# NATIONAL HIGHWAY BRIDGE CONSTRUCTION 

 IN
## THE KINGDOM OF BHUTAN

## FINAL REPORT <br> VOLUME 3

## APPENDIX



PACIFIC CONSULTANTS INTERNATIONAL HOKKAIDO ENGINEERING CONSULTANTS Co., Lid.

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF COMMUNICATIONS, THE ROYAL GOVERNMENT OF BHUTAN

## THE STUDY <br> ON

NATIONAL HIGHWAY BRIDGE CONSTRUCTION
IN
THE KINGDOM OF BHUTAN

FINAL REPORT
VOLUME 3
APPENDIX

JULY 1998

PACIFIC CONSULTANTS INTERNATIONAL HOKKAIDO ENGINEERING CONSULTANTS Co., Ltd.

## NOTE

The following exchange rate was adopted through this report.
US $\$ 1.00=\mathrm{Nu} .38 .6$ (March 1998)
Legend : $\quad \stackrel{0}{2}$
Capital Major Town
Major Town
international Boundary
Ozongknag Boundary
(undor the PWD administration)
National Mighway
(undor the India administration)
District Road .... :
(under the PWD administration)
Location of 22 bridges for the study
No. : Bridge Name Bridurizampa : Chamkar Zam ): Bjec (4): Wachy Zam : Wangdigang 7): Pan rmani
 ): Hesothangkha (1) Lawakha Rurichu пчวर्ध : : Kamichu
(63): Warachu
 (18): Burichu ."

 4soyuns: (20)

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## APPENDIX

## Appendix-A

Outline of 22 Bridges

BRIDGE NO. 1 KURIZAMPA BRIDGE



## LOCATION MAP



BRIDGE SITE MAP

| Existing Conditions |  |
| :---: | :---: |
| 1. Location: | Kurichu River, Mongar Drongkhag |
| 2. Class of road: | National Ilighway Route No. 1 |
| 3. Superstructure: | Bailcy TSR |
| 4.Substructure: | Masonry abutments on natural rock |
| 5.Approach roads: | Sealed macadan paved 4 m wide |
| 6. Bridge length: | 42.7 m |
| 7.Bridge width: | 3.36 m (carriagenay) |
| 8. Maintenance, especially repaintisg manner, is not satisfactory. |  |

Existing Conditions I. Location:
2. Class of road:
3.Superstructure:
4.Substructure:
5. Approach roads:

6 . Bridge lengin:
8. Maintenance, especially repainting manner, is not satisfactory.

## Other Information

1. Completed in

1971
2. Original load capacity: 18 tom

Present limited load capacity: 5 ton
3. In down stream, Kurichu Hydto Power Plant is under construction. However there is no influence to water level at the bridge site.

1. Near bridge site a space for construction materials and equipment is available.

## BRIDGE NO. 2 CIIAMKAR ZAM BRIDGE



LOCATION MAP

| Existing Conditions |  |
| :---: | :---: |
| I. . owation: | Chamkarchu River, Bumbthang Drorgkhag |
| 2.Class of road: | National Ilighway Route No.l |
| 3.Supersmacture: | Britey DS |
| $4 . S$ Substructure: | Masonry abutments on natural rock |
| 5 Approach roads: | Sealed macadam paved 4 nm wide |
| 6. Bridge length: | 33.7 m |
| 7. Bridge width: | 3.22 m (carriageway) |
| 8 Maintenance. especially on the underside of stigersimicture, is mol satisfactory. The rast has gone into steel members. |  |

superstructure is not satisfactory. The rust has gone into steel members.

## Other Information

1. Completed in 1973
2. Original load capacity: 18 ton

Present fimited load capacity: $S$ ton
3. Near bridge site a space for construction materials and equipment is available.

## BRIDGE NO. 3 B.JEE BRIDGE



BRIDGE SITE MAP

Existing Conditions
1.Location:
2. Class of road:
3. Superstructure:
4.Substructure:
5.Approach roads:
6.3ridge length:
7.13ridge width:
8. The underside of the superstructure is very rusty and there is no sign of past maintenance. A turn-buckle doesn't work as slown in the photo, pins are missing, and main beans are coushed by vehicles and len ben severely at 24 locations.

Oiher Information

1. Completed in 1971
2. Original load capacity: 18 ton

Present limited load capacity: 9 ton
3 Near bridge site a space for construction materials and equipment is available.


LOCATION MAP

## Existing Conditions

1. I ocation:

2 Class of road:
3.Superstructure:
4.Substructure:
5.Approach soads:

6 . Bridge leogh:
7.13ridge wida:

Dangchu River, Wongdue Drongkhag
National IIighway Route No. 1
Bailey DSR
Masonry abutments on satural rock
Sealed macadam paved 4 m wide
33.7 m 3.15 m (cariageway)
8. Main steel members are seriously got rusted into the mother materials.


BRIDGE SITE MAP

## Other Information

1. Completed in

1969
2. Original load capacity: $\quad 18$ ton

Present load capacity: 18 ton
3. Near bridge site a space for construction materials and cquipment is available.

## BRIDGE NO. 5 MANGDICUU BRIDGE



LOCATION MAP


BRIDGE SITE MAP

Existing Conditions
1.Location:
2. Class of road:
3.Superstructure:
4. Substructure
S.Approach roads:
6. Bridge length:
7.Bridge widh:

Mangdichu River, Zhengang Dzongkhag
National lighway Route No. 4
Bailey Suspension
Masonry abutments on
Sealed macadam paved 4 m wide
97.4 m
3.20 m (carriageway)
8. Some wires of main cables were danaged. It is very dangerous.

## Other information

1. Completed in
2. Original load capacity: Present limited load capacity: 18 ton
3. Near bridge site a space for constuction materials and cquipment is available.

BRIDGE NO. 6 WANGDIGANG BRIDGE


## LOCATION MAI'

| Fxisting Conditions |  |
| :---: | :---: |
| I. .ocation: | Wangdigangciu River, Themgang Drongkhag |
| 2. Cass of roas: | National Ilighway Routc No. 4 |
| 3 Superstrecture: | Bailey DS |
| 4.Substacture: | Masonry abutnents on natural rocks |
| 5. Approach roads: | Sealed macadam paved 4 m wide |
| 6.13ridge length: | 30.5 m |
| 7.3ridge widh: | 3.35 m (carriageway) |

8. One pin on the end post is missing, and main frames were crushed and bent at 3 locations.

Other Information

1. Completed in 1969
2. Original load capacity: 15 ton

Present load capacity: 15 ton
3. Near bridge site a space for construction materials and equipment is available.


## LOCATION MAP

## BRIDGE SITE MAP

| Existing Conditions |  |
| :---: | :---: |
| I.Location: | Kartigangchu River, frongsa Drongkhag |
| 2.Class of road: | National llighway Roule No. 4 |
| 3. Superstructure: | Steel 1 girder with timber deek |
| 4.Substructure: | Masonry abutments |
| 5.Approach roads: | Scalcd macadam paved 4 m wide |
| 6. Bridge lenglh: | 9.0 m |
| 7.13ridge width: | 4.0 m (cariageway) |
| 8. Fomer Bailey b | was danaged by flood and f |

Existing steel girder with log deck is a temporary one.
Heavy trucks are crossing the river bed at upper stream Oiber Information

1. Completed in 1995
2. Originat load capacity: unktown

Present limited load capacity: 7 ton
3. Near briuge site a space for construction materials and cquipment is available

BRIDGE NO. 8 ISHIGANGCIIU BRIDGE


LOCATION MAP


BRIDGE SITE MAP

| Fristing Conditions |  |
| :---: | :---: |
| 1.Location: | Ishigangchu River, Trongsa |
|  | Dzongkhag |
| 2.Class of road: | National lighway Route No. 4 |
| 3. Supersfructure: | Bailey DS |
| 4. Subsructure: | Masonry abutments on natural rock |
| 5. Approach roads: | Scaled macadam paved 4 m wide |
| 6.3 ridge length: | 36.6 m |
| 7.13ridge width: | 3.34 m (carriageway) |
| 8 This is a temporary bridge. |  |

## Other Information

1. Completed in

1992
2. Original load capacity: 18 ton

Present limited load capacity: 15 ton
3. Near bridge site a space for construction materials and equipment is available.

BRIDGE NO. 9 IIESOTHANGKHA BRIDGE


BRIDGE SITE MAP

## LOCATION MAP

| Existing Conditions |  |
| :---: | :---: |
| 1.Location: | Hesothangkhachu River, Wangdu Dzongkhag |
| 2.Class of road: | National Ilighway Route No. 5 |
| 3. Supersiructure: | Bailey SS |
| 4. Substructure: | Masonry abutments on natural rock |
| 5. Approach roads: | Sealed macadam paved 4 m wide |
| 6.Bridge length: | 9.2 m |
| 7. Bridge widit: | 3.34 m (cartiageway) |
| 8. totally very good | condition |

## Other Information

1. Completed in
2. Original load capacity: 24 ton

Present limited load capacity: 18ton
3. Near bridge site a space for construction materials and equipment is available.



LOCATION MAP


BRIDGE SITE MAP

| Viviting Conditions |  |
| :---: | :---: |
| 1. Iocation: | Lawakhachu River, Wangdue |
|  | Droughtag |
| 2 class of road: | National Ilighway Rout No. 5 |
| 3.Superstructure: | Bailey DSR |
| 4 Substrscture: | Masonry abulments on natural rocks |
| S.Approach roads: | Scaled macadan paved 4 m wide |
| 6.3ridge longth: | 30.5 m |
| 7.13sidge width: | 3.37 m (carriageway) |
| 8.Deck timber is deteriorated. |  |

Other Information

1. Completed in 1988
2. Original load cagacity: 24 ton Presen limited load capacily: 18 ton
3. Near bridge site a space for constaction materials and equipment is available.

## BRIDGE NO. 11 BASOCLU BRLDCE



Scale 1:1,000

## LOCATION MA?

## BRIDGE SITE MAP

| Existing Conditions |  |
| :---: | :---: |
| 1.Location: | Basochu River, Wangiue Dwnothag |
| 2. Class of roas: | National Ifighway Route No. 5 |
| 3. Superstructure: | Bailey SSR |
| 4. Subsfructure: | Masonry abutments on natural reck |
| 5 Approach roads: | Sealed macadam paved 4 m wide |
| 6. Bridge longth: | 18.3 m |
| 7.13ridge widh: | 3.34 m (carriageway) |

Other Information

1. Completed in
2. Original load capacity: 18 ton Present limited load capacity: 15 ton
3. Near bridge site a space for construction materials and equipment is available.

BRIDGE NO. 12 RURICHU BRIDGE


LOCATION MAP
BRIDGE SITE MAP
$\left[\begin{array}{ll}\text { Wisting Conditions } & \text { Rurichu River, Wangdue } \\ \text { 1.Location: } & \text { Dzongkhag } \\ & \\ \text { 2. Class of road: } & \text { National Highway Route No. } 5 \\ \text { 3.Superstructure: } & \text { Bailey SS } \\ \text { 4. Substructure: } & \text { Masonry abutments on natural rock } \\ \text { S. Approach roads: } & \text { Sealed macadam paved } 4 \mathrm{~m} \text { wide } \\ \text { 6. Bridge length: } & 15.3 \mathrm{~m} \\ \text { 7. Bridge width: } & 3.34 \mathrm{~m} \text { (cariageway) } \\ \text { 8. Very good condition, except bearings. }\end{array}\right.$

| Other Information |  |  |
| :--- | :--- | :--- |
| 1. | Completed in | 1987 |
| 2. | Original load capacity: | 18 ton |
|  | Present load capacity: $\quad 18$ ton |  |
| 3. | Near bridge site a space for construction materials |  |
|  | and equipment is availablc. |  |

## BRIDGE NO. 13 BAYCHU BRIDGE




LOCATION MAP


Scale 1:1,000
BRIDGE SLTE MA?

| Fxisting Conditions  <br> 1.Location: Baychu River, Wangdue <br>  Drongkhag <br> 2. Class of road: National Hlighway Route No. 5 <br> 3. Superstructure: Bailey SS <br> 4. Substructure: Masonry abutments on natural rock <br> 5. Approach roads: Scaled macadam paved 4 m wide <br> 6. Bridge length: 15.3 m <br> 7. Bridge width: 3.34 m (carriageway) <br> 8. Very good condition  |
| :--- | :--- |

Other Information

1. Completed in 1985
2. Original load capacity: 18 ton Fresent limited load capacity: $\quad 17 \mathrm{ton}$
3. Near bridge site a space for construction materials and equipnent is available.

## BRIDGE NO. 14 KAMICIIU BRIDGE



LOCATION MAP

## BRIDGE SITE MAP

| Fxisting Conditions |  |
| :---: | :---: |
| I.docation: | Kamichu River, Wangdue |
|  | [ Mougkhag |
| 2.Class of road: | National llighway Route No. 5 |
| 3.Sugerstneture: | Bailey SS |
| 4.Substoucture: | Masonry abutments on natural rocks |
| 5 Approach roads: | Scaled nacadam paved 4 m wide |
| 6. Bridge length: | 18.3 m |
| 7.13 sidge width: | 3.34 m (carriageway) |

## Other Information

| 1. | Completed in | 1986 |
| :--- | :--- | :--- |
| 2. Origisal load capacity: | 24 ton |  |
|  | Present linited load copacity: | 15 ton |

3. Near bridge site a space for construction materials and equipment is available.



LOCATION MAP


BRIDGE SITE MAP

## Existing Conditions

1. Location: 2. Class of road:
3.Superstructure:
4.Substructure:
2. Approach roads:

6 Bridge length:
7. Bridge widh:
8. Very good condition

Narachu River, Daga Drongkhag National Ilighway Routc No. 5 Bailey DS
Masorry abutments on nalural rock Sealed macadam paved 4 m wide 30.5 m
3.31 m (carriageway)

## Other Information

| 1. | Completed in | 1991 |
| :--- | :--- | :--- |
| 2. | Original soad capacity: | 24 ton |
|  | Present load capacity: | 24 ton |

3. Near bridge site a space for construction materials and equipment is available.

## BRIIJGE NO. 16 WAKLEYTAR BRIDGE



## LOCATION MAP



BRIDGE SITE MAP

Wisting Conditions
I.focation:
2. Class of road
3.Superstructure:
4.Substructure:

5 Appread roads:
6. Bridge length:
7. Bridge width: $\quad 3.37 \mathrm{~m}$ (carriageway)
8. Members underside of superstructure is very rusty. The above photo shows one example of very rusty turn-buckles.

Sunkosh River, Tsirang Dzongkhag National Ilighway Route No. 5 Bailey Suspension
Masonry abotinents on natural rock Scaled macadam paved 4 m wide 73.2 m

37 m (carniageway)

Other lufornation

1. Completed in

## 1987

2 Original load capacity: 24 ton
Present limited load capacity: 12 ton
3. Near bridge site a space for construction materials and equipment is avaitable.

## BRIDGE NO. 17 MECHIKHOLA BRIDGE



LOCATION MAP


BRIDGE SITE MAP

## Existing Conditions

1.Location:
2. Class of road:
3. Superstructure:
4.Substructure:
5.Approach roads:
6.Bridge length:
7.Bridge width:
8. Very good condition. However in PWD's classification, this is a temporary bridge

## Other Information

1. Completed in

1990
2. Original load capacity: 18 ton Pesent limited load capacity: 8 ton
3. Near bridge site a space for construction materials and equipment is available.

BRIDGE NO. 18 BURICILU BRIDGE



LOCATION MAP


BRIDGE SITE MAP

```
Existing Conditions
    l.location:
    2.Class of road:
    3.Superstructure
    4.Substructure:
    5.Approach roads:
    6.Bridge length:
    7.3ridge width:
8. Very good condition
```

l.location:
2. Class of road:
3.Superstructure: 4 Substructure: 5 Approach roads: 6. Bridge length: 8. Very good condition

Burichu River, Tsirang Dzongkhag
National Highway Roule No. 5
Bailey DS
Masonty abutments on natural rocks
Sealed nacadam paved 4 ma wide
27.5 m
3.37 m (carriagcway)

Other Information

1. Completed in 1985
2. Original load capacity: 24 ton

Present limited load capacity: 18 ton
3. Near bridge site a space for construction materials and equipnent is available.

## BRIDGE NO. 19 CHANCIIY IRRIDGE



## BRIDGE SITE MAP

| Existing Conditions |  |
| :--- | :--- |
| 1.Location: | Chancheychu River, Tsirang |
|  | Dzongkhag |
| 2. Class of road: | National Highway Route No. 5 |
| 3. Superstructure: | Bailey TS |
| 4.Substructure: | Masonry abutments on natural rock |
| 5.Approaclı reads: | Scaled macadam pased 4 m wide |
| 6.Bridge length: | 39.7 m |
| 7.3 ridge width: | 3.31 m (carriageway) |
| 8.Very good cendition |  |

## Other Information

1. Completed in
2. Original load capacity: 24 ton Present limited load capacity: 18 ton
3. Near bridge site a space for construction materials and equipment is available.

BRIDGENO. 20 LORINGKHOLA BRIDGE


LOCATION MAP


BRIDGE SITE MAP

| Existing Conditions |  |
| :---: | :---: |
| 1.location: | 1 , oringhthola River, Sarpang Dzongkhag |
| 2. Class of road: | National Highway Route No. 5 |
| 3. Supersinucure: | Bailcy DDR |
| 4. Substructure: | Masonry abutments on matural rock |
| S.Approacin roads: | Sealed macadam paved 4 m wide |
| 6. Bridge length: | 48.8 m |
| 7.Bridge width: | 3.30 m (carriageway) |
| SEnviromment the br waterfall at the upp | dge site is very wel by the high er stramin side. |

## or

2. Class of road:
3. Supersincture:
S.Substruciure:
S.Approach roads:
6.Brige kons. 48.8 m
3.30 m (cartiageway)

Enviromment the bridge site is very wet by the high waterfall at the upper stream side.

## Other Information

1. Completed in

1992
2. Original load capacity: 24 ton Present limited load capacity: 18 ton
3. Near bridge site a space for consinuction materials and equipment is available.

## BRIDGE NO. 21 TANGMACHU BRIDGE



## LOCATION MAP



BRIDGE SITE MAP

| Existing Contitions |  |
| :---: | :---: |
| 1.Location: | Kurichu River, M huentse Drongkhag |
| 2. Class of read: | District Road Monga-Lhuentse |
| 3.Superstructure: | Bailcy Suspension |
| 4.Substructure: | Masonry abutments on natural rock |
| 5.Appreach seads: | Sealed macadam paved 4 m wide |
| 6 Bridge length: | 85.4 m |
| 7.Bridge width: | 3.30 m (carriageway) |

## Other Information

1. Completed in 1982
2. Original load capacity: 24 tom Present limited load capacity: 12 ton
3. Near bridge site a space for construction materials and equipment is availabic.

## BRIDGE NO. 22 SUNKOSH BRIDCE



LOCATION MAP


BRIDGE SITE MAP

| Existing Conditions |  |
| :---: | :---: |
| 1. iocation: | Sunkosh River, Daga Dzongkhag |
| 2. Class of road: | National Ilighway Route No. 5 |
| 3. Superstructure: | Bailcy Suspension |
| 4.Substacture: | Masonry abutments on natural rocks |
| S.Approach roads: | Sealed macadam paved 4 mm wide |
| 6.13idge length: | 85.4 m |
| 7.13ridge width: | 330 m (carriageway) |

Other Information

1. Completed in

1982
2. Original load capacity: 24 ton

Present limited load capacity: 12 ton
3. Near bridge site a space for construction materials and equipment is available.

