

What is a Submersible Bridge?

Through Explanation of the Inquiry Sheet

Dr. NAKAO Tadahiko
Japan Infrastructure Partners (JIP)

The Ford where a school master was drowned dead

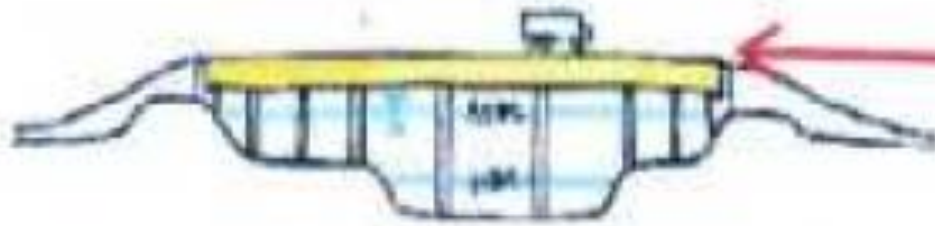


Natural riverbed without any provisions

Comparison of two types

Comparison of 2 types

Conventional bridge



Submersible bridge(SMB)



An actual Submersible Bridge: Yoma Bridge



- Now, students can quite safely cross the Itone Creek to school by the Yoma Bridge.

SMB may be closed a few times in a year.



- In case an large flood should occur, a SMB will be closed for a short time.
- If the bridge height is higher, the occurrence of closure will be fewer. However, the cost will also get higher.
- There is a sort of trade-off.

Initial Site Examination Form

- Proposed to JIP (Japan Infrastructure Partners)
- Prepared by: Name, Organization and Contact information.
- Date:
-

1. Location of the site

- (1) Named of State/Region, Township and Villages on the both bank
 - (2) Coordinates (latitude, longitude)
 - (3) Pinpoint on topographic map (if any topographic map is available)
 - (4) Aerial photo from Google Earth(R) with scale bar
- Official name until the completion of the bridge

JIP and other organization members can know the site from the maps using coordinates.
 - Usually topographic map is difficult to get in Myanmar, so this item may be skipped.
 - Google Earth® (pro) is very useful.

How to get Ordinates



Free applications for Smart phones have been provided.



Some cameras have GPS functions.

2. Characteristics of the Villages near the Bridge

- (1) Numbers of villages concerned, population of residents and students
 - (2) Numbers of four-wheeled and two-wheeled motor vehicles
 - (3) Schools (locations, numbers of students and teachers)
 - If populations of the villages are difficult to get, population of the township is good, but this should be noted on the paper.
 - Same as the population.
- Numbers of schools and students are important factor for the project to be taken up.

3. Present traffic of river crossing (Ford or Bridge if any bridge is existing)

- (1) Number of all Pedestrians including Students
 - (1 - 1) Number of students
- (2) Number of Motor-bikes, if any
- (3) Number of Four-wheeled vehicles, if any
- (4) Distance to the nearest detour of the crossing (km)
- Large number of pedestrians is to be appreciated.
- Especially, number of students is important.
- Rough number of motor-bikes is all right.
- Ox wagons are to be included in the four wheeled vehicles.
- If there is no bridges near the site, fill in the word “none”.

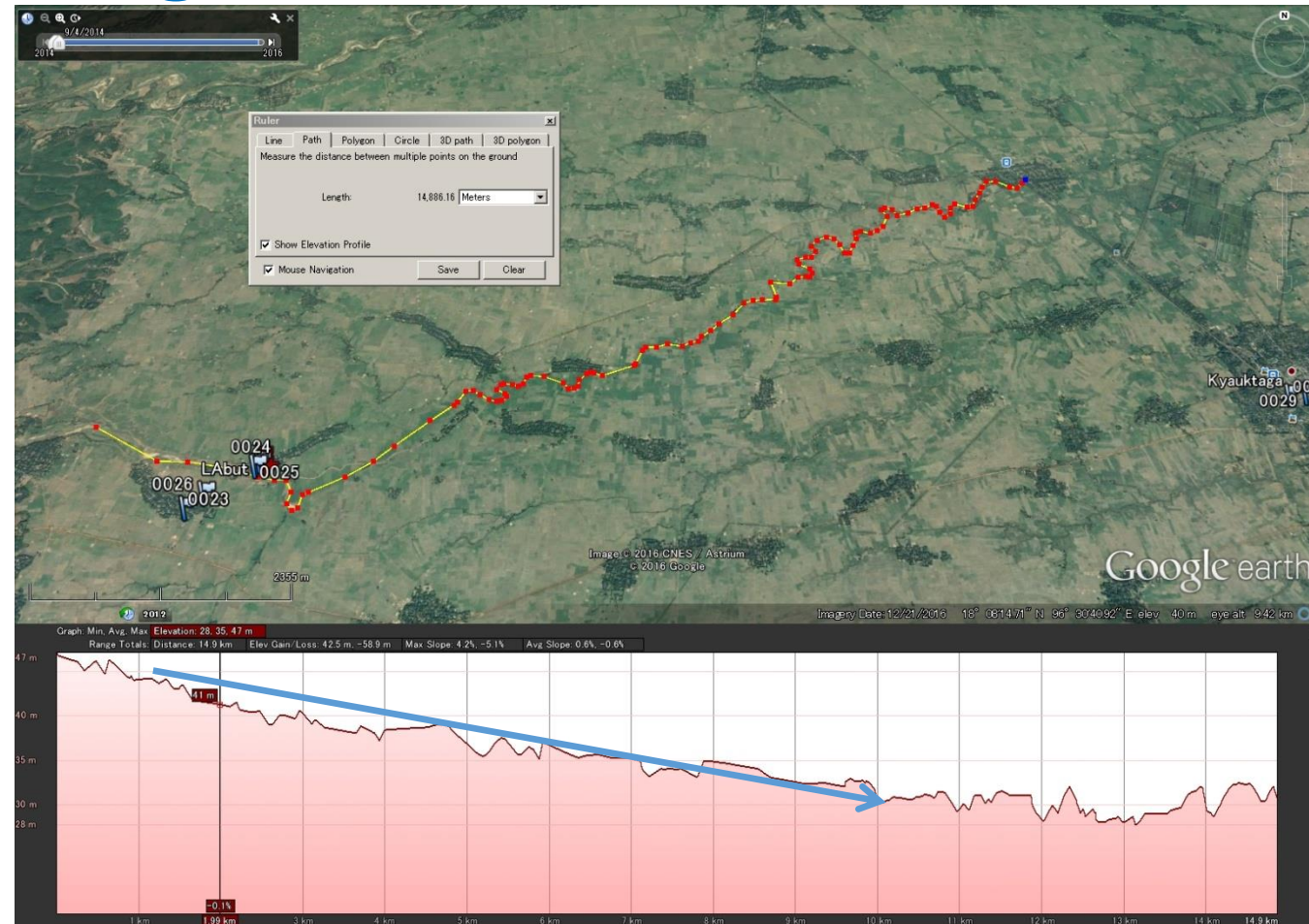
4. Hydraulic structure and data

- (1) Show the catchment area on a topographic map or Google Earth photo
- (2) Name of closest water gauge station, if any
- (3) Is the river channel Straight or Bended?
- (4) Stability of the channel, namely did the channel change the active flow course in these 10 years? When did the change take place, and how?
- When the catchment area is wide, duration period of the flood, hence high water level will be long.
- Water gauges are rarely set up in Myanmar. So write in “none”.
- It is clear from the Google Earth.
- Stability of the channel is judged from the Google Earth (Open “View” and check the “Historical imagery”).

Channel characteristics

- (5) Average streambed slope (%)
- (6) Water elevations based on river bed/river bank or any other benchmark
 - (6 - 1) Low water level (LWL)
 - (6 - 2) High water level (HWL)
 - (6 - 3) Abnormal high water level(AHWL)
- Average streambed slope is measured from Google Earth Pro (“Tools” – “Ruler” – “Path” and check “Show Elevation Profile). Refer to the next slide.
- Water elevations are very important to design a submersible bridge. Benchmark is best, or other object is also good, or river bed is all right.
- Residents near the site will give you these elevations, so ask them.

Measurement of the Channel gradient using a Google Earth function



Channel gradient in the Rational formula is calculated as $I = \text{height difference} / \text{length}$. ¹³

Water Elevations

- (6) Water elevations based on river bed/river bank or any other benchmark
 - (6 - 1) Low water level (LWL)
 - (6 - 2) High water level (HWL)
 - (6 - 3) Abnormal high water level(AHWL)
- Knowledge of local people is maybe necessary.

Channel Characteristics (continued)

- (7) Water level or depth and corresponding velocity, if any data is available
 - (7 - 1) Depth (m) and velocity (m/s) in dry seasons
 - (7 - 2) Depth (m) and velocity (m/s) in rainy seasons
 - (8) Width at the proposed location of the crossing
 - (8 - 1) Width from bank to bank (m)
 - (8 - 2) Width of active channel in recent rainy seasons
 - If there may be no velocity measurement, write in “none”.
 - Depth in “rainy seasons” means ordinary (not flood time” depth. Rough figures are all right.
- Widths can also be measured from the Google Earth (“Tools” – “Measure” – “Line”).

5. Foundation conditions

- (1) Characteristics of surface or local materials
- (2) Estimated depth to bedrock
- (3) Any special foundation conditions?
- Rough description is good.
- Later JIP may request relevant authority(s) to make a boring test.
- If you have met special problems related to the geology, please describe the issue.

6. Existing structures, if any,

- (1) Type of existing structure
 - Ford, Causeway, or Bridge
- (2) Size
 - Total length, Number and length of spans, Width, Height (from the riverbed)
 - Size of culverts, if any
- (3) Closing of traffic by floods
 - Frequency, and duration
 - Overtopping height (m) from the structure
- In most cases, the answer will be “none”.
- If local people builds some make-shift structure annually, this should be mentioned.
- Frequency and durations of traffic closure is important information.
- Overtopping height from the structures may be rough, or skipped.

7. Proposed SMB structure (by your opinion)

- (1) Locate it on the map or aerial photo
- (2) Total length of the bridge (m)
- (3) Numbers and length of the span
- (4) Width of carriageway and sidewalk
- (5) Design loading (ton)
- “You” means the writer(s) of this examination form him(her or them)self.
- You may describe your own opinion. Your opinion will be a good source of designing.

8. Protection measures against debris and scouring

- For the reach within 300 m upstream or downstream of the bridge
- (1) Describe instability of banks or scour
 - Deposition, Erosion
- (2) Characteristics of Flood debris
 - Amount and Contents (Tree trunk, Branch, Timber, Rock, etc.)
- Characteristics of the reach (section) may be perceived from (also!) the Google Earth.
- River engineers like Dr. Suzuki or others could make some suggestions.
- Flood debris may break (at least, parts of) the bridge, or clog the channel and causing severe damages through raising the flood height and/or scouring banks.

Large timber also at the Itone Creek Bridge Site



Bridge built by the local residents was broken partly by the floating timber.

Accumulation of Debris



Accumulation of debris will amplify the Lateral Force against Bridge Structures. Bridge slab should be rigidly fixed to the piers and to the foundation.

Timbers floated down by a Flood



Some Preventive Measures had been taken, still timbers were accumulated. Slab and piers should have enough strength to resist against the shock force of the floating timbers.
In case of JIP's submersible bridges, minimum of 50 cm is maintained.

Fast Degradation of the River Bed

(Tanzania)



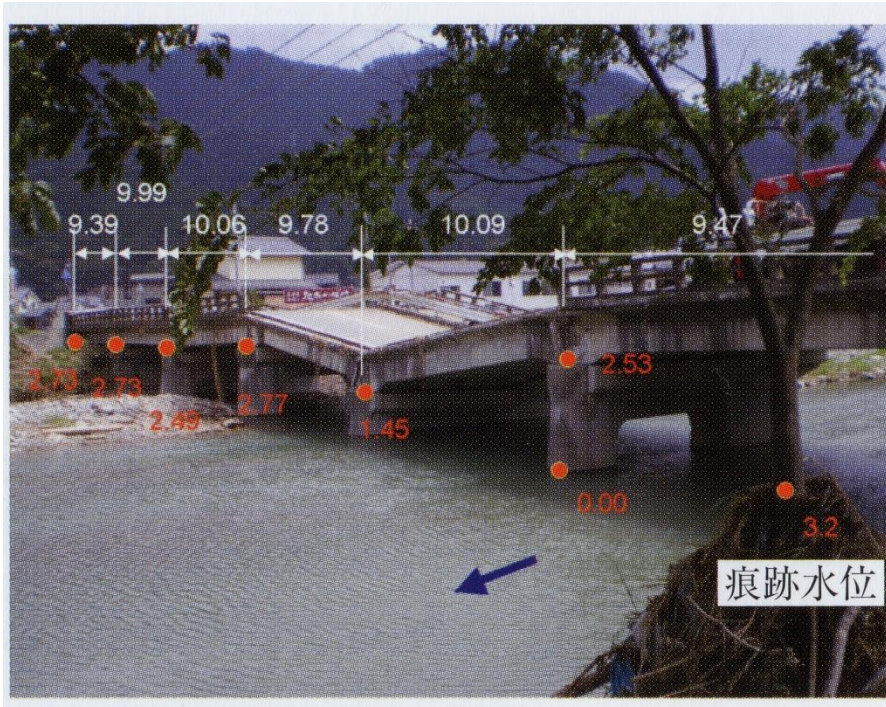
Though Investigation of the Historical Floods is advisable, it is often difficult.

Subsidence of Piers (Tanzania)



Scouring around Piers should be analyzed.
Piles should be placed down to enough depth.

Subsidence of a Pier (Japan)



After Flood



During Flood
Floating Timbers are also remarkable.

9. Attach drawings and Photographs

- Field sketch, Longitudinal profile and Cross sections of the river and the proposed bridge.
- Hand-writing is good for this prupose.
- Photographs are very powerful tool to persuade officials to take up the project.

JIP showed these photos to Japan
Government to get Money



Thank you for listening.

If you should have any question, please
access via e-mail.

nakao@dream.nifty.jp

