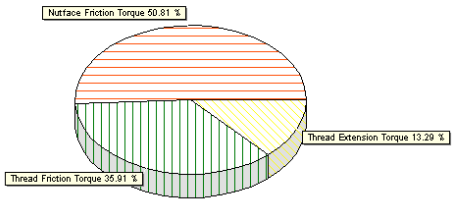
Torque Analysis using the BOLTCALC Program

Torque Distribution Chart

Example Analysis of a Flanged Head M12 Bolt



Thread Extension Torque = 11.13 Nm
Thread Friction Torque = 30.07 Nm
Nutface Friction Torque = 42.55 Nm
Total Tightening Torque = 83.75 Nm

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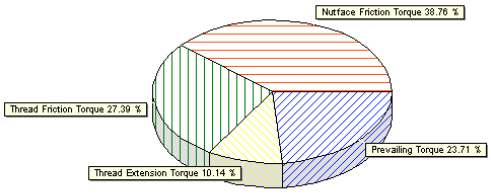


Prevailing Torque Specified = 21.00 Nm
Thread Extension Torque = 8.98 Nm
Thread Friction Torque = 24.27 Nm
Nutface Friction Torque = 34.34 Nm
Total Tightening Torque = 88.58 Nm

It is a common problem having to establish what would be an appropriate tightening torque to apply to a threaded fastener. Or knowing the torque, what clamp force would this torque generate.

The clamp force acting on the joint from the fastener is known as preload. The BOLTCALC program will allow the appropriate torque to be determined for a given fastener size and strength. It can also determine the resulting preload from a tightening torque or the tightening torque given a specified preload.

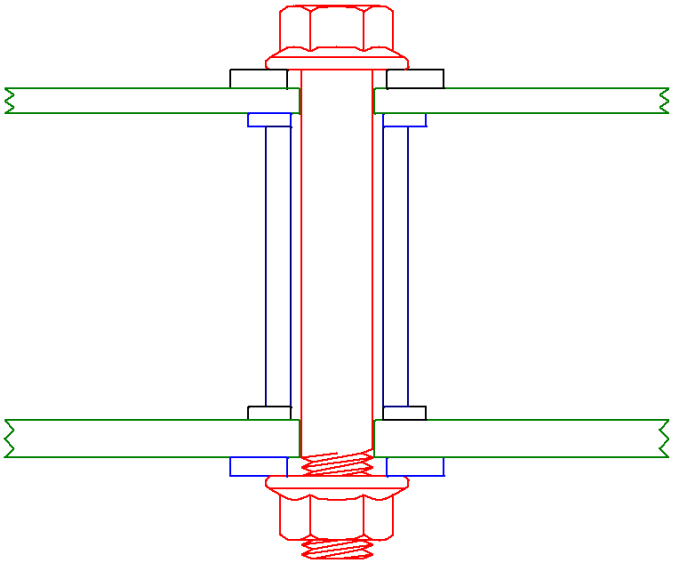
Before giving details of how to use this part of the BOLTCALC program, some background information is presented on torque tightening.

When a nut is tightened on a bolt, the majority of the applied tightening torque is used to overcome friction. Friction is present in the threads and under the face of the part being rotated - the nut face or under the bolt head.

Because of the sensitivity of the tightening torque to friction variation, there tends to be a significant variation in the preload resulting from a specified torque value.

Some fasteners have a prevailing torque. A prevailing torque is the torque that is needed to run a nut down a thread on certain types of fasteners designed to resist vibration loosening. The resistance can be provided by a plastic insert or a noncircular head.

Such fasteners can have a significant effect what the appropriate tightening torque should be specified.



In this first example, the tightening torque for a M12 flange headed bolt is required. The bolt and nut are Dacromet coated.

The bolt head is to be tightened and the clearance hole of the washer next to the head is 14.5 mm.

A bolt of property class 10.9 is to be used.

Note: Normally it does not matter whether the bolt or nut is tightened. However if the nut bearing diameter is different to the head diameter and/or the hole diameter next to the part is different, then it is important which part is to be tightened. Otherwise, the preload will vary for a specified torque value depending upon which part is tightened.

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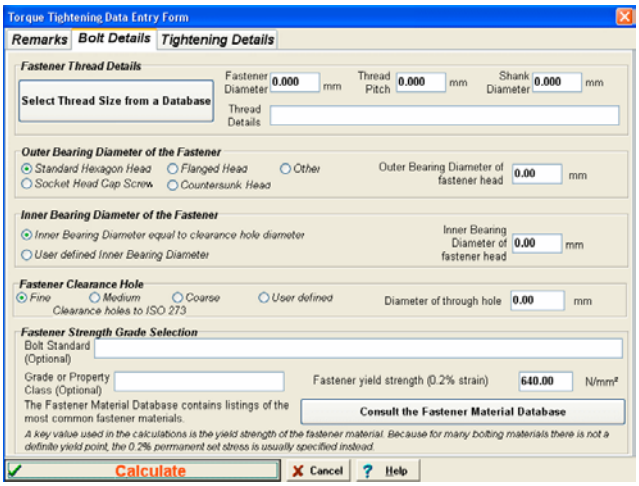
Torque Analysis using the BOLTCALC Program (continued)

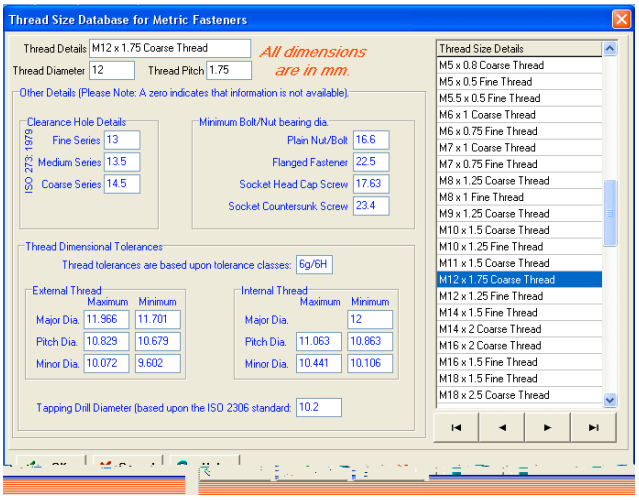
Start the BOLTCALC program and first ensure that metric units are selected by checking that 'Metric Units' is given in the bottom right hand corner.

(Side) From the main menu select 'Analysis Type' and then click on the option marked 'Torque Analysis'.

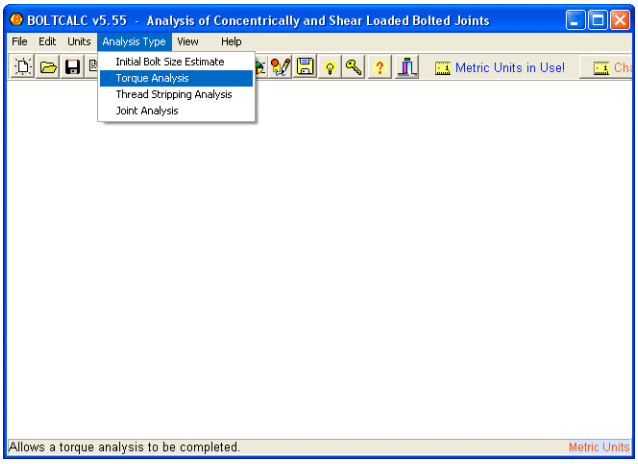
(Below) A form will appear that has tabs at the top. To start entering the data relating to the problem, first click on the button marked 'Select Thread Size from a Database'.



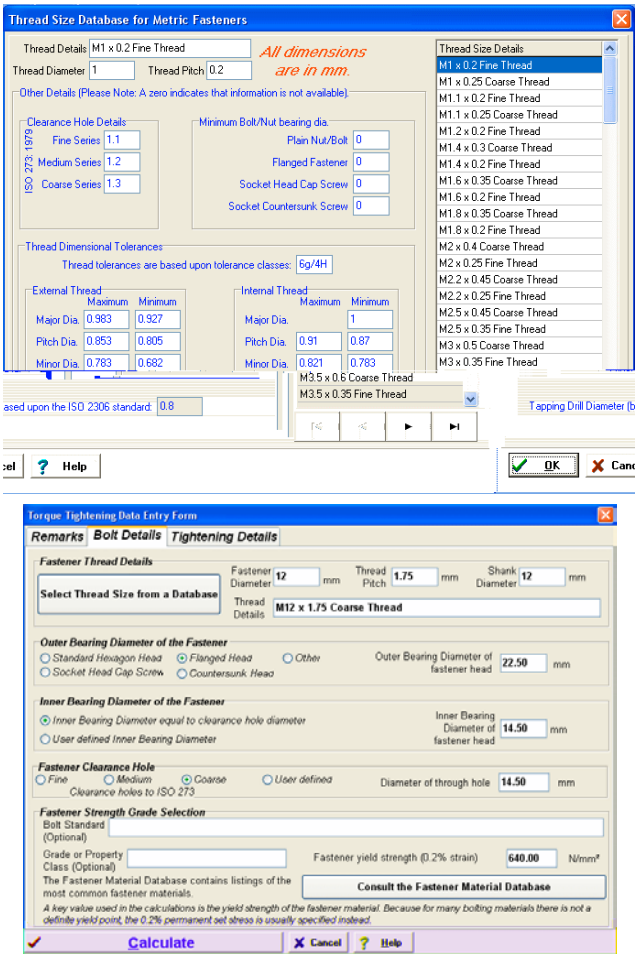
(Below) Select the entry marked M12 x 1.75 Coarse Thread. Details about this thread and fastener sizes associated with this thread will appear on the form. Click 'Ok' to return to the main data entry form.



(Side) Details of the thread selected will now appear on the main form.



(Below) The thread database form will appear that contains the vast majority of threads that are in use. To select the thread size that you want to use, scroll down the list at the right.



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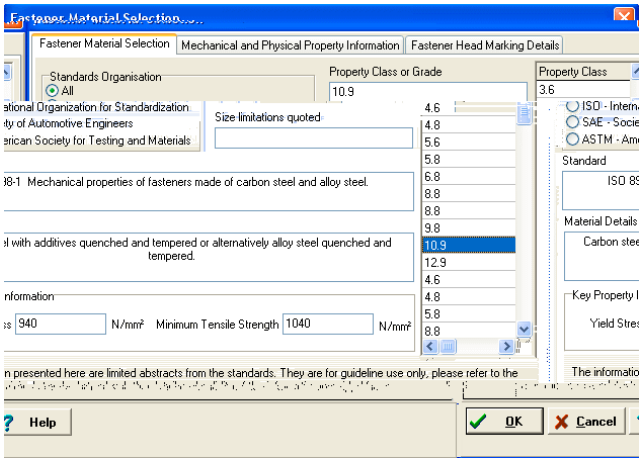
Torque Analysis using the BOLTCALC Program (continued)

(Side) Select that a flanged head fastener and a coarse fastener clearance hole is being used.

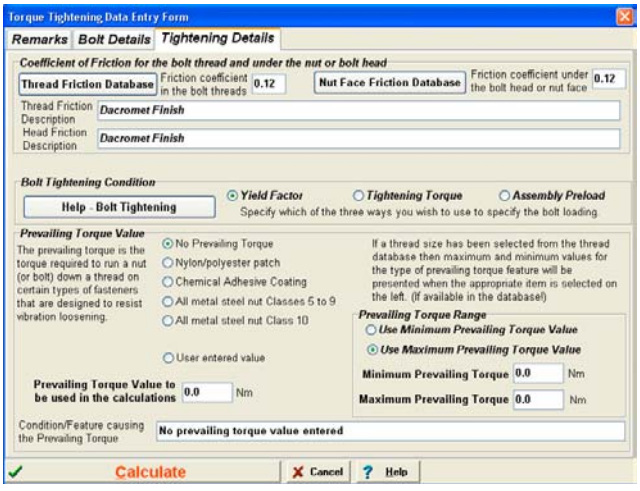
To select the property class of the fastener, click on the button marked 'Consult the Fastener Material Database'.

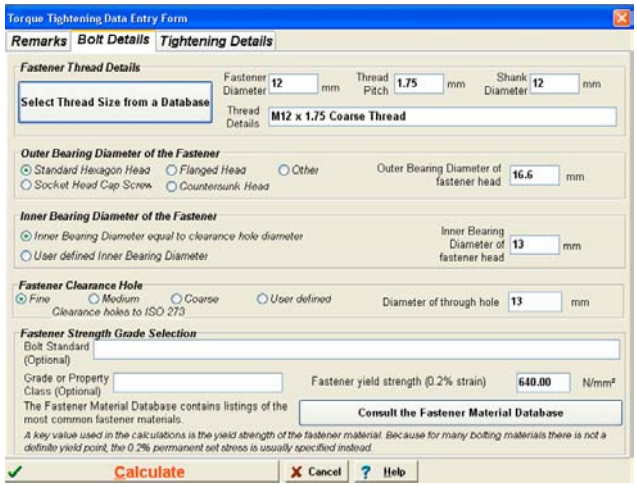
(Below) The Fastener Material Selection form will appear allowing you to select the appropriate property class from a large range of alternatives. Select 10.9 and details about this property class will appear on the form.

Click 'Ok' to return to the main data entry form.

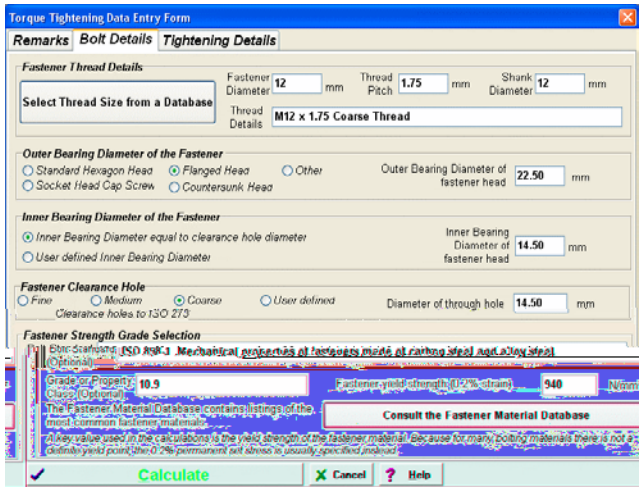


(On this page, details related to tightening the bolt are entered. Dacromet is the default finish and so can be left. The yield factor method is also default. This method is based upon a percentage of the yield strength of the fastener being used as a result of combined tension and torsion created by the tightening torque.
Click on the 'Calculate' button to determine the results.

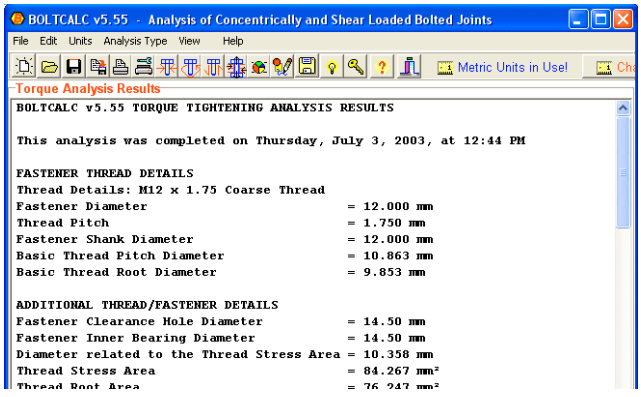




(Below) Details about the property class will now be entered on the main form. To move to the tightening details page of the form, click on the tap at the top of the form marked 'Tightening Details'



The results will appear on the main form. Scroll down to see all the results.



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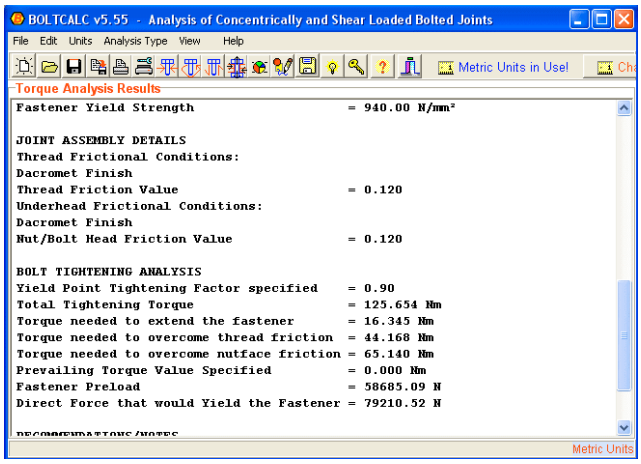
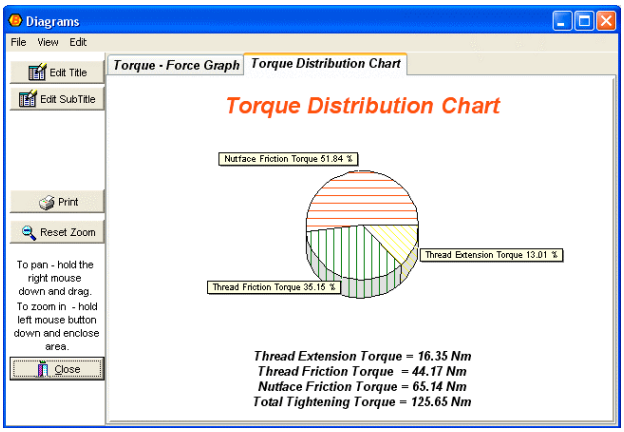
Torque Analysis using the BOLTCALC Program (continued)

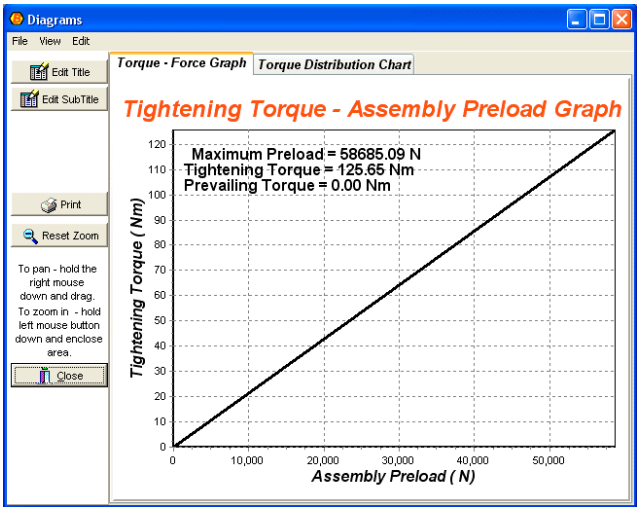
(Side) The calculation indicates that a tightening torque of 125 Nm would be appropriate. With the data used, the calculation also indicates that a bolt preload of 58685 N would result. Graphs of the torque distribution can now be viewed by clicking on the piechart speed button.



(Below) A torque distribution chart will be displayed showing graphically how the torque is split between the various elements.



(Side) By clicking the tab at the top of the form marked 'Torque-Force Graph', a chart will be displayed showing the relationship between torque and preload. To return to the main form - click 'Close'



The presentation shows how the friction databases that the program uses can be accessed together with how the preload can be calculated for a bolt given the tightening torque.

The program offers further facilities relating to torque tightening, such as calculating the tightening torque from the preload. Please consult the User Guide and help files for further detail.

For further assistance – please contact Bolt Science.

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