IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
IJARSCT
Impact Factor: 7.301
Volume 3, Issue 1, September 2023

Static Analysis of Coal Bunker

Prof. Sharif Shaikh[1], Nikhil Dayma[2], Rutuja Gaikwad[3]
Project Guide, Department of Civil Engineering[1]
Final Year Students, Department of Civil Engineering[2,3]
G H Raisoni College of Engineering and Management, Pune, India

Abstract*: The project titled "Static Analysis of a Coal Bunker" aims to investigate and analyze the structural behavior and stability of a coal bunker under various loading conditions. The objective is to ensure the safe and efficient storage of coal while considering factors such as the bunker's dimensions, material properties, and loading scenarios. The study begins with a comprehensive literature review on the static analysis of bunkers, including relevant research papers, design guidelines, and industry practices. This review serves as a foundation for understanding the key considerations and methodologies employed in analyzing bunkers. The project utilizes finite element analysis (FEA) as the primary analytical tool to simulate the behavior of the coal bunker. A three-dimensional model of the bunker is created, incorporating accurate geometric details and material properties. The model is subjected to different loading conditions, including empty, half-loaded, and fully loaded scenarios, to evaluate the structural response..*

Keywords: Failure of Bunker, linear static analysis, optimise

I. INTRODUCTION

Bunkers are the structures used to store the solid and granular materials at power plants. Bunkers are so designed that they can withstand the live pressure acting on walls as well as their self- weight. The bunker failure is caused due to lack of required structural redundancy in most of the structures, as well as lack of alternate load path to redistribute stresses and forces within the structure. The main issue is to check the deformation and stresses in bunker during analysis so that the bunker failure can be reduced. The analysis results are then validated using STADD PRO software.
Static analysis of a coal bunker involves the evaluation of its structural integrity and stability under static conditions. This analysis aims to ensure the safety and reliability of the coal storage structure. It begins by considering the geometric configuration and material properties of the bunker, including dimensions, shape, thickness, and material strength. The next step is to determine the static loads acting on the bunker, such as the weight of the stored coal, additional equipment, and environmental loads like wind or snow.

II. LITERATURE REVIEW

Panesar, D.et. al. (2008)"Stress Analysis of Reinforced Concrete Coal Bunkers Using Strut-and-Tie Models"
This research focuses on the stress analysis of reinforced concrete coal bunkers using strut-and-tie models. The authors propose simplified models based on the principles of truss analogy and strut-and-tie methodology to evaluate the stress distribution and internal forces in the bunkers. The study provides et al insights into the behavior of reinforced concrete coal bunkers, including the effects of different design parameters, such as boundary conditions, reinforcement detailing, and load patterns.
Chowdhury, A., et al (2010) "Analysis and Design of Reinforced Concrete Coal Bunkers Subjected to Silo Pressures"
This study focuses on the analysis and design of reinforced concrete coal bunkers considering the pressure exerted by the stored coal. The authors employ numerical analysis techniques to evaluate the structural response of the bunkers, including stress distribution, deformation, and stability. The paper provides insights into the design parameters affecting the behavior of reinforced concrete coal bunkers, emphasizing the importance of proper reinforcement detailing, load estimation, and adequate safety factors.
Wang, H., Li, X., et al (2012) "Structural Analysis and Design of Large Capacity Coal Bunkers"
This research focuses on the structural analysis and design of large capacity coal bunkers. The authors investigate the behavior of the bunkers under different loading conditions, including the weight of stored coal and environmental loads. The study utilizes both analytical methods and numerical techniques, such as FEA, to evaluate the stress distribution,

deformation, and stability of the bunkers. It provides insights into the design considerations for large-scale coal bunkers, addressing issues such as wall thickness, reinforcement detailing, and load-bearing capacity.

Kumar, R., et. al. (2014) "Analysis of Coal Bunker Stresses in Thermal Power Plant using ANSYS"

This study focuses on the stress analysis of coal bunkers in thermal power plants using ANSYS software. The authors analyze the structural behavior of the bunkers under the weight of stored coal and other applied loads. They discuss the significance of proper material selection, reinforcement detailing, and load estimation in ensuring the structural integrity and safety of coal bunkers. The paper provides insights into the practical application of numerical analysis tools for static analysis of coal bunkers.

III. WORKING PRINCIPLE

Define Problem and Gather Data:

↓

Establish Boundary Conditions:

↓

Model Creation:

↓

Apply Loads:

↓

Perform Static Analysis:

↓

Evaluate Safety Factors:

↓

Review and Interpret Results:

↓

Design Recommendations:

↓

Finalize Design and Documentation:

The static analysis of the coal bunker under different loading conditions involves a systematic approach to evaluate its structural behavior. The following methodology will be employed for conducting the analysis:

1. Model Development: A three-dimensional computational model of the coal bunker will be developed using a suitable software or analytical tool. The model will accurately represent the geometry and structural components of the bunker, including walls, columns, and any other relevant features. The model will be based on the design specifications and dimensions of the actual coal bunker.
2. Material Properties: The material properties of the bunker's structural elements will be considered in the analysis. The mechanical properties of the materials, such as concrete or steel, will be defined, including modulus of elasticity, Poisson's ratio, and yield strength. The properties may be obtained from material testing or from established literature.
3. Boundary Conditions: Appropriate boundary conditions will be applied to the model to simulate realistic constraints. Fixed supports or restrained boundaries will be assigned to the base or specific points, depending on the actual bunker's connections with the foundation. Boundary conditions will be selected to represent the actual support conditions of the bunker.
4. Load Analysis: The loading conditions specified for the fully loaded, half loaded, and empty scenarios will be applied to the model. The loads will include the weight of the coal, dynamic loads during loading/unloading operations, and any relevant environmental loads. of the loads will be based on design considerations and engineering standards

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, September 2023

IV. RESULT AND CONCLUSION

In conclusion, the static analysis of the 3x3m square coal bunker under different loading conditions (empty, half loaded, and fully loaded) has provided valuable insights into its structural behavior and performance. The key findings and conclusions from the analysis are as follows:

- Bunker model analysis in staad.pro is given in Fig. 3 and Fig. 4
- Loading Variations for 100 %, 50 % and 0 % loading is given in Fig. 4, Fig. 5 and Fig. 6 respectively.
- Displacement of plate no 156 for 100%, 50 % and 0 % loading is given in Table 1,2 and 3 respectively.

1. Structural Response:

The analysis revealed the deflections, stresses, and deformations experienced by the side walls and hopper bottom of the bunker under each loading condition. The maximum absolute stresses were determined for critical sections, highlighting areas of potential concern. The structural response was found to vary significantly depending on the loading condition, with higher stresses observed during full loading and half loading.

2. Design Considerations:

Based on the analysis results, design modifications and reinforcement measures can be implemented to enhance the load-carrying capacity and structural integrity of the bunker. Material selection, such as the use of M30 grade concrete and Fe 415 steel, was found to be suitable for the anticipated loads and stresses.The analysis identified critical areas, such as stress concentration points or regions of excessive deflections, which can guide targeted design improvements.

3. Safety and Code Compliance:

The study emphasized the importance of considering safety factors and compliance with relevant design codes and standards. By ensuring adherence to appropriate safety measures and codes, the structural integrity and overall safety of the coal bunker can be maintained.

REFERENCES

[1]. Panesar, D., & Chopra, A. (2008)"Stress Analysis of Reinforced Concrete Coal Bunkers Using Strut-and-Tie Models"
[2]. Chowdhury, A., & Bhattacharya, B. (2010) "Analysis and Design of Reinforced Concrete Coal Bunkers Subjected to Silo Pressures"
[3]. Wang, H., Li, X., & Liu, H. (2012) "Structural Analysis and Design of Large Capacity Coal Bunkers"
[4]. Kumar, R., & Kanchan, R. (2014) "Analysis of Coal Bunker Stresses in Thermal Power Plant using ANSYS"
[5]. Zhang, Y., Zhao, X., & Li, J. (2015) "Static and Dynamic Analysis of Steel Coal Bunkers under Seismic Loads"
[6]. Li, Z., Xu, G., & Liu, Z. (2016) "Evaluation of Structural Performance and Safety Factors of Reinforced Concrete Coal Bunkers"
[7]. Ahmad, S., Ahmad, S., & Hussain, M (2016) "Structural Analysis of Coal Bunkers: A Case Study of a Power Plant in Malaysia"
[8]. Chen, L., Wang, Q., & Zhang, X. (2017) "Static Analysis and Stability Assessment of Circular Coal Bunkers"
[9]. Smith, J., Johnson, A., & Brown, R. (2018) "Structural Analysis and Design of Coal Bunkers"