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AD45 Front Strut Handling Tool

George Fisher Mine, Mount Isa Mines, a Glencore Company

The Problem

Removal and replacement of the front suspension struts on Caterpillar AD45 underground haulage ejector trucks is a difficult and physically demanding process, exposing maintenance personnel to a combination of hazards. This exposure is due primarily to the weight of the strut (145kg) coupled with the restricted space in and around the front axle area of the truck, which restricts vertical lifts.

The strut is currently removed and replaced utilising an eye bolt fitted to the top of the strut body to allow attachment of a soft sling connected to an overhead crane. However, a direct vertical lift of the strut is not possible as it is impeded by other componentry directly above the strut, creating the following hazards through the different phases of the task:

- Maintenance personnel working in close proximity to suspended loads during the removal and installation of strut pins potentially exposing personnel to the line of fire from the gravitational energy source.
- Manual handling exposure due to the out of balance force created following the removal of the initial pin during strut removal, and also the physical exertion required to re-align the strut for the installation of the final pin during replacement. The potential for strains and sprains is also coupled with the hazard exposure to pinch points due to the restricted space in the work area.

Removal and replacement of a pair of suspension struts usually takes a complete shift due to the difficulty of the task outlined above. George Fisher Mine currently has a fleet of four operational AD45 Trucks each requiring the struts to be changed out on average once per year.

The Solution

George Fisher Mine's philosophy of leading with safety in recent years has positively impacted the safety culture of the workforce onsite and provided the opportunity to continually improve everyday work practices. This notion was the springboard for members of the Mobile Assets team to have a voice and seek assistance to solve a problem which they believed exposed not only themselves but their co-workers to unnecessary risk during the strut replacement task.

Three members of the Mobile Assets team; a diesel fitter, an auto electrician and a boilermaker approached the department Manager outlining the problem but also seeking assistance to further refine a concept (Figure 1) they believed mitigated risk for this task. The team was quickly expanded to four with the inclusion of a structural project engineer to further develop the concept.

Together the team determined the requirements for a new tool to remove the risks associated with the task of removal and replacement of the front suspension struts. The



initial concept required three elements; the ability to firmly restrain the strut, functionality to allow a vertical lift, and the ability to rotate the strut allowing it clear access and egress from the underside of the truck.

Commercial off the shelf tools were investigated however nothing suitable was available either from the OEM or an aftermarket engineering company to solve this problem.

The decision was made to design and build a tool in-house. The following steps formed part of the design development and execution process:

- Lidar Scanning of an AD45 truck with the front wheels removed to allow the survey data to be imported into a 3D drafting package.
- Refined concept sketches of the tool prepared by the engineer.
- Review and design consultation with the maintenance personnel to agree on the concept.
- Development of 3D model of the tool considering the front axle of the truck. (*Figure 2*)
- Additional site measurements of the truck to ensure there were no clashes or interactions during the task.
- Engagement with local hydraulics company to confirm design for the actuation of the tool to complete the task.
- Issuing of shop detail drawings to allow fabrication of the tool.
- Fabrication of strut handling tool by boilermaker.
- Trial field test of the tool by the team prior to fitment of the hydraulics. This was carried out to ensure there were no clashes with truck components and to determine if any other modifications were required. Minor changes were made to the tool at this stage of development to improve operation.
- Installation of hydraulic componentry by local hydraulics company.
- Final field test of the tool. (*Figures 3, 4 and 5*)

External personnel engaged during the design development process included a surveyor for lidar scanning of the truck, drafting services for modelling and shop detail drawings, steelwork fabricator for profile cutting and machining of components and a local hydraulic company for supply and installation of the hydraulic componentry.

Benefits/Effects

The deployment of this tool into the workshop environment is only in its infancy although it has significantly reduced the inherent risk associated with this task. The strut is restrained in the clamp during the critical steps of the task mitigating exposure to suspended loads, manual handling and pinch point hazards. The hydraulic cylinders are also equipped with counterbalance valves which prevent any unplanned movement due to a loss of hydraulic pressure further mitigating exposure to the line of fire.

This tool has also provided a productivity improvement by reducing the task duration by approximately 11hrs.



With the successful trial of the A45 Front Strut Handling Tool, the Standard Work Instruction (SWI) is now being updated to include its use.

The success of this project has also assisted in further fostering a culture of continuous improvement and leading with safety onsite. The team involved has taken a problem identified from within and developed their idea into working tool which provides a real and meaningful benefit to the broader Mobile Assets department. It is hoped that the success of this project gives other members of the department the confidence to voice their concerns, opinions and ideas, knowing that they will be supported to further improve safety outcomes for the site.

The following quotes have been provided in response to the success of the strut handling tool.

Jason Haddon, Mobile Asset Maintenance Supervisor, C Crew - *“This project has really given the guys confidence that they can make a valid contribution to safety onsite”*

Blain McCormack, Mobile Assets Auto Electrician, C Crew - *“The best way to improve safety is to ELIMINATE a hazard, the strut removal tool does just that”*

Wayne Hilton, Mobile Assets Leading Hand Diesel Fitter, C Crew - *“I have learnt through this process that it’s a good idea to express your opinion and receive the extra help to complete a safety improvement that will make a difference”*

Jason Wernowski, Maintenance Services Boilermaker - *“I feel proud to have been part of a team that was able to develop a piece of equipment that will make our workplace safer and more productive”*

The AD45 Front Strut Handling Tool is in the early stages of implementation and is currently only suitable for the AD45 Truck. Plans are in place to assess its suitability for other trucks currently used onsite including the Atlas Copco MT65 and MT6020 dump trucks. It is envisaged that this tool will be rolled out to the wider Glencore business in due course.

Transferability

Currently, the tool is specifically designed for use on a Caterpillar AD45 truck. The strut clamp is sized specifically for the AD45 strut and the range of vertical motion is also specific to that truck. The concept however can easily be applied to other vehicles with a similar suspension arrangement. As a 3D CAD model of the tool already exists, modifications required to apply this concept to other vehicles can easily be determined by combining the tool model with that of a vehicle to ascertain the space restrictions and required range of motion.

Approximate Cost

Design including Lidar scan modelling and drawings	\$6,990
Direct Costs including parts and fabrication	\$9,350
Total	\$16,340



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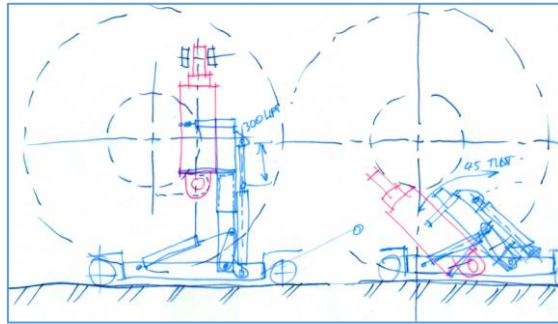


Figure 1. Concept Sketches

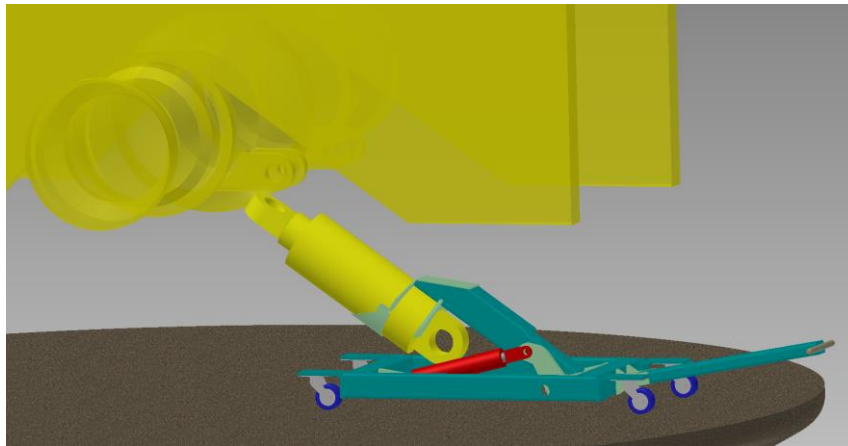


Figure 2. Model Development



Figure 3. AD45 Front Strut Handling Tool with extracted Strut

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Figure 4. AD45 Truck with AD45 Front Strut Handling Tool in place

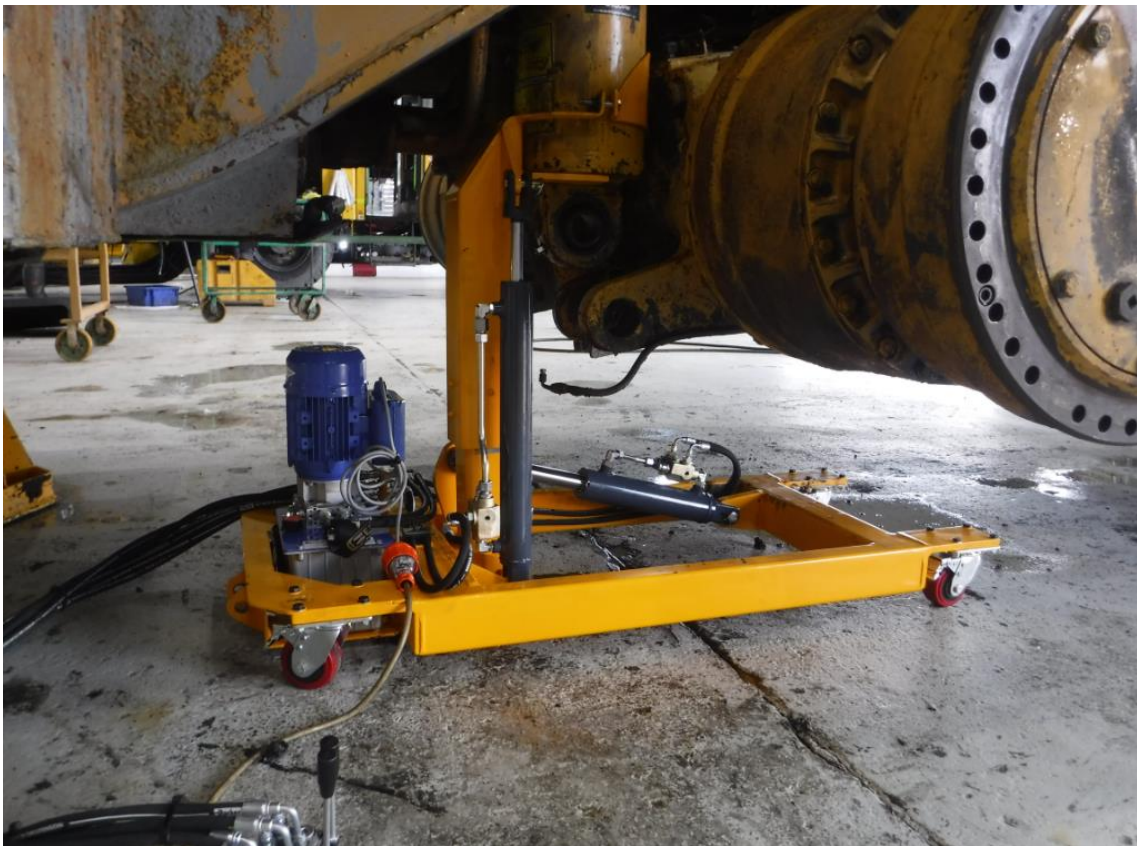


Figure 5. AD45 Front Strut Handling Tool in place

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