

CRASH FENCE ASSEMBLY**FIELD OF THE INVENTION**

- 5 Embodiments of the present invention relate to crash fence assemblies.

BACKGROUND TO THE INVENTION

- Fence assemblies are widely used to protect an area, building or otherwise.
- 10 Many such assemblies will fail quite readily upon impact such as for instance by a motor vehicle driven at the fence. On such an impact with conventional fences, fence panels are often readily torn from adjacent uprights, the fence panels may collapse, and/or respective uprights may shear. With such impacts a very high localised force may occur on the fence, causing it to fail.

- 15 The purpose of a crash fence assembly is to prevent the motor vehicle from completely penetrating the crash fence assembly without disabling the motor vehicle.

- 20 A previous effective design of crash fence assembly employs cross bars that are braced together by the façade of the crash fence assembly. Therefore, the façade must have significant structural strength in order for the crash fence assembly to function. Subsequent development of the previous design focussed on strengthening façade elements and their respective connections
- 25 to the cross bars.

BRIEF DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION

- According to an aspect of the invention there is provided a crash fence
- 30 assembly, the crash fence assembly including:
- first and second uprights locatable spaced from each other upstanding from the ground; and

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a first fence panel extendible between the first and second uprights,
the first fence panel comprising:

one or more barrier elements configured to define a barrier between the
first and second uprights;

5 a first cross-panel member configured to span between the first and
second uprights;

a first upstanding brace configured to be secured to the first cross-panel
member at least a first span distance from the first upright to distribute impact
load, wherein the first upstanding brace has a greater stiffness than the or each
10 barrier element.

An advantage is a crash fence assembly with flexibility over what the
façade/barrier is made of. The first upstanding brace may be secured behind a
rear of the barrier to brace the first cross-panel member. The barrier does not
15 have to contribute to the strength or brace the first cross-panel member.

The barrier may be a mesh panel. The one or more barrier elements may be
mesh wires or expanded mesh elements.

20 The crash fence assembly may comprise a second cross-panel member
configured to span between the first and second uprights, and locatable at a
different vertical height than the first cross-panel member.

The first upstanding brace may be configured to secure the first cross-panel
25 member and the second cross-panel member to each other, to transfer impact
load between the first and second cross-panel members.

The crash fence assembly may be configured to locate the first upstanding
brace to extend substantially vertically.

30 The first upstanding brace may be configured to be suspended above the
ground by the first and second cross-panel members. The first upstanding

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brace may be configured to be suspended above a bottom edge of the barrier by the first and second cross-panel members. A lower end of the first upstanding brace may terminate at the lower one of the first and second cross-panel members, above the ground/bottom edge of the barrier.

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The crash fence assembly may comprise a second upstanding brace configured to be secured to one of or both of the first and second cross-panel members at least a second different span distance from the first upright to distribute impact load, wherein the second upstanding brace has a greater stiffness than the or each barrier element.

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The second upstanding brace may be configured to secure the first cross-panel member and the second cross-panel member to each other, to transfer impact load between the first and second cross-panel members.

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The crash fence assembly may be configured to locate the first and second upstanding braces to extend substantially parallel to each other in-use.

The crash fence assembly may be configured to locate the first and second upstanding braces to extend substantially vertically.

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The crash fence assembly may be configured to locate the second upstanding brace adjacent the first upstanding brace in-use, separated from the first upstanding brace such that the second span distance is no less than X metres greater than the first span distance, where X is a value selected from the range 0.3 metres to 1 metre.

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The crash fence assembly may comprise a third upstanding brace configured to be secured to one of or both of the first and second cross-panel members at least a third different span distance from the first upright to distribute impact load, different from the first and second span distances, wherein the third upstanding brace has a greater stiffness than the or each barrier element.

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The crash fence assembly may be configured to locate the first, second, and third upstanding braces to extend substantially parallel to each other in-use.

- 5 The crash fence assembly may be configured to locate the first, second, and third upstanding braces to extend substantially vertically.

- The crash fence assembly may be configured to locate the first, second, and third upstanding braces to be spaced at Y metre centres, wherein Y is a value
10 selected from the range 0.3 metres to 1 metre.

- The crash fence assembly may be configured to locate the first and second cross-panel members proximal to the ground and distal from tops of the first and second uprights, to absorb a vehicle impact. The crash fence assembly
15 may be configured to locate the first and second cross-panel members at a lower half of the first and second uprights, to absorb a vehicle impact.

- The first and second cross-panel members and the first and second uprights together may be connectable via a plug-socket system configured to support
20 the first and second cross-panel members.

- The plug-socket system may be configured to permit sloping of the first and second cross-panel members relative to the first and second uprights, to follow sloping ground.
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- The plug-socket system may be defined by notches in each cross-panel member, and corresponding formations in the uprights engageable with the notches. The formations may comprise edges of openings in the uprights. The notches may be insertable through the openings and lowerable onto the edges
30 of said openings to engage the edges with the notches.

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The crash fence assembly may comprise a third cross-panel member configured to span between the first and second uprights, locatable at a different vertical height than the first and second cross-panel members.

- 5 The crash fence assembly may be configured to locate the first, second, and third cross-panel members to extend substantially parallel to each other in-use. They may extend substantially parallel to the ground.

- 10 The crash fence assembly may be configured to locate the third cross-panel member proximal to tops of the first and second uprights. The crash fence assembly may be configured to locate the third cross-panel member at an upper half of the first and second uprights.

- 15 The third cross-panel member may be above the first and second cross-panel members.

- 20 A vertical separation between the first and second cross-panel members may be less than a vertical separation between the second and third cross-panel members.

- The first upstanding brace may be configured to secure the first, second, and third cross-panel members to each other, to transfer impact load between the first, second, and third cross-panel members.

- 25 The second upstanding brace may be configured to secure the first, second, and third cross-panel members to each other, to transfer impact load between the first, second, and third cross-panel members.

- 30 The third upstanding brace may be configured to connect the first, second, and third cross-panel members to each other, to transfer impact load between the first, second, and third cross-panel members.

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The barrier may be in the form of a barrier panel. The barrier panel may be a mesh panel or other panel.

5 The first upright may comprise a barrier support to attach a first side of the barrier panel to the first upright. The second upright may comprise a barrier support to attach a second side of the barrier panel to the second upright.

10 The or each barrier support may extend over more than 50% of an above-ground height of the first upright. The or each barrier support may extend over more than 50% of a total height of the first upright.

15 Each barrier support may be in the form of an elongate panel bracket extending continuously along the respective upright and comprising a series of fixing points to receive fixings for securing the barrier panel.

20 The first upright may comprise a further barrier support to attach a second side of a barrier panel of an adjacent fence panel to the first upright. The second upright may comprise a further barrier support to attach a first side of a barrier panel of another adjacent fence panel to the second upright.

The or each further barrier support may have the features of the barrier supports as defined above.

25 Openings may be provided in the first and second uprights. Adjacent fence panels may be configured to be structurally interconnected, with a load path between the adjacent fence panels extending through the openings. Cross-panel members of adjacent fence panels may be structurally interconnected.

30 A first interconnector may be configured to extend through the openings of the first upright to structurally interconnect one of the cross-panel members of the first fence panel with a corresponding cross-panel member of a first adjacent fence panel. A second interconnector may be configured to extend through the

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openings of the second upright to structurally interconnect the one of the cross-panel members of the first fence panel with a corresponding cross-panel member of a second adjacent fence panel.

- 5 A first end of the first cross-panel member may be configured to terminate at the first upright. The first interconnector may be configured to be secured at one end to the first cross-panel member and at the other end to an opposite cross-panel member of a different fence panel terminating at the first upright.
- 10 A second end of the first cross-panel member may be configured to terminate at the second upright. The second interconnector may be configured to be secured at one end to the first cross-panel member and at the other end to an opposite cross-panel member of a different fence panel terminating at the second upright.
- 15 Interconnectors of the same type may be provided for each of the first, second, and optional third cross-panel members.
- 20 The crash fence assembly may comprise a first energy absorbing member engageable against the first upright if the first cross-panel member moves from a rest position. The movement may comprise axial movement of the first cross-panel member.
- 25 The or each energy absorbing member may be in the form of a body of a resilient material that is more compressible than a material of the first upright. The resilient material may comprise rubber.

- The or each energy absorbing member may have a reducing cross-section shape, extending to a tip that is configured to impact the respective upright first.
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The crash fence assembly may comprise a second energy absorbing member engageable against the second upright if the first cross-panel member moves from a rest position.

- 5 The crash fence assembly may comprise a third energy absorbing member engageable against the first upright if the first cross-panel member moves from the rest position in the opposite direction.

- 10 The crash fence assembly may comprise a fourth energy absorbing member engageable against the second upright if the first cross-panel member moves from a rest position in the opposite direction.

- 15 At least one energy absorbing member may be provided for each of the first, second, and optional third cross-panel members. Sets of first to fourth energy absorbing members as defined above may be provided for each of the first, second, and optional third cross-panel members.

- 20 The crash fence assembly may comprise a first pair of energy absorbing members provided on each side of the first upright, a first of which is the first energy absorbing member, engageable against the first upright if the first cross-panel member moves from the rest position in a first direction, and wherein the second one of the first pair of energy absorbing members is engageable against the first upright if the first cross-panel member moves from the rest position in a second opposite direction.

- 25 The crash fence assembly may comprise a second pair of energy absorbing members provided on each side of the second upright, a first of which is the second energy absorbing member, engageable against the second upright if the first cross-panel member moves from the rest position in a first direction, and wherein the second one of the second pair of energy absorbing members is engageable against the second upright if the first cross-panel member moves from the rest position in a second opposite direction.
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BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of various examples of embodiments of the present invention reference will now be made by way of example only to the accompanying drawings in which:

FIG. 1 illustrates a front elevation of an example crash fence assembly;

FIG. 2 illustrates a detail view of a barrier panel of the crash fence assembly;

FIG. 3 illustrates a rear elevation of a section of the crash fence assembly;

FIG. 4 illustrates a rear perspective view of a connection between a fence panel and an upright of the crash fence assembly;

FIG. 5 illustrates a front perspective detail view of a section of the upright;

FIG. 6 illustrates a side elevation detail view of an opening in the upright; and

FIG. 7 illustrates a plan view of a connection between a barrier panel and the upright.

DETAILED DESCRIPTION OF VARIOUS EMBODIMENTS OF THE INVENTION

FIG. 1 and 3 show a crash fence assembly 10. The crash fence assembly 10 comprises a plurality of uprights 12 to be mounted to the ground, for example by foundations 22, so as to extend upwardly therefrom. The ground is defined herein as the top of the foundations 22 (e.g., concrete foundations) of the uprights 12 (or as the bottom of later-described element 21A/21B, if different).

The uprights 12 are spaced apart, and a respective fence panel 14 extends between each pair of uprights 12.

The crash fence assembly 10 shown in FIG. 1 comprises four uprights 12 and three corresponding fence panels 14. It is to be realised that a crash fence assembly of any required length and shape can be provided.

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Each fence panel 14 comprises a barrier in the form of a rectangular barrier panel 17, defining a façade. In other examples, the barrier can be other than a panel.

- 5 FIG. 2 shows a welded wire mesh fence, the barrier panel 17 comprising a plurality of barrier elements 16A, 16B in the form of wire strands. The wire strands are welded together to form a mesh. The wire strands may be formed from any appropriate high-modulus material such as steel. Each wire strand has a small diameter such as less than 3 millimetres.

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In another example, the mesh panel is woven, knitted, expanded, sintered, etched, or electroformed.

- The advantages of a mesh panel compared to palisade fencing are greater
15 transparency and tens of percent less material required.

In an alternative implementation, the barrier panel 17 is a solid non-structural sheet such as a wood or metal sheet.

- 20 The uprights 12 shown are vertical columns of a high-strength material such as steel. The illustrated uprights 12 comprise upwardly extending hollow sections. The hollow sections extend into concrete foundations 22.

- As shown in FIG. 1, each fence panel 14 can comprise a plurality of parallel
25 cross-panel members 18 in the form of cross bars. Any appropriate high strength material may be used, such as steel. Each cross-panel member 18 spans between an adjacent pair of uprights 12. Three cross-panel members 18A, 18B, 18C are shown, each at a different vertical height.

- 30 As shown, the cross-panel members 18 can have a cross section with a limb pointing rearwardly and a limb pointing downwardly. The illustrated cross section is an L-section. In some examples, a cross-panel member 18 can

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comprise a main member (e.g., L-section) and an additional reinforcing member attached thereto, such as a C-section channel. The additional reinforcing member may be bolted to the rearward limb. The additional reinforcing member can be omitted for lower strength implementations (e.g., vehicles up to 2.5 tonnes) and included for higher strength implementations (e.g., vehicles up to 7.5 tonnes).

In another example, the cross-panel members 18 are cables such as a steel/fibre rope.

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Assuming level ground, the cross-panel members 18 extend substantially horizontally and are parallel to each other. However, if the ground slopes, the cross-panel members 18 may also slope to remain parallel with the ground and each other. This ensures that the cross-panel members 18 remain aligned with the bumper of an impacting motor vehicle.

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Two of the cross-panel members 18A, 18B are positioned less than one metre above the ground. This ensures proper engagement with a motor vehicle. The lower one 18A may be less than 0.5 metres above the ground. The lower one 18A may be above the bottom of the barrier panel 17.

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The top cross-panel member 18C can be positioned much higher to prevent the vehicle from over-riding the barrier and to ensure the capture of tall vehicles. For example, the illustrated top cross-panel member 18C is within one metre of the top of the uprights 12. The top cross-panel member 18C may be below the top of the barrier panel 17.

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Instead, the barrier panels 17 are mounted directly to the uprights 12 as best shown in FIGS. 3, 5, and 7 and described later. This enables the barrier panels 17 to be positioned independently of any of the members of the fence panels 14. The barrier panels 17 are 'floating' with respect to the members of the fence

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panels 14. This improves security by making the barrier panel 17 hard to climb because it flexes.

5 Since the barrier panels 17 have fixed shapes, they cannot slope and instead will be stepped in series to follow sloped ground. By contrast, the cross-panel members 18 may slope. It is therefore convenient that the barrier panels 17 are mounted to the uprights 12 without being mounted cross-panel members 18, for sloping ground.

10 Since the barrier panels 17 are not connected to any members of the fence panel 14 (and in any case offer limited structural strength), a different member for bracing the cross-panel members 18 to each other is shown. FIGS. 1 and 3 illustrate the members being a plurality of parallel upstanding braces 19 in the form of columns, securing the cross-panel members 18 to each other. The
15 braces 19 secure all of the cross-panel members 18 to each other. Three braces 19A, 19B, 19C are shown.

The braces 19 transfer (spread) the impact load between the cross-panel members 18. This avoids high stress concentrations associated with the cross-
20 panel member 18 closest to the localised impact force. One brace 19 inhibits an $n=1$ Euler buckling mode, two braces 19A, 19B further inhibits the $n=2$ Euler buckling mode, and three braces 19A, 19B, 19C as illustrated inhibits an $n=3$ Euler buckling mode. An absence of braces 19 could lead to the cross-panel members 18 deflecting over and under a motor vehicle and allowing the motor
25 vehicle to pass through, or at least allowing greater penetration.

The braces 19 may extend substantially vertically as shown. Any appropriate high strength material can be used, such as steel. The illustrated braces 19 are planar in cross-section. In the illustrated example, the braces 19 are flat bars
30 orientated with their minor bending axes parallel to the barrier panels 17, to define a low profile and minimise the thickness of the fence panel 14.

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The braces 19 do not engage with the ground. The illustrated braces 19 terminate at the lowest cross-panel member 18 and terminate at the highest cross-panel member 18. Therefore, the braces 19 are shorter than the height of the barrier panel 17, and are suspended by the cross-panel members 18
5 above ground level and the bottom edge of the barrier panel 17.

The braces 19 have significantly greater stiffness than each barrier element 16A, 16B (e.g., wire strand) of the barrier panel 17. The braces 19 have greater rigidity than each barrier element 16A, 16B. The braces 19 have a significantly
10 greater cross-sectional area than each barrier element 16A, 16B, such as more than 5 or more than 10 or more than 20 or more than 30 times greater.

The braces 19 can have a lower stiffness, rigidity, and cross-sectional area than the cross-panel members 18, as less stiffness is needed to be an effective
15 brace whereas the cross-panel members 18 receive the highest forces and should resist fracture. The uprights 12 have greater stiffness, rigidity, and cross-sectional area than any of the members of the fence panel 14.

Not many braces 19 are required to prevent the cross-panel members 18 from
20 buckling around a motor vehicle. The bracing of a fence panel 14 may consist of fewer than ten, or fewer than five of the braces 19. More than ten may be wasteful.

The braces 19 and cross-panel members 18 comprise fixing points such as
25 apertures, enabling them to be connected to each other at specified points by fasteners such as bolts. The illustrated braces 19 are evenly spaced at 'X' centres, wherein X is a value selected from the range 300 to 1000 mm, which is less than the width of a motor vehicle.

30 Each one-third span section of each cross-panel member 18 comprises a connection to one of the braces 19. The braces 19A and 19C may be closer to

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their adjacent uprights 12 than the central brace 19B. This is to maintain equal distance between brace 19c and the next panels brace 19a.

5 The braces 19 and cross-panel members 18 are behind the barrier panel 17 (behind the plane(s) of the barrier elements 16A, 16B). The braces 19 may be connected to the downward limbs of the cross-panel members 18. The braces 19 may be between the barrier panel 17 and the cross-panel members 18, with an air gap between the barrier panel 17 and the braces 19. The braces 19 are not connected to the barrier panel 17.

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As shown in FIGS. 3, 4, and 7, the barrier panel 17 connects to the uprights 12 via barrier supports in the form of brackets 21. Each upright 12 comprises a pair of the brackets 21A, 21B, facing each adjacent fence panel 14.

15 The brackets 21 extend as flanges/wings from the front face of the uprights 12. The illustrated brackets 21 extend continuously from the ground (top of the concrete foundation 22) to a top end region of the uprights 12 (e.g., within <10cm centimetres of the top).

20 Metal welds 37 connect the brackets 21 to the uprights 12. Alternatively, the brackets 21 may be integrally formed portions of the uprights 12. As shown in FIG. 7, each bracket 21 comprises a pair of parallel spaced-apart elongate members 33, 35 such as flat bars, wherein the side periphery of the barrier panel 17 is inserted into the gap between the elongate member 33, 35. Each member 33, 35 comprises a series of fixing points 23, such as apertures, wherein the series are aligned enable fasteners such as bolts to interconnect the members 33, 35 extending through the barrier panel 17.

25 In the example of a mesh panel, the bolts pass through the apertures 33, 35 of the members 33, 35 via the aligned apertures of the mesh, to anchor the mesh panel to the brackets 21.

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The brackets 21 hold the barrier panel 17 in front of the frontal plane of the upright 12, and in front of the members of the fence panel 14 with an air gap behind the barrier panel 17 to the members. This spacing, combined with the small mesh hole sizes, improves security to resist access by an angle grinder or other tool.

In another example, the barrier panel 17 extends behind the uprights 12.

As shown in FIGS. 4, 5, and 6, openings 25 are provided on each side of each upright 12. Note that in FIG. 4, the uprights 12 are transparent for illustrative purposes, to see inside. The openings 25 may be the same shape as the cross-panel members 18, such as L-shaped. The upper limb of the openings 25 is of increased thickness relative to the remainder of the opening 25.

As shown in FIG. 4, a notch 20 is provided on each cross-panel member 18 a short distance from the end thereof. The notch 20 is formed on the bottom edge of the downward limb. The notches 20 engage with the edge of the openings 25 in the uprights 12. The ends of the cross-panel members 18 can be slid through the openings 25 and then lowered such that the notches 20 fully engage. The ends of the cross-panel members 18 extend into, and terminate within, the hollow sections (uprights 12). The cross-panel members 18 rest on the edges of the openings 25. The cross-panel members 18 cannot be axially pulled out without raising the notches 20 from the openings 25. The notches 20 and openings 25 together define a plug-socket system. This type of plug-socket system enables vertical rotation of the cross-panel members 18 into upwards and downwards sloped orientations, as required to remain parallel to the ground.

As shown in FIG. 4, an interconnector 26 is provided extending between adjacent fence panels 14 at each location of a cross-panel member 18 meeting a respective upright 12. The interconnector 26 connects to a structural member

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of each fence panel 14 to structurally interconnect (transfer impact forces between) the fence panels 14.

Each interconnector 26 is in the form of a length of flat bar aligned horizontally
5 in use. The interconnector 26 extends through the openings 25 in the uprights 12 above the cross-panel members 18, hence the upper limb of the openings 25 being of increased thickness. The interconnector 26 is slidably movable through the respective openings 25 in the upright 12. Therefore, a cross-panel member 18 of a fence panel 14 that is buckled horizontally by a frontal impact
10 will axially pull its neighbouring cross-panel members 18 of neighbouring fence panels 14.

As shown in FIG. 4, energy absorbing members 28 are provided in the form of parabolic blocks of rubber, the tips facing the sides of the uprights 12. They are
15 configured as shock absorbers. Each energy absorbing member 28 is mounted to an end section of a cross-panel member 18, and/or to an interconnector 26. Each upright 12 has two energy absorbing members 28 facing it, one to each side. The pair of energy absorbing members 28 are positioned with their tips facing towards each other, the upright 12 being positioned therebetween.

20 Each illustrated energy absorbing member 28 is mounted to a downwardly facing limb of an L-shaped further flat bar 30. One limb of the flat bar 30 is mounted to the underside of the respective cross-panel member 18, and a downwardly facing limb at the end of the further bar 30 adjacent the upright 12
25 mounts the energy absorbing member 28.

If the interconnected cross-panel members 18 move from a rest position through the upright 12 in either direction, one of the pair of opposing energy absorbing members 28 will strike the upright 12. The use of a resilient material
30 such as rubber will dissipate energy. The use of a reducing/tapering cross-section shape, such as a parabolic shape, reduces peak stress by extending the duration over which the force is applied. It would be appreciated that

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different materials similar to rubber, and/or different cross-section shapes, can be used without affecting the function of the energy absorbing members 28. For example a nylon donut could be mounted to a continuous wire rope acting as the cross-panel member. In a further implementation, a spring may be used as
5 the energy absorbing member 28.

FIG. 4 also shows a top reinforcer in the form of a top bar 44, mountable on top of the interconnector 26. Each end region of each interconnector 26 is layered between a top bar 44 and a respective cross-panel member 18. The top bar 44
10 provides a plurality of fixing points 46 (apertures) which align with respective fixing points in the interconnector 26 and cross-panel member 18. Fasteners, such as bolts 46, extend through the apertures. The use of multiple fixing points in series, each in a three-layer arrangement, ensures a strong connection between the cross-panel members 18 and the interconnectors 26. The same
15 fasteners may also attach the bar 30 for the energy absorbing member 28. Covers 48 are provided on the top ends of the bolts to prevent access thereto.

In use, the interconnectors 26 can be installed during erection of a crash fence assembly 10, or alternatively the interconnectors 26 and energy absorbing
20 members 28 can readily be retrofitted to existing crash fence assemblies. If a substantial impact is received anywhere on the fence assembly 10, this will put a stress on the respective fence panel 14. This will tend to break the notch 20 or part of the opening 25 in the upright 12 adjacent thereto, and thus permit the respective fence panel 14 to move to a certain degree relative to adjacent
25 uprights 12, by sliding movement of the interconnector 26 through the uprights 12. The energy absorbing members 28 will collide with the uprights 12 and cause energy to be dissipated.

The invention therefore provides a crash fence assembly 10 with complete
30 flexibility over what the façade/barrier is made of. The façade does not have to contribute to the strength. The interconnectors 26 and energy absorbing members 28 distinguish the crash fence assembly 10 from those in which the

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impact would be solely born at the point of impact, with a significant likelihood of failure of the crash fence assembly 10 at this point. In contrast the impact energy will be absorbed along a length of the fencing and by the energy absorbing members 28, thereby tending to dissipate the energy with significantly less damage to the fencing.

However, it was surprisingly discovered as a result of comparative finite element simulations, that the brackets 21 connected to a barrier panel 17 having the simulated strength of a welded wire mesh panel contributed significantly to the structural integrity of the crash fence assembly 10. This reduced the simulated penetration of a 7500kg mass at 48km/hr from 2.3 metres (barrier panel 17 ignored) to just 1.3 metres from the plane of the barrier panel 17. Both results performed better than the 2.9-3.5 metre penetrations of the previous design mentioned in the background section of this disclosure.

Although embodiments of the present invention have been described in the preceding paragraphs with reference to various examples, it should be appreciated that modifications to the examples given can be made without departing from the scope of the invention as claimed. For example, the crash fence assembly may comprise a single cross-panel member. For example, the first upstanding brace may connect a mid-span position of the cross-panel member to an upright, in a diagonal manner.

Features described in the preceding description may be used in combinations other than the combinations explicitly described.

Although functions have been described with reference to certain features, those functions may be performable by other features whether described or not.

Although features have been described with reference to certain embodiments, those features may also be present in other embodiments whether described or not.

Whilst endeavoring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable
5 feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

CLAIMS

1. A crash fence assembly including:
first and second uprights locatable spaced from each other upstanding
5 from the ground; and
a first fence panel extendible between the first and second uprights,
the first fence panel comprising:
one or more barrier elements configured to define a barrier between the
first and second uprights;
10 a first cross-panel member configured to span between the first and
second uprights;
a first upstanding brace configured to be secured to the first cross-panel
member at least a first span distance from the first upright to distribute impact
load, wherein the first upstanding brace has a greater stiffness than the or each
15 barrier element.
2. The crash fence assembly of claim 1, wherein the barrier is a mesh
panel, and wherein the one or more barrier elements are mesh wires or
expanded mesh elements.
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3. The crash fence assembly of claim 1 or 2, configured to locate the first
upstanding brace to extend substantially vertically.
4. The crash fence assembly of claim 1, 2, or 3, comprising a second cross-
25 panel member configured to span between the first and second uprights, and
locatable at a different vertical height than the first cross-panel member.
5. The crash fence assembly of claim 4, wherein the first upstanding brace
is configured to secure the first cross-panel member and the second cross-
30 panel member to each other, to transfer impact load between the first and
second cross-panel members.

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6. The crash fence assembly of claim 5, wherein the first upstanding brace is configured to be suspended above the ground by the first and second cross-panel members.

5 7. The crash fence assembly of claim 4 or 5, comprising a second upstanding brace configured to be secured to one of or both of the first and second cross-panel members at least a second different span distance from the first upright to distribute impact load, wherein the second upstanding brace has a greater stiffness than the or each barrier element.

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8. The crash fence assembly of claim 7, wherein the second upstanding brace is configured to secure the first cross-panel member and the second cross-panel member to each other, to transfer impact load between the first and second cross-panel members.

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9. The crash fence assembly of claim 7 or 8, configured to locate the first and second upstanding braces to extend substantially parallel to each other in-use.

20 10. The crash fence assembly of claim 7, 8, or 9, comprising a third upstanding brace configured to be secured to one of or both of the first and second cross-panel members at least a third different span distance from the first upright to distribute impact load, different from the first and second span distances, wherein the third upstanding brace has a greater stiffness than the
25 or each barrier element.

11. The crash fence assembly of claim 10, configured to locate the first, second, and third upstanding braces to extend substantially parallel to each other in-use.

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12. The crash fence assembly of any one of claims 4 to 11, configured to locate the first and second cross-panel members proximal to the ground and distal from tops of the first and second uprights, to absorb a vehicle impact.
- 5 13. The crash fence assembly of any one of claims 4 to 12, wherein the first and second cross-panel members and the first and second uprights together are connectable via a plug-socket system configured to support the first and second cross-panel members.
- 10 14. The crash fence assembly of claim 13, wherein the plug-socket system is configured to permit sloping of the first and second cross-panel members relative to the first and second uprights, to follow sloping ground.
- 15 15. The crash fence assembly of claim 13 or 14, wherein the plug-socket system is defined by notches in each cross-panel member, and corresponding formations in the uprights engageable with the notches.
- 20 16. The crash fence assembly of any one of claims 4 to 15, comprising a third cross-panel member configured to span between the first and second uprights, locatable at a different vertical height than the first and second cross-panel members.
- 25 17. The crash fence assembly of claim 16, configured to locate the first, second, and third cross-panel members to extend substantially parallel to each other in-use.
18. The crash fence assembly of claim 16 or 17, configured to locate the third cross-panel member proximal to tops of the first and second uprights.
- 30 19. The crash fence assembly of claim 16, 17, or 18, wherein a vertical separation between the first and second cross-panel members is less than a vertical separation between the second and third cross-panel members.

20. The crash fence assembly of any one of claims 16 to 19, wherein the first upstanding brace is configured to secure the first, second, and third cross-panel members to each other, to transfer impact load between the first, second,
5 and third cross-panel members.

21. The crash fence assembly of any preceding claim, wherein the barrier is in the form of a barrier panel, wherein the first upright comprises a barrier support to attach a first side of the barrier panel to the first upright, and wherein
10 the barrier support extends over more than 50% of an above-ground height of the first upright.

22. The crash fence assembly of claim 21, wherein the barrier support is in the form of an elongate panel bracket extending continuously along the first upright and comprising a series of fixing points to receive fixings for securing
15 the barrier panel.

23. The crash fence assembly of claim 21 or 22, wherein the first upright comprises a further barrier support to attach a second side of a barrier panel of
20 an adjacent fence panel to the first upright.

24. The crash fence assembly of any preceding claim, wherein openings are provided in the first and second uprights, and wherein adjacent fence panels are configured to be structurally interconnected, with a load path between the
25 adjacent fence panels extending through the openings.

25. The crash fence assembly of any preceding claim, wherein the crash fence assembly comprises a first energy absorbing member engageable against the first upright if the first cross-panel member moves from a rest
30 position.