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ABSTRACT

Dowels 10, 11, 12 and 13 are V-shaped or U-shaped and bridge a joint 17 between adjacent concrete slabs. Legs 15 and 16 are imbedded in one slab and the apical or bend section 18 up to the juncture line 17 between the slabs may be greased and with an insert 14 in place it results in the apical section being free to move back and forwards in the corresponding slab relatively speaking. The dowel 11 is located inside a sleeve 19 as lost form work in one of the slabs as for the insert 14. The dowel 11 has its apical region 18 in position by reason of stops 20 and 21 inside the sleeve 19. The capacity of the assembly may be supplemented by an additional dowel 11 shown in phantom which is nested inside the first dowel.
JOINTS IN MATERIAL LAID WHILE WET AND ALLOWED TO HARDEN

FIELD OF THE INVENTION

THIS INVENTION relates to joints in material laid while wet and allowed to harden and in particular but not limited to joints in concrete. More particularly, the invention relates to dowelled joints and to a dowel assembly and arrangement of dowels in concrete joints usually applicable to control movement of adjacent concrete slabs due to expansion and contraction.

BACKGROUND TO THE INVENTION

It is known to utilise metal dowels bridging across a joint between adjacent concrete slabs. The joints are usually in the form of construction joints where two slab sections are laid at different times. It is desirable and usual to maintain the slabs in alignment over the life of the slab by using parallel spaced dowels bridging the joint. "Dowel" as herein refers to that on which a slab can slide.

It is common therefore to utilise parallel dowel bars whether of circular or square section or to utilise flat plate dowels. The dowels project from a first poured slab into the space to be occupied by the second poured slab. After the second slab is poured and hardened sheer load is taken by the dowels. As the slabs expand and contract at least one of the slabs slide on the dowels. It is usual for one end of the dowel to adhere to one slab while the other end of the dowel is free to move in the other slab. Freedom of movement is achieved by greasing the dowel or placing the dowel in a sleeve, the sleeve being embedded in the slab and the dowel and sleeve move relative to each other. The present invention has an object to provide a new form of dowel in a crowded and highly developed art. Preferred forms of the invention have other
objects as follows. One object is to provide a dowel arrangement whereby installation is simple and effective and a single bar is employed to provide two times the capacity of a standard dowel of the same thickness and material. A further object is to provide a simple means to increase capacity by simply adding bars which simply nest together in a sleeve.

**OUTLINE OF THE INVENTION**

In one aspect therefore the present invention provides a material laid while wet and allowed to harden and having at least one joint dividing the material into adjacent first and second slabs, the first and second slabs being separated at the joint, the first and second slabs being maintained in alignment by spaced dowel units bridging across the joint, at least one dowel unit comprises a dowel assembly having spaced apart legs and a connector connecting the legs such that the legs are located in one only of the said first and second slabs.

Preferably, the connector and legs are formed as an integral unit and the connector is located in the other one of the said first and second slabs.

In one form, the at least one dowel unit comprises a bar having legs comprising a first leg and a second leg and the connector is in the form of an apical section joining the first and second legs, the apical section comprising a bend in the bar so that the bar is generally V-shaped. Typically, the at least one dowel unit further comprises a sleeve surrounding the apical region, the sleeve being embedded in the other one of said first and second adjacent slabs and the apical region of the V-shaped bar being slidable within the sleeve.
In another form the at least one dowel unit comprises a bar having legs comprising a first leg and a second leg and the connector is in the form of an apical region joining the first and second legs, the apical region comprising a bend in the bar so that the legs diverge from the apical region and the bar is generally U-shaped. Typically, the at least one dowel unit further comprises a sleeve surrounding the apical region, the sleeve being embedded in the other one of said first and second adjacent slabs and the apical region of the U-shaped bar being slidable within the sleeve. In an alternative the apical region is embedded in the other one of said first and second slabs and the legs are slidable relative to the one only of the said first and second slabs. The legs may be pre-greased. Alternatively, the legs may be held in respective sleeve means, the sleeve means being embedded in the said one only of the said first and second slabs, the apical region being embedded in the other one of said first and second slabs and the legs being slidable in said sleeve means relative to the one only of the said first and second slabs.

Preferably, the at least one dowel unit includes lost form work located between the legs. This is used to prevent wet material flowing between the legs on that side intended to allow sliding as upon hardening this would prevent sliding. Typically, the lost form work comprises an insert used to block flow of wet material into the space occupied by the insert.

Preferably, the at least one dowel unit comprises a dowel assembly having at least two bent bars operatively configured for dowel operation. Typically, the at least two bent bars are located in the sleeve with the two bars
being nested together in the sleeve, the assembly being operatively configured for dowel operation.

In another aspect the invention provides a dowel adapted to bridge across a joint, the joint being in concrete, the concrete being on opposite sides of the joint, the dowel comprising a bent bar having a first leg, a second leg and a bend intermediate the first and second legs, the first leg having a free end and the second leg having a free end, the free ends being disposed to one side of the dowel and the bend on the opposite side so that both the free ends may be located on one side of the joint with the bend on the other side of the joint. In one form the legs of the dowel diverge generally at an acute angle. Typically, in this form the legs of the dowel diverge so that the dowel is generally V-shaped.

In another form the legs of the dowel are parallel. Typically, in this form the dowel is generally U-shaped.

In a still further aspect the invention provides a dowel assembly comprising at least one dowel and a dowel sleeve, the dowel comprising a bent bar having a first leg, a second leg and a bend intermediate the first and second legs, the first leg having a free end and the second leg having a free end, the free ends being disposed to one side of the dowel and the bend to the opposite side, the dowel being operatively located within the sleeve with a said side of the dowel within the sleeve the other one of the said sides of the dowel projecting from the sleeve.

In one form of the dowel assembly the side projecting from the sleeve has the bend. In this form of the dowel assembly the legs may or may not be parallel.
In another form of the dowel assembly the side projecting from the sleeve has the legs. In this form of the dowel assembly the legs are parallel.

Where it is desirable to vary the load capacity of the dowel assembly the sleeve includes capacity for additional dowels. Typically, there is capacity for two dowels to be operatively located in the sleeve. Thus in an especially preferred form, the dowel assembly includes the at least one dowel and at least a further dowel operatively located in the sleeve, the said further dowel comprising a bent bar having a first leg, a second leg and a bend intermediate the first and second legs, the first leg of the said further dowel having a free end and the second leg of the said further dowel having a free end, the free ends of the said further dowel being disposed to one side of the said further dowel and the bend to the opposite side of the said further dowel, the said further dowel being operatively located within the sleeve with a said side of the said further dowel within the sleeve and the other one of the said sides of the said further dowel projecting from the sleeve. In one form the sides of the at least one dowel and at least one further dowel projecting from the sleeve have the bend. In this form the legs of both dowels are parallel to each other and to the legs of the other dowel. In another form the sides of the at least one dowel and at least one further dowel projecting from the sleeve have the legs. In this form the legs may or may not be parallel. Typically, the legs diverge.

It will be appreciated that it is usual in one preferred form that the dowel assembly is simply a bent dowel bar in the form of a first leg, a return bend being effectively the connector and a second leg, the return typically comprises a bend in the bar so that the dowel is generally V-shaped or U-shaped. In use the V or
U is generally symmetrically positioned with a leg on either an imaginary line extending at right angles to the joint. Thus the bar effectively straddles that imaginary line.

In use, where the dowel is V-shaped, the legs are typically imbedded in one slab and the apex or the bent section and a marginal region thereof, referred to above as the apical region, is free to move in the other slab. It may be pre-greased for this purpose. To this end, it is preferable that the apical region between the two legs has some form of void form or insert located between the legs in the apical region of the dowel to block ingress of wet material. Thus the apical region and the insert together comprise form work making a recess into the slab so that the slab may slide on the apical region of the dowel. As set out above in the alternative, the assembly may include a sleeve, the apical region being located inside the sleeve, the sleeve being lost form work.

In those embodiments employing a sleeve it is preferable that the sleeve includes stop means which are preferably frangible and locate the dowel within the sleeve at a predetermined spacing from walls of the sleeve to allow for some sideways movement of the dowel within the sleeve. Sideways movement refers to movement generally in the plane of the dowel but transverse the direction of joint separation.

Where the dowel is V-shaped the legs typically diverge at up to about 90° with the lower angle of divergence being about 30°. Thus the angle of divergence ranges from 30° to 90°.

The dowels or dowel assemblies may be formed so that each dowel or assembly is individually aligned as the form work is being built on-site.
Alternatively, a number of dowels or assemblies may be put together in the factory as a preassembled group already aligned. In this case respective dowels or dowel assemblies as described above are coupled to a support which hold the dowels or dowel assemblies in predetermined spaced and operative alignment for dowel operation in a joint, the dowels or dowel assemblies being releasable from the support when in-situ. The support typically comprises parallel spaced bars. The dowels or dowel assemblies may be coupled to the support by frangible connection including one or more tack welds that break under slab contraction or clips to sleeves and so on, the object being to have the dowels and support held together for transport and installation but separate under load in-situ. The couplings may of course be manually released in-situ but some automatic release is preferred in case users forget to manually release.

Thus the dowels may be coupled to the support either directly or indirectly where a sleeve is employed in the case of an assembly and there may be multiple frangible connections associated with each dowel which release automatically in-situ. In the case of parallel wires the dowels are coupled to one of the wires indirectly via respective dowel sleeves for transport purposes, and there being frangible connections which release the dowels automatically in-situ. In this case there would usually as a minimum be a frangible connector from the dowel to the sleeve.

**BRIEF DESCRIPTION OF THE DRAWINGS**

So that the present invention may be more readily understood and be put into practical effect reference will now be made to the accompanying drawings which illustrate preferred embodiments of the invention and wherein:-
Figures 1 to 4 illustrate typical dowels;

Figures 5 to 7 illustrate an arrangement of dowels employing a first dowel and an optional second dowel where the apical ends of the dowels are located inside a sleeve;

Figures 8 to 10 are a further embodiment of the invention employing a U-shaped dowel where the legs of the dowel are located in a sleeve;

Figures 11 to 13 illustrate a further form of the invention wherein the dowel illustrated in Figures 6 to 8 has its apical end located in a sleeve; and

Figures 14 and 15 illustrate an embodiment whereby the dowels according to the present invention are assembled in the factory in predetermined relative position utilising parallel spaced bars whereby the dowel assembly may be releasable in-situ or on site from one of the bars after the assembly has been placed in position thus releasing the dowels for proper operation of the dowels.

METHOD OF PERFORMANCE

Referring to the drawings and initially to Figures 1 to 4, there is illustrated four dowels 10, 11, 12 and 13, with the dowels 10, 11 and 12 being V-shaped and the dowel of Figure 4 being U-shaped. Section 14 in each case illustrates the use of some form of insert to prevent ingress of concrete into the corresponding apical region between the legs 15 and 16 with the "dot dash" line 17 illustrating the joint between adjacent concrete slabs. It will be appreciated in its most general form the legs 15 and 16 are imbedded in one slab and the apical or bend section 18 up to the juncture line 17 between the slabs may be greased and with the insert 14 in place it results in the apical section being free to move back and forwards in the corresponding slab relatively speaking.
Another option is illustrated in Figures 5 to 7 where the dowel 11 of Figure 2 is located inside a sleeve 19 with the juncture line 17 being illustrated generally (it will be appreciated that there will be form work defining the exact position of this line) but that the sleeve 19 will be lost form work in one of the slabs as for the insert 14. It would usually be nailed to the inside of a timber form. The dowel 11 has its apical region 18 in position by reason of stops 20 and 21 inside the sleeve 19. The embodiment of Figures 5 to 7 has a further application insofar as subject to the loading capacity of the dowel 11 the capacity of the assembly may be supplemented by an additional dowel 11 shown in phantom which is nested inside the first dowel. Again, subject to the requirements the sleeve may be made larger to accommodate any number of dowels within practical limits and the required dowel size may be factored in accordingly to allow for a complete universal system adapted for dowelling in this way. Thus the inventory of dowels may be limited to a single dowel size for all applications.

Figures 8 to 13 illustrate the use of sleeves in relation to the dowel of the type illustrated in Figure 4 and it will be appreciated that due to the parallel nature of the legs 15 and 16 in this case, that the two different sleeve forms 20 and 21 may be utilised in relation to the apical region or in relation to the legs as illustrated in Figures 6, 7 and 8. The sleeve 21 of Figure 11, includes stops 22 which hold the dowel in spaced position relative to the inner wall 23 of the dowel so that there is sufficient room for movement of the dowel within the sleeve 21.

While the embodiments of Figures 1 to 13 illustrate typical application of the present invention involving dowels inserted and placed in position as separate entities, the present invention may also be utilised where each of the
dowels are placed in a factory made dowel assembly 24 as illustrated in the example of Figures 14 and 15 wherein this case, the V-shaped dowels 25 (at this case with legs diverging at 54 degrees) are spaced evenly along parallel spaced bars 26 and 27 and this is all assembled at the factory. The dowels may be secured in any suitable manner so that the whole assembly is rigid yet releasable in-situ for proper operation of the dowels. This may be achieved by spot welding the dowels with the weld adapted to break once the slabs have been poured and as the slabs contract the welds break. Sleeves may be suitably utilised on the apical sections as previously described and clipped or otherwise mounted to the bars 26 and 27 and the dowels may, for example, also be simply clipped to the bars or spaced connecting wires may be adapted to be manually cut on site. The bars may be clipped inside the sleeves again so that they are released automatically under load.

Whilst the above has been given by way of illustrative example of the present invention many variations and modifications thereto will be apparent to those skilled in the art without departing from the broad ambit and scope of the invention as described herein and set out in the claims.
1. Material laid while wet and allowed to harden and having at least one joint dividing the material into adjacent first and second slabs, the first and second slabs being separated at the joint, the first and second slabs being maintained in alignment by spaced dowel units bridging across the joint, at least one dowel unit comprises a dowel assembly having spaced apart legs and a connector connecting the legs such that the legs are located in one only of the said first and second slabs.

2. Material laid while wet and allowed to harden according to claim 1 wherein the connector and legs are formed as an integral unit and the connector is located in the other one of the said first and second slabs.

3. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit comprises a bar having legs comprising a first leg and a second leg and the connector is in the form of an apical section joining the first and second legs, the apical section comprising a bend in the bar so that the bar is generally V-shaped.

4. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit comprises a bar having legs comprising a first leg and a second leg and the connector is in the form of an apical region joining the first and second legs, the apical region comprising a bend in the bar so that the legs diverge from the apical region and the bar is generally U-shaped.

5. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit comprises a bar having legs comprising a first leg and a second leg and the connector is in the form of an apical region joining the first
and second legs, the apical region comprising a bend in the bar so that the bar is generally V-shaped, the dowel unit further comprising a sleeve surrounding the apical region, the sleeve being embedded in the other one of said first and second adjacent slabs and the apical region being slidable within the sleeve.

6. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit comprises a bar having legs comprising a first leg and a second leg and the connector is in the form of an apical region joining the first and second legs, the apical region comprising a bend in the bar so that the bar is generally U-shaped, the dowel unit further comprising a sleeve surrounding the apical region, the sleeve being embedded in the other one of said first and second adjacent slabs and the apical region being slidable within the sleeve.

7. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit comprises a bar having legs comprising a first leg and a second leg and the connector is in the form of an apical region joining the first and second legs, the apical region comprising a bend in the bar so that the bar is generally U-shaped, the apical region being embedded in the other one of said first and second slabs and the legs being slidable relative to the one only of the said first and second slabs.

8. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit comprises a bar having legs comprising a first leg and a second leg and the connector is in the form of an apical region joining the first and second legs, the apical region comprising a bend in the bar so that the bar is generally U-shaped, the legs being held in respective sleeve means, the sleeve means being embedded in the said one only of the said first and second
slabs, the apical region being embedded in the other one of said first and second slabs and the legs being slidable in said sleeve means relative to the one only of the said first and second slabs.

9. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel comprises a bar having legs comprising a first leg and a second leg and the connector is in the form of an apical region joining the first and second legs, the apical region comprising a bend in the bar so that the bar is generally U-shaped, a sleeve embedded in the said one only of the said first and second slabs, the apical region of the bar being embedded in the other one of said first and second slabs and the legs being slidable in said sleeve relative to the said one only of the said first and second slabs.

10. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit includes lost form work located between the legs.

11. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit includes lost form work located between the legs, the lost form work comprising an insert used to block flow of wet material into the space occupied by the insert.

12. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit includes lost form work located between the legs, the lost form work comprising a v-shaped insert used to block flow of wet material into the space occupied by the insert.

13. Material laid while wet and allowed to harden according to claim 1 wherein the at least one dowel unit comprises a dowel assembly having at least two bent bars operatively configured for dowel operation.
14. Material laid while wet and allowed to harden according to claim 1 wherein
the at least one dowel unit comprises a dowel assembly having at least two bent
bars and a sleeve with the two bars being nested together in the sleeve, the
assembly being operatively configured for dowel operation.

15. A dowel adapted to bridge across a joint, the joint being in concrete, the
concrete being on opposite sides of the joint, the dowel comprising a bent bar
having a first leg, a second leg and a bend intermediate the first and second
legs, the first leg having a free end and the second leg having a free end, the
free ends being disposed to one side of the dowel and the bend to the opposite
side so that both the free ends are adapted to be located on one side of the joint
with the bend on the other side of the joint.

16. A dowel according to claim 15 where the legs diverge generally at an
acute angle.

17. A dowel according to claim 15 where the legs diverge so that the dowel
is generally V-shaped.

18. A dowel according to claim 15 where the legs are parallel.

19. A dowel according to claim 15 where the dowel is generally U-shaped.

20. A dowel assembly comprising at least one dowel and a dowel sleeve, the
dowel comprising a bent bar having a first leg, a second leg and a bend
intermediate the first and second legs, the first leg having a free end and the
second leg having a free end, the free ends being disposed to one side of the
dowel and the bend to the opposite side, the dowel being operatively located
within the sleeve with one of said sides of the dowel within the sleeve the other
one of the said sides of the dowel projecting from the sleeve.
21. A dowel assembly according to claim 20 wherein the side projecting from the sleeve has the bend.

22. A dowel assembly according to claim 20 wherein the side projecting from the sleeve has the legs.

23. A dowel assembly according to claim 20 wherein the side projecting from the sleeve has the legs and the legs are not parallel.

24. A dowel assembly according to claim 20 wherein the side projecting from the sleeve has the bend and the legs are parallel.

25. A dowel assembly according to claim 20 wherein the assembly includes two dowels operatively located in the sleeve.

26. A dowel assembly according to claim 20 wherein the assembly includes the at least one dowel and at least a further dowel operatively located in the sleeve, the said further dowel comprising a bent bar having a first leg, a second leg and a bend intermediate the first and second legs, the first leg of the said further dowel having a free end and the second leg of the said further dowel having a free end, the free ends of the said further dowel being disposed to one side of the said further dowel and the bend to the opposite side of the said further dowel, the said further dowel being operatively located within the sleeve with a said side of the said further dowel within the sleeve and the other one of the said sides of the said further dowel projecting from the sleeve.

27. A dowel assembly according to claim 20 wherein the assembly includes the at least one dowel and at least a further dowel operatively located in the sleeve, the said further dowel comprising a bent bar having a first leg, a second leg and a bend intermediate the first and second legs, the first leg of the said
further dowel having a free end and the second leg of the said further dowel having a free end, the free ends of the said further dowel being disposed to one side of the said further dowel and the bend to the opposite side of the said further dowel, the said further dowel being operatively located within the sleeve with a said side of the said further dowel within the sleeve and the other one of the said sides of the said further dowel projecting from the sleeve, the sides of the at least one dowel and at least one further dowel projecting from the sleeve have the bend.

28. A dowel assembly according to claim 20 wherein the assembly includes the at least one dowel and at least a further dowel operatively located in the sleeve, the said further dowel comprising a bent bar having a first leg, a second leg and a bend intermediate the first and second legs, the first leg of the said further dowel having a free end and the second leg of the said further dowel having a free end, the free ends of the said further dowel being disposed to one side of the said further dowel and the bend to the opposite side of the said further dowel, the said further dowel being operatively located within the sleeve with a said side of the said further dowel within the sleeve and the other one of the said sides of the said further dowel projecting from the sleeve, the sides of the at least one dowel and at least one further dowel projecting from the sleeve have the legs.

29. A dowel assembly according to claim 20 wherein the assembly includes the at least one dowel and at least a further dowel operatively located in the sleeve, the said further dowel comprising a bent bar having a first leg, a second leg and a bend intermediate the first and second legs, the first leg of the said
further dowel having a free end and the second leg of the said further dowel having a free end, the free ends of the said further dowel being disposed to one side of the said further dowel and the bend to the opposite side of the said further dowel, the said further dowel being operatively located within the sleeve with a said side of the said further dowel within the sleeve and the other one of the said sides of the said further dowel projecting from the sleeve, the sides of the at least one dowel and at least one further dowel projecting from the sleeve have the legs and the legs are not parallel.

30. A dowel assembly according to claim 20 wherein the assembly includes the at least one dowel and at least a further dowel operatively located in the sleeve, the said further dowel comprising a bent bar having a first leg, a second leg and a bend intermediate the first and second legs, the first leg of the said further dowel having a free end and the second leg of the said further dowel having a free end, the free ends of the said further dowel being disposed to one side of the said further dowel and the bend to the opposite side of the said further dowel, the said further dowel being operatively located within the sleeve with a said side of the said further dowel within the sleeve and the other one of the said sides of the said further dowel projecting from the sleeve, the sides of the at least one dowel and at least one further dowel projecting from the sleeve have the bend and the legs are parallel.

31. A dowel support and a plurality of dowels assembled together in the factory with the dowels coupled to the support which holds the dowels in predetermined spaced and operative alignment for dowel operation in a joint, the
dowels being releasable from the support when in-situ, the dowels comprising dowels according to any one of claims 15 to 19.

32. A dowel support and a plurality of dowels assembled together according to claim 31 wherein the support comprises parallel spaced bars.

33. A dowel support and a plurality of dowels assembled together according to claim 31, the dowels being coupled to the support either directly or indirectly by a frangible connection(s) which release(s) automatically in-situ.

34. A dowel support and a plurality of dowels assembled together according to claim 31 wherein the support comprises parallel spaced bars, the dowels being coupled to the support either directly or indirectly by a frangible connection(s) which release(s) automatically in-situ.

35. A dowel support and a plurality of dowels assembled together according to claim 31, each dowel being located inside a dowel sleeve, frangible connections coupling the dowel sleeves to the support for transport purposes, whereby the frangible connections release the dowel sleeves automatically in-situ.