LECTURE

NOTES

ON

MINE MACHINERY-1(5th sem)

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WIRE ROPE

→ It is the combination of wires arround a central core

→ It may be of 2 types depending upon the strand.

(i) Stranded rope

(ii) Non stranded rope

STRANDED ROPE

→ In stranded rope few wires are laid around a central core or independent wire in clockwise or anticlockwise direction to make a strand.

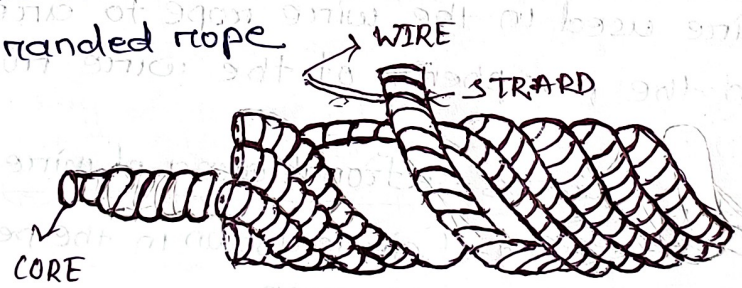
→ Few substances are laid arround a central core in clockwise or anti clockwise direction to form the rope.

(STRANDED ROPE)

NON STRANDARD ROPE →

→ As the name suggest there is no strand remain in this wire rope it looks like a single strand.

→ Few layer of wire laid around a central core to from a non-stranded rope



LAYS →

→ The wires in the strand or wire rope are laid either in right hand or left hand direction in the wire rope.

→ When the wires are laid in right hand direction or the strands are laid in wire rope in clockwise direction then it is called as right hand lay.

→ And when the wires are laid in ~~ati~~ anticlockwise direction then called as left hand lay.

LANG LAY →

→ When the wires in the strand and strands in the wire rope are laid in direction then it is called an lang lay.

ORDINARY LAY →

→ When the wire rope in the strand and strands in the wire rope are laid in opposite direction then it is called an ordinary lay.

FACTOR OF SAFETY →

→ It is the ratio between the breaking strength of the wire rope to the actual load applied to it.

mathematically FOS = $\frac{\text{Breaking strength of wire rope}}{\text{Actual load applied to rope.}}$

→ FOS of man winding should not less than 10.

→ For metal winding it should be ~~6-7~~ 6-7 as per Legislation.

SPACE FACTOR →

→ It is a ratio between sumation of cross sectional area of the wire used in the wire rope to area of circle drawn in the periphery of the wire rope.

space factor = $\frac{\Sigma \text{cross-sectional area of wire in wire rope}}{\text{Area of circle drawn in the periphery of the wire rope.}} \times 100$

→ For stranded rope SF is lies between 60% – 70%.

→ For non-stranded rope SF is more than 75%.

Classification of wire rope →

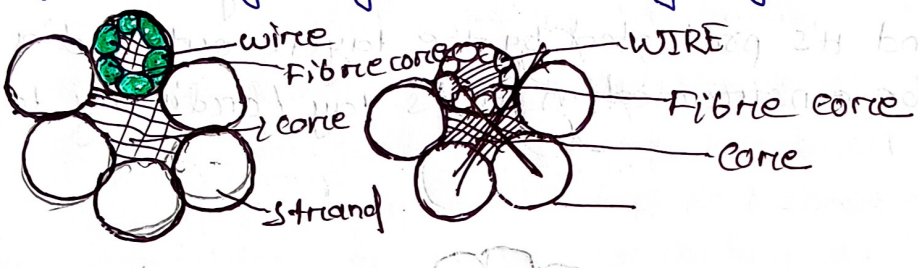
- wire rope
  - stranded
    - Round stranded rope
      - simple
      - compound
    - multi-stranded rope
    - Flattened stranded rope
  - Non strainded
    - Locked coil rope
      - Half-locked
      - Full-locked
    - Guide rope

SIMPLE STRANDARD ROPE →

→ It is a strandard rope in which 6 wire of equal dimeter are laid arround a centeral core to make a strand.

→ similar 6 strand are laid around the centel core to make ~~more~~ the wire rope

→ It may be Lang's lay or ordinary lay in construction.



IWRC
-India workers Resouce centre (6x(6+1) simple stranded wr)

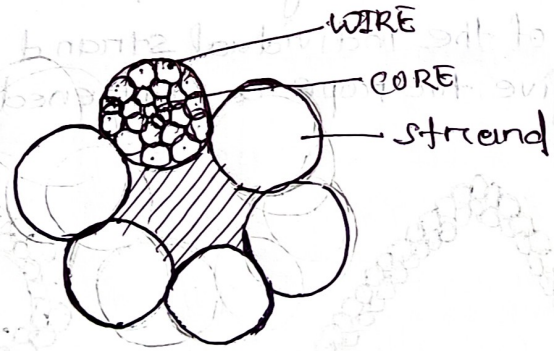
COMPOUND STRANDED ROPE →

→ It is a stranded rope where multiple layer of strong are available in a rope

→ The strands may be simple or compound in construction

→ This type of rope are neutral to the torque between the layers of strand.

→ The torque generally developed due to the right hand left hand lay of innere strand in opposite to that of outer lay of strands.



6 X 11/7 -1) compound stranded wr

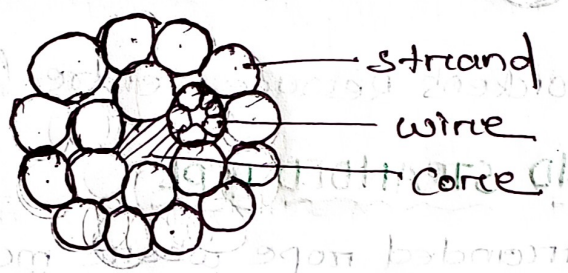
MULTI STRANDED ROPE →

→ It is a stranded rope wire each strand is made of multiple layer of wire.

→ Here the diameter of the wires of different layer may varies.

→ The smaller dia wire are laid centrally around the fibre core and it's protected by the layer outer dia wire.

→ It may be constructed in lang's lay / ordinary lay.



1 (12/6 X6) multi strandard Rope

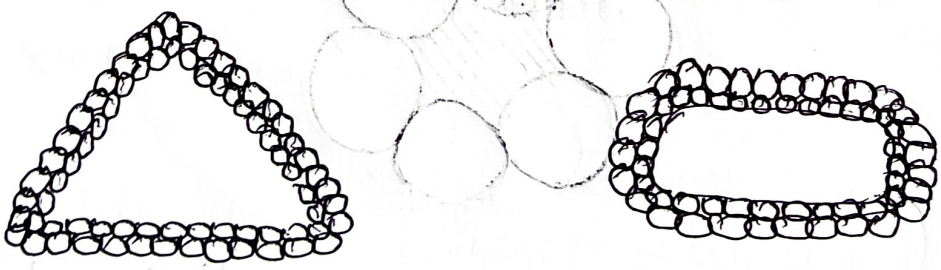
FLATIENED STRAND ROPE →

→ It is a strandard rope in which each individual wire gives a flattened loop to the rope

→ This type of wire rope is used wire more cross-section area is needed.

→ Here the strand may be simple and compound strand.

→ The core of the individual strand are oval or triangula shape to give the rope a flattened look.



Trangulation shape. oval shape

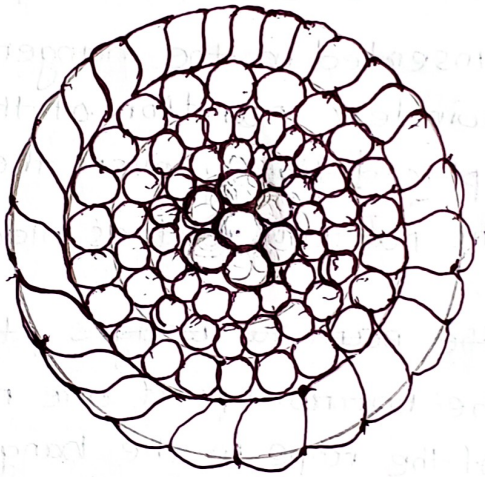
LOCKED COIL ROPE →

→ It is a non-standard rope and looks like a single strand and here the no of layers around the central core is more for thicker rope production.

→ It is of 2 types (i) Half locked coil Rope
(ii) Full locked coil Rope

→ When the rope is protected by outer sheath of PVC coating then it is called an full locked coil rope, but in case of half locked coil rope alternate round wires and shape wires are in layers around the central core to protect against unlying of individual wires from the rope.

→ The outer surface is smaller due to the interlocking shaped wires.



Full Lock coil

GUIDE COIL ROPE →

→ The Locked coil rope is used for guiding the cage from pit top to pit bottom

→ So this is termed a guide coil rope

ROPE CAPEL →

→ It is an arrangement at the one end of the rope where load is to be attached.

→ There are 3 types of capel generally practiced in mines.
(i) splits and riverts type capel
(ii) cone capel
(iii) Reliance / interlocking wedge type capel.

(1) SPLIT AND RIVET TYPE ~~CA~~ CAPEL →

→ In split and rivet type capel a hanger which narrow wedges is available the length of the narrow wedges determind the length of capel.

→ Initialy the end of the rope where load is to be attached is bind with binding wire leaving the length of capel from the end of the wire rope.

→ The strands ~~wir~~ and wire are unlaid upto the twin winding the core of rope is cut at twin winding point and the wires are straightened.

→ 1/3rd no of wires are cut 1/3 Length of capels winded over the notch at twin winding and over the rope.

→ similarly all the wire are binded over the rope to have a bulging shape at the end of the rope.

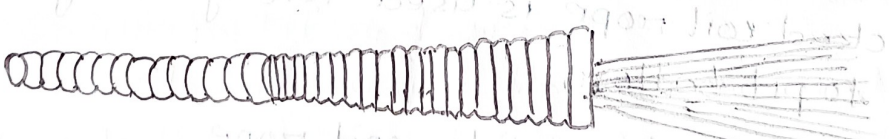
→ Now the rope is inserted in the hanger where the bulging shape face the winder portion of the hanger and the narrow wedges placed tightly over the rope.

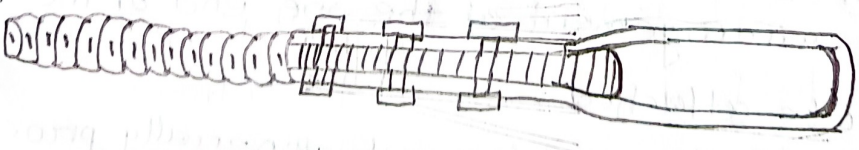
→ This portion of the narrow wedges placed tightly over the rope.

→ ~~This portion of the narrow wedges placed tightly over~~

→ This portion of the narrow part are rehited conforming that no slippage of the rope in the hanger.

→ Now Load can be apply to the inner part of the hanger.





2. CODE CAPEL →

→ In cone ~~capl~~ capel a hallow cone of cost iron is available the end of the rope white capelling is to be done is allow to pass through the hollow portion of cone.

→ The length of the cone should be the length of the capel. So leaving the length of capel from the end of the ropea twin binding is provided.

→ The strand and the wire are unlaid and straightened to form a brush shape.

→ The core is allow to cut from the unlaid portion.

→ The wires are free form Lubricants by use of kerosene, petrol or diesel.

→ Now the brush shape wire are pulled back to accomodate within the hollow portion of the Copel.

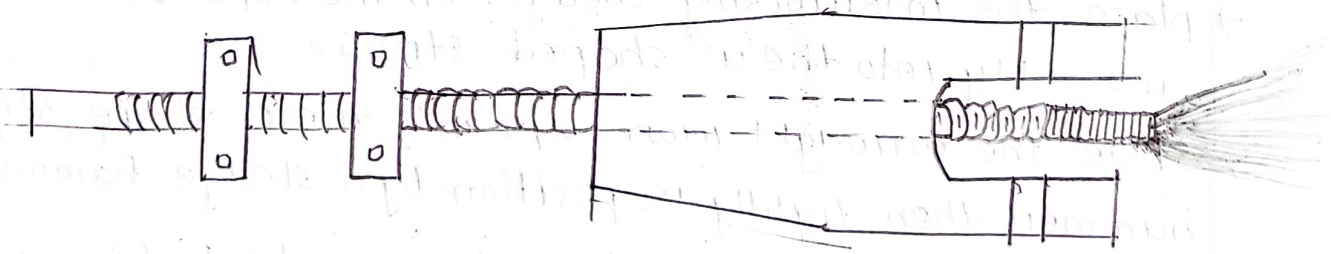
→ white metal is an alloy of Lead — 80%.
Antimeny — 15%.
Tin — 5%.

→ The white metal is pouring at molten space to the hollow portion of the capel.

→ At the time of pouring temp of white metal should be 365°c white as the cone temp is 100°C

→ Now it is cooled by natural means upto the room temp.

→ Now load can be applied to the capling end.

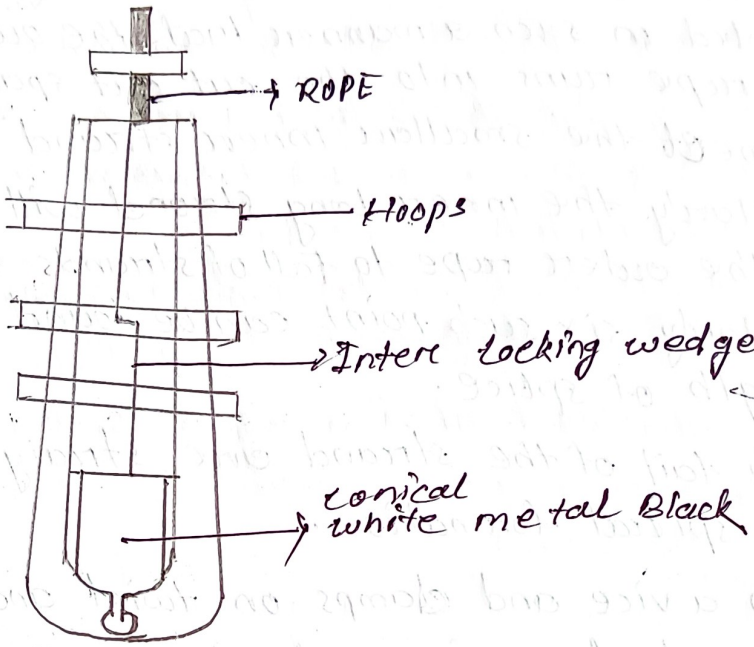


RELIANCE / INTERLOCKING WEDGE TYPE CAPEL →

→ It consists of following parts
(i) U shaped strap
(ii) Two tapered iron wedges
(iii) Cone
(iv) 4-5 wrolight Iron loops.

procedure →

→ At the end of rope at a distance equal to the tapered Length of the capel ~~ea~~ Lase a layer of binding wire on the rope.
→ Similarly lash a layer of binding wire on the rope at about 200mm from the end.
→ Thread the wrought iron hoops on the rope in correct order which they will occupy on the capel then thread the metall cone on the rope.
→ Fixed a set of clamps to the end rope portion which will at the end of operation remain inside the wedges.
→ Open up the wires for a length equal to the length of cone clean them with disel / kerosene to remove grease Lubricants cut out the exposed fibre core if any.
→ Slide the ~~ma~~ metalice cone on the brush shape and of rope.
→ warm up the cone to 100°c by a blow lamp and them pour white metal into the cone at 365°C
→ Cooled it up to atmosphere temperature by naturally so that the wire metal and cone become one solid mass.
→ place the interlocking wedges on the rope and the whole ansembly into the 'u' shaped strap.
→ Slide the wrought iron hoops into the u shape strop and hummer then lightly in position by a sledge hammer.
→ The end cone should not touch the interlocking wedges and when the capes will be in used the slight gap between the wedges and the cone will indicate that the rope is not sliding up the capel.



ROPE SPLIEING →

→ It is the procedure of joining two wire role of same type without any special attachment.

→ The length of the splice depends upon the diameter of the rope generaly 15mm dia rope and the length of splice is 6m where as the 25mm dia rope the length of splice will be 10 to 12m.

→ It can only be done in strandard rope.

PROCEDURE OF SPLICING →

→ Decide the length of splice.

→ Bring the two ends of rope to be spliced side by side ~~the two~~ for the length of splice.

→ Let it is 6mm on each rope from the ~~binding~~ end beared the total length of splice lie twin binding on each rope.

→ open out the strands of rope up to twine binding and cut the fibre core.

→ cut out alternate strands of each rope so that it can accomodate at equal distance in the splice langth

→ Bring the two rope face to face so that alt out cores will meet at a point known as marking point.

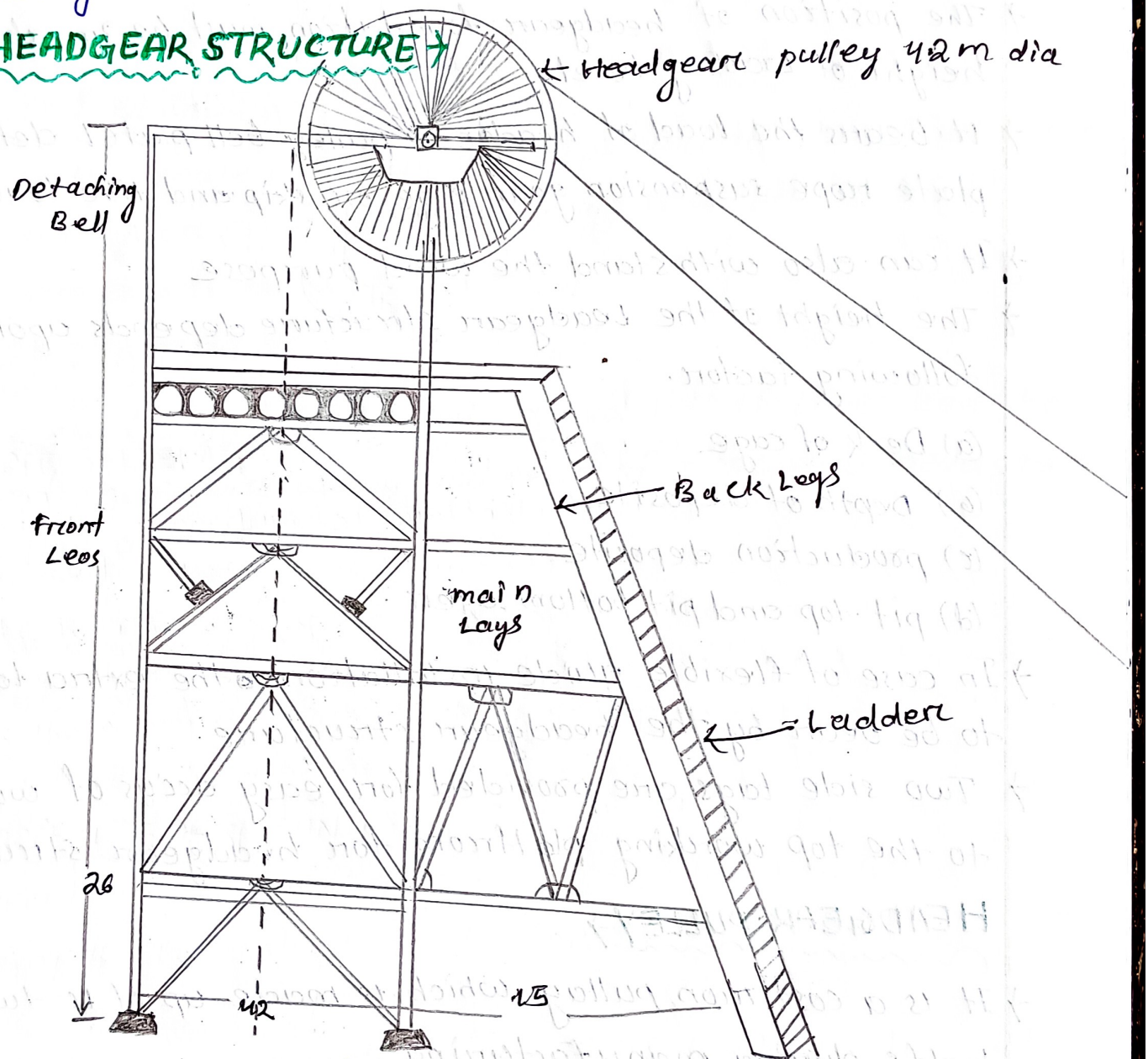
- The strand of left hand rope and right hand rope are caupled in such a manner that the outer long strand of one rope runs into the cut out space of another rope to meet the smallar inner strand of other rope.
- Similarly the inner long strand will meet the short strand of the outer rope to fall of strands at one point and similardy six such point can be found through out the length of splice.
- Each tail of the strand are straightened by removing any spiral formation.
- with a vice and clamps on twist and open the rope at the end of crossing and wires are joined at that place.
- Tuck the tail of the strand to the core of the rope and other surface is smoother by the help of wooden mallet tangue etc.
- Simillarely operation is repeated of the other 5 points where the tails are meet to each other.

HEADGEAR

→ For hoisting of mineral or for lowering and raising of men a lift like conveyance is used is called an cage or skip.

→ The other equipment for raising of mineral or men includes a tower like structure of steel or concrete is called Leadgear.

→ **HEADGEAR STRUCTURE** →



→ The Leadgear structure is install at the mouth of the shaft which is a tower like structure and lattice is construction

→ The main purpose is

- → To support the headgear pulley
- → To bear the load of hoisting rope, cage, rope guide and the load of men and material.
- → It also guide the cage from top to bottom.

→ The 4 main legs are Indined towards the centre of the shaft at an indine of 1 in 8

→ The member of headgear are either steel / concrete. materials no wooden headgear structure is allowed as at is prohbited by law.

→ The position of headgear foundation must be 3m about the height of Loading level.

→ It bears the load of headgear pulley bell platel detecting plate rope suspension gear cage or skip and live load.

→ It can also with stand the wind purpose

→ The height of the Leadgear structure depends upon following factor.

(a) Deck of cage

(b) Depth of deposite

(c) production deposite

(d) pit-top and pit bottom layer.

→ In case of flexible guide installation the extra load is to be bear by the headgear structure.

→ Two side lags are provided for easy accus of worker to the top working platfrom for headgear structure.

HEADGEAR PULLEY →

→ It is a cast iron pullay which is made up of is two halfs during manufacturing.

→ Two halfs may bolted together to form a pulley during its used.

→ The pulley how grive which can accomodate the rope within it and prevent from slepping of the rope when it works.

→ For stranded rope the groove sheave should be 105% than that of diameter of rope.

→ In case of non stranded rope it is 110%.

→ The diameter of the pullay must be 100 times the diameter of the rope.

→ In general 2.5 m dia headgear pullay is used in mines. (Indian mines)

FLEET ANGLE →

→ It is the angle between the rope and the vertical plane of headgear pulley when the cage is at pit top or pit bottom and tends to start its journey.

LIMITATION →

→ The fleet angle should not exceed 1.5° if it exceed the limit then more wear and tear of rope and headgear pulley occure.

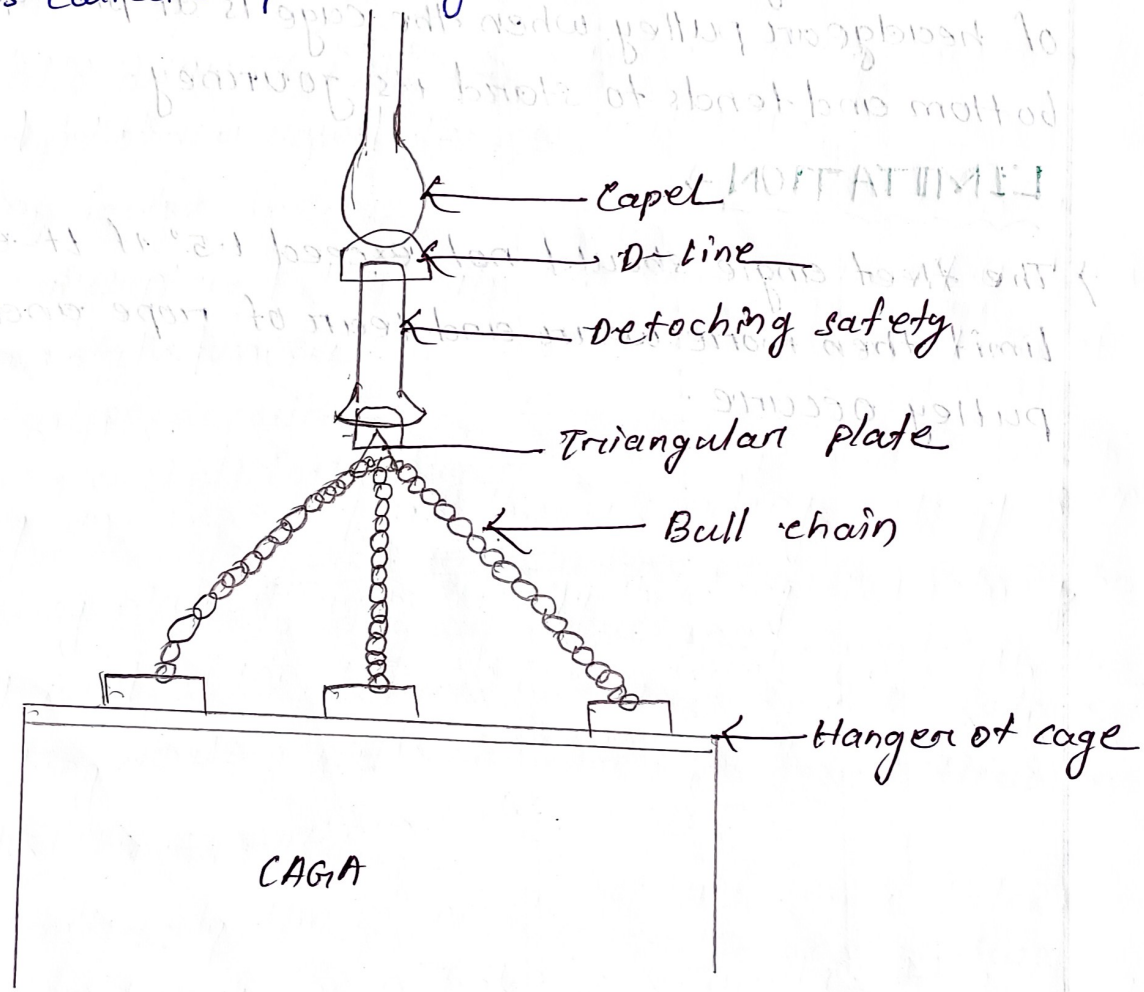
CAGE AND SHAFT FITTING

CAGE →

→ For hoisting of mineral or for lower and raising of men a lift like conveyance is use. is called as cage or skip.

SUSPENSION GEAR →

→ The arrangement of attaching cage to the winding rope is called suspension gear.



→ At one end of winding rope capeling is done to bear the load of that end through a D.link a detaching hook is attach to the capel

→ Again Bull chain is suspended from detaching hook through DLink.

→ At the lower end of bull chain a D-link is provided to attach triangular distribution plate from triangular plate cage chains are suspended to hold the hanger of cage.

DETACHING HOOK →

→ Detecting hook which is always placed just below the rope capel which is a safety device and acts when an overwinding takes place.

→ Its surface is to suspend the cage (skip in the head gear if an overwind ocures and at the some time to release the rope (along with capel) to grover the Headgear pulley.

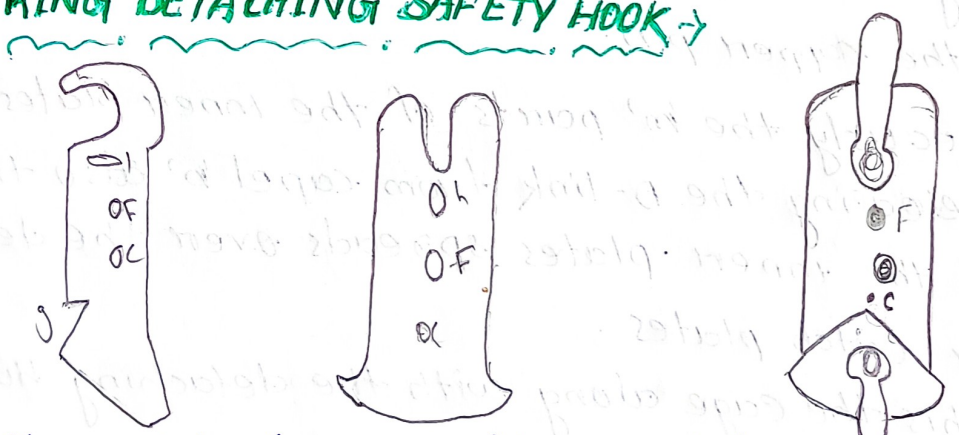
→ These are used only for vertical shaft but they are not used on ~~kope~~ koepe winder.

→ There are two types of detaching hooks.

(i) Ormerod detaching safety hook

(ii) King detaching safety hook.

(i) KING DETACHING SAFETY HOOK →



→ It consists of 4 wrought iron plates among which 2 are Fixed and 2 are movable.

→ 4 plates are jointed by a central bolt through the hole '7'

→ The two inner plates are placed together in opposite ways so that the hook 'm' of one plate and that of otherly jointly securely form a hole to recive the D-link from the rope capel.

→ The purpose of main bolt is bind the place together and to transmite the tension of winding rope from the hooks of the inner plates and the D-link of from capel.

→ Still them 2 inner plates can move freely within the 2 fixed plates around the central hole.

→ To secure the inner plates in proper position a copper pin placed through the hole 'c' in all 4 plates and reverted over the prevent the momentum of inner plates.

→ During an overwind an the ascending cage goes upto detaching plate allow partially the king detaching hool The 'd' pard of inner ~~parts~~ plates stroke beneath the detaching plate creats a shearing force which breaks the copper pin.

→ Simultaneously the 'm' parts of the inner plates moves apart releasing the D-link from capel 'n' also the 'g' part of the inner plates spreads over the detaching plate or catch plates.

→ Due to this the cage along with the detaching hook ~~sw~~ suspends in the headgear.

→ To restore the cage few rails are placed across the shaft top. Then the winding rope along with the cape and D-link are come across the headgear

pulley and the labour from the ~~platt~~ plat form insert the D-link in hole 'h' of four plates.

→ Now the hook raised slightly and the g portion of the inner plates are hammered to kept the 4 plates in positions.

→ Now a small iron rod is placed at the central hope to make the inner plate secure within the outer plates.

→ Now the cage along with the rope capel is lower down upto shaft mouth and cage rest over rail spread before.

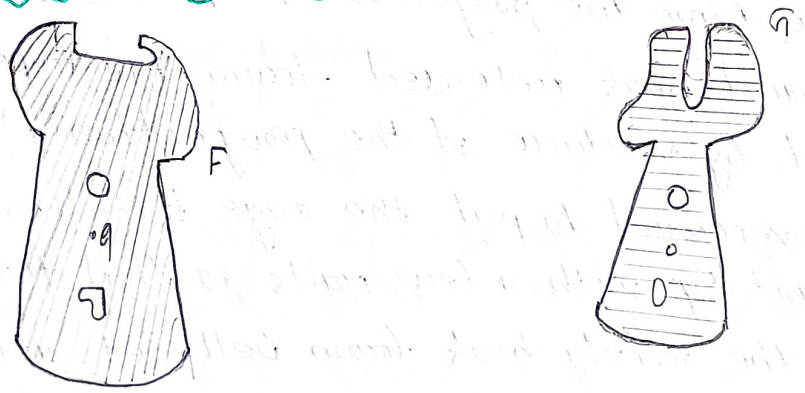
→ Now the end of the rope examine throughly and recapping is done at the end of the rope of the rope is in good condition otherwise the rope also replaced.

→ Now again the D-link from the lapel displaced in the socket formed by the 'm' path of the inner plates and again a central bolt and copper is placed in hole 'f' and c.

→ Now the cage raised slighthy to remove the rails spreaded over the mouth of the shaft.

→ Now the proces the restore.

ORMEROD DETACHING SAFETY HOOK →



→ It consists of 3-mild steel plates among which one centre plate and two outer plates.

- The plates are assembled on a common centre pivot and a copper rivet posses through a small hole of the plates when assembled.
- The upper rivet holds the three plates in their relative position after assembly the top portion of plates is attached to a D-link hung from the rope capel by means of slotted holes.
- The bottom portion open out to give the appearance of a wedge.
- The bottom slotted holes each plate carry the pin of D-link which supports the triangular distribution plate and the cage.
- The outer cages actually transmit the load of the cage to the rope.
- when overwind takes place ancending cage rises high enough for the hook to pam through the bell then wedge shaped portion of the outer plates are pressed inwards by which the copper rivet to shear.
- The plates open out at the top releasing the D-link pin of the rope capel which then pomes over the headgear pulley.
- At the same time the projection 'F' of the outer plates open out and hook released from the rope rests on the bell set by virtue of the projection 'F'
- After an overwind to put the cage back in operation cover the pit top with a few rails so that the cage/skip.
- To remove the safety hook from bell-set attach the ropes to the tip hole 'G' of the centre plate by a D-link and lift the cage slightly and the outer plates will move downward slightly so that the top part of the hook becomes narrower.

→ This allows it to pass through the bell and the cage can be send-down to rest on the detaching hook and ~~sw~~ suspension gear.

→ To replase both hook and cage chains with a set which have been antealed.

KEPS →

→ keps are rectangular support for cages have to be used at the pit top under mine regulation.

→ There is no use of keps at pit bottom as it can rest over ~~sted~~ steel griders mrigid platfrom.

→ keps are manually operated by bank's man at the pit top.

→ In some rigid keps may installed which does not depends on the Banksman for ancending cages.

→ The ancending cage pushes the keps fall back in position by gravitational force and when it is ready to move down word the cage is raised slightly and the platform is wider by operating lever and then after the cage starts its journey.

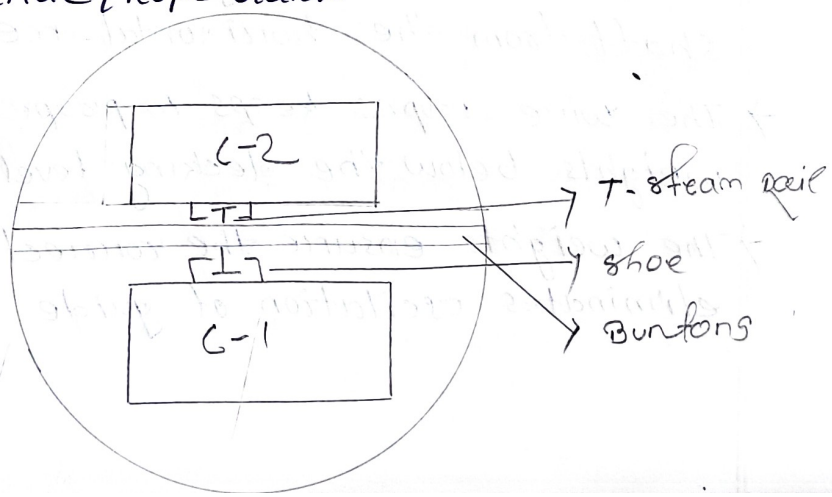
SHAFT GUIDE →

→ There are 2 types of shaft guide used in the mine.

(1) Rigid Guide

(2) Flexible Guilde / Rope Guide

(1) RIGID GUIDE →



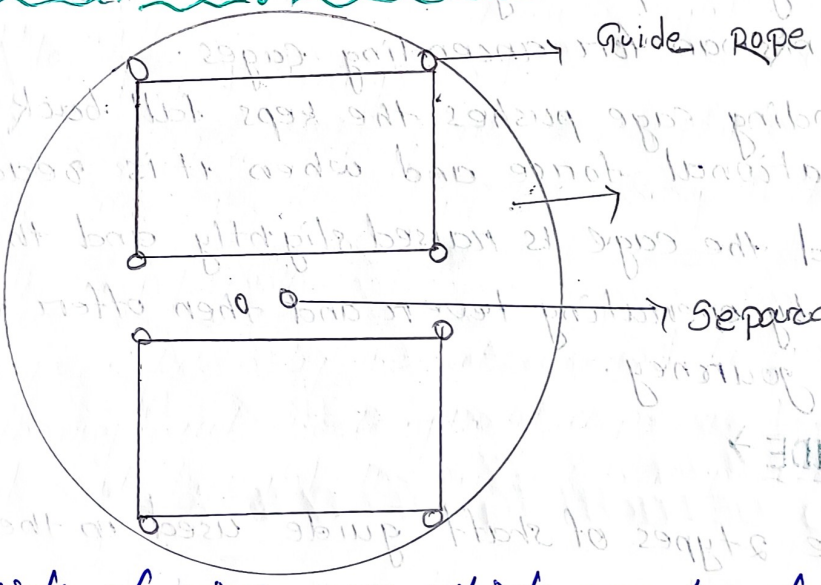
→ In rigid guide horizontal griders called Buntons are installed at the middle of the shaft through out the length at certain interval (1.8m – 3m)

→ On both side of buntons T-section rails are fixed with ~~con~~ counter sunk bolt with the buntons.

→ The T-section rail weighing 20-55 kg per meter length and available upto 13m length.

→ On the one side of the cage towards the bunton side cage shoes is fixed to the cage and embroue the T-section rail with roller and the lage moves by rolling on the T-section rail

(2) **FLEXIBLE GUIDE / ROPE GUIDE** →



→ It consists of wire rope which may be of locked coil construction and they are suspended in a vertical shaft from the horizontal member of headgear.

→ The wire ropes keeps in proper tension by placing choose weights below the decking level of shaft bottom.

→ The weights ensure the correct verticality and also eliminates oscilation of guide rope due to wind.

DIFFERENCE BETWEEN RIGID GUIDE AND ROPE GAIDE / HEXIBIE GAIDE

RIGID GUIDE	ROPE GUIDE
1. No oscilation is there	1. Oscilation of cage is there
2. Less space required.	2. more space required.
3. It costly	3. It is cheap
4. Installation is difficult.	4. Installation is easy
5. Required more mainmtenanu	5. Required lay maintenance.
6. more resistance to fire.	6. Less resistance to fire
7. No load on head gear	7. Complete load on head gear
8. Only dameged part can be replaced.	8. Any damage cause replace meat
9. Buntons are required through the shaft.	9. No Buntons are required
10. more life	10. them life
11. wear and tear	11. No wear and tear
12. T. section mail is there	12. Rope is there
13. Vibration is quite high.	13. Vibration is low.

TESTING OF ROPE →

→ The quality of rope is judged by following test.

(i) Tension test
(ii) Torsion test
(iii) Bending test
(iv) wrapping test
(v) Looping test / Hand test

(i) TENSION TEST →

→ A specified length of wire is straightened and its two end are griped into a vice and the rope is stretched untill the wire breaks then the ultimate tensile strength of wire can be determine in tonnage per square centimeter

2. TORSION TEST →

→ In this test the two end of the rope are griped by vices. and one end is twisted until it breaks this measure the ductility and uniformity of wire in the rope.

3. Bending test →

→ In this test one end of the wire is fixed in a vice and the other end is bend backward and forward through 180° over the jaw of vice untill it breake

→ The no of complete bends before fracture is measure of ductility.

4. WRAPPING TEST →

→ In wrapping test the wire used in the rope are wrapping tightly within each other with tight turns and then unwarked and straightend.

→ In 8 turns of wrapping there should not be any sign of cracks this also known as wrapping test.

5. LOOPING TEST / HAND TEST →

→ The rope is taken by the labour and Looping is carried out through out the length of rope and again it is pulled out straight the process is repeated untill the wire breaks.

→ wrapping and looping test are auxilliary test may not needed after tension and torsion test.

EXAMINATION OF WIRE ROPE →

→ when the wire rope are in used it need certain examination for the safety of man and machinary.

→ Rope examination is of 4 types.

(i) Daily examination → 1.5 m/s
(ii) weekly examination → 1 m/s
(iii) monthly examination → 0.5 m/s

] manually examination.

(iv) Electromagnetic examination

(1) DAILY EXAMINATION →

→ In man/material winding whine cage /skip is used a man with a handtup of cotton strands near the pit top before shift work and hold the rope on smoethly and the rope is allowed to move at a speed of 1.5 m/s

→ If any fracture developed in outer surface of the rope may tear out cotton along with it by knowing which remodial measures may taken.

2. WEEKLY EXAMINATION →

→ In weekly examination the whole rope is examine through by possing the rope at a speed not more than 1 m/s

→ In this examination the diameter of the rope is measure by slide calipers to observes any chance in diameter

→ Also the lubrication of wire rope is done in weekly examined.

3. MONTHLY EXAMINATION →

→ In monthly examination the rope is allow to pass at a speed of 0.5 m/s

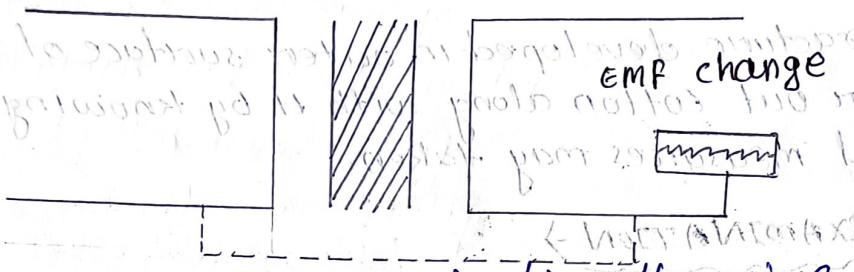
→ In this test few length of rope is examine throughly by keeping the rope by steel this procedure is followed through out the length of the wire rope.

→ In this examination the interial as well as the out condition of rope is examine by tapping actim by wooden hammer to observe any change in sound in some portion particularlly upon the head gear structure on the pulley the section whine rope capelling is done the winding portion of the rope on the drum where keyed is examined.

→ In monthly examination electromagnetic test is also done to known the internal condition of wire or strands near the core.

→ The dia of the rope is also measured in montly examined
→ Daily and weekly examination is not done on the day of monthly examination.

4. ELECTROMAGNETIC EXAMINATION →

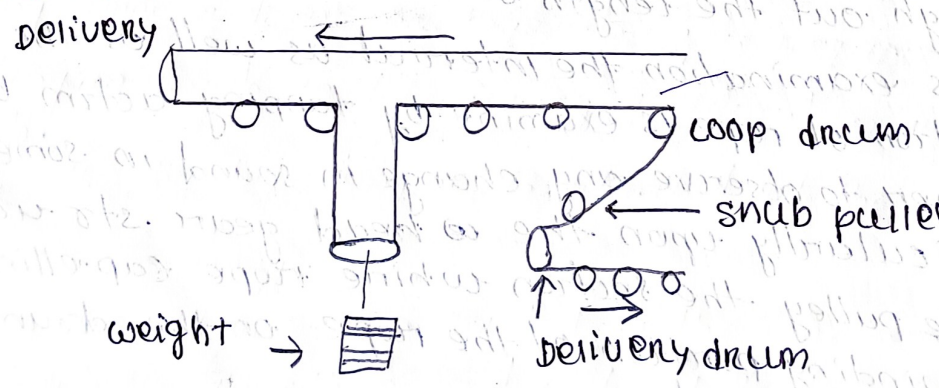


→ In electromagnetic examination the wire rope in use is allow to pass through an electric magnet if its entire length.

→ By passing the wire rope in electromagnetic field flux is generated which depends on the cross-sectional area of material section.

→ The emf produce depends on the magnetic flux in any change in material section of wire will produce change in magnetic flux thus the emf also varies which can be recorded in a visual electronic device.

TENSION ARRANGEMENT →



→ The bell should be kept in proper tension if it is loose slack on the driving drum then it is unable to transmit the power to the belt so the belt should be in proper tension.

→ So the tension end of a belt ~~com~~ conveyor of a small length is the return drum mounted in a steel frame worke to which hooks are filled for tensioning by means of sylvestor proy withdrawer or by tensioning screw.

→ On a belt conveyor system of more or less permanent nature the tension arrongement is provide mean the drive head, and it consists of weight placed on a ~~ma~~ movable pulley on drum over which the belt passes.

→ Very tight loop tension will cause excessive stress in the looded belt which is liable to break on damage joints and shorten the belt life.

→ So it is an important that no belt conveyor should be run with the loop at a higher tension then its necessary to obtain starting and stopping without slip under the various condition of load.

DISTINGUISH BETWEEN CAGE WINDING and skip WINDING →

CAGE WINDING	SKIP WINDING
→ It is rectangular like structure with bace and canopy with 2 side wall.	→ It looks like a pentagon with top loading system are bottom discharging system.
→ It is used for moderately depth shaft with low output.	→ It is best suited for dip shaft where high output is disirable
→ The ratio of pay load to gross load is very low	→ The ratio of pay load to grass is very high.
→ It fascilate manual loading system through tube	→ Automatic loading and unloading by tipper.
→ The height of headgear is less than skip winding system.	→ The height of headgear is more and length of skip and weight of pay loap is more.

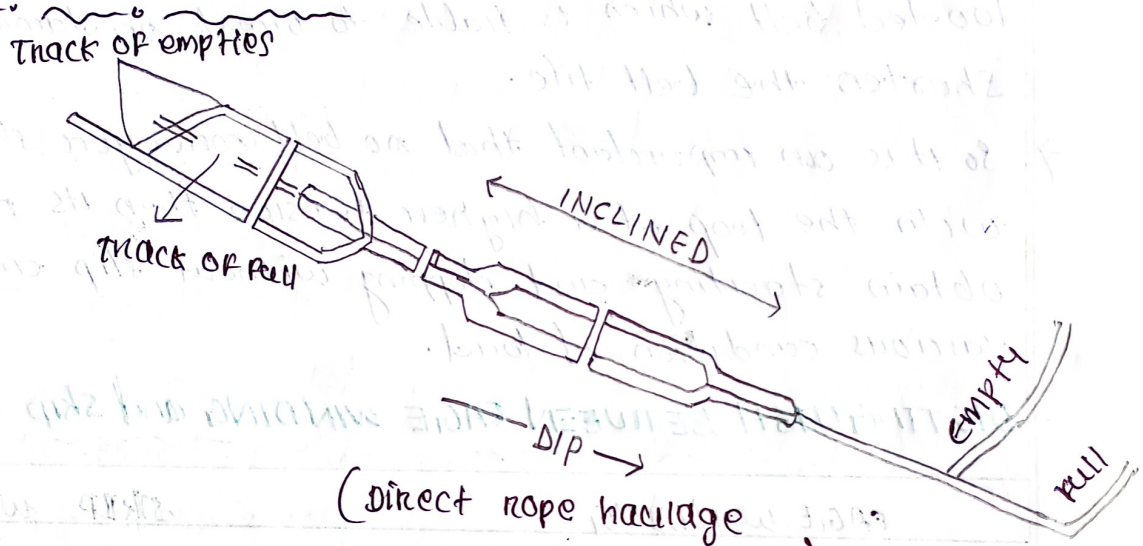
ROPE HAULAGE

The transportation in u/g mines with the help of rope is called as rope haulage.

→ There are 4 type of rope haulage

(i) Direct rope haulage
(ii) Main and Tail rope haulage
(iii) Endless rope haulage
(iv) Gravity rope haulage.

DIRECT ROPE HAULAGE :-



(Direct rope haulage track layout)

→ It is the simplest system of ropes haulage where one pulling rope and one haulage drum is required for hauling minerals in tubs having gradient more than 1 in 10.

→ Here the haulage engine is situated of the top of an incline roadway.

→ The train of tube is attached to the one end of the rope where as other end is fixed to the winding drum.

→ The winding drum is coupled to a slipring motor as high starting torque is required during the starting of the loaded tube.

- The empty tubs attached to the end of haulage rope travelled on down gradient by their own weight so do not required any power during the down ward journey.
- At a time the motor is disengaged by clutching ~~is~~ to free the axle of the winding rope Here the dutch used a jaw clutch.
- The rope or haulage speed in direct rope haulage system is 10-12 km/h
- Here single track is required for the transportation. material branch track can be provided for smoth loading and unloading material.
- A back stay is fixed to the last of a set of tube when the loaded tubs hold up gradient / ascending gradient this is the safety provison to at arrest the run away tubs if any breakage of tubs or couping tubs.
- It is not provided in the empty tubs when moving down gradient.

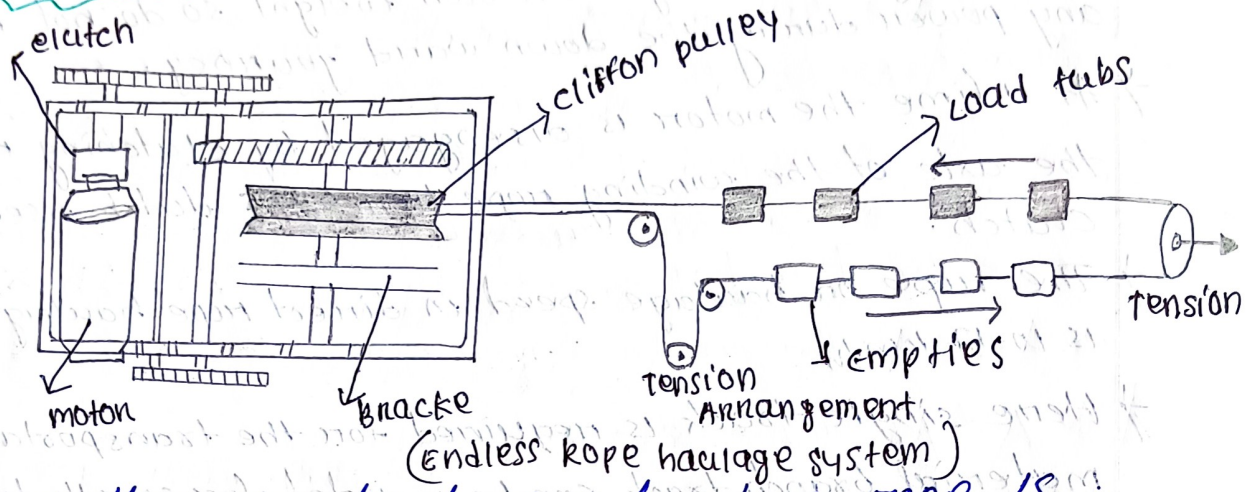
ADVANTAGES:

- Speed of the haulage is more so production will be more
- A single track is ~~uspe~~ used to so supervision is easy
- It is cheaper haulage system.

Disadvantages:

- High peak power is required so more power cost.
- Accident can't be avoided due to high speed.
- Serve breaking duty during downward movement.
- maintenance cost is high as a single track is there.
- If any drailment occurs then total haulage system stand stills.

2. ENDLESS ROPE HAULS →



→ In endless rope haulage a haulage rope is driven between driving head and returned head thus the rope has no end and the haulage system contineously serves so it is called as endless rope haulage.

→ In endless rope haulage there are two parallel tracks side by side one for the loaded tubs and the other is empties and an endless rope passes through the driving pullay and return pulley through a tension buggy.

→ It is of two types depending upon the dip used.

(i) over head endless rope haulage

(ii) under ~~hen~~ head endless rope haulage.

APPLICABILITY CONDITION →

1) ditton pulley (Driving Pulley)

2) Return pulley

3) Tension buggy

4) Different types of dips.

5) Two parallel track
6) squirrel cage motor clutch brakes, gear box.

DIFFON PULLEY →

→ This pulley is also known as e-pulley or surge wheel.
→ The main steel segment with taperness of 1 in 8. is fitted to protect the driving drum from wears and tears.
→ The segments have side flanges which covers up the surface of the drum.
→ The segments are fixed on the ring of the driving wheel by counter sunk bolt.
→ The incoming rope pulling the rope at larger diameter of the drum while as leavel at the smaller diameter for keeping the tension of both side at equilibrium condtion.
→ Due to fluctuation of load motor may be over-loading because of this a tension buggy is mounted near the drive head and on leaves side of the rope.

RETURN PULLEY →

→ The return pulley is placed at the out side of the haulage roadway.
→ It's purpose is to returning back the endless rop to the diffon pulley and to maintain proper tension so that the power transmission from diffon pulley is maintained.

TENSION BUGGY:-

- For proper power transmission the rope should be kept in proper tension b/w drive head and the return head.
- If the ropes are in excess tension then it will stretch and detonate the rope.
- If the rope is loose b/w drive head and return head then the rope will slip from pulley and proper transmission of power is not possible so a tension buggy is mounted.
- Near the driven head to take extra loose rope within it.
- For this purpose 8-pulleys in a hanger are placed in such a way that if we are wait to the lower middle pullay then it will drag excess rope passes through it.
- Tension buggy is placed in a inclined surface for getting the advantage of gravitational force.
- If T_1 and T_2 is tension of entering and existing rope from the pulley then the ratio T_1/T_2 should not exceed $e^{\mu\alpha}$ and the value is 1.5.

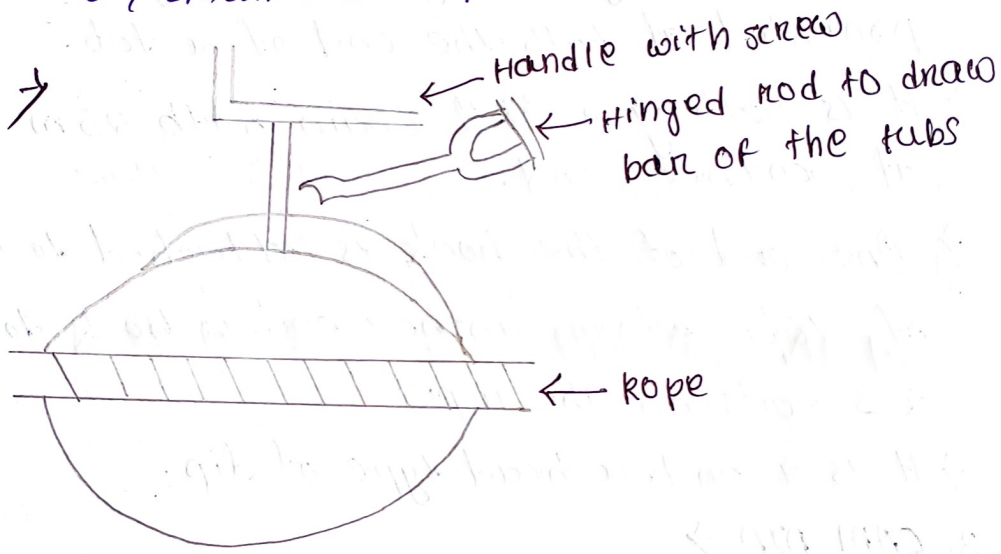
$$\boxed{\frac{T_1}{T_2} \leq e^{\mu\alpha} = 1.5}$$

DIFFERENT TYPES OF DIP →

→ Depending upon the over rope haulage or under rope haulage various types of dips are used to attach the tubs with the moving rope of endless rope haulage.

→ These are S → Screw dip
L → Lashing chain
C → Cam dip
S → Small man dip

Screw dip →



→ It is made up of with two plates one side of the two plate are hinged with each other and the other side is free to open with the help of a screw ~~eit~~ with handle.

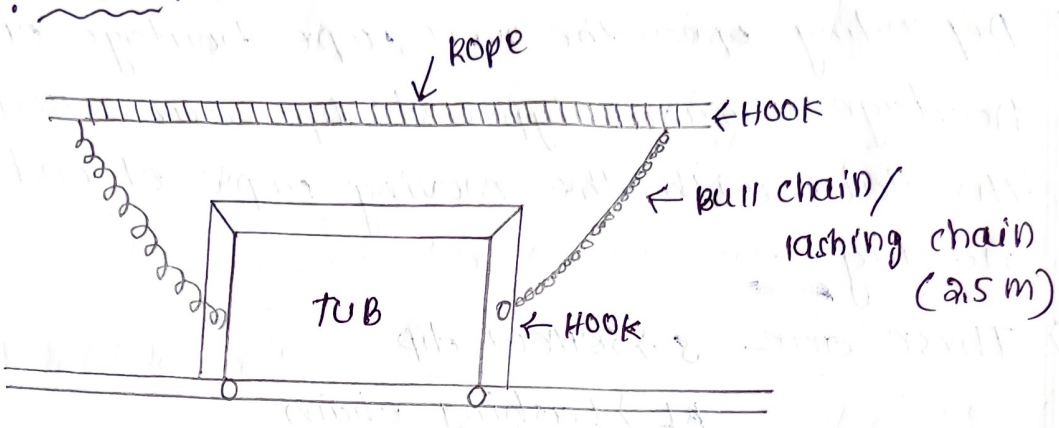
→ In b/w two plates there is a grove to grip the rope within it.

→ By screwing activites we can grip and release the rope from the dip quickly and smoothly.

→ A hinged bar is also provided to the upper plate which may connect to the draw bar of the tub.

→ It is a under rope type of dip.

2 LASHING CHAIN →



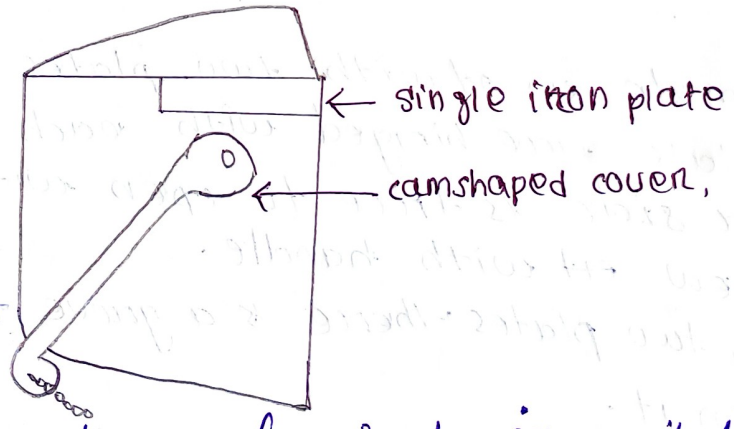
→ On undulating haulage road ways Lashing chain is provided at both the end of a tub.

→ It is nothing a bull chain with 25 m length having hook at anther end.

→ One end of the hook is attached to the draw bar of tube whire anther end is hook to the rope after 2-3 coils on the rope.

→ It is a under head type of dip.

3. CAM DIP →

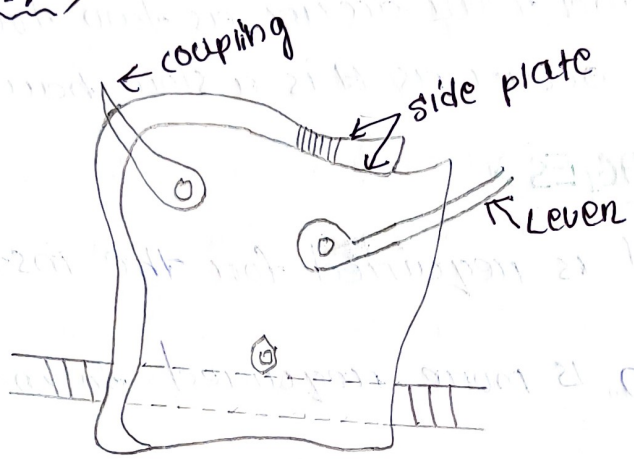


→ A cam dip is made up of a single iron plate whose upper part is design to accomodate to rope within the plate & a cam shaped lever which is pivoted in the plate.

→ The position of camshaped lever is design in such a way that when it drags the tubs the cam portion of the lever will grip the rope between the plate and the lever.

→ At the end of the journey the lever is hammered in opposite direction to force the rope
→ It is an over head type of dip.

SMALL MAN DIP →



→ It is a under head haulage dip which is made up of two plates together by a hexagonal bolt at the centre.
→ A spring is provided in the belb between two plate to kept them apart.
→ A wooden wedge is placed between two plates at the upper side and can be move inside the plate with the help of a lever.
→ At the back side of two plates a ~~ca~~ coupling hook is provided which connect two plates and kept them in proper position.
→ When the lever move downward the wedge moves inner part of two plates by which the upper portion become wider at the same time the lower part of two plates grip the rope
→ The lower part of plate is called jaw of dip which is 15 cm arround in length ~~winere~~ whenever we want to release the rope the liver moves in upward direction which loose the grip ~~from~~ from the rope at the jaw part of two plates.

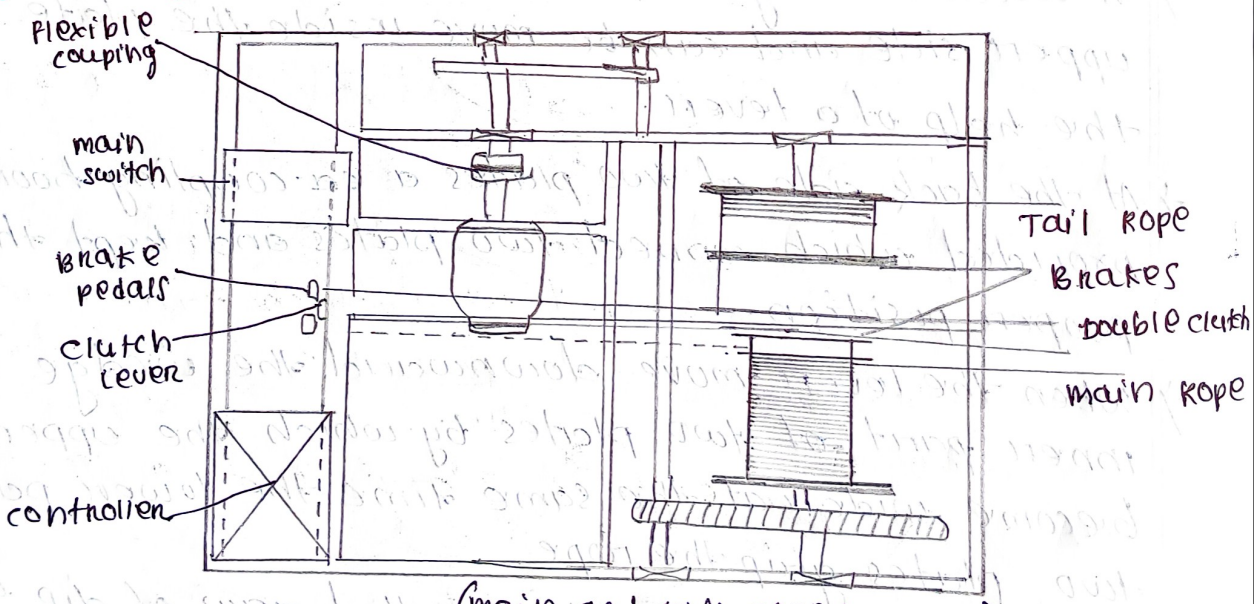
ADVANTAGES OF ENDLESS ROPE HAULAGE

- Contineous production can be achieved due to contineous movement of the haulage.
- Less wear and tear occur as two tracks are available
- Less accident occur as it is a slow haulage system.

DISADVANTAGES →

- More capital is required for the installation of two track.
- supervision is more required to maintain the track.
- It is a slow haulage so less production is achieved.
- More labour is required to attach and detach the tub from the cage.

MAIN AND TAIL ROPE HAULAGE →



(main and tail rope haulage)

- It consists of a single track
- main and tail drum
- A return pulley
- Loop take up arrangement to keep the rope in proper tension.

→ Different types of dip for attachment and dettachment of the tube.

→ ~~clutch~~ Clutchs brakes couping and gear box with a squarel cage induction motor.

→ stain and tail rope houlage generally used for trail dispasal and is ~~to~~ used in undulating roadways.

→ Here two drums where shaft is coupled to each of by fluid coupling system is connected to the squar cage induction motor.

→ The drum which houl the loaded tubs and ploued in the line of track is called as main drum where as the tail drum is only assist the haulage system so diameter of main drum is double that of tail drum.

→ During haulage of looded tubs from the out by side the main drum is angaged at the same time the tail drum is clutched to leave the rope winded over of

→ The loaded tubs are attached to the rope by means of dip.

→ The main drim puils the loaded tubs to its unloodey points at the same ~~time~~ time the empty tubs are attached to the rope.

→ Now the tail drum is engaged to winded off the rope over it in the non-haulage side and at the same time the main drum is clutch thus the empty tubs is hold to the out by side towards the return pulley.

Gravity Rope Haulage :-

- This is a haulage where no-external power & motor is needed for transportation of materials.
- It consists of a jig pulley of 1.3 - 2.8 m dia having brake path on one side and strap brake on other side.
- The jig pulley is a cast iron pulley and it is located at the top of the inclined haulage roadways.
- This haulage system utilize the gravitational force as transporting force which gives advantages in a self inclined path way where the inclination is more than the angle of repose.
- The jig pulley is vertically with rotateson horizontal axis for controlling the speed of haulage brake path can be use but for emergency breaking system stop brake comes into act.
- In this haulage system the loading point is at the top of the inclination where as the unloading point is at the bottom of the inclined haulage path.
- So a wire rope is needed exactly the two times the length of the haulage path where one end is out as loaded tub at the top of the inclined where as the other end is attached with empty at the unloading point.
- So a wire rope is needed exactly the two times the length of the haulage path where one end is act as loaded tub at the top of the inclined where as the other end is attached with empty at the unloading point.

→ when the loaded tubs start its journey in downward direction due to force of gravity the momentum created by the loaded tubs helps the empty for rising the inclination.

→ In this haulage system a single track is needed but its branch can be provided at the middle of the haulage roadways where the empty loaded tubs cross each other with the run away switch.

→ The length of the branch track depend upon the no of tubs used at both the end.

Safety Devices in Haulage Roadways →

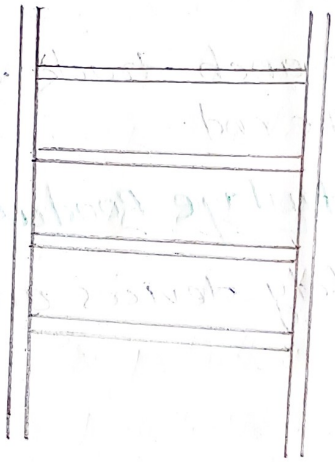
Different types of safety devices are used in haulage roadways.

1) stop block
2) Back stay
3) Drop warwick
4) Buffer
5) Run away switches
6) Jazz rail
7) Man hole
8) Signalling Arangement
9) safety cage (~~atom~~ monkey catch
10) Braking system and its maintenance
11) Tub Rerailer
12) Kheent
13) signal approaching device.

1. STOP BLOCK →

→ It consist of a wooden beam lying across the rail whose one end is provided and other end held against a pivoted wooden block.

→ Generally it is provided at the top of the incline where the train accurs starts its journey.



2. Back stay →

→ This is used behind an ascending set of tubs in a direct rope haulage or endless rope haulage.

→ It is attached the tub axle and in the event of any breakdown pivoted against the sleeper to arrest the train of tubs.

3. BUFFER →

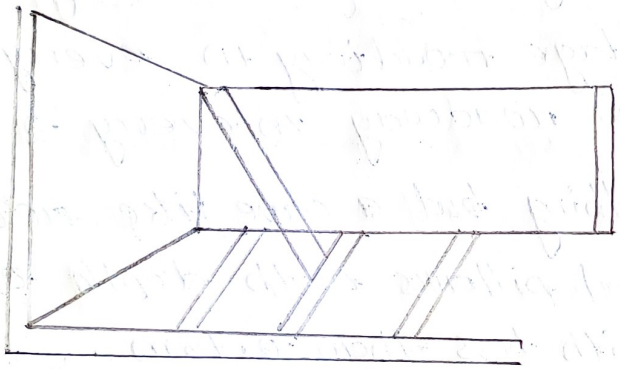
→ It is similar to the stop block which is used in emergency cases.

4. DROP WARWICK →

→ It consist of a heavy girder linged at one end to the roof between the track the other end of the girder is held of by eye bolt and pin.

→ A wire from the eye bolt pin is released to the side of the haulage track.

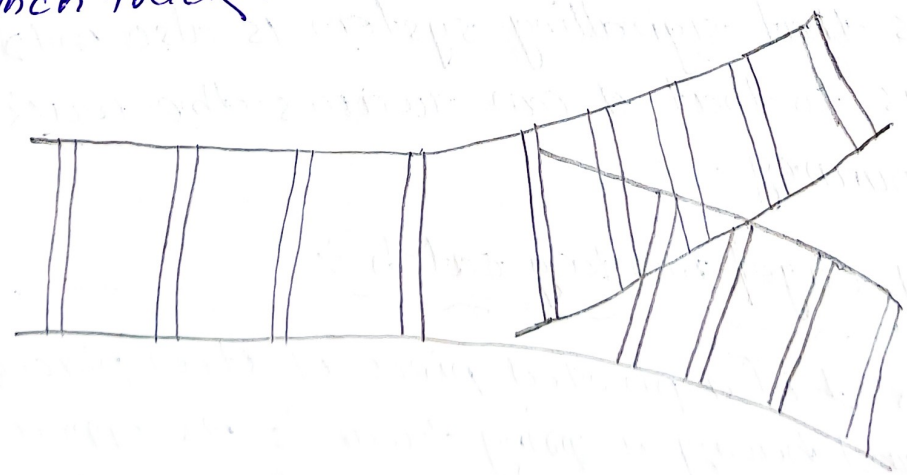
→ In case of any danger the wooden girder lock can be released by pulling the wire to with draw the pin inside the eye bolt which will help to arrest the discending tubs.



5. Run Away Switch →

→ These are nothing but a track changing device which is placed white branch track are provided.

→ It is a V-S haped rail connected through a level which engaged or disengaged the main track from its branch track.



6. Jazz Rail →

→ In the haulage roadway whire rail is to be pass at slower speed the rails cut to a suitable curvature so that a slow moving train of tubs can over come it easily.

→ But whin the speed of the tub is more then it can't over come the zigzag curve and a derailment occurs

7. man Hole :-

→ In inclined roadway haulage roadway it is mandatory to provide a haulage roadway in every 10m distance and the horizontal roadway in every 20m interval.

→ man hole are nothing but a cave like rectangular structure in coal pillars with depth of 2m height ~~2 m~~ 2-5m and with less than 0.75m.

→ The man hole should be while washed to visualize the worker working in less illumination.

8. SIGNALLING ARRANGEMENT →

→ It provides a systematic operation system in haulage roadways between the loading and unloading point.

→ Besides that signalling system is also introduced in set of thus so that it can awares the workers during its journey.

9. Safety cage/ monkey catch →

→ It consist of a pivoted piece of steel placed between the rail and having a spring towards its upper part when a upgradient tub move upward the tub can easily pass the roul by pressing the spring by its tub.

→ But when move backward the tub axis can be arrested by the rail piece.

10. Braking system and its maintenance →

→ A brake is a mechanism which designed to regulate the speed of a tube or to stop the motion there of absorbing the kinetic energy of the moving parts.

→ Brakes are of (i) mechanical
(ii) manually
(iii) electrical.

RMS - Torque (Root mean square Torque →

→ The motor size of the winder is determined by RMS torque.

mathematically

$$\text{RMS Torque} = \sqrt{\frac{\Sigma \frac{t}{3}(T_1^2 + T_1T_2 + T_2^2)}{\frac{2}{3}(t_a + t_r) + t_c + \frac{1}{3}t_d}}$$

Where t = duty cycle period in sec.

T_1 = Net torque (Nm) during start of journey (static + dynamic)

T_2 = Net torque (Nm) after 't' second

t_a = Acceleration period in sec

t_r = Retardation period in sec.

t_c = Constant speed period in sec

t_d = Decking period in sec.

T_e → The equivalent time period which represent

$$\boxed{\frac{2}{3}(t_a + t_r) + t_c + \frac{1}{3}t_d}$$

→ The current is more / less propotional to the torque So for all splits the RMS torque will be propotional to mean heating effect of the motor.

POWER OF THE MOTOR →

$$\text{power of motor} = \frac{\text{RMS torque (kNm)} \times \text{speed (m/s)}}{d/2}$$

where 'd = diameter of the drum.

TRACTIVE EFFECT / TRACTIVE FORCE →

→ It is the force required for the moment of a tub or mine car.

→ It is the force required to cause moment of the object and depend in the weight of the object and friction of additional between the object and surface.

mathematically

$$\text{Tractive effect } \boxed{T = \mu W}$$

where :

T = tractive effect

μ = co-efficient of addition or static friction

W = weight of locomotive or object.

Q. what is the max^m tractive effect that can be developed 15 tonne diesel locomotive of 15 kW of power Assume co-efficient of addition is 0.25 Find the max^m tractive effect.

Sol given

$W = 15$ tonne $\mu = 0.25$

$T = 0.25 \times 15000 \times 9.8$

36.750 kg force

SUPER ELEVATION →

→ On a curve the centrifugal action creats a tendency for the train to leave the track and praced along a tangential to the curve due to centrifugal force, the outer track should be raised over to the inner one this is called an super elevation,

→ The amount of super elevation depends upon radious of curvature, speed of the train and track gauge,

mathematically

$$\boxed{\text{super elevation} = \frac{AV^2}{gR}}$$

where
A = track gauge in meter (0.6 M/s)
V = velocity of the train in M/S
g = 9.81 m/sec²
R = Radian of curvature in meter

Q) A locomotive weight of is tonne travelled around a curve of 80m radius at a speed of 30 km/hr if track gauge is in what should be the super elevation in outer rail,

Sol) given
A = 1 m
g = 9.8 m/sec²
R = 80 m
V = 30 km/hr = 30 × 0.27 = 8.33 m/s

$$\text{Super elevation} = \frac{AV^2}{gR} = \frac{1 \times (8.33)}{9.8 \times 80} = 0.088 \text{ m},$$

Track Gauge →

→ it is the horizontal distance between two rails of the track

→ it's length is 1M,

WINDING DRUM

DRUM WINDING

→ Drum winding system is the simplest winding employing a cylindrical drum adopted in different mines,

→ One end of the wire rope is secured in hoisting drum and other end of winding drum holds the convience (cage/skip)

→ Generally in mines two cage/skip are employed within a shaft to balance the winders when one cage moves downward the other one is in upward journey,

→ Both the cage control by the winding drum which is couple to a meter,

→ Due to foundation of rope on either side of the cage different forque is found of either side of the cage which may overload the motor and some time motor fails to wind,

→ To counter act on balance the forque a tail rope may be used in case of cylinderical drum,

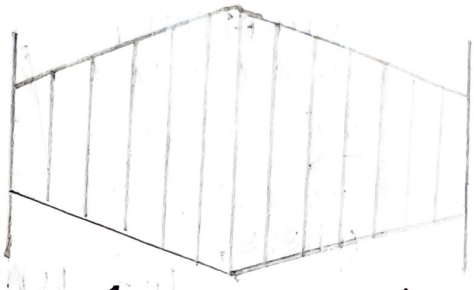
→ The tail rope in same diameter on that of hoisting rope and has some length & depth of the shaft & attached to the bottom of two cages,

→ For deep shaft to reduced the cost of power tail rope is a solution,

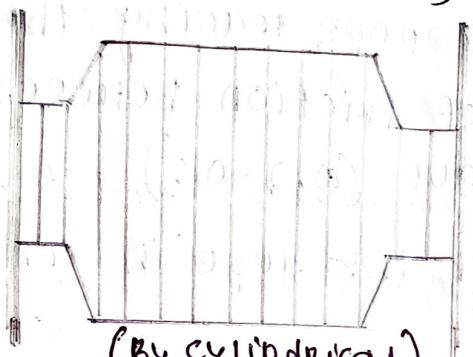
→ Beside the tail rope different drum profile may also adopted to minimise the forque these are,

1) cylindrical drum
2) conical drum
3) Bi-cylindrical drum
4) Bi-cylindrical conical drum,

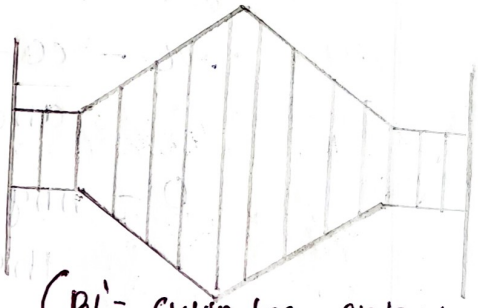
(cylindrical drum)



(conical drum)



(By cylindrical)



(Bi- cylindro conical drum)

KOEPE WINDING (OR) PRIOTION WINDING →

→ The koepe winding system is invented by fredric koepe,

→ In this system the drum is replaced by sheave coated, with renewable friction lying and driven by an electric motor,

→ The sheaves is so design and grooved that the angle of contact between the rope and sheave varies between 185°-230°

→ A tail rope whose ends are attached to the under side cages is always used in koepe winding system,

→ In koepe winding system the power is transmitted through the friction between the sheave lyning & the rope,

→ The bonic principle of koepe winders is that when the rope passing over the sheave haip to different tension at the point of entering and the point of leaving the sheave,

→ The relation between the tension is given by the equation,

$$\boxed{\frac{T_1}{T_2} = e^{\mu\theta}}$$

where,

T_1 – tension in the rope entering the sheave,

T_2 – tension in the rope leaving the sheave,

μ – co-efficient of friction between the rope and the sheave (0.2 – 0.5)

θ – Angle of arc of the rope in contact with the pulley

e – Base of logarithm,

→ The rope may sheave over the pulley in the ratio T_1/T_2 exceed the value of 1.5,

→ Koepe winding system is of 2 types

1) Ground mounted Koepe system

2) Tower mounted Koepe system

Ground mounted Koepe winding →

→ In ground mounted Koepe winding the engine is installed at the ground level and the head gear sheaves is situated one above the another on the headgear to improve the arc of contact between the sheave and the rope.

→ The rope operate in the plane of Koepe driving wheel without any angle of fleet,

→ A tail rope is always needed to balance the weight on the both side of cage or skip,

Tower mounted koepe →

→ In tower mounted koepe system the winding engine is erected on the headgear structure.

→ tower mounted koepe has more advantages than ground mounted koepe. As

(i) A large angle of contact can be achived as sufficient space for instruction is available,

(ii) The winding rope is protected against in case of adverse weather condition an we can canopy on working station at the highest point of headgear structure.

(iii) The headgear structure may not be more stronger as that of use of drum winding system,

→ it eleminates any obstruction by a winding engine house never to pit top,

→ The rope is subjected to less nos of bend and wrapping so the life a rope is more than that use for drum winding system.

Advantages of koepe winding system →

→ This is most suitable for winding heavy payload, from larger depth, where as in drum winding the drum has to be of larger diameter for deep shaft and multilayer coiling on drum result in reduce rope life on account of crushing and heavy wear,

→ It is simple for manufacture compact and lighter than the drum winder so initial cost less for similar duties.

→ Less costly engine foundation are required for koepe winder due to lighter weight is compactness.

→ There is no fleet angle in it and wear on the winding sheave is reduced.

→ This system tends itself to adoption of multi rope winding which has important advantages.

→ A smaller length of main rope is required compared with drum hoisting using a balanced rope as there are no extra ~~coils~~ coils.

→ The skip/cage does not rest on the keps and therefore to start it no shock loads the transmitted to the rope so this system kind to the rope and a smaller factor of safety.

→ Operating cost are less due to the smaller rated output of motor.

DISADVANTAGES →

→ koepes system can be used only for vertical shaft and not for inclined as guiding and terminating of balance rope posses problems.

→ It can't be used during shaft shinking.

→ The system is not suitable for shallow shaft as the cylindrical drum size if drum winding is adopted would be nearly the same as the koepe sheave size.

→ A deeper shaft sump is required to accomidate the tail rope loop.

→ Separate run with one cage is impossible.
→ If the rope breaks both cages fall in the shaft.

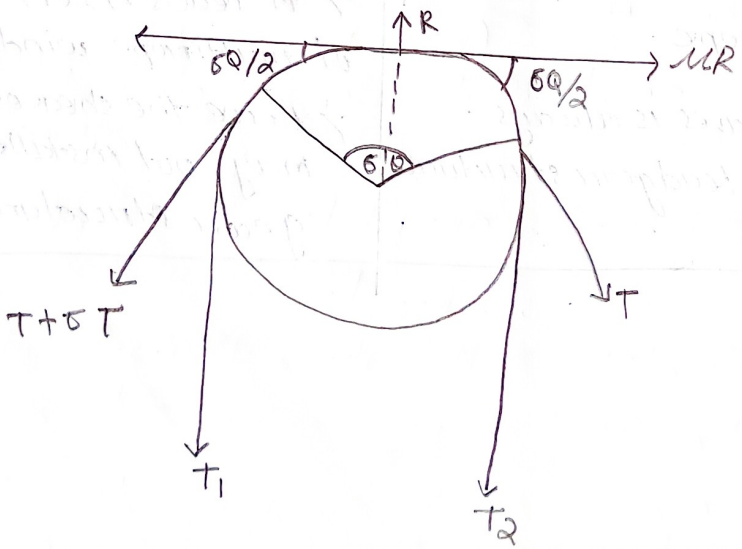
Distinguish Between drum winding and koepe winding.

Drum winding	Koepe winding.
→ In this system the drum is to be of larger diameter for deep shaft.	→ It is most suitable for ~~Anding~~ heavy payload from longer path
→ As fleet angle is there so wear of winding sheave occure.	→ There is no fleet angle in this system so wear is less.
→ In this system a tail rope may or may not used.	→ A tailrope is always used.
→ Here a drum is employed on which one end of exnding rope is secured through pins or bolt.	→ Here the rope passes over a sheave which is driven by a prime mover the tension between both end on a sheave must be in a relationship. $\frac{T_1}{T_2} \leq e^{\mu\theta}$. $e^{\mu\theta} = 1.5$
→ It is used for shaft shinking	→ It is not used for shaft shinking.
→ Here safety hook is used for safety in case of over winding	→ Also safety hook is used.
→ Larger length of winding rope is needed	→ Exact length of winding rope is required.
→ Cage/skip rests on keps	→ cage/skip does not rests on keps.
→ A single ~~exite~~ wire rope is used as winding rope.	→ It leads itself to adoption of multirope winding.
→ Here the sheaves is always installed on headgear structure	→ Here the sheaves may or may not installed on head-gear structure.

Distinguish Between Ground mounted koep and tower mounted Koepe

Ground mounted koepe	Tower mounted koepe
→ In ground mounted koepe system the sheave is mounted on the ground adjacent to the headgear.	→ Here the sheave/pulley is mounted in a tower over shaft.
→ Here the winding engine is installed at the ground level.	→ Here the winding engine is erected on a tower over the shaft.
→ The winding rope is not protected against adverse weather condition.	→ The winding rope is protected against adverse weather condition.
→ It does not eleminates any obstruction.	→ It eleminates any obstructcan by a winding engine house in the neighbous hood of the pit head.
→ It is rope bend in maximum amount an compare to tower mounted koepe	→ It's rope psubyected to less no of bends on a tower mounted koepe.

Formation of $\boxed{T_1/T_2 = e^{\mu\omega}}$ formula →



T_1 = Tension tight side

T_2 = Tension on slack side

θ = Angle of loop of friction between rope / bell and pulley.

R = Normal Reaction.

Consider a short length of rope over the pulley which forms an angle $\delta\theta$ at the centre.

Let R = Normal reaction

T = Tension on slack side of the pulley

δT = Increase of tension on tight side than the slack side.

$T+\delta T$ = Tension on tight side.

The friction μR will act tangential to the pulley and T and $T+\delta T$ will act in the direction perpendicular to the radi

Resolving the force in the x-axis

$$\mu R + T\cos\frac{\delta\theta}{2} - (T+\delta T)\cos\frac{\delta\theta}{2} = 0$$

As $\frac{\delta\theta}{2}$ is small so $\cos\frac{\delta\theta}{2}$ is nearly equal to 1

So $\mu R + T - (T+\delta T) = 0$

$\Rightarrow \mu R + T - T - \delta T = 0$

$\Rightarrow \delta T = \mu R$ —— ①

Resolving the force in the y-axis

$$R - T\sin\frac{\delta\theta}{2} - (T+\delta T)\sin\frac{\delta\theta}{2} = 0$$

As $\frac{\delta\theta}{2}$ is small so $\sin\frac{\delta\theta}{2}$ is nearly equal to $\frac{\delta\theta}{2}$

Then $R - T\frac{\delta\theta}{2} - T\frac{\delta\theta}{2} - \delta T\frac{\delta\theta}{2} = 0$

Neglecting the product of two negligible quantity.

$\boxed{R = T\delta\theta}$ —— ②

Now putting the value of R in eq^n ①

$$\delta T = \mu T \delta\theta$$

$$\Rightarrow \frac{\delta T}{T} = \mu \delta\theta$$

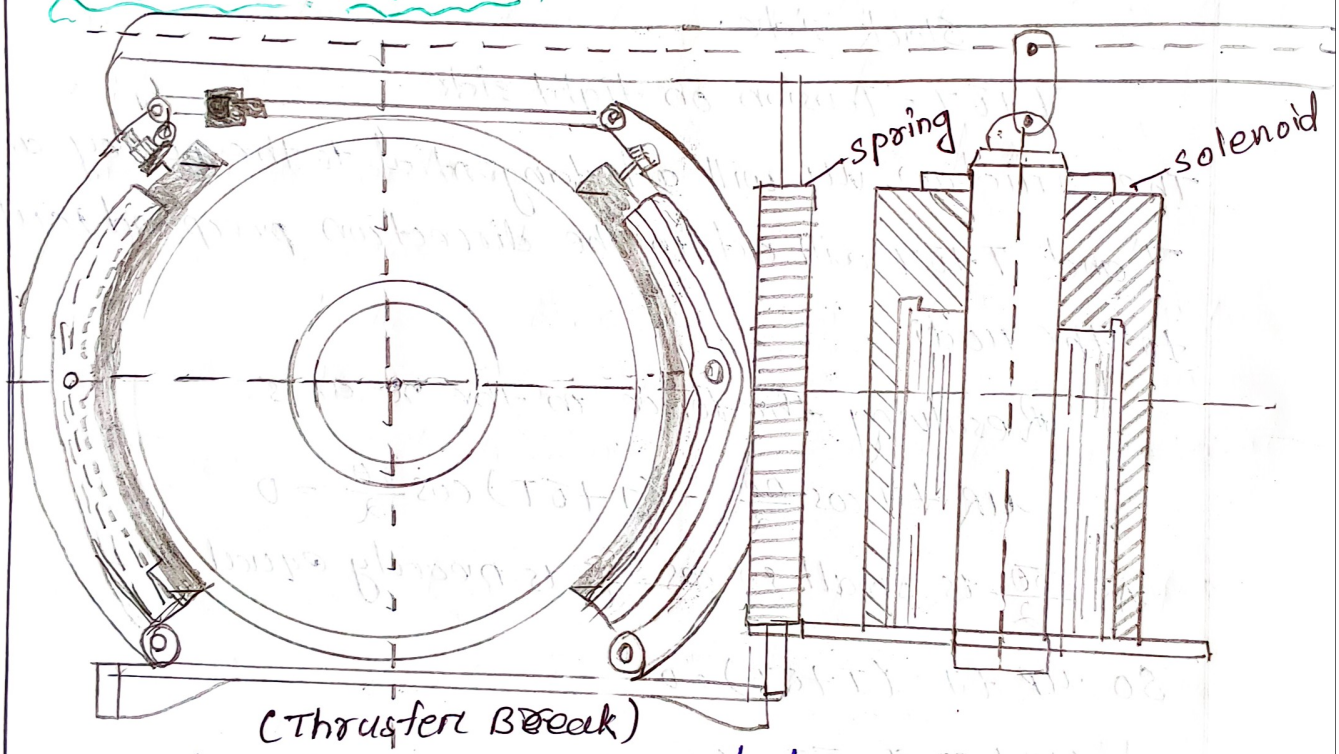
Integrating both side

$$\int_{T_2}^{T_1} \frac{\delta T}{T} = \int_0^{\theta} \mu \delta\theta$$

$$\Rightarrow \log_e \frac{T_1}{T_2} = \mu\theta$$

$$\Rightarrow \boxed{\frac{T_1}{T_2} = e^{\mu\theta}}$$

THRUSTER BREAK →



(Thruster Break)

→ Thruster break or solenoid break is electro magnetic in action.

→ The break is set by an adjusting spring.

→ When the current passes through the electric motor winders due to rotation of the drum the solenoid gets energy and its extend a force to pull out the break blocks from the drum and the drum moves freely its own axel.

→ If there is failure of electric power then no pull force is in the solenoid and the break is auto applied by the tension in the spring.

→ current to the solensid is regulated by the operation by hand or foot operations. the break's

→ In some thruster breaks the thruster is worked by oil pressure generated by an impeller driven by an electric motor.

→ on the stoppage of electric current the solenoid. energised or the oil pressure reduce and break is applied by spring tension.

ELECTRIC BRAKING OF WINDER →

→ To reduce the speed of winders at constant time period and retardation time period of winder electric breaking system is adopted in whole time cycle of a cage or skip winding.

→ The electric braking system is adopted as per mining rows are

(i) counter current braking

(ii) Dynamic braking

(iii) Regenerative braking

(iv) Foldy braking

Among which first three are widely used in ~~Among which~~ mines.

1. Counter current braking →

→ It is effected by reversing the electric supply to the starter.

→ In this case two phases of the starter supplied are interchanged by the winding operator to bring the level off position first then to the position where the drum can run in opposite direction.

→ The amount of braking depends upon the position of the lever since lowering the resistance in the controller greater in the rotor current and braking torque produced.

→ The disadvantages are associated ~~a~~ -

→ A Large amount of electrical energy is converted to heat energy and its effect the wire system of panel board.

→ It involves high line current and cables which cost more.

→ The reversal switch is subject to heavy wear and tear.

→ when the direction of the starter is reversed the voltage between the starter and motor is double and the insulation both starter and motor must be adequate to prevent any breakdown.

→ The method as will prove to be bad for ~~winding~~ winding rope.

(ii) Dynamic Breaking System

→ it is an electric breaking system baned on principle of the AC winders by using and exciton in the stanton can convert into DC supply,

→ The AC supply is at or from the stanton & in its place DC is applied to the stanton of a supring induction motor The DC supply results a stationary magnetic field in which the noton (winding drum) notates,

→ it causes the winding motors to give a nesistance to its forque,

→ to nedure the speed of the winding drum it is a cheif & simple principle of appling brake to the winding system,

→ The dynamic brake forque is directly propotional to the stanton flux multiplied with noton current,

mathematically,

The dynamic forque =

$$\text{the exiting current} \times \frac{\text{noton voltage}}{\text{noton resistance}}$$

so, By increasing the nesistance of the noton speed is contorl

Regenerative Breaking

→ If the forque due to down going cage or skip is more or less that the forque develope in winding motor for ancending case they down going load accelenate than the motor,

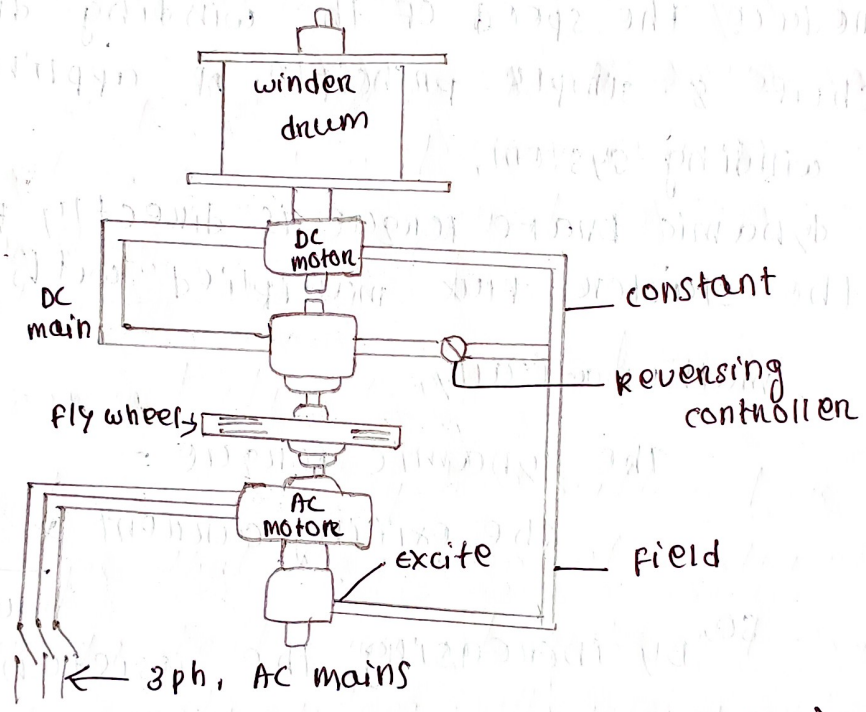
→ If a DC motor with field strength is use for winding then in case of ward leonard method than the DC motor is function an or dynamo

For down going load in the cage and accelerate the winding system due to excess power generated by dynamo.

→ The net effect is the winding motor recieve less power to operate and it act as speed reduction motor of the AC-motor coupled to the winding drum

→ This type of speed control in case of ward leonard method system is called as regen-erative braking

Ward leonard method of speed control →



(ward leonard control of winder)

→ Ward leonard method of speed control is generally used of winders of heavy-duty nearly 800kw or more power consumption.

→ It consists of following part

(I) 3-phase AC motor

(II) DC Generator

(III) An exciter or DC motor.

→ In this system the winding engine drawn is driven by through DC motor through gearinge the DC motor recieve its power from a DC generator at a voltage which can be varied or can be reversed

→ where as the field of DC motor is always constant

→ The DC generator is shunt wound and is driven by constant speed 3 phase ac motor.

→ On the same shaft of the AC motor and exciter is mounted which helps in supply of direct current to the DC motor for the operation of winder.

→ The exciter also supply direct current to the DC generate an whose magnitude can be vary and reversed.

principle of action →

→ The AC motor and DC generator set runs continuously through out the shift but the winder motor (DC motor) is operated only when operated.

→ The EMF generated by DC generated is given by the formula

$$\boxed{E = \phi \times P \times \frac{Z}{a} \times \frac{N}{60} \times 10^{-8} \text{ volts}}$$

where

E = EMF generated

ϕ = Flux per pole

P = No of poles

Z = No of armature used

N = speed in RPM

a - The no of parallel path in the armature

→ The speed of the DC shunt motor is directly propotional to the EMF generated by the DC generated where the flux is constant so by reversing the current from the DC motor we can controll the speed of the DC motor.

→ The voltage of DC generator is propotional to the magnetic flux.

→ The output of DC generator can be varies from zero to the full voltage by varying the excitation. Also the output can be reversed by using the controller.

→ The reversing controller deal with only small amount of current and its position decide the output voltage to be supplied to the winder motor at variable speed.

Ward Leonard ilgner method →

→ The ward leonard system suffered as ~~dis advatage~~ disadvanteges ~~that~~ the moment of inertia of moving parts due to shaft current picks and transmitted to power supply system ~~call~~ causing wide fluctuation of voltage.

→ This advantage can be eleminated by using slipring induction motor with a slip regulator for driving motor generator sets and mounting a flywheel one end.

→ So the flywheel store the energy and used for heavy energy whenever required for high starting torque.

→ So the flywheel store the extra current / energy.