The Big Train Project Status Report (Part 132)

This month's article is the third in the series describing design and construction of the EnterTRAINment Junction (EJ) layout's aerial tramway. With the tram cars now functionally complete and needing only cosmetic enhancements (painting, décor, and passengers), the focus changes to the more difficult functional aspects: the running gear. This time, we'll look at the design and implementation of the track cables and haulage rope and their mountings.

In order to do a proper job of preparing the main elements of the running gear before installing it all on the layout, we needed a new test fixture which would include the following: the upper and lower tram stations; the supports and tensioning system for the track cables; and the routing, drive mechanism, and length adjustment system for the haulage rope. To do this, we were offered a rolling table to which we could mount some temporary structure and the key tram components, simulating all of the critical features but with a shortened span of the track cables. Figure 1 shows the tram running gear elements installed on that fixture.

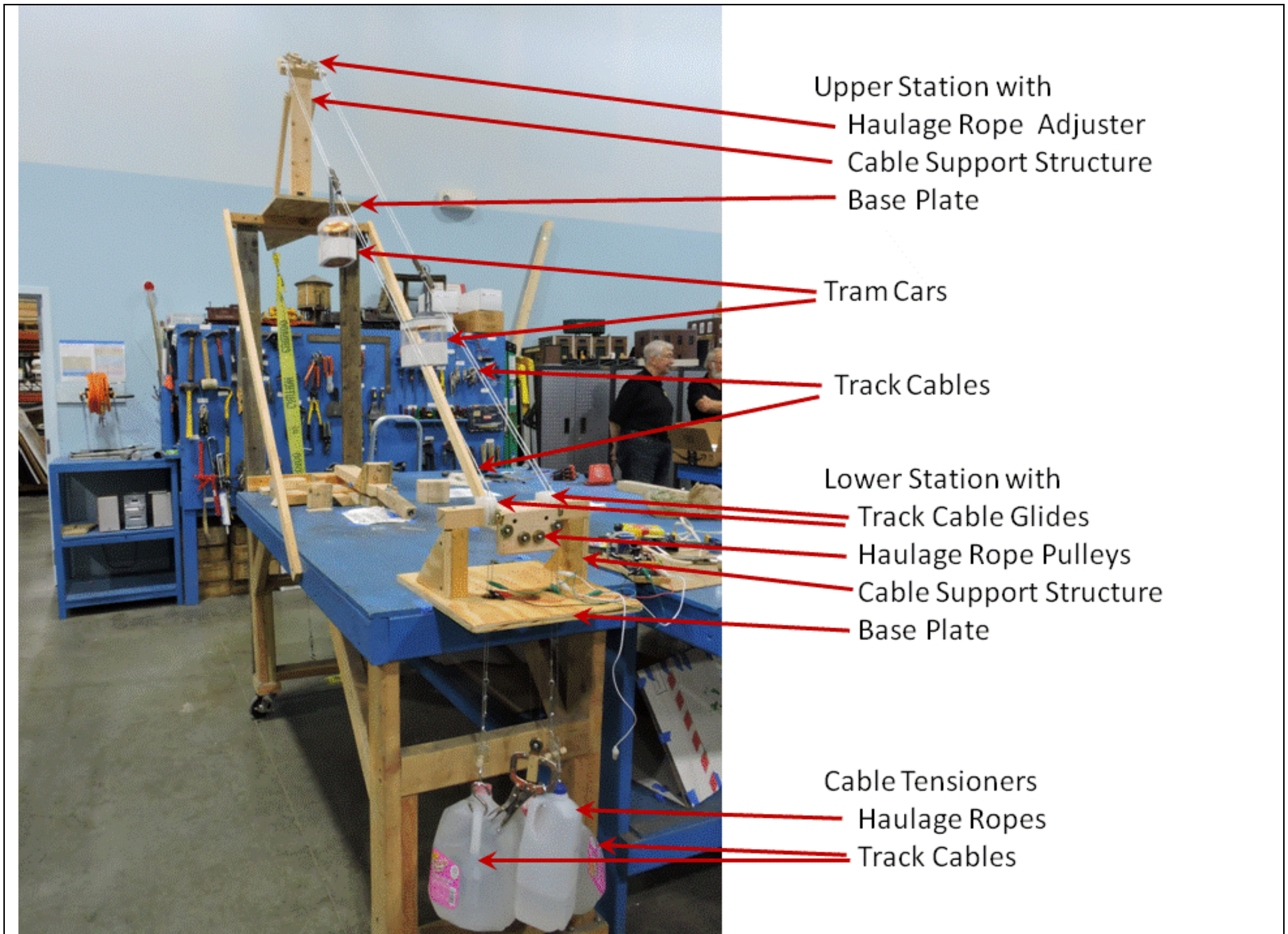

Figure 1. Aerial Tramway Test Fixture

Since this tramway will have no intermediate cable support towers, the cable support structure in each of the stations and their location on the layout will set angle and height of the track cables and the clearances needed for the tram cabs. The actual angle on the layout was measured (35 degrees) using a string stretched from the planned location of the upper station to the location of the lower station and measuring its angle. The cable span was also measured (the length of the string from point to point: 17 feet 7 inches). The test fixture models the cable angle relative to level (about 40 degrees, providing some margin for cable sag) but it cannot model the installed cable length.

The track cables are fixed at the upper station in pairs via an insulated bracket. The insulation allows the two wires in the pair to be used to provide the electricity to the cabs for lighting. The lower cable support structure incorporates a set of grooved glides for each track cable pair, which set the side-to-side spacing of the cables and route the cables from their suspension angle to vertical (Figure 2). The glides allow the cables to move slightly in response to any differences in thermal expansion and contraction between the cables and the layout itself. Constant tension for the track cables is provided by weights, which are located below the layout and out of sight. For the initial test setup, the track cable tensioning system used a gallon milk jug filled with water hooked to another insulated bracket for each cable pair. This provided about four pounds of tension on each of the four track cables. A turnbuckle was used on one of the cables of each track cable pair to allow adjustment of the length of that cable to equalize it with the length of the other cable in the pair and so to equalize the tension of both. The alligator clips in Figure 2 provide electricity to the track cable pairs, which can be seen to successfully lights the cabs.

Figure 2. Lower Cable Support Structure

Unlike the track cables, which are essentially static elements, the upper and lower haulage ropes are in motion along their entire lengths any time the tram cabs are in motion. To minimize friction, ball-bearing sheaves are needed to route the haulage cables where they need to go. Rollers for sliding screen doors proved to be the most readily available sheaves, and their metal construction provides the desired durability. Figure 3 shows a schematic of the haulage rope system. A length adjuster is included in the routing for the upper haulage rope to deal with a limited amount of any stretching of the upper rope that may occur over time. The length of the upper rope determines where the upper tram car stops in the upper station when the lower car is at its sensor-controlled stop in the bottom station. In the lower station, a somewhat complicated routing of the lower haulage rope is needed to keep the rope and its tensioning system from interference with the cable tensioning system and to simplify installation of the lower haulage rope itself. This tensioning system is critical for moving the tram cars when the drive motor drum turns clockwise and pulls the haulage rope up from below and slackens the tension of the rope above the drum. In that situation, the tensioning system weight needs to be large enough to overcome all of the frictions in the haulage rope system in order to get the cars moving up on the right and down on the left. If tension is insufficient, the rope above the drum goes slack (very bad for tangles in the rope or for it jumping off the drum), and the rope below merely lifts the tensioning weight without moving either of the tram cars. In the other direction, the situation is not as critical, because the motor is pulling the car on the right directly down via the lower rope and the car on the left directly up via the upper haulage rope, through the upper pulleys. This requires much less tension to eliminate any slack.

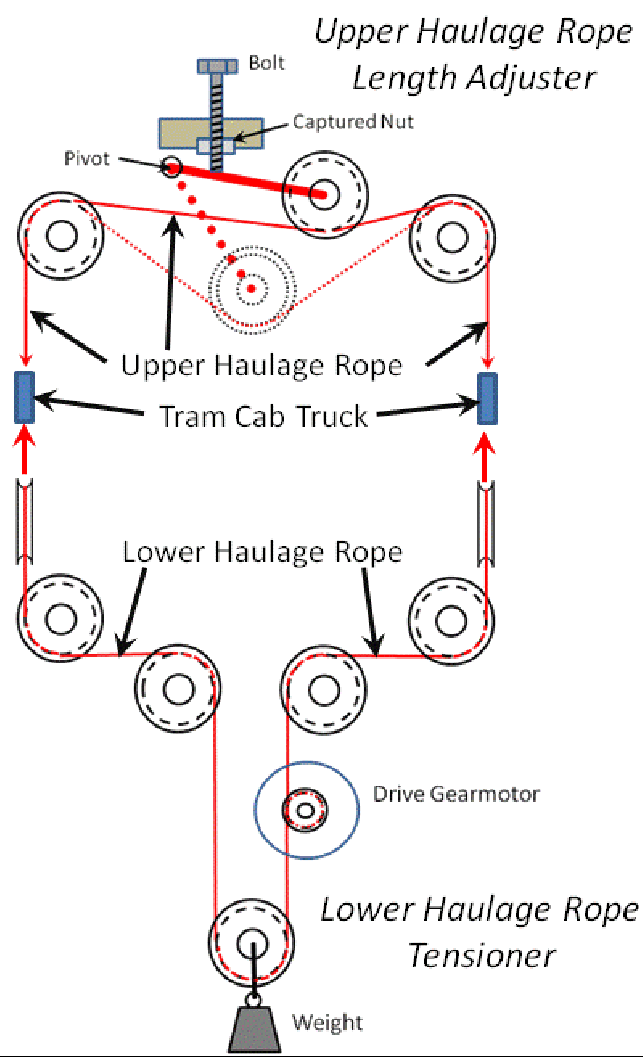

Figure 3. Haulage Rope Schematic

Figure 4 shows a side view of the tram test fixture. The upper and lower station structures with their base plates will be used on the layout, along with the tram cars, the turnbuckles, and various brackets and S-hooks. A lever system will replace the direct-connected gallon milk jugs on track cable tensioning system, and a more compact haulage rope tensioning weight will replace the temporary one. And, of course, new longer track cables will be needed.

Figure 4. Aerial Tram Test Fixture Side View

Still to be built for testing on the fixture are the following: the lever-actuated track cable tensioning system; the upper and lower station buildings with their loading platforms for the passengers; a mounting system for the haulage rope drive motor; a push-button-actuated start system; and a sensing and emergency-stop system for slowing the tram cars to a stop in their stations and reversing the direction of operation at the next actuation. Beyond that, quite a bit of site preparation on the layout is also needed, so there's a lot still to be done.

Look for further updates on the progress of the tram project in future reports.

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