MAINTENANCE EMPLOYEES WORKING AT HEIGHTS ON EARTH MOVING EQUIPMENT

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SUMMARY

This paper aims to highlight fall from height risks that maintenance employees in the mining industry are exposed to when working on earth moving equipment.

The object of this paper is not to provide an all encompassing solution to this problem, but rather to outline the processes that were used within the project to:

- Identify those tasks performed at heights on earth moving equipment.
- Identify possible fall points on the earth moving equipment.
- Document the tasks and possible fall points.
- Perform risk assessments on each possible fall point.
- Develop possible solutions to the problems.

INTRODUCTION

Approximately 18 months ago whilst reviewing the site working at heights policy it was identified that the heavy equipment workshop was one of the areas where workers were being exposed to the possible risk of falling from heights.

Working at heights, up to 6 metres above the ground, whilst performing maintenance on large earthmoving equipment is common for maintenance workers (diesel fitters, auto electricians, etc.) in the coal industry. Examples of this include:

- Working on top of the gooseneck of a Cat scraper, 3.5 metres above the ground
- Repairing lighting cable a top of a Cat 777 water cart, 5.0 metres above the ground
- Working on top of tilt cylinders on a Cat 994 loader, 4.5 metres above the ground

Due to the large size of the earthmoving equipment, the potential is present for a fall resulting in a major permanent injury or fatality. With the ever increasing size of earthmoving equipment, the requirement for maintainers to work at heights can only be seen to increase in the future. If current working at height practices are continued in the industry, the risk exposure will also rise.

If we are serious about reducing the number of fatalities in the industry, work needs to be focused in this area to provide some risk reducing strategies.

It was for these reasons that a working at heights project was undertaken in the heavy equipment workshop at Blair Athol Coal.

There is little evidence available in the mining industry to show of any specific programs that have been undertaken to address the issue of maintainers working at heights on earthmoving equipment. There may be a number of reasons to explain this including:

- The perceived size and amount of time needed to be given to such a project, and with little related information on the topic available, it may be considered an onerous task, ie. too difficult to tackle
- The issue of maintainers working at heights on earthmoving equipment may be one that the industry has overlooked due to work in other areas being considered more beneficial
- The risks associated with working at heights on earthmoving equipment may have been underestimated. For example in the construction industry a great deal of time and effort has been invested in the area of working at heights. This may be due to the fact that working at heights at a construction site is an easily identifiable risk where as working at heights on earthmoving equipment does not immediately spring to mind as a principle hazard on a mine site.

For whatever reason limited effort has been focused on maintainers working at heights on earthmoving equipment.

BAC WORKING AT HEIGHTS PROJECT

The working at heights project undertaken at Blair Athol Coal can be broken down into three distinct phases.

1. Information Gathering phase
2. Problem Solving Phase
3. Implementation Phase

INFORMATION GATHERING PHASE

This phase involved defining the size and extent of the project.

1. Identifying those tasks performed at heights on earthmoving equipment.

   It was necessary to first set the guidelines of what was considered working at heights. For the project this was defined as any work performed at a height greater than 1.2m outside physical edge protection (eg. handrails).

   Next, all tasks performed on each type of earthmoving equipment were identified. This was achieved by attending the weekly heavy equipment workshop planning meetings, where all tasks to be performed by the maintainers in the next two weeks would be discussed with the work group. All of the tasks were reviewed by the workgroup to identify if they involved working at heights. All tasks identified as having a working at heights component were highlighted for further analysis when the task was being performed.

2. Identifying possible fall points on each type of earthmoving equipment.

   All potential fall points on each piece of equipment were identified by:

   - watching the maintainers perform the job
   - discussing with the maintainers possible fall points whilst performing the job
   - taking photographs of the task being performed
   - measuring possible fall distances

3. Documenting the tasks and possible fall points on each type of earthmoving equipment.

   After watching and analysing the working at heights task, the task would be documented. The documentation would include a brief description of the following:

   - the task being performed at heights
   - how the maintainer gained access and egress to the possible fall point (ie. work area)
   - the possible fall point
   - any additional hazards eg. sloped surface, slippery surface
   - the height at which the task is performed (fall distance to next surface)
   - a photograph of the maintainer performing the task
   - the work posture required whilst performing the task
   - the tools used during the job
   - any manual handling involved in the task

4. Performing a risk assessment for each fall point on each equipment type.

   A risk assessment was performed for each fall point on each type of equipment. The risk assessment for each fall point was performed in consultation with the maintainers performing the job to ensure that the resulting risk score was a realistic assessment.

   The risk assessment used the following components:

   - Frequency of task
   - Worst case outcome
   - Likelihood of Falling.

   Tables 1, 2 and 3 were used in the risk assessment to calculate the risk score.

Table 1

Worst Case Outcome	
Multiple fatalities	100
Fatality	40
Major Permanent Injury	15
Permanent Injury	8
Major Temporary Injury	3
Temporary Injury	1

Table 2

Likelihood of Falling	
Likely	10
Possible	6
Unusual but Possible	3
Remotely Possible	1
Impossible	0

Table 3

Frequency of Task	
Continuous	10
Daily	6
Few Times per Week < Monthly	3
Monthly < Few Times per Year	2
Few Times per Year < Once a Year	1
Once per Year	0.5
No Exposure	0

Table 4: Ranking Of Possible Fall Points On A Caterpillar 637D Scraper

Equipment	Possible Fall Point	Hazards	Height	Consequence	Frequency	Likelihood	Risk
Cat Scraper	Top of gooseneck	Slippery surface (grease & oil), trip hazard (hydraulic and grease lines), carrying tool bag.	3.5m	40	3	6	720
	Draft tube	Surface is not flat (circular), slippery surface (grease & oil), difficult to access.	3.1m	40	3	6	720
	Top of cabin	Restricted space to stand on	3.5m	40	2	6	480
	Front mudguard	Slippery surface (grease & oil)	2.7m	40	3	3	360
	Rear mudguard	Lifting or lowering heavy objects such as a starter motor whilst lying on the mudguard	2.4m	40	3	1	120
	Bonnet	Slippery surface	2.4m	40	2	1	80

The risk scores obtained from the risk assessments were used to rank fall points on each type of equipment. Table 4 shows the possible fall points on a Caterpillar 637D Scraper ranked in order of their risk score.

The ranking of fall points on each piece of equipment was used to decide which fall points would be looked at first when each type of equipment was being reviewed. For example when the Caterpillar 637D Scraper was going to be reviewed, the fall point from the top of the gooseneck and the draft tube were reviewed first as they both had the highest risk scores for that piece of equipment (see table 4).

An example of the documentation obtained from steps 3 and 4 of the information gathering phase can be seen in Table 5 for working on a scrapers gooseneck.

5. Performing a risk assessment for each type of equipment type (eg dozer, scraper, grader etc).

   The equipment was ranked according to the risk posed. This was required for the problem solving and implementation phases to ensure the highest risks were addressed first.

Table 5 : Documentation for Working on a Cat 637D Scraper Gooseneck

Equipment	Caterpillar 637D Scraper
Task	Working on top of Goose- neck (Inspecting pin wear, checking/replacing lines)
Access – Egress	1. Ladder 2. Step up onto Transmission 3. Step up onto Mudguard 4. Climb up cushion hitch 5. Move along gooseneck squatting, holding lines for balance.
Activity Whilst on Gooseneck	Squatting down and standing on gooseneck inspecting pin wear or inspecting and replacing lines.
Possible Fall Point	Top of Gooseneck
Height	3.5 metres
Hazards	• Slippery surface (grease and oil from lines) • Trip hazard (hydraulic and grease lines) • Carrying tool bag
Worst Case Outcome	40 (fatality)
Frequency of Task	3 (Task performed 6 wkly, No. of scrapers = 3 Frequency of task = 2 wkly)
Likelihood of Falling	6 (Possible)
Risk Score	720

Ranking each type of equipment's relative risk was performed by calculating an average fall point risk score for each type of equipment. The calculation used was just a simple mean calculation, ie. add all the individual fall point risk scores for each piece of equipment and divided them by the number of fall points for that piece of equipment. Table 6 shows the average risk score for each type of equipment.

Table 6: Average Fall Point Risk Score For Each Type Of Equipment

Equipment	No. of Fall Points	Average Risk Score
Cat D10 Dozer	4	480
D90K Overburden Drill	2	480
Coal Drill	2	480
Hitachi EX1800 Excavator	1	480
Cat 637D Scraper	6	413
Cat 16G Grader	1	360
Cat 994 Loader	5	304
Cat 789 Haul Truck	5	288
Cat 777 Water Cart	3	285
Komatsu 575 Superdozer	4	251
Komatsu WA800 Loader	5	245
Komatsu PC400 Excavator	1	240

On completion of this phase the following information was available:

- the tasks performed at heights on earthmoving equipment
- the possible fall points on each type of earthmoving equipment
- documentation on the tasks and possible fall points
- a risk assessment on each fall point on each type of earthmoving equipment
- a risk assessment for each type of earthmoving equipment

PROBLEM SOLVING PHASE

6. Workgroup feedback sessions were held with maintainers during normal toolbox meetings.

   Issues discussed were:

   - the progress of the working at heights project.

     (All the documentation on the working at heights project was discussed with the maintainers to ensure that they understood the project and also to ensure that the information that had been collected was complete.)

   - future direction of the project.

   - what part they were going to play in the future phases of the project.

7. Small work teams formed to look at solutions for each fall point on each piece of equipment.

   Small work teams (3-4 people) of maintainers were formed to look at risk reducing solutions for each fall point on each piece of equipment.

   Four work teams were formed, with each work team meeting fortnightly to look at the working at height issues.

   The average risk score (shown in table 6) for each type of equipment was used to prioritise the order of analysis. So the first work team formed looked at the D11 dozer and the second work team looked at the overburden drill.

   The format of the work team sessions were as follows:

   - Identify the earthmoving equipment type to be looked at

   - The work team facilitator would present the documentation compiled on the piece of equipment. This included:
     - how the maintainer gained access and egress to the possible fall point (ie. work area)

     - the possible fall point

     - additional hazards eg. sloped surface, slippery surface

     - the height at which the task is performed (fall distance to next surface)

     - a photograph of the maintainer performing the task

     - a risk assessment for each fall point

     - the work posture required whilst performing the task

     - the tools used during the job

     - any manual handling involved in the task

   - Each possible fall point on the piece of equipment, would then be looked at individually, starting from the fall point with the highest risk score down to the fall point with the lowest risk score.

   Brain storming sessions were conducted to identify as many solutions as possible. Whilst in this brainstorming mode constraints such as time and money were not raised and all ideas mentioned were taken on board.

   Once the work team had exhausted all the possible solutions that they could think of, the team worked through a process of elimination to come up with the most suitable solution. This involved discussing the merits and limitations of each solution and coming to a team agreement on the best solution.

   These work team sessions were run until solutions had been found for all of the earthmoving equipment that had been identified as having possible fall points.

IMPLEMENTATION PHASE

8. Small project teams (1- 2 people) of maintainers have been formed, with each team given a solution from the brain storming sessions to implement. This is currently an on-going phase, which is envisaged to take many months to complete.

   Each work team has mapped out a planning strategy to implement their solution and time is being scheduled

accordingly to allow team members to work on their solution.

As this working at heights issue involves many different tasks being performed on a diverse range of earthmoving equipment, it is of little surprise that there was a wide array of solutions. Some of the solutions being implemented include:

- portable modular handrails that can be slid into attachments that are permanently fixed to the equipment
- use of a single person elevating work platform
- use of a safety harness, attached to an inertia reel running along a monkey rail on the overhead gantry crane
- fitting additional and modifying existing handrails
- fitting additional walkway areas
- fitting ladders to allow easier access to certain parts of equipment
- placing lanyard attachment points on equipment in certain areas
- designing removable catch areas to cover possible fall areas in the engine bays of haul trucks

A number of these solutions have to be designed and built, rather than just being bought, and this is why it is expected that the solutions will be progressively implemented as each work team completes their assignment.

9. Training

As the solutions are implemented all maintainers will have to be trained in the correct use of the implemented solutions. It is expected that after the solutions are implemented a brief document will be produced on each piece of equipment outlining the standard working procedures to be followed whilst working at heights. These documents will be included in the maintenance manual for each specific piece of equipment and will also be placed on a working at heights board in the heavy equipment workshop.

10. Review: Success/Failure

Once all the solutions have been implemented a review program will be initiated to evaluate the degree of success or failure of the program. Finding indicators to measure the success or failure of the program is a difficult issue. Comparing incident statistics is of no use as there has never been a fall from heights incident in the heavy equipment workshop, and with the solutions implemented we hope it remains that way. Other indicators that may be used to review the project include:

- feedback from the maintainers regarding their views of the implemented solutions
- task observations of the maintainers performing working at height tasks.

11. Future Direction

Whilst this project only addressed the issue of maintainers working at heights on earthmoving equipment in a workshop environment, there is still a need to address the same work whilst it is performed outside the workshop. As a large majority of breakdown maintenance is performed on earthmoving equipment outside the workshop, in an environment not suited to the use of elevated work platforms or monkey rails for attaching safety harness, it is this area that needs to be addressed next.

We are presently looking at the exposure to equipment operators working at heights whilst performing their daily tasks. Activities that come to mind are:

- Cleaning the windscreen of a Cat 16G grader
- Cleaning the back window of a Cat D11 dozer
- Climbing on top of a water cart.

Project teams have already been organised from the Mining Department to address these issues and are currently working through the Data Gathering and Problem Solving phases.

CONCLUSION

Whilst we have made a start in reducing the exposure that maintainers have to fall from heights, we do not profess to having all the solutions. The process that we have taken in attempting to address this issue however, has ensured that the solutions we have obtained have been practical to the work situation, and therefore will have a greater degree of acceptance amongst our workforce. Ultimately leading to a safer workplace.