

## Tech Note 5

2004/04/10

## Rigging for Two-Dimensional Motion

### 1 The problem

It is fairly straightforward to rig an object to move vertically (using a simple pulley configuration) or horizontally (by means of a traveler track). However, frequently a production calls for an object to move both horizontally and vertically. This note presents a design that combines these two mechanisms to solve this problem.

### 2 The design

This design was presented by David Krajec of Cardinal Stritch College in Milwaukee, Wisconsin [1]. It uses a modified traveler truck that moves horizontally across a standard track and allows an object (in his example, a chandelier) hanging from the truck to be moved vertically.

Horizontal motion is achieved in essentially the same manner as rigging a curtain. A single truck moves along a standard traveler track. The load is attached to this truck. By attaching a line to each side of the truck, it can be moved back and forth just like a curtain.

To rig an object to fly vertically, we would normally attach it to a lift line that passes through a loft block and head block before reaching the operator, who can then raise and lower it. The most obvious approach to the two-dimensional problem would be to use this design, placing the pulley on the traveler truck. This can be made to work, but it has a problem: as the truck is moved back and forth along the track, the vertical line's length will change, causing the load to move up and down. In some situations, this might be tolerable (e.g. if it's being moved during a scene change, not in view of the audience). However, generally a better solution is needed.

The solution is to anchor one end of the lift line to the far wall, and have it pass through a pulley on the load and on each side of the traveler truck, as in Figure 1. Two eye bolts with washers are added to the truck. One pulley is attached to each of these eye bolts using a quick link. A third pulley is attached to the top of the load. Finally, another eye bolt is added offstage at the end of the track opposite the operator's control line. The line is then tied off to this eye bolt, passes through the first pulley on the truck down to the load pulley and back up to the second truck pulley, and finally to a block at the other end of the track and down to the operator. The result is that the vertical line can be let in and out in order to move the load up and down, and the horizontal line can be used to move the load left and right *without affecting the vertical position*.

The operator is presented with two control lines: one for moving the load horizontally and one for moving it vertically; they act independently. A cleat should be used to tie off the lines to prevent the load from moving.

One issue not fully addressed by this design is that the load may rotate when moving. This can be dealt with by attaching the load's pulley to the load using some sort of fixed attachment that ensures that it cannot rotate. For certain objects, such as the chandelier previously mentioned, this sort of attachment is difficult to accomplish. In such cases, using an appropriate braided cord may serve to minimize undesired spin.

This design requires only slightly more space than a standard traveler track, and thus is suitable for use in theaters with little or no fly space (a problem we are all too familiar with, especially here).

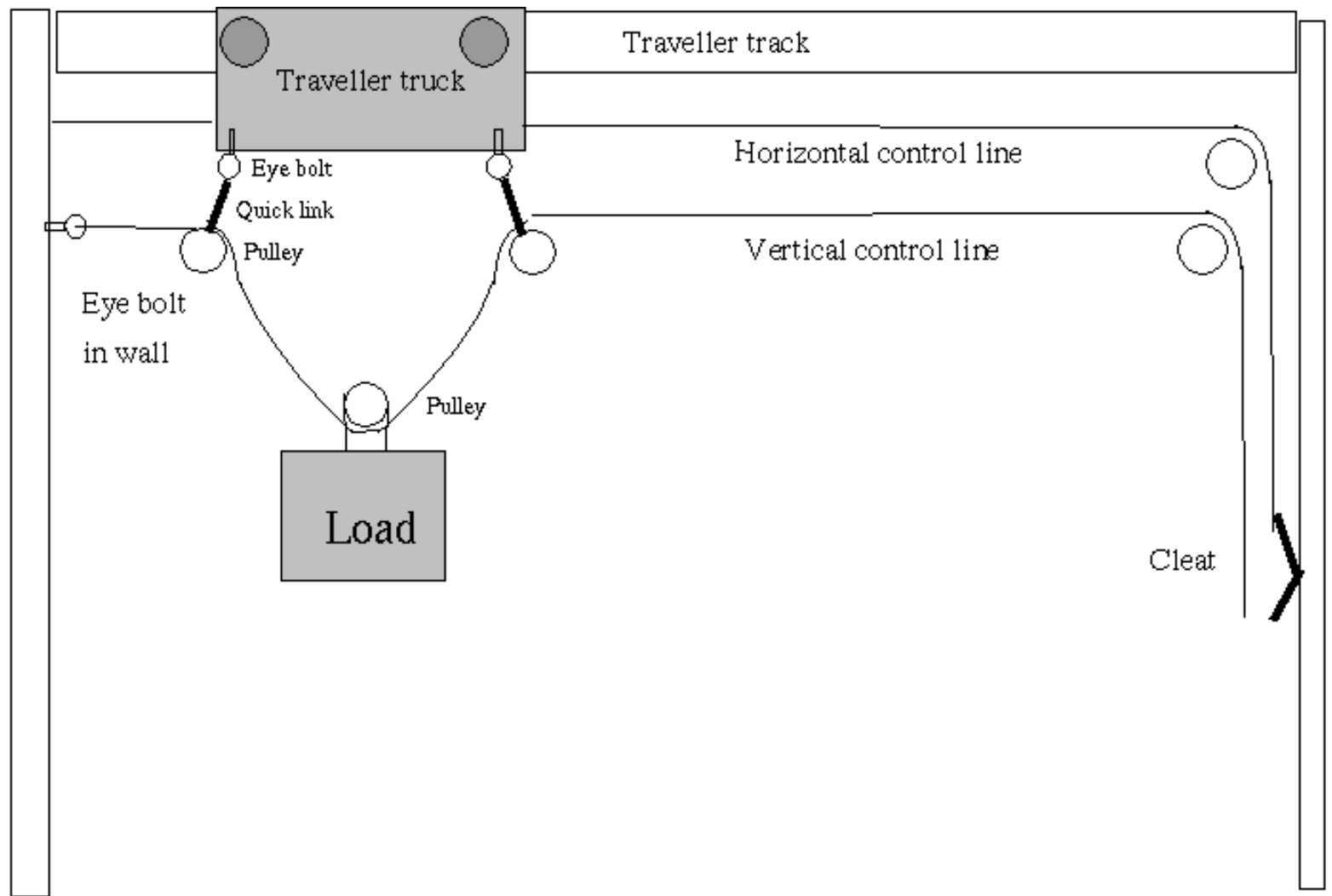
In addition, it provides a 2 : 1 mechanical advantage since there are pulleys both at the top of the load and on the truck. This is a side-effect of the design for vertical motion rather than an intentional choice, but it has the convenient property that a larger load can be controlled by a single operator. For even heavier loads, one could imagine using a counterweight rigging system for the vertical lift line. This would mean that the operator's ability to lift the load would no longer be the limiting factor.

## References

- [1] D. Krajec, "Rigging for vertical and horizontal movement," in *USITT Technical Source Guide*. USITT Technical Production Commission, Roy Hoglund, ed.,

Apr. 1995, no. 16, available at [http://info.nwmissouri.edu/~pimmel/usitt/source\\_guide/issue16.htm](http://info.nwmissouri.edu/~pimmel/usitt/source_guide/issue16.htm).

- [2] P. Carter, *Backstage Handbook*, 3rd ed. Louisville, Kentucky: Broadway Press, 1994.



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Figure 1: Rigging overview