SRI International

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Informal Note #10

DESIGN PROCEDURE FOR A DOWTY EQUIPPED YARD

A simple design procedure for a Dowty equipped yard has been developed. This procedure has been developed from information contained in several papers (see references at end of the note), and may not coincide with Dowty Co. procedures, if any exist.

A profile of a Dowty equipped yard is shown in Figure 1. It has been assumed that the designer has selected V_o (hump speed, based on desired yard performance); V_c (coupling speed); ℓ_1, ℓ_2, ℓ_3, and ℓ_4 (lengths of the track segments, based on the available space for the yard and the required class track length); and L_H (headway required for switching). The designer must also select from the available car data R_h and R_e (the design hard and design easy rolling resistances); W_m (maximum probable car weight); and L_c (car length). He must also have values for the average wind, switch and curve resistances.

Referring to the figure, the procedure is

1. Assuming the speed in the switching area is held constant:

$$V_s = \frac{L_c + L_H}{L_c} V_o = \text{speed required to achieve the necessary headway } L_H.$$

2. The slope of the acceleration section, Θ_1, must be able to accelerate the hardest rolling cars to V_s:

$$V_s = \sqrt{V_o^2 + 2a\ell_1} \quad \text{where } a = (\Theta_1 - R_h)g.$$

Solving for Θ_1 gives

$$\Theta_1 = (V_s^2 - V_o^2)/2\ell_1 g + R_h$$

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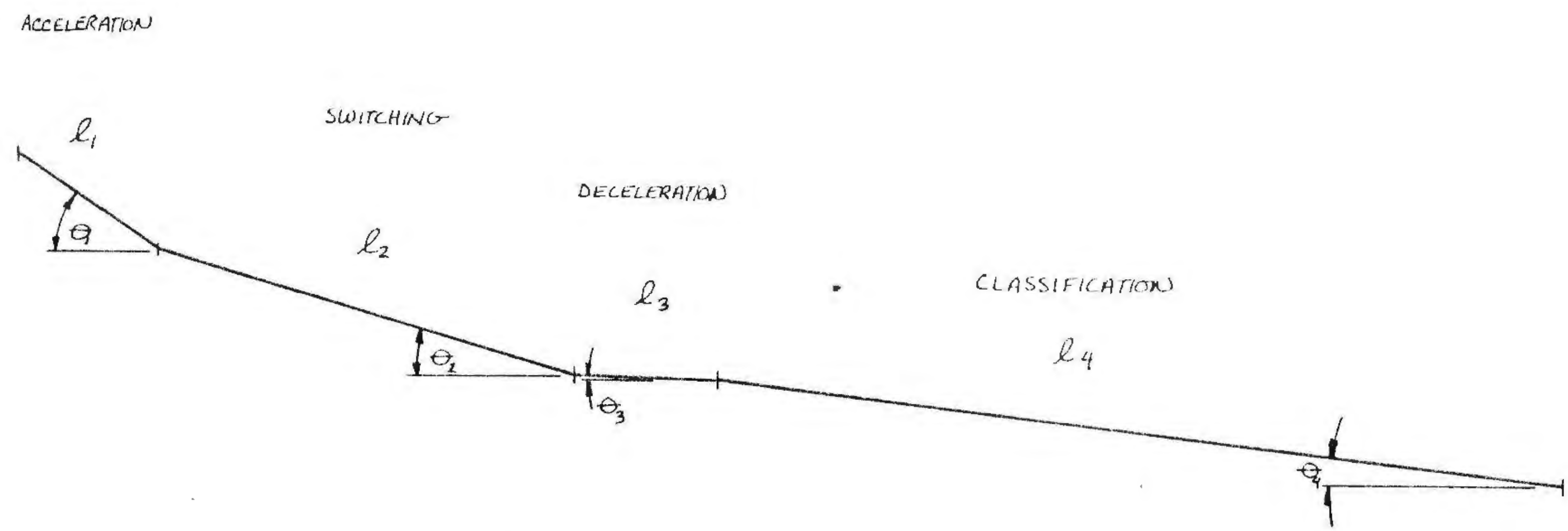

REQUIRED DESIGN INPUT: V_o = humping speed
V_s = coupling speed
L_H = required headway
R_h = rolling resistance of hardest rolling car (% grade)
R_e = rolling resistance of easiest rolling car (% grade)
L_c = car length
W_m = maximum car weight
The wind switch and curve resistances

FIGURE 1. PROFILE OF DOWTY EQUIPPED YARD

Retarder units will have to be installed on the acceleration section to prevent an easy rolling car from accelerating above V_s. The retarders in the switching area must have a combined energy absorbing capacity

$$E_1 = W_m \ell_1 (\Theta_1 - R_e) - \frac{1}{2} \frac{W_m}{g} V_s^2 .$$

3. The switching area must have a slope that will maintain the speed of the worst rolling car:

$$\Theta_2 = R_h + \text{(wind, switch and curve resistances)}.$$

The switching area must also have the retarder capacity to control an easy rolling car of maximum weight, with the retarders set to V_s. The retarders in the switching area must have a combined energy absorbing capacity

$$E_2 = W_m \ell_2 (\Theta_2 - R_e).$$

4. The deceleration section must bring cars to the coupling speed V_c from the switching speed V_s. The slope in this section is usually 0^o to aid in deceleration and the retarders are set to V_c. The retarders in the deceleration area must have a combined energy absorbing capacity.

$$E_3 = \frac{1}{2} \frac{W_m}{g} (V_s^2 - V_c^2) - R_e \ell_3 W_m .$$

5. The design of the classification tracks must allow a car to roll the entire length of the classification tracks at no less than the minimum coupling speed. This can be accomplished with either

   1) a slope that permits the hardest rolling car to roll at a constant speed, with enough retarder units to control the speed of the easier rolling cars, or

   2) a shallow slope with enough booster-retarder units to maintain the speed of the harder rolling cars.

The choice between these two approaches must be based on

1) the cost of the required retarder units.

2) the cost of the required booster-retarder units.

3) the cost of grading a classification yard with the required Θ_4.

In any case, the design must satisfy

1) maximum energy removal = $(\Theta_4 - R_e)\ell_4 W_m$.

2) maximum boost energy = $(R_h - \Theta_4)\ell_4 W_m$.

The retarder or booster-retarder units should be spaced evenly along the track wherever they are used. In addition, retarder units must be placed close enough together so that an easy rolling car will not accelerate to an unacceptably high speed between retarders. Booster-retarder units must be placed close enough together so that a hard rolling car can not stop between booster units.

REFERENCES

1. "Quasi-Continuous Speed Control in Gravity Yards Using The Dowty Retarder," Railway Gazette International, V.132, N.10, Oct 1976, pp. 376-381, Konig, H.

2. "Dowty Control System for Marshalling Yard," Railway Gazette, N.J. Alexander, Oct 1965.

3. "The Dowty Wagon Speed Control System," The Institute of Railway Signal Engineers, P.E. Checkley (Dowty Mining Equipment Ltd.), 1964.