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Ways to Increase Efficiency in Teaching the Topic of “Ball Bearing”

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Аннотация. Ушбу мақолада «Шарикли подшипник»ни Siemens NX дастурида лойиҳалаш услуби кўриб чиқилган. Жумладан: Шарикли подшибникнинг ташки ва ички обоймасини чизиш, Шарикли подшибникнинг шарикини чизиш ва Шарикли подшибникни йигиш услублари Siemens NX дастурида келтирилган.

Аннотация. В статье приведена методика проектирования шарикового подшипника с помощью программы Siemens NX. А также методика проектирования внешнего и внутреннего обойми подшипника, шарика шарикового подшипника и сборка самого шарикового подшипника.

Anotation. This article discusses how to design a "ball bearing" in the Siemens NX program. These include: Drawing the outer and inner bearing of a ball bearing, drawing a ball bearing ball, and assembling a ball bearing in Siemens NX.

Калит сузлар: Лойихалаш, техника, шарикли подшипник, шарик, сепаратор, парчин (заклепка) , ташки обойма, ички обойма.

Ключевые слова: Проектирование, техника, шарик, шарико подшипник, сепаратор, заклепка, внешняя обойма, внутренная обойма.

Key words: Designing, a technique, a ball, the ball bearing, separator, rivet, an external holder, an internal holder.

NX software is one of the most advanced software packages in the field of **CAD / CAM / CAE Siemens PLM Software**. The program works using the **Parasolid** geometric modeling core. The latest version of NX 9.0 was released on October 14, 2013, and in practice, the updated versions are still in use today.

CATIA and **Elementes / Pro (ProEnjgineer)** programs from **Dassault** Systemes are **RTSs** competing with Siemens NX software systems.

Today, the Siemens NX program is gaining popularity in Russia, CIS countries and Belarus. In Europe, Siemens NX Automated Design Systems is the leader in SolidWorks, owned by Dassault Systemes, in terms of the number of users on CAD. It is known that recently the interest in Siemens NX has been growing significantly. In this article, we will look at the design of a ball bearing on a Siemens NX.

Download the Siemens NX 10 software to your computer:

1) **Draw the outer wallpaper**.

To do this, first go to **New**, from there select **Model** and click **OK**. Then click the **Sketch** button to select any surface {(x: y), (x: z), (y, z)} (M: (y, z) surface) and click **OK**. We draw a rectangle on this surface using the **Rectangle** command (the rectangle we are drawing is at the top relative to the coordinate system) and set the dimensions using the **Raped Dimension** command: Adjust the center of gravity of the rectangle to the direction of the vertical axis (ie set the distance between the center of gravity of the rectangle and the vertical axis to 0). ; width 31;

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height 12; the radius of the curve is 65 (the distance from the top of the rectangle to the horizontal axis of the coordinate system). Using the arc command, we draw an arc to the bottom of the right rectangle (the center of the **arc** is in the direction of the vertical axis, and the arc being drawn is plunged into the right rectangle) and resize (the radius of the arc is 12, the distance between the center of the arc and the bottom of the rectangle is 8). We make the top two corners of the right rectangle an arc of radius 2.1 using the **Fillet** command (Figure 1.1). Clicking **Finish Sketch** will create the view in Figure 1.2. Using the **Revolve** command, we rotate the drawing around the center. To do this, select **Revolve**, select a graph for **Select Curve**, select a horizontal vector for **Specify Vector**, select the coordinate head for **Specify Point**, type 0 in **Start Angle** and 360 in **End Angle**. Then press <**OK**> to create an external wallpaper. (Figure 1.3).

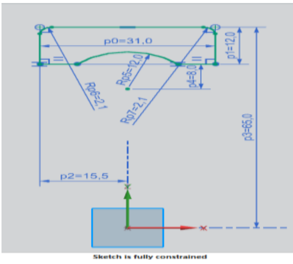

Figure 1.1

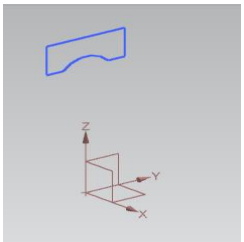

Figure 1.2

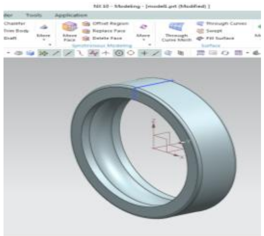

Figure 1.3

2) **Draw the inner wallpaper**

Go to **New** again, select **Model** and click **OK**. Click **Sketch**, select a surface, and click **OK**. We draw a right rectangle on this surface using the **Rectangle** command (the rectangle we are drawing is at the top relative to the coordinate system) and set the dimensions using the **Raped Dimension** command: We align the center of gravity of the rectangle with the vertical axis; width 31; height 12; the radius of the curve is 25 (the distance from the bottom of the rectangle to the horizontal axis of the coordinate system). Draw an arc on the top side of the right rectangle (the center of the **arc** is in the direction of the vertical axis and the arc you are drawing is plunged into the right rectangle) and set the dimensions (arc radius 12 , the distance between the center of the arc and the top of the rectangle is given as 8). We make the bottom two corners of the right rectangle an arc of radius 2.1 using the **Fillet** command (Figure 2.1). Then click **Finish Sketch** to create the view in Figure 2.2. Using the **Revolve** command, we rotate the drawing around the center. To do this, select Revolve, select a graph for **Select Curve**, select a horizontal vector for **Specify Vector**, select the coordinate head for **Specify Point**, type 0 in **Start Angle** and 360 in **End Angle**. Then press <**OK**> to create an internal wallpaper (Figure 2.3).

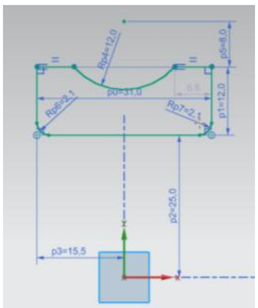

Figure 2.1

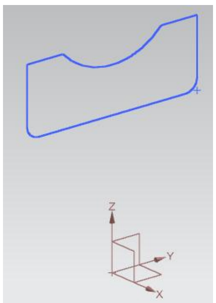

Figure 2.2

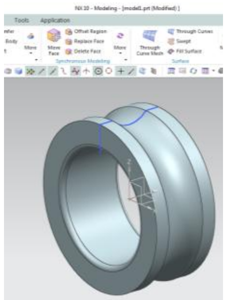

Figure 2.3

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3) **Draw a ball**

Go to **New** again, select **Model** and click **OK**. Click **Sketch**, select a surface, and click **OK**. Draw a semicircle on this surface using the **Arc** command (to draw a semicircle, select the Arc command, select **Arc** by **Center and Endpoints**. Draw an arc of 1800 as the origin) and **Radial** Using the dimension command, we select the arc radius to be 12 (Figure 3.1). Clicking **Finish Sketch** creates the view shown in Figure 3.2. Using the **Revolve** command, we rotate the drawn arc around the center. To do this, select **Revolve**, select the arc in **Select Curve**, select the horizontal vector in **Specify Vector**, select the coordinate head in Specify Point, type 0 in **Start Angle** and 360 in **End Angle**. Then press <**OK**> to form a ball (Figure 3.3).

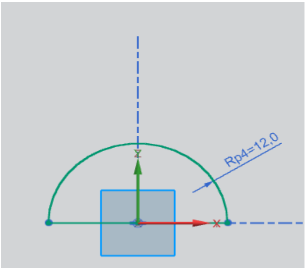

Figure 3.1

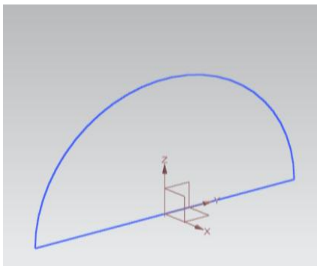

Figure 3.2

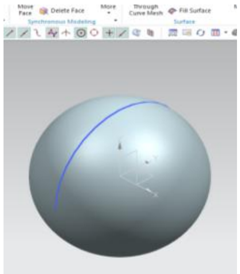

Figure 3.3

4) **Draw the separator**

Go to **New** again, select **Model** and click **OK**. **Click Sketch**, select a surface, and click **OK**. Using the **Circle** command, we can draw 2 circles by making the center of this surface at the beginning of the coordinates. We measure the diameter of one of them 94 and the other 86, we do **Finish Sketch**. We then grow these two circles using the **Extrude** command to make a total of 16 units (8 units as **Symmetric Value**). Select the surface of one side of the resulting cylindrical shape (go to Sketch and select one side and click **Ok**). Draw a circle with a radius of 90 on the selected side and make it an auxiliary line. Draw a semicircle with a radius of 12 lying at the center of this circle (Figure 4.1). Using the **Revolve** command, we rotate this semicircle around the central axis to 3600 and selectively cut the **Subtract** (the sphere created by rotating the semicircle will be cut out of the cylinder by the **Subtract** command). We rotate the 2 corner edges of the cut area with a radius of 2.1 mm using the **Edge Blend** command. Then we go to **Pattern Feature**, select **Circular in Layout**, select the created surfaces and create 8 such surfaces around the center (Figure 4.2). We enter the **shell** equipment. Select the face, leaving the desired area, set the **thickness** to 1.5 mm and click Ok (Figure 4.3). Select **Sketch** and select the desired surface to open the rivet surface. We draw a circle with a diameter of 2 from the center of this surface, grow this circle with **Extrude** and cut it from the separator. The result is a hole for the rivet. By selecting **Pattern Feature**, we make 8 holes for the rivet (Figure 4.4).

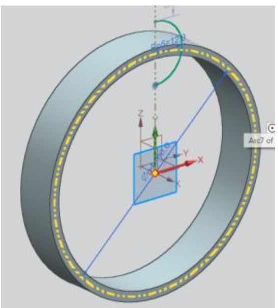

Figure 4.1

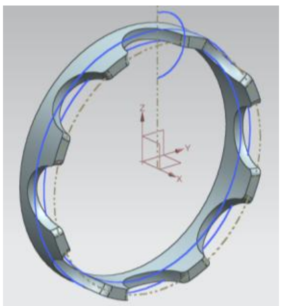

Figure 4.2

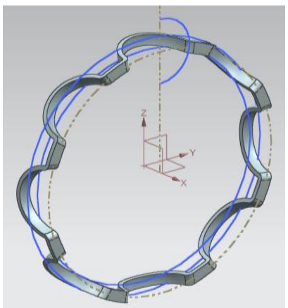

Figure 4.3

Figure 4.4

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5) **Draw a rivet**

Go to **New** again, select **Model** and click **OK**. Click **Sketch**, select a surface, and click **OK**. Draw a straight line on the horizontal axis of the coordinate system and set the size to 5.4. We merge the center of the straight line at the origin. At the top of this straight line, we draw another straight line parallel to it, make a dimension 3, and join its center to the vertical axis. And we make the distance between the two straight lines 1. We draw a vertical line from one end of the line above to the top, setting the size to 0.75. Connect the upper end of this vertical line with an arc of radius 1.9 to the end on the same side of the lower horizontal line. Then we mark the vertical line and arcs and mirror the other side with the **Mirror Curve** command (Figure 5.1), make a **Finish Sketch**. We enter the **Revolve** command. Select the drawing for **Select Curve**, select the horizontal straight line to **Specify Vector** and select **Ok**, the rivet drawing will be ready (Figure 5.2).

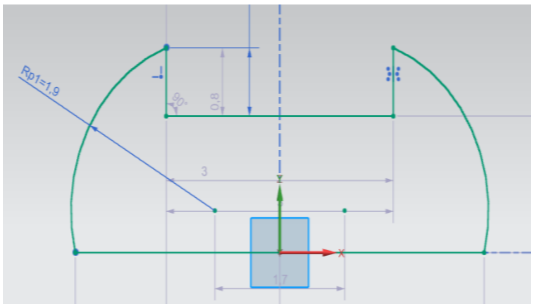

Figure 5.1

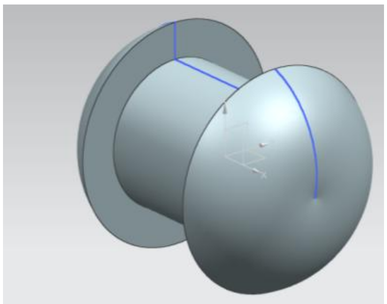

Figure 5.2

6) **Now let's do the assembly**

Go to **New** and select **Assembly** and click **OK** to perform the collection.

a) Select the **Assemblies** menu from the menu bar and go to the **Add** section. In the resulting **Add Component window**, go to **Open**. From there, select the outer wallpaper and click **OK**. We enter **Assembly Constrains**. Set the **Type** section to **Fix**, select the external wallpaper for **Select Object**, and click **Ok**.

b) Go to the **Add** section again. In the resulting **Add Component** window, go to **Open**. From there, now select the inner wallpaper and click **Ok** and click **Ok** again. Make the necessary settings using the **Move Component** command. We enter the **Assembly Constrains** command. By selecting **Concentric** from the **Type** section of the resulting window, the outer and inner wallpaper circles are selected sequentially. As a result, the inner wallpaper is placed inside the outer wallpaper.

c) Go to the **Add** section again. In the resulting **Add Component** window, go to **Open**. From there, select the ball and click **Ok** and click **Ok** again. Make the necessary settings using the **Move Component** command. We enter the Assembly Constrains command. **Select Touch Align** in the **Type** section of the resulting window, **Align** to **Orientation** in **Geometry** to **Constrain**, and select **Two Objects** to select the corresponding surface of the coordinate system in the sphere with the surface of the coordinate system parallel to the wallpaper. Click Apply. Then select **Touch** in **Orientation** and select **Two Objects** with the ball surface and the moving surface of the ball in the wallpaper. As a result, the sphere is placed in its range of moving wallpaper (inner and outer wallpaper) (Figure 6.1). We enter the **Pattern Component**. Select the ball to **Select Component**, the vector perpendicular to the wallpaper to **Specify Vector** and the

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circle to the wallpaper to **Specify Point**, type **Count** to 8, type 360/8 to **Pitch Angle** and click **Ok**. As a result, the bearing is formed of 8 balls (Figure 6.2).

d) Go to the **Add** section again. In the resulting **Add Component** window, go to **Open**. From there, select the separator and click **Ok** and click **Ok** again. Make the necessary settings using the **Move Component** command. We enter the **Assembly Constrains** command. In the resulting window, select **Touch Align** in the **Type** section, **Touch** in **Orientation** in **Geometry** to **Constrain**, and select the center of the separator with the center of the wallpaper in **Select Two Objects**. Click **Apply**. In the next Select **Two Objects**, select the surface of the separator with the surface of the sphere. And in the same way we can place a separator on the other side.

e) Go to the **Add** section again. In the resulting **Add Component** window, go to **Open**. From there, select the rivet and click **Ok** and click **Ok** again. Make the necessary settings using the **Move Component** command. We enter the **Assembly Constrains** command. Select **Touch Align** in the **Type** section of the resulting window, **Align** to **Orientation** in **Geometry** to **Constrain**, and select the center of the circle where the rivet is located in the separator with the center of the rivet circle in Select **Two Objects**. Click **Apply**. And again in the **Type** section, select **Touch Align**, Touch to **Orientation** in Geometry to Constrain, and select **Two Objects** to select the corresponding inner surface of the rivet with the rivet placement surface in the separator. As a result, the rivet falls into place.

f) We enter the **Pattern Component**. Select the rivet on the **Select Component**, the vector perpendicular to the wallpaper on the **Specify Vector**, and the circle of the wallpaper on the **Specify Point**, type Count to 8, type 360/8 to **Pitch Angle**, and click **Ok.** The rivets on the bearing also take their place. As a result, the bearing is formed in the fully assembled view in Figure 6.3.

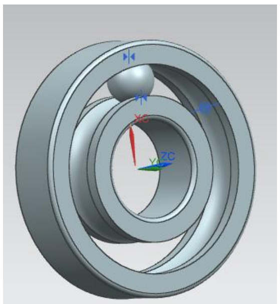

Figure 6.1

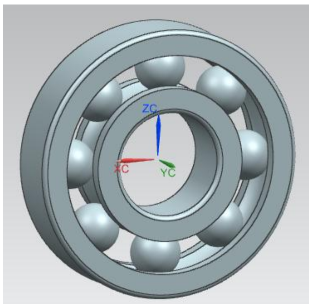

Figure 6.2

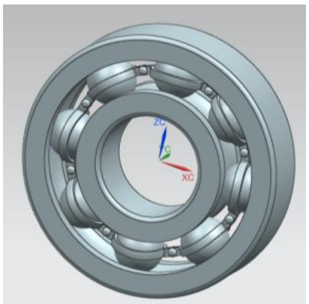

Figure 6.3

In summary, the Siemens NX 10 is one of the programs that currently offers a great opportunity to users of computer graphics. With the help of this program you will be able to model not only the "ball bearing" but also other details. Students will develop skills in modeling and researching technical details using this program.

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