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INDUSTRIAL PLANTS

Chapter twelve:

Hoists and winches – second part

DOUBLE DEGREE MASTER IN

“PRODUCTION ENGINEERING AND MANAGEMENT”

SEAT OF PORDENONE

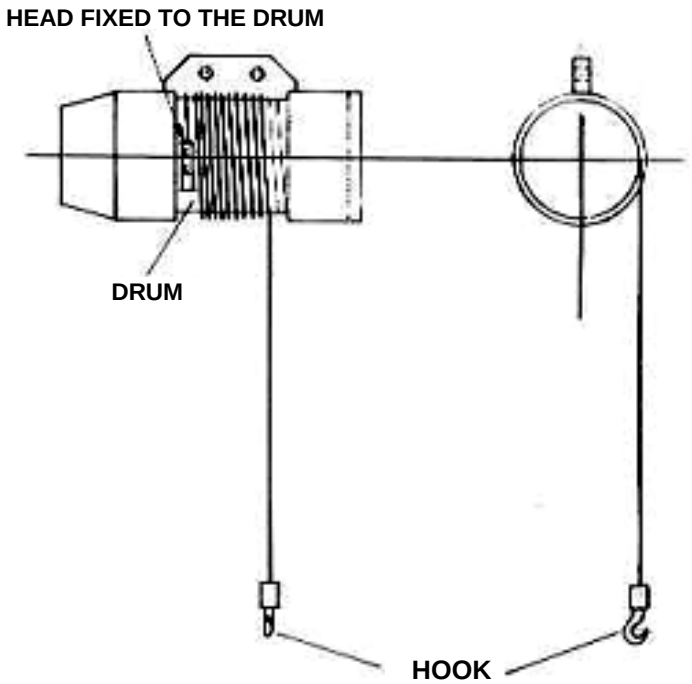
UNIVERSITY OF TRIESTE

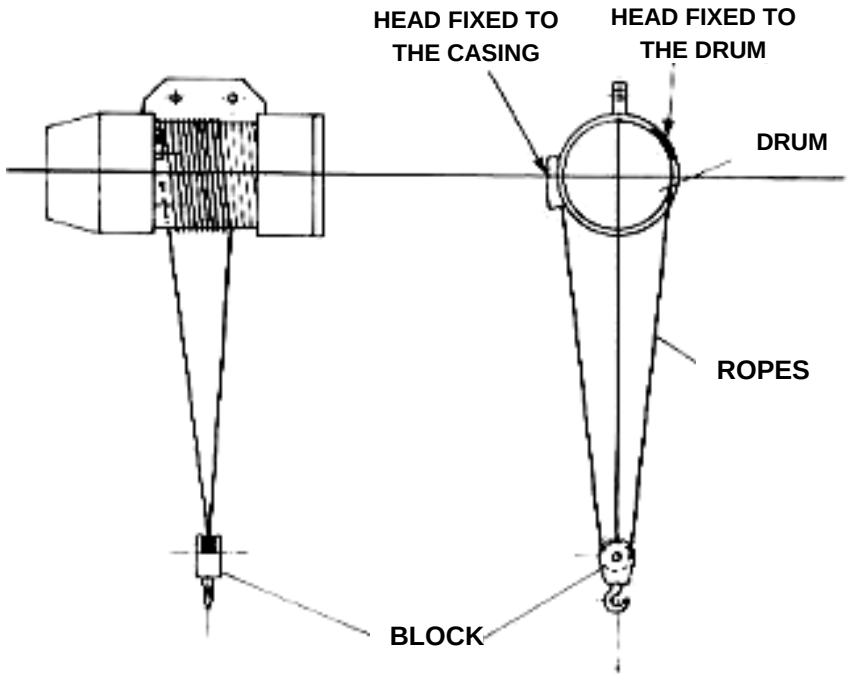
Hoists

The **hoists** are divided into:

- **electric hoists**

  The hoists can reach flow rates of 5 t, although up to 2 t the ropes can be replaced by chains. The hoist may have rarely one, but certainly two, four, eight or more draughts of rope.

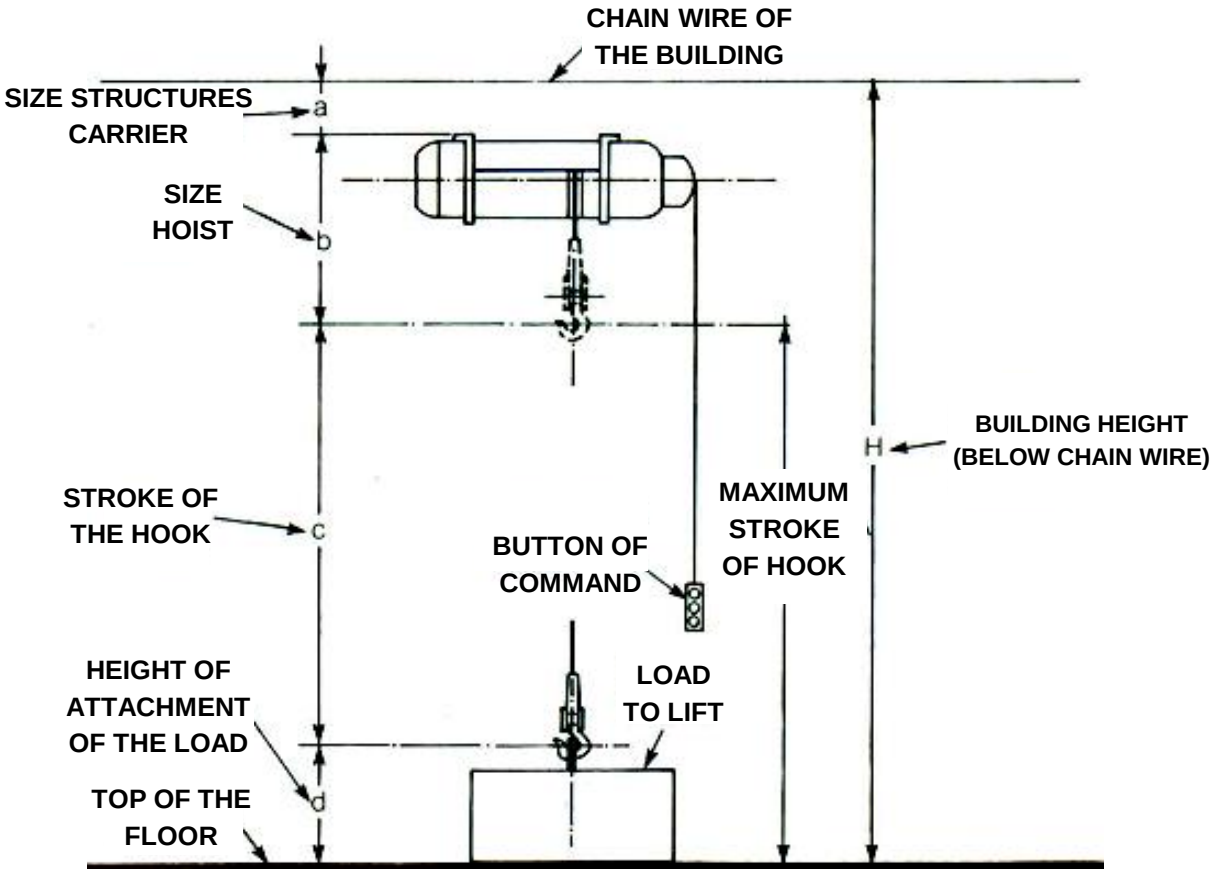




Hoists

The criteria for selection of hoists must take account of:

- the **geometrical factors** characteristic of the application, which are related both to the building that to the type of the load (UdC)



Hoists

The criteria for selection of hoists must take account of:

- the **rules for the calculation of lifting devices** (FEM - Fédération Européenne de la Manutention) which classify and have the purpose of adjusting the mechanical parts of the hoist on the basis of the conditions of use (type of load and operating cycle)

The mechanical parts subject to dynamic stress (gearboxes, bearings, cables, motors, etc.) must be sized so as to ensure a reasonable period of use, but do not have to be oversized.

Hoists

The resistance of these parts depends on the frequency of use or the average time of daily use and the extent of prevailing stresses or loads lifted. The classes introduced by F.E.M. take into account the type of load and the average time of daily use.

The average daily operating time in hours (T_g) is given by the relation:

$$T_g = \frac{2 \cdot H_m \cdot C \cdot h_g}{60 \cdot v}$$

where:

H_m = running or height of lifting average of the hook (m);

C = number of cycles per hour required by the hoist (cycles/h);

h_g = number of working hours per day (h/day);

v = speed of the hook (m/minute).

Hoists

The F.M.E. 9511 define nine classes for the operating time marked by:

$$V_{0,06},\ V_{0,12},\ V_{0,25},\ V_{0,5},\ V_1,\ V_2,\ V_3,\ V_4,\ V_5$$

in which the indices are the maximum number of hours of operation in the working day.

The type of load that depends on the extent to which you are using the reach of block and tackle in this regard, the FEM defines four types of loads and their load factors (k = factor cubic medium):

a) lightweight: solicitations rarely maximum, usually very low
   $k \leq 0,50$;
b) average: solicitations often maximum, usually low
   $0,50 < k \leq 0,63$;
c) heavy: solicitations often maximum, usually medium
   $0,63 < k \leq 0,80$;
d) very heavy: solicitations usually close to maximum
   $0,80 < k \leq 1,00$.

Hoists

Taking into account the average time of operation and the type of load, the EMF 9511 identifies eight classes of mechanisms for hoists that are inserted in increasing order of solicitation.

$1D_m$	$1C_m$	$1B_m$	$1A_m$	2_m	3_m	4_m	5_m
M1	M2	M3	M4	M5	M6	M7	M8

It is noted that for each type of load passing from one group to the upper one, the average time of operation increases by a factor 2 and the permissible useful load is reduced by a factor 1.25

Type of load	Factor cubic medium	Class of operation								
		$V_{0,06}$	$V_{0,12}$	$V_{0,25}$	$V_{0,5}$	V_1	V_2	V_3	V_4	V_5
		Average time of operating (h/day)								
		≤ 0,12	≤ 0,25	≤ 0,5	≤ 1	≤ 2	≤ 4	≤ 8	≤ 16	> 16
1	k ≤ 0,50			$1D_m$	$1C_m$	$1B_m$	$1A_m$	2_m	3_m	4_m
2	0,50<k≤0,63		$1D_m$	$1C_m$	$1B_m$	$1A_m$	2_m	3_m	4_m	5_m
3	0,63<k≤0,80	$1D_m$	$1C_m$	$1B_m$	$1A_m$	2_m	3_m	4_m	5_m	
4	0,80<k≤1,00	$1C_m$	$1B_m$	$1A_m$	2_m	3_m	4_m	5_m		

Hoists

A classification of electric hoists according to the rules FEM is shown below referring to drums with a groove and different shots of rope.
If we consider a unit load (capacity) of 63 kN (G), type of heavy load, 2 rope falls, the average run of the hook of 6 m (Hm, usually 3-4 m and 6-12 m for chain hoists for those rope), 18 cycles/h (C), 8 hour working day (h_g) and speed of the hook of 10 m/minute (v, must not exceed the hoist 25 m / minute), it has a average daily operating time T_g of:

$$T_g = \frac{2 \cdot H_m \cdot C \cdot h_g}{60 \cdot v} = \frac{2 \cdot 5 \cdot 18 \cdot 8}{60 \cdot 10} = 2{,}88 \ \ h$$

The model of electric hoist needed belongs to the group F.E.M. 2m.

Hoists

Shorts of rope			Type of load	Average time of operating (h/day)					
			1 light	Until 2	2 -4	4-8	8-16	Over 16	-
			2 average	Untile 1	1-2	2-4	4-8	8-16	Over 16
			3 heavy	Until 0,5	1,5-1	1-2	2-4	4-8	Over 8
1	2	4	4 very heavy	Until 0,25	0,25-0,5	0,5-1	1-2	2-4	Over 4
Unit load (N)			Electric hoists – Class						
1600	3200	6300							5_m
2000	4000	8000						4_m	
2500	5000	10000					3_m		
3200	6300	12500				2_m			
4000	8000	16000			$1A_m$				
5000	10000	20000		$1B_m$			3_m		
6300	12500	25000				2_m			5_m
8000	16000	32000			$1A_m$			4_m	
10000	20000	40000		$1B_m$			3_m		
12500	25000	50000				2_m		4_m	
15000	30000	60000			$1A_m$		3_m		
20000	40000	80000				2_m		4_m	
25000	50000	100000			$1A_m$		3_m		5_m
32000	63000	125000				2_m		4_m	
40000	80000	160000			$1A_m$		3_m		
50000	100000	200000				2_m			
-	125000	250000			$1A_m$				

Hoists

It can therefore calculate the power absorbed by the electric motor P for lifting the load, according to the relation (kW):

$$P = \frac{G \cdot v}{1000 \cdot \eta}$$

where:

G = load to be lifted (kN);

v = lifting speed (m/s)

η = performance of the electric motor (0,7-0,9) even if the aim is to use electric motors with high efficiency.

In the example:

$$P = \frac{63 \cdot 600}{1000 \cdot 0{,}85} = 4{,}45 \ \ kW$$

Hoists

The choice of the electric motor depends by:

- number of cycles required to hoist;
- number of insertions per hour of the electric motor;
- relationship of intermittence R, reported to 10 minutes, defined by:

$$R = \frac{\sum times\ of\ operation\ (ascent + descent)\ of\ the\ electric\ motor\ of\ the\ hoist}{\sum times\ of\ operation + \sum times\ of\ stop\ of\ the\ electric\ motor\ of\ the\ hoist} \cdot 100$$

Hoists

If we mean by t_s, t_d and T the times of rise and fall of the load, and the total time of a cycle T (expressed in s), assuming that the rate of ascent and descent are equal and indicating with H the stroke of the hook, the number of cycles hours C are defined:

$$C = \frac{1}{T} = \frac{R}{(t_s + t_d) \cdot 100} = \frac{R \cdot v}{200 \cdot H}$$

The maximum value of the race can not be higher than allowed by the duty cycle refers to a cycle of 10 minutes is:

$$H_{\max} \leq \frac{R \cdot v}{20}$$

Is often required a lifting speed respect at the speed main in the case consider movements of approach and adjustment; it is obtained by a epicyclic gear train driven by appropriate motor.

Hoists