ULTRA LOW WEIGHT COMBINED LV/OF CABLE FOR STEEP CABLE CAR PATHWAY

Boris **DARDEL**, Marc **BRESSENEL**, Jean **WITTWER,** François **COCHET** - Nexans Suisse SA, CH-2016 Cortaillod (Switzerland). boris.dardel@nexans.com, marc.bressenel@nexans.com, jean.wittwer@nexans.com, francois.cochet@nexans.com

ABSTRACT

A three phase plus neutral low voltage cable combined with 12 optical fibres was developed for aerial installation on a steep cable car pathway. The design takes into account high mechanical load requirements due to long spans and 5kg/m admissible ice load.

KEYWORDS

Hybrid cable, aerial installation, high load

INTRODUCTION

In the frame of a high altitude antenna installation in the Graubünden region of the Swiss Alps, Nexans Cortaillod was asked to deliver a three phases plus neutral low voltage cable combined with 12 optical fibres for power supply from the valley. In order to reduce the laying costs, an old cable car pathway was found to be a good route as it allowed installing the cable in one length over a path ranging from 1500 m up to 1740 m altitude on about a 500 meter horizontal distance. The path exhibits a maximum slope of approximately 60° over 60m meter span and a maximum span of 200 meters with 30° slope.

Span #	1	2	3	4	5	6
Altitude (m)	1470	1564	1685	1732	1737	1743
Span length (m)	47	197	121	25	59	58
Span height (m)	93	121	47	5	6	1
Slope (°)	63	32	23	11	6	1

Table1: Path configuration

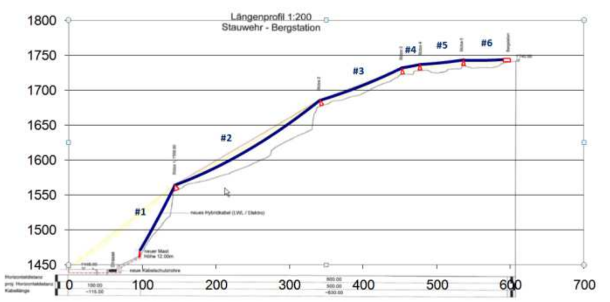

Fig. 1: Path configuration (blue line)

Also requested was a 100km/h wind resistance and a maximum admissible ice load of 5 kg/m.

DESIGN CONSTRAINTS

Initial design considerations were given by

- Maximal electrical load
- Cable weight considerations
- Maximal cable strain under full load

50mm² Aluminium conductors were chosen in order to comply with electrical load and weight considerations.

Tensile strength of 4000 daN was estimated for the worst operational conditions (span #2)

CABLE DESIGN

Aerial optical fibre cable designs are usually based on stranded loose tubes than can guarantee strain free fibres even in the case of cable elongation. This is allowed by the possible displacement of the fibres inside the tubes. This defines the maximum permissible cable elongation in operation (0.6% in our case).

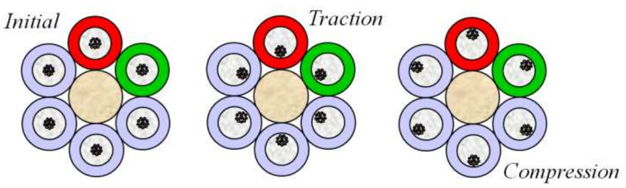

Fig. 2: Fibre movement under cable elongation

Due to the stranded nature of low voltage conductor and core arrangement, the strain/stress curve is generally not well defined before a certain constraint is applied on the cable. It is then not obvious to rigorously control the total cable elongation under strain.

Moreover, aluminium cross-section is not sufficient to bear the maximal calculated load and the introduction of a steel messenger would lead to similar absolute elongation considerations.

Table 2 gives an overview of the mechanical properties of main materials used for electrical lines [1] compared to aramide. The mechanical strength over linear weight ratio is strongly in favour of aramide. Moreover this material can bear elongation up to at least 1% (to be compared to 0.2% elasticity limit usually considered for metallic materials) and has a low (even negative) linear thermal coefficient of elongation which limits the sag increase when the cable heats up.

The choice of aramide yarns as strength members for this cable was hence considered as the best alternative compared with steel armouring that would have led to increased weight and dimensions. Although expensive, this design is well known and proven in All-Dielectric Self-Supported (ADSS) optical fibre cables.