

ALIGNMENT CHANGES - DESIGN AND PLAN REVIEW PROCEDURES

Permanent alignment changes and temporary alignments (shoo-flies) to facilitate construction activities on the main track should be designed to accommodate existing timetable speed. A conceptual layout of the new alignment will be prepared by Engineering Services and presented to the Division General Manager who will approve, in writing, the proposed speed.

Design of the shoo-fly will assume 110% of the approved speed. For example, if the approved speed is 60 MPH for freight, the design needs to be good for 66 MPH. Typically this means the spiral length needs to accommodate an additional 1.0 inch of super-elevation in the curve. This is to account for loss in elevation as the track settles. Final plans for alignment changes will be reviewed by Engineering Services and need to show plan/profile views with the following design criteria:

Horizontal Curves

- Engineering stationing on all curve points
 - TS – tangent to spiral
 - SC – spiral to curve
 - CS – curve to spiral
 - ST – spiral to tangent
- Degree of curvature (chord definition) in degrees, minutes, seconds
- Length of spirals (entry and exit lengths should be the same) to nearest foot
- Delta of tangents in degrees, minutes, seconds
- Super-elevation (SE)
- Calculated speed (freight and passenger, if applicable)
 - $\text{Square_root} \{ (\text{SE} + \text{Unbal Elev}) / (\text{Deg Cv in decimal form}) (0.0007) \}$
 - Unbal Elev = 2.0”- Freight, 3.0”- Passenger

Vertical Curves

- Engineering stationing and datum elevations on all curve points
 - PVC – point of vertical curve
 - PVI – point of vertical intersection
 - PVT – point of vertical tangency
- Grade (%) of entry and exit profile tangents to the nearest 0.01’
- Length of vertical curve
- Rate of change value (R)
 - $R = (\text{Algebraic diff in grades}) / (\# \text{ of } 100' \text{ stations})$

For alignments that allow a speed greater than 50 MPH, an as-built survey must be performed on the new alignment as soon as possible after it is placed in service, but after the last qualifying train as prescribed by Engineering Instruction 4.10. The as-built survey will locate centerline of track approximately every 50 feet for the entire length of the new alignment. A “best-fit” curve will be derived from the field measurements. A table showing design curve criteria vs. as-built data will be prepared and included in a plan/profile sketch with the same information as required in the final plan. The main

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purpose of the as-built survey is to make sure the new alignment will support the approved speed (plus 10% for a shoo-fly).

The as-built survey will also capture datum elevations for the low rail on the new track. A plot of this rail profile will be shown in the profile view of the survey sketch. The measured profile line should be in a different line style than the plan for clarity on the sketch.

Super-elevation (SE) shall be measured at the same points located for centerline and rail profile. A standard track level, tested for accuracy per EI 5.1.7, should be used. An average SE will be shown in the table of design vs. as-built data, and those measurements outside of allowable limits need to be communicated to the Roadmaster immediately.

EI Table 4-1 limits speed to 40 MPH until the required number of qualifying trains operates over the restricted track. Also, EI 4.10 requires the temporary speed restriction for passenger trains to remain in effect 24 hours longer than required for freight trains. The as-built data will need to be analyzed by Engineering Services prior to releasing speed restrictions to maximum authorized speed. The analysis, with Engineering Services approval and/or comments and recommendations, will be forwarded to the Division Engineer and Division General Manager.

The Geometry Car should be run over the new alignment as soon as possible after cut-over, when practicable. This will give a check to the as-built survey as well as determine areas where loss (or excessive gain) in super-elevation has occurred.

Super-elevations on the new trackage will be maintained by the Roadmaster. Periodic measurements will need to be taken to ensure the proper super-elevation is maintained to support the approved speed. This spot-surfacing activity can be done any time and should not be deferred until the as-built survey is performed.

For temporary alignments, after construction, an as-built survey will also need to be performed on the main track prior to releasing any speed restrictions to timetable speed. The same criteria apply to this survey, sketch and analysis as the shoo-fly as-built survey.

The as-built surveys should be performed by a consultant independent of the original design, or by BNSF employees. The survey and Task Order will be scheduled well in advance of the cut-over dates to ensure timely response.

Funding for the consultant will be provided for out of the authority for the track work associated with the project, and should be included in the estimate and any agreements with outside agencies. For estimating purposes \$10,000 should cover both surveys, and agencies will pay on actual charges through recollectible billing.