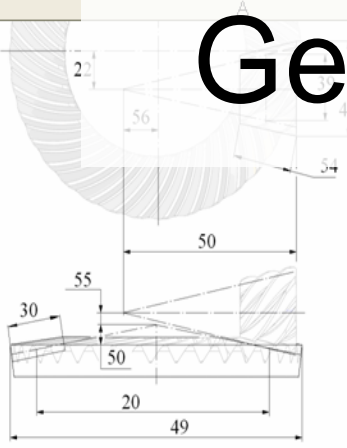
A 3D CAD model of a hypoid gear set. The gears are shown in a perspective view. The teeth of the smaller gear in the foreground are highlighted in a vibrant red color, while the larger gear behind it is rendered in a metallic grey. The text is overlaid on the image in white boxes with black text.

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

With help of Microsoft Excel
and
Spiralbevel.com



Generate 3d tooth surfaces.

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 ACCURACY [1,2,3,...,N]	4

Calculation progress [%] 100

STEP 2: Input:

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
PINION COEFFICIENT OF ADDENDUM:	0.80000	1.68200
COEFFICIENT OF TOOL CORRECTION:	0.00000	0.00000
PINION MEAN TRANSVERSE CIRCULAR TOOTH THICKNESS:	19.83008	19.83008
NORMAL MEAN BACKLASH:	0.15850	0.15850
GEAR FACE ANGLE:	85.36899	85.36899
GEAR ROOT ANGLE:	85.36899	85.36899
PINION MEAN PITCH DIAMETER:	26.28436	26.28436
PINION FACE ANGLE:	3.51553	3.51553
PINION ROOT ANGLE:	1.04972	1.04972
FACE CUTTER GENERATING DIAMETER:	200.00000	200.00000
PROFILE CROWNING:	0.02005	0.02005
LEAD CROWNING:	0.02864	0.02864
% FROM TOE TO MEAN POINT OF CONTACT [0,1]	0.40000	0.40000
% FROM GEAR TOOTH TIP TO MEAN POINT OF CONTACT [0,1]	0.50000	0.50000

Suggestions

2	6
40	120
40.95760	40.95760
22.50000	22.50000
35.00000	35.00000
1.68200	1.68200
0.00000	0.00000
19.83008	19.83008
0.15850	0.15850
85.36899	85.36899
85.36899	85.36899
26.28436	26.28436
3.51553	3.51553
1.04972	1.04972
200.00000	200.00000
0.02005	0.02005
0.02864	0.02864
0.40000	0.40000
0.50000	0.50000

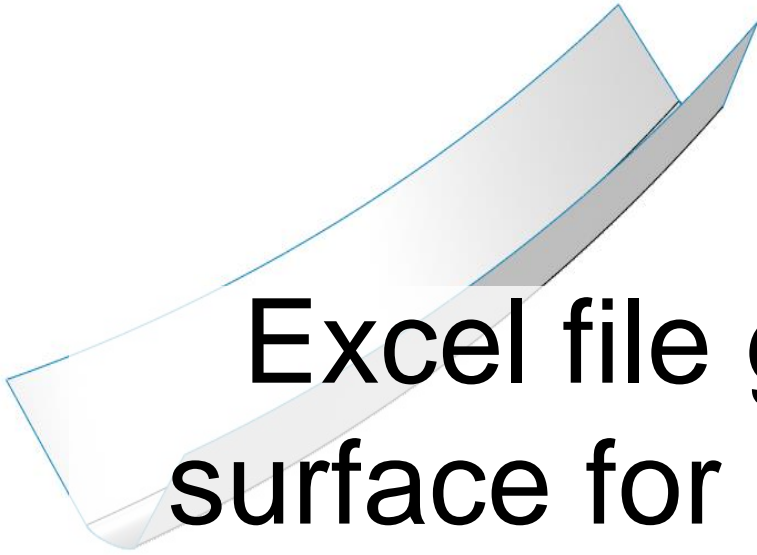
Output:

GEAR	PINION	
OUTSIDE DIAMETER	240.2912655	35.87089637
PITCH DEBY TO CROWN	0.024940557	0.727685391

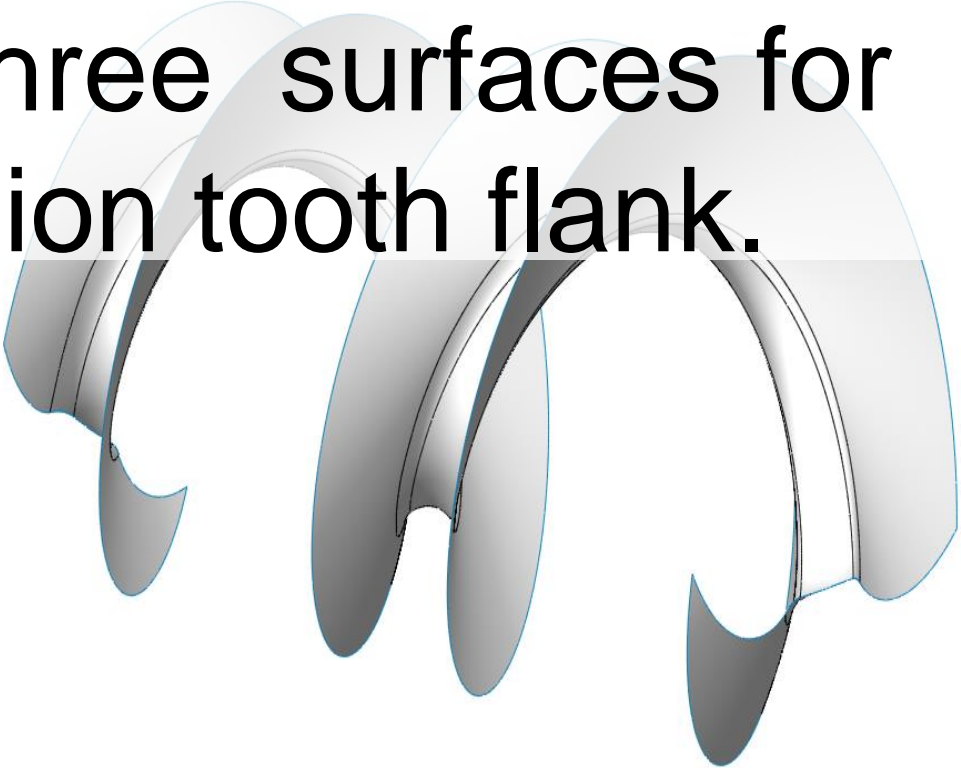
radial clearance coefficient	0.2000000	0.819152044
gear toe addendum	3.7994860	
gear heel addendum	4.3574734	
pinion heel dedendum	5.1766254	
pinion toe dedendum	4.6186381	
pinion toe addendum	2.4580012	
gear toe dedendum	3.2771533	
radial clearance normal to gear pitch cone	0.8191520	
gear heel dedendum	4.9143672	
pinion circular space without backlash	-4.8076170	
pinion circular backlash	0.5504984	
suggested amount of normal tooth thickness correction	2.3140525	
suggested amount of tool correction	2.7933085	
suggested coefficient of tool correction	0.6820000	
gear coefficient of dedendum	1.0000000	
gear circle normal tooth thickness	-1.4982937	
gear circular tooth thickness	-1.8290788	
suggested pinion coefficient of addendum	1.6820000	
gear/pinion circular pitch	15.7079633	
epsilon	0.6399262	36.66507291
tetta	0.0217920	1.248590998
tetta shtrikh	0.0217920	1.248589583
coefficient of hypoid offset	0.3000000	
gear pitch angle	1.5343125	87.909632016
gear mean circular module	5.0000000	
mean normal module	4.0957602	
gear mean addendum	4.0957602	
gear mean cone distance	100.0665903	
gear addendum angle	0.0139488	0.799206168
gear face angle	85.36899	85.36899
gear root angle	85.36899	85.36899
gear max cone distance	100.0665903	
gear min cone distance	80.0665903	
pinion axial face width	50.9725343	
half pinion angular tooth thickness	0.7595802	43.52074168
half gear angular tooth thickness	0.0395136	1.382976246
pinion pitch cone angle	0.0292628	1.676634683
pinion axial from mean to heel	23.9076800	
mean clearance	0.8191520	
pinion mean addendum	3.2766082	3.2749207
pinion mean dedendum	4.9149123	
pinion mean cone distance	449.1729716	
pinion max cone distance	473.0989115	

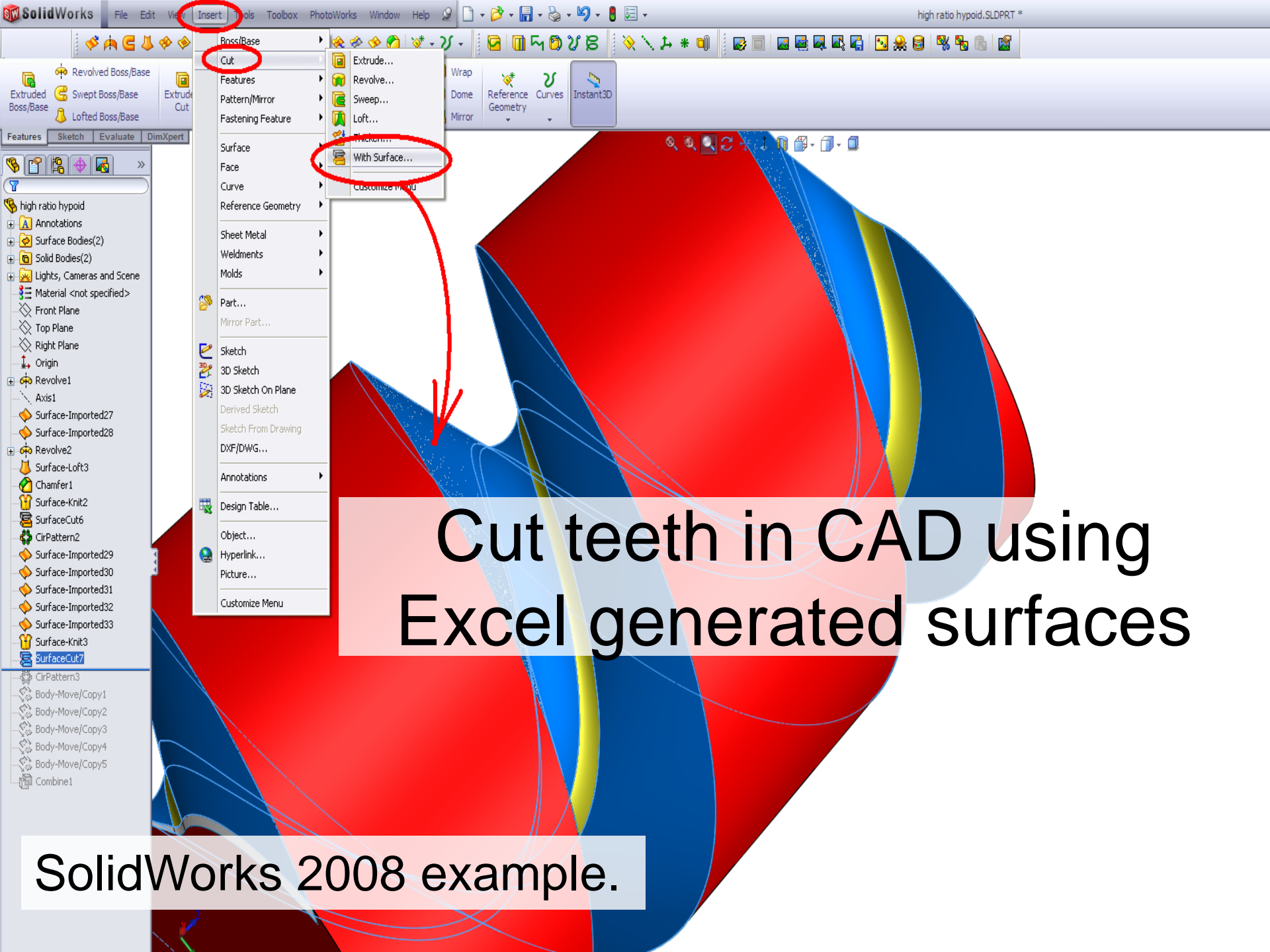
STEP 3: Optional Input:
Remove some profile points from root

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:		
NUMBER OF TEETH ON PINION:	2	Suggestions: 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

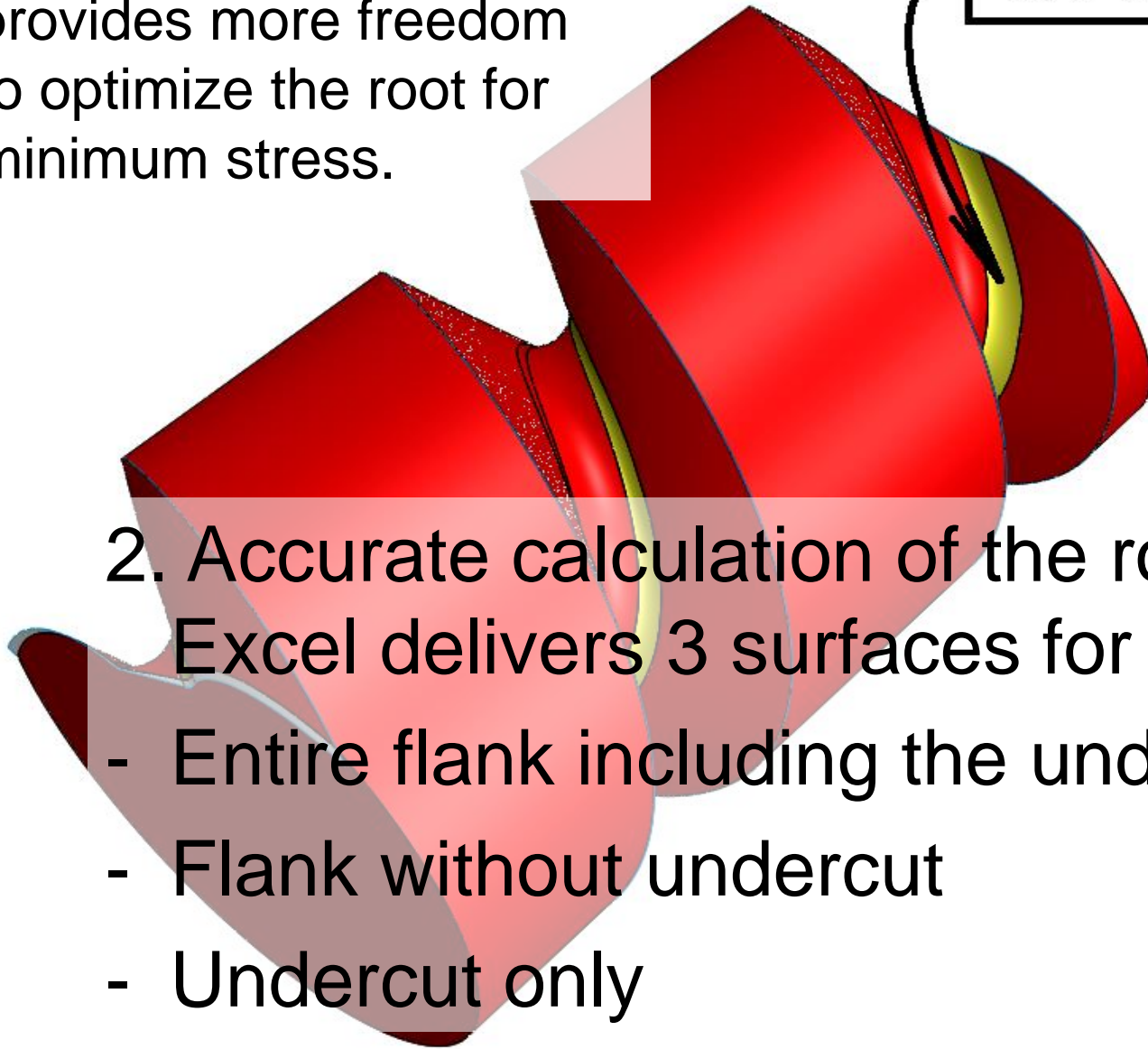
Variety of the outputs provides more freedom to optimize the root for minimum stress.

UNDERCUT

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.

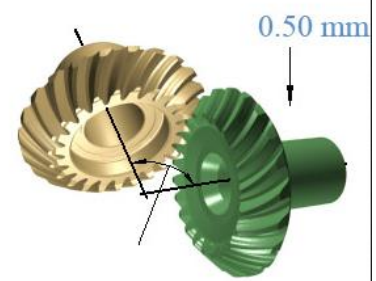
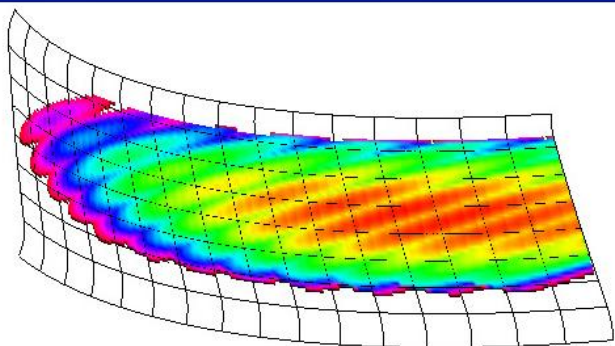
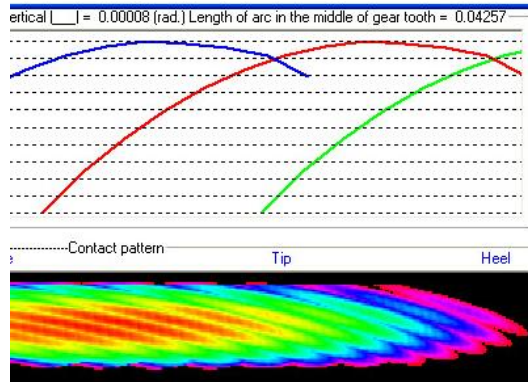
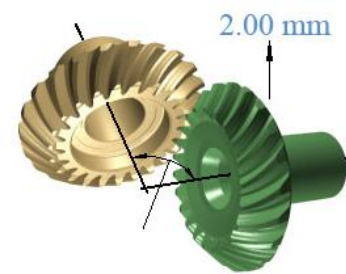
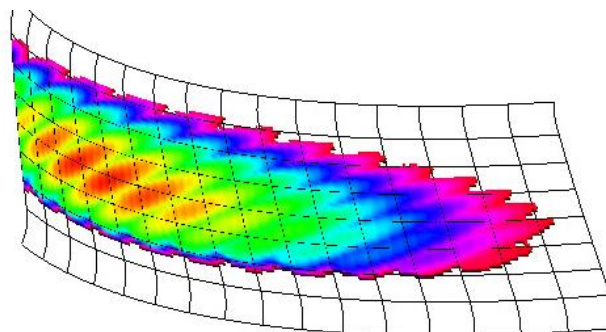
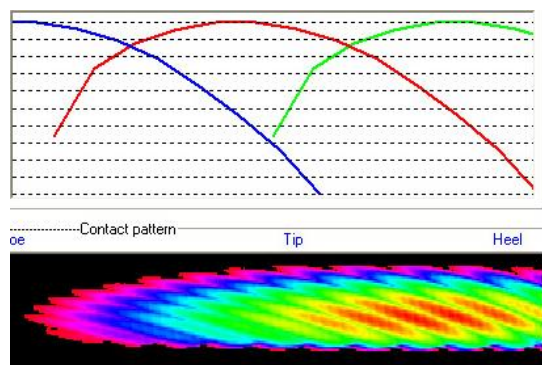
It is also used as a master gear to derive original gear machine summary if gear needs to be cut on a gear generating machine such as Gleason or Klingelnberg.

```
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

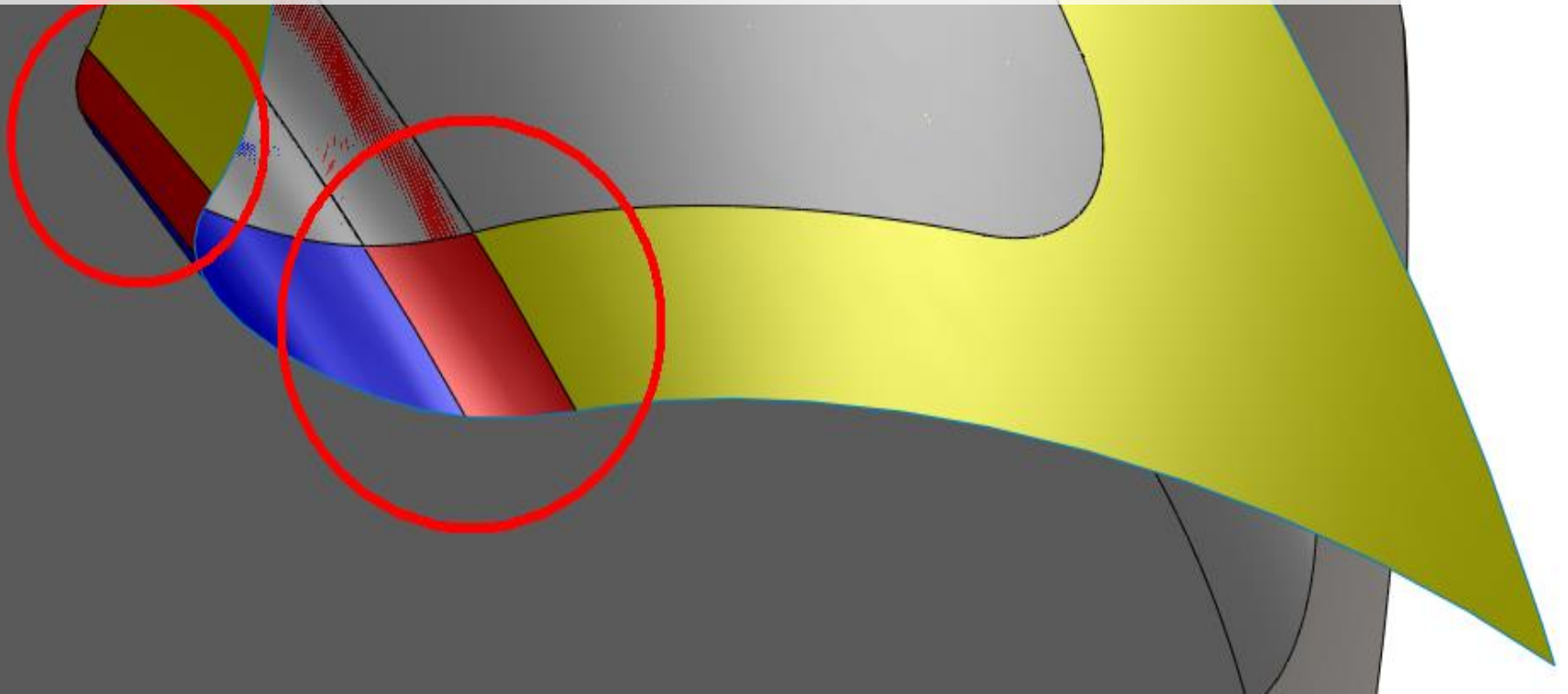
6. Communication with advanced Tooth Contact Analysis (TCA) program from spiralbevel.com for more detailed TCA such as VH and α in 3d animation.



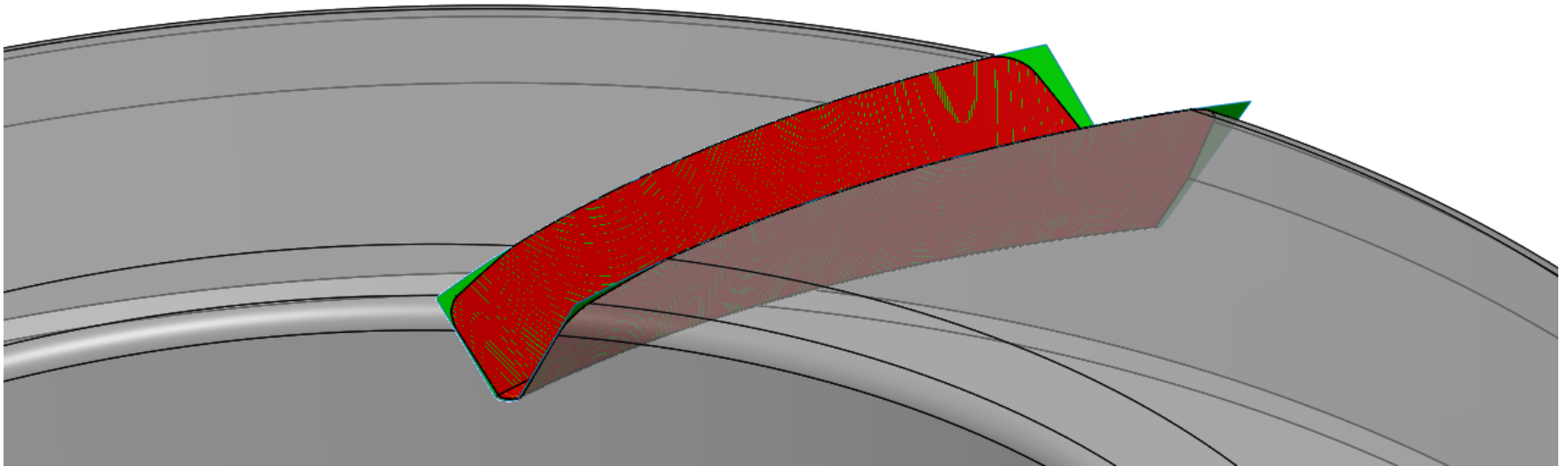
7. Tooth geometry calculation formulas provided if needed for study and customization for each unique project

	Radial clearance coefficient	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	2.0000000		
	Gear toe addendum	2.3914666		
	Gear Heel addendum	4.5190783		
	Pinion heel dedendum	5.6898935		
	Pinion toe dedendum	4.1246838		
	Pinion toe addendum	4.0398222		
	Gear Toe dedendum	5.2100394		
	radial clearance normal to gear pitch cone	1.1702172		
	Gear heel dedendum	8.3644802		
	Pinion circular space without backlash	5.2534421		
	Pinion circular backlash	0.2696351		
	Suggested Amount of normal tooth thickness correction	2.9772369		
	Suggested Amount of tool correction	3.1923525		
	Suggested Coefficient of tool correction	0.6820000		
	Gear coefficient of dedendum	0.8000000		
	Gear circle normal tooth thickness	3.3426479		
	Gear circular tooth thickness	4.0806196		
	Suggested Pinion coefficient of addendum	1.6820000		
	Gear/pinion circular pitch	17.9519580		
	epsilon	0.2643906	15.14846625	
	Tau	0.0393347	2.253709971	
	Tau shtrikh	0.0393337	2.253653954	
	Coefficient of hypoid offset	0.1350000		
	gear pitch angle	1.4213196	81.435616358	TEC 3 Output
6	Gear mean circular module	5.7142857		remove some pr
35	Mean normal module	4.6808688		
80869	Gear mean addendum	3.7446951		
50000	Gear mean cone distance	101.1276599		
00000	Gear addendum angle	0.0332901	1.907380732	
82000	Gear face angle	83.3429971	4775.201985	
25000	Gear mean dedendum	6.7872598		
42888	Gear dedendum angle	0.0670153	3.839691391	
15549	Gear root angle	77.5959250		
34300	Pinion mean spiral angle	50.4851891	0.881132773	
59592	Gear max cone distance	124.6276599		
13987	Gear min cone distance	77.6276599		
95598	Pinion axial face width	48.3870093		
43115	Half pinion angular tooth thickness	0.2815795	16.1333149	
100000	Half gear angular tooth thickness	0.0404418	1.415463954	
32005				
32864	Pinion pitch cone angle	0.1442457	8.264668082	
10000	Pinion axial from mean to heel	23.9578596		
50000	Mean clearance	1.1702172		
	Pinion mean addendum	5.6170428	5.6053394	
	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	3.091313036	
	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	71.8568935		
	Generating gear min cone distance	64.741265		
	Generating gear face width	107.421785		
	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		

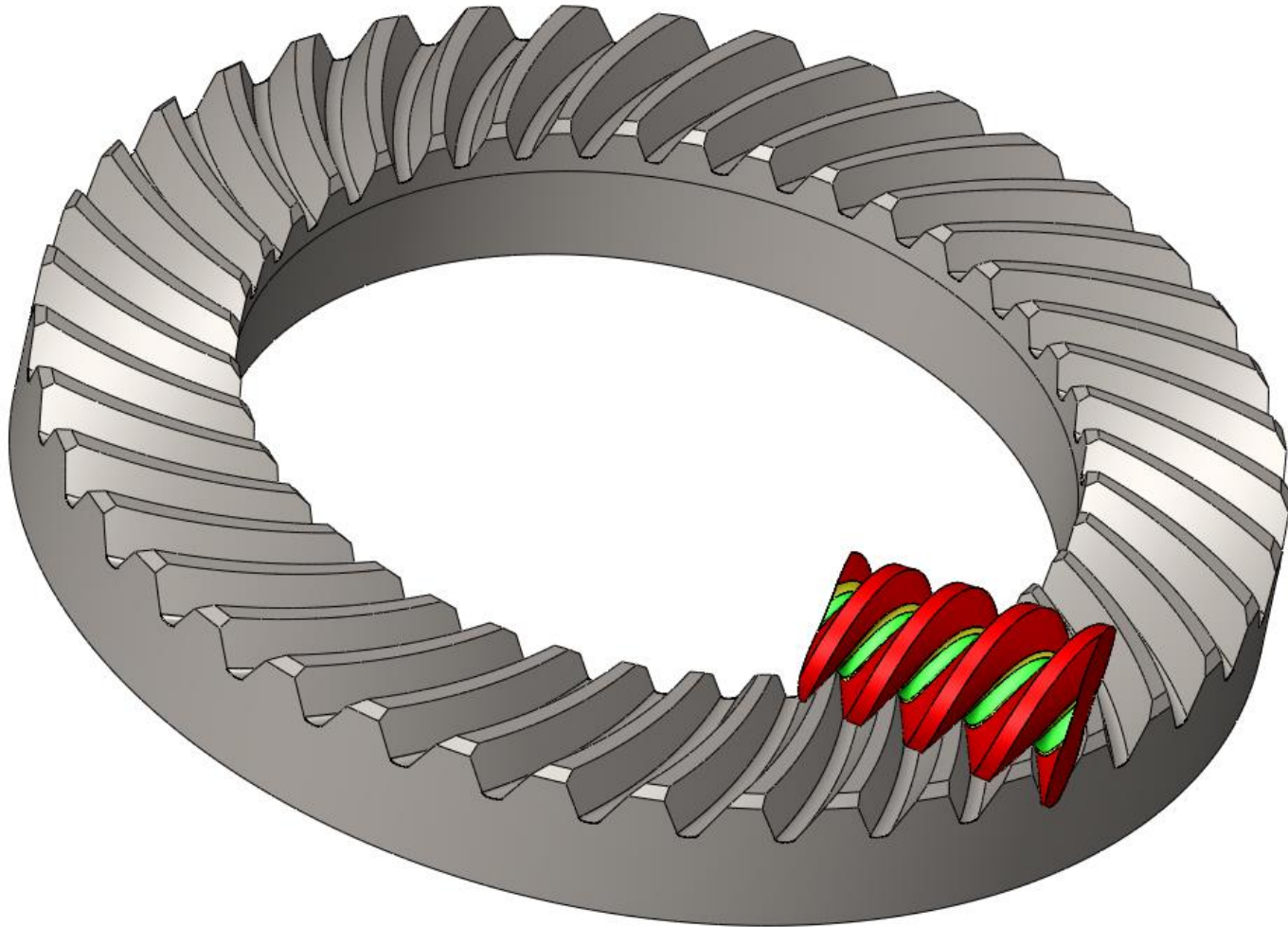
8. Accurate high resolution UNDERCUT modeling for Finite Element Analysis (FEA). The undercut is generated by the generating wheel exactly as it is generated on gear generating machines a.k.a. Gleason or Klingelnberg.



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