A PROJECT REPORT

SUBMITTED FOR

COMPUTER AIDED DESIGN AND ANALYSIS

(UME 411) OF

PROJECT 3

ANALYSIS OF FOUR BAR MECHANISM BY:

Name: Shivu Chauhan

Roll Number: 101809031

Sub-Group: MTX2 (Batch of 2022)

Submitted To:

THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

MECHANICAL ENGINEERING DEPARTMENT

THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY,
PATIALA– 147004, PUNJAB, INDIA

Project 3

Redesign the mechanism to remove any interference of parts. Plot the trace curve of the point 'pnt0' (please unhide it if not visible) on triangle_abc.prt. Design the push feeder mechanism parts of the connecting rod and the slider. Place the slider on a plane parallel to the straight-line part of the trace curve of 'pnt0'.

Find the crank motor rpm if the point 'pnt0' on triangle_abc.prt is to be used to give a maximum velocity of 0.15 m/s in its approximated straight-line part of the trace curve for use as a linear push feeder 'pnt0' and any point on the slider together to verify.. mechanism. Plot the graphs of the velocity of point

TABLE OF CONENTS:

(j) Calculation

(k) Conclusion

Objective:

- To Redesign the given Four bar mechanism.
- Design a Push Feeder mechanism and attach along with the modified four bar mechanism.

Procedure:

- ## Identifying initial interference:

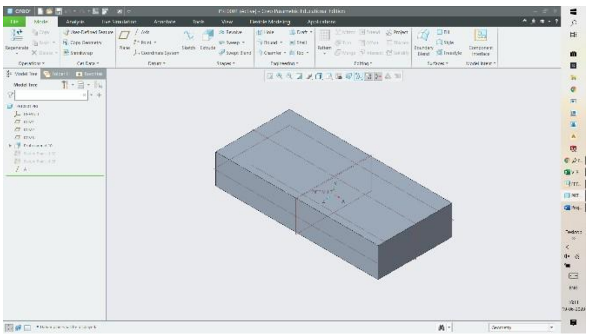
1. Assemble the given four bar mechanism following instructions from tutorial 2.
2. Go to Application>Mechanism>Servo Motor, to attach a servo motor on the axis of Crank and Block.
3. Go to Mechanism analysis, under the Type select Kinematic, give appropriate start and end time and Run.
4. Go to playback, select your analysis.
5. In collision setting select global collision.
6. Run the playback and notice the section of interference.

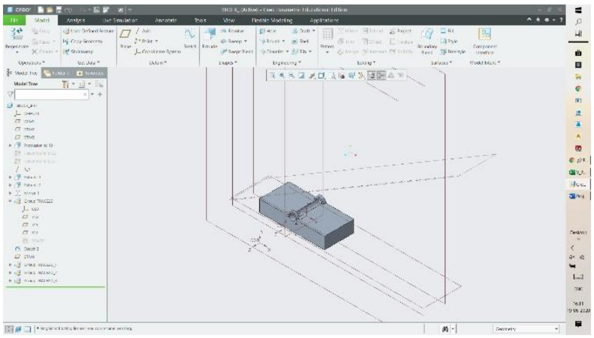
- <u>Redesigning to remove interference:</u>

1. Open every part separately.
2. Redesign every part to clear out interferences.

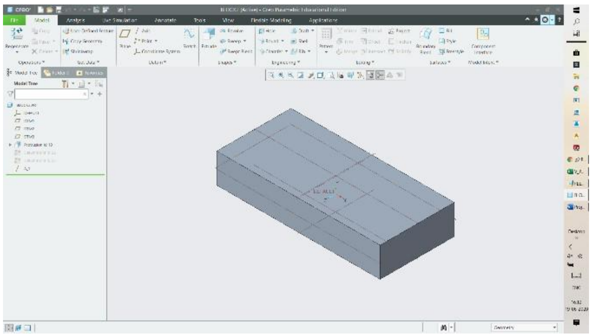
Before: After:

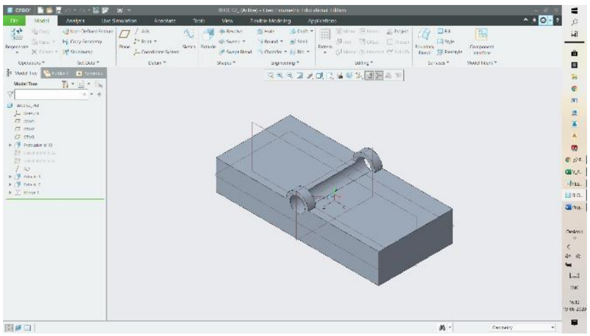
<u>Block:</u>



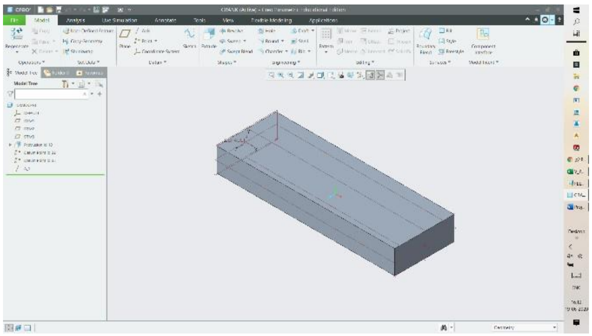
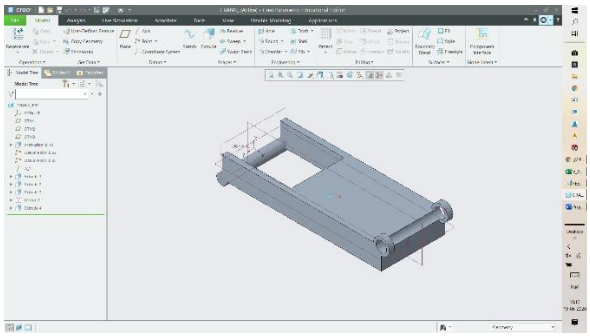


<u>Block_2:</u>

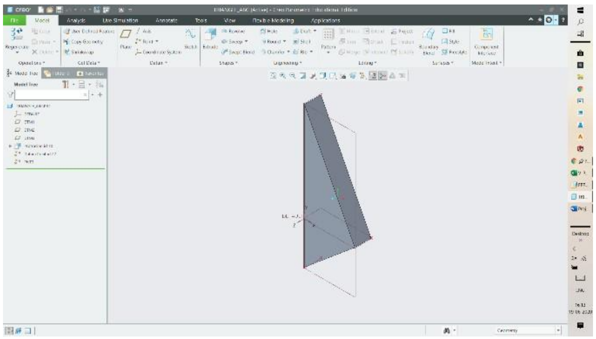
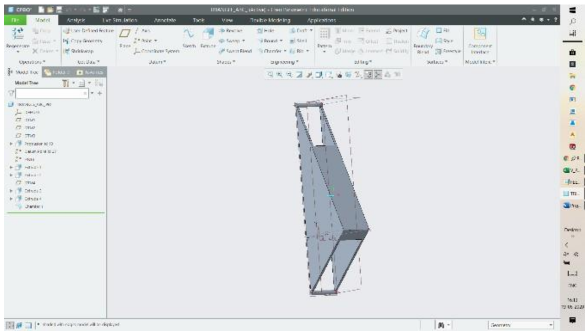




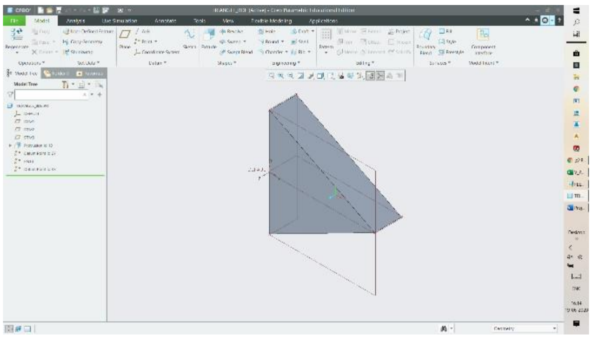
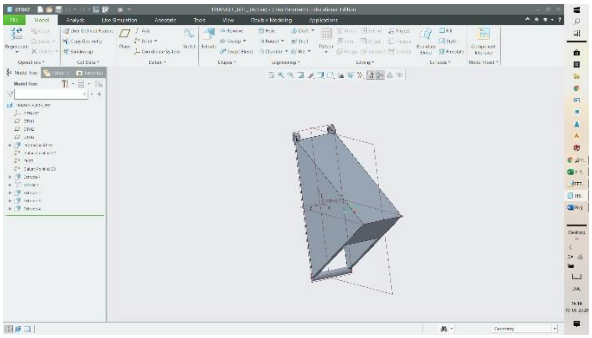
Crank:

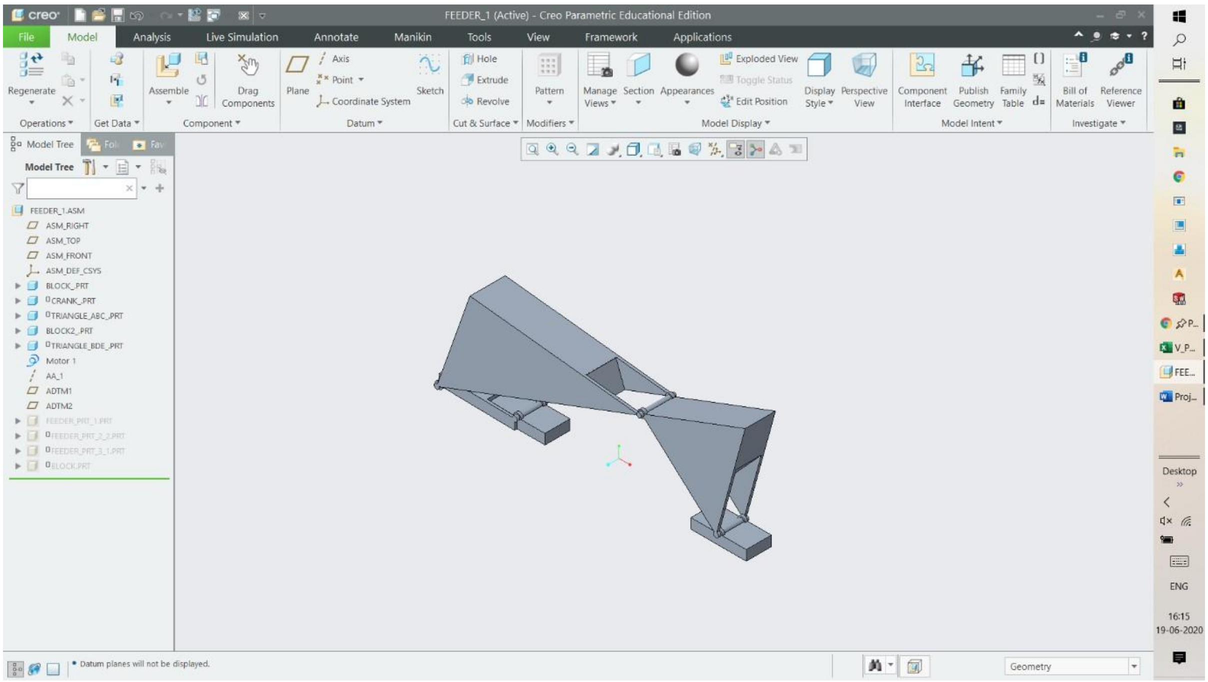
Triangle_abc:

Triangle_bde:

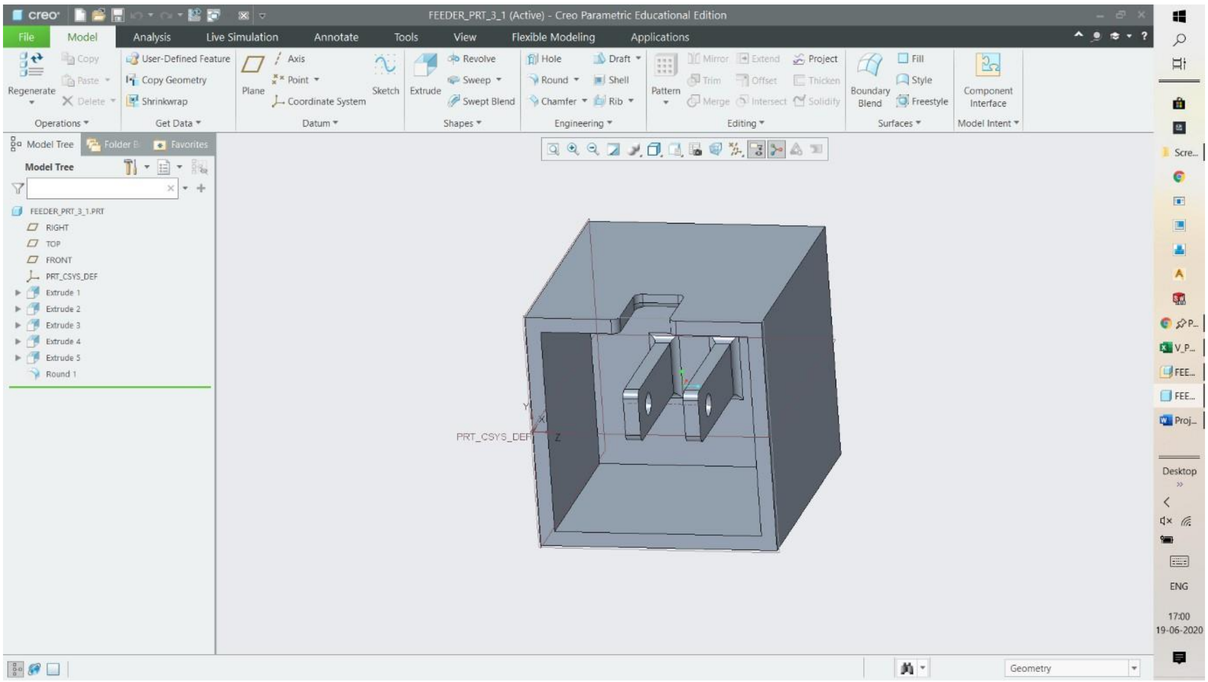



<u>Final Assembly:</u>



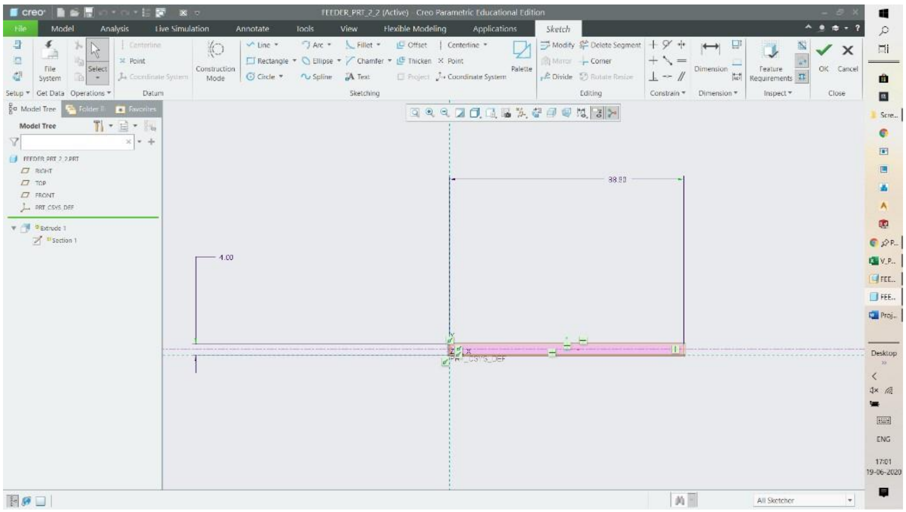
- <u>Designing Push Feeder Mechanism:</u>
    1. Piston:
        a. Select front plane for extrusion.
        b. Sketch a rectangle and extrude it make it cuboid.
        c. Make it hollow with a particular wall thickness.
        d. Then on inner base of the cuboid make a extrude for pin joint of connecting rod and piston.

e. Give appropriate rounds to the edges.

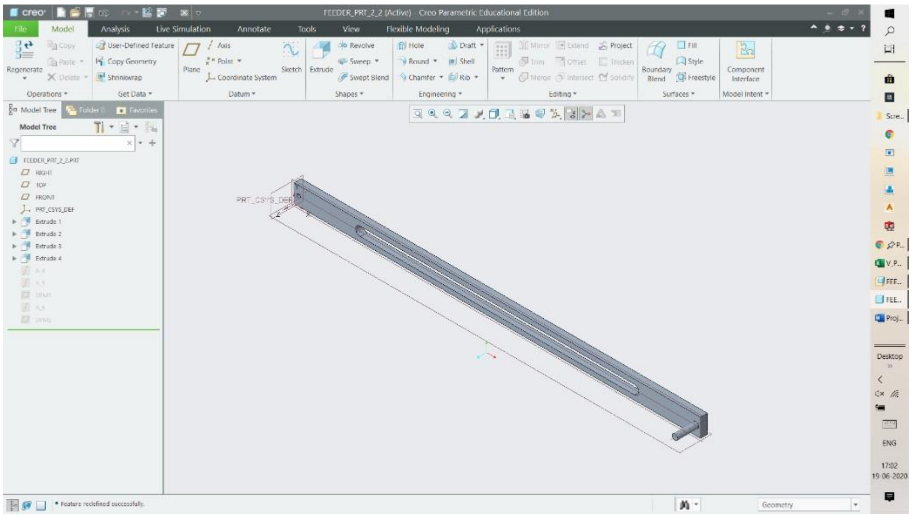


Ref.1. Piston

2. Connecting Rod:
   a. Select front plane for extrusion.
   b. Refer ref. for the sketch and the extrude.
   c. Make a slot for the adjustable block.
   d. Make a pin on left end for pin joint .
   e. Make a hole on the right end for pin joint with piston.

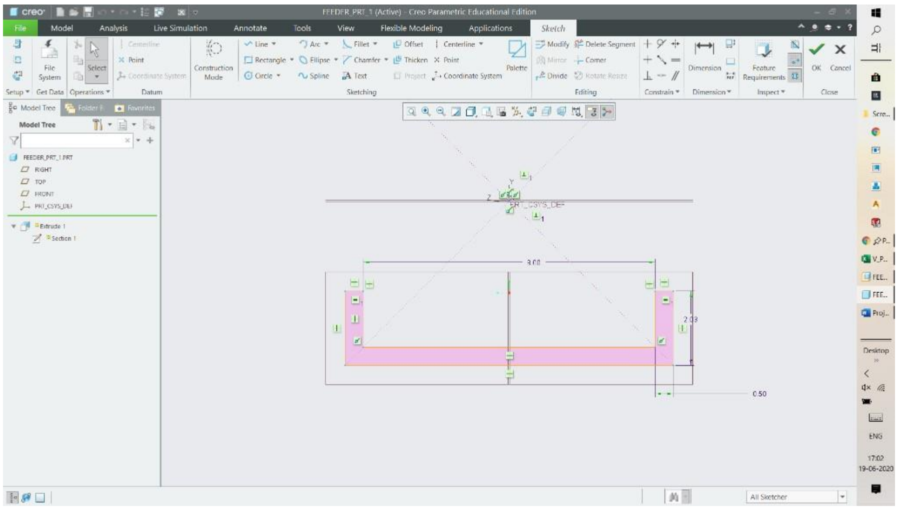


Ref.2. Connecting Rod Sketch

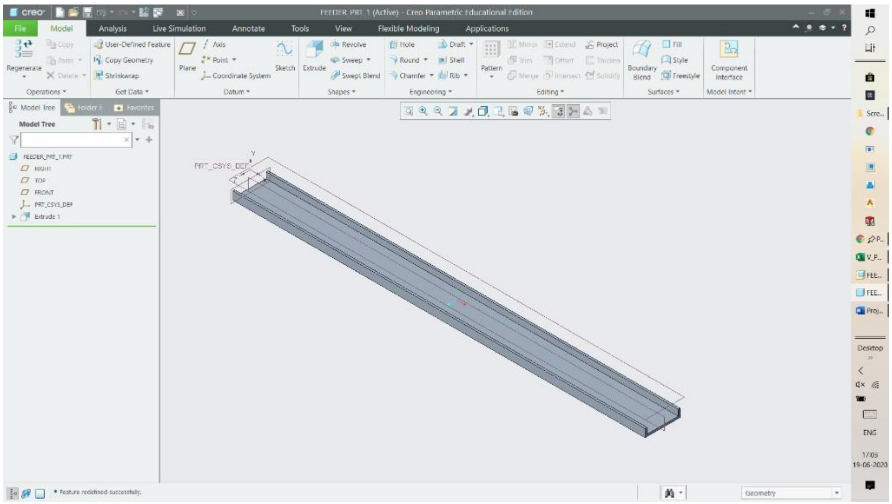


Ref.3. Connecting rod

3. Base Plate for sliding:
   a. On the right plane sketch a C-Shaped crosssection (ref.).
   b. Extrude.

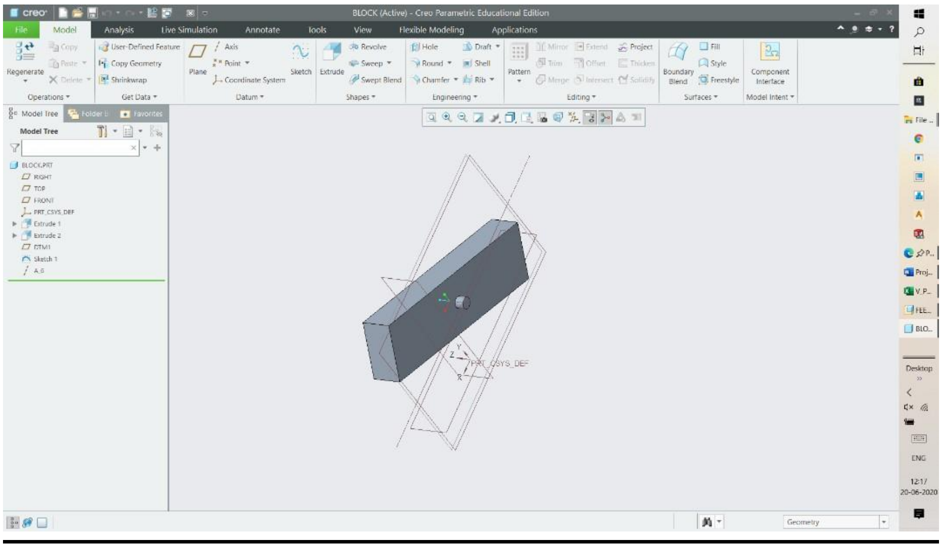


Ref.4. Sketch for base plate



Ref.5. Base plate

4. Sliding Block:
    a. Select front plane and sketch as in ref.
    b. Extrude.
    c. Make a pin on the surface of the block.
    d. Define a axis normal to the surface of pin.



Ref.6. Sliding block

- <u>Assembly of redesign model:</u>

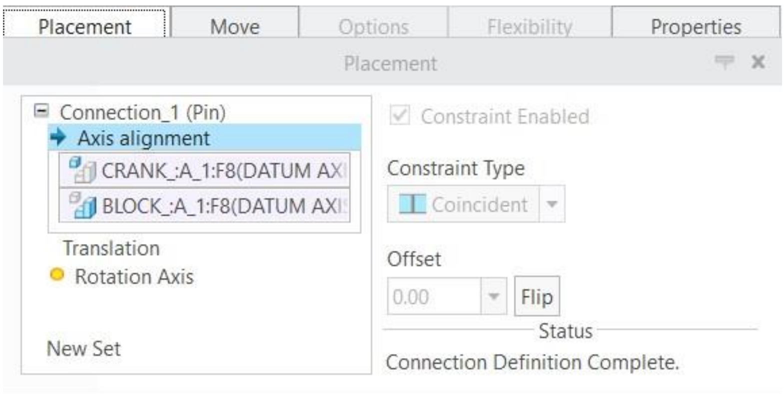
    a. Inserting first part:

1. Click or insert component assemble. The open dialog box opens.
2. Select block.prt. The component placement dashboard appears.

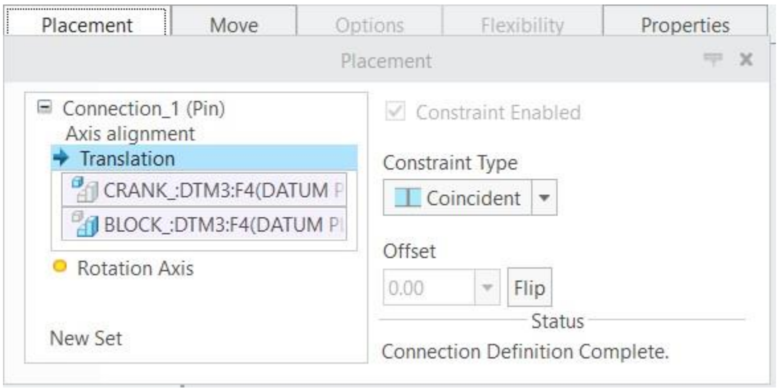
3. Choose default on the automatic list to define the block as the ground body and assemble it in the default location.
4. Click ok.

b. Creating first pin joint:

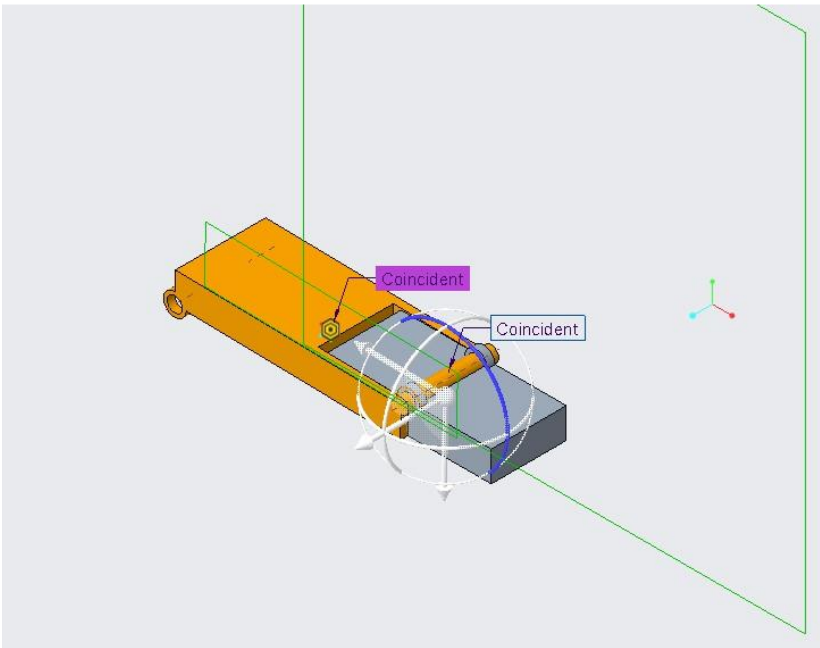
1. Click or insert component assemble.
2. Choose crank.prt. The component placement dashboard appears.
3. Choose pin from the user defined list.
4. Choose axis A-1 on block.prt and A-1 on crank.prt to define axis alignment.
5. For the translation constraint, select datum 3 on both parts.
6. Look at the model. Crank.prt should rest on top of block.prt.



Ref.7. Axis Alignment of Crank and Block



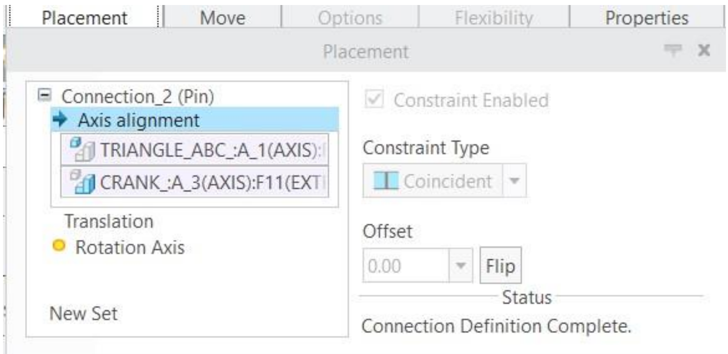
Ref.8. Translation of Crank and Block



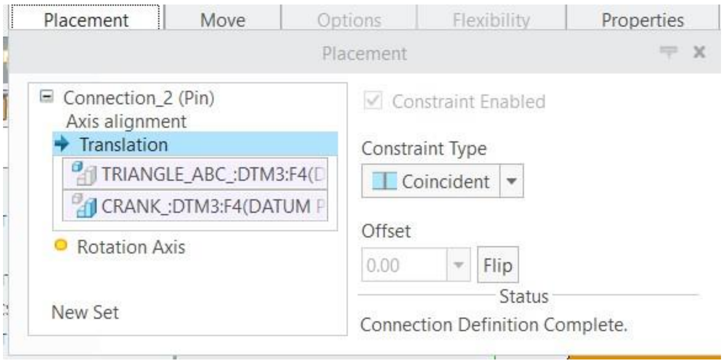
Ref.9. First pin joint

c. Creating second pin joint:

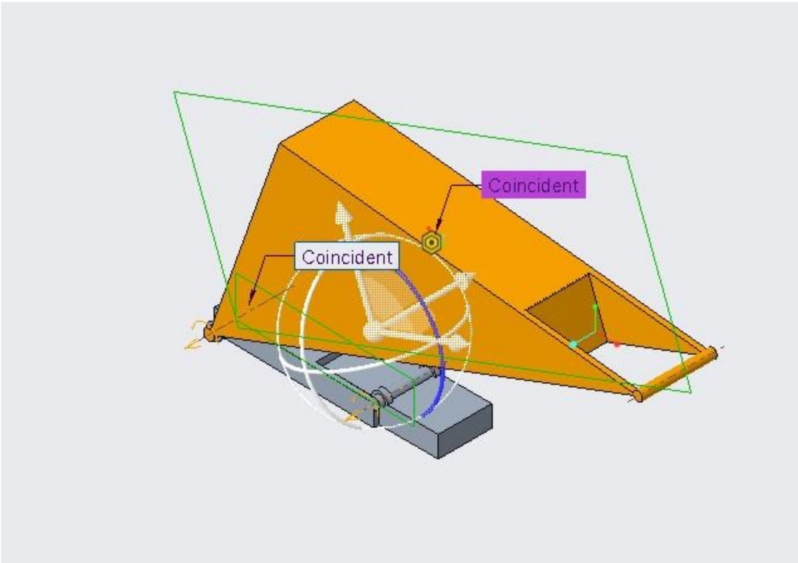
1. Click or insert component assemble and choose triangle_abc.prt. The component placement dashboard appears.
2. Choose pin from the user defined list.
3. Select the axis on top of crank.prt that contains PNT2.
4. Select the axis on triangle_abc.prt that contains PNT2 and PNT3.
5. For translation select the DTM 3 of triangle_abc and DTM 3 of crank.prt.
6. Click OK .



Ref.10. Axis Alignment of Crank and Block



Ref.11. Translation of Crank and Block

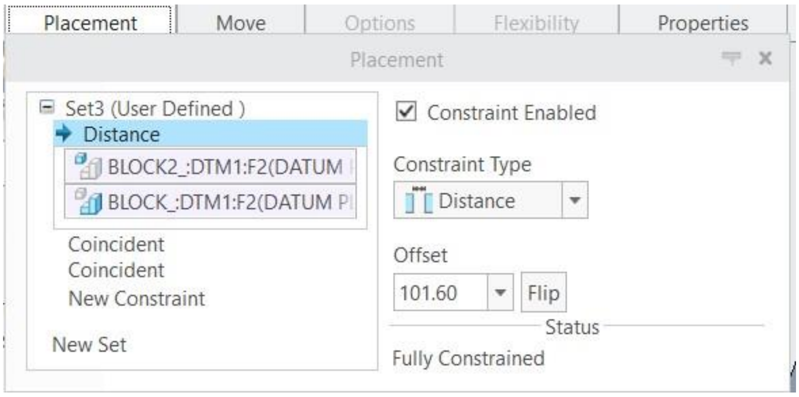


Ref.12. Second pin joint

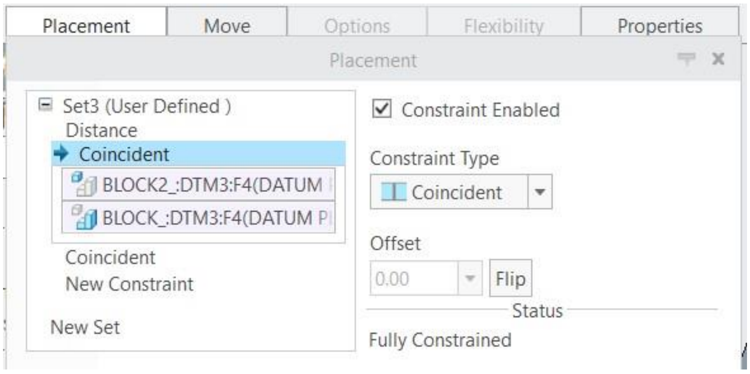
d. Adding fixed part to ground:

1. Click or insert component assemble and choose block2.prt. The component placement dashboard appears.
2. Select DTM1 on block.prt and DTM1 on block2.prt. An align constraint set is created. Enter for the offset value.

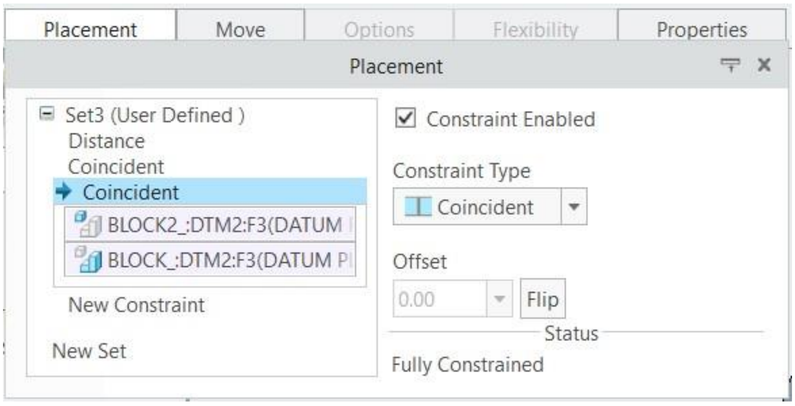
3. Align DTM2 to DTM2, and DTM3 to DTM3.
4. Click OK.



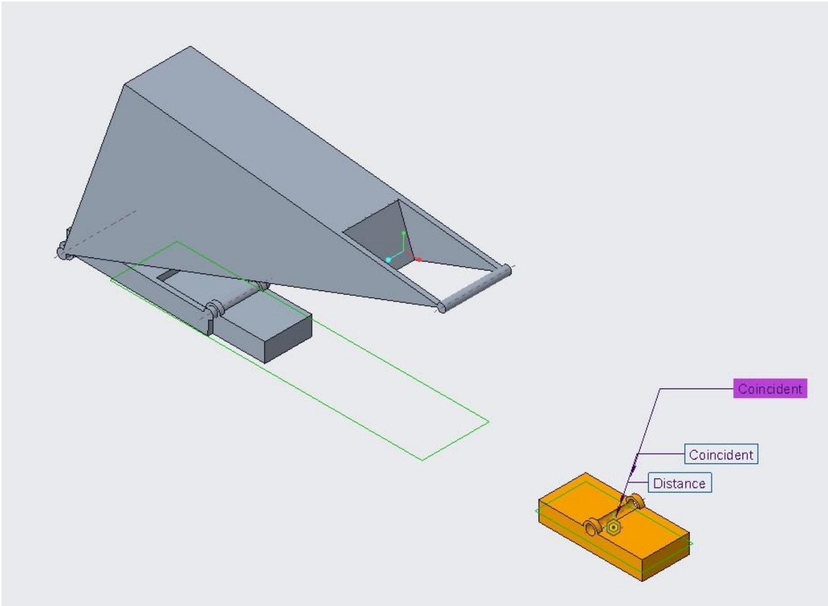
Ref.13. Distance Constraint of block and block2



Ref.14. Coincident DTM3 of block and block2



Ref.15. Coincident DTM2 of block and block2

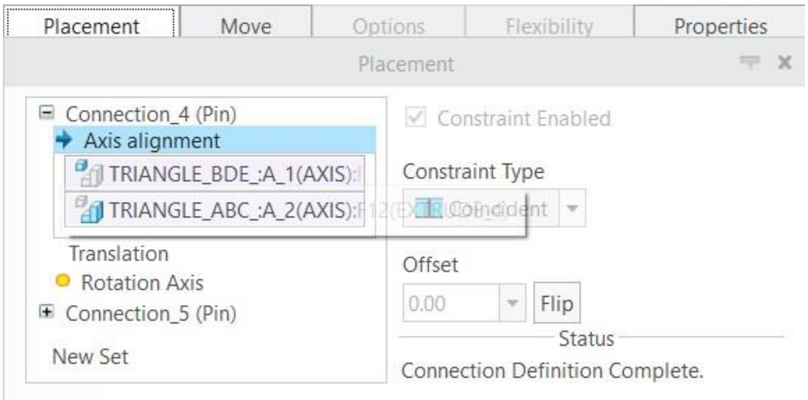


Ref.16. Fixed block2

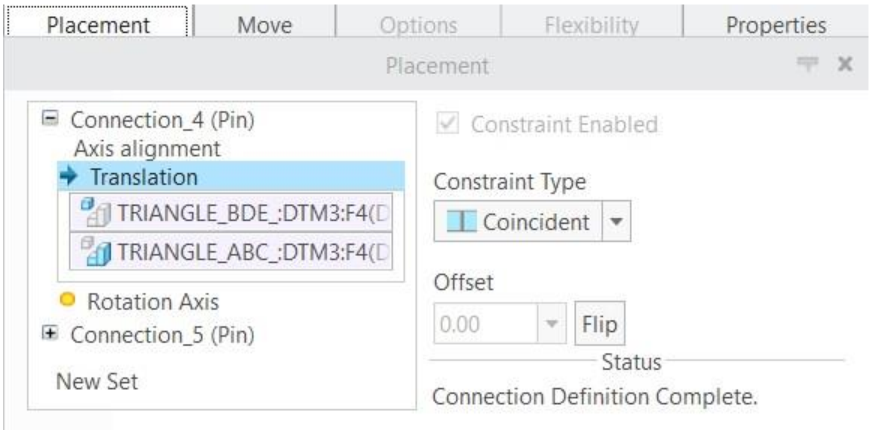
e. Closing the loop of Four-Bar mechanism:

1. Click or insert component assemble and choose triangle_bde.prt. The component Placement dashboard appears.

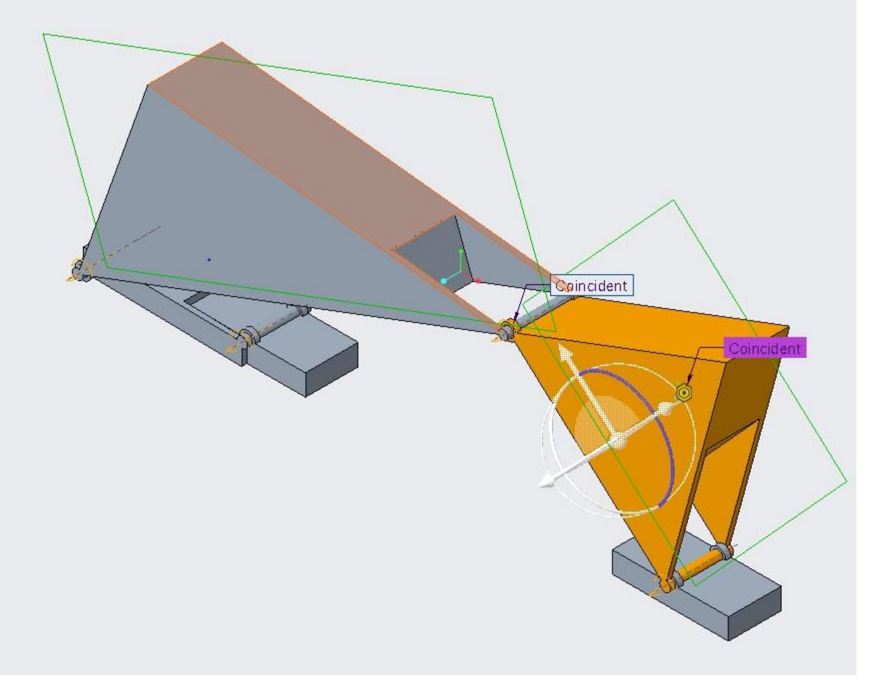
2. Choose pin from the user defined list. Select axis on triangle_abc.prt and axis on triangle_bde.prt.
3. Add new set of constraint, choose pin from user defined.
4. Choose the axis on the other side of triangle_bde.prt as the component reference. Choose axis A-1 on block2.prt as the assembly reference.
5. Click OK.



Ref.17. Axis alignment of triangle_bde and triangle_abc



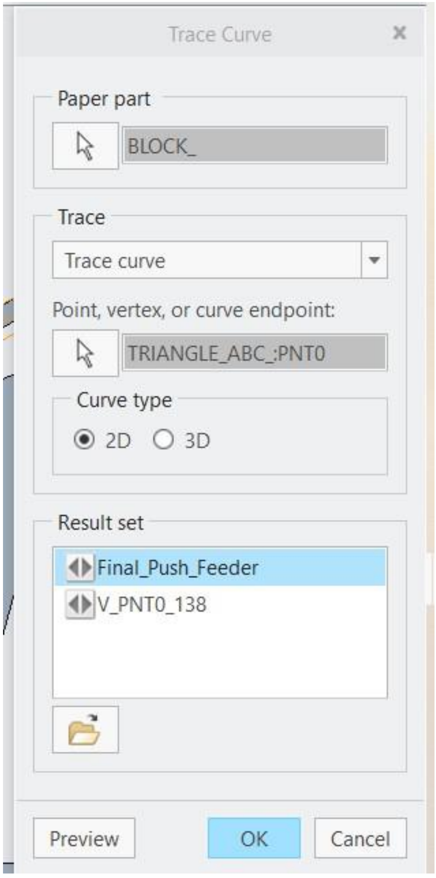
Ref.18. Translation of triangle_bde and triangle_abc



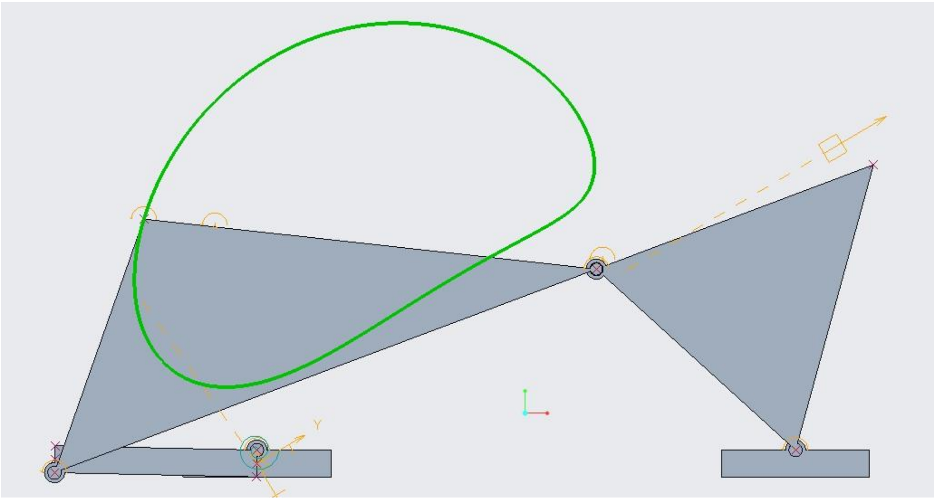
Ref.19. Closing the loop

- <u>Tracing the curve of PNT0:</u>
  1. Go to Application>Mechanism>Mechanism Analysis.
  2. Run the analysis.
  3. Go to trace curve.
  4. Select block as paper part.
  5. Select PNT0 as trace point.

6. Choose the performed analysis 7. Click on preview and the OK.

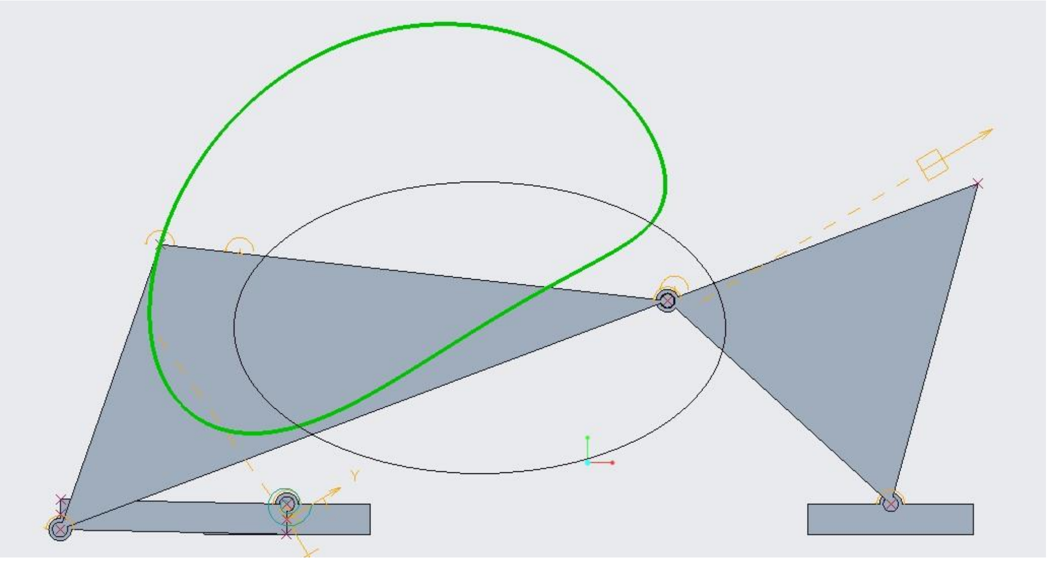


Ref.20. Defining Trace curve



Ref.21. Trace curve of PNT0.

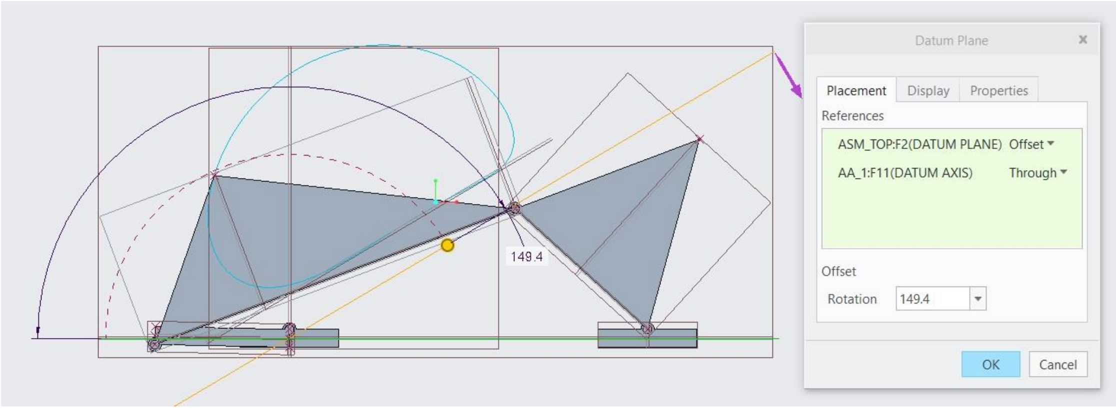
- <u>Finding the straight line section of trace curve:</u>



Ref.22. Above outlined part is straight line section of the trace curve

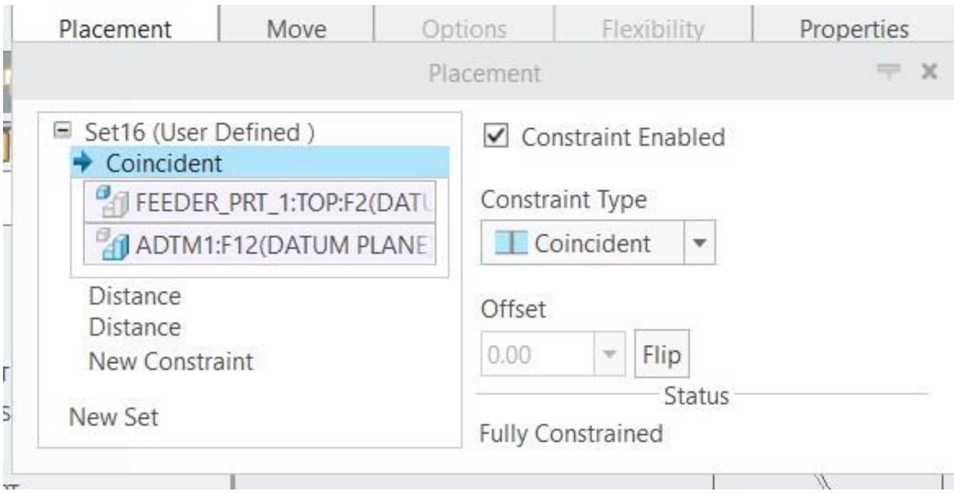
- <u>Assembly of feeder mechanism:</u>

1. Defining a plane parallel to the straight line section of trace curve.



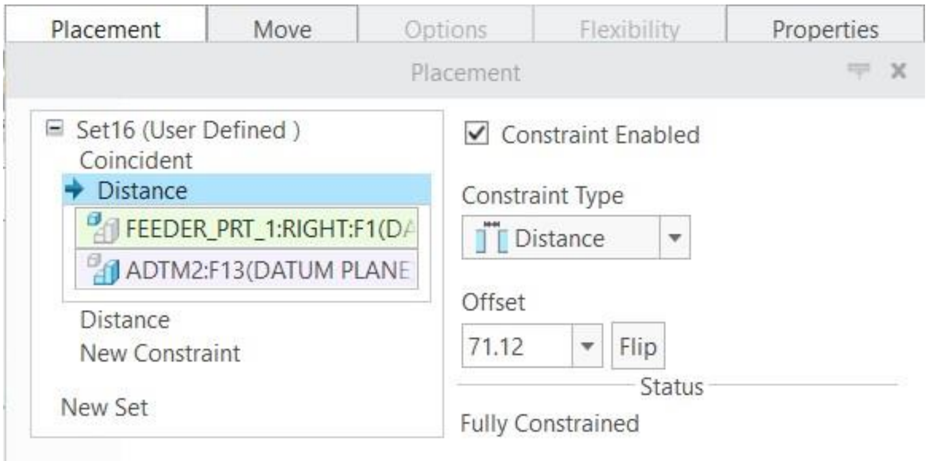
Ref.23. Plane parallel to straight line section

2. Base plate for sliding:
   a. Under user define constraint select coincident top plane of the plate and the DATUM plane created parallel to the straight line section.



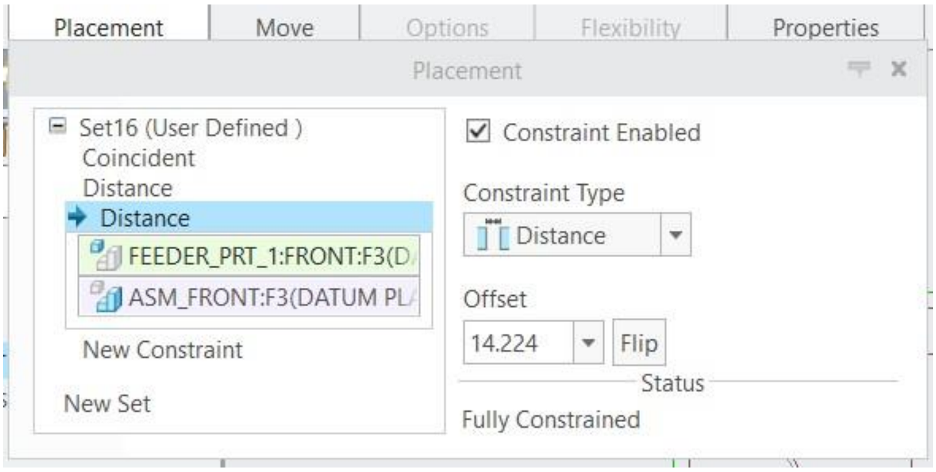
Ref.24. Coincident constraint of top plane and DATUM plane created

   b. Give distance constraint between right plane of plate of sliding and plane perpendicular to the datum plane created.



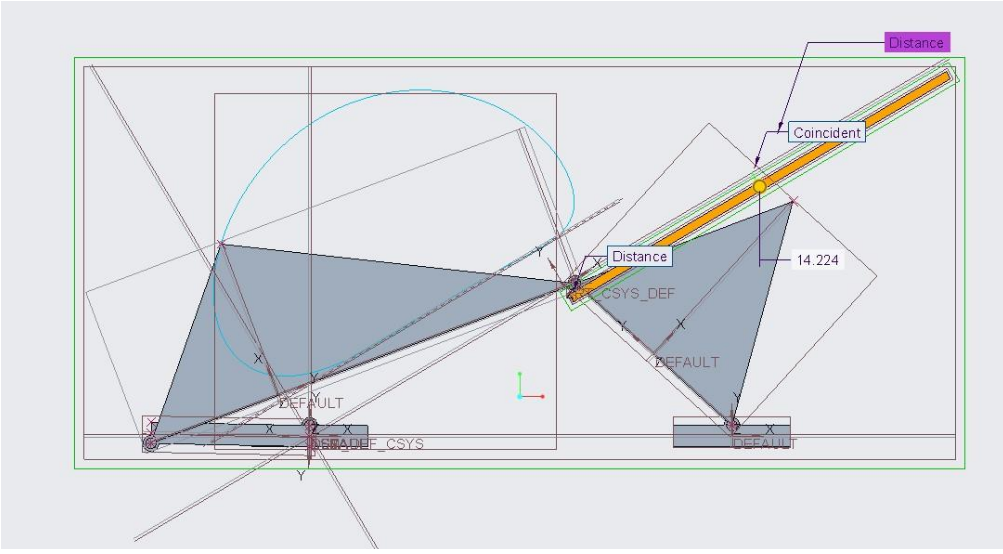
Ref.25. Distance constraint

c. Give distance constraint between front plane of plate of sliding and front plane.



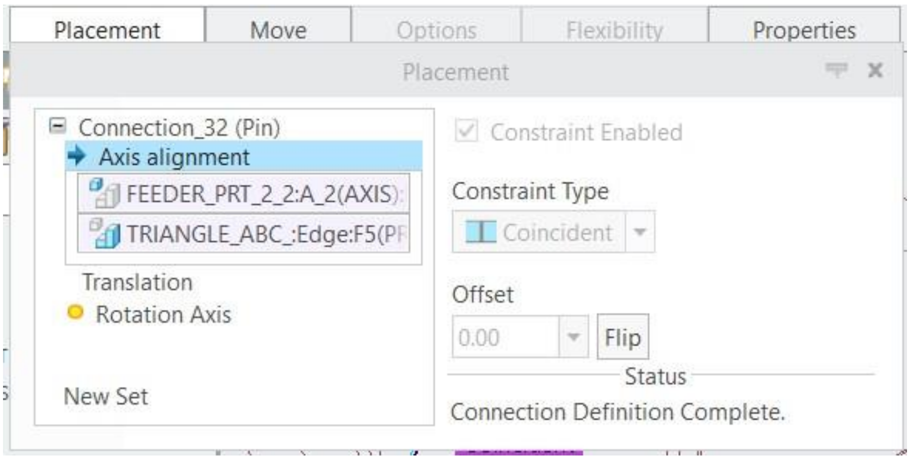
.

Ref.26. Second distance constraint



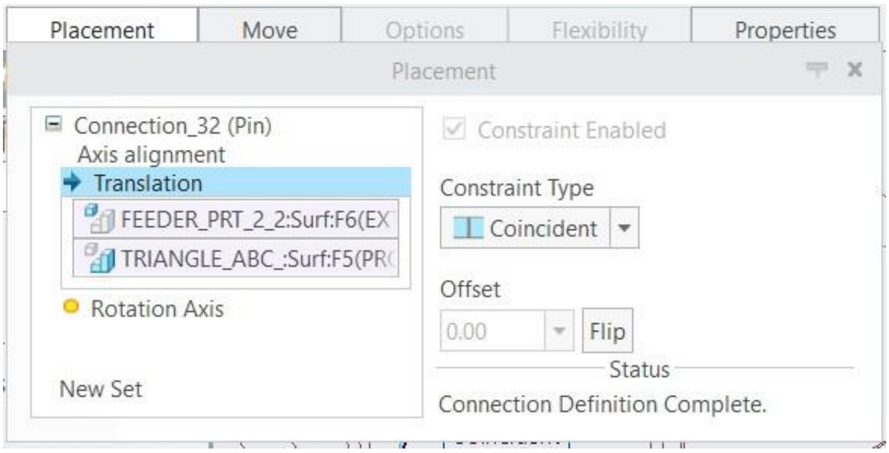
Ref.27. Base plate

3. Connecting rod:
   a. Select pin joint
   b. Under axis alignment select A_2 axis of connecting rod and edge of Triangle_abc containing PNT0.

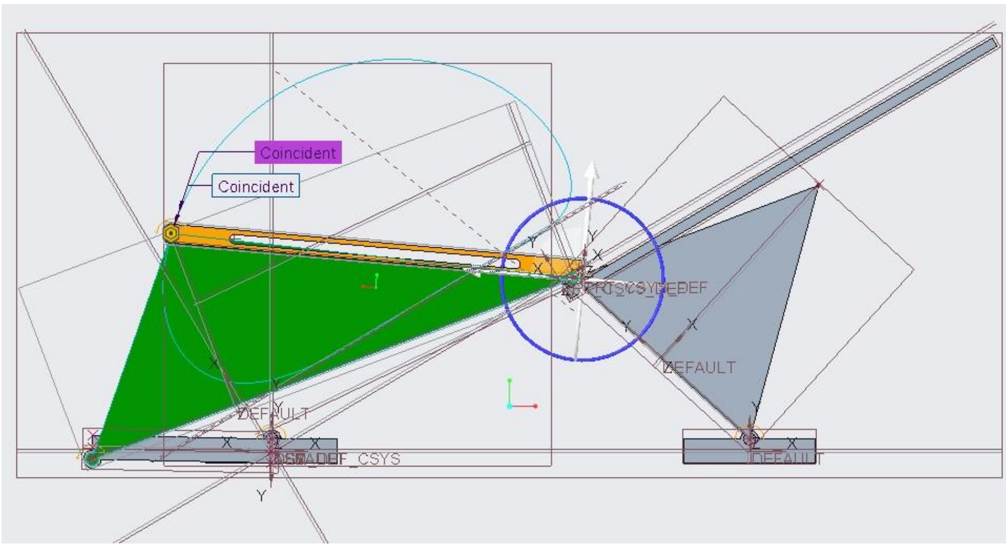


Ref.28. Axis alignment of connecting rod

c. In translation select surface of pin on connecting rod and the surface of triangle_abc.

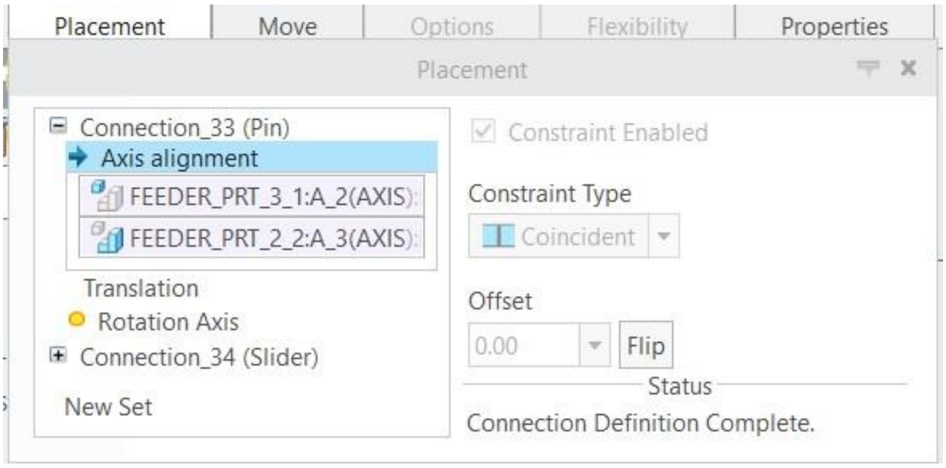


Ref.29. Translation for connecting rod



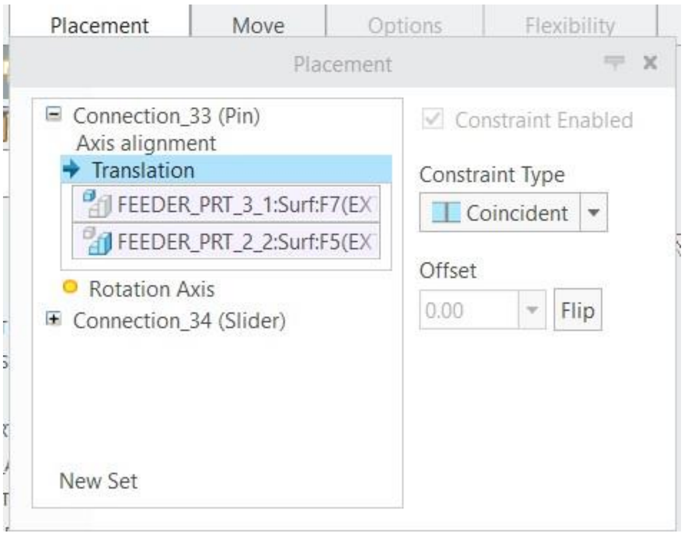
Ref.30 Connecting rod

4. Piston:
   a. Select pin joint
   b. For axis alignment select A_2 axis of piston and A_3 axis of connecting rod.



Ref.31. Axis alignment of piston

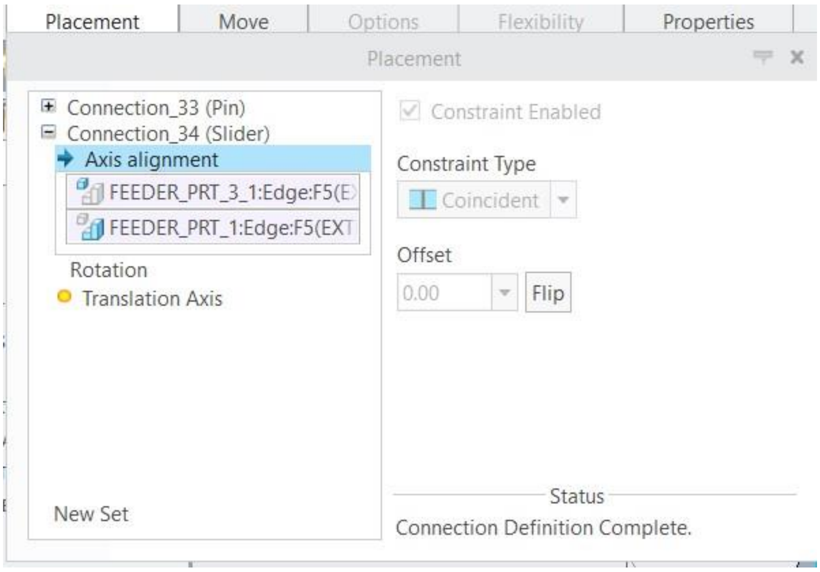
   c. For translation, select surface of the support created inside of piston for pin joint and corresponding surface of connecting rod.



Ref.32. Translation for piston

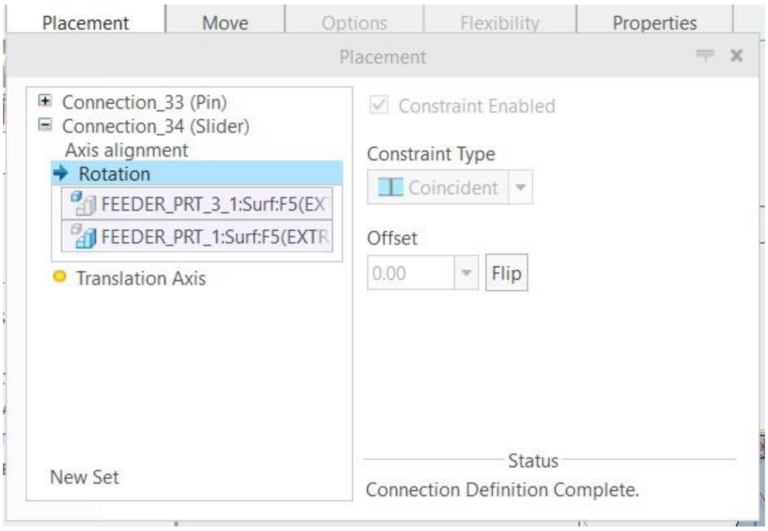
d.Select a new set, select slider

e. For axis alignment, select edges of contact of piston and base plate for sliding.

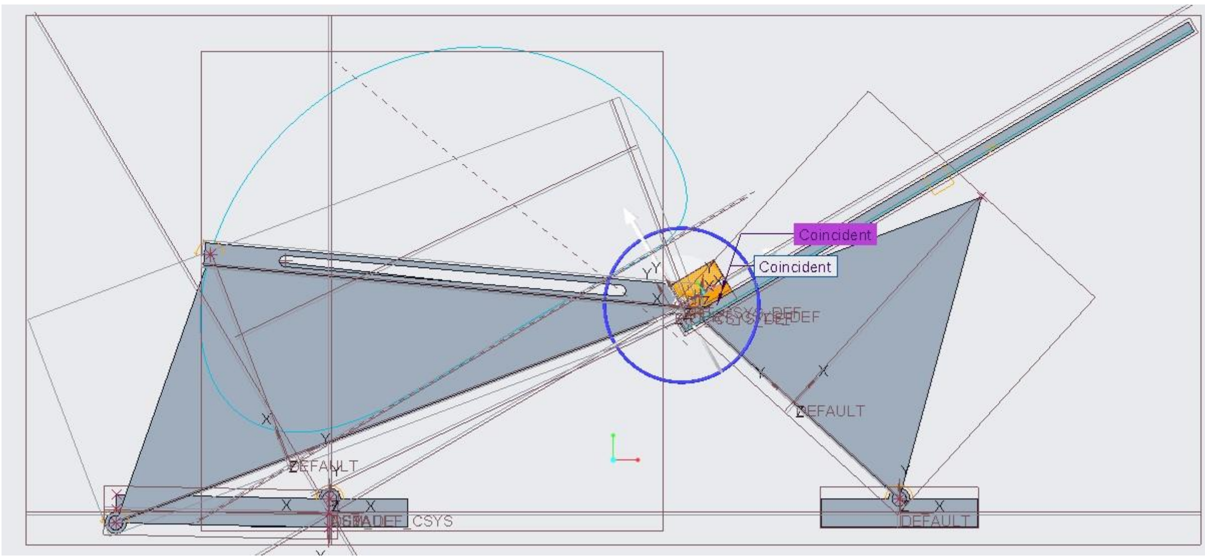


Ref.33. Axis alignment of slider joint of piston.

f. For rotation, select the contact surfaces of piston and base plate for sliding.

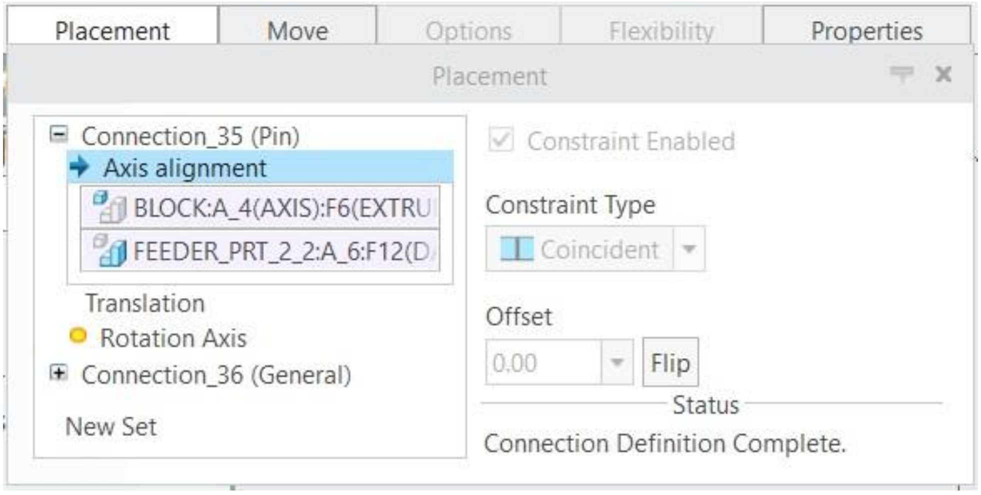


Ref.34. Rotation constraint for piston.



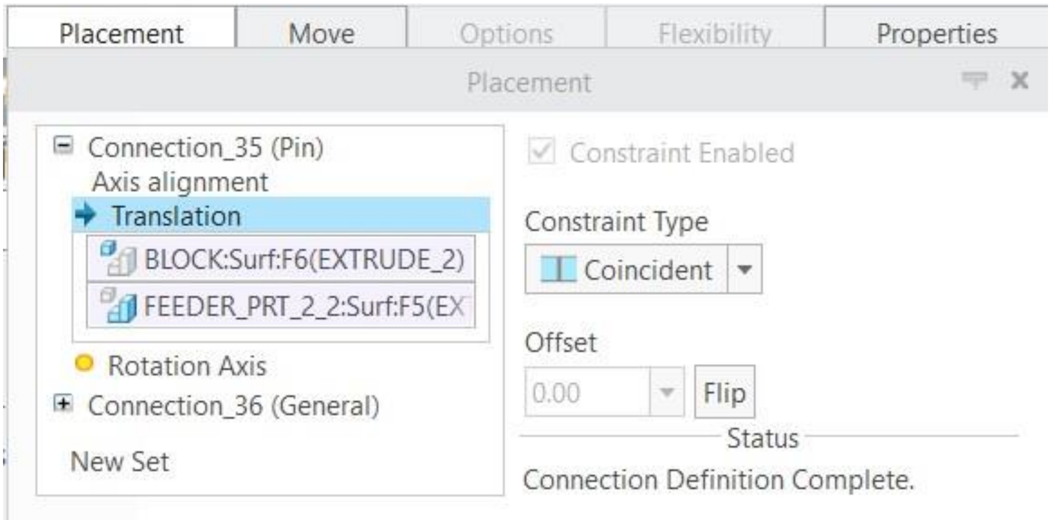
Ref.35. Piston

5. Sliding Block:
   a. Select pin
   b. For axis alignment, select A_4 axis of sliding block and A_6 of slot created in connecting rod.

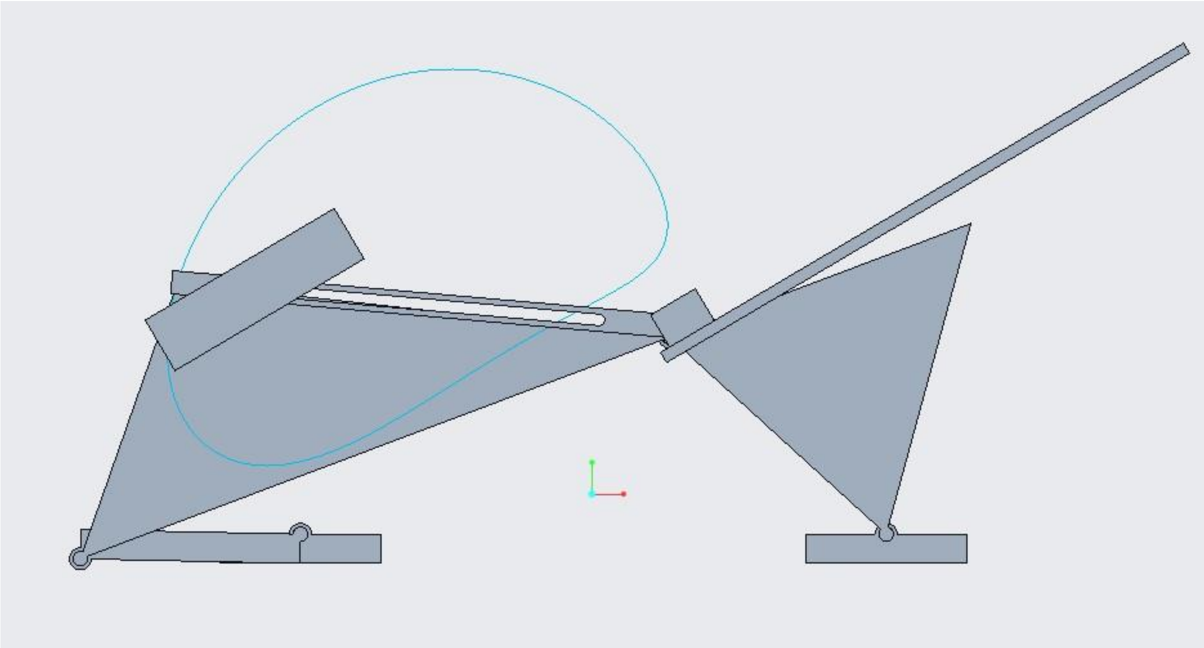


Ref.36. Axis alignment for sliding block.

c. For translation, select contact surfaces of connecting rod and sliding block.



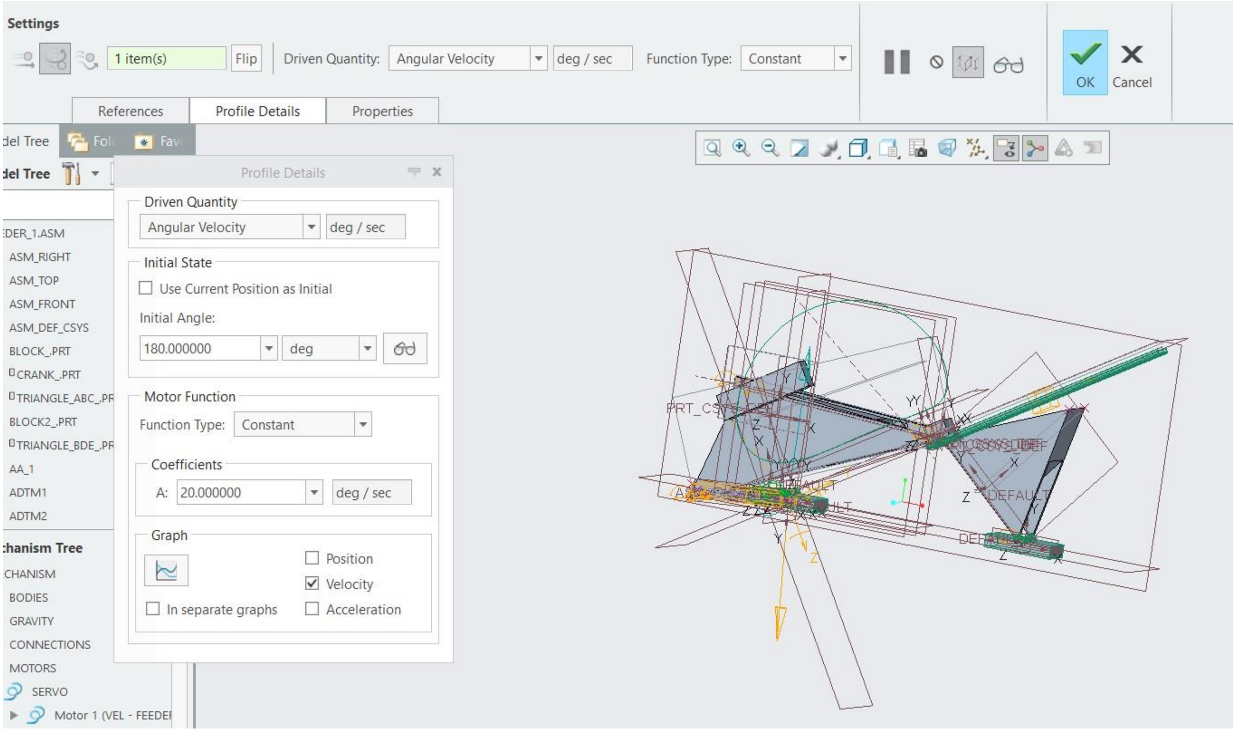
Ref.37. Translation constraint for sliding block



Ref.38. Final Assembly of push feeder mechanism.

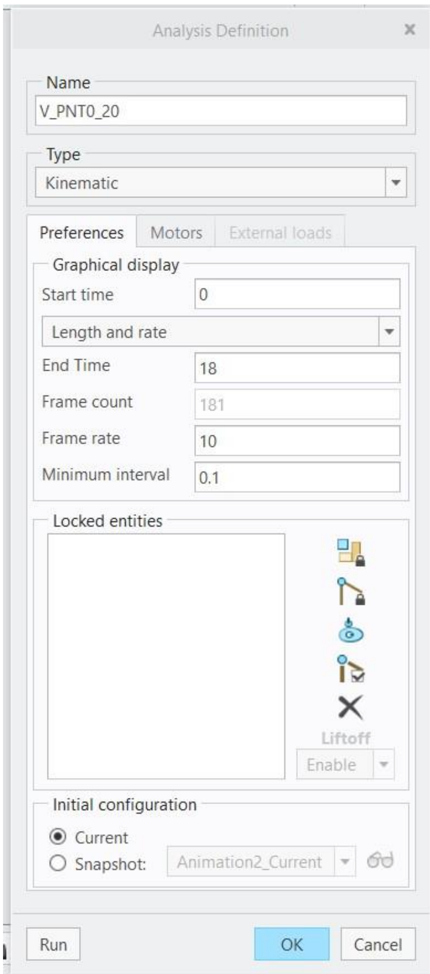
- <u>Mechanism Analysis and RPM calculation for maximum velocity of PNT0 in straight line section equals to 0.15m/s (or 150mm/s):</u>

1. Go to Application>Mechanism>Servo Motor.
2. Define servo motor, take A_1 axis of Block as axis of rotation.
3. Select profile details and define the specification of motor.

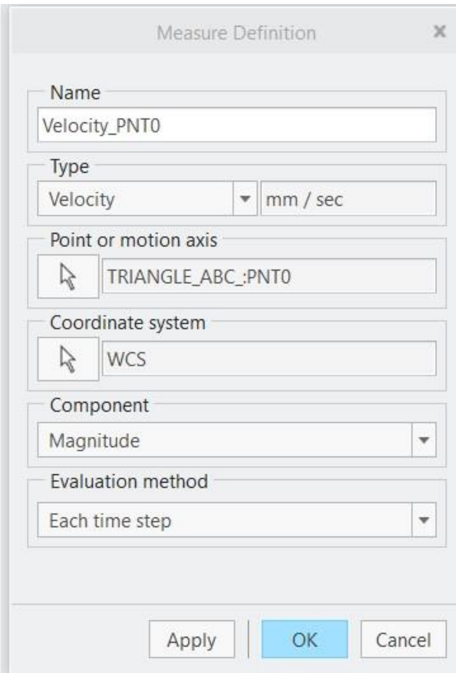


Ref.39. Profile details of motor.

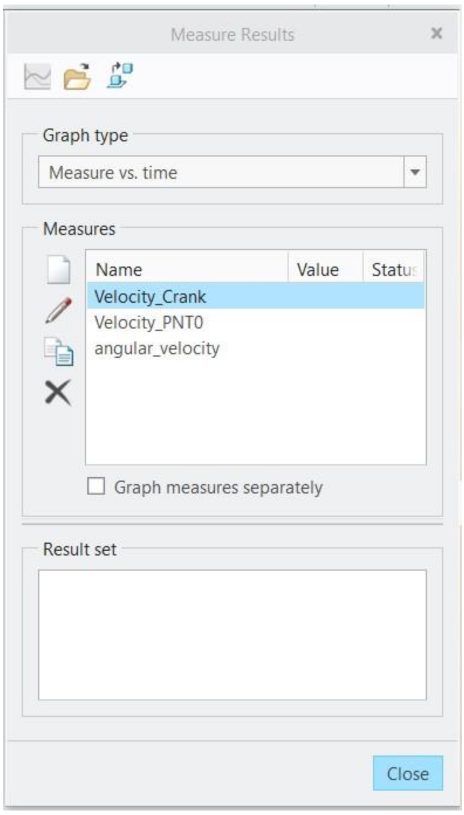
4. After defining motor go to mechanism analysis.
5. Under the type select kinematic 6. Give appropriate time for one cycle.
7. Run.
8. Save the analysis.
9. Go to measure.
10. Create a new measure.
11. Under type select velocity.
12. Select the PNT0 point for measure.
13. Click Apply and OK, and then create it as a parameter.



Ref.40. Defining Mechanism Analysis

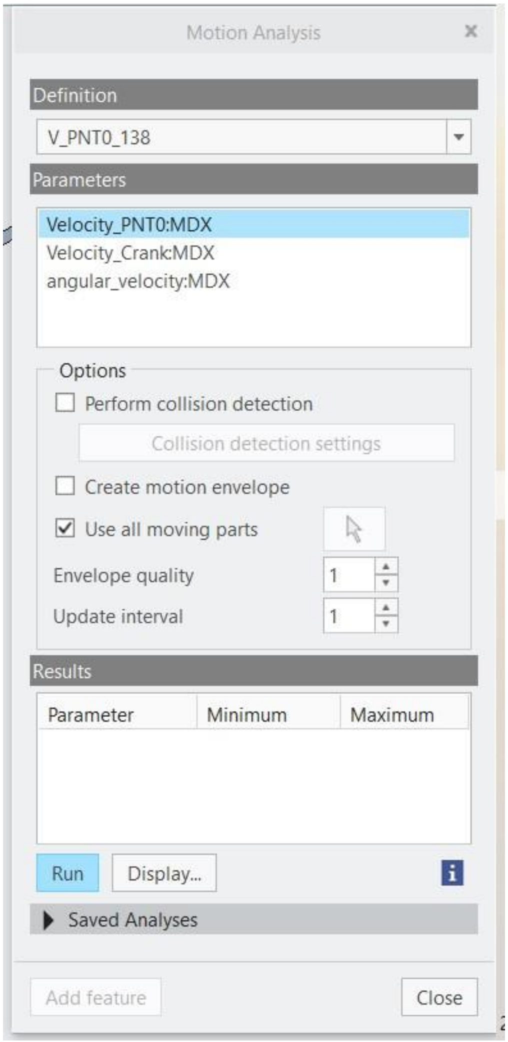


Ref.41. Defining measure.

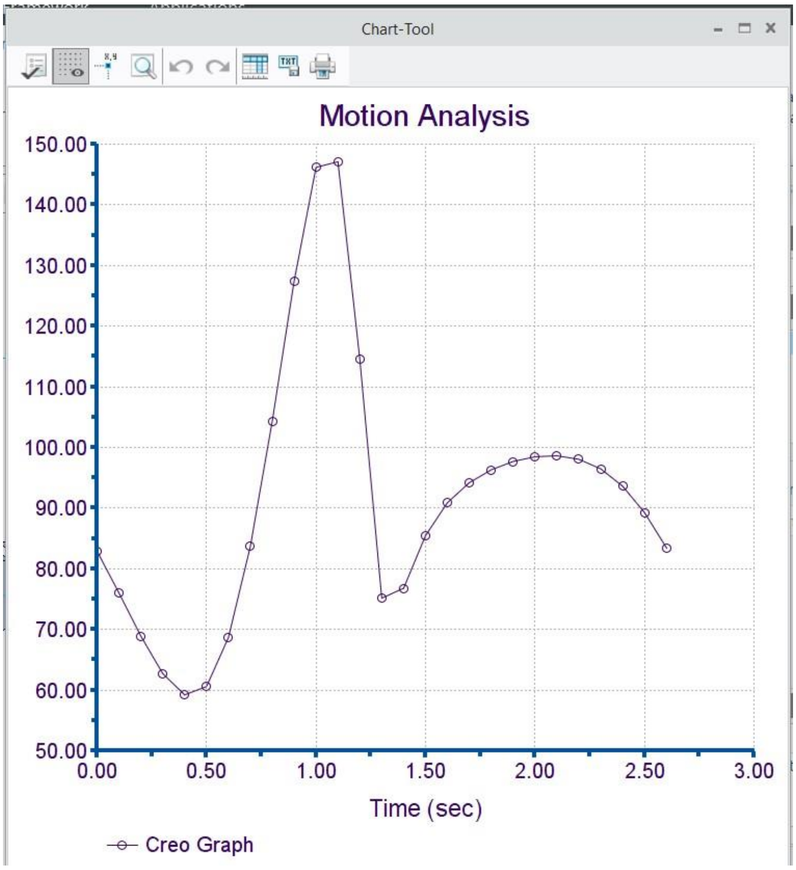


Ref.42. Setting measure as a parameter.

14. After mechanism analysis exit the mechanism menu.
15. Go to Analysis>Motion Analysis.
16. Under definition select the analysis performed.
17. Under parameter select Velocity_PNT0:MDX.
18. Run the analysis.

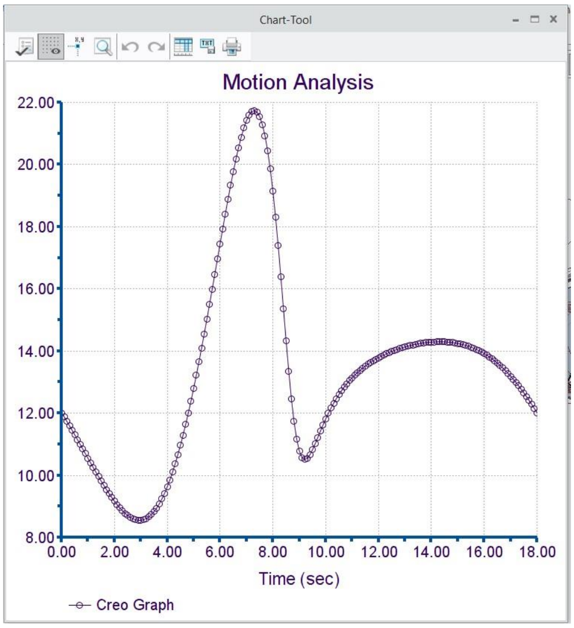


Ref.43. Defining Motion Analysis.

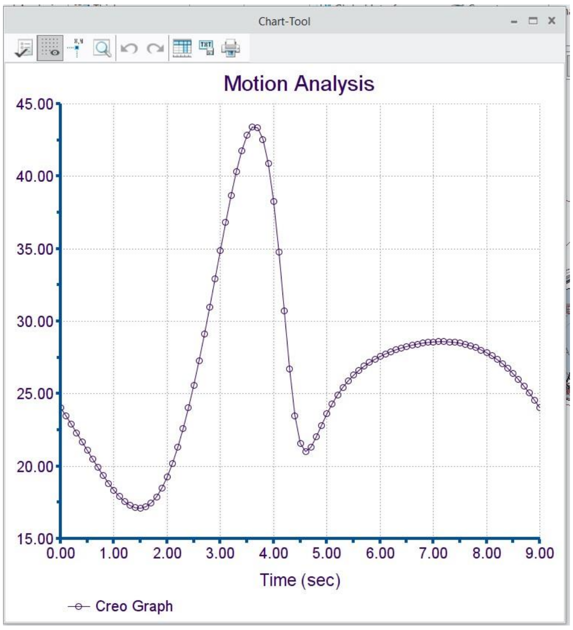


Ref.44. Result of Motion Analysis.

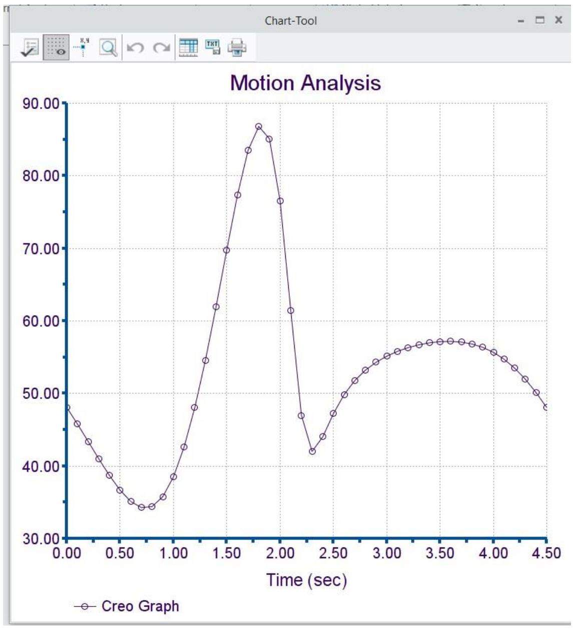
- Results of Motion Analysis at different Angular velocities (deg/sec):



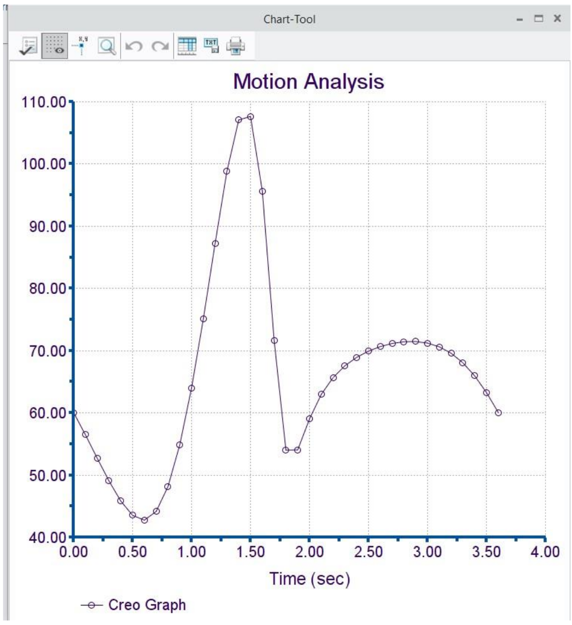
At V= 20deg/sec



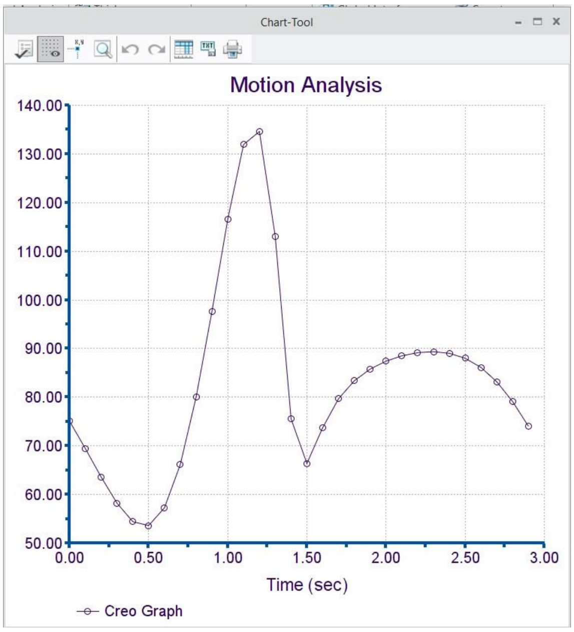
At V= 40deg/sec



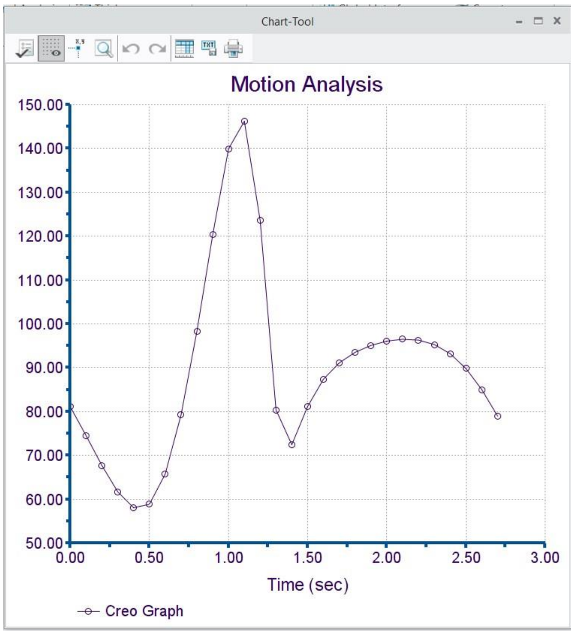
At V= 80deg/sec



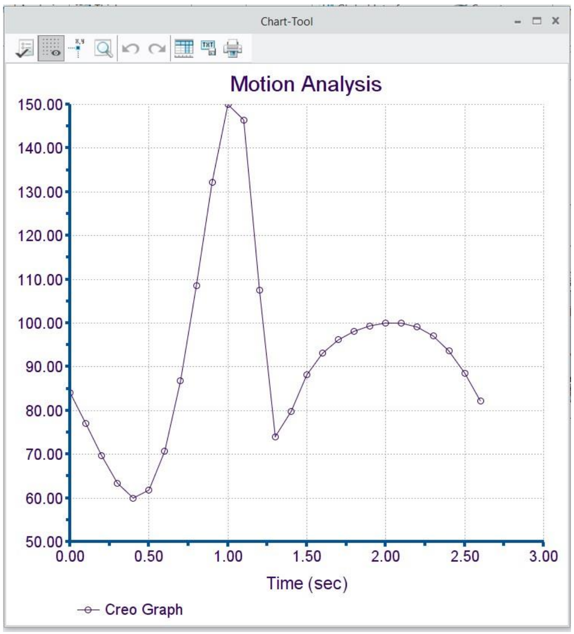
At V= 100deg/sec



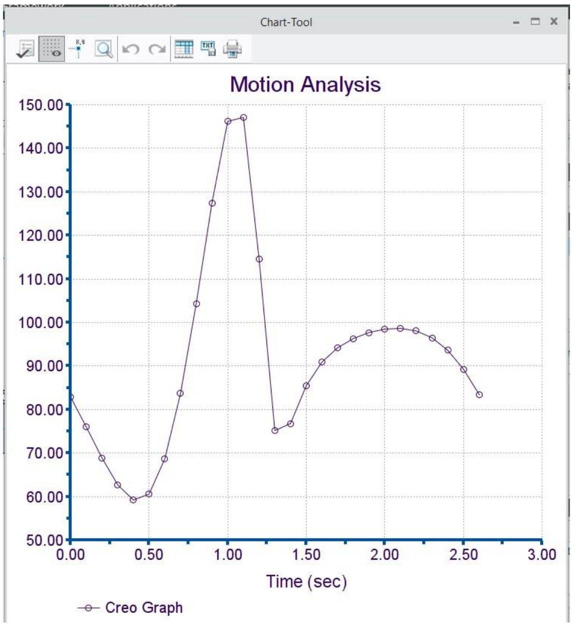
At V= 125deg/sec



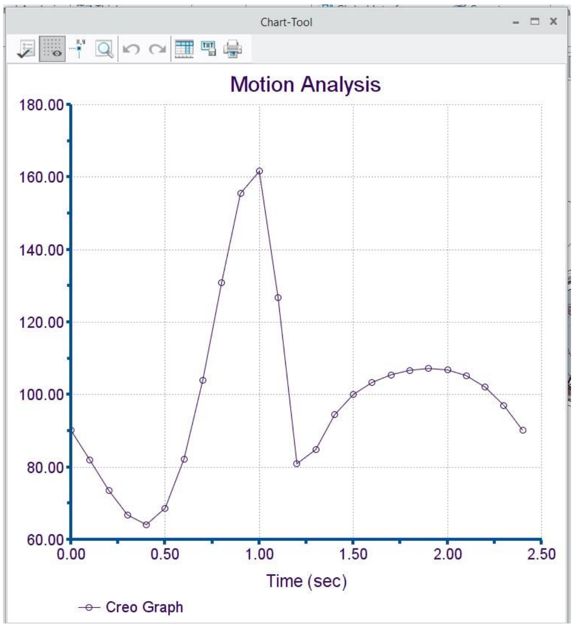
At V= 135deg/sec



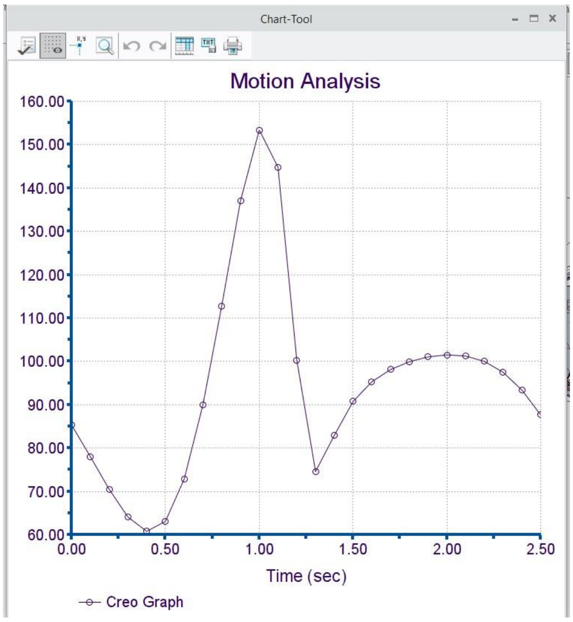
At V= 138deg/sec



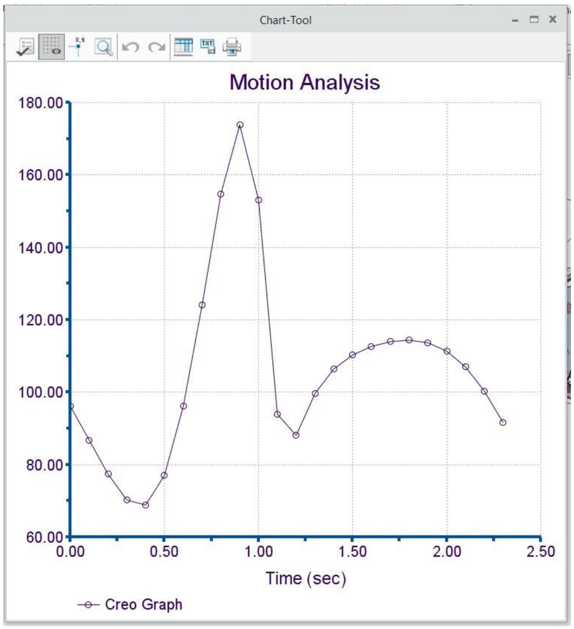
At V= 140deg/sec



At V= 142deg/sec



At V= 150deg/sec

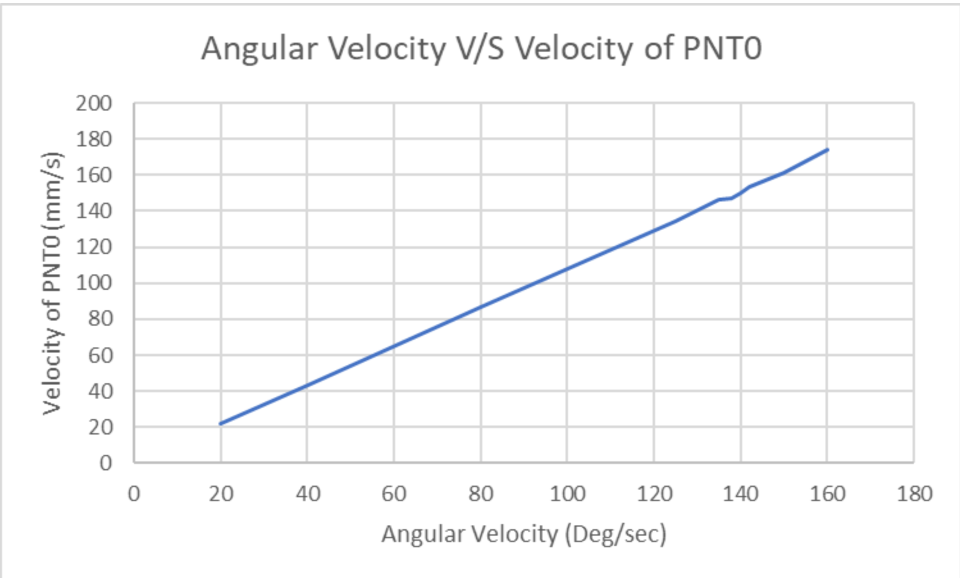


At V= 160deg/sec

- Complying Max velocity of PNT0 corresponding to the value of angular velocity given in Microsoft Excel and plotting Graph between angular velocity and Max velocity of PNT0 at straight line section:

Angular Velocity(deg/sec)	Max_Velocity of PNT0 (in mm/s)	Max_Velocity of PNT0 (in m/s)
20	21.741316	0.021741316
40	43.398168	0.043398168
80	86.802812	0.086802812
100	107.657894	0.107657894
125	134.608696	0.134608696
135	146.22283	0.14622283
138	147.102163	0.147102163
140	149.986701	0.149986701
142	153.45729	0.15345729
150	161.613003	0.161613003
160	173.814116	0.173814116

Ref.45. Values of Max_velocity of PNT0 with corresponding angular velocity.



Ref.46. Plot Angular velocity V/S max_velocity of PNT0

Using interpolation to find out angular velocity corresponding to 0.15m/s velocity of PNT0:

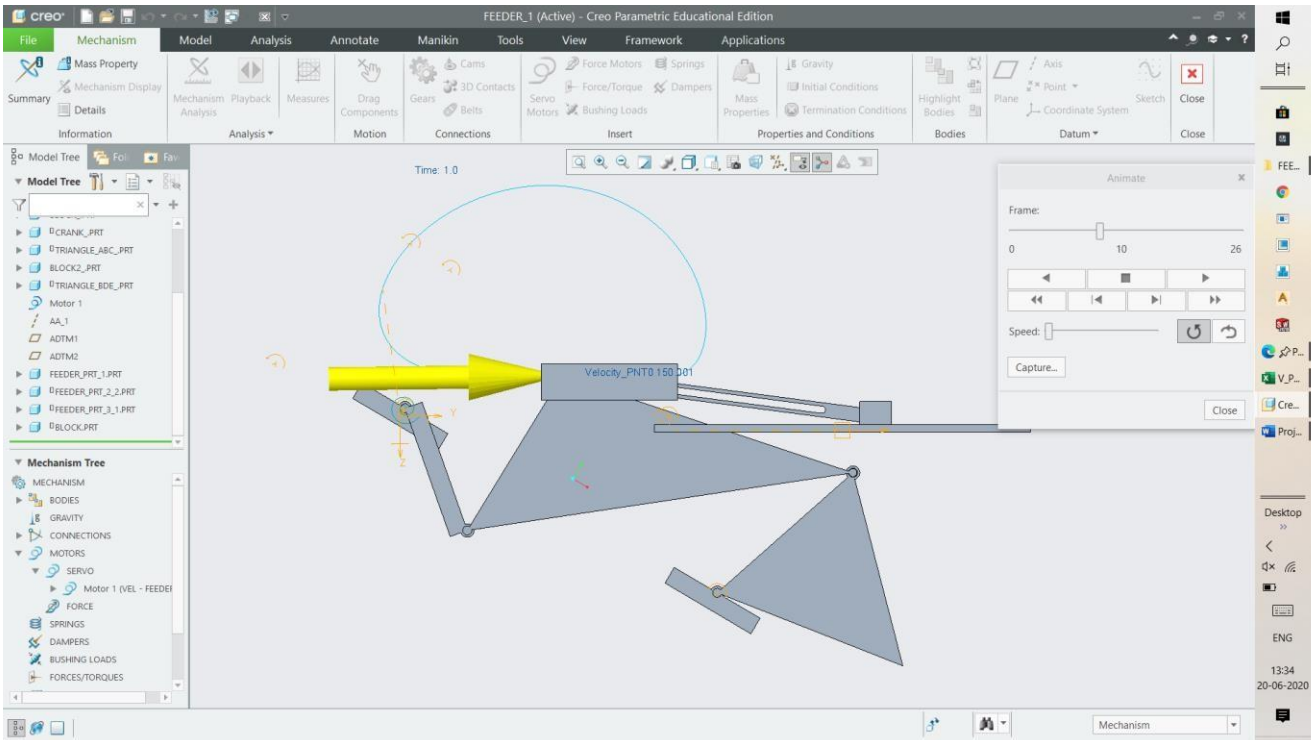
$$142 - \frac{(142 - 140)}{(153.45729 - 149.986701)}(153.45729 - 150)$$

$= 140.0076638287$deg/sec

In RPM=

$140.0076638287 \times \frac{60}{360} = 23.3346106381$ rpm

Conclusion: For 0.15m/s velocity of PNT0 over straight line section of trace curve approximate angular velocity needed is 23 rpm.



Ref. Max_velocity of PNT0 equals 150mm/s