



Construction of suspensions pipe bridge

1. Appended document:

Suspension bridge dimensioning spreadsheet: The excel spreadsheet to dimension the bridge ([Suspension bridge dimensioning spreadsheet.xlsx](#))

2. Preliminary consideration:

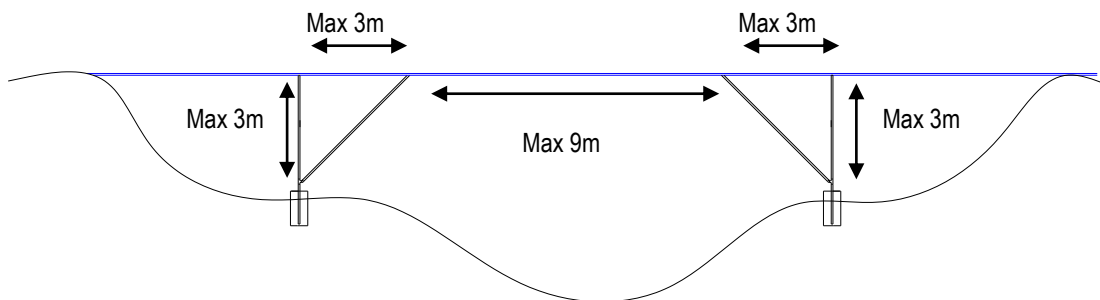
The pipe used for a suspension bridge must be GI pipe $\geq \frac{3}{4}$ "

The construction of a suspension bridge is costly (stainless steel cables), lengthy and very difficult for community to maintain. The alternatives must be explored before choosing this solution.

Standard pipe support: using a standard support (concrete, stone masonry or pipe) is always easier. Deep foundation can be made to account for unstable ground.

Span < 9m: Can be allowed for pipe > 1 ½", when using smaller diameter use a 2" sleeve.

Span < 15m: If the terrain allows, a 45° pipe support can reduce the pipe span. Use a tee, nipple and 45° elbow to create the support.



For this solution to be advantageous, the ground needs to slope downward before the gully. The piers foundation must be located on stable ground.

3. Construction:

1/ Construction of posts and anchors:

Step 1: Determine the diameter of the water pipe needed to be used in the bridge.

Step 2: Measure the distance between the two foreseen locations of the posts. These posts must be far (at least 3m) from any sign of erosion.

Step 3: Make all the calculation using the Excel spreadsheet.

Step 4: Prepare the 2 posts:

- Four 2" GI pipe of length given in the Excel spreadsheet "BoQ" (1.2m + H) as poles
- Two 19 to 25mm smooth steel bar of length 50cm (a digging stick or a spud bar can be used).
- Two 10cm long piece of 1 or 2" GI pipe.
- Two 10mm steel rebar of length 50cm.

Assemble and weld these pieces as specified in the drawings on the Excel sheet "Design":

- The 19 to 25mm smooth steel bar should be inserted through the GI pipe at 1m + H from the bottom of the poles.
- The 10cm piece of 1 or 2" pipe will be inserted (not welded) around the smooth steel rebar, between the 2 poles. It will help during cable tension and it will protect the cable as it will increase the bending radius.
- The 10mm steel rebar will be welded at 80cm from the bottom of the poles in order to maintain them.

Step 5: Cast the post and anchor (make sure these 4 structures are in line with the future pipeline).

Each post should be embedded 1m deep in a 1:2:3 mix concrete foundation of 70x50x100cm. Two 8mm steel bars should be placed to hold the future pipeline at each post.

The anchor (size and position are given in the Excel spreadsheet) are in 1:2:3 mix concrete with a 12mm rebar loop embedded in 2/3 of the concrete depth.

Cyclopean concrete can be used in these foundations to reduce cement consumption

Step 6: Let the concrete set during 1 week minimum.



2/ Pipe, main cable and loop cable setting:

Cable manipulation:

Unwind the cable in the winding direction, or use a base (drum) to roll out the cable.!



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Avoid working alone for cable manipulation and don't unwind the cable on the ground by overlapping loops.

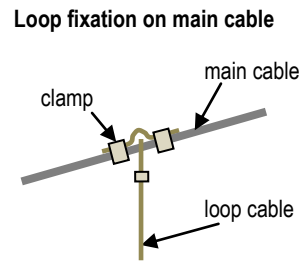
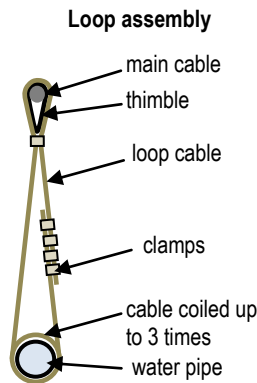
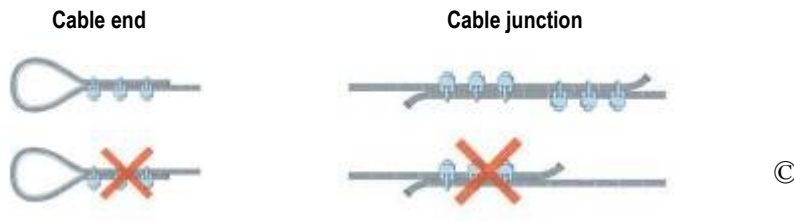
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Case A: The pipe can be installed and supported by local timber

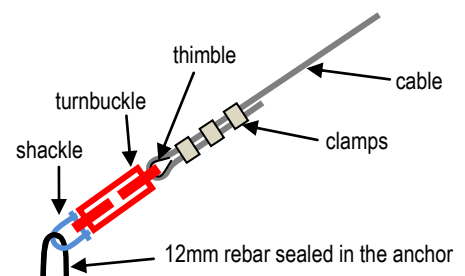
Step 7a: Install the GI pipe. The pipe must pass between the 2 posts and avoid the anchor. There must be 2 unions just after the posts toward the inside. The pipes must be supported by local timber in order to be horizontal.

Step 8a: Install the secondary cable loop (position and length given in the spreadsheet). The cable can be rolled up to three times around the pipe to avoid unwanted shifts. The other end should be placed around the main cable using thimbles. The two end of the cable must be attached using 2 or 3 clamps, depending of cable size.

Loop can be attached on the main cable by using 2 clamps on each side of the thimble with a short piece of cable. Always use the clamp with bolts on the main line (live end), not on the end part (see figures) and on both side for cable junction. This is to protect the live or stress-bearing end of the rope against crushing and abuse. The flat bearing seat and extended prongs of the clamp's body are designed to protect the rope and are always placed against the live end.



Step 9a: Install the main cable. Attach one end of the cable to one of the anchor using 2 or 3 clamps (depending of cable size) and shackles. Pull the cable with the cable puller until the pipe center of the pipe is 5cm above his horizontal position (while pulling makes sure all the secondary cable stay in place). Attach the other extremity of the cable to the second anchor using two clamps and one cable turnbuckle. Release the cable puller.



Step 10a: Cast concrete on top of the post foundation to fix the pipeline.

Cable fixation on anchor



Case B: The pipe cannot be installed before the bridge is built

The aim is to install the pipe and the cable on one bank (Bank A) of the gully and to pull the whole apparatus in place from the other bank (Bank B). The problem is that the pipe will follow the curve of the gully.

The number of pipe that should be pulled across the gully should be minimized. Only connect the pipes that will be out of reach.

The cable has to be at least 2 times longer than the bridge span. One span length will be attached to the pipe, on span length will cross the gully. The second length can be replaced with a very sturdy rope.



Step 7b: Connect all the pipes on one side of the gully.

Step 8b: Line the main cable along the pipeline.

Step 9b: Attach the secondary cable to the pipes every 2 or 3 meters. The cable can be rolled up to three times around the pipe to avoid unwanted shifts and attached with a clamp.

The other end should be attached with a clamp to the main cable. The position of the attachment on the main cable is given in the spreadsheet.

Step 10b: Attach the main cable to a turnbuckle (unscrewed) using a thimble blocked with 2 or 3 clamps and 2 shackles. This should be done on the side that will be connected to the Bank A pier.

On the pipe end that will be toward Bank B pier attach temporary rope shorter than the cable loop (eg 50 cm), in order for the pipe to "follow" the cable (see drawing below)

Step 11b: Get the other end of the cable across the gully; pull the cable with 5-6 people. When the pipes cross the gullies get people on each bank to support and guide the pipes.

When the turnbuckle is close to anchor A connect it.

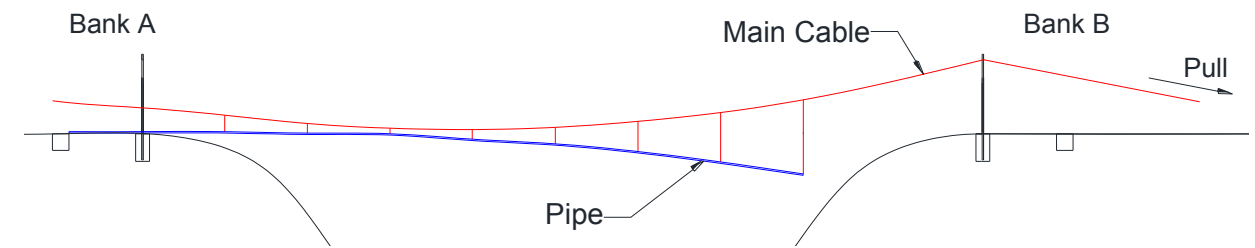
When the tension is too high for people to pull, use the cable puller.

Pull until the pipe is 5cm above the horizontal

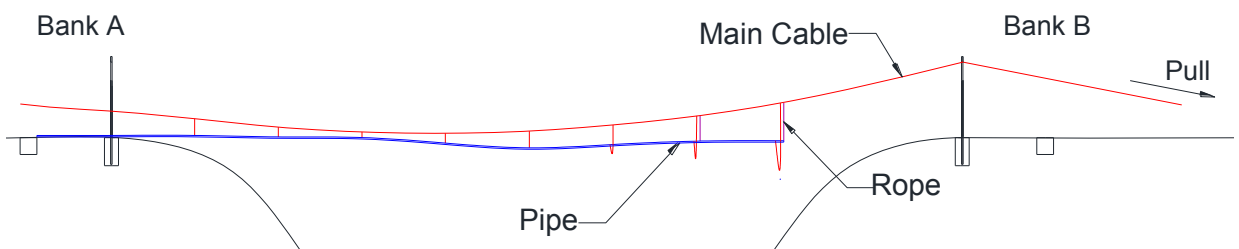
Step 12b: Attach the other extremity of the cable to the second anchor using 2 or 3 clamps and one thimble and one shackle if needed.

Release the cable puller

Step 13b: Cast concrete on top of the post foundation to fix the pipeline



As we pull, the pipe end will be stuck into bank B

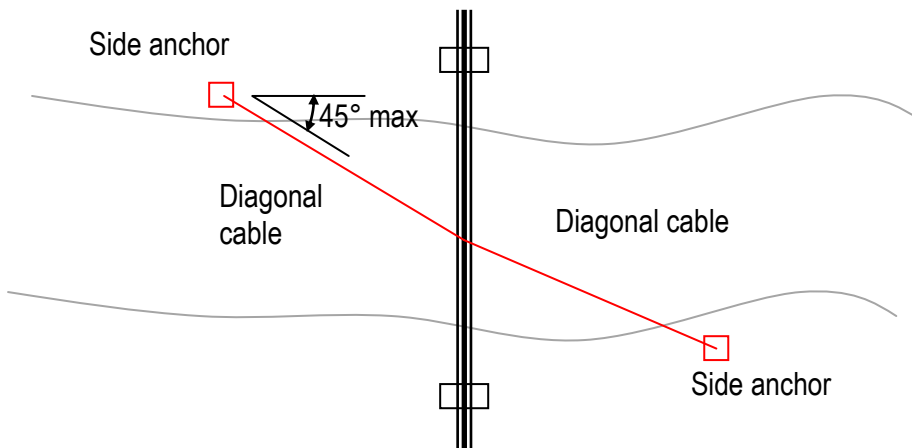


Using temporary rope we can better direct the pipe



72m long bridge with 1" pipe

When building long bridges exposed to the wind, it would be useful to add diagonal cable to prevent the bridge from moving. This wind-brace cable should be of the same diameter as the secondary cable for loops. Connected to the middle of the pipeline (mid-span or less, with a 45° angle maximum) and to 2 side anchors of 0.5m³ each.



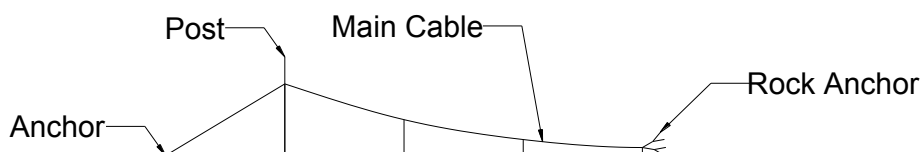
Special cases

Single pier bridge: when rock formation makes it impossible to install a pier. The cable can be anchored directly in the cliff face. Anchor the cable with 2 to 4 expansion bolt (depending on rock strength). Equalize the cable to distribute the force, the expansion bolts must be spaced less than 20cm, in order for the cable to form an acute angle and minimize forces.



Case 1: Anchor at the same height as the pier, this can be designed as a "normal" suspension bridge.







Case 2: Anchor a little above pipe level; in this case this point will be the lower point of the parabola formed by the cable. Do a normal dimensioning to get cables diameter and the dimensioning of the one pier. Then double the bridge span to get the secondary loop size.



Support at different level: The pipeline slope can be quite steep (< 30%) without impacting the bridge design. The design should be done as if it would be horizontal; the reality is just a rotation from the horizontal design.



Glossary:

French	English	Picture
Câble métallique	Steel wire rope	
Cosse coeur	Thimble	
Serre câble	Cable clamp	
Manille	Shackle	
Tendeur / Tendeur cloche	Turnbuckle	
Treuil à main / Tire fort	Cable puller / Hand winch	
Grenouille tire câble / Bloque câble	Cable grip / Cable puller tool	