



THE GLOBAL ENGINEERING CONFERENCE ON SUSTAINABLE  
DEVELOPMENT AND WORLD FEDERATION OF ENGINEERING  
ORGANISATIONS EXECUTIVE COMMITTEE MEETINGS.

15<sup>th</sup> - 18<sup>th</sup> October 2024, Kigali, Rwanda

# Theme: Engineering Innovations for a Sustainable Future

@RwandaEngineers

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# RURAL ACCESS INFRASTRUCTURE FOR SUSTAINABLE COMMUNITIES

## Eng. Rwunguko J.D'Amour B2P

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# More than **1 IN 7** rural residents

struggle to reach  
markets, jobs, schools,  
clinics, hospitals and  
government services  
because of a lack of  
connectivity.



# SAFE ACCESS IS A HUMAN RIGHT



*We work with governments and isolated communities to create access to basics of life by building Innovative rural access infrastructure over impassable rivers.*

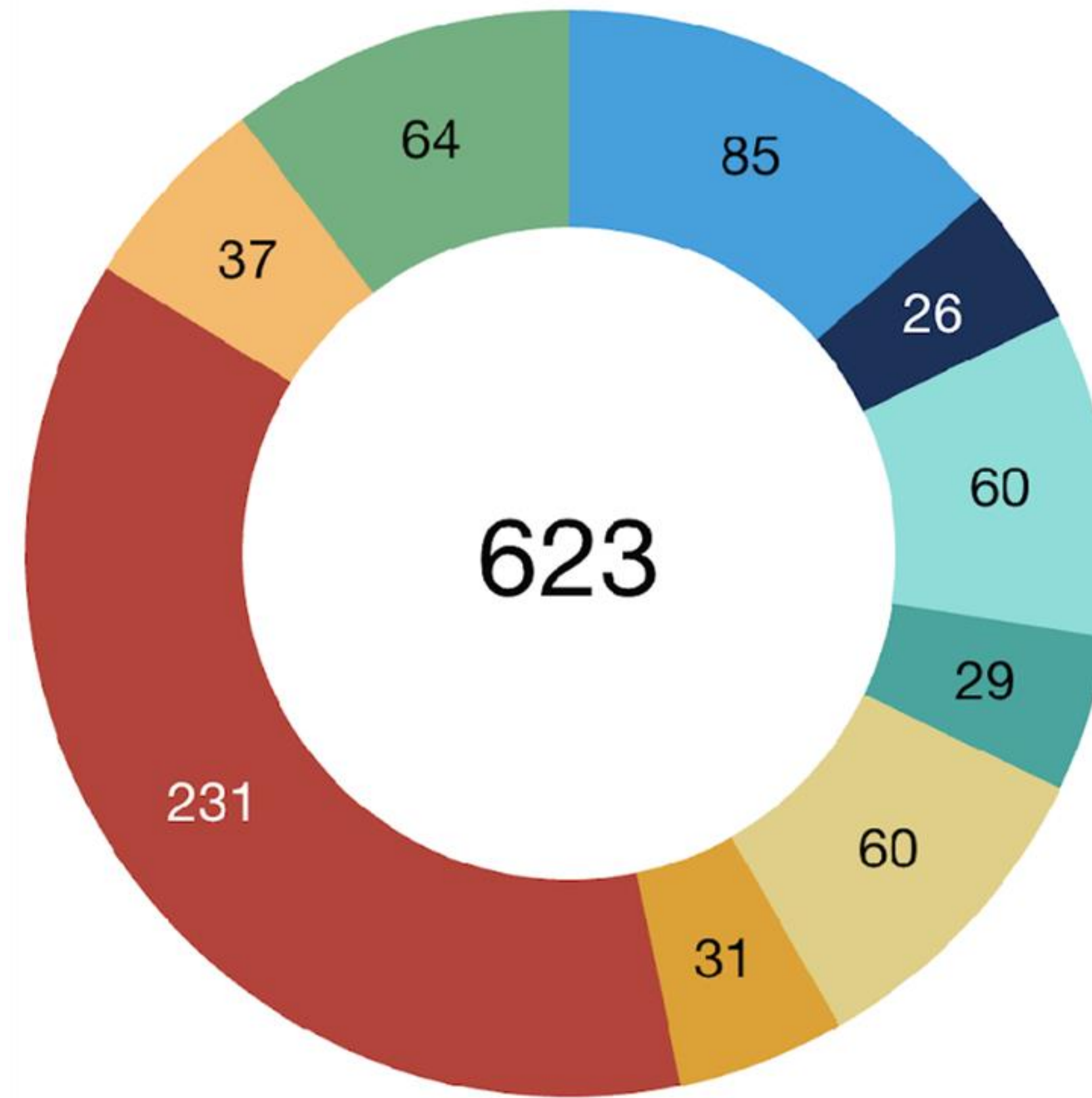
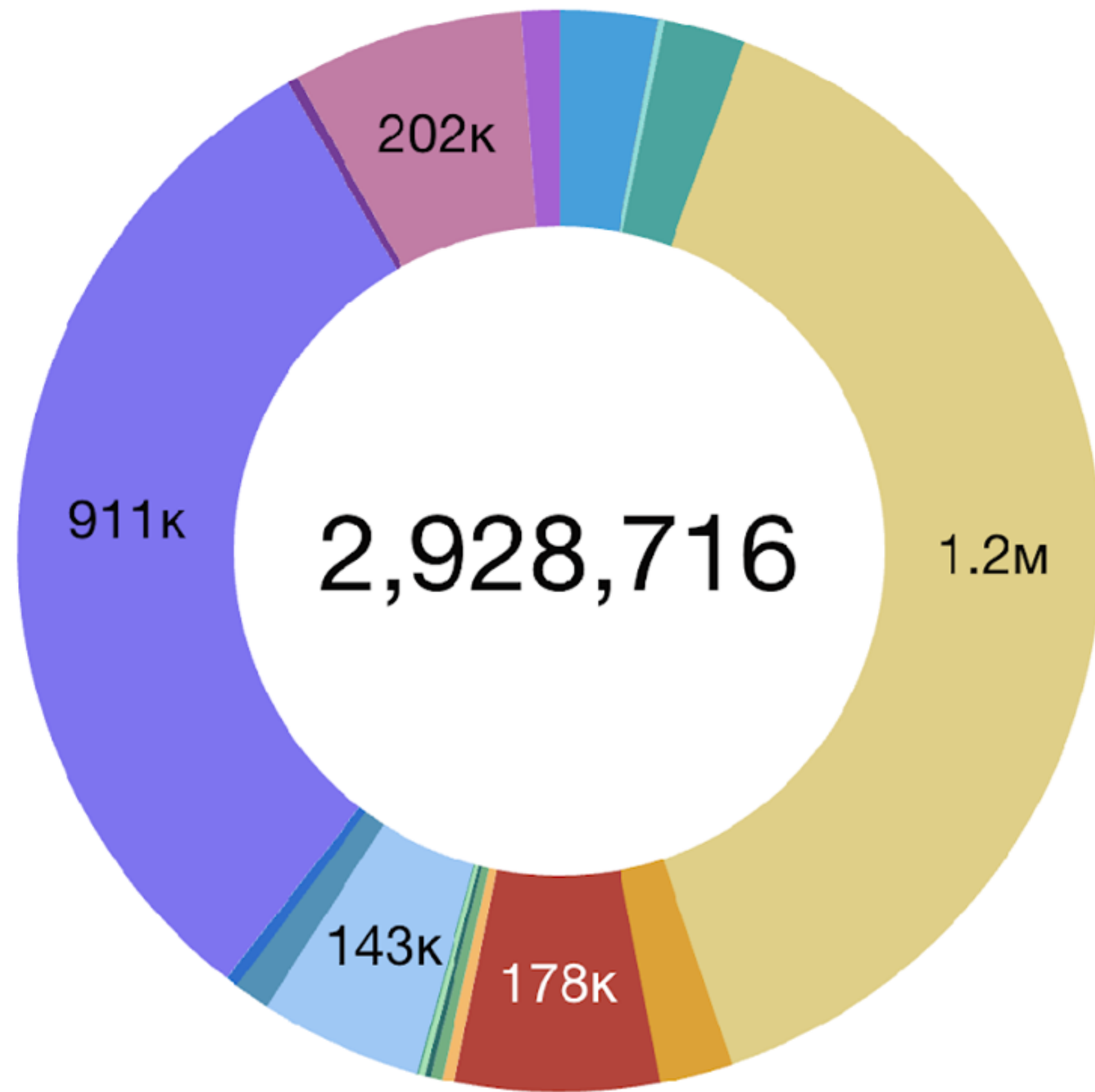
*B2P envisions a world without poverty caused by rural isolation, because we believe that:*

***“Rural isolation is the root cause of perpetual poverty”.***



# TRACK RECORD OF WORK

*21 countries in 23 Years*



- Bolivia
- Eswatini
- Ethiopia
- Guatemala
- Nicaragua
- Other
- Panama
- Rwanda
- Uganda

# ACCESS SOLUTION

## Trail Bridge (TB)

Trail bridges (Pedestrians \$ Trails) are a scalable intervention that addresses a myriad of symptoms of poverty in a sustainable way:

- Cost-effect, durable, and safe
- Easy to build, maintain, and replicate
- \_Rarely considered in the investments, despite a high ROI\_49%
- Leverage locally sourced materials and repurposed materials and create jobs to communities.

**Suspended, Suspension & Hybrid**



**Suspension type TB**



**Suspended type TB**

# Suspended Bridge

<https://b2p.europedigital.arup.com/>

## Layout

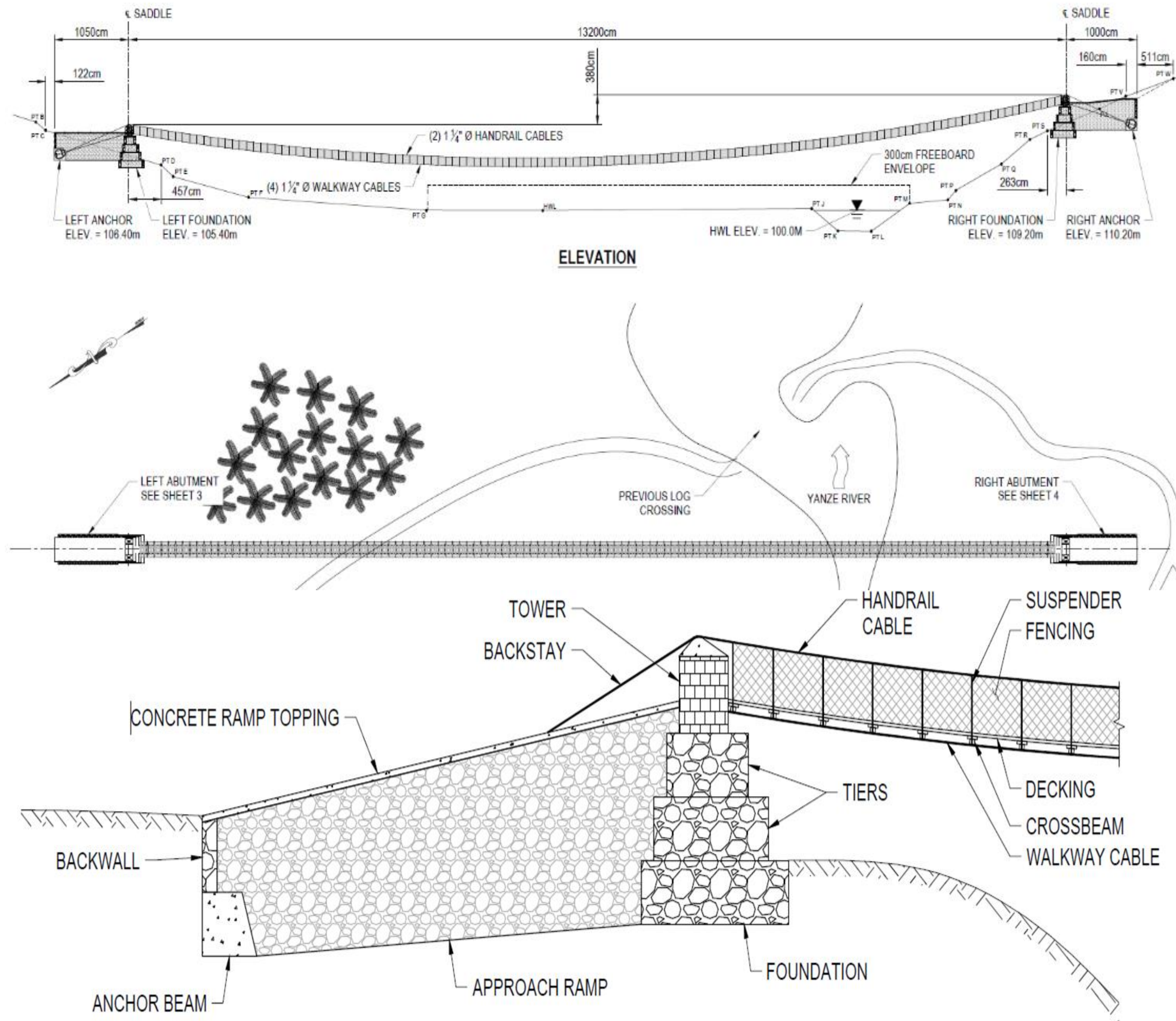
“When side banks are high enough to accommodate a hammock-like hanging walkway profile”

## Engineering aspect

The front foundation system composed by different tiers topped by concrete towers which act like a saddle for the handrail cables.

In the back, all the main cables loop around a concrete anchor connected to the foundation through 2 masonry walls, filled with rocks and topped with a concrete slab.

The walkway system hangs from steel wire rope cables, with transversal crossbeams and longitudinal steel decking panels, finished with a diamond mesh lateral fence.



# Suspension Bridge

<https://b2p.europedigital.arup.com/>

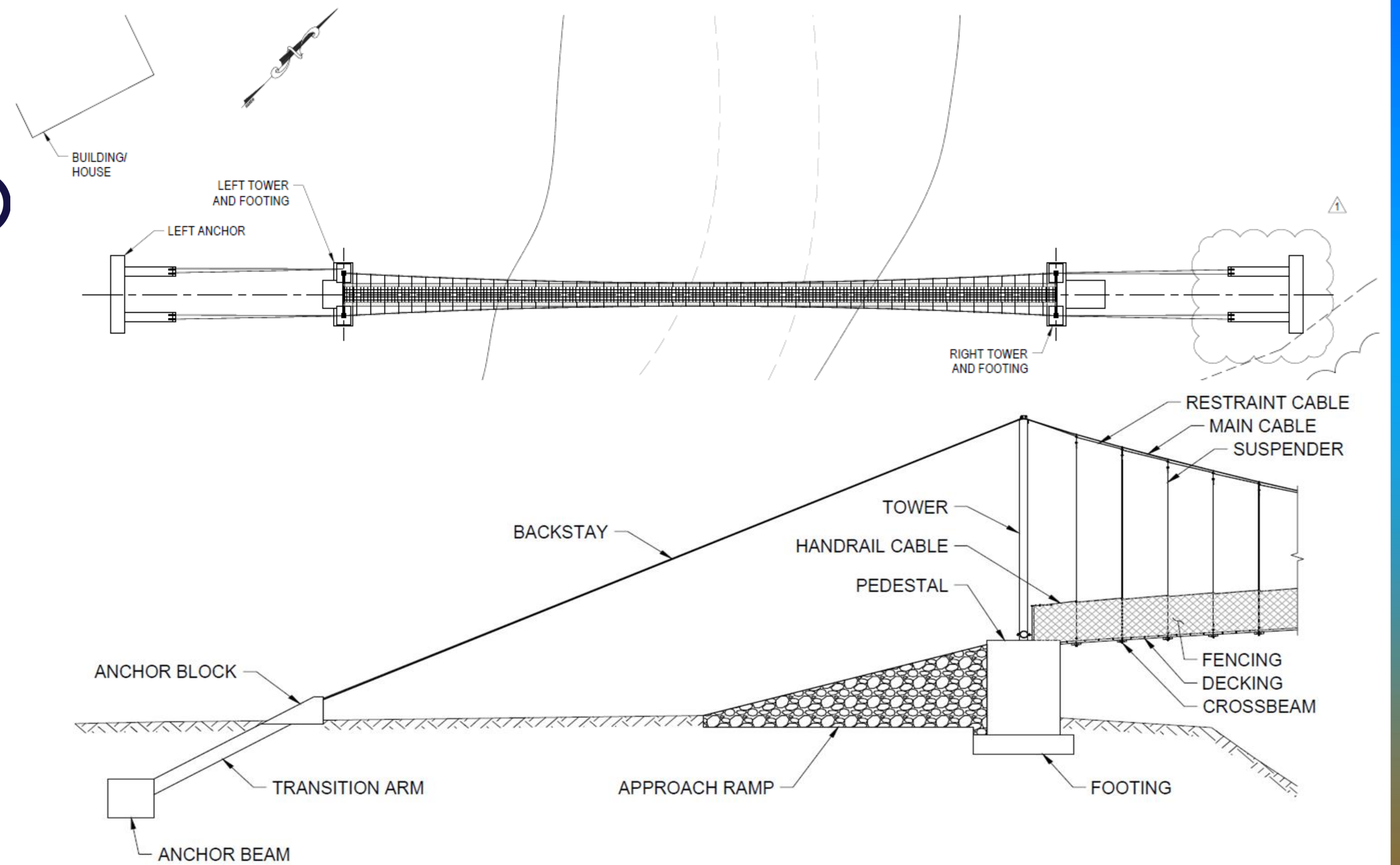
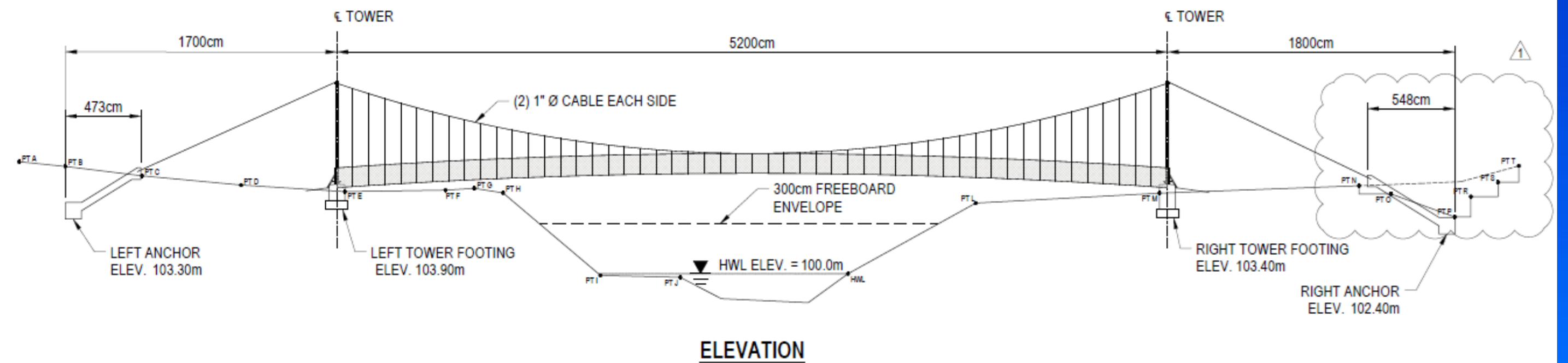
## Layout

Typically, in floodplains, the difference in height between the banks and the riverbed is not enough to permit the hanging walkway profile of a suspended bridge,

## Engineering Aspect

The tall steel towers are laying on two pedestals and a concrete footing, while the cables are connected in the back to a concrete anchor system with an underground beam with two arms providing the connection points for the cables.

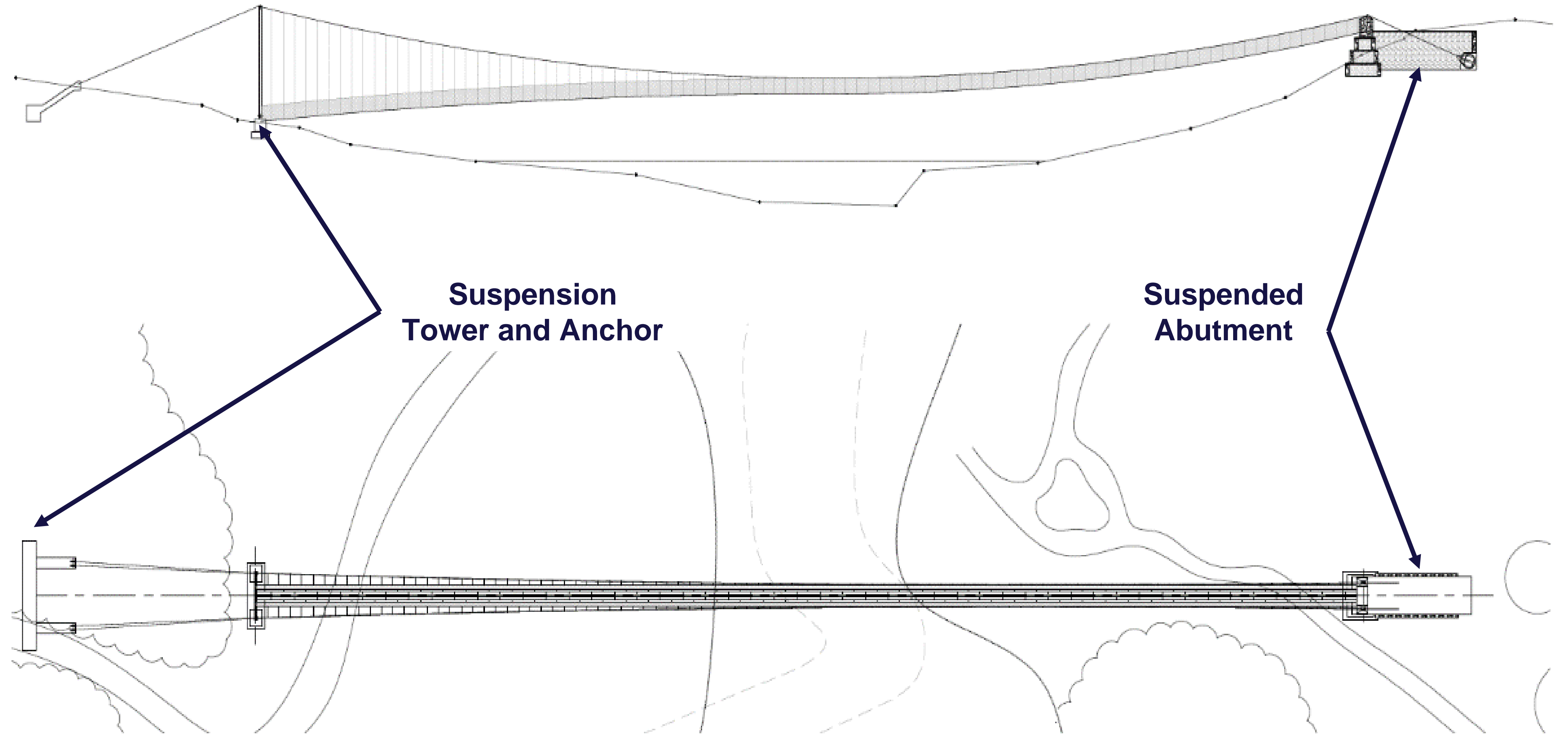
The walkway system is the same as the one for the suspended design, just with variable length of the suspenders.





# Hybrid Bridge – combines both

<https://b2p.europedigital.arup.com/>



# General Impact Information

## Access to economic opportunity

Households in communities with new trail bridges saw:



**+75%**  
Farm  
Profits



**+60%**  
Women Entering  
the Labor Force



**+36%**  
Labor Market  
Income




**+30%**  
Overall Household  
Income

In addition, the volume of agricultural goods transported across the river increased by nearly **14x (1,350%)**



# Access to education

More than 30% of rural households must cross a river to reach a school. Improved rural access led to:



**+60%**  
Literacy for  
Women



**+200%**  
Attendance for  
Girls

New trail bridges alone led to:



**+12%**  
Student  
Enrollment



**+22%**  
Student  
Attendance



# Access to healthcare

57% of rural households must cross a river to reach a hospital, and communities with new trail bridges saw:

 **+18%**  
Health Facility  
Visits

Every minute of every day, at least one woman dies as a result of complications of pregnancy and childbirth, and 99% of those deaths occur in lower-income nations.

The World Bank estimates that more than 75% of maternal deaths could be prevented by timely access to essential childbirth-related care.



# Trail Bridge and Climate

## Issue at hand!

- The implications of climate change is that it hits hardest to those who are already vulnerable, and who often contribute least to the causes of that change – people in the global South, and they are least equipped to survive and adapt.
- When communities aren't able to reach resources and services reliably year-round, that impacts the way they make decisions;
- They store more of their crop for personal consumption, they keep their children (in particular girls), Maternity operations take place at home, access to civic and socio-Economic Engagement is stopped.
- Flooding destroys crops and homes.....



# Climate Action

## *“Trail Bridges are a Multi-Dimensional Climate Solution”*

- Trail bridges are critical components of a larger strategy to build climate-resilient and sustainable communities.
- They provide reliable access, reduce emissions, support economic development, and enhance the adaptive capacity of rural populations and they would thrive despite the challenges posed by climate change.



# TB Sustains Communities Lifestyle (Adaptability and Resilience)

## TB, a Tool to Year round access in the same ecosystem

- TB ensures continuous access and communities keep their pedestrianization lifestyle and avoiding dependency on Fuel.
- When a drought threatens their crop, they have the option to seek wage labor. Should storms become a regular, they can direct newly-earned income to building water management systems.
- They choose to send children to the closest school, just on the other side of the river. They also get options to attend clinics.



# TB\_Minimizing Carbon Footprint

## Cutting Carbon Emissions

- Trail bridges encourage walking and non-motorized transport, reducing the shift to motorized vehicles and lowering emissions.
- **2,100 Tones of CO2 emissions** are saved annually by making it possible for a single community in Rwanda to remain in a pedestrian lifestyle.



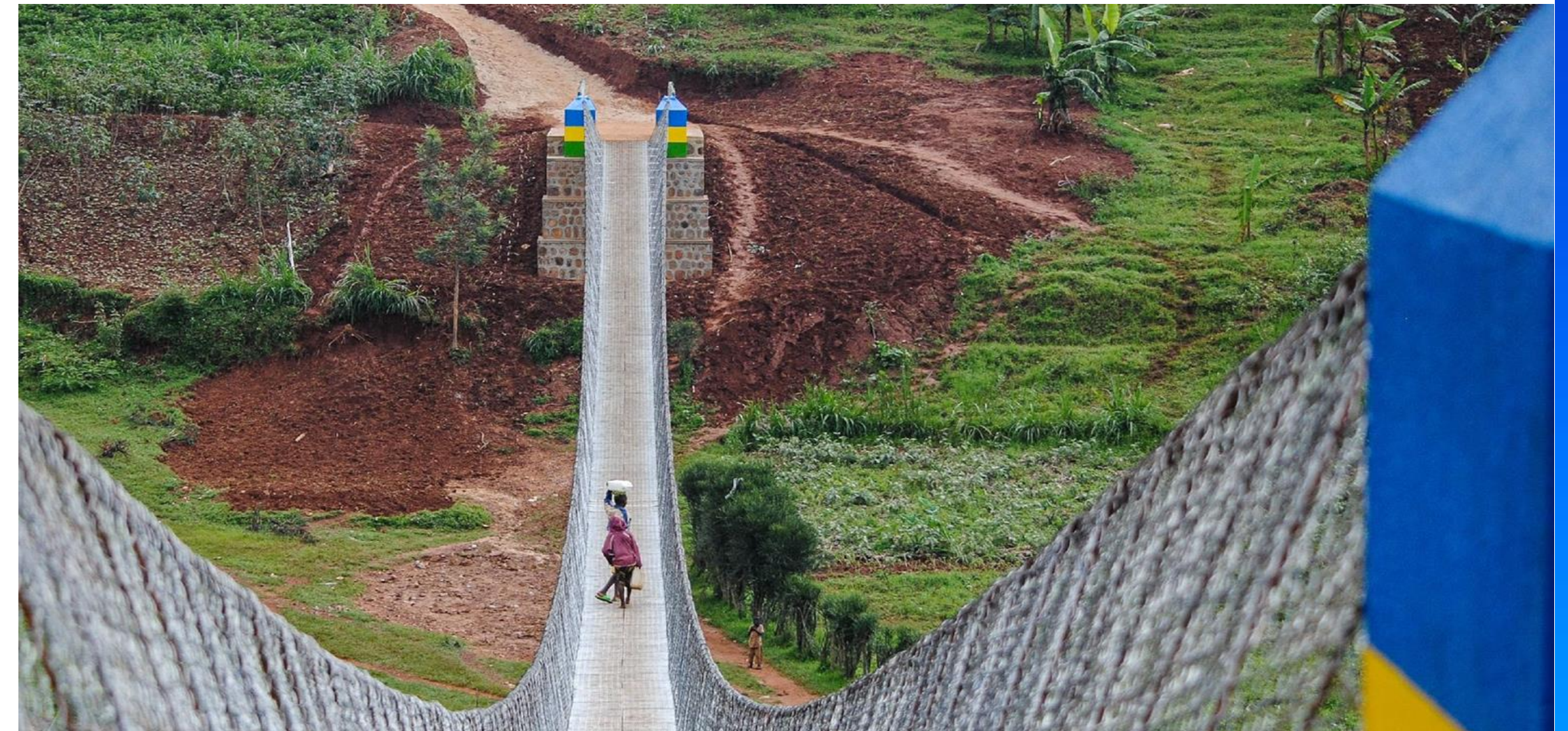


# Minimizing Co2 Footprint

## TB\_Better By Design - Climate Smart Construction

Building over river crossing points established by local communities, so excavations and construction are minimized, and they have a small footprint.

Using materials from shipping ports and large construction projects and repurposing steel cable, clamps, and pipe, and purchase locally-sourced materials and hire laborers from the bridge owners-Communities

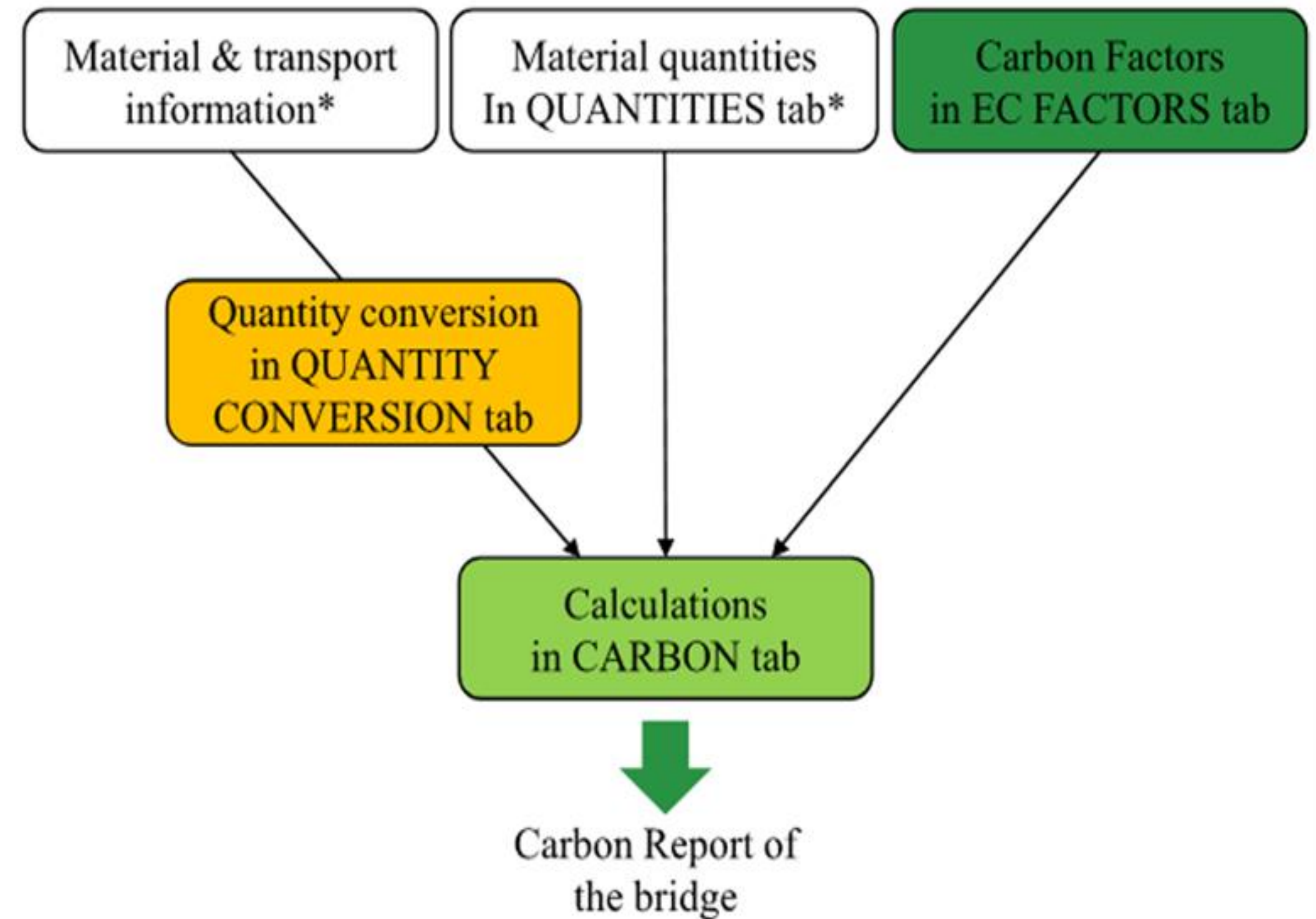


# TB Carbon Calculation B2P and Arup

***“Sustainable infrastructure goes beyond construction and includes precise carbon management”***

B2P uses a dedicated tool to estimate the embodied carbon of our bridges.

[The manual](#) includes detailed spreadsheets that calculate and track carbon emissions for various materials like cement and steel, from sourcing to installation.



# CO2 Calculation

The carbon factors calculated are tailored to the local context, such as the use of 30% Pozzolana cement in Rwanda, which significantly reduces the carbon emissions compared to using standard Portland Cement.

The embodied carbon for a **50m suspended bridge** in Rwanda is calculated to be approximately 40,000 kgCO<sub>2</sub>e, with cement and steelwork being the largest contributors.

## Embodied Carbon

How do I calculate it for my bridge?

$$\begin{array}{l} \text{Embodied Carbon} \\ \text{Total emissions to} \\ \text{build something} \\ \text{kg CO}_2\text{e} \end{array} = \begin{array}{l} \text{Quantity} \\ \text{Material mass or} \\ \text{process amount} \\ \text{Unit} \\ \text{(kg for a material)} \end{array} \times \begin{array}{l} \text{Carbon Factor} \\ \text{Carbon for a} \\ \text{particular Material /} \\ \text{Process} \\ \text{kg CO}_2\text{e /unit} \end{array}$$

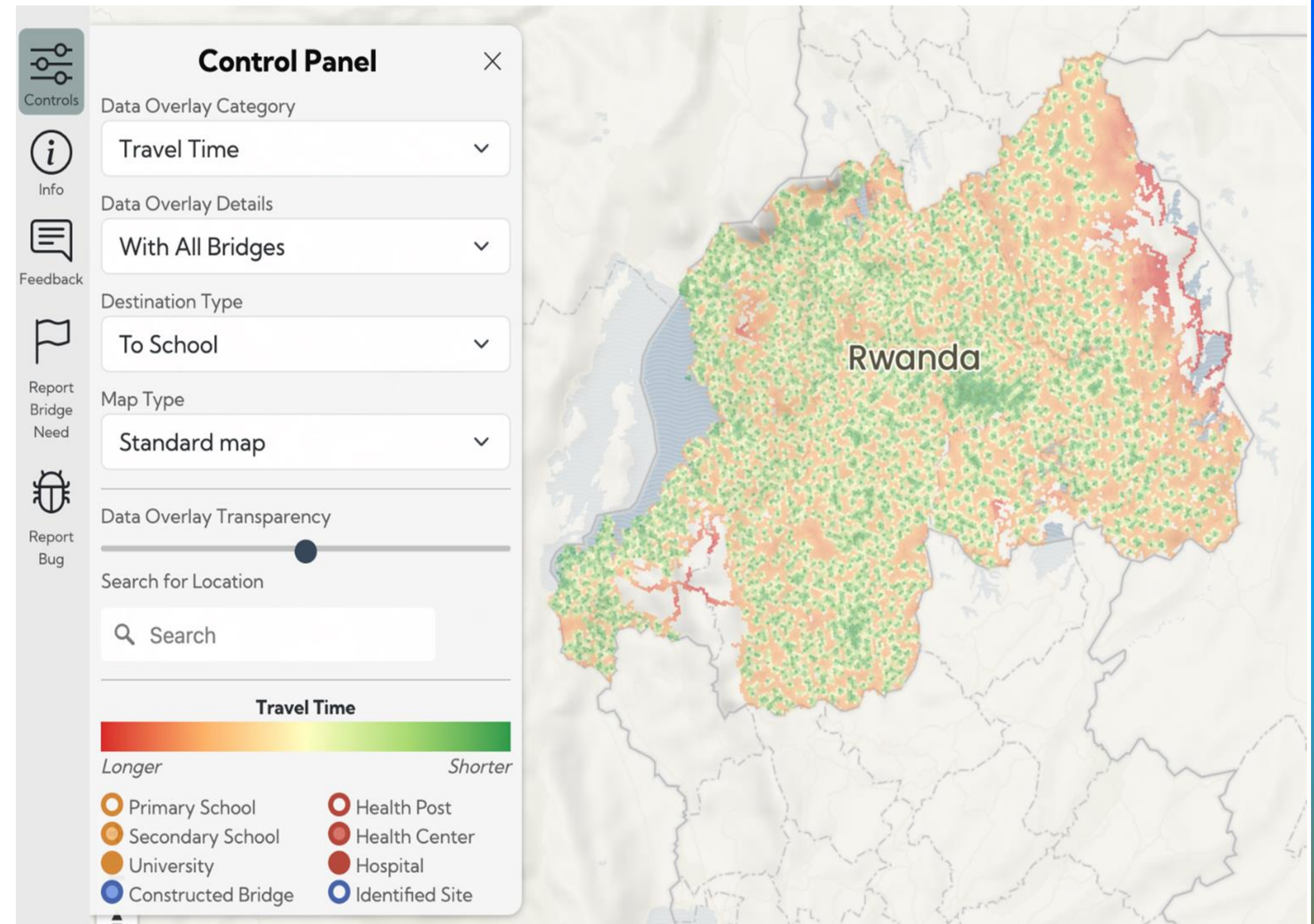
ARUP



# The future in Climate Action

## Climate Modeling and Data-Driven Decisions

- Our approach is Working with governments to plan long-term rural access programs. This requires a thorough understanding of the scope of the rural access problem.
- Our needs assessments indicated that rivers in the rural areas aren't just poorly mapped, but rarely mapped at all.
- Hence, development of an AI and remote sensing tool suite called **Fika Map**. A Swahili name that means "To Arrive". Once complete, this tool is expected to include models, such as:

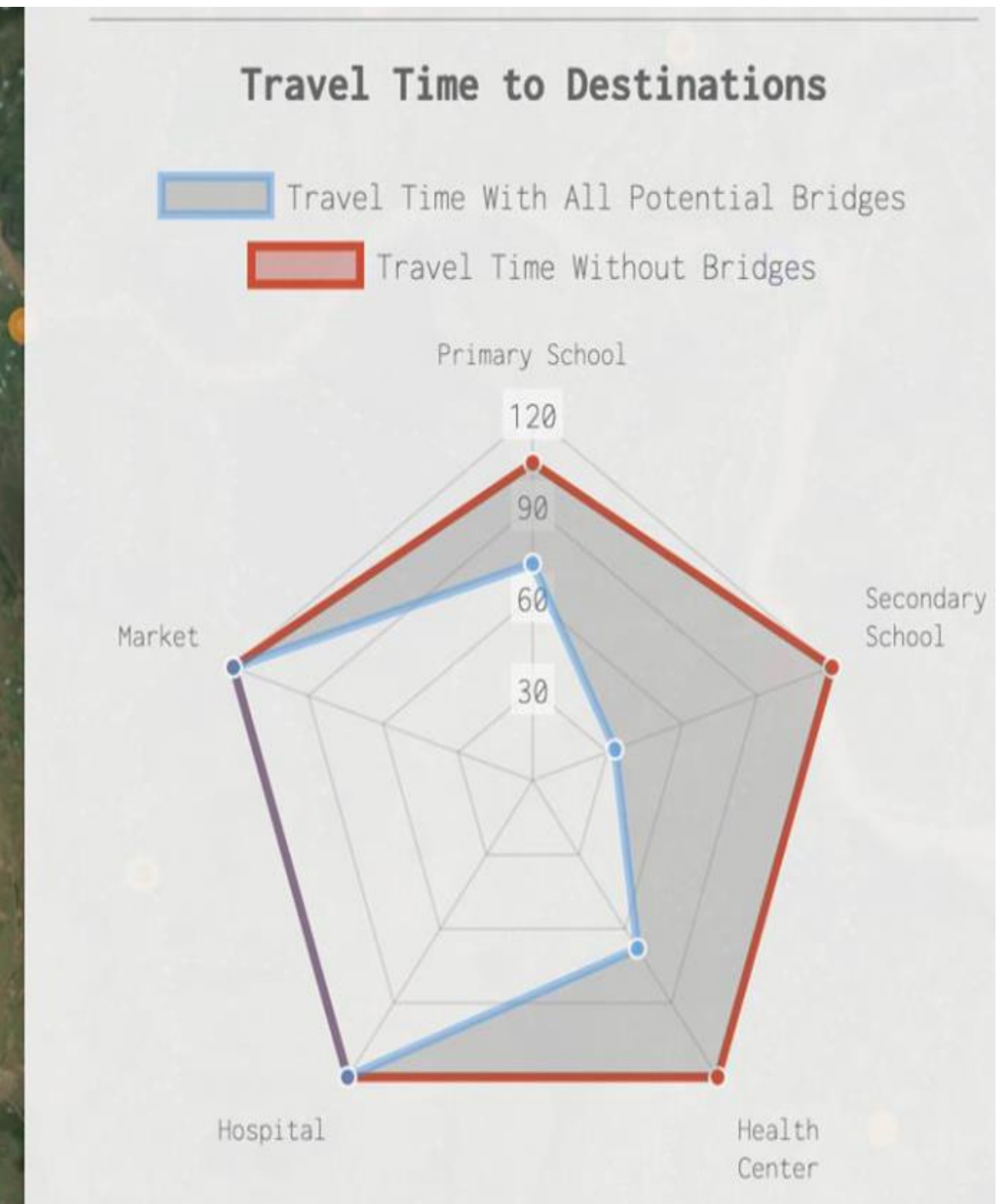


# Climate Modeling and Data-Driven Decisions

**A waterway detection model**, and a deep learning model prediction of waterways and stream order at a global scale.

**A predictive impact model** that uses changes in travel time to estimate the impact that a trail bridge would have on surrounding communities,

**A remote site prediction model** which predicts remotely and at scale where bridge sites are needed to guide the needs assessment teams on ground.



As we continue to invest in this work, we will cover critical data gaps that won't just make it possible to plan effectively for rural transportation access, but will allow governments, their constituents, and key investors and implementers to make more cost-effective, climate-smart decisions in general.



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