Design and Development of Vertical Bicycle Parking

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Abstract- *In today's world Cycling is becoming increasingly recognised for the contribution it can make as a sustainable and healthy form of transport for trips within and around our towns and cities. The increase in pollution has caused the countries to take preventive measures for the environment, and to avoid further detonation of the environment people has started using bicycle as a mode of transportation. Various available parking systems like Rack Design, covered bicycle parking, bicycle lockers, bicycle cages, U-rack design, V-rack design etc. are affordable and easily available system, these systems provides an easy way to manage the parking facilities of any company and office. But these systems are not very efficient when it comes to space saving issues. This report tells about an alternate of these available parking systems, one may notice that as for horizontal parking allowed space is approximately of two feet by six feet for each bicycle. To save space this system utilize the vertical space available, when the bicycles are arranged in vertical position allowed space for bicycle become four feet by two feet and a height of six feet each. This system can save up to 30 % if the total available space.*

Keywords- vertical parking, bicycle, spring, lock etc.

I. INTRODUCTION

Cycling is becoming increasingly recognised for the contribution it can make as a sustainable and healthy form of transport for trips within and around our towns and cities. To support this, various countries are putting effort to make bicycle the means of transport. Cycling is becoming increasingly recognised for the contribution it can make as a sustainable and healthy form of transport for trips within and around our towns and cities. Since there is an increase in understanding of good principles for cycle parking publically, little thought has been given to what should be done where most journeys begin and end i.e. in the home. Cycle parking needs to be designed early on in the process, as space needed to accommodate cycles is very significant. The importance of well thought out design cannot be neglected, as most of the space set aside for cycle parking is left half empty because it is either impossible to manipulate cycles into the designated space, or the location is not proper. This in turn leads to cycles being left attached to railings or near the entrance. It is imperative that cycle parking forms an integral part of any full or reserved matters planning application, rather than treating it as a secondary issue to be resolved by condition. Thus a detailed description of the location, type of rack, spacing, numbers, method of installation and access to cycle parking should be provided.

The system described and developed in and by this paper is a better way to provide simple, easy to use and convenient bicycle parking system.

II. BASIC PARTS AND BLOCK DIAGRAM FOR MACHINE

Basic parts of the bicycle parking system include

- Lifting mechanism: - It contains a metal dolly in which the front wheel of the bicycle could be fixed.
- Frame: - The frame contains the basic structure in which the whole assembly is assembled.
- Slider: - It is a special wheeled rolled designed in such a way that it can slide in the slide ways of designated specification on which the dolly is fixed.
- Slider ways: - It is a T slotted metal block in which is designed according to the specification of slider.
- Locking mechanisms: - It is a basic latch lock used to lock the mechanism against the force of spring, and also for the locking of front wheel.

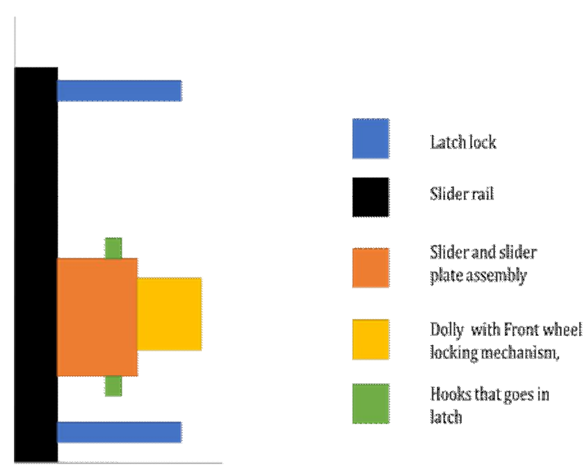

Figure 1. Block diagram for system

III. DESIGN OF PROPOSED SYSTEM

A. Design for spring [1]-

The design of a helical compression spring involves the following assumptions:

Type of loading – Whether the spring is subjected to static or infrequently varying load or alternating load.

Following are requirement concerned with spring design,

- Is there any space restriction.
- Required life for springs subjected to alternating loads.
- Environmental conditions such as corrosive atmosphere and temperature.
- Economy desired.

A helical compression spring, that is too long compared to the mean coil diameter, acts as a flexible column and may buckle at comparatively low axial force. Springs which cannot be designed buckle- proof must be guided in a sleeve or over an arbour. This is undesirable because the friction between the spring and the guide may damage the spring in the long run. It is therefore preferable, if possible, to dividing the spring into buckle proof component springs separated by plates which are guided over a arbour or in a sleeve.

If,

$$\frac{\text{free length}}{\text{mean coil diameter}} \leq 2.6 \text{ (Guide not necessary)}$$
$$\frac{\text{free length}}{\text{mean coil diameter}} \geq 2.7 \text{(Guide is needed)}$$

Following procedure can be used for designing helical compression spring,

1) Diameter of wire -

Shear stress $\tau = \frac{8FDk}{\pi d^3}$

Wahl's stress factor $k = \frac{4c-1}{4c-4} + \frac{0.615}{c}$

Spring index $c = \frac{D}{d}$

Where d = diameter of spring wire

'c' generally varies from 4 to 12

2) Mean Diameter of Coil –

Mean coil diameter D = cd

Outer diameter of coil Do= D+d

Inner diameter of coil Di= D – d

3) Number of coil or turns –

Axial Deflection $y = \frac{8FD^3 i}{Gd^4}$

Where i = Number of active turns or coils

4) Free length –

$$l_0 \geq (i + n)d + y + a$$

Where,

y = Maximum deflection

Clearance 'a' = 25% of maximum deflection.

Assume 'squared and ground end'

∴Number of additional coil n = 2

5) Stiffness or Rate of spring (F_0) –

$$F_0 = \frac{F}{y}$$

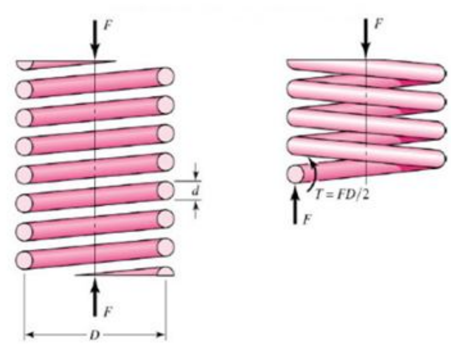

Figure 2.

6) Pitch –

For end types of compression springs

$$p = \frac{l_0 - 2d}{i}$$

B. Design of guide ways and slider [2] –

Following are factors used in design of guide ways,

d= diameter of ball (mm)

K=load coefficient (kgf/cm^2)

P=load capacity (N)

P_{max}=Maximum pressure on ball

δ=Deformation

N=Normal load (kg)

R=Radius of ball (mm)

1. Sample calculation-

Diameter of ball = 4 mm
Length of the block = 80 mm
Number of balls = 18 balls
Total number of ball in contact = 18×4= 72
Assume K= 0.6 N /mm2

Load on each ball,

$$K \text{ x } d^2 = 0.6 \times 4^2 = 9.6 \text{ N}$$

Load carrying capacity of 72 balls,

$$P = 9.6 \times 72 = 691.2 \text{ N}$$

Pressure on guide ways,

$$P_{max} = 91.8 \, x \sqrt[3]{\frac{P}{K^2 * d^2}}$$

$$= 91.8 \, x \sqrt[3]{\frac{9.6}{0.6^2 * 4^2}}$$

$$= 108.84 \text{ N/mm}^2$$

For 72 balls,
P_{max} = 108.84× 72= 7836.48 N/mm^2

This load acts on one block of the slider.

IV. 2) To calculate standard deformation-

The relationship between deformation and Normal load for steel guides with ball sideways;

$$\delta = 1.48 \sqrt[3]{N^2/r}$$

N=normal load on ball=20kg,
r=radius of ball=2mm,
$\delta = 8.65 \text{ x } 10^{-3}$mm,

Here, the standard deformation for radius 2 mm is 9.76×10^{-3}mm and calculated deformation is 8.65×10^{-3}mm.

Therefore, the design is safe [2].

V. APPLICATION

A. The system can be used in homes.
B. The system can be used in schools.
C. It can be used in hallways, offices and other places.
D. As it saves space, one can use it to store large amount of the bicycle, like storages facilities of large bicycle producers.

VI. CONCLUSION

By following the design procedure mentioned in the vertical parking system for bicycle is fabricated. By experimentation and testing it is being found that the system can save up to 30% of total available parking space. This system could be used in households, offices, and even by bicycle manufacturer to store the stock of bicycle and save up to 30% of total space. The system is easy to operate and it creates little or no strain on human body during application.

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