Appendix 5. Other Relevant Data

5. 1 JICA guideines for environmental and social considerations

5. 2 Technical memorandum on February 20, 2004

5. 3 Results of topographical and geological surveys

5. 1 JICA guideines for environmental and social considerations

JAPAN INTERNATIONAL COOPERATION AGENCY GUIDELINES
FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Appendix 3. Screening Format

Name of a Proposed Project:

BASIC DESIGN STUDY ON THE PROJECT FOR REHABILITATION OF BRIDGES ON THE ASMARA-MASSAWA ROAD

Project Executing Organization:

Ministry of Public Works, Infrastructure Department

Name, Post, Organization and Contact Point of a Responsible Officer

Name: Mr. Petros Tseggay
Post: Chief of Environmental Unit
Organization: Ministry of Public Works, Infrastructure Department
Tel: (291-1)120442
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Date: June 1, 2004
Signature:

Check Items

Question 1

Address of a project site

Asmara-Massawa Road

Question 2

Outline of the project

The Asmara-Massawa road is serving as a unique lifeline road of greatest importance between the capital Asmara and Massawa, *one of the two international seaports* for the country. The road was built in 1930's together with the objective bridges for the Project. After the independence in 1993 up to 1997, the road alignment and drainage system have been reestablished and asphalt pavement and safety facilities have been improved by a financial assistance of the European Union. However, the bridges over 25 meters long were excluded from the EU funded improvement

project and have been left unimproved so far. They still remain serving in such danger as having major elements destroyed with great possibility of losing structural soundness by aging and collision by vehicles. Under such background, it was decided to promote the realization of the Project aiming at avoiding the worst accident such as collapse of bridge and securing safe traffic between Asmara and Massawa by reconstruction or repair of the five bridges.

Question 3

Is the project a new one or an on-going one? In the case of an on-going one, have you received strong complaints etc. from local residents?

☐New ☐On-going(there are complaints) ☐On-going (there are no complaints)

■Others(Ghindae Bridge : New, Other four Bridges : On-going (there are no complaints))

Question 4

Environmental Impact Assessment including Initial Environmental Examination is required for the project according to a law or a guideline in a host government? In the case of necessity, is a procedure of EIA finished or is it planned to implement EIA?

☐Necessity (☐finished ☐under implementation ☐under planning ☐no plan)

☐Not necessity ■Others(Rehabilitation or reconstruction of the five bridges : Not necessity. However, because Ghindae bridge construction is included in "Ghindae Bypass Road Project", the EIA for "Ghindae Bypass Road Project" is necessity ***and is finished***)

Name of a law or a guideline:

"Eritrea Environmental and Social Impact Management Guideline for Road Operation"

"National Environmental Assessment Procedures and Guideline"

Question 5

Is there a sensitive area inside or the surrounding project site?

☐Yes ■No

If yes, please mark corresponding items.

☐National park, protection area designated by the government (coast line, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

☐Virgin forests, tropical forests

☐Ecological important habitat area (coral reef, mangrove wetland, tidal flats)

☐Habitat of valuable species protected by a domestic law or an international treaty

☐Likely salts cumulus or soil erosion area on a massive scale

☐Remarkable desertification trend area

☐Archaeological, historical or cultural valuable area

☐Living area of ethnic, indigenous people or nomads who have a traditional lifestyle, or special

socially valuable area

Question 6

Does the project have adverse impacts on the environment and local communities?

☐Yes ■No

Reason:

However, 'Ghindae Bypass Road Project" including Ghindae bridge construction ***has indirect/temporary*** impacts such as resettlement, noise and dust.

In the case of that both answers of Question 5 and 6 are 'No", there is no need to respond following questions, otherwise please proceed with them.

Question 7

Does the project need to deal with an emergency?

■Yes ☐No

Reason:

The five bridges have serving in such danger as having major elements destroyed with great possibility of losing structural soundness by aging and collision by vehicles.

Question 8

Does the project come under following sectors?

■Yes ☐No

If yes, please mark corresponding items.

☐Mining development

☐Industrial development

☐Thermal power (including geothermal power)

☐Hydropower, dams and reservoirs

☐River/erosion control

☐Power transmission and distribution lines

■Roads, railways and bridges

☐Airports

☐Ports and harbors

☐Water supply, sewage and waste treatment

☐Waste management and disposal

☐Agriculture involving large-scale land-clearing or irrigation

☐Forestry Tourism

Question 9

Please mark related the environmental and social impact.

(Rehabilitation or reconstruction of the five bridges ***have no adverse*** environmental impact. The environment impacts of 'Ghindae Bypass Road Project" are as follows :)

- ■Air pollution
- ☐Water pollution
- ☐Soil pollution
- ■Noise and vibration
- ☐Ground subsidence
- ☐Offensive odors
- ☐Bottom sediment
- ☐Biota and ecosystem
- ☐Water usage
- ☐Accidents
- ☐Greenhouse gas
- ☐Geographical features
- ☐Involuntary resettlement
- ☐Local economy such as employment and livelihood etc.
- ☐Land use and utilization of local resources
- ☐Social institutions such as social infrastructure and local decision-making institutions
- ☐Existing social infrastructures and services
- ☐The poor, indigenous of ethnic people
- ☐Equality of benefit and losses, and equality in the developing process
- ☐Gender
- ☐Children's rights
- ☐Cultural heritage
- ☐Local conflict of interests
- ☐Infectious diseases such as HIV/AIDS etc.

Question 10

Is the project planned to deal with following items?

☐Yes ■No

(However, 'Ghindae Bypass Road Project" will ***have resettlements*** of about 50 houses.)

If yes, please mark following items.

- ☐Involuntary resettlement (scale: persons)
- ☐Groundwater pumping (scale: m3/year)
- ☐Land reclamation, land development and land-clearing (scale: hectors)
- ☐Logging (scale: hectors)

Question 11

In the case of that environmental impact assessment was taken steps, was EIA approved by relevant laws in a host country? If yes, please mark date of approval and the competent authority.

(With regard to the EIA for 'Ghindae Bypass Road Project")

☐Approved (without a supplementary condition) ☐Approved (with a supplementary condition) ■Under appraisal ☐Not yet started an appraisal process

Date of approval:

Competent authority: Ministry of Land Water and Environment, Department of Environment

Question 12

If it is requested to another authorization regarding the environment and society other than EIA, please indicate a name of authorization.

☐Already authorized ☐Need authorization but not yet done ■Not requested ☐Others

Name of authorization:

Question 13

When environmental and social conditions are requested, is it possible to secure information disclosure to stakeholders and a meeting with them?

■Yes ☐No

Question 14

When environmental and social conditions are requested, is it possible to open a request from a recipient government to the public?

■Yes ☐No

Question 15

Please note a scale of the project (development area, facility capacity, production, power generation, distance etc.).

Objective Bridges	Reconstruction / Repair Plan
Gindae Bridge (L=39.0m)	New bridge construction together with new bypass
Gahtelay1 Bridge (L=29.9m)	Replacement of superstructure at the existing location
Dogali 1 Bridge (L=139.4m)	Repair of existing bridge
Dogali 2 Bridge (L=34.9m)	New bridge construction at an adjacent location
Emculu Bridge (L=132.3m)	Repair of existing bridge

I want more information about the following items.

1. Public Consultation of EIA for 'Ghindae Bypass Road Project"

The public consultation of EIA for 'Ghindae Bypass Road Project" is planned to be carried out during the Impact Review of the Final EIA Report by the Department of Environment (DoE). This is expected to take place in the month of June 2004. The Impact Review Committee will consist of all stakeholders including representatives of the affected community and Ms. Hanako will be invited to attend in the public consultation process to represent JICA.

2. Construction waste disposal

So far there is no any regulation on waste disposal in the country; however, according to the DoE, the regulation on solid and liquid waste disposal for the urban environment is under preparation. In the mean time with regard to construction waste disposal any one of the International Guideline on Construction Waste Disposal can be applied for the current project.

3. Basic policy on compensation to resettlement and land acquisition

Apart from Proclamation No. 58/1994 and Legal Notice No. 31/1997 there is no other regulation with regard to Land Acquisition and Resettlement.

The basic policy of the State of Eritrea on land acquisition and compensation to resettlement is that any citizen above the age of 18 has the right to acquire land for housing in any part of the country free of charge. The land cannot be transferred to any other person. With regard to compensation, houses built legally means that they are registered within the town administration and built in accordance to approved plans by authorized institution, such as Municipality. Any house built outside this regulation is considered illegal. Accordingly, those houses built legally will be compensated for the loss of property at current prices. However, houses built illegally will not be compensated but have the right to get land to build their houses at their own expenses.

Memorandum of the Rehabilitation of Bridges on the Asmara – Massawa Road in the State of Eritrea at the second site survey conducted from January to February 2004,regarding bridge design and repair works

Eritrean side heading Kidane Berhane and Japanese Consultant Team held series of discussions together with site survey regarding bridge and repair works during 20th January up to 20 th February ,2004.

In series of discussions, repair works on Emculu Bridge is especially highlight based on attachment of chapter 2 "Items Requested by Eritrean Side " describing as "- Emculu Bridge; Repair works to be considered subjected to further investigation" in " Minutes of Discussions on the Basic Design Study on the Project for Rehabilitation of Bridges on the Asmara-Massawa Road in the State of Eritrea(The second field study)" signed January 23, 2004.

Both side have reached to agreement as attached to following pages.
Eritrean side,however, emphasized that the treatment of Emculu Bridge will be clarify after receiving draft final report to be submitted around the end of May,2004.

Asmara、 February 20 、2004

Kidane Berhane
Director General
Department of Infrastrucure
Ministry of Public Works
State of Eritrea

Kazumasa Tada
Japanese Consultant Team
in charge of bridge design

Memorandum regarding the Rehabilitation of Bridges on the Asmara – Massawa Road in the State of Eritrea at the second site survey conducted from January to February 2004.

1 Comparison with Live Load between AASHTO and Japan Standard

Maximum shearing force and maximum bending moment inclusive of impact are compared regarding Truck Load and Lane Load through 20 – 50 m span bridges, referring Eritrean live load (HS20-44x1.25) and Japan criteria (B live load) .

After comparison with both above mentioned criteria, Eritrean side agreed to apply Japan Standard regarding live load with some consideration into HS20-44x1.25 because induced force by Japan Standard always exceeds that of Eritrean standard.

Attachment 1 (Comparison between HS20-44x1.25 and B Live Load)

2 Ghindae Bridge

2－1 Location of planned bridge

Left side two lanes from Asmara in Section (0+000-1+110) is to be implemented as stage construction by Eritrean side in which bridge portion is targeted to be implemented by Japan side, scheduled to be roughly completed whole said by-pass plan totaling 3.3 km long by Eritrean side within 2004 year.

Attachment 2－1 (Location of bridge)

2－2 Bridge Design

2－2－1 Bridge Type

Eritrean side keenly requested to apply Prestressed-Concrete Type Bridge in every newly constructed bridge including this Ghindae Bridge.

Both Japan and Eritrean side agreed to design this Ghindae Bridge as follows;

Bridge length will be 39m long as same as that of Ghindae by-pass plan initially designed by Eritrean side.

2－2－2 Standard Cross Section

(1) Width of Carriageway

Width of Carriageway; (2x3.5m+2x0.25) = 7.50m
Authority; Road Design Standard Part-2 Geometric Design State of Eritrea Ministry of Public Works Infrastructure Department April, 2003
Chapter 6.3 Lane Width, Shoulder Width and Marginal Strip

(2) Side Walks

1) Necessity of both side walks

Authority; Infrastructure Department of Ministry of Public Works has directed to provide side walk on both side of the bridge because of two direction traffic.

Attachment 2－2－2－1 (Reference drawings in other project such as Kna-Fna Bridge)

Road Rank classification for Kna-Fna Bridge (Adikeyih-Menddefera Road) is categorized into the secondary road. Kna-Fna Bridge is scheduled to implement by World Bank finance.

2) Width of Side Walks

1.5m; it is just same as Ghindae Bridge in 4 lane plan.

Attachment 2－2－2－2 (Standard cross section as reference drawings in Ghindae Bridge / 4 lane traffic in By-Pass Plan)

(3) Hand Rail on side walk

New Bridge will be same specification shown in Kna-Fna Bridge (h=1.1m).

2－2－3 General Plan on Ghindae Bridge (Stage Construction, two lane to be constructed by Japanese side)

Attachment 2－2－3 (General Drawing on Ghindae Bridge)

2－2－4 River Bank Protection

River Bank Protection is to be constructed by Japanese side up to 20m away to upstream and downstream on both sides from abutment, judging from violent erosion hazard due to steep valley with zigzag flow around Ghindae Bridge.

3 Ghtelay 1 Bridge・Dogali 2 Bridge

3−1 Carriageway Width and Side Walk

It will be the same as Ghindae Bridge.

3−2 Bridge location of Dogali 2 Bridge

Planned bridge's location is shown in attached topographical survey conducted by Japanese Consultant.

Attachment 3−2 (Location of bridge)

4 Vertical Clearance on the Bridge

Required clearance along Road is stipulated as follows;

Maximum vehicle height shall be 4.60 m height as designated in Article 7 Vehicle External Dimension (b) in Gazette of Eritrean Laws Legal Notice No.61/2002 (Asmara, May 13/2002).

Required vertical clearance stipulated as 5.00 m height directed by the Ministry of Public Works.

Attachment 4 (Vertical Clearance on Existing Concrete Arch Bridge between Asmara and Massawa measured by Japanese Consultant on February, 2004)

5 Emculu Bridge (Repair works)

Attachment 5 (Present condition)

5−1 Repair of Portal (middle span)

Vertical clearance of middle span at Emculu Bridge is measured by 4.74m height, of which clearance is the least one among other concrete bridges except Ghtelay 1 Bridge and Dogali 2 Bridge, so that both Asmara and Massawa side portal members (upper cross beams) were wholly collapsed due to passing vehicles.

Repair works;

Following proposed repair works shown in attachment 5−1 are to secure required vertical clearance at portal position as 5.0 m height so as to install lower portion of repairing portal member at the height of existing lateral member.

In addition, every proposed plan is to provide steel gate with 5.0 m clearance at the out side of concrete arch structure in Asmara and Massawa direction in order to prevent for passing vehicle with excesses height from entering into existing concrete arch.

Alternative A;

Repairing portal member is established, reusing some of remaining reinforcement steel bars at collapsed portal member rapping with new concrete.

Alternative B;

New portal member with H shape girder is connected with friction high-tension bolts through splice plates at the connector made of steel plates installed with concrete main arch. This H shape girder is to embedded with concrete as steel reinforced concrete (SRC) structure.

Alternative C;

Anchor to be fixed with portal member is set at arch main member, drilling arch member. Portal member is connected with this anchor as reinforced concrete or SRC structure.

Among these three alternatives, the Consultant recommends alternative A.

Reason; Judging from overall evaluation of each alternative, alternative A is recommended.

Attachment 5－1 (3 alternatives on repair works of portal member and evaluation of 3 alternatives)

5－2 Investigation results at bearings

Investigation on bearing structures at Emculu Bridge was conducted on 14th, February, 2004. Following facts can be recognized in the wake of this site investigation.

5－2－1 Tilting movable bearing

Some displacement can be found at the movable bearing mainly due to temperature change. This displacement is rotation at bearing structure of which is composed of vertical displacement to the bridge axis and angle rotation.

Rectangular shape of pillow member made of reinforced concrete sandwiched between upper shoe and lower one has rotated induced by bearing rotation seems to be tilted as if shoe structure itself would have tilted. Tilting at this pillow member has not indicated malfunction of movable bearing, preferably has been showing normal performance as expected to the movable bearing.

Attachment 5－2－1 (Observation Results of Movable Bearing Emculu Bridge / Dogali 1 Bridge)

5－2－2 General description induced by temperature stroke regarding movable bearing

(1) To satisfy characteristics of 3 hinged arch structure in proper movement at movable bearing

Proper movement at movable bearing ensures that no constrain force occurs、namely no internal force, at bearing, transforming to displacement at bearing by angle rotation and horizontal displacement, on an account of temperature stress, enforced movement by seismic force to the direction of bridge axial or some reason, for example, running vehicle's collision force to portal member.

It is judged that these bridges characteristics, that are statically determinate one, can be satisfied as properly movable at bearing as expected.

(2) Movement history of movable bearing caused by temperature stress

Movement of movable bearing by temperature is not always followed by change of temperature. Namely, it is said that movement of superstructure normally shows discontinuous history.

(3) Bi- metal effect

A movement induced by temperature in general is rotatary displacement at movable bearing with so called by-metal effect due to two dimensional configuration of superstructure, which is bridge axis direction and vertical direction, rather than one dimensional horizontal displacement.

5－2－3 Fixed bearing

Following facts can be recognized after site investigation conducted 14th, February, 2004.

(1) Fixed bearing has properly maintained initially expected function as no major displacement has occurred.

(2) Excessive external force caused by constrain of displacement could be produced because of constrain of movement due to temperature change and other external force such as seismic force or collision force so on. From these reasons, crock around end

lateral beam near by bearing and bearing attachment, and flaking of covering concrete.

5−3 Repair works of bearing

5−3−1 Replacement of bearing shoe

In displacing bearing shoe, following procedure is applied normally.

a) jacking up superstructure
b) replacement existing shoe by new one
c) jacking down to proper position after removal of support to superstructure

Following problems may arise in order to above mentioned procedure in jacking up method.

(1) It is concerned about possibility of collapse to superstructure because of friction cut at the position of hinge portion at arch crown.

(2) Although this collapse is prevented in physically, but it needs considerable costly countermeasures. For this reasons, this jacking up method is not recommendable in terms of technically and economically stand views.

(3) When Emculu Bridge was constructed; jacking up method for replacement of bearing was not anticipated. As no installation of jacking up point in which reinforcement or strengthening rigidly at the contact point was introduced, additional reinforcement is required.

From these several reasons, it is not applied to replace bearing by jacking up method.

5−3−2 Recommendable countermeasure towards bearing repair

Following four repair works on bearing is proposed;

Attachment 5−3−2 (Repair work plan on bearing)

(1) Expansion of bearing position

It is necessary that bridge superstructure should not fall down from substructure in case of strong earthquake for bridges between Asmara and Massawa located in Great Rift Valley in African Continent.

For this purpose, girder has long enough to the extent that girder has adequate room to the forced horizontal movement not to fall down by expanding length of bearing position.
This installation will enable to prevent from extreme tragedy situation such as personnel damage due to falling down of running vehicles over bridge or bridge collapse influencing social impact in rainy season by loosing crossing over bridge.
It is also expected that substructure's reinforcement could be secured by expanding bearing position as reinforcement of exposed steel bars or surface cracks are repaired for strong earthquake.
However, this proposal was not accepted by the Ministry of Public Works.

(2) Installation of stopper on bearing
It is vital for superstructure not to deviate from proper bearing position to the strong earthquake force by equipping with stopper to bridges located between Asmara and Massawa situated in Great Rift Valley zone.

(3) Repair works on end lateral beam around shoe
As steel bar exposure or cracks can be found around end lateral beam near bearing, rigid ness of end beam is expected to decrease compared with initial construction day.
In order not to further deteriorate rigid ness of end beam.

(4) Cleaning abutment and pier around bearing
Investigation around bearing clarifies following facts;
A piece of mounding up asphalt falling between slab gaps was accumulated as if function of bearing may hinder from proper movement. This asphalt shall be removed periodically, say once a year.

5－4 Repair works on main members
Depending on deteriorated members of superstructures, members to be repaired are categorized as follows;
(1) Slightly damaged member which is possible to be reused
(2) Seriously damaged member to the extent that its reinforced steel bar is needed to replace as this bar yielded
According above criteria, each member is classified to way of repairs works.

Attachment 5－4 (Repair work plan on main members)

6 Dogali 1 Bridge (Repair works)

Dogali 1 Bridge with over 5.0 m vertical clearance is not damaged on portal member by passing vehicles over bridge. On the other hand, repairs on main member like Emculu Bridge are needed to be repaired.

In addition, there are some problems for the bearing but it is not as serious as Emculu Bridge.

Attachment 6 (Present condition and repair work plan)

7 Repair works on lower slab deck on Emculu Bridge and Dogali 1 Bridge

Concrete is spalling off and steel bar is exposed at lower slab deck. In order for bar rust not to penetrate into inside portion, epoxy resin is apply to this slab surface, but this measure is not substantial repair to strong then loading capacity to slab.

Number of repair portion (enclosed section between lateral and stringer)

(1) Emculu Bridge; 30 portions

(2) Dogali 1 Bridge; 20 portions

8 Handrail on Emculu Bridge and Dogali 1 Bridge

As both bridges are lacking of handrail, it is strongly recommended to install handrail made of steel to prevent from falling accidents.

Attachment 1

(Comparison between HS20-44x1.25 and B Live Load)

Summary of bending moment and shaer force depending on span length

1. Bending moment and shaer force without impact

Following table shows maximum forces(bending moment and shearing force) due to life load on siml beams, in which larger value in T-load and L-load will be applied to design works in AASHOTO or Japan Standard.

Bending moment

span L (m)	span L (feet)	AASHTO(HS20-44) T-Mmax (kNm)	L-Mmax (kNm)	Mmax (kNm)	(Mmax) (xE3 f-p)	Japan Standard(BLiveLoad) T-Mmax (kNm)	L-Mmax (kNm)	Mmax (kNm)
20.000	65.617	1,222	867	1,222	901	1,500	1,650	1,650
25.000	82.021	1,622	1,230	1,622	1,196	1,875	2,320	2,320
29.000	95.144	1,942	1,562	1,942	1,433	2,175	2,904	2,904
30.000	98.425	2,022	1,651	2,022	1,492	2,250	3,056	3,056
35.000	114.829	2,423	2,131	2,423	1,787	2,625	3,858	3,858
38.000	124.672	2,663	2,447	2,663	1,964	2,850	4,370	4,370
39.000	127.953	2,743	2,556	2,743	2,023	2,925	4,546	4,546
40.000	131.234	2,823	2,669	2,823	2,082	3,000	4,725	4,725
45.000	147.638	3,223	3,265	3,265	2,408	3,375	5,658	5,658
50.000	164.042	3,624	3,920	3,920	2,891	3,750	6,656	6,656

Shearing force

span L (m)	span L (feet)	AASHTO(HS20-44) T-Smax (kN)	L-Smax (kN)	Smax (kN)	(Smax) (xE3 p)	Japan Standard(BLiveLoad) T-Smax (kN)	L-Smax (kN)	Smax (kN)
20.000	65.617	275	209	275	62	300	375	375
25.000	82.021	284	232	284	64	300	419	419
29.000	95.144	289	251	289	65	300	450	450
0.000	98.425	290	256	290	65	300	458	458
5.000	114.829	294	279	294	66	300	492	492
8.000	124.672	296	293	296	67	300	512	512
9.000	127.953	297	298	298	67	300	519	519
40.000	131.234	297	302	302	68	300	525	525
45.000	147.638	300	326	326	73	300	556	556
50.000	164.042	302	349	349	78	300	587	587

2. Bending moment and shearing force with impact

Following table shows maximum forces(bending moment and shearing force) due to life load on siml beams. In this table, forces with impact for steel and PC bridge are sumalized while imact coeficient is categolized into various type of bridge such as steel bridge, reinforced concrete bridge(T-load and L-load) and prestressed concrete bridge(L-load).

Bending moment

span	span	AASHTO(HS20-44)			Japan Standard(BLiveLoad)				
L	L	Mmax	I	Mmax+I	Mmax	i-steel	Mmax+I(M)	i-PC	Mmax+I(P)
(m)	(feet)	(kNm)		(kNm)	(kNm)		(kNm)		(kNm)
20.000	65.617	1,222	26.2%	1,542	1,650	28.57%	2,121	22.22%	2,017
25.000	82.021	1,622	24.2%	2,014	2,320	26.67%	2,939	20.00%	2,784
29.000	95.144	1,942	22.7%	2,383	2,904	25.32%	3,639	18.52%	3,442
30.000	98.425	2,022	22.4%	2,475	3,056	25.00%	3,820	18.18%	3,612
35.000	114.829	2,423	20.8%	2,928	3,858	23.53%	4,766	16.67%	4,501
38.000	124.672	2,663	20.0%	3,196	4,370	22.73%	5,363	15.87%	5,064
39.000	127.953	2,743	19.8%	3,285	4,546	22.47%	5,568	15.63%	5,257
40.000	131.234	2,823	19.5%	3,374	4,725	22.22%	5,775	15.38%	5,452
45.000	147.638	3,265	18.3%	3,864	5,658	21.05%	6,849	14.29%	6,466
50.000	164.042	3,920	17.3%	4,598	6,656	20.00%	7,988	13.33%	7,544

Shearing force

Sspan	span	AASHTO(HS20-44)			Japan Standard(BLiveLoad)				
L	L	Smax	I	Smax+I	Smax	i-steel	Smax+I(M)	i-PC	Smax+I(P)
(m)	(feet)	(kN)		(kN)	(kN)		(kN)		(kN)
20.000	65.617	275	26.2%	347	375	28.57%	482	22.22%	458
25.000	82.021	284	24.2%	352	419	26.67%	531	20.00%	503
29.000	95.144	289	22.7%	354	450	25.32%	564	18.52%	534
0.000	98.425	290	22.4%	355	458	25.00%	572	18.18%	541
5.000	114.829	294	20.8%	356	492	23.53%	608	16.67%	574
8.000	124.672	296	20.0%	356	512	22.73%	629	15.87%	593
39.000	127.953	298	19.8%	357	519	22.47%	635	15.63%	600
40.000	131.234	302	19.5%	361	525	22.22%	642	15.38%	606
45.000	147.638	326	18.3%	386	556	21.05%	673	14.29%	636
50.000	164.042	349	17.3%	410	587	20.00%	704	13.33%	665

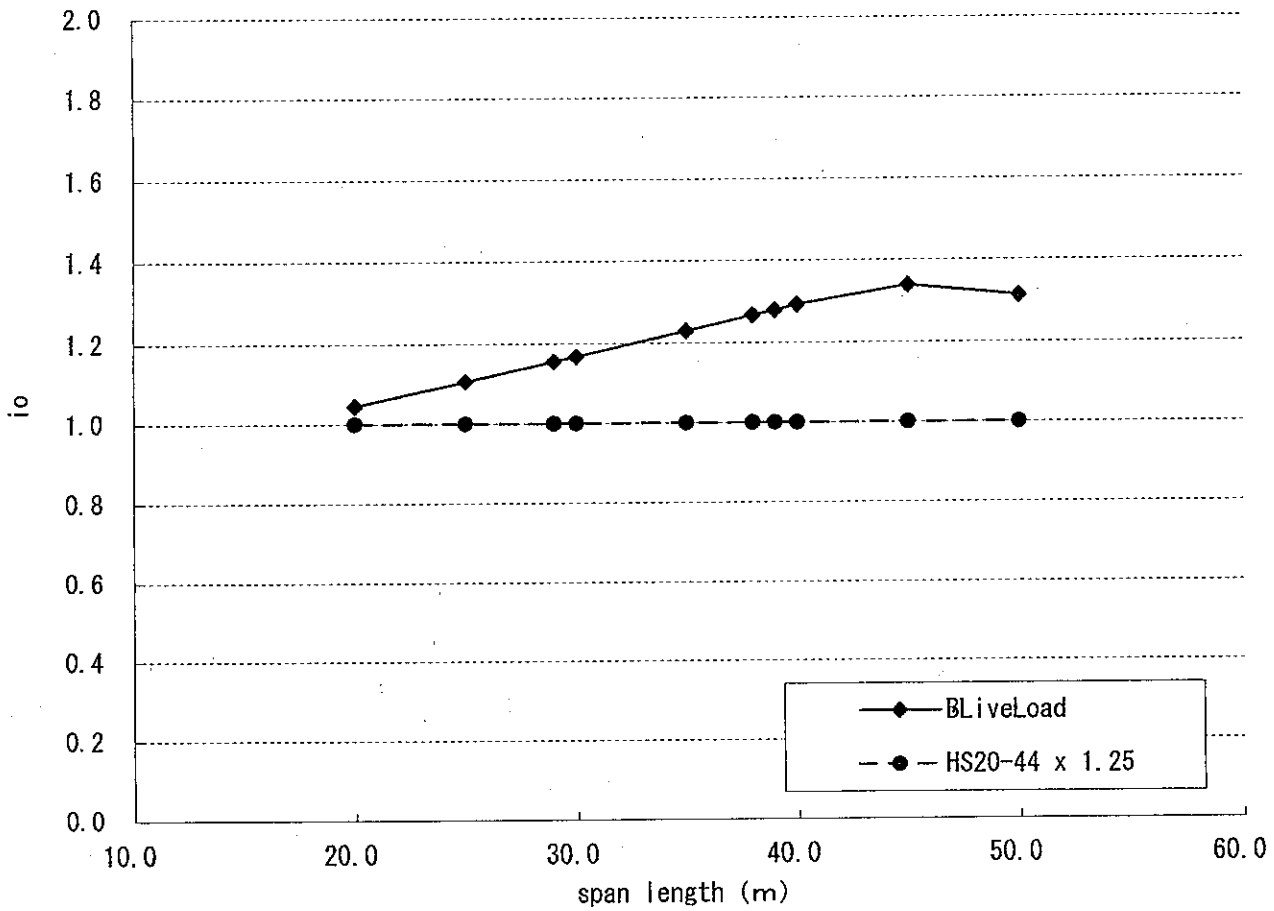
(comparative figure on bending moment)

span L (m)	span L (feet)	ASSHTO(HS20-44) Mmax (kNm)	x 1.25 (kNm)	Japan Standard(BLiveLoad※1) Mmax (kNm)	Ratio ※2
20.000	65.617	1,542	1,928	2,017	1.046
25.000	82.021	2,014	2,517	2,784	1.106
29.000	95.144	2,383	2,979	3,442	1.155
30.000	98.425	2,475	3,094	3,612	1.167
35.000	114.829	2,928	3,660	4,501	1.230
38.000	124.672	3,196	3,995	5,064	1.267
39.000	127.953	3,285	4,107	5,257	1.280
40.000	131.234	3,374	4,217	5,452	1.293
45.000	147.638	3,864	4,830	6,466	1.339
50.000	164.042	4,598	5,747	7,544	1.313

※1 impact coeffi. (BLiveLoad,PC,L load

※2 Ratio; BLiveLoad／HS20-44 x 1.25

Ratio ; Bending moment



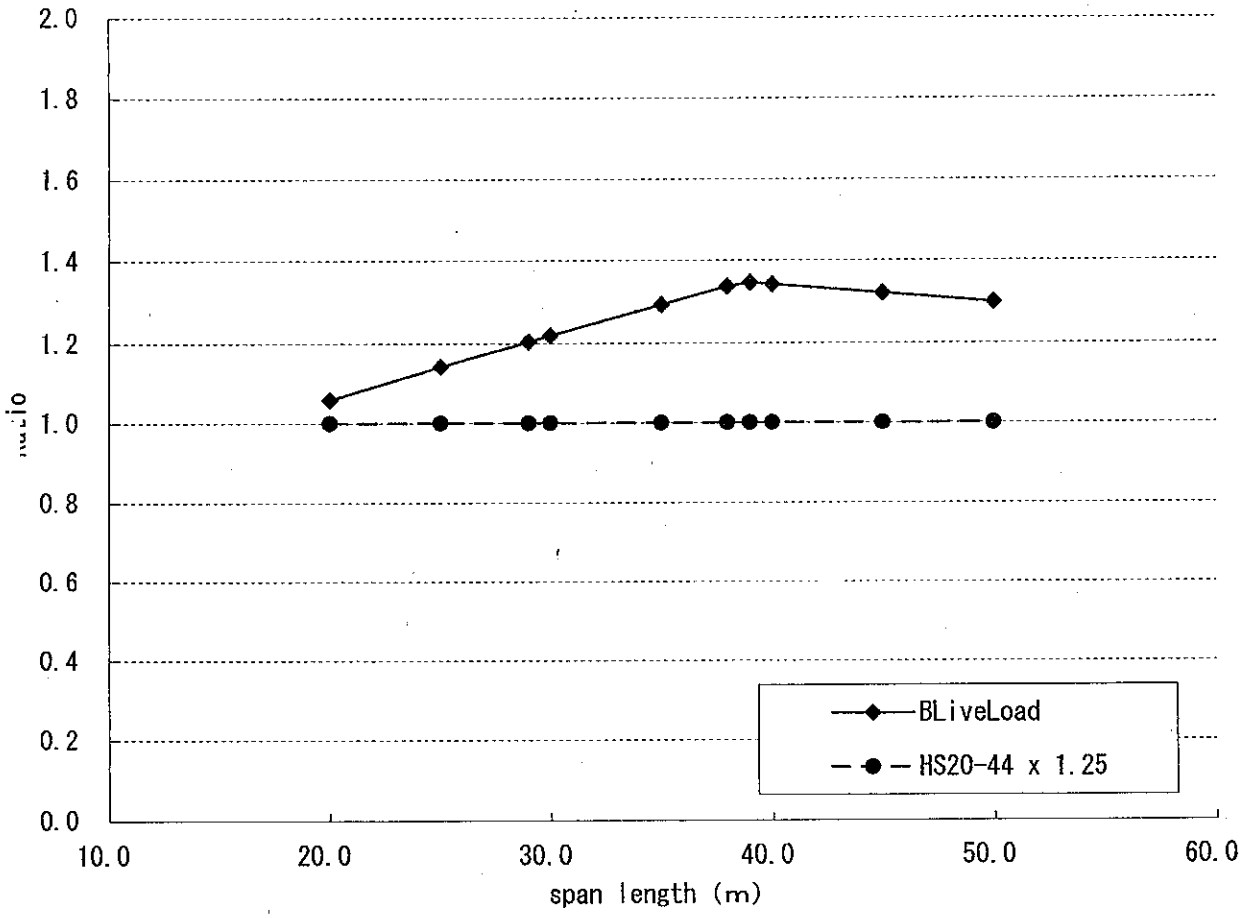
(comparative figure on shearing force)

span L (m)	span L (feet)	ASSHTO(HS20-44) Smax (kN)	x 1.25 (kN)	Japan Standard(BLiveLoad※1) Smax (kN)	Ratio ※2
20.000	65.617	347	433	458	1.057
25.000	82.021	352	440	503	1.142
29.000	95.144	354	443	534	1.204
30.000	98.425	355	443	541	1.219
35.000	114.829	356	444	574	1.292
38.000	124.672	356	445	593	1.335
39.000	127.953	357	446	600	1.345
40.000	131.234	361	452	606	1.341
45.000	147.638	386	482	636	1.319
50.000	164.042	410	512	665	1.298

※1 impact coeffi. (BLiveLoad,PC,L load

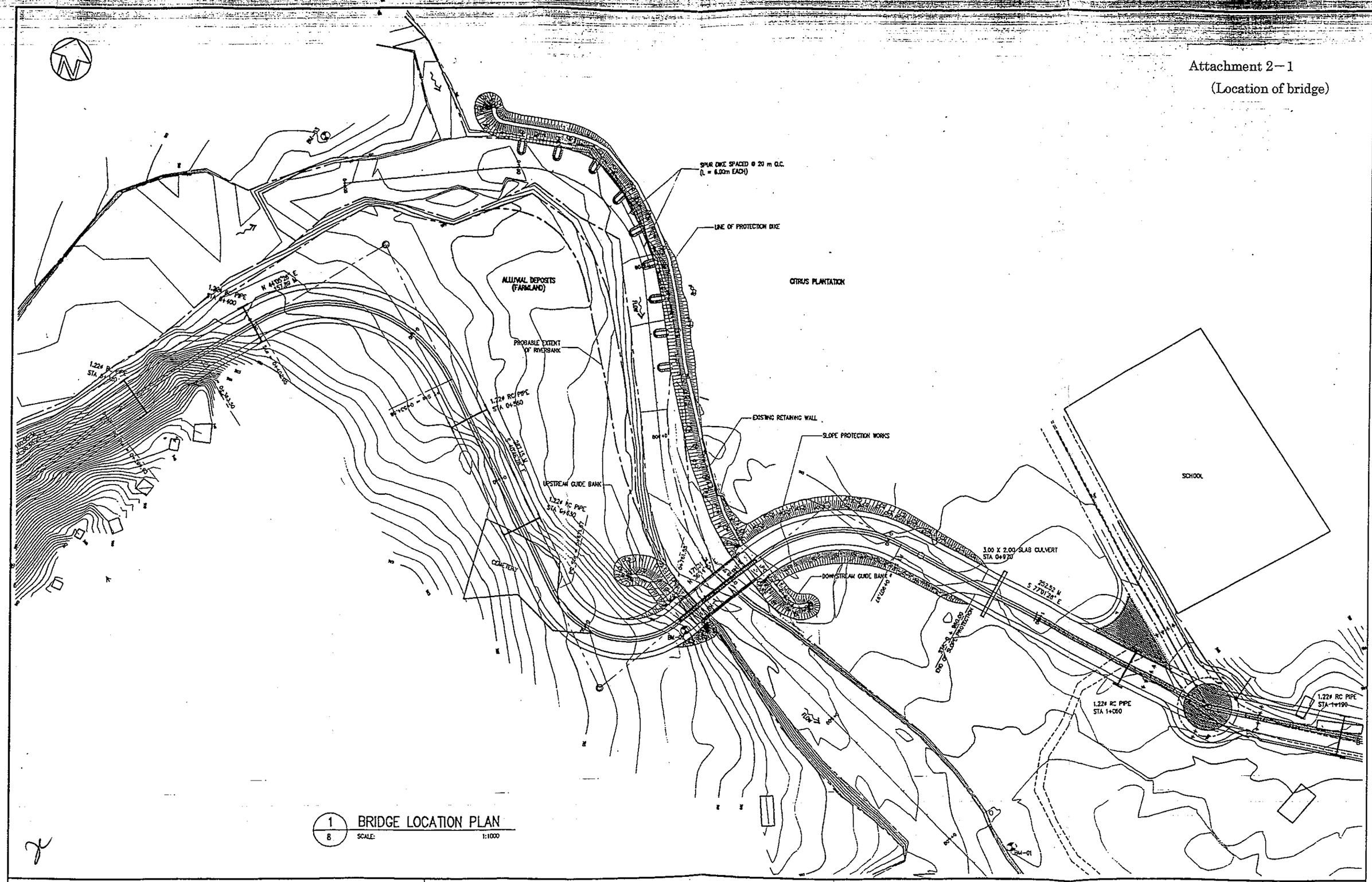
※2 Ratio; B life load／HS20-44 x 1.25

Ratio : shearing force



Attachment 2－1
(Location of bridge)

Attachment 2−1
(Location of bridge)

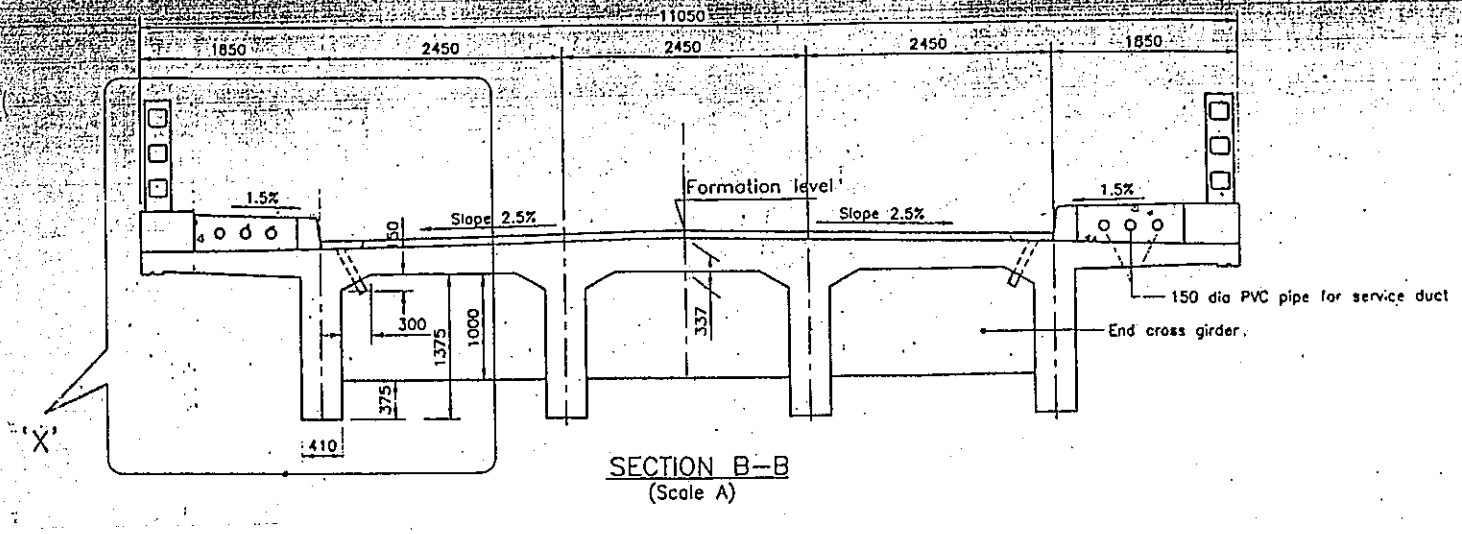


1/8 BRIDGE LOCATION PLAN
SCALE: 1:1000

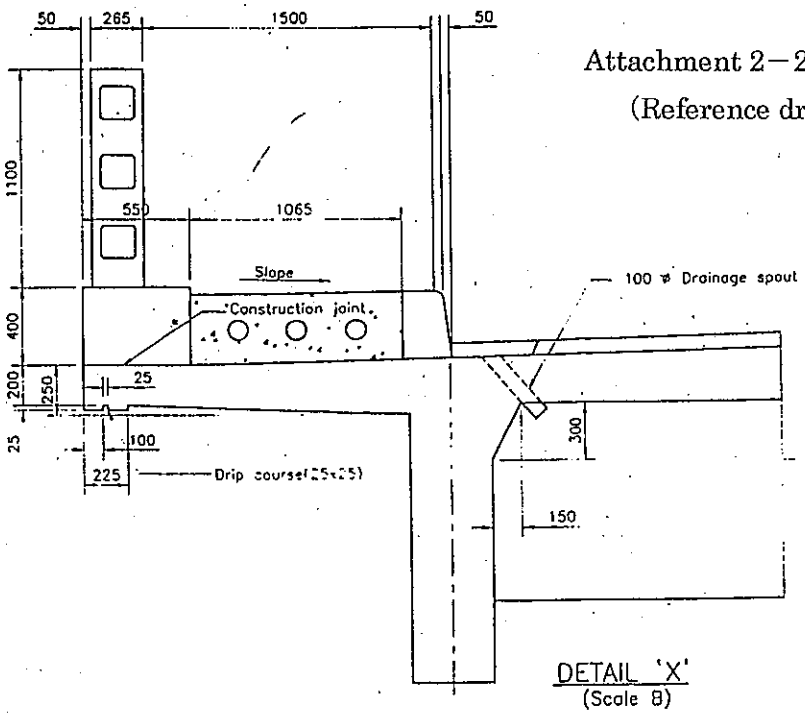
GEDECC GENERAL DEVELOPMENT, ENGINEERING & CONSTRUCTION CO., P.L.C. ENGINEERS • CONSULTANTS • CONTRACTORS	CLIENT: MINISTRY OF PUBLIC WORKS	PROJECT TITLE : GHINDA'E TOWN BY-PASS AND ASSOCIATED BRIDGES	DRAWING NO. 8
DRAWN BY: r e d e	RECOMMENDED APPROVAL: KIDANE BERHANE DIRECTOR/CD	SHEET CONTENT : BRIDGE LOCATION PLAN SHOWING THE LAYOUT OF PROTECTION WORKS.	DATE PRINTED:
CHECKED BY: J. E. NASH	APPROVED BY: HABTEAB TESFATZION DIRECTOR GENERAL/CD		SHEET 8 OF 31
APPROVED BY (ACTING DIRECTOR): R. D. ACKROYD			
GENERAL MANAGER: MOGES GEBREZION			

Attachment 2−2−2−1

(Reference drawings in other project such as Kna-Fna Bridge)



SECTION B–B
(Scale A)



DETAIL 'X'
(Scale B)

Attachment 2–2–2–1

(Reference drawings in other project such as Kna–Fna Bridge)

sym.

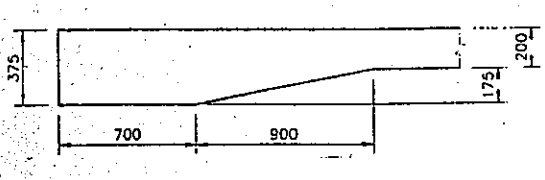
A1

NOTES:

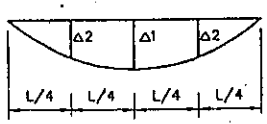
1. All dimensions are in millimetres unless otherwise spec
2. Dimensions are not to be scaled. Only written dimensic shall be followed.
3. For spacing of drainage spouts in plan refer general arrangement drawing of bridge.
4. Concrete in various elements shall be of A1 grade.
5. Longitudinal girders shall be given an upward camber Δ1 on account of dead load as shown.
6. For details of sidewalk refer miscellaneous drawing.

REFERENCE DRAWINGS:

• General notes	2001148/KNA-FNA/BS/GEN/C
• Reinforcement details of deck slab	2001148/KNA-FNA/BS/003
• Reinforcement details of longitudinal girders	2001148/KNA-FNA/BS/004
• Reinforcement details of cross girders	2001148/KNA-FNA/BS/005
• Miscellaneous drawings	2001148/KNA-FNA/BS/MISC/ to



SECTION C–C
(Scale B)



Δ1 = 11mm

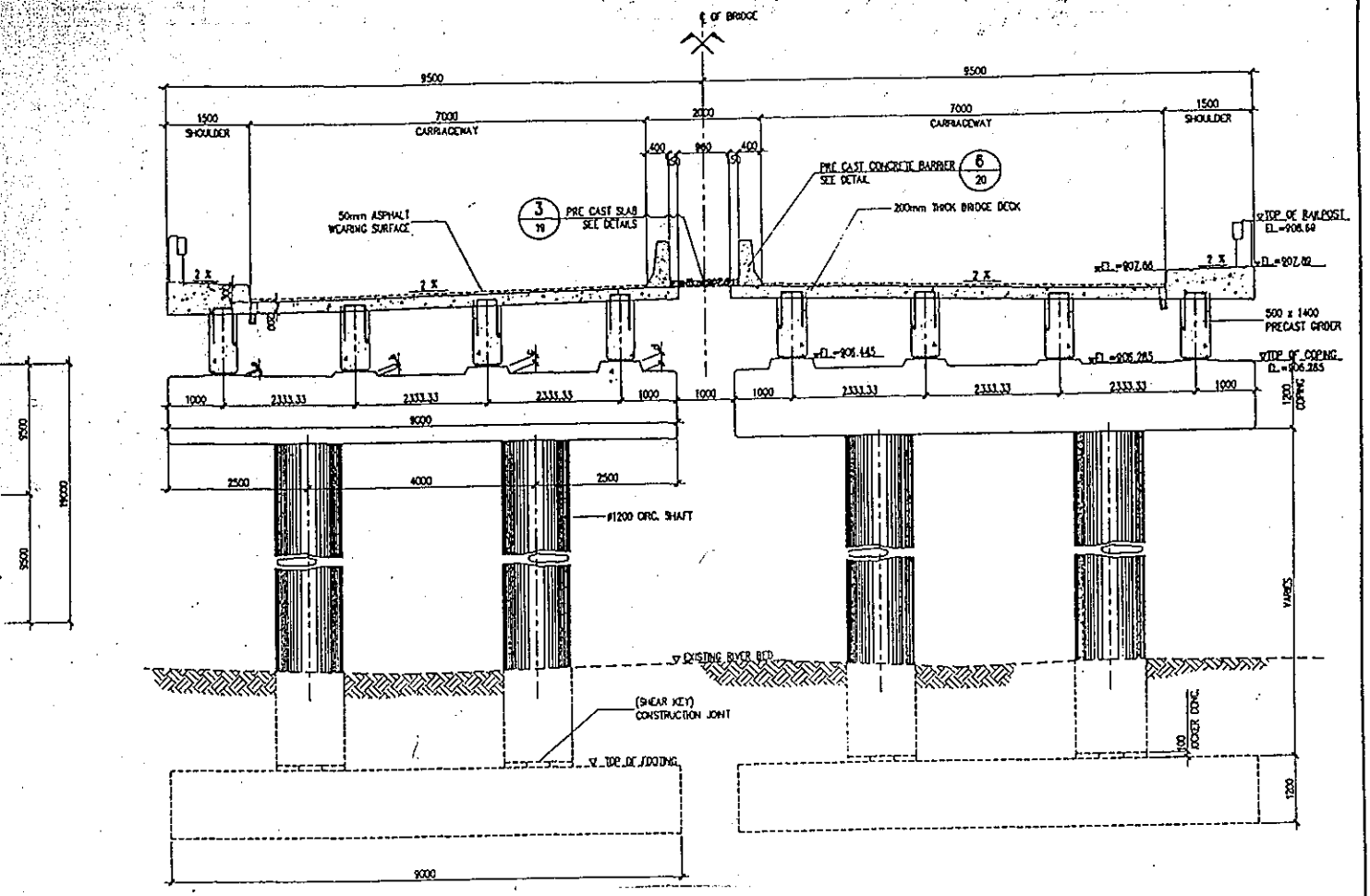
Δ2 = 8mm

DEAD LOAD DEFLECTION DIAGRAM
(NTS)

INFRASTRUCTURE DEPARTMENT MINISTRY OF PUBLIC WORKS, ERITREA	PREP.BY	Seoult f.		SCALE –A 1 0 1 2 3 4m	BRIDGE
ONSULTANCY SERVICES FOR FEASIBILITY STUDY AND DETAILED ENGINEERING DESIGN OF KNA–FNA BRIDGE	CHK.BY	S.Gupta		SCALE –B 0 1 2 2.5m	DRAWING NO. 2001148/KNA–FNA/BS/
GENERAL ARRANGEMENT OF SUPERSTRUCTURE	APPROVED BY	A. Mukhopadhyay			REV. R0 DATE : JANUARY,

Attachment 2−2−2−2

(Standard cross section as reference drawings in Ghindae Bridge / 4 lane traffic in By-Pass Plan)



Attachment 2-2-2-2

(Standard cross section as reference drawings in Ghindae Bridge / 4 lane traffic in By-Pass Plan)

GENERAL STRUCTURAL NOTES

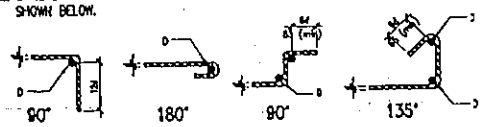
REFERENCE CODES
1. AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGES (1996 EDITION).
2. UBC FOR SEISMIC ANALYSIS. (AS BUILT-IN WITH STAAD SOFTWARE)

DESIGN LOADS:
1. CONCRETE DENSITY = 24.5 kN/m^3
2. FUTURE WEARING SURFACE (50mm THK) = 0.90 KPa
3. LIVE LOAD:
   3.a. TRUCK LOAD = HS 20-44 + 25 %
   3.b. LANE LOAD = 3.60 KPa/LANE

DESIGN AND MATERIALS PROPERTIES

C.1 STRUCTURES	CONC. COMP. STRENGTH (28 DAYS)
C.1a. FOOTING	21 MPa
C.1b. PIER SHAFTING	25 MPa
C.1c. GIRDERS/SLAB DECK/RAILINGS	25 MPa
C.1d. PILES (IF APPLICABLE)	21 MPa

C.2 REINFORCING STEEL.
C.2a. REINF. STEEL SHALL BE INTERMEDIATE DEFORMED BARS (GRADE 40) CONFORMING TO ASTM A-615 OR AASHTO M-31, f_y = 414 MPa
C.2b. THE CONTRACTOR SHALL SUBMIT DRAWINGS AND BAR BENDING DIAGRAM TO THE ENGINEER FOR APPROVAL PRIOR TO FABRICATION.
C.2c. BARS SHALL BE COLD BENT. HOOKS SHALL BE FABRICATED AS SHOWN BELOW.



C.2d. DIMENSIONS RELATING TO SPACING IN MILLIMETERS ARE CENTERS OF BARS.
C.2e. UNLESS SHOWN ON THE DRAWINGS, THE CLEAR DISTANCE BETWEEN PARALLEL BARS SHALL NOT BE LESS THAN 1.5 TIMES BAR DIAMETER NOR 1.5 TIMES THE MAXIMUM SIZE OF THE COARSE AGGREGATE. WHEN REINFORCEMENT IN THE BEAMS OR GIRDERS IS PLACED IN TWO OR MORE LAYERS, SPACING SHALL NOT BE LESS THAN ONE BAR DIAMETER AND THE BARS IN THE UPPER LAYER SHALL BE PLACED DIRECTLY ABOVE THOSE IN THE BOTTOM LAYER.

D. CONCRETE COVER FOR REINFORCING STEEL
D.1 UNLESS OTHERWISE SHOWN ON THE DRAWINGS OR IN THE FOLLOWING TABLE (D.2) CONCRETE COVER SHALL BE 50mm.

TABLE D.2	
TOP OF DECK	30 mm
BOTTOM OF SLAB	25 mm
STIRRUPS IN ORDER	25 mm
BOTTOM OF FOOTING	75 mm
PILES	75 mm

E. MINIMUM REQUIREMENTS FOR BAR SPLICES AND EMBEDMENT IN ACCORDANCE TO AASHTO 8-33.

TABLE E-1				
BAR SIZE	SPLICE LENGTH		EMBEDMENT LENGTH	
	TENSION	COMPRESSION	TENSION	COMPRESSION
10 mmø	300	300	300	200
12 mmø	300	300	300	200
16 mmø	420	320	300	240
20 mmø	850	400	360	290
25 mmø	1020	500	570	360
28 mmø	1270	560	650	410
32 mmø	1550	640	970	470
38 mmø	2100	720	1510	510

F. ALL CONSTRUCTION JOINT CONCRETE SURFACES SHALL BE SCORED OR ROUGHENED WHILE CONCRETE IS STILL GREEN.

METERS UNLESS OTHERWISE INDICATED.
ING ARE IN METERS UNLESS OTHERWISE INDICATED.

IC WORKS
HABITAB CREATION
DIRECTOR GENERAL

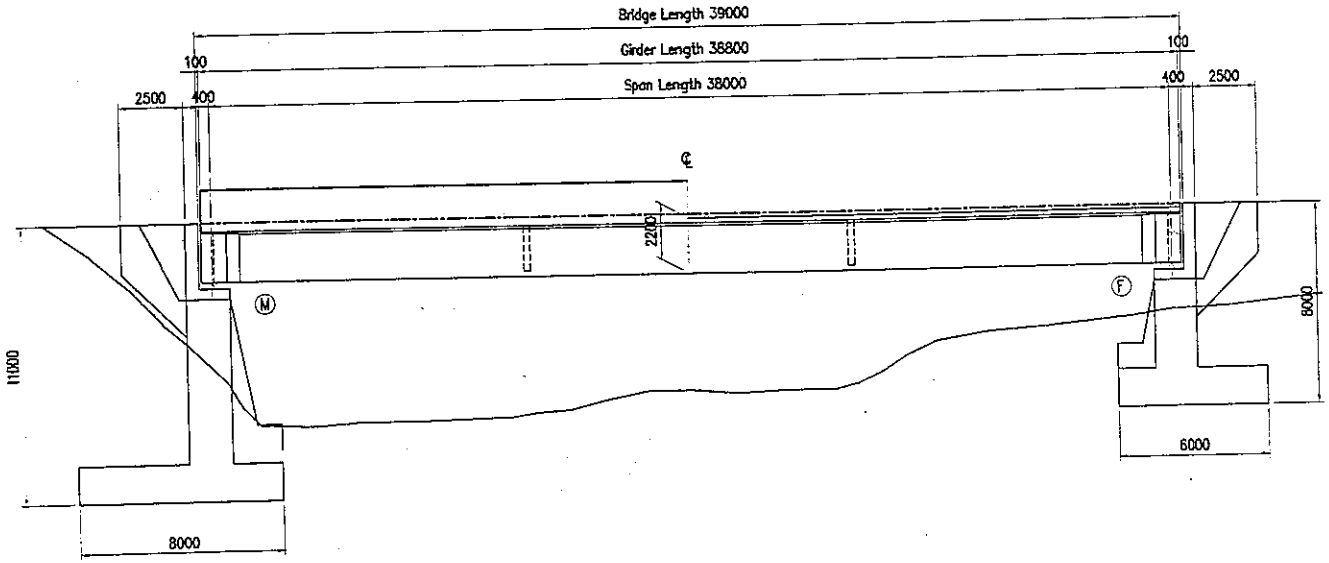
PROJECT TITLE : GHINDA'E TOWN BY-PASS AND ASSOCIATED BRIDGES
SHEET CONTENT : PROPOSED BRIDGE - BRIDGE PLAN, ELEVATION, AND BRIDGE SECTION

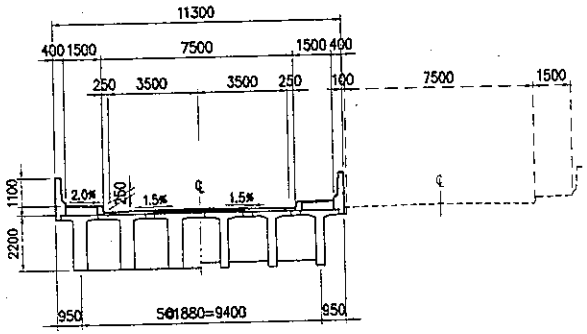
DRAWING NO. 9
DATE PRINTED:
SHEET 9 OF 31 SHEETS

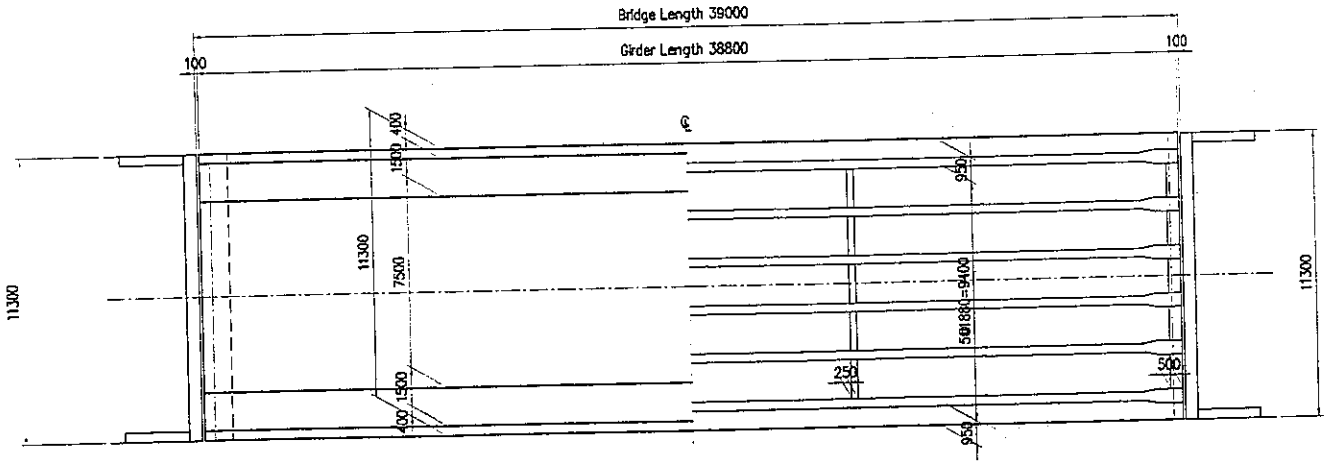
Attachment 2－2－3

(General Drawing on Ghindae Bridge)

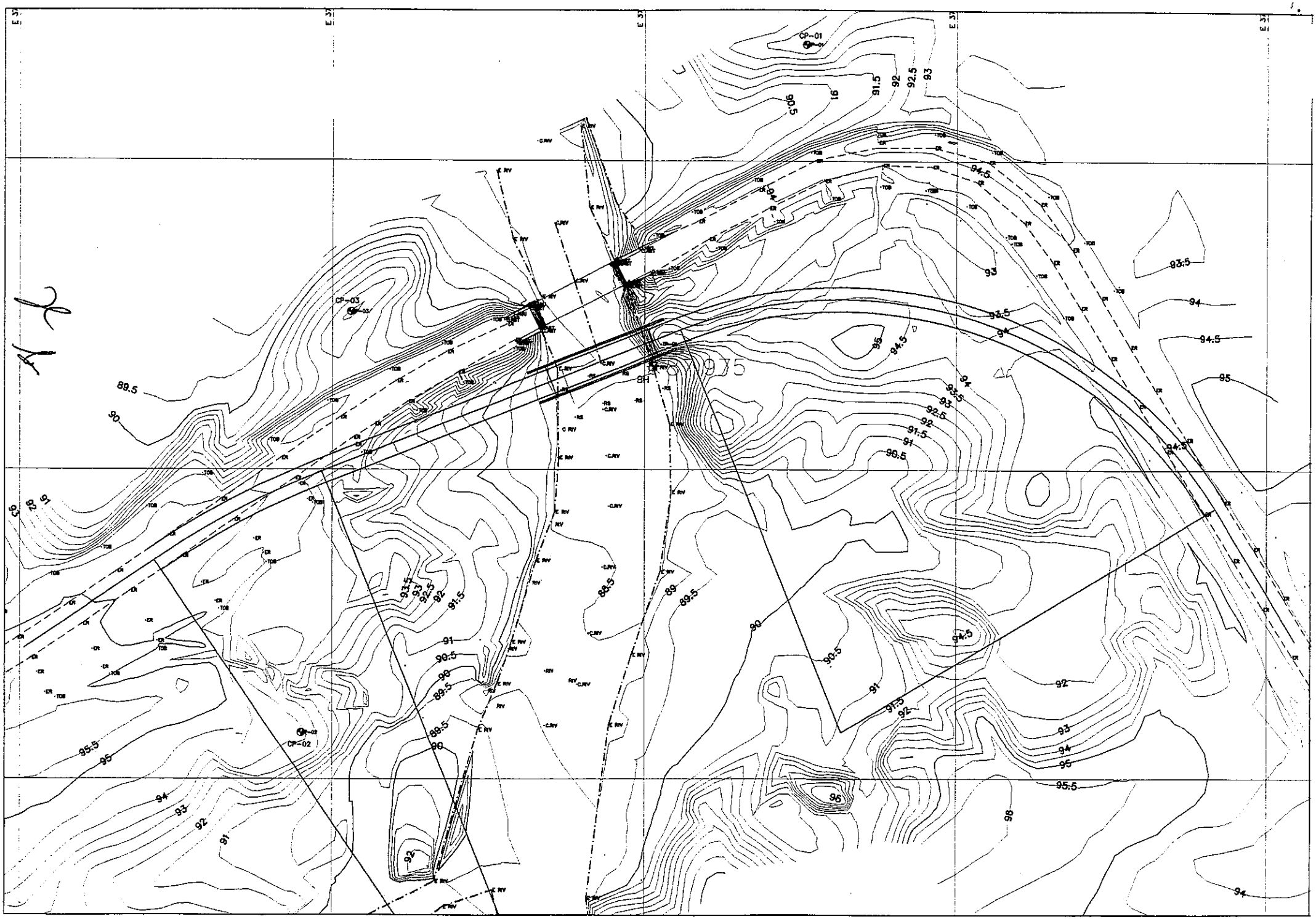
No.1 Gindae Bridge (Ghinda Bridge)





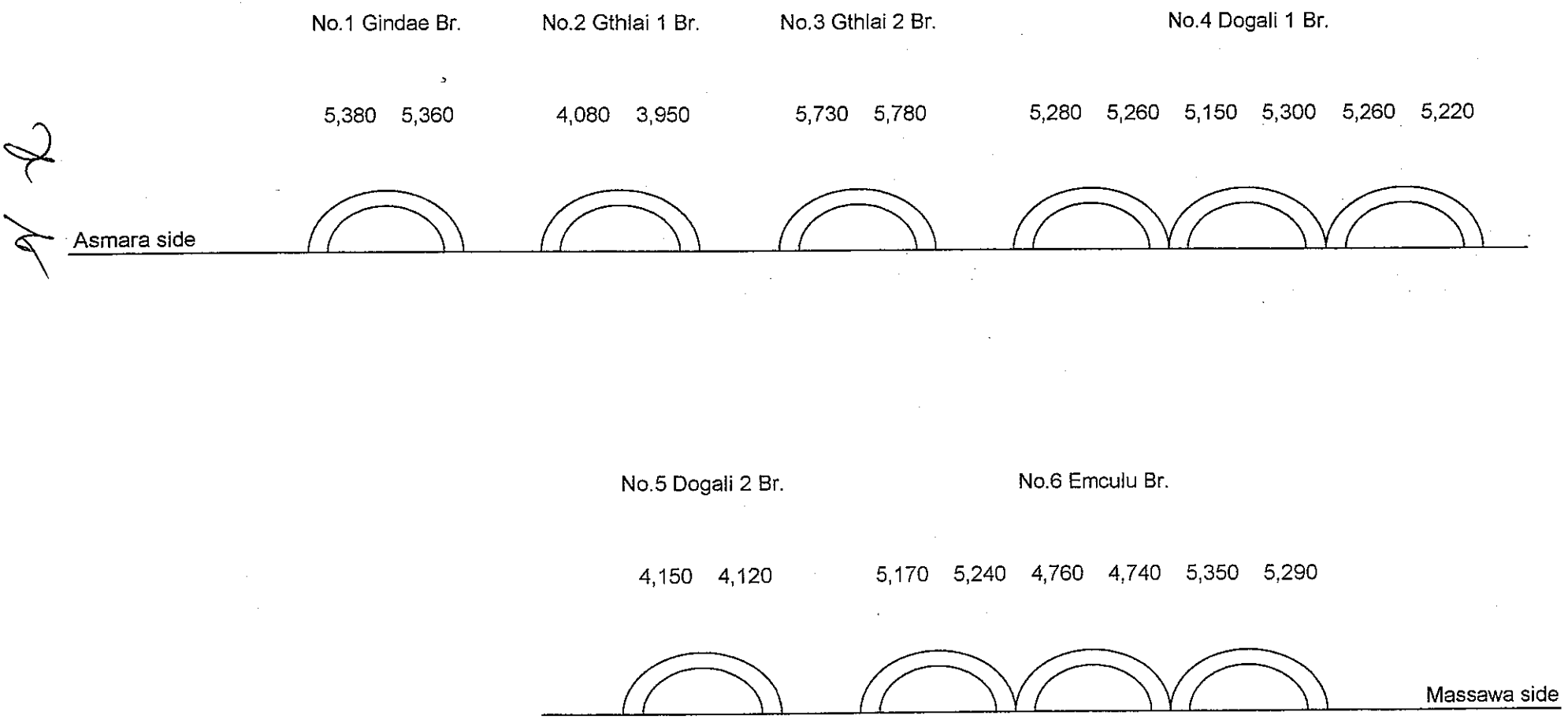


Attachment 3－2
(Location of bridge)


CP-01
CP-02
CP-03
BH 1975

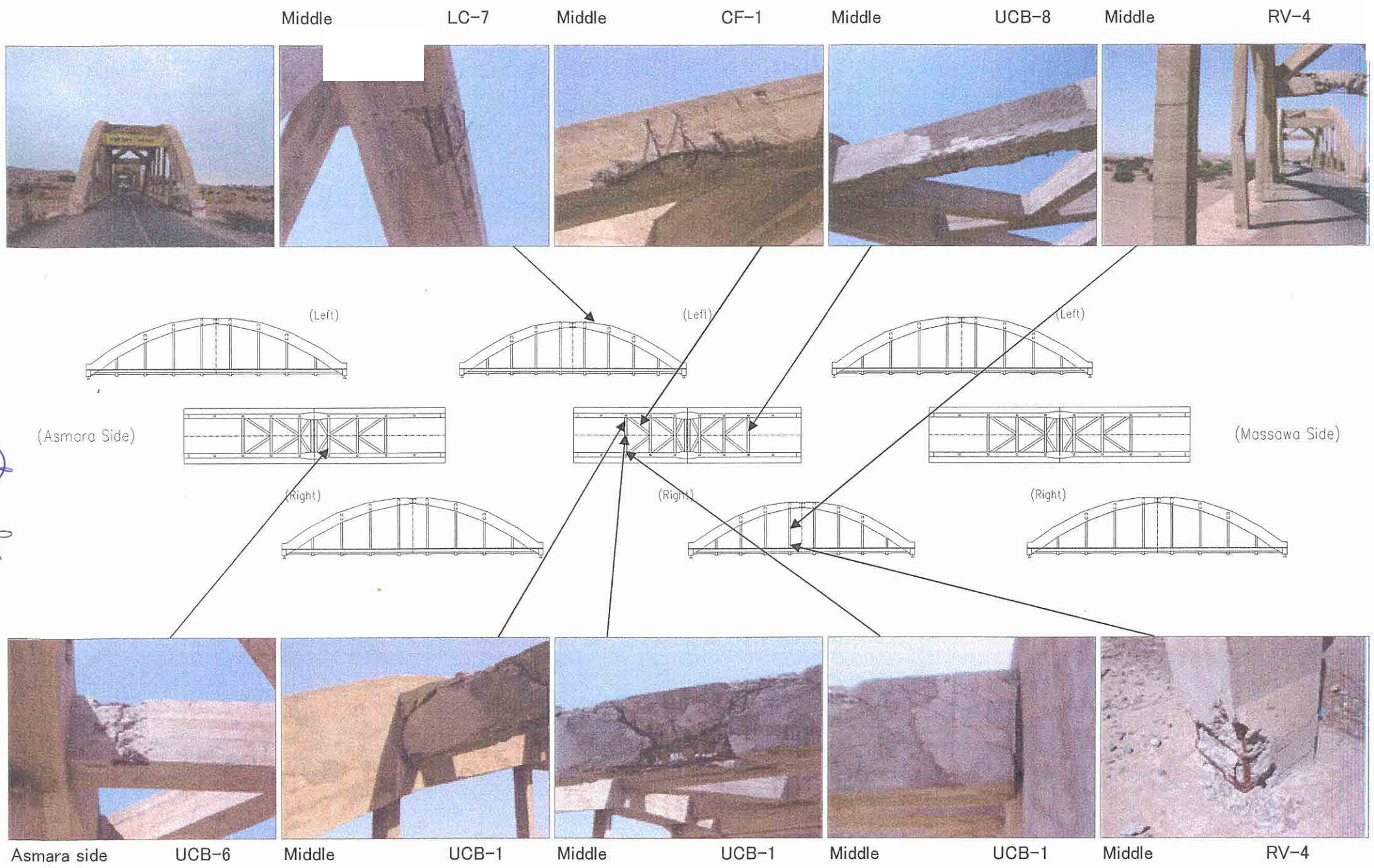
Attachment 4

(Vertical Clearance on Existing Concrete Arch Bridge between Asmara and Massawa measured by Japanese Consultant on February, 2004)


No.1 Gindae Br.
No.2 Gthlai 1 Br.
No.3 Gthlai 2 Br.
No.4 Dogali 1 Br.
5,380 5,360
4,080 3,950
5,730 5,780
5,280 5,260 5,150 5,300 5,260 5,220
Asmara side
No.5 Dogali 2 Br.
No.6 Emculu Br.
4,150 4,120
5,170 5,240 4,760 4,740 5,350 5,290
Massawa side

Attachment 5
(Present condition)

No.6 Emculu Bridge



No.6 Emculu Bridge