

Modular Barrier

The present disclosure relates to a barrier. In particular, the disclosure relates to a modular vehicle impact barrier.

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The provision of vehicle impact barriers for use in vehicle highways or pedestrian highways, or both, often poses a significant engineering challenge.

10 A vehicle impact barrier must be of sufficient strength and engineering integrity to be able to withstand very high impact forces. Commonly, a plurality of bollards are collectively arrayed to provide the vehicle impact barrier. To enable each individual bollard of the barrier to be firmly, fixedly and permanently set into the ground, at least a portion of each bollard is buried in an excavated trench under the surface of the ground. The deeper the bollard forming the impact barrier is buried, the less likely it is
15 to be pulled out of the ground when impacted by a vehicle. Therefore, when there are no constraints upon the depth of excavation for accommodating such an impact barrier, the engineering form and structure of the barrier may be relatively simple. However, when severe constraints are imposed on permissible excavation depths, the form and structure of the vehicle impact barrier must be very carefully considered to meet the stringent requirements imposed by the excavation depth limitations while
20 simultaneously meeting the requirements associated with the necessary strength of the barrier.

25 Further, vehicle impact barriers often need to have an adaptable trajectory (i.e. a path of the barrier defined by a series of bollards) in order to avoid obstacles or to follow a desired arcuate route (e.g. due to a turn in a pavement). The adaptable trajectory can be achieved by using a range of different modular barrier members, which may be interconnected to form an appropriate path of the barrier. Traditional modular barriers are frequently composed of a series of directly connected base members, where each
30 base member has a bollard upstanding therefrom. In order for the traditional modular barriers to have a non-linear trajectory, a large variety of differently shaped base members are required. Designing and manufacturing a large variety of differently shaped base members leads to inefficiencies in the manufacturing process. Furthermore, barrier installers are required to store a large inventory of differently-

shaped base members in order to avoid any obstacles they may encounter during installation.

5 The present invention aims to provide means which may be used to assist in addressing some or all of the problems identified above.

Summary

10 In accordance with a first aspect, there is provided a barrier. The barrier may comprise a first base member and a second base member. The first base member may comprise a bollard upstanding therefrom. The second base member may comprise a bollard upstanding therefrom. The barrier may further comprise an intermediate member rigidly connecting the first base member to the second base member. The first base member may comprise a first coupling portion positioned at a first edge of the first base member. The second base member may comprise a second coupling portion positioned at a first edge of the second base member. The intermediate member may comprise a pair of third coupling portions positioned at a first edge and a second edge of the intermediate member respectively. The third coupling portions may be complementary to both the first coupling portion and the second coupling portion. The first base member, the second base member and the intermediate member may extend in a common plane. Both the first coupling portion and the second coupling portion may be configured to engage the third coupling portions as the first base member and the second base member are translated along the common plane relative to the intermediate member.

25 It should be appreciated that translation of the first and second base members relative to the intermediate member includes the case in which the first base member and the second base member move while the intermediate member remains stationary, but is not limited thereto. Relative translation along the common plane can also be achieved by moving the intermediate member and the second base member while the first base member remains stationary. Alternatively, relative translation along the common plane can be achieved by moving the intermediate member and the first base member while the second base member remains stationary.

The terms “assembly”, “assembling”, “installation”, “installing”, and “making a barrier” are used interchangeably to refer to the process of constructing a barrier from its component parts at the location at which it is used to stop vehicles. In contrast, the terms “manufacture” and “manufacturing” refer to the process(es) of fabricating the component parts of the barrier, which are typically carried out in a factory rather than the location at which the barrier will eventually be used.

The barrier may further comprise a second intermediate member and a third base member. The third base member may comprise a bollard upstanding therefrom. The second intermediate member may rigidly connect the third base member to a second edge of the first base member.

The first base member may comprise a fourth coupling portion positioned at the second edge of the first base member. The third base member may comprise a fifth coupling portion positioned at a first edge of the third base member. The second intermediate member may comprise a pair of sixth coupling portions positioned at a first edge and a second edge of the second intermediate member respectively. The sixth coupling portions may be complementary to both the fifth coupling portion and the fourth coupling portion.

The first base member, the second base member, the third base member, the intermediate member and the second intermediate member may extend in the common plane. The fourth coupling portion and the fifth coupling portion may be configured to engage the sixth coupling portions as the first base member and the third base member are translated along the common plane relative to the second intermediate member.

It should be appreciated that translation of the first and third base members relative to the second intermediate member includes the case in which the first base member and the third base member move while the second intermediate member remains stationary, but is not limited thereto. Relative translation along the common plane can also be achieved by moving the second intermediate member and the third base member while the first base member remains stationary. Alternatively, relative translation along the common plane can be achieved by moving the second

intermediate member and the first base member while the third base member remains stationary.

5 The barrier may be designed to withstand a high-speed vehicle impact and prevent that vehicle from entering a restricted access control area. More specifically, the bollard of the first base member and/or the second base member and/or the third base member may be configured to at least partially absorb an impact of a vehicle that collides with the barrier.

10 A modular barrier composed of a plurality of separate base members and/or intermediate members is especially advantageous, as it allows for easy assembly and rapid onsite installation of the barrier. For example, the individual elements of the barrier may be easily transported to the installation site and quickly assembled by
15 sliding the one or more base members along the common plane relative to the one or more intermediate members. In contrast, installing a barrier that is formed by a single element may be cumbersome due to its size and weight.

Further, the modular nature of the barrier allows for individual base members and/or intermediate members to be easily replaced should they suffer from any damage or
20 wear and tear.

Lastly, the components making up the modular barrier provide adaptability and flexibility. For example, the different base members and/or intermediate members may be utilized to adapt the overall shape of the barrier to suit the environment in which the
25 barrier is installed. In some instances, the shape of the barrier must be adapted to avoid any fixed obstacles such as trees, street furniture, lay-bys and underground services (e.g., underground cables or pipes).

Any of the base members and/or the intermediate members may be adapted for
30 ground engagement by embedment within a ground or floor surface.

The embedment may be achieved by digging a trench and subsequently burying the base members and/or the intermediate members therein. The barrier may be a shallow-mount barrier. In a shallow-mount barrier, the height of the base member is
35 less than the height of the bollard. Shallow-mount barriers may require just a fraction of

the excavation depth needed when installing a traditional bollard barrier. The shallow-mount barrier may require an excavation depth of less than 500mm for its installation. In some embodiments, the shallow-mount barriers may require an excavation depth ranging from 300mm to 40mm.

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The installation of traditional bollard barriers is often problematic, as it requires the excavation of deep foundations. This can cause inconvenience due to the associated need to avoid underground services during excavation, or to relocate the underground services to allow excavation. Advantageously, a shallow-mount barrier does not require deep foundations to be excavated. Instead, a smaller excavation depth is required for burying the base members and/or the intermediate members in the ground or floor surface. This makes the shallow-mount barrier suitable for securing sites where excavation depth is severely restricted, for example in urban areas.

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The intermediate member may connect the first base member in a non-linear angular relationship with respect to the second base member. More specifically, the angle of connection between the first base member and the second base member may not be 180°. In other words, the first base member and the second base member may not be arranged in a straight line. The angle of connection between the first base member and the second base member may range between 5° and 170°. For example, the angle of connection between the first base member and the second base member may be 5°, 10°, 20°, 30°, 40°, 50°, 60°, 70°, 80°, 90°, 100°, 110°, 120°, 130°, 140°, 150°, 160° or 170°.

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The second intermediate member may connect the first base member in a non-linear angular relationship with respect to the third base member. More specifically, the angle of connection between the first base member and the third base member may not be 180°. In other words, the first base member and the third base member may not be arranged in a straight line. The angle of connection between the first base member and the third base member may range between 5° and 170°. For example, the angle of connection between the first base member and the third base member may be 5°, 10°, 20°, 30°, 40°, 50°, 60°, 70°, 80°, 90°, 100°, 110°, 120°, 130°, 140°, 150°, 160° or 170°.

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The existence of obstacles on the intended positioning or linear trajectory of the barrier may pose difficulties during the installation of traditional barriers. For example, sharp

turns in the trajectory of the barrier may be required to avoid obstacles (e.g. street furniture) or to follow a desired arcuate route (e.g. due to a turn in a pavement). Advantageously, by allowing the first base member to be connected in a non-linear angular relationship with respect to the second base member and/or the third base member, obstacles such as trees may be avoided, and features such as lay-bys and corners may be followed, by selecting the base members and/or the intermediate members that collectively have the required trajectory.

The third coupling portion at the first edge of the intermediate member may be positioned in a non-linear angular relationship with respect to the third coupling portion at the second edge of the intermediate member. More specifically, the angle between the third coupling portion at the first edge of the intermediate member and the third coupling portion at the second edge of the intermediate member may not be 180° . In other words, the third coupling portion at the first edge of the intermediate member and the third coupling portion at the second edge of the intermediate member may not be arranged in a straight line. The angle between the third coupling portions may range between 5° and 170° . In this manner, the shape and arrangement of the respective third coupling portions dictates the angle of connection between the first base member and the second base member.

The sixth coupling portion at the first edge of the second intermediate member may be positioned in a non-linear angular relationship with respect to the sixth coupling portion at the second edge of the second intermediate member. More specifically, the angle between the sixth coupling portion at the first edge of the second intermediate member and the sixth coupling portion at the second edge of the second intermediate member may not be 180° . In other words, the sixth coupling portion at the first edge of the second intermediate member and the sixth coupling portion at the second edge of the second intermediate member may not be arranged in a straight line. The angle between the sixth coupling portions may range between 5° and 170° . In this manner, the shape and arrangement of the respective sixth coupling portions dictates the angle of connection between the first base member and the third base member.

The first coupling portion positioned at the first edge of the first base member may be positioned in a linear angular relationship with respect to the fourth coupling portion positioned at the second edge of the first base member. More specifically, the angle

between the first coupling portion positioned at the first edge of the first base member and the fourth coupling portion positioned at the second edge of the first base member may be 180°. In other words, the first coupling portion and the fourth coupling portion may be arranged in a straight line.

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The first base member and the second base member may be identical. The third base member may be identical to both the first base member and the second base member.

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As such, the barrier may be constructed from a plurality of identical base members and a range of differently shaped intermediate members. For example, the shape of the intermediate member may be different from the shape of the second intermediate member. More specifically, the angle of connection between the first and second base members facilitated by the intermediate member may be different from the angle of connection between the first and third base members facilitated by the second intermediate member. A barrier constructed in this manner simplifies the installation process, while simultaneously allowing the assembled barrier to have a desired non-linear trajectory.

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Traditional modular barriers are often composed of a series of directly connected base members with no intermediate members connected in-between them. In order for traditional modular barriers to have a non-linear trajectory, a large variety of differently shaped base members is required. Each base member is fairly time-consuming and difficult to manufacture, since its structure must accommodate an appropriately anchored bollard. In contrast, the structure of the intermediate members is significantly less complex, as it is not designed to accommodate a bollard. Therefore, a barrier constructed from a plurality of identical base members and a range of differently shaped intermediate members is quicker and easier to manufacture than a barrier constructed from a range of differently shaped base members.

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The first base member may comprise a first pair of opposed parallel plates separated by, and fixed to, the first coupling portion. The second base member may comprise a second pair of opposed parallel plates separated by, and fixed to, the second coupling portion. The intermediate member may comprise a third pair of opposed parallel plates separated by, and fixed to, the pair of third coupling portions.

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The first pair of opposed parallel plates may also be separated by, and fixed to, the fourth coupling portion. The third base member may comprise a fourth pair of opposed parallel plates separated by, and fixed to, the fifth coupling portion. The second intermediate member may comprise a fifth pair of opposed parallel plates separated by, and fixed to, the pair of sixth coupling portions.

In other words, each of the coupling portions is sandwiched between the respective pair of opposed parallel plates.

A first top plate of the first pair of opposed parallel plates, a second top plate of the second pair of opposed parallel plates and/or a third top plate of the third pair of opposed parallel plates may comprise an opening for receiving a ballast material. A fourth top plate of the fourth pair of opposed parallel plates and/or a fifth top plate of the fifth pair of opposed parallel plates may comprise an opening for receiving a ballast material.

The ballast material may comprise concrete, grout, sand, asphalt, tarmac and/or gravel. The ballast material may be inserted through the opening in the respective top plate of the pair of opposed parallel plates. In this manner, the ballast material can fill in the volume defined between the opposed parallel plates of the respective base members and intermediate members. The ballast material may allow for a better engagement between the third coupling portions and the respective first coupling portion and the second coupling portion. Additionally, the ballast material may allow for a better engagement between the sixth coupling portions and the respective fourth coupling portion and the fifth coupling portion.

The ballast material may remove the need for welding the respective coupling portions together during installation. This eliminates the time-consuming process of having to weld the individual elements together on-site during assembly of the barrier. In conventional barriers, the respective coupling portions need to be welded together which burns off the galvanized surface at the weld area leading to an increased risk of corrosion. By using the ballast material to improve the engagement between the respective coupling portions, the risk of corrosion is reduced or eliminated.

Each of the first and the second coupling portions may comprise at least one slot. The third coupling portions may comprise at least a pair of arms. Each arm may fit into a respective one of the slots to rigidly connect the intermediate member to each of the first and the second base members.

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The third coupling portion at the first edge of the intermediate member may be symmetrical to the third coupling portion at the second edge of the intermediate member.

10 The symmetrical nature of the coupling portions improves the ease of assembly of the barrier, since the user does not have to worry about the orientation of the intermediate member with respect to the neighbouring base members when assembling the barrier. Further, the intermediate member may be rotated by 180° to change the angle of connection between the first base member and the second base member. This further
15 reduces the number of different intermediate members which need to be manufactured to achieve the desired trajectory of the barrier.

The first coupling portion may comprise a first slot and a second slot. The second slot may be aligned with, and spaced apart from, the first slot. The second coupling portion
20 may comprise a third slot and a fourth slot. The fourth slot may be aligned with, and spaced apart from, the third slot. The third coupling portions may comprise a first arm that fits into both the first and the second slots and a second arm that fits into both the third and the fourth slots, respectively.

25 More specifically, the first slot and the second slot may have the same shape and size, such that there is a continuous passage through the first slot and the second slot for receiving the first arm of a third coupling portion. Similarly, the third slot and the fourth slot may have the same shape and size, such that there is a continuous passage through the third slot and the fourth slot for receiving the second arm of a third coupling
30 portion.

Advantageously, the continuous passage created by the first slot and the second slot prevents the first arm of the third coupling portion from rotating within the first coupling portion. Similarly, the continuous passage created by the third slot and the fourth slot
35 prevents the second arm of the third coupling portion from rotating within the second

coupling portion. In this manner, the intermediate member is prevented from rotating relative to the first base member and the second base member during a vehicular impact. This not only improves the structural integrity of the barrier, but also ensures that during a collision the energy is spread out across different sections of barrier,
5 rather than being focused on a single impact point.

The first coupling portion may further comprise a fifth slot and a sixth slot. The sixth slot may be aligned with, and spaced apart from, the fifth slot. The second coupling portion may further comprise a seventh slot and an eighth slot. The eighth slot may be
10 aligned with, and spaced apart from, the seventh slot. The third coupling portions may further comprise a third arm that fits into both the fifth and the sixth slots and a fourth arm that fits into both the seventh and the eighth slots, respectively.

More specifically, the fifth slot and the sixth slot may have the same shape and size,
15 such that there is a continuous passage through the fifth slot and the sixth slot for receiving the third arm of a third coupling portion. Similarly, the seventh slot and the eighth slot may have the same shape and size, such that there is a continuous passage through the seventh slot and the eighth slot for receiving the fourth arm of a third coupling portion.

20 Advantageously, by having the additional fifth, sixth, seventh and eighth slots as well as the third and fourth arms, the connection between the first base member, the intermediate member and the second base member is strengthened.

25 In an alternative embodiment, the third coupling portions may comprise at least a pair of slots. Each of the first and the second coupling portions may comprise an arm fitting into a respective one of the slots to rigidly connect the intermediate member to each of the first and the second base members.

30 The third coupling portion at the first edge of the intermediate member may be symmetrical to the third coupling portion at the second edge of the intermediate member.

The third coupling portions may comprise a first slot, a second slot, a third slot and a
35 fourth slot. The second slot may be aligned with, and spaced apart from, the first slot.

The fourth slot is aligned with, and spaced apart from, the third slot. The first coupling portion may comprise a first arm that fits into both the first and the second slots. The second coupling portion may comprise a second arm that fits into both the third and the fourth slots.

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More specifically, the first slot and the second slot may have the same shape and size, such that there is a continuous passage through the first slot and the second slot for receiving the first arm of the first coupling portion. Similarly, the third slot and the fourth slot may have the same shape and size, such that there is a continuous passage through the third slot and the fourth slot for receiving the second arm of the second coupling portion.

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The third coupling portions may further comprise a fifth slot, a sixth slot, a seventh slot and an eighth slot. The sixth slot may be aligned with, and spaced apart from, the fifth slot. The eighth slot may be aligned with, and spaced apart from, the seventh slot. The first coupling portion may further comprise a third arm that fits into both the fifth and the sixth slots. The second coupling portion may further comprise a fourth arm that fits into both the seventh and the eighth slots.

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The fifth slot and the sixth slot may have the same shape and size, such that there is a continuous passage through the fifth slot and the sixth slot for receiving the third arm of the first coupling portion. Similarly, the seventh slot and the eighth slot may have the same shape and size, such that there is a continuous passage through the seventh slot and the eighth slot for receiving the fourth arm of the second coupling portion.

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Although not described in detail here, the fourth coupling portion of the first base member may be substantially identical to the first coupling portion of the first base member. The fifth coupling portion of the third base member may be substantially identical to the first coupling portion of the first base member. The sixth coupling portions of the second intermediate member may be substantially identical to the third coupling portions of the intermediate member.

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The one or more slots may be contained within a volume defined by the respective first pair of parallel plates and/or the second pair of parallel plates and/or the third pair of parallel plates. More specifically, the one or more slots of the first coupling portion may

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be contained within a volume defined between the first pair of parallel plates. The one or more slots of the second coupling portion may be contained within a volume defined between the second pair of parallel plates. The one or more slots of the third coupling portions may be contained within a volume defined between the third pair of parallel plates. The one or more slots of the fourth coupling portion may be contained within a volume defined between the first pair of parallel plates.

Additionally or alternatively, the one or more slots may be contained within a volume defined by the respective fourth pair of opposed parallel plates and/or the fifth pair of opposed parallel plates. More specifically, the one or more slots of the fifth coupling portion may be contained within a volume defined between the fourth pair of parallel plates. The one or more slots of the sixth coupling portions may be contained within a volume defined between the fifth pair of parallel plates.

Advantageously, by allowing the one or more slots to be positioned within the volume defined by the respective pair of opposed parallel plates, the connection between the coupling portions is encased within the respective base members and/or intermediate members. This in turn strengthens the connection between the respective intermediate members and base members.

An opening defined by the one or more slots may have a substantially rectangular cross-section. Correspondingly, a cross-section through each of the one or more arms may be substantially rectangular. The rectangular shape of the one or more slots and the corresponding rectangular cross-section of each of the one or more arms ensures that the arms are not able to rotate within the corresponding slots.

The intermediate member may comprise one or more tabs. The tabs may be detachable to allow the angle between the first base member and the second base member to be adjusted during assembly. The one or more tabs may allow the angle of connection between the first base member and the second base member to be adjusted by $\pm 5^\circ$.

The one or more tabs may be positioned at the first edge and the second edge of the intermediate member. More specifically, the one or more tabs may be connected to, or formed by, one or both of the third pair of opposed parallel plates.

The second intermediate member may comprise one or more tabs. The tabs may be detachable to allow the angle between the first base member and the third base member to be adjusted during assembly. The one or more tabs may allow the angle of connection between the first base member and the third base member to be adjusted by $\pm 5^\circ$.

The one or more tabs may be positioned at the first edge and the second edge of the second intermediate member. More specifically, the one or more tabs may be connected to, or formed by, one or both of the fifth pair of opposed parallel plates.

The one or more tabs may be detached from the respective intermediate members by snapping, cutting or breaking.

Advantageously, by allowing the angle of connection between the respective base members to be adjusted slightly during assembly, the assembly process is more flexible and adaptable to the exact environment in which the barrier is to be positioned. For example, small changes in the direction of the barrier trajectory may be facilitated by removing the one or more tabs. This allows the barrier to have a greater assembly tolerance that may account for a reasonable amount of error in the initially predicted barrier trajectory. Further, a single intermediate member may provide two potential angles of connection between the respective base members. For example, a single intermediate member may connect the first base member to the second base member at an angle of 10° or 15° . This reduces the total number of distinct intermediate members which need to be produced, thereby simplifying and increasing the efficiency of the manufacturing process.

The first base member may comprise a third edge, the third edge being adjacent to the first edge of the first base member. The second base member may comprise a second edge, the second edge being adjacent to the first edge of the second base member. The barrier may further comprise at least one leg extending away from the third edge of the first base member and/or the second edge of the second base member.

The third base member may comprise a second edge, the second edge being adjacent to the first edge of the third base member. The barrier may further comprise a leg extending away from the second edge of the third base member.

5 In use, the third edge of the first base member may be positioned furthest away from the expected direction of vehicle impact (e.g. the third edge of the first base member faces the area to be protected from oncoming vehicles). Similarly, the second edge of the second base member may be positioned furthest away from the expected direction of vehicle impact (e.g. the second edge of the second base member faces the area to be protected from oncoming vehicles). Further, the second edge of the third base member may be positioned furthest away from the expected direction of vehicle impact (e.g. the second edge of the third base member faces the area to be protected from oncoming vehicles).

15 The distance to the distal edge of the one or more legs, located furthest away from the bollards, is much shorter than the total length of the barrier. Thus, the impact forces (which are transferred from the impacting vehicle to the ground surface through the base members and/or the intermediate members) are concentrated on a relatively limited distal edge length of the one or more legs. This concentration of force increases the pressure applied to the ground surface by the one or more legs, enhancing the tendency of the one or more legs to dig into the ground surface. Consequently, when vehicle impact forces are imparted to the one or more bollards, some of the impact load may be transferred from the bollard to the one or more legs through the base members and/or the intermediate members. This provides an efficient means of load transfer away from the barrier and into the ground.

20 The third edge of the first base member and/or the second edge of the second base member may comprise a recess for receiving the at least one leg. Additionally or alternatively, the second edge of the third base member may comprise a recess for receiving the at least one leg.

30 The recess may have a suitable size and shape to accommodate an end of the one or more legs. For example, the recess may have a substantially rectangular cross-section and the one or more legs may have a corresponding rectangular profile.

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Prior to assembly, the one or more legs may not be connected to the respective base members. This improves the flexibility of the assembly process. For example, once on-site, the user can decide where to place the one or more legs in order to avoid any obstacles along the trajectory of the barrier. Further, the separate base members and legs are easier to store and transport.

The first base member and the second base member may comprise a socket for receiving the respective bollards. Additionally or alternatively, the third base member may comprise a socket for receiving a bollard.

The socket may be configured to rigidly hold the bollard therein. The socket may have a substantially annular profile. The bollard may be cylindrical. Prior to assembly, the one or more bollards may not be connected to the respective base members. The separate bollards and base members are easier to transport and store.

The barrier may be provided in a disassembled form. More specifically, the barrier may be supplied as a kit of parts which can be assembled into a barrier at the location at which the barrier is to be installed. The barrier disclosed herein is particularly suited to being supplied as a kit of parts, because the individual base members and intermediate members do not need to be welded together. The base members and the intermediate members are instead secured together by using the ballast material, which can easily be achieved on a construction site. By supplying the barrier as a kit of parts, its component parts can be more easily transported and stored than if the barrier were to be supplied in an assembled form.

In accordance with a second aspect, there is provided a kit of parts for making a barrier. The kit of parts may comprise a first base member and a second base member. Each of the base members may comprise a socket for receiving a bollard therein. The kit of parts may further comprise an intermediate member configured to rigidly connect the first base member to the second base member. The first base member may comprise a first coupling portion positioned at a first edge of the first base member. The second base member may comprise a second coupling portion positioned at a first edge of the second base member. The intermediate member may comprise a pair of third coupling portions positioned at a first edge and a second edge of the intermediate member respectively. The third coupling portions may be complementary to both the

first coupling portion and the second coupling portion. The first base member, the second base member and the intermediate member may extend in a common plane when assembled. Both the first coupling portion and the second coupling portion may be configured to engage the third coupling portion as the first base member and the second base member are translated along the common plane relative to the intermediate member.

The kit of parts may further comprise a second intermediate member. Additionally, the kit of parts may comprise a third base member comprising a socket for receiving a bollard therein. The second intermediate member may be configured to rigidly connect the third base member to a second edge of the first base member.

The first base member may comprise a fourth coupling portion positioned at the second edge of the first base member. The third base member may comprises a fifth coupling portion positioned at a first edge of the third base member. The second intermediate member may comprises a pair of sixth coupling portions positioned at a first edge and a second edge of the second intermediate member respectively. The sixth coupling portions may be complementary to both the fifth coupling portion and the fourth coupling portion.

The kit of parts may further comprise one or more bollards. The one or more bollards may be configured to slot into a respective one of the sockets within the one or more base members.

The first base member, the second base member, the third base member, the intermediate member and/or the second intermediate member according to the second aspect may comprise some or all of the features of the corresponding first base member, the second base member, the third base member, the intermediate member and/or the second intermediate member according to the first aspect.

The skilled person will appreciate that except where mutually exclusive, a feature described in relation to any of the aspects, examples or embodiments described herein may be applied to any other aspect, example, embodiment or feature. Further, the description of any aspect, example or feature may form part of or the entirety of an embodiment of the invention as defined by the claims.

Brief Description of the Drawings

Embodiments will now be described, purely by way of example, with reference to the accompanying drawings, in which like features are denoted by like reference signs, and in which:

Figure 1 shows an exploded isometric view of a barrier;
Figure 2a shows an isometric view of a base member;
10 Figure 2b shows an exploded isometric view of the base member of Figure 2a;
Figure 3a shows an exploded isometric view of an intermediate member;
Figure 3b shows a close up of an area A of Figure 3a;
Figure 4a shows an isometric view of an assembled barrier;
Figure 4b shows an isometric view of an internal structure of the barrier of Figure 4a;
15 Figure 5a shows a plan view of the barrier of Figure 4a;
Figure 5b shows a plan view of a barrier comprising an intermediate member without tabs;
Figure 6 shows a plan view of nine different intermediate members; and
Figure 7 shows a barrier having a plurality of base members and intermediate
20 members.

Detailed Description

In the drawings, like features are assigned like reference symbols. It will be understood
25 that the use of terms such as vertical, horizontal, left, right etc. are for descriptive purposes only to aid comprehension, and thus do not preclude alternative orientations or configurations of the disclosed invention.

Figure 1 shows an exploded isometric view of a barrier 100. The barrier 100 comprises
30 a first base member 102, a second base member 106 and an intermediate member 104.

The first base member 102 comprises a first body 108 and a first bollard 112. The first
body 108 is rectangular in shape. The first body 108 comprises a first socket 116 for
35 receiving the first bollard 112 therein. The first base member 102 comprises a first

coupling portion 105 positioned at a first edge of the first base member 102. More specifically, the first coupling portion 105 is positioned at a first edge of the first body 108. The first base member 102 further comprises a fourth coupling portion 113 positioned at a second edge of the first base member 102. More specifically, the fourth
5 coupling portion 113 is positioned at a second edge of the first body 108. The first edge of the first body 108 is located opposite to the second edge of the first body 108.

The second base member 106 comprises a second body 110 and a second bollard 114. The second body 110 is rectangular in shape. The second body 110 comprises a
10 second socket 118 for receiving the second bollard 114 therein. The second base member 106 comprises a second coupling portion 107 positioned at a first edge of the second base member 106. More specifically, the second coupling portion 107 is positioned at a first edge of the second body 110. The second base member 106 is identical to the first base member 102.

15 The intermediate member 104 comprises a pair of third coupling portions 111, 109 positioned at a first edge and a second edge of the intermediate member 104 respectively. The third coupling portions 109, 111 are complementary to both the first coupling portion 105 and the second coupling portion 107. For example, the third
20 coupling portion 111 at the first edge of the intermediate member 104 is complementary to the first coupling portion 105 at the first edge of the first base member 102 and the third coupling portion 109 at the second edge of the intermediate member 104 is complementary to the second coupling portion 107 at the first edge of the second base member 106.

25 In this embodiment, the third coupling portion 111 at a first edge of the intermediate member 104 is identical to the third coupling portion 109 at a second edge of the intermediate member 104. Further, the first coupling portion 105 at the first edge of the first base member 102 is identical to the second coupling portion 107 at the first edge
30 of the second base member 106.

The intermediate member 104 is configured to rigidly connect the first base member 102 to the second base member 106. When the barrier is assembled, the first base member 102, the second base member 106 and the intermediate member 104 extend
35 in a common plane. The common plane may coincide with a surface (e.g., the base of

an excavation) in which the barrier 100 is to be installed. Both the first coupling portion 105 and the second coupling portion 107 are configured to engage the third coupling portions 111, 109 when the first base member 102 and the second base member 106 are translated along the common plane relative to the intermediate member 104, as will
5 be further described with reference to Figures 4a and 4b.

The intermediate member 104, the first base member 102, and the second base member 106 are adapted for ground engagement by embedment within a ground or floor surface. More specifically, when the barrier 100 is assembled on-site, the
10 intermediate member 104, the first body 108 of the first base member 102 and the second body 110 of the second base member 106 are buried within a ground or floor surface.

The barrier 100 is a shallow-mount bollard barrier. A “*shallow-mount*” bollard barrier is
15 the term generally given to ground-engaging bollards, often for use in impact-resistant barriers, possessing a significant laterally extending base member (e.g. the first base member 102 and the second base member 106), fixed at a base of the respective upstanding bollards (e.g. first bollard 112 and second bollard 114), for engaging and
20 extending across the ground at the base of an excavation which is subsequently filled in to bury the base member (e.g. with earth, concrete or tarmac). The base member provides support to the upstanding bollard, and resistance to the forces that may be applied to the bollard by a vehicular impact, and requires a much shallower excavation to accommodate it than is required for other types of impact-resistant bollard barriers.

Figure 2a shows an isometric view of the first base member 102 and Figure 2b shows
25 an exploded isometric view of the first base member 102. The structure of the first base member 102 will be described in more detail with reference to both Figure 2a and Figure 2b. Although not described in detail, the structure of the second base member 106 is substantially identical to the structure of the first base member 102.

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The first body 108 of the first base member 102 comprises a lid 210 and a foundation 211. The lid 210 is configured to slot over the foundation 211.

The lid 210 is substantially u-shaped, comprising a first shoulder 212, a first top plate
35 216 and a second shoulder 218. The first shoulder 212 is connected at a 90° angle to

the first top plate 216. The second shoulder 218 is connected at a 90° angle to the first top plate 216. The first shoulder 212, the second shoulder 218 and the first top plate 216 may be integrally formed from a single plate of metal. By forming the lid 210 from a single U-shaped plate of metal, the lid 210 may be manufactured quickly and inexpensively, while maintaining adequate strength to withstand the force of a vehicular impact.

The second shoulder 218 defines a third edge of the first base member 102 and the first shoulder 212 defines a fourth edge of the first base member. When the first body 210 is assembled, the third edge of the first base member 102 is adjacent to both the first and second edges of the first base member 102. The fourth edge of the first base member 102 is adjacent to both the first and second edges of the first base member 102, and opposite to the third edge.

The first top plate 216 comprises an opening 220. The opening 220 is configured to slot over the first socket 116. In the example shown, the opening 220 is circular. When assembled, the first bollard 112 is inserted through the opening 220 and into the first socket 116. After being inserted into the first socket 116, the first bollard 112 cannot easily be displaced by a vehicular impact.

The first socket 116 comprises one or more gusset plates 299. The gusset plates 299 are connected to an outer surface of the first socket 116. More specifically, the gusset plates 299 are connected to an upper portion of the outer surface of the first socket 116. The gusset plates 299 are configured to brace the upper portion of the first socket 116 against the top plate 216. In some embodiments, the gusset plates 299 are present along the whole outer perimeter of the first socket 116. Alternatively, the gusset plates 299 are only present on the side of the first socket 116 furthest away from the anticipated direction of a vehicular impact, so as to strengthen the first socket 116 and in turn provide additional support to the first bollard 112.

The first top plate 216 further comprises a plurality of openings 214 for receiving a ballast material. Only three openings 214 are labelled in Figure 2a, but the example shown in the figures comprises twelve openings. The ballast material may comprise concrete, grout, cement, sand, asphalt, tarmac and/or gravel. The ballast material may be inserted through the plurality of openings 214 in the first top plate 216. In this

manner, the ballast material may fill in the volume defined between the lid 210 and the foundation 211 of the first base member 102. The ballast material may allow for a better engagement between the third coupling portion 111 at the first edge of the intermediate member 104 and the first coupling portion 105 at the first edge of the first base member 102.

The foundation 211 comprises four U-shaped portions.

A first U-shaped portion comprises a first wall 268, a first base plate 290 and a second wall 262a (best seen in Figure 4b). The first wall 268 and the second wall 262a are connected to the first base plate 290. Both the first wall 268 and the second wall 262a are perpendicular to the first base plate 290. In some embodiments, the first wall 268, the second wall 262a and the first base plate 290 are integrally formed. For example, the first wall 268, the second wall 262a and the first base plate 290 may be formed from a single bent metal plate.

A second U-shaped portion comprises a third wall 262b, a second base plate 292 and a fourth wall 260a (best seen in Figure 4b). The third wall 262b and the fourth wall 260a are connected to the second base plate 292. Both the third wall 262b and the fourth wall 260a are perpendicular to the second base plate 292. In some embodiments, the third wall 262b, the fourth wall 260a and the second base plate 292 are integrally formed. For example, the third wall 262b, the fourth wall 260a and the second base plate 292 may be formed from a single bent metal plate.

A third U-shaped portion comprises a fifth wall 260b, a third base plate 294 and a sixth wall 258a (best seen in Figure 4b). The fifth wall 260b and the sixth wall 258a are connected to the third base plate 294. Both the fifth wall 260b and the sixth wall 258a are perpendicular to the third base plate 294. In some embodiments, the fifth wall 260b, the sixth wall 258a and the third base plate 294 are integrally formed. For example, the fifth wall 260b, the sixth wall 258a and the third base plate 294 may be formed from a single bent metal plate.

A fourth U-shaped portion comprises a seventh wall 258b, a fourth base plate 296 and an eighth wall 240. The seventh wall 258b and the eighth wall 240 are connected to the fourth base plate 296. Both the seventh wall 258b and the eighth wall 240 are

perpendicular to the fourth base plate 296. In some embodiments, the seventh wall 258b, the eighth wall 240 and the fourth base plate 296 are integrally formed. For example, the seventh wall 258b, the eighth wall 240 and the fourth base plate 296 may be formed from a single bent metal plate.

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The second wall 262a of the first U-shaped portion is connected to the third wall 262b of the second U-shaped portion. The fourth wall 260a of the second U-shaped portion is connected to the fifth wall 260b of the third U-shaped portion. The sixth wall 258a of the third U-shaped portion is connected to the seventh wall 258b of the fourth U-shaped portion. In this manner, the four U-shaped portions collectively form a single unit.

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In this embodiment, the foundation 211 is formed by four U-shaped portions. However, in other embodiments the foundation 211 may be formed by one, two, three, five, or more U-shaped portions. Additionally or alternatively, some of the U-shaped portions may be replaced by L-shaped portions. For example, the second and third U-shaped portions may be replaced by corresponding L-shaped portions (e.g. the L-shaped portions that do not have the fourth wall 260a and the seventh 258a of the respective U-shaped portions).

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The first base plate 290, the second base plate 292, the third base plate 294 and the fourth base plate 296 collectively form a first bottom plate. When assembled, the first bottom plate is parallel to the first top plate 216. The first wall 268, the second wall 262a, the third wall 262b, the fourth wall 260a, the fifth wall 260b, the sixth wall 258a, the seventh wall 258b and the eighth wall 240 are connected to, and effectively sandwiched between, the first bottom plate and the first top plate 216. The first socket 116 is fixed to fourth wall 260a, the fifth wall 260b, the second base plate 292 and the third base plate 294.

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By constructing the foundation 211 from a plurality of integrally formed U-shaped portions, the first base member 102 can be manufactured quickly and inexpensively, while also having a robust structural integrity.

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The first coupling portion 105 comprises a first slot 244, a second slot 246, a third slot 242, a fourth slot 248, a fifth slot 250, a sixth slot 254, a seventh slot 252 and an eighth

slot 256. The first slot 244, the third slot 242, the fifth slot 250 and the seventh slot 252 are located within (in other words, pass through) the eighth wall 240. The second slot 246, the fourth slot 248, the sixth slot 254 and the eighth slot 256 are located within the sixth wall 258a and the seventh wall 258b. The second slot 246 is aligned with, and spaced apart from, the first slot 244, such that the first slot 244 and the second slot 246 collectively form a continuous channel. The fourth slot 248 is aligned with, and spaced apart from, the third slot 242, such that the fourth slot 248 and the third slot 242 collectively form a continuous channel. The sixth slot 254 is aligned with, and spaced apart from, the fifth slot 250, such that the sixth slot 254 and the fifth slot 250 collectively form a continuous channel. The seventh slot 256 is aligned with, and spaced apart from, the eighth slot 252, such that the seventh slot 256 and the eighth slot 252 collectively form a continuous channel.

The fourth coupling portion 113 comprises a first slot 276, a second slot 280, a third slot 274, a fourth slot 278, a fifth slot 272, a sixth slot 264, a seventh slot 270 and an eighth slot 266. The first slot 276, the third slot 274, the fifth slot 272 and the seventh slot 270 are located within the first wall 268. The second slot 280, the fourth slot 278, the sixth slot 264 and the eighth slot 266 are located within the second wall 262a and the third wall 262b. The second slot 280 is aligned with, and spaced apart from, the first slot 276, such that the first slot 276 and the second slot 280 collectively form a continuous channel. The fourth slot 278 is aligned with, and spaced apart from, the third slot 274, such that the fourth slot 278 and the third slot 274 collectively form a continuous channel. The sixth slot 264 is aligned with, and spaced apart from, the fifth slot 272, such that the sixth slot 264 and the fifth slot 272 collectively form a continuous channel. The seventh slot 270 is aligned with, and spaced apart from, the eighth slot 266, such that the seventh slot 270 and the eighth slot 266 collectively form a continuous channel.

All of the slots 244, 246, 242, 248, 250, 254, 252, 256, 276, 280, 274, 278, 272, 264, 270, 266 are contained within a volume defined between the first top plate 216 and the first bottom plate.

The first base member 102 further comprises a leg 222. The leg 222 comprises one or more rails, which may be substantially parallel to each other. In the example shown, the leg 222 comprises a first rail 232, a second rail 230, a third rail 224 and a fourth rail

226. The first rail 232, the second rail 230, the third rail 224 and the fourth rail 226 are connected together using perpendicularly placed connecting bars 236, 234, 228 and 227. The distal ends of the first rail 232, the second rail 230, the third rail 224 and the fourth rail 226 are configured to slot through a first group of recesses (not shown) in the second shoulder 218, channels defined by the second U-shaped element and the third U-shaped element, and into a second group of recesses 241 in the first shoulder 212.

In the embodiment shown, the leg 222 comprises four rails 232, 230, 224, 226. However, in different embodiments the leg 222 may comprise any number of rails. For example, the leg 222 may comprise one, two, three, five, six, or more rails. Similarly, the leg 222 may comprise any number of connecting bars. For example, the leg 222 may comprise, one, two, four, five, or more connecting bars.

Advantageously, when vehicle impact forces are imparted to the bollard 112, some of the impact load is transferred from the bollard 112 to the leg 222 through the first body 108. This provides an efficient means of load transfer away from the barrier 100 and into the ground.

Prior to assembly, the bollard 112 and the leg 222 may not be connected to the first body 108. For example, the bollard 112, the leg 222 and the first body 108 may be transported separately and only assembled on-site. This allows for a more efficient transportation of parts, as the individual elements can be easily stacked. Further, this improves the flexibility of the assembly process. For example: once on-site, the user can determine which base member (e.g. 102, 106) should receive the leg 222 in order to avoid any obstacles (e.g. underground services or street furniture) along the trajectory of the barrier 102. In other words, the leg 222 is optional. The leg may be omitted from a particular base member if the leg 222 would interfere with obstacles, or if the leg 222 is deemed to be unnecessary in view of the magnitude of the vehicle impact forces that a barrier is designed to withstand.

Figure 3a shows an exploded isometric view of the intermediate member 104. Figure 3b shows a close up of an area A of Figure 3a.

The intermediate member 104 comprises a second top plate 300 and a second bottom plate 315. The second top plate 300 is parallel to the second bottom plate 315. The

intermediate member 104 further comprises two supporting plates 317, 319. The two supporting plates 317, 319 are sandwiched between, and connected to, both of the second top plate 300 and the second bottom plate 315.

5 The third coupling portion 111 at the first edge of the intermediate member 104 comprises a first arm 318, a second arm 320, a third arm 322 and a fourth arm 310. The first arm 318, the second arm 320, the third arm 322 and the fourth arm 310 are substantially parallel to each other and extend away from the first edge of the intermediate member 104.

10 The third coupling portion 109 at the second edge of the intermediate member 104 comprises a fifth arm 316, a sixth arm 314, a seventh arm 312 and an eighth arm 313. The fifth arm 316, the sixth arm 314, the seventh arm 312 and the eighth arm 313 are substantially parallel to each other and extend away from the second edge of the
15 intermediate member 104.

As shown in Figure 3a, the first arm 318 and the fifth arm 316 are formed by a single continuous bar; the second arm 320 and the sixth arm 314 are formed by a single continuous bar; the third arm 322 and the seventh arm 312 are formed by a single
20 continuous bar; and the fourth arm 310 and the eighth arm 313 are formed by a single continuous bar. All of the arms 318, 320, 310, 322, 316, 314, 312 and 313 are connected to, and sandwiched between, the second bottom plate 315 and the second top plate 300.

25 In this embodiment, the third coupling portion 111 at the first edge of the intermediate member 104 is positioned in a linear angular relationship with respect to the third coupling portion 109 at the second edge of the intermediate member 111. However, in other embodiments, the third coupling portion 111 at the first edge of the intermediate member 104 may be positioned in a non-linear angular relationship with respect to the
30 third coupling portion 109 at the second edge of the intermediate member 111.

The second top plate 300 comprises two openings 302, 304 for receiving a ballast material. The ballast material may comprise concrete, cement, sand, asphalt, tarmac and/or gravel. The ballast material may be inserted through the two openings 302, 304
35 in the second top plate 300. In this manner, the ballast material may fill in the volume

defined between the second top plate 300 and the second bottom plate 315 of the intermediate member 104. The ballast material may allow for a better engagement between the third coupling portions 111, 109 and the respective first coupling portion 105 and the second coupling portion 107, as will be described in more detail with reference to Figure 4a and 4b.

The second top plate 300 of the intermediate member 104 further comprises a first tab 306 and a second tab 308. The first tab 306 and the second tab 308 are integrally formed with the second top plate 300. The first tab 306 is positioned at the first edge of the intermediate member 104 and the second tab 308 is positioned at the second edge of the intermediate member 104. The first tab 306 may be detached from the second top plate 300 by snapping it off along a cut line 342. Similarly, the second tab 308 may be detached from the second top plate 300 by snapping it off along a second cut line 340. By detaching the tabs 306, 308 from the second top plate 300, an angle of connection between the first base member 102 and the second base member 106 can be adjusted during assembly as will be described further with reference to Figures 5a and 5b.

Figure 4a shows an isometric view of the assembled barrier 100 and Figure 4b shows an isometric view of an internal structure of the barrier 100 depicted in Figure 4a. For the sake of clarity, the respective bollards 112, 114 are omitted from Figures 4a and 4b.

The structure of the second base member 106 is identical to the structure of the first base member 102.

More specifically, the second coupling portion 107 of the second base member 106 also comprises a first slot 418, a second slot 416, a third slot 420, a fourth slot 414, a fifth slot 424, a sixth slot 412, a seventh slot 422 and an eighth slot 410. The first slot 418, the third slot 420, the fifth slot 424 and the seventh slot 422 are located within a first wall 450 of the second base member 106. The second slot 416, the fourth slot 414, the sixth slot 412 and the eighth slot 410 are located within a second wall 452 of the second base member 106. The second slot 416 is aligned with, and spaced apart from, the first slot 418, such that the first slot 418 and the second slot 416 collectively form a continuous channel. The fourth slot 414 is aligned with, and spaced apart from, the

third slot 420, such that the fourth slot 414 and the third slot 420 collectively form a continuous channel. The sixth slot 412 is aligned with, and spaced apart from, the fifth slot 424, such that the sixth slot 412 and the fifth slot 424 collectively form a continuous channel. The seventh slot 410 is aligned with, and spaced apart from, the eighth slot 422, such that the seventh slot 410 and the eighth slot 422 collectively form a continuous channel.

Further, the second base member 106 also comprises a third top plate 404 and a plurality of openings 402 located within the third top plate 404.

During assembly, the first base member 102 and the second base member 106 are translated along the common plane relative to the intermediate member 104 until the first coupling portion 105 engages the third coupling portion 111 at the first edge of the intermediate member 104 and the second coupling portion 107 engages the third coupling portion 109 at the second edge of the intermediate member 104.

As the first base member 102 is translated along the common plane relative to the intermediate member 104, the respective arms of the third coupling portion 111 fit into the respective slots of the first coupling portion 105. More specifically: the first arm 318 fits through both the first slot 244 and the second slot 246, the second arm 320 fits through both the third slot 242 and the fourth slot 248, the third arm 322 fits through both the fifth slot 250 and the sixth slot 254, and the fourth arm 310 fits through both the seventh slot 252 and the eighth slot 256.

As the second base member 106 is translated along the common plane relative to the intermediate member 104, the respective arms of the third coupling portion 111 fit into the respective slots of the second coupling portion 107. More specifically: the fifth arm 316 fits through both the first slot 418 and the second slot 416, the sixth arm 314 fits through both the third slot 420 and the fourth slot 414, the seventh arm 312 fits through both the fifth slot 424 and the sixth slot 412, and the eighth arm 313 fits through both the seventh slot 422 and the eighth slot 410.

Each arm fits into the respective slots to rigidly connect the intermediate member 104 to each of the first 102 and the second 106 base members. Advantageously, the continuous passages created by the slots prevent the arms of the third coupling

portions 111, 109 from rotating within the first coupling portion 105 and the second coupling portion 107. In this manner, the intermediate member 104 is prevented from rotating relative to the first base member 102 and the second base member 106 during a vehicular impact. This not only improves the structural integrity of the barrier 100, but also ensures that the energy of a vehicular impact is spread out across different sections of barrier 100, rather than being focused on a single impact point.

After the third coupling portions 111, 109 are engaged with the respective first coupling portion 105 and the second coupling portion 107, the ballast material is inserted through the plurality of openings 214, 304, 302 and 402 in the first top plate 216, the second top plate 300 and the third top plate 404, respectively.

The ballast material fills in the space between the third coupling portions 111, 109 and the respective first 105 and the second 107 coupling portions, thereby immobilising the arms of the third coupling portions 111, 109 within the respective slots of the first 105 and second 107 coupling portions. As such, the ballast material allows for a better engagement between the third coupling portions 111, 109 and the respective first coupling portion 105 and the second coupling portion 107.

The ballast material may remove the need for welding the respective coupling portions 105, 111, 107, 109 together during installation. This eliminates the time-consuming process of having to weld the individual elements together on-site during the assembly of the barrier 100. In conventional barriers, the respective coupling portions need to be welded together which burns off the galvanized surface at the weld area leading to an increased risk of corrosion. By using the ballast material to improve the engagement between the respective coupling portions 105, 111, 107, 109, the risk of corrosion is reduced or eliminated.

In the above embodiment the third coupling portions 111, 109 are depicted as arms and the first 105 and second 107 coupling portions are depicted as slots. However, in a second embodiment (not shown), the third coupling portions 111, 109 comprise a plurality of slots and the first 105 and second 107 coupling portions comprise two or more corresponding arms (i.e. the position of the arms and slots on the respective coupling portions is swapped).

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Figure 5a shows a plan view of the barrier 100. Figure 5b shows a plan view of the barrier 100 comprising an intermediate member 104 without the first tab 306 and the second tab 308.

- 5 In Figure 5a, the intermediate member 104 connects the first base member 102 to the second base member 106 at a 180° angle. In other words, the first base member 102 and the second base member 106 extend along a straight line.

10 Sometimes, the angle of connection between the first base member 102 and the second base member 106 may need to be modified slightly. For example, on-site a slight deviation from the linear trajectory of the barrier 100 may be required due to the presence of an obstacle.

15 By detaching (e.g. by snapping, cutting or breaking) the first tab 306 and/or the second tab 308 away from the second top plate 300, the angle between the first base member 102 and the second base member 106 can be modified. In the example shown in Figure 5b both the first tab 306 and the second tab 308 have been detached and the angle between the first base member 102 and the second base member 106 has been modified by +/- 5°. In other embodiments, only a single tab may be removed. For example, if only one of the first tab 306 and the second tab 308 is detached, the angle between the first base member 102 and the second base member 106 can be modified by +/- 2.5°. When the first tab 306 and the second tab 308 are removed, the lower portion of the first base member 102 and the lower portion of the second base member 106 can be slid further along the arms of the third coupling portions 111, 109. In this manner, the angle between the first base member 102 and the second base member 106 is altered.

25 Although in this embodiment the tabs 306, 308 allow for a modification of +/- 5° in the angle of connection, in other embodiments the tabs 306, 308 may be configured to allow the angle of connection to be modified by +/- 1°, +/- 2°, +/- 3°, +/- 4°, +/- 6°, +/- 7°, +/- 8°, +/- 9° or +/- 10°.

30 The angular relationship between the first base member 102 and the second base member 106 can be further modified by using an appropriately shaped intermediate member as will be described in more detail with reference to Figure 6.

Figure 6 shows a plan view of nine different intermediate members. All of the intermediate members depicted in Figure 6 may connect a first base member 102 in a non-linear angular relationship with respect to the second base member 106. All of these intermediate members comprise a plurality of coupling portions (arms) positioned at a first edge and a second edge of the intermediate member, respectively. The coupling portions at the first edge of the intermediate member are positioned in a non-linear angular relationship with respect to the coupling portions at the second edge of the intermediate member.

10 A second intermediate member 600 is configured to connect the first base member 102 at an angle of 10° to the second base member 106. A third intermediate member 602 is configured to connect the first base member 102 at an angle of 20° to the second base member 106. A fourth intermediate member 604 is configured to connect the first base member 102 at an angle of 30° to the second base member 106. A fifth intermediate member 606 is configured to connect the first base member 102 at an angle of 40° to the second base member 106. A sixth intermediate member 608 is configured to connect the first base member 102 at an angle of 50° to the second base member 106. A seventh intermediate member 610 is configured to connect the first base member 102 at an angle of 60° to the second base member 106. An eighth intermediate member 612 is configured to connect the first base member 102 at an angle of 70° to the second base member 106. A ninth intermediate member 614 is configured to connect the first base member 102 at an angle of 80° to the second base member 106. A tenth intermediate member 616 is configured to connect the first base member 102 at an angle of 90° to the second base member 106. More angle variations, which are not explicitly depicted here, are possible.

Figure 7 shows a barrier 700 having a plurality of base members and intermediate members.

30 More specifically, the barrier 700 comprises the first base member 102, the intermediate member 104, the second base member 106, a left facing fifth intermediate member 606a, a right facing fifth intermediate member 606b, a third base member 704, a fourth base member 706, the ninth intermediate member 614 and a fifth base member 708.

The first base member 102, the second base member 106, the third base member 704, the fourth base member 706 and the fifth base member 708 are all identical. The left facing fifth intermediate member 606a is identical to the right facing fifth intermediate member 606b (the only difference being their relative orientation, as the right facing fifth intermediate member 606b is rotated by 180° with respect to the left facing fifth intermediate member 606a).

The second base member 106 is rigidly connected to the first base member 102 using the intermediate member 104. The first base member 102 is rigidly connected to the third base member 704 using the left facing fifth intermediate member 606a. Specifically, the fourth coupling portion 113 (shown in Figure 2b) is connected to the corresponding coupling portion of the left facing fifth intermediate member 606a. The third base member 704 is rigidly connected to the fourth base member 706 using the right facing fifth intermediate member 606b. The fourth base member 706 is in turn rigidly connected to the fifth base member 708 using the ninth intermediate member 614.

Although not depicted in Figure 7, barriers having different trajectories can be constructed from a plurality of identical base members and a plurality of different intermediate members (shown, for example, in Figure 6). Advantageously, a barrier constructed from a plurality of identical base members and a range of differently shaped intermediate members is quicker and easier to manufacture than a barrier constructed from a range of differently shaped base members.

The existence of obstacles on the intended positioning or linear trajectory of the barrier 700 may pose difficulties during assembly of traditional barriers. Additionally, sharp turns in the trajectory of the barrier may be required to avoid obstacles (e.g. street furniture) or to follow a desired arcuate route (e.g. due to a turn in a pavement). Advantageously, by allowing individual base members to be connected in a non-linear angular relationship with respect to the consecutive base members, an obstacle 702 (such a tree, lay-by or corner) can be avoided by selecting an appropriate set of base members 106, 102, 704, 706, 708 and the intermediate members 104, 606a, 606b, 614.

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Although the bollards illustrated herein have a circular cross-section, the present disclosure can be applied to bollards with other shapes (e.g., bollards with oval, square, rectangular, polygonal or irregular cross-sections). In such cases, the shape of the sockets of the base members will complement the shape of the bollards.

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It will also be understood that the barrier 700 can have any number of base members and/or intermediate members. Further, each base member may comprise more than one bollard, or even no bollards at all. Sometimes, a portion of the barrier may be required to not have any upstanding bollards (e.g., to provide a break in the barrier, thus allow vehicles to pass through a specific area in the barrier). By allowing one or more base members not to have any bollards, a break in the barrier is facilitated while allowing the barrier to maintain a continuous line of underground base members and/or intermediate members along which a force of a vehicular impact may be spread.

Further, the first coupling portion 105, the second coupling portion 107 and the fourth coupling portion 113 have been described as possessing eight different slots. However, in other embodiments, the first coupling portion 105, the second coupling portion 107 and the fourth coupling portion 113 may comprise any number of slots. For example, the first coupling portion 105, the second coupling portion 107 and the fourth coupling portion 113 may each comprise one, two, three, four, five, six, seven, nine, or more slots.

Similarly, the third coupling portions 111, 109 of the intermediate member 104 have been described as having eight different arms. However, in other embodiments the coupling portions of the intermediate members may comprise any number of arms. For example, the third coupling portions may comprise two, three, four, five, six, seven, nine or more arms.

It will be appreciated by the person of skill in the art that various modifications may be made to the above described embodiments without departing from the scope of the invention. Any embodiment described herein is not necessarily to be construed as preferred or advantageous over other embodiments.

CLAIMS:

1. A barrier comprising:
 - a first base member and a second base member, each comprising a respective
 - 5 bollard upstanding therefrom; and
 - an intermediate member rigidly connecting the first base member to the second base member;
 - the first base member comprising a first coupling portion positioned at a first edge of the first base member,
 - 10 the second base member comprising a second coupling portion positioned at a first edge of the second base member,
 - the intermediate member comprising a pair of third coupling portions positioned at a first edge and a second edge of the intermediate member respectively, the third coupling portions being complementary to both the first coupling portion and the
 - 15 second coupling portion, and
 - wherein the first base member, the second base member and the intermediate member extend in a common plane, and both the first coupling portion and the second coupling portion are configured to engage the third coupling portions as the first base member and the second base member are translated along the common plane relative
 - 20 to the intermediate member.
2. A barrier according to claim 1, further comprising:
 - a second intermediate member; and
 - a third base member comprising a bollard upstanding therefrom,
 - 25 wherein the second intermediate member rigidly connects the third base member to a second edge of the first base member.
3. A barrier according to claim 2, wherein:
 - the first base member comprises a fourth coupling portion positioned at the
 - 30 second edge of the first base member;
 - the third base member comprises a fifth coupling portion positioned at a first edge of the third base member; and
 - the second intermediate member comprises a pair of sixth coupling portions positioned at a first edge and a second edge of the second intermediate member

respectively, the sixth coupling portions being complementary to both the fifth coupling portion and the fourth coupling portion.

4. A barrier according to any of the preceding claims, wherein any of the base members and/or the intermediate members are adapted for ground engagement by embedment within a ground or floor surface.
5. A barrier according to any of the preceding claims, wherein the intermediate member connects the first base member in a non-linear angular relationship with respect to the second base member.
6. A barrier according to claim 5, wherein the third coupling portion at the first edge of the intermediate member is positioned in a non-linear angular relationship with respect to the third coupling portion at the second edge of the intermediate member.
7. A barrier according to any of the preceding claims, wherein the first base member and the second base member are identical.
8. A barrier according to any of the preceding claims, wherein:
the first base member comprises a first pair of opposed parallel plates separated by, and fixed to, the first coupling portion; and/or
the second base member comprises a second pair of opposed parallel plates separated by, and fixed to, the second coupling portion; and/or
the intermediate member comprises a third pair of opposed parallel plates separated by, and fixed to, the pair of third coupling portions.
9. A barrier according to claim 8, wherein a first top plate of the first pair of opposed parallel plates, a second top plate of the second pair of opposed parallel plates and/or a third top plate of the third pair of opposed parallel plates comprise an opening for receiving a ballast material.
10. A barrier according to any of the preceding claims, wherein:
each of the first and the second coupling portions comprises at least one slot;
and

the third coupling portions comprise at least a pair of arms, each arm fitting into a respective one of the slots to rigidly connect the intermediate member to each of the first and the second base members.

- 5 11. A barrier according to claim 10, wherein:
 the first coupling portion comprises a first slot and a second slot, the second slot being aligned with, and spaced apart from, the first slot;
 the second coupling portion comprises a third slot and a fourth slot, the fourth slot being aligned with, and spaced apart from, the third slot; and
10 the third coupling portions comprise a first arm that fits into both the first and the second slots and a second arm that fits into both the third and the fourth slots, respectively.
12. A barrier according to claim 11, wherein:
15 the first coupling portion further comprises a fifth slot and a sixth slot, the sixth slot being aligned with, and spaced apart from, the fifth slot; and
 the second coupling portion further comprises a seventh slot and an eighth slot, the eighth slot being aligned with, and spaced apart from, the seventh slot; and
 the third coupling portions further comprise a third arm that fits into both the fifth and the sixth slots and a fourth arm that fits into both the seventh and the eighth slots, respectively.
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13. A barrier according to any of claims 1 to 9, wherein:
 the third coupling portions comprise at least a pair of slots; and
25 each of the first and the second coupling portions comprises an arm fitting into a respective one of the slots to rigidly connect the intermediate member to each of the first and the second base members.
14. A barrier according to claim 13, wherein:
30 the third coupling portions comprise a first slot, a second slot, a third slot and a fourth slot, wherein the second slot is aligned with, and spaced apart from, the first slot and the fourth slot is aligned with, and spaced apart from, the third slot;
 first coupling portion comprises a first arm that fits into both the first and the second slots; and

the second coupling portion comprises a second arm that fits into both the third and the fourth slots.

15. A barrier according to claim 14, wherein:

5 the third coupling portions further comprise a fifth slot, a sixth slot, a seventh slot and an eighth slot, wherein the sixth slot is aligned with, and spaced apart from, the fifth slot and the eighth slot is aligned with, and spaced apart from, the seventh slot;

the first coupling portion further comprises a third arm that fits into both the fifth and the sixth slots; and

10 the second coupling portion further comprises a fourth arm that fits into both the seventh and the eighth slots.

16. A barrier according to any of claims 10 to 15 as dependent on claim 8 or claim 9, wherein the slots are contained within a volume defined by the respective first pair of parallel plates and/or the second pair of parallel plates and/or the third pair of parallel plates.

17. A barrier according to any of the preceding claims, wherein the intermediate member comprises one or more tabs, the tabs being detachable to allow the angle between the first base member and the second base member to be adjusted during assembly.

18. A barrier according to any of the preceding claims, wherein:

25 the first base member comprises a third edge, the third edge being adjacent to the first edge of the first base member; and

the second base member comprises a second edge, the second edge being adjacent to the first edge of the second base member; and

the barrier further comprises at least one leg extending away from the third edge of the first base member and/or the second edge of the second base member.

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19. A barrier according to claim 18, wherein the third edge of the first base member and/or the second edge of the second base member comprise a recess for receiving the at least one leg.

20. A barrier according to any of the preceding claims, wherein the first base member and the second base member each comprise a socket for receiving the respective bollards.
- 5 21. A kit of parts for making a barrier, the kit of parts comprising:
a first base member and a second base member, each comprising a socket for receiving a bollard; and
an intermediate member configured to rigidly connect the first base member to the second base member;
- 10 the first base member comprising a first coupling portion positioned at a first edge of the first base member,
the second base member comprising a second coupling portion positioned at a first edge of the second base member,
the intermediate member comprising a pair of third coupling portions positioned
15 at a first edge and a second edge of the intermediate member respectively, the third coupling portions being complementary to both the first coupling portion and the second coupling portion, and
wherein the first base member, the second base member and the intermediate member extend in a common plane when assembled, and both the first coupling portion and the second coupling portion are configured to engage the third coupling portion as the first base member and the second base member are translated along the common plane relative to the intermediate member.
- 20 22. A kit of parts according to claim 21, the kit of parts further comprising:
a second intermediate member; and
a third base member comprising a socket for receiving a bollard,
wherein the second intermediate member is configured to rigidly connect the third base member to a second edge of the first base member.
- 30 23. A kit of parts according to claim 22, wherein:
the first base member comprises a fourth coupling portion positioned at the second edge of the first base member;
the third base member comprises a fifth coupling portion positioned at a first edge of the third base member; and

the second intermediate member comprises a pair of sixth coupling portions positioned at a first edge and a second edge of the second intermediate member respectively, the sixth coupling portions being complementary to both the fifth coupling portion and the fourth coupling portion.

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24. A kit of parts according to any of claims 21 to 23, further comprising one or more bollards.