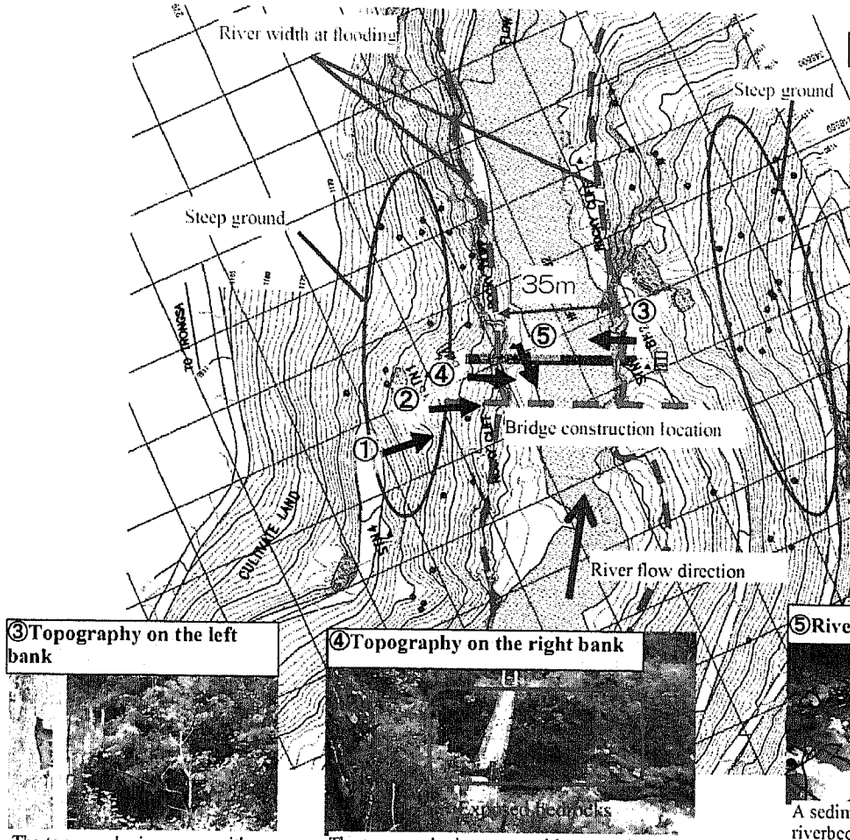
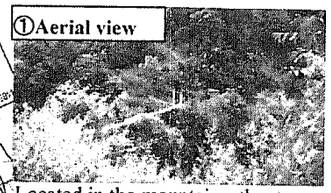
No.19 Kela Bridge




①Aerial view

Located in the mountains, the topography is steep and narrow.


②Existing bridge

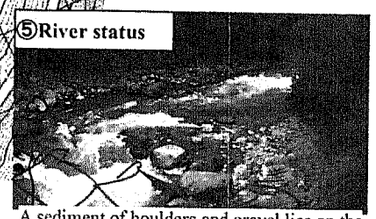
The existing bridge is a pedestrian suspension bridge.

③Topography on the left bank

The topography is narrow with exposed bedrocks.

④Topography on the right bank

The topography is narrow with exposed bedrocks.
A farm road has been constructed at the back.


⑤River status

A sediment of boulders and gravel lies on the riverbed.
The flow rate is relatively high.

(1) Outline of the site

1) Outline of the topography and the geology

The site is located on a steep topography in the mountains. A sediment of boulders and gravels lies on the riverbed. The slopes are very steep with exposed bedrocks. Both banks consist of bedrocks and the average N value exceeds 50.

2) Outline of the river

The flow rate of the river is relatively high, but judging from the flood mark, the existing bridge has a sufficient clearance. (The vertical clearance is 7m.)

(2) Setting the bridge route

The bridge should be constructed on the upstream of the existing bridge. It should not interfere with the existing bridge and should enable crossing the river at the shortest distance.

(3) Setting the bridge length and the span length

Since the river width is 35m and bridge piers cannot be installed in the river because of the need to ensure the standard span length to be 20m or longer, the new bridge should be comprised of a single span.

As described later, the superstructure will be a Bailey suspension bridge. Consequently, the span length should be determined by selecting the value applicable to this topography out of the catalog values. The bridge should be of 160FT type with the span length as 48m.

(4) Setting the types of the substructure and the foundation

As the skeleton height is around 3m (no more than 5m) and the material transportation needs to be minimized because the topography is very steep, the bridge abutment of the substructure should be gravity-type. Also, since the layer of which the average N value is 50 or greater is observed at less than 5m below the ground surface, the foundation should be a spread foundation.

(5) Setting the type of the superstructure

1) Basic conditions

- The superstructure should consist of a single span extending over the width of 48m.
- The bridge is built on a farm road.
- The superstructure is constructed by the Bhutanese side.

2) Setting the type of the superstructure

Considering 1) basic conditions, the superstructure should be a Bailey bridge of 160FT type.

(6) Setting of the road surface height

The road gradient of the Bailey bridge should be horizontal and it should be connected to the farm road on the right bank. Therefore, the road surface height should be 1146.000m.

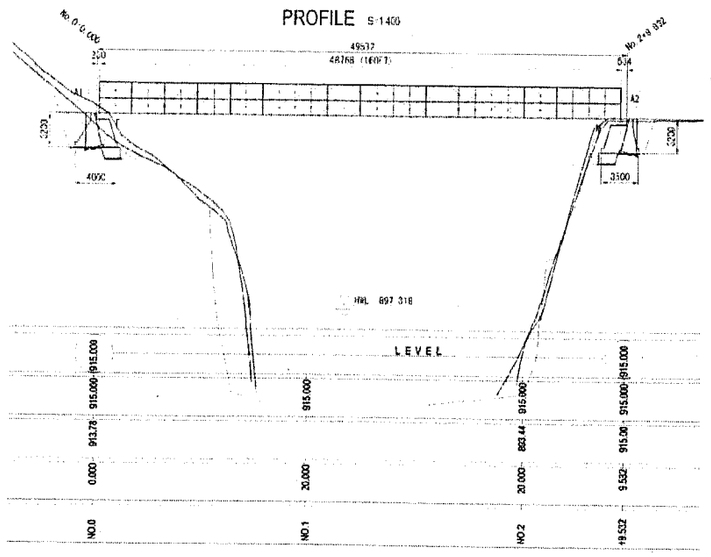
(7) Examining the margin of vertical clearance

As shown below, the vertical clearance ensures the necessary margin.

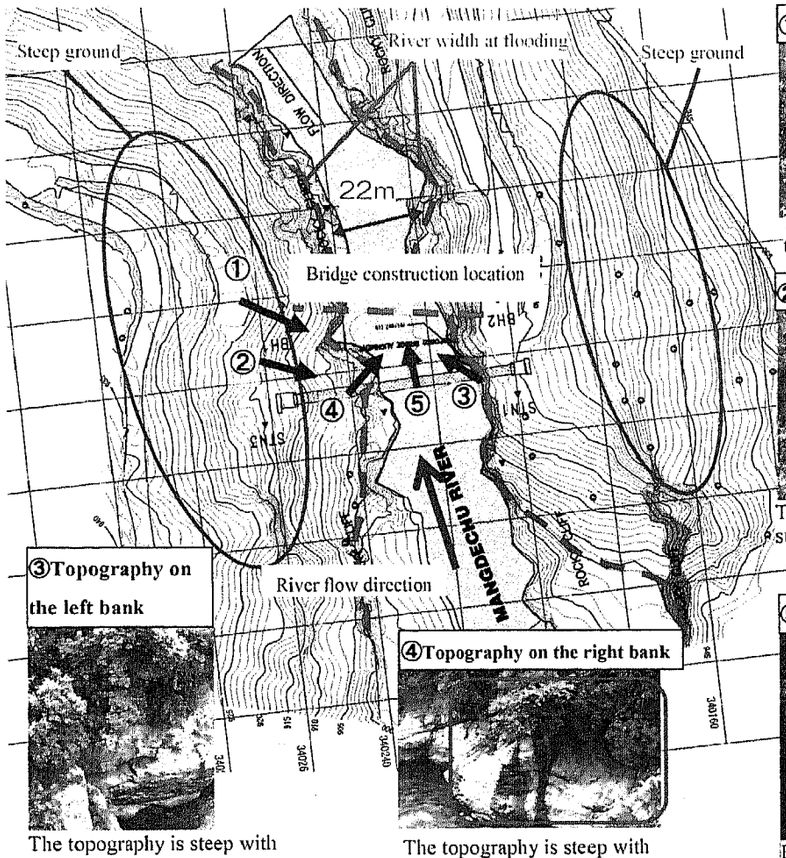
Vertical clearance 1145.525m

Margin of vertical clearance Vertical clearance 1145.525- HWL1137.232=8.293m>1.0m ∴OK

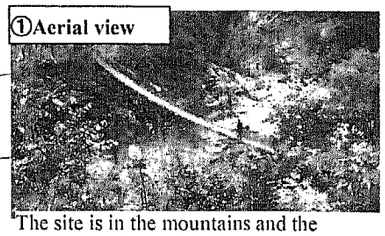
※limit value Margin of vertical clearance become1.0m. because of flood Inverse calculation 860 m^3/s . (Law of river structure)



No.20 Jangbi Bridge



①Aerial view



The site is in the mountains and the topography is steep and narrow.

②Existing bridge

The existing bridge is a pedestrian suspension bridge made of steel.

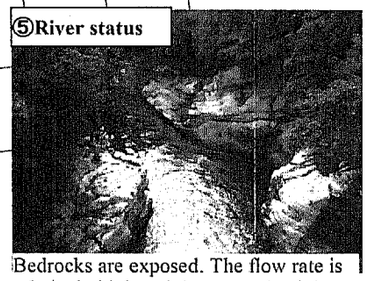
③Topography on the left bank

The topography is steep with exposed bedrocks.

④Topography on the right bank

The topography is steep with exposed bedrocks.

⑤River status



Bedrocks are exposed. The flow rate is relatively high and the water depth is large.

(1) Outline of the site

1) Outline of the topography and the geology

The site is located on a steep topography in the mountains. The slopes are very steep with exposed bedrocks. Both banks consist of bedrocks and the average N value exceeds 50.

2) Outline of the river

The flow rate of the river is relatively high, but judging from the flood mark, the existing bridge has a sufficient clearance. (The vertical clearance is 8.8m.)

(2) Setting the bridge route

The bridge should be constructed on the upstream of the existing bridge. It should not interfere with the existing bridge and should enable crossing the river at the shortest distance.

(3) Setting the bridge length and the span length

Since the river width is 22m and bridge piers cannot be installed in the river because of the need to ensure the standard span length to be 20m or longer, the new bridge should be comprised of a single span.

As described later, the superstructure will be a Bailey suspension bridge. Consequently, the span length should be determined by selecting the value applicable to this topography out of the catalog values. The bridge should be of 160FT type with the span length as 48m.

(4) Setting the types of the substructure and the foundation

As the skeleton height is around 3m (no more than 5m) and the material transportation needs to be minimized because the topography is very steep, the bridge abutment of the substructure should be gravity-type. Also, since the layer of which the average N value is 50 or greater is observed at less than 5m below the ground surface, the foundation should be a spread foundation.

(5) Setting the type of the superstructure

1) Basic conditions

- The superstructure should consist of a single span extending over the width of 48m.
- The bridge is built on a farm road.
- The superstructure is constructed by the Bhutanese side.

2) Setting the type of the superstructure

Considering 1) basic conditions, the superstructure should be a Bailey bridge of 160FT type.

(6) Setting of the road surface height

The road gradient of the Bailey bridge should be horizontal and it should be connected to the farm road on the right bank. Therefore, the road surface height should be 915.000m.

(7) Examining the margin of vertical clearance

As shown below, the vertical clearance ensures the necessary margin.

Vertical clearance 914.525m

Margin of vertical clearance Vertical clearance 914.525- HWL897.318=17.207m>1.0m ∴OK

※limit value Margin of vertical clearance become1.0m.7 because of flood Inverse calculation 709 m^3/s (Law of river structure)