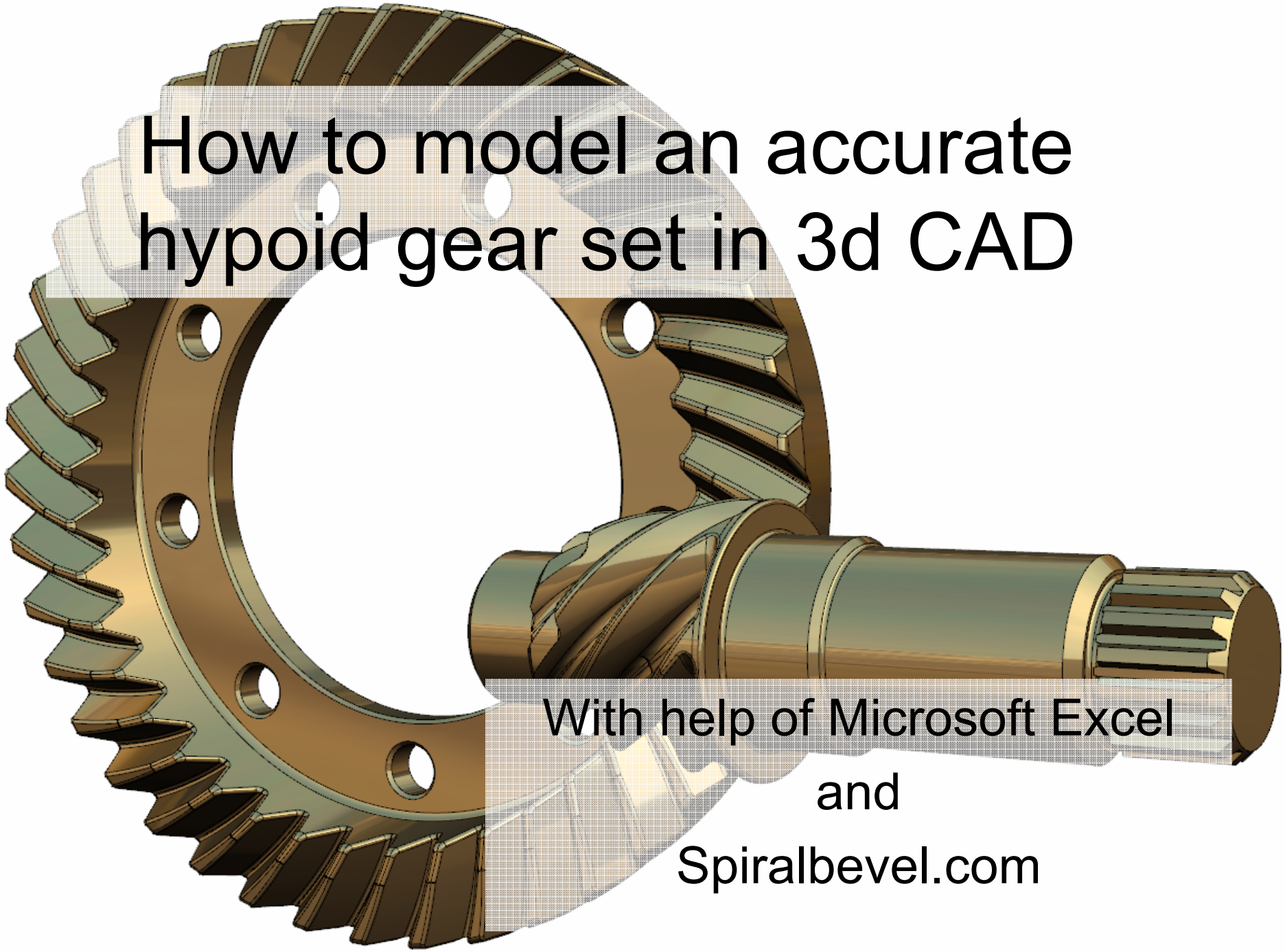
How to model an accurate hypoid gear set in 3d CAD



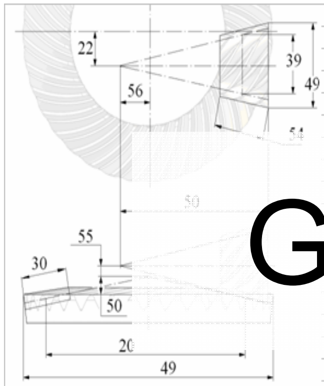
With help of Microsoft Excel

and

Spiralbevel.com

Generate 3d tooth surfaces.

Use hypoid Excel file from spiralbevel.com to generate gear tooth surfaces



STEP 1: Input:	
GEAR MEAN PITCH DIAMETER:	200.000
RATIO ([PINION RPM] / [GEAR RPM]):	5.833
HYPOID OFFSET	27.000
HAND OF SPIRAL ON GEAR (LEFT OR RIGHT):	RIGHT
UNITS (MM or INCH)	MM
CALCULATION ACCURACY [1,2,3,... ,N]	2

STEP 2: Input:		Suggestions:
NUMBER OF TEETH ON PINION:	6	6
NUMBER OF TEETH ON GEAR:	35	35
GEAR FACE WIDTH:	47	46.80869
PRESSURE ANGLE [DEG]:	25	22.50000
GEAR MEAN SPIRAL ANGLE [DEG]:	35	35.00000
PINION COEFFICIENT OF ADDENDUM	1.20000	1.68200
COEFFICIENT OF TOOTH DEPTH:	2.25000	[illegible]
PINION MEAN TRANSVERSE CIRCULAR TOOTH THICKNESS	[illegible]	[illegible]
NORMAL MEAN BACKLASH	[illegible]	[illegible]
GEAR FACE ANGLE	[illegible]	83.34300
GEAR ROOT ANGLE	77.59592497	77.59592
PINION MEAN PITCH DIAMETER	44.13867	[illegible]
PINION FACE ANGLE	[illegible]	[illegible]
PINION ROOT ANGLE	[illegible]	[illegible]
FACE CUTTER GENERATING DIAMETER:	200.000	200.00000
PROFILE CROWNING:	0	0.02005
LEAD CROWNING:	0	0.02864
% FROM TOE TO MEAN POINT OF CONTACT [0,1]	0.4	0.40000
% FROM GEAR TOOTH TIP TO MEAN POINT OF CONTACT [0,1]	0.4	0.50000

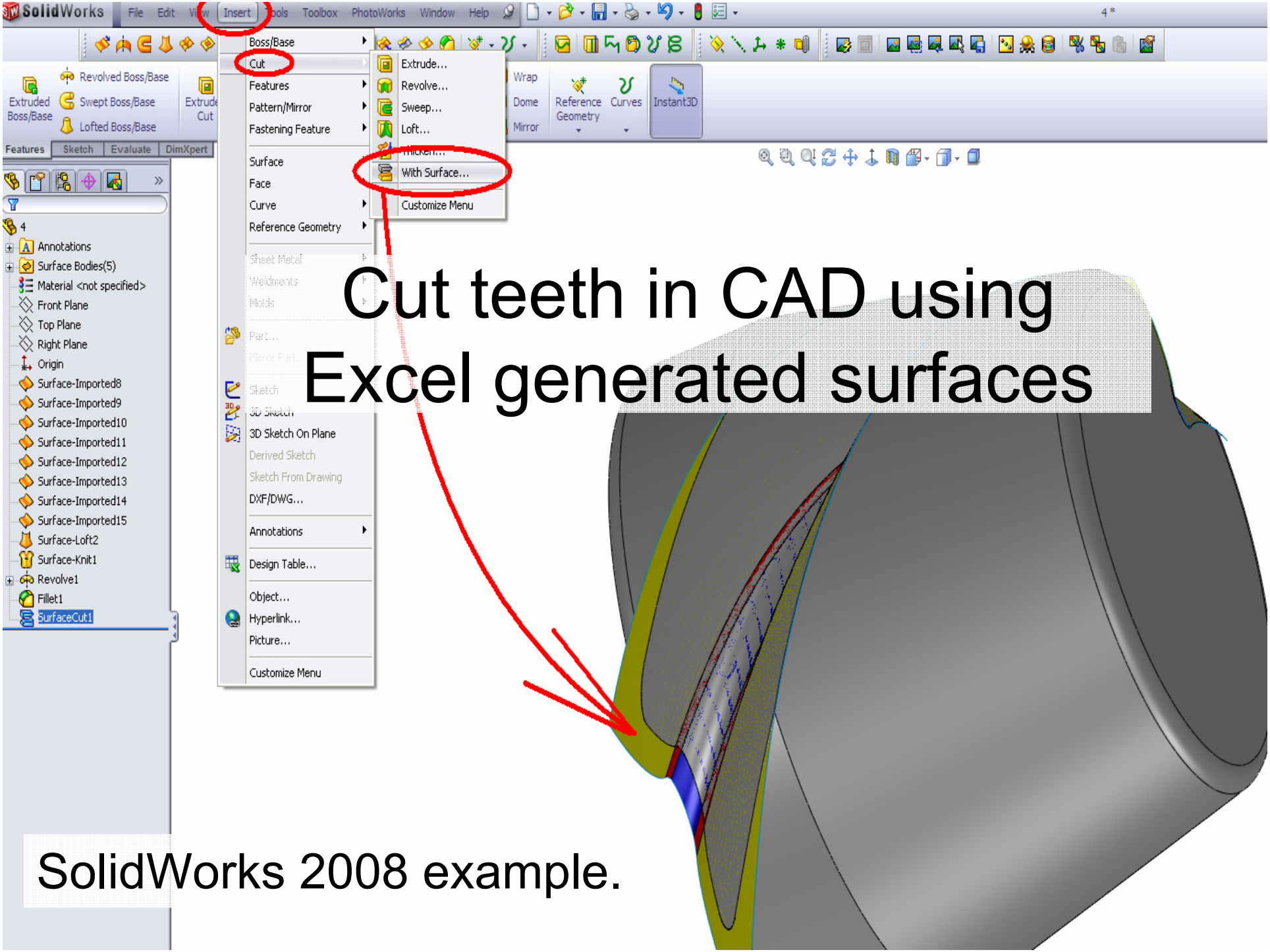
Output:	GEAR	PINION
OUTSIDE DIAMETER	247.8220569	65.33893868
PITCH APEX TO CROWN	14.09035596	174.8634814
NORMAL CHORDAL MEAN TOOTH THIKNESS	6.625601093	7.908219216
DISTANCE TO MEAN POINT FROM TOP LAND	3.742620261	5.605389422
HEEL PITCH DIAMETER	246.4759098	51.09984308
FACE WIDTH	47	48.89480042
AXIS OFFSET FROM GEAR PITCH APEX	0	7.009934676
PINION PITCH APEX OFFSET FROM GEAR AXIS	0	55.65373591

Version 04.18.17_Hypoid http://www.spiralbevel.com/

Radial clearance coeffitient	0.2500000	1.170217206
Input Amount of normal tooth thickness correction	0.8730900	
Input Amount of tool correction	0.9361738	
Input coefficient of tool correction	0.2000000	
Gear toe addendum	2.9544666	
Gear Heel addendum	4.5196783	
Pinion heel dedendum	5.6898955	
Pinion toe dedendum	4.1246833	
Pinion toe addendum	4.0398222	
Gear toe dedendum	5.2100394	
[illegible]	[illegible]	
Gear heel dedendum	[illegible]	
Pinion circular space without backlash	[illegible]	
Pinion circular backlash	0.2696351	
Suggested Amount of normal tooth thickness cor	2.9772369	
Suggested Amount of tool correction	3.1923525	
Suggested Cefficient of tool correction	0.6820000	
Gear coefficient of dedendum	0.8000000	
Gear circle normal tooth thickness	3.3426479	
Gear circulat tooth thickness	4.0806196	
Suggested Pinion coefficient of addendum	1.6820000	
Gear/pinion circular pitch	17.9519580	
epsilon	0.2643906	15.14846625
Tetta	0.0393347	2.253709971
Tetta shtrikh	0.0393337	2.253653954
Coeffitient of hypoid offset	0.1350000	
gear pitch angle	1.4213196	81.435616358
Gear mean circular module	5.7142857	
Mean normal module	4.6808688	
Gear mean addendum	3.7446951	
Gear mean cone distance	101.1276599	
Gear addendum angle	0.0332901	1.907380732
Gear face angle	83.3429971	4775.201985
Gear mean dedendum	6.7872598	
Gear dedendum angle	[illegible]	[illegible]
Gear root angle	[illegible]	
Pinion mean spiral angle	50.4851691	0.881132773
Gear max cone distance	124.6276599	
Gear min cone distance	77.6276599	
[illegible] width	[illegible]	
Half pinion angular tooth thickness	[illegible]	[illegible]
Half gear angular tooth thickness	0.0404418	1.415463954
Pinion pitch cone angle	0.1442457	8.264668082
Pinion axial from mean to heel	23.9578596	
Mean clearance	1.1702172	
Pinion mean addendum	5.6170426	5.6053894
Pinion mean dedendum	4.9149123	
Pinion mean cone distance	153.5342801	
Pinion max cone distance	177.7435623	
From gear axis to pinion mean along pinion axis	96.2860322	
Pinion heel addendum	7.1942630	
Pinion addendum angle	0.0644256	3.691313036
Pinion min cone distance	128.8487619	
Pinion Dedendum angle	0.0320009	1.833516246
From pinion axis to gear apex	7.0099347	
From pinion apex to gear axis	55.6537359	
From gear axis to pinion toe	71.8568825	
Generating gear min cone distance	64.7417265	
Generating gear face width	107.4221785	
Generating gear max cone distance	172.1639051	170.2441303
From gear axis to pinion heel	120.2438919	
Cutter radial distance	92.8758044	
Cutter radius reduction on addendum	1.5825765	
Pinion mean normal circular space	6.7971639	

STEP 3: Optional Input:		Suggestions:
Remove some profile points from root	1	1

Excel file generates one surface for each gear tooth flank and three surfaces for each pinion tooth flank.


SolidWorks
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Weldments
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Mirror Part...
Sketch
3D Sketch
3D Sketch On Plane
Derived Sketch
Sketch From Drawing
DXF/DWG...
Annotations
Design Table...
Object...
Hyperlink...
Picture...
Customize Menu
Extrude...
Revolve...
Sweep...
Loft...
Thicken...
With Surface...
Customize Menu
Revolved Boss/Base
Swept Boss/Base
Lofted Boss/Base
Extruded Boss/Base
Extruded Cut
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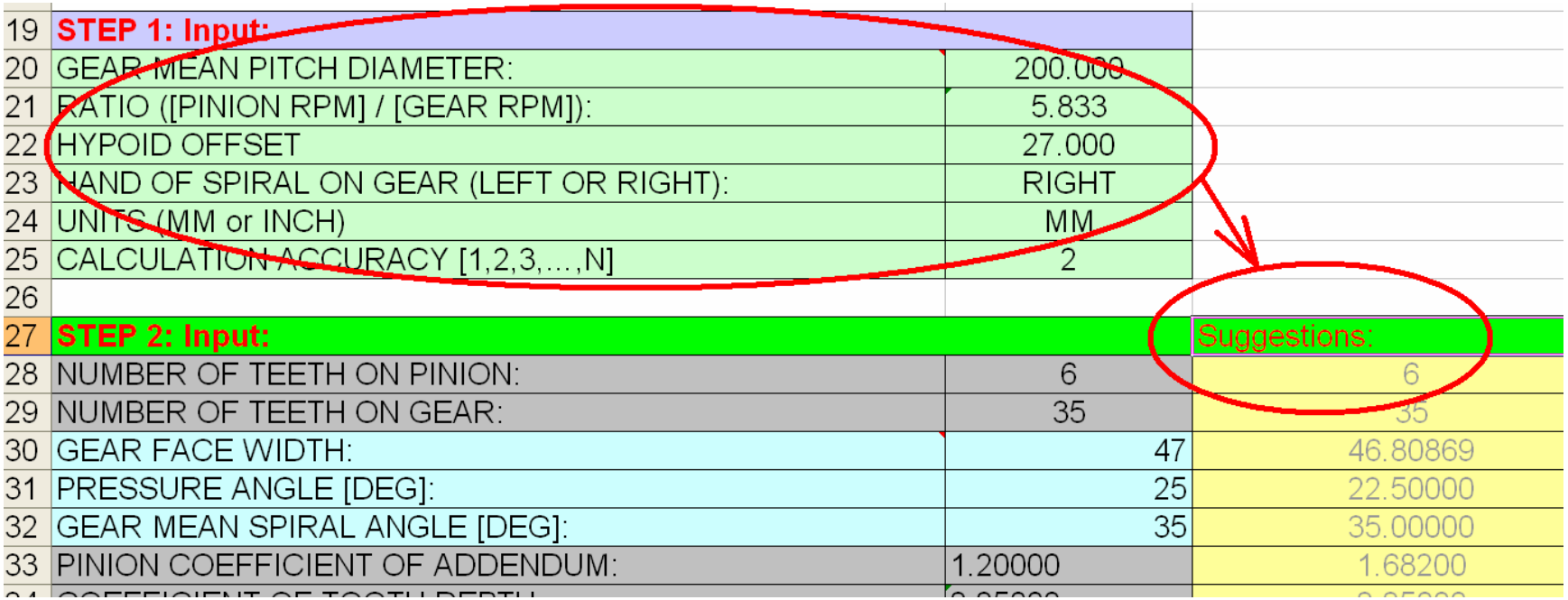
Dome
Mirror
Reference Geometry
Curves
Instant3D
Features
Sketch
Evaluate
DimXpert
4
Annotations
Surface Bodies(5)
Material <not specified>
Front Plane
Top Plane
Right Plane
Origin
Surface-Imported8
Surface-Imported9
Surface-Imported10
Surface-Imported11
Surface-Imported12
Surface-Imported13
Surface-Imported14
Surface-Imported15
Surface-Loft2
Surface-Knit1
Revolve1
Fillet1
SurfaceCut1
Cut teeth in CAD using
Excel generated surfaces
SolidWorks 2008 example.

Why Excel?

- Easy to use. Reduce training cost.
- No installation cost.
- No approval required from IT department.
- Customize your own interface.
- Add you own formulas.
- Change to your preferred language.
- Easy to copy and give it to a friend to evaluate.
- Simple way to store digital master gear. Excel generates exactly the same digital master for the same input data.

Why spiralbevel.com

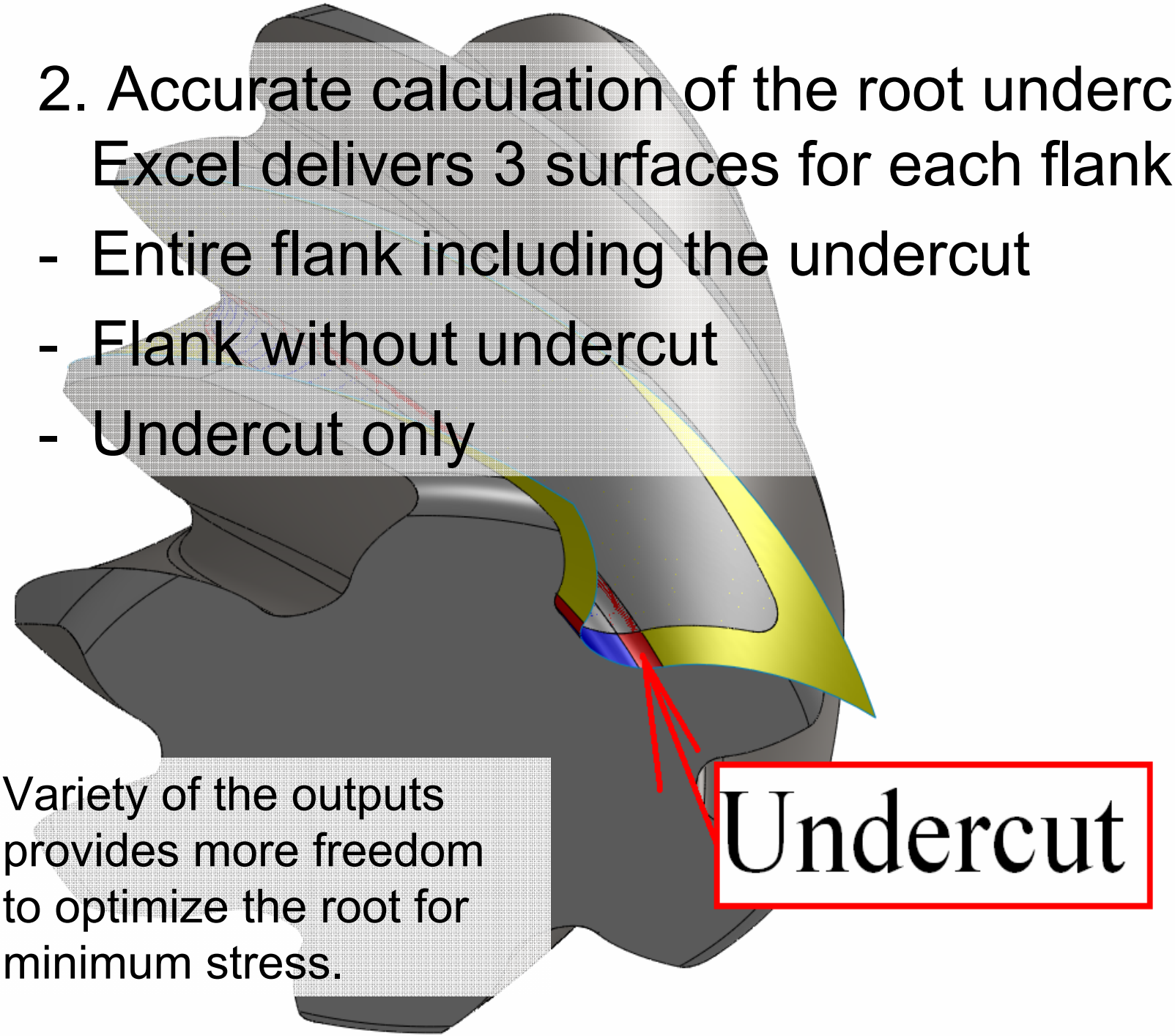
1. No gear experience needed. Just start entering what you know and the program will recommend the remaining gear data.



19	**STEP 1: Input:**		
20	GEAR MEAN PITCH DIAMETER:	200.000	
21	RATIO ([PINION RPM] / [GEAR RPM]):	5.833	
22	HYPOID OFFSET	27.000	
23	HAND OF SPIRAL ON GEAR (LEFT OR RIGHT):	RIGHT	
24	UNITS (MM or INCH)	MM	
25	CALCULATION ACCURACY [1,2,3,…,N]	2	
26			
27	**STEP 2: Input:**		Suggestions:
28	NUMBER OF TEETH ON PINION:	6	6
29	NUMBER OF TEETH ON GEAR:	35	35
30	GEAR FACE WIDTH:	47	46.80869
31	PRESSURE ANGLE [DEG]:	25	22.50000
32	GEAR MEAN SPIRAL ANGLE [DEG]:	35	35.00000
33	PINION COEFFICIENT OF ADDENDUM:	1.20000	1.68200

2. Accurate calculation of the root undercut.
   Excel delivers 3 surfaces for each flank:

- Entire flank including the undercut
- Flank without undercut
- Undercut only



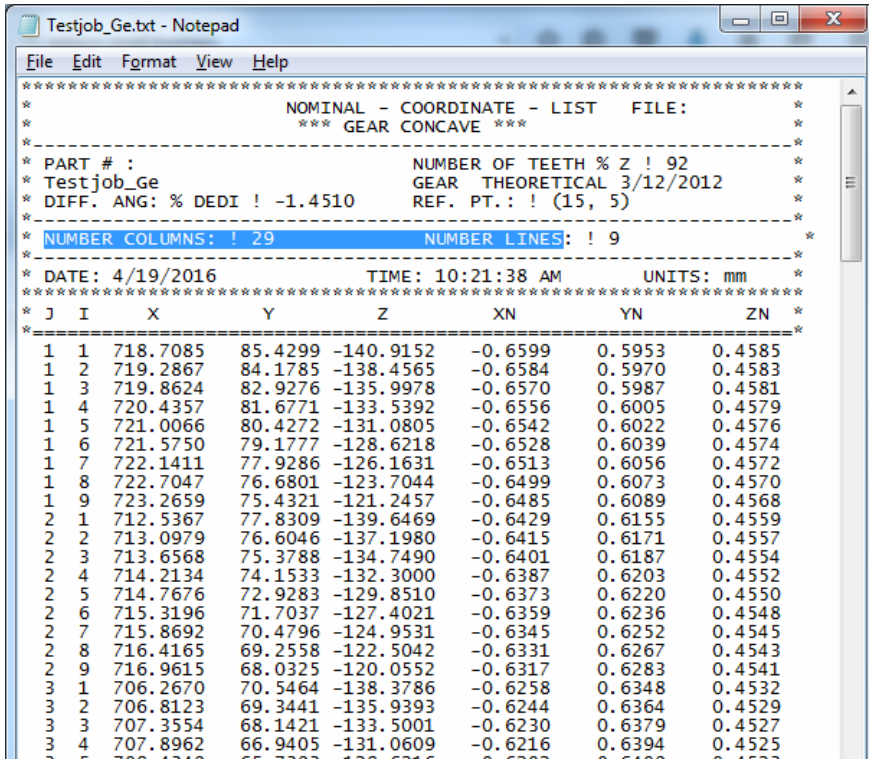
Variety of the outputs provides more freedom to optimize the root for minimum stress.

3. Select calculation accuracy (model resolution) in Excel. “2” is good for production gears. “4” is good for digital master used in CMM inspection.

19	**STEP 1: Input:**		
20	GEAR MEAN PITCH DIAMETER:	200.000	
21	RATIO ([PINION RPM] / [GEAR RPM]):	5.833	
22	HYPOID OFFSET	27.000	
23	HAND OF SPIRAL ON GEAR (LEFT OR RIGHT):	RIGHT	
24	UNITS (MM or INCH)	MM	
25	CALCULATION ACCURACY [1,2,3,…,N]	2	
26			
27	**STEP 2: Input:**		Suggestion
28	NUMBER OF TEETH ON PINION:	6	

4. Nominal data file is used for CMM inspection of spiral bevel and hypoid gears.

It is also used as a master gear to derive original gear machine summary if gear needs to be cut on a gear generating machine such as Gleason or Klingelnberg.



Testjob_Ge.txt - Notepad

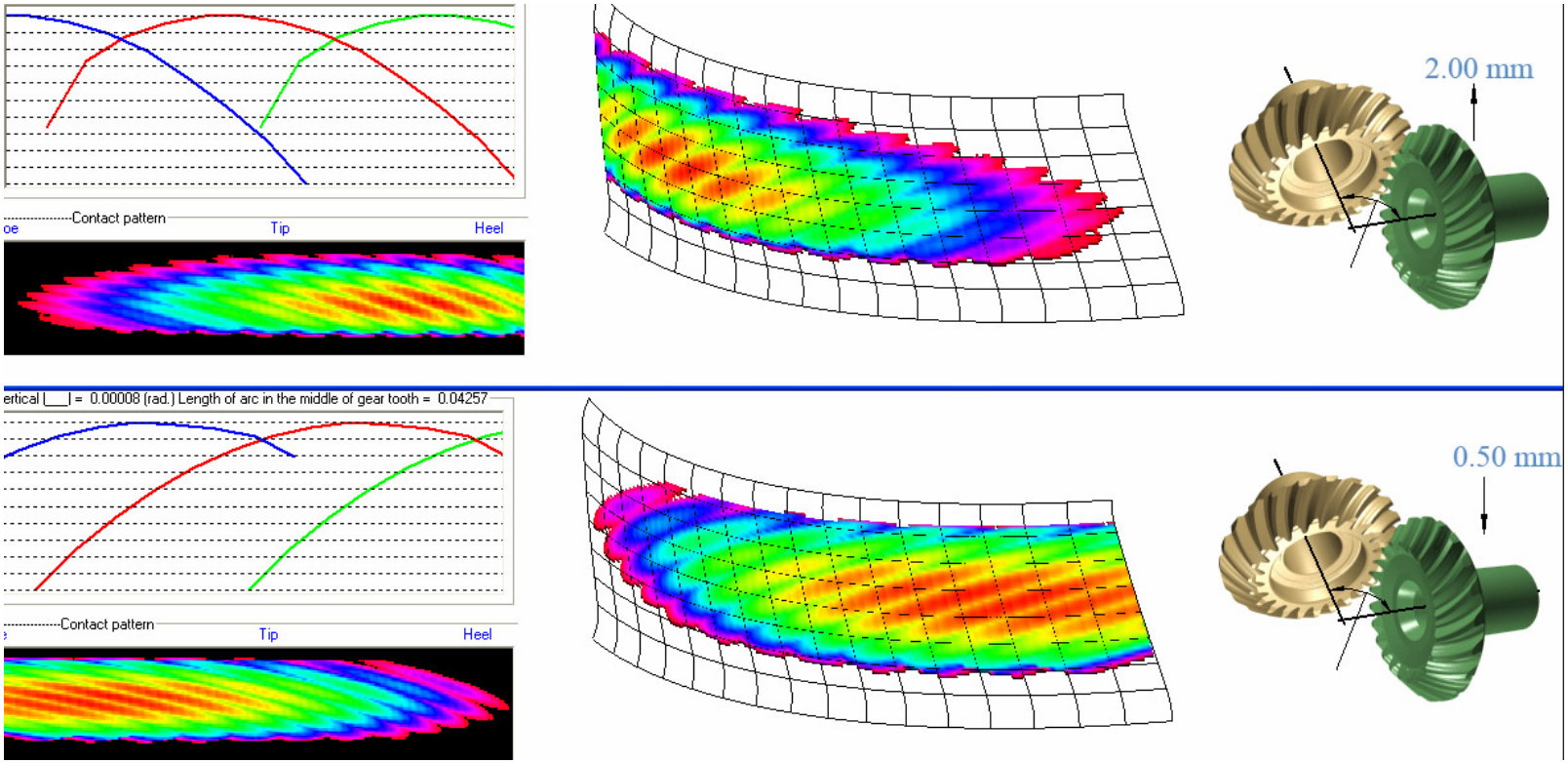
File Edit Format View Help

```
*************************************************************************
*                      NOMINAL - COORDINATE - LIST   FILE:              *
*                        *** GEAR CONCAVE ***                           *
*-----------------------------------------------------------------------*
* PART # :                          NUMBER OF TEETH % Z ! 92             *
* Testjob_Ge                        GEAR  THEORETICAL 3/12/2012          *
* DIFF. ANG: % DEDI ! -1.4510       REF. PT.: ! (15, 5)                  *
*-----------------------------------------------------------------------*
* NUMBER COLUMNS: ! 29              NUMBER LINES: ! 9                    *
*-----------------------------------------------------------------------*
* DATE: 4/19/2016             TIME: 10:21:38 AM       UNITS: mm         *
*************************************************************************
* J  I      X          Y          Z          XN         YN         ZN    *
*=======================================================================*
  1  1   718.7085   85.4299 -140.9152   -0.6599    0.5953    0.4585
  1  2   719.2867   84.1785 -138.4565   -0.6584    0.5970    0.4583
  1  3   719.8624   82.9276 -135.9978   -0.6570    0.5987    0.4581
  1  4   720.4357   81.6771 -133.5392   -0.6556    0.6005    0.4579
  1  5   721.0066   80.4272 -131.0805   -0.6542    0.6022    0.4576
  1  6   721.5750   79.1777 -128.6218   -0.6528    0.6039    0.4574
  1  7   722.1411   77.9286 -126.1631   -0.6513    0.6056    0.4572
  1  8   722.7047   76.6801 -123.7044   -0.6499    0.6073    0.4570
  1  9   723.2659   75.4321 -121.2457   -0.6485    0.6089    0.4568
  2  1   712.5367   77.8309 -139.6469   -0.6429    0.6155    0.4559
  2  2   713.0979   76.6046 -137.1980   -0.6415    0.6171    0.4557
  2  3   713.6568   75.3788 -134.7490   -0.6401    0.6187    0.4554
  2  4   714.2134   74.1533 -132.3000   -0.6387    0.6203    0.4552
  2  5   714.7676   72.9283 -129.8510   -0.6373    0.6220    0.4550
  2  6   715.3196   71.7037 -127.4021   -0.6359    0.6236    0.4548
  2  7   715.8692   70.4796 -124.9531   -0.6345    0.6252    0.4545
  2  8   716.4165   69.2558 -122.5042   -0.6331    0.6267    0.4543
  2  9   716.9615   68.0325 -120.0552   -0.6317    0.6283    0.4541
  3  1   706.2670   70.5464 -138.3786   -0.6258    0.6348    0.4532
  3  2   706.8123   69.3441 -135.9393   -0.6244    0.6364    0.4529
  3  3   707.3554   68.1421 -133.5001   -0.6230    0.6379    0.4527
  3  4   707.8962   66.9405 -131.0609   -0.6216    0.6394    0.4525
```

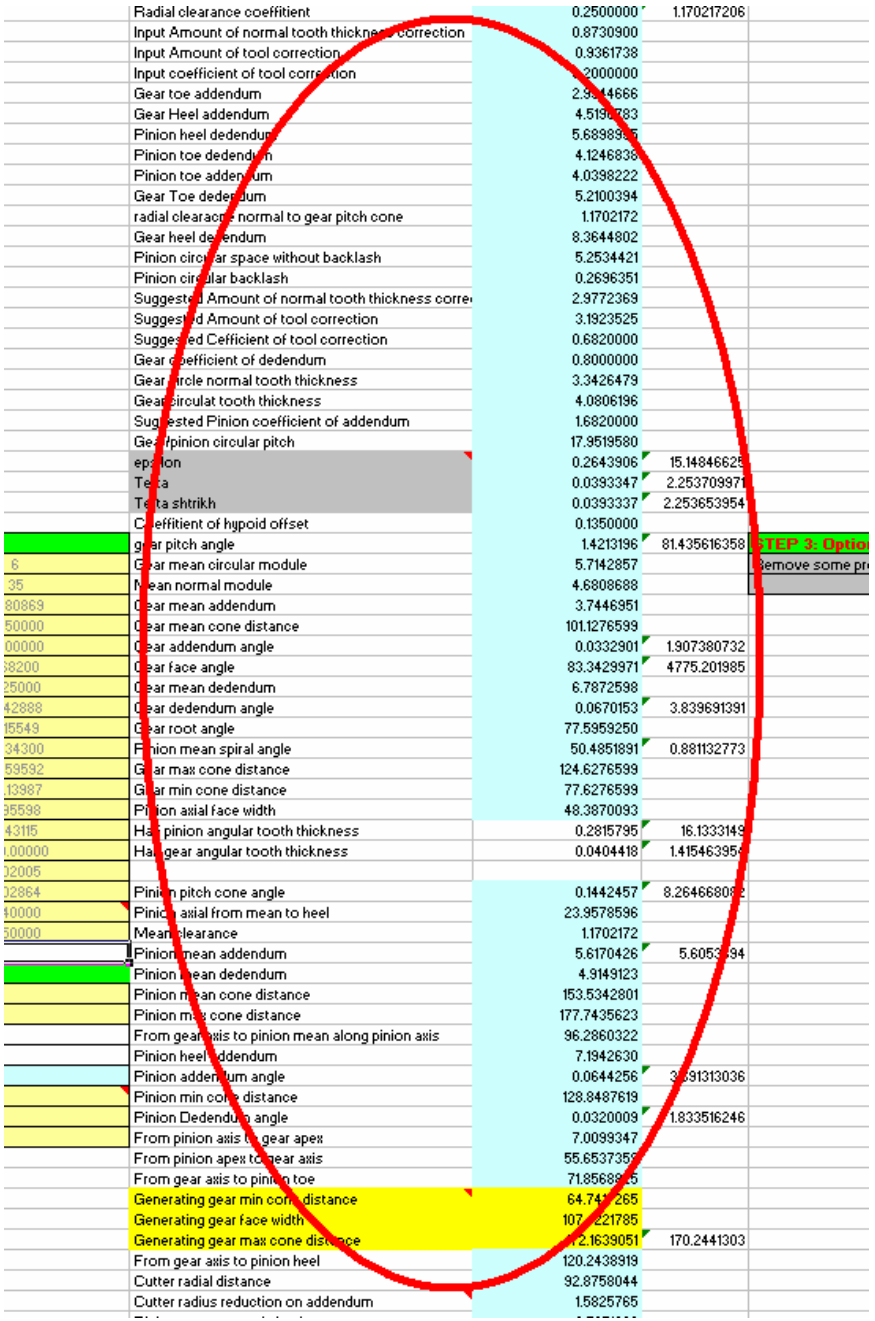
5. Easy tooth contact pattern development. Just enter amount of crowning on lead and profile with the relevant position of the center of the contact. The program automatically generates an ideal tooth contact for quietest roll and highest endurance.

38	GEAR ROOT ANGLE	77.59592497	77.59592
39	PINION MEAN PITCH DIAMETER	44.13987	44.13987
40	PINION FACE ANGLE	11.95598	11.95598
41	PINION ROOT ANGLE	6.43115	6.43115
42	FACE CUTTER GENERATING DIAMETER:	200.000	200.00000
43	PROFILE CROWNING:	0	0.02005
44	LEAD CROWNING:	0	0.02864
45	% FROM TOE TO MEAN POINT OF CONTACT [0,1]	0.4	0.40000
46	% FROM GEAR TOOTH TIP TO MEAN POINT OF CONTACT [0,	0.4	0.50000
47			
48	**Output:**	**GEAR**	**PINION**
49	OUTSIDE DIAMETER	247.8220569	65.33893868

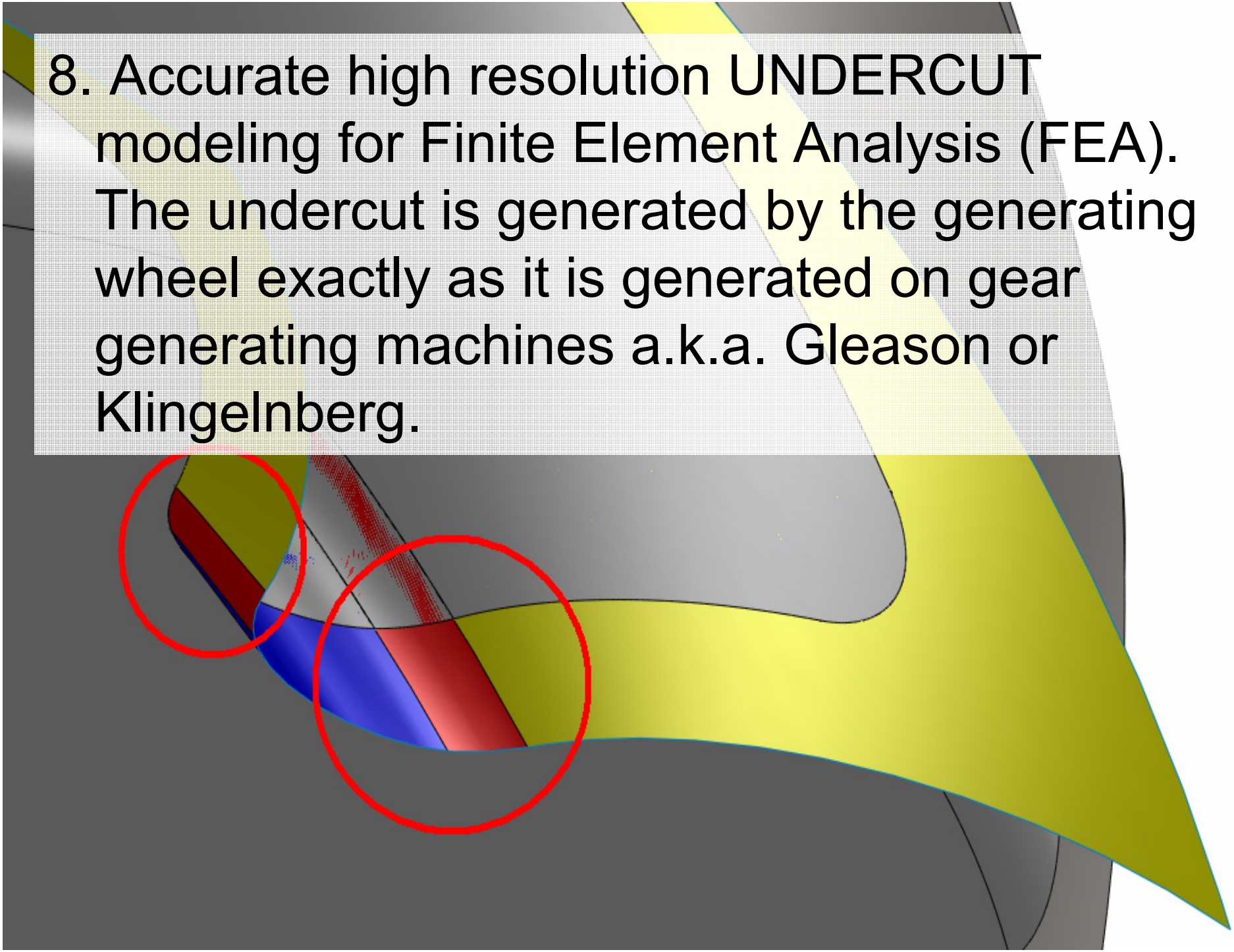
6. Communication with advanced Tooth Contact Analysis (TCA) program from spiralbevel.com for more detailed TCA such as VH and α in 3d animation.



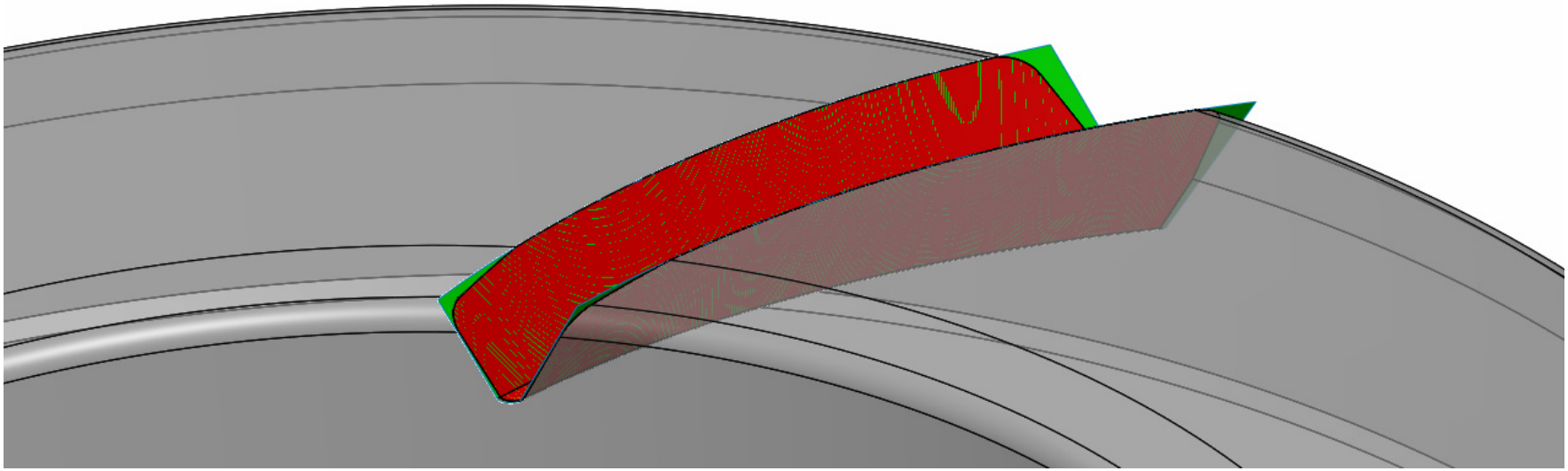
7. Tooth geometry calculation formulas provided if needed for study and customization for each unique project



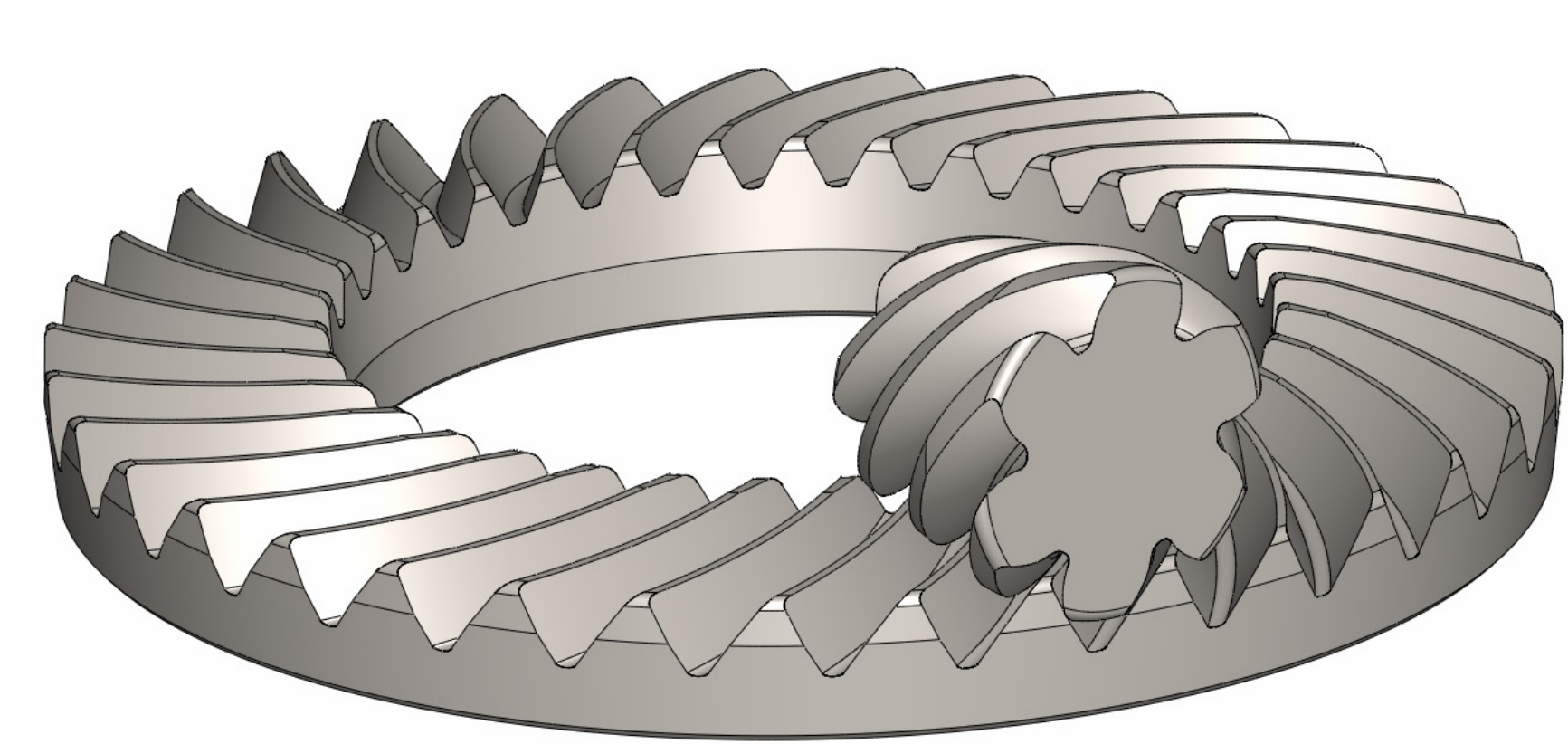
8. Accurate high resolution UNDERCUT modeling for Finite Element Analysis (FEA). The undercut is generated by the generating wheel exactly as it is generated on gear generating machines a.k.a. Gleason or Klingelnberg.



9. Easy to machine ring gear tooth. No need 5 axis. Can be machined by a form cutter in one pass due to constant cross section of the tooth slot. This method is also known as FORMATE per Gleason.



10. Comparable with any CAD software. Excel generates 3d surface file in iges protocol that is used in any CAD/CAM




Spiral Bevel Corporation
2017