DESIGN OF STEEL TRUSS PEDESTRIAN BRIDGE

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Abstract - *Provision for height clearance (minimum 5m) in multi-storied and long span buildings is mandatory to be provided for smooth movement of fire engines during fire emergencies and for traffic circulation. To fulfill these headroom provisions, generally the height up to second floor is kept unconstructed. Accessibility from one wing to another in the building is hence blocked. In such cases, a steel trussed pedestrian bridge can be installed across the unconstructed passage. This bridge can be aided with a hydraulic system controlled with a Programmable Logic Controller to operate the motion of hydraulic system. The bridge can be lowered up to floor level to allow travel across the passage. When not in use, it can be lifted up in the vertical direction to provide necessary headroom for traffic circulation. The hydraulic system can also be eliminated by fixing bridge at an elevated position and providing a staircase for its access. The pedestrian bridge will be provided with trusses and cross beams to achieve lightweight and economical installation.*

***Key Words*: Movable bridge, Pedestrian bridge, Hydraulic system, Traffic circulation, Headroom provision**

1. INTRODUCTION

When a multi-storied building is constructed, it is mandatory to provide the necessary clearance in horizontal and vertical directions. This clearance is given to provide access to fire engines and movement of firemen and for traffic circulation. In order to fulfill these clearance provisions, this width is kept unconstructed up to the first floor height. A minimum height of 5 meters from the ground floor should be left unconstructed. This causes discontinuity at first floor level and it is not possible to cross the unconstructed passage across the same floor. It is not possible to walk to the other wing of the building without changing the floor. One has to either scale up to the floor upstairs, then walk to the other wing and then descend down to the first floor or climb down to ground floor and then reach the other wing via its staircase or elevator. This increases efforts and time whenever it is required to reach the other wings separated by the passage. Transferring heavy materials, machinery and equipment across the wings further intensifies the efforts. A connection provision in this passage connecting the two wings can help to solve this issue.

1.1 Method

A steel pedestrian bridge is designed to be installed across the passage. The bridge is provided with trusses to distribute the forces effectively. Chequered plates of sufficient required thickness are provided for the walkway. Cross beams are provided to take the loads and distribute the forces into the truss members. I-section light-weight beams and equal leg angle sections are provided for the cross beams and truss members respectively. Sections are selected so as to achieve an economical and light weight bridge installation. Two methods of installing the bridge in the passage without disturbing the headroom codal provisions were worked out.

1.2 Motive of the Truss

[1] Truss was adopted so as to minimize the amount of material required in the construction of the bridge.
[2] Truss enables safe distribution of forces across the entire span of bridge reducing the chances of structural failure.
[3] Tension and compression forces developing in the bridge members are safely taken care of without bending or shear.

1.3. Features of the Bridge

[1] The bridge is provided with cross-beams in the transverse direction to take the loads. Beams along the longitudinal direction are not required.
[2] Light-weight design of bridge is possible.
[3] The bridge can be economically constructed due to considerable reduction in bulky section required to take the load.
[4] Provision of chequered plates for the walkway eliminates the need for concrete work.

2. Provision of Staircase

A staircase can be provided wherein the movement of bridge in the vertical direction is not desired. The bridge can be fixed into position at an elevated position leaving the necessary headroom for traffic circulation underside. The position of bridge is permanent and cannot be altered easily once it is installed. Since the bridge is now above the first floor level, two short staircases can be provided to climb up onto the bridge, one in each wing. The staircase should also be made of steel to avoid concrete work - which is permanent in nature. It should be constructed and installed separately and without any connection (bolted or welded) to the bridge. Angle sections, channels can be used for the construction of its framework. Chequered plates of adequate thickness can be provided on the tread portion of the steps. This method can cut down the expenses of installing a hydraulic system. A power source is not required in this case. The staircase can also be provided with wheels or rollers underneath so as to slide it away when the bridge is not in use, making room for use of the floor area.

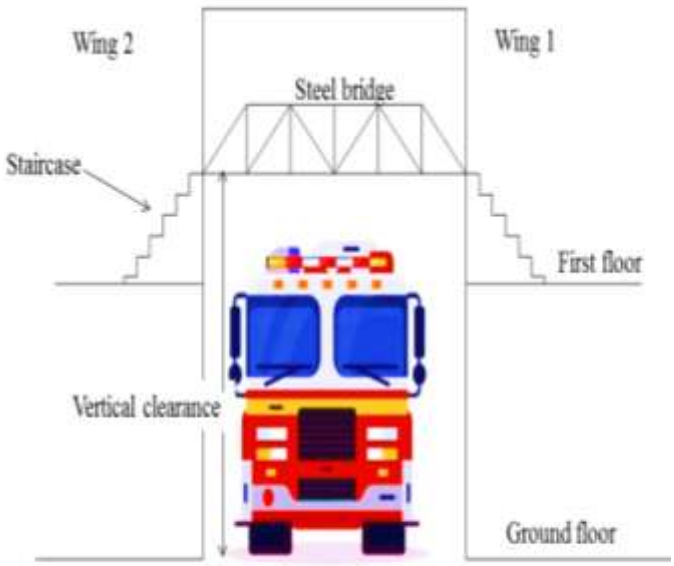

Fig -1: Provision of staircase

3. Provision of Hydraulic system

The other way to install the bridge in the passage is with the aid of hydraulic system. This method allows movement of the bridge in vertical direction. The bridge can be supported with hydraulic cylinders of sufficient bore diameters as per load requirements. A hydraulic pump, an electric motor, oil reservoir, required valves and accessories can be connected in a circuit which can be controlled by the Programmable Logic Controller (PLC). The motion of the hydraulic cylinders and in turn, the bridge, can be precisely controlled using a PLC. The stroke length of the cylinders is so adopted to lift the bridge up above the required headroom.

The bridge when to be used, the PLC can operate the fluid flow into the system from the upper valves of the hydraulic cylinders. This will cause retraction of the piston into the cylinder. A pressure compensating flow divider value can be provided to ensure that the pistons move at a uniform rate without relative level difference between them. The bridge will gradually be lowered within the time period adopted during flow rate design.The bridge comes to rest at the first foor level when the piston reaches its fully retracted position. People can now cross the bridge to reach either wings of the buiding. Machines and equipments can also be transported across the bridge.

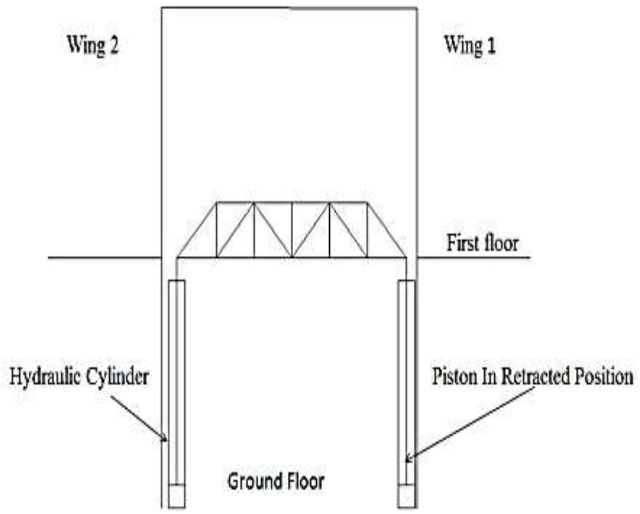

Fig -2: Position of bridge and cylinder piston when in use

When not in use, the PLC directs fluid flow from the lower valve of the cylinder in the upwardward direction which causes extension of the piston. The bridge gradully rises to the maximum stroke length of the cylinder. The bridge reaches the top when the piston reaches its fully extended position providing headroom for traffic circuation. Vehicles can now easily pass from underside of the bridge.

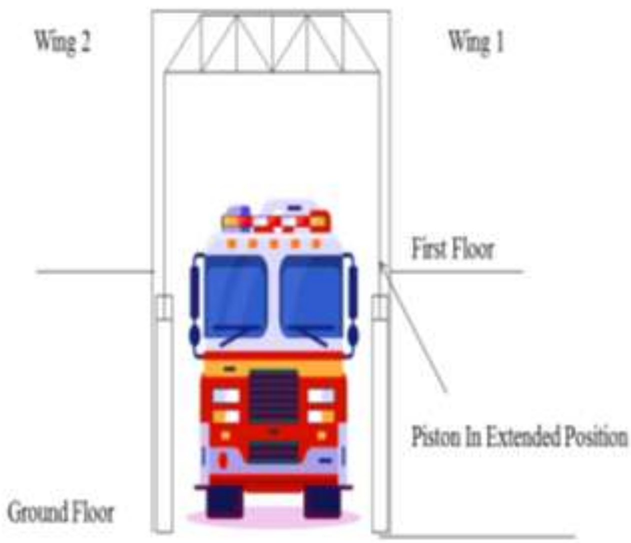

Fig -3 : Position of bridge and cylinder piston when not in use

4. CONCLUSIONS

A solution to reduce the efforts required during movement across the wings is worked out. Two methods of bridge installation are suggested to execute the suggested plan. Steel truss bridges can be provided for access in multi-storied building without disturbing the codal provisions for fire safety. The bridges can be easily fabricated and installed economically in educational institutions, government buildings and corporate working areas owing to their extensive dimensions of construction. This bridge can be of great help in hospitals to take patients from one part of building to another without changing the floor. The bridge supported with the hydraulic system can further find wide applications for various purposes in industrial and commercial world.

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