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NIT-DURGAPUR

PROBLEM STATEMENT- Design a 6:1 gear reduction compound gear train in SolidWorks and analyse it in ANSYS.

ASSUMPTIONS:

Power Transmitted by driver=40KW

Speed of driver=3600 RPM

Design Considerations:

For Compound Gear train of 6:1 gear reduction I have taken 4 spur gears.
Gear 1 (Driver Gear)- 20 Teeth , Module 3.
Gear 2 (Intermidiate Gear)- 40 Teeth , Module 3.
Gear 3 (Intermideate Gear)- 18 Teeth , Module 3.
Gear 4 (Output Gear)- 54 Teeth , Module 3.
*In our Case Gear 1 meshed with Gear 2 and Gear 3 Meshed with Gear 4.
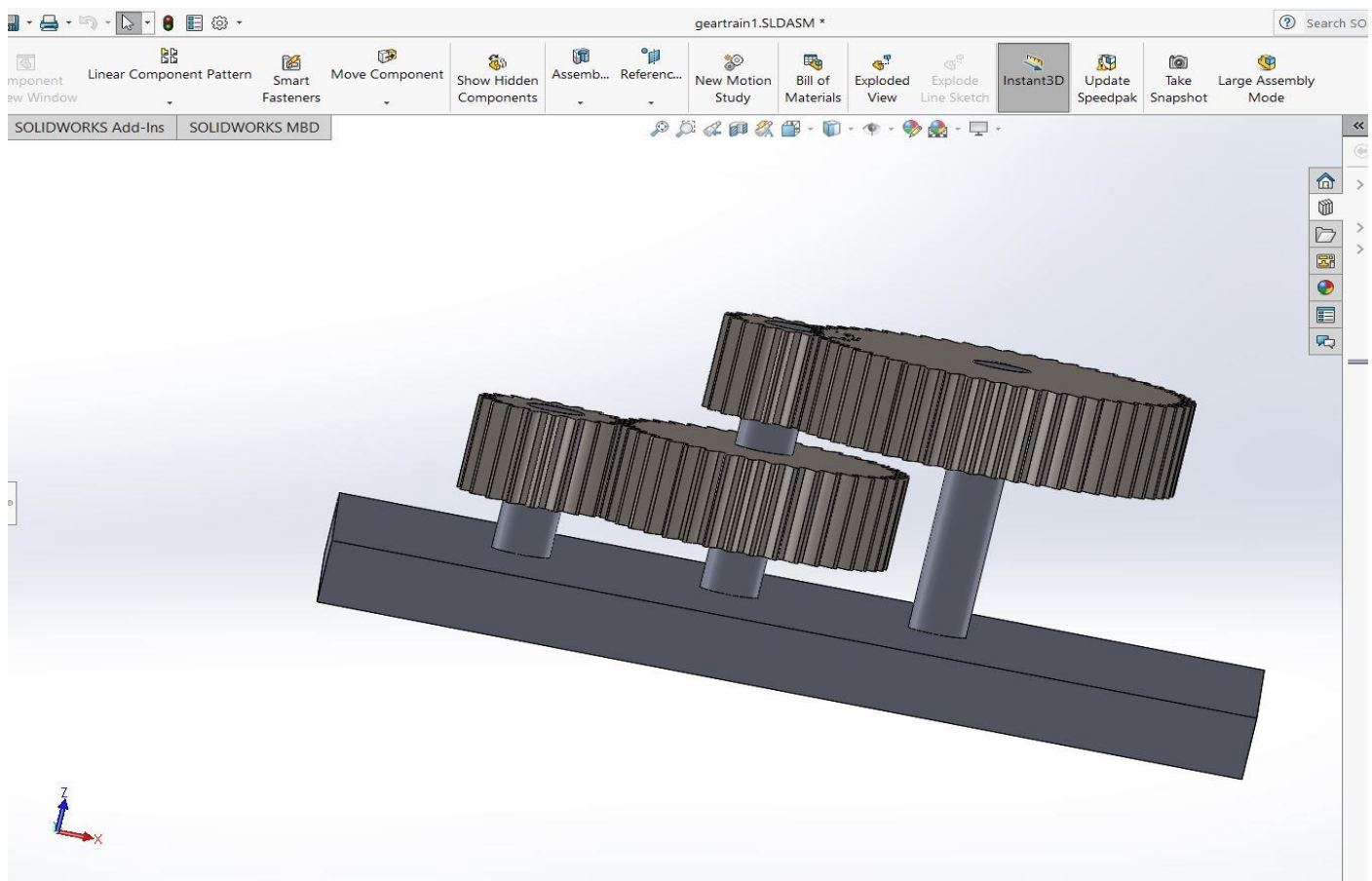Pressure Angle =20 degrees**.**

FIG:SOLIDWORKS ASSEMBLY OF 6:1 GEAR REDUCTION OF COMPOUND GEAR TRAIN.
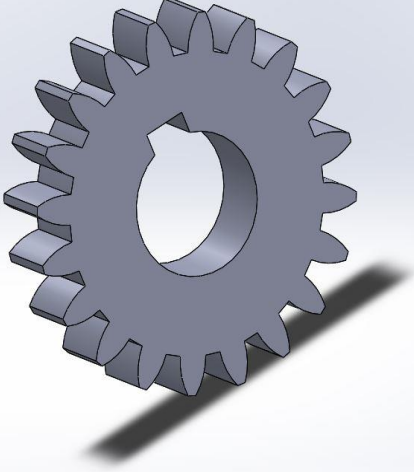
SPUR GEAR DESIGN CALCULATIONS

Equations, Global Variables, and Dimensions

Name	Value / Equation	Evaluates to	Comments
Global Variables			
"Teeth"	= 20	20	
"Module"	= 3	3	
"pcd"	= "Teeth" * "Module"	60	
"circularpitch"	= 3.1415 * "Module"	9.4245	
"diametricalpitch"	= 1 / "Module"	0.333333	
"addendum"	= "Module"	3	
"addendumCircularDiameter"	= "pcd" + 2 * "Module"	66	
"clearance"	= "circularpitch" / "Teeth"	0.471225	
"dedendum"	= "addendum" + "clearance"	3.47123	
"dedendumCircularDiameter"	= "pcd" - 2 * "dedendum"	53.0575	
"pressureangle"	= 20	20	
"circularpitchangle"	= "circularpitch" * 360 / (3.1415 * "pcd")	4.5	
"shaft diameter"	= 25mm	25mm	
Add global variable			
Features			
Add feature suppression			
Equations			
"D2@Sketch2"	= "addendumCircularDiameter"	66mm	
"D1@Sketch2"	= "pcd"	60mm	
"D3@Sketch2"	= "dedendumCircularDiameter"	53.06mm	
"D4@Sketch2"	= "pressureangle"	20deg	
"D6@Sketch2"	= "circularpitchangle"	4.5deg	
"D1@CirPattern1"	= "Teeth"	20	

Input Driver Gear Calculations(Gear-1)
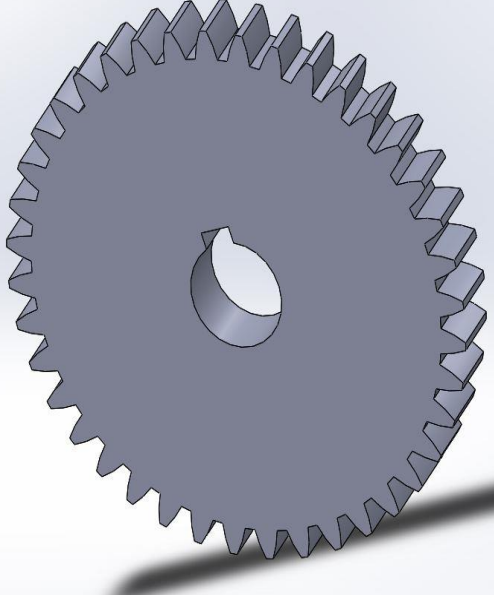
Equations, Global Variables, and Dimensions

Name	Value / Equation	Evaluates to	Comments
Global Variables			
"Teeth"	= 40	40	
"Module"	= 3	3	
"pcd"	= "Teeth" * "Module"	120	
"circularpitch"	= 3.1415 * "Module"	9.4245	
"diametricalpitch"	= 1 / "Module"	0.333333	
"addendum"	= "Module"	3	
"addendumCircularDiameter"	= "pcd" + 2 * "Module"	126	
"clearance"	= "circularpitch" / "Teeth"	0.235612	
"dedendum"	= "addendum" + "clearance"	3.23561mm	
"dedendumCircularDiameter"	= "pcd" - 2 * "dedendum"	113.529mm	
"pressureangle"	= 20	20	
"circularpitchangle"	= "circularpitch" * 360 / (3.1415 * "pcd")	2.25mm	
Add global variable			
Features			
Add feature suppression			
Equations			
"D2@Sketch2"	= "addendumCircularDiameter"	126mm	
"D1@Sketch2"	= "pcd"	120mm	
"D3@Sketch2"	= "dedendumCircularDiameter"	113.53mm	
"D4@Sketch2"	= "pressureangle"	20deg	
"D6@Sketch2"	= "circularpitchangle"	2.25deg	
"D1@CirPattern1"	= "Teeth"	40	
Add equation			

Intermidiate Driven Gear Calculations (Gear-2)
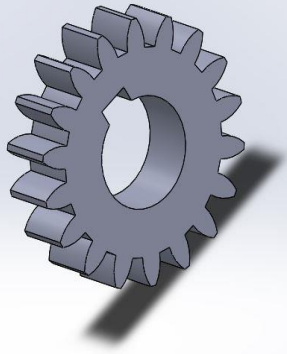
Intermideate Driver Gear Calculations(Gear-3)

Name	Value / Equation	Evaluates to	Comments
Global Variables			
"Teeth"	= 18	18	
"Module"	= 3	3	
"pcd"	= "Teeth" * "Module"	54	
"circularpitch"	= 3.1415 * "Module"	9.4245	
"diametricalpitch"	= 1 / "Module"	0.333333	
"addendum"	= "Module"	3	
"addendumCircularDiameter"	= "pcd" + 2 * "Module"	60	
"clearance"	= "circularpitch" / "Teeth"	0.523583	
"dedendum"	= "addendum" + "clearance"	3.52358mm	
"dedendumCircularDiameter"	= "pcd" - 2 * "dedendum"	46.9528mm	
"pressureangle"	= 20	20	
"circularpitchangle"	= "circularpitch" * 360 / (3.1415 * "pcd"	5mm	
"shaft diameter"	= 25mm	25mm	
Add global variable			
Features			
Add feature suppression			
Equations			
"D2@Sketch2"	= "addendumCircularDiameter"	60mm	
"D1@Sketch2"	= "pcd"	54mm	
"D3@Sketch2"	= "dedendumCircularDiameter"	46.95mm	
"D4@Sketch2"	= "pressureangle"	20deg	
"D6@Sketch2"	= "circularpitchangle"	5deg	
"D1@CirPattern1"	= "Teeth"	18	

Output Driven Gear Calculations(Gear-4)

Name	Value / Equation	Evaluates to	Comments
Global Variables			
"Teeth"	= 54	54	
"Module"	= 3	3	
"pcd"	= "Teeth" * "Module"	162	
"circularpitch"	= 3.1415 * "Module"	9.4245	
"diametricalpitch"	= 1 / "Module"	0.333333	
"addendum"	= "Module"	3	
"addendumCircularDiameter"	= "pcd" + 2 * "Module"	168	
"clearance"	= "circularpitch" / "Teeth"	0.174528	
"dedendum"	= "addendum" + "clearance"	3.17453mm	
"dedendumCircularDiameter"	= "pcd" - 2 * "dedendum"	155.651mm	
"pressureangle"	= 20	20	
"circularpitchangle"	= "circularpitch" * 360 / (3.1415 * "pcd"	1.66667mm	
"shaft diameter"	= 25mm	25mm	
Add global variable			
Features			
Add feature suppression			
Equations			
"D2@Sketch2"	= "addendumCircularDiameter"	168mm	
"D1@Sketch2"	= "pcd"	162mm	
"D3@Sketch2"	= "dedendumCircularDiameter"	155.65mm	
"D4@Sketch2"	= "pressureangle"	20deg	
"D6@Sketch2"	= "circularpitchangle"	1.67deg	
"D1@CirPattern1"	= "Teeth"	54	

DRAFTING IN SOLIDWORKS
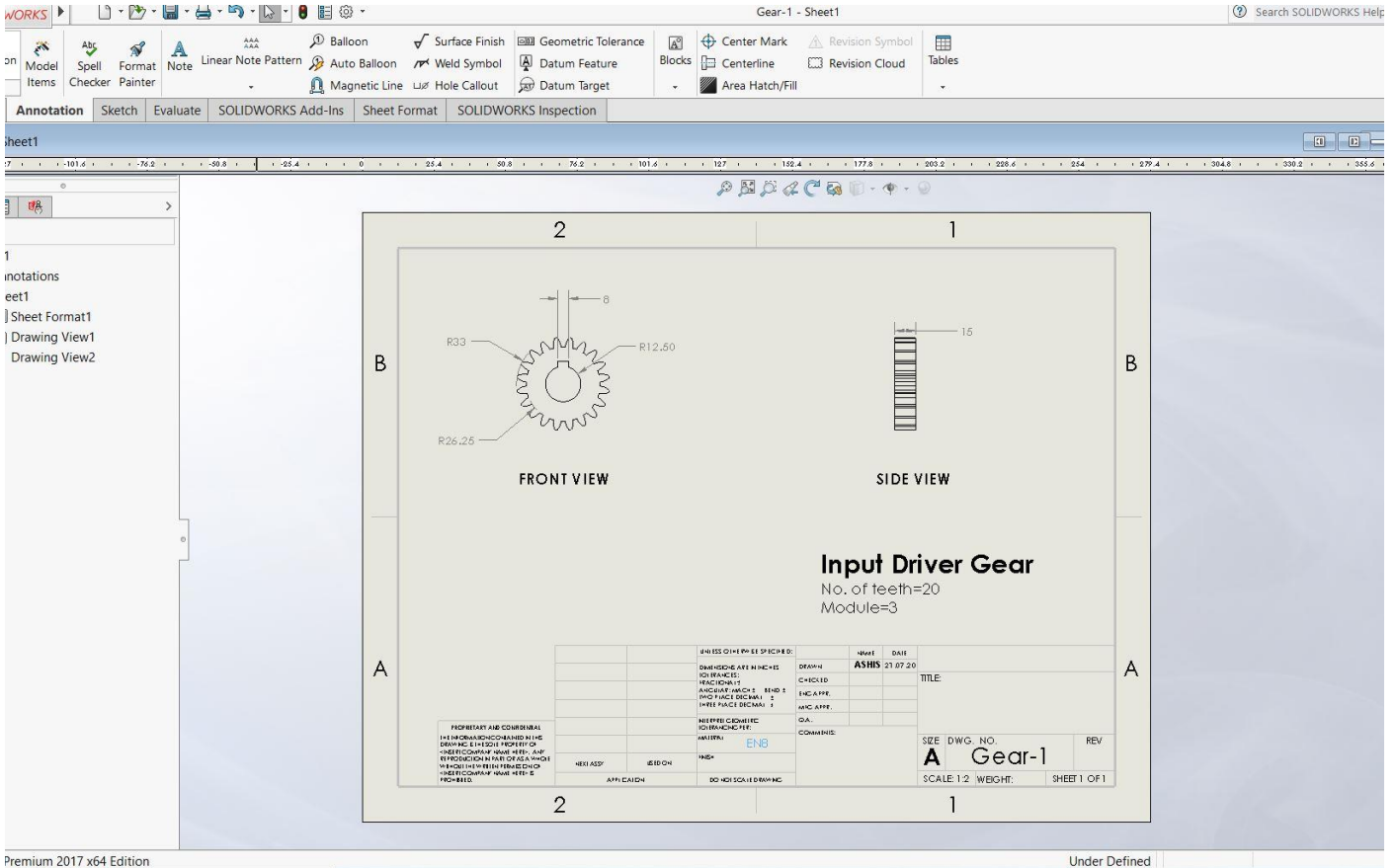
Fig: Gear 1
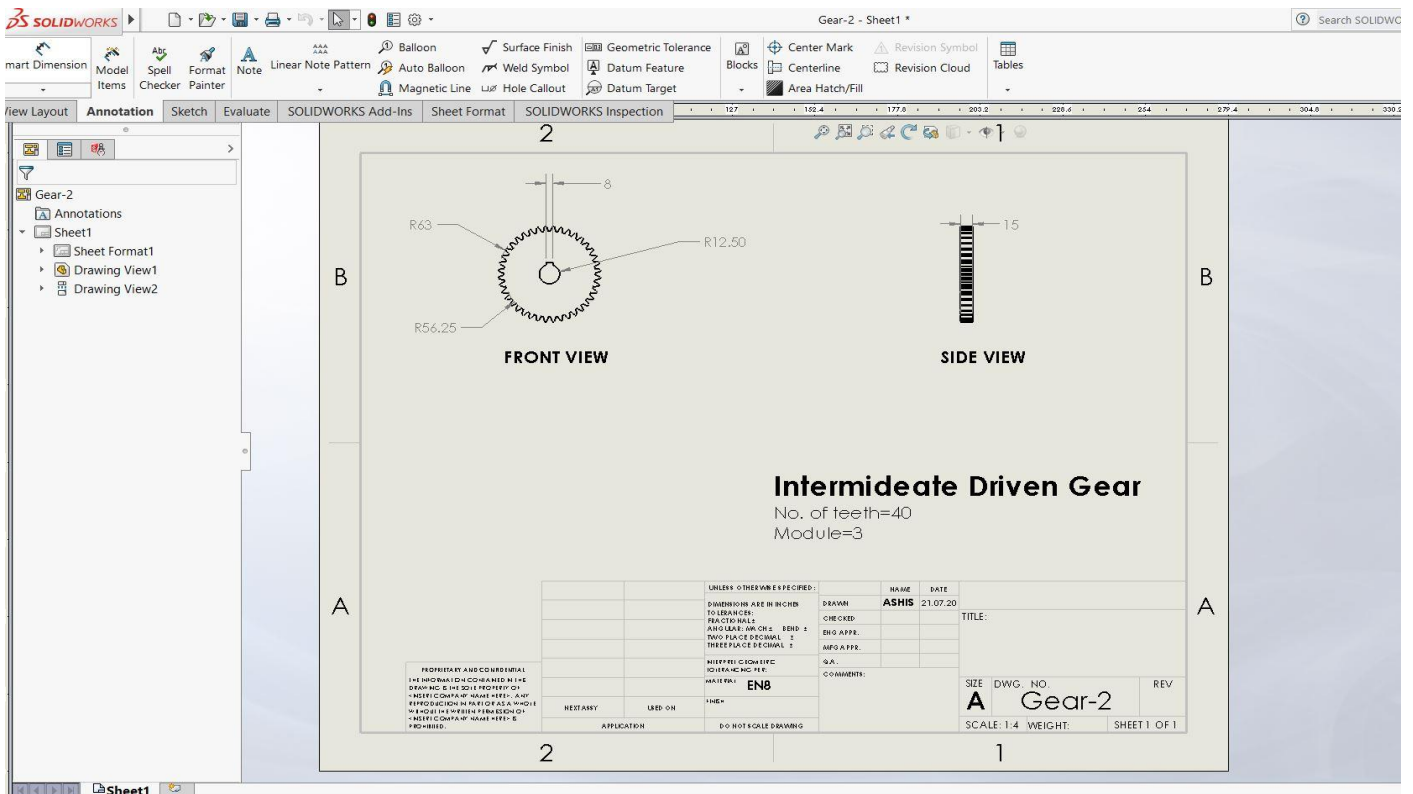
Fig: Gear 2
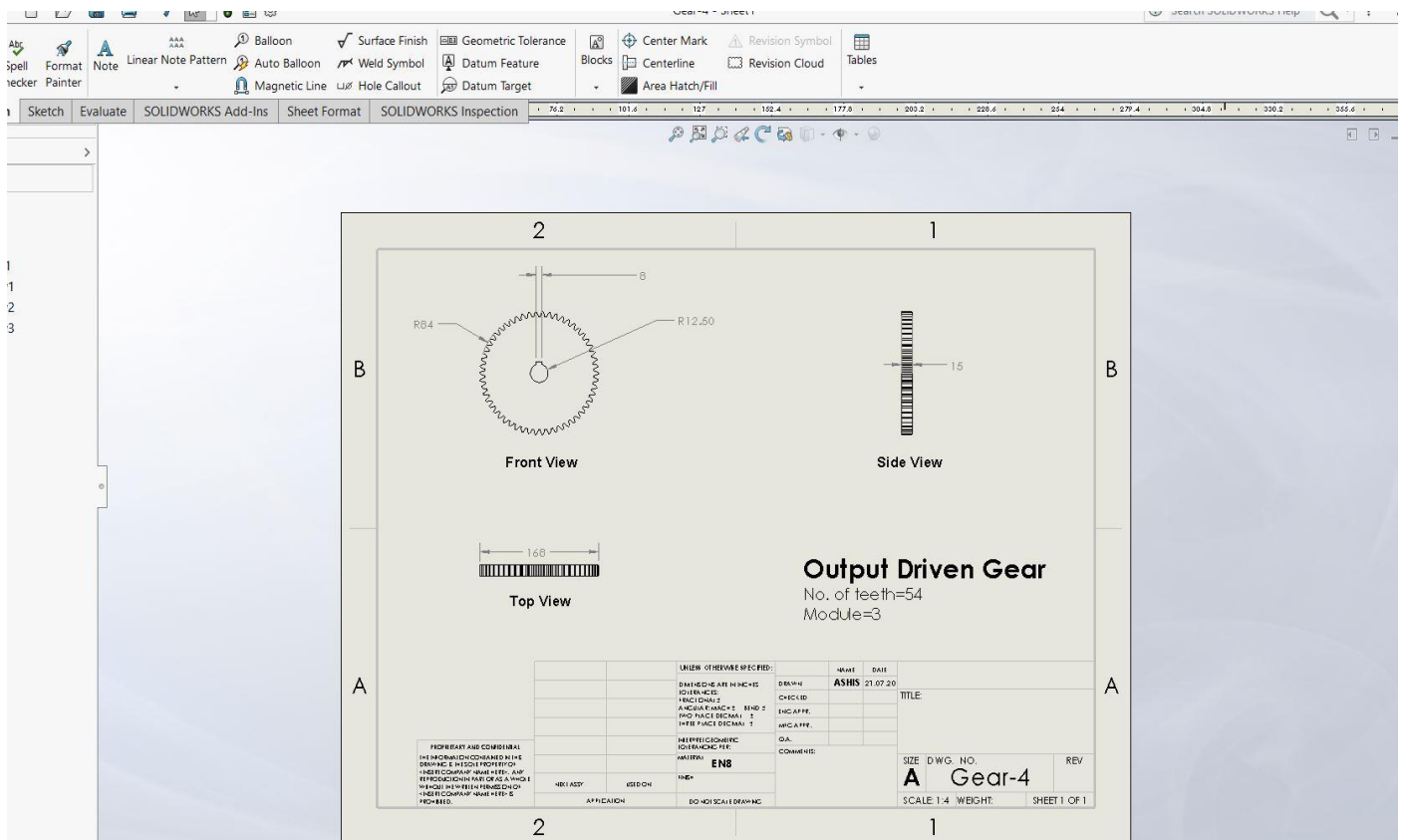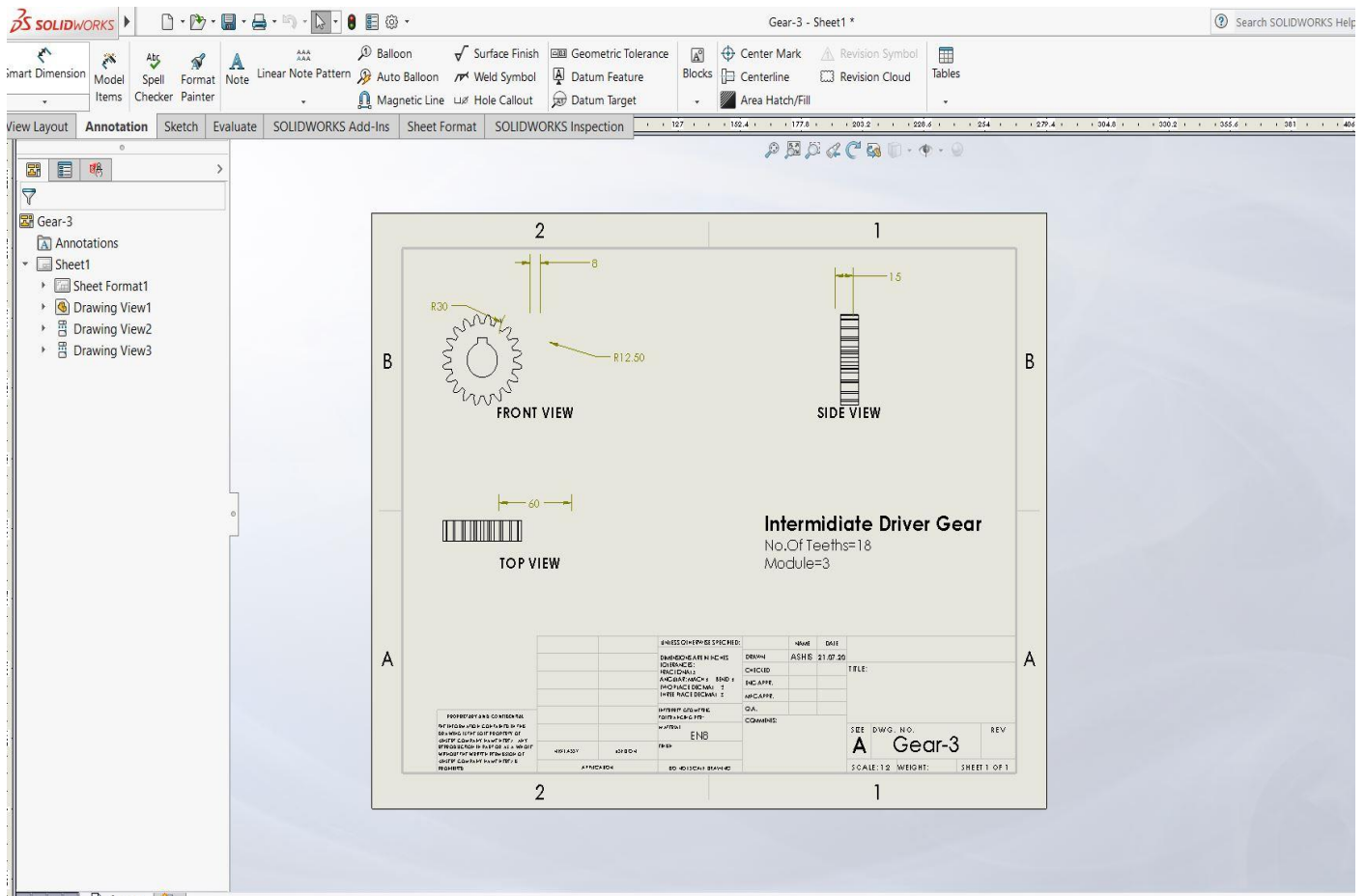
Fig:Gear 3

Fig:Gear 4

Material Estimation
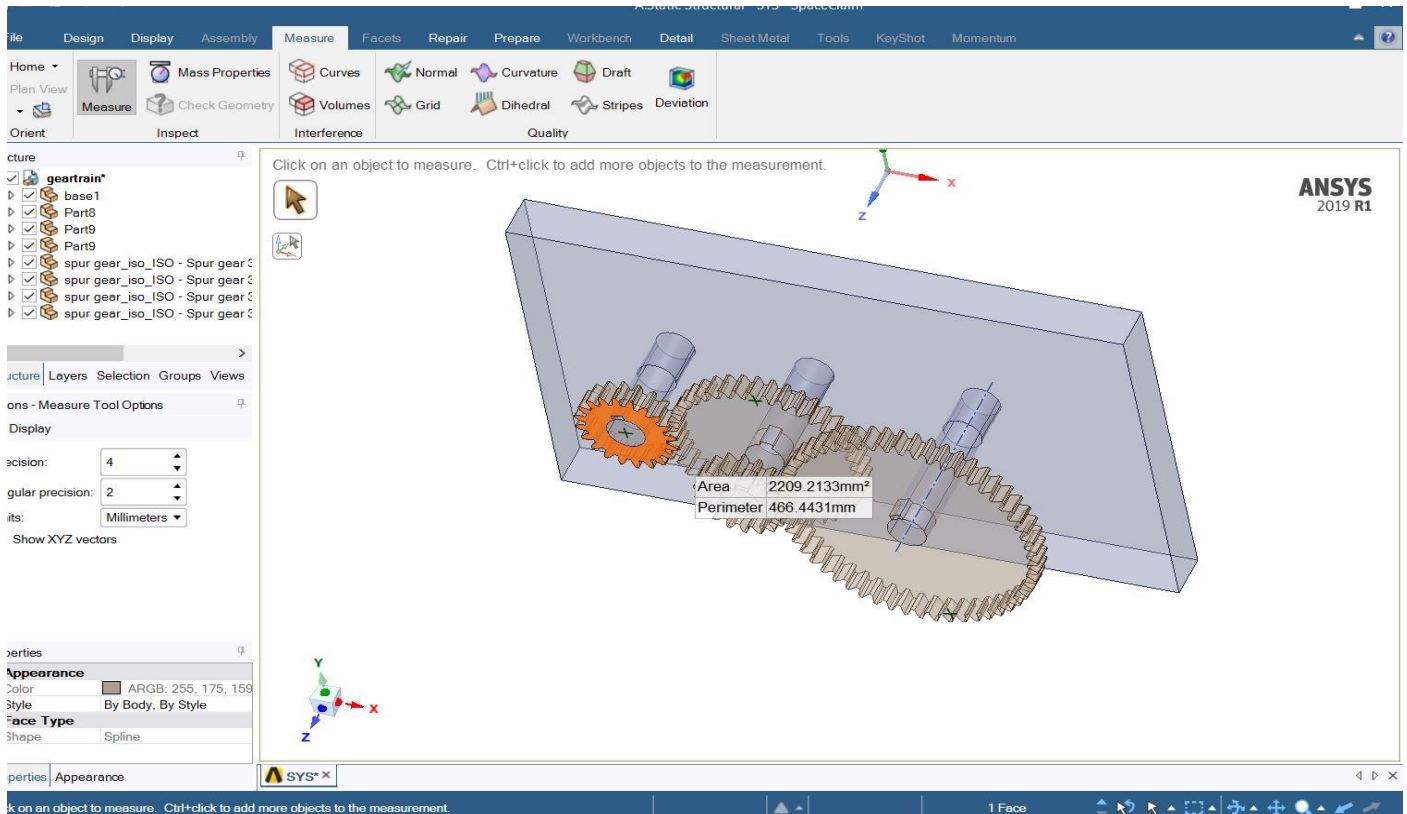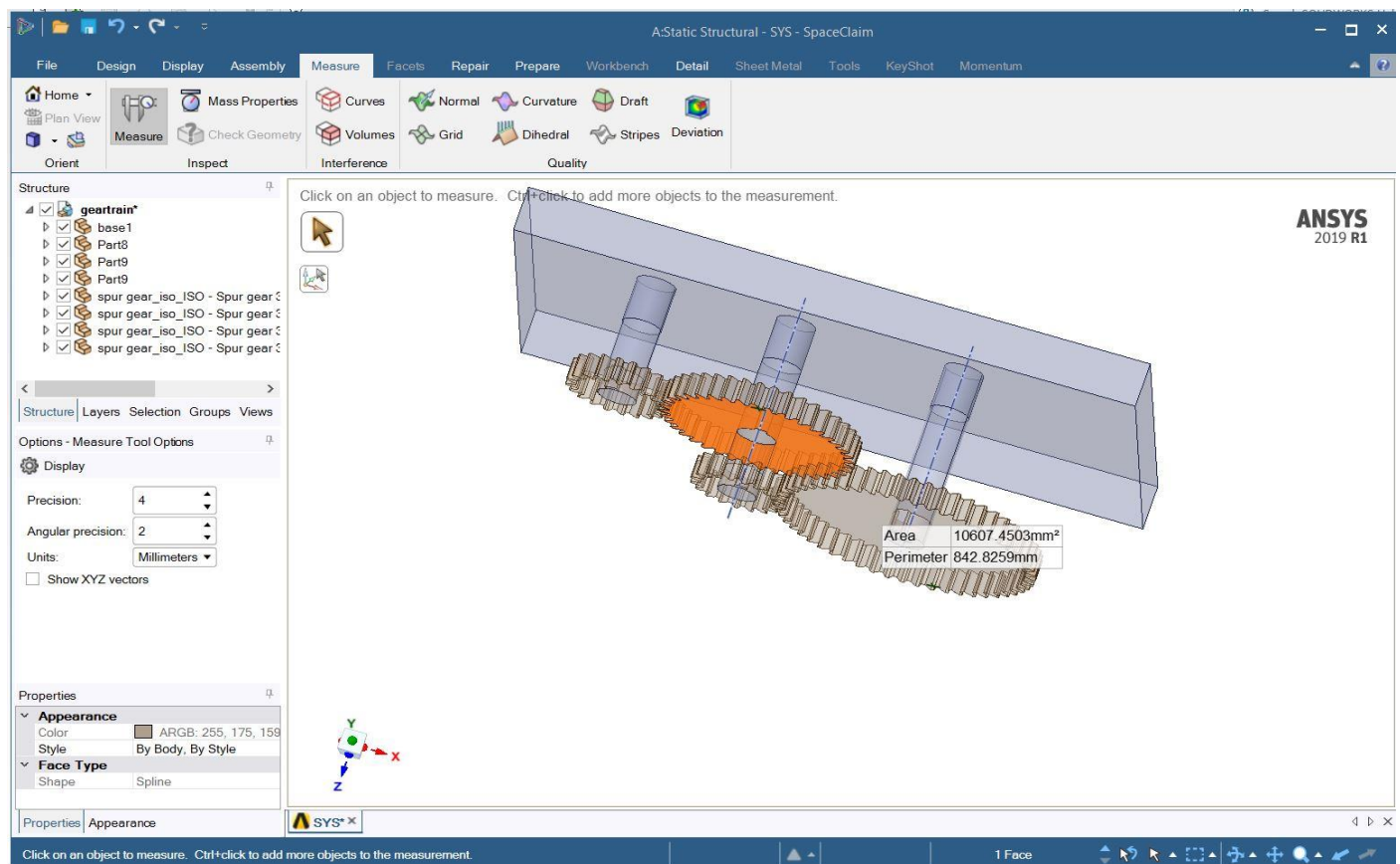

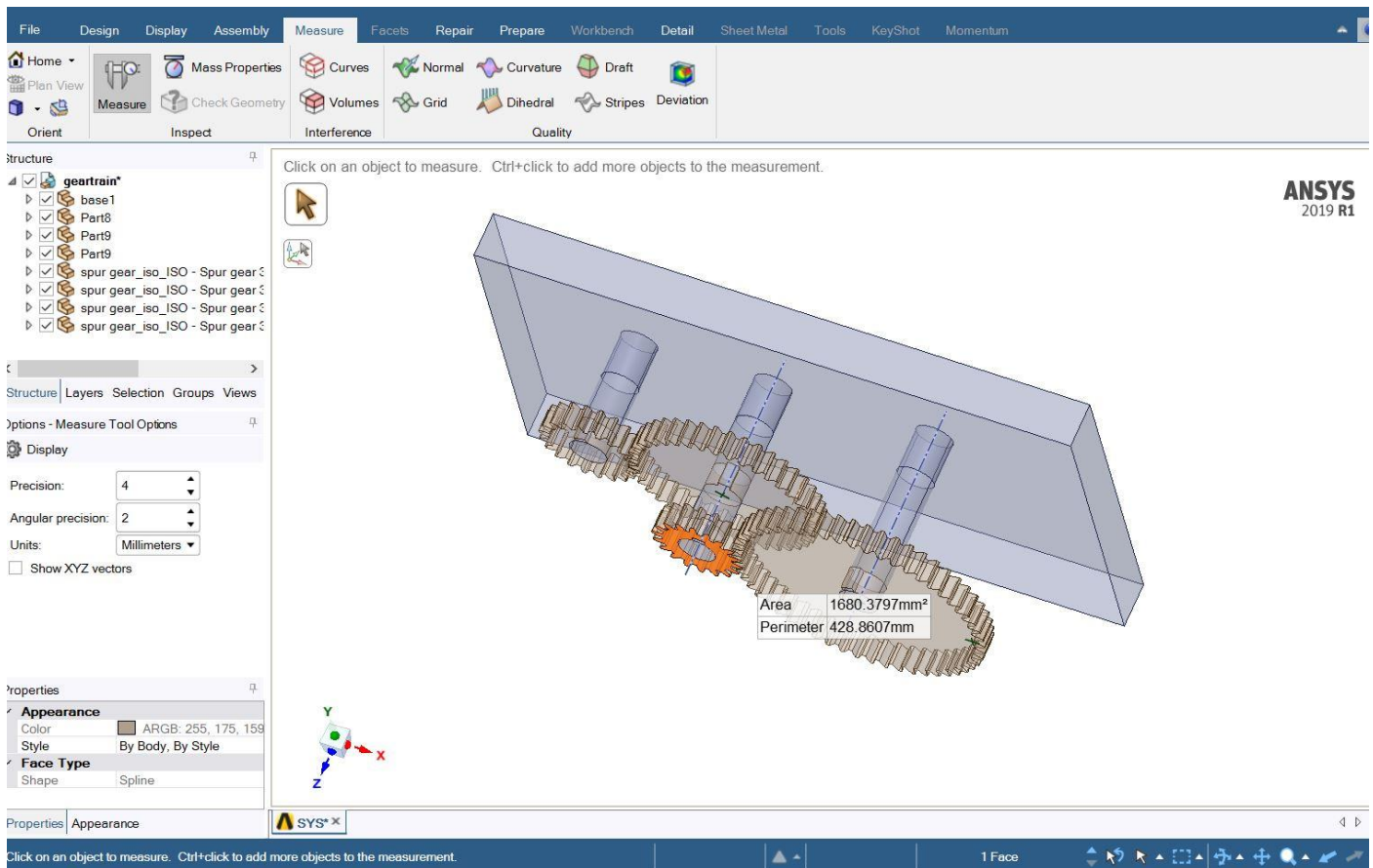**Fig:Gear 1**

Fig:Gear 2
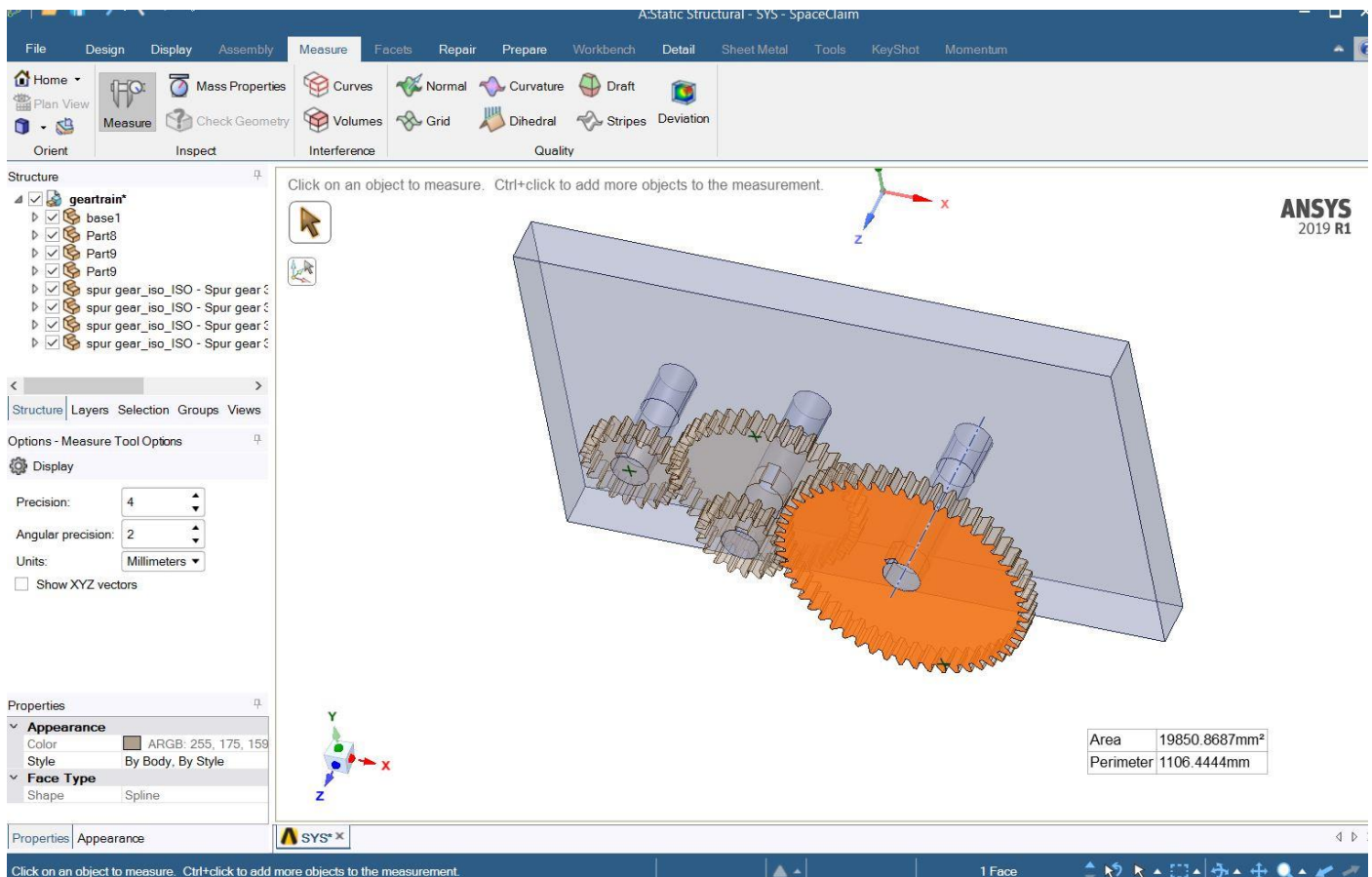
Fig:Gear 3

Fig:Gear 4

FORCE ANALYSIS ON SPUR GEAR:

ASSUMPTIONS:

Power Transmitted by driver=40KW

Speed of driver=3600 RPM

CALCULATIONS:

Formulas Used:

Power(W) =[2*3.141*speed(RPM)*Torque(N-m)]/60

Speed1/speed2 = Torque2/Torque1

Tangential Force(Ft)= (2*Torque)/pitch circle diamter

Radial Force(Fr) = Tangential force * tan(pressure angle)

Total force(Ft)= Tangential force / cos(pressure angle)

No.of teeth on gear 1 (Z1)= 20   pcd of Gear 1= 60mm

No.of teeth on gear 2 (Z2)= 40   pcd of Gear 2= 120mm

No.of teeth on gear 3(Z3)= 18   pcd of Gear 3= 54mm

No.of teeth on gear 4 (Z4)= 54   pcd of Gear 4= 162mm

Pressure Angle=20 degrees.

Torque on Gear 1(input Gear)=106.10 N-m

Torque on Gear 2 and Gear 2(intermidiate Gear)=212.20N-m

Torque on Gear 3(output Gear)=636.60 N-m

Force Analysis for Meshing Gears 1 and 2   **Force Analysis for Meshing Gears 3 and 4**

Tangential Force=3536.66 N   Tangential Force=7859.26N

Radial Force=1287.24 N   Radial Force=2860.53 N

Total Force on Tooth=3763.64N   Total Force on Tooth=8363.64N

Analysis has been done in the Other Pdf.