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INDUSTRIAL PLANTS

Chapter twelve:

Hoists and winches – third part

DOUBLE DEGREE MASTER IN

“PRODUCTION ENGINEERING AND MANAGEMENT”

SEAT OF PORDENONE

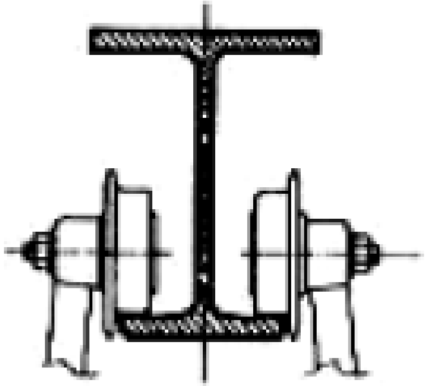
UNIVERSITY OF TRIESTE

Monorail hoists on sliding

It is hoists mounted on carriages that can translate on special profiles:

Monorail hoists on sliding

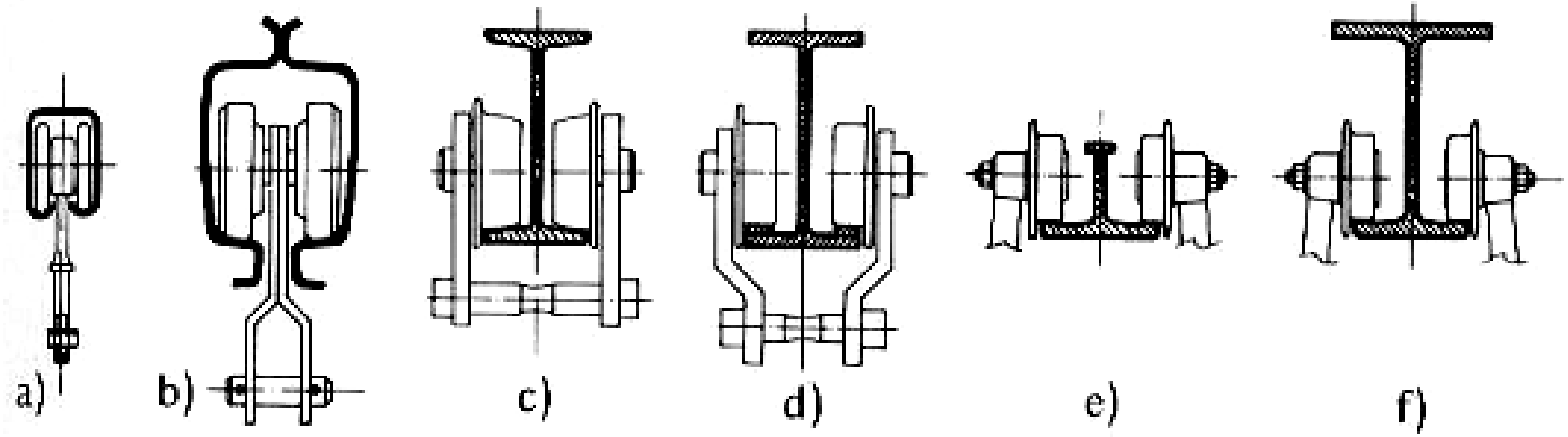
The wheels of the cart (one or more pairs) roll on the lower wings of the profiles IPN, IPE or special. The profile must be high enough to allow the passage of the wheels. In the realizations often there is the presence of a **wear plate** interposed between the lower wing of the profile and the wheels.



The monorail must be straight or curved, although in the latter case the radius of curvature must allow the sliding of the hoist without jamming of the carriage that supports it.

Monorail hoists on sliding

The types of runways used for the hoists are those given.



Monorail hoists on sliding

The upper wing, compressed of the beam to I is stiffened in a horizontal direction and, if appropriate, by a U section or by a lintel. The minimum profile to be assigned to the beam to I, so that the hoist embracing the profile with two wheels can flow freely between the lower wing of it, is as shown in table.

Capacity or load to be lifted of the hoist (N)	Minimun profile of the beam to I carrier	Diameter of the wheel of slip (mm)
2.500	140	90
5.000	160	120
10.000	180	135
15.000	200	150
20.000	240	175
30.000	260	200

Monorail hoists on sliding

Runways are fixed:

- at the roof structure of industrial buildings;
- to appropriate distribution beams.

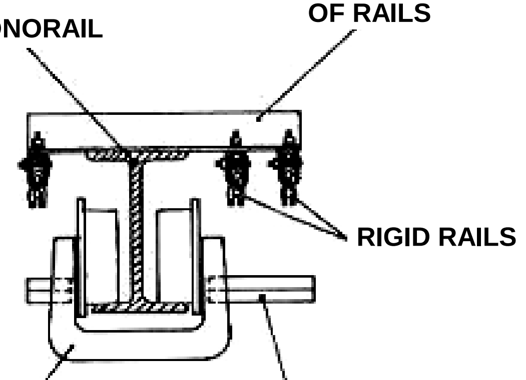
The translation of the hoist can be:

- at push;
- by chain and drive wheel;
- with electric motor and one move wheel and one drive wheel.

Monorail hoists on sliding

If the translation of the hoists is with the electric motor that moves the one moved wheel and one drive wheel, it can ensure the electrical supply to the hoist by:

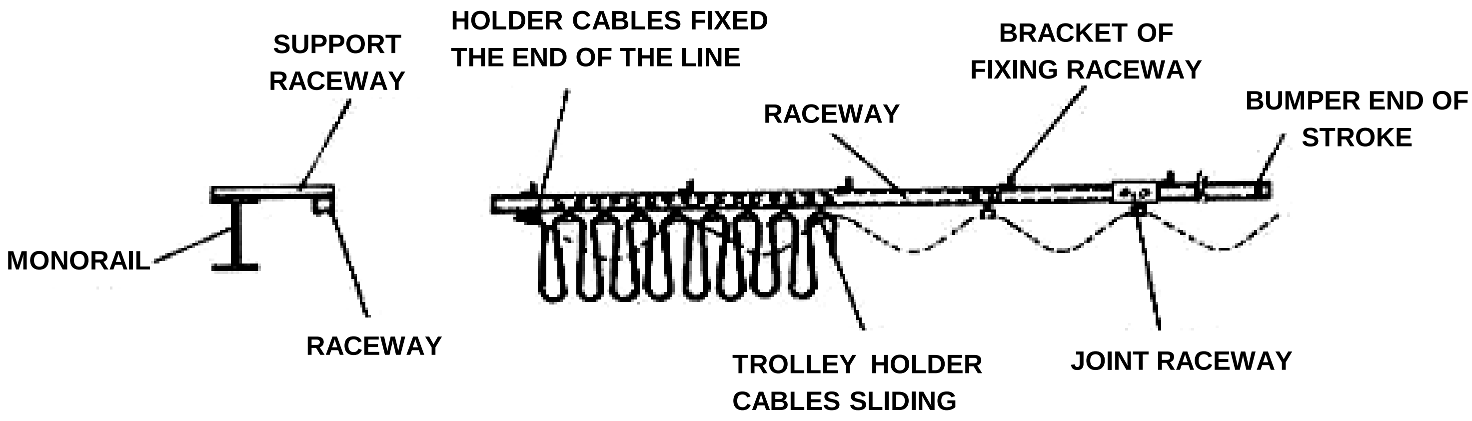
- rigid rails of limited dimensions with bulb of copper in the case of outdoor paths



Monorail hoists on sliding

If the translation of the hoists is with the electric motor that moves the one moved wheel and one drive wheel, it can ensure the electrical supply to the hoist by:

- conductor in flexible cable supported by trolleys sliding



- bare conductors encased in a protective channel with sliding contacts (blindo-trolley).

Winches

These are systems that replace the lifting hoists for heavy duty and higher capacity rates to 100 kN. Very often, the winches are mounted on metal frames that slide on rails.

Sizing of ropes and drums of the hoists and winches

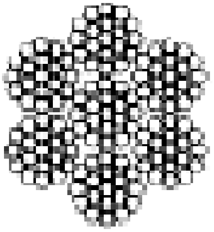
Known the lifted load and choose the number of ropes, it is ascertained maximum tensile stress for each rope, which must be multiplied by a safety factor of not less than 5.

Considering the steel cables with a steel core having a number of elementary wires ≥ 100 it is noted that the breaking load, for a rope diameter of 6.0 mm, is equal to 20,600 N.

Stainless steel AISI 316 - 133 wires

Ø steel thread (mm)	Ø outer wires thread (mm)	weight for m (Kg)	Min. breaking force (kN)
2,0	0,13	0,017	2,5
2,5	0,16	0,025	3,5
3,0	0,20	0,036	6,0
4,0	0,26	0,063	9,5
5,0	0,33	0,098	13,8
6,0	0,40	0,140	20,6
7,0	0,46	0,197	30,5
8,0	0,52	0,259	37,5
10,0	0,66	0,380	59,0
12,0	0,80	0,587	84,5

7 (12+6+1)
crusade dx
Resistance 1570 N/mm^2



Sizing of ropes and drums of the hoists and winches

According to FEM rules, the minimum diameter of the ropes is calculated from the report:

$$d = C' \cdot \sqrt{S}$$

where:

S = effort tensile stress of the rope (N)

C' = selection factor of the rope function of 3 parameters:

- minimum coefficient of utilization of the rope Z_p
- empirical factor of the minimum tensile strength of a rope K
- minimum breaking solicitation of the wires of the rope σ_o (N/mm^2)

For a σ_o = 2000 N/mm^2, it finds a value C equal to:

$$C' = \sqrt{\frac{Z_p}{K \cdot \sigma_o}}$$

Sizing of ropes and drums of the hoists and winches

Is detected:

Class F.E.M.	Z_p UNI ISO 4308	Ropes with cored:		C'
		tissue	steel	
$1D_m$/M1	3,15	0,332	0,359	0,085
$1C_m$/M2	3,35	0,330	0,356	0,085
$1B_m$/M3	3,55	0,330	0,356	0,085
$1A_m$/M4	4,00	0,293	0,346	0,085
2_m/M5	4,50	0,293	0,346	0,085
3_m/M6	5,60	0,328	0,328	0,090
4_m/M7	7,10	0,318	0,318	0,100
5_m/M8	9,00	0,280	-	0,112

Sizing of ropes and drums of the hoists and winches

In the example above the class F.E.M. 2_m is obtained by a selection factor of the rope of 0.085 which allows to determine, for a maximum tensile stress of 261.7 N, that the minimum diameter of the ropes is 1.37 mm smaller than the diameter of the rope chosen (6.0 mm).

The duration of the ropes with a core made of fabric or steel depends on the diameter of the drum and of the pulleys in which the ropes are wrap and the number of shots of the ropes.

Laws require that the diameter of the drum is not less than 25 times the diameter of the ropes and 300 times the diameter of elementary wires. The diameter of the pulleys must be not less than 20 to 250 times.

Sizing of ropes and drums of the hoists and winches

The diameter of drums and scheave according to the rules FEM are detected by the relation:

$$D \geq H \cdot d$$

where:

D = diameter of the drum, the scheave contained in the block or scheave of postponement (mm)

d = nominal diameter of the rope (mm)

H = coefficient for drums and sheaves, which depends from the parent group of the hoist.

Class F.E.M.	Drum	Sheaver	Scheave of balancing
$1D_m$/M1	11,2	12,5	11,2
$1C_m$/M2	12,5	14,0	12,5
$1B_m$/M3	14,0	16,0	12,5
$1A_m$/M4	16,0	18,0	14,0
2_m/M5	18,0	20,0	14,0
3_m/M6	20,0	22,4	16,0
4_m/M7	22,4	25,0	16,0
5_m/M8	25,0	28,0	18,0

Sizing of ropes and drums of the hoists and winches

Considering the nominal diameter of the wire of 6.0 mm and the coefficient H for the class F.E.M. 2_m, it determines the diameter for the:

- drum: ≥ 108 mm (120 mm)
- sheave contained in the block: ≥ 120 mm (130 mm)
- scheave of balancing: ≥ 84 mm (90 mm)

The length of the drum is determined based on the total length of the rope to be wound, the number of turns including the 2-3 turns on drum, the pitch of the turns and lateral to the franks (50-200 mm per side depending on the diameter of rope).

Sizing of ropes and drums of the hoists and winches

Having considered a rope to two pitches and the average running of the hook of 3 m, the total length L of the drum on which wrap the rope so spiral is:

$$L = \left(\frac{2 \cdot H_m + 3 \cdot \pi \cdot D}{\pi \cdot D} \right) \cdot (d+1) - 1 + 100 = \left(\frac{2 \cdot 6000 + 3 \cdot \pi \cdot 130}{\pi \cdot 130} \right) \cdot (6+1) - 1 + 100 = 627{,}9 \ mm$$