Bridges making a Difference

Interview

In 1987, an earthquake hit Ecuador. Images of the suffering caused to the local people were conveyed to the world via television news. These images greatly affected one 19-yearold Swiss in particular, Toni Rüttimann. On the night of his High School graduation, he left Switzerland for Ecuador, with only a few thousand dollars collected from the people in his home valley and a desire to help. Once in the disaster area, Toni Rüttimann saw at first hand the desperation in the faces of the people trapped by the loss of access routes. Desperation caused by the removal of access to hospitals, schools and markets and the overall restriction o f mobility. Here, he understood for the first time the suffering that could be relieved through the construction of a single bridge.

Now, 13 years later, Toni Rüttimann, 32, and his Ecuadorian partner Walter Yânez, 29, (Fig. 1) have constructed over 130 non-vehicle suspension bridges, the longest of them with a span of 264 m. The work of these two friends has already improved the daily life of over 400 000 people.

Fig. 1: Walter Yanéz and Toni «El Suizo» Rüttimann

In November 1998, Toni and Walter moved to Honduras, after hurricane Mitch had caused extensive damage, leaving many communities isolated. They have already constructed 30 bridges there (Fig. 2).

In June 1999, Toni Rüttimann gave captivating presentations of his experiences to large enthusiastic audiences at the Swiss Federal Institutes of Technology in Lausanne and Zurich, Switzerland. The following interview was conducted by Bryan Adey, Prof Marc Badoux, and Prof Eugen Brühwiler at the Swiss Federal Institute of Technology in Lausanne.

In 1987, when you arrived in Ecuador at the age of 19 you were unaware of how you could help. How did you decide to construct bridges?

My objective was to alleviate the suffering of the people I saw trapped by rivers. Fortunately I met up with a Dutch engineer, with whose help I transformed the donations from my home valley into my first bridge. Deeply impressed by the people's need and the importance of a simple bridge, I returned home and started my studies in civil engineering. Six weeks later, I quit. I could not stand the thought of studying for five long years, immersing myself deep into life in Switzerland and risking the loss of my desire to help those in need. With this desire still burning inside me, I headed back to Ecuador, without money, knowledge or tools, in order to build bridges. Luckily, I found oil-company managers to give me junked cable, engineers to give me knowledge, *campesinos* (poor farmers) to give me food and places to stay, and catholic

missionaries to pick me up when I struggled with malaria and skin diseases.

Why bridges, instead of hospitals or schools?

In Switzerland, we have no idea what it means not to have a bridge. We have never stood with our baby dying in our arms at a swollen river, knowing that there is no way to cross. We do not need to risk our lives to get our crops to the markets, or our sick to the hospital, or to risk our child's life to send them to school. When I saw these things, and the material discarded by the oil companies, I knew the answer.

The construction of a bridge is a challenging task. Normally, to build a bridge you require a technical education, money and construction workers. How did you acquire these three things?

I asked for advice from many engineers and oilfield experts: Dutch, Mexican, US American, Argentinean and Ecuadorian. They taught me simplified design and cable-tension formulae. They calculated the load-carrying capacities of the towers, foundations and anchor blocks as a function of the materials I was using. I invented the details for hanger elements, floor structure and hook-up, also considering the available materials, as well as the non-availability of money. For the erection procedure, I simplified heavy oilfield equipment-aided procedures into manually applicable ones. Over the years, my partner Walter Yanéz and I have further refined and simplified the design, prefabrication, transportation and erection procedure.

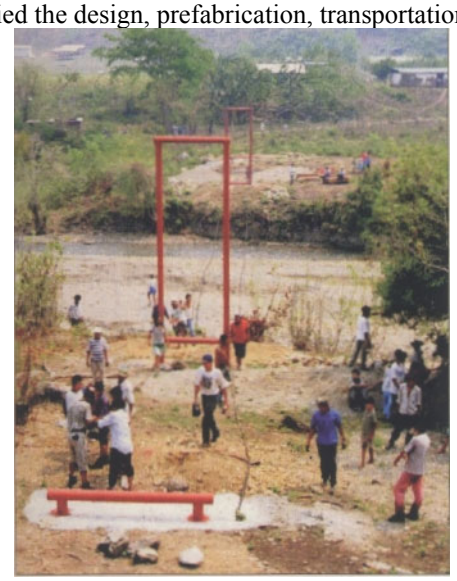

Fig. 2: The 51-m suspension bridge under construction over the Yuri river, Honduras

Today, a typical 50-m bridge costs approximately USD 500, which we receive from donations, mainly from my home valley in Switzerland. It is used mainly for transportation and a few specific items, such as welding rods, clamps and paint. Oil companies give us their used cables and steel pipe. The citizens of the communities provide the 80 sacks of cement, which represents another USD 500, and all the wood for the bridge deck.

The construction workers are the entire community. On our first day at a bridge site, we measure, calculate and define the bridge layout and mark the excavations to be made. During the next few days, the local people do all the excavating, the collecting of stone and sand, and the cutting and hauling of the wood for the bridge deck. On our second day, we position the towers and anchors and pour all the concrete. A week later, we return for the third day with the measured, marked and cut cables and set up the entire bridge: stringing the main cables, fastening the hangers to the main cables with the clamps, and assembling the bridge floor. To the people, this is a miracle unfolding before their eyes. But that is the beauty of it. The people build their own bridge. They solve their own problem. They create their own miracle.

Why did you choose suspension bridges over other bridge types?

I chose suspension bridges *(Fig. 3)* because of the spans required, the fact that no heavy materials are

needed, and because the raw materials can be found amongst the items discarded by oil companies.

Do you have different types of suspension bridges?

In general, we categorise our bridges into two classes: bridges for spans under 50 m and those for spans greater than 50 m. The former have fixed towers, the latter have hinged towers. The tower foundations and the anchorage systems for the two bridge types are also different.

Erection of the small bridges takes three days of our time on site. Erection of the large bridges takes at least five days of our time on site, following the same construction phases as for the smaller bridges.

What is involved in preparing the bridge foundations?

The bridge foundations are excavated by hand and made from *in situ* concrete with large aggregate. For bridge spans up to 50 m, the tower foundations typically measure 2.5 x 1 x 2 m', and the cable anchor blocks are 3.5 x I x 2 m'. For bridge spans greater than 50 m, the anchor blocks can be as large as 5 x 6 x 2 m'. The tower foundations are placed at sufficient distances from the river to adequately limit the risk of scouring.

What is the longest bridge you have ever constructed?

The fourth bridge I built had a span of 264 m *(Fig. 4)*. It was built over the Rio Aguarico, Ecuador. It took me two years to build, because in the beginning I had no money or equipment. It was built entirely with recovered material from 22 oil companies, and the labour of the 11 beneficiary communities.

How do you know that the bridges you construct are safe?

We oversize all the bridge components, so that the forces in each component are far from their maximum capacities as determined by professional engineers. In the main cables we usually have safety factors of approximately six, but our minimum acceptable safety factor is three. The anchors are designed considering only their mass, the earth pressure is neglected. The towers are loaded only vertically, with equal entry and exit angles of the main cables. Wind forces are controlled with wind-cable bracing systems on larger bridges.
Through these calculations, the track record of our bridges and our experience, we are confident that our bridges are safe. I would like, however, to verify the maximum load-carrying capacities and certain details of our bridges to determine the weak points.

How do you ensure that the maximum service load on your bridges is not exceeded?

By space. The maximum service load on the bridge is the one that will create a third of the maximum tensile force in the cables. I select the width of the bridge deck to ensure that this maximum service load is not exceeded: the longer the bridge span, the narrower the deck.

Have you had any accidents during construction?

We have never had anyone seriously hurt, thank God. None of our bridges are extremely high, and Walter and I do the more dangerous work ourselves. I have fallen once but escaped serious injury.

How do you determine the height of the bridge deck?

The height of the bridge deck is determined by asking the community the height of the highest water level that they have ever seen and then putting the deck well above that level.

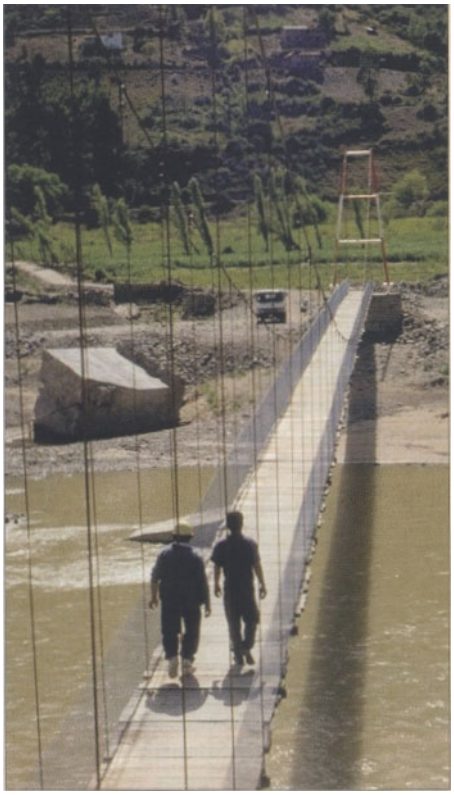

Fig. 3: The 100-m suspension bridge over the Rio Paute, Ecuador

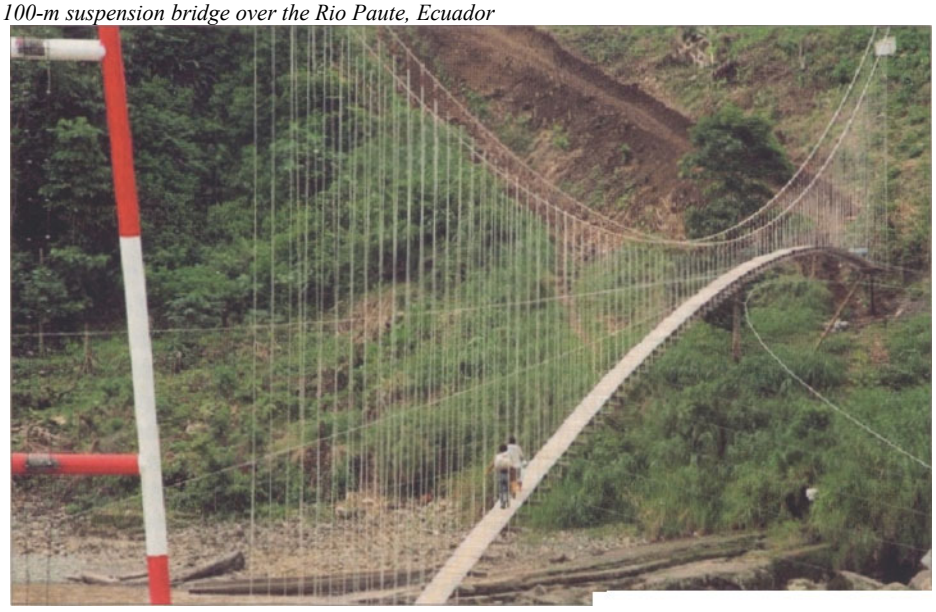

Fig. 4: The 264-m suspension bridge over the Rio Aguarico, Ecuador

Your bridges deteriorate due to corrosion of the metal structural components and rotting of wood. What is the life expectancy of your bridges?

We know, so far, that without maintenance our bridges will remain standing at least 12 years. If maintenance were performed regularly, such as replacing deck elements and painting the towers, the life expectancy of our bridges would be greatly increased. On about one third of the bridges, maintenance is not regularly performed by the communities.

Why is maintenance not regularly performed?

As humans, we often do not cherish what we have. The community unites to build a bridge because they really need one and the benefits from its construction are readily apparent. When maintenance is to be performed, however, an immediate gain is not seen and therefore many communities simply wait for their neighbours to do it.
It is not that the people do not know what to do. The people of the community have helped build the bridge with us and know what is to be done and how. In my opinion, if they do not love their bridge enough to do the little maintenance required then they do not really deserve the bridge's services for a long period of time.
Despite this lack of maintenance, a bridge that exists for 10 years is still a large improvement over no bridge at all. In fact we call our bridges PEN, "peor es nada" in Spanish or "better than nothing" in English. For official matters, we use the term Rescue Bridge.

What are the changes in the villages where you have built bridges?

There is an improvement in the quality of life of the local people. There is an increase in mobility. The rivers traversed by the bridges can now be crossed 24 hours a day, by a woman or child, alone, in the rain and during the night. The bridges have made it possible to bring crops to market year round, which has in turn increased commercial production. Children are going to school safely, and sick and wounded people are receiving timely medical attention. Most importantly, people realise that by making small individual sacrifices and working together toward a common greater goal that they can solve problems themselves.

There must be many villages that could benefit from a bridge. How do you choose the location of the bridges that you construct?

Basically the selection criteria is whether the people are willing to work for their bridge or not. We also take into consideration the number of families served, the degree of isolation, and technical elements such as span, topography, behaviour of the river, and accessibility of materials.
Rüttimann Rescue Bridge building is neither a technical problem, nor a financial problem, but a matter of commitment and trust. To build Rescue Bridges you must be able to transmit spirit to the communities, and honesty to the companies supplying the materials. As
soon as government contracts are involved, political interests and corruption may show up, and spirit shies away. Once the spirit is gone you need to pay for services, materials and workers, and it then takes millions of dollars to do what we do with thousands.

With regard to the future, what do you see personally and professionally?

Personally, I try not to think about the future. Bridge building is my life, and many bridges are needed for many poor people in this world. While I have good health and my dream to help people, I will continue. Professionally, with my loyal partner Walter, I am laying the groundwork to multiply the effect of our work.

Do you have a vision?

Rescue Bridges as a commodity. If a village needs a bridge and is willing to work for it and transport it, then they should be able to have it, without political, economic or religious barriers.

Do you have advice for people that would like to follow in your footsteps?

Never give up on your dreams. Try, every day, to make a difference in the lives of others and act accordingly. Get involved in this world, and contribute as much as possible.

Critical Comments

With all due respect for the work and devotion of Toni Rüttimann in his bridge-building efforts, consideration of his work raises professional and ethical questions. Toni Rüttimann has no engineering degree or professional training, but nevertheless builds pedestrian bridges with spans of up to 264 m. The interviewing team received a number of comments from the reviewers of the above article, and consequently asked themselves the following questions.

In terms of safety, are the actions of Toni Rüttimann irresponsible?

Toni Rüttimann's bridges are auxiliary bridges or, as he calls them, Rescue Bridges. They are built using simple design rules and construction guidelines that have been learned from and developed with professional engineers. In our discussions with Toni, he demonstrated that he is well aware of the risks associated with the construction of his bridges. The designs are conservative, and the bridges are built following a strict procedure to ensure the necessary quality and safety. The bridge designs would be accepted by most structural engineers.

What safety level is acceptable for Rescue Bridges?

In 1999, 29 Rescue Bridges were built, which directly and positively affect the lives of approximately 150000 people. The safety levels of these bridges are higher than those that the bridge users accept in other aspects of their daily life. In this situation, helping people in need is more relevant than passing judgement on the risk acceptance levels of more-developed countries. The people who benefit from these bridges are grateful for the improvement in their standard of living, and are capable of deciding the risk level they'are willing to accept.

Who is responsible if one of these bridges fail?

As with any structure the owner is responsible. In the case of Rescue Bridges, the owners are the communities who helped build them and benefit from them. Toni Rüttimann has helped these communities provide themselves with a temporary way to cross rivers. The responsibility for ensuring their continued functionality rests with the communities themselves.

Is it only in less-developed countries where bridges built by nonprofessionals are possible?

The success of the Rescue Bridge builders can be attributed partly to their extreme efficiency and "professionalism". These attributes allow them to react and intervene where help is needed much faster than many local government agencies or relief organisations. It is this ability to help people in need that counts.
Bridges built by non-professionals are also in use in many more-developed countries. In Switzerland, for example, footbridges built by non-professionals provide many recreational hikers with access across deep valleys in the Alps.

Does IABSE endorse bridge building by non-professionals?

One aspect of the role of IABSE and *Structural Engineering International* should be to report on unusual aspects of structural engineering. Building pedestrian suspension bridges from used material with the aid of untrained people, who are willing to help build a bridge because of their desire to have one, falls into this category. One specific objective of this interview is to show, especially to young engineers, that structures, in particular bridges, help people.

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