MONT BLANC
NEW ROPEWAYS
construction and operation in extreme working conditions

DIMENSIONE INGENIERIE
INGEGNERIA PER LA MONTAGNA

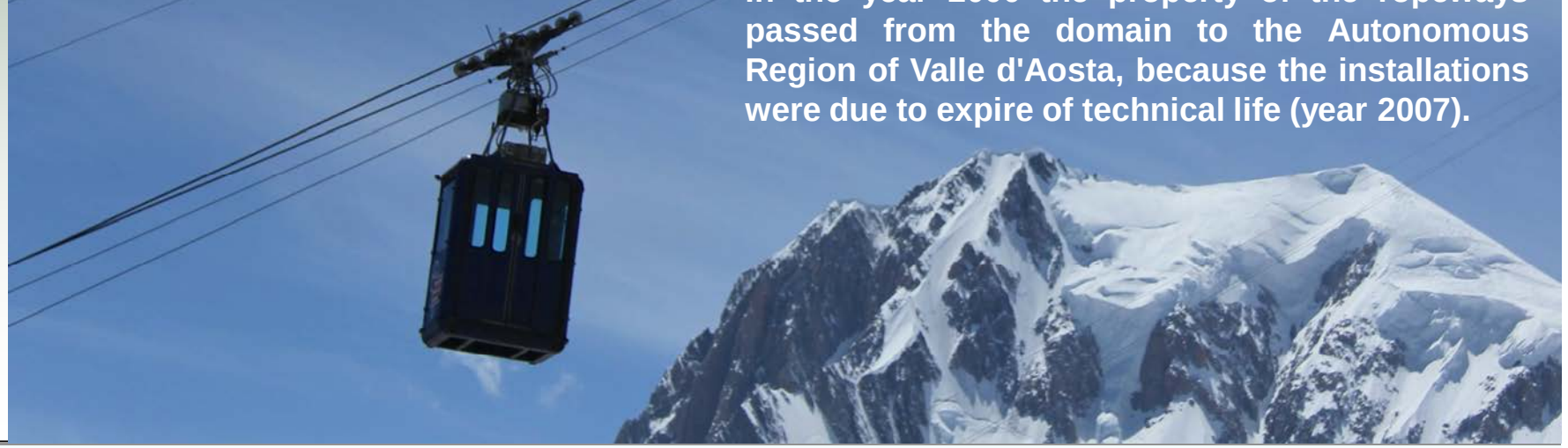
cordée Mont Blanc

THE CURRENT ROPEWAYS

Mont Blanc ropeways were made between 1940 and 1947 from military state property.

The current ropeways consist of three sections that lead from La Palud - Courmayeur (1370 m) to Punta Helbronner (3452 m), in the core of the Mont Blanc mountain chain.

In the year 2000 the property of the ropeways passed from the domain to the Autonomous Region of Valle d'Aosta, because the installations were due to expire of technical life (year 2007).



First section "La Palud – Pavillon"

-Tensioning bottom station	1370 m a.s.l.
-Driving upper station:	2178 m a.s.l.
-Inclined length:	1806 m
-Difference in level:	808 m
-Capacity:	260 p/h
-Capacity of each car	26+1 persons
-Maximum speed	8 m/s
-Trip duration:	5 minutes

Second section "Pavillon – Rifugio Torino"

-Tensioning bottom station:	2181 m a.s.l.
-Driving upper station:	3329 m a.s.l.
-Inclined length:	2440 m
-Difference in level:	1148 m
-Capacity:	300 p/h
-Capacity of each car	30+1 persons
-Maximum speed	10 m/s
-Trip duration:	5 min. 56 Sec

Third section"Rif. Torino – Punta Helbronner"

- Driving bottom station	3320 m a.s.l.
-Tensioning upper station	3452 m a.s.l.
-Inclined length:	252 m
-Difference in level:	132 m
-Capacity	400 p/h
-Capacity of each car	8 persons
-Maximum speed	6 m/s
-Trip duration:	1 min. 7 Sec.

BRIGDE OVER TWO NATIONS

Mont Blanc ropeways are an integral part of international transport connection between Courmayeur (Italy) and Chamonix (France), and form a strong relationship between the two alpine communities located at the foot of the Mont Blanc. During the years of the tunnel traffic closure they represented the only cross-border direct connection between the two valleys.

The glacier crossing from Courmayeur (1370 m) to Chamonix (1030 m), through Punta Helbronner (3452 m) and Aiguille du Midi (3842 m), by the cable car is still one of the most audacious transport infrastructure in the world.

The brilliance and uniqueness of solutions are still astonishing (eg suspended tower), and it's remarkable the genius of the inventor ing. Lora Totino and the work of all the people who have worked for their realization more than 60 years ago. It is a transport infrastructure which is both a link between the alpine communities, and cultural heritage and technology to be exploited

THE GREAT PRECURSOR

The new ropeways project is divided in two sections from 1308 m of altitude of Pontal d'Entreves to 3452 m of Punta Helbronner.

OBJECTIVES

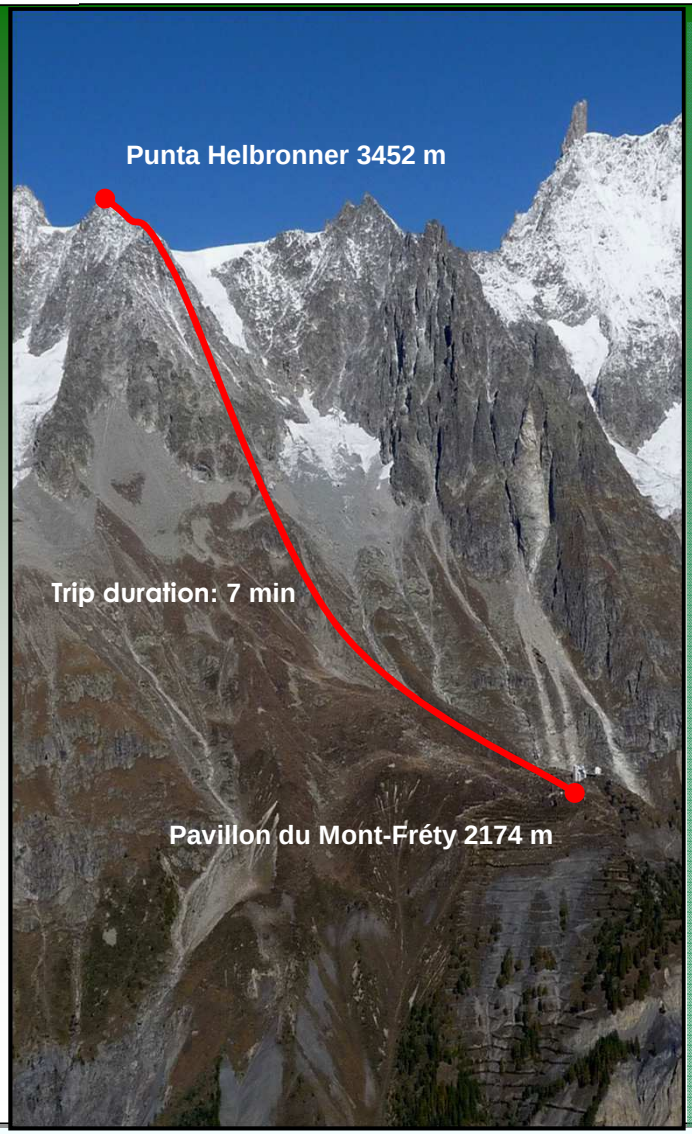
1. **Increase transport capacity**: replace the current expiring ropeways improving the hourly flow and ensuring the international connection with the plants in France
2. **Improve safety and reliability**: ensure access and evacuation of tourists, especially from sites at high altitude, in all weather conditions
3. **Valorize the features of the site**: build installations and stations so that customers can enjoy the incomparable view of the Mont Blanc
4. **Provide facilities and comfort**: equip the stations of appropriate areas of public utility released by commercial facilities and dining options, museum areas, paths of study, multimedia and scenic areas outdoor and indoor to allow a pleasant stay also in the days of bad weather
5. **Respect for the environment**: build stations integrated and harmonized with surrounding areas by reducing environmental impact and energy requirements; install highly technological plant for water supply and waste management; recovery of the areas of the site and the old volumes disused

CHARACTERISTICS

1st section
Pontal d'Entrèves – Mont Fréty

Hourly flow	800	pers/h
Inclined length	1.748	m
Height difference	864	m
Line speed with main drive	9,0	m/s
Carrier mass with full load	15.000	kg
Carriers capacity	80	pers
Main drive power	650	kW
Reserve drive power	325	kW
Recovery drive power	120	kW
Rescue drive power	120	kW
Towers	3	
Carrying ropes diameter	64	mm
Upper hauling rope diameter	35	mm
Lower hauling rope diameter	35	mm
Rescue rope diameter	16	mm

CHARACTERISTICS



2nd section
Mont Fréty – Punta Helbronner

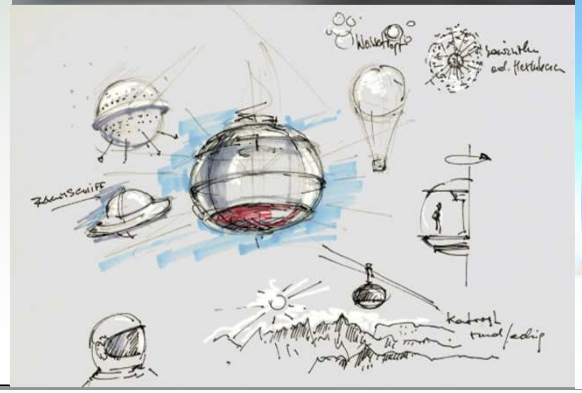
Hourly flow	600	pers/h
Inclined length	2.636	m
Height difference	1.273	m
Line speed with main drive	9,0	m/s
Carrier mass with full load	15.000	kg
Carriers capacity	75	pers
Main drive power	600	kW
Reserve drive power	300	kW
Recovery drive power	120	kW
Rescue drive power	120	kW
Towers	2	
Carrying ropes diameter	64	mm
Upper hauling rope diameter	37	mm
Lower hauling rope diameter	35	mm
Rescue rope diameter	16	mm

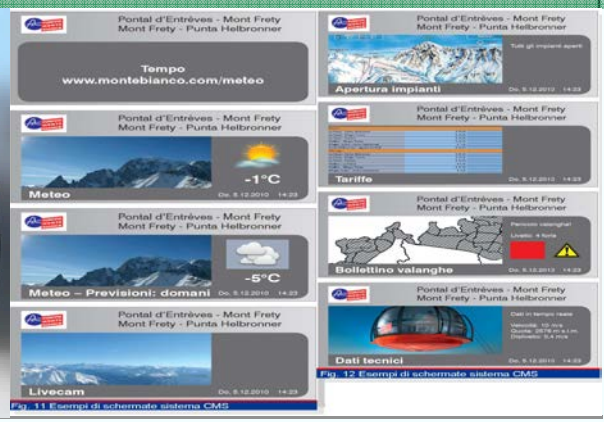
ROPEWAY CHARACTERISTICS

A ropeway ball-like (the spherical shape has always been the preferred design for the spaceships) for Mont Blanc, offers many advantages. The sphere is the shape that has the outer surface lower with respect to the volume. It has no corners or edges, so it is able to support the load evenly from all sides. It does not show structural defects and it is the form less wasteful of energy.

The cars become a center of information and entertainment during the trip. Passengers receive on the screens detailed information on current weather, avalanche risk, offers, schedules of the plant, events, promotions and various news. A camera placed under the floor allows to transmit in the cab panoramic images of the valley below.

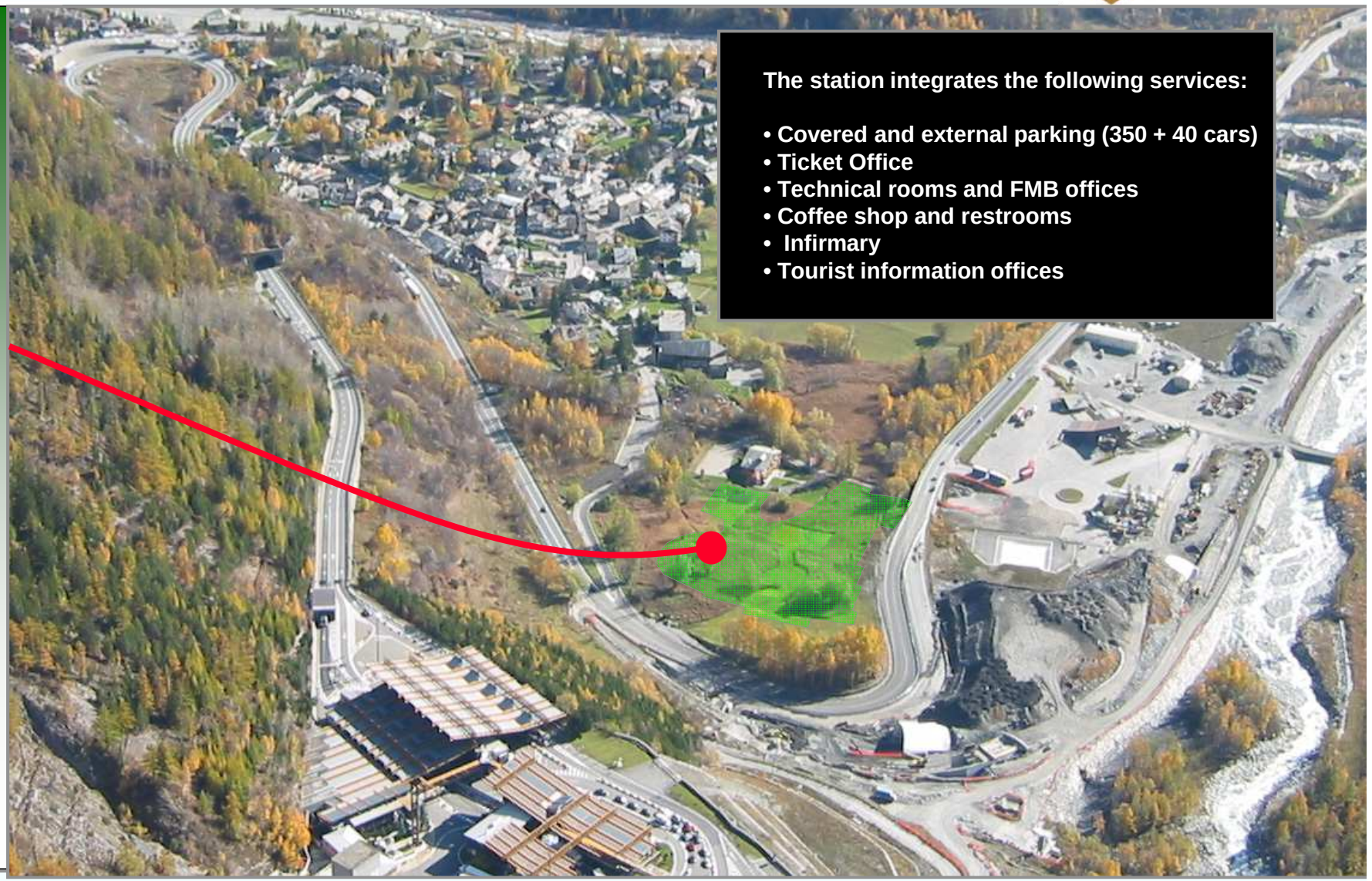
The rotating cab does a complete turn during the single trip allowing everyone to see the panorama to 360°





PONTAL D'ENTRÈVES

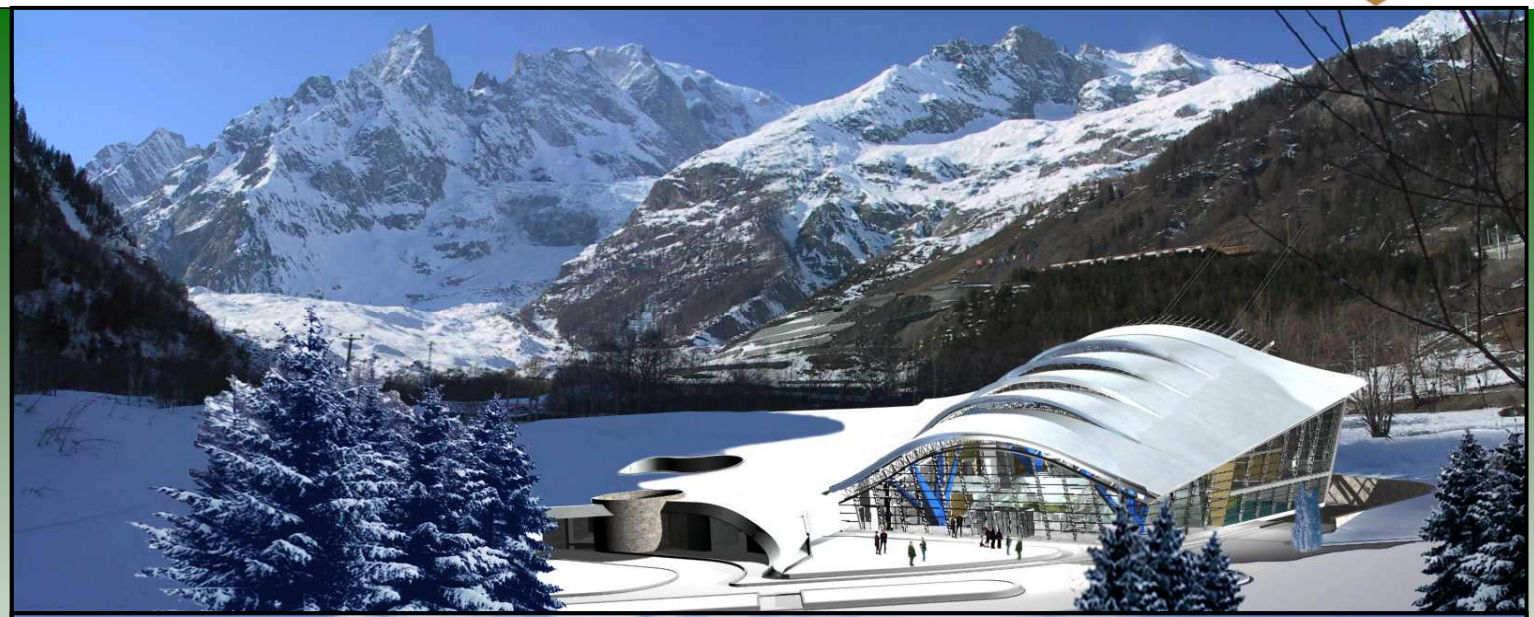
PONTAL D'ENTREVES



The station integrates the following services:

- Covered and external parking (350 + 40 cars)
- Ticket Office
- Technical rooms and FMB offices
- Coffee shop and restrooms
- Infirmary
- Tourist information offices

PONTAL D'ENTREVES

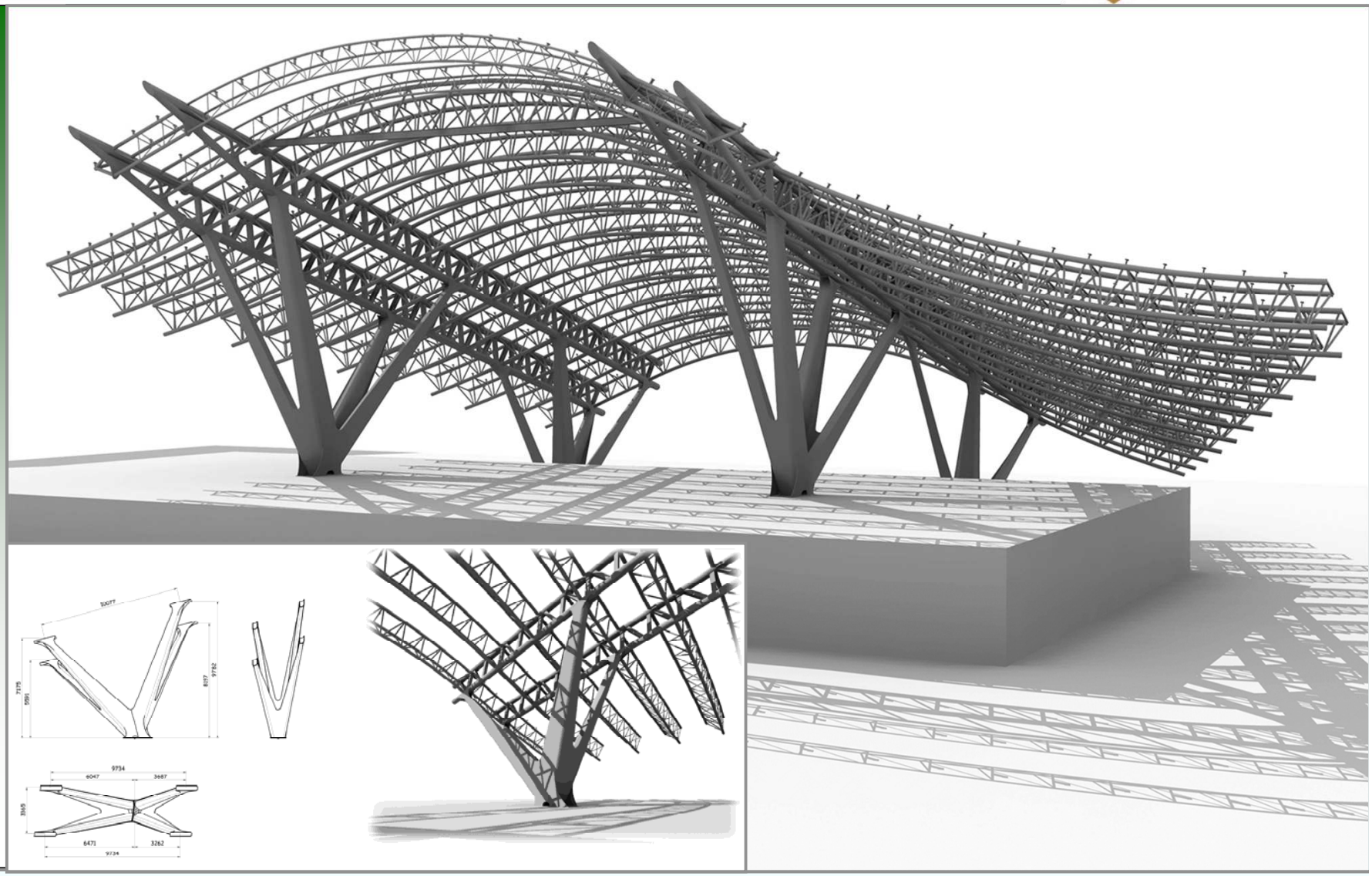


PONTAL D'ENTREVES

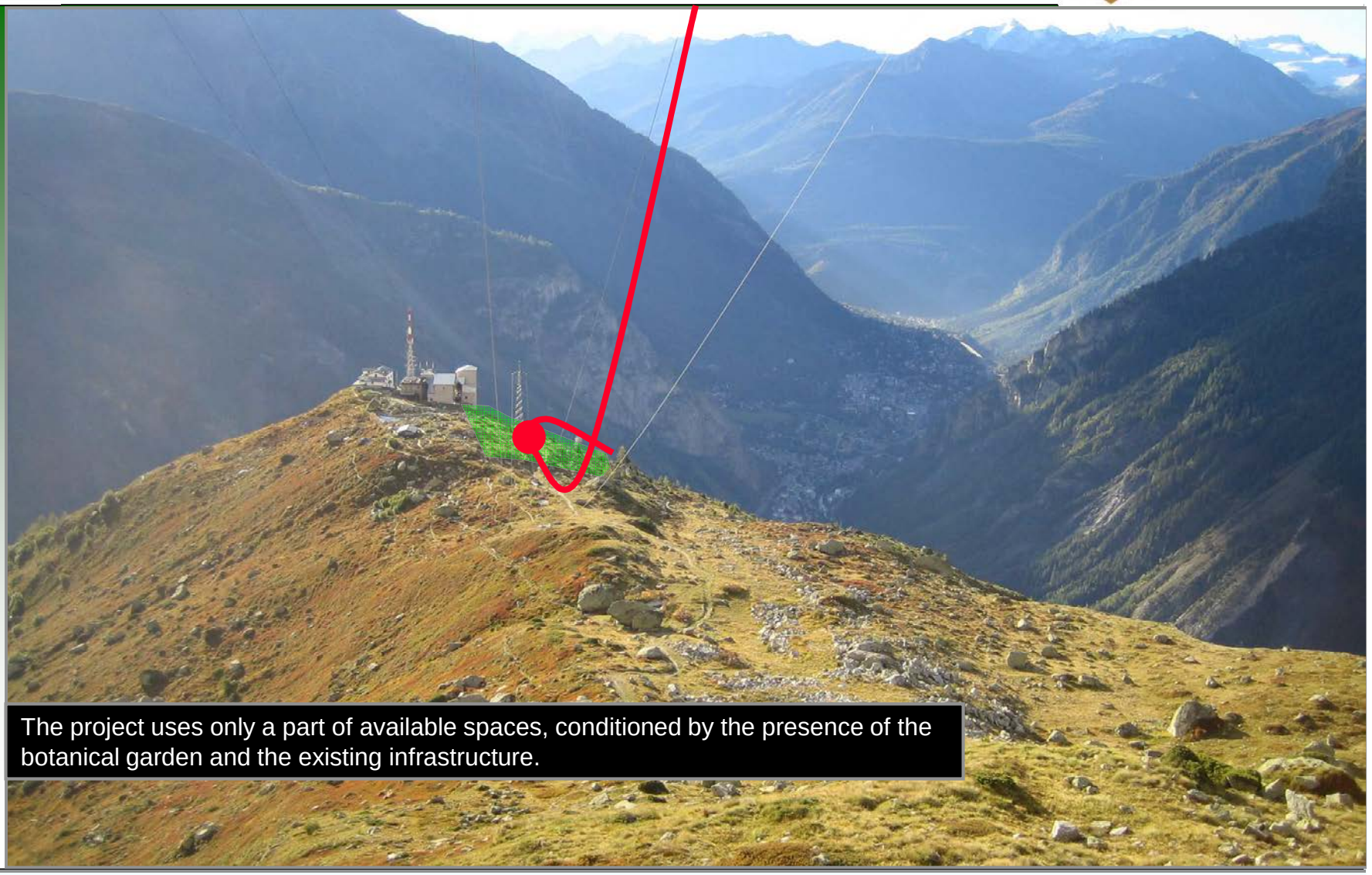
PONTAL D'ENTREVES

The roofing of the station is made by 10 curved beams wave formed, supported by four large longitudinal beams and tubular pylons.

PONTAL D'ENTREVES



PAVILLON DU MONT-FRETY

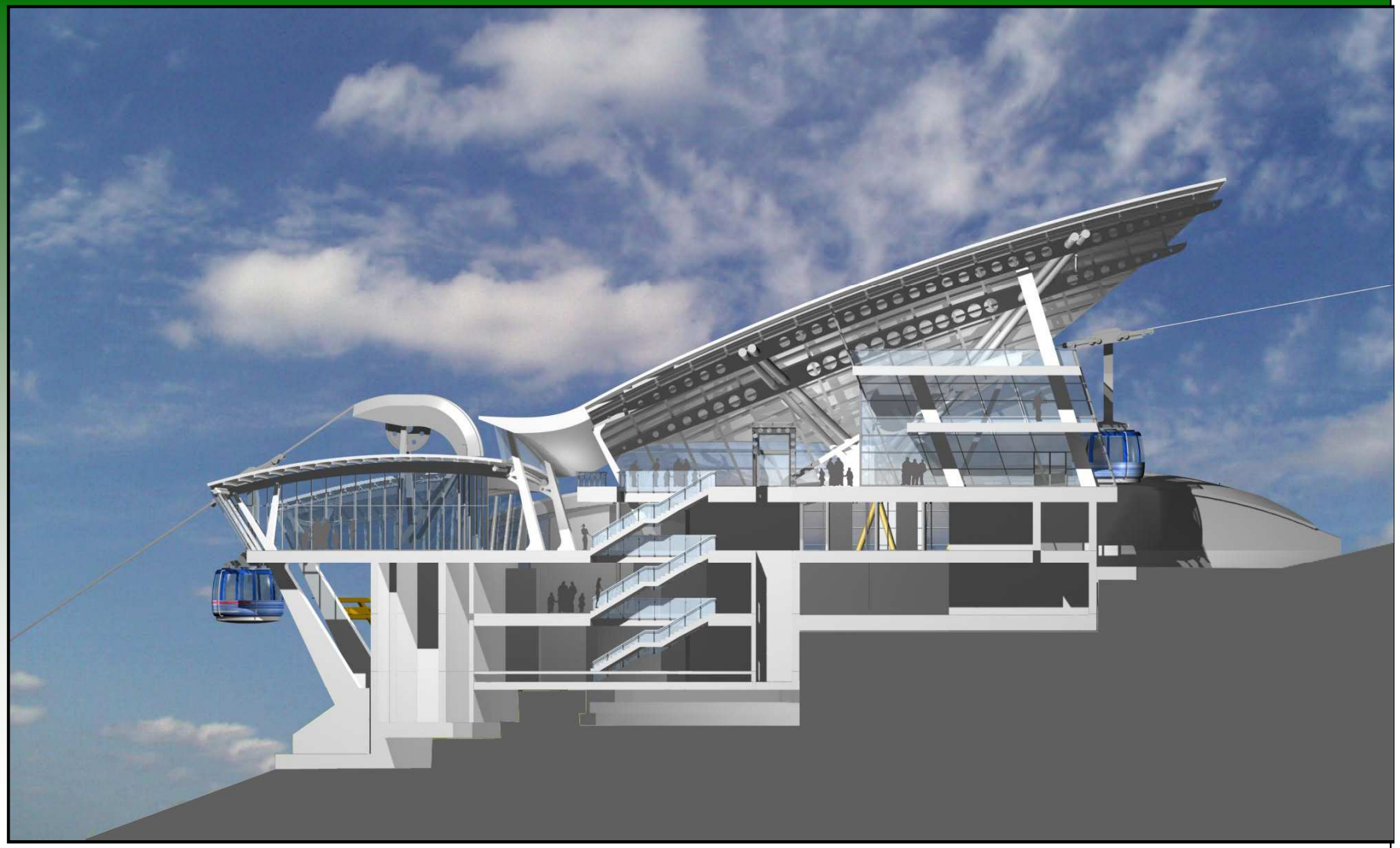


The project uses only a part of available spaces, conditioned by the presence of the botanical garden and the existing infrastructure.

PAVILLON DU MONT-FRETY

Pavillon intermediate station was designed to fit elegantly within the corrugated alpine context of Mont Frety.

PAVILLON DU MONT-FRETY



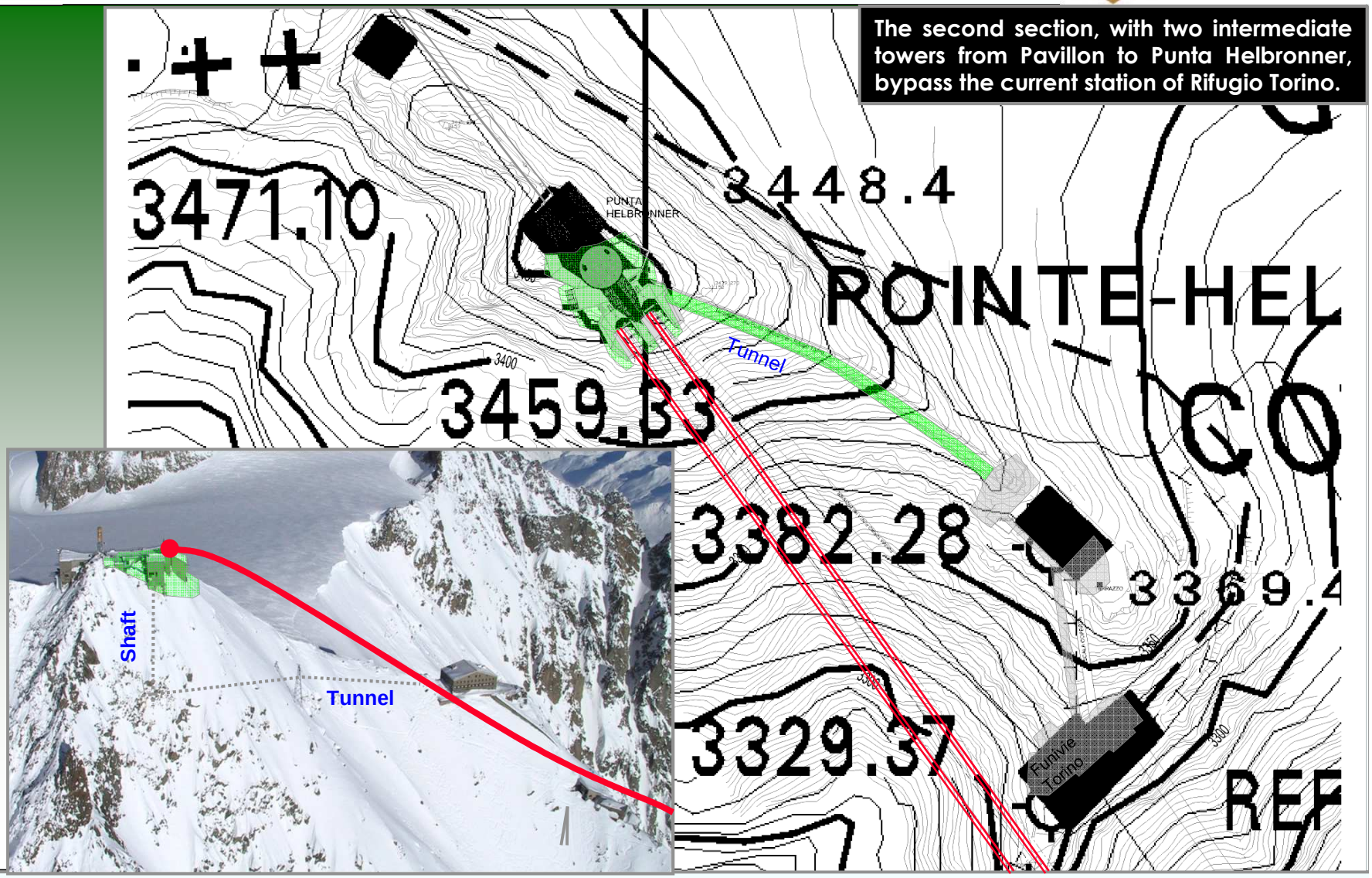
PAVILLON DU MONT-FRETY

The features of the site allow the insertion of a series of complementary services :

- Inner lifts
- Bar with panoramic terrace
- High level restaurant with panoramic terrace
- Typical Restaurant
- Multimedia room and theater with 100 seats
- Commercial Areas
- Wide museum area
- Thematic communication areas
- External routes of approach to nature
- Botanical Garden
- Solarium with the view of Mont Blanc

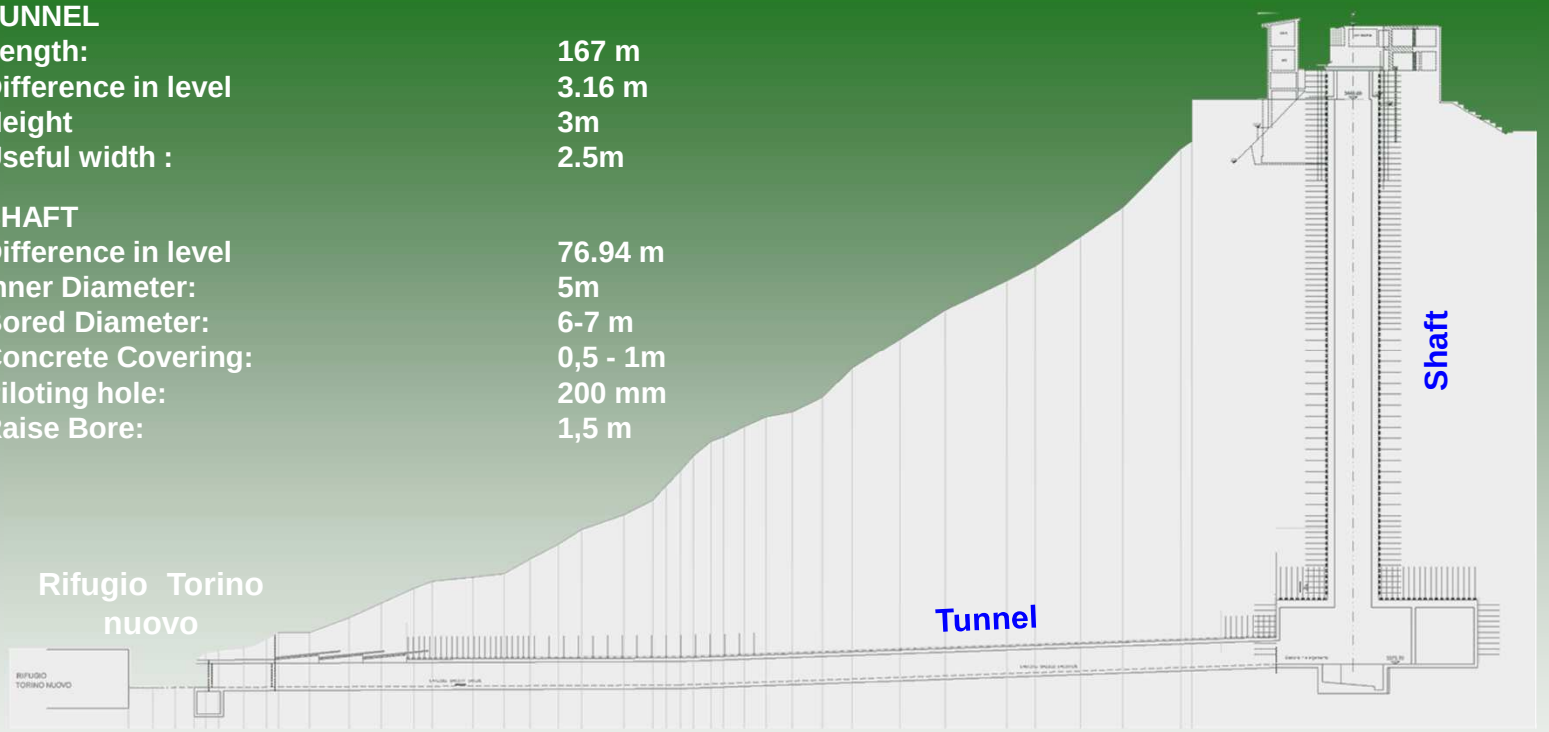
PUNTA HELBRONNER

The second section, with two intermediate towers from Pavillon to Punta Helbronner, bypass the current station of Rifugio Torino.



PUNTA HELBRONNER – TUNNEL - SHAFT

TUNNEL	
Length:	**167 m**
Difference in level	**3.16 m**
Height	**3m**
Useful width :	**2.5m**
SHAFT	
Difference in level	**76.94 m**
Inner Diameter:	**5m**
Bored Diameter:	**6-7 m**
Concrete Covering:	**0,5 - 1m**
Piloting hole:	**200 mm**
Raise Bore:	**1,5 m**



The shaft, made by reinforced concrete with internal diameter of 5 m and about 80 meters deep in the rock, ensures the consolidation of the rocky substrate and provides maximum safety to the anchorages of the ropes. The structure equipped with central elevators and emergency staircase, offers the connection between the refuge "Torino Nuovo" and the new station, because the new project, will eliminate the current stop near the Refuge.

The edgy nature of the external forms is in close relationship with the use of materials with high performance. The selected shapes are also able to avoid accumulation of snow and ice on the outside surfaces of the building, even through the contribution of thermostatic performance of the coating materials.

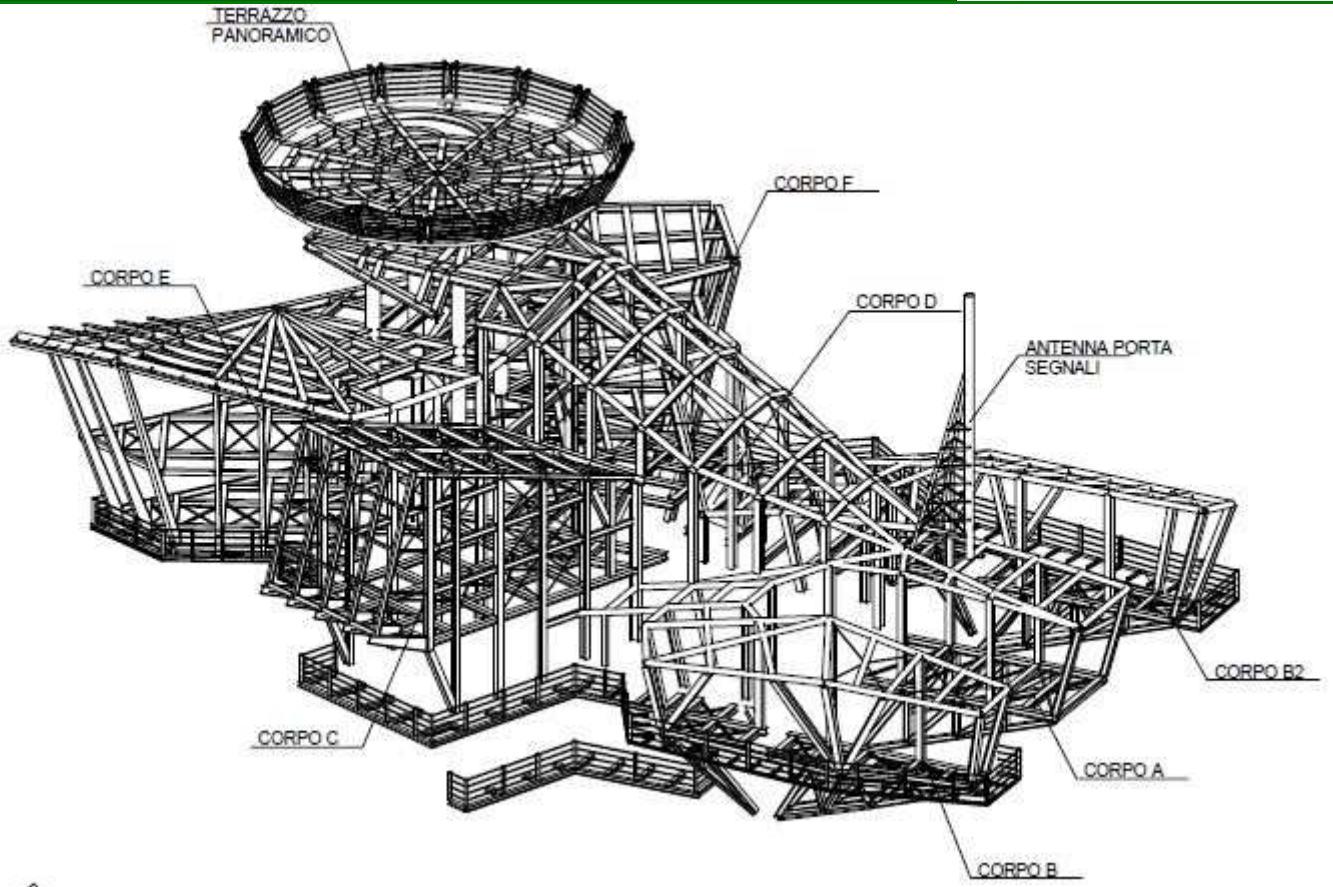
PUNTA HELBRONNER

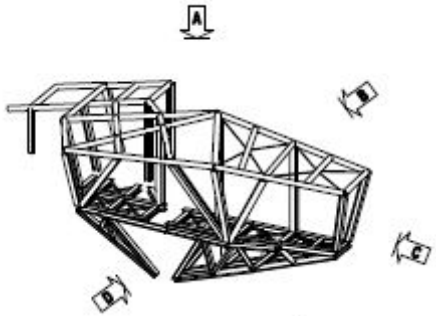
The stingy space availability has pushed the shapes toward the empty slopes in search of spaces projecting. The elements of different materials (reinforced concrete, steel, wood and glass), provides an original interior environmental content in close relationship with the outside

PUNTA HELBRONNER

PUNTA HELBRONNER

PUNTA HELBRONNER – Pre assembly

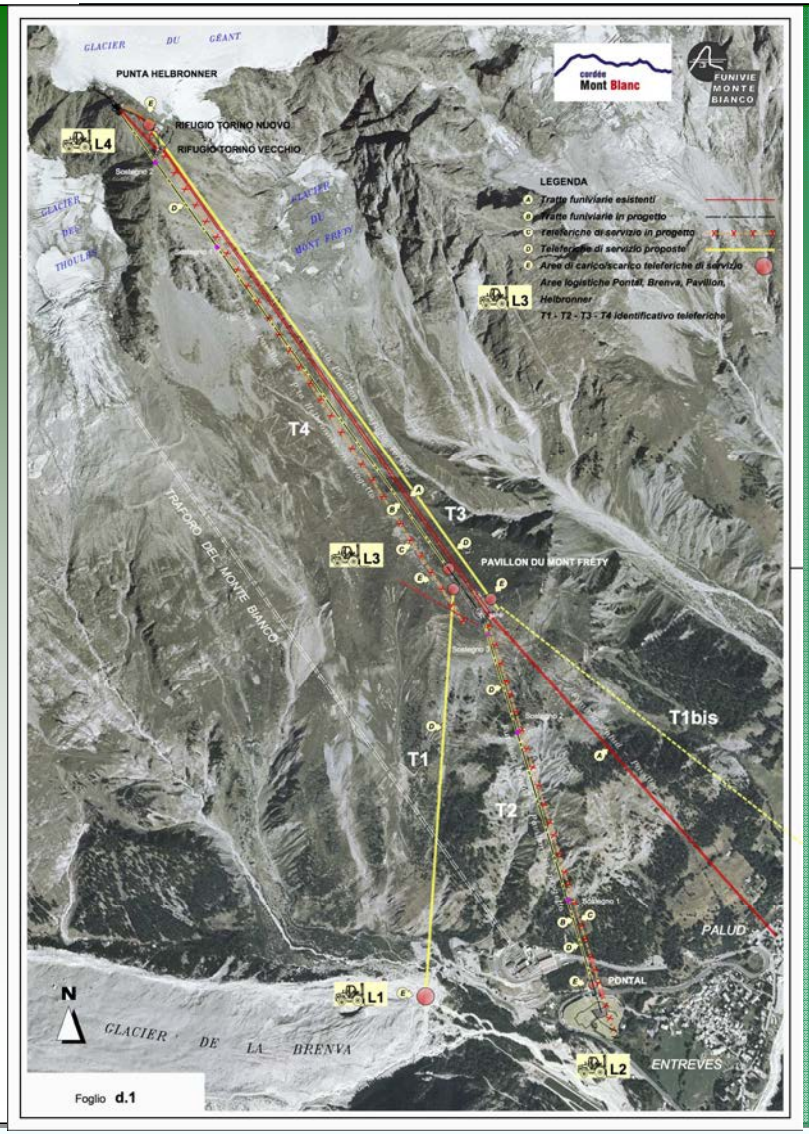




Nothing can go wrong on top of a mountain at 3500 meters!
The structures are fully pre assembled in the workshop, disassembled and reassembled in blocks up to 5 tons (maximum weight for ropeway conveyor and cranes at Punta Helbronner).

The highest yard in Europe

SITE ORGANIZATION

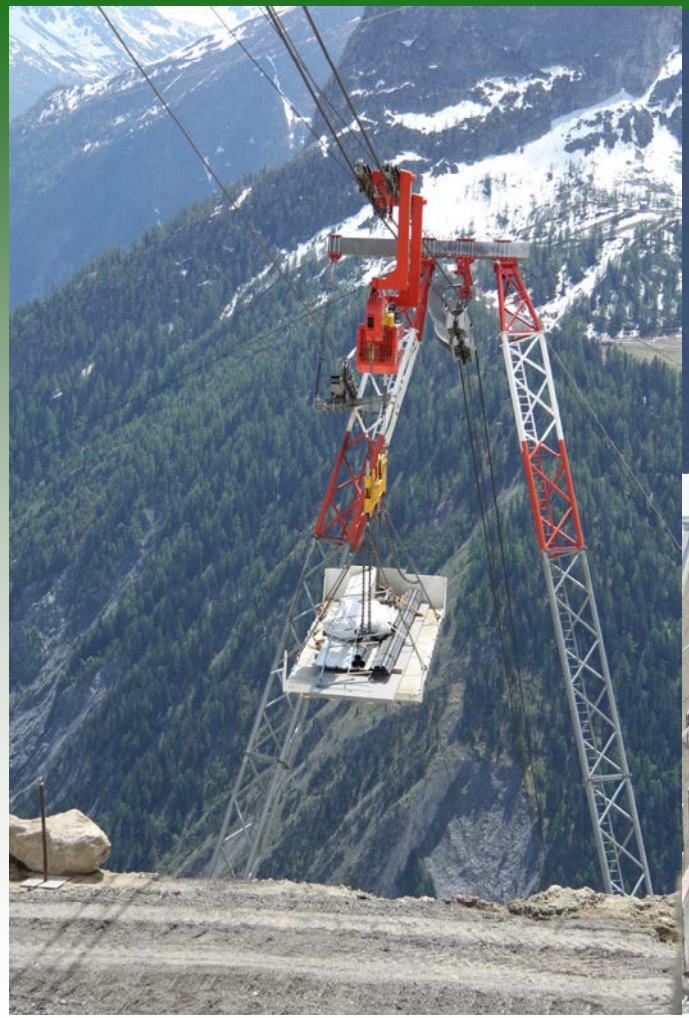


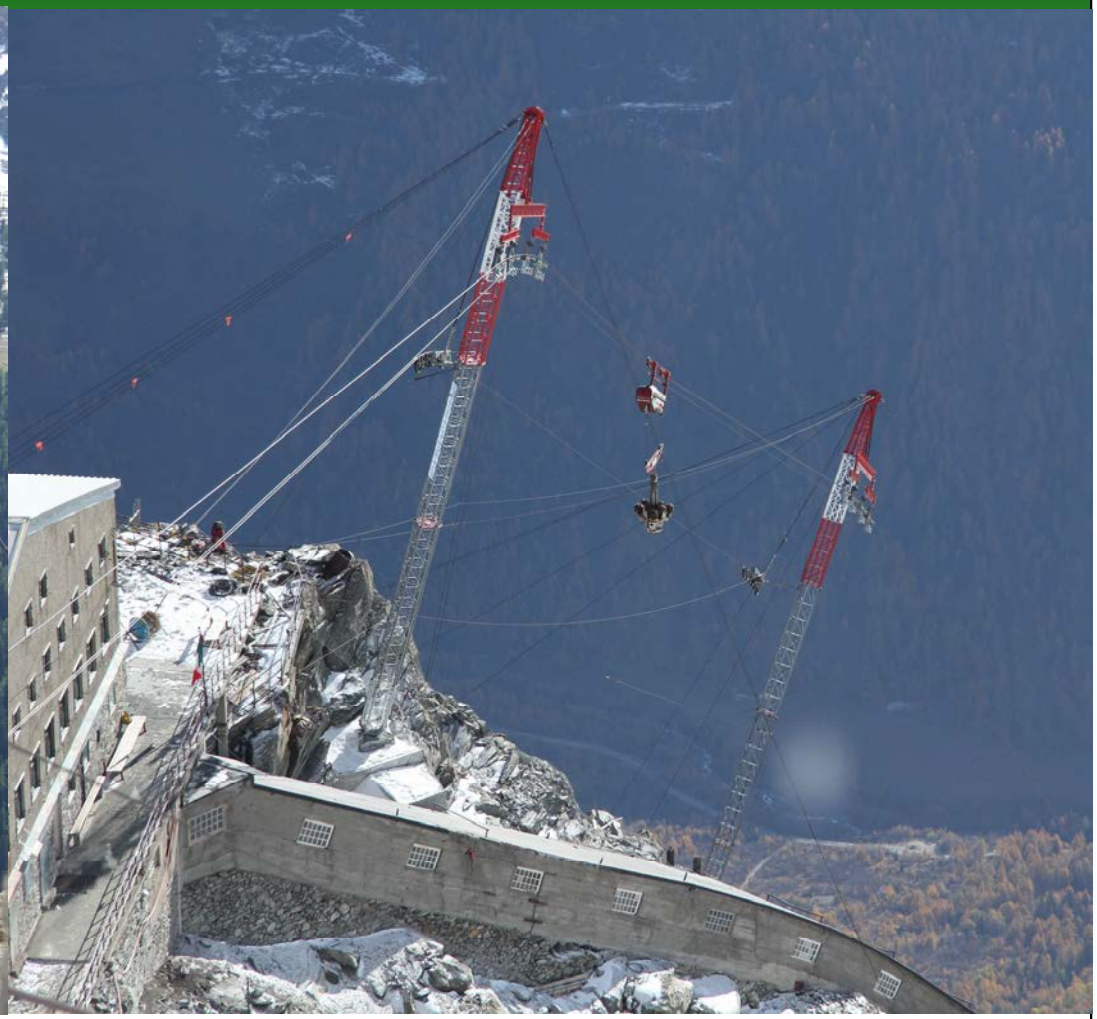
Today 120 people are working over the 7 different sites.

The supply of the materials is organized through the use of four ropeway conveyors and seven cranes:

Ropeway conveyors:
T1 – Brenva – Pavillon (10 ton)
T2 – Line 1 (5 ton)
T3 – Pavillon – Rifugio Torino (5 ton)
T4 – Line 2 (5 ton)

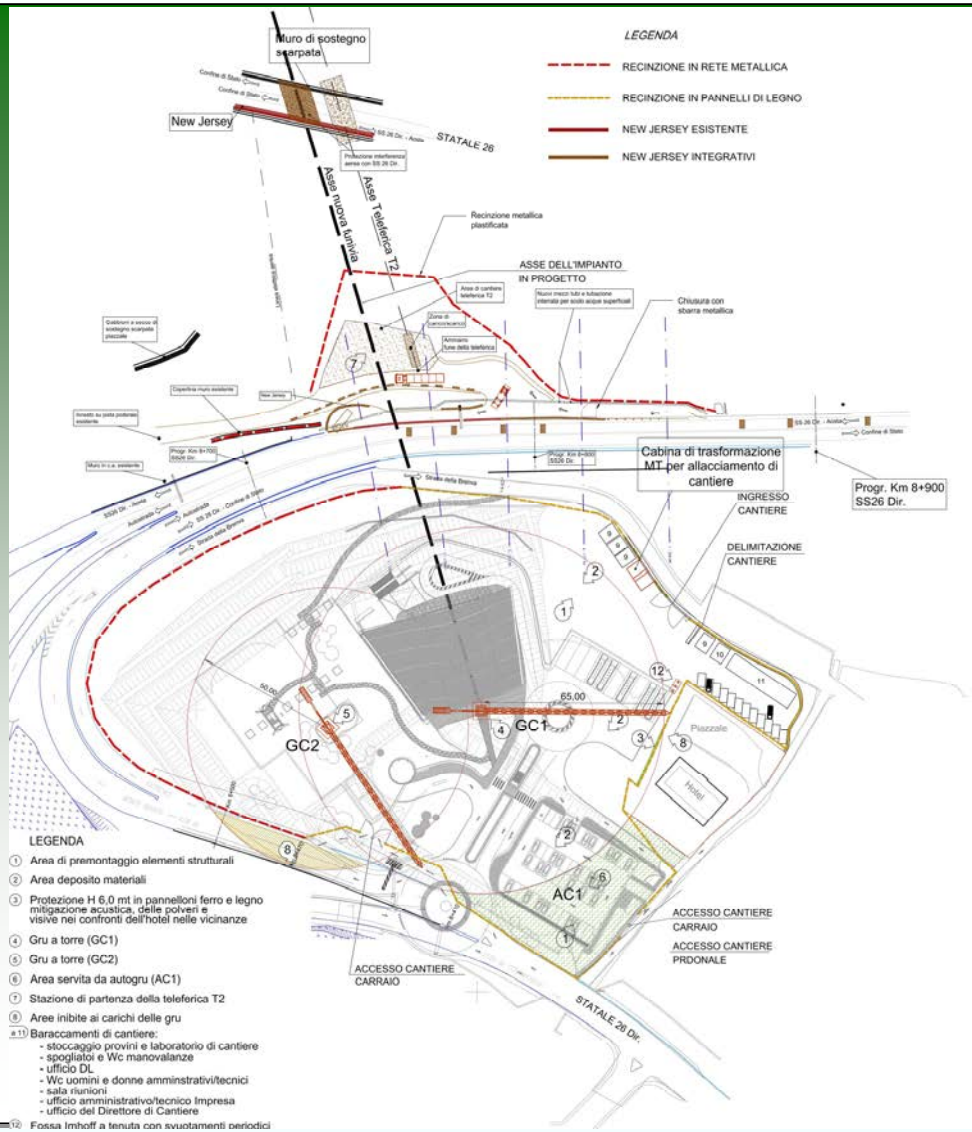
Cranes:
- 2 at the site of Pontal
- 1 at the site of Pavillon
- 3 at the site of Punta Helbronner (2 of them are used to carry material from the T3 top station to Punta Helbronner)
- 1 along the line to carry out the assembly of towers

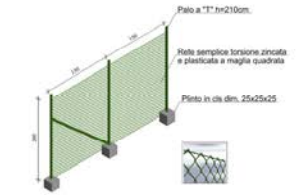




ROPEWAY CONVEYORS

PONTAL YARD





RECINZIONE DI CANTIERE CON RETE METALLICA

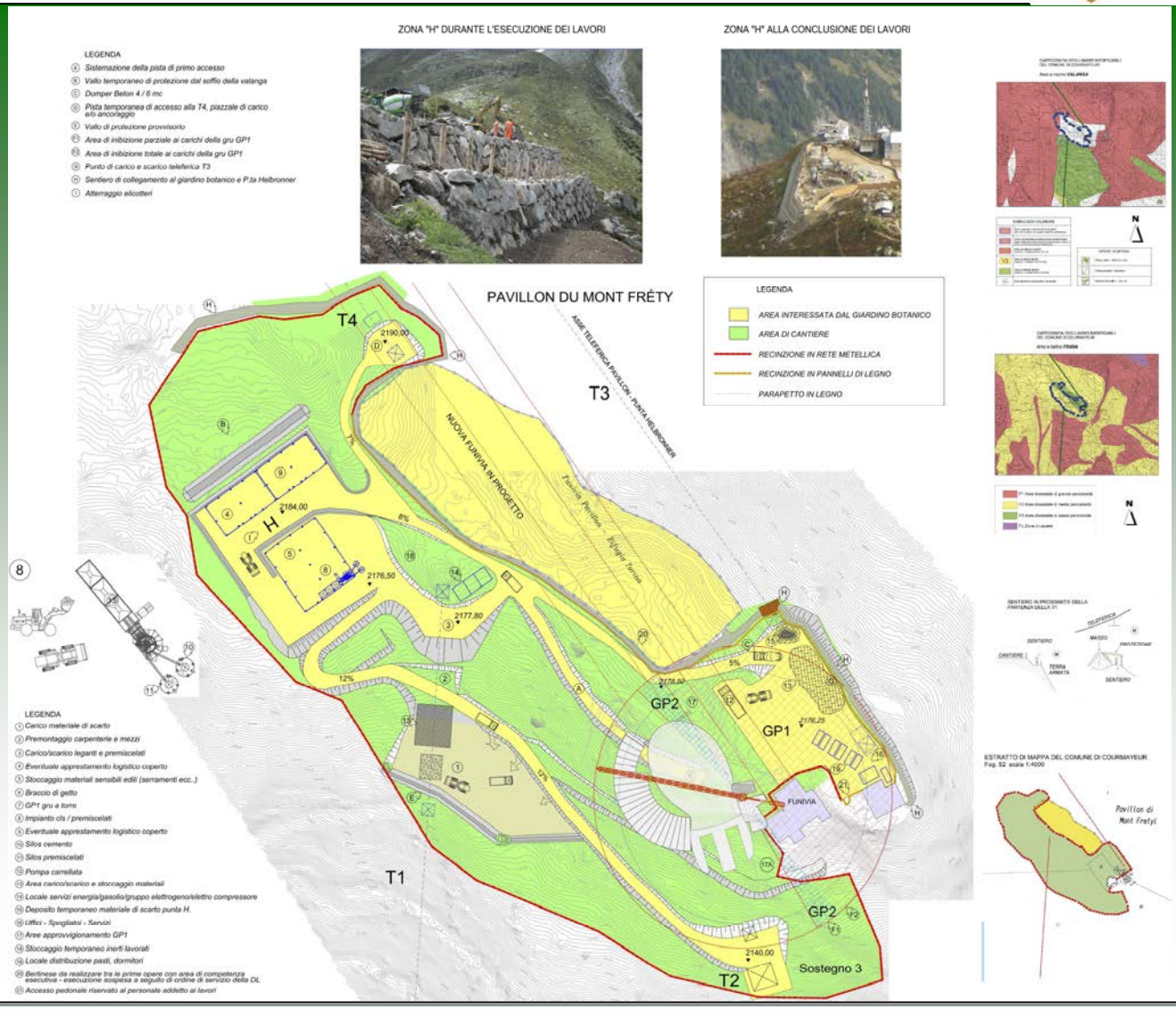
RECINZIONE DI CANTIERE IN PANNELLI OSB

POSA SU ROCCIA PALI RECINZIONE IN PANNELLI DI LEGNO

POSA SU ROCCIA PALETTI RECINZIONE IN RETE METALLICA

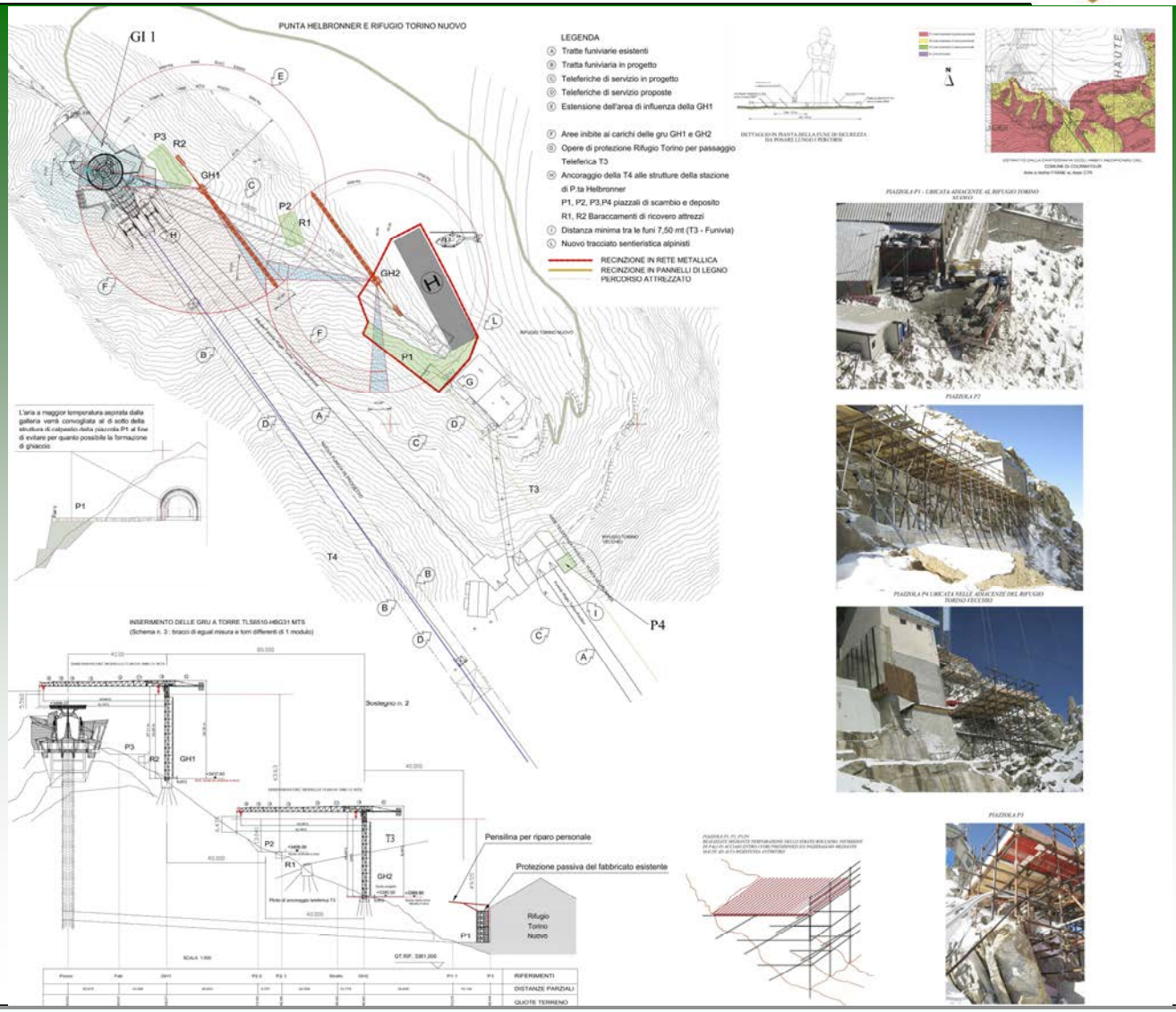
PONTAL YARD

PAVILLON YARD



PAVILLON YARD

PUNTA HELBRONNER YARD



PUNTA HELBRONNER YARD

PUNTA HELBRONNER YARD

ACCLIMATISATION
Overnight stay in altitude of workers at Rifugio Torino

SHIFT WORK
tests to define correct shifts to balance the efforts made and the appropriate recovery time (initially 7 working days and 4 days of rest, then 6 working days and 3 days of rest)

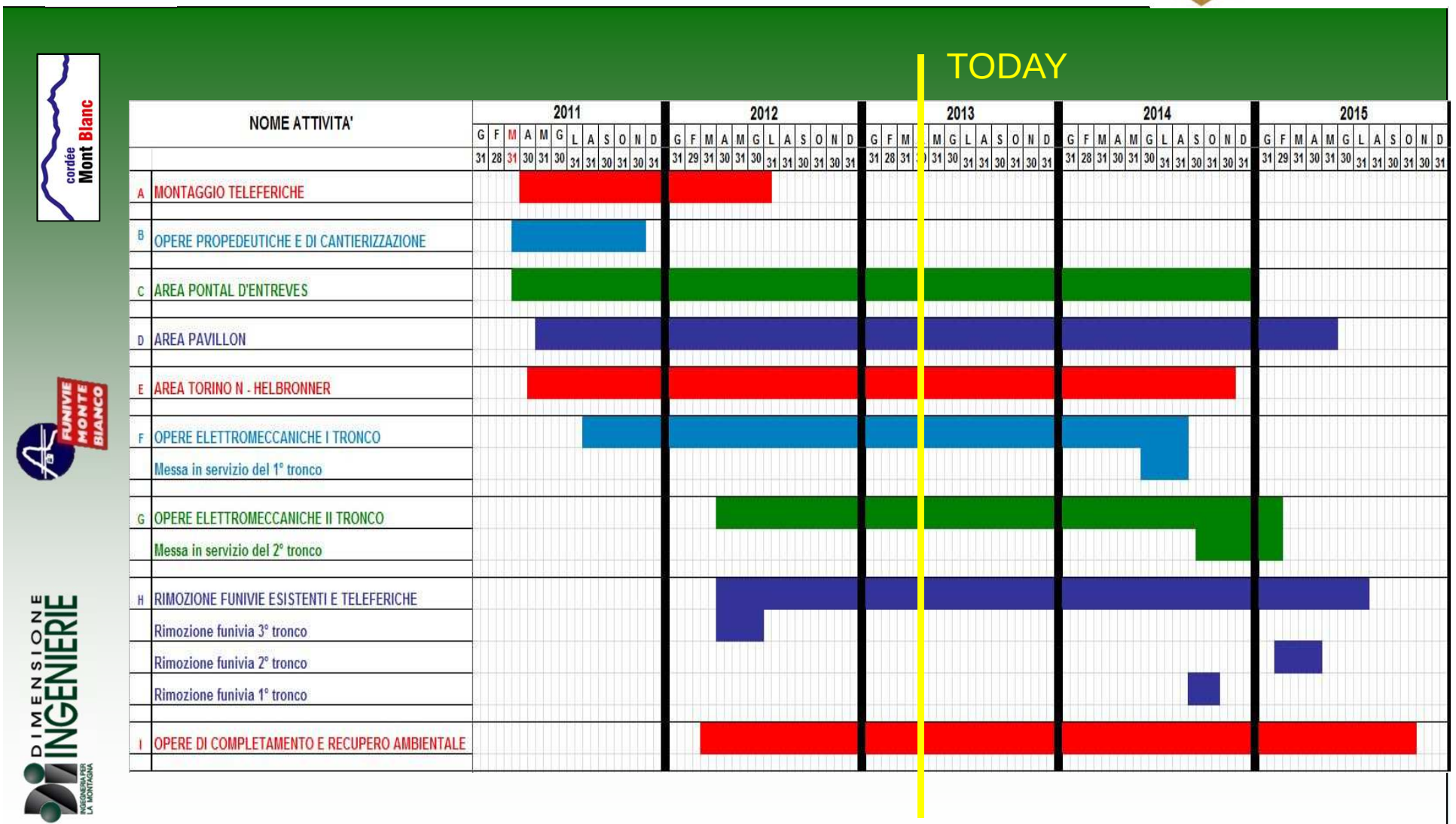
MEDICAL EXAMINATIONS
specialist visits in the medical mountain surgery of Aosta (general physical examinations, tests hypoxia)

TRAINING COURSES WITH DOCTORS AND RESCUERS

FIRST AID EQUIPMENT
bottled oxygen
defibrillator
winched stretchers
winched infirmary box

EVACUATION PROCEDURE IN CASE OF ACCIDENT
helicopter
current cableways
ropeway conveyor

TIMESCALE


TODAY
NOME ATTIVITA'
2011
2012
2013
2014
2015
A MONTAGGIO TELEFERICHE
B OPERE PROPEDEUTICHE E DI CANTIERIZZAZIONE
C AREA PONTAL D'ENTREVES
D AREA PAVILLON
E AREA TORINO N - HELBRONNER
F OPERE ELETTROMECCANICHE I TRONCO
Messa in servizio del 1° tronco
G OPERE ELETTROMECCANICHE II TRONCO
Messa in servizio del 2° tronco
H RIMOZIONE FUNIVIE ESISTENTI E TELEFERICHE
Rimozione funivia 3° tronco
Rimozione funivia 2° tronco
Rimozione funivia 1° tronco
I OPERE DI COMPLETAMENTO E RECUPERO AMBIENTALE

COSTS

Total Amount	**€**	**110.814.480,22**
Works and supplies	€	106.546.163,88
Security burden:	€	4.198.091,85
Charges of landfill:	€	70.224,49

MATERIALS

Concrete :	mc	35.000
Steel for reinforced concrete:	ton	4.000
Steel structural works:	ton	2.000
Steel for ropeway structural works:	ton	1.000
Excavations and infill:	mc	150.000
Carrying ropes (Ø = 64 mm L = 18.000 m)	ton	400
Hauling ropes (Ø = 35-37 mm L = 10.000 m)	ton	60
Rescue ropes (Ø = 16 mm L = 10.000 m)	ton	10

DIMENSIONE INGENIERIE Srl

(Team-Leader Mandatory and Service Coordinator)

FUNIPLAN Srl
Arch. CARLO CILLARA ROSSI
SI.ME.TE s.n.c
STUDIO CORONA Srl
PROTEO Srl
STUDIO CANCELLI ASSOCIATO
Ing. SERGIO RAVET
Dott. For. SILVIO DURANTE
Dott. For. PAOLO TERZOLO
Dott. Geol. ROBY VUILLERMOZ

cordée Mont Blanc

Consorzio Cordée Mont Blanc:

cordée Mont Blanc

Cogeis SpA
Doppelmayr Italia Srl

I.V.I.E.S. SpA
Costruzioni Stradali B.G.F Srl
P.A.C. SpA
Consorzio Stabile Valle d'Aosta S.C.ar.l
Boma Construction Srl

FUNIVIE MONTE BIANCO

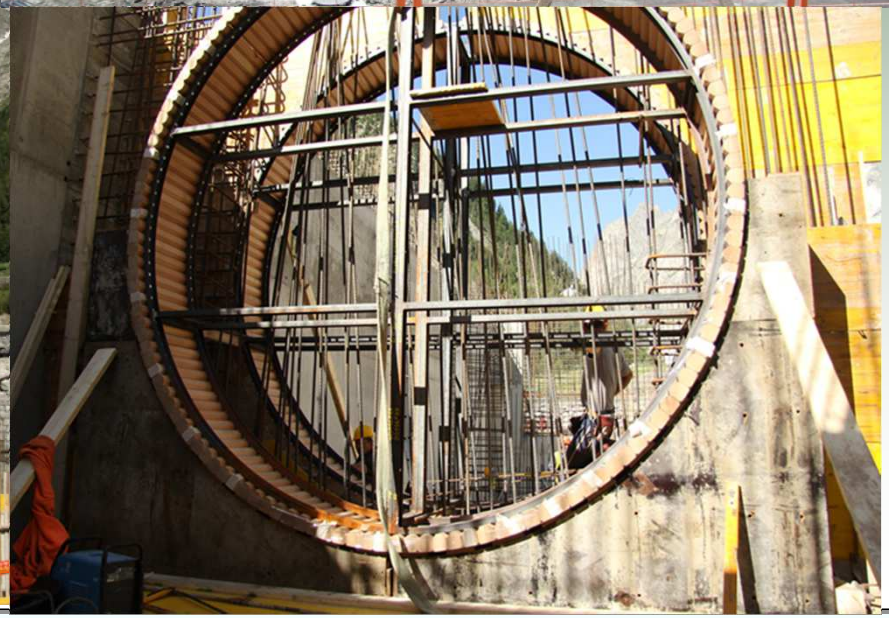
DIMENSIONE INGEGNERIE

COGEIS S.p.A. COSTRUZIONI GENERALI EDILI IDRAULICHE STRADALI

Doppelmayr

Work in progress

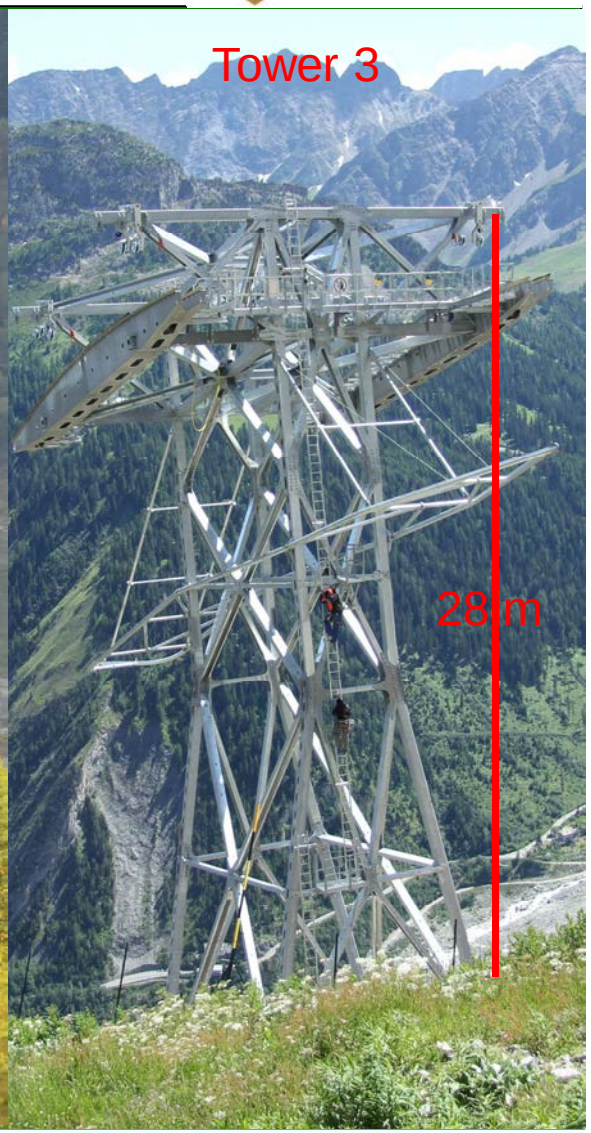
PONTAL YARD



PONTAL YARD


Tower 1
42 m


Tower 2
52 m


Tower 3
28 m

1ST SECTION TOWERS

PAVILLON YARD

TUNNEL – SHAFT

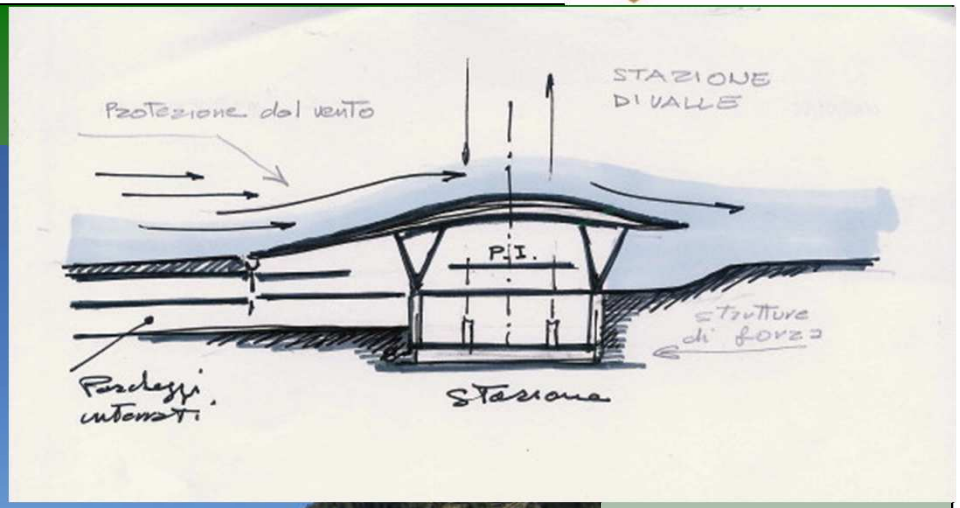
PUNTA HELBRONNER DEMOLITION

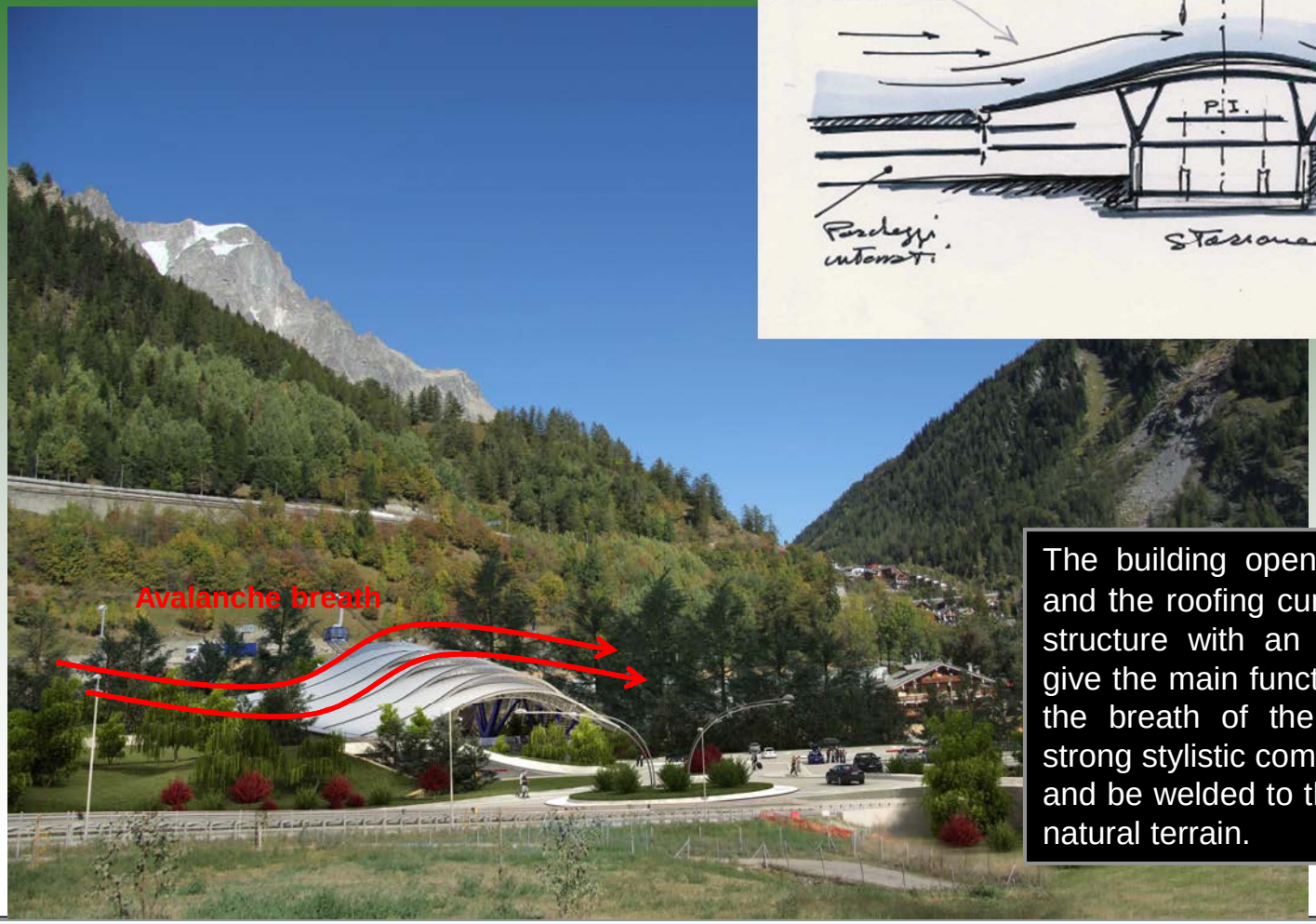
PUNTA HELBRONNER YARD

PUNTA HELBRONNER YARD

Measures to improve operation

PROTECTION BY THE AVALANCHE BREATH





The building opened on several sides and the roofing curvature, providing the structure with an aerodynamic shape, give the main function of "protection" by the breath of the avalanche, even a strong stylistic component, able to adapt and be welded to the morphology of the natural terrain.

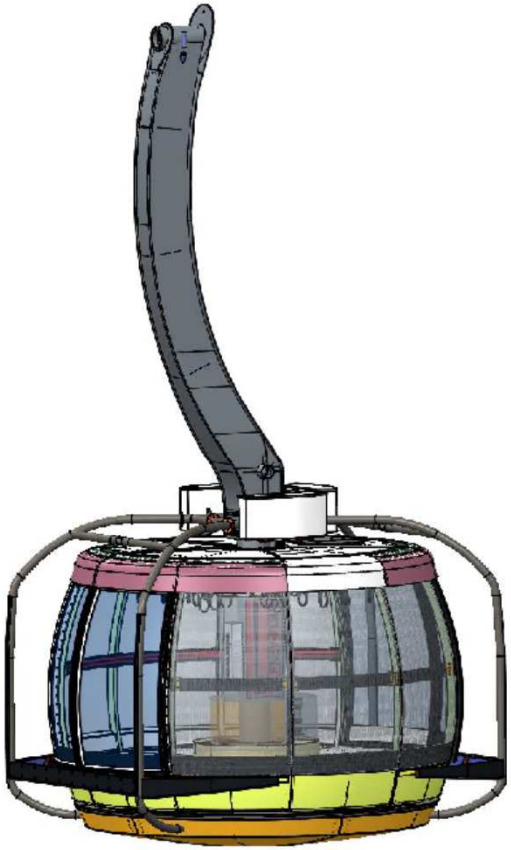
PROTECTION AGAINST SNOW AND WIND

The plans of boarding stations in altitude will be completely closed to avoid during windy days the accumulation of snow and so reduce days with delayed opening and operational interruptions

PROTECTION AGAINST THE WIND

The spherical shape of the cabin reduces the surface area exposed to the wind and improves its "Cx"

PROTECTION AGAINST THE WIND



It's possible to ballast the cabin filling the water tank located under the floor

PROTECTION AGAINST THE WIND

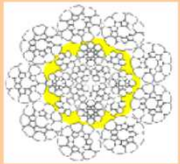
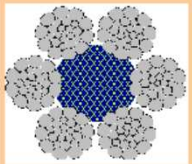
Redaelli

Wire Ropes Division
Redaelli Tecna S.p.A.
Via A. Volta, 16
20093 Cologno Monzese (Milano)
Tel. +39 02 25307219
Fax +39 02 25307212
wireropes@redaelli.com www.redaelli.com

Stabilimento/Factory:
Via Matteotti, 323
25063 Gardone V.T.
(Brescia)
Tel. +39 030 89171
Fax +39 030 8917814

Sede Legale/Registered Office:
Piazzale Libia, 2
20135 Milano
Capitale sociale: € 5.463.118,78 i.v.
REA Milano 1080570
N. Reg. Imp., C.F. e P. IVA 06247740159

Wire Rope Technical Comparison Data Sheet

Sezione retta della fune			
Caratteristiche Tecniche			
Costruzione		9xK19S-EPIWRC	6xK26WS-SFC
diametro nominale [d]	mm	37,0	37
diametro atteso (fune in tensione 20% MBL)	mm	37,9	38,1
diametro [H] fili esterni (prima della compattazione)	mm	2,52	2,75
sezione [A] (solo trefoli esterni)	mm²	558	617
sezione [A] (totale)	mm²	743	617
classe di resistenza fune	N/mm²	1960	1960
resistenza nominale fili	N/mm²	1960	1960
carico somma dei soli trefoli esterni	kN	1093	NA
carico di rottura dei soli trefoli esterni	kN	896	NA
Carico Somma minimo fune completa	kN	1456	1320
Carico Rottura minimo fune completa	kN	1194	1127
massa (con plastica)	kg/m	6,41	5,47
avvolgimento		PD	PD
numero dei trefoli esterni		9	6
passo di cordatura	mm	247	259
trefoli compattati		si	si
modulo elastico [E] (dal 20 al 40% MBF)	kN/mm²	120	125
rigidezza assiale [EA]	MN	89,2	77,1
plastificazione dell'anima metallica		SI	NO
protezione dell'acciaio		zincatura	zincatura

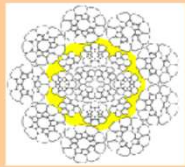
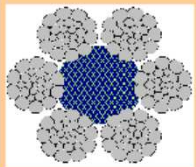
Redaelli

Wire Ropes Division
Redaelli Tecna S.p.A.
Via A. Volta, 16
20093 Cologno Monzese (Milano)
Tel. +39 02 25307219
Fax +39 02 25307212
wireropes@redaelli.com www.redaelli.com

Stabilimento/Factory:
Via Matteotti, 323
25063 Gardone V.T.
(Brescia)
tel. +39 030 89171
Fax +39 030 8917814

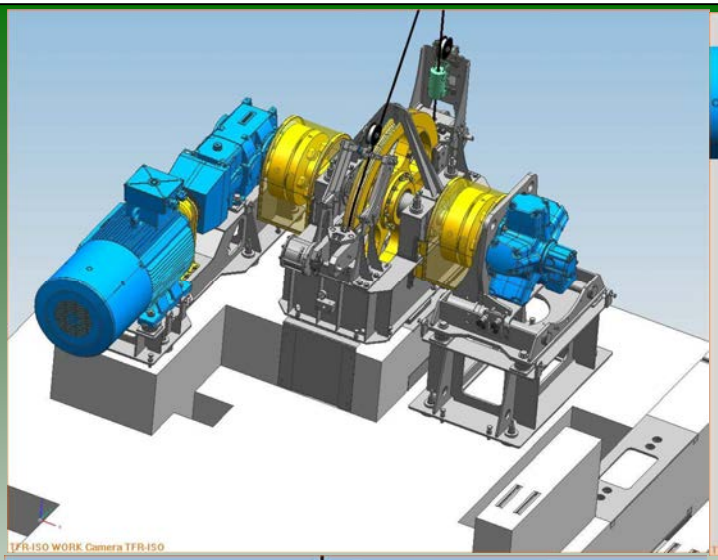
Sede Legale/Registered Office:
Piazzale Libia, 2
20135 Milano
Capitale sociale € 5.463.118,78 i.v.
REA Milano 1080570
N. Reg. Imp., C.F. e P. IVA 06247740159

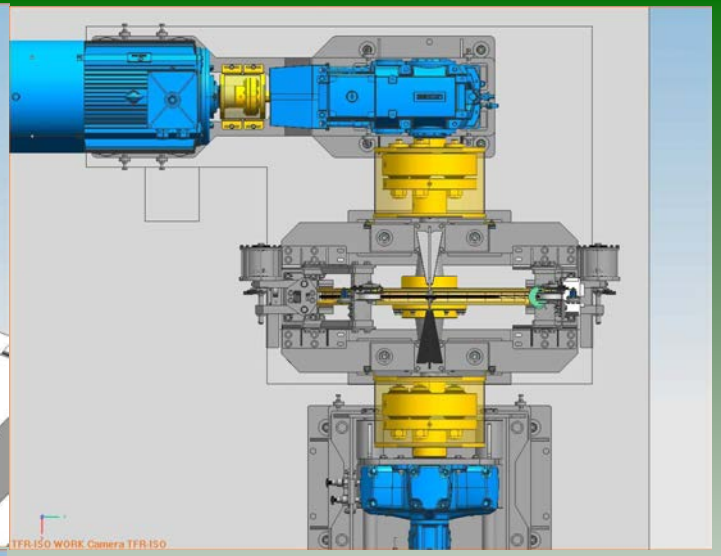
Wire Rope Technical Comparison Data Sheet

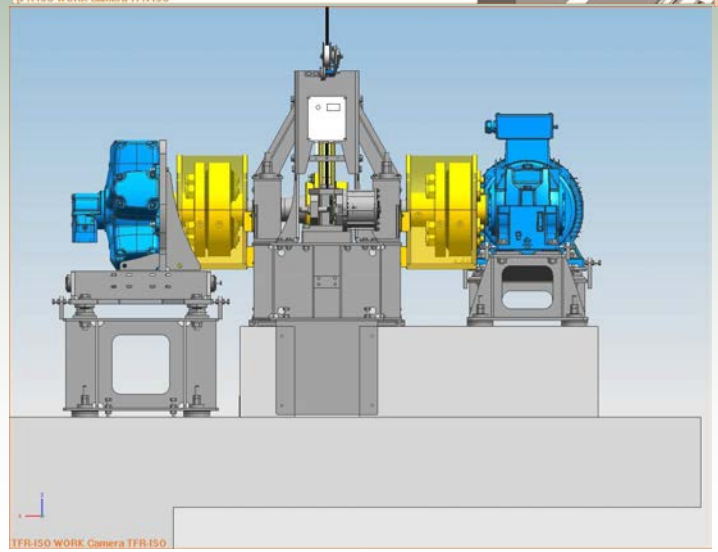
Sezione retta della fune			
Caratteristiche Tecniche			
Costruzione		9xK19S-EPIWRC	6xK26WS-SFC
diametro nominale [d]	mm	35,0	35,0
diametro atteso (fune in tensione 20% MBL)	mm	35,9	36,1
diametro [H] fili esterni (prima della compattazione)	mm	2,39	2,60
sezione [A] (solo trefoli esterni)	mm²	499	552
sezione [A] (totale)	mm²	665	552
classe di resistenza fune	N/mm²	1960	1960
resistenza nominale fili	N/mm²	1960	1960
carico somma dei soli trefoli esterni	kN	978	NA
carico di rottura dei soli trefoli esterni	kN	802	NA
Carico Somma minimo fune completa	kN	1303	1064
Carico Rottura minimo fune completa	kN	1068	909
massa (con plastica)	kg/m	5,73	4,90
avvolgimento		PD	PD
numero dei trefoli esterni		9	6
passo di cordatura	mm	233	245
trefoli compattati		SI	SI
modulo elastico [E] (dal 20 al 40% MBF)	kN/mm²	120	125
rigidezza assiale [EA]	MN	79,8	69,0
plastificazione dell'anima metallica		SI	NO
protezione dell'acciaio		zincatura	zincatura

The increase of diameter and mass of the hauling cables gives greater stability against the wind

PROTECTION AGAINST HUMIDITY AND ICING







The winch rope rescue of both sections will be equipped with two drives: the first will be an hydraulic drive and the second an electric one, which will be powered and kept in operation during the night to prevent the formation of ice sleeves


THANK'S FOR YOUR ATTENTION
FUNIVIE MONTE BIANCO
DIMENSIONE INGENIERIE
Follow us on www.nuovefuniviemontebianco.com