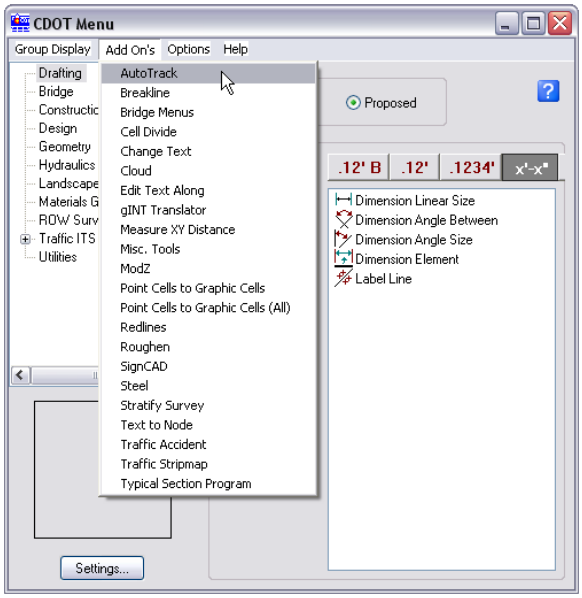
Using AutoTrack

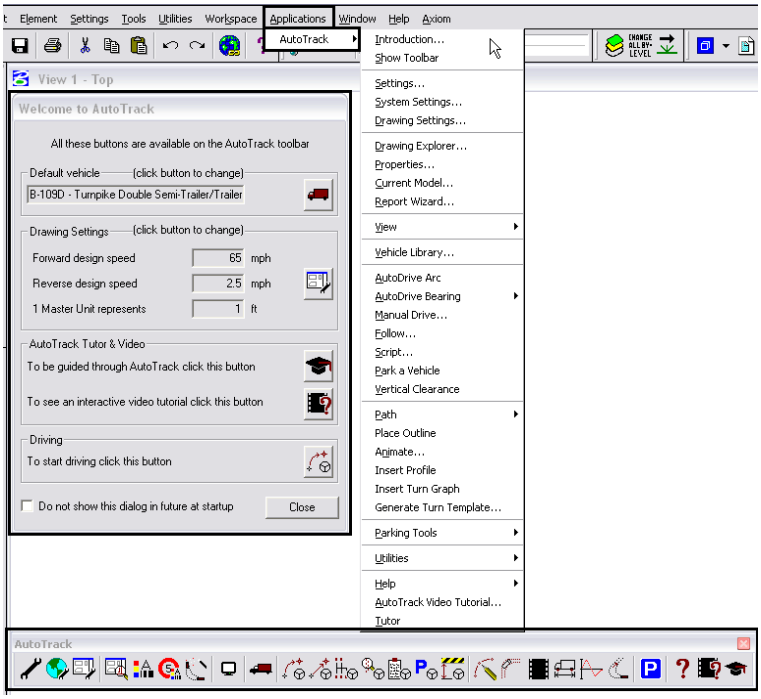
This document guides you through the use of the AutoTrack software. AutoTrack is used to determine the space required to maneuver vehicles.

Opening AutoTrack

1. From the CDOT Menu, select **Add On's > Launch AutoTrack**.



2. Depending on the skill level setting for AutoTrack, up to three AutoTrack menus will appear. On the MicroStation Menu bar, the **Applications** pull-down can be used to access the AutoTrack commands. An AutoTrack toolbar will also displayed. If the skill level is set to **Novice**, the **Welcome to AutoTrack** wizard is displayed.



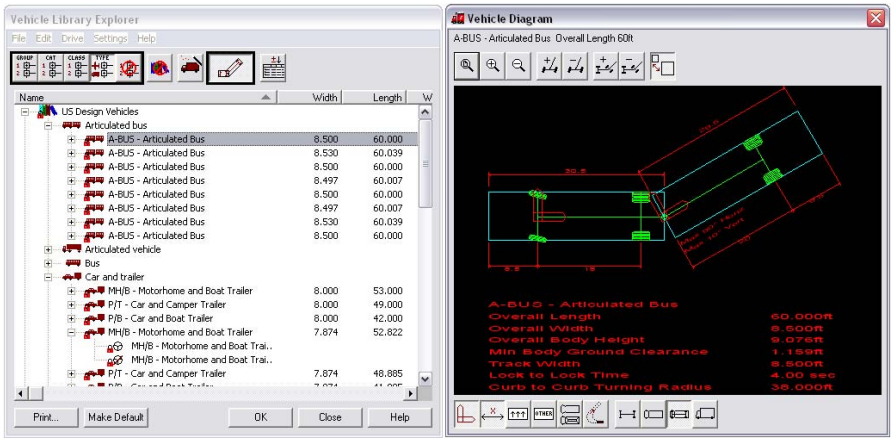
Setting up AutoTrack

There are a number of settings that control the behavior of AutoTrack. These settings include: Vehicle size, Units of measure, Scale, Tracking Point, Model, Speed, and Dynamics.

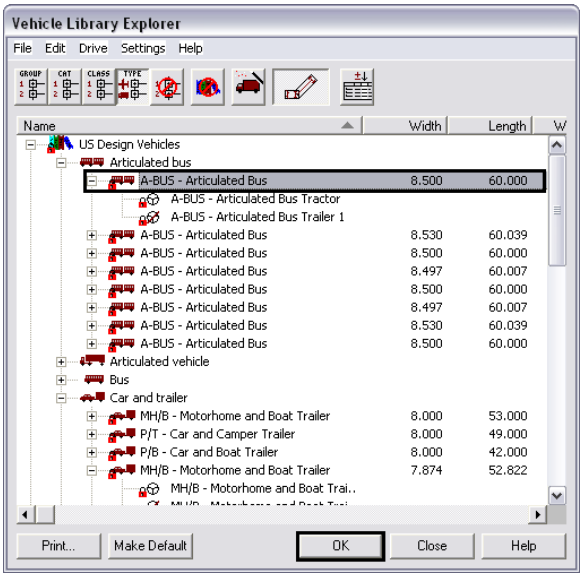
Selecting a Vehicle

1. **<D>** the AutoTrack Explore Library button from the toolbar to display the Vehicle Library Explorer.

2. The vehicles in the library can be sorted by **Group**, **Category**, **Classification**, or **Type**. They can also be left unsorted. **<D>** one of the five buttons to choose a sorting method. **<D>** the **Vehicle Diagram** button to display a picture and data of highlighted vehicle.



3. To select a vehicle, highlight the name from the list box on the left, and **<D> OK**. The **Vehicle Library Explorer** and **Vehicle Diagram** dialog boxes will be dismissed.

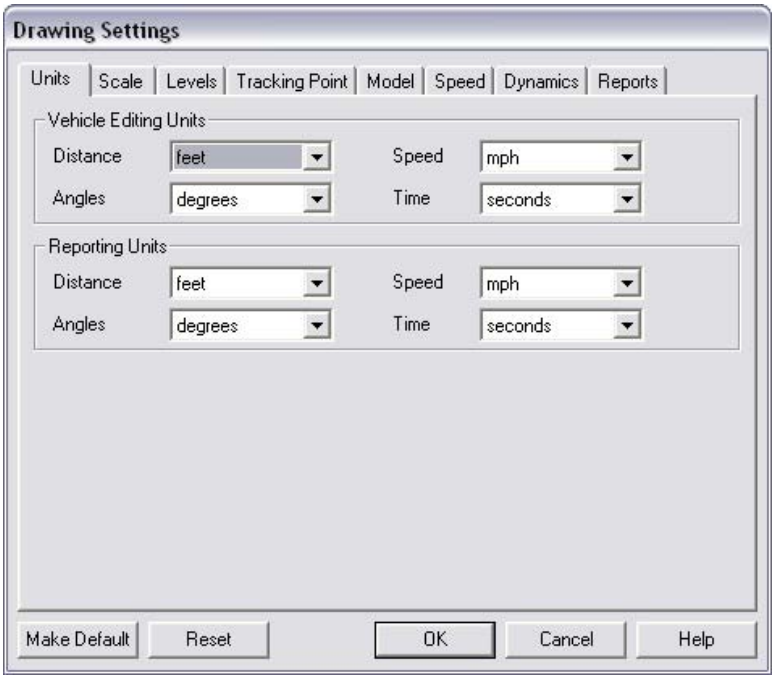


Drawing Settings

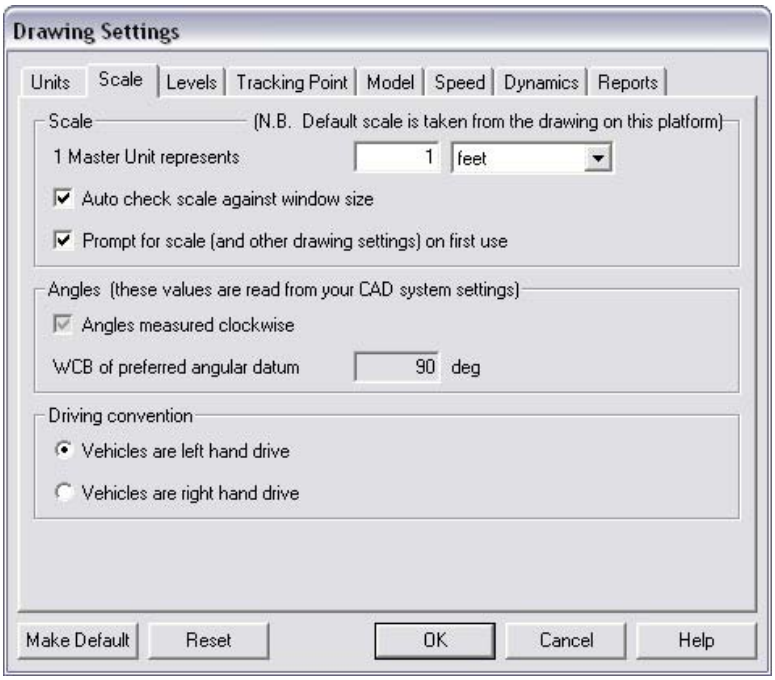
The remaining settings mentioned above are controlled through the **AutoTrack Drawing Settings** dialog box.

1. **<D>** the **AutoTrack Drawing Settings** button from the toolbar to display the **Drawing Settings** dialog box.

2. The first tab on the **Drawing Settings** dialog box is the **Units** tab. There are two areas on this tab. **Vehicle Editing Units** settings control the units governing a vehicles performance as well as the graphic elements displayed in MicroStation. **Reporting Units** determines the units use for AutoTrack generated reports. The settings used should reflect those shown in the diagram below.

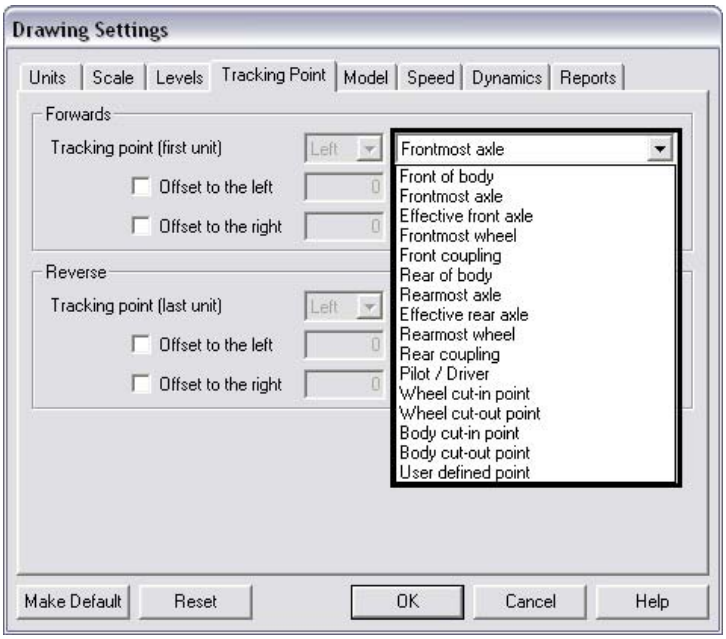


3. Select the **Scale** tab. There are two areas on this tab that can be modified; **Scale** and **Driving Convention**. The **Angles** area is controlled through MicroStation and is for informational purposes only. The **Scale** settings should reflect the Master Units in MicroStation (typically 1 Feet). The **Driving Convention** area tells the program where the driver sits in the vehicle. In the U.S., **Vehicles are left hand drive**.

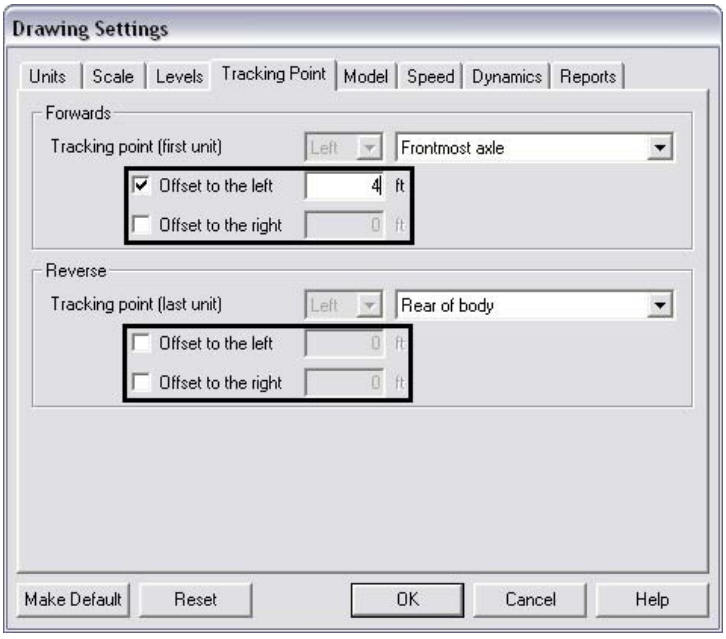


Note: There are two check boxes in the **Scale** settings area. The **Auto check scale against window size** will warn the user if the MicroStation window is zoomed out too far to accurately place the driving path. **The Prompt for scale (and other drawing settings) on first use** displays the **Drawing Settings** dialog box (with the Scale tab showing) the first time a path is being defined. The **Drawing Settings** dialog box will not display for subsequent paths. These can be turned on or off depending on your preference.

4. Select the **Tracking Point** tab. These settings define what part of the vehicle will follow the defined path. There are two areas on this tab; **Forwards** and **Reverse**. **Forwards** controls the tracking point when the vehicle is moving forward and **Reverse** controls the tracking point when the vehicle is backing up. Use the drop-down list to select the desired tracking point. **Frontmost axle** and **Pilot / Driver** are most commonly used for Forwards and **Rear of body** for Reverse.

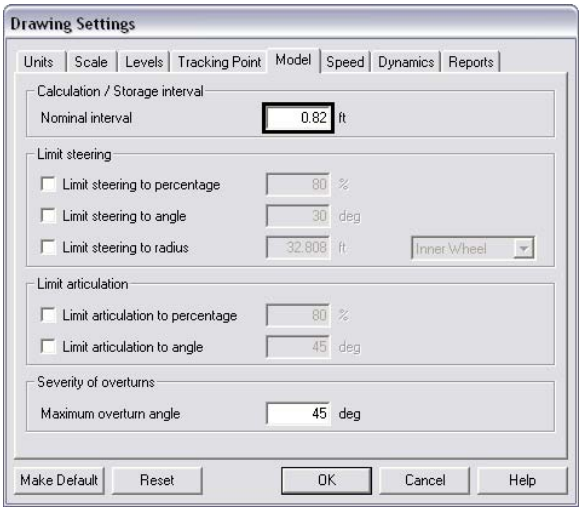


There are also two check boxes in the **Forwards** and **Reverse** areas. These checkboxes are labeled **Offset to the left** and **Offset to the right**. These are used to move the tracking point to the left or right of the selected location on the vehicle. To use an offset, indicate the offset side, then key in a value in the field to the right of the checkbox.



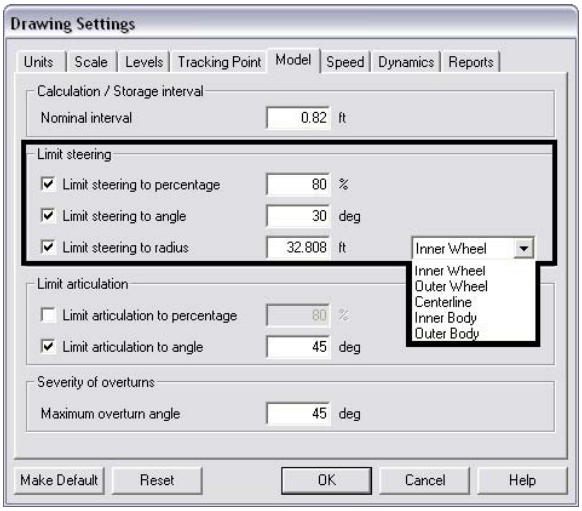
5. Select the **Model** tab. This tab contains four areas; **Calculation / Storage interval**, **Limit Steering**, **Limit articulation**, and **Severity of overturns**. The settings default to those applied to the vehicle.

   In the **Calculation / Storage interval** area, the **Nominal interval** sets how often data is collected as the vehicle runs along the path. A smaller number collects more data but takes longer to process. A larger number collects less data and is faster but less accurate. Values between 0.083 and 4.92 can be used. To change the interval, type a new value in the field, overwriting the current setting.



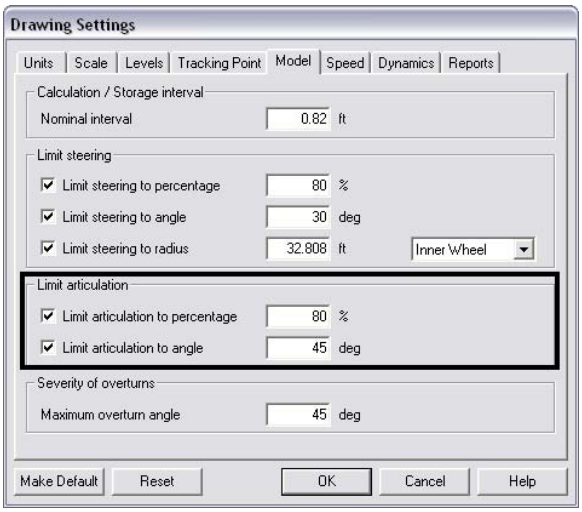
Limit Steering and ***Limit articulation*** change the vehicle's performance. Steering determines turning radius of the tractor. Under ***Limit Steering***:

- **Limit steering to percentage -** reduces the steering angle to percentage indicated.
- **Limit steering to angle-** sets a maximum steering angle.
- **Limit steering to radius-** sets a minimum radius the vehicle can turn in. With this a drop-down list is provided with options that can be used to indicate from where on the vehicle the radius is measured.



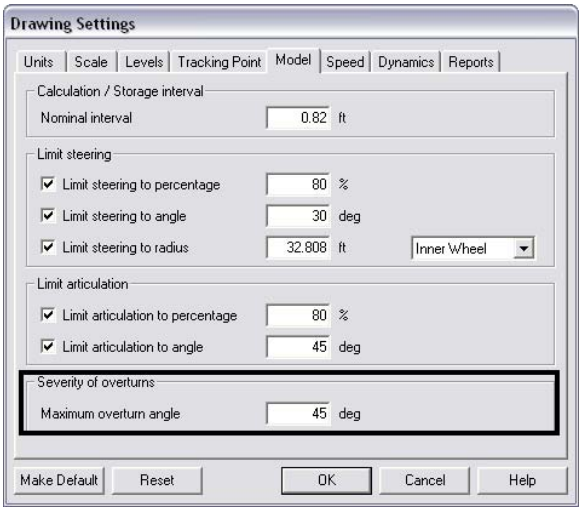
Articulation is the angle of the trailer in relation to the tractor. Under ***Limit articulation***:

- **Limit articulation to percentage -** reduces the articulation angle to percentage indicated.
- **Limit steering to angle-** sets a maximum articulation angle.



Overturn is when a vehicle swings out in the opposite direction or continues forward some distance before making a turn. The ***Severity of overturns*** area is used to define the amount of overturn to be used.

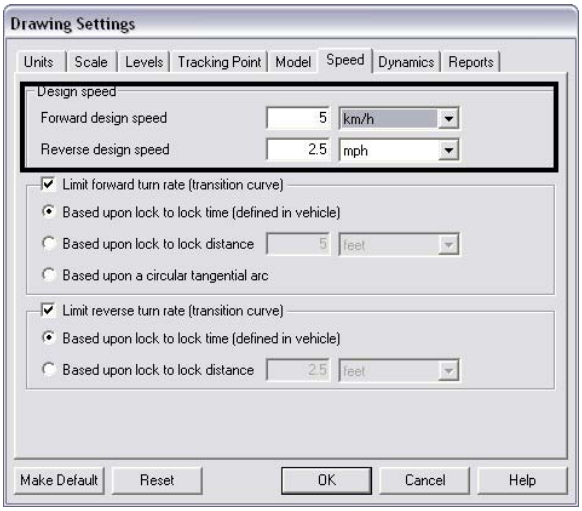
- **Maximum overturn angle-** sets the maximum angle of the vehicle's wheels off of the intended path if no overturn were used.



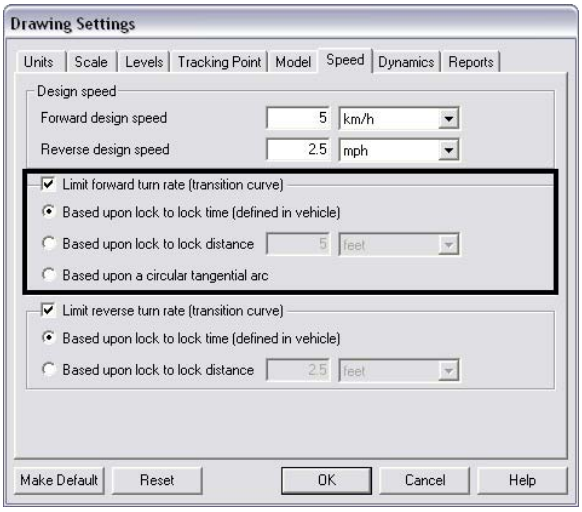
6. Select the **Speed** tab. This tab contains three areas: ***Design Speed***, ***Limit forward turn rate(transition curve)***, and ***Limit reverse turn rate(transition curve).***

   The **Design Speed** is the speed used to calculate the path of the vehicle. The design speed can be set differently for forward and reverse.

   - **Forward design speed**- The key in field is used to set the value for the forward design speed. The drop down menu is used to set the unit for the design speed
   - **Reverse design speed**- The key in field is used to set the value for the reverse design speed. The drop down menu is used to set the unit for the design speed.



The ***Limit forward turn rate(transition curve)*** models the time and distance traveled forward whilst turning the steering wheel. This is done so that the wheels do not go from straight ahead to fully turned in an instant. There are three options for the forward turn rate:

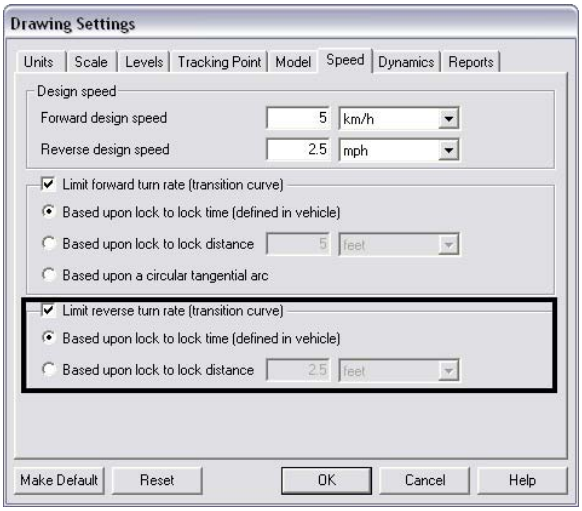


   - **Based upon lock to lock time (defined in vehicle)**- Each vehicle profile has a Lock to Lock time. This is the amount of time it takes to

turn the wheel from a full turn in one direction to a full turn in the other direction. The vehicle's path is calculated using the design speed (above) and the lock to lock time of the vehicle.

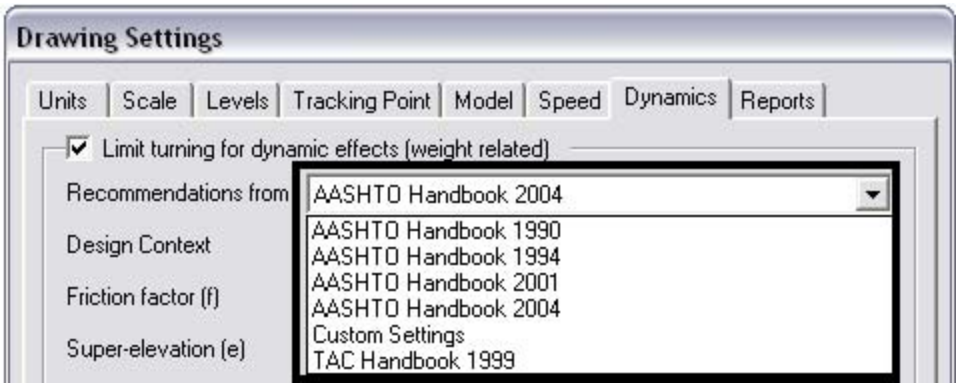
- **Based upon lock to lock distance**- This option specifies a set distance traveled for the lock to lock time. This option does not use the design speed in the path calculations.
- **Based upon a circular tangential arc**- This option forces the steering point of the vehicle to follow a perfectly circular path around the curve. This method does not use design speed or lock to lock time. This is the method used by AASHTO.

The ***Limit reverse turn rate(transition curve)*** works like the forward turn rate, except in reverse. There are only two options for limiting the reverse turn rate; **Based upon lock to lock time (defined in vehicle)** and **Based upon lock to lock distance**. The above descriptions apply to these options as well.

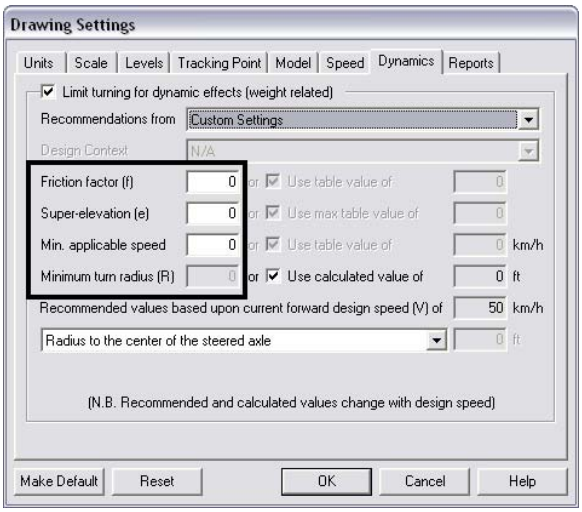


7. Select the ***Dynamics*** tab. This tab is used to apply conditional factors such as Friction or Superelevation to calculate the minimum turn radius.

   - Toggle on ***Limit turning for dynamic effects (weight related)*** to use the information on this tab.
   - **Recommendations From** is used to determine the source data for the calculations. The illustration below lists the various options.

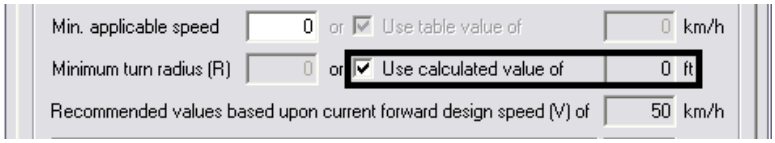


If ***Custom Settings*** is selected, the fields on the left side of the dialog box are activated for user input.

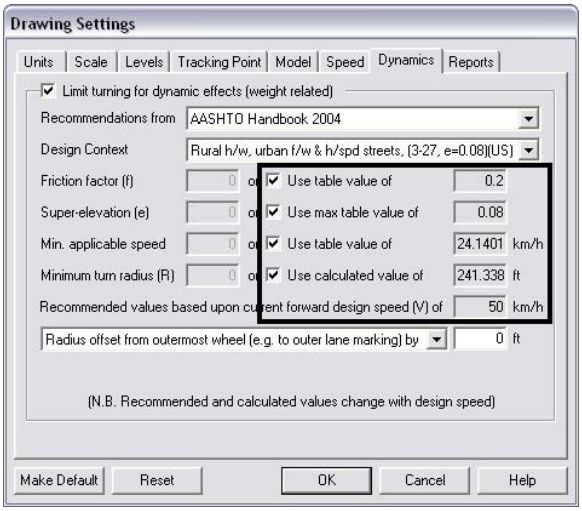


From top to bottom, the fields are: **Friction factor (f), Super-elevation (e), Min. applicable speed,** and **Minimum turn radius.**

A separate toggle determines if the **Minimum turn radius** field is available for user entry. If the **Use calculated value of** option is toggled on, the **Minimum turn radius** field is disabled and the minimum turn radius will be calculated based on the data entered above.

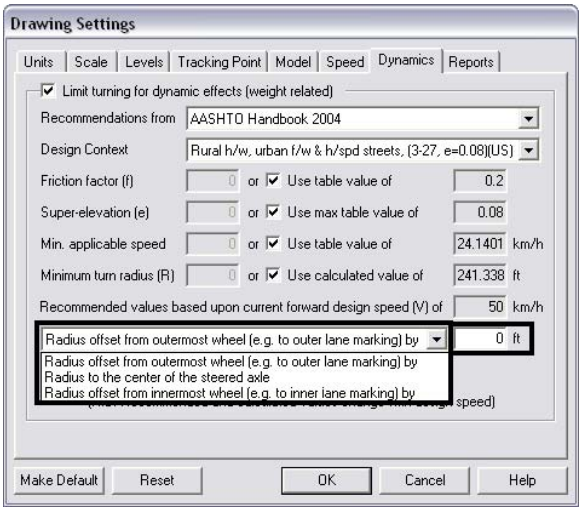


If one of the AASHTO or TAC Handbooks is selected, the fields on the left will be disabled and the calculations will be made with data from the specified handbook. Toggles are provided to turn on or off: **Friction factor (f)**, **Super-elevation (e)**, **Min. applicable speed**, and **Minimum turn radius**.



The drop down menu at the bottom of the dialog box is used to specify what part of the vehicle will follow the radius specified. There are three options; ***Radius offset from outermost wheel (e.g. to outer lane marking) by, Radius to the center of the steered axle,*** and ***Radius offset from innermost wheel (e.g. to inner lane marking) by*****.**

- **Radius to the center of the steered axle-** This places the center of the vehicle on the calculated radius.
- **Radius offset from outermost wheel by**- This option puts the radius on the outside lane marking. When selected, the **ft** field becomes active. Use this field to specify a distance from the lane marking for the radius.
- **Radius offset from innermost wheel by-** This option puts the radius on the inside lane marking. Use the **ft** field to specify a distance from the lane marking for the radius.



Creating a Path

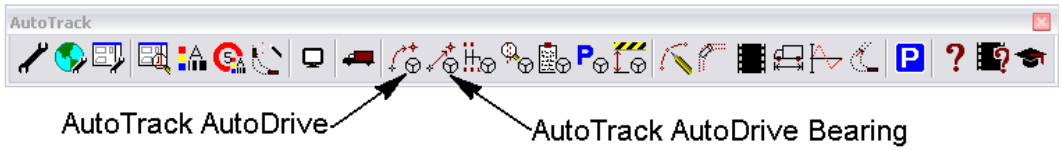
Once the desired settings have been made, a path can be created for the vehicle to use. The two options described are **AutoDrive** and **Follow**. **AutoDrive** creates the path dynamically, based on user input. **Follow** uses an element displayed in the dgn file to create the path. The first two examples below will illustrate the AutoDrive and Follow options. The third example will use both AutoDrive and Follow to create a single path.

In the first example, the vehicle will travel up the northbound road around the curve to the intersection. It will then make a right turn onto the cross street. The maneuver around the curve will use standard AutoDrive, with **<D>** mouse clicks determining the radius and direction of the path. At the intersection the ***Turn onto bearing*** option will be used. Here the turning radius is based on the design speed and the degree of turn.

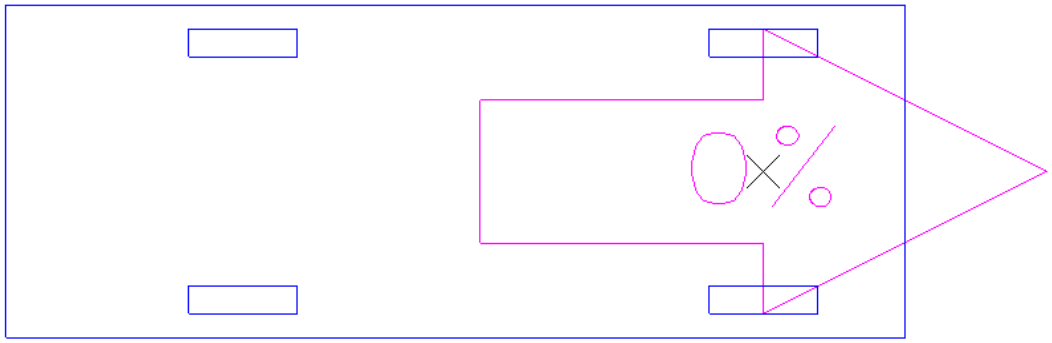
Creating a Path with AutoDrive

There are two icons on the AutoTrack toolbar that can be used to start AutoDrive; **AutoTrack AutoDrive** and **AutoTrack AutoDrive Bearing.** Both display the same dialog box, the only difference is in the toggle settings in the **AutoDrive** dialog box.

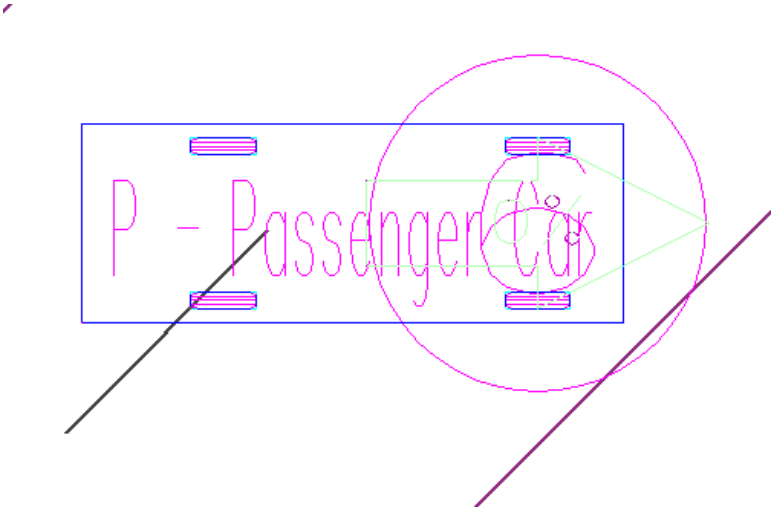
1. Zoom in on the area where the path is to begin.
2. Select one of the two **AutoTrack AutoDrive** icons.



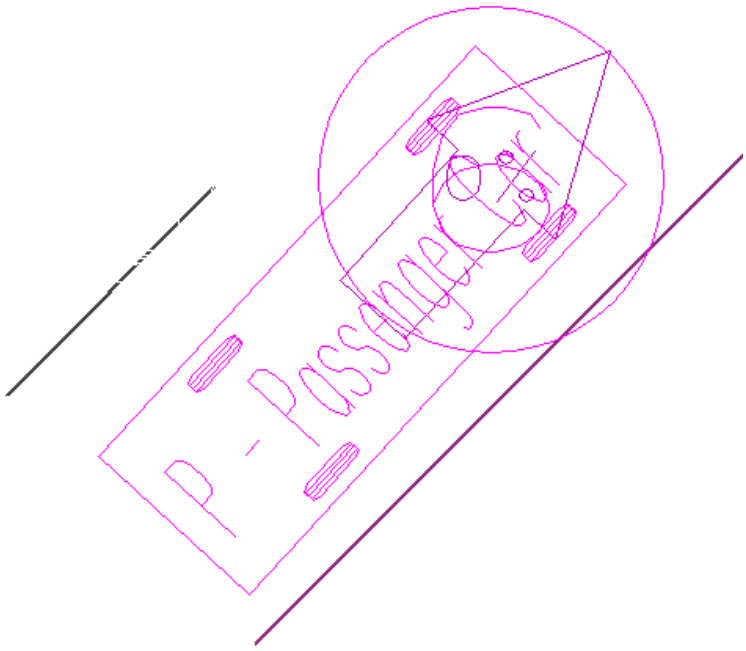
A cell of the vehicle is attached to the cursor.



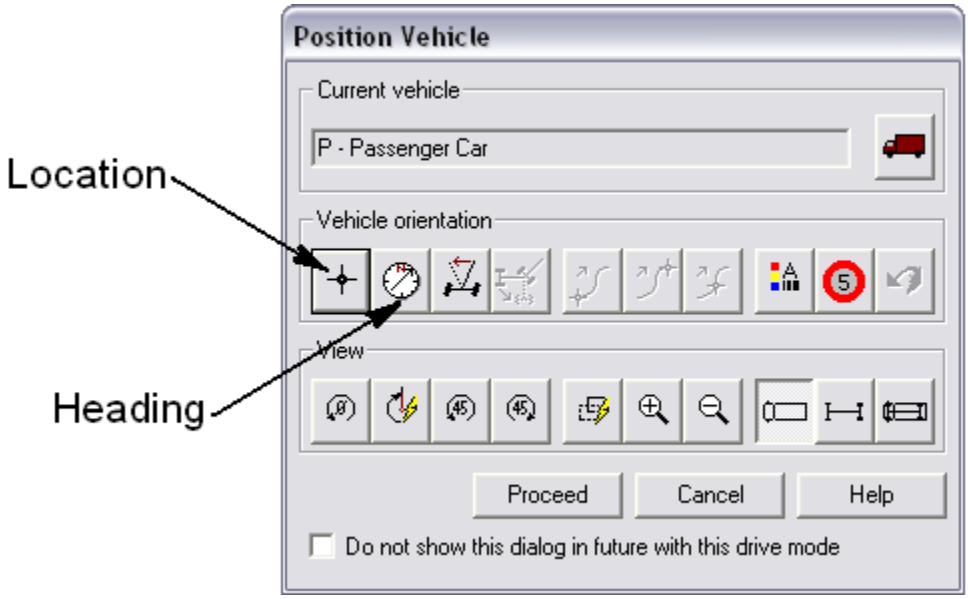
3. Move the cursor to the desired start point and **<D>** to identify the vehicle's starting location.



4. The vehicle cell will pivot around the selected location. Rotate the cell to the desired orientation and **<D>.**



5. The Position Vehicle dialog box will display. If the cell is not located in the exact position it should be, it can relocated at this time. Use the **Location** icon to change the vehicle's starting position (it will maintain its orientation). Use the **Heading** icon to rotate the cell while maintaining its position.

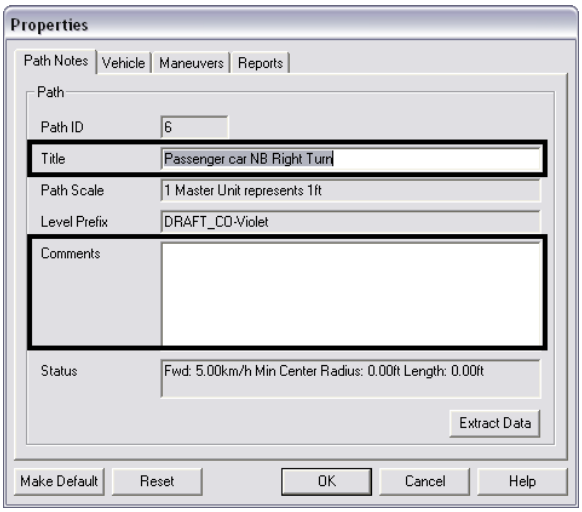


Note: The MicroStation view controls are operational during this procedure. Use them as needed to get the proper placement of the vehicle throughout the design of the path.

6. A number of the settings made above can be changed at this point if necessary. Use the following icons:

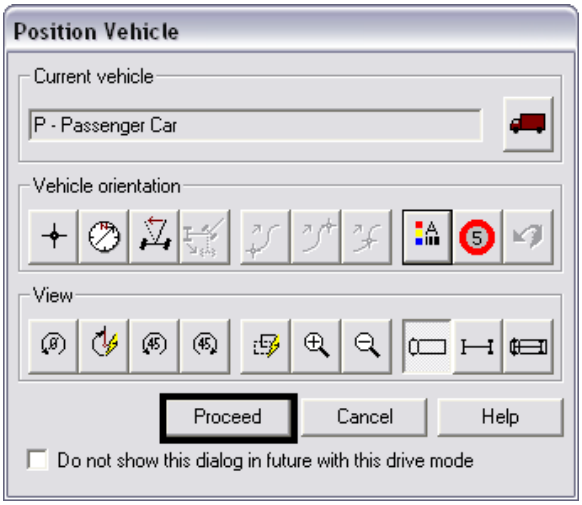
   Select Vehicle- Use to select a different vehicle profile (see steps 9 – 11 above).

   Autotrack Model Properties- This is used to change design speed, tracking point, dynamics, etc. (see steps 15 – 18 above).



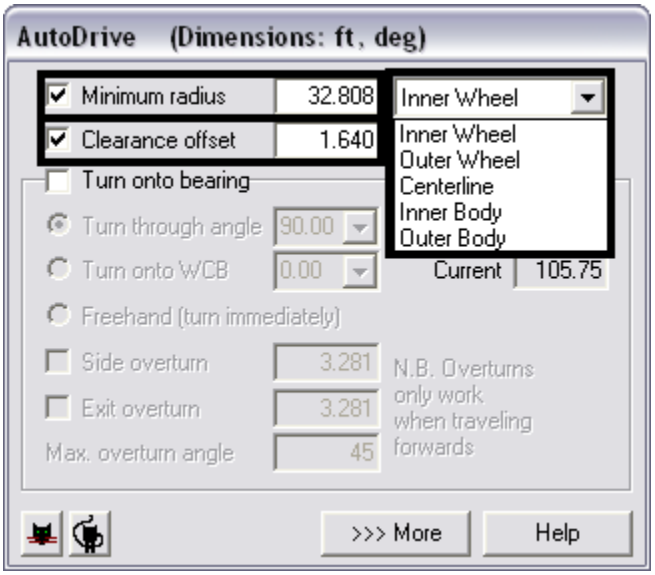
   Path Properties- A **Title** and **Comments** can be added to the path using this icon. A user can key in title information and comments at this point (optional). The other tabs are used for informational purposes only.

7. Once the cell is in position and any changes have been made to the settings, **<D>** the **Proceed** icon.

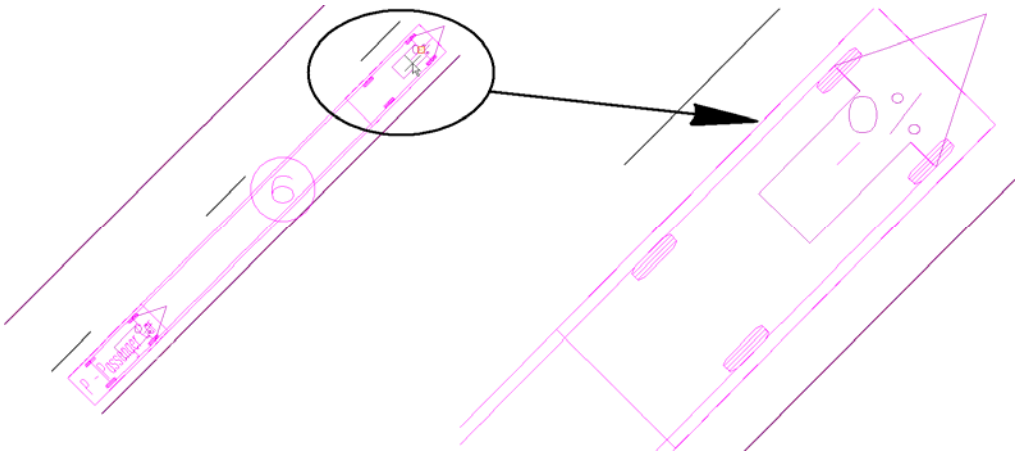


8. The **AutoDrive** dialog box is displayed. A number of settings (and setting overrides) can be made from this dialog box. The first two will be described here:

   - **Minimum Radius -** This is an override to the setting made on the ***Models*** tab of the **Drawings Settings** dialog box (step 16 above). Use the left field to key in the minimum radius. Use the drop down list to select the part of the vehicle that will follow the radius.
   - **Clearance Offset -** This displays a temporary line around the vehicle at the specified distance. It is used to show the additional space needed for the vehicle to avoid curbs and oncoming traffic.

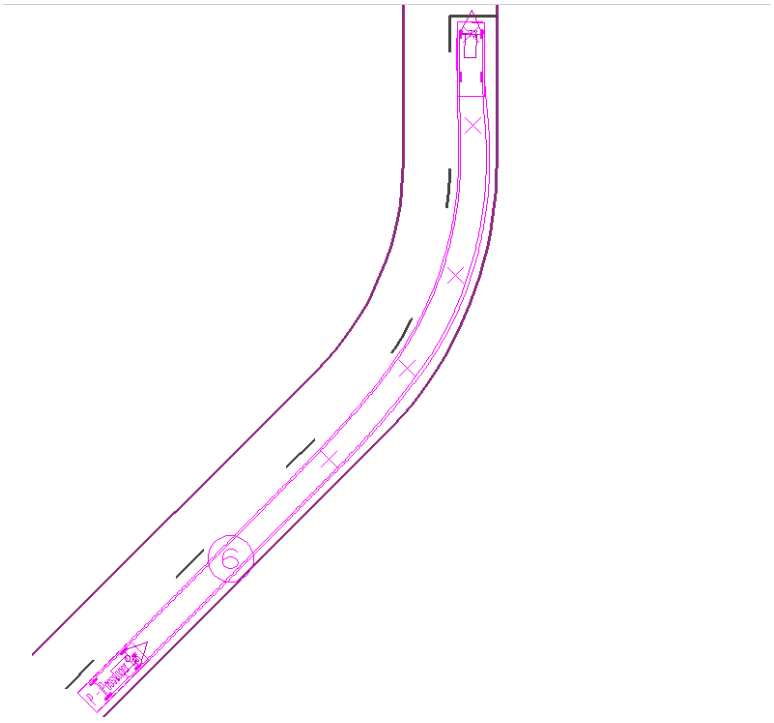


9. Position the cursor at the next position along the path and **<D>** to accept that location.



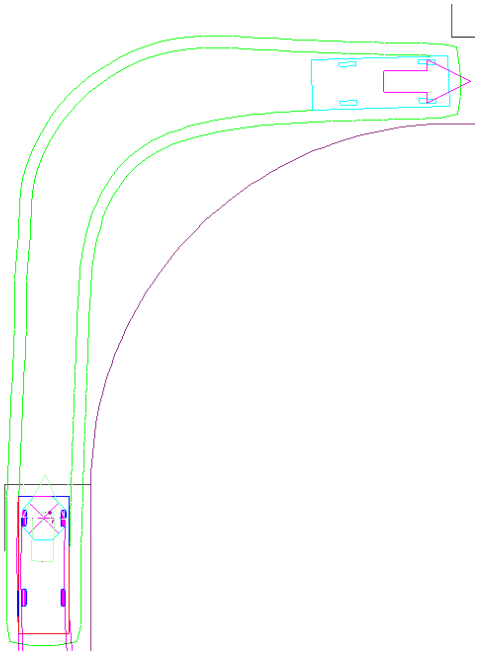
Note: As seen in the detail above, the percent that the wheels are turned is displayed on the cell. Be aware that this text is proportional to the cell and will be difficult to see when zoomed out.

10. Continue to **<D>** along the path of the vehicle. Each Data point will be indicated by an 'X' on the path.



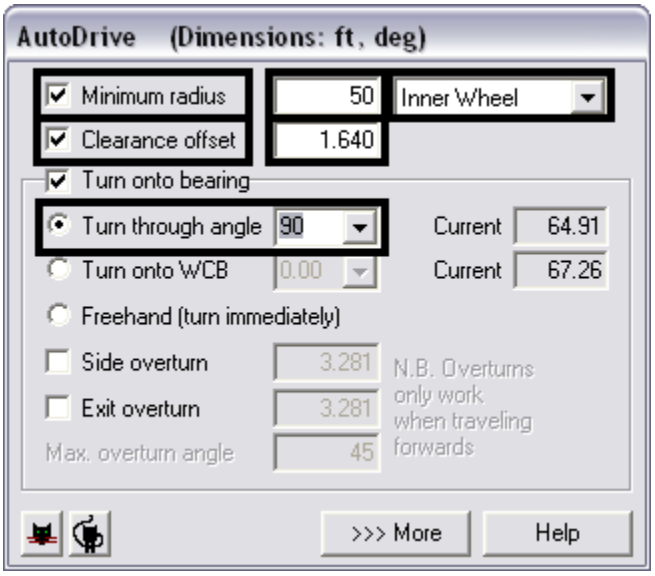
In the illustration above, the path has been defined around the bend and to the intersection.

At the intersection, a 90 degree right turn is required. This is done using the **Turn onto bearing** option. In addition to this option, the Minimum radius will also be reset. The default minimum radius for the vehicle selected is 32.808 feet while the street return radius is 50 feet. Using the default radius gives an undesirable result as illustrated below:

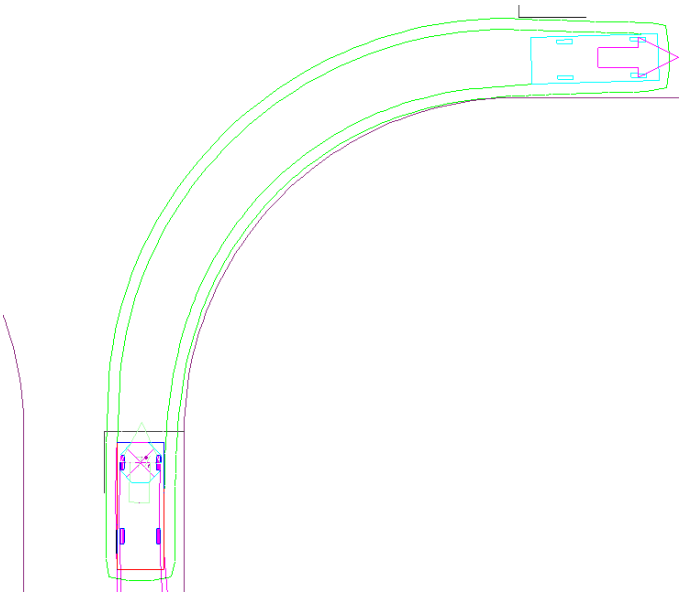


By resetting the ***Minimum radius*** to that of the street return and relocating the ***tracking point to the Inner Wheel*** a smoother maneuver can be accomplished. The use of the ***Clearance offset*** will help keep the vehicle off the curb and out of oncoming traffic.

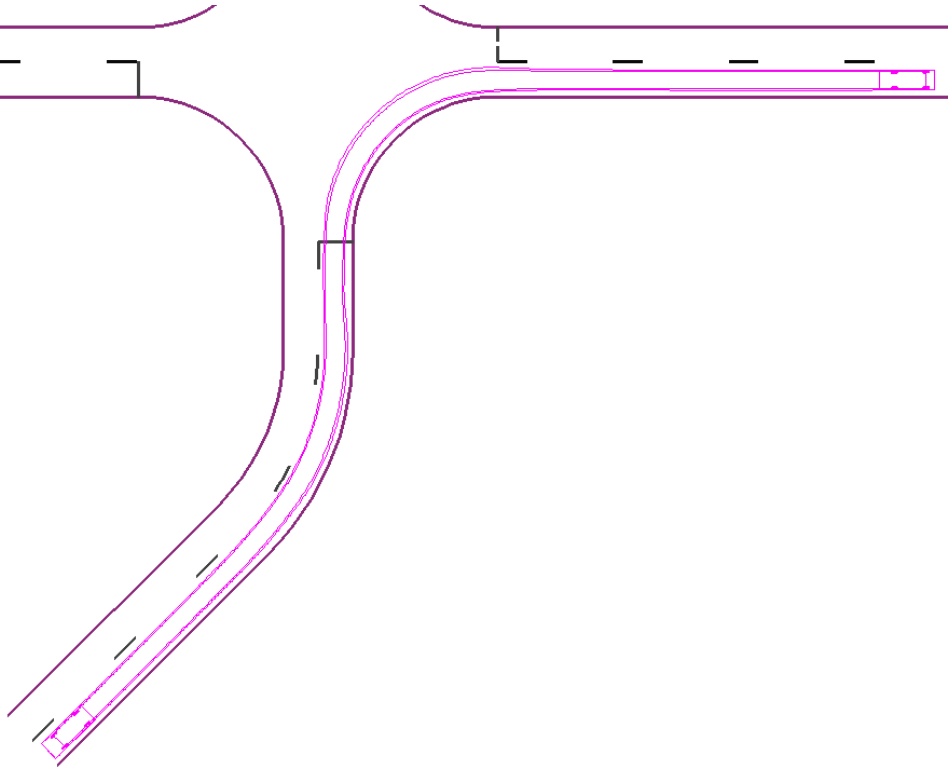
11. In the **AutoDrive** dialog box, toggle on **Minimum radius**. In the field to the right, key in the new radius (for this example **50** will be used).
12. From the drop-down list, select **Inner Wheel.**
13. Toggle on **Clearance offset** if it is not already on.
14. Toggle on **Turn onto bearing**.
15. Toggle on **Turn through angle**. From the adjacent drop-down list, select **90**.



16. Move the cursor to the center of the lane on the cross-street and **<D>**. As shown in the illustration below, a much smoother maneuver is achieved with the new settings.

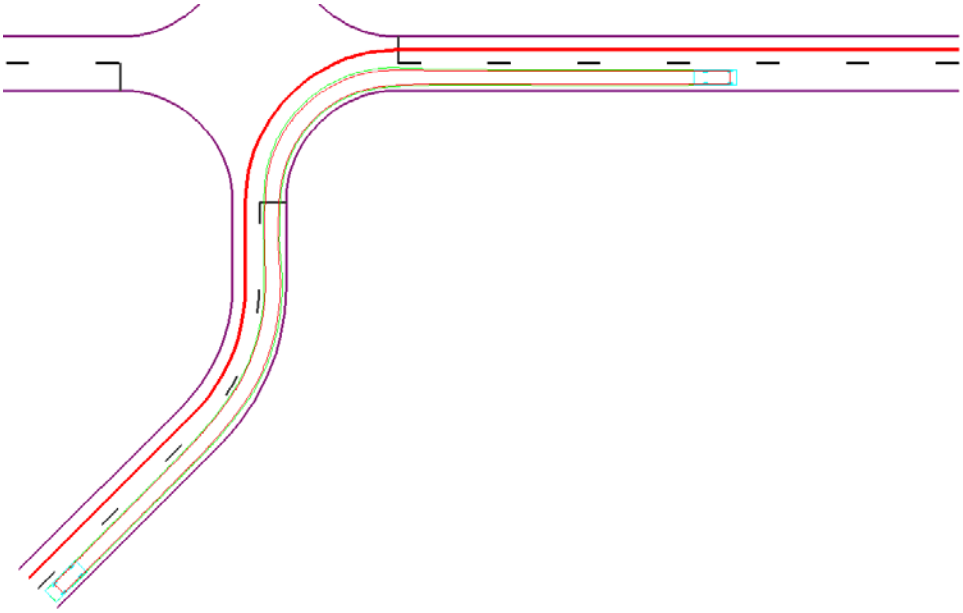


17. Move the cursor further down the road and **<D>** then **<R>** to complete the path. The Finished example is shown below:



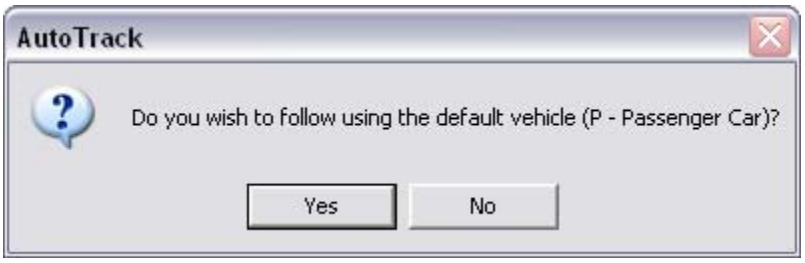
Creating a Path with Follow

As stated above the **Follow** command uses a graphic element to define the path of a vehicle. When working with contiguous elements, it is best to create a MicroStation ***Complex Chain*** from these elements. This will speed up the process by reducing the number of times the command must be selected in order to complete the path. In this example, the red line traveling east and making a left turn will be used to define the vehicle's path.



1. From the **AutoTrack** toolbar, select the **Follow** icon.

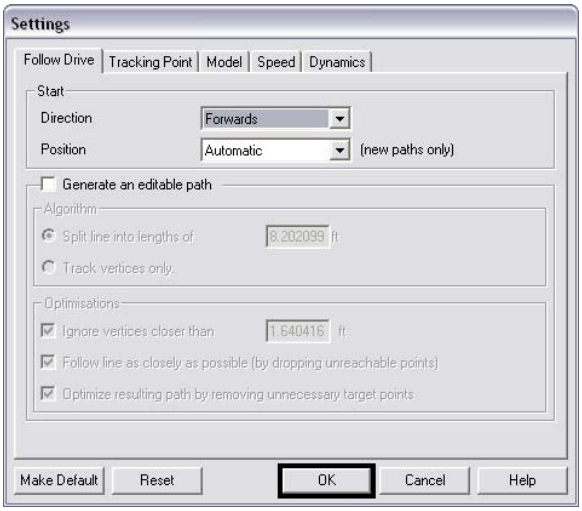
2. A message window appears asking, ***"Do you wish to follow using the default vehicle?"*** **<D> Yes** to use the default vehicle. If the **No** is selected, the **Vehicle Library Explorer** dialog box is displayed and a new vehicle can be selected.



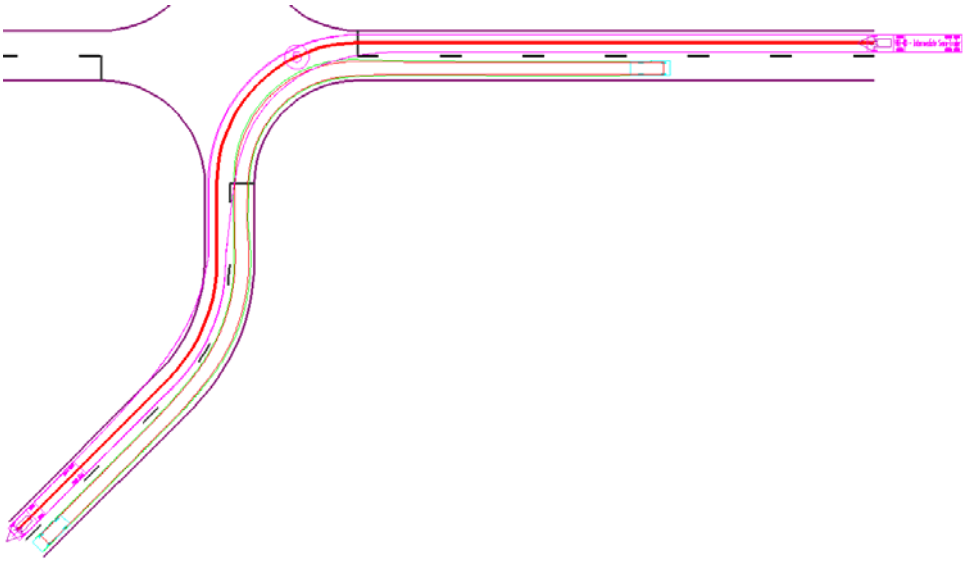
For this example, the ***WB-40 – Intermediate Semi-Trailer*** was selected.

3. The prompt in the lower left corner of the MicroStation window reads***, "Select Object to Follow"***. **<D>** on the element defining the vehicle's path near the beginning. The line will highlight. **<D>** again in a blank area to accept the element.

4. The **Settings** dialog box is displayed. Make any necessary changes in the settings, then **<D> OK**.



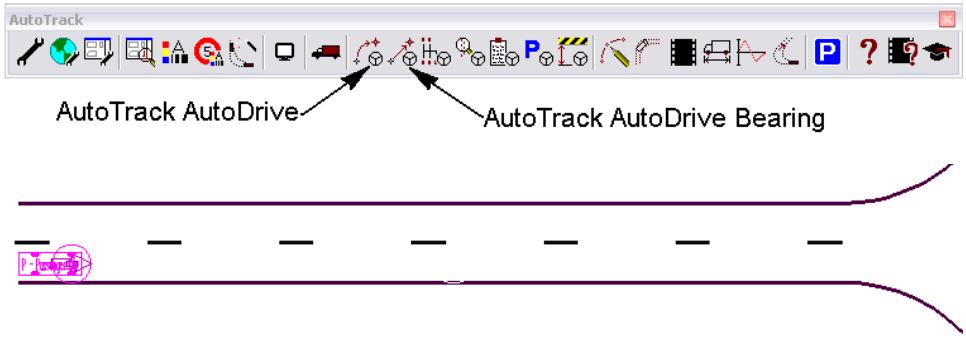
The path will automatically be created along the element as shown in the illustration below:



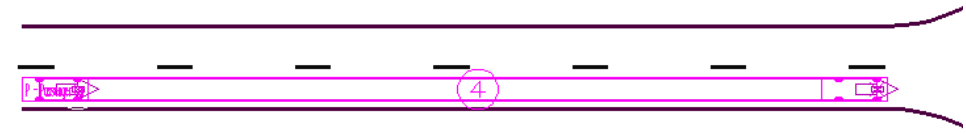
Creating a Path with AutoDrive and Follow

In this example, the vehicle heading east will make a right turn using the AutoDrive commands. After completing the turn, the Follow command will be used to incorporate the red line into the path.

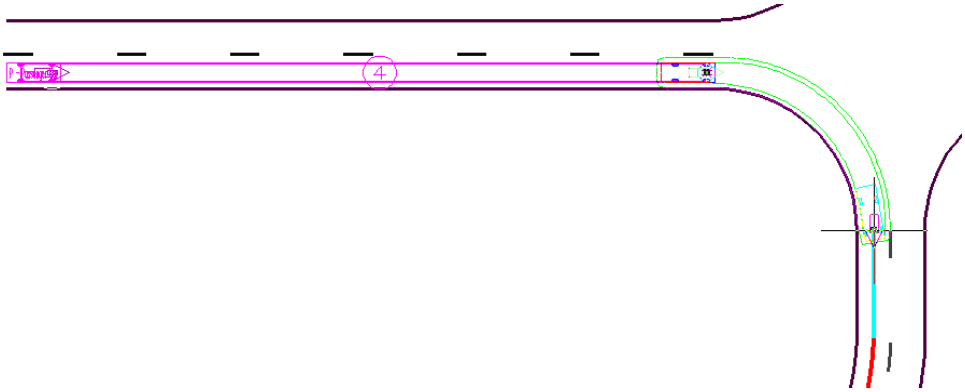
1. Select the **AutoDrive** icon from the AutoTrack toolbar and place the vehicle as described in steps 21 through 25 above.



2. Extend the path to the intersection (see steps 26 through 28 above).

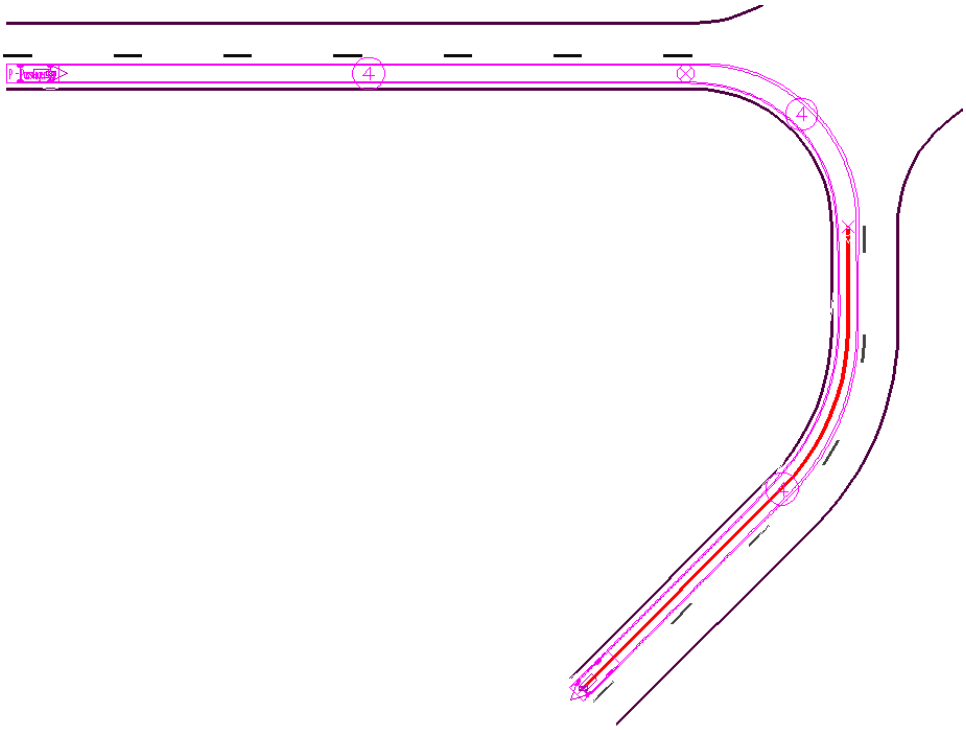


3. Using the ***Turn onto bearing*** option (described in steps 29 through 34 above), **<T>** to the end of the line defining the remainder of the path. **<D>** to accept the location.



4. From the ***AutoTrack*** toolbar, select the **Follow** icon.

5. **<D>** on the line defining the remainder of the path. **<D>** again to accept the element. Make any desired settings changes (step 39 above) and **<D> OK** to complete the path.



AutoTrack Reports

An AutoTrack report is the graphic display related to the vehicle path and not textual data. There are four different reports that can be displayed from AutoTrack: Body and Chassis Envelopes, Spaced Vehicle Outlines, Hatched Body Envelope, and Clearance Envelope. All of these reports have six common elements: Body Outline, Chassis Outline, Symbols, Annotation, Profile, and Graph.

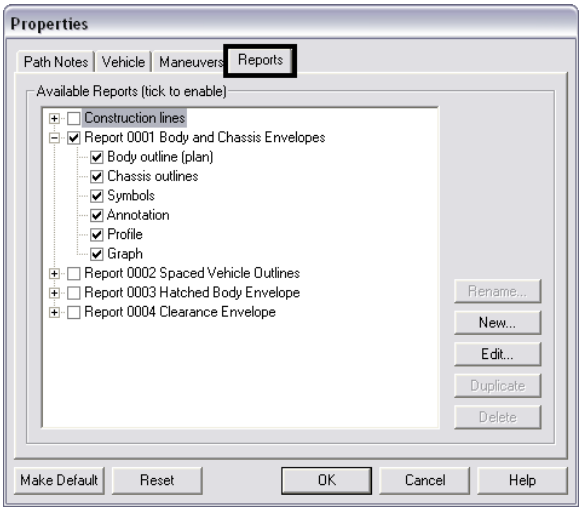
Working with AutoTrack Reports

AutoTrack reports are accessed through the path's Properties dialog box.

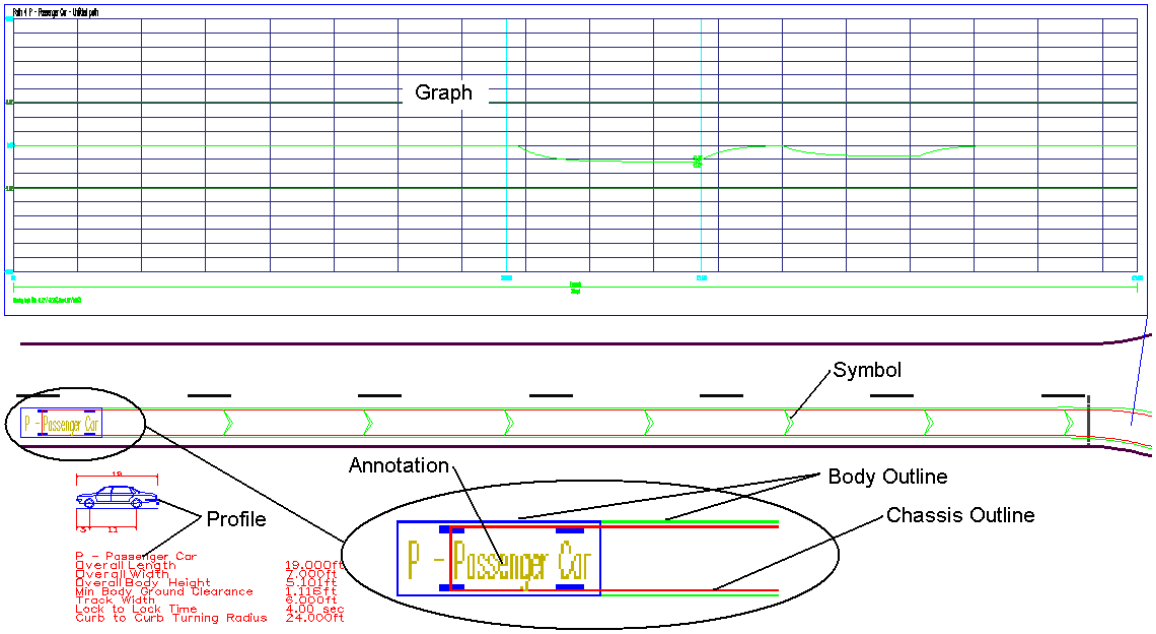
1. Highlight the path to report on then **<D>** the **AutoTrack Properties** icon on the **AutoTrack** toolbar.

The **Properties** dialog box is displayed.

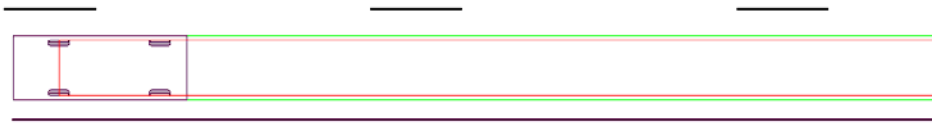
2. From the **Properties** dialog box, select the **Reports** tab.



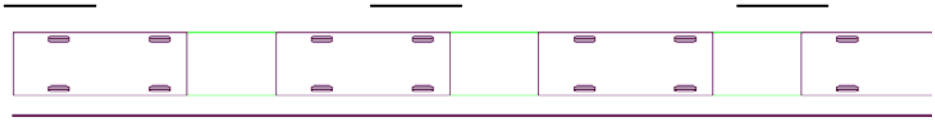
The illustration below identifies each of the six elements that can make up a report.



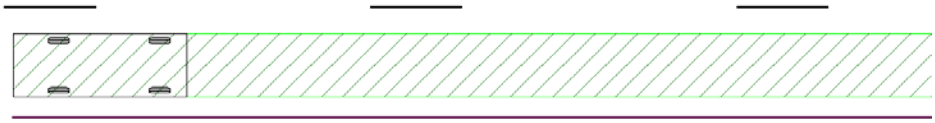
The illustrations below show the differences in each of the reports. (**Note:** Graph, Profile, Annotation, and symbol have been turned off in all of the illustrations.)



Body and Chassis Envelope



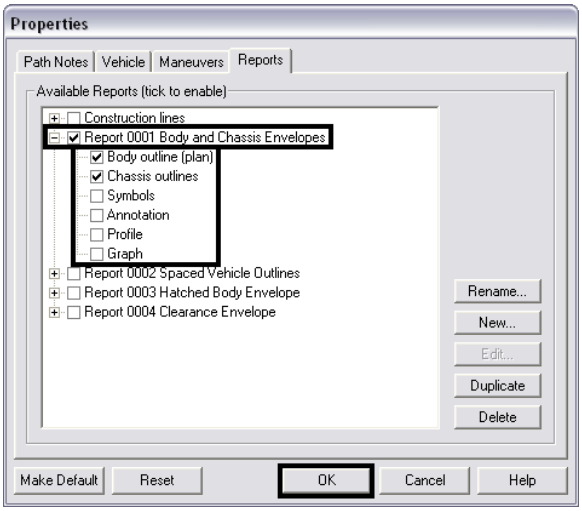
Spaced Vehicle Outlines



Hatched Body Envelope

Clearance Envelope

3. Toggle on the report type and report elements then **<D> OK**. The **Properties** window is dismissed and the report is displayed.



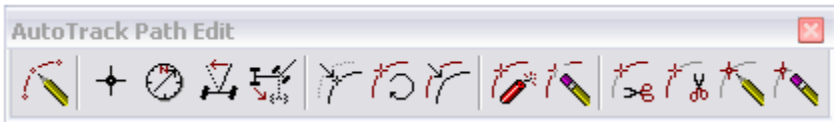
Editing an AutoTrack Path

Existing paths can be modified using the commands on the **AutoTrack Path Edit** toolbar. Each of the commands on this toolbar is explained below.

1. To display the **AutoTrack Path Edit** toolbar, select the **AutoTrack Path Edit** icon from the **AutoTrack** toolbar.

2. To begin editing a path, **<D>** to highlight the path.

3. Select the desired icon from the ***AutoTrack Path Edit*** toolbar.



Note: The leftmost icon on this toolbar is not used. The command associated with that icon launches the toolbar, which is already displayed.

4. To move the path by the starting location, select the **Initial Vehicle Location** icon. When selected the path is attached to the cursor by its starting location. **<D>** on the new starting location to move the path. The relationship between points is maintained during this operation and no modification to lengths, radii, or bearing is made.

5. To change the vehicle's starting direction, select the **Initial Vehicle Heading** icon. When selected, the vehicle rotates with the movement of the cursor. The path is modified to attempt to pass through points located on the path. This should only be used for minor corrections in bearing as major alterations will drastically alter the path.

6. By default, the vehicle's wheels are in the straight ahead position when placed. If the path starts in a turn, the angle of the wheels can be adjusted by selecting the **Initial Vehicle Steering** icon. This changes the angle of the wheels with the movement of the cursor, but leaves the orientation of the vehicle unchanged. Like the **Initial Vehicle Heading** command, this operation can drastically change the path.

7. The **Initial Vehicle Articulation** is used to change the starting orientation of a trailer to its tractor (or car). This will not greatly affect the path as the tractor maintains it orientation.

8. The **Move Path** command is similar to the **Initial Vehicle Location** command in that it moves the path without changing the relationships of any of the points on the path. The difference is that with this command a base point is located which does not have to be on the path. A second point is then located to specify the distance and direction that the path is moved.

9. **Rotate Path** is used to spin the entire path about a specified point while maintaining the relationship of all the points within the path.

10. The **Copy Path** command works like the MicroStation copy. The highlighted path is picked up by its origin and a **<D>** indicated the origin of the copy.

11. To delete a path but retain the graphics, use the **Explode Path** command.

    Note: The graphic elements are a cell and the Complex Status will have to be dropped in order to manipulate the individual elements.

12. The **Delete Path** command deletes the path and its graphics.

13. The **Trim Start of Path** moves the initial point (and the vehicle cell) along the path. A **<D>** identifies the new starting point. All information behind the new starting point is removed.

14. The **Trim End of Path** moves the end point (and the vehicle cell) along the path. A **<D>** identifies the new ending point. All information behind the new end point is removed.

15. The **Edit Target Point** can be used to move existing points on the path (including the beginning and end points). It can also be used to add additional points to the path. When selected, the cursor moves along the path. To move an existing point, **<D>** on the point. The point is then attached to the cursor and a second **<D>** will identify its new location. A **<D>** on the path, but not on an existing point will add a new point. A second **<D>** is used to its location as well.

16. **Delete Last Target Point** removes the data from the end of the path back to the next point on the path.

Note: The MicroStation **UnDo** command can be used to negate the editing done in AutoTrack.

Inserting a Turn Graph

A turn graph can be placed as part of a report when creating or displaying a path. However, when done this way the Graph is placed at a specific location from the paths origin. This may not always be the best location. Using the **Insert Turn Graph** command allows the user to dynamically place the graph.

1. Select the **Insert Turn Graph** icon from the **AutoTrack** toolbar.

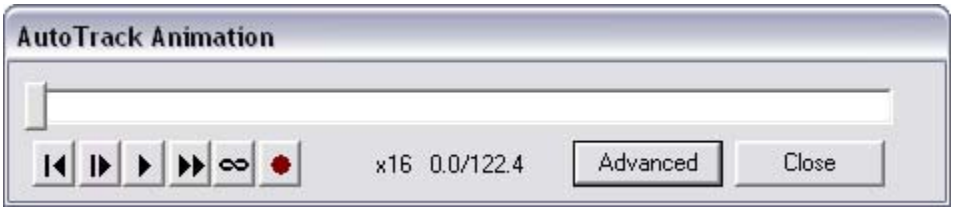
2. The lower left corner is attached to the cursor. **<D>** to identify the location of the graph.

AutoTrack Animation

Using the AutoTrack Animation tool the vehicle cells can actually move along their paths.

1. Select the **Animate Vehicle** icon from the ***AutoTrack*** toolbar.

The ***AutoTrack Animation*** dialog box is displayed.



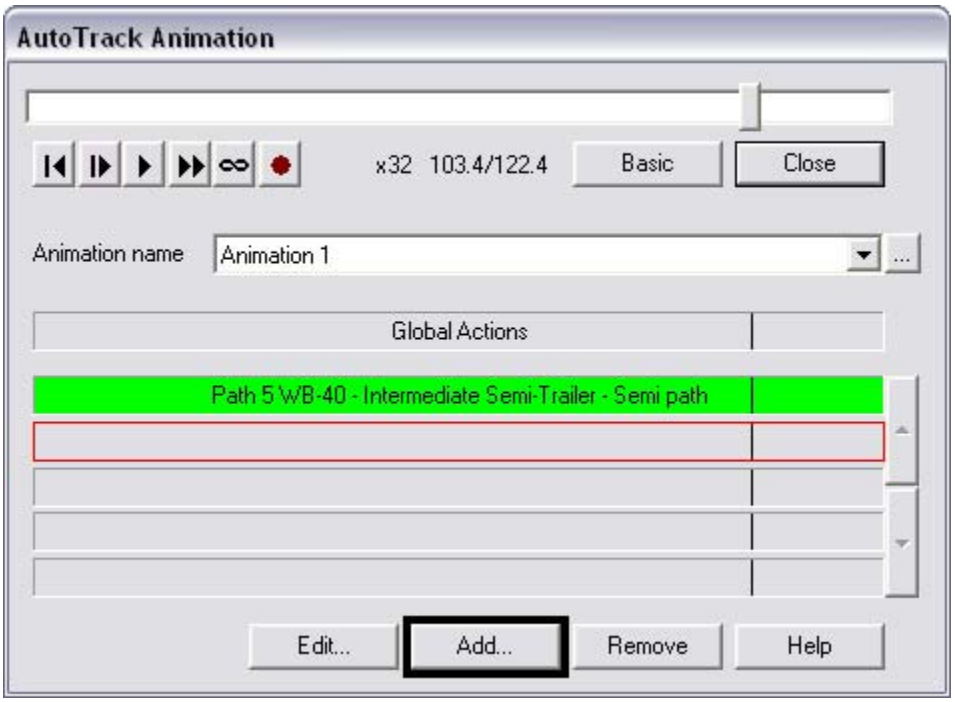
2. The icons in the lower left corner of the dialog box are the animation controls. From left to right they are:

   - **Reset -** This moves all vehicles to their initial point.
   - **Single Step Forward -** The vehicles are moved along their path one step for each push of the icon.
   - **Play -** The animation runs from beginning to end.
   - **Fast Forward -** This is used to set the speed of the animation.
   - **Loop Indefinitely -** This replays the animation until the play icon is toggled off.
   - **Record -** this creates an avi file of the animation.

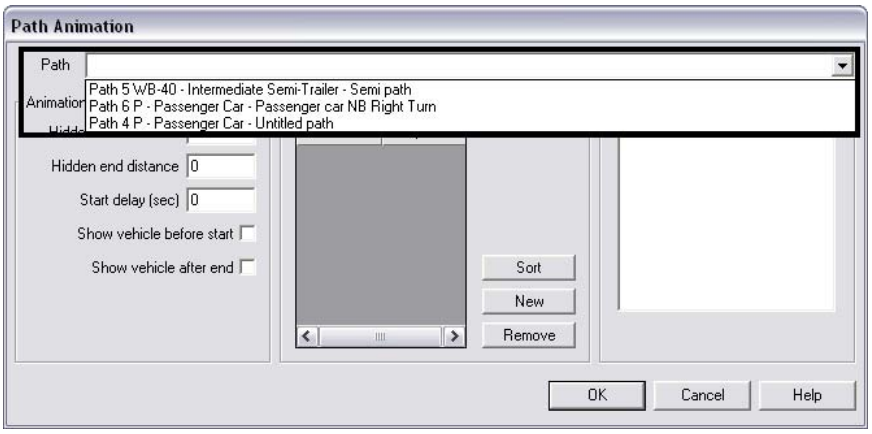
3. The slider bar, across the top of the dialog box, can also be used to move back and forth through the animation.

4. **<D>** Advanced button.

5. The expanded dialog box shows the currently loaded paths in the animation highlighted in green. To insert additional paths into the animation, **<D> Add**.

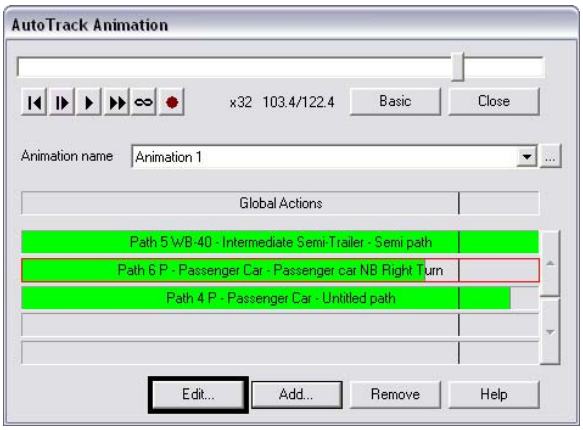


6. The **Path Animation** dialog box is displayed. Use the ***Path*** drop-down list to select an additional path to add to the animation.



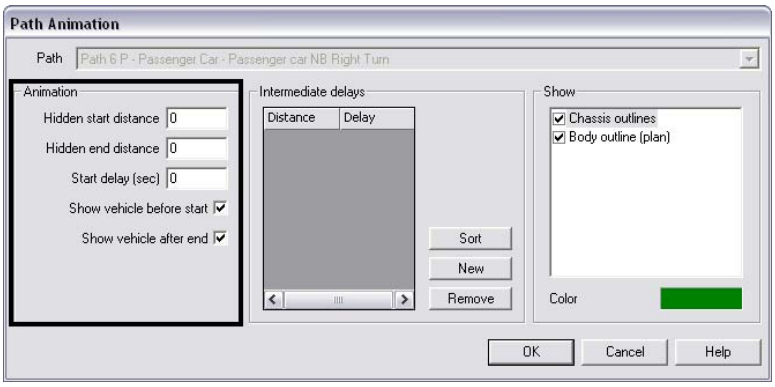
7. **<D> OK** to add the path. Additional paths can be added the same way.

8. The active path is shown with a red box around it. This path can be edited or removed. To edit the path, **<D> Edit**.



9. The ***Path Animation*** dialog box is displayed again this time relating to the selected path. The following options are available:

   - **Hidden start distance -** The vehicle is started further up the path by the distance entered.
   - **Hidden end distance -** The vehicle stops on the path the distance entered fro the end point.
   - **Start delay (sec) -** The vehicle waits the indicated number of seconds before moving. This can be set differently for each path.
   - **Show vehicle before start -** When toggled on the vehicle cell is shown before the play icon is pressed. When off the cell is not displayed until the play icon is pressed.
   - **Show vehicle after end -** This works the same as the **Show vehicle before start.**



10. After all changes to settings are made, use the animation controls described in steps 61 and 62 to view the animation.