Method for producing steel profiles

The invention relates to the field of steel processing and steel production, in particular the production of steel profiles. The invention relates to a method for producing steel profiles. The invention further relates to a steel profile, in particular a steel profile produced according to an aforementioned method. The invention also relates to a sheet pile, in particular a Z sheet pile. The invention further relates to a system for producing a steel profile from a workpiece, in particular a steel blank, preferably a steel strip blank.

Methods for producing a steel profile, steel profiles, sheet piles and systems for producing a steel profile are basically known from the prior art. In steel mills, steel profiles are often produced by continuous casting, by hot rolling or by cold rolling. Steel profiles made by mass forming of steel blanks are also known. When building sheet pile walls, steel profiles in the form of sheet piles are often used as components of the sheet pile walls. Z-shaped sheet piles and U-shaped sheet piles, in particular, are known in this context, and are connected to each other by various forms of interlock, e.g. by means of “Larssen interlocks”. The sheet piles are generally connected to each other by inserting the interlocks into each other when inserting, ramming or vibrating the sheet piles into the ground.

The object of the present invention is to provide an improved method for producing steel profiles, an improved steel profile, an improved sheet pile and an improved system for producing a steel profile from a workpiece.

This object is achieved, according to the invention, by a method for producing steel profiles, the method comprising the steps of: providing a workpiece, in particular a steel blank, preferably a steel strip blank, forming a weakened point in the region of a planned bend in the workpiece and bending the workpiece to produce a bend in the workpiece.

The invention is based on the realisation that prior art methods have several disadvantages. Prior art methods are energy-intensive, labour-intensive and involve high setup and/or start-up costs. This results in large minimum order volumes and comparatively long delivery periods, so it is essential that production is planned long in advance and that large amounts of stock be kept in order to respond in a flexible manner to customer orders.

The advantages of the method according to the invention are that steel profiles can be produced autonomously, flexibly and fully automatically, preferably directly from a coil and/or a roll of steel strip, or with flat rolled steel workpieces as starting material. Production costs are also kept low due to comparatively low tooling costs, low labour

Claims

1. A method for producing a steel profile, said method comprising the steps of:
providing a workpiece (2, 44, 52), in particular a steel blank, preferably a steel strip blank,
forming a weakened point (10) in the region of a planned bend in the workpiece (2, 44, 52) and
bending the workpiece (2, 44, 52) to produce a bend in the workpiece (2, 44, 52).

2. The method according to claim 1,
wherein the weakened point (10) is formed by forming an indentation (11), in particular a notch, in the workpiece (2, 44, 52).

3. The method according to claim 1 or 2,
wherein the weakened point (10), in particular an indentation (11) forming the weakened point (10), is formed by milling, rolling, punching or stamping.

4. The method according to any one of the preceding claims,
wherein the weakened point (10) after bending is reinforced by welding, in particular by laser welding, and preferably by a laser hybrid welding technique.

5. The method according to any one of the preceding claims,
wherein an indentation (11) forming the weakened point (10) and which is formed on an inner side of the bend (21) in the workpiece (2, 44, 52) is reduced in size or closed during bending, or
wherein an indentation (11) forming the weakened point (10) and which is formed on an outer side of the bend in the workpiece (2, 44, 52) is enlarged during bending.

6. The method according to any one of the preceding claims,
with an indentation (11) forming the weakened point (10) in the workpiece (2, 44, 52),
wherein the indentation (11) formed on an inner side of the bend (21) in the workpiece (2, 44, 52) is closed after bending by welding, in particular by laser welding.

7. The method according to claim 6,
in which welding is done using a focused laser beam (1310) which is aimed from the outer side of the bend (1320) in the workpiece (1300) to the inner side of the bend (1321), in particular along a zero gap formed by the indentation (410) after bending, the focus of said beam preferably being inside the workpiece (1300).

8. The method according to any one of the preceding claims,
wherein sides (16) which define an indentation (11) forming the weakened point (10) are undetachably joined together.

9. The method according to any one of the preceding claims,
wherein bending is done by free bending, folding or die bending.

10. The method according to any one of the preceding claims,
wherein the workpiece (2, 44, 52) is provided by unrolling a steel strip roll (42), in particular a coil.

11. The method according to any one of the preceding claims,
wherein an indentation (810) is introduced before bending into a workpiece (800) in the form of a steel strip blank (801), said indentation being oriented substantially transverse to the longitudinal direction (815) of the steel strip blank and being open at a lateral edge (816) of the steel strip blank (801).

12. The method according to claim 11,
wherein the indentation (810) projects into the steel strip blank (801) in such a way that a bending moment (840) in a first region (820) of the steel strip blank (801) which limits a first portion (821) of the indentation (810) is not transmitted to a second region (830) of the steel strip blank (801) which limits a second portion (831) of the indentation (810).

13. A steel profile, in particular a steel profile produced by a method according to any one of the preceding claims, comprising:
a workpiece (2, 44, 52) which has a weakened point (10) in a bending region.

14. The steel profile according to claim 13,
wherein the weakened point (10) is formed as an indentation (11) in the workpiece (2, 44, 52).

15. The steel profile according to claim 13 or 14,
the workpiece (2, 44, 52) having a substantially V-shaped indentation (11) in the bending region, wherein the sides (16) of the indentation (11) preferably form an angle ranging from 90° to 135°.

16. The steel profile according to any one of claims 13 to 15,
the workpiece (400) having a substantially W-shaped indentation in the bending region.

17. The steel profile according to any one of claims 13 to 16,
the workpiece (400) having an indentation (410) which is V-shaped in a first region (412) and W-shaped in a second region (425), in particular in a bottom region of the indentation (410),
the sides (413, 414) of the V-shaped region (412) preferably forming an angle ranging from approximately 50° to 110°.

18. The steel profile according to any one of claims 16 and 17,
the sides of the W-shaped indentation adjoin the sides of the V-shaped indentation, in particular in such a way that the respective outer sides of the W-shaped indentation adjoin the sides of the V-shaped indentation.

19. The steel profile according to any one of claims 13 to 18,
the the workpiece (2, 44, 52) having a weld seam (30), in particular a laser weld seam, for reinforcing the weakened point (10) in the bending region (12).

20. A sheet pile, in particular a Z sheet pile formed by a steel profile which is produced by a method according to any one of the preceding claims.

21. A sheet pile, in particular a Z sheet pile, comprising:
a lock member (512; 1012) for connecting the sheet pile (511; 1011) to a lock member (522; 1022) of another sheet pile (521; 1021) or of a support element,

comprising a neck strip (513; 1013) extending from a wall section (515; 1015) of the sheet pile (511; 1011), in particular substantially at right angles thereto, and
a claw strip (514; 1014) extending from the neck strip (513; 1013),
wherein the claw strip (514; 1014) is oriented substantially at an angle (α; ψ) of at least 90°, in particular at an angle of 100° to 130°, to the neck strip (513; 1013), and one end (502; 1002) of the claw strip (514; 1014) faces the wall section (515; 1015).

22. The sheet pile according to claim 21,
the neck strip (1013) being oriented at an angle (ω) of at most 90°, in particular at an angle of approximately 20° to 50°, preferably 30° to 40°, to the wall section (1015).

23. A sheet pile, in particular a Z sheet pile, comprising:
a lock member (522; 1022) for connecting the sheet pile (521; 1021) to a lock member (512; 1012) of another sheet pile (511; 1011) or of a support element,
comprising a neck strip (523; 1023) extending from a wall section (527; 1027) of the sheet pile (521; 1021), in particular at right angles thereto,
a head strip (524; 1024) extending from the neck strip (523; 1023), in particular substantially at right angles thereto,
a front strip (525; 1025) extending from the head strip (524; 1024), in particular substantially at right angles thereto, and
a claw strip (526; 1026) extending from the front strip (525; 1025),
wherein the claw strip (526; 1026) is oriented substantially at an angle (β; ψ) of at least 90°, in particular at an angle (β) of 100° to 130°, to the front strip (525; 1025), and extends from the front strip (525; 1025) in a U-shaped region (528; 1028) formed by the neck strip (523; 1023), the head strip (524; 1024) and the front strip (525; 1025).

24. The sheet pile according to claim 23,
wherein the neck strip (1023) is oriented at an angle (χ) of at most 90°, in particular at an angle of approximately 30° to 70°, preferably 45° to 55°, to the wall section (1027) and/or
wherein the head strip (1024) is oriented at an angle (φ) of at most 90°, in particular at an angle of approximately 20° to 50°, preferably 30° to 40°, to the neck strip (1023) and/or

wherein the front strip (1025) is oriented at an angle (σ) of at most 90°, in particular at an angle of approximately 30° to 70°, preferably 45° to 60°, to the head strip (1024).

25. The sheet pile according to any one of claims 21 and 24,
in which the claw strip (1026) is oriented substantially at an angle (ψ) of 120° to 140° to the front strip (1025).

26. The sheet pile according to any one of claims 21 and 22,
wherein one end (402; 502; 503) of the claw strip (514; 524) is rounded.

27. A sheet pile wall comprising at least two sheet piles, in particular Z sheet piles, according to any one of the preceding claims.

28. A system for producing a steel profile from a workpiece, in particular a steel blank, preferably a steel strip blank (4, 702), comprising:
a weakening device (14, 56) for forming a weakened point (10) in the workpiece (2, 44, 52), in particular an indentation (11), in the region of a planned bend in the workpiece (2, 44, 52) and
a bending device (20, 60, 725) for bending the workpiece (2, 44, 52) in the region of the weakened point (10).

29. The system according to claim 28, comprising
a feeding device (50, 704) for providing the workpiece (2, 44, 52), in particular the steel blank, preferably the steel strip blank (4, 702).

30. The system according to any one of 28 to 29,
wherein a cutting device (43) is provided for dividing a steel strip fed from a steel strip coil (42) into workpieces (2, 44, 52).

31. The system according to any one of 28 to 30,
wherein a cutting device (720) is designed to introduce an indentation (810) which is oriented substantially transverse to the longitudinal direction (815) of the steel strip blank and which is open to a lateral edge (816) of the steel strip blank (801).

Claims

1. A method for producing a steel profile, the method comprising steps of:

providing a steel blank workpiece;

forming a weakened point by forming an indentation in a region of a planned bend in the workpiece; and

bending the workpiece to produce a bend in the workpiece,

wherein the indendation formed on an inner side of the bend in the workpiece is closed after bending by laser welding,

wherein the laser welding uses a focused laser beam aimed from an outer side of the bend in the workpiece to the inner side of the bend, the focus of the beam being inside the workpiece.

2. The method according to claim 1, wherein the indentation is formed by forming a notch, in the workpiece.

3. The method according to claim 1, wherein the indentation is formed by milling, rolling, punching or stamping.

4. The method according to claim 1, further comprising, after the step of bending, reinforcing the weakened point by a laser hybrid welding technique.

5. The method according to claim 1, wherein during the step of bending, the indentation forming the weakened point and which is formed on an outer side of the bend in the workpiece is enlarged during bending.

6. The method according to claim 1, wherein sides which define the indentation forming the weakened point are undetachably joined together.

7. The method according to claim 1, wherein bending is done by free bending, folding or die bending.

8. The method according to claim 1, wherein the step of providing a steel blank workpiece includes unrolling a steel strip coil.

9. The method according to claim 1, wherein the step of forming an indentation includes forming the indentation substantially transverse to a longitudinal direction of the steel blank and being open at a lateral edge of the steel blank.

10. The method according to claim 9, wherein the indentation projects into the steel blank in such a way that a bending moment in a first region of the steel blank which limits a first portion of the indentation is not transmitted to a second region of the steel blank which limits a second portion of the indentation.