Underground Mining of Metalliferous Deposits
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Lecture 14
Incline Shaft

INCLINE SHAFT

Incline shafts are driven at an angle with the horizontal. The angle is maintained consistently so that the movement can be made through either as steps for men, or as Railway track for materials. The compartment run on the railway track is called either wagon/mine car or if it is a simple single box it is called skip. If it is wagon, it is called direct haulage. Indian incline in general wagon is not preferred. For very steep incline steps are not allowed. Then only skip is used.
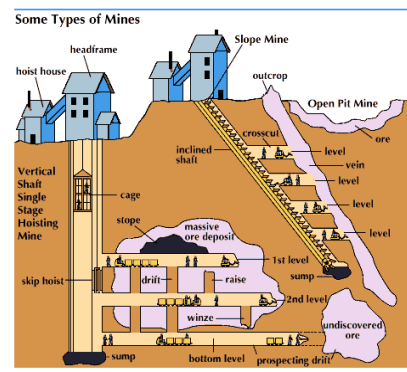

Figure1: Incline shaft

Inclination for laying the hauling track is very important. Often platforms are made, either wooden or concrete for the smooth hauling. For the deep incline, where the skips are used as man winding, utmost care should be taken.

You can see the figure above of one inclined shaft where you can see the opening. These openings are called portal. So this is the portal of the inclined shaft. In figure, rails are

provided in the inclined shaft which allows wagons or skips to move on. If we use this type of wagon, we call it rope haulage.

EXCAVATION TECHNIQUES – INCLINE OPENING

Discrete method of excavations

1) Drilling

2) Blasting

3) Loading

4) Transportation

Continuous method of excavations
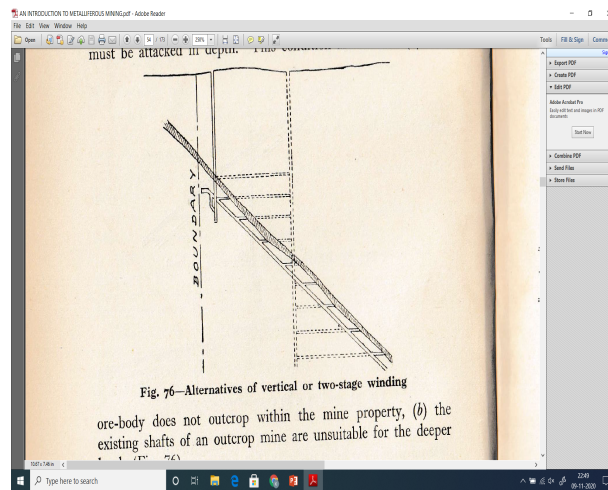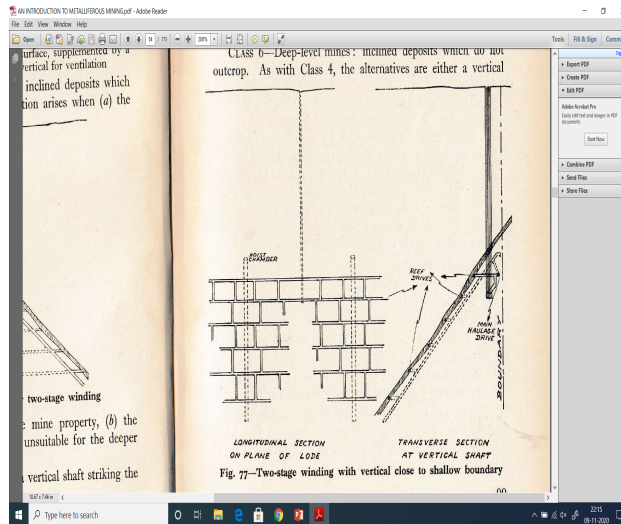
1) Large diameter drilling

Discrete method

- Drilling   handheld drill

- Blasting   Wedge cut, burn cut

- Mucking   manual or cactus grab

- Transportation   Mine car, Haulage, skip,

TWO STAGE WINDING

Two stage winding is applicable for –

(i) ore body deep-seated (>300m)

(ii) Inclined (moderate – not steep not mild)

(iii) Cost comparison

CLASS 6—Deep-level mines : inclined deposits which do not outcrop. As with Class 4, the alternatives are either a vertical

LONGITUDINAL SECTION ON PLANE OF LODE

TRANSVERSE SECTION AT VERTICAL SHAFT

Fig. 77—Two-stage winding with vertical close to shallow boundary

Fig. 76—Alternatives of vertical or two-stage winding

ore-body does not outcrop within the mine property, (b) the existing shafts of an outcrop mine are unsuitable for the deeper

Single shaft	Single incline	Two stage (V+I)	Two stage (V+V)
Shaft cost	Shaft cost	Shaft cost + incline cost	Shaft cost + shaft cost + cross cut
X- cut (S-O)	X- cut (S-O)	X- cut (S-O)	X- cut (S-O) + X-cut (S-S)
Transportation ✔ Skip ✔ Haulage	Transportation ✔ Skip ✔ Haulage	Transportation ✔ Skip + Skip ✔ Haulage	Transportation ✔ Skip + Skip

			✔ Haulage +
			Haulage + Conveyor
Cost= Construction + Transportation			
No manoeuvring	No manoeuvring	Manoeuvring	Manoeuvring
Single system	Single system	Two system	Three system

PROBLEM

An incline shaft is constructed at an angle of 30 degree with horizontal. The winding system of the incline is fitted with two 10 tonne skips where one acts as the counter weight of another. The skip is loaded at 200 m depth from surface through an ore bin. If the skip runs with an acceleration/deceleration of 2 m/s^2 and the maximum constant speed of 10 m/s. If daily available material hoisting hour is 15, Determine the capacity of the shaft in tonne/day.

Consider loading and unloading time together is 1 min.

Solution:

GIVEN	
Depth of hoisting (m) =	200
Incline angle with horizontal (deg) =	30
Acceleration/decelleration (m/s^2) =	1
Maximum speed (m/s) =	10
Loading + unloading time (min) =	2
Skip capacity (tonne) =	10
Utilised hoisting day (hr) =	15

acceleration time (s) =	10
Decceleration time (s) =	10
Length of incline (m) =	400
Length of acceleration (m) =	50
Length of acceleration (m) =	50
Length travelled at constant speed (m) =	300
Constant speed travel time (s) =	30
Total travel time (s) =	50
Total Cycle time (s) =	220
Hoist load in one cycle (tonne) 2 skips =	20
Hoisting/day (tonne) =	4909