

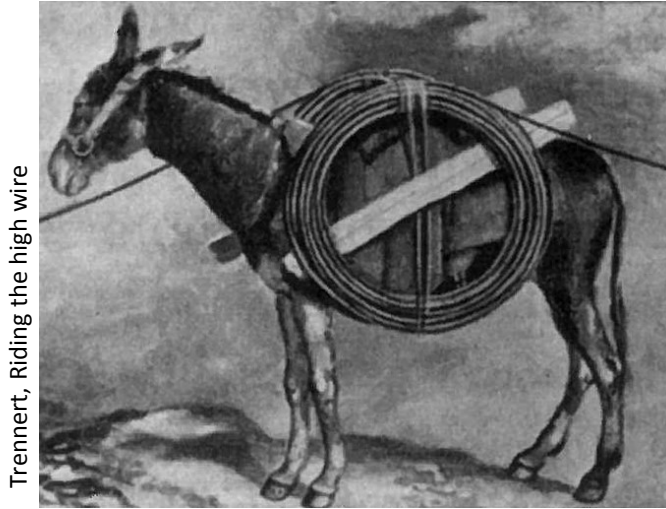


# Fiber Ropes for building up ropeways

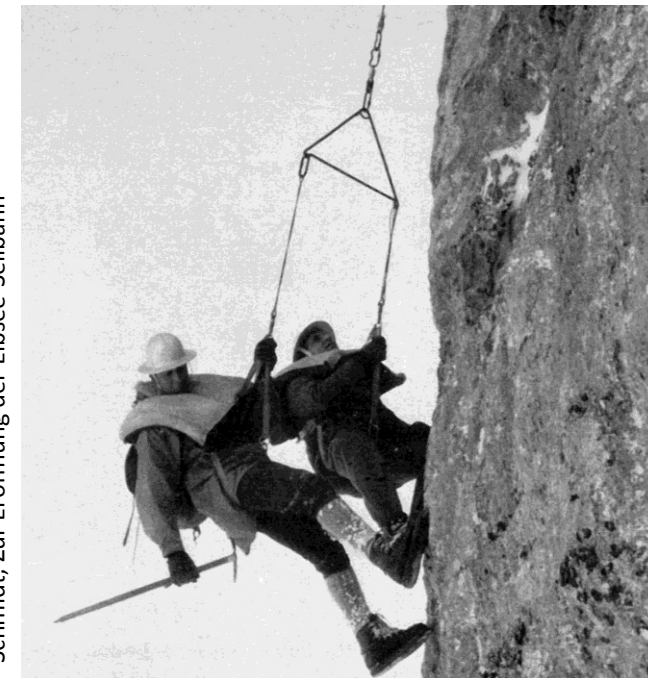
Konstantin Kuehner, IFT University of Stuttgart  
Urs Schneider, Jakob AG  
Fredy von Moos, Garaventa AG

# 1. State of the art in rope mounting

- Time of pioneers: manual transport of main rope
  - by mules (end of 19th century)
  - by human hand (begin of 20th century)
- Manual transport of an advanced pre-rope (around 1950)



Trennert, Riding the high wire



Schmidt, Zur Eröffnung der Eibsee-Seilbahn

## 2. Problem and Solution

**Today:** helicopter transport & multiple pre-ropes

**Problems:**

- Expensive and time-consuming
- Increased risk of accidents within rope pull
- Rope twist has to be compensated
- Work is highly dependent on weather

**Idea:**

Helicopter transport of a single high-tensile fiber rope and direct pull of the final main rope





## 2. Problem and Solution

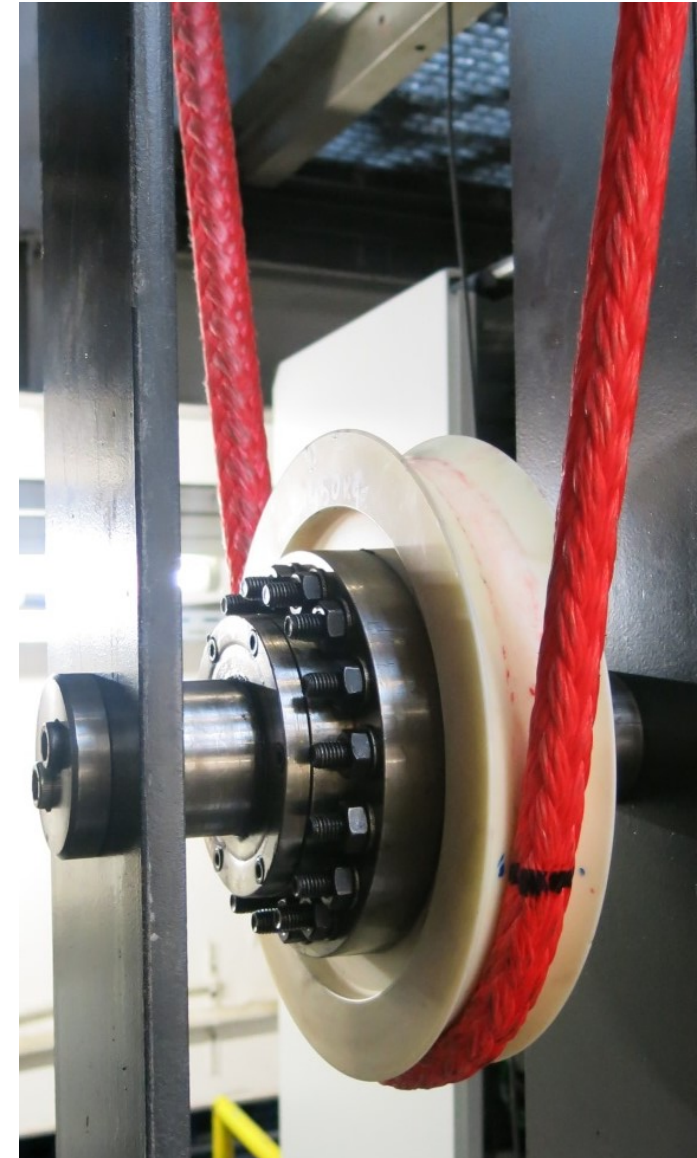
- Garaventa AG and Jakob AG:
  - Selection of a pilot rope
  - Proof of basic feasibility by first rope pull
- IFT University of Stuttgart:
  - Investigation of operational limits by laboratory testing
  - Setup of a user-manual



espazium.ch

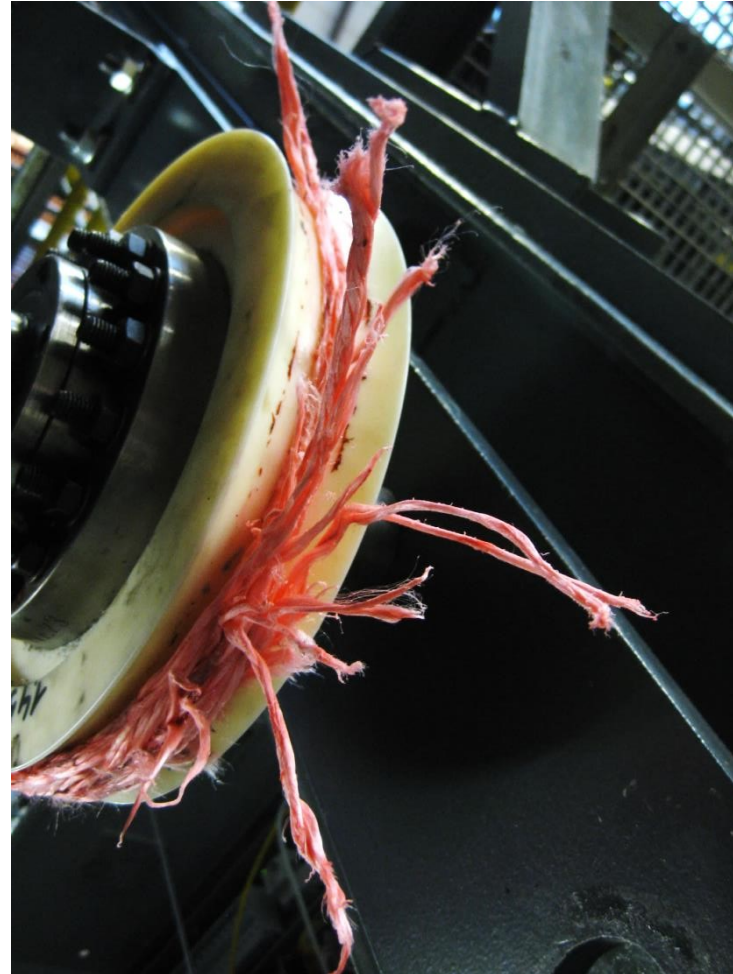
### 3. Realization (I): Laboratory tests

- 3 different rope designs
- $\varnothing$  22mm, breaking load 300kN, material Dyneema
- Bending tests on polyamide sheave





### 3. Realization (I): Laboratory tests

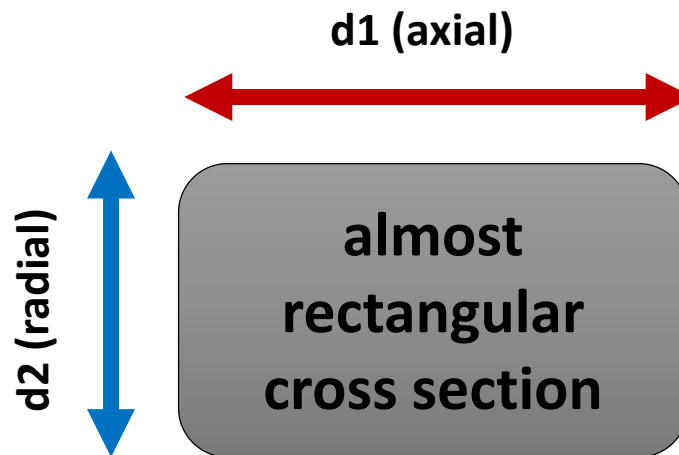
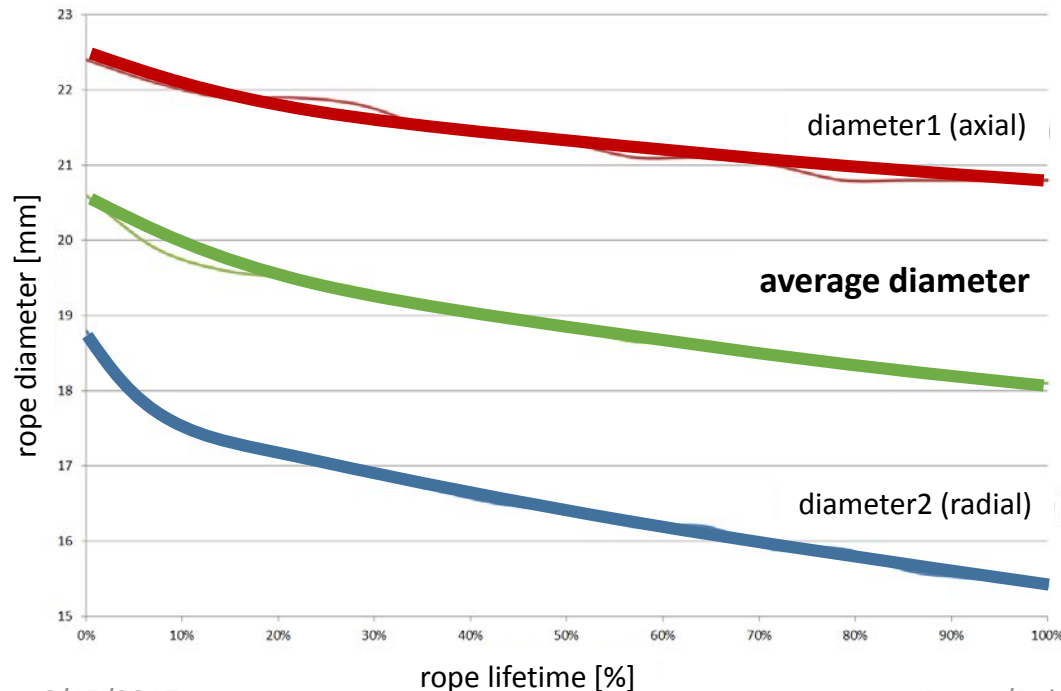


### 3. Realization (I): Laboratory tests



# 3. Realization (I): Laboratory tests


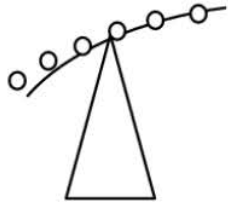

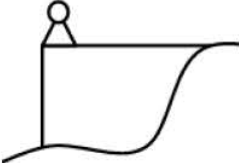

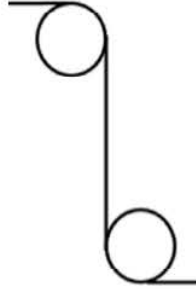
- Continuous diameter reduction of ropes
- Ropes only show little outer wear in advance, first strand breaks only occur close to total rope failure





## 4. Realization (II): user manual for field application

- Introduction of discard maturity and visual inspection
- Determination of bending cycles until discard in style of DIN 15020-part 1
- Rope exchange after 6 years or additional tests by manufacturer or accredited experts

					
drum / winch	support tower / roller battery	terrain ground roller	ground roller at basement	point of deflection	reverse bending

# 4. Realization (II): user manual for field application

Application protocol  
and point rating  
system until discard

LIROS D-Pro-XTR „red“ with protective cover, Inventory no. 000.1					
Initial operation of rope: 17.09.2016					
	1	2	3	4	5
<b>project / Location</b>	Mount Example	...			
<b>date</b>	xx.xx. - xx.xx.2016	...			
<b>used auxiliary devices</b>	1 x drum (pay-off) 2 x support tower 2 x terrain ground roller 1 x reverse bending 1 x point of deflection 1 x winch (drive)	...			
<b>bending cycles per rope pull</b>	9 (fictive project!)	...			
<b>amount of rope pulls</b>	4	...			
<b>sum of bending cycles</b>	36	...			
<b>residual maximum amount of bending cycles</b>	266 (fictive project!)				
<b>visual inspection</b>	no abnormalities				
<b>person in charge</b>	Kuehner, IFT Uni Stuttgart				

## 5. Conclusion and prospects

- Rope pulls using high tensile fiber ropes are technically feasible
- User, manufacturer and test laboratories have determined safe limitations for in-field operation
- User-manual and documentation allow an increase of efficiency by a growing base of experience
- Presented method can be exemplary for industrial application of high-tensile fiber ropes





# Thank you.

