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Mining Machinery – II

Books → Mine Hoisting
M. A. Ramlu
Elements of Mining Technology – II
– D. J. Deshmukh

Headgear:-

Steel or concrete framework installed on the shaft mouth whose purpose is to support the ropes, pulleys, cages or skips

. 3 types of material for headgear construction:-

1) Timber / wooden
2) Steel
3) Concrete

Timber:-

disadvantages
1) not used in moist places, it rottens
2) load capacity is lesser
3) It may catch fire (coal mines)
4) To avoid deforestation

advantages:
1) temporary head gear for small scale hoisting, where headgear is not required on surface after completion of work.

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Concrete:-

1) it can be made faster → advantages
2) it is a bit cheaper than steel → adv
3) It does not require any painting → adv
4) It does not require any stays → adv

Steel:-

1) easily dismantled and structure can be changed depending on production changes. → adv
2) lesser space occupied on the shaft mouth → adv
3) maintainace cost is less → made of several parts so some part can be changed when damaged → adv
4) It can be prepared at a different place and used at shaft mouth (simultaneously) without occupying place at shaft mouth. → adv

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Design Of Head gear:-

Factors affecting design of head gear.

1) Geological disturbances on shaft mouth
2) Hoisting time/wind (Duty cycle)
3) Hourly Production/hour
4) Strength of head gear
5) Geometry (shape, size, dia)
6) Depth of Shaft
7) Pulleys/Sheaves
8) Type of winding
9) Height of Headgear
10) Environmental Conditions (climate)

1) Geological disturbance:-
concrete - heavier than steel so prefer steel because of this disturbances if the strength of shaft mouth is not much

2) Hoisting time/wind:-
Based on ~~speed~~ hourly output the duty cycle can be determined

3) Strength of head gear:-
Strength should be sufficient enough to deal with (dead loads, live loads and rope loads)

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dead loads → safety attachments, head gear, extra rope length, skips, cage attachments, suspension gears, pulleys

live loads → man and material loads depends on acceleration period, deceleration period and const. speed period.

4.) Geometry:-

Based on diameter of shaft, Geometry is decided.

Generally circular shape of shaft is preferred due to high safety factor

5.) Depth of shaft:-

It imports the duty cycle and hence the production.

It is directly linked to the height of head gear.

6.) Pulleys / Sheaves:-

→ dead loads of pulleys imports the strength

→ We require power to overcome the dead load of pulley to start winding

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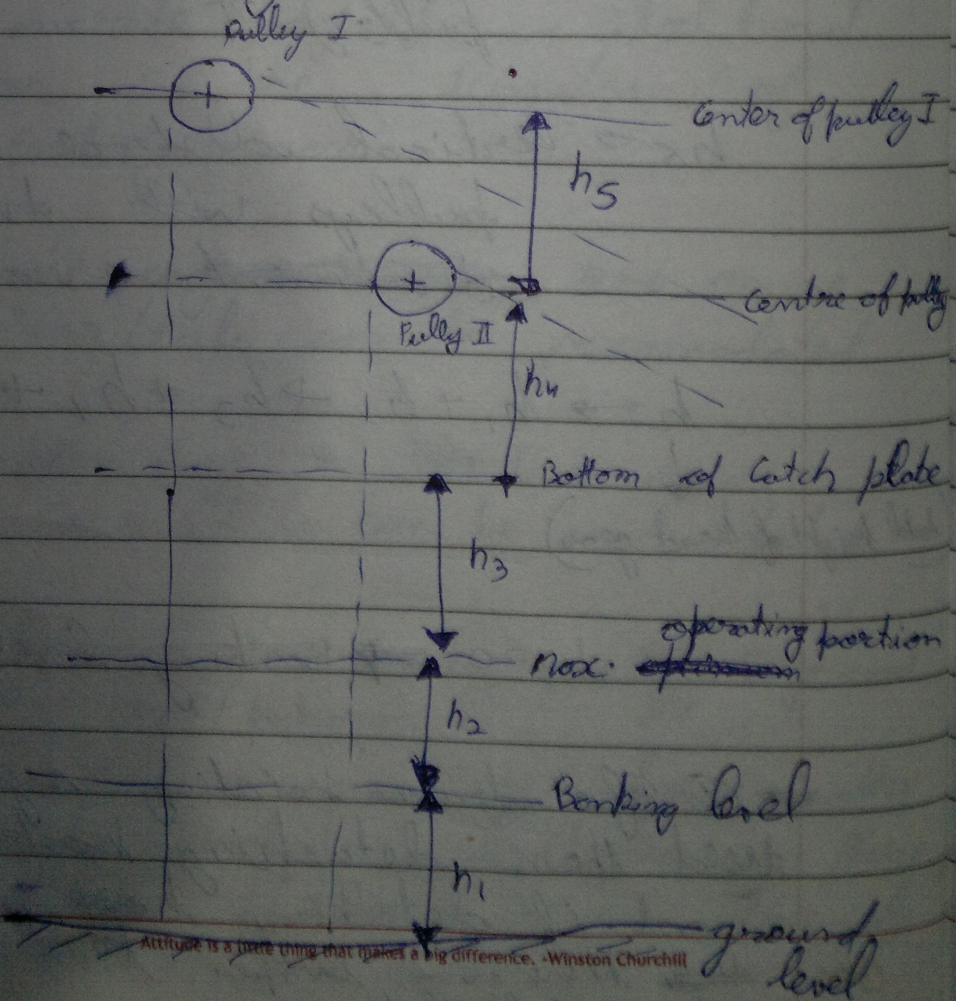
→ the design should be such that it is sufficient for the length of rope depending on the depth of the shaft

→ (Drum/Sheave dia ≥ 100 times Rope dia)

Reason → To avoid the bending stress on the wire

Height of head gear

1) Banking level



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h_1 → height of banking level above shaft collar level

h_2 → Max height of trap conveyed when discharging above banking level

h_3 → overwind allowance upto bumper beam / catch plate

h_4 → Vertical distance between bumper beam and centre of pulley II

h_5 → Vertical distance between pulleys with two tier ~~attachment~~ arrongment

$h \rightarrow h_1 + h_2 + h_3 + h_4 + h_5$

(total height of head gear)

$h_1 = 0 \Rightarrow$ Banking level = Ground level

→ ⊛ If a drum hoisting system is used then detaching hook is compulsory and if detaching hook is used then there is a bumper beam with catch plate or bell plate.

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$h_5 = 0$ ⟹ Either one pulley or pulleys lie at the same vertical level

$h_3 = 0$ ⟹ if Koppe winding is used (h_3 varies from 1.3 to 3m if present)

⟹ height of headgear varies from 20-60m

Terminologies:-

Steel legs:-

We have back legs (absent in concrete headgear) in steel head gear in the direction of winding room

Single cage → when one mine car/tub can be accomodated

Tandem Cage → Two mine cars/tubs can be accomodated

Single deck → only one cage and one level/platform

double deck → one cage above another cage attached simultaneously. There are two platforms so simultaneously output is at 2 levels

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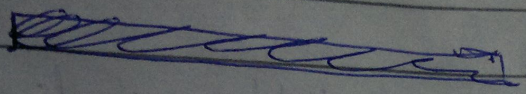
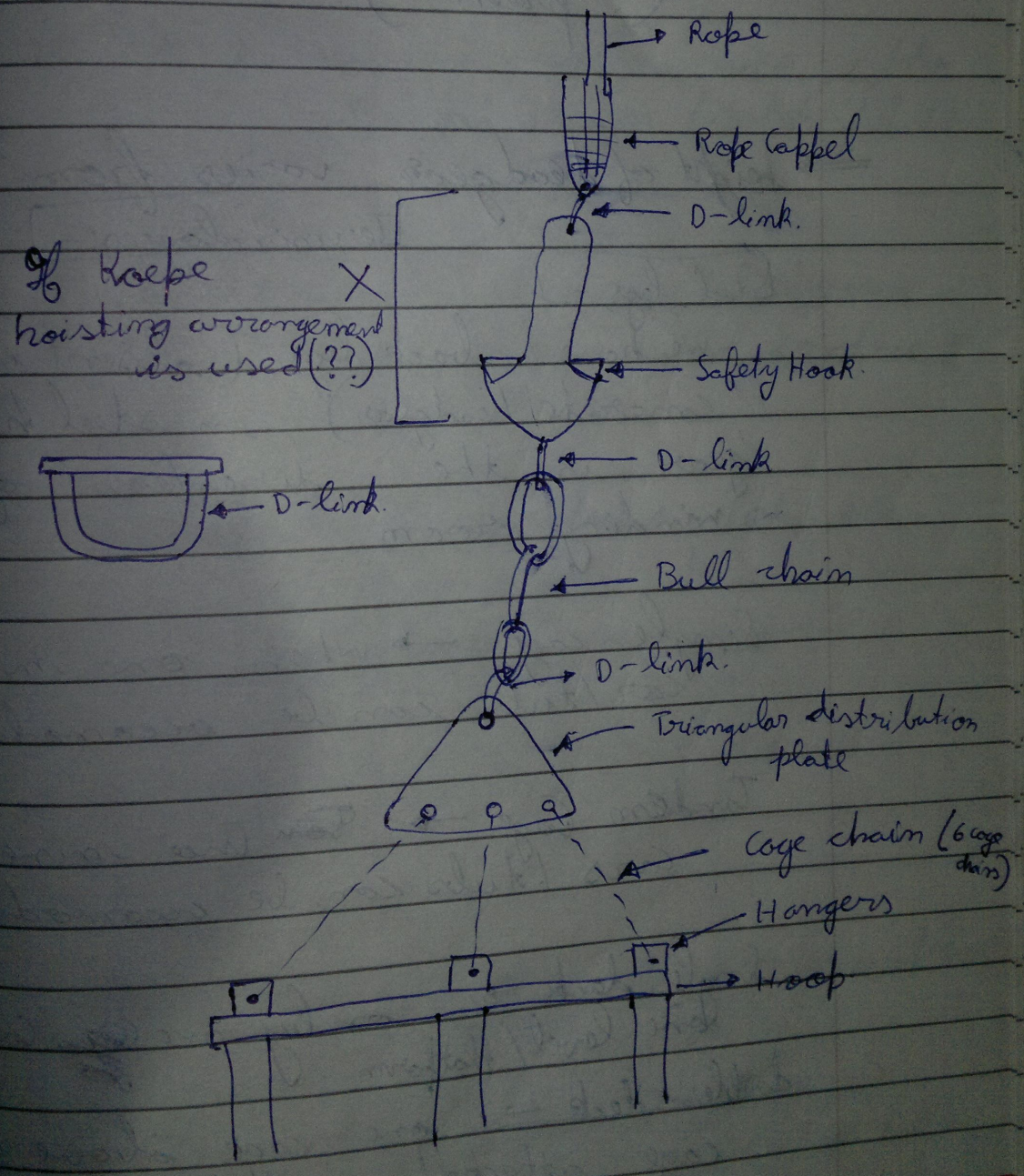


CAGE ATTACHMENTS:-



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Use of 4 and 6 cage chains → there is central movement of the cage

guides → To guide the cage or skip from surface to the underground and vice versa

pit top → surface level
pit bottom → lower end of shaft.

Based on capacity and mode of transportation-

rigid guides	flexible guides
Wooden bars or (steel) rail bars beings used:	Rope guides
wooden - 10cm X 20cm fixed by bolts to the buntons at 1.8-3m interval	flexible guides are hanged from shaft top to bottom
Steel → Flat bottomed/ T section 13mm length one side of cage	At the bottom Dead change weights at the lower end of the wire so that wire remains and tensions For one cage → 4 rope guides

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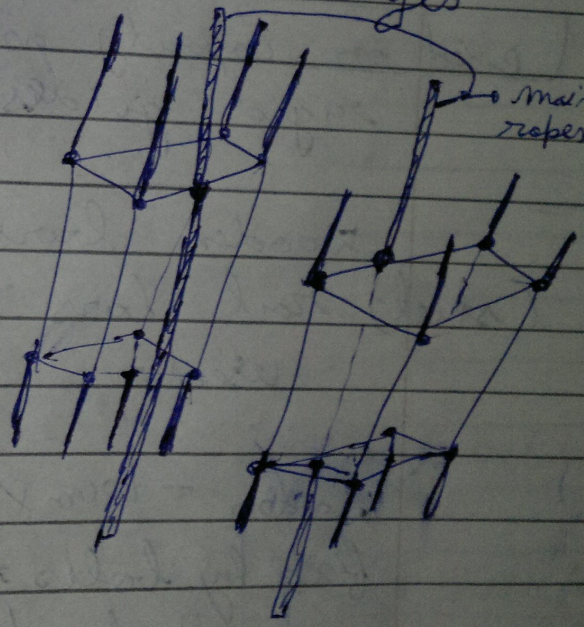
- In 2 tier - arrangements → 2 Cages used so that one cage at pit top and other at pit bottom or some level.

10 ~~guides~~ rope guides used → 4 for each cage and 2 main rope guides for separating the two cages



→ Locked coil rope
→ Suspended in a vertical shaft

→ Tensioning by cheese weights
10KN cheese wts / 100m - shallow depth
5KN cheese wts / 100m - deep shaft

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Difference :-

	Flexible	Rigid
1.)	Truely vertical shaft	inc line as well as Vertical shafts
2.)	No buntons	buntons at intervals
3.)	No resistance to ventilating current	There can be resistance due to buntons
4.)	Maintainance is easier and cheaper	High maintainance (fish plates and other spare parts)
5.)	Complete replacement of rope	replacement of some sections
6.)	dead load on headgear because of cheese weights	No dead loads required.

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fleet angle → It is the angle ~~between~~ between the vertical place of the pulley and the wire rope when ~~the~~ the cage lies at the pit top or pit bottom

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* Detaching safety hook :→ It is a safety device placed just below the rope capel, & it is used in case of drum winding system. It acts on the overwinding.

→ Detaching safety hook placed just below the rope capel, is a safety device & used in drum winding system, & acts when an overwinding occurs.

→ main purpose of a safety detaching hook are to detachen the winding rope, from the conv. in the event of an overwind & to support the conveyance in the headgear after such an event.

3 types :→

- ~~Ormerod~~ Ormerod detaching safety hook
- king's " " "
- Humble's " " hook → not being used.

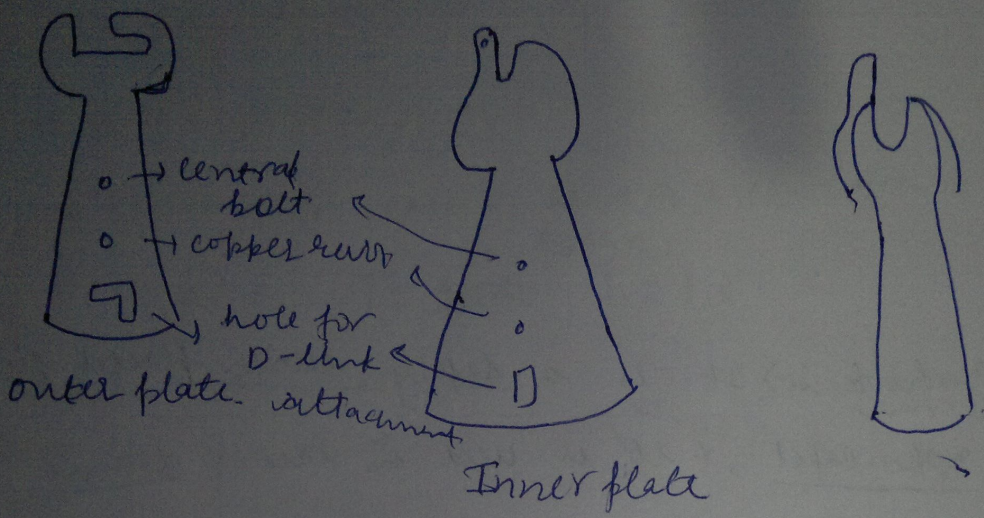
~~Ormerod~~ Ormerod :→

(1) 3 plates (iron / ms) → 2 outer plate & 1 inner.

→ made of 3 ms. plates, 2 outer & 1 inner

→ these are pivoted on a central bolt P & held in position by a copper pin C passing through the 3 plates

→ slots are cut in the plates to enclose the pin in shackle A to which the winding rope is attached.

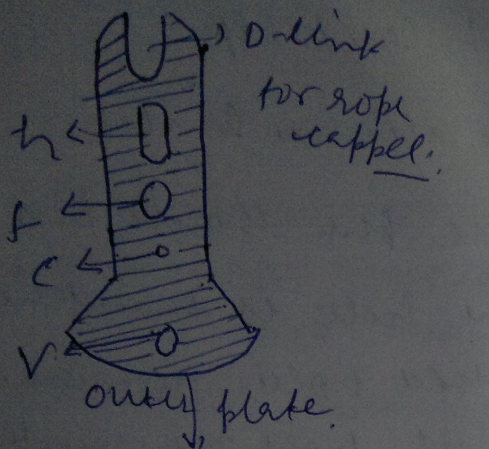


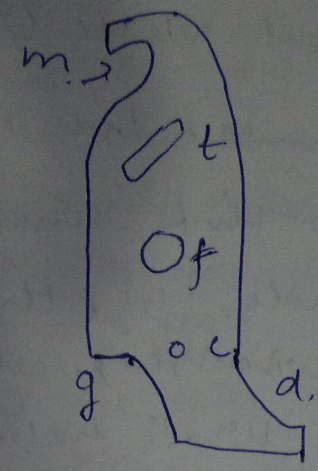
→ close the shaft mouth with rail bars / wooden bars.

(2) king's detaching safety hook: → 4 ms steel plates mounted together.

- 2 inner plates are placed together in opposite ways.
- A main bolt or centre pin passes through the hole 'f' in all 4 plates.
  - It bind the plates together.
  - It provides a pivot on which inner plates can move.
- The hooks 'm' are so curved that the pull of the winding rope has no tendency to open out the inner plates
- A ductile copper pin is placed through a hole 'c' in all plates to prevent undesired movement of inner plates when they are not under tension
- A vertical hole 'h' in outer plate 4 inches, here 'f' are provided for lowering the cage after overwinding.

Constructional features :->





Inner plate.

C → copper bolt
f → centre pin

- 2 fixed inner wrought iron inner plates.
- 2 movable wrought iron outer plates.
- A ductile copper pin.
- A centre of pivot.

Functioning of king detaching hook :->

- During a overwind, the safety hook is partially passed through the circular hole in the catch plate, securly attached to the horizontal member of the headgear & the lower wing of each inner plate is forced inwards.
- The copper pin is thus sheared & allow the rel. movement of inner & outer plates simultaneously releasing the D-link attached to the rope capel.
- The catches on the inner plates are forced outwards so that they rest on the upper shoulder of the catch plate & the cage is thus safely hanged on the bell plates.

Operations after overwindings :-

- Cover the shaft now mouths with few rails / wooden bars to prevent accidental release of cage / skip.
- The rope cable is brought back & attached to the plates through the D-link. whose pin should pass clear through the hole 'n' (the hole is maintain even after the overwinding ; vertical holes remain at the same position. While inclined holes get equally & opp. inclined)
- Raise the cage slightly.
- The pull of the rope on the new D-link pin causes it to move along the inclined slot
- The hooks 'm' & catches 'g' move inwards to their normal position.
- Lower the cage to the banking level.