

Paving Unit

Field of the invention

5 The present invention is directed to improvements in or relating to paving units. More particularly the present invention relates to paving units having the capability of forming an integral structural surface.

Background of the invention

10 In this specification, where a document, act or item of knowledge is referred to or discussed, this reference or discussion is not an admission that the document, act or item of knowledge or any combination thereof was at the priority date:

- (i) part of common general knowledge; or
- (ii) known to be relevant to an attempt to solve any problem with which this specification is concerned.

15 Whilst the following discussion concerns paving units, their installation and manufacture, in particular, paving units capable of interlocking with adjacent paving units, it is to be understood that the same principles apply to paving units of any shape or colour.

20 Small element paving comprises a plurality of paving units arranged together to provide a paved surface. Over the last thirty years small element paving has developed from its initial use as a surface for footpaths and other light duty applications to use as an integral structural surface for heavy duty pavements. Heavy duty pavements are used for example at ports, trucking stations, on roads, at bus stops and at airports.

25 Such structures must be resistant to the movement of individual paving units relative to one another. If a paving unit is separated from its adjacent paving unit, whether it be due to subsidence of the ground on which the paving unit is laid or to a breakdown in the connection between adjacent paving units, it is likely to present a gap or an otherwise uneven surface.

30 It will be apparent that that is a potentially dangerous situation, as a pedestrian may catch a heel or the toe of a shoe in the gap created, and may trip and fall. Depending on the width of the gap, it may also have adverse consequences for the tyres and wheels and

hence the suspension system of trucks and aircraft, and may lead to a catastrophic outcome if any of those elements was to fail.

A dislodged paving unit may also pose a risk to the turbines of aircraft engines if a loose paving unit was drawn into the engine.

5 Standard paving units have proved to be inefficient as they do not inherently have sufficient 'interlock'.

The concept of interlock relates to the ability of an individual paving unit to articulate independently of an adjacent unit without being dislodged from the overall paving structure.

10 Three forms of interlock should ideally be present in a block paving system, namely:

- rotational interlock, which is achieved by the presence of edge restraints.
 - vertical interlock, which is provided by the presence of stable compacted sand between all adjacent units.
 - horizontal interlock, which is achieved by a combination of laying paving units in a
- 15 herringbone pattern and by the use of shaped units.

These forms of interlock are intended to prevent paving units from 'creeping', that is, moving horizontally when a force is applied to the paving unit in a direction which is not perpendicular to an upper face of the unit. It is also intended to resist rotational and vertical movement relative to an adjacent unit.

20 Small element paving units rely on the continuous presence of compacted sand between individual paving units to provide the necessary 'interlock' to resist horizontal, vertical and/or rotational displacement of the paving unit. This sand also inhibits ingress of water into the underlying pavement structure. Displacement may manifest itself when a substantial weight is repeatedly placed on an individual unit by, for example, continuous

25 trafficking over an individual unit.

Further displacement can occur as a result of changes in the underlying substratum on which the paving is laid.

Unfortunately, the sand which provides the interlock between the adjacent paving units can, over a period of time, be displaced from the joints by various agents of erosion such as

jet blast, use of vacuum sweepers, water flow, and degradation and liquefaction of laying course materials, thereby resulting in a loss of interlock.

The loss of sand in the joints negates the interlock which can lead to serious deformation and eventual disintegration of the paving surface as shown in Figures 8 to 13.

5 Earlier attempts to provide further interlock between individual paving units consisted of designing various shapes to increase interlock. This included E-shaped, Y-shaped and L-shaped paving units with a plurality of engagement points for adjacent paving units.

Although these various shapes have been tested, problems still persist as shaped paving units appear not to provide sufficient interlock for use as part of heavy duty pavements.
10 These paving units are also costly to manufacture and time consuming to lay given their often convoluted design. Further more existing manufacturing plants need to be modified to produce paving units of particular convoluted shape.

Other attempts to provide suitable heavy duty pavements include the adoption of a mechanical locking device involving complementary recesses and protrusions on adjacent
15 paving units. This feature provided a further degree of interlock between adjacent paving units.

However, whilst an apparent improvement, "self-locking" paving units do not readily resist vertical or horizontal movements. The paving units can also be rotated and become uneven should there be a slight deformation in the overall pavement either by external
20 pressure or by changes in the underlying ground. Hence these are consequently unsuitable for heavy duty pavements with constant traffic.

Similarly, these paving units are also unsuitable for airports as jet aircraft engines can provide a suction effect that can result in the displacement of the individual paving units.

Summary of the invention

25 The present invention accordingly provides in one embodiment a paving unit for use as part of a paving arrangement, the paving unit having a top surface and a plurality of side surfaces with one of the side surfaces of the paving unit being provided with at least one substantially asymmetric protrusion, the protrusion comprising a ridge portion and a second portion, the ridge portion and the second portion being spaced apart by an
30 intermediate portion, the protrusion being locatable in a complementary recess on an

adjacent paving unit, wherein the interengagement between the protrusion and the recess provides interlock between the paving unit and an adjacent paving unit.

The paving unit together with compacted sand in joints according to the invention has been found to provide a degree of interlock to reduce the incidence of vertical and rotational movement of the paving unit. The interlock is enhanced by the dimensions of
5 the protrusion/complementary recess and the engagement therein.

The protrusion can take any suitable form to allow for interlocking between adjacent paving units. The protrusion is preferably substantially vertically extending when the paving unit is in an as laid form. Typically the protrusion will be tapered. The taper
10 may be inward or outward with respect to a side surface of the paving unit. Preferably the protrusion tapers in the direction of a side surface of the paving unit.

The second portion may take any suitable form. The second portion is preferably substantially planar. Typically the second portion will be tapered. The taper may be towards or away from a side surface of the paving unit. Preferably the second portion
15 tapers in the direction of a side surface of the paving unit.

The intermediate portion may take any suitable form. Preferably the intermediate portion is substantially planar. An outer surface of the intermediate portion typically extends in a direction which is substantially parallel to a side surface of the paving unit.

Preferably the protrusion is a substantially vertically extending tongue comprising a
20 ridge portion and a substantially tapering portion, the ridge portion and the tapering portion being spaced apart by an intermediate portion, the protrusion engaging a complementary groove in an adjacent paving unit.

The paving unit can take any suitable shape. Preferably the top surface of adjacent paving units is of substantially similar configuration. Preferably the top surface is
25 substantially planar. The top surface may be of a substantially rectangular configuration. It may be of substantially square configuration. It may be of another polygonal configuration, such as a hexagon. Other shapes are envisaged within the scope of the invention.

In a typical preferred configuration, a paving unit according to the invention has on
30 opposed side surfaces at least one protrusion as described and at least one complementary recess to receive a protrusion as described.

In an alternative arrangement within the scope of the invention, opposed side surfaces may both carry protrusions. In another alternative arrangement, the opposed sides may carry complementary recess(es). Alternatively, opposed sides may have a combination of protrusions and recesses. In these preferred embodiments, adjacent paving
5 units will have either protrusions, complementary recesses or a suitable combination to allow for interengagement and interlock.

A paving unit according to the invention having a substantially rectangular configuration will typically have on its opposed shorter side surfaces at least one protrusion and at least one complementary recess. Alternatively, opposed shorter side
10 surfaces may both have protrusions. Alternatively, opposed shorter side surfaces may have complementary recesses. Alternatively, opposed shorter side surfaces may have a combination of protrusions and recesses. In the latter embodiments, adjacent paving units will of course have either protrusions, complementary recesses or a suitable combination to allow for interengagement and interlock with adjacent paving units.

According to a further preferred form of the invention, the paving units may be manufactured in a wide range of colours. Preferably the top surface of the paving unit will include an at least partly reflective surface. The reflective surface may take any suitable form. It will typically be integral with the top surface of the paving unit, although it may be provided by the application of a layer to the surface. The reflective surface may be
15 formed by the application of a reflective composite mix.

According to a further preferred form of the invention, the paving units may include a noise reducing agent. The noise reducing agent may take any suitable form. Preferably the noise reducing agent is provided in part by chamfering edges of the paving unit.

The present invention provides in another embodiment a paving unit for use as part of a paving arrangement, the paving unit having a top surface and a plurality of side surfaces with one of the side surfaces of the paving unit being provided with at least one substantially asymmetric recess, the recess being contoured so as to be capable of receiving in a complementary fashion a protrusion carried by an adjacent paving unit, the
25 protrusion comprising a ridge portion and a second portion, the ridge portion and the second portion being spaced apart by an intermediate portion, wherein the interengagement
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between the protrusion and the recess provides interlock between the paving unit and an adjacent paving unit.

The present invention provides in another embodiment a pavement comprising an array of paving units as described herein interlocked by a recess and protrusion arrangement as described so as to form a substantially continuous pavement.

The pavement will typically be constructed by fitting paving units with complementary side surfaces adjacent to one another, such as side by side with one another or end to end. Side surfaces of the paving units can as described herein include various combinations of protrusions and complementary recesses arranged to interengage adjacent paving units, thereby providing an interlocked pavement.

A pavement according to the invention may take any suitable form. Preferably the paving units are within a square coordinating space. Other pavement configurations are envisaged within the scope of the invention.

The present invention provides in another embodiment a method for laying a paving unit as described herein, the method comprising the step of interlocking a multiplicity of paving units according to the invention in a final laying pattern to form a pallet, whereby to facilitate mechanical laying of the multiplicity of paving units from the pallet.

The method may include the step of interengaging edges of adjacent pallets during a mechanical laying step to form a pavement.

Pallets can subsequently engage adjacent pallets with the paving units of one pallet interengaging the protrusions or recesses of paving units of the adjacent pallet. In this way a continuous pavement can be rapidly laid. The interlock provided by the interengagement of protrusions and complementary recesses is also intended to reduce the incidence of paving units becoming dislodged during a pallet forming operation.

The present invention provides in another separate embodiment a method for modifying an automated block making machine, the method comprising the step of inserting suitable moulds in the machine to provide protrusions and complementary recesses on a paving unit described.

The modifications may take any suitable form. Preferably the modifications include modifications to the automated block making machine's hydraulic and control systems.

Description of the drawings

- 5 The invention will now be further explained and illustrated by reference to the accompanying drawings in which:

Figures 1 to 4 are perspective views of a paving unit according to one embodiment of the present invention;

Figure 5 is a side view of the paving unit of Figures 1 to 4 arranged as part of a pavement;

- 10 Figure 6 is a plan view of the pavement of Figure 5;

Figure 7 is a cross sectional view of the pavement of Figure 5: and

Figures 8 to 13 are examples of problems associated with standard paving units of the prior art.

- 15 Turning to the drawings, a paving unit 1 includes a top surface 2 and a plurality of side surfaces 3, 4, 5 and 6. In this preferred embodiment, the top surface 2 is of a substantially rectangular prism configuration although other configurations are envisaged within the scope of the invention. As a consequence of its rectangular configuration, the paving unit 1 has opposed longer side surfaces 3 and 4 and opposed shorter side surfaces 5 and 6.

- 20 As is shown in Figures 3 and 4, a longer side surface 3 has a pair of asymmetric protrusions 10. Each protrusion extends substantially vertically from side surface 3 and tapers outwards from the side surface. Each protrusion includes a ridge portion 11 and a second portion 12, ridge portion 11 and second portion 12 being spaced apart by an intermediate portion 13. As is shown in Figures 2 and 4 a protrusion 10 is also located on
25 a shorter side surface 5.

As shown in Figures 1 and 2, the remaining longer side surface 4 has a pair of complementary recesses 20. The dimensions of the recesses 20 correspond to the extended dimensions of the protrusions 10. Consequently, a protrusion 10 of an adjacent paving unit may be located within the recess 20. The dimensions of the protrusions 10 and

complementary recesses 20 and the interengagement between them provides interlock between adjacent paving units to reduce the incidence vertical and rotational movement.

As is shown in Figures 1 to 4, second portion 12 tapers towards the side surface of the paving unit 1. The intermediate portion 13 is in the embodiment shown substantially
5 planar, with an outer surface extending approximately parallel to the side surface to give the appearance of a tongue like projection. The corresponding recesses can be conveniently considered as a complementary groove.

The paving unit 1 may be manufactured in a wide range of colours. The top surface 2 may include an integral reflective surface (not shown). The paving units may
10 also include a noise reducing agent. As shown in Figures 1 to 4, the top edges 30 of the paving unit 1 are chamfered edges of the paving unit.

As shown in Figure 5 and 6 a plurality of paving units 1 can be arranged to form a pavement by fitting paving units 1 with complementary side surfaces to allow for inter engagement and provide a degree of interlock. As is shown in figure 6, the paving units
15 can be arranged in a herringbone arrangement to maximize inter lock. As is shown in Figure 12 the pavement results in a mat like structure to accommodate for substantial deformation or ground settlement.

A multiplicity of paving 1 can be interlocked in a final laying pattern to form a pallet, whereby to facilitate mechanical laying of the pallet. Pallets can subsequently
20 engage adjacent pallets with the paving units of one pallet interengaging the protrusion 10 or recesses 20 of paving units 1 of the adjacent pallet. In this way a continuous pavement can be rapidly laid. The interlock provided by the interengagement of protrusions and complementary recesses is also intended to reduce the incidence of paving units becoming dislodged during a pallet forming operation.

25 The word 'comprising' and forms of the word 'comprising' as used in this description and in the claims does not limit the invention claimed to exclude any variants or additions. Modifications and improvements to the invention will be readily apparent to those skilled in the art. Such modifications and improvements are intended to be within the scope of this invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A paving unit for use as part of a paving arrangement, the paving unit having a top surface and a plurality of side surfaces with one of the side surfaces of the paving unit being provided with at least one substantially asymmetric protrusion, the protrusion comprising a ridge portion and a second portion, the ridge portion and the second portion being spaced apart by an intermediate portion, the protrusion being locatable in a complementary recess on an adjacent paving unit, wherein the interengagement between the protrusion and the recess provides interlock between the paving unit and an adjacent paving unit.
2. The paving unit according to claim 1 wherein the protrusion is substantially vertically extending when the paving unit is in an as laid form.
3. The paving unit according to claim 2 wherein the protrusion is tapered.
4. The paving unit according to claim 3 wherein the protrusion tapers towards a side surface of the paving unit.
5. The paving unit according to claim 1 wherein the second portion is substantially planar.
6. The paving unit according to claim 5 wherein the second portion is tapered.
7. The paving unit according to claim 5 wherein the second portion tapers towards a side surface of the paving unit.
8. The paving unit according to claim 1 wherein the intermediate portion is substantially planar.
9. The paving unit according to claim 1 wherein the intermediate portion extends in a direction which is substantially parallel to a side surface of the paving unit.
10. The paving unit according to claim 1 wherein the protrusion is a substantially vertically extending tongue comprising a ridge portion and a substantially tapering portion, the ridge portion and the tapering portion being spaced apart by an intermediate portion, the protrusion capable of engaging a complementary groove in an adjacent paving unit.
11. The paving unit according to claim 1 wherein the top surface of the paving unit is of substantially similar configuration as an adjacent paving unit.

12. The paving unit according to claim 1 wherein the top surface is of a substantially similar configuration to the paving unit.
13. The paving unit according to claim 1 wherein the paving unit has on opposed side surfaces at least one protrusion and at least one complementary recess to receive a protrusion.
14. The paving unit according to claim 1 wherein opposed side surfaces both carry protrusions.
15. The paving unit according to claim 1 wherein opposed sides both carry complementary recess(es).
16. The paving unit according to claim 1 wherein opposed sides both have a combination of protrusions and recesses.
17. The paving unit according to claim 1 wherein the top surface of the paving unit includes an at least partly reflective surface.
18. The paving unit according to claim 17 wherein the reflective surface is provided by the application of an at least partially reflective layer to the top surface of the paving unit.
19. The paving unit according to claim 1 wherein the paving unit includes a noise reducing agent.
20. The paving unit according to claim 19 wherein the noise reducing agent is provided in part by chamfering the edges of the paving unit.
21. A paving unit for use as part of a paving arrangement, the paving unit having a top surface and a plurality of side surfaces with one of the side surfaces of the paving unit being provided with at least one substantially asymmetric recess, the recess being contoured so as to be capable of receiving in a complementary fashion a protrusion carried by an adjacent paving unit, the protrusion comprising a ridge portion and a second portion, the ridge portion and the second portion being spaced apart by an intermediate portion, wherein the interengagement between the protrusion and the recess provides interlock between the paving unit and an adjacent paving unit.

22. A pavement comprising an array of paving units, the paving units being as claimed in any preceding claim interlocked by said recess and protrusion arrangement to form a substantially continuous pavement.
23. The pavement according to claim 22 wherein the paving units are arranged with complementary side surfaces adjacent to one another.
24. The pavement according to claim 22 wherein the paving units are within a square coordinating space.
25. A method for laying a multiplicity of paving units, the paving units being as claimed in claim 1, the method comprising the step of interlocking in a final laying pattern said multiplicity of paving units to form a pallet, and mechanically laying the pallet.
26. The method according to claim 25 and further including the step of interengaging edges of adjacent pallets during a mechanical laying step to form a pavement.