

A FEMALE COUPLER AND ASSEMBLY

FIELD OF INVENTION

The present invention relates to a female coupler adapted to receive, align,
5 and direct a male coupler. The present invention has particular but not exclusive application for joining and/or tensioning precast concrete structural elements. The patent specification describes this use, but it is by way of example only and the invention is not limited to this use.

BACKGROUND OF THE INVENTION

In the building industry, the construction of structures typically involves the assembly of multiple individual components that are secured together to form a cohesive whole. For instance, building walls are often constructed from concrete sections that need to be joined together, requiring processes such as pre-tensioning
15 or post-tensioning to ensure stability and strength. To facilitate the joining and reinforcement of these structural elements, couplers are commonly employed. These couplers play a crucial role in mechanically connecting various components using advanced joining or reinforcing construction techniques.

Despite their widespread use, connection points for structural elements
20 frequently present challenges due to their tendency to be obscured or located in hard-to-reach areas. This obscurity complicates the process of achieving proper alignment between the structural elements. In such scenarios, identifying, assessing, and correcting defects that arise from misalignment can prove to be particularly challenging. The difficulties involved in rectifying these issues often lead to increased
25 costs, extended timeframes, and a significant expenditure of resources. Moreover, the failure to properly connect and secure structural elements can have severe implications for the integrity and safety of the entire construction project.

A notable example of a known structure coupling means is detailed in WO2021243414A1, which pertains to 'A coupler assembly'. This document
30 describes a coupler assembly that includes a male coupler equipped with transverse pins and a female coupler designed to receive the male coupler, the female coupler having transverse bores specifically adapted to accommodate the transverse pins. When the coupler assembly is engaged, it provides a secure join between structural elements, even in situations where the connection points are obscured. However,

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despite the secure join provided by this assembly, there are still significant challenges encountered during the connection and alignment of the male and female couplers, especially when they are located in areas that are obscured or difficult to access.

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OBJECT OF THE INVENTION

It is an object of the present invention to overcome or at least alleviate one or more of the above-mentioned problems with coupling structures and/or provide the consumer with a useful or commercial choice.

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SUMMARY OF THE INVENTION

In one aspect, the present invention broadly resides in a female coupler adapted to receive a male coupler with at least one transverse pin, the female coupler having:

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a cavity, the cavity having an opening to receive the male coupler, and at least one transverse hole extending transversely from the cavity adapted to receive at least one transverse pin when the male coupler is in a received position, wherein the cavity further has

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at least one first alignment portion, each first alignment portion having a curved and sloped surface converging towards a longitudinal axis of one of the at least one transverse hole, the surface adapted to bias a corresponding one of the at least one transverse pin toward a corresponding one of the at least one transverse hole as the male coupler moves towards the received position, and

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at least one second alignment portion, each second alignment portion having a surface geometry adapted to bias a corresponding one the at least one transverse pin toward a corresponding one of the at least one first alignment portion as the male coupler moves towards the received position.

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Preferably, the radius of curvature of the curved surface of the at least one second alignment portion on a transverse plane is less than the radius of curvature of the curved surface of the first alignment portion on the transverse plane. Preferably, the smaller radius of curvature of the curved surface of the at least one second alignment portion allows for more pronounced lateral biasing of the at least

one transverse pin allowing the at least one transverse pin to enter a first alignment portion.

Preferably, the curvature of at least one first alignment portion curves around an axis which is parallel to a longitudinal axis of the female coupler.

5 Preferably, the curvature of at least one second alignment portion curves around an axis which is parallel to a longitudinal axis of the female coupler.

Preferably, the opening has a fillet or chamfer around at least a portion of a perimeter edge. In one embodiment where the male coupler has a curve on a bottom leading edge of one of the at least one transverse pin and the female coupler
10 has a fillet or chamfer around at least a portion of a perimeter edge of the opening, when the male coupler is inserted into the female coupler the curved edge of one of the at least one transverse pin contacts with the filleted or chamfered opening. Preferably, when the male coupler is inserted into the female coupler the curved edge of one of the at least one transverse pin contacts with the filleted or chamfered
15 opening to align the male coupler with the female coupler.

Preferably, the coupler assembly is used in activities for joining and/or tensioning structural components. Preferably, the female coupler can be used in activities for joining and/or tensioning concrete structural components.

Preferably, the female coupler is used to connect structural components such
20 as wires, bars and frames made of metal, polymer, plastic, or composite material. Preferably, the structural components are of sufficient size, shape, and configuration to be used in the construction of reinforced concrete structures.

Preferably, the female coupler is fabricated from any suitable material. Preferably, the female coupler is fabricated partially or entirely from metal.
25 Preferably, the female coupler is fabricated partially or entirely from high tensile steel. More preferably, the female coupler is fabricated partially or entirely from 4140T high tensile steel. Alternatively, the female coupler is fabricated partially or entirely from stainless steel. Alternatively, the female coupler is fabricated partially or entirely from polymer, plastic, or composite material.

30 Preferably, the female coupler is fabricated by any suitable means including but not limited to casting, forming, cutting, moulding, joining, forging, friction welding, 3D printing or any suitable combination thereof. In one embodiment the female coupler or part thereof can undergo one or more finishing processes during fabrication including but not limited to machining, threading, boring, drilling,

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chamfering, knurling, grinding, heat treating, electroplating, or any suitable combination thereof.

Preferably, one of the at least one transverse pin is received in a corresponding one of the at least one hole such that the transverse pin restricts lateral and/or transverse movement of the male coupler and female coupler relative to one another.

Preferably, the cavity restricts transverse movement of the male coupler during insertion into and/or while received by the female coupler.

In one embodiment, the slope of the first alignment portion aids transverse travel of the at least one transverse pin.

In one embodiment, the curvature of the first alignment portion aids rotational travel of the at least one transverse pin.

Preferably, the slope of the first alignment portion aids location of the male coupler in the female coupler.

Preferably, the coupler has at least one proper alignment of the male coupler and the female coupler wherein one of the at least one transverse pin is received in a corresponding one of the at least one transverse hole. Preferably, the first alignment portion and the second alignment portion allow for the coupler to correct misalignment. More preferably, the first alignment portion and the second alignment portion allow for the coupler to correct misalignment by biasing the at least one transverse pin toward a corresponding one of the at least one transverse hole.

Preferably, when a transverse pin is at the first alignment portion, the surface of the first alignment portion biases one of the at least one transverse pin toward a corresponding one of the at least one transverse hole.

Preferably, when a transverse pin is at the second alignment portion, and thus the misalignment is more severe, the surface of the second alignment portion biases the transverse pin toward the first alignment portion.

In one embodiment, the female coupler and/or the male coupler is lubricated to facilitate ease of movement of the parts in contact.

In one embodiment, the female coupler and/or the male coupler is treated with a roughening substance to restrict movement of the parts in contact.

Preferably, the at least one transverse pin has a retracted position and an extended position, and the at least one transverse pin is biased to the extended position. Preferably, the at least one transverse pin is biased to the extended

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position by a biasing member. Preferably, the biasing member is a spring. Preferably the spring is made from a 1mm to 2mm stainless steel 304 wire. More preferably the spring is made from a 1.2mm stainless steel 304 wire. Preferably the at least one transverse pin is biased to the extended position by a force of between
5 10 to 100 Newtons. More preferably the at least one transverse pin is biased to the extended position by a force of between 20 to 50 Newtons. In another embodiment the at least one transverse pin is biased to the extended position by a force of between 60 newtons to 180 newtons. In another embodiment the at least one transverse pin is biased to the extended position by a force of between 100 newtons
10 to 900 newtons.

In one embodiment, the male coupler has a retraction means adapted to move the at least one transverse pin to the retracted position and enable controlled removal of the male coupler from the female coupler.

Preferably, when the male coupler is in the received position each of the at
15 least one transverse pin is in the extended position, and each of the at least one transverse pin is received within and retained by a corresponding one of the at least one transverse hole.

In one embodiment, the male coupler includes a locking means to inhibit the at least one transverse pin from moving to the retracted position. Preferably the
20 locking means is a lock nut. Preferably in use, the lock nut is adapted to bias the male coupler and female coupler apart, engaging the at least one transverse pin in the at least one transverse hole. Preferably the engagement of the at least one transverse pin in the at least one transverse hole inhibits the at least one transverse pin from moving to the retracted position.

25 Preferably, the female coupler is adapted to move the at least one transverse pin to the retracted position as the male coupler moves towards the received position.

Preferably, the at least one second alignment portion has a surface geometry that is curved and sloped. Preferably, the curvature of the at least one second
30 alignment portion aids rotational travel of the at least one transverse pin. Preferably, the slope of the at least one second alignment portion aids transverse travel of the at least one transverse pin. Preferably, the slope of the at least one second alignment portion aids location of the male coupler in the female coupler.

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Preferably, the at least one first alignment portion and/or the at least one second alignment portion is adjacent the opening. In one embodiment, the at least one first alignment portion and/or the at least one second alignment portion is adjacent the opening. In an alternate embodiment, the at least one first alignment
5 portion and/or the at least one second alignment portion is positioned away from the opening, further into the female coupler.

Preferably, the cavity further has at least one third alignment portion to bias a corresponding one the first transverse pin or the second transverse pin towards a closest one of the at least one second alignment portion. Preferably, the at least one
10 third alignment portion has an angled surface. In one embodiment, the at least one third alignment portion has a curved surface.

Preferably, the female coupler has a substantially cylindrical body.

Preferably, the male coupler has a substantially cylindrical body.

Preferably, the female coupler has two first alignment portions. Preferably,
15 each first alignment portion is adjacent the opening. Preferably, the female coupler has two first alignment portions opposite one another. Preferably, the female coupler has four second alignment portions. Preferably, each second alignment portion is adjacent the opening. Preferably, each second alignment portion is adjacent one first alignment portion. Preferably, the female coupler has two third
20 alignment portions. Preferably, each third alignment portion is adjacent the opening. Preferably, the female coupler has two third alignment portions opposite one another. Preferably, the female coupler has two third alignment portions, each third alignment portion adjacent two second alignment portions.

In an alternate embodiment, the female coupler has four third alignment
25 portions, each third alignment portion adjacent one second alignment portion.

Preferably, the female coupler has two transverse holes extending transversely from the cavity and opposite one another. More preferably, both of the transverse holes share a longitudinal axis transverse to the longitudinal axis of the female coupler.

30 Preferably, at least one portion of the at least one first alignment portion, second alignment portion and/or third alignment portion is angled substantially between 5 degrees and 50 degrees to a longitudinal axis of the female coupler. More preferably, at least one portion of the at least one first alignment portion, second alignment portion and/or third alignment portion is angled substantially

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between 15 degrees and 35 degrees to a longitudinal axis of the female coupler. More preferably, at least one portion of the at least one first alignment portion, second alignment portion and/or third alignment portion is angled substantially 25 degrees to a longitudinal axis of the female coupler.

5 Preferably, the opening has a substantially circular transverse cross-sectional area. In one embodiment, the opening has a transverse cross-sectional area substantially the shape of a stadium. A stadium, also known as an obround, is a rectangle with two semicircular ends.

10 Preferably, the surface of one of the at least one first alignment portion and the surface of an adjacent one of the at least one second alignment portion is such that at least one transverse pin can smoothly transition between the portions. Preferably, the surface of one of the at least one second alignment portion and the surface of an adjacent one of the at least one third alignment portion is such that the at least one transverse pin can smoothly transition between the portions.

15 Preferably, the female coupler has a connector to connect the female coupler to a joining component, a tensioning component, or a structural component. Preferably, the joining component or tensioning component is a rod, frame, wire, or anchor of a system for joining and/or tensioning structural components. More preferably, the female coupler has a connector which has a threaded portion
20 adapted to fasten to a joining component, a tensioning component, or a structural component. In one embodiment, the female coupler is attachable to a stranded steel wire. In one embodiment, the male coupler is attachable to a stranded steel wire.

25 Preferably, the female coupler has an edge defined by the cavity and one of the at least one first alignment portion. Preferably, the edge has a channel adjacent thereto. Preferably, the channel is curved. The channel can aid reception of a transverse pin into longitudinal alignment with the one of the at least one transverse hole.

30 Preferably, at least one second alignment portion and an adjacent first alignment portion define a transition boundary, the transition boundary being where the surface of the at least one second alignment portion transitions to the surface of the adjacent first alignment portion. Preferably, the coupler has a channel that runs along the transition boundary. Preferably, the channel is angled substantially between 5 degrees and 50 degrees to a longitudinal axis of the female coupler. Preferably, the channel has a smaller angle to a longitudinal axis of the female

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coupler than either the at least one second alignment portion or adjacent first alignment portion.

Preferably, at least one third alignment portion and an adjacent second alignment portion define a transition boundary, the transition boundary being where
5 the surface of the at least one third alignment portion transitions to the surface of the adjacent second alignment portion. Preferably, the coupler has a channel that runs along the transition boundary. Preferably, the channel is angled substantially between 5 degrees and 50 degrees to a longitudinal axis of the female coupler. Preferably, the channel has a smaller angle to a longitudinal axis of the female
10 coupler than either the at least one third alignment portion or adjacent second alignment.

Preferably the cavity further includes a body portion to accommodate at least part of the male coupler. Preferably the at least one first alignment portion and the at least one second alignment portion extend outwardly from the body portion.
15 Preferably the body portion is substantially cylindrical. Preferably the body portion is cylindrical. Preferably two transverse holes extending transversely from the body portion. Preferably the edge is defined between the body portion and one of the at least one first alignment portion. More preferably the edge is defined between the body portion, one of the at least one first alignment portion and one of the at least
20 one second alignment portion.

In another aspect, the present invention broadly resides in a coupler assembly including:

a male coupler with at least one transverse pin, and
a female coupler having;
25 a cavity, the cavity having an opening to receive the male coupler, and
at least one transverse hole extending transversely from the cavity adapted to receive at least one transverse pin when the male coupler is in a received position,
wherein the cavity further has
30 at least one first alignment portion, each first alignment portion having a curved and sloped surface converging towards a longitudinal axis of one of the at least one transverse hole, the surface adapted to bias a corresponding one of the at least one transverse pin toward a corresponding one of the at least one hole as the male coupler moves towards the received position, and

at least one second alignment portion, each second alignment portion having a surface geometry adapted to bias a corresponding one of the at least one transverse pin toward a corresponding one of the at least one first alignment portion as the male coupler moves towards the received position.

5 Preferably, the radius of curvature of the curved surface of the at least one second alignment portion on a transverse plane is less than the radius of curvature of the curved surface of the first alignment portion on the transverse plane. Preferably, the smaller radius of curvature of the curved surface of the at least one second alignment portion allows for more pronounced lateral biasing of the at least
10 one transverse pin allowing the at least one transverse pin to enter a first alignment portion.

Preferably, the curvature of the surface of the at least one first alignment portion has a larger radius of curvature than the curvature of the surface of the at least one second alignment portion.

15 Preferably, at least one transverse pin has a pin end.

Preferably, the pin end has a first side and a second side each one side of a plane coaxial with a central longitudinal axis of the male coupler and coaxial with a longitudinal axis of the at least one transverse pin.

Preferably, at least one pin end is curved. More preferably, the curved end
20 has a first curve and a second curve.

Preferably, the first curve is convex.

Preferably, the curvature of the first curve curves around an axis which is parallel to a longitudinal axis of the male coupler.

Preferably, the first curve curves from an outermost point of the pin end on a
25 plane coaxial with the central longitudinal axis of the male coupler and coaxial with a longitudinal axis of the transverse pin inwards towards the body of the male coupler on both the first side and the second side. Preferably, the curvature of the first curve on the first side is mirrored by the curvature of the first curve on the second side along a plane coaxial with central longitudinal axis of the male coupler and coaxial
30 with a longitudinal axis of the transverse pin.

Preferably, the curvature of first curve has a smaller radius of curvature than the curvature of the surface of the at least one first alignment portion. Preferably, the curvature of first curve has a greater radius of curvature than the curvature of the surface of the at least one second alignment portion.

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Preferably, the curvature of first curve is such that when one of the at least one transverse pin is in contact with the second alignment portion no more than half of the length of the curve is in contact with the second alignment portion. Preferably, the curvature of first curve is such that when one of the at least one transverse pin is

5 in contact with the second alignment portion only one of either the first side or the second side of the transverse pin is in contact with the second alignment portion.

Preferably, the curvature of first curve is such that when one of the one of the at least one transverse pin is in contact with the first alignment portion both the first side and the second side of the transverse pin are in contact with the first alignment

10 portion.

Preferably, the second curve is convex.

Preferably, the curvature of the second curve curves around an axis which is transverse to a longitudinal axis of the male coupler. Preferably, the curvature of the second curve curves around an axis which is transverse to a longitudinal axis of the

15 at least one transverse pin.

Preferably, the second curve curves from an outermost point of the pin end inwards towards the body of the male coupler. Preferably, a point of the second curve closest to the central longitudinal axis of the male coupler is on a side of the male coupler that would be presented to the female coupler. More preferably, a

20 point of the second curve closest to the central longitudinal axis of the male coupler is on a side of the male coupler that would be presented to the female coupler such that when a male coupler is to be inserted into a female coupler the male coupler presents a smaller transverse cross section towards the female coupler.

Preferably, when the male coupler is inserted into the female coupler the

25 second curve assists in locating the male coupler in the female coupler.

Preferably, when the male coupler is inserted into the female coupler the second curve contacts the wall of the cavity of the female coupler.

Preferably, the at least one transverse pin has a retracted position and an extended position, and the at least one transverse pin is biased to the extended

30 position. Preferably, the second curve assists in forcing the at least one transverse pin to the retracted position.

Preferably, a side of the pin end of the at least one transverse pin opposite to the second curve is not curved so as to resist removal of male coupler from the female coupler. In one preferred embodiment, a side of the pin end of the at least

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one transverse pin opposite to the second curve is not curved such that when the at least one transverse pin is received within the at least one transverse hole attempting to pull the male coupler out of the female coupler does not force the at least one transverse pin to the retracted position.

- 5 Preferably, a side of the pin end opposite to the second curve is not curved so as to require the transverse pin to be retracted to a greater extent when withdrawing the male coupler from the female coupler.

In another aspect, the present invention broadly resides in a system for joining and/or tensioning structural components, the system including,

- 10 at least one coupler assembly, each coupler assembly including;
 a male coupler with at least one transverse pin, and
 a female coupler having;
 a cavity, the cavity having an opening to receive the male
 coupler, and
15 at least one transverse hole extending transversely from the
 cavity adapted to receive at least one transverse pin when the male
 coupler is in a received position
 wherein the cavity further has
 at least one first alignment portion, each first alignment portion
20 having a curved and sloped surface converging towards a longitudinal
 axis of one of the at least one transverse hole, the surface adapted to
 bias a corresponding one of the at least one transverse pin toward a
 corresponding one of the at least one transverse hole as the male
 coupler moves towards the received position, and
25 at least one second alignment portion, each second alignment
 portion having a surface geometry adapted to bias a corresponding
 one the at least one transverse pin toward a corresponding one of the
 at least one first alignment portion as the male coupler moves towards
 the received position,
30 a first anchor secured to a first structural component, the first anchor
 connected to the male coupler, and
 a second anchor secured to a second structural component, the second
 anchor connected to the female coupler,

wherein the at least one coupler assembly joins and/or tensions the first structural component and the second structural component.

Preferably, the at least one coupler assembly is connected to the first anchor and/or the second anchor by at least one rod.

5 Preferably, the structural components are predominately made of concrete.

Preferably, the at least one coupler assembly is used to pre-tension the at least one reinforced concrete structural component.

Preferably, the at least one coupler assembly is used to post-tension the at least one reinforced concrete structural component.

10 In one embodiment the first anchor is integrally formed with the male coupler, and the second anchor is integrally formed with the female coupler.

In another aspect, the present invention broadly resides in a method for joining and/or tensioning structural components, the method including the steps of

15 securing a first anchor to a first structural component,
securing a second anchor to a second structural component,
connecting the first anchor connected to a male coupler,
connecting the second anchor connected to a female coupler with a cavity adapted to receive the male coupler, and

20 receiving the male coupler within the female coupler such that the male coupler is guided to a received position wherein at least one transverse pin of the male coupler is received within a corresponding one of the at least one transverse hole in the female coupler,

25 whereby a corresponding one of the at least one transverse pin is biased toward a corresponding one of the at least one hole by a first alignment portion of the cavity, the first alignment portion having a curved and sloped surface converging towards a longitudinal axis of one of the at least one transverse hole, as the male coupler moves towards the received position.

30 Preferably, when at least one transverse pin is at the first alignment portion, the surface of the first alignment portion biases the at least one transverse pin toward a corresponding one of the at least one transverse hole.

Preferably, a corresponding one of the at least one transverse pin is biased toward a corresponding one of the at least one first alignment portion by one of the at least one second alignment portion of the cavity, the second alignment portion having a curved and sloped surface, as the male coupler moves towards the

received position. Preferably, once the at least one transverse pin reaches the first alignment portion the at least one transverse pin is biased toward a corresponding one of the at least one hole.

Preferably, when one of the at least one transverse pin is at one of the at least
5 one second alignment portion, the surface of the second alignment portion biases the at least one transverse pin toward the first alignment portion which then further biases the at least one transverse pin toward a corresponding transverse hole.

Preferably, the method for joining and/or tensioning structural components is used to pre-tension the at least one reinforced concrete structural component.

10 Preferably, the method for joining and/or tensioning structural components is used to post-tension the at least one reinforced concrete structural component.

In a further aspect, the present invention broadly resides in a female coupler adapted to receive a male coupler with at least one transverse pin, the female coupler having:

15 a cavity, the cavity having an opening to receive the male coupler, and at least one transverse hole extending transversely from the cavity adapted to receive at least one transverse pin when the male coupler is in a received position, wherein the cavity further has

at least one first alignment portion, each first alignment portion having a
20 curved and sloped surface converging towards a longitudinal axis of one of the at least one transverse hole, the surface adapted to bias a corresponding one of the at least one transverse pin toward a corresponding one of the at least one transverse hole as the male coupler moves towards the received position, and

at least one second alignment portion, each second alignment portion having
25 a surface geometry adapted to bias a corresponding one the at least one transverse pin toward a corresponding one of the at least one first alignment portion as the male coupler moves towards the received position,

wherein the cavity further includes a cylindrical portion to accommodate at least part of the male coupler, and wherein the at least one first alignment portion
30 and the at least one second alignment portion extend outwardly from the cylindrical portion. Preferably the curve of the at least one second alignment portion creates a channel that runs adjacent the border between the at least one second alignment portion and the cylindrical portion towards the at least one first alignment portion.

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In another aspect, the present invention broadly resides in a female coupler adapted to receive a male coupler with at least one transverse pin, the female coupler having:

- a cavity, the cavity having an opening to receive the male coupler, and
- 5 at least one transverse hole extending transversely from the cavity adapted to receive at least one transverse pin when the male coupler is in a received position, wherein the cavity further has
- at least one first alignment portion, each first alignment portion having a curved and sloped surface converging towards a longitudinal axis of one of the at
- 10 least one transverse hole, the surface adapted to bias a corresponding one of the at least one transverse pin toward a corresponding one of the at least one transverse hole as the male coupler moves towards the received position, and
- at least one second alignment portion, each second alignment portion having a surface geometry adapted to bias a corresponding one the at least one transverse
- 15 pin toward a corresponding one of the at least one first alignment portion as the male coupler moves towards the received position,
- wherein the cavity further includes a body portion to accommodate at least part of the male coupler, and wherein the at least one first alignment portion and the at least one second alignment portion extend outwardly from the body portion.
- 20 The features described with respect to one aspect also apply where applicable to all other aspects of the invention. Furthermore, different combinations of described features are herein described and claimed even when not expressly stated.

BRIEF DESCRIPTION OF THE DRAWINGS

- 25 In order that the present invention can be more readily understood reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention and wherein:
- Figure 1 is a detail perspective view of a female coupler according to an embodiment of the present invention;
- 30 Figure 2 is a top view of the female coupler of Figure 1;
- Figure 3 is a top view of the female coupler of Figure 1 with grid lines;
- Figure 4 is a side view of the female coupler of Figure 1;
- Figure 5 is a section view A-A;
- Figure 6 is a section view B-B;

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Figure 7 is an exploded assembly view of the female coupler of Figure 1 and a male coupler;

Figure 8 is a side view of an assembly of the female coupler of Figure 1 and a male coupler with anchors on each end;

5 Figure 9 is a section view C-C; and

Figure 10 is a perspective view of part of a female coupler according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

10 With reference to Figures 1 to 6 there is depicted a female coupler 10 in accordance with a preferred embodiment of an aspect of the present invention.

The female coupler 10 is adapted to receive a male coupler (not shown). The female coupler 10 has a substantially cylindrical body 20 with a cavity 22 to receive the male coupler. The cavity 22 having an opening 24. The female coupler 10 has a
15 longitudinal axis 80.

A first transverse hole 60A extends transversely from the cavity 22 adapted to receive a first transverse pin (not shown) when the male coupler is in a received position. A second transverse hole 60B extends transversely from the cavity 22 opposite the first transverse hole 60A and is adapted to receive a second transverse
20 pin (not shown) when the male coupler is in the received position. The first transverse hole 60A and the second transverse hole 60B share a transverse axis 82 (transverse to the longitudinal axis 80).

The cavity 22 has adjacent to the opening 24 two first alignment portions 30A,30B arranged opposite one another. The cavity 22 has adjacent to the opening
25 24 two third alignment portions 50,52 arranged opposite one another. The cavity 22 has adjacent to the opening 24 four second alignment portions 40A,42A,40B,42B each second alignment portion adjacent one first alignment portion and one third alignment portion.

Figures 1 and 3 show the alignment portions
30 30A,30B,40A,42A,40B,42B,50,52 marked with grid lines 90 for clarity of depiction of the surface of the cavity 22. Figure 3 shows extended projections of grid lines 90 representing sloped portions 30A,30B,40A,42A,40B,42B shown in Figure 1 for clarity of depiction of the surface of the cavity 22.

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Each first alignment portion 30A,30B has a curved and sloped surface converging towards the longitudinal axis 82 of the transverse holes 60A,60B. The longitudinal axis 82 is transverse to the longitudinal axis 80.

Each curved and sloped surface of each first alignment portion 30A,30B is adapted to bias a corresponding one of the first transverse pin or the second transverse pin toward a corresponding one of the transverse holes 60A,60B as the male coupler moves towards the received position.

Each second alignment portion 40A,42A,40B,42B has a curved and sloped surface adapted to bias a corresponding one the first transverse pin or the second transverse pin toward a corresponding one of the first alignment portions 30A,30B as the male coupler moves towards the received position.

The third alignment portions 50,52 are sloped to bias a corresponding one the first transverse pin or the second transverse pin towards a closest one of the second alignment portions 40A,42A,40B,42B.

The transverse pin is preferably sufficiently forced to maintain contact with the alignment portions 30A,30B,40A,42A,40B,42B,50,52, and thus facilitate rotation of the male coupler towards the received position. The force on the transverse pin can be sufficient to provide the moving force required to move the transverse pin along a curved and/or sloped surface of the alignment portions 30A,30B,40A,42A,40B,42B,50,52.

The female coupler 10 has a connector 70 connected to the body 20 and extending oppositive to the opening 24.

From the top perspective a transverse pin at the second alignment portion 40A would be biased clockwise towards first alignment portion 30A. From the top perspective a transverse pin at the second alignment portion 42A would be biased anticlockwise towards first alignment portion 30A. From the top perspective a transverse pin at the second alignment portion 40B would be biased anticlockwise towards first alignment portion 30B. From the top perspective a transverse pin at the second alignment portion 42B would be biased clockwise towards first alignment portion 30B.

The surfaces of the first alignment portions 30A,30B and the second alignment portions 40A,42A,40B,42B are each curved around a separate axis (not shown), each axis parallel to the longitudinal axis 80 of the female coupler 10. The smaller radius of curvature of the second alignment portions 40A,42A,40B,42B in

comparison to the radius of curvature the first alignment portions 30A,30B allows for more pronounced lateral biasing of at least one transverse pin at the second alignment portions 40A,42A,40B,42B in comparison to the lateral biasing of the at least one transverse pin at the first alignment portions 30A,30B.

5 Each first alignment portion 30A,30B and second alignment portion 40A,42A,40B,42B has a separate axis (not shown) parallel to the longitudinal axis 80 to which the slope of the respective portion is angled. The first alignment portion 30A has an angle relative to an axis parallel to the longitudinal axis 80 of substantially between 29 degrees adjacent a second alignment portion 40A,42A and 25 degrees
10 in the centre of the first alignment portion 30A. The first alignment portion 30B has an angle relative to an axis parallel to the longitudinal axis 80 of substantially between 29 degrees adjacent a second alignment portion 40B,42B and 25 degrees in the centre of the first alignment portion 30B. The second alignment portion 40A has an angle relative to an axis parallel to the longitudinal axis 80 of substantially
15 between 29 degrees adjacent a first alignment portion 30A and 33 degrees adjacent a third alignment portion 50. The second alignment portion 42A has an angle relative to an axis parallel to the longitudinal axis 80 of substantially between 29 degrees adjacent a first alignment portion 30A and 33 degrees adjacent a third alignment portion 52. The second alignment portion 40B has an angle relative to an
20 axis parallel to the longitudinal axis 80 of substantially between 29 degrees adjacent a first alignment portion 30B and 33 degrees adjacent a third alignment portion 50. The second alignment portion 42B has an angle relative to an axis parallel to the longitudinal axis 80 of substantially between 29 degrees adjacent a first alignment portion 30B and 33 degrees adjacent a third alignment portion 52. Each third
25 alignment portion 50,52 has an angle relative to a plane formed from the longitudinal axis 80 and the longitudinal axis 82 of substantially 33 degrees.

With reference to Figures 7 to 9 there is depicted a female coupler 110 and a male coupler 210 in accordance with a preferred embodiment of an aspect of the present invention. Figure 7 depicts the female coupler 110 and the male coupler 210
30 separately in orientations that allow coupling. Figures 8 and 9 depict the female coupler 110 and the male coupler 210 connected, with the male coupler 210 being in a received position. Figures 8 and 9 further depict a first anchor 310 and a first nut 410 connected to the male coupler 210, and a second anchor 510 and a second nut 610 connected to the female coupler 110. The first nut 410 is a lock nut to keep the

first anchor 310 secured to the male coupler 210. The second nut 610 is a lock nut to keep the second anchor secured to the female coupler 110.

The female coupler 110 has a substantially cylindrical body 120 with a cavity with an opening to receive the male coupler 210, a connector 170, a longitudinal axis 180, a first transverse hole extending transversely from the cavity, and a second transverse hole extending transversely from the cavity. The opening has a fillet around a perimeter edge of the opening. The cavity of the female coupler 110 has a pair of first alignment portions 130A, 130B arranged opposite one another. The first transverse hole and the second transverse hole are arranged opposite one another and share a longitudinal axis 182. The longitudinal axis 182 is transverse to the longitudinal axis 180.

The male coupler 210 has a substantially cylindrical body 220, a connector 270, a longitudinal axis 280, a first transverse pin 260A, and a second transverse pin 260B. The first transverse pin 260A and the second transverse pin 260B arranged opposite one another and sharing a longitudinal axis 282. The longitudinal axis 282 is transverse to the longitudinal axis 280.

The first transverse pin 260A and the second transverse pin 260B each having a retracted position and an extended position. The retracted position being wherein the respective transverse pin 260A, 260B are withdrawn substantially into respective recesses of the body 220 such that the body 220 can enter the cavity of the female coupler 110.

The first transverse pin 260A and the second transverse pin 260B each have a pin end. Each pin end has a first side and a second side each one side of a plane coaxial with longitudinal axis 280 and coaxial with longitudinal axis 282. Each pin end is curved with a first curve and a second curve.

The first curve is convex. The curvature of the first curve curves around an axis which is parallel to longitudinal axis 280. The first curve curves from an outermost point of the pin end on a plane coaxial with longitudinal axis 280 and coaxial with longitudinal axis 282 inwards towards the body 220 on both the first side and the second side. The curvature of the first curve on the first side is mirrored by the curvature of the first curve on the second side along a plane coaxial with longitudinal axis 280 and coaxial with longitudinal axis 282. The curvature of first curve has a smaller radius of curvature than the curvature of the surface of either of the first alignment portions 130A, 130B. The curvature of first curve has a greater

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radius of curvature than the curvature of the surface of either of a pair of second alignment portions (not shown). The curvature of first curve is such that when one of the transverse pins 260A,260B is in contact with one of the first alignment portions 130A,130B both the first side and the second side are in contact with the first alignment portion 130A,130B. The curvature of first curve is such that when one of the transverse pins 260A,260B is in contact with one of the second alignment portions (not shown) only one of either the first side or the second side is in contact with one of the second alignment portions.

The second curve is convex. The curvature of the second curve curves around an axis which is transverse to longitudinal axis 280 and transverse to longitudinal axis 282. The second curve curves from an outermost point of the pin end inwards towards the body 220. A point of the second curve closest to the longitudinal axis 280 is on a side of the male coupler 210 that would be presented to the female coupler 110 such that when the male coupler 210 is to be inserted into a female coupler 110 the male coupler 210 presents a smaller transverse cross section towards the female coupler 110. The second curve assists in forcing at least one of the transverse pins 260A,260B to the retracted position.

A side of the pin end of the transverse pins 260A,260B opposite to the second curve is not curved so as to resist removal of male coupler 210 from the female coupler 110.

The first transverse pin 260A and the second transverse pin 260B have a biasing means 262. The biasing means 262 is adapted to bias the transverse pins 260A,260B to the respective extended positions. The biasing means 262 applies a biasing force to the transverse pins 260A,260B sufficient to maintain connection of the transverse pins 260A,260B on the alignment portions 130A,130B as the male coupler 210 is inserted into the female coupler 110 thus facilitating rotation of the male coupler 210 via the biasing provided by the alignment portions 130A,130B.

The male coupler also includes a lock nut 420. The lock nut 420 is adapted to secure the male coupler 210 to the female coupler 110 by biasing the male coupler 210 and the female coupler 110 apart, this engages the transverse pins 260A,260b in the first transverse hole 60A and the second transverse hole 60B respectively. Engaging the transverse pins 260A,260b in this manner inhibit them from moving towards the retracted position.

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The first alignment portions 130A,130B of the cavity converge towards the longitudinal axis 182.

When the male coupler 210 is inserted into the female coupler 110 the second curve assists in locating the male coupler 210 in the female coupler 110. When the
5 male coupler 210 is inserted into the female coupler 110 the second curve contacts a wall of the cavity of the female coupler 110.

When the male coupler 210 is inserted into the female coupler 110 the first alignment portions 130A,130B of the cavity bias the transverse pins 260A,260B to the first transverse hole and the second transverse hole respectively. The wall of the
10 cavity forces the transverse pin 260A,260B to the respective retracted positions. When one of the transverse pins 260A,260B is in contact with one of the second alignment portions force is only applied to either the first side or the second side to bias the transverse pin 260A,260B toward a corresponding one of the first alignment portions 30A,30B.

15 When the longitudinal axis 182 and the longitudinal axis 282 are coaxially aligned and the transverse pins 260A,260B are no longer restricted by the wall of the cavity the transverse pins 260A,260B move to the respective extended positions within the first transverse hole and the second transverse hole.

The male coupler 210 is then in the received position with the transverse pins
20 260A,260B in the first transverse hole and the second transverse hole restricting longitudinal and rotational transverse movement, and the cavity restricting transverse movement.

With reference to Figure 10, there is shown a female coupler 300 in accordance with an embodiment of an aspect of the present invention.

25 The female coupler 300 is adapted to receive a male coupler (not shown). The female coupler 300 has a substantially cylindrical body 320 with a cavity 322 to receive the male coupler. The cavity 322 having an opening 324.

The cavity 322 has adjacent to the opening 324 two first alignment portions 330A (opposed alignment portion not shown) arranged opposite one another. The
30 cavity 322 has adjacent to the opening 324 two third alignment portions 350,352 arranged opposite one another. The cavity 22 has adjacent to the opening 24 four second alignment portions 340A,342A, (opposed alignment portions not shown) each second alignment portion adjacent one first alignment portion and one third alignment portion.

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Figures 10 show the alignment portions 330A,340A,342A,350,352 marked with grid lines 390 for clarity of depiction of the surface of the cavity 322. Figure 10 also shows the edge 370 between the body portion 372 and the alignment portions 330A,340A,342A,350,352. The lowest point of the edge 370 is in line with the first transverse hole 360A. In use, as a male coupler (not shown) enters the female coupler 300, if a first transverse pin (not shown) of the male coupler is aligned with the first transverse hole 360A, the first transverse pin is biased substantially equally on the left and right side to keep it aligned with the first transverse hole 360A. If the first transverse pin moves to the left as the male coupler enters the female coupler, there would be more of a biasing force on the left side of the first transverse pin, biasing the first transverse pin right towards alignment with the first transverse hole 360A. Similarly, if the first transverse pin moves to the right as the male coupler enters the female coupler, there would be more of a biasing force on the right side of the first transverse pin, biasing the first transverse pin left towards alignment with the first transverse hole 360A. If the first transverse pin is aligned with the first transverse hole 360A, there is no or very little biasing force on a middle portion of the pin.

ADVANTAGES

An advantage of the preferred embodiment of the female coupler is the provision of a coupling means that performs simple location and alignment of a male part and a female part that can be performed in obscured or hard-to-reach areas. An advantage of the preferred embodiment of the coupler assembly is that the coupler assembly is self-aligning when being connected. An advantage of the preferred embodiment of the coupler assembly is the ease-of-use of the coupler assembly to achieve a properly aligned connection reliably in the first instance.

VARIATIONS

While the foregoing has been given by way of illustrative example of this invention, all such and other modifications and variations thereto as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of this invention as is herein set forth.

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Throughout the description and claims of this specification the word “comprise” and variations of that word such as “comprises” and “comprising”, are not intended to exclude other additives, components, integers or steps.

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CLAIMS

1. A female coupler adapted to receive a male coupler with at least one transverse pin, the female coupler having:
 - 5 a cavity, the cavity having an opening to receive the male coupler, and
at least one transverse hole extending transversely from the cavity adapted to receive at least one transverse pin when the male coupler is in a received position, wherein the cavity further has
at least one first alignment portion, each first alignment portion having a
10 curved and sloped surface converging towards a longitudinal axis of one of the at least one transverse hole, the surface adapted to bias a corresponding one of the at least one transverse pin toward a corresponding one of the at least one hole as the male coupler moves towards the received position, and
at least one second alignment portion, each second alignment portion having
15 a surface geometry adapted to bias a corresponding one the at least one transverse pin toward a corresponding one of the at least one first alignment portion as the male coupler moves towards the received position.
2. A female coupler as claimed in claim 1, wherein the at least one transverse
20 pin has a retracted position and an extended position, and the at least one transverse pin is biased to the extended position.
3. A female coupler as claimed in claim 2, wherein the at least one transverse
pin moves to the extended position as it is received within and retained by a
25 corresponding one of the at least one hole.
4. A female coupler as claimed any of the preceding claims, wherein the female
coupler has a surface geometry adapted to move the at least one transverse pin to
the retracted position as the male coupler moves towards the received position.
30
5. A female coupler as claimed in claim in any of the preceding claims, wherein
the at least one second alignment portion has a surface geometry that is curved and
sloped.

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6. A female coupler as claimed in claim 5, wherein the radius of curvature of the curved surface of the at least one second alignment portion on a transverse plane is less than the radius of curvature of the curved surface of the first alignment portion on the transverse plane.
- 5
7. A female coupler as claimed in any of the preceding claims, wherein the at least one first alignment portion and/or the at least one second alignment portion is adjacent the opening.
- 10
8. A female coupler as claimed in any of the preceding claims, wherein the cavity further has at least one third alignment portion to bias a corresponding one the first transverse pin or the second transverse pin towards a closest one of at least one second alignment portion.
- 15
9. A female coupler as claimed in claim 8, wherein the at least one third alignment portion has an angled surface.
10. A female coupler as claimed in any of the preceding claims, wherein at least one portion of the at least one first alignment portion, second alignment portion and/or third alignment portion is angled substantially between 5 degrees and 50 degrees.
- 20
11. A female coupler as claimed in any of the preceding claims, wherein at least one portion of the at least one first alignment portion, second alignment portion and/or third alignment portion is angled substantially between 15 degrees and 35 degrees to a longitudinal axis of the female coupler.
- 25
12. A female coupler as claimed in any of the preceding claims, wherein at least one portion of the at least one first alignment portion, second alignment portion and/or third alignment portion is angled substantially 25 degrees to a longitudinal axis of the female coupler.
- 30
13. A female coupler as claimed in any of the preceding claims, wherein the opening has a transverse cross-sectional area substantially the shape of a stadium.

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14. A female coupler as claimed in any of the preceding claims, wherein the cavity further includes a body portion to accommodate at least part of the male coupler, and wherein the at least one first alignment portion and the at least one
5 second alignment portion extend outwardly from the body portion.

15. A coupler assembly including:
a male coupler with at least one transverse pin, and
a female coupler having;
10 a cavity, the cavity having an opening to receive the male coupler, and
at least one transverse hole extending transversely from the cavity adapted to receive at least one transverse pin when the male coupler is in a received position, wherein the cavity further has
at least one first alignment portion, each first alignment portion having a
15 curved and sloped surface converging towards a longitudinal axis of one of the at least one transverse hole, the surface adapted to bias a corresponding one of the at least one transverse pin toward a corresponding one of the at least one hole as the male coupler moves towards the received position, and
at least one second alignment portion, each second alignment portion having
20 a surface geometry adapted to bias a corresponding one the at least one transverse pin toward a corresponding one of the at least one first alignment portion as the male coupler moves towards the received position.

16. A system for joining and/or tensioning structural components, the system
25 including,
at least one coupler assembly, each coupler assembly including;
a male coupler with at least one transverse pin, and
a female coupler having;
a cavity, the cavity having an opening to receive the male coupler, and
30 at least one transverse hole extending transversely from the cavity adapted to receive at least one transverse pin when the male coupler is in a received position wherein the cavity further has
at least one first alignment portion, each first alignment portion having a curved and sloped surface converging towards a longitudinal axis of one of the at

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least one transverse hole, the surface adapted to bias a corresponding one of the at least one transverse pin toward a corresponding one of the at least one hole as the male coupler moves towards the received position, and

at least one second alignment portion, each second alignment portion having
5 a surface geometry adapted to bias a corresponding one the at least one transverse pin toward a corresponding one of the at least one first alignment portion as the male coupler moves towards the received position,

a first anchor secured to a first structural component, the first anchor connected to the male coupler, and

10 a second anchor secured to a second structural component, the second anchor connected to the female coupler,

wherein the at least one coupler assembly joins and/or tensions the first structural component and the second structural component.

15 17. A system for joining and/or tensioning structural components as claimed in claim 16, wherein the at least one coupler assembly is connected to the first anchor and/or the second anchor by at least one rod.

18. A system for joining and/or tensioning structural components as claimed in
20 claims 16 and 17, wherein the first anchor is integrally formed with the male coupler, and/or the second anchor is integrally formed with the female coupler.

19. A method for joining and/or tensioning structural components, the method including the steps of

25 securing a first anchor to a first structural component,
securing a second anchor to a second structural component,
connecting the first anchor connected to a male coupler,
connecting the second anchor connected to a female coupler with a cavity adapted to receive the male coupler, and

30 receiving the male coupler within the female coupler such that the male coupler is guided to a received position wherein at least one transverse pin of the male coupler is received within a corresponding hole in the female coupler,

whereby a corresponding one of the at least one transverse pin is biased toward a corresponding one of the at least one hole by a first alignment portion of the

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cavity, the first alignment portion having a curved and sloped surface converging towards a longitudinal axis of one of the at least one transverse hole, as the male coupler moves towards the received position.

- 5 20. A method for joining and/or tensioning structural components as claimed in claim 19, wherein a corresponding one of the at least one transverse pin is biased toward a corresponding one of the first alignment portion by a second alignment portion of the cavity, the second alignment portion having a curved and sloped surface, as the male coupler moves towards the received position.

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