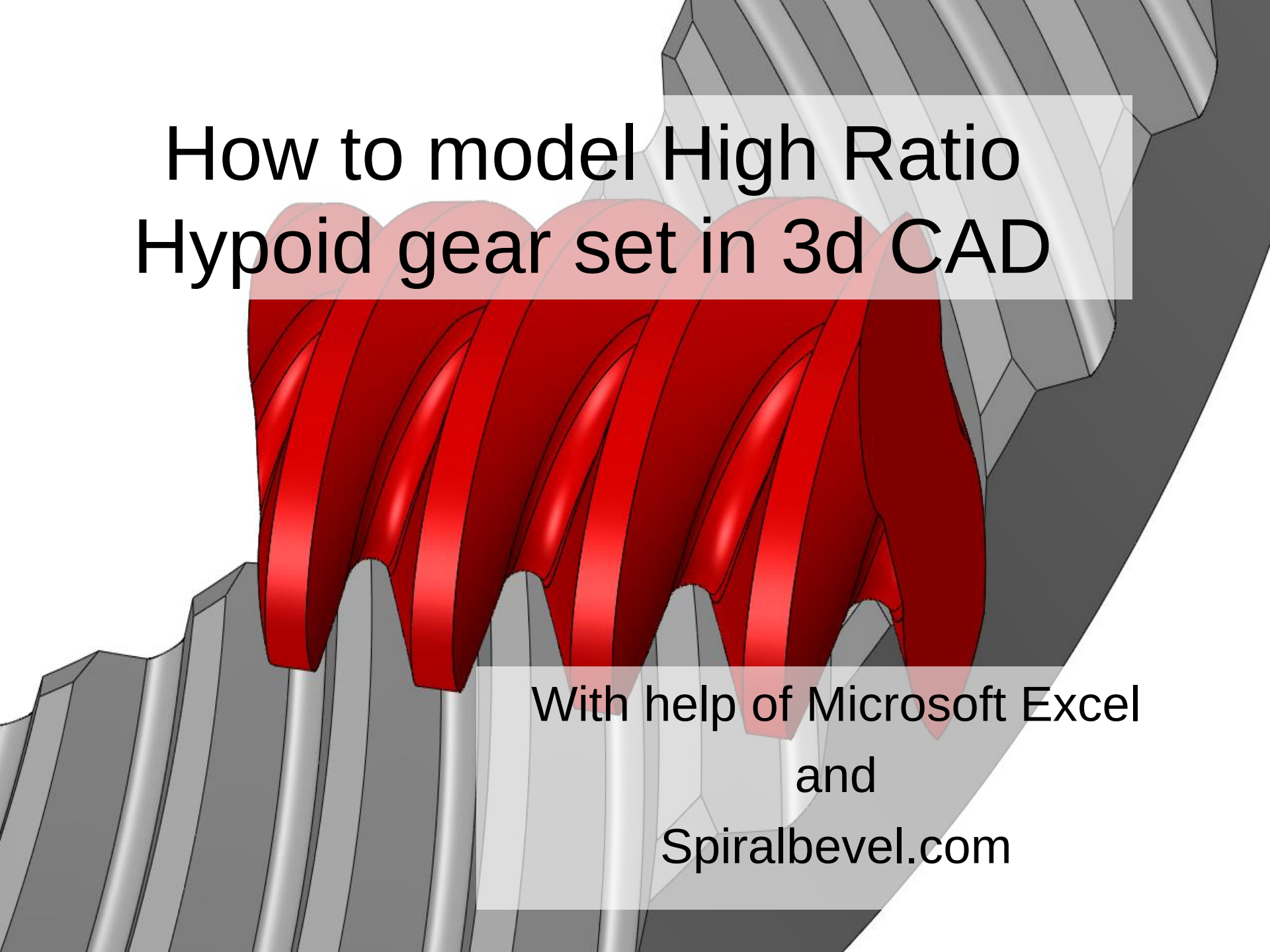
How to model High Ratio Hypoid gear set in 3d CAD



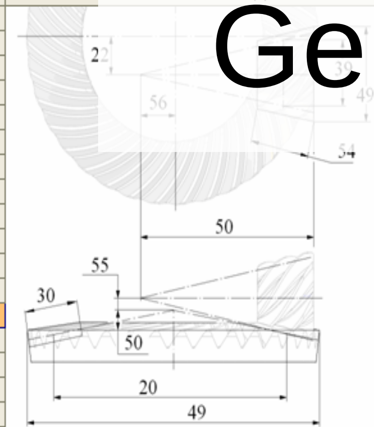
With help of Microsoft Excel

and

Spiralbevel.com

Generate 3d tooth surfaces.

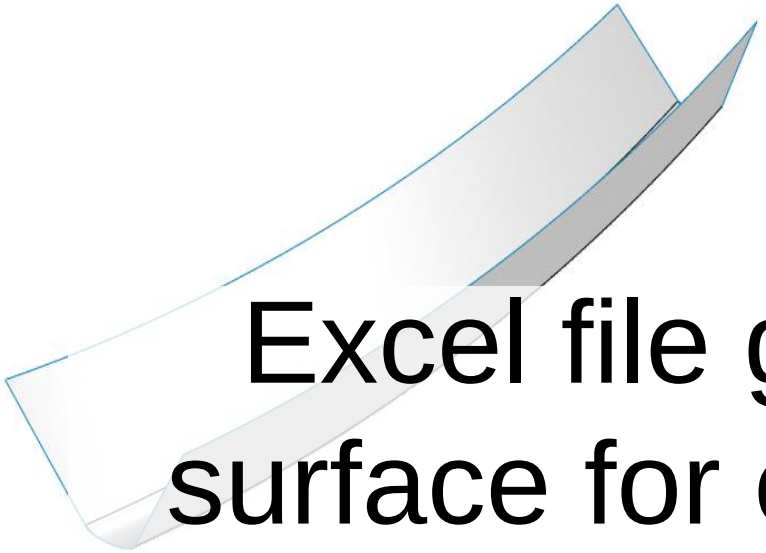
Microsoft Excel - High ratio Hypoid_5_04_17_DEVELOPMENT.xls

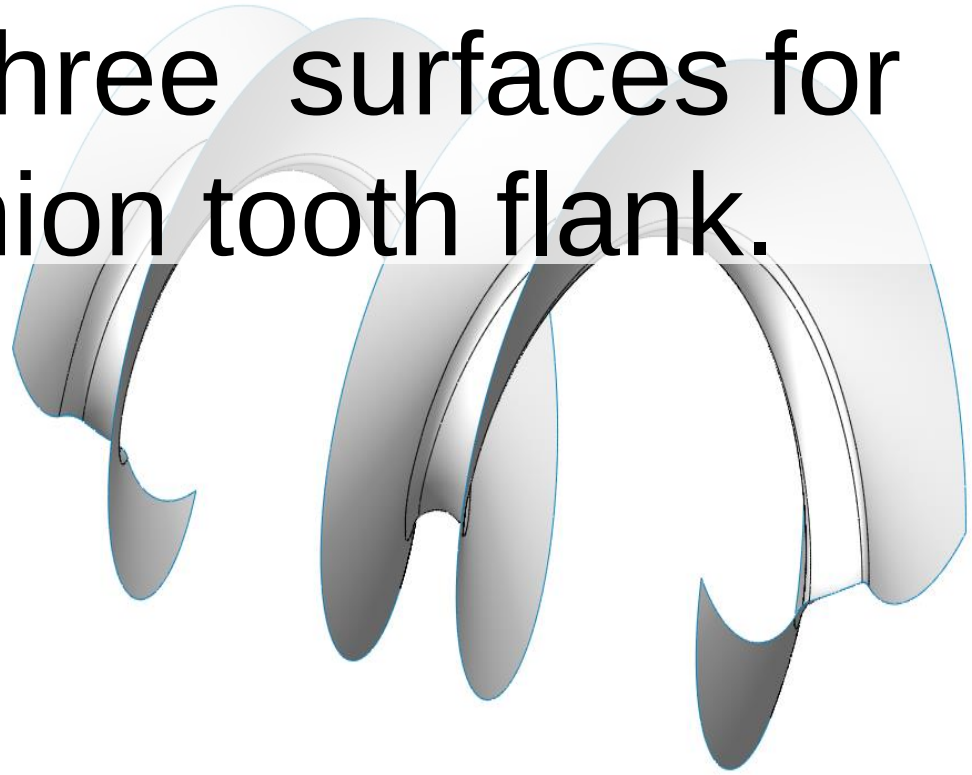


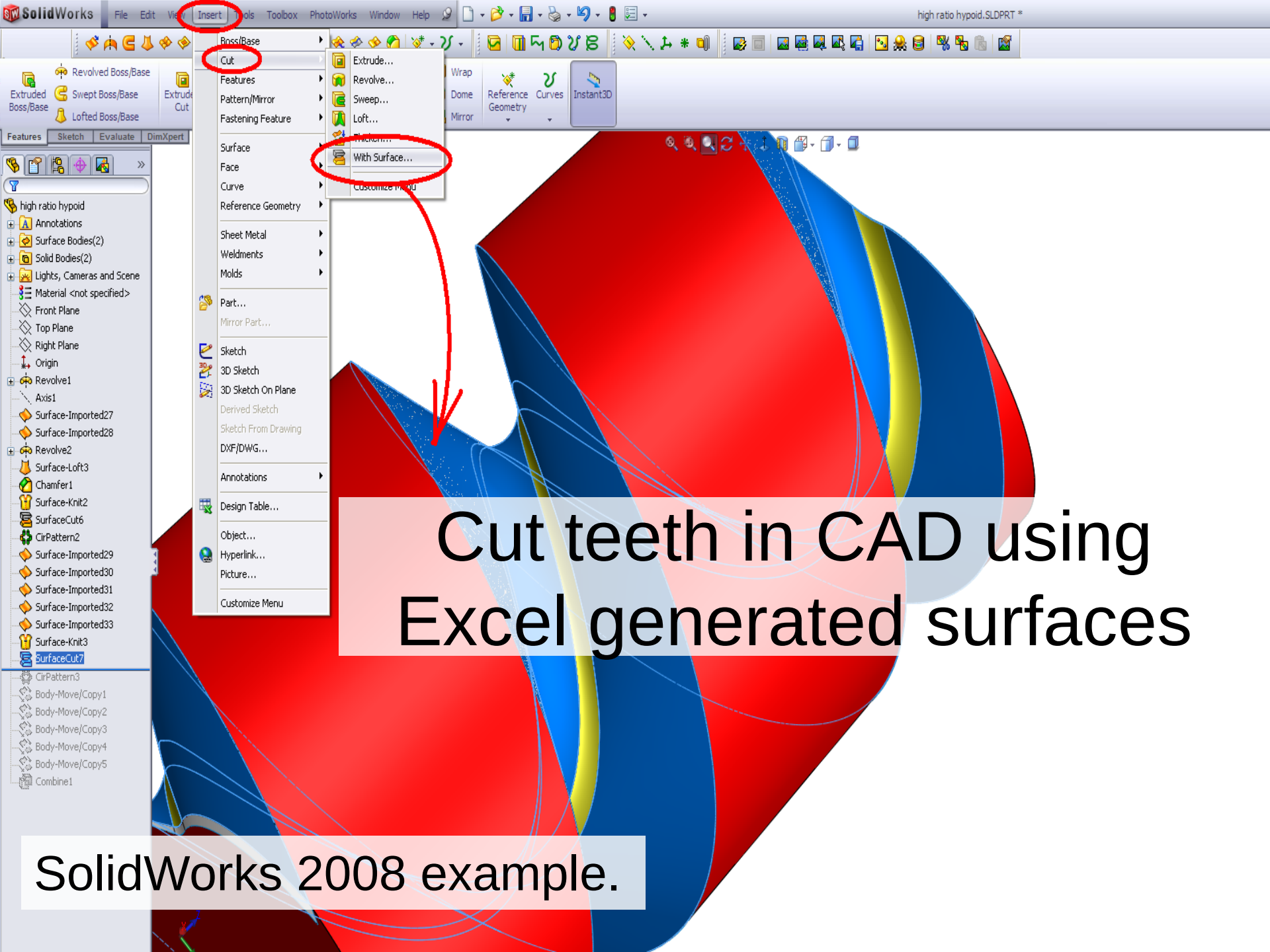
	A	B	C	D	E	F	G
1				Radial clearance coeffi[illegible]	0.2000000	0.819152044	
2				Input Amount of normal tooth thickness correction	[illegible]		
3				Input Amount of tool correction	[illegible]		
4				Input coefficient of tool correction	-0.2000000		
5				Gear toe addendum	3.7994860		
6				Gear Heel addendum	4.3574734		
7				Pinion heel dedendum	5.1766254		
8				Pinion toe dedendum	4.6186381		
9				Pinion toe addendum	2.4580012		
10				Gear Toe dedendum	3.2771533		
11				radial clearacne normal to gear pitch cone	0.8191520		
12				Gear heel dedendum	4.9143672		
13				Pinion circular space without backlash	-4.8076170		
14				Pinion circular backlash	0.5504984		
15				Suggested Amount of normal tooth thickness corr	2.3140525		
16				Suggested Amount of tool correction	2.7933085		
17				Suggested Cefficient of tool correction	0.6820000		
18				Gear coefficient of dedendum	1.0000000		
19	STEP 1: Input:			Gear circle normal tooth thickness	-1.4982937		
20	GEAR MEAN PITCH DIAMETER:	200.000		Gear circulat tooth thickness	-1.8290788		
21	RATIO ([PINION RPM] / [GEAR RPM]):	20.000		Suggested Pinion coefficient of addendum	1.6820000		
22	HYPOID OFFSET	60.000		Gear/pinion circular pitch	15.7079633		
23	HAND OF SPIRAL ON GEAR (LEFT OR RIGHT):	RIGHT		epsilon	0.6399262	36.66507291	
24	UNITS (MM or INCH)	MM	Calculation progress [%]	Tetta	0.0217920	1.248590998	
25	CALCULATION ACCURACY [1,2,3,...,N]	4	100	Tetta shtrikh	0.0217920	1.248589583	
26				Coeffitient of hypoid offset	0.3000000		
27	STEP 2: Input:		Suggestions:	gear pitch angle	1.5343125	87.909632016	STEP 3: Optional Input:
28	NUMBER OF TEETH ON PINION:	2	6	Gear mean circular module	5.0000000		Remove some profile points from root
29	NUMBER OF TEETH ON GEAR:	40	120	Mean normal module	4.0957602		
30	GEAR FACE WIDTH:	40	40.95760	Gear mean addendum	4.0957602		
31	PRESSURE ANGLE [DEG]:	22.5	22.50000	Gear mean cone distance	100.0665903		
32	GEAR MEAN SPIRAL ANGLE [DEG]:	35	35.00000	Gear addendum angle	0.0139488	0.799206168	
33	PINION COEFFICIENT OF ADDENDUM:	0.80000	1.68200	Gear face angle	[illegible]	[illegible]	
34	COEFFICIENT OF TOOTH DEPTH:	[illegible]	[illegible]	Gear mean dedendum	[illegible]		
35	PINION MEAN TRANSVERS CIRCULAR TOOTH THICKNESS	19.56508	[illegible]	Gear dedendum angle	[illegible]	[illegible]	
36	NORMAL MEAN BACKLASH	0.15850	[illegible]	Gear root angle	[illegible]		
37	GEAR FACE ANGLE	[illegible]	[illegible]	Pinion mean spiral angle	[illegible]	[illegible]	
38	GEAR ROOT ANGLE	85.56580	85.56580	Gear max cone distance	[illegible]		
39	PINION MEAN PITCH DIAMETER	26.28436	26.28436	Gear min cone distance	80.0665903		
40	PINION FACE ANGLE	3.51553	3.51553	Pinion axial face width	50.9725343		
41	PINION ROOT ANGLE	1.04972	1.04972	Half pinion angular tooth thickness	0.7595802	43.52074168	
42	FACE CUTTER GENERATING DIAMETER:	200.00000	200.00000	Half gear angular tooth thickness	0.0395136	1.382976246	
43	PROFILE CROWNING:	0.02005	0.02005				
44	LEAD CROWNING:	0.02864	0.02864	Pinion pitch cone angle	0.0292628	1.676634683	
45	% FROM TOE TO MEAN POINT OF CONTACT [0,1]	0.40000	0.40000	Pinion axial from mean to heel	23.9076800		
46	% FROM GEAR TOOTH TIP TO MEAN POINT OF CONTACT [0,1]	0.50000	0.50000	Mean clearance	0.8191520		
47				Pinion mean addendum	3.2766082	3.2749207	
48	Output:	GEAR	PINION	Pinion mean dedendum	4.9149123		
49	OUTSIDE DIAMETER	240.2912655	35.87089637	Pinion mean cone distance	449.1729716		
50	PITCH APEX TO CROWN	[illegible]	[illegible]	Pinion max cone distance	[illegible]		

Use High Ratio Hypoid (HRH) Excel file from spiralbevel.com to generate HRH tooth surfaces

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







Cut teeth in CAD using Excel generated surfaces

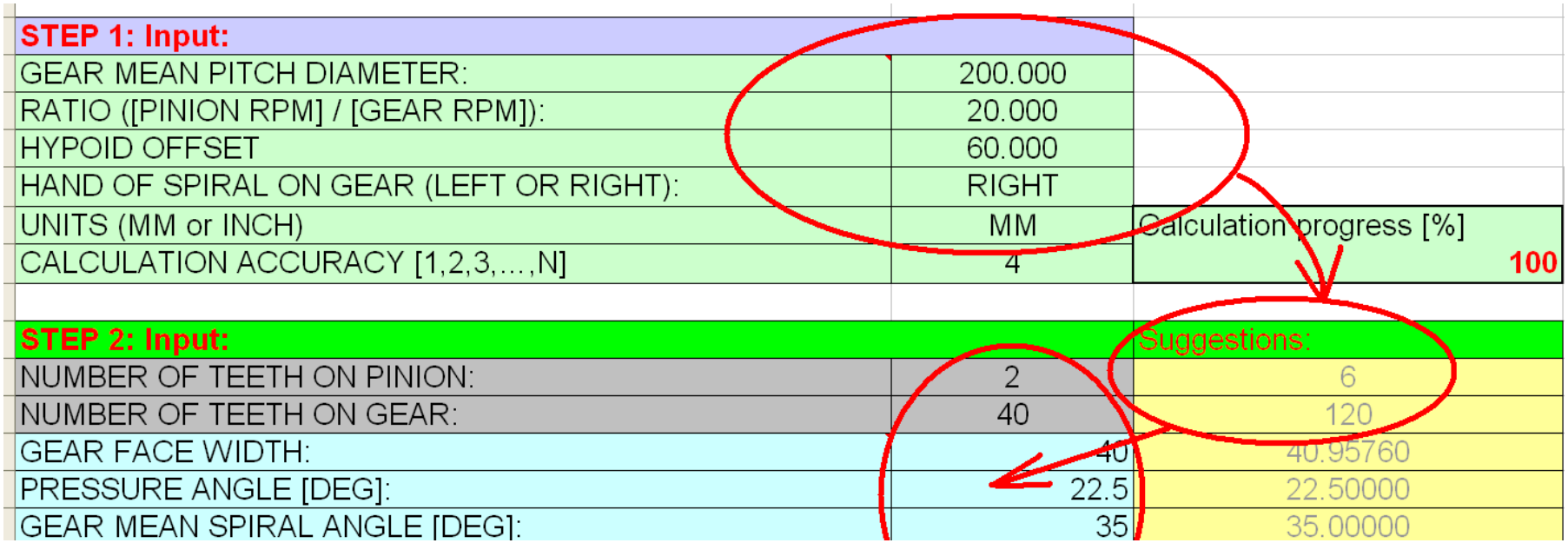
SolidWorks 2008 example.

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.

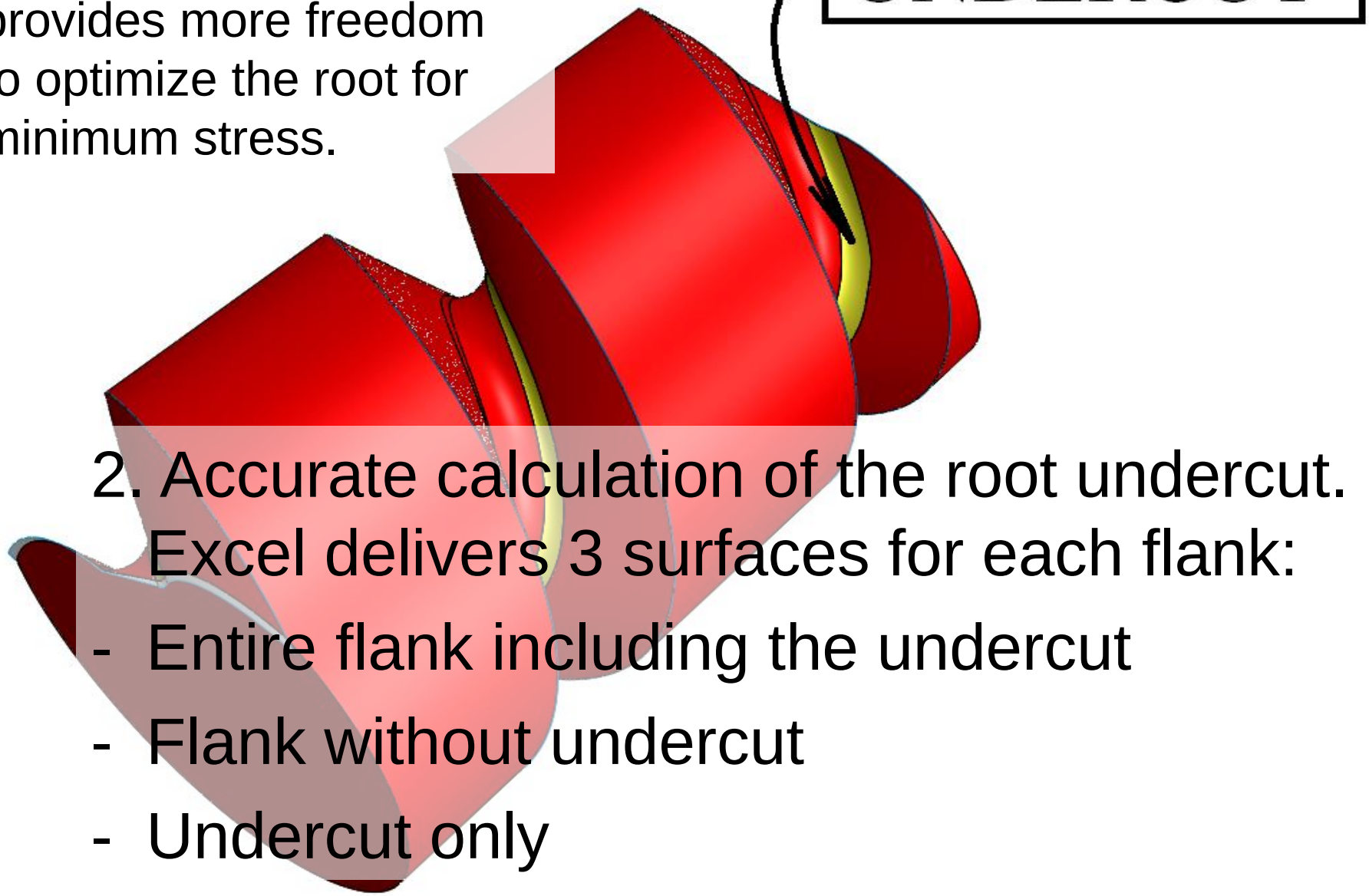
Why spiralbevel.com

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



STEP 1: Input:		
GEAR MEAN PITCH DIAMETER:	200.000	
RATIO ([PINION RPM] / [GEAR RPM]):	20.000	
HYPOID OFFSET	60.000	
HAND OF SPIRAL ON GEAR (LEFT OR RIGHT):	RIGHT	
UNITS (MM or INCH)	MM	Calculation progress [%]
CALCULATION ACCURACY [1,2,3,…,N]	4	100
STEP 2: Input:		Suggestions:
NUMBER OF TEETH ON PINION:	2	6
NUMBER OF TEETH ON GEAR:	40	120
GEAR FACE WIDTH:	40	40.95760
PRESSURE ANGLE [DEG]:	22.5	22.50000
GEAR MEAN SPIRAL ANGLE [DEG]:	35	35.00000

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

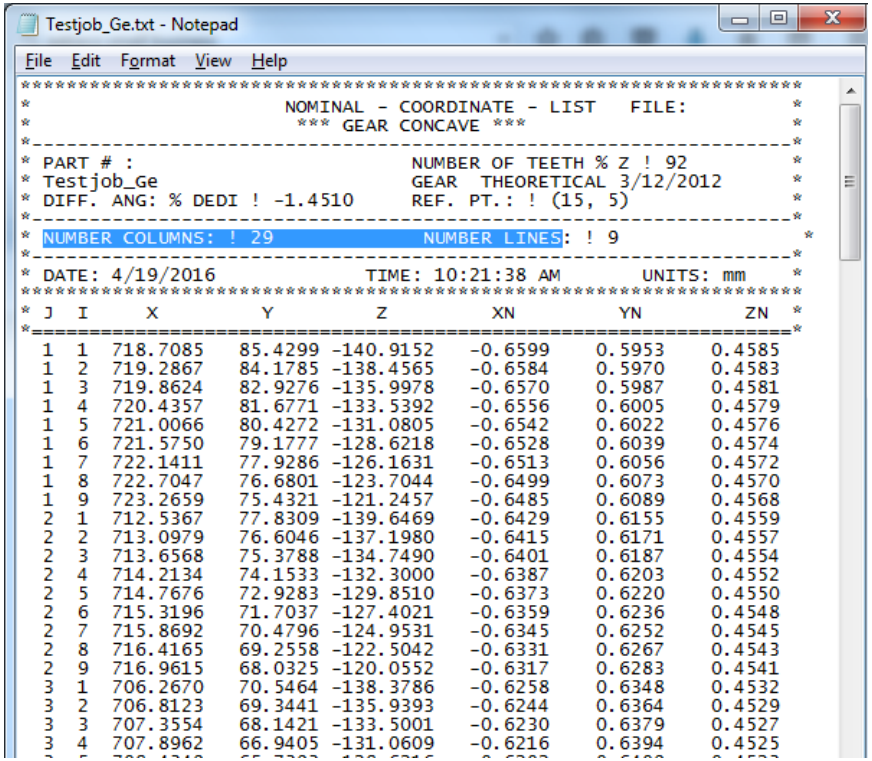


2. Accurate calculation of the root undercut.
   Excel delivers 3 surfaces for each flank:

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

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

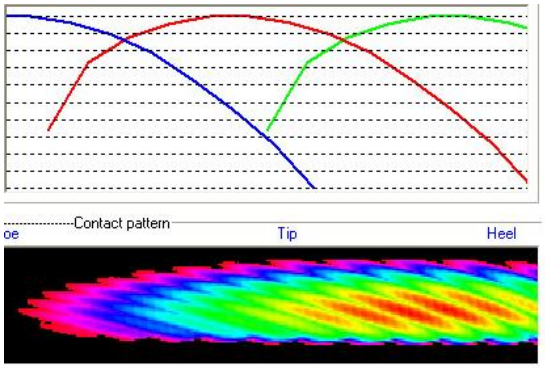
File Edit Format View Help

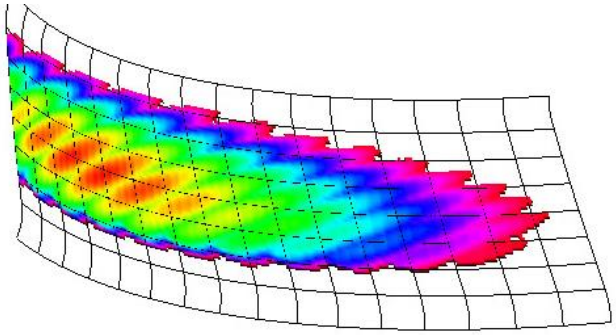
```
**************************************************************************
*                      NOMINAL - COORDINATE - LIST   FILE:               *
*                        *** GEAR CONCAVE ***                            *
*------------------------------------------------------------------------*
* 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
```

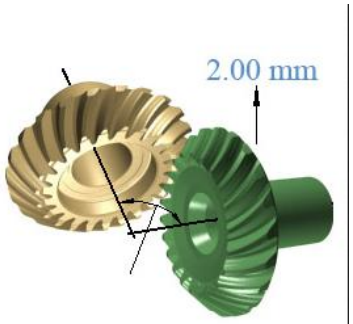
5. Easy tooth contact pattern development.
   Just enter amount of crowning on lead and profile with the relevant position of the center of the contact. The program automatically generates an ideal tooth contact for quietest roll and highest endurance.

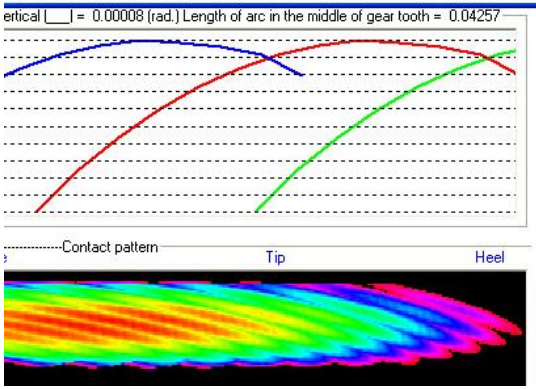
38	GEAR ROOT ANGLE	77.59592497	77.59592
39	PINION MEAN PITCH DIAMETER	44.13987	44.13987
40	PINION FACE ANGLE	11.95598	11.95598
41	PINION ROOT ANGLE	6.43115	6.43115
42	FACE CUTTER GENERATING DIAMETER:	200.000	200.00000
43	PROFILE CROWNING:	0	0.02005
44	LEAD CROWNING:	0	0.02864
45	% FROM TOE TO MEAN POINT 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

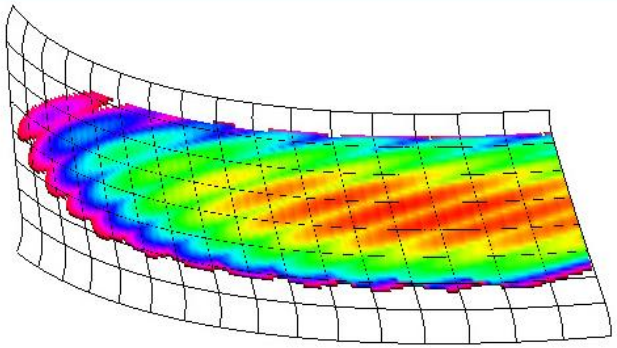
6. Communication with advanced Tooth Contact Analysis (TCA) program from spiralbevel.com for more detailed TCA such as VH and α in 3d animation.

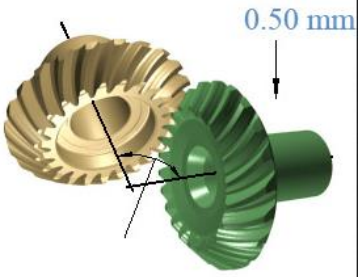




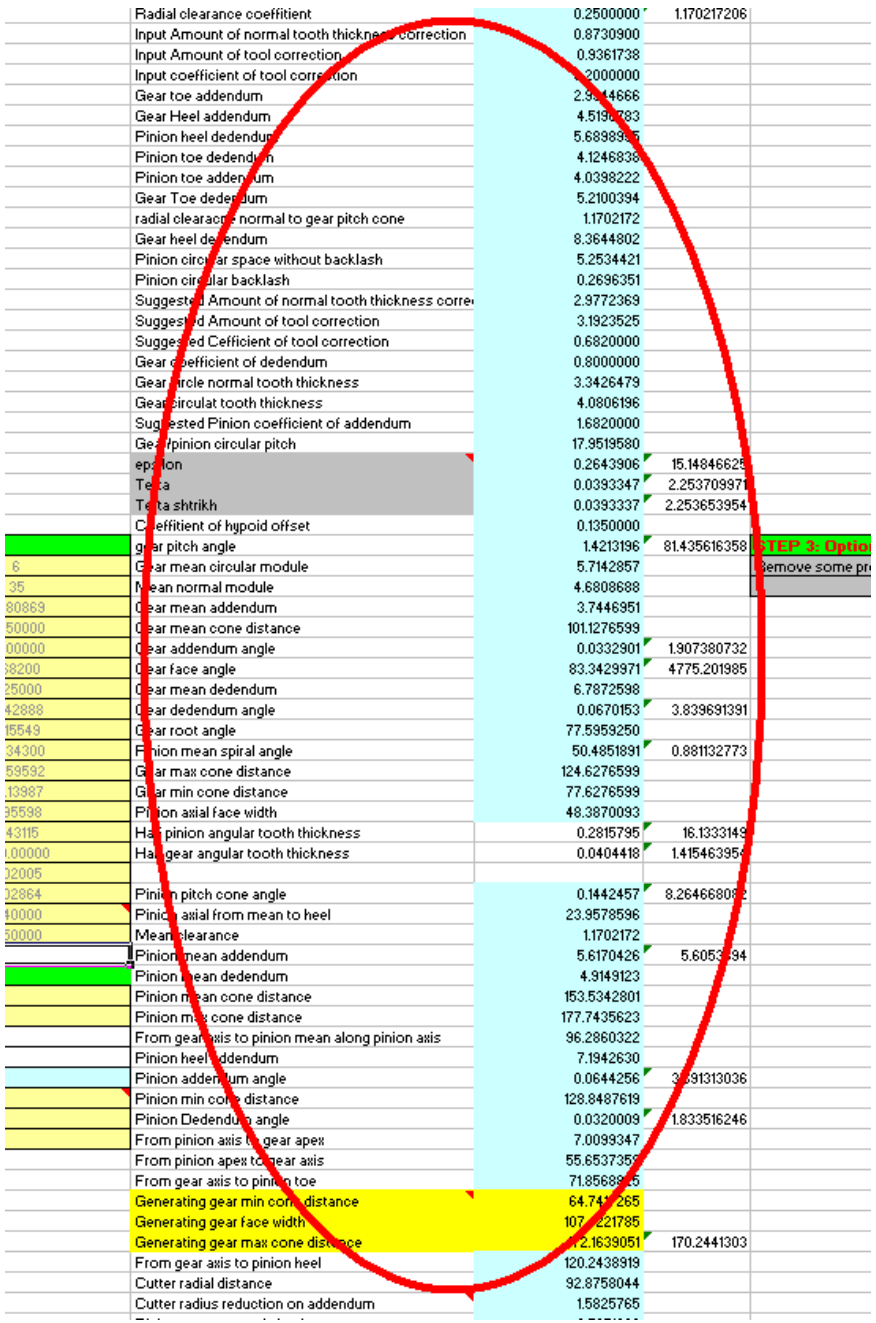




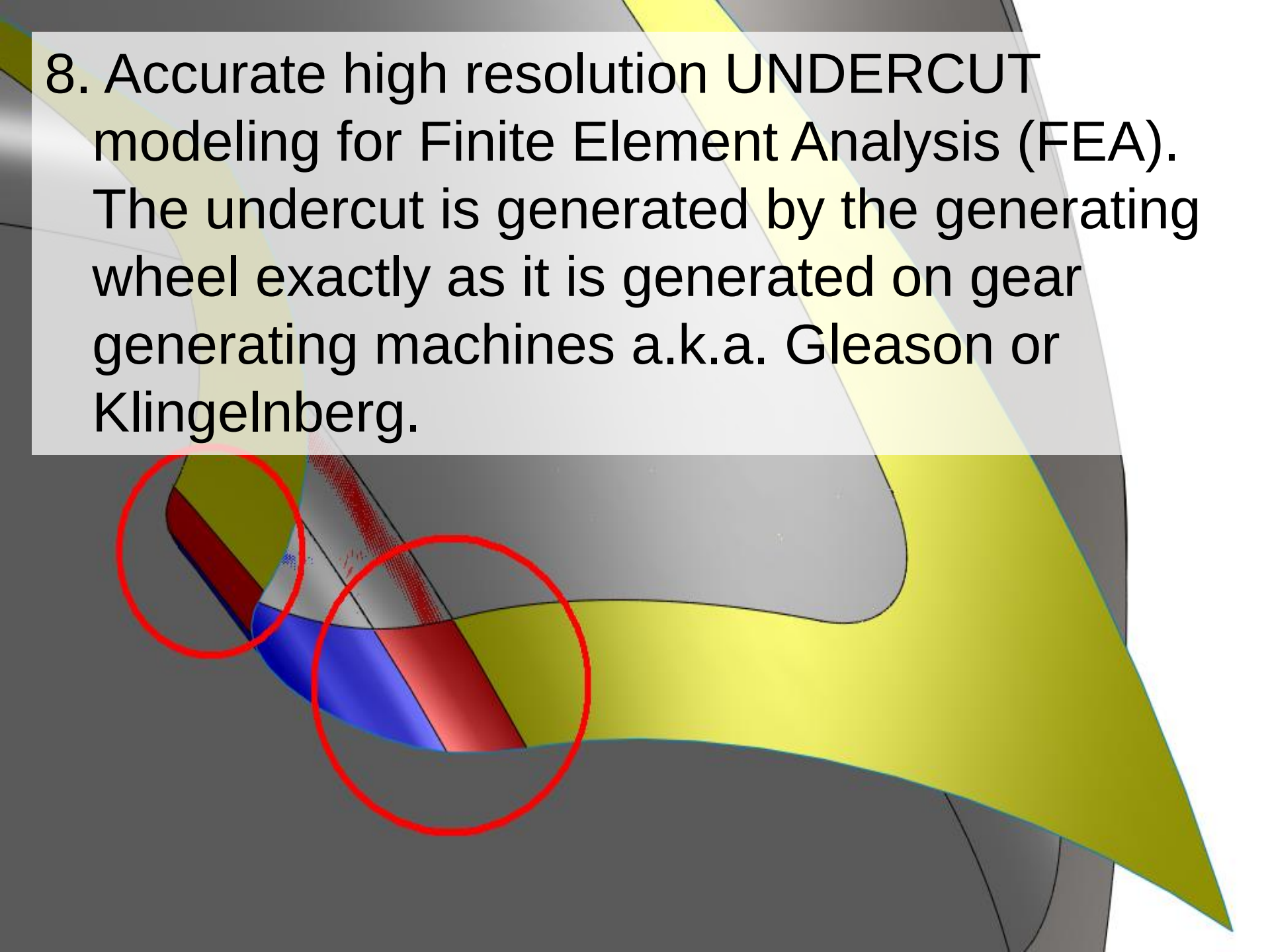




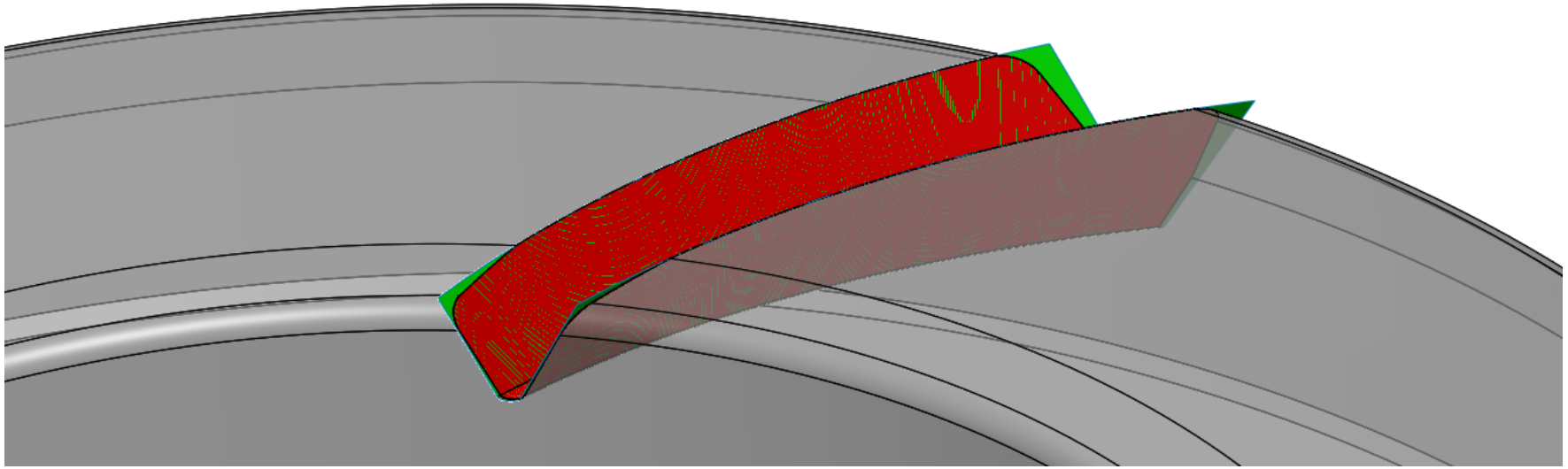
7. Tooth geometry calculation formulas provided if needed for study and customization for each unique project



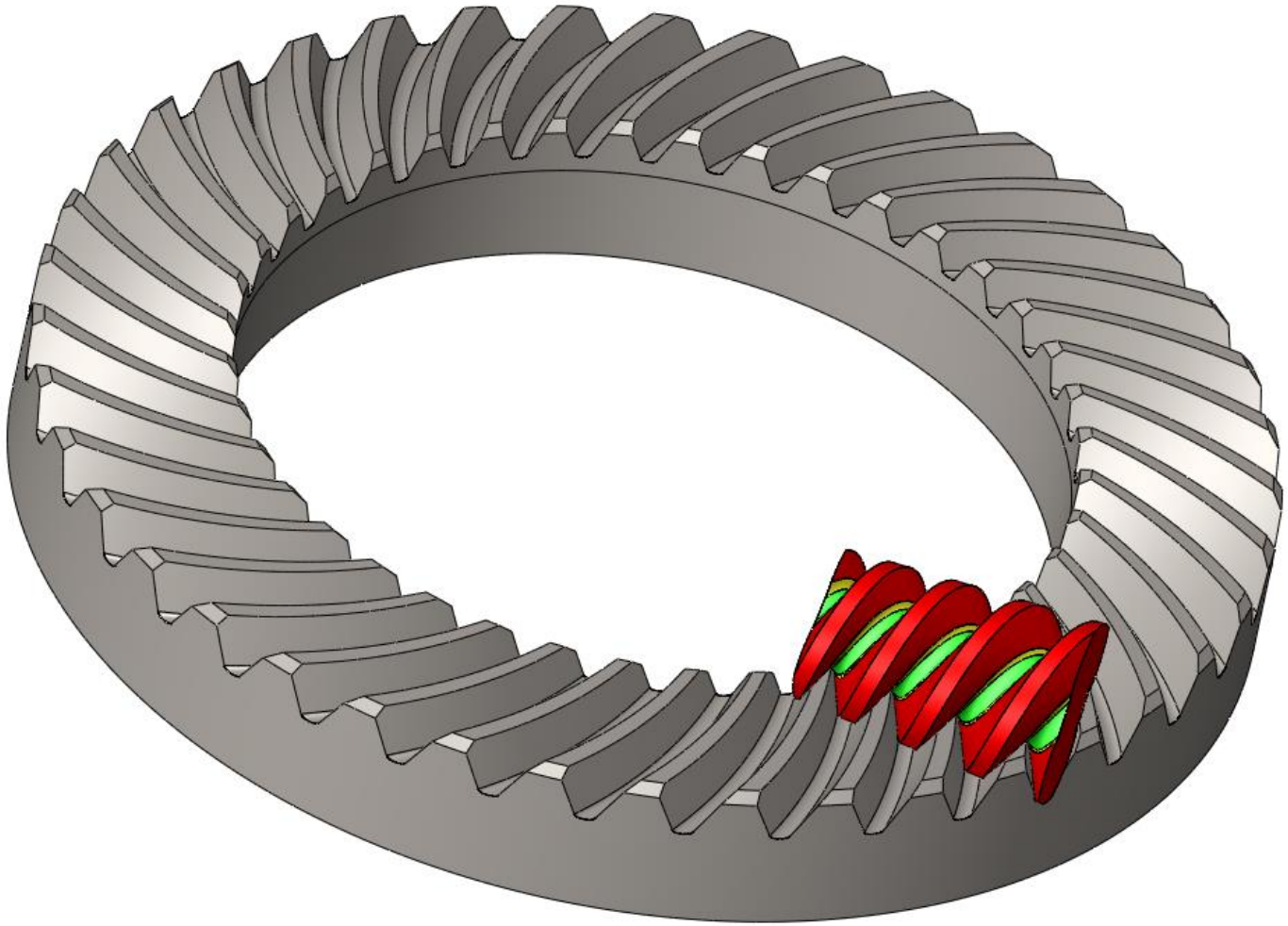
8. Accurate high resolution UNDERCUT modeling for Finite Element Analysis (FEA). The undercut is generated by the generating wheel exactly as it is generated on gear generating machines a.k.a. Gleason or Klingelnberg.



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