

The Punakha Dzong or Druk Pungthang Dechen Phodrang Dzong (Palace of Great Happiness)

Is the most important Dzong of Bhutan, built 1637-38 by Shabdrung Ngawang Namgyal, the founder of Bhutan as one nation. In a secret temple, embalmed, he lies in state and has been venerated as a living god until today.

He was born 1594 at Ralung, Tibet, descendant from the forefather of the Monastic Drukpa Lineage of Mahayana Buddhism. He was the legitimate abbot at Ralung Monastery, the traditional seat of the Drukpa Kagyu School. Ousted by a rival and facing arrest, 1616 he left Tibet for Bhutan. He followed a vision that Mahakala did send him to Bhutan to strengthen Buddhism there. Being a striking personality, he overcame the division of the warring rulers and soon was the supreme worldly and religious leader of Bhutan. To solidify the new power structure of Bhutan, he created a chain of 16 large Dzongs (monastery-castles) in the main valleys of Western Bhutan as the centres of religious and civil authority.

The Punakha Dzong is the second oldest and most majestic Dzong in Bhutan. It measures 180 metres (590 ft) in length with a width of 72 metres (236 ft)

and has three docheys (courtyards) and three utzes (temple towers).

Why did the Shabdrung choose this place for the Punakha Dzong where he lived and ruled until his death in 1651?

It is attributed to a prophesy by Guru Padmasambhava: at a place resembling the head of an elephant, the Shabdrung should build his stronghold. The mountain above the confluence of the two rivers Mo Chhu (mother river) and Po Chhu (father river) can be seen as the head, the narrow flat area between the two rivers as the trunk of the elephant on which the Dzong was built.

During winter, this Dzong is the Residence of His Holiness, the Je Khenpo, the Supreme Abbot of the Kingdom, with more than 500 monks.

All the Kings of Bhutan have been coronated here. The present King, H.M. Jigme Khesar Namgyel Wangchuck on November 1, 2008. Until 1955, the Punakha Dzong was the seat of the Government of Bhutan when it moved to Thimphu.

Dzongs in General

Until today, reflecting the "duality power", the worldly and the religious functions have been living in the Dzongs of Bhutan side by side under one roof: on one side, formerly the regional Prince or Penlop, nowadays the Dzongda or District Governor; in a separate part, the monastery with its many temples under a high ranking Abbot with his monks.

By tradition, Dzongs are constructed without the use of architectural plans. Instead construction proceeds under the direction of a high Lama who defines each dimension by means of spiritual inspiration.

The sites for Dzongs were chosen in regard to their function as defensive fortresses. Above some Dzongs, directly uphill, a ta-dzong or watchtower was built: its purpose was to keep the slope above clear of attackers who might otherwise shoot fire arrows onto the wooden shingle roofs and destroy the Dzong. Trongsa Dzong and Paro Dzong are examples. Some of the defensive features of Dzongs are the steep wooden draw stairways and heavy wooden doors, closed at night or against attack.

The heavy masonry curtain walls usually surround one or more courtyards. In the center of a courtyard

usually stands an utze, a tower with temples on various levels which can be used as an inner defensible citadel. utzes and other religious buildings, like all other structures, are whitewashed inside and out, but distinguished by a broad red ochre band at the outside top. The larger internal spaces of temples and halls have massive timber columns and beams, elaborately carved and painted. Some columns are covered by gilded copper sheets. The beams and columns create sometimes multistoried, galleries around an open central area.

The materials used in building a Dzong consist of compacted earth, stones and timber in floors, ceilings, doors and windows. The roofs are massively constructed in hardwood and bamboo, highly decorated at the eaves. Traditionally they are constructed without the use of nails. They are open at the eaves to provide a ventilated storage area. The roofs were traditionally finished with timber shingles weighted down with stones; but in almost all cases they have by now been replaced with corrugated iron. The courtyards are usually stone-flagged. All doors have high thresholds to discourage the entrance of spirits.

Bhutanese Bazams or Wooden Cantilever Bridges

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:

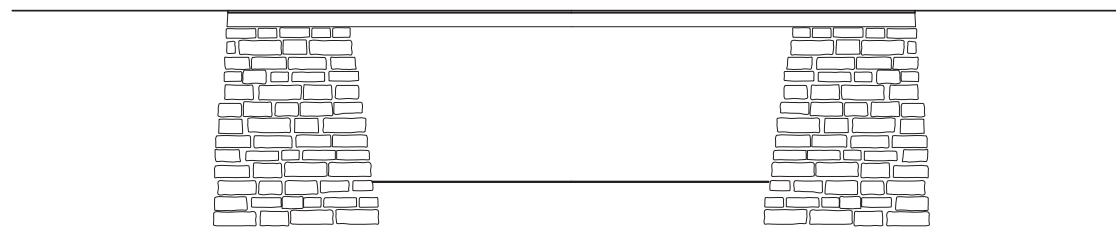
- stone masonry bridge towers, roofed with wooden shingles above the abutments or bridge head structures
- instead of heaps of big stones, the towers serve as counter weights over the ends of the beams.
- In addition to esthetical reasons they have 3 main functions:
 - to allow access to the bridge in a straight line.
 - 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.

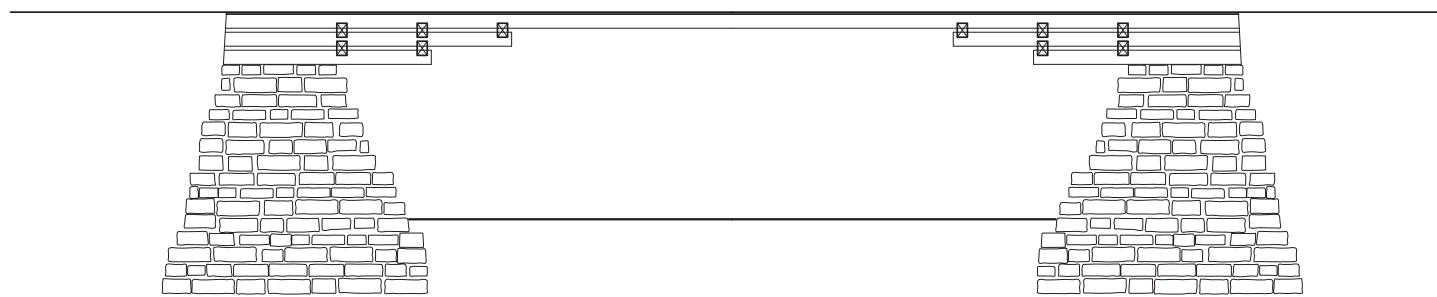
There are a number of Bazams still in use, like those in or near Thimphu, in Paro, near Cheri Monastery, near Trongsa Dzong. The longest Bazam ever built in Bhutan is the one to the Punkaha Dzong, spanning 56 meters, possible the longest in the world, designed, planned, financed by "Pro Bhutan, Germany", 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

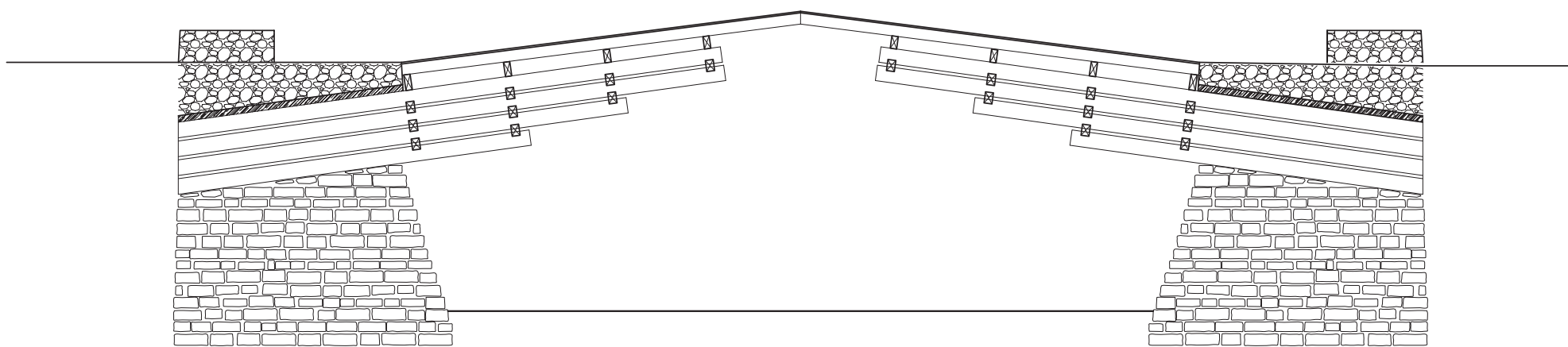


The single-span fore-runner

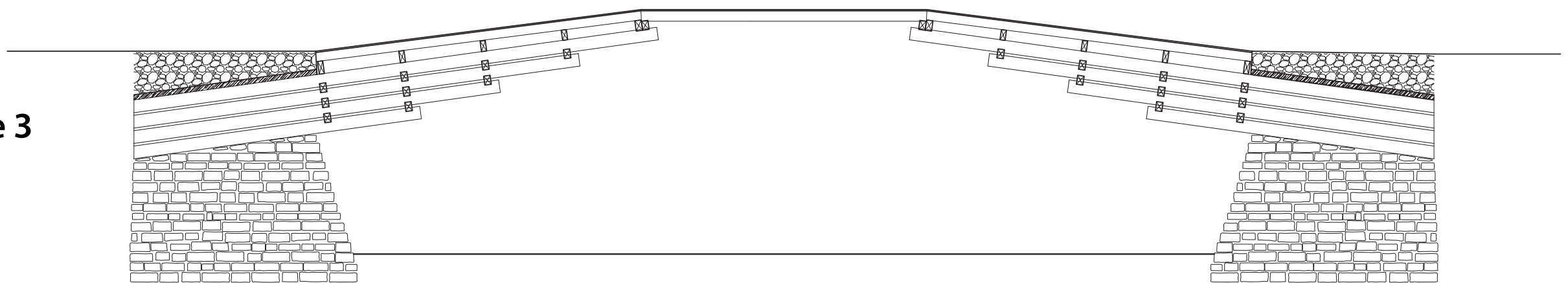
Type 1



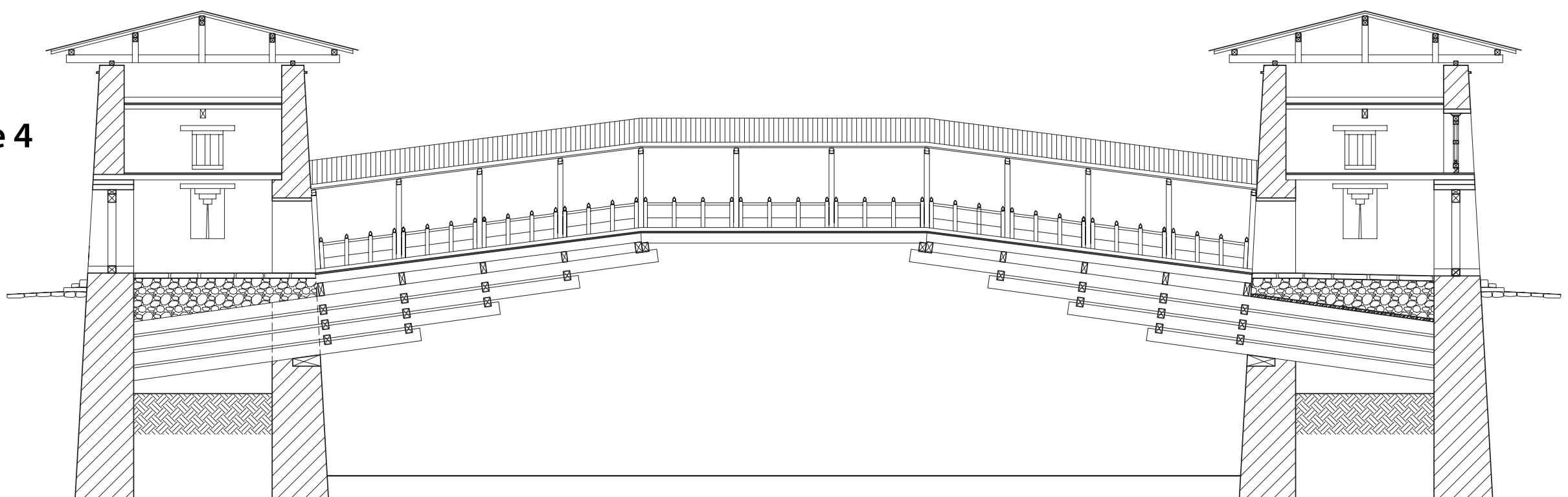
Type 2



Type 3



Type 4



The new Bazam of the Punakha Dzong and 'Pro-Bhutan, Germany'

The History

1958, a flood caused by a bursting glacier lake, high up in the Lunana mountains, destroyed the original Bazam which was built around 1637/38. The flood was reinforced by drift wood of thousands of uprooted trees. It disintegrated the bridge and the right bridge tower opposite the Dzong. The flood wave devoured thousands of tons of earth of the 10 meters high river bank where the tower had stood. The river was widened by more than 20 meters. The bridge tower at the Dzong side was spared.

To give access to the Dzong, a steel cable suspension bridge was built to reach the Dzong from Punakha village. This ungainly improvised solution lasted until 2007 when removed for the construction of the new "Pro Bhutan" Bazam.

In 2000, then Prime Minister Sangay Ngedup asked "Pro Bhutan" to plan, finance and rebuild the Bazam in traditional architecture. A great technical challenge: the new span had to be 56 meters instead of 35 meters of the original Bazam! It would be impossible to build such a long bridge, without intermediate support, by using traditional wooden cantilever technology.

The Planning

Carlo Galmarini of the engineering company Walt +Galmarini, Dipl. Bauingenieure ETH SIA USIC, Zurich, specialized, among other fields, in designing bridges, offered his generous help. His engineer Wolfram Kübler and "Pro Bhutan"-architect Fritz Baumgartner developed the solution: traditional image combined with most advanced bridge technology. The idea: invisible steel elements would be incorporated into the structure of the overlong Bazam. Only in this way, the high bridge arc could be stabilized and prevented from falling side wards due to horizontal forces caused by strong winds or swaying when a large number of persons would pass the bridge. The concept for the Punakha Bazam was developed in excellent cooperation between "Pro Bhutan" and the Ministry of Home and Cultural Affairs, then headed by Minister Jigmi Y. Thinley.

The Construction

For the construction, 165 beams were required. Suitable Chir Pine trees had to be found, among them 2 dozen trees of 40 meters. These exceedingly high trees were found only on steep and

inaccessible mountain slopes up to 30 km from Punakha. Experienced Bhutanese carpenters, with their simple tools, carved and joined the 4 massive gates of the two bridge towers, the hand railings, columns and lintels for the roof of the Bazam. All the work force was supervised by "Pro Bhutan" site engineer Padam Bahadur Chuwan.

Attention had to be given to special flood protection of the new tower. Dzong and Bazam are situated in the "red danger area" of GLOFs (Glacial Lake Outburst Floods). Professor Dr. Juerg Speerli of the University of Applied Sciences Rapperswil, Switzerland, designed the concept: 32 armed concrete pipes would form a semicircular barrier and support the platform on which the foundation of the tower is built. They were placed vertically into the river bed. Each pipe is 3.5 meters long and weighs 8 tons, and was cast at the site and filled with concrete and gravel. In addition, 700 "Toskanes" (double-T formed concrete blocks) each weighing 700 kg, were cast at the site and placed into the riverbed in front of the pipe barrier. Hundreds of natural boulders, each weighing 500 to 1000 kg, were piled on top of the "Toskanes", adding to the protection and hiding the ungainly concrete pipes and blocks.

The total costs of the Bazam were of 850.000,- €. They were covered by "Pro Bhutan" with private donations from Germany. This sum includes a contribution of 50.000,- € made by the German Embassy in India. The engineering company Walt +Galmarini and Professor Speerli generously contributed their enormously important work free of charge.

The Inauguration

On 10th of May 2008, the new Bazam was inaugurated by H.E. Jigmi Y. Thinley, now Prime Minister of Bhutan, and "Pro Bhutan, Germany" Chairman, German Ambassador Harald N. Nestroy.

The Prime Minister praised the bridge saying that for the last half a century, the holy Punakha Dzong, without the bridge, was like a human being having lost a limb. He emphasized that the new Bazam was a very substantial contribution to the celebrations of "100 years of Wangchuck Monarchy in 2008" and to the coronation of His Majesty King Jigme Khesar Namgyel Wangchuck in Punakha Dzong on 1. November 2008; and that the Bazam is a symbol of the deep friendship between the peoples of Bhutan and Germany.

Protection of Bridge Tower against Floods by Concret Pipes (red) and Toskanes (yellow)

