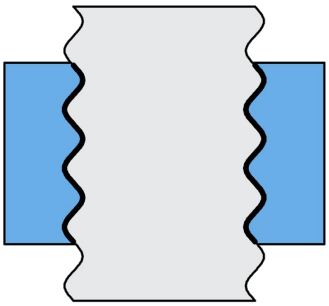
Thread Designer



User Manual

Applicable version V1.0

Horycon (Tianjin) Technology Co., Ltd.

2023.10.19

1. Software Introduction

The general steps for precise thread finite element calculation are: (1) Discretization of the thread model; (2) Selection of displacement mode;

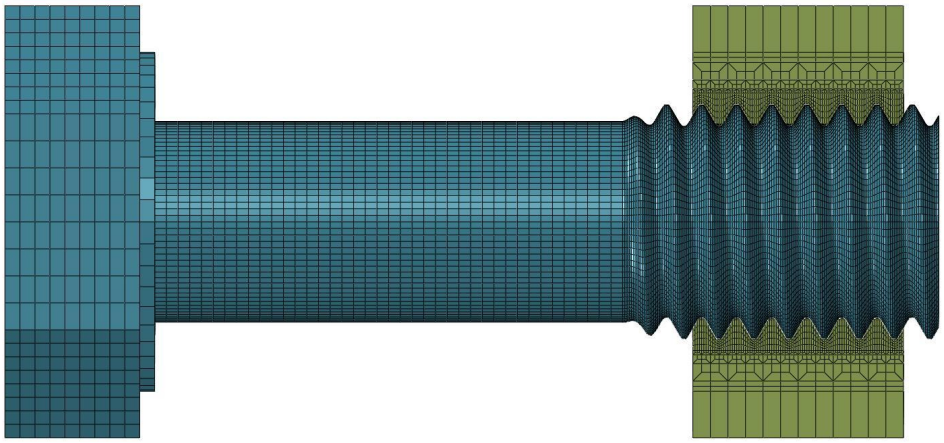
(3) Mechanical property analysis; (4) Equivalent node stress calculation. Among these, steps (2), (3), and (4) are general steps in finite element analysis; while step (1), the discretization of the thread model, is the key and difficult part of the calculation. The quality of the elements directly affects the convergence and accuracy of the finite element calculation. In addition, the complex contour of the thread makes the discretization (meshing) very difficult. The mesh around the thread cannot be manually divided and requires computer programs to achieve. Currently, relevant research in this area is still concentrated in universities and research institutions, and multiple 'technological islands' have been formed.

The core value of precise finite element modeling software lies in helping technical personnel skip step (1) discretization of the thread model. By inputting bolt parameters, it can quickly and fully generate precise finite element meshes, enabling engineers with finite element calculation experience to rapidly achieve precise finite element simulation analysis for bolted joints.

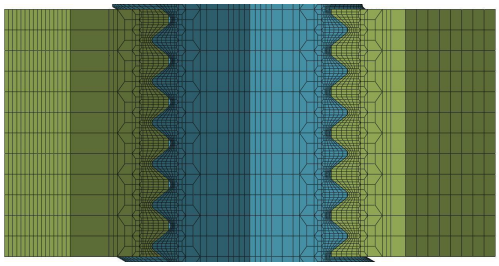
Product Introduction: Balancing high quality, high precision, and high efficiency, parameterized generation of high-precision threaded component finite element models, significantly improving the computational efficiency of numerical analysis for threaded joints. It also helps engineering technicians with finite element analysis background in the design and verification of threaded joints.

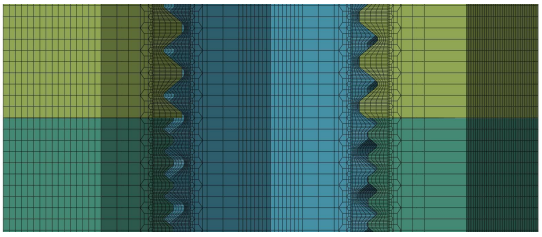
Product positioning: An finite element mesh generation tool (finite element preprocessor) to assist simulation personnel in completing precise finite element simulation analysis for threaded joints;

- In expert mode, display 'Standard threads' and 'Special threads' (including MJ threads, SAE threads,

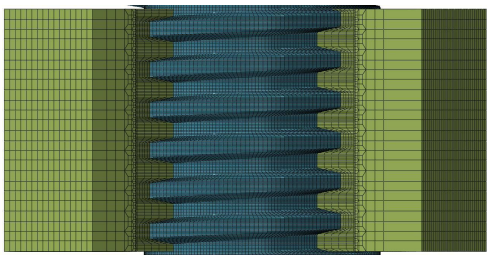


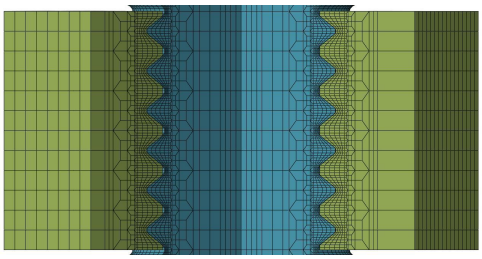
M10 bolt (nut half-section) accurate finite element mesh



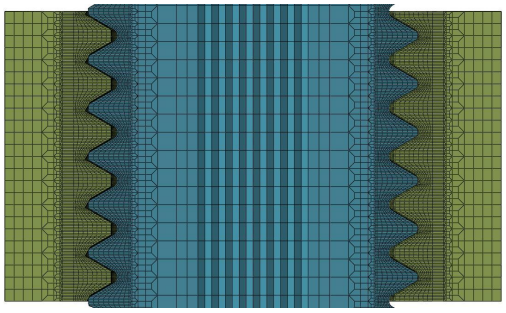


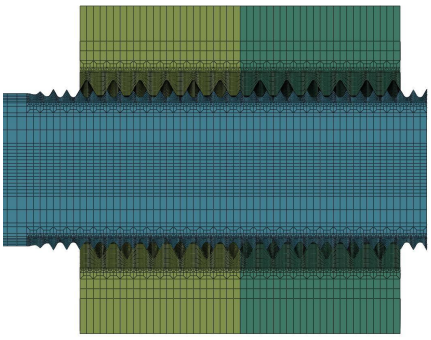
Metric thread Double-start thread





Trapezoidal thread Parallel thread





Spiralock nut Tang thread

Various precise bolt finite element meshes

2. Installation and Configuration

Welcome to use Thread Designer, the precise finite element modeling software for threaded components. This section will guide you through the software installation and configuration. Basic configuration

Operating system: Windows 7 64-bit system and above

- CPU: Recommended Intel Core i5 8600K or higher, or AMD Ryzen 5 3500X or higher

- Memory: minimum 8GB RAM

- Graphics card: recommended configuration for integrated graphics

- Operating System: Windows 11 64-bit system

- CPU: Intel Core i9 13900K or AMD Ryzen 9 7900X

- Memory: 32GB RAM

- Graphics card: NVIDIA GeForce RTX 3060 or equivalent performance graphics card Please ensure that your computer meets the minimum system requirements to achieve the best performance and experience. Installation steps

1. Download the software installation file (Setup.exe).

2. Double-click Setup.exe to start the installation wizard.

3. Follow the instructions to proceed. Note: Before execution, ensure you have administrator privileges.

4. The installation program will guide you through the following steps:

- Read and accept the license agreement.

- Choose the installation location (by default, the software will be installed in C:\Program Files\Thread Designer).

Configure start menu and desktop shortcut

- Choose whether to create a desktop shortcut.

- Complete Installation

5. After installation, you can start the software. License information

- On the first start of the software, you will be prompted to enter license information. Please provide your license key to activate the software.

- If you need a license key or have license issues, please contact our customer support team. Special configuration options for Abaqus:

If you plan to use this with Abaqus finite element analysis software from Dassault, ensure that your Abaqus version is 6.14 or higher. We recommend using version 2020 of Abaqus for optimal compatibility and performance. For use with other finite element software:

If you plan to use the software with other finite element analysis software (e.g., ANSYS), please note that you need to install Hypermesh software from Altair company first. Through Hypermesh, you can perform format conversion to import the model data generated by our software into Hypermesh and work with other finite element analysis software.

Now, you have successfully installed and configured the Thread Designer thread component precise finite element modeling software. You can begin to enjoy its functions and advantages.

If you encounter problems during installation or configuration, refer to the "Troubleshooting" section of this manual, or contact our support team for assistance.

3. Getting Started

Welcome to Thread Designer Threaded Component Finite Element Modeling Software. This section will guide you through a quick introduction to the software, including how to start the software, create a new project or file, import/export data, etc.

1. Start the software

- Double-click the Thread Designer.exe shortcut on your computer's desktop to start the software.

2. Login

- In the login interface, enter the account information you have already activated and log in. Once logged in successfully, you will enter the main interface.

3. Main interface

The main interface will display a tree structure on the left side of the software, listing various thread types.

4. Creating a new project or file

Select the thread type you are interested in and click to enter the parameter input interface.

In the parameter input interface, enter or adjust the relevant parameters to meet your needs.

5. Parameter check

- After you complete the parameter input, click the 'Parameter Check' button. The software will automatically perform the check and display the results.

6. Creating a model file

- If the check result is passed, click the 'Create' button.

Select a folder to save your precise finite element model file (typically in .inp format).

At the same time, the software also generates an XML file storing the configuration parameters of this session.

7. Manually generate configuration parameter xml file

- If you need to manually generate a configuration parameter XML file, click the 'Start' button, then select 'Save'. This will allow you to manually save the configuration parameters.

- The XML file can be opened with a text editor and parameters can be modified manually.

8. Importing previous configuration parameters

- If you need to import previous configuration parameters, click the 'Start' button, then select 'Open'.

Select a previously saved XML file to quickly import configuration parameters.

This is a quick start guide to help you become familiar with the basic operations of the software. When using the software more deeply, you can explore more functions and options according to your actual needs. We hope you can make full use of the ThreadDesigner software to meet your project requirements.

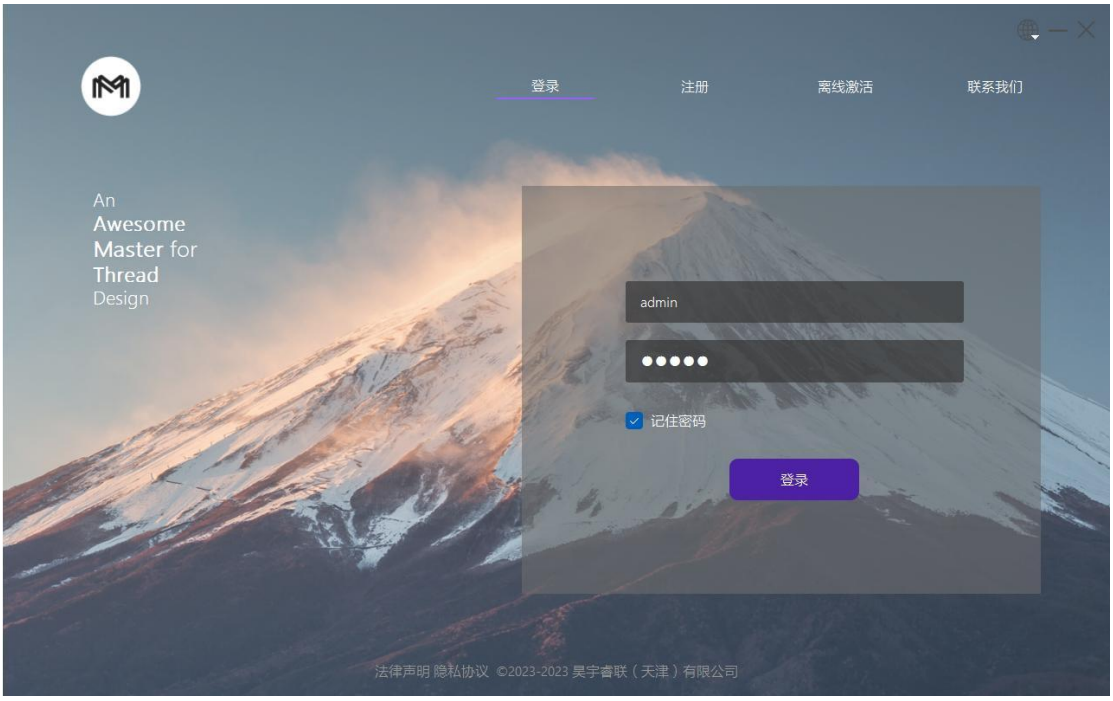
4. User Interface

This section describes the user interface, including explanations of each component. Note that due to software version updates, the interface displayed in this section may differ from your version, but the main functional logic remains consistent and does not affect understanding and use.

1. Login interface:

Software features: Ultra-high freedom - can generate precise thread profile mesh of any type, size, transition, and arrangement.

The 'Settings' button is provided in the upper right corner, allowing users to change the software language and other settings.



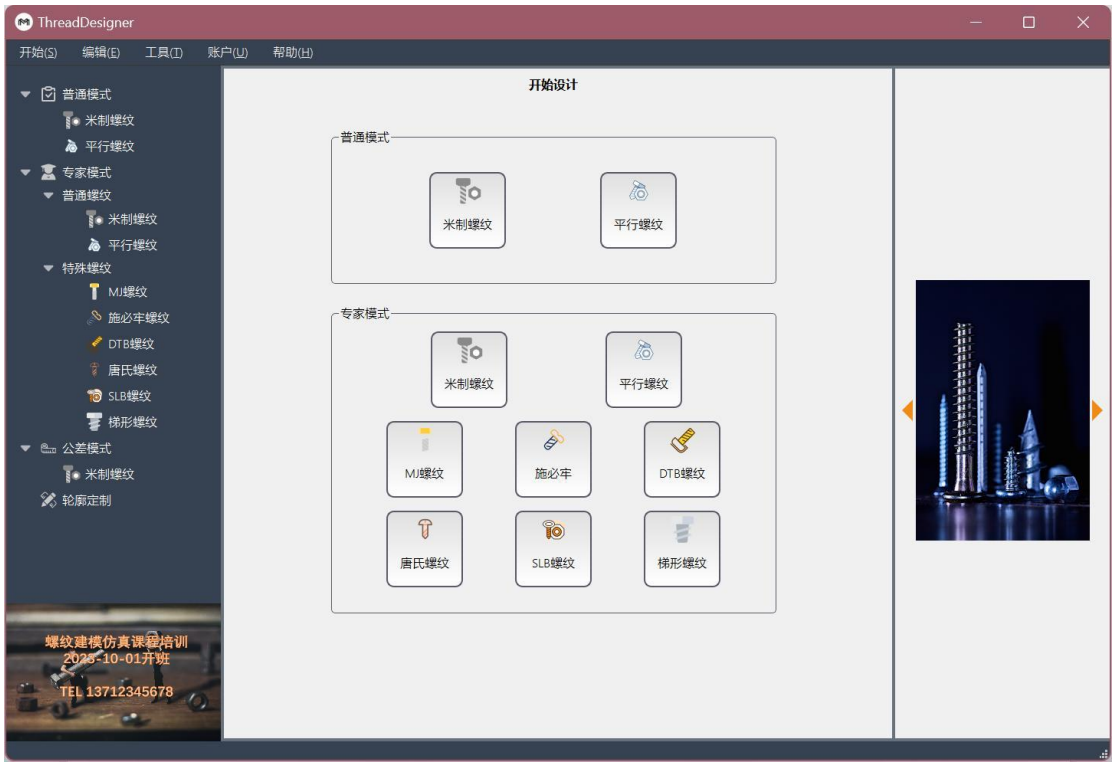
2. Main interface:

- The main interface consists of multiple components.

- The top menu bar includes "Start," "Edit," "Tools," "Account," and "Help" menus, providing different functional options.

On the left is a model selection tree, which lists different thread types.

Right side includes a mode selection interface for selecting different working modes.



3. Menu bar:

Start menu includes options: new design, open, save, close.



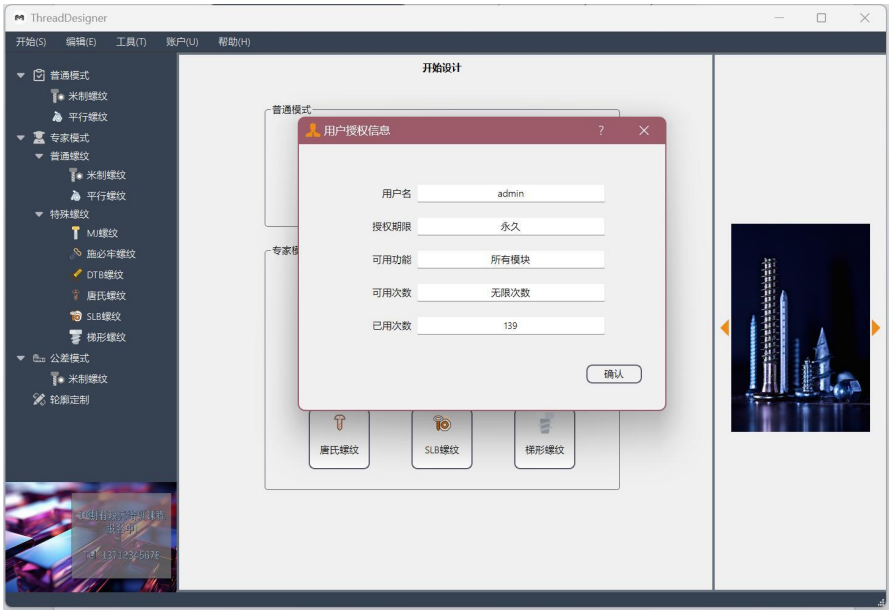
- The Edit menu provides options to clear and reset, as well as to set parameters to default values (the option is not available in the software version shown in the image).



- The tools menu includes design records and preferences options.



- Account Menu for Checking User Account Permissions



- The help menu provides technical support and information about the software.



4. Tree view:

In ordinary mode, displays 'metric threads' and 'parallel threads'.

- Select a folder to save your precise finite element model file (usually in INP format).

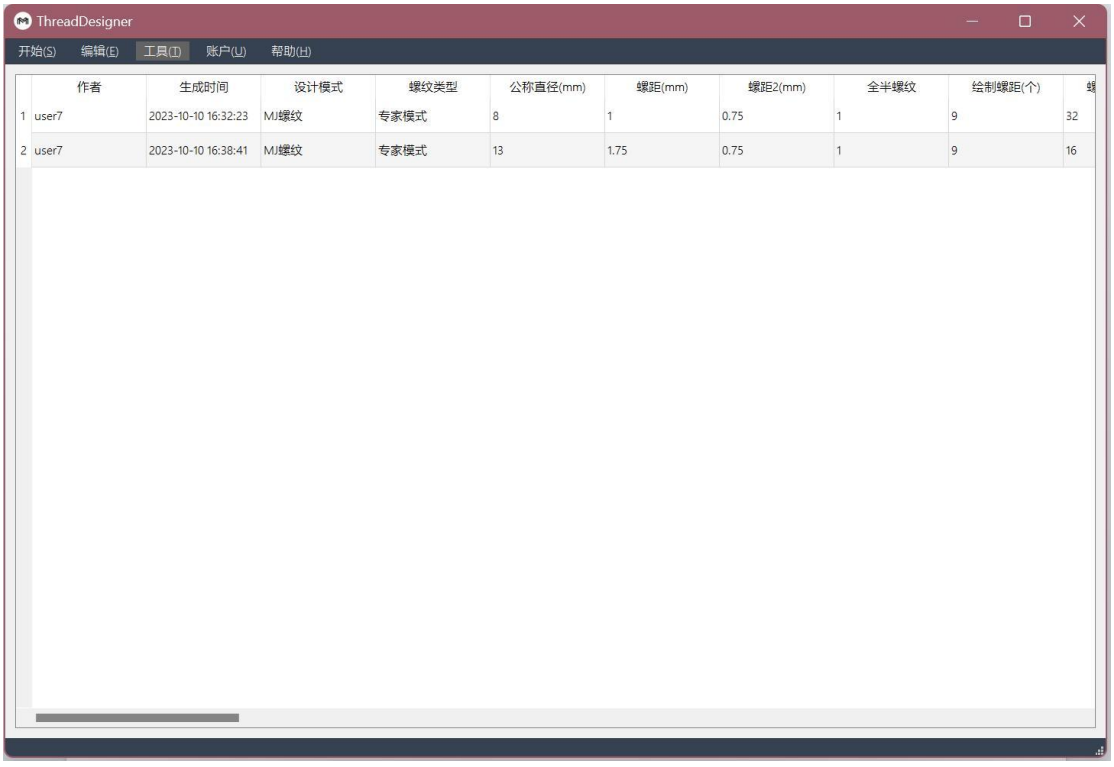
DTB threads, Dowell threads, SLB threads, trapezoidal threads).

- Tolerance Mode and Contour Customization Functions Are Currently Unavailable



5. Design record interface:

Records are saved for each model creation, allowing users to view historical designs at any time.

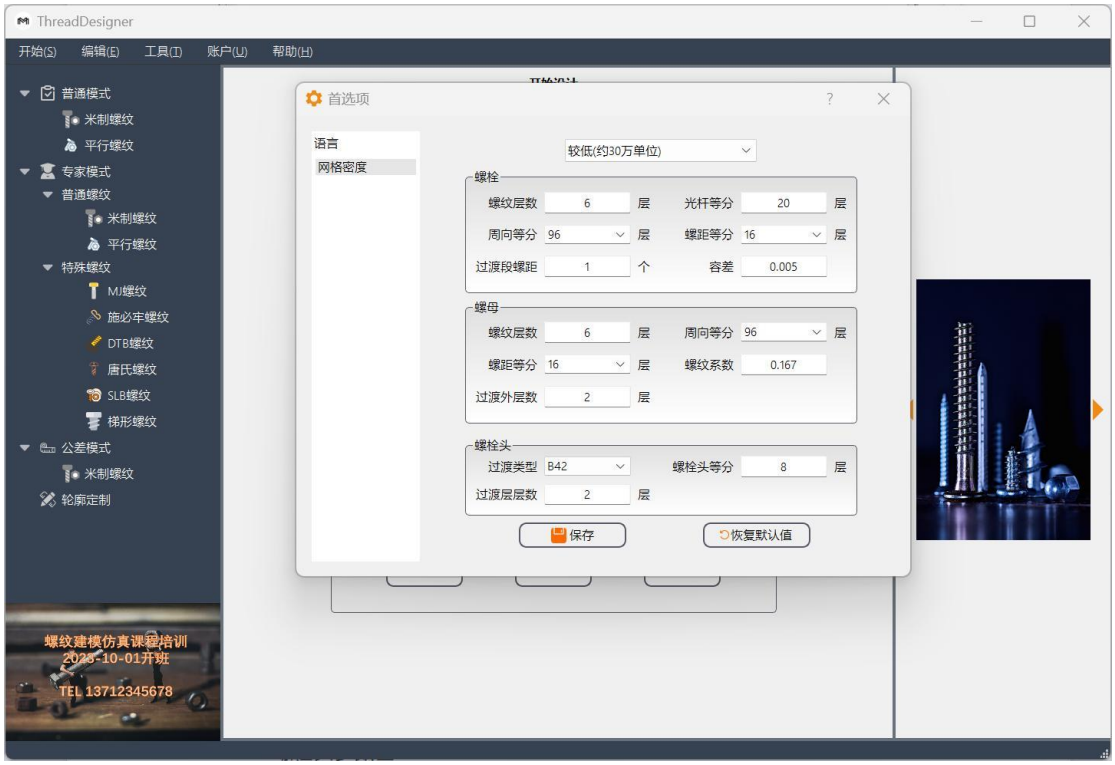


	作者	生成时间	设计模式	螺纹类型	公称直径(mm)	螺距(mm)	螺距2(mm)	全半螺纹	绘制螺距(个)	
1	user7	2023-10-10 16:32:23	MJ螺纹	专家模式	8	1	0.75	1	9	32
2	user7	2023-10-10 16:38:41	MJ螺纹	专家模式	13	1.75	0.75	1	9	16

6. Preferences interface:

Preferences include language and mesh density options.

- Mesh density options allow users to adjust configuration parameters for different mesh densities, applicable to regular mode.



7. Ordinary mode design interface:

- The design interface is divided into the following areas:

- Bolt Parameters Area

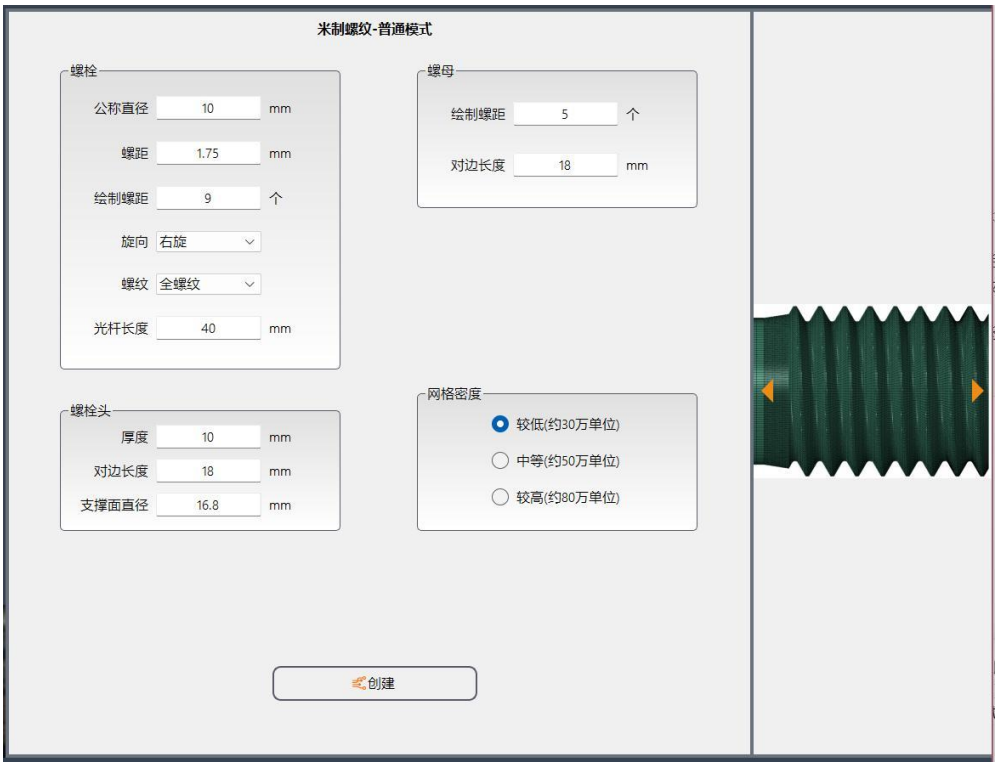
- Nut Parameters Area

- Bolt Head Parameter Area

- Mesh density selection area

- Create button

Right-side schematic switch, used for visualizing parameters and design concepts.



8. Expert mode design interface:

- The design interface is divided into the following areas:

- Bolt Parameters Area

- Nut Parameters Area

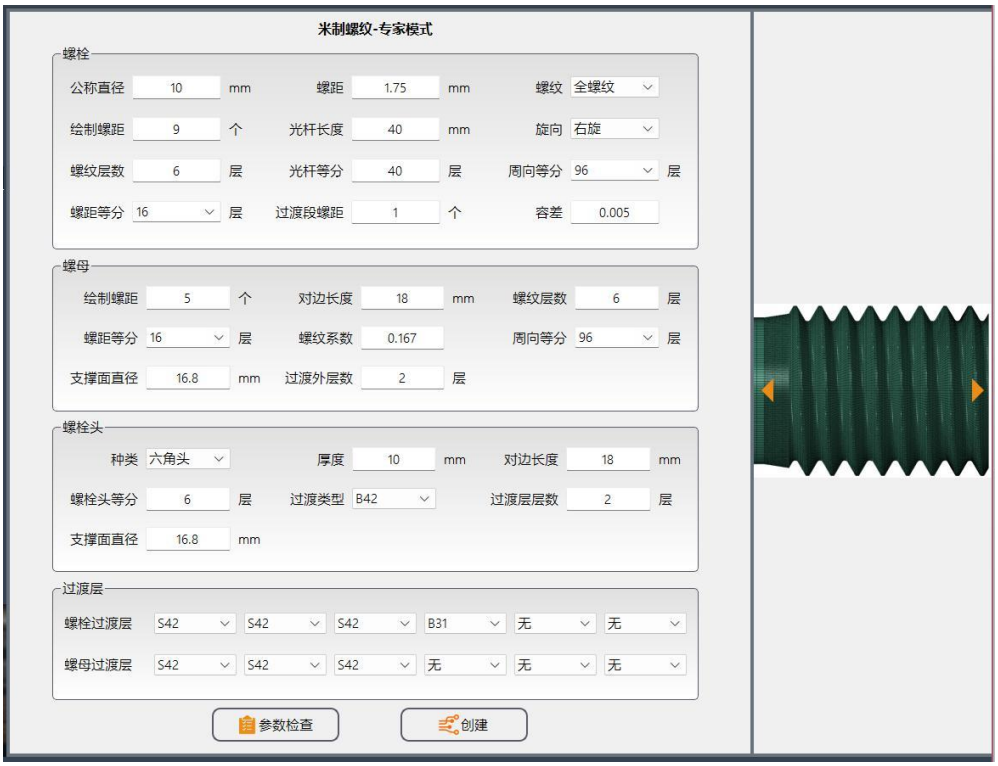
- Bolt Head Parameter Area

- Transition Parameters Area

- Parameter Check Button

- Create button

Right-side schematic switch, used for visualizing parameters and design concepts.



Users can click on any thread type to enter the design interface, then configure various parameters according to their needs, perform checks, and generate the corresponding precise finite element model file.

This section describes the user interface overview to help users become familiar with the various parts and functions of the software. It helps users operate and navigate within the software.

5. Core Features

The following is a detailed introduction to the core functions of the ThreadDesigner software, including the process of parameterized generation of precise finite element models for bolts in different modes:

Core Function: Generate Precise Finite Element Models for Bolts. The main function of Thread Designer software is to generate precise finite element models for various bolts (INP format, applicable to Abaqus and Hypermesh software).

5.1 Core Operation Process

1. Selecting the working mode

Thread Designer provides two working modes, standard mode and expert mode, to meet the needs of different users:

- Ordinary mode: Suitable for users who do not require high levels of model customization or for new users who are unfamiliar with complex parameters. In this mode, fewer parameters are required, and the knowledge level of the user is relatively lower.

- Expert Mode: Suitable for users with some professional knowledge. The model is highly customizable. In this mode, users need to input more parameters to precisely configure the bolt model.

2. Enter the design interface

After selecting the appropriate thread type, click on that type to enter the parameterized generation interface for the precise finite element model of the bolt.

3. Enter parameters (parameter details are explained in Section 5.2)

In the design interface, you need to input various parameters to precisely configure the bolt model. These parameters include bolt parameters, nut parameters, bolt head parameters, and transition layer parameters.

- Bolt parameters: include nominal diameter, pitch, thread type, drawn pitch, shank length, thread direction, etc.

Nut parameters: include drawn pitch, end length, number of threads, and number of thread layers.

- Bolt head parameters: include bolt head type, thickness, end-to-end length, bolt head number of layers, transition type, etc.

- Transition layer parameters: include configuration of bolt transition layer and nut transition layer, support different types of transition layers.

4. Parameter check

After completing the parameter input, click the 'Parameter Check' button. The software will automatically check the validity of the input parameter configuration and provide an estimated number of mesh nodes for the bolt and nut.

5. Create model

If the check is passed and the mesh count meets the user's requirements, you can click the "Create" button, select the output folder, and complete the model generation.

This process will generate an accurate finite element model file (usually in INP format), and also generate an XML file for storing configuration parameters. This model file can be used in Abaqus and Hypermesh finite element analysis software.

Please note that special parameters such as transition layer settings require adjustment only under trained or professional supervision to ensure successful model generation. Understanding the software's advanced features can help users configure models more flexibly.

5.2 Parameter Detailed Comments

When input parameters are used to generate a precise finite element model for a bolt, it is necessary to provide a detailed description of each parameter's meaning and input method. The following are detailed descriptions of each parameter, including the content you mentioned: Bolt parameters:

1. Nominal Diameter:

Standard Diameter of Bolt, Usually Expressed in Millimeters or Inches

2. Pitch:

The distance between adjacent threads, usually expressed in millimeters or inches.

3. Thread type (Thread Type):

Select thread type, including full thread and half thread.

4. Draw the pitch (Thread Length):

Thread drawing length on bolt, expressed in millimeters.

5. Shank length (Shank Length):

Length of the shank part of the bolt, expressed in millimeters.

6. Thread Direction:

Specify thread direction, typically left-hand or right-hand.

7. Number of threads (Thread Layers):

The number of layers in the bolt thread profile affects the mesh density in the thread area.

8. Number of shank layers (Shank Layers):

Number of layers in the shank section, affecting the mesh density in the shank area.

9. Circumferential Divisions:

The number of outer mesh elements in the circumferential direction for the bolt bottom surface.

10. Pitch Divisions:

The number of outer mesh layers in the bolt profile within one pitch in the radial direction.

11. Transitional Pitch:

Refers to the Pitch of the Thread Transition Section, Engineering Known as the Lead-Out Slot

12. Tolerance (Tolerance):

Tolerance for specified bolt parameters is usually expressed as a percentage. Nut parameters:

1. Draw the pitch (Thread Length):

The thread drawing length of the nut, expressed in millimeters, must be an integer multiple of the pitch.

2. Across Flats Length:

Distance between parallel sides of the outer hexagon of the nut, usually expressed in millimeters.

3. Number of threads (Thread Layers):

Number of layers in the nut thread section, typically consistent with the bolt.

4. Pitch Divisions:

The number of outer mesh layers in the nut profile within one pitch in the radial direction.

5. Circumferential Divisions:

The number of outer mesh elements in the circumferential direction for the nut bottom surface.

6. Thread factor (Thread Factor):

It is related to the width of the dense mesh in the threaded area. Usually, the default parameter is maintained. If there are problems with the dense mesh in the threaded area after the model is generated or the width dimension is too small, the parameter can be adjusted.

7. Bearing Diameter:

The equivalent diameter of the contact surface of the nut, typically consistent with the contact surface diameter of the bolt head, shall not exceed the distance between opposite edges. It can be calculated by formula or referenced from mechanical design handbooks. If the outer transition mesh size of the nut is too small, this parameter can be increased to adjust, which does not affect the actual structure, but the maximum value shall not exceed the distance between opposite edges.

8. Number of transitional outer layers (Transitional Layers):

Number of divisions in the transition region from dense mesh to hexahedral mesh, which is usually kept at the default value. Bolt head parameters:

1. Bolt head type (Head Type):

Select bolt head type, such as hex head. If a round head is needed, simply delete the hexagonal mesh directly.

2. Thickness (Thickness):

The thickness of the bolt head, in millimeters.

3. Across Flats Length:

Distance between parallel sides of the bolt head outer hexagon

4. Number of head layers (Head Layers):

Number of layers in the thickness direction of the bolt head

5. Transitional Type:

Specify the type of transitional layers between the dense mesh inside the bolt head and the sparse mesh outside.

6. Number of transitional layers (Transitional Layers):

Configure the number of layers in the transition region between the dense mesh inside the bolt head and the sparse mesh outside.

7. Bearing Diameter:

The equivalent diameter of the support surface of the bolt head can be obtained through formula calculation, relevant standards, or reference to mechanical design handbooks. Unlike the support surface diameter of the nut, the equivalent diameter of the support surface of the bolt head is not allowed to be arbitrarily modified. This parameter has a significant impact on the stress area of the bolt head contact surface. Transition layer parameters:

Configuration of the bolt transition layer and nut transition layer supports 3 to 6 transition layers, and supports multiple transition layer types, including S42, S31, B42, and B31.

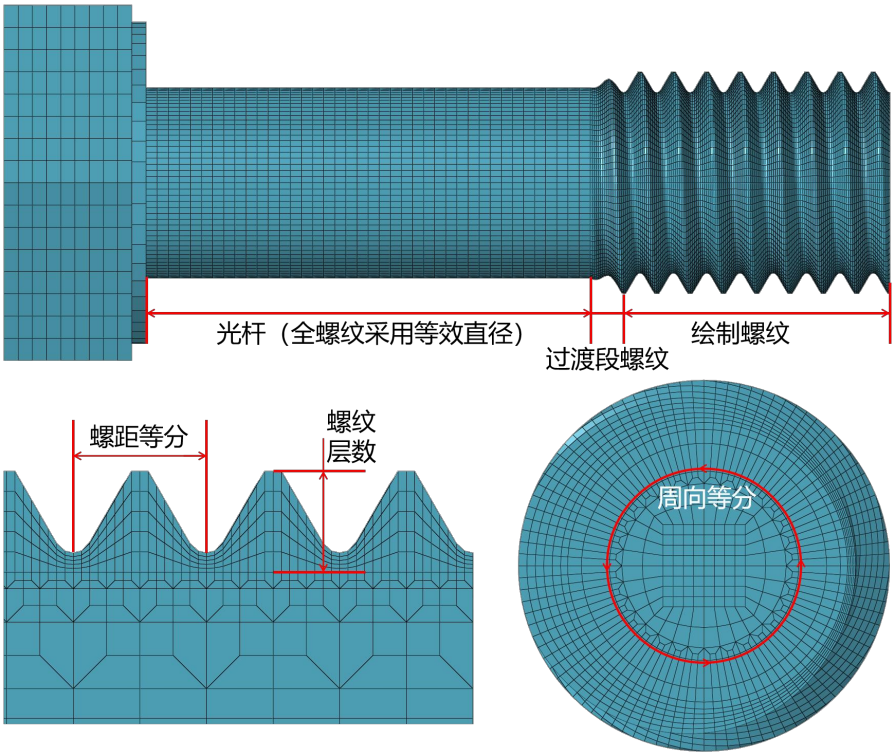
Transition layer settings affect whether the model can be generated. Keep the default settings unless you have been trained to change them. Section 6, Advanced Features, explains the transition layer options in detail.

After completing the parameter input, click the 'Parameter Check' button to verify whether the input parameter configuration can successfully generate the model, and provide an estimated number of bolt mesh and nut mesh. If the check passes and the mesh count meets the user's requirements, click the 'Create' button to select the output folder and complete the model output.

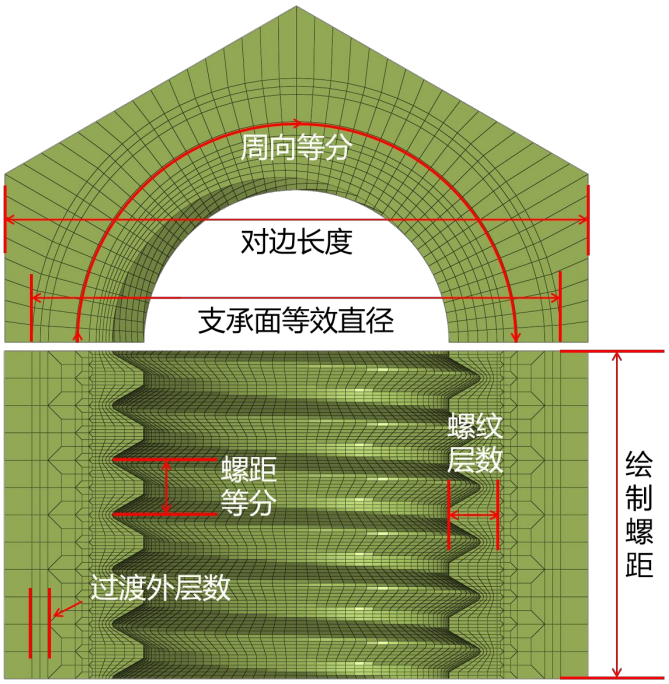
By correctly entering these parameters, you can generate an accurate finite element model of a bolt that conforms to specifications for subsequent finite element analysis. In expert mode, users need to have a certain level of expertise to ensure the accuracy of parameter configuration and the quality of the model.

6. Advanced Features

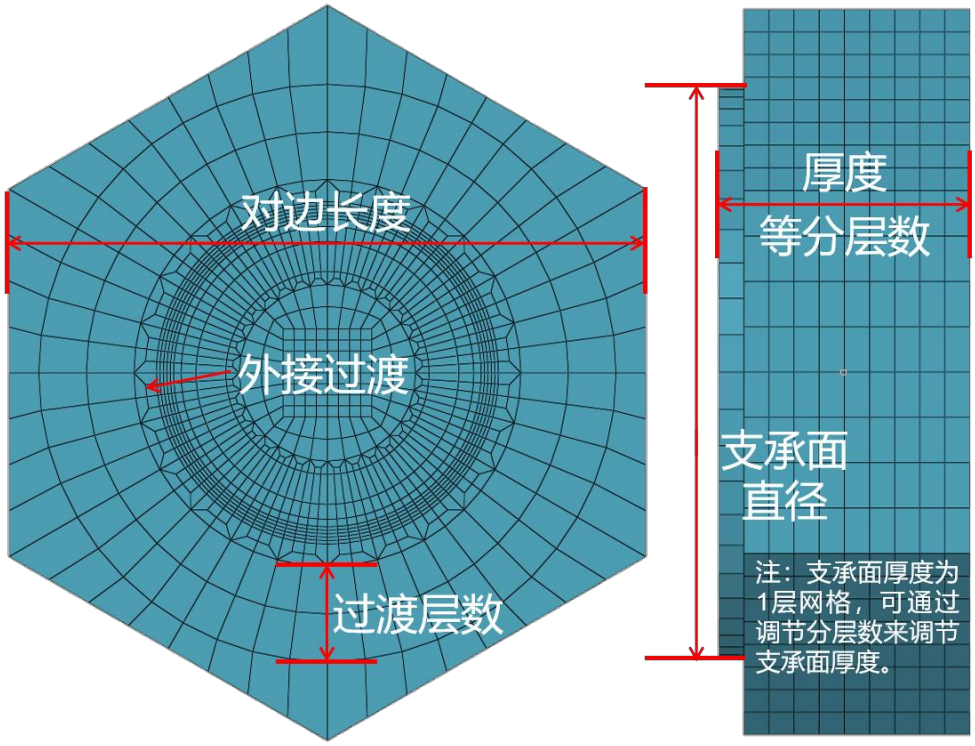
1. Variable diagram bolt parameter area



Nuts Parameters Area

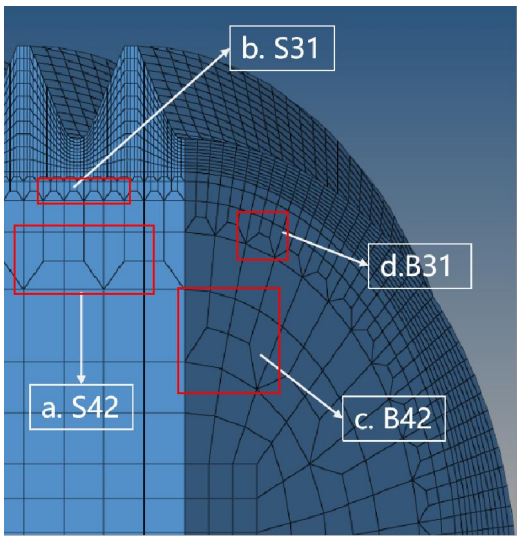


Bolt Head Parameters Area



The above diagram can be popped up by clicking on the blank area of the corresponding component in the design interface.

2. Explanation of the transition area



The transition parameter selection area contains four transition methods: S42: Section 4 to 2. S indicates section, and 42 indicates that the transition method for the grid from dense to sparse is 4 grid transition to 2 grid.

S31: Section 3 to 1. S indicates section, 31 indicates the transition method from dense mesh to hexahedral mesh as 3.

The mesh transitions to 1 mesh.

B42: Bottom 4 to 2. B indicates the bottom, and 42 indicates the transition method from dense to sparse mesh is 4 mesh to 2 mesh.

B31: Bottom 3 to 1. B indicates the bottom, and 31 indicates the transition method from dense to sparse mesh is 3 mesh to 1 mesh.

3. Whether parameters can be checked by calculation method

S = number of equal divisions in the pitch direction; B = number of equal divisions in the circumferential direction; Transition layer effect: In the S direction: S42 (1) will make S/2 (S42 is S divided by 4 when it is the end of the pitch direction), S31 (2) will make S/3.

Two conditions must be satisfied in the B direction:

(1)B42(3) will make B/2, B31 will make B/3, the B layer needs to be divided into 4 equal parts at the end (transitioning to the central square), and this 4 is definitely a divisor.

(2) When transitioning outward, the B layer needs to be divided by the nut transition method, then divided by 6 (the bolt head is divided into 6 parts). It must be ensured that the number of divisions is divisible by all transition layers. To ensure the accuracy of the calculation, the number of divisions for the nut is generally the same as that for the bolt.

Taking the transition layer [S42 S42 B42 S42 B31] as an example: The number of layers in the pitch direction S: S/2/2/4 (S42 is S divided by 4 when it is the end of the pitch direction); the number of layers in the circumferential direction B: (must satisfy two conditions simultaneously)

(1)B/2/3/4(B layer needs to be divided into 4 equal parts, this 4 is mandatory)=integer

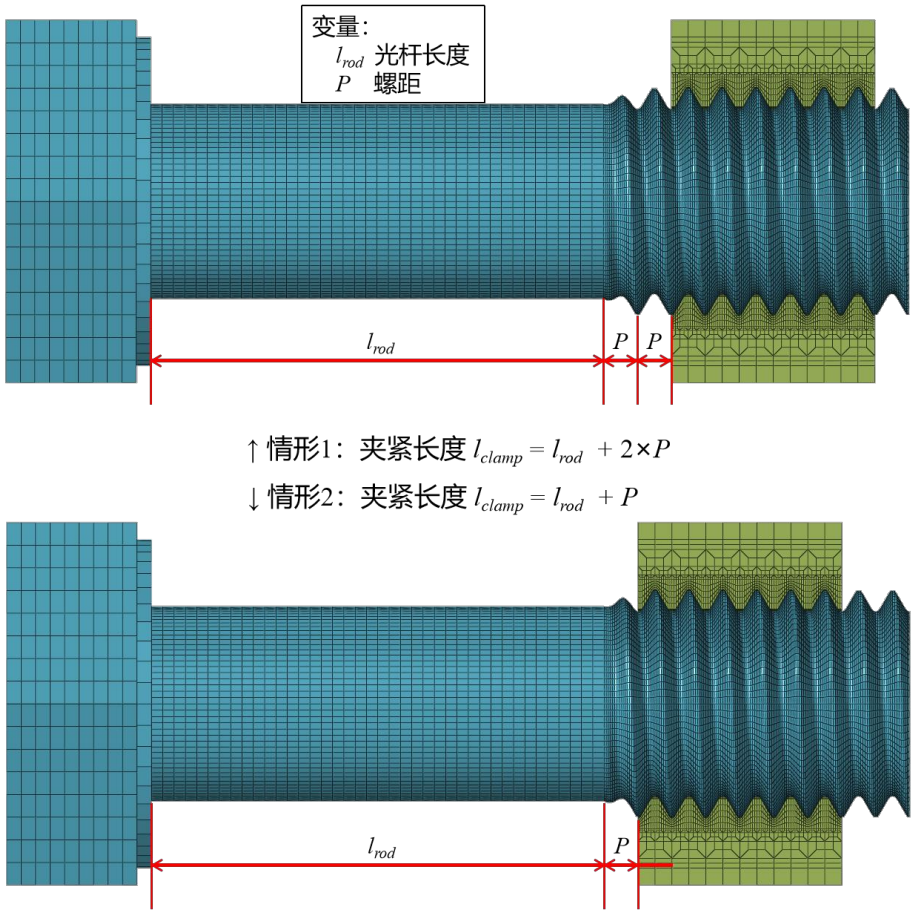
(2)B/(Nut Transitional Method)/6 (Bolt head needs to be divided into 6 equal parts) = integer

4. How to generate a model with clamping length that meets the requirements

Generally, when a bolt clamps the clamped members, there are two scenarios: Scenario 1 - in addition to reserving a thread withdrawal slot, reserve one pitch (this scenario is applicable for finite element simulation using rotational tightening loading methods, such as the rotation angle method or torque method)

Case 2 - Only reserved retraction slot, no separate reservation of pitch (this case is applicable for finite element simulation using non-rotational tightening loading methods, such as the Bolt Load loading method).

The specific calculation formulas for the two cases are shown in the figure below.

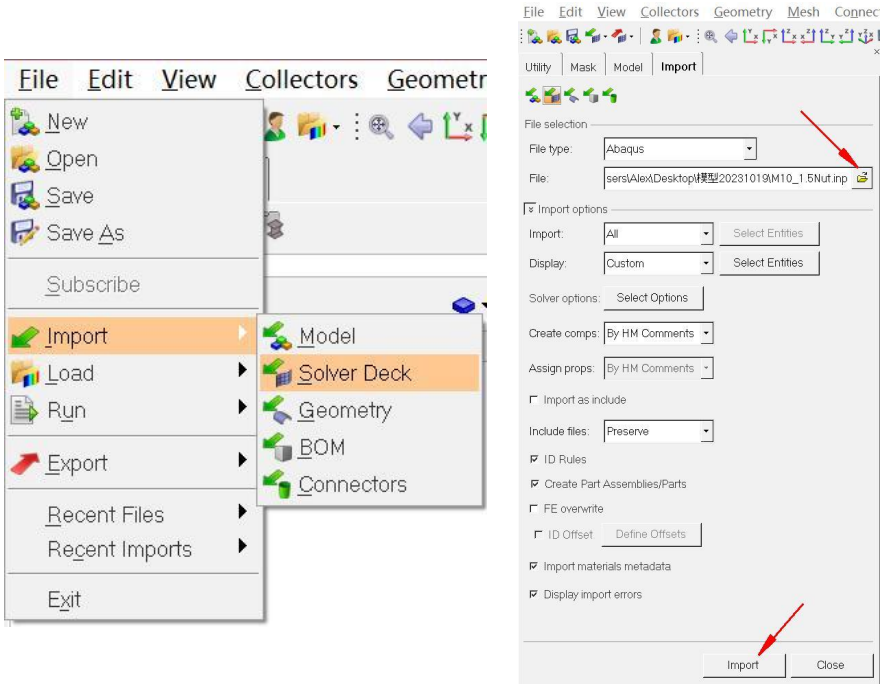


5. Subsequent node operations for the model

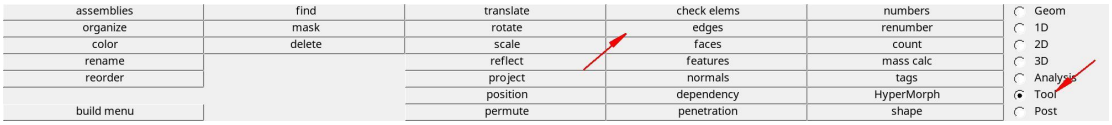
The finite element model generated by this software has duplicate nodes, and the "merge duplicate nodes" operation must be performed in the finite element to be used perfectly.

This section uses Hypermesh 2020 and Abaqus 6.14 software as examples to demonstrate the 'merge nodes' operation. Hypermesh 2020 software operation: First, open the Hypermesh software, then click on 'File' -> 'Import' -> 'Solver' in the menu bar.

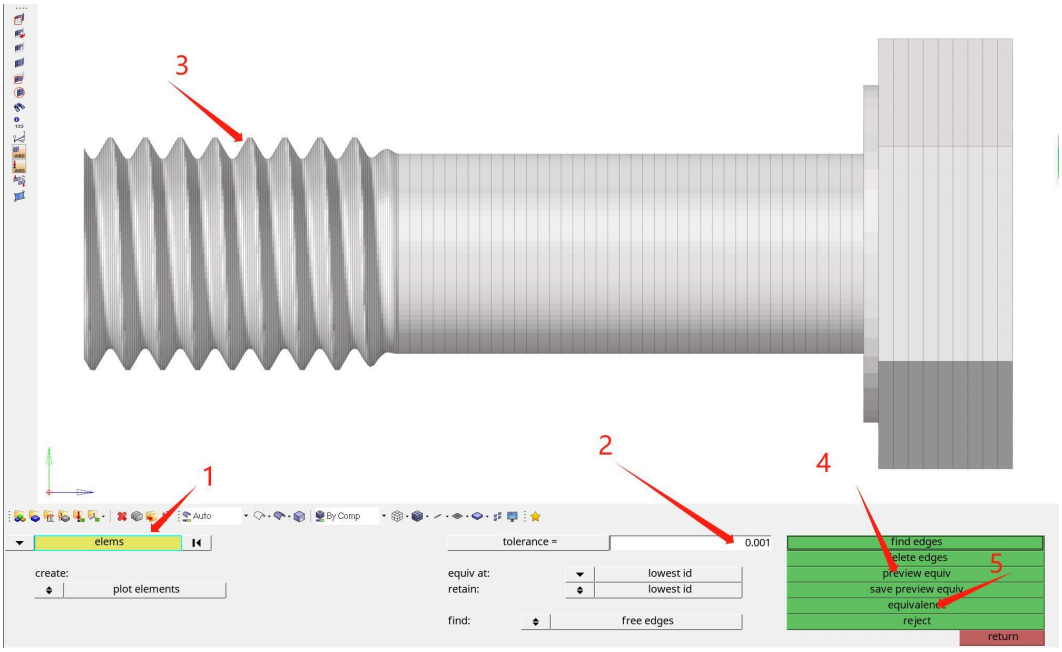
Select the 'Deck' option in the Import tab, choose the file path you want to import, and click 'Import' to import the finite element model.



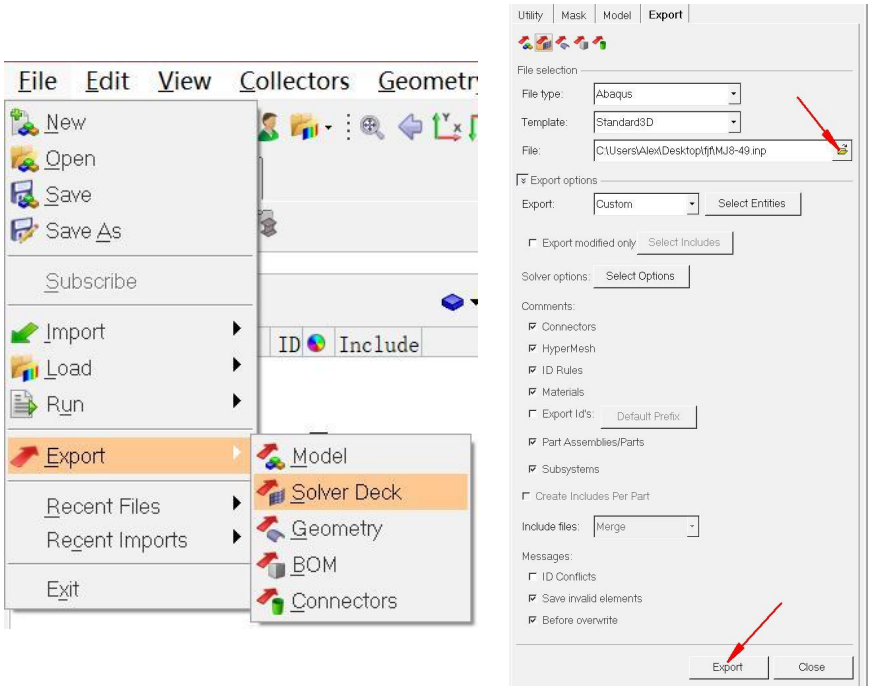
In the lower options interface, click 'Tool' -> 'edges' to enter the next operation interface.



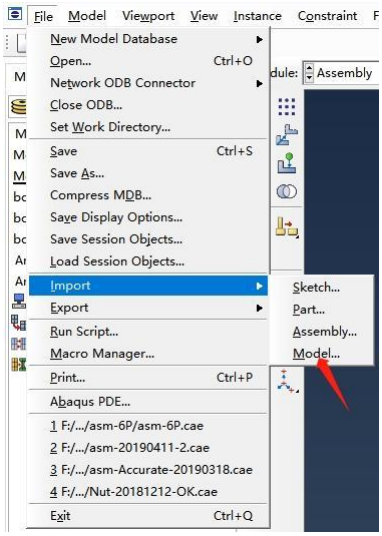
Change the selection range to 'elems', set tolerance to 0.001, hold down Shift and left-click the mouse to select the entire part, click 'preview equiv', repeat node highlighting, and click 'equivalence' to merge nodes.



After completing the node merging operation, click on 'File' -> 'Export' -> 'Solver Deck' in the menu bar. Select the file path you want to export in the 'Export' tab, then click 'Export' to export the finite element model. If you need to export the model in a format compatible with other finite element software (e.g., ANSYS), select the corresponding software in the 'File type' option.

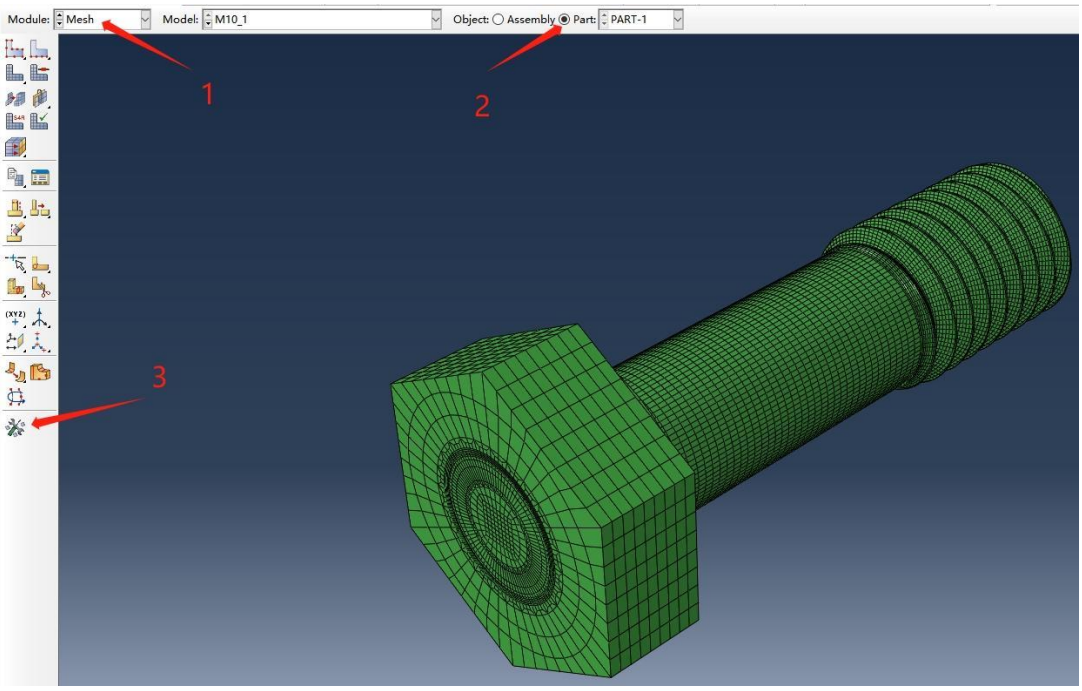


Abaqus 6.14 Software Operation: First, open the Abaqus software, click on the 'File' menu -> 'Import' -> 'Model' option, and select and import the INP file.

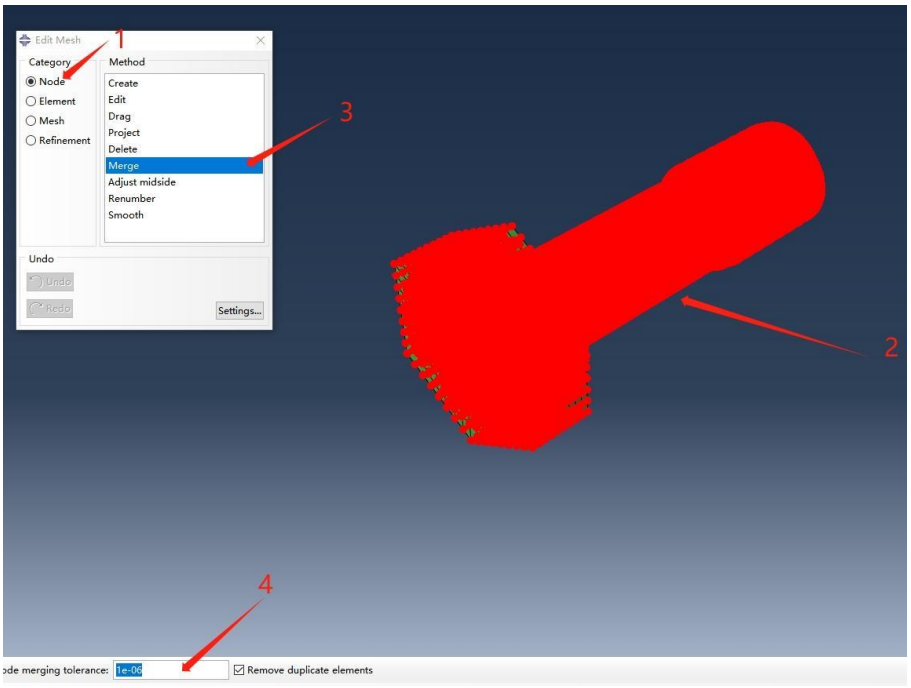


Switch the Abaqus module to the 'Mesh' interface, and switch the object from 'Assembly' to 'Part',

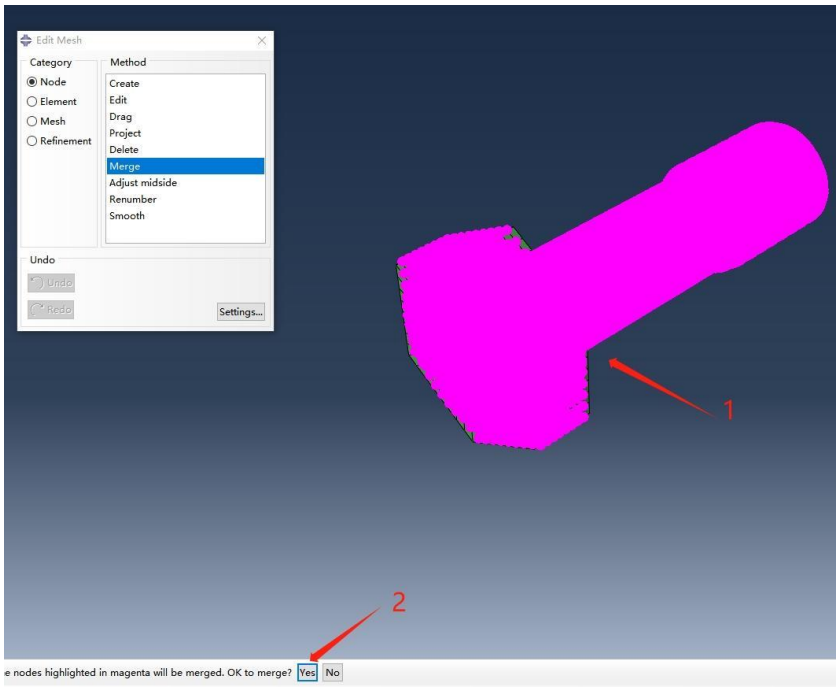
Click the 'Edit mesh' button to enter the editing interface.



In the editing interface, click 'Node' in the directory to switch the tab, select the parts to be merged, and then click the 'Merge' button. A 'Merge Tolerance' will pop up at the bottom of the software. Set the tolerance to '1e-04', and press the 'Enter' key on the keyboard.



At this time, the nodes to be merged will be displayed in purple, and the software will prompt whether to merge the nodes. Clicking 'Yes' will complete the node merging operation.



6. Mesh quality for the generation mode

The precise finite element mesh for bolts uses a fully eight-node hexahedral element. Its greatest advantage is that it can perfectly reproduce the complex contour of bolts while ensuring high mesh quality, making finite element calculations more likely to converge.

The table shows various mesh ratios when the mesh size is 55μm (high mesh density). The proportion of high-quality meshes is almost entirely above 80%, and the proportion of error meshes is 0%. Note that this result is only for the case of high mesh density. If the density is reduced, the proportion of high-quality meshes will be higher.

螺栓模型	正常网格	警告网格	错误网格
普通螺纹	84.19%	15.81%	0%
普通螺母	83.14%	16.86%	0%
平行螺纹	82.64%	17.36%	0%
DTB螺纹	84.67%	15.33%	0%
SLB螺纹	84.23%	15.77%	0%
MJ螺纹	89.16%	10.84%	0%
唐氏螺纹	87.56%	12.44%	0%
施必牢螺母	78.96%	21.04%	0%

7. Settings and Preferences

The Thread Designer software provides some settings and preferences to allow users to customize their experience. These options allow users to personalize configurations to meet their needs and preferences.

1. Language settings:

Thread Designer supports multiple languages. In the settings, users can choose the interface language of the software to more easily understand and operate the software.

When switching languages in the settings, the change will take effect when the software is next started.

- Language switching can also be completed in the right upper corner of the software login interface, and no software restart is required.

2. Mesh density settings:

- Mesh density settings allow advanced users or administrators to adjust the mesh density in different areas. This is important for the level of detail and accuracy of the model. Users can increase or decrease the mesh density according to project requirements.

- The mesh density setting corresponds to the "low," "medium," and "high" options in standard mode. It does not take effect in expert mode.

3. Design records:

- The Thread Designer software allows users to view design records, which record detailed information about each model creation. This helps users track and manage their projects and find previous designs.

These settings and preferences help users customize the software according to their needs and project requirements, providing a better user experience. Users can easily adjust these options to meet different project and requirement needs. These options offer greater flexibility, allowing users to fully utilize the features of the Thread Designer software.

8. Troubleshooting

This section provides information about possible faults and troubleshooting methods to help users solve problems on their own.

1. Unable to start the software.

Solution: Ensure that your computer system meets the minimum system requirements. Check the operating system version, CPU, memory, and graphics card hardware configuration. You may also try reinstalling the software or checking system error reports for more information.

2. Software crash or stop responding.

Solution: Ensure that there are not too many background applications running on your computer, as this may cause the software to crash. Ensure that the software is the latest version to obtain fixes for known issues.

3. Model generation failure.

Solution: Check the input parameter configuration to ensure they comply with specifications and requirements. Pay special attention to the configuration of transition layers, as they may affect the model generation. You can refer to the user manual for detailed information on parameter configuration.

4. Unable to import or export data.

Solution: Check the format and compatibility of the data file. Ensure that you are using a file format supported by the software. If import or export fails, check if the file is damaged.

5. Interface or graphical display issues.

Solution: Check if your graphics driver is up to date and compatible with the software. Try adjusting the resolution or graphics settings to resolve display issues.

6. License issues.

Solution: If you encounter license issues, please ensure that your license is activated and the license file is valid. If there are problems, contact the software supplier for support and solutions.

7. Performance issues.

Solution: If the software runs slowly, try closing other background applications to release computational resources. You may also consider upgrading computer hardware, such as larger memory or a faster processor.

8. Error occurs with mclmcrrt9_7.dll missing.

Solution: This error indicates that your computer is missing the required runtime environment or that the critical runtime file is damaged. Please follow these steps to resolve the issue:

- Try running the Thread Designer software again after restarting the computer.

- Fully uninstall and then reinstall the Thread Designer software. If the problem persists, contact the software supplier.

9. The 'Create' button is displayed as gray and cannot be pressed

Solution: This is usually due to insufficient user permissions. You can follow the following steps to resolve the issue:

Click on 'Account' -> 'Management' to view your account permissions.

If your permissions are restricted, contact the software administrator or supervisor to obtain the necessary permissions.

10. The generated model has issues with missing mesh or structural deformation.

- If you need to add new modules or permissions, or make other configuration changes to the software, please contact your software administrator.

- Perform parameter checks to ensure the input parameters are valid. The software provides error messages to help you identify the problem.

If parameter checks fail, correct according to the error message.

- If the problem persists, it may be due to a bug in the algorithm. Contact the software administrator or technical support for a corrected model or to report the bug. They will resolve the issue as soon as possible.

11. Other issues.

Solution: If other issues are encountered, it is recommended to consult the user manual or online documentation for more information. Additionally, you can contact the technical support team of the software supplier for professional assistance.

Please note that troubleshooting may vary depending on the specific issue, so sometimes further support and guidance may be required. When solving problems, always ensure to back up important data in case of unexpected situations. If the problem cannot be resolved, it is recommended to contact the software supplier or technical support for professional assistance.

IX Common Questions (FAQ)

1. What is the purpose of the diagram on the right side of the design interface?

The figure on the right is used to display the appearance and structure of the current thread type. It allows users to visualize the appearance of bolts or nuts before designing parameters. You can switch between different views by clicking the left and right arrows or by scrolling the mouse wheel over the image to better understand the model's appearance.

2. Problems occur with stress distribution calculation results in the generated model during simulation.

This issue is usually related to finite element calculations, possibly due to incorrect boundary conditions. The solution is as follows:

Check that the boundary conditions are correct and complete. If they are, check for duplicate nodes that were left unmerged. Section 6 explains how to merge them.

3. If you want to add new modules or permissions during software usage, how should you operate?

First, you need to contact the software administrator or system administrator to express your request to add new modules or permissions.

When communicating with the software administrator, clearly specify the specific content of the new module or permission you need. This includes the name of the module, its function, and access permissions. Clear requirements will help the administrator better meet your needs. The software administrator will provide a quotation and contract based on your requirements. Of course, users can freely experience the new module content within a limited number of times.

After purchasing new modules, the software administrator will upgrade your account according to your needs. After the upgrade is complete, you can restart the software to ensure that the local function modules are open.

10. Support and Contact Information

If you encounter any problems while using the ThreadDesigner software, or have other questions, you can contact us through the following methods:

Technical support team:

- Our professional technical support team is available to assist and answer your questions at any time.

- Email support: dyrxsw@163.com

- Telephone support: 181 80582576 (Business hours: Monday to Friday, 9:00 AM - 5:00 PM)

Software Administrator:

- The login interface includes four tabs: 'Login', 'Register', 'Offline Activation', and 'Contact Us'.

- Software administrator contact: 181 8058 2576

Online Resources:

We provide online user manuals and documentation to help you better understand and use the software.

- We provide a popular science introduction to bolted joint technology, not limited to finite element pre-processing and finite element calculation.

- We will conduct periodic training on finite element simulation techniques for bolted joints, helping users to use the software and improve their ability to perform accurate finite element simulations for bolted joint structures.

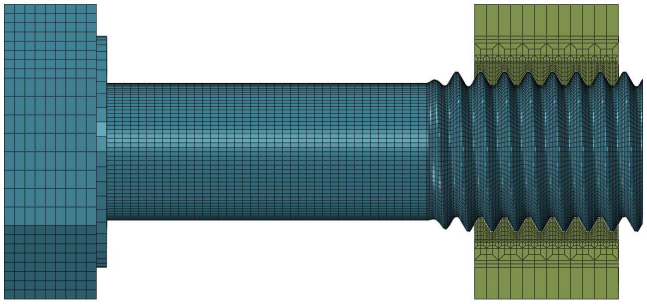
- Follow Horycon on WeChat.

Regardless of whether your question is about software usage, technical support, training needs, or any other aspect, we are happy to provide assistance. Please feel free to contact us, and we will strive to meet your needs.

11. Appendix

1. Metric threads

The metric thread is a commonly used thread for fastened joints, characterized by a wide range of specifications, multiple tolerance zones, good engagement, ease of processing, secure connection, and wide application range. Metric threads are generally marked as M, where 'M' indicates metric (Metric).



The metric thread traces back to the French SF thread introduced in 1894 (system French screw threads). French, Swiss, and German delegates revised it in Zurich in 1898 as the SI thread (system international screw threads). In 1940, the International Federation of the National Standardizing Associations (ISA), with agreement from Czechoslovakia, Denmark, Germany, France, Italy, Uganda, Norway, Switzerland, the Soviet Union, Finland, and Sweden as listed in the source, published the full ISA metric range, also known as ISA Bulletin 26, for coarse and fine threads. ISO subsequently reviewed the ISA metric series and published ISO metric screw threads in 1962.

Chinese standards for standard metric threads include GB/T 192-2003, Basic profile. GB/T 193-2003, Diameter and pitch series. GB/T 9144-2003, Preferred series. GB/T 196-2003, Nominal sizes. GB/T 197-2003, Tolerances. GB/T 15756-2008, Limits of sizes. GB/T 3934-2003, Technical requirements for gauges.

The thread profile angle α is 60°, and the thread is a triangular thread.

There are two types of threads: fine threads have smaller pitch, smaller lead angle, larger minor diameter, larger rod body area, higher strength, and better self-locking performance, but they are less wear-resistant and prone to disengagement. Coarse threads have a moderate ratio of diameter to pitch, good strength, and are most widely used.

Metric ordinary threads are mainly used for bolted joints. Generally, coarse threads are used for most connections, while fine threads are used for thin-walled parts. They are also commonly used for connections subjected to variable, vibrational, and impact loads, and can also be used for adjustment in micromechanical adjustment mechanisms. Ordinary metric threads are also known as general-purpose threads, which are the most commonly used type of thread.

The fundamental triangle for a standard metric thread is equilateral with a 60° angle. Truncating H/8 at the crest and H/4 at the root forms the basic profile. The internal and external threads share that profile and its basic dimensions. Smooth root arcs are tangent to the flanks. The external root radius exceeds the internal root radius. The theoretical values are 3P/12 and 3P/24, respectively. References. [1] Wen Bangchun. Mechanical Design Handbook: Joints and Fastening. China Machine Press, Beijing, 2020. [2] Cheng Daxian. Mechanical Design Handbook, 6th ed.: Joints and Fastening. Chemical Industry Press, Beijing, 2017. [3] Yamamoto Akira. Theory and Calculation of Threaded Connections. Shanghai Scientific and Technical Literature Publishing House, 1984.

2. Metric threads with different fit accuracies

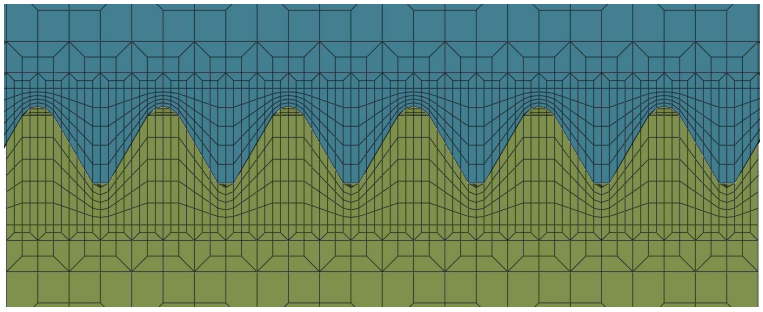
The actual bolts and nuts used should have good engagement and interchangeability for ease of assembly and disassembly. The effective thread pitch and the actual thread pitch must be within the thread pitch limit dimensions to ensure interchangeability and free engagement of threaded components. The limit dimensions of the pitch and the minor diameter for internal and external threads of different thread fit precision are referenced to GB/T 9146-2003.

3 MJ Thread

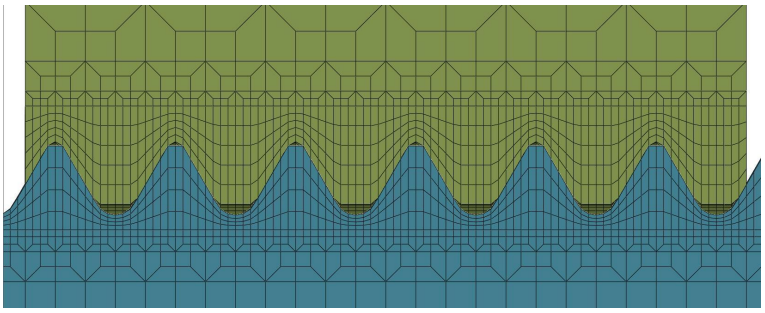
MJ threads are a type of metric symmetric thread specifically designed for aerospace structures, with a thread angle of 60° and an external thread root shaped as a large arc. MJ threads are a type of metric thread with an increased arc radius of the thread root and controlled shape. The 'MJ' designation includes 'M' for metric and 'J' for the large arc shape of the external thread root.

The shape represents the characteristics of the thread root. MJ threads are a new type of thread developed from standard threads. They are available in both US and metric systems abroad. US aerospace threads are called UNJ threads; metric aerospace threads are called MJ threads, and MJ threads originate from UNJ threads.

To reduce stress concentration when threads are subjected to loading, improve fatigue strength and fatigue life, the thread root of the MJ external thread has a larger radius of the root arc. The fatigue resistance of MJ threads is significantly higher than that of ordinary threads, so MJ threads are also called fatigue-resistant threads or reinforced threads.



Standard Metric Thread



MJ threads. The basic MJ profile differs from the standard metric M profile. MJ threads combine high dimensional accuracy with a rounded external root and a manufacturing process that rolls the thread after heat treatment. This improves surface quality and the fatigue strength of the joint. Tests show that the fatigue strength is sensitive to the root radius. A larger radius improves fatigue resistance. MJ threads were designed for this requirement.

The basic thread profile of MJ is similar to standard metric threads, except that the flattened height of the minor diameter of MJ threads is increased from H/4 to 5H/16, thereby increasing the arc radius of the external thread root.

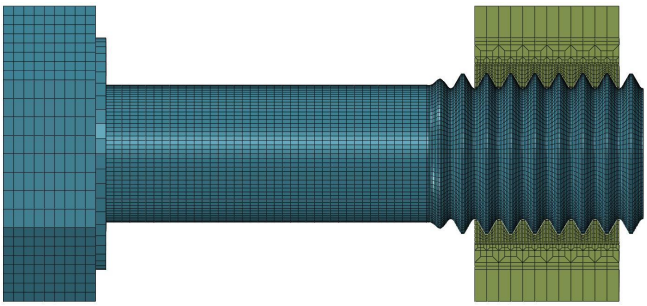
In summary, the geometric characteristics of the MJ thread profile: the external thread has a large circular arc bottom, the thread bottom arc is tangent to the thread flank, forming a smooth arc connection, and the radius of the thread bottom arc is within 13 3P/150~5 3P/48 (i.e.

The range is between 0.15011P to 0.18042P; the height of the thread profile for internal threads is 5H/16; high precision, with a pitch diameter tolerance of 4H, is a high-strength bolt suitable for areas with high fatigue strength requirements in ambient or high-temperature environments.

Based on the above characteristics, MJ threads have been widely used in aircraft. In important parts of aircraft, using MJ threads for tight connections extends the service life of bolts and reduces maintenance work. Due to the smaller diameter required for MJ threads after heat treatment rolling, the use of MJ threaded fasteners can reduce aircraft weight and improve flight performance. Reference [1] Tan Shenhang. Theory and calculation of MJ thread strength [M]. Xi'an: Northwest Institute of Science and Technology Press, 2014.

4. Threads without lead (parallel threads)

The geometric characteristics of threads with and without lead angle are similar and different: threads without lead angle (parallel threads) cannot be screwed into each other, so they do not actually exist in practice. The finite element model of threads without lead angle is essentially a three-dimensional finite element model of an axially symmetric threaded component. The longitudinal cross-section (along a plane through the axis) of the thread without lead angle is the same as that of a threaded component with lead angle. The transverse cross-section (perpendicular to the axis) changes according to a certain pattern. For threaded components with lead angle, the transverse cross-section shape is the same at any position on the thread segment, but the rotational phase angle around the axis differs.



The role of finite element models for non-rotating loose parts of undercut threads: To study the non-rotating loosening behavior of threaded connections through finite element simulation methods, such as elastic-plastic deformation, interface wear, creep, and temperature changes induced

Deformations along the axis of a bolted joint caused by inconsistent deformation in the axial direction can lead to changes in bolt axial force. It is necessary to eliminate the effect of thread face lead angle β using the method of controlling variables, so that under external loads, the engagement thread faces do not experience changes in bolt stiffness, torsional stiffness, and axial force due to relative motion. Threads without lead angle maintain the thread profile and eliminate the influence of thread face lead angle β, and can be used to study non-rotational loosening behavior in bolted joint structures. Reference [1] Liu Xuetong. Numerical study on loosening behavior of bolted joint structures under torsional excitation [D]. Chengdu: Doctoral dissertation of Southwest Jiaotong University, 2023.

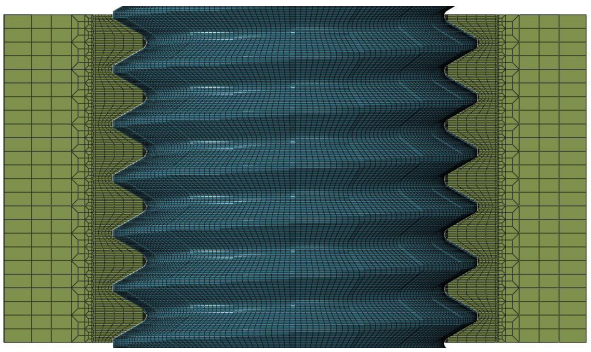
5.SLB(Step LockBolt) threads

In the late 1990s to early 2000s, researchers at Kyoto University in Japan, N. Sase, proposed an anti-loosening external thread, known as SLB (Step Lock Bolt) bolts. They studied the anti-loosening performance under lateral vibration and optimized the external thread profile. The shape represents the characteristics of the thread root. MJ threads are a new type of thread developed from standard threads. They are available in both US and metric systems abroad. US aerospace threads are called UNJ threads; metric aerospace threads are called MJ threads, and MJ threads originate from UNJ threads.

Early studies have found that loosening in threaded connections is mainly caused by two factors: one is the relative slip between the internal and external thread faces; the other is the relative slip between the bolt head or nut support surface and the clamped members. Under lateral loading, slip occurs between the thread faces and accumulates, ultimately causing complete slip between the engaged thread faces. Under external excitation, complete slip occurs between the thread faces in the loosening direction, and the accumulated torsional deformation in the bolt rod is released through complete slip between the bolt head or nut support surface and the clamped members. This process repeats with external excitation cycles, leading to rotational loosening of the bolt.

Preventing either relative slip at the mating flanks or slip between the head or nut bearing face and the clamped member can prevent loosening. A zero helix angle β would prevent elastic twist from building up in the shank, but the thread could no longer engage. A small β produces a fine thread with higher root stress concentration and lower bolt load capacity. An inclined bearing face on the bolt head, nut, or clamped member can also prevent slip, though uneven contact can damage the member surface.

N. Sase proposed a bolt profile with regularly spaced steps on its thread surface. The zero-helix sections are step segments and those with helix angle β are inclined segments. The step-lock bolt (SLB) can mate with a standard metric nut. Close contact between the external step segments and the internal thread transfers clamping force. In a standard metric joint with low thread friction, the mating flanks tend to slide along the helix and the joint can loosen by rotation. The SLB profile inhibits relative rotation of the engaged flanks.



The circumferential spacing of the step and inclined segments balances ease of engagement and resistance to loosening. Fewer alternating segments improve resistance to loosening while reducing engagement performance. More segments have the opposite effect. N. Sase studied two configurations: (1) 8 step segments and 8 inclined segments (8+8) and (2) 10 step segments and 10 inclined segments (10+10). The proportion of step segments strongly affects loosening resistance. A typical value is 50%, with equal numbers of step and inclined segments.

Combine the piecewise functions for a standard metric external thread and an external thread with zero helix angle to derive the piecewise SLB external profile. The software models 8 step segments and 8 inclined segments, the 8+8 configuration. For the axial range [0,] given in the source and circumferential range [0, 2π], the 8 inclined segments with helix angle are [0, π/8], [2π/8, 3π/8], [4π/8, 5π/8], [6π/8, 7π/8], [8π/8, 9π/8], [10π/8, 11π/8], [12π/8, 13π/8], and [14π/8, 15π/8]. The 8 zero-helix step segments are [π/8, 2π/8], [3π/8, 4π/8], [5π/8, 6π/8], [7π/8, 8π/8],

[9π/8, 10π/8], [11π/8, 12π/8], [13π/8, 14π/8], and [15π/8, 16π/8]. The 8 helical segments and 8 zero-helix segments alternate around the circumference. Their sections are continuous and identical at each boundary. The SLB profile repeats at one thread pitch axially and at 2π circumferentially.

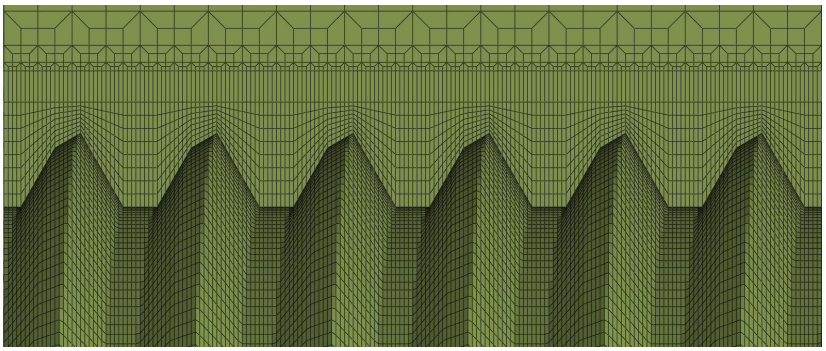
To improve engagement while retaining resistance to loosening under torsional excitation, consider increasing the number of alternating circumferential segments of each thread type from 8 to 16 per period. Blend the transitions between the two types. References. [1] Sase N, Nishioka K, Fujii H. Mechanics and mechanisms of newly developed anti-loosening screw fasteners. CSME Forum ’96, Toronto, Canada, 1996. [2] Sase N, Nishioka K, Koga S, et al. An anti-loosening screw-fastener innovation and its evaluation. Journal of Materials Processing Technology, 1998, 77:209-215. [3] Sase N, Fujii H. Optimizing study of SLBs for higher anti-loosening performance. Journal of Materials Processing Technology, 2001, 119:174-179. [4] Liu Xuetong. Numerical study of loosening in bolted joints under torsional excitation. PhD dissertation, Southwest Jiaotong University, Chengdu, 2023.

6. Spiralock (Spiralock, SPL) Thread

In the 1970s, engineers in the United States added a 30° wedge ramp at the root of the internal thread to change load transfer. Tightening the bolt into a Spiralock nut plastically deforms the external crest against the ramp. The resulting normal contact stress is comparatively high and acts at 60° to the bolt axis. For standard metric threads it acts at 30°. The Spiralock nut can engage a standard metric bolt or a matching Spiralock bolt. In the finite element model, the contact region between a standard bolt crest and the Spiralock internal thread is helical. Adjust the external crest slightly to match the wedge and establish stable contact.

Features and anti-loosening performance of Spiralock anti-loosening nut: The thread flank at the major diameter of the load-bearing side of the Spiralock nut

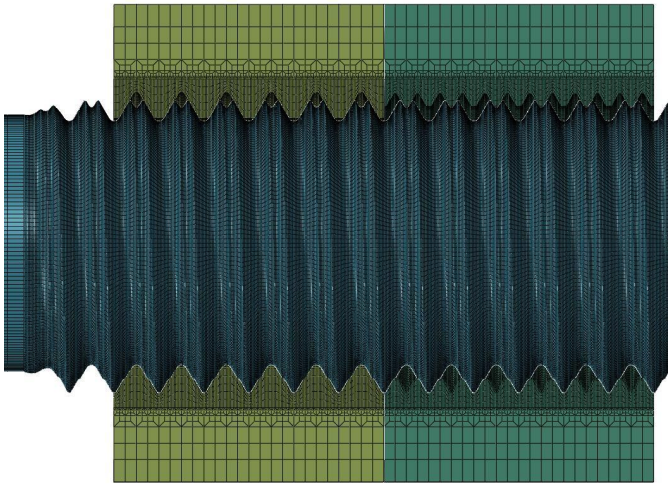
is 60°. The remaining flank angles are 30°, as with a standard thread. At the same preload, the normal force on the load-bearing flank of a Spiralock nut exceeds that of a standard nut, producing greater friction torque. Its radial load exceeds the axial load and is distributed symmetrically, making slip and loosening at the mating flanks less likely. The normal load acts at the bolt-thread crest, where higher compliance promotes more even load sharing across the engaged threads. The additional load-bearing threads improve capacity and service life. The line contact also removes the radial clearance that permits relative movement under external transverse loading, helping prevent rotational loosening.



Spiralock nuts resist vibration-induced loosening, have high load capacity and long life, and can be reused. They work with standard bolts without auxiliary locking devices and can be used under large temperature variations. A Spiralock tap produces holes with the same anti-loosening function for parts requiring self-locking. The nuts are easy to remove. Reference. [1] Cheng Daxian. Mechanical Design Handbook, 6th ed.: Joints and Fastening. Chemical Industry Press, Beijing, 2017.

7. DTB(Double Thread Bolt) Thread

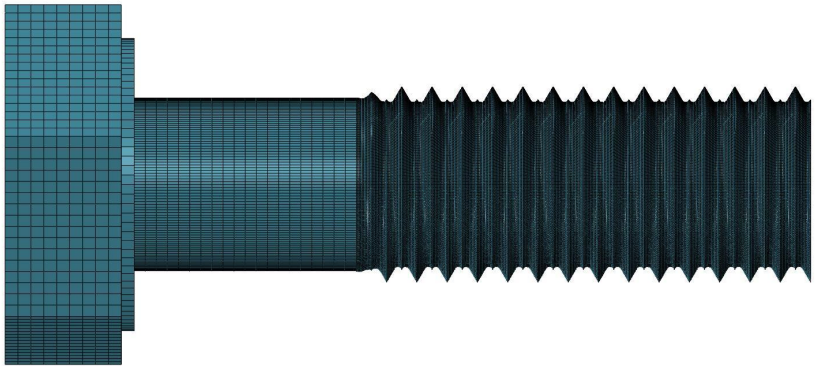
DTB (Double Thread Bolt) bolts can engage and secure with both coarse thread load-bearing nuts and fine thread locking nuts. Coarse thread has higher load capacity, while fine thread has better anti-loosening performance. DTB bolts combine both characteristics, effectively preventing rotational loosening between engaged thread surfaces.



Select the coarse and fine pitches independently. An integer ratio between them produces a periodic DTB profile. The profile also depends on the phase difference between the coarse and fine threads. To obtain the DTB node coordinates, compare the cylindrical radii of the coarse and fine profiles at a phase difference of 180° in the node-adjustment routine. Use the smaller radius at each point. References. [1] Takemasu T, Miyahara H. Development of thread rolled anti-loosening bolts based on the double thread mechanism and a performance evaluation. JSME International Journal Series A, 2005, 48(4):305-310. [2] Shinbutsu T, Amano S, Takemasu T, et al. Thread rolling and performance evaluations of a new anti-loosening double thread bolt combining a single thread and multiple threads. Procedia Engineering, 2017, 207:603-608. [3] Liu Xuetong. Numerical study of loosening in bolted joints under torsional excitation. PhD dissertation, Southwest Jiaotong University, Chengdu, 2023.

8. Taps

Downton threads have both left and right-handed threads in the same thread segment. They can be used to mate with both left and right-handed threads. Downton thread specifications are based on the enterprise standard Q/TANGS 5782.



□

□

□□,z □ □,z

, Left-hand external thread is marked as 'r', ordinary external thread is right-hand thread, its contour is marked as 'r'

□Similar to r l, the Dowell thread profile is denoted as r (θ, z). For each node i that requires generating a Dowell thread profile at the screw, separately calculate its r value in the cylindrical coordinate system according to the right-hand and left-hand profiles, denoted as rθ(i), z(i) and

TM

Solution: This may be due to incorrect parameter configuration or failure to pass the parameter check. Please follow these steps to resolve the issue:

r □□(i),z(i) □ r

Then, the node i follows the cylindrical coordinate expression of the Tang's thread profile as l r (□(i),z(i))□min[r(□(i),z(i)),r(□(i),z(i))]. In a simple and intuitive sense, the Tang's thread profile can be viewed as the minimum profile of the same thread segment taking either a left-handed or right-handed thread profile.

By performing a logical comparison of the node coordinates of each thread segment based on the cylindrical coordinate system of the right-handed and left-handed thread profiles, and taking the minimum value of the radii, r (□(i),z(i))□min[r(□(i),z(i)),r(□(i),z(i))], the corresponding Tang's thread node coordinates can be obtained.

When connecting, left and right threaded nuts are used. The nut on the supported surface of the clamped members is called a fastening nut, and the nut on the non-supported surface is called a locking nut. When in use, the fastening nut is tightened first, and then the locking nut is tightened.

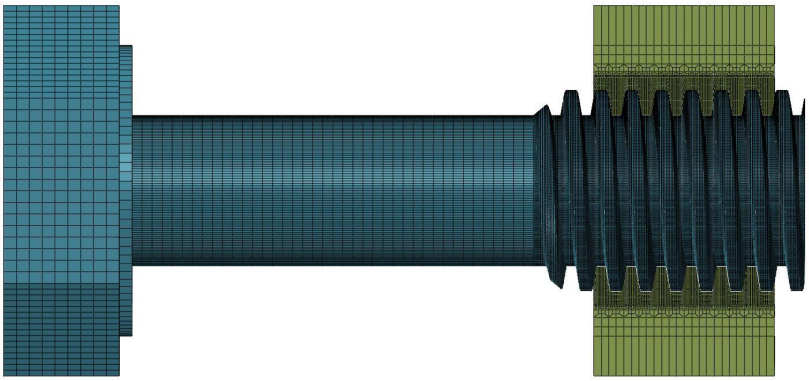
In the presence of vibration and impact, both the fastened nut and the locking nut may have a tendency to loosen. However, since the loosening direction of the fastened nut is the tightening direction of the locking nut, the tightening of the locking nut prevents the loosening of the fastened nut.

Installation requirements for Dowell threaded fasteners: When using Dowell threaded fasteners, the preload of the mounting nut and the locking nut should be different. The preload of the locking nut must be greater than that of the mounting nut, otherwise it will affect the anti-loosening performance. Generally, the preload of the mounting nut should be about 80% of the preload of the locking nut. Reference literature

[1] Tang Zongcai. Tang thread and its anti-loosening principle. Mechanical Engineer, 2001, 6:21-23. [2] Sun Feng, Tang Zongcai. Anti-loosening principle and performance of the Tang thread. Mechanical Engineer, 2002, 5:13-15. [3] Li Shibiao, Li Jianping. Strength analysis of the Tang thread using ANSYS. Machinery & Automation, 2008, 4(47):36-38. [4] Cheng Daxian. Mechanical Design Handbook, 6th ed.: Joints and Fastening. Chemical Industry Press, Beijing, 2017. [5] Liu Xuetong. Numerical study of loosening in bolted joints under torsional excitation. PhD dissertation, Southwest Jiaotong University, Chengdu, 2023.

9. Trapezoidal threads

The thread profile of a trapezoidal thread is an isosceles trapezoid, divided into metric and imperial types: the thread profile angle α of the imperial trapezoidal thread is 29°; the thread profile angle α of the metric trapezoidal thread is 30°. This software can generate finite element models parameterically for metric trapezoidal threads.



Trapezoidal threads have strong roots, are easy to manufacture, and provide good alignment between mating threads. A split nut allows clearance adjustment. Applications include power transmission such as machine tool lead screws and fastened joints. Transmission applications may impose strength and stiffness requirements. Efficiency is slightly lower than for square threads. Reference. [1] Wen Bangchun. Mechanical Design Handbook, 6th ed.: Joints and Fastening. China Machine Press, Beijing, 2020.

12. Conclusion

Horycon (Tianjin) Technology Co., Ltd. develops bolted-joint solutions informed by in-service performance evaluation and feedback. Its research draws on the School of Materials Science and Engineering at Southwest Jiaotong University, the State Key Laboratory of Rail Transit Vehicle Systems, and the Ministry of Education Key Laboratory of Advanced Materials Technology. The team studies loosening and fracture at critical joints in aerospace, rail transit, energy, and other advanced manufacturing industries. Its work spans failure analysis, numerical simulation, design optimization, in-service evaluation, metrology, and testing. Horycon provides engineering services from fastener and joint-system design through inspection, installation, operation, maintenance, and in-service assessment. Its capabilities include joint design from requirements, experimental testing, failure analysis, high-fidelity finite element simulation, surface treatment, and lubrication.

Thank you for choosing our software and consulting this operation manual. We hope this manual provides valuable guidance and support for your work and projects. Please remember, you are not alone, and our team is always ready to provide assistance and support.

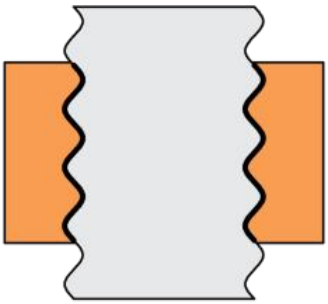
During the use of this software, you may encounter challenges and problems, but do not be discouraged. Every step is an opportunity to learn, and every difficulty will help you become more proficient with the software. Please contact our support team at any time; they will wholeheartedly provide assistance to ensure you can fully utilize the software's features.

Finally, we thank you for your trust and support. Your feedback and suggestions are very important to us, as they help us continuously improve and perfect the software to meet your needs. We look forward to working with you to create outstanding projects and results.

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If you have any questions or need assistance with this manual or software, please contact our support team. Thank you again for your trust and support. May this software assist you in efficiently and high-quality completing finite element simulation research for bolted joint structures.