DEVELOPMENT AND MANUFACTURING OF A SIDELIFTER*

Bir Sidelifter'ın Geliştirilmesi ve Üretilmesi

Erinç ULUDAMAR
Makine Mühendisliği Anabilim Dalı

Kadir AYDIN
Makine Mühendisliği Anabilim Dalı

ABSTRACT

In this study, a container loading and unloading mechanism which is assembled on a semi-trailer, is designed and manufactured. This design is supported with a mechanism which can be adjusted according to different dimensioned ISO standard containers. The main requirement of the above mentioned mechanism is the ability of loading and unloading of ISO containers up to 12,192 m long on every ground condition except at very soft and slope grounds.
Key Words : Container, Sidelifter, Logistic, Simulation

ÖZET

Bu çalışmada, römorkün üstüne yerleştirilmiş yeni bir konteyner yükleme ve indirme mekanizması tasarlanmış ve üretilmiştir. Bu tasarım, değişik boyutlarda ISO standartlarına göre üretilmiş konteyner boyutlarına uygun bir şekilde ayarlanabilen bir mekanizmayla desteklenmiştir. Bahsedilen mekanizmanın tasarımındaki ana kriter; 12,192 m uzunluğa kadar olan ISO konteynerini, çok eğimli ve yumuşak olan zeminler hariç, her türlü zeminde yükleme ve indirme yapabilmesidir.
Anahtar Kelimeler : Konteyner, Sidelifter, Lojistik, Simulasyon

Introduction

Transportation has always been strongly tied to economic development and sustainability; and regional, national or international economies have come to depend increasingly on efficient and secure transportation systems. Transportation systems connect vital regional economic components to ensure that employees can use these systems to get to work while also ensuring that businesses can use them to provide and receive various supporting services and/or supplies (Fries et al., 2009).

In today's world, Most of the supplies are transported into two types:

- Bulk shipping of huge quantities of commodities like crude oil, coal, ore, grain, etc., which are shipped using specialized vessels called bulk carriers;
- Containerized shipping in which a variety of goods are packed into standard size steel containers that are shipped on vessels (Murty et al., 2005).

Containers are large boxes, which are used to transport goods from one

* MSc. Thesis-Yüksek Lisans Tezi

destination to another. The introduction of a container system shows several benefits. Some of the above mentioned benefits are saving the handling trouble, reducing the damage potential for goods and decreasing the handling costs. Such a system contributes to a positive development of the intermodal system of freight transportation which enables a simplified movement of goods.

At container terminals, containers are transhipped from one mode of transportation to another. Within terminal different types of material handling equipment are used to tranship containers (Vis and Koster, 2003). Intermodal terminals are a point of interface between road and rail transport for containerized goods. Containers processed in intermodal terminals vary in length, height, weight and handling requirements. They are carried by trains consisting of a sequence of wagons which vary in length, deck height and carrying capacity. Containers are transferred to/from wagons by a variety of handling equipment such as forklifts, sidelifters, reachstackers and gantry cranes (Corry and Kozan, 2006). Advantages in using sidelifters over conventional forklifts or reachstackers include faster travelling speeds, safer operating conditions because of clearer visibility and the ability to use available space more efficiently.

Material and method

Material

In this study, CAD softwares are frequently used for the decision of the design, material and joining process. CAD model of the sidelifter is shown in Figure1.

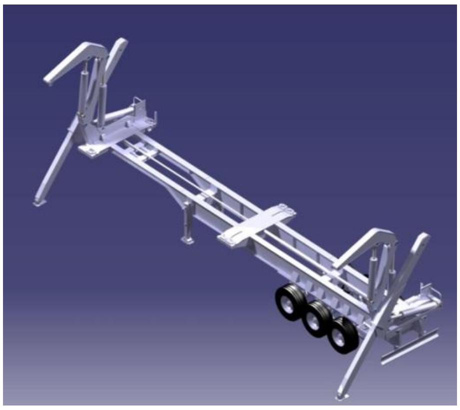

Figure 1. View of the sidelifter in CATIA V5

St 52-3 N steel was used as main material of the sidelifter. Steel grade St 52-3 N is a low carbon, high strength structural steel which can be readily welded to other weldable steel. With its low carbon equivalent, it possesses good cold forming properties. Mechanical properties of St 52-3 N quality steel given in Table 1.

Table 1. Mechanical properties of St 52-3 N (S355J2G3)

Young's modulus	Poisson's ratio	Tensile yield strength	Tensile ultimate strength
210 GPa	0,3	355 MPa	520 MPa

Gas metal arc welding was utilized as joining process between sheets. At this process metals were melted and joined by heating them with an arc established between a continuously fed filler wire electrode and the metals, as shown in Figure 4.21. Welding processes are utilized with the machine shown in Figure 2 and its properties are presented in Table 2.

Figure 2. Welding machine that used for welding operations

Table 2. Properties of welding machine

Model	Working power	Coolant
GKM 500	500 Amper	Water

Method

During the design steps different modules and workbenches of CATIA V5 software is used, these are:

- Sketcher Workbench
- Part Workbench
- Assembly Design workbench
- Real Time Rendering Workbench
- DMU Kinematics Workbench
- Sheet metal workbench
- Drafting workbench

Solidworks software program was used for the developments of the mechanism with RAYVAG Railcar Industry and Trade S.A. Technical drawings of sidelifter mechanism were prepared with the aid of this program.

Results and Discussion

For the manufacture of prototype, plain sheets are cut with CNC plasma machine, and then these sheets are welded together with gas metal arc process. Formed components are joined and auxiliary equipment are added together to compose the sidelifter. These processes are shown in Figure 4.18.

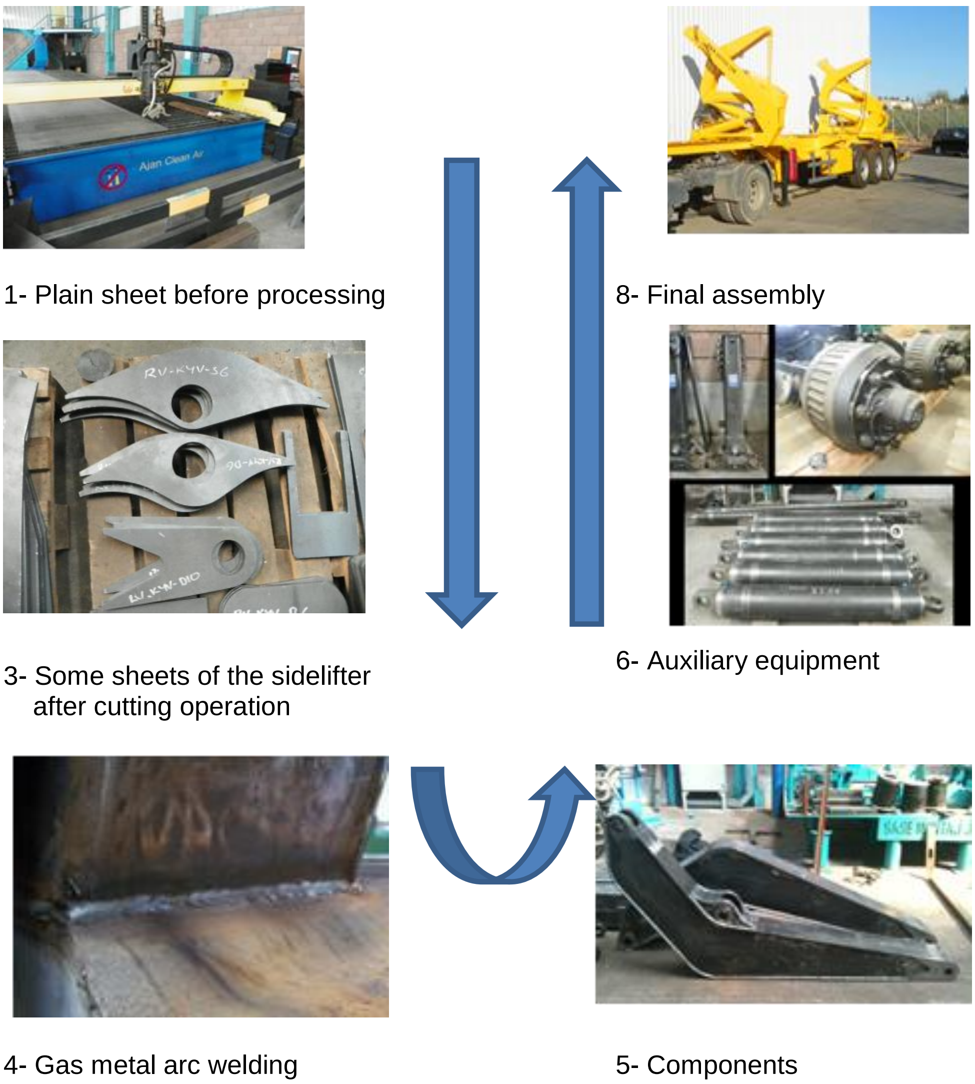

Figure 3. Manufacturing steps of the sidelifter,

After making all calculations the total cost of the sidelifter was found as 88.719,71 TL. The costs of all components are given separately in Table 3.This cost is valid for only prototype product and expected to decrease in case of mass production.

Table 3. Cost of the components

Materials	Quantity	Cost
1- Variable Thickness Sheet Materials (6mm–40mm)	For 1 Vehicle	9.610,46 TL
2- Lathe Materials (Transmission, Spindle)	For 1 Vehicle	1.338,40 TL
3- Poliamid	4	566,40 TL
4- Loader Leg	6	30.444,00 TL
5- Main-Leg Piston	2	9.204,00 TL
6- Assistant-Leg Piston	2	1.014,80 TL
7- Open-Close Piston	2	5.428,00 TL
8- Electropneumatic Control Level	2	8.873,60 TL
9- Twin Load-Holding Valves	8	2.171,20 TL
10- Twin Fastener	2	158,12 TL
11- Hydraulic Tandem Pump	1	2.714,00 TL
12- Axles (14 tonnes with air suspension)	3	3.510,89 TL
13- Tires	6	6.301,2 TL
14- SG2 – 1,2 mm Welding Wire	150 kg	362,85 TL
Total	**-**	**88.719,71TL**

Basic information about the sidelifter is presented in Table 4. Drafts of the sidelifter as folded and unfolded are shown in Figure 4 and 5 respectively.

Table 4. Some dimensions and properties of the sidelifter

Kerb weight	11.400 kg
Maximum load	40.000 kg
Length	13.586 mm
Width	2.532 mm
Axle width	2.340 mm
Tyres	385x65R 22,5K
Suspension type	Z spring

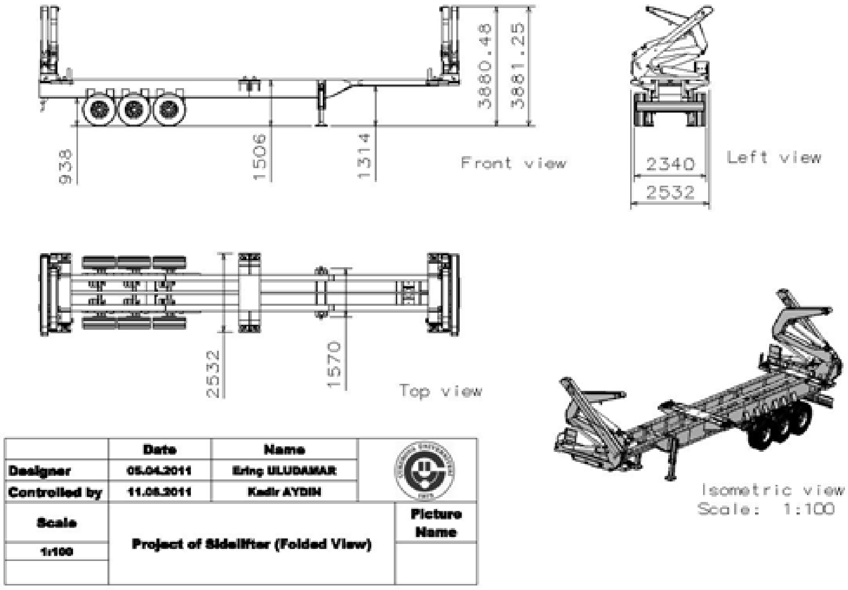

Figure 4. Technical drawing of the sidelifter as folded

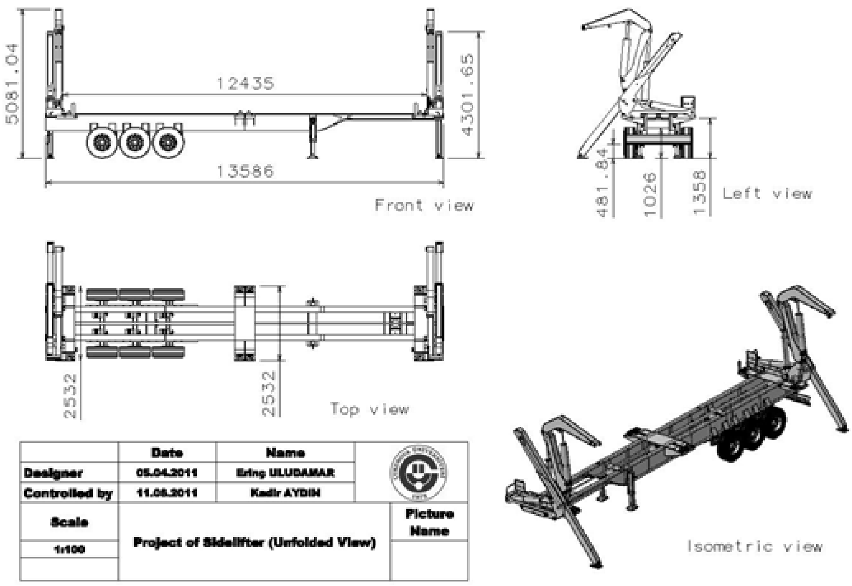

Figure 5. Technical drawing of the sidelifter as unfolded

Conclusion

The aim of this study was designing and developing a low cost and effective mechanism which can easily transfer industrial loads (containers) to railway wagon or trailers of the transporting vehicles. Firstly, previous studies and similar existing mechanisms were examined. Secondly, 3D drawing of the mechanism was prepared. Then, drafts' were prepared. On practical world, sheets have been cut with CNC plasma machine. These sheets were welded by using Gas–metal arc welding. Lastly, some components such as axles, tires, semitrailers' legs, etc. were added to the mechanism the final view of the sidelifter shown in Figure 6.

St 52-3 N quality steel has been chosen as main material for sidelifter, other kind of materials such as polyamide is used with small amount where slide movement occurs.

The sidelifter, which was developed in Çukurova University Automotive Engineering Laboratories, is able to lift up to 40 tonnes intermodal containers. The prototype was loaded with 20 and 30 tonnes without any fatal damage. Legs and the arms of the mechanism can be moved with the remote control for operator safety. Totally 10 number of hydraulic pistons are used on the mechanism.

In future, different chassis types including telescopic type, whose chassis are shorten and lengthen according to container dimensions, can be developed. Chasses for specific purposes can be also manufactured, which are able to carry one of the following container sizes; 20', 30' and 40'. Arm designs will be modified for better aerodynamics and decrease production costs.

Figure 6. Final view of the sidelifter, which is manufactured by this study

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