Design of Machines and Mechanical Systems (PC-BTM711)

Session 23

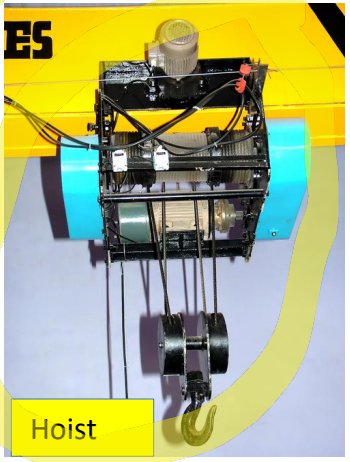
Module 6: Design of EOT Crane

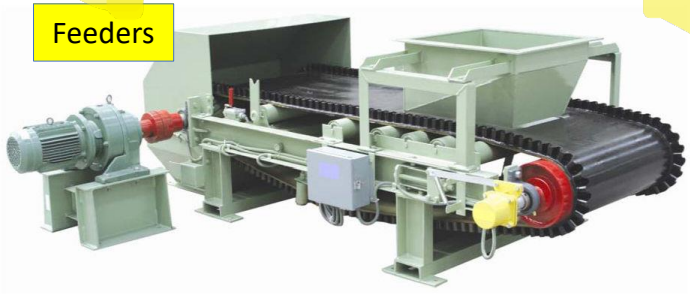
Session Outcomes

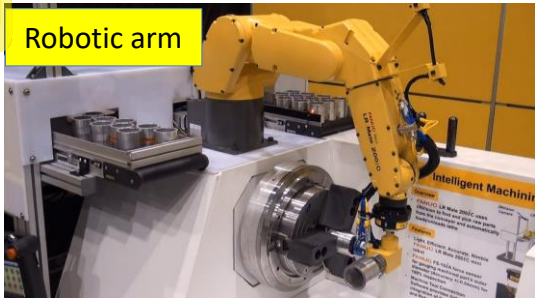
- Introduce EOT Crane system
- Perform design calculations for
  - Snatch block assembly
  - Rope drum assembly
  - Overhead trolley design

Classification of Material Handling Equipment

- Industrial vehicles/ trucks
- Conveyors
- Hoisting equipment
- Bulk handling system
- Auxiliary equipment
- Robotic handling systems







QUIZ

Classification of Material Handling Systems

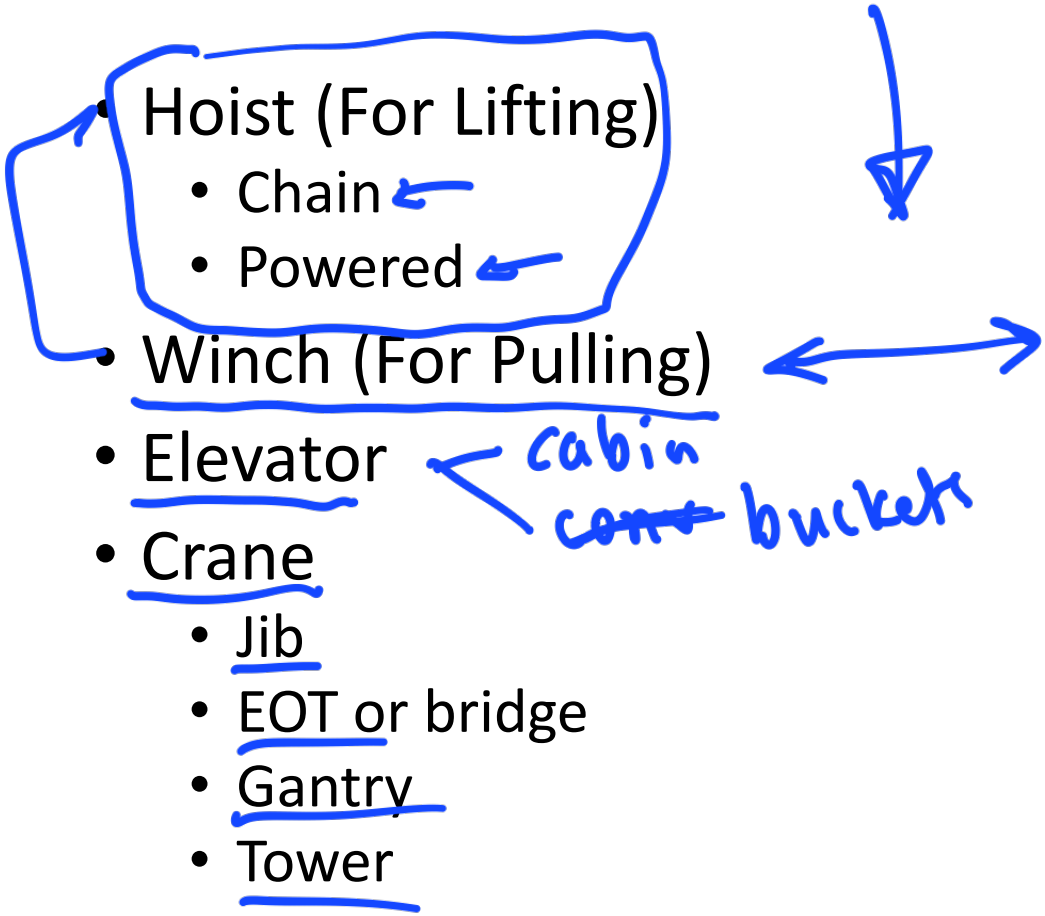
EOT crane falls under which category of material handling system?

1) Bulk Handling Systems

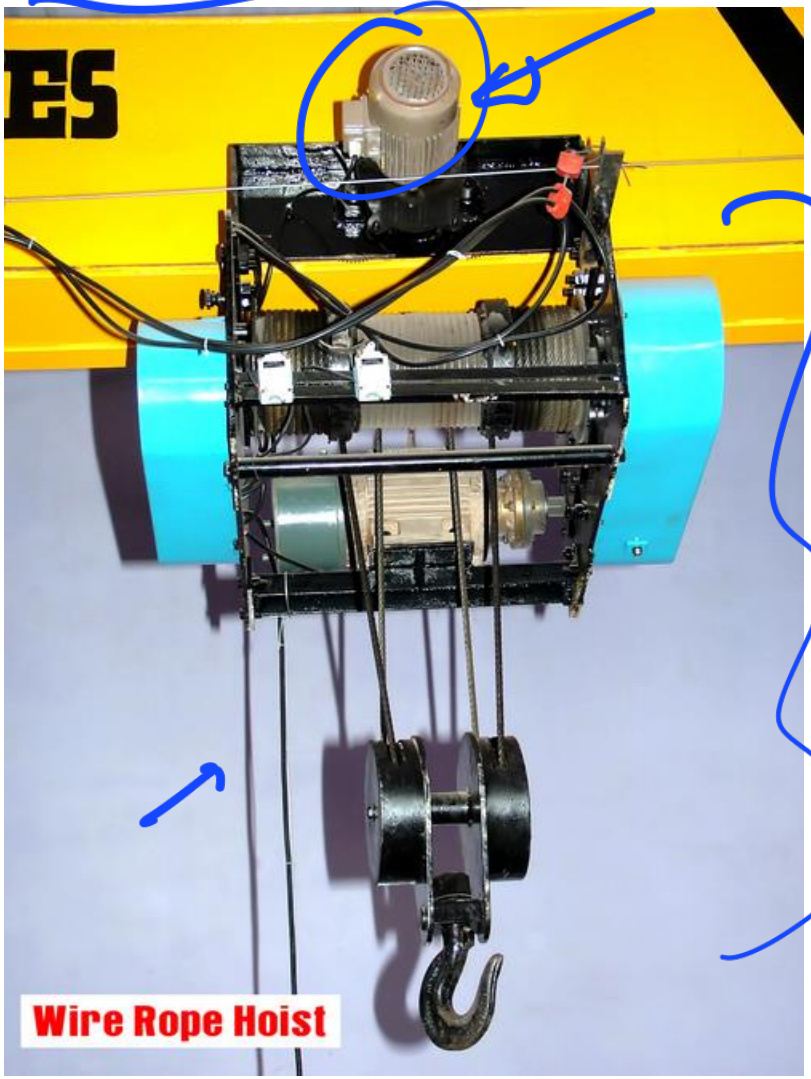
2) Industrial Vehicles

3) None of the above

Hoisting equipment

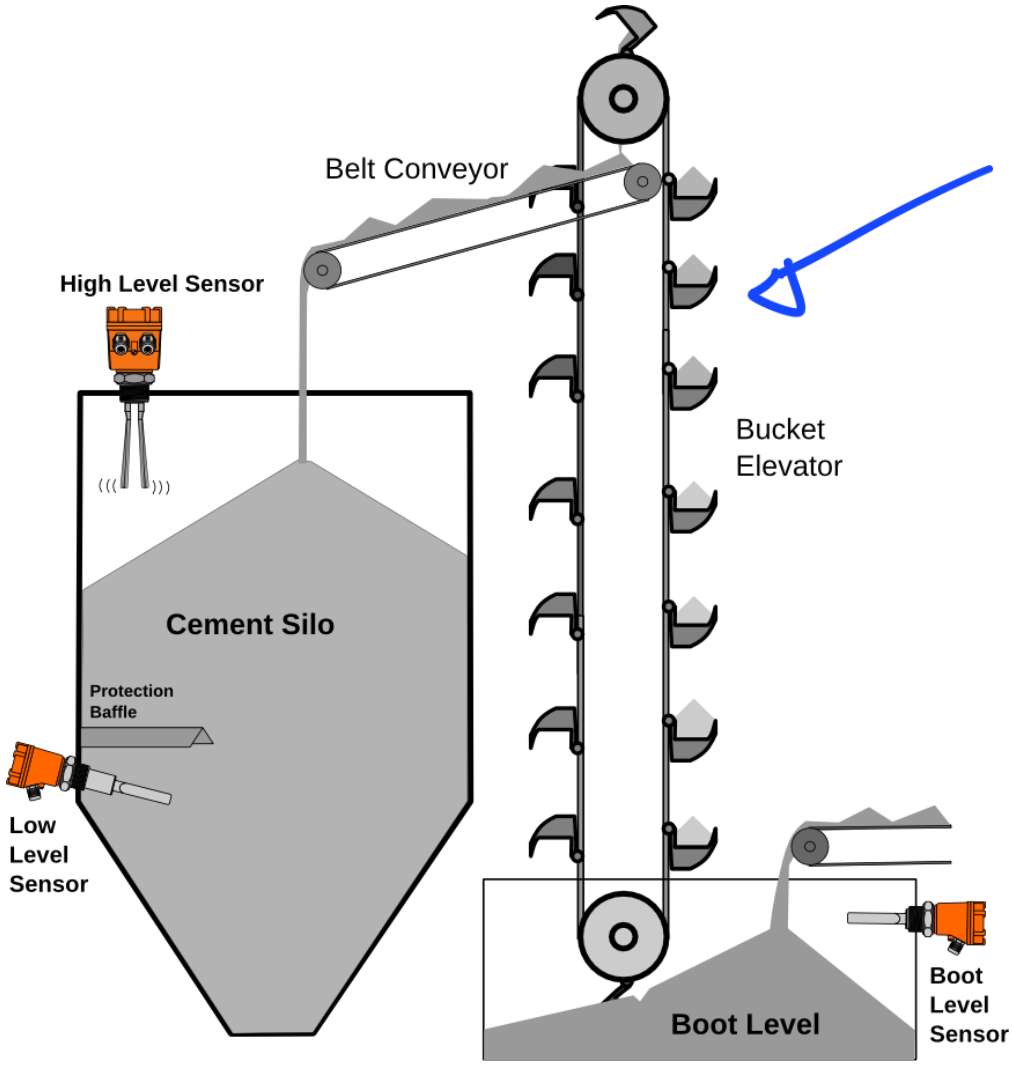


Hoist and Winch



http://pimg.tradeindia.com/01160206/b/2/Single-Girder-Hoist.jpg

Bucket elevator



http://www.trumen.in/images/app/cement-plant-application-bless.png

Jib crane

http://upload.wikimedia.org/wikipedia/en/thumb/d/dc/Pedestal_Jib.jpg/200px-Pedestal_Jib.jpg

Overhead crane

http://cranetekindia.com/double_grider.html#!prettyPhoto

Gantry crane

http://www.scraneengineering.com/prd/gantry-cranes.jpg

Tower crane

http://image.made-in-china.com/4f0j00fBJEsZuGYDzP/QTZ50-Topkit-Tower-Crane-TC5010-.jpg

QUIZ

Hoisting Systems

Which of the following is NOT hoisting system?

1) Bucket Elevator ✗

2) Conveyor ✓

3) None of the above ✗

Electric Overhead Travelling (EOT) crane

Cranes

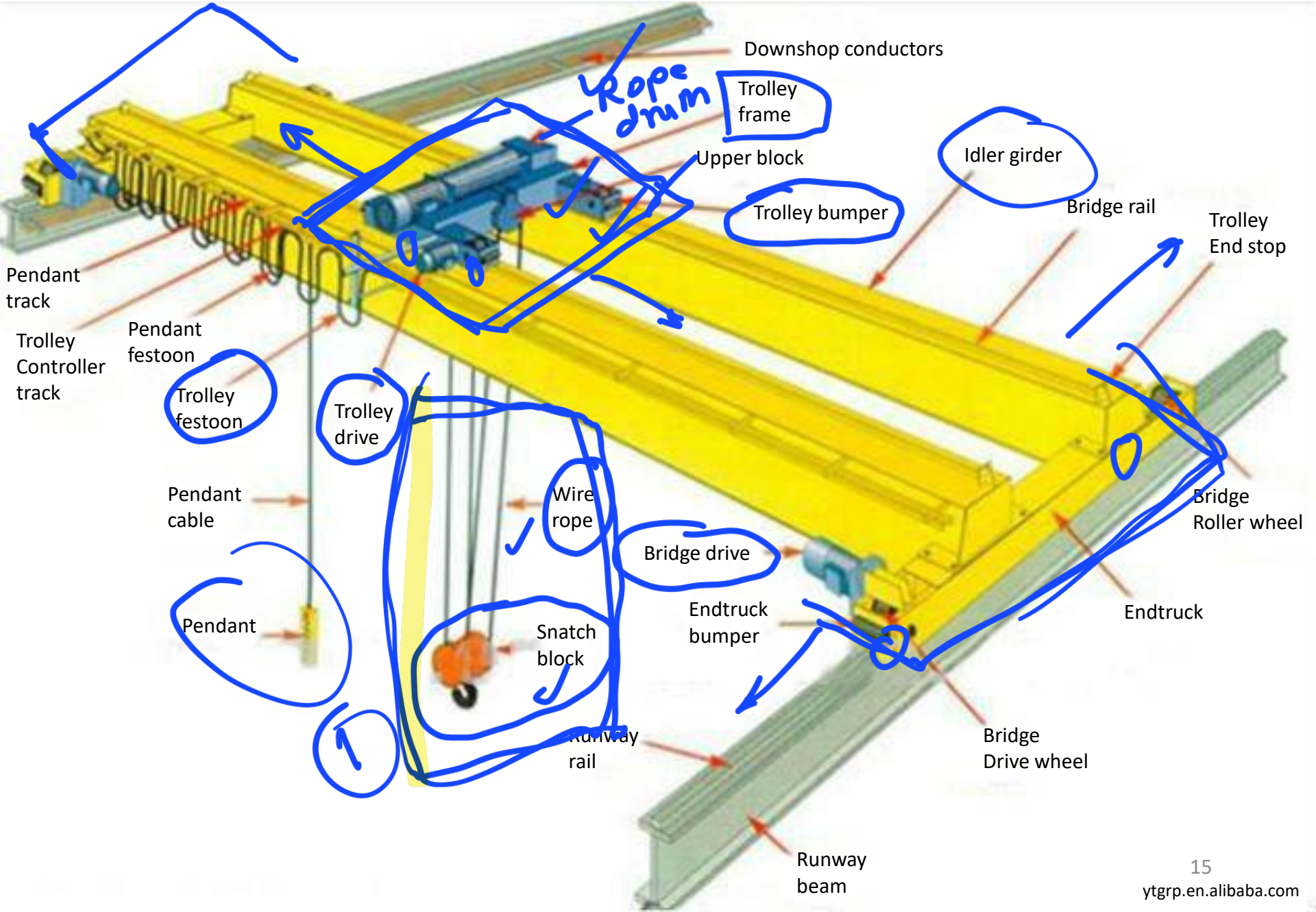
- Crane is a cyclic action machine intended for hoisting and moving in space of a load suspended by means of a hook or other load-handling device (IS 13473 Part 1)

http://upload.wikimedia.org/wikipedia/en/thumb/d/dc/Pedestal_Jib.jpg/200px-Pedestal_Jib.jpg

http://cranetekindia.com/double_grider.html#!prettyPhoto

http://www.scraneengineering.com/prd/gantry-cranes.jpg

Parts of EOT crane



Design standards for EOT crane

- **IS 3177**: Code of practice for electric overhead travelling cranes and Gantry cranes other than steel work cranes
- **IS 4137**: Code of practice for heavy duty electric overhead travelling cranes including special service machines for use in steel works
- **IS 13473**: Crane – Vocabulary, Part 1 - General
- **IS 13834**: Crane - Classification , Part 1 - General

QUIZ

IS Standard for EOT Cranes

Which of the following is IS standard for design of regular EOT cranes?

1) IS 4137

2) IS 3177 ✓

3) None of the above

Guidance for classification of overhead cranes (IS 13824 Part 5)

No.	Usage of crane	Service conditions	Group classification of the appliance as a whole	Group classification of the mechanism as a whole		
				Hoist	Trav-ersing	Travel-ling
1	Manually powered crane		A1	M1	M1	M1
2	Workshop crane for assembly purposes		A1	M2	M1	M2
3 a)	Power house crane		A1	M2	M1	M3
3 b)	Maintenance crane		A1	M3	M1	M2
4 a)	Workshop crane	Regular light use	A2	M3	M2	M3
4 b)	Workshop crane	Regular intermittent use	A3	M4	M3	M4
4 c)	Workshop crane	Intensive use	A4	M5	M3	M5
5 a)	Cranes in storage yards	Regular light use, hook duty	A3	M3	M2	M4
5 b)	Cranes in storage yards	Intensive use, grab or magnet duty	A6	M6	M6	M6
6 a)	Scrapyard crane	Regular light use, hook duty	A3	M4	M3	M4
6 b)	Scrapyard crane	Regular intermittent use, magnet or grab duty	A6	M6	M5	M6
7	Ship unloader		A7	M8	M6	M7
8 a)	Container handling crane		A5	M6	M6	M6
8 b)	Ship-to-shore container crane		A5	M6	M6	M4
9	Steelwork crane:					
9 a)	Roll changing crane		A2	M4	M3	M4
9 b)	Ladle crane		A7	M8	M6	M7
9 c)	Soaking pit crane		A7	M8	M7	M7
9 d)	Stripper crane		A8	M8	M8	M8
9 e)	Charging crane		A8	M8	M8	M8
10	Foundry crane		A5	M5	M4	M5

M1 — M8

IS 13834 Part 5

Classification of cranes in Design Data Book

Table 27.2 *Classification of electric overhead traveling (EOT) cranes*

Applications	Number of hours in service per year	Class	Number of cycles for fatigue calculations	Impact factor (applies in vertical plane)
Cranes for occasional use only, such as engine and power house cranes, hand and light power operated cranes	Up to 1000	Class 1 or Class 2	10^5	1.1
Medium-duty industrial cranes for intermittent use in stores and light machine shops, such as maintenance cranes, giant cranes, fixed and traveling gantries cranes and ice works cranes	Up to 2000	Class 2	6×10^5	1.3
Cranes for general use in factories, workshops and warehouses, such as heavy-duty industrial cranes for non-ferrous foundries, heavy engineering shops, stockyard, railway goods yards, light iron foundries, under-slug jib cranes, machine shop secondary cranes, and ship building cranes	2000 to 3000	Class 2	6×10^5	1.3
Cranes for steelworks service and light process cranes, heavy-duty foundry work, light magnet and grabbing duty, such as overhead traveling cranes not elsewhere included, and traveling gantry derrick cranes	Over 3000	Class 3	2×10^6	1.4
Continuous process cranes for steel-works such as continuous magnet work, continuous grabbing duty, and skull breaker cranes	Over 4000	Class 4	4×10^6	1.5

Note: The impact factor applied to the motion of hook in a vertical direction covers inertia forces including shock. The rated lifted load is multiplied by impact factor to find out the live loads in members of the structure. The impact factor does not apply to the dead weight of the crane.

Old and New classification of cranes

Old Equivalent	*New Classification*
I	M3
II	M5
III	M7
IV	M8

IS 3177

QUIZ

Classification of Cranes

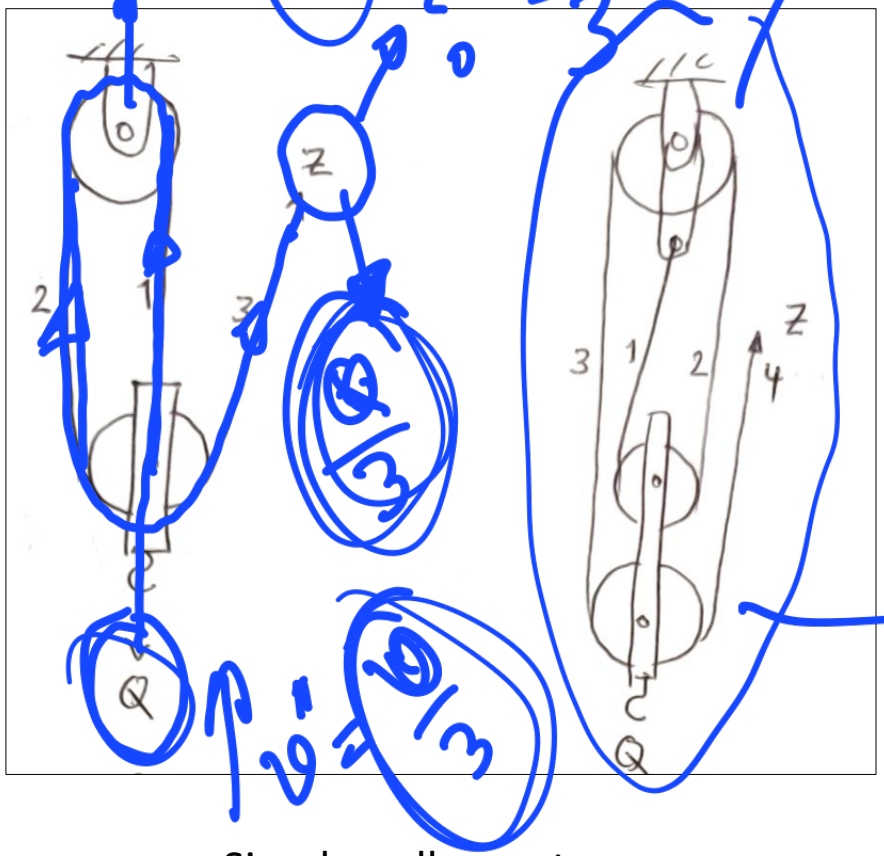
Classification of Crane depends on _____.

1) Usage of crane ✓

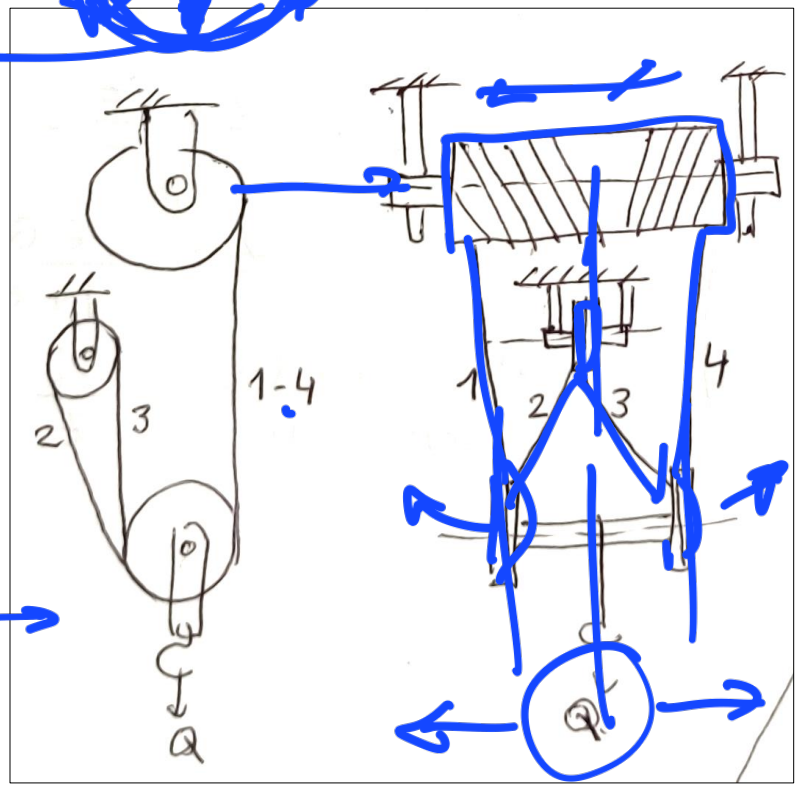
2) Number of hours in service per year ✓

3) Both of the above ✓

Pulley systems



Simple pulley system



Multiple pulley system

QUIZ

Simple and Multiple Pulley System

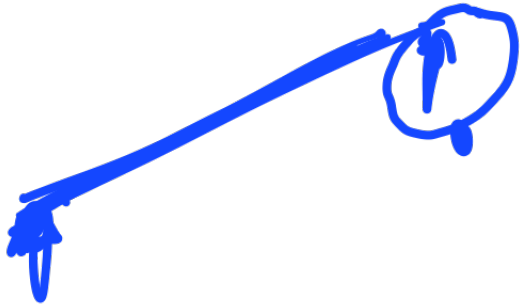
Simple pulley system is not used in EOT cranes because _____.

1) Less mechanical advantage ✗

2) Side movement of hook during hoisting ✓

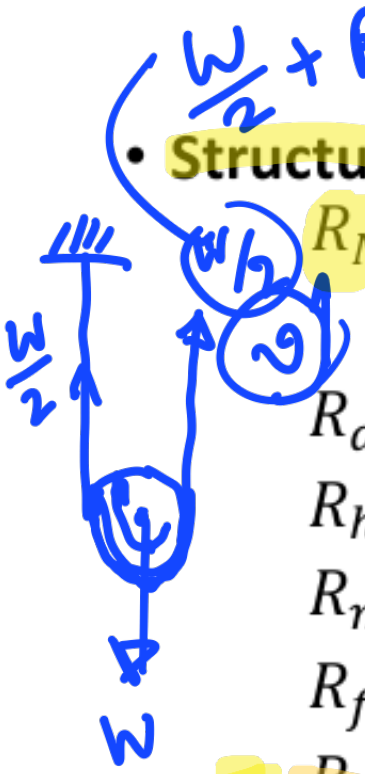
3) None of the above ✗

Loading to be considered in design



- Normal service
- Normal service with wind
- Crane out of service condition
- Exceptional loading
  - Testing
  - Erection and commissioning
  - Collision

Loads for Normal Loading condition, R_N



- **Structural parts**

$$R_N = Max(R_d + R_h + R_m + R_f, R_d + R_{hi})$$

R_d = Dead weight

R_h = Hook load (Safe Working Load, SWL)

R_m = Dynamic load from acceleration/braking

R_f = Frictional forces

R_{hi} = Hook load increased by impact factor

- **Rope design**

$$R_N^{rope} = R_d + R_h + R_m + R_f$$

QUIZ

Loads for Normal Condition

Which of the following is NOT to be considered for to calculate design load during normal loading condition of ROPE?

1) Load due to acceleration of object being lifted

2) Impact loading

3) Both of the above