

Pro Bhutan e.V.

philanthropischer Verein zur aktiven Entwicklungshilfe
im Himalaja Königreich Bhutan



Bhutanese Bazams or Wooden Cantilever Bridges (Text) and their Development (Drawing)



In Bhutan, with her unlimited number of rivers and gorges, all kind of bridges were built since times remembered. Bazams or wooden Cantilever Bridges were invented for situations where wooden single-span bridges were not sufficiently long to span a river. The limit for such bridges was about 10 meters.

The Bazams or wooden cantilever bridges have developed as follows:

Type 1:

one layer of wooden beams (between 2 and 7), no longer than 12 to 13 meters, from bank to bank; the ends of the beams lie on an abutment of a cross-beam placed on layers of stones; the main beams are supported by one or more additional layers of short beams cantilevering (protruding) below the main layer of beams from the abutment on either bank; counter-weight on top of the ends of the beams is not needed.

Type 2:

one layer of long wooden beams (between 5 and 8) protruding, at a light angle upwards, from both river banks towards the middle of the river. Here they are joint; this Bazam forms a flat single peak

arc. At each river bank, the ends of the beams lie on a strong abutment consisting of cross-beams placed on a heavy structure of stones (bridge head structure); in order to prevent the beams from capsizing into the river, a counter-weight, normally cross-beams and a pile of heavy stones are placed on the ends of the beams; this counter-weight has to be heavy enough to compensate the weight of the beams plus the loads by men and horses or yaks crossing the bridge.

Type 3:

for wider rivers, in addition to the 2 layers of beams protruding from both banks (up to 9) at a higher angle upward, a middle section (up to max. 11 meters) is placed on top or between the ends of the layers of beams; these 3 sections form a higher two-peaks arc.

This structure requires, as abutments, very solid bridge head structures on each bank, normally made of heavy natural stone masonry reinforced by timber on which the ends of the beams rest. Because of the much larger span and weight, the main layers of beams are supported by up to 5 layers of beams protruding from the abutment; the longest directly under the main

layers, then gradually being shorter, the lowest being the shortest. In order to prevent the beams capsizing into the river, heavy counter weights of big stones are loaded on cross-beams on the ends of the beams; they have to fight against the vertical forces downward and to stabilize the arc structure against falling sideward by horizontal forces like swaying or strong winds.

In some constructions, these counter-weight stones prevent men and horses etc. from entering the bridge in a straight line; thus the access to the bridge base is from the side, mostly over steps. As protection against rain and snow, this type of cantilever bridge frequently is covered by a roof, traditionally of wooden shingles.

Type 4:

is the most sophisticated one:

in principal like type 3, it has much more elaborate features like

- stone masonry bridge towers, roofed with wooden shingles above the abutments or bridge head structures
- instead of heaps of big stones, the towers serve as counter weights over the ends of the beams.

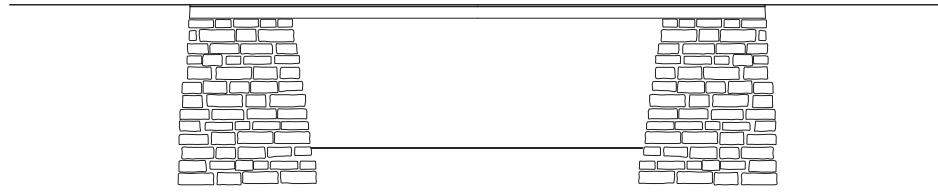
In addition to esthetical reasons they have 3 main functions:

- to allow access to the bridge in a straight line
- to control access to the bridge by installing heavy wooden gates which are locked at night.
- to have armed guards placed in a second floor above the entrances to the bridge.

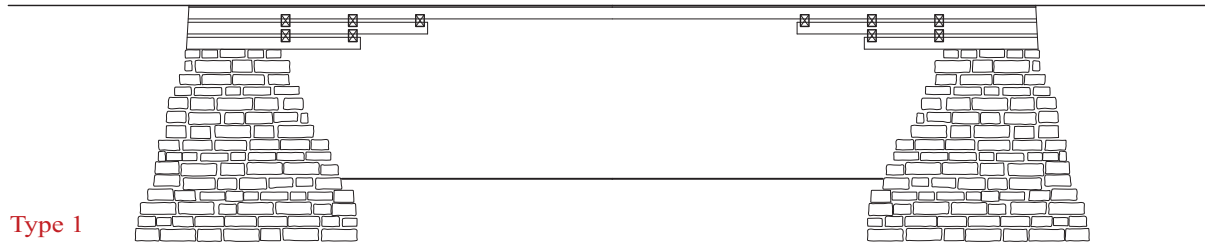
On top of the bridge towers and in the middle of the roof covering the bridge, often there are fixed “gyaltshen”, the Royal Umbrella, as symbol of Royal protection, in particular on Bazams leading to Dzongs.

The longest Bazam built in the past was the Wangdi Phodrang Bazam with a span of about 52 meters but without roof was built in 1684. It was washed away by flood in 1968. There are a number of Bazams still in use, like those in or near Thimphu, in Paro, near Cheri Monastery, near Trongsa Dzong. The longest Bazam ever built in Bhutan is the one to the Punkaha Dzong, spanning 56 meters, possibly the longest in the world, designed, planned, financed by “Pro Bhutan, Germany”, inaugurated 10. May 2008. It replaced the original Bazam, built around 1637 and destroyed 1958 by a flood.

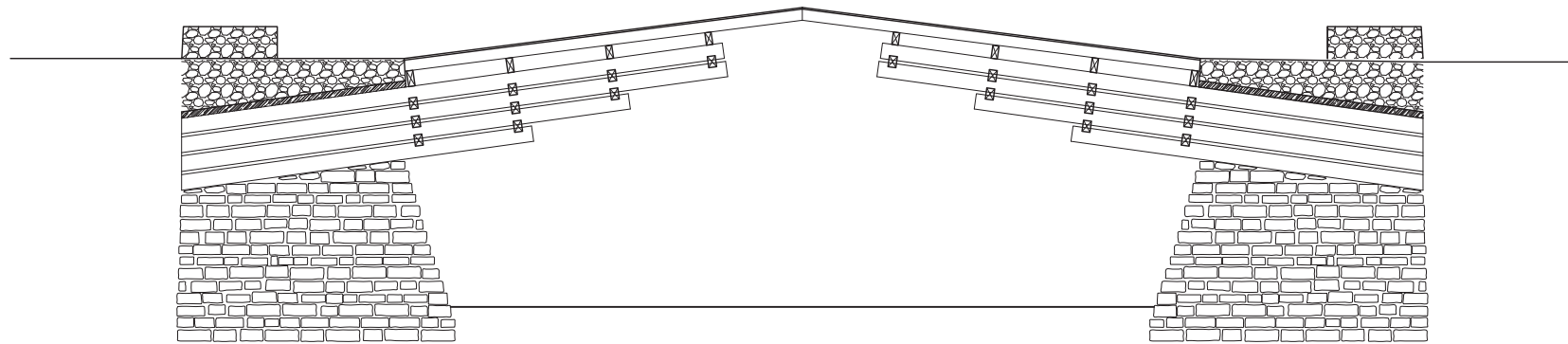
Development of Bhutanese Cantilever Bridges or Bazams



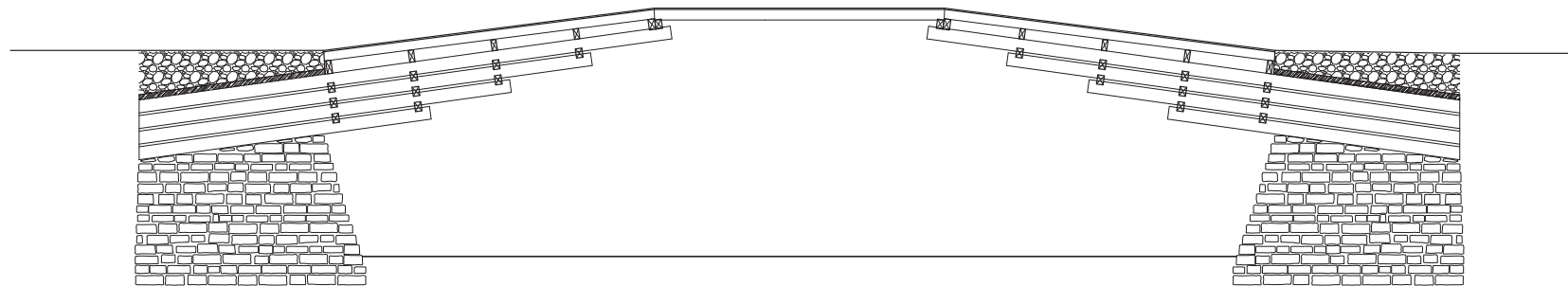
The single-span fore-runner



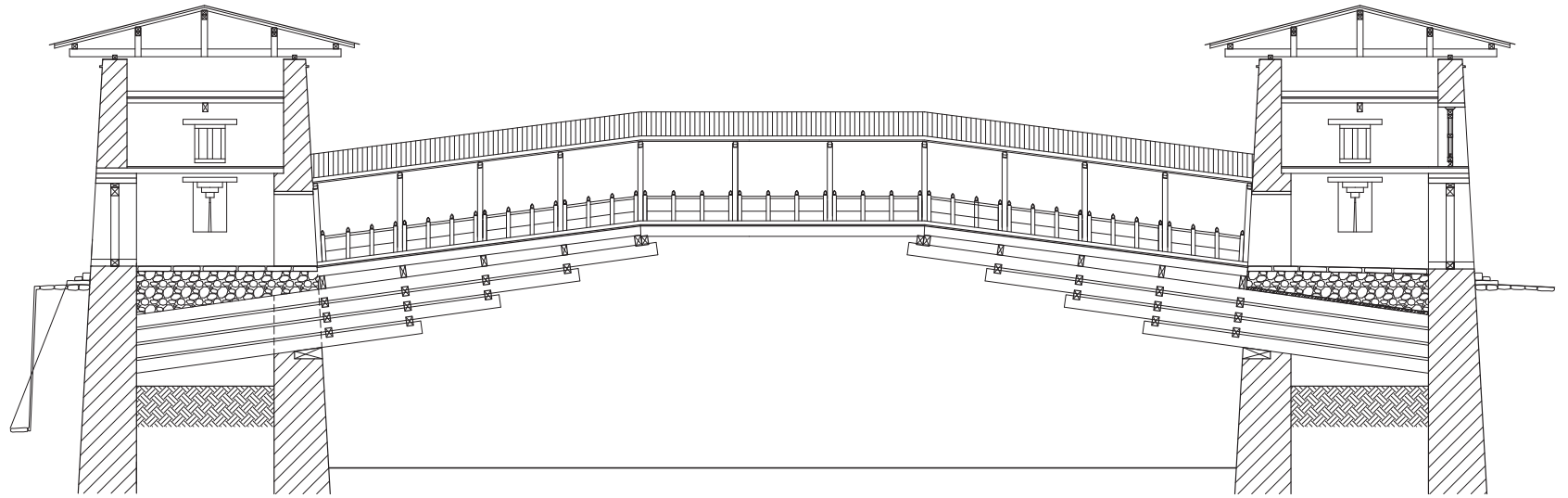
Type 1



Type 2



Type 3



Type 4