WOOD STAVE PIPELINE

A PIPE ASSEMBLED FROM TIMBER BEAMS, BOUND WITH STEEL RINGS, IS FLUSHED WITH WATER. OVER TIME, THE BEAMS SWELL TO SEAL THE PIPELINE FOR WATER TRANSPORT OVER LONG DISTANCES. WOOD STAVE PIPELINES ARE A RE-EMERGING, REGENERATIVE RESOURCE AND CAN BE EASILY BUILT IN DIFFICULT TO ACCESS AREAS DUE TO THEIR FLEXIBLE AND LIGHT MATERIAL.

RESEARCH CENTRE FOR STEEL, TIMBER AND MASONRY - TIMBER STRUCTURES AND BUILDING CONSTRUCTION

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ADVANTAGES OF WOOD STAVE PIPELINES IN COMPARISON TO STEEL OR CONCRETE PIPELINES

Heavy equipment for transport and construction is not necessary due to the **low weight of the individual components** and the **on-site nature of the assembly**. This is a convenient solution for pipe constructions in **remote** or **difficult-to-access-areas**.

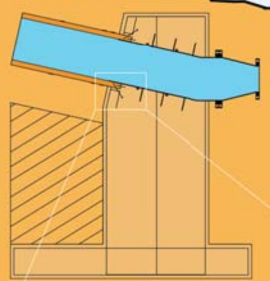
The high flexibility of the wood stave pipelines enables construction in difficult and mountainous terrain. Wood stave pipelines can be constructed with **diameters from 0,4 m up to 5,0 m** and for **pressure heads up to 60 m** (6,0 bar).

Because of the **low sensitivity of timber to temperature variations**, it is possible to lay wood stave pipelines **over several kilometres without any devices to compensate for expansion.**

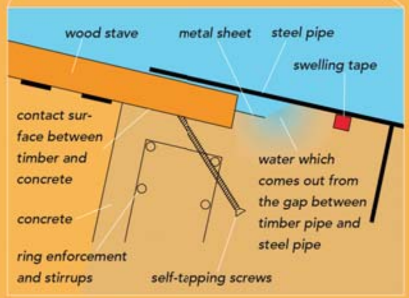
Wood stave pipelines do not suffer from roughening when aging. Instead, the **forming of a biofilm** inside the pipeline smoothens the inner surface, thereby **lowering its hydraulic loss coefficient**.

The simple construction method and the use of cheap materials lead to **financial benefits.**

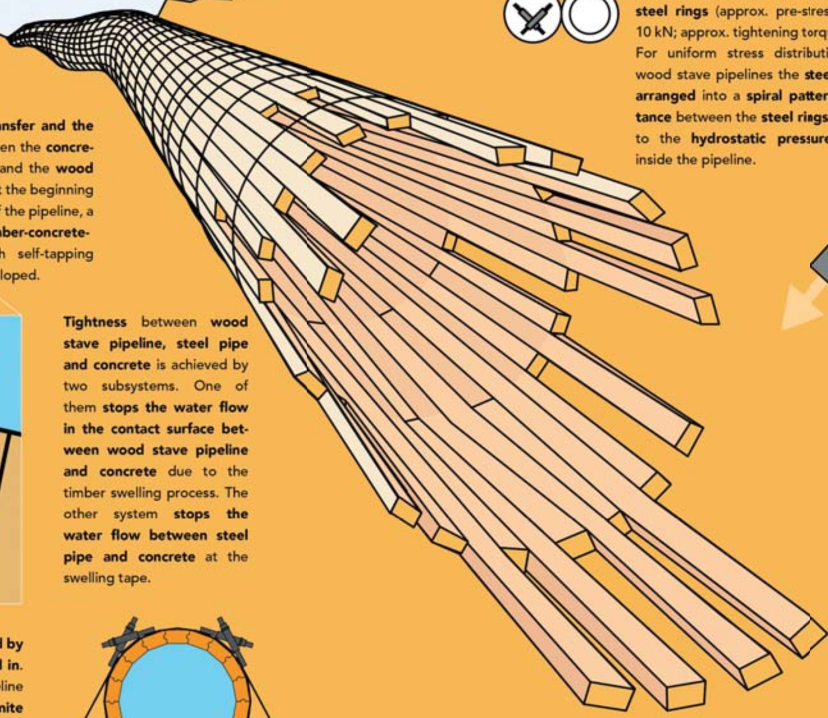
As an **ecologically sustainable technology**, wood stave pipelines represent an important contribution to the **protection of the environment** and to **sustainable forest management.**



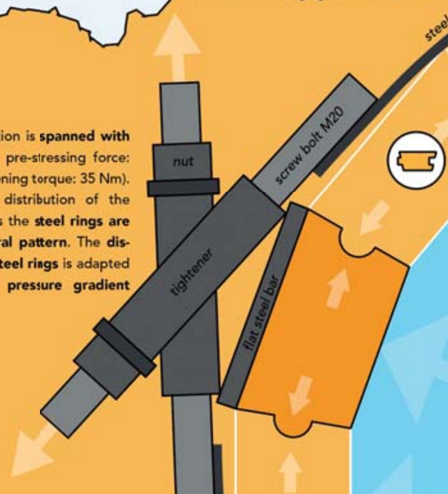
For the **load transfer and the tightness** between the **concrete components** and the **wood stave pipeline** at the beginning and at the end of the pipeline, a force-locked **timber-concrete-connection** with self-tapping screws was developed.



Tightness between wood stave pipeline, steel pipe and concrete is achieved by two subsystems. One of them **stops the water flow in the contact surface between wood stave pipeline and concrete** due to the timber swelling process. The other system **stops the water flow between steel pipe and concrete** at the swelling tape.



The entire cross-section is **spanned with steel rings** (approx. pre-stressing force: 10 kN; approx. tightening torque: 35 Nm). For uniform stress distribution of the wood stave pipelines the **steel rings are arranged** into a **spiral pattern**. The **distance between the steel rings** is adapted to the **hydrostatic pressure gradient** inside the pipeline.

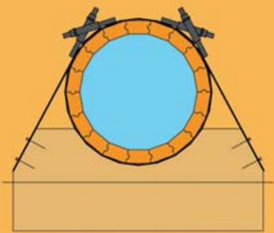


Wood stave pipelines were mainly used in the 19th century in North America as inlet pipes for hydropower plants. After a decrease in the mid-twentieth century, the application of wood stave pipelines has taken new importance of late thanks to the increasing demand for regenerative resources.

Unlike steel and concrete pipelines, wood stave penstocks are not delivered in large segments, but in **small, discrete parts** and **assembled on-site**. For the construction of a wood stave pipeline it is necessary to use **timber with a high resistance to termite attacks** such as **heartwood of teak**.

Every second stave is displaced in relation to the adjacent stave by half a stave length. Half of the wood staves are butt-jointed in one cross-section. **Tongue and groove joints of the staves** are in circumferential and longitudinal direction (longitudinal: additional tongue made of teak heartwood).

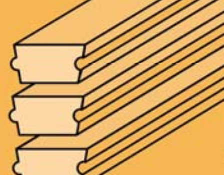
Assembly of **wood staves with maximum moisture content of 16-18%**, to **ensure sufficient swelling of the staves** and subsequent **tightness of the pipeline** in case of water filling. If the **wood dries out**, the staves could **deform and crack** and the wood stave pipeline is exposed to fungal and insect attack. The pipeline must therefore be **constantly filled with water.**



Wood stave pipelines can be built above ground, **supported by concrete saddles**, or in a **ditch that is subsequently filled in**. To make termite activity more visible, the wood stave pipeline should be a **minimum of 200 mm above ground** and a **termite shield** arranged on each support.
The **maximum support distance** is equivalent to the 3.0 m stave length. The **angle of the support**, which includes the wood stave pipeline at the bottom, is 120°. Above every support a tightening ring is arranged. An additional tightening ring is connected to each support.

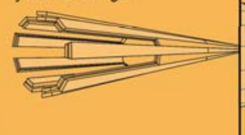
Teak logs from plantations with sustainable forestry

Kiln dried, sawed and milled wood staves

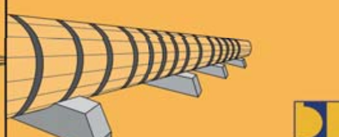


Detail of the tongue and groove joint of the staves in circumferential and longitudinal direction

Assembling of the wood stave pipeline; every second stave is displaced to the neighbour stave by half stave length



Completed wood stave pipeline supported by concrete saddles



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