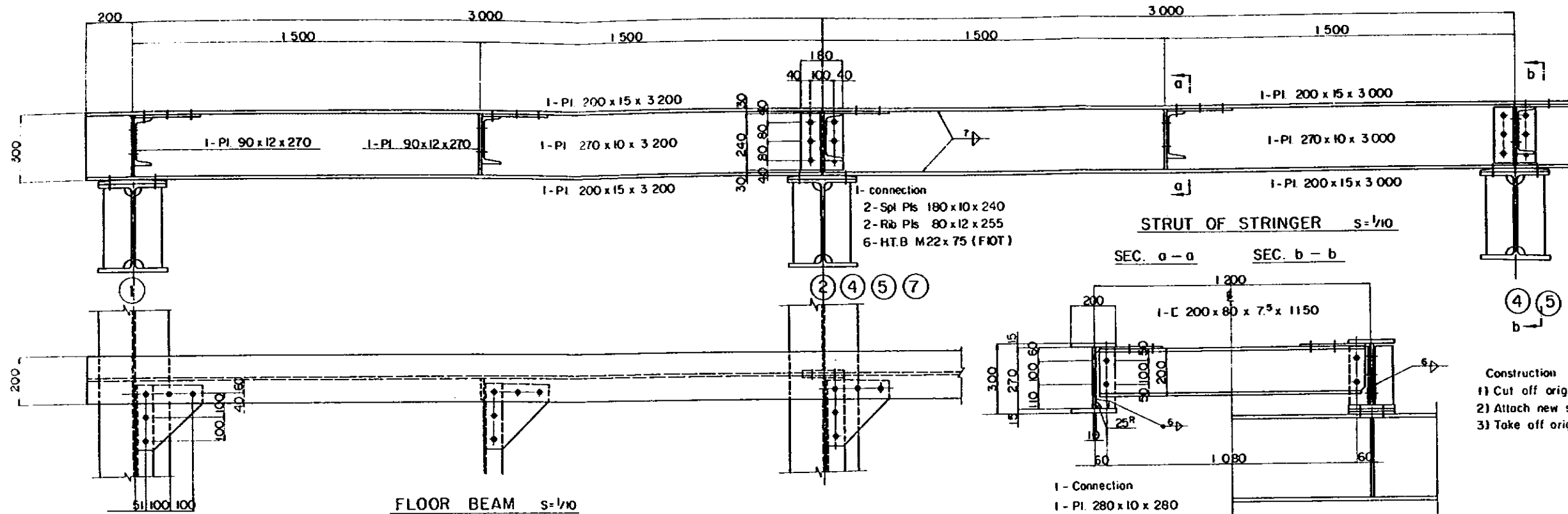
General Notes:

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All rivets are 19<sup>φ</sup> (Φ), and to be rolled steel for SV34 (JIS G 3104) or materials of equivalent
- 3) All dimensions to be checked in the field

THE STATE RAILWAY OF THAILAND				
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING				
Span Type	Members	DL 15 loading		
300 DT	MAIN TRUSS (NO.3)	Unit	Scale	
		mm	1/10	
K.M	577 + 622	Designed by		
DISTRICT	Lampang	Checked by		
LINE	Northern Line	Checked by		
Remarks		Checked by		
		Checked by		
		Checked by		
		Checked by		
DATE		DRAWING NO.		

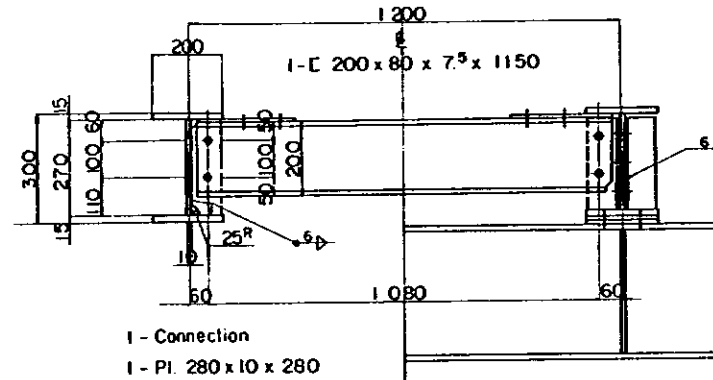
# FLOOR SYSTEM

STRINGER  $s=1/10$



STRUT OF STRINGER  $s=1/10$

SEC. a-a SEC. b-b

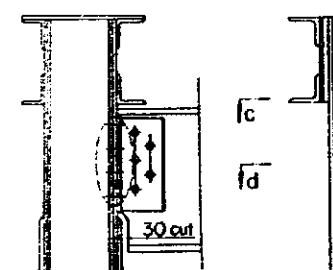


- 1- Connection
- 1- Pl. 280x10x280
- 2- H.T.B M22x60 (FIOT)
- 4- H.T.B M22x65 (FIOT)
- 1- H.T.B M22x80 (FIOT)

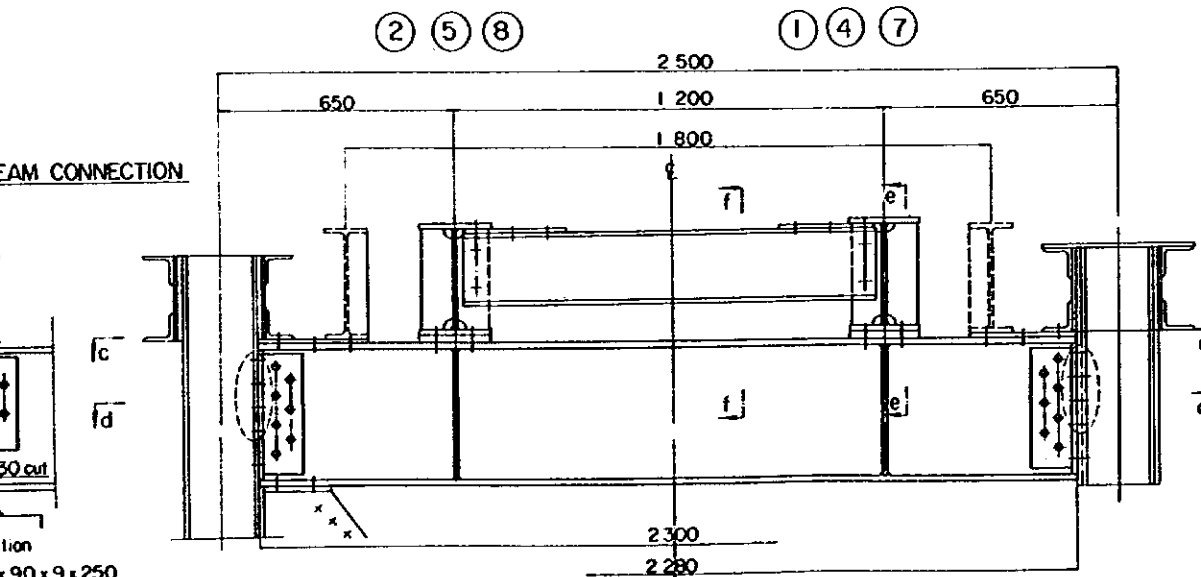
- Construction Method (Stringer)
- 1) Cut off original rivets
  - 2) Attach new stringers and tighten H.T.Bolts.
  - 3) Take off original stringers.

FLOOR BEAM  $s=1/10$

END FLOOR BEAM CONNECTION

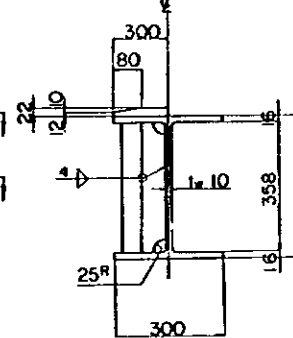


- 1- Connection
- 2- Ls 125x90x9x250
- 5- Rivets 19#
- 8- Rivets 19#



- 1- Connection
- 2- Ls 125x90x10x330
- 7- Rivets 19#
- 10- Rivets 19#
- 1- H 390x300x10x16x2300 (2280)
- 4- Pls 120x10x358
- 2- Pls 200x22x300
- 8- B.N M22x80

DETAIL e-e DETAIL f-f

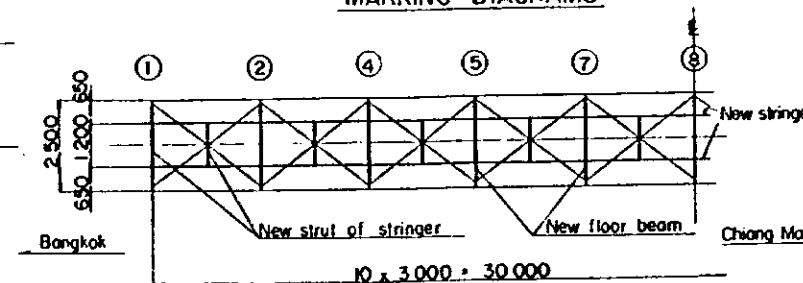


Construction Method (Floor)

- 1) Cut off original rivets.
- 2) Take off original floor beams.
- 3) Drill rivet holes.
- 4) Attach new floor beams and riveting.

Note  
 ; Re-Use Existing holes.

MARKING DIAGRAMS



### General Notes

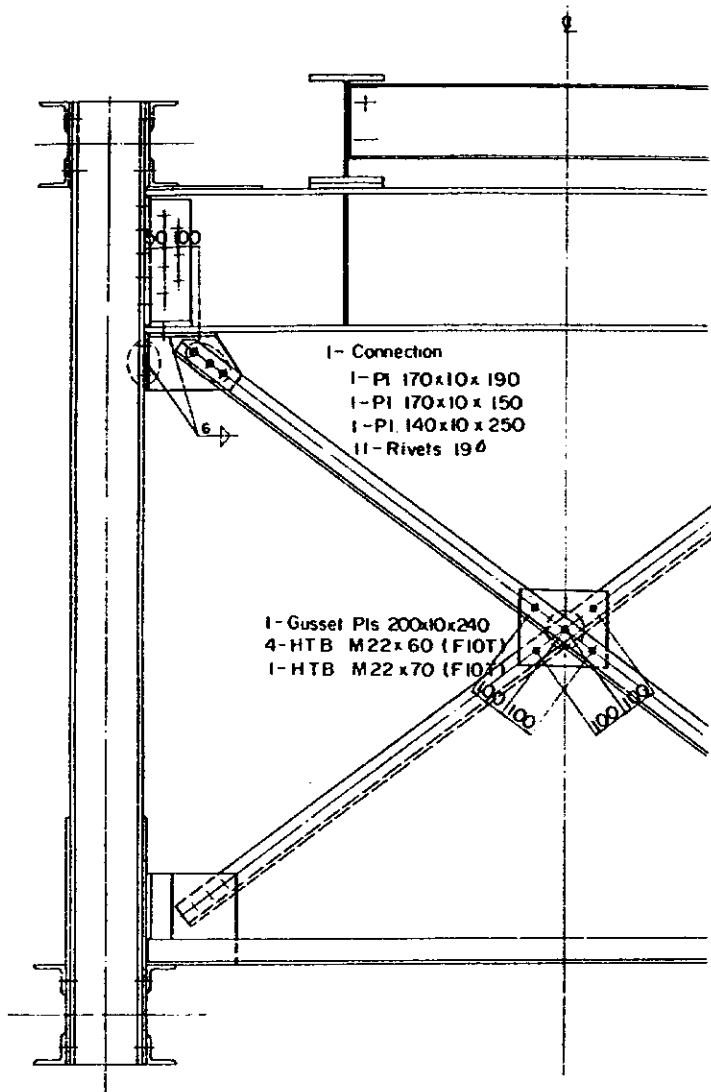
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (H.T.B.) are M22-( $\phi$ )(FIOT), and assumed frictional coefficient of contact surface as follows
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 19# ( $\phi$ ), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	D.L. 15 Loading	
300 DT	FLOOR SYSTEM	Unit	Scale
		mm	1/10
K.M	577 + 622	Designed by	
DISTRICT	Lompong	Checked by	
LINE	Northern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO	

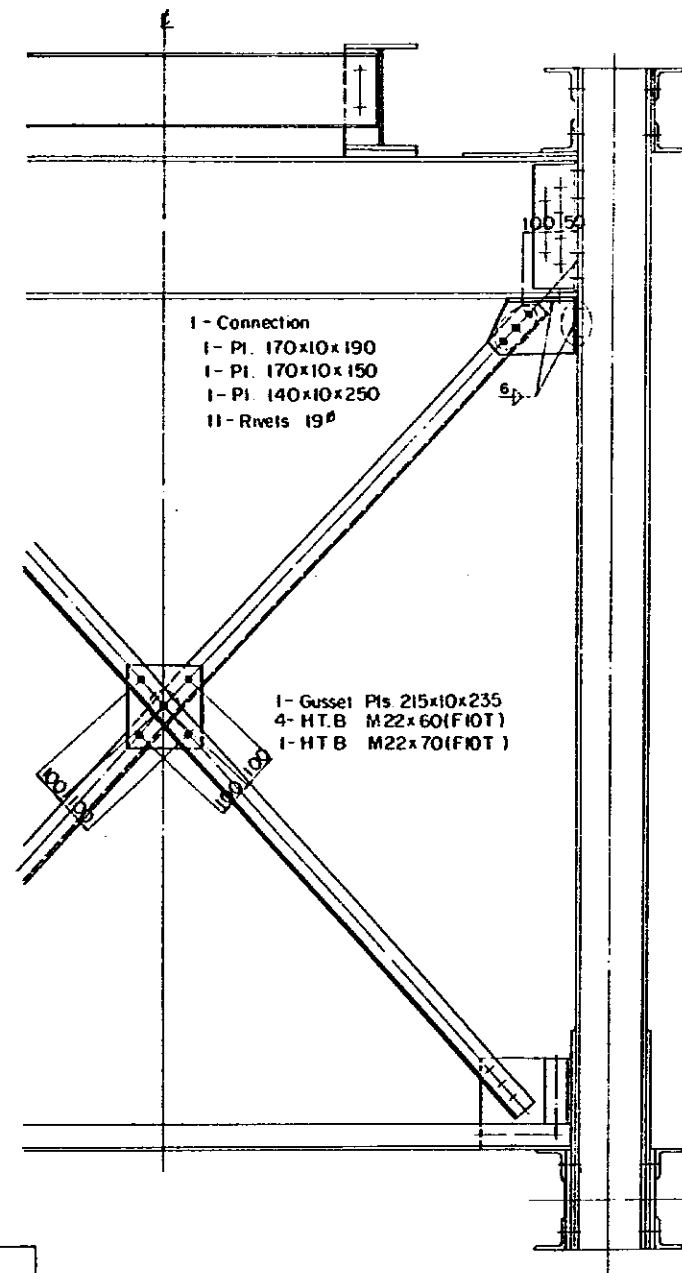


SWAY BRACING S=1/10

②-③, ⑭-⑮



⑤-⑥, ⑧, ⑨, ⑪-⑫



Construction Method

- 1) Drill new bolt holes
- 2) Cut off original rivets.
- 3) Take off original Gusset Plates
- 4) Clean surface between original members and additional plates.
- 5) Add new Plates or angles.
- 6) Tighten H.T. Bolts or rivetting.

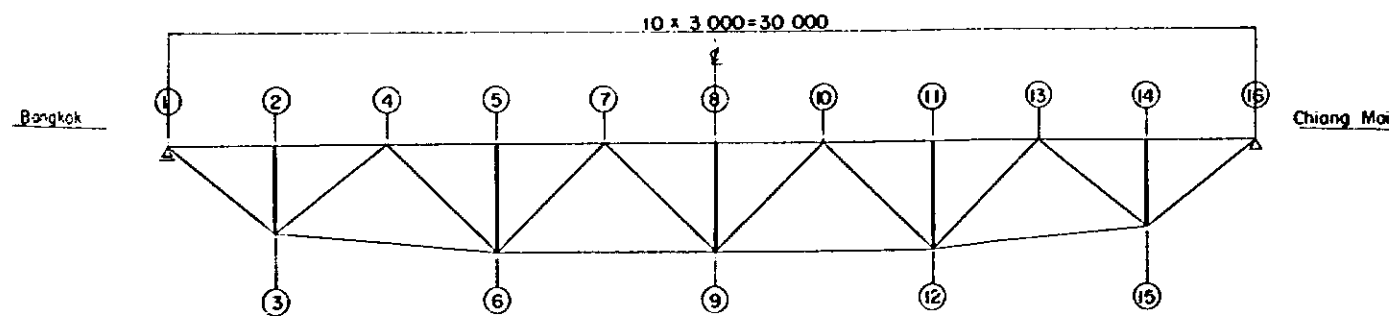
Note

○; Re- Use Existing holes

General Notes:

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent
- 2) All high-strength bolts (HTB) are M22(→)(F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 19<sup>ø</sup> (→) and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.

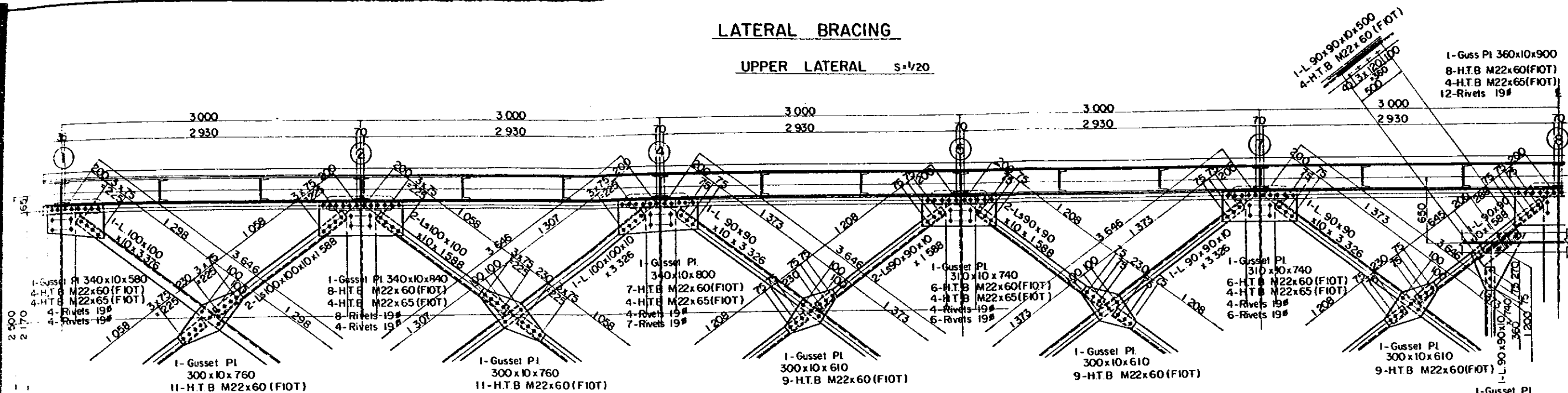
MARKING DIAGRAMS



THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	D.L. 15 loading	
300 DT	SWAY BRACING	Unit	Scale
		mm	1/10
K. M.	577 + 622	Designed by	_____
DISTRICT	Lampang	Checked by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

# LATERAL BRACING

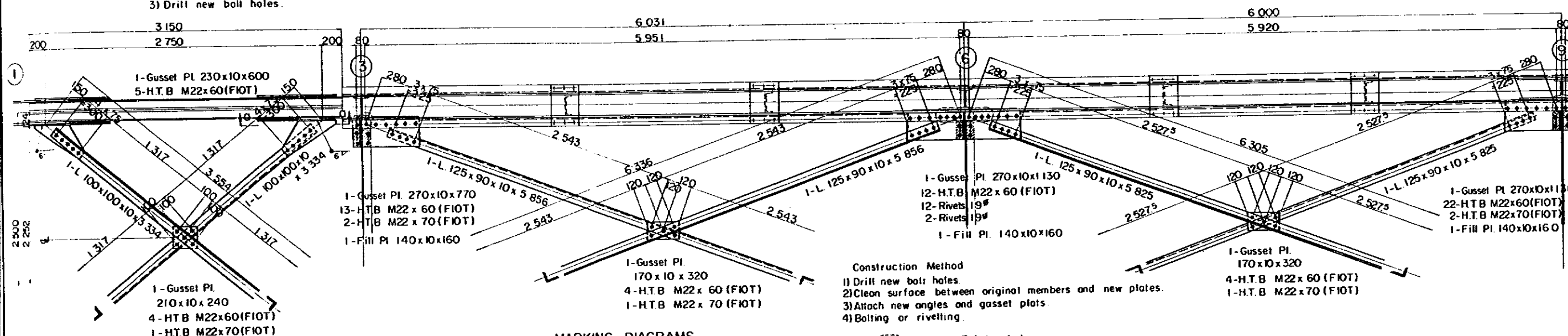
## UPPER LATERAL $s=1/20$



### Construction Method

- 1) Cut off original rivets
- 2) Take off original members and gusset plates.
- 3) Drill new bolt holes.
- 4) Clean surface between original members and additional plates.
- 5) Attach new angles and gusset plates
- 6) Bolting or rivetting.

## LOWER LATERAL $s=1/20$

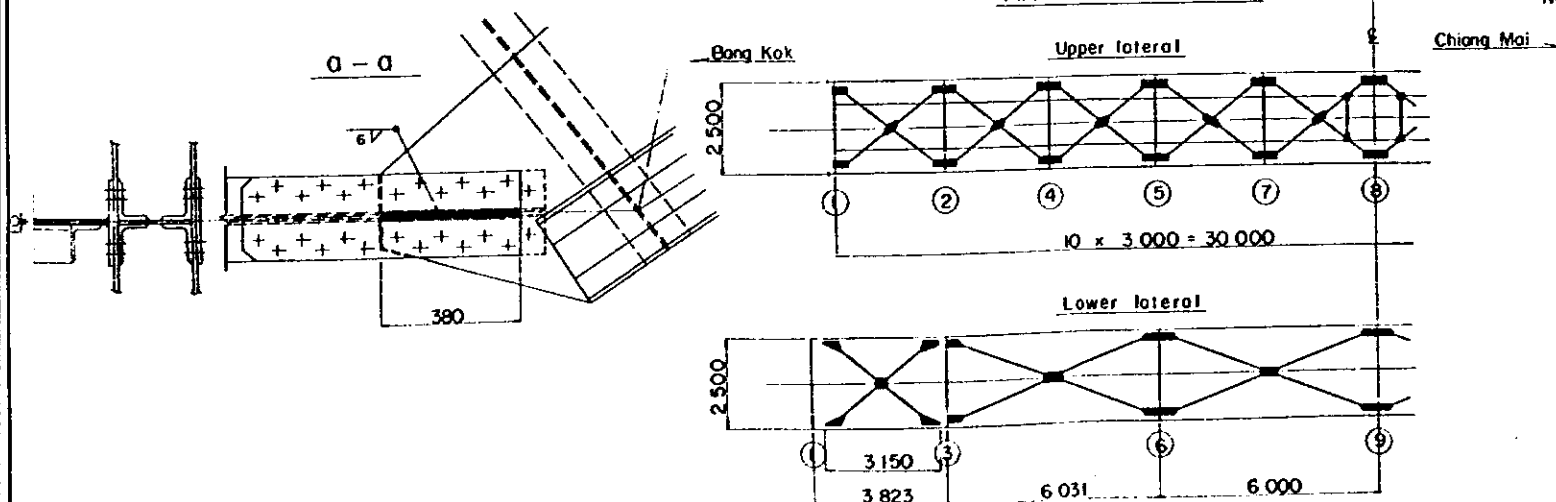


### Construction Method

- 1) Drill new bolt holes
- 2) Clean surface between original members and new plates.
- 3) Attach new angles and gusset plates.
- 4) Bolting or rivetting.

Note: : Re - Use Existing holes.

### MARKING DIAGRAMS



### General Notes:

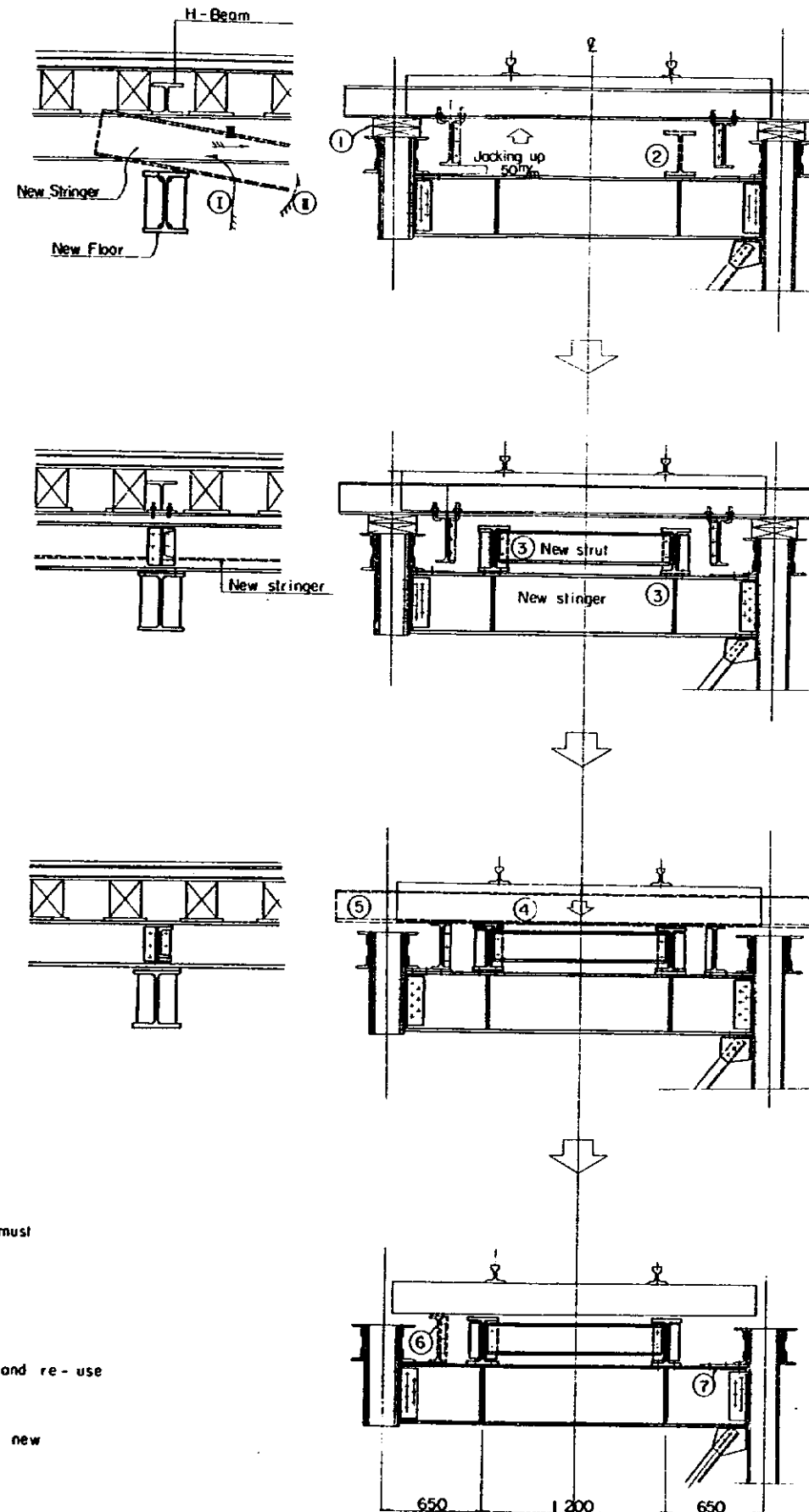
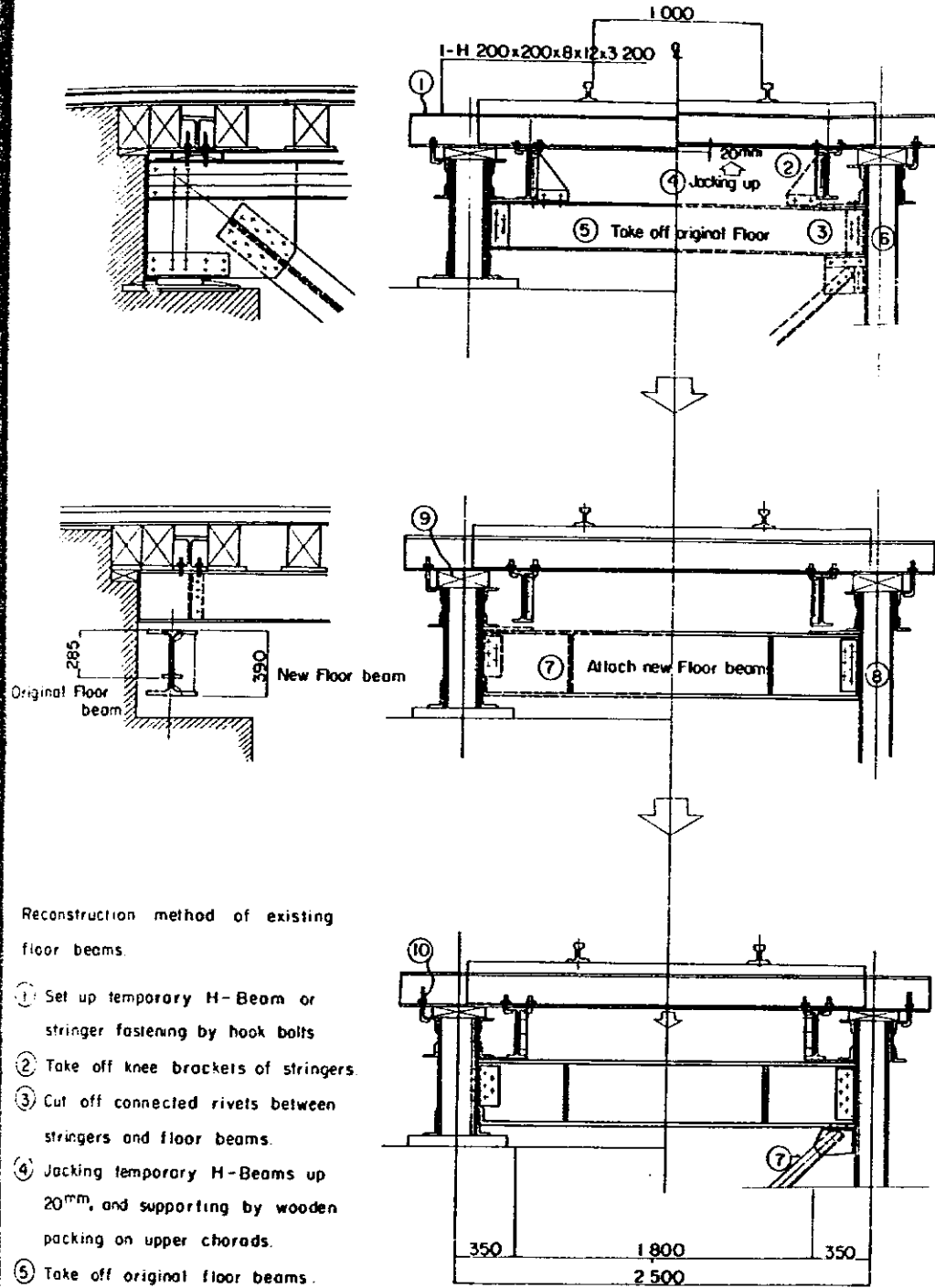
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high strength bolts (H.T.B) are M22-φ-(F10T), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f = 0.4$
  - ii) for stitch  $f = 0.3$
- 3) All rivets are 19# (φ), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
		Unit	Scale
300D.T	LATERAL BRACING	mm	1/20
K M	577 + 622	Designed by	
DISTRICT	Lampang	Checked by	
LINE	Northern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

# RECONSTRUCTION METHOD OF FLOOR SYSTEM

## FOR FLOOR BEAM

## FOR STRINGER



Reconstruction method of existing stringers.

- ① Jacking temporary H-Beams up 50<sup>mm</sup>, and add wooden supporting on upper chord.
- ② Attach new stringers and struts.
- ③ Bolting by HT Bolts.
- ④ Set up new packing between sleepers and new stringers by wooden packing.
- ⑤ Jack down original stringers and take off temporary H-Beams.
- ⑥ Take off original stringer by gas cutting.
- ⑦ Set up new lateral bracing.

For this reconstruction method, 1-Panel must be finished within 1 day.

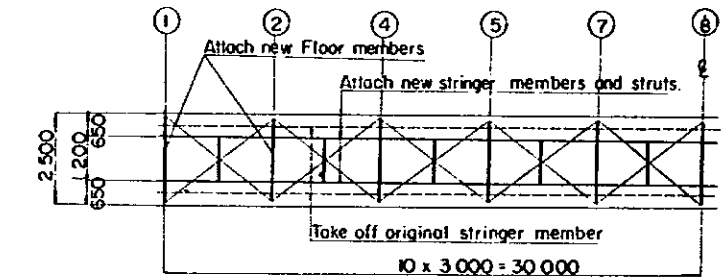
Reconstruction method of existing floor beams

- ① Set up temporary H-Beam or stringer fastening by hook bolts
- ② Take off knee brackets of stringers.
- ③ Cut off connected rivets between stringers and floor beams.
- ④ Jacking temporary H-Beams up 20<sup>mm</sup>, and supporting by wooden packing on upper chords.
- ⑤ Take off original floor beams.
- ⑥ Drill new bolt holes for floor beam connections
- ⑦ Attach new floor beams and original sway bracings.
- ⑧ Bolting the connection by HT Bolts.
- ⑨ Take off wooden support on upper chord and jacking place
- ⑩ Wooden supporting on upper chord and fastening temporary H-Beams by hook bolts.

For this Reconstruction method, 1-panel must be finished within 1 day.

Note ; for lateral sway bracing  
Set up new gusset plate connection and re-use original lateral bracing.  
Bolting temporary by service bolts at new gusset plate connections.

## MARKING DIAGRAMS

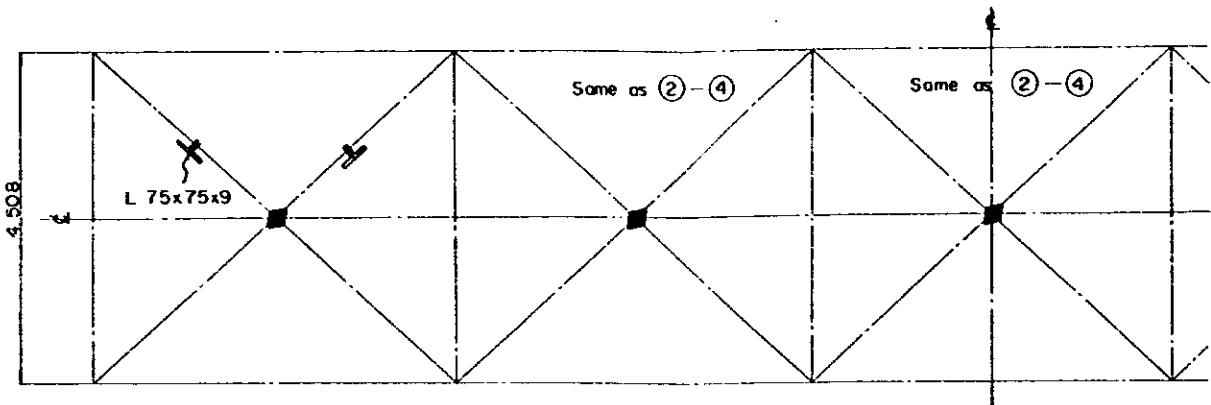


THE STATE RAILWAY OF THAILAND			
STANDARD DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	RECONSTRUCTION METHOD OF FLOOR SYST.	
300 D.T		DL. 15 loading	Unit Scale
K M	577 + 622	mm	
DISTRICT	Lawang	Designed by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

# GENERAL DIAGRAM

Bangkok (Mov)

## UPPER LATERAL

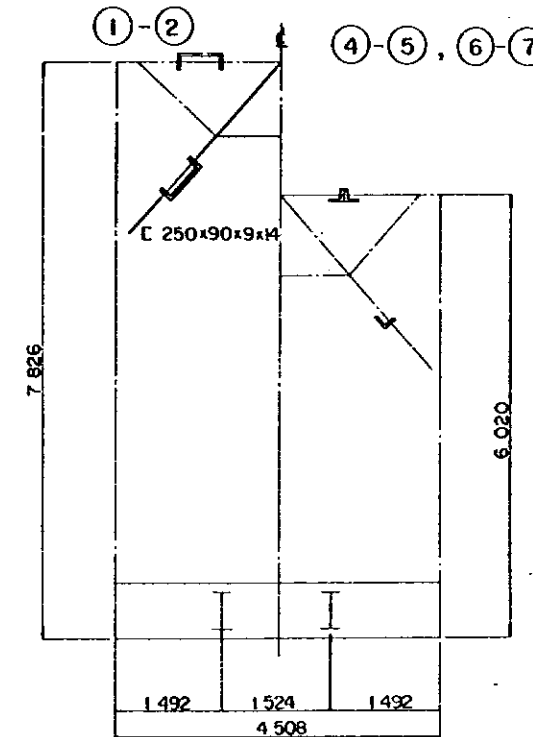


Chumphon (Fix)

Note:  
1)  $\blacklozenge$ : Strengthen Guss Plate

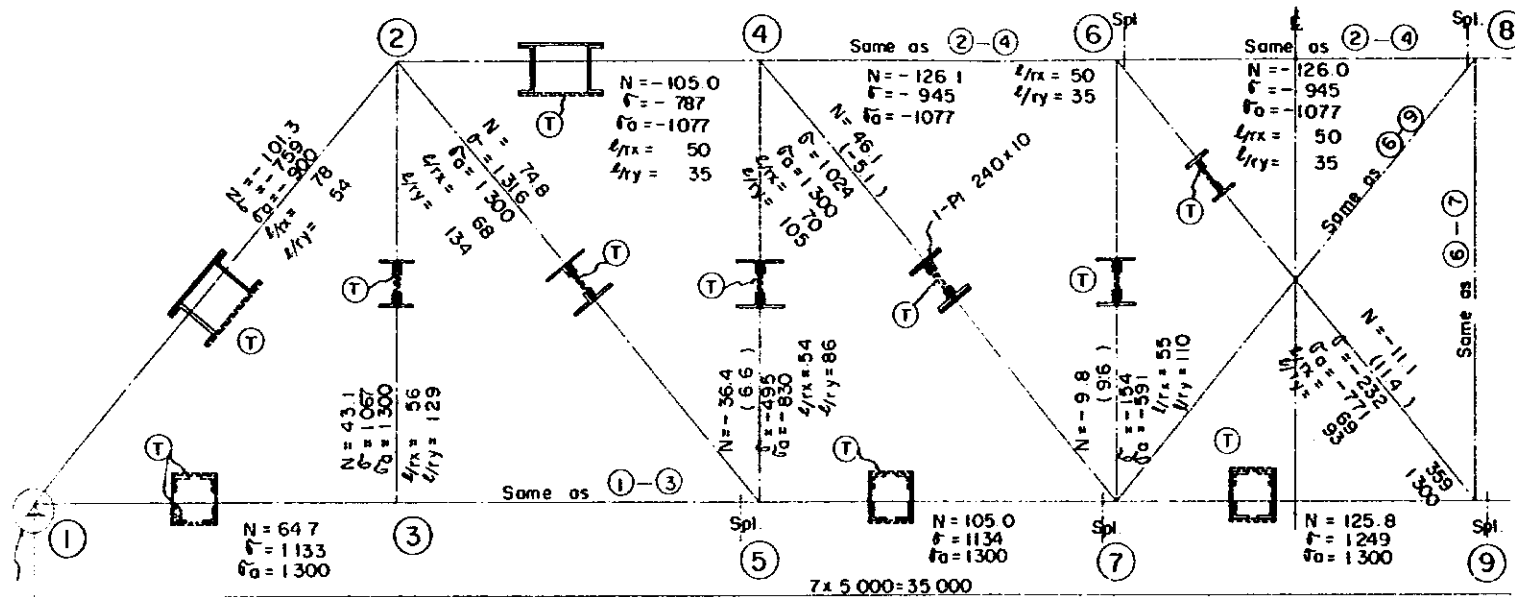
## PORTAL BRACING

## SWAY BRACING



Note:  
1)  $\textcircled{T}$ : Strengthen Tie plate

## MAIN TRUSS

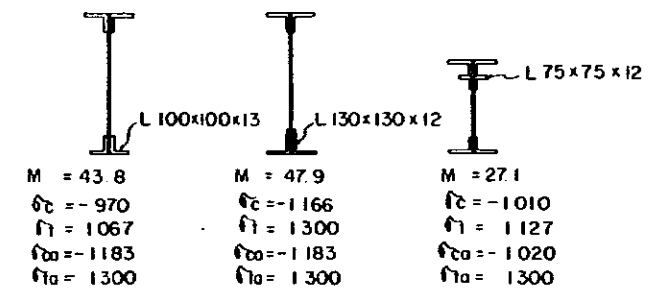


Repair misalignment of shoe rollers.

## END FLOOR

## INT. FLOOR

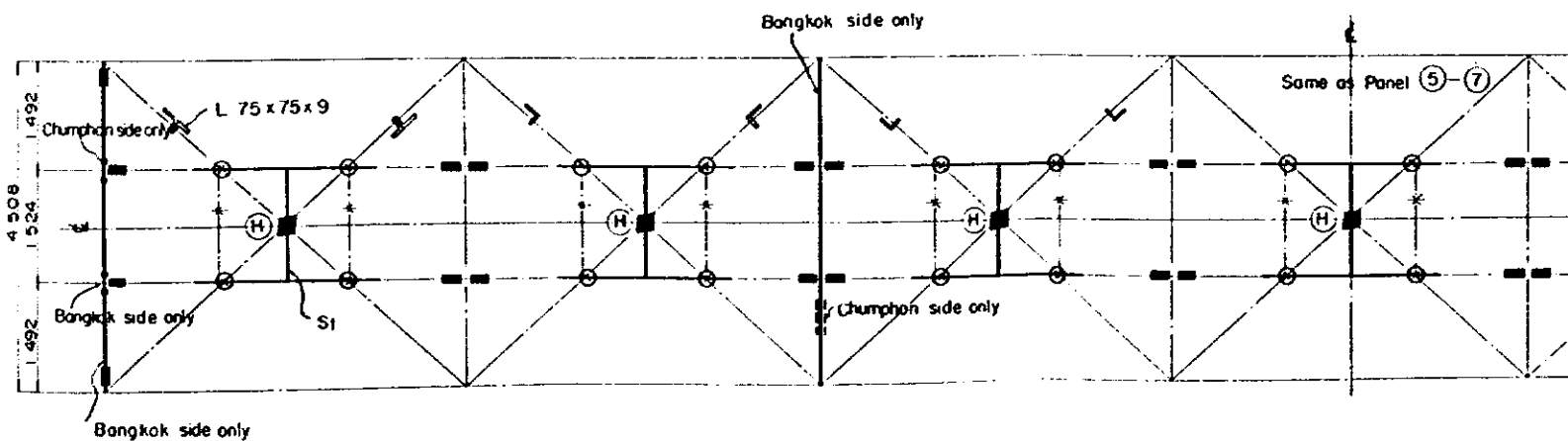
## STRINGER



General Notes:

- 1) Weak drawings show the original members. Deep drawings show the members to be improved.
- 2) Actual stresses are based on DL-15 loading.
- 3) Marks:

## FLOOR SYSTEM & LOWER LATERAL



Legends

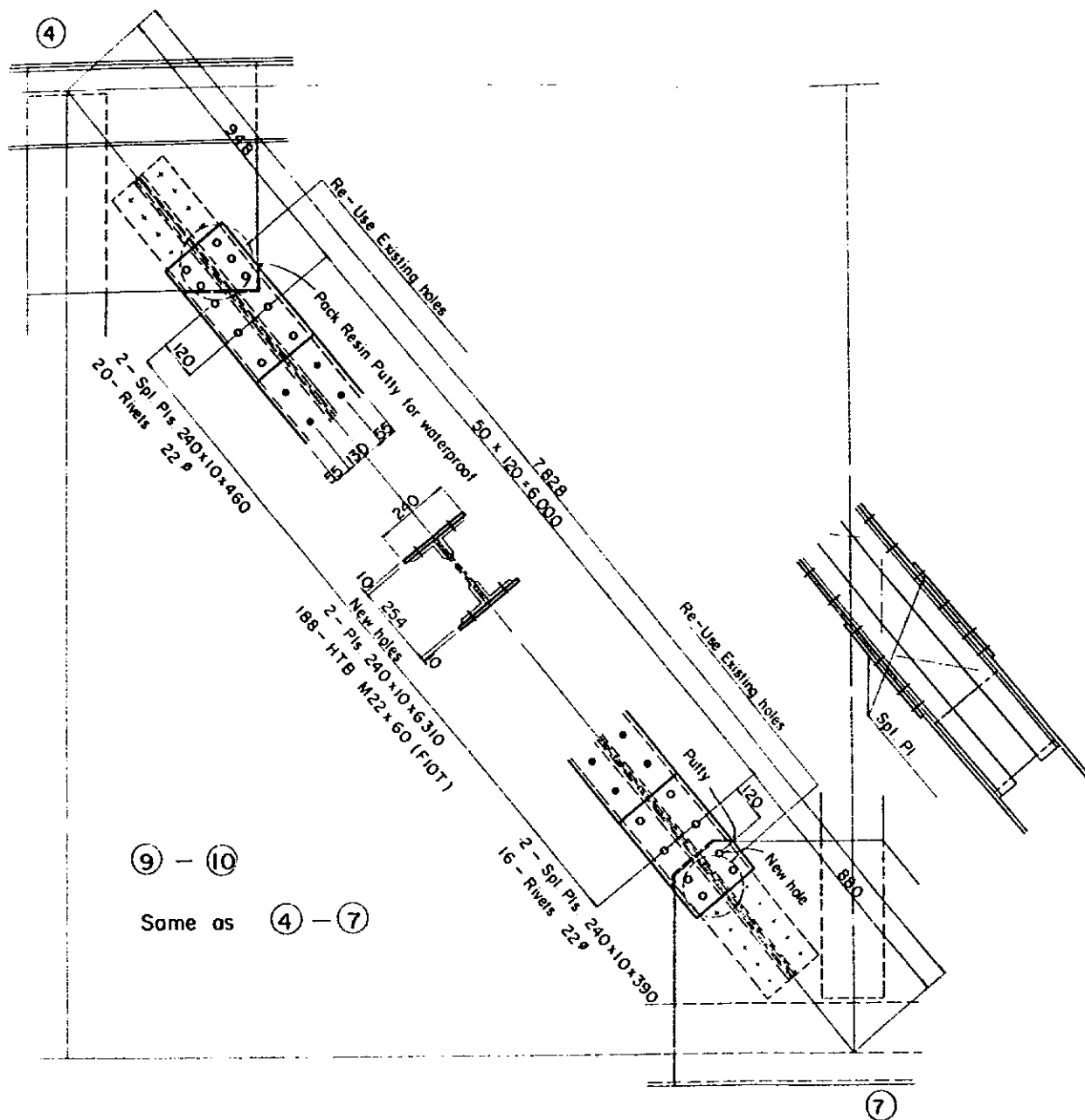
- 1)  $\blacksquare$ : Excessive stressed rivets to be strengthened.
- 2)  $\bullet$ : Loose rivets to be replaced.
- 3)  $\blacklozenge$ : Gussel plates to be improved.
- 4)  $\textcircled{H}$ : Hanger to be added.
- 5)  $\text{---}$ : Web plates to be repaired.
- 6)  $\ast$ : Defective member to be removed.
- 7)  $\textcircled{\ominus}$ : Defective hanger to be removed.
- 8) S1: New strut to be added.
- 9) T: Tie plates to be strengthened.

- M: Bending moment (t m)  $\lambda/r$ : Slenderness ratio  
 N: Axial force (t)  $\sigma$ : Actual stress ( $\text{kg/cm}^2$ )  
 L: Length of member (cm)  $\sigma_a$ : Allowable stress ( $\text{kg/cm}^2$ )  
 $r_x, r_y$ : Radius of gyration of sectional area for x or y axis (cm)

THE STATE RAILWAY OF THAILAND			
STANDARD DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	GENERAL DIAGRAM	DL 15 loading
350 T.T			Unit Scale
			mm
K M	403 + 257	Designed by	
DISTRICT	Chumphon	Checked by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE	DRAWING NO	5983	

# MAIN TRUSS (NO.1)

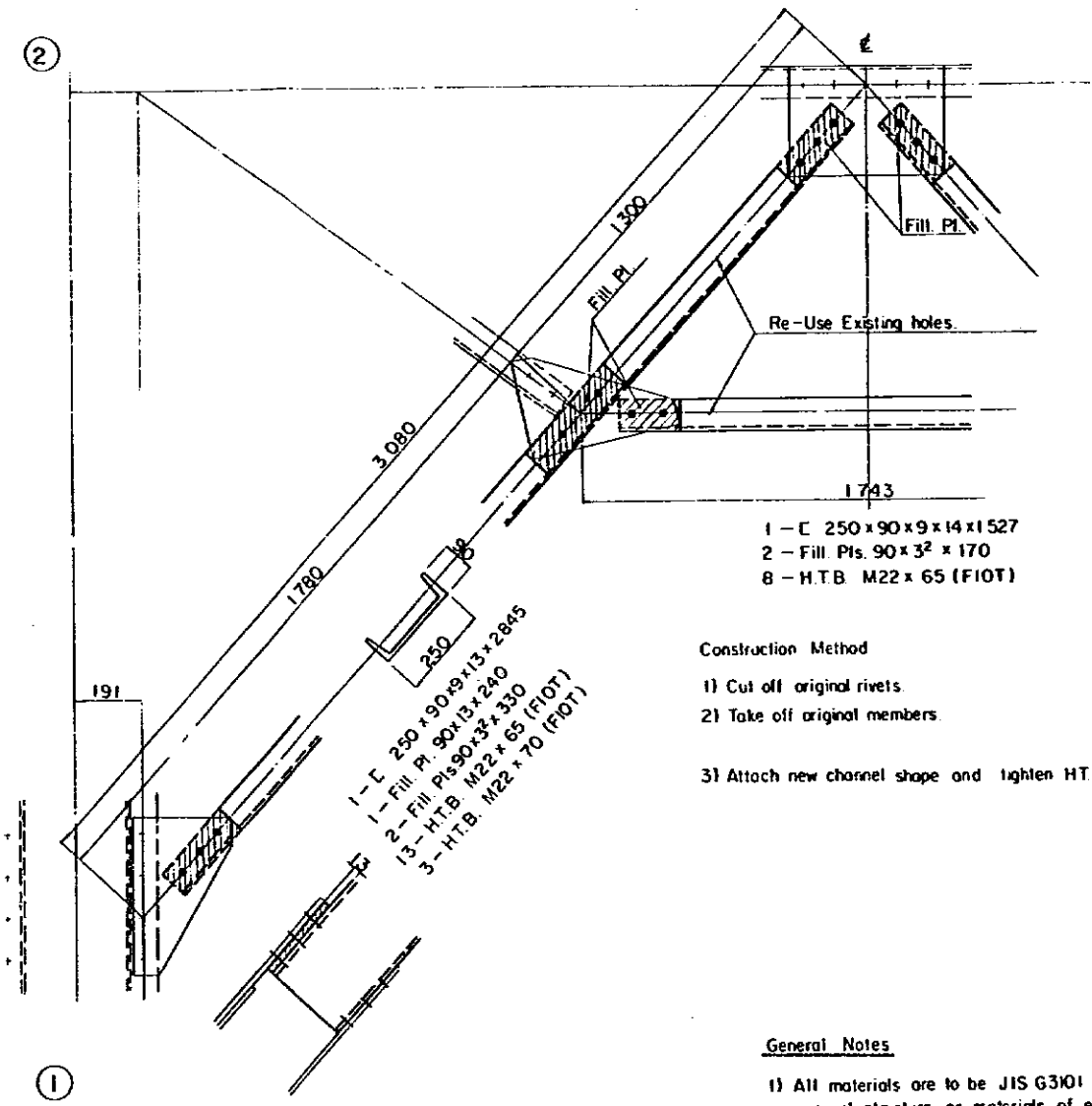
## DIAGONAL MEMBER s=1/10



- Construction Method**
- 1) Drill new bolt and rivet holes
  - 2) Cut off rivet of original members
  - 3) Clean surface between original and new members
  - 4) Add new plates and tighten HT Bolts
  - 5) Add splice plate and riveting

Note : ○ Re-Use Existing holes

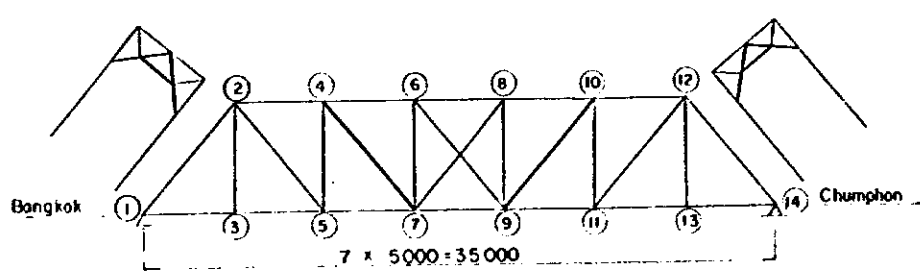
## PORTAL BRACING s=1/10



- Construction Method**
- 1) Cut off original rivets
  - 2) Take off original members
  - 3) Attach new channel shape and tighten HT Bolts

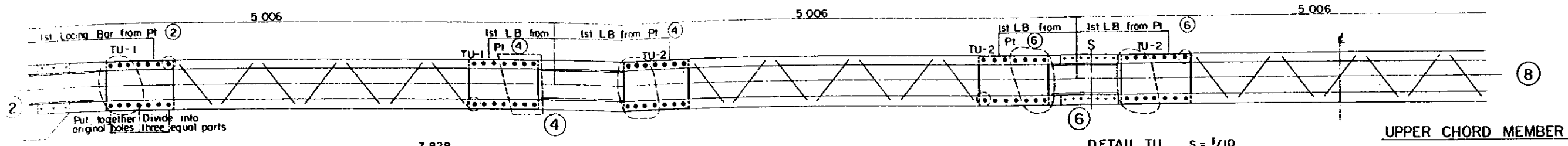
- General Notes**
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
  - 2) All high-strength bolts (HTB) are M22 (Φ) (FIOT), and assumed frictional coefficient of contact surface as follows:
    - i) for connection  $f \geq 0.4$
    - ii) for stitch  $f \geq 0.3$
  - 3) All rivets are 22# (Φ), and to be rolled steel for SV 34 (JIS G 3104) or materials of equivalent.
  - 4) All dimensions to be checked in the field

## MARKING DIAGRAMS

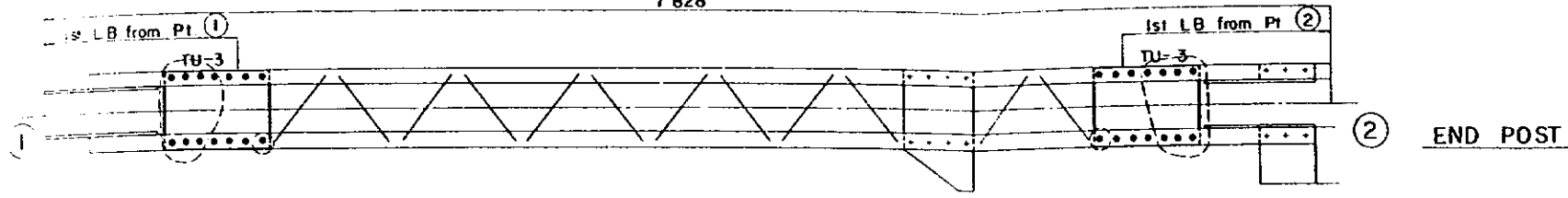


THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
		Unit	Scale
350 TT	MAIN TRUSS (NO.1)	mm	1/10
K M	403 + 257	Designed by	_____
DISTRICT	Chum Phon	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	5983

MAIN TRUSS (NO.2) s= 1/20

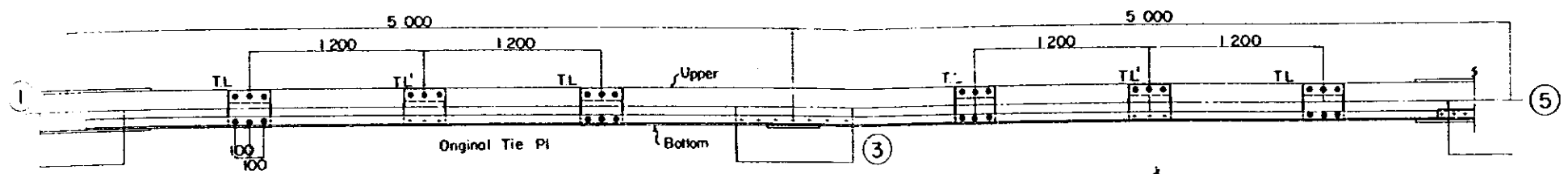
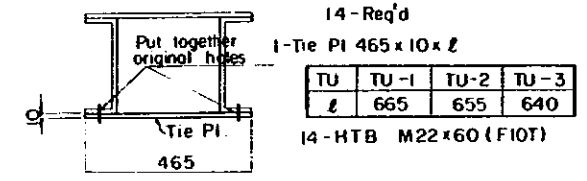


UPPER CHORD MEMBER



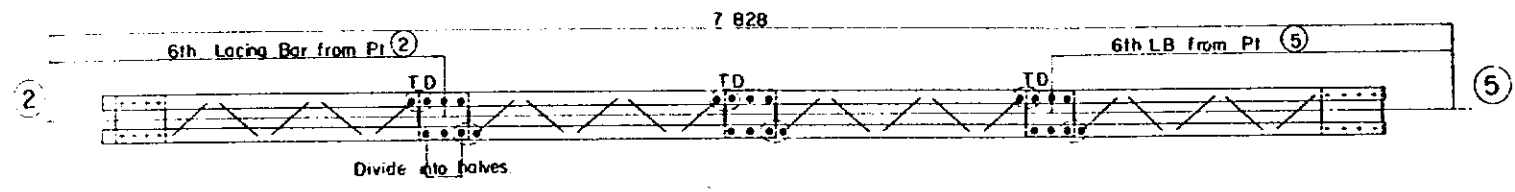
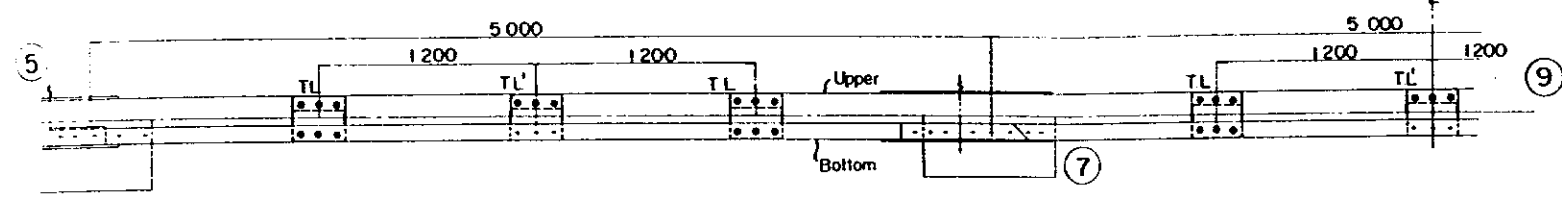
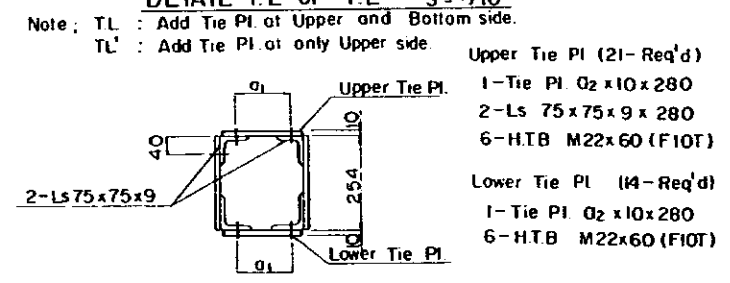
END POST

DETAIL TU s= 1/10



LOWER CHORD MEMBERS

DETAIL T.L or T.L' s= 1/10



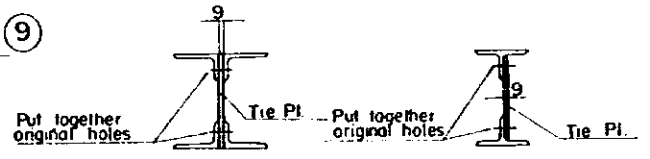
DIAGONAL MEMBERS

Note  
D ④-⑦ same as D ②-⑤



DETAIL TD or TV s= 1/10

DETAIL TD1 or TD2 s= 1/10



TD (6-Req'd)  
1-Tie Pl. 245 x 9 x 280  
6-HTB M22 x 70 (FIOT)

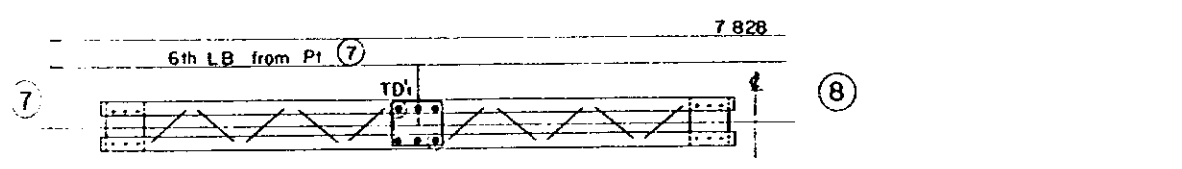
TV (14-Req'd)  
1 Tie Pl. 255 x 9 x 245  
6-HTB M22 x 70 (FIOT)

TD1 (6-Req'd)  
1-Tie Pl 228 x 9 x 280  
6-HTB M22x60 (FIOT)

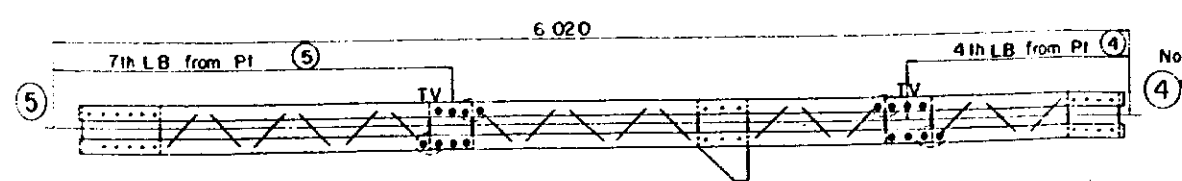
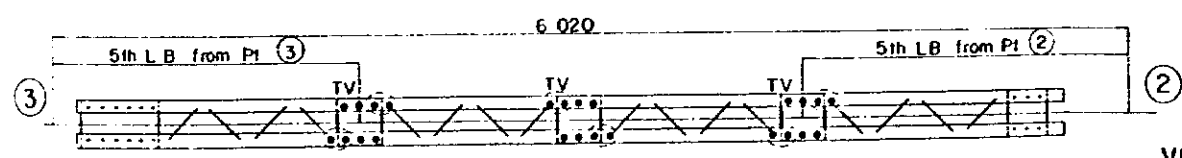
TD2 (1-Req'd)  
1-Tie Pl 228 x 9 x 600  
16-HTB M22 x 60 (FIOT)

General Notes:

- All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- All high-strength bolts (HTB) are M22 (φ XFIOT), and assumed frictional coefficient of contact surface as follows:
  - i) for connection f ≥ 0.4
  - ii) for stitch f ≥ 0.3
- All dimensions to be checked in the field.



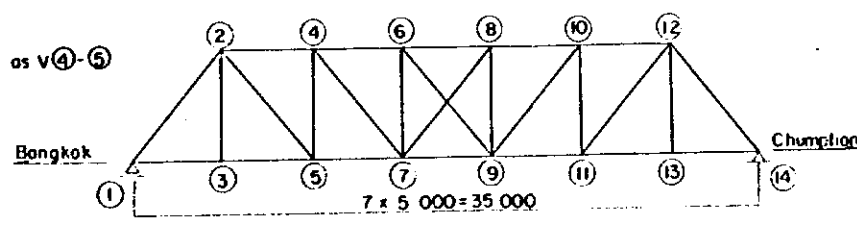
VERTICAL MEMBERS



Note  
④, ⑦, ⑥ same as V ④-⑤

Note: ○ : Re-Use Existing holes

MARKING DIAGRAMS

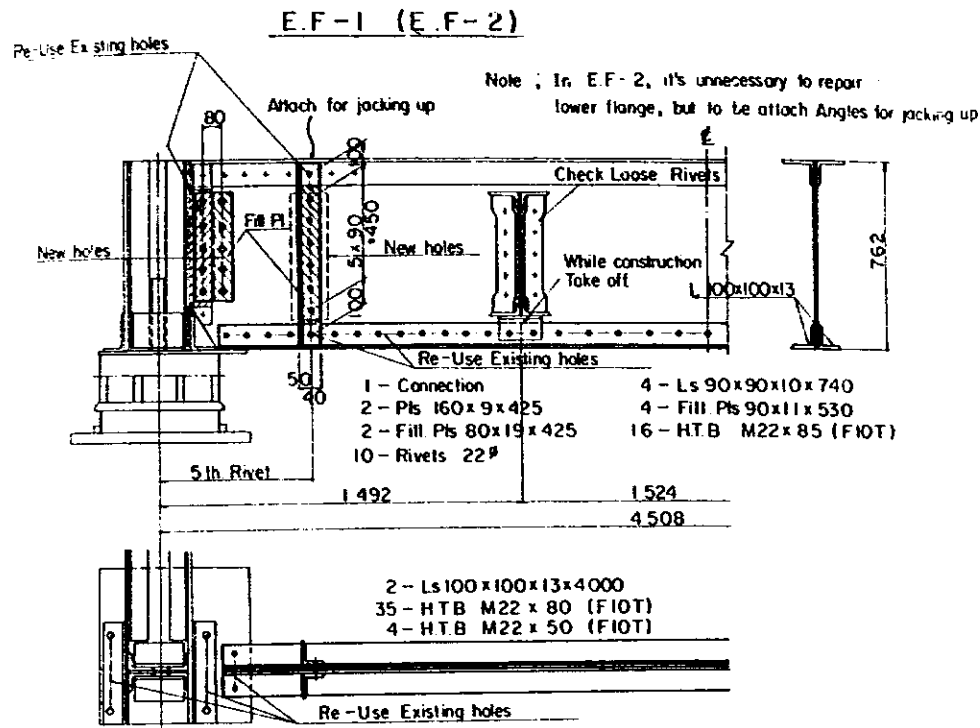


THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
350 TT	MAIN TRUSS (NO.2)	Unit	Scale
K. M	403 + 257	mm	1/20, 1/10
DISTRICT	Chumphon	Designed by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO	5983

FLOOR SYSTEM

FLOOR BEAM S-1/15

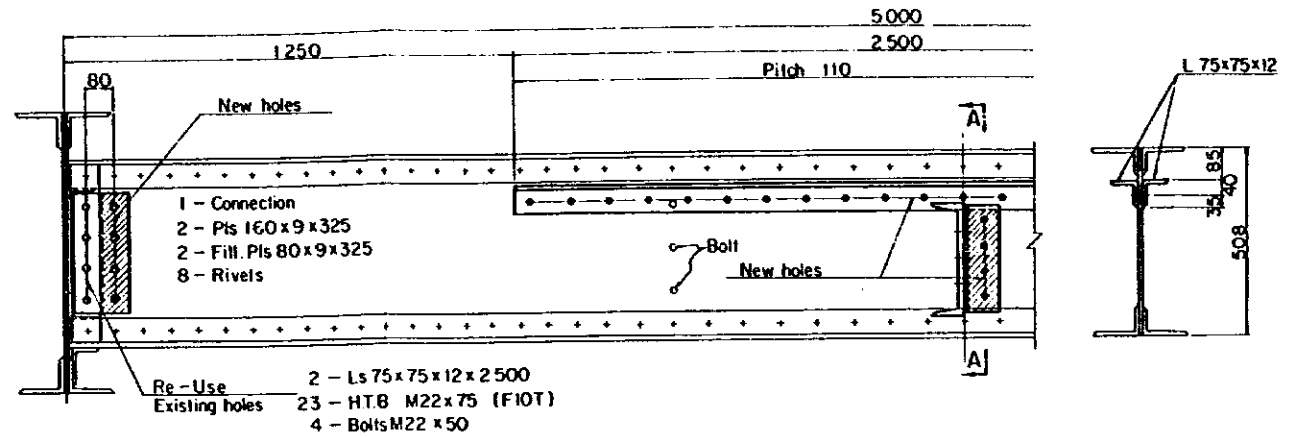
STRINGER S-1/10



Construction Method

- 1) Drill new bolt holes
- 2) Cut off original rivets of lower angles and connection (Main).
- 3) Take off original members.
- 4) Clean surface between original members and new angles
- 5) Attach new angles and tighten HT Bolts

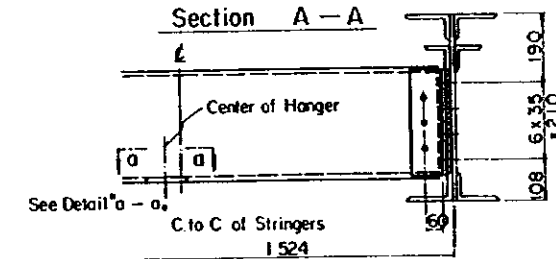
- 6) Strengthen connection (Attach Spl Pl and Riveting)
- 7) Jack up, and support temporarily.
- 8) Repair misalignment shoe rollers, and jack down



Construction Method

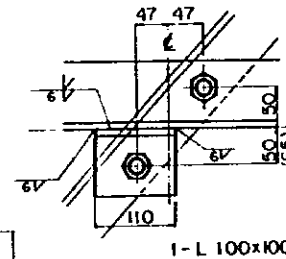
- 1) Drill new bolt holes
- 2) Clean surface between original members and new angles.
- 3) Attach new angles and tighten HT Bolts
- 4) Strengthen Strut of Stringer.

STRUT OF STRINGER (SI)



- 1- C 300x90x10x1450
- 2- Ls 100x100x10x290
- 2- Fill Pls 100x12x290
- 8- HTB M22x75 (FIOT)
- 6- HTB M22x60 (FIOT)

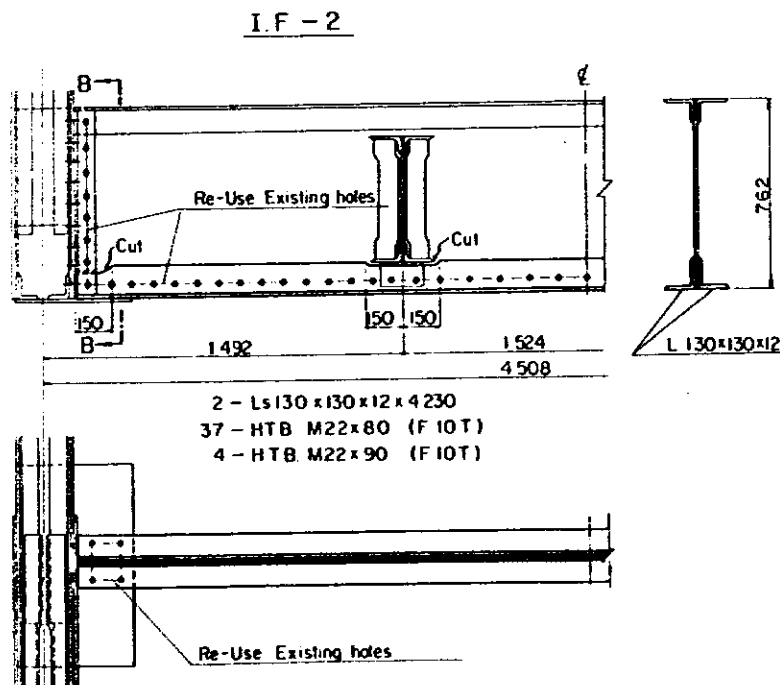
DETAIL "a-a" S-1/5



Note ; Size into ( ) shows Panel ①-③ and ⑬-⑮ members

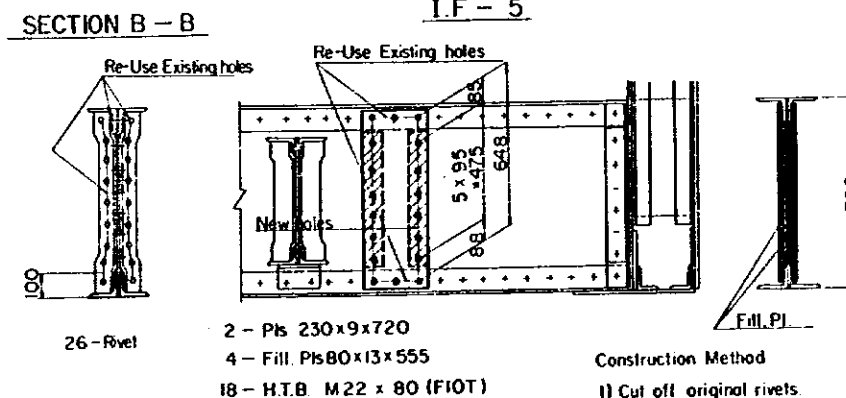
General Notes :

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent
- 2) All high-strength bolts (HTB) are M22 (φ) (FIOT), and assumed frictional coefficient of contact surface (f) as follows
  - i) for connection f ≥ 0.4
  - ii) for stitch f ≥ 0.3
- 3) All rivets are 22# (φ), and to be rolled steel for SV 34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.



Construction Method

- 1) Cut off original rivets.
- 2) Take off original members.
- 3) Clean surface between original and new members
- 4) Attach new angles and connection angles.
- 5) Tighten HT Bolts and rivets.

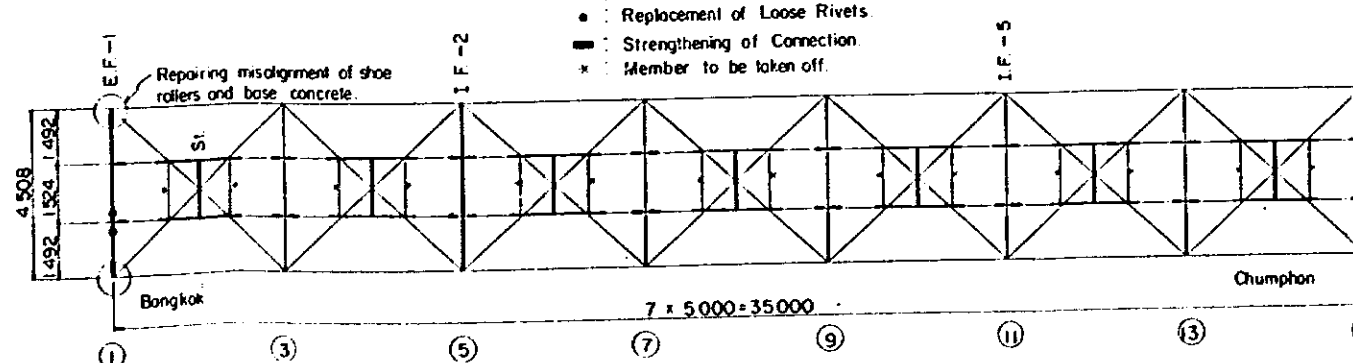


Construction Method

- 1) Cut off original rivets.
- 2)
- 3) Attach new members and

MARKING DIAGRAMS

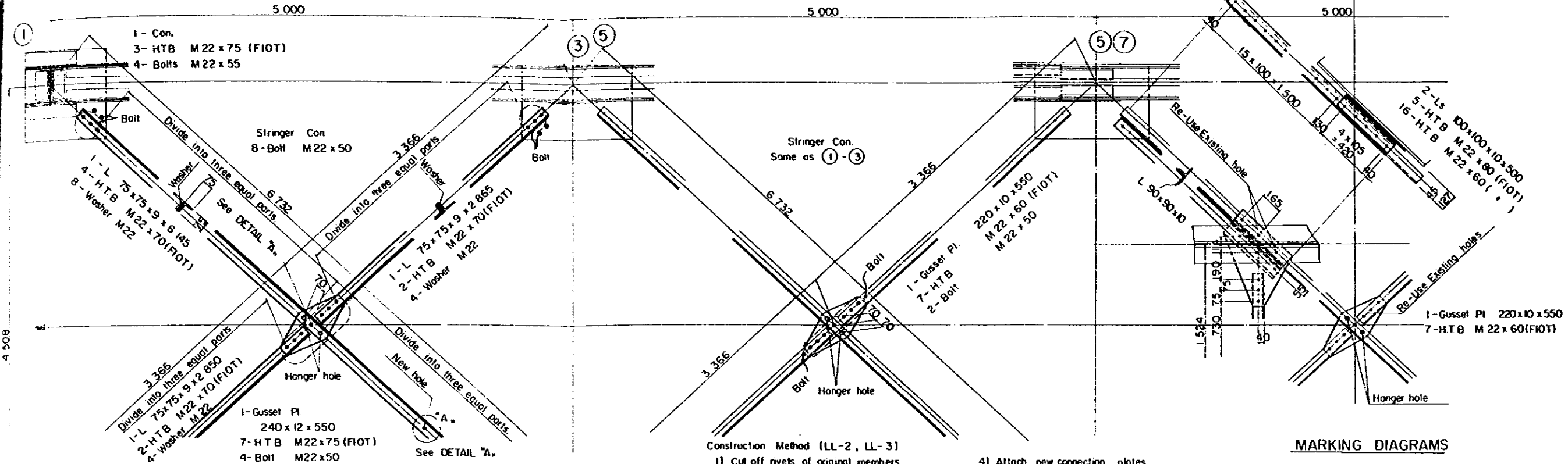
- Note :
- : Replacement of Loose Rivets
  - : Strengthening of Connection
  - x : Member to be taken off.



THE STATE RAILWAY OF THAILAND				
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING				
Span Type	Members	FLOOR SYSTEM	D.L. 15 Loading Scale	
350 TT			Unit	Scale
K.M	403 + 257		mm	1/15, 1/10, 1/5
DISTRICT	Chumphon	Designed by		
LINE	Southern Line	Checked by		
Remarks		Checked by		
		Checked by		
		Checked by		
		Checked by		
DATE		DRAWING NO	5983	

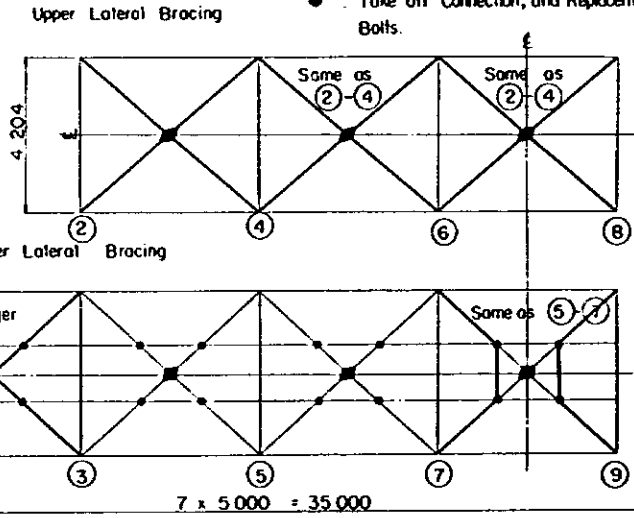


LOWER LATERAL



MARKING DIAGRAMS

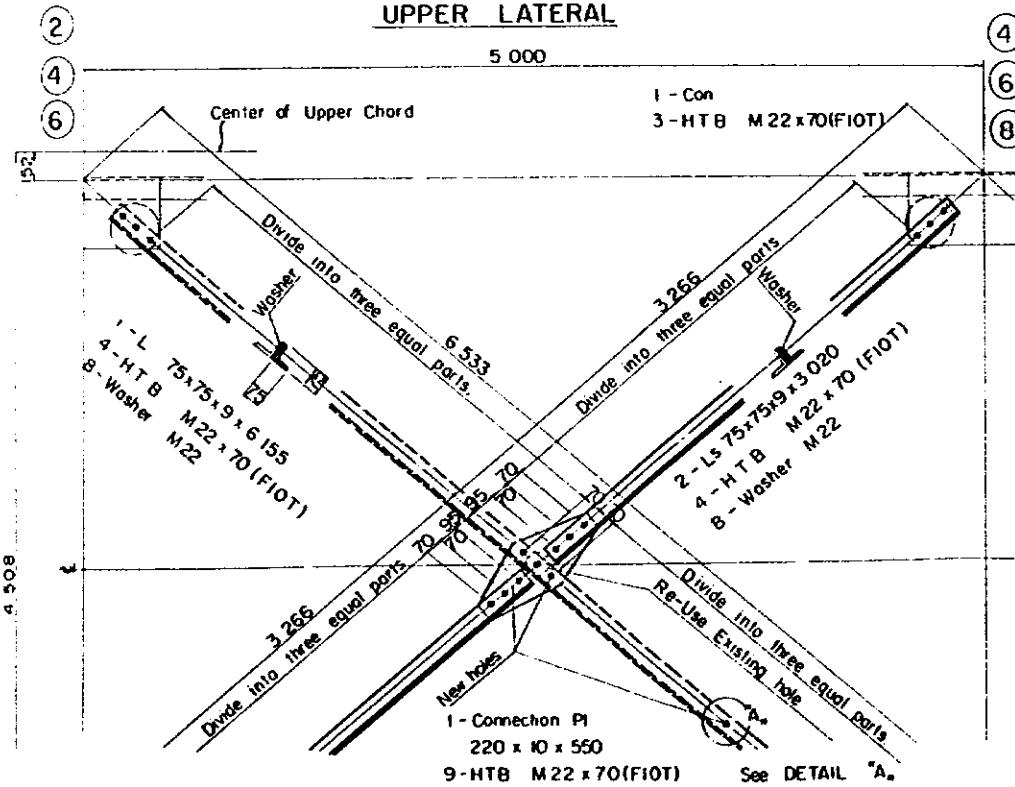
Note:  
 ◆ : Strengthen Connection and Hanger.  
 ● : Take off Connection, and Replacement Bolts.



- Construction Method (LL-1)  
 1) Cut off rivets of original members  
 2) Take off original members  
 3) Drill new bolt holes  
 4) Clean surface between original and new members.  
 5) Attach new angles and gusset plates  
 6) Tighten HT Bolts

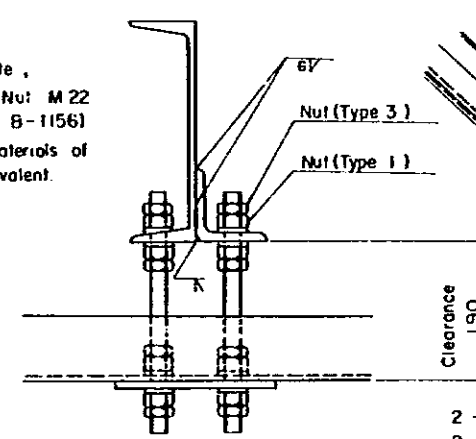
- Construction Method (LL-2, LL-3)  
 1) Cut off rivets of original members  
 2) Drill new bolt holes  
 3) Clean surface between original and new members.  
 4) Attach new connection plates.  
 5) Tighten HT Bolts.

UPPER LATERAL

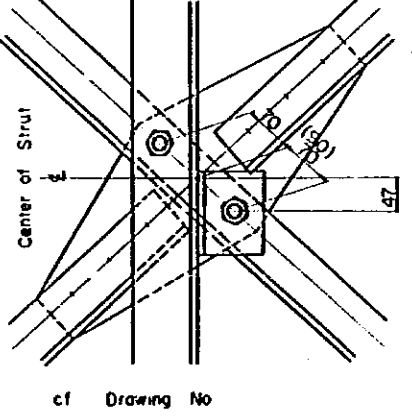


- Construction Method (UL-1)  
 1) Cut off rivets of original members.  
 2) Take off original members.  
 3) One member is cut to prescribed length  
 4) Drill new bolt holes  
 5) Clean surface between original and new members  
 6) Attach new angles and gusset plate  
 7) Tighten HT Bolts

HANGER s=1/5



DETAIL "A" s=1/5



- Note:  
 All Nut: M22 (JIS B-1156) or materials of equivalent.  
 1- HTB M22 x 70 (FIOT)  
 2- Washer M22 x 6  
 2- Round Bar 22# x 330  
 8- Nut M22 (Type 1)  
 8- Nut M22 (Type 3)  
 8- Washer M22

- Note: ( ) : Case LL-1  
 General Notes:  
 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.  
 2) All high-strength bolts (HTB) are M22 (+) (FIOT), and assumed frictional coefficient of contact surface (f) as follows.  
 i) for connection f 0.4  
 ii) for stitch f 0.3  
 3) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 Loading	
35.0 T.T	LATERAL BRACING	Unit	Scale
K M	403 + 257	mm	1/5, 1/5
DISTRICT	Chumphon	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	

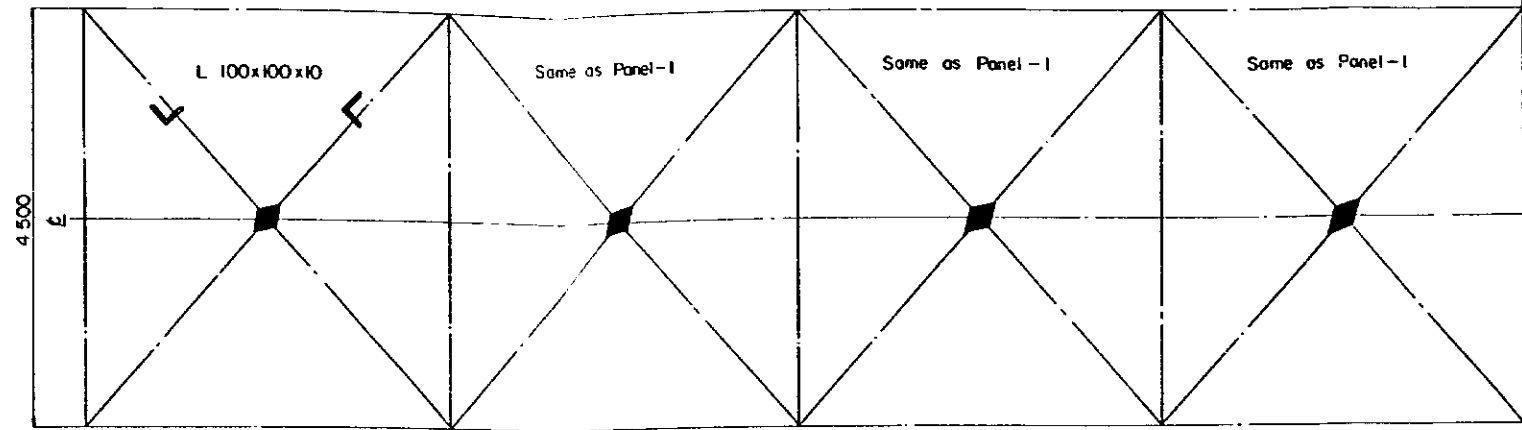


# GENERAL DIAGRAM

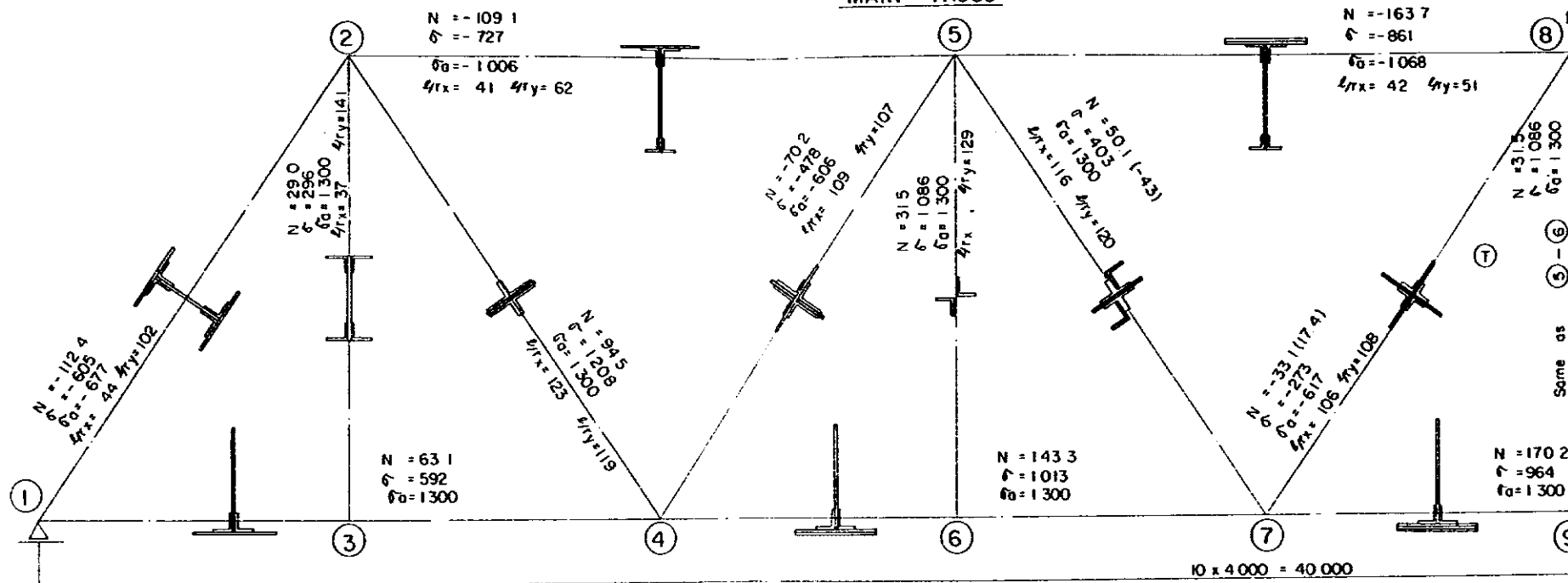
## UPPER LATERAL

Bangkok  
(Mov.)

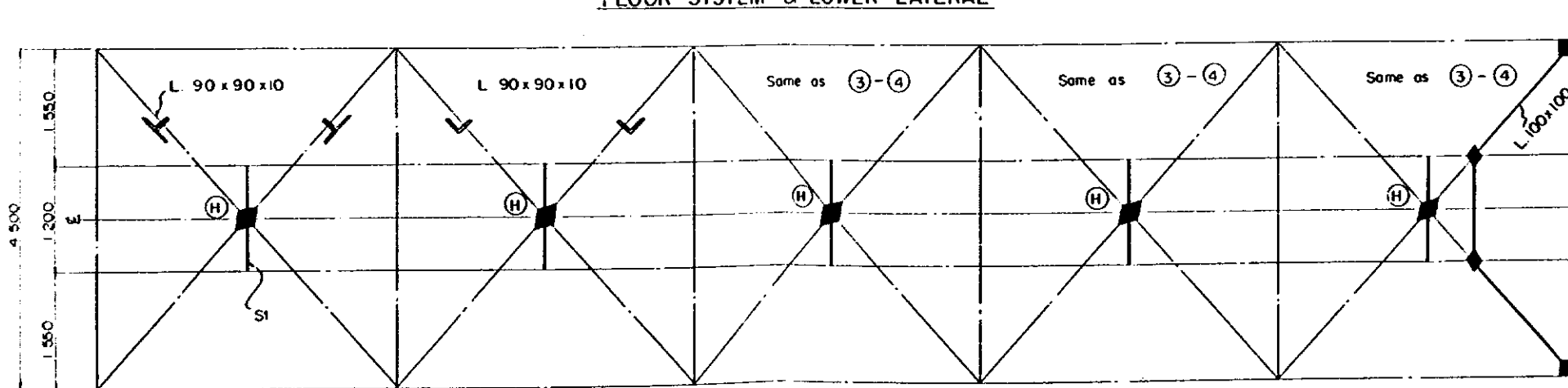
Chiangmai  
(Fix)



## MAIN TRUSS



## FLOOR SYSTEM & LOWER LATERAL

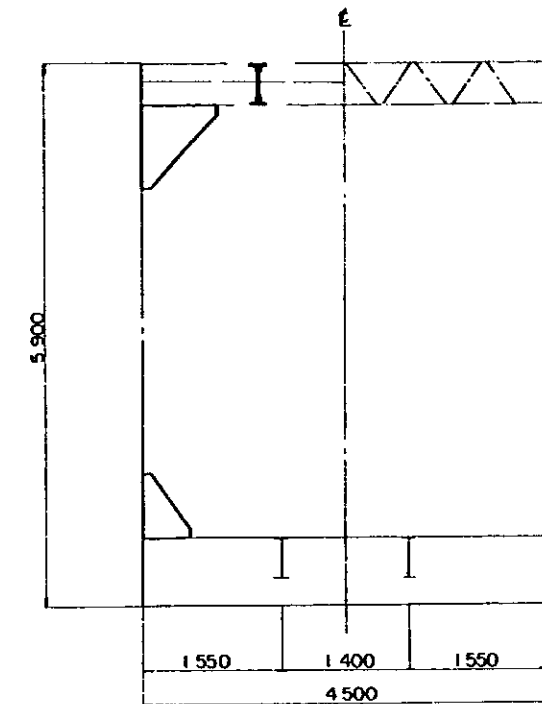


### Note

- 1) : Gusset plate to be changed
- 2) : Hanger of lateral bracing to be added.
- 3) : New strut to be added

## PORTAL BRACING

## SWAY BRACING



## END & INT. FLOOR BEAM

## STRINGER

END	INT	STRINGER
M = 41.7	M = 44.9	M = 17.2
σc = 750	σc = 759	σc = 835
σt = 884	σt = 894	σt = 835
σca = 1189	σca = 1189	σca = 923
σta = 1300	σta = 1300	σta = 1300

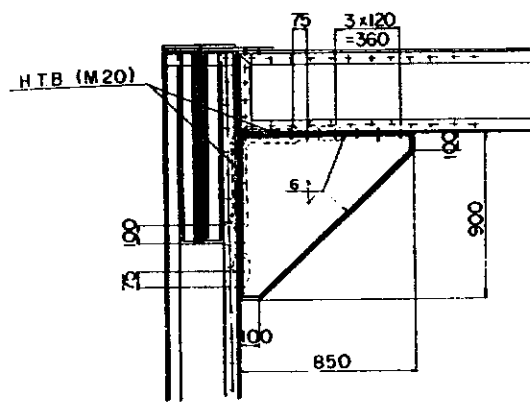
### General Notes

- 1) Weak drawings show the original members.  
Deep drawings show the members to be improved.
- 2) Actual stresses are based on DL-15 loading.
- 3) Marks
  - M : Bending moment (t m)
  - N : Axial force (t)
  - l : Length of member (cm)
  - x, y : Radius of gyration of sectional area for x or y axis (cm)
  - λr : Slenderness ratio
  - σ : Actual stress (kg/cm<sup>2</sup>)
  - σa : Allowable stress (kg/cm<sup>2</sup>)

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
400T T	GENERAL DIAGRAM	Unit	Scale
K.M	311 + 599		
DISTRICT	Nakhon Sawan	Designed by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	

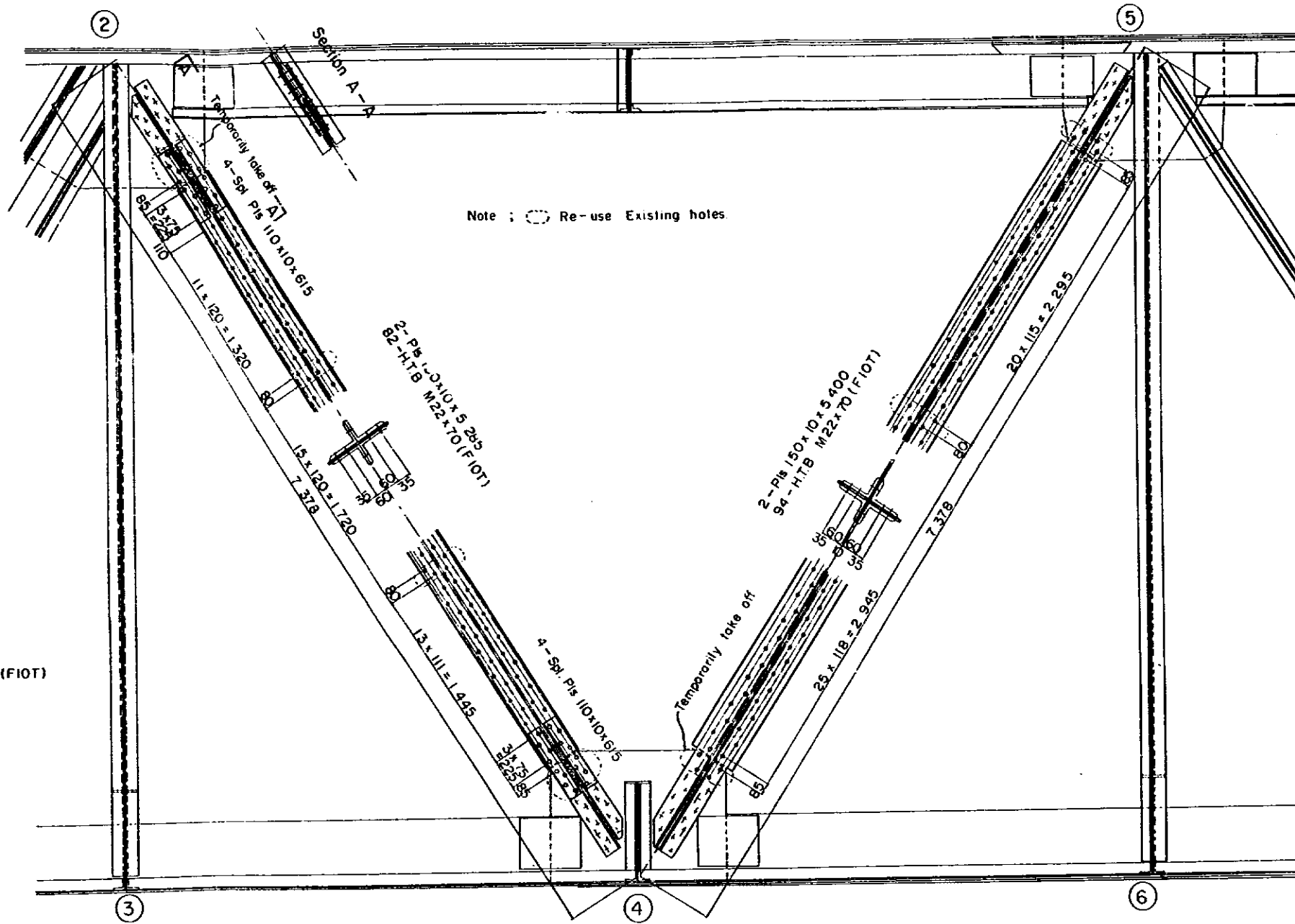
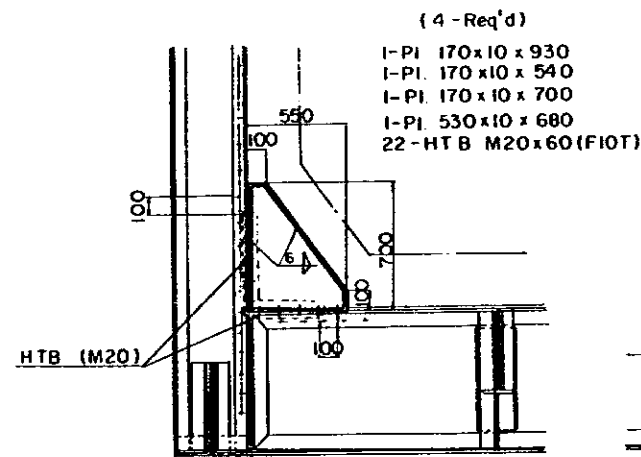
MAIN TRUSS (NO. 1) s-v20

PORTAL FRAME

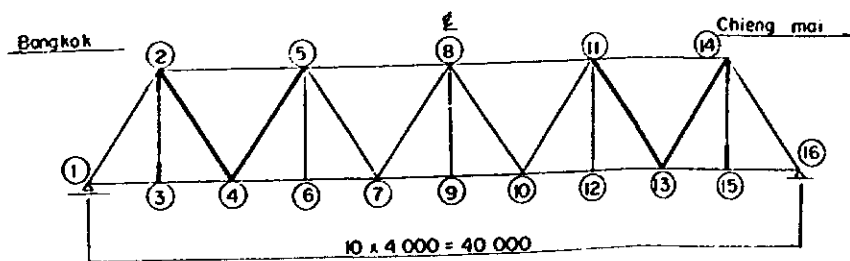


- (4 - Req'd)
- 1 - Pl. 170 x 10 x 1 275
  - 1 - Pl. 170 x 10 x 840
  - 1 - Pl. 170 x 10 x 900
  - 1 - Pl. 830 x 10 x 880
  - 38 - HTB M20 x 60 (FIOT)

Note  
Change to HTB (M20)



MARKING DIAGRAMS

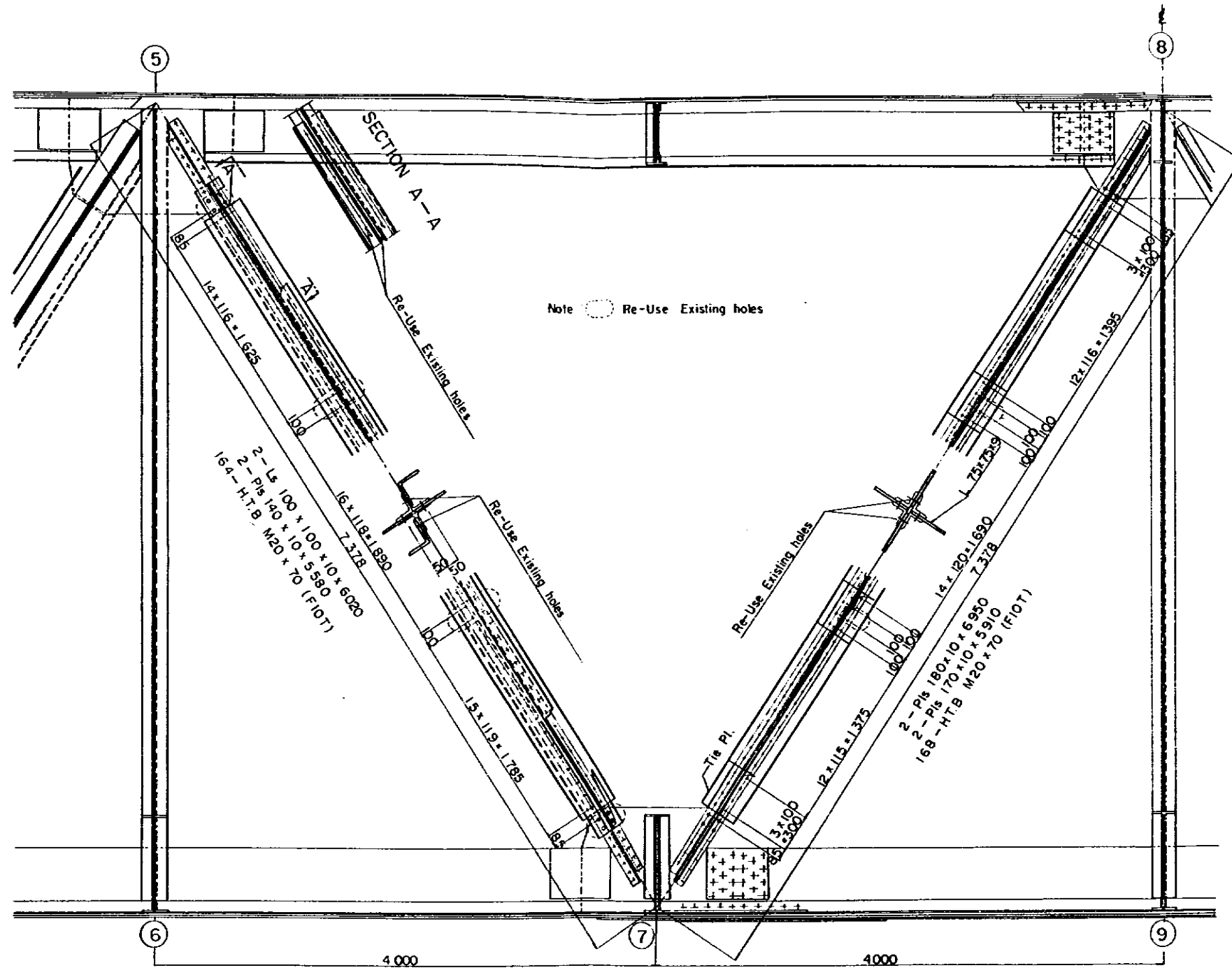


General notes:

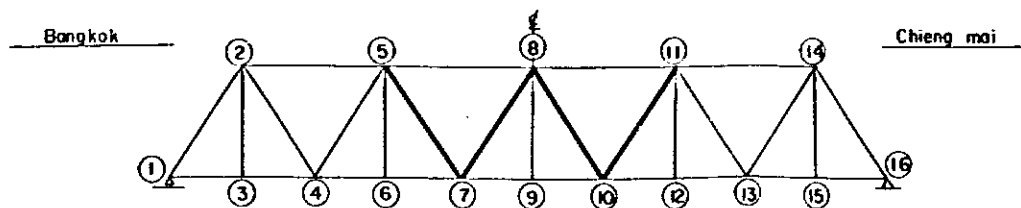
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (♣) (FIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22♣ (♣), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	Pl. 15 loading	
		Unit	Scale
400T	MAIN TRUSS (NO.1)	mm	V20
K M	311 + 599	Designed by	_____
DISTRICT	Nakhon Sawan	Checked by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	_____

MAIN TRUSS (NO. 2)  $s = 1/20$



MARKING DIAGRAMS



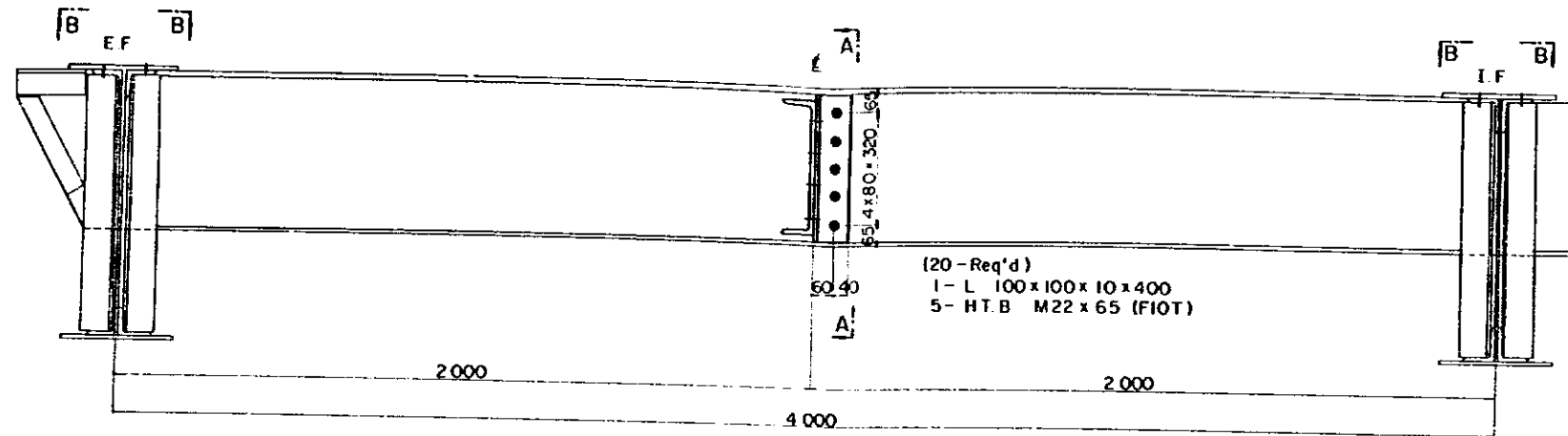
General Notes

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M20 (φ) (FIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 19# (φ), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.

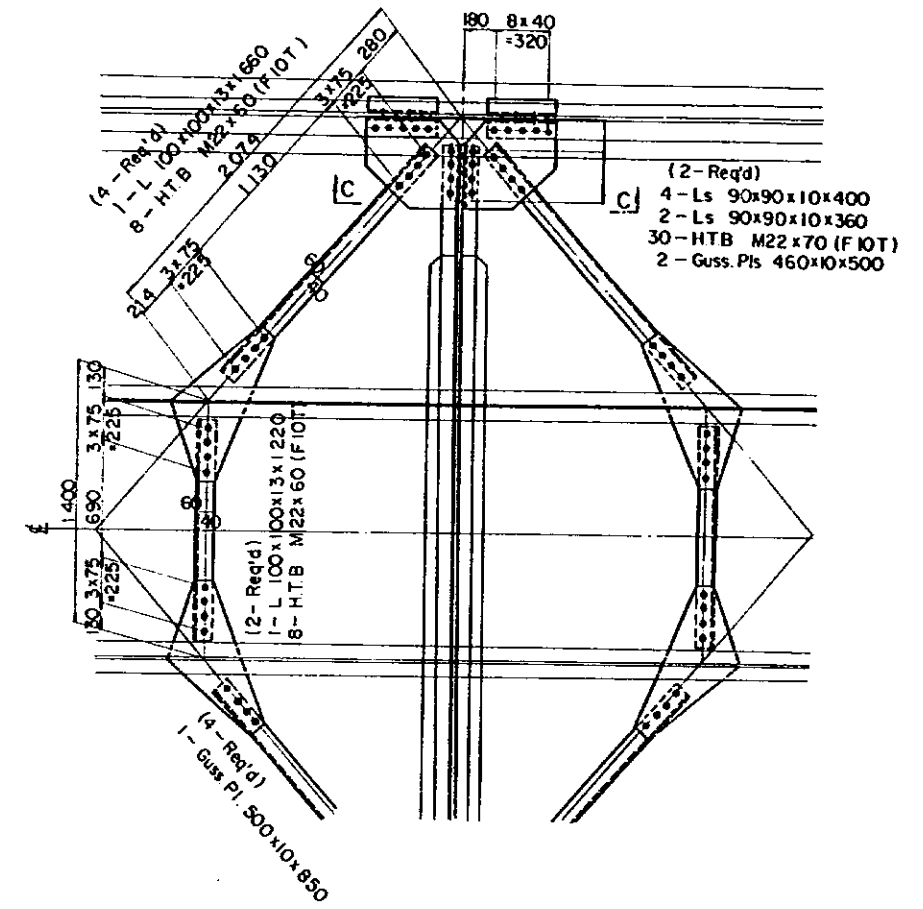
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
400 T.T	MAIN TRUSS (NO.2)	Unit	Scale
K.M.	311 + 599	mm	1/20
DISTRICT	Nakhon Sawan	Designed by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

# FLOOR SYSTEM

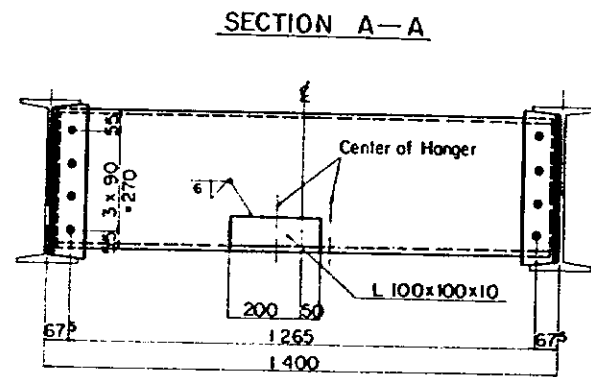
STRINGER s=1/10



BRAKE TRUSS s=1/20

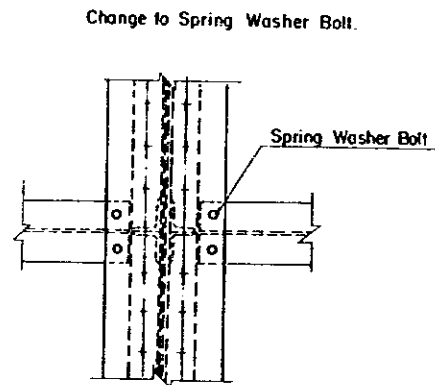


STRINGER STRUT (S1) s=1/10



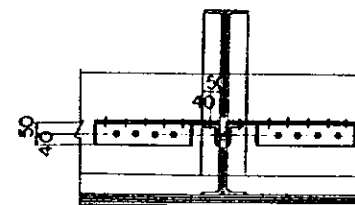
- (10 - Req'd)  
1 - C 380x100x10x1345  
8 - HT.B M22x60 (FIOT)  
1 - L 100x100x10x250  
cf. Drawing Lower Lateral

SECTION B-B s=1/10



- (22 - Req'd)  
4 - Spring Washer Bolts M22

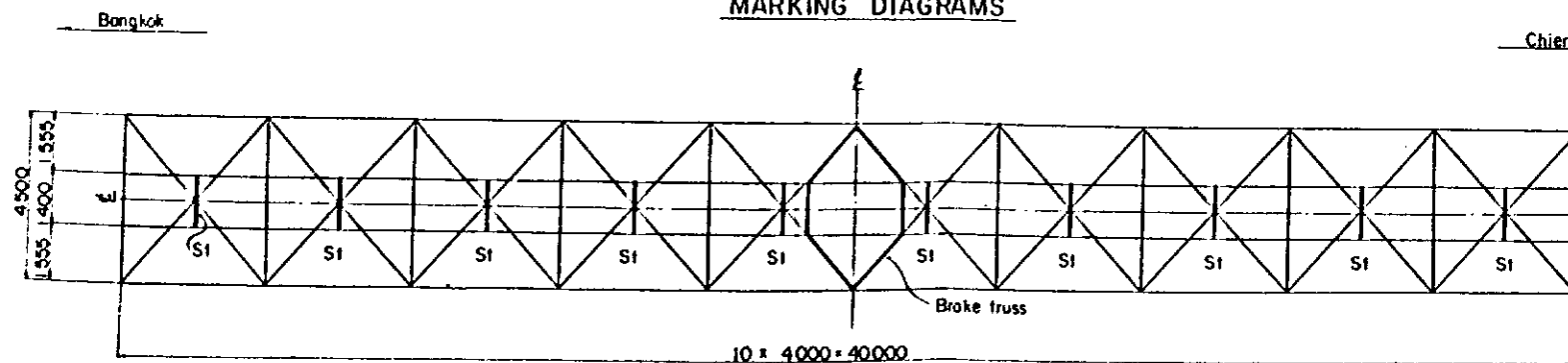
SECTION C-C s=1/15



**General Notes :**

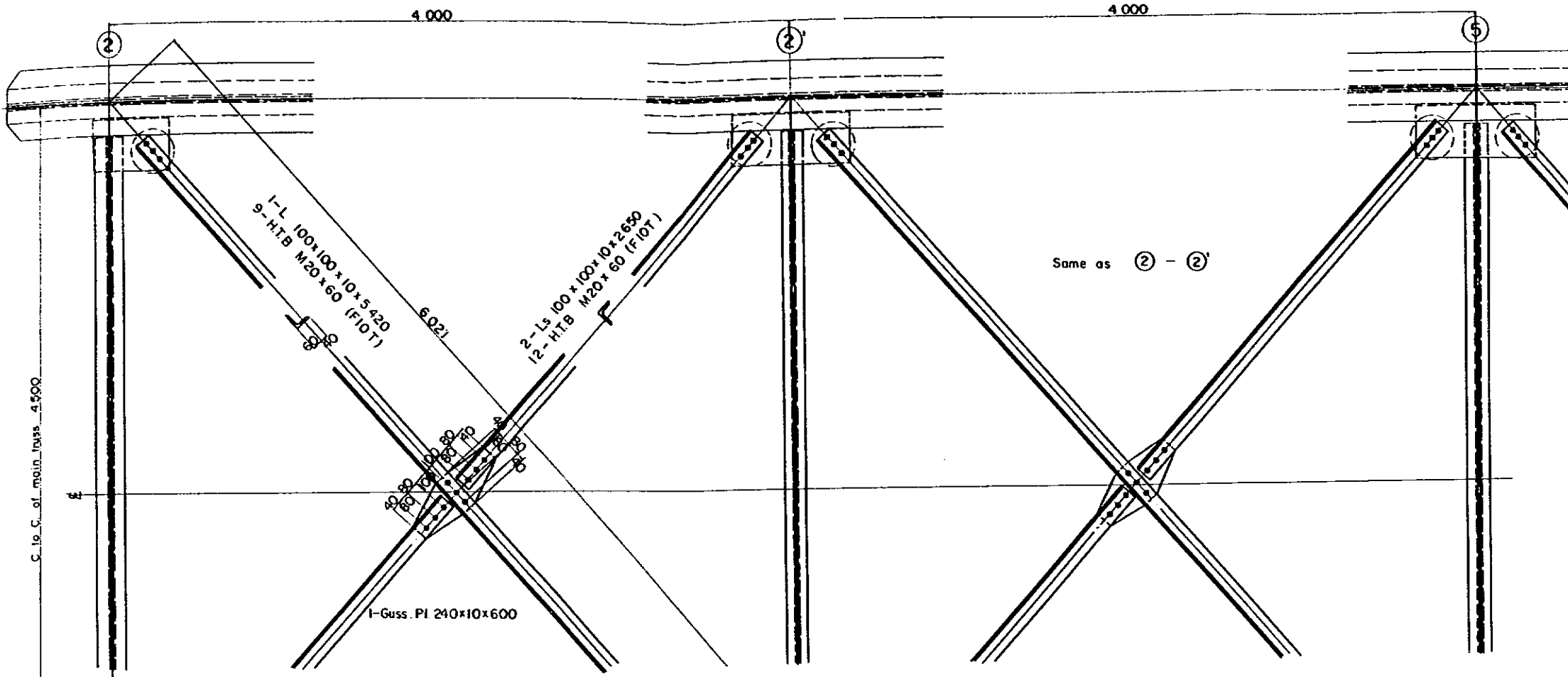
- All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- All high-strength bolts (HTB) are M22 (♠) (FIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- All dimensions to be checked in the field.

**MARKING DIAGRAMS**



THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
		Unit	Scale
400 TT	FLOOR SYSTEM	mm	1/15, 1/10
K M	311 + 599	Designed by	_____
DISTRICT	Nakhon Sawan	Checked by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	

UPPER LATERAL BRACING  $s=1/15$

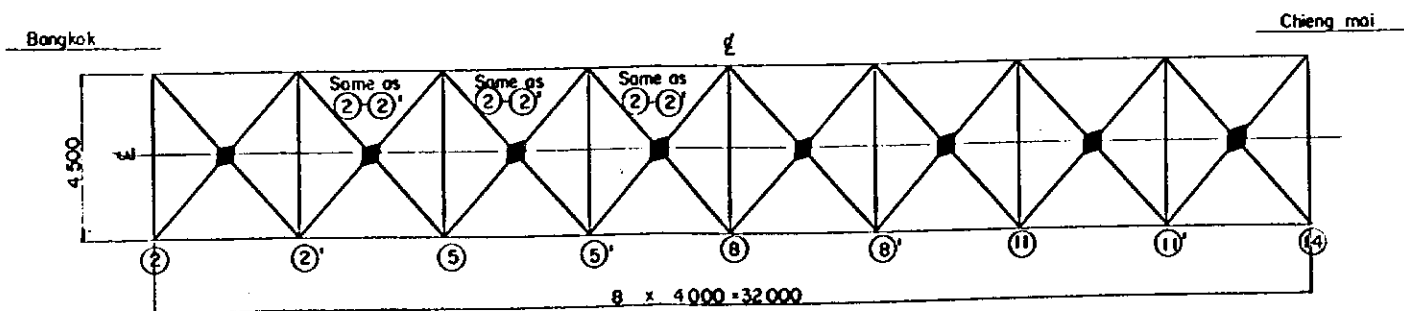


Note : Re-Use Existing holes.

General Notes

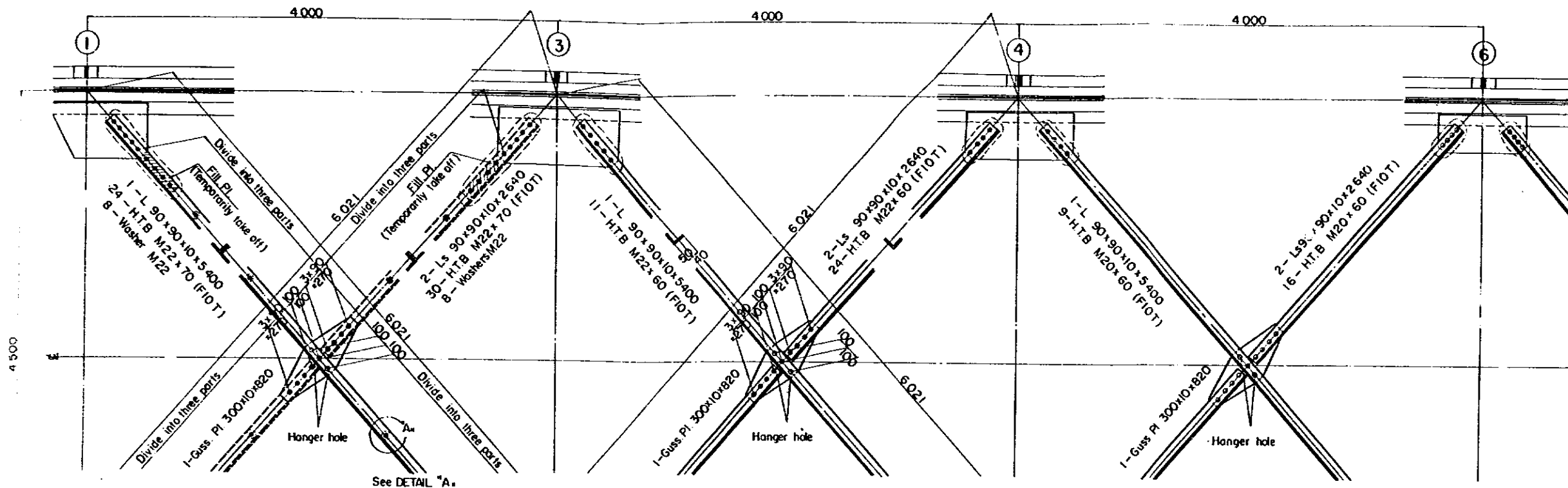
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M20 (F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

MARKING DIAGRAMS

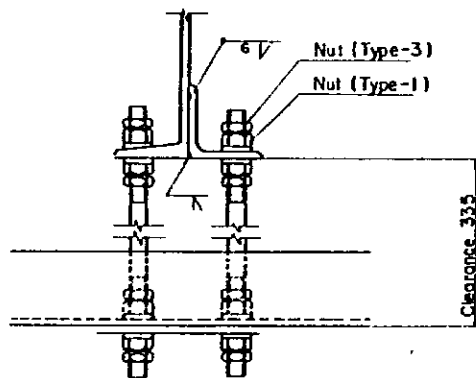


THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	UPPER LATERAL BRACING	
400 T.T		DL. 15 loading	
		Unit	Scale
		mm	1/15
K.M	311 + 599	Designed by	_____
DISTRICT	Nakhon Sawan	Checked by	_____
LINE	Northern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

LOWER LATERAL BRACING S=1/20



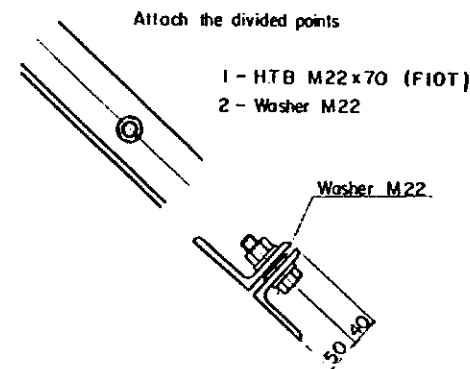
HANGER S=1/5



Note:  
All Nut M22 (JIS B1156)  
or materials of equivalent.

- 2 - Round Bar 22 $\phi$  x 480
- 8 - Nut M22 (Type-1)
- 8 - Nut M22 (Type-3)
- 8 - Washer M22

DETAIL "A" S=1/5



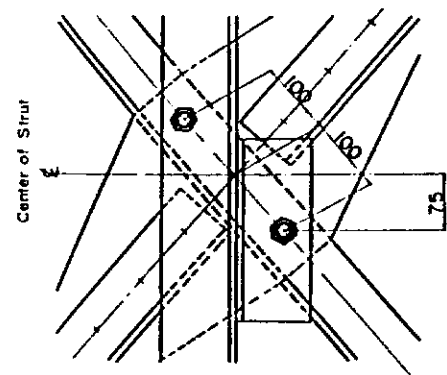
Attach the divided points

- 1 - HTB M22x70 (FIOT)
- 2 - Washer M22

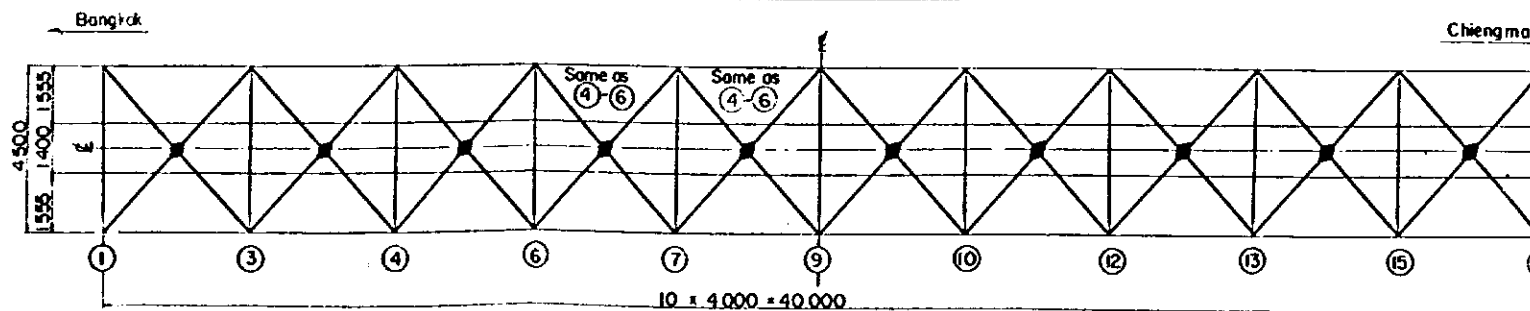
General Notes

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 ( $\phi$ )M20( $\phi$ )FIOT, and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $\geq 0.4$
  - ii) for slitch  $\geq 0.3$
- 3) All dimensions to be checked in the field.

MARKING DIAGRAMS



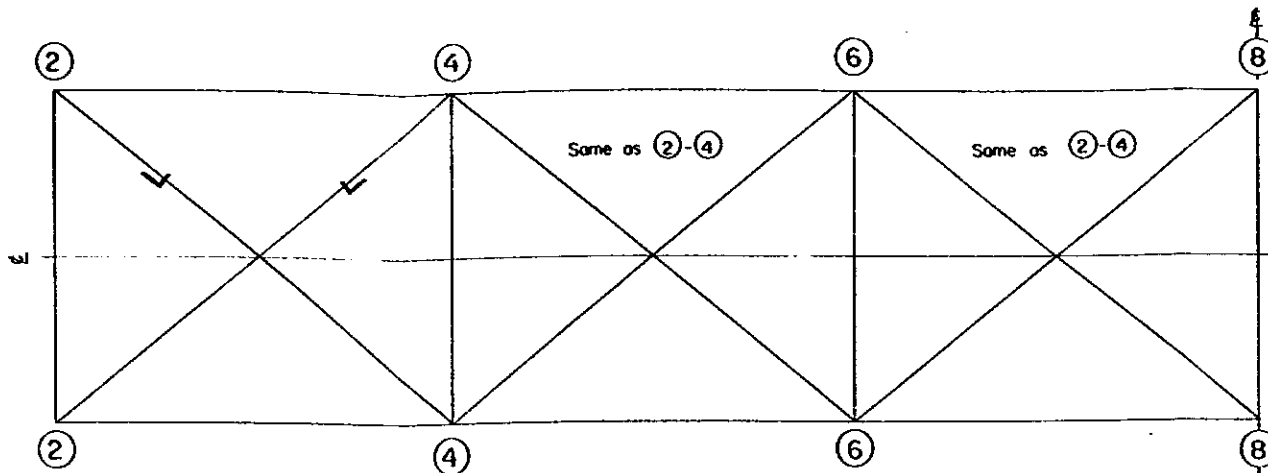
cf. Drawing No



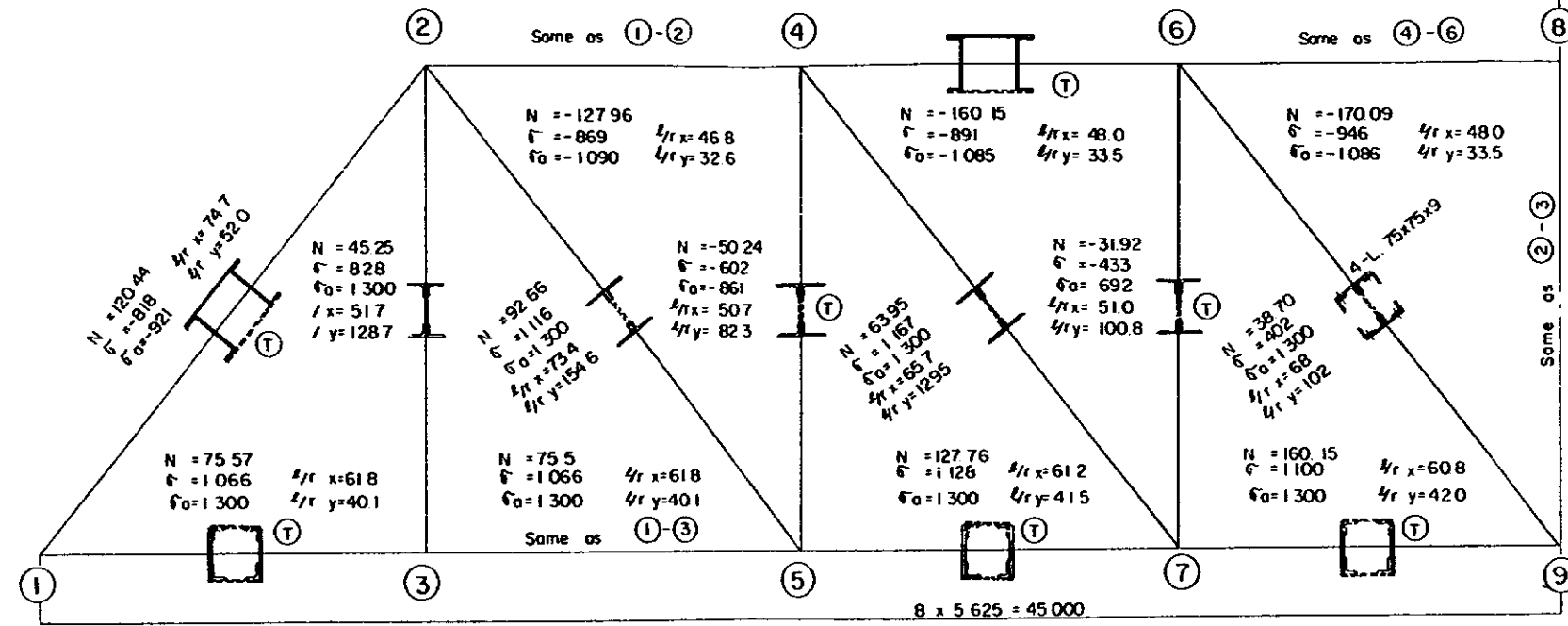
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	LOWER LATERAL BRACING	
40.0 T.T		DL. 15 loading	Unit Scale
		mm	1/20, 1/5
K. M.	311 + 599	Designed by	
DISTRICT	Nakhon Sawan	Checked by	
LINE	Northern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

# GENERAL DIAGRAM

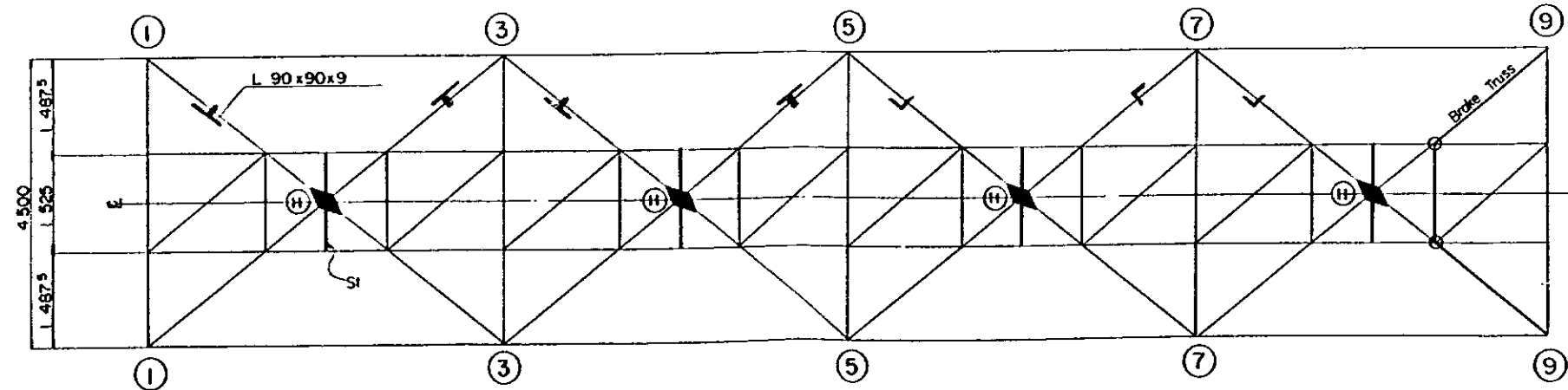
## UPPER LATERAL



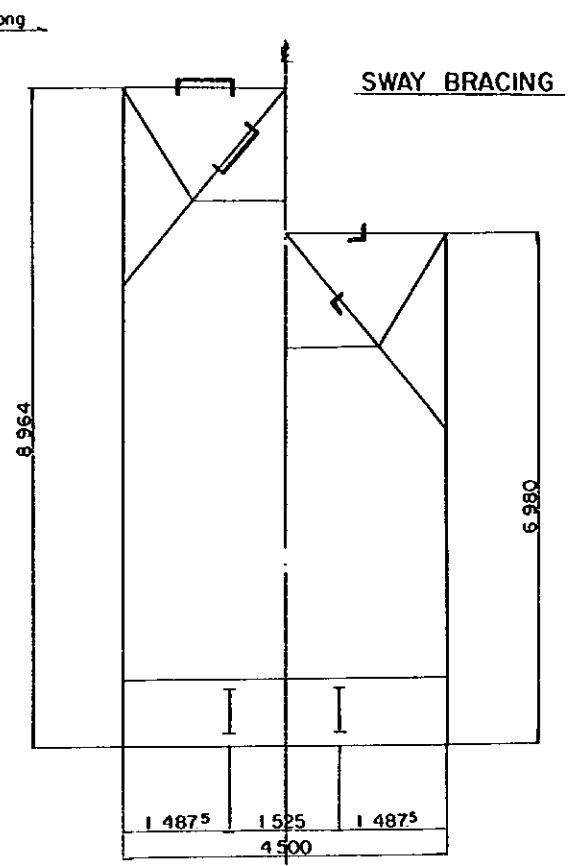
## MAIN TRUSS



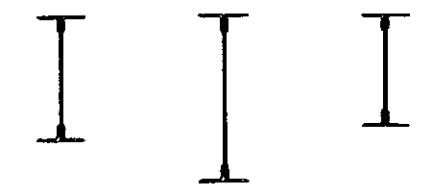
## FLOOR SYSTEM & LOWER LATERAL



## PORTAL BRACING



## END FLOOR INT. FLOOR STRINGER



M = 42 606	M = 49 335	M = 33 349
$\sigma_c = 1 086$	$\sigma_c = 817$	$\sigma_c = 1 087$
$\sigma_t = 1 203$	$\sigma_t = 904$	$\sigma_t = 1 221$
$\sigma_{oa} = 1 184$	$\sigma_{oa} = 1 184$	$\sigma_{oa} = 1 143$
$\sigma_{ta} = 1 300$	$\sigma_{ta} = 1 300$	$\sigma_{ta} = 1 300$

- General Notes:**
- Weak drawings show the original members. Deep drawings show the members to be improved.
  - Actual stresses are based on DL-15 loading.
  - Marks:
    - M: Bending moment (t.m)
    - N: Axial force (t)
    - l: Length of member (cm)
    - $r_x, r_y$ : Radius of gyration of sectional area for x or y axis (cm)
    - $\lambda_r$ : Slenderness ratio
    - $\sigma$ : Actual stress ( $\text{kg/cm}^2$ )
    - $\sigma_a$ : Allowable stress ( $\text{kg/cm}^2$ )

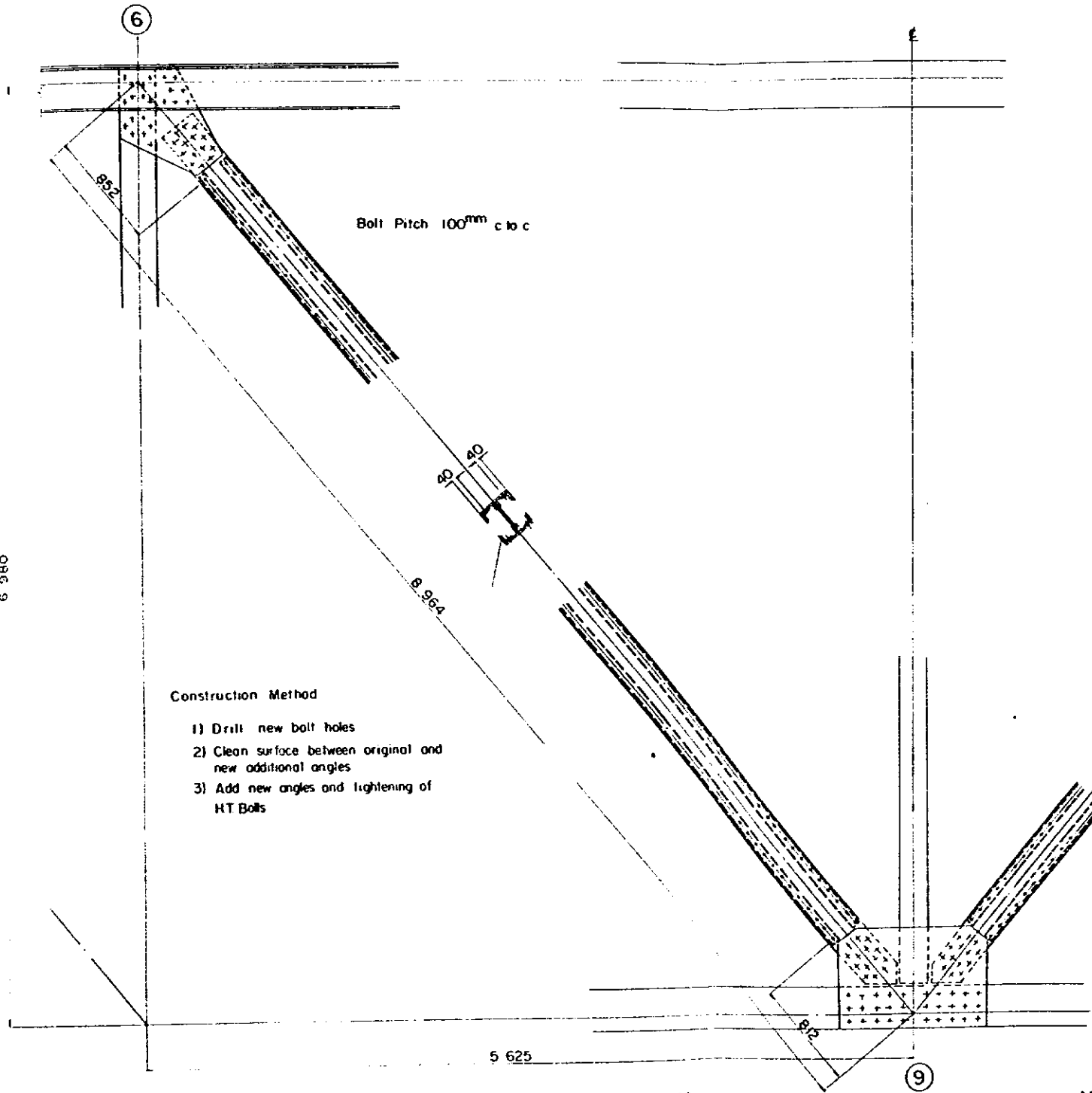
- Legends:**
- 1)  $\blacklozenge$  Gusset plates to be improved.
  - 2)  $\textcircled{H}$  Hanger to be added.
  - 3)  $\textcircled{T}$  Tie plates to be strengthened.
  - 4)  $\textcircled{O}$  Defective hanger to be removed.
  - 5) S1: New strut to be added.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	GENERAL DIAGRAM	DL-15 loading
450 T.T			Unit Scale
K M	672 + 874		
DISTRICT	Thung Song	Designed by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

# MAIN TRUSS AND FLOOR SYSTEM

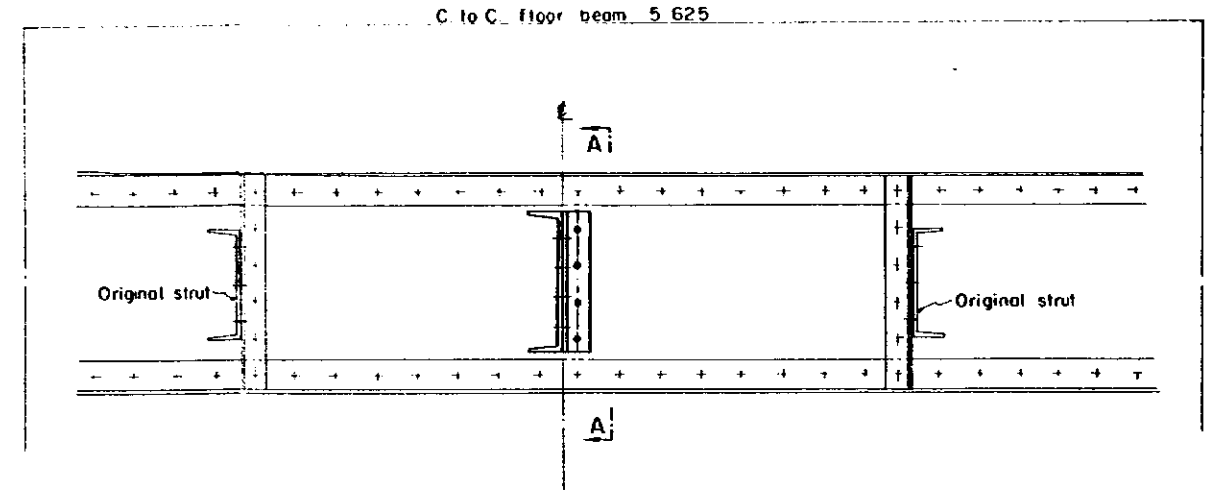
DIAGONAL MEMBER  $s = 1/20$

STRUT OF STRINGER (St)  $s = 1/10$

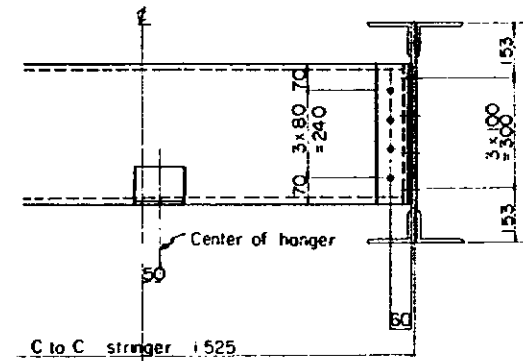


**Construction Method**

- 1) Drill new bolt holes
- 2) Clean surface between original and new additional angles
- 3) Add new angles and tightening of HT Bolts



**SECTION A - A**

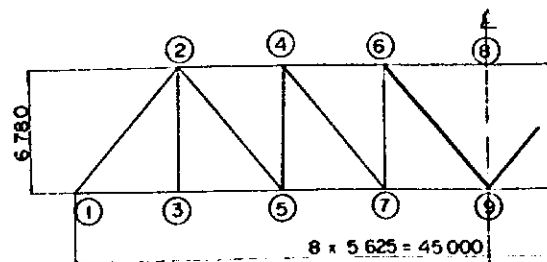


- 1-C 380x100 x10<sup>5</sup> x1480
- 2-Ls 100x100x10x380
- 16-HTB M22x60(F10T)

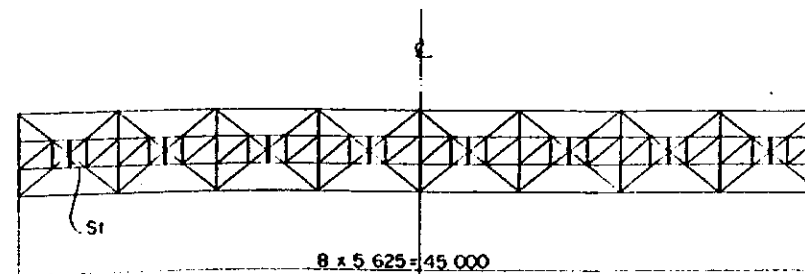
**General Notes:**

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent
- 2) All high-strength bolts (HTB) are M22(Φ)XF10T, and assumed frictional coefficient of contact surface(f) as follows
  - i) for connection  $f \geq 0.4$
  - ii) for slitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field

**MARKING DIAGRAMS**



**MARKING DIAGRAMS**



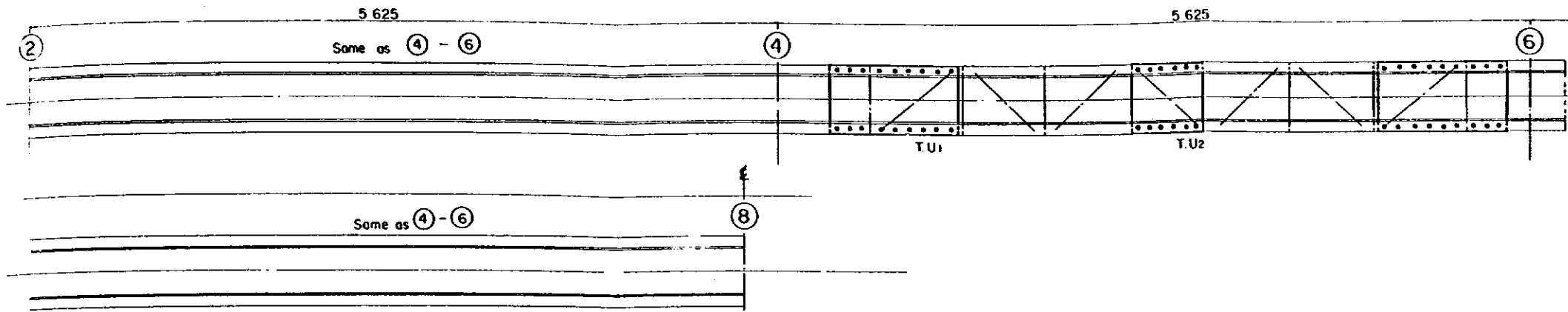
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
450 T.T	MAIN TRUSS AND FLOOR SYSTEM	Unit	Scale
		mm	1/20, 1/10
K M	672 + 874	Designed by	_____
DISTRICT	Thung Song	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	



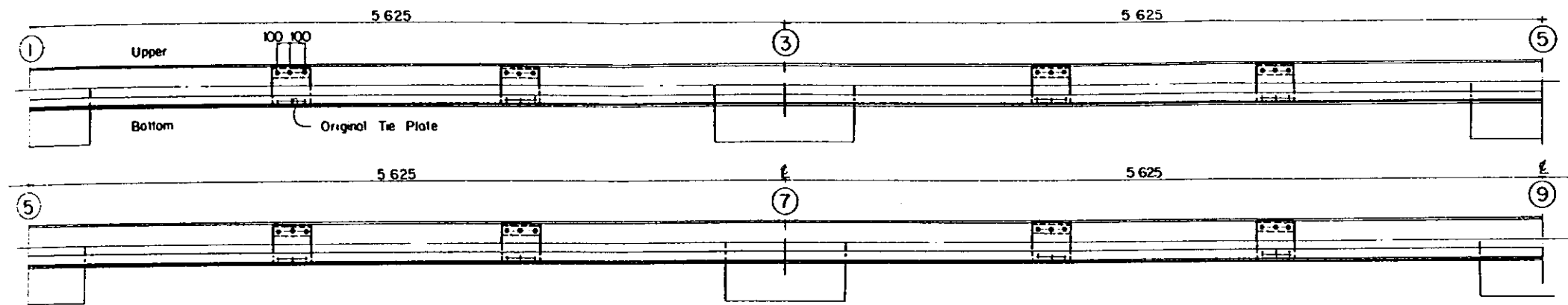
# MAIN TRUSS (NO. 2)

UPPER CHORD MEMBERS  $s = 1/20$

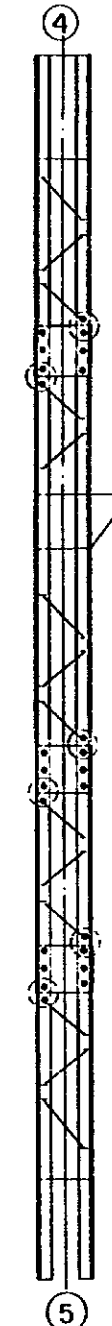
VERTICAL MEMBERS  $s = 1/20$



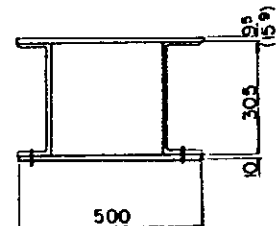
LOWER CHORD MEMBERS  $s = 1/20$



END POST MEMBERS



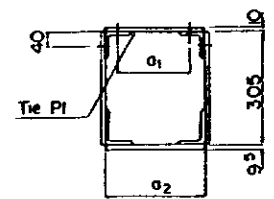
UPPER CHORD & END POST MEMBERS  $s = 1/10$



1 - Tie Pl 500 x 10 x 950  
18 - HTB M22 x 65 (F10T) } T U1

1 - Tie Pl 500 x 10 x 550  
12 - HTB M22 x 65 (F10T) } T U2

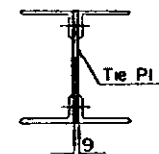
LOWER CHORD MEMBER  $s = 1/10$



1 - Tie Pl 280 x 10 x  $a_2$   
12 - HTB M22 x 60 (F10T)  
2 - Ls 75 x 75 x 9 x 280

Part	①	③	⑤	⑦	⑨
$a_1$	206	206	193	181	
$a_2$	286	286	273	261	

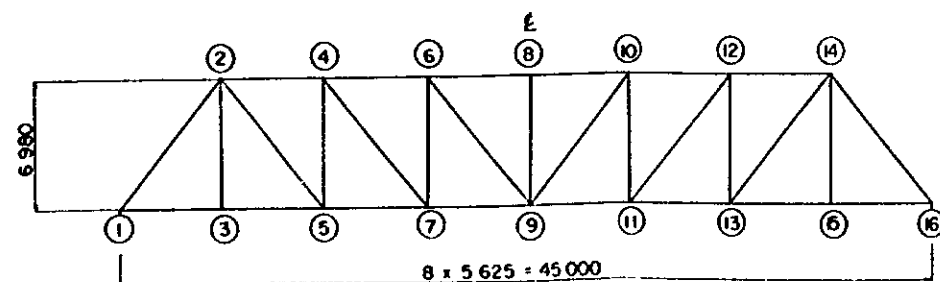
VERTICAL MEMBERS  $s = 1/10$



1 - Tie Pl 250 x 10 x 305  
8 - HTB M22 x 60 (F10T)

Note: ○ Re-use existing holes.

MARKING DIAGRAMS

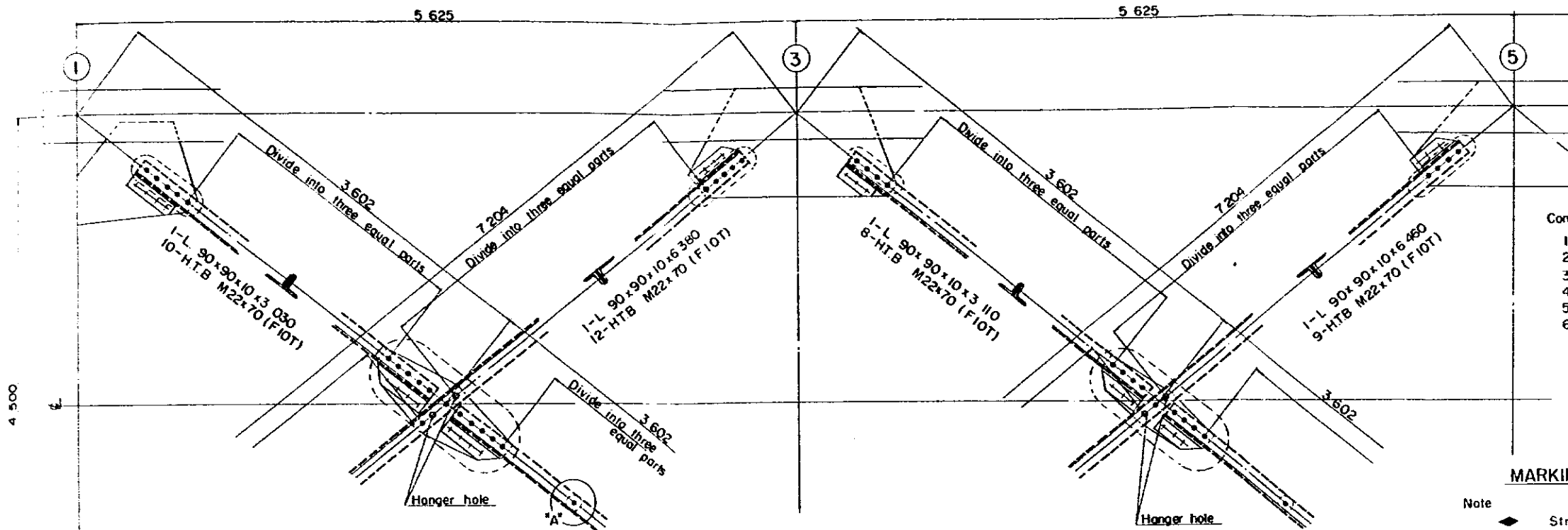


General Notes:

- All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- All high-strength bolts (HTB) are M22 (·X F10T), and assumed frictional coefficient of contact surface (f) as follows:
  - for connection  $f \geq 0.4$
  - for stitch  $f \geq 0.3$
- All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
450 TT	MAIN TRUSS (NO.2)	Unit	Scale
K M	672 + 874	mm	1/20, 1/10
DISTRICT	Thung Song	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	

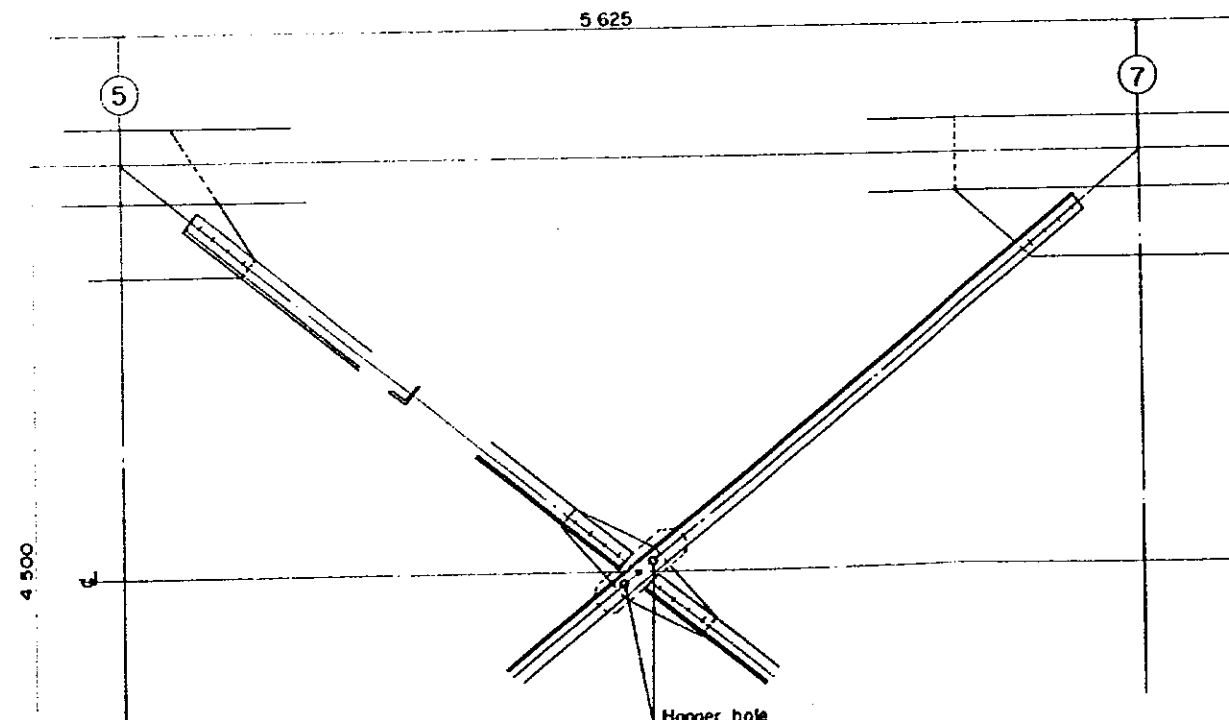
LOWER LATERAL BRACING S=1/15



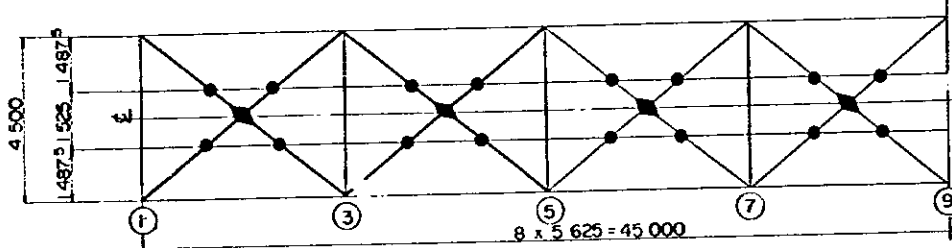
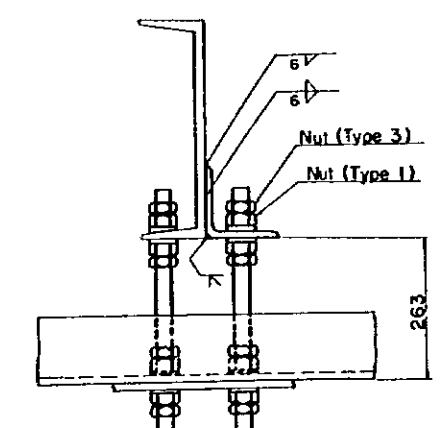
- Construction Method (LL-1, LL-2, LL-3)
- 1) Cut off original rivets
  - 2) Take off original members.
  - 3) Drill new bolt holes
  - 4) Clean surface between original and new members.
  - 5) Attach new angle and connection plate
  - 6) Tighten HT Bolts

MARKING DIAGRAMS

- Note
- ◆ Strengthening of connection and hanger.
  - Connection to be taken off.



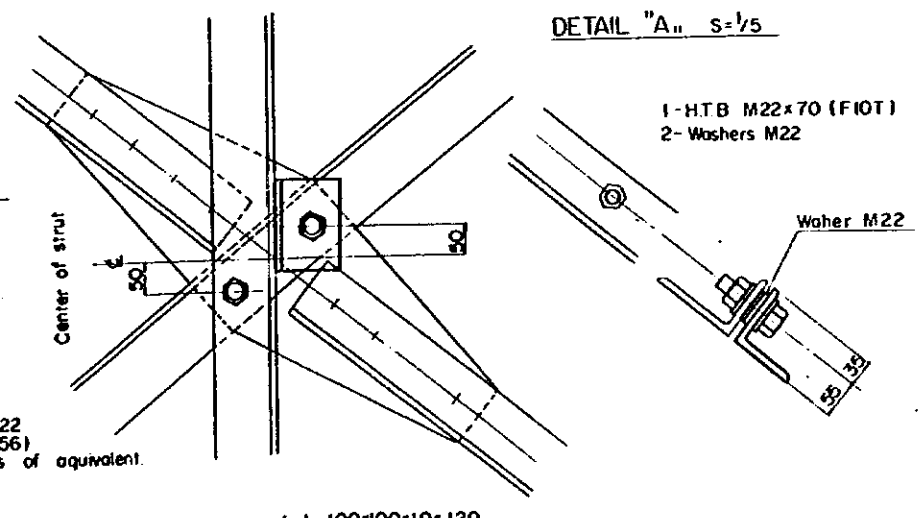
HANGER S=1/5



- 2-Round bars 22# x 400
- 8-Nuts M22 (Type-1)
- 8-Nuts M22 (Type-3)
- 8-Washers M22

- General notes:
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
  - 2) All high-strength bolts (HTB) are M22(+)(FIOT), and assumed frictional coefficient of contact surface as follows.
    - i) for connection  $f \geq 0.4$
    - ii) for slitch  $f \geq 0.3$
  - 3) All dimensions to be checked in the field.

DETAIL "A" S=1/5

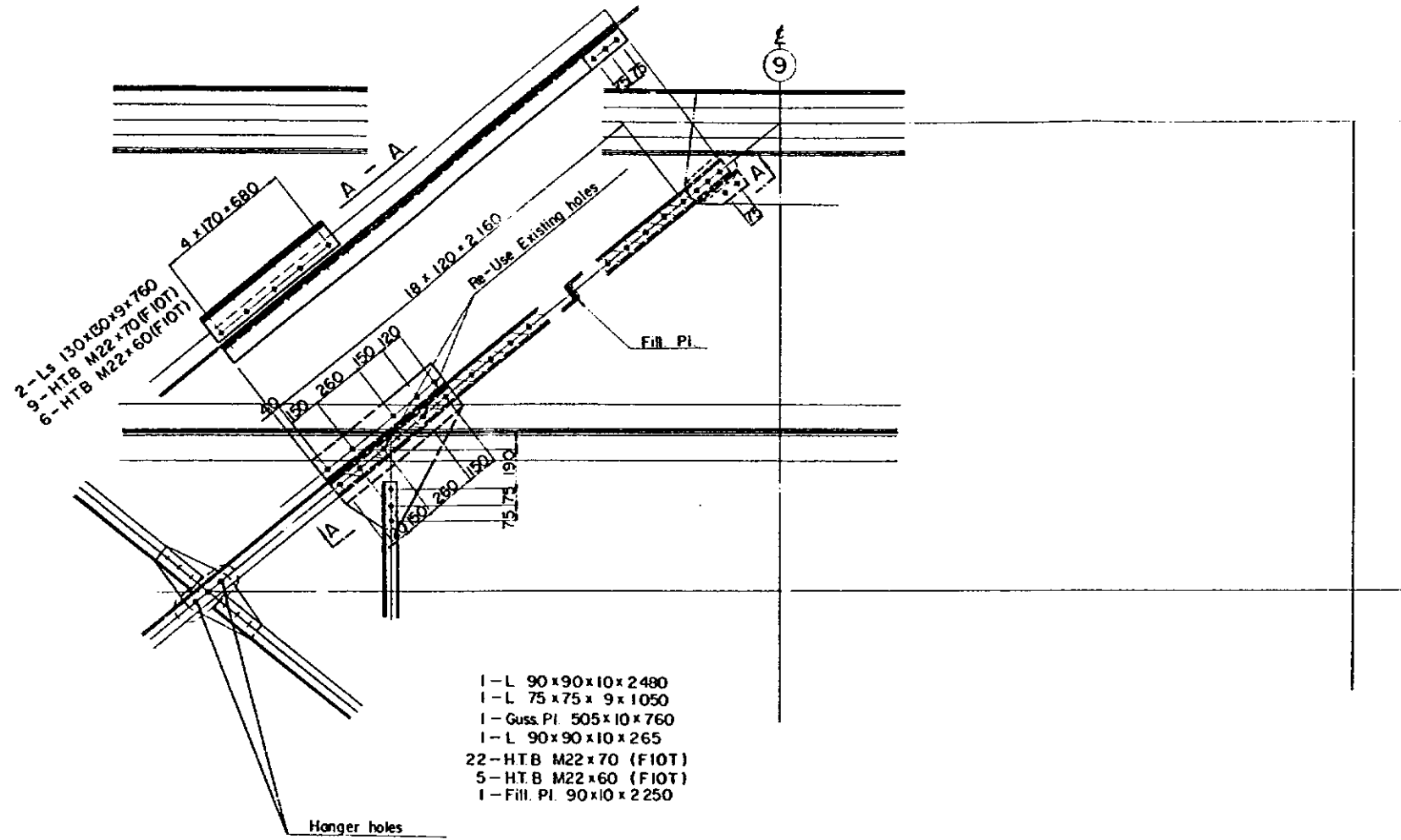


- Note:
- All Nut M22 (JIS B-1156) or materials of equivalent.

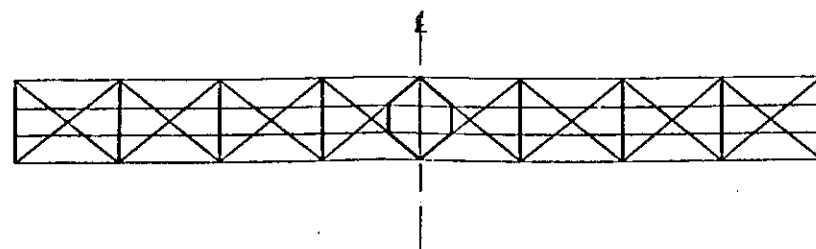
1-L 100x100x10x120

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL	Loading
45.0 T.T	LOWER LATERAL BRACING	Unit	Scale
		mm	1/5, 1/5
K.M	672 + 874	Designed by	_____
DISTRICT	Thung Song	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	_____

**BRAKE TRUSS** S=1/15



**MARKING DIAGRAMS**



**General Notes**

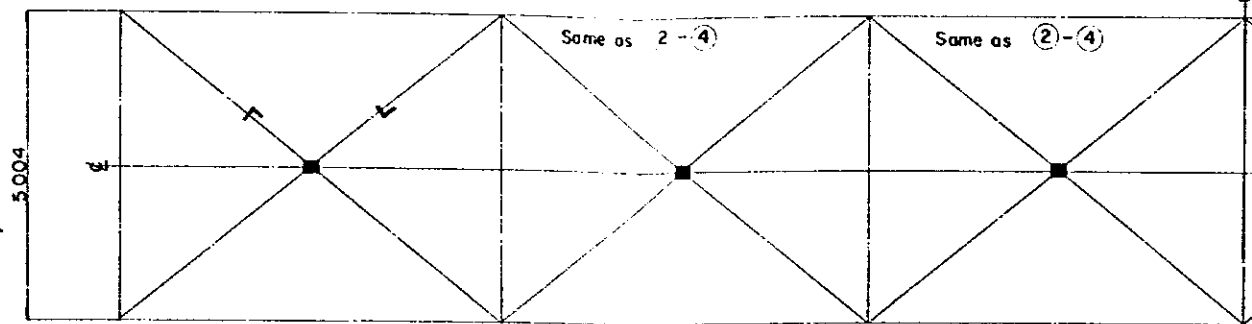
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (+) (F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
450 TT	BRAKE TRUSS	Unit	Scale
		mm	1/15
K. M.	672 + 874	Designed by	_____
DISTRICT	Thung Song	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

# GENERAL DIAGRAM

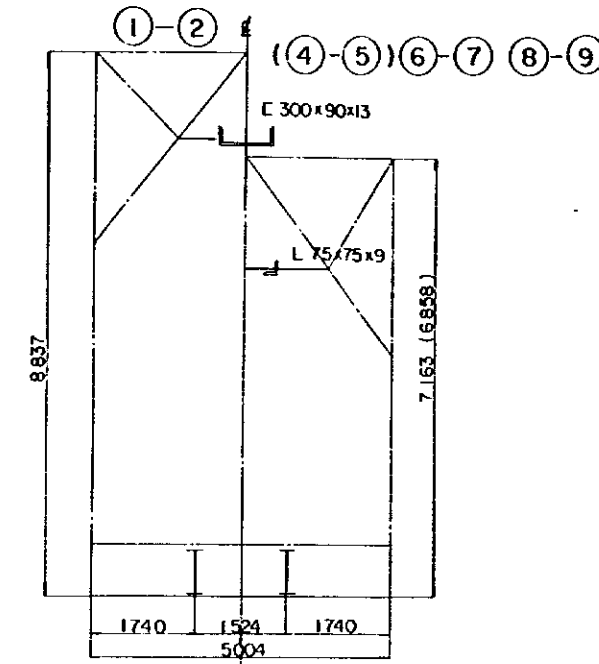
Bangkok (Mov)

## UPPER LATERAL



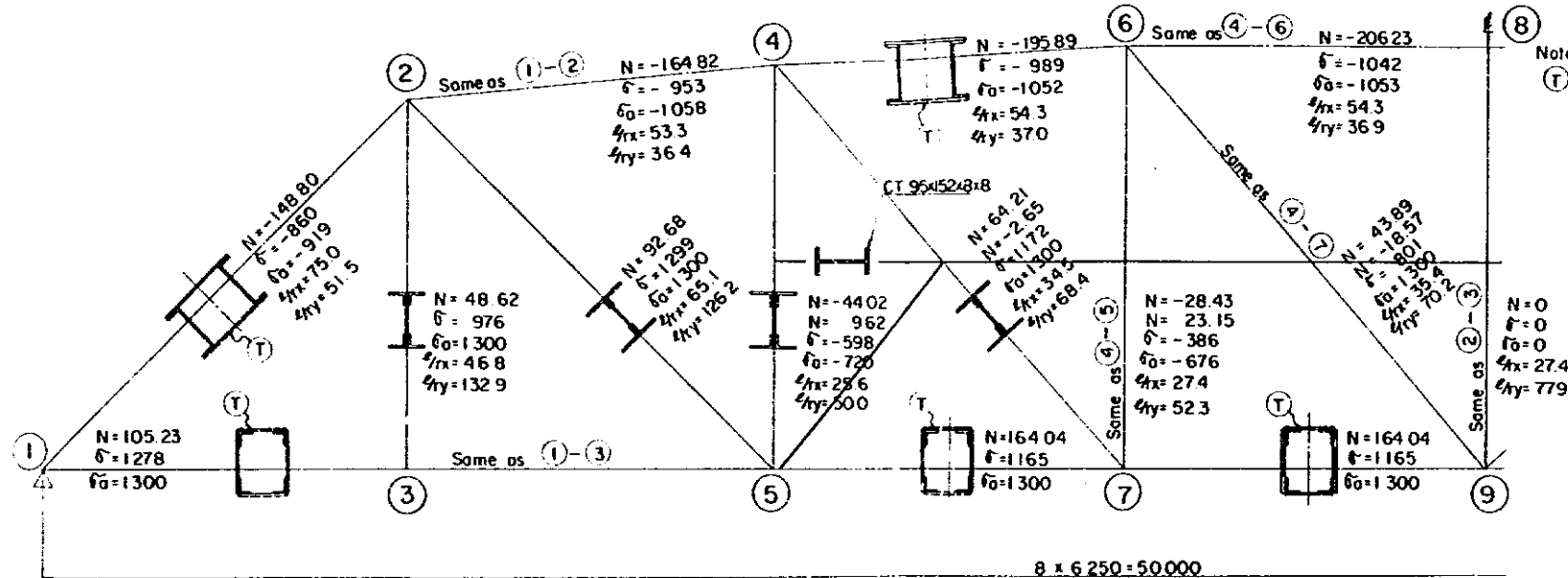
Sungai Kolok (Fix.)  
Note  
■ : Gusset plates to be changed

## PORTAL BRACING SWAY BRACING



Note  
Ⓣ : Strengthening of tie plates

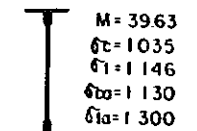
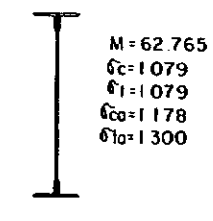
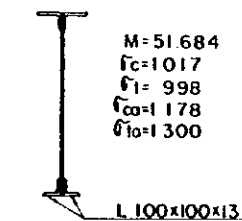
## MAIN TRUSS



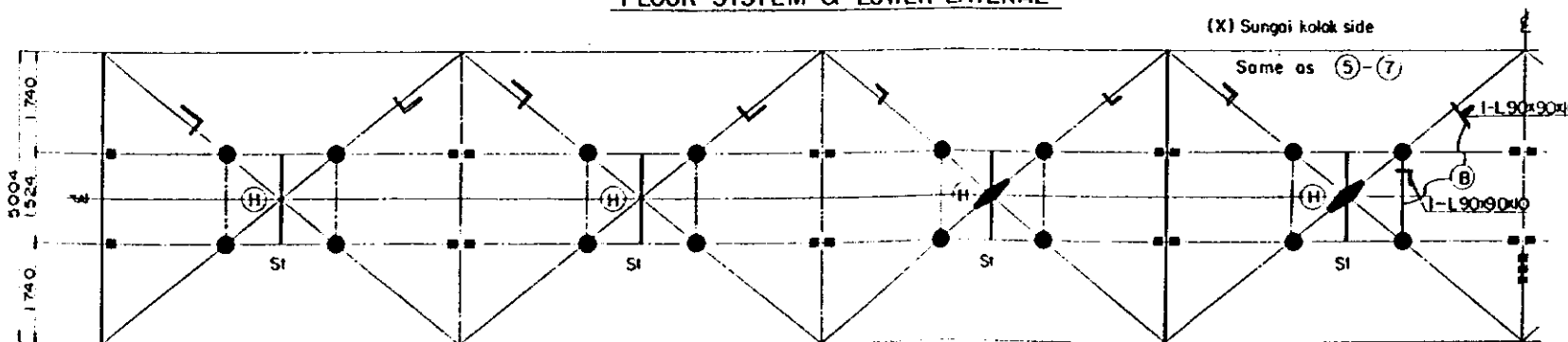
END FLOOR

INT FLOOR

STRINGER



## FLOOR SYSTEM & LOWER LATERAL



- Legends:
- 1) ● : Gusset plates to be improved
  - 2) ■ : Excessive stressed rivets to be strengthened
  - 3) ▨ : Web plates of floor beam to be repaired
  - 4) ● : Defective hanger to be removed
  - 5) (H) : Hanger to be added
  - 6) (B) : New brake truss to be added
  - 7) St : New struts to be added

### General Note :

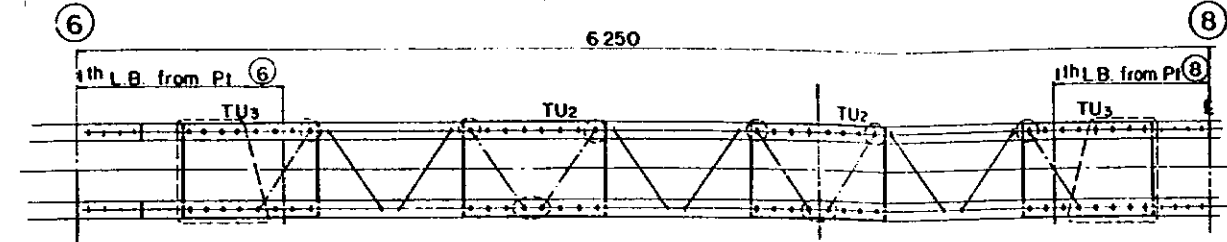
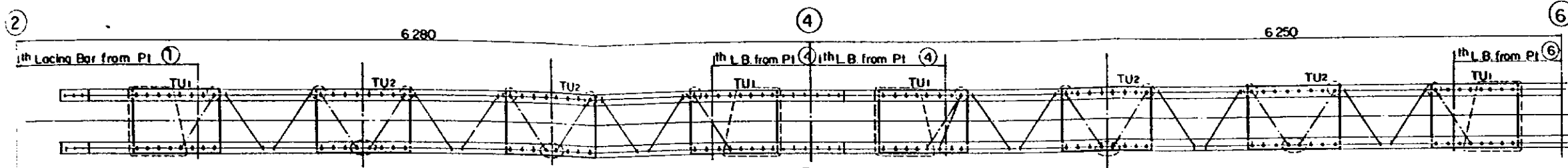
- 1) Weak drawings show the original members  
Deep drawings show the members to be improved.
- 2) Actual stresses are based on DL-15 loading
- 3) Marks

- M : Bending moment (t.m)
- N : Axial force (t)
- l : Length of member (cm)
- rx, ry : Radius of gyration of sectional area for x or y axis (cm)
- lt : Slenderness ratio
- f : Actual stress (kg/cm<sup>2</sup>)
- fa : Allowable stress (kg/cm<sup>2</sup>)

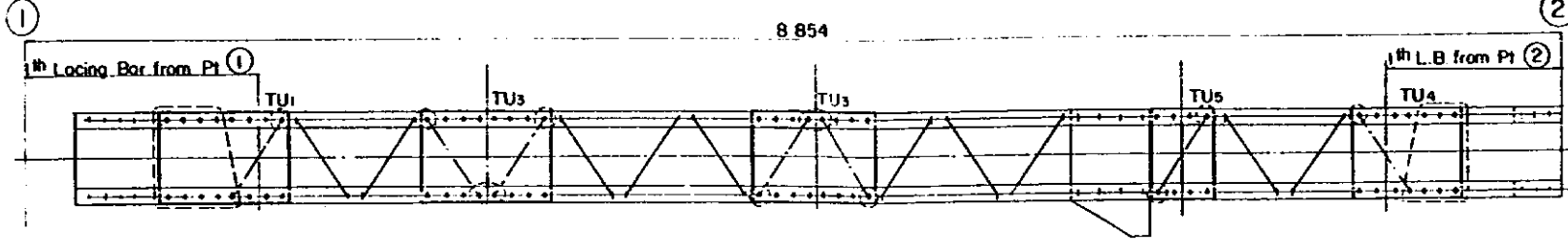
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	GENERAL DIAGRAM	DL-15 loading
50.0 T.T			Unit Scale
K.M	1063 + 810		
DISTRICT	Yala	Designed by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

# MAIN TRUSS (NO.1)

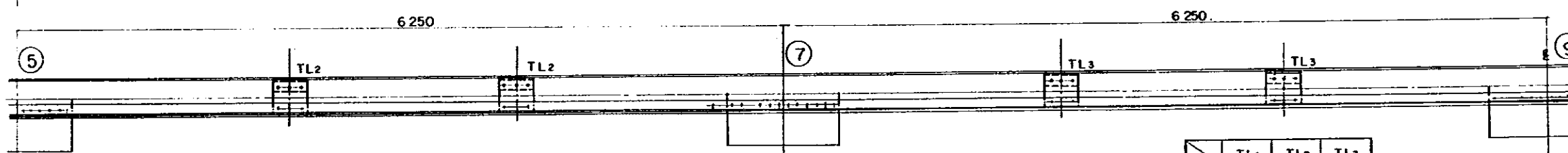
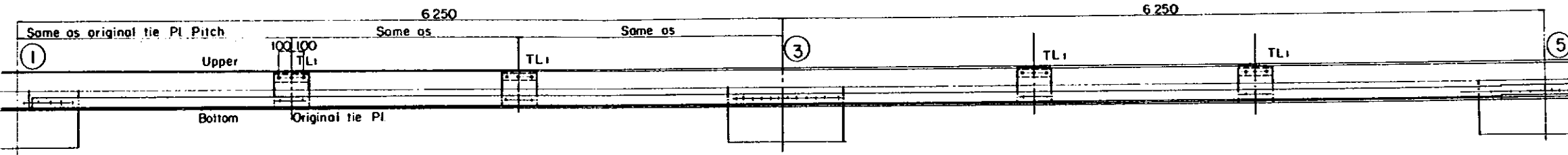
UPPER CHORD MEMBER  $s=1/20$



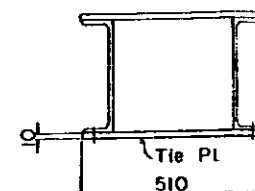
END POST  $s=1/20$



LOWER CHORD MEMBER  $s=1/20$



DETAIL OF TIE PLATE  $s=1/10$



Size of Tie Plate			
Tie Plate	TU1	TU2	TU3
$l$	720	755	740
Tie Plate	TU4	TU5	
$l$	635	370	

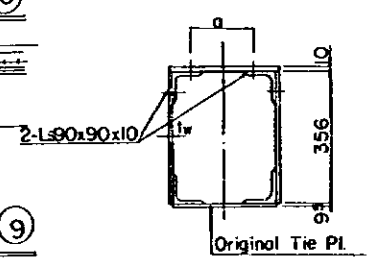
TU1 - TU4  
1-Tie Pl. 510x10x $l$   
16-HTB M22x65 (FIOT)

TU5  
1-Tie Pl. 510x10x $l$   
8-HTB M22x65 (FIOT)

- Construction Method**
- 1) Cut off original rivets.
  - 2) Take off original tie plates & lacing Bars.
  - 3) Drill new bolt holes.
  - 4) Clean surface between original members and additional plates.
  - 5) Attach new tie plate and tighten HT Bolts.

- Note**
- 1) : Re-Use Existing holes
  - 2) : Take off original lacing Bar.

DETAIL OF TIE PLATE  $s=1/10$

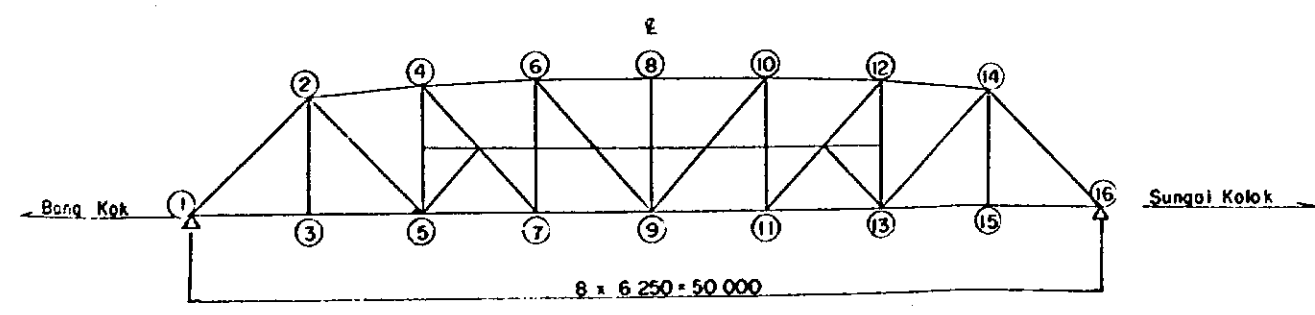


1-Tie Pl.  $b \times 10 \times 280$   
2-Ls 90x90x10x280  
6-HTB M22x65 (FIOT)  
6-HTB M22x $l$  (FIOT)

	TL1	TL2	TL3
$a$	185	170	160
$b$	265	250	240
$l$	60	70	75

- Construction Method**
- 1) Drill new bolt and rivet holes.
  - 2) Clean surface between original members and additional members.
  - 3) Attach new tie plates. Angles and tighten HT Bolts.

**MARKING DIAGRAMS**

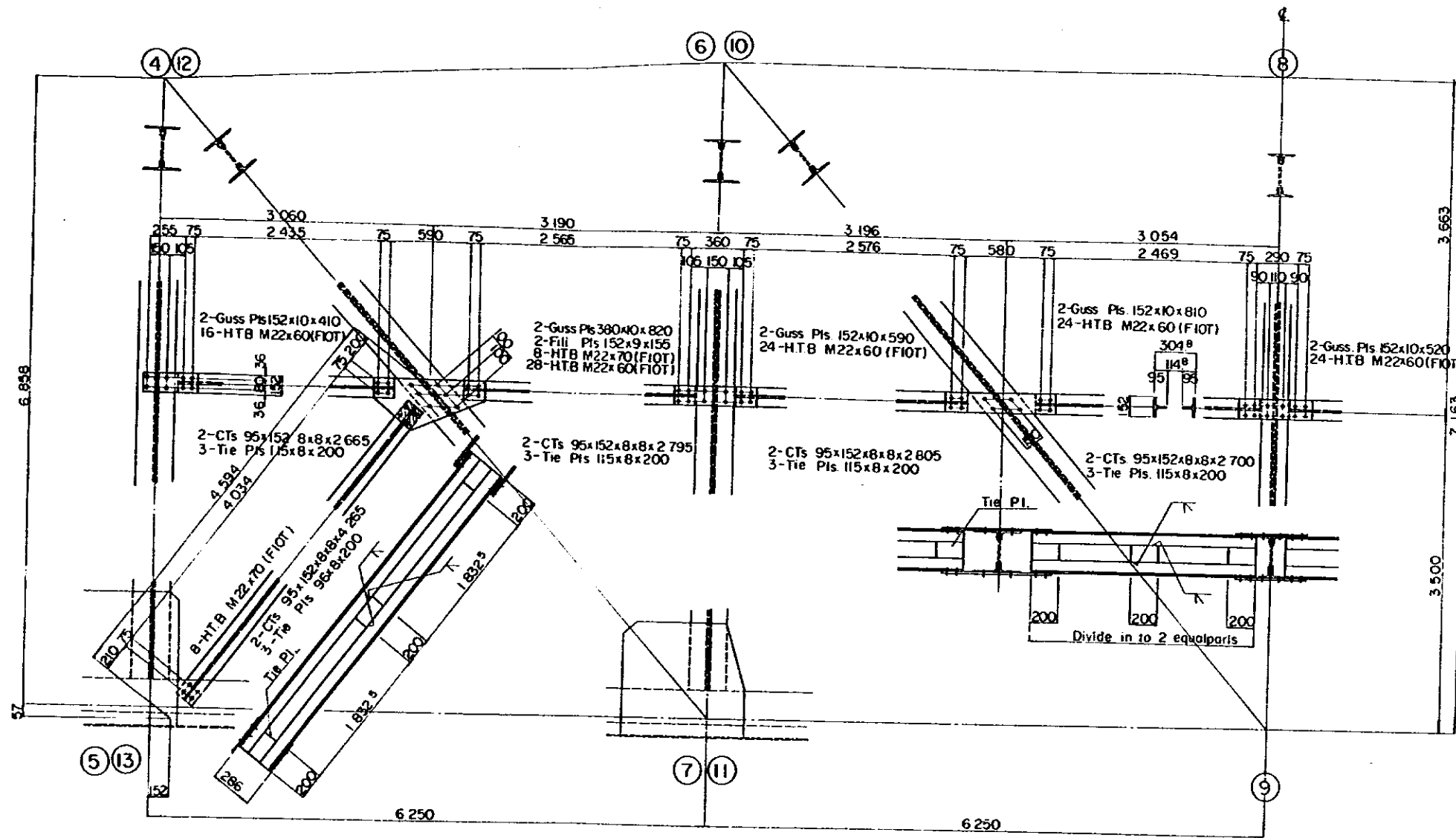


- General Notes :**
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
  - 2) All high-strength bolts (HTB) are M22 (  $\phi$  XF10T ), and assumed frictional coefficient of contact surface as follows
    - i) for connection  $f \geq 0.4$
    - ii) for stitch  $f \geq 0.3$
  - 3) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members MAIN TRUSS (NO.1)	DL 15 loading	
50.0 T		Unit	Scale
K M	1063 + 810	mm	1/20, 1/10
DISTRICT	Yala	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

# MAIN TRUSS (NO.2)

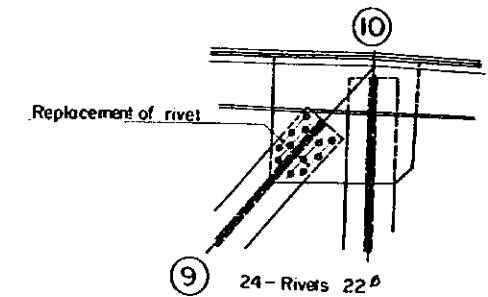
DIAGONAL MEMBER  $s=1/20$



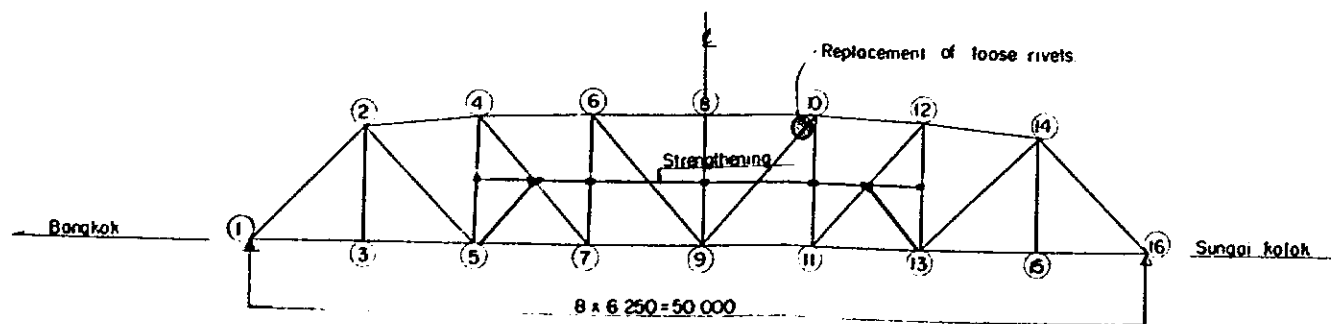
### Construction Method

- 1) New members are built up by welding
- 2) Clean surface between new gusset plates and original members
- 3) Drill new bolt holes.
- 4) Attach gusset plates.
- 5) Attach new members.
- 6) Tighten H.T Bolts.

### DIAGONAL CONNECTION $s=1/20$



### MARKING DIAGRAMS



### General Notes :

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent
- 2) All high-strength bolts (HTB) are M22 (F10T), and assumed frictional coefficient of contact surface as follows
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22<sup>D</sup> (F10T), and to be rolled steel for SV34 (JIS G 3104) or materials of equivalent
- 4) All dimensions to be checked in the field.

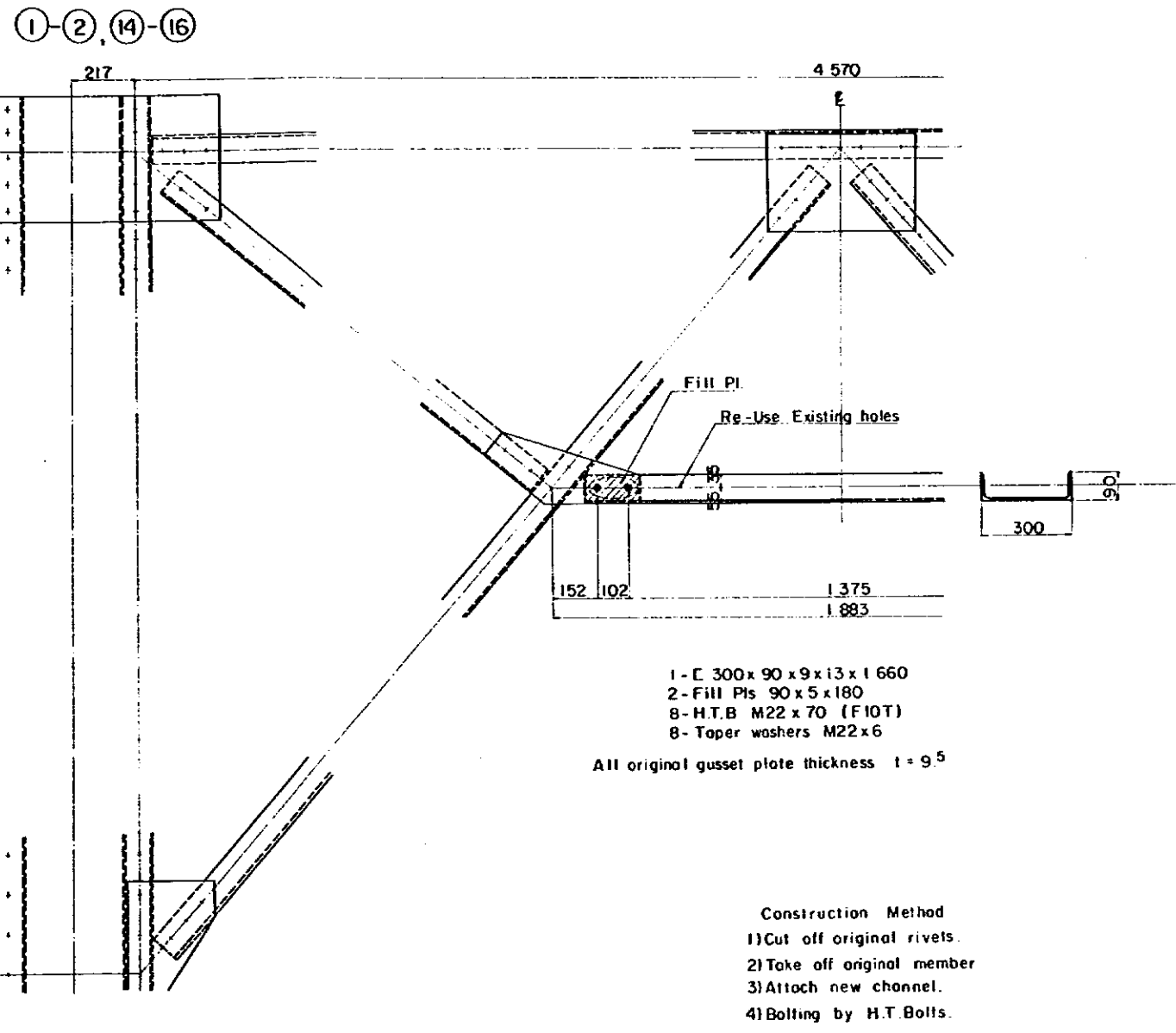
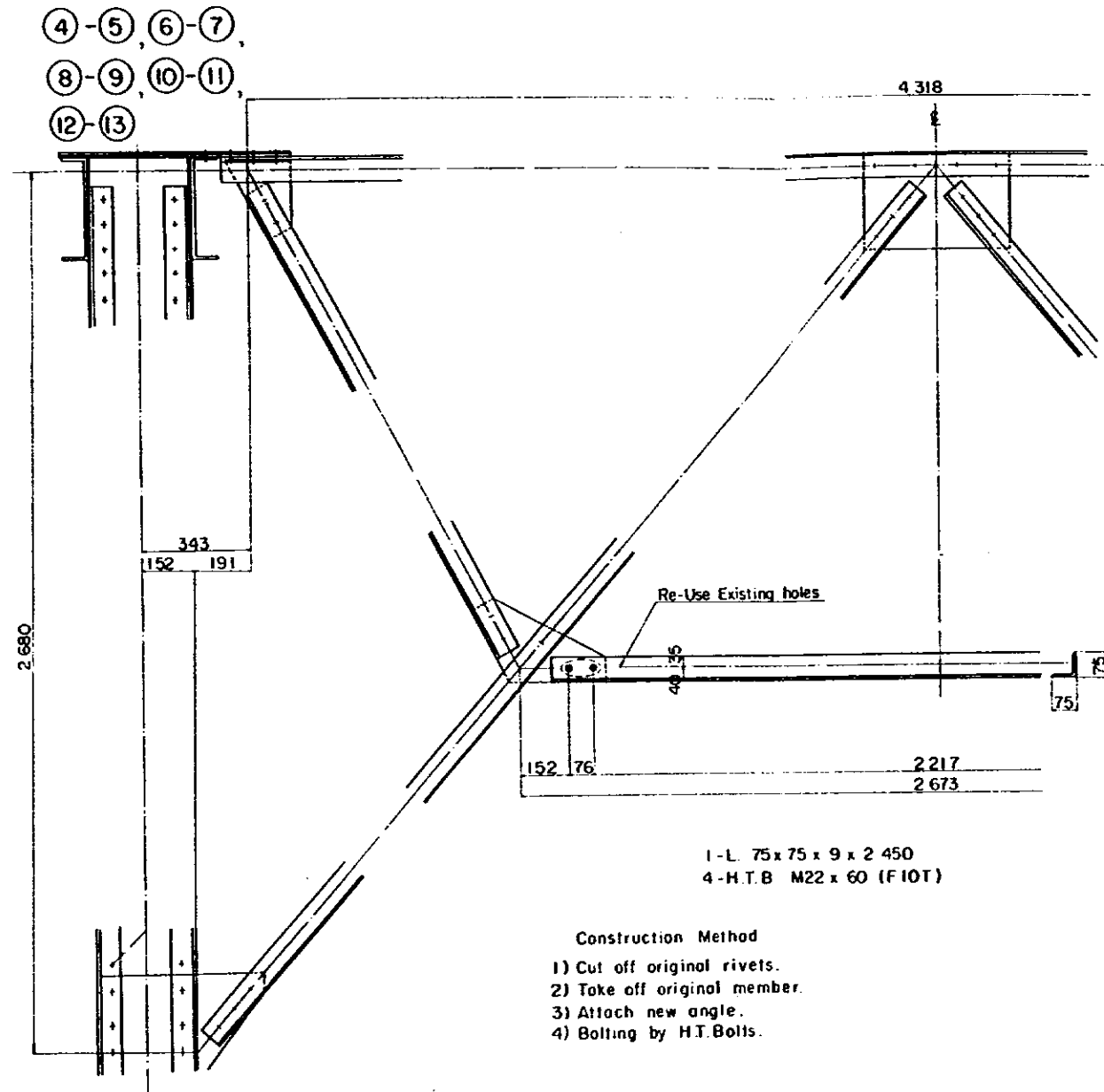
### THE STATE RAILWAY OF THAILAND

DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
50.0 T.T.	MAIN TRUSS (NO.2)	Unit	Scale
K.M.	1063 + 810	mm	1/20
DISTRICT	Yala	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	

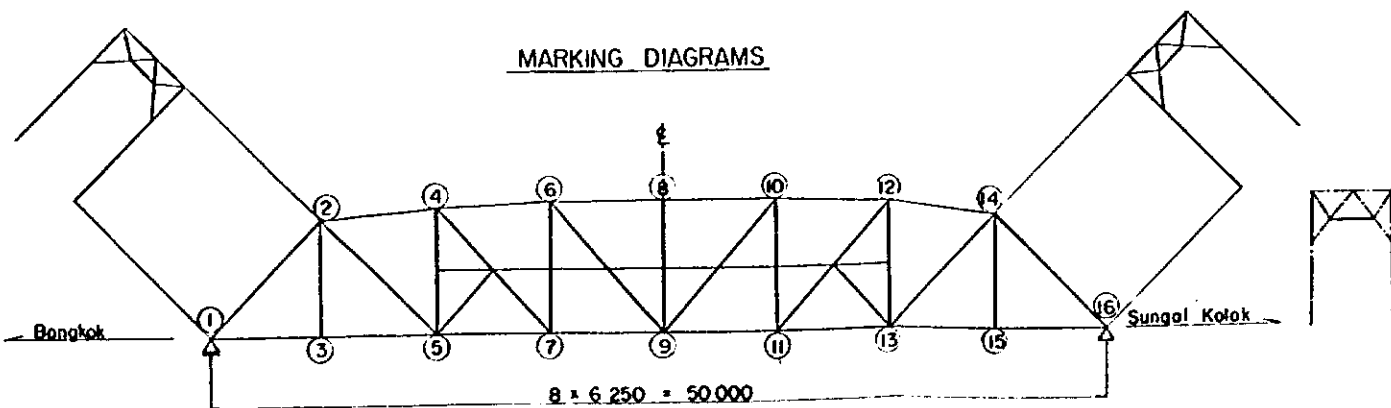
# MAIN TRUSS (NO. 3)

SWAY BRACING  $s=1/10$

PORTAL BRACING  $s=1/10$



## MARKING DIAGRAMS



### General Notes

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22(+)(F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for slitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

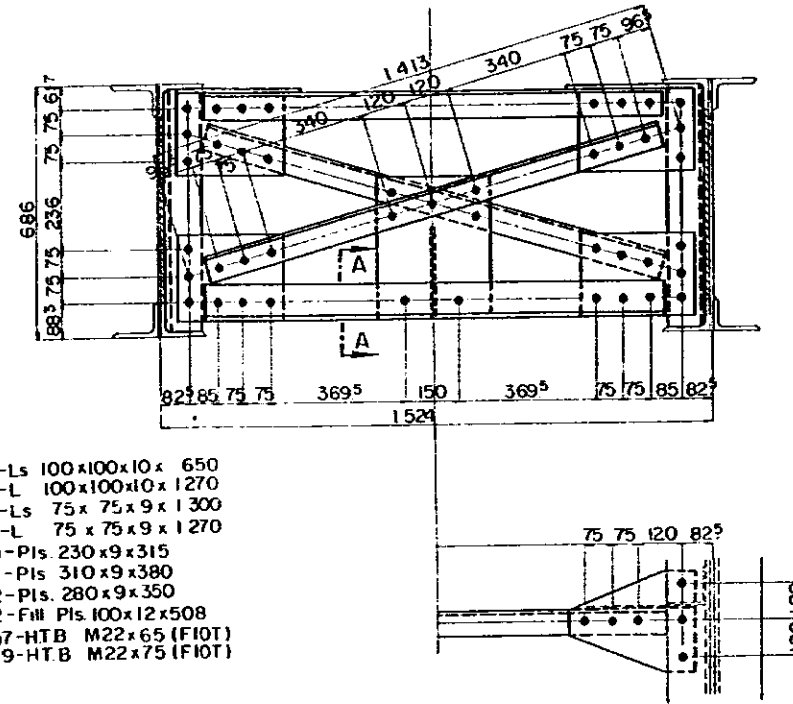
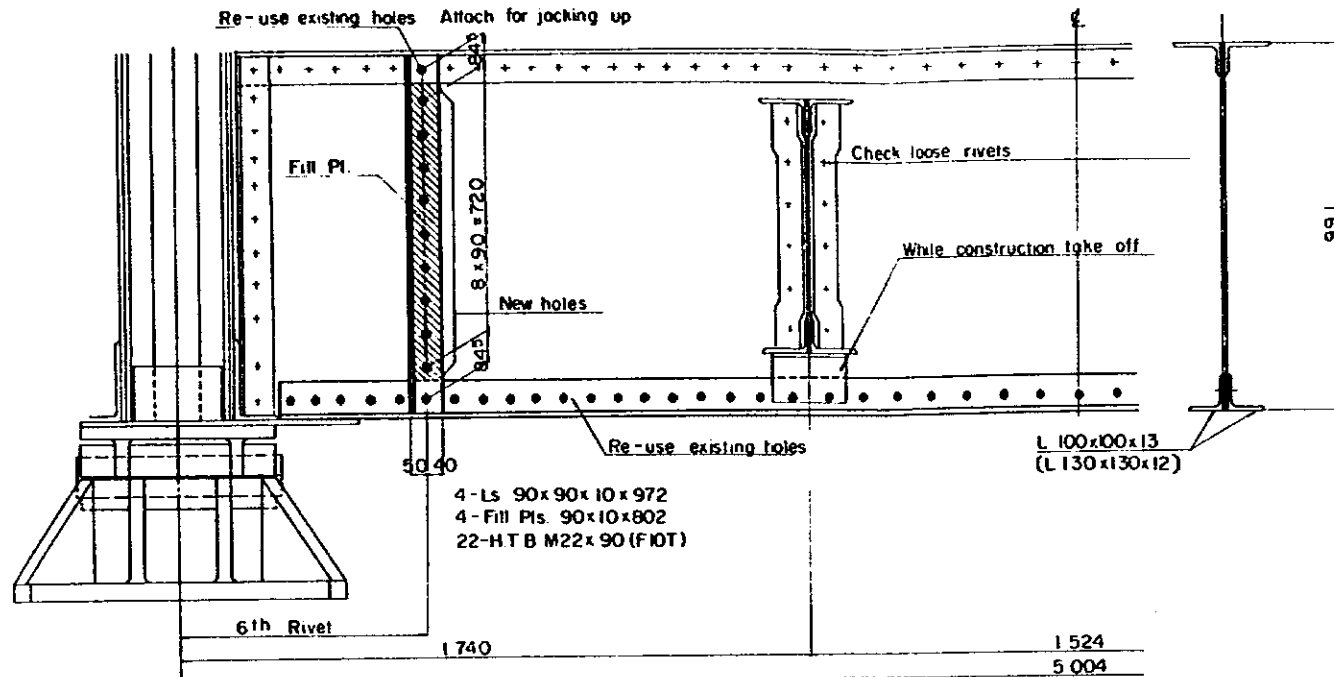
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 Loading	
		Unit	Scale
500 TT	Members MAIN TRUSS (NO.3)	mm	1/10
K M	1063 + 810	Designed by	_____
DISTRICT	Yolo	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	

# FLOOR SYSTEM

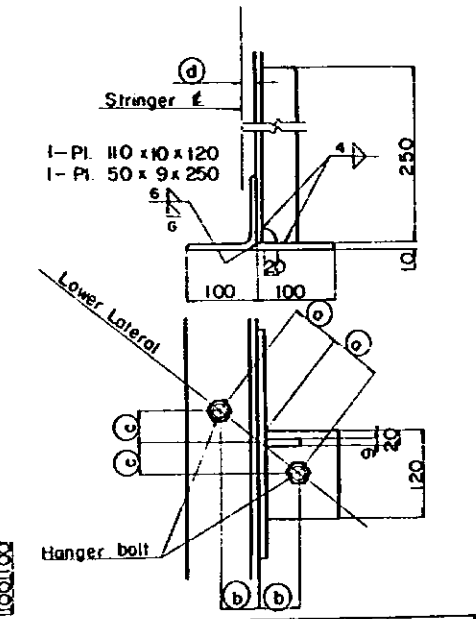
## END FLOOR BEAM (INT. FLOOR BEAM I.F-4) s=1/10

## SWAY BRACING OF STRINGER s=1/10

Note: In I.F-4, it's unnecessary to attach angles for jacking up

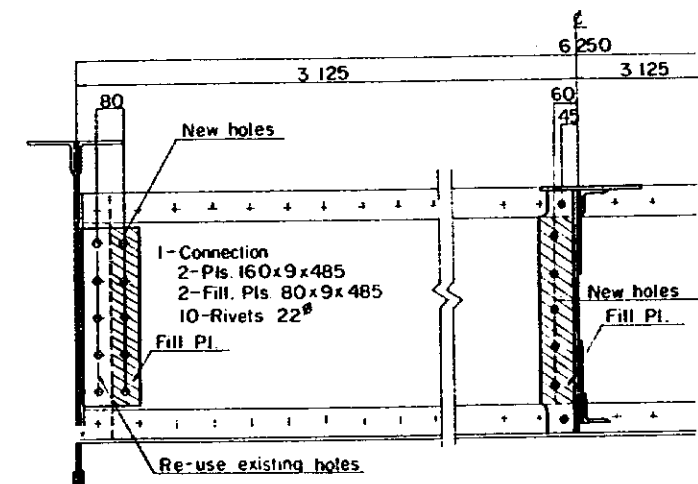


## DETAIL A - A s=1/5



	1-3	3-5	5-7	7-9
a	71.9	71.9	70	70
b	55.5	65.5	54	54
c	43.8	37.4	42.6	42.6
d	20.1	6.5	—	—

## STRINGER s=1/10



- Construction Method
- 1) Drill new bolt holes.
  - 2) Cut off original rivets.
  - 3) Clean surface between original members and new angles.
  - 4) Attach new angles and tighten HTBolts.
  - 5) Strengthen sway bracing of stringer
  - 6) Strengthen connection and new angles. (Attach Spl. Pl. and riveting)

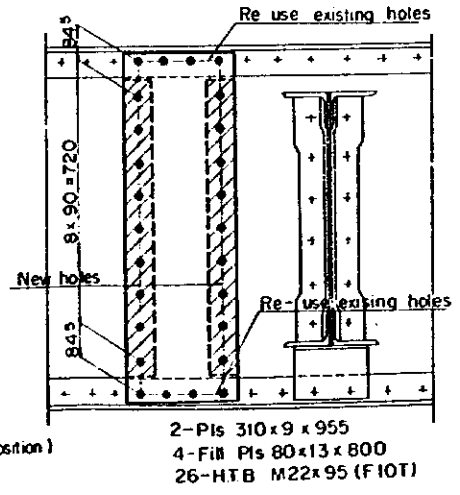
### General notes:

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (ΦXFIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22# (Φ), and to be rolled steel for SV34 (JIS G 3104) or materials of equivalent.
- 4) All dimensions to be checked in the field

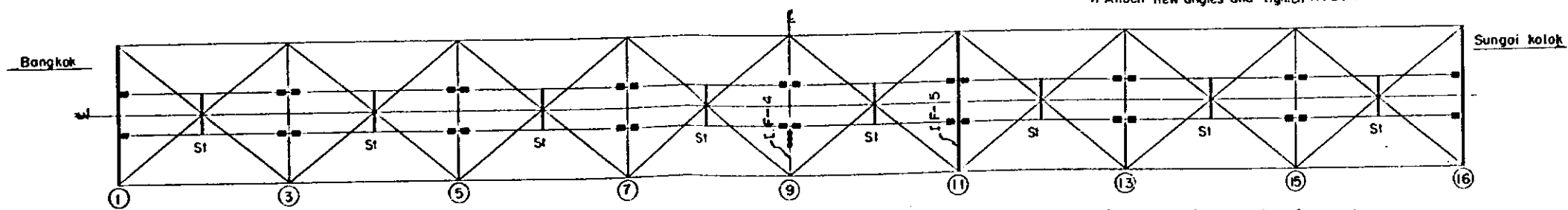
### Construction Method

- 1) Drill new bolt holes.
- 2) Cut off original rivets at lower flange angles.
- 3) Take off original members
- 4) Clean surface between original members and new flange angles
- 5) Attach new angles and tighten HTBolts (Lower and jack position)

## I.F-4



### MARKING DIAGRAMS



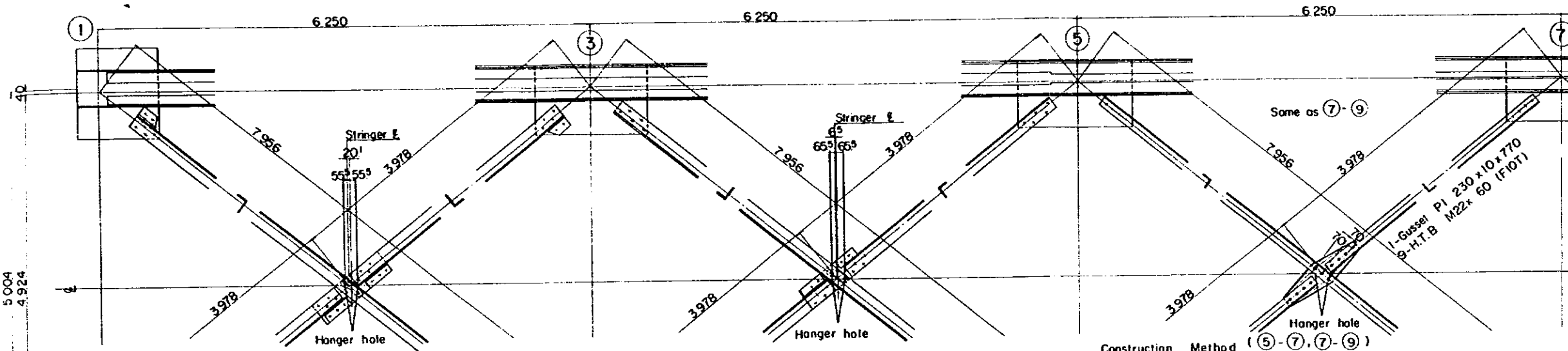
- Note:
- S2 : Strengthening of connection
  - S1 : New sway bracing of stringer to be added

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL. 15 loading	
500 T.T	FLOOR SYSTEM	Unit	Scale
K. M.	1063 + 810	mm	1/10, 1/5
DISTRICT	Yala	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

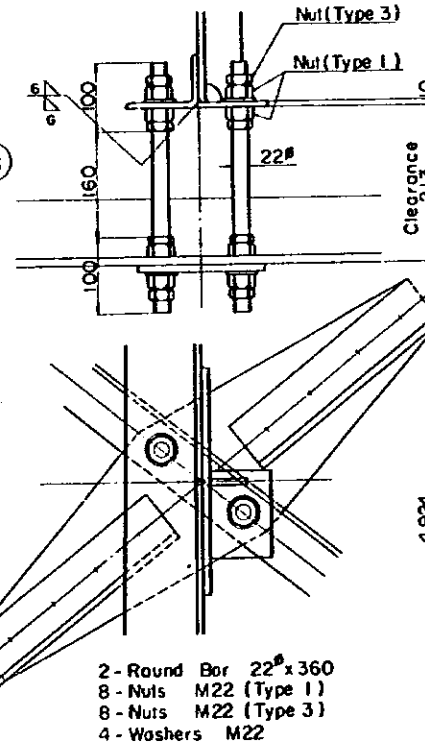


LATERAL BRACING S=1/20

LOWER LATERAL



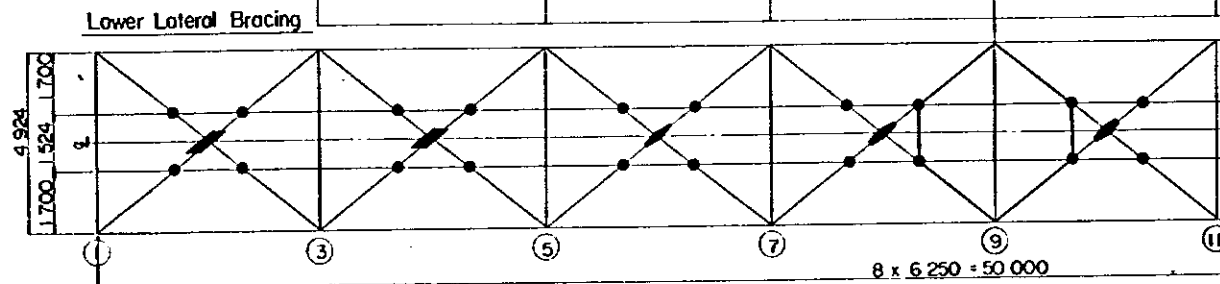
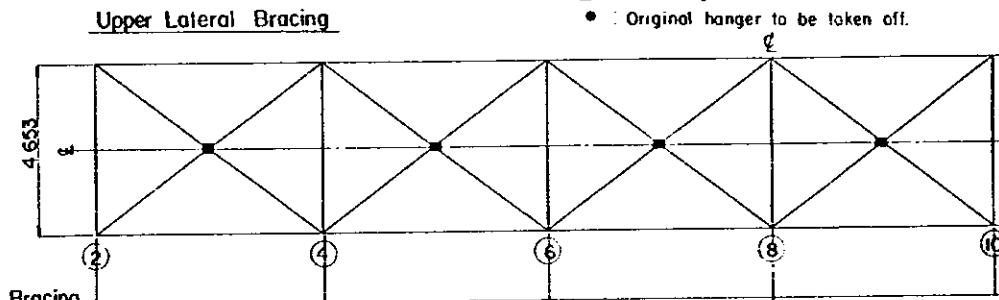
HANGER S=1/15



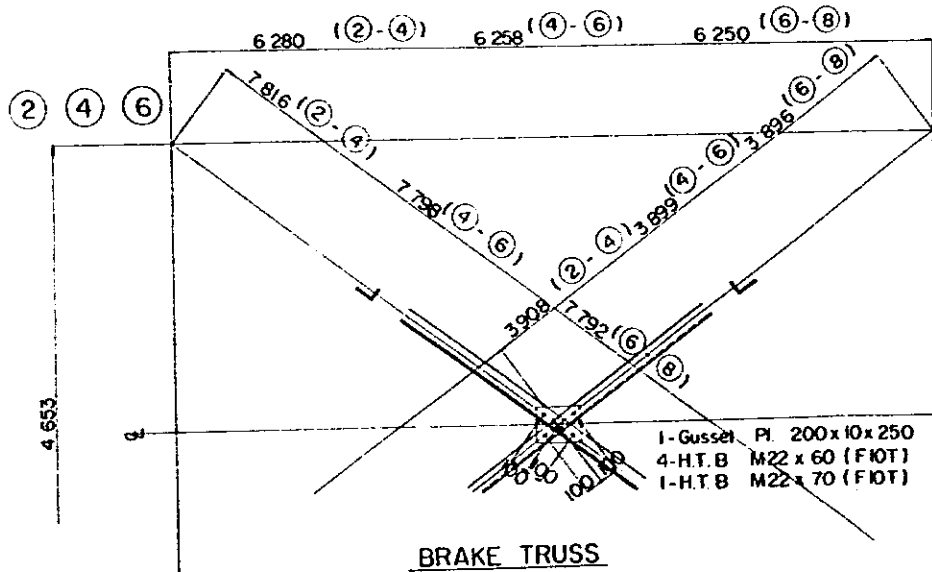
- Construction Method (5-7, 7-9)
- 1) Cut off original rivets.
  - 2) Drill new bolt holes.
  - 3) Clean surface between original members and additional plates.
  - 4) Attach new gusset plate
  - 5) Tighten HT Bolts

MARKING DIAGRAMS

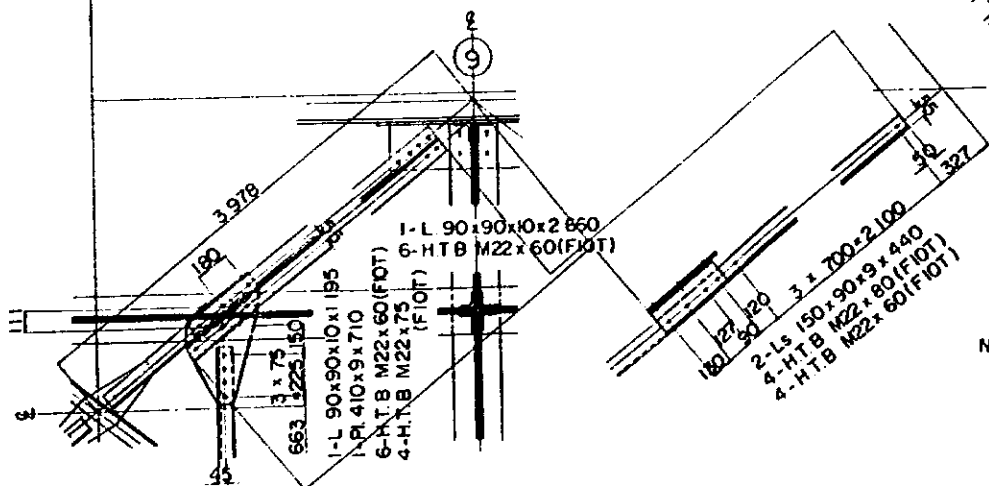
- Note:
- : New gusset plates of upper lateral.
  - : Strengthening of gusset plates connection & new hangers
  - ▨ : New hangers
  - : Original hanger to be taken off.



UPPER LATERAL



BRAKE TRUSS



General Notes:

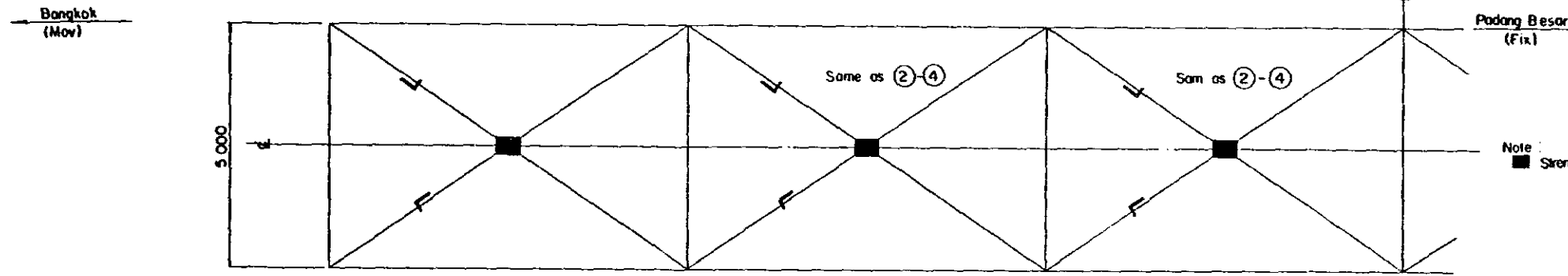
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (F) (FIOT), and assumed frictional coefficient of contact surface (f) as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field

Note: ○ : Re - Use Existing holes.

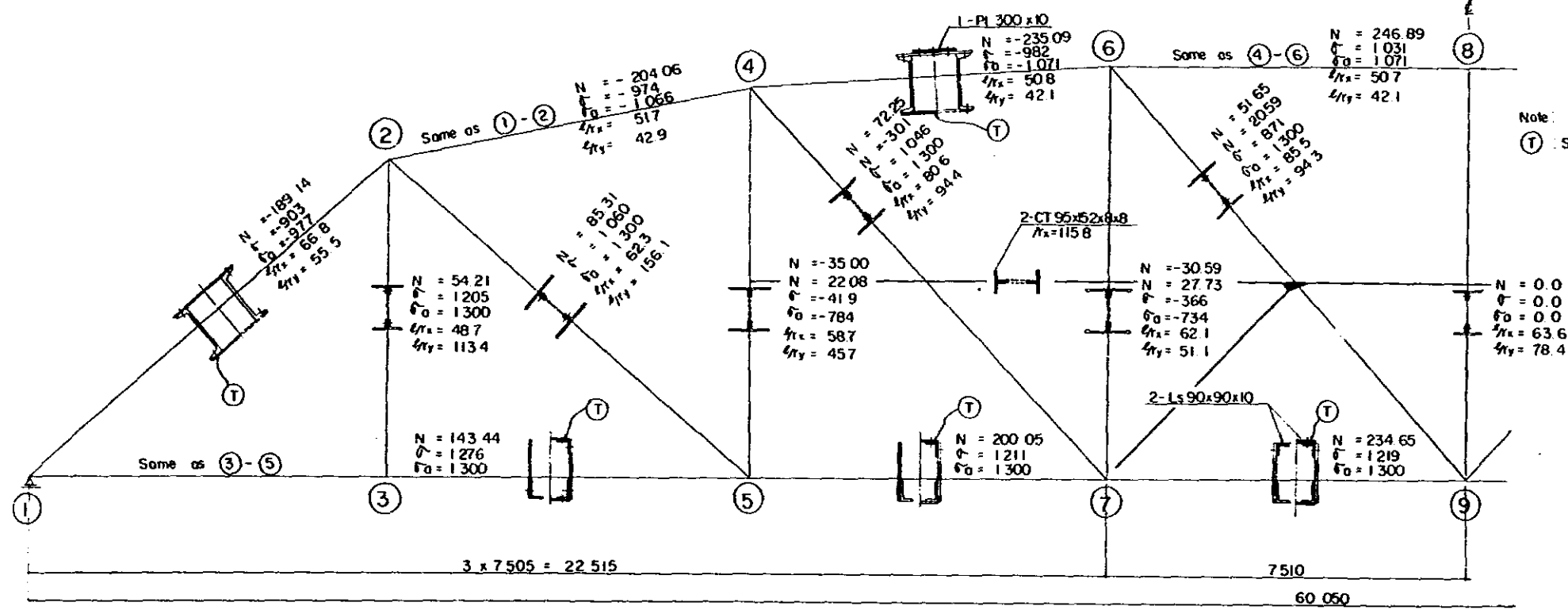
THE STATE RAILWAY OF THAILAND				
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING				
Span Type	Members	LATERAL BRACING		DL 15 loading
500 T.T		Unit	Scale	
K.M	1063 + 810	mm	1/20, 1/10	
DISTRICT	Yala	Designed by		
LINE	Southern Line	Checked by		
Remarks		Checked by		
		Checked by		
		Checked by		
		Checked by		
DATE		DRAWING NO		

# GENERAL DIAGRAM

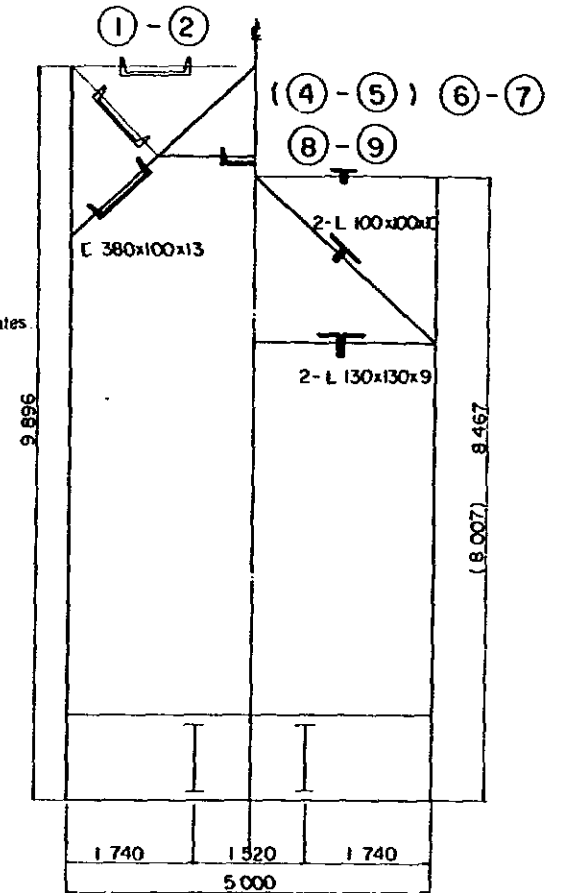
## UPPER LATERAL



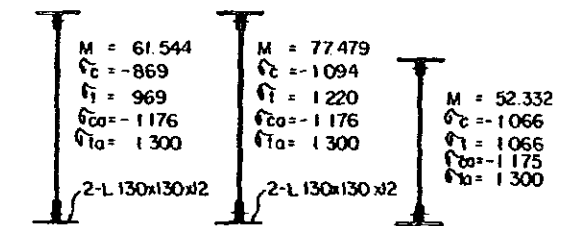
## MAIN TRUSS



## PORTAL BRACING SWAY BRACING



## END FLOOR INT. FLOOR STRINGER

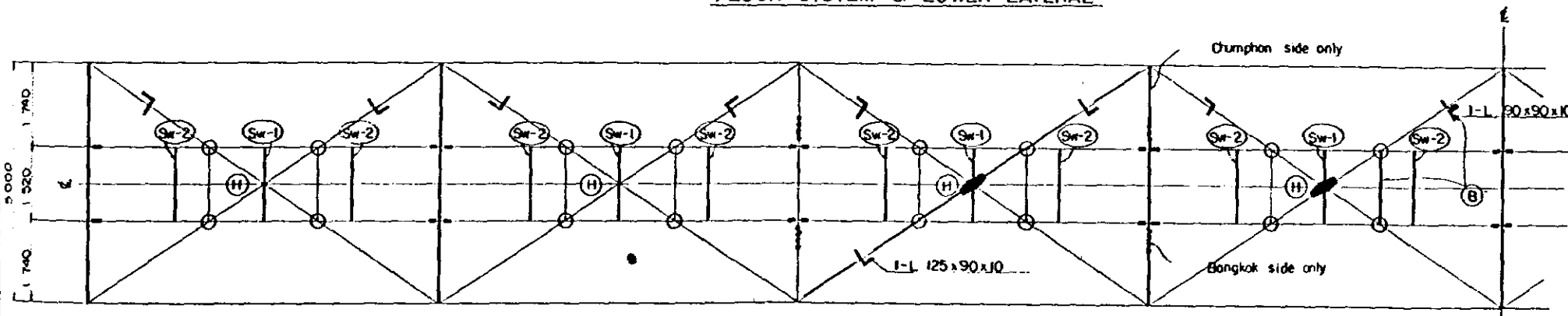


### General Note:

- Weak drawings show the original members  
Deep drawings show the members to be improved
- Actual stresses are based on DL-15 loading
- Marks

M : Bending moment (t.m)  $l_r$  : Slenderness ratio  
 N : Axial force (t)  $\sigma$  : Actual stress (kg/cm<sup>2</sup>)  
 L : Length of member (cm)  $\sigma_a$  : Allowable stress (kg/cm<sup>2</sup>)  
 $i_x, i_y$  : Radius of gyration of sectional area  
 for x or y axis (cm)

## FLOOR SYSTEM & LOWER LATERAL



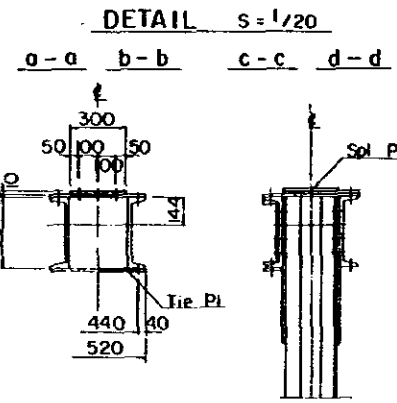
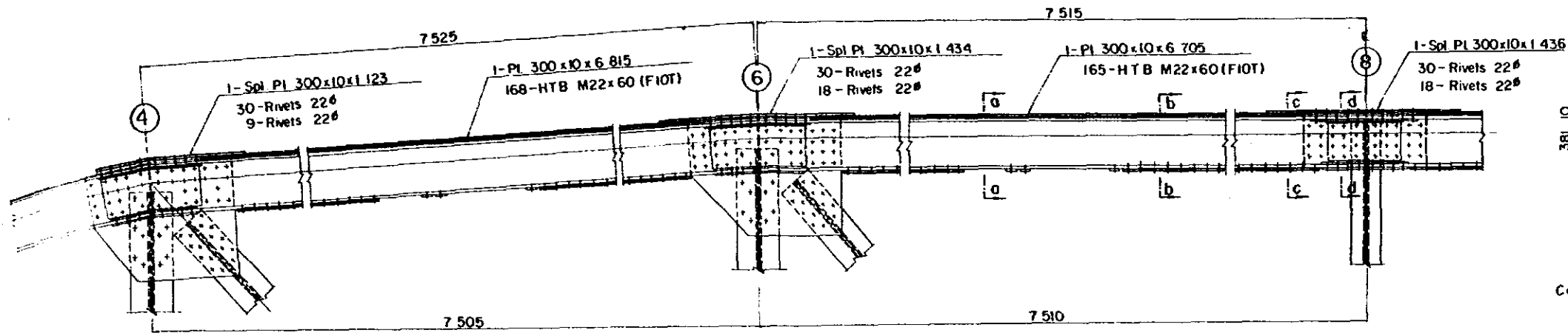
### Legends

- Excessive stressed rivets to be strengthened
- Gusset plates to be improved
- Floor beam to be repaired
- Defective hanger to be removed
- (H) : Hanger to be added
- (B) : New brake truss to be added
- (Sw) : New sway bracing of stringer to be added

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	GENERAL DIAGRAM	DL 15 loading
6005 T.T			Unit mm
K M	930 + 931		Scale
DISTRICT	Hot Yai	Designed by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO	

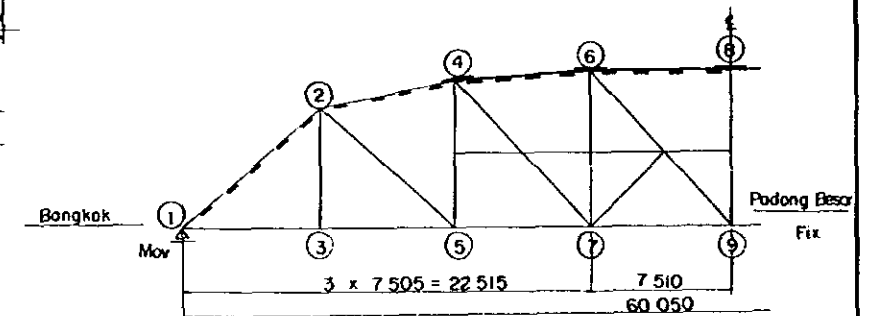
# MAIN TRUSS (NO.1)

UPPER CHORD MEMBER S=1/20



- Construction Method**
- 1) Drill new bolt holes.
  - 2) Clean surface between original and additional members
  - 3) Add new members and tighten HTBolts
  - 4) Cut off rivets of original splice plate.
  - 5) Add new splice plate and tighten HTBolts.

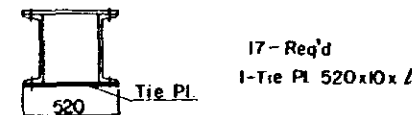
## MARKING DIAGRAMS



## General Notes:

- 1) All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (Φ) (FIOT), and assumed frictional coefficient of contact surface (f) as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22# (Φ), and to be rolled steel for SV34 (JIS G 3104) or materials of equivalent
- 4) All dimensions to be checked in the field

## DETAIL OF TIE PLATE S=1/20



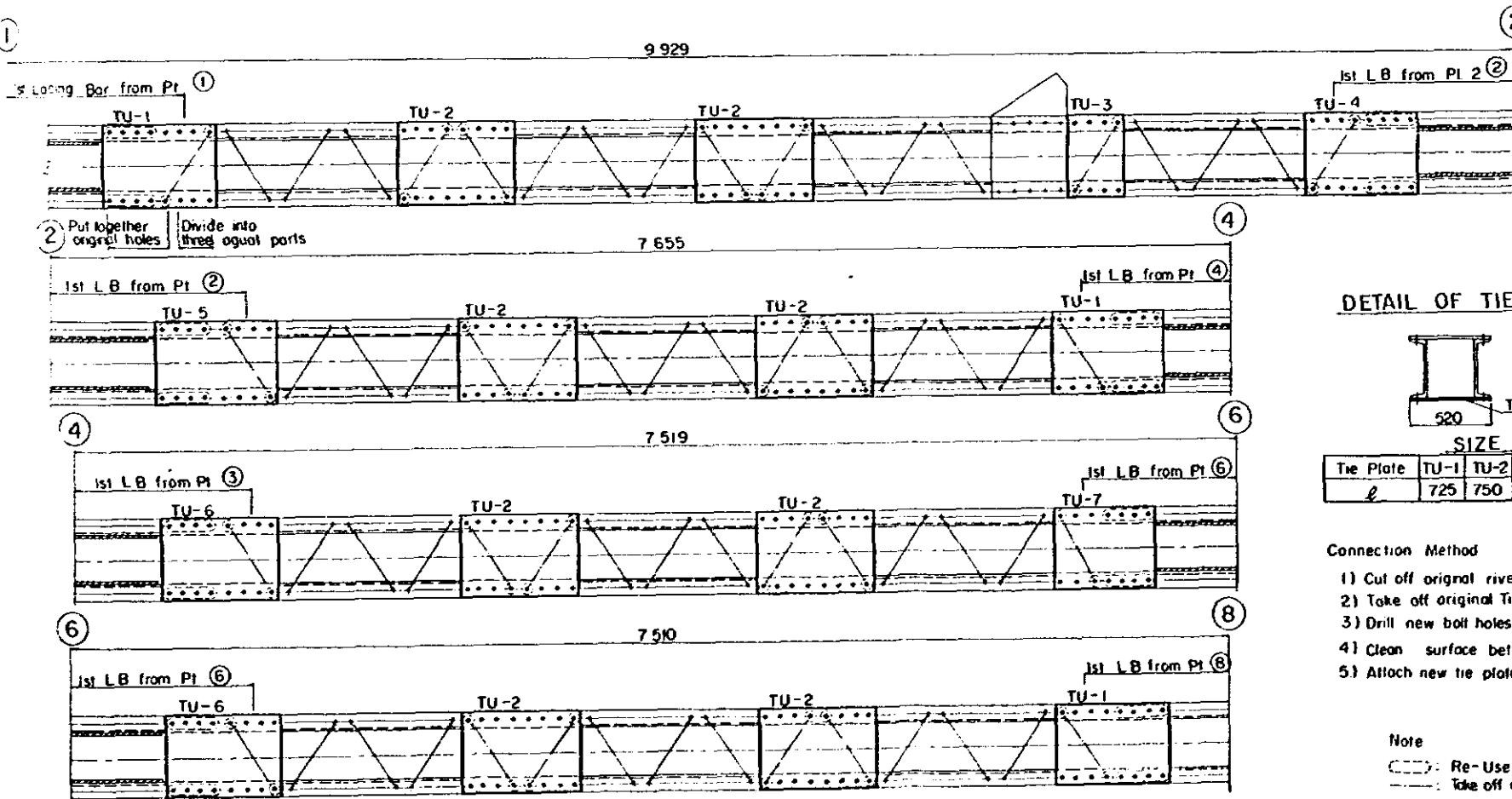
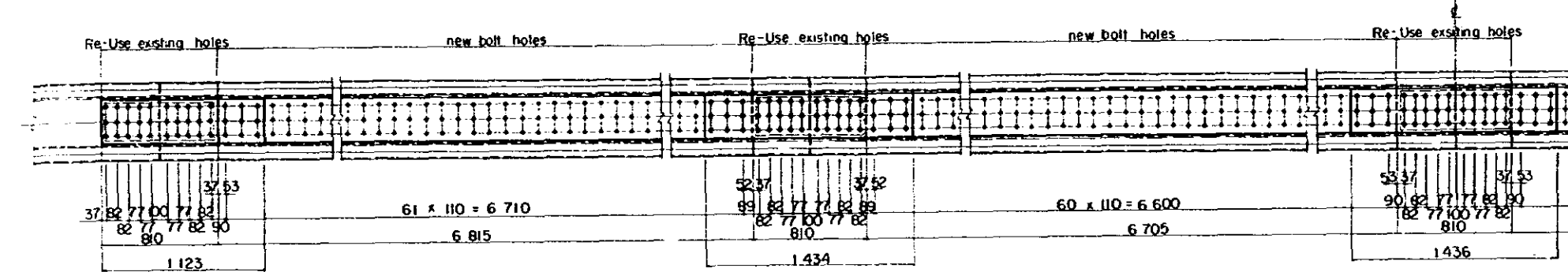
SIZE OF TIE PLATE							
Tie Plate	TU-1	TU-2	TU-3	TU-4	TU-5	TU-6	TU-7
ℓ	725	750	365	716	770	740	650

## Connection Method

- 1) Cut off original rivets
- 2) Take off original Tie Plates & Lacing Bar.
- 3) Drill new bolt holes
- 4) Clean surface between original members and additional plates.
- 5) Attach new tie plate and tighten HTBolts.

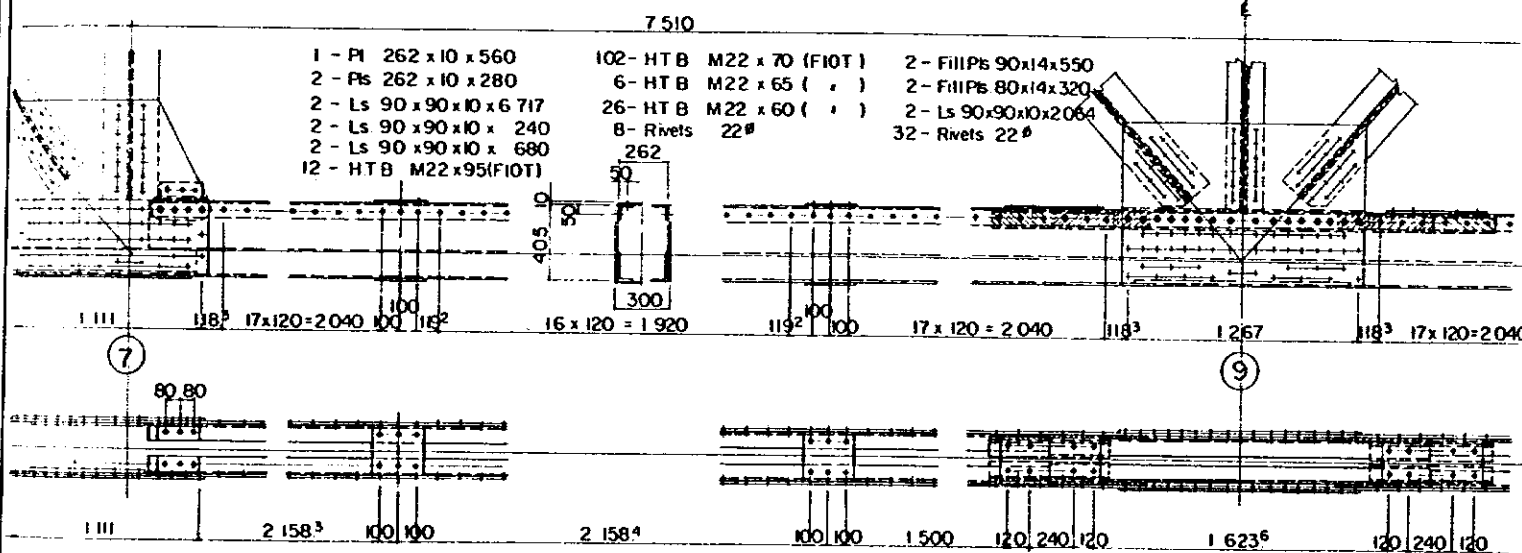
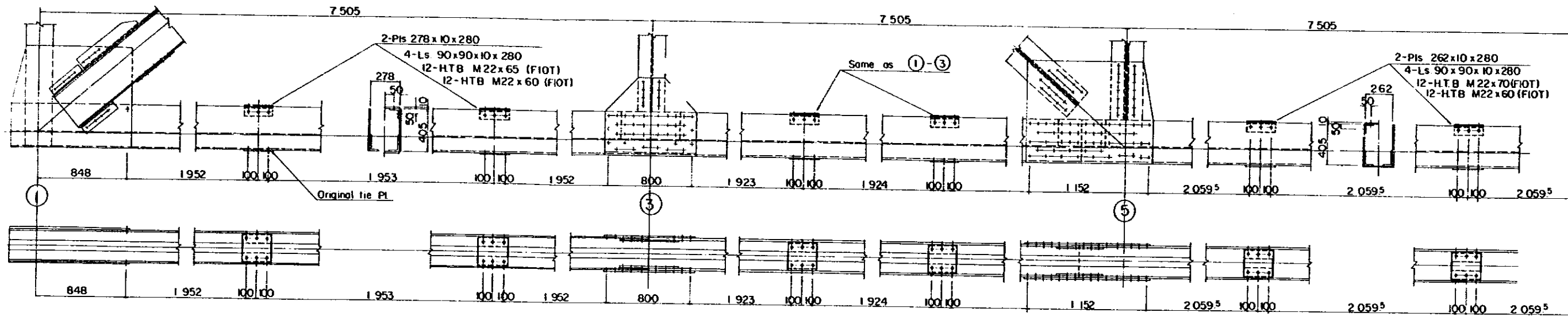
## Note

- Re-Use existing holes
- Take off original Lacing Bar.



THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
		Unit	Scale
600 T.T	MAIN TRUSS (NO.1)	mm	1/20
K.M.	930 + 931	Designed by	_____
DISTRICT	Hat Yai	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	_____

**MAIN TRUSS (NO.2)**  
**LOWER CHORD MEMBER**  $S=1/20$

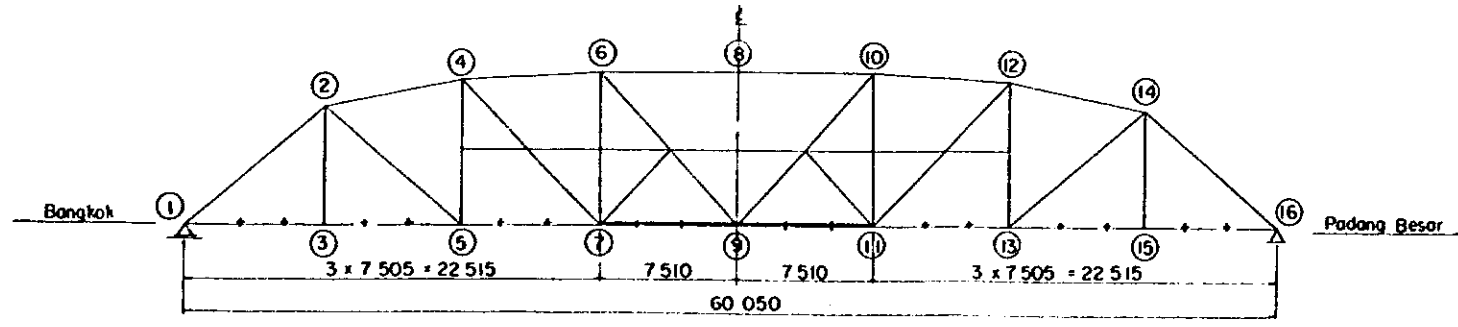


- Construction Method**
- 1) Drill new bolt and rivet holes.
  - 2) Cut off original rivets
  - 3) Clean surface between original and additional members.
  - 4) Add new plates, angles and tighten HT Bolts or riveting

**Note**  
 : Re-Use Existing holes.

- General Notes:**
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
  - 2) All high-strength bolts (HTB) are M22(Φ)(FIOT), and assumed frictional coefficient of contact surface( $f$ ) as follows  
 i) for connection  $f \geq 0.4$   
 ii) for stitch  $f \geq 0.3$
  - 3) All rivets are 22#(Φ), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent.
- \* All dimensions to be checked in the field

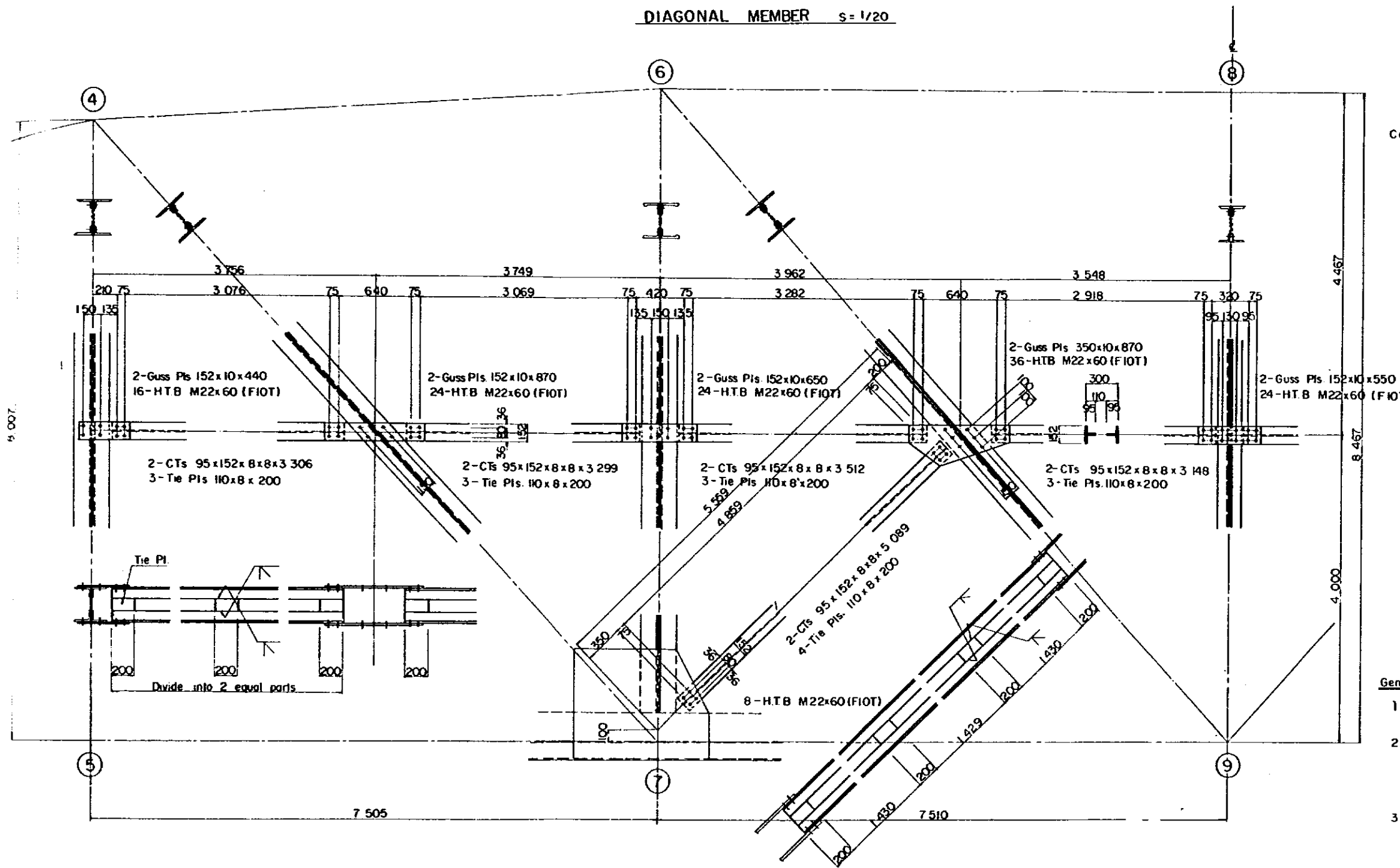
**MARKING DIAGRAMS**



THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 Loading Scale	
600 TT	MAIN TRUSS (NO.2)	Unit	1/20
K M	930 + 931	mm	
DISTRICT	Hal Yan	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	

**MAIN TRUSS (NO.3)**

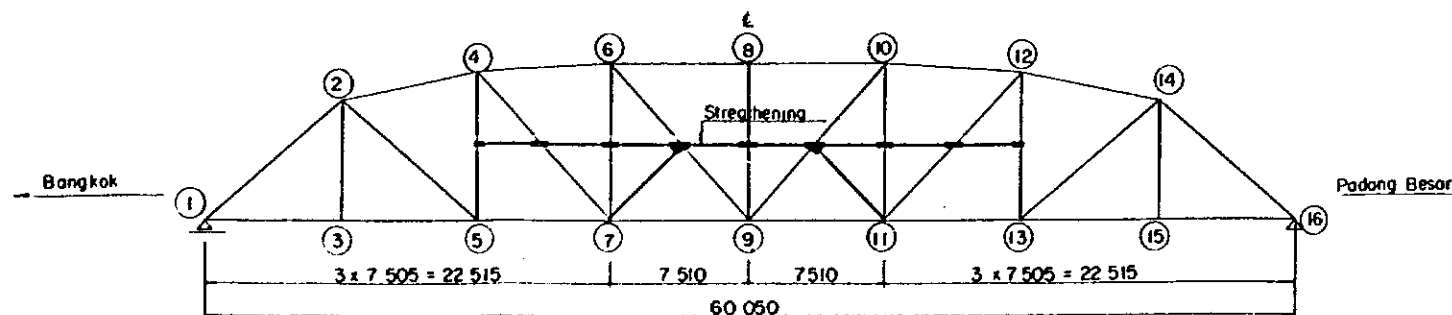
DIAGONAL MEMBER  $s = 1/20$



- Construction Method**
- 1) New members are built up by welding
  - 2) Clean surface between new gusset plates and original members
  - 3) Drill new bolt holes
  - 4) Attach new gusset plates
  - 5) Attach new members

- General Notes :**
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
  - 2) All high-strength bolts (HTB) are M22 (⦿) (FIOT), and assumed frictional coefficient of contact surface as follows.
    - i) for connection  $f \geq 0.4$
    - ii) for stitch  $f \geq 0.3$
  - 3) All dimension to be checked in the field

**MARKING DIAGRAMS**



THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members MAIN TRUSS (NO.3)	DL 15 loading	
600 T.T		Unit mm	Scale 1/20
K.M	930 + 931	Designed by	
DISTRICT	Hat Yai	Checked by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO	

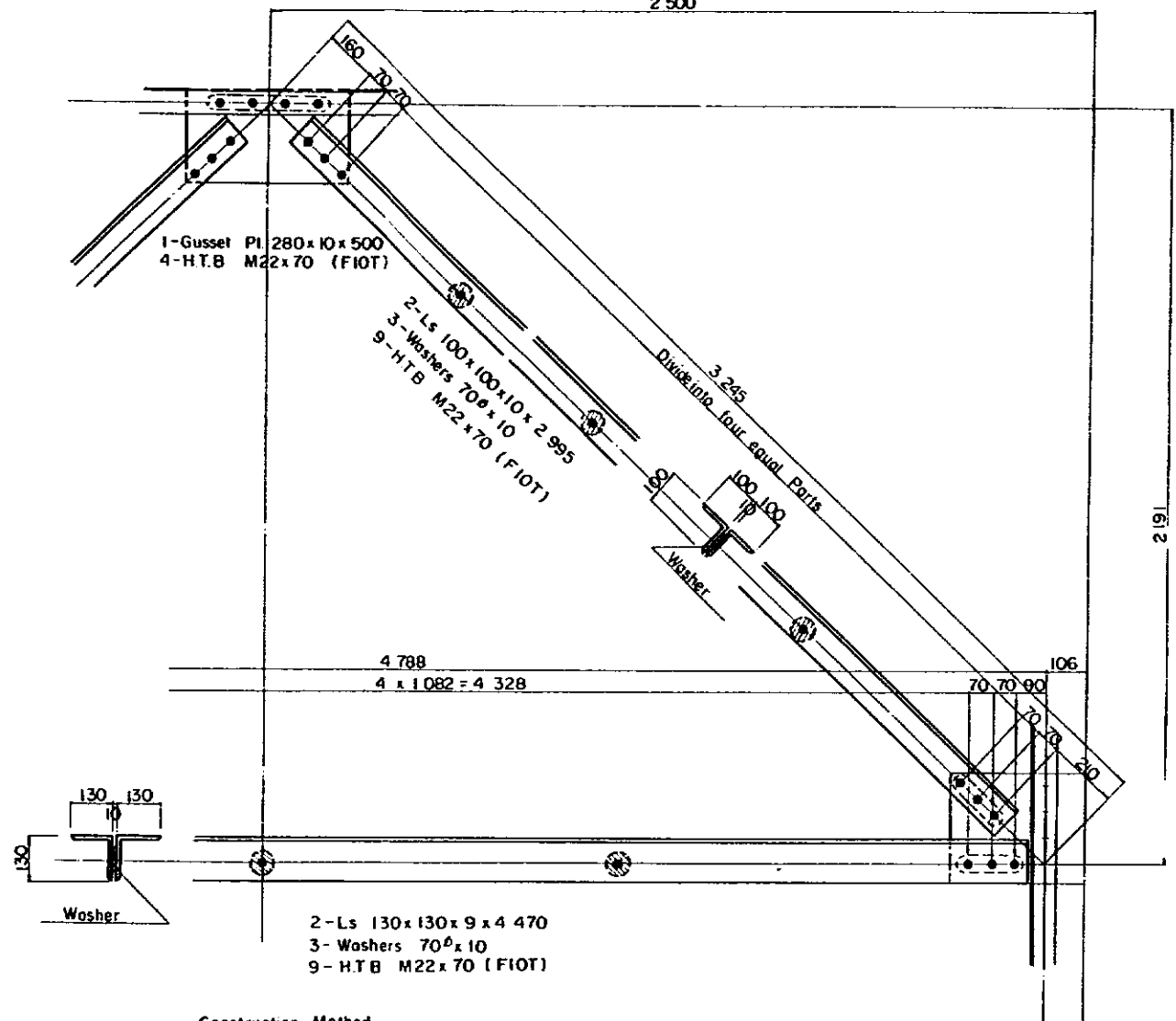
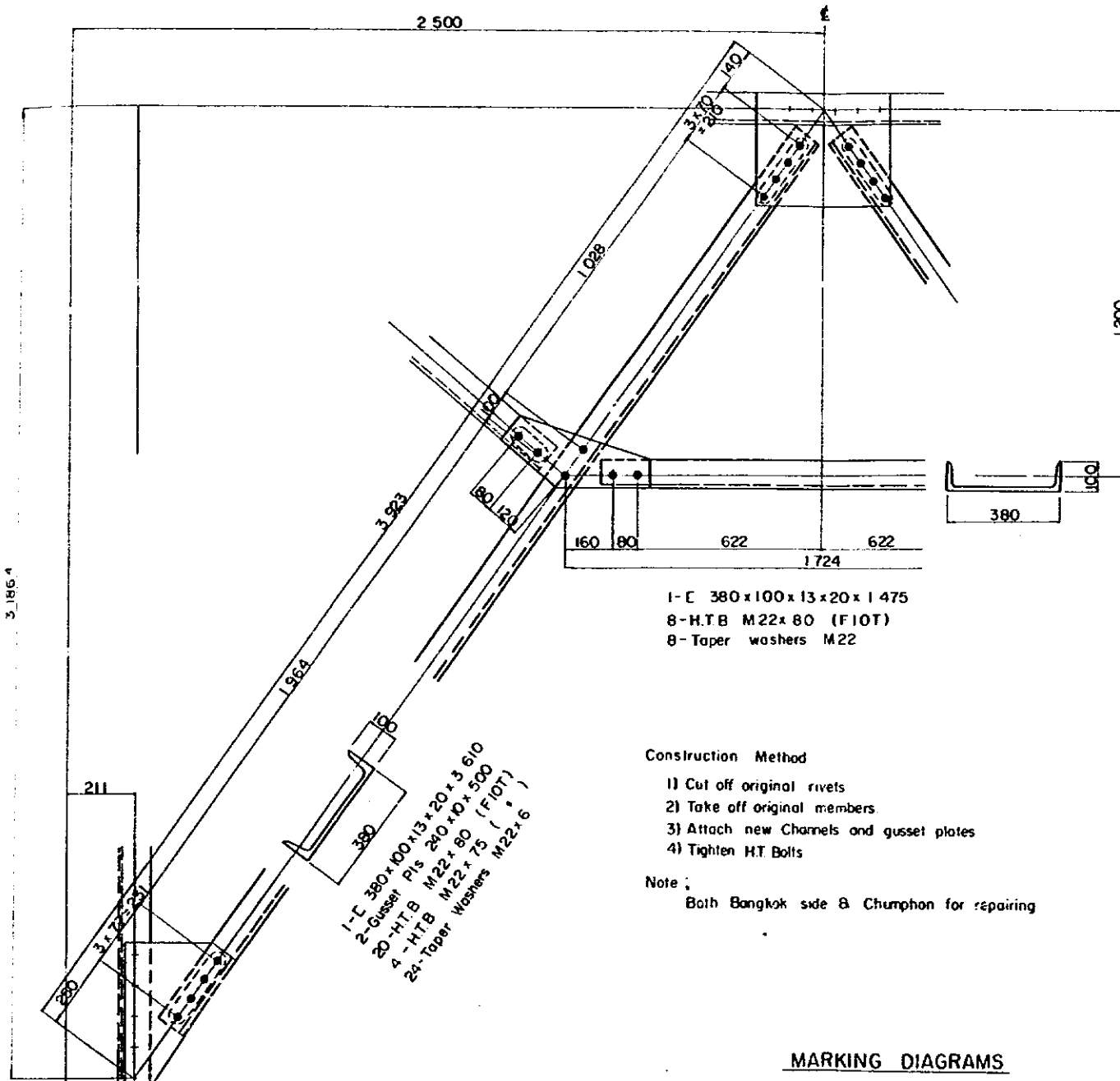
PORTAL BRACING  $s = 1/10$

MAIN TRUSS (NO.4)

SWAY BRACING  $s = 1/10$

① - ②

④ - ⑤ ⑥ - ⑦ ⑧ - ⑨



Construction Method

- 1) Cut off original rivets
- 2) Take off original members
- 3) Attach new Channels and gusset plates
- 4) Tighten HT Bolts

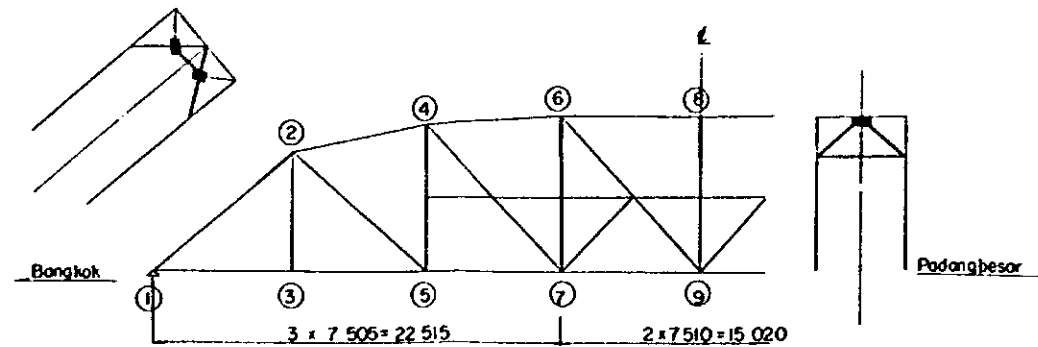
Note:

Both Bangkok side & Chumphon for repairing

Construction Method

- 1) Cut off original rivets.
- 2) Take off original member
- 3) Attach new angles and gusset plates.
- 4) Tighten HTBolts

MARKING DIAGRAMS



General Notes:

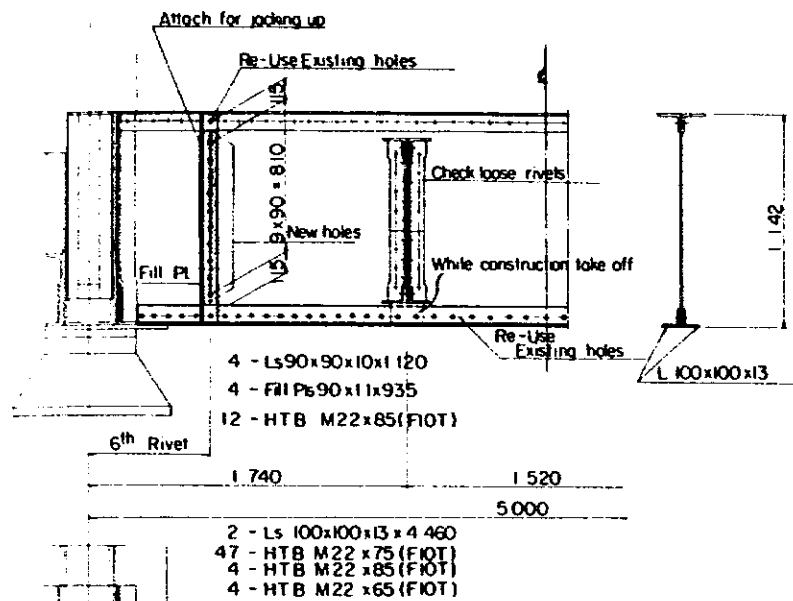
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent
- 2) All high-strength bolts (HTB) are M22 (F10T), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $\geq 0.4$
  - ii) for slitch  $\geq 0.3$
- 3) All dimensions to be checked in the field

THE STATE RAILWAY OF THAILAND				
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING				
Span Type	Members	MAIN TRUSS (NO.4)		DL 15 loading
6005 T.T				Scale
				Unit
				mm
				1/10
K M	930 + 931	Designed by		
DISTRICT	Hat Yai	Checked by		
LINE	Southern Line	Checked by		
Remarks		Checked by		
		Checked by		
		Checked by		
		Checked by		
DATE		DRAWING NO		

# FLOOR SYSTEM

## FLOOR BEAM S=1/20

E.F

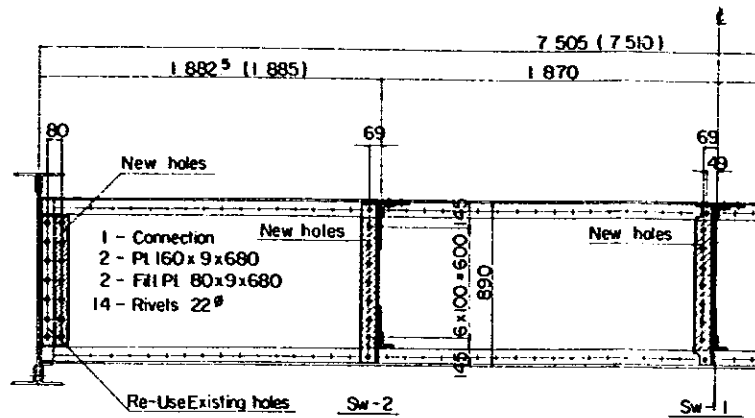


- 4 - Ls 90x90x10x1120
- 4 - Fill Pls 90x11x935
- 12 - HTB M22x85(FIOT)

- 2 - Ls 100x100x13 x 4 460
- 47 - HTB M22 x 75 (FIOT)
- 4 - HTB M22 x 85 (FIOT)
- 4 - HTB M22 x 65 (FIOT)

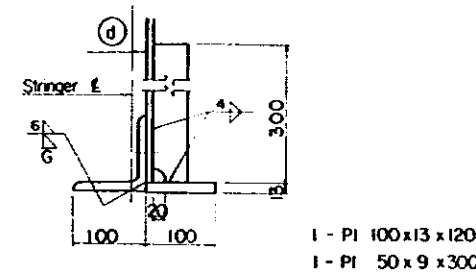
- Construction Method
- 1) Drill new bolt holes
  - 2) Cut off original rivets of lower flange angles
  - 3) Take off original members
  - 4) Clean surface between original surface and new flange
  - 5) Attach new angles, and tighten (Lower and jack) HT Bolts

## STRINGER S=1/20



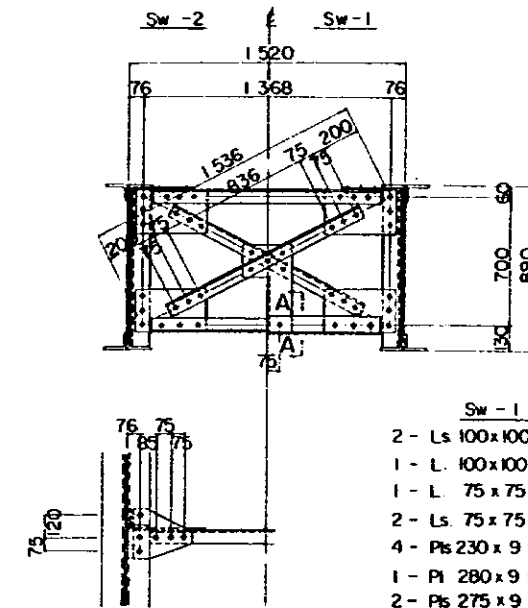
- Construction Method
- 1) Drill new bolt holes
  - 2) Cut off original rivets
  - 3) Attach new splice plates and new angles by riveting
  - 4) Strengthen sway bracings of stringer

### DETAIL A-A S=1/5



- 1 - Pl 100x13x120
- 1 - Pl 50x9x300

## SWAY BRACING OF STRINGER

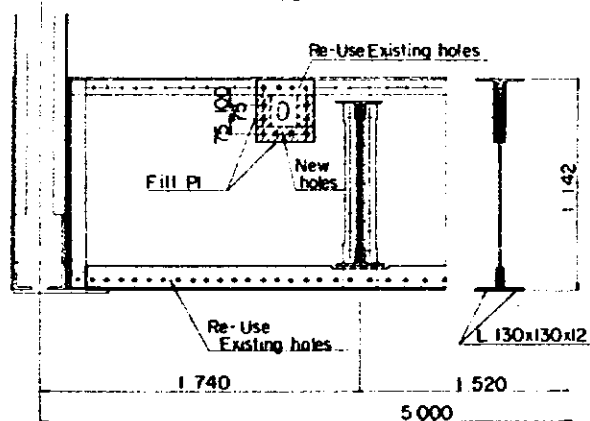


- | Sw-1                    | Sw-2                    |
|-------------------------|-------------------------|
| 2 - Ls 100x100x10x856   | 2 - Ls 100x100x10x856   |
| 1 - L 100x100x10x1268   | 2 - Ls 75x75x9x1268     |
| 1 - L 75x75x9x1268      | 4 - Pls 230x9x400       |
| 2 - Ls 75x75x9x1206     | 1 - Pl 180x9x280        |
| 4 - Pls 230x9x400       | 2 - Pls 275x9x315       |
| 1 - Pl 280x9x470        | 2 - Fill Pls 100x11x680 |
| 2 - Pls 275x9x315       |                         |
| 2 - Fill Pls 100x11x680 |                         |

### General Notes:

- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (Φ) (FIOT), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22# (Φ), and to be rolled steel for SV34 (JIS G3104) or materials of equivalent
- 4) All dimensions to be checked in the field

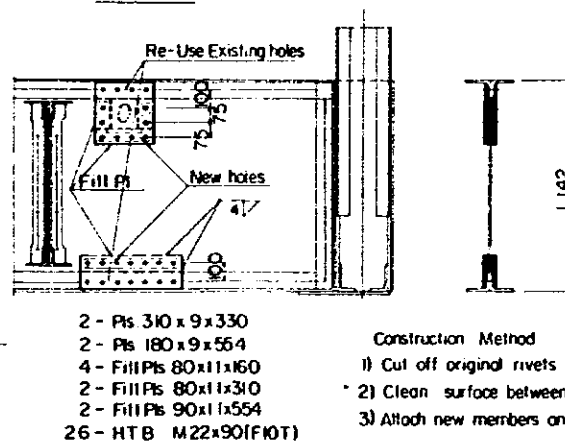
## IF-1



- 2 - Ls 130x130x12 x 4 477
- 49 - HTB M22 x 75 (FIOT)
- 4 - HTB M22 x 85 (FIOT)
- 4 - HTB M22 x 65 (FIOT)
- 2 - Pls 310x9x330
- 4 - Fill Pls 80x11x160
- 2 - Fill Pls 80x11x310
- 12 - HTB M22x90 (FIOT)

- Construction Method
- 1) Cut off original rivets
  - 2) Take off original members
  - 3) Clean surface between original and additional members
  - 4) Attach new angles
  - 5) Tighten HT Bolts

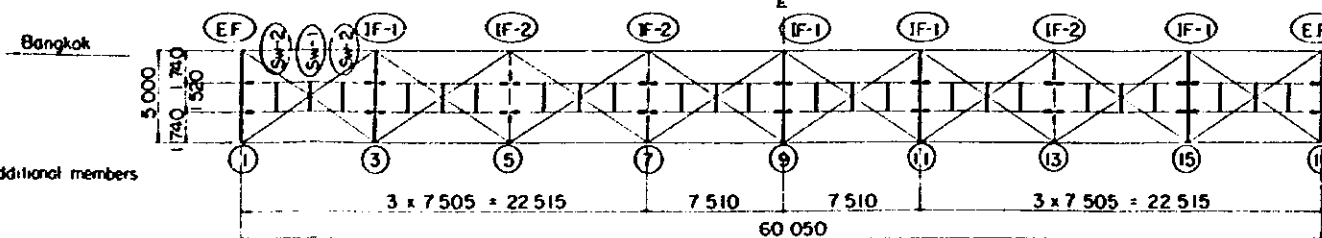
## IF-2



- 2 - Pls 310x9x330
- 2 - Pls 180x9x564
- 4 - Fill Pls 80x11x160
- 2 - Fill Pls 80x11x310
- 2 - Fill Pls 90x11x554
- 26 - HTB M22x90(FIOT)

- Construction Method
- 1) Cut off original rivets
  - 2) Clean surface between original and additional plates
  - 3) Attach new members and tighten HT Bolts

### MARKING DIAGRAMS



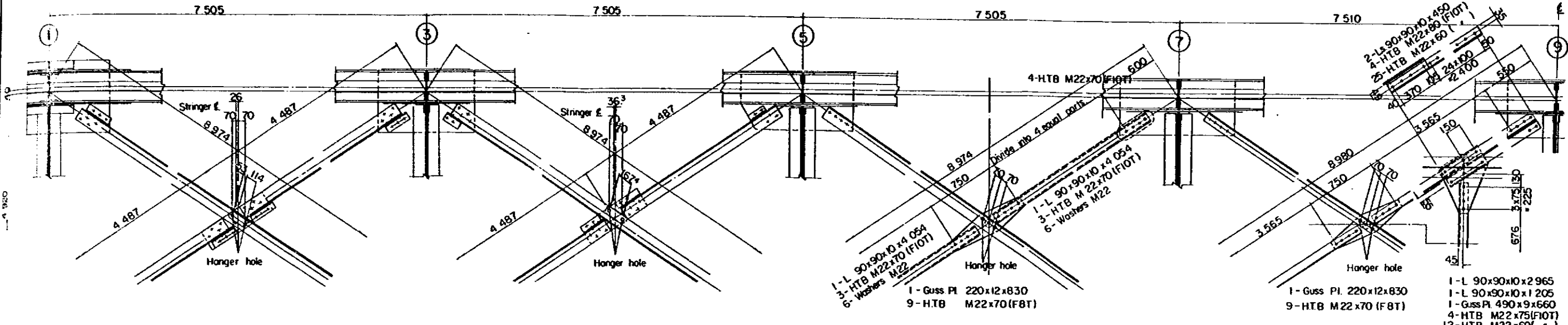
	①-③	③-⑤	⑤-⑦	⑦-⑨
①	83.7	83.7	70	70
②	70.0	70.0	58.5	58.5
③	45.9	45.9	38.4	38.4
④	26.0	36.3	—	—

Note - Strengthening of connection.

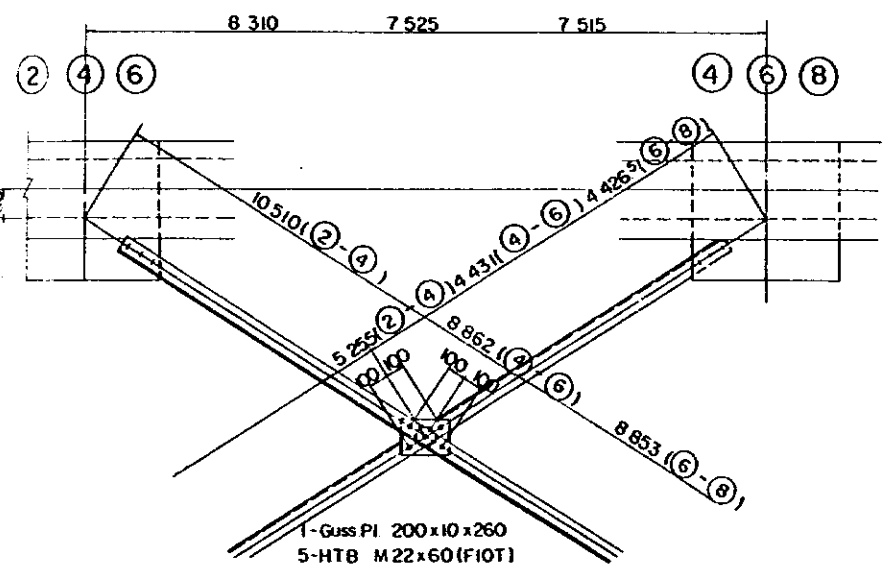
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	FLOOR SYSTEM	D.L. 15 Loading
60 T T			Unit Scale
			mm 1/20, 1/5
K M	930 + 931	Designed by	_____
DISTRICT	Hoi Yai	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

LATERAL BRACING s=1/20

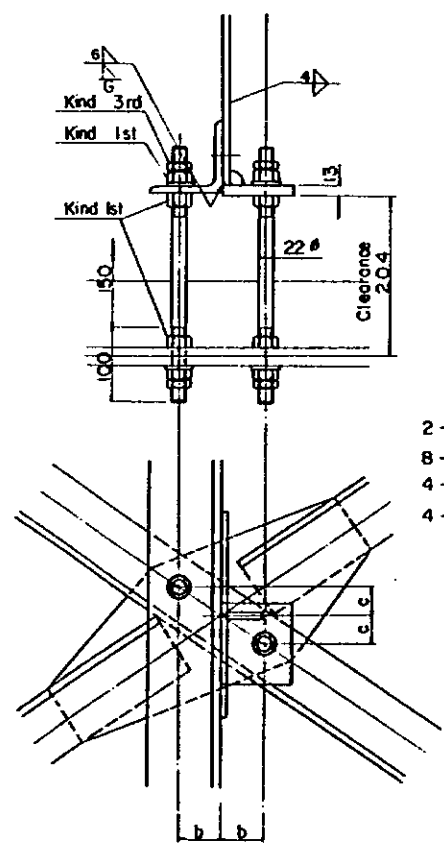
LOWER LATERAL



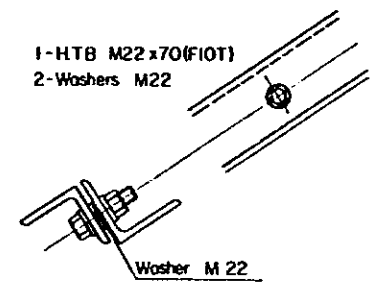
UPPER LATERAL



HANGER s=1/5



DETAIL "A" s=1/5



- 2 - Round Bars 22 $\phi$  x 350
- 8 - Nuts (1st) M 22
- 4 - Nuts (3rd) M 22
- 4 - Washers M 22

General Notes:

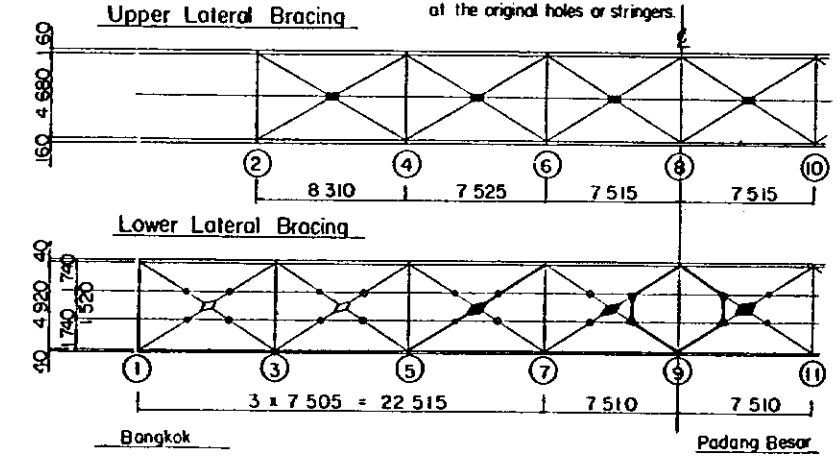
- 1) All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22 (F10T), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All rivets are 22 $\phi$  (F), and to be rolled steel for SV 34 (JIS G3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.

Note: Re-use existing holes.

MARKING DIAGRAMS

Note:

- New gusset plate of upper lateral.
- New hangers.
- Strengthening of gusset plates & new hangers.
- Take off original hanger and replace HTB bolts or rivets at the original holes or stringers.

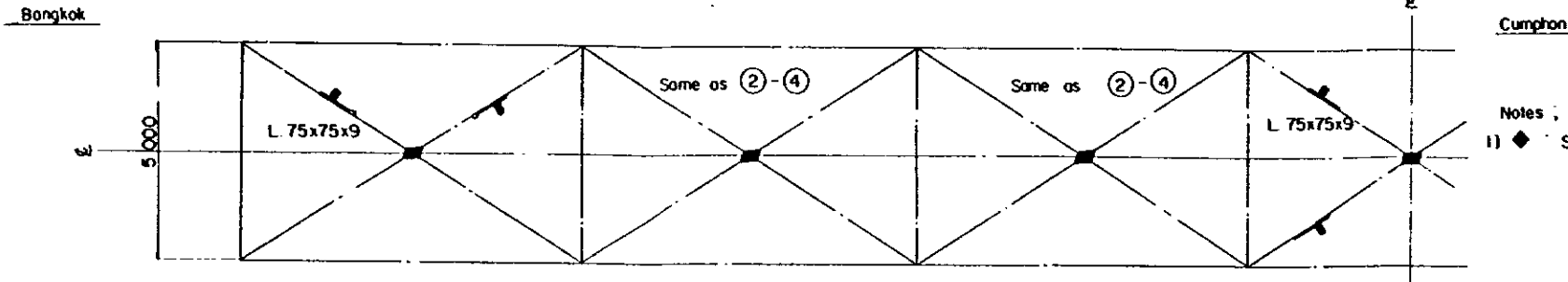


THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
6005 T.T	LATERAL BRACING	Unit	Scale
K.M	930 + 931	mm	1/20, 1/5
DISTRICT	Hat Yai	Designed by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	



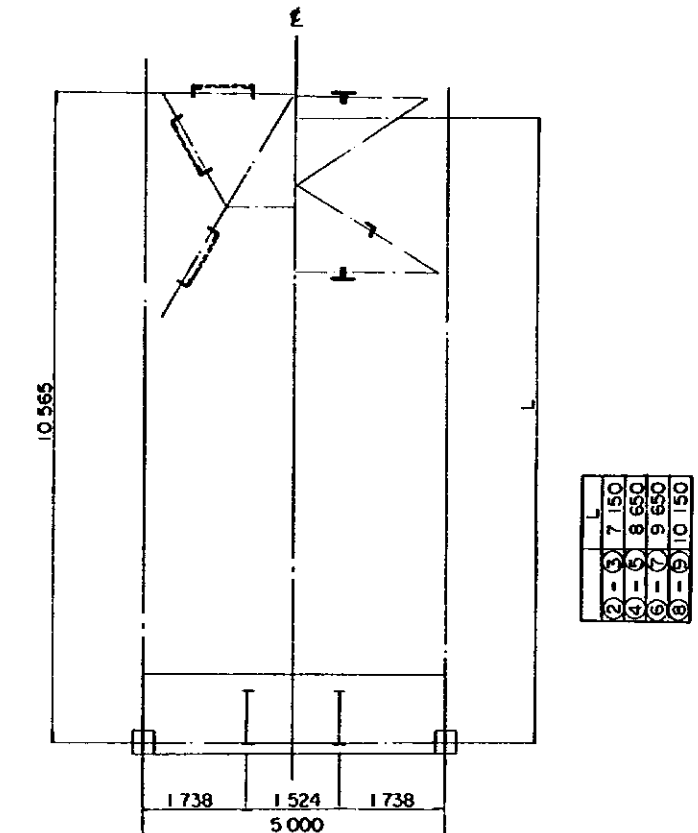
# GENERAL DIAGRAM

## UPPER LATERAL



## PORTAL BRACING

## SWAY BRACING

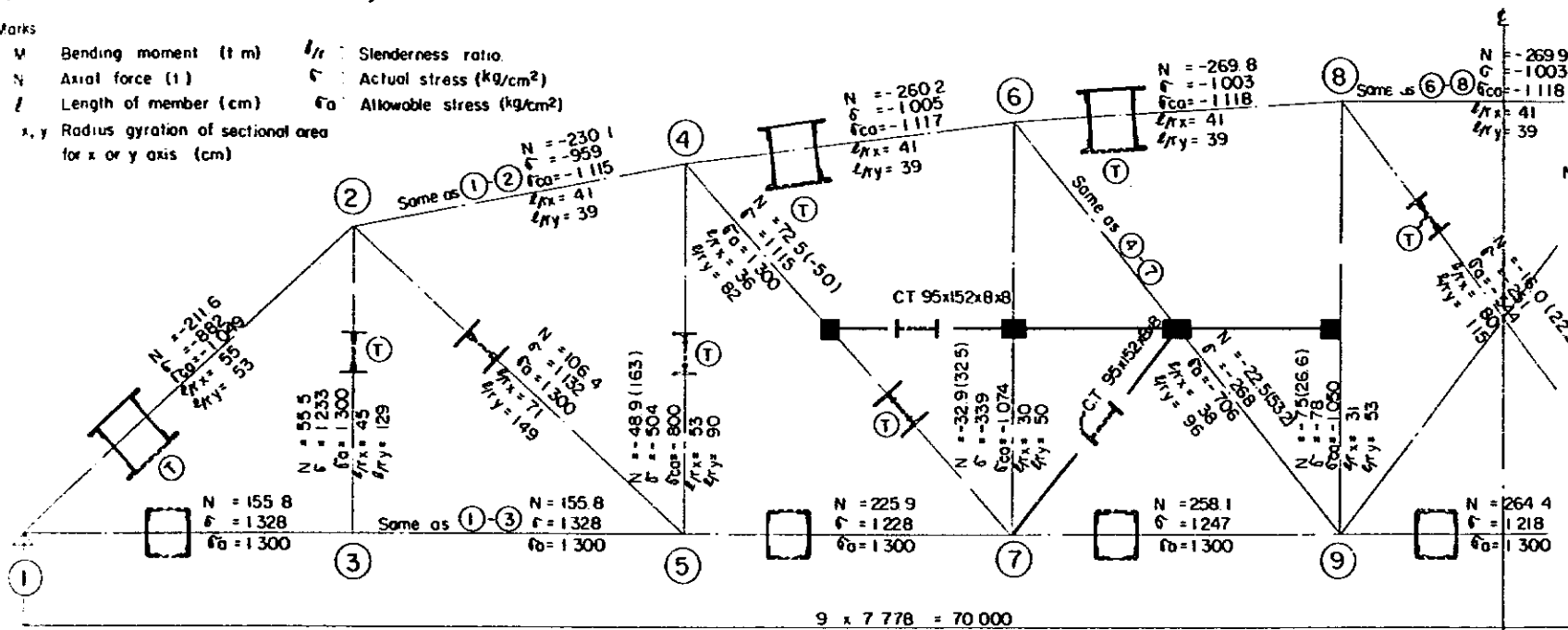


### General Notes:

- 1) Weak drawings show the original members. Deep drawings show the members to be improved.
- 2) Actual stresses are based on DL-15 loading.
- 3) Marks

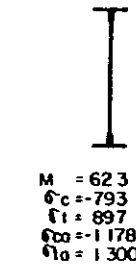
- M Bending moment (t m)
- N Axial force (t)
- L Length of member (cm)
- x, y Radius gyration of sectional area for x or y axis (cm)
- $l/r$  Slenderness ratio
- $\sigma$  Actual stress (kg/cm<sup>2</sup>)
- $\sigma_a$  Allowable stress (kg/cm<sup>2</sup>)

## MAIN TRUSS

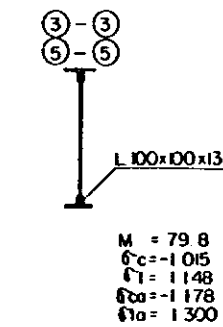


- Notes:
- 1) (T) Strengthen Tie Plate
  - 2) (■) Attach Guss Plate.

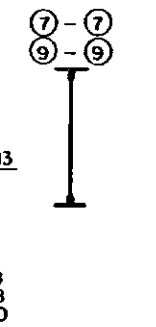
## END FLOOR



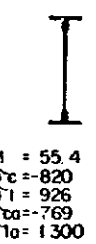
## INT. FLOOR



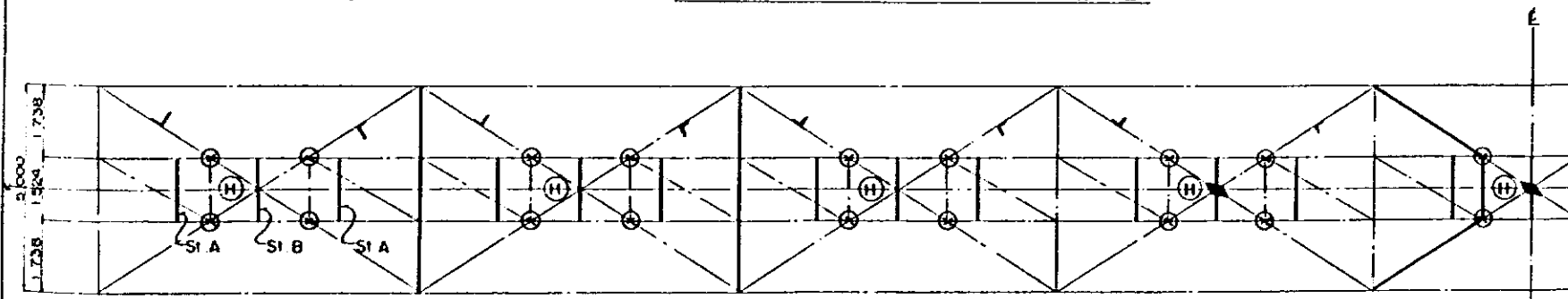
## INT. FLOOR



## STRINGER



## FLOOR SYSTEM & LOWER LATERAL

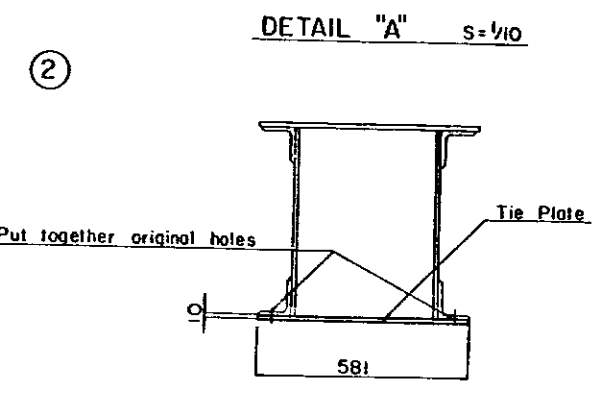
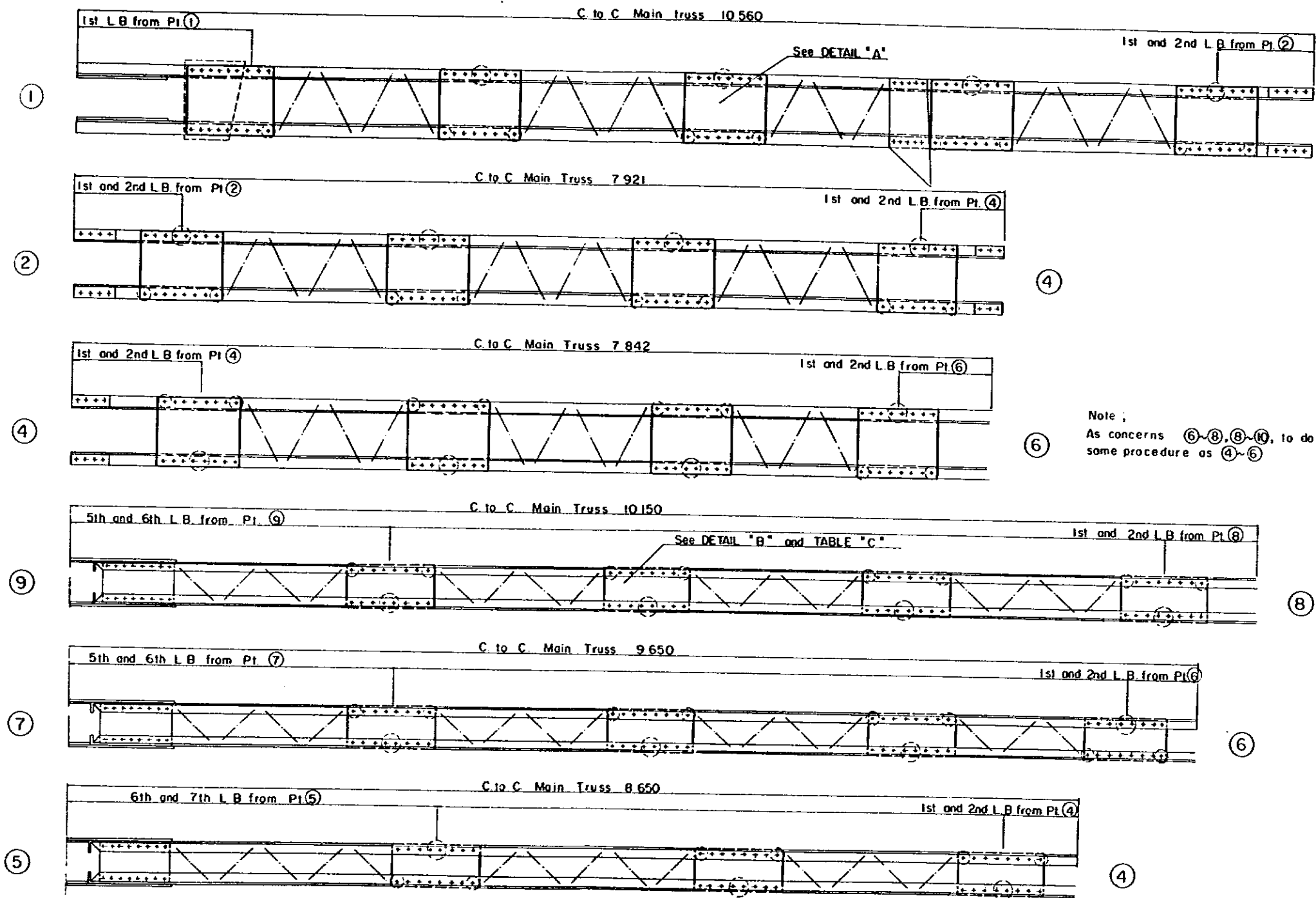


### Legends:

- 1) (◆) Gussel plates to be improved.
- 2) (H) Hanger to be added.
- 3) (⊖) Defective hanger to be removed.
- 4) St A, St B; New struts to be added.

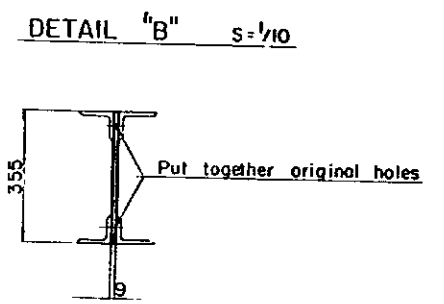
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	GENERAL DIAGRAM	DL-15 loading
700 T			Limit Scale
K.M	297 + 063		
DISTRICT	Yala	Designed by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO	

MAIN TRUSS (NO. 1) S=1/20



2 - Tie Pls 581 x 10 x 728  
 36 - Tie Pls 581 x 10 x 690  
 594 - H.T. Bolts M22 x 65 (FIOT)

Note ;  
 As concerns (6)-(8), (8)-(10), to do the same procedure as (4)-(6)



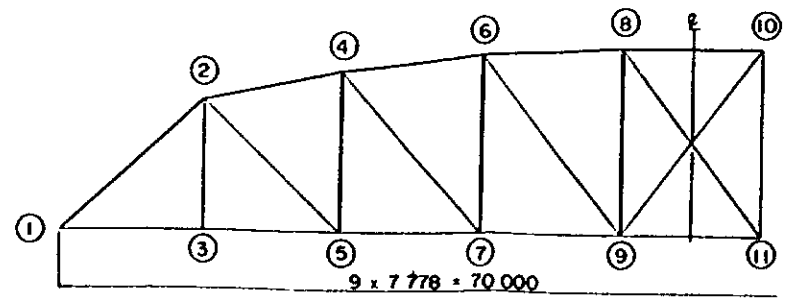
1 - Tie Pl 355 x 9 x l  
 16 - HT Bolts M22 x 70 (FIOT)

TABLE "C"

Pl	(9)~(8)	(7)~(6)	(5)~(4)
l	728	734	740
Number	4	4	3

Note : (○) Re-Use existing holes

MARKING DIAGRAMS

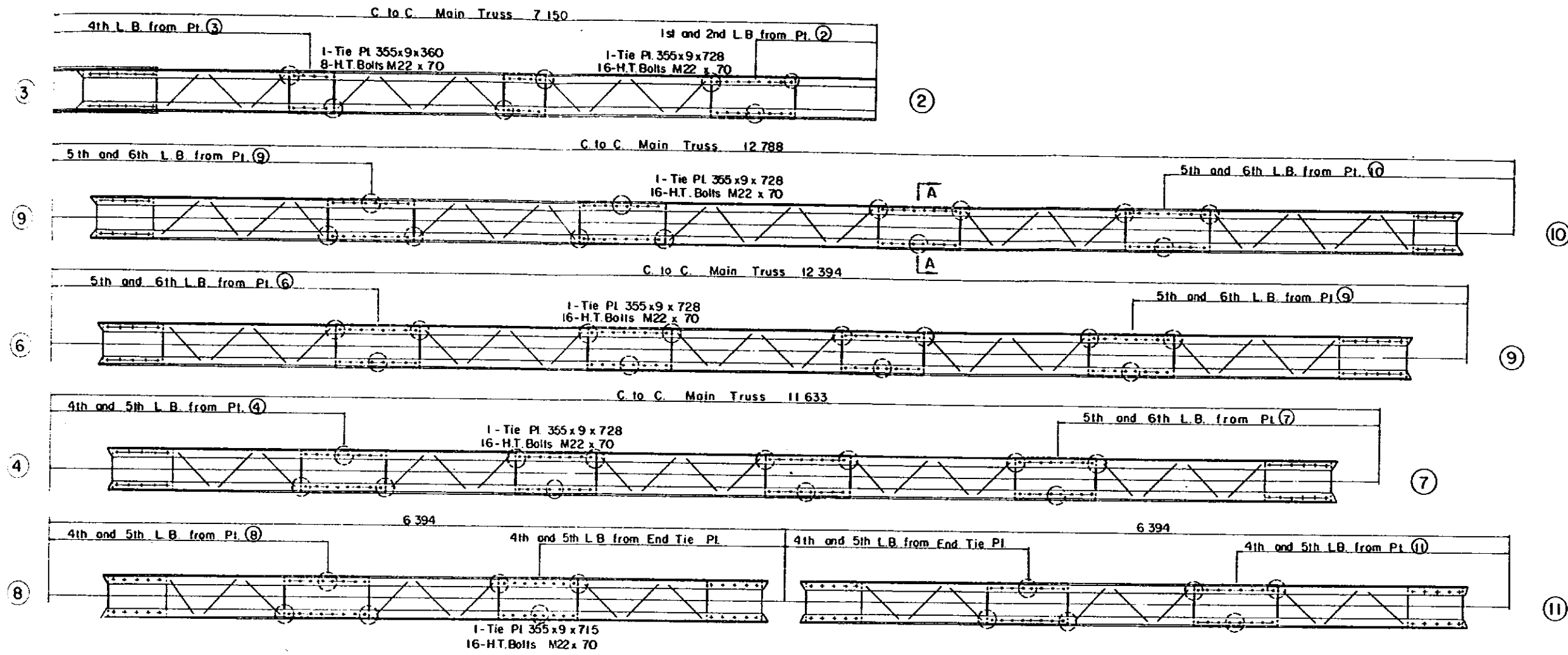


General Notes ;

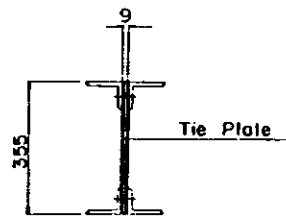
- All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- All high strength bolts (HTB) are M22 (•) (FIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for slitch  $f \geq 0.3$
- All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL. 15 loading	
70.0 T.T	MAIN TRUSS (NO. 1)	Unit	Scale
K.M	297 + 063	mm	1/20, 1/10
DISTRICT	Hua Hin	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	

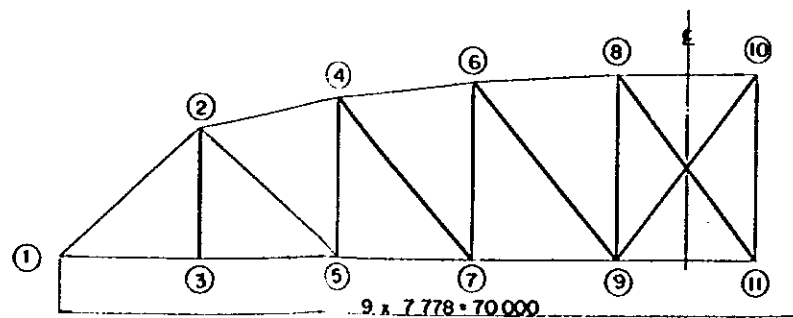
MAIN TRUSS (NO. 2) s=1/20



SECTION A - A s=1/10



MARKING DIAGRAMS



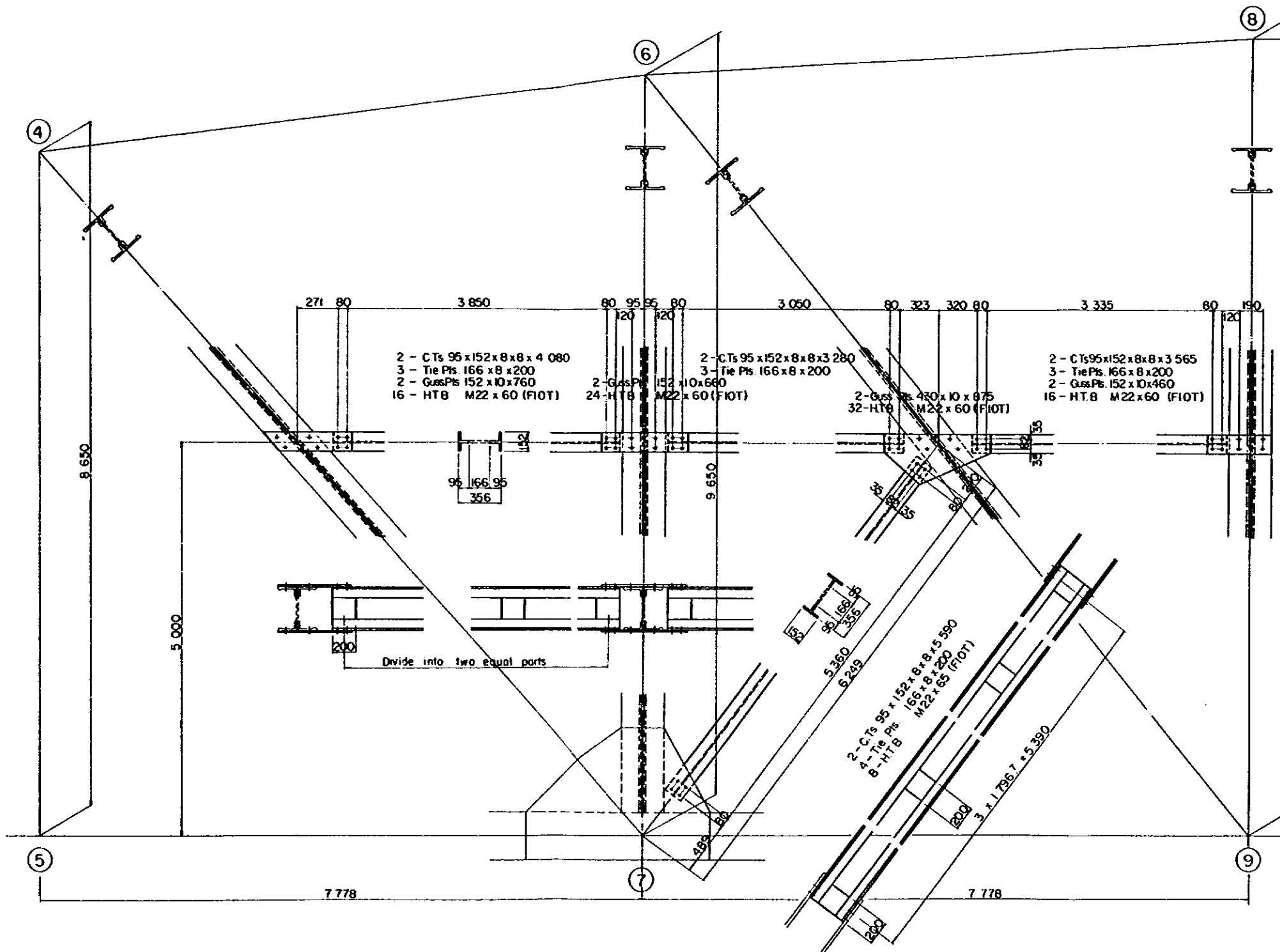
General Notes:

- 1) All materials are to be JIS G 301 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (H.T.B.) are M22 (φ J (F10T)), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for slitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

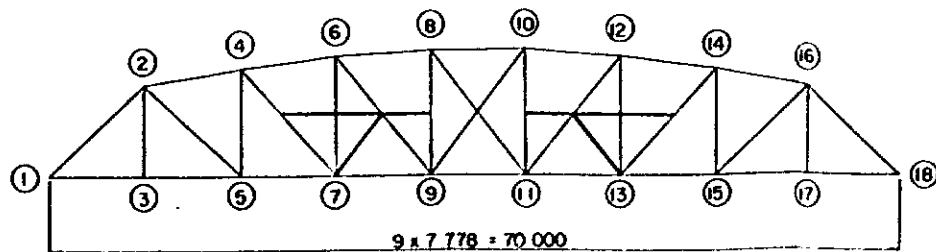
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	MAIN TRUSS (NO. 2)	
700 T.T		DL 15 loading	Unit Scale
K M	297+063	mm	1/20, 1/10
DISTRICT	Hua Hin	Designed by	
LINE	Southern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

MAIN TRUSS (NO. 3)

DIAGONAL MEMBER  $s=1/30, 1/20$



MARKING DIAGRAMS



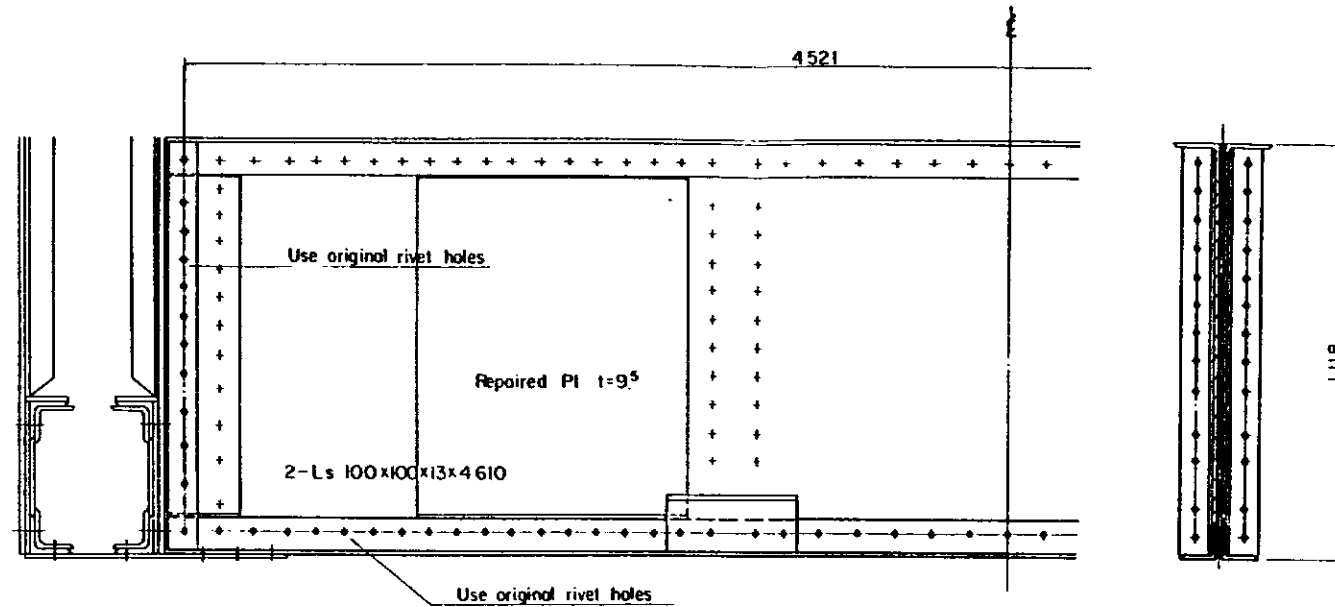
General Notes :

- 1) All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (H.T.B.) are M22 (φ) (FIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

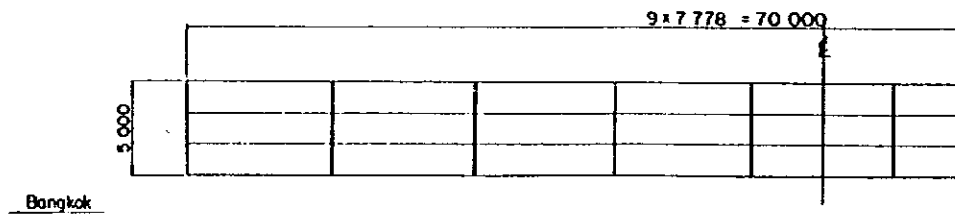
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
70.0 T.T	MAIN TRUSS (NO. 3)	Unit	Scale
K M	297+063	mm	1/30, 1/20
DISTRICT	Hua Hin	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	

REPAIRING OF FLOOR BEAM S=1/10

REPAIRING LOWER FLANGE



MARKING DIAGRAMS



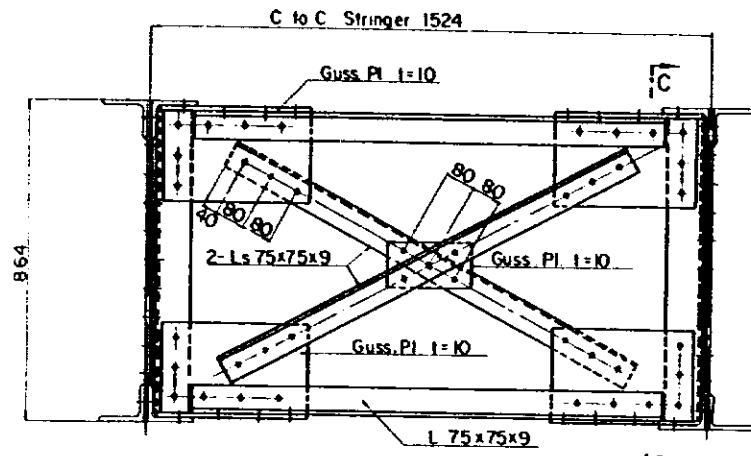
General Notes:

- 1) All materials are to be JIS G3101 SS-41 rolled steel for general structure or materials of equivalent
- 2) All high-strength bolts (HTB) are M22(-Φ)-(FIOT), and assumed frictional coefficient of contact surface as follows
  - i) for connection  $f \geq 0.4$
  - ii) for slitch  $f \geq 0.3$
- 2) All rivets are 22<sup>P</sup> (-Φ), and to be rolled steel for SV 34 (JIS G3104) or materials of equivalent.
- 3) All dimensions to be checked in the field

THE STATE RAILWAY OF THAILAND					
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING					
Span Type	Members	REPAIRING OF FLOOR BEAM		DL 15 loading	
		Unit	Scale	Unit	Scale
700 T.T		mm	1/10		
K.M.	297 + 063	Designed by			
DISTRICT	Hua Hin	Checked by			
LINE	Southern Line	Checked by			
Remarks		Checked by			
		Checked by			
		Checked by			
		Checked by			
DATE		DRAWING NO.			

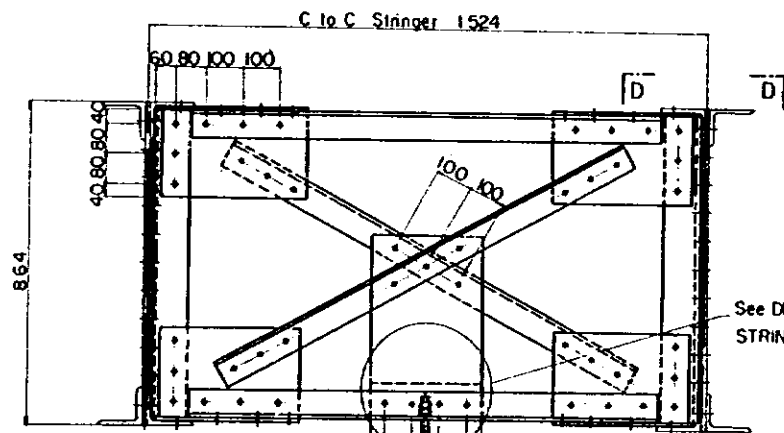
STRENGTHENING OF SWAY BRACING OF STRINGERS s=1/10

SECTION A



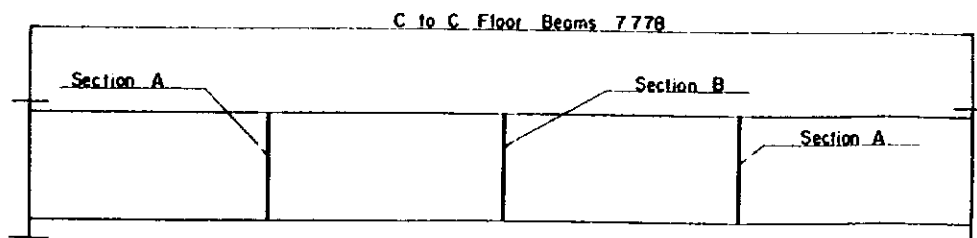
- 4- Guss Pls 240x10x370
- 4- Guss Pls 280x10x380
- 1- Guss Pl 240x10x120
- 2- Ls 100x100x10x840
- 2- Ls 75x75x9x1270
- 2- Ls 75x75x9x1290
- 2- Fill Pls 100x11x650
- 40- HT Bolts M22x60
- 24- HT Bolts M22x65
- 18- HT Bolts M22x75
- 4- Rivets 22# x80
- 1- HT Bolts M22x70

SECTION B



- 4- Guss Pls 240x10x370
- 4- Guss Pls 280x10x380
- 1- Guss Pl. 305x10x500
- 2- Ls 100x100x10x840
- 2- Ls 75x75x9x1270
- 2- Ls 75x75x9x1290
- 2- Fill Pls 100x11x650
- 40- HT Bolts M22x60
- 24- HT Bolts M22x65
- 5- HT Bolts M22x70
- 18- HT Bolts M22x75
- 4- Rivets 22#

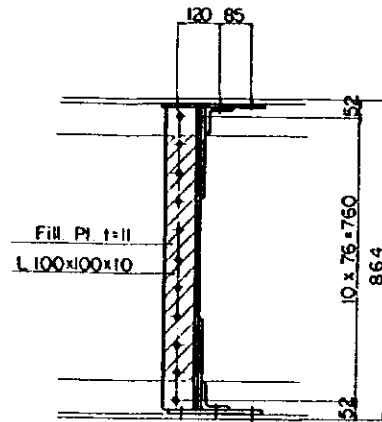
MARKING DIAGRAMS



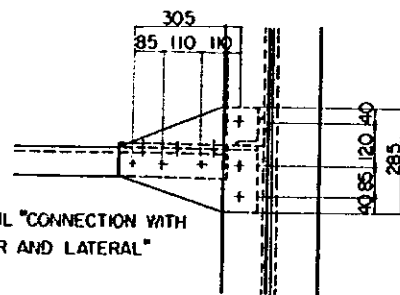
Notes:

Struts down by Section A are set up at the point which divide into 4.  
Struts down by Section B is set up at the point which is settled by Hanger A.

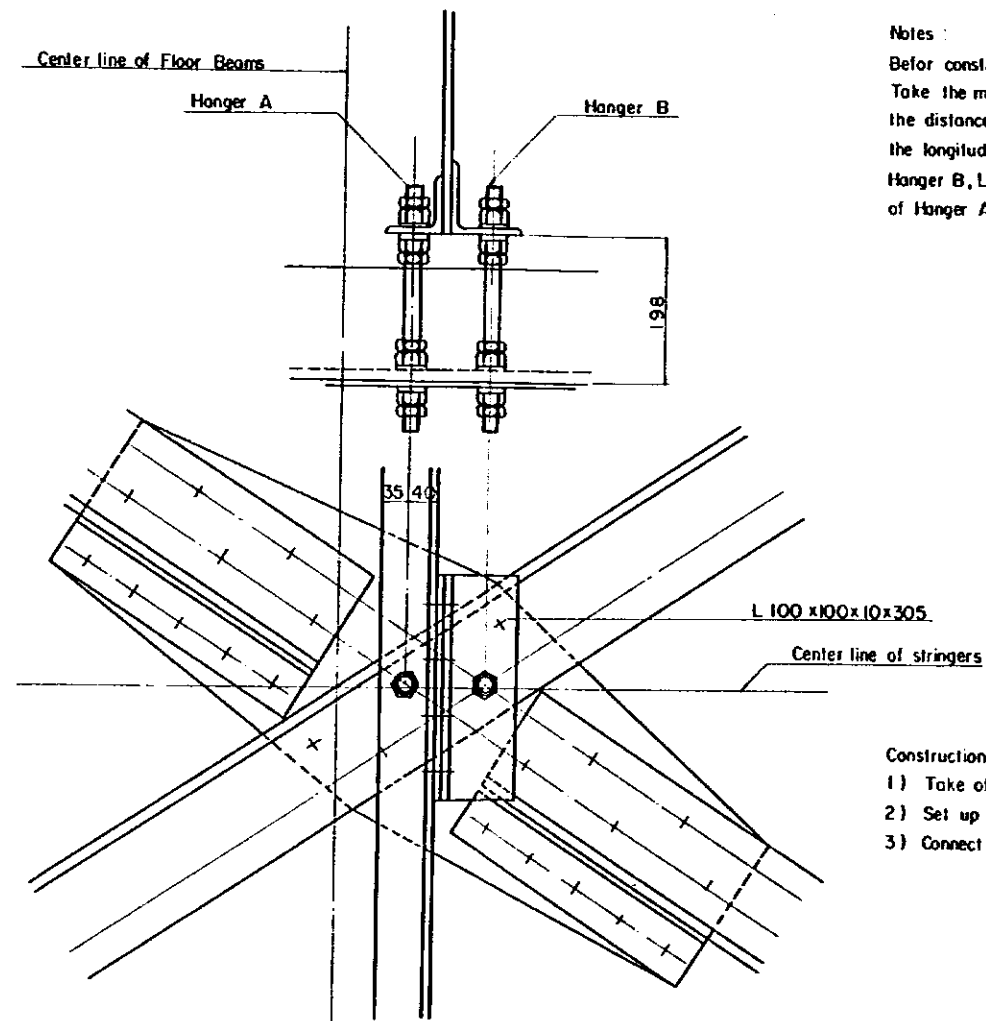
SECTION C - C



SECTION D - D



DETAIL "CONNECTION WITH STRINGER & LATERAL" s=1/5



Notes:

Before construction, we need certain values.  
Take the measure of three kind values, such as, the distance of Floor Beam from Hanger A, L<sub>A</sub>, the longitudinal distance of Hanger A from Hanger B, L<sub>x</sub>, and the transversal distance of Hanger A from Hanger B, L<sub>y</sub>.

Construction Method:

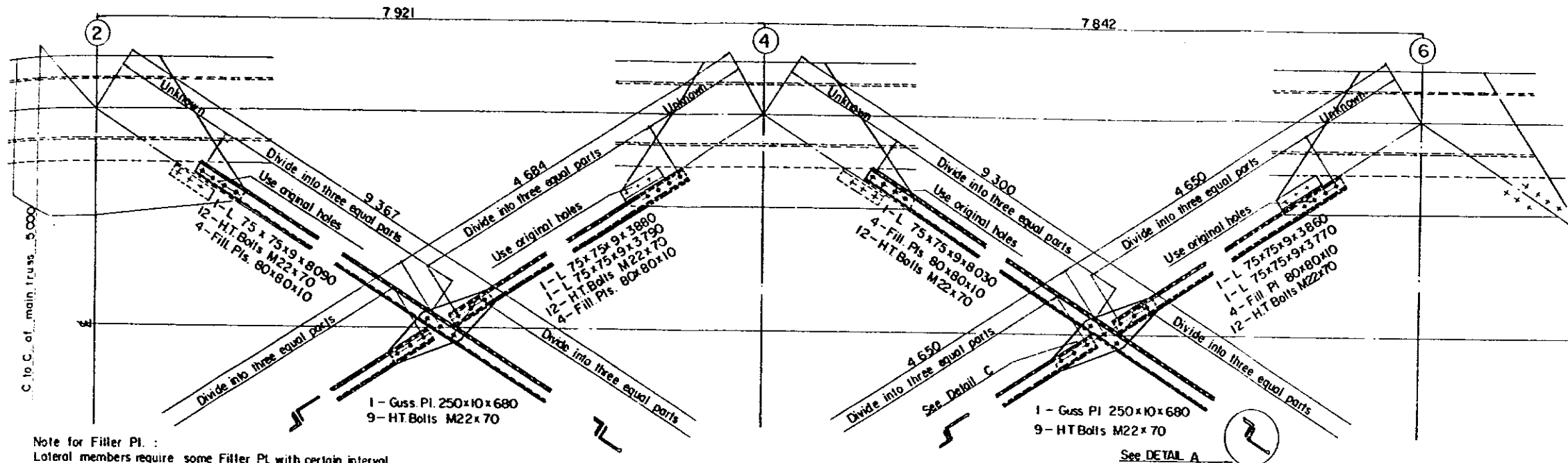
- 1) Take off Stringer Bracing.
- 2) Set up new Strut Bracing at settled place.
- 3) Connect with Strut Bracing and Lower Lateral.

General Notes:

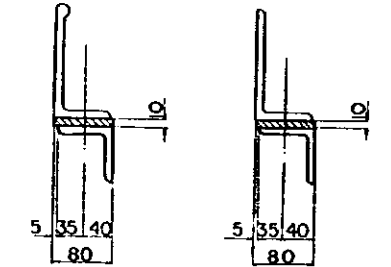
- 1) All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (H.T.B.) are M22(φ)(F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection f=0.4
  - ii) for stitch f=0.3
- 3) All rivets are 22# (φ), and to be rolled steel SV34 (JIS G 3104) or materials of equivalent.
- 4) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND				
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING				
Span Type	Members	STRENGTHENING OF SWAY BRACING OF STRINGER	D.L. 15 loading	
700 T.T			Unit	Scale
K.M.	297 + 063		mm	1/50
DISTRICT	Hua Hin	Designed by		
LINE	Southern Line	Checked by		
Remarks		Checked by		
		Checked by		
		Checked by		
		Checked by		
DATE		DRAWING NO.		

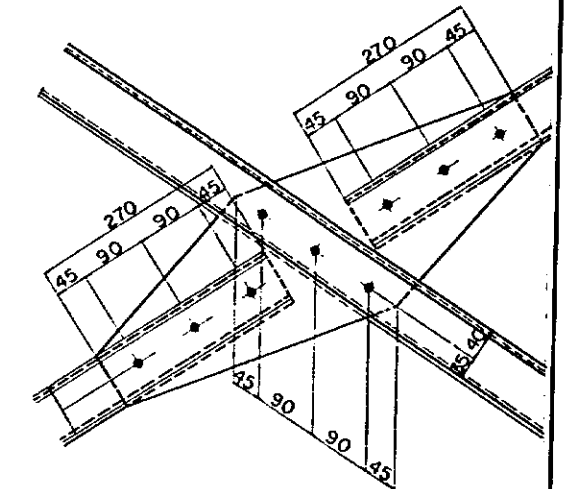
STRENGTHENING OF UPPER LATERAL s=1/30



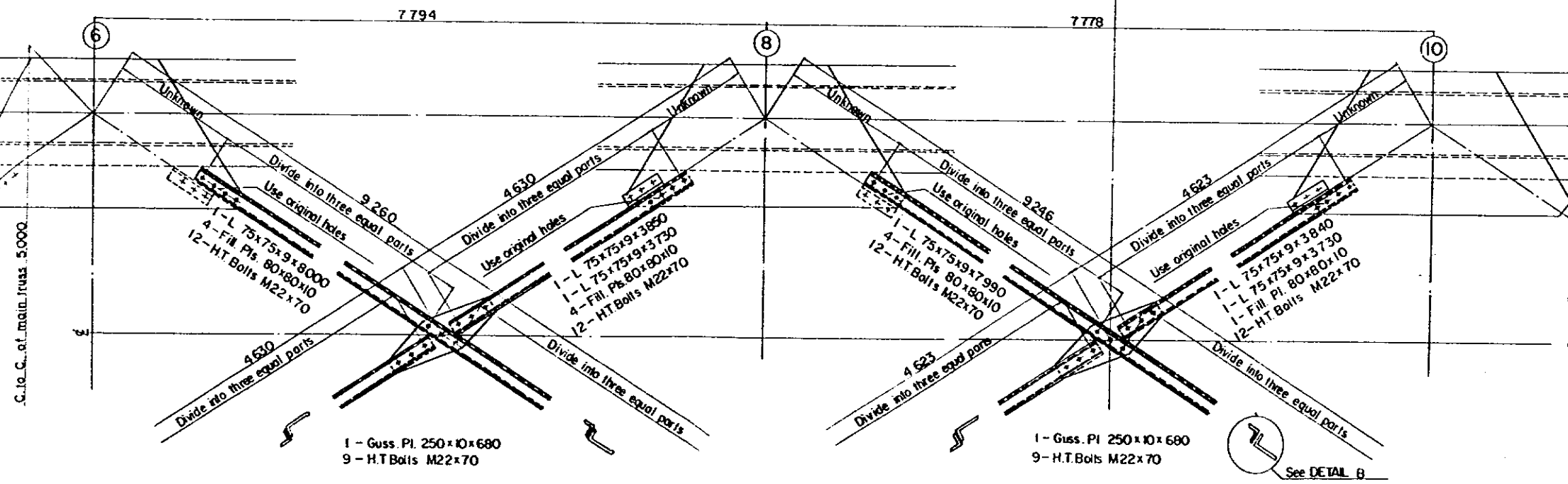
DETAIL A s=1/5      DETAIL B s=1/5



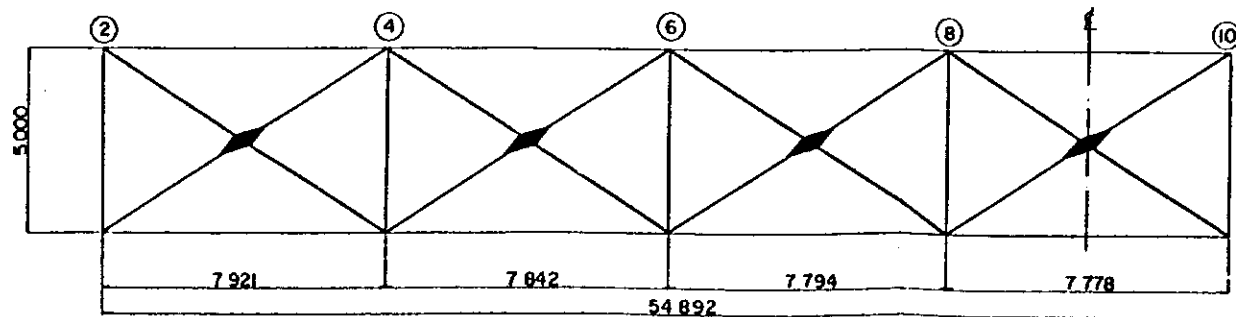
DETAIL C s=1/5



Notes:  
Since the center lines of upper lateral are not shown in the Field Drawing. We suggest to unify that the line are drawn along the edge of original member in this case.



MARKING DIAGRAMS



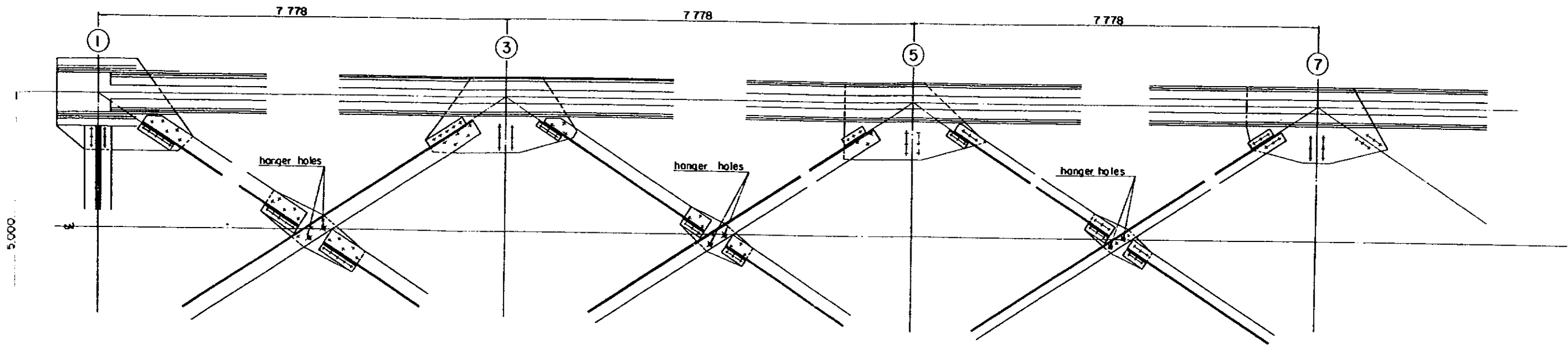
General Notes:

- All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- All high-strength bolts (H.T.B) are M22 (φ) (F10T), and assumed frictional coefficient of contact surface as follows:
  - for connection  $f \geq 0.4$
  - for stitch  $f \geq 0.3$
- All dimensions to be checked in the field

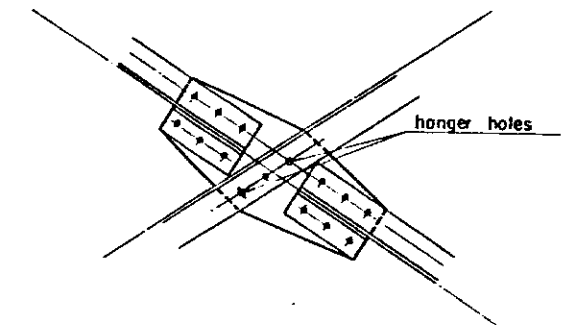
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	STRENGTHENING OF UPPER LATERAL	
700 T T		DL 15 loading	Unit Scale
K.M.	297 + 063	mm	1/30, 1/5
DISTRICT	Hua Hin	Designed by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	_____

# STRENGTHENING OF LOWER LATERAL

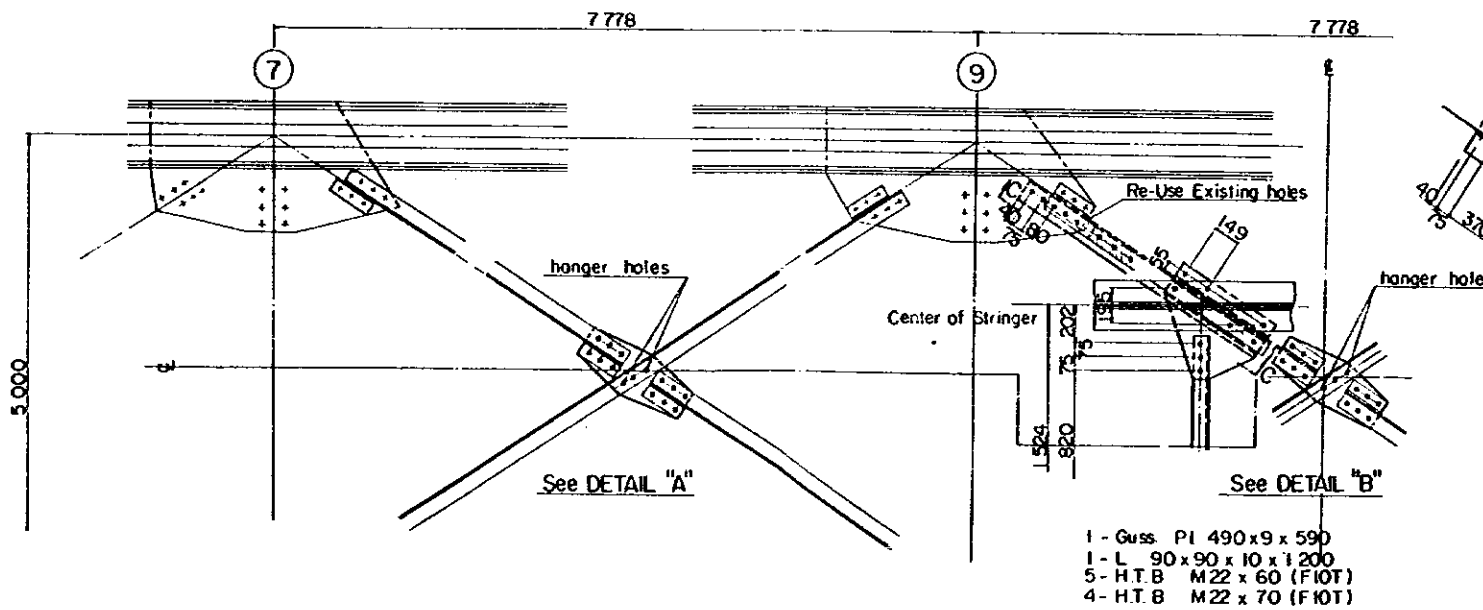
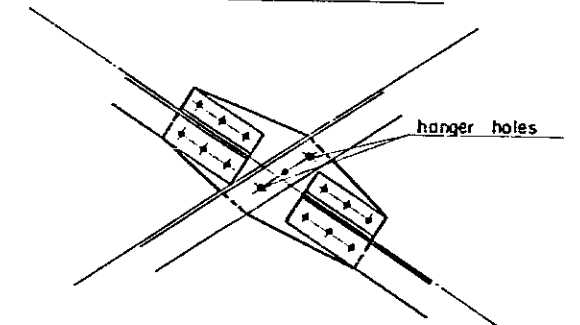
SKELTON s=1/40      DETAIL s=1/20



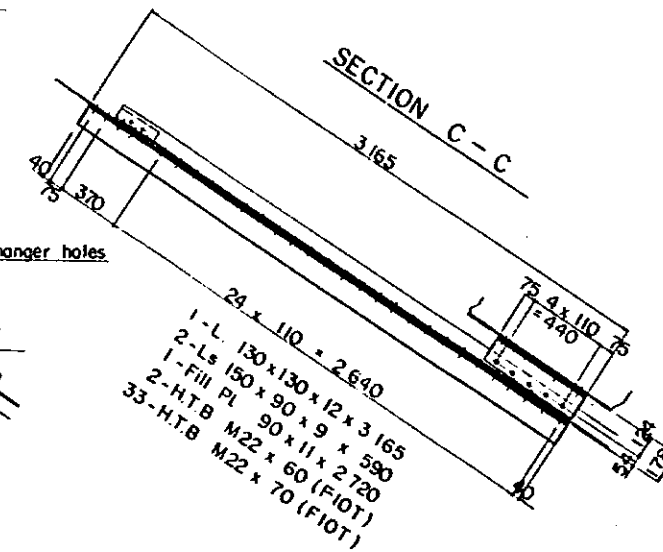
DETAIL "A" s=1/10



DETAIL "B" s=1/10

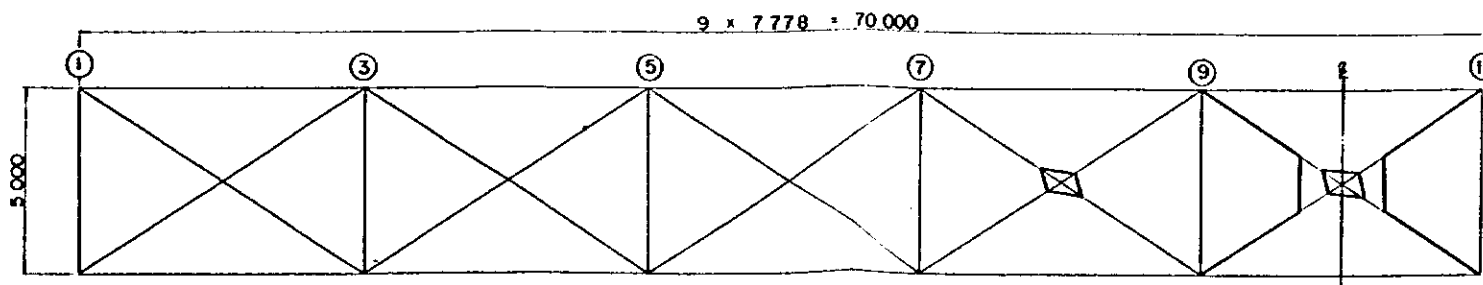


MARKING DIAGRAMS



**General Notes:**

- 1) All materials are to be JIS G 3101 SS 41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M22(+) (FIOT) and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field



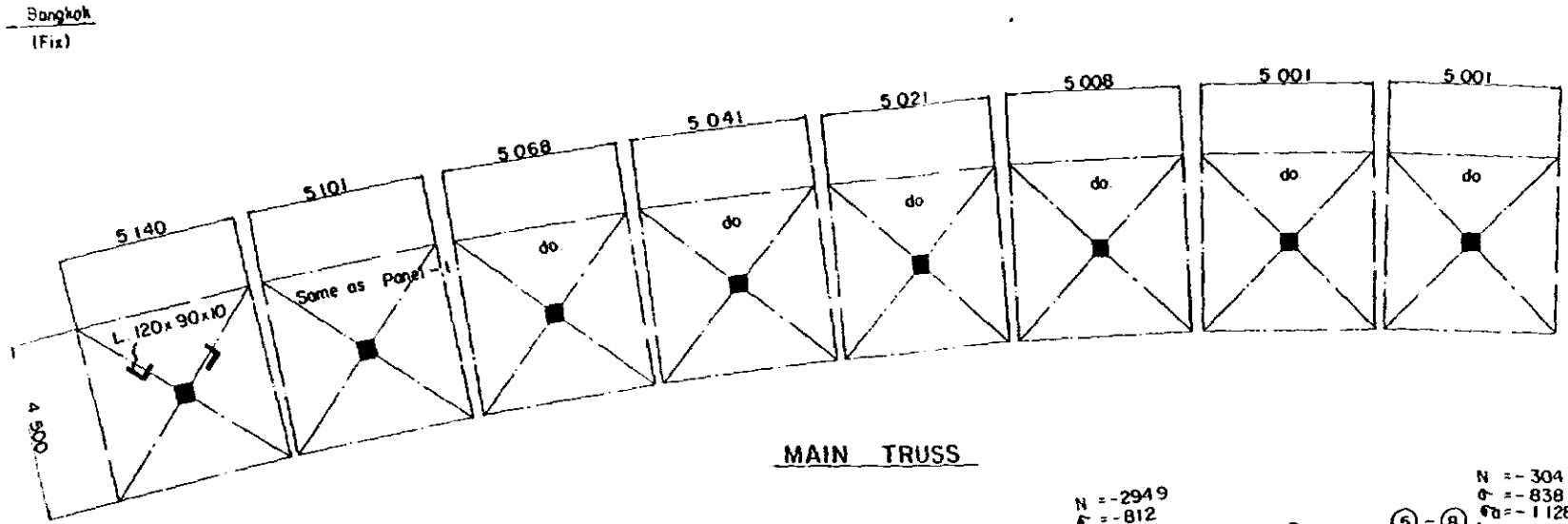
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	STRENGTHENING OF LOWER LATERAL	
700 TT		Unit	Scale
		mm	1/40, 1/20, 1/10
K.M.	297 + 063	Designed by	_____
DISTRICT	Hua Hin	Checked by	_____
LINE	Southern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	_____



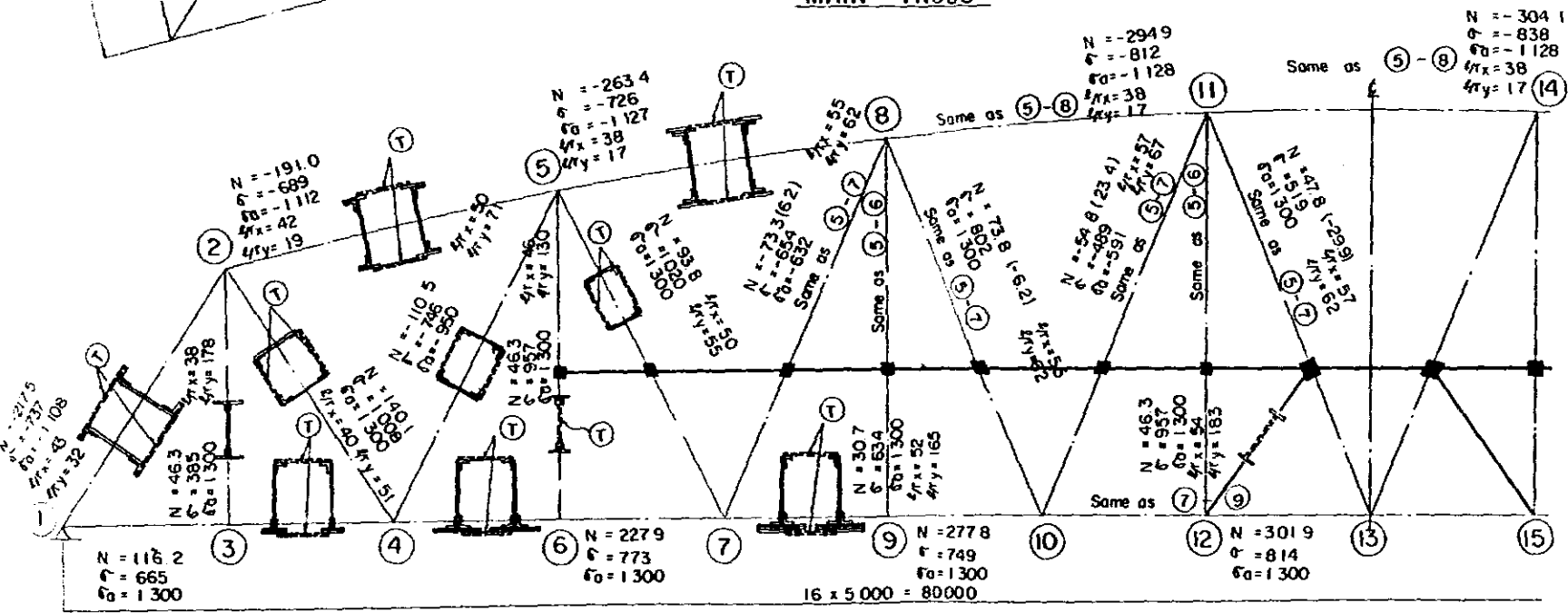
GENERAL DIAGRAMS

PORTAL SWAY BRACING

UPPER LATERAL



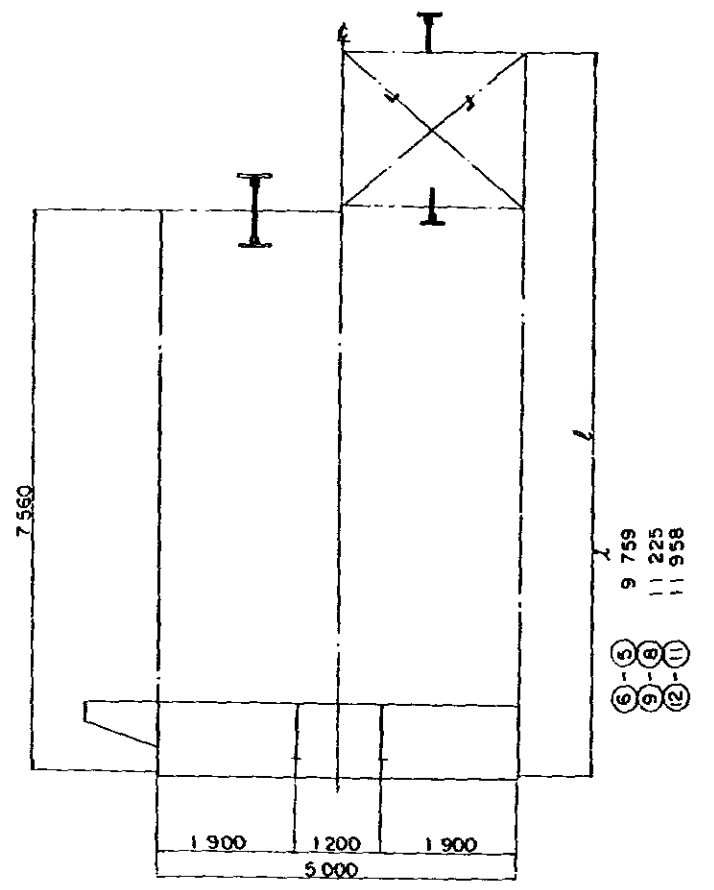
MAIN TRUSS



Si Saket (Mov)

Note:  
1) ■ : Gusset plates to be changed.

Note:  
1) (T) : Strengthen Tie Plate.  
2) ■ : Attach Guss. Plate.



END & INT. FLOOR BEAM

END  
M = 56.1  
σc = 690  
σt = 805  
σca = 1185  
σta = 1300

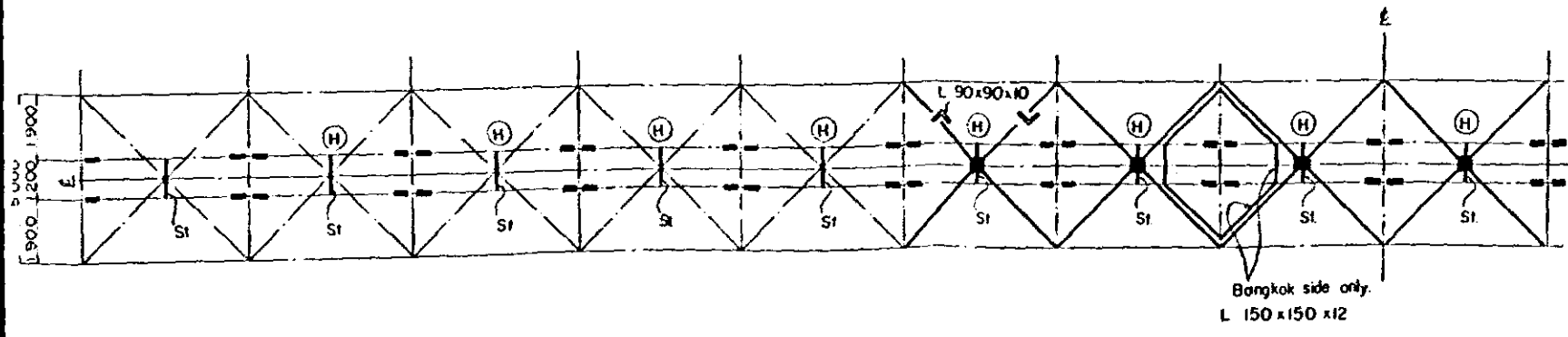


INT.  
M = 61.3  
σc = 754  
σt = 879  
σca = 1185  
σta = 1300

STRINGER

M = 27.1  
σc = 861  
σt = 1001  
σca = 1092  
σta = 1300

FLOOR SYSTEM & LOWER LATERAL



General Notes:

- Weak drawings show the original members. Deer drawings show the members to be improved.
- Actual stresses are based on DL-15 loading.
- Marks

Legends

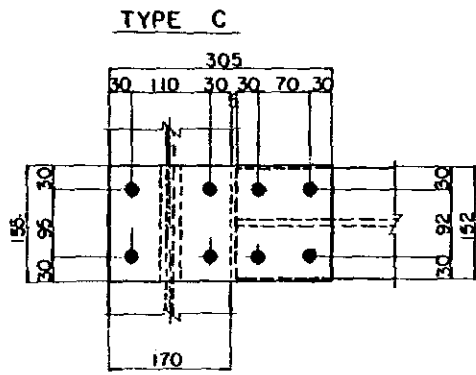
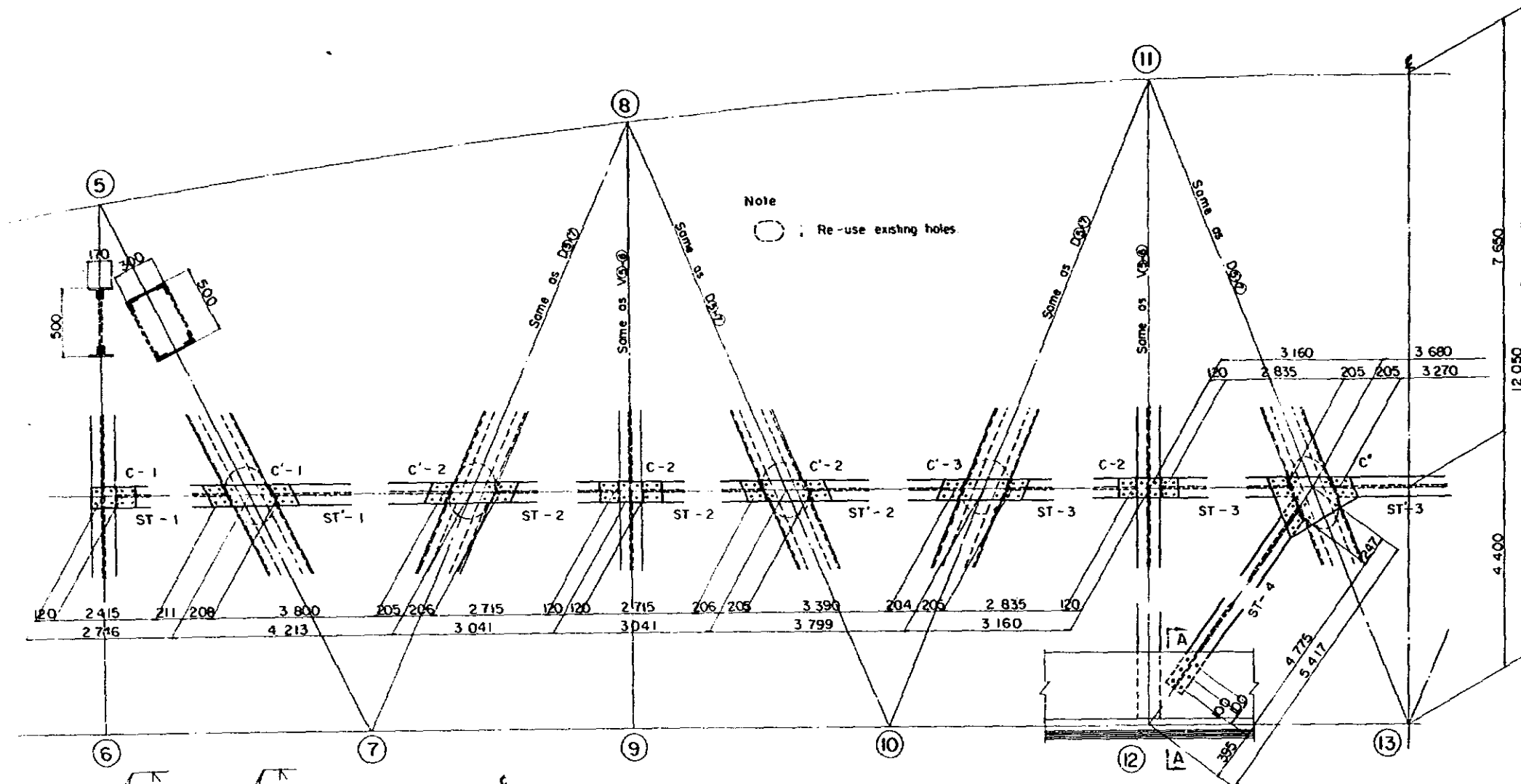
- Excessive stressed rivets to be strengthened.
- Gusset plates to be improved.
- Hanger to be added.
- St: New strut to be added.

- M: Bending moment (t.m)
- N: Axial force (t)
- l: Length of member (cm)
- x, y: Radius gyration of sectional area for x or y axis (cm)
- λr: Slenderness Ratio
- σ: Actual stress (kg/cm<sup>2</sup>)
- σa: Allowable Stress (kg/cm<sup>2</sup>)

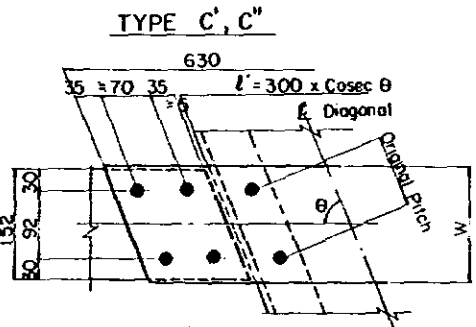
THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
800 T T	GENERAL DIAGRAM	Unit mm	Scale
K M	479 + 741	Designed by	
DISTRICT	Lam Chi	Checked by	
LINE	Northeastern Line	Checked by	
Remarks		Checked by	
		Checked by	
DATE		DRAWING NO	

MAIN TRUSS (NO. 1) s=1/20

DETAIL OF CONNECTION s=1/5



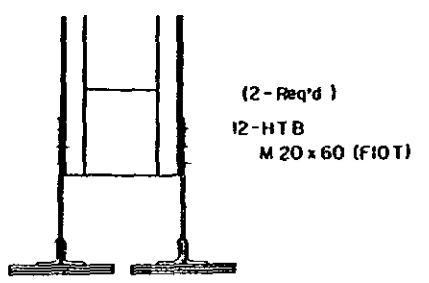
- C-1 (2-Req'd) 2-Con Pls 155 x 13 x 305  
16-HTB M20 x 65 (FIOT)
- C-2 (4-Req'd) 2-Con Pls 155 x 13 x 440  
24-HTB M20 x 65 (FIOT)



- TYPE C' (8-Req'd) 2-Con Pls 155 x 13 x 630  
24-HTB M20 x 65 (FIOT)
- TYPE C' (2-Req'd) 2-Con Pls 500 x 13 x 600  
38-HTB M20 x 65 (FIOT)

Note: Require over W=155

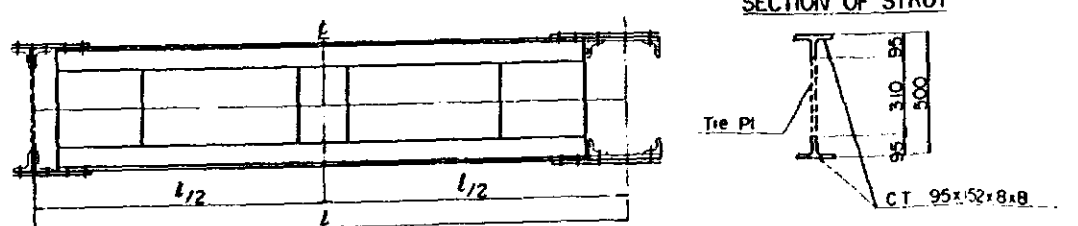
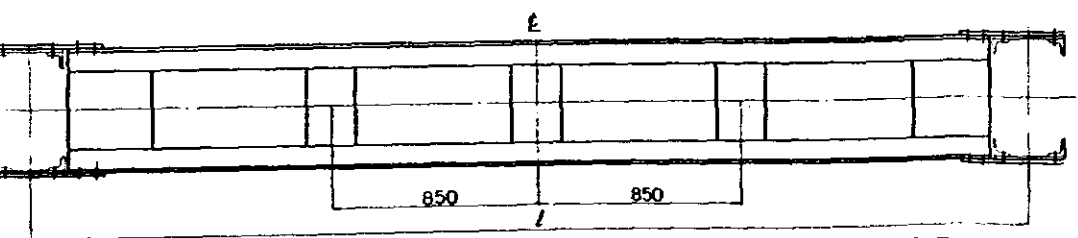
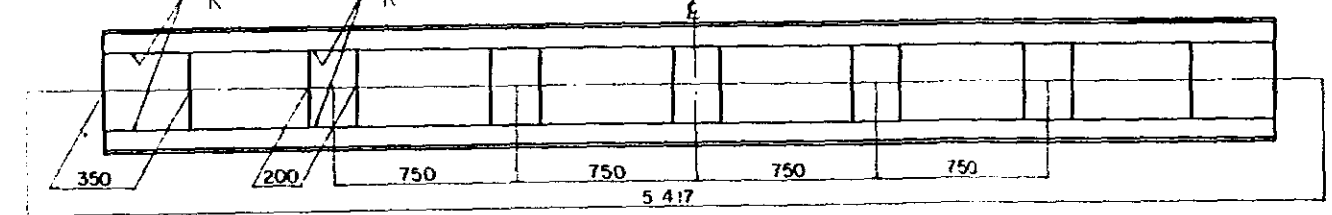
SECTION A-A s=1/15



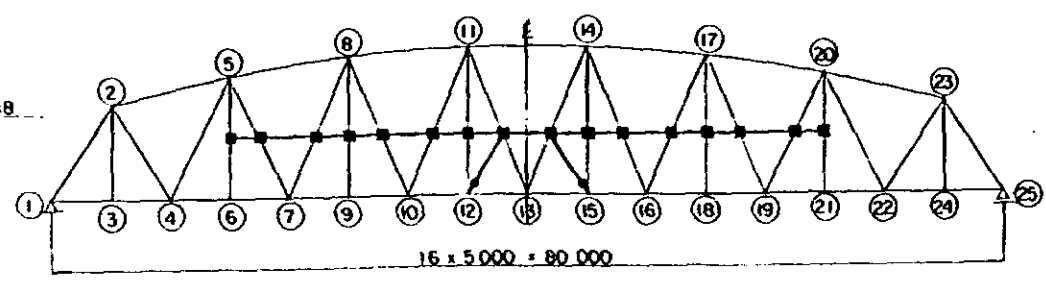
General Notes:

- All materials are to be JIS G3101 SS41 rolled steel for general structure or materials of equivalent.
- All high-strength bolts (H.T.B.) are M20(-)-J(FIOT), and assumed frictional coefficient of contact surface as follows:
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- All dimensions to be checked in the field.

- Construction Method
- New members are built up by welding
  - Clean surface between original and new members
  - Attach new members by H.T. Bolts.



MARKING DIAGRAMS

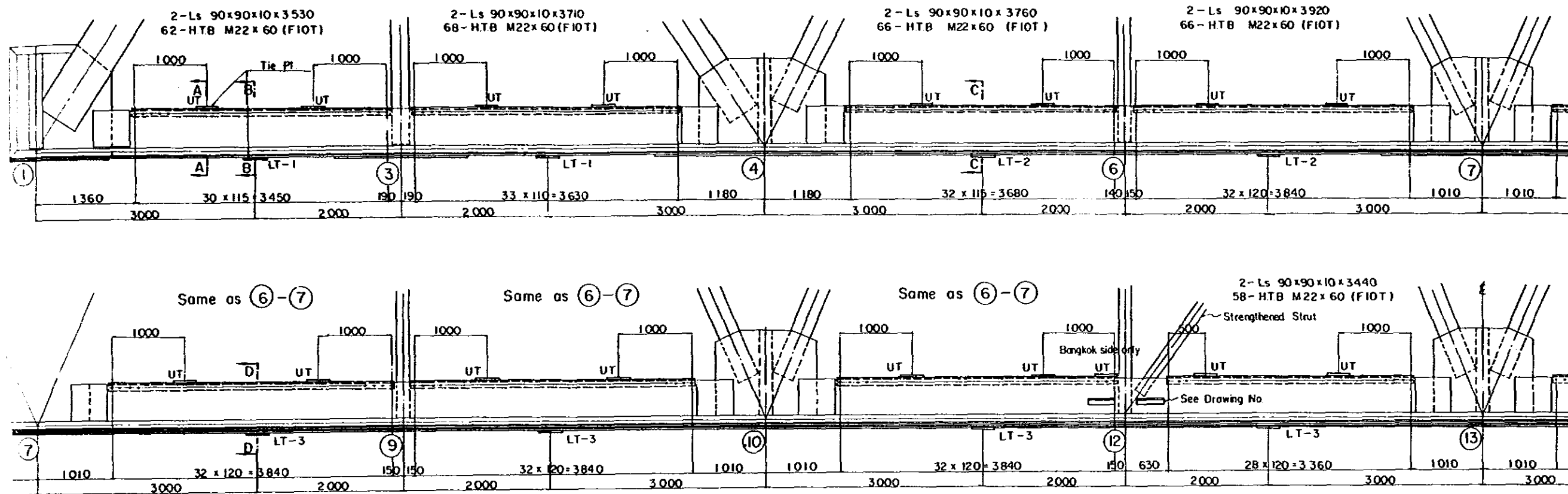


Member	l	L	N
ST-1 (2-Req'd)	2 746	2 480	1
ST'-1 (2-Req'd)	4 213	3 870	3
ST-2 (4-Req'd)	3 041	2 780	1
ST'-2 (2-Req'd)	3 799	3 460	3
ST-3 (4-Req'd)	3 160	2 900	1
ST'-3 (1-Req'd)	3 680	3 340	3
ST-4 (2-Req'd)	4 775	4 840	5

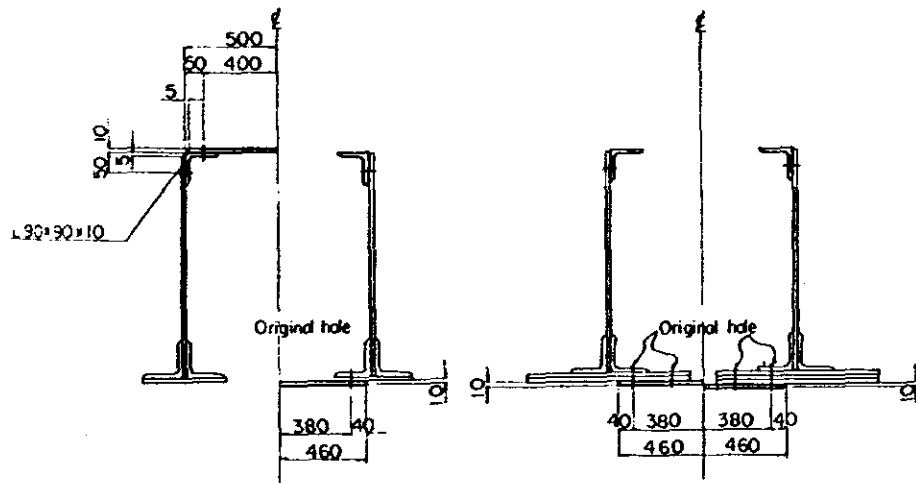
- 2-CT 95 x 152 x 8 x 8 x L
- N-Tie Pls 200 x 8 x 310
- 2-Tie Pls 310 x 8 x 350

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
800 T.T	MAIN TRUSS (NO.1)	Unit	Scale
K.M	479 + 741	mm	1/20, 1/15, 1/5
DISTRICT	Lam Chi	Designed by	
LINE	Northeastern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO	

**MAIN TRUSS (NO.2)**  
**LOWER CHORD MEMBERS s=1/30**

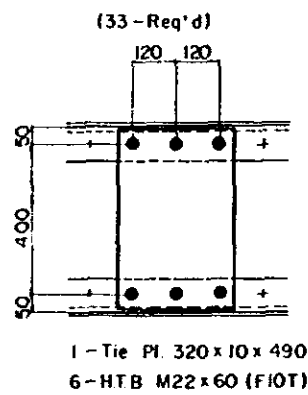


**DETAIL s=1/10**  
SECTION A-A    SECTION B-B    SECTION C-C    SECTION D-D

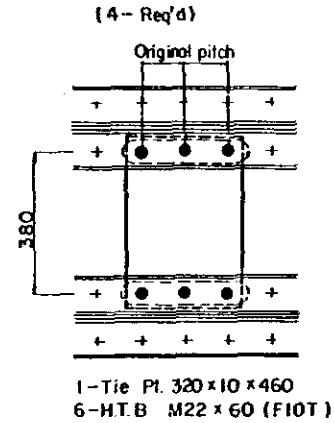


Note  
Rivets pitch of Lower Chord is unknown  
○ . Re-Use Existing holes.

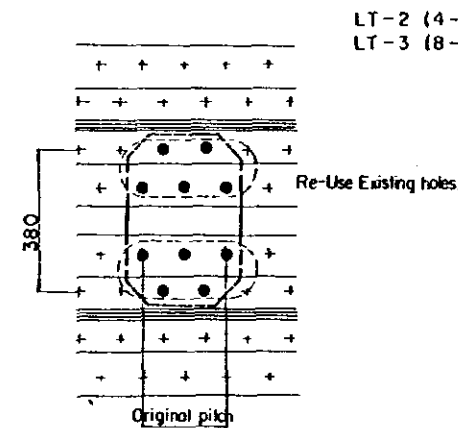
**DETAIL UT s=1/10**



**DETAIL LT-1 s=1/10**



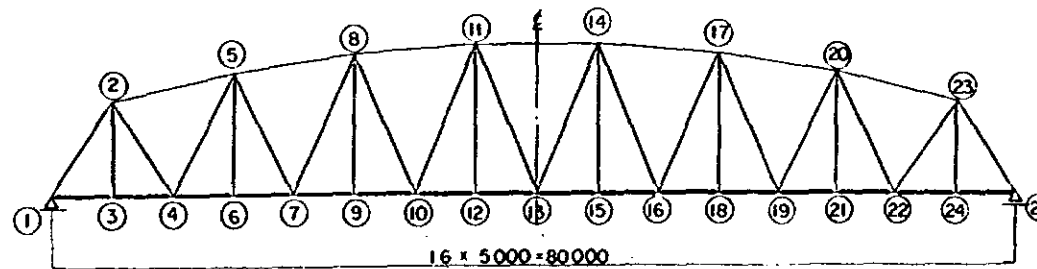
**DETAIL LT-2, LT-3 s=1/10**



**General Notes**

- All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- All high-strength bolts (HTB) are M22 (←) (FIOT), and assumed frictional coefficient of contact surface as follows.
  - for connection  $f \geq 0.4$
  - for stitch  $f \geq 0.3$
- All dimensions to be checked in the field.

**MARKING DIAGRAMS**

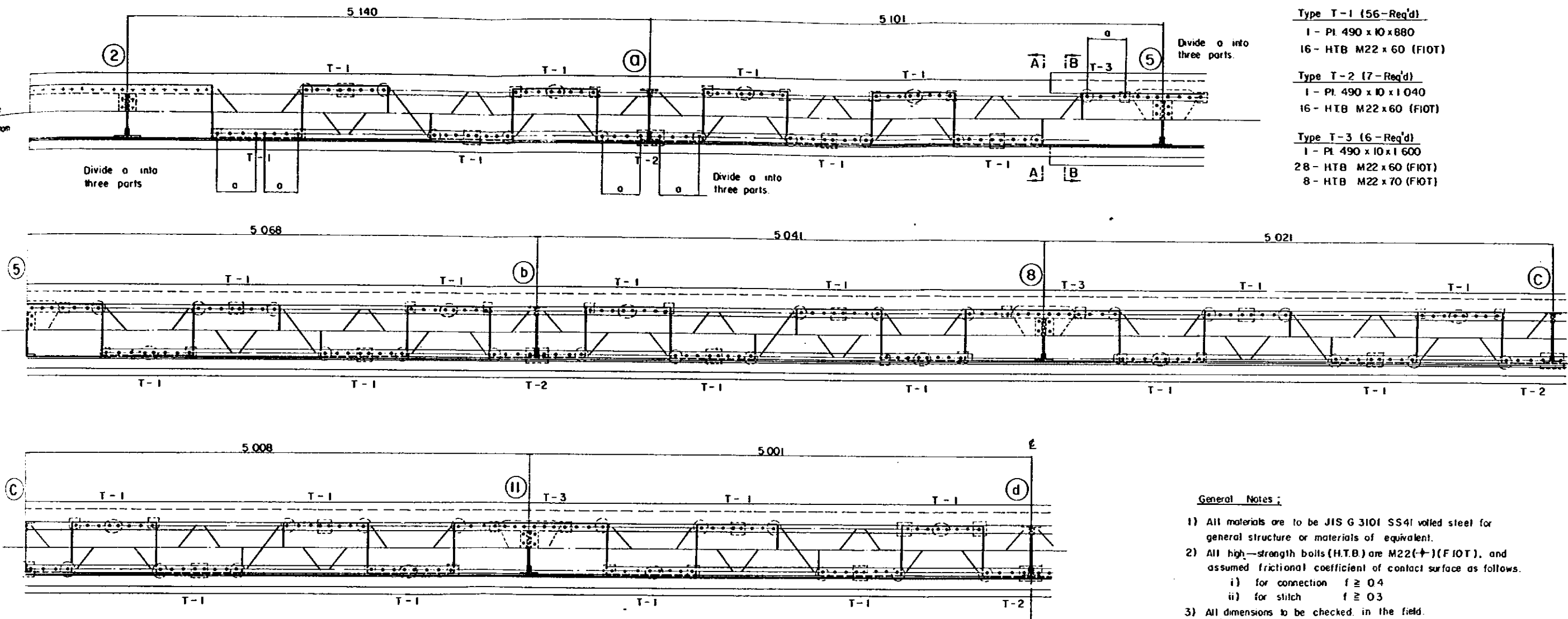


THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	MAIN TRUSS (NO.2)	DL 15 loading
800 TT			Unit Scale
			mm 1/30, 1/10
K.M	479 + 741	Designed by	_____
DISTRICT	Lam Chi	Checked by	_____
LINE	Northeastern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO	_____

# MAIN TRUSS (NO. 3)

UPPER CHORD MEMBERS  $S = 1/20$

Note: All Lacing Bar's dimensions is incomplete  
Therefore, all dimensions and materials are assumption.

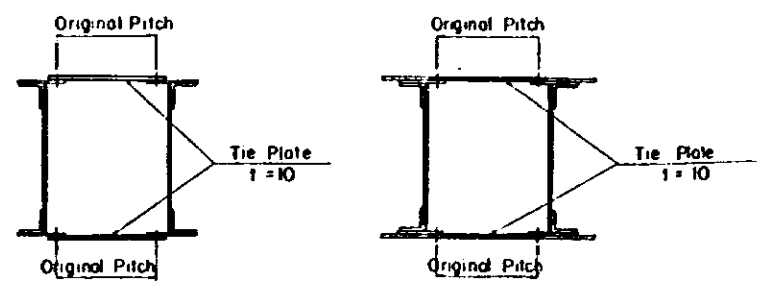


- Type T-1 (56-Req'd)
  - 1 - Pl. 490 x 10 x 880
  - 16 - HTB M22 x 60 (FIOT)
- Type T-2 (7-Req'd)
  - 1 - Pl. 490 x 10 x 1040
  - 16 - HTB M22 x 60 (FIOT)
- Type T-3 (6-Req'd)
  - 1 - Pl. 490 x 10 x 1600
  - 28 - HTB M22 x 60 (FIOT)
  - 8 - HTB M22 x 70 (FIOT)

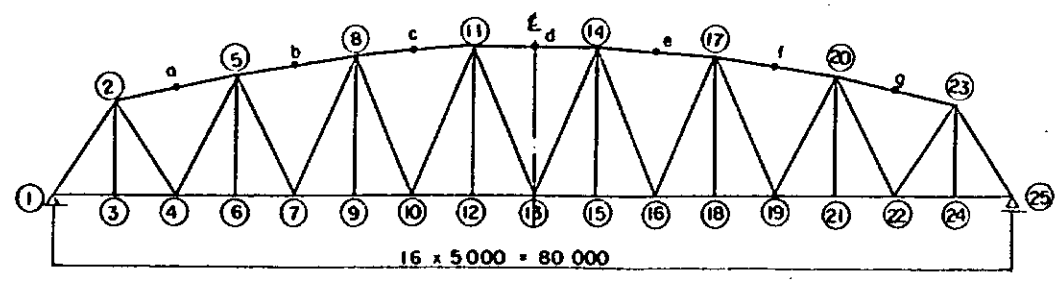
- General Notes:**
- 1) All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
  - 2) All high-strength bolts (H.T.B.) are M22(+)(FIOT), and assumed frictional coefficient of contact surface as follows.
    - i) for connection  $f \geq 0.4$
    - ii) for stitch  $f \geq 0.3$
  - 3) All dimensions to be checked in the field.
  - 4)  $\circ$  : Re-use existing holes  
 $\square$  : Re-use existing holes of the opposite side.

SEC. A - A

SEC. B - B



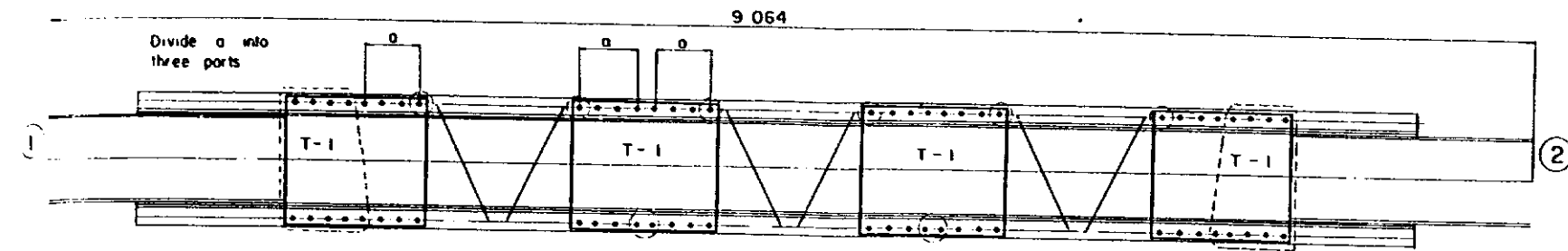
MARKING DIAGRAMS



THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members MAIN TRUSS (NO. 3)	DL 15 loading	
80.0 T.F		Unit	Scale
K.M	479 + 741	mm	1/20
DISTRICT	Lam Chi	Designed by	
LINE	Northeastern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

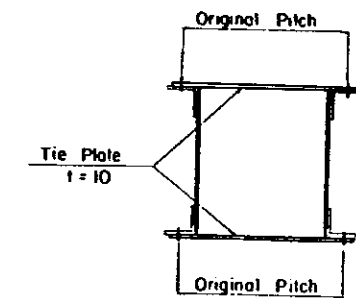
MAIN TRUSS (NO. 4) s=1/20

Note All facing bars dimensions is incomplete. Therefore, all dimensions and materials are assumption.

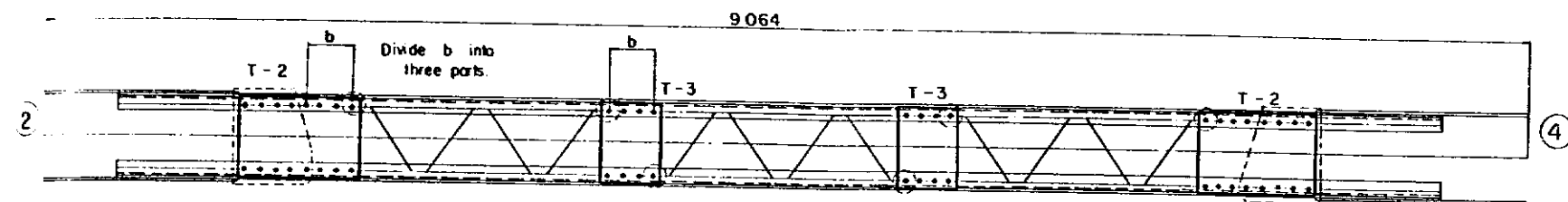


END POST

DETAIL SEC. ①-② s=1/15

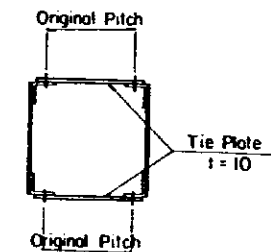


TYPE T-1 (16-Req'd)  
1 - Pl. 770 x 10 x 850  
16 - HTB M22 x 65 (FIOT)



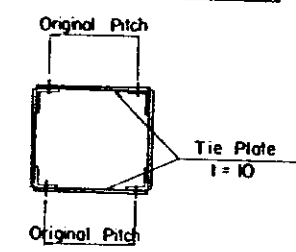
DIAGONAL MEMBERS

DETAIL SEC. ②-④ s=1/15

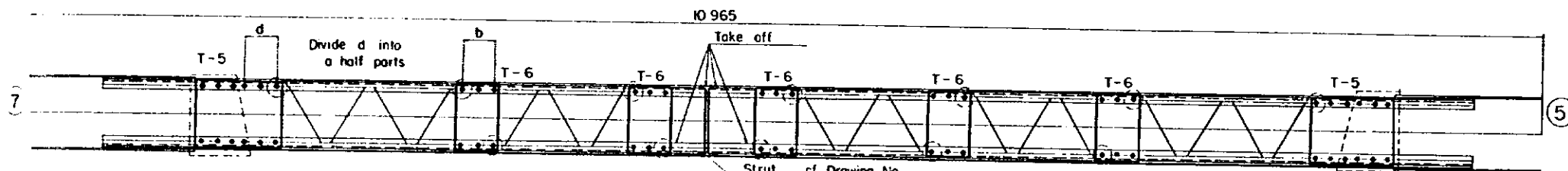
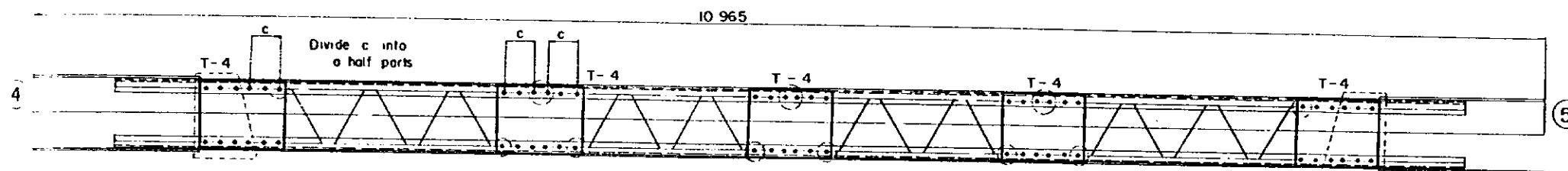


TYPE T-2 (8-Req'd)  
1 - Pl. 460 x 10 x 730  
16 - HTB M22 x 60 (FIOT)

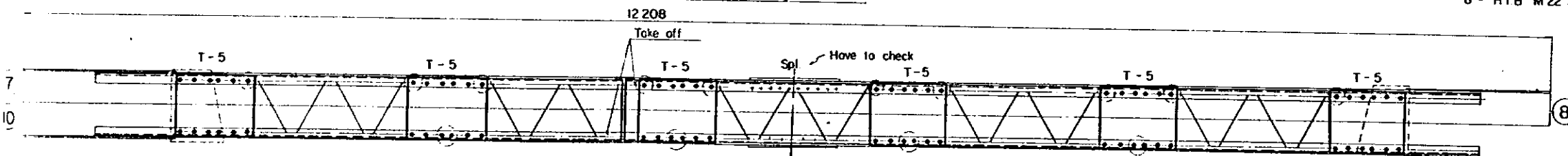
DETAIL SEC. ④-⑤ s=1/15



TYPE T-4 (20-Req'd)  
1 - Pl. 460 x 10 x 510  
12 - HTB M22 x 60 (FIOT)

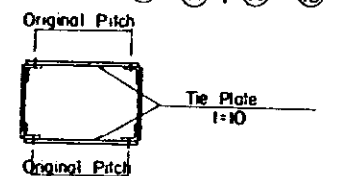


TYPE T-2 (8-Req'd)  
1 - Pl. 360 x 10 x 460  
8 - HTB M22 x 60 (FIOT)

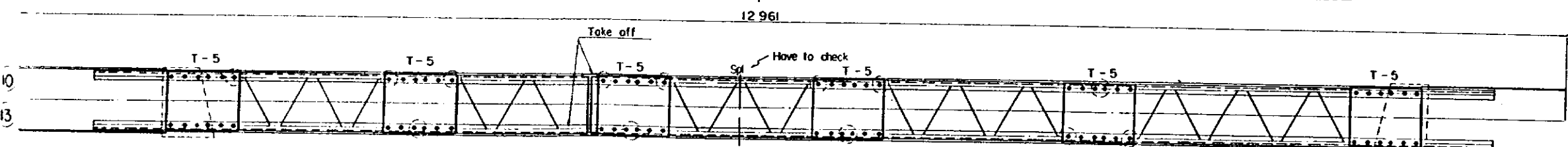


DETAIL SEC. ⑤-⑦ s=1/15

Same as Sec ⑦-⑧, ⑧-⑩, ⑩-⑪, ⑪-⑬



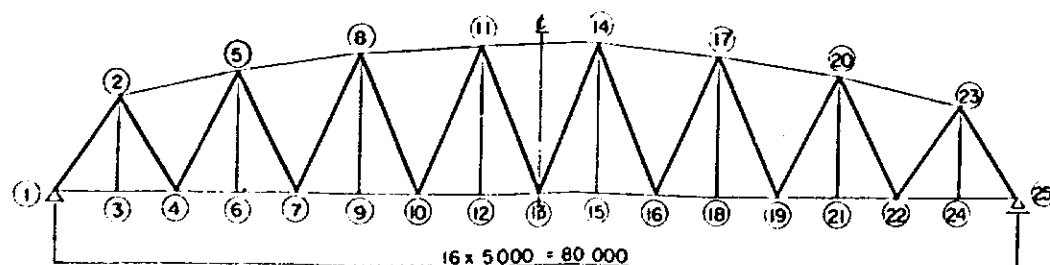
TYPE T-5 (56-Req'd)  
1 - Pl. 470 x 10 x 620  
12 - HTB M20 x 60 (FIOT)



1 - Pl. 310 x 10 x 470  
6 - HTB M20 x 60 (FIOT)

Note (○) Re-use existing holes

MARKING DIAGRAMS



General Notes:

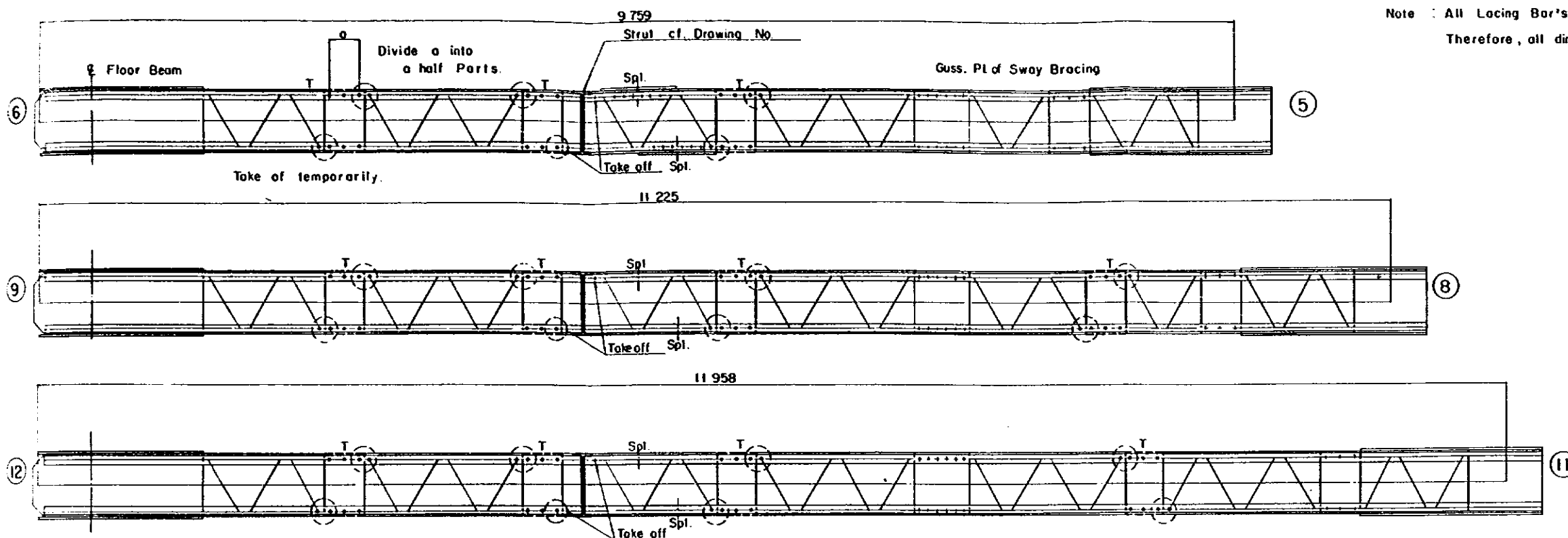
- All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- All high-strength bolts (H.T.B.) are M22 (φ) (FIOT), and assumed frictional coefficient of contact surface as follows.
  - for connection  $f \geq 0.4$
  - for stitch  $f \geq 0.3$
- All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members MAIN TRUSS (NO.4)	D.L. 15 loading	
BOOTT		Unit	Scale
K.M	479 + 741	mm	1/20, 1/15
DISTRICT	Lam Chi	Designed by	
LINE	Northeastern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO	

# MAIN TRUSS (NO. 5)

VERTICAL MEMBERS  $s=1/20$

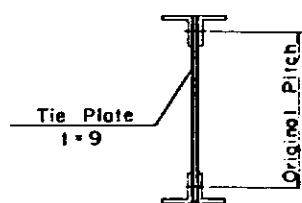
Note : All Lacing Bar's dimensions is incomplete.  
Therefore, all dimensions and materials are assumption.



Note :  
○ : Re-Use Existing holes.

DETAIL SEC. ⑤-⑥  $s=1/10$

Same as ⑧-⑨  
⑪-⑫



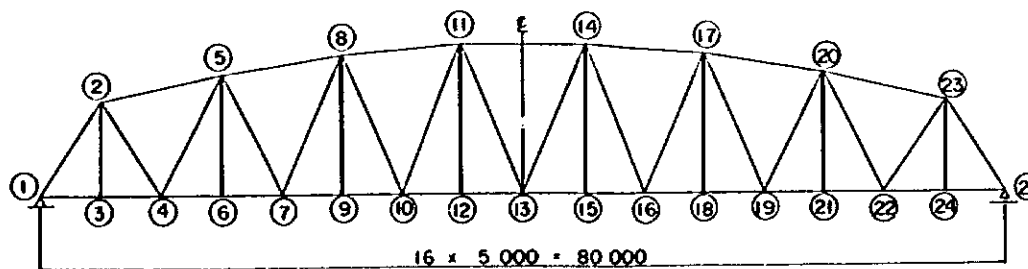
( 22 - Req'd )

1- Pl 320 x 9 x 500  
6- H.T.B M22 x 70 (F10T)

Other Bolts

38- H.T.B. M22 x 70 (F10T)

## MARKING DIAGRAMS



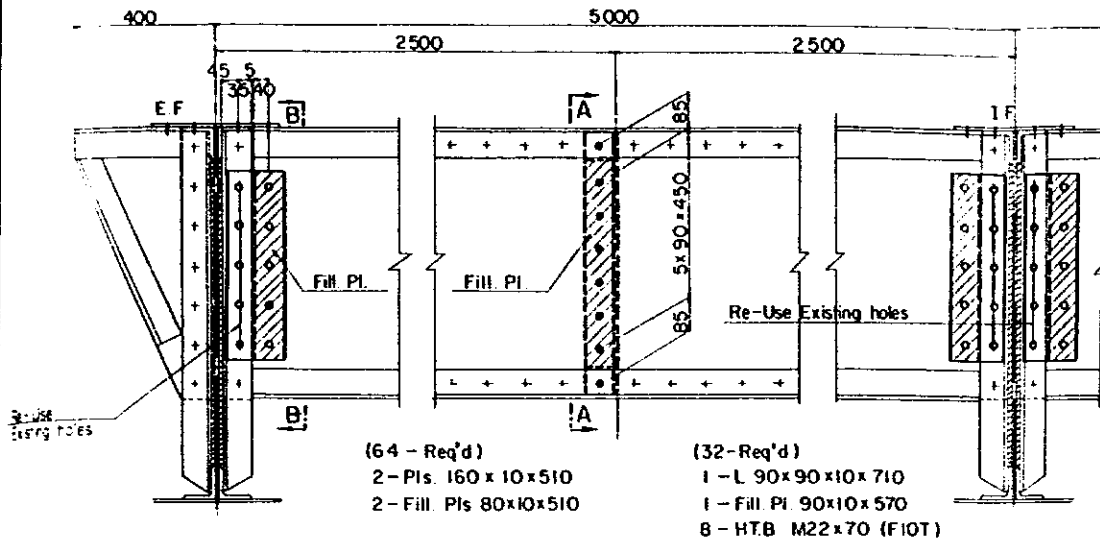
## General Notes :

- 1) All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (H.T.B) are M22 (F10T), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for stitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members MAIN TRUSS (NO.5)	DL 15 loading	Designed by _____
800 T.T		Unit	
		mm	1/20, 1/10
K.M.	479 + 741		Checked by _____
DISTRICT	Lam Chi		Checked by _____
LINE	Northeastern Line		Checked by _____
Remarks			Checked by _____
			Checked by _____
			Checked by _____
			Checked by _____
DATE		DRAWING NO.	

# FLOOR SYSTEM

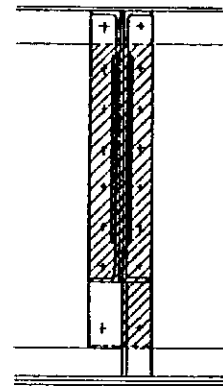
## STRINGER s-1/10



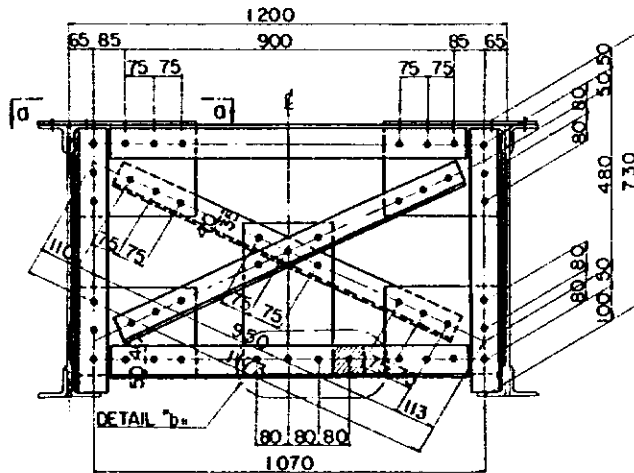
(64 - Req'd)  
2 - Pls. 160 x 10 x 510  
2 - Fill. Pls 80 x 10 x 510

(32 - Req'd)  
1 - L 90 x 90 x 10 x 710  
1 - Fill. Pl. 90 x 10 x 570  
8 - HTB M22 x 70 (FIOT)

## SECTION B - B

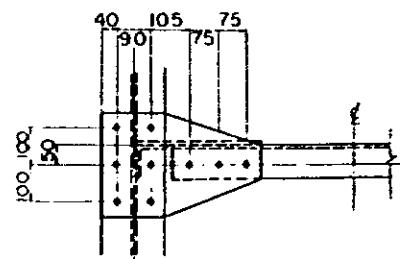


## STRUT (SECTION A - A)



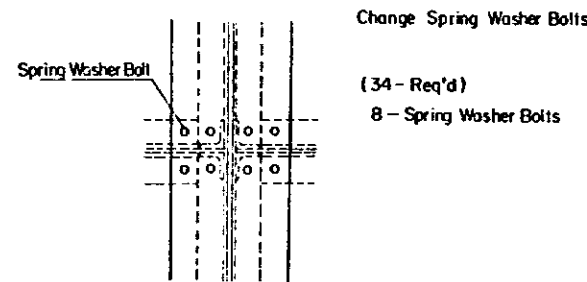
(16 - Req'd)  
2 - Ls 90 x 90 x 10 x 980  
2 - Ls 75 x 75 x 10 x 1030  
4 - Guss Pls 240 x 10 x 315  
1 - Guss Pl. 240 x 10 x 410  
43 - HTB M22 x 60 (FIOT)  
1 - HTB M22 x 70 (FIOT)

## SECTION a - a



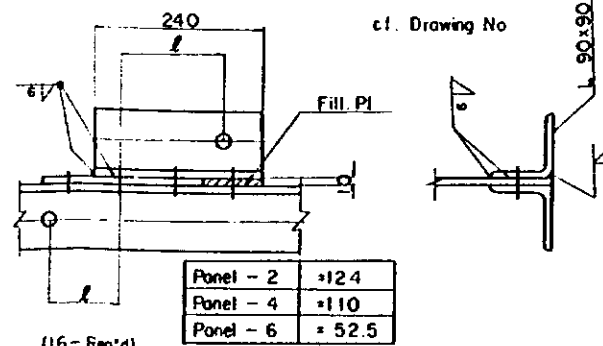
(32 - Req'd)  
1 - Guss. Pl. 280 x 10 x 385  
9 - HTB M22 x 60 (FIOT)

## SECTION C - C



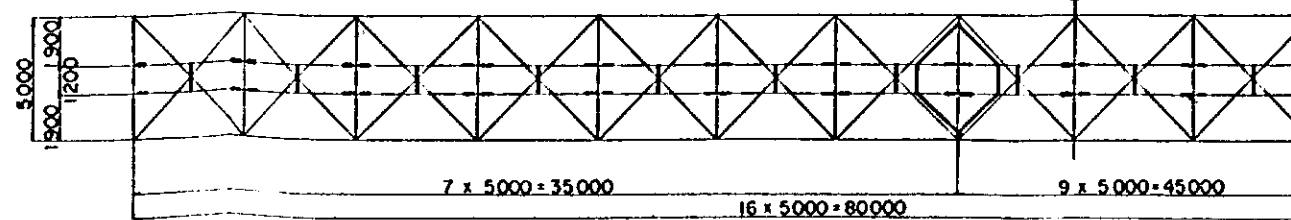
(34 - Req'd)  
8 - Spring Washer Bolts

## DETAIL "b" s-1/5

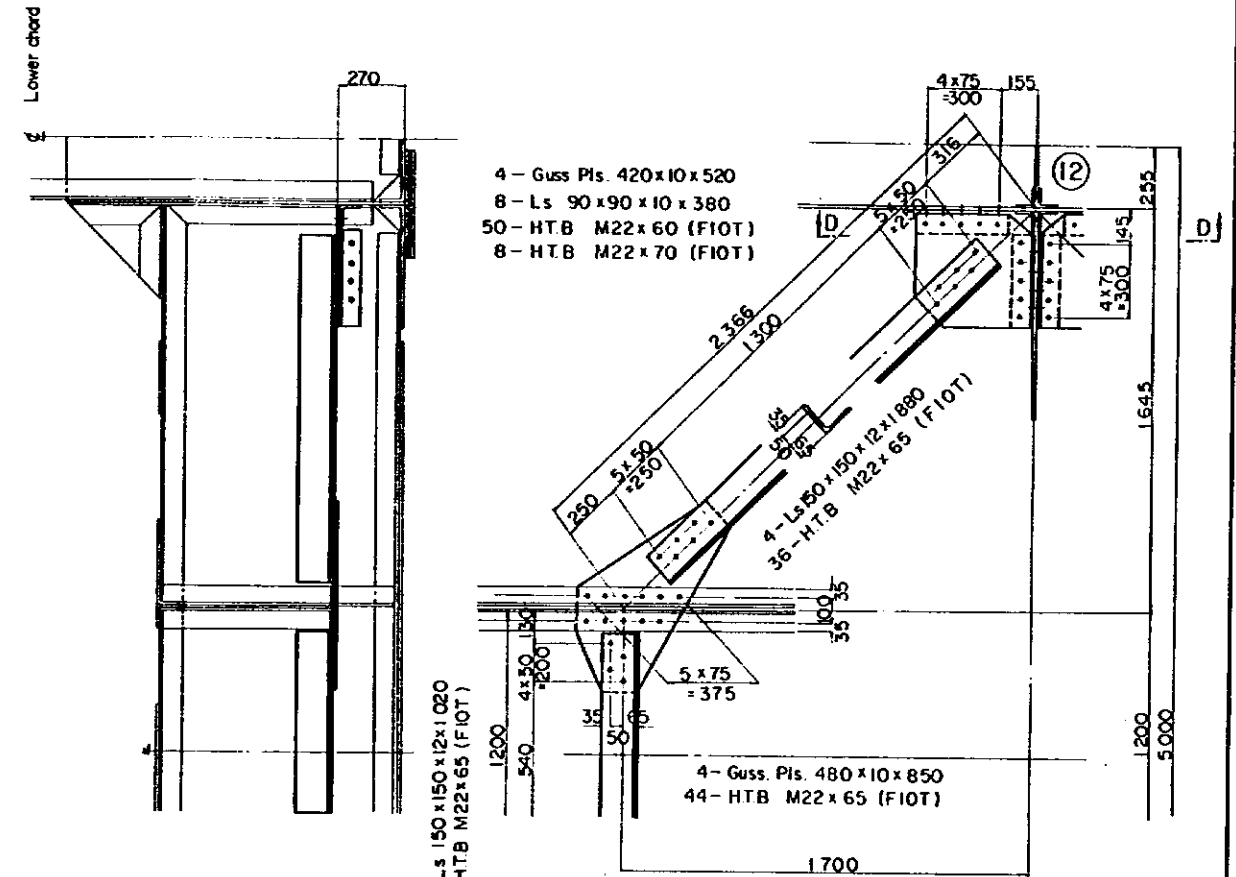


(16 - Req'd)  
1 - L 90 x 90 x 10 x 240  
1 - Fill. Pl. 90 x 10 x 80  
3 - HTB M22 x 70 (FIOT)  
1 - HTB M22 x 60 (FIOT)

## MARKING DIAGRAMS



## BRAKE TRUSS s-1/15



4 - Guss Pls. 420 x 10 x 520  
8 - Ls 90 x 90 x 10 x 380  
50 - HTB M22 x 60 (FIOT)  
8 - HTB M22 x 70 (FIOT)

2 - Ls 150 x 150 x 12 x 1020  
16 - HTB M22 x 65 (FIOT)

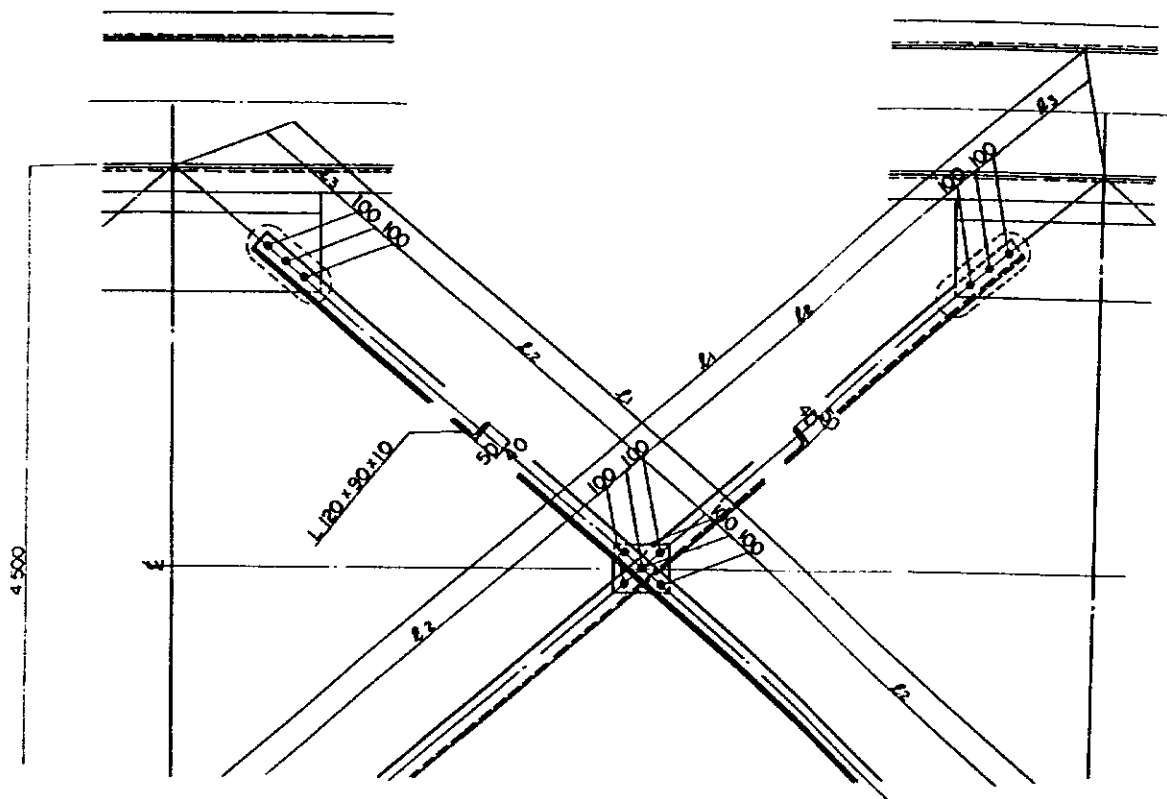
4 - Guss. Pls. 480 x 10 x 850  
44 - HTB M22 x 65 (FIOT)

## General Notes :

- All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- All high-strength bolts (H.T.B.) are M22 (F10T), and assumed frictional coefficient of contact surface as follows.
  - for connection  $f \geq 0.4$
  - for stitch  $f \geq 0.3$
- All rivets are 22 (F10T), and to be rolled steel for SV34 (JIS G 3104) or materials of equivalent.
- All dimensions to be checked in the field.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
800 TT	FLOOR SYSTEM	Unit	Scale
		mm	1/5, 1/10, 1/5
K.M.	479 + 741	Designed by	_____
DISTRICT	Lam Chi	Checked by	_____
LINE	Northeastern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	_____

UPPER LATERAL BRACING  $s = 1/20, s = 1/15$



2 - Ls 120 x 90 x 10 x L  
 1 - Connection Pl. 220 x 240 x 10  
 17 - HTB M22 x 70 (FIOT)

Note:  
 Unknown original section and skeleton.  
 Thereupon suppose to the above mentioned  
 and that original holes is unused.

Construction Method

- 1) Cut off original rivets.
- 2) Take off original members.
- 3) Clean surface between original and new members.
- 4) Attach new angles and tighten H.T. Bolts.

Note:

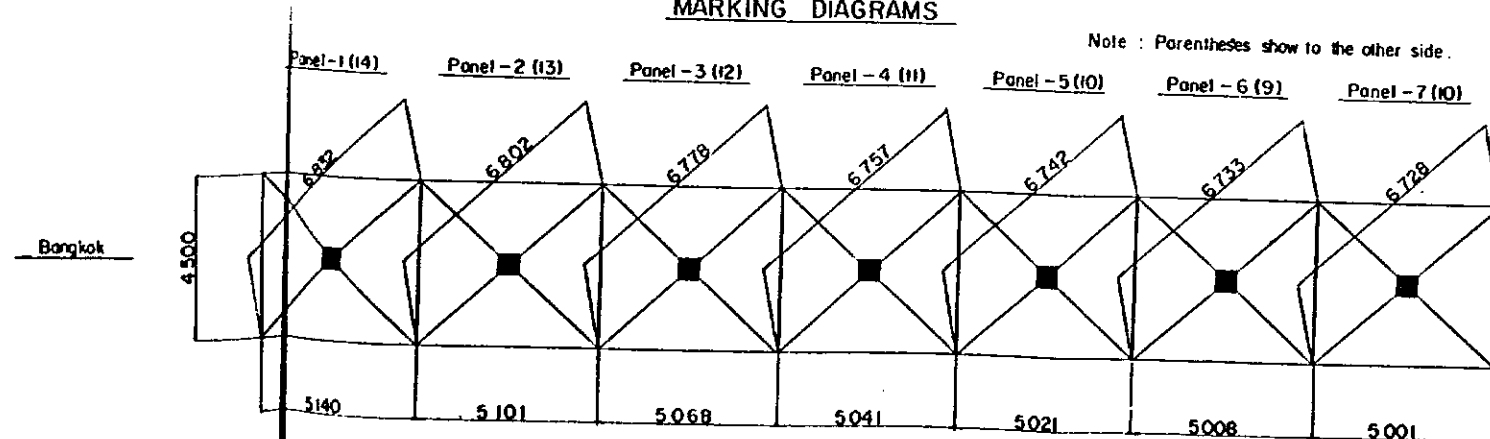
○ Re-Use Existing holes.

Panel	L1	L2	L3	L
Panel - 1 (14)	6 832	2 615	501	5 910
Panel - 2 (13)	6 802	2 600	501	5 880
Panel - 3 (12)	6 778	2 590	499	5 860
Panel - 4 (11)	6 757	2 580	498.5	5 840
Panel - 5 (10)	6 742	2 570	501	5 820
Panel - 6 (9)	6 733	2 565	501.5	5 810
Panel - 7 (8)	6 728	2 565	499	5 810

General Notes:

- 1) All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (HTB) are M 22 (FIOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for slitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

MARKING DIAGRAMS

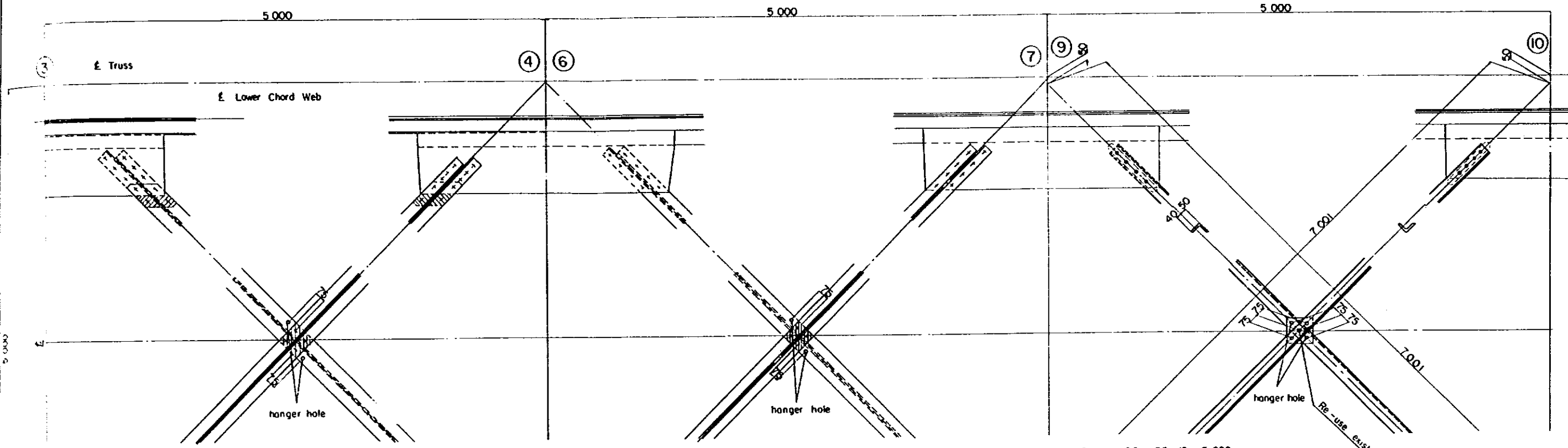


Note: Parentheses show to the other side.

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	UPPER LATERAL BRACING	
800 T.T	479 + 741	DL 15 loading	Unit Scale
K M		mm	1/20, 1/15
DISTRICT	Lam Chi	Designed by	_____
LINE	Northeastern Line	Checked by	_____
Remarks		Checked by	_____
		Checked by	_____
		Checked by	_____
DATE		DRAWING NO.	_____



LOWER LATERAL BRACING S=1/20, 1/15

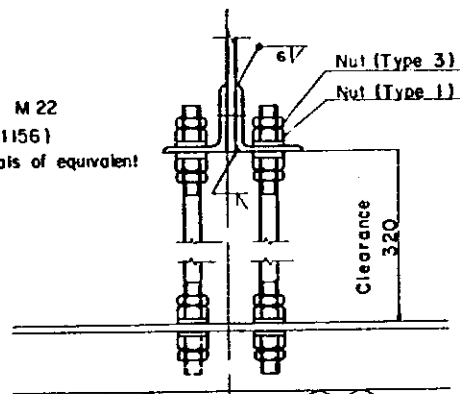


HANGER S=1/5

Note ○ : Re-use existing holes

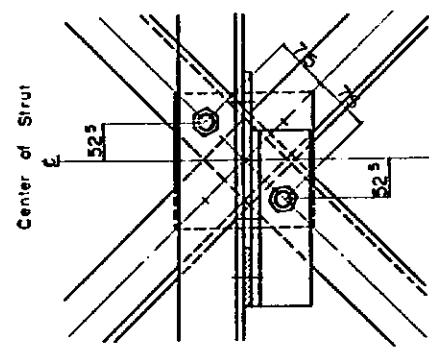
- 2 - Ls 90 x 90 x 10 x 5 620
- 1 - Guss Pl 185 x 10 x 190
- 16 - HT.B M22 x 60 (FIOT)
- 3 - HT.B M22 x 70 (FIOT)

Note All Nut M22 (JIS B-1156) or materials of equivalent



- 2 - Round Bar 22# x 460
- 8 - Nut M22 (Type 1)
- 8 - Nut M22 (Type 3)
- 8 - Washer M22

9-10

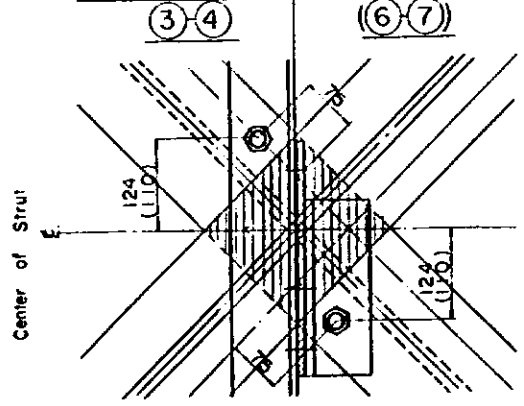
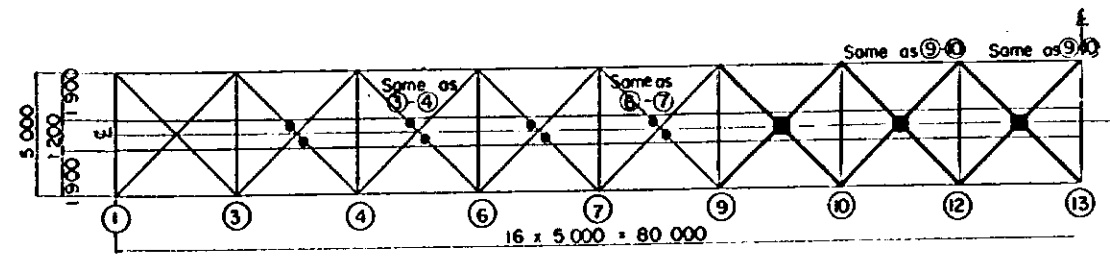


General Notes :

- 1) All materials are to be JIS G 3101 SS41 rolled steel for general structure or materials of equivalent.
- 2) All high-strength bolts (H.T.B) are M22 (F IOT), and assumed frictional coefficient of contact surface as follows.
  - i) for connection  $f \geq 0.4$
  - ii) for slitch  $f \geq 0.3$
- 3) All dimensions to be checked in the field.

MARKING DIAGRAMS

Note : ● : show to attach Hanger.



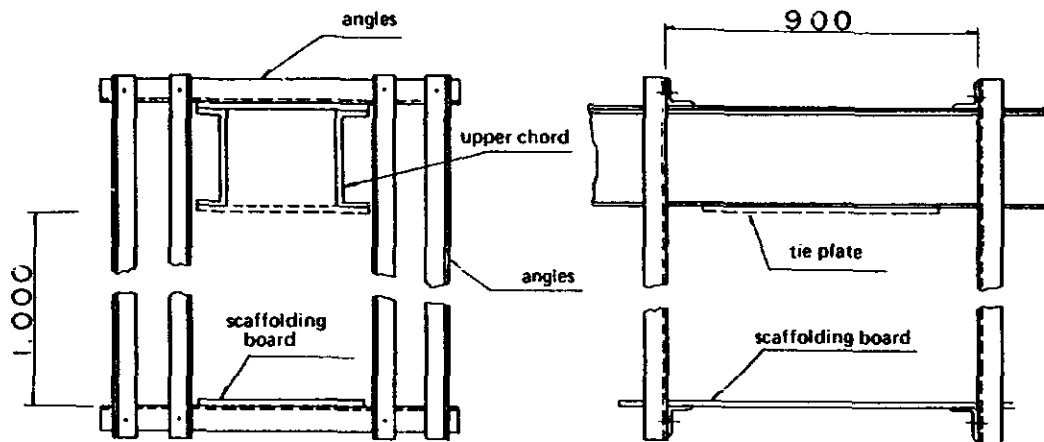
cf Drawing No

THE STATE RAILWAY OF THAILAND			
DETAIL DRAWING FOR STRENGTHENING AND/OR REPAIRING			
Span Type	Members	DL 15 loading	
800 T.T	LOWER LATERAL BRACING	Unit	Scale
K.M	479 + 741	mm	1/20, 1/15, 1/5
DISTRICT	Lam Chi	Designed by	
LINE	Northeastern Line	Checked by	
Remarks		Checked by	
		Checked by	
		Checked by	
		Checked by	
DATE		DRAWING NO.	

**I. Instruction for Improvement of Cleveland Types; 25m (T.T.), 30m (T.T.), 35m(T.T.) and 45m(T.T.)**

**1. Upper Chord (Installation of tie plate)**

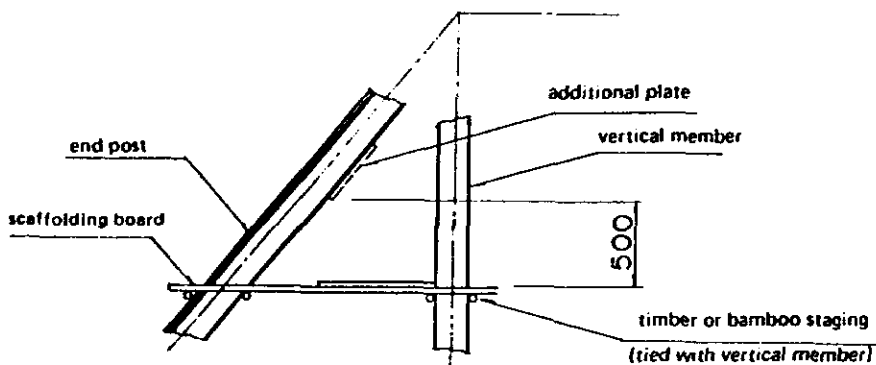
(a) Place a partial staging in the vicinity of a panel point as illustrated below.



- (b) Cut off the connection rivet of tie plates or lacing bars and remove them.
- (c) Mark the position of new holes on the new tie plate to be attached using mould and drill holes on them.
- (d) Install the new tie plates after cleaning of contact surface and fix them with some temporary bolts.
- (e) Install high-strength bolts and replace the temporary bolts with high-strength bolts also.

**2. End Post (Installation of tie plates)**

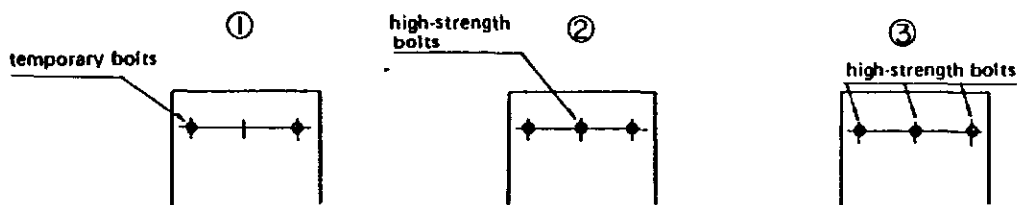
(a) A staging should be provided as illustrated below.



(b) For other works, refer to Para. 1 "upper chord."

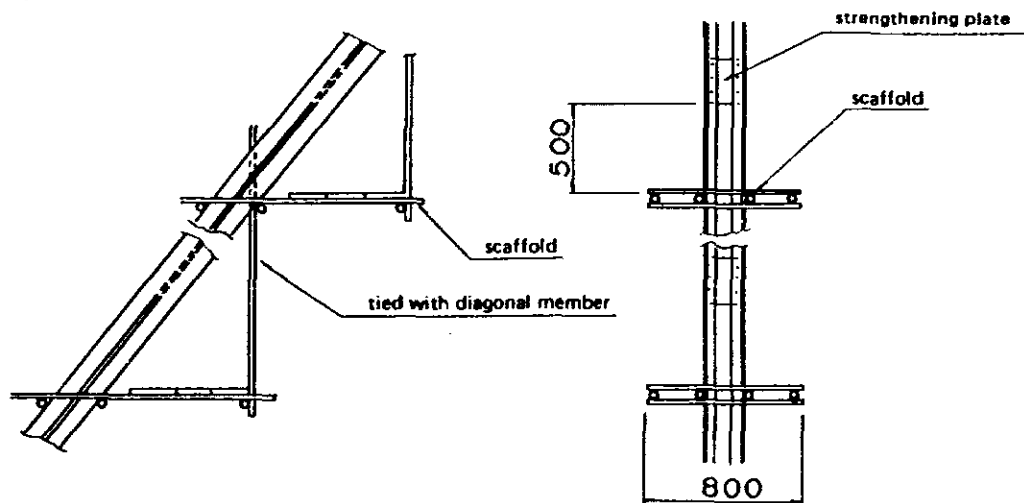
3. Lower Chord (Installation of tie plates)

- (a) A partial staging should be provided. The staging should be wider than the width of lower chord by two meters for strengthening work for web plates.
- (b) For attaching the tie plates, connection angles are fastened on the web plates with high-strength bolts.
- (c) Since a new tie plate has three bolt holes on each side, insert temporary bolts into the two end holes to fix the tie plate.
- (d) Install a high-strength bolt into the center hole and then replace the temporary bolts in the end holes with high-strength bolts one by one.

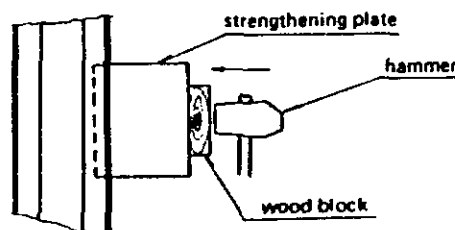


4. Diagonal Member and Vertical Member (Installation of tie plates)

- (a) A partial staging should be provided as illustrated below.

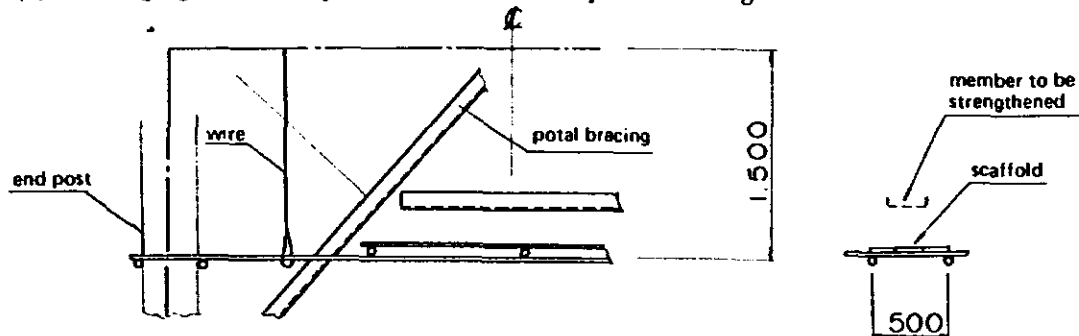


- (b) After cutting off the rivets of lacing bars and remove them, insert a scraper into opening between flange angles and remove old paint and rust.
- (c) Insert a strengthening plate by hammering and tighten it with high-strength bolts.

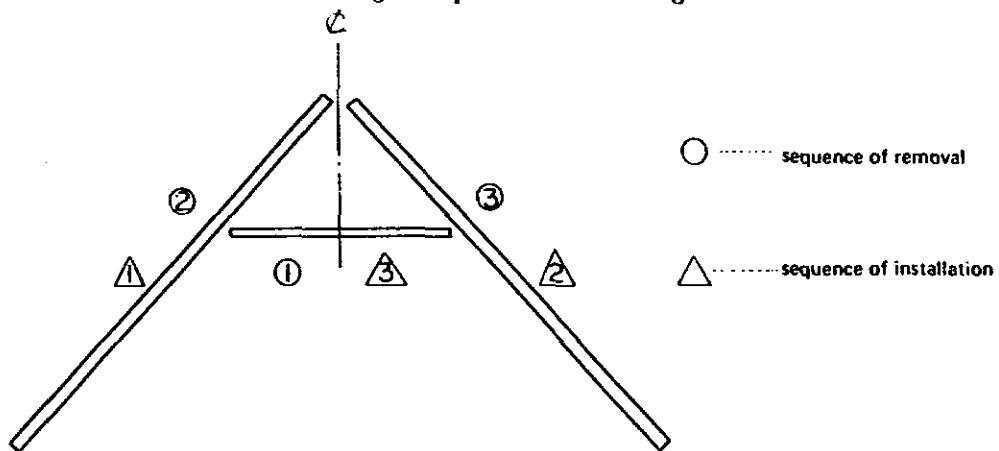


5. Portal Bracing

(a) A staging should be provided beneath the portal bracing as illustrated below.



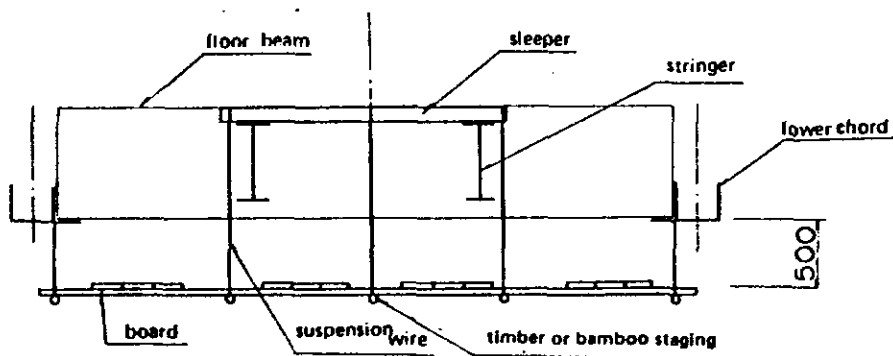
- (b) Cut off connection rivets of members to be strengthened/repaired and replace their rivets with temporary bolts.
- (c) Replace the existing members with new ones in such sequence as illustrated below, and fix them with temporary bolts.
- (d) Clean contact surface of the gusset plates before fixing the new members.



(e) Install high-strength bolts and replace the temporary bolts with high-strength bolts also.

6. Lower Lateral Member

A full-width staging should be provided beneath the bridge, which can be used also for strengthening work for floor beams and stringers.



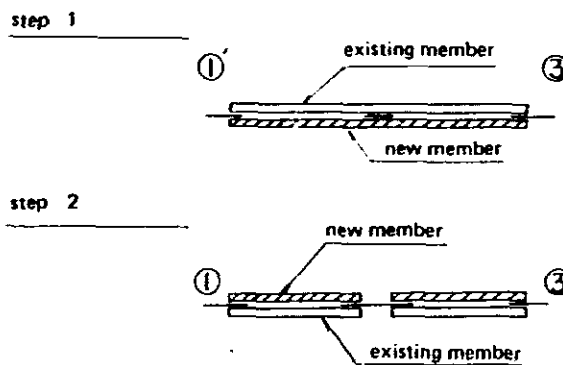
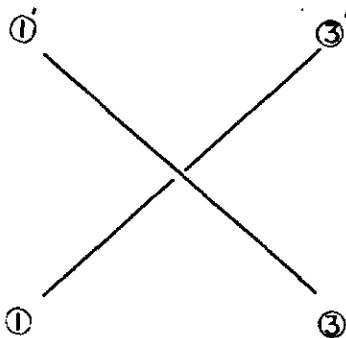
### 6-1 Strengthening of Members between Panel Points ③ and ①①

- (a) Cut off the rivets of gusset plates at the intersection point and replace the old gusset-plates with new ones.
- (b) Attach hangers to the lower laterals and fasten them with high-strength bolts.

### 6-2 Strengthening of Members between Panel Points ① and ③ and Panel Points ①① and ①②

The following procedure should be applied in addition to the method given in Para 6-1.

- (a) Drill new holes on the existing angles.
- (b) Cut off rivets connecting the gusset plates of lower chords and fix them with temporary bolts.
- (c) Attach new angles between Panel Points ①' and ③ by loosening the temporary bolts on old angles and retightening the temporary bolts, which should be replaced with high-strength bolts.
- (d) Add new angles between Panel Points ① and ③' in the same method as in Paragraph c).



### 6-3 Brake Truss

Brake truss is to be installed between Panel Points ⑦ and ⑨.

## 7. Floor Beams

The following improvement work is carried out for floor beams.

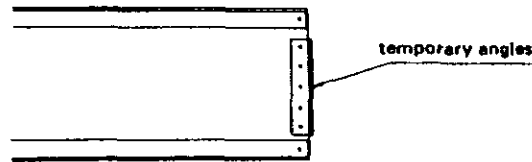
### 7-1 End Floor Beam (Replacement of flange)

- (a) Drill new holes through the web plate of floor beam, cut off rivets for connection with the lower chord, add new members and drive new rivets.
- (b) Cut off rivets of lower flange and replace them with temporary bolts.
- (c) Complete replacement within two hours during which it is allowed to close the operating line, including removal of the existing members, cleaning, installation of new members and fixing them with temporary bolts.
- (d) Replace the temporary bolts with high-strength bolts.

### 7-2 Intermediate Floor Beam (Replacement of flange and repair of web plate)

- (a) Cut off rivets for connection with the lower chord and replace them with temporary bolts.

- (b) Replace the connection angles with temporary ones.



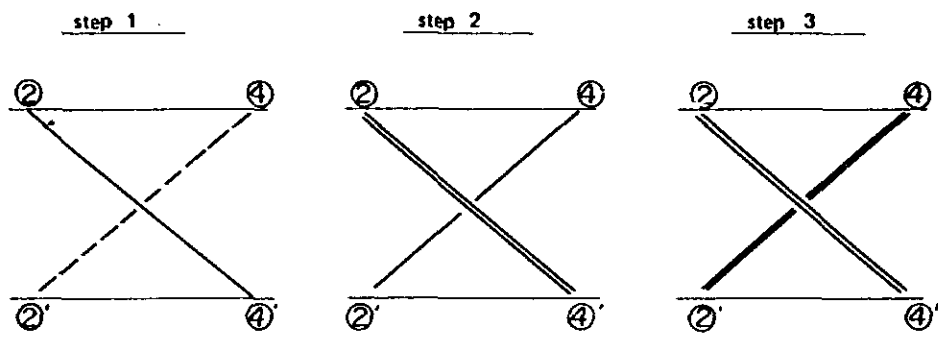
- (c) Replace the old lower flanges with new ones in the same procedure as in Paragraph 7-1, "end floor beam".
- (d) Replace the temporary angles with new connection angles and rivet them together.
- (e) Repair of a corroded web plate is to be carried out as follows;
- 1) Strike the corroded part of the web plate to get rust off.
  - 2) Drill new holes on the web plate.
  - 3) Cut off the rivets of the flange angles which are wrapped by the patch plates.
  - 4) Install plates after cleaning and fix them with temporary bolts.
  - 5) Replace the temporary bolts with high-strength bolts.

#### 8. Stringer

- (a) The railway track is to be supported with temporary rail girders on other devices.
- (b) Improvement of the connections of stringers with floor beams should be firstly carried out by the same procedure as for the floor beam.
- (c) Drill new holes for struts on the web plate of stringer.
- (d) Remove the existing strut and fix the strengthening angles with temporary bolts.
- (e) Fix the new struts with temporary bolts.
- (f) Replace the temporary bolts with high-strength bolts.
- (g) Fasten the lower lateral members with the strut by means of a hanger leaving a distance of 190mm between the member and the strut.

#### 9. Upper Lateral Member

- (a) A full-width staging should be provided as in the case of strengthening of lower lateral members.
- (b) Drill new holes in the existing members.
- (c) Cut off the rivets at the intersection point of lateral members and remove the filler plates.
- (d) Insert new gusset plate into the intersection point and fix it with temporary bolts.
- (e) Cut off the connection rivets on the upper chord side and fix the member with temporary bolts.
- (f) Remove angles between Panel Points (2) and (4), cut off them to obtain a required length and drill holes on them, and then reinstall them original place.
- (g) Attach new angles between panel Points (2) and (4).

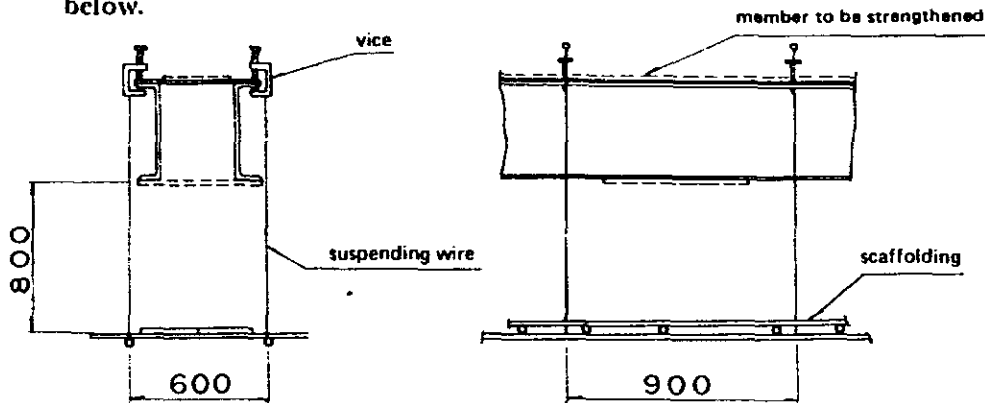


- (h) Attach new angles between Panel Points (2) and (4) , and tighten the entire upper lateral member with high-strength bolts.

11. Instruction for Repair and Strengthening of Cleveland Types ; 50m(T.T.), 60m (T.T.) and 70m (T.T.)

1. Upper Chord

(a) A full-width staging should be provided beneath the upper chord as illustrated below.



1-1 Strengthening of Upper Chord

- (a) Clean the contact surface of strengthening plate to be attached and cut off the rivets of upper flange plate which are wrapped by the strengthening plate.
- (b) Install the strengthening plate and drill new holes on the original flange plate.
- (c) Tighten them with high-strength bolts.

1-2 Installation of Tie Plate

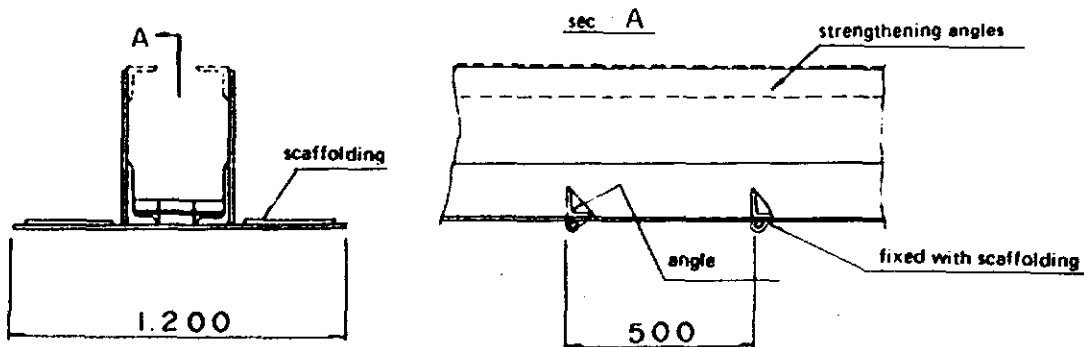
- (a) Replace lacing bars with the plates after strengthening the upper flange, and then tighten them with high-strength bolts.
- (b) As for other works, refer to the instructions in Paragraph I, Chapter I, "upper chord."

2. End Post

(a) All the instructions in Paragraph I "upper chord" are applicable.

3. Lower Chord (Strengthening of member and installation of tie plate)

(a) A full-width staging should be provided Panel Points between (7) , (9) and (11) , and partial stagings for other panels.

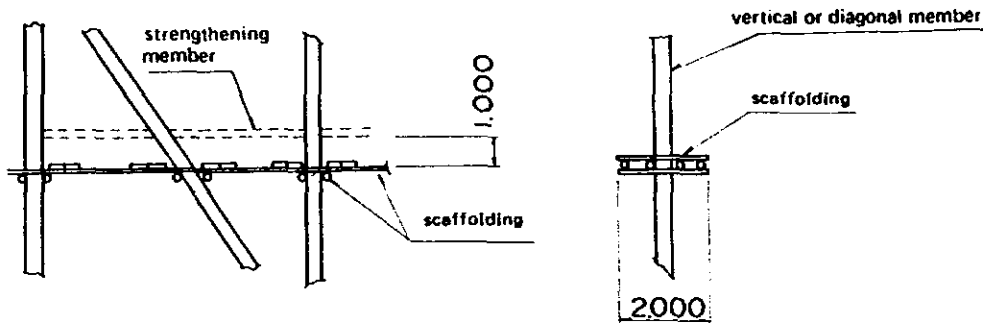




- (b) Attach strengthening angles on web plates after cleaning.
- (c) Drill new holes on the web plate, and tighten them with high-strength bolts.
- (d) All the instructions in Paragraph 3, Chapter I, "lower chord" are applicable for other works.

4. Diagonal and Vertical Members

- (a) A staging should be provided along the web members as illustrated below.



- (b) Refer to the instructions in Paragraph 4, Chapter I, "diagonal and vertical members," for strengthening of diagonal and vertical members.

(c) Installation of horizontal members.

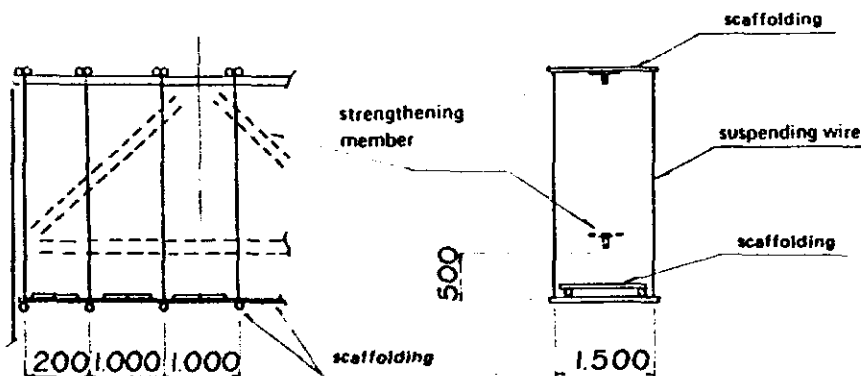
- 1) After drilling holes on web members and cleaning the contact surfaces, attach gusset plates with temporary bolts.
- 2) Install horizontal members with gusset plates and fix them with temporary bolts.
- 3) Fasten them with high-strength bolts.
- 4) Attach strengthening members to the existing diagonal and vertical members prior to install the horizontal members.

5. Portal Bracing

- (a) Refer to the instructions in the relative paragraph of Chapter I.

6. Sway Bracing (Replacement)

- (a) A staging should be provided as illustrated below.



- (b) Each members should be pre-assembled with high-strength bolts on the ground or in the bridge shop.
- (c) Remove existing members and install new ones after cleaning the contact surfaces where gusset plates are attached.
- (e) Tighten them with high-strength bolts.

7. Lower Lateral Members

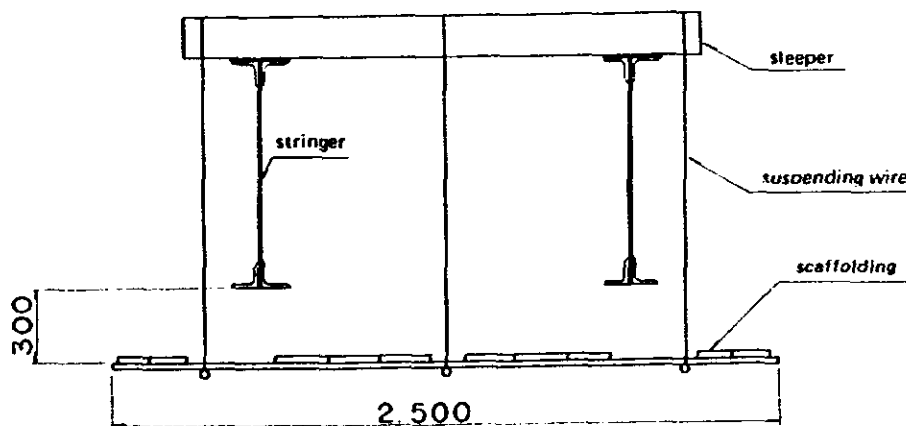
- (a) For strengthening of lower lateral members between Panel Points (5) and (13) , provide full-width stagings so that work can be performed also for stringers and floor beams. But utilize local stagings for stringers for improvement work of other lateral members.
- (b) Replace members between Panel Points (5) and (7) and between (11) and (13) in accordance with the following procedures:
  - 1) Cut off rivets of the gusset plate at the intersection point and install a new gusset plate after cleaning of its contact surface.
  - 2) Cut off rivets connecting the gusset plates of lower chord side.
  - 3) Replace the angle with a new one after cleaning and tighten it with high-strength bolts.
  - 4) Install a hanger between the strut of stringers and the lower lateral, and tighten its connection bolts.
- (c) Install brake trusses in front and rear of the floor beam at Panel Point (9) .

8. Floor Beam

The instructions in Par. 7-1 and Par. 7-2 of Chapter I should be applied.

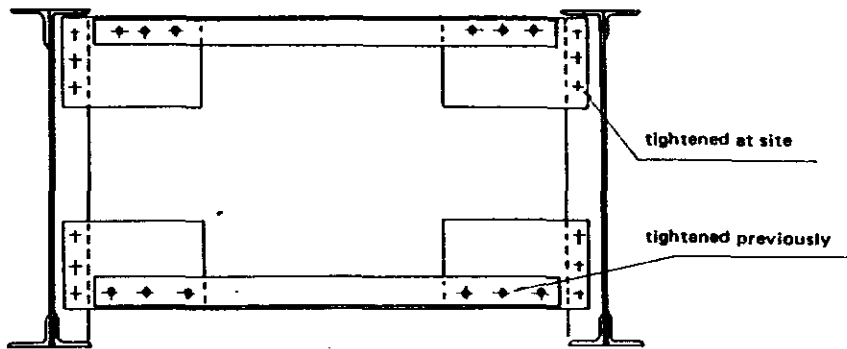
9. Stringer

- (a) A staging should be provided for members between Panel Points (1) and (5) and between (13) and (17) .



- (b) Strengthen firstly the connection of stringer with a floor beam and then install struts.  
For strengthening the connection of stringer, refer to the relative paragraph in Chapter I.

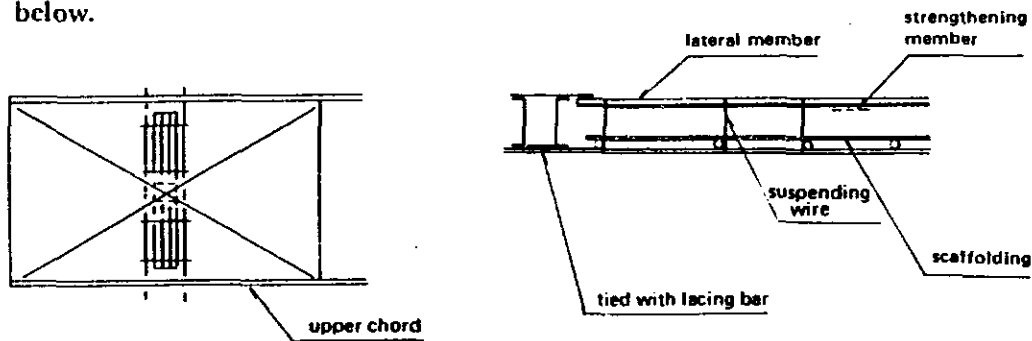
- (c) For installation of the struts between stringers on both sides, attach vertical angle steels on the web plates by high-strength bolts. Prior to it some rivets of the flanges must be cut off.
- (d) Install firstly the horizontal angle steels for the strut having gusset plates at their ends and then diagonal angle steels.
- (e) Tighten them with the vertical angles on the stringer web by high-strength bolts.



- (f) Lastly tighten the connection bolts of the struts and with the upper flanges of the stringers.

10. Upper Lateral Members

- (a) A partial staging should be provided beneath the upper lateral members as illustrated below.



- (b) For the improvement work, the instructions in Para. 6 of Chapter I "lower lateral member" should be adopted.

### III. Instructions for Strengthening and Repair of Day& Type ; 30m (T.T.)

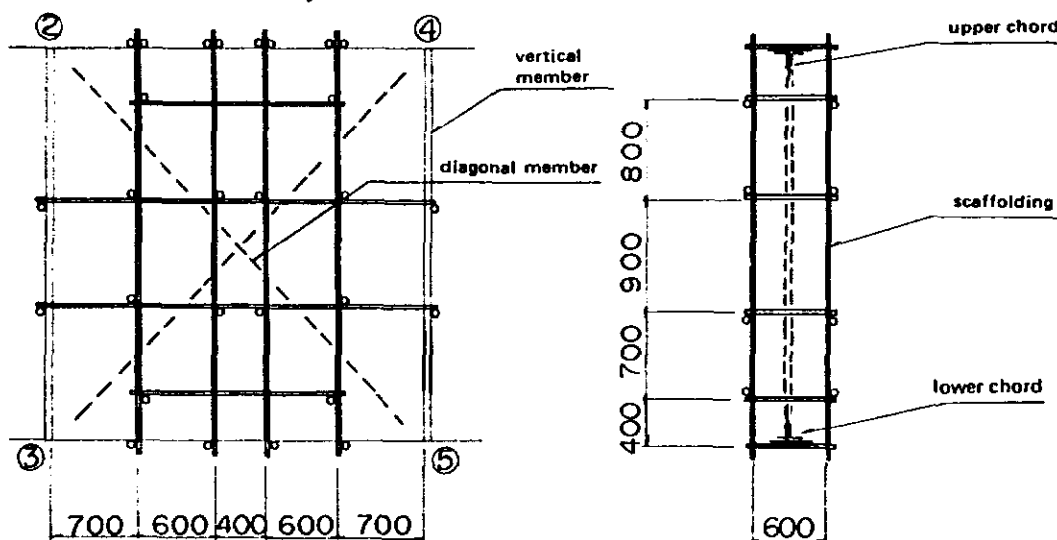
#### 1. Main Truss

In this bridge, the diagonal members are weak, requiring strengthening, while the upper and lower chord members and vertical members are strong enough.

Since there are a number of bridges of this type over the country, a strengthening methods which does not interfere with operation of trains is to be recommended.

#### 1-1 Diagonal Members in the Panels between Panel Points ② - ④ , ④ - ⑥ , ⑭ - ⑯ and ⑰ - ⑱ (See Fig. 6-4 of Main Report)

- (a) Multi-step stagings covering the space between the upper and lower chords should be provided as illustrated below. The stagings must be of such construction as will not interfere with the handling of structural members.



- (b) Strengthening work shall be carried out from the end panels to the central ones.
- (c) Cut off rivets of the filler plate at the intersection point of the diagonal members and replace it with a new gusset plate.
- (d) Cut off the rivets for connection with chord members and replace them with high-strength bolts temporarily.
- (e) Remove one of the angles in Member ② - ⑤ , cut it into two, drill new holes and reinstall them after cleaning it.
- (f) Attach strengthening plates to Member ② - ⑤ .
- (g) Attach two new angles to Member ④ - ③ after cleaning it.
- (h) Remove the remaining angles in Member ④ - ③ , drill new holes in them, clean and reinstall them.
- (i) Insert filler plate to the opening between the angles, if necessary, and tighten by high strength bolts.

#### 1-2 Diagonal Members in Pannels between Panel Points ⑥ - ⑧ , ⑧ - ⑩ , ⑩ - ⑫ and ⑫ - ⑭

The strengthening method is essentially the same as mentioned in 1-1. But the existing angles are also to be replaced with new ones, because they are too narrow for installation of high-strength bolts.

The holes which are not required should be filled with ordinary bolts.

## 2. Lower Lateral Member

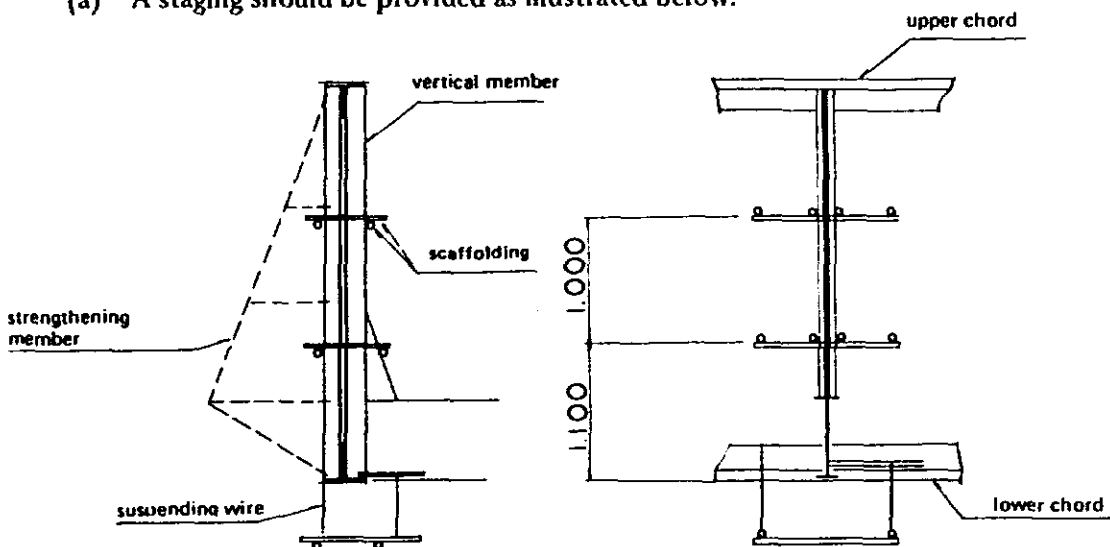
- (a) The same requirements as for Chapter I are applicable to the stagings ;
- (b) Cut off rivets of filler plate at intersection point and replace it with a new gusset plates.
- (c) Cut off all the rivets for connection with the lower chord members and install temporary bolts.
- (d) Replace the existing angles in Member ① - ③' and ①' - ③ with new angles.
- (e) At Panel Points ⑦ , ⑨ , ⑪ , ⑬ and ⑮ install new gusset plates before replacing the existing angles with new ones.

## 3. Stringer

- (a) Almost all the instructions for Chapter I are applicable to the work for stringers.

## 4. Knee Bracing

- (a) A staging should be provided as illustrated below.



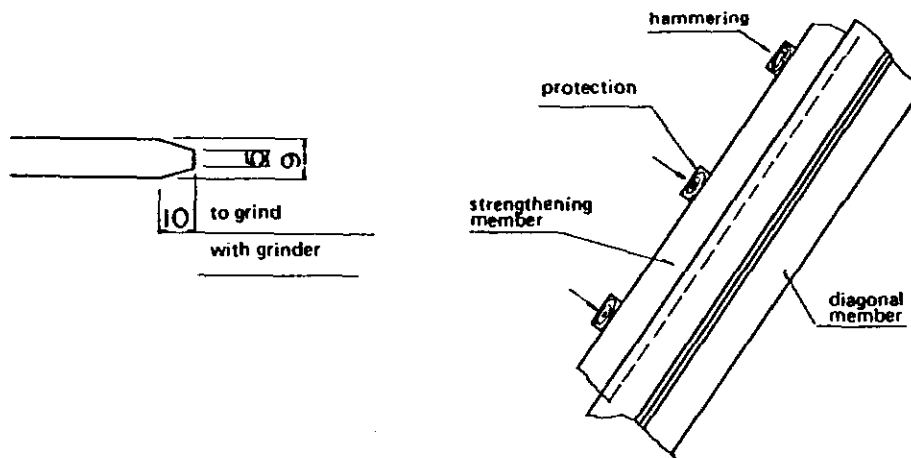
- (b) Drill new holes on vertical member and clean its contact surface.
- (c) Because the weight of each set of the strengthening structures is as small as about 200kg, the strengthening structure can be formed beforehand, and attached to the bridge.
- (d) Install the pre-fabricated strengthening to the vertical member and fix it by temporary bolts.
- (e) Strengthening of the floor beam is to be carried out after completion of the above-mentioned work.

#### IV. Instructions for Strengthening and Repair of Daydê Type; 40m (T.T.)

##### 1. Diagonal Member (Strengthening of member)

- (a) Staging should be erected over the entire height of the bridge.
- (b) Strengthening works for members in the panels between Panel Points (2) - (4) , (4) - (5) , (11) - (13) and (13) - (14)
  - i ) Cut off rivets which are required to be replaced, and install temporary bolts. But use of high-strength bolts is required for portion where stress is to be transmitted.
  - ii ) Remove the existing tie plates.
  - iii) Install new strengthening plates one by one.

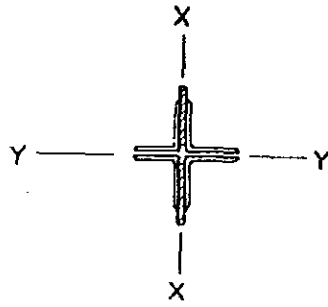
Each new strengthening plate is about 5m long and 9mm thick. To insert the plate into a 10mm opening between angles, shape its edge by grinding as illustrated below and hammer the plate uniformly over its entire length through timber protection blocks placed on the other edge of the strengthening plate.



- iv) Install splice plates and tighten with rivets.
- (c) Executing Sequence for Work for Members between Panel Points (5) and (7) and between (10) and (11) .

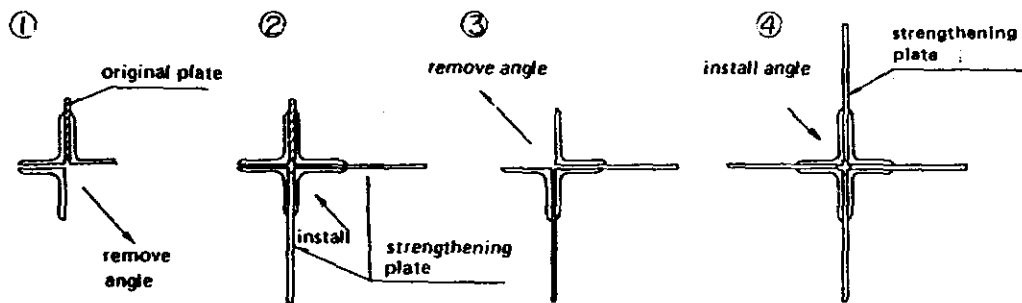
The same procedure as described in i), ii) and iii), Item (b) for Diagonal Member should be adopted.

  - i ) Enlarge the existing rivet holes to a diameter of 23.5mm for new rivets having a diameter of 22mm.
  - ii ) Install the strengthening angles.
- (d) Executing Sequence for Work for Members between Panel Points (7) and (8) and between (8) and (10) .



For Axis Y-Y, follow the same procedure as described in Item (b). However, the removal of the existing plate along Axis X-X is difficult under the existing condition. Therefore, the work must be executed in the following method:

- i ) Cut off the stitching rivets of the diagonal member and replace them with temporary bolts.
- ii ) Remove the existing tie plates.
- iii) Remove one of the four angles composing the member and also the existing plate along Axis X-X.
- iv) Reinstall the removed angle together with new strengthening plates along Axis X-X and Y-Y.
- v ) Fit strengthening plates to the remaining angle of diagonal member, in the same procedure as described in iii) and iv) above.
- vi) Perform the operations in iii) and iv) above during a two-hour train interval.  
The sequence of replacement is shown below.

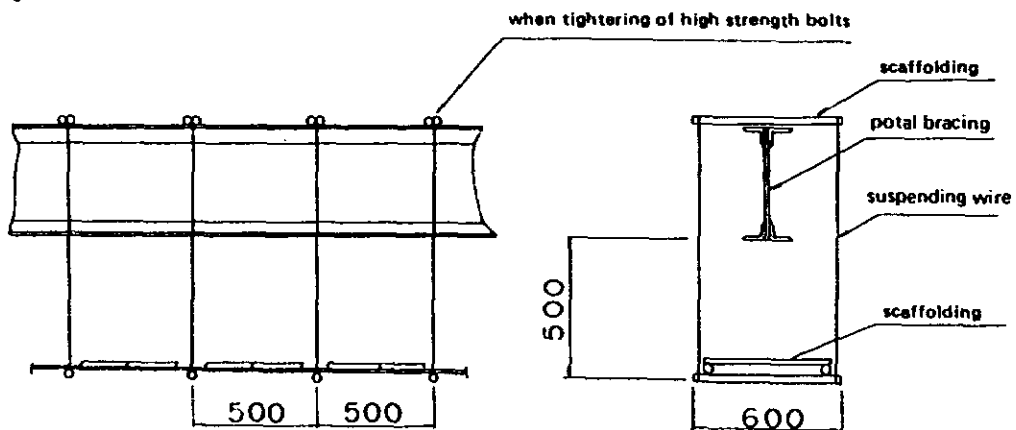


2. Vertical Member (Strengthening of members between Panel Points ② and ③ and between ⑭ - ⑮).

- (a) A staging should be erected over the entire height of the bridge.
- (b) Mark off the vertical member from outside using the same scale as for manufacturing of the strengthening plates and drill holes on them.
- (c) Install angles and tighten them by high strength bolts after cleaning.
- (d) Leave the connection of the corner strengthening parts of the portal and the floor beam untightened with high strength bolts.

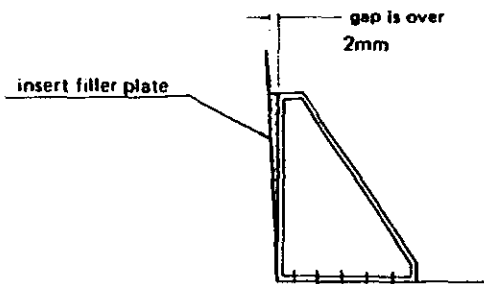
3. Portal Bracing

(a) A staging should be suspended as illustrated below.



(b) The same procedure as described in Items (b) and (c) of Section 2 "Vertical Member" should be adopted for installation of strengthening angles.

(c) In installing strengthening members at corners, insert fillers if an opening of over 2mm occurs.



4. Lower Lateral Member

(a) The same procedure as described in Item (d) of Section 6 "Lower Lateral Member" Chapter I should be adopted for strengthening of member between Panel Points ① and ③ and between ⑱ and ⑳ .

(b) The same procedure as for Chapter IV for strengthening of the other Panel Points.

5. Stringer

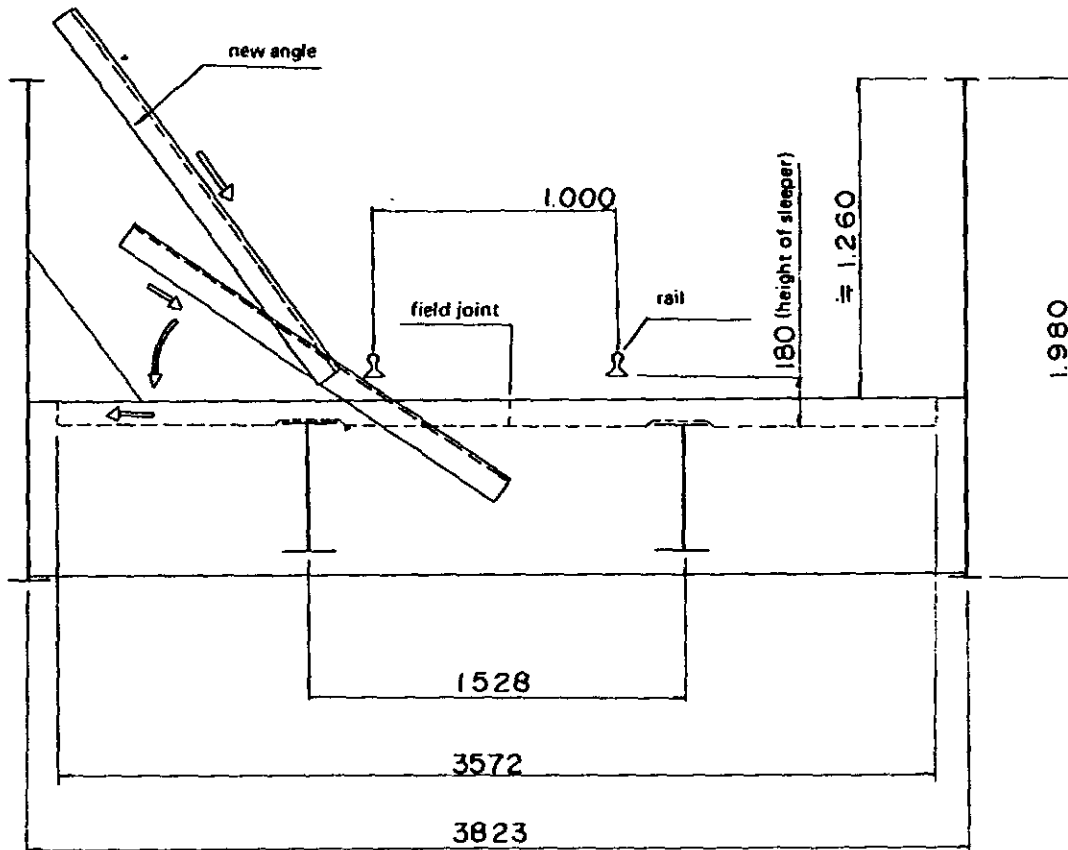
(a) Same procedure as for Chapter II is applicable only for installing of struts.



## V. Instructions for Strengthening and Repair Cleveland Type ; 20m (T.P.)

### I. Floor Beam

- (a) A full-width staging should be provided beneath the bridge which can be used also for improvement works for stringers and lower lateral members.
- (b) Strengthening work for lower flange and upper flange should not be executed at the same time.
- (c) Repair for corroded parts of the web plate should be done after the works on the lower and upper flanges are completed.
- (d) The temporary bolts inserted to the holes of the flange angles which are to be wrapped by patch plate for repair of corroded portion of the web plate should be replaced with high-strength bolts, when the patch plates are attached.
- (e) The same procedure as described in Items (b), (c) and (d) of "End Floor Beam" Chapter I should be adopted for treatment of the lower flange.
- (f) For repair of corroded portions, refer to the procedure in Section 7, "Floor Beam" Chapter I.
- (g) The procedure for replacement of the upper flange is as follows.
  - i ) Move sleepers 400mm away from edges of the flange plate.
  - ii ) Cut stitching rivets and replace them with temporary bolts and drift pins. Move the sleeper on one side 500mm away to permit the use of a corner drill.
  - iii) If a train is to pass during the above work, place a temporary packing between the sleeper and the flange to support the tracks.
  - iv) Carry out the works for replacement of the flange described in v), vi) and vii) below within a two-hour train interval.
  - v ) Remove the existing angles and install new angles.
  - vi) The new angles are to be provided with joints in the middle, to make it possible to be inserted between the rail and stringer diagonally from outside the track and then to be placed horizontally for installation in position.
  - vii) Install splice angles and fasten them with temporary bolts.
  - viii) Tighten the flange angles and web plates with high strength bolts.
  - ix) Cut the original angles in half and remove them into the reverse procedure for installation of the new angles.



2. **Stringer**

- (a) The same procedure as described in Paragraph 8 of Chapter I is applicable to the improvement work of stringer.
- (b) Remove the existing struts after the new strut has been installed.

3. **Lower Lateral Member**

- (a) The same procedure as described in Chapter IV is applicable to the improvement work for the lower lateral members.

## VI. Instructions for Strengthening or Repair of Deck Truss; 30m (D.T.)

### 1. Upper Chord Member

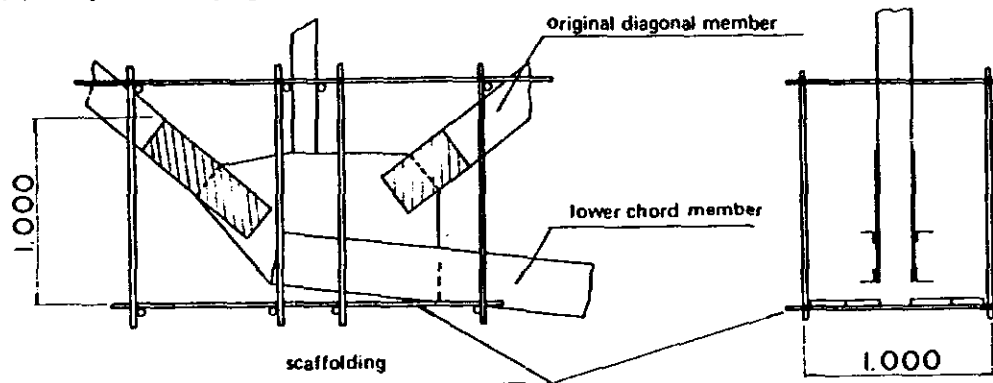
- (a) A full-width staging for the members between Panel Points ④ and ⑬ and partial stagings for other members should be provided.
- (b) The same procedure as described in Chapter I should be adopted for repair of the members between Panel Points ① and ④ and between ⑬ and ⑯ .
- (c) Mark on the upper chord to be repaired using the same scale as used in fabrication in shop and drill new holes on the original members.
- (d) Attach strengthening members to the original members and tighten them with rivets or high-strength bolts.

### 2. Lower Chord Member

- (a) A full-width staging for the members between Panel Points ⑥ and ⑫ and partial stagings for the other members should be provided.
- (b) The same procedure as for Type B should be adopted for repair of the members between Panel Points ③ and ⑥ and between ⑫ and ⑮ .
- (c) The same procedure as described in Item (c) of Section 1 "Upper Chord Member" is to be applicable for repair of the members between Panel Points ⑥ and ⑫ .

### 3. Diagonal Connection Member

- (a) A partial stagings should be provided as illustrated below.

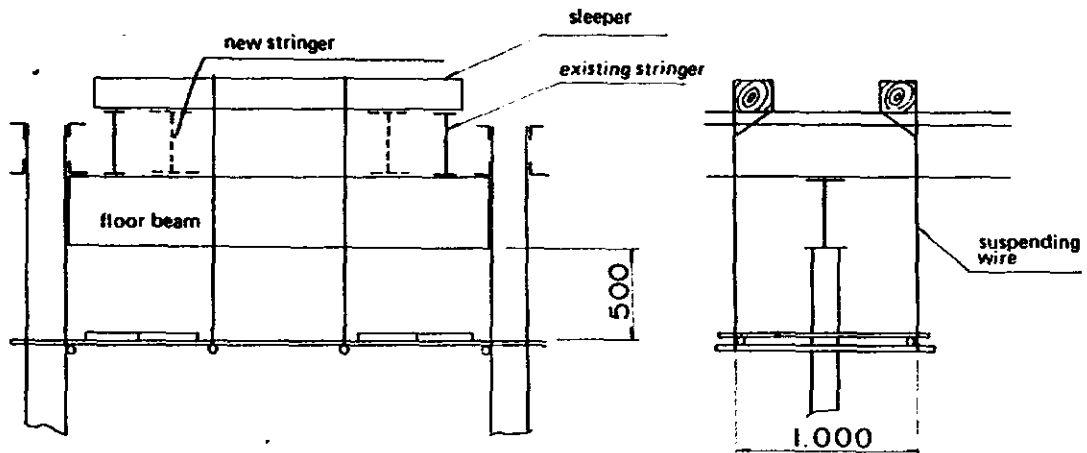


- (b) Drill new holes using the duplicate scale.
- (c) Cut off rivets and replace them with temporary bolts.
- (d) Install splice plates and filler plates and fasten them with temporary bolts.
- (e) Do the above work with respect to each side separately.
- (f) After riveting, fill the opening between gusset plates and fillers with resinous putty or zinc-rich putty.

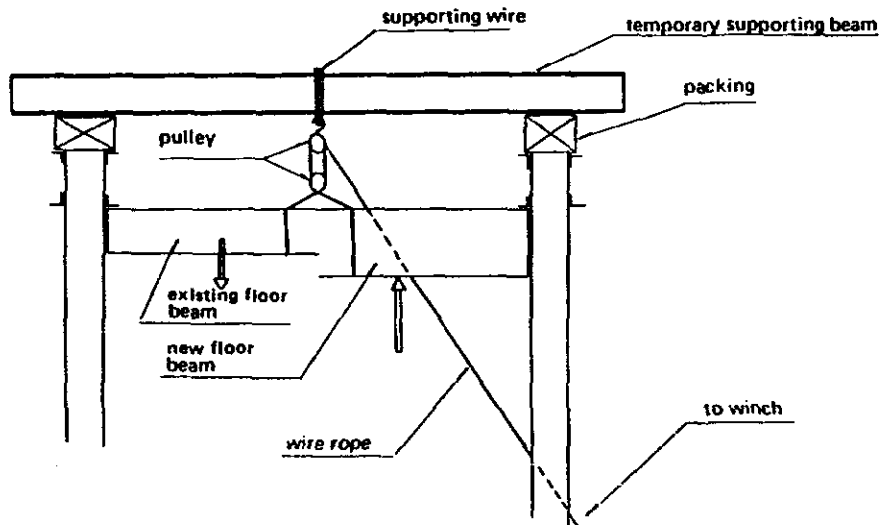
### 4. Floor Beam

- (a) A full-width staging should be provided beneath the floor beam, which can be used

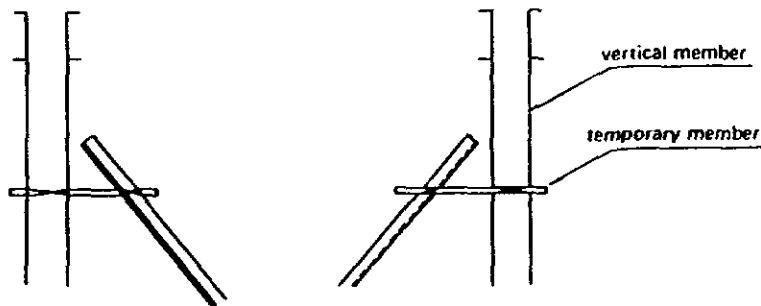
also for repairing the stringers and upper lateral members.



(b) Perform the work in accordance with the procedure as illustrated below.



- (c) Cut off the rivets connecting the floor beam with the vertical member and replace them with temporary high-strength bolts.
- (d) Provide a temporary H-shaped beam and equipment in order to remove the existing floor beam and install a new one.
- (e) Remove gusset plates of sway bracings and fix them with the vertical members temporarily.



- (f) The work for replacement of each floor beam should be carried out within a two-hour train interval.
5. Stringer
    - (a) Insert temporary packings under the sleepers.
    - (b) Cut all rivets and replace them with temporary bolts.
    - (c) Insert new stringers inside of the existing stringers from underside as illustrated in Para. 4.
    - (d) Cut the existing stringer and remove it using sleepers.
    - (e) Remove the temporary packings under the sleepers after completion of all the improvement works.
  6. Upper Lateral Member
    - (a) Replace gusset plates first.
    - (b) Perform the other operations in accordance with the procedure described in Chapter IV.
  7. Lower Lateral Member
    - (a) A full-width staging should be provided beneath the bridge.
    - (b) Drill new holes on the lower chord members for gusset plates.
    - (c) After cleaning the contact surfaces on which the gusset plates are attached, fixed them with temporary bolts.
    - (d) Install lateral angles and tighten them with high strength bolts.
  8. Sway Bracing
    - (a) A partial stagings should be provided.
    - (b) Install the new gusset plates to the floor beam.
    - (c) Drill new holes on new angles and install the angles and the gusset plates after cleaning their contact surfaces.
    - (d) Tighten them with high-strength bolts.

## **VII. Instructions for Strengthening or Repair of Daydè Type ; 80m (T.T.)**

The strengthening methods for various members are the same as described in respective past chapters.

- i ) As for strengthening of upper chord, lower chord and diagonal members, refer to Chapter I.
- ii ) As for strengthening of diagonal members by connecting with horizontal members, and strengthening of stringers and lower laterals, refer to Chapter II.
- iii) As for strengthening of upper laterals, refer to Chapter IV.

