Tacis

Rail Maintenance Central Asia:
Infrastructure Maintenance 2

Draft Final Report

July 1997

Module C / Annexes

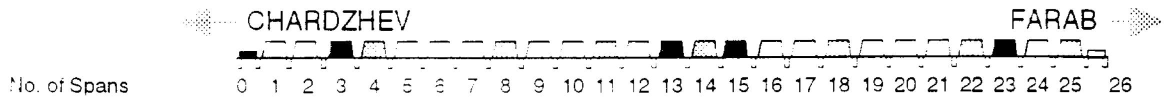
Annex A

TRACECA - MODULE C CHARDZHEV BRIDGE

ANNEX A
BRIDGE SYSTEM AND NOTATIONS

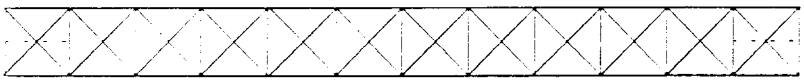
BRIDGE SYSTEM AND NOTATIONS

View in direction of river flow

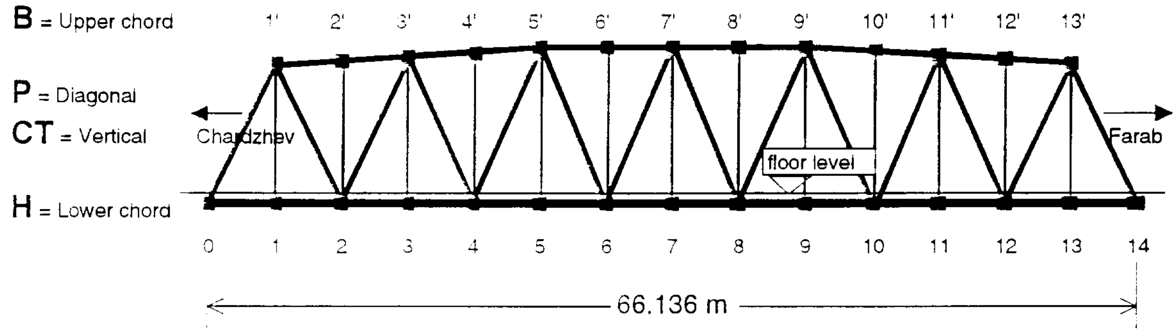


Total check   Partial check   Minor check

Upper Bracing - Plan

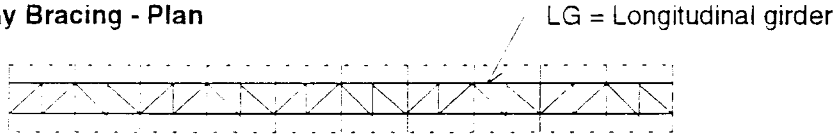


Main Girder - View

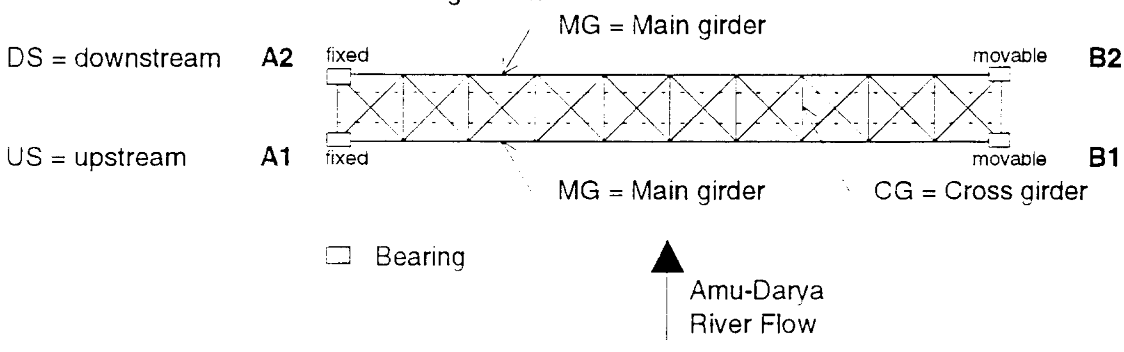


■ Nodes (gusset plates) with node numbers

Sway Bracing - Plan



Lower Bracing - Plan

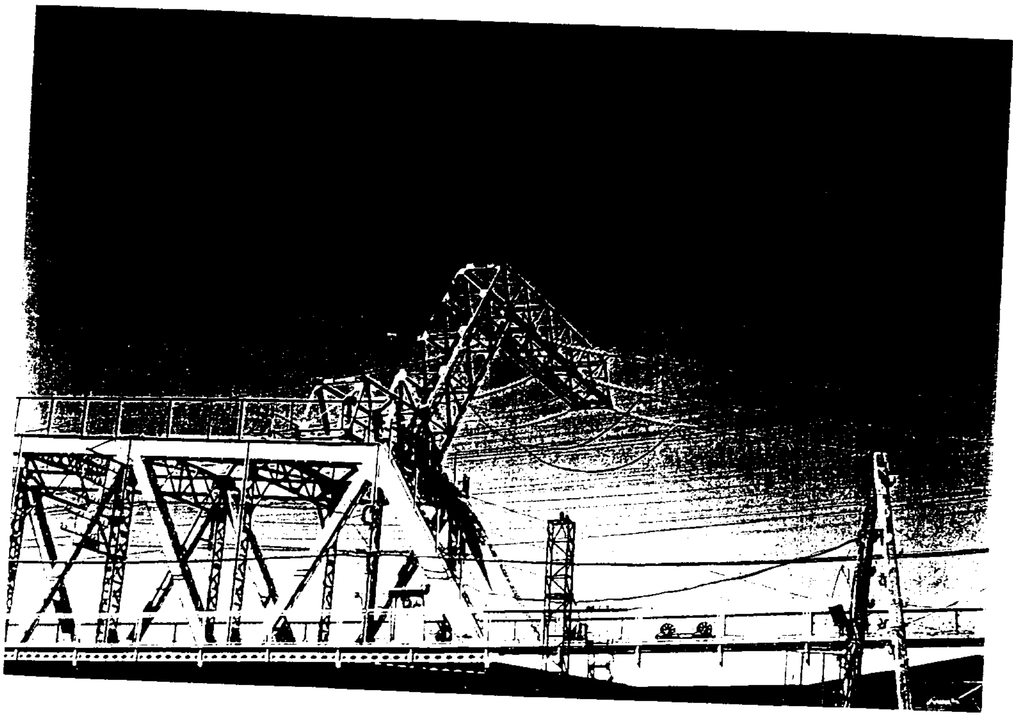


Annex B

TRACECA - MODULE C **CHARDZHEV BRIDGE**

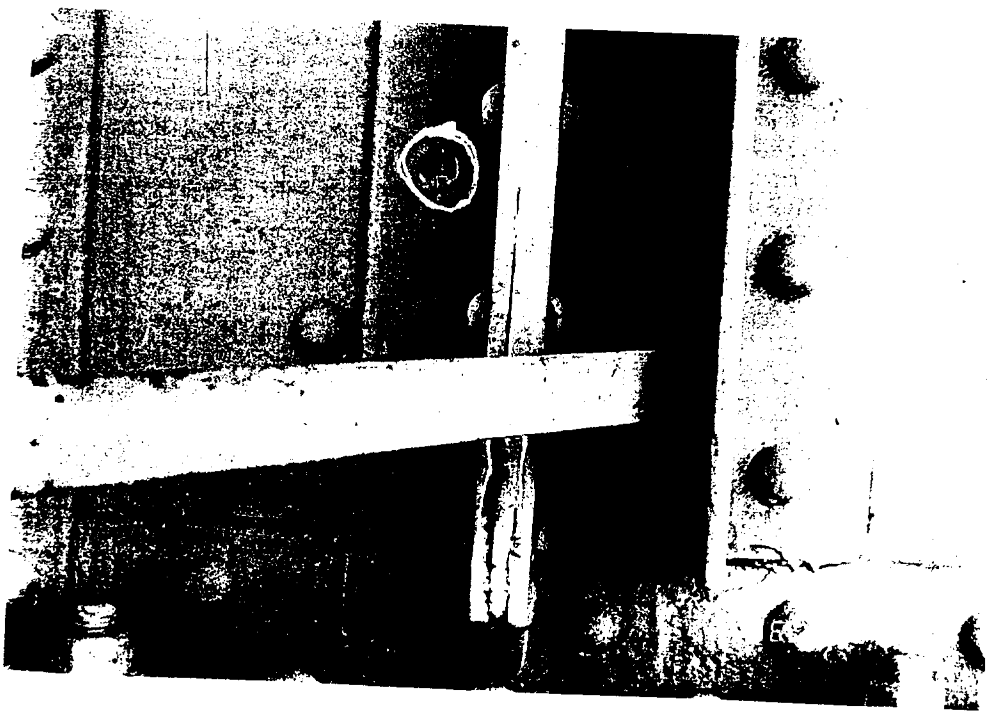
ANNEX B
PHOTOGRAPH DOCUMENTATION

containing photo pages 1 to 80



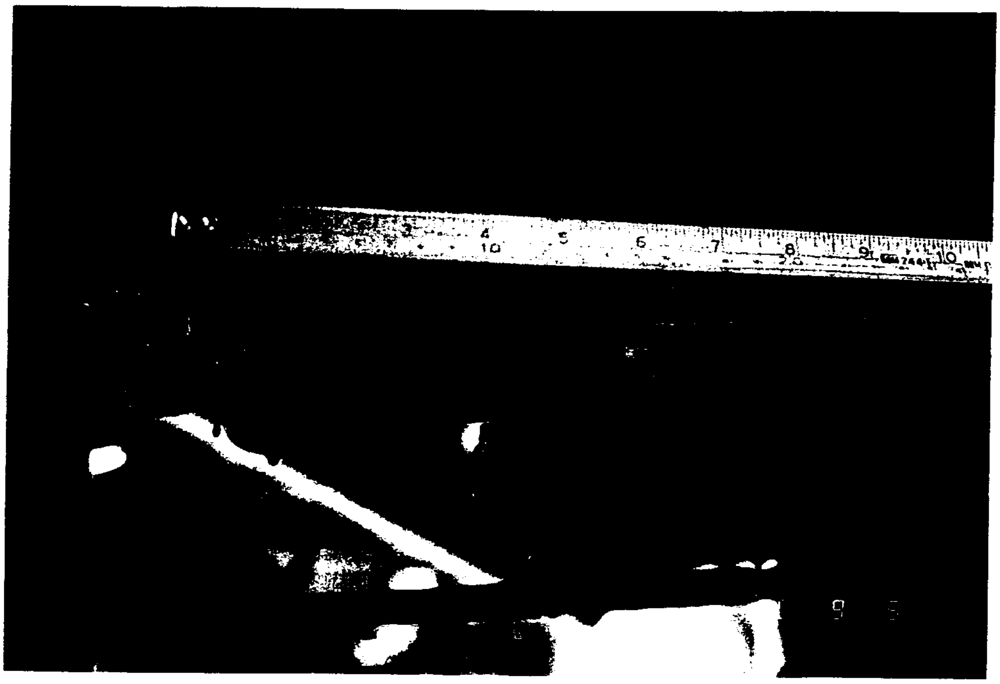
F1-08 Span 3
HV cantilever

F1-09 Span 3
Cross girder corros.

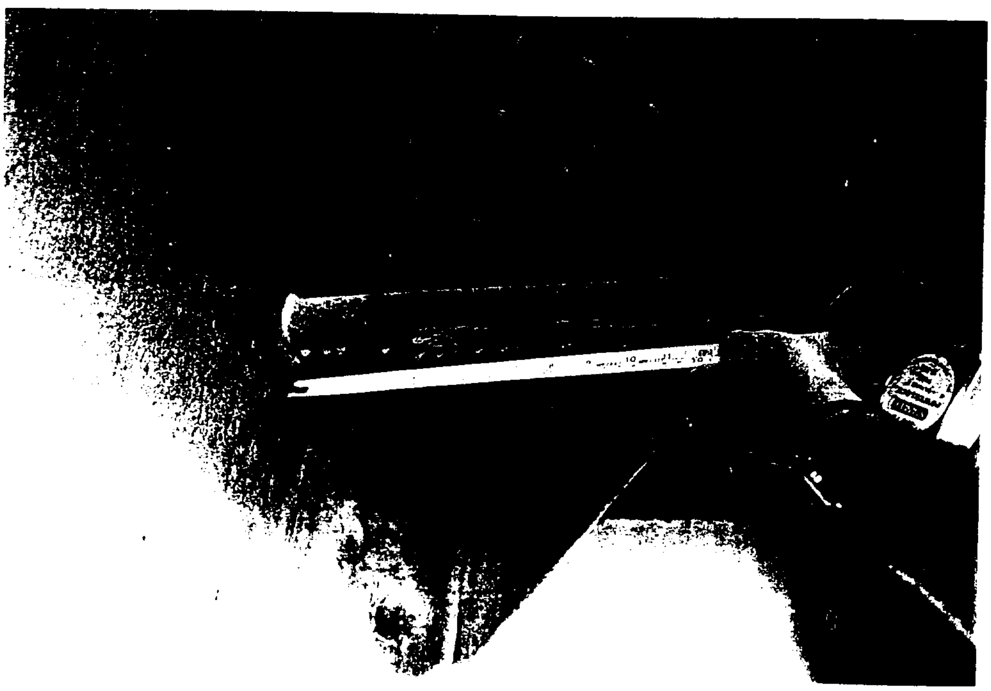


F1-10 Span 3
Cross girder
missing rivet

F1-11 Span 3
Cross girder streng-thening, as per 80% of all cross girders

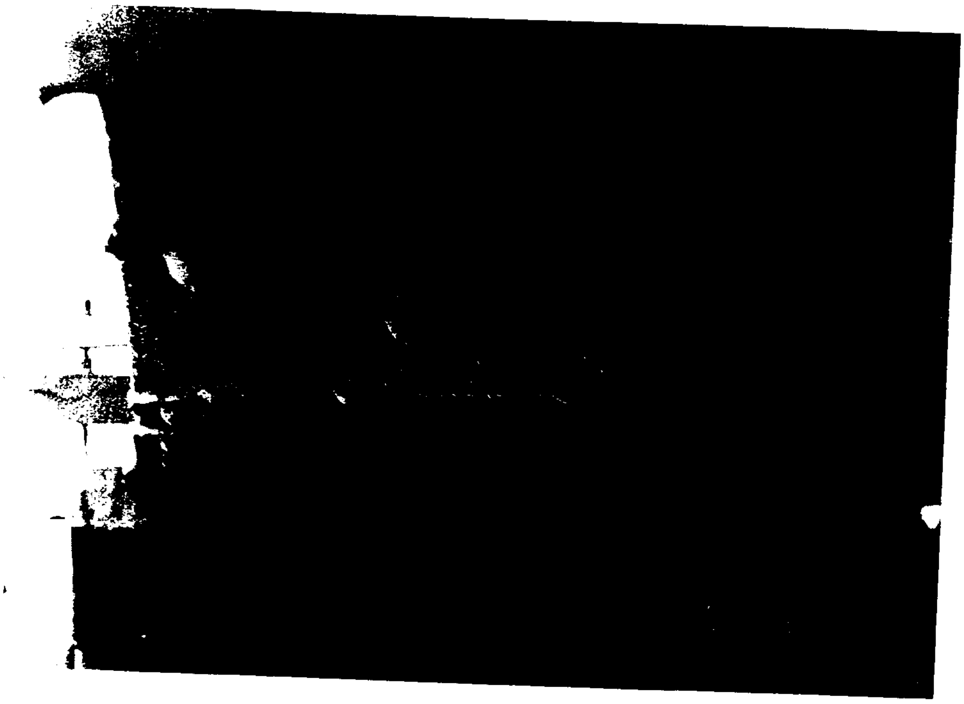


F1-12 Span 3
As F1-11, from below

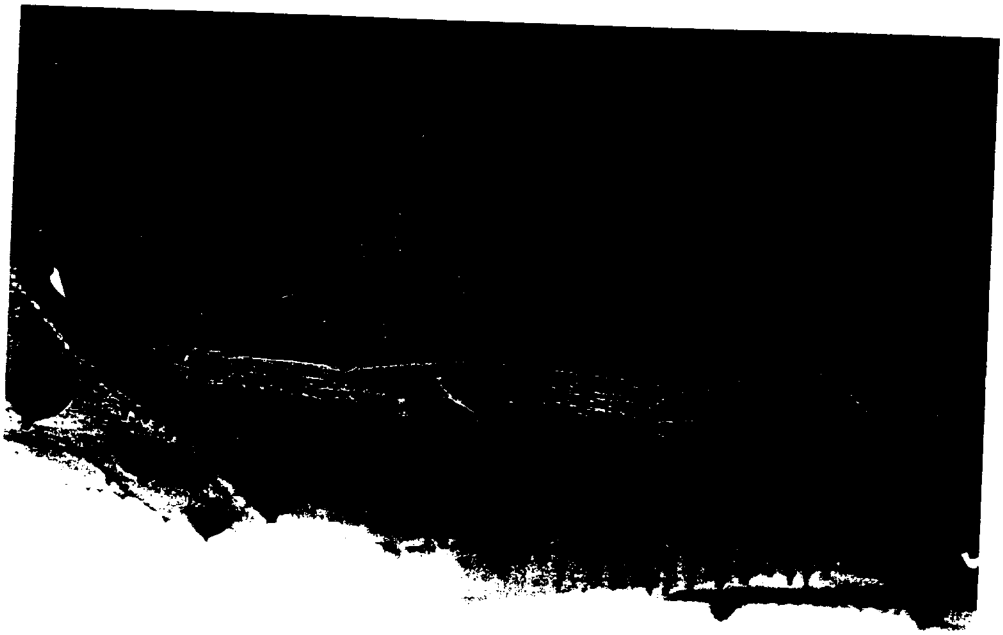


F1-13 Span 3
Longitudinal girder strengthening, cross girder perforated

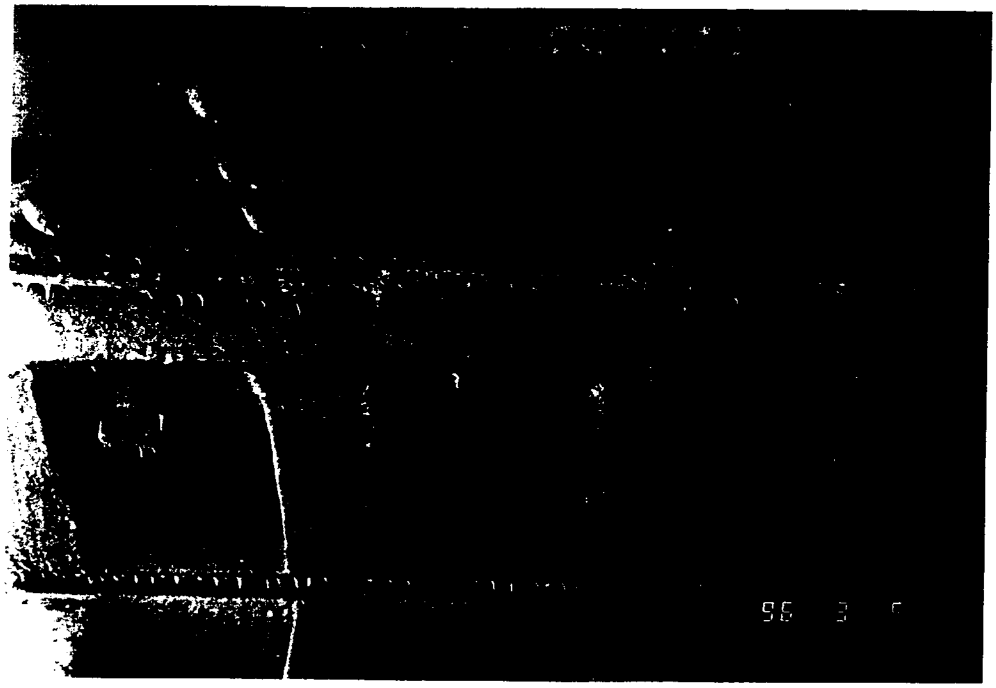
F1-14 Span 3
New runway canti-
lever girder bolted,
otherwise welded



F1-15 Span 3
Deformed LC
brackets

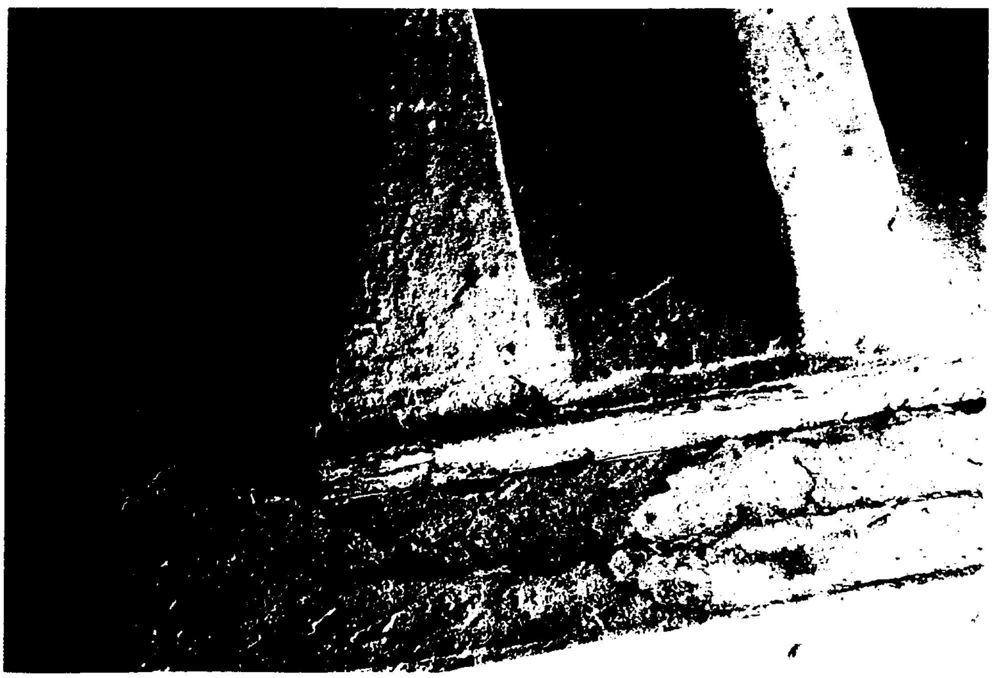


F1-16 Span 3
As F1-15, side view



F1-17 Span 3
Fixed bearing with lead inlay, sqeezed

F1-18 Span 3
All runway canti-levers DS are cut off



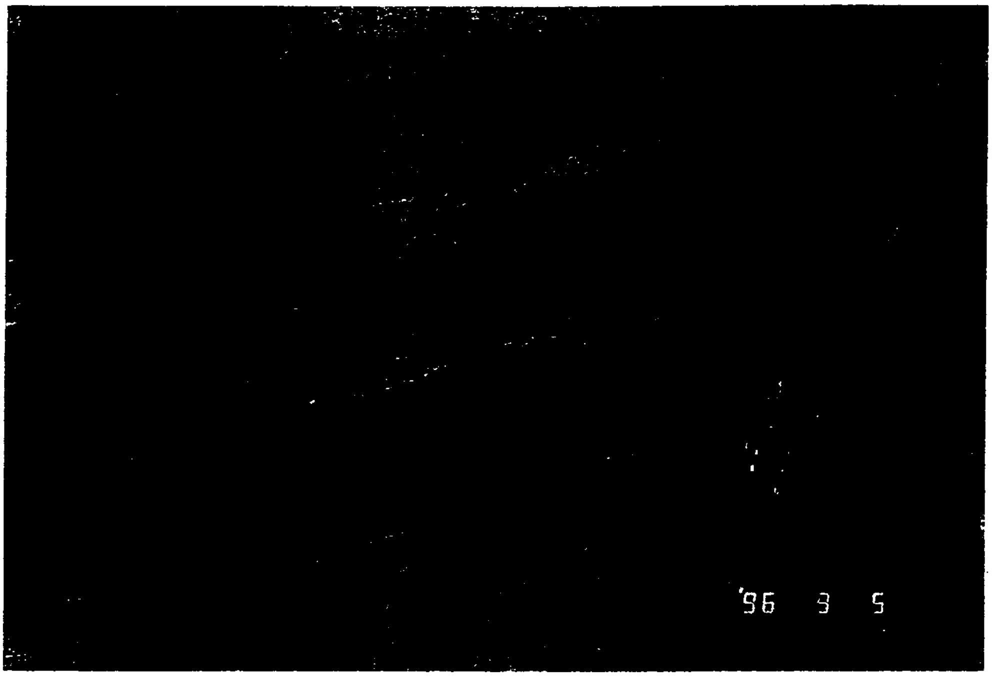
F1-20 Span 3
Fixed bearing lower part with fixing wedge

F1-21 Span 3
Corroded longitud. girder

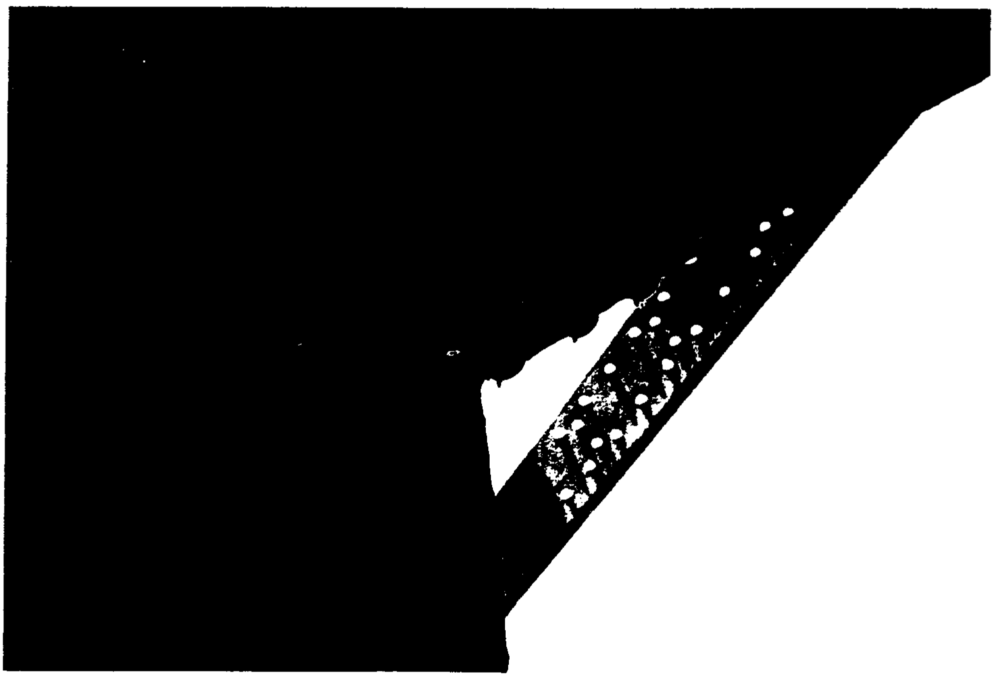
F1-22 Span 3
LC angle joint to cross girder filled up with spec.cement

F1-23 Span 3
Fixing of HV canti-lever arms

F1-25 Span 3
UC joint to cross bracing



F1-26 Span 3
UC strengthening angle corrosion

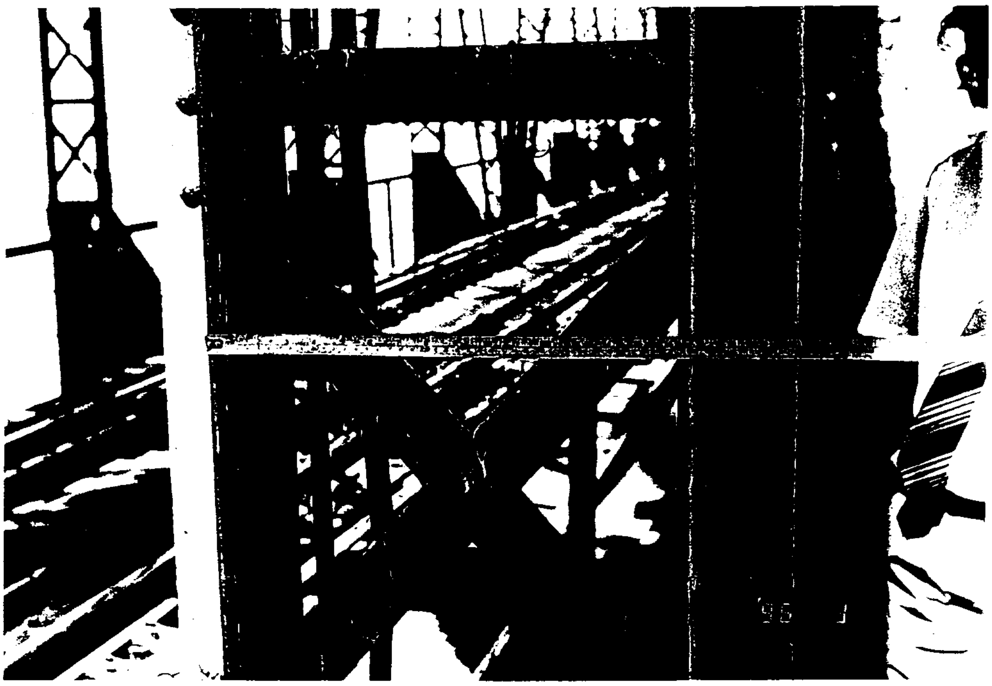


F1-27 Span 3
UC strengthening angle corrosion

F1-28 Span 3
Corrosin at diagon.

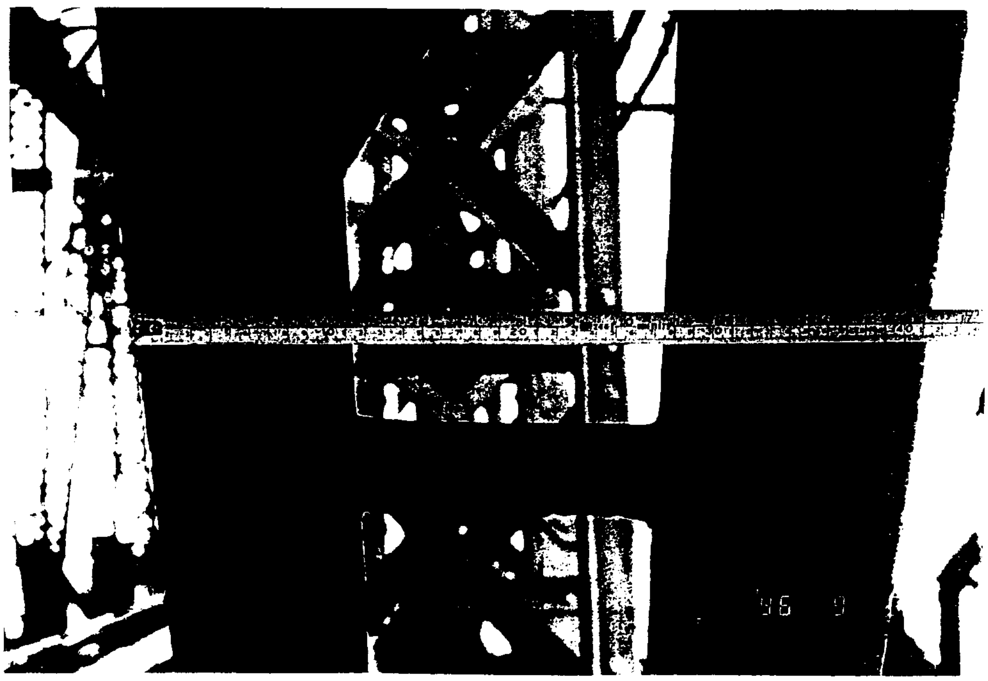
F1-29 Span 3
As F1-28

F1-30 Span 3
Runway with rails
for transport lorry

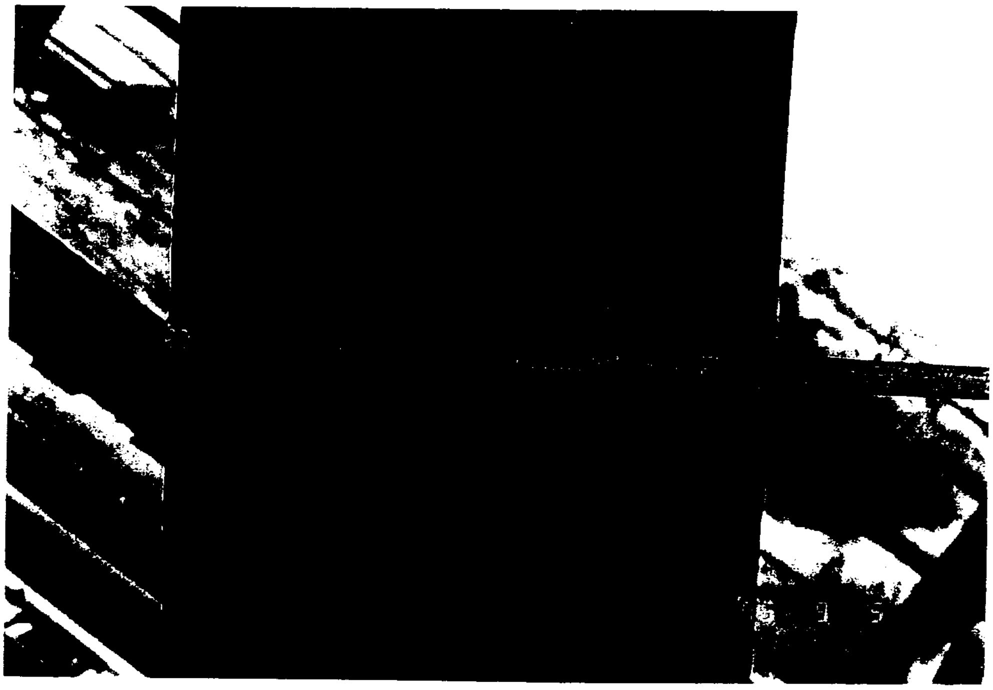


F1-31 Span 3
Vertical with bracing

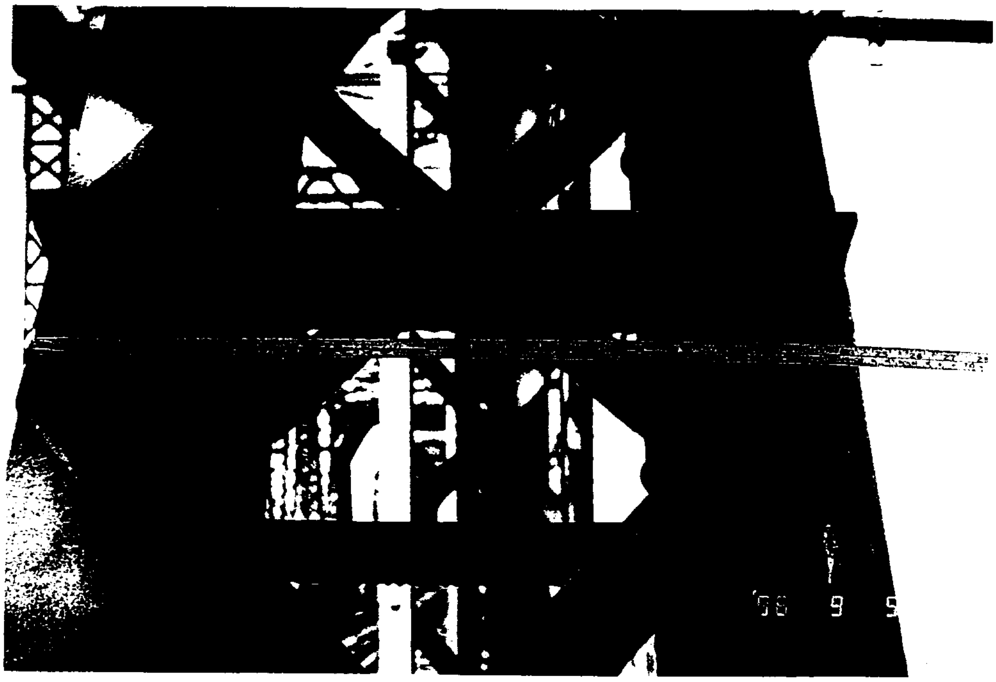
F1-32 Span 3
Vertical with cut off railing cantilever



F1-33 Span 3
Diagonal



F1-34 Span3
As F1-33

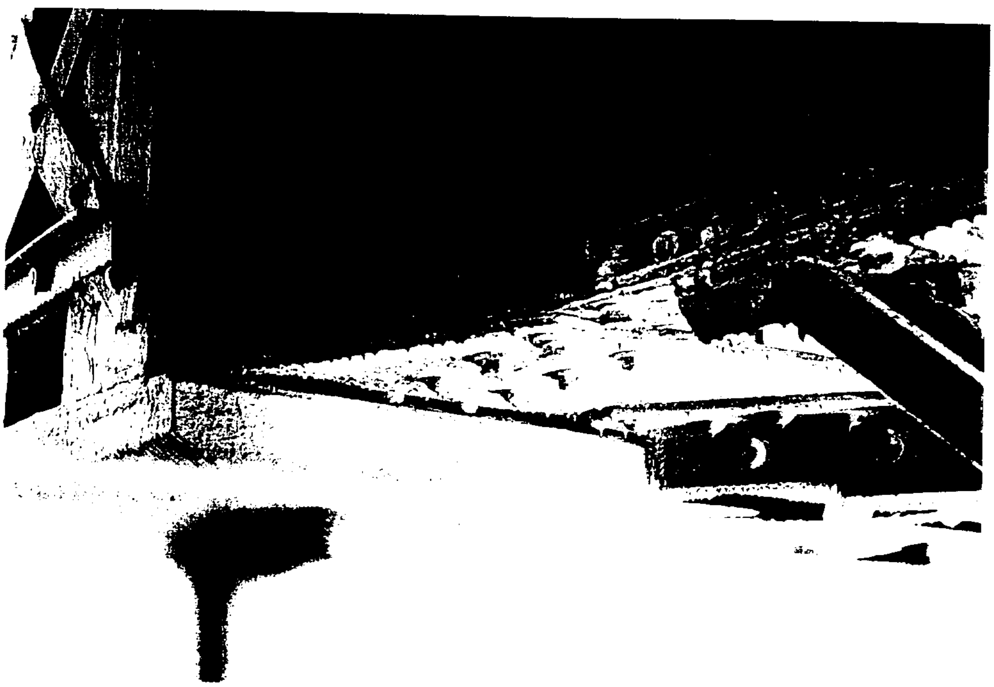


F1-35 Span 3
Diagonal

F1-36 Span 3
As F1-35

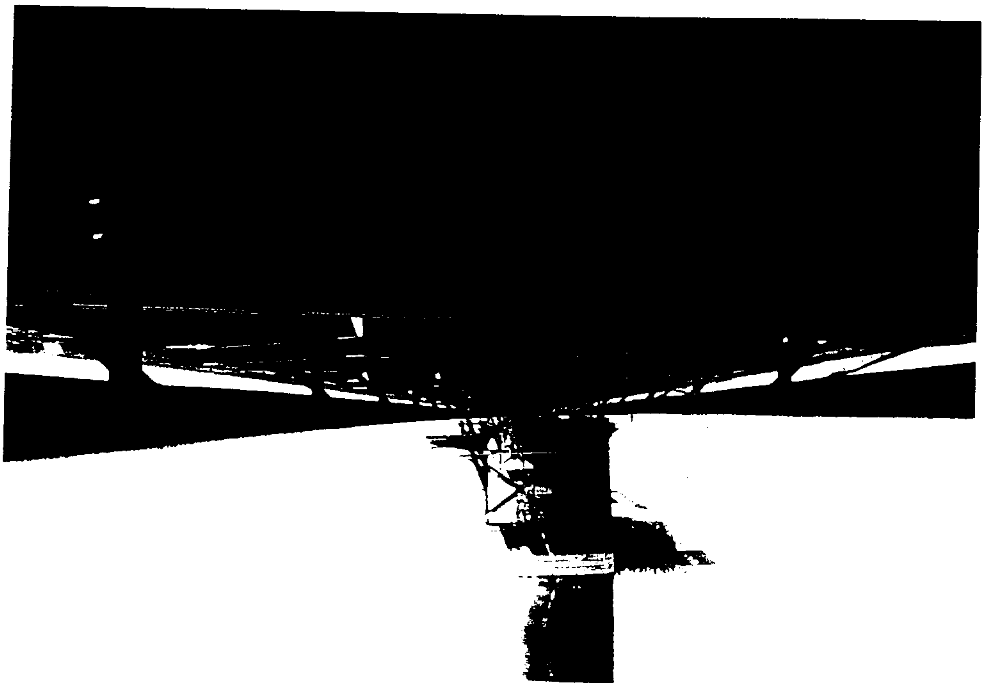
F1-37 Span 3
Diagonal

F2-01 Span 3
Movable bearing
Lower part



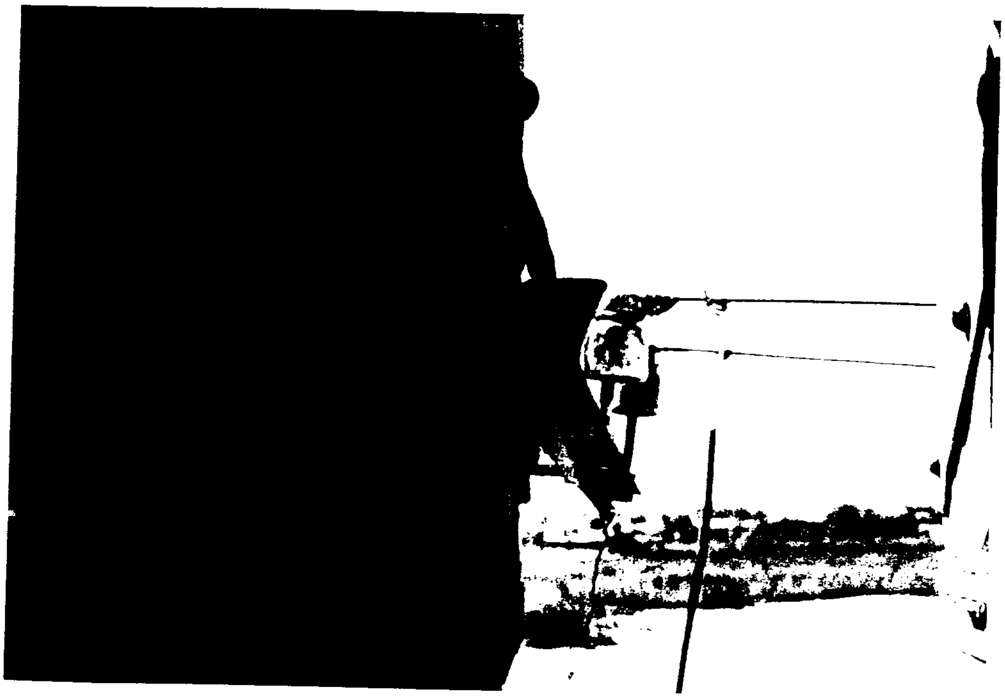
F2-02 Span 3
End cross girder
at movable bearing

F2-03 Span 3
Bearing
(flashlight defect)

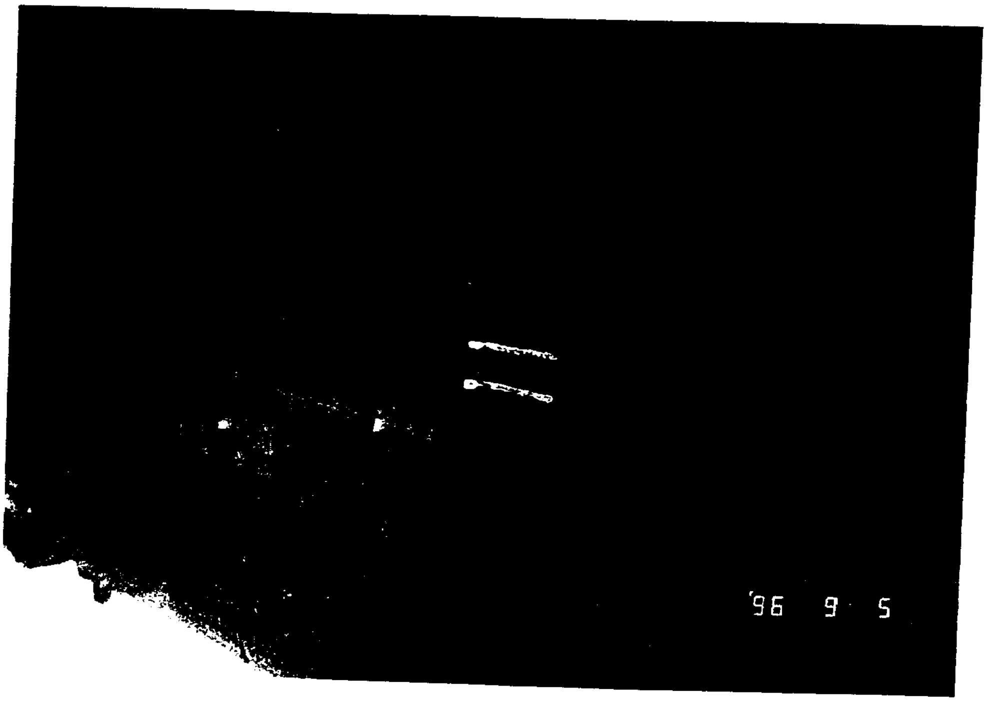


F2-04 Span 3
View from pier
with rails for
inspection car

F2-05 Span 3
Bearing with
squeezed lead inlay

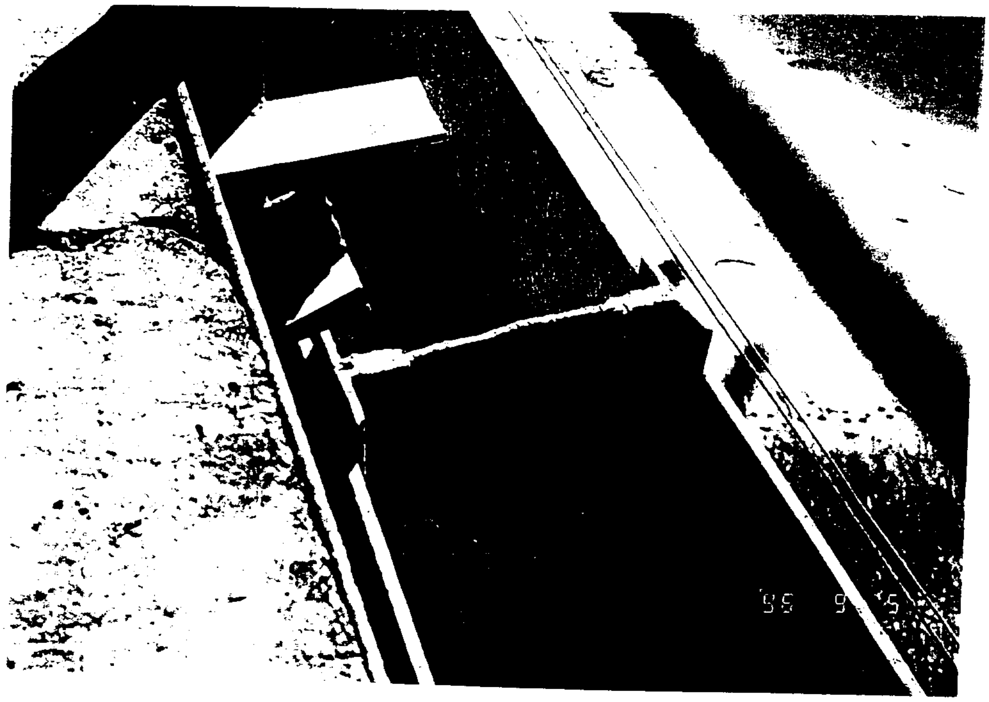


F2-06 Span 3
Angle for current conductors for ship signals



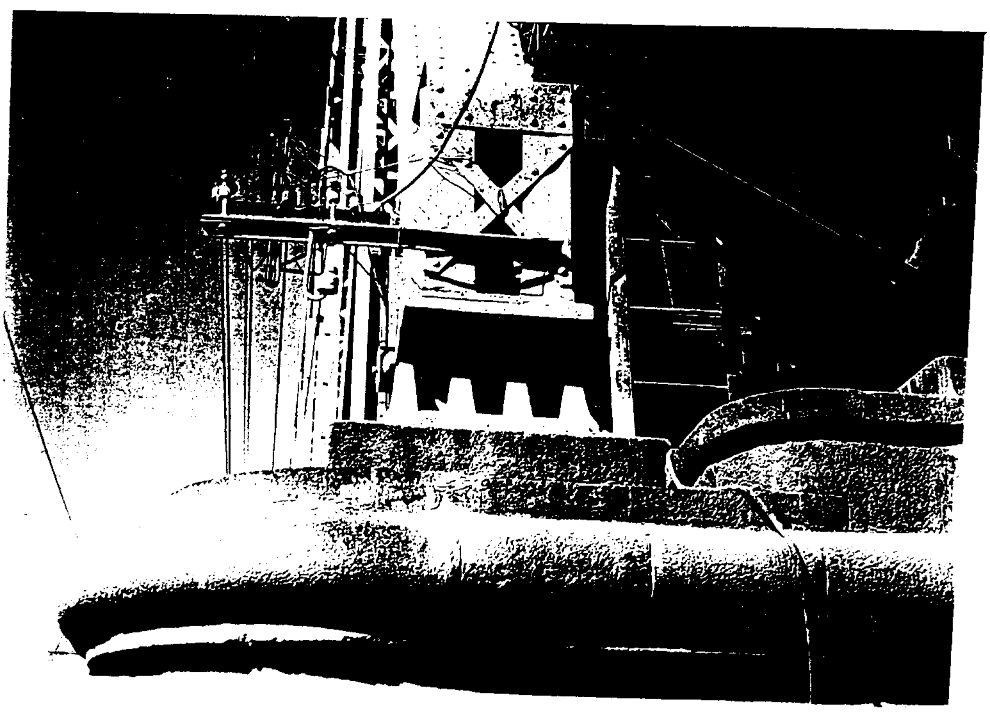
F2-07 Span 3
Cracked angle of inspection car rail

F2-08 Span 3
Loose support of telephone bracket, gap 12 mm

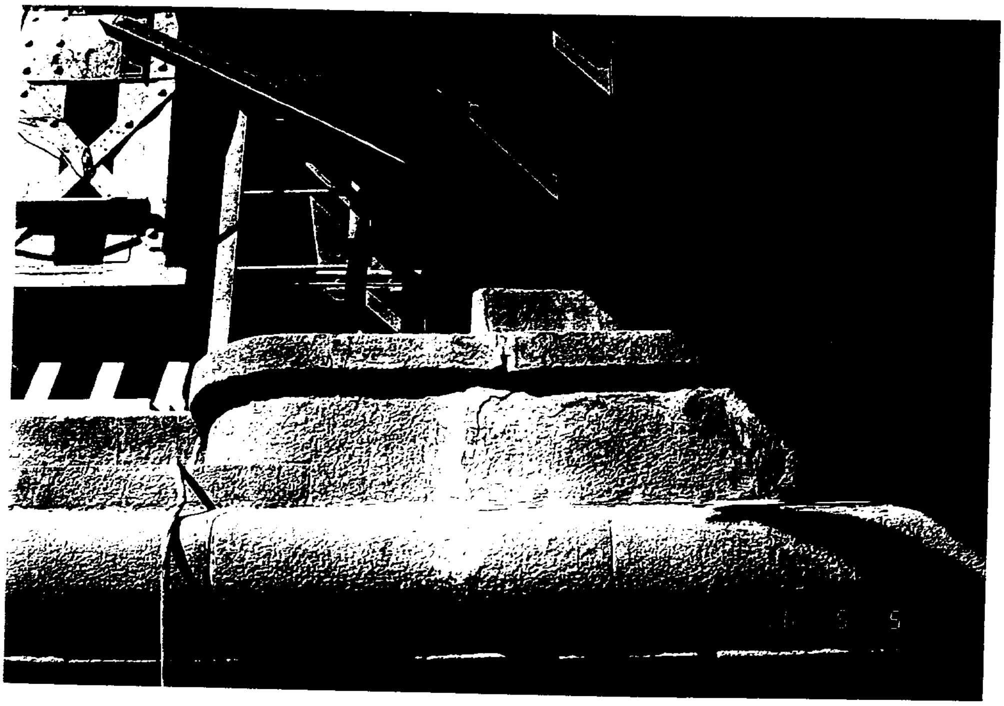


F2-09 Span 3
LC DS cut off
footway cantilever

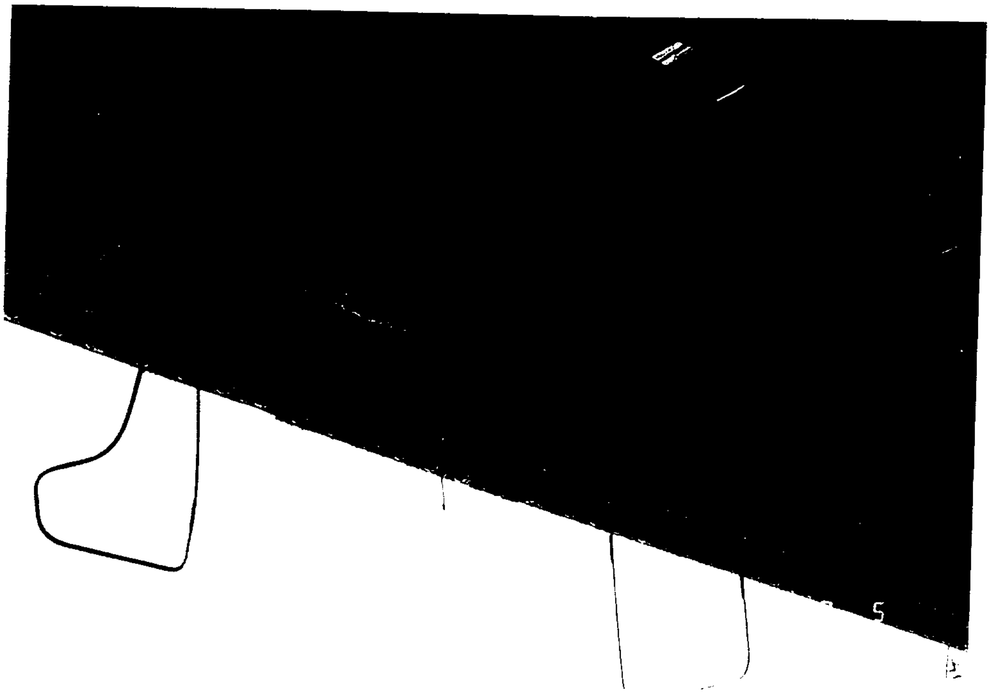
F2-10 Span 0
Bearing of plate
girder 0 (land)



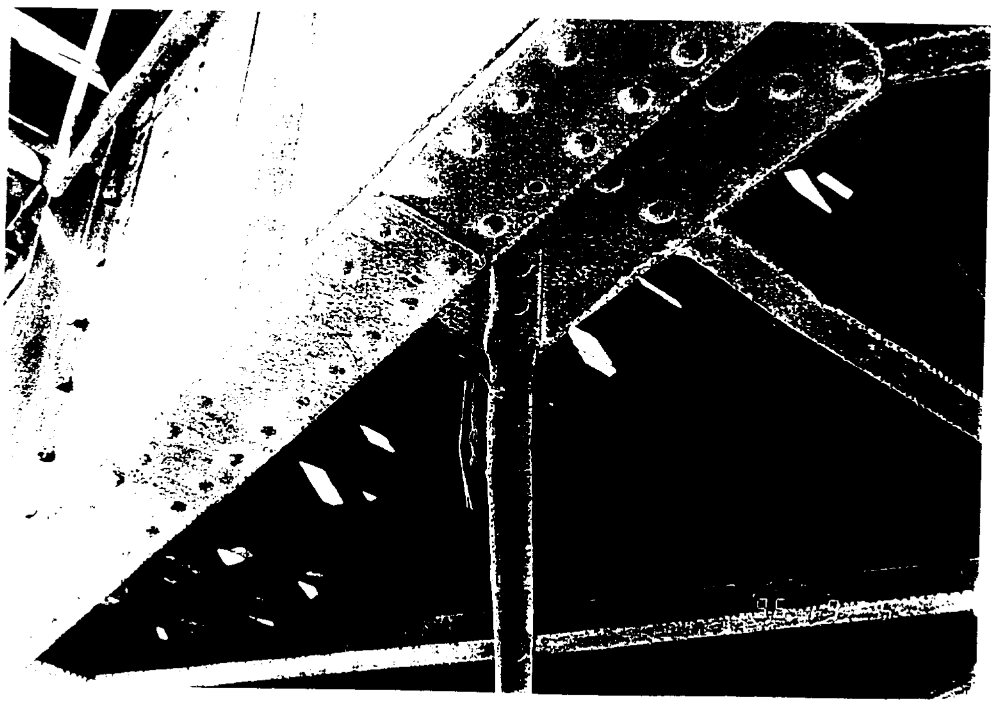
F2-11 Span 1
Fixed bearing of
span 1 DS



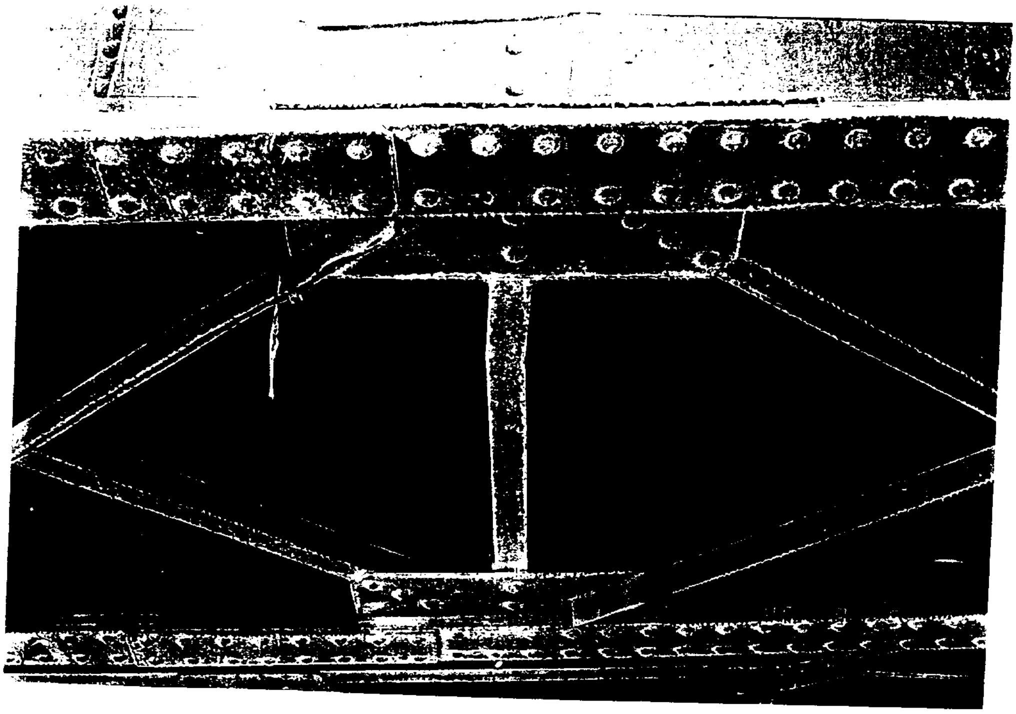
F2-12 Span 0
Bearing DS of span 0, crack in the stone



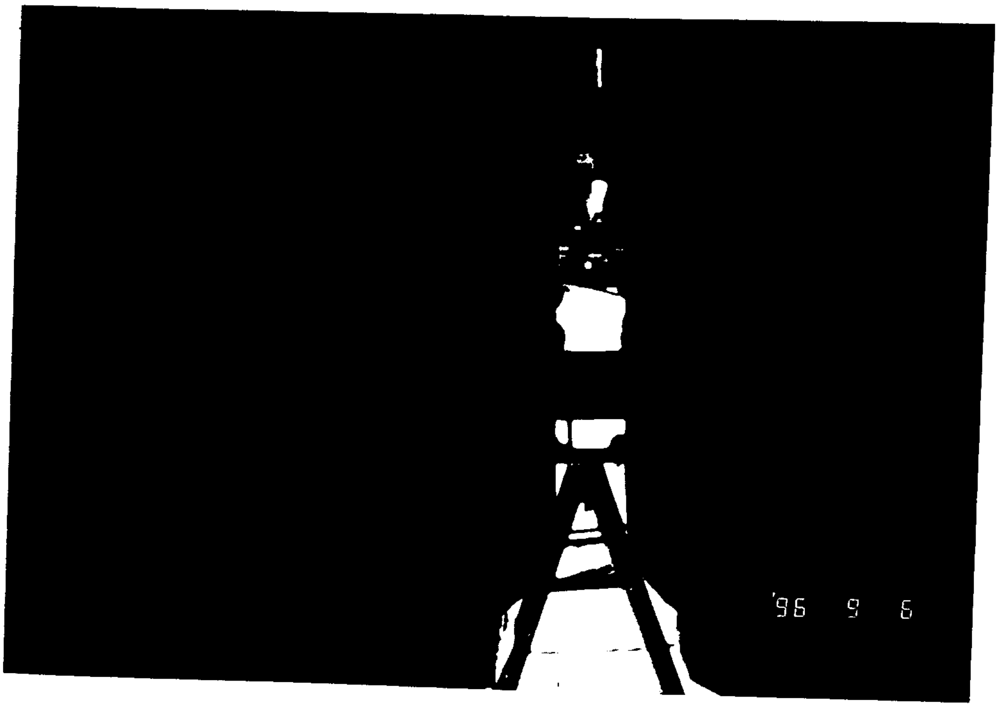
F2-13 Span 0
Deformed LC bracing angle



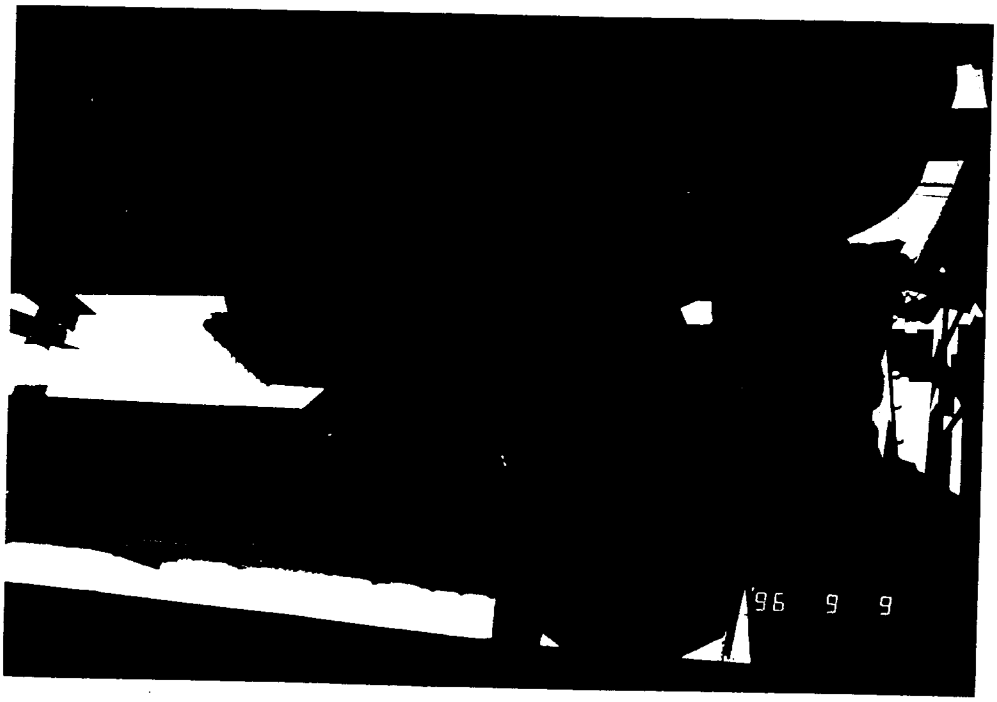
F2-14 Span 0
Deformed LC bracing angle



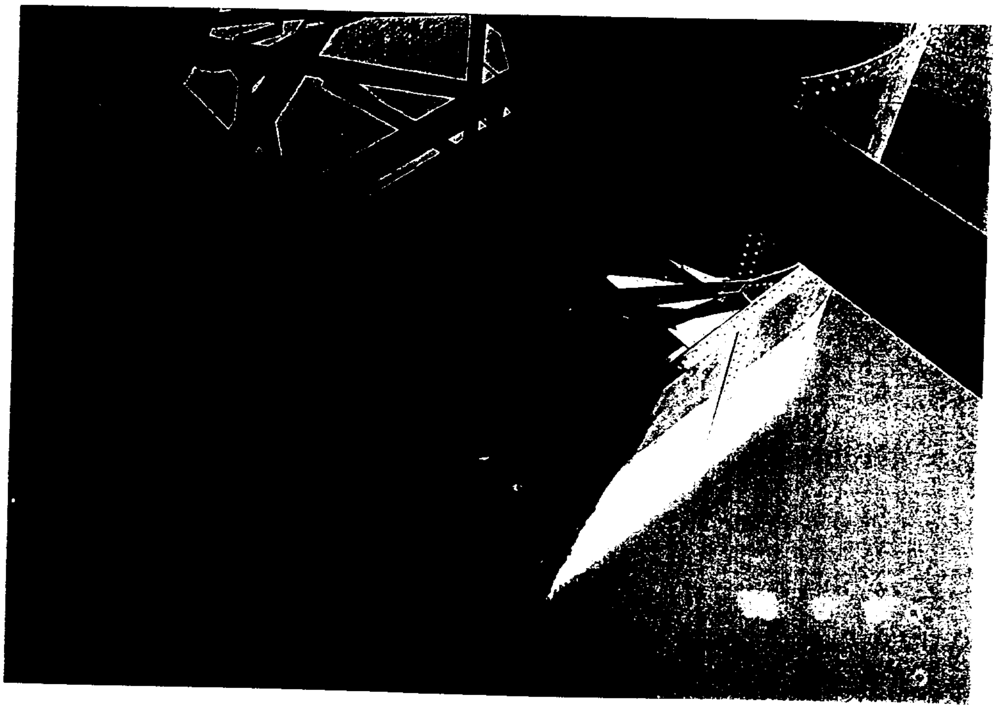
F2-15 Span 0
Deformed LC
bracing angle



F2-16 Span 2 and 3
Gap between
Span 2 and 3

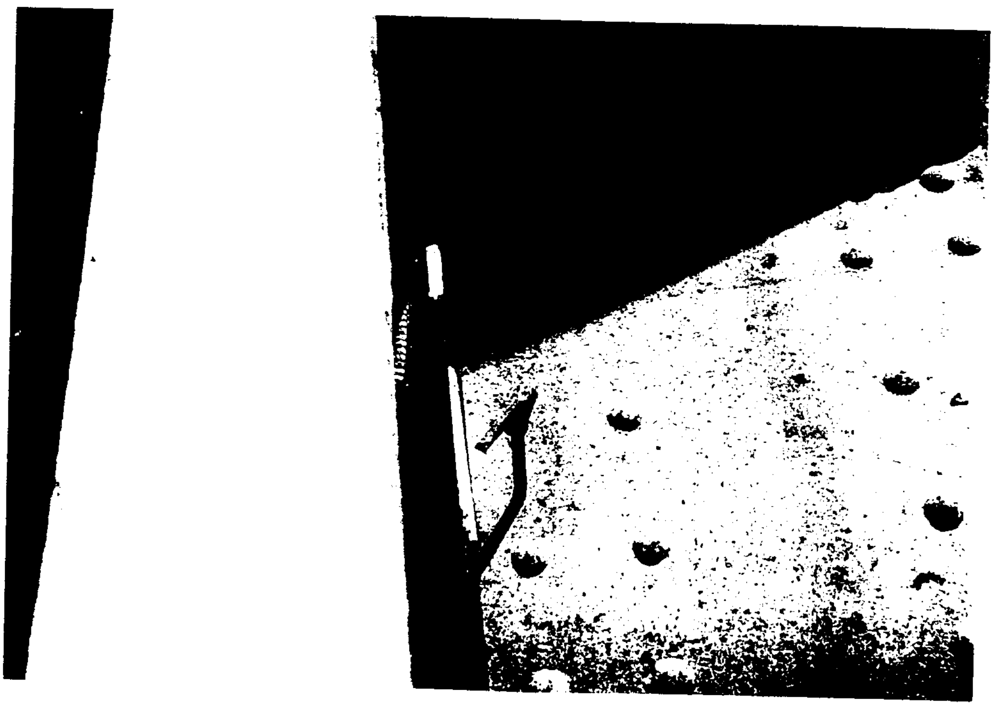


F2-23



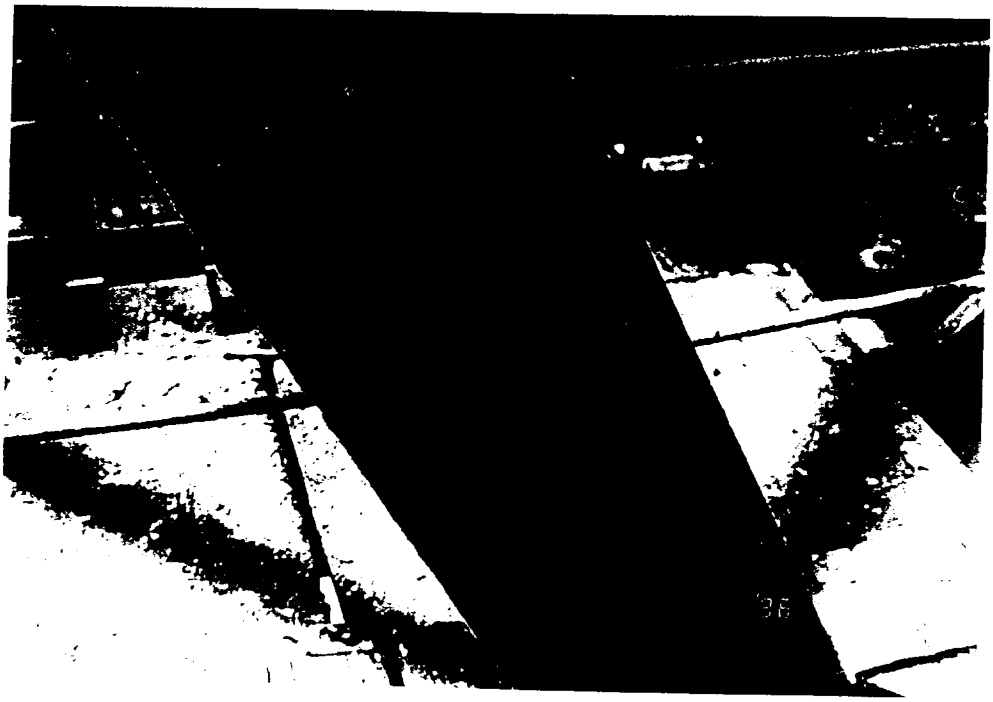
F2-24

F2-25

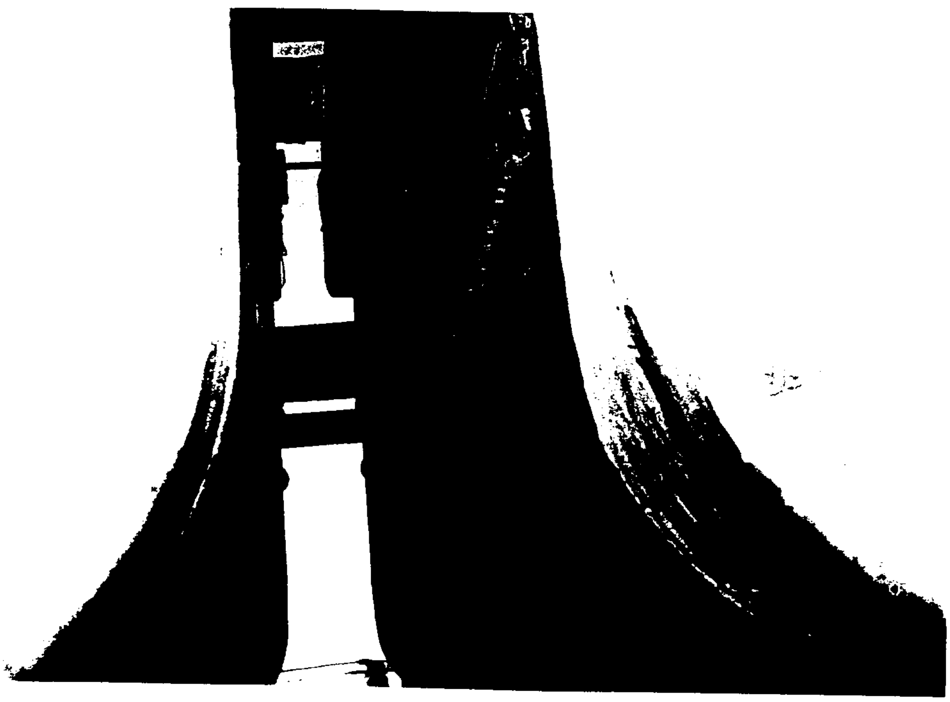


F2-26

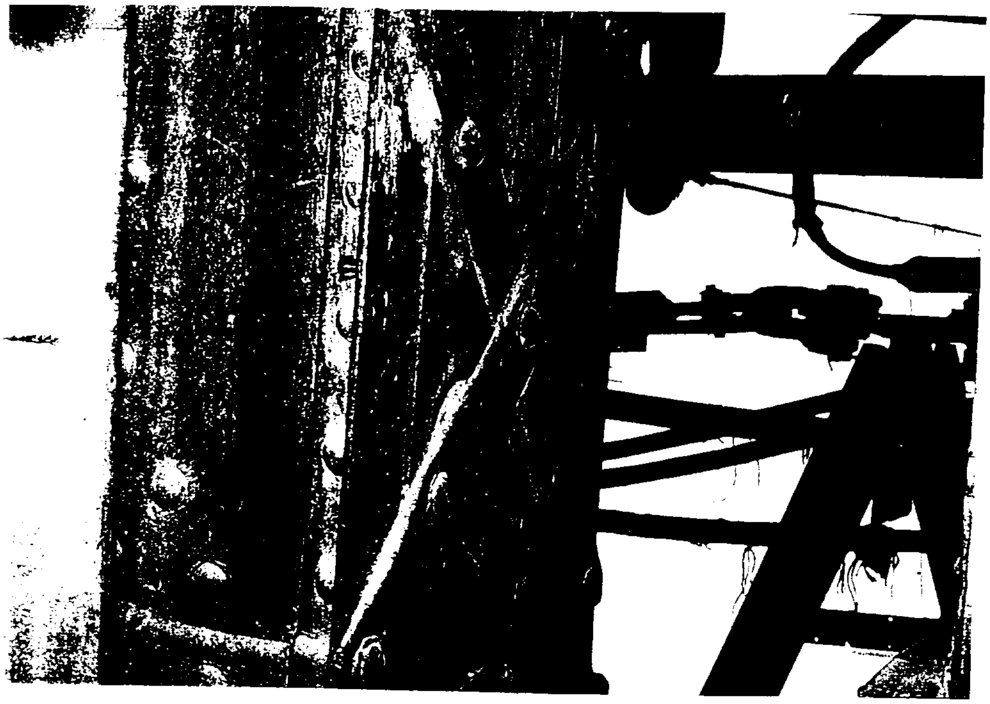
F2-27



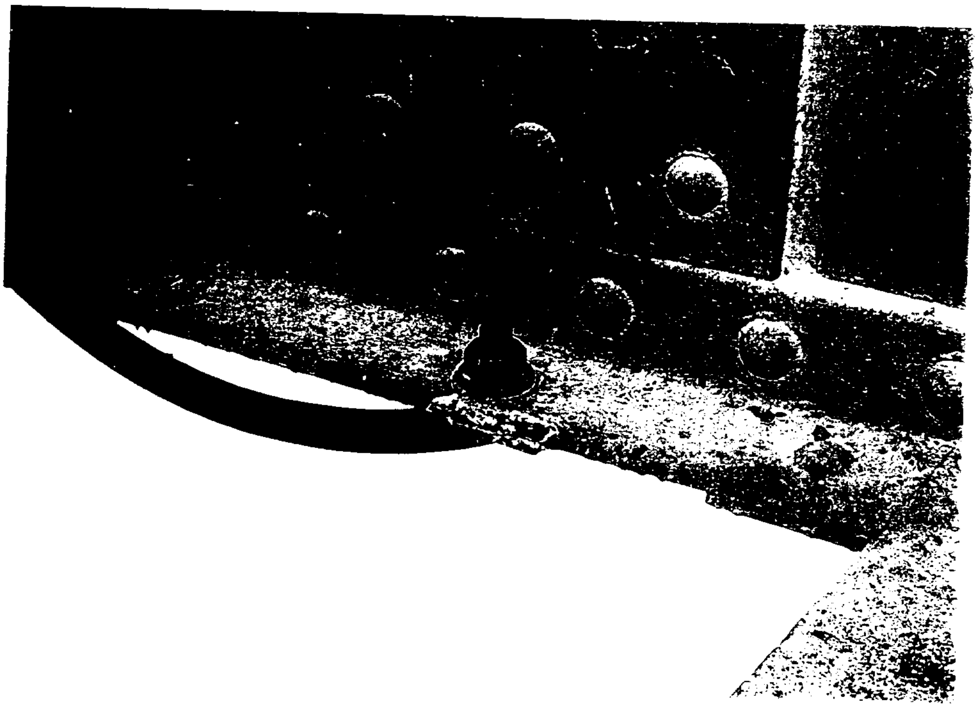
F3-01 Span 15
Corrosion signs



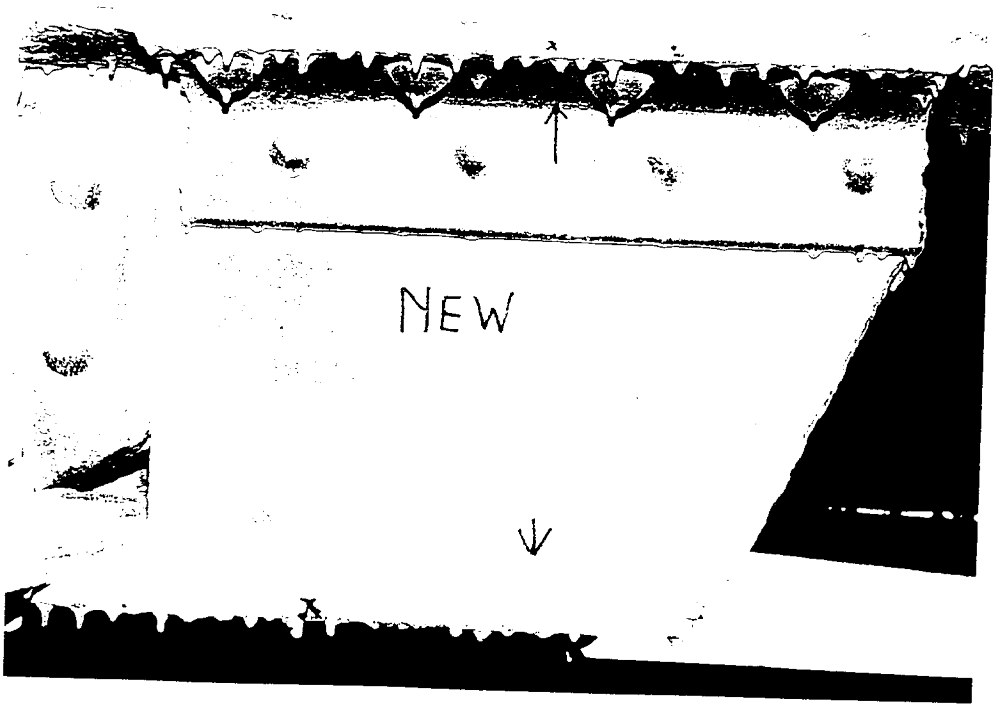
F4-01 Span 23
Expansion gap
with deformed
bracing



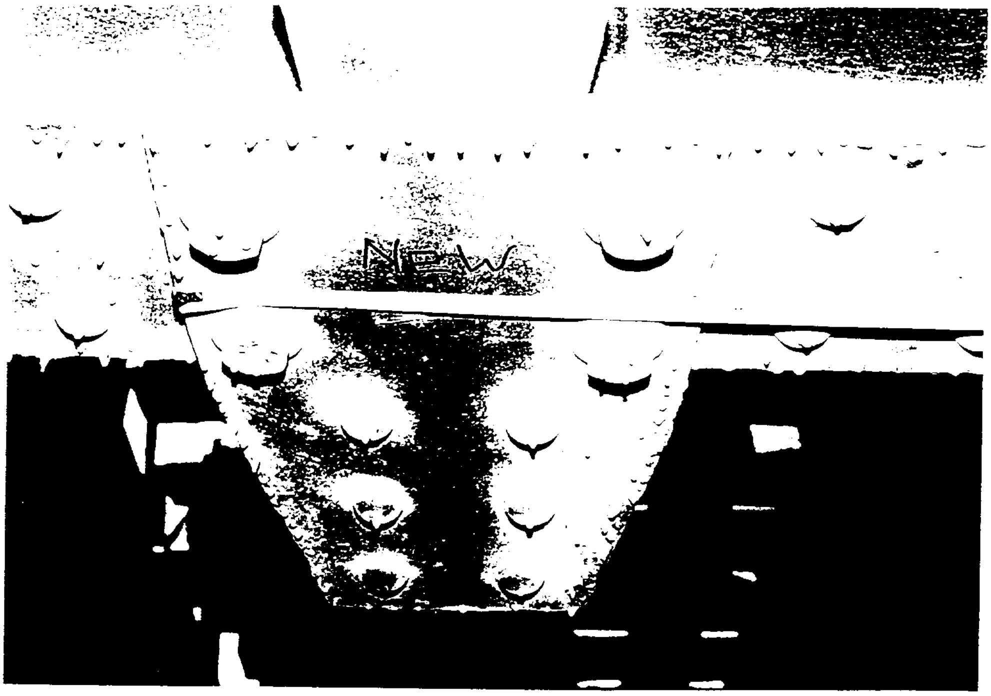
F4-02 Span 23
Deformed diagonal bracing



F4-03 Span 23
Bolt replaces rivet

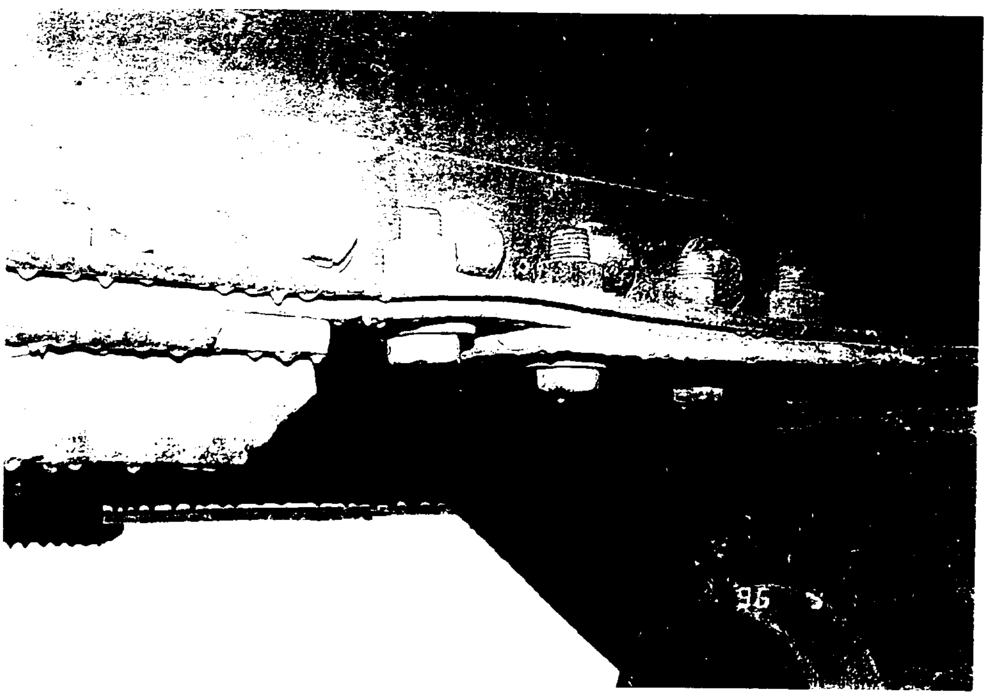


F4-05 Span 23
New angles at longitudinal girder to cross diaphragm



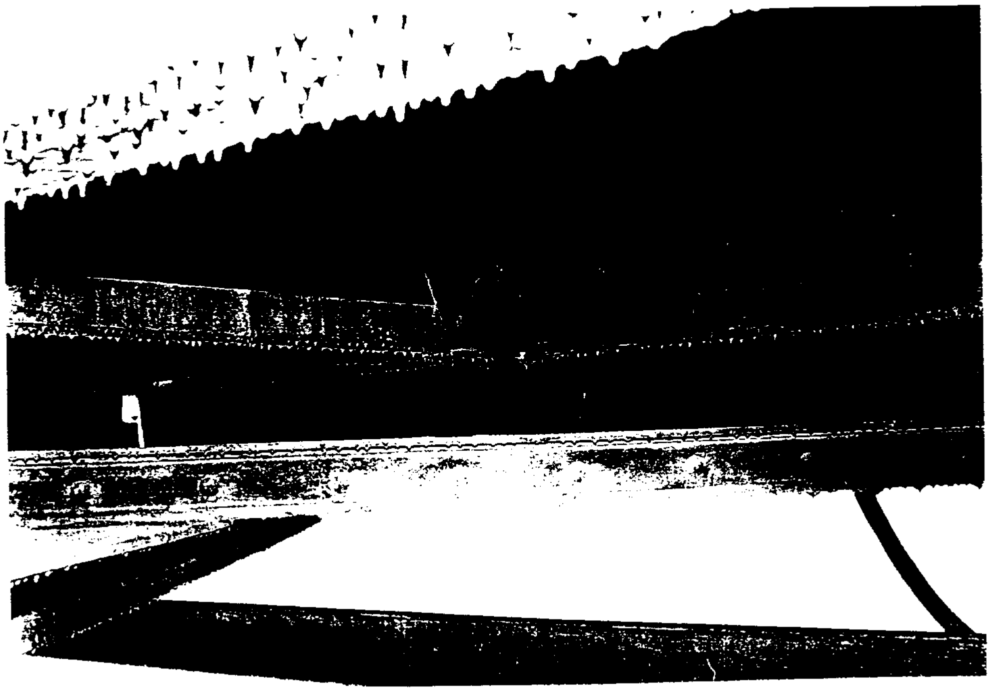
F4-06 Span 23
As F4-06, from below

F4-07 Span 23
Cross diaphragm warping of lower flange

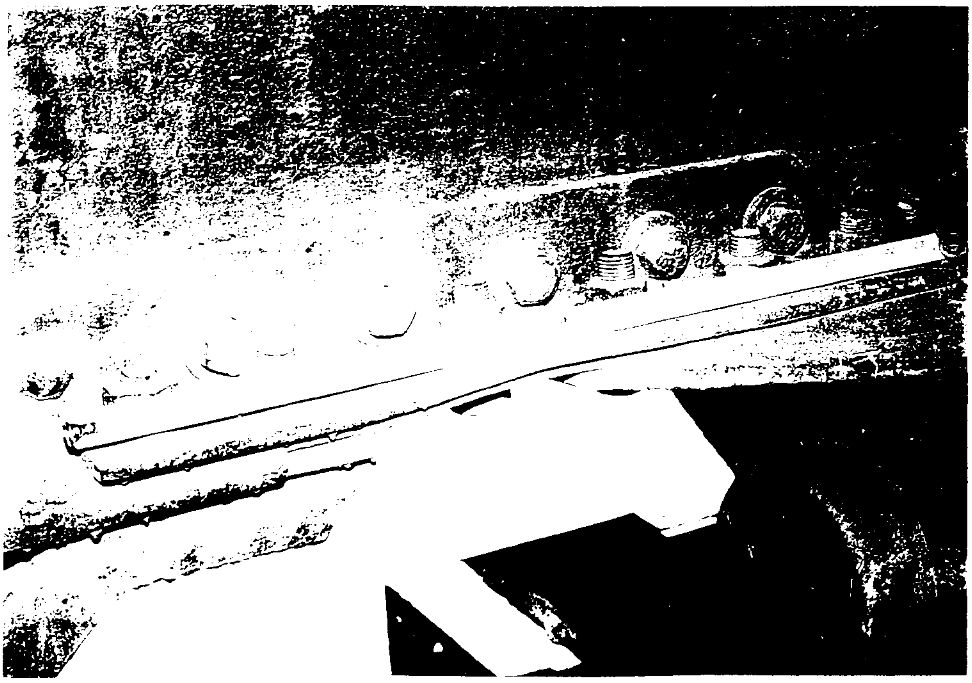


F4-08 Span 23
As F4-07

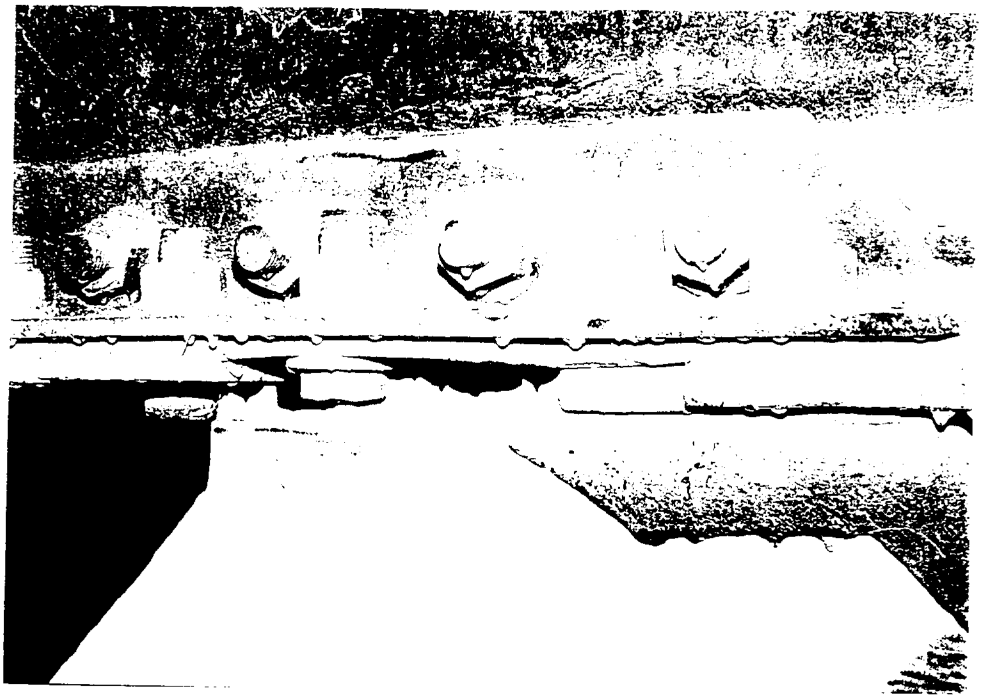
F4-09 Span 23
As F4-07



F4-10 Span 23
Bracing between longitudinal girders



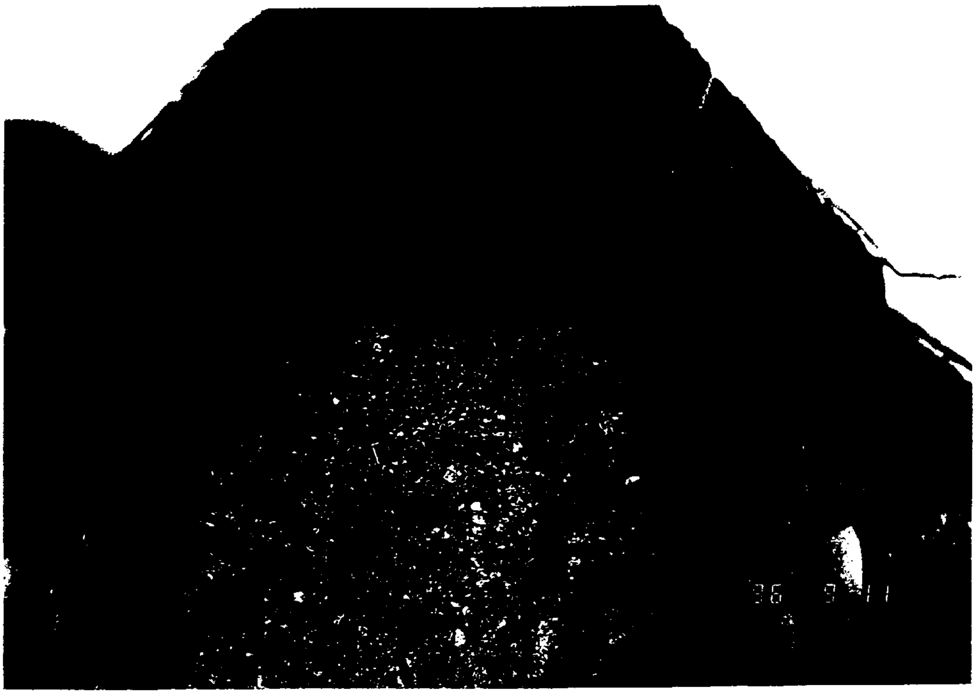
F4-11 Span 23
Cross diaphragm warping despite of strengthening



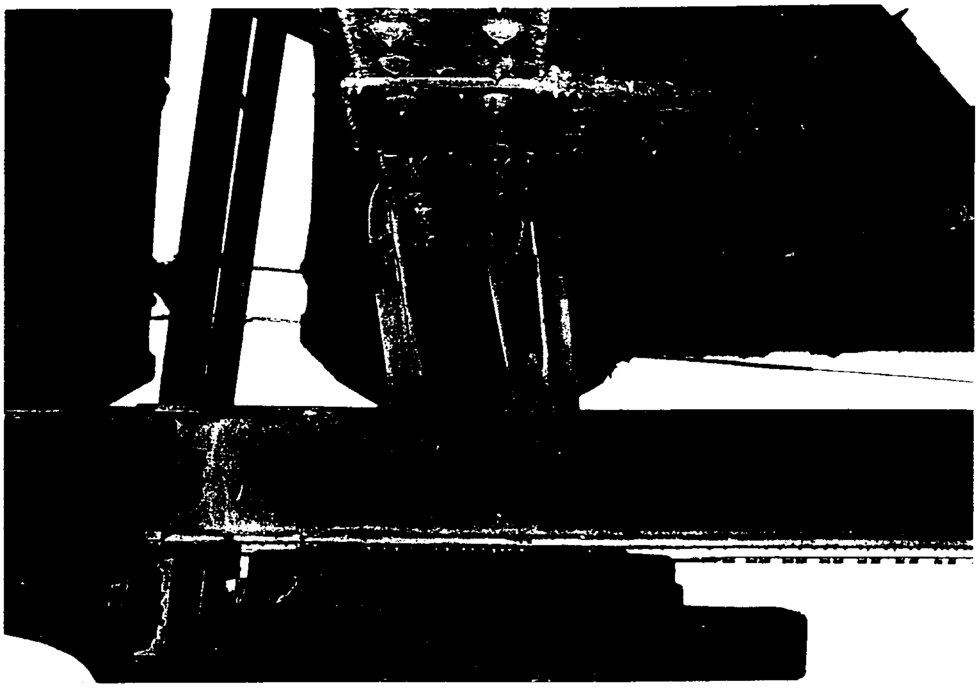
F4-12 Span 23
Strengthening of cross girder

F4-13 Span 23

F4-14 Span 23
Corrosion of longit. girder to cross girder

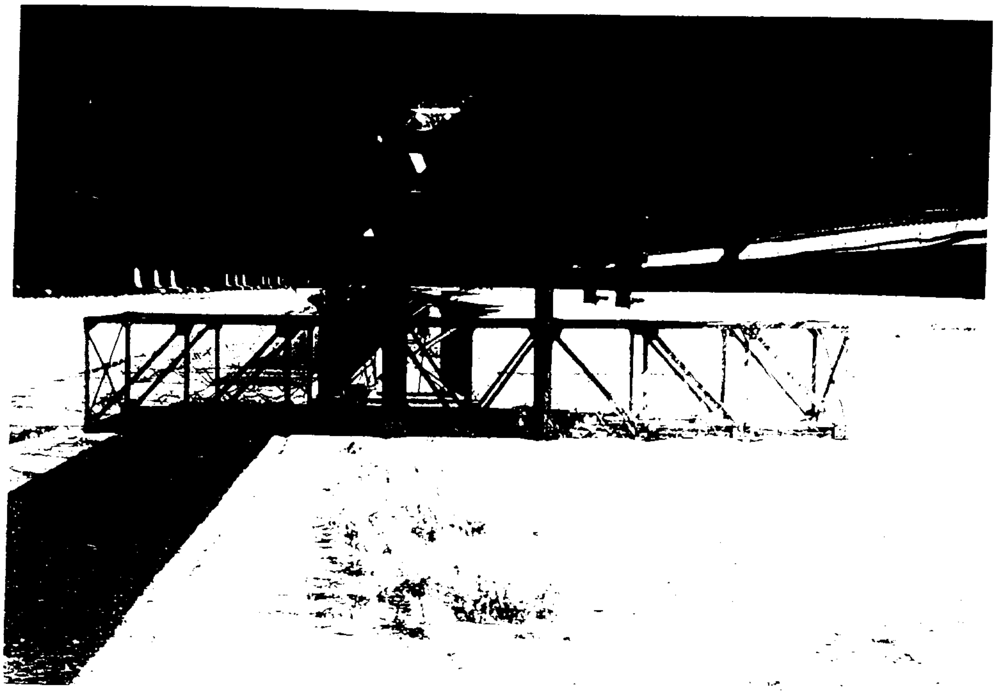


F4-15 Span 23
Corrosion of LC



F4-16 Span 23
Deformed support
of inspection car
track

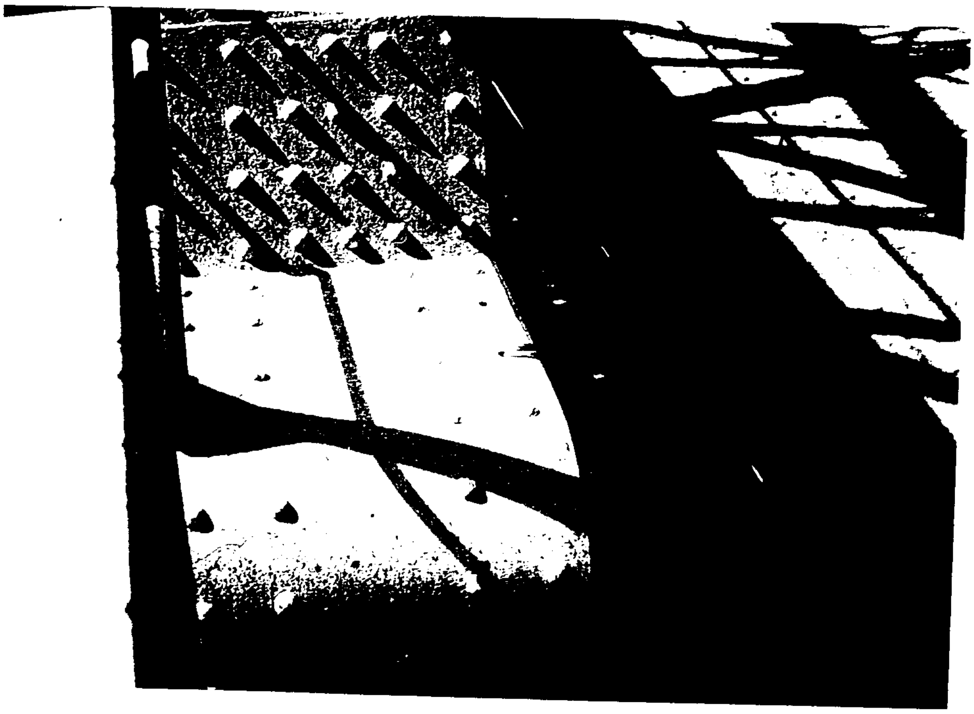
F4-17 Span 23
Inspection car
support



F4-19 Span 23
Inspection car only to be moved by hand of 12 men

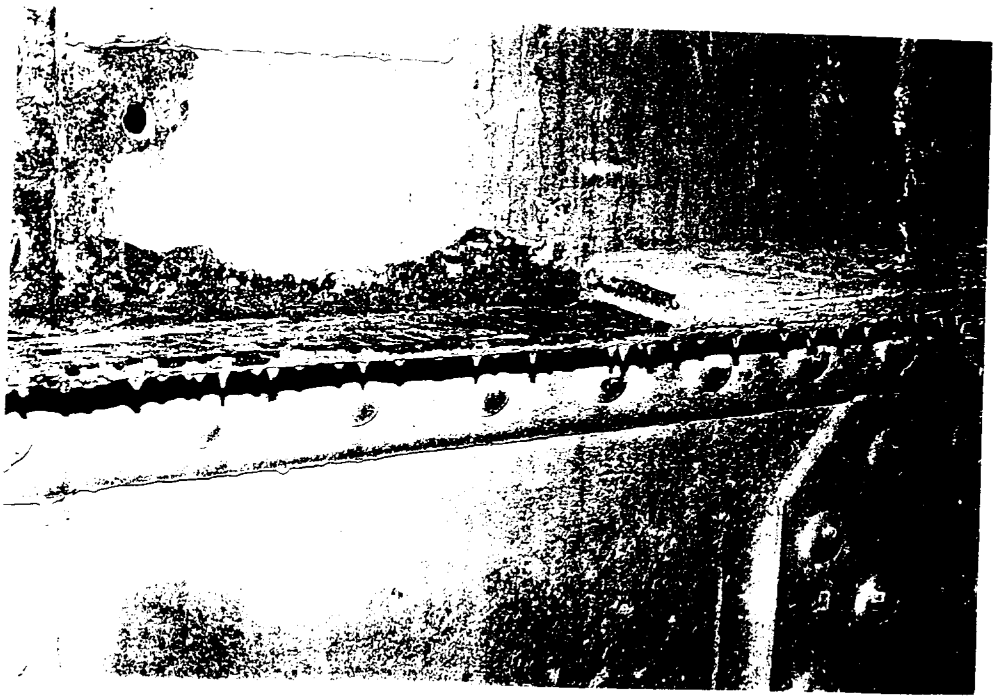
F4-20 Span 23
Cut off railing support

F4-21 Span 23
Missing rivet at end girder



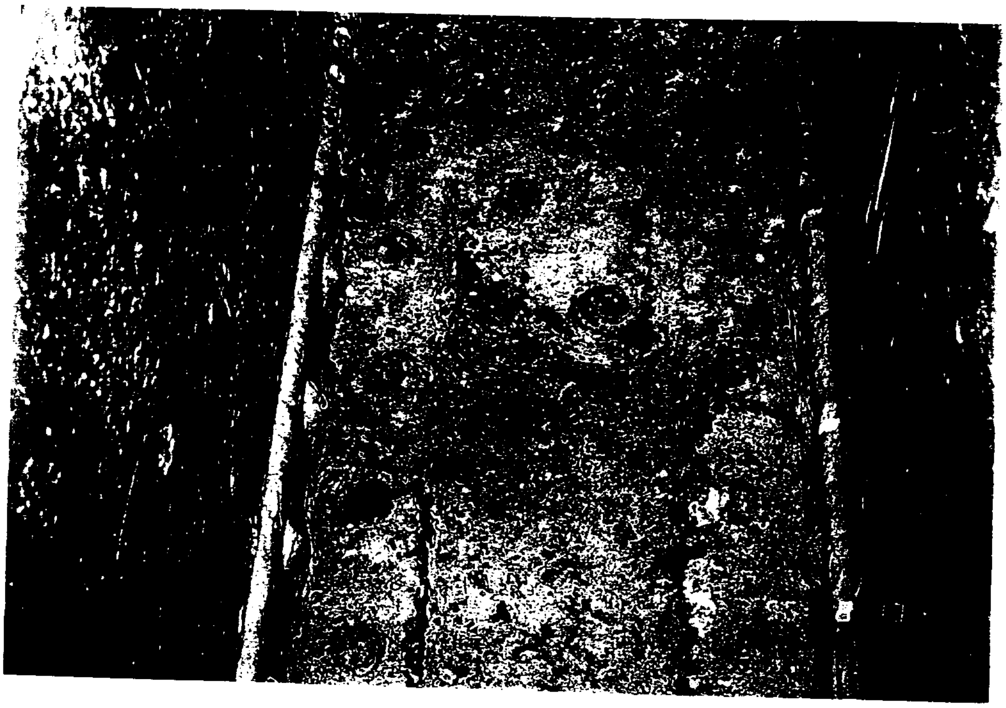
F4-23 Span 23
Missing rivet at end girder

F4-24 Span 23
Corrosion at cross girder

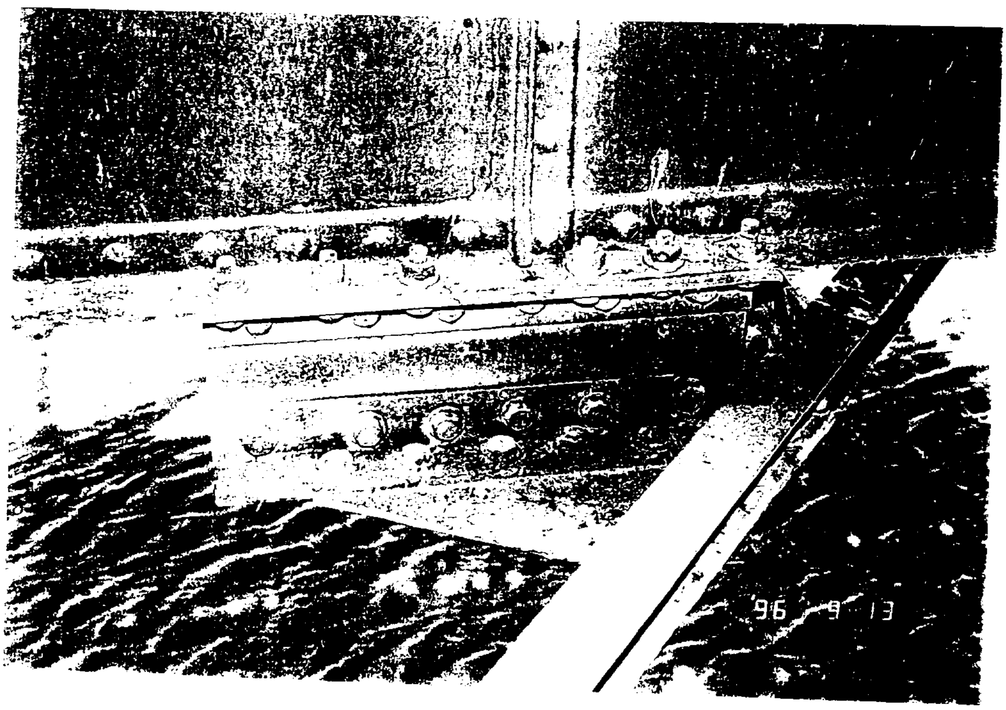


F4-25 Span 23
Missing rivet and corrosion at cross diaphragm

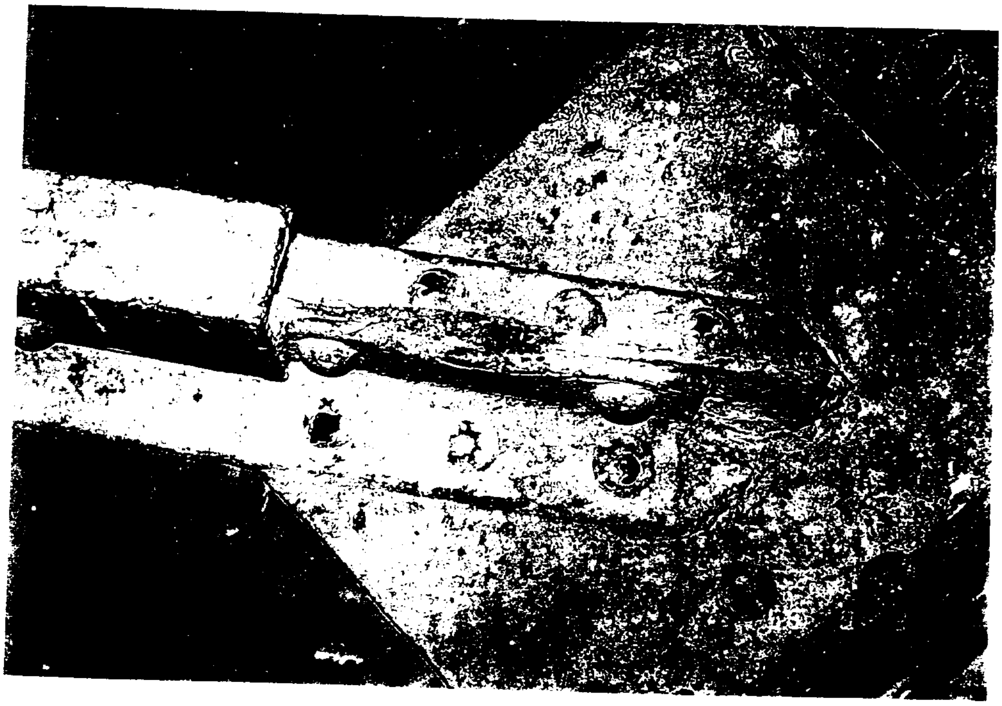
F4-26 Span 23
LC corrosion and warping



F4-27 Span 23
LC corrosion in the middle of LC node U4 US

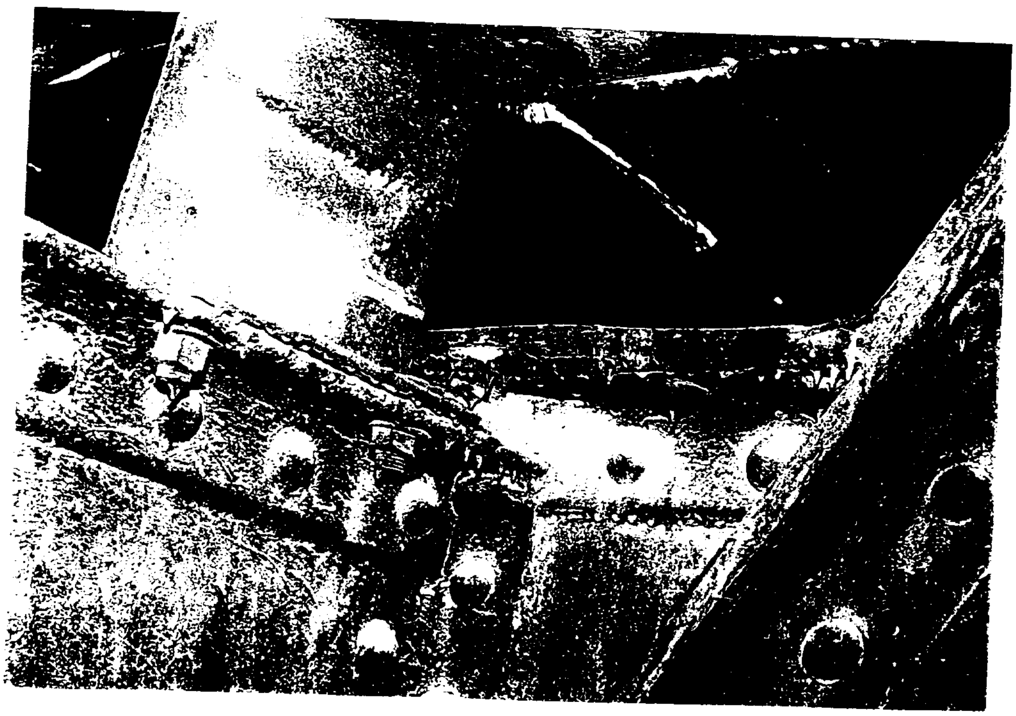


F4-28 Span 23
New strengthening at lower wind bracing

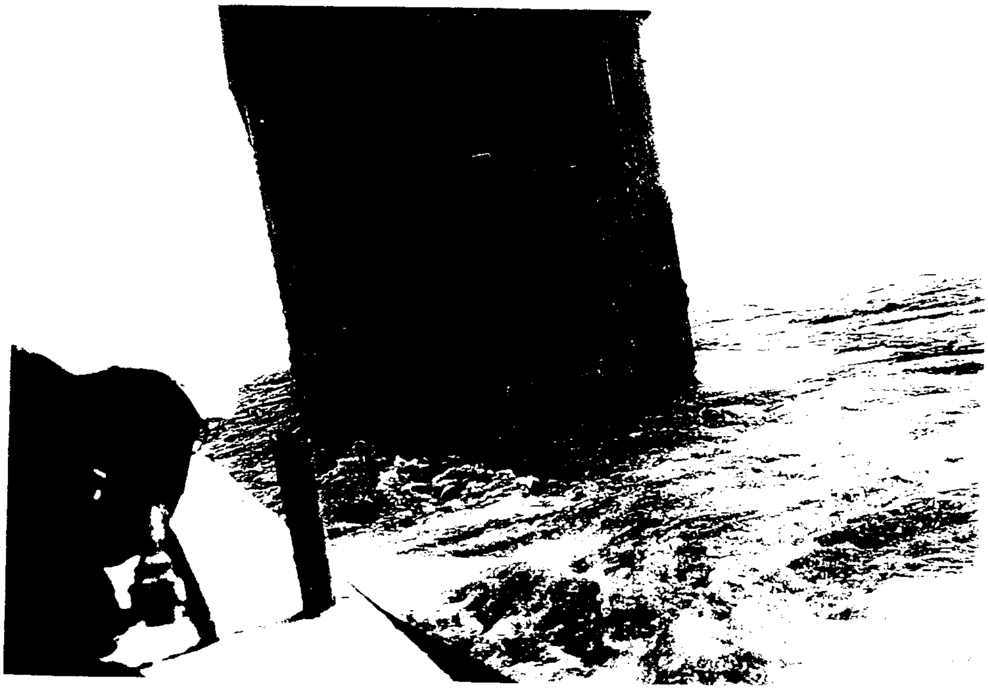


F4-29 Span 23
Lower wind bracing newly strengthened, corrosion

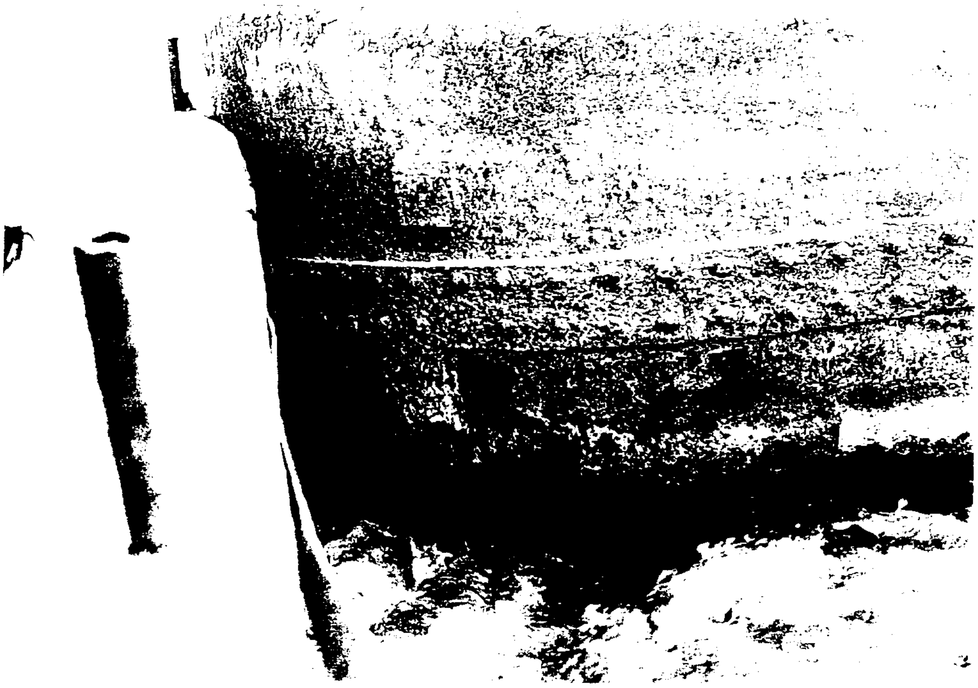
F4-30 Span 23
Cross diaphragm, hole without rivet or bolt



F4-31 Span 23
Corrosion at longit. girder to cross diaph.



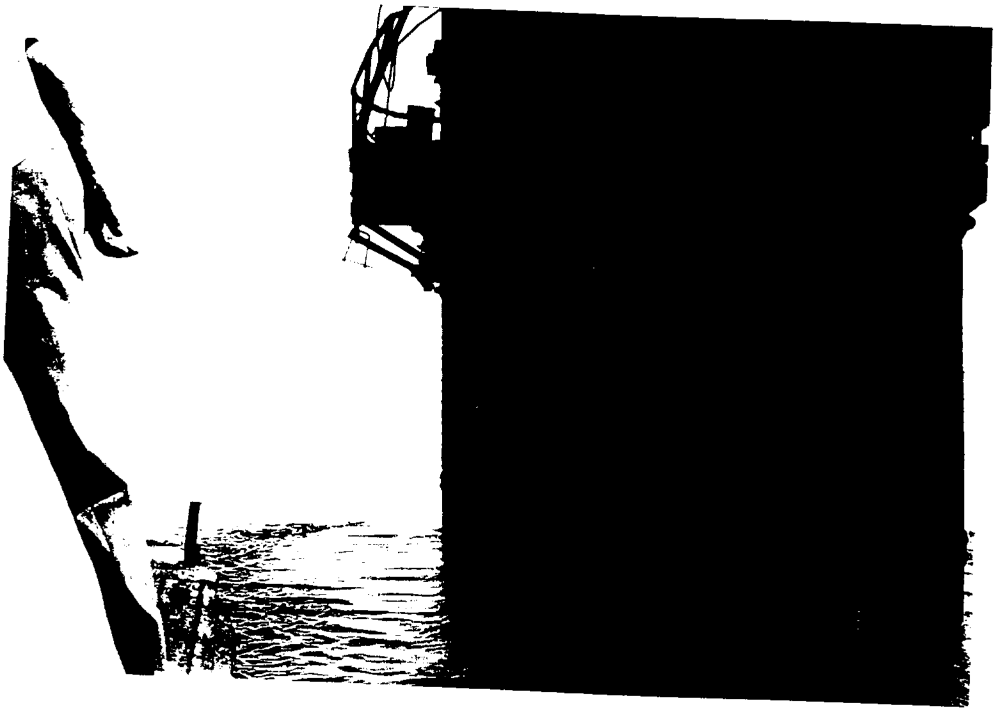
F4-32 Pier 25
Pier 25 from ship



F4-33 Pier 25
Pier 25 from ship
Heavy corrosion
leaks

F4-34 Pier 25
Pier 25, corrosion

F4-36 Pier 24
Pier 24 hit by a ship collision



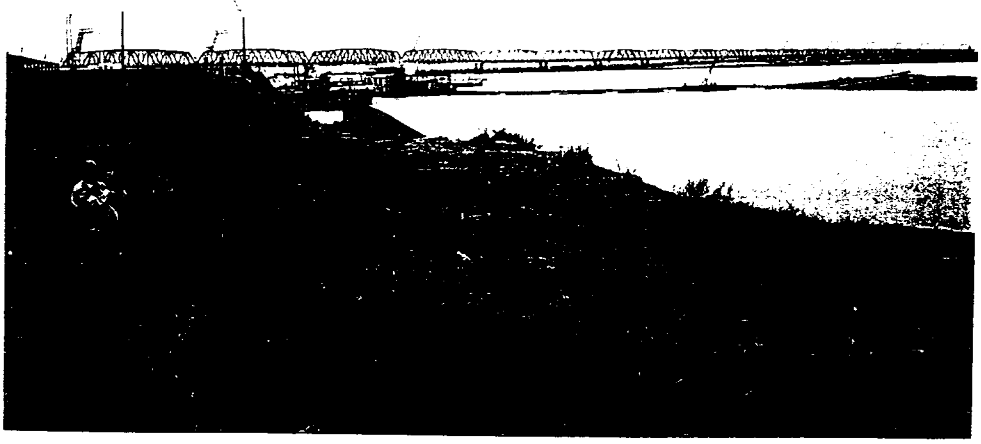
F4-37 Pier 24
As F4-36

F5-27
Sand banks near the bridge US

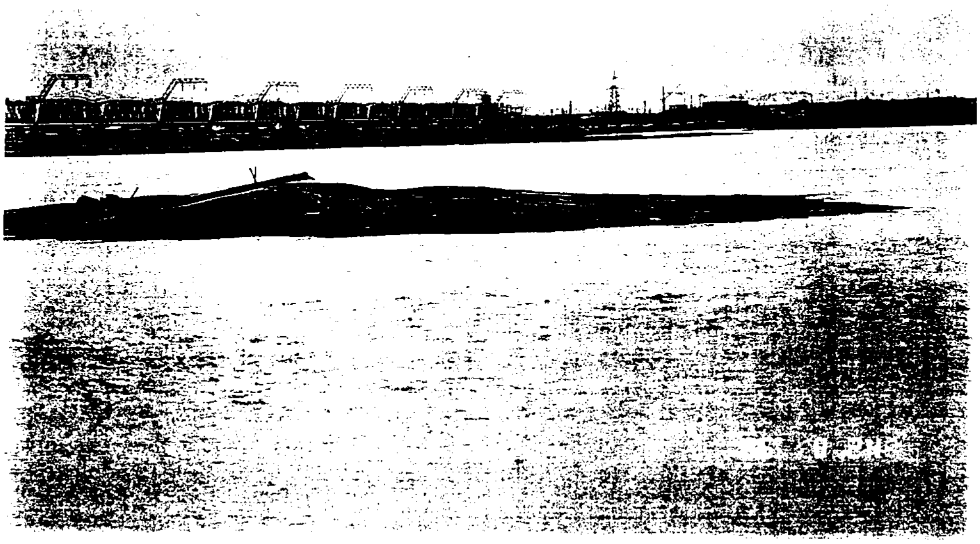
F5-28
Site of the new proposed bridge, DS

F5-29
As F5-28

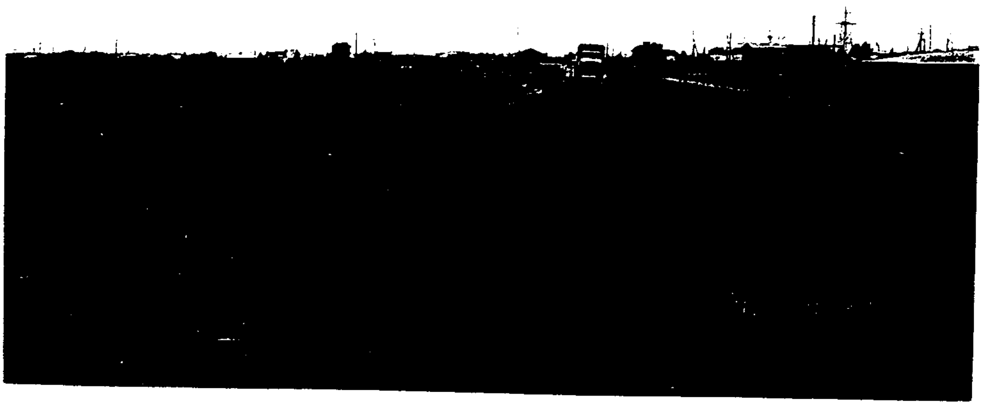
F5-30
View of the existing bridge



F5-31
As F5-30, with Mr. Fleischmann



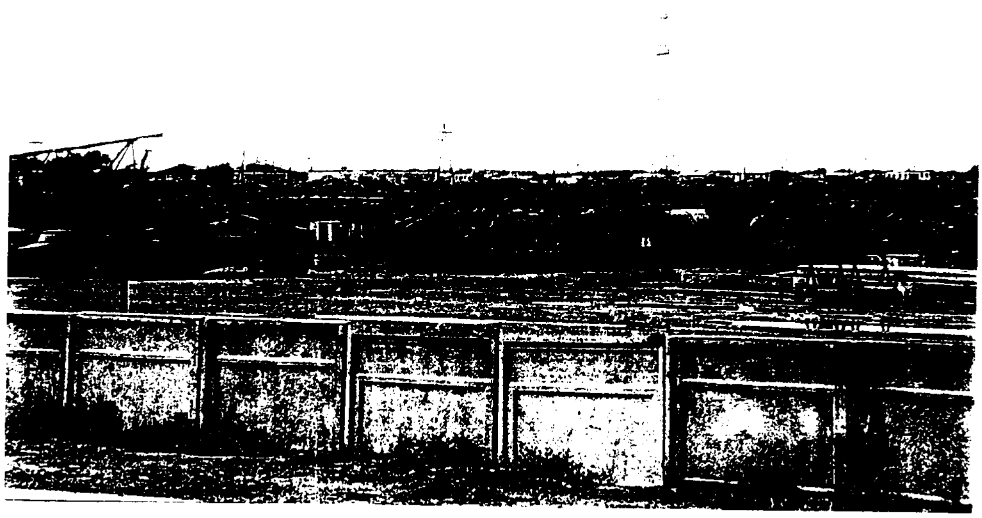
F5-32
As F5-30, with sand bank DS



F5-33
Bypassing road for heavy traffic

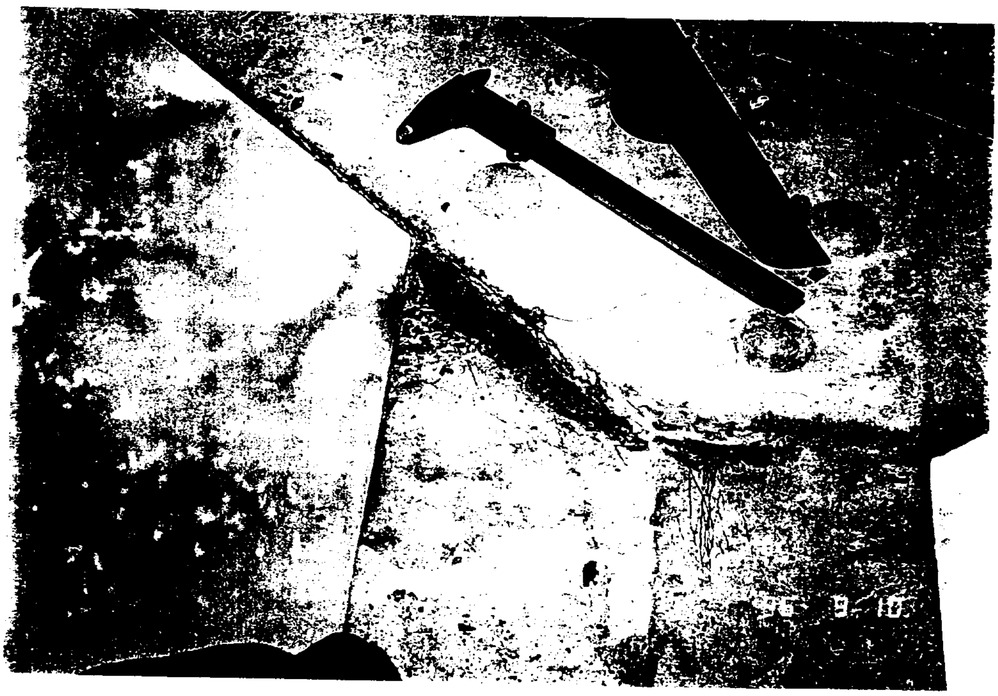
F5-34
Site of new bypass road

F5-35
As F5-34



F5-36
As F5-34

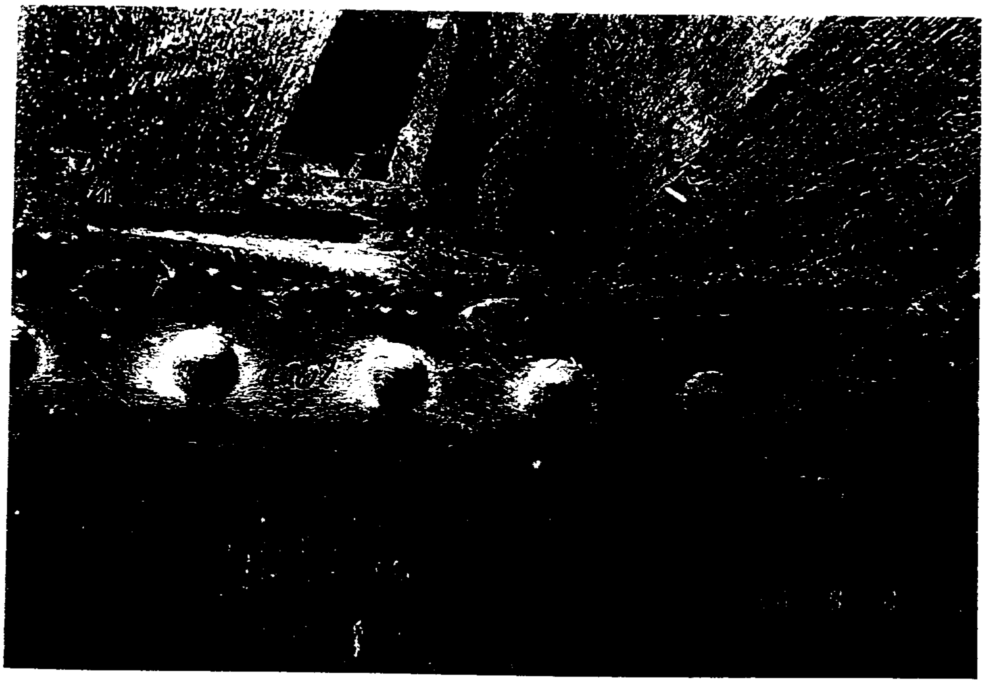
F5-37
As F5-34



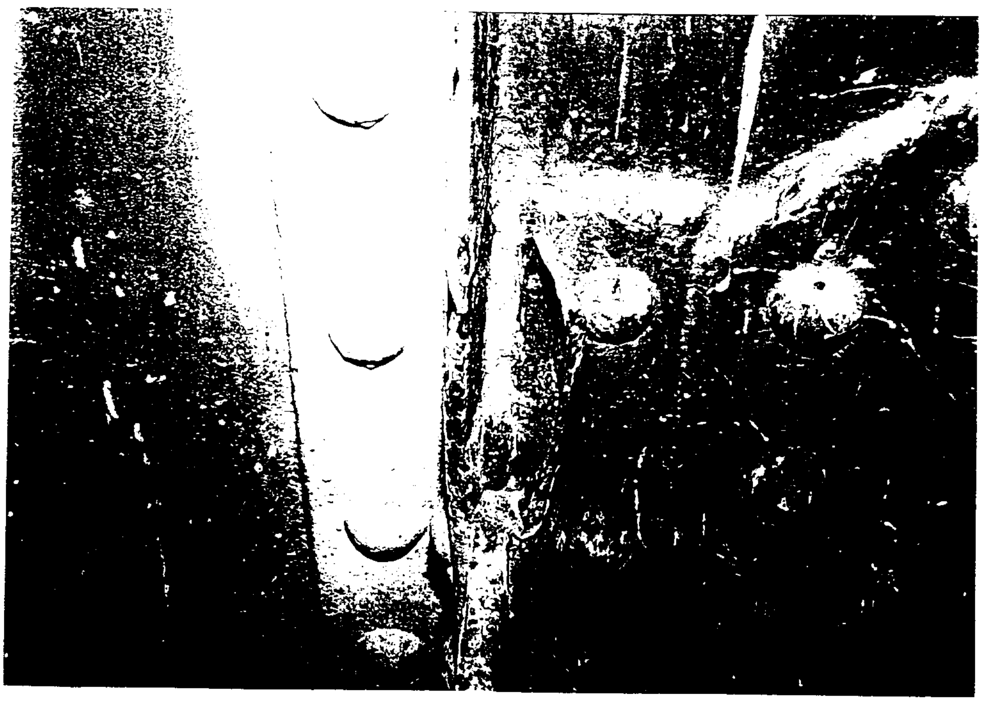
F6-01 Span 13
Corrosion at lower wind bracing, behind special cement

F6-02 Span 13
Corrosion at inspec. rail support

F6-03 Span 13
Special cement at LC node between angles US



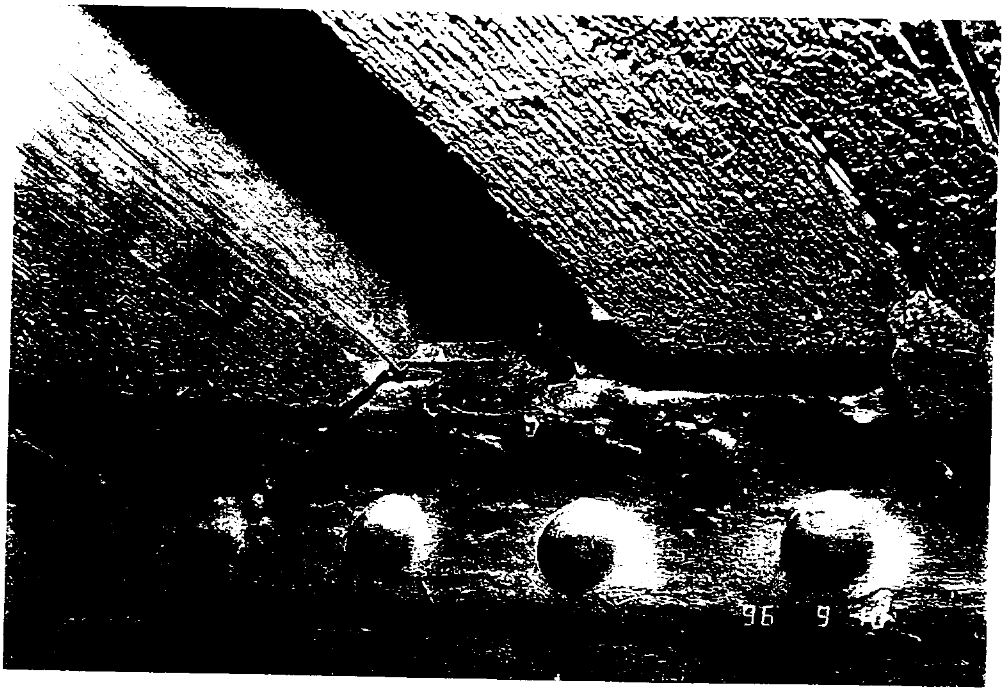
F6-04 Span 13
Lose and outstand. rivets at longitudinal girder



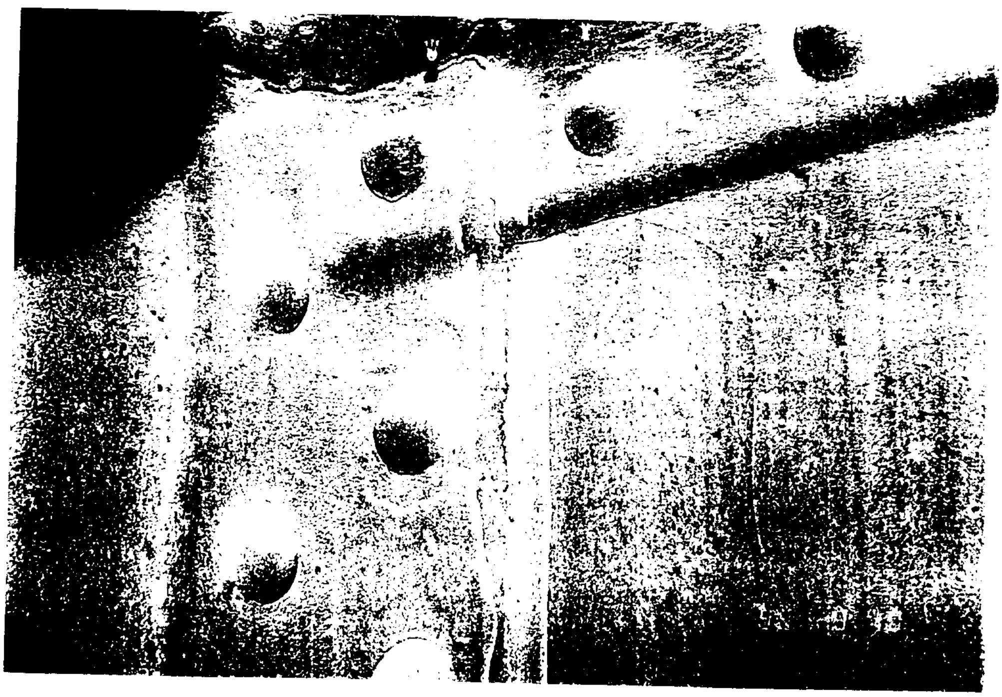
F6-05 Span 13
LC node as in F6-03

F6-06 Span 13
LC angle corrosion

F6-07 Span 13
LC node corrosion

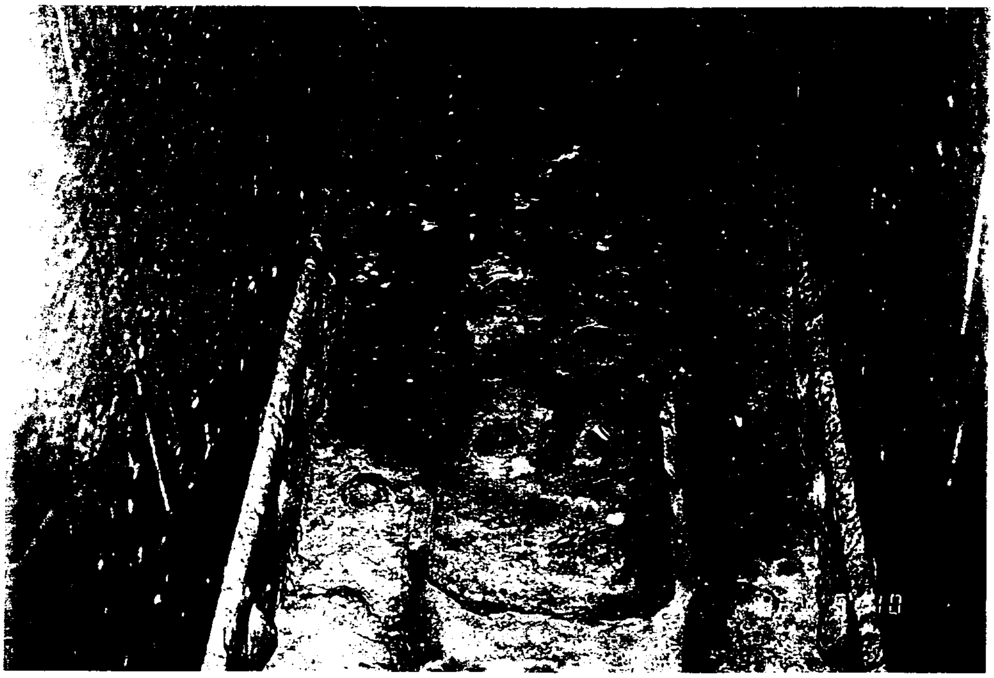


F6-08 Span 13
Longitudinal girder
upper flange corros.



F6-09 Span 13
Longitudinal girder
corrosion in chink to
cross girder

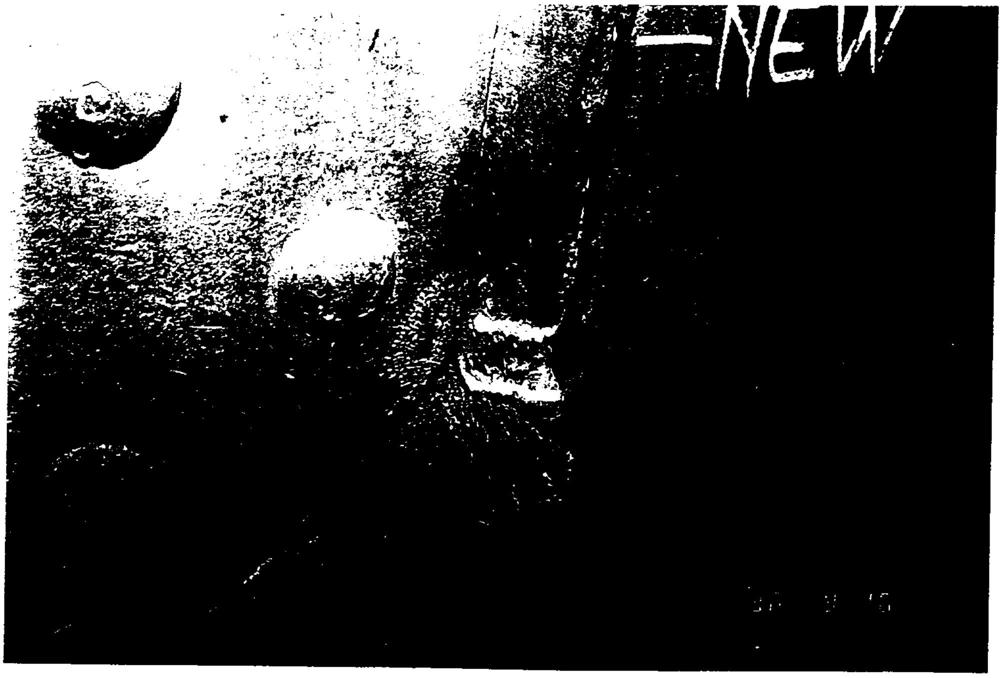
F6-10 Span 13



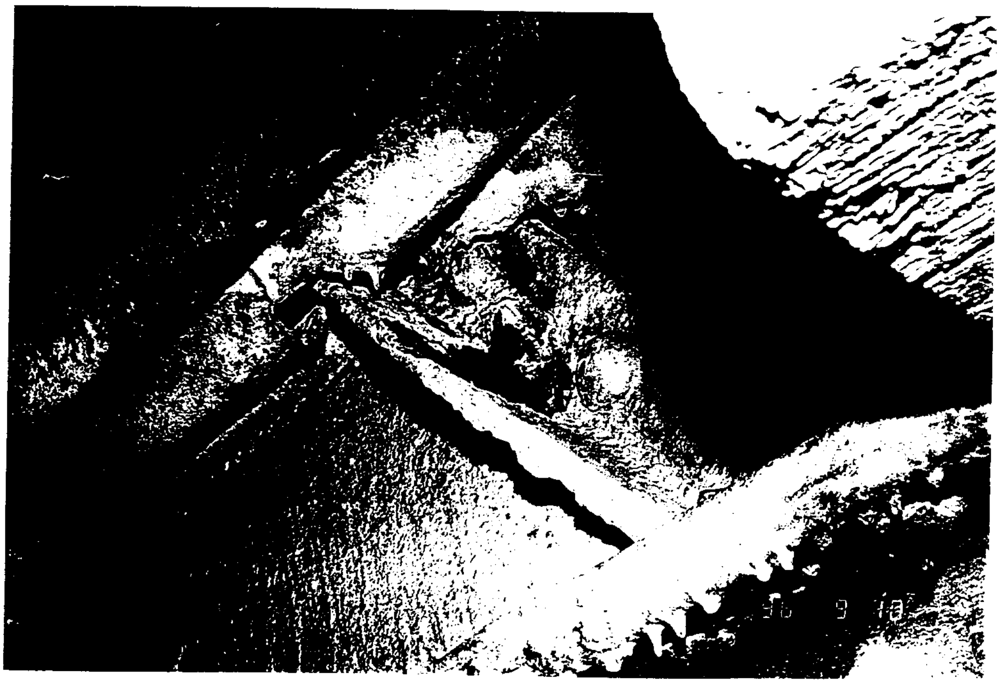
F6-11 Span 13
LC US node, rivet head and plate missing

F6-12 Span 13
As F6-11

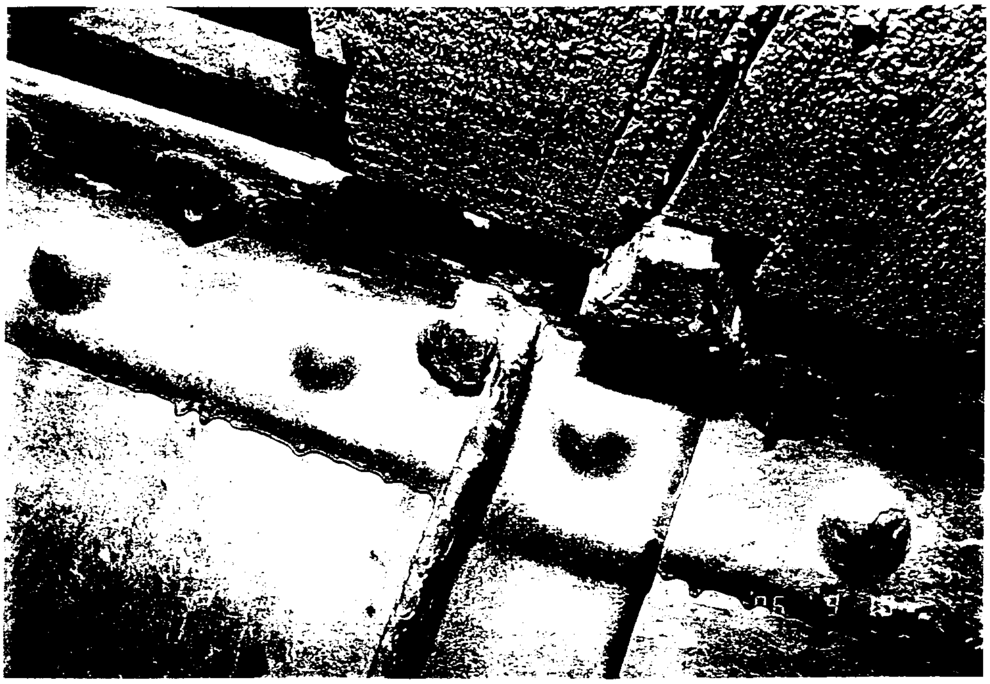
F6-13 Span 13
Broken inspection
rail support



F6-14 Span 13
As F6-13



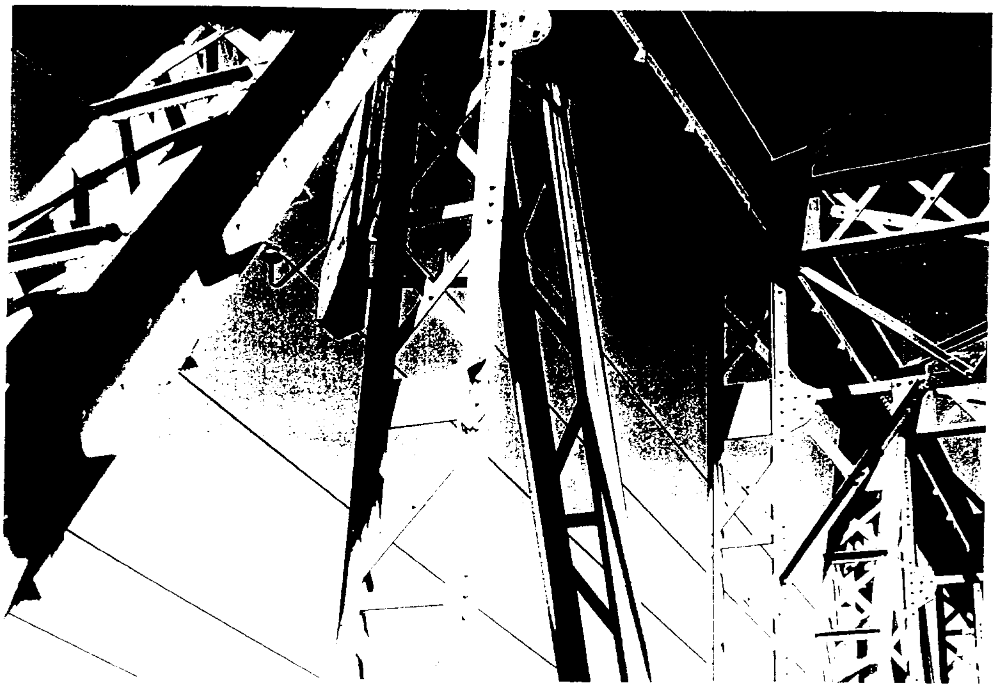
F6-15 Span 13
Longitudinal girder
upper flange corros.



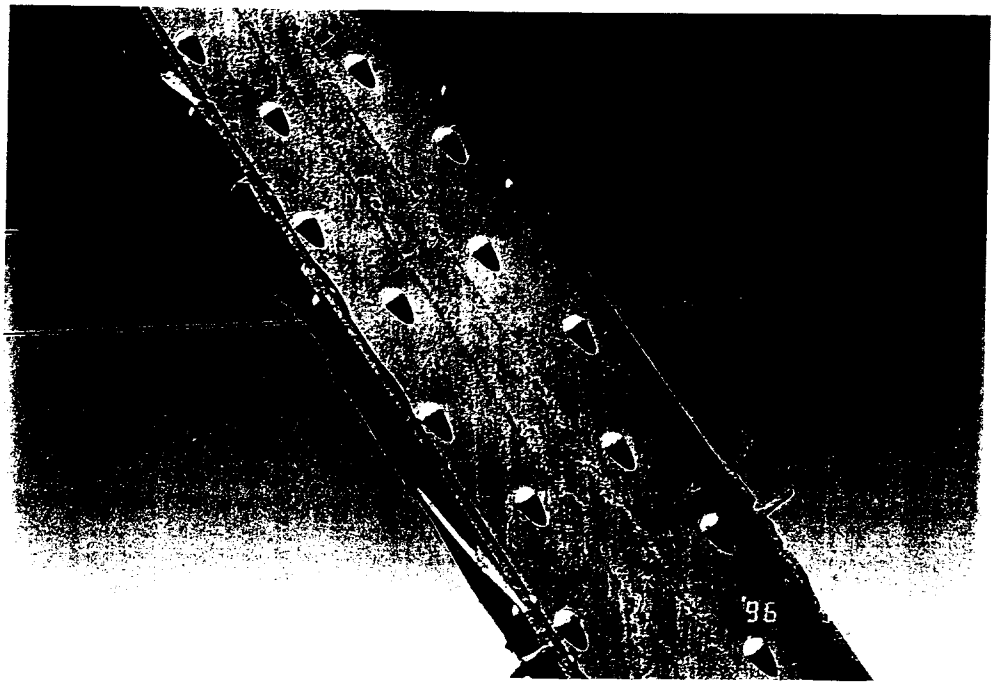
F6-16 Span 13
Longitudinal girder standing off rivet

F6-17 Span 13
LC US corrosion

F6-18 Span 13
Bracing angle out of axis



F6-19 Span 13
Bracing angle cut off. not replaced

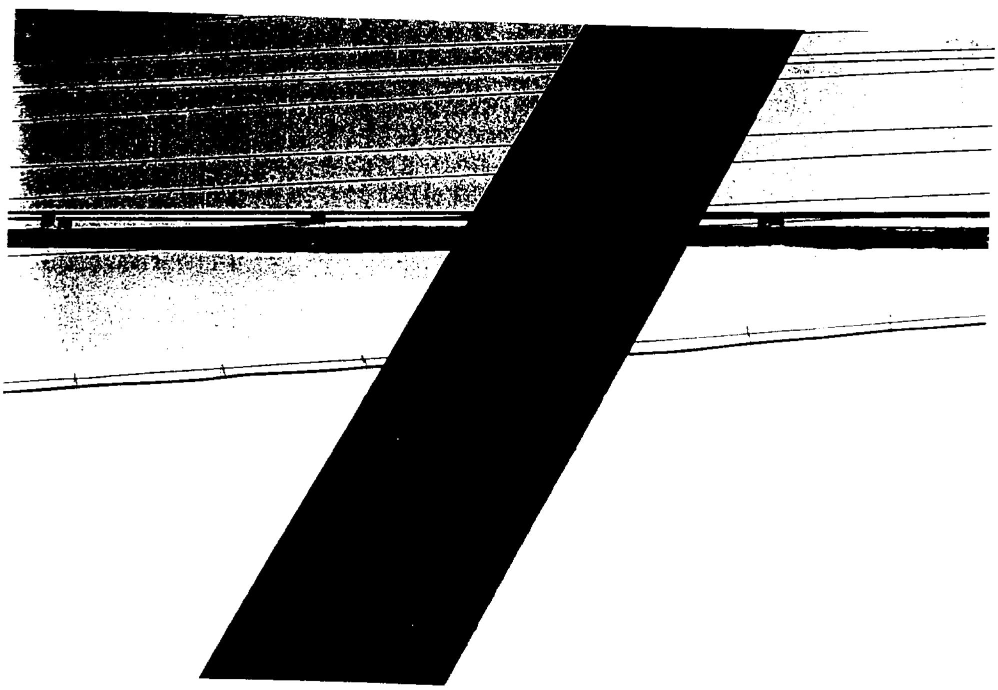


F6-20 Span 13
Corrosion behind special cement of diagonal

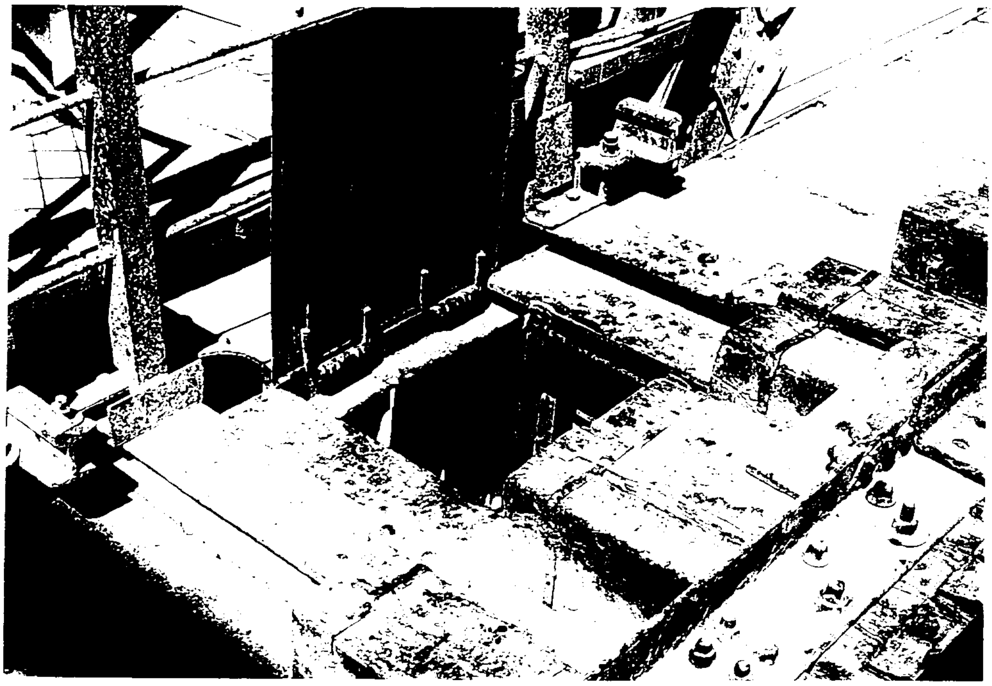
F6-21 Span 13
Deformation of flat plates of diagonal

F6-22 Span 13
As F6-21

F6-23 Span 13
Cut off cantilever of
former railing

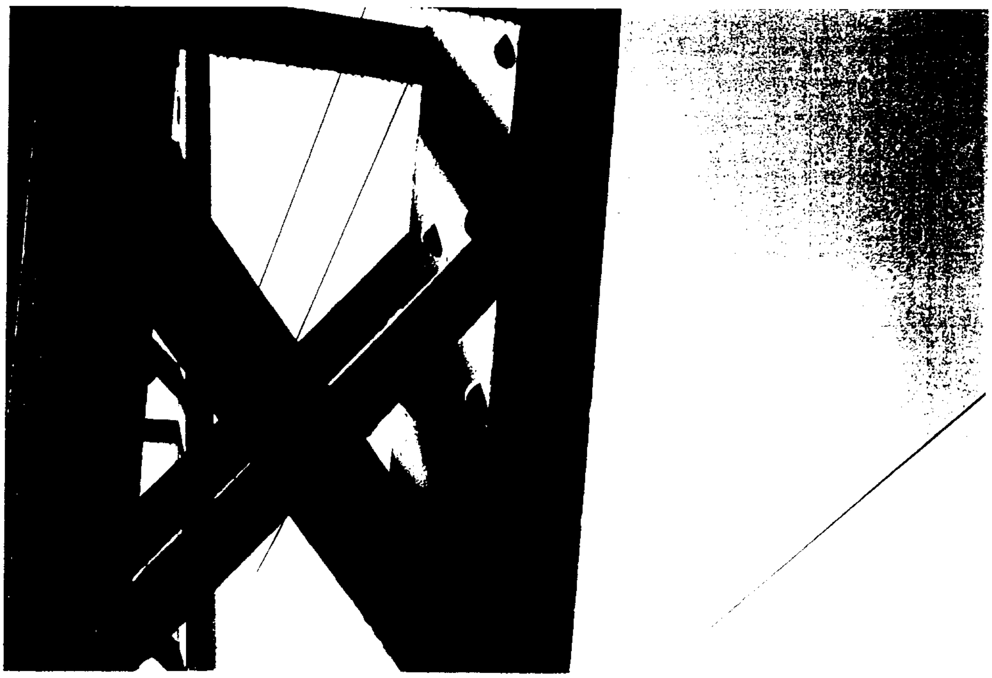


F6-24 Span 13
Corrosion at dia-
gonal



F6-25 Span 13
Trap-door at descent to bearings, at each span

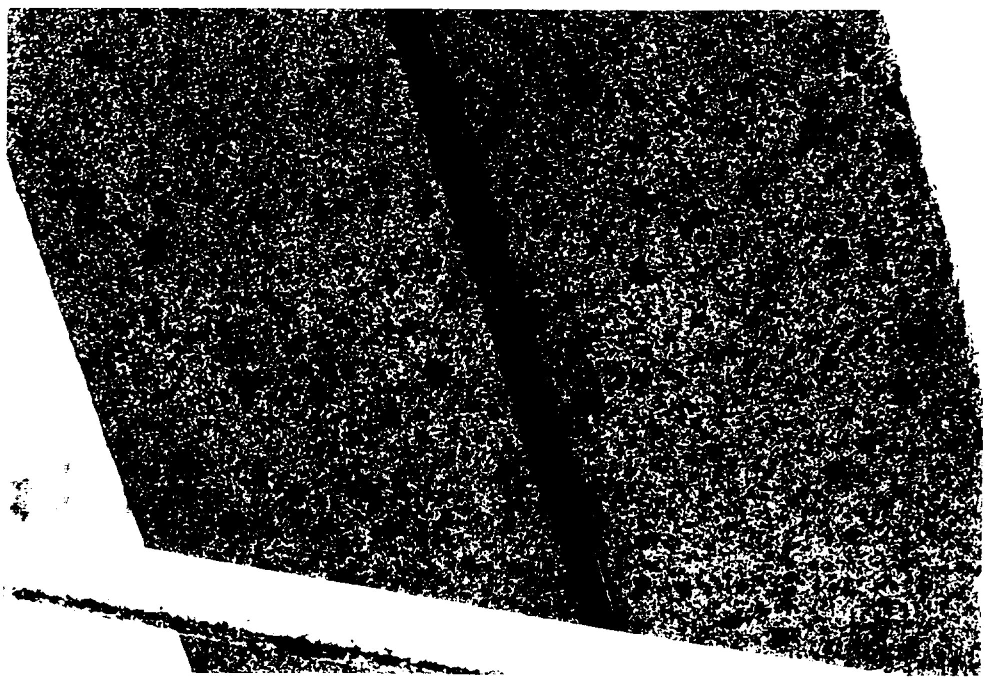
F6-26 Span 13
View along bridge inside



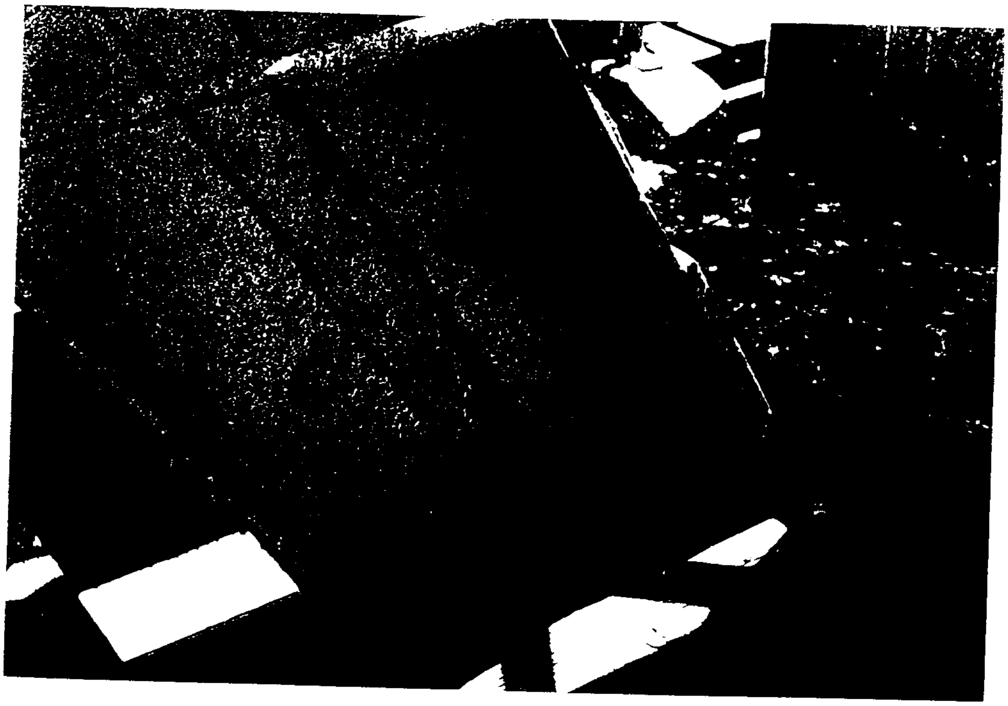
F6-27 Span 13
Corrosion at the vertical

F6-28 Span 13
UC node 1 missing rivet

F6-29 Span 13
Deformed stiffener plate between cross girder and vertical

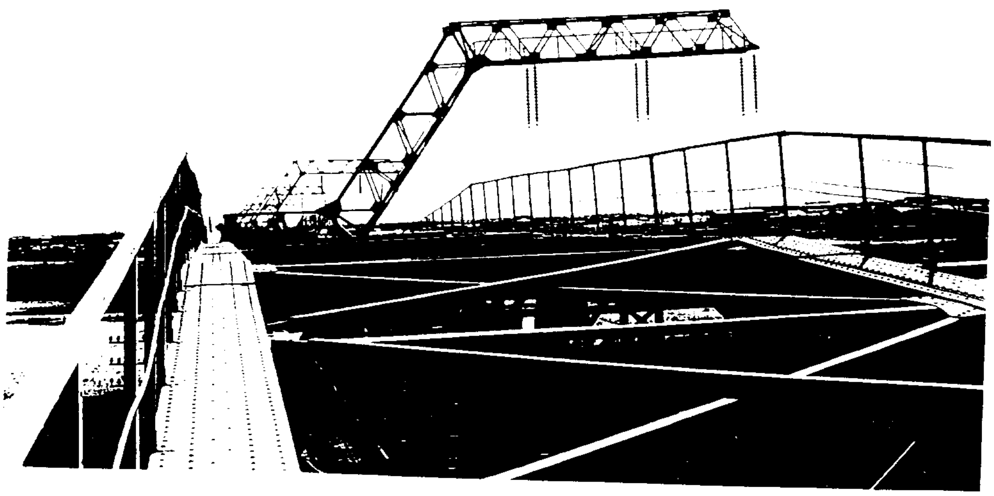


F6-30 Span 13
Corrosion at diagonal



F6-31 Span 13
As F6-30

F6-32 Span 13
LC DS angle
puffed up by corros.

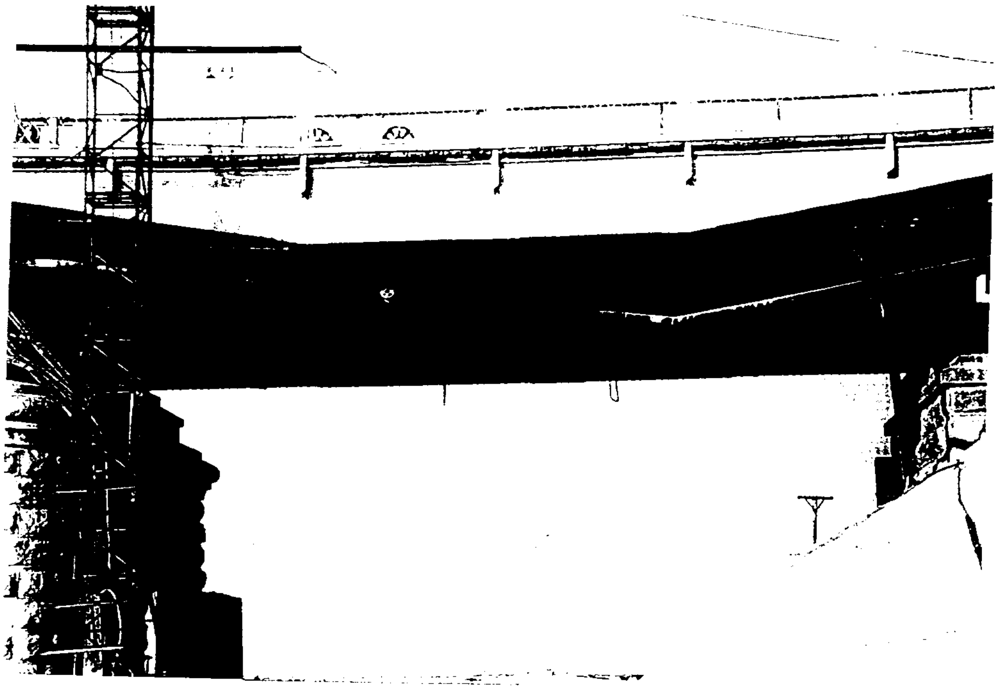


F6-33 Span 13
HV cantilever

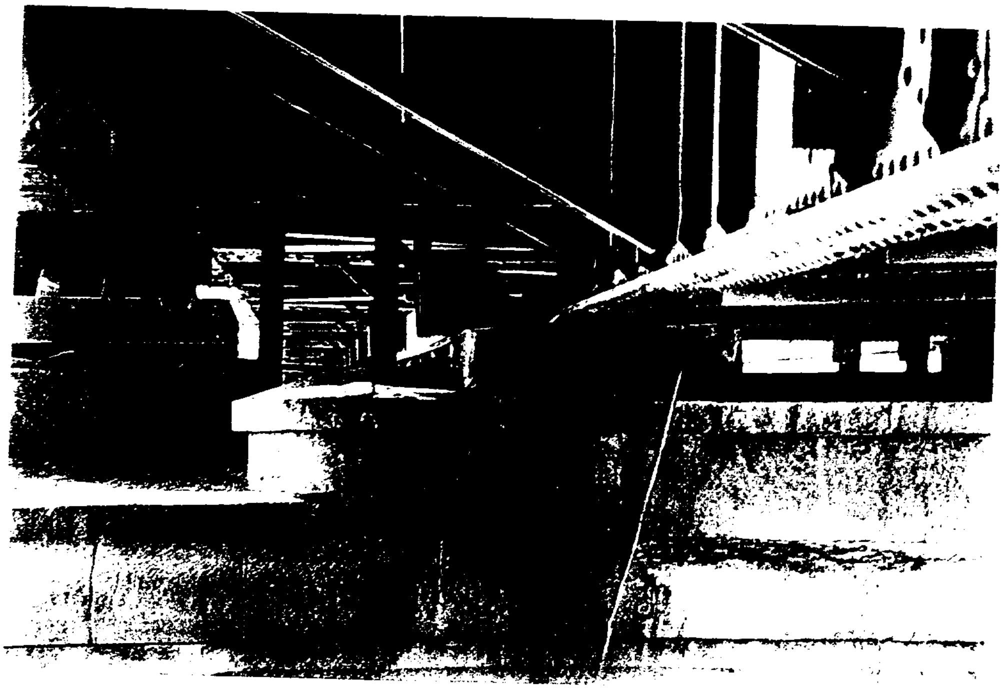
F6-34 Span 13
UC DS puffing up between rivets

F6-35 Span 13
As F6-34

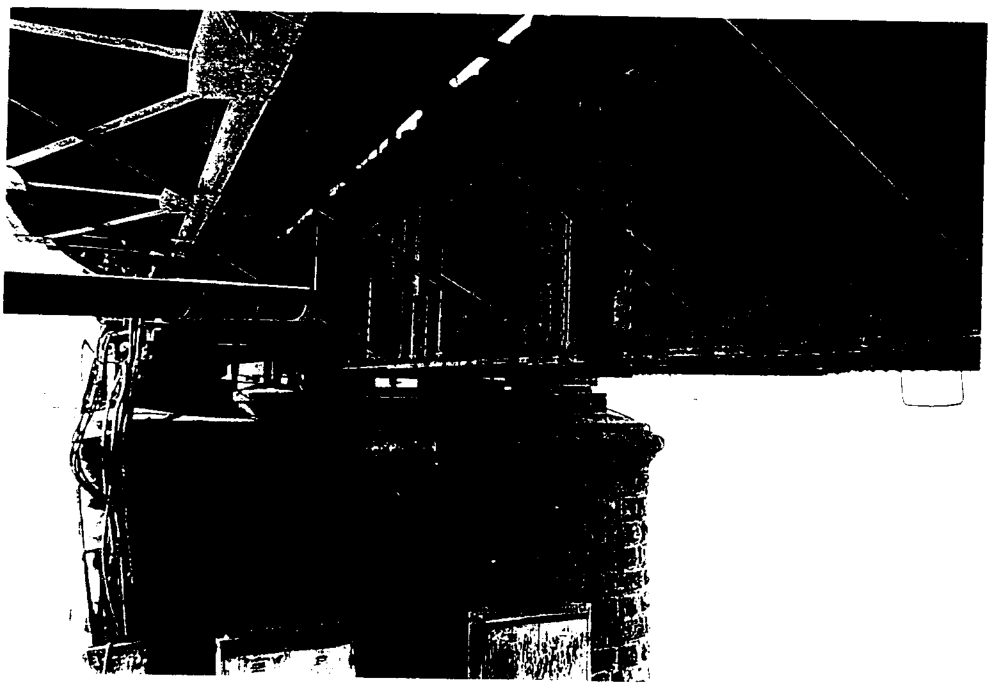
F6-37 Span 13
Corrosion of diagonal



F7-06 Span 26
View of footbridge

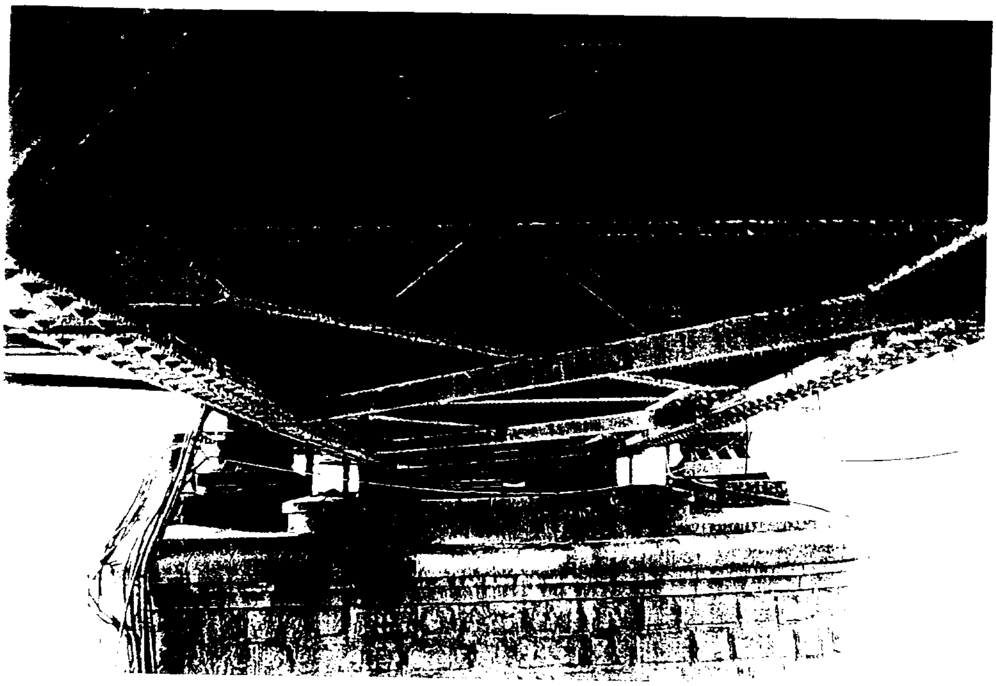


F7-07 Span 26
Bearing A1 with cracked stone

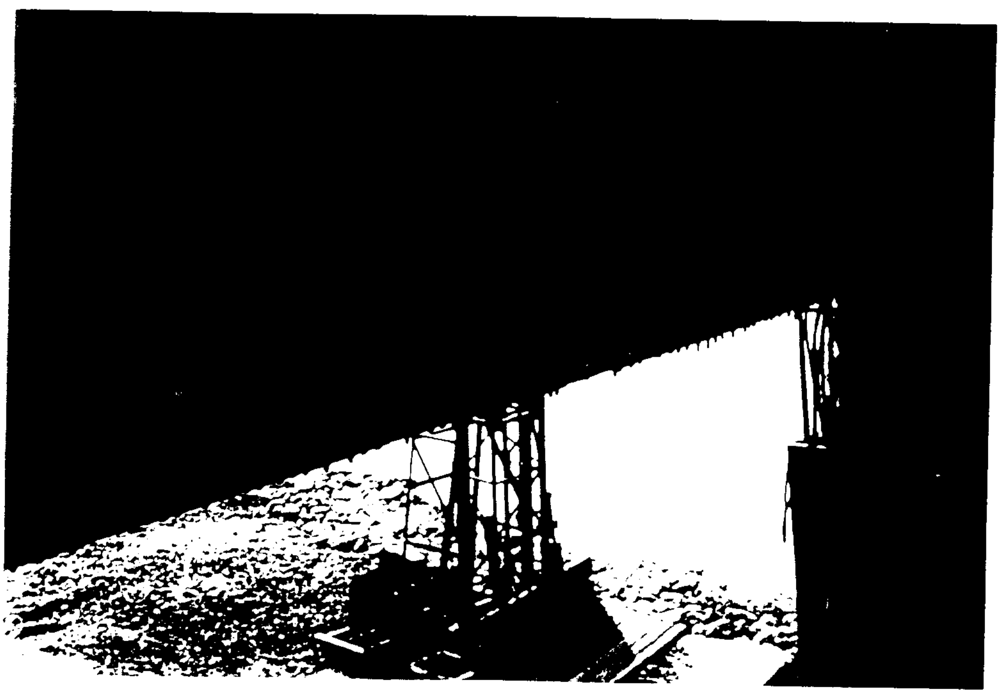


F7-08 Span 26
View from US

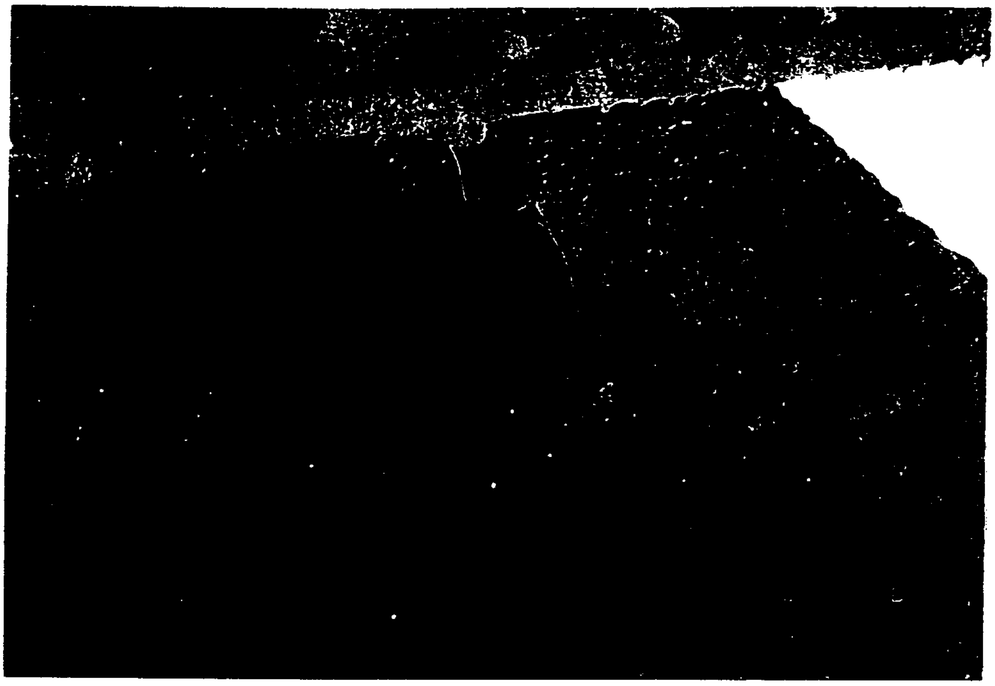
F7-09 Span 26
Footbridge - bolted cantilever



F7-10 Span 26
Bridge - lower side



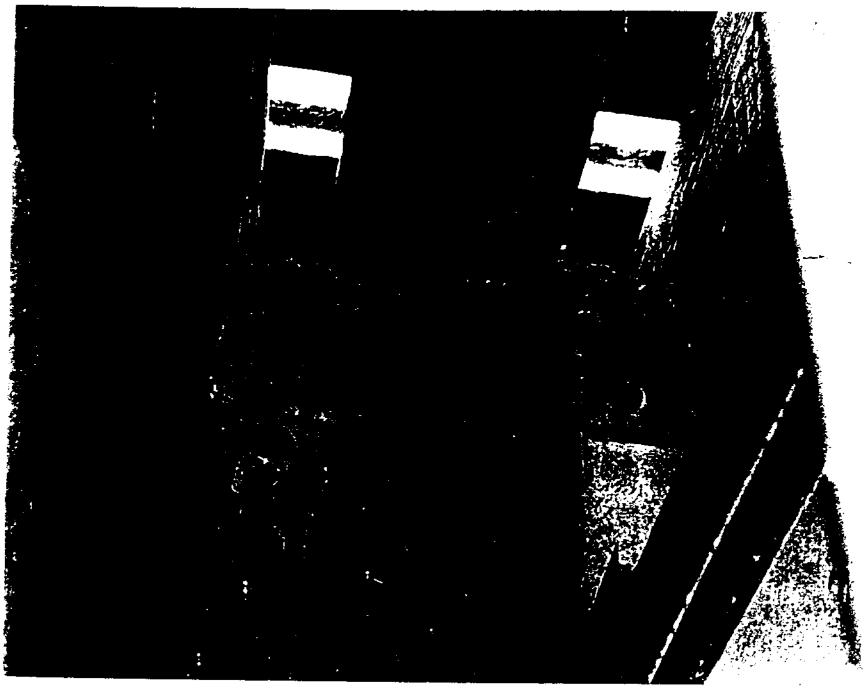
F7-11 Span 26
Main girder from DS



F7-12 Span 26
Bearing B2 -
defective mortar

F7-13 Span 26
Bearing B2 -
water channel

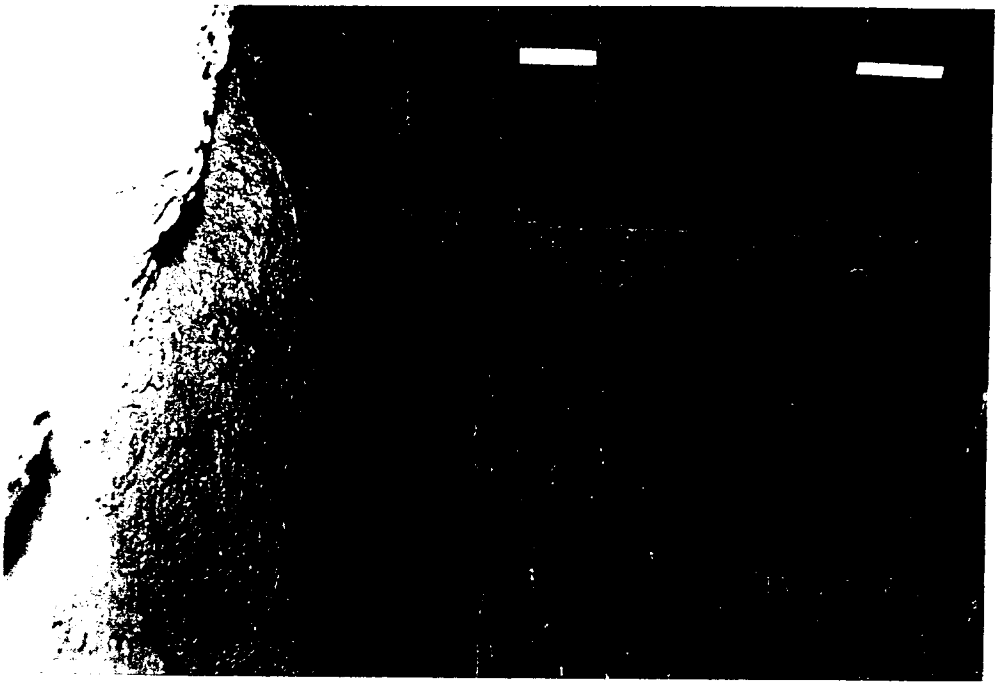
F7-14 Span 26
Bearing B2 -
defective mortar



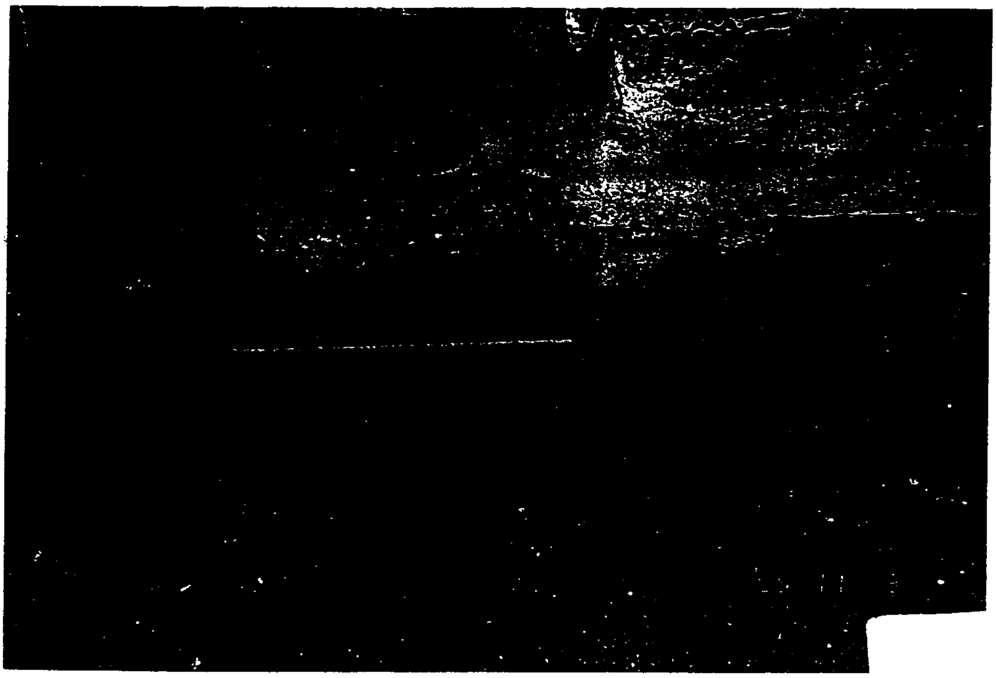
F7-15 Span 26
Angle welded to structure

F7-17 Span 26
Bearing B2

F7-18 Span 26
Bearing B2

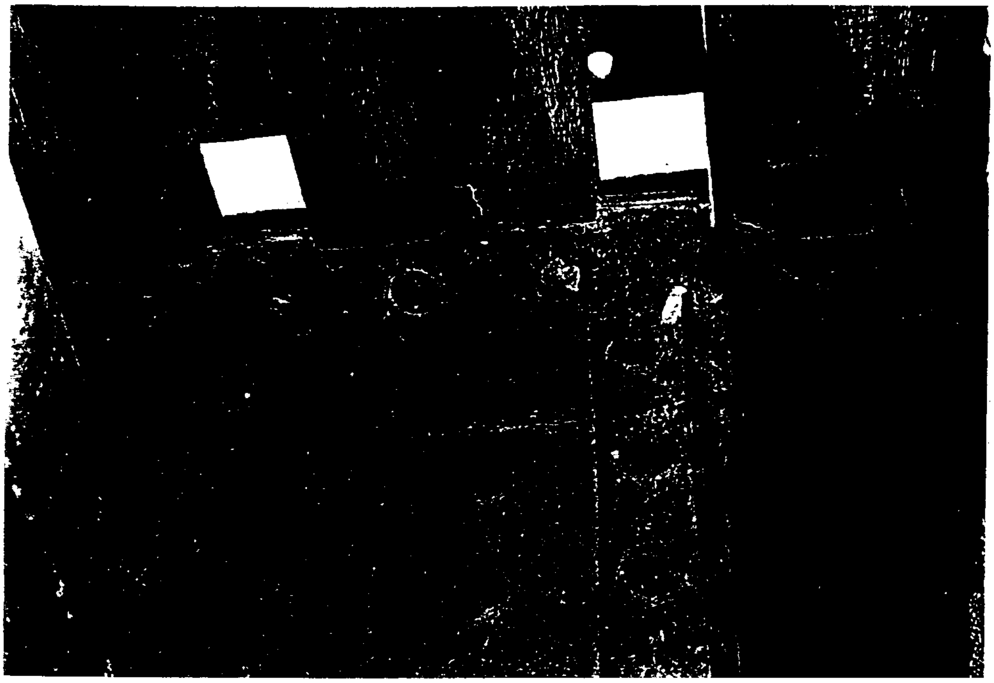


F7-19 Span 26
Angle welded to structure

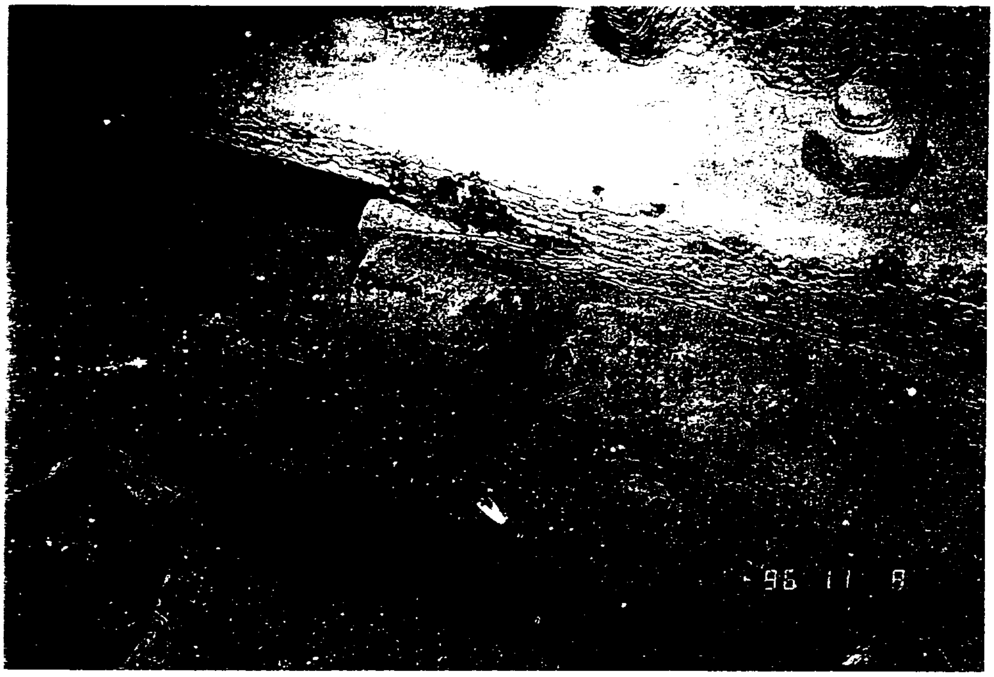


F7-20 Span 26
Bearing B2 - vertical movement

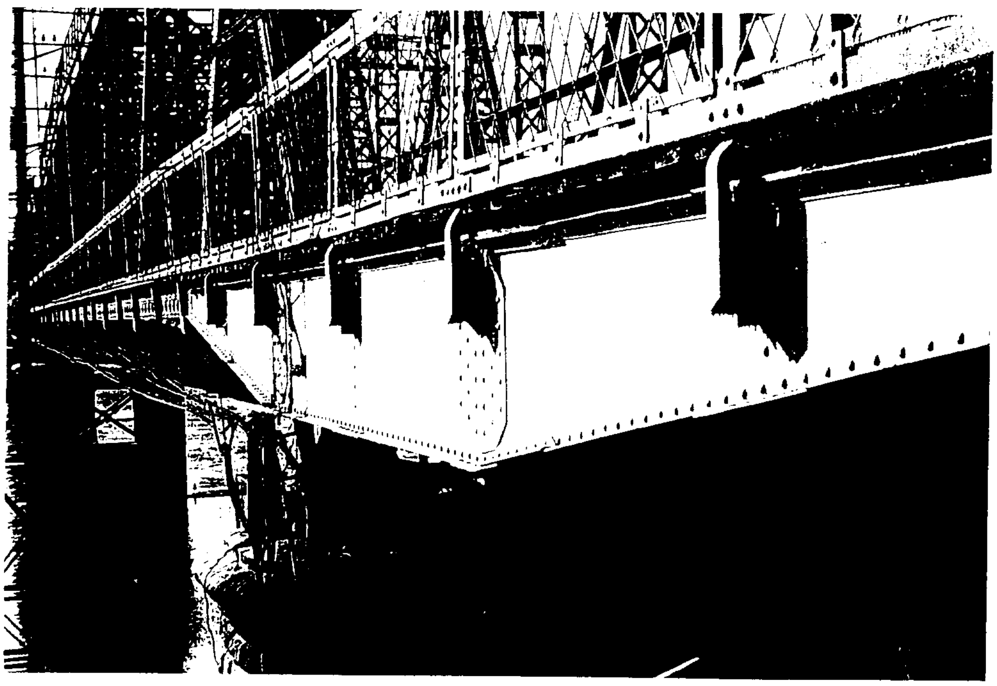
F7-22 Span 26
Bearing B1 - Distortion of upper bearing plate



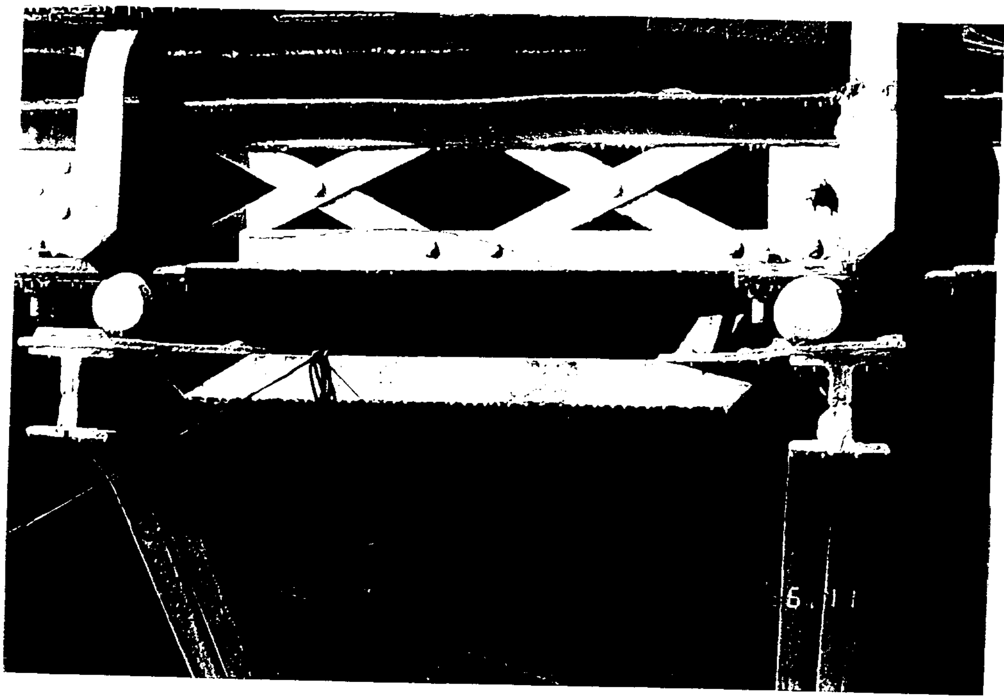
F7-23 Span 26
Welded fixing angle for sleepers



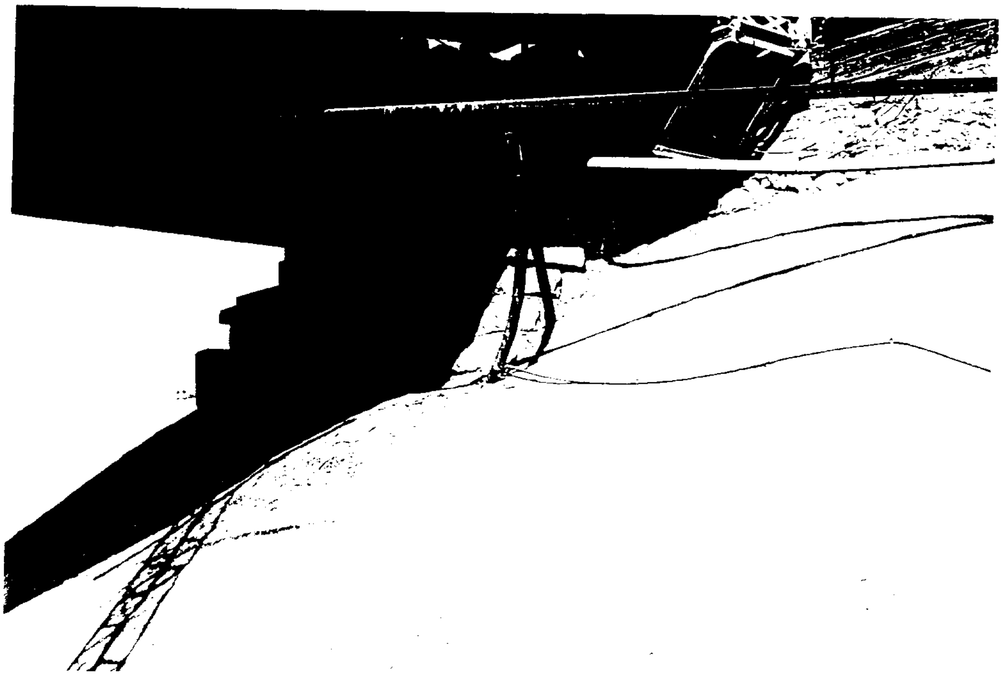
F7-24 Span 26
Bearing B1 - cracked lower plate



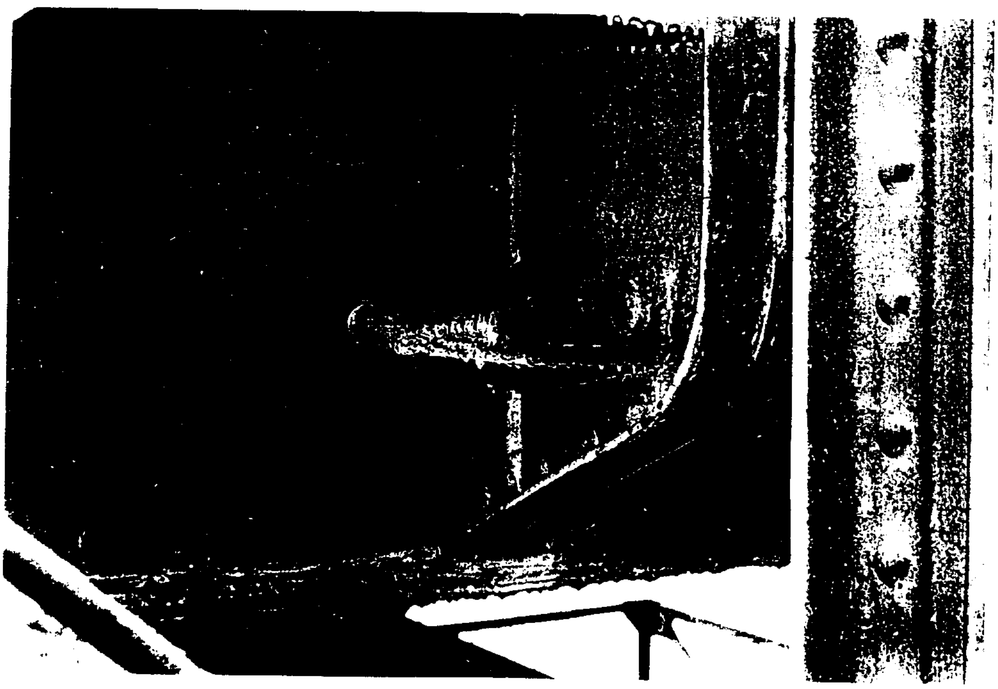
F7-25 Span 26
Footbridge US



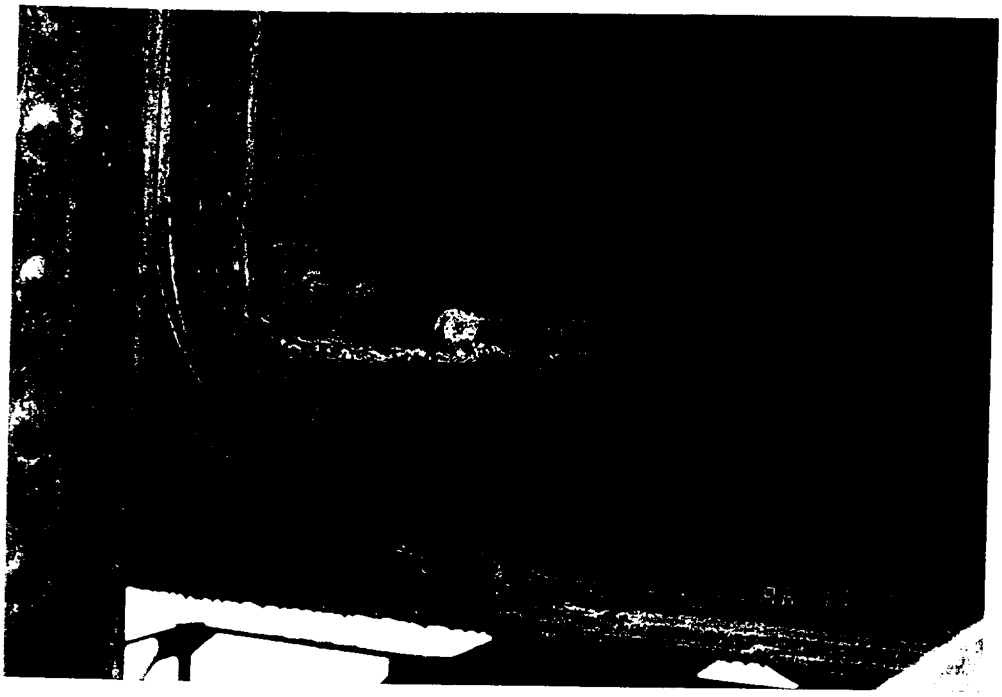
F7-26 Span 26
Roller bearing of footbridge - odd position of rollers



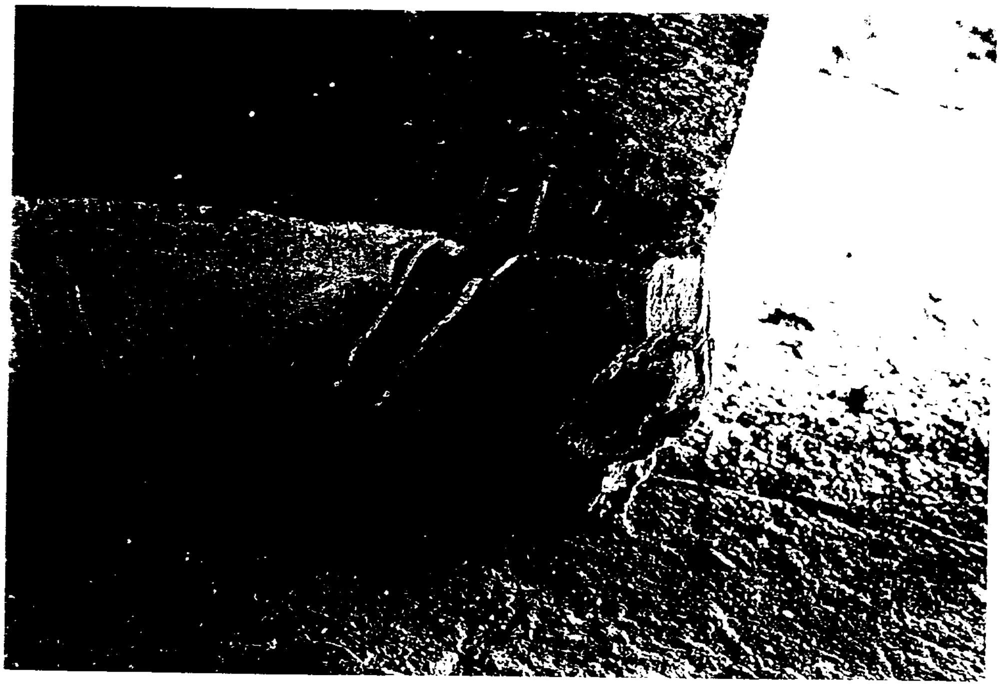
F7-27 Span 26
Farab abutment



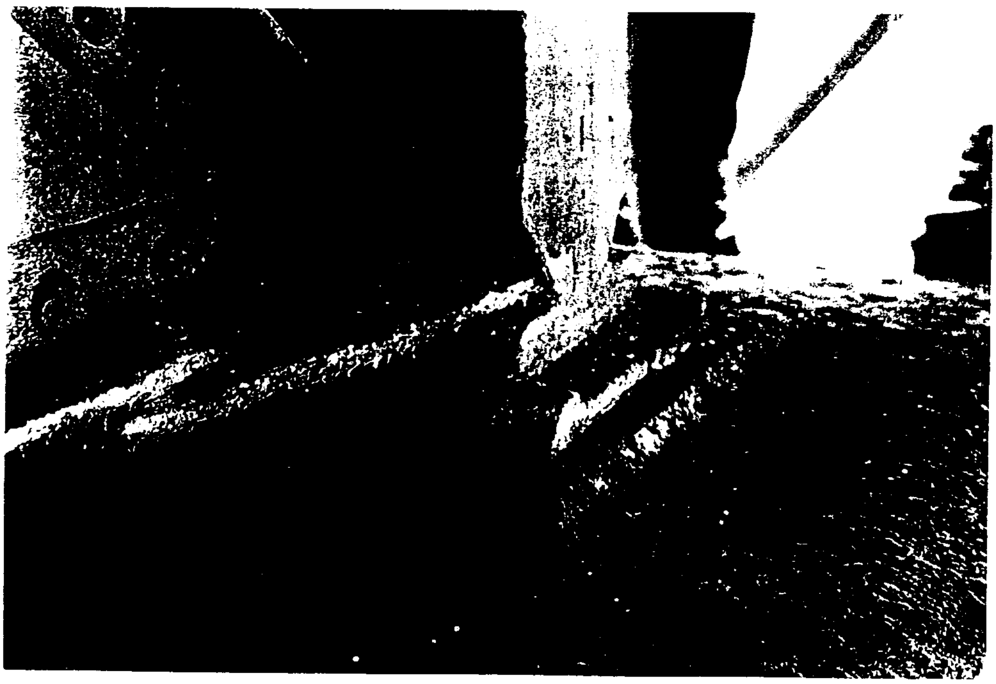
F7-28 Span 25
Reinforcement at end crossgirder, outside



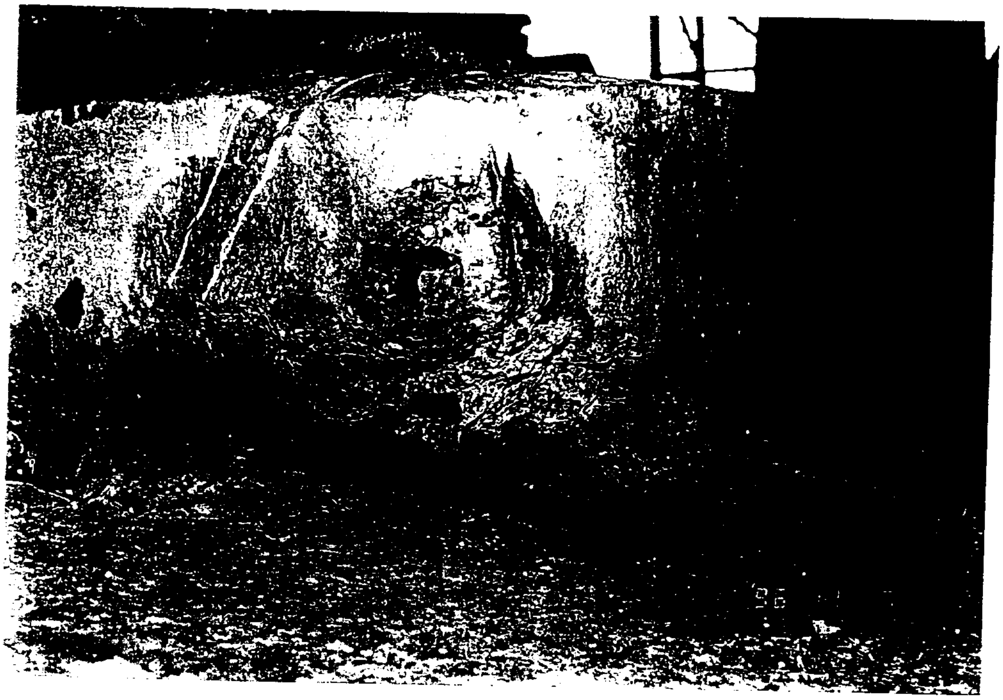
F7-29 Span 25
As F7-28,
other side



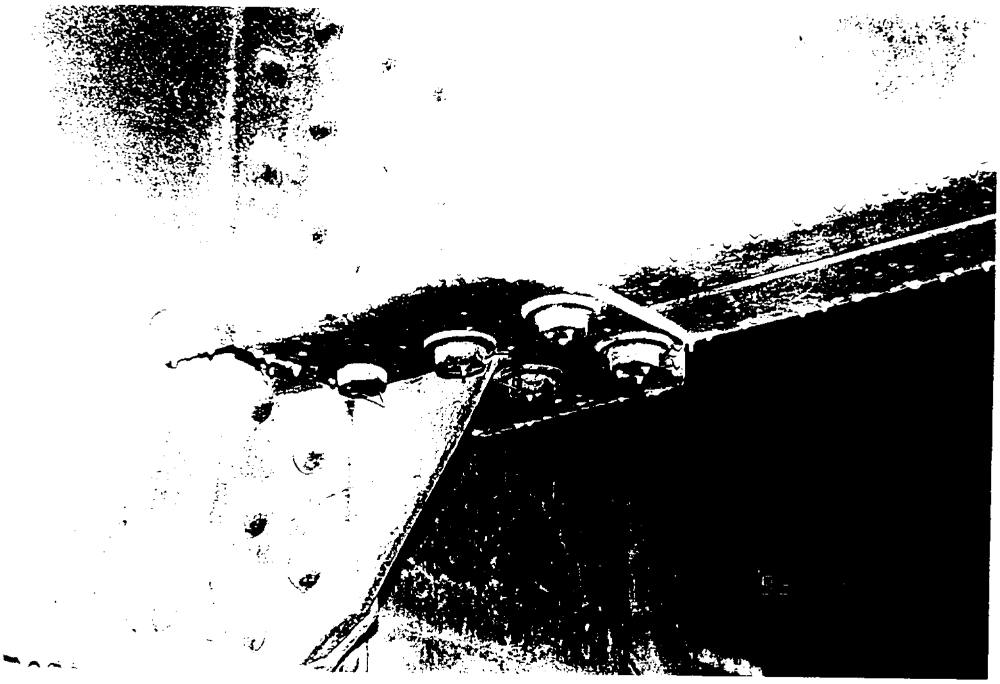
F7-30 Span 26
Bearing A1 - crack



F7-31 Span 26
Bearing A2
Fixed bearing

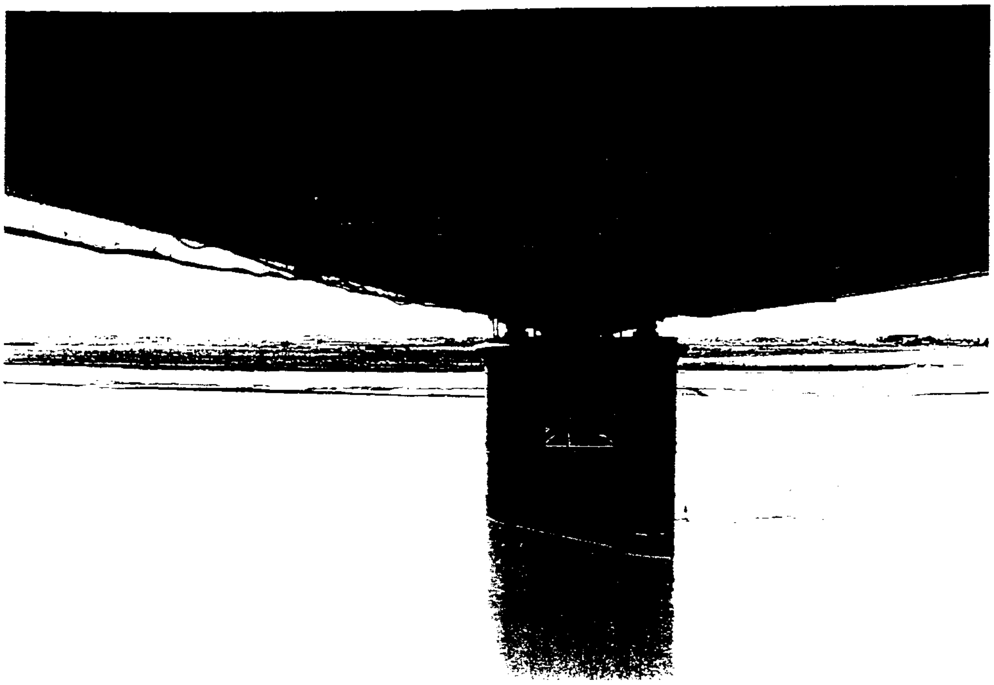


F7-32 Span 26
Bearing A1 -
bearing block



F7-33 Span 25
Reinforcement of
crossgirder

F7-34 Span 25
Lower side of span

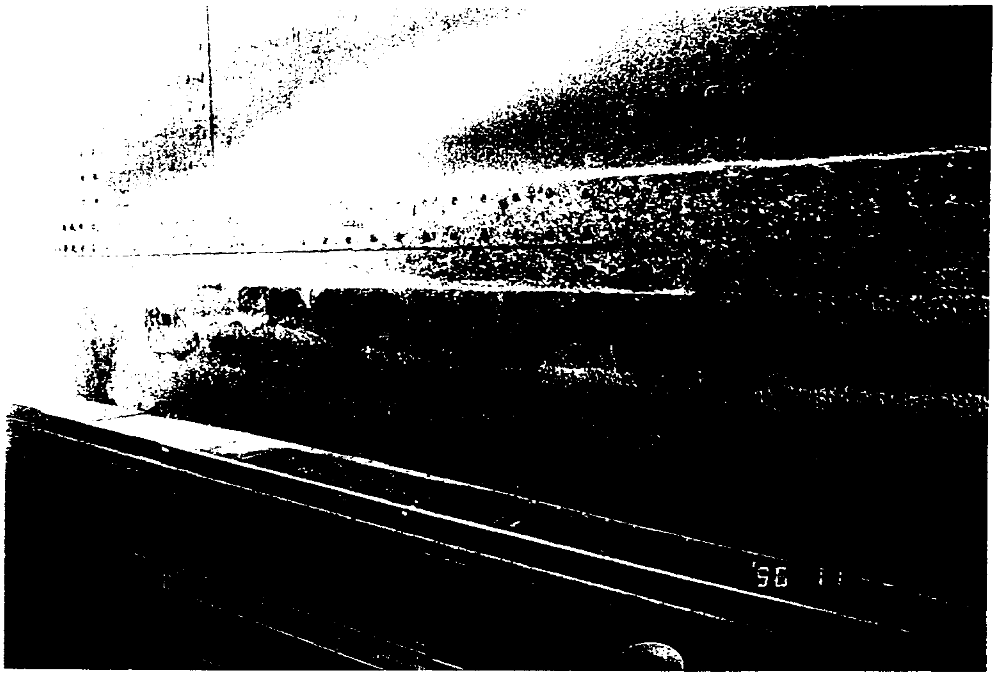


F7-36 Span 25
As F7-35

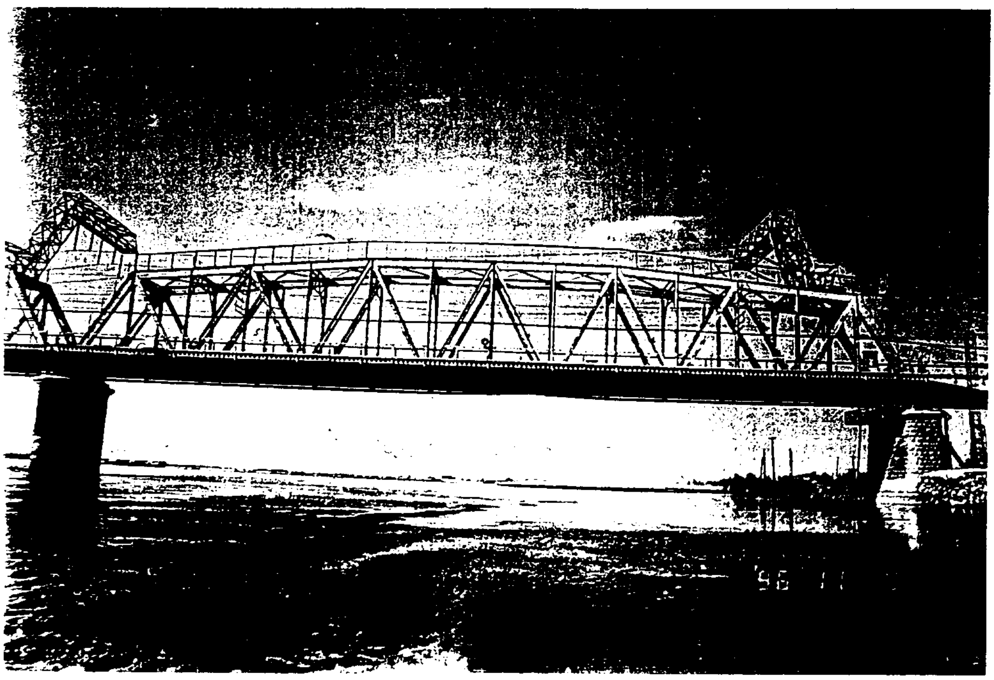
F8-00 Span 25
Bearing A1

F8-01 Pier 25
View from boat

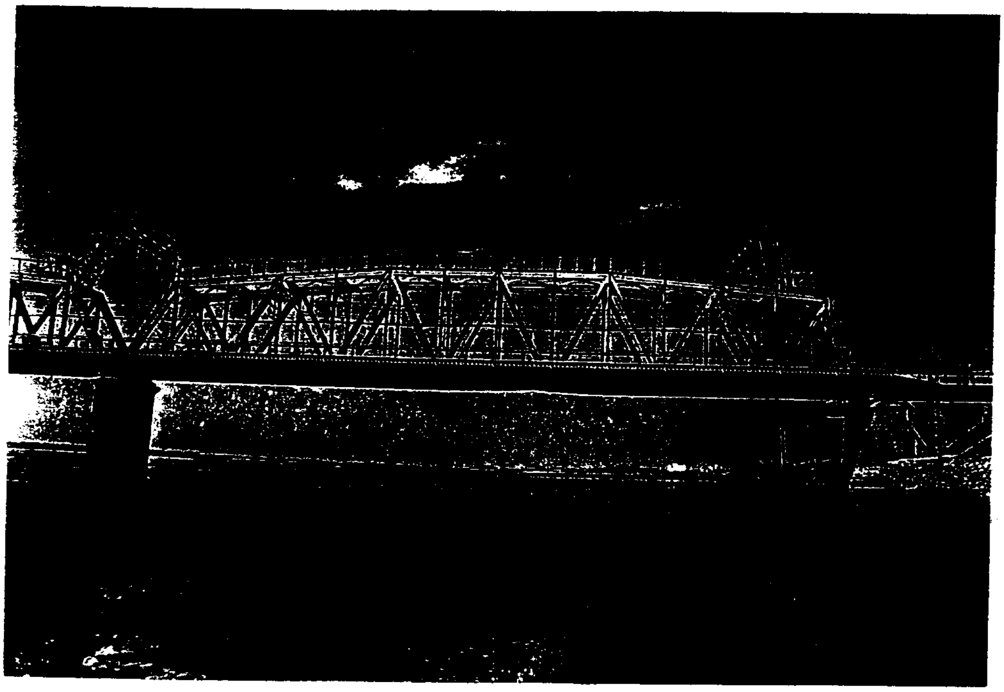
F8-02 Pier 25
As F8-01



F8-03 Pier 25
As F8-01

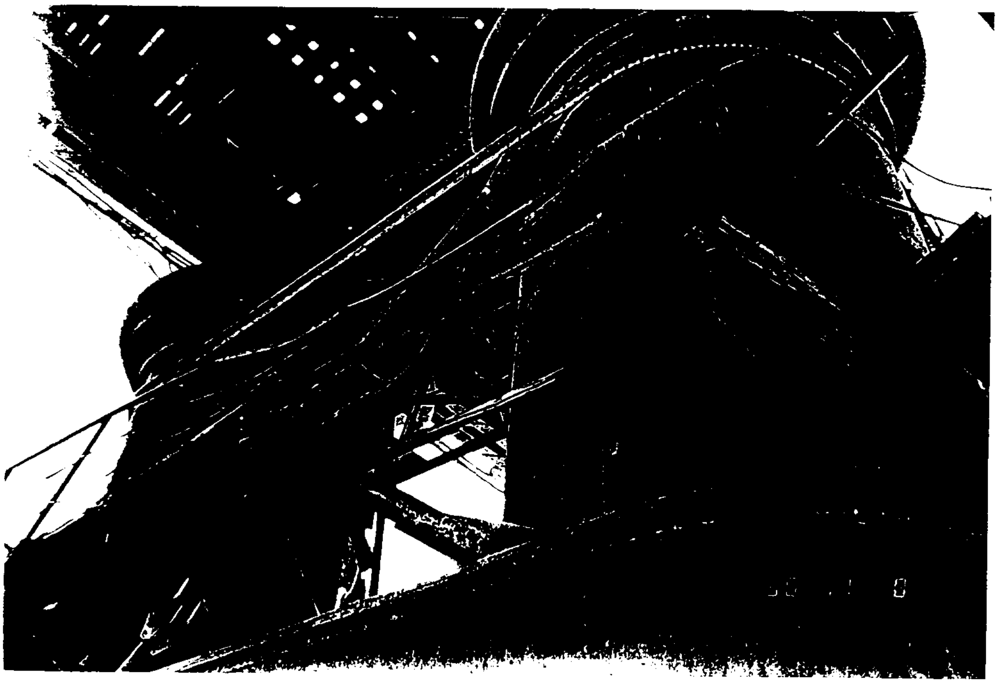


F8-04 Span 25
View from US

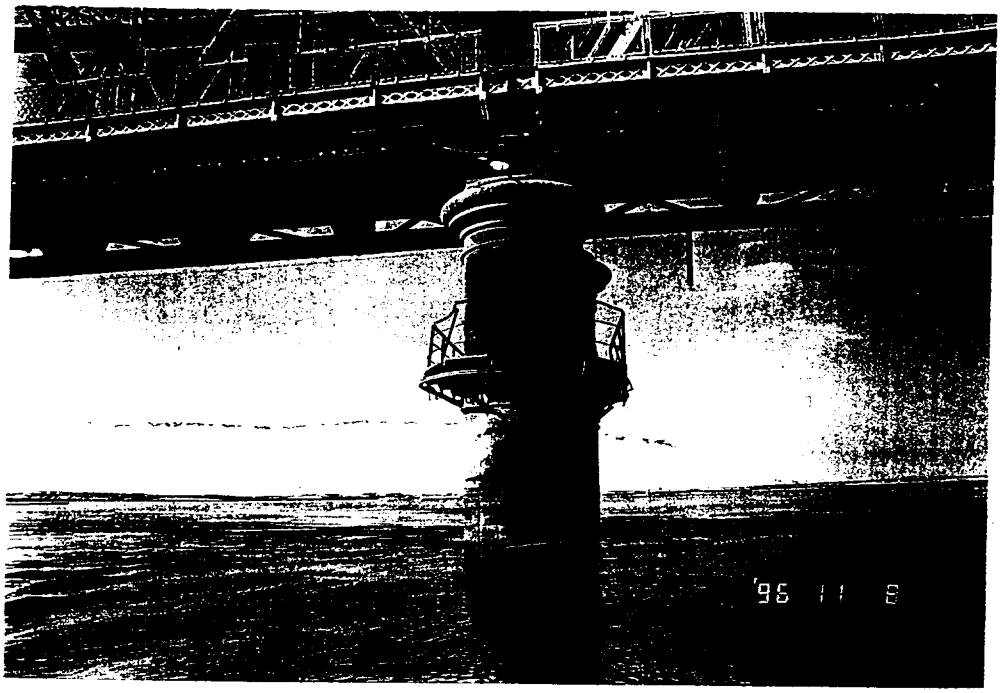


F8-05 Span 25
As F8-04

F8-06 Pier 24
Demolished after ship collision



F8-07 Pier 24
As F8-06

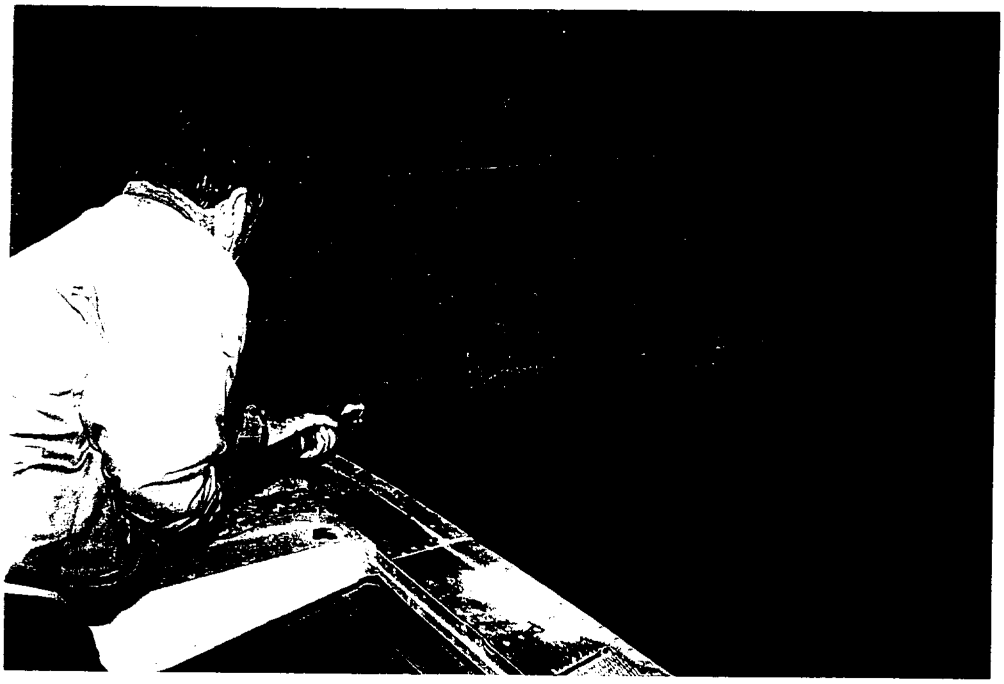


F8-08 Pier 24
As F8-06

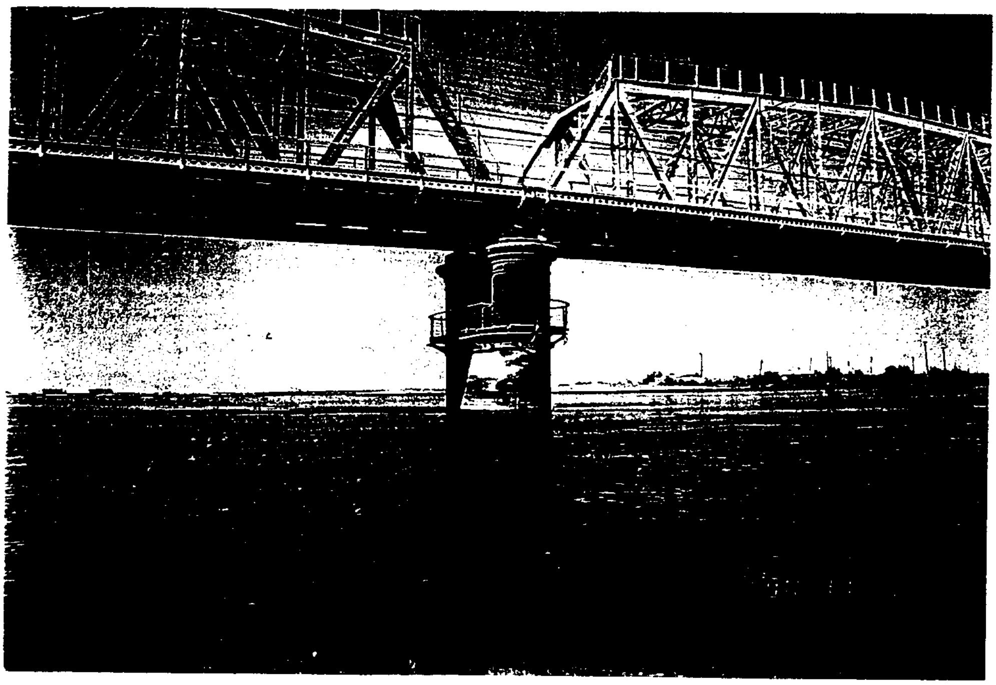
F8-09 Pier 24
As F8-06

F8-11 Pier 23
Detail

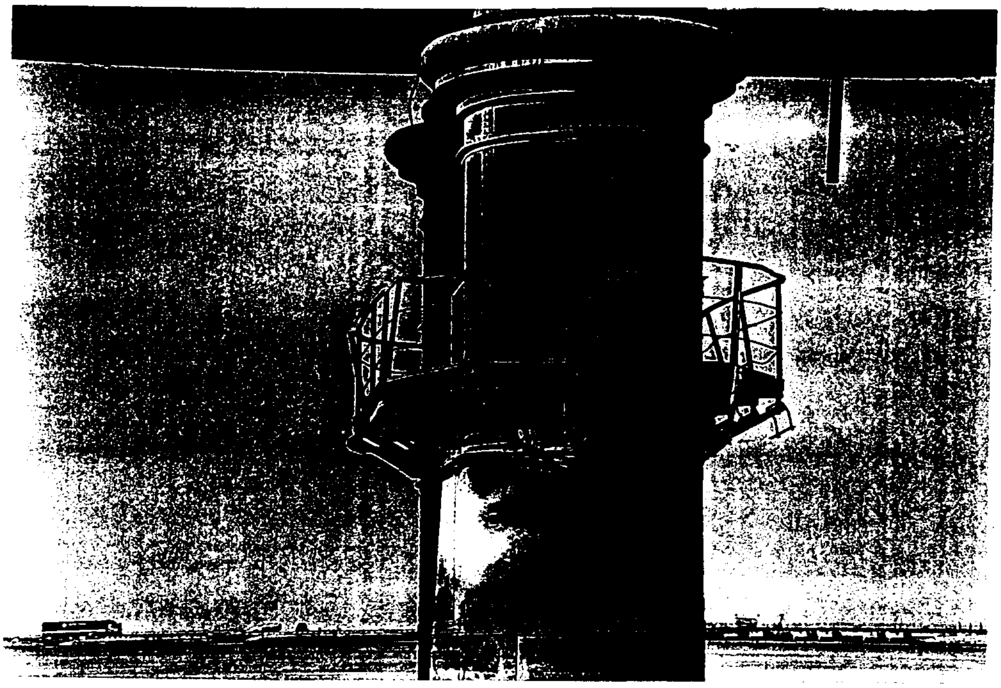
F8-12 Pier 23
Bracing



F8-13 Pier 23
Mr. Kazanov,
director

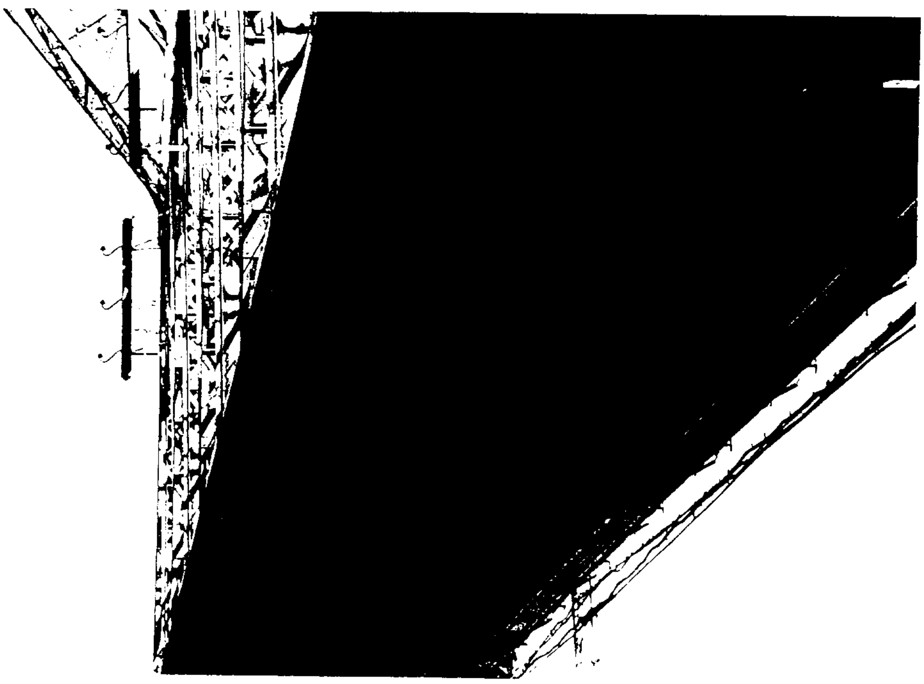


F8-14 Span 23-24

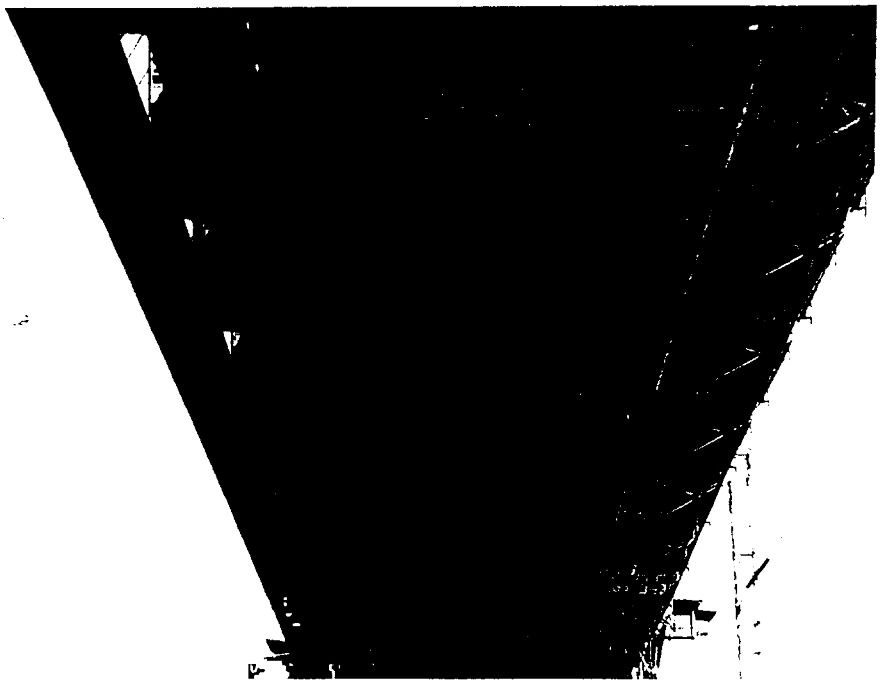


F8-15 Pier 24

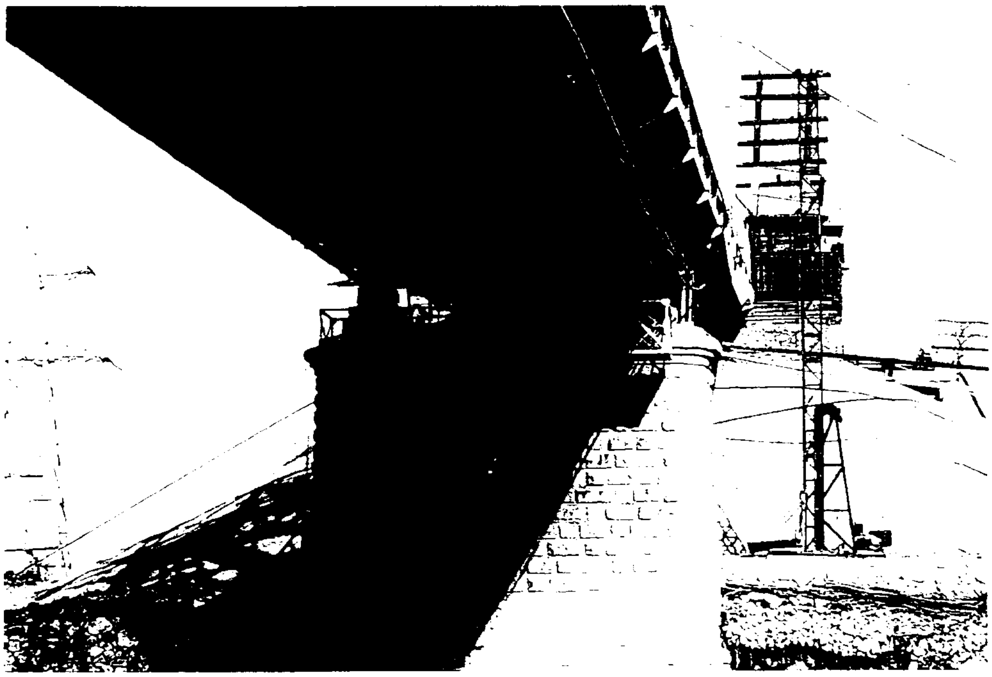
F8-16 Pier 24



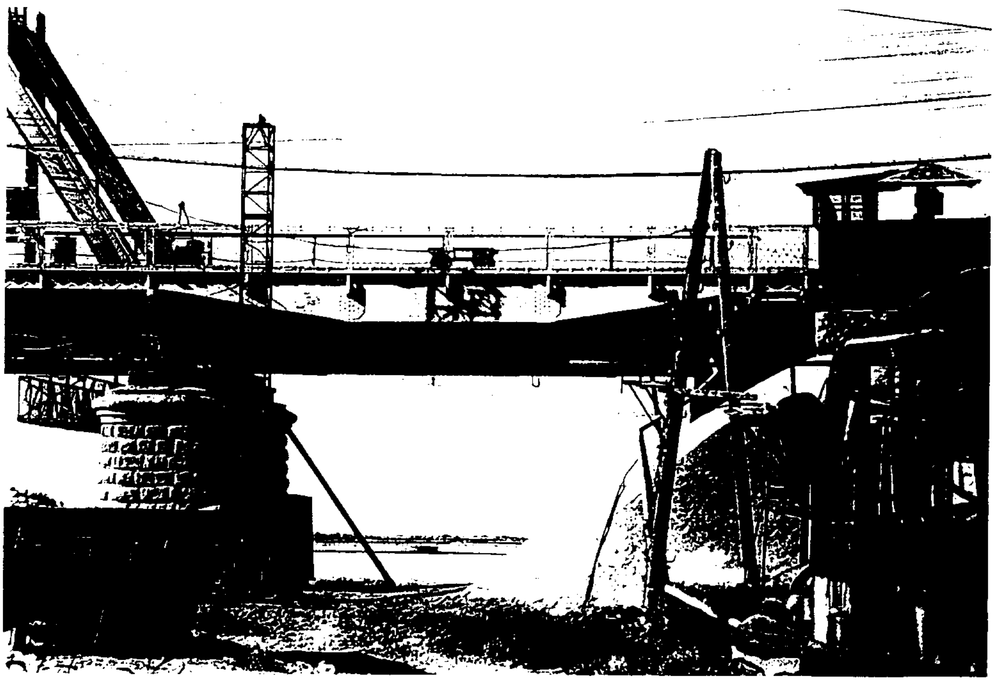
F8-17 Span 25
Bent rail of inspection car



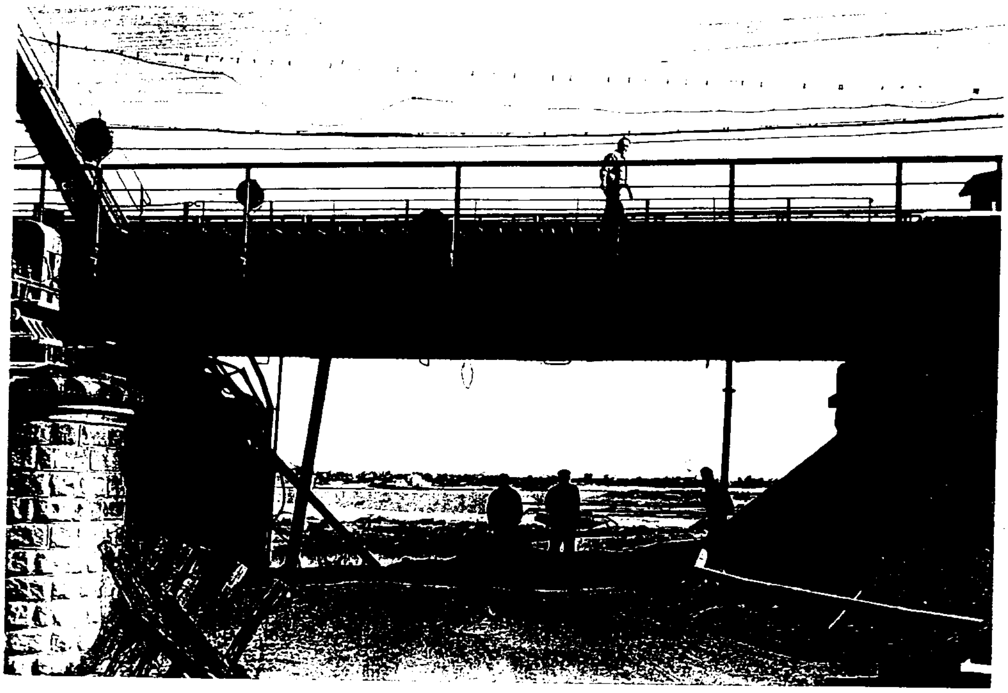
F8-19 Span 25
As F8-17



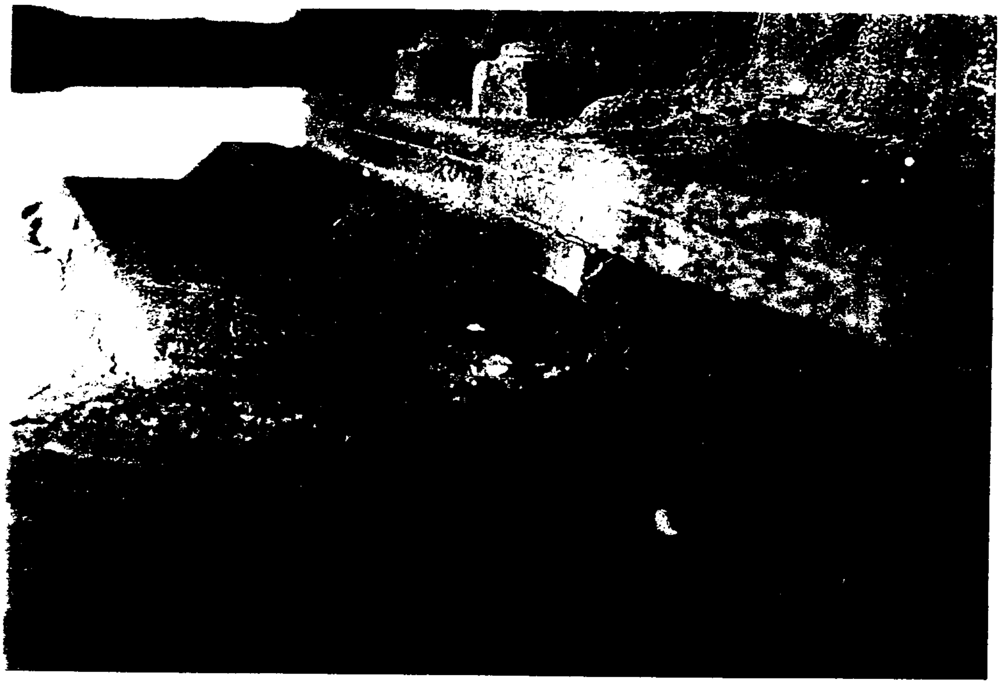
F8-21 Span 25
Bridge with guard room



F8-22 Span 26

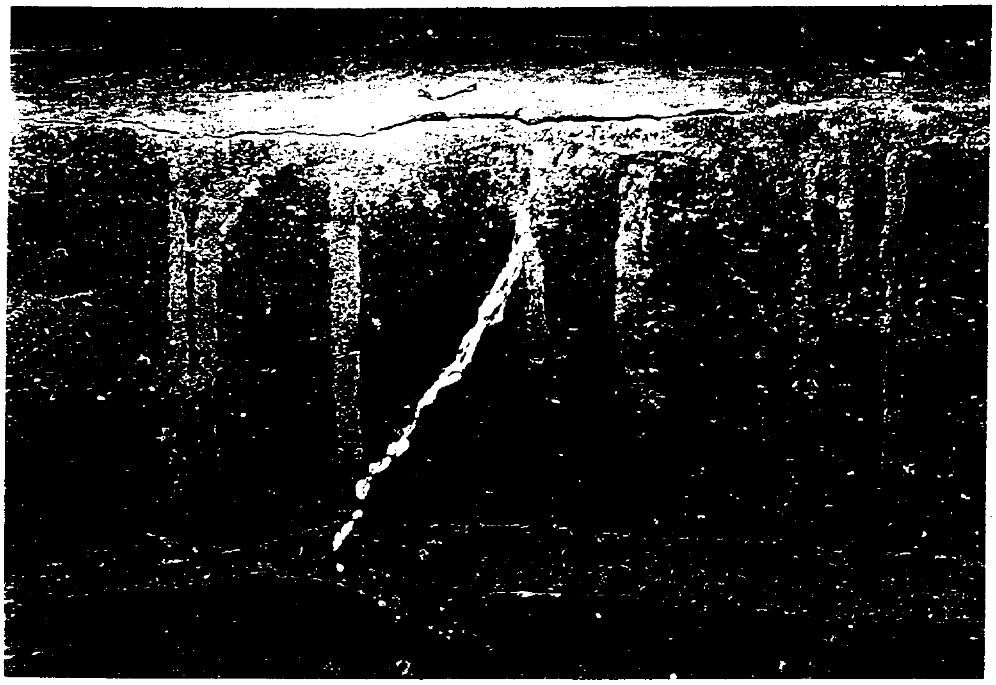


F8-24 Span 0

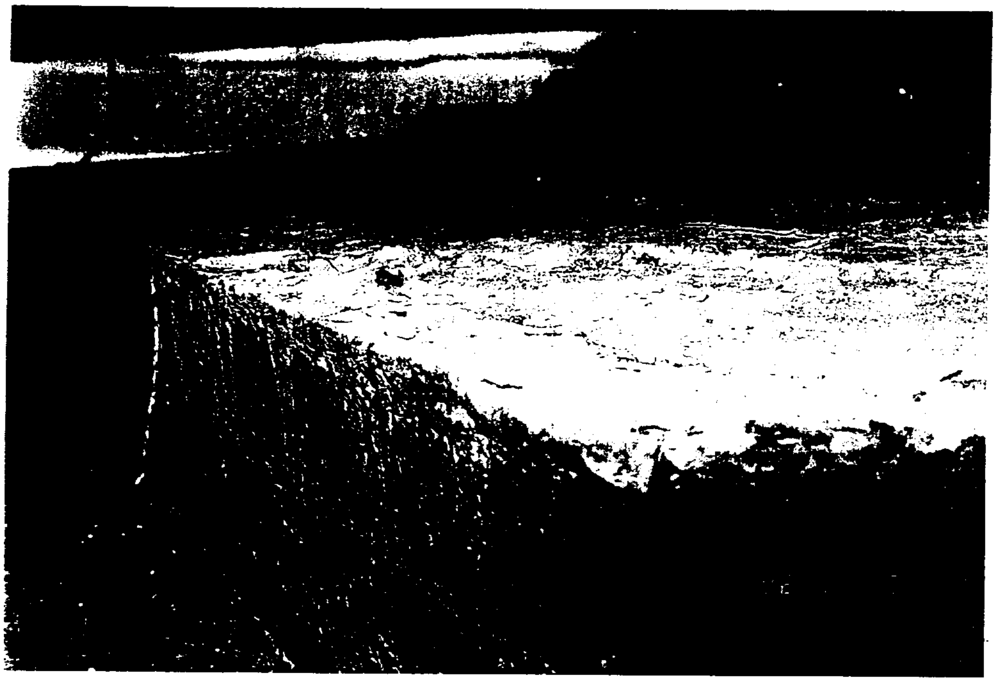


F8-25 Span 0
Bearing B1 -
vertical movement

F8-26 Span 0
Bearing A1 -
vertical movement

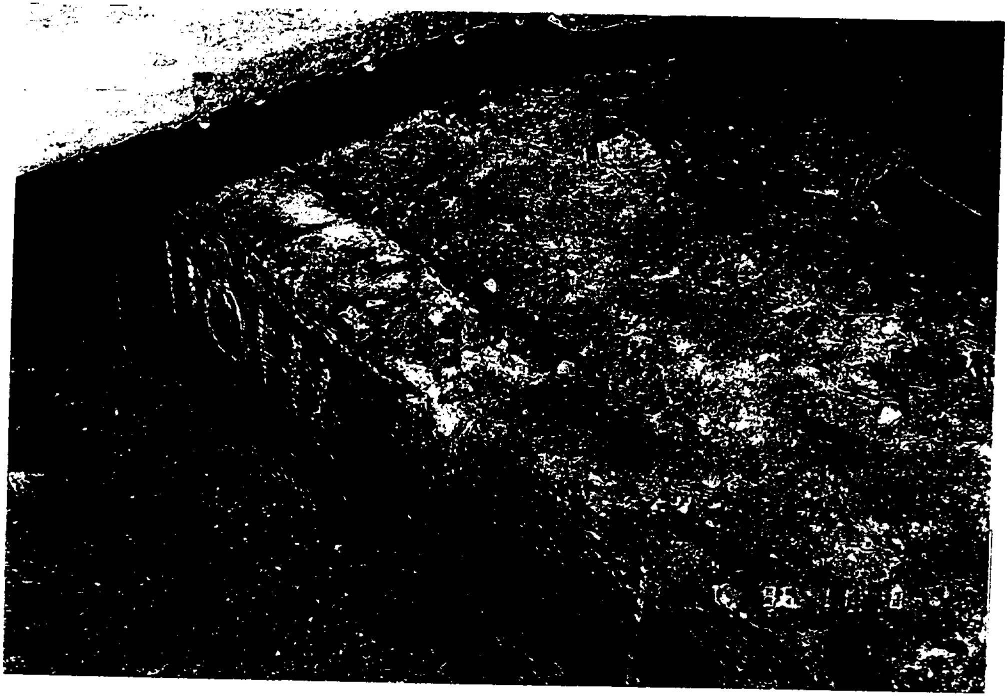


F8-27 Span 0
Bearing B1 -
concrete block stands
loose on stone



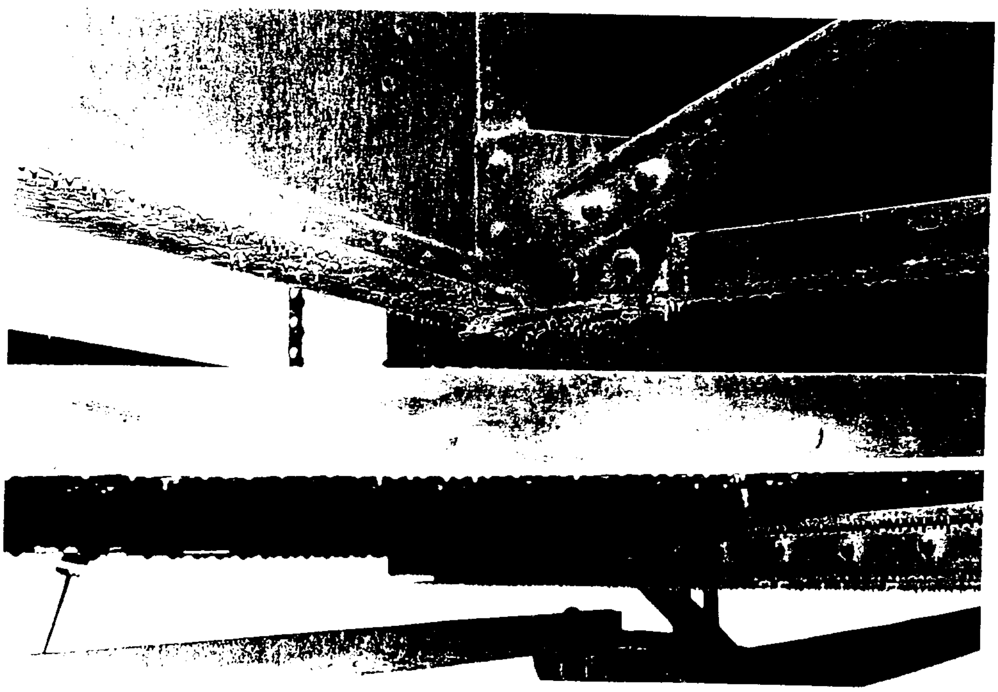
F8-28 Span 0
Bearing B1 -
concrete block

F8-29 Span 0
Bearing B1 -
concrete chipping



F8-30 Span 0
Bearing B1 - chipping to reinforcement

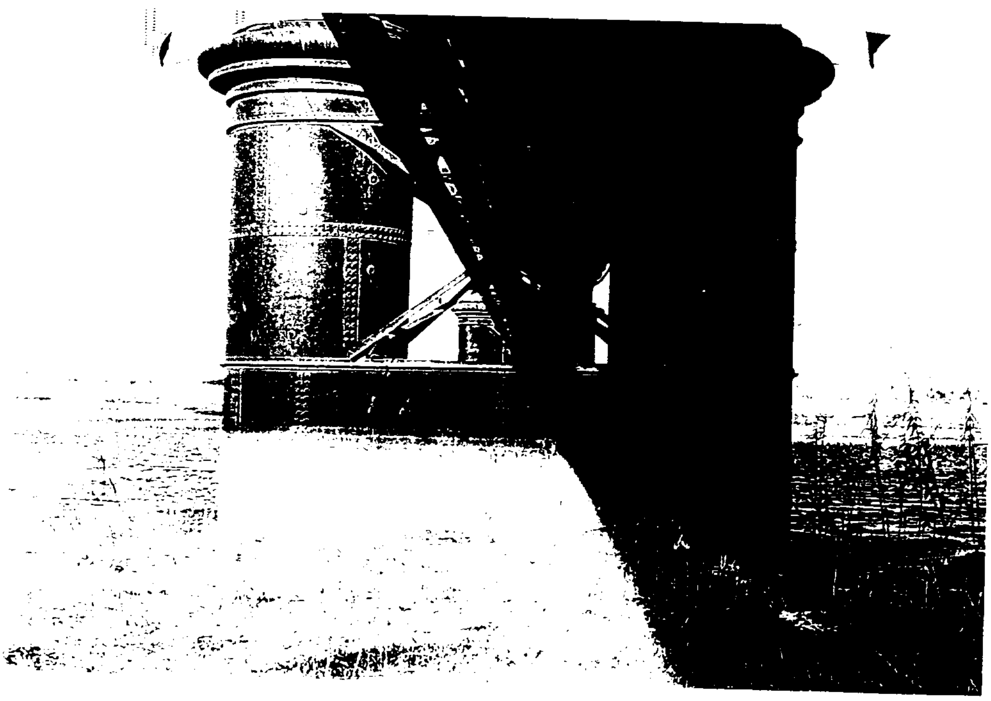
F8-31 Span 0
As F8-30



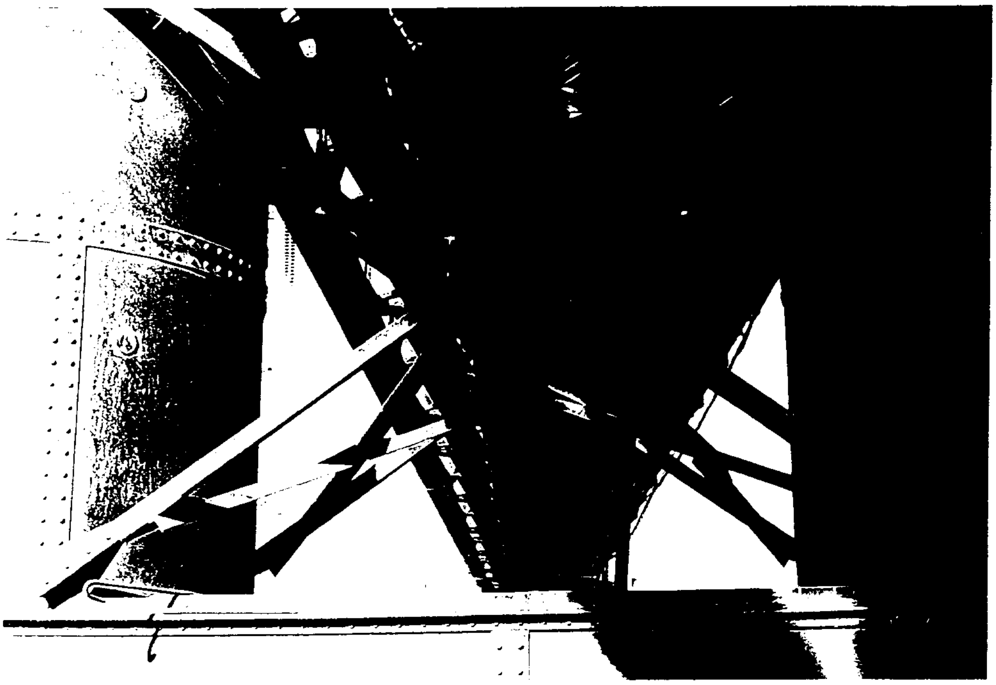
F8-32 Span 0
Gusset plate of longit. girder loose

F8-33 Span 0
Bearing A1 -
crack in concrete

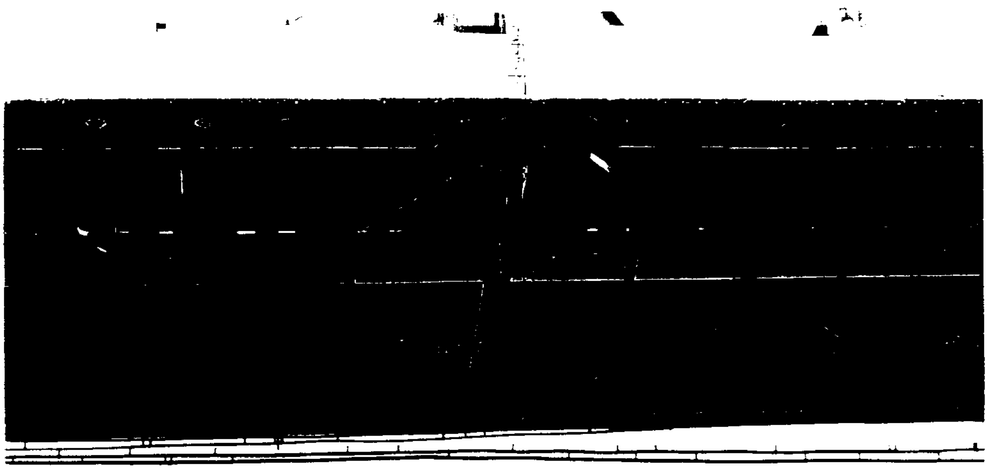
F8-34 Span 0
Bearing A1 -
chipping of concrete



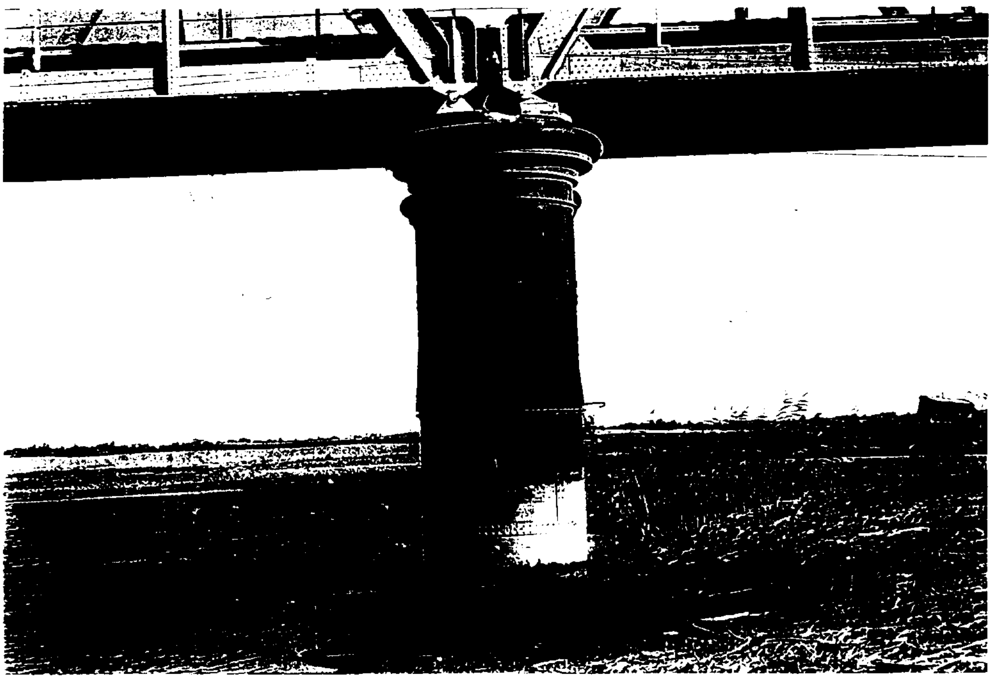
F8-35 Pier 3



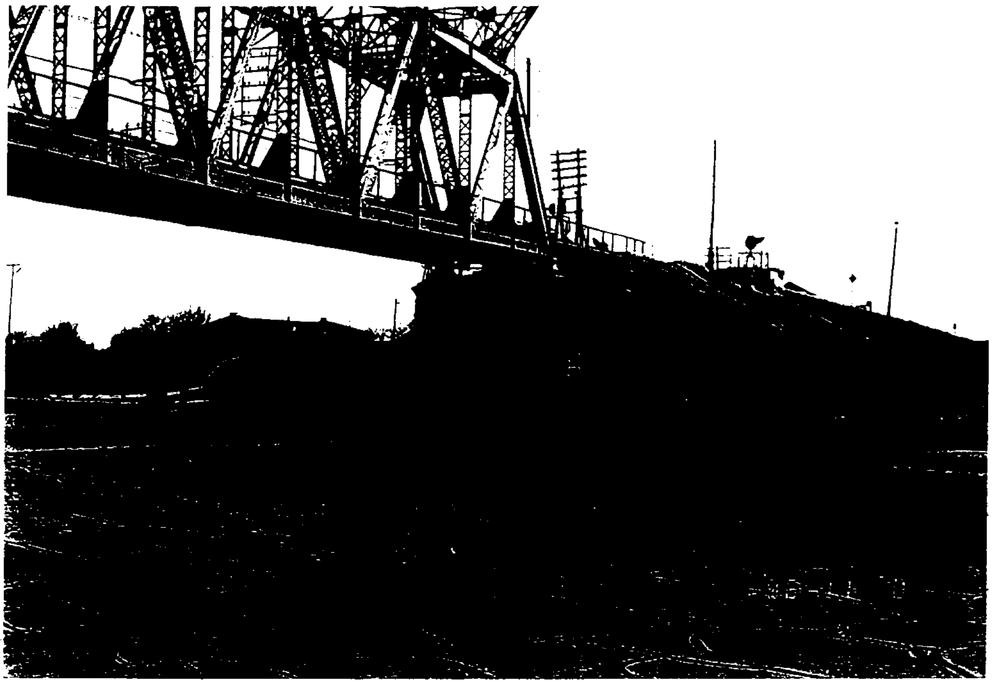
F8-36 Pier 3



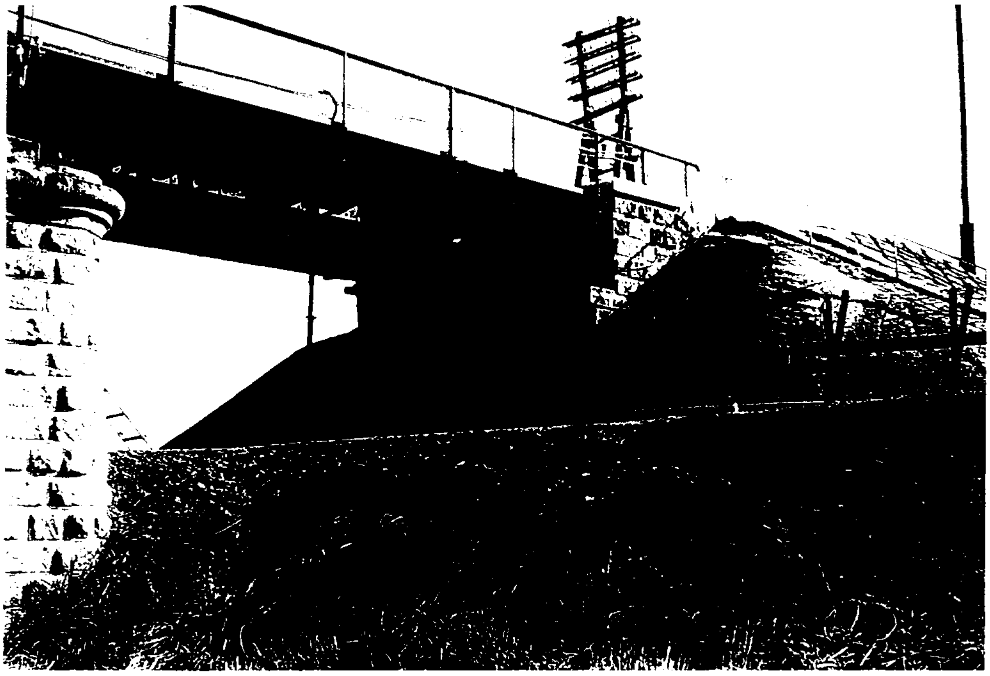
F9-00 Span 9
Reinforcements



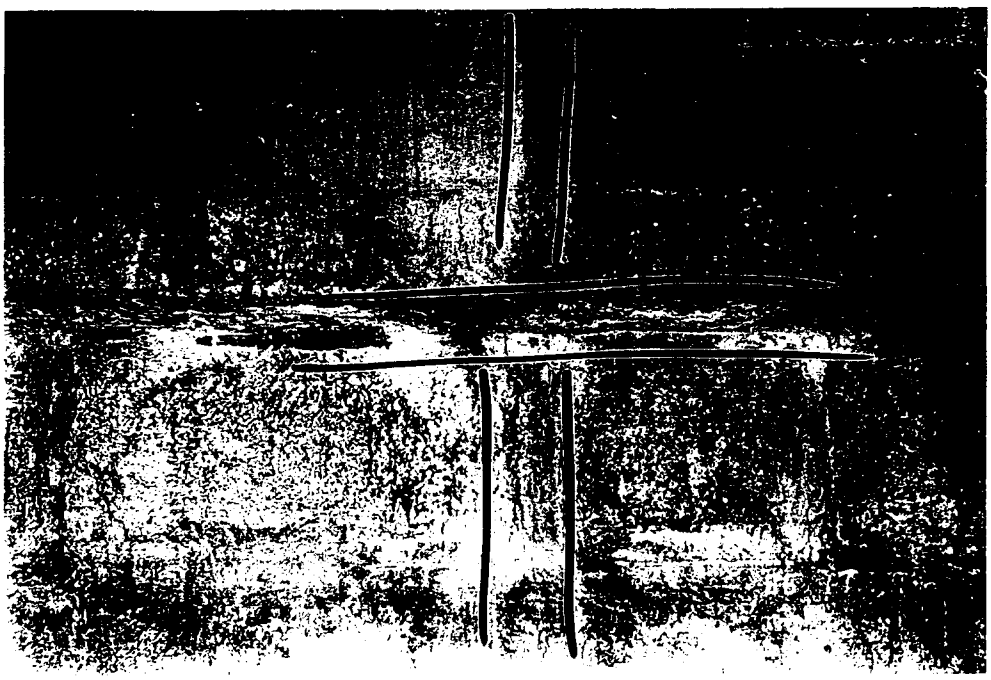
F9-01 Pier 6



F9-02 Span 1
Span 0 behind
span 1



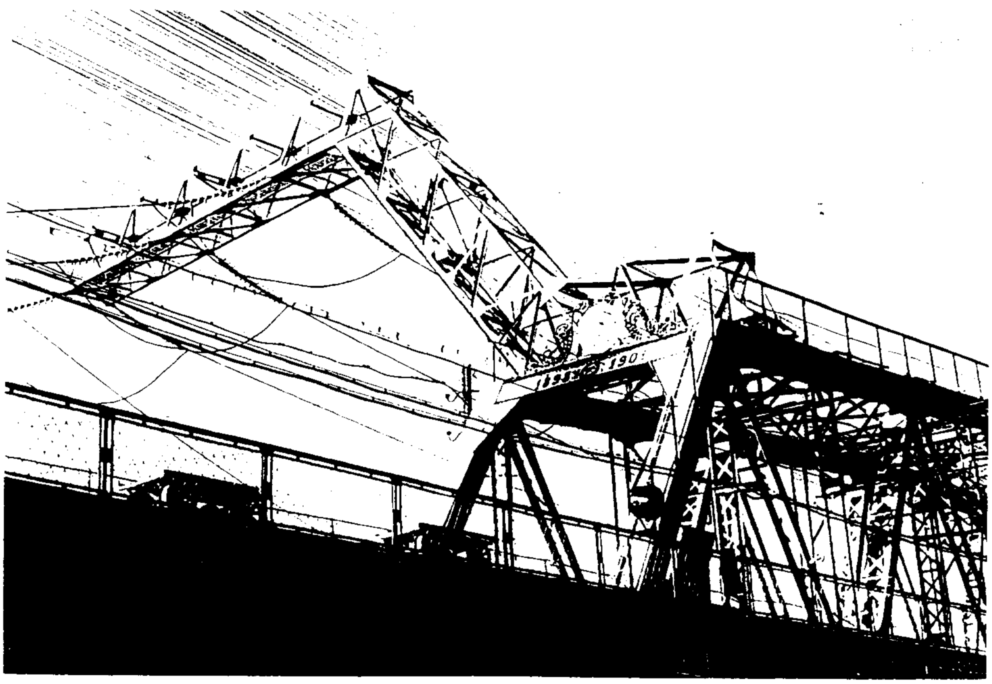
F9-03 Span 0



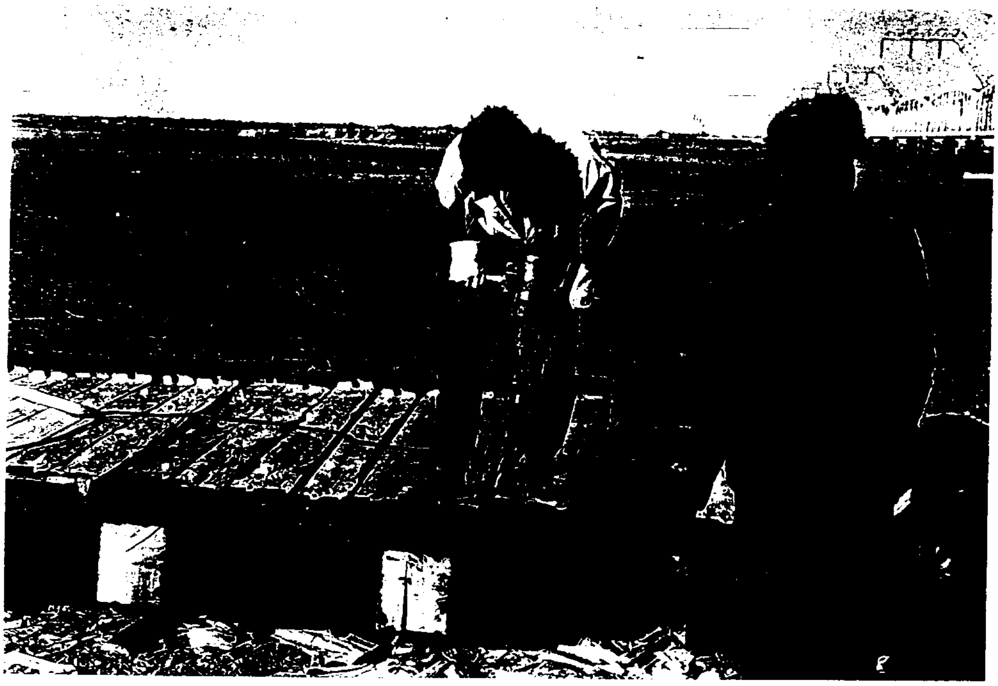
F9-04 Abutment 0
Cracks in the stone

F9-05 Span 0
Bearing B2 -
Broken part of upper bearing plate

F9-06 Span 0
As F9-05



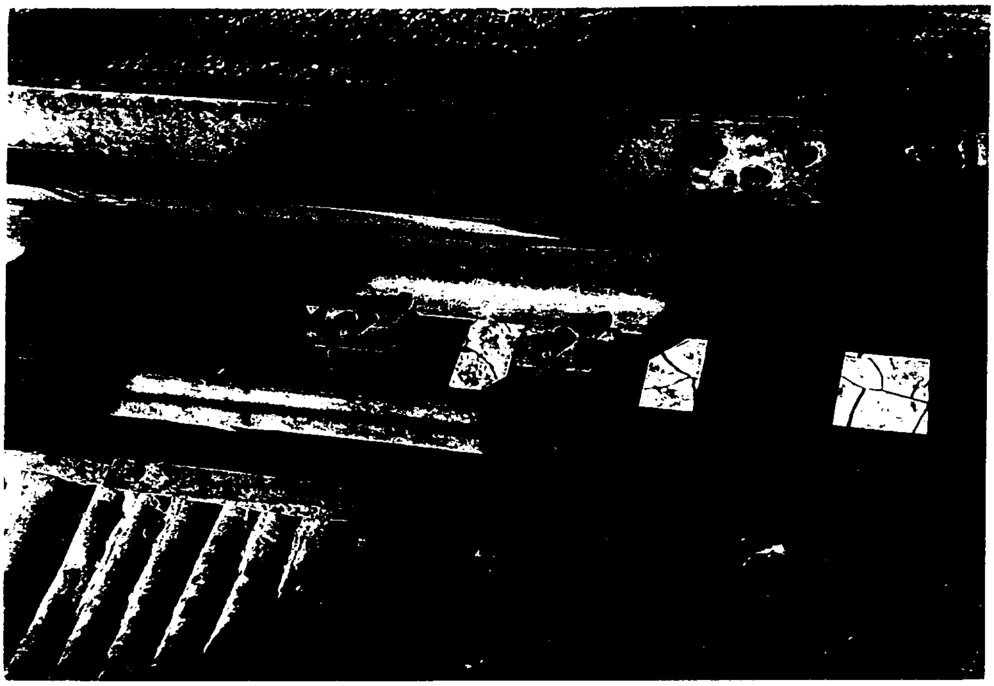
F9-07 Span 1
End frame with high voltage line



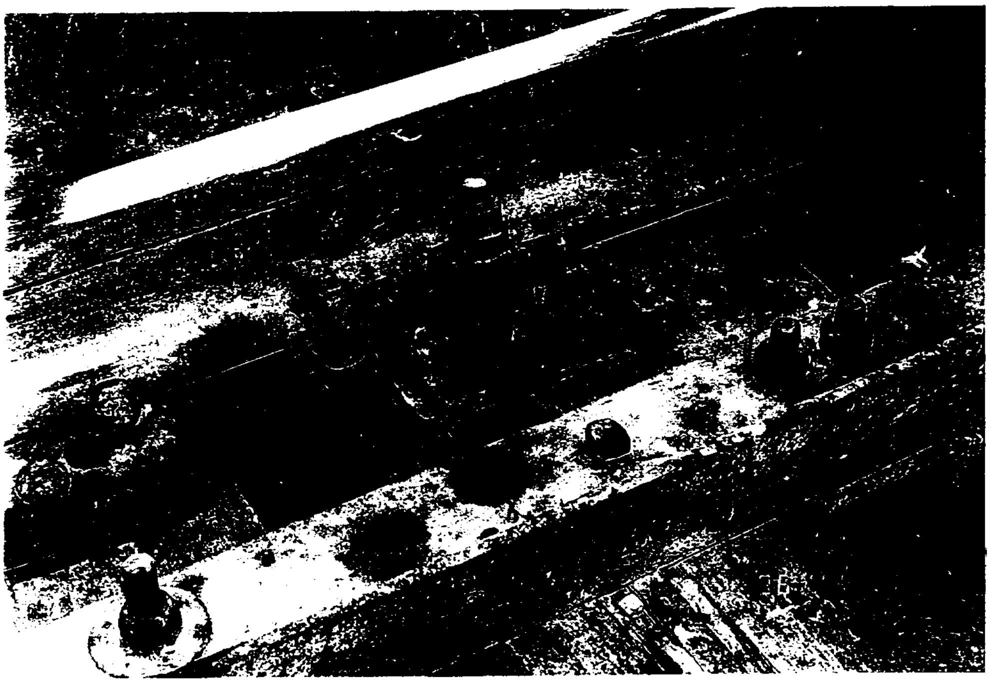
F9-10
Sleeper, no impreg-
nation

F9-11
As F9-10

F9-12
Total view



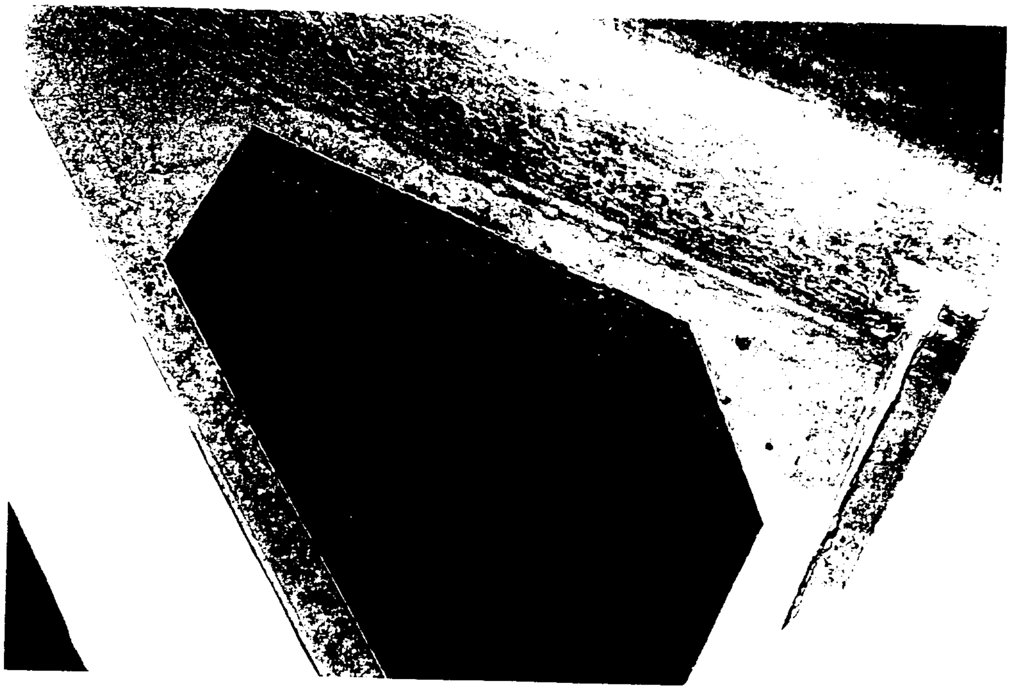
F10-00
Loose rail fasteners
(nails)



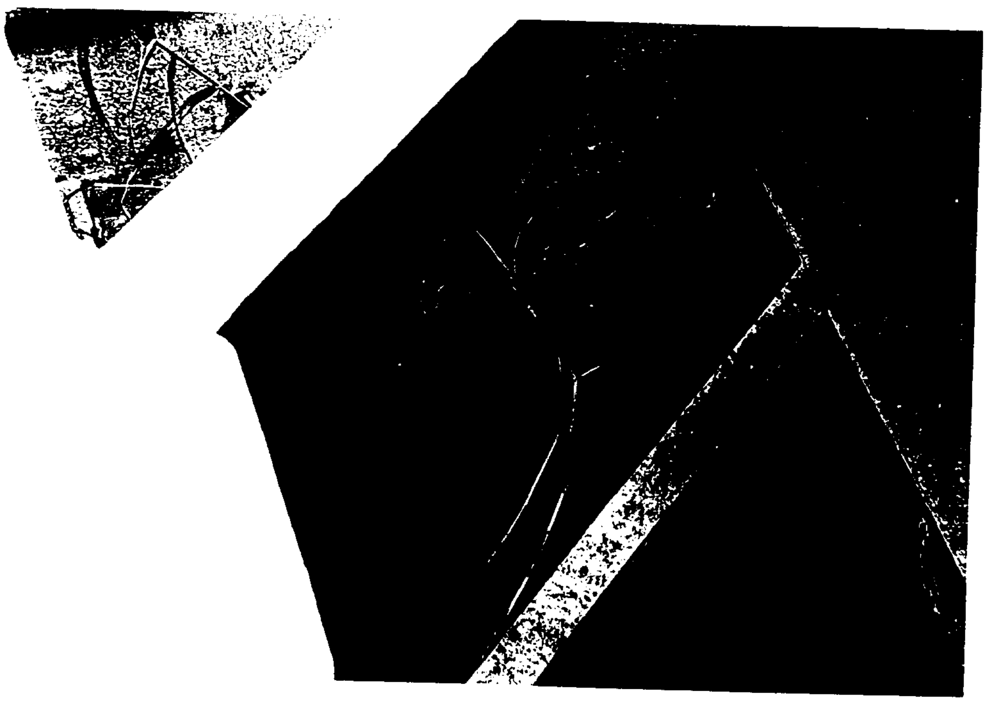
F10-05
As F10-00

F10-01 Pier 9
Corrosion at
bearing

F10-02 Span 1
End crossgirder bent and corroded plate

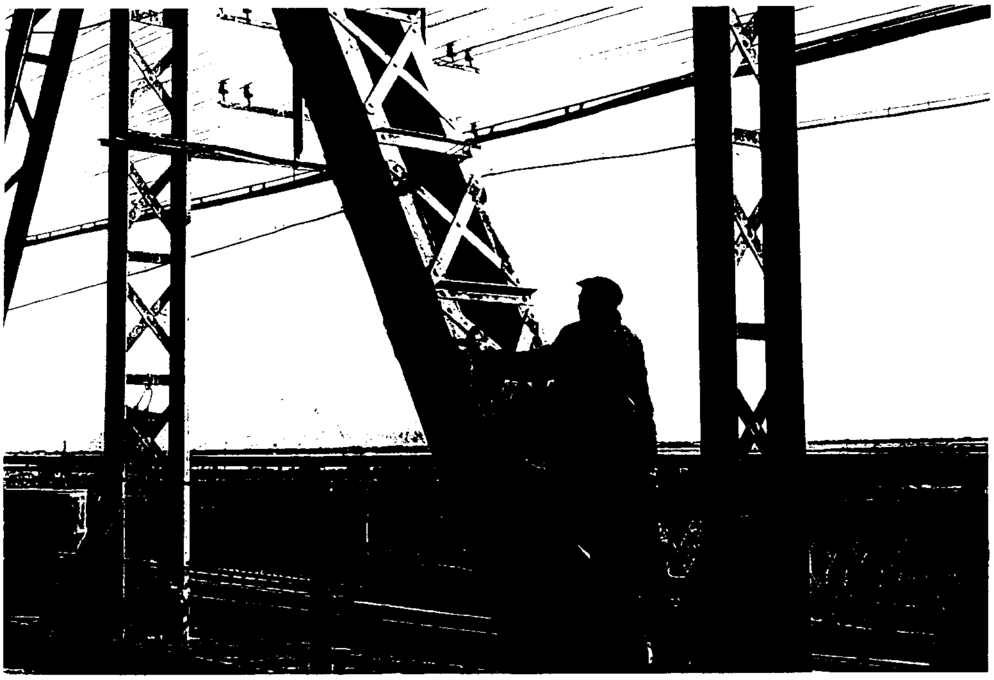


F10-03 Pier 4
Inside view water filled

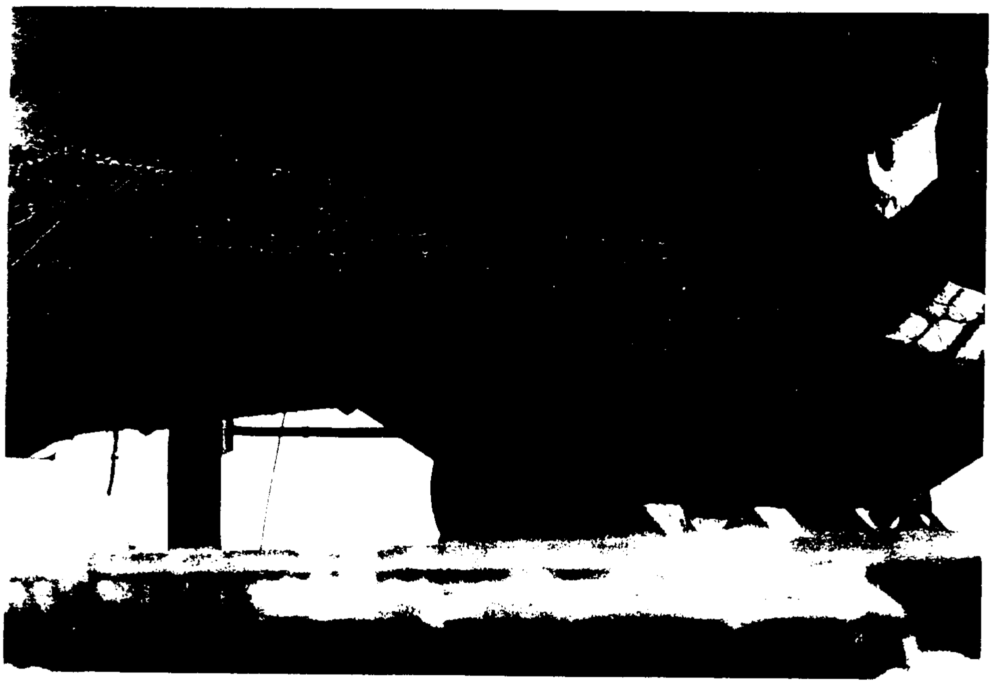


F10-04 Pier 4
As F10-03

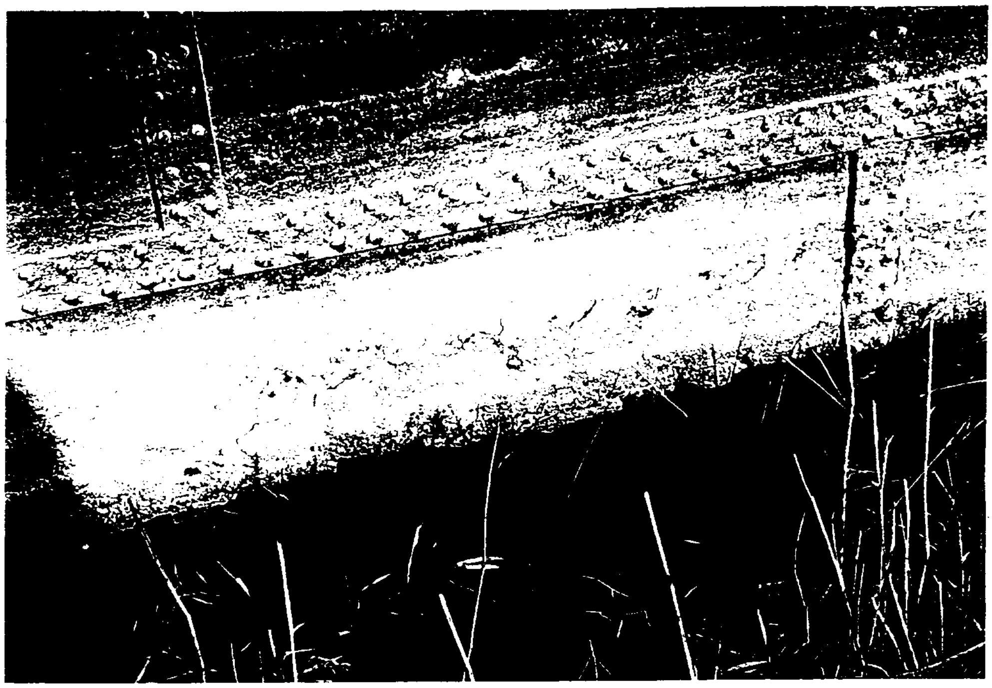
F10-06 Pier 5
Rust spots US



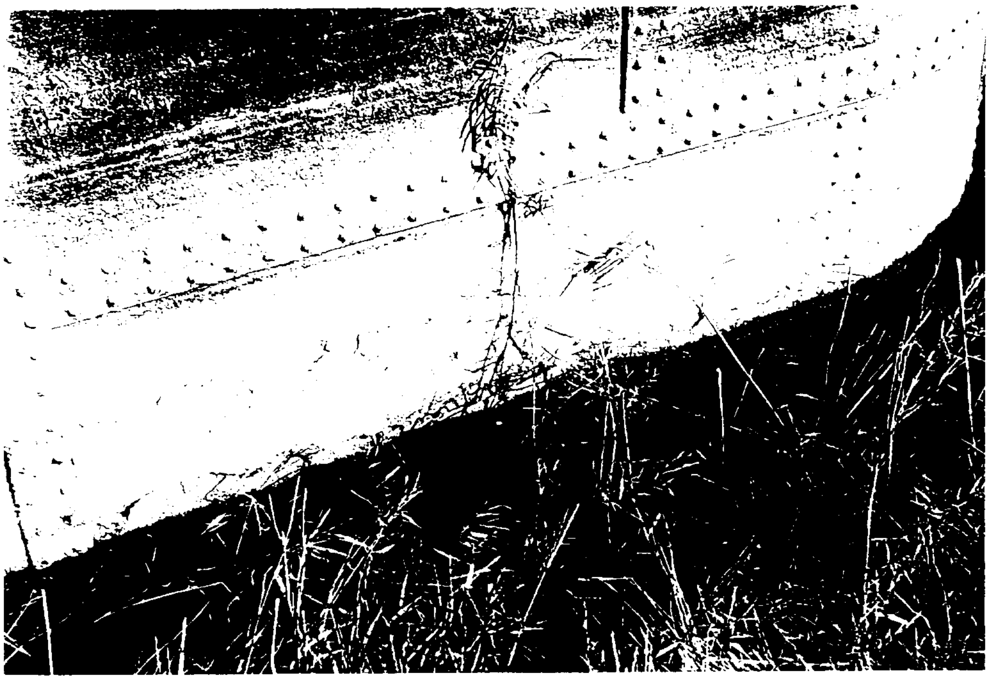
F10-07
Derusting
method with hammer



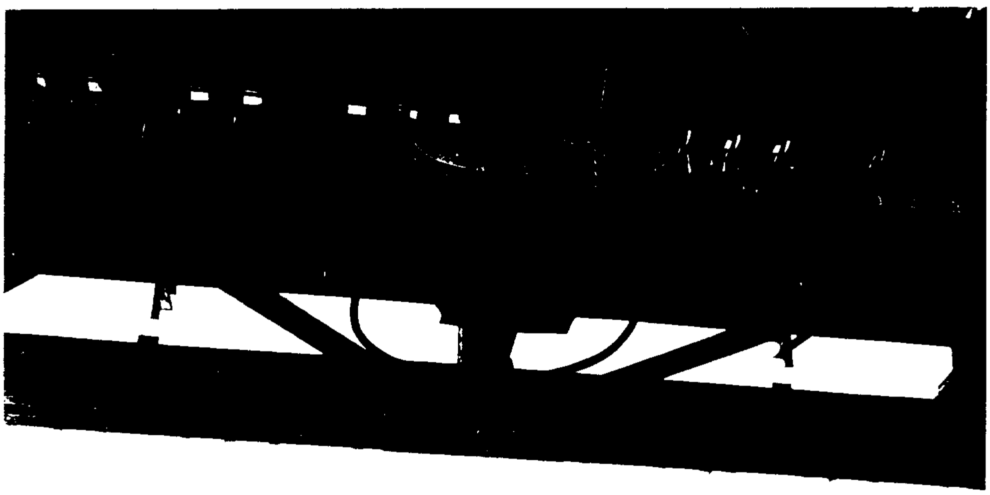
F10-08 Span 7
End crossgirder
bent gussset plate



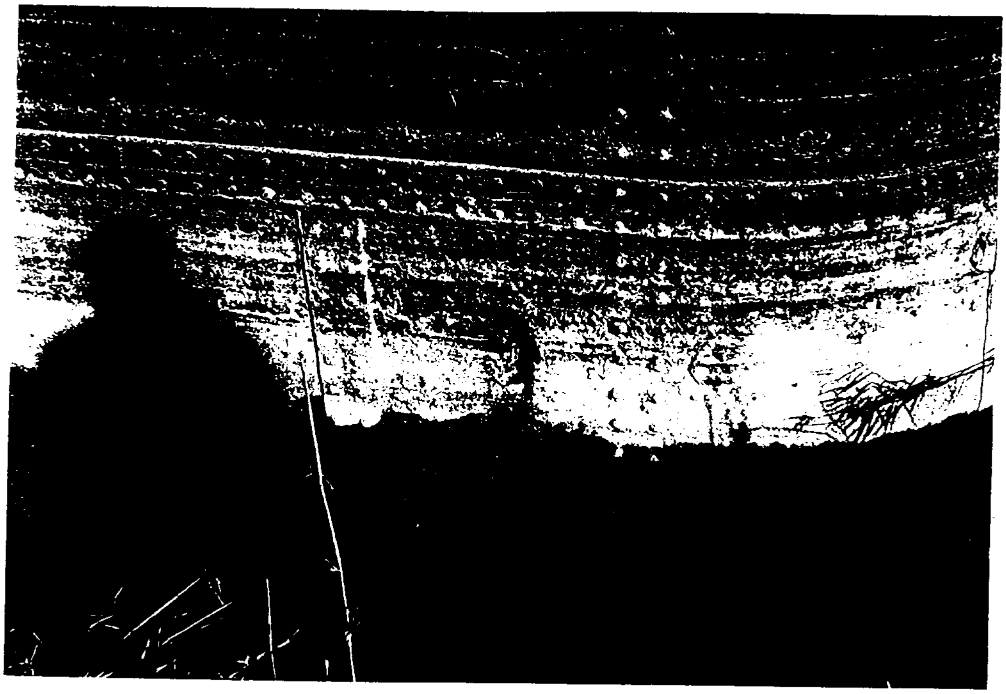
F10-09 Pier 7



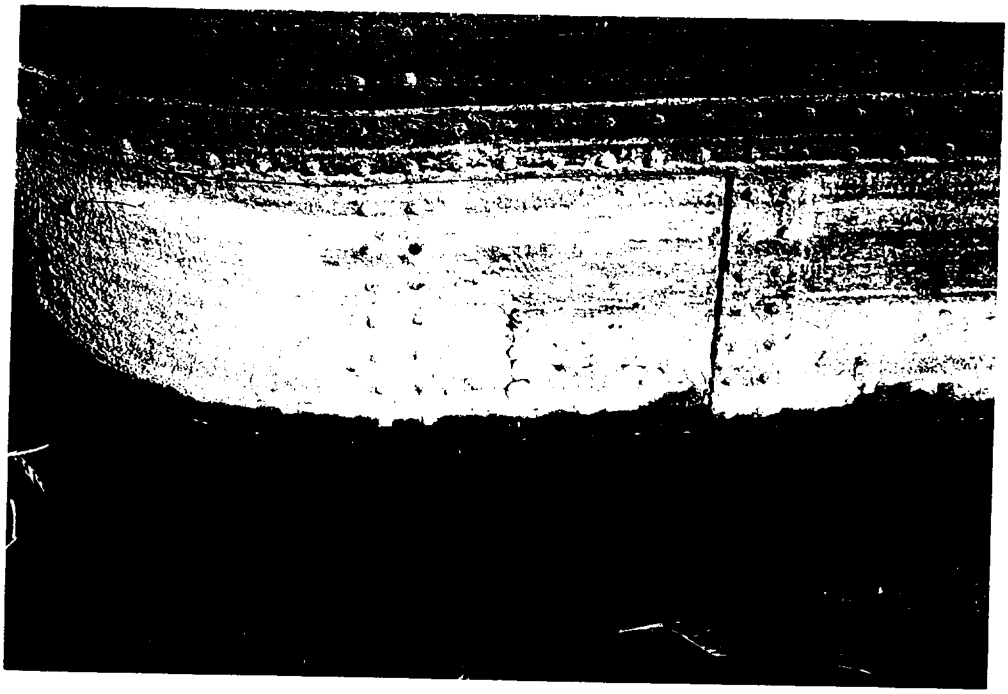
F10-10 Pier 7



F10-11 Span 5
Strengthening



F10-12 Pier 7
Hole in the steel shell US,
300 x 70 mm



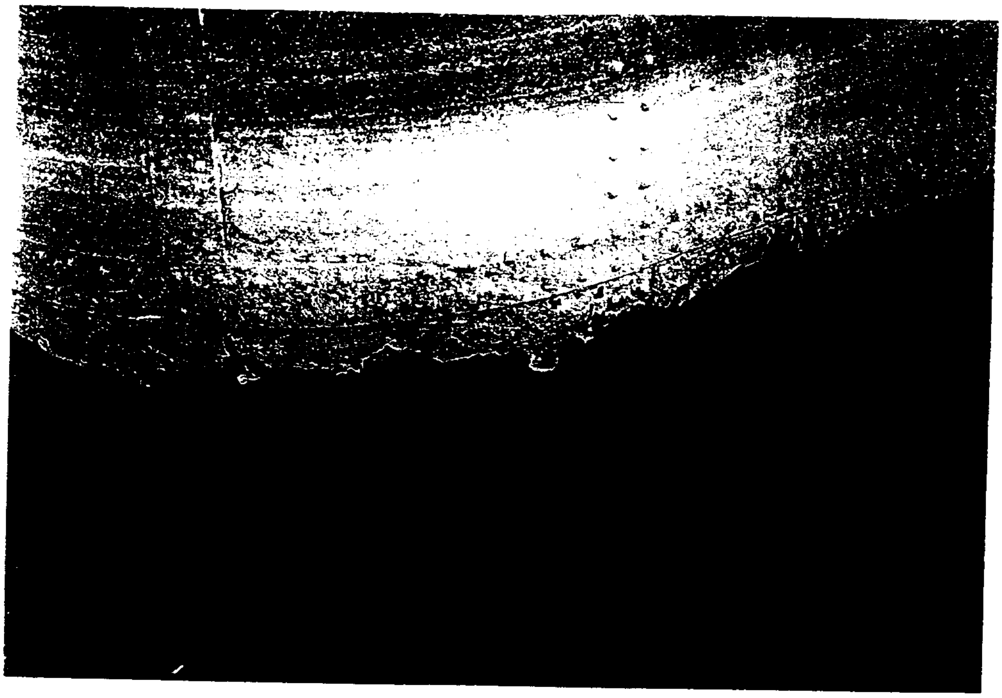
F10-13 Pier 7
Hole in the steel shell DS,
350 x 10 mm

F10-14 Pier 8
US view

F10-15 Pier 8
DS cracks

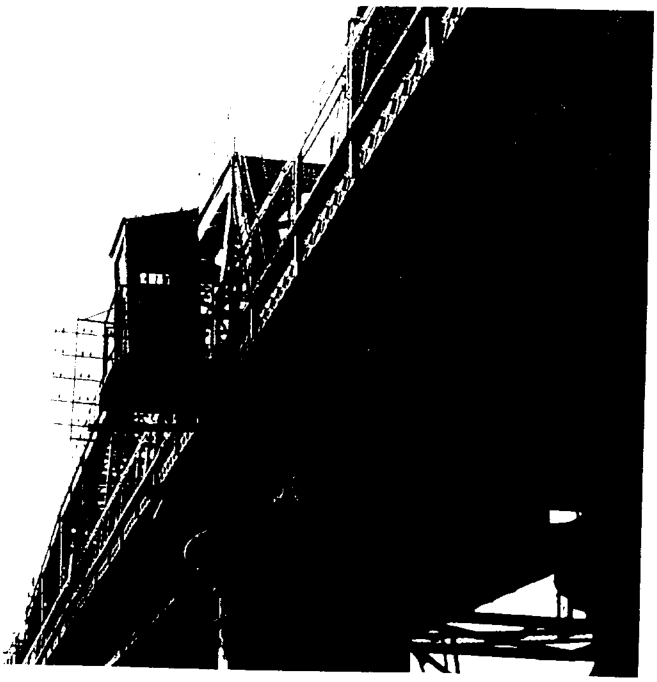
F10-16 Span 9
Strengthening

F10-17 Pier 12
Buckling by land
car, from inside

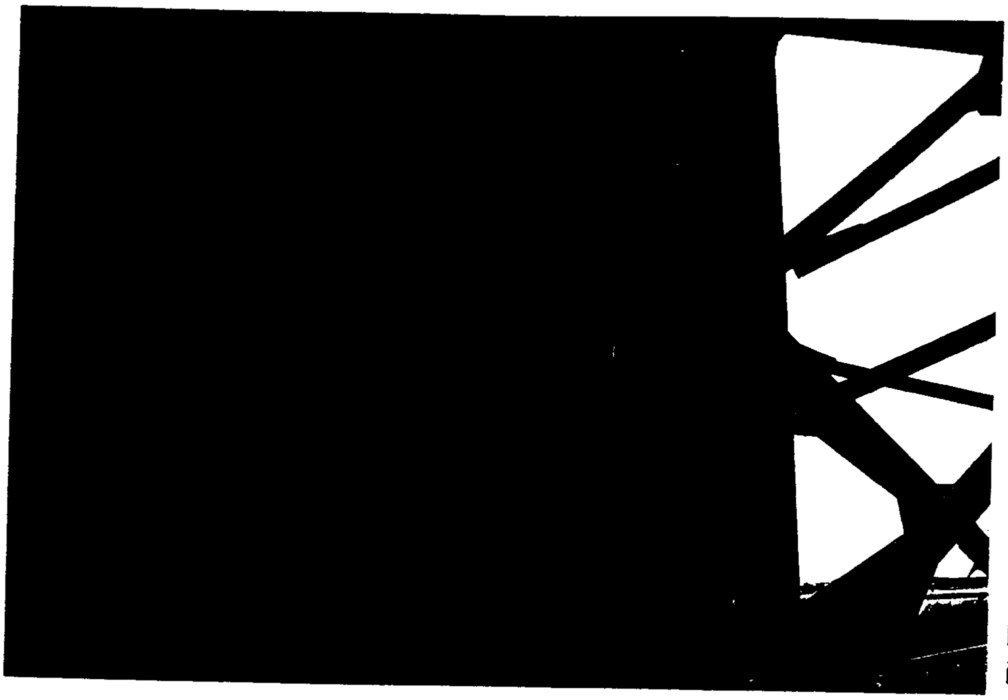


F10-18 Pier 12
View from outside

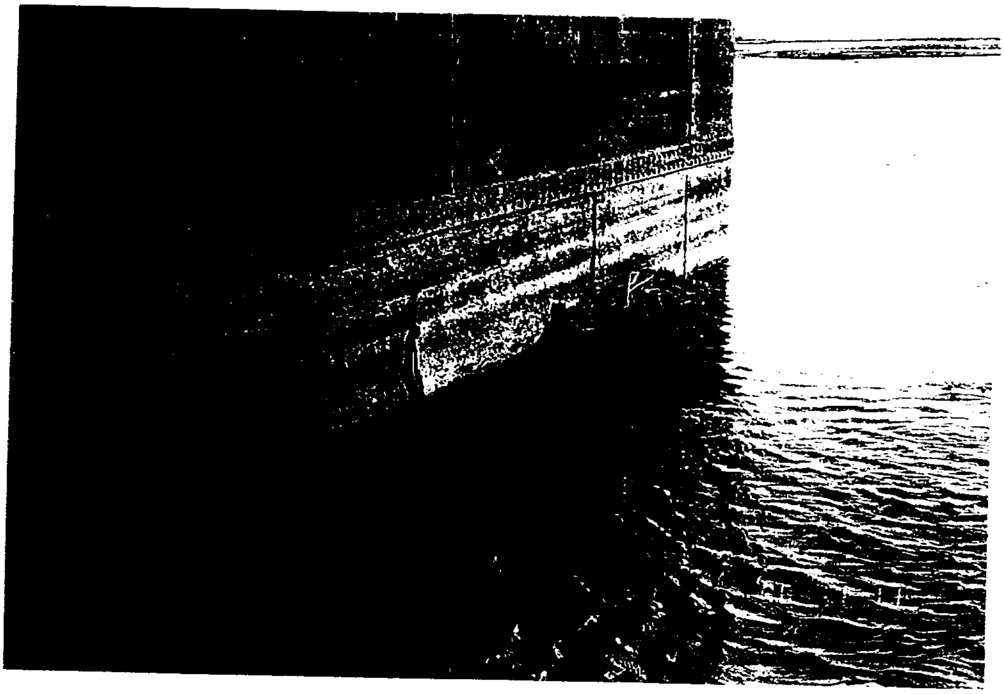
F10-19
Inspection car



F10-20
Guard room
(middle of bridge)

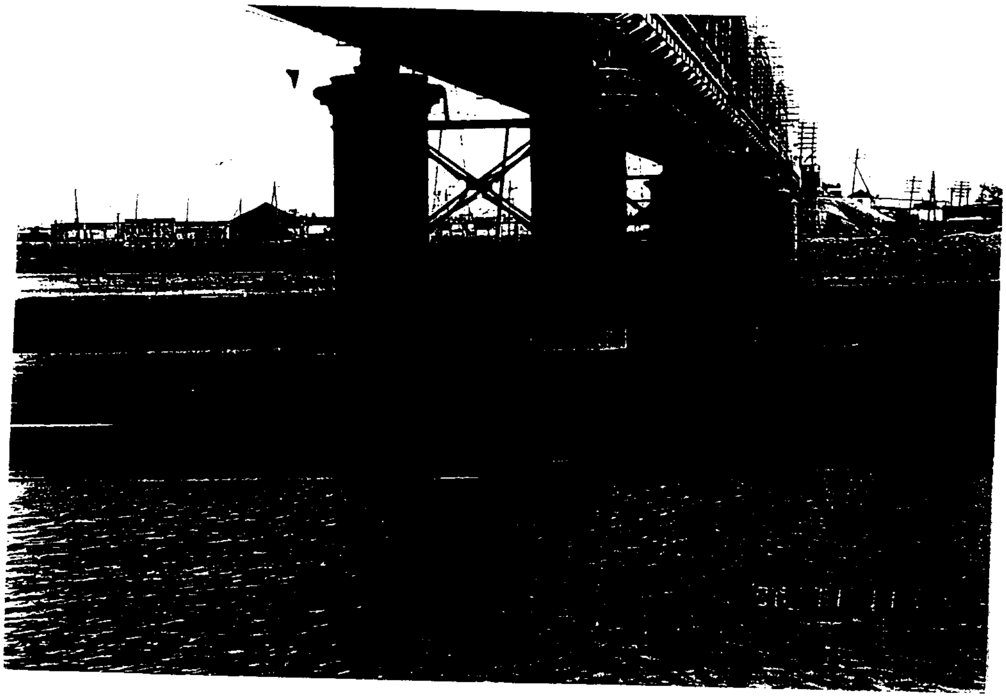


F10-21 Pier 13
Hole (not closed)
in the steel shell

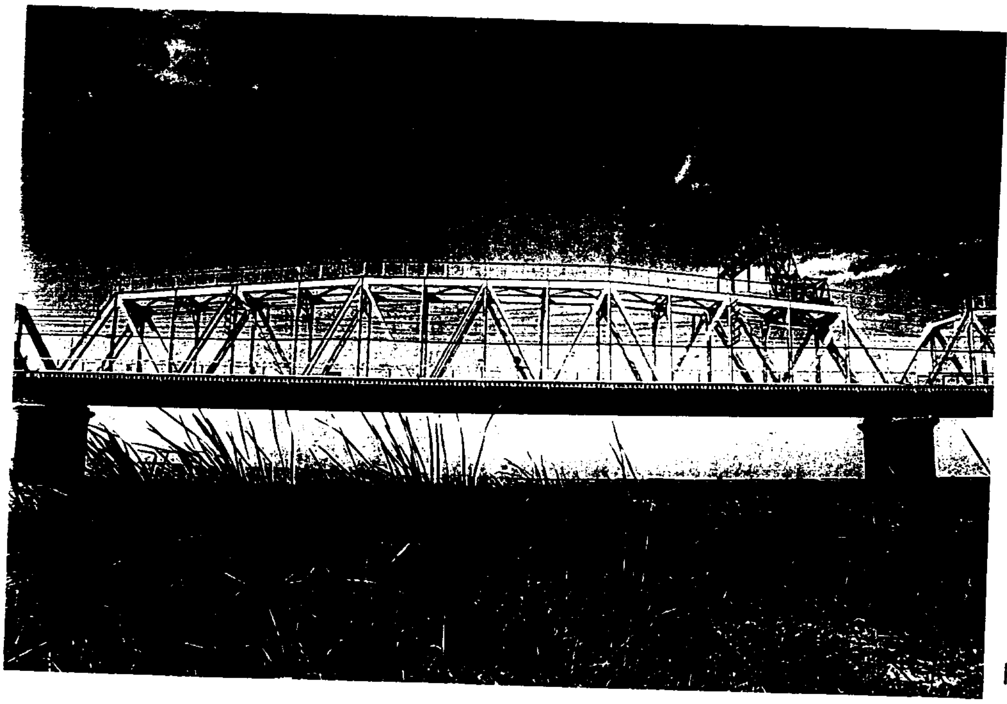


F10-22 Pier 19
Holes due to
corrosion

F10-23 Pier 19
As F10-22



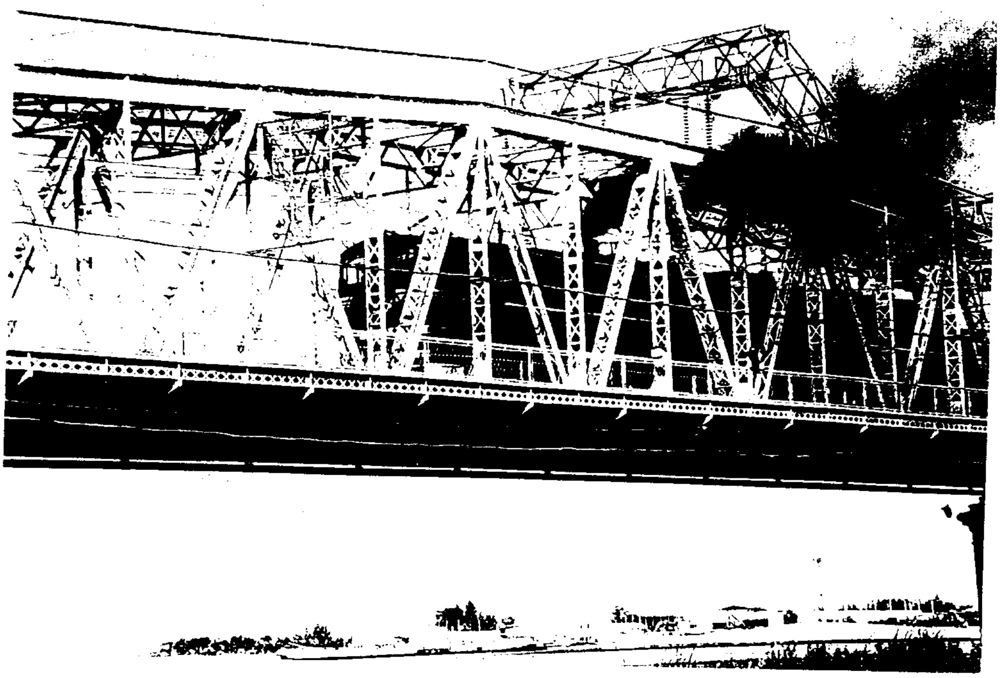
F10-24 Pier 21
Corrosion marks



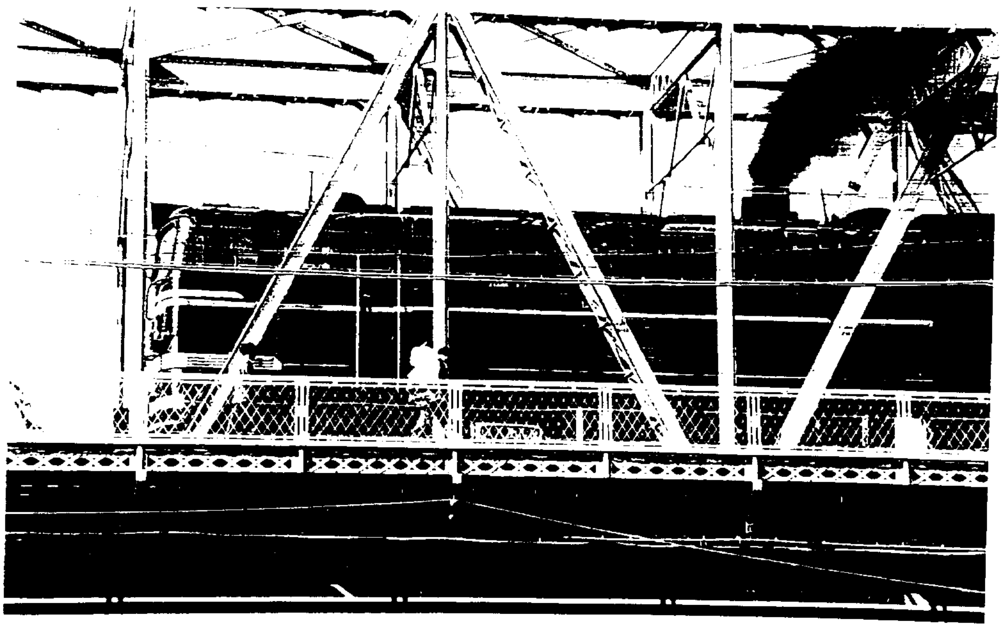
F10-25 Span 13

F10-26 Spans 22-25

F10-27
View to Farab

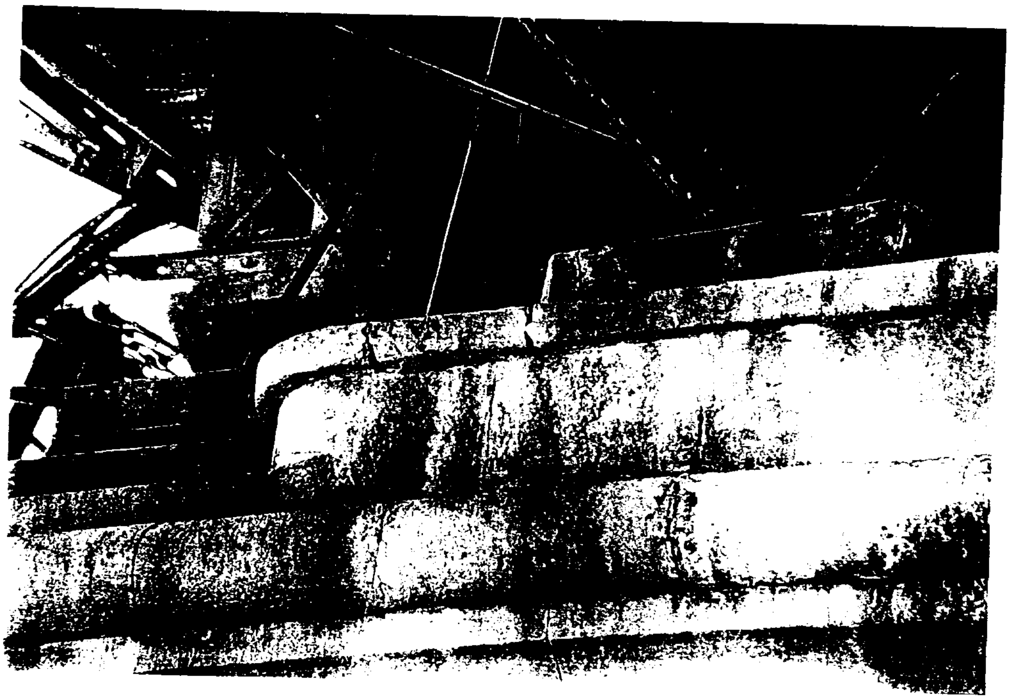


F10-28
Train passing

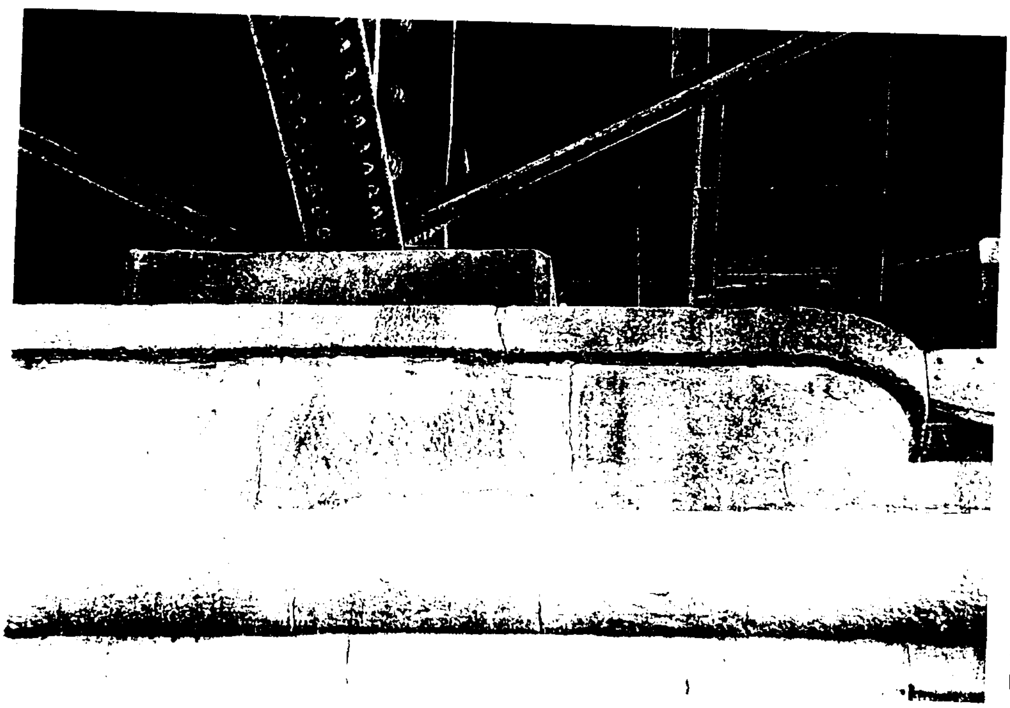


F10-29
As F10-28

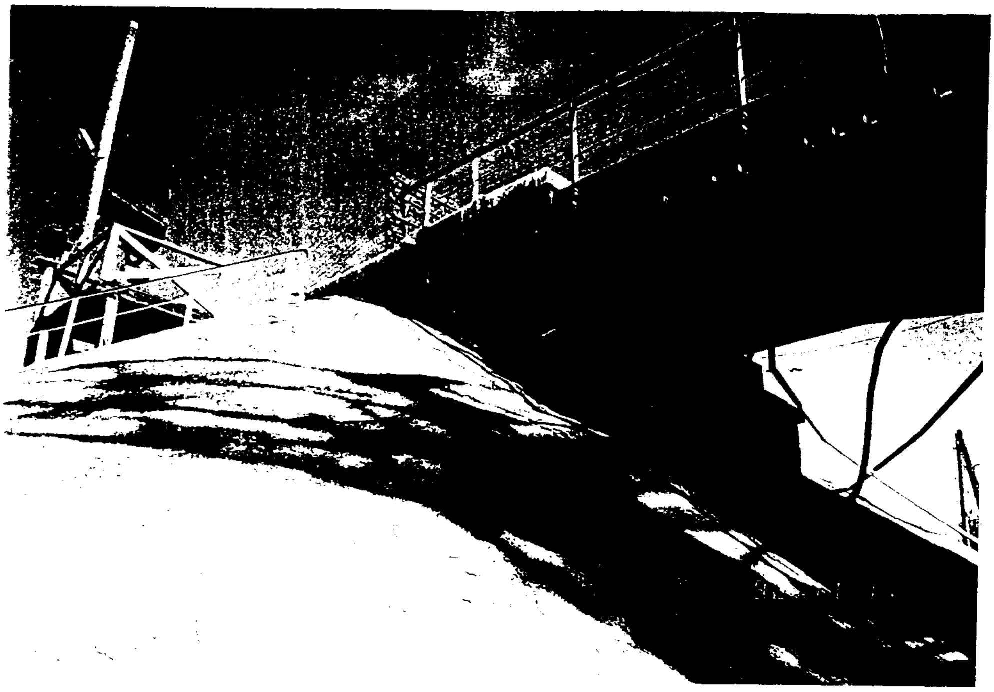
F10-30
As F10-28



F10-33 Abutment
26
DS



F10-34 Abutment
26
US



F10-35 Abutment 26
Total view

Annex C

TRACECA - MODULE C **CHARDZHEV BRIDGE**

ANNEX C
CHECK COMPUTATION

containing pages C/1 to C/66

Autor/Author	Datum/Date	Seite/Page No.	Änderung/Revis.	Auftrag/Order No.
[illegible]	22.10.96	C/1		20-007

CHECK COMPUTATION

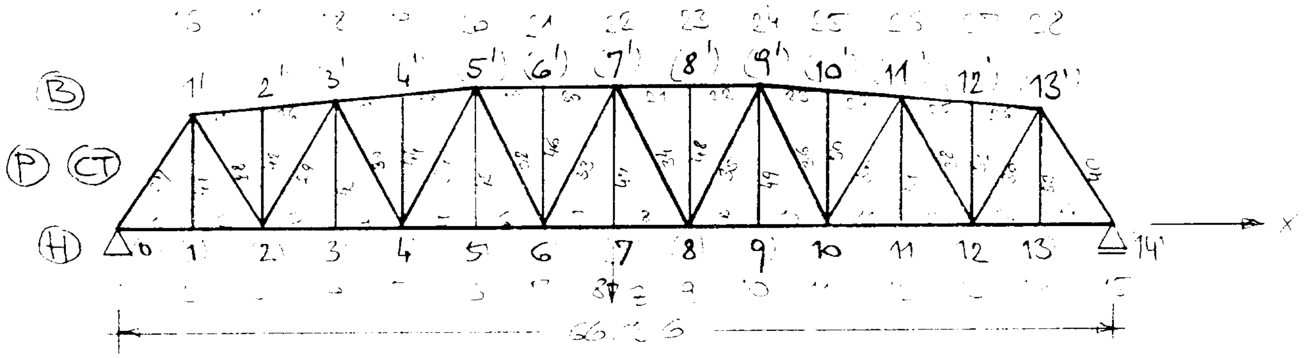
1 ft = 0,3048 m

1 in = 0,0254 m

1. BRIDGE SYSTEM COORDINATES

Numbers in brackets .. original drawings
see Annex A

Numbers : node numbers of electronic calculation



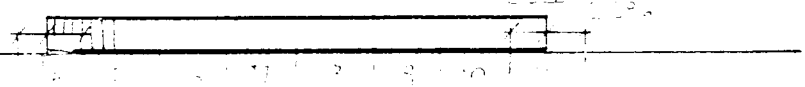
z		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9,144	9,144	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
x	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4,7724	0	4,7724	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

2. LOADS

[illegible]

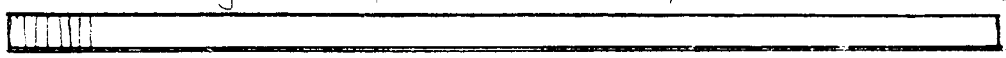
Load case 2 [illegible]

[illegible] → 0,84 · 100 [illegible]



Load case 1 unit load [illegible]

uniformly distributed load 84 kN/m = 0,84 · 100 kN/m



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[illegible]	22.10.96	C/2		20-007

load case LC3

[illegible] eccentric elements 1:7 loaded

load case LC4

dead load estimated:

according to [illegible] tables with approximated weight assumptions: (see page C/3)

[illegible] with [illegible] in bottom position, single track:

		kg/m²
a) main girder	g = 40 . 66 . 1.1 + 400 =	3046
b) [illegible]	g =	520
c) track girders	g = 85 . 55 + 200 =	671
d) other floor elements	g = 200 . 5.54 + 60 =	1168
e) [illegible]	g =	30
[illegible]		100
[illegible]		100
		5435

[illegible] 5500 kg/m²

≙ 55 kN/m²

for 1 main girder:

27.5 kN/m

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C/3

MASS ESTIMATION OF RAILWAY BRIDGES

Tafel 1

Näherungswerte für **Gewichte** ein- und zweigleisiger Eisenbahnbrücken aus St 37 und St 52 *) für die Lastenzüge **S, L,** N, E [1]

1	2	3	4	5	6	7	8	9	10	11
TYPE Bauart	SPAN Stützweite l m	ein- oder zweigleisig	Hauptträgerabstand b m	MATER. Baustahl	LOAD Lastenzug	Anteile für 1 m Brückenlänge – Stahlgewicht der Überbauten: Hauptträger [2] kg	Verbände: 1 Windverband kg	Verbände: 2 Windverbände kg	Fahrbahnträger [3] kg	übriges Fahrbahngewicht [4] kg
1. Brücken mit offener Fahrbahn										
Vollwandträger mit unmittelbarer Schwellenauflagerung	10 bis 50	eingl	2,0	St 37	S	57 l	150	200	20	760
					L	48 l				
					N	66 l				
					E	56 l				
				St 52	S	46 l				
					L	39 l				
					N	54 l				
					E	45 l				
Vollwandträger mit versenkter Fahrbahn [5])	10 bis 50	eingl	2,6 bis 4,85	St 37	S	57 l	80 bis 140	—	81 b + 190	200 b + 60
					L	48 l			76 b + 170	
					N	66 l			85 b + 200	
					E	56 l				
				St 52	S	46 l			67 b + 160	
					L	39 l			62 b + 145	
					N	54 l			70 b + 170	
					E	45 l				
TRUSS GIRDER Fachwerkträger *) a) Fahrbahn unten b) Fahrbahn oben oder etwas versenkt	25 bis 100	SINGLE TRACK eingl	a) 4,8 bis 5,3 b) 2,5 bis 3,2	St 37	S	34 l + 325	200	320	81 b + 190	200 b + 60
					L	27 l + 235			76 b + 170	
					N	40 l + 400	[illegible]	320	85 b + 200	
					E	32 l + 300				
				St 52	S	24 l + 305	130	280	67 b + 160	
					L	20 l + 180			62 b + 145	
					N	28 l + 370	140	280	70 b + 170	
					E	23 l + 270				
Fachwerkträger *) Fahrbahn unten	25 bis 100	zweigl	8,5 bis 9,5	St 37	S	46 l + 1080	320	580	115 b + 720	200 b + 120
					L	35 l + 790			115 b + 500	
					N	53 l + 1120	320	580	120 b + 750	
					E	43 l + 1000				
				St 52	S	29 l + 885	280	520	115 b + 460	
					L	22 l + 650			115 b + 270	
					N	36 l + 1070	280	520	120 b + 480	
					E	27 l + 820				
			Main girder distance b [m]		Train type, heaviest = N selected	Mass of main girder	Mass of 1 bracing	Mass of 2 bracings	Floor & track girder mass	Mass of other floor

*) St 52 T und St 55 S. Für Eisenbahnbrücken aus St 44 sind die Mittelwerte der Gewichte für St 37 und St 52 zu nehmen

Autor/Author	Datum/Date	Seite/Page No.	Änderung/Revis.	Auftrag/Order No.
[illegible]	22.10.96	C/4		20-007

3. CROSS SECTION TYPES

	Elements	Number	I_x [cm^4]	A [cm^2]	A_s [cm^2]
Upper chord	[illegible]	1	124.200	268	159
	[illegible]	2	175.300	380	159
	[illegible]	3	187.900	426	159
Lower chord	[illegible]	4	54.500	[illegible]	132
	[illegible]	5	90.900	200	145
	[illegible]	6	93.900	[illegible]	145
	[illegible]	7	[illegible]	[illegible]	159
	[illegible]	8	[illegible]	[illegible]	159
	[illegible]	9	[illegible]	[illegible]	159
Diagonals	[illegible]	10	[illegible]	[illegible]	[illegible]
	[illegible]	11	[illegible]	[illegible]	36
	[illegible]	12	[illegible]	[illegible]	[illegible]
	[illegible]	13	[illegible]	[illegible]	30
	[illegible]	14	[illegible]	[illegible]	26
	[illegible]	15	[illegible]	[illegible]	[illegible]
	[illegible]	16	[illegible]	[illegible]	[illegible]
Verticals	[illegible]	17	[illegible]	[illegible]	30

Assumption: [illegible] due to [illegible]

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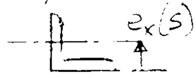
C/5

AMU-DARYA BRIDGE **ANGLES** Planungsgesellschaft für Stahl- und Maschinenbau Wien

Querschnittswerte von Blechträgern / Cross section values of plate girders A.Nr. 20-007

Querschnitt/cross section: **L89x76x8**

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
leg -	89	8	4	7,12	3	1	0
leg I	8	68	42	5,44	23	96	21
				0,00	0	0	0
				0,00	0	0	0
Equivalent plate 157×8		ex(s)[cm]	**2,05**	**12,56**	26	97	21
		H(tot)[mn	76,0	A[cm2]	i(x) [cm] 2,29	**Jx(s)[cm4]=**	**66**
		Note:				**Jx(s)[m4]=**	**6,5872E-07**
				x(o) [mm]	76,0	**Wx(o)[cm3]=**	**-11,9**
				x(a) [mm]		**Wx(a)[cm3]=**	**32,2**
				x(b) [mm]		**Wx(b)[cm3]=**	**32,2**
Vers.050894/Piringer				x(u) [mm]	0,0	**Wx(u)[cm3]=**	**32,2**



Querschnitt/cross section: **L 102x102x11**

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
leg -	102	11	5,5	11,22	6	3	1
leg I	11	91	56,5	10,01	57	320	69
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	**2,95**	**21,23**	63	323	70
193×11		H(tot)[mn	102,0	A[cm2]	i(x) [cm] 3,13	**Jx(s)[cm4]=**	**208**
		Note:				**Jx(s)[m4]=**	**2,0781E-06**
				x(o) [mm]	102,0	**Wx(o)[cm3]=**	**-28,7**
				x(a) [mm]		**Wx(a)[cm3]=**	**70,3**
				x(b) [mm]		**Wx(b)[cm3]=**	**70,3**
Vers.050894/Piringer				x(u) [mm]	0,0	**Wx(u)[cm3]=**	**70,3**

Querschnitt/cross section: **L 76x76x9,5**

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
leg -	76	9,5	4,75	7,22	3	2	1
leg I	9,5	66,5	42,75	6,32	27	115	23
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	**2,25**	**13,54**	30	117	24
		H(tot)[mn	76,0	A[cm2]	i(x) [cm] 2,31	**Jx(s)[cm4]=**	**72**
143×9,5		Note:				**Jx(s)[m4]=**	**7,2477E-07**
				x(o) [mm]	76,0	**Wx(o)[cm3]=**	**-13,5**
				x(a) [mm]		**Wx(a)[cm3]=**	**32,2**
				x(b) [mm]		**Wx(b)[cm3]=**	**32,2**
Vers.050894/Piringer				x(u) [mm]	0,0	**Wx(u)[cm3]=**	**32,2**

Querschnitt/cross section: **L 127x89x13**

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
leg -	89	13	6,5	11,57	8	5	2
leg I	13	114	70	14,82	104	726	161
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	**4,22**	**26,39**	111	731	162
		H(tot)[mn	127,0	A[cm2]	i(x) [cm] 4,01	**Jx(s)[cm4]=**	**424**
		Note:				**Jx(s)[m4]=**	**4,2412E-06**
203×13				x(o) [mm]	127,0	**Wx(o)[cm3]=**	**-50,0**
				x(a) [mm]		**Wx(a)[cm3]=**	**100,6**
				x(b) [mm]		**Wx(b)[cm3]=**	**100,6**
Vers.050894/Piringer				x(u) [mm]	0,0	**Wx(u)[cm3]=**	**100,6**

c/6

Querschnitt/cross section:	L 152x102x11						
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
leg -	102	11	5,5	11,22	6	3	1
leg l	11	141	81,5	15,51	126	1030	257
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	4,96	26,73	133	1034	258
		H(tot)[mn	152,0	A[cm2]	i(x) [cm] 4,87	Jx(s)[cm4]=	634
243 x 11		Note:				Jx(s)[m4]=	6,3413E-06
				x(o) [mm]	152,0	Wx(o)[cm3]=	-61,9
				x(a) [mm]		Wx(a)[cm3]=	127,9
				x(b) [mm]		Wx(b)[cm3]=	127,9
Vers.050894/Piringer				x(u) [mm]	0,0	Wx(u)[cm3]=	127,9

Querschnitt/cross section:	L 127x89x10						
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
leg -	89	10	5	8,90	4	2	1
leg l	10	117	68,5	11,70	80	549	133
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	4,11	20,60	85	551	134
		H(tot)[mn	127,0	A[cm2]	i(x) [cm] 4,05	Jx(s)[cm4]=	338
206 x 10		Note:				Jx(s)[m4]=	3,3803E-06
				x(o) [mm]	127,0	Wx(o)[cm3]=	-39,3
				x(a) [mm]		Wx(a)[cm3]=	82,3
				x(b) [mm]		Wx(b)[cm3]=	82,3
Vers.050894/Piringer				x(u) [mm]	0,0	Wx(u)[cm3]=	82,3

Querschnitt/cross section:	L 176x76x9,5						
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
leg -	176	9,5	4,75	16,72	8	4	1
leg l	9,5	66,5	42,75	6,32	27	115	23
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	1,52	23,04	35	119	25
		H(tot)[mn	76,0	A[cm2]	i(x) [cm] 1,98	Jx(s)[cm4]=	91
243 x 9,5		Note:				Jx(s)[m4]=	9,0747E-07
				x(o) [mm]	76,0	Wx(o)[cm3]=	-14,9
				x(a) [mm]		Wx(a)[cm3]=	59,8
				x(b) [mm]		Wx(b)[cm3]=	59,8
Vers.050894/Piringer				x(u) [mm]	0,0	Wx(u)[cm3]=	59,8

Querschnitt/cross section:	L 89x89x9,5						
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
leg -	89	9,5	4,75	8,46	4	2	1
leg l	9,5	79,5	49,25	7,55	37	183	40
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	2,57	16,01	41	185	40
		H(tot)[mn	89,0	A[cm2]	i(x) [cm] 2,73	Jx(s)[cm4]=	119
169 x 9,5		Note:				Jx(s)[m4]=	1,1941E-06
				x(o) [mm]	89,0	Wx(o)[cm3]=	-18,9
				x(a) [mm]		Wx(a)[cm3]=	46,4
				x(b) [mm]		Wx(b)[cm3]=	46,4
Vers.050894/Piringer				x(u) [mm]	0,0	Wx(u)[cm3]=	46,4

Datenschutz: psm

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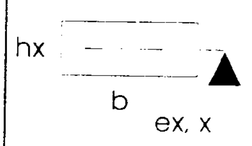
Querschnittswerte von Blechträgern / Cross section values of plate girders — A.Nr. 20-007

Querschnitt/cross section: **B 1'-2'-3'**

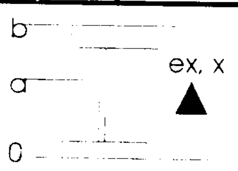
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	610	305	158,60	4837	147538	49179
lower L	157	16	590	25,12	1482	87443	5
upper L	193	44	30	84,92	255	764	137
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	**24,47**	**268,64**	6574	235745	49322
		H(tot)[mm	610,0	A[cm2]	i(x) [cm] 21,50	**Jx(s)[cm4]=**	**124.184**
		Note:				**Jx(s)[m4]=**	**0,001241843**
				x(o) [mm]	610,0	**Wx(o)[cm3]=**	**-3.399,7**
				x(a) [mm]	0,0	**Wx(a)[cm3]=**	**5.074,6**
				x(b) [mm]	0,0	**Wx(b)[cm3]=**	**5.074,6**
				x(u) [mm]	0,0	**Wx(u)[cm3]=**	**5.074,6**



Vers.050894/Piringer

Querschnitt/cross section: **B 3'-4'-5'**

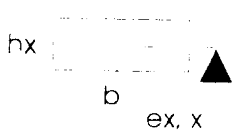
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	610	305	158,60	4837	147538	49179
lower L	157	16	590	25,12	1482	87443	5
upper L	193	44	30	84,92	255	764	137
upper pl	635	11	-5,5	69,85	-38	21	7
upper pl	381	11	-16,5	41,91	-69	114	4
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	**17,00**	**380,40**	6467	235880	49333
		H(tot)[mm	632,0	A[cm2]	i(x) [cm] 21,47	**Jx(s)[cm4]=**	**175.285**
		Note:				**Jx(s)[m4]=**	**0,001752849**
				x(o) [mm]	610,0	**Wx(o)[cm3]=**	**-3.983,7**
				x(a) [mm]	0,0	**Wx(a)[cm3]=**	**10.311,2**
				x(b) [mm]	0,0	**Wx(b)[cm3]=**	**10.311,2**
				x(u) [mm]	-22,0	**Wx(u)[cm3]=**	**9.129,7**



Vers.050894/Piringer

Querschnitt/cross section: **B 5'-6'-7'**

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	610	305	158,60	4837	147538	49179
lower L	157	16	590	25,12	1482	87443	5
upper L	193	44	30	84,92	255	764	137
upper pl	165	9,5	4,75	15,68	7	4	1
upper pl	635	22	-11	139,70	-154	169	56
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	**15,16**	**424,02**	6428	235917	49379
		H(tot)[mm	632,0	A[cm2]	i(x) [cm] 21,05	**Jx(s)[cm4]=**	**187.851**
		Note:				**Jx(s)[m4]=**	**0,001878514**
				x(o) [mm]	610,0	**Wx(o)[cm3]=**	**-4.097,9**
				x(a) [mm]	0,0	**Wx(a)[cm3]=**	**12.391,5**
				x(b) [mm]	0,0	**Wx(b)[cm3]=**	**12.391,5**
				x(u) [mm]	-22,0	**Wx(u)[cm3]=**	**10.821,2**

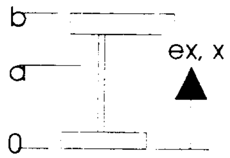


Vers.050894/Piringer

C/8

Querschnitt/cross section: **H 0-1-2**

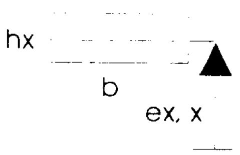
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	508	254	132,08	3355	85213	28404
lower L	193	44	30	84,92	255	764	137
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	**16,63**	**217,00**	3610	85977	28541
		H(tot)[mm	508,0	A[cm2]	i(x) [cm] 15,84	**Jx(s)[cm4]=**	**54.476**
		Note:				**Jx(s)[m4]=**	**0,000544761**
				x(o) [mm]	508,0	**Wx(o)[cm3]=**	**-1.594,5**
				x(a) [mm]	0,0	**Wx(a)[cm3]=**	**3.275,0**
				x(b) [mm]	0,0	**Wx(b)[cm3]=**	**3.275,0**
				x(u) [mm]	0,0	**Wx(u)[cm3]=**	**3.275,0**



Vers.050894/Piringer

Querschnitt/cross section: **H 2-3**

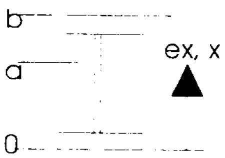
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	558	279	145,08	4048	112932	37644
lower L	193	44	30	84,92	255	764	137
lower pl	635	11	-5,5	69,85	-38	21	7
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	**14,22**	**299,85**	4264	113717	37788
		H(tot)[mm	569,0	A[cm2]	i(x) [cm] 17,41	**Jx(s)[cm4]=**	**90.867**
		Note:				**Jx(s)[m4]=**	**0,00090867**
				x(o) [mm]	558,0	**Wx(o)[cm3]=**	**-2.185,4**
				x(a) [mm]	0,0	**Wx(a)[cm3]=**	**6.389,8**
				x(b) [mm]	0,0	**Wx(b)[cm3]=**	**6.389,8**
				x(u) [mm]	-11,0	**Wx(u)[cm3]=**	**5.931,0**



Vers.050894/Piringer

Querschnitt/cross section: **H 3-4**

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	558	279	145,08	4048	112932	37644
lower L	193	44	30	84,92	255	764	137
lower pl	165	9,5	4,75	15,68	7	4	1
lower pl	635	11	-5,5	69,85	-38	21	7
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	**13,54**	**315,53**	4272	113721	37789
		H(tot)[mm	569,0	A[cm2]	i(x) [cm] 17,23	**Jx(s)[cm4]=**	**93.683**
		Note:				**Jx(s)[m4]=**	**0,000936827**
				x(o) [mm]	558,0	**Wx(o)[cm3]=**	**-2.216,7**
				x(a) [mm]	0,0	**Wx(a)[cm3]=**	**6.920,1**
				x(b) [mm]	0,0	**Wx(b)[cm3]=**	**6.920,1**
				x(u) [mm]	-11,0	**Wx(u)[cm3]=**	**6.400,0**



Vers.050894/Piringer

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Querschnitt/cross section: H 4-5

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	610	305	158,60	4837	147538	49179
lower L	193	44	30	84,92	255	764	137
lower pl	635	22	-11	139,70	-154	169	56
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
	ex(s)[cm]		**12,89**	**383,22**	4938	148471	49373
	H(tot)[mm		632,0	A[cm2]	i(x) [cm] 18,71	**Jx(s)[cm4]=**	**134.205**
hx	Note:					**Jx(s)[m4]=**	**0,001342046**
b				x(o) [mm]	610,0	**Wx(o)[cm3]=**	**-2.789,3**
ex, x				x(a) [mm]	0,0	**Wx(a)[cm3]=**	**10.414,3**
				x(b) [mm]	0,0	**Wx(b)[cm3]=**	**10.414,3**
Vers.050894/Piringer				x(u) [mm]	-22,0	**Wx(u)[cm3]=**	**8.895,6**

Querschnitt/cross section: H 5-6

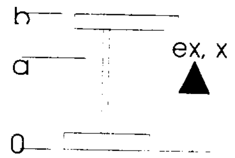
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	610	305	158,60	4837	147538	49179
lower L	193	44	30	84,92	255	764	137
lower pl	165	9,5	4,75	15,68	7	4	1
lower pl	635	22	-11	139,70	-154	169	56
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
b	ex(s)[cm]		**12,40**	**398,30**	4946	148475	49374
a / ex, x	H(tot)[mm		632,0	A[cm2]	i(x) [cm] 18,50	**Jx(s)[cm4]=**	**136.526**
	Note:					**Jx(s)[m4]=**	**0,001365256**
0				x(o) [mm]	610,0	**Wx(o)[cm3]=**	**-2.809,1**
				x(a) [mm]	0,0	**Wx(a)[cm3]=**	**11.011,2**
				x(b) [mm]	0,0	**Wx(b)[cm3]=**	**11.011,2**
Vers.050894/Piringer				x(u) [mm]	-22,0	**Wx(u)[cm3]=**	**9.351,8**

Querschnitt/cross section: H 6-7

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	610	305	158,60	4837	147538	49179
lower L	193	44	30	84,92	255	764	137
lower pl	635	22	-11	139,70	-154	169	56
lower pl	381	9,5	-26,75	36,20	-97	259	3
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
	ex(s)[cm]		**11,54**	**419,42**	4842	148730	49375
	H(tot)[mm		641,5	A[cm2]	i(x) [cm] 18,41	**Jx(s)[cm4]=**	**142.216**
hx	Note:					**Jx(s)[m4]=**	**0,00142216**
b				x(o) [mm]	610,0	**Wx(o)[cm3]=**	**-2.875,6**
ex, x				x(a) [mm]	0,0	**Wx(a)[cm3]=**	**12.319,9**
				x(b) [mm]	0,0	**Wx(b)[cm3]=**	**12.319,9**
Vers.050894/Piringer				x(u) [mm]	-31,5	**Wx(u)[cm3]=**	**9.678,8**

Querschnitt/cross section: **P 0-1'**

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	584	0	151,84	0	0	43155
lower L	143	19	-269,5	27,17	-732	19734	8
upper L	193	44	262	84,92	2225	58292	137
upper pl	610	9,5	296,75	57,95	1720	51031	4
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0

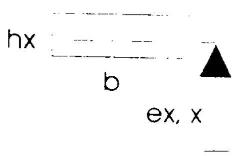


ex(s)[cm]	**9,98**	**321,88**	3212	129057	43304
H(tot)[mm	593,5	A[cm2]	i(x) [cm] 20,88	**Jx(s)[cm4]=**	**140.303**
Note:				**Jx(s)[m4]=**	**0,001403028**
		x(o) [mm]	301,5	**Wx(o)[cm3]=**	**-6.956,0**
		x(a) [mm]	0,0	**Wx(a)[cm3]=**	**14.058,5**
		x(b) [mm]	0,0	**Wx(b)[cm3]=**	**14.058,5**
		x(u) [mm]	-292,0	**Wx(u)[cm3]=**	**3.581,0**

Vers.050894/Piringer

Querschnitt/cross section: **P 1'-2**

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	330	0	85,80	0	0	7786
lower L	26	203	-46,2	52,78	-244	1127	1813
upper L	26	203	46,2	52,78	244	1127	1813
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0

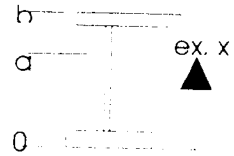


ex(s)[cm]	**0,00**	**191,36**	0	2253	11411
H(tot)[mm	330,0	A[cm2]	i(x) [cm] 8,45	**Jx(s)[cm4]=**	**13.664**
Note:				**Jx(s)[m4]=**	**0,000136645**
		x(o) [mm]	165,0	**Wx(o)[cm3]=**	**-828,2**
		x(a) [mm]	165,0	**Wx(a)[cm3]=**	**-828,2**
		x(b) [mm]	-165,0	**Wx(b)[cm3]=**	**828.2**
		x(u) [mm]	-165,0	**Wx(u)[cm3]=**	**828,2**

Vers.050894/Piringer

Querschnitt/cross section: **P 2-3'**

Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	381	0	99,06	0	0	11983
lower L	22	243	-140,9	53,46	-753	10613	2631
upper L	22	243	140,9	53,46	753	10613	2631
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0



ex(s)[cm]	**0,00**	**205,98**	0	21227	17244
H(tot)[mm	524,8	A[cm2]	i(x) [cm] 13,67	**Jx(s)[cm4]=**	**38.471**
Note:				**Jx(s)[m4]=**	**0,000384709**
		x(o) [mm]	262,4	**Wx(o)[cm3]=**	**-1.466,1**
		x(a) [mm]	190,5	**Wx(a)[cm3]=**	**-2.019,5**
		x(b) [mm]	-190,5	**Wx(b)[cm3]=**	**2.019,5**
		x(u) [mm]	-262,4	**Wx(u)[cm3]=**	**1.466,1**

Vers.050894/Piringer

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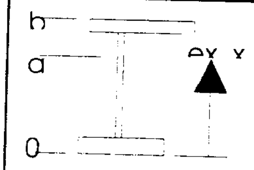
Querschnitt/cross section:	P 3'-4						
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	0	0	0	0,00	0	0	0
lower L	22	243	-53,6	53,46	-287	1536	2631
upper L	22	243	53,6	53,46	287	1536	2631
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	0,00	106,92	0	3072	5261
		H(tot)[mm	350,2	A[cm2]	i(x) [cm] 8,83	Jx(s)[cm4]=	8.333
hx		Note:				Jx(s)[m4]=	8,33303E-05
b				x(o) [mm]	175,1	Wx(o)[cm3]=	-475,9
ex, x				x(a) [mm]	156,0	Wx(a)[cm3]=	-534,2
				x(b) [mm]	-156,0	Wx(b)[cm3]=	534,2
Vers.050894/Piringer				x(u) [mm]	-175,1	Wx(u)[cm3]=	475,9

Querschnitt/cross section:	P 4-5'						
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	330	0	85,80	0	0	7786
lower L	19	143	-142,5	27,17	-387	5517	463
upper L	19	143	142,5	27,17	387	5517	463
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
b		ex(s)[cm]	0,00	140,14	0	11034	8712
a	ex x	H(tot)[mm	428,0	A[cm2]	i(x) [cm] 11,87	Jx(s)[cm4]=	19.747
		Note:				Jx(s)[m4]=	0,000197468
0				x(o) [mm]	214,0	Wx(o)[cm3]=	-922,7
				x(a) [mm]	165,0	Wx(a)[cm3]=	-1.196,8
				x(b) [mm]	-165,0	Wx(b)[cm3]=	1.196,8
Vers.050894/Piringer				x(u) [mm]	-214,0	Wx(u)[cm3]=	922,7

Querschnitt/cross section:	P 5'-6						
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	0	0	0	0,00	0	0	0
lower L	20	206	-45,1	41,20	-186	838	1457
upper L	20	206	45,1	41,20	186	838	1457
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
		ex(s)[cm]	0,00	82,40	0	1676	2914
		H(tot)[mm	296,2	A[cm2]	i(x) [cm] 7,46	Jx(s)[cm4]=	4.590
hx		Note:				Jx(s)[m4]=	4,58996E-05
b				x(o) [mm]	148,1	Wx(o)[cm3]=	-309,9
ex, x				x(a) [mm]	131,0	Wx(a)[cm3]=	-350,4
				x(b) [mm]	-131,0	Wx(b)[cm3]=	350,4
Vers.050894/Piringer				x(u) [mm]	-148,1	Wx(u)[cm3]=	309,9

9/12

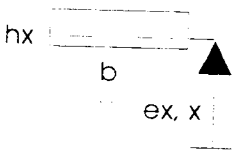
Querschnitt/cross section:	P 6-7'						
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	26	254	0	66,04	0	0	3551
lower L	19	243	-111,8	46,17	-516	5771	2272
upper L	19	243	111,8	46,17	516	5771	2272
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0



ex(s)[cm]	**0,00**	**158,38**	0	11542	8094
H(tot)[mm	466,6	A[cm2]	i(x) [cm] 11,13	**Jx(s)[cm4]=**	**19.636**
Note:				**Jx(s)[m4]=**	**0,000196361**
		x(o) [mm]	233,3	**Wx(o)[cm3]=**	**-841,7**
		x(a) [mm]	127,0	**Wx(a)[cm3]=**	**-1.546,2**
		x(b) [mm]	-127,0	**Wx(b)[cm3]=**	**1.546,2**
		x(u) [mm]	-233,3	**Wx(u)[cm3]=**	**841,7**

Vers.050894/Piringer

Querschnitt/cross section:	CT						
Bez.	by[mm]	hx[mm]	ex[mm]	A=b.h[cm2]	A*ex[cm3]	A*ex*ex[cm4]	Jx(o)[cm4]
webs	0	0	0	0,00	0	0	0
lower L	19	169	-29,7	32,11	-95	283	764
upper L	19	169	29,7	32,11	95	283	764
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0
				0,00	0	0	0



ex(s)[cm]	**0,00**	**64,22**	0	566	1528
H(tot)[mm	228,4	A[cm2]	i(x) [cm] 5,71	**Jx(s)[cm4]=**	**2.095**
Note:				**Jx(s)[m4]=**	**2,09497E-05**
		x(o) [mm]	114,2	**Wx(o)[cm3]=**	**-183,4**
		x(a) [mm]	93,0	**Wx(a)[cm3]=**	**-225,3**
		x(b) [mm]	-93,0	**Wx(b)[cm3]=**	**225,3**
		x(u) [mm]	-114,2	**Wx(u)[cm3]=**	**183,4**

Vers.050894/Piringer

Autor/Author	Datum/Date	Seite/Page No.	Änderung/Revis.	Auftrag/Order No.
[illegible]	22.10.96	C/13		20-007

4. SYSTEM ELEMENTS

Elem	i	k	GrNr	Elem	i	k	GrNr	Elem	i	k	GrNr
[illegible]	[illegible]	[illegible]	4	[illegible]	20	21	[illegible]	[illegible]	11	26	13
[illegible]	–	3	4	20	21	22	[illegible]	[illegible]	26	13	12
[illegible]	[illegible]	4	5	21	22	23	[illegible]	[illegible]	[illegible]	28	11
[illegible]	[illegible]	5	6	22	23	24	[illegible]	[illegible]	28	15	10
5	5	6	[illegible]	23	24	25	[illegible]	[illegible]	[illegible]	16	17
[illegible]	[illegible]	[illegible]	2	[illegible]	25	26	[illegible]	[illegible]	[illegible]	17	17
[illegible]	[illegible]	2	[illegible]	[illegible]	26	[illegible]	[illegible]	[illegible]	[illegible]	12	[illegible]
[illegible]	7	[illegible]	[illegible]	26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16	[illegible]	[illegible]	5	[illegible]	[illegible]
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[illegible]	11	12	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2	22	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24	[illegible]	[illegible]				

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5. ELECTRONIC COMPUTATION

On the following pages C/16 to C/31 the following loadcases are computed:

LC1 ... total load: 100 kN/m over full span

LC2 ... centric load: 100 kN/m length 33 m in middle of span

LC3 ... excentric load 100 kN/m on left half of span

On pages C/32 to C/56 load combinations are investigated to get the most unfavourable forces for fatigue check:

COMBINATION 301 Dead load 27,5 kN/m = 1 main girder

COMBINATION 302 Centric traffic load 42 kN/m 

COMBINATION 303 Total traffic load 42 kN/m 

COMBINATION 304 Dead load + either

 traffic load centric

 traffic load excentric

 traffic load total

whatever gives the most influence.

Combination 304 can be used to estimate effect of fatigue loading.

The program used is a German product, distributor and producer: Ing. DLUBAL

Am Zellweg 2

D-93464 Tiefenbach

The program is a finite element framework program (2D and 3D). It is a very common product in Germany and often approved.

The results are demonstrated graphically on pages C/58, C/59 - deflection under unit loads,
on pages C/60 to C/62 - normal forces max / min values.
On pages C/63 is given the result and comparison.

INHALTSVERZEICHNIS CONTENTS **BLATT**

Programmsystem RSTAB : Ebene/raeumliche Stabwerke nach FEM Version 4.61

Programm-Entwicklung : Ing.-Software Dlubal GmbH
Am Zellweg 2
D-93464 Tiefenbach
Telefon 09673/1775 o. 1776
Telefax 09673/1770

STRUKTUR-KENNGROESSEN STRUCTURAL DATA

Anzahl der
- Knoten : 28
- Materialien : 1
- Querschnitte : 17
- Stabendgelenktypen : 0
- Stabteilungstypen : 0
- Staebe : 53
- Auflager : 2

Stabwerktyp: 2-Dimensional

Anmerkung:
Main girder / 1 plane

KNOTEN-KOORDINATEN COORDINATES

Knoten-Nr.	Koordinaten-system	Pol-Knoten	Knoten-Koordinaten X (m)	Y (m)	Z (m)
1	Kartesisch	0	-33.068		0.000
2	Kartesisch	0	-28.344		0.000
3	Kartesisch	0	-23.620		0.000
4	Kartesisch	0	-18.896		0.000
5	Kartesisch	0	-14.172		0.000
6	Kartesisch	0	-9.448		0.000
7	Kartesisch	0	-4.724		0.000
8	Kartesisch	0	0.000		0.000
9	Kartesisch	0	4.724		0.000
10	Kartesisch	0	9.448		0.000
11	Kartesisch	0	14.172		0.000
12	Kartesisch	0	18.896		0.000
13	Kartesisch	0	23.620		0.000
14	Kartesisch	0	28.344		0.000
15	Kartesisch	0	33.068		0.000
16	Kartesisch	0	-28.344		-7.506
17	Kartesisch	0	-23.620		-7.916
18	Kartesisch	0	-18.896		-8.325
19	Kartesisch	0	-14.172		-8.735
20	Kartesisch	0	-9.448		-9.144
21	Kartesisch	0	-4.724		-9.144
22	Kartesisch	0	0.000		-9.144
23	Kartesisch	0	4.724		-9.144
24	Kartesisch	0	9.448		-9.144
25	Kartesisch	0	14.172		-8.735
26	Kartesisch	0	18.896		-8.325
27	Kartesisch	0	23.620		-7.916
28	Kartesisch	0	28.344		-7.506

MATERIALDATEN

Materia Nr.	Material-Bezeichnung	E-Modul (kN/cm^2)	G-Modul (kN/cm^2)	Sp.Gewicht (kN/cm^3)	Waermezahl (K^-1)
1	Stahl STEEL	2.100E+04	8.100E+03	7.850E-05	1.200E-05

TRAEGHEITSMOMENTE SECOND MOMENT BENDING

Quers Nr.	Mate Nr.	Querschnitts-Bezeichnung	Torsion I-1 (cm^4)	Biegung I-2 (cm^4)	Biegung I-3 (cm^4)
1	1	B 1'-2'-3'		124200.000	
2	1	B 3'-4'-5'		175300.000	
3	1	B 5'-6'-7'		187900.000	
4	1	H 0-1-2		54500.000	
5	1	H 2-3		90900.000	
6	1	H 3-4		93700.000	
7	1	H 4-5		134200.000	
8	1	H 5-6		136500.000	
9	1	H 6-7		142200.000	
10	1	P 0-1'		140300.000	
11	1	P 1'-2		13700.000	
12	1	P 2-3'		38500.000	
13	1	P 3'-4		8300.000	
14	1	P 4-5'		19700.000	
15	1	P 5'-6		4600.000	
16	1	P 6-7'		19600.000	
17	1	CT		2100.000	

QUERSCHNITTSFLAECHEN AREAS

Quers Nr.	Mate Nr.	Querschnitts-Bezeichnung	Normal A-1 (cm^2)	Schub A-2 (cm^2)	Schub A-3 (cm^2)
1	1	B 1'-2'-3'	269.000		159.000
2	1	B 3'-4'-5'	380.000		159.000
3	1	B 5'-6'-7'	424.000		159.000
4	1	H 0-1-2	217.000		132.000
5	1	H 2-3	300.000		145.000
6	1	H 3-4	315.000		145.000
7	1	H 4-5	383.000		159.000
8	1	H 5-6	399.000		159.000
9	1	H 6-7	419.000		159.000
10	1	P 0-1'	322.000		152.000
11	1	P 1'-2	191.000		86.000
12	1	P 2-3'	206.000		99.000
13	1	P 3'-4	107.000		50.000
14	1	P 4-5'	140.000		86.000
15	1	P 5'-6	82.000		40.000
16	1	P 6-7'	158.000		66.000

QUERSCHNITTSFLAECHEN

Quers Nr.	Mate Nr.	Querschnitts- Bezeichnung	Normal A-1 (cm^2)	Schub A-2 (cm^2)	Schub A-3 (cm^2)
17	1	CT	64.000		30.000

STABDATEN ELEMENTS DATA CROSS SECTION LENGTH

Stab Nr. (ELEMENT)	Stabtyp	Knoten Anf (START)	-	Knoten End (END)	Dreh-Winkel	Quersch Anf	Quersch End	Gelenktyp Anf-End	Stab-Teilung	Laenge (m)	Lage
1	Balken BEAM	1	-	2		4	4			4.724	HORI
2	Balken	2	-	3		4	4			4.724	HORI
3	Balken	3	-	4		5	5			4.724	HORI
4	Balken	4	-	5		6	6			4.724	HORI
5	Balken	5	-	6		7	7			4.724	HORI
6	Balken	6	-	7		8	8			4.724	HORI
7	Balken	7	-	8		9	9			4.724	HORI
8	Balken	8	-	9		9	9			4.724	HORI
9	Balken	9	-	10		8	8			4.724	HORI
10	Balken	10	-	11		7	7			4.724	HORI
11	Balken	11	-	12		6	6			4.724	HORI
12	Balken	12	-	13		5	5			4.724	HORI
13	Balken	13	-	14		4	4			4.724	HORI
14	Balken	14	-	15		4	4			4.724	HORI
15	Balken	16	-	17		1	1			4.742	ALLG
16	Balken	17	-	18		1	1			4.742	ALLG
17	Balken	18	-	19		2	2			4.742	ALLG
18	Balken	19	-	20		2	2			4.742	ALLG
19	Balken	20	-	21		3	3			4.724	HORI
20	Balken	21	-	22		3	3			4.724	HORI
21	Balken	22	-	23		3	3			4.724	HORI
22	Balken	23	-	24		3	3			4.724	HORI
23	Balken	24	-	25		2	2			4.742	ALLG
24	Balken	25	-	26		2	2			4.742	ALLG
25	Balken	26	-	27		1	1			4.742	ALLG
26	Balken	27	-	28		1	1			4.742	ALLG
27	Balken	1	-	16		10	10			8.869	ALLG
28	Balken	16	-	3		11	11			8.869	ALLG
29	Balken	3	-	18		12	12			9.572	ALLG
30	Balken	18	-	5		13	13			9.572	ALLG
31	Balken	5	-	20		14	14			10.292	ALLG
32	Balken	20	-	7		15	15			10.292	ALLG
33	Balken	7	-	22		16	16			10.292	ALLG
34	Balken	22	-	9		16	16			10.292	ALLG
35	Balken	9	-	24		15	15			10.292	ALLG
36	Balken	24	-	11		14	14			10.292	ALLG
37	Balken	11	-	26		13	13			9.572	ALLG
38	Balken	26	-	13		12	12			9.572	ALLG
39	Balken	13	-	28		11	11			8.869	ALLG
40	Balken	28	-	15		10	10			8.869	ALLG
41	Balken	2	-	16		17	17			7.506	VERT

STABDATEN

Stab-Nr.	Stabtyp	Knoten Anf	-	Knoten End	Dreh-Winkel	Quersch Anf	Quersch End	Gelenktyp Anf-End	Stab-Teilung	Laenge (m)	Lage
42	Balken	3	-	17		17	17			7.916	VERT
43	Balken	4	-	18		17	17			8.325	VERT
44	Balken	5	-	19		17	17			8.735	VERT
45	Balken	6	-	20		17	17			9.144	VERT
46	Balken	7	-	21		17	17			9.144	VERT
47	Balken	8	-	22		17	17			9.144	VERT
48	Balken	9	-	23		17	17			9.144	VERT
49	Balken	10	-	24		17	17			9.144	VERT
50	Balken	11	-	25		17	17			8.735	VERT
51	Balken	12	-	26		17	17			8.325	VERT
52	Balken	13	-	27		17	17			7.916	VERT
53	Balken	14	-	28		17	17			7.506	VERT

AUFLAGERDATEN BEARING RESTRAINTS

Lager Nr.	Knoten Nr.	Schieflagerung Alpha	Schieflagerung Beta	Feste Stuetzung in X-	Y-	Z-Richtung	Feste Einspannung um X-	Y-	Z-Achse
1	1			J		J		N	
2	15			N		J		N	

LASTFALL-VERZEICHNIS - BELASTUNG LOADING

LF-Nr.	Lastfall-Bezeichnung	Multiplikations-Faktor
1	Total loaded	1.000
2	Centric loaded	1.000
3	Excentric loaded	1.000

BELASTUNG LOADCASE 1

LASTFALL 1 : Total loaded

LF-Nr.	Eigengewicht in Richtung X	Y	Z	Anmerkung zum Lastfall
1	-	-	-	Uniformly, total length

STABLASTEN LOAD ON ELEMENT

Nr.	Stab-Nr. von	-	bis	Lastart Nr.	Richtung	P-1	P-2	A	B
1	1	-	14	1	Z	100.000	0.000	0.000	0.000

Lastart-Nr.
1: Linienlast
UNIFORM LOAD

Last-Parameter kN/m
P-1: Groesse der Linienlast

Einheit UNIT
(kN/m)

Richtung DIRECTION
Z: Global in Z-Richtung

LENGTH
Bezugslaenge der Stablast
Projizierte Stablaenge in X-Y-Ebene

BELASTUNG

LASTFALL 2 : Centric loaded

LF-Nr.	Eigengewicht in Richtung X	Y	Z	Anmerkung zum Lastfall
2	-	-	-	Uniformly, 33 m loaded length

STABLASTEN

Nr.	Stab-Nr. von	-	bis	Lastart Nr.	Richtung	P-1	P-2	A	B
1	4	-	4	4	Z	100.000	100.000	2.396	4.724
2	5	-	10	1	Z	100.000	0.000	0.000	0.000
3	11	-	11	4	Z	100.000	100.000	0.000	2.328

Lastart-Nr.
1: Linienlast
4: Trapezlast

Last-Parameter	**Einheit**
P-1: Groesse der Linienlast	(kN/m)
P-1: Randlast am Anfangsknoten	(kN/m)
P-2: Randlast am Endknoten	(kN/m)
A : Abstand P-1 vom Anfangsknoten	(m)
B : Abstand P-2 vom Anfangsknoten	(m)

Richtung
Z: Global in Z-Richtung

Bezugslaenge der Stablast
Projizierte Stablaenge in X-Y-Ebene

BELASTUNG

LASTFALL 3 : Excentric loaded

LF-Nr.	Eigengewicht in Richtung X	Y	Z	Anmerkung zum Lastfall
3	-	-	-	Uniformly, 33 m loaded length

STABLASTEN

Nr.	Stab-Nr. von	-	bis	Lastart Nr.	Richtung	Last-Parameter P-1	P-2	A	B
1	1	-	7	1	Z	100.000	0.000	0.000	0.000

Lastart-Nr.
1: Linienlast

Last-Parameter
P-1: Groesse der Linienlast

Einheit
(kN/m)

Richtung
Z: Global in Z-Richtung

Bezugslaenge der Stablast
Projizierte Stablaenge in X-Y-Ebene

ERGEBNISSE THEORIE I. ORDNUNG

LASTFALL LF 1 2 3

LASTFALL-VERZEICHNIS

LF	Lastfall-Bezeichnung
1	Total loaded
2	Centric loaded
3	Excentric loaded

LF ... LOAD CASE

SCHNITTGROESSEN STABBEZOGEN FORCES ON ELEMENT

Stab (ELEMENT) Nr.	LF	Knot-Nr.	x (m)	Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
1	1	1	0.00	1963.30		251.29		-201.18	
		2	4.72	1963.30		-221.11		-129.88	
	2	1	0.00	1043.38		5.40		-26.30	
		2	4.72	1043.38		5.40		-0.81	
	3	1	0.00	1440.53		248.59		-188.00	
		2	4.72	1440.53		-223.81		-129.47	
2	1	2	0.00	1964.21		221.38		-133.68	
		3	4.72	1964.21		-251.02		-203.70	
	2	2	0.00	1044.10		7.80		-3.74	
		3	4.72	1044.10		7.80		33.10	
	3	2	0.00	1441.08		217.47		-131.81	

NORMAL FORCE — SHEAR FORCE — BENDING MOMENT

SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LF	Knot-Nr.	x (m)	Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
2	3	3	4.72	1441.08		-254.93		-220.27	
3	1	3	0.00	4431.78		277.50		-263.51	
		4	4.72	4431.78		-194.90		-68.42	
	2	3	0.00	2816.32		-3.25		-6.60	
		4	4.72	2816.32		-3.25		-21.97	
	3	3	0.00	3021.28		278.58		-260.34	
		4	4.72	3021.28		-193.82		-60.12	
4	1	4	0.00	4432.72		206.56		-72.47	
		5	4.72	4432.72		-265.84		-212.51	
	2	4	0.00	2817.30		34.60		-26.21	
		5	4.72	2817.30		-198.20		-133.74	
	3	4	0.00	3021.75		197.06		-62.12	
		5	4.72	3021.75		-275.34		-247.03	
5	1	5	0.00	5499.05		278.40		-243.42	
		6	4.72	5499.05		-194.00		-44.04	
	2	5	0.00	3999.44		262.12		-179.30	
		6	4.72	3999.44		-210.28		-56.83	
	3	5	0.00	3353.30		288.96		-257.72	
		6	4.72	3353.30		-183.44		-8.49	
6	1	6	0.00	5499.62		201.85		-46.68	
		7	4.72	5499.62		-270.55		-208.94	
	2	6	0.00	4000.03		202.00		-59.48	
		7	4.72	4000.03		-270.40		-221.04	
	3	6	0.00	3353.25		179.83		-8.28	
		7	4.72	3353.25		-292.57		-274.59	
7	1	7	0.00	5968.71		289.12		-225.38	
		8	4.72	5968.71		-183.28		24.60	
	2	7	0.00	4470.70		289.25		-236.98	
		8	4.72	4470.70		-183.15		13.60	
	3	7	0.00	2984.60		294.66		-265.09	
		8	4.72	2984.60		-177.74		11.09	
8	1	8	0.00	5968.71		183.28		24.60	
		9	4.72	5968.71		-289.12		-225.38	
	2	8	0.00	4470.70		183.15		13.60	
		9	4.72	4470.70		-289.25		-236.98	
	3	8	0.00	2984.11		5.55		13.50	
		9	4.72	2984.11		5.55		39.71	
9	1	9	0.00	5499.62		270.55		-208.94	
		10	4.72	5499.62		-201.85		-46.68	
	2	9	0.00	4000.03		270.40		-221.04	
		10	4.72	4000.03		-202.00		-59.48	
	3	9	0.00	2146.37		-22.03		65.65	
		10	4.72	2146.37		-22.03		-38.40	
10	1	10	0.00	5499.05		194.00		-44.04	
		11	4.72	5499.05		-278.40		-243.42	
	2	10	0.00	3999.44		210.28		-56.83	
		11	4.72	3999.44		-262.12		-179.30	
	3	10	0.00	2145.75		10.56		-35.56	
		11	4.72	2145.75		10.56		14.31	

SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LF	Knot-Nr.	x (m)	Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
11	1	11	0.00	4432.72		265.84		-212.51	
		12	4.72	4432.72		-206.56		-72.47	
	2	11	0.00	2817.30		198.20		-133.74	
		12	4.72	2817.30		-34.60		-26.21	
	3	11	0.00	1410.97		-9.50		34.53	
		12	4.72	1410.97		-9.50		-10.34	
12	1	12	0.00	4431.78		194.90		-68.42	
		13	4.72	4431.78		-277.50		-263.51	
	2	12	0.00	2816.32		3.25		-21.97	
		13	4.72	2816.32		3.25		-6.60	
	3	12	0.00	1410.50		1.09		-8.30	
		13	4.72	1410.50		1.09		-3.17	
13	1	13	0.00	1964.21		251.02		-203.70	
		14	4.72	1964.21		-221.38		-133.68	
	2	13	0.00	1044.10		-7.80		33.10	
		14	4.72	1044.10		-7.80		-3.74	
	3	13	0.00	523.12		-3.90		16.57	
		14	4.72	523.12		-3.90		-1.87	
14	1	14	0.00	1963.30		221.11		-129.88	
		15	4.72	1963.30		-251.29		-201.18	
	2	14	0.00	1043.38		-5.40		-0.81	
		15	4.72	1043.38		-5.40		-26.30	
	3	14	0.00	522.76		-2.70		-0.40	
		15	4.72	522.76		-2.70		-13.18	
15	1	16	0.00	-3415.17		42.41		-113.33	
		17	4.74	-3415.17		42.41		87.78	
	2	16	0.00	-1970.17		17.35		-45.85	
		17	4.74	-1970.17		17.35		36.41	
	3	16	0.00	-2428.02		33.77		-90.36	
		17	4.74	-2428.02		33.77		69.77	
16	1	17	0.00	-3411.54		-11.30		83.31	
		18	4.74	-3411.54		-11.30		29.73	
	2	17	0.00	-1968.56		-8.77		33.54	
		18	4.74	-1968.56		-8.77		-8.06	
	3	17	0.00	-2425.16		-7.30		66.74	
		18	4.74	-2425.16		-7.30		32.14	
17	1	18	0.00	-5140.79		33.27		-17.77	
		19	4.74	-5140.79		33.27		139.97	
	2	18	0.00	-3558.05		36.22		-55.15	
		19	4.74	-3558.05		36.22		116.61	
	3	18	0.00	-3352.55		19.73		7.01	
		19	4.74	-3352.55		19.73		100.57	
18	1	19	0.00	-5135.76		-31.62		136.98	
		20	4.74	-5135.76		-31.62		-12.92	
	2	19	0.00	-3553.62		-25.17		112.67	
		20	4.74	-3553.62		-25.17		-6.69	
	3	19	0.00	-3349.76		-14.54		99.55	
		20	4.74	-3349.76		-14.54		30.59	
19	1	20	0.00	-5862.03		42.68		-34.20	

SCHNITTGROESSEN STABBEZOGEN

Stab- Nr.	LF	Knot- Nr.	x (m)	Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
19	1	21	4.72	-5862.03		42.68		167.44	
	2	20	0.00	-4364.13		39.34		-34.14	
		21	4.72	-4364.13		39.34		151.72	
	3	20	0.00	-3316.17		9.54		31.39	
		21	4.72	-3316.17		9.54		76.47	
20	1	21	0.00	-5862.48		-19.41		165.38	
		22	4.72	-5862.48		-19.41		73.70	
	2	21	0.00	-4364.57		-19.36		149.68	
		22	4.72	-4364.57		-19.36		58.23	
	3	21	0.00	-3315.94		-11.27		77.49	
		22	4.72	-3315.94		-11.27		24.26	
21	1	22	0.00	-5862.48		19.41		73.70	
		23	4.72	-5862.48		19.41		165.38	
	2	22	0.00	-4364.57		19.36		58.23	
		23	4.72	-4364.57		19.36		149.68	
	3	22	0.00	-2546.53		8.14		49.43	
		23	4.72	-2546.53		8.14		87.89	
22	1	23	0.00	-5862.03		-42.68		167.44	
		24	4.72	-5862.03		-42.68		-34.20	
	2	23	0.00	-4364.13		-39.34		151.72	
		24	4.72	-4364.13		-39.34		-34.14	
	3	23	0.00	-2545.86		-33.14		90.97	
		24	4.72	-2545.86		-33.14		-65.59	
23	1	24	0.00	-5135.76		31.62		-12.92	
		25	4.74	-5135.76		31.62		136.98	
	2	24	0.00	-3553.62		25.17		-6.69	
		25	4.74	-3553.62		25.17		112.67	
	3	24	0.00	-1786.00		17.07		-43.52	
		25	4.74	-1786.00		17.07		37.44	
24	1	25	0.00	-5140.79		-33.27		139.97	
		26	4.74	-5140.79		-33.27		-17.77	
	2	25	0.00	-3558.05		-36.22		116.61	
		26	4.74	-3558.05		-36.22		-55.15	
	3	25	0.00	-1788.24		-13.54		39.40	
		26	4.74	-1788.24		-13.54		-24.78	
25	1	26	0.00	-3411.54		11.30		29.73	
		27	4.74	-3411.54		11.30		83.31	
	2	26	0.00	-1968.56		8.77		-8.06	
		27	4.74	-1968.56		8.77		33.54	
	3	26	0.00	-986.38		4.00		-2.40	
		27	4.74	-986.38		4.00		16.57	
26	1	27	0.00	-3415.17		-42.41		87.78	
		28	4.74	-3415.17		-42.41		-113.33	
	2	27	0.00	-1970.17		-17.35		36.41	
		28	4.74	-1970.17		-17.35		-45.85	
	3	27	0.00	-987.14		-8.64		18.01	
		28	4.74	-987.14		-8.64		-22.97	
27	1	1	0.00	-3631.73		-34.09		201.18	
		16	8.87	-3631.73		-34.09		-101.12	

SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LF	Knot-Nr.	x (m)	Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
27	2	1	0.00	-1947.64		-7.05		26.30	
		16	8.87	-1947.64		-7.05		-36.20	
	3	1	0.00	-2655.91		-30.55		188.00	
		16	8.87	-2655.91		-30.55		-82.99	
28	1	16	0.00	2689.90		-2.03		9.18	
		3	8.87	2689.90		-2.03		-8.85	
	2	16	0.00	1719.60		-1.48		7.19	
		3	8.87	1719.60		-1.48		-5.92	
	3	16	0.00	1828.27		-1.29		5.57	
		3	8.87	1828.27		-1.29		-5.88	
29	1	3	0.00	-2076.13		-8.46		46.80	
		18	9.57	-2076.13		-8.46		-34.22	
	2	3	0.00	-1719.45		-6.61		31.22	
		18	9.57	-1719.45		-6.61		-32.06	
	3	3	0.00	-1215.74		-5.20		31.32	
		18	9.57	-1215.74		-5.20		-18.50	
30	1	18	0.00	1386.90		-1.68		9.51	
		5	9.57	1386.90		-1.68		-6.61	
	2	18	0.00	1463.46		-2.34		11.10	
		5	9.57	1463.46		-2.34		-11.25	
	3	18	0.00	640.06		-0.75		4.76	
		5	9.57	640.06		-0.75		-2.46	
31	1	5	0.00	-820.45		-3.53		21.32	
		20	10.29	-820.45		-3.53		-14.96	
	2	5	0.00	-985.88		-4.94		29.93	
		20	10.29	-985.88		-4.94		-20.94	
	3	5	0.00	-30.85		-0.69		7.16	
		20	10.29	-30.85		-0.69		0.07	
32	1	20	0.00	788.49		-0.57		3.76	
		7	10.29	788.49		-0.57		-2.12	
	2	20	0.00	792.10		-0.61		3.84	
		7	10.29	792.10		-0.61		-2.39	
	3	20	0.00	-80.34		0.23		-0.50	
		7	10.29	-80.34		0.23		1.86	
33	1	7	0.00	-228.84		-1.34		12.33	
		22	10.29	-228.84		-1.34		-1.50	
	2	7	0.00	-228.63		-1.34		11.58	
		22	10.29	-228.63		-1.34		-2.19	
	3	7	0.00	718.64		1.69		-6.55	
		22	10.29	718.64		1.69		10.82	
34	1	22	0.00	-228.84		1.34		-1.50	
		9	10.29	-228.84		1.34		12.33	
	2	22	0.00	-228.63		1.34		-2.19	
		9	10.29	-228.63		1.34		11.58	
	3	22	0.00	-947.48		3.03		-12.32	
		9	10.29	-947.48		3.03		18.88	
35	1	9	0.00	788.49		0.57		-2.12	
		24	10.29	788.49		0.57		3.76	
	2	9	0.00	792.10		0.61		-2.39	

SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LF	Knot-Nr.	x (m)	Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
35	2	24	10.29	792.10		0.61		3.84	
	3	9	0.00	868.82		0.80		-3.98	
		24	10.29	868.82		0.80		4.27	
36	1	24	0.00	-820.45		3.53		-14.96	
		11	10.29	-820.45		3.53		21.32	
	2	24	0.00	-985.88		4.94		-20.94	
		11	10.29	-985.88		4.94		29.93	
	3	24	0.00	-789.60		2.84		-15.03	
		11	10.29	-789.60		2.84		14.16	
37	1	11	0.00	1386.90		1.68		-6.61	
		26	9.57	1386.90		1.68		9.51	
	2	11	0.00	1463.46		2.34		-11.25	
		26	9.57	1463.46		2.34		11.10	
	3	11	0.00	746.85		0.93		-4.16	
		26	9.57	746.85		0.93		4.75	
38	1	26	0.00	-2076.13		8.46		-34.22	
		13	9.57	-2076.13		8.46		46.80	
	2	26	0.00	-1719.45		6.61		-32.06	
		13	9.57	-1719.45		6.61		31.22	
	3	26	0.00	-860.38		3.26		-15.72	
		13	9.57	-860.38		3.26		15.48	
39	1	13	0.00	2689.90		2.03		-8.85	
		28	8.87	2689.90		2.03		9.18	
	2	13	0.00	1719.60		1.48		-5.92	
		28	8.87	1719.60		1.48		7.19	
	3	13	0.00	861.63		0.74		-2.97	
		28	8.87	861.63		0.74		3.60	
40	1	28	0.00	-3631.73		34.09		-101.12	
		15	8.87	-3631.73		34.09		201.18	
	2	28	0.00	-1947.64		7.05		-36.20	
		15	8.87	-1947.64		7.05		26.30	
	3	28	0.00	-975.83		3.53		-18.13	
		15	8.87	-975.83		3.53		13.18	
41	1	2	0.00	442.49		-0.91		3.81	
		16	7.51	442.49		-0.91		-3.03	
	2	2	0.00	2.40		-0.72		2.94	
		16	7.51	2.40		-0.72		-2.45	
	3	2	0.00	441.28		-0.55		2.34	
		16	7.51	441.28		-0.55		-1.80	
42	1	3	0.00	54.54		-1.09		4.15	
		17	7.92	54.54		-1.09		-4.47	
	2	3	0.00	26.57		-0.69		2.55	
		17	7.92	26.57		-0.69		-2.87	
	3	3	0.00	41.67		-0.75		2.87	
		17	7.92	41.67		-0.75		-3.03	
43	1	4	0.00	401.46		-0.94		4.04	
		18	8.32	401.46		-0.94		-3.78	
	2	4	0.00	37.85		-0.98		4.24	
		18	8.32	37.85		-0.98		-3.92	

SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LF	Knot-Nr.	x (m)	Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
43	3	4	0.00	390.88		-0.47		2.00	
		18	8.32	390.88		-0.47		-1.87	
44	1	5	0.00	66.15		-0.68		2.98	
		19	8.73	66.15		-0.68		-2.98	
	2	5	0.00	62.29		-0.95		4.38	
		19	8.73	62.29		-0.95		-3.94	
	3	5	0.00	35.09		-0.24		1.08	
		19	8.73	35.09		-0.24		-1.02	
45	1	6	0.00	395.85		-0.57		2.64	
		20	9.14	395.85		-0.57		-2.56	
	2	6	0.00	412.28		-0.58		2.65	
		20	9.14	412.28		-0.58		-2.67	
	3	6	0.00	363.27		0.05		-0.21	
		20	9.14	363.27		0.05		0.22	
46	1	7	0.00	62.09		-0.44		1.99	
		21	9.14	62.09		-0.44		-2.06	
	2	7	0.00	58.70		-0.44		1.97	
		21	9.14	58.70		-0.44		-2.04	
	3	7	0.00	20.81		0.23		-1.09	
		21	9.14	20.81		0.23		1.02	
47	1	8	0.00	366.57		0.00		0.00	
		22	9.14	366.57		0.00		0.00	
	2	8	0.00	366.31		0.00		0.00	
		22	9.14	366.31		0.00		0.00	
	3	8	0.00	183.28		0.48		-2.41	
		22	9.14	183.28		0.48		2.02	
48	1	9	0.00	62.09		0.44		-1.99	
		23	9.14	62.09		0.44		2.06	
	2	9	0.00	58.70		0.44		-1.97	
		23	9.14	58.70		0.44		2.04	
	3	9	0.00	41.28		0.67		-3.08	
		23	9.14	41.28		0.67		3.08	
49	1	10	0.00	395.85		0.57		-2.64	
		24	9.14	395.85		0.57		2.56	
	2	10	0.00	412.28		0.58		-2.65	
		24	9.14	412.28		0.58		2.67	
	3	10	0.00	32.58		0.62		-2.85	
		24	9.14	32.58		0.62		2.78	
50	1	11	0.00	66.15		0.68		-2.98	
		25	8.73	66.15		0.68		2.98	
	2	11	0.00	62.29		0.95		-4.38	
		25	8.73	62.29		0.95		3.94	
	3	11	0.00	31.06		0.44		-1.90	
		25	8.73	31.06		0.44		1.97	
51	1	12	0.00	401.46		0.94		-4.04	
		26	8.32	401.46		0.94		3.78	
	2	12	0.00	37.85		0.98		-4.24	
		26	8.32	37.85		0.98		3.92	
	3	12	0.00	10.58		0.47		-2.04	

SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LF	Knot-Nr.	x (m)	Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
51	3	26	8.32	10.58		0.47		1.91	
52	1	13	0.00	54.54		1.09		-4.15	
		27	7.92	54.54		1.09		4.47	
	2	13	0.00	26.57		0.69		-2.55	
		27	7.92	26.57		0.69		2.87	
	3	13	0.00	12.87		0.34		-1.28	
		27	7.92	12.87		0.34		1.44	
53	1	14	0.00	442.49		0.91		-3.81	
		28	7.51	442.49		0.91		3.03	
	2	14	0.00	2.40		0.72		-2.94	
		28	7.51	2.40		0.72		2.45	
	3	14	0.00	1.20		0.36		-1.47	
		28	7.51	1.20		0.36		1.23	

AUFLAGERKRAEFTE UND -MOMENTE BEARING FORCES

Knot-Nr.	LF	Auflagerkraefte (kN) P-X	P-Y	P-Z (VERTICAL)	Auflagermomente (kNm) M-X	M-Y	M-Z
1	1	0.000		3306.800		0.000	
	2	0.000		1650.000		0.000	
	3	0.000		2480.100		0.000	
15	1	0.000		3306.800		0.000	
	2	0.000		1650.000		0.000	
	3	0.000		826.700		0.000	

Summen Lagerkraefte/Belastung SUM OF FORCES

Lage	1	0.000	6613.600
Bela		0.000	6613.599
Lage	2	0.000	3300.000
Bela		0.000	3300.000
Lage	3	0.000	3306.800
Bela		0.000	3306.800

KNOTEN-VERFORMUNGEN DEFLECTIONS

Knot-Nr.	LF	Verschiebungen (mm) u-X	u-Y	u-Z	Verdrehungen (mrad) Phi-X	Phi-Y	Phi-Z
1	1	0.00000		0.00000		-6.11581	
	2	0.00000		0.00000		-3.02338	
	3	0.00000		0.00000		-4.37482	
2	1	2.03525		28.12351		-5.27212	
	2	1.08162		16.04209		-3.58288	
	3	1.49332		19.01755		-3.25086	
3	1	4.07144		50.14172		-4.55913	
	2	2.16398		32.16973		-2.97701	

⟶ HORIZONTAL ↓ VERTICAL +) ROTATION

KNOTEN-VERFORMUNGEN

Knot-Nr.	LF	Verschiebungen (mm) u-X	u-Y	u-Z	Verdrehungen (mrad) Phi-X	Phi-Y	Phi-Z
	3	2.98722		31.88672		-2.84116	
4	1	7.39457		72.57640		-4.06411	
	2	4.27577		46.90534		-3.33054	
	3	5.25270		45.92493		-2.20424	
5	1	10.56013		87.86678		-3.02020	
	2	6.28771		61.62553		-3.06650	
	3	7.41064		52.65278		-1.45065	
6	1	13.78996		101.90000		-2.31220	
	2	8.63675		74.32631		-1.92824	
	3	9.38018		59.25085		-0.56454	
7	1	16.89059		109.40000		-1.35377	
	2	10.89193		80.48259		-1.17501	
	3	11.27071		58.24970		0.16938	
8	1	20.09507		114.40000		0.00000	
	2	13.29216		85.01307		0.00000	
	3	12.87307		57.18059		1.10222	
9	1	23.29954		109.40000		1.35377	
	2	15.69238		80.48259		1.17501	
	3	14.47518		51.16304		1.52315	
10	1	26.40018		101.90000		2.31220	
	2	17.94756		74.32631		1.92824	
	3	15.68528		42.68151		1.74766	
11	1	29.63000		87.86678		3.02020	
	2	20.29660		61.62553		3.06650	
	3	16.94557		35.21400		1.56955	
12	1	32.79557		72.57640		4.06411	
	2	22.30854		46.90534		3.33054	
	3	17.95320		26.65147		1.85987	
13	1	36.11870		50.14172		4.55913	
	2	24.42033		32.16973		2.97701	
	3	19.01085		18.25500		1.71797	
14	1	38.15489		28.12351		5.27212	
	2	25.50270		16.04209		3.58288	
	3	19.55315		9.10596		2.02126	
15	1	40.19014		0.00000		6.11581	
	2	26.58431		0.00000		3.02338	
	3	20.09507		0.00000		1.74099	
16	1	31.81660		25.65231		-4.60984	
	2	20.67231		16.02866		-3.17241	
	3	19.76153		16.55305		-2.79425	
17	1	31.03671		49.82050		-4.84210	
	2	20.39964		32.01321		-3.25826	
	3	19.02531		31.64130		-2.98143	
18	1	29.91730		70.08968		-3.81457	
	2	20.01013		46.67087		-3.02669	
	3	18.00910		43.50378		-2.08263	
19	1	28.35671		87.43686		-3.02759	
	2	19.15076		61.22067		-2.63088	
	3	16.78376		52.42474		-1.38983	

KNOTEN-VERFORMUNGEN

Knot- Nr.	LF	Verschiebungen (mm) u-X	u-Y	u-Z	Verdrehungen (mrad) Phi-X	Phi-Y	Phi-Z
20	1	26.31549		99.23918		-2.22862	
	2	17.92315		71.52135		-1.94834	
	3	15.16293		56.77934		-0.55170	
21	1	23.20540		109.00000		-1.43108	
	2	15.60777		80.08321		-1.24455	
	3	13.40354		58.10811		0.09392	
22	1	20.09507		111.90000		0.00000	
	2	13.29216		82.52085		0.00000	
	3	11.64427		55.93360		0.70300	
23	1	16.98474		109.00000		1.43108	
	2	10.97654		80.08321		1.24455	
	3	10.29321		50.88218		1.52500	
24	1	13.87465		99.23918		2.22862	
	2	8.66116		71.52135		1.94834	
	3	8.94251		42.45984		1.67692	
25	1	11.83343		87.43686		3.02759	
	2	7.43355		61.22067		2.63088	
	3	8.52213		35.01212		1.63777	
26	1	10.27284		70.08968		3.81457	
	2	5.57418		46.67087		3.02669	
	3	8.18687		26.58591		1.73194	
27	1	9.15343		49.82050		4.84210	
	2	6.18467		32.01321		3.25826	
	3	8.08367		18.17920		1.86067	
28	1	8.37354		25.65231		4.60984	
	2	5.91200		16.02866		3.17241	
	3	8.04000		9.09926		1.81559	
Maxi	1	40.19014		114.40000		6.11581	
	2	26.58431		85.01307		3.58288	
	3	20.09507		59.25085		2.02126	
Mini	1	0.00000		0.00000		-6.11581	
	2	0.00000		0.00000		-3.58288	
	3	0.00000		0.00000		-4.37482	

INHALTSVERZEICHNIS

BLATT

Programmsystem RSTAB : Ebene/raeumliche Stabwerke nach FEM Version 4.61

Programm-Entwicklung : Ing.-Software Dlubal GmbH
Am Zellweg 2
D-93464 Tiefenbach
Telefon 09673/1775 o. 1776
Telefax 09673/1770

ERGEBNISSE LF-UEBERLAGERUNG

LF-KOMBINATION LFK 301 302 303 304

LF-KOMBINATION-VERZEICHNIS

LFK	LF-Kombination-Bezeichnung	Kombinations-Kriterium
301	Dead load	0.275*1/s
302	Single engine load centric	0.42*2/s
303	2 engines (bridge length)	0.42*1/s
304	Max/min combination	0.275*1/s + 0.42*2 oder 0.42*3 oder 0.42* 1

KOMBINATIONSKRITERIEN

LFK		LF	LF-Bezeichnung	Ueber-lagerung	Wichtungs-Faktor
301		1:	Total loaded	Staendig	0.275
302		2:	Centric loaded	Staendig	0.420
303		1:	Total loaded	Staendig	0.420
304		1:	Total loaded	Staendig	0.275
	plus	2:	Centric loaded	Eventuell	0.420
	oder	3:	Excentric loaded	Eventuell	0.420
	oder	1:	Total loaded	Eventuell	0.420

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Selektier-Kriterium: /K

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
1	301	0.00	*MAX	539.91*		69.11		-55.32	
		0.00	*MIN	539.91*		69.11		-55.32	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	438.22*		2.27		-11.05	
		0.00	*MIN	438.22*		2.27		-11.05	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	824.58*		105.54		-84.49	
		0.00	*MIN	824.58*		105.54		-84.49	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	1364.49*		174.65		-139.82	
		0.00	*MIN	539.91*		69.11		-55.32	
			*MAX	LF 1 1					

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
1	304		*MIN	LF 1					
2	301	0.00	*MAX	540.16*		60.88		-36.76	
		0.00	*MIN	540.16*		60.88		-36.76	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	438.52*		3.28		-1.57	
		0.00	*MIN	438.52*		3.28		-1.57	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	824.97*		92.98		-56.15	
		0.00	*MIN	824.97*		92.98		-56.15	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	1365.12*		153.86		-92.91	
		0.00	*MIN	540.16*		60.88		-36.76	
			*MAX	LF 1	1				
			*MIN	LF 1					
3	301	0.00	*MAX	1218.74*		76.31		-72.46	
		0.00	*MIN	1218.74*		76.31		-72.46	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1182.86*		-1.37		-2.77	
		0.00	*MIN	1182.86*		-1.37		-2.77	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	1861.35*		116.55		-110.67	
		0.00	*MIN	1861.35*		116.55		-110.67	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	3080.09*		192.86		-183.14	
		0.00	*MIN	1218.74*		76.31		-72.46	
			*MAX	LF 1	1				
			*MIN	LF 1					
4	301	0.00	*MAX	1219.00*		56.80		-19.93	
		0.00	*MIN	1219.00*		56.80		-19.93	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1183.27*		14.53		-11.01	
		0.00	*MIN	1183.27*		14.53		-11.01	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	1861.74*		86.75		-30.44	
		0.00	*MIN	1861.74*		86.75		-30.44	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	3080.74*		143.56		-50.36	
		0.00	*MIN	1219.00*		56.80		-19.93	
			*MAX	LF 1	1				
			*MIN	LF 1					

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
5	301	0.00	*MAX	1512.24*		76.56		-66.94	
		0.00	*MIN	1512.24*		76.56		-66.94	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1679.77*		110.09		-75.30	
		0.00	*MIN	1679.77*		110.09		-75.30	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	2309.60*		116.93		-102.24	
		0.00	*MIN	2309.60*		116.93		-102.24	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	3821.84*		193.49		-169.18	
		0.00	*MIN	1512.24*		76.56		-66.94	
			*MAX	LF 1 1					
			*MIN	LF 1					
6	301	0.00	*MAX	1512.40*		55.51		-12.84	
		0.00	*MIN	1512.40*		55.51		-12.84	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1680.01*		84.84		-24.98	
		0.00	*MIN	1680.01*		84.84		-24.98	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	2309.84*		84.78		-19.61	
		0.00	*MIN	2309.84*		84.78		-19.61	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	3822.24*		140.29		-32.44	
		0.00	*MIN	1512.40*		55.51		-12.84	
			*MAX	LF 1 1					
			*MIN	LF 1					
7	301	0.00	*MAX	1641.39*		79.51		-61.98	
		0.00	*MIN	1641.39*		79.51		-61.98	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1877.69*		121.48		-99.53	
		0.00	*MIN	1877.69*		121.48		-99.53	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	2506.86*		121.43		-94.66	
		0.00	*MIN	2506.86*		121.43		-94.66	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	4148.25*		200.94		-156.64	
		0.00	*MIN	1641.39*		79.51		-61.98	
			*MAX	LF 1 1					
			*MIN	LF 1					
8	301	0.00	*MAX	1641.39*		50.40		6.76	

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
8	301	0.00	*MIN	1641.39*		50.40		6.76	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1877.69*		76.93		5.71	
		0.00	*MIN	1877.69*		76.93		5.71	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	2506.86*		76.98		10.33	
		0.00	*MIN	2506.86*		76.98		10.33	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	4148.25*		127.38		17.09	
		0.00	*MIN	1641.39*		50.40		6.76	
			*MAX	LF 1 1					
			*MIN	LF 1					
9	301	0.00	*MAX	1512.40*		74.40		-57.46	
		0.00	*MIN	1512.40*		74.40		-57.46	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1680.01*		113.57		-92.84	
		0.00	*MIN	1680.01*		113.57		-92.84	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	2309.84*		113.63		-87.75	
		0.00	*MIN	2309.84*		113.63		-87.75	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	3822.24*		188.03		-145.21	
		0.00	*MIN	1512.40*		74.40		-57.46	
			*MAX	LF 1 1					
			*MIN	LF 1					
10	301	0.00	*MAX	1512.24*		53.35		-12.11	
		0.00	*MIN	1512.24*		53.35		-12.11	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1679.77*		88.32		-23.87	
		0.00	*MIN	1679.77*		88.32		-23.87	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	2309.60*		81.48		-18.50	
		0.00	*MIN	2309.60*		81.48		-18.50	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	3821.84*		134.83		-30.61	
		0.00	*MIN	1512.24*		53.35		-12.11	
			*MAX	LF 1 1					
			*MIN	LF 1					
11	301	0.00	*MAX	1219.00*		73.11		-58.44	
		0.00	*MIN	1219.00*		73.11		-58.44	

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
11	301		*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1183.27*		83.24		-56.17	
		0.00	*MIN	1183.27*		83.24		-56.17	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	1861.74*		111.65		-89.25	
		0.00	*MIN	1861.74*		111.65		-89.25	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	3080.74*		184.76		-147.69	
		0.00	*MIN	1219.00*		73.11		-58.44	
			*MAX	LF 1 1					
			*MIN	LF 1					
12	301	0.00	*MAX	1218.74*		53.60		-18.82	
		0.00	*MIN	1218.74*		53.60		-18.82	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1182.86*		1.37		-9.23	
		0.00	*MIN	1182.86*		1.37		-9.23	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	1861.35*		81.86		-28.74	
		0.00	*MIN	1861.35*		81.86		-28.74	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	3080.09*		135.46		-47.56	
		0.00	*MIN	1218.74*		53.60		-18.82	
			*MAX	LF 1 1					
			*MIN	LF 1					
13	301	0.00	*MAX	540.16*		69.03		-56.02	
		0.00	*MIN	540.16*		69.03		-56.02	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	438.52*		-3.28		13.90	
		0.00	*MIN	438.52*		-3.28		13.90	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	824.97*		105.43		-85.56	
		0.00	*MIN	824.97*		105.43		-85.56	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	1365.12*		174.46		-141.57	
		0.00	*MIN	540.16*		69.03		-56.02	
			*MAX	LF 1 1					
			*MIN	LF 1					
14	301	0.00	*MAX	539.91*		60.80		-35.72	
		0.00	*MIN	539.91*		60.80		-35.72	
			*MAX	LF 1					

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
14	301		*MIN	LF 1					
	302	0.00	*MAX	438.22*		-2.27		-0.34	
		0.00	*MIN	438.22*		-2.27		-0.34	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	824.58*		92.86		-54.55	
		0.00	*MIN	824.58*		92.86		-54.55	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	1364.49*		153.67		-90.27	
		0.00	*MIN	539.91*		60.80		-35.72	
			*MAX	LF 1	1				
			*MIN	LF 1					
15	301	0.00	*MAX	-939.17*		11.66		-31.16	
		0.00	*MIN	-939.17*		11.66		-31.16	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-827.47*		7.29		-19.26	
		0.00	*MIN	-827.47*		7.29		-19.26	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-1434.37*		17.81		-47.60	
		0.00	*MIN	-1434.37*		17.81		-47.60	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-939.17*		11.66		-31.16	
		0.00	*MIN	-2373.54*		29.48		-78.76	
			*MAX	LF 1					
			*MIN	LF 1	1				
16	301	0.00	*MAX	-938.17*		-3.11		22.91	
		0.00	*MIN	-938.17*		-3.11		22.91	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-826.80*		-3.68		14.09	
		0.00	*MIN	-826.80*		-3.68		14.09	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-1432.85*		-4.75		34.99	
		0.00	*MIN	-1432.85*		-4.75		34.99	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-938.17*		-3.11		22.91	
		0.00	*MIN	-2371.02*		-7.85		57.90	
			*MAX	LF 1					
			*MIN	LF 1	1				
17	301	0.00	*MAX	-1413.72*		9.15		-4.89	
		0.00	*MIN	-1413.72*		9.15		-4.89	
			*MAX	LF 1					
			*MIN	LF 1					

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab- Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
17	302	0.00	*MAX	-1494.38*		15.21		-23.16	
		0.00	*MIN	-1494.38*		15.21		-23.16	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-2159.13*		13.97		-7.46	
		0.00	*MIN	-2159.13*		13.97		-7.46	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-1413.72*		9.15		-4.89	
		0.00	*MIN	-3572.85*		23.12		-12.35	
			*MAX	LF 1					
			*MIN	LF 1	1				
18	301	0.00	*MAX	-1412.33*		-8.69		37.67	
		0.00	*MIN	-1412.33*		-8.69		37.67	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-1492.52*		-10.57		47.32	
		0.00	*MIN	-1492.52*		-10.57		47.32	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-2157.02*		-13.28		57.53	
		0.00	*MIN	-2157.02*		-13.28		57.53	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-1412.33*		-8.69		37.67	
		0.00	*MIN	-3569.35*		-21.97		95.20	
			*MAX	LF 1					
			*MIN	LF 1	1				
19	301	0.00	*MAX	-1612.06*		11.74		-9.41	
		0.00	*MIN	-1612.06*		11.74		-9.41	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-1832.93*		16.52		-14.34	
		0.00	*MIN	-1832.93*		16.52		-14.34	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-2462.05*		17.93		-14.37	
		0.00	*MIN	-2462.05*		17.93		-14.37	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-1612.06*		11.74		-9.41	
		0.00	*MIN	-4074.11*		29.67		-23.77	
			*MAX	LF 1					
			*MIN	LF 1	1				
20	301	0.00	*MAX	-1612.18*		-5.34		45.48	
		0.00	*MIN	-1612.18*		-5.34		45.48	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-1833.12*		-8.13		62.87	

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
20	302	0.00	*MIN	-1833.12*		-8.13		62.87	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-2462.24*		-8.15		69.46	
		0.00	*MIN	-2462.24*		-8.15		69.46	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-1612.18*		-5.34		45.48	
		0.00	*MIN	-4074.42*		-13.49		114.94	
			*MAX	LF 1					
			*MIN	LF 1 1					
21	301	0.00	*MAX	-1612.18*		5.34		20.27	
		0.00	*MIN	-1612.18*		5.34		20.27	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-1833.12*		8.13		24.46	
		0.00	*MIN	-1833.12*		8.13		24.46	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-2462.24*		8.15		30.95	
		0.00	*MIN	-2462.24*		8.15		30.95	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-1612.18*		5.34		20.27	
		0.00	*MIN	-4074.42*		13.49		51.22	
			*MAX	LF 1					
			*MIN	LF 1 1					
22	301	0.00	*MAX	-1612.06*		-11.74		46.05	
		0.00	*MIN	-1612.06*		-11.74		46.05	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-1832.93*		-16.52		63.72	
		0.00	*MIN	-1832.93*		-16.52		63.72	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-2462.05*		-17.93		70.32	
		0.00	*MIN	-2462.05*		-17.93		70.32	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-1612.06*		-11.74		46.05	
		0.00	*MIN	-4074.11*		-29.67		116.37	
			*MAX	LF 1					
			*MIN	LF 1 1					
23	301	0.00	*MAX	-1412.33*		8.69		-3.55	
		0.00	*MIN	-1412.33*		8.69		-3.55	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-1492.52*		10.57		-2.81	
		0.00	*MIN	-1492.52*		10.57		-2.81	

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
23	302		*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-2157.02*		13.28		-5.43	
		0.00	*MIN	-2157.02*		13.28		-5.43	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-1412.33*		8.69		-3.55	
		0.00	*MIN	-3569.35*		21.97		-8.98	
			*MAX	LF 1					
			*MIN	LF 1 1					
24	301	0.00	*MAX	-1413.72*		-9.15		38.49	
		0.00	*MIN	-1413.72*		-9.15		38.49	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-1494.38*		-15.21		48.98	
		0.00	*MIN	-1494.38*		-15.21		48.98	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-2159.13*		-13.97		58.79	
		0.00	*MIN	-2159.13*		-13.97		58.79	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-1413.72*		-9.15		38.49	
		0.00	*MIN	-3572.85*		-23.12		97.28	
			*MAX	LF 1					
			*MIN	LF 1 1					
25	301	0.00	*MAX	-938.17*		3.11		8.18	
		0.00	*MIN	-938.17*		3.11		8.18	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-826.80*		3.68		-3.39	
		0.00	*MIN	-826.80*		3.68		-3.39	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-1432.85*		4.75		12.49	
		0.00	*MIN	-1432.85*		4.75		12.49	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-938.17*		3.11		8.18	
		0.00	*MIN	-2371.02*		7.85		20.66	
			*MAX	LF 1					
			*MIN	LF 1 1					
26	301	0.00	*MAX	-939.17*		-11.66		24.14	
		0.00	*MIN	-939.17*		-11.66		24.14	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-827.47*		-7.29		15.29	
		0.00	*MIN	-827.47*		-7.29		15.29	
			*MAX	LF 2					

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
26	302		*MIN	LF 2					
	303	0.00	*MAX	-1434.37*		-17.81		36.87	
		0.00	*MIN	-1434.37*		-17.81		36.87	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-939.17*		-11.66		24.14	
		0.00	*MIN	-2373.54*		-29.48		61.00	
			*MAX	LF 1					
			*MIN	LF 1	1				
27	301	0.00	*MAX	-998.73*		-9.37		55.32	
		0.00	*MIN	-998.73*		-9.37		55.32	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-818.01*		-2.96		11.05	
		0.00	*MIN	-818.01*		-2.96		11.05	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-1525.33*		-14.32		84.49	
		0.00	*MIN	-1525.33*		-14.32		84.49	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-998.73*		-9.37		55.32	
		0.00	*MIN	-2524.06*		-23.69		139.82	
			*MAX	LF 1					
			*MIN	LF 1	1				
28	301	0.00	*MAX	739.72*		-0.56		2.52	
		0.00	*MIN	739.72*		-0.56		2.52	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	722.23*		-0.62		3.02	
		0.00	*MIN	722.23*		-0.62		3.02	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	1129.76*		-0.85		3.85	
		0.00	*MIN	1129.76*		-0.85		3.85	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	1869.48*		-1.41		6.38	
		0.00	*MIN	739.72*		-0.56		2.52	
			*MAX	LF 1	1				
			*MIN	LF 1					
29	301	0.00	*MAX	-570.93*		-2.33		12.87	
		0.00	*MIN	-570.93*		-2.33		12.87	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-722.17*		-2.78		13.11	
		0.00	*MIN	-722.17*		-2.78		13.11	
			*MAX	LF 2					
			*MIN	LF 2					

PLANUNGSGESELLSCHAFT FÜR STAHL- UND MASCHINENBAU
Erzherzog Karl Straße 129a A-1221 Wien

SEITE: C/43
BLATT: 12

POSITION: TRUSS1 - TRUSS1
PROJEKT : TURKMEN - TURKMEN 1996.10.23

ERGEBNISSE LFK
LF-UEBERLAGERUNG

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
29	303	0.00	*MAX	-871.97*		-3.56		19.66	
		0.00	*MIN	-871.97*		-3.56		19.66	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-570.93*		-2.33		12.87	
		0.00	*MIN	-1442.91*		-5.88		32.53	
			*MAX	LF 1					
			*MIN	LF 1 1					
30	301	0.00	*MAX	381.40*		-0.46		2.61	
		0.00	*MIN	381.40*		-0.46		2.61	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	614.65*		-0.98		4.66	
		0.00	*MIN	614.65*		-0.98		4.66	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	582.50*		-0.71		3.99	
		0.00	*MIN	582.50*		-0.71		3.99	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	996.05*		-1.44		7.28	
		0.00	*MIN	381.40*		-0.46		2.61	
			*MAX	LF 1 2					
			*MIN	LF 1					
31	301	0.00	*MAX	-225.62*		-0.97		5.86	
		0.00	*MIN	-225.62*		-0.97		5.86	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-414.07*		-2.08		12.57	
		0.00	*MIN	-414.07*		-2.08		12.57	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-344.59*		-1.48		8.96	
		0.00	*MIN	-344.59*		-1.48		8.96	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-225.62*		-0.97		5.86	
		0.00	*MIN	-639.69*		-3.05		18.43	
			*MAX	LF 1					
			*MIN	LF 1 2					
32	301	0.00	*MAX	216.83*		-0.16		1.03	
		0.00	*MIN	216.83*		-0.16		1.03	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	332.68*		-0.25		1.61	
		0.00	*MIN	332.68*		-0.25		1.61	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	331.16*		-0.24		1.58	

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
32	303	0.00	*MIN	331.16*		-0.24		1.58	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	549.52*		-0.41		2.65	
		0.00	*MIN	183.09*		-0.06		0.82	
			*MAX	LF 1 2					
			*MIN	LF 1 3					
33	301	0.00	*MAX	-62.93*		-0.37		3.39	
		0.00	*MIN	-62.93*		-0.37		3.39	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-96.03*		-0.56		4.87	
		0.00	*MIN	-96.03*		-0.56		4.87	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-96.11*		-0.56		5.18	
		0.00	*MIN	-96.11*		-0.56		5.18	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	238.90*		0.34		0.64	
		0.00	*MIN	-159.04*		-0.93		8.57	
			*MAX	LF 1 3					
			*MIN	LF 1 1					
34	301	0.00	*MAX	-62.93*		0.37		-0.41	
		0.00	*MIN	-62.93*		0.37		-0.41	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-96.03*		0.56		-0.92	
		0.00	*MIN	-96.03*		0.56		-0.92	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-96.11*		0.56		-0.63	
		0.00	*MIN	-96.11*		0.56		-0.63	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-62.93*		0.37		-0.41	
		0.00	*MIN	-460.87*		1.64		-5.59	
			*MAX	LF 1					
			*MIN	LF 1 3					
35	301	0.00	*MAX	216.83*		0.16		-0.58	
		0.00	*MIN	216.83*		0.16		-0.58	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	332.68*		0.25		-1.00	
		0.00	*MIN	332.68*		0.25		-1.00	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	331.16*		0.24		-0.89	
		0.00	*MIN	331.16*		0.24		-0.89	

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
35	303		*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	581.74*		0.49		-2.25	
		0.00	*MIN	216.83*		0.16		-0.58	
			*MAX	LF 1 3					
			*MIN	LF 1					
36	301	0.00	*MAX	-225.62*		0.97		-4.11	
		0.00	*MIN	-225.62*		0.97		-4.11	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-414.07*		2.08		-8.79	
		0.00	*MIN	-414.07*		2.08		-8.79	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-344.59*		1.48		-6.28	
		0.00	*MIN	-344.59*		1.48		-6.28	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	-225.62*		0.97		-4.11	
		0.00	*MIN	-639.69*		3.0[illegible]		-12.91	
			*MAX	LF 1					
			*MIN	LF 1 2					
37	301	0.00	*MAX	381.40*		0.46		-1.82	
		0.00	*MIN	381.40*		0.46		-1.82	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	614.65*		0.98		-4.72	
		0.00	*MIN	614.65*		0.98		-4.72	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	582.50*		0.71		-2.78	
		0.00	*MIN	582.50*		0.71		-2.78	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	996.05*		1.44		-6.54	
		0.00	*MIN	381.40*		0.46		-1.82	
			*MAX	LF 1 2					
			*MIN	LF 1					
38	301	0.00	*MAX	-570.93*		2.33		-9.41	
		0.00	*MIN	-570.93*		2.33		-9.41	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	-722.17*		2.78		-13.47	
		0.00	*MIN	-722.17*		2.78		-13.47	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	-871.97*		3.56		-14.37	
		0.00	*MIN	-871.97*		3.56		-14.37	
			*MAX	LF 1					

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N		Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
38	303		*MIN	LF 1						
	304	0.00	*MAX	-570.93*			2.33		-9.41	
		0.00	*MIN	-1442.91*			5.88		-23.78	
			*MAX	LF 1						
			*MIN	LF 1	1					
39	301	0.00	*MAX	739.72*			0.56		-2.43	
		0.00	*MIN	739.72*			0.56		-2.43	
			*MAX	LF 1						
			*MIN	LF 1						
	302	0.00	*MAX	722.23*			0.62		-2.49	
		0.00	*MIN	722.23*			0.62		-2.49	
			*MAX	LF 2						
			*MIN	LF 2						
	303	0.00	*MAX	1129.76*			0.85		-3.72	
		0.00	*MIN	1129.76*			0.85		-3.72	
			*MAX	LF 1						
			*MIN	LF 1						
	304	0.00	*MAX	1869.48*			1.41		-6.15	
		0.00	*MIN	739.72*			0.56		-2.43	
			*MAX	LF 1	1					
			*MIN	LF 1						
40	301	0.00	*MAX	-998.73*			9.37		-27.81	
		0.00	*MIN	-998.73*			9.37		-27.81	
			*MAX	LF 1						
			*MIN	LF 1						
	302	0.00	*MAX	-818.01*			2.96		-15.21	
		0.00	*MIN	-818.01*			2.96		-15.21	
			*MAX	LF 2						
			*MIN	LF 2						
	303	0.00	*MAX	-1525.33*			14.32		-42.47	
		0.00	*MIN	-1525.33*			14.32		-42.47	
			*MAX	LF 1						
			*MIN	LF 1						
	304	0.00	*MAX	-998.73*			9.37		-27.81	
		0.00	*MIN	-2524.06*			23.69		-70.28	
			*MAX	LF 1						
			*MIN	LF 1	1					
41	301	0.00	*MAX	121.68*			-0.25		1.05	
		0.00	*MIN	121.68*			-0.25		1.05	
			*MAX	LF 1						
			*MIN	LF 1						
	302	0.00	*MAX	1.01*			-0.30		1.23	
		0.00	*MIN	1.01*			-0.30		1.23	
			*MAX	LF 2						
			*MIN	LF 2						
	303	0.00	*MAX	185.84*			-0.38		1.60	
		0.00	*MIN	185.84*			-0.38		1.60	
			*MAX	LF 1						
			*MIN	LF 1						

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N		Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
41	304	0.00	*MAX	307.53*			-0.63		2.65	
		0.00	*MIN	121.68*			-0.25		1.05	
			*MAX	LF	1	1				
			*MIN	LF	1					
42	301	0.00	*MAX	15.00*			-0.30		1.14	
		0.00	*MIN	15.00*			-0.30		1.14	
			*MAX	LF	1					
			*MIN	LF	1					
	302	0.00	*MAX	11.16*			-0.29		1.07	
		0.00	*MIN	11.16*			-0.29		1.07	
			*MAX	LF	2					
			*MIN	LF	2					
	303	0.00	*MAX	22.91*			-0.46		1.74	
		0.00	*MIN	22.91*			-0.46		1.74	
			*MAX	LF	1					
			*MIN	LF	1					
	304	0.00	*MAX	37.90*			-0.76		2.89	
		0.00	*MIN	15.00*			-0.30		1.14	
			*MAX	LF	1	1				
			*MIN	LF	1					
43	301	0.00	*MAX	110.40*			-0.26		1.11	
		0.00	*MIN	110.40*			-0.26		1.11	
			*MAX	LF	1					
			*MIN	LF	1					
	302	0.00	*MAX	15.90*			-0.41		1.78	
		0.00	*MIN	15.90*			-0.41		1.78	
			*MAX	LF	2					
			*MIN	LF	2					
	303	0.00	*MAX	168.61*			-0.39		1.70	
		0.00	*MIN	168.61*			-0.39		1.70	
			*MAX	LF	1					
			*MIN	LF	1					
	304	0.00	*MAX	279.01*			-0.65		2.81	
		0.00	*MIN	110.40*			-0.26		1.11	
			*MAX	LF	1	1				
			*MIN	LF	1					
44	301	0.00	*MAX	18.19*			-0.19		0.82	
		0.00	*MIN	18.19*			-0.19		0.82	
			*MAX	LF	1					
			*MIN	LF	1					
	302	0.00	*MAX	26.16*			-0.40		1.84	
		0.00	*MIN	26.16*			-0.40		1.84	
			*MAX	LF	2					
			*MIN	LF	2					
	303	0.00	*MAX	27.78*			-0.29		1.25	
		0.00	*MIN	27.78*			-0.29		1.25	
			*MAX	LF	1					
			*MIN	LF	1					
	304	0.00	*MAX	45.97*			-0.47		2.07	

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
44	304	0.00	*MIN	18.19*		-0.19		0.82	
			*MAX	LF 1	1				
			*MIN	LF 1					
45	301	0.00	*MAX	108.86*		-0.16		0.73	
		0.00	*MIN	108.86*		-0.16		0.73	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	173.16*		-0.24		1.11	
		0.00	*MIN	173.16*		-0.24		1.11	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	166.26*		-0.24		1.11	
		0.00	*MIN	166.26*		-0.24		1.11	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	282.01*		-0.40		1.84	
		0.00	*MIN	108.86*		-0.16		0.73	
			*MAX	LF 1	2				
			*MIN	LF 1					
46	301	0.00	*MAX	17.08*		-0.12		0.55	
		0.00	*MIN	17.08*		-0.12		0.55	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	24.65*		-0.18		0.83	
		0.00	*MIN	24.65*		-0.18		0.83	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	26.08*		-0.19		0.84	
		0.00	*MIN	26.08*		-0.19		0.84	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	43.15*		-0.31		1.38	
		0.00	*MIN	17.08*		-0.12		0.55	
			*MAX	LF 1	1				
			*MIN	LF 1					
47	301	0.00	*MAX	100.81*		0.00		0.00	
		0.00	*MIN	100.81*		0.00		0.00	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	153.85*		0.00		0.00	
		0.00	*MIN	153.85*		0.00		0.00	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	153.96*		0.00		0.00	
		0.00	*MIN	153.96*		0.00		0.00	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	254.76*		0.00		0.00	
		0.00	*MIN	100.81*		0.00		0.00	

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
47	304		*MAX	LF 1 1					
			*MIN	LF 1					
48	301	0.00	*MAX	17.08*		0.12		-0.55	
		0.00	*MIN	17.08*		0.12		-0.55	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	24.65*		0.18		-0.83	
		0.00	*MIN	24.65*		0.18		-0.83	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	26.08*		0.19		-0.84	
		0.00	*MIN	26.08*		0.19		-0.84	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	43.15*		0.31		-1.38	
		0.00	*MIN	17.08*		0.12		-0.55	
			*MAX	LF 1 1					
			*MIN	LF 1					
49	301	0.00	*MAX	108.86*		0.16		-0.73	
		0.00	*MIN	108.86*		0.16		-0.73	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	173.16*		0.24		-1.11	
		0.00	*MIN	173.16*		0.24		-1.11	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	166.26*		0.24		-1.11	
		0.00	*MIN	166.26*		0.24		-1.11	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	282.01*		0.40		-1.84	
		0.00	*MIN	108.86*		0.16		-0.73	
			*MAX	LF 1 2					
			*MIN	LF 1					
50	301	0.00	*MAX	18.19*		0.19		-0.82	
		0.00	*MIN	18.19*		0.19		-0.82	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	26.16*		0.40		-1.84	
		0.00	*MIN	26.16*		0.40		-1.84	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	27.78*		0.29		-1.25	
		0.00	*MIN	27.78*		0.29		-1.25	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	45.97*		0.47		-2.07	
		0.00	*MIN	18.19*		0.19		-0.82	
			*MAX	LF 1 1					

MAX/MIN/ZUG SCHNITTGROESSEN STABBEZOGEN

Stab-Nr.	LFK	x (m)		Kraefte (kN) N	Q-2	Q-3	Momente (kNm) M-T	M-2	M-3
50	304		*MIN	LF 1					
51	301	0.00	*MAX	110.40*		0.26		-1.11	
		0.00	*MIN	110.40*		0.26		-1.11	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	15.90*		0.41		-1.78	
		0.00	*MIN	15.90*		0.41		-1.78	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	168.61*		0.39		-1.70	
		0.00	*MIN	168.61*		0.39		-1.70	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	279.01*		0.65		-2.81	
		0.00	*MIN	110.40*		0.26		-1.11	
			*MAX	LF 1 1					
			*MIN	LF 1					
52	301	0.00	*MAX	15.00*		0.30		-1.14	
		0.00	*MIN	15.00*		0.30		-1.14	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	11.16*		0.29		-1.07	
		0.00	*MIN	11.16*		0.29		-1.07	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	22.91*		0.46		-1.74	
		0.00	*MIN	22.91*		0.46		-1.74	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	37.90*		0.76		-2.89	
		0.00	*MIN	15.00*		0.30		-1.14	
			*MAX	LF 1 1					
			*MIN	LF 1					
53	301	0.00	*MAX	121.68*		0.25		-1.05	
		0.00	*MIN	121.68*		0.25		-1.05	
			*MAX	LF 1					
			*MIN	LF 1					
	302	0.00	*MAX	1.01*		0.30		-1.23	
		0.00	*MIN	1.01*		0.30		-1.23	
			*MAX	LF 2					
			*MIN	LF 2					
	303	0.00	*MAX	185.84*		0.38		-1.60	
		0.00	*MIN	185.84*		0.38		-1.60	
			*MAX	LF 1					
			*MIN	LF 1					
	304	0.00	*MAX	307.53*		0.63		-2.65	
		0.00	*MIN	121.68*		0.25		-1.05	
			*MAX	LF 1 1					
			*MIN	LF 1					

MAX/MIN/ZUG AUFLAGERKRAEFTE UND -MOMENTE

Knot-Nr.	LFK		Auflagerkraefte (kN) P-X	P-Y	P-Z	Auflagermomente (kNm) M-X	M-Y	M-Z
1	301	Max P-X	0.00*		909.37		0.00	
		Min P-X	0.00*		909.37		0.00	
		Max P-X LF	1					
		Min P-X LF	1					
	302	Max P-X	0.00*		693.00		0.00	
		Min P-X	0.00*		693.00		0.00	
		Max P-X LF	2					
		Min P-X LF	2					
	303	Max P-X	0.00*		1388.86		0.00	
		Min P-X	0.00*		1388.86		0.00	
		Max P-X LF	1					
		Min P-X LF	1					
	304	Max P-X	0.00*		909.37		0.00	
		Min P-X	0.00*		909.37		0.00	
		Max P-X LF	1					
		Min P-X LF	1					
	301	Max P-Z	0.00		909.37*		0.00	
		Min P-Z	0.00		909.37*		0.00	
		Max P-Z LF	1					
		Min P-Z LF	1					
	302	Max P-Z	0.00		693.00*		0.00	
		Min P-Z	0.00		693.00*		0.00	
		Max P-Z LF	2					
		Min P-Z LF	2					
	303	Max P-Z	0.00		1388.86*		0.00	
		Min P-Z	0.00		1388.86*		0.00	
		Max P-Z LF	1					
		Min P-Z LF	1					
	304	Max P-Z	0.00		2298.23*		0.00	
		Min P-Z	0.00		909.37*		0.00	
		Max P-Z LF	1	1				
		Min P-Z LF	1					
15	301	Max P-Z	0.00		909.37*		0.00	
		Min P-Z	0.00		909.37*		0.00	
		Max P-Z LF	1					
		Min P-Z LF	1					
	302	Max P-Z	0.00		693.00*		0.00	
		Min P-Z	0.00		693.00*		0.00	
		Max P-Z LF	2					
		Min P-Z LF	2					
	303	Max P-Z	0.00		1388.86*		0.00	
		Min P-Z	0.00		1388.86*		0.00	
		Max P-Z LF	1					
		Min P-Z LF	1					
	304	Max P-Z	0.00		2298.23*		0.00	
		Min P-Z	0.00		909.37*		0.00	
		Max P-Z LF	1	1				
		Min P-Z LF	1					

MAX/MIN KNOTEN-VERFORMUNGEN

Knot-Nr.	LFK		Verschiebungen (mm) u-X	u-Y	u-Z	Verdrehungen (mrad) Phi-X	Phi-Y	Phi-Z
1	301	Max	0.0000		0.0000		-1.6819	
		Min	0.0000		0.0000		-1.6819	
	302	Max	0.0000		0.0000		-1.2698	
		Min	0.0000		0.0000		-1.2698	
	303	Max	0.0000		0.0000		-2.5686	
		Min	0.0000		0.0000		-2.5686	
	304	Max	0.0000		0.0000		-1.6819	
		Min	0.0000		0.0000		-4.2505	
2	301	Max	0.5597		7.7340		-1.4498	
		Min	0.5597		7.7340		-1.4498	
	302	Max	0.4543		6.7377		-1.5048	
		Min	0.4543		6.7377		-1.5048	
	303	Max	0.8548		11.8119		-2.2143	
		Min	0.8548		11.8119		-2.2143	
	304	Max	1.4145		19.5458		-1.4498	
		Min	0.5597		7.7340		-3.6641	
3	301	Max	1.1197		13.7890		-1.2538	
		Min	1.1197		13.7890		-1.2538	
	302	Max	0.9039		13.5113		-1.2503	
		Min	0.9039		13.5113		-1.2503	
	303	Max	1.7100		21.0595		-1.9148	
		Min	1.7100		21.0595		-1.9148	
	304	Max	2.8296		34.8485		-1.2538	
		Min	1.1197		13.7890		-3.1686	
4	301	Max	2.0335		19.9585		-1.1176	
		Min	2.0335		19.9585		-1.1176	
	302	Max	1.7958		19.7002		-1.3988	
		Min	1.7958		19.7002		-1.3988	
	303	Max	3.1057		30.4821		-1.7069	
		Min	3.1057		30.4821		-1.7069	
	304	Max	5.1392		50.4406		-1.1176	
		Min	2.0335		19.9585		-2.8246	
5	301	Max	2.9040		24.1634		-0.8306	
		Min	2.9040		24.1634		-0.8306	
	302	Max	2.6408		25.8827		-1.2879	
		Min	2.6408		25.8827		-1.2879	
	303	Max	4.4353		36.9041		-1.2685	
		Min	4.4353		36.9041		-1.2685	
	304	Max	7.3393		61.0674		-0.8306	
		Min	2.9040		24.1634		-2.1185	
6	301	Max	3.7922		28.0225		-0.6359	
		Min	3.7922		28.0225		-0.6359	
	302	Max	3.6274		31.2171		-0.8099	
		Min	3.6274		31.2171		-0.8099	
	303	Max	5.7918		42.7980		-0.9711	
		Min	5.7918		42.7980		-0.9711	
	304	Max	9.5840		70.8205		-0.6359	
		Min	3.7922		28.0225		-1.6070	

MAX/MIN KNOTEN-VERFORMUNGEN

Knot-Nr.	LFK		Verschiebungen (mm) u-X	u-Y	u-Z	Verdrehungen (mrad) Phi-X	Phi-Y	Phi-Z
7	301	Max	4.6449		30.0850		-0.3723	
		Min	4.6449		30.0850		-0.3723	
	302	Max	4.5746		33.8027		-0.4935	
		Min	4.5746		33.8027		-0.4935	
	303	Max	7.0940		45.9480		-0.5686	
		Min	7.0940		45.9480		-0.5686	
	304	Max	11.7390		76.0330		-0.3011	
		Min	4.6449		30.0850		-0.9409	
8	301	Max	5.5261		31.4600		0.0000	
		Min	5.5261		31.4600		0.0000	
	302	Max	5.5827		35.7055		0.0000	
		Min	5.5827		35.7055		0.0000	
	303	Max	8.4399		48.0480		0.0000	
		Min	8.4399		48.0480		0.0000	
	304	Max	13.9661		79.5080		0.4629	
		Min	5.5261		31.4600		0.0000	
9	301	Max	6.4074		30.0850		0.3723	
		Min	6.4074		30.0850		0.3723	
	302	Max	6.5908		33.8027		0.4935	
		Min	6.5908		33.8027		0.4935	
	303	Max	9.7858		45.9480		0.5686	
		Min	9.7858		45.9480		0.5686	
	304	Max	16.1932		76.0330		1.0120	
		Min	6.4074		30.0850		0.3723	
10	301	Max	7.2600		28.0225		0.6359	
		Min	7.2600		28.0225		0.6359	
	302	Max	7.5380		31.2171		0.8099	
		Min	7.5380		31.2171		0.8099	
	303	Max	11.0881		42.7980		0.9711	
		Min	11.0881		42.7980		0.9711	
	304	Max	18.3481		70.8205		1.6070	
		Min	7.2600		28.0225		0.6359	
11	301	Max	8.1482		24.1634		0.8306	
		Min	8.1482		24.1634		0.8306	
	302	Max	8.5246		25.8827		1.2879	
		Min	8.5246		25.8827		1.2879	
	303	Max	12.4446		36.9041		1.2685	
		Min	12.4446		36.9041		1.2685	
	304	Max	20.5928		61.0674		2.1185	
		Min	8.1482		24.1634		0.8306	
12	301	Max	9.0188		19.9585		1.1176	
		Min	9.0188		19.9585		1.1176	
	302	Max	9.3696		19.7002		1.3988	
		Min	9.3696		19.7002		1.3988	
	303	Max	13.7741		30.4821		1.7069	
		Min	13.7741		30.4821		1.7069	
	304	Max	22.7929		50.4406		2.8246	
		Min	9.0188		19.9585		1.1176	
13	301	Max	9.9326		13.7890		1.2538	

MAX/MIN KNOTEN-VERFORMUNGEN

Knot-Nr.	LFK		Verschiebungen (mm) u-X	u-Y	u-Z	Verdrehungen (mrad) Phi-X	Phi-Y	Phi-Z
		Min	9.9326		13.7890		1.2538	
	302	Max	10.2565		13.5113		1.2503	
		Min	10.2565		13.5113		1.2503	
	303	Max	15.1699		21.0595		1.9148	
		Min	15.1699		21.0595		1.9148	
	304	Max	25.1025		34.8485		3.1686	
		Min	9.9326		13.7890		1.2538	
14	301	Max	10.4926		7.7340		1.4498	
		Min	10.4926		7.7340		1.4498	
	302	Max	10.7111		6.7377		1.5048	
		Min	10.7111		6.7377		1.5048	
	303	Max	16.0250		11.8119		2.2143	
		Min	16.0250		11.8119		2.2143	
	304	Max	26.5176		19.5458		3.6641	
		Min	10.4926		7.7340		1.4498	
15	301	Max	11.0523		0.0000		1.6819	
		Min	11.0523		0.0000		1.6819	
	302	Max	11.1654		0.0000		1.2698	
		Min	11.1654		0.0000		1.2698	
	303	Max	16.8799		0.0000		2.5686	
		Min	16.8799		0.0000		2.5686	
	304	Max	27.9322		0.0000		4.2505	
		Min	11.0523		0.0000		1.6819	
16	301	Max	8.7496		7.0544		-1.2677	
		Min	8.7496		7.0544		-1.2677	
	302	Max	8.6824		6.7320		-1.3324	
		Min	8.6824		6.7320		-1.3324	
	303	Max	13.3630		10.7740		-1.9361	
		Min	13.3630		10.7740		-1.9361	
	304	Max	22.1125		17.8283		-1.2677	
		Min	8.7496		7.0544		-3.2038	
17	301	Max	8.5351		13.7006		-1.3316	
		Min	8.5351		13.7006		-1.3316	
	302	Max	8.5679		13.4456		-1.3685	
		Min	8.5679		13.4456		-1.3685	
	303	Max	13.0354		20.9246		-2.0337	
		Min	13.0354		20.9246		-2.0337	
	304	Max	21.5705		34.6252		-1.3316	
		Min	8.5351		13.7006		-3.3653	
18	301	Max	8.2273		19.2747		-1.0490	
		Min	8.2273		19.2747		-1.0490	
	302	Max	8.4043		19.6018		-1.2712	
		Min	8.4043		19.6018		-1.2712	
	303	Max	12.5653		29.4377		-1.6021	
		Min	12.5653		29.4377		-1.6021	
	304	Max	20.7925		48.7123		-1.0490	
		Min	8.2273		19.2747		-2.6511	
19	301	Max	7.7981		24.0451		-0.8326	
		Min	7.7981		24.0451		-0.8326	

MAX/MIN KNOTEN-VERFORMUNGEN

Knot- Nr.	LFK		Verschiebungen (mm) u-X	u-Y	u-Z	Verdrehungen (mrad) Phi-X	Phi-Y	Phi-Z
	302	Max	8.0433		25.7127		-1.1050	
		Min	8.0433		25.7127		-1.1050	
	303	Max	11.9098		36.7235		-1.2716	
		Min	11.9098		36.7235		-1.2716	
	304	Max	19.7079		60.7686		-0.8326	
		Min	7.7981		24.0451		-2.1042	
20	301	Max	7.2368		27.2908		-0.6129	
		Min	7.2368		27.2908		-0.6129	
	302	Max	7.5277		30.0390		-0.8183	
		Min	7.5277		30.0390		-0.8183	
	303	Max	11.0525		41.6804		-0.9360	
		Min	11.0525		41.6804		-0.9360	
	304	Max	18.2893		68.9712		-0.6129	
		Min	7.2368		27.2908		-1.5489	
21	301	Max	6.3815		29.9750		-0.3935	
		Min	6.3815		29.9750		-0.3935	
	302	Max	6.5553		33.6349		-0.5227	
		Min	6.5553		33.6349		-0.5227	
	303	Max	9.7463		45.7800		-0.6011	
		Min	9.7463		45.7800		-0.6011	
	304	Max	16.1278		75.7550		-0.3541	
		Min	6.3815		29.9750		-0.9946	
22	301	Max	5.5261		30.7725		0.0000	
		Min	5.5261		30.7725		0.0000	
	302	Max	5.5827		34.6588		0.0000	
		Min	5.5827		34.6588		0.0000	
	303	Max	8.4399		46.9980		0.0000	
		Min	8.4399		46.9980		0.0000	
	304	Max	13.9661		77.7705		0.2953	
		Min	5.5261		30.7725		0.0000	
23	301	Max	4.6708		29.9750		0.3935	
		Min	4.6708		29.9750		0.3935	
	302	Max	4.6102		33.6349		0.5227	
		Min	4.6102		33.6349		0.5227	
	303	Max	7.1336		45.7800		0.6011	
		Min	7.1336		45.7800		0.6011	
	304	Max	11.8044		75.7550		1.0341	
		Min	4.6708		29.9750		0.3935	
24	301	Max	3.8155		27.2908		0.6129	
		Min	3.8155		27.2908		0.6129	
	302	Max	3.6377		30.0390		0.8183	
		Min	3.6377		30.0390		0.8183	
	303	Max	5.8273		41.6804		0.9360	
		Min	5.8273		41.6804		0.9360	
	304	Max	9.6429		68.9712		1.5489	
		Min	3.8155		27.2908		0.6129	
25	301	Max	3.2542		24.0451		0.8326	
		Min	3.2542		24.0451		0.8326	
	302	Max	3.1221		25.7127		1.1050	

MAX/MIN KNOTEN-VERFORMUNGEN

Knot-Nr.	LFK		Verschiebungen (mm) u-X	u-Y	u-Z	Verdrehungen (mrad) Phi-X	Phi-Y	Phi-Z
		Min	3.1221		25.7127		1.1050	
	303	Max	4.9700		36.7235		1.2716	
		Min	4.9700		36.7235		1.2716	
	304	Max	8.2242		60.7686		2.1042	
		Min	3.2542		24.0451		0.8326	
26	301	Max	2.8250		19.2747		1.0490	
		Min	2.8250		19.2747		1.0490	
	302	Max	2.7612		19.6018		1.2712	
		Min	2.7612		19.6018		1.2712	
	303	Max	4.3146		29.4377		1.6021	
		Min	4.3146		29.4377		1.6021	
	304	Max	7.1396		48.7123		2.6511	
		Min	2.8250		19.2747		1.0490	
27	301	Max	2.5172		13.7006		1.3316	
		Min	2.5172		13.7006		1.3316	
	302	Max	2.5976		13.4456		1.3685	
		Min	2.5976		13.4456		1.3685	
	303	Max	3.8444		20.9246		2.0337	
		Min	3.8444		20.9246		2.0337	
	304	Max	5.3616		34.6252		3.3653	
		Min	2.5172		13.7006		1.3316	
28	301	Max	2.3027		7.0544		1.2677	
		Min	2.3027		7.0544		1.2677	
	302	Max	2.4830		6.7320		1.3324	
		Min	2.4830		6.7320		1.3324	
	303	Max	3.5169		10.7740		1.9361	
		Min	3.5169		10.7740		1.9361	
	304	Max	5.8196		17.8283		3.2038	
		Min	2.3027		7.0544		1.2677	
	301	MAX	11.0523		31.4600		1.6819	
		MIN	0.0000		0.0000		-1.6819	
	302	MAX	11.1654		35.7055		1.5048	
		MIN	0.0000		0.0000		-1.5048	
	303	MAX	16.8799		48.0480		2.5686	
		MIN	0.0000		0.0000		-2.5686	
	304	MAX	27.9322		79.5080		4.2505	
		MIN	0.0000		0.0000		-4.2505	

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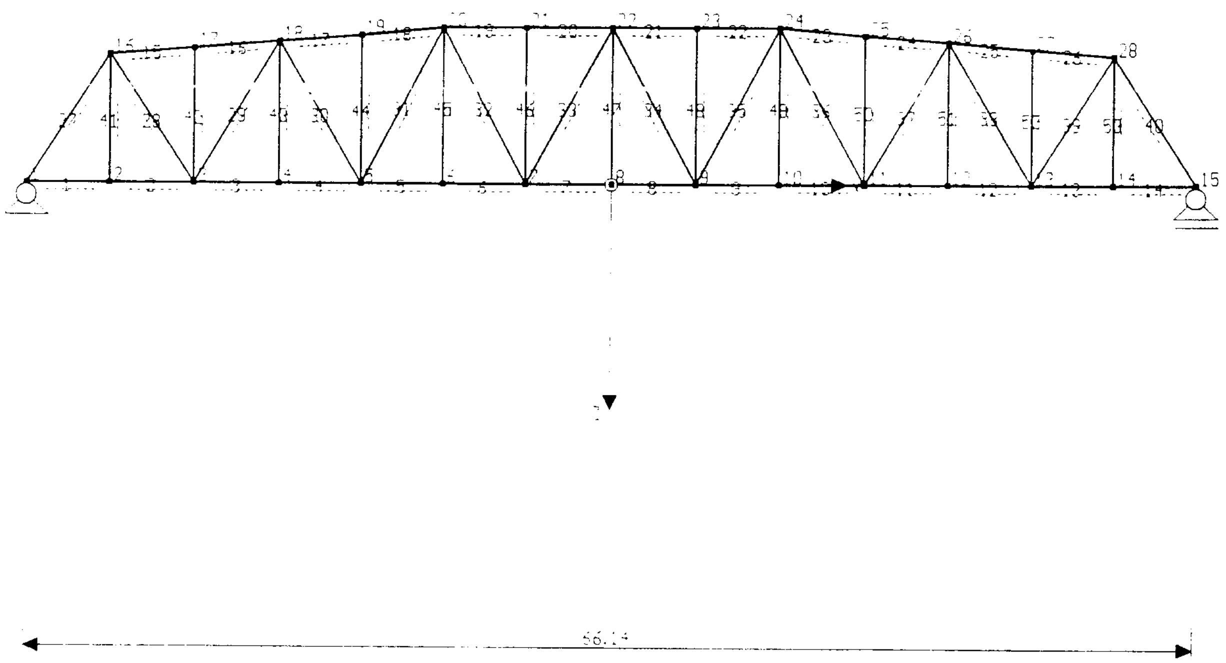
STRUKTUR - TRUSS1

IN Y-RICHTUNG



4.34 m

STABE:
01.B 03

WINKEL:
ALPHA: [illegible]
BETA : 42.0
GAMMA: 0.0

DARGESTELLTER BEREICH [m]
IN X: -100000. ... 100000.0
IN Y: -100000. ... 100000.0
IN Z: -100000. ... 100000.0

KNOTENNUMERIERUNG
STABNUMERIERUNG

VERZERRUNG
IN X: 1.00
IN Y: 1.00
IN Z: 1.00

ANZAHL DER KNOTEN : 28
ANZAHL DER STABE : 53
ANZAHL DER AUFLAGER : 2

PROJEKT: TURKMEN	PROJEKT-NAME: TURKMEN
POSITION: TRUSS1	POSITION-NAME: TRUSS1
	Programm RSTAB 4.61 (C) by ING.-SOFTWARE DLUBAL GMBH
SYSTEM	
Waagner-Biró AG. Stadlauer Str. 54 Wien	BLATT: SEITE:

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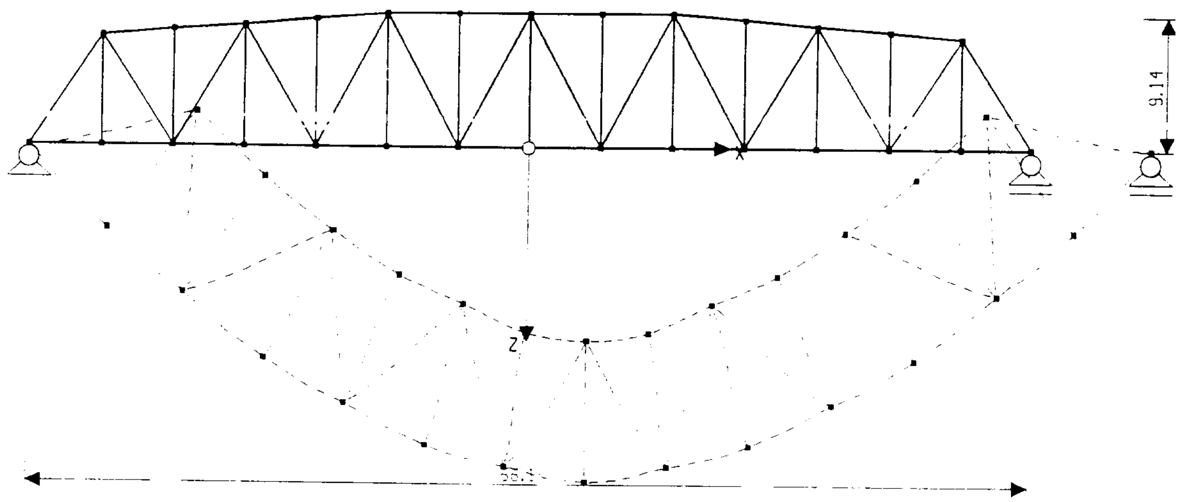
VERFORMUNGEN - TRUSS1 - LF 1

IN Y-RICHTUNG



DEFLECTION
TOTAL UNIT LOAD 100 kN/m

Max = 1[illegible] mm

5.07 m

STÄBE: [illegible]

LF/LG/LK 200*1 [illegible]

WINKEL:
ALPHA: [illegible]
BETA : 42.5
GAMMA: [illegible]

DARGESTELLTER BEREICH [m]
IN X: -100000. ... 100000.0
IN Y: -100000. ... [illegible]
IN Z: -100000. ... 100000.0

LF 1 : --- 200x

VERZERRUNG
IN X: 1.00
IN Y: 1.00
IN Z: 1.00

ANZAHL DER KNOTEN : 28
ANZAHL DER STÄBE : 53
ANZAHL DER AUFLAGER : 2

PROJEKT: TURKMEN
PROJEKT-NAME: TURKMEN
POSITION: TRUSS1
POSITION-NAME: TRUSS1

Lastfall: 1 200-fach
Total loaded

Programm RSTAB 4.61
(C) by ING.-SOFTWARE DLUBAL GMBH

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Stadlauer Str. 54 Wien

BLATT:
SEITE:

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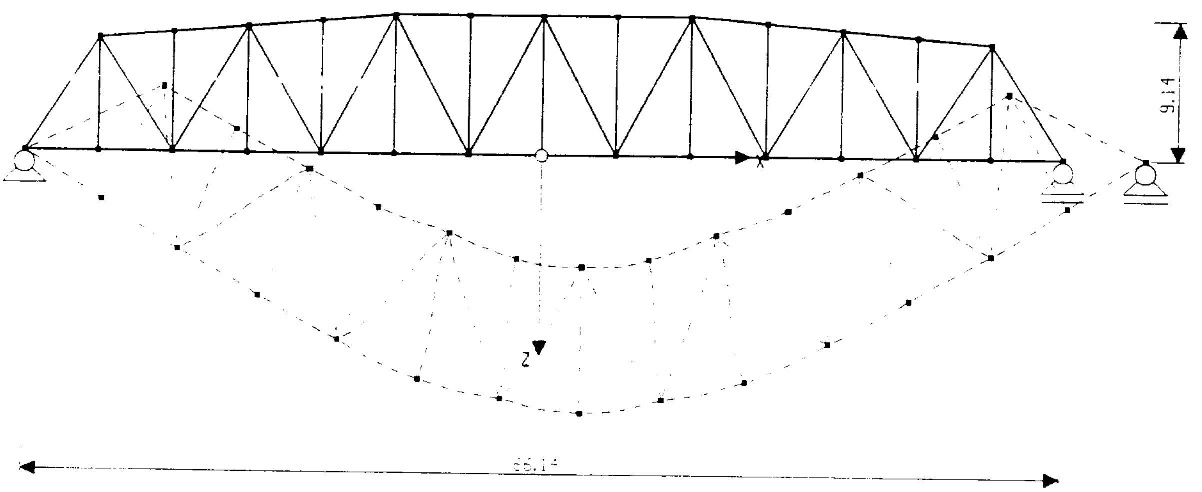
VERFORMUNGEN - TRUSS1 - LF 2

IN Y-RICHTUNG



DEFLECTION
CENTRIC UNIT LOAD 100 kN/m

Max = 86.046 mm

4.89 m

STÄBE: [illegible]

LF/LG/LK 200*2 [illegible] 01

WINKEL:
ALPHA: [illegible]
BETA : 42.0
GAMMA: 0.0

DARGESTELLTER BEREICH [m]
IN X: -100000. ... 100000.0
IN Y: -100000. ... [illegible]
IN Z: -100000. ... 100000.0

LF 2 : --- 200x

VERZERRUNG
IN X: 1.00
IN Y: 1.00
IN Z: 1.00

ANZAHL DER KNOTEN : 28
ANZAHL DER STÄBE : 53
ANZAHL DER AUFLAGER : 2

PROJEKT:
TURKMEN

POSITION:
TRUSS1

Lastfall: 2 200-fach
Centric loaded

PROJEKT-NAME:
TURKMEN

POSITION-NAME:
TRUSS1

Programm
RSTAB 4.61
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DLUBAL GMBH

Waagner-Biró AG.
Stadlauer Str. 54 Wien

BLATT:
SEITE:

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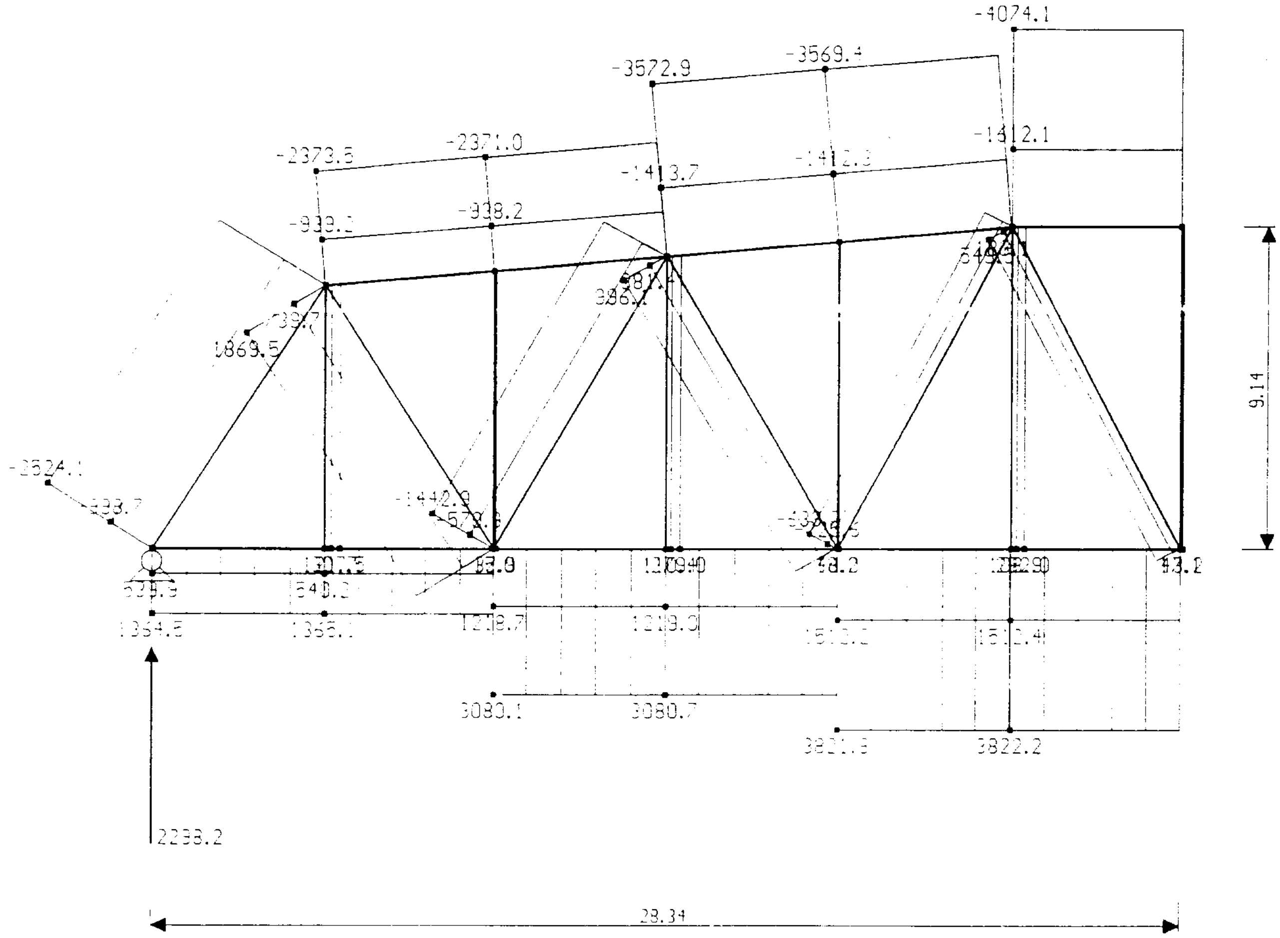
SCHNITTGROSSEN - TRUSS1 - LK 304

N

IN Y-RICHTUNG



LOAD COMBINATION 304

MAX/MIN NORMAL FORCES

1547.27 kN

Max = 3822.24, Min = -4074.11 kN

2.11 m

STÄBE:
31.8 /03

WINKEL:
ALPHA: [illegible]
BETA : 42.0
GAMMA: 0.0

DARGESTELLTER BEREICH [m]
IN X: -100000. ... 100000.0
IN Y: -100000. ... 100000.0
IN Z: -100000. ... 100000.0

VERZERRUNG
IN X: 1.00
IN Y: 1.00
IN Z: 1.00

ANZAHL DER KNOTEN : 28
ANZAHL DER STÄBE : 53
ANZAHL DER AUFLAGER : 2

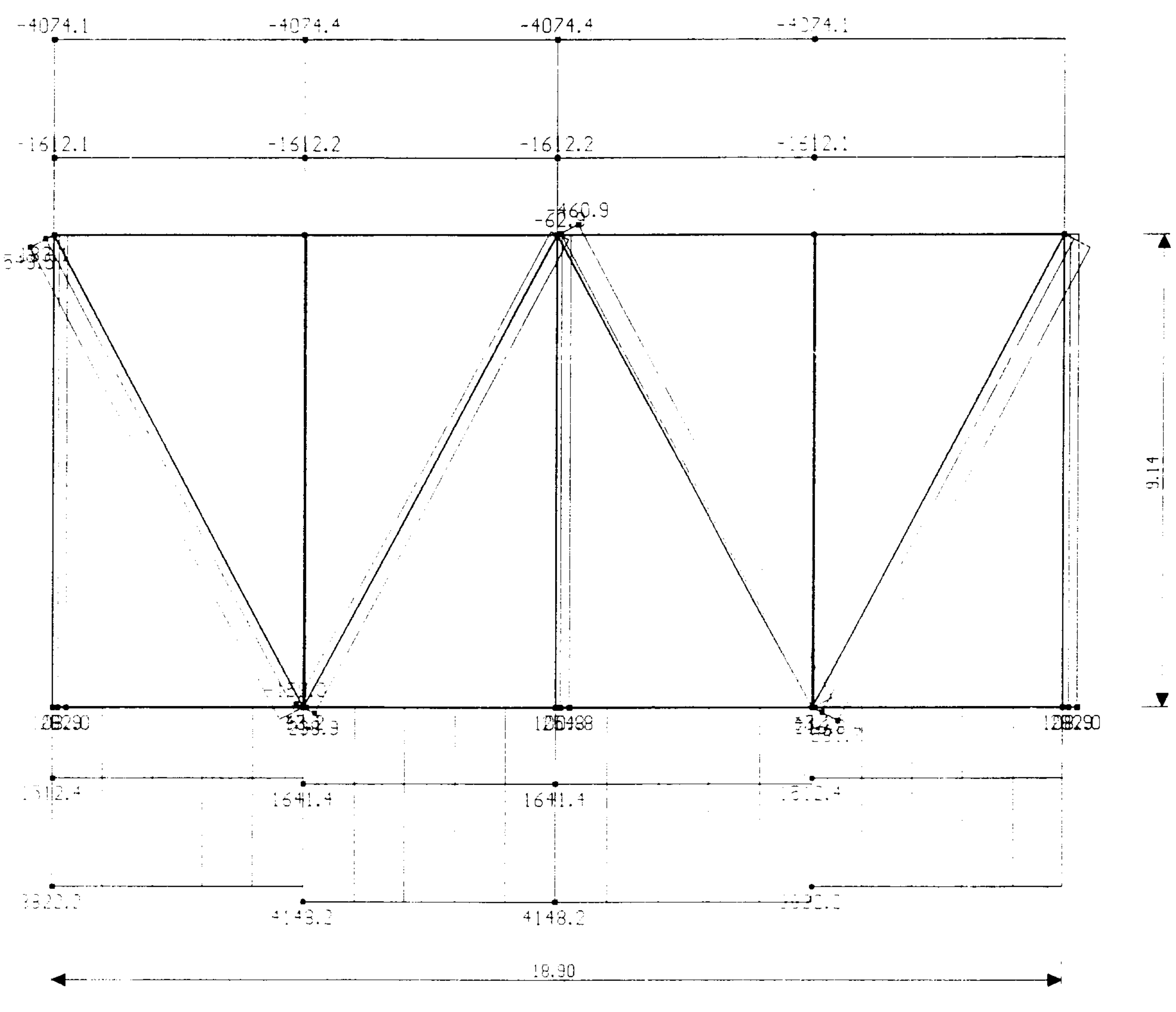
PROJEKT: TURKMEN	PROJEKT-NAME: TURKMEN
POSITION: TRUSS1	POSITION-NAME: TRUSS1
LF-KOMBINATION: 304 Max min combination	Programm RSTAB 4.61
Normalkräfte N Max N = 3822.24, Min N = -4074.11 kN	(C) by ING.-SOFTWARE DLUBAL GMBH
Waagner-Biró AG. Stadlauer Str. 54 Wien	BLATT: SEITE:

c/61

SCHNITTGROSSEN - TRUSS1 - LK 304

N

IN Y-RICHTUNG



1467.33 kN

Max = 4148.25, Min = -4074.42 kN

1.34 m

STÄBE:
1..53

WINKEL:
ALPHA: 0.0
BETA: 40.0
GAMMA: 0.0

DARGESTELLTER BEREICH [m]
IN X: -100000. ... 100000.0
IN Y: -100000. ... 100000.0
IN Z: -100000. ... 100000.0

VERZERRUNG
IN X: 1.00
IN Y: 1.00
IN Z: 1.00

ANZAHL DER KNOTEN : 28
ANZAHL DER STÄBE : 53
ANZAHL DER AUFLAGER : 2

PROJEKT:
TURKMEN
POSITION:
TRUSS1

PROJEKT-NAME:
TURKMEN
POSITION-NAME:
TRUSS1

LF-KOMBINATION: 304
Max/min combination

Normalkräfte N
Max N = 4148.25, Min N = -4074.42 kN

Programm
RSTAB 4.61
(C) by
ING.-SOFTWARE
DLUBAL GMBH

Waagner-Biró AG.
Stadlauer Str. 54 Wien

BLATT:
SEITE:

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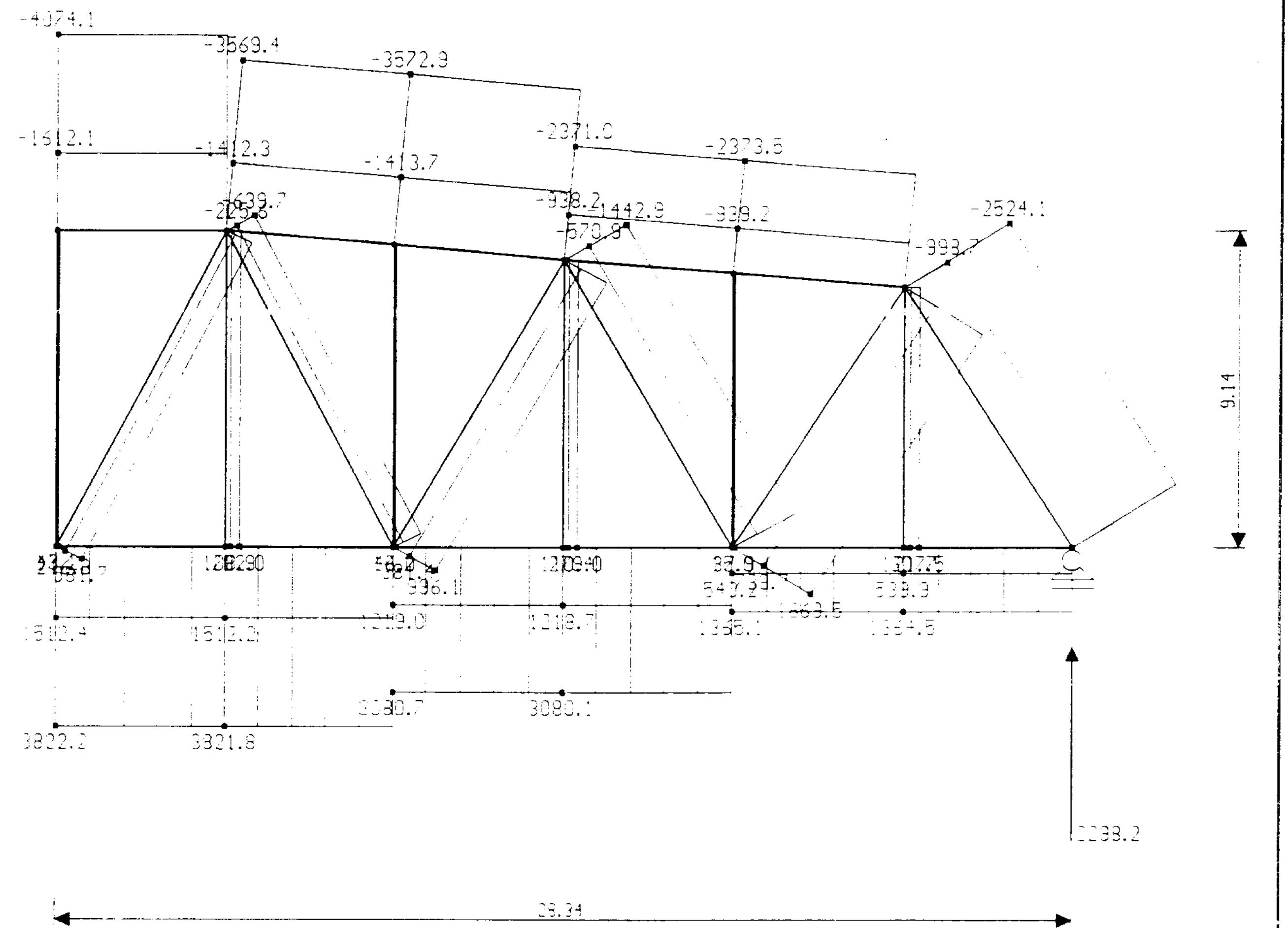
SCHNITTGROSSEN - TRUSS1 - LK 304

N

IN Y-RICHTUNG



1544.39 kN

Max = 3822.24, Min = -4074.11 kN

2.11 m

STÄBE:
1-31,3 /03

WINKEL:		DARGESTELLTER BEREICH [m]	
ALPHA:	0.0	IN X: -100000. ... 100000.0	
BETA:	42.0	IN Y: -100000. ... 100000.0	
GAMMA:	0.0	IN Z: -100000. ... 100000.0	
VERZERRUNG			
IN X:	1.00	ANZAHL DER KNOTEN:	26
IN Y:	1.00	ANZAHL DER STÄBE:	53
IN Z:	1.00	ANZAHL DER AUFLAGER:	2

PROJEKT: TURKMEN	PROJEKT-NAME: TURKMEN
POSITION: TRUSS1	POSITION-NAME: TRUSS1
LF-KOMBINATION: 304 Max/min combination	Programm RSTAB 4.61 (C) by ING.-SOFTWARE DLUBAL GMBH
Normalkräfte N Max N = 3822.24, Min N = -4074.11 kN	
Waagner-Biró AG. Stadlauer Str. 54 Wien	BLATT: SEITE:

6. CHECK RESULT

6.1 DEFLECTION

As documented in the inspection report paragr. 3.3 „Proof load Measurement" the deflections of the real structure are:

deflection mm	calculated	measured	%
centric load (2 locomotives)	36	28	78%
total load (4 locomotives)	48	38	79%

It is normal that measured deflection are less than calculated due to extra stiffness (gusset plates, bracings, action of cross + longitudinal girders acting with main girders).

In the reverse case this would be an alarming sign.

6.2 FATIGUE CHECK

It is assumed that the load applied (2 and 4 locomotives) is a characteristic load for fatigue check.
Due to rail and track discontinuities an impact factor of $\varphi = 1{,}40$ is applied which is very unfavourable and therefor is on the safe side.

Under these assumptions the fatigue check results as follows.

lower chord H 6-7-8 $A = 419\ cm^2$ (page C/9)

page C/35 Stab Nr. 7:

$F_{max} = 4148{,}25 \cdot 1{,}40 = 5808\ kN \quad \sigma = 139\ N/mm^2$

$F_{min} = 1641{,}39 \cdot 1{,}40 = 2298 \quad \sigma = 55$

$\Delta\sigma = 84\ N/mm^2$

due to tension: hole deduction estimated 20% $\Delta\sigma_{net} = \frac{84}{0{,}8} = 105\ N/mm^2$

EUROCODE 3: riveted structure eventually with fishplates → det. categ.: 112 > 105 upper chord B 6'-7'-8' $A = 424\ cm^2$ (page C/7)

page C/39 Stab Nr. 19

$F_{max} = -1612{,}06 \cdot 1{,}40 = -2257\ kN$ $\sigma = -53\ N/mm^2$

$F_{min} = -4074{,}11 \cdot 1{,}40 = -5704\ kN$ $\sigma = -135$

no netto-deduction $\Delta\sigma = 82\ N/mm^2$

EUROCODE 3: detail category 112 > 82

diagonal P1'-2 $A = 191\ cm^2$ (page C/10)

page C/42 Stab Nr. 28

$F_{max} = 1869{,}48 \cdot 1{,}40 = 2617\ kN$ $\sigma = 137\ N/mm^2$

$F_{min} = 739{,}72 \cdot 1{,}40 = 1036\ kN$ $\sigma = 54$

$\Delta\sigma = 83\ N/mm^2$

EUROCODE 3: detail category 112 > 83

Vertical CT $A = 64\ cm^2$ (page C/12)

Axle load = $23^t \hat{=} 230\ kN$ page C/48 Stab Nr. 45

Force on vertical $F_{max} = 282{,}01 \cdot 1{,}60 = 451\ kN$

Dynamic factor $\cong 1{,}60$ $F_{min} = 108{,}86 \cdot 1{,}60 = 174$

(Austrian standard)

$\sigma_{max} = 70\ N/mm^2$

$\sigma_{min} = 27$

$\Delta\sigma = 43\ N/mm^2$

hole deduction 20 % $\Delta\sigma_{net} = \frac{43}{0{,}8} = 54\ N/mm^2$

EUROCODE 3 detail category: 112 > 54

WARNING: If welding is applied (also if correctly executed, with smooth

transitions, no start-stop-positions,
correctly tested:
detail category can go down to

det. cat. = 100 for force-parallel throat welds
det. cat. = 80 for force-perpendic. throat welds
det. cat. = 50 for short welds,

assumed that the material is qualified for welding.

Danger of cracks exists if welding is executed on bad material, with no smooth transitions, sharp endings, etc.

Annex D

TRACECA - MODULE C CHARDZHEV BRIDGE

ANNEX D
SUMMARY OF FORMER INSPECTIONS

containing pages D/1 to D/4, pier drawings D/5 to D/8, part D-1, part D-2

SUMMARY OF STEEL QUALITY ASSESSMENT of bridge elements (as described in PART D-2 following):

Chemical analysis of the metal samples as described in chapter 2.6.1 (Most 51):

Carbon	Manganese	Silicon	Phosphorus	Sulphur
C	Mn	Si	P	S
0,051 - 0,13 %	0,33 - 0,54 %	0,0 - 0,05 %	0,058 - 0,12 %	0,051 -0,062 %

Comparison with steel quality Fe 360 = S235JO as defined in European Standard EN 10025 and EN 10027:

Carbon	Manganese	Silicon	Phosphorus	Sulphur	Nitrogene
C	Mn	Si	P	S	N
≤ 0.170	≤ 1,400	---	≤ 0,040	≤ 0,040	≤ 0,009

As there are no more elements checked a simplified Carbon-Equivalent (CEQ) is calculated:
CEQ = C + Mn/6 = (0,051 ... 0,13) + (0,33 ... 0,54)/6 = 0,106 ... 0,220
which were sufficient low values but the contents of Phosphorus and Sulphur are crucial as they indicate that the material is difficult to weld (less toughness, tendency of segregation, embrittlement). Contents of P and S should not be more than 0,045 % respective.

Mechanical characteristics of the samples (see table Most 119 on following page):

Values of yield stress, ultimate stress and strain show that the material are similar to steel quality Fe 360 = S235JO as defined in European Standard EN 10025 and EN 10027.
Only few values are below that standard:

sample 7.1	yield stress = 213,9 N/mm^2,	which is below 225 N/mm^2
sample 8.2	yield stress = 222,8 N/mm^2,	which is below 225 N/mm^2
sample 3.1	strain = 14,3 %,	which is below 25%.

In Most58 (see page 11 in D-2) an allowable stress is calculated assuming normal distribution:
$R' = m\sigma_t - 3.\sigma_s = 271{,}5 - 3.32{,}47 = 174$ N/mm^2 (based on 0,14 % fractile).

Calculating according to DIN or similar standards a characteristic value of $R_k = m\sigma_t - 1{,}645.\sigma_s$ is assumed (which is equivalent to 5 % fractile).
Therefor $R_k = 271{,}5 - 1{,}645.32{,}47 = 218{,}1$ N/mm^2.
The allowable stress is then derived to be R_k/safety factor = 218.1 / 1,4 = 156 N/mm^2.
This value is less than the above calculated to 174 N/mm^2. That fact indicates that the standard deviation of the material characteristics is higher than for normal steel according to DIN or European standards. Some caution is also based on this fact.

The following summary gives an overview which defects are detected in various spans if described in the inspection report.

MAIN GIRDER AND BRACING from tables 2.1, 2.2, 2.3

	TYPE OF DEFECT						
	RIVET				CRACK	DEFORMATION	
SPAN No.	loose	deformed	missing	replaced by bolt		main element	bracing element
1	2	1		12			
2	1			13			1
3	2			10		1	
4	2			14			
5	1			15			
6	4			17			1
7	1			22		2	4
8	3			11			
9	2			13			
10	5	7		12			
11	3	2		13			
12	2	4	1	18			
13	3	2		20			
14	4	2		15			
15	2	3		11			
16	5		1	8			
17	3		1	10			
18	4	2		20			
19	2		1	19			
20	4	11		22			1
21	8			22			
22	3	1		26			
23	19			25			
24	1	1		20			
25	9	2		15			

CROSS BEAMS AND LONGITUDINAL BEAMS, FISHPLATES AND GUSSET PLATES "B" TO "P" from tables 2.4. 2.5. 2.6. 2.7. 2.8

	TYPE OF DEFECT						
	RIVET				CRACK		STRENGTH.
SPAN No.	loose	deformed	missing	replaced by bolt	number	length mm	(ST) and No. of bolts
1		1		56	2	30	ST, 11
2				38			
3				8			ST, 9
4				115			ST, 5
5				34			
6				34			
7		1		34			
8				19	1	NV	ST, 5
9	1			56	2	NV	ST, 20
10				37			
11	3			38	1	NV	
12		1	1	60	1	NV	ST, 5
13				39	1	70	ST, 5
14				474	1	NV	
15				6			
16				15			
17	2			7	1	NV	
18				2	3	NV	
					5	20 to 60	
19	3			8			
20			1	6	1	NV	
21		1		31	2	NV	
					1	20	
					FP 3		
22	1			29			
23	6		3	46	FP 1		
24	1		2	51			
25	1	1	1	53	1	NV	
					FP 1		

NV ...
not visible due to overlapping by angle iron or fishplate

FP ...
cracks in fishplates

MOST119.PCX

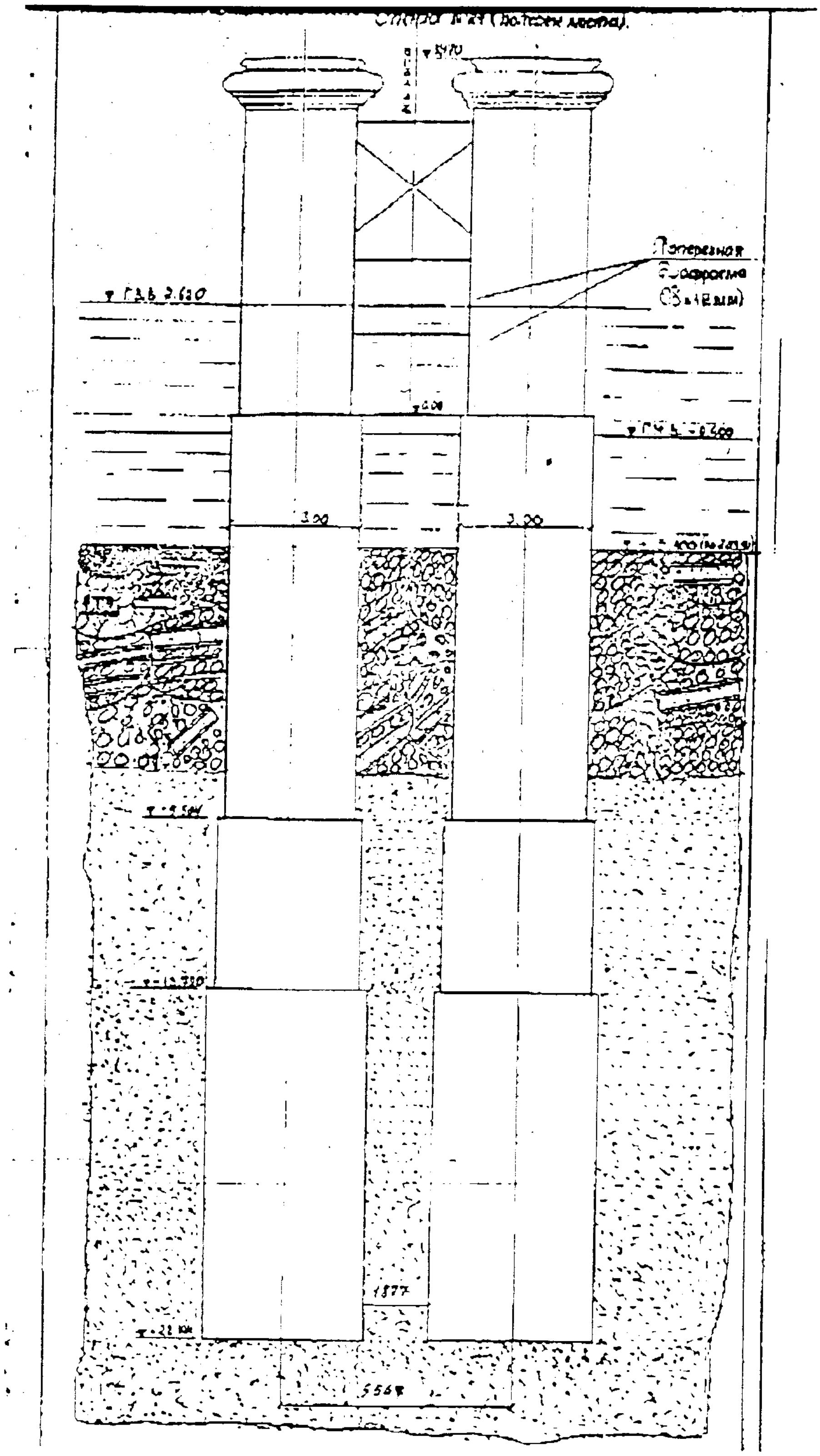
Таблица

МЕХАНИЧЕСКИЕ ХАРАКТЕРИСТИКИ ПРОБ МЕТАЛЛА

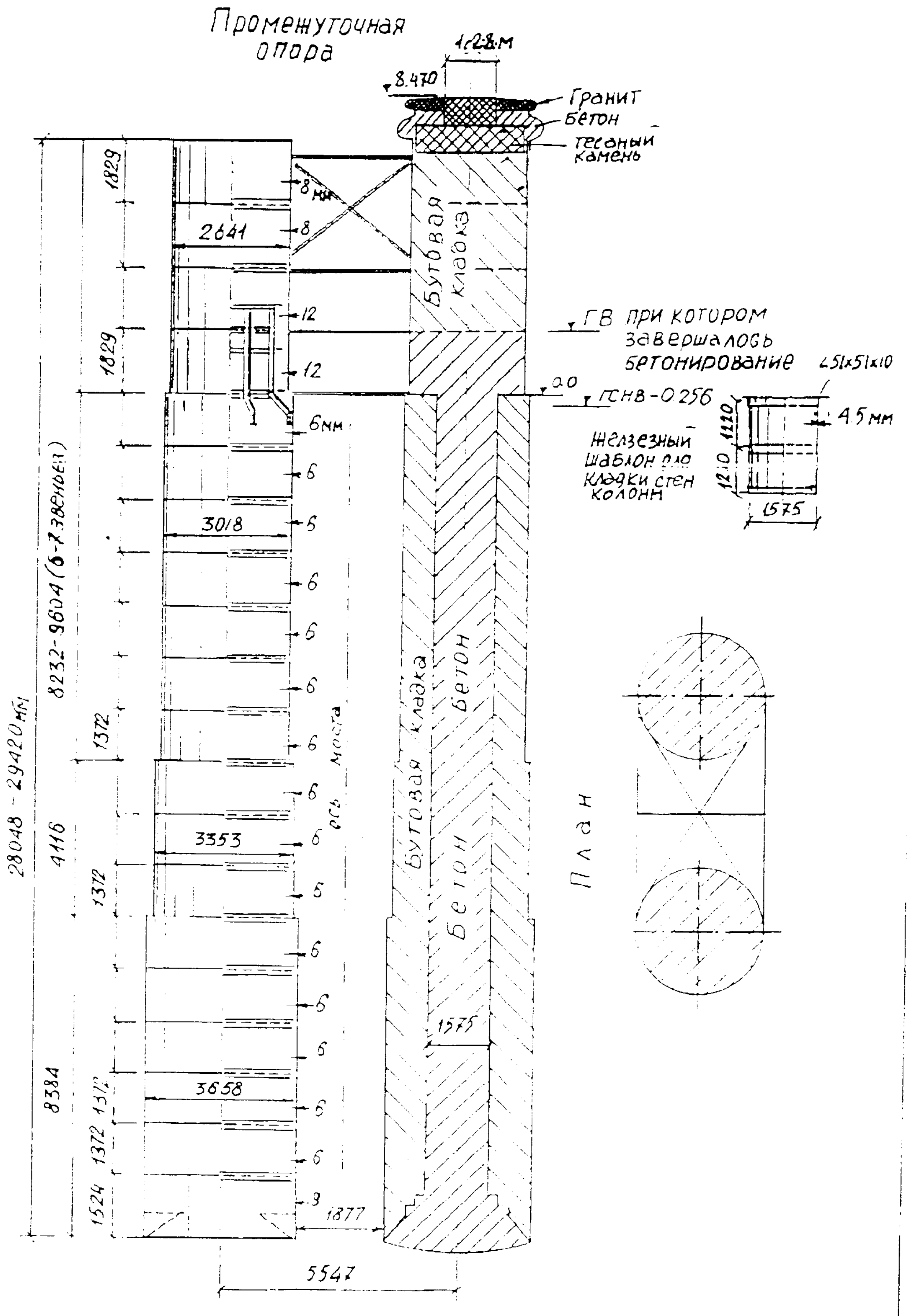
# ПС	ЭЛЕ-МЕНТ	МЕСТО ВЫРЕЗКИ	## ОБРАЗ.	σ тек. кг/$см^2$	σ вр. кг/$см^2$	δ %	М.О σ тек СКО σ тек	М.О σ вр СКО σ вр
1	2	3	4	5	6	7	8	9
2	0-1`	ВЕРХНИЙ УГОЛОК ВНЕШНЕЙ ВЕТВИ У НИЖН. УЗЛА	1.1 1.2 1.3 1.4 1.5 1.6	2603 2546 2490 2370 2688 2546	4188 4131 4131 3890 4138 4067	33.3	254.05 ——— 10.709	409.08 ——— 10.564
2	1-2	лист диаф-рагмы	2.1 2.2 2.3 2.4 2.5 2.6 2.7	2989 3059 3183 3006 3077 3042 ****	4131 4067 4279 4191 4155 4050 4208	30.3 32.0 30.3 30.7 35.0	305.93 ——— 6.884	415.83 ——— 8.739
2	1`-2	УГОЛОК —||—	3.1 3.2	**** 2882	3997 4244	14.3 31.3	288.20 ******	412.05 17.465
2	2-3`	УГОЛОК —||—	4.1 4.2	**** ****	3784 3890	31.0 28.3	****** ******	383.7 7.495
2	3`-4	УГОЛОК —||—	5.1 5.2 5.3	**** **** ****	3537 3890 3431	35.0 40.0 40.0	****** ******	361.93 ——— 24.032
2	4-5`	УГОЛОК ВНУТР. ВЕТВИ	6.1 6.2 6.3 6.4	2971 2988 2794 2829	4545 4686 4421 4562	33.0 31.0 32.0 26.0	289.55 ——— 9.830	455.35 ——— 10.341
2	5`-6	УГОЛКИ 2 пробы	7.1 7.2 7.3 7.4 7.5 7.6	2139 2476 2653 2440 2370 2405	3678 3855 4173 4138 3802 3855	39.3 34.3 31.7 35.0 40.3 34.3	242.28 ——— 14.970	391.68 ——— 19.617
2	6-7`	УГОЛОК —||—	8.1 8.2	2370 2228	3926 3608	32.0 32.0	229.90 10.040	376.70 22.486
2	1-1`	УГОЛОК —||—	9.1 9.2	2653 3006	3890 4368	36.7 30.0	282.95 24.961	412.90 33.800

D/5

MOST200.PCX



D/6



Промежуточная опора
1.28 м
8.470
Гранит
бетон
тесаный камень
1829
8 мм
8
2641
Бутовая кладка
12
ГВ при котором завершалось бетонирование
1829
12
0.0
ГСНВ -0.256
∠51x51x10
6 мм
4.5 мм
железный шаблон для кладки стен колонн
1120
1210
1575
8232-9604 (6-7 звеньев)
3018
28048 - 29420 мм
1372
Бетон
Бутовая кладка
ось моста
4116
3353
Бетон
План
1372
1575
8384
3658
1372
1372
1524
3
1877
5547

Рис. 1.16

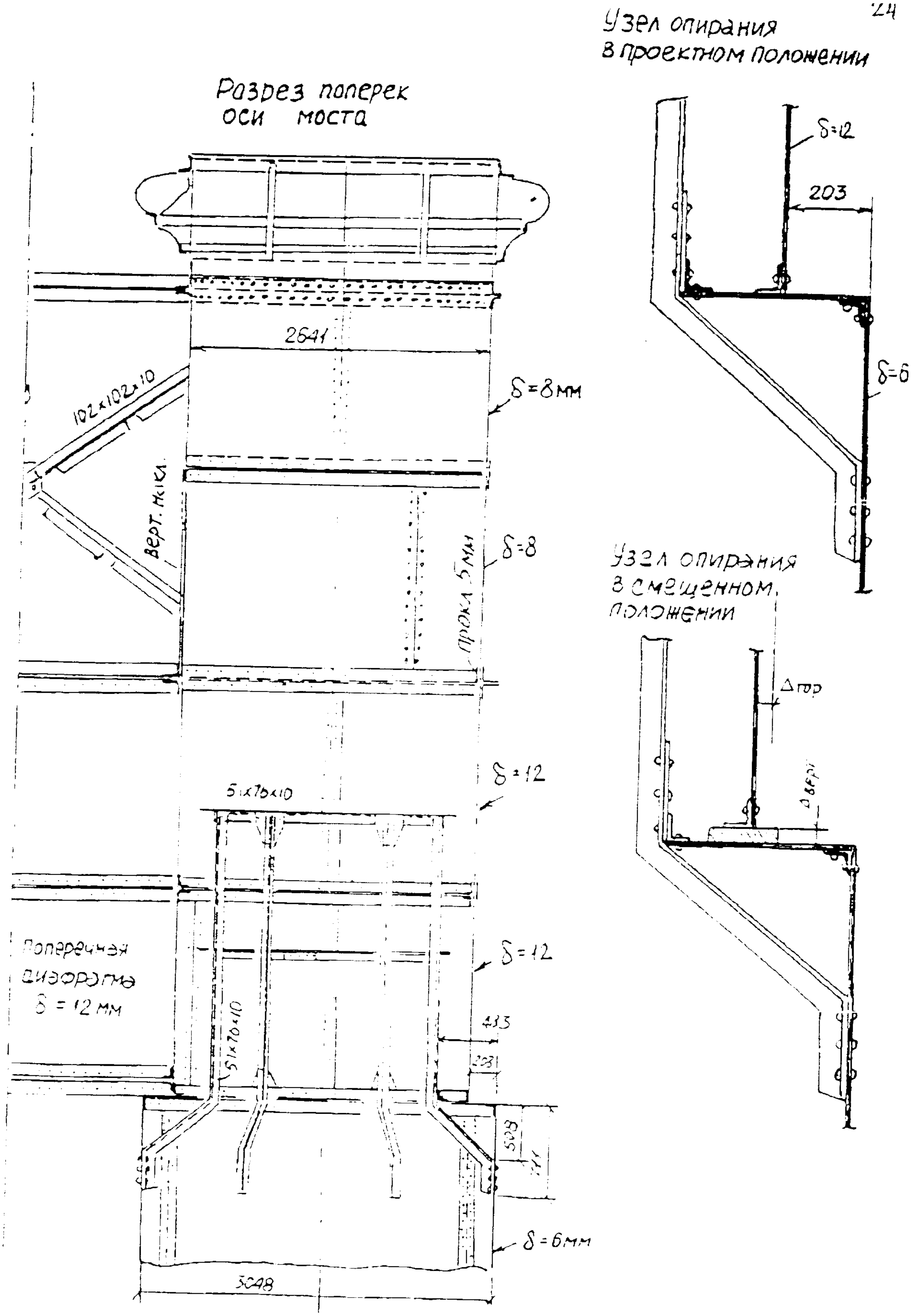

Узел опирания
в проектном положении
Разрез поперек
оси моста
δ=12
203
2641
δ=8мм
102х102х10
верт. н.кл.
δ=8
прокл 5мм
δ=6
Узел опирания
в смещенном
положении
Δгор
Δверт
δ=12
51х76х10
Поперечная
диафрагма
δ = 12 мм
δ=12
51х76х10
433
203
508
δ=6мм
3048

Рис. 1.17

Конструкция устоя

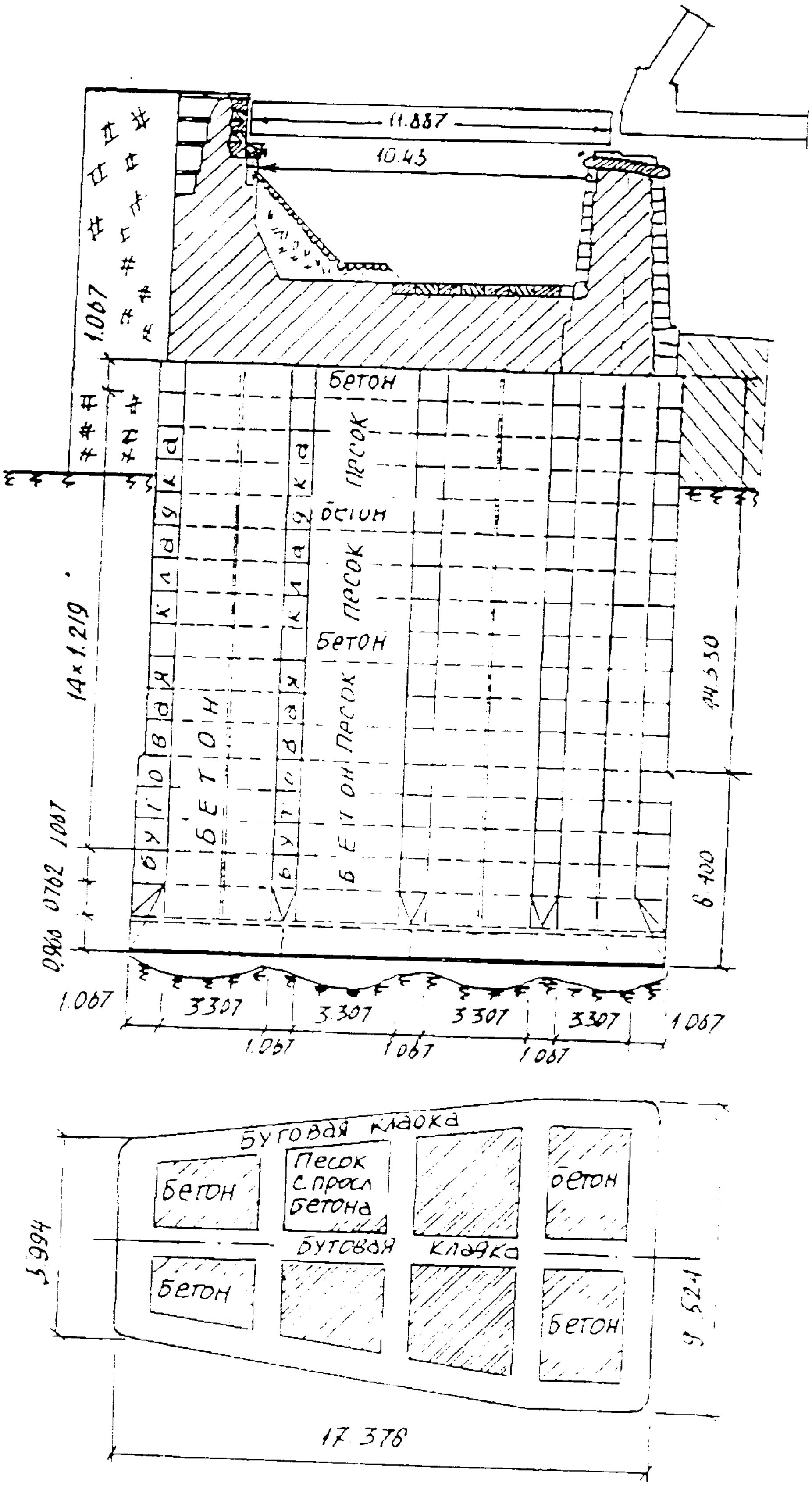


Рис. 1.20

PART D-1

REPORT OF LOCAL EXPERTS (FIRST PART)

containing pages 1 to 45 (including tables)

1. GENERAL DATA

1.1.TECHNICAL CHARACTERISTIC OF THE BRIDGE

The bridge is located on direct one-track horizontal section of the railway. The bridge openning is blocked by 27 span structures under chain 11.58 + 25x66. 14 + 11.58. The bridge was constructed in period from 1898 on 1901 Designing of the bridge was conducted since March 1895 according to norms of 1896. The engineer of ways of communication Ol'shevsky S.I controlled the construction. Span structures had been made on Bryansk factories. The current of the river in place of bridge of crossing from the right to the left if to look on course of the account of span structures. Supports. span structures and their elements are numbered against course of the account of kilometers. that is from the side of Chardzhou.

1.1.1. DESIGN OF SPAN STRUCTURES.

Span structures № 0 and № 26.

Coastal span structures of a beam type. with two continuous beams with top driving (Bнc.1.1: 1.2) are designed according to the norms of 1896 Calculated length 1-1.582 m..(36 ft). Complete length 11.89 m.. Distance between axes of beams 11.828 m. (6 ft). Height of a wall of a beam 1.52 m.. The wall along the length of a span is made of six sheets. connected by fishplates. Thickness of a wall - 9.5 mm. In near-support sections the top and bottoms chords of beams consist of angle irons 4 " x 4 " x 7/16 " (102x102x11.) and sheet 102x11. In sections located closer to middle of a span. from above and is from below added on one additional horizontal sheet 102x11. Vertical angle irons are the edges of rigidity. divide a beam on 15 sections. The beams in level of chords are connected by ties from angle irons. forming in the plan cross-shaped cross ties. There are also available cross-shaped cross ties. A material of span structures is metal (iron). A diameter of rivets - 22 mm.

Basic parts are flat. each consisting of two plates: top and bottom. The bottom plate from above has a deepening - a bed. which does not permit the top plate to be moved in cross direction. In its turn a bed of the top plate covers a chord of a main beam span structures.

Span structures Nr. 1 - № 25.

Channel span structures with bottom driving. with through trusses by effective span of 66.142 m. (217 ft). are designed according to the norms of 1896 of an Outline of the top chords of trusses is broken with effective heights of 7.874 m. - in section of first unit and 9,398 m. in sections at middle units. A lattice ie triangular with racks and hangers. Quantity of panels - 14 on 4,724 m. each. A material of span structures is metal (iron). All elements of span structures are riveted of rolling grade of metal. Tere are used both equal-side angle irons (3 " x 3 " x 3 " /8; 3"1/2 x 3 " 1/2 x 3 " /8; 4 " x 4 " x7 " /16), and different side angle irons 5 " x 3 " 1/2 x 1 " /2; 6" X 4 " * x 1H/2; 6" x 4 " x 7 /16). Section of elements are enclosed. In attachments of angle braces B1 - 2, B2 - 3 "; B3'- 4 and B5 " - 6 to chords rivets the diameter of 23.8 mm are delivered. (15 " /16). Rivets by a diameter of 22,2 mm. (7 " /8) are applied in all main partsB4 - 5 " and B6 7 ". in separate parts of angle braces and in attachment to chords of racks and supports. Rivets by a diameter 19.0 mm. (3 " /4) are used in attachments of elements of a connecting lattice.

Distance between axes of trusses of 5.537 m. (18 ft of 2 inches). The trusses are connected between themselves by longitudinal top and bottom ties, and as by cross ties, located in planes of racks and supports. Section of longitudinal ties in comparison with initial are changed during repair jobs and strengthening in 1955-58 In their structure is entered on one additional angle iron 100 x 75 x 8. In 1980 at average cross beams there were arranged brakes ties (fig.1.5) Thus longitudinal ties joined longitudinal beams through vertical sheet and between themselves they were joined with spacer.

Longitudinal and cross beams are continuous with arrangement of the top chords in one level. Distance between longitudinal beams 1,829 m. (6 of ft). Originally the joint of longitudinal beams had not the bottom fishes. Now, after strengthening, on all span structures (except span structures24 " " 25) there are installed the bottom fishes with tables. On span structure № 25 connections of longitudinal beams have other design. To bottom chords of longitudinal beams on sites of their joint to cross horizontal fishplates on high-strength bolts as with one, and on the other hand are attached. On horizontal fishplates steels cores of round section, missed through an openning in a wall of a cross beam are welded. The longitudinal beams are connected by cross ties - in middle of the panel and longitudinal ties - in level of the top chord. The cross beams are attached to units of main trusses with help of axes. Section of beams of the bridge road are shown on fig. 1.4.The top horizontal sheet at longitudinal beams are installed for strengthening in 1980. The horizontal sheets (two from above and two from below) on cross beams were delivered in 1937 - 1942.

On the half of span structures in 1965 support of a line of power transmission were installed. The support have a design in kind of console trusses with triangular lattice from angle irons with bolt connections . The supports are located on panels 13 14 (1 - 2) on top chords of main trusses.

Basic parts are hinged-balanced. The mobile basic parts are rolling and located from the side of Farab and have six rolls each wuth a diameter of 114 mm and length of 775 mm.

Bridge floor laid on wooden crosspieces. Rails R50. The levelling devices are not present. Bridge the bars by section 240 x 200 are attached to top chords of main and longitudinal beams with help лапчатых of bolts. КонтВуголки by section 160 x 160 x 20, security angle irons 160 x 100 x 16. Over cross beams there are installed transitive tables.

Main footwalk pass along the bridge is arranged on consoles at the upper (right) side of the bridge outside of span structures. A flooring of the pass is wooden. Along the whole length of the bridge on flooring there are stacked rails of a narrow track for moving of the technological carriage. Within the limits of coastal spans the footwalk the span is passed along span structures. each consisting of two continuous beams with broken outline of the bottom chord. Span structure of sidewalk leans on console. one of which is fixed on abutments. other on basic unit Вуслового span to structures m » 1 or T *? 25). The fastening fotwalk of pass to Вусловым span to structures is made in units of main trusses.

On whole length of the bridge there is the pass inside of span structures. This fotwalk pass is located from the low side from rail track (at the left). Plates of reinforced concrete of a pass are stacked on consoles. attached to vertical edges of rigidity of longitudinal beams. There are the refuges. From the right from rail track the space between bridge floor and main trusses is closed by corrugated steel sheets.

Over main fotwalk pass to elements of main trusses on consoles the power cables are attached.

1.1.2. DESIGN OF SUPPORTS OF THE BRIDGE AND INFORMATION ABOUT THEIR STRUCTURE

During designing of the bridge across Amu-Daria extensive prospecting work. reflected in an Album of the excutive drawings (8) were carried out. In this document the historical and geographical information on river to Amudarya in the region of Chardzhou oasis are shown. There are marked fast current of the river, its extremly turbid water. As in Chardzhou region both coasts are low-lying, and valley of the river consists from weak alluvial soils, the outline of coast has strongly changed, and their destruction occured very quickly. Width of the river during researches and construction on the average made 2 - 3 kms.. along the channel there are a lot of sand-banks and islands .

In the [8] there are given maps of the river in region of the bridge crossing at horizon of low water for period of 1888 on 1899 inclusive. Here there are clearly seen formation and erosion of islands and annual changes of channel.

Flood on Amu-Daria during researches and construction occured in June and July, that is connected with melting of glaciers in sources of the river. There was marked also spring flood in April, connected with melting of snow in prehills and долинах. In [8] the diagrams of horizons of water in Amu-Daria with 1886 on 1901 inclusive are shown. The lowest horizons of water were observed from November to April.

In 1887 higher along current from axis of the future bridge the temporary wooden bridge was constructed. Starting with 1888 there began erosion of support of this bridge. For struggle with erosion the bottom of the river was strengthened with stones. Then a work for strenghtening of coast in place bridge of crossing have begun.

During surveys investigation for determination of speeds of current of the river, areas of live section, heaviest charge of water, inclination of the river were lead. The openning of the bridge was nominated equal 11 x 1600 m.. It corresponded to effective average speed of water 2.75 m/sec., at average depth of water under bridge of 4.0 m..

In design materials data on geological structure of soils in place of the bridge crossing are shown. The bottom of the river was composed by powerful layers running ground and black sand, lower there are layers of clays, clays with sand, yellow sand, cemented grey.

All 24 intermediate support of the bridge have practically identical design. The support consists of two columns variable on height of a diameter. Each column is covered with riveted steel plating. The diameter of the bottom part of columns was chosen from condition of effective dipping of columns. at pressure on ground about 0.62 mPa of 2.5 poods per sq. inch). The bottoms parts of columns are supplied knife by a part with round openning by a diameter 1.58 m. For passing of a grab. having a diameter about 1200 mm.

On top part of knife section in accordance with dipping of columns a rubble masonry was erected. and for protection of fresh solution from erosion during the work of a grab. the masonry was protected inside a well by metal sheets by thickness 1.2 mm. For reduction of friction of the plating about ground of the outside there were done hidden head of rivets of knife section . Above knife section the plating of columns has yet five sections of the same diameter with thickness of sheets of 6.3 mm. (1/4 inch). The following three sections of columns have a smaller diameter. that was done for reduction of friction at dipping of columns. Appropriate ring-shaped step 152 mm in width was formed by angle irons 152 x 102 x 13 and 76 x 76 x 10. Above specified three rows there was arranged one more step of angle irons of the same size. In this part of a column from 6 up to 7 sections depending on depth of dipping. The whole section of a underwater part of columns. except knife one have thickness of sheets of 6.3 mm.

Inside both steps of a underwater part of columns are srtrengthened by six arms of curved angle irons.

The top edge of underwater part of columns after dipping exceeded on 0.25 m. horizon of the lowest waters. This part of a column is finished with ring-shaped platform 483 mm of width. And top head of rivets were here arranged as secret. Ring-shapedые of a platform. surrounded from within by curved angle iron 76 x 76 x 10 are strengthened by six arms from angle irons 51 x 76 x 10. The top part of angle irons of arms is continued up to horizon of the highest waters (up to 1/3 height of the second section of a surface part of a support) and is seized on height by two ring-shaped angle irons 51 x 76 x 10.

On underwater part of each column after its dipping. there were freely installed steel riveted section of the plating of a surface part. than before concreting these parts of columns had not been tied to something. It was done for in case of errors at dipping of columns. their surface parts could be installed in exact design position as lengthways. and across axis of the bridge. At erection of a masonry inside plating angle arms were immersed in concrete massif and rubble masonry and provided additional connection between underwater and surface part of a column.

The surface part of each column of intermediate support has a diameter of 2641 mm and consists of four stages with height of 1829 mm each.

For maintenance of necessary rigidity and stability of support, two of the bottom stages of a surface part have the additional plating by thickness 12 mm. Inside plating horizontal and vertical ties from angle irons were installed. Two top circles of columns, having thickness of sheets 8 mm., are also connected by horizontal, vertical and inclined ties. The horizontal and vertical joints of sheets of the plating of a surface part are blocked by outside fishplates of width 165 mm. All vertical seams of the plating place are tied.

On top parts of columns, is above angle irons surrounding top of columns , there were installed riveted metal headbands (cornices) from curved sheet and angle metal 6 mm. thick (fig. 1.17). The design of a cornice and its interface to column permitted to carry out certain adjustment of top of columns on height. The separate parts of a cornice, consisting of eight sections, incorporated to help of internal fishplates on rivets with outside secret головками. The internal part of cornices was filled by concrete. Complete height of a cornice is equal 1250 mm., height of the bottom part, interfacing a cornice to a column, makes 330 mm. An internal part of a cornice is strengthened by ties of six angle irons and curved anchoring strips.

The internal rubble masonry was erected ring-shaped only in underwater part of columns. After end of dipping of each column and installation of the bottom section of the plating of a surface part, concreting internal wellы and surface part of a column up to level was carried out, on which there was the water in river in operating time. A continuous rubble masonry was further erected, which was finished by two spacer rows with thickness of 0.32 m. each. After stacking of spacer rows they installed cornices and filled by concrete the bottoms emptiness between cornices with spacer rows. On spacer rows (through sauce) there were installed granite support stones. Empty space between under-truss stone and top part of a cornice was filled by concrete up to level of a bottom of the top part of a cornice. On this concrete there were installed overflow stones, having inclination of the top sides across axis of the bridge. In plan under-truss stones have two rectilinear sides, parallel an axis of the bridge, and two sides, cut on arch of a circle and contiguous directly to top part of a metal cornice.

The thickness of a stone ring masonry of columns was chosen from condition of immersing of a column on given depth under action of own weight rubble masonries and metal plating.

After shown account in project a conclusion was made, that immersing of a column up to effective depth cannot be provided only by scooping out ground. For immersing of columns on last 4,25 m. it was necessary to resort to artificial downturn of horizon of water inside well about on 5.3 m. with help pumping by the centrifugal pump, to cause a movement of water along outside surface of a column and to reduce friction of the plating about ground.

In design materials there is also given the effective substantiation of depth of immersing of columns of intermediate support, proceeding from minimum possible erosion . The size (effective) of erosion was accepted basing on the results of observations of maximum erosion at one of columns of a pier Nr. 22, which had been noticed in June 10 1900.

For pier # 22 the following parameters were calculated:

Weight of a underwater masonry of a column is 2387.0 kN (14922 poods)

Weight of a surface masonry is 688.0 kN (4302 poods)

Weight of the metal plating - 285.0 kN (1782 pood)

Gross Weight of a column V = of 3361.0 kN (21006 poods).

During pass of the highest waters in 1901 the depth of the basis relatively the bottom was h_1= 5.33 m.. For this case in design materials there was determined factor equal to:

$$m_1 = h_1 / h_2 = 1,91$$

In design materials there is given rather detailed description of manufacture of work for construction of intermediate supports. Their dipping was made from wooden stagings, based on a double piling . The dipping of both columns of one pier was carried out alternately by one excavator. In the beginning of work the dipping of columns was carried out by the steam Kekerill crane. Further on it appeared more conveniently and more safely to work with steam crabs, placed outside of stagings on separate platforms.

For digging out ground when dipping columns there was applied an excavator (two-jaws grab) of the Bull' system manufactured in Pristman factory in England.

When conducting the work the elevating chanes of a grab were some times broken off. that slowed down a course of dipping.

Each column was suspended to stagings with the help of four or six special chains. the regulation of which was carried out by elevating screws. The chains consist of separate demountable parts. length of which was equal to length of the screw.

When dipping of a column they carefully monitored uniform tension of all the chains.

When immersing. columns an excavator made up to 400 rises per day and could return up to 39 m^3 of rocks. The work by an excavator were conducted alternately on two columns. Under normal conditions in a day it was possible to lower both columns up to 1.6 m..

As a ground was excavated from column there was its dipping. and pendant chains stretched. With the help of an elevating screw column was lowered before easing of chains. After each dipping they determined position of a column in plan (with help four plumbs) and its deviation from vertical axis (with help of a level). For correction of columns when dipping they used stone counterbalances. jacks and spacers or regulation of a tension of pendant chains. After dipping of a column on 8 10 m. correction already was not required. The further dipping was carried out without pendant chains.

When the top of a ring masonry of a column reached on 0.4 m. horizon of water. further dipping of a column had been stopped. and excavator was moved for dipping of other column. On first column they put the following part of the steel plating and filled it by ring rubble masonry. which was conducted by 8 Italian masons. From internal side the masonry was limited by iron riveted former. the outside diameter of which was equal to a diameter of a column well. The former was suspended on drafts to runs of stagings at such height. that its bottom always was 1.0 m. below the surface of a ring masonry at the moment of escalating of a new link of the plating. Space from top of a former up to bottom of runs of stagings was covered by roofing iron. that served protection to masons at fulfilment of a ring masonry in operating time of an excavator.

At rise a grab shocked masonry and could destroy it. For protection of a masonry it was protected from within by the plating of sheet iron 1.2 mm thick. At the end of dipping of poles this plating was partially removed and rosen upwards, grasped by excavator. Partially this plating was removed after filling of the well on half of the depth and downturn of water horizon in the well with the help of centrifugal pump. It was done for maintenance of strong tie of a masonry with concrete. At erection of a ring masonry before termination of dipping of columns they used cement solution with ratio of cement. and sand 1:3. In surface part for stone masonry applied a solution with ratio 1:4.

When passing a knife of columns through layers of clays the dipping was much slowed down. In this case they applied a grab with teeth; increased speed of dipping of a grab. previously loosened ground with bit.

At dipping of columns of support ## 13 and 19 when passing f layers of clay they have applied blasting ground with help powder cartridges. Similar work have been carried out at dipping of columns of supports ## 17. 22. 23. 24. with the help of pyroxyline.

In [8] there are given the diagrams of a course of work when dipping piers ## 2 and 20. The columns of a pier # 2 were lowered from November 11 to December 18 1899. column of a pier # 20 from the 6th to 24th of March 1900 .

Simultaneously with dipping of columns separately they carried out assembly and riveting of two bottom parts of a surface part of a pier. After dipping of underwater parts up to necessary marks axial lines of a support were restored and careful measurement of distance up to next support (average effective temperature was accepted as 16 " C). The assembled parts of a surface part were installed on ring platforms of a surface part at first approximately. and then them levelled with help of metal wedges. laid under the bottom shels of the bottom angle irons of a surface part. After dipping of columns up to proper marks wells of columns were filled by concrete. The mix for concrete was prepared separately and in ready form moved to place of work. River grey sand from top part of layers of a ground. lifted by an excavator at dipping of columns was used.The dry mix of cement. and sand relating 1: 4 was mixed with washed out crushed stone and further on moved in so-called concrete mixers. with help of which the concrete was dippen in a well. They applied two kinds of concrete mixers: wooden and rectangular having capacity of 0,3 m^3 with unlockable bottom. and metal overturning ones. The concrete mixers were lowered in well with the help of manual or steam crabs. Unlocking of bottom or overturning of concrete mixers was carried out on given depth automatically with help of a cord. For complete filling of one well it was required 3 days of continuous work.

When constructing piers the following materials were applied. The steels parts of columns for twenty piers were delivered by Bryansk factories. for three piers by a Rudsky&C° factory in Warsaw and for one pier by a Nikopol'-Mariulol factory.

Rubble stone for masonry inside columns was extracted from quarry at Ziadin station in 230 kms. from Chardzhou (towards Samarkand). rock of stone is marble-like limestone. The extraction of stone was carried out by an explosive method. The stone passed test in Mechanical laboratory of Institute of the Engineers of Ways of Communication.

The piece stone for under-trusses and overflows was brought from vicinities of city of Samarkand. The rock of stone is similar to Serdobolsk granite. has large hardness and uniform structure.

The Portland-cement. for rubble and concrete masonry was delivered exclusively by factories of Society of Gluhoozersk factories in Вольске. All parties(sets) of cement. passed tests on rules of Ministry of Ways of the Communication.

The sand for rubble masonries was extracted when removing ground. at dipping of columns of supports.

The abutments of the bridge have a design of a separate type. The top part of abutments leans on common bases. carried out in a kind of so-called cards of caissons. The dipping of caissons of both abutments was carried out with help digging off ground by 8 excavators through eight rectangular well. taking place through ceiling of each caisson.

The internal space of caisson is divided on 8 well with the help of one longitudinal and three cross beams. located above the knife of a caisson on 97 cm . The metal plating of a caisson has thickness 3.2 mm (1/8 of inch) and is strengthened by fishplates.

For dipping of open caissons of the abutments special stagings. consisting of eight double wooden trusses were arranged. After assembly of a caisson it was suspended on 22 chains. attached to the top parts of cross beams and to angular arms of lateral walls. The dipping of a caisson was adjusted by the elevating screw.

Rubble masonry was carried out in space between wells and of them along perimeter of a caisson. They began masonry, when the bottoms edges of ceilings between wells reached water. After certain deepening of caissons in ground further supporting of them on chains was not required, as the dipping proceeded without appreciable deviations from vertical.

In accordance with dipping of caissons, their metal parts were increased; a rubble masonry was erected. Composition of cement solution for masonry had ratio 1:3.

Concreting of wells of open caissons of the abutments was carried out according to the same technology, as for well of piers. The concreting was carried out similtaneously in four wells. Two pairs of extreme wells along axis of the bridge had been concreted up to top, as on them futher on there were erected surface parts of the abutments. Middle wells were filled partially by concrete and partially by sand.

The top part of the abutments consists of two parts: of a supporting wall and pier. Between them a longitudinal wall is arranged, which blocks water flow between pier of the abutments and cone of embankment.

The surface part of the abutments was erected from rubble stone using cement solution with ratio 1:4. From outside side rubble masonry was covered with cut grey granite stone. Seams were pointed with cement, with admixture of dutch soot. The general view of a pier is shown.

On fig. 1.21 the diagram of a structure of intermediate supports and abutments of the bridge across Amu-Daria is shown, where main phases of work are outlined. First columns of a support # 9 were lowered, for that columns of support ## 10, 11, 13 were consistently lowered. Further many columns of support were lowered practically simultaneously the last were lowered in March 1900 - columns of support № № 20 - 24.

1.2. BRIEF INFORMATION ABOUT RESULTS OF PREVIOUS INSPECTIONS OF THE BRIDGE DURING ITS OPERATION

During the whole period of operation the bridge was repeatedly surveyed by various organizations. There are the information, that before Great Patriotic War the bridge was surveyed at least once - in 1928 by Saratov bridge-testing station. It was not possible to find the results of this work.

In post-war period the bridge was surveyed rather regularly. The first of such inspections was lead in 1947 bridge-testing station of Novosibirsk Institute of the Engineers of Railway Transport. The inspection was accompanied by detailed geophysical measurements. There was performed a binding head-bands and under-truss stones of all supports of the bridge in plan and in profile. In the report of NIERT of 1947 the following main damages of span structures and supports were marked:

- Extension of metal in riveted elements of through main trusses;

- Corrosion of elements of the brigge road;

- Curvature of elements of main trusses and connecting lattice;

- Weak top longitudinal ties between main trusses;

- Corrosion of ties between poles of supports in the level of change of horizon of water (reduction of thickness of shelves of separate angle irons of ties up to 60 %).

In 1951 Saratov bridge-testing station has noted the following damages:

- Corrosion of the plating of support: thickness of the plating is δ = 12.7 mm. in some separate sites it has decreased as an average on 3 - 4 mm.;

- Rusting of metal in cracks between separate parts of sections of elements of main trusses in consequence of a large step between binding rivets. but also in attachments of connecting lattice;

- Failures in maintenance of bridge-floor ;

- Frustration of rivets in attachment of longitudinal beams to cross beams.

In 1952 Bridge-investigating Diving Station of the CP MPS has carried out inspection of underwater and surface parts of the bridge supports. In appropriate report it was marked. that the waterway of the river is not constant. in current 8 - 10 years it keeps moving from one coast to other. In 1937 the waterway was at right coast. in 1942 - 45 years - at left-hand. During inspection a waterway passed at the middle of the river.

During underwater inspection support № № 14, 15, 16, 17, 22, 23, 24 were examined. Were revealed leaky tighted rivets in joint fishplates of the plating. It was marked, that rusting of underwater part of support has a kind of sinders, separated by plates 3 4 mm thick. Oxidation occurs mainly in fodder part of columns, where there is the least speed of current of water.

Breaks bridge covers, but also weak rivets in underwater part of support is found out was not.

At inspection of a surface part of support there was carried out knocking of metal covers with sledge hammer. Thus backlog of cover from masonry was found out in 253 places. Maximum backlog by the area of 6,5 mm are revealed on support #24. Was made 14 notches in covers of supports ## 9, and, 13, 16 and 23. The notches were done in all four stages of a surface part of columns in places of backlog of the cover from masonry, in places of occurrence rusty spots and through holes. Opening of columns has shown, that in places leaky пВилегания the backlash reaches 5 mm. It was also revealed, that in first stage of an over-foundation part of masonry is not concrete, but rubble with cement a solution. * Rubble stone of the masonry is marble-like lime-stone of satisfactory durability. Cement solution was crumbling at average impact of a hammer. The masonry was in satisfactory condition, though there were the emptiness of volume up to 2000 cm^3, and a diprod penetrated into emptiness on depth up to 43 cm.

In conclusion upon the results of inspection the Diving Station has given the following recommendations:

- To cut out the plating in zones of emptiness and to clean dust were available;

- To fill with plastic concrete emptiness in rubble masonry;

- To deliver on place of notches metal fishplates on welded seams;

- To paint a surface part of support not less often than once in five years;

- To monitor condition of under-truss platforms;

- To carry out injection of cement solution in emptiness of a masonry;

- To replace all rusty bottom ties between columns.

In 1952 under the orders of MPS there was lead inspection of hydro-geological conditions in place of the bridge crossing. In materials of inspection there is specified, that a zone of possible wandering of channel is about 3 times more than size of an openning of the bridge. Therefore the struggle against opportunity of bypass of the bridge by the river began at once after end of construction.

In materials under review the brief geological characteristic of the region of the crossing is given. Is specified, that долина of the river is formed by alluvial deposits, underlaid by hard tertiary rocks. The hard rocks are exposed on surface only on right side and they are almost not being erosed. On left-hand coast the exposure of hard rocks is is absent. The tertiary deposits are presented by dense sandy clays, and bycemented grey and yellow sands.

In data of 1952 on the regime of the river high rigidity of water in view of presence of sulfuric anhydride and sodium chlorine is marked. The charge of water in 1950 made 2225 5196 m^3 /sec. The process of erosion is as an average compensated by silting of ground.

On same data, maximum erosion under bridge was observed in 1919 at support № 19. The whirlpool with a diameter about 200 m. with centre in support # 19 for one night erosed to depth of 22.4 m., thus only 0.76 m remained up to mark of a support bottom.. In result of erosion the upper column of support # 19 has given a setting of 53 mm and roll of 77 mm. On the under-toss platform the horizontal deviation reached 336 mm. The lower column has received the same roll, but there was not any setting. The movement of trains had been interrupted, the liquidation of erosion was conducted during three days by a continuous load of rubble stone in a volume of 1850 m^3.

The practice of water of struggle during first 50 years of operation has established a compulsory load at eroded supports, when their deepening in ground becomes less than 11.0 meters. The dipping of gabions will be carried out directly from the bridge, as a rule, up to level of lowest waters and is higher on. It was marked, that during 50 years there had been poured a huge amount of a stone, the large part of which is broaught away by flow and is not saved.

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* During construction the concreting of a underwater part of columns was carried out up to level, on which there was the water in river in operating time (see section 1.1 of the present report).

In conclusions on given materials there is specified, that the openning of the bridge does not work on 40 % and can be reduced, and influence of this reduction owes be appreciated experimentally. It is recommended to continue designing and construction of regulating structures and dams for protection of Chardzhou. There also was made as a conclusion that it would be expedient to construct the bridge of the second track at the top side from existing one.

In 1953 Transmostproekt has developed the detailed design for capital reconstruction of crossing bridge across Amu-Daria. In this connection they carried out at support # 11 and 19 drilling by means of a hand- power percussion-rotary complete set with purpose to reveal presence of a rock fill at support. All 12 bore holes (6 for each support) have shown presence of a stone at the depth of 10 meters from the edge of foundation parts of support, that has confirmed preservation rock fills.

In the same 1953 Bridge Design Bureau of CP MPS has developed the detailed design on repair and strengthening of the bridge across Amu-Daria. In appropriate materials there are the results of geodetic surveys of the span structure # 11, building rise at which was 50 mm. for right truss, and 63 mm for left-hand one.

In same design order of the Bridge Design Bureau the data on turning loads H and modes of operation of the bridge had shown, that starting with 1952 traffic along the bridge has sharply increased. In 1953 ther was introduced a load from 2 oil engin locomotives and cars and pressure intensity 7.2 tc/m. In that time there also circulated trains with steam locomotives of the CO serie.

In 1959 the bridge was surveyed by Moscow Bridge-Testing Station of CP MPS. In appropriate report there was indicated that up to the moment there had been conducted strengthening of spacers of a connecting lattice with the help of angle irons..strengthening of a connecting lattice of the top chords also with the help of angle irons, strengthening of the top longitudinal ties between trusses, reconstruction of portals. It was marked, that to the moment of inspection (1959) repair and painting of all the supports had been completed. The repair consisted of cementation of separate support, repair of cross ties of supports and installation inspection traps between separate poles of supports. In report the recommendation is given to remove rail levelling devices, installed at every other span.

In 1966 the LJBK of MIIT experts surveyed and partially tested span structure of the bridge. In data about history of the bridge (report of MIIT of 1966) there was specified, that to that time span structures had been stregthen 3 times. In 1937 -

1942 cross beams were strengthened by addition of two horizontal sheets. voterens were replaced for bridge bars. In 1955 - 58 a connecting lattice of the top chords and angle braces was strengthened. there was strengthened attachment of elements in 3`- 4` to units 3`. connections between trusses were strengthened. there were performe a work for increase of a dimension under 2-C . plenty of weak rivets in attachments B and P were reriveted. In 1965 when installing consoles of a line of electrotransmission the top chords of main trusses in edge panels were strengthened by two horizontal sheets.

In the report there is marked. that in 1966 during a pass of the train an excavator cantilever had damaged "axes" in attachment of cross beams to units of main trusses.

In report of DZHEK MIIT there was marked. that main damage of main trusses of span structures to 1966 was beginning mass frustration of rivets in attachments of angle braces B5` - 6` and B8` - 9` to top units. During inspection there was found out 169 weak rivets in first lines of attachments. There was marked a beginning of work of separate riveted joints (rivets) in the III stage with substantial growth of factor of concentration of tension at rivet opennings.There were no cracks in these units . but their occurrence was predicted in nearest (after 1966) future. The endurance class of these angle braces was determined equal 4.66 with load class - 4.70 (TEZ + 7.2 ts / m).

Main damage of the bridge road in that time was frustration of rivets in attachment of longitudinal beams to cross beams (in walls P). observed already for a long time. It was marked. that in 1955-57 many weak rivets and 155 high-strength bolts had been reriveted. Cracks in the horizontal shels of the top chord angle irons of longitudinal beams and were found out also in separate profiles of attachment of ties to these beams.

During the tests tensions in angle brace B8 - 9` of a right truss span structure № 1 were measured. At trains taking place they have not exceeded 610 kg/cm^2 from temporary load). According to the MIIT data dynamic factor for main trusses in case of oil engin locomotive traction has made $(1 + \mu.) = 1.07$.

MIIT had also carried out test of unit of attachment of a longitudinal beam to a cross beam. Axial tensions(efforts) in assembly rivets and high-strength bolts were measured. There was made a conclusion. that mode of operations of bolts with axial tension 15.0 tn was better. than with tension 20.0 tn.. It was recommended in lines 1. 2. 6. 7 and 8 attachments of longitudinal beams to make tightening of bolts to the effort of 15.0 tn . in other lines to 20.0 tn.. In result of work of MIIT in 1966 the conclusions were made that span structures provide the passing of all the loads (trains with oil engin locomotives TEZ, steam engin locomotives E and L), circulating along the bridge in that time , without restriction of speed. The danger of mass frustration of rivets in attachments of angle braces 5 " - 6 was also specified .

It was recommended in nearest years to carry out strengthening of attachments of longitudinal beams to cross beams with maintenance of transfer of bending moment through fishes and other constructive elements, to strengthen longitudinal beams by horizontal sheets, to carry out strengthening of angle braces B5`- 6 and B8- 9` on endurance and durability. As urgent measures it was recommended to replace weak rivets of first two rows of attachment of angle braces B5` - 6 and B8 - 9` by high-strength bolts as in top and in bottom units, but also to replace weak rivets with high-strength bolts in attachment of longitudinal beams to cross beams (1, 2, 6, 7, 8 rows - with tension of 15.0 tn.. other - of 20.0 tn.).

In 1980 Kiev Bridge Station of CP MPS had inspected the bridge. In appropriate report when describing of general data there is specified, that after washout in 1919 of support # 19, the basic parts were moved on the distance of displacement of a pier (33 cm) not only on this support but also on support # 18 on distance 11.5 cm.

During inspection of 1980 on the bridge strengthening of longitudinal beams of bridge road was finished. It was marked, that the work of strengthening of longitudinal beams had been performed with law quality, there is the plenty of (weak) rivets, on each span structure (from 30 up to 100 rivets) .

In the results of inspection there were marked cracks in seams between stones of covering of the abutments and corrosion of the plating of piers in level of variable horizon of water.

During 1984 the bridge was jointly inspected by Tashkent Bridge Station and Repair - Investigation Diving Station of CP MPS.

In the conclusion of Tashkent Bridge-Testing Station there is shown the presence of "blind" joints in right rail string at $t=0°C$, loosing of leaning of rails on rail chair and pollution of ballast on approaches.

They has marked in supports of the bridge, in joints between columns and foundation the part formation of a niche, with depth up to 70 cm (on support №

23). During inspection of the bridge in 1984 works on repair of support under project of Giprotransput » were carried out. At the top side of supports # # 18 - 24 under this project there were arranged the chords of reinforced concrete.

At level of variable horizon of water strong corrosion of the plating and angle irons of tie between columns of support was marked.

In span structures Tashkent Bridge Station has revealed the following damages:

- Holes and cracks in top chord angle irons of longitudinal beams (all cracks are blocked by angle fishplates *;

- Cracks in top chord angle irons of longitudinal beams in panel 1-2 span structure № 4. not blocked by fishplates;

- Weak rivets on attachment of chord sheets of longitudinal beams;

- Swelling, corrosion, absence of rivets in profiles of ties of attachment of ties between longitudinal beams;

- The cracks in bottom chord angle irons of extreme cross beams (are blocked by angle fishplates);

- Local corrosion of horizontal sheets of the bottom chords of main trusses;

- Swelling in separate attachments of angle braces and racks to chords of trusses.

In the materials under review there are given the same classes of basic parts according to data of "Giprotransput" of 1974. The least rolls (K=6.1) have the least class. This class is the least for the bridge.

As a result there was made a conclusion about opportunity of passing of all the loads without restriction of speed. There is the list of measures on elimination of damages in span structures.

In conclusion of Diving Station of CP MPS 1984 there is no estimation of a condition of a underwater part of supports itself. The main attention here was paid to a condition of joints of a underwater and surface part. It is specified. that in view of leaky leaning of surface parts of covers (through levelling wedges) there began intensive destruction of concrete in zone of joints.

February 14 1984 there was made a notch in metal cover of a support # 24. It was found out, that inside top cover with diameter of 2.6 m. there is one more cover with diameter of 2,0 m., going in foundation part and densely attached by a horizontal ring sheet to the foundation cover in the cut level. Thickness of a wall of an internal cover is about 5 mm., and behind it there is the dense not destroyed concrete. Between covers (in place of the notch) there was found a dense mix of crushed stone with silty sand and traces of cement.. This layer is 1.0 m high above the edge of foundation parts, and above it there is concrete, passing to rubble masonry .

On the basis of conducted opening of the support # 24 there was made a conclusion that the executive documentation does not correspond to the reality, since the builders, have ostensibly changed a design of a support, without reflecting it in design materials. It is assumed, that due to internal metal cover, the destruction of a masonry on large depth could not take place, and inside support there is the pole of strong concrete with a diameter about 2.0 m.. In the same 1984 Bridge Faculty of Novosibirsk Institute of Engineers of Railway Transport has given the conclusion about condition of joints between surface and underwater parts of supports of the bridge. In this conclusion there was marked that for the first time backlashes in joints were found out in 1951-52 Their width was 1-7 and depth 4 - 10 cm.

During the inspection of joints of supports ## 18 and 19 NIERT experts have found out damages of joints to the depth of more than 30 cm. The assumption was stated, that the depth of destruction of joints is limited basically, by the width of a ring platform on the top side of columns.

Table 1.6

MAXIMAL DEPTHES NEAR SUPPORTS DURING OPERATION PERIOD

Support	3	10	16	17	19	21	24
Year	1908	1911	1934	1934	1919	1969	1973
Depth.m	19.2	18	17	17	22	19	21

Table 1.7

MEASUREMENTS OF DEPTH FOR APRIL 1990

Date	Abutement	24	23	22	21	20	4	3	2	1	Abutement
1.04	0.6	4.1	4.7	4.9	3.8	4.3		0.5			0.5
10.04	0.4	3.5	4.5	4.6	3.6	4		0.3			0.3
17.04	5.3	4	5.7	6.7	6.4	5.3	0.4	1	0.4	0.4	1

II. - RESULTS OF INSPECTION OF BRIDGE

II.1. GENERAL INFORMATION

During 1990 - 91 group of the employees of `Bridges` and laboratory of bridge constructions of MIIT made inspections of all designs of the bridge. Conducting of inspections preceded by detailed study of the engineering specifications for the bridge.

The primary inspection had been carried out in April 1990 and according to its results section of the preliminary conclusion was made. Repeated inspection was carried out in April and October 1991 During the inspection there were in details examined span structures. supports and basic parts. bridge floor of a design of consoles. line of electrotransmission). design of rolloing ways of inspection катания carriage; geodetic shootings of a longitudinal structure of the bridge are lead. For estimation of chemical structure of metal. its mechanical characteristics with the purpose of reception of specified effective parameters from a number of elements of span tests of metal were taken.

During the inspection of support on support 9 and 10 notches in plating of underwater and surface parts were made with the purpose of estimation of quality and durability of a masonry. determination of quality of metal of the plating, degree of its damage by corrosion. specification of the design.

Below in the present chapter results of all inspections are in detail stated. systematized and submitted in form of tables of damages. having large repeatability.

II.2. RESULTS OF INSPECTION OF SPAN STRUCTURES

II.2.1. RESULTS OF INSPECTION OF MAIN TRUSSES OF CHANNEL SPAN STRUCTURES

In result of inspection the following damages were found out:

1. Weak rivets attachment. mainly of long-drawn angle braces and supports to top units of trusses.

2. Frustration of rivets and tear off of their heads in attachments of elements of a connecting lattice between branches of angle braces and racks (suspension) of main trusses - on all without exception span structures. Except clearly expressed easing of rivets, the signs of their frustration are also rust circles, cracks in layer of a paint around of the heads and flows of a rust from under rods. The list of found out frustration of rivets is shown in Table 2.1.; Thus, in the table quantity of weak rivets and rivets with teared off heads in each branch of elements of all span structures are specified separately. Except frustration specified in the table, there was found out, one rivet with teared off head in attachment of a filling lattice of spacer between top units 4` on SS № 19

3. On all the span structures many rivets, the attachment of connecting rods in units between branches mainly of compressed angle braces are replaced with bolts, that testifies to mass frustration of these rivets having place early. The list of elements and quantity of rivets replaced with bolts are shown in Table 2.2.

4. In attachment of separate suspensions and angle braces of the main trusses to top units there are the rivets with defective heads: not formed, moved from their axis, connecting by part of surface of joining places and etc. Defects of heads of rivets - are of building origin, however their presence can promote frustration of attachment (easing of rivets, tears off of heads). The list of places, where defective rivets are found out, is given in Table 2.3..

5. On majority of span structures corrosion damages are as follows:

- Corrosion and extention of separate rods, uniting branches of angle braces;

- Spot corrosion and swelling of connecting rods of the bottom chords (so on SS # 1- at H12 - 13 of the left-hand truss corrosion makes up to 10 % of of a rod section; On SS 4 - at HO1; H12 - 13; H13 - 14 of the left-hand truss);

- The corrosion of heads of connecting rivets of horizontal places inside boxes (headers?) of the bottom chords, caused by stagnation of water due to choking or absence of drainage opennings (so on SS # 2 in panels H 8 - 9 - 10 - of the left-hand truss drainage opennings are absent, water becomes stale, 40 - 70 % of rivets heads have corrosion up to 10 %; on SS № 7 in HZ - 4 of left-hand trusses 50 % of rivets have the corrosion of 5 - 10 %);

- Swelling between connecting shels of angle irons of suspensions near bottom chords of trusses;

- Swelling of central profiles in top units of trusses in places of abutting to them mainly of long-drawn angle braces B 3 ` - 4; B 10 - 11' (so, on the SS № № 1 - 4 this phenomenon is expressed best of all);

- Swelling between bottom chords of cross beams and profiles of longitudinal ties of the main trusses.

6. In some elements of the bottom chords there take place swelling of vertical sheets from their plane. This phenomenon is expressed most of al on the SS # 5 in H8 - 9 of the left-hand trusses, where an outside sheet has a bend with length of 60 cm with arrow of 3 cm.

7. Some elements of main trusses and elements of a connecting lattice have curvatures:

- On the SS # 3 S7` - 7 of right trusses there is curvature (corner 3 - 4 `) near top unit on distance of 1 m. from profile;

- On the SS # 7 two top elements of a connecting lattice B 1` - 2 of right trusses are curved with an arrow of 7 cm, two bottom connecting plates C9 ` - 9 of right trusses are curved downwards;

- Deflection of filling rods in details of cross ties between trusses: on the SS № 2 in unit 7 (fourth cross from above); on the SS # 20 in unit 5 (third cross from above);

- On the SS № 6 the angle brace B2 - 3 ` of a left-hand truss has a curvature towards an axis of span structures with an arrow f_{max} = 19 mm.;

- On the SS # 7 angle braces B6 - 7 ` of a right truss has a curvature towards an axis of span structures with an arrow $f_{max}$ = 19 mm.; and angle brace B9 ` - 10 of left-hand truss with an arrow of f_{max} = 11 mm..

Table 2.1

WEAK RIVETS AND RIVETS WITH TORN OFF HEADS IN ATTACHMENTS OF CONNECTING LATTICE

Span Structure #	Elements and Quantity of Frustrated Rivets			
	Left Truss		Right Truss	
	Internal branch	External branch	Internal branch	External branch
1	2	3	4	5
1	B1`-2-2	B12-13`-1	B10-11`-1 (Head tear-off)	
2	B12-13`-2			
3	B3`-4-1		B10-11`-2	
4		B10`-11-1	B10`-11-1 B12-13`-2	
5	B3`-4-1			
6	B3`-4-1	B10-11`-1 B12-13`-2		B12-13`-1
7	B1`-2-2			
8	B10-11`-1			B1`-2-1 B8-9`-1
9			B3`-4-1 B10-11'-2 B12-13'-1	
10		B8-9'-1 B10-11'-1	B3'-4-1 B5'-6-1	B12-13'-1
11	B1'-2-1 B8-9'-1	-	-	B12-13'-3
12	B12-13'-1 B2-3`-1(absent)	-	B3'-4-1	-
13	B3'-4-1 (Head tear-off)	B1'-2-2 B 12-13'-2	B1'-2-1	-
14		B12-13'-1	-	B1'-2-1 B10-11'-1 B12'-13'-1
15	B10-11'-2	-	-	B1'-2-1
16	B1'-2-1 B12-13'-1	-	B1'-2-1 B12-13'-1 B9'-10-1(abs.)	B12-13'-1
17	BO-1'-1	B1'-2-1 B9'-10-1(abs)	B3'-4-1	
18	B10-11'-1	B1'-2-1	B1'-2-1	C11'-11-1
19	C12'-12-1	B1'-2-1	- _	-

1	2	3	4	5
20	Bl'-2-1 B12-13'-1	B1'-2-1 B3'-4-1	-	-
21	. B10-11'-1 B12-13'-1	B1'-2-1 B3'-4-1 B10-11'-1 BO-1'-1	Bl'-2-2	B3'-4-1
22	B1'-2-1	-	-	B10-11-1 B12-13'-1
23	B3'-4-2 B10-11'-1	C1'-1-1 B1'-2-1 B3'-4-1 B12-13'-1	BS'-6-2 B10-11'-1	B1'-2-2 B5'-6-1
24		-	B8-9`-1	.
25	B3'-4-1 B8-9'-1	-	B5'-6-1 B10-11'-1 B12-13'-1	BO-1'-1 Bl'-2-1 B3'-4-1 B5'-6-1

Table 2.2.

INFORMATION ABOUT REPLACEMENT OF WEAK RIVETS BY BOLTS IN ATTACHMENTS OF CONNECTING PLANKS IN ANGLE BRACES OF MAIN TRUSSES

Span Structure ##	Truss	Quantity of replaced rivets in angle braces					
		B2-3'	B4-5'	B6-7'	B7'-8	B9'-10	B11'-12
1	2	3	4	5	8	7	8
1	Left - .		2	2	1	2	
	Right		1	1	1	2	-
2	Left		2	1	2	2	
	Right	-	2	2	1	1	-
3	Left		1	2		1	2
	Right	1	-	-	2	1	
4	Left		2	2	1	2	
	Right	-	2	1	2	2	-
5	Left -		2	1	1	3	
	Right	-	3	1	1	3	-
6	Left -	-	3	3	3		
	Right	-	3	3	2		-
7	Left -		3	2	2	2	1
	Right	-	3	3	2	3	1
8	Left -		2	1	1	1	
	Right		2	1	1	2	
9	Left	-	2	1	1	2	
	Right	1	2	1	1	2	
10	Left		2	1	1		
	Right	-	2	2	2	2	
11	Left		2	2	2	2	_
	Right	-	2	1	1	1	
12	Left		2	2	2	2	1
	Right	-	3	3	2	3	-
13	Left	1	3	1	1	3	1
	Right	1	3	1	2	2	1
14	Left		3	1	1	1	
	Right		3	1	2	3	
15	Left		1	1	1	1	
	Right		3	1	1		2

1	2	3	4	5	8	7	8
16	Left	-	-	1	1	1	-
	Right	1	1	1	-	1	1
17	Left	-	1	1	-	1	1
	Right	-	2	-	1	2	1
18	Left	-	2	2	2	2	1
	Right	-	3	3	2	2	1
19	Left	1	3	-	-	2	1
	Right	1	3	2	2	3	1
20	Left	1	3	2	2	3	1
	Right	-	3	1	2	3	1
21	Left	1	3	2	2	2	1
	Right	-	3	2	2	3	1
22	Left	1	2	2	2	3	1
	Right	1	4	2	3	3	2
23	Left	2	2	2	2	3	1
	Right	1	4	2	2	3	1
24	Left	1	3	1	1	3	-
	Right	1	3	1	1	3	2
25	Left	1	1	2	1	1	-
	Right	1	1	2	2	2	1

Table 2.3.

RIVETS WITH DEFECTS IN ATTACHMENTS OF MAIN TRUSSES TO TOP UNITS

Span Structure ##	Truss	Element	Branch	Quantity	Outside or inside
1	2	3	4	5	6
10	Left -	C 7' - 7	Internal	2	Inside
	Left -	C 11' -11	Internal	4	Inside
.	Left -	C 3' - 3	Internal	1	Inside
11	Left	C 11' -11	External	1	Inside
	Left	B 5' - 6	External	1	Inside
12	Left	C 7' - 7	Internal	1	
	Left	C 7' - 7	External	1	Inside
	Left	C 9' - 9	Internal	1	and
	Right	C 7' - 7	Internal	1	Outside
13	Left	B 3' - 4	External	2	Inside
14	Left -	C 9' - 4	Internal	1	Inside
	Left -	C 11' -11	Internal	1	Inside
15	Left -	C 9' - 9	External	1	Inside
	Left -	C 9' - 9	Internal	1	Inside
	Left -	C 11' -11	Internal	1	Inside
18	Left -	C 7' - 7	Internal	2	Inside
20	Left -	B 8 - 9`	Internal	4	
	Left	C 9' - 9	Internal	3	
	Left	B 9` - 10	Internal	1	
	Right	C5` - 5	Internal	1	
	Right	C 9' - 9	Internal	2	
22	Right	C 7' - 7	External	1	Inside
24	Left	C5` - 5	External	1	
25	Left	C5` - 5	Internal	1	Inside
	Left	C 9' - 9	Internal	1	

II.2.2. RESULT OF INSPECTION OF BRIDGE ROAD OF CHANNEL SPAN STRUCTURES

Inspection of the bridge road have come to outlight defects and damages of:

- Longitudinal and cross beams;

- Ties between beams and rivets of their attachment;

- "Fishes" and rivets attachment B to P;

- Structures of rolling track for inspection carriage. More over there was fixed quantity and location of elements of strengthening of the bridge road structures, as:

- High-strength bolts in attachments, delivered instead of rivets;

- Presence of overlapping of cracks and holes in beams.

In result of inspection the following damages were found out:

1. Holes under bridge bars in horizontal shelves of the top chord angle irons of longitudinal beams. In total on all the span structures there is found out 13 holes , located mainly outside angle irons beams . 12 of them are overlapped by angle fishplates with atachment of the last by high-strength bolts (in 11 cases) and rivets (in one case), and one - in right B2 - 3 on SS # 16 is not overlapped (Fig.2.1.) evidently all holes had been formed. yet before strengthening of longitudinal beams by the top horizontal sheet. In Table 2.4. Data about the location were available holes and a character of their overlapping are shown.

Table 2.4

INFORMATION ABOUT HOLES IN CHORDE SECTIONS
OF LONGITUDINAL BEAMS

Span Structures ##	Longitudal beam	Panel	Branch	Position along the panel, counting from the beginning	Caracter of the overlapping and number of fixing boltes in B - chorde
1	Right	2 .- 3.	External	1./4	Angle iron
	Left	4.- 5	External	1./2	Angle iron
	Left	5. - 6	External	1./5	Angle iron,6 HSB
	Right	7. - 8	External	1./4	Angle iron,5 HSB
3	Left	2. - 3	External	3./4	Angle iron,9HSB
4	Left	4.- 5	External	1./3	Angle iron,5 rivets
8	Left	10. - 11	Internal	1./4	Angle iron,5 HSB
9	Left	4.- 5	External	1./2	Angle iron,8 HSB
	Left	8. - 9	External	3./4	Angle iron,6 HSB
	Left	9. - 10	External	3./4	Angle iron,6 HSB
12	Right	2 .- 3.	External	near P2	Angle iron,5 HSB
13	Right	0 - 1	Internal	1./3	Angle iron,5HSB
16	Right	2 .- 3.	External	2./3	Not overlapped

2. Cross fatigue cracks in horizontal shelves of the bottom chord angle irons of cross beams near their attachments to main trusses (Fig.2.2.). The cracks arise at edge of a shelf and are distributed to head of an angle iron. All cracks are located at edge of profiles of longitudinal ties of main trusses. where in structure of section of the bottom chord of a cross beam there are only the angle irons. since the horizontal sheet is broken off directly before profile. Thus in this zone the moment of resistance of a chord in horizontal direction appear much less. than on connecting sites. Besides follows to note. that all found out cracks are located only in four cross beams nearest on both ends span structures. Namely in them there are the heaviest deformations (bending moments in horizontal plane) because of inclusion of beams of the bridge road in joint work with main trusses. Set of the specified factors with rather high cyclicity of change of tension results in occurrence of described cracks.

On all the span structures in last four cross beams (П 11. Л 12. Л 13. П 14) zones of formation of cracks notwithstanding of their presence or absence - are attached by angle by fishplates with attachment thereof by high-strength bolts (Fig.2.3.). In initial cross beams such strengthening is not present (at exception of П 1 on SS # 9. near left-hand truss from the side of panels 1 - 2).

Information about found out cracks in angle irons of cross beams is shown in Table 2.5.

Table 2.5

Span Structure ##	## of cross beams	Near which truss	Angle iron P from the side of panel	Lenrth of crack, mm	Mark of overlapping
1	2	3	4	5	6
1	P1	Right	1. -2	30	No
	P2	Right	2. - 3	30	No
8	P13	Right	13 - 14	*	Yes
9	P1	Left	1. - 2	*	Yes
	P12	Left	11. - 12	*	Yes
11	P12	Right	12. - 13	*	Yes
12	P14	Left	13 - 14	*	Yes
13	P0	Right	0 - 1	70	No
13	P1	Right	0 - 1	30(Fig.2.4.)	No
	P13	Right	12. - 13	*	Yes
	P14	Left	Cantilever	*	Yes
14	P11	Right	10. - 11	*	Yes
17	P13	Right	13 - 14	*	Yes
18	P0	Left	0 - 1	25	No
	P1	Left	0 - 1.1-2	60.40(Fig.2.5	No
	P2	Right	2` - 3	60	No
	P3	Right	2. - 3	20	No
	P13	Left	13 - 14	*	Yes
	P14	Left.Right	13 - 14	*.*	Yes. yes
20	P13	Left	12. - 13	*	Yes
21	P0	Left	Cantilever	20	No
	P11	Right	10. - 11	*	Yes
	P14	Right	13 - 14	*	Yes
25	P13	Right	13 - 14	*	Yes

* Length of the crack was not measured. because it had been closed from the top by angle iron of oveerlapping

3. Cracks of the top "fishes" of attachments of longitudinal beams to crossbeams. All the cracks are found out in five "fishes" on three span structures they are located, as a rule, along chord of a cross beam from edges of rivet openings of the first row of the attachment of fishes to chords of longitudinal beams on whole or part of width of a "fish".

On the SS # 21:

- In attachment of right B 11 - 12 to P 12 - the crack begins at the edge of an openning of the first row and leaves on the outside edge of the "fish" » (Fig.2.6.); on internal edge of a "fish" the cracks are not found out. Here has place a tear off of the head of the second rivet of attachment of a "fish" to the top chord B (Fig.2.6.).

- In attachment of the left-hand B 11 - 12 to P 12 - the crack dissects the "fish" along whole its width on the first row of rivet of opennings. in zone of formation of a crack there is also marked a strong corrosion of the "fish".

- In attachment of left-hand B 13 - 14 to Л 13 - crack is similar to the described above (Fig.2.6.) on SS # 23 - in attachment of the right B 1 - 2 to P 1 a crack begins from the edge of an openning of a rivet of the first row. crosses the "fish" along the whole width and leaves on its internal and outside edges. Thus. from internal side the crack leaves at the feather of a chord angle iron B opposite to the of a rivet attachment of the "fish" second from the P. and goes obliquelly under the small corner to feather of an angle iron up to internal edge of the "fish" . From outside side near a feather of the chord angle iron the crack bifurcates: one passes along the feather. other leaves on the edge of the "fish" near chord P.

On the SS # 25:

- In attachment of the right B 10 - 11 to P 11 - from outside side hanging down over the chord angle iron of an edge of the "fish" is cut off (fig.2.7.); from internal side - the crack leaves at the feather of an angle iron along chord P and finishs not reaching 4 cm up to an edge of the "fish".

4. Frustration (easing), tear off of heads, absence of rivets of attachment of "fishes" to the top chords of longitudinal beams:

- On SS № 21 in attachment of the right B 11 - 12 to P 12 - tear off of the head (from below) of a rivet of attachment the second from the P from outside side of B

(Fig.2.6.); precisely such the damage is marked on SS # 25 in attachment of the left-hand B0 - 1 to the P 1;

- On SS # 24 in attachment of the right and left-hand B 13 - 14 to P 14 inside and outsidethere are absent rivets the first from the P (total 4 p.); precisely such a picture has a place on SS № 25 in attachment of both B0 - 1 to P0;
- On SS № 25 in attachment of the left-hand B 11 - 12 to the P 11 from internal side there is weak rivet which is the third from the P and which simultaneously with the fish attaches yet a profile of longitudinal ties between B.

5. In attachments of longitudinal beams to cross beams many rivets both in the wall P, and in the wall B are replaced with high-strength bolts, the separate rivets have easings or tear off of heads.

Below there are shown the information about damaged and replaced rivets; thus the account of rivets begins from the bottom chord P including the rivets in a "table" .

There are the following damages of rivets in the B wall:

- On the SS # 4 in the attachment of the right B to P 6 from inside the fifth rivet the head is torn off (a bridge maintenance team immediately replaced this rivet with high-strength bolt);
- On the SS # 19 in attachments right B to the P12 and P 13 outside there are the sighns of easing of the 2d, 3d, and 4th rivets;
- on the SS # 22 in attachment of the right B to the P 11 outside there are the sighns of easing of the 3d rivet;

- on the SS # 23 in attachments of the right B outside to:

-P 2 - the fifth rivet has signs of easing (the next fourth rivet on HSB);

-P 11 - signs of easing of the 4-th, 5-th, 6-th rivets;

-P 12 - signs of easing of the 2-nd and 3d rivets;

- on the SS # 24 in attachment of the right B to the P 5 outside the third rivet has signs of easing (next from 4-th to 7-th are replaced for HSB).

The list of rivets, in the wall P, replaced for high-strength bolts is given in the Table 2.6.

Table 2.6.

LIST OF RIVETS REPLACED FOR HIGH-STRENTH BOLTS IN THE WALL OF CROSS BEAM

Span Structure ##	Longitud. beam Right Left	Side External Internal	Nr.Nr. of relaced rivets in PNr.Nr (account from below)												
			P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P10	P 11	P 12	P13
1	Left	Internal	-	4,5	-	-	-	-	-	-	-	-	-	6	-
		External	-	5	-	6	2,4,5	4	-	4=8	4=6,8	-	8	4,5	4=6
	Right	Internal	4	4,5	-	-	-	4,5	7,8	4	-	-	-	4,5	-
		External	4; 7	-	-	-	-	4 ,5, 7	-	-	4,5	-	-	-	-
2	Left	Internal	9	4,5	-	-	-	-	-	-	-	-	-	-	4,5
		External	-	4;6,8	-	4	-	4	8,9	6	4,8	4,5	-	-	6,7
	Right	Internal	-	4	-	4,8	-	4	-	-	-	-	-	-	-
		External	4;9	4,5	-	6	4;6	-	-	-	-	-	-	9	-
3	Left	Internal	-	6	4,9	9	-	4,5	-	-	5	-	-	-	-
		External	-	-	-	-		-	-	-	-	-	-	-	-
	Right	Internal	-	-	-	-	-	-	-	-	-	-	-	10	-
		External	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Left	Internal		4	4,7	-	-	4	4,6=8	-	-	4=9	-	6	4,5,8,9
		External	-	45	5	47	4,5	-	4	5	4	3=9	5	-	4=9
	Right	Internal	59	4;9	4,5,7; 9	5=8	4,5	5	-	4	5=8	6=8	4=7	8=10	4=9
		External	4 ;6	4;7	4,6	4;6		4		-	5,6	-	-	4=8	4=6
5	Left	Internal		-		46	-		4	-	-	-	4,7	-	-
		External	-	-	6	4	-		-	5	-	-	4	4=7	-
	Right	Internal	8	-	-	4	4=9	-	-	-	-	-	-	-	-
		External	-	4	-	-	-	-	-	-	4	4	-	4	4=9
6	Left	Internal	-	-	-	5=7	4	-	-	4	-	4,7,9,10	-	4	4,5
		External	-	-	-	4,5,8	-	-	-	-	-	-	-	-	-
	Right	Internal	-	-	4	2	4	4	-	4,5	-	4,5	4,5	-	4
		External	-	4	-	4	-	-	4	4	-	-	-	-	-

Span Structure ##	Longitud. beam Right / Left	Side External / Internal	Nr.Nr. of relaced rivets in PNr.Nr (account from below) P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P10	P 11	P 12	P13
7	Left	Internal	-	-	-	-	-	4	45,7,9	-	-	-4	-	6	-
		External	5	4=6	-	5	-	-	-	-	-	-	4	-	-
	Right	Internal	-	-	48	-	-	4	45	45	-	-	-	-	-
		External	4	5 6	45	-	-	45	-	4=6	-	-	-	7.8	4.6
8	Left	Internal	-	3	-	5	6	-	5	-	4	-	-	-	-
		External	-	-	-	-	-	-	4,5	4	-	-	-	-	-
	Right	Internal	-	-	-	-	4=6	-	-	-	-	4	-	-	-
		External	-	-	6	5		-	4	6	-	45	-	-	4
9	Left	Internal	-	6	6	4	7=9	-	-	45	-	4,9	4.6	4	4.8.9
		External	4 6 9	-	5	4	4	4	-	-	4,5	4	6	4	8.9
	Right	Internal	-	-	-	-	-	-	-	4, 5	4,5	-	-	4	4
		External	4	-	-	4	-	4, 5	-	4	-	4 6.9	4	4=7	8.9
10	Left	Internal	-	49	4	-	4	49	4	4	9	-	8.9	8.9	4
		External	-	-	-	-	-	-	4	4	-	-	-	-	4
	Right	Internal	-	-	-	-	4	8	9	4	9	-	4.9		4 8.9
		External	5	4, 5	-	-	-	4= 6	4	-	-	4	4.5	-	-
11	Left	Internal	-	5	45	4	5	4=6	4	89	-	-	-	9	4
		External	-	4=6	56	4	-	-	6	-	-	5	-	4	4.7=9
	Right	Internal	-	45	4	8	4			5		4	4	-	-
		External	-	-	4	4	4	-	-	-	9	-	-	-	-
12	Left	Internal	4,8,9	4.8,9	4.9	4	4	4	4	4,8,9	4,8=10	4	-	-	8,9
		External	-	-	-	89	-	-	-	8,9	4,8	-	8,9	4	-
	Right	Internal	4	4	4	45	-	4,9	-	9	4,5	4	-	2.7=9	8,9
		External	4	4	-	45	4	-	-	4	4	4	4	4	4
13	Left	Internal	4	4	-	-	-	-	-	-	4	-	8,9	4	-
		External	4=6	-	-	-	-	-	-	-	-	-	4	4	-
	Right	Internal	-	-	-	89	-	45	9	4,8,9	8,9	9		4 5.7=9	-
		External	-	-	4	45	-	-.	4	4	4	-		8 4=6	-

Span Structure ##	Longitud. beam Right Left	Side External Internal	Nr.Nr. of relaced rivets in PNr.Nr (account from below)												
			P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P10	P 11	P 12	P13
14	Left	Internal	9,10	-	8:10	45,8,9	9	9,10	9	-	9,10	-	-	-	4=9
		External	-	-	6= 8	4: 8	4,9	-	-	-	-	-	-	-	-
	Right	Internal	-	-	.	4,8,9	8,9		-	-	-	-	-	-	-
		External	10	9,10	-	-	10	-	-	9	-	4	4	-	-
15	Left	Internal	-	5	-	-	-	-	-	-	-	-	-	-	-
		External	-	-	-	-	-	-	-	-	-	-	-	-	-
	Right	Internal	-	-	-	-	4		-	-	-	-	4,7	-	-
		External	-	-	-			-	-		-	-	-	-	-
16	Left	Internal	-	-	-	-	-	-	-	-	-	-	-	-	-
		External	-		-	-	-	-	-	-	-	-	4	-	-
	Right	Internal	-	-	-	-	-	-		-	-	-	-	-	-
		External	-	-	-	-	-	-	-	-	-	-		-	-
17	Left	Internal	-	-	-	-	-	9	-	-	-	-	-	-	-
		External	-	-	-		-	-	-	-	-	-	-	-	-
	Right	Internal	-	9,10	-	-	-	-	-	-	-	-	-	-	-
		External	-	-	-		-	-	-	-	-	-	-	-	-
18	Left	Internal								-	-	-	-	-	-
		External	-	-				-			-	-		-	-
	Right	Internal	-	-	-	-	-	-	-	-	-	-	-	-	-
		External	-	-	-	-	-	-	-	-	-	-	-	-	-
19	Left	Internal	-	-	-	-	-	-	-	-	-	-	-	4,5	-
		External	-	-	-	-	-	-	-	-	-	8	9	4,5	-
	Right	Internal	-	-	-	-	-	-	-	-	-	-	-	-	-
		External	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Left	Internal	-	-	-	-	-	-	-	-	-	-	-	-	-
		External	-	-	-	-	-	-	-	-	-	-	-	-	-
	Right	Internal	-	-	-	-	-	-	-	-	-	-	-	-	-
		External	-	4	-	-	-	-	-	-	-	-	-	-	-

Span Structure ##	Longitud. beam Right Left	Side External Internal	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P10	P 11	P 12	P13
			Nr.Nr. of relaced rivets in PNr.Nr (account from below)												
21	Left	Internal	-	-	-	4=7	4,5	-	-	-	-	4=8	-	-	-
		External	-	-	-	4=8	4=6,,9	5	-	-	-	-	-	-	4
	Right	Internal	-	-	-	-	-	.	-	-	-	-	4	-	-
		External	-		-	-	-	.	-	4	5	-	-	-	5
22	Left	Internal	-	-	-	-	-	.	-	4	-	-	-	4=9	-
		External	-	-	-	-	-	-	-	-	-	5	-	4=6	5
	Right	Internal	-	-	-	-	-	.	-	.	-	-	4	4,5	
		External	-	.	-	.		.		.	-	-		5	4
23	Left	Internal	-	4,5	5	-	-	4=9	-	.	-	-	-	4=8	4=6
		External	6	4=7	-	-	-	4,8	-	-	-	6	-	4=6	4
	Right	Internal	-	-	.	-	-	-	4,5		-	-	-	-	-
		External	-		7=9	-		-		4,6,7	4	4=7	-	-	-
24	Left	Internal	-	-	-	45	-	4	-	-	-	-	-	4	-
		External	-	-	4=7	-	-	-	45	-	-	4,6,7,9	4	-	-
	Right	Internal	-	-	5	-	-	.	5	-	-	5,6	6,7	-	4,5
		External	4,5	-	4=6	4 ,5	4=7	.	45	-	4	9-Apr	5,6	6=9	4,5
25	Left	Internal				4			45	45	4	4=6	5	4,5	-
		External	4=7		-	9	4=6	45	-	4		4=7		4=6	4=8
	Right	Internal	-	-	-	45	-	-	-	45	-	4=6	-	-	-
		External	-	-	-	-	-	.	-	4, 5	-	-	-	-	4,5

Easing and the defects of rivets in the wall B (incleding the ones of the wall "tables") are found out:

- on the SS # 19 in the wall B 1 - 2 at P 2 - there is no the first rivet (openning is not completely drilled);

- on the SS № 23 in the wall of the right B 1 - 2 at P 1 - there are loosed the rivets (from the fourth to the ninth.) along thr feather of an angle iron of the attachment ^ there are the traces of a rust (in attachment of this B to the P 1); the "fish" is also strongly damaged (See . P.3.);

- on the SS # 23 in the wall of the right B 7 -8 at P 8 there are signs of frustration of fourth. fifth and sixth rivets.

The list of the rivets in the wall 6 replaced for HSB. is given in table 2.7.

Table 2.7.

LIST OF RIVETS REPLACED FOR HIGH-STRENGTH BOLTS IN THE WALL OF LONGITUDINAL BEAM

Span Structur ##	Longitudin beam (left, right)	Panel	Strengthenin to the P ##	Numbers(from the bottom) of thr opennu\ings with HSB)
2	Left	4=5	B4	1
	Left	7=8	B8	4
4	Left	11=12	B12	4 : 5
	Right	8=9	B9	3
	Right	9=10	B10	3:4:5
5	Right	4=5	B4	3
	Left	7=8	B8	4
6	Left	11=12	B12	3
9	Right	7=8	B8	4
	Left	10=11	B10	3;4
12	Right	3=4	B4	4
13	Left	9=10	B10	3
15	Left	9=10	B10	4
16	Right	2=3	B3	4:5:6
	Right	11=12	B12	4:5:6:7
17	Right	3=4	B4	4:5.
	Right	5=6	B6	4:5:6
20	Right	11=12	B11	3:4:5

6. Frustration and defects of the top chord rivets and longitudinal beams:

- on the SS # 9 in the left-hand B 4 5 about P 5 there are signs of frustration (flows of a rust from under the chord angle iron) in the three rivets nearest to the P;

- on the SS # 11 in right B 13 - 14 in middle of the panel there is one weak rivet (attaching simultaneously both chord and angle iron of rigidity);

- on the SS # 20 in left-hand B 9 - 10 about P 9 - there is no rivetwhich is the first from the P (there is no openning in vertical sheet of a beam);

- on the SS # 1 in the left-hand B 2 - 3 (second half of panel) nine rivets are replaced for HSB.

7. Weak and absent rivets in "caps " of longitudinal beams (rivets, connecting the top angle irons to a horizontal sheet).

On many span structures there is marked a defect connected with work on strengthening of the top chords of beams - there are missed about two - three rivets of a cap » 6 on every site about edges of rigidity in middle of the panel (fig. 2.8.).

In these places there are the backlashes between angle iron and sheet. So. on the SS № 12 in middle of panels 3 - 4; 4 - 5; 5 - 6 of the left-hand B there is missed on one rivet under edge of rigidity; on the SS # 23 in middle of the panel 2 - 3 of the left-hand B there are missed three rivets см.Fig 2.8).

The list of places. where there are found out weak and replaced for HSB rivets of "caps" of the B. is shown in table 2.8.

Table 2.8.

WEAK AND REPLACED RIVETS IN THE "CAPS" OF B

Span Structures ##	Beam	Panel	Side	Quantity of weak rivets	Position along the panel, counting from the beginning
1	Right	7 .-8.	External.internal	1:1	3./4:3/4
	Left	2.- 3	External	2	1./3
9	Left	8. - 9	External. internal	3:3	3./4:3./4
13	Right	0 - 1	Internal.external	3:2	1./3
15	Left	0 - 1	External	1	1./4
16	Right	5 .- 6.	External.internal	3:3 gaps between angle iron and sheet	2./3;2/3
19	Right	10.-11	External	1	1./2
20	Left Right	12.-13	External	1:1	1./5:1/5
21	Left	7.-8	Internal	1	1./5
	Left	8.-9	External	1	3./4
	Right	8.-9	External	1:1	1./2:3/4
	Left	13-14	External	1	3./4
22	Right	3.-4	External	1	1./4
	Right	4.-5	External	1	3./4
	Left	4.-5	External	1:1	1./2:3/4
	Left	4.-5	Internal	1:1	1./2:3/4
	Left	11.-12	External.internal	3:1	1./2:1/2
	Right	12.-13	External	1	1./2
	Left	13-14	External	1	1./2
23	Left	12.-13	External	1	1./4
25	Left	4.-5	External	1	1./4
	Left	11.-12.12-13	External	2 HSBper each	1./2:1/2
	Right		External	2 HSB	1./2

8. Rivets, frustrated, defective and replaced for HSB of the attachment of elements of the top ties between longitudinal beams to profiles and profiles to chords B are marked:

- on the SS № - there is no head of one rivet of attachment of profile of ties to chord B 8 - 9 at P 8;

- on the SS # 9 - one weak rivet of attachment of the second diagonal of the panel of profile in the middle of length of the left-hand B 4 - 5;

- on the SS # 11 - two weak rivets of the attachment of the profiles of ties to chord of the right B 13 14 in middle of the panel (Fig.2 ..9), profile has significant horizontal movings at passing of a load ; above this place a joint of a working rail is located;

- on the SS # 12 there is one defective (poorly formed) rivet of attachment of the profile of ties to chord of the left-hand B 6 - 7 in middle of the panel;

- on the SS № 17 there are two weak rivets of attachment of profile of ties to chord of the left-hand B 4 - 5 in middle of the panel (Fig.2.10.);

- on the SS # 22 rivets of attachment of profile of ties to chord of the left-hand B 13 - 14 at P 14 are replaced for HSB;

- on the SS # 25 there is one weak rivet of attachment of profile of ties to chord of the left-hand B 11 - 12 at P 11 (simultenoiusly these profile attach the "fish" »);

- on the SS № 7 there is defective (unriveted) rivet of attachment of profile of the top spacer to chords of the left-hand and the right B0 - 1 in middle of the panel.

9. On the row of span structures there are observed a swelling of profiles ofattachment of bottom spacers between B in middle of panels and tear off of heads of rivets of their attachment (fig. 2.11):

- on the SS # 14 to right B 2 - 3;

- on the SS # 15 to right B 3 - 4, 6 8 - 9, to left-hand B 11 - 12, B 12 - 13;

- on the SS # 17 to right B 7 - 8;

- on the SS B # 18 to right B 5 - 6;

- on the SS B #19 to right Б7-8,БИ - 12;

- on the SS # 20 to left-hand B 7 - 8, B 9 - 10;

- on the SS № 24 to left-hand B 4 - 5, B 5 - 6, B 13 - 14, to right B 4 - 5, 6 13 - 14;

- on the SS # 25 to right B 2 - 3, B 6 - 7.

On the SS # 1 - there is no head (from above.) of one rivet of attachment of bottom spacer between B to profile in middle of the panel and the right B 4 - 5.

10. The corrosion damages meet on all the span structures and are expressed in kind of:

- surface and spot (cometimes through) corrosion of elements:

- swelling between elements in compound packages and in places of the attachment.

Everywhere there is marked corrosion of fishes of attachment of longitudinal beams to cross beams to the depth up to 5 mm. (for example, on the SS # 1 the "fishes" of attachment of the right B to P 3, P 4, P 10 have corrosion holes with depth of 4 - 5 mm.; on the SS # 21 "fish" of the attachment of the left-hand B 11 - 12 to P 12 have strong corrosion along chord P and crack on this direction).

In many places there is spot corrosion and swelling of chords of cross beams about their attachment to main trusses (for example, on the SS # 1 - in P 6 at right truss there is corrosion damage with depth of 2 mm. On length about 5 cm, on the SS # 3 in P 10 the left-hand truss has swelling and stratification of the bottom sheet).

The through corrosion of profiles of attachment of longitudinal ties between B in middle of the panel is found out in left-hand B 4 - 5 and B 7 - 8 on the SS # 1

11. Damage of angle irons of suspension of rolling tracks of inspection carriage to cross beams: cracks, complete break, easing of rivets attachment. Cracks and the breaks of angle irons are located, as a rule, in places bending (FIG.2.12, 2.13). Near each cross beam the rolling tracks (each string) is attached by two inclined and two vertical angle irons, connecting accordingly bottom chord and a wall P to a

wall of channel iron of a track. Thus on each span structure there are present 60 inclined and vertical angle irons. Quantity of damaged ones separately for the left-hand and the right sides and the character of damages is specified in table 2.9.

As it is visible from the table, there are damaged 34,8 % from total of angle irons of rolling track suspension and number there of is increasing rapidly.

12. In attachments of the bottom basic "table" to the chord B and connection it with lower "fish" on some span structures rivets are replaced on HSB (fig. 2.14.). The heaviest quantity of HSB is installed on the SS # 14: 207 pieces in attachments to bottom chord B; 224 pieces in connection of the top angle irons and the wall of hte table itself. According to information, received in a distance department, the works on installation of HSB were carried out during strengthening of attachment B to P ("table") in connection with bad quality of the previous riveting.

II.2.3. RESULTS OF INSPECTION OF COASTAL SPAN STRUCTURES

The survey of stationary basic parts has not revealed in them any defects and damages. During the survey of mobile basic parts there were fixed mutual positions of the bottom balance weght, carriage with rolls and bottom basic plate. The gaugings were made in solar windy weather at positive temperature of air about 20° C. Besides they paid much attention to integrity of axial bolts of fastening of ralls in carriage, condition of rolling. The gaugings and survey were made on majority of basic parts, the other parts were not inspected in details due to impossibility of access to the rolls because of design features of casings. So at all basic parts of span structures № № 21 - 25 casings are all-riveted, not demountable, at some other covers of casings cannot be open. By results of measurements of a position of elements of basic parts sizes of mutual displacement of the bottom balance weghts, carriages and basic plates are counted up, which are shown in table 2.10.

Table 2.10

VALUES OF MUTUAL DISPLACEMENTS OF THE BOTTOM BALANCE WEIGHTS AND BASIC PLATES OF MOBILE BASIC PARTS

Span ##	On the support ##	Displacement of balance weight axle in relation to axle of basic plate mm "+" from span."-" in span		Displacement of rolling carriage axle in relation to axle of basic plate mm "+" from span."-" in span	
		Left	Right	Left	Right
1	1	+23	+21	+12	+14
2	2	+3	-5	-3	+4
3	3	-6	-22	+1	-2
4	4	+1	+5	-4	+10
5	5	-15	-27	-8	-6
6	6	-14	-13	-7	-3
7	7	-19	-4	-11	-2
8	8	+3	+5	-17	-10
9	9	+21	+28	+12	+12
10	10	-	+20	-	-3
11	11	-	-	-	-
12	12	+15	-	5	-
13	13	-8	-26	0	-2
14	14	+25	27	10	+10
15	15	-6	-6	-4	+1
16	16	+7	-	-8	-
17	17	-33	-9	+3	-7
18	18	-5	-8	+3	-7
19	19	+23/+33	-25/-32	+10/+20	-10/-5
20	20	+31	+21	-11	+6

As shows the analysis of received results all mobile basic parts are in close to normal position, corresponding to temperature of air and metal of span structures. The maximum sizes of displacement of axes of the bottom balance weghts and carriages with ralls in relation to axes of basic plates make 33 and 20 mm. accordingly. On support # 19, which has an inclination to the right side from axis of the bridge, the sizes of displacement were measured twice on each basic part - from internal and outside side. It was found, that there was the heaviest skew of the and balance weghts in relation to basic plates, making up to 10 mm.

On the support # 2 in the right mobile basic part in the extreme span roll from its internal side an axial bolt of fastening of roll in the carriage is cut off. A condition of rolling surfaces are good, meeting the requirements of the "Instruction for Maintenance of Artificial Structures".

PART D-2

REPORT OF LOCAL EXPERTS (SECOND PART)

containing pages 1 to 14
(including headers of tables; the original tables are added on the following pages respective)

Most 12

The data concerning convertible loads and bridge operating conditions are given in the same project specifications of the Bridge Design Bureau. It is noted that since 1952 the traffic on the bridge has greatly increased. In 1953 the load of 2 diesel locomotives and cars was introduced with pressure intensity of 7.2 t/m. Trains with series CO steam locomotives were used at that time.

In 1959, the bridge was inspected by the Moscow Bridge Testing Station (ЦП МПС)[1]. They have described in their report the strengthening of strut joining grid spacers with angles, strengthening of joining grid of upper booms with angles, strengthening of upper longitudinal connections between trusses, reconstruction of portals that had been carried out by that time. It was noted that repair and painting of all piers had been completed by the moment of inspection (1959). The repair included cementation of individual piers, repair of transverse pier connections and installation of inspection ladders between individual pier columns. The recommendation was given in the report to remove rail levelling instruments located on every other span.

In 1966 span structures of the bridge were inspected and partially tested by the experts of ЛЖБК МИИТ[2]. It was shown in the bridge history (report of МИИТ), 1966) that the span structures had been strengthened 3 times by that time. Transverse beams were strengthened in 1937-1942 by adding two horizontal sheets, "voterens" were replaced with bridge beams. In 1956-58, the joining grid of upper booms and struts was strengthened, the connection of elements in 3'-4' to joint 3' was strengthened, intertruss connections bindings were strengthened, clearance was increased in accordance with 2-C, great amount of weak rivets in Б-П connections were replaced. In 1965 in view of installation of power line brackets, upper booms of main trusses were strengthened in end panels with two horizontal sheets.

Most 13

It was noted in the report that the "axes" in connections of transverse beams to main truss joints were damaged by an excavator jib in the result of train passing in 1966. The table of element classes obtained in 1953 by the Bridge Design Bureau of ЦП МПС is presented in the same report.

[1] ЦП МПС - Central Permanent Way Department of the MPS (Ministry of Rail Transport)
[2] ЛЖБК МИИТ - specialised laboratory of the Moscow Rail Engineer Institute (МИИТ)

Table 1.4

Element	cm^2	Class		Element	cm^2	Cross-section class	Notes
		As to cross-section	As to connection				
							Compression of joint Compression out of joint Tension Compression in joint Compression out of joint Tension Compression in joint Compression out of joint Tension Compression in joint Compression out of joint

Longitudinal beam class according to the same data:
As to bending moment - 7.86
As to lateral force - ~~10.61~~ 10.61
As to connection to П on Б wall - 8,56
As to rivets in П wall - 20,6
It is noted in (ЛЖБК МИИТ) report that the major damage of the main span structure trusses by 1966 was loosening of rivets in the connections of Ð5'-6 and Ð8-9' struts to the upper joints. During the inspection, 169 weak rivets were detected in the first rows of connections.

Most 17

...are situated, as a rule, along the boom of a transverse beam in the direction from rivet hole edges of the first row of "fish" connections to the booms of longitudinal beams over all or a part of a "fish" width.
In position No 21:
- in the connection of the right Б11 to П12 - the crack starts from the edge of the hole in first row and runs to the outer edge of the "fish" (Fig. 2.6); no crack is detected on the inner edge of the "fish". The break of the second rivet head of the "fish" connection to the upper boom Б (Fig. 2.6);
- in the connection of the left Б11 to П12 - the crack crosses the whole "fish" along the first row of rivet holes; strong corrosion of the "fish" is also detected in the area of crack formation;
- in the connection of the left Б13-14 to П13 - the crack similar to the above one (Fig. 2.6).

In position No 23: in the connection of the right Б1-2 to П1 - the crack starts from the hole edge of the first row rivet, crosses the whole "fish" transversely and runs to its inner and outer edges. From the inner side, the crack runs out at the blade of boom angle Б opposite the second from П rivet of "fish" connection and runs diagonally at the small angle with respect to the angle blade to the inner edge of the "fish"; the экскаватора были повреждены "топорики" в прикреплении поперечных балок к узлам главных ферм.

В том же отчете приведена таблица классов элементов, полученных в 1963 году мостовым проектным бюро ЦП МПС.

Таблица 1.4

Классы элементов, 1963 год

Эл-т ELEMENT	См² cm²	Класс CLASS		Эл-т ELEMENT	См² cm²	Класс по сечению CROSS SECTION CLASS	Примеч.
		По сеч. CROSS SECT.	По прикр. CONNECTION				
В1′-2′	223	8,92	7,8	Р0-1′	268	10,5	Сж. узла 1)
В2′-3′	223	-"-	-"-	Р0-1′	261	9,75	Сж. вне узла 2)
В3′-4′	376	8,6		Р1′-2	157,8	7,03	Растяж. 3)
В4′-5′	376	8,6	7,8	Р2-3′	172,3	10,?7	Сж. в узле 1)
В5′-7′	355	8,44	7,33	Р2-3′	147	8,36	Сж. вне узла 2)
Н0-2	171	12,75		Р3′-4	111,3	8,35	Растяж. 3)
Н2-3	242	7,13		Р4-5′	116,1	11,50	Сж. в узле 1)
Н3-4	255	7,7		Р4-5′	86	8,?5	Сж. вне узла 2)
Н4-5	312	7,75		Р5′-6	72,8	6,03	Растяж. 3)
Н6-7	342	7,79		Р6-7′	95,9	12,65	Сж. в узле 1)
[illegible]	51,35	8,25		Р6-7′	66,5	8,90	Сж. вне узла 2)

По тем же данным класс продольных балок:

По изгибающему моменту - 7,86

По поперечной силе - 10,61

По прикреплению к П в стенке Б - 8,56

По заклепкам в стенке П - 20,6

1) COMPRESSION OF JOINT
2) COMPRESSION OUT OF JOINT
3) TENSION

В отчете ЛЖБК МИИТа отмечено, что основным повреждением главных ферм пролетных строений к 1966 году являлось начавшееся массовое расстройство заклепок в прикреплениях раскосов Р5′-6 и Р8-9′ к верхним узлам. При обследовании было обнаружено 169 слабых заклепок в первых рядах прикреплений. Отмечалось начало работы

crack doubles on the outer side near the blade of the boom angle: one runs along the blade, and the other one - reaches the edge of the "fish" near П boom.
In position No 25: in the connection of the right Б1-2 to П1 - from the outer side, edge of the "fish" hanging over the boom angle is chopped off (Fig. 2.7); on the inner side - the crack runs out at the blade of the angle along П boom and comes to an end 4 cm from the edge of the "fish".

Most 19

4. Loosening, head break, lack of rivets joining the "fishes" with the upper booms of longitudinal beams:
- on position No 21 in the connection of the right Б11-12 to П12 - break of head (from below) of the second from П rivet of the connection to the outer side Б (Fig. 2.6.); the same damage is detected on position No 25 in the connection of the left Б0-1 to П1;
- on position No 24 in the connection of the right and left Б13-14 to П 14 the rivets nearest to П are absent from the inner and outer sides (4 pieces); the same is on position No 25 in the connection of both Б0-1 to П0;
- on position No 25 in the connection of the left Б11-12 to П11 on the inner side - the third from П rivet is loosened, which, besides the "fish", fastens shaped element of longitudinal bonds between Б.
5. In the connections of the longitudinal beams to the transverse ones, many rivets both on П and Б walls are replaced with high-strength bolts, some rivets are weakened or have torn off heads.
Data concerning damaged or replaced rivets are shown hereinafter; the numbering of rivets starts from the lower boom П, including the rivets in the "table".
The following damages of rivets on the wall П are detected:
- on position No 4 in the connection of the right Б to П6 on the inside - the head of the fifth rivet is torn off (it was replaced immediately with the high-strength bolt by the bridge repairing team);
- on position No 19 in the connection of the right Б to П11 on the outer side - the signs of the rivets No 2, 3 and 4 loosening;
- on position No 22 in the connection of the right Б to П11 on the outer side - the signs of the rivet No 3 loosening;

Most 20

- on position No 23 in the connections of the left Б on the outer side to:
- П2 - the fifth rivet has the signs of loosening (the neighbouring rivet is replaced with high-strength bolts);
- П 12 - the signs of the 4th, 5th and 6th rivets loosening;
- П 12 - the signs of the 2nd and 3rd rivets loosening;
- on position No 24 in the connection of the right Б to П5 on the outer side - the third rivet has the signs of loosening (the neighbouring rivets from 4th to 7th are replaced with high-strength bolts).

The list of the rivets on the П wall replaced with high-strength bolts is given in Table 2.6.

The following loosenings and defects of the rivets on Б wall (considering the "table" wall) are detected:

- on position No 19 on the wall of the left Б1-2 near П2 - the first rivet is missed (the hole is not completely drilled);
- on position No 23 on the wall of the right Б1-2 near П1 - The rivets from 4th to 9th are loosened, signs of corrosion along the blade of connection angle (the "fish" in the connection of that Б to П1 is also strongly damaged - refer to p.3);
- on position No 23 on the wall of the right Б7-8 near П8 - the signs of the 4th, 5th and 6th rivets loosening.

The list of the rivets on the Б wall replaced with high-strength bolts is represented in Table 2.7.

6. Loosening and defects of the upper boom rivets of longitudinal beams:
- on position No 9 in the left Б4-5 near П5 - signs of weakening (corrosion sags from the boom angle) of three rivets nearest to П;
- on position No 11 in the right Б13-14 in the middle of the panel - one loosened rivet (fixing both boom and stiffener);

Most 24

...(individually for left and right sides) and nature of damages are shown in Table 2.9.

As one can see from the Table, 34.8% of total amount of angles of rolling track suspensions are damaged and their number is rapidly increasing.

12. In the connections of the lower bearing "table" to Б boom and its connections to the lower "fish" of some span structures, the rivets are replaced with high-strength bolts (Fig. 2.14). The greatest number of such high-strength bolts are located on position No 14: 207 pcs. in the connection to the lower boom Б; 224 pcs. in the connection of the upper angles to the "table" wall. According to the information obtained from track inspection, strength bolts placing was carried out while strengthening the connection of Б to П ("table") due to low quality of previous riveting.

2.2.3. The results of ground based span structures inspection.

The ground based span structures No 1 and 26 are in satisfactory condition; no essential damage effecting capacity is detected. The corrosion of the upper horizontal sheets of the main beams is of a surface nature, the resulting sheet damage is no more that 10% of their cross-section.
Damage of the upper plates is detected while inspecting supporting elements of span structures. Near the left supporting element of the abutment No 0, the plate is cleaved in two parts by inclined crack (Fig. 2.15); the similar damage is near the supporting element of the abutment No 26, and the elements of the beam lower boom are deflected in the point of resting upon the plate.
The last bridge beam of the left bank span structure (near the cabinet wall) is resting on the short beams made of angle 160 x 160 x 20 which are welded to the butt ends of the main beams with vertical joints. When train is running, these angles are strongly deformed, and this point of resting of the last bridge beam is unreliable.

Most 25

Table 2.9. Damages of angles of rolling track suspensions for inspection trolley.

Span structure No	Side	Number of damaged angles and their connections		Nature of damage
		Inclined	vertical	
		left		cracks
		right		
				cracks
				complete fracture
				cracks
				cracks
				complete fracture

Most 26

				cracks
				one connection rivet is loosened
				complete fracture
				cracks
				complete fracture
				cracks
				one connection rivet is loosened
				cracks
				complete fracture
				cracks
				complete fracture
In all for the whole bridge				cracks
				complete fracture
				loosened connection rivets

Most 28

2.3. The results of inspection of supporting elements of channel span structures.

The inspection of stationary supporting elements has not revealed any defect or damage.
While inspecting movable supporting elements, relative position of the lower balance beam, carriage with rollers, and lower supporting plate was determined. Measurements were carried out in sunny, windy weather, at the temperature about +20°C. Besides that, attention was paid to the integrity of axial bolts connecting rollers and carriage and condition of rolling surface. Measurements and inspection were carried out for the most of supporting elements; the rest were not inspected in details because of inaccessibility of the rollers due to design of their cases. The cases of all supporting elements of span structures No 21-25 are all-riveted, stationary, lids of some other cannot be opened. After the results of the measurements of supporting elements positions, the values of relative displacements of lower balance beams, carriages and supporting plates are calculated, the results are presented in Table 2.10.
According to the analysis of obtained results, all movable supporting elements are in position close to the normal one corresponding to the temperature of air and span

Таблица 2.9

Повреждения уголков подвеса путей катания смотровой тележки

Пролетное строение NN	Сторона	Количество поврежденных уголков и их прикреплений		Характер повреждений
		наклонных	вертикальн.	
1	2	3	4	5
1	левая	11	1	трещины
	правая	6	1	
2	левая	10	—	— " —
	правая	8	—	
3	левая	16	—	— " —
	правая	18	—	
4	левая	16	—	— " —
	правая	10	1	
5	левая	11	—	— " —
	правая	10	—	
6	левая	11	—	— " —
	правая	7	—	
7	левая	11	—	— " —
	правая	8	—	
8	левая	15	—	— " —
	правая	14	—	
9	левая	23	—	— " —
	правая	18	—	
10	левая	19	—	— " —
	правая	23	—	
11	левая	23	1	— " —
	правая	21	—	
12	левая	16	1	трещины
	левая	—	1	полный разрыв
	правая	14	—	трещины
13	левая	21	—	трещины
	правая	19	2	
14	левая	27	—	— " —
	правая	27	—	
	правая	—	2	полный разрыв

Продолжение таблицы 2.9

1	2	3	4	5
15	левая	29	—	трещины
	правая	26	2	
16	левая	25	2	—"—
	правая	24	—	
	правая	—	1	одна слаб. заклепка прикрепления
	левая	—	1	полный разрыв
17	левая	—	1	—"—
	левая	26	—	трещины
	правая	17	1	
18	левая	28	1	—"—
	правая	27	1	
	левая	—	1	полный разрыв
	правая	—	2	
19	левая	21	2	трещины
	правая	26	—	
20	левая	32	1	—"—
	правая	28	—	
21	левая	32	—	—"—
	правая	24	1	
	правая	—	1	одна слаб. заклепка прикрепления
22	левая	26	—	трещины
	правая	24	1	
	левая	—	1	полный разрыв
	правая	1	1	
23	левая	28	1	трещины
	правая	23	—	
24	левая	22	—	—"—
	правая	27	—	
25	левая	33	—	—"—
	правая	27	—	
	правая	—	1	полный разрыв
Итого по всему мосту		1011	20	трещины
		1	11	полный разрыв
		—	2	слабые заклепки прикреплен.

structure metal. The maximum displacement values for axes of lower balance beams and carriages with rollers relative to supporting plates axes are 33 and 20 mm respectively. Displacement values for the pier No 19 inclined to the right with respect to the bridge axis were measures twice for each supporting element - on the inner and outer side.

Most 29

Table 2.10.
Values of relative displacements of lower balance beams and supporting plates of movable supporting elements.

Span No	On the pier No	Balance beam axis displacement relative to supporting plate axis Δ_1, mm; "+" - from the span "-" - into the span		Carriage with rollers displacement relative to supporting plate axis Δ_2, mm; "+" - from the span "-" - into the span	
		left	right	left	right

Most 30

It is determined that there is a small misalignment of rollers and balance beams relative to supporting plates - up to 10 mm.
Axis bolt fixing roller to the carriage of the last roller in the span on the pier No 2 in the right movable supporting element is cut down on the inner side.
The condition of rolling surface is good and meets the requirements of the "Artificial construction maintenance regulations".

Most 31

2.4. The results of piers inspection.

The inspection of bridge piers was carried out by the team of experts of the Chair of Bridges of the МИИТ in April 1990 and October 1991. The inspection of underwater part was carried out by the specialists of (ЦП МПС) divers' station in November 1990 and March 1991.
Layouts of bridge passage as on April 1990 and March 1991 are shown in Fig. 2.16 and 2.17. The results of depth measurements near piers obtained by channel station during the period of fulfilment of the present work are shown in Table .
Stone caps. Each round stone cap is 270 cm in diameter and consists of a plane masonry plate and two draining plates inclined in respect to the truss axis. In the most of the caps (besides the cases noted below), joints between individual blocks are dense by appearance, there are no cracks or gaps in joints, specific "jingling" sound is heard when beating caps with hammer.
The lower supporting plates of supporting elements are mounted in the recesses of stone caps without anchor bolts. The places of contact of supporting plates and granite on all the piers are dense by appearance without any cracks, tear-outs, destructions. On some caps, the places of contact of supporting parts with stone are cemented.

Таблица 2.10

Величины взаимных смещений нижних балансиров и опорных плит подвижных опорных частей

Пролет NN	На опоре NN	Смещение оси балансира относительно оси опорной плиты Δ1, мм „+" из пролета; „–" в пролет		Смещение каретки с катками относительно оси опорной плиты Δ2, мм „+" из пролета; „–" в пролет	
		левая	правая	левая	правая
1	1	+23	+21	+12	+14
2	2	+3	–5	–3	+4
3	3	–6	–22	+1	–2
4	4	+1	+5	–4	+10
5	5	–15	–27	–8	–6
6	6	–14	–13	–7	–3
7	7	–19	–4	–11	–2
8	8	+3	+5	–17	–10
9	9	+21	+28	+12	+12
10	10	—	+20	—	–3
11	11	—	—	—	—
12	12	+15	—	+5	—
13	13	–8	–26	0	–2
14	14	+25	+27	+10	+10
15	15	–6	–6	–4	+1
16	16	+7	—	–8	—
17	17	–33	–9	+3	–7
18	18	–5	–8	0	+3
19	19	+23/+33	–25/–32	+10/+20	–10/–5
20	20	+31	+21	–11	+6

The major attention was paid to the condition of stone caps and contact of supporting elements with them on the pier No 19 that was inclined in 1919 due to a disastrous erosion. Supporting elements on that pier are displaced by 35 cm relative to the centres of caps transverse to the axis of a passage in the direction of river flow. Here, the bearing pressure is transferred partially to the blocks of a drainage besides heavy duty blocks of masonry plate. No serious disturbance in resting of supporting elements plates upon pier No 19 caps was detected.

Most 32

Layout of bridge passage according to the data of channel station (April 1990).

Most 33

Layout of bridge passage according to the data of channel station (March 1991).

Most 34

Table 2.11

The results of depth measurements near piers (m)

Year Pier
Month
March
April
may
June
July
August
September
October
November
December
January
February
March
April
may
June
July
August
September
October

Most 45

The inspection of the lateral surface of foundation coating of the same pier using a rigid probing rod has shown that coating metal at the depth of one meter has no considerable corrosion damage. The investigated metal surfaces, always situated below water or flooded soil level, are less corroded comparing with the surfaces situated in the zone of variable water level.
In April 1991 while inspecting piers, the recess was made in the forth (from the top) layer of the pier No 9 top column. The recess 42x42 cm in size was on the transverse axis of the pier, its lower edge was on the level of the midheight of the forth layer of the above-foundation part. The opening was made after water pumping from the pit near the pier, before that the level of water was on the level of the middle of the 4th pier (Fig. 2.27).
Coating surface in the opening zone on the level of variable water level is strongly corroded. Rivet heads of vertical cover-plates near the recess are corroded by approximately 3/4 (Fig. 2.28). The part of the coating, that was cut out, appeared to be dry from within and covered remainders of paint. The thickness of the cut part strongly corroded from the outer side, measured over the whole perimeter, was 10.5 - 11 mm (design thickness is 1/2" or 12.7 mm). Dry, high quality rubble masonry was opened which was hardly effected when using electrical pick-hammer. At the depth of 44.5 cm from the coating surface, vertical angle was opened with the size of the wing 75 mm (Fig. 2.29). The opening of the angle has revealed that the joining

Данные промеров глубин у опор (м)

Таблица 2.11

год	опора / мес	уст	1	2	3	4	·	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	уст
	март	0,9	0.5	0.5	0.9	0.5												5.0	8.0	6.5	5.6	5.3	10.4
	апрель	1,3	0.9	0.9	1.5	0.9												5.8	6.6	7.0	5.9	4.9	5.2
	май	2.3	1.7	1.7	2.3	1.7											9.3	8.7	10.5	10.0	11.8	9.7	4.6
0	июнь	2.0	1.7	1.7	2.3	1.7										9.5	9.1	8.4	9.0	8.7	6.7	10.6	5.1
	июль	2.3	1.7	1.7	2.3	1.7						4.2	10.7	9.1			11.5	9.8	9.2	6.8	6.9	13.0	5.0
9	август	2.0	1.5	1.5	1.9	1.5								4.9	8.8	7.9	7.8	8.5	6.4	6.7	6.6	12.1	3.5
	сент	1.5	0.9	0.9	1.6	1.0						6.3	7.5	8.5	7.6	3.9	2.1	5.8	5.8	6.0	8.5	7.6	1.3
9	окт	0.9	0.6	0.8	1.4	0.8						6.3	7.5	8.2	7.6	4.0	0.5	3.6	3.6	4.9	8.4	5.3	1.1
	ноябрь	0.9	0.3	0.3	0.9	0.3						6.5	6.5	5.3	4.0	4.3	2.6	2.9	2.9	3.5	4.1	7.7	1.4
1	декабрь	1.0	0.2	0.2	0.8	0.3						6.9	7.8	6.2	4.0	2.4	2.6	3.5	3.0	3.0	3.4	7.7	1.3
	январь	0.7	0.2	0.1	0.7	0.2						7.0	7.7	5.8	2.2	0.2	1.3	1.9	1.9	2.7	5.0	5.8	0.6
	февраль	0.8	0.2	0.2	0.8	0.1						4.7	5.8	5.2	2.5	1.7	2.4	1.5	2.3	4.0	5.7	5.7	1.0
1	март	0.6	0.6	0.1	0.1	0.7						7.0	7.4	5.7	2.3	0.7	1.5	1.9	1.9	2.7	5.0	5.9	0.5
	апрель	2.2	2.2	1.6	2.2	1.9						2.6	5.2	6.7	7.9	8.5	7.5	6.0	5.2	7.3	6.8	8.9	2.3
9	май	2.5	1.9	1.9	2.5	1.9						9.3	11.6	8.3	7.5	6.2	5.0	5.8	6.5	6.3	8.8	9.6	1.6
	июнь	2.4	2.4	1.8	2.4	1.8			2.0	2.3	11.1	9.0	8.9	8.0	8.1	5.2	5.0	5.5	5.6	5.8	9.0	13.8	4.9
9	июль	2.1	1.6	2.2	2.2	1.6			9.5	11.0	8.5	7.5	5.6	4.9	4.5	3.7	3.2	4.2	4.2	5.2	9.0	13.6	4.6
	август	2.1	1.5	1.5	2.1	1.5			9.1	7.9	6.8	5.4	4.2	4.0	4.2					6.5	8.2	12.0	4.1
1	сент	1.7	1.2	1.2	1.7	1.2		0.7	8.6	7.8	6.3									3.0	8.5	9.1	3.9
	октябрь	1.2	0.6	1.2	0.6			6.9	6.5	5.0	3.4								5.2	6.1	8.4	8.0	2.4

9.1

structure of the above-foundation and foundation parts of the pier, that was built first during construction, corresponds to the design (Fig. 1.17).

Most 49

Inspection of underwater part of the piers was carried out by the specialists of the Repair and Inspection Pilot Station of ЦП МПС. The results of underwater inspection of pier coating and inspection of foundation and above-foundation parts joint at low water level are shown in their report (annex No 4). The results of pier No 24 coating opening carried out in 1984, as well as the ideas concerning the design of that pier coating joint, that differs from the initial design according to the results of the opening, are also shown.
The conclusion was made after the results of pier metal surfaces inspection carried out by divers that coating metal of underwater part of the piers is in good condition; through corrosion of pier coating and other considerable damages in the underwater part were not detected.
The inspection of the bridge abutments has shown that there are cracks between individual stones of the covering masonry. On the right-bank (Farab) abutment, the block of a cordon stone on the front face of the revetment wall lower side has separated from the masonry and is displaced towards the span. This damage is partially eliminated by cementing joints. There are cracks in masonry stones of the same pier revetment wall.

Most 51

2.6. Metal and concrete quality assessment

2.6.1. Span structures metal quality assessment

The most important design parameters in the method of limiting states are design resistances. Both welding iron and ingot steel were in use when the bridge was built, the speed-torque characteristics of which differ considerably. There are no reliable data concerning the metal of span structures and its quality.
Considering the above, as well as taking into account the importance of the construction, the main design resistance of the metal of span structures was obtained basing on the results of detailed material investigations in laboratory conditions. 30 metal samples were taken from unstrained zones of working elements (booms, struts, etc.) of span structures No 2, 4, 5, 10, 24. Metal samples 5x15 cm in size were cut out using cutting torch in accordance with the "Table of sample cutting out" shown in Annex No 1.
The laboratory investigations included:
- chemical analysis;
- structural analysis
- speed-torque characteristics determination.
Basing on the chemical analysis of span structures metal samples, the following percentage composition of main chemical elements is determined (Annex 1):
Carbon - C - 0.051-0.13%
Manganese - Mn - 0.33-0.54%
Silicon - Si - 0-0.05%
Phosphorus - P - 0.058-0.12%
Sulphur - S - 0.051-0.062%.

Most 58

It should be noted that the results of the tests conform with the results obtained previously while investigating ingot steel produced before 1905 and used in other bridges, but there is a great variation of characteristics of the bridge metal.
The main characteristic defining the first limiting state as to metal span structures strength is yield limit.
The main design resistance of metal, when estimating bridge capacity, may be considered R_0=R', where R' - the smallest value of yield limit, the probability of which is no more than 0,0014. In the case of normal distribution σ_t

$$R' = m\sigma_t - 3\sigma_s = 271.5 - 3 \cdot 32.47 = 174 \text{ MPa}$$

Basing on this, the main design resistance of span structure metal in capacity calculations is taken as R = 174 MPa, that is lower than value recommended by "Instructions on Capacity Calculation of Railway Bridge Metal Span Structures", 1987, for that type of metal (ingot steel produced before 1906), according to which R_0 = 185 MPa.

Most 59

2.6.2. Assessment of Intermediate Piers' Rubble and Brick Masonry Quality.

Recesses were made in piers No 9 and 10 in April 1990 and October 1991 in order to assess the quality of rubble and brick masonry of inner filling of piers' covering. The results of the inspection are shown in Section 2.4. of the present Report.
The strength of rubble and brick masonry was defined by non-destructive method using Schmidt sclerometer. Sclerometer readings, as well as the values of cubic strength of rubble and brick masonry obtained using calibration curves, are shown in Tables 2.17, 2.18. Average value (expected value) of cubic strength is 26.8 MPa for rubble masonry and 22.8 MPa for brick masonry. These values correspond to calculated resistance values R_b = 10.0 MPa for rubble masonry and R_b = 8.5 MPa for brick masonry [3].
When specifying design value of concrete strength to calculate joints of foundation and above-foundation parts of intermediate piers, it was taken into account that pier columns masonry operates within metal covering. That effects positively filling material and increases its supporting power. Besides that, joint damages were detected in many piers being the result of concrete quality deterioration in the places of above-foundation coatings resting on ring platforms through levelling pads at the depth no more than the size of ring platform, the inner diameter of which being d = 208 cm.
Considering the above, the design resistance of the material was specified as R_b = 0.9·85 = 76.5 kg/cm^2, where m_{tc} = 0.9 is the factor of operation condition of the pier. m_{tc} factor was specified in accordance with guide draft on determination of pier load-carrying capacity of railway bridges in operation.

Most 60

Strength determination of rubble masonry of pier No 10 3rd layer using Schmidt sclerometer.

Table 2.17

Reading in the moment of impact	
Cubic strength	

Average value (expected value) is 26.8 MPa

Strength Determination of concrete masonry of pier No 10 4th layer using Schmidt sclerometer.

Table 2.18

Reading in the moment of impact	
Cubic strength	

Average value (expected value) is 22.8 MPa.

Most 61

3. Assessment of Bridge Elements Load-carrying Capacity and Reliability

3.1. Load-carrying Capacity of Span Structures.

Most 64

Table 3.1.
Comparison of elements classes of span structures main trusses with load classes.

Element	Element classes			Load classes of II category	Load Classes of III category
	as to strength, stability	as to strength, stability, considering wind brake load	as to durability		

Определение прочности склерометром Шмидта бутовой кладки 3 - го яруса опоры № I0

Таблица 2.17

Отсчет при ударе	29	34	32	34	32	30	24
Кубиковая прочность	230	3I0	280	3I0	280	240	I50
Отсчет при ударе	33	33	32	3I	30	20	38
Кубиковая прочность	290	290	275	260	240	230	380

Среднее значение (математическое ожидание) 26,8 МПа

Определение прочности склерометром Шмидта бетонной кладки 4 -го яруса опоры № I0

Таблица 2.18

Отсчет при ударе	24	25	24	I7	26	22	29
Кубиковая прочность	I55	I70	I55	-	I80	I30	230
Отсчет при ударе	28	24	36	24	29	25	29
Кубиковая прочность	2I0	I55	340	I55	230	I70	230
Отсчет при ударе	27	38	38	34	40	I7	28
Кубиковая прочность	200	380	380	3I0	420	-	2I0
Отсчет при ударе	30	35	3I	29	26	-	-
Кубиковая прочность	240	325	260	225	I80	-	-

Среднее значение (математическое ожидание) 22,8 МПа

Таблица 3.1

Сравнение классов элементов главных ферм пролетных строений с классами нагрузки

Элемент	λ, м	α	Классы элементов: по прочности, устойчивости	Классы элементов: по прочности, устойчивости, в сочетании с ветровой и тормозной нагрузками	Классы элементов: по выносливости	Классы нагрузки II категории	Классы нагрузки III категории
Н 0-2	66,I4	0,07I	I4,I2	I0,88	I0,9I	7,I7	6,53
Н 2-3	66,I4	0,2I4	7,97	6,88	6,55	7,28	6,58
Н 3-4	66,I4	0,2I4	8,58	7,34	7,09	7,28	6,58
Н 4-5	66,I4	0,357	8,52	7,5I	7,06	7,38	6,6I
Н 5-6	66,I4	0,357	9,0I	7,95	7,49	7,38	6,6I
Н 6-7	66,I4	0,500	8,79	7,82	7,3I	7,48	6,65
В I'-2'	66,I4	0,I43	I0,63	II,03	–	7,23	6,55
В 2'-3'	66,I4	0,I43	8,I8	8,25	–	7,23	6,55
В 3'-5'	66,I4	0,286	8,39	8,44	–	7,33	6,59
В 5'-7'	66,I4	0,429	8,58	8,65	–	7,4I	6,63
Р 0-I'	66,I4	0,07I	8,90	7,I8	–	7,I7	6,53
Р I'-2	60,83	0,068	7,39	–	6,28	7,04	6,46
Р 2-3'	55,57	0,065	8,53	–	II,79	6,86	6,37
Р 3'-4	50,36	0,062	7,77	–	5,89	6,78	6,26
Р 4-5'	45,20	0,059	I0,33	–	I2,84	6,70	6,30
Р 5'-6	40,70	0,07I	7,2I	–	2,2I	6,75	6,50
Р 6-7'	35,62	0,07I	I2,67	–	4,26	6,98	6,62
С	9,45	0,500	8,07	–	3,56	6,I9	5,97

Most 85

General information about magnetic records made using strain resistors placed on the elements of span structure No 11.

Table 3.6.
1. Strain resistor No
2. Channel No
3. Strain resistor position
4. Figure No
5. Number of records
6. Full load
7. Mixed
8. Empty
9. Passengers'
10. Passengers', local
11. Individual locomotive
12. In all
13. Including braking on the bridge

Most 87

3.2.3. Analysis of Results of Span Structure Elements Fatigue Life Assessment

Most 88

Table 3.7.
Measure of damages accumulation in the element П13-2 during the whole period of bridge operation.

Most 100

3.3. Load-carrying Capacity of Piers.

Most 117

ANNEX No 1

Results of Laboratory Investigations of Metal Speed-torque Characteristics.

Approved by
Head of Track Service
of Middle Asia Railway

Общие сведения о магнитограммах, записанных с тензорезисторов, установленных на элементах пролетного строения № II

Таблица 3.6

№№ тензорезисторов	№№ каналов	Месторасположение тензорезисторов	№№ рисунка	Количество записанных реализаций							
				Полногрузные	Смешанные	Порожние	Пассажирские	Пассажирск. местные	Отдельный локомотив	Всего	В том ч. с торможением на мосту
I	2.	3	4	5	6	7	8	9	I0	II	I2
I	I	CI -I' внешняя ветвь у I'	3.3	3	36	3	9	II	9	7I	-
2	2	PI'-2 внешняя ветвь у I'	3.3	4	4I	3	II	I2	9	80	-
3		P3'-4 внешняя ветвь у 3'	3.2	3	36	3	9	II	9	7I	-
4	4	C5-5' внешняя ветвь у 5'		3	36	3	9	II	9	7I	-
5	5	P5'-6 внешняя ветвь у 5'	3.1	3	37	3	9	I2	9	73	-
6	6	H6-7 внутр.стенка у 7'	3.4	3	36	3	9	II	9	7I	-
7	I	P5'-6 внутр.ветвь у6	3.5	-	I	-	-	I	-	2	-
8	6	P5'-6 наружн.ветвь у6	3.9	-	I	-	-	I	-	2	-
9	2	"Рыбка" П7, Б6-7-2	3.6	I	8	I	3	2	-	I5	2
I0	6	Стенка Б6-7-2 у П7	3.6	I	8	I	3	2	-	I5	2
II	6	Вертикальная подвеска путей катания смотровой тележки	3.7	I	I3	I	6	2	I	24	-
I2	I	Наклонная подвеска путей катания смотровой тележки	3.7	I	I3	I	6	2	I	24	2

I	2	3	4	5	6	7	8	9	I0	II	I2
I3	4	Горизонт.полка нижнего поясного уголка П6 со стороны 5-6	3.7	I	I4	I	6	3	I	26	2
I4	5	Горизонт.полка нижнего поясного уголка ПI со стороны 0-I	3.8	I	II	I	6	2	I	22	2
I5	3	Горизонет.полка нижнего поясного уголка ПI со стороны I-2	3.8	I	II	I	6	2	I	22	2

ИТОГО: 589 реализаций

MOST88.PCX

Таблица 3.7

Мера накопления повреждений в элементе Р1'-2 за весь период эксплуатации моста

Тип поезда	Этапы эксплуатации, гг.		Макс. напряжения цикла	Кол-во поездов в блоке N тыс	Мера накопления повреждений от поездов 100000	поездов N	вагонов 100000	вагонов N
1	2	3	4	5	6	7	8	9
смешан.	1930-47	2.76	79.81	276.00	0.005066	0.013982	0.001239	0.003420
	1948-64	2.76	82.58	260.60	0.006218	0.016203	0.001701	0.004434
	1965-80	2.76	83.45	306.60	0.006619	0.020295	0.001748	0.005358
	1980-91	2.76	86.84	210.80	0.007809	0.016462	0.002330	0.004911
						0.066941		0.018123
полногр.	1930-47	2.76	71.32	13.20	0.004849	0.000640	0.000000	0.000000
	1948-64	2.76	73.81	12.50	0.005715	0.000714	0.000000	0.000000
	1965-80	2.76	74.58	14.70	0.006084	0.000894	0.000000	0.000000
	1980-91	2.76	77.61	10.10	0.007720	0.000780	0.000000	0.000000
						0.003029		0.000000
порожние	1930-47	2.76	71.80	26.20	0.003874	0.001015	0.000000	0.000000
	1948-64	2.76	74.30	24.70	0.004755	0.001174	0.000000	0.000000
	1965-80	2.76	75.08	29.10	0.005062	0.001473	0.000000	0.000000
	1980-91	2.76	78.13	20.00	0.006423	0.001285	0.000000	0.000000
						0.004947		0.000000
пассаж.	1930-47	2.76	53.61	84.10	0.001319	0.001109	0.000000	0.000000
	1948-64	2.76	62.56	79.40	0.002460	0.001953	0.000000	0.000000
	1965-80	2.76	62.56	97.30	0.002460	0.002393	0.000000	0.000000
	1980-91	2.76	69.52	66.90	0.003886	0.002600	0.000000	0.000000
						0.008055		0.000000
местные Чарджоу	1930-47	2.76	38.65	84.10	0.000000	0.000000	0.000000	0.000000
	1948-64	2.76	43.48	79.45	0.000000	0.000000	0.000000	0.000000
	1965-80	2.76	43.48	97.35	0.000000	0.000000	0.000000	0.000000
	1980-91	2.76	48.31	66.95	0.000623	0.000417	0.000000	0.000000
						0.000417		0.000000
местные Фараб	1930-47	2.76	32.84	84.10	0.000000	0.000000	0.000000	0.000000
	1948-64	2.76	36.94	79.45	0.000000	0.000000	0.000000	0.000000
	1965-80	2.76	36.94	97.35	0.000000	0.000000	0.000000	0.000000
	1980-91	2.76	41.05	66.95	0.000000	0.000000	0.000000	0.000000
						0.000000		0.000000
						0.083389		0.018123

Итого : V = 0.101512

13.3

Таблица 3.2

МЕРА НАКОПЛЕНИЯ ПОВРЕЖДЕНИЙ В ЭЛЕМЕНТЕ Р3'-4 ЗА ВЕСЬ ПЕРИОД ЭКСПЛУАТАЦИИ МОСТА

Тип поезда	Этапы эксплуатации, гг.		Макс. напряжения цикла	Кол-во поездов в блоке N тыс.	Мера накопления повреждений от			
					поездов		вагонов	
					100000	N	100000	N
1	2	3	4	5	6	7	8	9
смешан.	1930-47	2.88	69.64	276.00	0.003375	0.009315	0.000842	0.002324
	1948-64	2.88	73.56	260.60	0.004491	0.011703	0.001321	0.003441
	1965-80	2.88	73.56	306.60	0.004491	0.013769	0.001321	0.004049
	1980-91	2.88	76.70	210.80	0.005547	0.011693	0.001675	0.003530
						0.046480		0.013345
полногр.	1930-47	2.88	56.66	13.20	0.002171	0.000287	0.000000	0.000000
	1948-64	2.88	59.84	12.50	0.002791	0.000349	0.000000	0.000000
	1965-80	2.88	59.84	14.70	0.002791	0.000410	0.000000	0.000000
	1980-91	2.88	62.40	10.10	0.003566	0.000360	0.000000	0.000000
						0.001406		0.000000
порожние	1930-47	2.88	65.28	26.20	0.002983	0.000781	0.000000	0.000000
	1948-64	2.88	68.94	24.70	0.004107	0.001014	0.000000	0.000000
	1965-80	2.88	68.94	29.10	0.004107	0.001195	0.000000	0.000000
	1980-91	2.88	71.89	20.00	0.005246	0.001049	0.000000	0.000000
						0.004040		0.000000
пассаж. Чарджоу	1930-47	2.88	60.23	42.05	0.002190	0.000921	0.000000	0.000000
	1948-64	2.88	67.76	39.70	0.004362	0.001732	0.000000	0.000000
	1965-80	2.88	67.76	48.65	0.004362	0.002122	0.000000	0.000000
	1980-91	2.88	75.29	33.45	0.007472	0.002499	0.000000	0.000000
						0.007274		0.000000
пассаж. Фараб	1930-47	2.88	63.29	42.05	0.002257	0.000949	0.000000	0.000000
	1948-64	2.88	71.20	39.70	0.004497	0.001785	0.000000	0.000000
	1965-80	2.88	71.20	48.65	0.004497	0.002188	0.000000	0.000000
	1980-91	2.88	79.11	33.45	0.007322	0.002449	0.000000	0.000000
						0.007371		0.000000
местные Чарджоу	1930-47	2.88	36.58	84.10	0.000000	0.000000	0.000000	0.000000
	1948-64	2.88	41.16	79.45	0.000000	0.000000	0.000000	0.000000
	1965-80	2.88	41.16	97.35	0.000000	0.000000	0.000000	0.000000
	1980-91	2.88	45.73	66.95	0.000227	0.000152	0.000000	0.000000
						0.000152		0.000000
местные Фараб	1930-47	2.88	35.40	84.10	0.000000	0.000000	0.000000	0.000000
	1948-64	2.88	39.82	79.45	0.000334	0.000266	0.000000	0.000000
	1965-80	2.88	39.82	97.35	0.000334	0.000325	0.000000	0.000000
	1980-91	2.88	44.25	66.95	0.000518	0.000347	0.000000	0.000000
						0.000938		0.000000
						0.067662		0.013345

ИТОГО : V=0.081006

Таблица 3.9

МЕРА НАКОПЛЕНИЯ ПОВРЕЖДЕНИЙ В ЭЛЕМЕНТЕ Р5'-6
ЗА ВЕСЬ ПЕРИОД ЭКСПЛУАТАЦИИ МОСТА

Тип поезда	Этапы эксплуатации, гг.		Макс. напряжения цикла	Кол-во поездов в блоке N тыс.	Мера накопления повреждений от			
					поездов		вагонов	
					100000	N	100000	N
1	2	3	4	5	6	7	8	9
смешан. Чарджоу	1930-47	3.10	73.23	138.00	0.003280	0.004526	0.000972	0.001341
	1948-64	3.10	77.61	130.30	0.004560	0.005942	0.001479	0.001927
	1965-80	3.50	78.02	153.30	0.010279	0.015758	0.004565	0.006998
	1980-91	3.97	81.10	105.40	0.026104	0.027513	0.014272	0.015042
						0.053739		0.025308
смешан. Фараб	1930-47	3.10	64.38	138.00	0.003222	0.004447	0.000472	0.000652
	1948-64	3.10	68.23	130.30	0.004485	0.005844	0.000874	0.001138
	1965-80	3.50	68.59	153.30	0.010020	0.015360	0.002871	0.004400
	1980-91	3.97	71.30	105.40	0.025612	0.026995	0.010250	0.010804
						0.052646		0.016994
рефрижер.	1930-47	3.10	46.50	13.20	0.001175	0.000155	0.000000	0.000000
	1948-64	3.10	49.29	12.50	0.001952	0.000244	0.000000	0.000000
	1965-80	3.50	49.54	14.70	0.004486	0.000659	0.000000	0.000000
	1980-91	3.97	51.50	10.10	0.014101	0.001424	0.000000	0.000000
						0.002483		0.000000
порожние	1930-47	3.10	64.11	26.20	0.002797	0.000733	0.000000	0.000000
	1948-64	3.10	67.95	24.70	0.003877	0.000958	0.000000	0.000000
	1965-80	3.50	68.30	29.10	0.008571	0.002494	0.000000	0.000000
	1980-91	3.97	71.00	20.00	0.022061	0.004412	0.000000	0.000000
						0.008597		0.000000
пассаж. Чарджоу	1930-47	3.10	0.07	126.10	0.000000	0.000000	0.000000	0.000000
	1948-64	3.10	0.07	119.10	0.000000	0.000000	0.000000	0.000000
	1965-80	3.50	63.37	146.00	0.002849	0.004160	0.000000	0.000000
	1980-91	3.97	79.21	100.40	0.020065	0.020145	0.000704	0.000707
						0.024306		0.000707
пассаж. Фараб	1930-47	3.10	0.06	126.10	0.000000	0.000000	0.000000	0.000000
	1948-64	3.10	0.06	119.10	0.000000	0.000000	0.000000	0.000000
	1965-80	3.50	51.29	146.00	0.001753	0.002559	0.000000	0.000000
	1980-91	3.97	64.12	100.40	0.012633	0.012684	0.000000	0.000000
						0.015243		0.000000
						0.157013		0.043009

ИТОГО : V=0.200022

Таблица 3.10

МЕРА НАКОПЛЕНИЯ ПОВРЕЖДЕНИЙ В ЭЛЕМЕНТЕ С1-1'
ЗА ВЕСЬ ПЕРИОД ЭКСПЛУАТАЦИИ МОСТА

Тип поезда	Этапы эксплу-атации, гг.		Макс. напря-жения цикла	Кол-во поездов в блоке N тыс.	Мера накопления повреждений от			
					поездов		вагонов	
					100000	N	100000	N
1	2	3	4	5	6	7	8	9
смешан. Чарджоу	1930-47	2.83	68.33	138.00	0.005692	0.007856	0.006612	0.009125
	1948-64	3.49	57.62	130.30	0.009335	0.012163	0.013361	0.017409
	1965-80	3.49	54.11	153.30	0.006709	0.010284	0.008649	0.013259
	1980-91	3.49	58.50	105.40	0.010107	0.010653	0.016332	0.017214
						0.040956		0.057007
смешан. Фараб	1930-47	2.83	64.65	138.00	0.003463	0.004778	0.005762	0.007951
	1948-64	3.49	54.52	130.30	0.005199	0.006775	0.010663	0.013894
	1965-80	3.49	51.20	153.30	0.004190	0.006423	0.007654	0.011733
	1980-91	3.49	55.35	105.40	0.005629	0.005933	0.012725	0.013412
						0.023909		0.046991
полногр.	1930-47	2.83	57.12	13.20	0.002638	0.000348	0.000000	0.000000
	1948-64	3.49	48.17	12.50	0.004277	0.000535	0.000456	0.000057
	1965-80	3.49	45.23	14.70	0.003074	0.000452	0.000000	0.000000
	1980-91	3.49	48.90	10.10	0.004631	0.000468	0.000493	0.000050
						0.001802		0.000107
порожние	1930-47	2.83	59.74	26.20	0.002554	0.000669	0.000000	0.000000
	1948-64	3.49	50.38	24.70	0.004473	0.001105	0.000000	0.000000
	1965-80	3.49	47.31	29.10	0.003066	0.000892	0.000000	0.000000
	1980-91	3.49	51.15	20.00	0.004843	0.000969	0.000000	0.000000
						0.003634		0.000000
пассаж. Чарджоу	1930-47	2.83	35.56	42.05	0.000000	0.000000	0.000000	0.000000
	1948-64	3.49	40.01	39.70	0.003247	0.001289	0.000000	0.000000
	1965-80	3.49	40.01	48.65	0.003247	0.001580	0.000000	0.000000
	1980-91	3.49	44.46	33.45	0.004945	0.001654	0.000000	0.000000
						0.004523		0.000000
пассаж. Фараб	1930-47	2.83	43.22	42.05	0.000420	0.000177	0.000000	0.000000
	1948-64	3.49	48.62	39.70	0.004027	0.001599	0.000000	0.000000
	1965-80	3.49	48.62	48.65	0.004027	0.001959	0.000000	0.000000
	1980-91	3.49	54.02	33.45	0.007315	0.002447	0.000000	0.000000
						0.006181		0.000000
местные Чарджоу	1930-47	2.83	39.80	84.10	0.000000	0.000000	0.000000	0.000000
	1948-64	3.49	44.78	79.45	0.001326	0.001053	0.002010	0.001597
	1965-80	3.49	44.78	97.35	0.001326	0.001291	0.002010	0.001957
	1980-91	3.49	49.75	66.95	0.002307	0.001544	0.003497	0.002341
						0.003888		0.005895
местные Чарджоу	1930-47	2.83	39.80	84.10	0.000000	0.000000	0.000000	0.000000
	1948-64	3.49	44.78	79.45	0.000000	0.000000	0.000000	0.000000
	1965-80	3.49	44.78	97.35	0.000000	0.000000	0.000000	0.000000
	1980-91	3.49	49.75	66.95	0.000000	0.000000	0.000000	0.000000
						0.000000		0.000000
						0.084894		0.109999

ИТОГО : V=0.194893

Таблица 3.11

МЕРА НАКОПЛЕНИЯ ПОВРЕЖДЕНИЙ В ЭЛЕМЕНТЕ С5-5'
ЗА ВЕСЬ ПЕРИОД ЭКСПЛУАТАЦИИ МОСТА

Тип поезда	Этапы эксплуатации, гг.		Макс. напряжения цикла	Кол-во поездов в блоке N тыс.	Мера накопления повреждений от			
					поездов		вагонов	
					100000	N	100000	N
1	2	3	4	5	6	7	8	9
смешан. Чарджоу	1930-47	2.96	66.23	138.00	0.005891	0.008130	0.005891	0.000000
	1948-64	3.78	55.85	130.30	0.020073	0.026155	0.020073	0.000000
	1965-80	3.78	52.45	153.30	0.009643	0.014783	0.009643	0.000000
	1980-91	3.78	56.70	105.40	0.021655	0.022924	0.021655	0.000000
						0.071891		0.000000
смешан. Фараб	1930-47	2.96	54.14	138.00	0.003026	0.004177	0.003026	0.000000
	1948-64	3.78	45.65	130.30	0.009961	0.012979	0.009961	0.000000
	1965-80	3.78	42.87	153.30	0.005680	0.008707	0.005680	0.000000
	1980-91	3.78	46.35	105.40	0.010746	0.011327	0.010746	0.000000
						0.037190		0.000000
воннегр.	1930-47	2.96	47.30	13.20	0.000535	0.000071	0.000000	0.000000
	1948-64	3.78	39.89	12.50	0.001650	0.000206	0.000000	0.000000
	1965-80	3.78	37.46	14.70	0.000981	0.000144	0.000000	0.000000
	1980-91	3.78	40.50	10.10	0.002047	0.000207	0.000535	0.000054
						0.000628		0.000054
порожние	1930-47	2.96	41.87	26.20	0.000305	0.000080	0.000000	0.000000
	1948-64	3.78	35.31	24.70	0.001198	0.000296	0.000000	0.000000
	1965-80	3.78	33.16	29.10	0.000761	0.000221	0.000000	0.000000
	1980-91	3.78	35.85	20.00	0.001532	0.000306	0.000000	0.000000
						0.000904		0.000000
пассаж. Чарджоу	1930-47	2.96	24.40	42.05	0.000000	0.000000	0.000000	0.000000
	1948-64	3.78	27.45	39.70	0.000000	0.000000	0.000000	0.000000
	1965-80	3.78	27.45	48.65	0.000000	0.000000	0.000000	0.000000
	1980-91	3.78	30.50	33.45	0.000644	0.000216	0.000000	0.000000
						0.000216		0.000000
пассаж. Фараб	1930-47	2.96	32.61	42.05	0.000000	0.000000	0.000000	0.000000
	1948-64	3.78	36.68	39.70	0.000671	0.000266	0.000000	0.000000
	1965-80	3.78	36.68	48.65	0.000671	0.000326	0.000000	0.000000
	1980-91	3.78	40.76	33.45	0.001265	0.000423	0.000000	0.000000
						0.001016		0.000000
местные Чарджоу	1930-47	2.96	26.70	84.10	0.000000	0.000000	0.000000	0.000000
	1948-64	3.78	30.03	79.45	0.000000	0.000000	0.000000	0.000000
	1965-80	3.78	30.03	97.35	0.000000	0.000000	0.000000	0.000000
	1980-91	3.78	33.37	66.95	0.000944	0.000632	0.000000	0.000000
						0.000632		0.000000
местные Фараб	1930-47	2.96	31.03	84.10	0.000000	0.000000	0.000000	0.000000
	1948-64	3.78	34.91	79.45	0.000737	0.000586	0.000000	0.000000
	1965-80	3.78	34.91	97.35	0.000737	0.000718	0.000000	0.000000
	1980-91	3.78	38.79	66.95	0.001064	0.000712	0.000000	0.000000
						0.002016		0.000000
						0.114492		0.000054

ИТОГО : 0.114546

Таблица 3.12

МЕРА НАКОПЛЕНИЯ ПОВРЕЖДЕНИЙ В ЭЛЕМЕНТЕ Н6-7
ЗА ВЕСЬ ПЕРИОД ЭКСПЛУАТАЦИИ МОСТА

Тип поезда	Этапы эксплу- атации, гг.		Макс. напря- жения цикла	Кол-во поездов в блоке N тыс.	Мера накопления повреждений от			
					поездов		вагонов	
					100000	N	100000	N
1	2	3	4	5	6	7	8	9
смешан.	1930-47	2.66	39.23	276.00	0.000000	0.000000	0.000000	0.000000
	1948-64	2.86	38.80	260.60	0.000000	0.000000	0.000000	0.000000
	1965-80	2.86	39.50	306.60	0.000000	0.000000	0.000000	0.000000
	1980-91	2.86	38.80	210.80	0.000000	0.000000	0.000000	0.000000
						0.000000		0.000000
полногр.	1930-47	2.66	35.59	13.20	0.000000	0.000000	0.000000	0.000000
	1948-64	2.86	35.20	12.50	0.000000	0.000000	0.000000	0.000000
	1965-80	2.86	35.83	14.70	0.000000	0.000000	0.000000	0.000000
	1980-91	2.86	35.20	10.10	0.000000	0.000000	0.000000	0.000000
						0.000000		0.000000
порожние	1930-47	2.66	32.55	26.20	0.000000	0.000000	0.000000	0.000000
	1948-64	2.86	32.20	24.70	0.000000	0.000000	0.000000	0.000000
	1965-80	2.86	32.78	29.10	0.000000	0.000000	0.000000	0.000000
	1980-91	2.86	32.20	20.00	0.000000	0.000000	0.000000	0.000000
						0.000000		0.000000
пассаж.	1930-47	2.66	27.01	84.10	0.000000	0.000000	0.000000	0.000000
	1948-64	2.86	30.39	79.40	0.000000	0.000000	0.000000	0.000000
	1965-80	2.86	30.39	97.30	0.000000	0.000000	0.000000	0.000000
	1980-91	2.86	33.76	66.90	0.000000	0.000000	0.000000	0.000000
						0.000000		0.000000
местные	1930-47	2.66	14.09	168.20	0.000000	0.000000	0.000000	0.000000
	1948-64	2.86	15.85	158.90	0.000000	0.000000	0.000000	0.000000
	1965-80	2.86	15.85	194.70	0.000000	0.000000	0.000000	0.000000
	1980-91	2.86	17.61	133.90	0.000000	0.000000	0.000000	0.000000
						0.000000		0.000000
						0.000000		0.000000

ИТОГО : V=0.000000

13.8

П Р И Л О Ж Е Н И Е I

Результаты лабораторных исследований механических характеристик металла

УТВЕРЖДАЮ:

Начальник службы ПУТИ
Средне-Азиатской Ж.Д.

Таблица вырезки проб металла мостового перехода через реку Аму-Дарью у г. Чарджоу

№№ проб	№ пролтроения	ферма лев/прав	элемент фермы	место вырезки проб
I	2	3	4	5
I	2	лев	0 - I	уголок внешней ветви у нижнего узла
2	2	прав	0 - I	_ "" _
3	2	лев	I - 2	_ "" _
4	2	лев	2 - 3'	_ "" _
5	2	лев	3' - 4	_ "" _
6	2	лев	4 - 5'	_ "" _
7	2	лев	5' - 6	_ "" _
8	2	лев	6 - 7'	_ "" _
9	2	лев	5 - 5'	_ "" _
I0	2	лев	4 - 5'	нижний уголок внешней ветви
II	2	лев	5' - 6	_ "" _
I2	2	лев	прод балка	уголок консоли прод балки
I3	2	прав	_ "" _	_ "" _
I4	5	лев	I - 2	уголок внешней ветви у нижнего поясф
I5	5	лев	3' - 4	_ " _
I6	5	лев	5' - 6	_ "" _
I7	5	лев	6 - 7'	нижний уголок внешн ветви
I8	5	лев	фасонка св	по месту
I9	5	прав	_ "" _	_ "" _

14.1

Annex E

TRACECA - MODULE C CHARDZHEV BRIDGE

ANNEX E
REVIEW OF MOSCOW BRIDGE INSTITUTE FEASIBILITY STUDY („MBIFS“)

containing 2 coverpages, table of contents, translated pages 1 to 33 (which are the numbers of pages in the Russian original).

СССР

МИНИСТЕРСТВО ТРАНСПОРТНОГО СТРОИТЕЛЬСТВА

ГЛАВТРАНСПРОЕКТ

Государственный ордена Трудового Красного Знамени
проектно-изыскательский институт по проектированию
и изысканиям больших мостов

„ГИПРОТРАНСМОСТ"

Инв. № 2602

Для служебного пользования
Экз. № 6
Экз. №№ 1,3,4,5,6 - Союздорпроекту
Экз. № 2 - Гипротрансмосту

— Cover page of the original —

ОБОСНОВЫВАЮЩИЕ МАТЕРИАЛЫ

строительства мостового перехода через реку
Амударью в районе города Чарджоу Туркменской
ССР

Варианты совмещенного и железнодорожного
мостов

ПОЯСНИТЕЛЬНАЯ ЗАПИСКА

МОСКВА

USSR

MINISTRY OF TRANSPORTING CONSTRUCTION

GLAVTRANSPROEKT

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of big bridges
bearer of the "order of the labour red banner"

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SUBSTANTIATING MATERIALS

of construction of bridging crossing over the Amudarya river
in the area of Chardzhev City of Turkmenian SSR

- Combined and railway bridges versions -

EXPLANATORY NOTE

MOSCOW

1982

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EXPLANATORY NOTE

1. *Introductory part*

The combined and railway bridge versions carrying-out as a part of "SUBSTANTIATING MATERIALS of construction of bridging crossing over the Amudarya river in the area of Chardzhev City of Turkmenian SSR" is executed by GIPROTRANSMOST institute in compliance with request for proposal of Sojuzdorproekt and according to agreement with it.

The following three ranges of bridge crossing over Amudarya river were considered:

- range 1 - up the river in a distance of 13 km from the existing railway bridge, in Yumalanda grove,
- range 2 - down the river in a distance of 250 m from the existing railway bridge,
- range 3 - up the river in a distance of 8 km from the railway bridge.

The diagram of the bridge crossing ranges location is given in the drawing No. 1.

The combined bridge versions are considered with all the ranges, the railway bridge versions are considered, in compliance with request for proposal, with range No. 2 only, but with calculations of their costs for ranges 1 and 3.

There are given two versions of combined bridges: for one - level driving and for two - level driving.

The railway bridge versions are considered with supports for single and double tracks / taking into account prospects / with span structures for single track, for design load C14.

The road train clearance limits is taken for SNiP P-D.5-72[2], table 43, for motor roads of category II G 11.5 /2+7, 5+2/ + 2x1.5 m, i.e. of 14.5 m wide.
The total width of the span structures on the top, including barriers and railings is 15.5 m.

The design temporary loads - 2 lines of motor load N-30 and crowd in the pavement 400 kg/m • or one truck NK-80 type on the span structure.

According to letter No. 3-12-347 of April 2, 1981 from The Central Asiatic steamship line Basin railroad administration the following underbridge clearance limit dimensions are adopted for bridges over Amudarya river in the area of Chardzhev City:

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[1] number of pages in the Russian original
[2] SNiP - Soviet standards for construction and design (СНиП)

clear width - 70 m,
height - 7.5 m above RSG[3].

In connection with roving navigating fairway the bridge must have an iso-span (symmetrical) plan.

According to SNiP II-7-81, Chardzhev City and settlement Farap are classified as seismic area with seismicity of 7 points.

The basic specifications for the design are following:
SNiP II D.7-62^{X}, SNiP II D.5-72, SNiP II A.7-81, SN 200-62, SN 365-67, SNiP III-4-30 "Safety engineering in building".

2. *The engineering - hydrological conditions* and the bridge crossing calculations are characterised with following data:

Maximal water flow rate in the river during freshet with repetition of:
1% - 9600 m^3/sec; 0.33% - 10400 m^3/sec.
The water flow speed - up to 4.0 m/sec.
The water flow rate drops during ebb in 15 - 20 times, flow speed is 0.8 - 1.0 m/sec.

The design elevations of water for the ranges

	Range 1	Range 3	Range 2
1%	192.46	191.23	189.27
10%	192.26	190.99	189.06
RSU[4]	191.66	190.70	188.80
Average ebb	189.91	188.89	187.25

Long - term freshet in the Amudarya river takes place from April to September with maximum water level in June - July.

In some years the maximum water level is in winter, as a result of ice jams, as, for instance in 1969.

The bed and banks of Amudarya river in the bridge crossing ranges area / to the exclusion of right bank for range No. 1/ consist of easy washing-out sandy and dusty soils and are remarkable for their regular intensive bedding vertical and planning deformations.

[3] abbreviation not clear (РСГ), some water level indication
[4] abbreviation not clear (РСУ), may be local average level

The usual average depth of water in the river bed within the fairway /which is often roving/ from ebb level is 6 - 7 m, dropping near the non-washing-out banks down to 3 - 4 m and raising near the washing-out banks up to 8 - 10 m.

The depths of concentrated wash-out reach in the natural conditions up to 13 - 16 m from the high water level, near through and streamlined obstacles - up to 13 - 20 m and near solid barriers - up to 25 - 30 m.

Amudarya river is seldom ice-covered in the area of Chardzhev City, it was from the time of 1886 only in 1900, 1916, 1930, 1949 and 1969.

As a rule, freeze-up is a number of ice coffer-dams on water surface, in some years the river branches are frozen and submerged off-shore ices of a few meters width are seen in the bed. The ice thickness in the bed is 5 - 6 cm, and in branches - 15 - 20 cm.

Partial ice cover is preserving not long in the river and is completing with sludge ice drifting. Ice drifting takes place in the river only in severe winters, where all the river is ice covered.

It was not seen dangerous influence of ice to banks' artificial structures and to railway bridge.

For further details please see separate report.

<u>3. *The bridge versions for range No. 2*</u>

The range No. 2 is located in a distance of 250 m from existing railway bridge down the river and is adopted as basic i.e. in accordance to request for proposal on this range the railway and combined bridge versions were considered. According to results of these versions consideration the adopted treatments were spreaded to other ranges.

The existing railway bridge was built in 1901. The Amudarya river is bridged with 27 metal span structures, which are girders with triangle grids, spans of 66 m with driving below on wooden bridge timbers. Each support has in its basements two round water lowering wells of 3.65 m diameter, which are lowered in 22 m below supports foundation mats bottom.

During the 80 - years usage of the bridge its bedding supports were repeatedly washed-out up to the wells blade level. The washed- out pits were filled with stones near supports.

The choice of the range near existing bridge place is based on the river bed stability over the 300 m from the existing railway road down the river with its sudden widening outside this area, the convenience of location of existing bridge close to existing railway stations Chardzhev and Farap and other facilities. In addition, there number of city public buildings are located down the river / culture club and so on/.

The 4 versions of railway bridge and 2 versions of combined bridge were considered for range No. 2.

The railway versions are remarkable for their spans 66 /version 1/ and 132 /version 2/ and for their supports - for single track /A/ and for double track /B/ taking into account prospects. The span structures in all the versions are provided for single track.

The choice of the span size is based on the new and existing bridges' alignment providing necessity, which will be existing simultaneously during r building and after it till the old bridge disassembly.

The cut girders with 66 m spans according to type design inventory number 690/4 are adopted for versions 1A and 1B.

The continuous span structures 2 x 132 m, according to recommended for repeated use GIPROTRANSMOST design, are adopted for versions 2A and 2B.

The railway bridges designs are characterised:
for versions 1A and 1B: - 27 x 66 m, the bridge length - 1780 m,
for versions 2A and 2B: - 38+ 6 x /2 x 132/ + 88 m, the bridge length - 1830 m.

The combined bridge versions No. 3 and 4' repeat the railway bridge version 2B /supports for two tracks/ with spans of 132 m - 38 +6 x /2 x 132/+ 38 m.

Version No. 3 for one level driving is differed from the version No. 2B for its wider supports and motor-road span structures of 15.5 m width with driving on the top.

The various designs of the span structures for motor load were considered during the carrying out: reinforced concrete, steel - reinforced concrete and metal continuous beam of constant height with orthotropic plate.

The reinforced concrete span structure in the form of polygonal box badly suits for railway girders, gives the substantial increasing of support reactions and requires increasing of poles in the supports basis and organization of two technologies of combined bridge span structures manufacture and mounting, and therefore were rejected.

Comparing of multyspan continuous steel - reinforced concrete and steel box section span structures according to unity of manufacturing and mounting technology and labour - intensity led to choice of steel construction with orthotropic plate of the driving part.

The supports of prefabricated monolithic reinforced concrete are common for all the span structures, with openings.

The supports base adopted after consideration of various types of bases /lowered wells, reinforced concrete shell piles of 0.6 m and 1.6 m in diameter, reinforced concrete drill packed poles of 1.5 m in diameter and with spreads of 3.5 m in diameter/, see section 6, are reinforced concrete shell piles of 1.6 m in diameter.

The version No. 4 for two driving levels is differed from the version No. 3 on the front for presence of driving part orthotropic plate of 15.5 m in diameter with panel of 11 m and reinforced concrete overpasses of 530 m length at the ends of the bridge instead of embankments of approaches for vehicles climb /descent/ to 13.4 m, with vertical curve R = 1000 m and angle tangent is 0.04.

The support body in cross - piece is designed two-poled in this version, as wide driving part in the second level requires to increase distance between axles of girder - structures in the first place and from 3.3 m to 13 m for the future. The foundation mat width and poles quantity in supports base are the same as in version No. 3.

In connection with complete hydrogeological conditions of the supports base building and use, the considerable depths of common and local wash-out and deep placing of the base poles, the designs with big spans of span structures, half as much supports quantity, i.e. with spans of 132 m were adopted as basic.

This principle, the span structures design, type of the supports base and supports body design are extended to ranges 1 and 3.

<u>4. *The bridge versions for range No. 3*</u>

The range No. 3 is located approximately in the middle between ranges No. 1 and No. 2 and crosses the river in the point, where the banks are stable with the bed width of approximately 1500 m.

The feature of the range is transport / especially transit/ traffic withdrawal out of the development area border of Chardzhev City.

The combined bridge versions design, which is adopted for the range, is 7 x / 2 x 132/ and it makes the bridge length of 1870 m, which is close to the bridge length for range No. 2.

The combined bridge versions No. 1 and 2 are identical with the versions No. 3 and 4 for ranges No. 2.

According to these versions the bridges are located on a platform.

Translation of the Text on the drawing (map of the bridge area)

1 - Zerger Station 2 - Talkhambazar 3 - settlement Karl Marx 4 - to Kerki 5 - The Chapaev Collective Farm 6 - to Huzhrab 7 - Chardzhev-1 Station 8 - Chardzhev City 9 - Chardzhev City development area border 10 - Range 2 11 - The Amudarya river 12 - Range 3 13 - Range 1 14 - Farap Station 15 - settlement Kyzylkashun 16 - settlement Kuybishev 17 - Yumalanda 18 - For service usage only, copy No. 6 19 - Turkmenian SSR 20 - Bukhara 21 - Uzbekistan SSR	22 - Amu-Bukhar Channel 23 - Scheme of the ranges of bridge crossing over the Amudarya river in the area of Chardzhev City 24 - Inventory number 2597sp 25 - Copy of Almaatagiprotrans versions scheme No. 265-I-143-DSP-82 sheet 61 26 - Chardzhev-2 Station 27 - settlement Komsomolsk 28 - settlement Proletaryat 29 - settlement Krupskaya 30 - settlement Dzhariev 31 - The Komsomol Collective Farm 32 - to Cotton Depot 33 - settlement Bolshevik 34 - The Lenin Collective Farm 35 - settlement Engels 36 - The Chief Engineer of the Design Krylov Y.K. 37 - to pier 38 - pier 39 - passing point 48

Для служебного пользования
Экз № 6

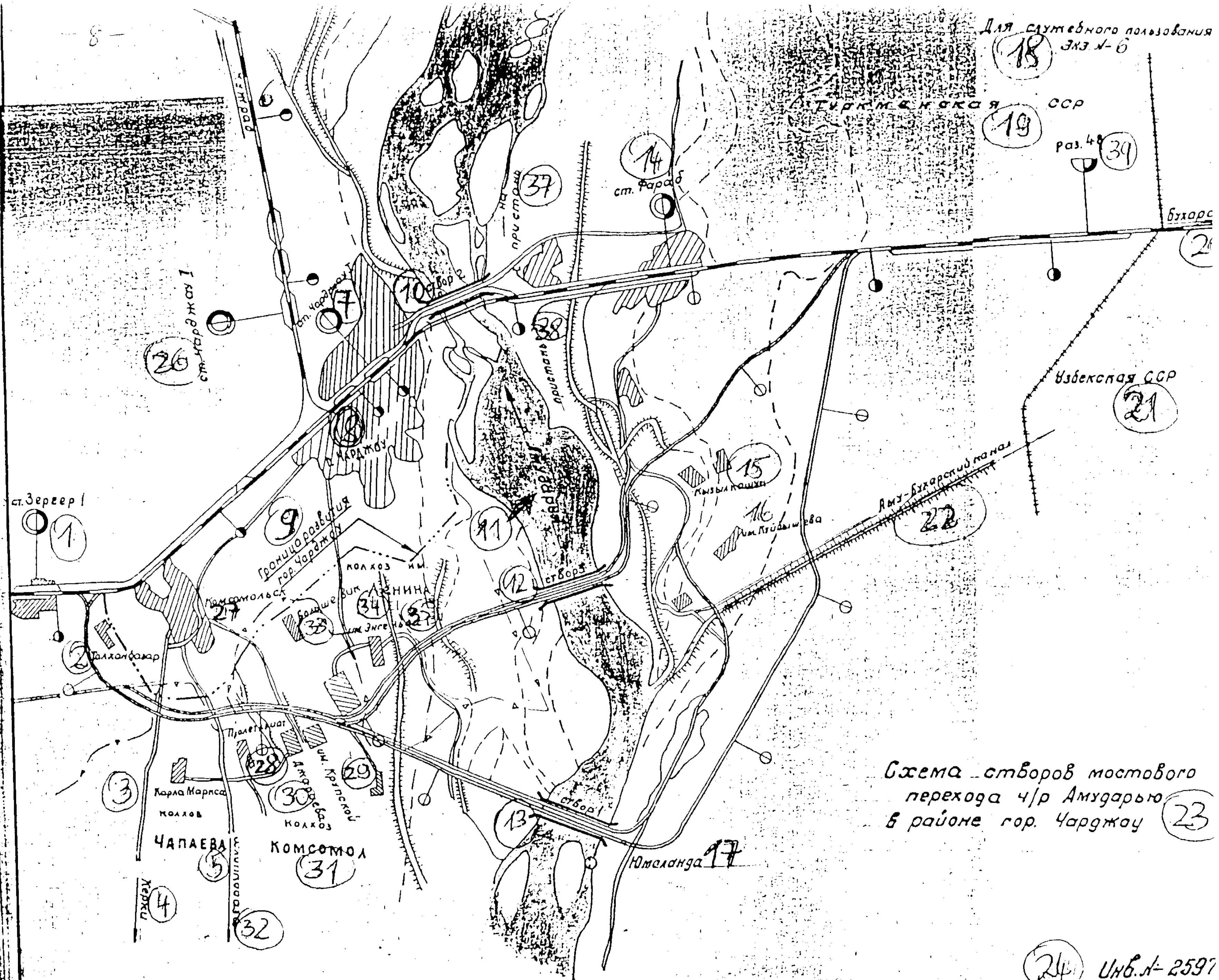

Схема створов мостового перехода ч/р Амударью в районе гор. Чарджоу

Инв. № 2597

Гл. инж. проекта Крылов

Выкопировка с схемы вариантов Алмаатагипротранса № 265-И-143-ДСП-82 л. 61

Technical and economical characteristics of the bridge versions for range 3

No	Name	Unit	Quantity		Including		
			Version No. 1	Version No. 2	Name	Quantity	
						Version No. 1	Version No. 2
1	All the metals of the bridge span structures	t	24938	18993	steel 15XSND 16D, 40X, 10XSND	24938	18993
2	Reinforced concrete and concrete of bridge supports	m³	65260	63100	assembled monolithic	16258 49004	15158 47946
3	Reinforced concrete and concrete of trestle supports	m³	-	7918	assembled monolithic	- -	7918 -
4	Reinforced concrete of trestle span structures	m³	-	6060	assembled monolithic	- -	6060 -
5	Adjusting preserving walls' masonry	m³	41090	41090	assembled monolithic	790 40360	790 40360
6	All the metal of adjusting preserving walls' anchors	t	1070	1070	steel VSt5sp2	1070	1070
7	The bridge cost	mil. Rub.	49.69	41.62			
8	The trestle cost	mil. Rub.	-	5.4			
9	The adjusting preserving walls' cost	mil. Rub.	9.06	9.06			
10	The bridge crossing total cost according to Chapter 3 of consolidated budget	mil. Rub.	58.75	56.08			

5. *The bridge versions for the range No. 1*

The range No. 1, which is located in Yumalanda, is remarkable for number of features. The first feature of the range No. 1 is its sharp asymmetry of the river banks: the right bank is high, steep and rises above the river for 40 m, while the left bank is low and flat. Subsequently the bridge must be placed on one - sided grade i = 0.04. The second feature of the range No. 1 is multitude of the river branches: there are three channels of 340 - 150 m and 150 m width apart from the main bed of 500 m width, which is pressed to the left bank.

The extreme right of them, the head part of Amu-Bukhar channel, is separated from the next channel by the island of approximately 500 m width. Two intermediate channels, which are separated by the hydraulic filling stripes, each of 200 m width, serve as water level regulators in the Amu-Bukhar irrigation channel / with help of hydraulic filling cross soil coffer - dams/.

The third feature of the range No. ~~3~~ 1 is its big length of 2250 m, which is for 500 m longer than in ranges 2 and 3.

The adopted bridge design for the range No. 1 is following:
110+8 x / 2 x 132 /+ 110 m. The bridge length is 2360 m, i.e. for 30% longer, than in the other ranges.

The subversions with the bridge length reducing for the range by means, for instance, of 400 m length earth embankment building in the island near Amu-Bukhar channel, or by means of pouring of 50 - 65% range width from the left bank side in embankment with providing of huge protection against wash - out and washing / the providing of "gorge" near the right bank with the river bed breaking/ are hydrologically and economically unreal and unsound.

Such a wilful river as Amudarya will not allow to move its bed and to lock it inside a channel near the opposite bank /i.e. move on the range for approximately 1700 m /.

In this connection Giprotransmost has not legalised the reduced length bridge versions.

In the motor road span structures for ranges No. 2 and No. 3 the water - ways system, which is directed to the banks side, with water sedimentation tanks is provided. For range No. 1 the water - way is directed to the left bank side / the bridge on the slope i = 0.04 / with water sedimentation tank in the left bank only.

Technical and economic characteristics of the bridge versions for range No. 1

No	Name	Unit	Quantity		Including		
			Version No. 1	Version No. 2	Name	Quantity	
						Version No. 1	Version No. 2
1	All the metals of the bridge span structures	t	31400	23600	steel 15XSND 16D, 40X, 10XSND	31400	23600
2	Reinforced concrete and concrete of bridge supports	m³	82370	79840	assembled monolithic	22418 59954	20558 59286
3	Reinforced concrete and concrete of trestle supports	m³	-	6120	assembled monolithic	- -	6120 -
4	Reinforced concrete of trestle span structures	m³	-	4545	assembled monolithic	- -	4545 -
5	Adjusting preserving walls' masonry	m³	20650	20650	assembled monolithic	450 20200	450 20200
6	All the metal of adjusting preserving walls' anchors	t	670	670	steel VSt. 5sp2	670	670
7	The bridge cost	mil. Rub.	61.02	50.55			
8	The trestle cost	mil. Rub.	-	4.1			
9	The adjusting preserving walls' cost	mil. Rub.	4.55	4.55			
10	The bridge crossing total cost according to Chapter 3 of consolidated budget	mil. Rub.	65.57	59.20			

Technical and economic characteristics of the bridge versions for range No. 2

No.	Name	Unit	Quantity				Including				
			Version 1A 1B	Version 2A 2B	Version 3	Version 4	Name	Quantity: Version 1A 1B	Version 2A 2B	Version 3	Version 4
1	2	3	4	5	6	7	8	9	10	11	12
1	All the metals of the bridge span structures	t	6090	9640	23610	17880	steel 15XSND 16D, 40X, 10XSND	6090	9640	23610	17880
2	Reinforced concrete and concrete of bridge supports	m³	31270 / 48500	32650 / 51600	64640	63460	assembled monolithic	8460 / 12960 22810 / 35540	7900 / 12130 24700 / 39470	16280	15070
3	Reinforced concrete and concrete of trestle supports	m³	-	-	-	7920	assembled monolithic	- -	- -	- -	7920 -
4	Reinforced concrete of trestle span structures	m³	-	-	-	6060	assembled monolithic	- 14100	- 14100	- 14100	6060 14100
5	Adjusting preserving walls' masonry	m³	14600	14600	14600	14600	assembled monolithic	500 14100	500 14100	500 14100	500 14100
6	All the metal of adjusting preserving walls' anchors	t	310	310	310	310	steel VSt. 5sp2	310	310	310	310
7	The bridge cost	million Rubles	17.4 / 23.65	21.18 / 26.01	47.32	39.92					

1	2	3	4	5	6	7	8	9	10	11	12
8	The trestle cost	million Rubles	-	-	-	5.4					
9	The adjusting preserving walls' cost	million Rubles	3.18	3.18	3.18	3.18					
10	The bridge crossing total cost according to Chapter 3 of consolidated budget	million Rubles	30.58 / 26.83	24.36 / 30.09	51.00	46.50					

An existing railway bridge in the city of Chardzhev and modern combined bridge with railway and auto-traffic flowing in turns completed in 1982 at the city of Termez could serve as a prototype of bridge over Amudarya.

The railway bridge in Chardzhev was built in 1901 and there is no economical data left on it. As for the bridge at Termez, this one is combined and has railway and auto-traffic going in rotation and could be used as an analogy for design choosing and technology of pier foundations building.

For the bridge at Termez the foundations made of tubular-piles d=1.6 m, deepened by 32 meters, has been used.

The technology of such deep pier foundations has been well developed by the company Mostostroy No. 7 which is to build the new bridge in Chardzhev.

6. *Choice of bed supports foundation design*

Difficult hydro-geological conditions of the bridge over the Amudarya river at Chardzhev are as follows: travelling river-bed, great thickness (up to 35 m), easy to wash away small and dust-like sands which are supported by underlying in a great depth neogenic clays, large overall and local erosion which reaches together with consideration of guaranteed margin 22.7 m from $GVV_{1\%}$[1]. Erosion observed at piers of existing railway bridge reached 24 m (see hydrological report).

Along the range No. 2 of the bridge in the depth of 29-58 m from $GVV_{1\%}$ there is a layer of weak sandstone (of thickness 3-8 m) with few layers of rigid sandstone of 10 cm in thickness inside which rests on hard and semi-hard clays. Sandstone practically is sand slightly cemented by clay-gypsum cement.

Water of the Amudarya river is not aggressive towards concrete of any density but ground water separated from the river is highly aggressive in its sulphate property towards concrete of any density made of non-sulphate-resistant types of the Portland cement.

Under the recommendation of the CNIIS institute and being recognised as the best suited for given geological conditions, the design versions of piers made of vertically-deepened tubular-piles d=1.6 m, filled with concrete throughout the whole height; made of drill-filling piles d=1.5 m with a pedestal d=3.5 m, which are located with the tilt rate 6:1 and are protected against aggressive erosion by sheet steel 12 mm thick in their upper section which is situated in zone of summary erosion of the pier concrete; foundations made of vertical tubular-piles d=3.0 m filled with concrete and foundations built of massive descending ring.

For all types of foundations, but pit, the foot of tubular-piles are deepened in depth of clay supported sands. Mark of the pit's foot was determined by maximum

[1] abbreviation not clear (ГВВ).

depth of deepening, in case of its transforming into caisson due to possible penetration through the sandstone layers in the depth of sands.

Supporting power at the pier head was counted by formulas of SNiP P-17-77 "Pier foundations" and amounted as follows:

- for pier made of tubular-piles d=1.6 m and filled with concrete throughout the whole height, foot of which was deepened by 43 m deeper than $GVV_{1\%}$ - 500 tons;
- for pier made of drill-filling piles d=1.5 m with a pedestal d=3.5 m, foot of which was deepened by 46 m deeper than $GVV_{1\%}$ - 720 tons;
- for pier made of vertical tubular-piles d=3.0 m filled with concrete, foot of which was deepened by 43 m deeper than $GVV_{1\%}$ - 1000 tons.

Pier foundation mats were designed as solid blocks made of armoured concrete, but pier bodies - combined solid and sectional.

Pier general views are represented on drawings No. 107207, 107208, 107209.

From the pier cost analysis for the range No. 2 it is clear (see chart) that the cheapest is the pier made of drill-filling piles d=1.5 m with a pedestal d=3.5 m, but the most expensive - is the pier made of vertical tubular-piles d=3.0 m filled with concrete.

Taking in consideration the experience of Central Asia bridge building organisations and their supply of bridge building equipment, the foundation made of vertical tubular-piles d=1.6 m filled with concrete throughout the whole height. See the section "Constructing the piers" of Reference Note.

Comparing the pier cost of combined bridge over the Amudarya river at the city of Chardzhev (spans 2 x 132 m, on different foundations, for range No. 2)

2 x 132.0 m

Type of foundation	= 1.6 m			= 3.0 m			= 3.0 m with widening d=3.5 m			sunk well foundation		
	Concrete volume, m^3	Cost of m^3, Rub.	Total cost, Rub.	Concrete volume, m^3	Cost of m^3, rub.	Total cost, Rub.	Concrete volume, m^3	Cost of m^3, Rub.	Total cost, Rub.	Concrete volume, m^3	Cost of m^3, Rub.	Total cost, Rub.
1. Solid concrete of pier body	700	120	84000	700	120	84000	700	120	84000	700	120	84000
2. Solid concrete of foundation mat	876	70	80900	975	70	68250	730	70	51180	550	70	38500
3. Assembled reinforced concrete tubular-piles with filling	3045	383 *	1166235	5275	402**	2120550	-	-	-	-	-	-
4. Solid reinforced concrete piles d=1.5 m with a widening 3.5 m	-	-	-	-	-	-	1710	300	513000	-	-	-
5. Solid reinforced concrete sunk well (descending ring) with filling	-	-	-	-	-	-	-	-	-	4220	170	717400
6. Metal by-pass tubes L=1530 mm, d=12 mm, km / t	-	-					529/ 236 km / t	131 km	69360	-	-	-
Cost of pier	131	1150		227	2860		717	460				
Cost of pier per 1 km of bridge	9939		17220								839900	
Percentage		100			173.3			54.7			64.1	

* price of 383 Rub. is obtained through increasing the base price (taken from list of complex single prices) 1.5 times to consider the price of work.

** same, but increased 1.65 times.

This design of foundation has been decided upon for all the bridge versions and all the ranges of the bridge.

7. Defending - regulating structures.

In purpose to ensure uniform design of protecting-and-regulating structures at the ends of bridge versions which were considered on 3 bridge ranges and according to addressing and recommendation of Sojuzdorproekt institute (letter No. 3012-03/3281 of 3.8.1982) the concrete wall in the ground (0.7 m wide and 23 m deep), which is to be built by the "Pokloin" aggregate with the use of clay mortar has been decided upon as a main design for such bridges.

Walls are armoured with reinforcing cage, are reinforced with cross stiffening ribs and are anchoring at pull-off poles d=1.6 m with the use of powerful steel cable d=90 mm.

The main purpose of walls is to protect the head sections of the bridge against erosion. Therefore the top of the walls is designed up to the ground level of both river banks at the bridge abutments. Abutment's cones and bulb-shaped stream-guiding dams are protected by armour reinforced slabs. Length of the river section where the wall in the ground for ranges is to be built is as following:

range No. 2	2 x 350 m	= 700 m
range No. 3	2 x 1000 m	= 2000 m
range No. 1	1000 m (only on the left bank of the river).	

The shorter wall sections along the left river bank are caused by the fact that they are adjusted to existing system of protecting dams of railway bridge.

For ranges No. 2 and No. 3 the wall length is stated with consideration its curving line on the plan with the intention of covering potential erosion zone of 500 m width.

Construction of the bridge foresees full use of existing protecting-and-regulating structures on banks of the Amudarya river in the area of the bridge designed regardless of the ranges locations.

As for protection of the village of Farap against natural calamities which periodically happen on the river, such as flood in 1969 caused by pressure ice-jam at the village of Yumalanda, this protection is spread over section of the right bank of the river for more than 15 km in length. Specialised project and scientific institutions were working for years on its design.

Therefore it seems to be unreasonable to associate the designing bridge with the problem of Farap's protection. This is an independent, specific and expensive problem At this given stage the following could be said in regard with this problem: after the selection of the range of the bridge, general construction of the bridge and protection-and-regulating structures on the river banks have been chosen, the latter should be specified together with the protection system of the village of Farap (if such a project is completed by that time), or should be included in the system in future.

8. *Building organisation*

A. - Building site.

Main construction site is situated on the left bank of the river in close neighbourhood with the construction. The square of it is about 13-15 ha.

On the right bank of the river the small construction site is organised to store that part of assembled steel sections of the bridge which will be mounted and move from the right bank, and also the pier structures which will be constructed on the right bank and peninsulas at the right bank. Next to that the wagons for warming construction workers and their other needs and small black-smith work-shop are installed. The square of the construction site on the right bank is about 2 ha.

On the main construction site there are situated the concrete production shop, warehouses and sites for storing materials and constructions, reinforcement shop and reinforced concrete construction shop, boiler room, compressor house, garages, work-shops, work superintendent's rooms, wardrobe, canteen and other facilities necessary for building the bridge.

The railway branch line is constructed from the city of Chardzhev to the construction site on which all the materials and constructions are delivered, except for those used on the right river bank.

As for the right bank's construction site, all the constructions are delivered there by trucks from Farap.

To deliver constructions from the left bank to floating facilities near the left bank the landing stage is built which is equipped with the crane type SKG-30 of lifting power 30 t. For the first and second ranges the landing stage is organised on islands as well.

All the loading works are performed by gantry and jib cranes.

The construction site territory in submerging zone is poured off to the mark of 39.5 m for the range No. 2, the slopes are reinforced with stones.

All the construction site wasted water is lead away to the settling basins and then are poured into the river.

After the end of the construction all the construction sites' territory is to be recultivated, the landing stage - dismounted, piles and bearding - pooled out of the ground.

B. - Piers erection

Several versions of the foundation have been considered. Those are: made of tubular-piles d=1.6 m, made of vertical tubular-piles d=3.0 m, made of drill-filling piles with a widening and sunk well foundation (descending rings).

The most reasonable way from the point of view of construction organization is to use tubular-piles d=1.6 m, which are very good known by regional bridge-building organization Mostostroy No. 7. There are all the necessary equipment and mechanisms for work with this tubular-piles.

For descending the first section of tubular-piles d=3 m afloat the crane of lifting ability of 150 tons is necessary. The bridge builders does not have such a crane. Also the specific equipment could be used which allows to descend the pile on the bottom of river by building-up the pile.

The drill-filling piles with a pedestal needs machine of CNIIS type to be built. The total need of such machines for the bridge construction is at least 4 which is rather unrealistic on the currant stage of bridge builders' technical supply.

In case there are sandstone layers in the ground the probability is high that descending rings could be exchanged for caissons to work with which the special equipment and specially trained staff of which bridge builders have no possession at the moment.

Below is given the description of works with the use of tubular-piles d=1,6 m.

30-50 % of piers situated on substantial depth, depending on range, are constructed afloat. To place mechanisms and equipment on each pier three[2] self-lifting pontoons of PMK-67 type are used on which the crane of KS-8362 K8 type[3] with lifting ability 100 tons and the crane of 3-2508 type[4] and lifting ability 60 tons as well as mobile power plant of US-14 type and capacity 200 kW are mounted. The self-lifting pontoons of PMK-67 type are mounted by floating crane "Blaker"[5] of lifting capacity 50 t.

The foundation mats are built in descending boxes which also serve as a guides for tubular-piles d=1.6 m. The walls of the box are mounted of metal bearding "Larsen IV" which is aligned by outline as the frame is descending in position according to project and is lead to specific beams.

The other piers are constructed from islands to which roads are poured off and from the land. The islands and the roads are reinforced with boulders. Project foresees double amount of ground considering possible ground erosion caused by floods.

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[2] this figure might be wrong (not to decipher)
[3] the type of the crane might be wrong (not to decipher)
[4] the type of the crane might be wrong (not to decipher)
[5] the type of the crane might be wrong, may be Bleichert, too (not to decipher)

The foundation mat is constructed in fencing made of metal bearding "Larsen IV", 14 m in length, descending by diesel-hammer of UR-1200 type from piling plant of S-532 type.

Loading works are performed by the crane SKG-30.

The tubular-piles d=1.6 m are descended by the vibro-descender of BU-1.6 type with the use of drilling units.

On the land the unit of MVS-1.7 type is used, which drills the well d=1.7 m in which tubular-pile is descended following with its deepening by vibrator.

When working afloat, the tubular-pile is first descended on possible depth, ground is removed from the tubular-pile. A leader drilling is carried out by the machine of FA-12 type and then the tubular-pile is descended on the project depth mark.

The ground is removed from the tubular-pile cavity and from the bearding fencing by airlift.

Descend of the tubular-piles to project depth marks is carried out with the help of inventory sections of tubular-piles 8 m in length which are reused.

C. - Mounting the span structures

Mounting the metal road-transport span structures with the ortho-trop slabs is carried out with the use of the method of erection by lengthwise protrusion from the right and left river banks.

The rear-conveyer assembling of span structures is carried out with the whole profile on building berths which were erected on the bridge-approach fills of the right and left river-banks. Protruding is performed in low level. Abutments are completed with concrete works after the span is mounted in its project position.

As the length of the bridge is erected it is pushed forward towards the centre of the river by specific pushing equipment. The pushing equipment consists of 8 jacks united in the assembly of GD-170/1120 type and lifting capacity 170 tons each, chain thrust and rest which is mounted on the end of protruding part of length.

Abutments are used as stops for the jacks.

The antifrictional material naphtlen is used in rolling appliances there.

To reinforce the span structure the tie rod is mounted with the pylon 30 m in height on the front end of the protruding length there.

To choose the deflection of the end of the bridge bracket and to mount it on the rolling-up equipment the specific lift is used which is equipped with jacks, mounted on the front end of the bridge length.

The loading and lifting works during the span structures' group assembly is performed by the gantry crane of K-45TM type with lifting capacity 65 t.

Assembling the trussing span structure is carried out by overhang by erecting crane of UMK-2 type moving on railway which is built on the top of the bridge truss.

Mounting is carried out from the left river bank towards the right one. To assemble the span 1-2 the anchor span structure of the same length is assembled on the bridge-approach fill.

This structure is additionally loaded with counterweights. One of the span structures of main constructions is used as an anchor span structure.

Assembled steel section is delivered by railway road to the construction site on the left bank of the river. After cleaned and enlarged blocks are transported by railway carts moving upon temporary railways laid on lengthwise beams to erecting crane.

For mounting period the span structure is connected with previously mounted additional connection elements. After the connecting elements are dismounted the assembled span is set on supporting part and its rear end is fixed to the previous span structure by temporary anchor. The tension in connecting elements is eliminated though the jack support of the front end of span structure.

Disassembling anchor span structure and temporary connection elements and railways for crane is carried out by the second crane UMK-2.

Assembling first three panels of the anchor span structure and of the two UMK-2 cranes is performed by crane SKG-30.

D. - Safety and accident prevention

All the bridge construction works have to be carried out according to requirements of SNiP (Construction norms and rules) ?-4-80[6] "Accident prevention technique in construction", of the "Regulations on design and safe operation of cranes" of Gosgortekhnadzor[7], of "Accident prevention and sanitation technique for pipes and bridge construction" and similar documents.

F. - Term of the bridge construction

Term of construction of combined railway and road traffic bridges more than one kilometre in length is not limited by any valid standardising documentation /SNiP/ and is determined from the experience of similar bridges erection and the bridge building organization industrial equipment's quality.

The nearest analogy of the bridge over the Amudarya river at the city of Chardzhev is the construction of combined bridge over the Amudarya river at Termez-

---

[6] not to decipher

[7] Technical Control Board

Khayraton[8] which was completed by Mostostroy No. 7 in 1982. The construction took 3.5 years.

Term of the bridge construction in years are determined as follows:
(for different ranges)

Ranges	L, km	Combined bridge, L=132m	Railway bridge, L=132 m	Railway bridge, L=132 m
Construction period, years				
Range No. 1	2.36	6.5	5.0	-
Range No. 2	1.78	5.5	4.0	4.5
Range No. 3	1.83	5.5	4.0	-

9. *Analysis of the bridge versions costs*

The cost of different versions of the bridge separately on each range is figured out from the amount of work for building main structures and from the rough figures of construction-mounting works which have been worked out by the rating team of Giprotransmost with consideration of region coefficients, transport logistic conditions and sources of materials' supply of regional bridge building trust - Mostostroy No. 7.

In the chart there are mentioned the cost of piers erection, span structures, road-transportation high-ways (for two-decks version), total cost for the bridge, the cost of protection-regulating structures, total cost of chapter 3, total cost of chapters 1-7, total cost of the bridge mounting works, and overall cost of the bridge. Next to that, the future growth of the bridge cost by the time of its completing due to inflation and other factors (for 9 years' period) k = 1.176

Also the following factors have been determined: cost of the construction of one kilometre of the bridge, cost of the road section of the bridge, which will help to exactly calculate the share of Ministry of auto-and-bridge building of Turkmenian SSR and Ministry of Railways, and also ratio of different bridge version costs for different basis to be compared.

[8] Afghanistan border

ANALYSIS OF THE BRIDGE VERSIONS COST

Railway and combined bridges separately for ranges of the bridge over the Amudarya river at the city of Chardzhev, Turkmenian SSR, million rubles.

		Range No. 2, L=1780m / L=1830 m						Range No. 3, L=1870m				Range No. 1, L=2360 m			
		Railway bridge				Combined		Combined		Railway bridge		Combined		Railway bridge	
							two-deck bridge		two deck bridge				two-deck bridge		
		1 track, L=66, Vers 1a	piers under 2nd track Vers. 1b	1 track, L=132, Vers. 2a	piers under 2nd track Vers. 2b	Vers. 3	Vers 4	Vers. 1	Vers. 2	1 track, L=132, Vers. 3a	piers under 2nd track Vers. 3b	Vers. 1	Vers. 2	1 track, L=132, Vers. 3a	piers under 2nd trac Vers 3b
1. Pier	for 1 railway track	11 5	-	12 1	-	-	-	-		12.1	-	-	-	16.05	-
	for 2 railway tracks	-	17.75	-	17.83	22.23	21 34	22.67	21.94	-	17.83	27.19	26.37	-	23.6
2. Span structures	for 1 railway track	5.90	5.90	9.08	9.08	9.08	18.08	9.30	19.68	9.30	9.30	12.1	24.18	12.1	12.1
	road traffic	-	-	-	-	16.51	18.08	17.72	19.68	-	-	21.73	24.18	-	-
3. Elevated road		-	-	-	-	-	5 4	-	5.4	-	-	-	4.1	-	-
4. The whole bridge, totally		17.40	23.65	21.18	25.91	47.82	45.32	49.69	47.02	21.40	27.13	61.02	54.65	28.15	35.7
5. Protection-regulating structures		3.18	3.18	3.18	3.18	3.18	3 18	9.06	9.06	9.06	9.06	4.55	4.55	4.55	4.55
6. Totally on chapter 3		20.58	26.83	24.36	30.09	51.00	48.50	56.75	56.08	30.46	36.19	65.57	59.20	32.70	40.25
7. Totally on chapters 1-7		21.14	27.41	24.92	30.62	51.62	49.12	59.37	56.70	31.08	36.31	66.24	59.87	33.37	40.92
8. Totally on summary invoice	construction mounting	27.06	34.97	31.80	39.00	64.42	62.08	74.51	71.92	32.5	39.9	32.36	75.80	41.0	50.3
	Totally	30.24	38.98	35.43	43.35	72.32	69.11	83.26	79.78	36.2	44.2	92.79	84.30	44.6	55.8
9. K-1.T. 76 Totally, considering cost increase by the time of the construction end		35.00	45.09	41.09	50.22	83.65	80.02	36 27	88.32	42.0	51.4	107.37	97.64	52.9	64.8
10. Cost of road traffic part of combined bridge (point 4).						99% 20.91						120% 25.32			
11. Correlation of bridge versions cost (point 4).		106%	136%	121% 100% 78.5%	155%/ 56.5% 127% 100%	100% 226% 178%	95% 214% 178%	104% 185%	98.5% 175%	101% 79.5%	128% 101%	128% 227%	114.5% 196%	133% 165%	169% 133%
12. Cost of 1 km of bridge (p. 4)		9.80	13.30	11.60	14.7	26.2	24.3	26.6	25.2	11.5	14.5	25.8	23.4	13.9	15.2

Extraction of enlarged cost factors of combined and railway bridges, million rubles

	Range No. 2			Range No. 3			Range No. 1		
	Vers. 2b	Vers. 3	Vers. 4	Vers. 1	Vers. 2	Vers. 3b	Vers. 1	Vers. 2	Vers. 3b
Bridge and trestle	26.91	47.82	59.92 5.4	49.69	41.52 5.4	27.13	61.02	50.55 4.1	36.7
Protection-regulating structures	3.18	3.18	3.18	9.06	9.06	9.06	4.55	4.55	4.55
Totally for chapter 3	30.09	51.00	48.50	58.78	56.08	36.19	65.57	59.20	46.25
Approaches along the trestle length	-	-	-0.60	-	-0.60	-	-	-0.45	-
Σ	30.09	51.00	47.90	58.78	55.48	36.19	65.57	58.75	
Totally, according to invoice	43.35	62.32	69.11	83.26	79.78	44.2	92.79	84.30	
Same, counting cost increase by the time of the construction end k=1.176	50.22	83.65	80.02	96.27	86.82	51.4	107.37	97.64	
Same, counting the approaches		106%	79.0 100%	122%	85.8 108.5%		136%	96.9 124%	

As it could plainly be seen from the table, the most optimum economical parameters are those of the combined bridge versions for the range No. 2. And what draws attention is that comparing two-deck combined version No. 4 with version No. 3 (two separate parallel lines on one deck) we can decrease the bridge construction cost in its road-traffic part.

In chapter 3 - 3.1 million rubles, in overall cost - from 4.0 to 4.65 million rubles.

Calculating share participation of Ministry of Railways, Moscow, and Ministry of Road construction and operation of Turkmenian SSR:

Version No. 4 - chapter 3.	
Combined bridge	45.32 million rubles
Railway bridge with piers under 2nd track	26.91 million rubles
Road traffic part of the bridge	45.32 - 26.91 = 13.41 million rubles
Share of Ministry of Railways (MPS)	26.91 + 0.5 x 5.18 = 18.41 million rubles (60%)
Share of Ministry of Road construction and operation of Turkmenian SSR	18.41 + 1.59 = 20.0 million rubles

Same considering decrease of approaches cost for the trestle length: 20.0-0.6=19.4 million rubles (40%)

Totally in chapter 3:	47.9 million rubles (100%)
Overall bridge cost	69.1 million rubles
Railway bridge	43.35 million rubles (63.5%)
Road traffic part of the bridge	25.75 million rubles
Excluding cost of approaches	25.75 - 1.4 x 0.6 = 24.91 million rubles (36.5%)
Totally	63.26 million rubles (100%)

Same considering the inflation by the time of bridge completing and other factors affecting the bridge cost (coefficient k=1.176):

Overall cost of the bridge according to invoice	80.0 million rubles
Railway bridge	50.22 million rubles (63.5%)
Road traffic part of the bridge	29.73 million rubles.
Excluding the approaches cost	29.73 - 1.4 x 1.176 x 0.60 = 29.78 million rubles (36.5%)
Totally	79.0 million rubles

Thus, the share of Ministry of Railways amounts to 50.2 million rubles (63.5%), but the share of Ministry of Road construction and operation of Turkmenian SSR is 29.8 million rubles (36.5%).

Comparing to version No. 3 the share of Ministry of Road construction and operation of Turkmenian SSR decreased by 4.85 million rubles (16%).

CONCLUSIONS

Based upon above and considering the work performed by Almaatagiprotrans institute in analysing the railway approaches for diverse ranges of the bridge, Giprotransmost recommend to accept version No. 4 - the combined two-deck bridge - on the range No. 2 which is situated 250 m below existing railway bridge. Position of the range must be specified on the stage of work on the project (moving it 100 m towards the railway bridge) for better conditions of traffic intersection of the road traffic part of the bridge as well as decrease of the approach slopes size.

The cost of the bridge construction for the recommended bridge version is 79.0 million rubles, which are distributed among the participants as follows:

Ministry of Railways	50.2 million rubles,
Ministry of Road construction and operation of Turkmenian SSR	29.8 million rubles.

Chief engineer of Hiprotransmost	**Signature** /L. N. Zhuravov
Head of Department of Steel Bridges	**Signature** /B. N. Monov
Chief engineer of the project	**Signature** /Yu. K. Krylov

Appendix 1

'CONFIRMED'
Director of Sojuzdorproekt
Signature /V. F. Rogozhev/
'___' 06.1980

ASSIGNMENT[9]

For State Project Institute Giprotransmost to take part in designing technical and economical feasibility of the construction of bridge over the Amudarya river near the city of Chardzhev of Turkmenian SSR

1. The technical and economical feasibility (TEO) of the construction of bridge over the Amudarya river near the city of Chardzhev of Turkmenian SSR is worked out by Sojuzdorproekt (general contractor) with participation of Giprotransmost and Tashgiprotrans, basing on technical assignment which was issued by Turkmendoradministration on 14.06.79. and confirmed by Deputy Minister of the auto-transport and roads of Turkmenian SSR on 24.12.1979.

2. While working out the technical and economical reasoning were used the following documentation: materials of TEO compiled by Sojuzdorproekt in 1971 on this title, and also resume of Gosstroy USSR[10] and Gosplan USSR[11] made on the letter No. 20/9-146 of 27.07.1978 about this work, resume of the Railway Ministry (MPS) No. 15 of 19.11.1971 and letter of the Railway Ministry No ZUEP-15 of 30.05.1980.

3. Giprotransmost is to consider the versions of location of combined and railway bridges for the following ranges:

- fairly near the existing railway bridge - combined and railway bridges;
- above the existing railway bridge near the isolated natural feature Yumalanda (in 8 and 13 kilometres' distance) - combined bridge.

4. To co-ordinate the concrete ranges situation for the version of combined bridge for railway and road traffic with Tashgiprotrans and Sojuzdorproekt.

5. The overall dimensions of the bridge auto-transport pass must be taken according to Construction Standards and Rules II-D.5-72 (table 43 for roads of 2[nd] category) - G 11.5/2+7.5+2/+2x1.5m

The railway part must be for one and two tracks with service side-walks.

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[9] similar to Terms of Reference
[10] former Soviet Commission for Planning of construction works
[11] former Soviet Central Planning Board

6. The calculated loads must be according to valid standards: the railway - S-14, the auto-transport - 2 lanes of the load N30 or one vehicle NK-80, the crowd on the side-walks - 400 kg/m^2.

7. Consider location of the railway and auto-transport passes on same level or on two different levels.

8. The height of under-bridge clearance from the calculated navigating horizon (RSG) and the value of the bridge ranges are to be chosen from Construction Standards and Rules NSP 103-52 and through co-ordination with basin administration of the Middle Asian steamship company.

9. Consider different materials for the range structure design.

Piers - with diverse types of foundation.

10. For reasoning depth of the river bottom erosion near piers, the opening of the designed bridge, regulating structures, passing marks near the bridge and on approaching section within the river width - to collect all the necessary hydrological materials and perform necessary hydrological calculations. Carry out necessary engineer and hydrological research on the Amudarya river in the areas of planned bridges site.

11. The materials of engineer and hydrological research obtained during fulfilment of works on item 10 of this assignment are to be handed over to Soyuzdorproekt (one copy) to perform works associated with designing the versions of road bridge.

12. Sojuzdorproekt provides for the following:

- co-ordination of works on carrying out this technical and economical reasoning and co-ordination of materials developed by different designing organisations;
- necessary topography /except for river-bed photographing/ and geological materials, including aerial photographing, mapping materials and general plan of the Chardzhev city development;
- working out of versions of road bridge and approaches to it, development of economical part of the technical and economical reasoning.

13. Development of the section of the technical and economical reasoning about approaches to railway and combined bridges is performed by the Tashgiprotrans Institute.

14. The term of research and design works of co-contractors for separate stages of working out of this technical and economical reasoning as well as terms of mutual giving the necessary materials to each other are defined by co-ordinated schedule.

The main design solutions of recommended version of combined bridge along with explanation note, calculation of the cost of construction, graphic materials according to additionally co-ordinated with Soyuzdorproekt contents of the this technical and economical reasoning are handed over to the latter - by October 15, 1981.

Chief engineer of State Project Institute Sojuzdorproekt

Signature / V. R. Silkov /

Co-ordinated:

Head of Giprotransmost ***Signature*** / O. A. Popov /

'___' ____________ 1980.

Title of the first scheme (drawing): */above/*

The combined bridge (version 1) and railway bridge (versions 3A and 3B) railway part scheme (drawing)

Title of the second scheme (drawing): */centre/*

The combined bridge (version 1) motorway part scheme (drawing)

Title of the third scheme (drawing): */below/*

The two level driving combined bridge (version 2) scheme (drawing)

in drawing 1-1:
автодорожная часть - motorway part

Notes:

1. The railway bridges versions with index "A" have supports for single track; the railway bridges versions with index "B" have supports for double track.

2. The dimensions and marks in the schemes (drawings) are indicated in meters. The bridge beginning marks and stationing are conventional, as in Giprotransmost system.

Additional Notes:
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Table on the right side:

Technical and economical characteristics of the bridge versions for range 1

No.	Name	Unit	Quantity		Including		
			Version No. 1	Version No. 2	Name	Quantity	
						Version No. 1	Version No. 2
1	All the metals of the bridge span structures	t	31400	23600	steel 15XSND 16D, 40X, 10XSND	31400	23600
2	Reinforced concrete and concrete of bridge supports	m^3	82370	79840	assembled monolithic	22418 59954	20558 59285
3	Reinforced concrete and concrete of trestle supports	m^3	-	6120	assembled monolithic	- -	6120 -
4	Reinforced concrete of trestle span structures	m^3	-	4545	assembled monolithic	- -	4545 -

5	Adjusting preserving walls' masonry	m^3	20650	20650	assembled monolithic	450 20200	450 20200
6	All the metal of adjusting preserving walls' anchors	t	670	670	steel VSt5sp2	670	670
7	The bridge cost	mil. Rub.	61.02	50.55			
8	The trestle cost	mil. Rub.	-	4.1			
9	The adjusting preserving walls' cost	mil. Rub.	4.55	4.55			
10	The bridge crossing total cost according to Chapter 3 of consolidated budget	mil. Rub.	65.57	59.20			

Table on the right side (below)

SUBSTANTIATING MATERIAL of construction of bridging crossing over the Amudarya rive in the area of Chardzhev City of Turkmenian SSR Combined and railway bridges versions			Range No. 1 The bridge versions' designs		
Chief Engineer of the Institute	Dzuravov	Signature	Code 613	Sheet N 4	Inventory N 2601 sp
Chief of division	Monov	Signature	Scale 1:2000, 1:500		1982
Chief Engineer of the Project	Krylov	Signature			
The team-leader	Illarionov	Signature	Giprotransmost Moscow		
Checked	Illarionov	Signature			
Executed	Subbotina	Signature			

Title of the first scheme (drawing): */above/*

The railway bridge design scheme (drawing): versions N 1A and N 1B

Title of the second scheme (drawing): */centre - above/*

The combined bridge (version 3) and railway bridge (versions 2A and 2B) railway part scheme (drawing)

Title of the third scheme (drawing): */centre - below/*

The combined bridge (version 3) motorway part scheme (drawing)

Title of the fourth scheme (drawing): */below/*

The two level driving combined bridge (version 4) scheme (drawing)

Notes:

1. The railway bridges versions with index "A" have supports for single track; the railway bridges versions with index "B" have supports for double track.

2. The dimensions and marks in the schemes (drawings) are indicated in meters. The bridge beginning marks and stationing are conventional, as in Giprotransmost system.

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Table on the right side:

Technical and economical characteristics of the bridge versions for range No. 2

No.	Name	Unit	Quantity				Including				
			Vers. 1A 1B	Vers. 2A 2B	Vers. 3	Vers. 4	Name	Quantity			
								Vers. 1A 1B	Vers. 2A 2B	Vers. 3	Vers. 4
1	All the metals of the bridge span structures	t	6090	9640	23610	17880	steel 15XSND 16D, 40X, 10XSND	6090	9640	23610	17880
2	Reinforced concrete and concrete of bridge supports	m^3	31270 / 48500	32650 / 51600	64640	63460	assembled	8460 / 12960	7900 / 12130	16280	15070
							monolithic	22810 / 35540	24700 / 39470		

3	Reinforced concrete and concrete of trestle supports	m³	-	-	-	7920	assembled monolithic	- -	- -	- -	7920 -
4	Reinforced concrete of trestle snap structures	m³	-	-	-	6060	assembled monolithic	- 14100	- 14100	- 14100	6060 14100
5	Adjusting preserving walls' masonry	m³	14600	14600	14600	14600	assembled monolithic	500 14100	500 14100	500 14100	500 14100
6	All the metal of adjusting preserving walls' anchors	t	310	310	310	310	steel VSt. 5sp2	310	310	310	310
7	The bridge cost		17.4 23.65	21.18 26.01	47.32	39.92					
8	The trestle cost	mil. Rub.	-	-	-	5.4					
9	The adjusting preserving walls' cost	mil. Rub.	3.18	3.18	3.18	3.18					
10	The bridge crossing total cost according to Chapter 3 of consolidated budget	mil. Rub.	30.58 26.83	24.36 30.09	51.00	46.50					

Table on the right side (below)

SUBSTANTIATING MATERIAL of construction of bridging crossing over the Amudarya river in the area of Chardzhev City of Turkmenian SSR Combined and railway bridges versions			Range No. 2 The bridge versions' designs		
Chief Engineer of the Institute	Dzuravov	Signature	Code 613	Sheet N 2	Inventory N 2599 sp
Chief of division	Monov	Signature	Scale 1:2000, 1:500		1982
Chief Engineer of the Project	Krylov	Signature			
The team-leader	Illarionov	Signature	Giprotransmost Moscow		
Checked	???	Signature			
Executed	???	Signature			

Title of the first scheme (drawing): */above/*

The combined bridge (version 1) and railway bridge (versions 3A and 3B) railway part scheme (drawing)

Title of the second scheme (drawing): */centre/*

The combined bridge (version 1) motorway part scheme (drawing)

Title of the third scheme (drawing): */below/*

The two level driving combined bridge (version 2) scheme (drawing)

Notes:

1. The railway bridges versions with index "A" have supports for single track; the railway bridges versions with index "B" have supports for double track.

2. The dimensions and marks in the schemes (drawings) are indicated in meters. The bridge beginning marks and stationing are conventional, as in Giprotransmost system.

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Table on the right side:

Technical and economical characteristics of the bridge versions for range 3

No.	Name	Unit	Quantity		Including		
			Version No. 1	Version No. 2	Name	Quantity	
						Version No. 1	Version No. 2
1	All the metals of the bridge span structures	t	24938	18993	steel 15XSND 16D, 40X, 10XSND	24938	18993
2	Reinforced concrete and concrete of bridge supports	m³	65260	63100	assembled monolithic	16258 49004	15158 47946
3	Reinforced concrete and concrete of trestle supports	m³	-	7918	assembled monolithic	- -	7918 -
4	Reinforced concrete of trestle span structures	m³	-	6060	assembled monolithic	- -	6060 -

5	Adjusting preserving walls' masonry	m^3	41090	41090	assembled monolithic	790 40360	790 40360
6	All the metal of adjusting preserving walls' anchors	t	1070	1070	steel VSt5sp2	1070	1070
7	The bridge cost	mil. Rub.	49.69	41.62			
8	The trestle cost	mil. Rub.	-	5.4			
9	The adjusting preserving walls' cost	mil. Rub.	9.06	9.06			
10	The bridge crossing total cost according to Chapter 3 of consolidated budget	mil. Rub.	58.75	56.08			

Table on the right side (below)

SUBSTANTIATING MATERIALS of construction of bridging crossing over the Amudarya river in the area of Chardzhev City of Turkmenian SSR Combined and railway bridges versions			Range No. 3 The bridge versions' designs		
Chief Engineer of the Institute	Dzuravov	Signature	Code 613	Sheet N 3	Inventory N 2600 sp
Chief of division	Monov	Signature	Scale 1:2000, 1:500		1982
Chief Engineer of the Project	Krylov	Signature			
The team-leader	Illarionov	Signature	Giprotransmost Moscow		
Checked	Illarionov	Signature			
Executed	Subbotina	Signature			

Appendix 5.

List of equipment and mechanisms.

No.	Mechanism designation	Range 2	
		Version 3	Version 4
1	Drilling unit MBS-1,7	2	2
2	Drilling machine FA-12	2	2
3	Vibro-deepener BU-1.6	3	3
4	Bearding extractor #P-1[12]	1	1
5	Crane SKG-30	4	4
6	Pile-driver S-532	1	1
7	Diesel-hammer UR-1250	1	1
8	Pumps C-204, Q=120 m^3/hour	10	10
9	Airlift	4	4
10	Floating crane "Bleichert"[13] (lifting ability 50 tons)	1	1
11	Reloading crane on landing stage SKG-30	2	2
12	Crane KS-8362 ??[14] (lifting ability 100 tons)	2	2
13	Crane E-2508[15] (lifting ability 60 tons)	2	2
14	Mobile power station, Electrical power = 600 kW.	2	2
15	Self-lifting pontoons PMK-67	4	4
16	Jacks, lifting ability 200 tons (PMK)	3	3
17	High pressure pumps	4	4
18	Compressor KS-8	2	2
19	Hoist manual, lifting ability 7.5 tons	16	16
20	Towboat, 800 horse powers	1	1
21	Towboat, 800 horse powers	1	1
22	Crane UMK-8	2	2
23	Jacks DG-500	12	8
24	Motorcar	1	1
25	Crane K-45 ??[16] , lifting ability 65 tons	2	-
26	Jacks GD-170/1120	16	-
27	Aggregate "Pokloin"	2	2

Compiled by *Signature* /Shleyfer/.

[12] not to decipher
[13] see footnote 5
[14] not to decipher, see footnote 3
[15] not to decipher, see footnote 4
[16] not to decipher

Appendix 6.

LIST

of main materials necessary for bridge erection

(Range No. 2, Versions No. 3 and 4)

No.	Name of material	Measure unit	Amount
1	Steel bearding	t	1150
2	Pontoons	t	231
3	Metal	t	2230
4	Reinforced concrete	m^3	1340
5	Concrete	m^3	9330
6	Stone and crushed stone	m^3	11000
7	Timber	m^3	615

Compiled by ***Signature*** / Chernyaev /.

STATE CONCERN "TURKMENAVTOYOLLARI"

PROJECT INSTITUTE "TURKMENDORPROYEKT"

VERIFICATION AND ANALYSIS

of Substantiating Materials on the Project
of Bridging the Amudarya River

(i.e. the Technical and Economic Feasibility Study of 1982
regarding to the Road Part of the Project
in technical and economical terms)

DIRECTOR OF THE INSTITUTE: O .G. Brozda

EXECUTIVE: CHIEF EXPERT L. N. Mirgorodsky

Ashgabat - 1996

Verification of the existing project (i.e. Technical and economic Feasibility study of 1982), analysis of the existing project on building a new bridge in technical and economical terms (concerning the road part of the Project)

ANNOTATION

In the present work, we have studied the "Materials substantiating the engineering feasibility and economical expediency of the project of building a bridge across the Amudarya river" developed by SOYUZDORPROYEKT in co-operation with GIPROTRANSMOST and ALMAATAGIPROTRANS (Technical and economic Feasibility study of 1982[1]).

To achieve our first objective, we reviewed practically all the relevant documents since as early as 1953 (correspondence, engineering conclusions, records of engineering councils and other materials dealing with this complicated technical and economic problem).

We considered all the important documents and transport/economical indications for freight and passenger transportation across the river under the present-day circumstances, as well as future growth rates in view of further development of linear transport infrastructure.

We studied the previously used methods which had served as a basis for calculations of future transportation volumes and traffic intensity, as well as characteristics of the bridge and motor access roads accepted in TEO-82, i.e. project norms and standards including estimated loads.

In pursuit of our second objective, we studied the information concerning the river hydrology and its specific features: critical bed deformation, significant erosion of its banks, displacement of the navigable waterway, engineering geological analysis of the project site's seismicity.

We considered the validity of location of the competitive variants of bridge leaves and access roads of traffic junctions as presented in TEO-82 and evaluated the potential environmental effects.

---

[1] further abbreviated as TEO-82

We have studied the cost estimates of building access ways including maintenance and repair costs.

The present verification and analysis were performed only in respect to the road part of the project. Various schemes of the bridge and its design features were not considered as agreed upon with a representative of DE-Consult.

On the whole, the analysis of TEO-82 was made in an attempt to study the substantiating materials to see whether they comply with the existing engineering standards and the decisions on the project.

The present analysis can be used in discussions on the given matter.

Chief Expert /Signature/ L. N. Mirgorodsky

Analysis and verification of the existing Feasibility study (TEO-1982)

1. *Explanation for the necessity to build a bridge across the Amudarya river*

1.1 *The current situation*

The development of the given project was caused by the necessity of radical improvement of freight and passenger transportation across the river.

In the TEO-82, the necessity of building a bridge was treated in view of the current situation of the river crossing and the railway bridge, the regional economic prospects, development of road, railway and river transport.

The existing crossing consists of a railway bridge built in 1901 and a pontoon crossing with reserve ferries. This crossing is of a great importance in terms of both local and transit transportation. In view of the on-going growth of traffic intensity, the existing crossing cannot be considered satisfactory.

Every year the river crossing gets closed for a few days due to high water.

The existing pontoon crossing is unreliable, especially for heavy cars.

Due to frequent fluctuations of the waterway, the navigable depth and bank erosion, the reserve ferry boat crossing has no stable mooring or fixed access which results in increased idle time of motor transport.

As a result of all this and because of the poor navigation of the river, most of freight and passenger transportation (even local) across the Amudarya river is performed by railway transport.

The high volume of short-distance railway freight transits increases ineffective costs.

Inefficient transportation causes additional expenses which will be even higher in future as the traffic becomes more intense. On the whole, the information presented in the TEO-82, on the whole, is true and valid.

1.2 *Transport communications*

The TEO-82's description of the regional transport and economic characteristics of the catchment area of the river crossing is well-founded and has not undergone any significant changes by 1996.

The TEO-82's current and the prospective levels of freight and passenger transportation are based on the data obtained from all the major consignors and consignees. The levels need to be updated for 1996, and further estimates must be done.

The main highway of the region involved is the motorway of national importance M-37 Samarkand - Chardzhev - Turkmenbashi. The section Mary - Chardzhev is a third category motorway (foundation width - 12-14 m, carriageway width - 7-10 m). The same refers to the section from Chardzhev to the border of Uzbekistan. The motorway's technical conditions are satisfactory.

Transit via the city's roads is hampered by heavy urban traffic.

1.3 Volumes of freight and passenger transportation across the Amudarya river

The estimated volume of freight traffic for the year of 2000 is 2.12 mln. tons, for 2005 - 3.4 mln. tons. The prospective freight traffic volume was calculated by taking into account the annual increment of 3-5 %.

However, in view of the current and the future transport communications, the freight traffic volumes and structure must be updated and recalculated. Besides, one should specify short-distance railway freight traffic volumes.

The TEO-82's current and the prospective levels of freight and passenger transportation are based on the data obtained from all the major consignors and consignees, as well as passenger services.

Of the total traffic flow passing across the river, 45% is motor transport.

The given project of building a bridge across the Amudarya river by the city of Chardzhev is supposed to contribute to higher levels of intercity passenger traffic and motor tourism.

It is estimated that in the year of 2005 the passenger traffic volume along the projected bridge will be 2.5 mln. people including 1.4 mln. people travelling by bus.

The average passenger traffic estimates were calculated using the data provided by the Institute of Complex Transport Problems (ICTP) concerning the growth rates of passenger car traffic.

The prospective levels and the dynamics of passenger traffic must be updated; traffic flow and its growth rate must be estimated more precisely.

1.4 Road traffic intensity

The current traffic intensity can be determined by a test measurement taking into account the composition of the road transport flow.

Road traffic intensity is calculated by the relevant method using the known levels of freight and passenger traffic including passenger car traffic.

The prospective intensity estimate for the year of 2005 is 4800 cars per day which corresponds to the second technical category motorway. Therefore, in accordance with standard SNiP 2.05.02-85 "Motor roads" the projected motorway was assigned second technical category.

In compliance with the second technical category and SNiP 2.05.03-84 "Bridges and pipe culverts", the overall dimensions of the carriageway of the projected bridge must be G - 11.5 + 2 x 1.5 m. However, the estimate of traffic intensity needs updating since the proportions of transit and local traffic have changed.

2. Geotechnical and hydrogeological situation

The territory involved in the project was evaluated using the following criteria:

1. Climate
2. Relief
3. Soil and Vegetation
4. Geological Structure
5. Tectonics, Seismicity
6. Engineering and Geology (3 versions)

The information about the natural environment was taken from local directories.

The estimated regional seismicity must be more precise.

According to SNiP P-7-81 "Construction work in high-seismicity regions", the seismicity of the given region is 7 points. Taking into consideration the relatively complicated geology of the building site, the recommended seismicity is 8 points (see Table 1 of SNiP P-7-81).

The engineering and geology data are sustained by "The Schematic Map of Engineering and Geology Regions" and the lithological conditions of the bridge range versions.

The physical and mathematical data and the depth of geological structure substantiate the design of the bridge foundations and supports in Feasibility (TEO) level.

The specific features of the river's hydrology and the dynamics of general and local floods are also provided in the TEO.

General contents of the chapter agrees with the recommended structure of TEO.

More details about the river and its bed deformation are available at the Project Institute TURKMENGIPROVODKHOZ.

3. *Versions of the bridge range*

Of all the possible bridge ranges versions, three competitive versions were selected for final consideration:

<u>Version 1</u>
Within the natural boundary of Yumalanda, 13 km from the railway bridge, up the river, outside the prospective limits of the city of Chardzhev. The estimated length of the bridge is 878 m. The total length of the access roads is 31.7 km.

<u>Version 2</u>
Within the limits of the city of Chardzhev, 250 m from the railway bridge, down the river. The estimated length of the bridge is 1880 m. The total length of the access roads is 24.7 km.

<u>Version 3</u>
At the prospective borderline of the city of Chardzhev, 8 km away from the railway bridge, up the river. The estimated length of the bridge is 1484 m. The total length of the access roads is 25.9 km.

The versions were selected by taking into account the hydrology and morphology of the river, as well as the principles of location of access roads and road infrastructure.

Calculations of the engineering and economical effectiveness of the three versions have shown that Version 2 is the most effective.

The recommended version of the bridge range has the lowest construction costs (compared to the other two versions). Its operation costs are twice lower. Besides, it will improve transport communications directly between Farap and Chardzhev.

4. *Access roads*

Access roads are part of the route M-37 which belongs to the transport corridor of the CIS Central Asian infrastructure "North - South".

The general direction of access roads is determined by the location of the bridge according to Version 2 (within the city).

According to the TEO-82 and Version 2, all transits will go through the northern part of the city affecting both social and economic aspects.

The best solution would be locating the left-bank access road in such a way that it could bypass the city.

Visual examination of the area and the General Plan of the city of Chardzhev demonstrated that the left-bank access road would conveniently join a section of the prospective bypass road, then it would pass outside the residential area, along the borderline of an industrial area and join the motorway M-37 leading to Mary. The final location of the motorway will be determined on the basis of the General Plan with local adjustments.

The technical category of the access roads must be further substantiated taking into account the prospective traffic intensity, as well as the probable proportion of local traffic.

The technical category is supposed to be that of a main road of the city, i.e. in compliance with SNiP 2.07.01-89 "Planning and constructing of urban and rural settlements".

Any possible road design must be substantiated by the specific local climatic and hydrogeological features of the area and availability of local or imported road-building materials.

In designing the road, provisions should be made for the prospective trolley-bus traffic.

Initial Data for TEO on Access Roads to the Bridge across the Amudarya River (according to data of TEO-82)

Indicators	Range version 1	Range version 2	Range version 3
1. Length of access roads to the bridge (km)	31	23	25
2. Construction costs (mln. rbl.) (prices valid in 1984)	23.8	21.8	25
3. Number of bridges (length and dimensions) G-11.5 (units/running metres)	7/312	1/27	3/131
4. Number of flyovers (units/running metres)	-	1/53	-
5. Transport and operation costs (mln. rbl.)	2.37	2.19	2.41

CONCLUSIONS

Having analysed the "Substantiating Materials on Bridge Construction Expediency Across the Amudarya River near the City of Chardzhev" (i.e. TEO-82), we recommend Range version 2 (within the city) for further development of the project's materials as it has the best engineering and economic indicators and is the most reasonable.

The TEO-82 must be revised taking into account the following:

- The location of the bridge range according to Range version 2 must be determined more precisely and in co-ordination with access roads and junctions with the R-35 Road Chardzhev - Tashauz and the railway at the station of Chardzhev-2 at different levels.

- The left-bank access road must comply with the existing standards of urban development, the sanitary requirements and the General Plan of the city of Chardzhev.

- The seismicity of the planned bridge location should be stated more precisely.

Besides, in the analysis of the TEO-82, the following aspects were considered:

1. Project Standards:

The given project complies with the existing project standards of Turkmenistan SNiP 2.05.02-85 "Motor roads" and SNiP 2.05.03-84 "Bridges and pipe culverts ".

Geometrical planning and longitudinal profile of motor roads must comply with the above-mentioned standards and norms.

The recommended minimum width of the carriageway of the bridge is 11.5 m.

The technical category of access roads should be determined in accordance with SNiP 2.07.01-89 "Planning and construction of urban and rural settlements", as these requirements are compatible with the existing urban arrangement and the General Plan of the city of Chardzhev.

2. Carrying Capacity:

The carrying capacity of the bridge including motor access roads, as well as their load levels, must be estimated on the basis of detailed motor transport flow forecasts for the coming 25-30 years.

3. Geotechnical Conditions:

The geotechnical conditions must be stated more precisely when designing the bridge and access roads.

4. Hydrological Situation and Navigational Requirements:

The conditions and requirements presented in the TEO-82 are well-founded. However, the navigational aspects must be agreed upon with the Steamship Administration of the Amudarya River.

5. Construction and Maintenance Costs:

Construction costs, presented in the TEO-82, were estimated by analogy. They should be more precise.

6. Construction Methods:

The methods of construction are subject to reconsideration and depend upon the design of supports and spans of the bridge.

7. Required Funding by Local and Foreign Investors

It depends on the terms of investment.

8. Acquisition of Land. Compensation Payments. Social Consequences.

These aspects can be decided upon when all the documents concerning the location of the building site and the bypass motor roads will be ready.

9. Environmental Effects

The access roads will be located outside ecologically sensitive areas.

The location is, for the most part, a lowland agricultural area which makes it possible to design the minimum longitudinal slopes in order to avoid excessive air pollution. Determining the location of the building site for the bridge may prove to be complicated.

Chief Expert: /signature/ L. N. Mirgorodsky

Annex F

TRACECA - MODULE C **CHARDZHEV BRIDGE**

ANNEX F
REVIEW OF MOSCOW BRIDGE INSTITUTE FEASIBILITY STUDY („MBIFS“)
DRAWINGS

containing a general situation plan (F/1), bridge design drawing (view - on pages F/2 to F/7) of option N2.

Для служебного пользования
Экз. № 6

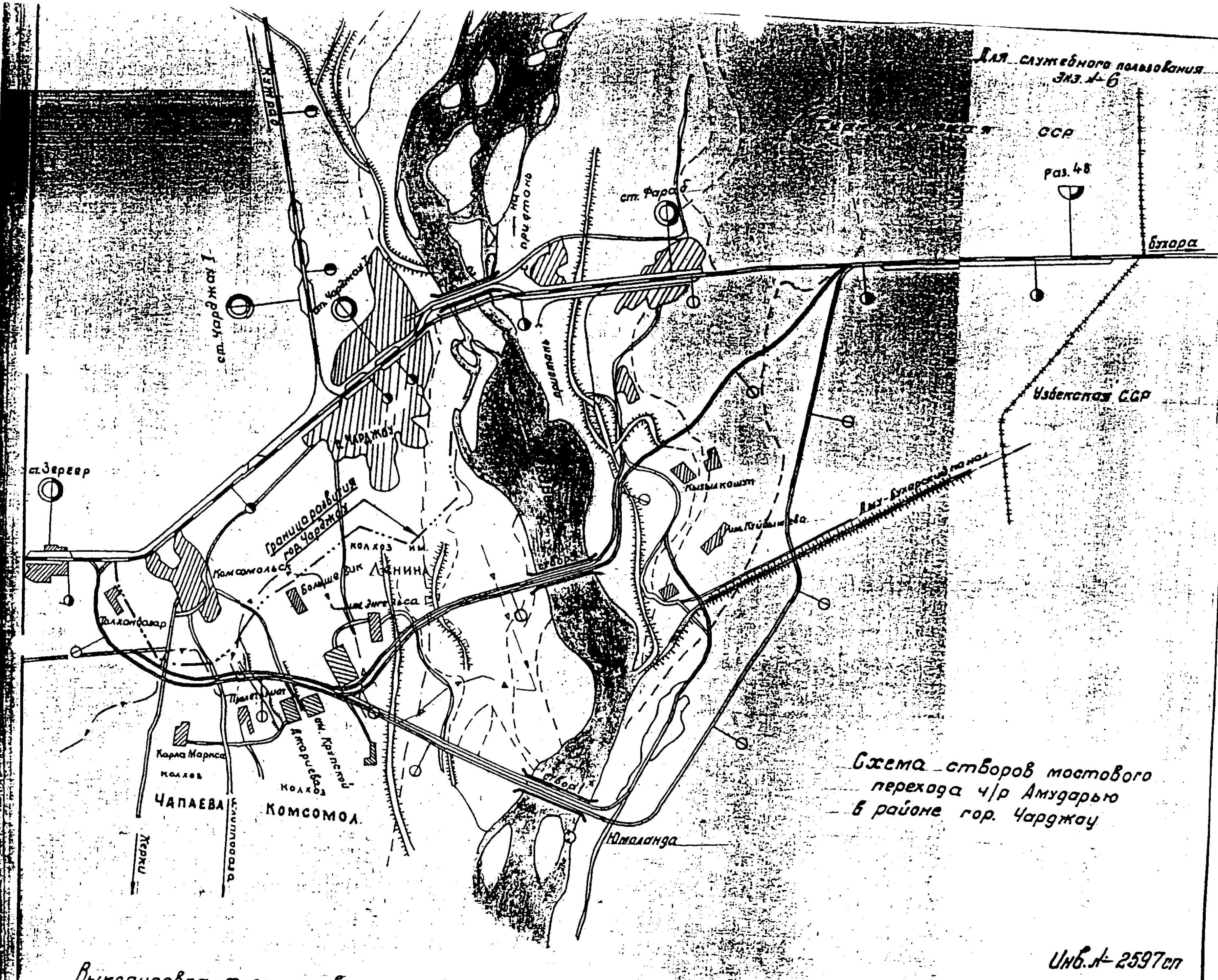
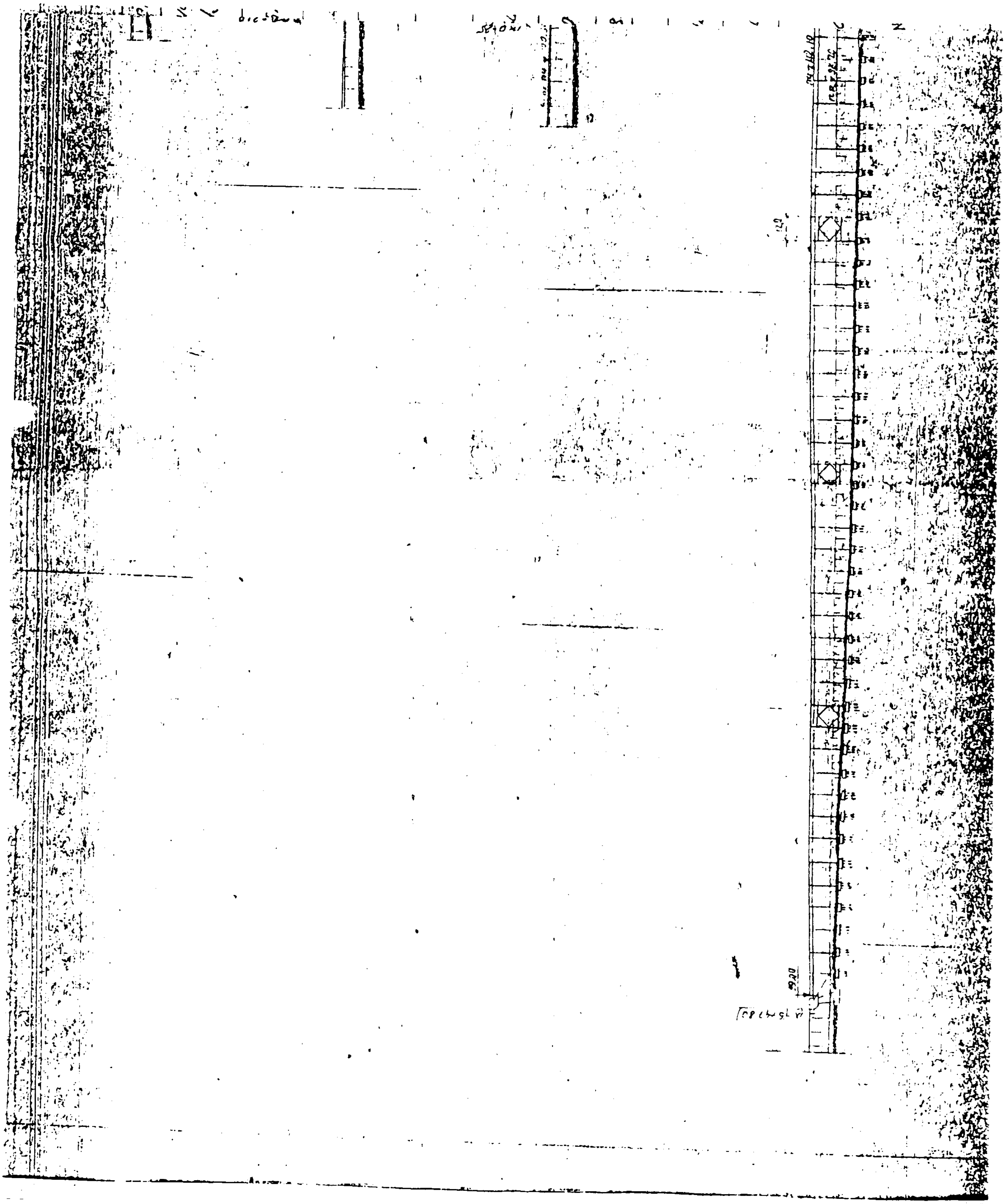


Схема створов мостового перехода ч/р Амударью в районе гор. Чарджоу

Инв. № 2597сп

Выкопировка с схемы вариантов ...

7/2



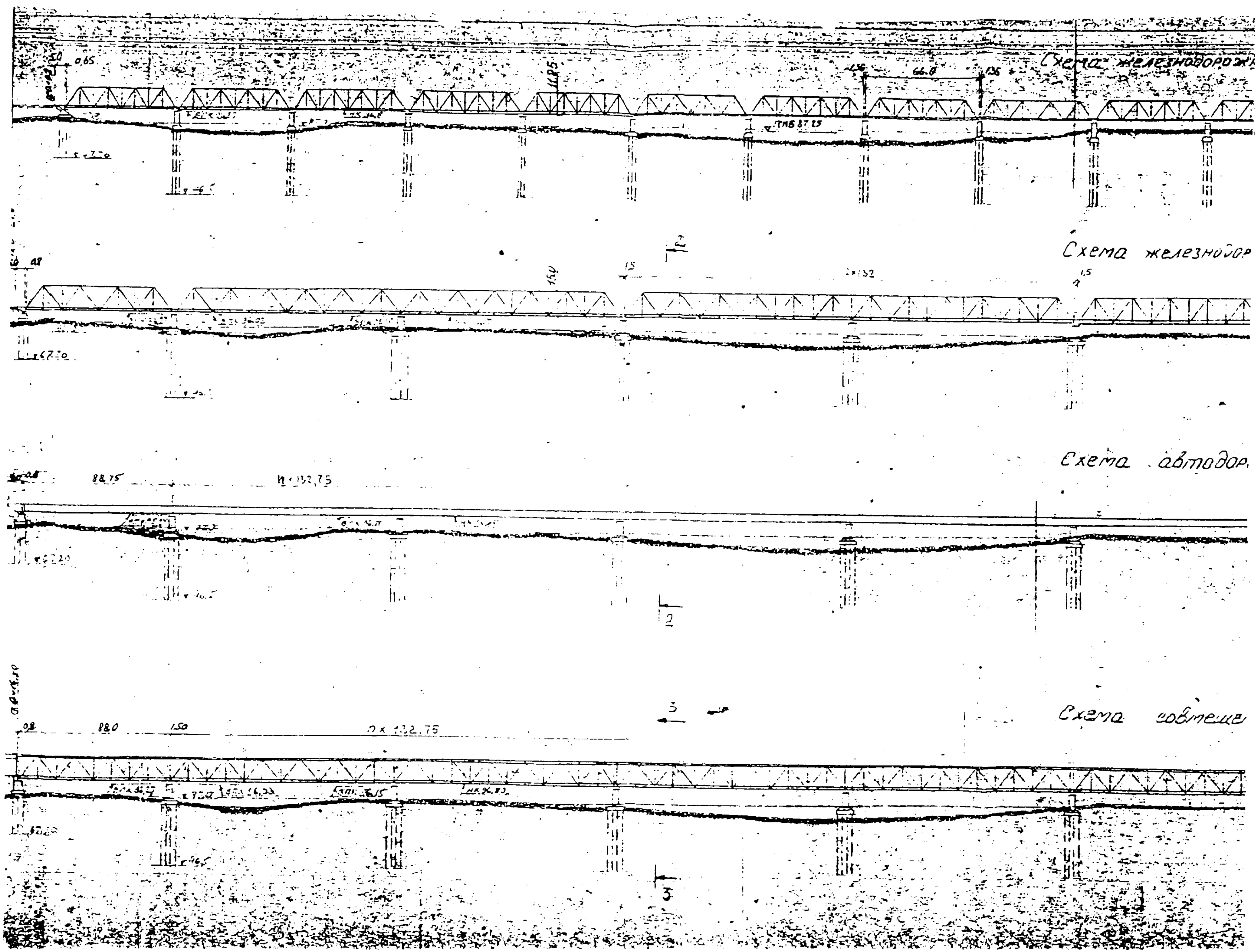
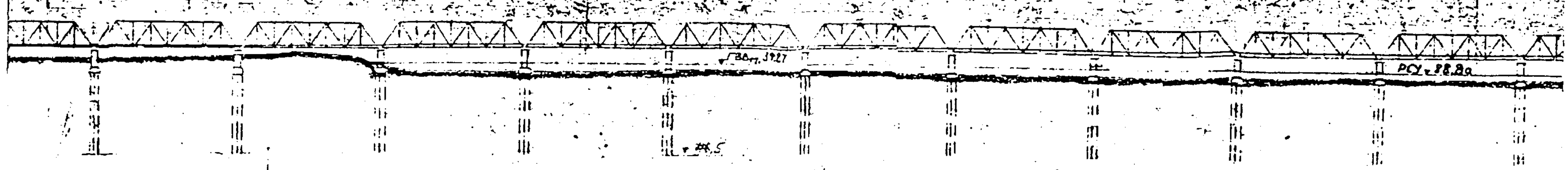
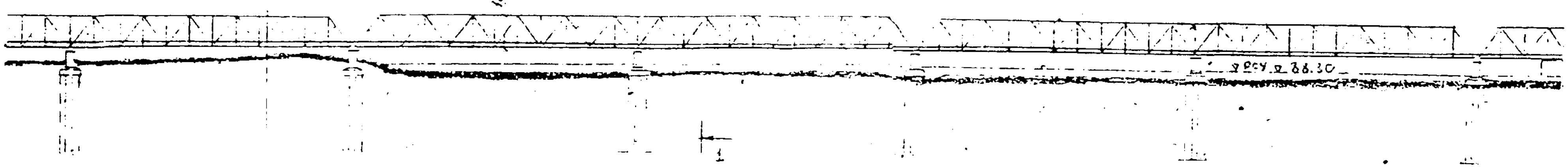


Схема железнодорож
66.8
1.35
11.85
ТМВ 87.25
Схема железнодор
2×152
1.5
Схема автодор
88.75
11×132.75
2
Схема совмеще
88.0
1.50
2×132.75
3

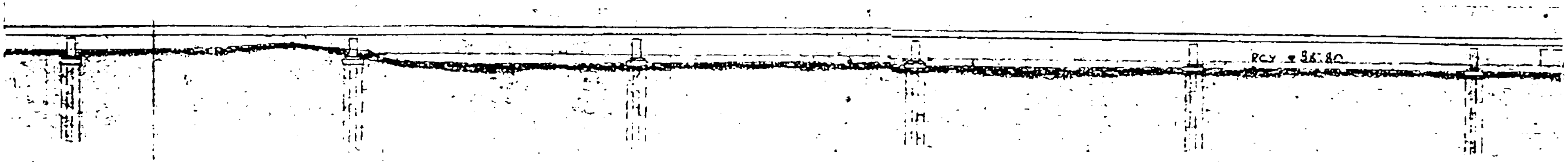
ного моста - Варианты N 1А и N 1Б



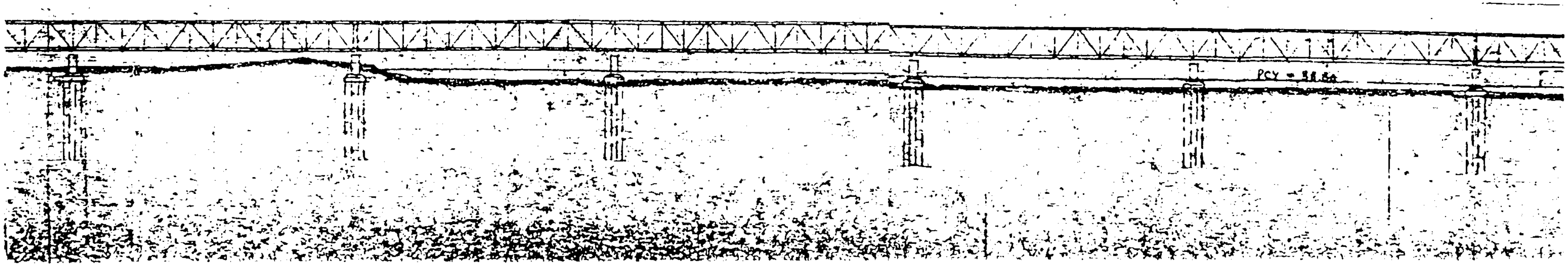
ожной части совмещенного (вариант 13) и железнодорожного (Варианты N 21 и N 25) мостов



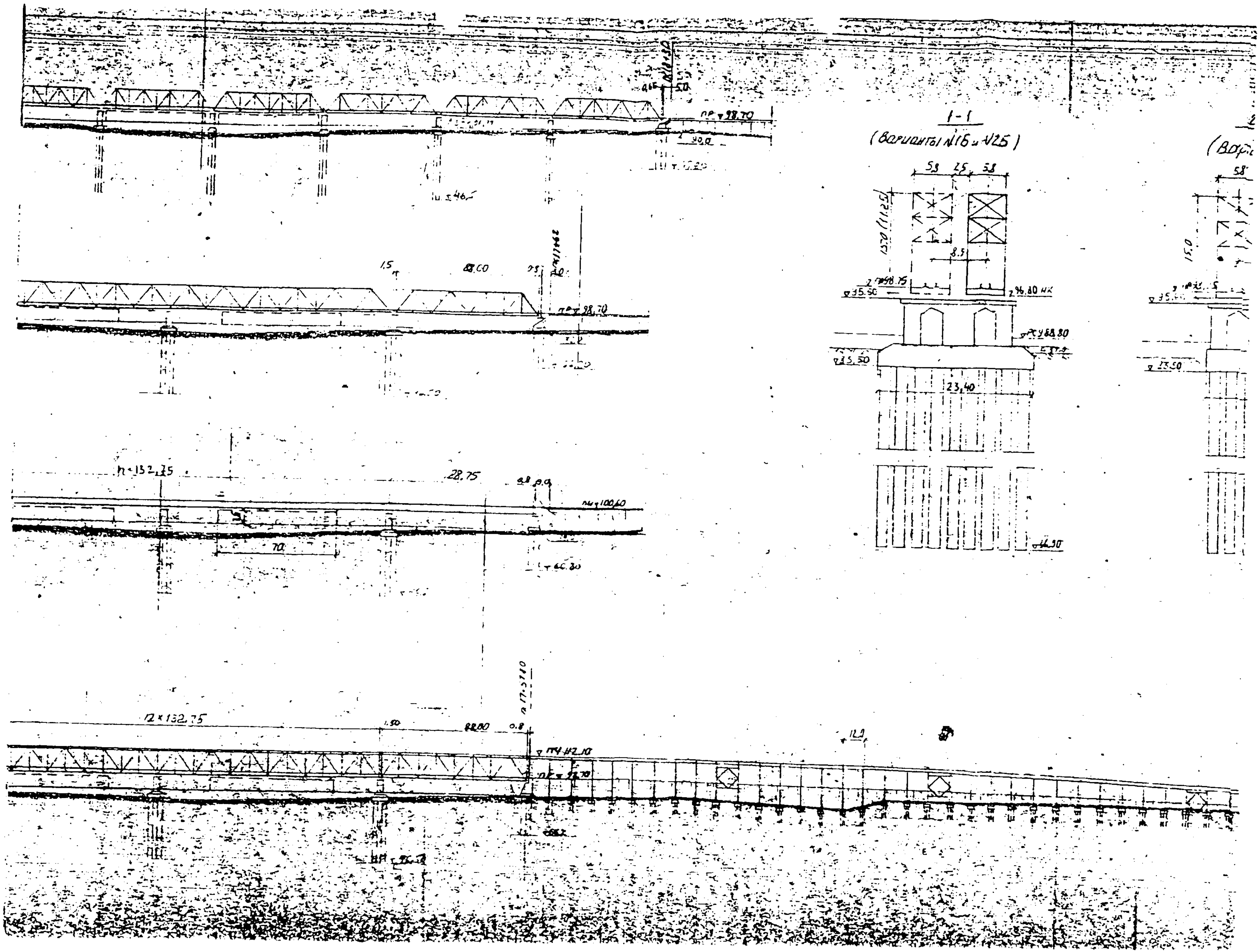
ожной части совмещенного моста - Вариант N 3



чного моста с ездой в двух ярусах - Вариант N 4.

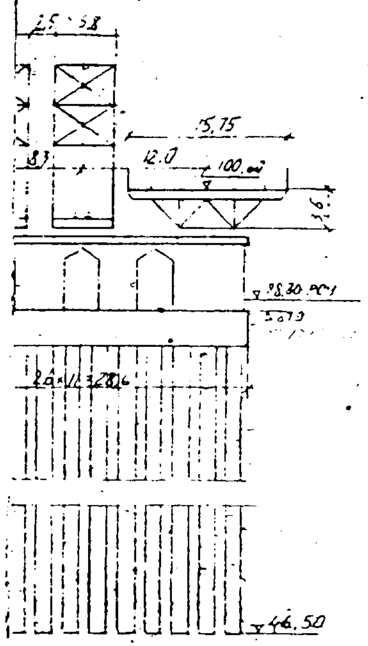


F/5

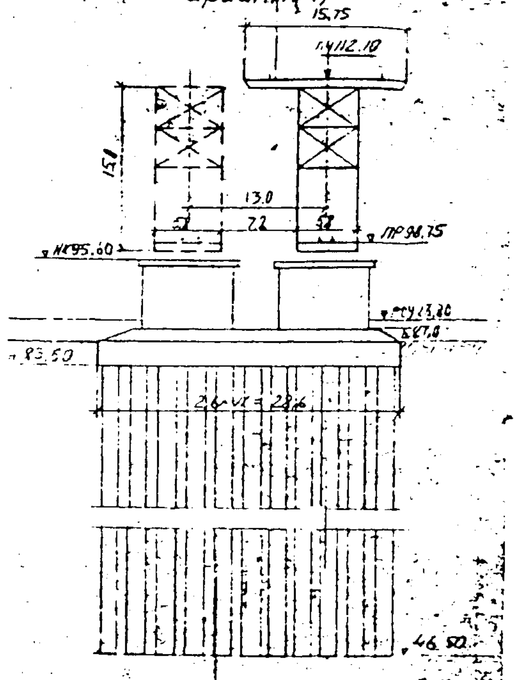


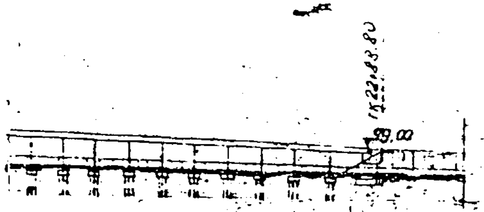
-2

(Вариант №3)



3-3 (Вариант 4)





Техно...

№№ п/п	Наименование	Един. изм.	Количес... Вариант №1А/№1Б	Вариант №2А/№2Б	Вари... №...
1	Всего металла пролетных строений моста	т	6090	9640	236...
2	Железобетон и бетон опор моста	м³	31270/48500	32650/51600	646...
3	Железобетон и бетон опор эстакады	м³			
4	Железобетон пролетных строений эстакады	м³			
5	Кладка регуляционно-защитных стенок	м³	14600	14600	146...
6	Всего металла анкеров регуляционно-защитных стенок	т	310	310	310
7	Стоимость моста	млн.руб.	17,41/23,65	21,18/26,91	47,8...
8	Стоимость эстакады	—"—	—	—	—
9	Стоимость регуляционно-защитных стенок	—"—	3,18	3,18	3,1...
10	Общая стоимость моста (гл. 2 сводной сметы)	—"—	20,58/26,83	24,36/30,09	51,...

Примечания:

1. Варианты железнодорожных мостов с индексом „А" имеют опоры под один путь, с индексом „Б" – под два пути.
2. Размеры ... показаны в метрах. Отметки ...

Для служебного пользования
Экз. № 16

Союздорпроект экз. №
Гипротрансмост экз.

F/7

Экономические показатели

...тво		В том числе				
...ант 3	Вариант N4	Наименование	Количество Вариант N1А/N1Б	Вариант N2А/N2Б	Вариант N3	Вариант N4
...10	17880	сталь 15ХСНД, 16Д, 40Х, 10ХСНД	6090	9640	23610	17880
...0	63460	сборный	8460/12960	7900/12130	16280	15070
		монолитный	22810/35540	24750/39470	48360	48390
	7920	сборный	—	—	—	7920
		монолитный	—	—	—	—
		сборный	—	—	—	6060
		монолитный	—	—	—	—
...0	14600	сборный	500	500	500	500
		монолитный	14100	14100	14100	14100
	310	сталь ВСт5сп2	310	310	310	310
2	39.92					
	5.4					
3	3.18					
7	48.50					

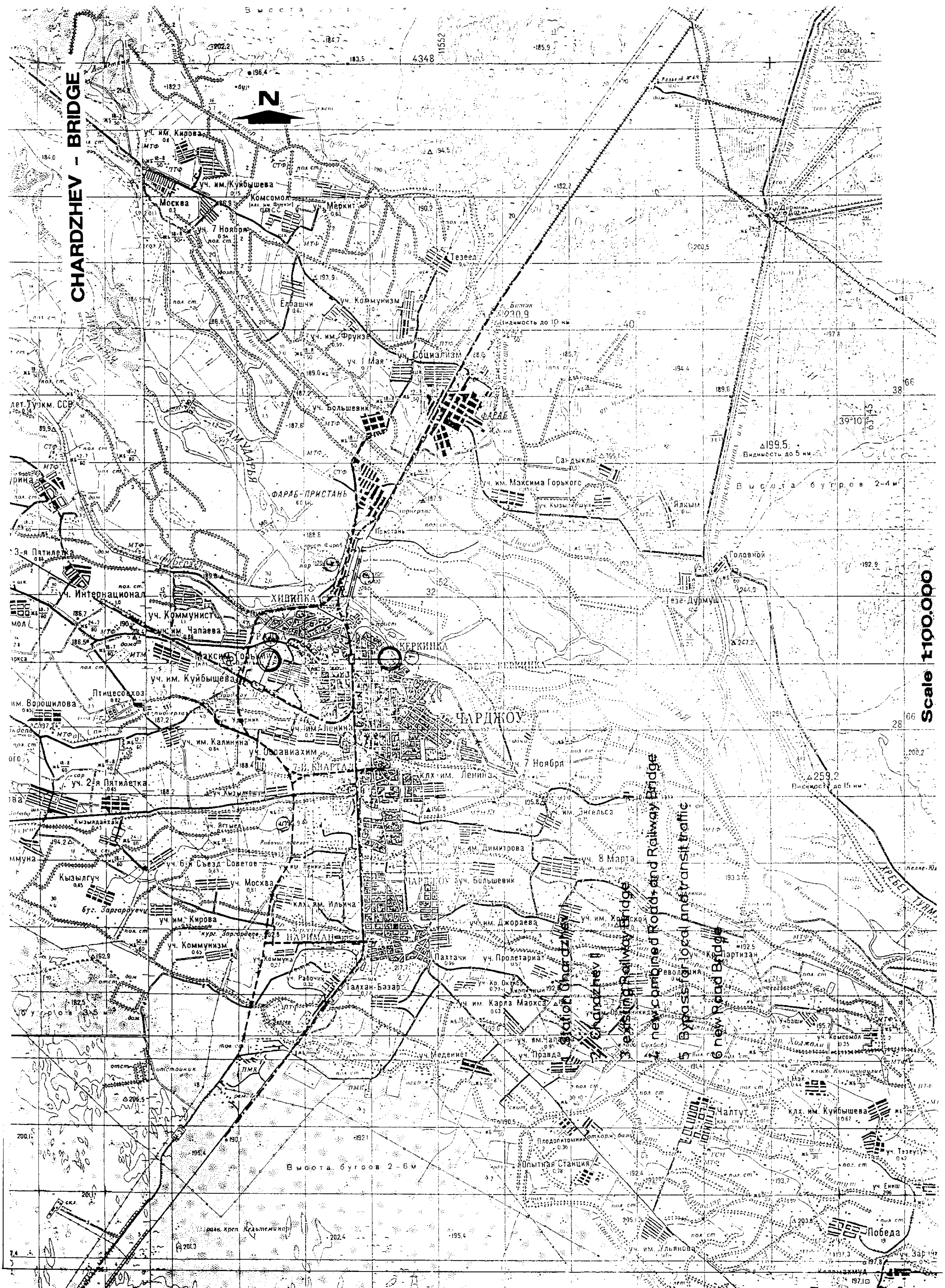
...льзования
N1,3,4,5,6
N2

Обосновывающие материалы строительства мостового перехода ч/р Амударья в р-не г. Чарджоу Туркменской ССР. Варианты совмещенного и железнодорожного мостов

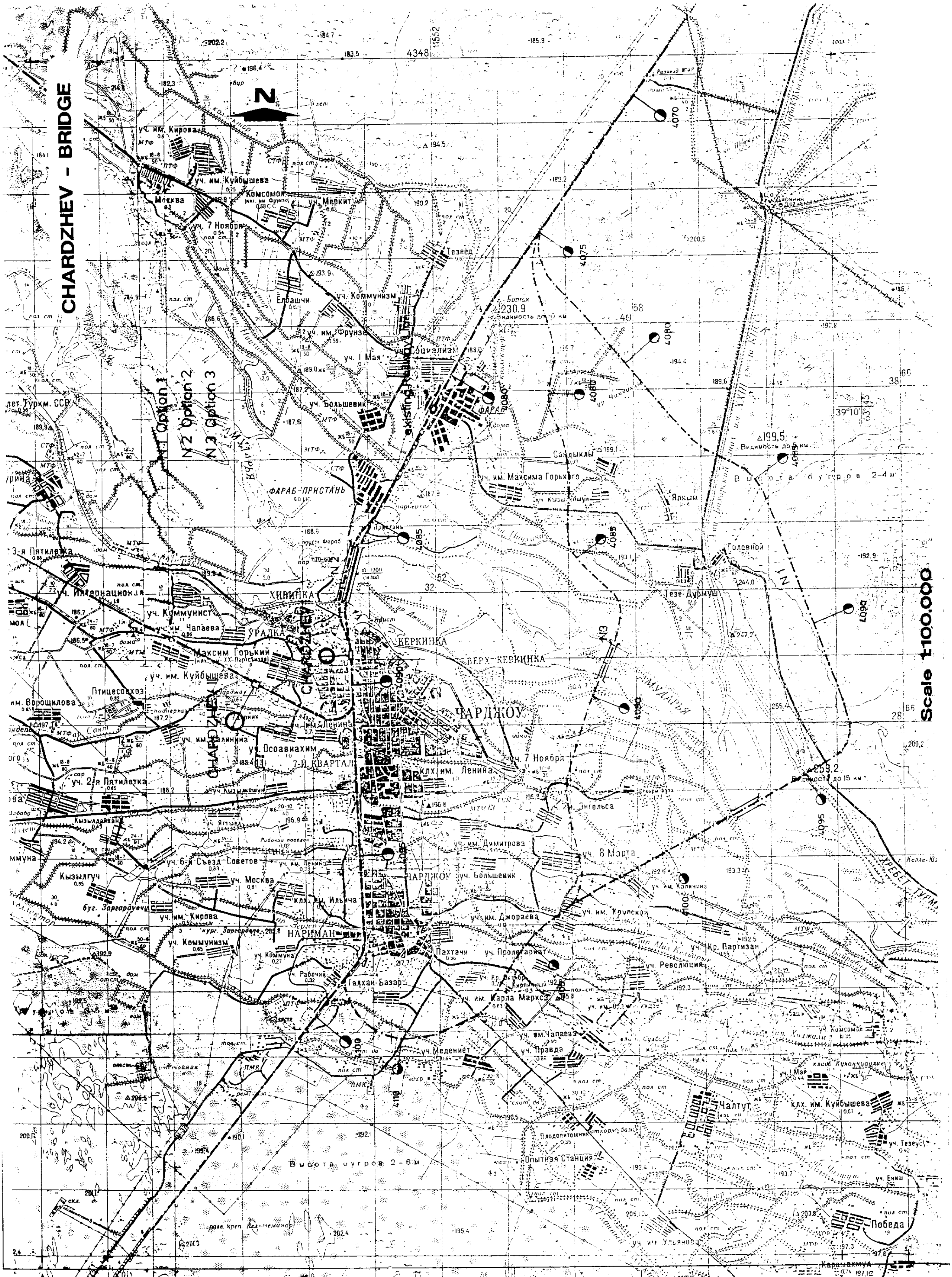
Створ N2

Схема вариантов моста

			Шифр	Лист	Инв.
Гл. инж. ин-та	Журавлев	[подпись]	613	N2	N 2599сс
Нач. отдела	Момов	[подпись]			
Гл. инж. пр-та	Крылов	[подпись]	Г 1:2000 В 1:500		1982



CHARDZHEV - BRIDGE
N
Scale 1:100.000
1 Station Chardzhev
2 Chardzhev
3 existing Railway Bridge
4 new combined Road and Railway Bridge
5 Bypass for local and transit traffic
6 new Road Bridge



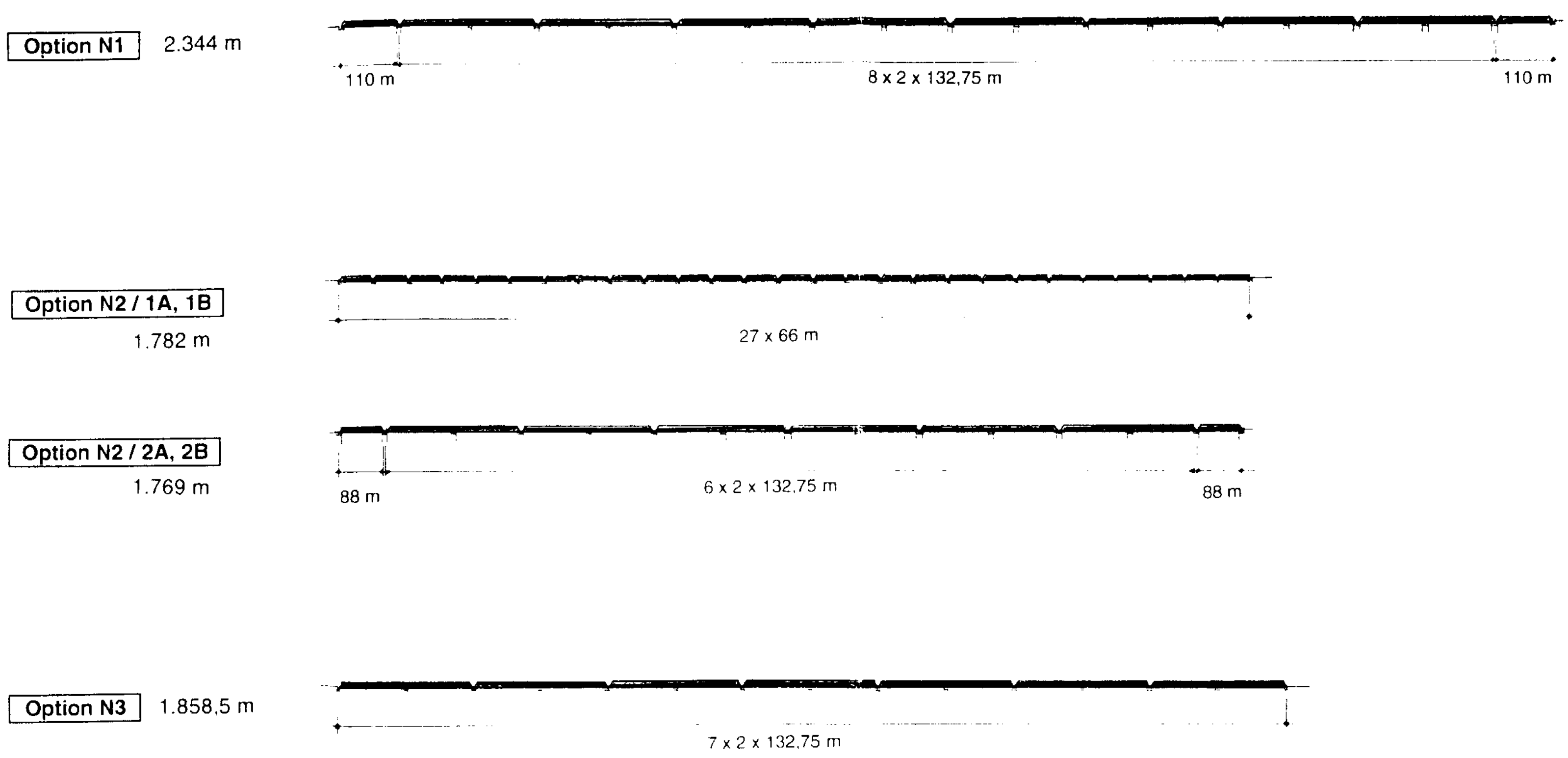
CHARDZHEV - BRIDGE
N
N 1 Option 1
N2 Option 2
N 3 Option 3
existing bridge
Scale 1:100,000
ЧАРДЖОУ
ФАРАБ
ФАРАБ-ПРИСТАНЬ
ХИВИНКА
КЕРКИНКА
ВЕРХ-КЕРКИНКА
УРАДКА
НАРИМАН
АМУДАРЬЯ
Высота бугров 2-4 м
Высота бугров 2-6 м
Тезе-Дурмуш
Голевиой
Сандыклы
Ялкым
Чалтут
Победа
Опытная Станция
Галхан-Базар
Пахтачи
Москва
Комсомол
Тезеоп
Елгашчи

Annex G

TRACECA - MODULE C CHARDZHEV BRIDGE

ANNEX G
DESIGN DRAWINGS OF RAILWAY AND ROAD BRIDGES

(pages G/1 to G/3)



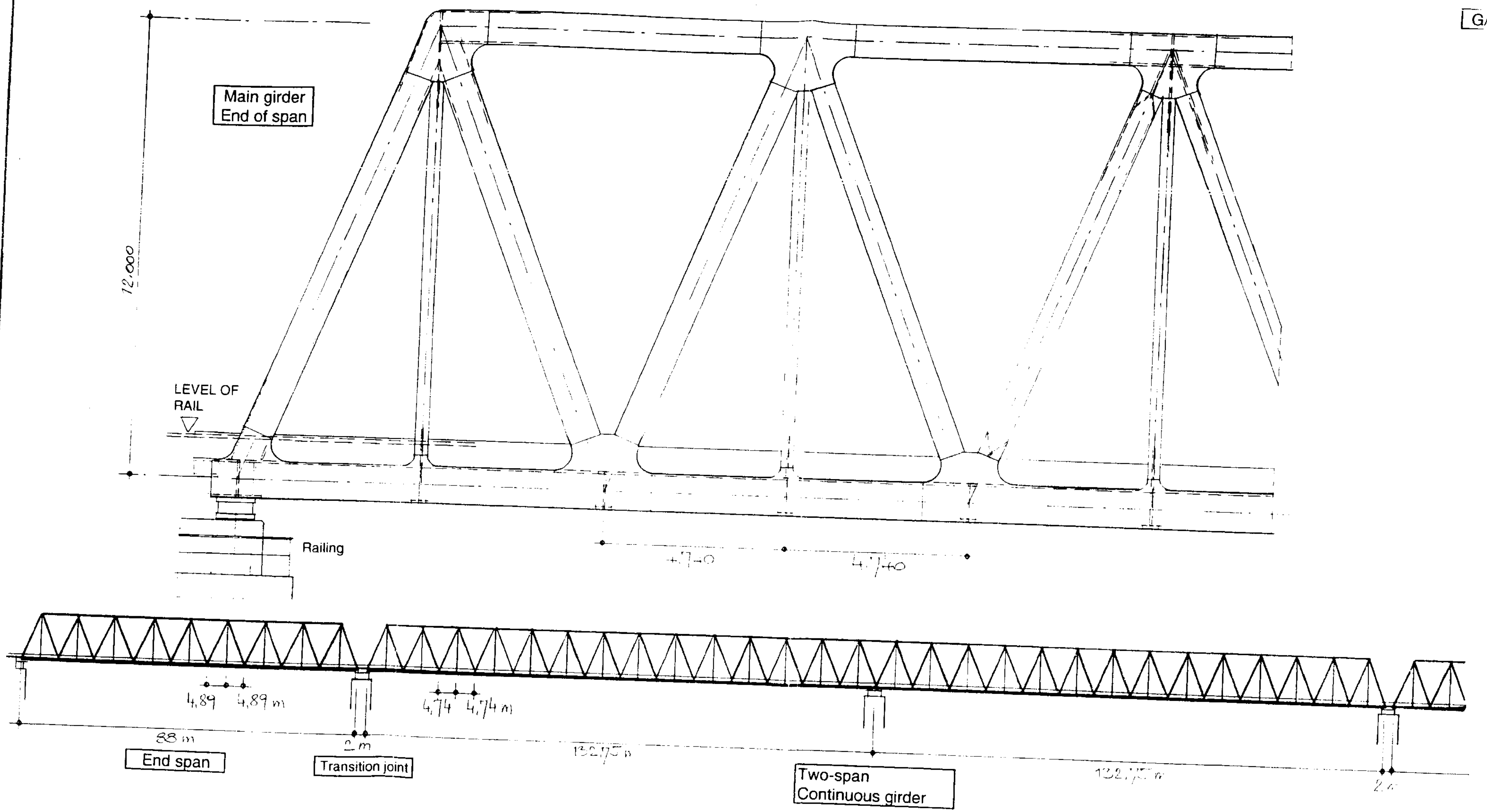
TRACECA - MODULE C

CHARDZEV BRIDGE

TRACECA proposal of railway and road bridge
COMPARISON OF OPTIONS

SCALE 1 : 10.000

17.04.1997



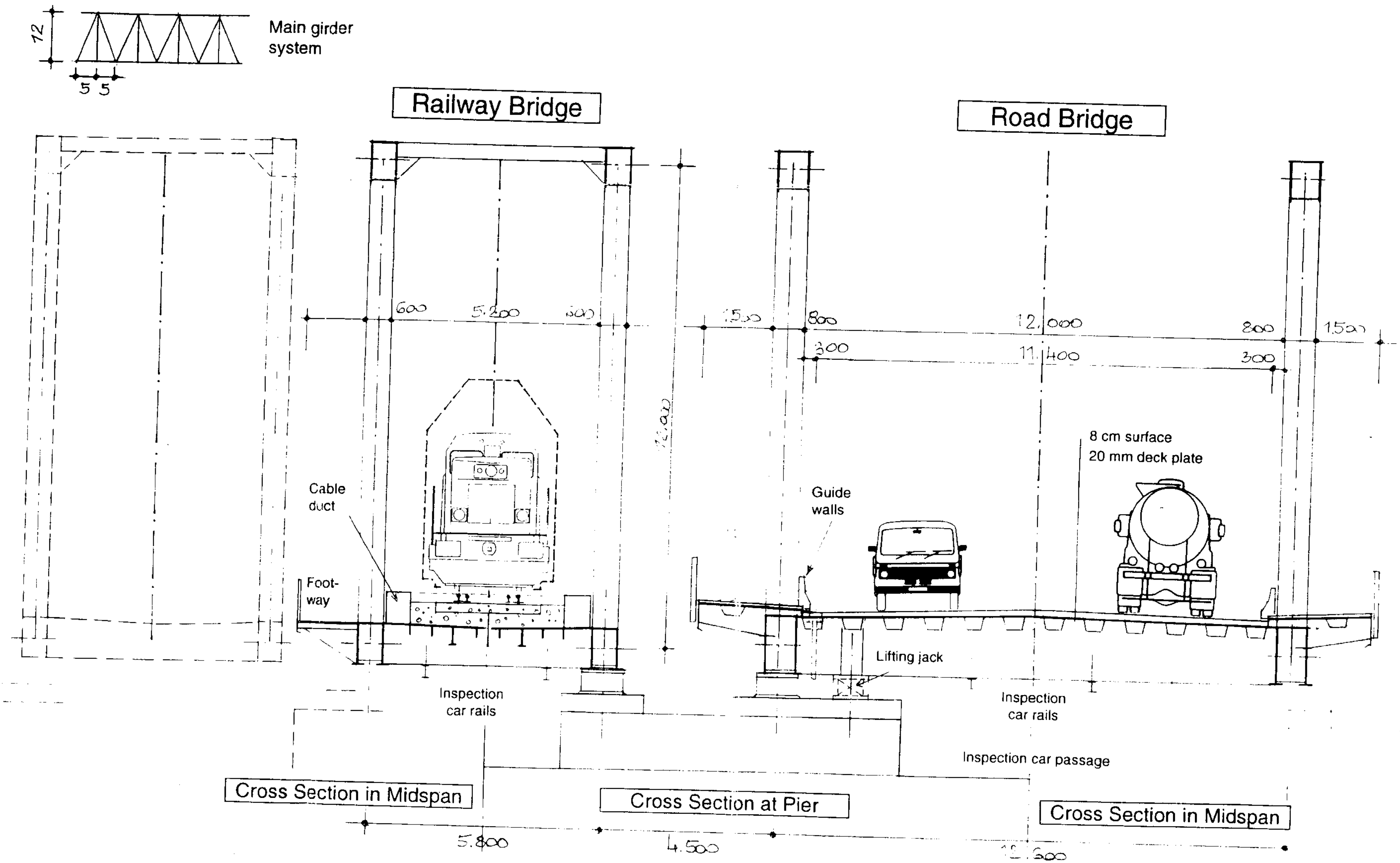
TRACECA - MODULE C

CHARDZEV BRIDGE

TRACECA proposal of railway and road bridge
MAIN GIRDER end detail, system 88 + 2x132,75 m

SCALE 1 : 100, 1 : 1000

17.04.1997



TRACECA - MODULE C

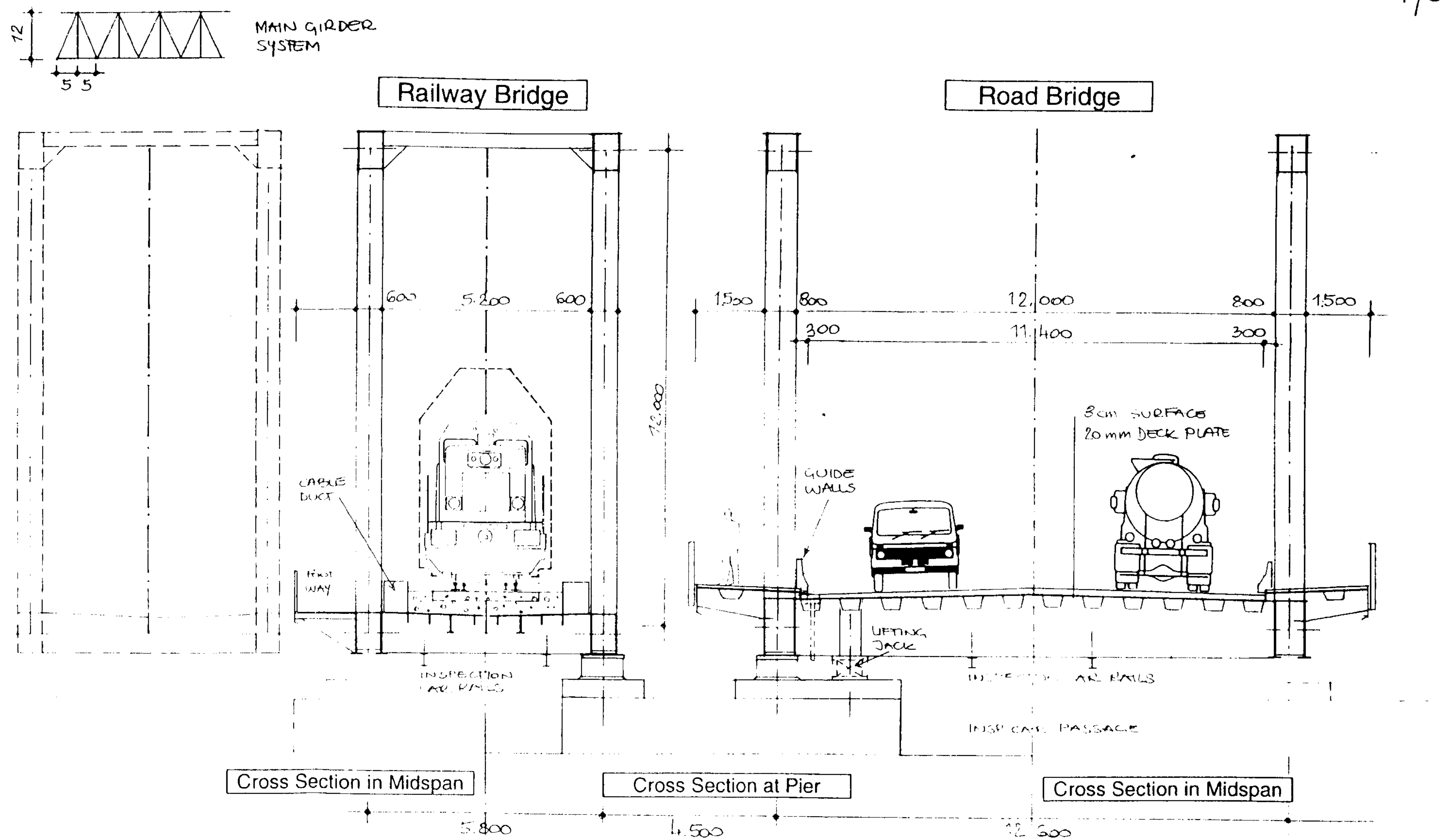
CHARDZEV BRIDGE

TRACECA proposal of railway and road bridge CROSS SECTION of a 132 m span

SCALE 1 : 100

17.04.1997

F/8



TRACECA - MODULE C - WS 3200

CHARDZHEV BRIDGE

TRACECA proposal of railway and road bridge
CROSS SECTION of a 132 m span

SCALE 1:100

1997 02 10

Annex H

TRACECA - MODULE C CHARDZHEV BRIDGE

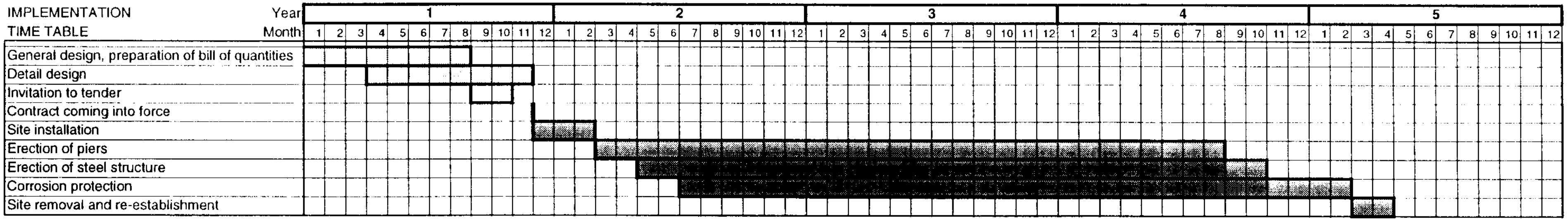
ANNEX H
RAILWAY AND ROAD BRIDGES - TIME TABLE

TRACECA - MODULE C

CHARDZEV BRIDGE

OPTION N2 / 1B

Railway Bridge 27 x 66 m



TRACECA - MODULE C

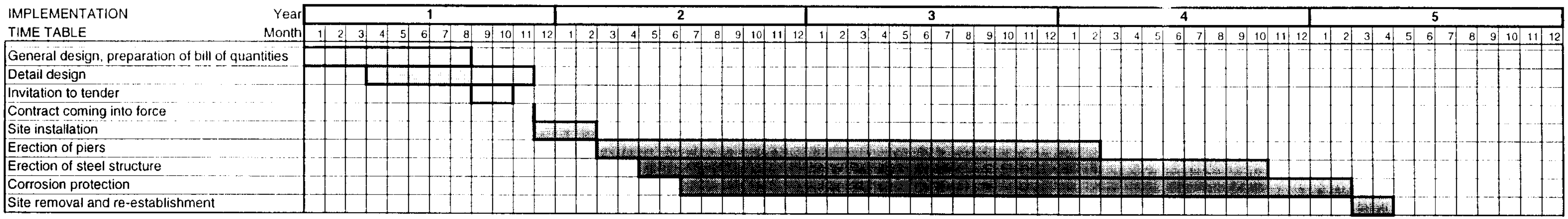
CHARDZEV BRIDGE

OPTION N2 / 2B

Railway Bridge 88 + 6 x 2 x 132 + 88 m

IMPLEMENTATION

TIME TABLE

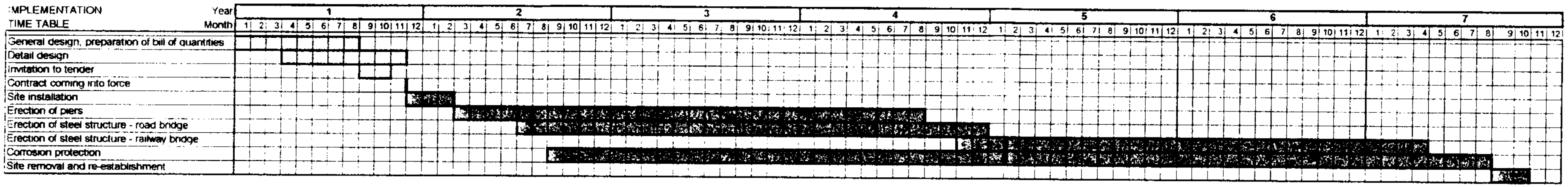


TRACECA - MODULE C

CHARDZEV BRIDGE

OPTION N2 / 3

Railway Bridge + Road Bridge 88 + 6 x 2 x 132 + 88 m



Annex I

TRACECA - MODULE C - WS 3200 CHARDZHEV BRIDGE

ANNEX I

COSTS FOR REVISION AND MAINTENANCE OF THE BRIDGE

COSTS FOR REVISION AND MAINTENANCE OF THE EXISTING BRIDGE AND FOR THE NEW BRIDGE

ANNUAL COSTS:

Regular checks by the local experts have to be executed. Minor repair works could then be done also.
Costs:

40 man hours per month — <u>total per 1 year:</u> **500 HRS**

COSTS ARISING EVERY 5 TO 7 YEARS:

Thoroughly inspection every 5 to 7 years by a crew of experts (bridge maintainer, material experts, testing experts, experts from technical universities).
Costs:

every 5 year: 1500 man hours; <u>total per 1 year:</u> **300 HRS**

RENEWAL OF CORROSION PROTECTION:

Every 15 to 20 years the corrosion protection must be renewed if a correct coating was executed.
Costs:

7.400.000,- US$ — <u>total per 1 year:</u> **370.000,- US$**

AVERAGE COSTS FOR MAINTENANCE OF BRIDGES:

As an average value for maintenance and normal repair of concrete as well as steel bridges a percentage of **0,7 to 1,4 % of building costs** of the bridge could be assumed per year (reference: BUNDESMINISTER FÜR VERKEHR, Informationen über Brücken der Bundesfernstraßen; 1986; Bundesministerium für Verkehr/Deutschland; also other references available).

Annex J

TRACECA - MODULE C - WS 3200 **CHARDZHEV BRIDGE**

ANNEX J
STEPS OF PROVISIONS FOR MAINTENANCE AND BRIDGE ERECTION

STEPS OF PROVISIONS FOR REFURBISHMENT AND MAINTENANCE OF THE EXISTING AND ERECTION OF A NEW BRIDGE

REFURBISHMENT:

Period	Measure	Costs US$	additional man hours
1st year	Repair of defects and leaks in piers	21.000,-	1.300
	Corrosion protection of piers	92.000,-	
	Repair of most serious defects of steel structure	50.000,-	3.000
	Corrosion protection of repaired steel structure	1.000.000,-	
	Inspection		500
2nd year and 3rd year	Repair of inspection car	25.000,-	
	Repair of remaining defects of steel structure	100.000,-	4.900
	Corrosion protection of total steel structure	6.400.000,-	
	Inspection 2 x 500 man hours		1.000
	TOTAL	7.688.000,- US$	10.700 HRS

A possible supervision by a site engineer should be added to the costs.

MEASURES TO INCREASE LIFETIME OF THE BRIDGE:

a) TRAIN LENGTH:

As the spans of the existing bridge are of a length not more than 66,1 m and are separated as single span girders it is strongly recommended to arrange only one heavy locomotive in one span.
A train could then be arranged so that one locomotive is pulling the train at the front end and another is pushing at the rear end if the train has a length of more than 66 m plus length of one locomotive. In this case only one locomotive loads one span.

b) HIGH VOLTAGE LINE:

The High Voltage Line arranged on the top of the bridge structure is very exposed to wind influence and shows oscillations due to Karman effects. Such oscillations are dangerous as fatigue cracks are produced in the structural elements which carry the cantilevers and masts. The number of cycles of wind produced oscillations is so very high that also under low stresses a fatigue damage can result.

It is therefore strongly recommended to dismantle the High Voltage Line if there is any possibility to carry the line in another way.

c) TRAIN SPEED RESTRICTIONS:

Approximating calculations show that speeds of about 30 km/h and 60 km/h can effect oscillations of 2,0 to 2,2 Hz which is the calculated Eigen frequency of the bridge plus train. Train speeds near such values should be avoided.
A recommendation could be given: to measure the extreme amplitudes during train passage for verification with various train speeds of 30 to 60 km/h (span over land, to enable measuring). The speeds with maximum deflection should be avoided as far as possible.

NEW BRIDGE STRUCTURE:

The new bridge construction should be of lightweight type due to danger of seismic action in this region. As damage due to heavy earthquake is linearly dependent of the selfweight a reinforced concrete structure (with a mass of more than 5 times of the mass of a steel bridge) is very critical. It must also be said that in case of defects a steel structure is much more easier to repair than a concrete structure.

New Version of Chapter 5.2 and 5.3.

including actualised financial calculation tables

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5.2 Definition of Operating Costs

In estimating the costs involved for the proposed measures Option N2 Variant No. 3 has been taken into consideration, in accordance with the recommendations of the technical experts, and in line with the calculations contained in 5.1 above.

It is therefore assumed that the present bridge will be refurbished and that a road/rail bridge will be constructed in ten years time. It is further assumed that in connection with the construction of the bridge only the minimum prerequisite as far as access roads are concerned will be considered. Any extension of the road network will form part of a general plan of enhancement.

In the absence of any historical data concerning the financial aspects of the bridge's operations the investment expenditures have been taken as a basis for estimating the operating costs. It is considered that to maintain the bridge in good condition the annual charge for maintenance could amount to 1.5% of the investment costs. This estimate is in line with European guidelines for comparable constructions: See Annex I. The depreciation charges are based on a 50 year life on a straight-line basis. Likewise the costs for the refurbishment of the bridge are amortised over ten years, since this is considered the period which the present bridge must last before the construction of a new one. The estimated design and consulting fees have also been amortised over ten years. It could however be argued that these costs form part of the expenditures for the erection of the bridge and be included in the total costs which are depreciated over 50 years. The effect in either case can not be considered as significant in comparison to the total costs of the recommended measures to be taken.

The operating costs calculated in accordance with the above assumptions are contained in Table 5.3.4.

In order to provide the necessary data to enable more exact calculations in the future it is recommended that the Railway reorganise its accounting system to supply detailed information on the bridge's operations. The bridge should in fact be considered as a cost centre, and should tolls be charged for usage of the bridge it should become a profit centre. During the Soviet era such considerations did not have the same importance as under a market oriented system so that considerable steps in this direction still have to be taken.

5.3 Cost-Benefit Analysis

5.3.1 Alternatives Available

As pointed out in other sections of this report the bridge must be regarded as a strategic necessity for Turkmenistan; - e.g. approx. one third of external trade passed over the railway bridge in 1995 in the form of exports of oil products and imports of various materials and foodstuffs: See 2.1.3.2. The location of the bridge at Chardzhev is the most logical with regard to the traffic flows and the alternatives to a fixed crossing at this point involve a long re-routing of railway traffic and continuing use of the pontoon bridge for road traffic. No other alternatives would seem to be conceivable at present and further use of the pontoon bridge cannot be regarded as feasible in the long-term. Moreover the relevance of the crossing at Chardzhev as part of the "New Silk Road" and Transcaspian Corridor has been established by the Governments of the region. This topic is addressed in Chapter 2.2.2.

5.3.1.1 Do Nothing Scenario

Under the present situation the bridge is not expected to last much longer than ten years; see Chapter 3.4. If nothing is done the bridge will reach a state which will be unsafe for rail traffic beyond this time period. The consequence will be that this traffic will have to be re-routed over the new bridge at Kerki, resulting in an estimated detour of some 500 km for traffic from Bukhara and an additional 200 to 300 km for traffic from Samarkand, thereby adding additional costs and time loss of up to an extra day to the journey. In addition this will be an extra burden on the line from Kerki to Zerger, whose primary purpose is intended to be to provide a link between Central and East Turkmenistan, thereby avoiding passage through Uzbekistan; see Chapter 2.2.

A further consequence of not renewing the bridge will be that local rail traffic will no longer be possible between Chardzhev and Farap on the opposite bank of the river. This will cause hardship to the residents of the area; (over 930,000 in number; see Table 3.2), since many must cross the bridge to work or for domestic reasons. The present daily average is 4,620, as noted in Table 2-14. Furthermore it was as a result of the policies of former governments that communities were set up on the Farap bank and therefore there is an implicit responsibility for the authorities to provide a means of transport to and from Chardzhev.

If there is no possibility to commute by rail between Farap and Chardzhev the logical repercussion will be that commuters will have to travel by bus or private car which will further encumber the pontoon bridge, already accommodating over 2,000 vehicles per day, and result in even greater road traffic bottlenecks.

The state of the pontoon bridge is such that it is already overburdened and potentially dangerous: As noted in Chapter 2.1.4 trucks must wait until each float is free before proceeding in order to prevent dangerous tilting of the floats. Truck drivers are also reluctant to cross at night because the bridge is unlit and potentially hazardous.

In view of all these conditions, action is urgently needed to find a lasting solution, since the financial and social consequences of delay will increase with the passage of time. The logical conclusion would seem to be that a bridge at this crossing point is indispensable, not only from the local socio-economic aspect but also because, as pointed out in Chapter 2, it is a vital link between Central Asia and the West, as well as for traffic en route to and from Iran and points beyond. The new bridge at Kerki would not be a viable alternative to a road/rail bridge at Chardzhev for the reasons mentioned above.

5.3.1.2 Financing Possibilities

The points raised above demonstrate that apart from the financial considerations the social element is also very important. Nonetheless the bridge can contribute to its financing if tolls are charged for its use by road traffic in the same manner as the present pontoon bridge, which would then contribute to the financing of both the road and the rail portions. An attempt has therefore been made to estimate the costs involved in operating the bridge and the possible toll revenues which could offset these costs. The present toll revenues are contained in Table 5.3.1.

Taking the forecasts contained in Chapter 2.2 as a base, the development of the volume of road traffic up to the year 2005 is demonstrated in Table 5.3.2. below. This has been made for both the high and the low variants.

From the figures obtained, an estimate has been made in Table 5.3.3. of the toll revenues which can be expected, based on the tariffs charged by the current operator of the pontoon bridge and presuming that toll revenues will commence on the day the bridge is first opened to road traffic. See Table 2-24. Here again calculations for both the high and the low variants have been made.

These estimates show that toll revenues should be adequate to cover the costs of operating the bridge and provide a reserve for its eventual replacement through depreciation charges, once the bridge is opened to traffic in 2009. See Tables 5.3.4. and 5.3.5 The tables also show the net revenues without taking into account the depreciation charges.

To determine the extent to which these net revenues are sufficient to cover the financial costs involved, the internal rate of return (IRR) and net present values for the combined road and rail bridge has been calculated based on the forecast developments in road traffic and the recommended investment option: See Tables 5.3.6 and 5.3.7 The calculations have been made taking into consideration a 30 year and a 40 year payback period for the total investment and both the high and the low traffic prognoses.

The calculations show that for both variants the IRR is low and the toll revenues will not be sufficient to make the bridge a commercially viable proposition. In fact the best returns obtained are 7.72% and 7.43% which would hardly be sufficient to cover financing at current rates of interest. The other variants may be considered as too low to finance the investments and the operating expenses.

In Tables 5.3.8 and 5.3.9 the cash flow effect of the investments are shown for three selected interest rates between 5% and 9% for both variants and payback periods. It is assumed that the toll revenues will only be credited to the bridge operations once it is opened to road traffic; i.e.; after the fourth year from the beginning of construction.

The results show that only for the most favourable variant; high traffic volume with loans at 5% interest, are the revenues sufficient to cover all the operating expenses and the financial costs.

Road Bridge Operations

In Tables 5.3.10 and 5.3.11 the effect of separating the road portion of the bridge from the combined bridge is shown, so that the toll revenues offset the costs attributable to the road service only. The result is that IRRs between 13.9% and 16.5% are obtained, which show that the road bridge operations are viable in as far as that financial and operating costs are covered if total revenues are credited to the road bridge operations and the railway portion of the bridge is isolated.

The residual values in each case represent the net book value based on 50 years straight-line depreciation.

Tables 5.3.12 to 5.3.15 show the cash flow effect for the road bridge only, assuming that all the revenues are allocated to the upkeep of the road portion of the bridge and the railway portion separately administered. Toll revenues in this case are high enough to provide a positive cash flow once the bridge is completed. Nonetheless, assuming that the recommendation to refurbish the bridge to allow its further use for the next ten years is accepted, investments amounting to over USD55million will need to be financed before toll revenues are earned.

Rail Operations

The considerations described above under 'Financing possibilities' assume that the toll revenues from the road traffic will be used to finance the combined bridge operations. This form of cross subsidy is however not necessarily the only appropriate method and the appropriate solution could be that the railway should be required to bear its portion of the costs.

In Table 5.3.16 the operating costs of the bridge for rail traffic have been estimated. In this case depreciation has been included to introduce an element of repayment of investment costs into the calculation. The calculations show that the costs for rail usage under the forecast scenarios amount to fifteen US cents per passenger and twenty three cents per tonne under the low variant and six cents per passenger and fifteen cents per tonne for the high variant. It is presumed that the costs will only be met by payments by foreign users of the bridge, as is essentially the case at present. These figures are in marked contrast to the present tolls levied for road transport: USD3.125 per passenger and USD1.75 per tonne; extrapolated from Tables 2-22 and 2-24. These rail costs could therefore be incorporated into the tariffs for international traffic crossing the bridge.

Table 5.3.17 illustrates the shortfall in revenues under differing scenarios already discussed. Taking these figures into consideration and assuming that the rail operations were required to cover their operating costs, the additional revenues generated would be sufficient to finance at least the high variant at an interest rate of 7.5%.

On the other hand if the bridge were to be regarded from a purely commercial standpoint, it can be argued that rail traffic should be charged for the use of the bridge at the same level as the road users. This would put the road and rail operations on an equal competitive level.

In such a case the following annual revenues can be assumed once the bridge is fully operational:

Figs in USD'000s

	High Variant	Low Variant
Revenues from road traffic	8,796	7,619
Revenues from rail traffic	22,239	14,218
Total	31,035	21,837

The calculation for rail traffic usage being based on the following:

	High Variant	Low Variant	Calculation
Local Passengers	13	13	7656x360x0.005/7017x360x0.005
Long Distance Passengers	1,903,500	1,215,000	1,440x423x3.125/1,080x360x3.125
Freight	20,335,000	13,002,500	11,620 x 1.75 / 7,430 x 1.75
Total	22,238,513	14,217,513	

If this solution were to be accepted the revenues will give an IRR of 31% for the high variant and 22% for the low variant: See Tables 5.3.19 and 5.3.20. If this solution were to be introduced the bridge operator could not be the Railway but would have to be an independent authority or conceivably a private undertaking.

5.3.1.3 Toll Levels

As Table 2-24 demonstrates; the present pontoon bridge is essentially financed by the foreign traffic using the bridge. It is not foreseeable that this situation will change with the construction of the new bridge. Salaries and wages in Turkmenistan are likely to remain at levels comparative to those at present, so that no significant increase can be expected in tolls charged to local traffic. It can therefore be assumed that the foreign traffic will continue to provide the revenues for the bridge.

If the road users were to continue to cross-subsidise the rail operations and tolls raised to a level sufficient to cover the estimated shortfall in revenues, the effect would be as demonstrated in Table 5.3.18, where passenger cars could be paying up to seven dollars and freight up to $2.76 per tonne to cross the bridge. It is difficult at this stage to determine whether the users would be prepared to bear these costs and whether at some stage an alternative would be sought.

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5.3.2 Financial Planning

As outlined in 5.3.1.2. and 5.3.1.3 it may be possible to finance the operations from toll revenues generated by the traffic using the bridge. If this solution does not prove to be viable these costs must be covered from other sources. These sources can either be:

- The Railway from its current operations

  or

- The Government.

From the financial information provided it is not possible to judge the extent to which the Railway is capable of covering these expenses from its regular operations, it must however be emphasised that for the long-term proper functioning of the bridge the appropriate funds must be made available for maintenance.

If the Government is to carry the financial burden of operating the bridge, the most likely solution would be either in the form of subsidies for the Railway infrastructure or directly through the appropriate government department.

In addition to the operating expenses of the bridge the question of funding must also be addressed.

It is assumed that outside financing will be required for the project in question and this will most likely be provided by an international institution. The financing must be the subject of negotiation by the parties involved and a detailed audit by the lending institution.

At this present stage therefore it can only be speculated as to the form such financing can take. Calculations show that the net revenues assumed, even in the case of the high variant, will not be sufficient to cover the financial costs of the proposed investment and therefore other possibilities must be considered to cover the shortfall. These would include:

- Financing out of the Railways other operations
- Subsidies from the Government
- The Government assumes the financial costs; possibly through the appropriate government department
- The tariffs are increased to a level which can be regarded as the optimum which the traffic will bear in conjunction with one or more of the other measures suggested above.

In conclusion it is clear that over the next 15 years investments in the order of USD100 million will be necessary to improve the rail and road traffic situation at Chardzhev. In addition the following measures will be necessary:

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- More funds must be made available on an annual basis than is the case at present for the proper upkeep of the bridge.

- A more transparent presentation of the financial situation than at present will be necessary for the Railway to convince possible lending institutions of the Railway's capacity to manage repayments of any loans provided.

- A detailed audit of the accounts of the Railway must be made to establish its financial situation before any loans are granted.

Traceca Central Asia

Module C: Chardzhev Bridge

Table 5.3.1 Road Traffic Revenues as of May 1996:

	Unit Price (Avge) in USD		Avge Daily Volume		Avge Annual Volume		Avge Annual Revenue	
	Local Users	Foreign Users	Local	Foreign	Local	Foreign	Local	Foreign
Local Passengers	0.005		995		358,054	0	1,790	0
Passenger Cars	0.050	4.500	850	254	306,029	91,411	15,301	411,350
Buses	1.025		37		13,367	0	13,701	0
Tourist Coaches		25.000		42	0	15,073	0	376,830
Freight 1 tonne		1.750	85	180	30,623	64,777	0	113,359
Trucks 3.5 - 7 tonnes		11.000	38	80	13,636	28,844	0	317,283
Trucks 10 - 20 tonnes		25.000	96	204	34,668	73,332	0	1,833,300
Other			156		56,160		2808	
Total Income by Category							33,601	3,052,123
Total Income: Local & Foreign								3,085,723

Table 5.3.2 Estimated Growth in Traffic:

Low Variant

Avge Annual Volume	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign
Year	1996		1997		1998		1999		2000	
Annual Increase			6%	10%	6%	10%	6%	10%	6%	10%
Local Passengers	358,054	0	379,537	0	402,309	0	426,448	0	452,035	0
Passenger Cars	306,029	91,411	324,391	100,552	343,854	110,608	364,485	121,668	386,354	133,835
Buses	13,367	0	14,169	0	15,019	0	15,920	0	16,875	0
Tourist Coaches	0	15,073	0	16,581	0	18,239	0	20,062	0	22,069
Freight 1 tonne	30,623	64,777	32,461	71,254	34,408	78,380	36,473	86,218	38,661	94,839
Trucks 3.5 - 7 tonnes	13,636	28,844	14,454	31,728	15,321	34,901	16,241	38,391	17,215	42,230
Trucks 10 - 20 tonnes	34,668	73,332	36,748	80,665	38,953	88,732	41,290	97,605	43,768	107,365
Other	56,160	0	59,530	0	63,101	0	66,887	0	70,901	0

Avge Annual Volume	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign
Year	2001		2002		2003		2004		2005	
Annual Increase	7%	10%	7%	10%	7%	10%	7%	10%	7%	10%
Local Passengers	483,677	0	517,534	0	553,762	0	592,525	0	634,002	0
Passenger Cars	413,399	147,219	442,337	161,941	473,301	178,135	506,432	195,948	541,882	215,543
Buses	18,057	0	19,321	0	20,673	0	22,120	0	23,668	0
Tourist Coaches	0	24,276	0	26,703	0	29,373	0	32,311	0	35,542
Freight 1 tonne	41,368	104,323	44,263	114,756	47,362	126,231	50,677	138,854	54,225	152,740
Trucks 3.5 - 7 tonnes	18,420	46,453	19,710	51,099	21,089	56,209	22,566	61,830	24,145	68,012
Trucks 10 - 20 tonnes	46,831	118,102	50,109	129,912	53,617	142,903	57,370	157,194	61,386	172,913
Other	75,864	0	81,174	0	86,856	0	92,936	0	99,442	0

Traceca Central Asia

Module C: Chardzhev Bridge

Estimated Growth in Traffic:

High Variant

Avge Annual Volume	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign
Year	1996		1997		1998		1999		2000	
Annual Increase			7%	12%	7%	12%	7%	12%	7%	12%
Local Passengers	358,054	0	383,117	0	409,936	0	438,631	0	469,335	0
Passenger Cars	306,029	91,411	327,451	102,381	350,372	114,666	374,898	126,133	401,141	141,269
Buses	13,367	0	14,302	0	15,304	0	16,375	0	17,521	0
Tourist Coaches	0	15,073	0	16,882	0	18,908	0	20,799	0	23,294
Freight 1 tonne	30,623	64,777	32,767	72,550	35,061	81,256	37,515	89,381	40,141	100,107
Trucks 3.5 - 7 tonnes	13,636	28,844	14,591	32,305	15,612	36,182	16,705	39,800	17,874	44,576
Trucks 10 - 20 tonnes	34,668	73,332	37,095	82,132	39,691	91,988	42,470	101,186	45,443	113,329
Other	56,160	0	60,091	0	64,298	0	68,798	0	73,614	0

Avge Annual Volume	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Foreign
Year	2001		2002		2003		2004		2005	
Annual Increase	8%	12%	8%	12%	8%	12%	8%	12%	8%	12%
Local Passengers	506,882	0	547,433	0	591,227	0	638,526	0	689,608	0
Passenger Cars	433,233	158,221	467,891	177,208	505,323	198,472	545,748	222,289	589,408	248,964
Buses	18,923	0	20,437	0	22,072	0	23,837	0	25,744	0
Tourist Coaches	0	26,090	0	29,221	0	32,727	0	36,654	0	41,053
Freight 1 tonne	43,352	112,120	46,820	125,574	50,566	140,643	54,611	157,520	58,980	176,423
Trucks 3.5 - 7 tonnes	19,304	49,925	20,848	55,916	22,516	62,626	24,318	70,141	26,263	78,558
Trucks 10 - 20 tonnes	49,078	126,928	53,004	142,160	57,245	159,219	61,824	178,325	66,770	199,724
Other	79,503	0	85,864	0	92,733	0	100,151	0	108,164	0

Module C: Chardzhev Bridge

Table 5.3.3 Estimated Growth in Traffic Revenues (in USD):

High Variant

	Unit Price (Avge) in USD		Unit Price from 1997 (+ 5%)					
	Local Users	Foreign Users	Local Users	Foreign Users	1996	1997	1998	1999
Local Passengers	0.005		0.005		1,790	2,011	2,152	2,303
Passenger Cars	0.050	4.500	0.053	4.725	426,652	500,939	560,192	615,660
Buses	1.025		1.076		13,701	15,393	16,471	17,623
Tourist Coaches		25.000		26.250	376,830	443,152	496,330	545,963
Freight 1 tonne		1.750		1.838	113,359	133,310	149,307	164,238
Trucks 3.5 - 7 tonnes		11.000		11.550	317,283	373,125	417,900	459,690
Trucks 10 - 20 tonnes		25.000		26.250	1,833,300	2,155,961	2,414,676	2,656,144
Other					2,808	3,155	3,376	3,612
Total Income: Local & Foreign					3,085,723	3,627,047	4,060,405	4,465,233

	2000	2001	2002	2003	2004	2005	Total
Local Passengers	2,464	2,661	2,874	3,104	3,352	3,620	26,332
Passenger Cars	688,555	770,339	861,870	964,312	1,078,968	1,207,298	7,674,785
Buses	18,857	20,366	21,995	23,755	25,655	27,707	201,523
Tourist Coaches	611,479	684,856	767,039	859,084	962,174	1,077,635	6,824,543
Freight 1 tonne	183,947	206,020	230,743	258,432	289,444	324,177	2,052,978
Trucks 3.5 - 7 tonnes	514,853	576,635	645,831	723,331	810,131	907,346	5,746,125
Trucks 10 - 20 tonnes	2,974,881	3,331,867	3,731,691	4,179,494	4,681,033	5,242,757	33,201,802
Other	3,865	4,174	4,508	4,868	5,258	5,679	41,302
Total Income: Local & Foreign	4,998,900	5,596,918	6,266,551	7,016,379	7,856,014	8,796,220	55,769,390

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Module C: Chardzhev Bridge

Estimated Growth in Traffic Revenues (in USD):

Low Variant:

	Unit Price (Avge) in USD		Unit Price from 1997 (+ 5%)					
	Local Users	Foreign Users	Local Users	Foreign Users	1996	1997	1998	1999
Local Passengers	0.005		0.005		1,790	1,993	2,112	2,239
Passenger Cars	0.050	4.500	0.053	4.725	426,652	492,140	540,673	594,018
Buses	1.025		1.076		13,701	15,249	16,164	17,134
Tourist Coaches		25.000		26.250	376,830	435,239	478,763	526,639
Freight 1 tonne		1.750		1.838	113,359	130,930	144,023	158,425
Trucks 3.5 - 7 tonnes		11.000		11.550	317,283	366,462	403,108	443,419
Trucks 10 - 20 tonnes		25.000		26.250	1,833,300	2,117,462	2,329,208	2,562,128
Other					2,808	3,125	3,313	3,512
Total Income: Local & Foreign					3,085,723	3,562,599	3,917,363	4,307,514

	2000	2001	2002	2003	2004	2005	Total
Local Passengers	2,373	2,539	2,717	2,907	3,111	3,329	25,110
Passenger Cars	652,655	717,312	788,392	866,534	952,442	1,046,889	7,077,706
Buses	18,162	19,433	20,794	22,249	23,807	25,473	192,166
Tourist Coaches	579,303	637,233	700,956	771,052	848,157	932,973	6,287,143
Freight 1 tonne	174,267	191,694	210,864	231,950	255,145	280,659	1,891,316
Trucks 3.5 - 7 tonnes	487,761	536,537	590,191	649,210	714,131	785,544	5,293,645
Trucks 10 - 20 tonnes	2,818,341	3,100,175	3,410,193	3,751,212	4,126,333	4,538,967	30,587,320
Other	3,722	3,983	4,262	4,560	4,879	5,221	39,384
Total Income: Local & Foreign	4,736,584	5,208,907	5,728,367	6,299,674	6,928,005	7,619,054	51,393,791

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Module C: Chardzhev Bridge

Table 5.3.4 Estimated Revenues and Expenses: (USD'000s)

Option N2 High Variant

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Refurbishment of Bridge			2,691	2,691	2,691													8,073
Access Roads & Installations												640	1,280	1,280	480	480	240	4,400
Design and Consulting										2,834								2,834
Construction of New Bridge											14,316	14,316	14,317	14,317	14,317	14,717		86,300
Total Investment	0	0	2,691	2,691	2,691	0	0	0	0	2,834	14,316	14,956	15,597	15,597	14,797	15,197	240	101,607
Maintenance Costs		0	0	0	0	0	0	0	0	0	215	439	673	907	1,129	1,357	1,361	6,080
Depreciation											286	585	897	1,209	1,505	1,809	1,814	8,107
Amortisation of Refurbishment Expenses		0	269	538	807	807	807	807	807	807	807	807	538	269	0			8,073
Amortisation of Design & Consulting										283	283	283	283	283	283	283	283	2,267
Total Operating Costs		0	269	538	807	807	807	807	807	1,091	1,592	2,115	2,392	2,669	2,918	3,450	3,458	24,527
Offset By:																		
Toll Revenues	3,086	3,627	4,060	4,465	4,999	5,597	6,267	7,016	7,856	8,796	8,796	8,796	8,796	8,796	8,796	8,796	8,796	117,343
Net Revenues	0	0	-269	-538	-807	-807	-807	-807	-807	-1,091	-1,592	-2,115	-2,392	6,127	5,879	5,347	5,338	10,657
Net Revenues without Depreciation	0	0	0	0	0	0	0	0	0	0	-215	-439	-673	7,889	7,667	7,439	7,436	29,105

☐ = Period in which toll revenues accrue to pontoon bridge.

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Module C: Chardzhev Bridge

Estimated Revenues and Expenses: (USD'000s)

Option N2 Low Variant

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Refurbishment of Bridge			2,691	2,691	2,691													8,073
Access Roads & Installations												640	1,280	1,280	480	480	240	4,400
Design and Consulting										2,834								2,834
Construction of New Bridge											14,316	14,316	14,317	14,317	14,317	14,717		86,300
Total Investment	0	0	2,691	2,691	2,691	0	0	0	0	2,834	14,316	14,956	15,597	15,597	14,797	15,197	240	101,607
Maintenance Costs		0	0	0	0	0	0	0	0	0	215	439	673	907	1,129	1,357	1,361	6,080
Depreciation											286	585	897	1,209	1,505	1,809	1,814	8,107
Amortisation of Refurbishment Expenses		0	269	538	807	807	807	807	807	807	807	807	538	269	0			8,073
Amortisation of Design & Consulting										283	283	283	283	283	283	283	283	2,267
Total Operating Costs		0	269	538	807	807	807	807	807	1,091	1,592	2,115	2,392	2,669	2,918	3,450	3,458	24,527
Offset By: Toll Revenues	3,086	3,563	3,917	4,308	4,737	5,209	5,728	6,300	6,928	7,619	7,619	7,619	7,619	7,619	7,619	7,619	7,619	104,727
Net Revenues	0	0	-269	-538	-807	-807	-807	-807	-807	-1,091	-1,592	-2,115	-2,392	4,950	4,701	4,170	4,161	5,949
Net Revenues without Depreciation	0	0	0	0	0	0	0	0	0	0	-215	-439	-673	6,712	6,490	6,262	6,259	24,396

= Period in which toll revenues accrue to pontoon bridge

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Module C: Chardzhev Bridge

Table 5.3.5 Investment Planning: (USD'000s)

Years		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Total Investment		0	0	2,691	2,691	2,691	0	0	0	0	2,834	14,316	14,956	15,597	15,597	14,797	15,197	240	101,607
Repayments: Interest	5%			175	350	525	525	525	525	525	710	1,641	2,614	3,628	4,643	5,605	6,594	6,610	35,196
Period(Years)	30																		
Interest	5%			157	314	470	470	470	470	470	636	1,470	2,342	3,251	4,159	5,022	5,907	5,921	31,531
Period(Years)	40																		
Net Revenues Ignoring Depreciation:																			
Low Variant		0	0	0	0	0	0	0	0	0	0	-215	-439	-673	6,712	6,490	6,262	6,259	24,396
High Variant		0	0	0	0	0	0	0	0	0	0	-215	-439	-673	7,889	7,667	7,439	7,436	29,105

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Module C: Chardzhev Bridge

Investment Planning: (USD'000s)

Years		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Total Investment		0	0	2,691	2,691	2,691	0	0	0	0	2,834	14,316	14,956	15,597	15,597	14,797	15,197	240	101,607
Repayments: Interest Period(Years)	7.5% 30			228	456	684	684	684	684	684	924	2,136	3,402	4,723	6,043	7,296	8,583	8,603	45,811
Interest Period(Years)	7.5% 40			214	427	641	641	641	641	641	866	2,003	3,190	4,429	5,667	6,842	8,049	8,068	42,959
Net Revenues Ignoring Depreciation:																			
Low Variant		0	0	0	0	0	0	0	0	0	0	-215	-439	-673	6,712	6,490	6,262	6,259	24,396
High Variant		0	0	0	0	0	0	0	0	0	0	-215	-439	-673	7,889	7,667	7,439	7,436	29,105

Years		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Total Investment		0	0	2,691	2,691	2,691	0	0	0	0	2,834	14,316	14,956	15,597	15,597	14,797	15,197	240	101,607
Repayments: Interest Period(Years)	9% 30			262	524	786	786	786	786	786	1,062	2,455	3,911	5,429	6,947	8,387	9,867	9,890	52,663
Interest Period(Years)	9% 40			250	500	750	750	750	750	750	1,014	2,345	3,735	5,185	6,635	8,010	9,423	9,445	50,295
Net Revenues Ignoring Depreciation:																			
Low Variant		0	0	0	0	0	0	0	0	0	0	-215	-439	-673	6,712	6,490	6,262	6,259	24,396
High Variant		0	0	0	0	0	0	0	0	0	0	-215	-439	-673	7,889	7,667	7,439	7,436	29,105

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Module C: Chardzhev Bridge

Table xxxxx Investment Planning: (USD'000s)

Years		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Total Investment		0	0	2,691	2,691	2,691	0	0	0	0	2,834	14,316	14,956	15,597	15,597	14,797	15,197	240	101,607
Repayments: Interest Period(Years)	7.5% 30			228	456	684	684	684	684	684	924	2,136	3,402	4,723	6,043	7,296	8,583	8,603	45,811
Interest Period(Years)	7.5% 40			214	427	641	641	641	641	641	866	2,003	3,190	4,429	5,667	6,842	8,049	8,068	42,959
Net Revenues Ignoring Depreciation:																			
Low Variant		3,086	3,563	3,917	4,308	4,737	5,209	5,728	6,300	6,928	7,619	7,404	7,180	6,946	6,712	6,490	6,262	6,259	98,647
High Variant		3,086	3,627	4,060	4,465	4,999	5,597	6,267	7,016	7,856	8,796	8,581	8,357	8,123	7,889	7,667	7,439	7,436	111,263

Years		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Total Investment		0	0	2,691	2,691	2,691	0	0	0	0	2,834	14,316	14,956	15,597	15,597	14,797	15,197	240	101,607
Repayments: Interest Period(Years)	9% 30			262	524	786	786	786	786	786	1,062	2,455	3,911	5,429	6,947	8,387	9,867	9,890	52,663
Interest Period(Years)	9% 40			250	500	750	750	750	750	750	1,014	2,345	3,735	5,185	6,635	8,010	9,423	9,445	50,295
Net Revenues Ignoring Depreciation:																			
Low Variant		3,086	3,563	3,917	4,308	4,737	5,209	5,728	6,300	6,928	7,619	7,404	7,180	6,946	6,712	6,490	6,262	6,259	98,647
High Variant		3,086	3,627	4,060	4,465	4,999	5,597	6,267	7,016	7,856	8,796	8,581	8,357	8,123	7,889	7,667	7,439	7,436	111,263

Table 5.3.6 Internal Rate of Return Road and Rail Bridge: 30 Year Payback:

USD'000s

Year	Investmts	High Variant			Low Variant		
		Revenues	Op'tng Costs	Net Outlays /Revenues	Revenues	Op'tng Costs	Net Outlays /Revenues
2005	2,834	0	0	-2,834	0	0	-2,834
2006	14,316	0	215	-14,531	0	215	-14,531
2007	14,956	0	439	-15,395	0	439	-15,395
2008	15,597	0	673	-16,270	0	673	-16,270
2009	15,597	8,796	907	-7,708	7,619	907	-8,885
2010	14,797	8,796	1,129	-7,130	7,619	1,129	-8,307
2011	15,197	8,796	1,357	-7,758	7,619	1,357	-8,935
2012	240	8,796	1,361	7,196	7,619	1,361	6,019
2013		8,796	1,361	7,436	7,619	1,361	6,259
2014		8,796	1,361	7,436	7,619	1,361	6,259
2015		8,796	1,361	7,436	7,619	1,361	6,259
2016		8,796	1,361	7,436	7,619	1,361	6,259
2017		8,796	1,361	7,436	7,619	1,361	6,259
2018		8,796	1,361	7,436	7,619	1,361	6,259
2019		8,796	1,361	7,436	7,619	1,361	6,259
2020		8,796	1,361	7,436	7,619	1,361	6,259
2021		8,796	1,361	7,436	7,619	1,361	6,259
2022		8,796	1,361	7,436	7,619	1,361	6,259
2023		8,796	1,361	7,436	7,619	1,361	6,259
2024		8,796	1,361	7,436	7,619	1,361	6,259
2025		8,796	1,361	7,436	7,619	1,361	6,259
2026		8,796	1,361	7,436	7,619	1,361	6,259
2027		8,796	1,361	7,436	7,619	1,361	6,259
2028		8,796	1,361	7,436	7,619	1,361	6,259
2029		8,796	1,361	7,436	7,619	1,361	6,259
2030		8,796	1,361	7,436	7,619	1,361	6,259
2031		8,796	1,361	7,436	7,619	1,361	6,259
2032		8,796	1,361	7,436	7,619	1,361	6,259
2033		8,796	1,361	7,436	7,619	1,361	6,259
2034		8,796	1,361	7,436	7,619	1,361	6,259
2035		8,796	1,361	7,436	7,619	1,361	6,259
2036		8,796	1,361	7,436	7,619	1,361	6,259
2037		8,796	1,361	7,436	7,619	1,361	6,259
2038		8,796	1,361	7,436	7,619	1,361	6,259
Residual Value		35,429		35,429	35,429		35,429
Total	93,534	299,316	41,453	164,328	264,001	41,453	129,013
NPV							
5%	75,661			24,204			9,317
7.50%	68,489			-487			-10,897
9%	64,641			-9,350			-17,917
IRR				7.43%			5.95%

Table 5.3.7 Internal Rate of Return Road and Rail Bridge: 40 Year Payback: (USD'000s)

Year	Investmnts	High Variant Revenues	High Variant Op'tng Costs	High Variant Net Outlays /Revenues	Low Variant Revenues	Low Variant Op'tng Costs	Low Variant Net Outlays /Revenues
2005	2,834	0	0	-2,834	0	0	-2,834
2006	14,316	0	215	-14,531	0	215	-14,531
2007	14,956	0	439	-15,395	0	439	-15,395
2008	15,597	0	673	-16,270	0	673	-16,270
2009	15,597	8,796	907	-7,708	7,619	907	-8,885
2010	14,797	8,796	1,129	-7,130	7,619	1,129	-8,307
2011	15,197	8,796	1,357	-7,758	7,619	1,357	-8,935
2012	240	8,796	1,361	7,196	7,619	1,361	6,019
2013		8,796	1,361	7,436	7,619	1,361	6,259
2014		8,796	1,361	7,436	7,619	1,361	6,259
2015		8,796	1,361	7,436	7,619	1,361	6,259
2016		8,796	1,361	7,436	7,619	1,361	6,259
2017		8,796	1,361	7,436	7,619	1,361	6,259
2018		8,796	1,361	7,436	7,619	1,361	6,259
2019		8,796	1,361	7,436	7,619	1,361	6,259
2020		8,796	1,361	7,436	7,619	1,361	6,259
2021		8,796	1,361	7,436	7,619	1,361	6,259
2022		8,796	1,361	7,436	7,619	1,361	6,259
2023		8,796	1,361	7,436	7,619	1,361	6,259
2024		8,796	1,361	7,436	7,619	1,361	6,259
2025		8,796	1,361	7,436	7,619	1,361	6,259
2026		8,796	1,361	7,436	7,619	1,361	6,259
2027		8,796	1,361	7,436	7,619	1,361	6,259
2028		8,796	1,361	7,436	7,619	1,361	6,259
2029		8,796	1,361	7,436	7,619	1,361	6,259
2030		8,796	1,361	7,436	7,619	1,361	6,259
2031		8,796	1,361	7,436	7,619	1,361	6,259
2032		8,796	1,361	7,436	7,619	1,361	6,259
2033		8,796	1,361	7,436	7,619	1,361	6,259
2034		8,796	1,361	7,436	7,619	1,361	6,259
2035		8,796	1,361	7,436	7,619	1,361	6,259
2036		8,796	1,361	7,436	7,619	1,361	6,259
2037		8,796	1,361	7,436	7,619	1,361	6,259
2038		8,796	1,361	7,436	7,619	1,361	6,259
2039		8,796	1,361	7,436	7,619	1,361	6,259
2040		8,796	1,361	7,436	7,619	1,361	6,259
2041		8,796	1,361	7,436	7,619	1,361	6,259
2042		8,796	1,361	7,436	7,619	1,361	6,259
2043		8,796	1,361	7,436	7,619	1,361	6,259
2044		8,796	1,361	7,436	7,619	1,361	6,259
2045		8,796	1,361	7,436	7,619	1,361	6,259
2046		8,796	1,361	7,436	7,619	1,361	6,259
2047		8,796	1,361	7,436	7,619	1,361	6,259
2048		8,796	1,361	7,436	7,619	1,361	6,259
Residual Value		17,289		17,289	17,289		17,289
Total	93,534	369,138	55,058	220,545	322,051	55,058	173,459
NPV							
5%	75,661			30,635			14,017
7.50%	68,489			1,727			-9,375
9%	64,641			-8,179			-17,150
IRR				7.72%			6.27%

Table 5.3.8 Cash Flow Effect: High Variant 30 Years (USD'000s)

Year	Net Results before Interest & Repayments	Interest & Loan Repayments			Accumulated Cash Flow		
		Interest Rates					
		5%	7.50%	9%	5%	7.50%	9%
1998	0	175	228	262	-175	-228	-262
1999	0	350	456	524	-525	-684	-524
2000	0	525	684	786	-1,050	-1,367	-786
2001	0	525	684	786	-1,575	-2,051	-786
2002	0	525	684	786	-2,101	-2,734	-786
2003	0	525	684	786	-2,626	-3,418	-786
2004	0	525	684	786	-3,151	-4,101	-786
2005	0	710	924	1,062	-3,860	-5,025	-1,062
2006	-215	1,641	2,136	2,455	-5,501	-7,161	-2,455
2007	-439	2,614	3,402	3,911	-8,115	-10,563	-3,911
2008	-673	3,628	4,723	5,429	-11,743	-15,285	-5,429
2009	7,889	4,643	6,043	6,947	-8,497	-13,439	-4,487
2010	7,667	5,605	7,296	8,387	-6,435	-13,068	-5,207
2011	7,439	6,594	8,583	9,867	-5,590	-14,212	-7,635
2012	7,436	6,610	8,603	9,890	-4,764	-15,379	-10,089

= Revenues accrue to pontoon bridge

Cash Flow Effect: High Variant 40 Years (USD'000s)

Year	Net Results before interest & Repayments	Interest & Loan Repayments			Accumulated Cash Flow		
		Interest Rates					
		5%	7.50%	9%	5%	7.50%	9%
1998	0	157	214	250	-157	-214	-250
1999	0	314	427	500	-470	-641	-500
2000	0	470	641	750	-941	-1,282	-750
2001	0	470	641	750	-1,411	-1,923	-750
2002	0	470	641	750	-1,882	-2,564	-750
2003	0	470	641	750	-2,352	-3,205	-750
2004	0	470	641	750	-2,823	-3,846	-750
2005	0	636	866	1,014	-3,459	-4,712	-1,014
2006	-215	1,470	2,003	2,345	-4,928	-6,715	-2,345
2007	-439	2,342	3,190	3,735	-7,270	-9,905	-3,735
2008	-673	3,251	4,429	5,185	-10,521	-14,334	-5,185
2009	7,889	4,159	5,667	6,635	-6,791	-12,111	-3,931
2010	7,667	5,022	6,842	8,010	-4,145	-11,286	-4,274
2011	7,439	5,907	8,049	9,423	-2,614	-11,895	-6,257
2012	7,436	5,921	8,068	9,445	-1,099	-12,527	-8,267

= Revenues accrue to pontoon bridge

Table 5.3.9 Cash Flow Effect: Low Variant 30 Years (USD'000s)

Year	Net Results before interest & Repayments	Interest & Loan Repayments			Accumulated Cash Flow		
		Interest Rates					
		5%	7.50%	9%	5%	7.50%	9%
1998	0	175	228	262	-175	-228	-262
1999	0	350	456	524	-525	-684	-524
2000	0	525	684	786	-1,050	-1,367	-786
2001	0	525	684	786	-1,575	-2,051	-786
2002	0	525	684	786	-2,101	-2,734	-786
2003	0	525	684	786	-2,626	-3,418	-786
2004	0	525	684	786	-3,151	-4,101	-786
2005	0	710	924	1,062	-3,860	-5,025	-1,062
2006	-215	1,641	2,136	2,455	-5,501	-7,161	-2,455
2007	-439	2,614	3,402	3,911	-8,115	-10,563	-3,911
2008	-673	3,628	4,723	5,429	-11,743	-15,285	-5,429
2009	6,712	4,643	6,043	6,947	-9,674	-14,616	-5,664
2010	6,490	5,605	7,296	8,387	-8,790	-15,422	-7,562
2011	6,262	6,594	8,583	9,867	-9,122	-17,743	-11,166
2012	6,259	6,610	8,603	9,890	-9,473	-20,088	-14,798

= Revenues accrue to pontoon bridge

Cash Flow Effect: Low Variant 40 Years (USD'000s)

Year	Net Results before interest & Repayments	Interest & Loan Repayments			Accumulated Cash Flow		
		Interest Rates					
		5%	7.50%	9%	5%	7.50%	9%
1998	0	157	214	250	-157	-214	-250
1999	0	314	427	500	-470	-641	-500
2000	0	470	641	750	-941	-1,282	-750
2001	0	470	641	750	-1,411	-1,923	-750
2002	0	470	641	750	-1,882	-2,564	-750
2003	0	470	641	750	-2,352	-3,205	-750
2004	0	470	641	750	-2,823	-3,846	-750
2005	0	636	866	1,014	-3,459	-4,712	-1,014
2006	-215	1,470	2,003	2,345	-4,928	-6,715	-2,345
2007	-439	2,342	3,190	3,735	-7,270	-9,905	-3,735
2008	-673	3,251	4,429	5,185	-10,521	-14,334	-5,185
2009	6,712	4,159	5,667	6,635	-7,968	-13,289	-5,108
2010	6,490	5,022	6,842	8,010	-6,500	-13,640	-6,628
2011	6,262	5,907	8,049	9,423	-6,145	-15,427	-9,789
2012	6,259	5,921	8,068	9,445	-5,808	-17,236	-12,976

= Revenues accrue to pontoon bridge

Table 5.3.10 Internal Rate of Return Road Bridge Only: 30 Year Payback:

USD'000s

Year	Investmts	High Variant			Low Variant		
		Revenues	Op'tng Costs	Net Outlays /Revenues	Revenues	Op'tng Costs	Net Outlays /Revenues
2005	1,481	0	22	-1,504	0	22	-1,504
2006	7,483	0	134	-7,617	0	134	-7,617
2007	7,948	0	254	-8,202	0	254	-8,202
2008	8,414	0	380	-8,794	0	380	-8,794
2009	8,414	8,796	506	-124	7,619	506	-1,301
2010	7,833	8,796	624	340	7,619	624	-837
2011	8,042	8,796	744	10	7,619	744	-1,167
2012	175	8,796	747	7,875	7,619	747	6,698
2013		8,796	747	8,049	7,619	747	6,872
2014		8,796	747	8,049	7,619	747	6,872
2015		8,796	747	8,049	7,619	747	6,872
2016		8,796	747	8,049	7,619	747	6,872
2017		8,796	747	8,049	7,619	747	6,872
2018		8,796	747	8,049	7,619	747	6,872
2019		8,796	747	8,049	7,619	747	6,872
2020		8,796	747	8,049	7,619	747	6,872
2021		8,796	747	8,049	7,619	747	6,872
2022		8,796	747	8,049	7,619	747	6,872
2023		8,796	747	8,049	7,619	747	6,872
2024		8,796	747	8,049	7,619	747	6,872
2025		8,796	747	8,049	7,619	747	6,872
2026		8,796	747	8,049	7,619	747	6,872
2027		8,796	747	8,049	7,619	747	6,872
2028		8,796	747	8,049	7,619	747	6,872
2029		8,796	747	8,049	7,619	747	6,872
2030		8,796	747	8,049	7,619	747	6,872
2031		8,796	747	8,049	7,619	747	6,872
2032		8,796	747	8,049	7,619	747	6,872
2033		8,796	747	8,049	7,619	747	6,872
2034		8,796	747	8,049	7,619	747	6,872
2035		8,796	747	8,049	7,619	747	6,872
2036		8,796	747	8,049	7,619	747	6,872
2037		8,796	747	8,049	7,619	747	6,872
2038		8,796	747	8,049	7,619	747	6,872
Residual Value		18,877		18,877	18,877		18,877
Total	49,791	282,764	22,829	210,144	247,449	22,829	174,829
NPV							
5%	40,258			64,572			49,684
7.50%	36,434			35,877			25,467
9%	34,382			24,760			16,192
IRR				**16.33%**			**13.86%**

Table 5.3.11 Internal Rate of Return Road Bridge Only: 40 Year Payback:

USD'000s

Year	Investmnts	High Variant			Low Variant		
		Revenues	Op'tng Costs	Net Outlays /Revenues	Revenues	Op'tng Costs	Net Outlays /Revenues
2005	1,481	0	22	-1,504	0	22	-1,504
2006	7,483	0	134	-7,617	0	134	-7,617
2007	7,948	0	254	-8,202	0	254	-8,202
2008	8,414	0	380	-8,794	0	380	-8,794
2009	8,414	8,796	506	-124	7,619	506	-1,301
2010	7,833	8,796	624	340	7,619	624	-837
2011	8,042	8,796	744	10	7,619	744	-1,167
2012	175	8,796	747	7,875	7,619	747	6,698
2013		8,796	747	8,049	7,619	747	6,872
2014		8,796	747	8,049	7,619	747	6,872
2015		8,796	747	8,049	7,619	747	6,872
2016		8,796	747	8,049	7,619	747	6,872
2017		8,796	747	8,049	7,619	747	6,872
2018		8,796	747	8,049	7,619	747	6,872
2019		8,796	747	8,049	7,619	747	6,872
2020		8,796	747	8,049	7,619	747	6,872
2021		8,796	747	8,049	7,619	747	6,872
2022		8,796	747	8,049	7,619	747	6,872
2023		8,796	747	8,049	7,619	747	6,872
2024		8,796	747	8,049	7,619	747	6,872
2025		8,796	747	8,049	7,619	747	6,872
2026		8,796	747	8,049	7,619	747	6,872
2027		8,796	747	8,049	7,619	747	6,872
2028		8,796	747	8,049	7,619	747	6,872
2029		8,796	747	8,049	7,619	747	6,872
2030		8,796	747	8,049	7,619	747	6,872
2031		8,796	747	8,049	7,619	747	6,872
2032		8,796	747	8,049	7,619	747	6,872
2033		8,796	747	8,049	7,619	747	6,872
2034		8,796	747	8,049	7,619	747	6,872
2035		8,796	747	8,049	7,619	747	6,872
2036		8,796	747	8,049	7,619	747	6,872
2037		8,796	747	8,049	7,619	747	6,872
2038		8,796	747	8,049	7,619	747	6,872
2039		8,796	747	8,049	7,619	747	6,872
2040		8,796	747	8,049	7,619	747	6,872
2041		8,796	747	8,049	7,619	747	6,872
2042		8,796	747	8,049	7,619	747	6,872
2043		8,796	747	8,049	7,619	747	6,872
2044		8,796	747	8,049	7,619	747	6,872
2045		8,796	747	8,049	7,619	747	6,872
2046		8,796	747	8,049	7,619	747	6,872
2047		8,796	747	8,049	7,619	747	6,872
2048		8,796	747	8,049	7,619	747	6,872
Residual Value		9,215		9,215	9,215		9,215
Total	49,791	361,064	30,298	280,976	313,978	30,298	233,889
NPV							
5%	40,258			74,007			57,389
7.50%	36,434			39,457			28,355
9%	34,382			26,784			17,813
IRR				**16.42%**			**13.99%**

Table 5.3.12 Cash Flow Effect: High Variant 30 Years (USD'000s)

Road Portion of Bridge

Year		2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Investment Costs:											
Road Access Way				465	931	931	349	349	175		3,200
Bridge Costs		1,481	7,483	7,483	7,484	7,484	7,484	7,693			46,591
Total		1,481	7,483	7,948	8,414	8,414	7,833	8,042	175	0	49,791
Maintenance		22	134	254	380	506	624	744	747	747	4,158
Toll Revenues		0	0	0	0	8,796	8,796	8,796	8,796	8,796	43,981
Net Operating Revenues		-22	-134	-254	-380	8,290	8,173	8,052	8,049	8,049	39,823
Interest and Loan Repayments:											
Rate of Interest:	5%	96	583	1,100	1,648	2,195	2,704	3,228	3,239	3,239	18,032
	7.5%	125	759	1,432	2,144	2,857	3,520	4,201	4,216	4,216	23,471
	9%	144	873	1,646	2,465	3,284	4,047	4,829	4,846	4,846	26,982
Cash Flow	5%	-119	-836	-2,190	-4,218	1,878	7,346	12,170	16,981	21,791	
	7.5%	-148	-1,041	-2,727	-5,251	182	4,834	8,685	12,519	16,352	
	9%	-166	-1,173	-3,073	-5,919	-913	3,213	6,436	9,639	12,842	

Table 5.3.13 Cash Flow Effect: High Variant 40 Years (USD'000s)

Road Portion of Bridge

Year		2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Net Operating Revenues		-22	-134	-254	-380	8,290	8,173	8,052	8,049	8,049	39,823
Interest and Loan Repayments:											
Rate of Interest:											
	5%	86	522	986	1,476	1,966	2,423	2,892	2,902	2,902	16,155
	7.5%	118	712	1,343	2,011	2,679	3,301	3,940	3,953	3,953	22,010
	9%	138	833	1,572	2,354	3,137	3,865	4,612	4,629	4,629	25,768
Cash Flow	5%	-109	-765	-2,005	-3,861	2,463	8,213	13,373	18,521	23,668	
	7.5%	-140	-986	-2,583	-4,974	637	5,509	9,621	13,717	17,813	
	9%	-160	-1,128	-2,954	-5,688	-534	3,773	7,213	10,634	14,055	

Table 5.3.14 Cash Flow Effect: Low Variant 30 Years (USD'000s)

Road Portion of Bridge

Year		2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Maintenance			134	254	380	506	624	744	747	747	4,136
Toll Revenues		0	0	0	0	7,619	7,619	7,619	7,619	7,619	38,095
Net Operating Revenues		0	-134	-254	-380	7,113	6,995	6,875	6,872	6,872	33,960
Interest and Loan Repayments:											
Rate of Interest:	5%	96	583	1,100	1,648	2,195	2,704	3,228	3,239	3,239	18,032
	7.5%	125	759	1,432	2,144	2,857	3,520	4,201	4,216	4,216	23,471
	9%	144	873	1,646	2,465	3,284	4,047	4,829	4,846	4,846	26,982
Cash Flow	5%	-96	-814	-2,168	-4,195	723	5,014	8,661	12,294	15,927	
	7.5%	-125	-1,019	-2,705	-5,229	-973	2,502	5,176	7,832	10,489	
	9%	-144	-1,151	-3,051	-5,896	-2,068	881	2,926	4,952	6,978	

Table 5.3.15 Cash Flow Effect: Low Variant 40 Years (USD'000s)

Road Portion of Bridge

Year		2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Net Operating Revenues		0	-134	-254	-380	7,113	6,995	6,875	6,872	6,872	33,960
Interest and Loan Repayments:											
Rate of Interest:											
	5%	86	522	986	1,476	1,966	2,423	2,892	2,902	2,902	16,155
	7.5%	118	712	1,343	2,011	2,679	3,301	3,940	3,953	3,953	22,010
	9%	138	833	1,572	2,354	3,137	3,865	4,612	4,629	4,629	25,768
Cash Flow	5%	-86	-743	-1,983	-3,839	1,308	5,881	9,864	13,834	17,805	
	7.5%	-118	-964	-2,560	-4,951	-518	3,177	6,112	9,031	11,950	
	9%	-138	-1,106	-2,931	-5,666	-1,689	1,441	3,704	5,948	8,191	

Table 5.3.16 Costs for Rail Usage

USD'000s

Total Investment	93,534	
Road Portion	49,791	
Portion applicable to rail	43,744	
Annual operating costs incl.Depr.	3,458	
Road Portion	1,743	
Portion applicable to rail	1,715	
Forecast Development:	No. of Trains Daily	
	High	Low
Long-Distance Passenger Traffic	4	3
Long-Distance Freight trains	19	12
	Annual Volume	
	High	Low
Long-Distance Passenger Traffic	1,440	1,080
Long-Distance Freight trains	6,795	4,345
Cost per train (USD)	208.29	316.18
Long-Distance Passenger Traffic	36.42	62.94
Long-Distance Freight trains	171.87	253.23
Cost per Passenger: Avge= 423	0.09	0.15
Total Tonnage(' 000s Tonnes)	11,620	7,430
Cost per Tonne (USD)	0.15	0.23

Table 5.3.17 Shortfall in Toll Revenues

USD'000s

	Interest Rates		
	5%	7.50%	9%
Required Annual Coverage	6,610	8,603	9,890
Coverage per Present Toll Levels:			
High Variant	7,436	7,436	7,436
Low Variant	6,259	6,259	6,259
Additional Coverage Required:			
High Variant	-826	1,167	2,454
Low Variant	351	2,345	3,632
Percentage Increase Required in Tolls:			
High Variant	0	15.70	33.01
Low Variant	5.61	37.46	58.02

Table 5.3.18 Revised Tolls in Accordance with Various Price Increases:

	Unit Price (Avge) in USD		Price Incr.= 5.61%		Price Incr. = 15.70%	
	Local Users	Foreign User	Local Users	Foreign User	Local Users	Foreign User
Local Passengers	0.005		0.005		0.006	
Passenger Cars	0.050	4.500	0.053	4.752	0.058	5.207
Buses	1.025		1.083		1.186	
Tourist Coaches		25.000		26.403		28.925
Freight 1 tonne		1.750		1.848		2.025
Trucks 3.5 - 7 tonnes		11.000		11.617		12.727
Trucks 10 - 20 tonnes		25.000		26.403		28.925

	Price Incr. = 33.01%		Price Incr.= 37.46%		Price Incr. = 58.02%	
	Local Users	Foreign User	Local Users	Foreign User	Local Users	Foreign User
Local Passengers	0.007		0.007		0.008	
Passenger Cars	0.067	5.985	0.069	6.186	0.079	7.111
Buses	1.363		1.409		1.620	
Tourist Coaches		33.253		34.365		39.505
Freight 1 tonne		2.328		2.406		2.765
Trucks 3.5 - 7 tonnes		14.631		15.121		17.382
Trucks 10 - 20 tonnes		33.253		34.365		39.505

Table 5.3.19 Internal Rate of Return Road and Rail Bridge: 30 Year Payback: Assuming Charges for Rail Usage

USD'000s

Year	Investmts	High Variant			Low Variant		
		Revenues	Op'tng Costs	Net Outlays /Revenues	Revenues	Op'tng Costs	Net Outlays /Revenues
2005	2,834	0	0	-2,834	0	0	-2,834
2006	14,316	0	215	-14,531	0	215	-14,531
2007	14,956	0	439	-15,395	0	439	-15,395
2008	15,597	0	673	-16,270	0	673	-16,270
2009	15,597	31,035	907	14,531	21,837	907	5,333
2010	14,797	31,035	1,129	15,109	21,837	1,129	5,911
2011	15,197	31,035	1,357	14,481	21,837	1,357	5,283
2012	240	31,035	1,361	29,435	21,837	1,361	20,237
2013		31,035	1,361	29,675	21,837	1,361	20,477
2014		31,035	1,361	29,675	21,837	1,361	20,477
2015		31,035	1,361	29,675	21,837	1,361	20,477
2016		31,035	1,361	29,675	21,837	1,361	20,477
2017		31,035	1,361	29,675	21,837	1,361	20,477
2018		31,035	1,361	29,675	21,837	1,361	20,477
2019		31,035	1,361	29,675	21,837	1,361	20,477
2020		31,035	1,361	29,675	21,837	1,361	20,477
2021		31,035	1,361	29,675	21,837	1,361	20,477
2022		31,035	1,361	29,675	21,837	1,361	20,477
2023		31,035	1,361	29,675	21,837	1,361	20,477
2024		31,035	1,361	29,675	21,837	1,361	20,477
2025		31,035	1,361	29,675	21,837	1,361	20,477
2026		31,035	1,361	29,675	21,837	1,361	20,477
2027		31,035	1,361	29,675	21,837	1,361	20,477
2028		31,035	1,361	29,675	21,837	1,361	20,477
2029		31,035	1,361	29,675	21,837	1,361	20,477
2030		31,035	1,361	29,675	21,837	1,361	20,477
2031		31,035	1,361	29,675	21,837	1,361	20,477
2032		31,035	1,361	29,675	21,837	1,361	20,477
2033		31,035	1,361	29,675	21,837	1,361	20,477
2034		31,035	1,361	29,675	21,837	1,361	20,477
2035		31,035	1,361	29,675	21,837	1,361	20,477
2036		31,035	1,361	29,675	21,837	1,361	20,477
2037		31,035	1,361	29,675	21,837	1,361	20,477
2038		31,035	1,361	29,675	21,837	1,361	20,477
Residual Value		35,429		35,429	35,429		35,429
Total	93,534	966,479	41,453	831,492	690,539	41,453	555,552
NPV							
5%	75,661			305,457			189,131
7.50%	68,489			196,184			114,841
9%	64,641			152,507			85,563
IRR				**31.32%**			**22.09%**

Table 5.3.20 Internal Rate of Return Road and Rail Bridge: 40 Year Payback: (USD'000s)
Assuming Charges for Rail Usage

Year	Investmnts	High Variant			Low Variant		
		Revenues	Op'tng Costs	Net Outlays /Revenues	Revenues	Op'tng Costs	Net Outlays /Revenues
2005	2,834	0	0	-2,834	0	0	-2,834
2006	14,316	0	215	-14,531	0	215	-14,531
2007	14,956	0	439	-15,395	0	439	-15,395
2008	15,597	0	673	-16,270	0	673	-16,270
2009	15,597	31,035	907	14,531	21,837	907	5,333
2010	14,797	31,035	1,129	15,109	21,837	1,129	5,911
2011	15,197	31,035	1,357	14,481	21,837	1,357	5,283
2012	240	31,035	1,361	29,435	21,837	1,361	20,237
2013		31,035	1,361	29,675	21,837	1,361	20,477
2014		31,035	1,361	29,675	21,837	1,361	20,477
2015		31,035	1,361	29,675	21,837	1,361	20,477
2016		31,035	1,361	29,675	21,837	1,361	20,477
2017		31,035	1,361	29,675	21,837	1,361	20,477
2018		31,035	1,361	29,675	21,837	1,361	20,477
2019		31,035	1,361	29,675	21,837	1,361	20,477
2020		31,035	1,361	29,675	21,837	1,361	20,477
2021		31,035	1,361	29,675	21,837	1,361	20,477
2022		31,035	1,361	29,675	21,837	1,361	20,477
2023		31,035	1,361	29,675	21,837	1,361	20,477
2024		31,035	1,361	29,675	21,837	1,361	20,477
2025		31,035	1,361	29,675	21,837	1,361	20,477
2026		31,035	1,361	29,675	21,837	1,361	20,477
2027		31,035	1,361	29,675	21,837	1,361	20,477
2028		31,035	1,361	29,675	21,837	1,361	20,477
2029		31,035	1,361	29,675	21,837	1,361	20,477
2030		31,035	1,361	29,675	21,837	1,361	20,477
2031		31,035	1,361	29,675	21,837	1,361	20,477
2032		31,035	1,361	29,675	21,837	1,361	20,477
2033		31,035	1,361	29,675	21,837	1,361	20,477
2034		31,035	1,361	29,675	21,837	1,361	20,477
2035		31,035	1,361	29,675	21,837	1,361	20,477
2036		31,035	1,361	29,675	21,837	1,361	20,477
2037		31,035	1,361	29,675	21,837	1,361	20,477
2038		31,035	1,361	29,675	21,837	1,361	20,477
2039		31,035	1,361	29,675	21,837	1,361	20,477
2040		31,035	1,361	29,675	21,837	1,361	20,477
2041		31,035	1,361	29,675	21,837	1,361	20,477
2042		31,035	1,361	29,675	21,837	1,361	20,477
2043		31,035	1,361	29,675	21,837	1,361	20,477
2044		31,035	1,361	29,675	21,837	1,361	20,477
2045		31,035	1,361	29,675	21,837	1,361	20,477
2046		31,035	1,361	29,675	21,837	1,361	20,477
2047		31,035	1,361	29,675	21,837	1,361	20,477
2048		31,035	1,361	29,675	21,837	1,361	20,477
Residual Value		17,289		17,289	17,289		17,289
Total	93,534	1,258,689	55,058	1,110,097	890,769	55,058	742,177
NPV							
5%	75,661			344,576			214,730
7.50%	68,489			211,454			124,711
9%	64,641			161,298			91,202
IRR				31.32%			22.13%

Revised List of Annexes

and Annex K

This project is financed by the European Union's Tacis Programme, which provides grant finance for know-how to foster the development of market economies and democratic societies in the New Independent States and Mongolia

TRACECA Rail Maintenance Central Asia

Module C: Feasibility Study for Chardzhev Bridge

LIST OF ANNEXES

Annex K: Questionnaire for Survey of Users of the Chardzhev Pontoon Bridge

date of the count	day	time		sheet No:		name of the interviewer	

Question 1: direction (to be crossed where applicable)

11 Chardzhev - Farap		*12 Farap - Chardzhev*	

Question 2: type of vehicle (to be crossed where applicable):

21 heavy goods vehicles/ four-wheelers	22 heavy goods vehicles/ six-wheelers	23 heavy goods vehicles/ with more than six wheels and semi-trailer units	24 passenger cars	25 buses	26 other vehicles
☐	☐	☐	☐	☐	☐

Question 3: country of registration of the vehicle (to be crossed where applicable: country/area):

31 Turkmenistan	32 Kazakstan	33 Uzbekistan	34 other countries of CIS
35 Iran	36 Afghanistan	37 Turkey	38 other countries

Question 4: origin and destination of the transport (to be crossed where applicable: country/area):

41	Origin/ country of origin		43	Destination/country of destination	
411	Iran		431	Iran	
412	Afghanistan		432	Afghanistan	
413	Turkey		433	Turkey	
414	Kazakstan		434	Kazakstan	
415	Uzbekistan, Oblast Bukhara		435	Uzbekistan, Oblast Bukhara	
416	Uzbekistan, other regions		436	Uzbekistan, other regions	
417	Turkmenistan, city of Ashgabat		437	Turkmenistan, city of Ashgabat	
418	Turkmenistan, Velayat Achalskij		438	Turkmenistan, Velayat Achalskij	
419	Turkmenistan, Velayat Balkanskij (e.g. Turkmenbashy, Nebit-Dag)		439	Turkmenistan, Velayat Balkanskij (e.g. Turkmenbashy, Nebit-Dag)	
420	Turkmenistan, Velayat Maryiskij (e.g. Mary, Bajramali)		440	Turkmenistan, Velayat Maryiskij (e.g. Mary, Bajramali)	
421	Turkmenistan, Velayat Dashkhovuskij		441	Turkmenistan, Velayat Dashkhovuskij	
422	Turkmenistan, Velayat Lebapskij (Chardzhev)		442	Turkmenistan, Velayat Lebapskij (Chardzhev)	
423	other countries of CIS		443	other countries of CIS	
424	other countries		444	other countries	

Question 5 with goods transports: Which kind of good is carried? (to be crossed where applicable)

Food, agricultural products 51	Mineral oil products, petrol, paraffin etc. 52	Building material (stones, cement, building equipment etc.) 53	Chemical products, fertiliser 54	Machines, vehicles, industrial semi-finished and finished products 55
Iron and steel products 56	Consumer goods, textile products 57	other products 58		

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Question 6

61	weight of the load (tonnes)	

Question 7 with passenger transports: purpose of travelling (to be crossed where applicable)

Business 71	Holiday, visit to relatives 72	Private reasons (shopping, visit of authorities etc.) 73	others 74

Question 8

81	number of persons per vehicle	

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