

May 31, 2019

The following analysis was performed as a demonstration of MicroStation combined with AutoTURN (Transoft Solutions) for determining the viability of using the two softwares for assessing unique truck configurations with respect to the turning radius and off-set values of the trucks. The analysis was performed by the North Dakota State University – Upper Great Plains Transportation Institute DOT Support Center (DOTSC) students under the guidance of the NDDOT DOTSC design supervisor Aaron Murra. The example trucks and specific steering and offset values were supplied by TranSystems of Great Falls MT. The example trucks shown in this document do not show the individual axle spacings needed to perform the analysis as that is confidential information and is only supplied by the proposer during the analysis. This demonstration, however, shows that government engineers and consultants with access to MicroStation and AutoTURN can apply unique truck configurations to the analysis package for assessment of the impacts of longer trucks to individual intersections.

Tim Horner – NDSU-UGPTI Program Director

AutoTURN Inputs

Summary: Profile information for three tractor-trailer combination vehicles was provided by Transystems LLC. Three turning templates were created using AutoTURN software based on the provided vehicle information. The turning templates show a 180° turn and paths for the front outside wheel and overhang, the rear inside wheel, and the centerline turning radius. Default and assumed values for AutoTURN inputs are summarized in the following document.

1. Vehicle 1

- a. Lock to Lock Time: 6.0 sec – AutoTURN default setting
- b. Steering Lock Angle: 17.7° – Controlled by articulating angle
- c. Tractor Width: 8.0 ft – AutoTURN default setting
- d. Trailer Width: 8.5 ft – AutoTURN default setting
- e. Articulating Angle: AA1 = 45° AA2 = 70° – AASHTO Green Book values for WB-92D design vehicle
- f. Pitch: 20° – AutoTURN default setting
- g. Centerline Turning Radius (CTR): 48.0 ft – Controlled by articulating angle

2. Vehicle 2

- a. Lock to Lock Time: 6.0 sec – AutoTURN default setting
- b. Steering Lock Angle: 17.2° – Controlled by articulating angle
- c. Tractor Width: 8.0 ft – AutoTURN default setting
- d. Trailer Width: 8.5 ft – AutoTURN default setting
- e. Articulating Angle: AA1 = 45° AA2 = 70° – AASHTO Green Book values for WB-92D design vehicle
- f. Pitch: 20° – AutoTURN default setting
- g. Centerline Turning Radius (CTR): 49.0 ft – Controlled by articulating angle

3. Vehicle 3

- a. Lock to Lock Time: 6.0 sec – AutoTURN default setting
- b. Steering Lock Angle: 28° – Controlled by articulating angle
- c. Tractor Width: 8.0 ft – AutoTURN default setting
- d. Trailer Width: 8.5 ft – AutoTURN default setting
- e. Articulating Angle: AA1 = 70° – AASHTO Green Book value for WB-67 design vehicle
- f. Pitch: 20° – AutoTURN default setting
- g. Centerline Turning Radius (CTR): 34.1 ft – Controlled by articulating angle

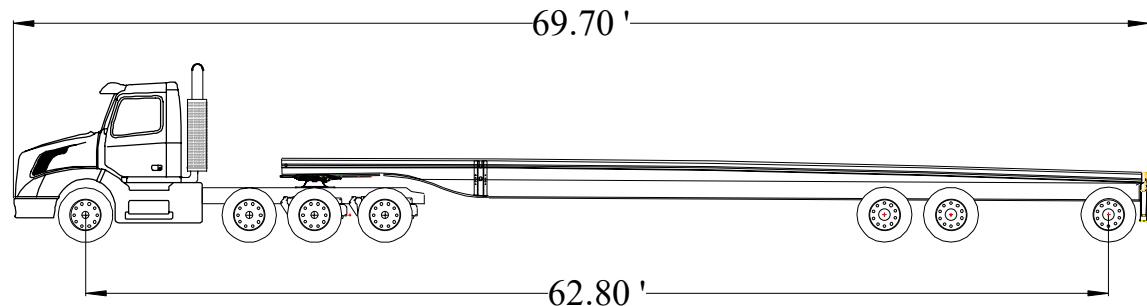
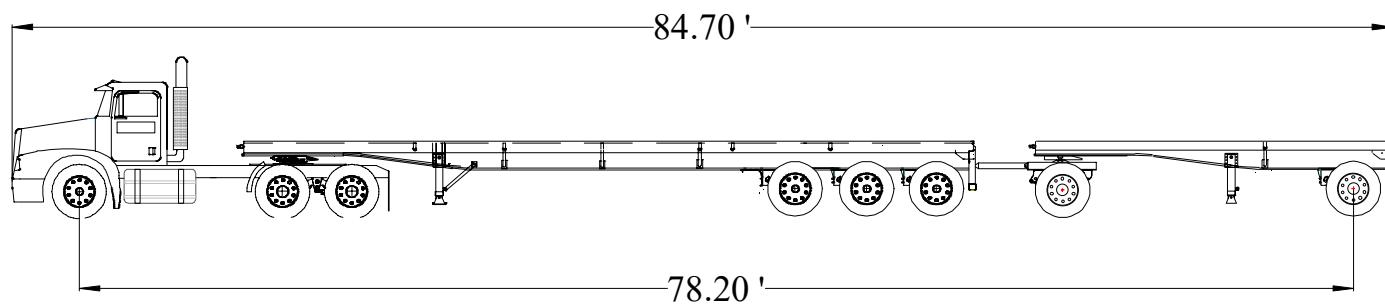
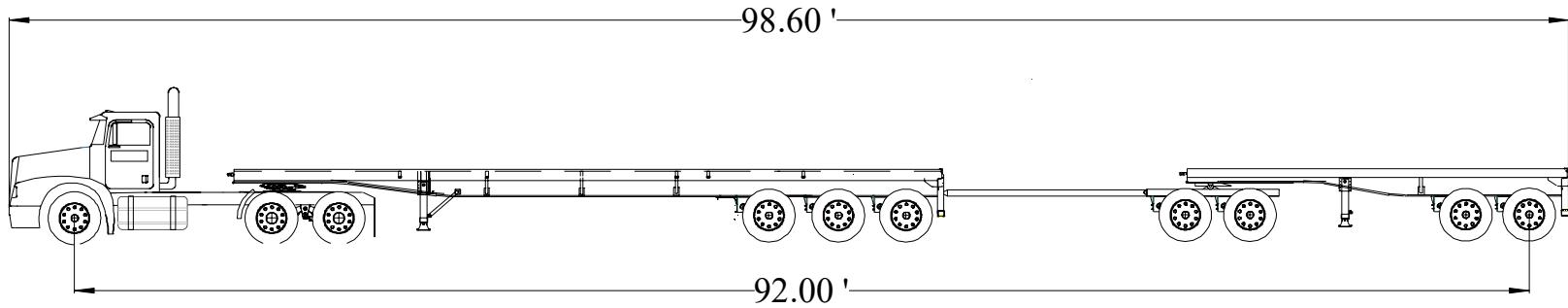
4. Definitions

- a. *Steering angle* – The average of the angles made by the left and right steering wheels with the longitudinal axis of the vehicle when the wheels are turned to their maximum angle. This maximum angle controls the minimum turning radius of the vehicle [AASHTO, 2018].

- b. *Articulating angle* – The angle between adjoining units of a tractor/semitrailer when the combination unit is placed into a turn; this angle is measured between the longitudinal axes of the tractor and trailer as the vehicle turns. The maximum tractor/trailer angle occurs when a vehicle makes a 180-degree turn at the minimum turning radius; this angle is reached slightly beyond the point where maximum swept path width is achieved. A combination vehicle with more than one articulating part will have more than one articulating angle. The articulating angles are designated as AA1, AA2, etc., starting from the front to the end of vehicle [AASHTO, 2018].
- c. *Centerline Turning Radius (CTR)* – The turning radius of the centerline of the front axle of a vehicle with its steering wheels at the steering lock position [AASHTO, 2018].

c. Reference

AASHTO (American Association of State Highway and Transportation Officials). *A Policy on Geometric Design of Highways and Streets*, 7th edition, AASHTO, Washington, DC, **2018**.

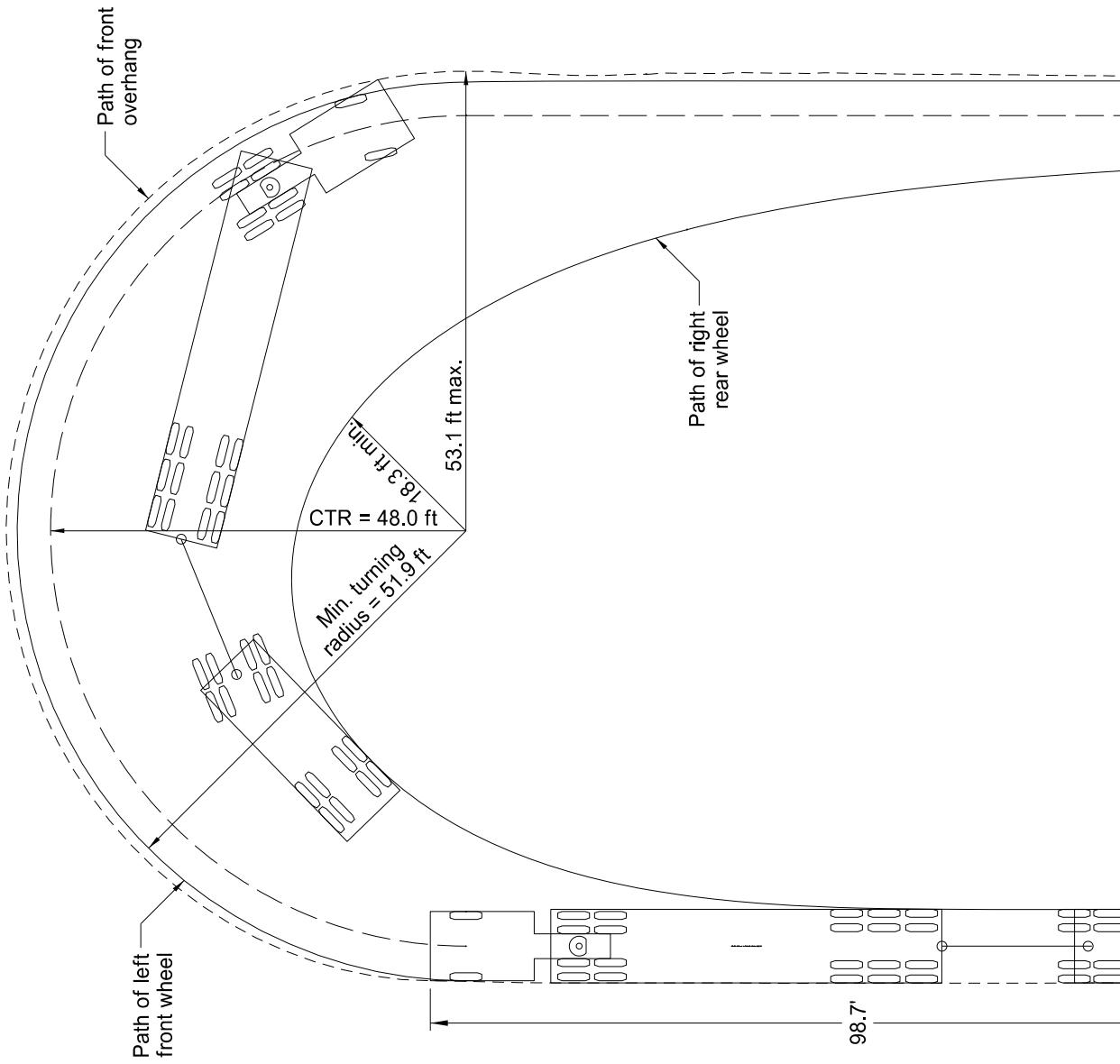


Title / Description

General Arange
North Dakota

12/27/18

Not to Scale



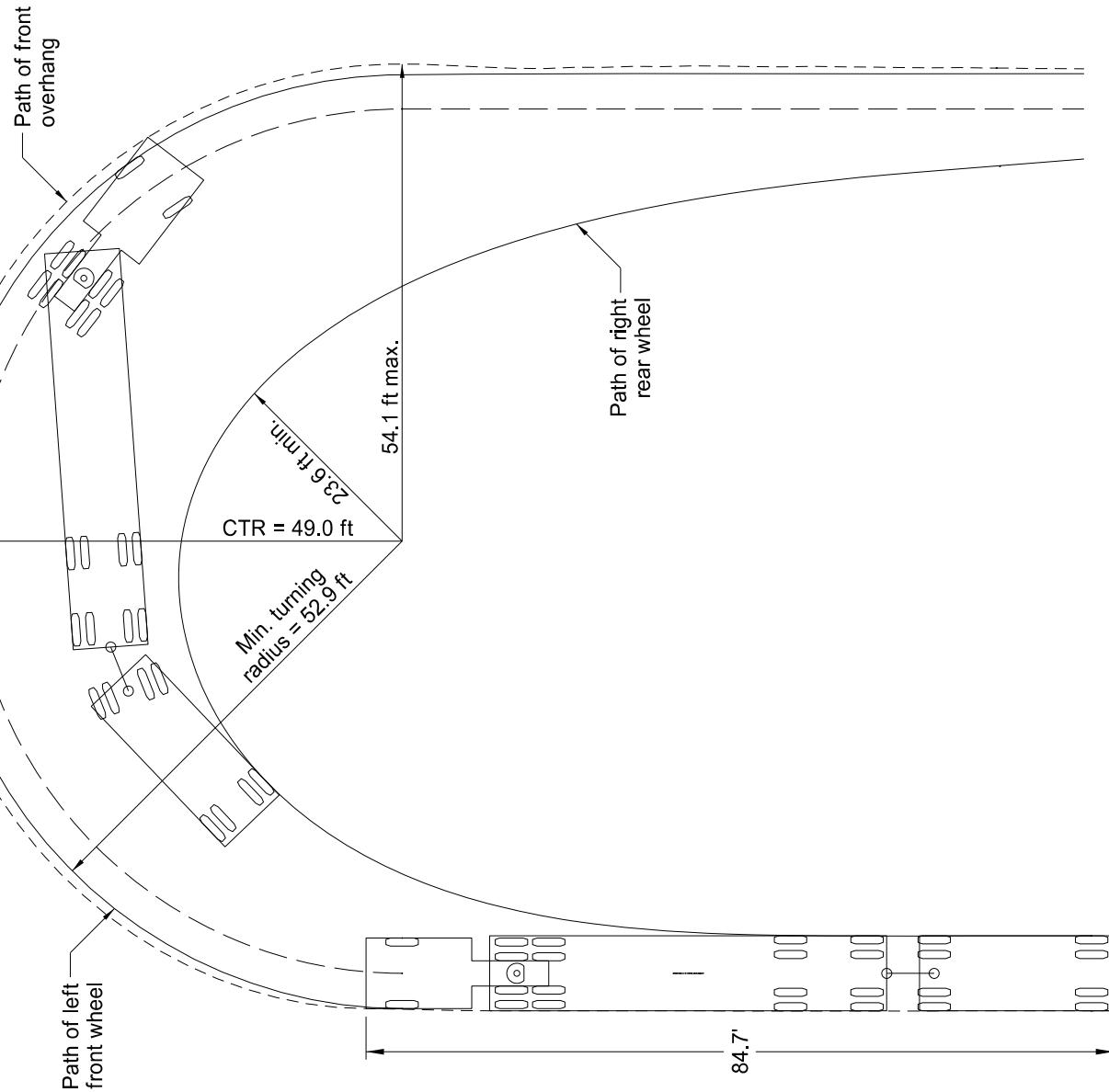
Assumed or Default Values	
Lock to Lock Time (sec)	6
Steering Lock Angle (deg)	17.7
Tractor Width (ft)	8
Trailer Width (ft)	8.5
AA1 (deg)	45
AA2 (deg)	70
Pitch (deg)	20

CTR = Centerline Turning Radius
 AA1 = Articulating Angle Between Tractor and Trailer
 AA2 = Articulating Angle Between Trailers

Vehicle 1
 Scale: 1"=20'

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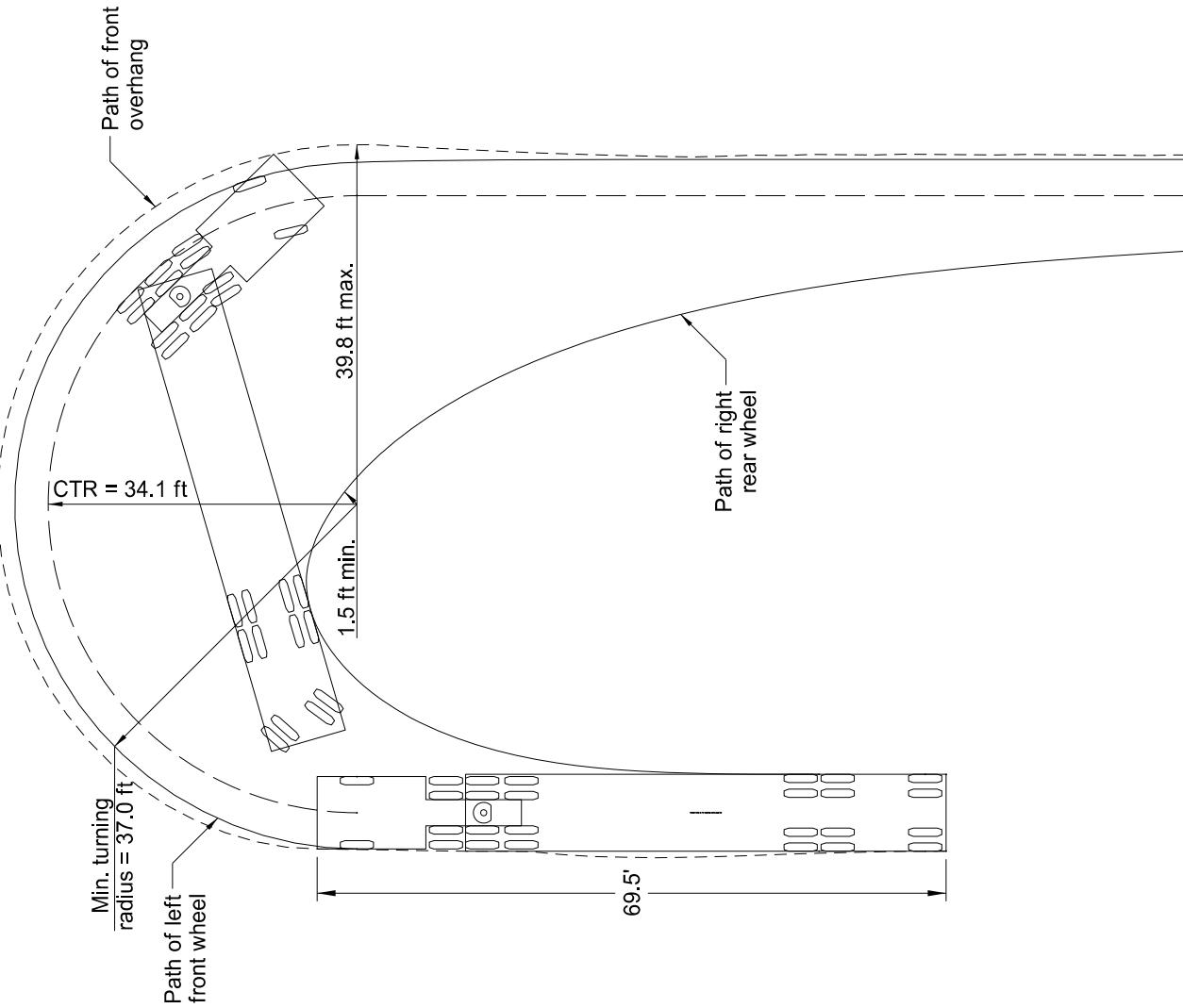


Assumed or Default Values	
Lock to Lock Time (sec)	6
Steering Lock Angle (deg)	17.2
Tractor Width (ft)	8
Trailer Width (ft)	8.5
AA1 (deg)	45
AA2 (deg)	70
Pitch (deg)	20

CTR = Centerline Turning Radius
 AA1 = Articulating Angle Between Tractor and Trailer
 AA2 = Articulating Angle Between Trailers

Vehicle 2

Scale: 1"=20'



Assumed or Default Values	
Lock to Lock Time (sec)	6
Steering Lock Angle (deg)	28
Tractor Width (ft)	8
Trailer Width (ft)	8.5
AA1 (deg)	70
Pitch (deg)	20

CTR = Centerline Turning Radius
 AA1 = Articulating Angle Between Tractor and Trailer

Vehicle 3
 Scale: 1"=20'

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