

A RAILWAY RAIL ANCHORING DEVICE

The present invention relates to a railway rail anchoring device.

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Background

In railway track fastening applications, two important parameters associated with a track fastening are its ability to provide vertical adjustment and its vertical stiffness.

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Vertical adjustment is required to make corrections to rail level, particularly in the case of slab track applications (i.e. those without ballast) where it is not possible to adjust (i.e. "tamp") the ballast.

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For such applications which require moderate levels of stiffness, it is typical to provide a fastening system with an adjustable baseplate where the only resilience comes from a rail pad that fits between the rail and the baseplate. The baseplate provides the capability of adjustment, but adds significantly to the cost and weight of the rail fastening system.

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Accordingly, a rail fastening assembly that can provide moderate stiffness and vertical adjustment without an expensive or heavy baseplate is desirable.

30 The present disclosure seeks to address this issue.

Statements of Invention

Herein disclosed is a railway rail anchoring device for fastening a railway rail to an underlying foundation, the anchoring device comprising a protrusion provided on a lower surface of the anchoring device, the anchoring device protrusion being configured to engage with a corresponding recess provided in a receiving portion associated with the underlying foundation, wherein the anchoring device protrusion is further configured such that the engagement of the anchoring device protrusion with the receiving portion recess permits a substantially vertical adjustment of the anchoring device relative to the underlying foundation and that the anchoring device protrusion and recess remain in engagement during such vertical adjustment.

According to a first aspect, there is provided a railway rail fastening assembly comprising a railway rail anchoring device for fastening a railway rail to an underlying foundation, wherein the anchoring device is configured to receive a first fastening means for fastening the anchoring device to the underlying foundation when in an installed configuration, and wherein the anchoring device is further configured to receive a second fastening means, which bears down on the rail when in the installed configuration, the second fastening means being separate from the first fastening means, the anchoring device comprising a protrusion provided on a lower surface of the anchoring device, the anchoring device protrusion being configured to engage with a corresponding recess provided in a receiving portion associated with the underlying foundation, wherein the anchoring device protrusion is further configured such that the engagement of the anchoring device protrusion with

the receiving portion recess permits a substantially vertical adjustment of the anchoring device relative to the underlying foundation and that the anchoring device protrusion and recess remain in engagement during such adjustment, wherein the railway rail fastening assembly further comprises the receiving portion associated with the underlying foundation, the receiving portion comprising the recess, and wherein the receiving portion recess comprises a first side surface and a second side surface, the first side surface and the second side surface being substantially perpendicular to the lower surface of the anchoring device when in the installed configuration; or angled relative to the lower surface of the anchoring device such that the first side surface and the second side surface are vertical in the installed configuration.

According to a second aspect, there is provided a railway rail fastening assembly, the railway rail fastening assembly comprising: a railway rail anchoring device for fastening a railway rail to an underlying foundation; and an intermediate member, the intermediate member being configured for placement between the anchoring device and the underlying foundation, wherein the anchoring device is configured to receive a first fastening means for fastening the anchoring device to the underlying foundation when in an installed configuration, wherein the anchoring device is further configured to receive a second fastening means, which bears down on the rail when in the installed configuration, the second fastening means being separate from the first fastening means, wherein the anchoring device comprises a protrusion provided on a lower surface of the anchoring device, the anchoring device protrusion being configured to engage with a corresponding recess

provided in the intermediate member, wherein the anchoring device protrusion is further configured such that the engagement of the anchoring device protrusion with the intermediate member recess permits a substantially vertical
5 adjustment of the anchoring device relative to the underlying foundation and that the anchoring device protrusion and recess remain in engagement during such adjustment, wherein the intermediate member recess comprises a first side surface and a second side surface,
10 the first side surface and the second side surface being substantially perpendicular to the lower surface of the anchoring device when in the installed configuration; or angled relative to the lower surface of the anchoring device such that the first side surface and the second side
15 surface are vertical in the installed configuration, and wherein the intermediate member is configured such that it may be cast into the underlying foundation.

According to a third aspect, there is provided a method of
20 forming an underlying foundation, the method comprising: positioning the intermediate member of any of claims 21 to 24; pouring a mixture around the intermediate member; and solidifying the mixture so as to form the underlying foundation with the intermediate member fixed to the
25 underlying foundation.

As shown in the first and second aspect, the anchoring device is configured to receive a first fastening means for fastening the anchoring device to the underlying foundation
30 when in an installed configuration. The anchoring device is further configured to receive a second fastening means, which bears down on the rail when in the installed configuration. The second fastening means

is separate from the first fastening means. Accordingly, the rail may be clamped to the underlying foundation indirectly, e.g. via the first fastening means, anchoring device and second fastening means.

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Accordingly, the present invention advantageously provides a means for fastening a railway that may have moderate stiffness and the ability to make positional adjustments.

10 The anchoring device protrusion may be configured such that the cooperation of the anchoring device protrusion with the

receiving portion recess may limit lateral movement and/or rotation of the anchoring device relative to the underlying foundation.

- 5 The anchoring device protrusion may be provided on a lower surface of the anchoring device. The anchoring device protrusion may extend from the lower surface, e.g. in a downwards direction when in the installed configuration.
- 10 The anchoring device protrusion may be provided at a position further away from the railway rail than the first fastening means configured to fasten the anchoring device to the underlying foundation when in an installed configuration. Alternatively, the anchoring device
- 15 protrusion may be provided at a position closer to the railway rail than the first fastening means configured to fasten the anchoring device to the underlying foundation when in an installed configuration.
- 20 The anchoring device protrusion may be provided in a region of the anchoring device away from the railway rail when in the installed configuration. Alternatively, the anchoring device protrusion may be provided in a region of the anchoring device adjacent to the railway rail when in the
- 25 installed configuration.

- The second fastening means may comprise a rail fastening clip. The anchoring device may be configured to receive the rail fastening clip, which may bear down on the rail
- 30 when in the installed configuration. In the event that the anchoring device engages a clip, the anchoring device protrusion may be provided on the lower surface of the anchoring device at a point spaced apart from a contact

point at which the clip contacts the anchoring device in an installed configuration. The railway rail anchoring device may comprise a railway rail fastening clip anchoring device.

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The anchoring device may engage directly with the underlying foundation, for example, the anchoring device may be directly fastened to the underlying foundation. The anchoring device may further comprise an opening configured
10 to cooperate with the first fastening means, e.g. a bolt. The first fastening means may be configured to fasten the anchoring device to the underlying foundation. The opening may be provided in a region of the anchoring device adjacent to the rail when in the installed configuration,
15 e.g. so that the opening may be closer to the rail than the protrusion. Alternatively, the opening may be provided in a region of the anchoring device away from the rail when in the installed configuration.

20 The anchoring device protrusion may comprise a first side surface and a second side surface. The first side surface and/or the second side surface may be substantially perpendicular to a lower surface of the anchoring device. The first side surface and/or the second side surface may
25 be angled relative to the lower surface of the anchoring device, e.g. such that the first side surface and/or the second side surface are vertical in the installed configuration.

30 As shown in the first and second aspect, a railway rail fastening assembly comprises the railway rail anchoring device described above.

As shown in the first and second aspect, the railway rail fastening assembly further comprises the receiving portion associated with the underlying foundation. The receiving portion comprises the recess. The recess may be provided
5 in the underlying foundation. The receiving portion may be a portion of the underlying foundation. The receiving portion may be separate from the underlying foundation. The receiving portion may be substantially level with the underlying foundation. For example, a top surface of the
10 receiving portion may be substantially level with a top surface of the underlying foundation.

As shown in the first and second aspect, the receiving portion recess comprises a first side surface and a second
15 side surface. The first side surface and/or the second side surface may be substantially perpendicular to a lower surface of the anchoring device and/or the local top surface of the receiving portion when in the installed configuration. The first side surface and/or the second
20 side surface may be angled relative to the lower surface of the anchoring device and/or the local top surface of the receiving portion, e.g. such that the first side surface and/or the second side surface are vertical in the installed configuration.

25 The railway rail fastening assembly may further comprise an intermediate member. The intermediate member may comprise the receiving portion such that the recess is provided in the intermediate member. The intermediate member may be
30 configured for placement between the anchoring device and the underlying foundation. Alternatively, the underlying foundation may comprise the receiving portion with the recess.

The intermediate member may advantageously provide a mould surface to form the recess in the underlying foundation. The intermediate member may also advantageously provide a more resilient surface for the anchoring device protrusion
5 to engage with.

The intermediate member may comprise a protrusion. The intermediate member protrusion may be configured to engage a further recess provided in the underlying foundation.
10 Alternatively, the intermediate member may not comprise a protrusion and the intermediate member may fit in a further recess provided in the underlying foundation.

The recess may be provided on a first surface of the
15 intermediate member. The intermediate member protrusion may be provided on a second surface of the intermediate member. The first surface may oppose the second surface. The recess and intermediate member protrusion may or may not be coincident. A structure forming the intermediate
20 member protrusion may also form the recess.

The intermediate member may further comprise one or more fastening means receiving portions. The fastening means receiving portions may be configured to cooperate with the
25 first fastening means. The first fastening means may be configured to fasten the anchoring device to the underlying foundation. The fastening means receiving portions may be integral with or separate from the remainder of the intermediate member.

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The intermediate member and the underlying foundation may be joined together, e.g. by virtue of casting. The intermediate member may be configured such that it may be

cast into the underlying foundation. For example, the intermediate member may comprise formations for interacting with the underlying foundation when cast.

5 The railway rail fastening assembly may further comprise one or more shims. The shims may be configured for placement between the anchoring device and the underlying foundation. The one or more shims may comprise a first side and a second side. The first and/or second sides may
10 be substantially flat.

The railway rail fastening assembly may further comprise one or more fastening means, one or more rail clips, a further anchoring device for other side of rail and/or one
15 or more base-plates.

Herein disclosed is a railway rail fastening assembly, the railway rail fastening assembly comprising: a railway rail anchoring device for fastening a railway rail to an
20 underlying foundation; and an intermediate member, the intermediate member being configured for placement between the anchoring device and the underlying foundation, wherein the anchoring device is configured to receive a first fastening means for fastening the anchoring device to the
25 underlying foundation when in an installed configuration, wherein the anchoring device is further configured to receive a second fastening means, which bears down on the rail when in the installed configuration, the second fastening means being separate from the first fastening
30 means, wherein the anchoring device comprises a protrusion provided on a lower surface of the anchoring device, the anchoring device protrusion being configured to engage with

a corresponding recess provided in the intermediate member, wherein the anchoring device protrusion is further configured such that the engagement of the anchoring device protrusion with the intermediate member recess permits a substantially vertical adjustment of the anchoring device relative to the underlying foundation and that the anchoring device protrusion and recess remain in engagement during such adjustment, and wherein the intermediate member is configured such that it may be cast into the underlying foundation.

According to a third aspect of the present invention there may be provided an intermediate member configured for placement between the above-mentioned anchoring device and the underlying foundation, the intermediate member comprising one or more receiving portions with recesses, wherein the recesses are configured to engage with the anchoring device protrusions so as to permit a substantially vertical adjustment of the anchoring devices relative to the underlying foundation with the anchoring device protrusion and recess remaining in engagement during such adjustment.

The intermediate member may comprise two receiving portions each with a recess for engagement with a respective anchoring device. The two receiving portions may be arranged such that anchoring devices may be provided either side of the rail.

The intermediate member may further comprise one or more fastening means receiving portions. The fastening means receiving portions may be configured to cooperate with a first fastening means. The first fastening means may be

configured to fasten the anchoring device to the underlying foundation. The intermediate member may be configured such that it may be cast into the underlying foundation.

5 According to a fourth aspect of the present invention there is provided a method of forming an underlying foundation, the method comprising: positioning the above-mentioned intermediate member; pouring a mixture, such as concrete or cement, around the intermediate member; and solidifying the
10 mixture so as to form the underlying foundation with the intermediate member fixed to the underlying foundation. The method may comprise: placing the above-mentioned intermediate member in a mould; and forming the underlying foundation in the mould such that the underlying foundation
15 is formed around the intermediate member.

The underlying foundation may comprise a sleeper or a slab, e.g. as used in track slab application. The underlying foundation may be formed from concrete, cement or any other
20 mouldable material.

Brief Description of the Drawings

Reference will now be made to the accompanying drawings in
25 which:

Figures 1a and 1b show side and plan views respectively of a railway rail fastening assembly according to an example of the present invention;

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Figures 2a, 2b and 2c show a side view, a first perspective view and a second perspective view respectively of a

railway rail fastening clip anchoring device according to an example of the present invention;

Figures 2d and 2e show perspective views of railway rail
5 fastening clip anchoring devices with differing protrusion heights according to an example of the present invention;

Figure 3a shows a side sectional view of an intermediate member and Figures 3b and 3c show a plan view and a side
10 sectional view respectively of an intermediate member according to an example of the present invention;

Figures 4a and 4b show a plan view and a side sectional view of a shim according to an example of the present
15 invention;

Figure 5 shows a side view of a railway rail fastening clip anchoring device according to a further example of the present invention;

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Figures 6a and 6b show sectional side views of railway underlying foundations according to further examples of the present invention;

25 Figures 7a and 7b show schematic side views of alternative adjustment arrangements of the present invention; and

Figure 8 shows a side view of a railway rail anchoring device according to a further example of the present
30 invention.

Detailed Description

With reference to Figures 1a and 1b a railway rail fastening assembly 10, according to an example of the present invention, comprises an anchoring device 12, e.g. a shoulder, configured to receive a railway rail fastening clip 14. (The clip 14 has been omitted from Figure 1b.) The anchoring device 12 is operatively connected to an underlying foundation 18 (Shown in part in Figures 1a and 1b), such as a railway sleeper or slab. Respective anchoring devices 12 are provided on either side of a railway rail 16 for retaining clips 14 which bear on a rail foot 17. The clip 14 secures the railway rail 16 to the underlying foundation by virtue of forces exerted by the clip on the anchoring device 12 and the rail 16.

15 The clip 14 may be configured such that it can be deflected from a non-operative configuration to at least one operative configuration in which a toe portion 15 of the clip bears on the rail. The clip 14 may be resilient and may be made from a rod of resilient material. The clip 14, as shown in Figure 1a, may be of the type that is inserted into engagement with the anchoring device 12 and rail 16 in a substantially lateral direction relative to a longitudinal axis of the rail.

25 The railway rail fastening assembly 10 may further comprise a railway rail pad 20. The pad 20 may comprise a plate of resilient material for providing cushioning between the rail foot 17 and the underlying foundation 18.

30 The railway rail fastening assembly 10 may further comprise one or more electrically insulating wear pieces, such as a toe insulator 22 and a side post insulator 24. The toe insulator 22 may be carried by the toe portion 15 of the

clip 14 and may bear against the rail foot 17 in an installed configuration. The toe insulator 22 may electrically insulate the rail from the clip and/or limit wear between the rail and the clip. The side post
5 insulator 24 may be positioned between the anchoring device 12 and the rail foot 17 in an installed configuration and the side post insulator 24 may extend along the width of the anchoring device. The side post insulator 24 may electrically insulate the rail from the anchoring device
10 and/or limit wear between the rail and the anchoring device.

With particular reference to Figure 1b, the railway rail fastening assembly 10 may further comprise one or more
15 fastening means 26, such as a bolt. The fastening means 26 may be configured to fasten the anchoring device 12 to the underlying foundation 18.

Referring now to Figures 2a to 2e, the anchoring device 12
20 comprises a protrusion 28 provided on a lower surface 30 of the anchoring device, e.g. facing the underlying foundation when in the installed configuration. The anchoring device protrusion 28 is configured to cooperate with a corresponding recess described with reference to Figure 3
25 below. The recess is provided in a receiving portion associated with the underlying foundation. The cooperation of the anchoring device protrusion 28 with the receiving portion recess permits a substantially vertical adjustment of the anchoring device 12 relative to the underlying
30 foundation 18.

It is appreciated that the rail may be angled with respect to the vertical, e.g. due to opposing rails being angled

towards one another and/or due to a cant angle. As a result, references to a substantially vertical adjustment of the anchoring device may also comprise a component of lateral adjustment, e.g. the adjustment may be in a
5 direction substantially parallel to a midline of the respective rail. Alternatively, the adjustment may be in a vertical direction whether the rail is angled or not. In any event, references to a vertical adjustment of the anchoring device may simply mean that the anchoring device
10 has been adjusted to a higher or lower position.

As best shown in Figure 2b, the anchoring device further comprises an opening 32 configured to cooperate with the fastening means 26. The fastening means 26 passes through
15 opening 32 when in the installed configuration. For example, a bolt shaft may pass through the opening 32. The opening 32 may be sized such that a head of the bolt, or intermediate washer, abuts a top surface 34 of the anchoring device. As mentioned above, the fastening means
20 26 is configured to fasten the anchoring device 12 to the underlying foundation 18.

As is also depicted in Figure 2, the anchoring device comprises first and second engaging surfaces 35a, 35b for
25 engaging respective portions of the clip 14. The first and second engaging surfaces 35a, 35b are provided on respective first and second side walls 37a, 37b, which extend from the top surface 34 of the anchoring device. The first and second engaging surfaces 35a, 35b are
30 arranged so as to face the top surface 34. The first and second side walls 37a, 37b are provided either side of the opening 32.

The protrusion 28 may be provided in a region of the anchoring device 12 away from the railway rail 16 when in the installed configuration. In particular, the protrusion 28 may be provided at an end of the anchoring device 12
5 furthest from the railway rail 16. For example, the protrusion 28 may, at least in part, form a rear face 27 of the anchoring device. By contrast, the opening 32 may be provided in a region of the anchoring device adjacent to the rail 16 when in the installed configuration, e.g. as
10 shown in Figure 1b. The protrusion 28 may be spaced apart from the opening 32, e.g. an edge of the opening.

The protrusion 28 may be provided on the lower surface 30 of the anchoring device 12 at a point spaced apart from a
15 contact point at which the clip 14 contacts the anchoring device in the installed configuration. With reference to Figure 1a, the contact point may be a point 14a at which the clip 14 may exert a substantially upwards force on the anchoring device, e.g. via the first and second engaging
20 surfaces 35a, 35b, or a point 14b at which the clip 14 may exert a substantially downwards force on the anchoring device, e.g. via the top surface 34 of the anchoring device. In particular, the protrusion 28 may be set back (relative to the rail) from the point 14b at which the clip
25 14 may exert a substantially downwards force on the anchoring device.

As shown in Figures 2b and 2c, the protrusion 28 may extend across the width, e.g. the entire width, of the anchoring
30 device 12. The protrusion 28 may be substantially elongate and the protrusion 28 may extend in a direction substantially parallel to the longitudinal axis of the rail 16. The protrusion 28 cross-section (in a horizontal plane

when installed) may however be any other shape, such as square, rectangular, or any other shape. The protrusion 28 may be integral with the anchoring device. Apart from the protrusion 28, the lower surface 30 of the anchoring device 12 may be substantially flat.

It will be appreciated that when in the installed configuration the clip 14 may exert a substantially upwards force on the anchoring device, e.g. via the first and second engaging surfaces 35a, 35b. In addition, the clip 14 may exert a substantially downwards force on the anchoring device, e.g. via the top surface 34 of the anchoring device. The fastening means 26 may also exert a substantially downwards force on the anchoring device 12. As a result of these forces, the anchoring device may be subject to a torque. The arrangement of the protrusion mentioned above, e.g. with the perpendicular side surfaces, may assist in resisting such a torque. Furthermore, the arrangement of the protrusion mentioned above ensures that contact is maintained between the protrusion and the recess when a substantially vertical adjustment is made.

Although a particular anchoring device, which cooperates with a corresponding clip, is shown in Figure 2, it is envisaged that the present invention may apply to any other type of anchoring device, clip and/or anchoring devices without clips.

Figures 3a, 3b and 3c show an example of the above-mentioned recess 36, which is provided in a receiving portion associated with the underlying foundation 18. As depicted in Figure 3, an intermediate member 38 may comprise the receiving portion with the recess 36.

Alternatively, the recess 36 may be provided in the underlying foundation itself, for example such that the receiving portion is part of the underlying foundation.

5 Accordingly, the railway rail fastening assembly 10 may further comprise an intermediate assembly 40 comprising the intermediate member 38. The intermediate member 38 comprises the receiving portion such that the recess 36 is provided in the intermediate member. The intermediate
10 member 38 is configured for placement between the anchoring device 12 and the underlying foundation 18.

As depicted, the recess 36 is provided on a first surface 44 of the intermediate member 38, which is an upper facing
15 surface when in the installed configuration. The first surface 44 of the intermediate member 38 may be substantially level with a top surface of the underlying foundation when in the installed configuration.

20 Referring to both Figures 2 and 3, further details of the protrusion and corresponding recess will now be described. The protrusion 28 comprises a first side surface 29a and a second side surface 29b. The first side surface 29a may face the rail 16 when in the installed configuration. The
25 second side surface 29b may face away from the rail when in the installed configuration. The second side surface 29b may form, at least in part, the rear face 27 of the anchoring device. The first and/or second side surfaces 29a, 29b may reside in a plane that is substantially
30 parallel to the longitudinal axis of the rail 16 when in the installed configuration. The first and second side surfaces 29a, 29b may be substantially parallel to one another. The first and/or second side surfaces 29a, 29b

may be at least partially substantially flat. The first side surface and/or the second side surface 29a, 29b may be substantially perpendicular to the lower surface 30 of the anchoring device. Accordingly, one of the first and second
5 side surfaces 29a, 29b may be perpendicular to the lower surface 30, whilst the other side surface may not be perpendicular to the lower surface 30.

The receiving portion recess may comprise corresponding
10 first and second side surfaces 37a, 37b. The first and second side surfaces 37a, 37b may be orientated in the same manner as the first and second side surfaces 29a, 29b of the protrusion. For example, the first recess side surface 37a and/or the second recess side surface 37b may be
15 substantially perpendicular to the first surface 44 of the receiving portion and/or a lower surface of the anchoring device when in the installed configuration. The first and second recess side surfaces 37a, 37b may be substantially parallel to one another. However, one of the first and
20 second recess side surfaces may be perpendicular to the lower surface 30, whilst the other recess side surface may not be perpendicular to the lower surface 30.

An interaction between respective recess side surfaces 37a, 37b and protrusion side surfaces 29a, 29b may restrict
25 lateral movement of the anchoring device. The spacing between the first and second recess side surfaces 37a, 37b and spacing between the first and second protrusion side surfaces 29a, 29b may be configured such that there is a
30 tight fit between the protrusion and recess in the lateral direction. However, the spacing between the first and second recess side surfaces may be greater than the spacing

between the first and second protrusion side surfaces, e.g. so that there is a loose fit in the lateral direction.

The first protrusion side surface 29a and anchoring device
5 lower surface 30 may meet at right angles, e.g. so as to
define a substantially right-angled corner 30a.
Alternatively, the corner between the first protrusion side
surface 29a and the anchoring device lower surface 30 may
be radiused. Similarly, one or more of the recess side
10 surfaces 37a, 37b may meet the receiving portion upper
surface at a right angle, e.g. so as to define a
substantially right-angled corner 44a. Alternatively or
additionally, the corner 44b between one or more of the
recess side surfaces and the receiving portion upper
15 surface 44 may be radiused.

The protrusion 28 may further comprise a first end surface
29c and a second end surface 29d. The first and second end
surfaces 29c, 29d may be provided between the first and
20 second side surfaces 29a, 29b. Accordingly, the receiving
portion recess may comprise corresponding first and second
end surfaces 37c, 37d. The first and second recess end
surfaces 37c, 37d may be orientated in the same manner as
the first and second end surfaces of the protrusion.

25 An interaction between respective recess end surfaces 37c,
37d and protrusion end surfaces 29c, 29d may restrict
longitudinal movement of the anchoring device, e.g. in a
direction parallel to the longitudinal axis of the rail.
30 The spacing between the first and second recess end
surfaces 37c, 37d and spacing between the first and second
protrusion end surfaces 29c, 29d may be configured such
that there is a tight fit between the protrusion and recess

in the longitudinal direction. However, the spacing between the first and second recess end surfaces may be greater than the spacing between the first and second protrusion end surfaces, e.g. so that there is a loose fit
5 in the longitudinal direction.

Referring again to Figure 3, the intermediate member 38 may comprise a further protrusion 42, which is provided on a second surface 46 of the intermediate member. The second
10 surface 46 opposes the first surface 44 and faces the underlying foundation when in the installed configuration. The intermediate member protrusion 42 is configured to engage a further recess 48 provided in the underlying foundation 18.

15 As depicted, the intermediate member recess 36 and intermediate member protrusion 42 may be coincident such that a structure 50 forming the intermediate member protrusion 42 also forms the intermediate member recess 36.

20 In an alternative configuration (not shown), the intermediate member may not comprise a protrusion and the entire second surface 46 of the intermediate member may fit in a recess provided in the underlying foundation. For
25 example, the entire second surface 46 of the intermediate member may be substantially flat and the intermediate member may be a plate with recesses formed on a top surface. It will be appreciated that with such an arrangement, the thickness of the intermediate member 38
30 may be greater than the depth of the recess 36 on the first surface 44 of the intermediate member.

Whether an intermediate member is provided or not, the shape and dimensions of the recess 36, 48 may correspond to those of the anchoring device protrusion 28 such that the protrusion 28 fits within the recess 36, 48. For example, 5 the recess 36, 38 may be substantially elongate and the recess 36, 38 may extend in a direction substantially parallel to the longitudinal axis of the rail 16.

It will be appreciated that the cooperation of the 10 anchoring device protrusion with the receiving portion recess permits a substantially vertical adjustment of the anchoring device, and thus the rail, relative to the underlying foundation. It will also be appreciated that at least a portion of a lateral load between the anchoring 15 device and the underlying foundation may be transmitted between the protrusion and the receiving portion recess.

The depth of the recess 36 may be greater than or equal to the height of the protrusion 28. The height of the 20 protrusion 28 may be greater than the maximum anticipated vertical adjustment, e.g. so that there is an overlap between the protrusion 28 and the recess 36 when the maximum vertical adjustment has been made. In particular, the height of the protrusion 28 may be selected such that 25 when the maximum vertical adjustment has been made there is an overlap between the protrusion and the recess sufficient to resist any lateral forces between the anchoring device and the underlying foundation. In other words, the height of the protrusion 28 may be greater than or equal to the 30 sum of the maximum anticipated vertical adjustment and the minimum vertical overlap required between the protrusion and the recess.

By way of example, the height of the protrusion 28 (e.g. from the lower surface) may be approximately 20mm. The depth of the recess 36 may also be approximately 20mm, although it may be greater. The maximum anticipated
5 vertical adjustment may be approximately 10mm. The minimum vertical overlap between the protrusion and the recess may be approximately 10mm. The first and second protrusion side surfaces 29a, 29b may be spaced apart by approximately 10mm.

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With particular reference to Figures 2d and 2e, anchoring devices 12, 12' with different protrusion heights may be provided. For example, a further anchoring device 12' may have a protrusion 28' with a height greater than the
15 protrusion 28 of the anchoring device 12. The anchoring devices 12, 12' may otherwise have the same dimensions such that they may be interchangeable. The further anchoring device 12' may be used when a larger vertical adjustment may be required. The height of the protrusion 28' (e.g.
20 from the lower surface) may be approximately 30mm or may be any other desired value. Further anchoring devices with different protrusion heights may be provided, for example, a range of anchoring devices with varying protrusion heights.

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The cooperation of the anchoring device protrusion 28 with the receiving portion recess 36, 48 may also limit movement of the anchoring device relative to the underlying foundation, e.g. in a horizontal plane. For example, the
30 cooperation of the protrusion 28 with the recess 36 may limit movement of the anchoring device in a direction perpendicular to the longitudinal axis of the rail and/or in a direction parallel to the longitudinal axis of the

rail. The cooperation of the protrusion 28 with the recess 36 may limit rotation of the anchoring device relative to the underlying foundation 18.

5 As shown in Figure 3a, the intermediate assembly 40 may further comprise one or more fastening means receiving portions 52. The fastening means receiving portions 52 may cooperate with the fastening means 26 to secure the anchoring device 12 to the underlying foundation 18. The
10 fastening means receiving portions 52 may be positioned between the fastening means 26 and the underlying foundation 18 when in an installed configuration. The fastening means receiving portions 52 may provide a surface for the fastening means 26 to engage, e.g. for the threads
15 of a bolt to thread into. For example, an inner surface of the fastening means receiving portions 52 may be threaded.

The fastening means receiving portions 52 may be substantially tubular, e.g. so as to receive the fastening
20 means 26, which may be in the form of a bolt. The fastening means receiving portions 52 extend from the second surface 46 of the intermediate member 38 and as such extend into the underlying foundation 18 when in the installed configuration.

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The intermediate member 38 may comprise one or more openings 54. Each opening 54 may be associated with a corresponding fastening means receiving portion 52, such that the fastening means 26 may pass through the opening 54
30 in the intermediate member 38 and into the fastening means receiving portions 52. Accordingly, the fastening means receiving portions 52 may be open at an end which engages

the intermediate member 38. By contrast, the opposite end of the fastening means receiving portions 52 may be closed.

5 The fastening means receiving portions 52 may or may not be integral with the intermediate member 38. In other words, the fastening means receiving portions 52 may be separate components from the intermediate member 38. The fastening means receiving portions 52 may engage with the respective openings 54 in the intermediate member 38. For
10 example, the fastening means receiving portions 52 may be secured to the intermediate member 38 by virtue of an interference fit. Accordingly, the fastening means receiving portions 52 may be sized and/or shaped to fit in the intermediate member openings 54.

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The fastening means receiving portions 52 may comprise an abutment shoulder 56 disposed about an outer surface of the fastening means receiving portions. The abutment shoulder 56 may comprise an annular ring. The abutment shoulder 56
20 may abut the second surface 46 of the intermediate member 38, e.g. to ensure that the fastening means receiving portions 52 do not protrude beyond the first surface 44 of the intermediate member. Accordingly, the abutment shoulder 56 may be set back from an end of the fastening
25 means receiving portions 52, e.g. by a distance substantially equal to or less than the thickness of the intermediate member 38.

The fastening means receiving portions 52 may further
30 comprise one or more splines (not shown) to resist rotational forces acting on the fastening means receiving portions. The splines may engage the underlying foundation or corresponding splines provided in the openings 54 of the

intermediate member 38. The fastening means receiving portions 52 may further comprise one or more engaging surfaces 56 to engage the underlying foundation 18. The engaging surfaces 56 may resist movement of the fastening means receiving portions 52 (and hence fastening means 26) relative to the underlying foundation, e.g. in a vertical direction when in the installed configuration.

The recess 36 and opening 54 of the intermediate member 38 may be spaced apart by a distance corresponding to the spacing between the protrusion 28 and opening 32 of the anchoring device 12. In other words, when the protrusion 28 of the anchoring device 12 is located in the recess 36, the openings 32, 54 may coincide such that the fastening means 26 may pass through the openings to secure the anchoring device to the underlying foundation 18.

As is apparent from the Figures, the intermediate member 38 may comprise two openings 54 and two recesses 36, with each opening 54 and recess 36 corresponding to one anchoring device 12. Similarly, the intermediate member 38 may comprise two fastening means receiving portions 52 and hence two fastening means 26, e.g. one per each anchoring device.

Each intermediate member recess 36 may be provided at opposing ends of the intermediate member and each opening 54 may be set back from the respective ends of the intermediate member. The intermediate member 38 may be symmetrical about an axis substantially parallel to the longitudinal axis of the rail. The intermediate member 38 may also be symmetrical about an axis substantially perpendicular to the longitudinal axis of the rail.

It will be appreciated that the intermediate member 28 may support two anchoring devices 12, one at each end of the intermediate member. As depicted in Figure 1a, the rail is supported between the two anchoring devices 12. The railway pad 20 may be placed between the intermediate member 38 and the rail foot 17.

The intermediate member 38 and/or fastening means receiving portions 52 may be formed of a plastic, such as a high viscosity nylon or any other suitable plastic. The cost and weight of these components may therefore be kept to a minimum. By contrast, the anchoring device 12 may be made from iron and may be cast iron.

The underlying foundation 18 may be formed by positioning the intermediate member 38; pouring a mixture around the intermediate member; and solidifying the mixture so as to form the underlying foundation with the intermediate member fixed to the underlying foundation. For example, the underlying foundation 18 may be formed by placing the intermediate assembly 40 in a mould (not shown) and filling the mould with an appropriate substance, such as concrete or cement. The intermediate assembly 40 may be held in place with respect to the mould by virtue of the fastening means receiving portions 52. For example, bolts may be inserted into the fastening means receiving portions 52 to hold the intermediate assembly in place relative to the mould. In this way, the intermediate assembly may be cast into the underlying foundation, e.g. such that the intermediate assembly and underlying foundation are joined together. The bolts and mould may then be removed and the

underlying foundation can be put in place in the required location.

Alternatively, the underlying foundation 18 may be formed
5 with a "top down" construction in which the intermediate
assembly may be suspended in the required position, e.g.
connected to the anchoring device and rail, and a mixture
may be poured up underneath it to form the underlying
foundation and fix the intermediate member in position. In
10 either case, the intermediate member 38 may advantageously
provide a mould surface to form the recess 48 in the
underlying foundation.

Casting a recess with parallel sidewalls is difficult to
15 reliably achieve. The intermediate member with the recess
that may be cast into the underlying foundation
advantageously overcomes this issue. The recess may be
provided in the intermediate member and the intermediate
member does not have to be removed from the underlying
20 foundation.

With reference to Figure 4, the railway rail fastening
assembly 10 may further comprise one or more shims 58
configured for placement between the anchoring device 12
25 and the underlying foundation 18 or intermediate member 38.
The shim 58 may extend across both openings 54 of the
intermediate member. As such, a pair of anchoring devices
28 either side of the rail may be placed on a single shim
58. The railway pad 20 may also be placed on the shim 58.
30 The thickness of the shim 58 and/or number of shims may be
varied to adjust the height of the anchoring devices 12
relative to the underlying foundation 18.

The shim 58 may be securely located in the installed configuration thanks to one or more openings 60 in the shim, through which the fastening means 26 may pass.

The shim openings 60 may be spaced apart with the same
5 spacing as the openings 54 in the intermediate member 38. The shim 58 may have substantially the same shape as the intermediate member 38. The shim 58 may be substantially flat on both sides.

10 The shims may be formed of a plastic, such as a high viscosity nylon or any other suitable plastic.

With reference to Figure 5, in a further example of the present invention, the anchoring device protrusion 128 may
15 be provided in a region of the anchoring device 112 adjacent to the railway rail when in an installed configuration. In particular, the protrusion 128 may be provided at an end of the anchoring device 112 closest to the railway rail 16. Accordingly, the position of the
20 recess in the intermediate member may be adjusted such that each intermediate member opening may be provided at opposing ends of the intermediate member and each recess may be set back from the respective ends of the intermediate member. Otherwise, it will be appreciated
25 that the features described above in respect of the intermediate assembly and anchoring device may apply equally to the intermediate member and anchoring device of this further example of the present invention.

30 Although not depicted, it will be appreciated that in the further example of the present invention, the opening for receiving the fastening means may be provided in a region

of the anchoring device 112 away from the rail 16 when in the installed configuration.

Referring now to Figures 6a and 6b, further examples of an
5 underlying foundation 118, 218 are shown in part. As depicted in Figure 6 and mentioned above, the intermediate member 38 may be omitted and the anchoring device protrusion 28, 128 may interface directly with a recess 136, 236 provided in the underlying foundation.

10

The particular examples shown in Figure 6 are suited for the anchoring device 112 shown in Figure 5, for which the protrusion 128 may be provided at an end of the anchoring device 112 closest to the railway rail 16. However,
15 alternative underlying foundation arrangements are equally contemplated, which would cooperate directly with the anchoring device 12 shown in Figure 2, for which the protrusion 28 may be provided at an end of the anchoring device 12 furthest from the railway rail 16.

20

As shown in Figure 6a, the underlying foundation may comprise a single recess 136, or as depicted in Figure 6b, two recesses 236 may be provided in the underlying foundation either side of the rail longitudinal axis. In
25 the case of the single recess 136 shown in Figure 6a, the railway pad 20 may reside in the recess 136. This arrangement may accommodate a larger rail pad, for example with a lower stiffness.

30 In either case, fastening means receiving portions 152, 252 may be provided to facilitate engagement of the fastening means 26 with the underlying foundation 118, 218. The fastening means receiving portions 152, 252 may be cast

into the underlying foundations in a manner similar to that described above.

Referring now to Figures 7a and 7b, the rail may be angled
5 with respect to the vertical, e.g. due to opposing rails
being angled towards one another. As depicted in Figure
7a, the recess 336 and protrusion 328 may be configured
such that the adjustment may be in a direction
substantially parallel to a midline 362 of the respective
10 rail. In other words, the first and/or second protrusion
side surfaces 329a, 329b may be parallel to the midline 362
of the rail. Similarly, the corresponding first and/or
second recess side surfaces 337a, 337b may be parallel to
the midline 362 of the rail. As a result, adjustment of
15 the anchoring devices 312 may be in a direction 364
parallel to the midline 362 of the rail.

However, in an alternative arrangement depicted in Figure
7b, the recess 436 and protrusion 428 may be configured
20 such that the adjustment may be in a vertical direction
despite the rail being angled. With the arrangement shown
in Figure 7b, the first and/or second protrusion side
surfaces 429a, 429b may be vertical. Similarly, the
corresponding first and/or second recess side surfaces
25 437a, 437b may be vertical. As a result, adjustment of the
anchoring device 412 may be in a vertical direction 464.

With the arrangement shown in Figure 7b, the opening 432 in
the anchoring device 412 may be elongate, e.g. extending in
30 a direction perpendicular to the longitudinal axis of the
rail. The elongation of the opening 432 may permit lateral
movement of the anchoring device 412 relative to the
fastening means.

The above-mentioned examples comprise an anchoring device which receives a fastening clip, which in turn bears down on the rail. However, as depicted in Figure 8, in an
5 alternative arrangement, the anchoring device 512 may not receive the clip 14. The anchoring device 512 may instead engage a base-plate 566, which may in turn receive the clip. The base-plate 566 may comprise one or more surfaces (not shown) which engage the clip. As for the previous
10 examples, the anchoring device 512 comprise a protrusion 528 which engages a corresponding recess 536. In addition, the anchoring device 512 may comprise a lip 568 for engaging a corresponding portion 570 of the base-plate, the lip being configured to bear down on the base-plate and
15 hold the base-plate in place. A corresponding anchoring device (not shown) may be provided on the other side of the base-plate, such that the base-plate is held down on both sides. The base-plate may be resiliently mounted with a
20 pad underneath.

CLAIMS

1. A railway rail fastening assembly comprising a railway
rail anchoring device for fastening a railway rail to an
5 underlying foundation,

wherein the anchoring device is configured to receive a
first fastening means for fastening the anchoring device to
the underlying foundation when in an installed
configuration, and

10 wherein the anchoring device is further configured to
receive a second fastening means, which bears down on the
rail when in the installed configuration, the second
fastening means being separate from the first fastening
means,

15 the anchoring device comprising a protrusion provided on
a lower surface of the anchoring device, the anchoring
device protrusion being configured to engage with a
corresponding recess provided in a receiving portion
associated with the underlying foundation, wherein the
20 anchoring device protrusion is further configured such that
the engagement of the anchoring device protrusion with the
receiving portion recess permits a substantially vertical
adjustment of the anchoring device relative to the
underlying foundation and that the anchoring device
25 protrusion and recess remain in engagement during such
adjustment,

wherein the railway rail fastening assembly further
comprises the receiving portion associated with the
underlying foundation, the receiving portion comprising the
30 recess, and

wherein the receiving portion recess comprises a first
side surface and a second side surface, the first side
surface and the second side surface being substantially
perpendicular to the lower surface of the anchoring device

when in the installed configuration; or angled relative to the lower surface of the anchoring device such that the first side surface and the second side surface are vertical in the installed configuration.

5

2. A railway rail fastening assembly as claimed in claim 1, wherein the anchoring device protrusion is configured such that the cooperation of the anchoring device protrusion with the receiving portion recess limits lateral
10 movement of the anchoring device relative to the underlying foundation.

3. A railway rail fastening assembly as claimed in claim 1 or 2, wherein the anchoring device protrusion is provided at a position further away from the railway rail than the first fastening means.

5

4. A railway rail fastening assembly as claimed in claim 1 or 2, wherein the anchoring device protrusion is provided at a position closer to the railway rail than the first fastening means.

10

5. A railway rail fastening assembly as claimed in any of the preceding claims, wherein the anchoring device protrusion is provided in a region of the anchoring device away from the railway rail when in the installed

15 configuration.

6. A railway rail fastening assembly as claimed in any of claims 1 to 4, wherein the anchoring device protrusion is provided in a region of the anchoring device adjacent to the railway rail when in the installed configuration.

20

7. A railway rail fastening assembly as claimed in any of the preceding claims, wherein the anchoring device further comprises an opening configured to cooperate with the first fastening means.

25

8. A railway rail fastening assembly as claimed in claim 7, wherein the opening is provided in a region of the anchoring device adjacent to the rail when in the installed configuration.

30

9. A railway rail fastening assembly as claimed in claim 7, wherein the opening is provided in a region of the

anchoring device away from the rail when in the installed configuration.

10. A railway rail fastening assembly as claimed in any of
5 the preceding claims, wherein the second fastening means comprises a rail fastening clip and the anchoring device is configured to receive the rail fastening clip, which bears down on the rail when in the installed configuration.

10 11. A railway rail fastening assembly as claimed in claim 10, wherein the anchoring device protrusion is provided on the lower surface of the anchoring device at a point spaced apart from a contact point at which the rail fastening clip contacts the anchoring device in the installed
15 configuration.

12. A railway rail fastening assembly as claimed in any of the preceding claims, wherein the anchoring device protrusion comprises a first side surface and a second side
20 surface, the first side surface and/or the second side surface being substantially perpendicular to the lower surface of the anchoring device.

13. A railway rail fastening assembly as claimed in any of
25 claims 1 to 11, wherein the anchoring device protrusion comprises a first side surface and a second side surface, the first side surface and/or the second side surface being angled relative to the lower surface of the anchoring device such that the first side surface and/or the second
30 side surface are vertical in the installed configuration.

14. A railway rail fastening assembly as claimed in any of the preceding claims, wherein the railway rail fastening assembly further comprises an intermediate member, the intermediate member comprising the receiving portion such
5 that the recess is provided in the intermediate member, the intermediate member being configured for placement between the anchoring device and the underlying foundation.

15. A railway rail fastening assembly as claimed in claim
14, wherein the intermediate member comprises a protrusion,
the intermediate member protrusion being configured to
engage a further recess provided in the underlying
5 foundation.

16. A railway rail fastening assembly as claimed in claim
14 or 15, wherein the intermediate member is configured
such that it may be cast into the underlying foundation.

10

17. A railway rail fastening assembly as claimed in any of
claims 14 to 16, wherein the intermediate member further
comprises one or more fastening means receiving portions,
the fastening means receiving portions being configured to
15 cooperate with the first fastening means.

18. A railway rail fastening assembly as claimed in any of
the preceding claims, wherein the railway rail fastening
assembly further comprises one or more shims, the shims
20 being configured for placement between the anchoring device
and the underlying foundation.

19. A railway rail fastening assembly as claimed in claim
18, wherein the one or more shims comprise a first side and
25 a second side, the first and/or second sides being
substantially flat.

20. A railway rail fastening assembly, the railway rail
fastening assembly comprising:
30 a railway rail anchoring device for fastening a railway
rail to an underlying foundation; and

an intermediate member, the intermediate member being configured for placement between the anchoring device and the underlying foundation,

wherein the anchoring device is configured to receive a
5 first fastening means for fastening the anchoring device to the underlying foundation when in an installed configuration,

wherein the anchoring device is further configured to receive a second fastening means, which bears down on the
10 rail when in the installed configuration, the second fastening means being separate from the first fastening means,

wherein the anchoring device comprises a protrusion provided on a lower surface of the anchoring device, the
15 anchoring device protrusion being configured to engage with a corresponding recess provided in the intermediate member,

wherein the anchoring device protrusion is further configured such that the engagement of the anchoring device protrusion with the intermediate member recess permits a
20 substantially vertical adjustment of the anchoring device relative to the underlying foundation and that the anchoring device protrusion and recess remain in engagement during such adjustment,

wherein the intermediate member recess comprises a
25 first side surface and a second side surface, the first side surface and the second side surface being substantially perpendicular to the lower surface of the anchoring device when in the installed configuration; or angled relative to the lower surface of the anchoring
30 device such that the first side surface and the second side surface are vertical in the installed configuration, and

wherein the intermediate member is configured such that it may be cast into the underlying foundation.

21. An intermediate member for use in the railway rail
fastening assembly of any preceding claim, wherein the
intermediate member is configured for placement between the
anchoring device and the underlying foundation, the
5 intermediate member comprising one or more receiving
portions with the recesses, wherein the recesses are
configured to engage with the anchoring device protrusions
so as to permit a substantially vertical adjustment of the
anchoring devices relative to the

underlying foundation with the anchoring device protrusions and recesses remaining in engagement during such adjustment.

5 22. An intermediate member as claimed in claim 21, wherein the intermediate member comprises two receiving portions each with a recess for engagement with a respective anchoring device, wherein the two receiving portions are arranged such that anchoring devices may be provided either
10 side of the rail.

23. An intermediate member as claimed in claim 21 or 22, wherein the intermediate member further comprises one or more fastening means receiving portions, the fastening
15 means receiving portions being configured to cooperate with a first fastening means, the first fastening means being configured to fasten the anchoring device to the underlying foundation.

20 24. An intermediate member as claimed in any of claims 21 to 23, wherein the intermediate member is configured such that it may be cast into the underlying foundation.

25 25. A method of forming an underlying foundation, the method comprising:

positioning the intermediate member of any of claims 21 to 24;

pouring a mixture around the intermediate member; and
solidifying the mixture so as to form the underlying
30 foundation with the intermediate member fixed to the underlying foundation.