

Thread Stripping Analysis using the BOLTCALC Program

When an external thread (such as a bolt) is engaged into an internal thread (nut or tapped hole) and the fastener tightening, there are, in general, three ways in which the assembly can fail. By tensile fracture – usually across the threaded section, by the internal thread shearing and thirdly, by the external thread shearing.

The height of a standard nut has been established on the basis that the load to cause thread stripping is greater than the tensile fracture load. (Assuming that the appropriate property class of nut is matched to the bolt.)

The reason for this design criteria is that bolt fracture is sudden and it is apparent that a replacement part is needed. Thread stripping is progressive and can occur over a period of time. Thus, at the time of assembly it may not be apparent that anything is wrong. The risk is then that a defective product may enter service.

The BOLTCALC program will check if thread stripping will occur and the minimum length of thread engagement needed to ensure that the bolt will fracture first.

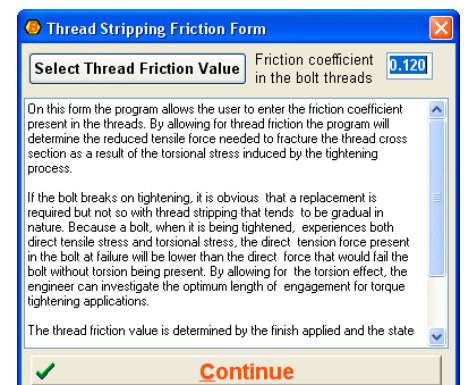
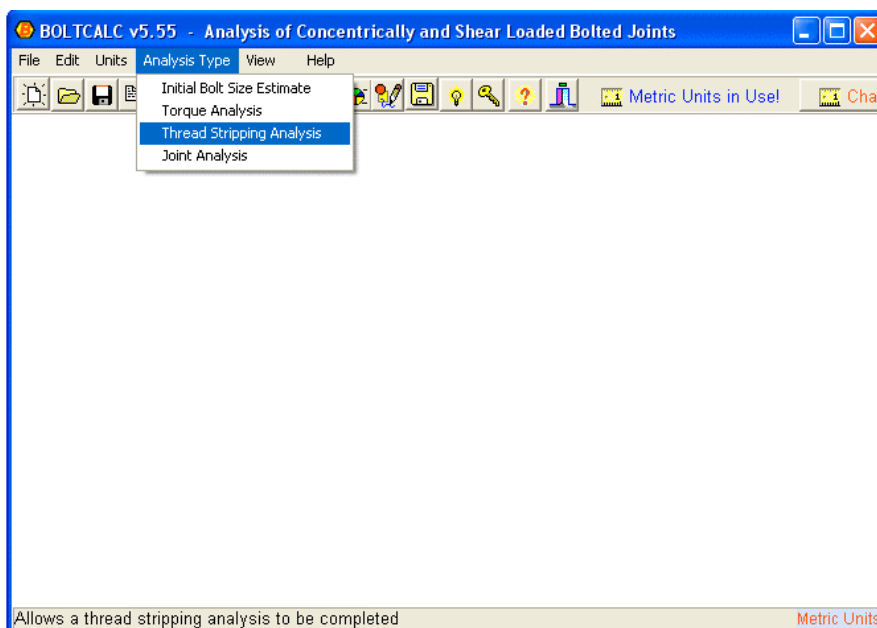
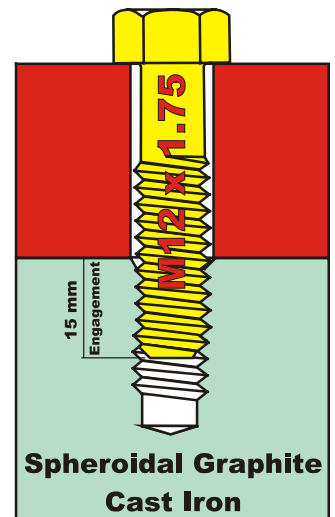
In this example an M12 bolt (property class 10.9) is used to secure a bracket to a casting that is made from spheroidal graphite cast iron of tensile strength 500 N/mm².

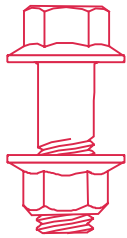
The tolerance class of the bolt thread is 6g and that of the internal thread is 6H. A tapping drill of 10.2 mm diameter was used to form the internal thread. The bolt has a black oxide finish.

Will either the internal or external thread strip before the bolt will break?

Below: Start BOLTCALC ensuring that the units are set to metric. On the main menu do to 'Analysis Type' and then click on the entry marked 'Thread Stripping Analysis'. A form will appear that requests the value of the friction coefficient in the bolt threads. (The reason why this is important is that it influences the bolt failure load when the fastener is being torqued.)

Click on the button marked 'Select Thread Friction Value'





Thread Stripping Analysis using the BOLTSCALC Program (continued)

(Side) The Thread Friction Coefficient Form will appear. Select the entry shown and then click the 'OK' button.

(Below) On clicking 'Continue' from the Thread Stripping Friction Form, the Thread Strength Data Entry Form will appear. To enter details about the thread, click on the button marked 'Access the Thread Database'.

Selection of the Thread Friction Coefficient

Details about Thread Finish/Lubrication

- Anti Seize
- Beldonite ASC
- Berutex FH-34
- Berutex FH-35
- Biral BASC
- Black oxide steel bolt with a cut & oiled thread, female thread in cast iron
- Black oxide steel bolt with a cut thread, no finish or oil on steel nut
- Black oxide steel bolt with a rolled & oiled thread, female thread in aluminium alloy
- Black oxide steel bolt with a rolled & oiled thread, female thread in cast iron**
- Black oxide steel bolt with a rolled & oiled thread, no finish on steel nut

Thread Finish: Black oxide steel bolt with a rolled & oiled thread, female thread in cast iron

Minimum Value: 0.1 Mean Value: 0.14 Maximum Value: 0.18

Source of Data: VDI 2230 'Systematic Calculation of High Duty Bolted Joints'

Notes: Friction range quoted in source

Thread Friction Coefficient to be used in calculations: 0.1

The minimum friction value is normally selected since this will result in the minimum tightening torque so that the risk of over tightening is minimised.

Basis of the Tightening Torque Calculation

Minimum Friction Value Average Friction Value Maximum Friction Value

If you wish to change or enter your own values for the friction coefficient into the database - this cannot be completed from this form. To change or add data you must use the separate database editor program.

OK Cancel Help

Thread Strength Data Entry Form

Thread Details:

Thread Description:

Bolt Diameter: Thread Pitch:

External Thread: Major Dia. Minimum Pitch Dia. Minor Dia.

Internal Thread: Major Dia. Minimum Pitch Dia. Minor Dia.

Access the Thread Database

Material Properties for the External Thread:

Min. External Strength: N/mm²

Max. External Strength: N/mm²

Ratio of Tensile to Shear Strength:

Min. Shear Strength: N/mm²

Access Bolt Material Database

Material Properties for the Internal Thread:

Material used: Steel Cast Iron SG Cast Iron Aluminium Other

Description for the material:

Minimum Tensile Strength: N/mm²

Ratio of Tensile to Shear Strength:

Minimum Shear Strength: N/mm²

Thread Engagement Details:

Length of Thread Engagement: Details of what the thread is tapped into? Plate/Casting Boss/Nut

Fastener Chamfer Details:

Chamfer of Fastener Thread present within the engaged length? Yes No

Counterbore Details:

Number of sides that are counterbore: Diameter of Counterbore: Counterbore Angle: Degrees

Tapping Drill Details:

Tapping Drill Diameter to be used in thread stripping calculations: No Yes

Tapping Drill Diameter: Length of Bellnouching: Bellnouching Ratio:

Please Note: All dimensions are in mm

OK Cancel Help

(Side) The Thread Size Database form will appear - select the M12 x 1.75 entry as shown. Details about this thread will appear on the form. Click the 'OK' button to return to the previous form.

(Below) Details about the M12 thread selected will now be transferred to this form. To define the strength of the bolt click on the button marked 'Access Bolt Material Database'.

Thread Size Database for Metric Fasteners

Thread Details: M12 x 1.75 Coarse Thread All dimensions are in mm.

Thread Diameter: 12 Thread Pitch: 1.75

Other Details (Please Note: A zero indicates that information is not available):

Clearance Hole Details:

Fine Series: 13 Medium Series: 13.5 Coarse Series: 14.5

Minimum Bolt/Nut bearing dia.:

Plain Nut/Bolt: 16.6

Flanged Fastener: 22.5

Socket Head Cap Screw: 17.63

Socket Countersunk Screw: 23.4

Thread Dimensional Tolerances:

Thread tolerances are based upon tolerance classes: 6g/6H

External Thread:

	Maximum	Minimum
Major Dia.	11.966	11.701
Pitch Dia.	10.829	10.679
Minor Dia.	10.072	9.602

Internal Thread:

	Maximum	Minimum
Major Dia.	11.063	10.963
Pitch Dia.	11.063	10.963
Minor Dia.	10.441	10.106

Tapping Drill Diameter (based upon the ISO 2306 standard): 10.2

Thread Size Details:

- M5 x 0.8 Coarse Thread
- M5 x 0.5 Fine Thread
- M5.5 x 0.5 Fine Thread
- M6 x 1 Coarse Thread
- M6 x 0.75 Fine Thread
- M7 x 1 Coarse Thread
- M7 x 0.75 Fine Thread
- M8 x 1.25 Coarse Thread
- M8 x 1 Fine Thread
- M9 x 1.25 Coarse Thread
- M10 x 1.5 Coarse Thread
- M10 x 1.25 Fine Thread
- M11 x 1.5 Coarse Thread
- M12 x 1.75 Coarse Thread**
- M12 x 1.25 Fine Thread
- M14 x 1.5 Fine Thread
- M14 x 2 Coarse Thread
- M16 x 2 Coarse Thread
- M16 x 1.5 Fine Thread
- M18 x 1.5 Fine Thread
- M18 x 2.5 Coarse Thread

OK Cancel Help

(Below- right) On the Fastener Material Selection form that now appears, select the 10.9 entry. Details about this property class will appear on the form. Click the 'OK' button to accept.

Thread Strength Data Entry Form

Thread Description: M12 x 1.75 Coarse Thread

Bolt Diameter: 12 Thread Pitch: 1.75

External Thread: Major Dia. 11.966 11.701 Pitch Dia. 10.829 10.679 Minor Dia. 10.072 9.602

Internal Thread: Major Dia. 11.063 10.963 Pitch Dia. 11.063 10.963 Minor Dia. 10.441 10.106

Access the Thread Database

Material Properties for the External Thread:

Min. External Strength: N/mm²

Max. External Strength: N/mm²

Ratio of Tensile to Shear Strength:

Min. Shear Strength: N/mm²

Access Bolt Material Database

Material Properties for the Internal Thread:

Material used: Steel Cast Iron SG Cast Iron Aluminium Other

Description for the material:

Minimum Tensile Strength: N/mm²

Ratio of Tensile to Shear Strength:

Minimum Shear Strength: N/mm²

Thread Engagement Details:

Length of Thread Engagement: Details of what the thread is tapped into? Plate/Casting Boss/Nut

Fastener Chamfer Details:

Chamfer of Fastener Thread present within the engaged length? Yes No

Counterbore Details:

Number of sides that are counterbore: Diameter of Counterbore: 12.06 Counterbore Angle: 90.0 Degrees

Tapping Drill Details:

Tapping Drill Diameter to be used in thread stripping calculations: No Yes

Tapping Drill Diameter: 10.3 Length of Bellnouching: 6 Bellnouching Ratio: 1.03

Please Note: All dimensions are in mm

OK Cancel Help

Fastener Material Selection

Fastener Material Selection Mechanical and Physical Property Information Fastener Head Marking Details

Standards Organisation:

All

ISO - International Organization for Standardization

SAE - Society of Automotive Engineers

ASTM - American Society for Testing and Materials

Property Class or Grade: 10.9

Property Class: 3.6, 4.6, 4.8, 5.6, 5.8, 6.8, 8.8, 8.8, 9.8, 10.9, 12.9, 4.6, 4.8, 5.8, 8.8

Standard: ISO 898-1 Mechanical properties of fasteners made of carbon steel and alloy steel.

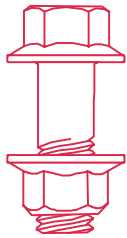
Material Details: Carbon steel with additives quenched and tempered or alternatively alloy steel quenched and tempered.

Key Property Information:

Yield Stress: 940 N/mm² Minimum Tensile Strength: 1040 N/mm²

The information presented here are limited abstracts from the standards. They are for guideline use only, please refer to the latest original standards to check the detail and validity of the information provided for your own application.

OK Cancel Help



Thread Stripping Analysis using the BOLTCALC Program (continued)

(Side) Details about the bolt strength will now be transferred onto this form. (Note that the property or thread values can be entered directly onto this form if known.) To enter details about the internal thread properties, click the button marked SG Cast Iron and enter 500 as the minimum tensile strength.

Below: Enter 15 as the thread engagement length and click on the Yes button to indicate that a chamfer is present at the end of the bolt thread - a default chamfer equal to the pitch of the thread is automatically included. Click the Yes button to indicate that a tapping drill diameter is used. Click the 'OK' button on the form to allow the results to be calculated.

(Above) The results of the analysis will be presented, scroll down the form to check the results.

(Side) As can be seen from the results, the bolt will fail by tensile fracture before the threads will strip. The program calculates that this will occur for lengths of engagement longer than 9.7 mm. Hence the length of engagement could be reduced to 10 mm if wished.

The thread stripping analysis also includes facilities to allow for threads tapped into bosses and to allow for effects such as bell mouting and countersinking of the tapping hole. Details about these effects can be found in the program's user guide or the help files that the program uses.