



VEGETATED CRIBWALL (LAYER-BASED DESIGN)

SWB9



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ADDRESSED
HAZARDSPROTECTED CRITICAL
INFRASTRUCTURE

Primary functions and key services

(Schiechl, 1980; Sorolla et al., 2020; Sorolla et al., 2021)

- **Slope and bank stabilisation:** designed to provide structural support and withstand load stresses. Soil slippage is prevented, live fascines and stakes provide initial surface protection, long-term soil armouring and deciduous forest re-establishment.
- **Load distribution:** distribute both vertical and lateral earth pressures through their interlocking timber beams, effectively resisting overturning and sliding forces.
- **Flood mitigation:** act as longitudinal **barriers and bank protectors**, resist heavy debris and sediment bed loads, slow down water flow during flood events, reducing erosive power while initiating riparian forests and belts.
- **Infrastructure protection:** shield infrastructures like **roads, bridges** or **embankments**.

Additionally, vegetated cribwalls provide benefits to bank and riparian forest recovery.

Site suitability, scale and coverage

Cribwalls are suitable to different environments, classified here as: (Sorolla et al., 2020)

- **Fluvial spaces:**
The installation of cribwalls in riverbeds is one of the main site applications of this kind of system, in combination with live fascines to ensure full surface coverage against sediment leakage. In general, they require sufficiently resistant foundation, usually secured by heavy stone loads and additional vertical anchorage. A proof of safety is usually required.
- **Outside fluvial spaces,** in vegetated cribwalls are effectively implemented in terrestrial slopes. Foundation needs and proof of safety must be assessed for keeping its overall stability (e.g. contribution lands, fixations to the original terrain, etc).
- **Within urban environments:**
In rural or urban settings, methods are usually associated to conventional structures relying on concrete, however studies demonstrated that replacing engineering containment with SWB designs such as vegetated cribwalls can often times ensure the same stability while reducing non desirable environmental and social impacts. Cribwalls implemented as a NbS alternative to concrete wall structures have many advantages in terms of ecosystem services, such as landscape improvement, aquifer recharge, soil humidification, nutrient retention, CO₂ fixation, erosion and runoff management, diffuse pollution reduction, flood risk reduction, temperature and humidity regulation or wind control.

What is it?

Vegetated cribwall (layer-based design) is a retention and gravity structure for stabilising slopes and banks, built from interlocking timber beams filled with soil or rock. Live cribwalls use untreated wood and live fascines (for application at river banks only) and/or stakes (for hillside application) that root into the fill, merging with native soil for stability. Vegetation eventually supports the structure, preventing erosion and taking over the stabilising function when the wooden cribwall box is rotting.

(Schiechl, 1980; Sorolla et al., 2020; Sorolla et al., 2021)



Live cribwall after construction at Veitschbach

Image Credit: [Tina Vorstandlechner, BOKU], [2024]. Used with permission;



Live cribwall two years after construction at Veitschbach

Image Credit: [Tina Vorstandlechner, BOKU], [2024]. Used with permission;

Challenges this NbS addresses

(Schiechl, 1980; Sorolla et al., 2020; Sorolla et al., 2021)

- **Erosion control**, helping to diminish sediment transport into **drainage systems, local streets** or **spillways** and **dams** downstream.
- **Slope and embankment stabilisation**, to reduce problems of potential earth movements or landslides that may affect critical infrastructure in the nearby area, such as **roads** or **housing**.
- **Flood protection**, helping to attenuate flooding impacts in the region damaging **transport corridors, housing, bridges** or **drainage systems**.



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▼ Cost-benefit profile

Recent years of practical experiences in the development of vegetated cribwall systems demonstrated that often times this SWB technique becomes more accessible and affordable compared to combinations of civil engineering structures (Acharya, 2018)

In fact, as stated by Acharya (2018), generally, conventional retaining structures made of materials such as masonry, concrete or gabion, are increasingly raising their cost due to the incremental cost of construction materials, and the repair and maintenance labour when it is necessary, especially after intense rainfalls, exacerbated with the climate change.

▼ Main components

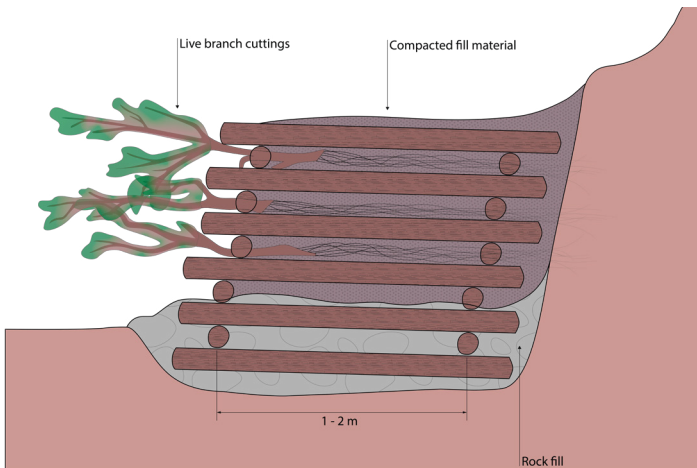
- **Live cribwalls** safeguard streambank toes or steep slopes.
 - Require **a stable foundation**, must withstand lateral loads and resist overturning.
- **Live fascines** provide surface protection, **stakes and poles** in the crib structure strengthen the fill.

Environmental impacts (EU taxonomy)

- ✓ Climate change mitigation
- ✓ Climate change adaptation
- ✓ Sustainable use and protection of water and marine resources
- Transition to a circular economy
- ✓ Pollution prevention and control
- ✓ Protection and restoration of biodiversity and ecosystems.

Ecosystem services

- ▶ Ecosystem restoration
- ▶ Habitat creation
- ▶ Biodiversity enhancement
- ▶ Landscape connectivity
- ▶ Pollination
- ▶ Shading
- ▶ **Carbon sequestration:** increased CO₂ capture and storage in above- and below-ground living biomass.



Schematic of Vegetated Cribwall (layer-based design), NbS Typology for Soil and Water Bioengineering

Image Credit: [Alchemia-Nova Research and Innovation], [2025]

Example of installation

- ▶ **Stream restoration and cribwall performance case study in southern ontario** (Krymer & Robert, 2014)
- ▶ **Location:** Cribwalls applied to two small streams in Southern Ontario, Canada.
- ▶ **Implemented by:** Central Lake Conservation Authority [CLOCA]
- ▶ **Description and results:** The monitoring demonstrated the best design suitability of cribwalls to the diverse local stream settings. As part of the important parameters to be taken into account there is the channel planform, bed and bank sediment distributions, and stream power. The study showed that a sinuous channel planform enhances the effectiveness of cribwall for channels with a moderate slope. Also, in such cases, the monitoring evidenced that cribwalls help increase the soil cohesion, infiltration and nutrients availability.

Cribwalls showed to be less effective in more straight sections of the channel, with increasing slope and stream power. The above conditions result in sediments and erosion problems in the toe of the bank, and a high bank height ratio. (Krymer & Robert, 2014)

References

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