

# Review of devices employed with staircase climbing mechanism

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## ABSTRACT

*In industry as well as in domestic, hoisting the load and moving from one place to another has its own importance. Way of carrying the load and duration need for operation also increase the risk of injuries. Ergonomical method of handling the weight is one method. On the other hand, devices can be developed to make the load carrying operation more effortless. Devices with stair climbing mechanism are such devices which makes hoisting the object easy. This paper reviewed published literature, which reported the development of load hoisting devices with staircase climbing mechanism. Review indicates that device which can withstand the maximum load is 1962 N. Most of the devices developed till date are lifting the objects easily when the angle of staircase is 44°. This review article will be useful to make a staircase climbing mechanism for the load carrying device for elderly people.*

**Key words:** *Devices, Staircase, Mechanism, Climb*

## 1. INTRODUCTION

Lifting and moving different objects from one place to the other is a significant task within industry as well as in domicile (WSHC 2014; OHD 2007). However, carrying weight is always a difficult job, which usually cause injuries to humans (WSHC 2014). Injuries are caused not only by the increased weight but also due to the way of handling it and duration of use (OHD 2007). One way to reduce the risk is to practice ergonomic way of handling the weight (CDIR 2007; KellerOnline 2012). On the other hand, devices can be employed which reduce human effort (CDIR 2007; KellerOnline 2012).

This paper aims to review the published research articles in the field of devices employed with staircase climbing mechanism, which reduced human effort to carry weight in buildings through stairs. It can be useful for elderly and differently abled people to bring various objects which cannot be carried by hand. Such devices can also be used at library, hospitals, colleges and universities, industries etc (Gaikwad and Kadam 2013). This work is carried out in view of developing a load carrying machine to assist elderly people.

## 2. VARIOUS DEVICES WITH STAIRCASE CLIMBING MECHANISM

Hossain et al. (2010) modified the existing type of stair climbing wheels to a curved type wheel and found that it working efficiently if the stair angle is at 44°. Additionally, Gaikwad and Kadam (2013) constructed a hand-truck with stair wheel mechanism, which can be used for different sizes of stairs by altering the frame. The paper also reported that mechanism will work efficiently when inclination of the stair is 44° and beyond this value, climbing was found impossible.

Apart from this, modeling of a stair climbing trolley was completed by Gangadia et al. (2015) for a load of 491 N and found some demerits such as high power consumption and working is more noisy. Focusing further, a stair climbing hand trolley was fabricated by a team of researchers for carrying heavy load near to 630 N using tri-star

wheels (Praveen Raj et al. 2016). Gondole et al. (2016) designed a hand trolley with stair climbing mechanism to carry a load of 539 N and found it can carry the load effortlessly through stairs. Furthermore, a light-weight trolley was developed for lifting load over staircase using tri-star wheel using Nylon 66 with a wheel diameter of 370 mm (Ajay et al. 2017).

Additionally, a domestic load carrier trolley was manufactured using tri-star wheel for climbing stair case and designed to withstand a load of 1962 N (Kumar et al. 2018). In addition to this, a trolley for carrying heavy loads equipped with tri-star stair climbing wheel was engineered for industrial and domestic purposes, which is designed to carry a load of 539 N (Kaviyarasu et al. 2018). Rajkumar et al. (2018) designed a universal trolley carrier for a load of 785 N with a stair climbing mechanism and found safe based on analysis using Workbench 14.5.

Table 1 tabulated the reviewed literature and type of devices, which are employed with staircase climbing mechanism. Most of the researchers used tri-star wheel and maximum design load was found as 1962 N. Design load varies from 491 N to 1962 N. Paper reveals that further advancements are required in the field of stair climbing devices for different purposes both in industry and domestic.

**Table 1 Devices utilizing stair case climbing mechanism**

Authors	Year	Design load/Angle of staircase/Diameter of Stair Climbing Wheel	Equipment	Material (Stair Climbing Wheel)
Hossain et al.	2010	44 <sup>0</sup>	-	-
Gaikwad and Kadam	2013	44 <sup>0</sup>	Hand Truck	-
Gangadia et al.	2015	491 N	Trolley	-
Praveen Raj et al.	2016	630 N	Hand Trolley	-
Gondole et al.	2016	539 N	Trolley	-
Ajay et al.	2017	370 mm	Light-Weight Trolley	Nylon 66
Kumar et al.	2018	1962 N	Load Carrier Trolley	-
Kaviyarasu et al.	2018	539 N	Trolley	-
Rajkumar et al.	2018	785 N	Universal Trolley	-

### 3. Conclusions

Purpose of this review is to have a knowledge in stair climbing mechanism, which can be used for various devices. Mechanism is employed in various equipments such as trolley, truck etc. This will make easy handling of load from one place to other especially to hoist the load in industry as well as domestic purposes. Literature shows that need of such mechanism is obvious and further research is needed to help the industry.

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