3-2-2 Basic Plan

3-2-2-1 Applicable Standards

(1) Applicable Standards

i) Road Design

For road design, "Standards & Quality Control Authority, Specifications For Building & Road Work (2009), Ministry of Works & Human Settlement, Royal Government of Bhutan," "Technical Guidelines for the Construction of Farm Roads (May 2009), Department of Agriculture, Ministry of Agriculture, Royal Government of Bhutan," and "Technical Specifications & Standard Drawings for the Construction of Farm Roads (May 2009), Department of Agriculture, Ministry of Agriculture, Royal Government of Bhutan" should be used.

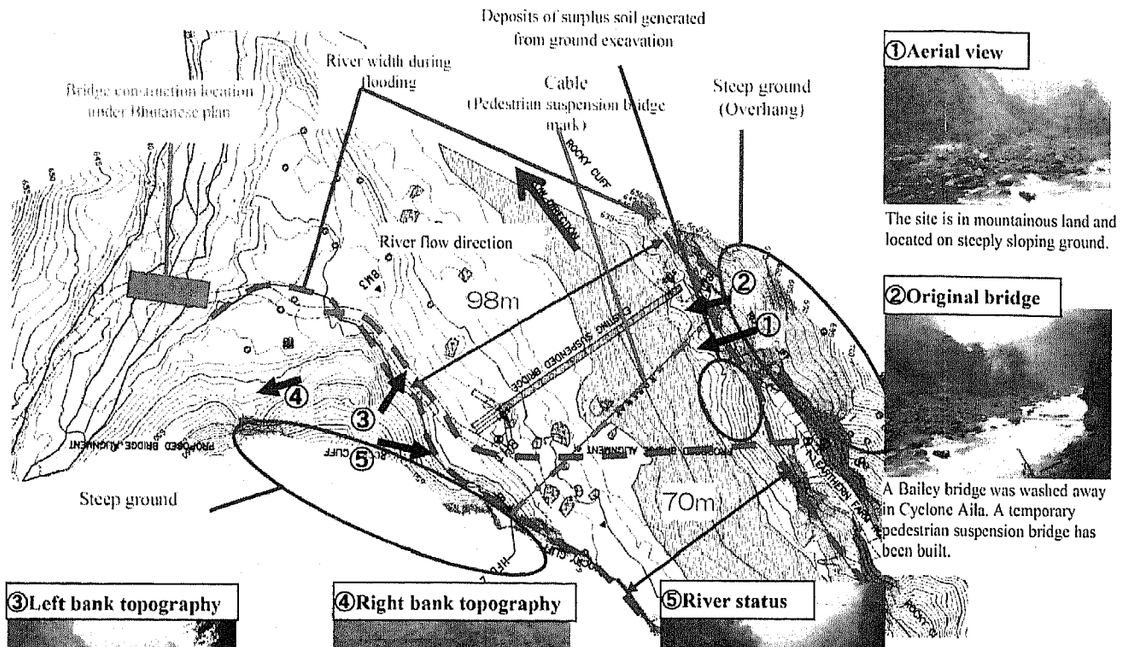
ii) Bridge Design

For bridge design, "Standard Specifications and Code of Practice for Road Bridges, The Indian Roads Congress (IRC standards)" should be used in principle. However, with respect to those items that are not clearly specified in these standards, such as the method of calculating the load-bearing capacity of members, provisions in the Japanese Specifications for Highway Bridges should be referred to.

3-2-2-2 Types of Bridges

The type of each bridge is given in the following pages.

No.9 Mangdechhu (Reotala)Bridge



①Aerial view

The site is in mountainous land and located on steeply sloping ground.

②Original bridge

A Bailey bridge was washed away in Cyclone Aila. A temporary pedestrian suspension bridge has been built.

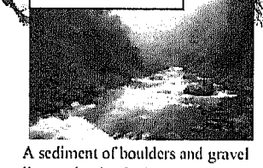
③Left bank topography

The ground is steep.

④Right bank topography

There are deposits of surplus soil generated from the construction of a forest road.
The ground is steep and partially overhanging.

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 steeply sloping ground in a mountainous area. A sediment of boulders and gravel lies on the riverbed. The slopes are very steep, with exposed bedrock. With the gravel deposits, the average N value of the riverbed is over 50.

2) Outline of the river

Judging from the flood marks, the river is 70-98m wide. The flow rate during flooding exceeds 10,000m^3/s.

(2) Determination of the bridge location

The bridge should be built at a location upstream of the original bridge so as not to interfere with the original bridge, which connects to the relatively wide section of the farm road on the right bank.

(3) Determination of the main tower spacing and selection of the span length

Since the superstructure and the pier of the original bridge were washed away in Cyclone Aila, it is highly probable that if the bridge pier were to be placed in the river, it would be struck by a similar disaster. Therefore, the new bridge should comprise a single span.

As described later, the superstructure will be a Bailey suspension bridge. Consequently, the main tower spacing and the span length should be selected out of the catalog values so as to be suited to the topography of the site.

Thus, the main tower spacing should be 103.7m and the span length should be 97.6m (320FT type).

(4) Determining the types of the substructure and the foundation work

Since the skeleton height is 10m, the bridge abutment of the substructure should be an inverted T-type abutment.

Also, since a layer with an average N value of 50 or higher has been confirmed less than 5m below ground surface, the foundation should be a spread foundation.

(5) Determining the type of the superstructure

1) Basic conditions

- The superstructure should consist of a single span extending over a length of 90m.
- The bridge will be built on the farm road.
- The superstructure is to be constructed by the Bhutanese side.

2) Determining of the superstructure type

Considering the basic conditions, the superstructure should be a Bailey suspension bridge of 320FT type.

(6) Determining the road surface height

The basic conditions are that the road surface of the Bailey suspension bridge should be horizontal, and that it should connect with the farm road on the right bank. Thus, the height of the road surface should be 651.0m.

(7) Examining the margin of vertical clearance

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

Vertical clearance 650.880m

Margin of vertical clearance Vertical clearance650.880- HWL643.876=7.004m>1.5m ∴OK

※limit value Margin of vertical clearance become1.5m. because of flood Inverse calculation9860 m^3/ s (Law of river structure)