

## FAÇADE CLEANING DEVICE FOR PULLEY SYSTEM MECHANISM

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**Abstract** - Due to the development of construction technology, there is a considerable increase in the number of skyscrapers in the world. But when it comes to the cleaning of all those glasses till to a particular height is fine manually, when we keep on going to high level the danger of the humans who are cleaning it keeps on increases and it's really a risking duty for the maintenance department. Now we took this problem and started working to find a suitable solution which is easy to operate and economical. So here we are proposing a design that can be used to clean the glasses attach to the building. The device needs to satisfy certain criteria that are; portable, small size, lightweight, automatically operated and can clean all the corner of the windowpane. The device is operated by pulley system mechanism and four wheels for easy upward and downward motion. The application of the device in the real world is hoped to help humans and reduce cost in office window cleaning activities.

**Key Words:** skyscrapers, danger, economical, automatically, lightweight.

### 1. INTRODUCTION

Recently, we have seen that most of the buildings are found with the facade system considering its aesthetic looks. So this building with glass facade system needs to maintain periodically. The conventional methods require the human labors and the pulley system. It is taking more time as well as the labor safety becomes the more important factor while in the cleaning process.

In order to improve the efficiency in the cleaning and the factor of human safety to eliminated. Here we present the project "façade cleaning device using pulley system"

The another important factor in the cleaning process considering the device it should be small in size, portable easy to handle and the cost and maintenance of the device should be as minimum as possible.



**Fig - 1:** Workers Suspended In Air

The device overall weights is around 3.5 kg which is bit easy to operate due to which the forces applied on the glass is less which can be easily sustain by the glass. Fluid supply arrangement is done by using fluid line suspended along with façade cleaning device which continuously sprayed soapy water solution to the passage above roller brush. As the machines a move vertically cleaning also takes place. To supply continuous water fluid line is connected to tap water. Sufficient supply of water periodically checked to avoid dry cleaning by roller brush.

### 1.1 OBJECTIVES

1. To design a small cleaning machine for office window which is portable, small size, lightweight, automatic operation and can clean all the corners of the office window
2. To build a man less façade cleaning system.
3. To reduce intervention of man avoiding human loss.
4. To reduce the work time thereby increasing more work orders.
5. To reduce the cost of system.

## 2. MODEL DISCRPTION

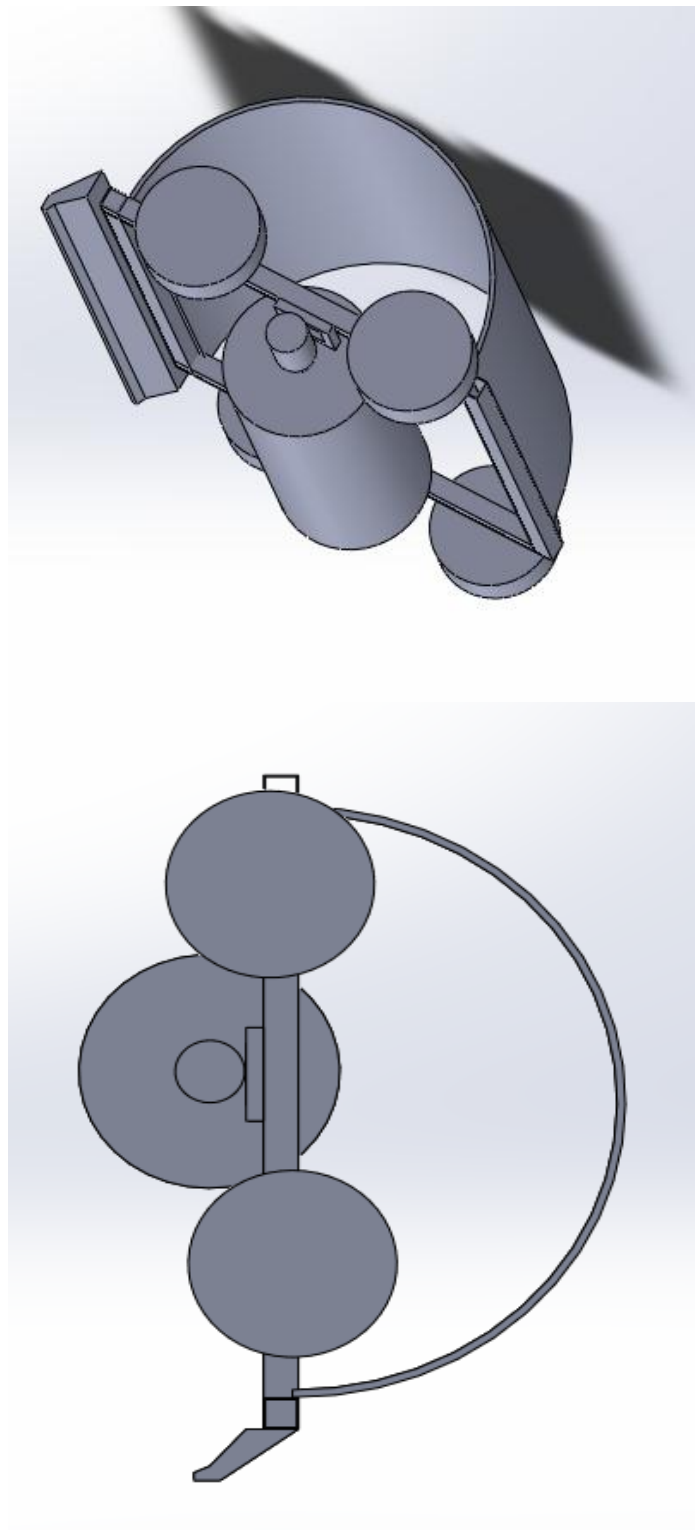


Fig -2: Proposed Model

## 2.1 MAJOR COMPONENTS

### 2.1.1 Roller Brush



Fig -3: Roller Brush

Table -1: Brush specification

Application	Road/Runway Sweeping & Cleaning machine
Size	Brush Diameter 150 mm
Base Material	HDPE (High density Polyethylene Pipe)
Brush Material	Nylon Black colour 1.2mm
Drive	Pipe shaft (20 mm)
Remark	One Piece Brooms for Efficient Cleaning Manufactured on Imported M/C

### 2.1.2 BATTERY



Fig -4: Battery

**Specification:**

Company name: Accplus

Voltage: 12 V

Current: 1.3 Ah

Type: Lead Acid Battery

Battery No: PK20191225

**2.1.3 PLUMMER BLOCK HOUSING UNIT UCP204 - SHAFT: 20 MM**



**Fig -5:** Bearing

**2.1.4 AL TYPE - ALUMINIUM JAW COUPLING**



**Fig -6:** Flexible Coupling

Flexible couplings are devices used to mechanically connect two shafts to transmit power from one shaft to the other. They are also able to compensate for shaft misalignment in a torsionally rigid way. Misalignment can be angular, parallel or skew. This is particularly important for applications where misalignment could affect the velocity and acceleration of the driven shaft. The performance of the coupling depends largely upon how it is installed, aligned and maintained.

**2.1.5 MOTOR**

**Specification**

Name: SKU-5693

Speed: 300 RPM

Operating voltage: 12 V

Rated torque: 2.5 Kg-cm

Stall torque: 3.5 Kg-cm

Load current: 0.3 A

**3. CALCULATIONS**

**CALCULATION FOR MOTOR SELECTION**

- 1) Weight = 3.5 kg
- 2) Diameter of brush = 150 mm
- 3) Acceleration = 9.81 m/s<sup>2</sup>

**1. Force:**

$$\begin{aligned} \text{Force} &= \text{mass} * \text{acceleration} \\ &= \text{weight} / 9.81 * \text{acceleration} \\ &= 3.5 / 9.81 * (9.81) \end{aligned}$$

**Force= 3.5 N**

**2. Torque :**

$$\begin{aligned} \text{Torque} &= \text{force} * \text{radius of brush} \\ &= 3.5 * 0.075 \end{aligned}$$

Torque = 0.2625 Nm

**Torque = 2.625 Kgf cm**

**4. PROPOSED WORK**

As every mechanism has some advantages and disadvantage, we finally have come out with a simple design that which is totally based on the pulley systemmechanism. In order to clean the glass, a cleaning surface must be engaged on the window. To clean properly we required ‘T’ shape wiper and cloth also soapy water is required. This process replaced by using rotating brush which is used to wipe out dirt .Hence we select second method as we aimed to reduce human involvement. Third important priority is cleaning passage this is done by after a vertical section of the building is washed, the pulley system is repositioned laterally so that the next adjacent vertical section of the building may

be cleaned. This procedure may be repeated until the entire building has been washed.

For our design we devised a system that moves along the length of an array of window panels, cleaning the entire array. This design was selected primarily for its simplicity. The device moves across a column of panels and cleans using a spinning motion of brushes. The system will move using soft rubber wheels driven by pulley system. The rotating brush system will be mounted on a rotating axle which is also spun by the main drive motor. Using a single motor is advantageous for both cost and simplicity. However, the drive motor will need to deliver high torque in order to function effectively. To reduce the stress on both the system and the window panel surface, a series of lighter cleaning cycles will be used rather than a single more intense cleaning. This device will run across a column of window panels and back to its original position. The device will be powered by an internal battery. Fluid supply arrangement is done by using fluid line suspended along with facade cleaning device which continuously sprayed soapy water solution to the passage above roller brush. As the machines moves vertically cleaning also takes place. To supply continuous water fluid line is connected to tap water. Sufficient supply of water periodically checked to avoid dry cleaning by roller brush. To rotate the brush motor is attached to brush shaft. The electric supply is given using battery which is rechargeable. The motor is attached to shaft through coupling. Bearing is used to support the shaft at one side on the frame.

This work intends to replace or minimize human involvement in cleaning the window by replacing it with a small cleaning device for office window with several capabilities. The abilities are; portable, small size, lightweight, automatic operation and can clean all the corner of the office window.

## 5. RESULT, OUTCOME AND DISCUSSION

In evaluating our facade cleaning device there are certain aspects that could be improved upon. The first would be easy removal of brush. The arrangement should be such that after particular period rough teeth roller brush get easily removed to replace with new one. Because of daily repetitive use brush teeth gets shorten in length and hence fails to get uniform cleaning. Other areas to improve on are including making our design automatically detect the edges of the window. This could be done by using either optical sensors or bumpers. The base would need to be redesigned in order to accommodate these sensors. This would also make it necessary for the device to carry its own power source with it. Our battery is currently too large and heavy so we would need a smaller one and redesign the base to accommodate it. These are some of the improvements possible for our facade cleaning device.

## 6. CONCLUSIONS

The report introduces a new small size, light, and inexpensive facade cleaning device. As compared to other available window cleaning device, it has the advantage of being operated by a single electrical motor and system of suspended ropes. The single motor is able to advance the body in a vertical section of the window pane and simultaneously clean the window with the roller brush attached to the body. It can be operated in automatic and manual mode. It will provide a safe cleaning of the office or home windows, especially for high-rise buildings. The test run of the machine has demonstrated the efficiency of the model.

The product thus developed is fully operational and gives desired motion. The roller brush design should be modified in future because the current design has few problems. Few of those are the motor is not detachable and the high rpm leads to vibration of the whole system. If these features will be modified, this will work well. In our case sensor system is not used. With addition of this sensor technology the movement of model easily monitored. This helps to prevent damage of any mechanical part. This will be the next development stages. This increases reliability of the instrument. Overall the concept is very much helpful and there is scope of a lot of development in mechanical parts. The optimization will continue till achieving the best one. Overall the project is successful to its intent and will definitely change the automation and facade cleaning. The development can be made in the field of sensing. But this product has the capability to detect as well as move in the direction of dust and thus resulting in better cleaning of windows. As a whole this is a successful product developed that can be used in current Indian facade cleaning industry.

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