DESIGN AND OPERATION OF BARROSO FLYINGBELT

Alberto Contin[1], Matteo Colombo[1]
Presenter: Stefano Cattaneo[2]

[1] AGUDIO – LEITNER S.p.A.
[2] LEITNER S.p.A.

***Abstract* -- This document is a comparison between design data and operational data of the Barroso Flyingbelt, the longest conveyor belt in the world suspended on ropes. The Flyingbelt is in operation in a cement plant in Southeastern Brazil and is transporting about 1,500 tph of limestone from the quarry to the factory – an output that would require a minimum of 40 trucks per hour. Utilisation of this technology significantly reduces road traffic and CO2 emissions. The world's longest aerial belt conveyor utilises a single 15,000-meter-long rubber belt as well as 60,000 meters of rope and 25,000 rollers.**

INTRODUCTION

A cement manufacturer launched the "Barroso Expansion Project" in 2012, this was a large investment, with the target to increase production capacity of the Barroso cement plant from 1.2 Mtons of cement per year to 3.6 Mtons per year.

The demand for limestone required the supply from a new quarry, located 15 km (by road) from the old quarry and the cement plant:

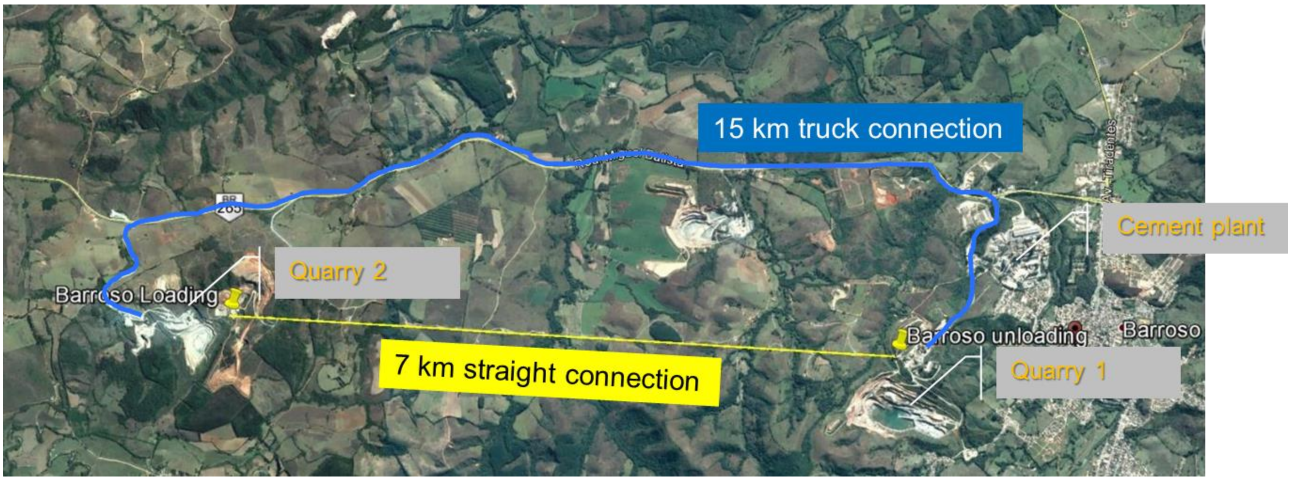


Figure 1 – Map of cement plant and quarries

A new raw material conveying system was needed and this typology of aerial belt was selected as the best option because it was perfectly suitable to overcome challenges associated with a conveyor system such as:

- Minimisation of CAPEX: No land purchase + Less steel structures + No forest cut + Limited civil works
- Minimisation of environmental impact: Low visual impact: the aerial conveyor is a “line” suspended with 18 support towers.
- Maximisation of availability: using commercial and reliable components normally used for traditional conveying systems (belt, rollers, transoms, roller bases, drives, etc.).
- Customisation of the system: transfer points were designed and manufactured according to Mechanical, Electrical and Safety requirements from the Customer.
- Integration of control system: the Flyingbelt is controlled by a PLC and it can be integrated in the SCADA system of a “Crusher-to-Mill” transport chain, together with equipment from other OEM suppliers.
- Minimisation of OPEX: The aerial belt has similar operational costs of a conventional overland conveyor.

The main challenges of the project were: the high capacity (1500 tph), several geological and environmental constraints, the need for a “suspended” solution not to impact a preserved area, no transfer, no fencing and/or surveillance along the line, easy inspection and maintenance intervention along the line.

The solution proposed by the Supplier is the result of a fully customised detailed study carried out by the Supplier’s engineers specialising in several fields, such as: rope design, belt analysis, mechanical design, geological analysis, constructability analysis. This study was carried out following guidelines for material ropeways (OITAF book 8) and for conveyors (CEMA 7th), using software specifically developed by the Supplier to simulate the static and dynamic behaviour of the system in different conditions (start-up, shut-down, normal operation, emergency stop, partial load operation).

Main technical data of the Barroso aerial belt are as follows:

• Material	Limestone / Clay
• Horizontal Length	7200 m
• Difference in Height	50 m
• Belt width	1200 mm
• Track ropes	55 mm
• Hauling ropes	20 mm
• Number of towers	18
• Number of intermediate anchors	3
• Motors nominal power (belt)	3 x 615 kW
• Motors nominal power (maintenance vehicle)	4x30 kW
• Speed of belt	4.00 m/s

In the following paragraphs the way ropes and belts have been calculated is explained.

Rope Line Calculation

This aerial conveyor is a traditional conveyor suspended on ropes anchored on both ends (loading/tail station and off-loading/head station).

The choice of track rope construction form, size and mechanical properties is the result of a detailed analysis performed in several conditions:

- minimum temperature, loaded belt
- maximum temperature, loaded belt
- minimum temperature, empty belt
- maximum temperature, empty belt
- loaded belt + max wind on service (250 Pa)
- empty belt + max wind out of service (1200 Pa)
- mounting conditions (bare ropes, line frames installation)

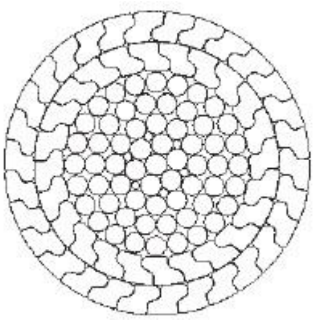
The operating temperature range taken into consideration is 60°C.

Track ropes comply with the guidelines by international standards (*) about material transportation; according to these, the minimum track rope safety factor is:

- On service, without wind: ≥ 2.50
- Out of service, with wind (1200 Pa): ≥ 2.00
- On service, with wind (300 Pa): ≥ 2.50

(*) O.I.T.A.F., book no. 8, § 2.1.6.2, edition 2016, which states a minimum value of 2.50 on service. Concerning out of service + wind condition, the minimum admissible safety factor for material transportation is 2.00, proportionally derived from EN 12930:2015, § 7.4.2.

Track rope suitable for the installation is of a locked coil type, with two layers of “Z” shaped wires, diameter 55mm; its main features are listed below:



Description	Locked coil rope with "Z" shaped wires	
Diameter	[mm]	55
Mass	[kg/m]	17.0
Section	[mm^2]	2057
Elasctic Modulus	[N/mm^2]	160000
Minimum Breaking Force	[kN]	2703

Figure 2 Tracking ropes characteristics

The calculation of the anchored track ropes implies the definition of a "reference condition", which is assumed as a steady condition with empty belt and minimum ambient temperature.

In this situation, an assigned tension is given to the track ropes, which is chosen in order to optimise the ropes' behaviour and the running conditions.

Starting from these assumptions, the calculation procedure obtains all the line parameters in the "reference condition", with simple closed formulas assumed as known.

In detail, the procedure calculates the "section cumulative actual length", that is the length assumed by the rope lying on a horizontal plane, without tension and without weight.

For each load condition (different temperature or different load on the belt) the procedure iterates the calculation several times, varying the track rope tension, ending the calculation when the new values of the "section cumulative actual length" equal the original reference length.

For the purpose of line calculation, the full system is treated as a single anchored rope with the following assumption:

- equivalent rope tension equals the sum of track ropes
- equivalent rope weight equals the sum of track ropes, suspended frames, rollers and miscellanea, carry and return side of the belt, bulk load on the belt

The weight of the suspended frames and rollers is applied as a uniform load distributed along the track ropes; live load may be different in different spans, according to the load condition investigated.

An example of track rope dimensioning is reported below.

Table 1 Analysis of ropes in minimum temperature conditions

RUNNING CONDITIONS

condition codex		1	MINIMUM TEMPERATURE
INPUt PARAMETERS			
temperature delta	deg	0	1
fixed load	N/m	1427	2
belt weight	N/m	786	3
belt friction		0.025	4
live load	N/m	1073	5
BELT PARAMETERS			
cumulative mobile weight	N	13292436	
cumulative weight component	N	49100	
cumulative belt friction	N	332311	
cumulative periphericaI force	kN	381411	
belt length	m	7158.3827	
tension system displacement	m	-0.78	

ROPE PARAMETERS

section		1	2	3	4
reference tension	N	4546303	4838674	4686489	4750363
rope actual length	m	1907.453	2062.483	1835.567	1338.343
length goal	m	1907.453	2062.484	1835.567	1338.343
length discrepancy	m	0.000	0.000	0.000	0.000
maximum tension	N	4688518	4717849	4728015	4772724
rope safety factor		**3.140**	**3.120**	**3.113**	**3.084**

RUNNING CONDITIONS 1 MINIMUM TEMPERATURE

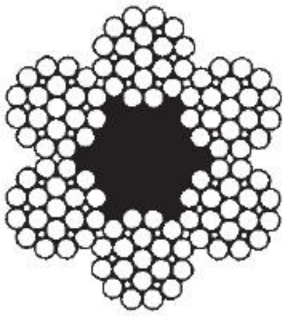
vertex number		1	2	3	4	5	6	7	8	9	10
vertex name		AV	S1a	S1b	S2a	S2B	S3a	S3b	S4a	S4b	S4c
live load factor		1	1	1	1	1	1	1	1	1	1
mobil load	N/m	1859	1859	1859	1859	1859	1859	1859	1859	1859	1859
total load	N/m	3286	3286	3286	3286	3286	3286	3286	3286	3286	3286
track rope tension at first span end	N	4546303	4645522	4648690	4661490	4661262	4639557	4639215	4654369	4655654	4654840
track rope tension at last span end	N	4645522	4648690	4661490	4661262	4639557	4639215	4654369	4655654	4654840	4685592
belt tension at first span end	N	419206	548463	552590	569265	568967	540692	540246	559988	561662	560602
belt tension at last span end	N	548463	552590	569265	568967	540692	540246	559988	561662	560602	600663
rope inclination at first span end	rad	0.0925	0.2073	0.0675	-0.0184	-0.1592	-0.0260	-0.1198	0.0816	-0.0570	-0.1373
rope inclination at last span end	rad	0.3105	0.2139	0.1258	-0.0117	0.0800	-0.0192	0.1660	0.0882	-0.0504	0.2124
average track rope tension	N	4595912	4647106	4655090	4661376	4650410	4639386	4646792	4655012	4655247	4670216
cumulative horizontal tension	N	4944963	5082754	5189441	5229870	5163869	5178501	5142498	5197023	5208830	5166888
span vertical sag	m	9.587	0.009	0.680	0.009	11.377	0.009	16.216	0.009	0.009	24.595
added span lenght	m	0.685	0.000	0.013	0.000	0.911	0.000	1.555	0.000	0.000	2.895
track rope elastic elongation	m	1.199	0.037	0.328	0.038	1.337	0.037	1.591	0.038	0.038	1.974
track rope actual length	m	342.793	10.582	92.579	10.584	377.926	10.580	450.600	10.576	10.582	557.354
section cumulative actual lenght	m	342.793	353.375	445.953	456.537	834.463	845.043	1295.642	1306.219	1316.801	1874.154
searching maximum rope tension	N	4645522	4648690	4661490	4661490	4661262	4639557	4654369	4655654	4655654	4685592
rope deviation on vertex	rad		0.1032	0.1464	0.1442	0.1475	0.1060	0.1006	0.0844	0.1453	0.0870
rope load on vertex	N		479242	680525	671996	687636	491625	466616	393003	676310	404832
horizontal span length	m	336.19	10.38	92.46	10.62	378.05	10.61	450.51	10.58	10.60	556.02
maintenence vehicle added sag	m	0.544	0.016	0.143	0.016	0.586	0.016	0.701	0.016	0.016	0.861
live load component	N	74606	2382	9625	-172	-16320	-258	11395	966	-612	23123
belt bending radius	m	1505	1547	1579	1592	1571	1576	1565	1582	1585	1572
belt span actual length	m	343.497	10.602	92.752	10.603	378.638	10.600	451.452	10.596	10.602	558.366

Haul Rope Calculation

Haul rope for maintenance vehicle is related to an emergency rope.
It complies with the guidelines by European standard EN12927-2 for people transportation; according to it, the minimum haul rope safety factor is ≥ 3.00 (reference: §5.2.1.6).

Haul rope is closed in a loop with two socket end fixings, which are connected to the hanger pin of the vehicle.

Haul rope is a Redmont 6k19, diameter 20mm; its main features are listed below:



Description	Redmont 6k19 (6 x k19 S - SFC)	
Diameter	[mm]	20
Mass	[kg/m]	1.60
Section	[mm^2]	180
Elasctic Modulus	[N/mm^2]	125000
Minimum Breaking Force	[kN]	272

Figure 3 Hauling ropes characteristics

An example of haul rope dimensioning is reported below:

Table 2 Analysis of hauling rope in nominal conditions

MAINTENENCE ROPE

	section	1	2	3	4
checked parameter	codex		governing span		
maximunm gradient	1	1	23	28	41
minimum gradient	2	5	18	33	44

codex	**1**	
running direction	1	
concentrated load	32000	N
rope weight	14.56	N/m

	section	1	2	3	4	extreme
reference tension	N	41128	49891	44548	48955	
rope actual length	m	3808.545	4121.107	3667.206	2674.454	
length goal	m	3808.545	4121.107	3667.206	2674.454	
length discrepancy	m	0.000	0.000	0.000	0.000	
maximum tension	N	52201	50830	52143	53835	53835
minimum tension	N	41128	47697	44548	48382	41128
rope safety factor		5.21	5.35	5.22	5.05	5.05
peripherical force	N	10052	3060	6794	5223	10052

Belt Conveyor Line Calculation

The choice of the belt conveyor is the result of static analysis performed in six different conditions:

- minimum temperature (-20°C), loaded belt
- maximum temperature (40°C), loaded belt
- minimum temperature (-20°C), empty belt
- maximum temperature (40°C), empty belt
- worst starting condition (with an inclined section loaded and minimum temperature)
- worst braking condition (with a declined section loaded and maximum temperature)

The layout of the track ropes is set as input for the belt calculation; the rope configuration corresponding to maximum temperature and loaded belt is prudently considered for all conditions.

The belts comply with the limits imposed by the manufacturer (e.g. safety factor, minimum radius in vertical convex curves, transition distances, turnover lengths …), in detail:

- average running (laden belt or empty belt) safety factor: ≥ 6.67
- average transient phases (starting/stopping) safety factor: ≥ 4.60
- local transient phases (starting/stopping) safety factor: ≥ 4.00

The dimensioning loads and factorisation of belt tension along the turnovers was subject to and approved by the belt manufacturer, considering also the beneficial effect of the high splicing efficiency foreseen for this application.

The idlers on the carry side are 6-roll garlands with a 2.0m spacing, while on the return side they are two-roll garlands, with 6.0m spacing.

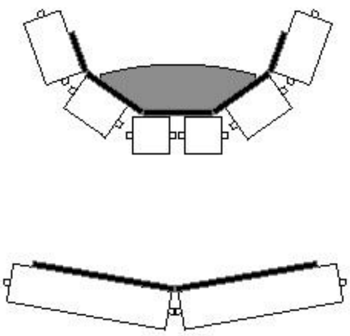


Figure 4 Rollers

The 6-roll garland was selected for its 70° troughing angle able to maximize the stability of the system: the material is kept in the centre of the system, with a resulting mass-centre than the geometrical-centre. This configuration is maximising the stability of the system in all the load configuration also in case of high side wind:

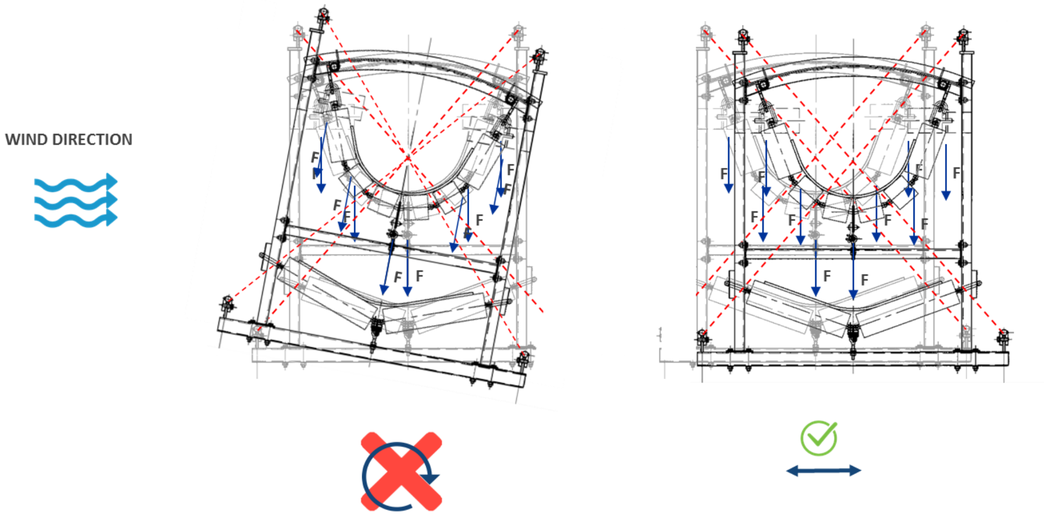


Figure 5 Wind effect

On towers, the garlands on the carry side and on the return one are replaced respectively by three-roll and one-roll fixed frame idlers, reducing their spacing, in order to enable vertical convex curves with a radius of 75m.

The troughing angle of the carry side on towers is 25°, in order both to reduce local tension on the edges of the belt and to avoid compression in the middle; the filling factor and the edge distance with 25° troughing angle are respectively 61% and 187mm, avoiding any risk of material spillage.

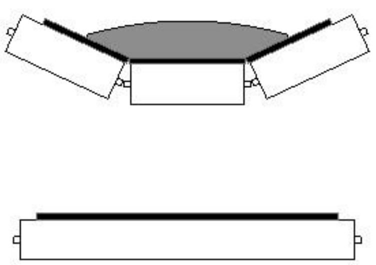


Figure 6 Traditional conveyor rollers

Belt line calculation is performed according to CEMA 7th – Universal method, using the software Belt Analyst™, written by Overland Conveyor Company Inc.

The belt of the aerial conveyor is computed according to the following data:

- Load capacity: 1500 mtph
- Belt speed: 4.0 m/s
- Belt width: 1200 mm
- Bulk density: 1350 kg/m^3
- Surcharge angle: 15°
- Maximum lump size: 300 mm

The resulting filling factor (for 70° troughing angle) and edge distance are respectively 43% and 237 mm.

The belt is tensioned by a gravity take-up, which is installed in the head station.

Two drive pulleys are installed in the head station, while one drive pulley is placed in the tail station. Each drive pulley has one motor; the motor and gear unit type is the same for all drive pulleys.

Each drive pulley has a wrap angle of 210° and ceramic lagging, in order to ensure drive friction.

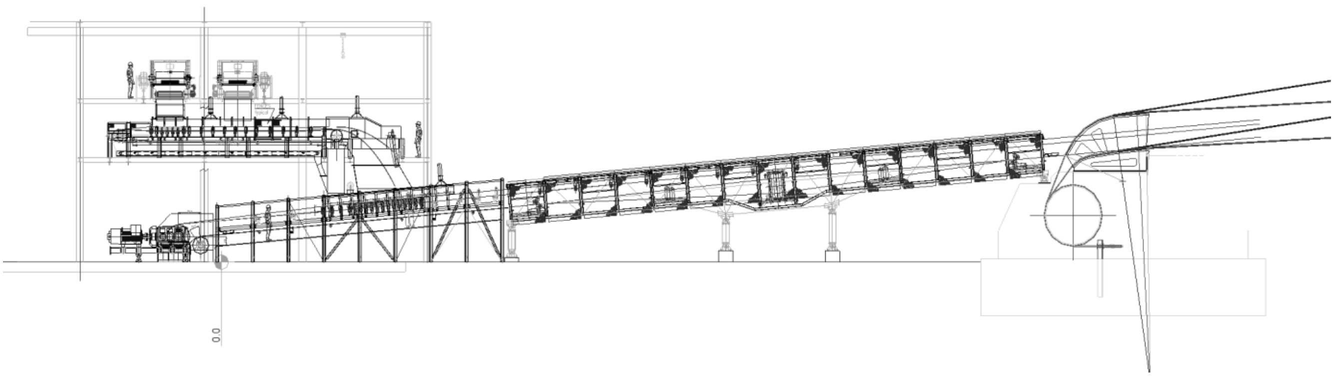


Figure 7 Loading station

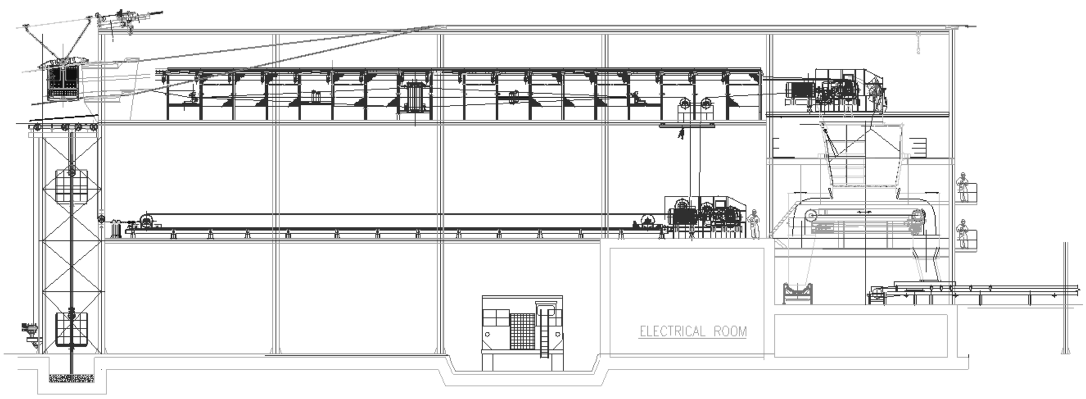


Figure 8 Offloading station

The belt is calculated considering 160s start time, while stopping the belt, using only the electric motor, occurs in 30s. In order to take into account the behaviour of the belt during transient phases (start/stop), a detailed dynamic analysis is performed.

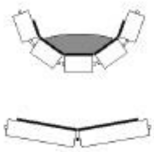
All garlands have Ø159mm steel rolls. Idler to belt friction coefficient is 0.50.

An example of belt dimensioning is reported below.

Table 3 Analysis in nominal conditions

General

Belt Width	mm	1200
Belt Speed	m/sec	4.00
Load	mtph	1500
Low Temp	C	25
Total Mass	kg	1659012
Total HS Inertia	kg-m^2	1077
Calculation Methodology		CEMA Universal (6th
Friction Force	kN	263.4
Lift Force	kN	52.0
Misc Drag	kN	31.6
Equivalent DIN f Friction Factor		0.0186
Equivalent DIN C Friction Factor		1.12



Idlers

		Carry	Return
Specification			
Description		D6	D6
Estimated No of Idlers		3,843	1,555
Belt Width	mm	1194	1194
No of Rolls		5	2
Angle	Deg	70	20
Roll Diameter	mm	160	160
Type		Fixed	Fixed
Rotating Weight	kg	32.0	26.0
Bearing Type		Ball	Ball
Rating	N	5387	4470
Max Actual Load	N	2748	2118
Max Calc Load	N	4068	2318
RPM		477	477
Min L10 Life	Hrs	145,911	450,933
Average L10 Life	Hrs	207,349	953,415
Vert. Misalign	mm	3.175	3.175
Angl. Install Tol.	mm	12.700	12.700
Forward Tilt	Deg	0.000	1.000
Mfg. Tolerance	mm	2.540	2.540
Idler/Belt Friction		0.50	0.50
Seal Drag - Kis	Nm	0.169	0.169
Speed Factor - Kiv	Nm/rpm	0.0000	0.0000
Load Factor - Ciw	mm-N/N	0.0518	0.0518
Regen Factor - Rris		0.00	0.00
Drag Multiplier		1.00	1.00
Kt Multiplier		1.01	1.01

Takeup

Type		Auto	
Tension	kN	122.6	
Max/Min Tension Accel/Decel		155.7	96.6
No of Pulleys		1	
Weight	kg	50,000	
Takeup Req'd for ...		Sag	Slip
Running	kN	85.4	90.3
Accelerating	kN	110.1	118.3
Decelerating	kN	23.2	19.6
Selected Due To		Accel Slip	
Approx Carriage Travel Due to ...		(Refer to Belt Manufacturer)	
Run Tensions	m	2.72	
Accel Tensions	m	1.85	
Decel Tensions	m	2.55	
Permanent	m	15.54	
Total	m	[illegible]	

Material

Description		Limestone, Crushed
Density	kg/m^3	1350
Surcharge Angle	Deg	15
Actual Area	m^2	0.077
Percent Loaded	%	43
Edge Distance	mm	237
Bed Depth	mm	173
Lump Size	mm	350
Chute Drop Hght	m	3.20
Impact Energy	N-m	2,271

Profile

Horizontal Length	m	7,231
Vertical Lift	m	51

Belt

Type		
Description		1200 Steel Cord 2500
Cover Gauge	mm	6.0 x 6.0
Cover Rubber Constants		user defined
Rating	kN / N/mm	366 / 305
Safety/Design Factor		8.20
Elastic Modulus	N/mm	140,000
Belt Weight	kg/m	36.0
Apparent Length	m	14,595
Max Run Ten	kN / N/mm / %	353.9 / 295 / 97%
Max Accel Ten	kN / N/mm / %	350.2 / 292 / 96%
Max Decel Ten	kN / N/mm / %	279.2 / 232 / 76%
Ave Run Ten	kN / N/mm / %	198.2 / 165 / 54%
Ave Accel Ten	kN / N/mm / %	179.1 / 149 / 49%
Ave Decel Ten	kN / N/mm / %	194.7 / 162 / 53%
Min Run Ten	kN / N/mm / %	54.3 / 45 / 15%
Min Accel Ten	kN / N/mm / %	23.9 / 20 / 7%
Min Decel Ten	kN / N/mm / %	110.8 / 92 / 30%

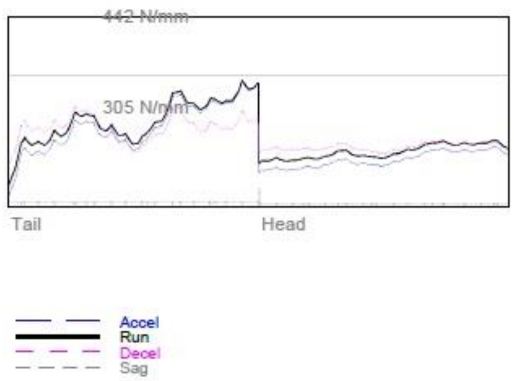


Table 4 Drives analysis in nominal conditions

Drives				
Number		1	2	3
Location		171	177	355
Number of Drives		1	1	1
Total Nameplate	kW	615	615	615
Power Ratio		0.33	0.33	0.33
Efficiency		0.90	0.90	0.90
Wrap Angle	Deg	180	193	210
Synchronus	RPM	1500	1500	1500
High Spd Inertia	kg-m^2	43.12	43.12	43.12
Running				
Required	kW	515	514	513
% Nameplate		83.8	83.6	83.4
Eff Tension	kN	116.0	115.6	115.4
Friction Factor		0.50	0.50	0.50
Wrap Factor		0.26	0.23	0.19
Slip Ratio		4.81	5.40	6.24
Actual T1/T2 Ratio		1.48	1.94	3.11
Breakaway				
Brkwy Frict Mult		1.50		
Rqr'd Brkwy Torq	% FLT	119		
Motor Peak Torque	% FLT	225		
Acceleration				
Start Time	Sec	160.0		
Start Torque, Avg	% FLT	94		
Eff Tension	kN	128.1	127.7	127.5
Friction Factor		0.55	0.55	0.55
Wrap Factor		0.22	0.19	0.15
Slip Ratio		5.63	6.39	7.50
Actual T1/T2 Ratio		1.56	2.32	6.30
Stopping				
Est. Drift Time	Sec	19.1		
Dr. Stop Time	Sec	30.0		
Stop Torque, Avg	% FLT	41		
Decel Eff Ten	kN	46.8	49.9	50.3
Decel Ratio		0.33	0.33	0.33
Friction Factor		0.55	0.55	0.55
Wrap Factor		0.22	0.19	0.15
Slip Ratio		5.63	6.39	7.50
Actual T1/T2 Ratio		1.23	1.32	1.45

Table 5 Belt tensions in concave and convex curves

Comments: **VERTICAL CURVE ON THE FIRST TOWER**

Belt Data

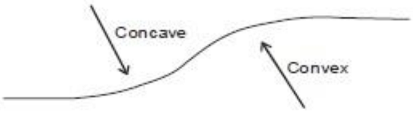
Belt Specification	
Belt Width (mm)	1200
Belt Rating (N/mm)	305
Elastic Modulus (N/mm)	140,000
Belt Weight (kg/m)	36.00

Curve Data

Curve Location	9
Incoming Angle (deg)	18.00
Outgoing Angle (deg)	3.93
Radius (m)	75
Arc Length (m)	18
Curve Type	Convex

Idler Data

Trough Angle (deg) 40



Minimum Tension Calculation Method

Input Method (C or Z) Z

(CEMA or Zero Stress)

Vertical Curve Tension Data

Input	Max	Running Min	Starting Max	Stopping Min
Overall Tension (N)	178,436	178,436	149,663	226,512
(N/mm)	149	149	125	189
Output				
Maximum Tension (N/mm)	348	348	324	388
	114%	*114%*	*106%*	*127%*
Minimum Tension (N/mm)	47	47	23	87
	15%	*15%*	*8%*	*29%*

Liftoff Radius (m)
Projected Length (m)
Empty Belt Liftoff (mm)

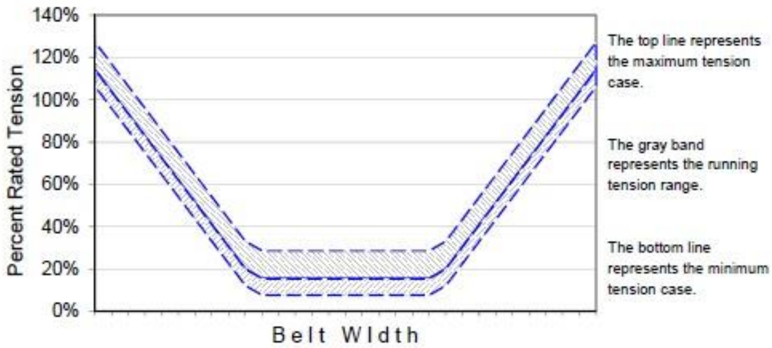
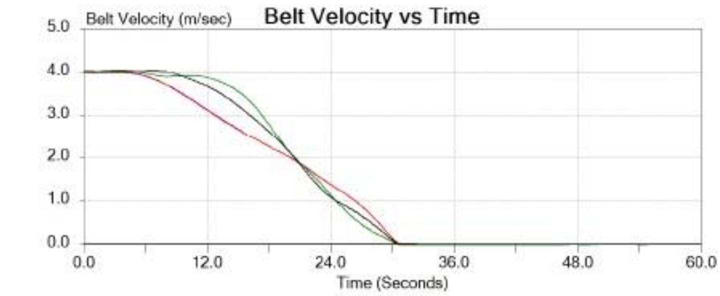


Table 6 Dynamic analysis of stopping cycle

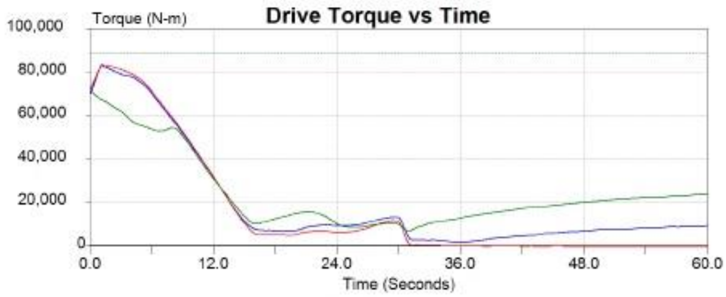
Belt conveyor line calculation
DYNAMIC ANALYSIS
STOP WITH INVERTER

Belt Velocity - STOP



Location	Maximum (m/sec)	Minimum (m/sec)
Drive #1/Head	4.00	0.00
Drive #2	4.00	0.00
Takeup	4.03	-0.01
Drive #3	4.01	0.00

Drive Torque - STOP



Location	Maximum (N-m)	Minimum (N-m)
Drive #1/Head	83,338	1,443
Drive #2	82,565	-330
Drive #3	71,533	6,774

CONCLUSION

The result of the study is the longest aerial belt in the world composed of one single belt of 14.4 km running from the loading station to the unloading station suspended by 4 segments of tracking ropes (to reduce the construction time) through 18 supporting towers at a speed of 4 m/s.

From May 26th, 2016 and June 1st, 2016 the commissioning and start-up of the system has been done successfully demonstrating the operational parameters vs contract requirements, in particular: 1,500 Tph max. capacity (even if normal operation capacity will be 1,000 Tph) and max. power consumption of 1,750 kW.

The conveyor has been tested in the following conditions:

- Loading
- Constant feeding
- Raise to nominal capacity
- Drop of capacity
- Overloading
- Emergency stop

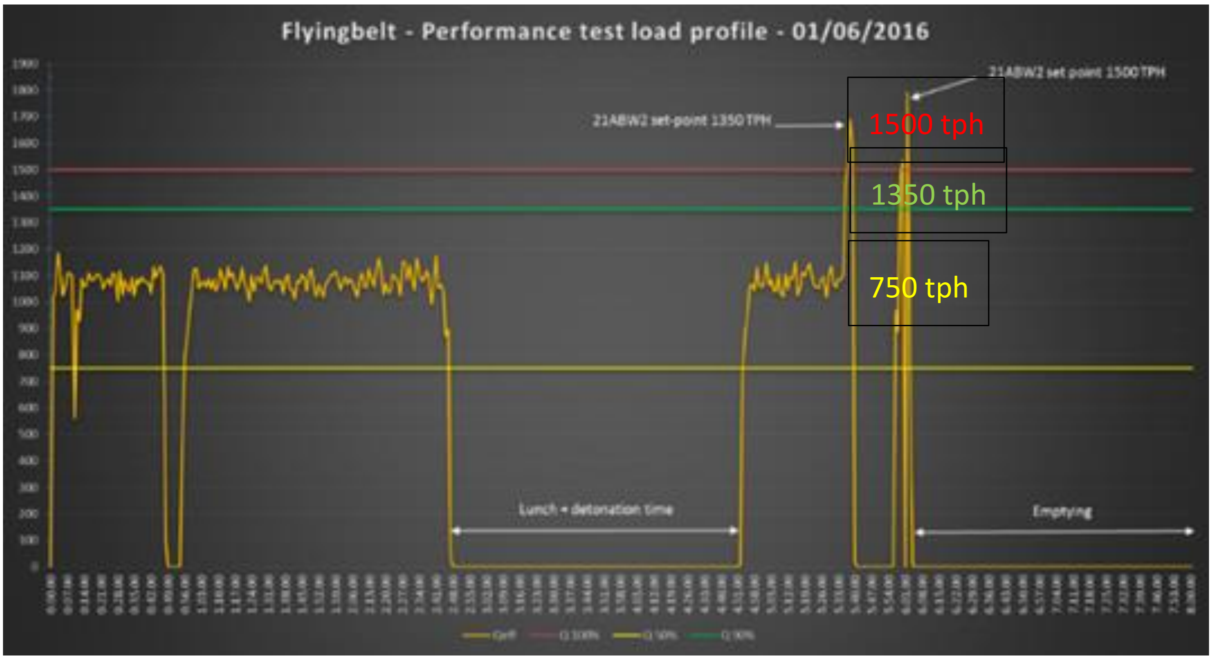


Figure . 9 Example of load diagram during commissioning

During the first 8 months of operation, real operating data has been collected and compared to the design parameters, the result is the following:

Table 7 Operational data year 2016

Month	Average Tph	Load percentage	Tons transported	Power consumpion (kWh)
June	1.026	68,4%	12.183	14.010
July	949	63,3%	2.961	3.405
August	1.035	69,0%	35.304	40.600
September	1.142	76,1%	32.401	37.261
October	1.073	71,5%	83.615	96.157
November	991	66,1%	54.892	63.126
December	1.015	67,7%	82.303	94.648
January	1.021	68,1%	65.138	74.909
TOT	**1.037**	**65-75%**	**368.797**	**424.116**

The above data, even if for a limited number of operating time per day compared to the theoretical use, are demonstrating the compliance with the design parameters, in particular 1,15 kWh/ton means, assuming a cost of 0,12 USD/kWh, 0,138 USD per ton transported, a very competitive value considering that the consumption includes the inspection along the line with the maintenance vehicle.

Moreover, no spare parts or maintenance intervention has been done in this period and only six people are required during the operation (2 in quarry main control room + 4 for maintenance of the whole crushing and conveying).

REFERENCES

Standards:
O.I.T.A.F. (International Organizations for Transportation by Rope) - BOOK 8 – edition 2010: recommendations for the construction and operation of material handling unidirectional and reversible ropeway installations, cable cranes and material handling funiculars (www.oitaf.org).
CEMA Belt Book “Belt Conveyors for Bulk Materials” 7th edition

ABOUT THE AUTHORS

ALBERTO CONTIN

Alberto Contin graduated in Mechanical Engineering at Politecnico di Torino. He started his work at Agudio-Leitner in 1997 as mechanical designer in the technical office where he has been involved in different types of cableways. In 2008 he started focusing on material transportation and he developed the recent installations of cablecranes, material ropeways and Flyingbelt. Today he is the senior product manager for material handling under the brand Agudio.

Alberto Contin

LEITNER SpA – Office Leini
Senior Product Manager
Ph +39 011 997 33 55
alberto.contin@agudio.com
www.agudio.com

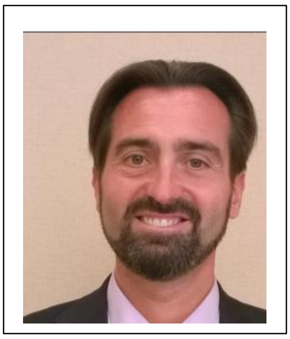
MATTEO COLOMBO

Matteo Mario Colombo has a degree in Civil Engineering – Transportation and a degree in Aerospace Engineering, from Politecnico di Milano. He works as Project Engineer at the technical office of Leitner, designing ropeway installations for both people and material transportation.

Matteo Colombo

LEITNER SpA – Office Leini
Senior Product Manager
Ph. +39 011 069 12 94
matteo.colombo@leitner.com
www.agudio.com

ABOUT THE PRESENTER



STEFANO CATTANEO

Stefano Cattaneo has a degree in mechanical engineering from Politecnico di Milano and an MBA from MIP business school. He started his career in Foster Wheeler as an engineer and then moved into management positions in leading engineering companies.

Today he is Global Sales and Marketing Manager for rope-hauled material transportation systems in Agudio-Leitner”.

Stefano Cattaneo

LEITNER SpA – Office Leini
Global Sales and Marketing Manager
Ph +39 011 997 33 55
stefano.cattaneo@agudio.com
www.agudio.com

