A

PROJECT REPORT

ON

'BUCKET WHEEL EXCAVATOR'

IN OPEN CAST MINES

A PROJECT REPORT SUBMITTED IN PARTIAL FULFFILMENT OF THE REQUIREMENT AWARD OF THE

DIPLOMA IN MINING ENGINEERING

Submitted by:

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DEPARTMENT OF MINING ENGINEERING

CERTIFICATE

This is to certify that the project work entitled 'BUCKET WHEEL EXCAVATOR IN OPEN CAST MINES' is the bonafied work of project members

PIN:22046-MN-003,020,021,041,043,044,046,050, Of final year **D.MNG.E 2022-2025** along with his batch mates in practical fulfilment of the requirement for the award of THE DIPLOMA IN MINING ENGINEERING, OF STATE BOARD OF TECHNICAL EDUCATION AND TRAINING, TELANGANA STATE during the academic session

2024-2025.

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Having you as team members has helped us take on project that would not have been possible otherwise. Your skills and street smartness have certainly made our work easier. I appreciate it more than you know.

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Signature of guide

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Presentation, Inspiration & Motivation have always played a key role in the success of our project.

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We are very much obligated to our **Family & Friends** for the immense love and moral support they had given is truly immeasurable.

I feel to acknowledge my indebtedness and deep sense of gratitude to my Project stakeholders whose valuable co-operation and kind supervision given to me throughout the course which shaped the present work as its show.

Yours sincerely

Project Members

CONTENT

CHAPTER-1

INTRODUCTION

Mining industry is the backbone for the development of any nation. In mining the basic aim is to achieve maximum extraction of minerals keeping in view the environmental, economic and lease constraints. With the advancement of civilization, the requirement of different minerals has increased manifold to meet this demand. There is an upsurge in interest and action in opencast mining because of the improved productivity, recovery and safety of mining operation. Improvement in production has been achieved with the help of large capacity opencast machineries, continuous mining system with improved design, development of modern generation, explosives and accessories, process innovations and application of information technologies and increased adoption of computerised mine planning and control.

Bucket wheel excavators are colossal machines used extensively in open-pit mining operations, renowned for their impressive efficiency and capacity. These behemoths typically feature a massive wheel with multiple buckets attached around its circumference. As the wheel rotates, the buckets scoop up material, such as overburden (earth and rock covering valuable minerals) or ore, and transfer it onto a conveyor belt system for further processing or transport. One of the key advantages of bucket wheel excavators is their Ability to continuosly and systematically remove large volumes of material from the mining site making them invaluable for operation requiring high productivity and material handling capabilities.

FIG: 1.1

The design and functionality of bucket wheel excavators have evolved significantly over time to meet the demands of modern mining operations. Early versions of these machines emerged in the early 20th century, primarily for lignite mining in Germany. As mining technology advanced, bucket wheel excavators became larger, more powerful, and more versatile. Today, they are utilised in a variety of mining applications, including coal, phosphate, and other mineral extraction projects around the globe. Their automation features, coupled with advanced control systems, allow for precise and efficient operation while minimising human intervention and safety risks in hazardous mining environments.

Bucket wheel excavators play a crucial role in maximizing mining efficiency and profitability. Their immense size and capacity make them particularly suited for handling large-scale mining projects, where continuous excavation and material removal are paramount. These machines are often integrated into sophisticated mining systems that include conveyor belts, spreaders, and other equipment to streamline the entire mining process. With ongoing advancements in technology and design, bucket wheel excavators continue to be at the forefront of surface mining operations, contributing significantly to the extraction of valuable resources from open-pit mines worldwide.

CHAPTER- 2

BUCKET WHEEL EXCAVATOR

Bucket Wheel Excavators (BWE) are continuous cutting machines for soft to semi hard materials like clay, sand, gravel, marl and their blendings as well as lignite and hard coal. The primary function of BWEs is to act as a continuous digging machine in large-scale open pit mining operations.

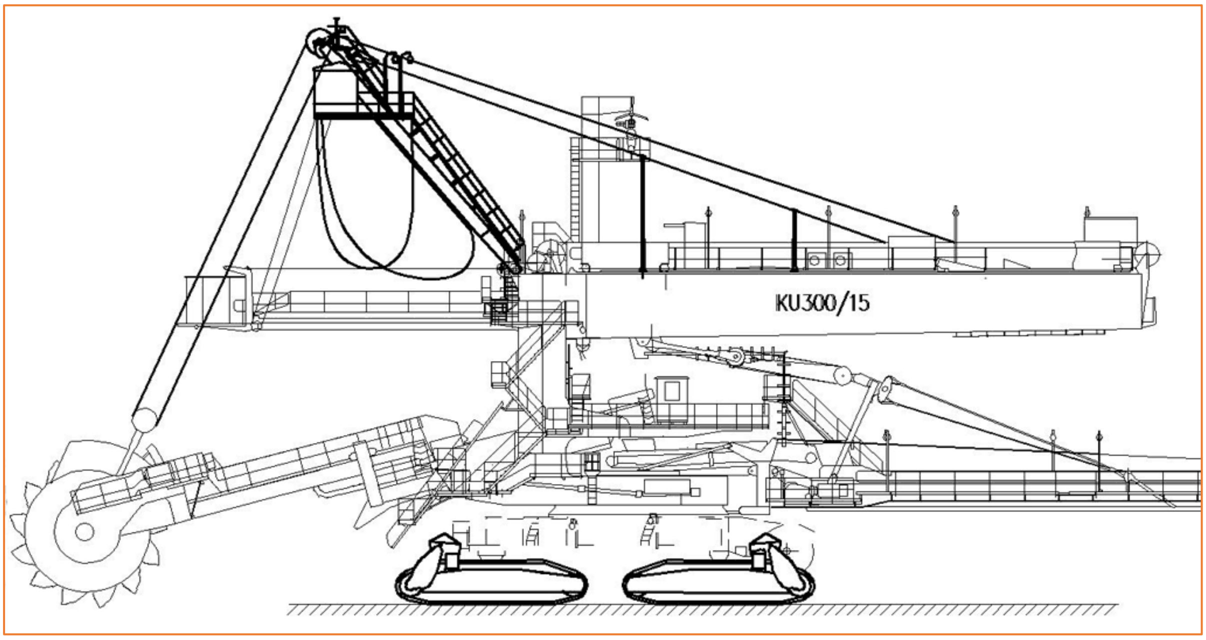

FIG : 2.1

BWE are used for continuous overburden removal in surface mining applications.They use their cutting wheels to strip away a section of earth (the working block) dictated by the size of the excavator

One of the largest bucket wheel excavators in the world. Commission in 1978 an still in operation in a German lignite open pit mine.

Total height: approx. 96 m

Total length: approx. 240 m Bucket wheel diameter:

21.60 m

A bucket wheel excavator is a massive mining machine used primarily for surface mining operations. It features a rotating wheel equipped with buckets that scoop up material, such as soil, rock, or ore, and transfer it to a conveyor belt for transport. These machines are known for their efficiency in extracting large quantities of material quickly and are commonly used in open-pit mining operations for coal, lignite, and other minerals. It can I move 240,000 cubic metres of earth per day, it's as heavy as more than 8,600 cars, and it's as tall as the statue of liberty these are just some of the outstanding features of bucket wheel excavator in the world, and it is still one of the biggest land vehicles today Unified selective mining conveyance and dumping of solum incorporates utilisation of available ECS system equipment running at the top level of the open pit mine.

FIG- 2.2

Bucket wheel excavator running at the top level (under terrain surface) in the height block selectively mines the solum in the first cut of the height block, with the cut height equivalent to the thickness of solum, the excavator mines the fertile soil, that further on is conveyed by the existing conveyors up to the spreader at the waste dump. The spreader deposits the solum mass over the top part of the dumping mass thus forming the surface with fertile soil required for biological land-reclamation Upon completion of one cycle of bucket wheel excavator mining of solum (deep down to the full cut depth), the excavator continues with mining of the remaining part of overburden in the height block. The spreader deposits those masses in the height block at the dump, representing a basis for the next solum laying Machines used to mine large volumes of minerals over longer periods must above all be efficient and economical.

Machines used to mine large volumes of minerals over longer periods must above all be efficient and economical. operations, removing thousands of tons of overburden a day. What sets BWEs apart from other large-scale mining equipment, such as bucket chain excavators, is their use of a large wheel consisting of a continuous pattern of buckets used to scoop material as the wheel turns. They rank among the largest vehicles (land or sea) ever produced, and the largest of the bucket-wheel excavators (the 14,200 ton bagger 293) still holds the Guinness world record for heaviest land-based vehicle ever constructed.

It can move 240,000 cubic metres of earth per day, it's as heavy as more than 8,600 cars, and it's as tall as the statue of liberty these are just some of the outstanding features of bucket wheel excavator in the world, and it is still one of the biggest land vehicles today. Machines used to mine large volumes of minerals over longer periods must above all be efficient and economical. And this is where Thyssenkrupp's continuous mining technology comes into play. Bucket wheel excavators are the ideal solution they can move as much lignite and overburden in a day as 40,000 workers-240,000 cubic metres, equivalent to more than 10,000 dump truck loads. The material is picked up by the bucket wheel and transported on conveyors over three metres in width. The overburden is dumped by spreaders.

A bucket-wheel excavator (BWE) is a large heavy equipment machine used in surface mining.Their primary function is that of a continuous digging machine in large-scale open-pit mining operations, removing thousands of tons of overburden a day. What sets them apart from other large-scale mining equipment, such as bucket chain excavators, is their use of a large wheel consisting of a continuous pattern of buckets which scoop material as the wheel turns. They are among the largest land or sea vehicles ever produced. The 14,200-ton Bagger 293 holds the Guinness World Record for the heaviest land-based vehicle ever built.

CHAPTER-3

TYPES

World Largest Mining equipment Used for Digging the OB (Over Burden) it consists of three types:-

(A) C-TYPE

FIG : 3.1

(B) NORMAL TYPE

FIG : 3.2

(C) COMPACT TYPE

FIG : 3.3

CHAPTER-4

SPECIFICATIONS OF BUCKET WHEEL EXCAVATOR

- ◆ Capacity (heaped 4.800m³/h
- ◆ Specific digging force 1000N/cm
- ◆ Maximum cutting height. 23.0m
- ◆ Maximum cutting depth. -2.0m
- ◆ Wheel boom length. 27m (centre - bucket wheel to center of excavator)
- ◆ Discharge boom length 32.5m (centre - excavator to center of discharge chute)
- ◆ Maximum allowed longitudinal equipment gradient 11%
- ◆ Bucket wheel diameter 10.5 m
- ◆ Nominal power of bucket wheel drive. 900kW
- ◆ Number of buckets. 17
- ◆ Bucket volume including annular cells. 1.05m³
- ◆ Number of discharges at 85% of bucket
- ◆ wheel speed 77/min
- ◆ Belt width. 1.8 m
- ◆ Service weight (depending on accessories). 1.200t
- ◆ Maximum longitudinal leveling of superstructure. 8%
- ◆ Cutting Boom Slewing Range 360 degree

- ◆ Belt Width. 2000 mm
- ◆ Belt Speed. 4.2 m/sec
- ◆ Type Of Belt. ST2250
- ◆ Cable Drum Length 1000 m
- ◆Of A Cable
- ◆ Supply Voltage. 11000V
- ◆ Operating 3.3/0.433
- ◆ Voltage KV, 110 V
- ◆ Total Power 4537 KW Installed

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APPLICATIONS OF BUCKET WHEEL EXCAVATOR

FIG : 5.1

Bucket wheel excavator were first applied in the united states at one of United Electric coal company's ILLINOIS surface coal mines The machine, designed and built by Frank Kclbe and other United Electric Coal Company engineers, was put into operational trial in 1944 and had an average production OF 960 bank cubic yards per hour From this start the "IlKolbe Wheels" that followed were quickly up-graded to cape cities of 0500 bank cubic yards per hour This rapid increase in BWE capacity was made possible by the introduction of cell-less wheels, increased wheel speeds, new belting and' belt speeds, and chain backed buckets to reduce the problems of sticking material.

Initially, American and foreign BWE's were designed for working in easy-to-dig materials. This severely limited the application of these machines and generally confined their use to areas where at least some of the overburden was glacial in origin or of similar friable Bucket wheel excavators and bucket chain excavators take jobs that were previously accomplished by rope shovels and draglines. They have been replaced in most applications by hydraulic excavators, but still remain in use for very large-scale operations, where they can be used for the transfer of loose materials or the excavation of soft to semi-hard overburden.

Lignite mining:

FIG : 5.2

The primary application of BWEs is in lignite (brown coal) mining, where they are used for soft rock overburden removal in the absence of blasting. They are useful in this capacity for their ability to continuously deliver large volumes of materials to processors, which is especially important given the continuous demand for lignite. Because of the great demand for lignite, lignite mining has also been one of the areas of greatest development for BWEs. The additions of automated systems and greater manoeuvrability, as well as components designed for the specific application, have increased the reliability and efficiency with which BWEs deliver materials.

Materials handling:

Bucket wheel technology is used extensively in bulk materials handling. Bucket wheel reclaimers are used to pick up material that has been positioned by a stacker for transport to a processing plant. Stacker/reclaimers, which combine

tasks to reduce the number of required machines, also use bucket wheels to carry out their tasks. In shipyards, bucket wheels are üsed for the continuous loading and unloading of ships, where they pick up material from the yard for transfer to the delivery system. Bucket chains can be used to unload material from a ship's hold. TAKRAF's continuous ship unloader is capable of removing up to 95% of the material from a ship's hold, owing to a flexibly-configured digging attachment.

Heap leaching:

An extension of their other uses, BWEs are used in heap leaching processes. Heap leaching entails constructing stacks of crushed ore, through which a solvent is passed to extract valuable materials. The construction and removal of the heaps are an obvious application of stacking and reclaiming technology. Bucket wheel excavators and bucket chain excavators take jobs that were previously accomplished by rope shovels and draglines. They use have been replaced in most applications by hydraulic excavators, but still remain in use for very large-scale operations, where they can be used for the transfer of loose materials or the excavation of soft to semi-hard overburden.

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HISTORY

Bucket-wheel excavators have been used in mining for the past century, with some of the first being manufactured in the 1920s. They are used in conjunction with many other pieces of mining machinery (conveyor belts, spreaders, crushing stations, heap-leach systems, etc.) to move and mine massive amounts of overburden (waste). While the overall concepts that go into a BWE have not changed much, their size has grown drastically since the end of World War II. In the 1950s two German mining firms ordered the world's first extremely large BWEs, and had three BWEs built for mining lignite near Cologne, Germany.

The German BWEs had a wheel of over 16 m (52 ft) in diameter, weighed 5,500 short tons (5,000 t) and were over 180 m (600 ft) long, with eighteen crawler units for movement and could cut a swath of over 180 m (600 ft) at one time BWEs built since the 1990s, such as the Bagger 293, have reached sizes as large as 96 m (315 ft) tall, 225 m (738 ft) long, and as heavy as 14,200 t (31,300,000 lb). The bucket-wheel itself can be over 21 m (70 ft) in diameter with as many as 20 buckets, each of which can hold over 15 m3 (20 cu yd) of material. BWEs have also advanced with respect to the extreme conditions in which they are now capable of operating. Many BWEs have been designed to operate in climates with temperatures as low as -45 °C (-49 °F). Developers are now moving their focus toward automation and the use of electrical power.

FIG : 6.1

CHAPTER-7

STRUCTURE OF BUCKET WHEEL EXCAVATOR

A bucket wheel excavator (BWE) consists of a superstructure to which several more components are fixed. The bucket wheel from which the machines get their name is a large round wheel with a configuration of scoops which is fixed to a boom and is capable of rotating. Material picked up by the cutting wheel is transferred back along the boom. In early cell-type bucket wheels, the material was transferred through a chute leading from each bucket, while newer cell-less and semi-cell designs use a stationary chute through which all of the buckets discharge. A discharge boom receives material through the superstructure from the cutting boom and carries it away from the machine, frequently to an external conveyor system. A counterweight boom balances the cutting boom and is cantilevered either on the lower part of the superstructure (in the case of compact BWEs) or the upper

part (in the case of mid-size C-frame BWEs). In the larger BWEs, all three booms are supported by cables running across towers at the top of the superstructure. Beneath the superstructure lay the movement systems. On older models these would be rails for the machine to travel along, but newer BWEs are frequently equipped with crawlers, which grant them increased flexibility of motion. To allow it to complete its duties, the superstructure of a BWE is capable of rotating about a vertical axis (slewing). The cutting boom can be tilted up and down (hoisting). The speeds of these operations are on the orders of 30 m/min and 5 m/min, respectively. Slewing is driven by large gears, while hoisting generally makes use of a cable system.

FIG : 7.1

<u>Size:</u>

The scale of BWEs varies significantly and is dependent on the intended application. Compact BWEs designed by ThyssenKrupp may have boom lengths as small as six metres (20 ft), weigh 50 tons, and move 100 m3 (3,500 cu ft) of earth per hour. Their larger models reach boom lengths of 80 m (260 ft), weigh 13,000 tons, and move 12,500 m3 (440,000 cu ft) per hour. [6] The largest BWE ever constructed is TAKRAF's Bagger 293, which is 93 metres tall and 225 metres long, weighs 14,200 tonnes and is capable of moving 240,000 m3 (8,500,000 cu ft) of overburden every Day. Excavations of 380,000 m3 (13,000,000 cu ft) per day have been recorded. The BWEs used in the United States tend to be smaller than those constructed in Germany.

Operation:

BWEs are used for continuous overburden removal in surface mining.

applications. They use their cutting wheels to strip away a section of earth (the working block) dictated by the size of the excavator. Through hoisting, the working block can include area both above and below the level of the machine (the bench level). By slewing, the excavator can reach through a horizontal range. The overburden is then delivered to the discharge boom, which transfers the cut earth to another machine for transfer to a spreader. This may be a fixed belt conveyor system or a mobile conveyor with crawlers similar to those found on the BWE. Mobile conveyors permanently attached to the excavator take the burden of directing the material off of the operator. The overburden can also be transferred directly to a cross-pit Spreader, which reaches across the pit and scatters overburden at the dumping ground.

FIG : 7.2

Automation :

Automation of the BWEs requires integrating many sensors and electrical components such as GPS, data acquisition systems, and online monitoring capabilities. The goal of these systems is to take away some of the work from the operators in order to achieve higher mining speeds. Project managers and operators are now able to track crucial data regarding the BWEs and other machinery in the mining operations via the Internet. Sensors can detect how much material is being scooped onto the conveyor belt, and the automation system can then vary the speed on the conveyor belts in order to feed a continuous amount of material.

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PARTS OF BUCKET WHEEL EXCAVATOR

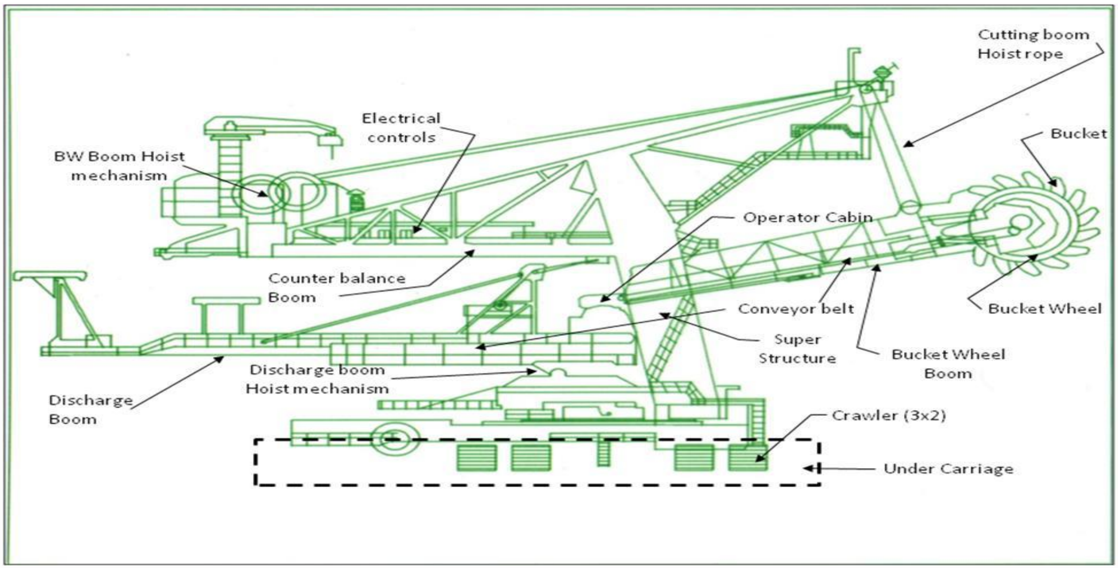

FIG : 8.1

Bucket wheel boom:

The innovative wheel boom design future a combination of full web and framework structures. This design enhances the torsional stiffness of the structure and minimises its susceptibility to oscillation. The bucket wheel head with the powerful 900 KW bucket wheel gear box was developed especially for The mining of soft to medium hard materials. Equipping the bucket wheel drive with a 6 kV medium voltage motor and frequency converter has reduced transformer power loss and cable cross sections.

Bucket by use of FEM calculation the buckets are designed to withstand major digging forces. The bucket design also lends itself for use in sticky material. larger internal radii and a special cutting tool carrier height/width aspect ratio of the buckets reduce material adhesion inside the buckets. An extended bucket body minimises the contact of the excavated material with the annular space of the bucket wheel. The chain buckets facilitate the material discharge.

Wheel boom hoisting gear:

The wheel boom is supported by two hoisting cylinders which are hydraulically coupled using specially designed circuits. This ensures low-vibration of the SR(H)1050, even where continuously changing material hardness in the block occurs and eases the mining of thin material layers. Each of the hoisting cylinder is equipped with mobile piston protection system to protect them against damage.

Crawler tracker:

The optimised design of the crawlers with 6 track rollers enables more efficient production, maintenance and repair of all crawler track components and a more efficient rate of advance of the SRs(H) 1050 compact bucket wheel excavator.

The shorter and more compact crawlers facilitate extremely economically block excavator. The latest generation of crawler girders and equalisers are integrated in an open crawler girder design which facilitates maintenances are repair of wear components(equalisers can be removed without lifting equipment). In addition to this, rockers and track rollers are constructed according to the reliable lifetime design.

Front steering track (FST)

Front steering track is placed at face of bucket wheel left side it has two crawler this track move forward of bench face.

Reverse steering track (RST)

Reverse steering track is placed at the back of the (FST) discharge boom of BWE it move backward of front bench

Self alignment track (SAT)

Self alignment track is placed at right side of the bucket wheel which is help to move right and left side for BWE

Cable routing:

Cables are routed between the undercarriage and superstructure via a unique cable saddle that is seated in two independent pivots in the enclosed machine room of the SRs(H)1050 There they are protected against dust and dirt. This method of cables routing achieves an operational superstructure slewing range of 360°relative to the undercarriage via a simple, trouble free design.

Conveyor:

Conveyor is used in BWE us B1 belt and B2 belt the belt B1 is fitted with hoper near the bucket wheel it receive the OB and lignite from bucket wheel passed to the receiving boom and the boom is deliver to the belt B2 which is fitted with receiving boom the belt is then passed to delivery boom end of the bucket wheel.

FIG : 8.2

Operator cabin:

Operator cabin is for operating bucket wheel the cabin is only for the operator the cabin is carrying with one A/C and fan then monitor which is connected with cameras, all data monitors display for overall BWE to check the problems of

BWE one landline phone etc... Operator cabin is one for bucket wheel and another one wheel for discharge boom.

Electrical controls:

The electrical control is placed at the top of the BWE near the counter weight it has three transformer the electrical cables are fitted at bottom of BWE cable drum all the electrical cables wires are plugged with electrical room all the current, power source are noted at the room with metre circuit.

Receiving boom and discharge boom:

The receiving boom is receive the OB and lignite from the B1 belt one conveyor the receiving boom is fitted at centre of the BWE it carry heavy amount of OB and lignite and deliver to the B2 belt to the discharge boom the discharge boom is end of the bucket wheel it discharge the OB and lignite to direct main conveyor or to the MTC

Hoisting rope:

Hoisting rope is to hoist the bucket wheel and discharge boom in vertical direction the rope are totally 22 which is winded with 16 wire rope are well grease to be strong.

Rotary plate:

The rotary plate is fitted with near the bucket wheel it receive the OB and lignite it will direct to the hoper the rotary plate has 8 plate.

Size of Bucket Wheel Excavator:

The scale of BWEs varies significantly and is dependent on the intended application. Compact BWEs designed by ThyssenKrupp may have boom lengths as small as six metres (20 ft), weigh 50 tons, and move 100 m3 (3,500 cu ft) of earth per hour. Their larger models reach boom lengths of 80 m (260 ft), weigh 13,000 tons, and move 12,500 m3(440,000 cu ft) per hour. The largest BWE ever constructed is TAKRAF'S Bagger 293, which weighs 14,200 tonnes and is capable of moving 240,000 m3 (8,500,000 cu ft) of overburden every day. Excavations of 380,000 m3 (13,000,000 cu ft) per day have been recorded. The BWEs used in the United States tend to be smaller than those constructed in Germany.

CHAPTER-9

WORKING OF BUCKET WHEEL EXCAVATOR:

Full block method:

This is commonly adopted and is the position of the excavator by numerals 1, 2, 3, of the full block method is practised with a bucket wheel excavator having a boom that can be pushed out and pulled back i.e., capable of thrust forward the full block method as practised with an excavator having a bucket wheel boom that can be lifted and lowered but has no thrust movement, Where selective wining of minerals is not necessary, full block method is employed so that the bucket wheel cuts in full blocks and parallel operationwith cuts which are made as wide as possible the blocks removed by giant bucket wheel excavators have a width 45 m to 100 m. this large width of cut which can be maintained along the whole face, not only reduces the travel way for the crawlers, and consequently, the time required for this displacement, but also that shifting work required for the transport system used to dispose of the mineral.

FIG : 9.1

The method is therefore simple and 1:20 into the new block and finally excavators the ramp also Lateral block method. In order to remove continuously waste partings or mineral seams of minor thickness selectively the excavators adopts the method of cutting lateral blocks. Both bucket wheel excavators with thrust or without thrust-can dig the necessary lateral slopes. The width of the block depends, however, always on the length of bucket wheel boom. bucket wheel excavators with a short bucket-wheel boom are not suitable for cutting lateral blocks. Should the level of the selected seam lie high above the travel-way of the machine, and taking into account the necessary slope angle, a "super" bucket wheel would be required, i.e., with a diameter large than that which would actually be needed for the output required.

In any case, the amount of crawler travel increase with decreasing width of blocks. the travel-way is reduced if an excavator with thrust is employed. The excavated rock is transported by a system of belt conveyor mounted on the machine to hopper cars and then to belt conveyors or rail wagons. The loading belt of the machine is also mounted on boom.Common bucket wheels are designed with a bucket wheel body on which the individual buckets and precutter are mounted separately. With the new wheel the buckets and teeth are an integral part of the wheel body and the flow of the circumferential forces goes undisturbed from the teeth directly into the main wheel plate.

The teeth itself are designed in a long and pointed form.

This profile assures that the teeth attack the material with the tip only and the full power of the strong wheel is directed at a small area into the material. The high specific force which is gained by this makes it possible to cut even very hard material handlingBucket wheel technology is used extensively in bulk materials handling. bucket wheel reclaimers are used.

CHAPTER – 10

EXCAVATING OF OB AND LIGNITE :

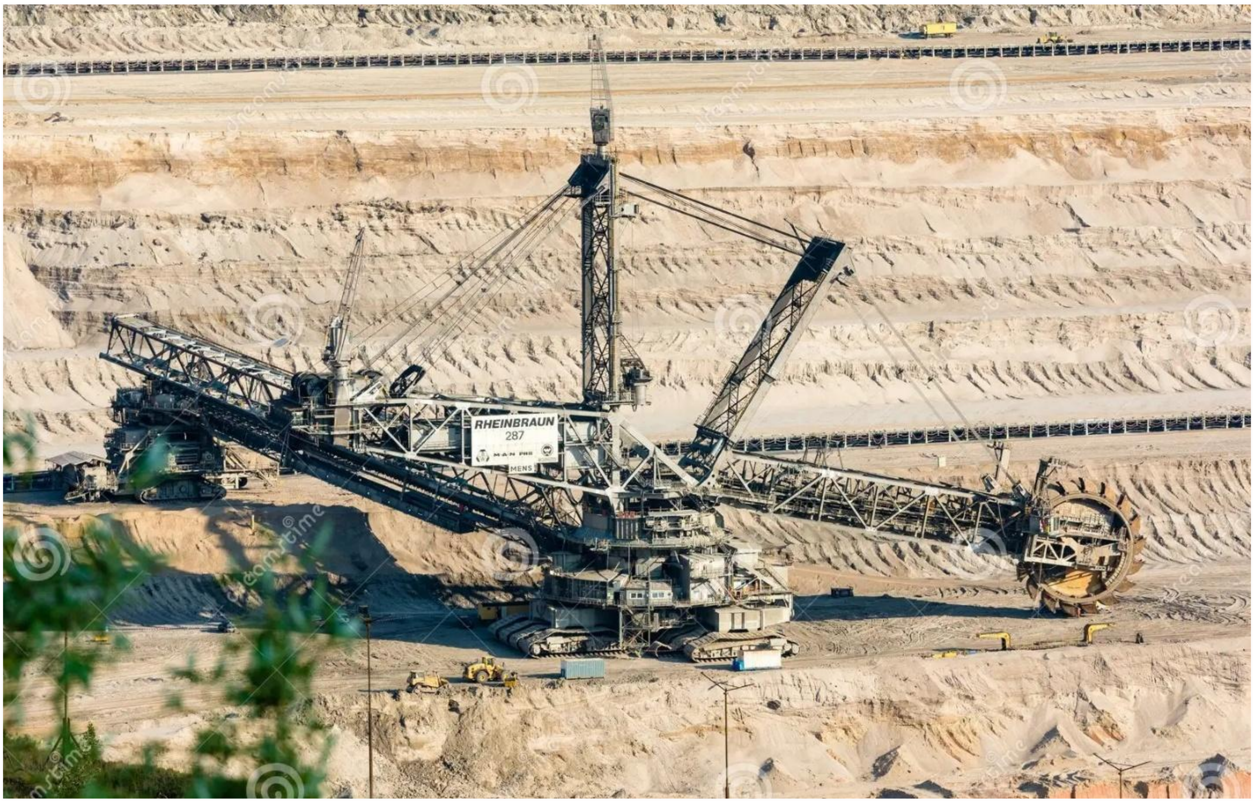

FIG : 10.1

Wheel and Digging:

The "sector" for the ability of the machine to dig through semi-hard rock lies in its wheel and in its digging technique.Common bucket wheels are designed with a bucket wheel body on which the individual buckets and precutter are mounted separately. With the new wheel the buckets and teeth are an integral part of the wheel body and the flow of the circumferential forces goes undisturbed from the teeth directly into the main wheel plate. The teeth itself are designed in a long and pointed form. This profile assures that the teeth attack the material with the tip only and the full power of the strong wheel is directed at a small area into the material. The high specific force which is gained by this makes it possible to cut even very hard material.

Material handling:

Bucket wheel technology is used extensively in bulk materials handling. bucket wheel reclaimers are used to pick up material that has been positioned by a stacker for transport to a processing plant. Stacker reclaimers, which combine tasks to reduce the number of required machines, also use bucket wheels to carry out their tasks. In shipyards, bucket wheel are used for the continuous loading and unloading of ships, where they pick up material from the yard for transfer to the delivery system

Modernisation of a Bucket-Wheel Excavator :

❖ **The task**

An SRs 6300.50/15.0+VR bucket-wheel excavator used for overburden removal at the Welzow-South lignite mine in Germany had been in operation since 1981. An e-lectrical rehabilitation became necessary in 1997, due to the long years of operation under extreme mining conditions. The job was given to ABB Cottbus with the target to enable the machine to work, under the geological and operational conditions of the mine, for another fifteen to twenty years and to achieve a marked reduction of electrical maintenance costs.

Variable-speed drives :

The main drives of the conveying system consisted of slipring motors with rheostatic starters that did not allow, because of their fixed speeds, any optimisation by adapting performances to varying operational requirements. The introduction of variable-speed drives for the 4 belt conveyors, in addition to the main drives and the bucket-wheel drive, laid the basis for a complex automation of material conveying. The new solution yields essential operational advantages

➤Squirrel-cage motors can be used.

➤Starting and slip resistors that caused high losses are no longer needed.

➤Performance is adapted by speed reduction (power saving).

➤Motors can be run at crawling speed (for removing large rocks in the overburden).

➤Starting and stopping torques can be controlled. B Mechanical maintenance is reduced.

The noise level decreases.

ABB Cottbus has chosen the reliable ABB frequency converters ACV 700 Multidrive, and for smaller drives the model ACS 600. The incoming supplies of the main drives in the superstructure of the excavator work as self-commutated grid inverters. The system is characterised by the following features:

➤high overall efficiency of >94.5%

➤regenerative braking at minimum system perturbation (distortion factor of<3%)

➤ improved power factor

➤high availability through parallel power supply

➤fully digitalised power electronics

➤powerful optical-fibre interfaces for diagnostic routines

The control of drive speeds is based on active vector regulation, with the application control (APC) implementing torque setpoints. Moreover, the application control serves to visualise all inverter signals for each drive on a local display.

Control System and Process Management:

The machine is controlled and supervised from the control room of the excavator that has been designed according to modern ergonomic principles. The installation consists of an OS 520 operator station from the ABB Advant Open Control System and three powerful AdvantController 450 processing stations of the same family. Those controllers have a high processing capacity, a comprehensive process periphery, a wide range of different process input and output devices as well as a large number of communication interfaces. All process data is stored fully configurable in databases. The Advant process control stations and the controllers are connected to a Master-Bus 300 network. The MasterBus 300 is based on the connection-free data circuit service protocol according to IEEE 802.2, class 1, and the access protocol as to IEEE 802.3 CSMA/CD. The process level uses the sensor-actor bus INTERBUS-S specified by the customer.

Communication Infrastructure:

Signal transmission within the excavator complex as well as to and from a central control station is based on a powerful communication structure using most modern components, such as optical-fibre connections for data communication and signal exchanges between the individual sections of the system. A wide-band communication system (OTN) makes it possible to print out signalisation, fault and operation records at any point of the excavator. All data can be received at the central control station via Ethernet.

Automation functions

The modernised excavator features a high degree of automation: automatic positioning of the loading conveyor over the hopper

Optimisation of starting and stopping the conveyor:

➤ Accelerated start

➤ Control of belt speed

Operational cycles and programmed control moves for -slewing angle limitation

➤Cutting depth control

➤Slice thickness

➤Slice height

➤Formation of even surfaces - 1/coso control

➤Lateral slope formation - front slope formation

➤Deep cutting

➤Performance control

◆Excavation and transport of rocks

◆Automatic transmission of specified values (setpoint and limit values)

System diagnosis:

For the first time a comprehensive diagnostic programme has been introduced in order to support maintenance and repair measures. All necessary software modules and communication interfaces have been concentrated at a diagnosis desk located in the substructure of the excavator. That desk can be remote-controlled via TCP/IP network connection. The programme breaks up into "operative diagnosis" and "extended diagnosis" "Operative diagnosis" covers the examination of individual system components for faults and maintenance status. That is done by means of the tailor-made diagnostic tools the manufacturers provide for their devices as well as on the basis of the information gathered in the central control system.

"Extended diagnosis" means the longer-term supervision of wear and tear by means of

Relevant control data

A Central data library kept on a database server. evaluation of specific applications.

New technological possibilities such as client server databases and INTRANET have been utilised to implement that function.

CHAPTER-11

PRODUCTIVITY ANALYSIS OF BUCKET WHEEL EXCAVATOR (BWE)

Productivity in its broadest sense refers to a rate at which a certain individual or machine makes contributions to effect production. For the purpose of this analysis, BWE productivity will be measured in cubic yards per hour. This figure is a function of the following variables:

Bucket Capacity (Bc) The theoretical capacity of each bucket as provided by the manufacturer. It is expressed in cubic yards.

Bucket Fill Factor (fB) A ratio of the actual volume of material excavated by each bucket to the theoretical bucket capacity (Bc).

Number of Buckets (n) The number of individual buckets located around the circumference of the bucket wheel.

Angular Velocity (Wr) - The number of revolutions made by the bucket wheel per unit of time, which also accounts for cutting resistance experienced by the BWE. For this analysis, revolutions per hour will be used.

Operating Time (to) The actual number of hours that the BWE is operating.

This figure will only be used in determining productivity for a time period other than an hour. Functional relationships of these variables can be expressed in the following equation: P = (Bc x fB x n)Wr or P = (BcxfBx n)Wr X to (To convert units of time)

Age of each BWE observed along with operating parameters for each unit. Percentages were used in Figure 4 to offset the variations in BWE size and number of operating days per year. For each BWE the actual productivity was calculated along. with productivity at 85% machine availability to show realisable increases in production for corresponding increases in machine availability. Detailed availability/downtime statistics were available for 4 BWEls.

Information was dichotomized into mechanical-electrical downtime and operational downtime. These data are presented in Figure 5 through Figure 10. Figures 5, 7 and 9 relate individual downtime statistics to an overall category (mechanical-electrical or operational downtime) as a percentage of that category. Figures 6, 8 and 10 relate 1 those same statistics to total downtime as a number of shifts per year lost. By presenting the data in this fashion, it becomes immediately.

CHAPTER-12

SAFETY OPERATIONS OF BUCKET WHEEL EXCAVATOR (BWE)

Excavators consist of a boom, dipper or stick, bucket, and cab on a rotating platform known as the upper structure or revolving frame. This upper structure sits on the top of an undercarriage with tracks or wheels. Excavators fall under the heavy equipment category and like any other heavy equipment, they are costly and hence, need to be safely operated and properly maintained so as to boost their life.

If you are a contractor or a construction company owner or an excavator operator, then you might agree that adherence to the safety and maintenance tips not only keep the equipment in the good condition but give you peace of mind too that the equipment will not show signs of depreciation too early and can be used efficiently for years together with high uptime. Further, observance of safety tips can also increase job site safety. So what are these excavator safety tips? Well, here is a look at those excavator safety tips for before, during, and after the operation.

One shift = 7.25 hours for BWE 2

Safety tips before the operation:

Read the operators' manual to get familiar with the controls of the equipment.

❖ Read the warning labels and stickers as well as maintenance information, specification charts, and other important information posted around the machine.

❖Visually inspect controls, engine compartment, undercarriage parts, hydraulic parts, and other parts and see that everything is in proper condition.

❖ Check that mirrors are clean and set properly.

❖ Check all the attachments of the excavator. See if everything is in its proper place.

❖ Check the track system as well before operating the excavator so that accidents can be prevented at the Jobsite.

❖ Walk around the equipment and check loose bolts, trash build-up, oil leaks, or damaged parts.

❖ Always ensure that all the safety equipment is working and clean.

❖ Make it a point to know and understand the width of the machine in order to maintain proper clearances from surrounding obstacles and obstructions.

❖ Switch on the key and check for any diagnostic codes or warning alerts that are active. Rectify the code before starting the operation.

❖ Test the equipment thoroughly before the operation to check its condition and effectiveness.

❖ Always use seat belts as they are provided for comfort and safety. Check with the concerned person if there are any underground lines or structures at the job site.

❖ Excavators should never be used too close to the edge of trench.

<u>Safety tips during operation:</u>

◆Excavators have only one seat where the operator should sit, apart from that no one should be allowed in the bucket, cab or anywhere else on the machine.

◆ Don't start the equipment before you are in full control. Match speed with job conditions.

◆ The excavator speed should be reduced while working on rough terrain or within congested areas.

◆ The bucket should be kept lower to the ground during transportation as this can increase visibility and machine stability.

◆ The flat route should be selected as far as possible when moving the excavator around the Jobsite.

◆ The equipment should be steered as straight as possible and only small gradual changes in the direction should be made when turning is needed.

◆ On travelling up the slopes, the equipment should be moved vertically instead of diagonally.

◆ The boom and arm should be extended with the bucket lowered and rolled out when driving up the slopes. This can help in dropping the bucket and preventing the equipment from sliding.

◆ The bucket bottom should be kept low and parallel to the ground when moving down the slope.

◆ In very slippery conditions, boom and arm can be used to move up and down the slope.

CHAPTER-13

MODEL PREPARING:

Material Required:-

PVC cardboards, DC Motors, Syringes, Saline Pipes, Battery, Switches, Forward and Reverse panels, etc....

Procedure:-

Firstly we have been cutted the PVC cardboard in the required sizes and then we have been placed the wheel in the bottom cardboard. Then we have been placed then swing motor in between the base and the top body then make it into the required position and moment. Then we have been made the two booms and the boom containing the conveyor system on it then one the end of the cutting boom the bucket wheel has been placed with the DC Motor then then syringes has been attached to the two boom in correct position by then join with the help of the saline pipes.

Now the supporting rope has been placed at the top of the Machine. Then finally the circuit connection to the all the DC Motor/ Special motors then lights are also been installed in the top of the Machine then a model of open cast mine has been made then it was placed inside a wooden box made specially for the opencast mine then the Machine has been installed in the coloured and decorated opencast mine model and finally made then transparent glass in to then cuboid without one side of the glass to install it in the wooden box then the model of the bucket wheel excavator has been completed has shown in the below image.

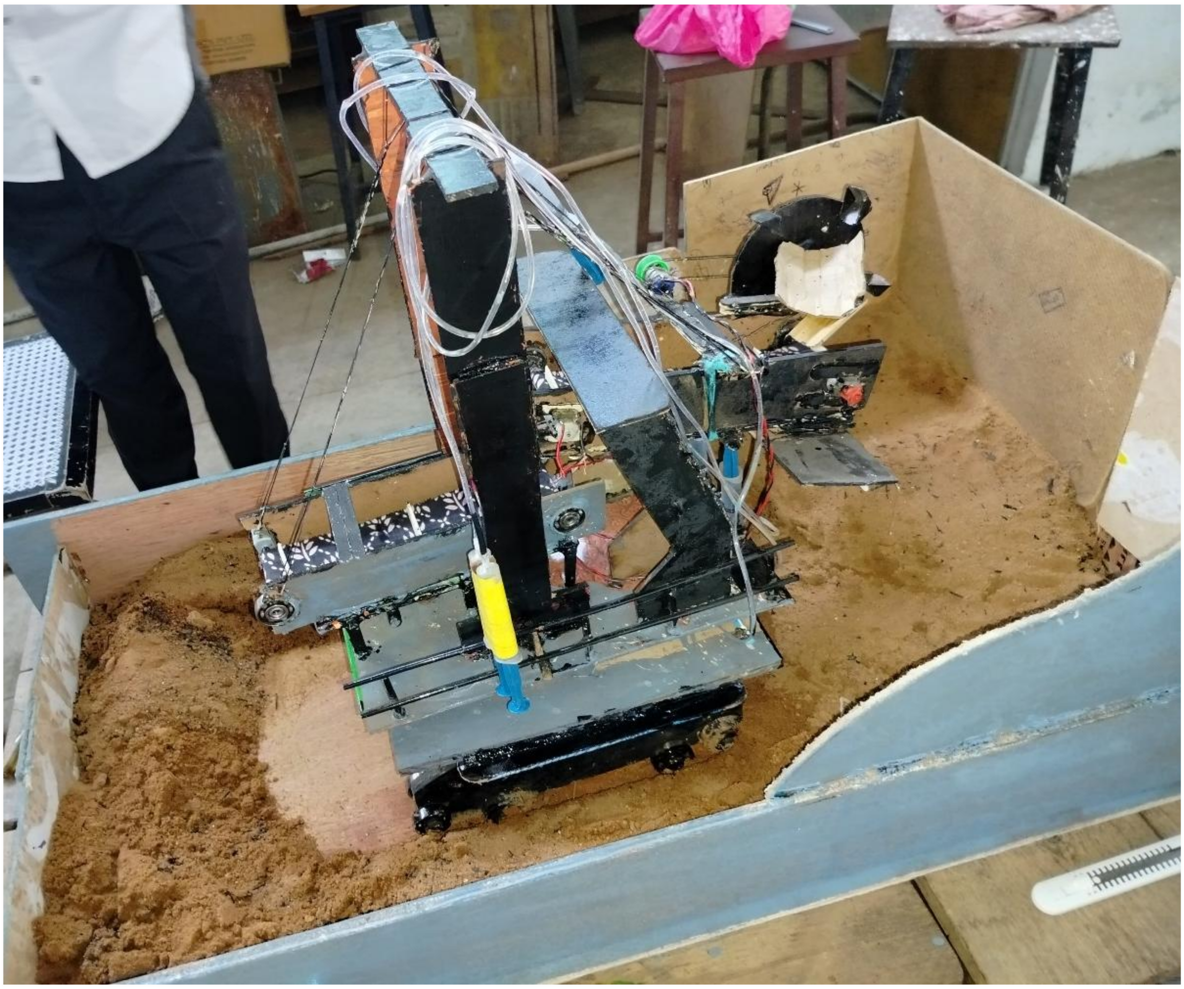

FIG : 13.1

CHAPTER-14:

CONCLUSION:

Bucket-wheel excavators have been in use at the neyveli lignite mine in the state of Tamil Nadu, India, since the early nineteen-sixties. The mining environment has been particularly harsh for BWE application. The adverse influencing factors are the hardness of the overburden formation, high abrasivity of rock and artesian ground water condition in this paper, the performances of the BWEs at Neyveli have been statistically analysed to determine the effects of physic-mechanical properties of overburden, blasting and rainfall on machine productivity, availability, wear-and-tear of bucket teeth, power consumption, production efficiency and cost of mining.an empirical relationship between the production efficiency, defined as the ratio of actual production rate to the theoretical one, and the bench height and width, height of slices, specific cutting resistance of the overburden material and its clay content, consumption of explosives, and conveyor length has been established.

CHAPTER-15:

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