WHAT IS CLAIMED IS:

1. A reinforcing bar coupling assembly comprising:

a tubular sleeve with an inner surface that encloses at least part of at least one reinforcing bar when coupled with the at least one reinforcing bar, the inner surface shape of the tubular sleeve generally matching that of the at least one reinforcing bar to be coupled; and

at least one pin having a body and two opposing ends fitted with interference between, and causing local plastic deformation about, at least part of the inner surface of the sleeve and local plastic deformation about, at least part of, an adjacent outer surface of the at least one reinforcing bar, where at least part of the body of the at least one pin is in contact with at least part of the inner surface of the sleeve and the outer surface of the at least one reinforcing bar when coupled with the at least one reinforcing bar and wherein local plastic deformation of the inner surface of the sleeve and the adjacent outer surface of the at least one reinforcing bar results in mechanical interlocking of the coupling assembly;

wherein the at least one pin is inserted tangentially and orthogonally to the longitudinal length of the reinforcing bar between the inner surface of the sleeve and the adjacent outer surface of the at least one reinforcing bar when coupled with the at least one reinforcing bar; and

wherein, when a tractive force is applied to the coupling assembly, the coupling assembly is configured so that reinforcing bar material piles up or shears before a pin.

2. The reinforcing bar coupling assembly as claimed in claim 1, wherein pin embedment in the sleeve and reinforcing bar to pin diameter (PED ratio) is at least 15%.

3. The reinforcing bar coupling assembly as claimed in claim 2, wherein the PED ratio is from 15 to 30%.

4. The reinforcing bar coupling assembly as claimed in claim 1, wherein the pin, prior to coupling, has a generally straight elongated and slender form along its body and two opposing ends, one end being a leading end and a second end being a following end, the leading end entering between the sleeve and reinforcing bar first during fitting or coupling.

5. The reinforcing bar coupling assembly as claimed in claim 4, wherein the following end comprises a head with a form that extends outwardly beyond the cross-section width of the pin body.

6. The reinforcing bar coupling assembly as claimed in claim 4, wherein the leading end of the at least one pin remains within the sleeve once fitted.

7. The reinforcing bar coupling assembly as claimed in claim 1, wherein the local plastic deformation is generated on installation of the pin to between the sleeve and reinforcing bar via use of an impulse energy input to forcibly insert the pin between at least part of the inner surface of the sleeve and the adjacent outer surface of the at least one reinforcing bar.

8. The reinforcing bar coupling assembly as claimed in claim 1, wherein local plastic deformation occurs to the at least one pin during installation.

9. The reinforcing bar coupling assembly as claimed in claim 8, wherein the pin is configured to bend during fitting.

10. The reinforcing bar coupling assembly as claimed in claim 1, wherein the pin, when fitted, passes through at least one orifice extending from the exterior of the sleeve to at least one groove recessed into the sleeve inner surface;

wherein the at least one orifice and/or at least one groove is/are formed in part or in full before coupling and wherein the orifice is undersized relative to the

pin size to ensure an interference fit of the pin into the orifice.

11. The reinforcing bar coupling assembly as claimed in claim 10, wherein the at least one pin itself produces the form of all or part of the at least one orifice and/or at least one groove.

12. The reinforcing bar coupling assembly as claimed in claim 10, wherein the at least one orifice and/or at least one groove is/are formed in part or in full before coupling and wherein the orifice is undersized relative to the pin size to ensure an interference fit of the pin into the orifice.

13. The reinforcing bar coupling assembly as claimed in claim 1, wherein a plurality of pins is inserted to couple the at least one reinforcing bar and sleeve.

14. The reinforcing bar coupling assembly as claimed in claim 1, wherein, during fitting of the pin, heat generated by friction during deformation causes the at least one pin to weld to at least a portion of the sleeve and/or at least one reinforcing rod.

15. The reinforcing bar coupling assembly as claimed in claim 1, wherein the sleeve is double ended and used to couple two reinforcing bars together in a substantially axial manner.

16. The reinforcing bar coupling assembly as claimed in claim 1, wherein the sleeve is shaped to couple a first reinforcing bar and at least one additional reinforcing bar, the bars joining in a non-axial manner.

17. The reinforcing bar coupling assembly as claimed in claim 1, wherein the sleeve and the at least one reinforcing bar are coaxially aligned when coupled together.

18. The reinforcing bar coupling assembly as claimed in claim 1, wherein the local plastic deformation is generated on installation of the pin to the sleeve and at least one

reinforcing bar via use of continuous pressure to forcibly insert the pin into at least part of the inner surface of the sleeve and into the adjacent outer surface of the at least one reinforcing bar.

19. The reinforcing bar coupling assembly as claimed in claim 18, wherein the continuous pressure is a press configured to press the at least one pin into at least part of the inner surface of the sleeve and the adjacent outer surface of the at least one reinforcing bar.

20. A coupler configured to couple together reinforcing bar ends, the coupler comprising:

a sleeve with an inner surface that encloses, coaxially, an end of a first reinforcing bar to be coupled and an end of a second reinforcing bar to be coupled;

an array of pins configured to mechanically interlock the sleeve and the first reinforcing bar end, the pins in the array fitted, with interference, tangentially and generally orthogonally to the longitudinal length of the first reinforcing bar end, between the sleeve inner surface and the first reinforcing bar end so that the pins in the array, on fitting, cause local plastic deformation about part of an outer surface of the first reinforcing bar end.

21. The coupler as claimed in claim 20, wherein the array once fitted comprises a row of pins inserted on both sides of the first reinforcing bar end.

22. The coupler as claimed in claim 21, wherein pins in each row of the array once fitted are located perpendicularly opposite each other.

23. The coupler as claimed in claim 21, wherein pins in each row of the array once fitted are perpendicularly offset from each other.

24. The coupler as claimed in claim 21, wherein the array once fitted comprises three or more pins in each row of the array.

25. The coupler as claimed in claim 20, wherein, once the pin array is fitted, the first reinforcing bar is mechanically interlocked by two rows of three or more pins.

26. The coupler as claimed in claim 20, wherein, before and after pin insertion, the pins remain straight.

27. The coupler as claimed in claim 20, wherein, each pin in the array, prior to fitting, has a generally straight elongated and slender form along its body and two opposing ends, one end being a leading end and a second end being a following end, the leading end entering first between the sleeve and the first reinforcing bar end during fitting.

28. The coupler as claimed in claim 27, wherein the leading ends of the pins in the array remain within the sleeve once the pins are fitted.

29. The coupler as claimed in claim 20, wherein each pin in the array once fitted, is embedded in the sleeve and/or the first reinforcing bar to a pin diameter (PED ratio) of at least 15%.

30. The coupler as claimed in claim 20, wherein the local plastic deformation is generated on fitting of the pins between the sleeve and the first reinforcing bar via use of continuous pressure to forcibly insert each pin in the array between the sleeve inner surface and an adjacent outer surface of the first reinforcing bar end.

31. The coupler as claimed in claim 30, wherein the continuous pressure is a press configured to press fit one or more pins between the inner surface of the sleeve and an adjacent outer surface of the first reinforcing bar end.

32. The coupler as claimed in claim 20, wherein each pin, when fitted, passes through at least one orifice on the exterior of the sleeve to at least one groove recessed into the sleeve inner surface, wherein the at least one orifice and/or at least one groove

is/are formed in part or in full before coupling and wherein the orifice is undersized relative to the pin size to ensure an interference fit of the pin into the orifice.

33. The coupler as claimed in claim 20, wherein, the pins in the array, on fitting, also cause local, and predominantly plastic deformation, about part of the inner surface of the sleeve.

34. The coupler as claimed in any one of claims 20 to 33, comprising at least one further pin configured to mechanically interlock the sleeve and the second reinforcing bar end, the at least one further pin fitted, with interference, tangentially and generally orthogonally to the longitudinal length of the second reinforcing bar end, between the sleeve inner surface and the second reinforcing bar end so that the at least one further pin, on fitting, causes local plastic deformation about part of an outer surface of the second reinforcing bar end.

35. The coupler as claimed in any one of claims 20 to 33, comprising a further array of pins configured to mechanically interlock the sleeve and the second reinforcing bar end, the pins in the further array fitted, with interference, tangentially and generally orthogonally to the longitudinal length of the second reinforcing bar end, between the sleeve inner surface and the second reinforcing bar end so that the pins in the further array, on fitting, cause local plastic deformation about part of an outer surface of the second reinforcing bar end.

36. The coupler as claimed in claim 35, wherein, once the further pin array is fitted, the second reinforcing bar end is also mechanically interlocked by two rows of three or more pins.

37. The coupler as claimed in any one of claims 34 to 36, wherein, when a tractive force is applied to the interlocked sleeve and first and second reinforcing bars, reinforcing bar material piles up or shears before a pin.

38. A method of coupling reinforcing bars, the method comprising the steps of:

providing a tubular sleeve having an inner surface that encloses at least part of at least one reinforcing bar when coupled with the at least one reinforcing bar,

the inner surface shape of the tubular sleeve generally matching that of the at least one reinforcing bar to be coupled;

inserting an end of a first reinforcing bar to be coupled and an end of a second reinforcing bar to be coupled, into the sleeve, the first and second reinforcing bar ends being coaxially aligned; and

fitting an array of pins, with interference, tangentially and generally orthogonally to the longitudinal length of the first reinforcing bar, between the sleeve interior face and the first reinforcing bar end, so that the pins in the array cause local plastic deformation about part of an outer surface of the first reinforcing bar, the pin array mechanically interlocking the sleeve and first reinforcing bar end together.

39. The method as claimed in claim 38, wherein at least one pin in the array is fitted with interference by applying a force to the pin by continuous pressure.

40. The method as claimed in claim 39, wherein the continuous pressure is a press configured to press one or more pins in the array between part of the inner surface of the sleeve and into an adjacent outer surface of the first reinforcing bar.

41. The method as claimed in claim 40, wherein multiple pins in the array are pressed during fitting.

42. The method as claimed in claim 38, wherein the pins in the array on fitting, also cause local, and predominantly plastic deformation, about part of the inner surface of the sleeve.

43. The reinforcing bar coupling assembly as claimed in claim 1, wherein adhesive is located between the inner surface of the tubular sleeve and the outer surface of the at least one reinforcing bar, the adhesive fusing and/or bonding the at least one pin and either, or both, the inner surface of the sleeve, or the outer surface of the at least one reinforcing bar.

44. The reinforcing bar coupling assembly as claimed in claim 43, wherein the adhesive is selected from: chemical adhesive, flux, metal plating, alloying elements, and chemical bonding.

45. The coupler as claimed in any one of claims 38 to 42, comprising fitting at least one further pin, with interference, tangentially and generally orthogonally to the longitudinal length of the second reinforcing bar, between the sleeve interior face and the second reinforcing bar end, so that the at least one further pin causes local plastic deformation about part of an outer surface of the second reinforcing bar, the at least one further pin mechanically interlocking the sleeve and second reinforcing bar end together.

46. The coupler as claimed in any one of claims 38 to 42, comprising fitting a further array of pins, with interference, tangentially and generally orthogonally to the longitudinal length of the second reinforcing bar, between the sleeve interior face and the second reinforcing bar end, so that the pins in the further array cause local plastic deformation about part of an outer surface of the second reinforcing bar, the further array of pins mechanically interlocking the sleeve and second reinforcing bar end together.

47. The method as claimed in claim 45 or claim 46, wherein a coupling assembly comprising the interlocked sleeve and first and second reinforcing bars is configured so that, when a tractive force is applied to the coupling assembly, reinforcing bar material piles up or shears before a pin.

48. The reinforcing bar coupling assembly as claimed in claim 1, wherein the at least one pin and tubular sleeve inner surface and/or at least one reinforcing bar outer surface are configured to provide a camming action of the at least one pin relative to the sleeve inner surface and/or at least one reinforcing bar outer surface, as axial displacement occurs between the at least one reinforcing bar and sleeve during axial loading of the reinforcing bar coupling assembly.

49. The reinforcing bar coupling assembly as claimed in claim 48, wherein the camming

action increases interference between the at least one pin and the at least one reinforcing bar.

50. The reinforcing bar coupling assembly as claimed in claim 48, wherein the camming action decreases interference between the at least one pin and the at least one reinforcing bar.

51. The reinforcing bar coupling assembly as claimed in claim 48, wherein the camming action results in rotation of the at least one pin on application of an axial force, embedding an edge of the at least one pin further into the at least one reinforcing bar.

52. A method of coupling a reinforcing bar to a coupler, the method comprising the steps of:

providing a coupler in the form of a sleeve having an inner surface;

inserting an end of a reinforcing bar to be coupled into the sleeve, the reinforcing bar end being coaxially aligned with a longitudinal axis of the coupler sleeve; and

fitting an array of pins, with interference, tangentially and generally orthogonally to the longitudinal length of the reinforcing bar, between the sleeve interior face and reinforcing bar end, so that the pins in the array cause local-plastic deformation about part of an outer surface of the reinforcing bar, the pin array mechanically interlocking the sleeve and reinforcing bar end together.

53. The method as claimed in claim 52, wherein a coupling assembly comprising the interlocked sleeve and first reinforcing bars is configured so that, when a tractive force is applied to the coupling assembly, reinforcing bar material piles up or shears before a pin.