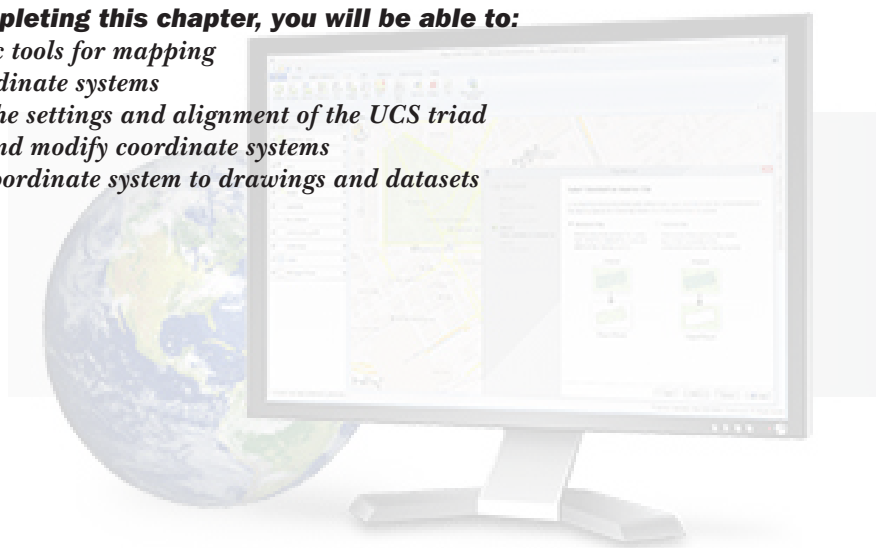
Chapter 3

Working with Basic Tools and Coordinate Systems

Learning Objectives

After completing this chapter, you will be able to:

- *Use basic tools for mapping*
- *Use coordinate systems*
- *Modify the settings and alignment of the UCS triad*
- *Create and modify coordinate systems*
- *Assign coordinate system to drawings and datasets*



INTRODUCTION

In this chapter, you will learn about some of the basic navigation and productivity enhancement tools, such as **Zoom**, **Pan**, and **Snap**, which are frequently used while creating and analyzing the drawing data. These tools provide a flexible viewing and editing environment thereby enhancing the productivity and accuracy of the spatial database.

In this chapter, you will also learn to perform various operations such as zooming, panning, and scaling the drawings and to use the Ortho mode and the snap options.

Further in this chapter, you will learn about the User Coordinate System (UCS) and the World Coordinate System (WCS) in AutoCAD Map 3D. Also, the coordinate system for referencing drawing objects to the real world will be discussed in this chapter.



USING THE BASIC NAVIGATION TOOLS

The mapping procedures, such as editing and reviewing data, frequently require the drawing data to be scaled, zoomed, and panned. These operations require the use of the **Pan** and **Zoom** tools which makes them the most extensively used tools in AutoCAD Map 3D. Some of these frequently used navigation tools are discussed next.

Zoom Tools

Command: ZOOM or Z

In GIS, sometimes you may need to check the minute spatial details of the data displayed, and alter it, if required. For carrying out such tasks, using an enlarged view of the objects in the drawing area would be advantageous. The zoom tools are used to enlarge or reduce the view of a drawing without affecting the actual size of the drawing objects. You can use various zoom tools such as **Extents**, **Realtime**, **Window**, **Previous**, **Object**, and **All** to view a particular area of the drawing in an enlarged view/window.

To use different zoom tools in the drawing process, click on the down-arrow next to the **Extents** tool in the **Navigate** panel of the **View** tab; all the zoom tools will be displayed in a drop-down. Figure 3-1 shows the zoom tools available in the drop-down. Choose the required zoom tool from the drop-down to proceed. Some of the important zoom tools are discussed next.

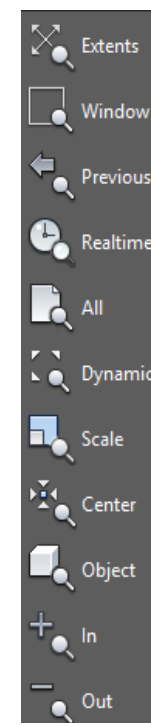


Figure 3-1 *Various zooming tools*

Extents



The **Extents** tool is used to display all the objects in the drawing within the extent of the current drawing window. To display all the drawing objects within the drawing, choose the **Extents** tool in the **Navigate** panel from the **View** tab; the selected data will get enlarged.

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Tip

*You can use the **Zoom to Extents** option to display all the data of feature layer. To do so, right-click on the required layer in the **TASK PANE**; a shortcut menu will be displayed. Choose the **Zoom to Extents** option from the displayed menu; the drawing will zoom to display all the data within the extent of the selected layer.*

Window



You can zoom in a region of a drawing by drawing a window around the area to be zoomed. To do so, choose the **Window** tool from **View > Navigate > Extents** drop-down; you will be prompted to specify the first corner of the area to be zoomed. Click in the drawing; you will be prompted to specify the opposite corner. Specify the other corner. You can also specify the two corner points of the rectangular area by entering the coordinates in the Command prompt. On specifying the area, the center of the specified area (window) will become the center of the new display screen. When you use this zoom tool, the area inside the window gets magnified and fills the drawing window.

Previous



While working on a complex drawing, you may need to zoom in on a portion of the drawing to edit some minute details of the drawing object. After you have completed the editing, you may want to return to the previous view. This can be done by using the **Previous** tool. AutoCAD remembers the last ten views, and these views can be restored by using the **Previous** tool.

Realtime



You can use the **Realtime** tool to zoom in and zoom out a drawing interactively by using the left mouse button. To do so, choose the **Realtime** tool from **View > Navigate > Extents** drop-down; the **Realtime** tool will be invoked. Next, press and hold the left mouse button and then drag the cursor up or down to zoom in or zoom out the drawing. To exit the **Realtime** zooming mode, right-click in the drawing window; a shortcut menu will be displayed. Choose the **Exit** option from this menu. You can also press ESC or ENTER to exit the mode.



Tip

You can also use the scroll wheel to zoom in or out the drawing.

All



This tool is used to zoom to the drawing limits or the extents of the objects in the drawing window, whichever is greater. Whenever you increase the limits, the current display is not affected and hence it is not displayed. In this case, you need to use the **All** tool to display the limits of the drawing. Sometimes it is possible that the objects are drawn beyond the limits. In such a case, the **All** tool zooms to fill the drawn objects in the drawing area, irrespective of their limits.

Scale



This tool is commonly used while plotting a drawing. This tool allows you to zoom in the drawing using the specified scale. To zoom a drawing using this option, choose the **Scale**

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tool from **View > Navigate > Extents** drop-down; you will be prompted to specify the scale factor. Enter the scale factor and then press ENTER; the drawing will be zoomed to the specified scale.

Center



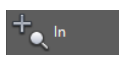
This tool is used to increase or decrease the magnification of the view in the current viewport. To zoom in or zoom out the view using this option, choose the **Center** tool from **View > Navigate > Extents** drop-down; you will be prompted to specify the center. Click in the drawing to specify the center point; you will be prompted to specify the magnification or height. Specify the magnification and press ENTER; the drawing will zoom with the specified point at its center and at the given magnification.

Object



You can use the **Object** tool from the **Extents** drop-down to zoom the selected object/s. When you choose the **Object** tool, you will be prompted to select the object/s. You can select the required objects in the current drawing by using the selection box or by clicking on individual object/s. After selecting the object, press ENTER; the drawing window will zoom the selected objects.

In



You can use the **In** tool from the **Extents** drop-down to increase the apparent size of the object. When you choose this tool, you will be prompted to specify corner of the window or the scale factor. Note that here the absolute units of the objects will remain unchanged and only their apparent size will increase.

Out



You can use the **Out** tool from the **Extents** drop-down to decrease the apparent size of the object. When you choose this tool, you will be prompted to specify corner of the window or the scale factor. Note that here the absolute units of the objects will remain unchanged and only their apparent size will decrease.

Pan Tool

Ribbon:	View > Navigate > Pan
Command:	PAN



You can use the **Pan** tool to pan a drawing interactively. This means you can shift a drawing by sliding it, and then placing it at the required position. To slide a drawing, choose the **Pan** tool from the **Navigate** panel; the cursor will change into a hand symbol, indicating that you are in the pan mode. Place the cursor in the drawing area and then press and hold the left mouse button. Now, you can drag the cursor to the required place on the screen to move the drawing. To exit the pan mode, right-click in the drawing; a shortcut menu will be displayed. Next, choose the **Exit** option from displayed menu. You can also press the ESC or ENTER key to exit the pan mode.

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AutoCAD Map 3D Scale

Status Bar: AutoCAD Map 3D Scale

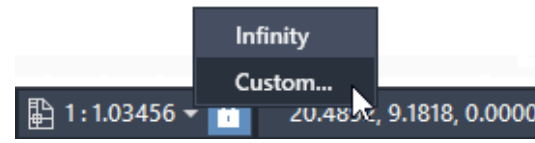


Figure 3-2 *The **AutoCAD Map 3D Scale** tool with the pop-up menu displayed and the **Custom** option chosen*

The **AutoCAD Map 3D Scale** tool in the Status Bar is used to set the scale of a layer or a view. If you change this scale, the zoom level of the drawing will also get changed. To zoom using the **AutoCAD Map 3D Scale** tool, click on the down arrow in the Status Bar displayed on the right of the **AutoCAD Map 3D Scale** tool; a pop-up menu will be displayed, as shown in Figure 3-2. Choose the **Custom** option from the pop-up menu; the scale editing window will be displayed. In this window, you can specify the scale of the drawing viewport. To do so, enter the required value in the **Enter scale value** edit box. Next, choose the **OK** button in this window; the drawing will be displayed at the modified scale value.

If you increase the scale value by using the **AutoCAD Map 3D Scale** tool, the size of the drawing view will be reduced in the drawing window, as shown in Figure 3-3. If you decrease the scale value by using this tool, the size of the drawing view in the drawing window will be magnified.

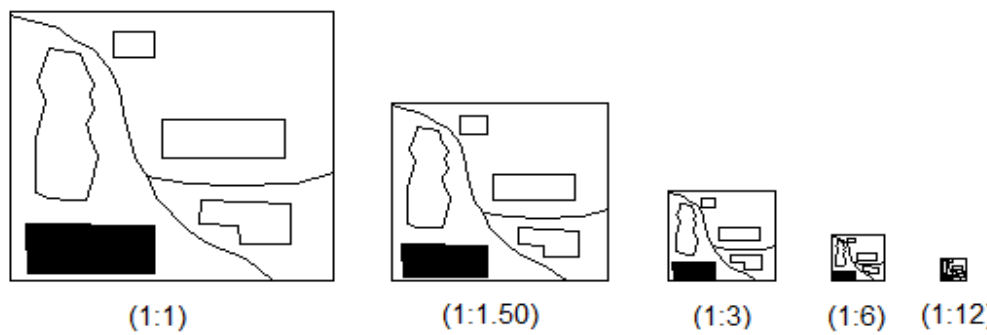


Figure 3-3 *The drawing views at different scale values*

Note

*1. If a drawing view is altered by using a **Zoom** tool, the scale value in the **AutoCAD Map 3D Scale** tool will also be altered accordingly.*

*2. Any modification made in a drawing view by using the **AutoCAD Map 3D Scale** or **Zoom** tool will not affect the physical measurements of the drawing.*

USING THE SNAP FUNCTIONS IN MAP 3D

In AutoCAD Map 3D, you can snap the cursor or snap to a desired point in an object using the snap functions. If you activate the snap function while in the drawing mode, you can track some of the known object points, vertices, or nodes in the drawing. AutoCAD Map 3D provides two basic types of snap functionalities, grid snap and object snap. These snap functions are discussed next.

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Snapping Cursor (Using Snap Spacing)

The **Snap Mode** button from the Status Bar is used to activate the function that allows the user to snap to the points using specified snap spacing. You can specify the parameters for snapping using the options in the **Snap and Grid** tab of the **Drafting Settings** dialog box.

To invoke the **Drafting Settings** dialog box, click on the down-arrow next to the **Snap Mode** button; a menu will be displayed. Choose the **Snap Settings** option; the **Drafting Settings** dialog box will be displayed, as shown in Figure 3-4. The method of setting the properties in the **Snap and Grid** tab of this dialog box is discussed next.

Note

*Choosing the **Grid Mode** button from the Status Bar will result in the display of the grid along the XY plane in the drawing window.*

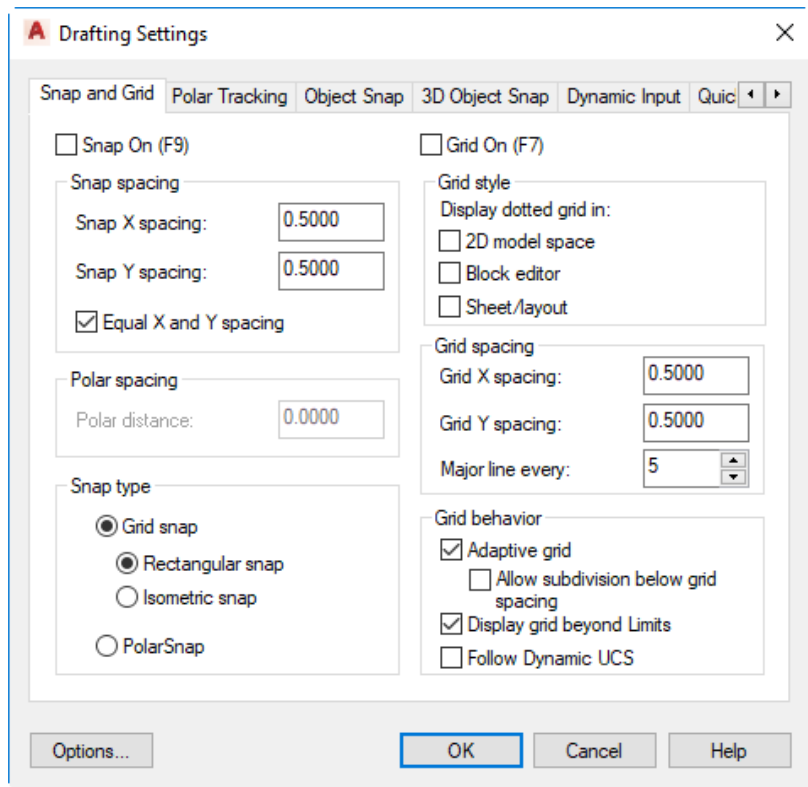


***Figure 3-4** The **Drafting Settings** dialog box with the **Snap and Grid** tab chosen*

Snap and Grid Tab

Choose the **Snap and Grid** tab in the **Drafting Settings** dialog box to display various options. The **Snap On (F9)** check box in this tab is clear by default, which allows the cursor to move freely in the drawing window. Selecting the **Snap On (F9)** check box will activate the Snap Mode. As a result, the cursor will snap to the points at the specified snap spacing. The **Grid On (F7)** check box is also clear by default in this tab. Therefore, the grid pattern will not be displayed.

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You can select the **Grid On (F7)** check box to display the grid pattern in the drawing window. The different areas in this tab are discussed next.



Tip

*You can display the grid lines in any 2D drawing space by choosing the **Grid Mode** button in the Status Bar. Similarly, you can invoke the snapping mode by choosing the **Snap Mode** button in the Status Bar.*

Grid style Area

The options in the **Grid style** area are used to specify the display style of the dotted grid pattern in the 2D model space, block editor, or the sheet or layout modeling space. You can select the **2D model space** check box to display the dotted grid pattern in the 2D drawing environment. Similarly, you can select the **Block editor** check box to display the dotted grid pattern while editing blocks.

Grid spacing Area

The options in the **Grid spacing** area are used to adjust the spacing between grid points along the X and Y axes. To modify the spacing between grid points along the X axis, enter the required value in the **Grid X spacing** edit box. Similarly, to modify the spacing between grid points along the Y axis, enter the required value in the **Grid Y spacing** edit box. To modify the number of minor lines between two major lines while working in the 3D sketching mode, enter a value in the **Major line every** edit box or set the value using the spinner located next to it.

Grid behavior Area

The options in the **Grid behavior** area are used to modify the settings for the grid display. The **Adaptive grid** check box in this area is selected by default. As a result, the number of grid lines or grid line density between the major grid lines will be limited during zoom out. Select the **Allow subdivision below grid spacing** check box in the **Adaptive grid** option in the **Grid behaviour** area if you want to display subdivision lines in the minor grid lines, while zooming in the drawing. To display grids beyond the limits of window, select the **Display grid beyond Limits** check box. To attach the grid plane to the current UCS, select the **Follow Dynamic UCS** check box.

Snap spacing Area

The options in the **Snap spacing** area are used to set the snap spacing in the grid mode. To modify the snapping distance between two snap points along the X-axis, enter the required value in the **Snap X spacing** edit box. Similarly, to set the snapping distance between two snap points along the Y-axis, enter the required value in the **Snap Y spacing** edit box. To set different snapping spaces between snap points along the X and Y axes, clear the **Equal X and Y spacing** check box. Various methods to customize the snap spacing are discussed next.

Snap to Grid: In the snap to grid mode, if you move the cursor in the XY-plane, the cursor will snap to the adjacent grid point, refer to **(1)** in Figure 3-5.

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Snap to Spacing: In the snap to spacing mode, if you modify the snap spacing without changing the grid spacing, the cursor will snap to the point located at the modified snap spacing, refer to **(2)** in Figure 3-5.

Snap to Unequal X Spacing and Y Spacing: In the snap to unequal X spacing and Y spacing, if the snap spacing in the X axis and the Y axis are different, then the cursor will trace the next grid point with the corresponding snap spacing given in the X and Y axes, refer to **(3)** in Figure 3-5.

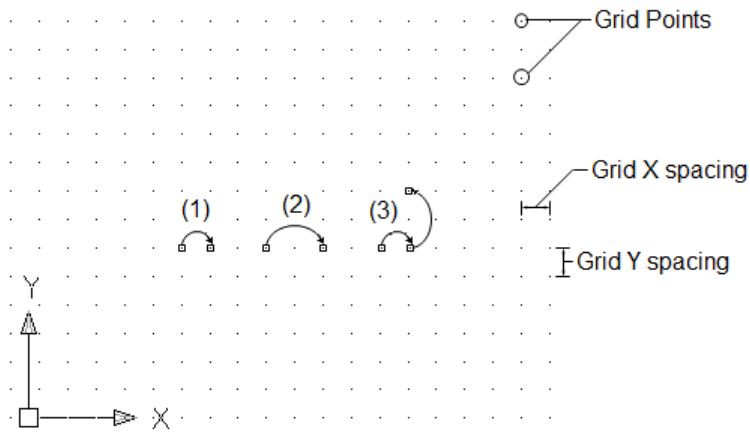


Figure 3-5 *Different grid snapping options with grid details*

Snap type Area

The options in the **Snap type** area are used to specify the snap type. To snap the cursor to grid points in the X and Y axes, select the **Grid snap** radio button. In the grid snap mode, you can choose an option depending on your drawing requirement. To draw a geometric model in the rectangular snap mode, select the **Rectangular snap** radio button. To draw a geometric model in the isometric snap mode, select the **Isometric snap** radio button. While working in the **Polar Tracking** mode, you can set the cursor to snap along the polar alignment angles by selecting the **PolarSnap** radio button.

Object Snap

The object snapping helps the users to snap to the precise locations on the objects. You can activate object snapping by pressing the F3 function key. AutoCAD Map 3D identifies various locations such as end point, midpoint, center, node and intersection as snap locations. You can choose the required snap modes from the **Object Snap** tab of the **Drafting Settings** dialog box. The various options in the **Object Snap** tab are discussed next.

Object Snap Tab

The options in the **Object Snap** tab are used to snap to geometric points on a drawing object. In this tab, the **Object Snap On (F3)** and **Object Snap Tracking On (F11)** check boxes are selected by default. Additionally, you can toggle the object snap and object snap tracking on or off. The options in the **Object Snap modes** area are used to control the object snap tracking types. Some of the frequently used object snap tracking options are discussed next.

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Tip

*You can also turn on an object snap option by right-clicking on the **Object Snap** button in the Status Bar, and then choosing the required snapping option from the shortcut menu displayed.*

Endpoint

The **Endpoint** object snap tracking option is used to draw an object with reference to an endpoint of another drawing object. If you select the **Endpoint** check box, the crosshair will trace the endpoint of the drawing object in the drawing mode. The endpoint object snapping is illustrated in Figure 3-6.

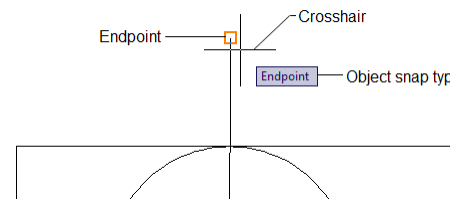


Figure 3-6 *The Endpoint object snapping*

Midpoint

The **Midpoint** object snap option is used to draw an object with reference to the middle point of a line drawing. If you select the **Midpoint** check box, the crosshair will snap to the middle point of a nearby line drawing. The midpoint object snapping is illustrated in Figure 3-7.

Center

The **Center** object snap option is used to track the center of a circle, arc, ellipse, or elliptical arc and then draw objects with reference to the center. To use this option in the drawing, select the **Center** check box. Figure 3-8 shows an example of the center object snapping.

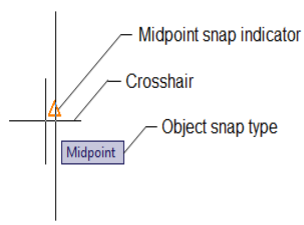


Figure 3-7 *The Midpoint object snapping*

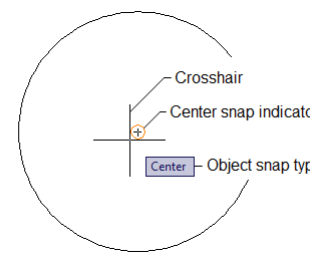


Figure 3-8 *The Center object snapping*

Tangent

The **Tangent** object snap option is used to track a tangent point along an arc and a circular geometry. To invoke this option, select the **Tangent** check box. The tangent object snapping is illustrated in Figure 3-9.

Quadrant

The **Quadrant** object snap option is used to create a drawing with respect to one of the four quadrant points. To invoke this option, select the **Quadrant** check box. Figure 3-10 illustrates an example of using the **Quadrant** object snapping option.

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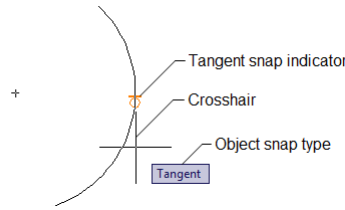


Figure 3-9 *The Tangent object snapping*

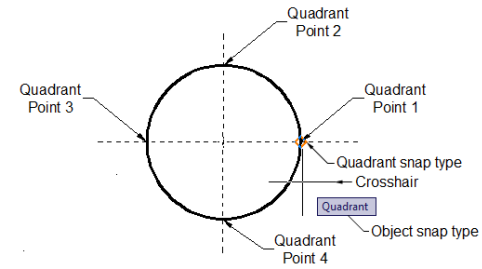


Figure 3-10 *The Quadrant object snap located at the first quadrant*

Node

The **Node** option is used to snap to a point object in the drawing mode. To apply the node object snapping to the drawing mode, select the **Node** check box. You can draw an object from the point object by using this option. An example of drawn line using three point (nodes) is shown in Figure 3-11.

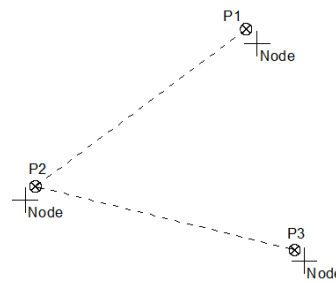


Figure 3-11 *The node object snapping*

Note

The other object snap options such as ***Intersection***, ***Extension***, ***Insertion***, ***Perpendicular***, ***Nearest***, ***Apparent intersection***, *and* ***Parallel*** *are used to snap crosshair at different points along the drawing objects in the drawing mode.*

WORKING IN THE ORTHO MODE

You can turn the Ortho mode on or off by choosing the **Ortho Mode** button in the Status Bar or by using the F8 key. The Ortho mode allows you to draw lines at right angles in 2D drawings only. Whenever you use the pointing device to specify the next point, the movement of the rubber-band line connected to the cursor will be either in the horizontal (parallel to the X axis) or vertical (parallel to the Y axis) direction. To draw a line in the Ortho mode, specify the starting point at the **Specify first point** prompt. To specify the second point, move the cursor with the pointing device and click at the desired point. The line thus drawn will be either vertical or horizontal depending on the direction of movement of the cursor, refer to Figures 3-12 and 3-13.

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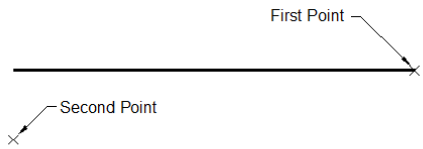


Figure 3-12 *Drawing a horizontal line using the Ortho mode*

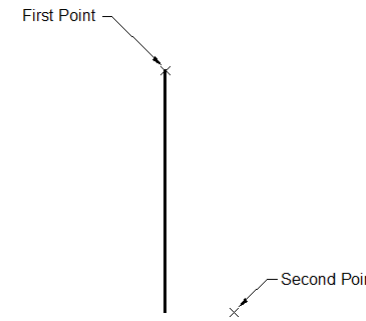


Figure 3-13 *Drawing a vertical line using the Ortho mode*

Note

You can turn the Ortho mode on and off at any time during drawing and editing. But in 3D views, the Ortho mode restricts the cursor movement in up and down directions.

COORDINATE REFERENCE SYSTEM (CRS)

A coordinate reference system (CRS) defines how an object relates spatially to the locations on the Earth's surface. CRS is a mathematical model used to locate geographical entities. Using a coordinate reference system, you can integrate multiple datasets with different CRS into your project. In AutoCAD Map 3D, there are two coordinate system: a fixed reference system called world coordinate system (WCS) and a user defined coordinate system called user coordinate system (UCS). CRS is referred to as coordinate system or global coordinate system. Assigning appropriate coordinate system is the most essential part of the data preparatory work.

A CRS associates a coordinate system with an object by means of a datum. As a result, the definition of a CRS must encompass the definition of a coordinate system and a datum. Everest 1830, NAD 83 and WGS 72 are some of the commonly used datum.

A geographic data can be represented using the Geographic Coordinate System and the Projected Coordinate System. A Geographic Coordinate System is defined as a 3D surface model and measured in latitudes and longitudes. A Projected Coordinate System is a model that is defined by a flat 2D surface and can be measured in meters and feet. Coordinate systems provide a framework for defining real world locations.

The Prime Meridian located at the Royal Observatory, Greenwich is used as a reference point for measuring Longitudes or East/West angles. Longitude (λ) of a point is defined as the angle from the prime meridian to the meridian plane of a given point while latitude (ϕ) is the angle between the equatorial plane and the perpendicular to the ellipsoid through a given point. Figure 3-14 shows the latitude and longitude of point P.

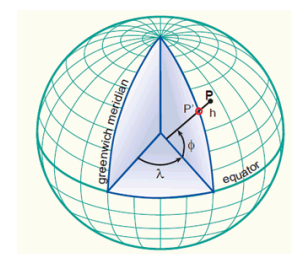


Figure 3-14 *Latitude and Longitude of point P*

Next, you will learn to define a new coordinate reference system using the **Create** tool in AutoCAD Map 3D.

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Creating a Coordinate Reference System

Ribbon:	Map Setup > Coordinate System > Create drop-down > Create Coordinate System
Command:	MAPCSCREATE

You can define a new datum, ellipsoid, or a coordinate system using the **Create Coordinate System** tool in the **Coordinate System** panel of the **Map Setup** tab. The new coordinate system can be created by modifying an existing coordinate system or by defining the parameters for the coordinate system.



Note

It is recommended that a user must thoroughly know the concepts of the terrestrial and celestial reference systems or map projections. If you do not have sufficient knowledge and accurate defining parameters, avoid defining a new global coordinate system.

AutoCAD Map 3D saves all the defined coordinate reference systems in a single folder. You will require a written permission to save the created CRS in this folder. Follow the steps given next to change the permission for this folder.

1. Close the **AutoCAD Map 3D 2022** software application if it is running.

2. In the **Windows Explorer**, browse to the following folder location:

   C:\ProgramData\Autodesk

3. In the **Autodesk** folder, right-click on the **Geospatial Coordinate Systems <version>** folder; a menu will be displayed. In the menu, choose the **Properties** option; the **Geospatial Coordinate Systems <version> Properties** dialog box will be displayed.

4. In this dialog box, choose the **Security** tab; the options in this tab will be displayed. Choose the **Edit** button in this tab; the **Permissions for Geospatial Coordinate Systems <version>** dialog box will be displayed.

5. In this dialog box, select a user name from the **Group or user names** list box; the permissions assigned to the selected user will be displayed in the **Permissions for <Users>** list box.

6. In the **Permissions for <Users>** list box, select the check box corresponding to the **Full control** option in the **Allow** column.

7. Next, choose the **Apply** button and then choose the **OK** button from this dialog box; the **Permissions for Geospatial Coordinate Systems <version>** dialog box will be closed and settings will be saved.
8. Again, choose the **OK** button in the **Geospatial Coordinate Systems <version> Properties** dialog box to close it.

After setting the user access, you can define a coordinate system based on the mapping, modeling, or project requirements. You can define a new coordinate system by creating a coordinate system definition, datum, ellipsoid, geodetic transformation, and geodetic transformation path. In

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addition to creating a coordinate system, you can create a new coordinate system category. The method of creating a coordinate system by using the **Create a coordinate system definition** option is discussed next.

Creating a Coordinate System by Using the Create a Coordinate System Definition Option

The **Create a coordinate system definition** option is used to create a coordinate system by defining the parameters of the required coordinate system. While creating a coordinate system, you need to specify various options in different pages of the **Create Coordinate System** wizard. To create a coordinate system, choose the **Create Coordinate System** tool from the **Map Setup > Coordinate System > Create** drop-down; the **Create Coordinate System** wizard will be displayed, as shown in Figure 3-15. The different pages of this wizard are discussed next.

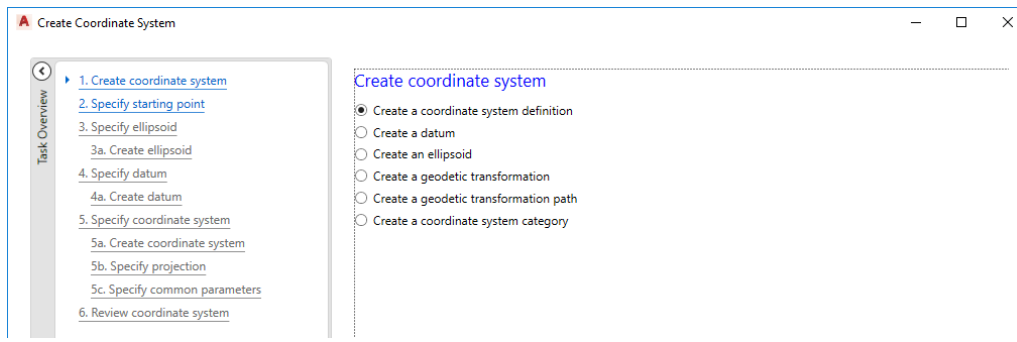


***Figure 3-15** The **Create Coordinate System** wizard*

Create coordinate system Page

By default, the **Create coordinate system** page is displayed in the wizard with the **Create a coordinate system definition** radio button selected.

To create the coordinate system definition, choose the **Next** button on this page; the **Specify starting point** page of the wizard will be displayed.

Specify starting point Page

In this page, by default, the **Start with an ellipsoid** radio button is selected. As a result, you are prompted to create a coordinate system based on ellipsoid. Also, you can select the **Start with a coordinate system** or **Start with a datum** radio button to redefine a coordinate system or define a coordinate system based on the existing datum. To continue with the method used for creating a coordinate system, retain the default setting in this page and then choose the **Next** button; the **Specify ellipsoid** page will be displayed.

Specify ellipsoid Page

In this page, you can specify the method of creating an ellipsoid. You can choose to create an ellipsoid either by defining a new ellipsoid or by modifying the parameters for an existing ellipsoid.

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To create an ellipsoid by modifying the parameters for an existing ellipsoid, select the **Create a new ellipsoid from an existing ellipsoid** radio button; the **Select** button in the **Specify ellipsoid** page will be activated.

Choose the **Select** button; the **Coordinate System Library** dialog box will be displayed, as shown in Figure 3-16. Choose the required ellipsoid from the list box in this dialog box and then choose the **Select** button; the name of the selected ellipsoid will be displayed in the **Ellipsoid** text box. Choose the **Next** button; the **Modify ellipsoid** page will be displayed. This page will display parameters of the selected ellipsoid. You can modify the required parameters in this page.

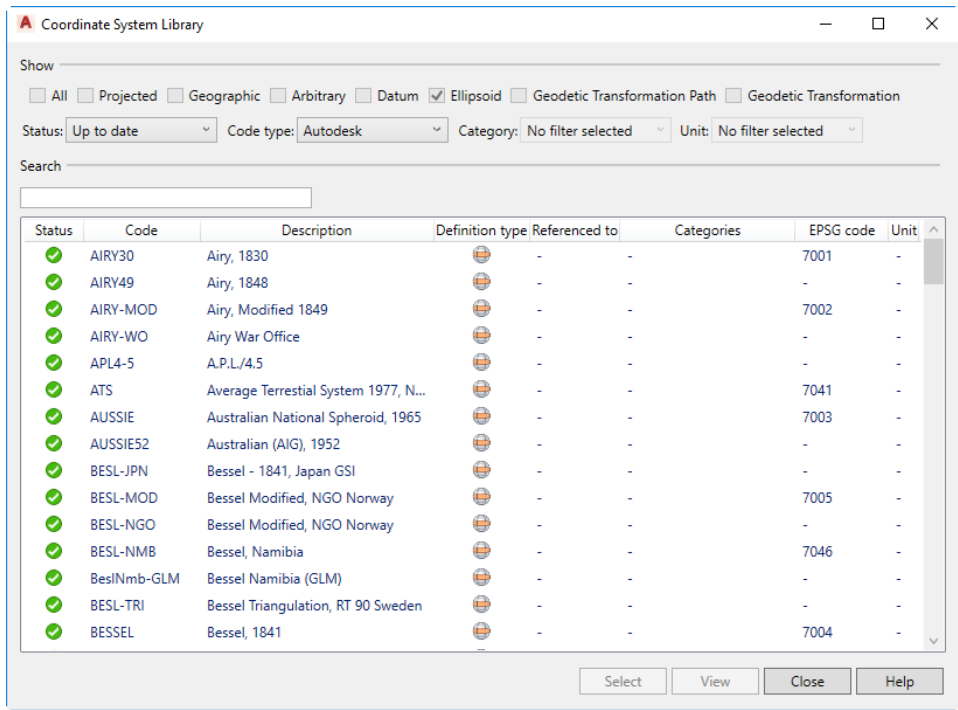


Figure 3-16 *The* ***Coordinate System Library*** *dialog box*

To create an ellipsoid by defining all the ellipsoidal parameters, select the **Create a new ellipsoid** radio button from the **Specify ellipsoid** page of the wizard. Next, choose the **Next** button; the **Create ellipsoid** page will be displayed. The various options in this page are discussed next.

Create ellipsoid Page

In this page, assign a desired code name to the ellipsoid in the **Code** edit box. You can also enter a brief description about the ellipsoid in the **Description** text box.

The **Reference this ellipsoid (rather than a datum) in the coordinate system** check box is cleared by default. As a result, the current ellipsoid will be used for reference in this coordinate system definition. If you select this check box, the links to the page for specifying datum

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will be removed. In the **Ellipsoid Dimensions** area, you can specify whether you want to create an ellipsoid or a sphere by selecting the radio button corresponding to the required option. Depending on the selection of the radio button, the edit boxes for defining the ellipsoid parameters will be enabled.

Next, you need to specify values in the **Equatorial radius (meters)**, **Inverse flattening**, **Polar radius (meters)**, and **Eccentricity squared** edit boxes. Figure 3-17 shows the **Create ellipsoid** page with the defined parameters.

After specifying all values in this page, choose the **Next** button; the **Specify datum** page of the **Create Coordinate System** wizard will be displayed.

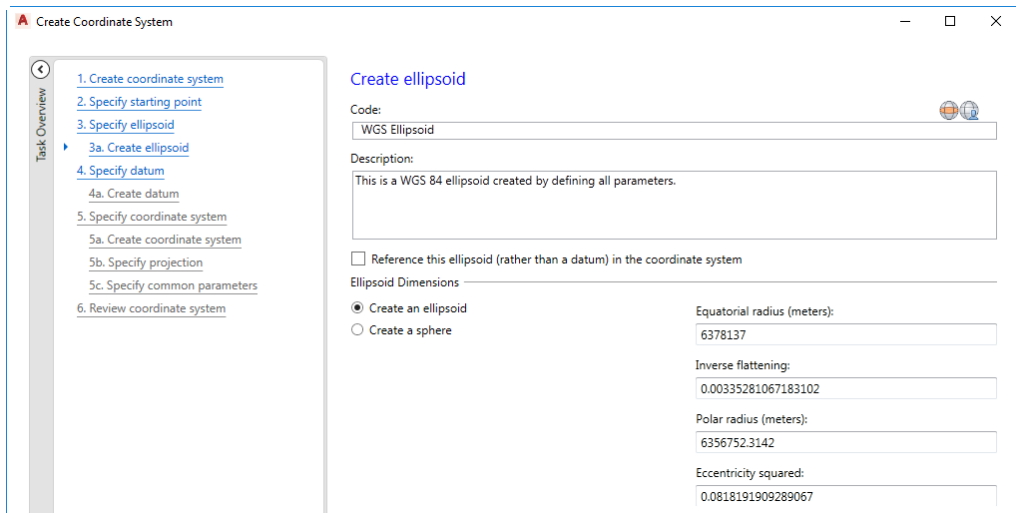


Figure 3-17 *The* ***Create ellipsoid*** *page displaying the parameters for creating an ellipsoid*

Specify datum Page

Similar to the **Create ellipsoid** page, you can select the method of creating datum in the **Specify datum** page. To create a new datum by defining its parameters, select the **Create a new datum** radio button and then choose the **Next** button; the **Create datum** page of the wizard will be displayed.



Note

To create a datum by modifying parameters of an existing datum, select the ***Create a new datum from an existing datum*** *radio button in the* ***Specify datum*** *page; the* ***Datum*** *edit box and the* ***Select*** *button will be activated. Next, choose the* ***Select*** *button; the* ***Coordinate System Library*** *dialog box will be displayed. In this dialog box, choose the required datum and then choose the* ***Select*** *button; the* ***Coordinate System Library*** *dialog box will be closed and the selected datum name will be displayed in the* ***Datum*** *edit box of the* ***Specify datum*** *page. Choose the* ***Next*** *button in the* ***Specify datum*** *page to proceed.*

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Create datum Page

In the **Create datum** page, you can create a new datum with reference to an existing ellipsoid. To create a new datum, enter a suitable code in the **Code** edit box. You can also add a brief description about the datum in the **Description** text box. By default, the name of the ellipsoid specified earlier is displayed in the **Ellipsoid** edit box. If you want to select another ellipsoid, choose the **Select** button; the **Coordinate System Library** dialog box will be displayed. Select the required ellipsoid from the list box in the **Coordinate System Library** dialog box and then choose the **Select** button; the dialog box will be closed and the name of the selected ellipsoid will be displayed in the **Ellipsoid** edit box. Next, enter the name of the data source containing the information about selected ellipsoid in the **Source** edit box. After specifying all the settings in this page, choose the **Next** button; the **Specify coordinate system** page will be displayed.

Specify coordinate system Page

You can use the options in the **Specify coordinate system** page to create a new coordinate system by using your own settings or create a new coordinate system from an existing coordinate system.

By default, the **Create a new coordinate system** radio button is selected in the **Specify coordinate system** page. Select an option from the **Coordinate system type** drop-down list to specify the type of coordinate you wish to create. You can create a **Projected**, **Geographic**, or **Arbitrary** coordinate system. On specifying all the options in the **Specify coordinate system** page, choose the **Next** button; the **Create coordinate system** page will be displayed, as shown in Figure 3-18. Based on the type selected, an icon will be displayed on upper right corner of this page.



Note

*If you select the **Create a new coordinate system from an existing coordinate system** radio button in the **Specify coordinate system** page, the **Select** button will be activated. You can use this button to select an existing coordinate system.*

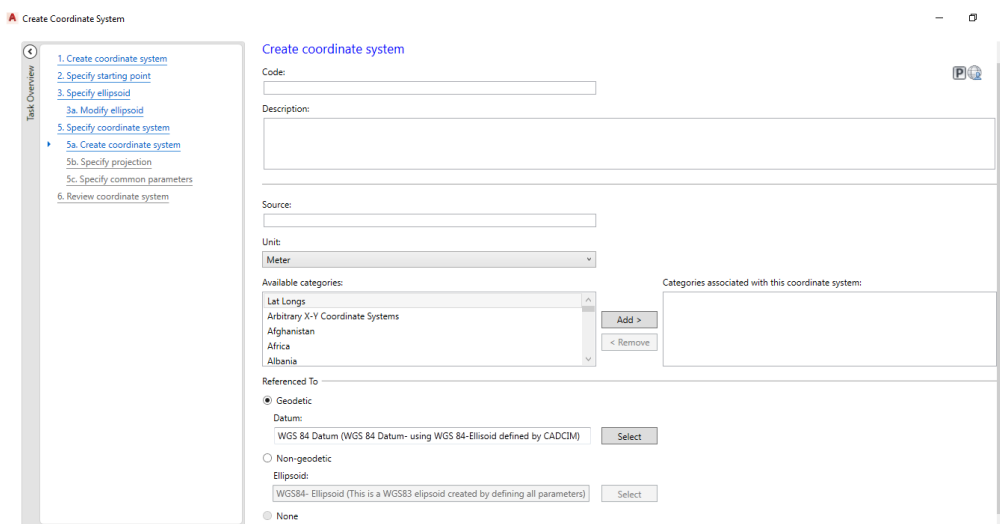


***Figure 3-18** The **Create Coordinate System** wizard with the **Create coordinate system** page*

Create coordinate system Page

In this page, you can specify the settings for a coordinate system based on your project requirements. To apply a code to the coordinate system to be created, enter a suitable code in the **Code** edit box and then enter the desired information in the **Description** text box. Next, enter the name of the data source that contains information about current coordinate system in the **Source** edit box. To specify a measuring unit for the current coordinate system, select an option from the **Unit** drop-down list. To associate the current coordinate system with an existing category, select the option from the **Available categories** list box and then choose the **Add** button; the selected category will be added to the **Categories associated with this coordinate system** list box. To remove a category from this list box, select the unwanted category and then choose the **Remove** button; the selected category will be removed.

You need to reference the current coordinate system with a datum or an ellipsoid. By default, the **Geodetic** radio button is selected in the **Referenced To** area of this page. As a result, the **Datum** edit box and the **Select** button on its right are activated. Also, the code of the datum created in earlier pages is displayed in the **Datum** edit box. To reference a different datum, use the **Select** button.

You can select the **Non-geodetic** radio button from the **Referenced To** area to reference an ellipsoid for the current coordinate system. On selecting this radio button, the **Ellipsoid** edit box will be activated and the code of the ellipsoid created earlier will be displayed in it. You can use the **Select** button to specify a different ellipsoid. After specifying all settings, choose the **Next** button; the **Specify projection** page of the **Create Coordinate System** wizard will be displayed.

Specify projection Page

In this page, you need to specify the settings for the projection parameters. To apply a projection to the current coordinate system, select an option from the **Projection** drop-down list. Depending on the option selected in this drop-down list, a list of parameters will be displayed in the **Specify projection** page. For example, on selecting the **Albert Equal Area Conic** option in the **Projection** drop-down list, you need to specify the northern and southern standard parallel, and the origin latitude and longitude in the **Northern standard parallel**, **Southern standard parallel**, **Origin longitude**, and **Origin latitude** edit boxes, respectively.

After specifying all the parameters in this page, choose the **Next** button; the **Specify common parameters** page will be displayed.



Note

*The options displayed in the **Parameters** area will be based on the projection type selected from the **Projection** drop-down list.*

Specify common parameters Page

In this page, you can specify the parameters used for projecting given map coordinates. To apply a scale to the current coordinate system, enter the scale value in the **Map (paper) scale** edit box. Next, select the relevant option from the **X increases to the** and **Y increases to the** drop-down lists in the **Quadrant** area. Next, you need to specify the geographic limits of the location in terms of latitudes and longitudes. The values entered must be in the degree format and measured with respect to Greenwich. To specify the range for the

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geographic location under study, enter the minimum and maximum values of the latitudes and longitudes in their respective edit boxes in the **Useful Range: Geographic** area.

In the **Minimum Non-Zero Coordinate Values** area, you can specify the geographic limits of the location under study in terms of Cartesian coordinates. To do so, enter the non-zero x and y values in the **Non-zero X** and **Non-zero Y** edit boxes. To specify the limits in the form of Cartesian coordinates, choose the button corresponding to the **Useful Range:Cartesian** option; four edit boxes will be displayed. Next, enter the limits of the geographic location in their respective edit boxes. After specifying all parameters in this page, choose the **Next** button; the **Review coordinate system** page will be displayed.

Coordinate system Page

In this page, you can review the values, parameters, and settings applied to the current coordinate system. To modify any setting, choose the **Edit** button in the area corresponding to the option to be modified. On doing so, the page corresponding to the options to be modified will be displayed. In the page displayed, modify the settings of parameters based on project requirement and then choose the **Review coordinate system** link from the **Task Overview**; the **Coordinate System** page will be displayed with the modified settings. After reviewing all the parameters in this page, choose the **Finish** button; the **Create Coordinate System** dialog box will be closed and a coordinate system will be created in the specified category.

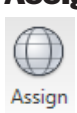
Assigning a Coordinate Reference System to Data

Ribbon:	Map Setup > Coordinate System > Assign
Command:	MAPCSASSIGN

As mentioned earlier, the coordinate reference system defines how an object spatially relates to a location on the Earth's surface. A spatial data with a defined CRS can be easily integrated into your project and can be used for the purpose of spatial analysis.

You can start a new project by defining its coordinate reference system and then create datasets. The procedure to define coordinate reference system to a dataset while importing it into your drawing environment and the procedure to assign coordinate reference system to your drawing (project) is discussed next.

Assigning CRS to the Drawing



You can use the **Assign** tool to define a coordinate system to the current drawing. To assign a CRS to the drawing, choose the **Assign** tool from the **Coordinate System** panel; the **Coordinate System - Assign** dialog box will be displayed, as shown in Figure 3-19. The options in different areas of the dialog box are discussed next.

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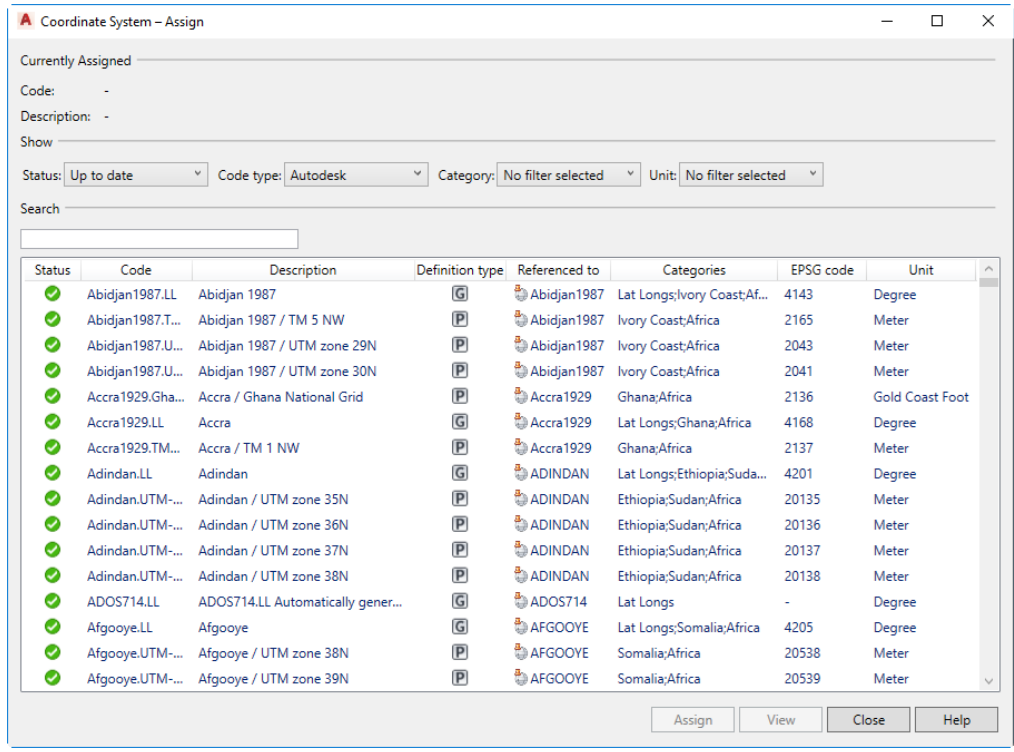


***Figure 3-19** The **Coordinate System - Assign** dialog box*

Currently Assigned Area

The **Code** and **Description** in this area display code and description of the coordinate system (CRS) that has been currently assigned to the drawing. In case no CRS has been defined, the **Code** and **Description** labels will display **N/A**.

Show Area

The **Show** area of the **Coordinate System - Assign** dialog box contains four drop-down lists, namely **Status**, **Code type**, **Category**, and **Unit**. You can use the options in these drop-down lists to filter the list of available coordinate system. These drop-down lists are discussed next.

Status: You can filter the coordinate system (CRS) based on the status by selecting the relevant option from the **Status** drop-down list in the **Show** area. To view the list of updated coordinate systems, select the **Up to date** option from the **Status** drop-down list. Similarly, to view the list of out of date coordinate systems, select the **Out of date** option from the drop-down list. You can also select the **User defined** option from the drop-down list to view the coordinate system created by the user.

Code: To filter the coordinate systems based on the code, select the relevant option from the **Code type** drop-down list. To filter the coordinate systems based on the EPSG (European Petroleum Survey Group) code, select the **EPSG** option from the drop-down list else select the **Autodesk** option from the drop-down list.

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Category: This drop-down list contains the list of available categories of coordinate systems. To filter the coordinate systems based on the category, select the required option from this drop-down list. For example, to display the list of geographic coordinate system, select the **Lat Longs** option from the drop-down list. Similarly, you can select the country name to filter the coordinate systems based on the country. For example, to view the list of coordinate systems for Australia, select the **Australia** option from the **Category** drop-down list. The coordinate system can also be filtered based on the arbitrary coordinate system, obsolete coordinate system, UTM coordinate system, and so on.

Unit: To view the list of coordinate system based on a particular unit, select the required option from the **Unit** drop-down list. For example, to view the list of coordinate systems based on the US Survey foot, select the **US Survey Foot** option from the drop-down list. Similarly, you can view the list of coordinate systems based on meters, international foot, degrees, and so on.

Search Area

You can use the edit box in the **Search** area to search the required coordinate system from the coordinate system library. To find a coordinate system, enter the code, description, details, or information of the coordinate system in this edit box. The list of coordinate systems displayed below the search edit box will dynamically update as you type in the search edit box.

After applying filters, select the required coordinate system from the list displayed below the search text box. To read the details about the selected coordinate system, choose the **View** button; the **Coordinate System** window will be displayed, refer to Figure 3-20. Choose the **Close** button in this window to exit. Next, to assign the selected coordinate system to the drawing, choose the **Assign** button from the **Coordinate System - Assign** dialog box; the dialog box will be closed and the coordinate system will be assigned to the current drawing.

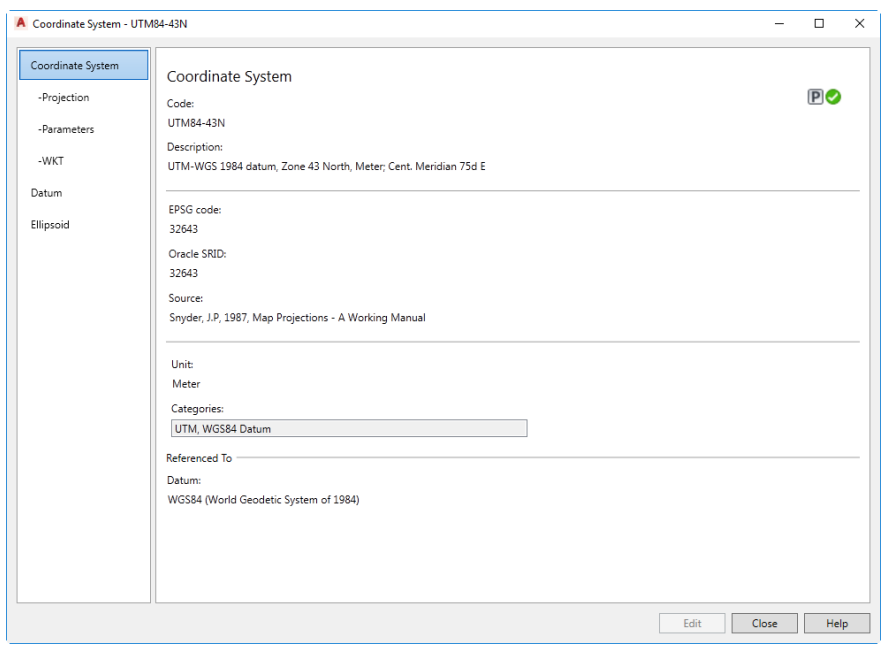
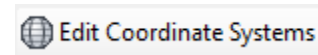


Figure 3-20 *Partial view of the* ***Coordinate System*** *window with the* ***Coordinate System*** *page*

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Using the Connect Tool to Assign a Coordinate System to a Dataset

A coordinate system can be assigned to a dataset using the **Connect** tool and also to load the data into the Workspace. To do so, select data in an external data format by using the **Connect** tool as explained in the previous chapter, and then choose the **Edit Coordinate Systems** button located at the top of the list box; the **Edit Spatial Contexts** dialog box will be displayed, as shown in Figure 3-21.



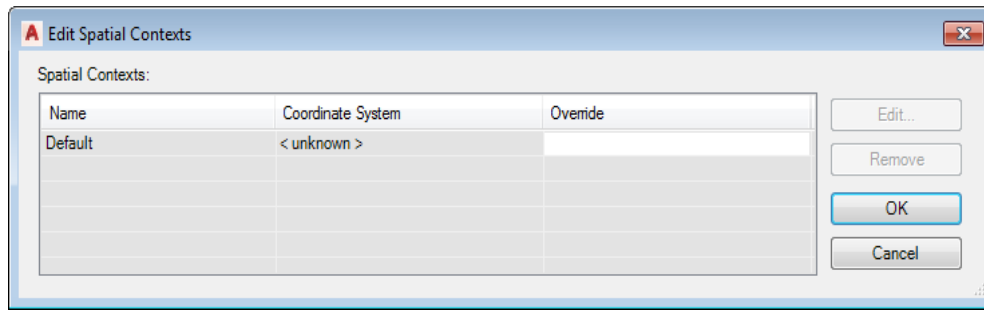


Figure 3-21 *The **Edit Spatial Contexts** dialog box*

To assign a new coordinate system or edit an existing coordinate system, double-click on the first record in the **Spatial Contexts** list box; the **Coordinate System Library** dialog box will be displayed. Alternatively, to invoke the **Coordinate System Library** dialog box, select the record in the **Spatial Contexts** list box and then choose the **Edit** button; the **Coordinate System Library** dialog box will be displayed. Select the required coordinate system from the **Coordinate System Library** dialog box and then choose the **Select** button; the dialog box will be closed and the code of the selected coordinate system will be displayed in the **Override** column of the **Edit Spatial Contexts** dialog box, refer to Figure 3-22. Next, choose the **OK** button; the dialog box will be closed and the selected coordinate system will be assigned to the dataset.

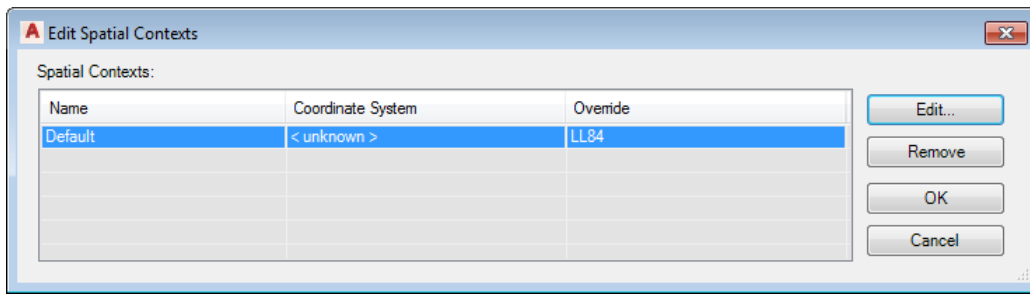


Figure 3-22 *The **Code** of the selected coordinate system displayed in the **Override** column*



Tip

*You can also invoke the **Edit Spatial Contexts** dialog box by choosing the **Edit Coordinate System** option from the shortcut menu. To display the shortcut menu, right-click on the dataset name in the DATA CONNECT wizard.*

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USER COORDINATE SYSTEMS IN AutoCAD

AutoCAD Map 3D application is developed using an AutoCAD platform. In AutoCAD, there are two coordinate systems: **World Coordinate System** (**WCS**) and **User Coordinate System** (UCS). These coordinate systems are also available in AutoCAD Map 3D. Whenever you start the AutoCAD Map 3D application, the drawing will be set to WCS. WCS is a fixed coordinate system and the X axis in WCS is the horizontal axis, the Y axis is vertical and the Z axis is perpendicular to the XY plane. The origin is defined at the intersection of X and Y axis (0, 0) in the lower left corner of the drawing. Using WCS, you can create 2D drawings and surface models. However, creating 3D models with multiple features using WCS is a cumbersome task. In such a scenario, a custom defined coordinate system may help accelerate the drafting process. A custom defined coordinate system is called as the User Coordinate System (UCS). You can define a UCS in terms of the WCS. While defining the UCS, you can specify its origin and the orientation of its axis. This helps you to specify points in three-dimensions. A brief description of working with UCS is given next.

Moving the UCS Triad

Ribbon: View > Coordinates > UCS
Command: UCS



To move the UCS triad, choose the **UCS** tool from the **Coordinates** panel of the **View** tab; the cursor changes into crosshair in the drawing window. Place the crosshair at the required point and then click; the UCS triad moves to the specified point. Next, press ENTER; the position of the UCS triad will be fixed at the specified point.

Rotating the UCS Triad about the X Axis

Ribbon: View > Coordinates > X
Command: UCS



You can rotate the UCS about the X axis in the YZ plane. To rotate the UCS icon in the YZ plane while keeping the X axis fixed, choose the **X** tool from the **Coordinates** panel; the cursor will change to a crosshair in the drawing window and you will be prompted to specify the rotation angle. Enter the rotation angle and press ENTER; the UCS will rotate about the X axis. The angle of rotation can be applied to the UCS icon, as shown in Figure 3-23.

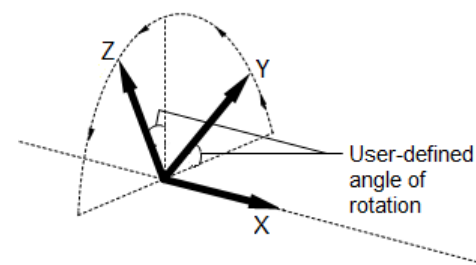


Figure 3-23 *Rotating the UCS icon keeping the X axis fixed*

Similarly, you can use the **Y** and **Z** tools from the **Coordinates** panel of the **View** tab to rotate the UCS icon in the XZ and XY plane, respectively.





Using a Named UCS for Drawings

Ribbon: View > Coordinates > UCS, UCS Settings Button



You can assign a name to the UCS and then use it anytime during the project. The UCS settings that need to be applied to many drawing objects in the project can be saved as a

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template so that you can use the new template for many drawing objects as per project requirement. In the previous section of this chapter, you learned how to realign a UCS as per your requirement. To specify a named UCS for the drawings in the project, choose the **UCS**, **UCS Settings** button from the **Coordinates** panel; the **UCS** dialog box will be displayed, as shown in Figure 3-24. The **Named UCSs**, **Orthographic UCSs**, and **Settings** tabs in the **UCS** dialog box are discussed next.

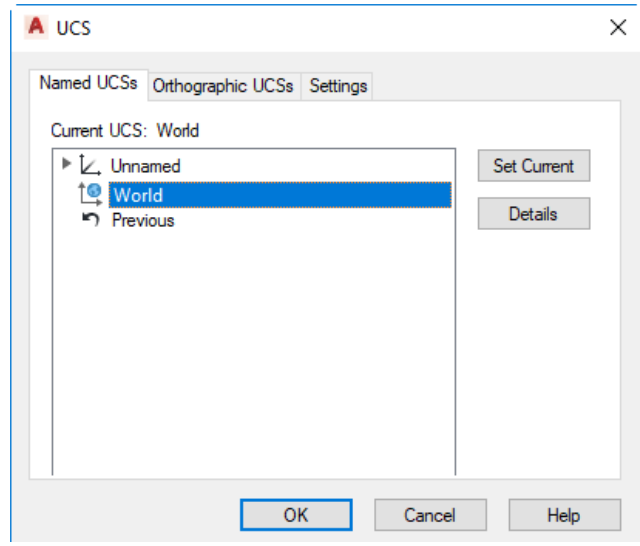


Figure 3-24 *The* ***UCS*** *dialog box*

Named UCSs Tab

The options in the **Named UCSs** tab are used to specify a name for the modified UCS settings and to set a named UCS as the current UCS. In the **UCS** dialog box, choose the **Named UCSs** tab, if it is not chosen by default. To rename a UCS, select it from the **Current UCS** list box and then right-click on the **Unnamed** option; a shortcut menu will be displayed. Choose the **Rename** option from this shortcut menu; the **Unnamed** option will change into an edit box. In this edit box, enter a name, and then press ENTER. To set a particular UCS as the current UCS, select it from the **Current UCS** list box and right-click; a shortcut menu will be displayed. Choose the **Set Current** option from the shortcut menu and the selected UCS will be set as the current UCS. Alternatively, to set the UCS as the current UCS, select the relevant UCS and then choose the **Set Current** button; the selected UCS will be set as the current UCS. To delete a particular UCS, choose the **Delete** option from the shortcut menu. You can also choose the **Details** option from the shortcut menu to view the details of the selected UCS.



Note

The ***Unnamed*** *option will appear only if you have modified the alignment of the default UCS icon.*

Orthographic UCSs Tab

The options in the **Orthographic UCSs** tab of the **UCS** dialog box are used to apply the orthographic coordinate system to the current drawing with reference to the available coordinate system. To apply a particular orthographic coordinate system to the current drawing, choose an option from the **Name** list box in the **UCS** dialog box. To apply the orthographic coordinate

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system with reference to an available coordinate system, choose an option from the **Relative to** drop-down list. To apply the modified settings to a coordinate system, choose the **Set Current** button. Next, choose the **OK** button; the UCS triad will change to the settings specified in the drawing window.

Settings Tab

The options in the **Settings** tab are used to specify the displaying and aligning properties of the UCS triad. These settings are discussed next.

UCS Icon settings Area

The options in the **UCS Icon settings** area are used to set the properties of the UCS icon. To hide the UCS icon from the drawing window, clear the **On** check box. To display the UCS icon at the lower left corner of the drawing window instead of displaying it at the origin of the coordinate system, clear the **Display at UCS origin point** check box. To apply the modified UCS settings to all viewports in the current drawing, select the **Apply to all active viewports** check box. To enable the selection of the UCS icon, select the **Allow Selecting UCS icon** check box. Note that, by default, this check box is selected.

UCS settings Area

The options in the **UCS settings** area are used to set viewports with UCS. The **Save UCS with viewport** check box is selected by default in this area. As a result, the modified UCS settings will be saved with the current viewport. If you clear the **Save UCS with viewport** check box, the modified settings will be applied to the entire drawing. To apply the current UCS settings to the viewport and ignore the UCS settings applied to a particular viewport, clear the **Save UCS with viewport** check box. To restore the plan view when the coordinate system in the viewport is changed, select the **Update view to Plan when UCS is changed** check box. Next, choose the **OK** button to close the dialog box.

TUTORIALS

General instructions for downloading tutorial files:

To complete the tutorials, you need to download the tutorial data to your computer. To download the tutorial data, follow the steps given below:

1. Log on to *www.cadcim.com* and browse to *Textbooks > Civil/GIS > Map 3D > Exploring AutoCAD Map 3D 2022*. In this page, select *c03_m3d_2022_tut.zip* file from the **Tutorial Files** drop-down list. Next, choose the corresponding **Download** button to download the data file.

2. Extract the contents of the zip file at the following location:

   C:\m3d_2022

Notice that the *c03_m3d_2022_tut* folder is created in the *m3d_2022* folder.

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Tutorial 1 Assigning CRS

In this tutorial, you will start with a new drawing file. Next, you will assign a Coordinate Reference System (CRS) to the current drawing. **(Expected time: 30 min)**

The following steps are required to complete this tutorial:

a. Start a new drawing file.
b. Assign the **NE83 - NAD83 Nebraska State Planes, Meter** coordinate system to the current workspace.
c. Save the file.

Starting a New Drawing

1. Choose **New > Drawing** from the Application Menu; the **Select template** dialog box is displayed.

2. In the **Select template** dialog box, select the *map2d.dwt* template file and then choose the **Open** button; the **map2d** template is applied to the Modelspace.

Assigning a Global Coordinate System to the Current Workspace

1. Choose the **Assign** tool from the **Coordinate System** panel in the **Map Setup** tab; the **Coordinate System - Assign** dialog box is displayed.



2. In the **Show** area of the dialog box, select the **USA, Nebraska** option from the **Category** drop-down list; a list of coordinate systems in this category is displayed in the list box of the dialog box.

3. Next, select the **NE83** code with description **NAD83 Nebraska State Planes, Meter** from the list box, and then choose the **Assign** button; the selected coordinate system is assigned to the Workspace.

Saving the Drawing File

1. Choose the **Save As** option in the Application Menu; the **Save Drawing As** dialog box is displayed.

2. In the **Save Drawing As** dialog box, enter **c03_Tut01a** in the **File name** edit box and make sure that the **AutoCAD 2022 Drawing (*.dwg)** option is selected in the **Files of type** drop-down list.

3. Next, choose the **Save** button; the drawing file is saved at the specified location.

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Tutorial 2 Creating a Coordinate Reference System

In this tutorial, you will create a Coordinate Reference System using the parameters given below and then assign it to the current drawing. **(Expected time: 45 min)**

Parameters of ellipsoid:
Code: CADCIM - GRS1980
Equatorial radius = 6378137 m
Polar radius = 6356752.31414035 m
Inverse flattening= 0.00335281068118332
Eccentricity squared= 0.0818191910428279

Parameters of datum:
Code: CADCIM- NAD83
Source: CADCIM

Parameters of new coordinate system:
Coordinate system type: Projected
Code: Austin TX
Source: CADCIM
Unit: US Survey Foot
Category: test only
Referenced to: (Geodetic) CADCIM - NAD83 datum

Projection: Lambert Conformal Conic, double standard parallel
Northern standard parallel: 31.8833333333333
Southern standard parallel: 30.1166666666667
Origin longitude: -100.333333333333
Origin latitude: 29.6666666666667
False easting: 2296583.33333333
False northing: 9842500

Common Parameters:
Map scale: 1
X Increases to the: East,
Y Increases to the: North
Minimum longitude: -108.3
Maximum longitude: -91.8666666666667
Minimum latitude: 29.5333333333333
Maximum latitude: 32.5
Non zero X:
Non zero Y: 0

The following steps are required to complete this tutorial:

a. Verify folder permissions.
b. Start a new drawing file.
c. Create a coordinate system definition using the given parameters.

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d. Assign the coordinate system to the current drawing.
e. Save the file.

Verifying Folder Permissions

AutoCAD Map 3D saves the created CRS in the **Geospatial Coordinate Systems** folder. As a result, you need to have write permission for this folder. In this part of the tutorial, you will verify the permissions for this folder and change them if necessary.

1. Close the **AutoCAD Map 3D 2022** software application, if it is running.

2. In the **Windows Explorer**, browse to the following location:

   C:\ProgramData\Autodesk



Note

*The **ProgramData** folder is a hidden folder. To view this folder, you need to turn on the **Show hidden files, folders and drives** option for your Windows operating system.*

3. In the **Autodesk** folder, right-click on the **Geospatial Coordinate Systems <version>** folder; a shortcut menu is displayed. In this menu, choose the **Properties** option; the **Geospatial Coordinate Systems <version> Properties** dialog box is displayed.

4. In this dialog box, choose the **Security** tab from this dialog box; the options in this tab are displayed. Choose the **Edit** button in this tab; the **Permissions for Geospatial Coordinate Systems <version>** dialog box is displayed.

5. In this dialog box, select a user name from the **Group or user names** list box; the permissions assigned to the selected user are displayed in the **Permissions for Users** list box.

6. In the **Permissions for Users** list box, select the check box corresponding to the **Full Control** option in the **Allow** column; all the check boxes in the **Allow** button are selected by default.

7. Next, choose the **Apply** and then the **OK** button from this dialog box; the **Permissions for Geospatial Coordinate Systems <version>** dialog box is closed and the settings are saved.

8. Again, choose the **OK** button in the **Geospatial Coordinate Systems <version> Properties** dialog box to close it.

Starting the AutoCAD Map 3D Application

1. Start the AutoCAD Map 3D 2022 application.

Creating a Coordinate System Definition Using the Given Parameters

In this part of the tutorial, you will define the coordinate system using the **Create Coordinate System** tool. You will first define an ellipsoid and datum. Next, using the defined ellipsoid, datum, and the parameters given in the tutorial data, you will create the coordinate reference system.

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1. Choose the **Create Coordinate System** tool from **Map Setup > Coordinate System > Create** drop-down; the **Create Coordinate System** wizard with the **Create coordinate system** page is displayed.

2. In this page, select the **Create a coordinate system definition** radio button if it is not selected by default. Next, choose the **Next** button; the **Specify starting point** page of the wizard is displayed.

3. In this page, select the **Start with an ellipsoid** radio button, if it is not selected by default. Next, choose the **Next** button; the **Specify ellipsoid** page is displayed.

4. In this page, select the **Create a new ellipsoid** radio button, if it is not selected by default and then choose the **Next** button; the **Create ellipsoid** page is displayed.

5. In the **Create ellipsoid** page, enter **CADCIM - GRS 1980** in the **Code** edit box.

6. Next, enter **Based on Geodetic Reference System of 1980** in the **Description** text box.

7. Make sure that the **Reference this ellipsoid (rather than a datum) in the coordinate system** check box is cleared and the **Create an ellipsoid** radio button is selected in the **Ellipsoid Dimensions** area.

8. Enter **6378137** as the equatorial radius, **0.00335281068118332** as the inverse flattening ratio and **6356752.31414035** as the polar radius in the **Equatorial radius (meters)**, **Inverse flattening**, and **Polar radius (meters)** edit boxes, respectively. Notice that the value for the eccentricity squared parameter is calculated and displayed automatically in the **Eccentricity squared** edit box, refer to Figure 3-25.

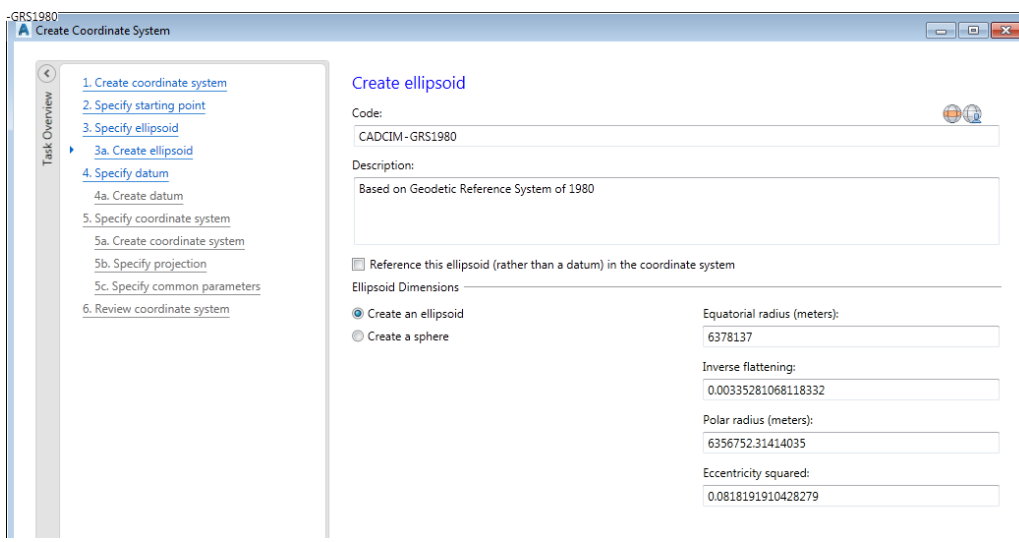


Figure 3-25 *Partial view of the* ***Create ellipsoid*** *page of the* ***Create Coordinate System*** *wizard*

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9. Choose the **Next** button; the **Specify datum** page of the wizard is displayed.

10. Make sure that the **Create a new datum** radio button is selected in this page and then choose the **Next** button; the **Create datum** page is displayed.

    Notice that the ellipsoid defined earlier as **CADCIM - GRS 1980** is selected and displayed as **CADCIM - GRS1980 (Based on Geodetic Reference System of 1980)** in the **Ellipsoid** text box of the **Create datum** page.

11. Next, enter **CADCIM-NAD83** in the **Code** edit box and **NAD 1983 Datum - Ellipsoid GRS 1980** in the **Description** text box.

12. Next, enter **CADCIM** in the **Source** edit box.

13. Choose the **Next** button in the **Create datum** page; the **Specify coordinate system** page of the wizard is displayed.

14. In this page, select the **Create a new coordinate system** radio button if it is not selected by default.

15. Select the **Projected** option from the **Coordinate system type** drop-down list, if it is not selected by default, and then choose the **Next** button; the **Create coordinate system** page is displayed in the wizard.

16. In this page, enter **AUSTIN - TX** in the **Code** edit box and **User defined CRS - Austin city** in the **Description** text box.

17. Enter **CADCIM** in the **Source** edit box.

18. Ensure the **US Survey Foot** option is selected in the **Unit** drop-down list.

19. Choose the **Test Only** option from the **Available categories** list box and then choose the **Add** button; the selected category is added to the **Categories associated with this coordinate system** list box.

20. Make sure that the **Geodetic** radio button is selected in the **Referenced To** area of this page and the **Datum** text box displays **CADCIM-NAD83 (NAD 1983 Datum - Ellipsoid GRS 1980)**, refer to Figure 3-26.

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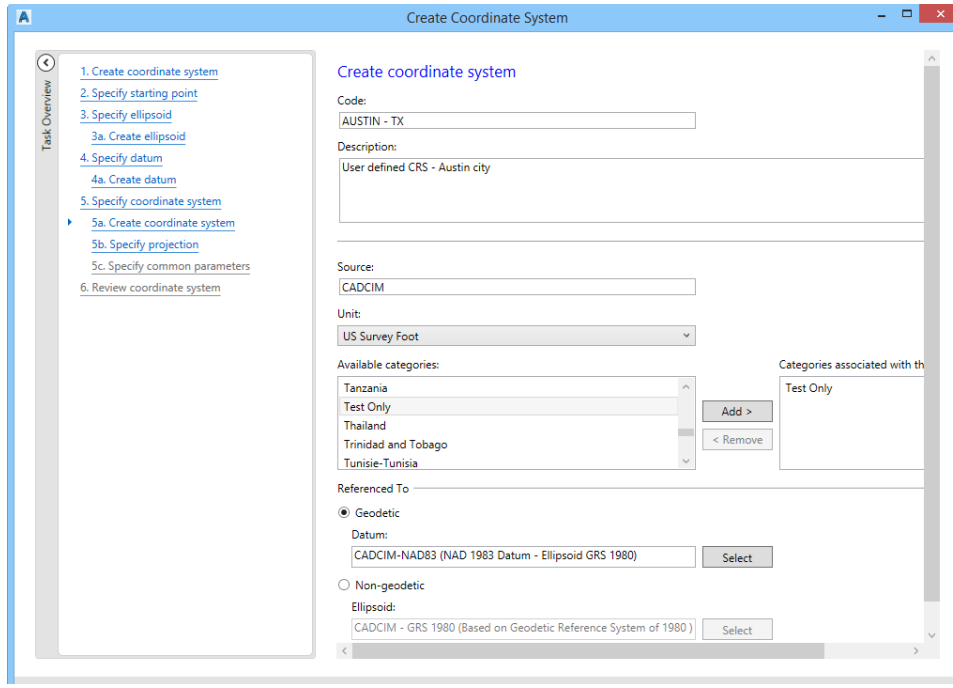


Figure 3-26 *The* ***Create coordinate system*** *page displaying various parameters for creating CRS*

21. Choose the **Next** button in the **Create coordinate system** page; the **Specify projection** page of the wizard is displayed.

    In this page, you will specify the projection parameters for the coordinate reference system.

22. Select the **Lambert Conformal Conic, double standard parallel** option from the **Projection** drop-down list; the **Create Coordinate System - Projection** message box is displayed. Choose the **Yes** button in this message box to close it.

23. In the **Parameters** area of the **Specify projection** page, enter **31.8833333333333** and **30.1166666666667** in **Northern standard parallel** and **Southern standard parallel** edit boxes, respectively.

24. Next, in the **Projection Origin** area, enter **-100.333333333333** and **29.6666666666667** in the **Origin longitude** and **Origin latitude** text boxes, respectively.

25. Enter **2296583.33333333** and **9842500** in the **False easting** and **False northing** text boxes, respectively. Figure 3-27 shows the **Specify projection** page of the wizard with the projection parameters.

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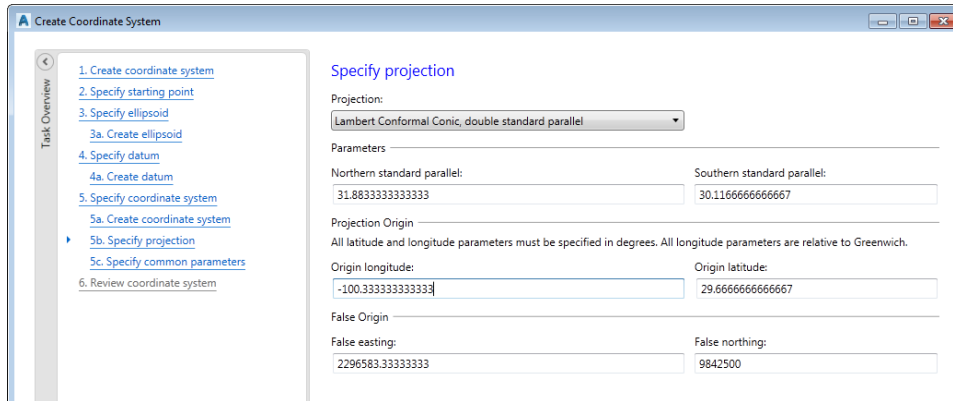


Figure 3-27 *Partial view of the* ***Specify projection*** *page*

26. Choose the **Next** button in the wizard; the **Specify common parameters** page is displayed.

27. In the **Scaling** area, specify **1** in the **Map (paper) scale** edit box.

28. Next, select the **East** and **North** options in the **X increases to the** and **Y increases to the** drop-down lists, respectively.

29. In the **Useful Range: Geographic** area, enter **-108.3** and **-89.8666666666667** in the **Minimum longitude** and **Maximum longitude** edit boxes, respectively.

30. Specify **29.5333333333333** and **32.5** as the minimum and maximum latitude values in the **Minimum latitude** and **Maximum latitude** edit boxes, respectively.

31. Retain **0** in both the **Non-zero X** and **Non-zero Y** edit boxes.

32. Choose the **Next** button in the **Specify common parameters** page; the **Coordinate system** page with a summary of the coordinate system is displayed.

33. Choose the **Finish** button; the **Create Coordinate System** wizard is closed and the coordinate system is saved in the **Geospatial Coordinate Systems** folder.

Assigning the Created Coordinate System to the Current Drawing

1. Choose the **Assign** tool from the **Coordinate System** panel in the **Map Setup** tab; the **Coordinate System-Assign** dialog box is displayed.



2. In the dialog box, select the **User defined** option from the **Status** drop-down list in the **Show** area; the list of user-defined coordinate systems is displayed in the list box below the **Search** area.

3. Select the **AUSTIN - TX** code from the displayed list and then choose the **Assign** button; the dialog box is closed and the selected coordinate system is assigned to the current drawing.

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Saving the Drawing File

1. Choose the **Save As** option in the Application Menu; the **Save Drawing As** dialog box is displayed.

2. In the **Save Drawing As** dialog box, enter **c03_Tut02a** in the **File name** edit box and select the **AutoCAD 2022 Drawing (*.dwg)** option in the **Files of type** drop-down list, if it is not selected by default. Now, choose the **Save** button next to the **File name** edit box; the current drawing file is saved with the given name.

Tutorial 3 Assigning CRS while Loading Data

In this tutorial, you will assign a coordinate system (CRS) to a dataset while loading it using the **Connect** tool. **(Expected time: 20 min)**

The following steps are required to complete this tutorial:

a. Start a new drawing file and then assign the **IslandsNET1993.LL ISN93** coordinate system to the dataset while loading data by using the **Connect** tool.
b. Save the file.

Starting a Drawing File

1. Choose **New > Drawing** from the Application Menu; the **Select template** dialog box is displayed.

2. In the **Select template** dialog box, select the *map2d.dwt* template file and then choose the **Open** button; the **map2d** template is applied to the Modelspace.

Assigning the Coordinate System to the Dataset Using the Data Connect Tool

1. Choose the **Connect** tool from the **Data** panel in the **Home** tab; the **DATA CONNECT** wizard is displayed.

2. In the **DATA CONNECT** wizard, select the **Add SHP Connection** option from the **Data Connections by Provider** list box; the **OSGeo FDO Provider for SHP** page is displayed in the right pane of the wizard.

3. In the **OSGeo FDO Provider for SHP** page, choose the browse button next to the **Source file or folder** edit box; the **Open** dialog box is displayed. In this dialog box, browse to the following location: *C:\m3d_2022\c03_m3d_2022\c03_tut03*.

4. Next, select the **c03-m3d-2022-tut03.shp** file from the list box and then choose the **Open** button; the **Open** dialog box is closed and the path of the shape file is added to the **Source file or folder** edit box in the **OSGeo FDO Provider for SHP** page.

5. Choose the **Connect** button; the selected shape file is displayed in the **Add Data to Map** list box.

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6. Choose the **Edit Coordinate Systems** button in the **Add Data to Map** area; the **Edit Spatial Contexts** dialog box is displayed.

7. In the **Edit Spatial Contexts** dialog box, select the first row and then choose the **Edit** button; the **Coordinate System Library** dialog box is displayed.

8. In the **Coordinate System Library** dialog box, select the **Iceland** option from the **Category** drop-down list; a list of coordinate systems in the selected category is displayed in the list box below the **Search** edit box.

9. Next, select the **IslandsNet1993.LL** code with the **ISN93** description option from the list box.

10. Choose the **Select** button in the **Coordinate System Library** dialog box; this dialog box is closed and the **IslandsNet1993.LL** code is displayed in the **Override** column of the **Edit Spatial Contexts** dialog box.

11. Choose the **OK** button in the **Edit Spatial Contexts** dialog box; the dialog box closes and the selected coordinate system is assigned to the shape file.

12. In the **DATA CONNECT** wizard, choose the **Add to Map** button; the shape file gets connected to the Workspace. Note that the **Display Manager** tab of the **TASK PANE** displays the name of the added feature class.

13. Close the **DATA CONNECT** wizard by choosing the Close **[X]** button from the upper left corner; this wizard is closed and the geometry of the shape file is displayed in the drawing window, refer to Figure 3-28.

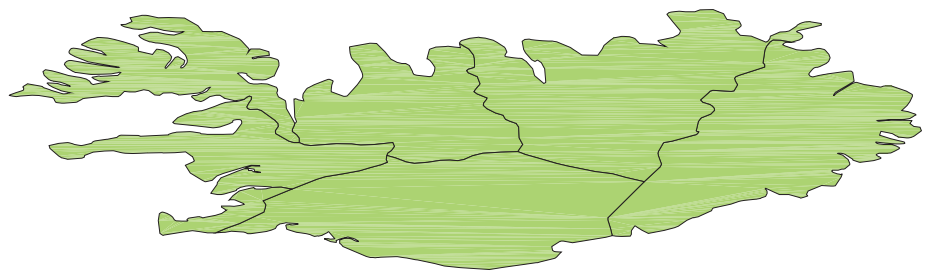


Figure 3-28 *Model created by combining various features*

Saving the Drawing File

1. Choose the **Save As** option in the Application Menu; the **Save Drawing As** dialog box is displayed.

2. In the **Save Drawing As** dialog box, enter **c03_Tut03a** in the **File name** edit box and select the **AutoCAD 2022 Drawing (*.dwg)** option in the **Files of type** drop-down list. Now, choose the **Save** button next to the **File name** edit box; the current drawing file is saved with the given name.

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Self-Evaluation Test

Answer the following questions and then compare them to those given at the end of this chapter:

1. Which of the following zoom options displays the previous zoom state of the drawing?

   (a) **Window** (b) **Realtime**
   (c) **Previous** (d) **Object**

2. Which of the following tools is used to specify a coordinate system for the dataset?

   (a) **Connect** (b) **Create**
   (c) **Assign** (d) **Export**

3. Which of the following shortcut keys is used to toggle the display of the grid in the drawing window?

   (a) **F7** (b) **F8**
   (c) **F10** (d) **F6**

4. Which of the following tabs in the **Drafting Settings** dialog box is used to specify the settings for the snap grid?

   (a) **Polar Tracking** (b) **Object Snap**
   (c) **Dynamic Input** (d) **Snap and Grid**

5. Which of the following functional keys are used to turn on the **Object Snap** in the drawing window?

   (a) F11 (b) F9
   (c) F3 (d) F7

6. You can use the _____ object snap option to track the end point of a line segment.

7. The _____ option in the **Navigate** panel of the **View** tab is used to zoom to the limits of the selected layer in the drawing window.

8. The _____ object snap option is used to snap to the center of an arc, circle, ellipse, or elliptical arc.

9. To view the list of coordinate systems that are created by the user, select the _____ option from the **Status** drop-down list of the **Coordinate System** dialog box.

10. The world coordinate system is a _____ coordinate system that cannot be modified.

11. As you increase the scale value in the **AutoCAD Map 3D Scale** option, the view of the drawing gets enlarged. (T/F)

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12. When you work in the Ortho mode, you can draw lines in any direction. (T/F)

13. You can define a new global coordinate system as per your requirement. (T/F)

14. You cannot align the User Coordinate System (UCS) in any direction. (T/F)

15. You cannot assign a coordinate system to a data from an external source. (T/F)

Review Questions

Answer the following questions:

1. The _____ tool in the **Coordinates** panel of the **View** tab is used to rotate the UCS icon in the YZ plane.

2. The **Midpoint** object snap mode is used to track the _____ point of a line segment.

3. The projected coordinate systems are derived from the _____ coordinate systems by using the map projections.

4. The angle between the prime meridian and the meridian plane of any point on earth's surface is known as _____.

5. You can invoke the **Edit Spatial Contexts** dialog box by choosing the _____ button in the **DATA CONNECT** wizard.

6. The Longitude is an angle between the ellipsoidal normal and the equatorial plane. (T/F)

7. The grid spacing and snapping cannot be adjusted as per the user requirement. (T/F)

8. You can create a user-defined coordinate system using an existing coordinate system. (T/F)

9. By specifying projection parameters, you can transform a coordinate system from one system to another. (T/F)

10. Map projections always results in Cartesian Coordinate System. (T/F)

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EXERCISE

Exercise 1

Create a geographic coordinate system using the parameters given below and then assign it to the current drawing. **(Expected time: 40 min)**

Units: degree
Minimum Longitude -180 Maximum longitude 180
Minimum Latitude -90 Minimum Latitude 90

Ellipsoid (WGS 84)
Code- UserDefinedWGS84 Equatorial radius: 6378137
Polar radius: 6356752.3142 Inverse Flattening: 0.00335281067183102
Eccentricity: 0.0818191909289067

Hint:
This coordinate reference system is based on LL84.

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Answers to Self-Evaluation Test
1. c, **2.** c, **3.** a, **4.** d, **5.** c, **6. Endpoint**, **7. Extents**, **8. Center**, **9. User defined**, **10.** fixed, **11.** T, **12.** F, **13.** T, **14.** F, **15.** F