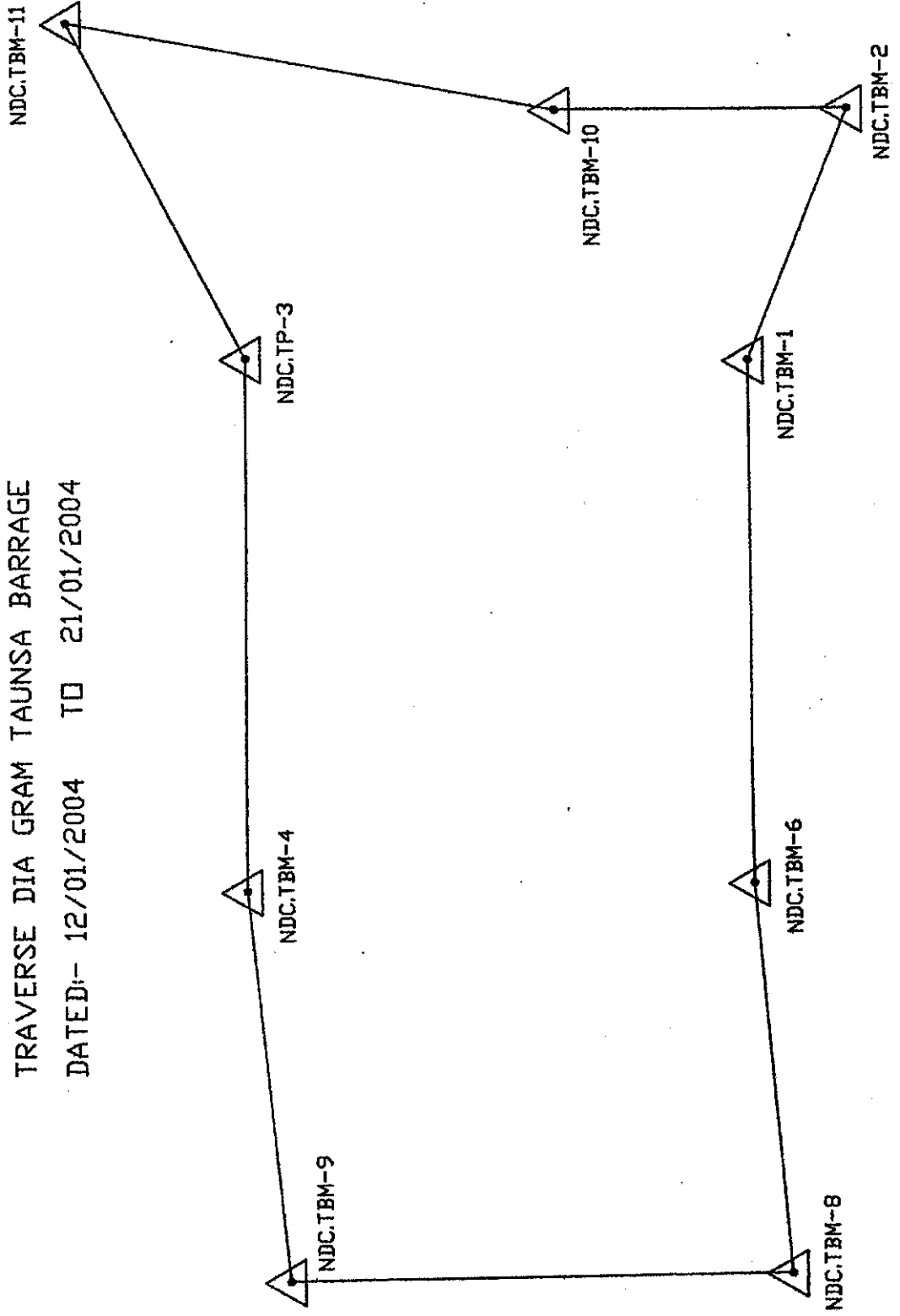


APPENDIX-B
TRAVERSE DIAGRAMME

TRVERSE DIA GRAM TAUNSA BARRAGE

DATED:- 12/01/2004 TO 21/01/2004



SUMMARY OF TRAVERSE

===== TAUNSA BARRAGE TRAVERSE =====

CLOSURE TYPE: Closed Loop

ADJUSTMENT RULE: Compass rule

ERROR SUMMARY:

Relative 1 : 142173
 Angular -0-00'28"
 Linear 0.0252 (m)
 Northing* -0.0210 (m)
 Easting* 0.0140 (m)
 Elevation* 0.0090 (m)
 Bearing* S33-41'24"E

* from: correct ending pt
 to: actual ending pt

TRAVERSE SUMMARY:

Length: * 3588.3081 (m)
 ** 3588.3081 (m)
 Points: * 10
 Area: 320247 (sq m)
 32.025 (hectares)
 ** 320247 (sq m)
 ** 32.025 (hectares)

* Beginning pt to Ending pt
 ** Includes Curved Sides

CLOSING PTS:	PT	NORTHING	EASTING	ELEVATION
Beginning	1	10000.0000	30000.0000	135.9260
Ending (actual)	11	9999.9790	30000.0140	135.9350
Ending (correct)	11	10000.0000	30000.0000	135.9260

TRAVERSE CALCULATION SHEET

SURVEY NAME: TAUNSA BARRAGE TRAVERSE

TRAVERSE NAME: TAUNSA BARRAGE TRAVERSE

S	PT	BEARING	SLOPE DIST (meters)	ZENITH	NORTHING (meters)	EASTING (meters)	ELEVATION (meters)
	1				10000.0000	30000.0000	135.9260
				[NDCTBM1			
	13	S72-02'54"E	203.024	89-36'40"	9937.4260	30193.1360	137.3040
				[NDCTBM2			
	2	N87-19'42"W	1277.459	90-03'35"	9996.9710	28917.0660	135.9710
				[NDCTBM6			
	3	N45-27'54"W	123.972	88-23'13"	10083.8840	28828.7310	139.4610
				[NDCTBM8			
	4	N 0-11'04"W	112.685	89-59'23"	10196.5680	28828.3680	139.4810
				[NDCTBM9			
	5	S78-34'17"E	84.470	91-09'31"	10179.8340	28911.1460	137.7730
				[NDCTBM4			
	6	N87-13'37"E	1094.700	90-00'56"	10232.7960	30004.5640	137.4760
				[NDCTP3			
	7	N79-43'03"E	162.840	89-20'08"	10261.8610	30164.7780	139.3640
				[NDCTBM11			
	8	S 1-53'20"E	182.027	90-00'05"	10079.9330	30170.7780	139.3600
				[NDCTBM10			
	12	S 8-54'45"E	144.247	90-49'47"	9937.4430	30193.1230	137.2710
				[NDCTBM2			
	11	N72-03'22"W	202.987	90-22'38"	9999.9790	30000.0140	135.9350
				[NDCTBM1			

12/

SURVEY NAME: TAUNSA BARRAGE TRAVERSE

TRAVERSE NAME: TAUNSA BARRAGE TRAVERSE

*Adjusted
Coordinates*

S	PT	BEARING	SLOPE DIST (meters)	ZENITH	NORTHING (meters)	EASTING (meters)	ELEVATION (meters)
	1				10000.0000	30000.0000	135.9260
				[NDCTBM1			
	13	S72-02'55"E	203.023	89-36'41"	9937.4272	30193.1352	137.3035
				[NDCTBM2			
	2	N87-19'41"W	1277.465	90-03'36"	9996.9797	28917.0602	135.9673
				[NDCTBM6			
	3	N45-27'53"W	123.973	88-23'13"	10083.8934	28828.7247	139.4570
				[NDCTBM8			
	4	N 0-11'05"W	112.685	89-59'24"	10196.5780	28828.3613	139.4767
				[NDCTBM9			
	5	S78-34'18"E	84.469	91-09'32"	10179.8445	28911.1390	137.7685
				[NDCTBM4			
	6	N87-13'36"E	1094.696	90-00'56"	10232.8129	30004.5527	137.4687
				[NDCTP3			
	7	N79-43'02"E	162.840	89-20'09"	10261.8789	30164.7661	139.3563
				[NDCTBM11			
	8	S 1-53'19"E	182.026	90-00'05"	10079.9520	30170.7654	139.3519
				[NDCTBM10			
	12	S 8-54'44"E	144.246	90-49'48"	9937.4628	30193.1098	137.2625
				[NDCTBM2			
	11	N72-03'21"W	202.988	90-22'38"	10000.0000	30000.0000	135.9260
				[NDCTBM1			

LEVELLING COMPUTATION SHEET

12

LEVELLING COMPUTAION SHEET						
BS	IS	FS	RISE	FALL		REAMRKS
1.78					139.446	BM at Guage Structure situated at D/S of Left Aabutment of Taunsa Barrage.
0.362		3.422	0	-1.642	137.804	
4.502		2.24	0	-1.878	135.926	NDC.TBM-1
1.495		0.739	3.763	0	139.689	
1.465		1.497	0	-0.002	139.687	
1.17		1.452	0.013	0	139.7	
1.45		1.198	0	-0.028	139.672	
1.487		1.45	0	0	139.672	
1.503		1.524	0	-0.037	139.635	
1.494		1.48	0.023	0	139.658	
1.515		1.496	0	-0.002	139.656	
1.493		1.493	0.022	0	139.678	
0.883		4.59	0	-3.097	136.581	
1.41		1.502	0	-0.619	135.962	NDC.TBM-6
4.592		0.805	0.605	0	136.567	
1.505		1.484	3.108	0	139.675	
1.495		1.734	0	-0.229	139.446	NDC.TBM-8
1.477		1.473	0.022	0	139.468	NDC.TBM-9
1.684		1.498	0	-0.021	139.447	
1.44		1.457	0.227	0	139.674	
0.81		4.543	0	-3.103	136.571	
1.41		1.415	0	-0.605	135.966	NDC.TBM-6
4.592		0.805	0.605	0	136.571	
1.503		1.505	3.087	0	139.658	
1.47		1.515	0	-0.012	139.646	
1.48		1.462	0.008	0	139.654	0.008
1.443		1.465	0.015	0	139.669	
1.47		1.43	0.013	0	139.682	
1.44		1.43	0.04	0	139.722	
1.447		1.46	0	-0.02	139.702	
0.904		4.502	0	-3.055	136.647	
1.55		1.631	0	-0.727	135.92	NDC.TBM1
4.473		0.822	0.728	0	136.648	
1.46		1.421	3.052	0	139.7	
1.116		1.704	0	-0.244	139.456	
0.734		1.265	0	-0.149	139.307	
2.7		2.746	0	-2.012	137.295	NDC.TBM-2
1.233		0.69	2.01	0	139.305	
1.471		1.175	0.058	0	139.363	NDC.TBM-10
1.413		1.382	0.089	0	139.452	
1.514		1.376	0.037	0	139.489	
1.603		1.65	0	-0.136	139.353	NDC.TBM-11
1.519		1.458	0.145	0	139.498	
1.47		1.53	0	-0.011	139.487	
		1.501	0	-0.031	139.456	BM at Guage Structure situated at D/S of Left Aabutment of Taunsa Barrage.
			17.67	-17.66	0.01	

添付 9

Damage Condition Report

**JAPAN INTERNATIONAL COOPERATION AGENCY
PAKISTAN OFFICE
ISLAMABAD**

**TOPOGRAPHIC SURVEY FOR THE
PREPARATORY STUDY ON THE PROJECT FOR
REHABILITATION OF GATES OF TAUNSA BARRAGE**

**DAMAGE CONDITION REPORT
FOR THE BARRAGE FLOOR**

BY

**NATIONAL DEVELOPMENT CONSULTANTS (Regd.)
26-K-II, MODEL TOWN,
LAHORE
Ph: 042-5867773, 5860870
Fax: 042-5869287**

JANUARY, 2004

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PROJECT FOR REHABILITATION OF GATES OF TAUNSA BARRAGE

DAMAGE CONDITION REPORT
FOR THE BARRAGE FLOOR
(JANUARY 2004)

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**DAMAGE CONDITION REPORT
FOR THE BARRAGE FLOOR**

JANUARY, 2004

**TOPOGRAPHIC SURVEY FOR THE PREPARATORY STUDY
ON THE PROJECT FOR REHABILITATION OF GATES
OF TAUNSA BARRAGE**

**DAMAGE CONDITION REPORT
FOR THE BARRAGE FLOOR`
(JANUARY. 2004)**

1.0 INTRODUCTION

Taunsa Barrage, constructed on the River Indus, was commissioned in the year 1958 to feed the following off-taking canals.

- i) Dera Ghazi (DG) Khan Canal on the right bank to irrigate areas on the West of the River.
- ii) Muzaffar Garh (MG) Canal on the left bank to irrigate areas on the East of the River.
- iii) Taunsa Punjnad (TP) Link on the left bank to deliver water to river Chenab for feeding the canals off-taking at Punjnad Headworks.

Ever since its commissioning, the Barrage has been facing several problems of varied nature. In order to assess the damages caused to the floor of the Barrage due to these problems, detailed topographic survey of the Barrage floor was carried out by the staff of National Development Consultants (Regd.) (NDC) Lahore Pakistan. A detailed Survey Report consisting of cross-sections and L- sections has been submitted to JICA Study Team for the Preparatory Study on the Project vide NDC letter No. NDC/ADMN/105 dated January 31, 2004.

It may be mentioned that Taunsa Barrage was closed by the Irrigation & Power Deptt. for the purpose of annual repairs from January 01 to 17, 2004. During this closure, the entire river flow passed through the Left Undersluice, while the Right Undersluice the weir Bays were enclosed by construction of bunds on the D/S sides. Water was pumped out from 4 bays of the Right Undersluice and from 5 bays out of the 52 Weir Bays. These 9 bays were inspected by our field team and the damages of varied nature were identified and sketched by our site staff. A plan of Taunsa Barrage showing the Right & Left Undersluices and the Weir Bays alongwith cross-sections are enclosed in Annex-I. The various problems faced at the Taunsa Barrage and the damages caused to the Barrage floor due to these problems are discussed below in the ensuing paragraphs:-

2.0 EXCESSIVE RETROGRESSION ON THE D/S SIDE.

Retrogression of the river bed on the D/S Side of the Barrage has been a vexing question since the opening of the Barrage in 1958. As compared to designed minimum retrogressed level of 419.5 at site, the actual retrogression far exceeded this value as well as other values for corresponding discharges. During the first three years, retrogression of about 5 ft. had taken place while during 1963, it was reported that against downstream water level of 436.70 for 3.0 lac cusecs discharge the actual water level observed was 430.40 ft. (i.e. 6.30 ft. lower). The maximum retrogression reported was 7.50 ft. against a discharge of 388,069 cusecs in 1979.

As a result of this excessive retrogression the hydraulic jump is not formed on the D/S glacis and the energy of high velocity flow is not properly dissipated. This high velocity jet causes the following types of damages:-

- i) Erosion/damage to the impact blocks at the toe of the glacis.
- ii) Uprooting/erosion of the friction/baffle blocks at the end of the stilling basin.
- iii) Rolling and settlement of loose stone apron at the end of the stilling basin.

3.0 NON-MONOLITHIC CONSTRUCTION OF SKIN CONCRETE WITH THE UNDERLYING MASS CONCRETE

The weir and undersluice floors of Taunsa Barrage are designed as gravity floors. The main floor consists of 1:4:8 mass concrete with a 1 ft. thick 1:2:4 cement concrete overlay with nominal temperature steel reinforcement of 3/8" diameter. The top 1 foot thick RCC skin is not constructed monolithic with the underlying mass concrete due to which there exists a cleavage plane between the top skin concrete and the underlying mass concrete.

The mass concrete in the Barrage floor was laid in layers rather than in one lift and then draglines and other machinery also traversed over the freshly laid mass concrete layers. This badly damaged the protruding steel bars, meant for anchoring different layers. In addition, the bars in the top surface were twisted and failed to provide an effective joint between the skin concrete and the underlying mass concrete. Skin concrete, being not monolithic with the mass concrete is prone to being lifted up due to uplift pressure and the high velocity flow with undissipated energy passing over it.

4.0 EROSION OF GLACIS AND PIERS DUE TO HIGH VELOCITY FLOW

The glacis D/S of the gate line is badly eroded. The reinforcement exposed by the abrasive action has also been worn away to the extent that in some places pieces of reinforcement have fallen apart.

In addition erosion of piers at their bottom has also taken place as a result of the high velocity flow escaping D/S through the gate openings above the crest of the Barrage.

5.0 BROKEN EDGES OF CONSTRUCTION JOINTS AND BOILING OF WATER FROM OPEN JOINTS

In view of the serious problems created by excessive retrogression on the D/S side, ripping off skin concrete and erosion due to high velocity flow, extensive repairs were carried out to the Barrage floor on many occasions. More recently, damages had to be repaired in 1986, 1994 and 1998 and in the last closure period of Jan. 2004. During these repairs, the edges of the construction joints were found to be broken at many places and sprouting water from underneath was observed at some points along the joints. The D/S floor in Bay No. 65 was also found depressed at one location by 0.18 M (max.) which is a serious phenomenon.

6.0 ESTIMATION OF DAMAGES OVER THE ENTIRE BARRAGE FLOOR

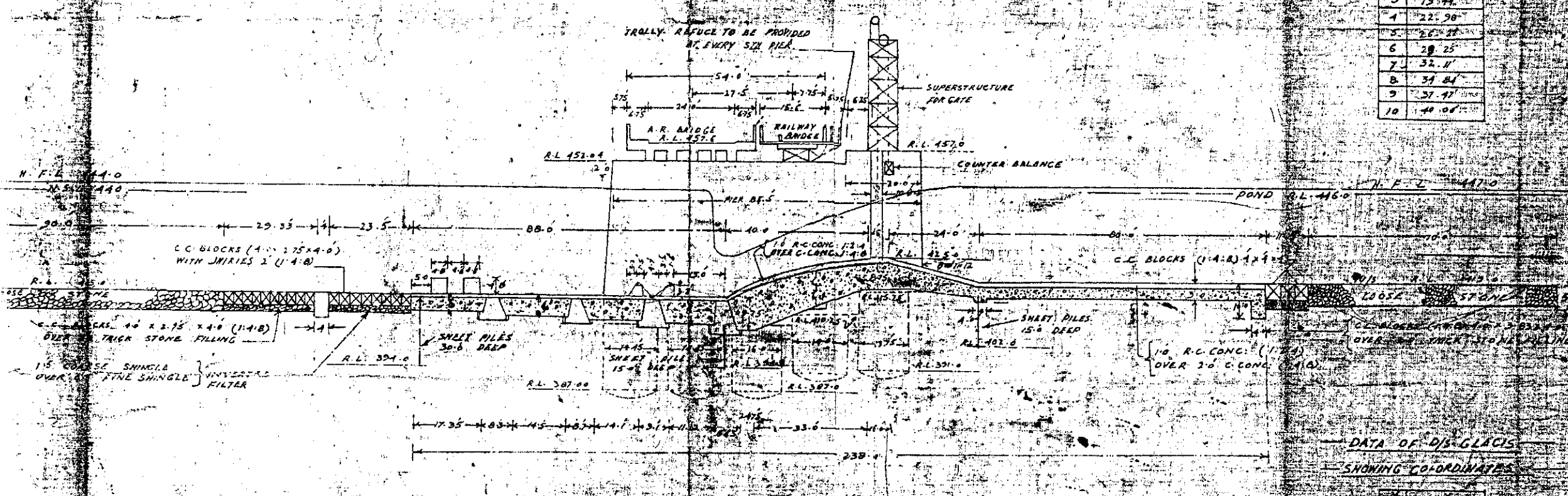
Damages of various natures as explained above have been clarified by sketches on the specified formats which are enclosed separately for each bay with this Damage Condition Report (Annexes II to X). It may be stated that these formats provide only examples of the damages of various types which were surveyed and sketched in the 9 bays inspected at site. Damages in other bays which could not be inspected, can be estimated in the same proportion for an assessment of the total damages over the entire Barrage area. The damages in the Right Undersluice can be used to assess the damages in the Left Undersluice. Similarly the damages in the Weir Bays which were not inspected, can be assessed from the damages caused in the bays which were inspected by our field team. The Annexes II to X to this Report cover the damages in Bays No. 65, 64, 63, & 62 of the Right Undersluice and Bays No. 37, 36, 35, 10 & 9 of the Weir portion. Each Annex gives a list of the damage points in each bay alongwith the formats of damages, that have been shown by sketches for a clear understanding of the nature of damage at each point.

**ANNEXURES
I TO X**

**PLAN OF TAUNSA BARRAGE
AND
CROSS-SECTIONS THROUGH THE UNDERSLUICE
AND THE WEIR BAYS**

CROSS SECTION THROUGH UNDER-SLUICE OF TAUNSA BARRAGE

SCALE = 1/500

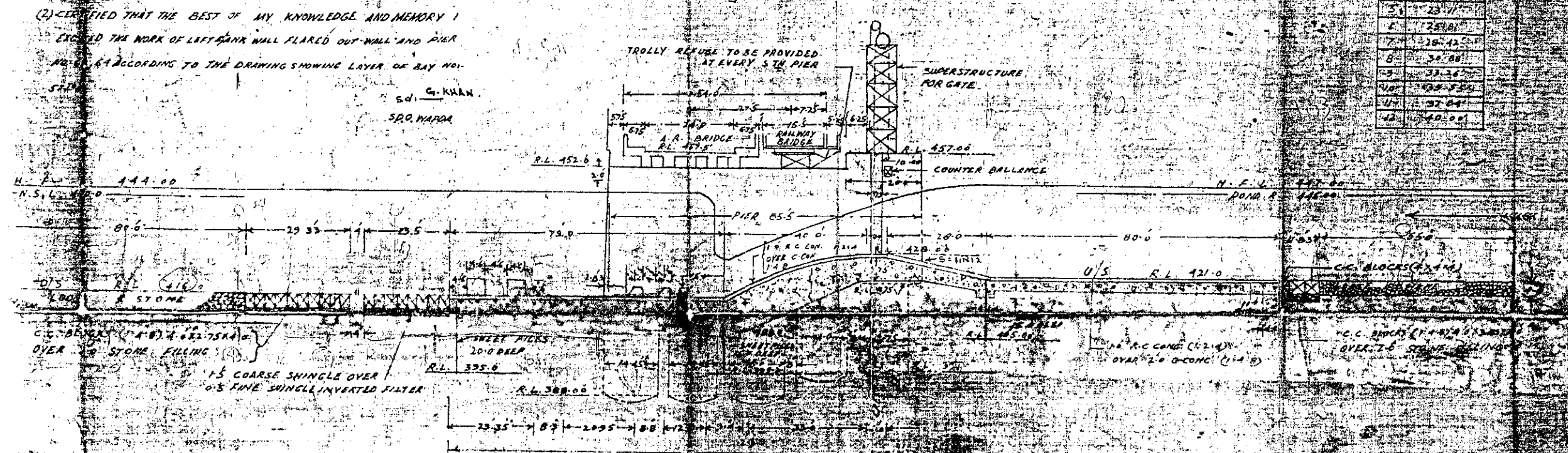


DATA OF D/S GLACIS
 SHOWING CO-ORDINATE

Y	X
1	10.45
2	15.42
3	19.44
4	22.90
5	26.27
6	28.25
7	32.11
B	34.84
9	37.11
10	44.06

CROSS SECTION THROUGH WEIR OF TAUNSA BARRAGE

SCALE = 1/300



DATA OF D/S GLACIS
 SHOWING CO-ORDINATE

Y	X
1	5.00
2	15.42
3	19.44
4	22.90
5	26.27
6	28.25
7	32.11
B	34.84
9	37.11
10	44.06

(2) CERTIFIED THAT THE BEST OF MY KNOWLEDGE AND MEMORY I
 EXECUTED THE WORK OF LEFT BANK WALL FLARED OUT WALL AND PIER
 NO. 64 ACCORDING TO THE DRAWING SHOWING LAYER OF BAY NO. 5
 S.D. G. KHAN
 SRO, WAFDA

(5) CERTIFIED THAT THE WORK OF LEFT UNDER SLUICE
 HEAD REGULATOR MURAFANGARH CANAL, LINK CANAL
 HEAD REGULATOR, BRIDGES BAY NO 11-01 WITH PORTION

PLAN OF PIER AND FOUNDATION WELLS