

A NEW CONSTRUCTIVE SOLUTION OF A COVER ROLLS OF RIBBON CONVEYOR

Prof. Geramitchioski T. PhD.¹, Doc. Trajceviski Lj. PhD.¹, Prof. Mitrevski V. PhD.¹, Doc. Vilos I. PhD.¹
Faculty of Technical Science – University St. Kliment Ohridski Bitola, Republic of Macedonia¹

Abstract: The main aim of the research in the paper is to determine the optimum geometry of the cover for closing and sealing of the conveyor rolls of ribbon. The optimal geometry will allow minimizing the risk of cracking that run into the cracks as a result of increased stress concentration and cause destruction on the cover, infiltration of impurities that would completely disrupt the operation of the rolling bearings and stop work of the ribbon conveyor. In a stress-deformation state research on the cover made of sheet metal with the technological process of extraction will be analyzed and other possible constructive solutions that will extend the life of the cover, roll and transporters in general.

Keywords: cover rolls, ribbon conveyor, transporters, constructions

1. Introduction

Transmission of large amounts of material from one place to another is very old process which evolve methods of primitive and expensive to advanced and economical. Today's ribbon conveyors can continuously transmit material through different terrains and environments. With today's carriers along the transport is unlimited, and also components of the transporter.

Transfer of material as a product line. Only a small process line can cause a delay of the final product. Similar to the cancellation of a portion of the transporter, you can eat the transfer of material. The functionality of each part of the transporter is of importance. Carriers in the transport bar figure 1, a series of rolls that stick tape is one such area. They are present along the entire length of the transporter and they require strict examination.



Fig 1. Carriers in the transport bar

2. Carrier tapes

Carrier's tapes (see Fig.2) are a series of rolls that adhere and protect the transport bar. Table carrying straps are most used for high loads. They are made of three equal rolls; two rolls are placed at an angle, and a central horizontal. Typical materials are transported sand, earth, stones and others. The rolls (see Fig.3) are the most important parts of the carrier tape. Rolls are made of a cylindrical part that rotates concentrically around the axle. Axle lies on the edge of the

carrier tape. At each end there is housing (heads) that is located bearing and is closed with tin lid.



Fig.2 Trapezoidal carrier conveyor belt



Fig. 3 Rolls

When moving the tape roll and the outer part of the bearing range, and axle and the inner part of the bearing idle. Usually roll or its components failure first. The most common failure of rollers are shown in Figure 4.



Fig.4 Failure of rollers

3. Types of bearings

Basically there are two types of bearings that are used in transporters, cone rolling bearings and rolling element bearings with ball.

For which of these two is better to use, each has its advantages and disadvantages depending on the place of application.

Cone bearings with rolling elements are made of housing, cone, rolling elements and carrier rolling elements (see Fig.5)



Fig.5 Cone bearing

Cone is inserted in the body in a way that determines axial moving the deposit. The angle of the rolling bearings with rolling element cone allows radial and axial load. Rolling bearings are made of inner and outer ring, and carrier roll folder (see Fig.6).



Fig. 6 rolling bearing

These bearings are designed for radial loads. Can be used for axial load if inner and outer ring with deep grooves for rolling. The bearings are factory welded to rings that inherent radial correct distance. Load of the carrier on the bar depends on the weight of the material, ribbon, punches in certain places, the tightness of the tape and the vertical distance between the rolls. The largest load center roll bears about 70%. Loads are used as data for determining the lifetime of the deposit. Cone bearings were rolling element receiving the load per line (see Fig.7).

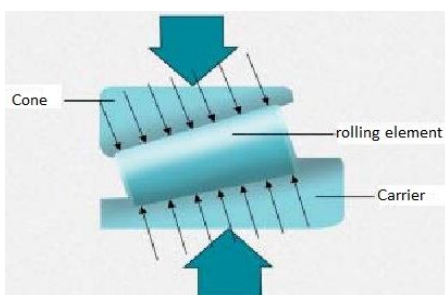


Fig.7 receiving the load per line on the cone bearing

Greater line of contact provides greater load capacity and axial and radial load. In the ball bearings, the force is

transmitted to the point. Therefore the carrier can accept less than that of cone bearings with rolling element (see Fig.8).

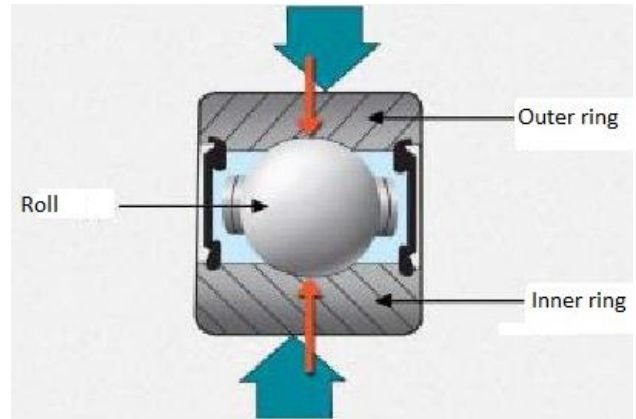


Fig. 8 rolling bearing – force transmitted to the point

4. Effectiveness of closures

Closures of the rolls are required to protect the lubricant from dirt, maintaining low rolling resistance and maximize the lifetime of use. A closure usually makes the manufacturer of tape carriers. A cone bearing with rolling element is only used with closures by the manufacturer. It is important to understand the impact of impurities present. Despite the advanced leather and methods of lubrication yet penetration dirt in bearings, which phenomenon is responsible for 50% defect of bearings.

In the vicinity of dirt and dust which is mixed with the lubricant can form abrasive layer which damages deposit. If the metal bearing surfaces come into contact with water, it forms iron oxide which also damages the bearings. Impurities can be sufficiently large to make the cavity contact surface of the channels for rolling elements; this significantly reduces the lifetime of the use of deposit. Manufacturers of closures have developed a range of labyrinthine seals to prevent penetration of dirt in place.

The labyrinth is combined with multiple channels combined with centrifugal forces to capture and remove dust and water. Centrifugal forces set up flying effect between rotating and stationary surfaces that assist in removing particles. In the vertical labyrinthine seals, radial canals and allow centrifugal forces that prevent movement of particles axial (see Fig 9).

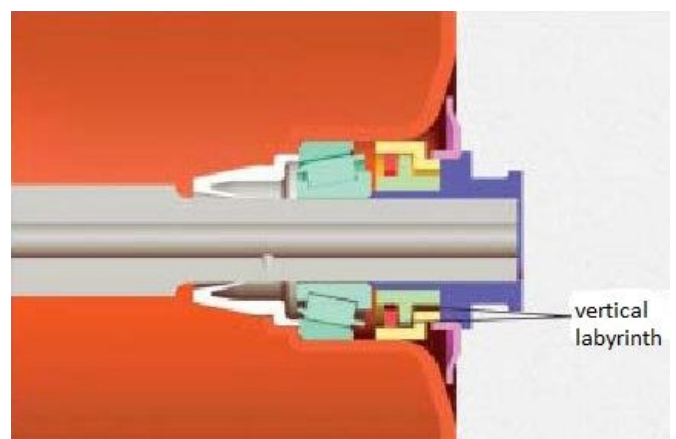


Fig.9 Vertical labyrinth seals

In horizontal seals labyrinthine channels do axial and centrifugal forces, and prevent radial movement of particles (see Fig.10) .

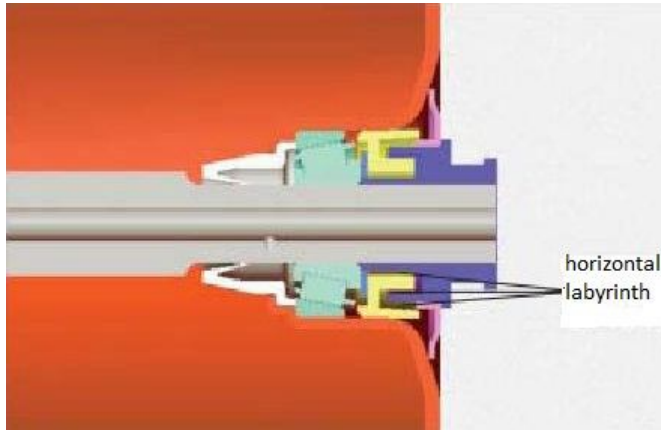


Fig.10 Horizontal labyrinth seals

Horizontal seals are easy to mount and require several more components of the vertical labyrinthine seals, they can be double, triple or more labyrinths and contact seals are not leather. From this it follows that do not restrict the speed of the bearings.

Edges leather are made of different materials and help to reduce infiltration of dust and other abrasive particles that pollute the lubricant bearings. Lubricants can also be arranged to prevent radial or axial preventing infiltration of impurities depending on the performance of the labyrinth. Edges leather are very effective in preventing dirt, but have some drawbacks that must be considered. First the leather have a short life, after this time edges allow penetration of dirt, air and moisture in place. Also limit the speed of the bearings, the leather is very close to the slot and increases the temperature generated by friction. This reduces the effectiveness of the lubricant and reduces the lifetime of the use of deposit. In some applications these seals are of great importance. Rolling bearings often compete with folder which is integrated directly into the bearing. Folder can be of metal or rubber edge contacts (see Fig. 11).

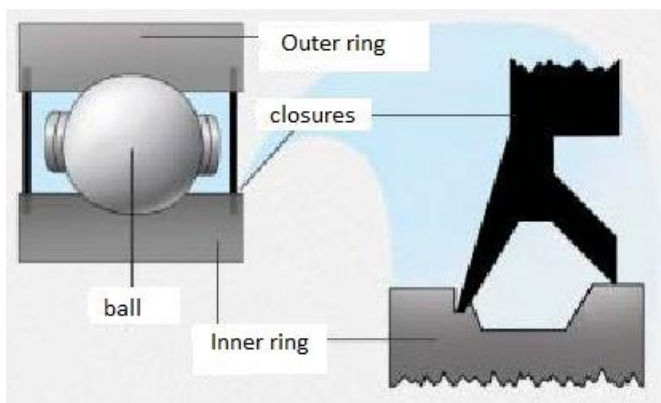


Fig.11 Rubber closures

Despite these seals still walked to the bearings of the impurities that reduce the lifetime of use. To prolong the life of bearings made of metal construction of new leather that have protective rubber element. Of great importance are the characteristics of the tire that is built to have good sealing and long life use.

5. FEM analysis of the closures element

Many times, geometry of part may already exist in a CAD system. In this example the geometry required for building the finite element model will be imported in the software FEMAP 9.2 from CAD software SOLIDWORKS.

Detail of sketch with front view created in Solid works is shown in Fig.12 and 3D model is shown in Fig.13.

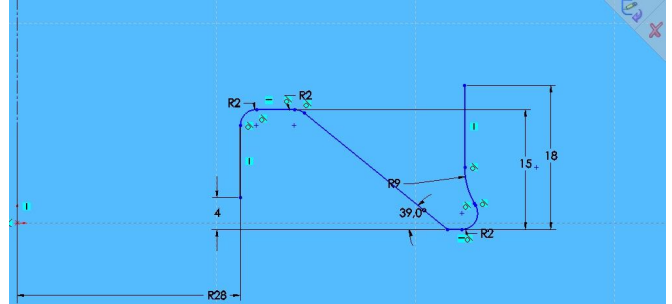


Fig.12 Front view of sketch

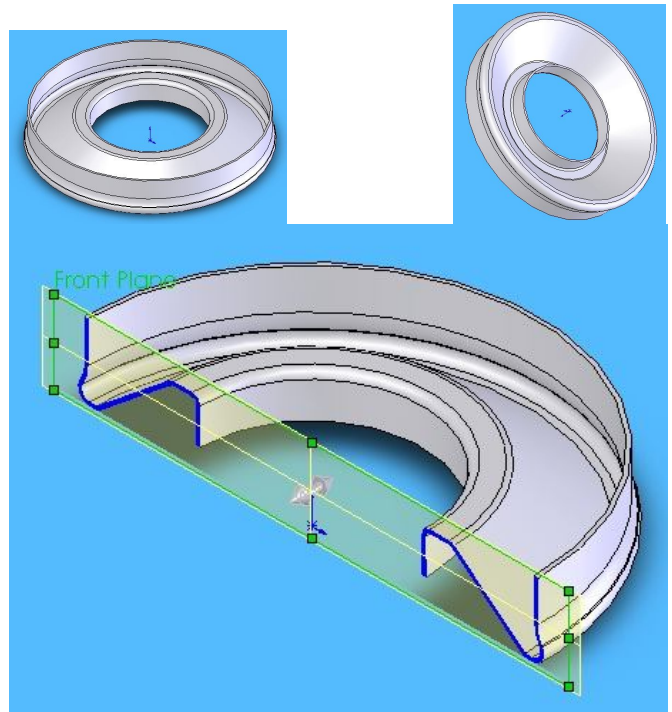


Fig.13 3D model

Next you need to do is import geometry of part in FEMAP and create a new model, or if FEMAP is already running, select FILE – NEW from the menu. To import the geometry:

Select FILE – IMPORT – GEOMETRY from the FEMAP menu.

FEMAP will now display the Windows File Open Common Dialog Box, maneuver to the directory where the stored and press Open to begin importing the geometric information.

If the labels for the points and curves that make up the geometry of this example are displayed, use the FEMAP Quick View Options (Ctrl-Q), and turn off all labels.

The geometry section of this example is complete, representing the simple import of existing geometry that will later form the basis of your finite element.

The screenshot displays the SolidWorks CAD environment. The top menu bar includes File, Tools, Geometry, Convert, Model, High, Modify, List, Delete, Group, View, Window, and Help. The left-hand tree view shows a hierarchy of features, with 'Coordinate Systems' currently selected. The central 3D view area shows a ring-like part with a central hole, rendered in a blue and white color scheme. The bottom status bar indicates the file path 'C:\Program Files\SolidWorks Corp\SolidWorks\Examples\HowTo\Part1\Part1.sldprt' and the date 'Tue May 15 00:17:42 2012'. The 'Messages' pane at the bottom shows the file path and date.

We will first set the global mesh size, then view it to verify that the mesh spacing is appropriate. You should see small diamonds along each of the geometric entities in FEMAP. These diamonds indicate where nodes will be created during any automatic meshing commands that use this geometry.

Automatic Mesh Sizing

Size For

☒ Tet Meshing ☐ Hex Meshing

Initial Sizing

Element Size

☒ Replace Mesh Sizes on All Curves

☒ Min Elements on Edge

☒ Max Angle Tolerance

☒ Max Elem on Small Feature

Max Size of Small Feature

☒ Mapped Meshing Refinement

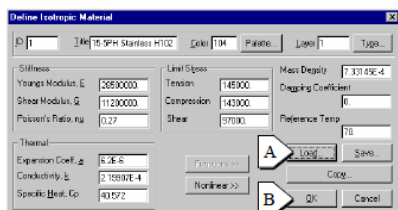
Assembly / Multi-Solid Sizing

☐ Adjacent Surface Matching

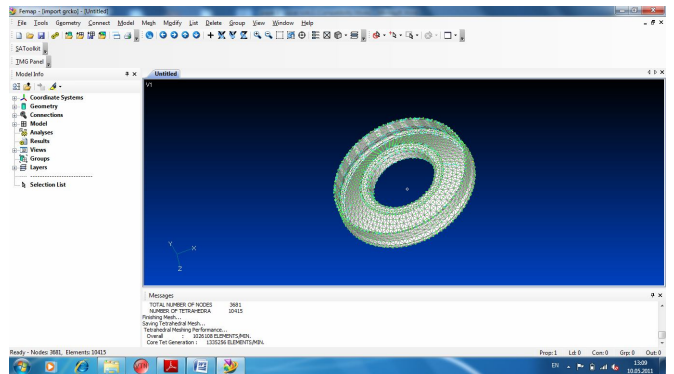
☐ Remove Previous Sizing

☐ Adjust Colors

Since no material has been created FEMAP prompts you to make one. You can enter in values or press the Load button to bring up the material library. The material library shipped with FEMAP contains material properties using English units (lb, in, sec) or DIN units. You can create your own materials and store them in this library or create your own library. Select a material and press OK (See Fig.16)



The auto mesh solids dialog box appears. Deselect the mid side nodes box to turn off automatic insertion of mid side node. This is not a recommended practice for any model, as four node tetrahedral elements behave too stiffly to get accurate answers. It is only done here to keep the number of nodes below 300. Press OK and the model now to ready for meshing (see Fig.17).



We will now create Property that references the AISI 4130 material that we just created Select **MODEL – PROPERTY** from the FEMAP menu. Initially, the default Property Type is Plate, A.) press the **ELEM/PROPERTY TYPE** button, and select Volume -Solid for the element type. Press OK to return to the property creation dialog box. Fill in the Title as shown, select the AISi 4130 that we just created as the material, and press OK to continue. FEMAP now prompts you for the creation of another property, press Cancel or hit the ESC key to end creation of properties.

We will now constrain and apply the load.

Create Loads on Surfaces

Load Set: 1 Unlinked

Color: 10 Palettes... Layer: 1 Coord Sys: 0, Global Rectangular

Force

- Force Per Area
- Force Per Node
- Moment
- Moment Per Area
- Moment Per Node
- Displacement
- Enforced Rotation
- Velocity
- Rotational Velocity
- Acceleration
- Rotational Acceleration
- Pressure

Direction

- ☒ Components
- ☐ Vector
- ☐ Along Curve
- ☐ Normal to Plane
- ☐ Normal to Surface

Method

- ☒ Constant
- ☐ Variable

Load

Magnitude	Value	Function Dependence
500	0. None	0. None

Phase: 0 Function Dependence: 0. None

☐ Midside Node Adjustment

OK Cancel

We will constrain this model at its base. Since this model is solid, there is no need to apply any loads and constraints out of plane. We will constrain the surfaces and fix.

Select MODEL-CONSTRAINT-ON SURFACE. FEMAP prompts you to create a constraint set. Type a name and press OK. Select the surface of the solid and press OK. Fix this surface (see Fig.19).

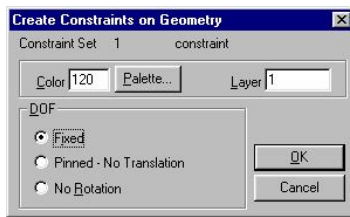


Fig. 19 Create constraints on geometry

Now model is complete and is ready for FEM analysis. The full model is show in Fig.20

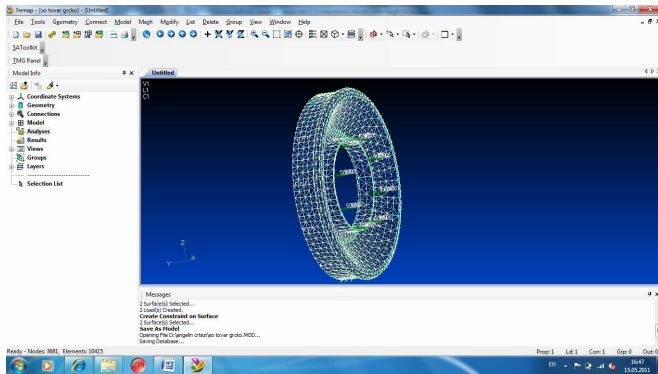


Fig.20 Model ready for post-processing

Solver as your using is NE NASTRAN v.3. After solving the model the total translation is shown in Fig.21.

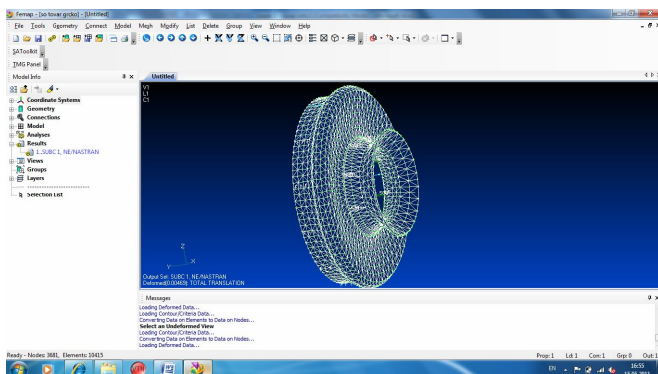


Fig. 21 Total Translation of solid model (0.00469m)

The contour Solid Von Mises is shown in a Fig.22

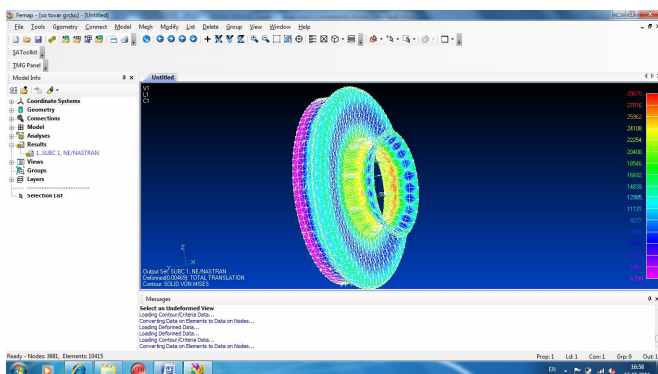


Fig.22 Contour Von Mises

CONCLUSION

From the presented calculations it is evident that strain intensity are very small and it is because the forces that occur in the bearings are very small and this closures has the task to reduce the entry of solid particles in the bearing which would prevent its damage. Therefore it is suggested instead of metal to use a combination of metal and rubber that would prevent the penetration of solid particles and further damage of bearings.

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