

REMOVABLE BOLLARD SYSTEM AND METHOD OF INSTALLATION

Field of Invention

5 The invention relates to an anti-ram bollard assembly in which the bollard member is removable, and to deployment of multiple removable bollard assemblies to arrest vehicular attacks and prevent penetration of the vehicle. The invention also relates to a method of installing a barrier system comprising a plurality of removable bollard assemblies.

10 Background of the Invention

In recent years for security reasons, many prominent establishments such as government buildings, embassies, convention centres, public transportation hubs and other perceived terrorist targets have been equipped with barrier systems to protect the establishments from vehicle attacks. Especially if the vehicle is heavyweight or moving
15 at high speeds or carrying explosives, the attack can cause extreme destruction.

Various barrier systems have since been employed with the intention of protecting buildings and structures from attacks. Metal or concrete barriers may be erected around a building to obstruct vehicular penetration. In order to resist large impacts from speeding heavy vehicles, the barriers have to be massive, resulting in a less aesthetic system.

20 Barrier systems employing conventional bollards may be more aesthetic. However, due to their small form factor and weight, conventional bollards are useful primarily as a barrier. In order to resist large impacts, the conventional bollards usually require large and deep bases, and deep excavations to anchor their bases. Because utilities transmission such as electricity lines, water pipes and communications lines are
25 often buried underground, deep excavation to install bollards is costly and time-consuming. In addition, deep excavation causes disruption to utility services, inconvenience to pedestrian traffic, and often results in a less aesthetic landscape.

Many conventional bollards are permanent fixtures which may not be easily removed from site. Although some conventional bollards may be retractable, they

require a deep recess to store the bollards. Providing a deep recess, however, may not be possible in structures where an installation surface is above ground and has limited excavation depth, including but not limited to, bridges. Further, these retractable bollards may not be able to withstand large impact forces.

5 Summary of the Invention

Embodiments of the invention are particularly advantageous as the removable bollard assemblies may be installed in very shallow trenches without the need for deep excavations that would disrupt various utility lines buried in the ground. The depth of such trenches may be about 1.0 m or less. Yet, the impact rating (i.e. maximum impact
10 loading) of the removable bollard assemblies may be improved over conventional bollards of similar form factors. This may be achieved by various features as hereinafter described.

Each bollard assembly comprises a base assembly and at least one reinforcement
15 member attached to the base assembly, and a bollard member that is removably engaged with the base assembly. The base assembly may be constructed in various ways, including but not limited to the following. The base assembly may include a sleeve formed therein to receive the removable bollard member. A coupling mechanism may be disposed in the sleeve to removably engage the bollard member to the base assembly.
20 The base assembly may include one or more I-beam arrangements to which the sleeve may be attached. One end of the reinforcement member may be attached to the base assembly while a distant free end may extend away from the base assembly to enlarge a base area provided by the base assembly. The base assembly may also be constructed to receive rebars for connecting adjacent base assemblies.

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According to one embodiment of the invention, a plurality of spaced apart base assemblies may be deployed to form a cohesive installation. Each base assembly may be arranged such that the free ends of the reinforcement members are spaced apart from remaining adjacent base assemblies. If an impact is expected to strike a first side of the
30 bollard assembly from a particular direction, a base assembly is arranged to have the

reinforcement member generally along the same direction of the expected impact and extending from a second opposed side of the base assembly. Rebars may be provided to connect various base assemblies to form a cohesive installation. When an impact strikes any of the bollard members installed in the base assemblies, the impact force or load is effectively transferred from the bollard members to their base assemblies and distributed among various base assemblies in the installation. As and when required, the bollard member may be removed from the base assembly to permit penetration.

A combination of these and other features are designed to enhance the flexibility of the barrier installation and to increase the impact rating of a barrier installation without having to significantly increase the dimensions of the bollard assemblies. Other advantages will be apparent upon reading of the following detailed description and review of the associated drawings.

Brief Description of the Drawings

FIG. 1A is a plan view of an installation of a removable bollard assembly according to one embodiment of the invention.

FIG. 1B is a side view of the installation of FIG. 1A.

FIG. 1C is another side view of the installation of FIG. 1A.

FIG. 2 is a side view of the installation of FIG. 1A having a plurality of rebars disposed therein.

FIG. 3A is a side view of the removable bollard assembly of FIG. 1A.

FIG. 3B is a plan view of the removable bollard assembly of FIG. 3A.

FIG. 3C is a side view of FIG. 3A without a bollard member and having a cover plate.

FIG. 4A is a side view of an installation without a bollard member according to one embodiment of the invention.

FIG. 4B is a side view of an installation of FIG. 4A having a bollard member secured therein.

FIG. 4C is a side view of FIG. 4B without a bollard member and having a cover plate.

Detailed Description

In the following description, numerous specific details are set forth in order to provide a thorough understanding of various illustrative embodiments of the present invention. It will be understood, however, to one skilled in the art, that embodiments of the present invention may be practiced without some or all of these specific details. In other instances, well known process operations have not been described in detail in order not to unnecessarily obscure pertinent aspects of embodiments being described. In the drawings, like reference numerals refer to same or similar functionalities or features throughout the several views.

Reference is made to FIGs. 1A, 1B and 1C illustrating various views of an installation of a removable bollard assembly according to one embodiment of the invention. The removable bollard assembly comprises a fixed component and a removable component. The fixed component comprises a base assembly 20 having a sleeve 40 therein, and at least one reinforcement member (32a, 32b) attached to the base assembly 20. The removable component comprises a removable bollard member 10 which may be received in the sleeve 40 and removably engaged with the base assembly 20.

The base assembly 20 includes at least one I-beam (or H-beam) cross-section arrangement. The I-beam arrangement comprises a top plate 22, a bottom plate 24 and at least one intermediate plate 26 interposed therebetween. The intermediate plates 26 may be fixedly attached to the top and bottom plates 24, such as by welding, to support the top and the bottom plates 24. In the embodiment of FIGs. 1A, 1B and 1C, four intermediate plates 26 are provided in the base assembly 20 and disposed substantially perpendicular to one another. However, it should be appreciated that other number of intermediate plates 26 may be provided and may be disposed at other angles with respect to one another. In the case where only two intermediate plates 26 are provided, the two intermediate plates 26 may be disposed at about 180 degrees with respect to each other. The I-beam cross-section arrangement is to provide reinforcement to the base assembly 20. More particularly, the intermediate plates 26 support the top and the bottom plates 24

to prevent deformation due to static loading prior to loading of an impact. To further reinforce the base assembly 20, additional I-beam structures may be disposed or nested between the top and the bottom plates 22, 24 to provide further support (see FIG. 1B).

5 The base assembly 20 also includes a sleeve 40 to receive a removable bollard member 10 therein. The sleeve 40 may be formed in the base assembly 20 and integrated with the I-beam arrangement. More specifically, the sleeve 40 may be fixedly attached, such as by welding, to the top plate 22, the bottom plate 24 as well as the intermediate plates 26. Such an arrangement is to increase the strength and stability of the bollard
10 assembly. An exemplary arrangement is illustrated in FIGs. 1A, 1B, 1C, 2 and 3A in which a lower end of the sleeve 40 is attached to a bottom plate 24 and supported by four intermediate plates 26 at the sides of the sleeve 40. Another exemplary arrangement is illustrated in FIG. 4A in which a non-end portion of the sleeve 40 is supported by four intermediate plates 26 at the sides with a lower end of the sleeve 40 projecting through
15 the bottom plate 24. (The embodiment of FIG. 4A will be described in later paragraphs). It should be appreciated that other arrangements allowing the bollard member 10 to be integrated with the I-beam arrangement may be envisaged in other embodiments of the invention.

20 A coupling mechanism is provided in the sleeve 40 to removably engage a bollard member 10 with the base assembly 20. Various forms of coupling mechanisms may be suitable with embodiments of the invention. An example is shown in FIG. 3A which illustrates a side cross-sectional view of a removable bollard installed at a site. The coupling mechanism may include a coupler socket 42 or receptacle, e.g., a Dywidag
25 coupler connection, attached to the base assembly 20, such as by welding the coupler socket 42 to the lower end of the sleeve 40. The coupler socket 42 may be threaded to receive in engagement a compatible threaded bar 44 provided with a removable bollard member 10.

30 In the removable bollard member 10 which may be provided in the form of a hollow tube, a stiff plate 46 may be provided proximate to an upper end and a lower end

of the bollard member 10. The stiff plates 46 may be fixedly attached to the hollow tube and may have apertures or perforations which are sized to receive a threaded bar 44 therein. A lower end of the threaded bar 44 may be received and secured in the coupler socket 42. An upper end of the threaded bar 44 may be secured to the bollard member 10
5 by fastening the threaded bar 44 to the stiff plate 46 with a fastening mechanism, including but not limited to, a lock nut 48 or hex nut 48. Additional stiff plates 46 may be inserted at intervals in the bollard member 10 to retain the threaded bar 44 in a predetermined position.

10 In the base assembly 20, one or more reinforcement members (30a, 30b) may be attached thereto to enlarge an effective base area which in turn increases stability of the bollard assembly. The base assembly 20 provides a base area in a direction generally perpendicular to the sleeve 40. One end of the reinforcement member (30a, 30b) may be attached to the base assembly 20 while a distant free end (32a, 32b) extends away from
15 the base assembly 20. The reinforcement members (30a, 30b) are to provide an extension to the base area in the same direction generally traverse to the sleeve 40. When a vehicle strikes the bollard member 10, the impact force is transmitted to the base assembly 20 and to the reinforcement members (30a, 30b) to be dissipated to the surroundings, e.g. ground. An enlarged base assembly 20 is therefore more capable of stabilizing a bollard
20 assembly when the bollard member 10 is struck by an impact.

In the embodiment of FIGs. 1A and 1B, a plurality of first reinforcement members 30a are fixedly attached, such as by welding, to a bottom plate 24 of the base assembly 20 to resist a tension force resulting from an impact. In addition, a plurality of
25 second reinforcement members 30b may be fixedly attached to a top plate 22 of the base assembly 20 to resist a compression force resulting from the impact. The reinforcement members (30a, 30b) may be cylindrical rods or any other suitable forms. The reinforcement members (30a, 30b) may have a length (L_{RM}) which is greater than a length (L_{BA}) of the base assembly 20, and a cross-section diameter or dimension (D_{RM})
30 which is substantially lesser than a height (H_{BA}) of the base assembly 20. These proportions are advantageous in reducing material costs. Optionally, stirrups 34 may be

provided to couple the first and the second reinforcement members 30b for additional support (see FIGs. 1A and 1B). Various modifications to the reinforcement members (30a, 30b) may be made depending on the impact rating required. Generally, to achieve higher impact rating, the number of reinforcement members (30a, 30b), length of reinforcement members (30a, 30b), cross-section area of reinforcement members (30a, 30b), or a combination thereof may be increased.

According to embodiments of the invention, a base assembly 20 may be connected to one or more other base assemblies 20 to provide a cohesive installation capable of arresting large impact forces. To this purpose, intermediate plates 26 of each base assembly 20 may be perforated to receive rebars 104 there through. The interconnection of several bollard assemblies via rebars 104 is described in greater detail in later paragraphs.

An exemplary removable assembly according to an embodiment (e.g. FIG. 1A) may have the following dimensions. The base assembly 20 may have a length (L_{BA}) of 0.50 m, a breadth (B_{BA}) of 0.50 m and a height (H_{BA}) of 0.175 m. The removable bollard member 10 may have a projection height (H_{BM}) of 1.20 m from the top plate 22 of the base assembly 20, an outer diameter (OD_{BM}) of 0.194 m. If the bollard member 10 is a hollow tubular member, an inner diameter may be 0.178 m such that a thickness of the bollard member 10 is 0.016 m. Accordingly, for this and other embodiments, the base assembly 20 may be installed within about 1.00 m below an installation surface level, e.g. ground or other levels. In an exemplary installation, several base assemblies 20 may be spaced apart by between about 1.0 m to about 1.5 m.

Dimensions of various embodiments of a bollard assembly are not limited to the above and may vary according to impact rating requirements and site conditions. Generally, to increase the impact rating of a bollard assembly, one of the following parameters or a combination thereof may be increased: dimensions of a base assembly 20 (including height, length and breadth), thickness of the plates forming the base assembly

20, dimensions of reinforcement members (30a, 30b) (including length and cross-section area), and number of reinforcement members (30a, 30b).

In FIGs. 1A, 1B and 1C, the base assembly 20 is formed from top and bottom
5 plates 24 having a square shape. The sleeve 40 and the bollard member 10 may have compatible circular cross-sections. It should be appreciated that the base assembly 20, sleeve 40 and the bollard member 10 may have cross-sections of other shapes, including but not limited to, rectangle, square, circle, oval, triangle, and any other geometrical and non-geometrical shapes. Also, the base assembly 20 may be prefabricated and or
10 assembled at the installation site. Further, the base assembly 20, reinforcement member (30a, 30b) and removable bollard member 10 may comprise a material of high strength, e.g. steel.

FIG. 2 is a side view of an installation the bollard assembly of FIG. 1A having a
15 plurality of rebars 104 disposed to connect a base assembly 20 to adjacent base assemblies 20. A shallow trench is provided in the ground in which several base assemblies 20 may be arranged therein and spaced apart from one another by a predetermined distance. The spacing of the base assemblies 20 would depend on the impact rating required of the installation.

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The base assemblies 20 are arranged such that their reinforcement members (30a, 30b) are disposed generally along a path expected of an impact but opposite the side of the bollard assembly receiving the expected impact. For example, if an impact is expected from a direction or path X towards a first side of a base assembly 20, the
25 reinforcement members (30a, 30b) may be disposed generally along direction or path X on a second side, which is opposed to the first side of the base assembly 20 (see FIG. 2). When a vehicle traveling along direction X strikes the bollard member 10, the bollard assembly would tend to tilt in the direction of the impact. Without the reinforcement members (30a, 30b) to resist the tensile and/or compression forces resulting from the
30 impact, a sufficiently large impact would topple the bollard member 10, dislodge the bollard assembly and eventually allowing the attacking vehicle to penetrate. With the

reinforcement members (30a, 30b) provided on a side of the bollard assembly opposite to the expected impact, the reinforcement members (30a, 30b) provide a larger effective base area to resist the impact force and thereby minimizing tilting and preventing dislodgement of the base assembly 20. The base assembly 20 may also be arranged such
5 that free ends 32 of the reinforcement members (30a, 30b) are spaced apart from adjacent base assemblies 20.

Impact rating of an installation of bollard assemblies may be further enhanced by connecting several base assemblies 20 to provide a cohesive installation having a larger
10 effective base area which in turn increases stability. To this purpose, one or more rebars 104 may be provided through perforations in the intermediate plates 26 of adjacent base assemblies 20 (see FIG. 2). The rebars 104 may be removably or fixedly arranged through the perforations. As illustrated in FIG. 2, rebars 104 are provided through intermediate plates 26 of adjacent bollard assemblies (see FIGs. 1A and 2). Additional
15 rebars 104 may also be provided in a generally perpendicular direction intersecting other rebars 104. The various reinforcement bars 30 intersect the base assemblies 20 to provide a reinforced foundation pad for the installation. When one or more bollard assemblies in a completed installation is struck by a vehicle, the impact is distributed to the enlarged base area formed by the reinforcement bars 30 interconnecting various base
20 assemblies 20. Since the network of reinforcement bars 30 interconnecting various base assemblies 20 is encased in a rigid bonding material, e.g. concrete, a stable foundation is provided to restrain movement of the bollard assemblies.

As and when required, the bollard members 10 may be secured to or removed
25 from the base assemblies 20. To secure a bollard member 10 to a base assembly 20, the bollard member 10 may be disposed in the sleeve 40. A threaded bar 44 may be inserted through the bollard member 10 so that one end of the threaded bar 44 is received in engagement with a coupling socket 42 disposed in the base assembly 20. The threaded bar 44 may be secured to the bollard member 10 by a fastener such as a lock nut 48, hex
30 nut 48 or any other suitable fastener. Upon removal of the bollard member 10 from the base assembly 20, a cover plate 52 may be provided to close an opening in the sleeve 40

so that the installation may appear substantially flush with an adjoining surface (see FIG. 3C).

Depending on the conditions of the installation site, a height of the sleeve 40 in
5 relation to a height of the base assembly 20 may be varied. At installation sites where
there is less constraint on excavation depth, the height of the sleeve 40 (H_{SL}) may be
approximately equal to the height (H_{BA}) of the base assembly 20, such as in the
embodiments of FIGs. 1A, 1B, 1C and 2. At installation sites where an installation
10 surface is above ground and the excavation depth is more limited (e.g. bridges,
highways), the height of the sleeve 40 (H_{SL}) may be substantially greater than the height
(H_{BA}) of the base assembly 20 (see FIG. 4A). In the embodiment of FIGs. 4A, 4B and
4C where the installation site (e.g. bridge 102) has a thickness of about 0.15 m, the height
of the sleeve 40 is substantially greater than the height of the base assembly 20 and is
15 lesser than the height of the removable bollard member 10. The greater sleeve 40 height
in relation to the height of the base assembly 20 is to provide a deeper recess to allow a
more secured installation of the removable bollard to the base assembly 20.

In the embodiment of FIG. 4A, a portion of the bridge 102 (e.g. a planar slab)
may be secured between a top plate 22 and a bottom plate 24 of a base assembly 20. Due
20 to site constraints, the sleeve 40 may project from the bottom plate 24 of the base
assembly 20. A sleeve support member 50 may be provided abutting the bottom plate 24
of the base assembly 20 to secure a lower portion of the sleeve 40 to the base assembly
20. In FIG. 4A, the sleeve support member 50 is illustrated as a hollow tubular member
but may take other forms in other embodiments. In addition, the sleeve support member
25 50 may be constructed to allow connection to an adjacent base assembly. For example,
the sleeve support member 50 member may be apertured to receive rebars 104 there
through, in which the rebars 104 may also be received by another sleeve support member
50 of an adjacent base assembly. The rebars 104 may be fixedly attached to the sleeve
support members 50, such as by welding. A layer of paver material 108 may be provided
30 around or on the top plate 22 of the base assembly 20.

FIG. 4B illustrates a base assembly 20 of FIG. 4A having a removable bollard member 10 installed therein. The coupling mechanism to secure the bollard member 10 to the base assembly 20 may be the same as that illustrated for FIG. 3A. FIG. 4C illustrates a base assembly 20 without a bollard member 10 and having a cover plate 52 thereon. The cover plate 52 closes an opening in the sleeve 40 to provide a substantially flush surface with an adjoining surface of the installation site.

A general method of installing a plurality of base assemblies 20 at a site is described as follows. The site is prepared by excavating a trench for receiving the base assemblies 20. Dimensions of the trench would depend on a height required of the bollards, spacing between adjacent base assemblies 20 as well as the dimensions of the base assembly 20 and reinforcement members (30a, 30b). An illustrative range of the depth of a trench may range from between about 0.20 m to about 1.00 m to avoid a need for deep excavations. Optionally, a leveling material, such as concrete, may be provided in the trench to form a level surface for easy installation of the base assemblies 20. Subsequently, a plurality of prefabricated base assemblies 20 may be arranged in the trench and separated by a predetermined distance with free ends 32 of their reinforcement members (30a, 30b) spaced apart from adjacent base assemblies 20. Optionally, a small amount of concrete may be provided at this stage to set the base assemblies 20 in position. The plurality of base assemblies 20 is arranged such that their reinforcement members (30a, 30b) are oriented to resist an impact expected from a predetermined direction. More particularly, the first reinforcement member 30a, which has one end attached to the base assembly 20 and a distant free end 32a extending away from the base assembly 20, is spaced apart from remaining adjacent base assemblies 20.

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Rebars 104 may connect the plurality of base assemblies 20 by providing the rebars 104 through appropriate perforations in the base assemblies 20. The number of rebars 104 and their arrangement would depend on site conditions as well as the desired impact rating required. A bonding material 106, such as concrete, is then provided to fill the trench as well as to anchor the base assemblies 20 to the site. If it is desired to conceal the base assembly 20, a layer of the bonding material 106 may be provided above

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the top plate 22 of the base assembly 20. This layer may range between 2.5 cm to about 6.0 cm but is not limited as such. Otherwise, if it is desired to have the top plate 22 of the base assembly 20 flush with an adjoining surface, the bonding material 106 should accordingly be provided only in the surroundings of the base assembly 20. Optionally,
5 paver materials 108 may be provided around the base assemblies 20.

When it is desired to install the removable bollard member 10, the bollard member 10 may be arranged in the sleeve 40 and a threaded bar 44 provided through the bollard member 10 to engage a lower end of the threaded bar 44 with a coupler socket 42
10 at the base assembly 20. An upper end of the threaded bar 44 may be secured to the bollard member 10 by a fastener such as a lock or hex nut 48. The bollard member 10 may form part of street furniture, including but not limited to, lamp posts, signage posts, bus shelters, benches, planters, trash bins.

15 Certain variations to the above general method may be required in the installation of the embodiment of FIG. 4A due to site conditions. For example, the trench for disposing the base assemblies 20 may be a through hole. Also, some parts of the base assembly 20 may be prefabricated and attached to other parts (e.g. top or bottom plates 24) on site. Further, if rebars 104 are desired, the rebars 104 may be provided to connect
20 the sleeve support members 50 of the base assemblies 20.

It is to be understood that other embodiments will be apparent to those skilled in the art from consideration of the specification and practice of the present invention. Furthermore, certain terminology has been used for the purposes of descriptive clarity,
25 and not to limit the invention. The embodiments and features described above should be considered exemplary, with the invention being defined by the appended claims.

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Claims

1. An assembly comprising:

a base assembly having a sleeve formed therein and providing a base area in a
5 direction generally perpendicular to the sleeve;

a coupling mechanism disposed in the sleeve; and

a first reinforcement member attached to the base assembly to enlarge the base
area, wherein the coupling mechanism is to removably engage the base assembly with a
bollard member to be received in the sleeve.

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2. The assembly of claim 1, wherein the base assembly comprises an I-beam arrangement
comprising:

a top plate;

a bottom plate; and

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an intermediate plate supporting the top plate and the bottom plate, wherein the
top plate, the bottom plate and the intermediate plate are attached to the sleeve.

3. The assembly of claim 2, wherein the coupling mechanism comprises a socket which
is to receive in engagement a coupling bar provided by the bollard member.

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4. The assembly of claim 2, wherein the first reinforcement member is attached to the
bottom plate.

5. The assembly of claim 4, further comprising a second reinforcement member which is
25 attached to the top plate.

6. The assembly of claim 2, wherein a height of the sleeve is approximately equal to a
height of the base assembly.

30 7. The assembly of claim 2, wherein a height of the sleeve is substantially greater than a
height of the base assembly, and is lesser than a height of the bollard member.

8. The assembly of claim 2, wherein the intermediate plate is perforated to receive a rebar there through.

5 9. The assembly of claim 2, wherein a length of the first reinforcement member is greater than a length of the base assembly.

10. The assembly of claim 1, wherein the base assembly further comprises a plurality of I-beam arrangements comprising:

10 a top plate;
a bottom plate; and
a plurality of intermediate plates arranged at an angle with one another to support the top plate and the bottom plate.

15 11. The assembly of claim 10, wherein the sleeve is attached to the plurality of intermediate plates.

12. The assembly of claim 11, wherein the plurality of intermediate plates are perforated to receive a plurality of rebars there through.

20 13. The assembly of claim 12, wherein the coupling mechanism comprises a socket to receive in engagement a coupling bar provided by the bollard member.

14. An installation comprising:

25 a plurality of base assemblies disposed at a predetermined distance from one another, each of the plurality of base assemblies having a sleeve disposed therein and providing a base area in a direction generally perpendicular to the sleeve, wherein said each base assembly comprises:

a coupling mechanism disposed in the sleeve;
30 a first reinforcement member attached to said each base assembly to enlarge the base area; and

a plurality of rebars connecting the plurality of base assemblies to restrain a movement of the plurality of base assemblies.

15. The installation of claim 14, wherein the first reinforcement member of said each
5 base assembly includes a free end spaced apart from an adjacent one of the plurality of base assemblies.

16. The installation of claim 15, wherein the first reinforcement member is disposed along an expected direction of an impact.

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17. The installation of claim 16, wherein a first side of said each base assembly is to receive the impact, and the first reinforcement member is disposed on a second opposed side of said each base assembly.

15 18. The installation of claim 15, wherein said each base assembly comprises an I-beam arrangement comprising:

a top plate;

a bottom plate; and

20 an intermediate plate supporting the top plate and the bottom plate, wherein the top plate, the bottom plate and the intermediate plate are attached to the sleeve.

19. The installation of claim 18, wherein the coupling mechanism comprises a socket which to receive in engagement a coupling bar provided by a bollard member.

25 20. The installation of claim 19, wherein the intermediate plate is perforated there through to receive the plurality of rebars.

21. The installation of claim 15, further comprising a second reinforcement member attached to the top plate, and wherein the first reinforcement member is attached to the
30 bottom plate.

22. The installation of claim 15, wherein a height of the sleeve is approximately equal to a height of said each base assembly.

23. The installation of claim 15, wherein a height of the sleeve is substantially greater than a height of said each base assembly, and is lesser than a height of a bollard member to be received therein.

24. The installation of claim 15, wherein said each of the plurality of base assemblies further comprises a sleeve support member secured to a lower end of the sleeve.

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25. The installation of claim 24, wherein the sleeve support member is perforated to receive the plurality of rebars there through.

26. The installation of claim 15, wherein the bollard member is to form part of a street furniture.

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27. The installation of claim 15, wherein said each base assembly is installed within about 1.00 m below grade level.

28. The installation of claim 15, wherein said each base assembly further comprises a plurality of I-beam arrangements comprising:

a top plate;

a bottom plate; and

a plurality of intermediate plates arranged at an angle with one another to support

the top plate and the bottom plate.

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29. A method of installation, comprising:

forming a trench;

disposing a plurality of base assemblies in the trench which are separated from one another, the plurality of base assemblies having a first reinforcement member attached thereto, the first reinforcement member having a free end spaced apart from an adjacent one of the plurality of the base assemblies;

connecting the plurality of base assemblies with a plurality of rebars; and

encasing the plurality of base assemblies and the plurality of rebars.

30. The method of claim 29, further comprising:

disposing a plurality of bollard members in a plurality of sleeves provided in the plurality of base assemblies; and

securing the plurality of bollard members to the plurality of assemblies using a plurality of coupling mechanisms provided in the plurality of sleeves.

31. The method of claim 30, wherein the trench has a height of between about 0.20 m to about 1.00 m.

32. The method of claim 31, wherein the plurality of bollard members is to form part of a street furniture.

33. The method of claim 31, wherein connecting the plurality of base assemblies with a plurality of rebars further comprising providing the plurality of rebars through the plurality of sleeve support members.

34. The method of claim 29, further comprising:

providing a plurality of sleeve support members to secure the plurality of sleeves to the plurality of base assemblies.