

## **Patria Mud Body Modification Study on Komatsu HD785-7 Unit for Overburden Transportation**

**Supriyanto<sup>1\*</sup>, Joshua Pribadi Wikan<sup>2</sup>, Steven Tammu<sup>3</sup>, Aadjudia Prida Pratama<sup>4</sup>,  
Muhammad Rafly Adha<sup>5</sup>, Anggun Azis Mulyanti<sup>6</sup>**

PT Antareja Mahada Makmur, Indonesia

Email: [supriyanto@ppa.co.id](mailto:supriyanto@ppa.co.id)<sup>1\*</sup>, [yosua.pribadi@amm.id](mailto:yosua.pribadi@amm.id)<sup>2</sup>, [steven.tammu@ppa.co.id](mailto:steven.tammu@ppa.co.id)<sup>3</sup>,  
[ajudyaprida@ppa.co.id](mailto:ajudyaprida@ppa.co.id)<sup>4</sup>, [rafly.adha@amm.id](mailto:rafly.adha@amm.id)<sup>5</sup>, [anggun.azis@amm.id](mailto:anggun.azis@amm.id)<sup>6</sup>

\*Correspondence

### **ABSTRACT**

**Keywords:** mud body modification; Komatsu hd785-7; overburden transportation. Coal mining activities require reliable means of transportation to support productivity and safety. PT AMM site ABP Energy uses a Komatsu HD785-7 off-highway dump truck with a Mud Body vessel and a Std Light Vessel which has significant differences in empty weight and payload capacity. The heavier Vessel Mud Body increases fuel consumption and the risk of overloading. This study aims to examine the modification of the Mud Body vessel to be lighter without reducing the payload capacity. The methods used include secondary data collection from technical specifications and modification simulation analysis. The results of the study show that the partial cutting of the side wall vessel of the Mud Body can reduce the empty weight by up to 3,345 kg, close to the specifications of the standard vessel. These modifications improve fuel efficiency, minimize the risk of overloading, and maintain the reliability of the unit. In conclusion, planned modifications are effective in improving operational efficiency and lowering operational costs without sacrificing safety and productivity.



### **Introduction**

In coal mining activities, PT. ABP Energy's AMM site uses the Open Pit mining method with the operation of mechanical equipment such as excavators for loading and dump trucks for transporting overburden and coal (Manurung, Joko, & Santosa, 2020). Overburden transportation is carried out from the front to disposal using an off-highway dump truck Komatsu HD785-7, through a mining road that is unsurfaced. In overburdened transportation activities, it is necessary to carry them out safely, effectively, and efficiently to support productivity and safety aspects. (Farahpoor, Esparza, & Soriano, 2023).

The off-highway dump truck unit Komatsu HD785-7 is owned by PT. ABP Energy's own AMM site has different unit configurations. Of the total HD785-7 units

available, there are 5 units that have a Mud Body vessel configuration from the Patria carousel manufacturer. As for the other units, it has a Std Light Vessel vessel configuration which is also made by the carousel manufacturer Patria (McFarlane et al., 2017).

In terms of specifications, there is a difference between a Mud Body vessel and a Std Light Vessel. Units with Mud Body vessels have a tailgate and the purpose of its application is to transport materials in the form of mud or mud and has a relatively stronger vessel structure so that the empty weight of the Mud Body vessel is also relatively heavier. (Wang, Yang, Chen, & Shah, 2015). Meanwhile, the unit with the Std Light Vessel vessel does not have a tailgate and its application is to transport overburdened materials and has a lighter empty weight than the Mud Body vessel. With a larger empty weight of the Mud Body vessel, there is a potential for the HD785-7 unit to carry a larger carryback load, and this will certainly affect the increase in fuel consumption of the unit. Modifications need to be made so that the empty weight of the Mud Body vessel becomes lighter, to get more efficient fuel consumption. (Felsch et al., 2019).

In addition, there are also significant or striking differences in geometry. The most striking difference is that the Mud Body Vessel can be seen to be taller in size compared to the Std Light Vessel. (Mustopa & Wiratama, 2022). The shape of the hull or hull of the vessel in the two types of vessels also has a striking difference. The Vessel Std Light Vessel has a convex hull or hull when compared to the Mud Body vessel when viewed from the rear of the unit. (Sari, 2021).

With the field conditions as described above, as well as to maximize the utilization of Komatsu HD785-7 unit assets at ABP Energy's job site and to optimize the productivity efficiency of HD785-7, PT. ABP Energy's AMM site decided to study related to the modification of the Patria Mud Body on the Komatsu HD785-7 unit for overburdened transportation. The preparation of this technical study prioritizes the safety and security aspects of operators when operating the unit, as well as considering the reliability factor of the unit based on existing technical specifications. (Patria, 2019).

The purpose of the Patria mud body modification study on the Komatsu HD785-7 unit for overburden transportation is as follows:

1. Ensuring the safety aspect of mining operations
2. Know the benefits & costs to operations.

## **Method**

### **Data Collection**

Secondary data collection was carried out in the preparation of a technical study on the modification of the Patria mud body on the Komatsu HD785-7 unit for overburden transportation. Secondary data is in the form of Komatsu HD785-7 unit specifications, and Patria mud body specifications.

### **Methodology**

The methodology used in the preparation of this technical study uses a literature study. Literature study is done by developing and calculating technical studies in accordance with the engineering data of Komatsu and Patria manufacturers.

### Activity Stages (Flowcart)

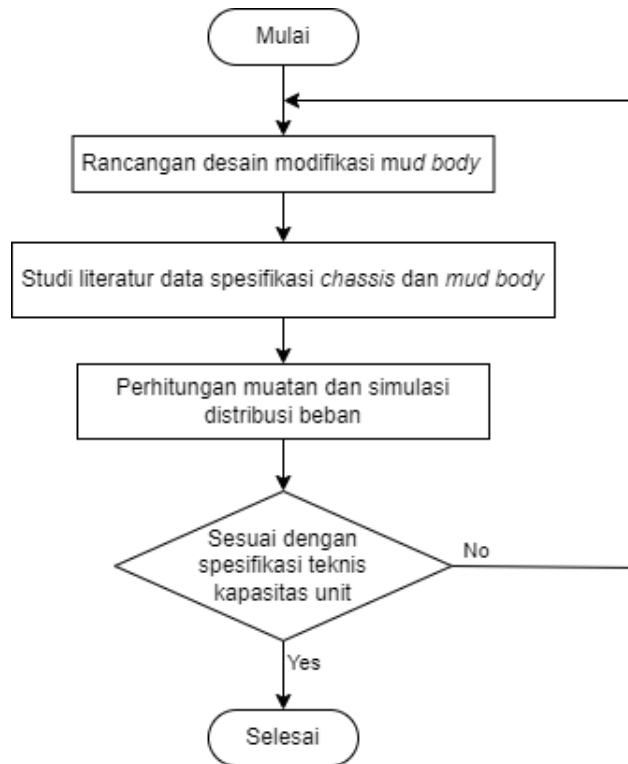


Figure 1

Activity Stages (Flowcart)

## Results and Discussion

### Unit Specifications

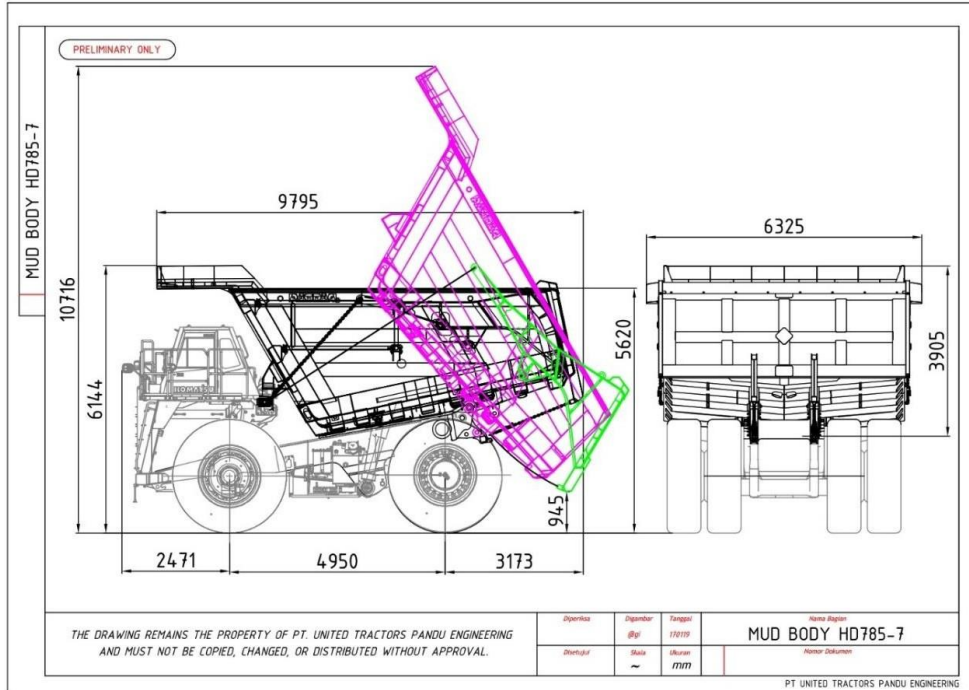
The Komatsu HD785-7 unit specification data is as follows:

OFF-HIGHWAY TRUCK <b>HD785-7</b>	
<b>SPECIFICATIONS</b>	
<p><b>ENGINE</b></p> <p>Model ..... Komatsu SAA12V140E-3                      Type ..... Water-cooled, 4-cycle                      Aspiration ..... Turbo-charged, after-cooled                      Number of cylinders ..... 12                      Bore x Stroke ..... 140 mm x 165 mm                      Piston displacement ..... 30.48 L                      Horsepower                      SAE J1995 ..... Gross 895 kW 1200 HP                      ISO 9249 / SAE J1349 ..... Net 879 kW 1178 HP                      Rated rpm ..... 1900 min<sup>-1</sup>                      Fan drive type ..... Mechanical                      Maximum torque ..... 5080 N m 518 kgm                      Fuel system ..... Direct injection                      Governor ..... Electronic control                      Lubrication system                      Method ..... Gear pump, force-lubrication                      Filter ..... Full-flow type                      Air cleaner ..... Dry type with double elements and precleaners,                      with dust indicator</p> <p>U.S. EPA Tire 2 emission certified.</p> <p><b>TRANSMISSION</b></p> <p>Torque converter ..... 3-elements, 1-stage, 2-phase                      Transmission ..... Full-automatic, planetary-gear type                      Number of gear ..... 7 forward and 2 reverse (RH, RL)                      Lockup clutch ..... Wet, multiple-disk clutch                      Forward ..... Torque converter drive in 1st gear,                      direct drive in 1st lockup and all higher gears                      Reverse ..... Torque converter drive, direct drive (Lockup)                      Shift control ..... Electronic shift control with automatic                      clutch modulation in all gears                      Maximum travel speed ..... 65 km/h</p> <p><b>AXLES</b></p> <p>Rear axles ..... Full-floating                      Final drive type ..... Planetary gear                      Ratios:                      Differential ..... 3.357                      Planetary ..... 6.333</p> <p><b>SUSPENSION SYSTEM</b></p> <p>Independent, hydropneumatic suspension cylinder with fixed throttle to dampen vibration.                      Effective cylinder stroke:                      Front suspension ..... 320 mm max.                      Rear suspension ..... 127 mm max.                      Rear axle oscillation ..... 6.5° max.</p> <p><b>STEERING SYSTEM</b></p> <p>Type ..... Fully hydraulic power steering with two double-acting cylinders                      Secondary steering ..... Meets ISO 5010, SAE J1511                      Minimum turning radius ..... 10.1 m                      Maximum steering angle ..... 41°</p> <p><b>CAB</b></p> <p>Standard ..... FOPS (ISO 3449 level 2)                      ROPS (ISO 3471)</p> <p><b>MAIN FRAME</b></p> <p>Type ..... Box-sectioned structure, integral front bumper</p>	<p><b>BRAKES</b></p> <p>Brakes meet ISO 3450 standard.                      Service brakes:                      Front ..... Fully hydraulic control, oil-cooled multiple-disc type                      Rear ..... Fully hydraulic control, oil-cooled multiple-disc type                      Parking brake ..... Spring applied, multiple-disc type (Actuates on all wheels)                      Retarder ..... Oil-cooled, multiple-disc front and rear brakes act as retarder.                      Secondary brake ..... Pedal operation                      When hydraulic pressure drops below the rated level,                      parking brake is automatically actuated.</p> <p>Brake surface                      Front ..... 37467 cm<sup>2</sup>                      Rear ..... 72414 cm<sup>2</sup></p> <p><b>BODY (GENERAL PURPOSE BODY)</b></p> <p>Capacity:                      Struck ..... 40 m<sup>3</sup>                      Heaped (2:1, SAE) ..... 60 m<sup>3</sup>                      Rated payload ..... 91.7 metric tons                      Material ..... 400 Brinell hardness high tensile strength steel                      Structure ..... V-shape body with V-bottom                      Material thickness:                      Bottom ..... 19 mm                      Front ..... 12 mm                      Sides ..... 9 mm                      Target area                      (inside length x width) ..... 7070 mm x 5150 mm                      Dumping angle ..... 48°                      Height fully raised ..... 10080 mm                      Bond prevention ..... Heating by exhaust gas</p> <p><b>HYDRAULIC SYSTEM</b></p> <p>Hoist cylinder ..... Twin, 2-stage telescopic type                      Relief pressure ..... 20.6 MPa 210 kg/cm<sup>2</sup>                      Hoist time                      Raise ..... 13 s                      Lower ..... 14 s</p> <p><b>WEIGHT (APPROXIMATE)</b></p> <p>Rated Empty Vehicle Weight (EVW) ..... 72000 kg                      Excludes optional equipments and operator.                      Rated Gross Vehicle Weight (GVW) ..... 163780 kg                      Includes optional equipments, operator (80 kg) and payload.                      Distribution:                      Empty: Front axle ..... 47%                      Rear axle ..... 53%                      Loaded: Front axle ..... 31.4%                      Rear axle ..... 68.6%</p> <p><b>TIRES</b></p> <p>Standard tire ..... 27.00 R49</p> <p><b>SERVICE REFILL CAPACITIES</b></p> <p>Fuel tank ..... 1308 L                      Engine oil ..... 129 L                      Torque converter, transmission and retarder cooling ..... 205 L                      Differential ..... 137 L                      Final drives (Total) ..... 128 L                      Hydraulic system ..... 175 L                      Brake control ..... 36 L                      Suspensions (Total) ..... 93 L</p>

13

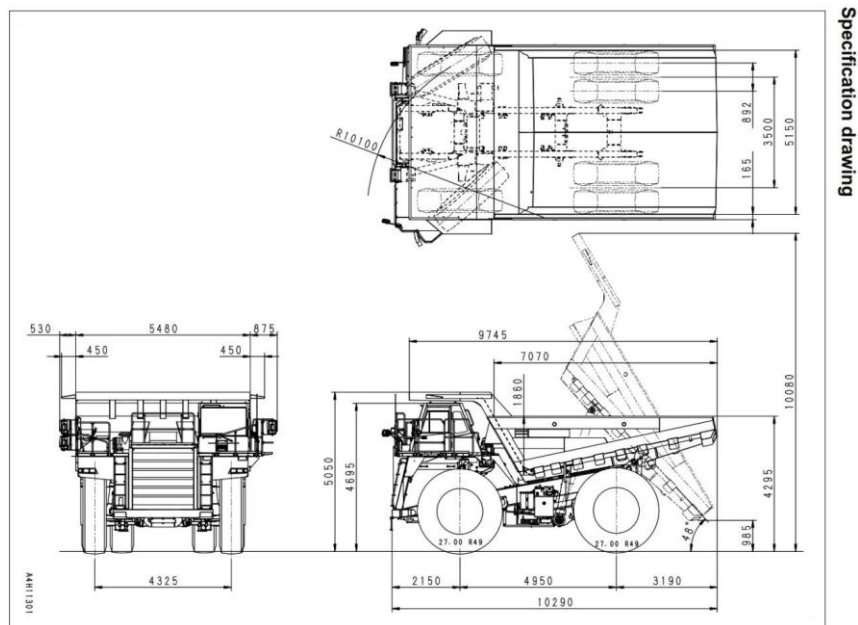
**Figure 1**  
**Komatsu HD785-7 unit specifications**

The data specification data of the Patria Mud Body vessel carousel on the Komatsu HD785-7 is as follows:



**Figure 2**  
General Assembly Drawing Mud Body Patria on Komatsu HD785-7 unit

The Komatsu standard vessel specification data on the Komatsu HD785-7 unit is as follows:



**Figure 3**

## General Assembly Drawing vessel standard Komatsu manufacturer

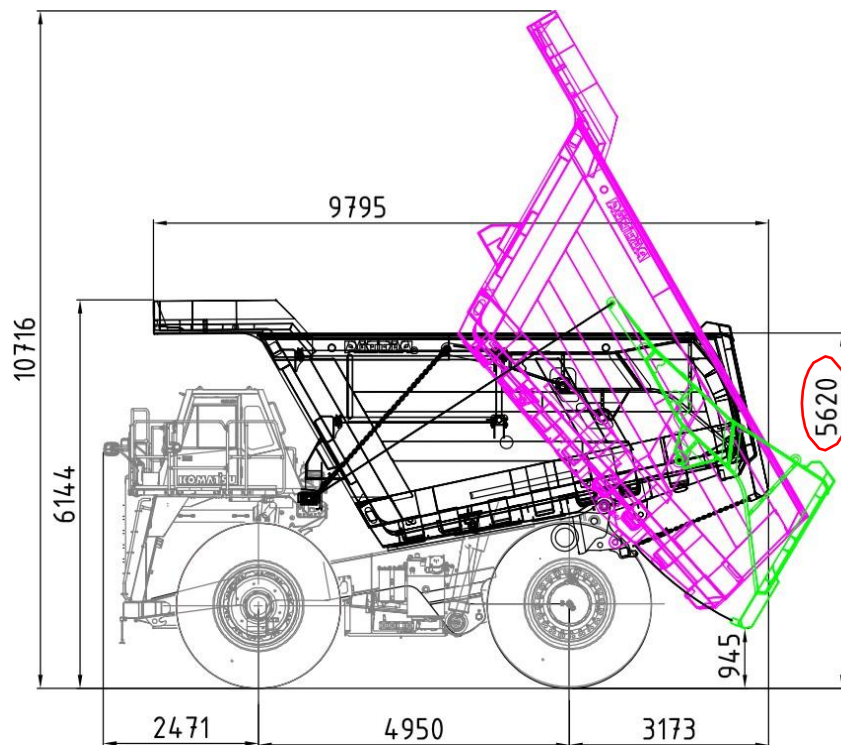
### Mud Body Modification Design

Initially, the Mud Body vessel installed on the Komatsu HD785-7 unit was designed by the Patria manufacturer to transport mud or mud materials. However, along with operational needs, the Mud Body is planned to be used for transporting overburdened materials.



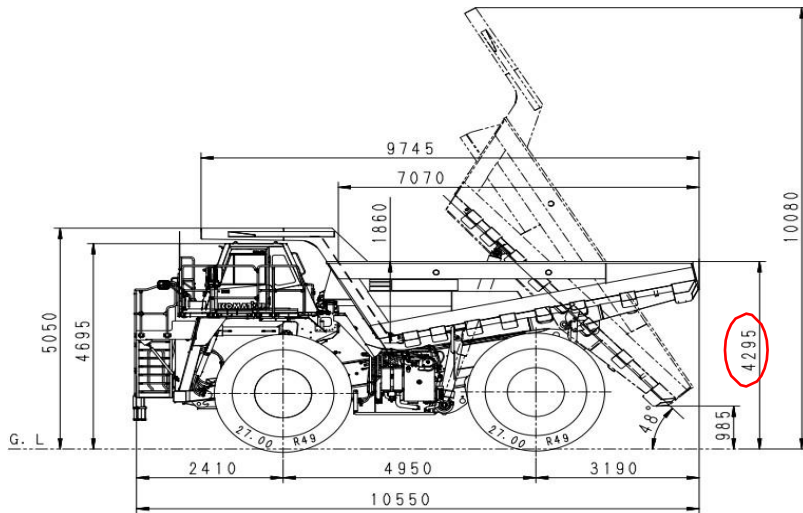
**Figure 4**  
**Illustration of the Komatsu HD785-7 unit with Mud Body attached**

Based on Patria's Mud Body specification data, the volume capacity of the Mud Body vessel is 60 M3, with a vessel and tailgate weight of 18,445 kg. Based on Komatsu standard vessel specification data, the volume capacity of the vessel is 40 M3 and the weight of the standard Komatsu vessel is 15,100 kg. If the Mud Body is compared to the standard vessel, there is a volume difference of 20 M3, and the weight difference reaches 3,345 kg. If the two vessels both function as overburden carriers, then there is a potential loss of 3,345 kg of payload weight per trip and greater fuel use, because there is a difference in the weight of the vessel empty. Therefore, to increase productivity to prevent overloading the Komatsu HD785-7 unit chassis and to achieve fuel efficiency, the Mud Body vessel will be modified to reduce volume by cutting part of the side wall of the Mud Body vessel, so that the empty weight of the vessel becomes lighter, but still has a volume capacity that is not much different from the Komatsu standard vessel so that it is expected not to reduce operational productivity.



**Figure 6**  
**Specifications of Patria's Mud Body vessel on the Komatsu HD785-7 unit**

Based on the data of the Mud Body Patria vessel specifications on the Komatsu HD785-7 unit, the Mud Body vessel has a height of 5620 mm or equivalent to 5.6 meters as shown in the image above. When compared to the standard Komatsu vessel height specification as in the picture below, which has a height of 4295 mm, there is a difference of 1325 mm or about 1.3 meters.

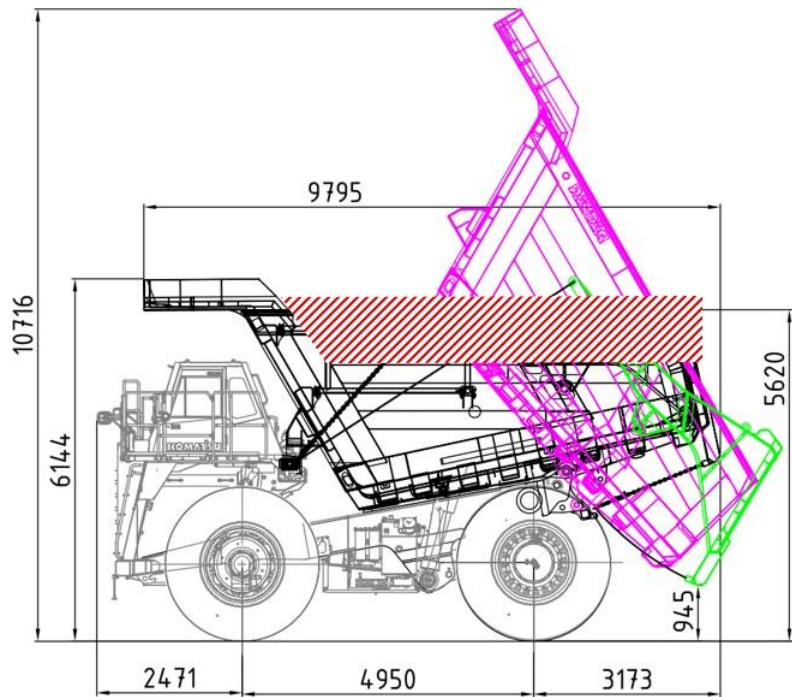


**Figure 7**  
**Komatsu standard vessel high-specification**

If a modification simulation is carried out in the form of cutting part of the side wall of the Mud Body Patria vessel, right at the top of the longitudinal side wall member, then the illustration of the vessel is shown in the following figure.



**Figure 8**  
**Illustration of Cutting the Mud Body Patria vessel**



**Figure 9**  
**Illustration of the estimated height of the vessel after modification**

In accordance with the drawing vessel of Patria's Mud Body, the overall length of the unit is 10.59 meters by 6.3 meters wide. With the dimensions of the unit, the planned location of the Mud Body modification activity is in an outdoor base with a flat surface and with location dimensions reaching 12.8 meters x 17.2 meters.



**Figure 10**  
**Layout Plan Location of Mud Body Modification Activity**

### Load Calculation and Load Distribution

The load calculation and load distribution were carried out to determine the impact of vessel modifications on the change in load distribution on the Komatsu HD785-7 chassis. After modifications, it is estimated that the volume of the Mud Body vessel will be the same as the volume of the standard Komatsu vessel. Therefore, the load distribution will also be the same according to the standard conditions of the unit as in the specifications below. This load distribution is by the technical specifications of the unit capacity of the Komatsu HD785-7 vessel is loaded according to the vessel capacity.

Weight distribution	Empty	(front)	kg	33,980 (47%)
		(rear)	kg	38,320 (53%)
	Gross	(front)	kg	51,440 (31.5%)
		(rear)	kg	111,860 (68.5%)

**Figure 11**  
**Specification of Weight Distribution unit with Komatsu standard vessel**

### Risk Analysis

Risk analysis was carried out to determine the potential hazards, and risks that arise and control/control of the potential hazards and risks that exist from the modification work of the Patria Mud Body vessel on the Komatsu HD785-7.

Activity Details	Potential Hazards	RISKS ARISING	Control/ROI
1 Parking the HD785 Unit	1. Unit Maneuver	1.1. Ran over	Engineering: - Administration: - Work practices: - The driver is the one who has the SIMPER unit and has been tested for eligibility - 2-way communication with the driver - Spotter helps with traffic flow and gives cues to unit testers - AMM-ABP-IK-PLANT-085-R0 DIRECTS THE PARKING UNIT AND OR MOVES Not in the maneuvering area of the unit Personal Protective Equipment: Safety Boots, Safety Helmet, Safety Glasses, Hand Gloves, Mask
		1.1. Hit	Engineering: - Administration: - Work practices: - The driver is the one who has the SIMPER unit and has been tested for eligibility - 2-way communication with the driver - Spotter helps with traffic flow and gives cues to unit testers - AMM-ABP-IK-PLANT-085-R0 DIRECTS THE PARKING UNIT AND OR MOVES Not in the maneuvering area of the unit Personal Protective Equipment: Safety Boots, Safety Helmet
2 Washing Unit HD785	2. Pressurized water canon	2.1. Sprayed	Engineering: - Administration: - Work practices: - P5M - AMM-ABP-IK-PLANT-62 – Washing the unit in the Wash Pad Personal Protective Equipment: Safety Boots, Safety Helmet, Safety Glasses
		2.2. Slippery work area	Engineering: - Administration: - Work practices: - P5M - AMM-ABP-IK-PLANT-62 – Washing the unit in the Wash Pad Personal Protective Equipment: Safety Boots, Safety Helmet, Safety Glasses
3 Cutting Vessels Using Oxygen & Acetylene	3. Sparks from cutting	3.1. Burn	Engineering: - Substitution of hose material by standards - Modified Tube Equipped with Flashback Arrestor Administration: -

				<p>Work Practice:</p> <ul style="list-style-type: none"> <li>-Implementation of P5M</li> <li>-Implementation of the initial inspection of the supervisor's shift</li> <li>-Socialization of cutting procedures using Oxy Acetylene</li> <li>-Socialization of oxygen acetylene welding procedures</li> <li>-Setting up the fire extinguisher</li> <li>-Welder Certification</li> </ul>
				<p>Personal Protective Equipment:</p> <p>Welding Masks, Welding Masks, Welding Aprons, Welding Gloves, Safety Shoes</p>
3.2	Part of a hot workpiece	3.2.1	Exposure to Heat	<p>Engineering:</p> <ul style="list-style-type: none"> <li>- Substitution of hose material by standards</li> </ul> <p>Administration:</p> <p>-</p>
				<p>Work practices:</p> <ul style="list-style-type: none"> <li>-Implementation of P5M</li> <li>-Implementation of the initial inspection of the supervisor's shift</li> <li>-Use fire blanked</li> <li>-Use a welding mask</li> <li>-Use a blower</li> <li>-Socialization of cutting procedures using Oxy Acetylene</li> <li>-Welder Certification</li> </ul>
				<p>AMM/APP/IK PLANT-055-R0 CUTTING USING CUTTING TORCH</p> <p>Personal Protective Equipment:</p> <p>Welding Masks, Welding Masks, Welding Aprons, Welding Gloves, Safety Shoes</p>
3.3	Work at height	3.3.1	Fall	<p>Engineering:</p> <ul style="list-style-type: none"> <li>- Provide Hand Rail</li> </ul> <p>Administration:</p> <p>-</p>
				<p>Work practices:</p> <ul style="list-style-type: none"> <li>-Using Body Harnes</li> <li>-Training working at height</li> <li>-Implement 3 points of contact</li> </ul>
				<p>Personal Protective Equipment:</p> <p>Welding Masks, Welding Masks, Welding Aprons, Welding Special Gloves, Safety Shoes, Body Harness</p>
4.1	Smoothing the surface with hand grinding	4.1.1	Electrocuted	<p>Engineering:</p> <ul style="list-style-type: none"> <li>- Compliant cable material substitution</li> </ul> <p>Administration:</p> <p>-</p>
				<p>Work Practice:</p> <p>Work Practice:</p> <ul style="list-style-type: none"> <li>-Implementation of the initial inspection of the supervisor's shift</li> </ul>
				<p>AMM/APP/IK PLANT-120 OPERATION OF HAND GRINDING MACHINE</p> <p>Personal Protective Equipment:</p> <p>Welding Masks, Welding Masks, Welding</p>

				Aprons, Welding Gloves, Safety Shoes
4.	Sparks from the grinder	4.2. 1	Burn	<p>Engineering: -</p> <p>Administration: -</p> <p>Work Practice: Work Practice: - Implementation of the initial inspection of the supervisor's shift - AMM-ABP-IK-PLANT-120 OPERATION OF HAND GRINDING MACHINE</p> <p>Personal Protective Equipment: Welding Masks, Welding Masks, Welding Aprons, Welding Gloves, Safety Shoes</p>
4.	Work at height	4.3. 1	Fall	<p>Engineering: - Provide Hand Rail</p> <p>Administration: -</p> <p>Work practices: - Using Body Harnes - Training working at height - Implement 3 points of contact</p> <p>Personal Protective Equipment: Welding Masks, Welding Masks, Welding Aprons, Welding Special Gloves, Safety Shoes, Body Harnes</p>
5	Welding Using Electric Welding	5. 1	The condition of the wires on the welding machine is not standard (chipped)	<p>5.1. Electrocuted 1</p> <p>Engineering: - Substitution of welding machine cable material by standards</p> <p>Administration: -</p> <p>Work Practice: Work Practice: - Implementation of the initial inspection of the supervisor's shift - Making check sheet P2H welding machine - Socialization of electric arc welding procedures - The welding process is not in a muddy place/Waterlogged - Welder Certification - AMM-ABP-SP-PLANT-005-R0 WELDING USING A WELDING MACHINE - AMM-ABP-SP-PLANT-005-R0 CABLE CURRENT DELIVERED</p> <p>Personal Protective Equipment: Welding Masks, Welding Masks, Welding Aprons, Welding Gloves, Safety Shoes</p>
5.	Sparks from welding	5.2. 1	Burn	<p>Engineering: - Modification with welding mask during welding</p> <p>Administration:</p>

				-
				Work practices: Work Practice: - Implementation of the initial inspection of the supervisor's shift - Making check sheet P2H welding machine - Socialization of electric arc welding procedures - The welding process is not in a muddy place/Waterlogged - Welder Certification - AMM-ABP- <del>IK-PLANT-054-R0 WELDING USING A WELDING MACHINE</del> - AMM-ABP- <del>SP-PLANT-005-R0 CABLE CURRENT DELIVERED</del>
				Personal Protective Equipment: Welding Masks, Welding Masks, Welding Aprons, Welding Gloves, Safety Shoes
5.	Work at	5.3.	Fall	Engineering: - Provide Hand Rail
3	height	1		Administration: -
				Work practices: - Using Body Harnes - Training working at height - Implement 3 points of contact
				Personal Protective Equipment: Welding Masks, Welding Masks, Welding Aprons, Welding Special Gloves, Safety Shoes, Body Harness

## Benefit & Cost Analysis

### 1. Benefit

The modification of the Patria Mud Body vessel on the Komatsu HD785-7 unit for overburden transportation provides advantages including:

- 1) Minimizing the potential for overload due to reduced empty vessel weight.
- 2) Minimizing the potential for reduced unit reliability with reduced overload potential.

### 2. Cost Analysis

The modification of the Patria Mud Body vessel on the Komatsu HD785-7 unit for overburden transportation completes the estimated cost of Rp 3,220,000 per unit and requires an estimated allocation of work time for 4 shifts carried out by a total of 4 manpower people.

It	Items	Volume	Estimated Cost
<b>Man Power</b>			
1	Labour	4	Rp 1.920.000

<b>Material</b>			
1	Mild Steel Plate th: 0.8 mm	0,5	Rp 250.000
2	Oxygen	2	Rp 220.000
3	Acetylene	2	Rp 830.000
<b>Total Cost</b>			<b>Rp 3.220.000</b>

### Implementation Plan and Monitoring

If the modification of the Patria Mud Body vessel on the Komatsu HD785-7 unit for overburden transportation is implemented, then a form of cargo monitoring, payload monitoring, and productivity monitoring of the Komatsu HD785-7 unit will be carried out.

### Conclusion

Based on the results of calculations, simulations, and risk analysis that have been carried out, the following conclusions are obtained:

1. The volume specification of the Mud Body Patria vessel is 60 M3, with a height of 5620 mm. The volume specification of the Mud Body Patria vessel is 40 M3, with a height of 4295 mm.
2. The design of the modification of the Patria Mud Body vessel is to cut part of the side wall, which is right at the top of the longitudinal side wall member on the Mud Body vessel, and the volume specification of the vessel will change to around 40 M3 or in accordance with the standard Komatsu vessel volume.
3. Vessel modification is predicted to have no negative impact on the reliability and safety aspects of the Komatsu HD785-7 unit if loaded according to the vessel's capacity.

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