

METHOD FOR FORMING A THREAD ON DEFORMED REINFORCING BAR

FIELD OF THE INVENTION

The present invention relates to a method for forming a thread onto a
5 deformed bar of the type used for reinforcing concrete.

BACKGROUND TO THE INVENTION

At construction sites and civil engineering works where concreting is
required, the concrete structure is generally reinforced with reinforcing bars to
provide added strength and stability. A reinforcing bar is typically a steel bar
10 manufactured with surface deformations such as ribs and fins to provide a locking
anchorage with the surrounding concrete, and is also known as a “deformed bar”.

The deformed bars are supplied in pre-cut lengths and accordingly it may
be necessary to connect several bars end to end for use depending upon the size
of the construction work.

15 One known method for connecting bar ends comprises forming a thread
portion at the connection end portion of each connecting bar, and threading a
connecting piece or coupler between the two bars around the corresponding
threaded portions.

However, to form the threads onto the end portions of the bars it is
20 necessary to eliminate the surface deformations on the bars to form a relatively
smooth round surface, which then allows the threads to be worked onto the end
portions of the bars.

One known method for eliminating the surface deformations is to grind away
the deformations to a sufficient level to achieve the smooth surface. However, this
25 method removes material from the bars, and accordingly the thread portion
attaching to the coupler has much lower strength and is susceptible to breakage.

Another known method for eliminating the surface deformations which
does not require removal of material from the bar is by cold-pressing the bar to
the desired diameter using a die and pressing machine. The method compresses
30 the surface deformation material inwards, which therefore maintains the strength
of the bar. However, the production time for forming the smooth surface is
relatively long, as is the cost of the machines and pressing dies. The shape of the
pressed bar is also typically unevenly shaped rather than a perfectly round shape.

It is therefore an object of the present invention to provide a method for forming a thread onto a deformed bar for reinforcing concrete that maintains the strength in the bar while also preferably reducing the production costs and time.

SUMMARY OF THE INVENTION

5 Broadly, the present invention extrudes the deformed bar to thereby reduce its diameter and produce a suitable surface for working threads upon.

 In one aspect, the present invention provides a method for forming a thread on a deformed bar of a type used for reinforcing concrete, the deformed bar including outwardly extending ribs and/or fins, the method comprising the
10 steps of: extruding an end of the deformed bar so that the end of the deformed bar is reduced to a predetermined diameter and for a predetermined length such that the ribs and/or fins are substantially flattened to form a substantially smooth cylindrical end; and forming a thread onto the extruded cylindrical end of the deformed bar.

15 In one form, the step of extruding an end of the deformed bar comprises urging the end of the deformed bar through a squeezing die.

 In another form, the squeezing die comprises a block having a substantially frusto-conical shaped opening extending through the block, one end of the opening having a diameter substantially equal to the predetermined
20 diameter.

 In one embodiment, the step of forming a thread onto the extruded cylindrical end of the deformed bar comprises cold-rolling the thread onto the extruded end of the deformed bar.

 In a second aspect, a deformed bar of the type used for reinforcing
25 concrete having at least one thread formed thereon, wherein the thread is formed by the method above is also provided.

 The present invention and/or forms thereof maintains the material in the bar to form the suitable surface for forming the threads upon. This accordingly maintains the strength in the bar. Squeezing the bar to reduce its diameter results
30 in a more consistent and even round shape than in other methods, and the result may be achieved in much less time. The method therefore reduces production costs and time while maintaining quality of the product and accordingly achieves the object.

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An illustrative embodiment of the present invention will now be described with reference to the accompanying figures. Further features and advantages of the invention will also become apparent from the accompanying

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 through Figure 19b are stage views showing a method for forming a thread onto a deformed bar for reinforcing concrete in accordance with one embodiment of the present invention, in particular:

5 Figure 1 shows a sectional view of an exemplary squeezing machine for implementing part of the method;

 Figure 2 shows a front elevational view of Figure 1;

 Figure 3 shows a plan view of Figure 1;

10 Figure 4a shows a sectional view of a squeezing die for use with the squeezing machine of Figure 1;

 Figures 4b and 4c show photographs of a squeezing die in accordance with one embodiment;

 Figure 5 shows a front elevational view of a deformed bar suitable for use with the method;

15 Figure 6 shows the machine of Figure 1 with the deformed bar positioned in a clamping vice;

 Figures 7 and 8 show the machine of Figure 1 with the squeezing die moved towards the deformed bar;

20 Figure 9 shows the machine of Figure 1 with the squeezing die moved away from the deformed bar once the squeezing has taken place;

 Figure 10 shows the machine of Figure 1 with the squeezed bar removed from the machine;

 Figures 11a to 11d show a close up view of the deformed bar and squeezing die before, during and after the squeezing process;

25 Figure 12 is a photograph of a steel squeezed bar;

 Figure 13 shows a front elevational view of an exemplary thread forming machine and squeezed bar of Figure 11;

 Figure 14 shows the machine of Figure 13 with the squeezed bar positioned in the clamping vice;

30 Figure 15 shows the machine of Figure 13 with the cold rolling head being moved towards the squeezed bar;

 Figure 16 shows the machine of Figure 13 with the cold rolling head moved around the squeezed bar;

Figure 17 shows squeezed and threaded bar of Figure 16 removed from the machine of Figure 13;

Figure 18 shows the squeezed and threaded bar; and

Figures 19a and 19b show two threaded bars of Figure 18 and an
5 exemplary coupler.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to Figures 1 to 3, there is shown a squeezing machine 10 for squeezing at least part of a deformed bar to a predetermined diameter to substantially eliminate the ribs and/or fins to form a substantially smooth surface.
10 The squeezing machine 10 comprises a squeezing die 12 connected to a squeezing head 14. The squeezing head 14 is hydraulically moveable along rails 16, 18, via a hydraulic cylinder 20. A clamping vice 22 is fixed at one end of the rails 16, 18.

Figure 4a shows an enlarged view of the squeezing die 12. The squeezing
15 die 12 is preferably formed of DF-2 tool steel, which exhibits a hardness of between 65 and 70 on the Rockwell scale. The squeezing die 12 includes a substantially frusto-conical shaped opening 13 between its ends for receiving a deformed bar. The diameter of the widest opening 13a is preferably larger than the diameter of the bar to be squeezed, while the narrowest opening 13b is
20 preferably about equal to the diameter of the squeezed bar (ie the predetermined diameter). Figures 4b and 4c show photographs of an exemplary squeezing die from each end.

An exemplary deformed bar which may be used with the present embodiment is shown in Figure 5. The deformed bar 24 comprises a steel
25 cylindrical body with ribs 25 and fins 26 along its outer peripheral face for providing a locking anchorage with the surrounding concrete when in use. The diameter of the deformed bar 24 may vary, but is typically within the range of 10mm to 50mm, with a strength of at least 500Mpa.

As the first step in the process for reducing the diameter of the bar 24, the
30 deformed bar 24 is positioned in the clamping vice 22, as shown in Figure 6. Hydraulic pressure is activated to move the vice 22 to securely grip the bar 24.

The main hydraulic cylinder 20 is then activated to move the squeezing head 14 towards the clamped bar 24, as indicated by the arrows in Figures 7 and

8. Pressure applied by the motor and hydraulic cylinder will force the squeezing die 12 to move along a predetermined length of the bar 24, thereby forcing the bar 24 through the smaller diameter opening 13b. The applied pressure forces the bar material, and in particular the ribs 25 and fins 26 to be squeezed inwards, as shown in greater detail in Figures 11a to 11d. The pressure required by the machine to push the squeezing die 12 along the bar 24 will depend upon the bar diameter, but typically will range from 100 to 350 ton. The time to complete the squeezing process is typically about 5 to 8 seconds.

In the present embodiment, the squeezing is performed while the deformed bar 24 is at a normal room temperature, although other temperatures may be used, such as outdoor temperature under the sun.

Once the predetermined length of bar 24 has been received through the squeezing die 14, the squeezing head 14 is moved back to its original position away from the bar 24, as shown in Figure 9. Preferably the predetermined length will be determined automatically by the machine from prior inputted data, although it may be performed manually if required. The predetermined length will vary depending upon the length of thread required, and the coupler to be used.

The clamping vice 22 may then be released and the squeezed bar removed from the machine 10, as indicated in Figure 10.

Figure 11d shows the final squeezed bar 24 once it has undergone the squeezing process. The end 24a of the bar 24 no longer includes ribs or fins, and rather has a relatively smooth surface ready for forming threads thereon. Figure 12 shows a photograph of a steel squeezed bar 24 after the squeezing process as described above has taken place.

The diameter of the squeezed bar 24 is dependent upon the initial diameter of the bar 24, and the desire of the user. Table 1 shows various diameters of deformed bars which may be used with the present embodiment, and the preferred diameters once the squeezing process as detailed above has taken place. The table also illustrates the preferred pitch of the threads to be formed thereon (as described further below). The deformed bar numbers, for example "T10", refer to the diameter of the bar (10mm), and the "T" refers to High Tensile Deformed Bars. The "Initial Diameter" includes the diameter of the outwardly extending ribs and fins.

Table 1: Dimensions of Deformed Bar

No.	Deformed Bar No.	Initial diameter (pre squeezing) in mm	Diameter after squeezing in mm	Thread Pitch in mm
1	T10	11 to 13	9.5 (± 0.5)	1.5
2	T12	13 to 15	11.5 (± 0.5)	1.5
3	T13	14 to 16	12.5 (± 0.5)	1.5
4	T16	17 to 19	15.5 (± 0.5)	2.0
5	T20	21 to 33	19.5 (± 0.5)	2.5
6	T22	23 to 25	21.5 (± 0.5)	2.5
7	T25	26 to 28	24.5 (± 0.5)	3.0
8	T28	29 to 31	27.5 (± 0.5)	3.5
9	T32	34 to 36	31.5 (± 0.5)	3.5
10	T36	38 to 40	35.5 (± 0.5)	3.5
11	T40	42 to 44	39.5 (± 0.5)	4.0
12	T50	52 to 54	49.5 (± 0.5)	4.0

To enable connection of the bar 24 to a coupler 40 as shown in Figures 19a and 19b, a thread is then formed onto the squeezed end of the bar 24.

5 Figure 13 shows an exemplary thread forming machine 30 for undertaking a cold rolling process for forming the threads. The thread forming machine 30 comprises a cold rolling head 32 hydraulically moveable along rails (not shown) via a motor 34. A clamping vice 36 is fixed at one end of the rails.

10 While the thread in the present embodiment has been formed by a cold rolling process, other thread forming processes may also be used.

The rolling head 32 is a conventional rolling head 32 as would be known to a person skilled in the art. The rolling head 32 comprises two rollers 32a and 32b which cold-roll the threads onto the bar 24. The thread pitch of the rollers 32a, 32b will vary depending upon the size of the deformed bar 24. Typically, a
15 deformed bar with a diameter of about 10mm will result in having a pitch of about 1.5mm and a depth of about 0.9mm, whereas a deformed bar with a diameter of 50mm will typically have a pitch of about 4.0mm and a depth of about 2.8mm.

Preferably the rolling step is performed while the bar 24 is at a normal room temperature to ensure there is no alteration of the inherent properties of the bar 24 to cause weakness. The working pressure during the rolling of the thread ranges from 800 PSI to 2,000 PSI. The revolutions of the roller machine are standard with the particular machine, and do not impact on the quality of the thread on the bar 24. Typically, the final thread is formed within 10 to 20 seconds depending upon the size of the bar 24 and the length of the thread.

The squeezed bar 24 is firstly positioned between the jaws of the clamping vice 36, as shown in Figure 14. Hydraulic pressure is activated to move the vice 36 to securely grip the bar 24 at a position away from the squeezed end portion 24a.

The cold rolling head 32 is then activated to move the head 32 towards the bar 24, while the motor is also activated to rotate the rolling head 32, as shown by the arrows in Figure 15. As the rolling head 32 continues to move forward as shown in Figure 16, the cold rolling head 32 will roll thread onto the squeezed area 24a of the bar 24. Once the required length of thread has been completed, the rolling head 32 will rotate backwards away from the threaded bar 24. The clamping vice 36 is then released and the threaded bar 24 removed from the machine 30, as shown in Figure 17. The final threaded bar 24 is shown in greater detail in Figure 18. The pitch and depth of the thread 24b formed on the bar 24 will be dependent upon the size and diameter of the bar 24. Various kinds and shapes of threads may be formed, such as a circular thread or triangular thread, however preferably the thread is a circular thread.

Once the cold rolling has been completed and the final thread has been formed on the bar 24, the bar 24 is ready for use. Each threaded end of the bar 24 may be connected to another bar by use of a coupler 40, as illustrated in Figures 19a and 19b. Each coupler 40 comprises corresponding thread formations and pitch profiles on an inner surface thereof, which accordingly mate with the thread formed on the outer surface of the ends of the bar 24. A continuous joint is then produced for use in reinforcing concrete, for example in the building construction industry.

Example

A deformed bar of 40mm in diameter was inserted into a clamping vice. A squeezing head having a first opening of 50mm in diameter and an exit opening of 39.5mm in diameter received the deformed bar. A pressure of 250 ton was applied for 6 seconds. The squeezing head was removed from the deformed bar, and the diameter of the bar was reduced to 39.5 mm, and had a substantially perfectly rounded shape ready for forming threads thereon.

The present embodiment reduces the production time for forming the threaded deformed bars, as the squeezing step to remove the ribs and fins is much faster than prior art methods. This accordingly reduces production costs, while maintaining the quality and strength of the threaded bars.

It will be appreciated that persons skilled in the art could implement the present invention in different ways to the one described above, and variations may be provided without departing from its spirit and scope.

CLAIMS:

1. A method for forming a thread onto a deformed bar of a type used for reinforcing concrete, the deformed bar including outwardly extending ribs and/or fins, the method comprising the steps of:

- 5 extruding an end of the deformed bar so that the end the deformed bar is reduced to a predetermined diameter and for a predetermined length such that the ribs and/or fins are substantially flattened to form a substantially smooth cylindrical end; and
forming a thread onto the extruded cylindrical end of the deformed bar.

10 2. A method according to claim 1, wherein the step of extruding an end of the deformed bar comprises urging the end of the deformed bar through a squeezing die.

3. A method according to claim 2, wherein the squeezing die comprises a block having a substantially frusto-conical shaped opening extending through the
15 block, one end of the opening having a diameter substantially equal to the predetermined diameter.

4. A method according to any one of the preceding claims, wherein the step of forming a thread onto the extruded cylindrical end of the deformed bar comprises cold-rolling the thread onto the extruded cylindrical end of the
20 deformed bar.

5. A deformed bar of a type used for reinforcing concrete having at least one thread formed thereon, wherein the thread is formed by the method of any one of claims 1 to 4.