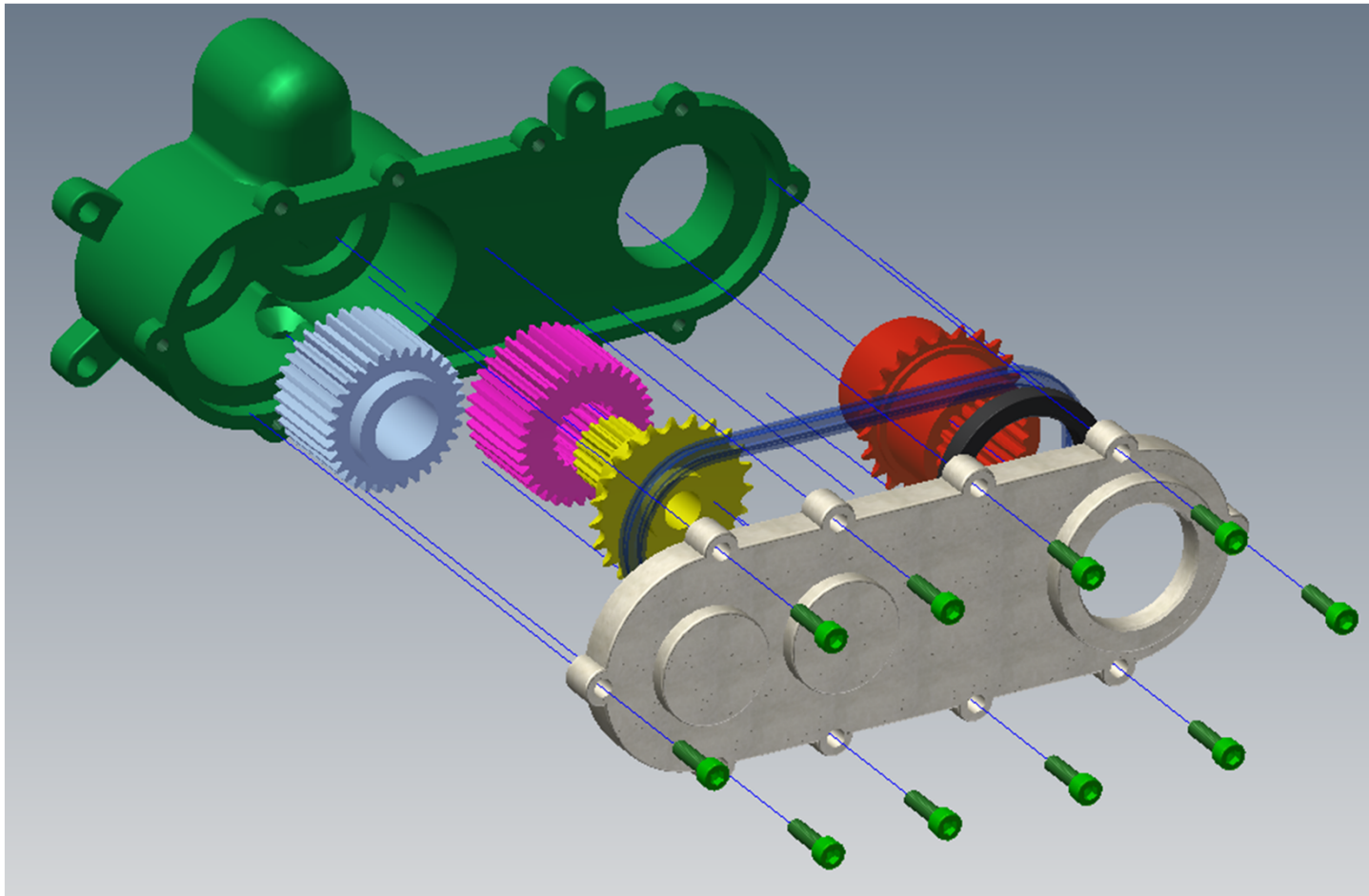


OIL PUMP WITH GEARS, POWERED BY CHAIN TRANSMISSION



Sprockets and chain generation

1 New drawing - >  Standard (mm).iam

2 Save as - > OilPump.iam

3

4

5

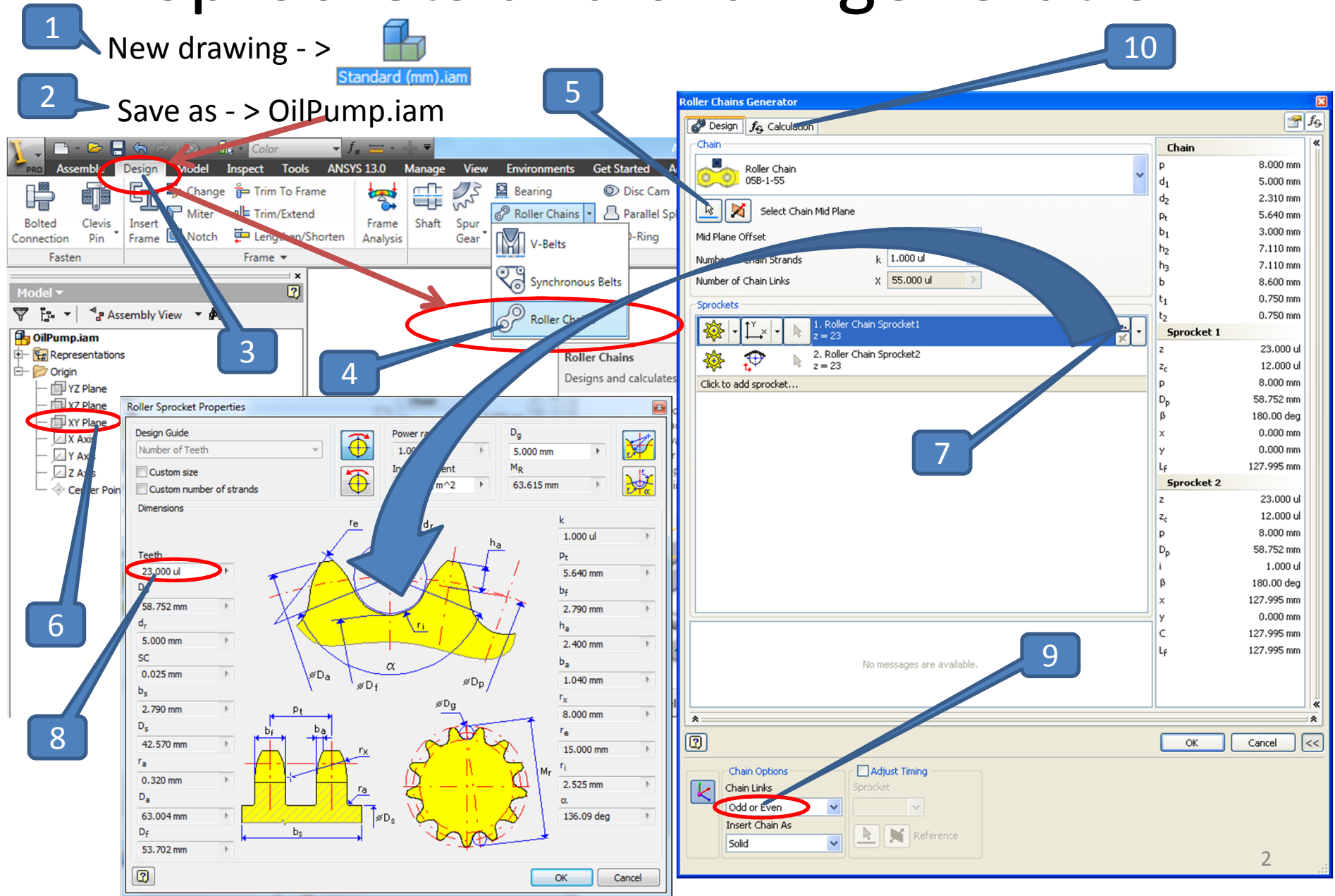
6

7

8

9

10



Roller Sprocket Properties

Design Guide: Number of Teeth: 1.000 ul

Custom size: ☐ Custom number of strands: ☐

Dimensions:

Teeth: 23.000 ul

D_p : 58.752 mm

d_r : 5.000 mm

SC: 0.025 mm

b_s : 2.790 mm

D_s : 42.570 mm

r_a : 0.320 mm

D_a : 63.004 mm

D_f : 53.702 mm

r_e : 2.790 mm

d_r : 5.000 mm

h_a : 2.400 mm

b_f : 2.790 mm

b_a : 1.040 mm

r_x : 8.000 mm

r_e : 15.000 mm

r_i : 2.525 mm

α : 136.09 deg

ϕD_a : 1.000 ul

P_t : 5.640 mm

b_f : 2.790 mm

h_a : 2.400 mm

b_a : 1.040 mm

r_x : 8.000 mm

r_e : 15.000 mm

r_i : 2.525 mm

α : 136.09 deg

Roller Chains Generator

Design | Calculation

Chain: Roller Chain 05B-1-55

Select Chain Mid Plane

Mid Plane Offset: 0.000 ul

Number of Chain Strands: k 1.000 ul

Number of Chain Links: x 55.000 ul

Sprockets:

1. Roller Chain Sprocket1 z = 23

2. Roller Chain Sprocket2 z = 23

Click to add sprocket...

Chain Options: Chain Links: Odd or Even

Insert Chain As: Solid

Adjust Timing: ☐ Sprocket: Reference

Chain	
p	8.000 mm
d_1	5.000 mm
d_2	2.310 mm
P_t	5.640 mm
b_1	3.000 mm
h_2	7.110 mm
h_3	7.110 mm
b	8.600 mm
t_1	0.750 mm
t_2	0.750 mm

Sprocket 1	
z	23.000 ul
z_c	12.000 ul
p	8.000 mm
D_p	58.752 mm
β	180.00 deg
x	0.000 mm
y	0.000 mm
L_f	127.995 mm

Sprocket 2	
z	23.000 ul
z_c	12.000 ul
p	8.000 mm
D_p	58.752 mm
i	1.000 ul
β	180.00 deg
x	127.995 mm
y	0.000 mm
C	127.995 mm
L_f	127.995 mm

Chain calculation

Roller Chains Generator

Design Calculation

Working conditions
 Power, Speed --> Torque

Power P 1.1 kW
 Torque T 3.501 N m
 Speed n 3000.000 rpm
 Efficiency η 0.980 ul
 Required service life L_h 10000.000 hr
 Maximum chain elongation ΔL_{max} 0.030 ul
 Application Slight shocks
 Environment Clean
 Lubrication Forced Feed

Chain Properties
☒ Tensile strength F_u 4400.000 N
☐ Specific mass m 0.200 kg/m
☒ Chain power rating P_R 1.1 kW
☐ Chain construction factor ϕ 1.000 ul

Power Correction Factors
☒ Shock factor Y 2.700 ul
☒ Service factor f_1 1.0 ul
☐ Sprocket size factor f_2 0.814 ul
☐ Strands factor f_3 1.000 ul
☐ Lubrication factor f_4 1.050 ul
☒ Center distance factor f_5 1.000 ul
☒ Ratio factor f_6 1.2 ul
☐ Service life factor f_7 0.850 ul

☐ Limit Chain Bearing Area Pressure
☐ Permissible pressure p_0 10.496 MPa
☐ Specific friction factor λ 0.608 ul

☐ Vibration analysis
 Chain stiffness c 1600.000 N/mm
 Limit of critical speed Δn 0.100 ul

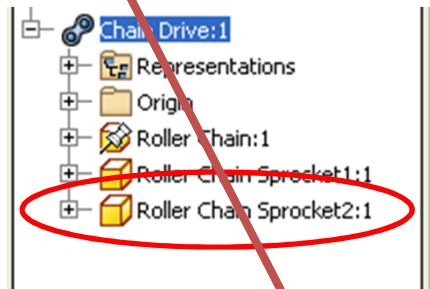
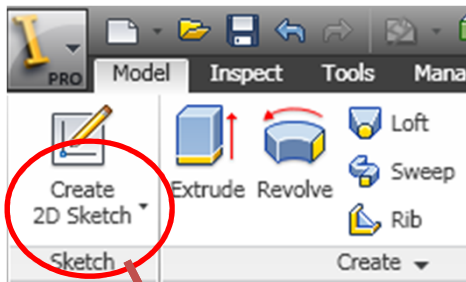
Results
 P_D 0.913 kW
 F_p 119.194 N
 F_C 17.034 N
 F_{Tmax} 136.227 N
 S_S 32.299 ul
 S_D 11.963 ul
Expected service life
 t_h 41701 hr
 t_{hL} 2777778 hr
 t_{hr} 11542 hr
Chain
 p 8.000 mm
 X 55.000 ul
 k 1.000 ul
 A 11.000 mm²
 v 9.229 mps
 p_B 12.384 MPa
Sprocket 1
 z 23.000 ul
 z_c 12.000 ul
 D_p 58.752 mm
 β 180.00 deg
 P_x 1.000 ul
 P 1.100 kW
 T 3.501 N m

19:44:05 Calculation: Recommended lubrication : Oil bath or disc lubrication
 19:44:05 Calculation: Maximum chain power rating is customized.
 19:44:05 Calculation: Calculation indicates design compliance!

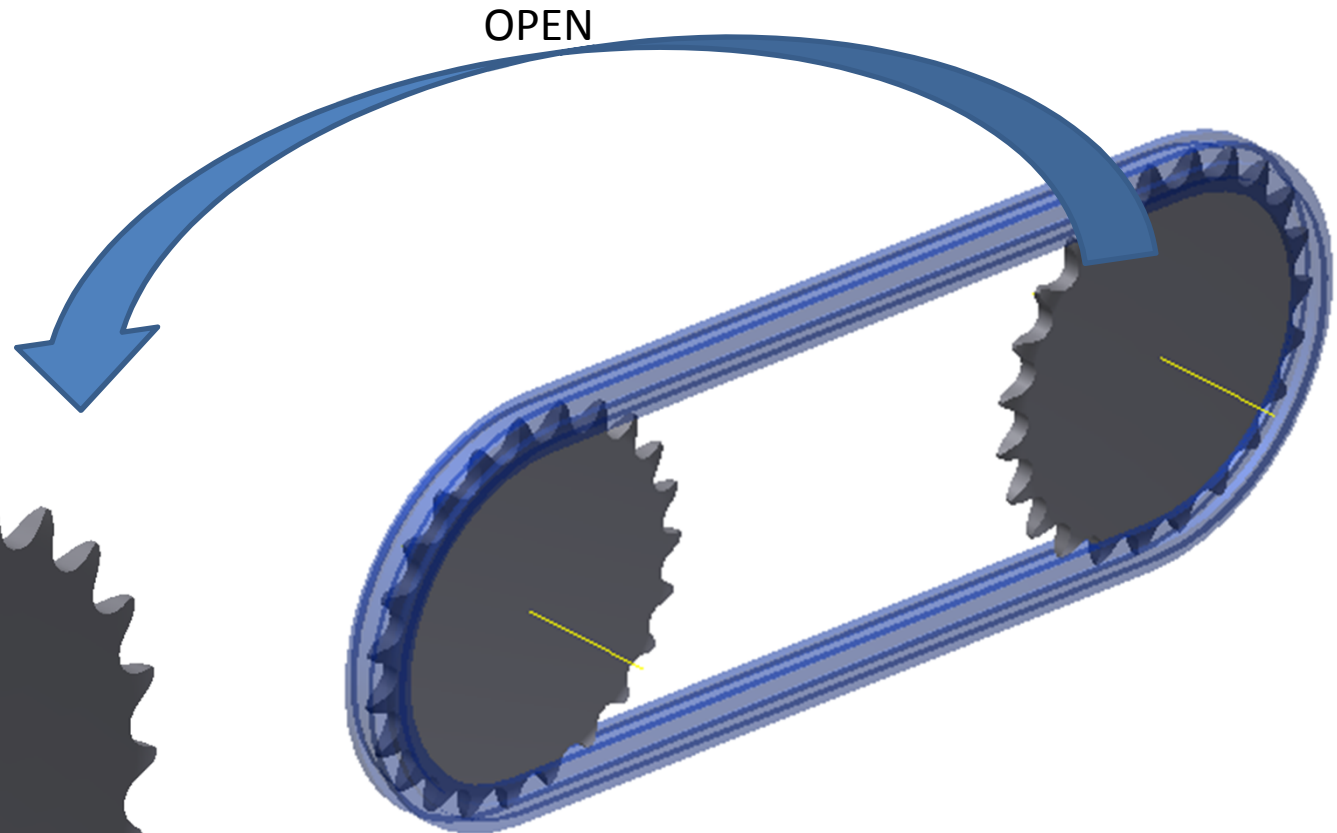
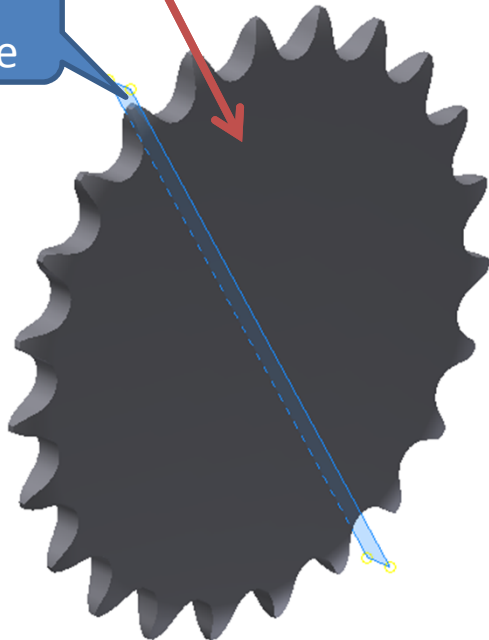
Calculate OK Cancel

Recommended safety factors
 Static S_{Smin} 7.000 ul
 Dynamic S_{Dmin} 5.000 ul
☒ Lubrication factor impacts just power rating limited by galling between pins and bushings

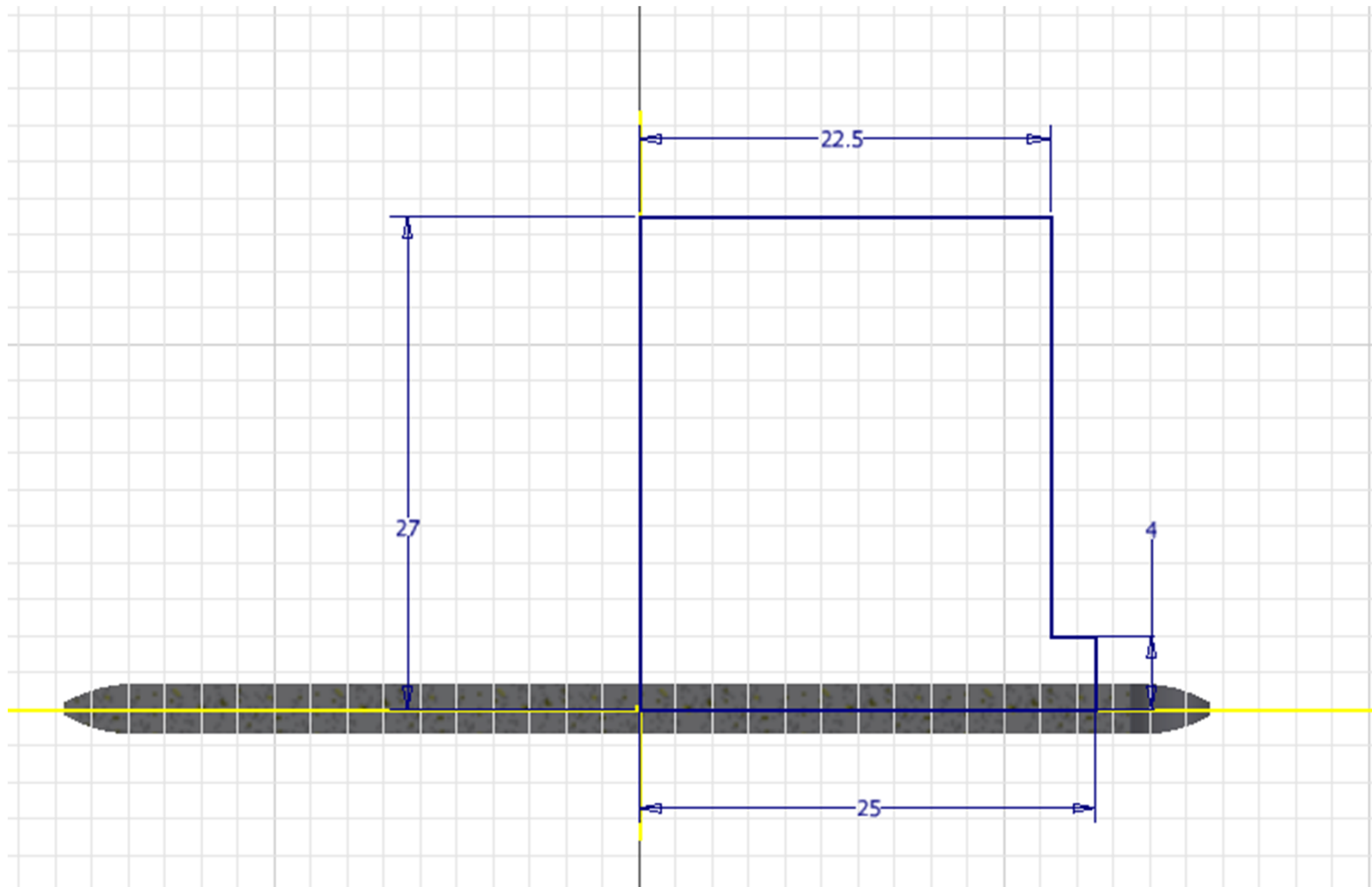
Sprocket 2 upgrade



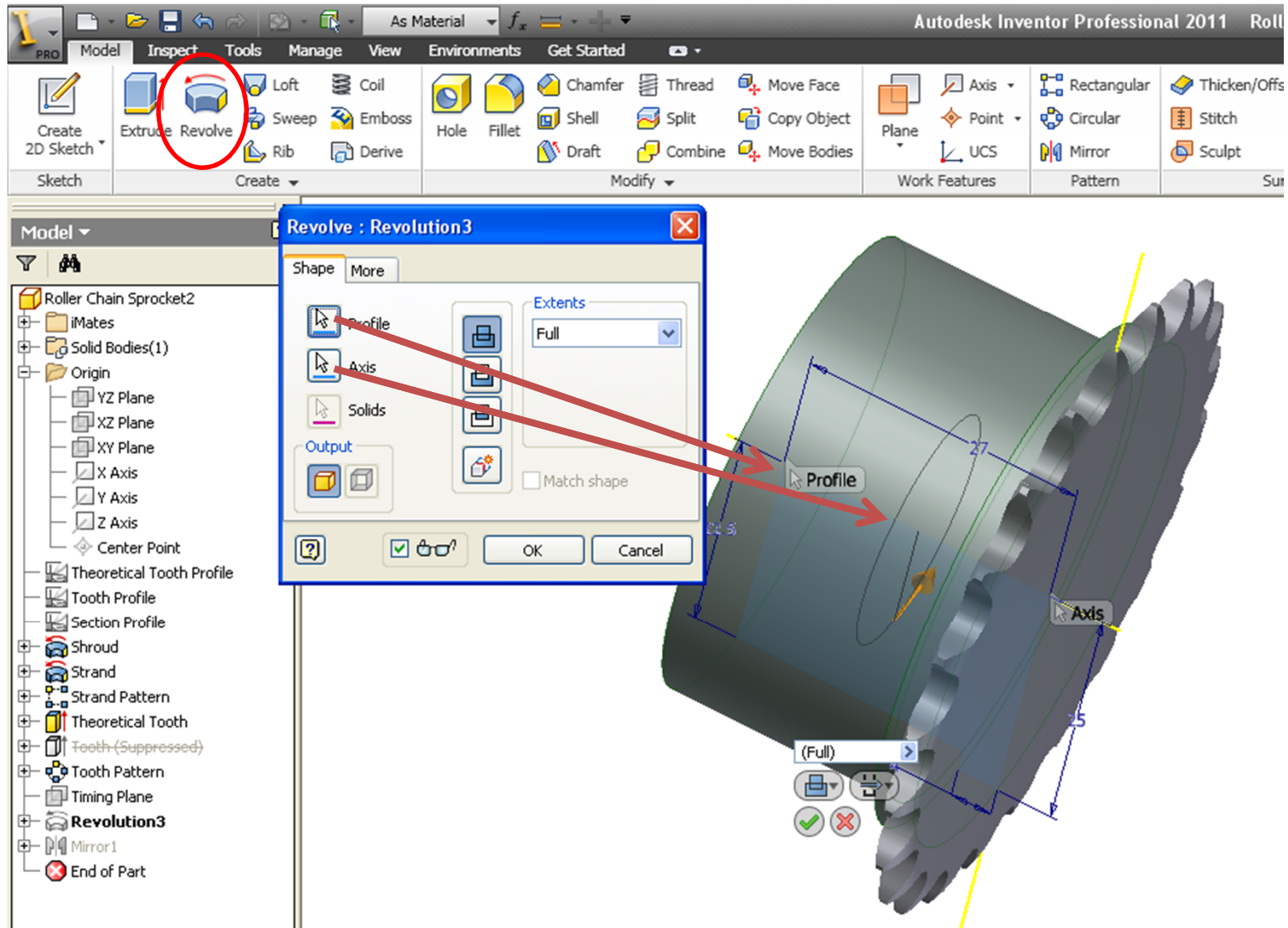
YZ
plane



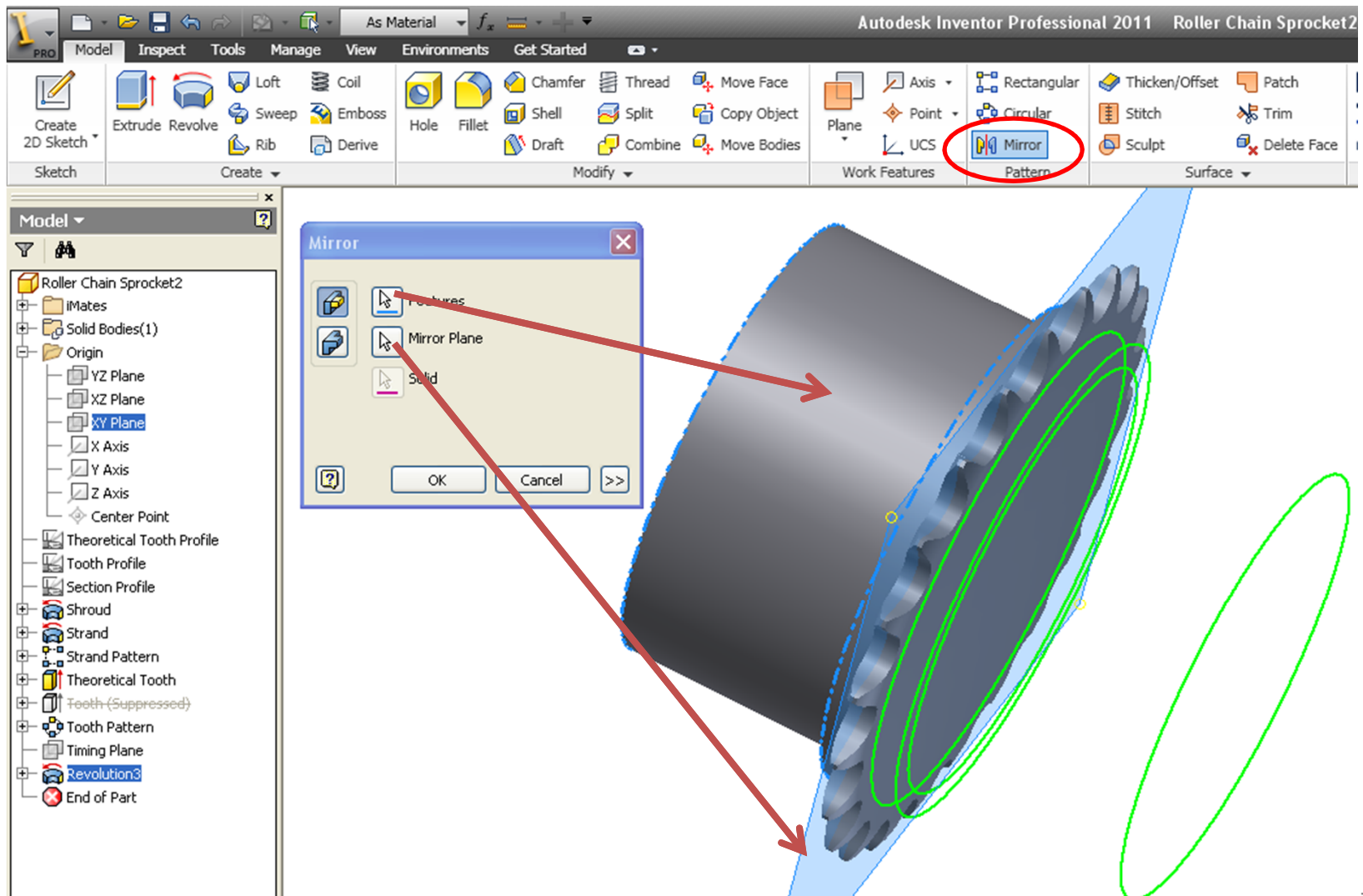
Profile 1 sprocket 2



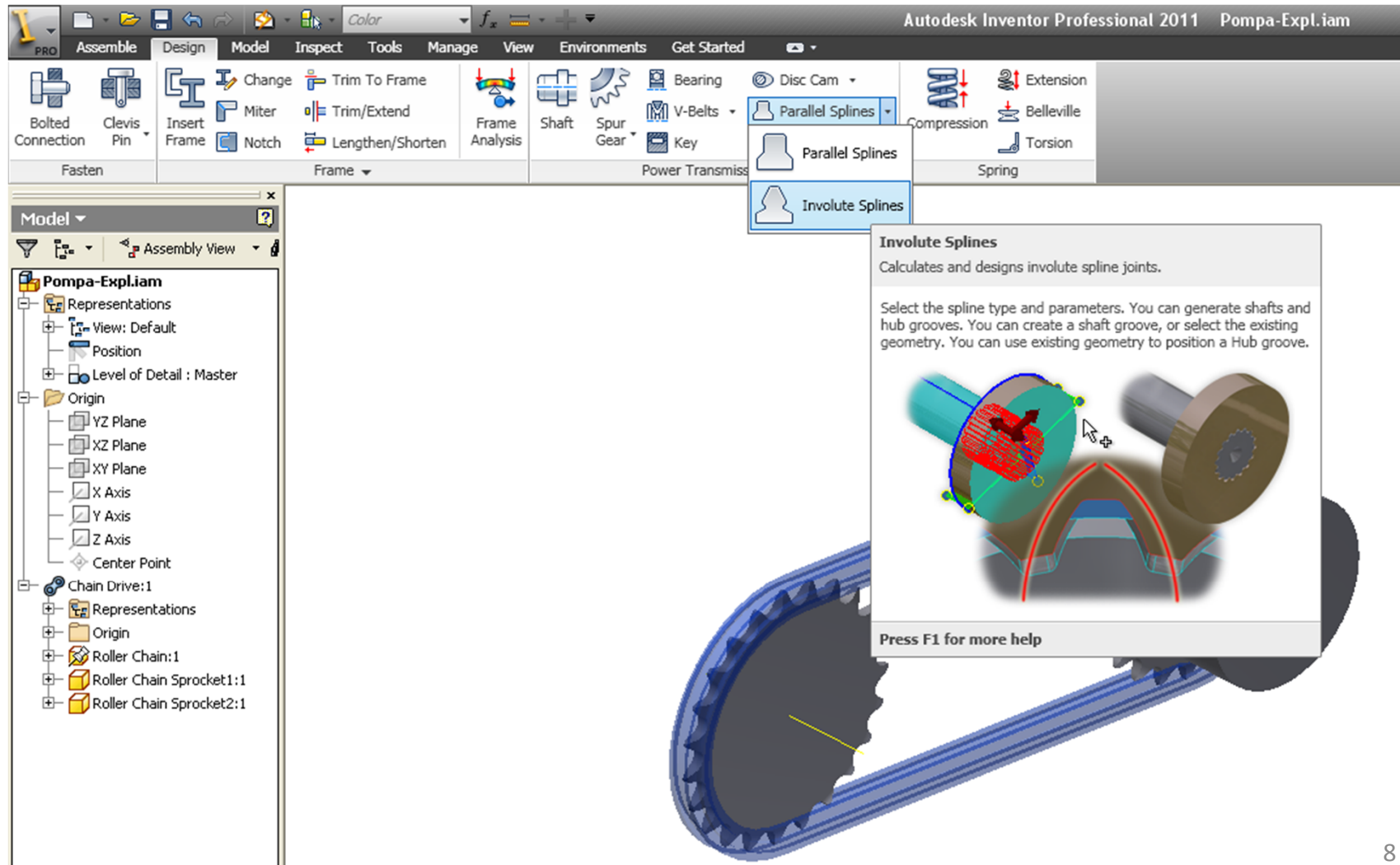
Revolve Feature



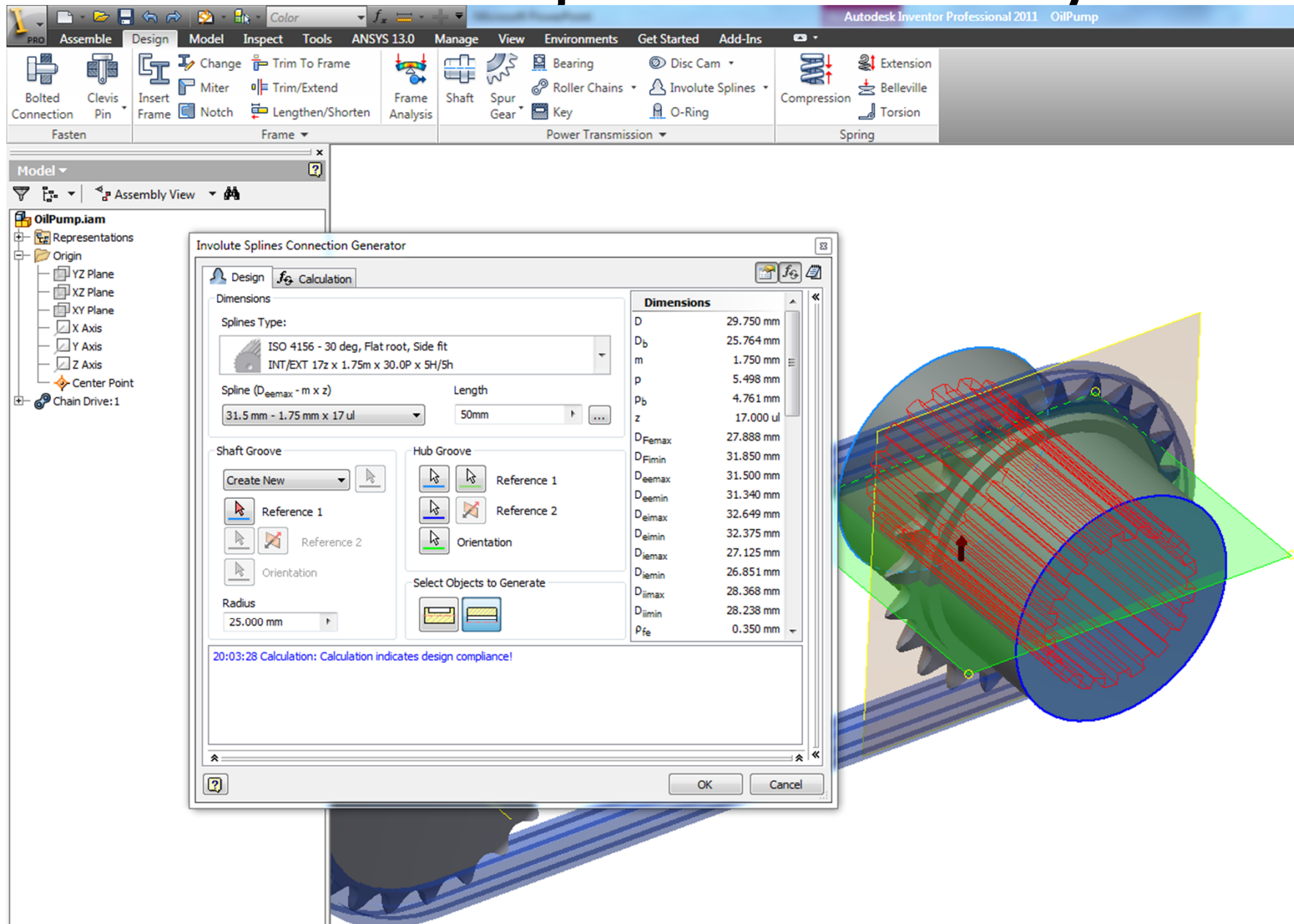
Mirror feature



Involute Spline Generation



Involute Spline Geometry



Involute Spline Calculation

Involute Splines Connection Generator

Design Calculation

Strength Calculation

Method: Metric Method

Type: Check Calculation

Loads

Power, Speed --> Torque

Power P : 1.1 kW

Speed n : 3600.000 rpm

Torque T : 2.918 N m

Dimensions

Spline: 31.5 mm - 1.75 mm x 17 ul

Hollow Shaft Inner Diameter d_h : 0.000 mm

Hub Outside Diameter D_{oi} : 30.000 mm

Spline Length l : 50 mm

Joint Properties

Desired Safety S_v : 1.000 ul

Loading Conditions

Shaft Material

User material

Allowable Pressure p_A : 246.000 MPa

Allowable Shear Stress τ_A : 344.000 MPa

Allowable Bending Stress σ_{BA} : 246.000 MPa

Hub Material

User material

Allowable Pressure p_A : 246.000 MPa

Results

d_{min} : 3.509 mm

l_{min} : 0.073 mm

Deformation of Grooving ...

p_c : 0.303 MPa

S : 812.810 ul

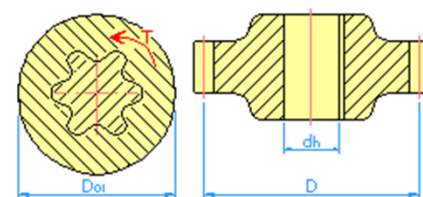
Bending Stress on Sides ...

σ_{cAlB} : 0.360 MPa

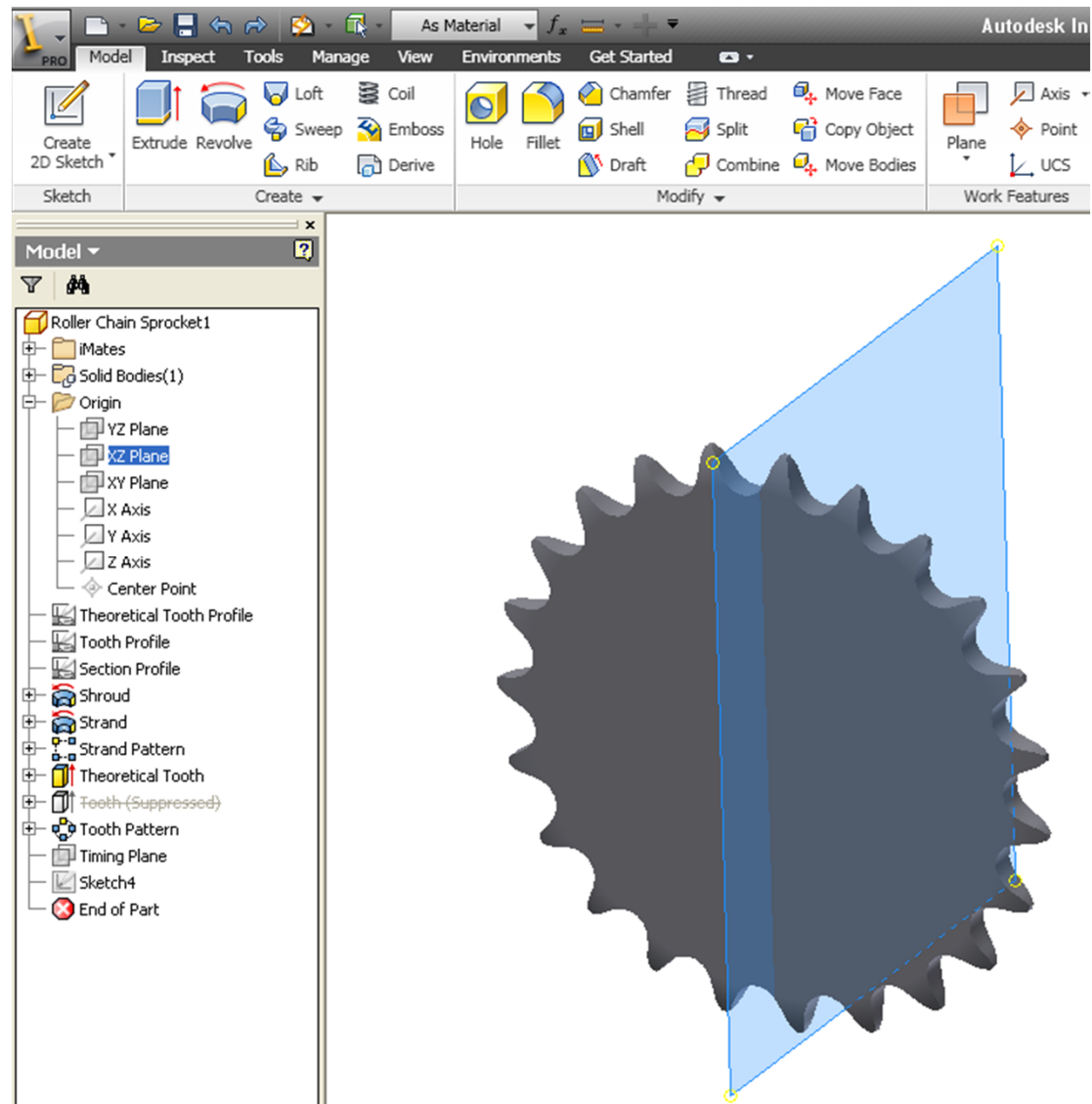
S : 683.223 ul

20:03:28 Calculation: Calculation indicates design compliance!

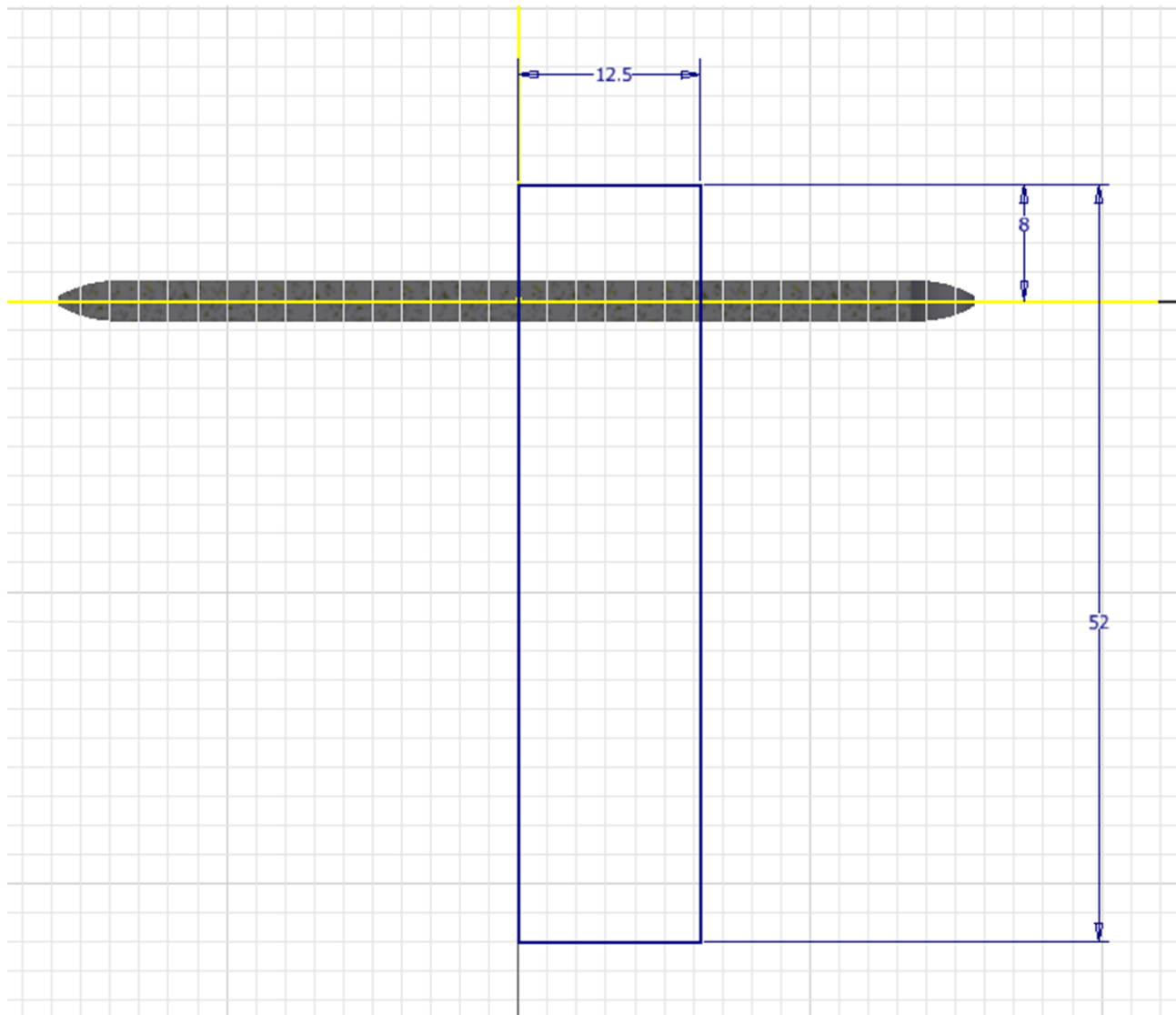
Calculate OK Cancel



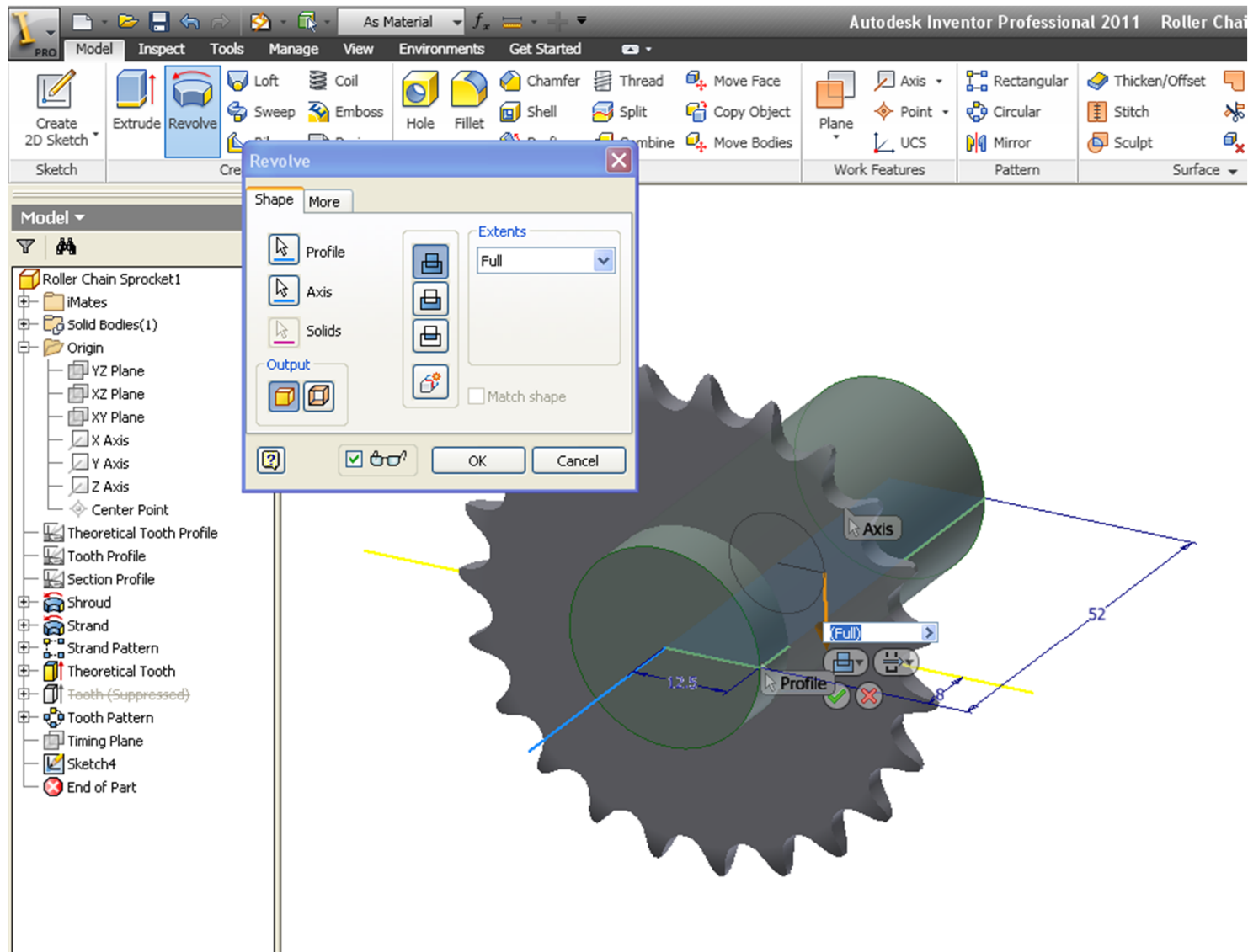
Sprocket 1 upgrade



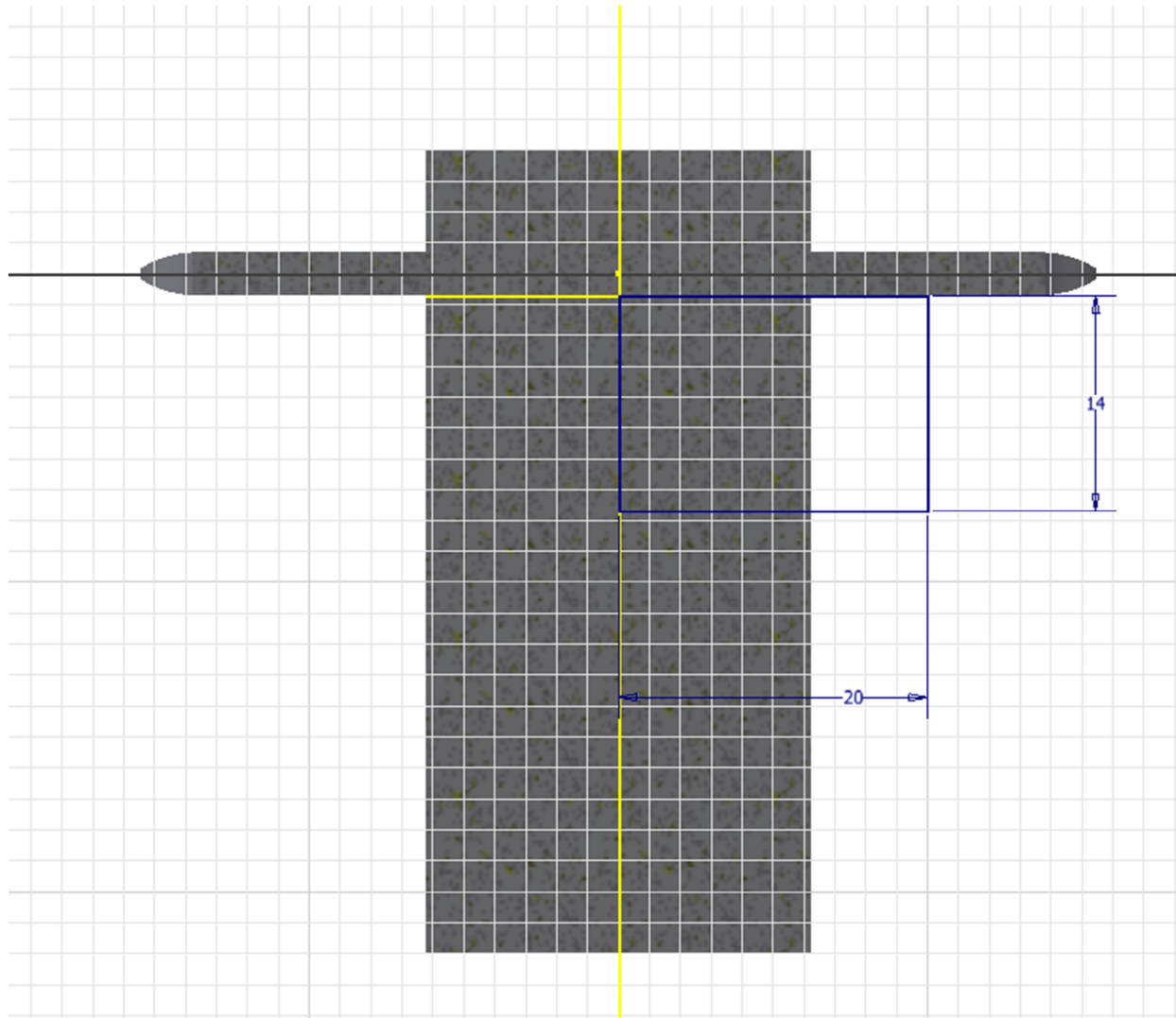
Profile 1 sprocket 1



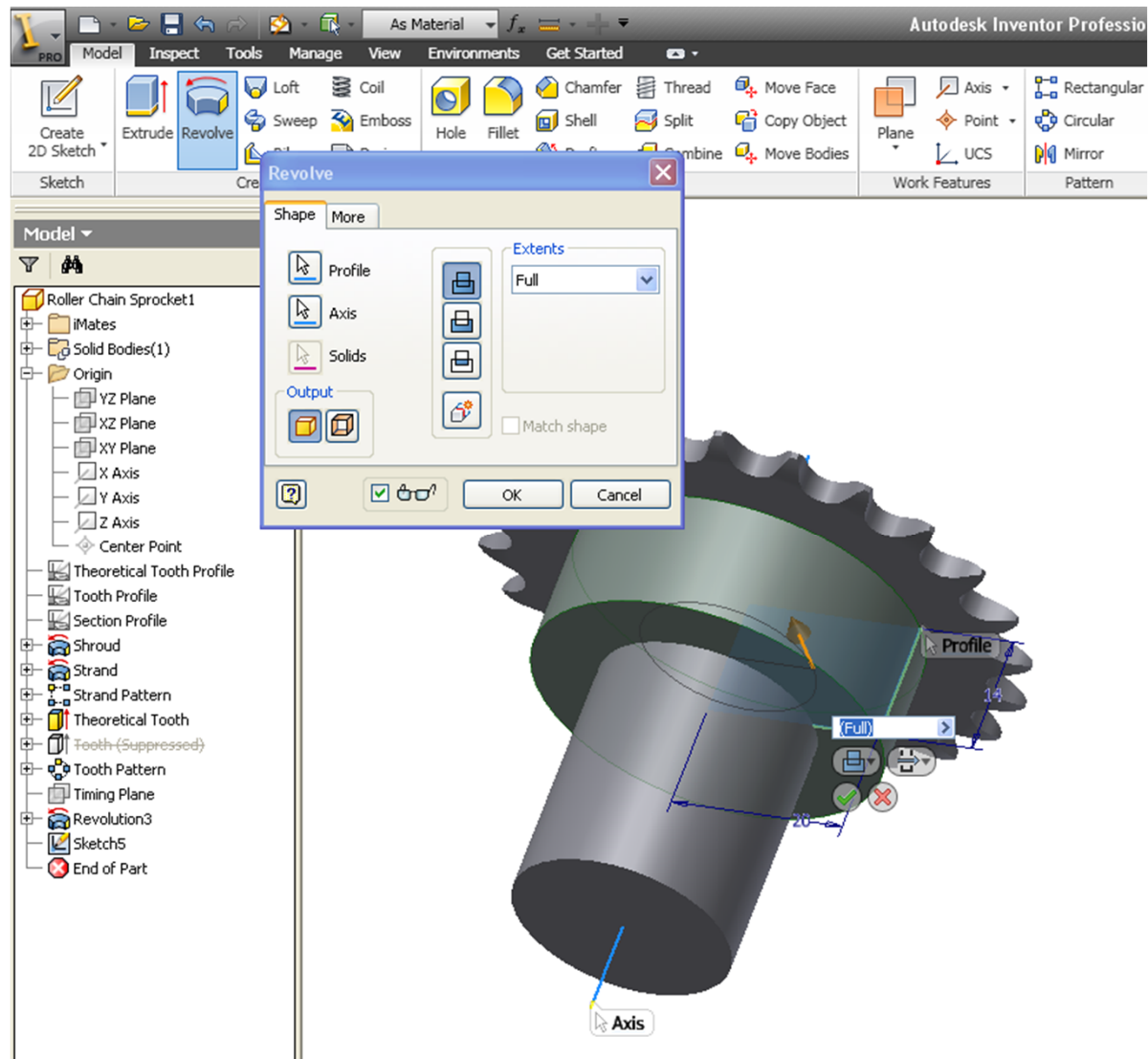
Revolve Feature



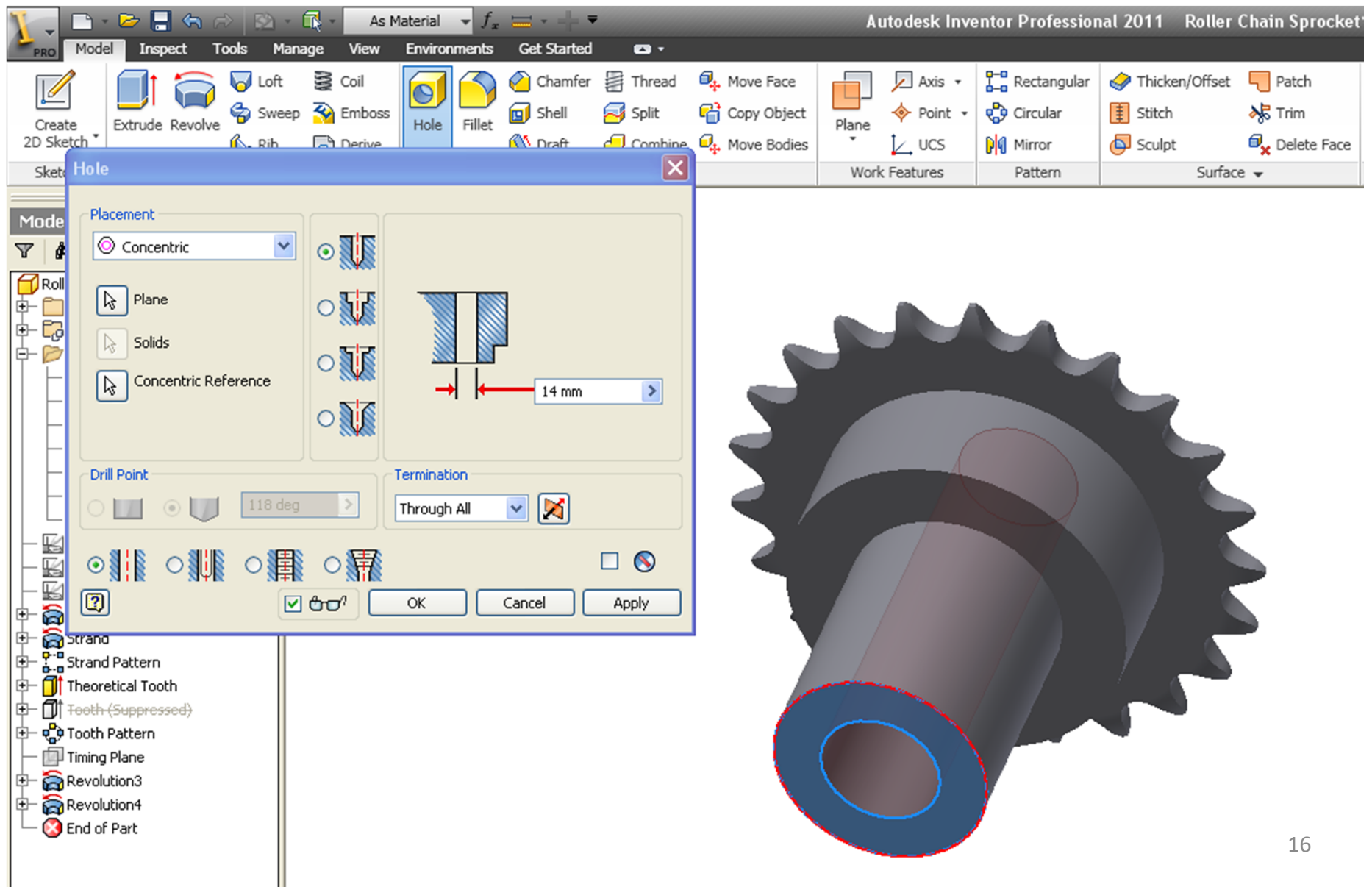
Profile 2 sprocket 1



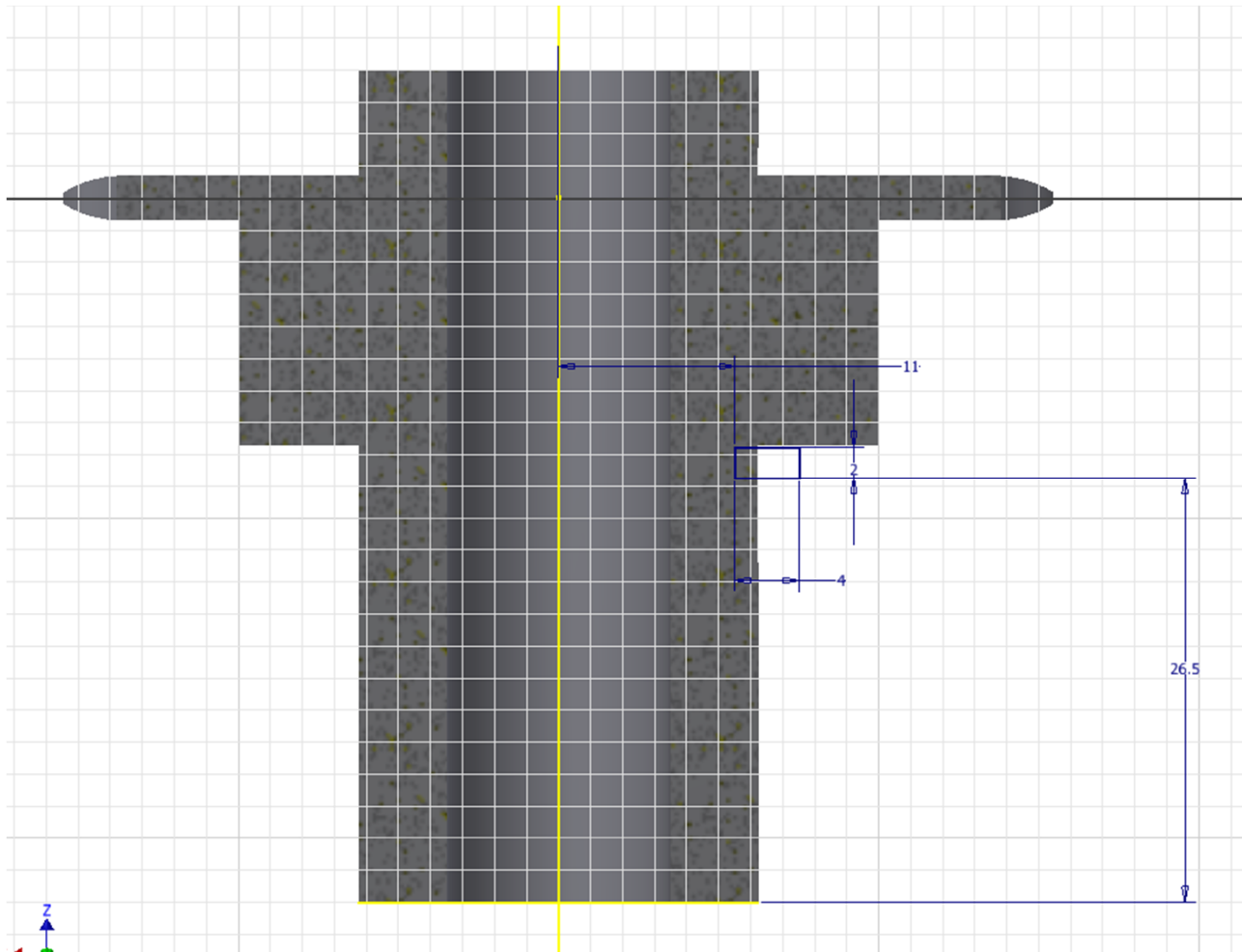
Revolve Feature 2



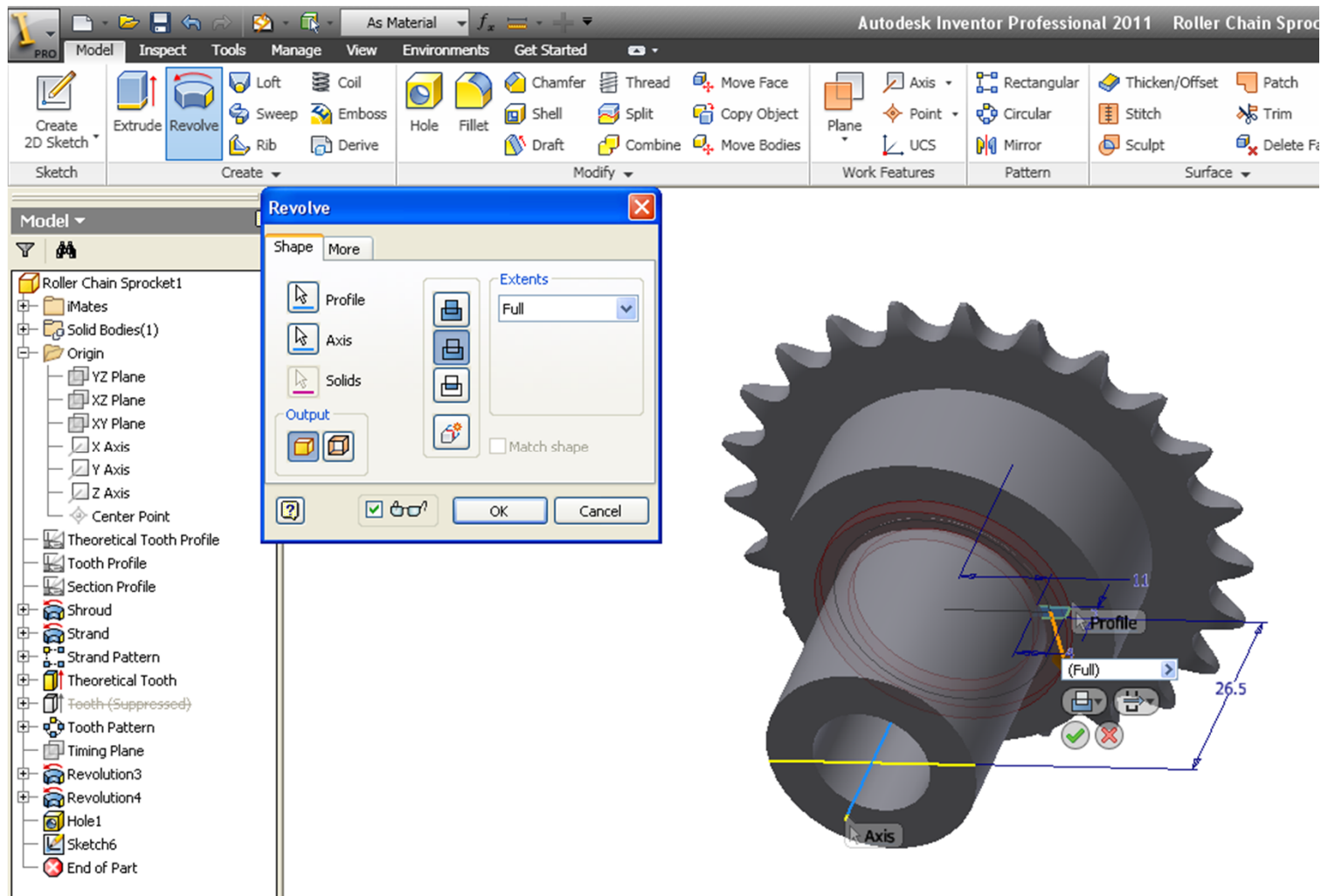
Hole Generation



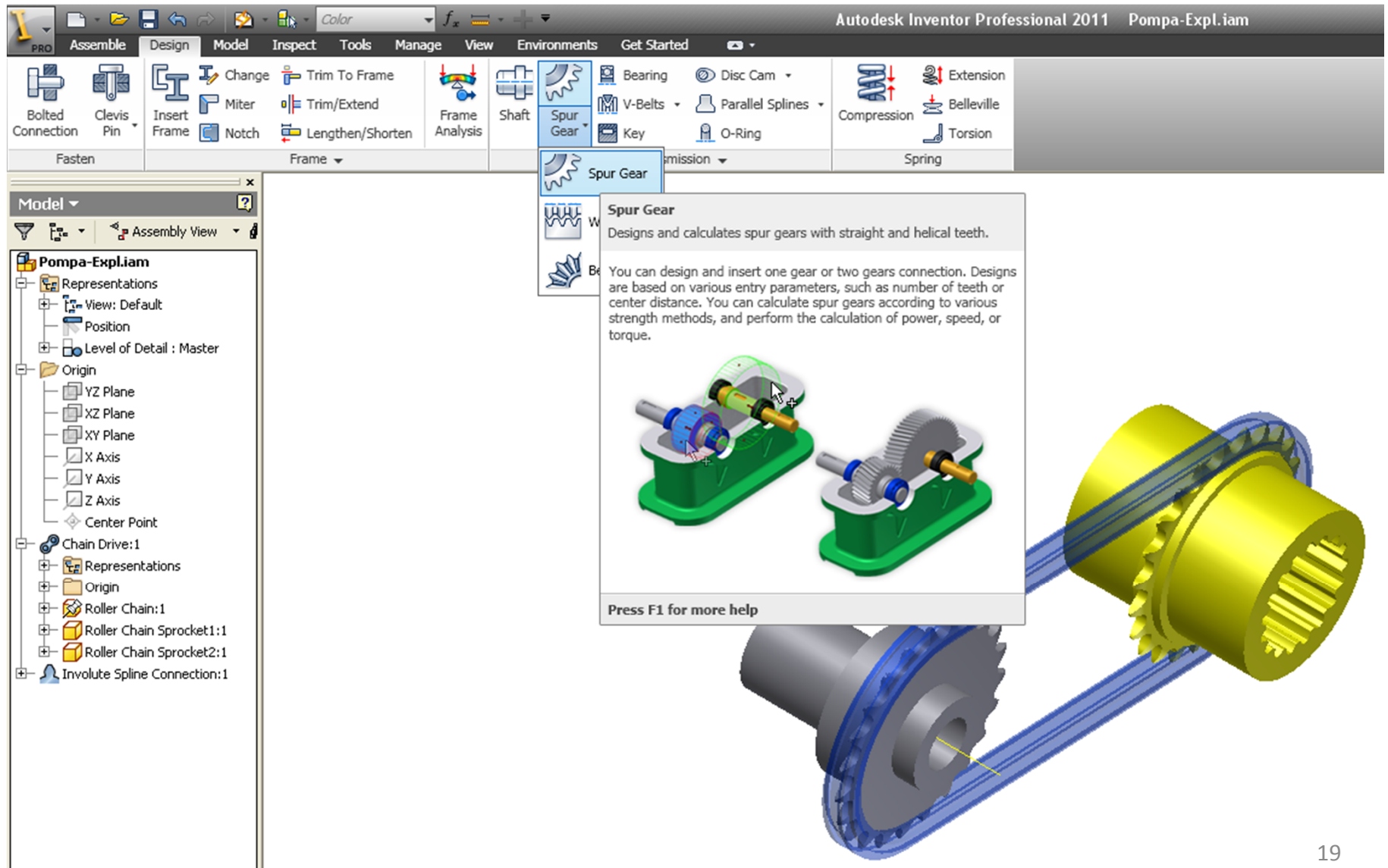
Undercut



Undercut feature



Spur Gear Train



Spur Gear Geometry

Spur Gears Component Generator

Design **Calculation**

Common

Design Guide
 Number of Teeth

Desired Gear Ratio
 1 ul ☐ Internal

Module Center Distance

Pressure Angle Helix Angle

Unit Corrections Guide
 User

Total Unit Correction **Preview...**

Gear1

Component

Number of Teeth

Facewidth Unit Correction

Gear2

Component

Number of Teeth

Facewidth Unit Correction

Results

i	1.0000 ul
ϵ	1.5824 ul
Gear 1	
d_a	52.463 mm
d	49.500 mm
d_f	45.750 mm
x_2	0.0550 ul
x_p	-0.9104 ul
x_d	-1.0804 ul
s_a	0.7580 ul
b_r	0.7071 ul
Gear 2	
d_a	53.500 mm
d	49.500 mm

15:20:58 Design: Gear 1: The Unit Correction (x) is less than the Unit Correction without Tapering (x_2)
 15:20:58 Design: Numbers of teeth are commensurable - shots of the same teeth are taken relatively regularly
 15:20:58 Calculation: Calculation indicates design compliance!

Calculate **OK** **Cancel** **>>**

Spur Gear Calculation

Spur Gears Component Generator

Design **Calculation**

Method of Strength Calculation
ISO 6336:1996

Loads

	Gear 1	Gear 2
Power	P 1.5 kW	1.470 kW
Speed	n 7000.00 rpm	7000.00 rpm
Torque	T 2.046 N m	2.005 N m
Efficiency	η 0.980 ul	

Material Values

Gear 1 ☐ User material ...

Gear 2 ☐ User material ...

	Gear 1	Gear 2
Bending Fatigue Limit	σ_{Flim} 352.0 MPa	352.0 MPa
Contact Fatigue Limit	σ_{Hlim} 1140.0 MPa	1140.0 MPa
Modulus of Elasticity	E 206000 MPa	206000 MPa
Poisson's Ratio	μ 0.300 ul	0.300 ul
Heat Treatment	2 ul	2 ul

Required Life L_h 10000 hr

Factors Accuracy

15:21:46 Design: Gear 1: The Unit Correction (x) is less than the Unit Correction without Tapering (x_2)
 15:21:46 Design: Numbers of teeth are commensurable - shots of the same teeth are taken relatively req
 15:21:46 Calculation: Calculation indicates design compliance!

Results

F_t	81.851 N
F_r	32.273 N
F_a	0.000 N
F_n	87.984 N
v	18.143 mps
n_{E1}	19821.334 rpm
Gear 1	
S_H	2.796 ul
S_F	10.776 ul
S_{Hst}	2.378 ul
S_{Fst}	21.547 ul
Gear 2	
S_H	2.830 ul
S_F	11.344 ul
S_{Hst}	2.407 ul
S_{Fst}	22.147 ul

Calculate OK Cancel <<

Type of Load Calculation

☒ Power, Speed --> Torque
☐ Torque, Speed --> Power
☐ Power, Torque --> Speed

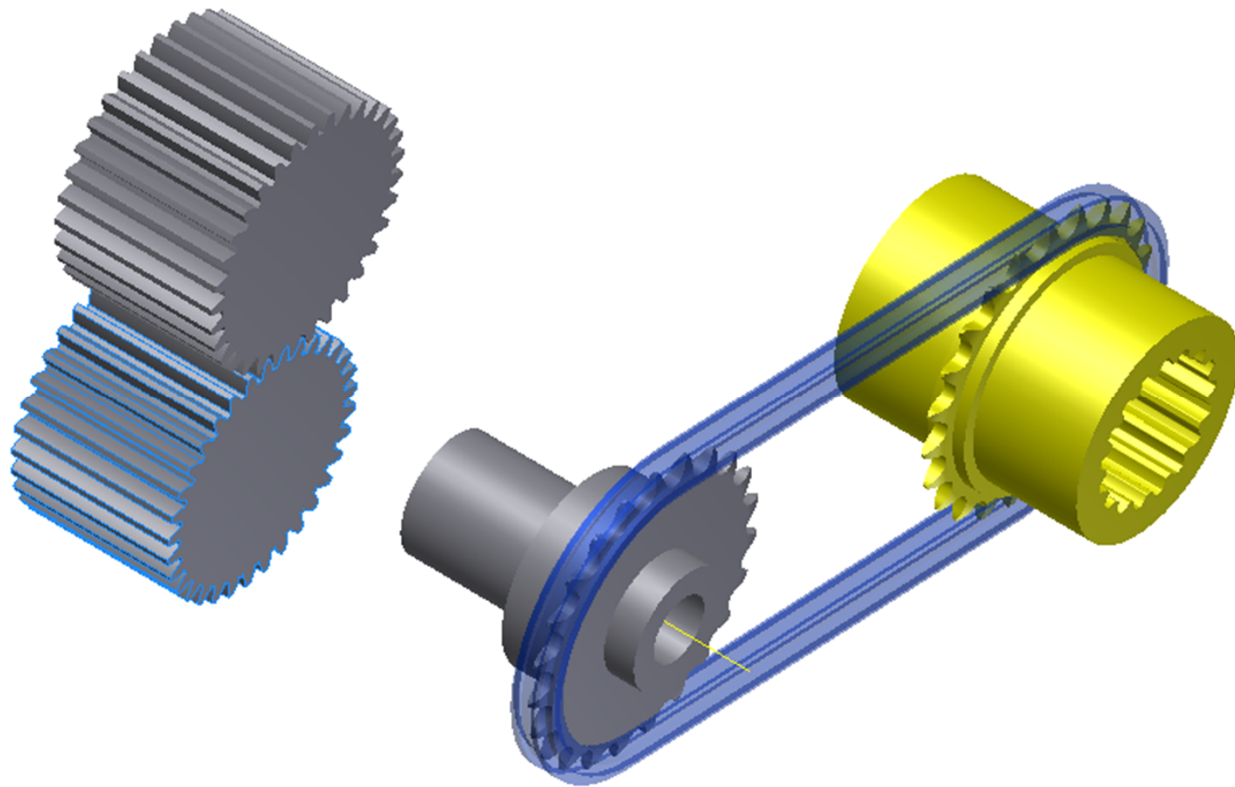
Type of Strength Calculation

Check Calculation

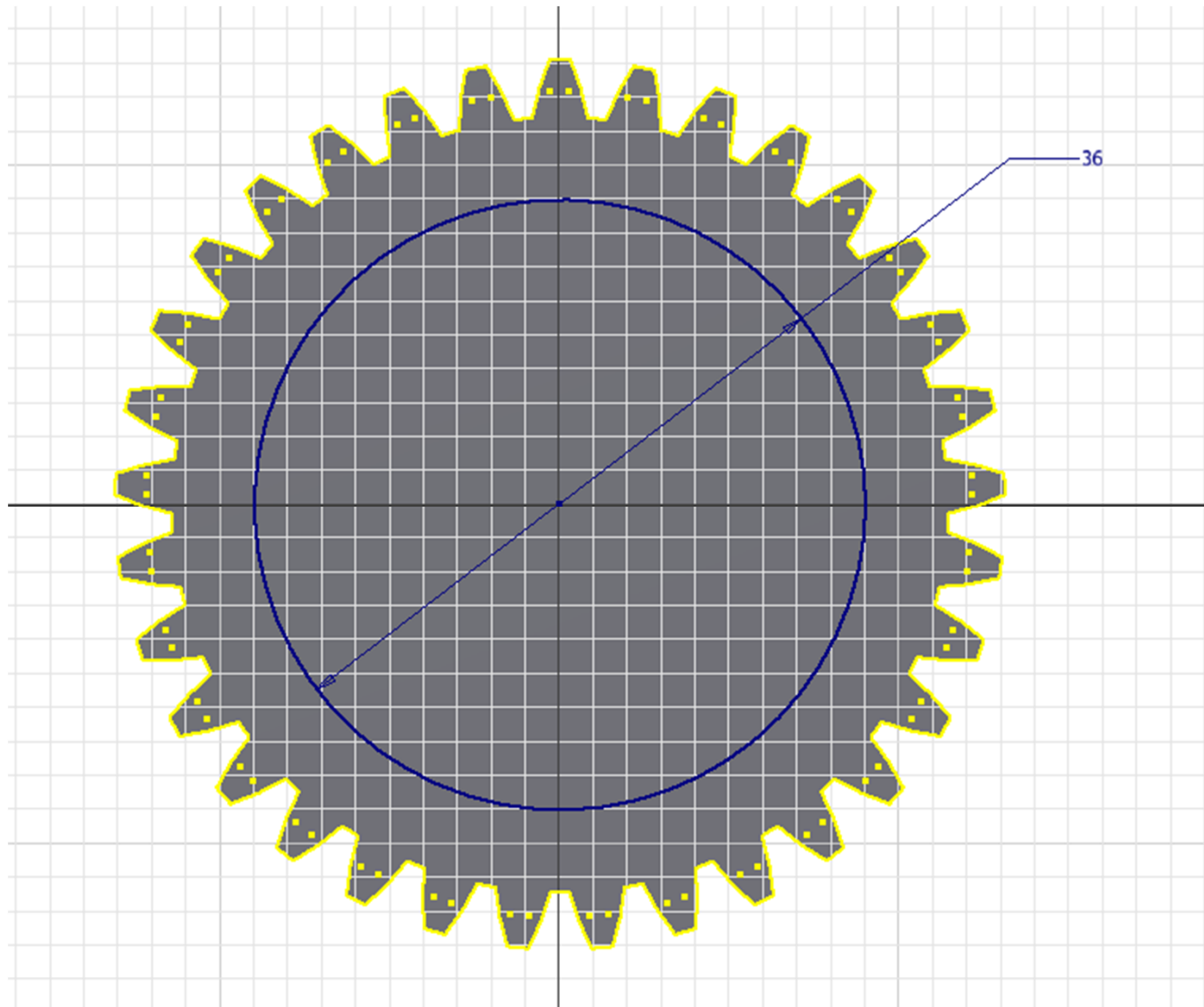
Limit Values

	Contact	Bending
Minimal Factor of Safety	1.200 ul	1.300 ul

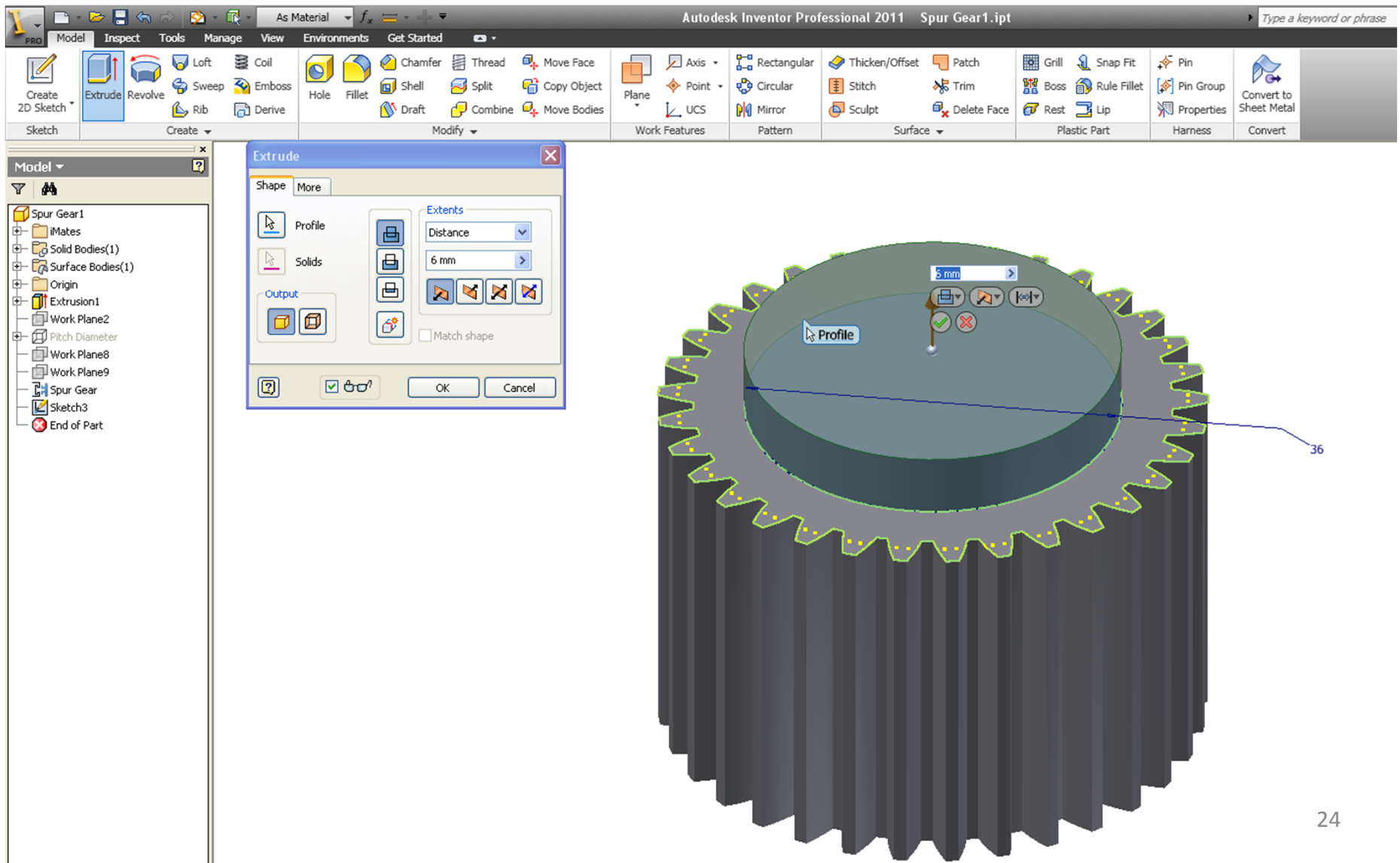
Generated Spur Gear Train



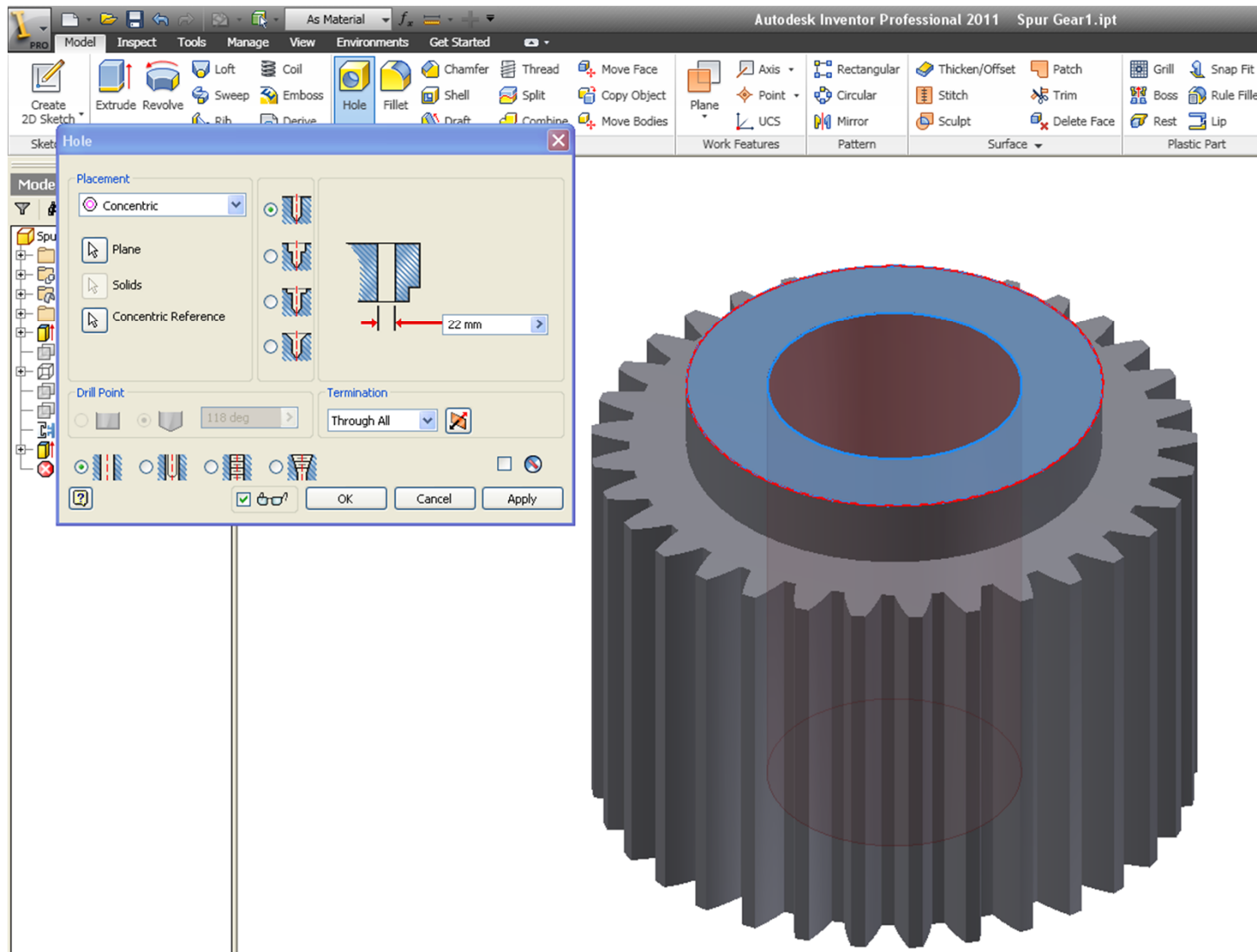
Gear 1 Shoulder profile



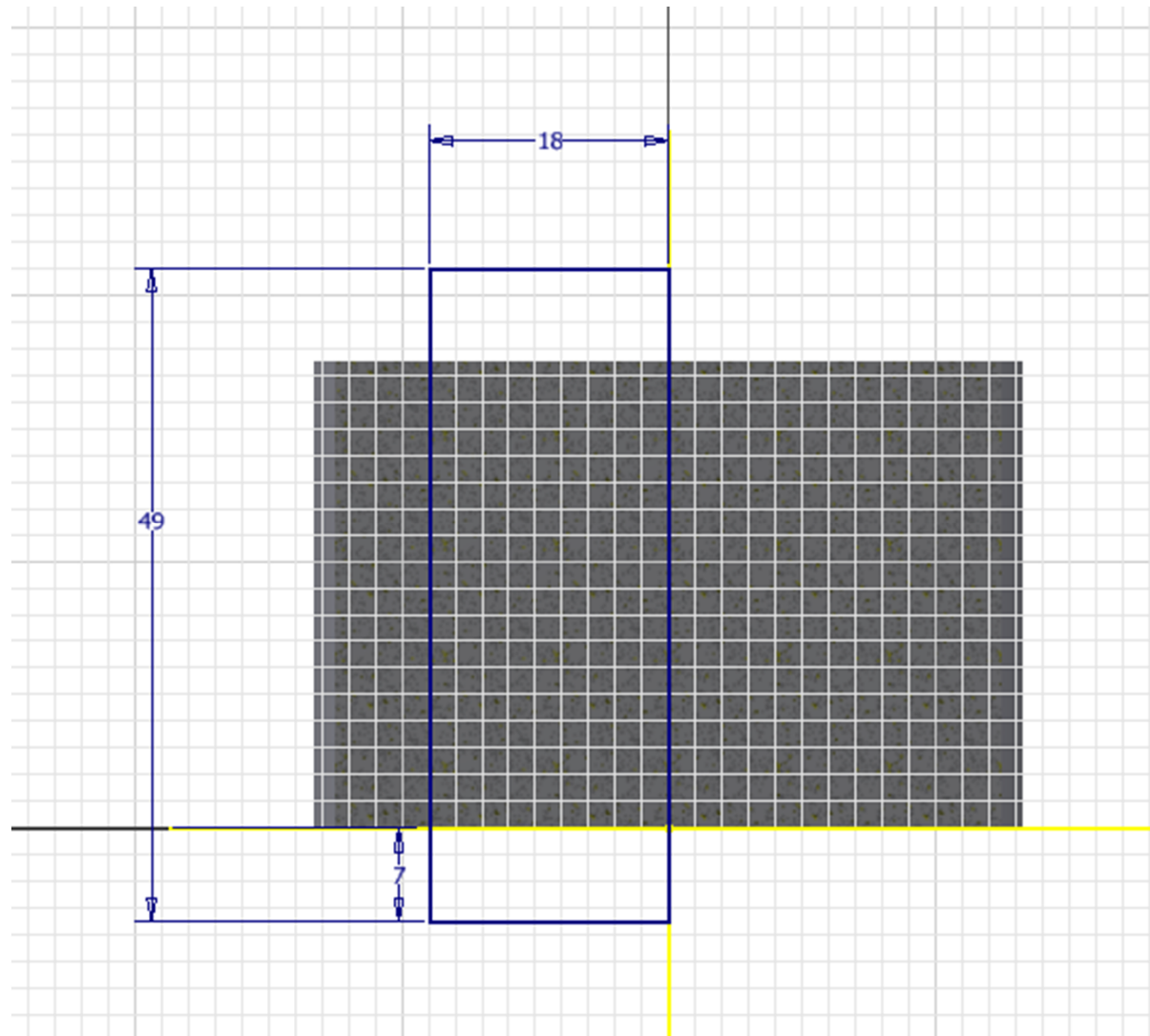
Shoulder



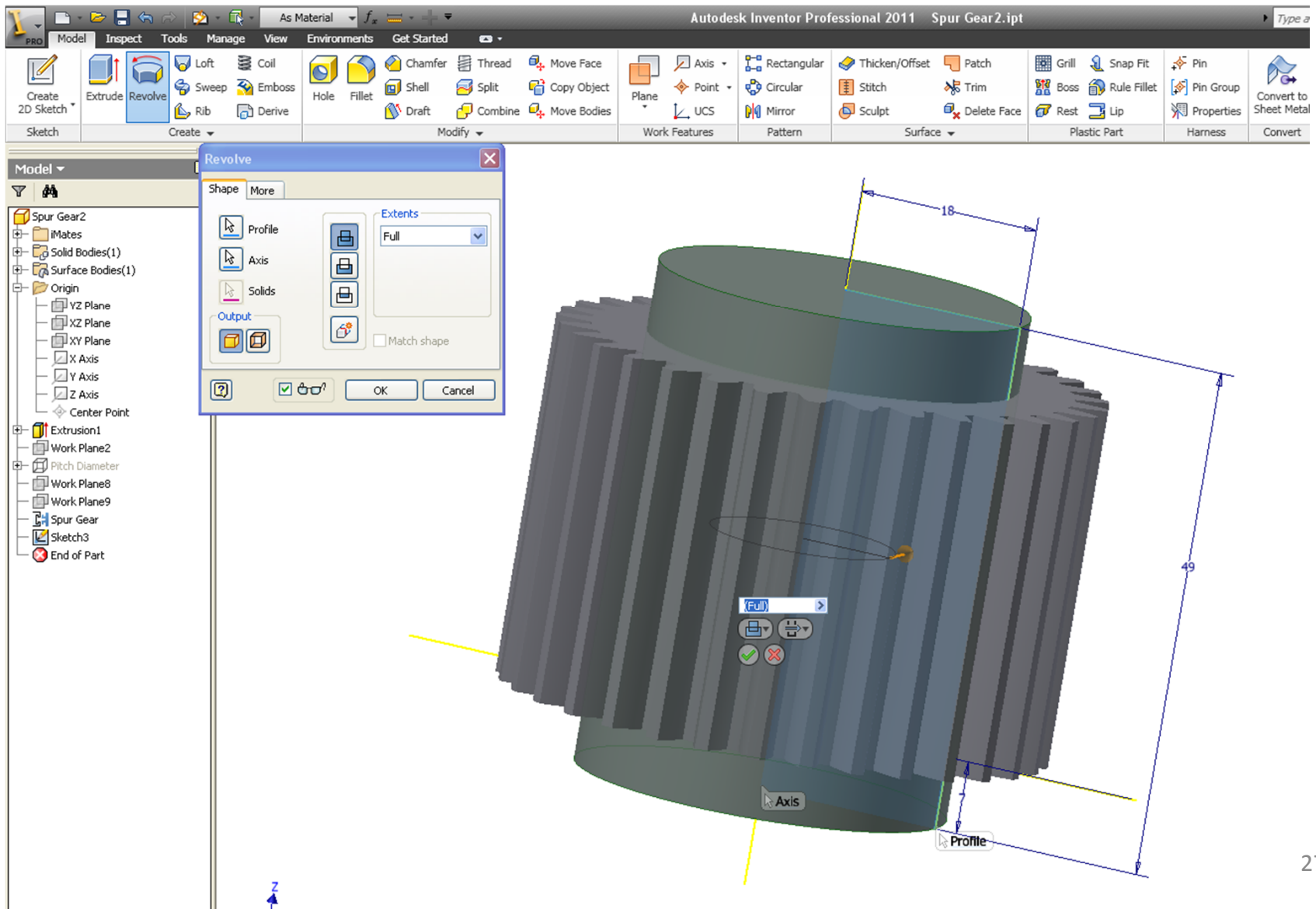
Hole Feature – drilling gear 1



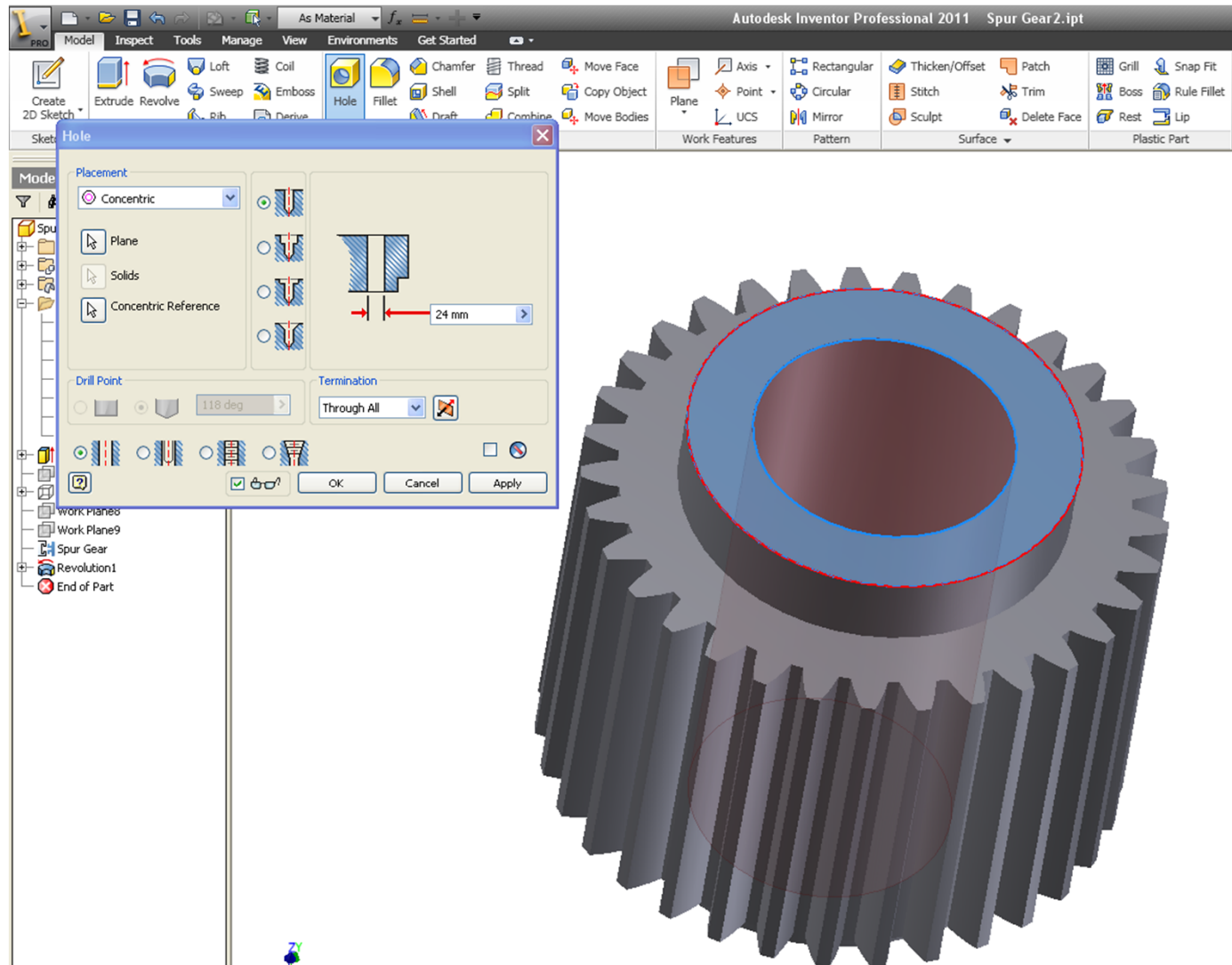
Gear 2 Shoulder profile



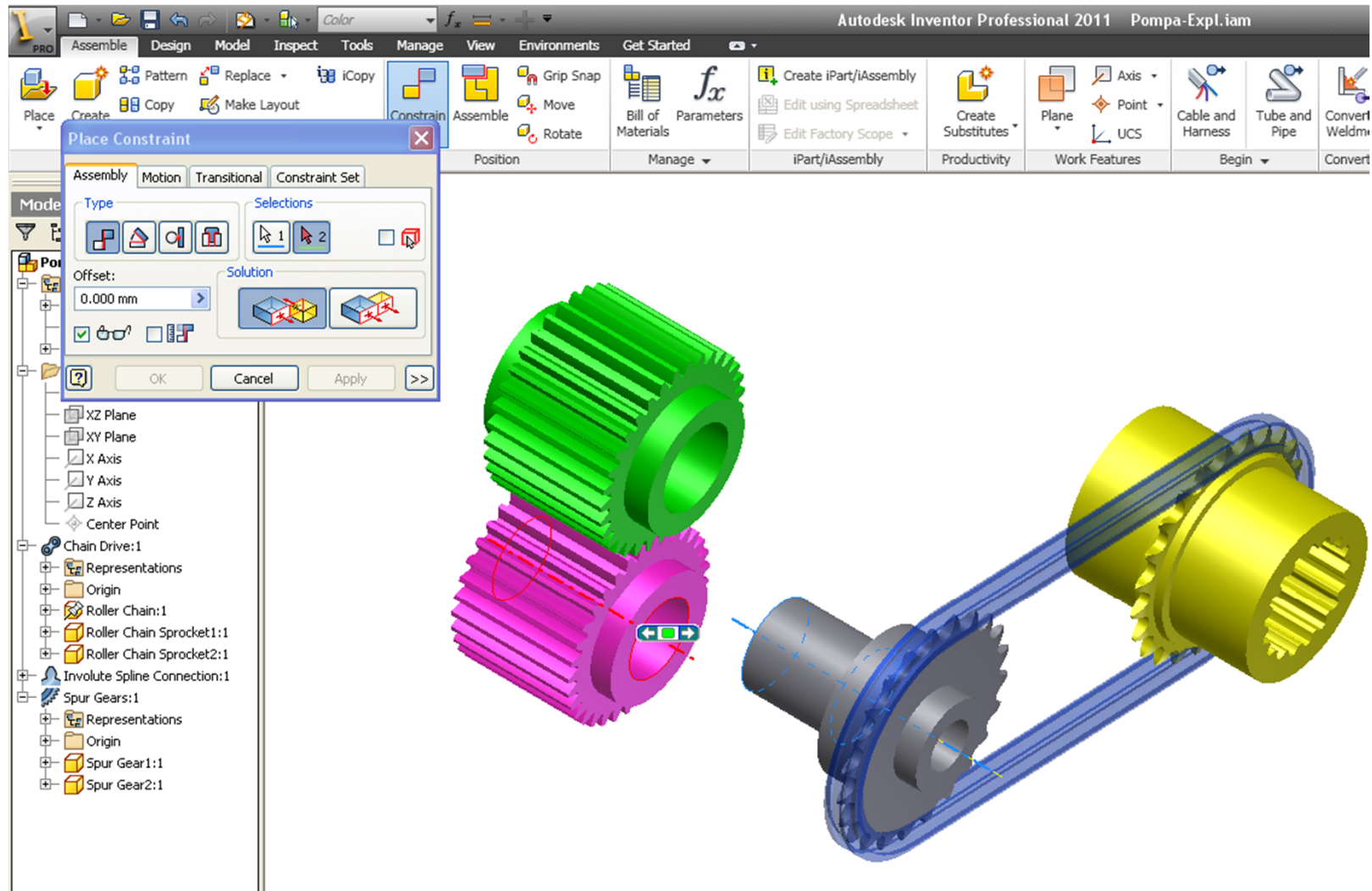
Gear 2 Shoulder



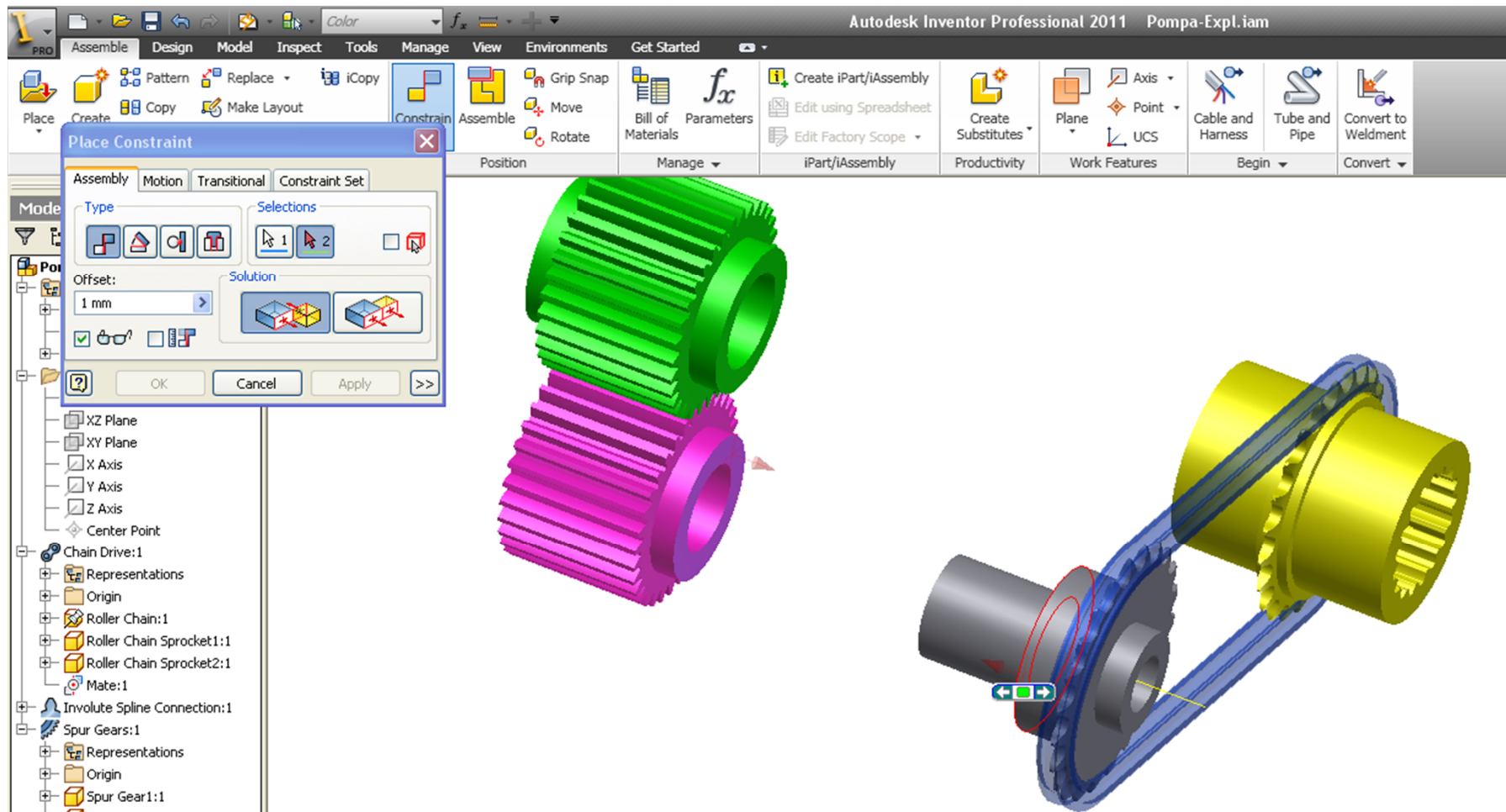
Gear 2 Hole



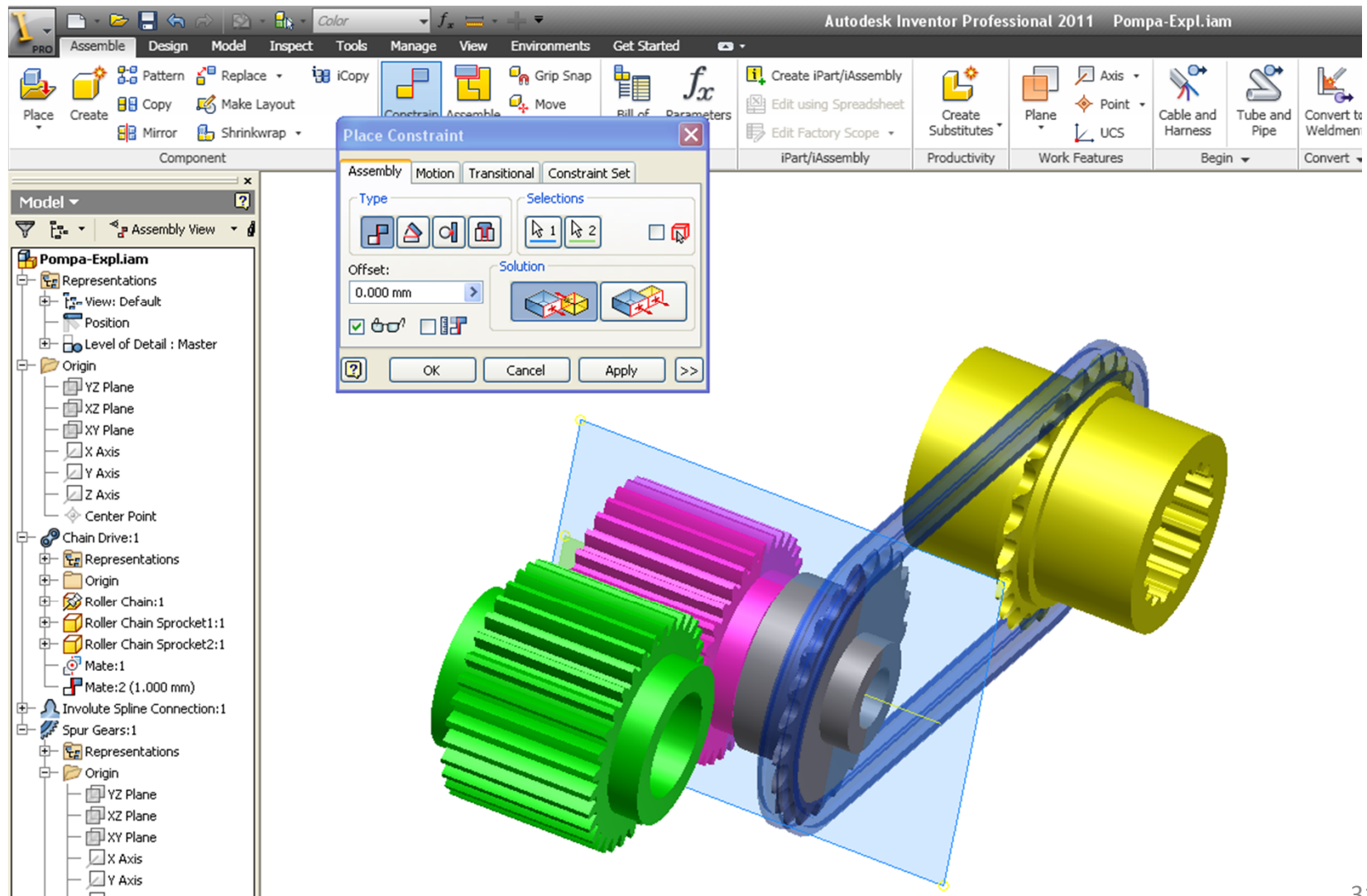
Upgraded Spur Gear



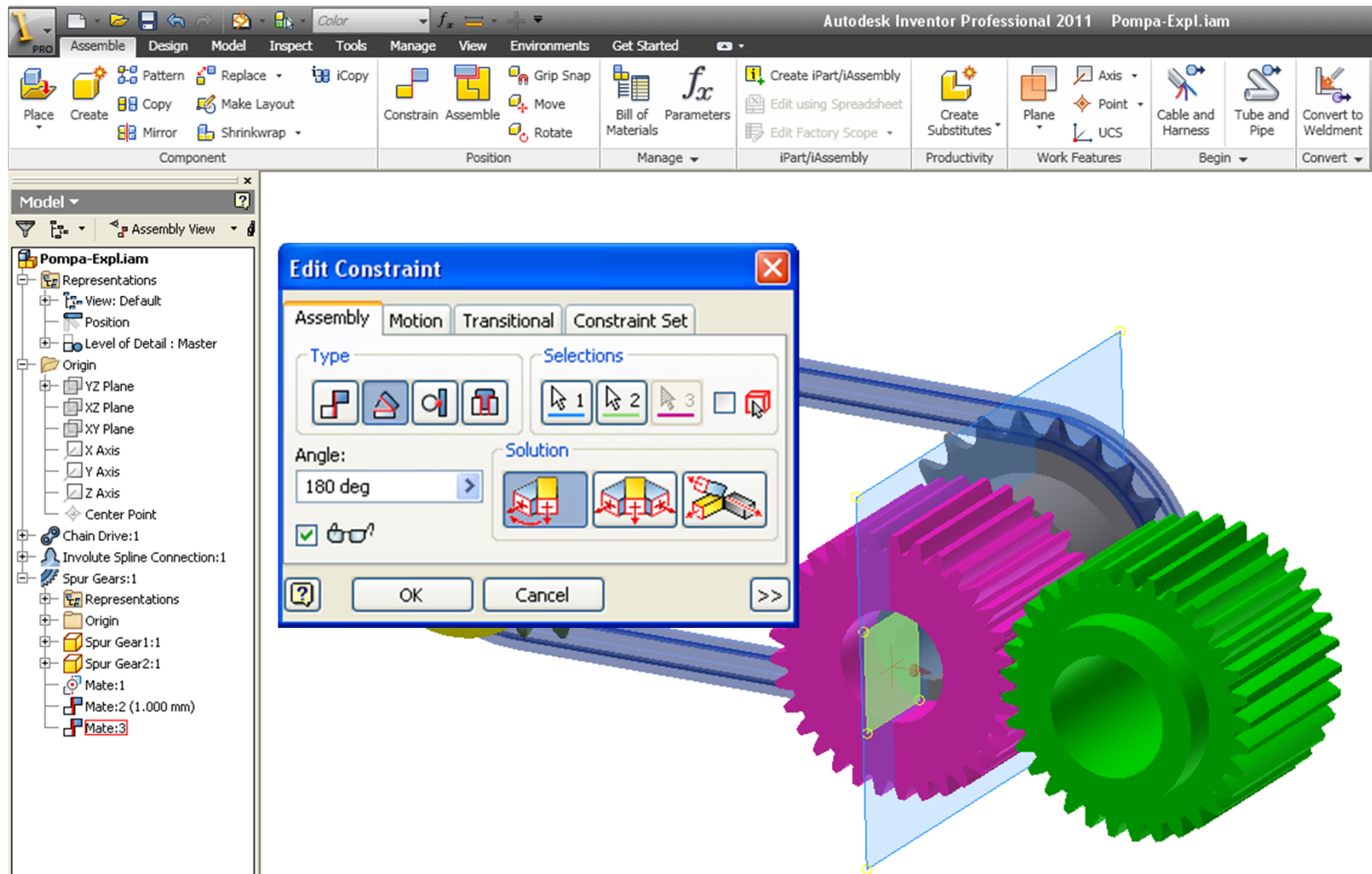
Constrain – mate: face-face



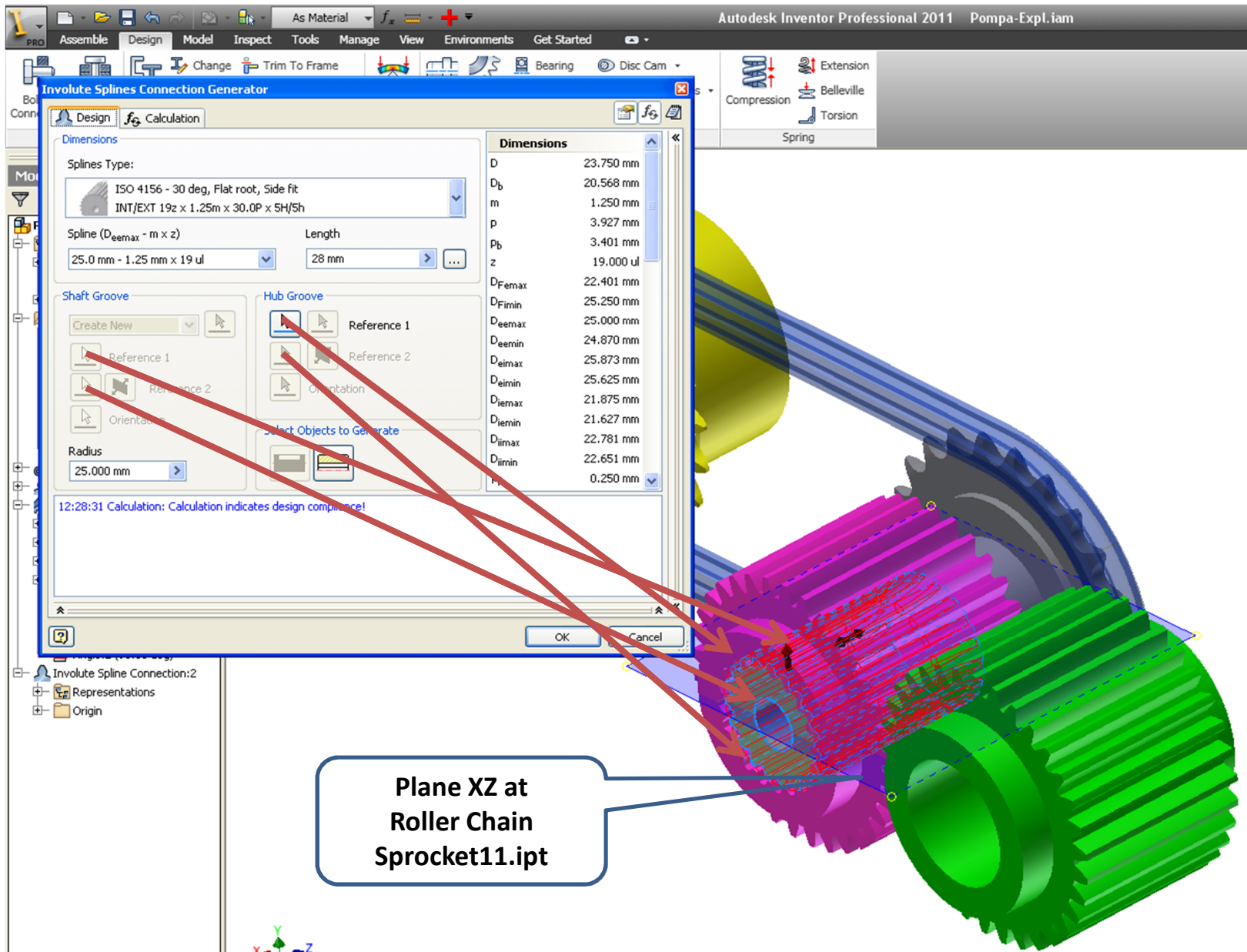
Constrain – mate: axis-axis



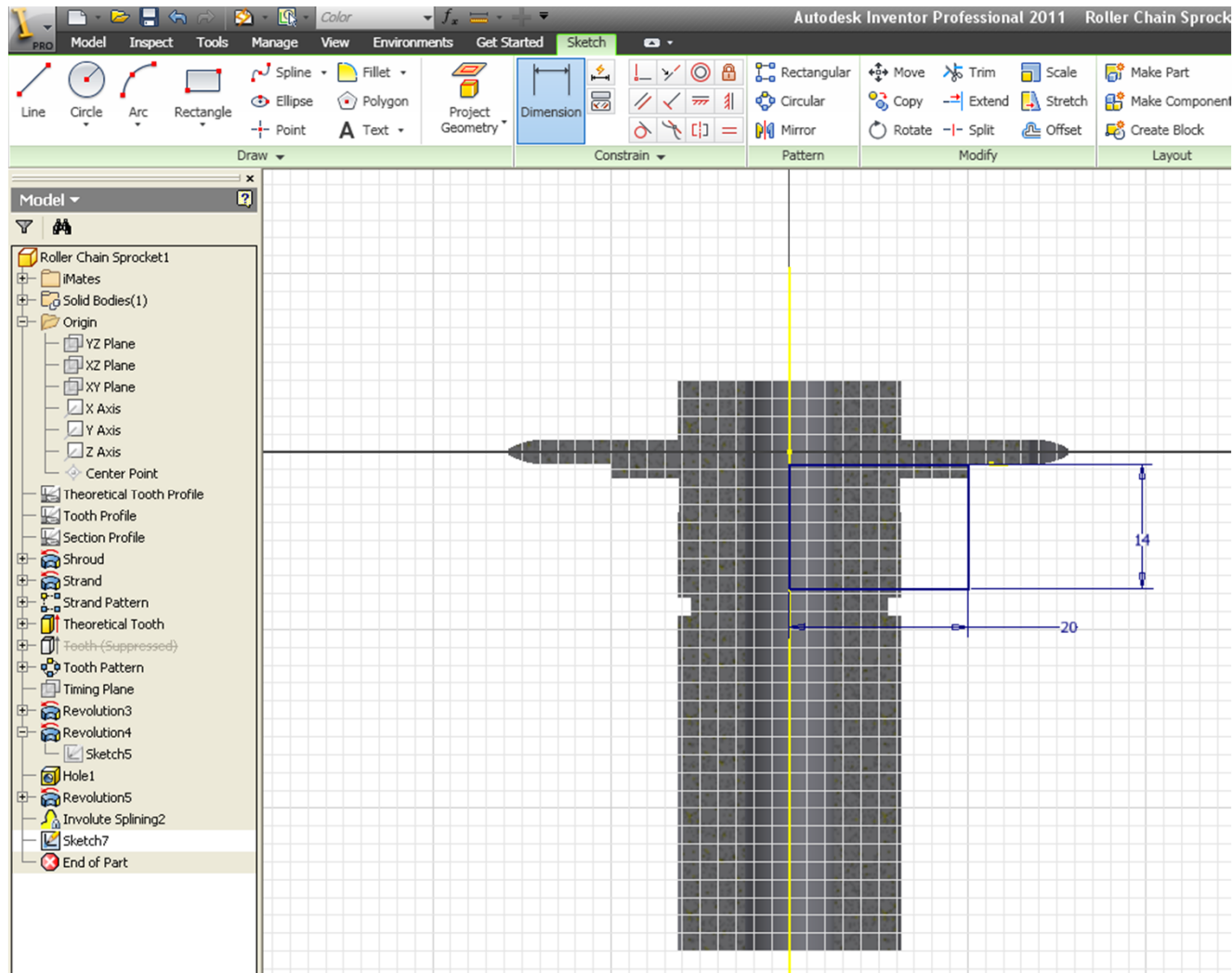
Constrain – Angle : plane-plane



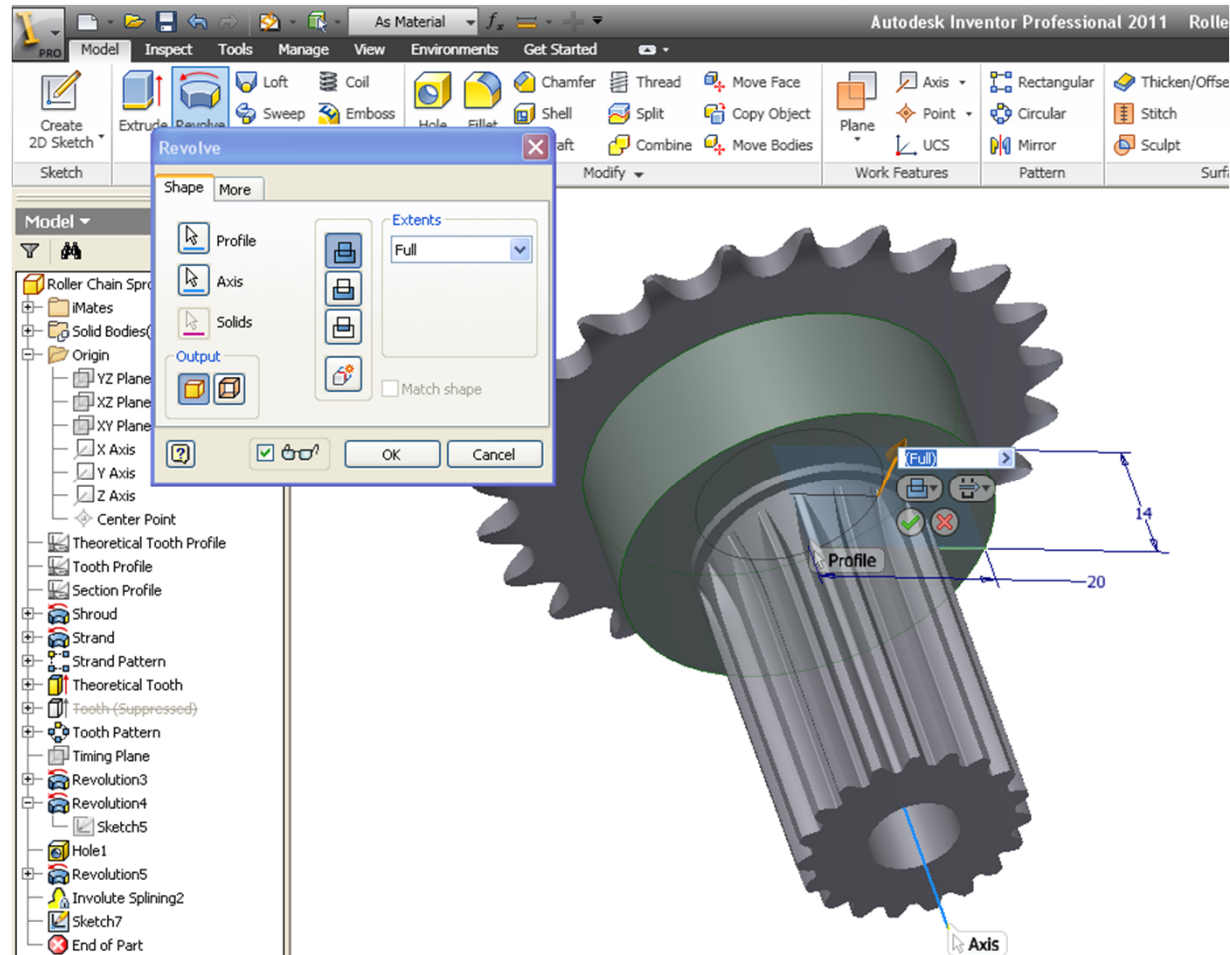
Involute spline generation



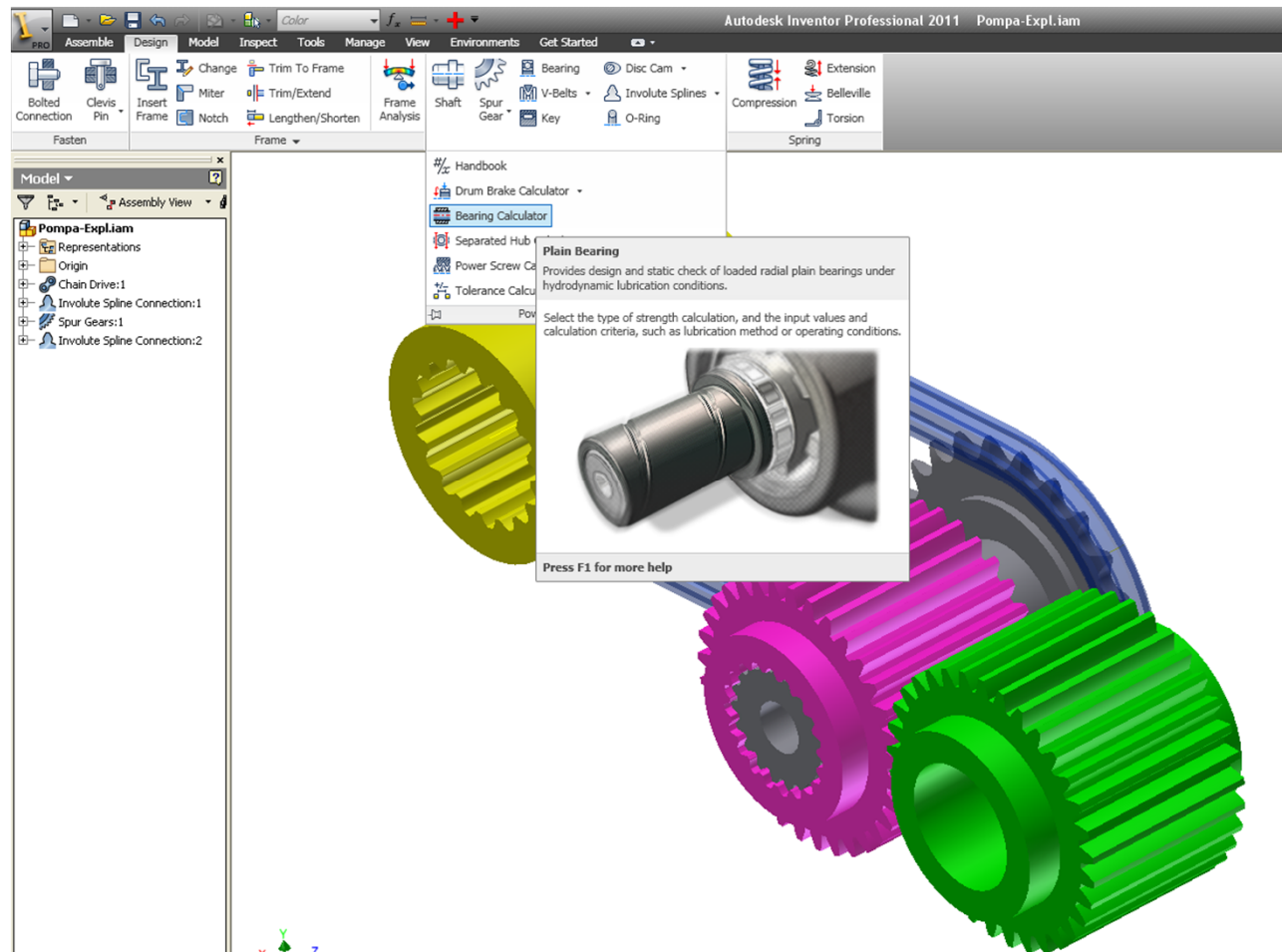
Finishing sprocket



Filling feature



Bearing calculation



Crankpin bearing calculation

1bar = 0.1MPa=0.1N/mm²

Φ90=> S=6361.725124mm²

Cylinder pressure 40 bars=4.05 MPa=>F=25446.90049 N

Plain Bearing Calculator (SI units)

Calculation

Type of Strength Calculation
Check Calculation

Loads

Loading force W 25446.000 N

Journal speed n 7000.000 rpm

Dimensions

Journal diameter d 50.000 mm

Bearing length L 50.000 mm

Journal surface texture R_{aH} 0.400 micron

Bearing surface texture R_{aL} 0.800 micron

☒ Bearing running-in considered

Diametral clearance Δd 0.0640 mm

Journal material

☒ Cast steel

Allowable Bending Stress σ 120.000 MPa

Bearing lubrication method

☒ Lubricant inlet through hole/pocket or axial groove

Hole diameter or groove length b_k 4.000 mm

Oil inlet position γ 0.00 deg

☐ Lubrication inlet through full circumferential/radial groove

Radial groove width s

☒ Wiping/splashing of heated oil

Operating conditions

Ambient temperature of bearing T_U 70.000 c

Lubricant input temperature T₀ 80.000 c

Lubricant input pressure p₀ 4 MPa

Lubricant ☒ Bearing Oil SAE 40

Lubricant temperature at bearing exit T_V 110.000 c

Lubricant dynamic viscosity η 0.0095 Pa s

Lubricant density at 20 Celsius Degree ρ₂₀ 905.000 kg/m³

Mesh size of oil filter o 3.000 micron

Results

v_H 18.326 mps

b_b 1.000 ul

ψ 0.001443 ul

Bearing capacity

P_m 10.178 MPa

P_{max} 28.708 MPa

S_o 2.191 ul

f 0.00296 ul

ε 0.715 ul

n_{min} 1963.917 rpm

F_{max} 90697.298 N

n_T 178079.395 rpm

n_V 14007.940 rpm

h₀ 10.287 micron

Bearing thermal balance

v_p 14.8823 cm³/s

v_u 3.7238 cm³/s

P 1378.333 W

v_z 14.4086 cm³/s

v 33.0147 cm³/s

P_U 0.000 W

ΔT 18.022 c

12:45:24 Calculation: Calculation indicates design compliance!

Calculate OK Cancel

Gear Width determination

B2

154

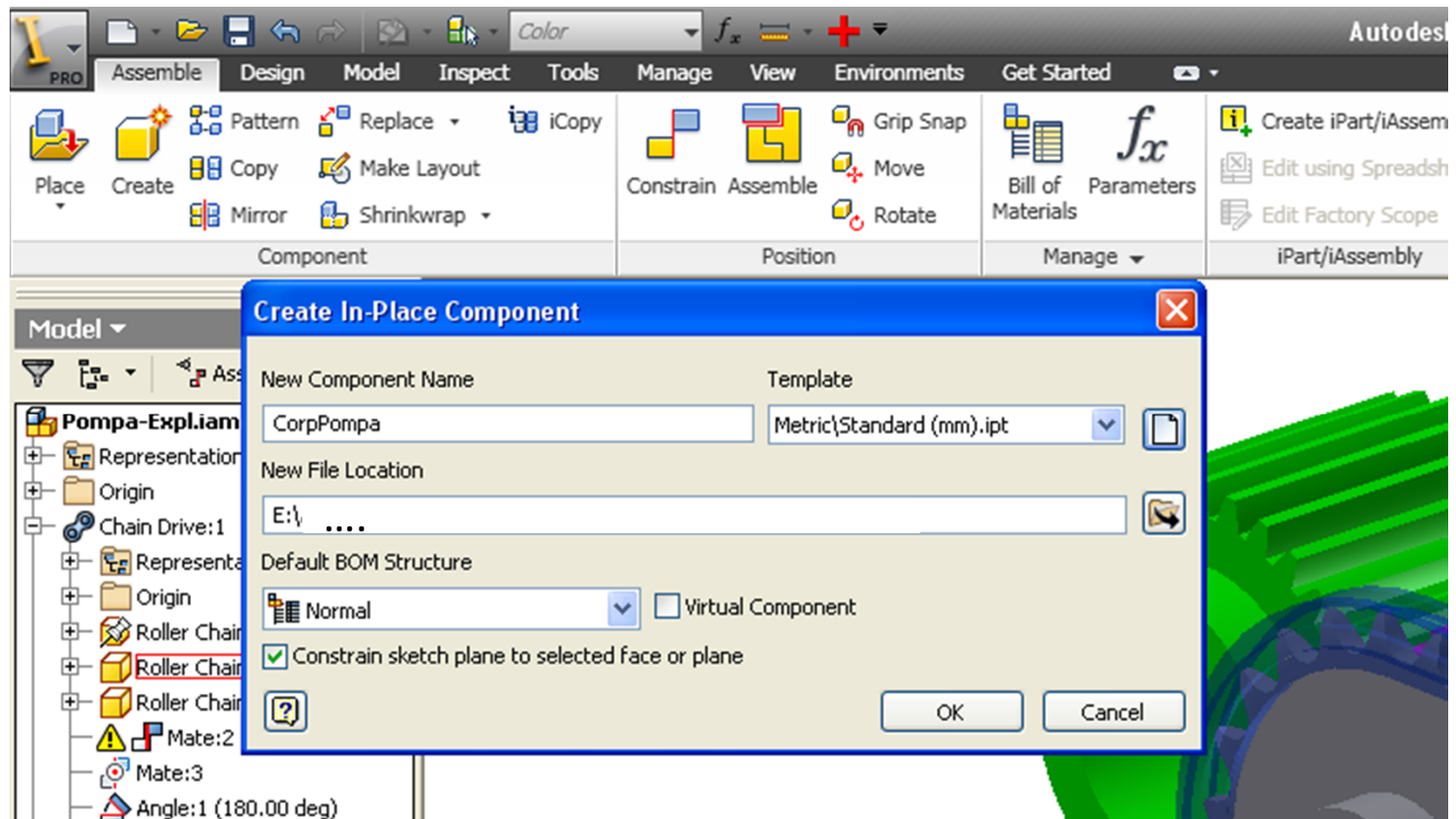
rb	alfa_a	alfa_1	z	eps	b	n
23.2575	21.519	20	33	1.5824	40	4000
	0.375577	0.349066				
3398.64597		2*PI()*B3^2				
0.15546744		TAN(C4)^2				
0.13247433		TAN(D4)^2				
0.009063		PI()^2/E3^2				
0.67252309		F3^2-2*F3+4/3				
2297.21699		B5*(B6-B7-B8*B9)*G3				
0.00918887		B11*H3/10^9				
153.147799						

What
if

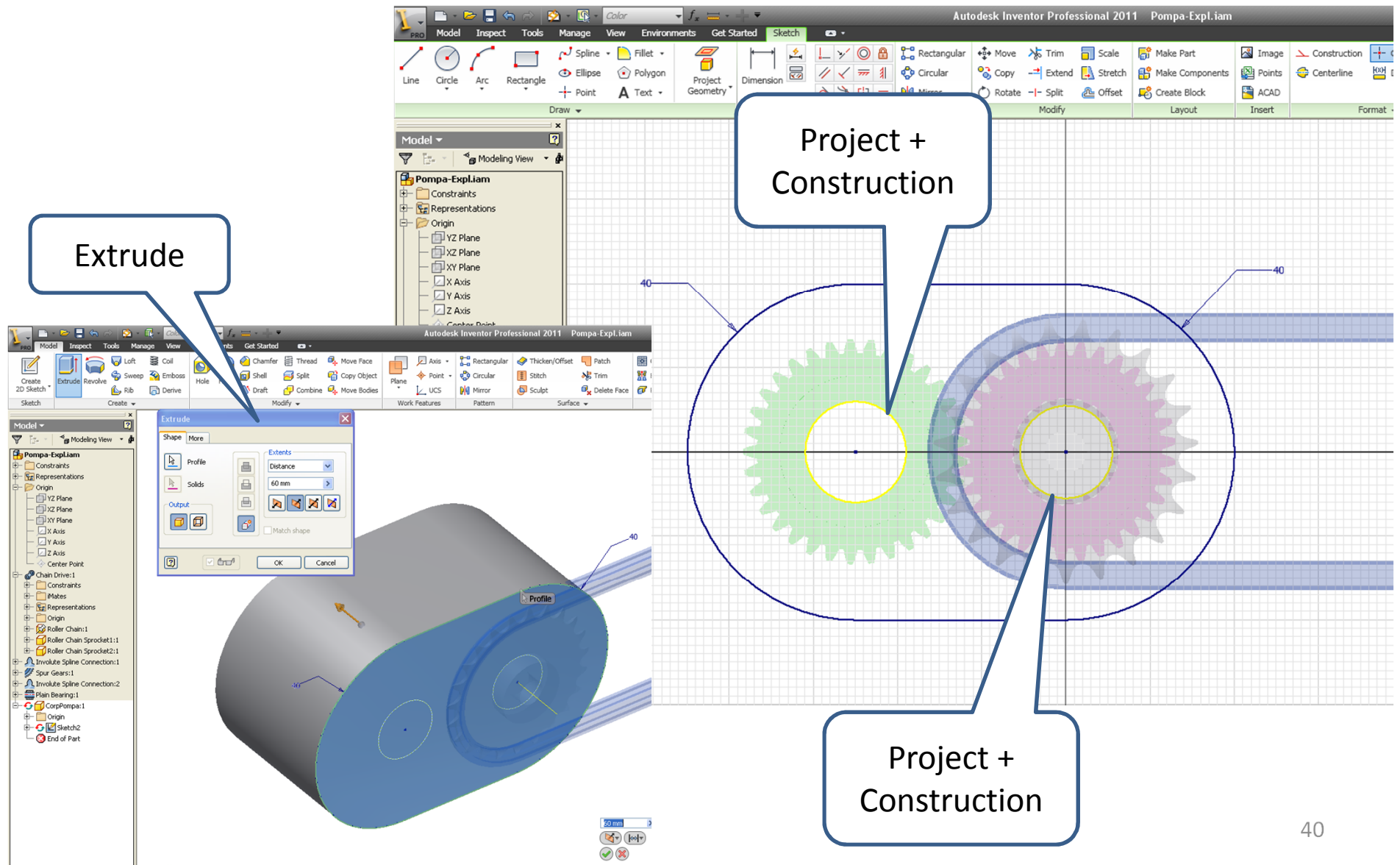
$$q = 2 \cdot \pi \cdot r_b^2 \left[\tan^2 \alpha_a - \tan^2 \alpha_1 - \frac{\pi^2}{z^2} \cdot \left(\varepsilon^2 - 2 \cdot \varepsilon + \frac{4}{3} \right) \right] \cdot b$$

$$Q = q \cdot n \text{ [cm}^3 \text{ / s]}$$

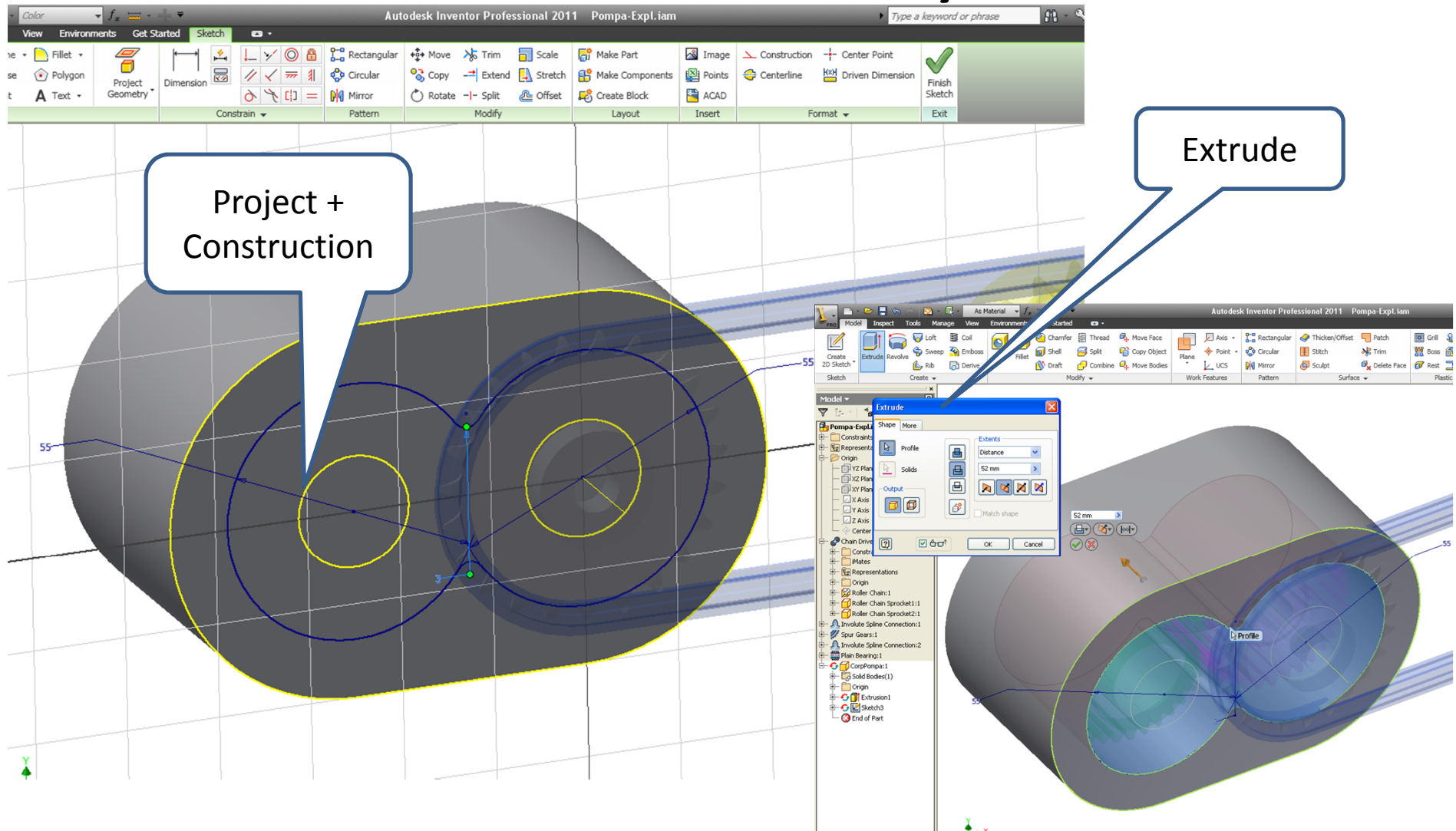
Body pump



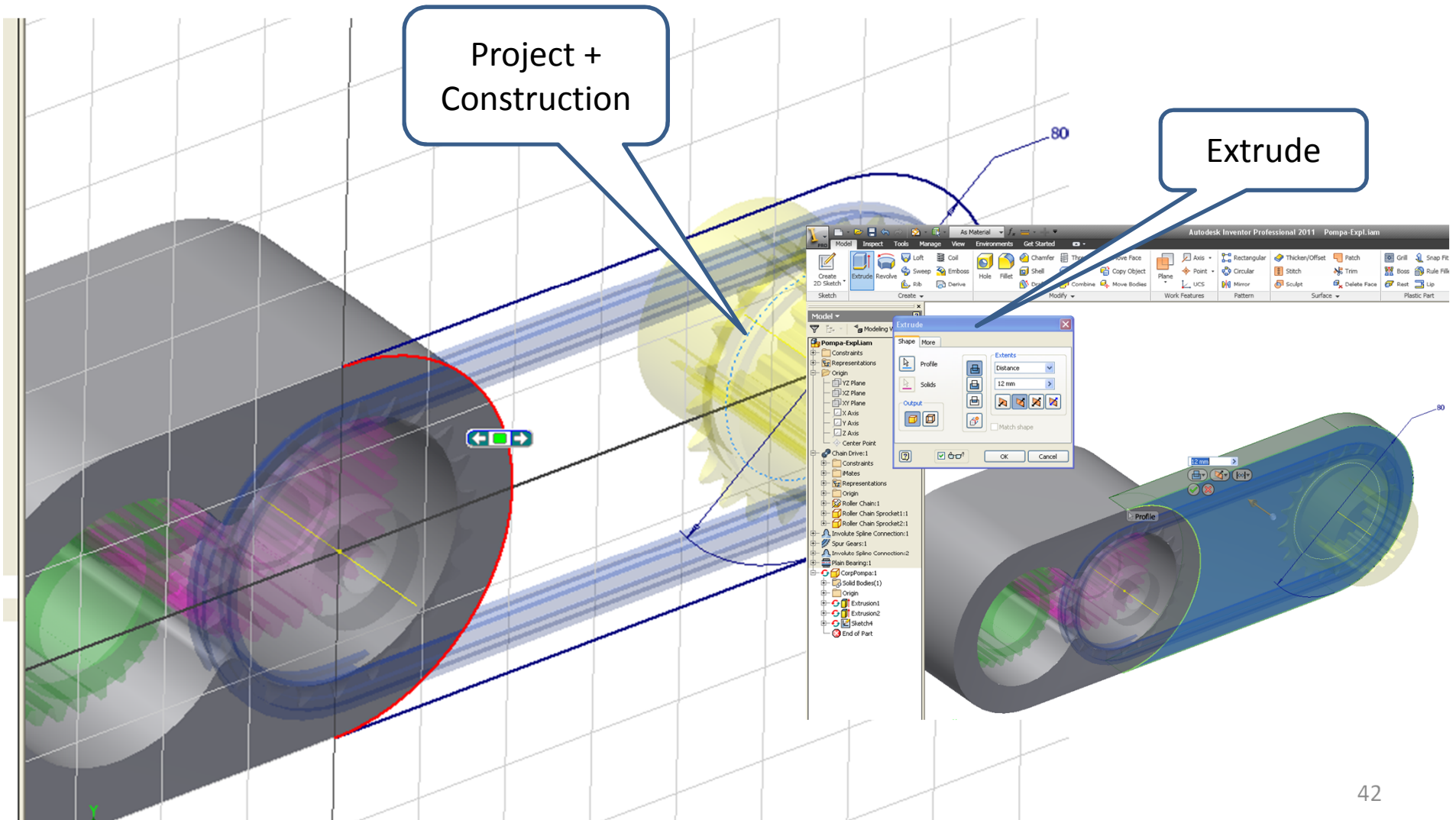
Profile 1



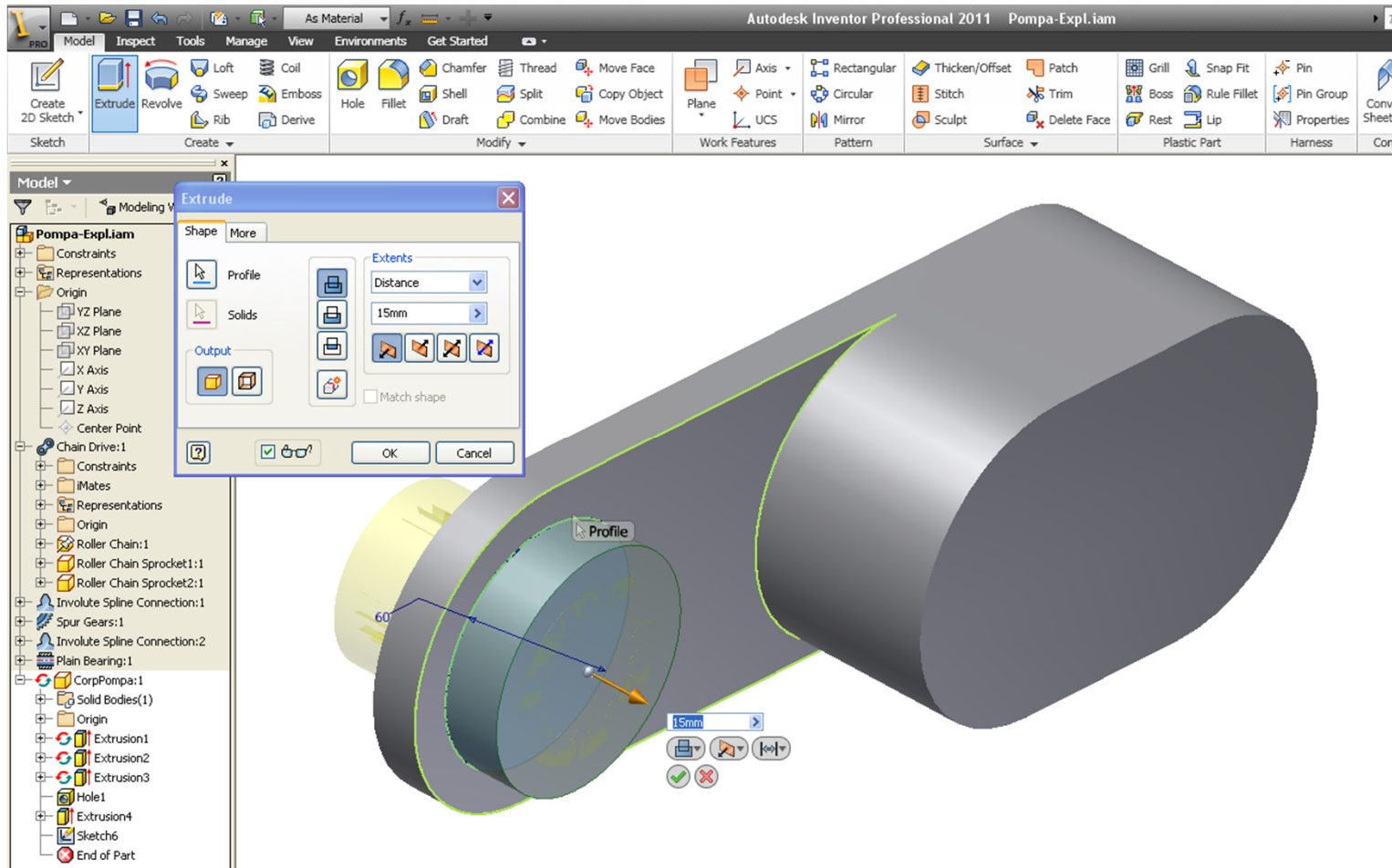
Inside cavity



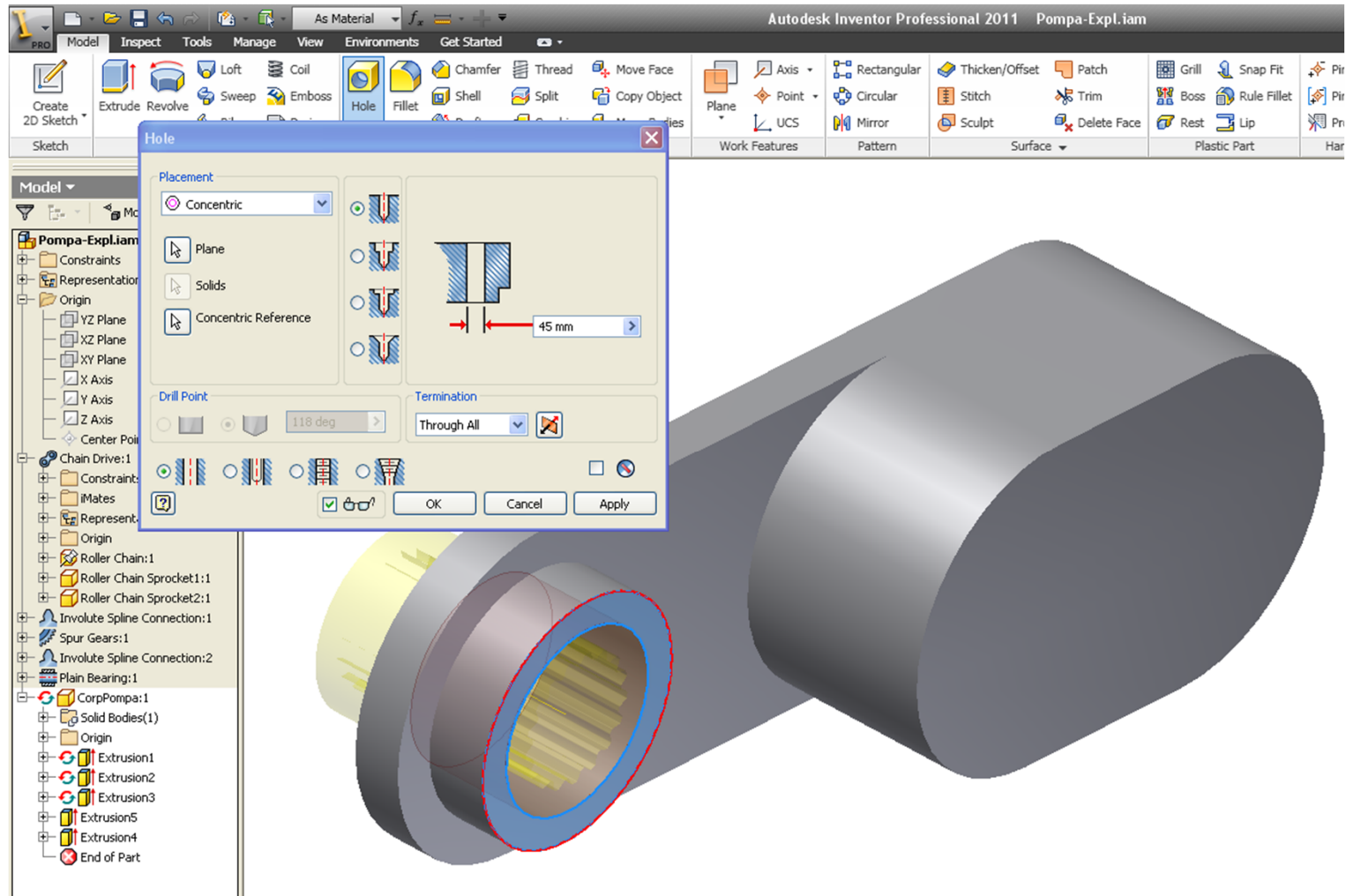
Chain Tail



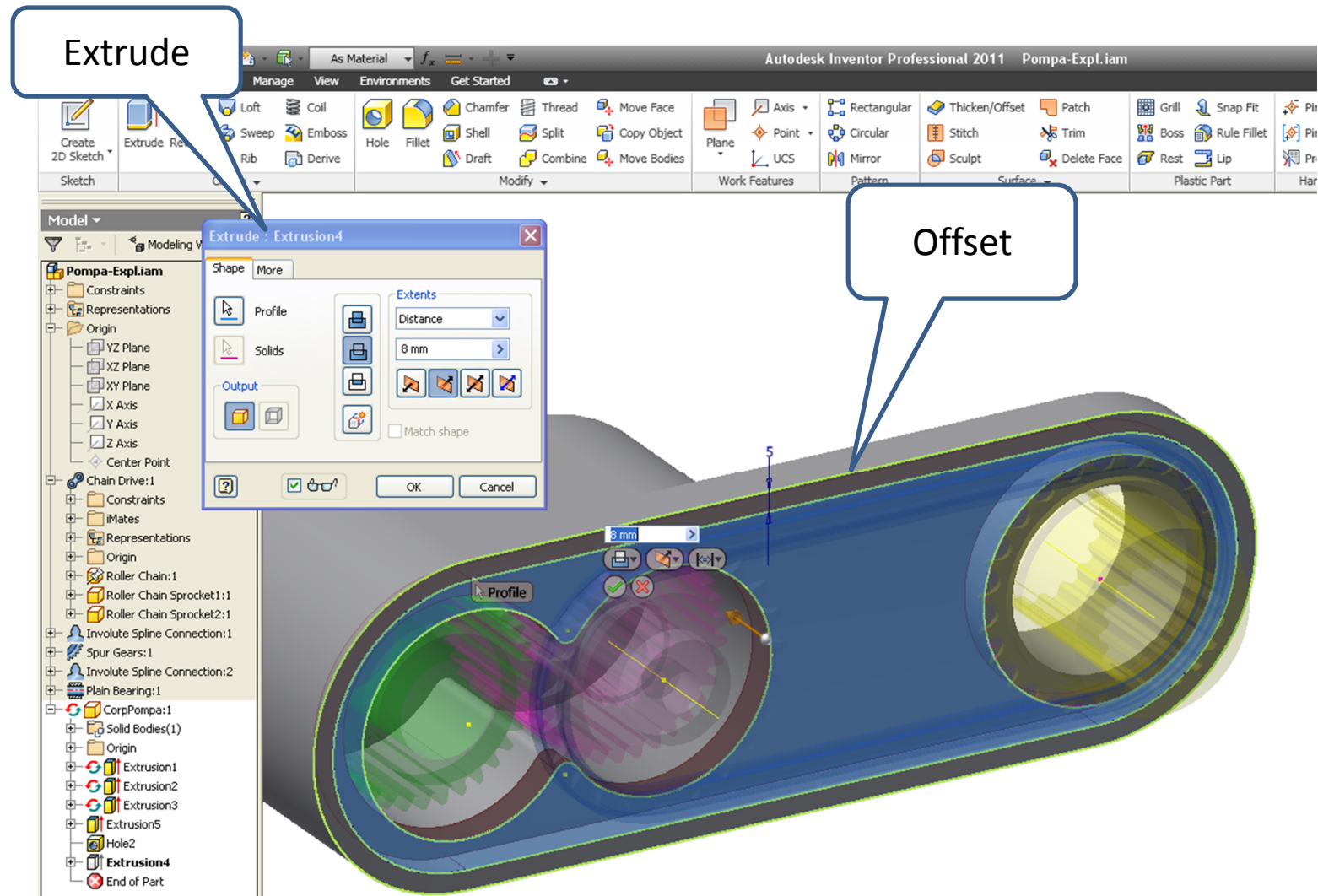
Crankshaft boss



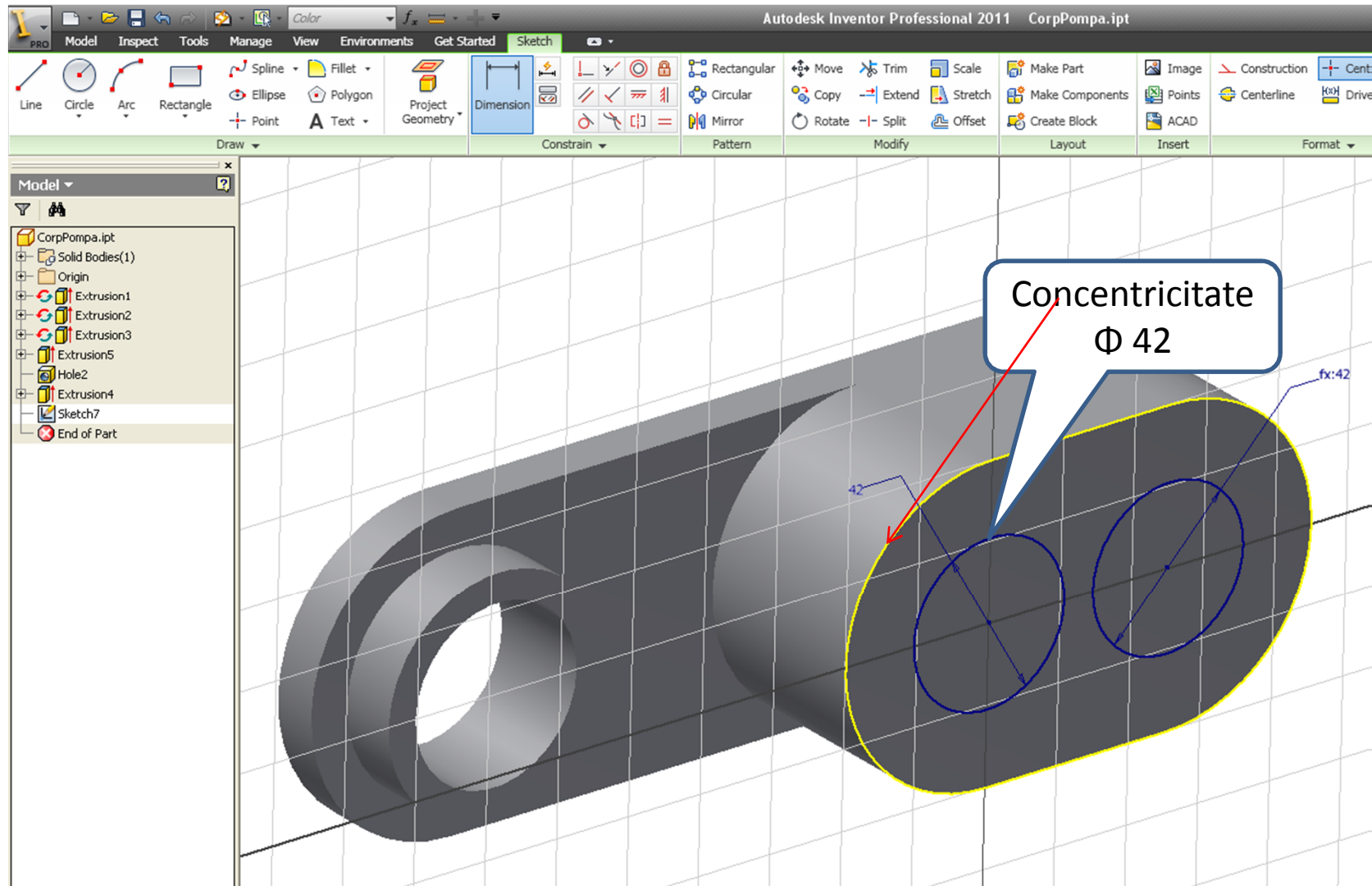
Crankshaft hole



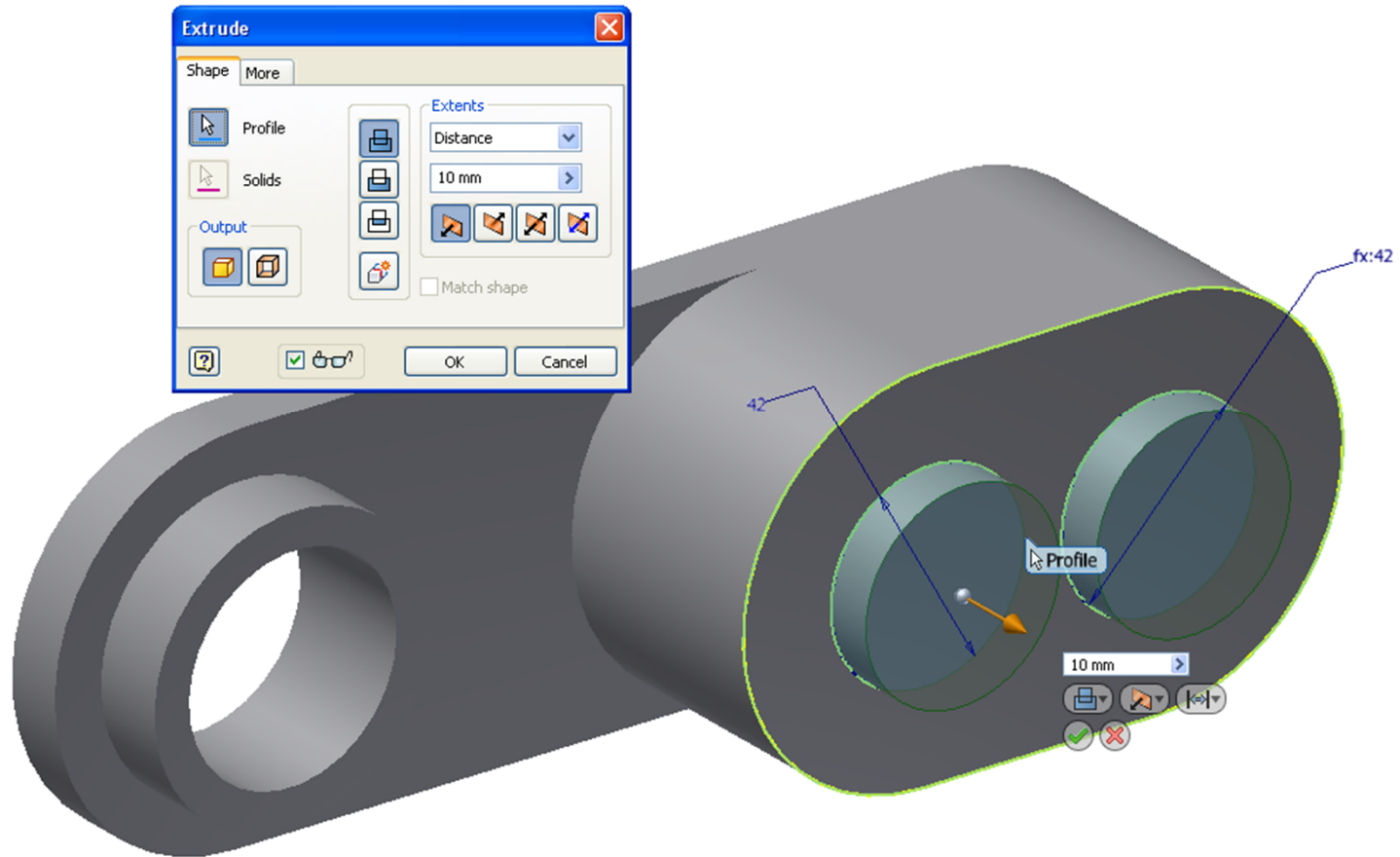
Chain clearance



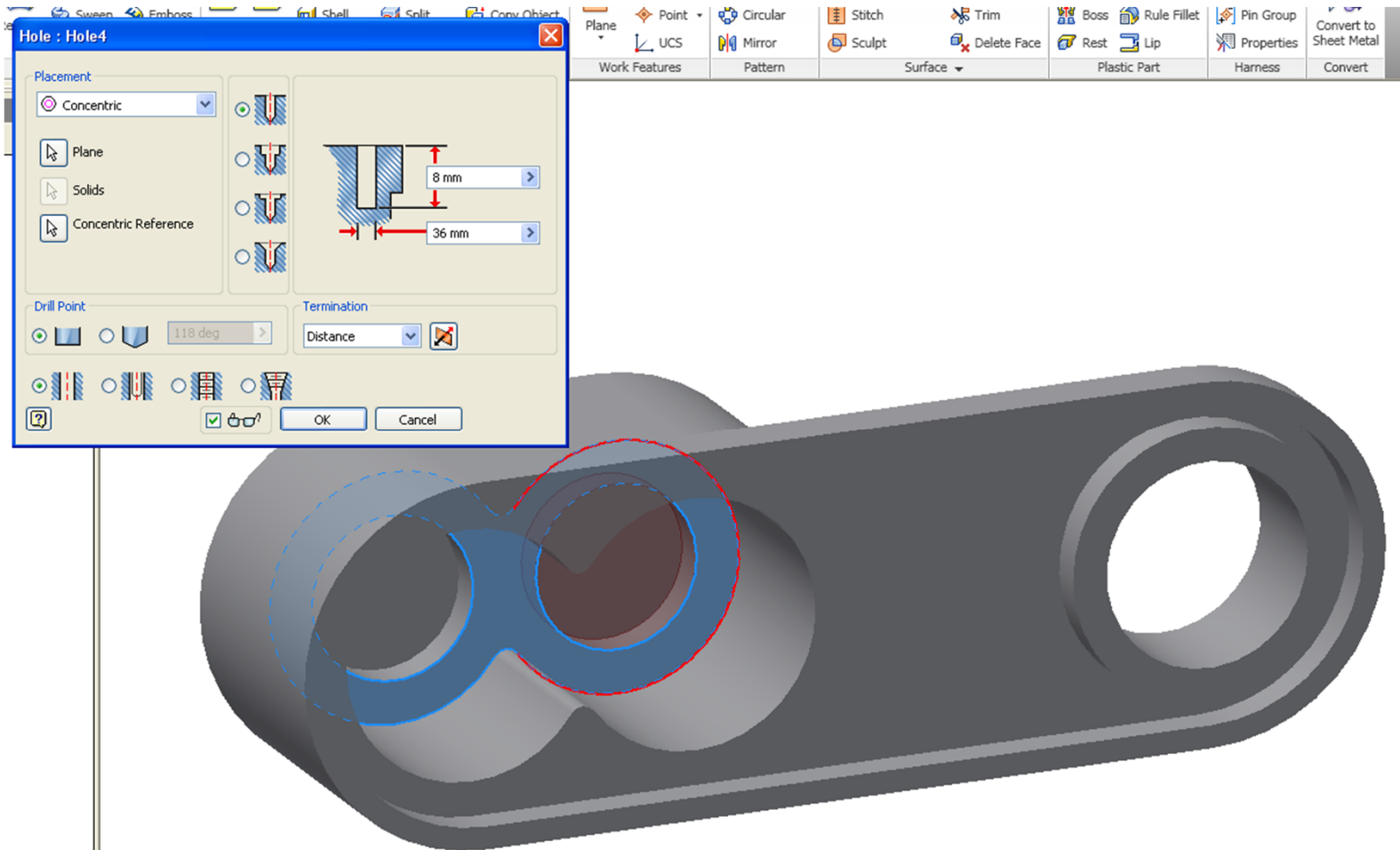
Gear boss profile



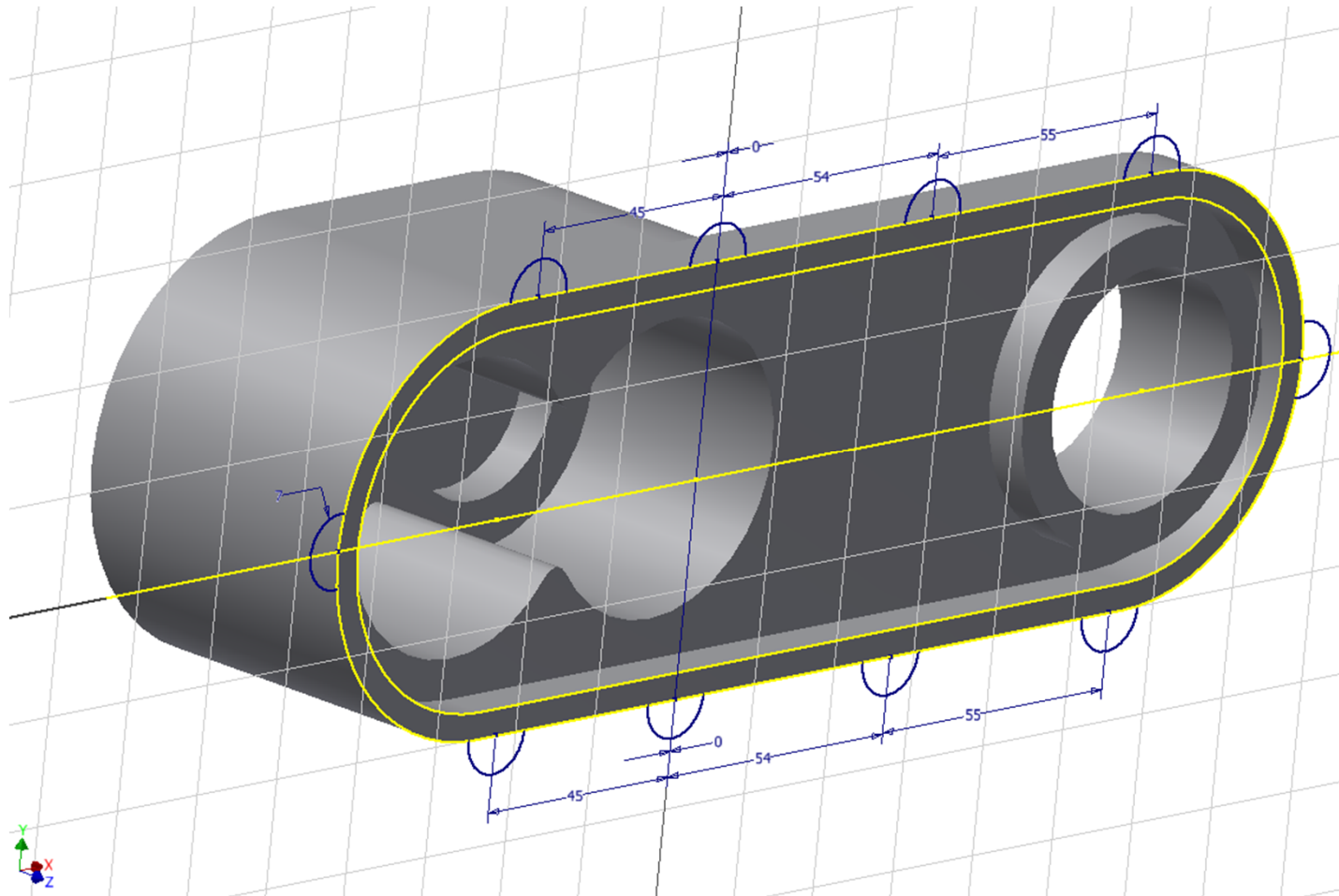
Gear boss



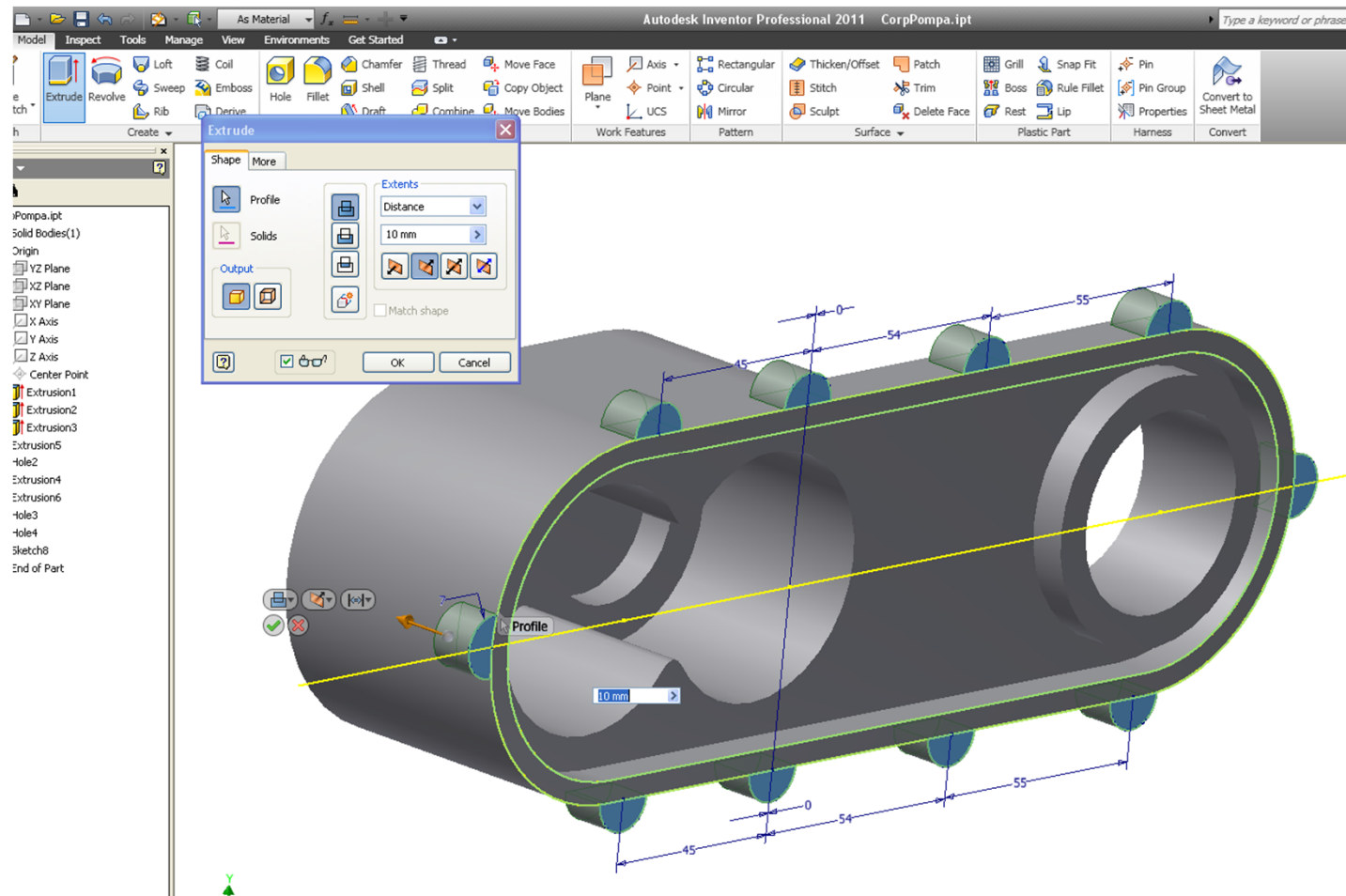
Gear bearings



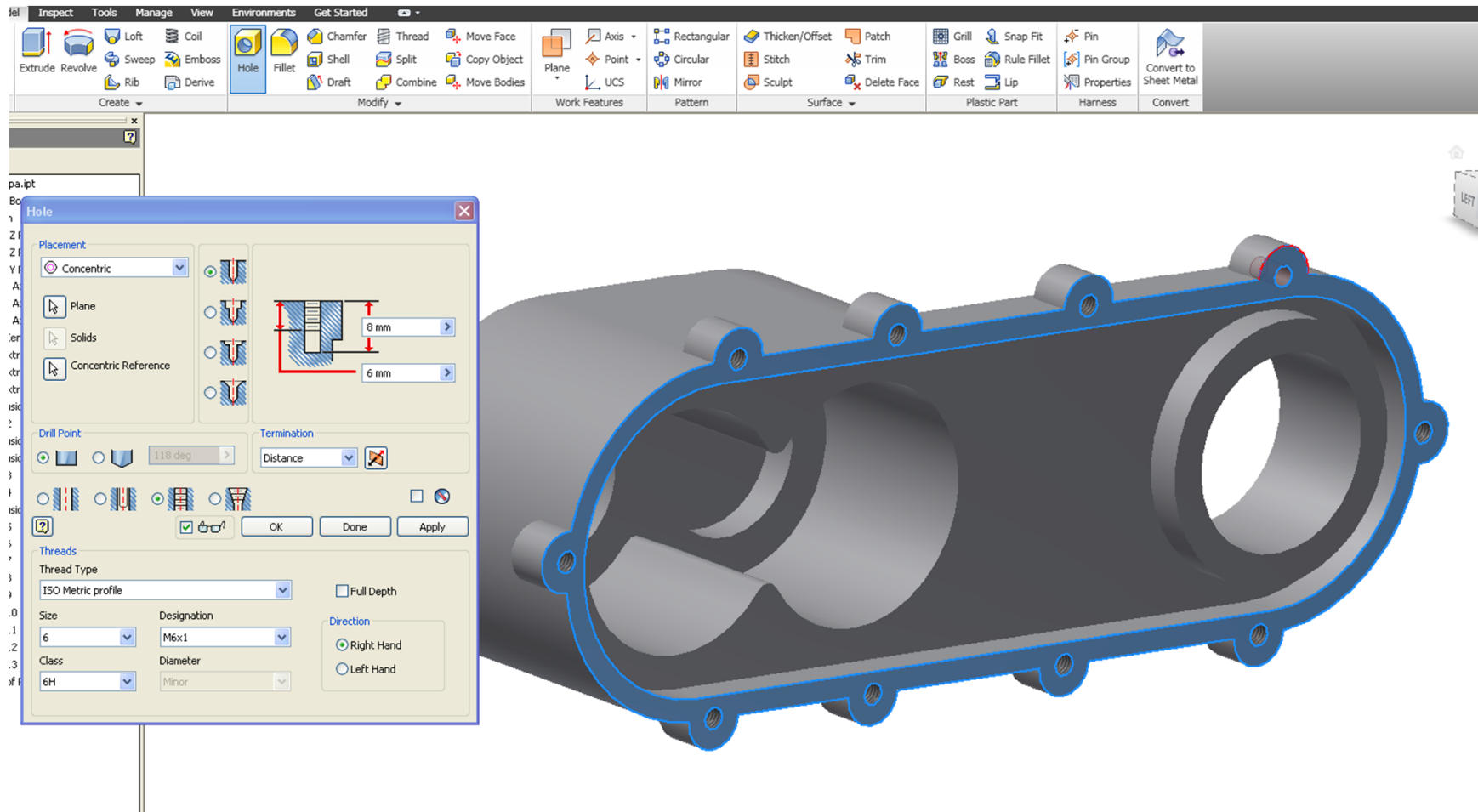
Cover base sketch



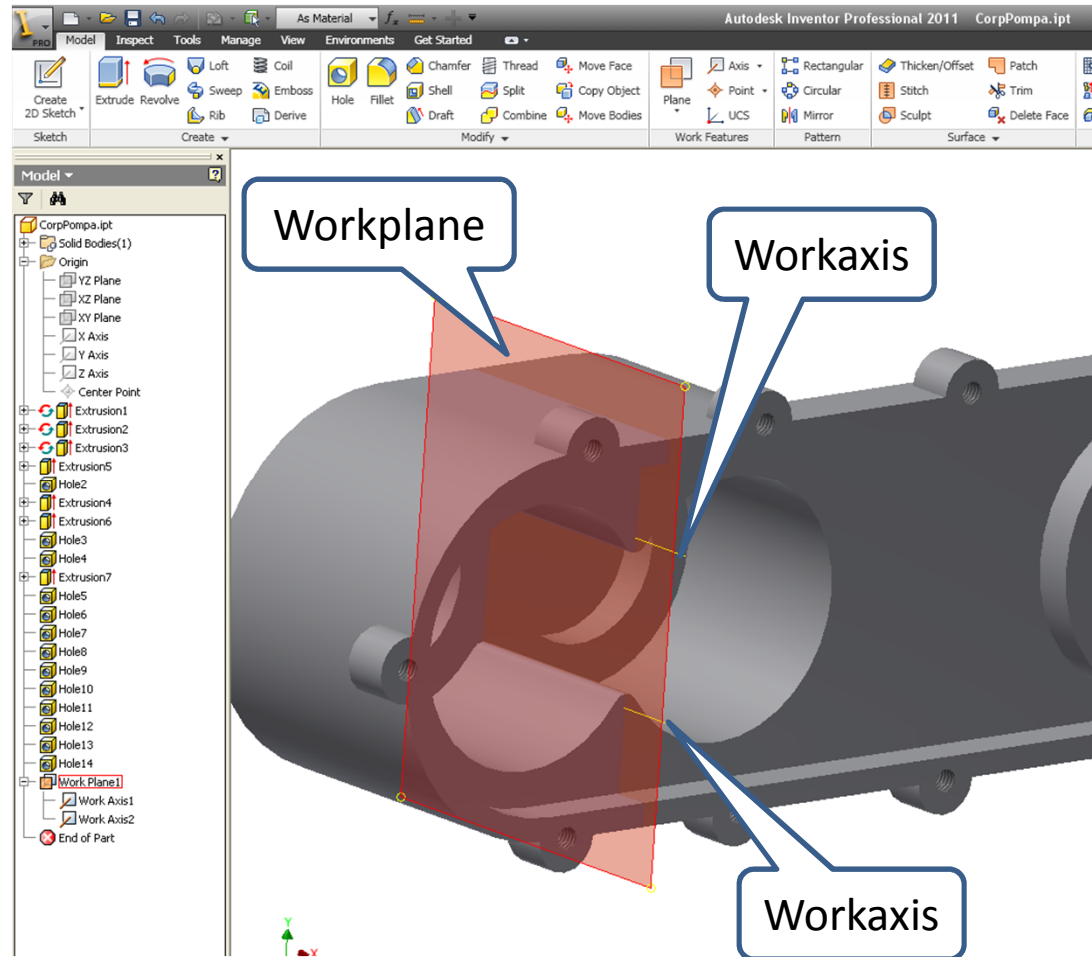
Cover bosses



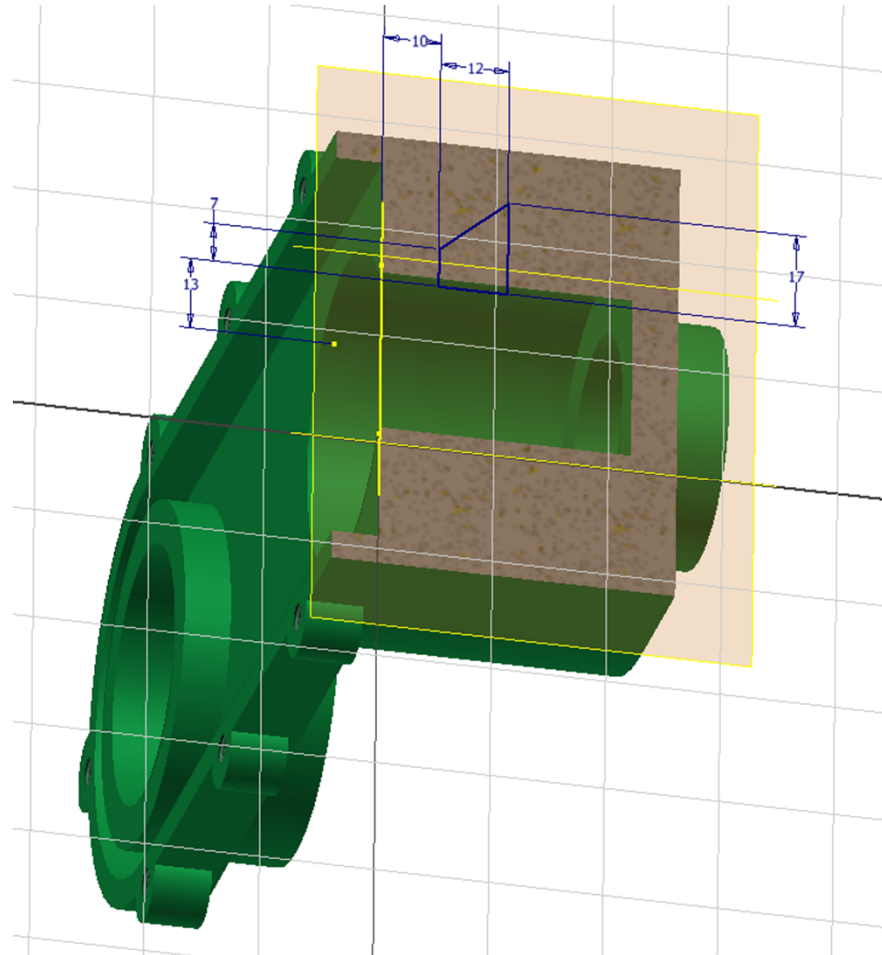
Cover assembly holes



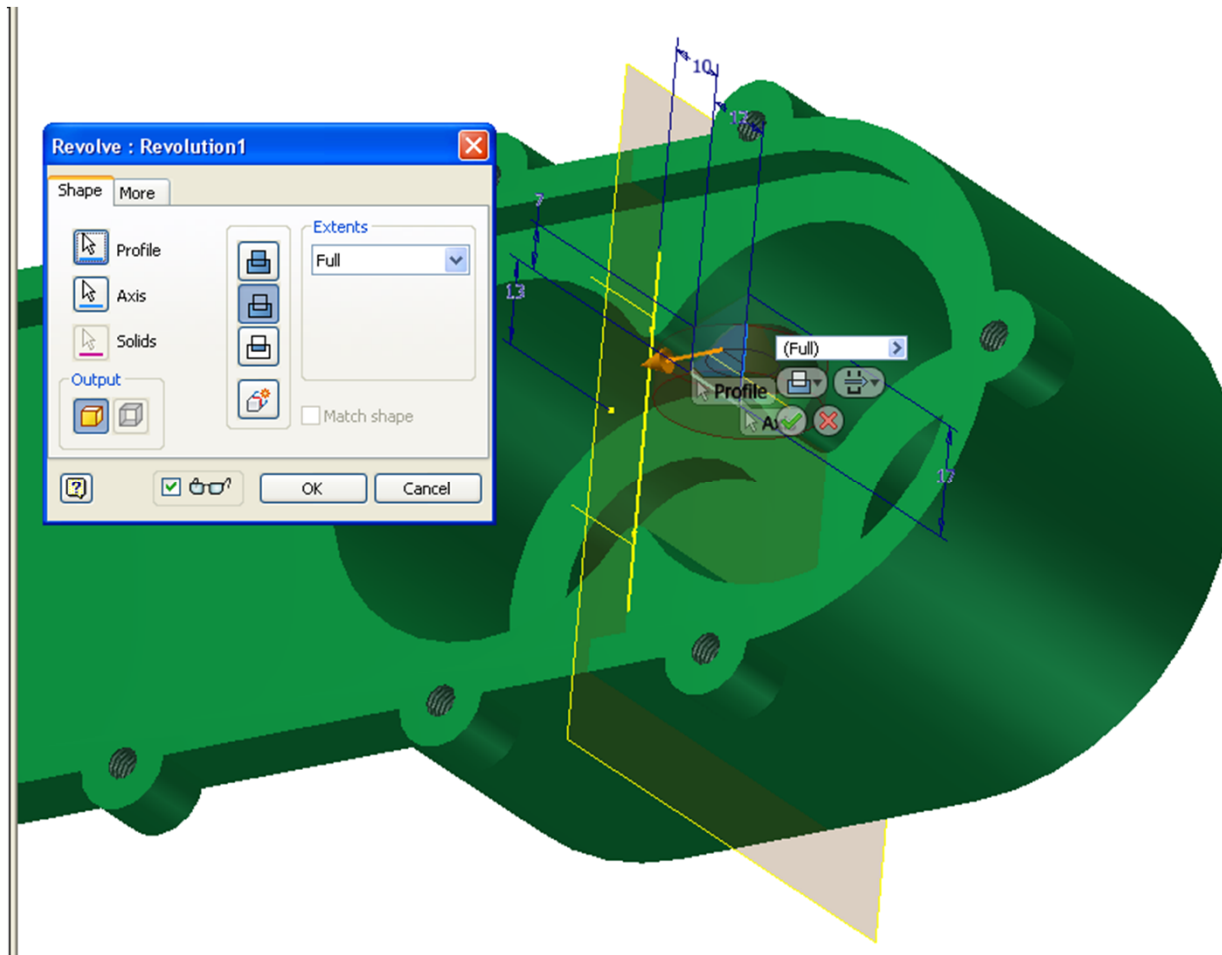
Reference elements



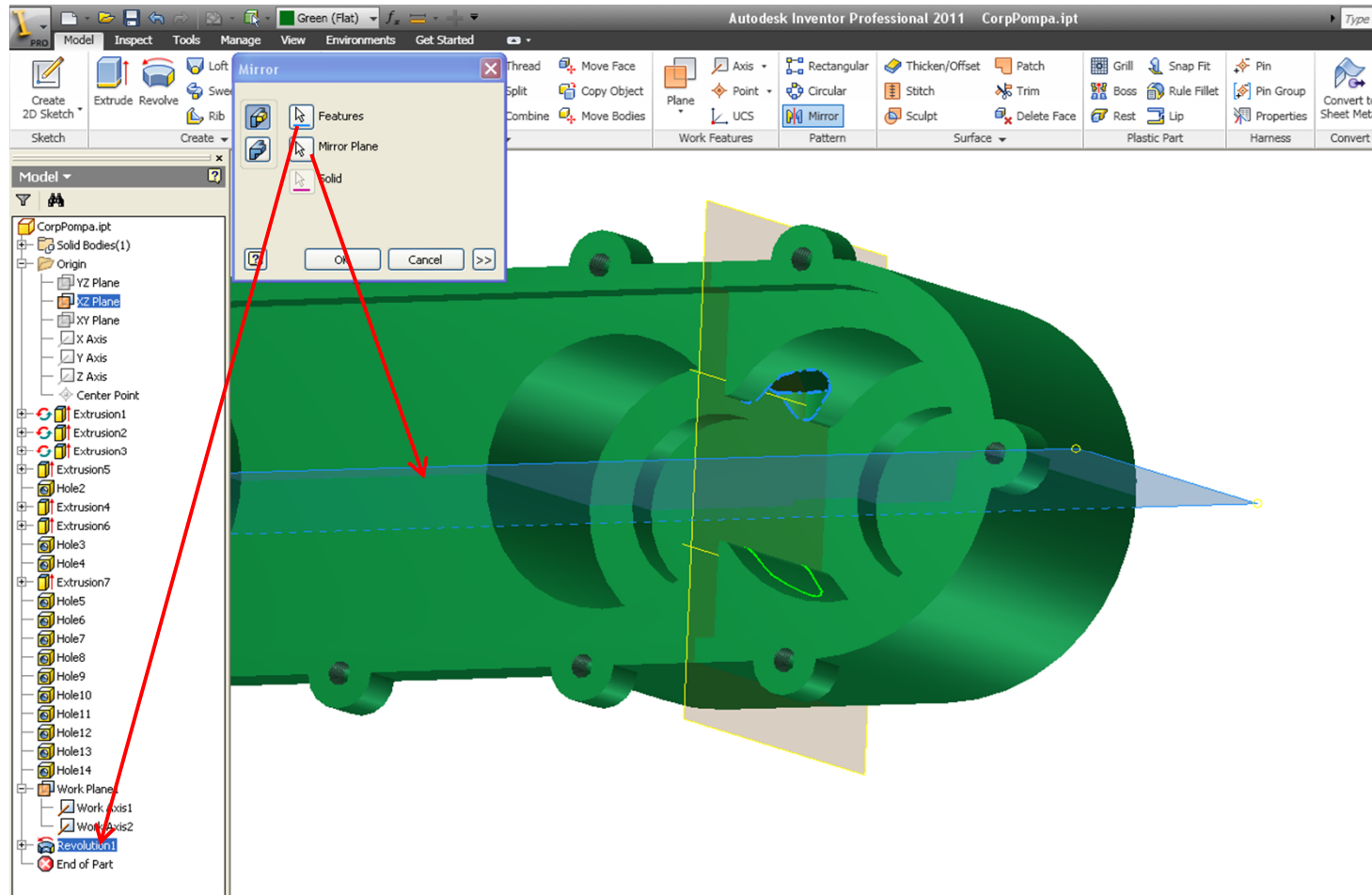
Exhaust route



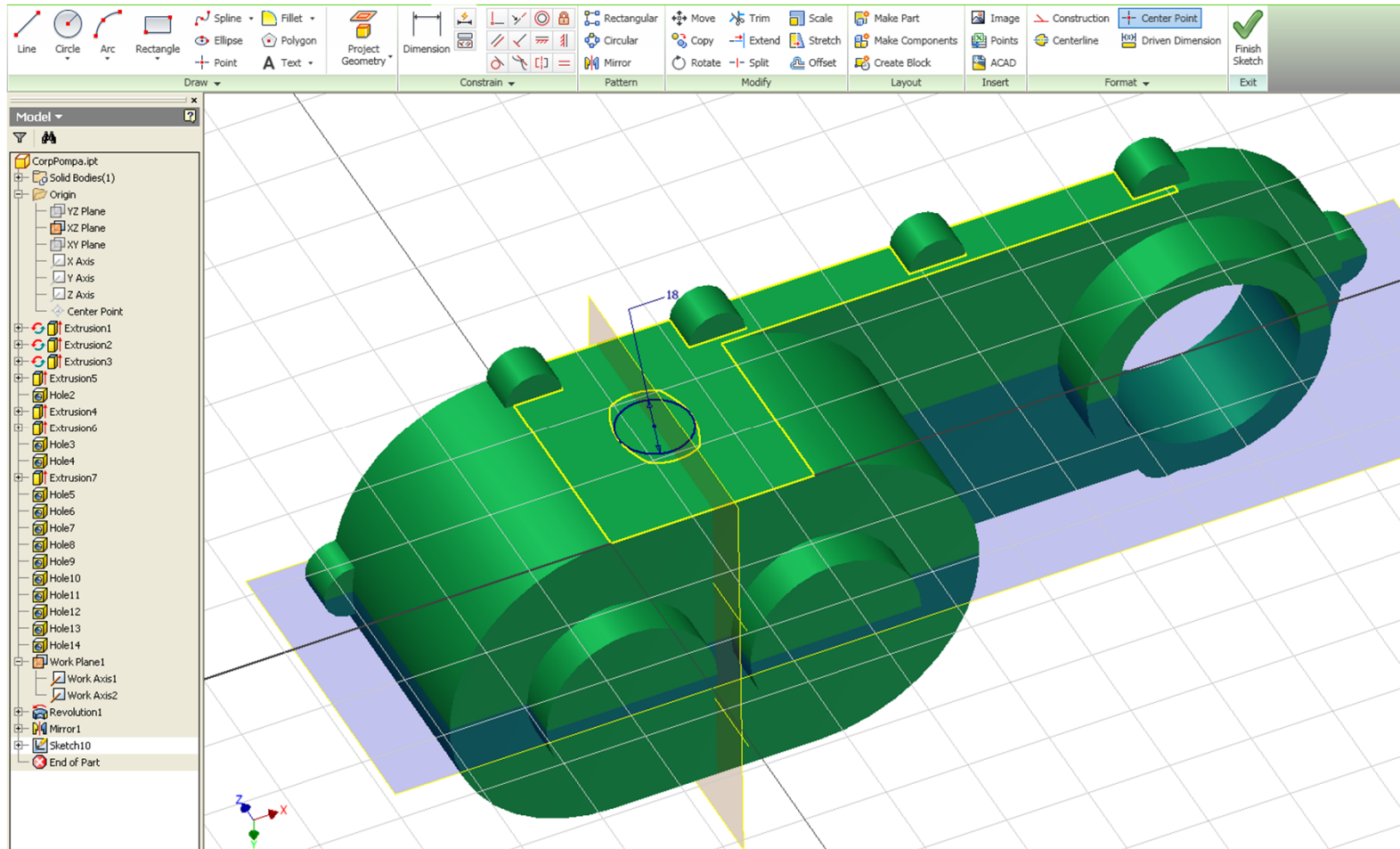
Exhaust outlet



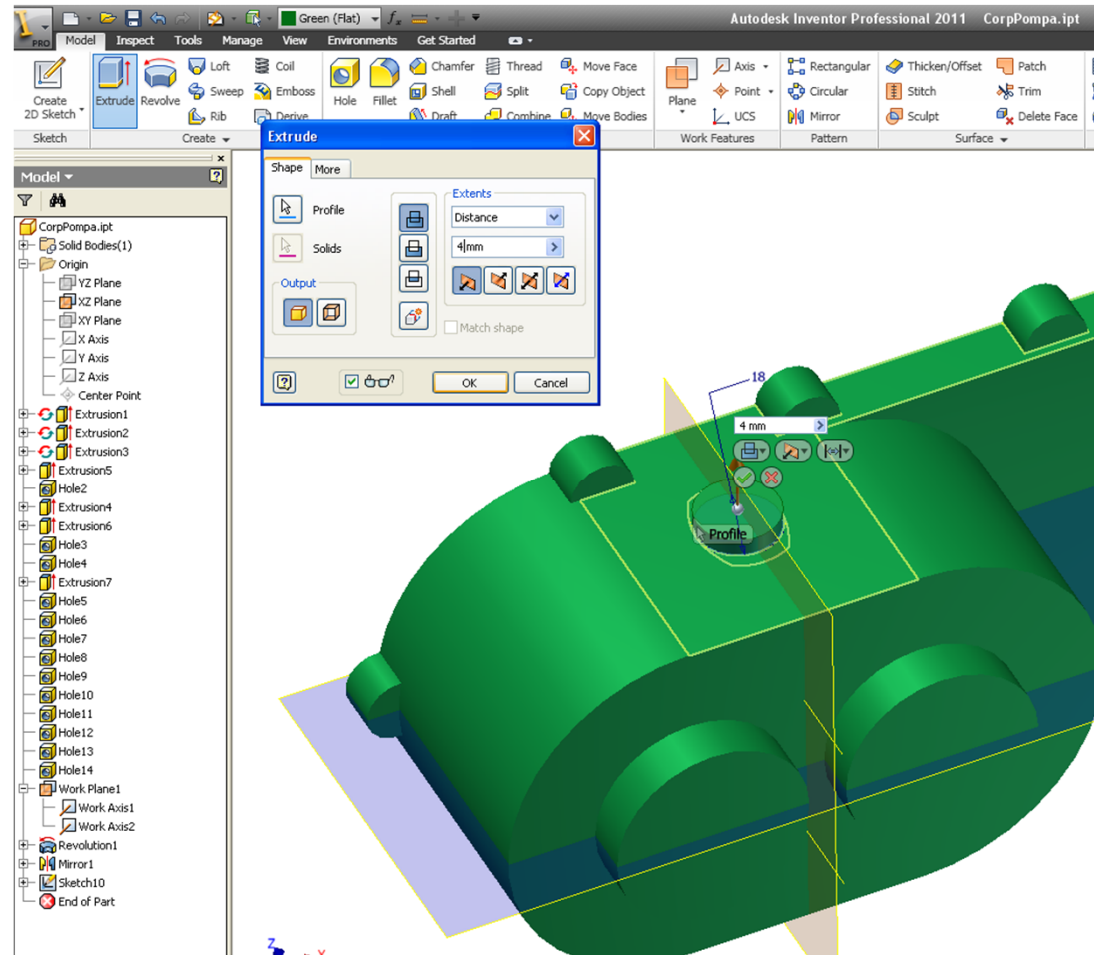
Inlet route



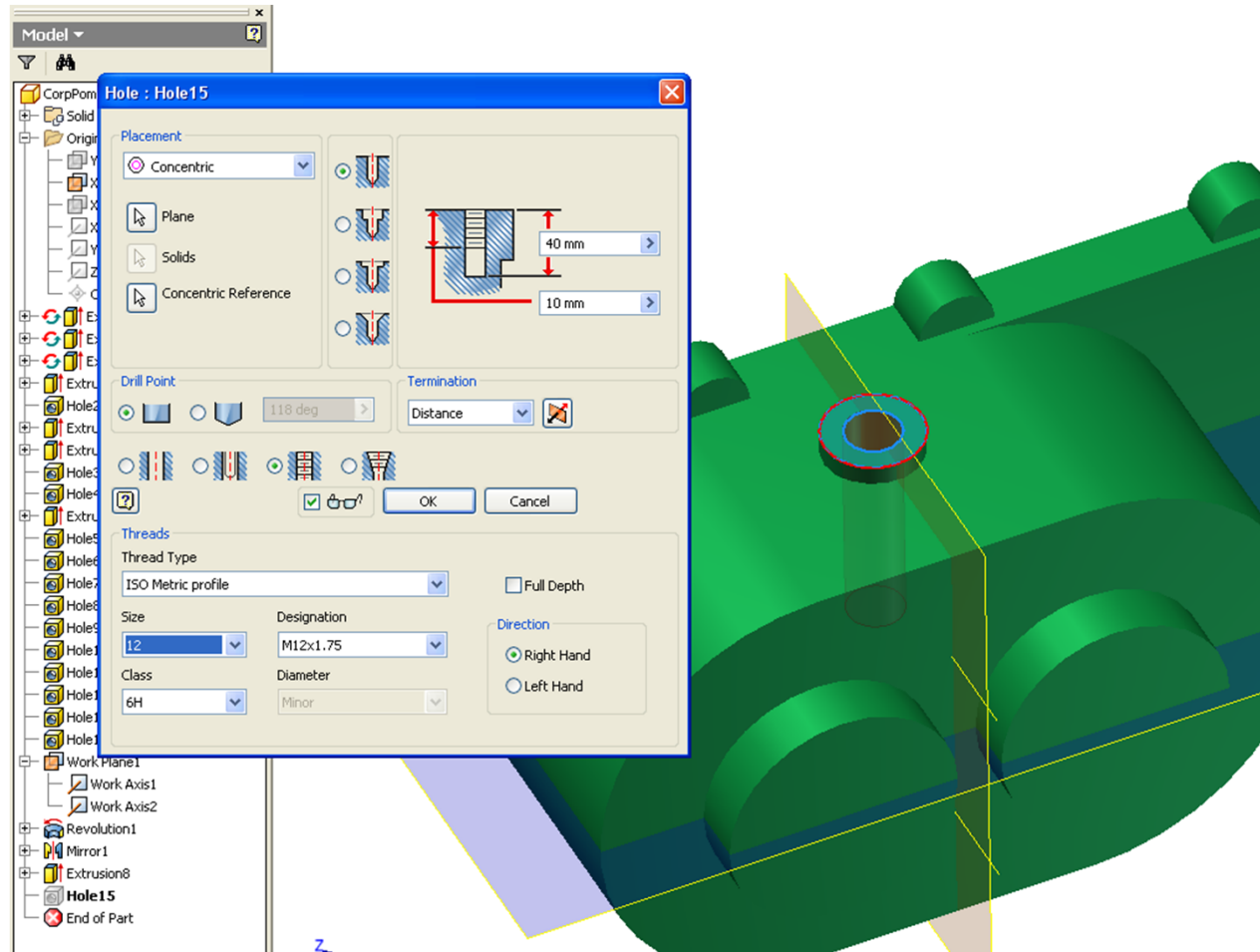
Inlet boss



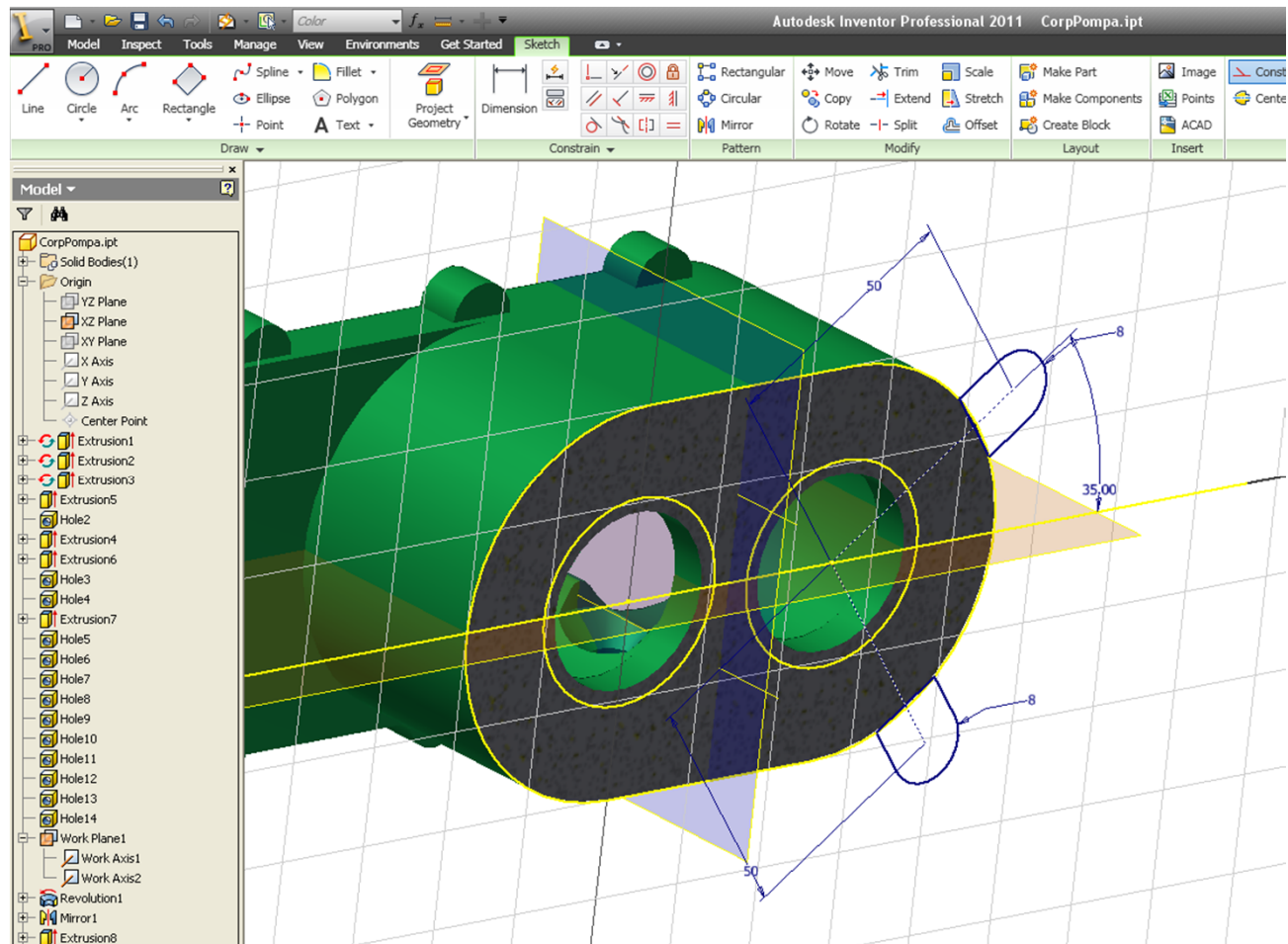
Inlet route



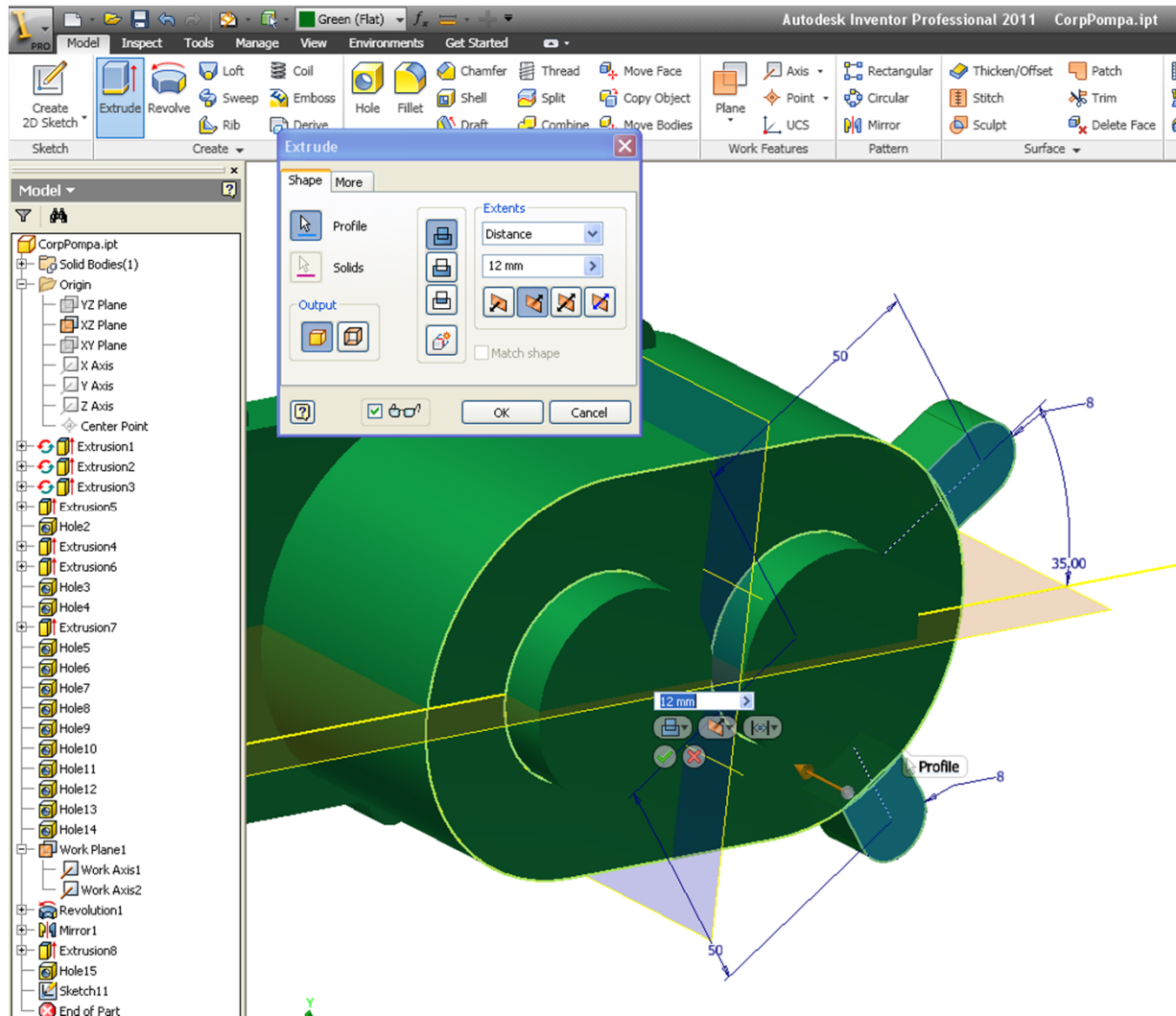
Threaded hole



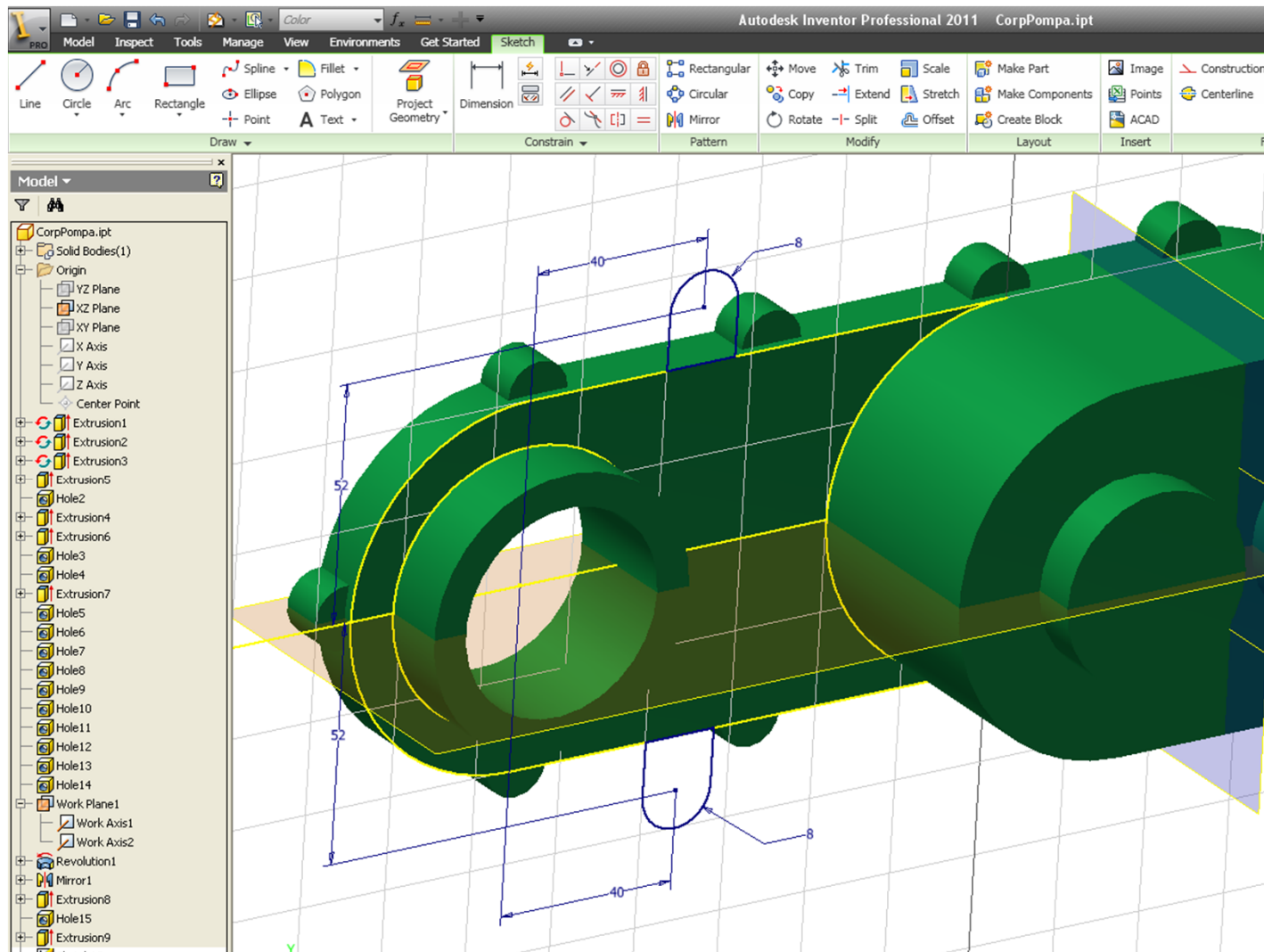
Grounding sketch 1



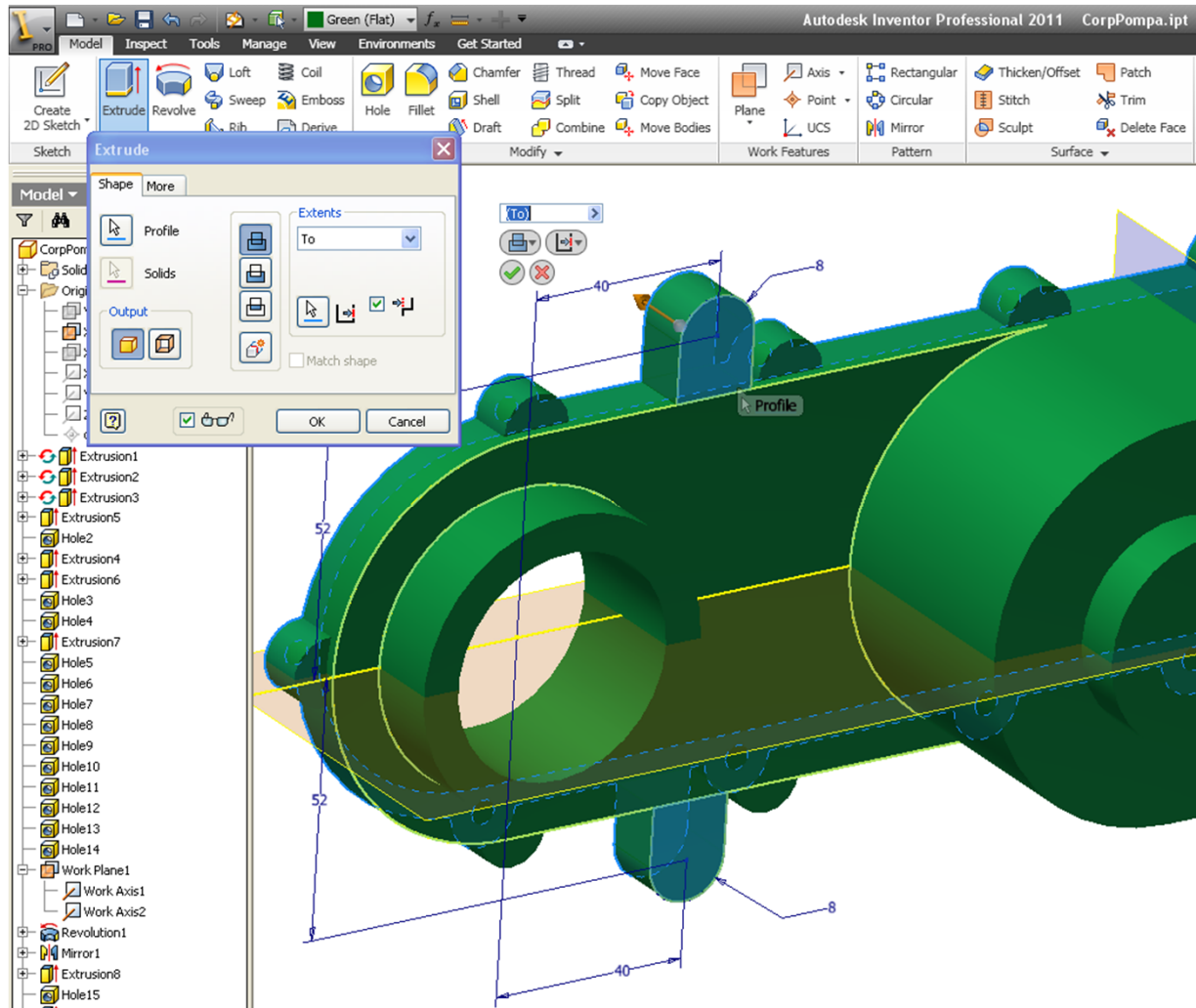
Grounding arms 1



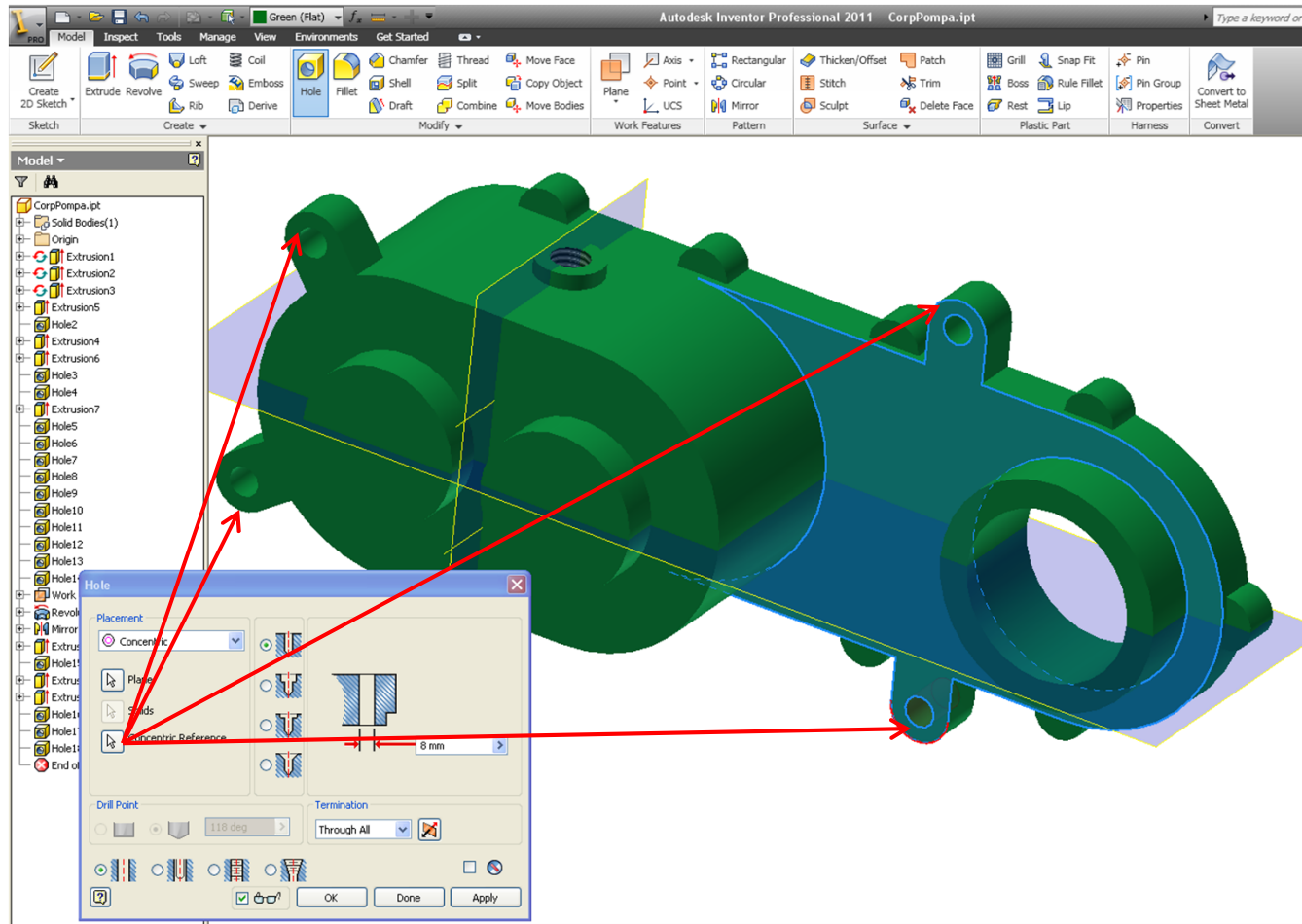
Grounding sketch 2



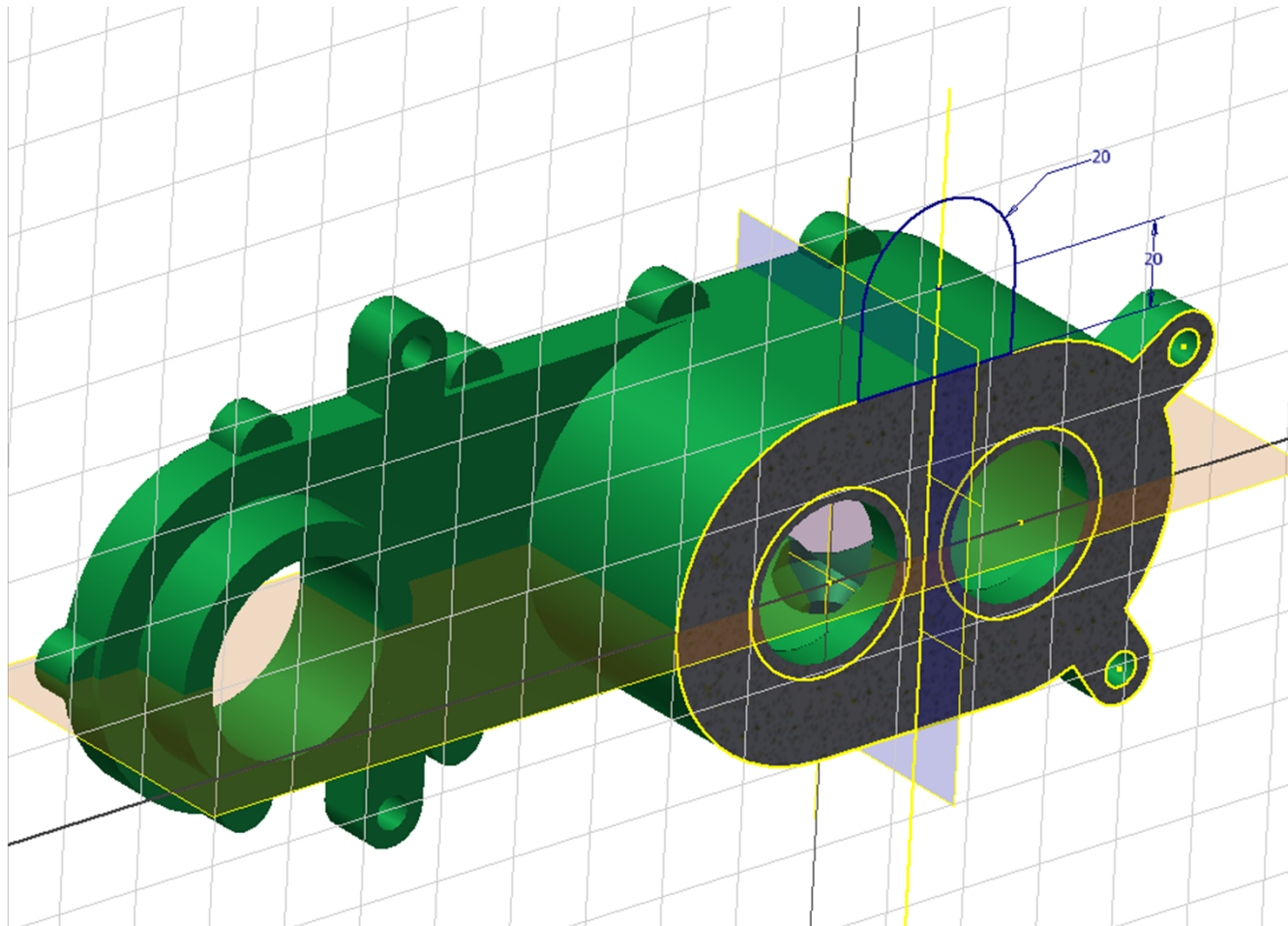
Grounding arms 2



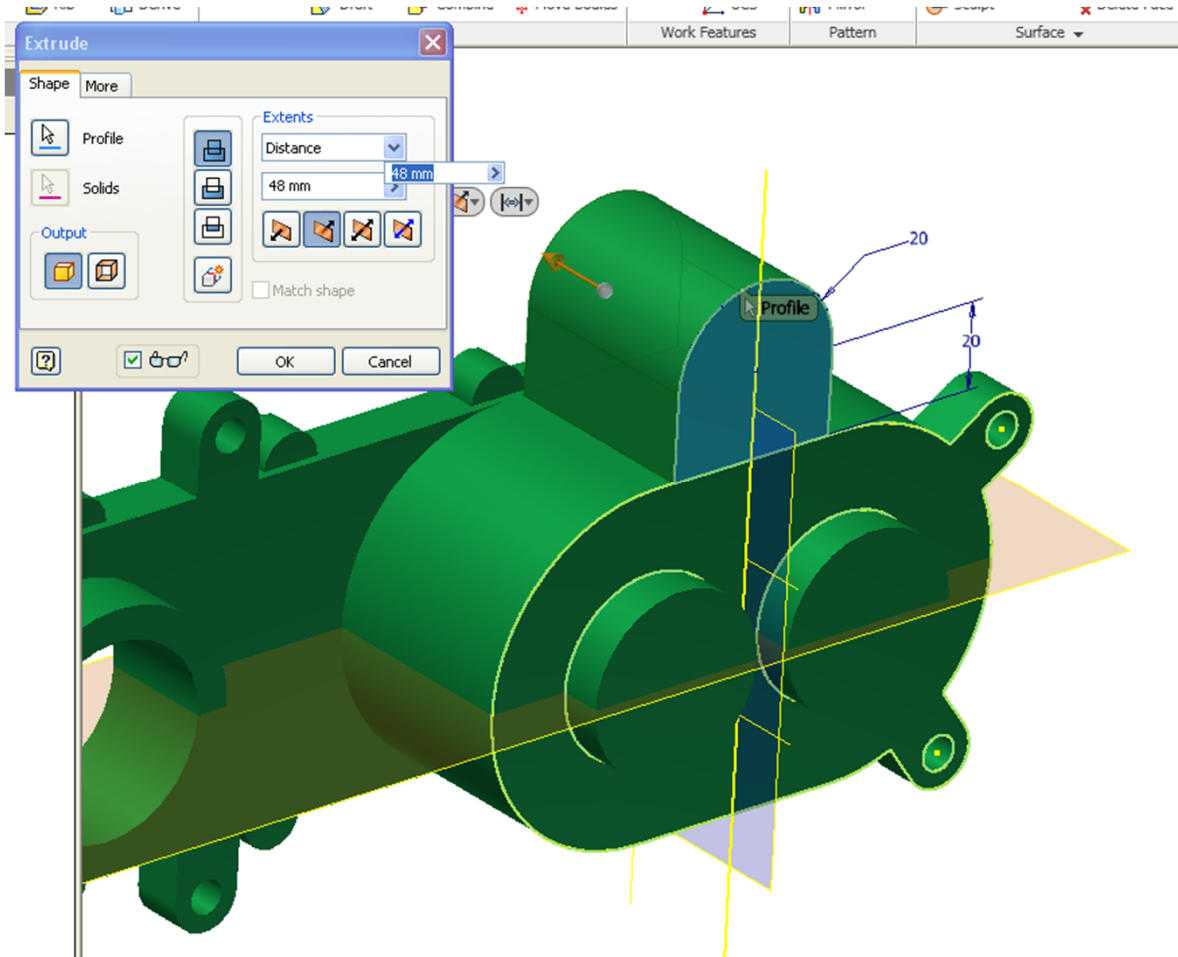
Grounding holes



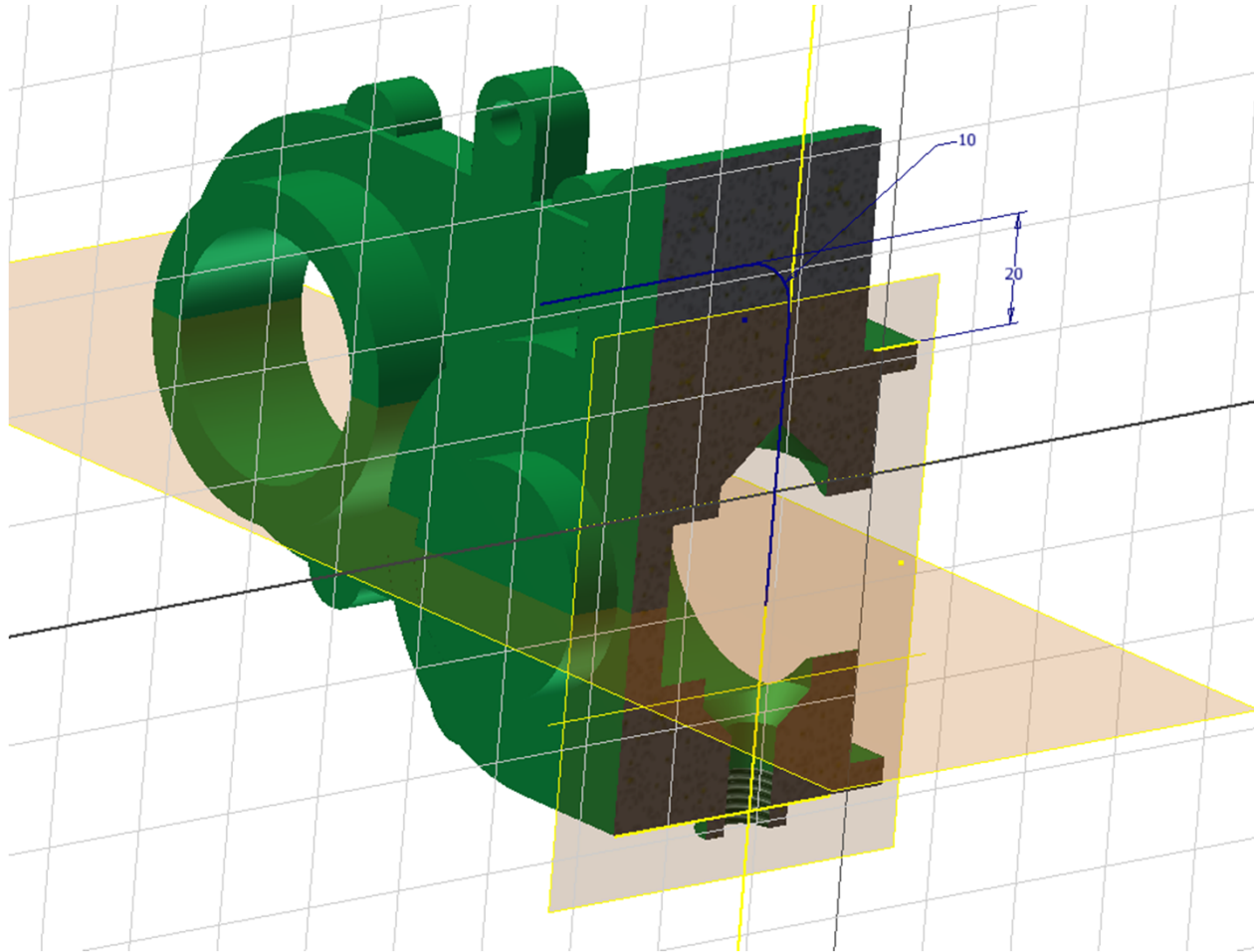
Exhaust sketch



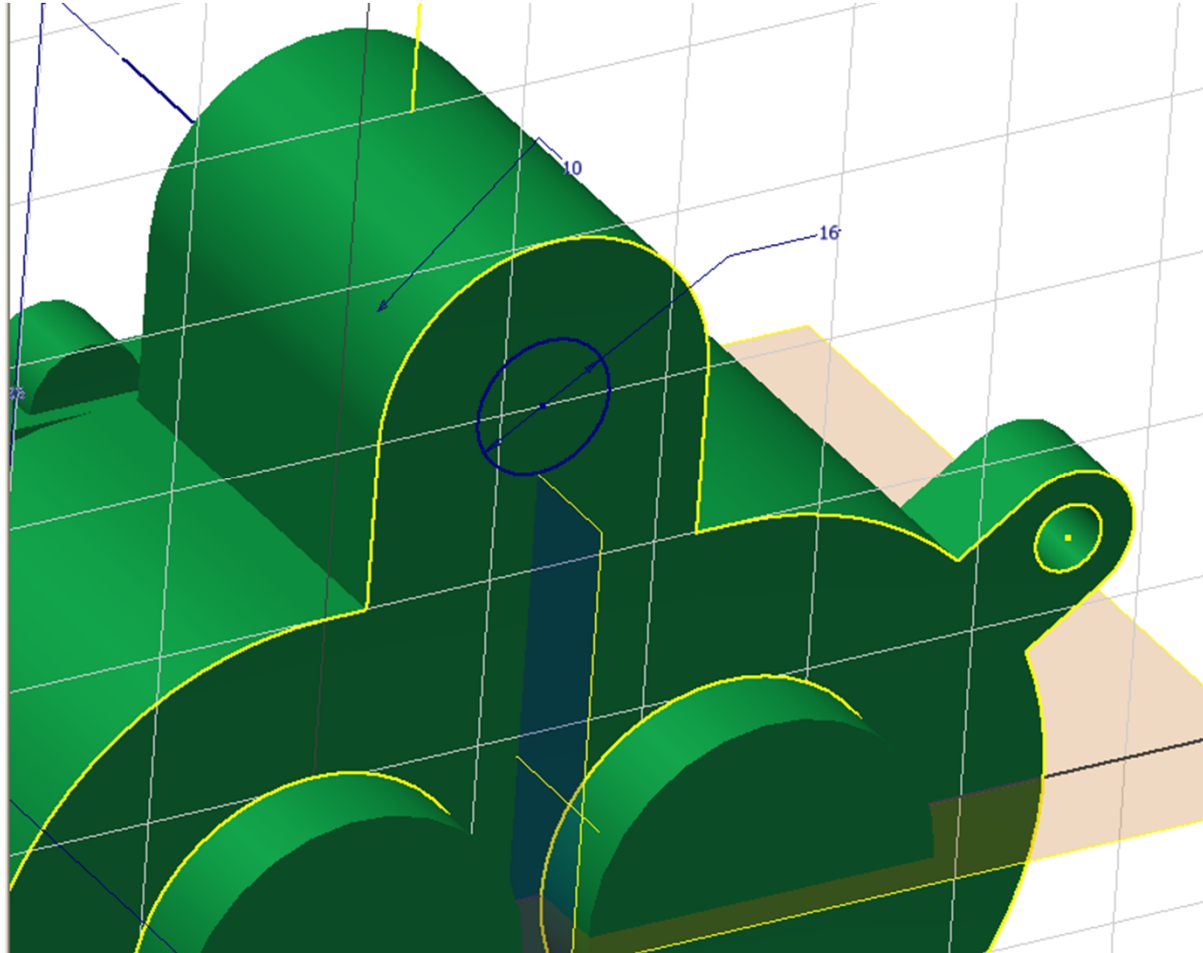
Exhaust boss



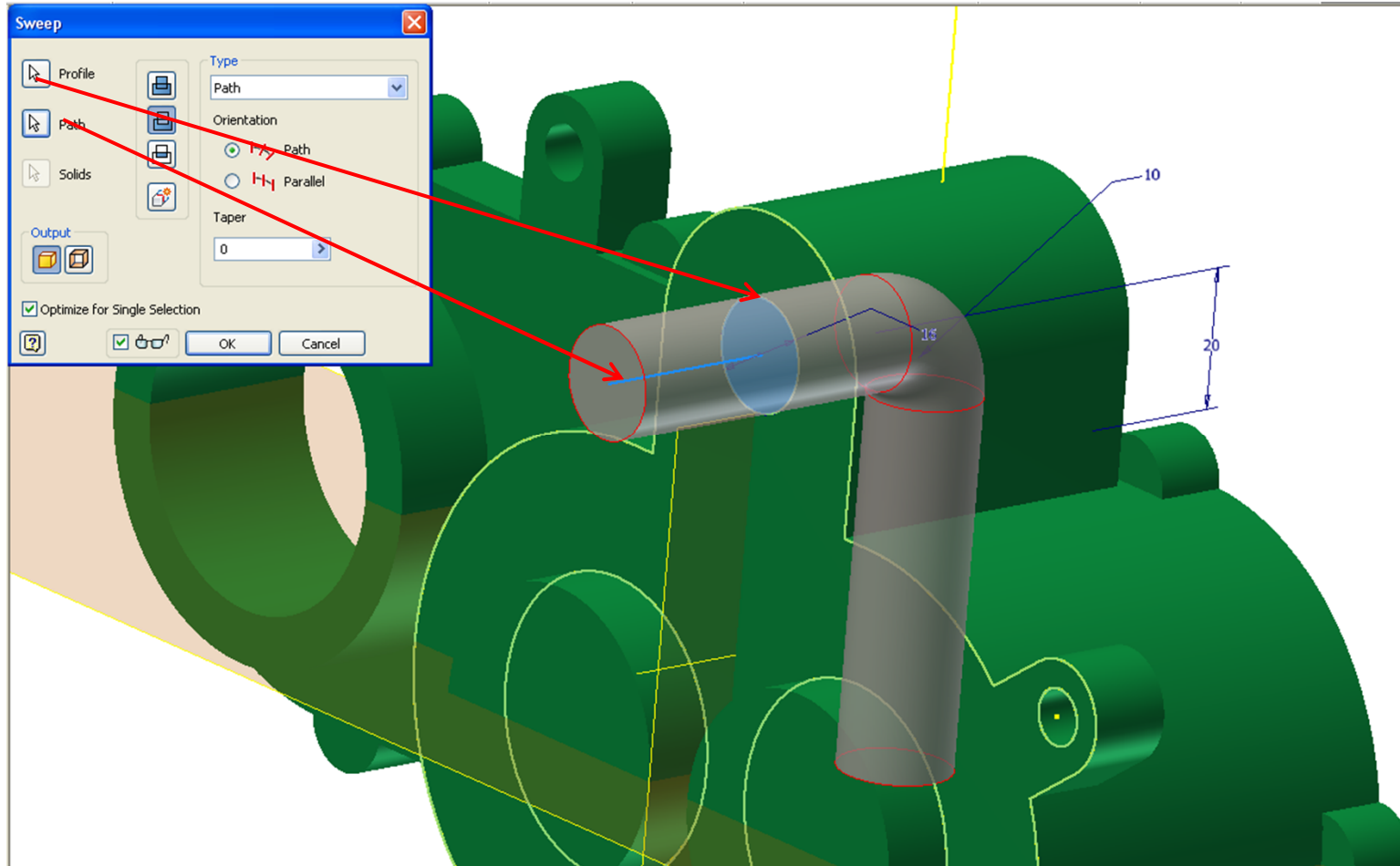
Exhaust route sketch



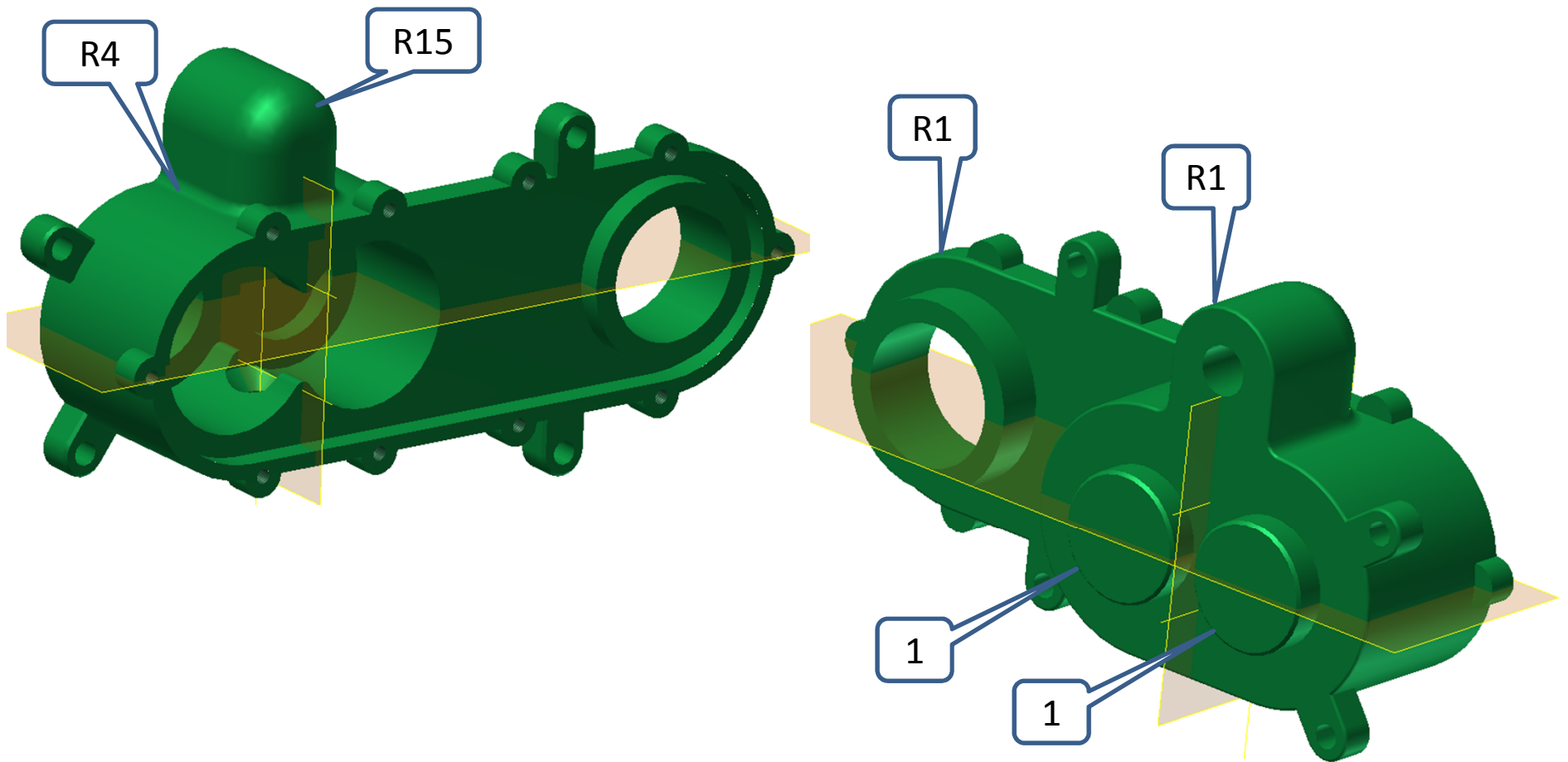
Profile of exhaust route



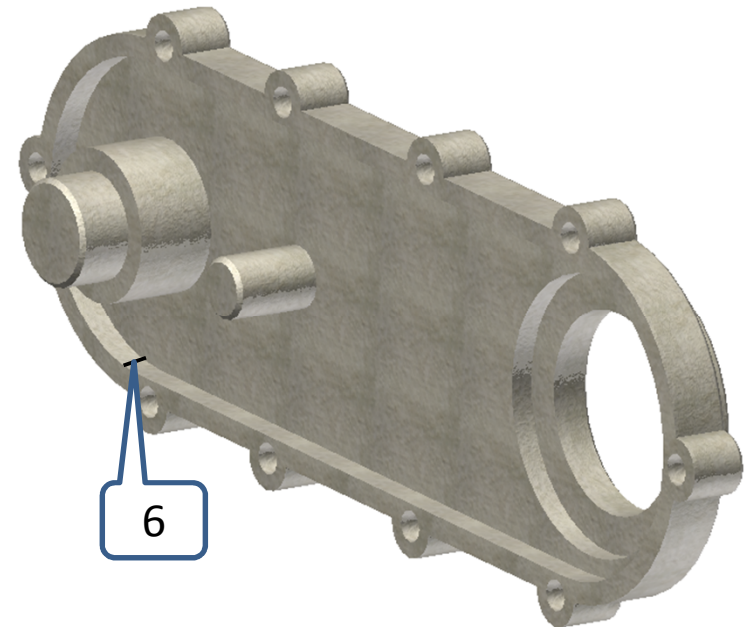
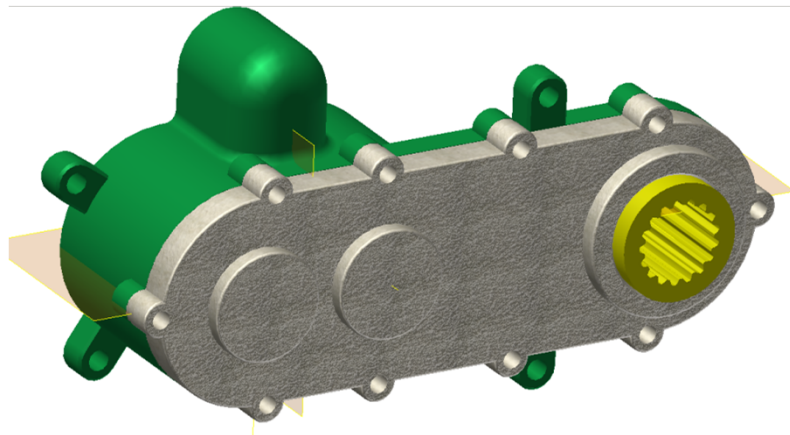
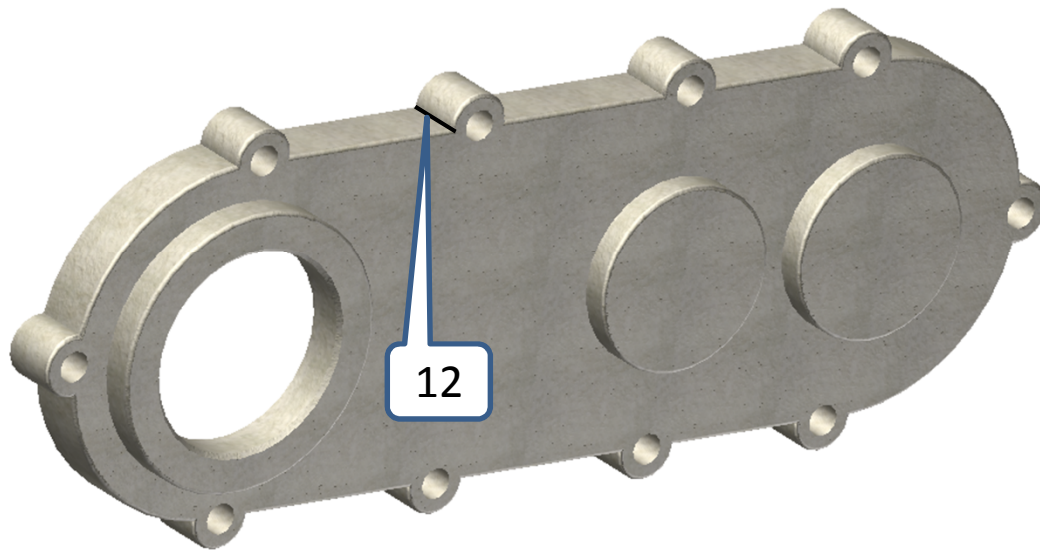
Exhaust route generation



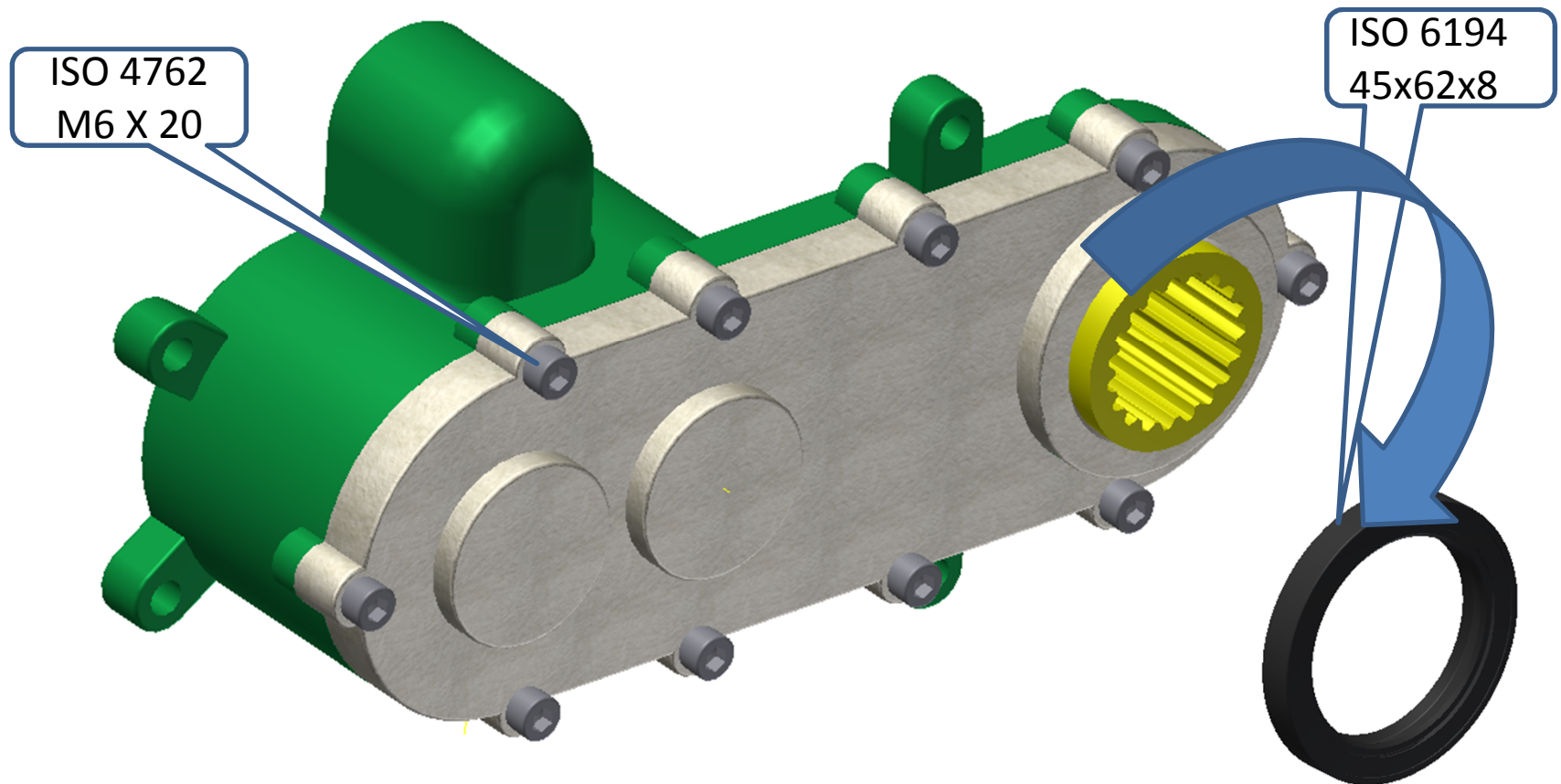
Fillets and chamfers



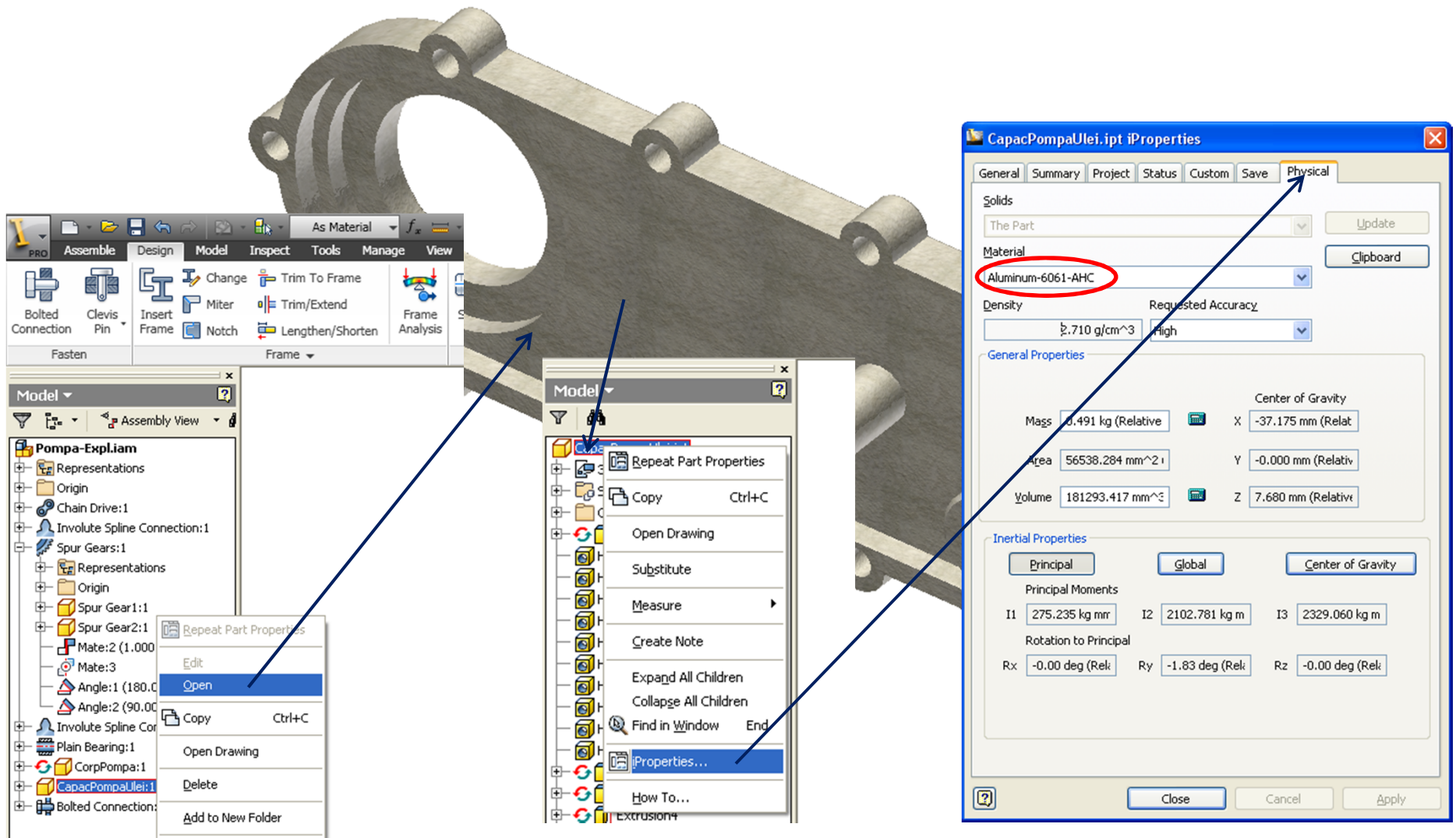
Cover filleting



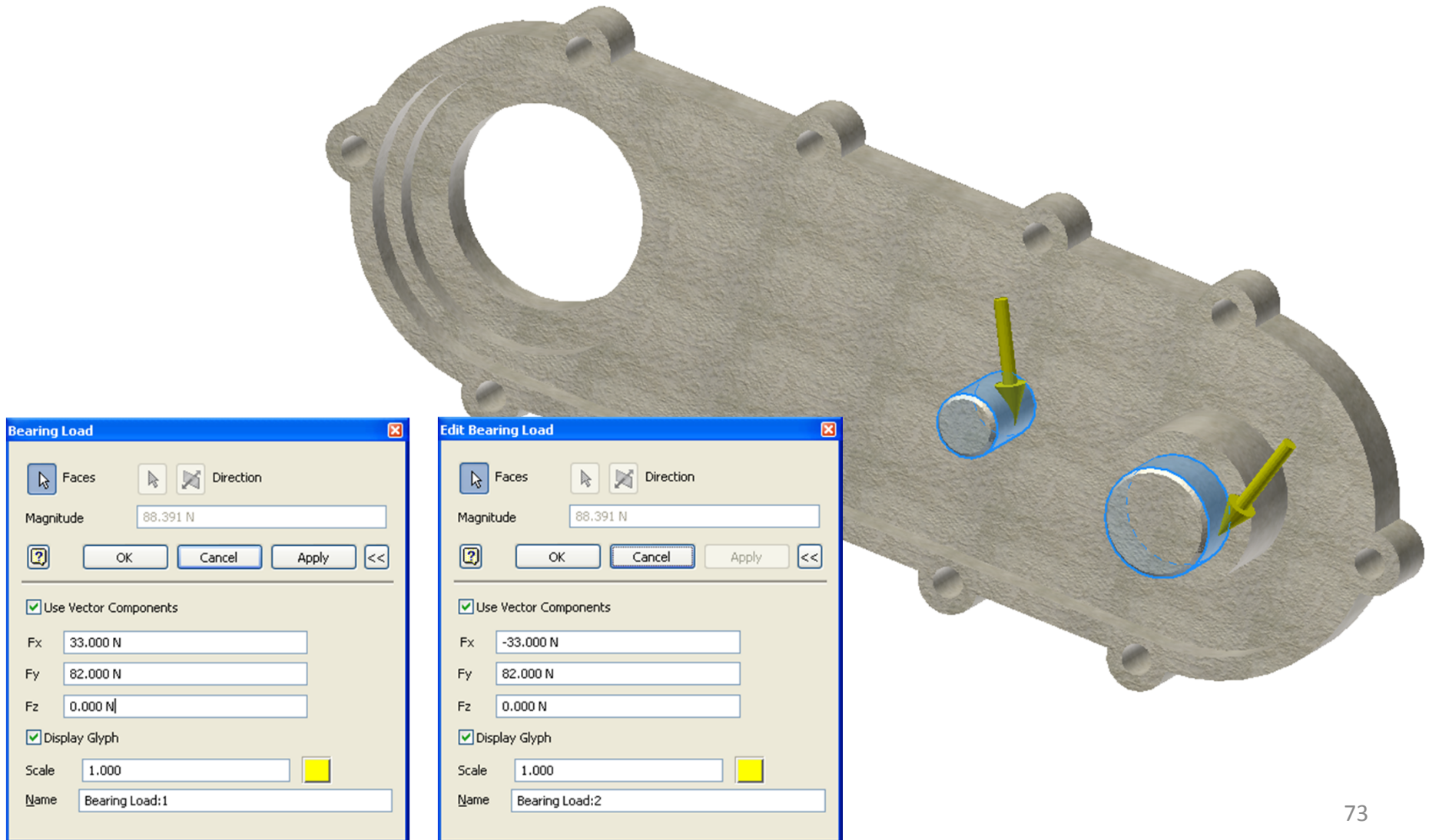
Screws and Seal ring



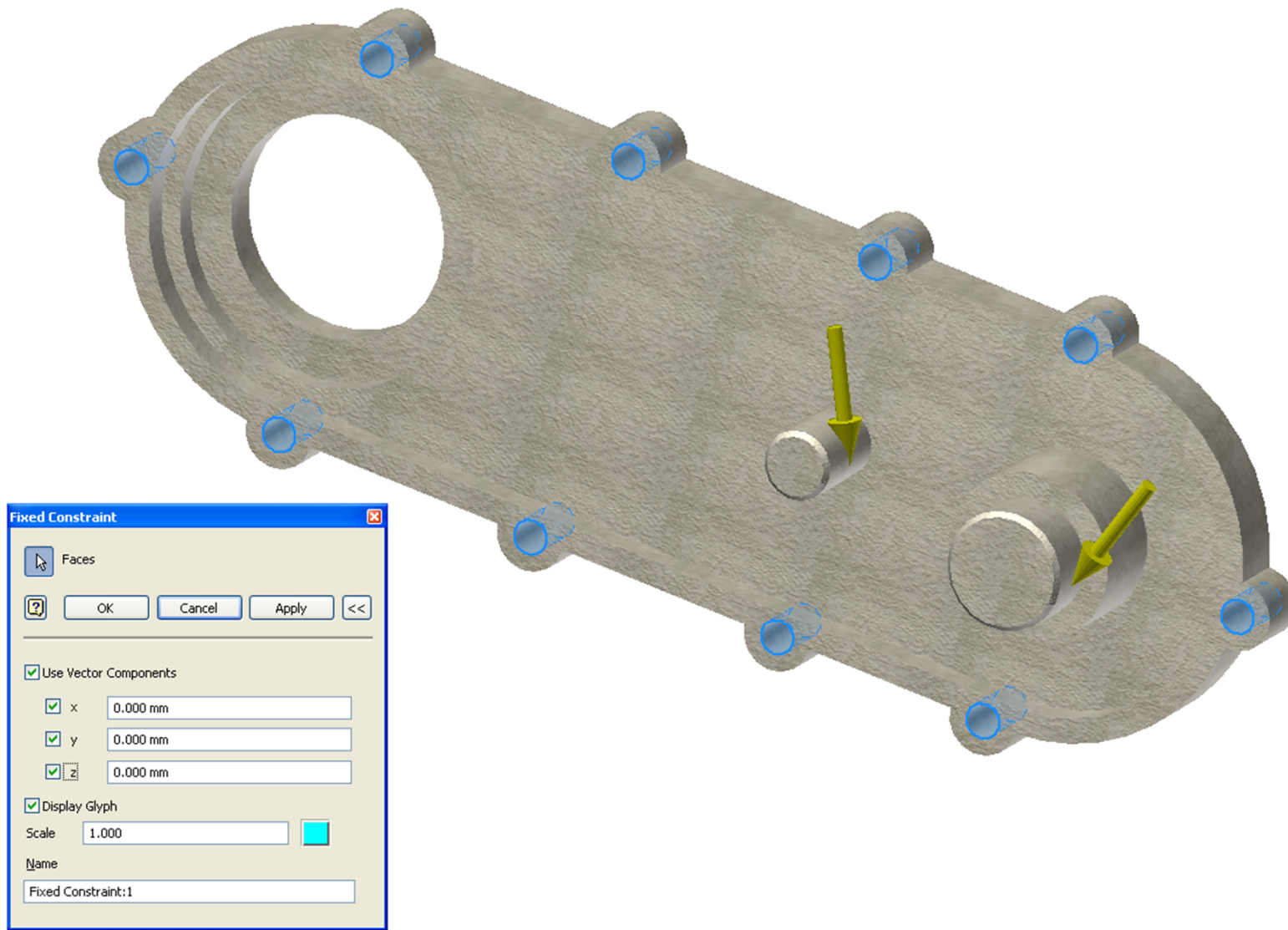
Cover – materials properties



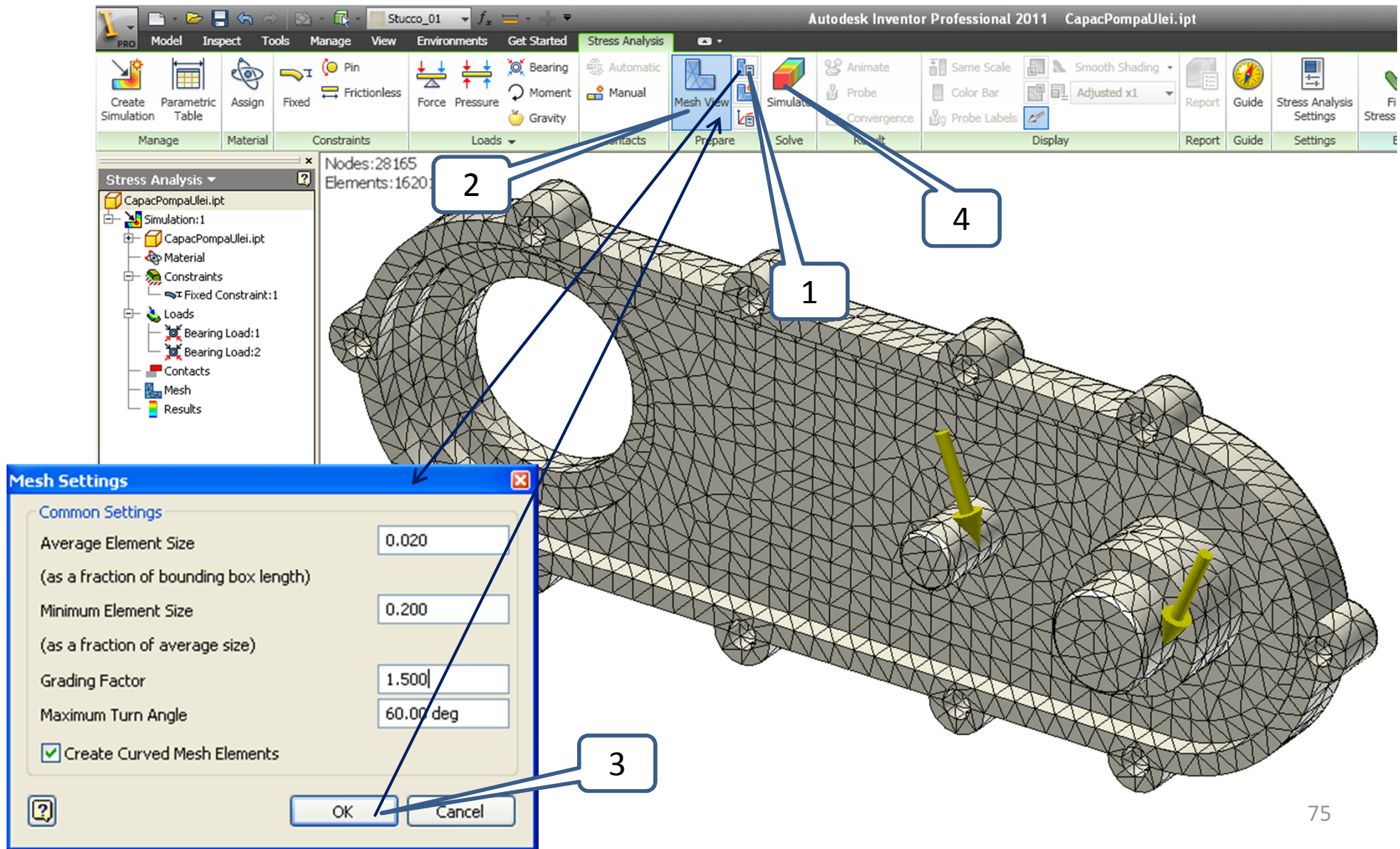
Applying loads (from spur gear feature – pag. 21)



Boundary conditions



Mesh generation



Displacement display

