

# ANSYS WORKBENCH分析应用基础

## LESSON25 齿轮案例预备：接触中的一个小技巧



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课程制作 张 晔

QQ交流群：205237137

机械人读书笔记

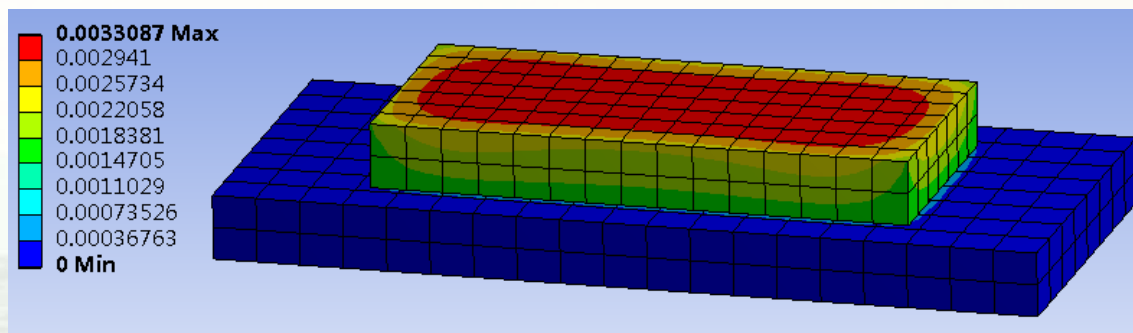
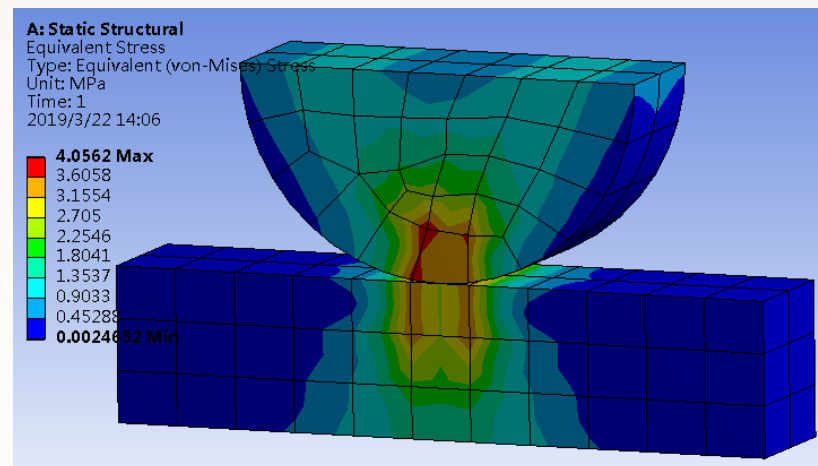
接触中到底哪个参数才是我们最需要关注的？接触算法？接触刚度？容差？还是pinball区域？

很遗憾，虽然以上4个名词在教材里或者在有限元学习过程中出镜率极高，但是困扰新手学习者由于接触参数设置问题导致无法解决分析问题的原因多数时候却不是他们，而是间隙！

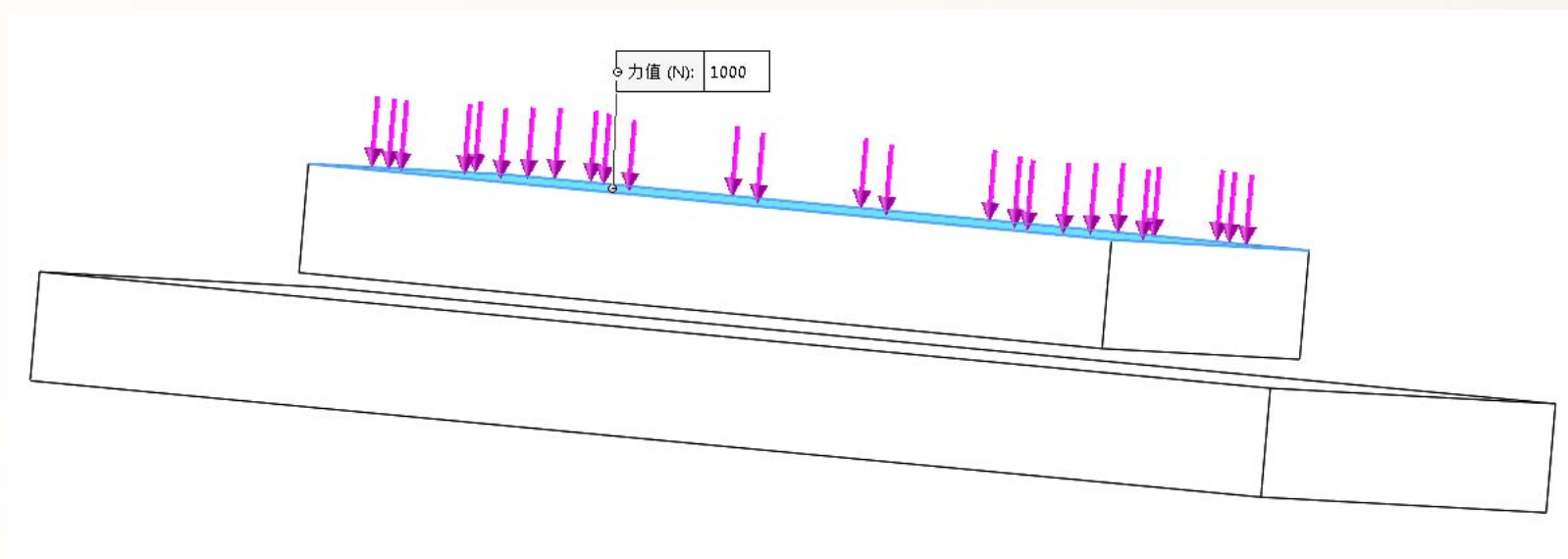


## 本课重点内容

1. 平面间隙问题;
2. 接触中OFFSET的使用;
3. 曲面接触间隙的形成;
4. 一个接触设置的小技巧。

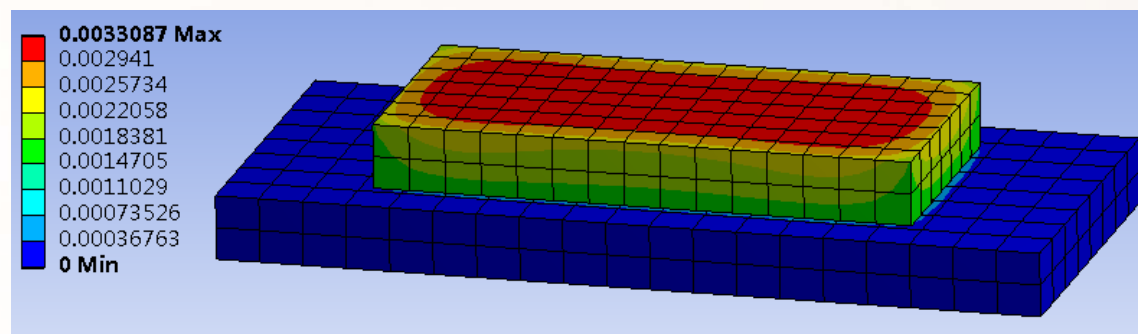


## 如果建模的时候存在间隙怎么办



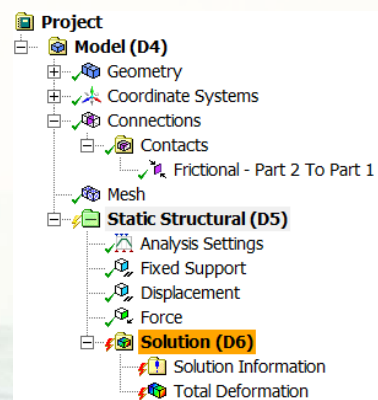
在实际产品过程中，很多时候由于设计问题，原本的接触面因为三维建模定位问题会出现间隙，如上图所示，此时如果不对模型进行处理，分析能正常进行么？

## 分析结果对比



不存在间隙的分析结果

存在间隙的  
计算结果



Details of "Static Structural (D5)"

Definition

### ANSYS Workbench - Error



An internal solution magnitude limit was exceeded. (Node Number 289, Body Part 1, DOF UZ) Please check your Environment for inappropriate load values or insufficient supports. You may select the offending object and/or geometry via RMB on this warning in the Messages window. Please see the Troubleshooting section of the Help System for more information.

确定



## 间隙的信息获取

The screenshot displays the ANSYS Workbench interface. On the left, the Project tree shows the hierarchy: Project > Model (D4) > Geometry > Coordinate Systems > Connections > Contacts > Frictional - Part 2 To Part 1 > Mesh > Static Structural (D5) > Analysis Settings > Fixed Support > Displacement > Force > Solution (D6) > Solution Information > Total Deformation. The Solution Information panel is active, showing a list of contact parameters and their values. A search dialog box is open over the Solution Information panel, with the search term 'gap' entered. The search results are displayed in a red-bordered box at the bottom of the Solution Information panel.

Project

- Model (D4)
  - Geometry
  - Coordinate Systems
  - Connections
    - Contacts
      - Frictional - Part 2 To Part 1
  - Mesh
  - Static Structural (D5)
    - Analysis Settings
    - Fixed Support
    - Displacement
    - Force
    - Solution (D6)
      - Solution Information
      - Total Deformation

constant set 3 and contact element type 3 has been set up. The companion pair has real constant set ID 4. Both pairs should have the same behavior.

ANSYS will deactivate the current pair and keep its companion pair, resulting in asymmetric contact.

Contact algorithm: Augmented Lagrange method

Contact detection at: Gauss integration point

Contact stiffness factor FKN 1.0000

The resulting initial contact stiffness 0.80000E+06

Default penetration tolerance factor FTOLN 0.10000

The resulting penetration tolerance 0.50000

Max. initial friction coefficient MU 0.20000

Default tangent stiffness factor FKT 1.0000

Default elastic slip factor SLTOL 0.10000E-01

The resulting elastic slip tolerance 0.68986E-01

Update contact stiffness at each iteration

Default Max. friction stress TAUMAX 0.10000E+21

Average contact surface length 6.8986

Average contact pair depth 5.0000

Default pinball region factor PINB 1.0000

The resulting pinball region 5.0000

\*WARNING\*: Initial penetration is included.

\*\*\* NOTE \*\*\* CP = 0.437 TIME= 13:32:43

Min. Initial gap 2 was detected between contact element 696 and target element 1023.

查找

查找(F): gap

☐ 全字匹配(W) ☐ 区分大小写(C)

☒ 突出显示所有匹配项(H)

上一个(P) 下一个(N)

如图所示在Solution Information的页面下搜索gap，获取到一段上图红色框框内的信息，这段信息的意思是有一对接触初始最小间隙为2（mm）。

# OFFSET设置

<b>Advanced</b>	
Formulation	Program Controlled
Small Sliding	Program Controlled
Detection M...	Program Controlled
Penetration ...	Program Controlled
Elastic Slip T...	Program Controlled
Normal Stiff...	Program Controlled
Update Stiff...	Program Controlled
Stabilization...	0.
Pinball Regi...	Program Controlled
Time Step C...	None
<b>Geometric Modification</b>	
Interface Tre...	Add Offset, No Ramping
<input checked="" type="checkbox"/> Offset	2
Contact Geo...	None
Target Geo...	None

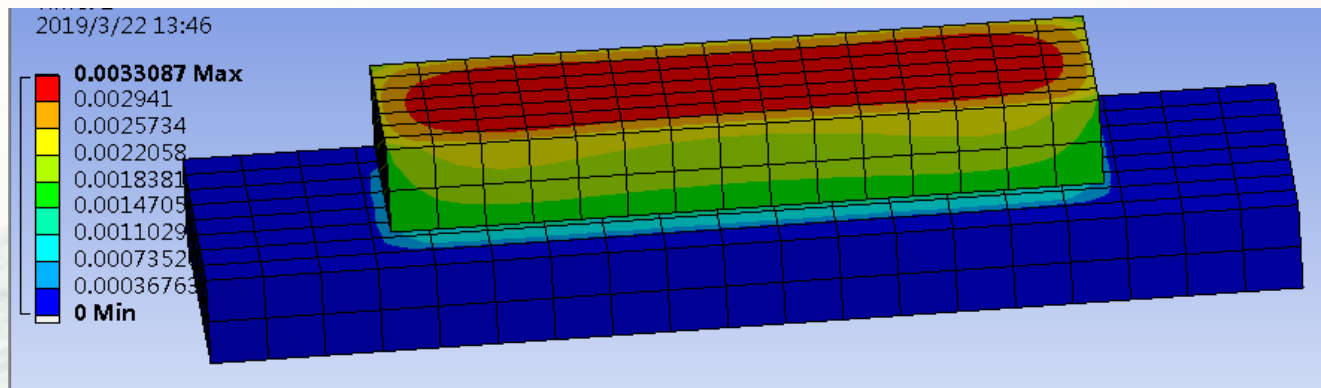
设置为OFFSET 为1mm

```
*** NOTE ***                      CP =      0.437   TIME= 13:43:20
Min. Initial gap 1 was detected between contact element 696 and target
element 1023.
```

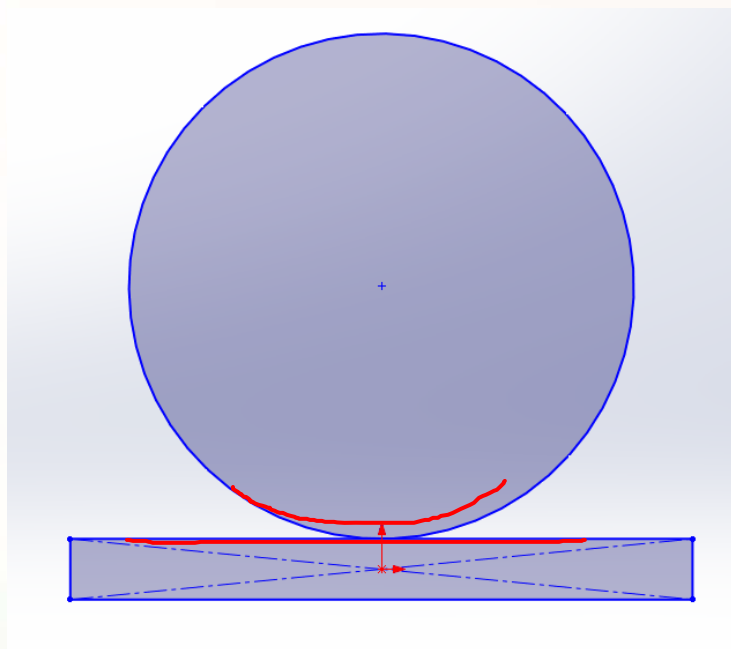
设置为OFFSET 为1.5mm

```
*** NOTE ***                      CP =      0.374   TIME= 13:44:45
Min. Initial gap 0.5 was detected between contact element 726 and
target element 997.
```

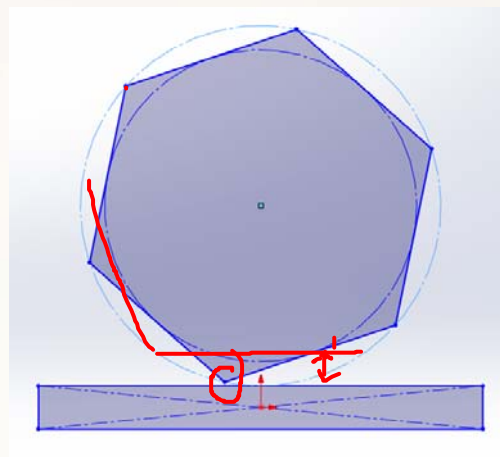
设置为OFFSET 为2mm，就无法搜索到gap信息



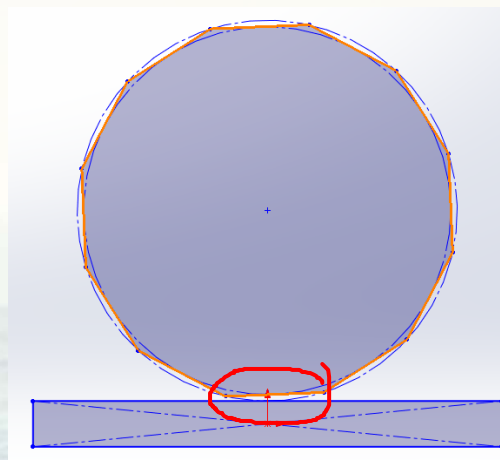
## 曲面接触的间隙产生



在三维模型状态下，底板表面  
和圆相切



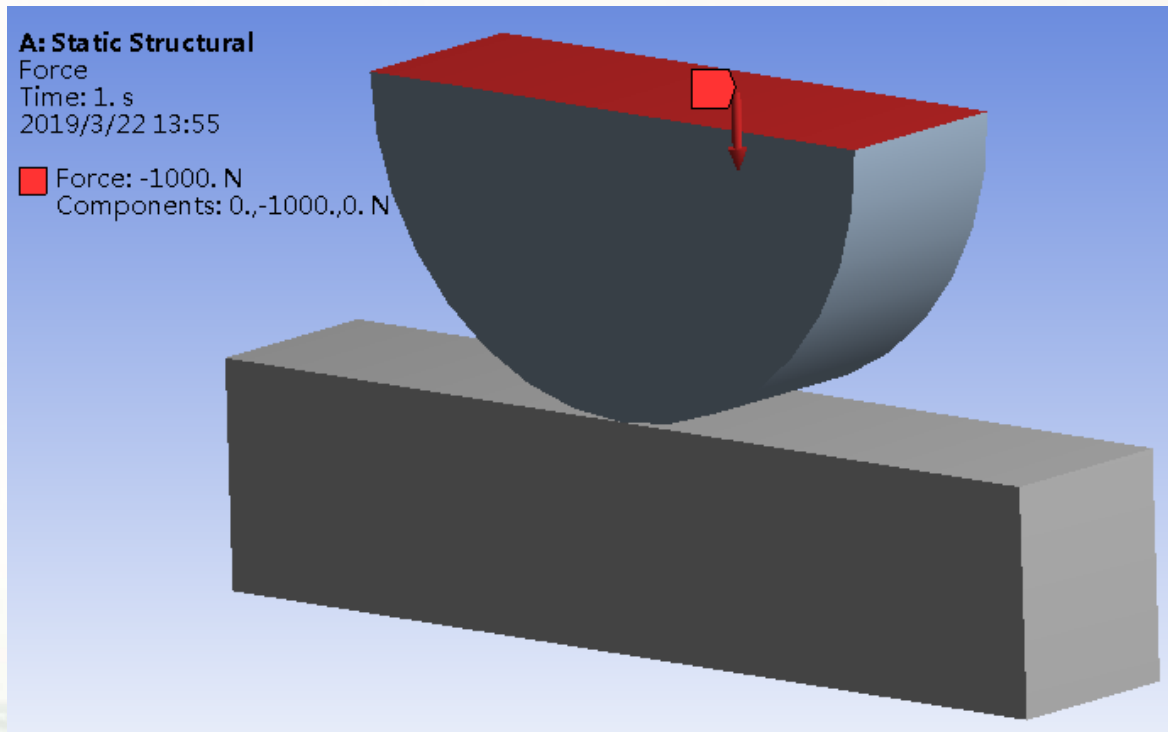
六边形



十二边形



## 曲面和平面接触问题



## 间隙统计

10mm网格间隙

```
*** NOTE ***                      CP =      0.374   TIME= 13:56:40
Min. Initial gap 0.106759356 was detected between contact element 138
and target element 127.
```

5mm网格间隙

```
*** NOTE ***                      CP =      0.421   TIME= 13:58:00
Min. Initial gap 2.925615872E-02 was detected between contact element
793 and target element 757.
```

2mm网格间隙

```
*** NOTE ***                      CP =      0.952   TIME= 13:59:04
Min. Initial gap 2.782378028E-03 was detected between contact element
11195 and target element 11338.
```

对于工程师来说，了解到这一步就足够解决接触间隙的问题，至于这个间隙阈值电脑是如何定义的对于多数软件使用者来说并不需要知道，对于我们工程人员来说这个值最好限制在0.01以下。

## 一个简单粗暴的设置方式：自动消除间隙

Advanced	
Formulation	Program Controlled
Small Sliding	Program Controlled
Detection Method	Program Controlled
Penetration Tolerance	Program Controlled
Elastic Slip Tolerance	Program Controlled
Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Stabilization Damping Factor	0.
Pinball Region	Program Controlled
Time Step Controls	None
Geometric Modification	
Interface Treatment	Adjust to Touch
Contact Geometry Correction	None
Target Geometry Correction	None

### A: Static Structural

Equivalent Stress

Type: Equivalent (von-Mises) Stress

Unit: MPa

Time: 1

2019/3/22 14:06

4.0562 Max

3.6058

3.1554

2.705

2.2546

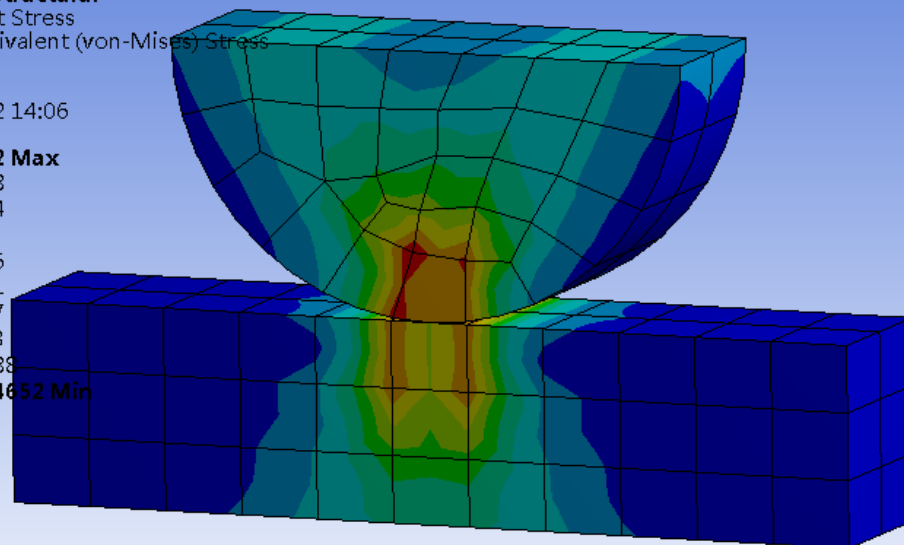
1.8041

1.3537

0.9033

0.45288

0.0024652 Min



Auto contact offset used to close gap 0.11774  
Initial penetration is excluded.

\*\*\* NOTE \*\*\* CP = 0.374 TIME= 14:06:40  
Min. Initial gap 0.116578779 was detected between contact element 130  
and target element 143.  
The gap is closed due to initial settings.  
\*\*\*\*\*

## 曲面接触问题



齿轮



轴承



The background is a dark teal color with a complex, light-colored technical drawing or blueprint pattern. The drawing features various mechanical components, including gears, shafts, and housing parts, rendered in a detailed, hatched style. The text is centered over this background.

下一期视频，我将和大家一起交流关于  
《齿轮案例预备：赫兹接触和齿轮失效》