MALLA REDDY ENGINEEERING COLLEGE

(Autonomous)

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DEPARTMENT OF MINING ENGINEERING

ASSESSMENT OF SLOPE STABILITY IN OPENCAST COAL MINES

UNDER THE GUIDENCE OF :-

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Presented by

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INTRODUCTION

- The various methods of mining a coal seam can be classified under two headings namely opencast mining and underground mining.
- In India, the demand of coal in the year 2016-17 was estimated 884.87 MT whereas the domestic availability of coal was estimated 724.71 MT. Here, the gap of 160.16 MT was projected to meet through the imports (Satyanarayana *et al.* 2017).
- In this regards, open cast mining technology can play a vital role to full fill the demand of estimated coal production as well as duo to large production capacity also.
- In India, the opencast mining methods accounts for about 95 per cent of coal production (DGMS Report, 2016).

- Consequently, the utilization of opencast mining innovation going further day by day with the most extreme stripping ratio being presently turning upward to 1:15, at the profundity about 500 m (Stacey *et al.* 2003).
- Thus, it is necessary to study the behaviour of the slope for efficient performance of the opencast mine
- The slopes are made by excavating the benches in ore body/overburden and by dumping excavated material.
- In general, the slope faces are designed to be stable, but where they are located in naturally variable or uncertain conditions, failures inevitably develop.
- The loss due to the slope failure is more than simply a cost encompassing unbudgeted expenditures, revenue reduction, and physical loss from injuries or worse, fatalities.
- The challenge is to minimize not only the incidence of failures but the severity of losses that result from those failures.

OBJECTIVES

1. To determine the geo-mechanical properties of mine site under study (cohesion, density, moisture content, compressive strength, tensile strength, Young's modulus, etc.)

2. To assess the stability analysis of high-wall in selected study area.

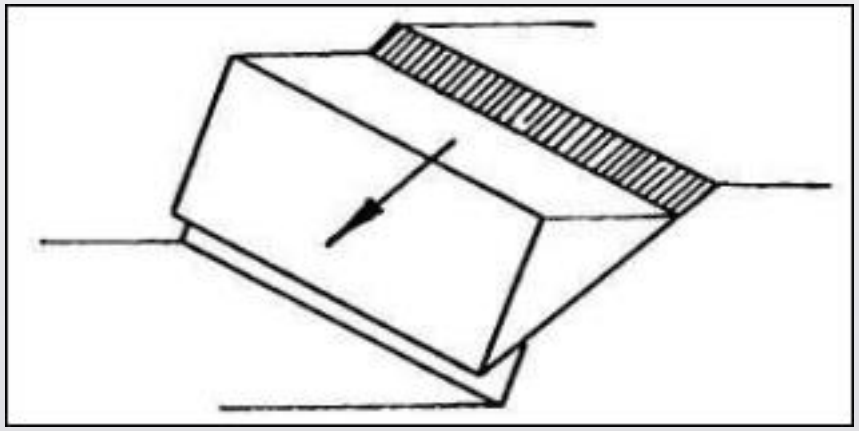
3. To suggest overall slope angle of pit in study area.

Types of Slope Failure

- Plane Failure
- Wedge Failure
- Circular Failure
- Toppling Failure

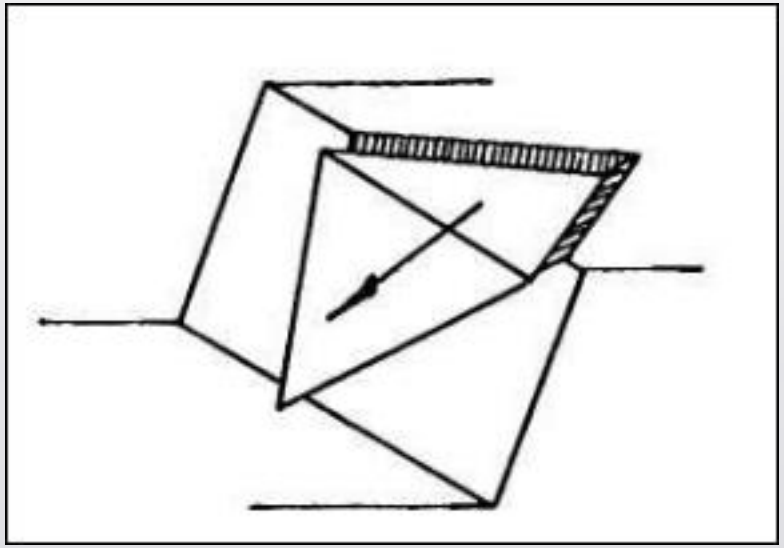
Plane Failure

Simple plane failure is the easiest form of rock slope failure to analyze. It occurs when a discontinuity strikes approximately parallel to the slope face and dipping at a lower angle intersecting the slope face, enabling the material above the discontinuity to slide.



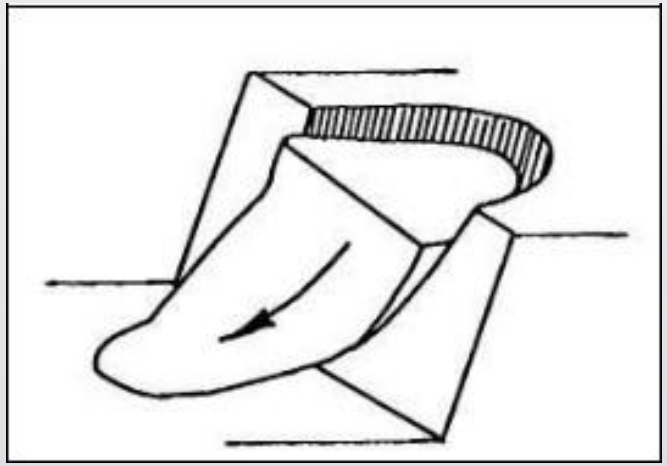
Wedge Failure

The three dimensional wedge failures occur when two discontinuities intersects in such a way that the wedge of material, formed above the discontinuities, can slide out in a direction parallel to the line of intersection of the two discontinuities.



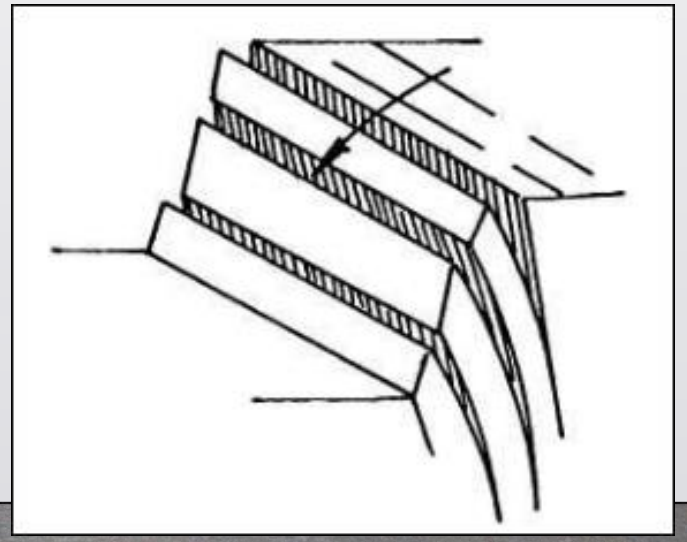
Circular Failure

This failure can occurs in soil slopes, the circular method occurs when the joint sets are not very well defined. When the material of the spoil dump slopes are weak such as soil, heavily jointed or broken rock mass, the failure is defined by a single discontinuity surface but will tend to follow a circular path



Toppling Failure

occurs in slopes having near vertical joint sets very often the stability depends on the stability of one or two key blocks. Once they are disturbed the system may collapse or this failure has been postulated as the cause of several failures ranging from small to large size. This type of failure involves rotation of blocks of rocks about some fixed base.



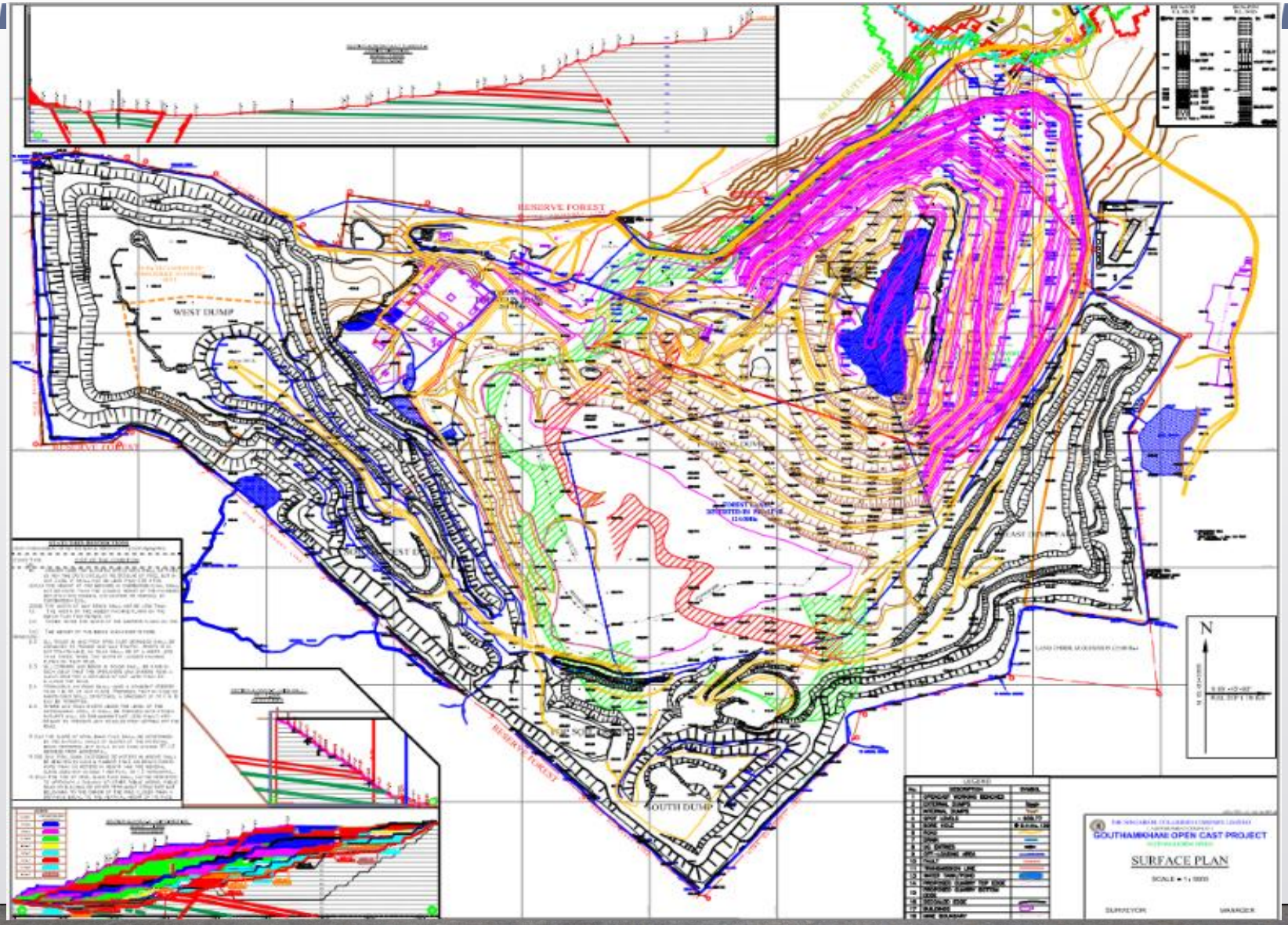
LITRATURE SURVEY

Reference	Work Done	Conclusion
Ramly *et a*l. (2002)	Conducted research on the impact of uncertainty on the reliability of slope design and performance assessment (ResearchGate)	An important conclusion of this study is that probabilistic analyses can be applied in practice without an extensive effort beyond that needed in a conventional analysis.
Verma *et al*. (2012)	In their paper present study a mine slope at Wardha Valley Coalfield in India has been numerically analysed to take into account the effect of number of joint sets on the stability. (ResearchGate)	▪The results show a reduction in factor of safety with an increase in joint sets. Stability of rock slopes depends on the scale of the slope, type of rock, orientation and density of the discontinuities etc. ▪The UCS, RQD and GSI values show reductions with an increase in joint density in the rock mass.

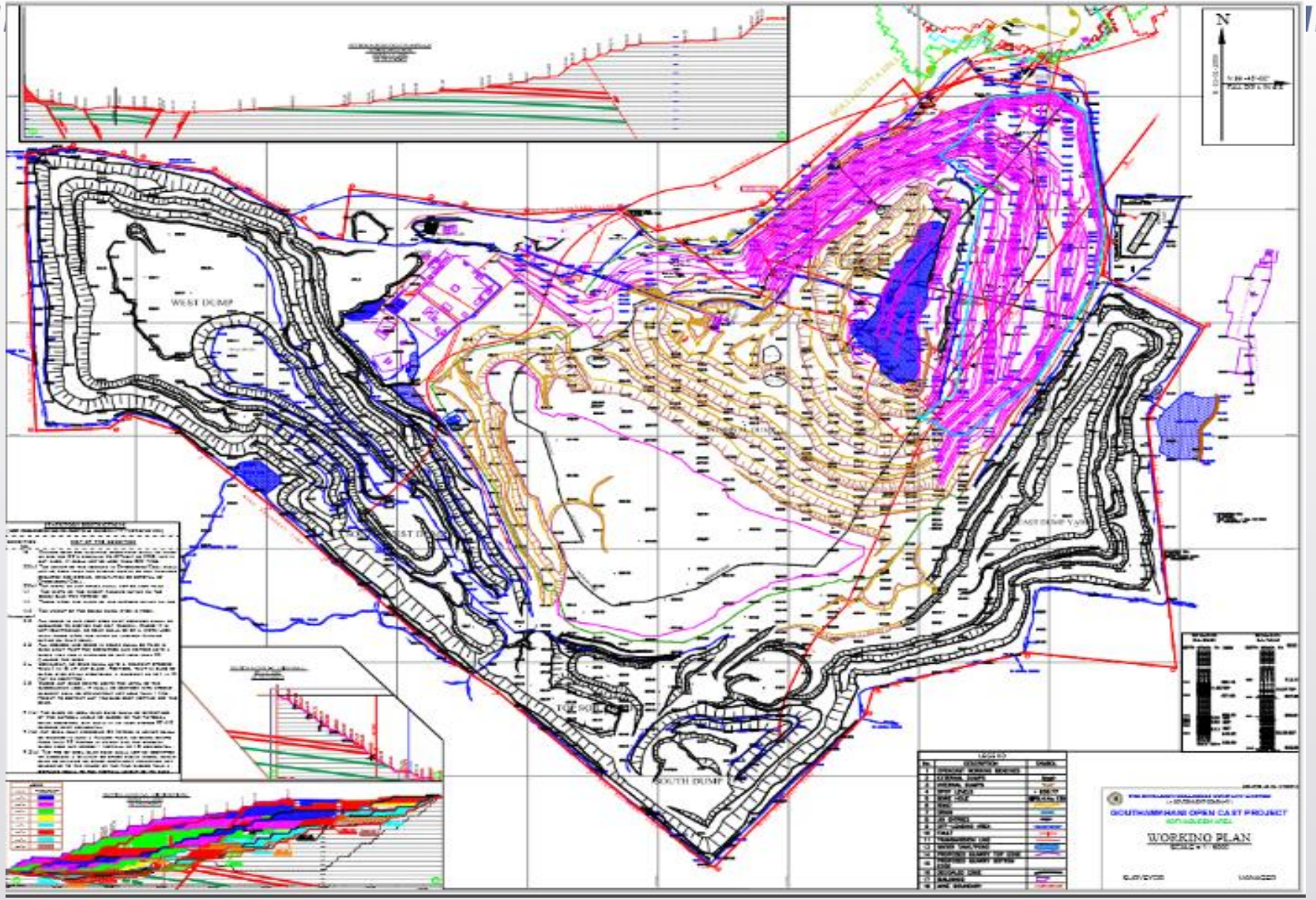
Reference	Work Done	Conclusion
Bhaskar *et al*. (2015)	In their paper presented usage of different geophysical logs at the proposed deep pit at Opencast-II Expansion Project of Ramagundam, SCCL (The Journal of Indian Geophysical Union)	These studies have therefore made use of different classification methods based on petrophysical and physic mechanical properties to understand overall competency of rocks. All these methods make more or less similar conclusions.
Griffiths and Marquez (2007)	Suggest that the vast majority of slope stability analyses are performed in two dimensions under the assumption of plane strain conditions. Even when two-dimensional (2D) conditions are not appropriate, three-dimensional (3D) analysis is rarely performed.	Results were validated against conventional 2D limit equilibrium analyses of a homogeneous slope and demonstrated the convergence of the 3D factor of safety on the 2D result as the out-of-plane dimension was increased.

Reference	Work Done	Conclusion
Tarapada and Sanjay (2013)	In their conducted research seismic stability analysis of the slope using Pseudo-Static Method.	From the study following things can be concluded. ▪The slope defined in the problem statement is quite stable under static condition. Using Swedish circle method the FOS is found to be less than the Bishop's method..
Little (2006)	His studied of complement the visual inspections, Siro-vision digital photogrammetry is now used for predicting where future failures may occur.	Due to the rapidity of the failures, it was determined that the Ground Probe slope stability radar (SRR) was the only monitoring device that could provide early warning of failure on the west wall.

Reference	Work Done	Conclusion
Ammar and Mohammed (2013)	Describes numerical simulation study of slope stability problems by using the computer based geotechnical software code Slope/w (Geo-slope 2007).	▪It was found that the factor of safety increases linearly with increasing the cohesion of the soil of slope stability for values greater than 10 kpa. ▪Analysis of the effect of internal friction angle on slope stability showed that the factor of safety increases nonlinearly with increasing the internal friction angle.
Satyanarayana *et al*.(2017)	In their study suggested that, slope stability analysis has been performed by using computer program FLAC/SLOPE to assess the effect of groundwater on stress distribution pattern and safety factor of pit slope.	▪The analysis of stability of slopes for the ultimate pit slope at Medapalli OCP indicated the safety factor exceeding 1.2 for slope angle of 45 degrees with proper drainage system. ▪However, the presence of water decreased the safety factor to around 0.98. The factor of safety computed with the strength reduction technique results to be 1.24 in drained condition and 0.98 in undrained condition



Goutham Khani Surface Plan



Goutham Khani Working Plan

CONCLUSION

- An assessment of the engineering and structural geology, strength properties and related geotechnical controls indicated following optimum design parameters for final high wall slopes.
- The slope monitoring of active ultimate mine slope is also strongly recommended to detect any instability well in advance.
- The periodic loose dressing of high wall faces is also advisable.
- If any deviation is observed or the remedial measures are not effective then this slope angle has to be corrected accordingly.
- The final slopes should be formed at pit cessation stage.
- In other words, cut the final slopes, backfill the area or vacate the area around final slope.

- The operating bench width should never be less than double of the bench height.
- The unavoidable small-scale bench failures associated with weak brown sandstone and intermittent clays could be arrested on these wide benches and large-scale slope failure can be avoided
- The extra wide bench will arrest the local bench failures and there would not be any operational problem.
- The exposure should be made within such an area, where the bottom could be touched within a maximum one year.
- This patch should be backfilled immediately.

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