

FOLDABLE BOLLARD SYSTEM AND METHOD OF INSTALLATION

FIELD OF INVENTION

The present invention relates to a foldable anti-ram bollard system and to a method of installation.

5 BACKGROUND OF INVENTION

The Vehicle Born Improvised Explosive Device (VBIED) has been recognized as a potential weapon of mass destruction and is fast becoming the weapon of choice for terrorists all over the globe. As we can now see daily, it is being used in Iraq for terrorist attack. To protect buildings, facilities and their occupants and users from the VBIED threats, anti-ram
10 barriers have been installed at the perimeters of many buildings and facilities to prevent vehicles from approaching. This strategy is called "first line of defense" against terrorist attacks.

Among all the anti-ram barriers, anti-ram bollard has been a popular choice because it is less compromising on the landscaping of buildings and facilities and can blend easily into the
15 street furniture.

Several types of the anti-ram bollard systems have been used in various situations. However, most of them are permanently installed and cannot be removed from the site if necessary. Although some other existing anti-ram bollard systems are removable, i.e., the anti-ram bollard withstanding an impact as a barrier can be removed/detached from the
20 installation site, the removed anti-ram bollard requires an off-site storage when they are not in use. This will incur additional costs for hoisting equipment requested for removing the anti-ram bollard, and transportation between the installation site and off-site storage. In addition, it takes a long time to reinstall them to the site, which may compromise operational requirement in emergency situations.

25 INVENTION DISCLOSURE

The objective of this invention is to provide a foldable anti-ram bollard system that can be easily installed and perform anti-ram function in the operational position after being installed, while the anti-ram bollard can be folded down to the non-operational position at any time when needed.

30 In order to achieve the above mentioned objective, the present invention provides a foldable anti-ram bollard system comprising:

an anti-ram bollard 1 pivoting between an operational position and a non-operational

position;

a groove 2 that can retain the anti-ram bollard in the non-operational position;

an upper supporting structure 3 and a lower supporting structure 4 which are disposed on the groove 2 in parallel with the foldable bollard 1 in the operational position and spaced apart vertically and horizontally, providing supporting forces to the anti-ram bollard upon receipt of an impact at the anti-ram bollard;

and a connecting mechanical device 5 movably linked to the anti-ram bollard.

The connecting mechanical device 5 movably linked one end of the anti-ram bollard to the inside or one end of the groove 2; the connecting mechanical device provides a pivoting point about which the anti-ram bollard is allowed to move. The anti-ram bollard 1 is completely retained in the groove 2 when it is in the non-operational position; the movable end of the anti-ram bollard pivots out of the groove 2 and in upright position when it is in operation;

The upper supporting structure 3 and the lower supporting structure 4 are disposed on each side of the anti-ram bollard respectively, spaced apart by the pivoting point of the anti-ram bollard in both directions parallel with and perpendicular to the groove. Thereby the movement of the anti-ram bollard is restricted between the operational position where the movable end of the anti-ram bollard pivots out of the groove 2 and the non-operational position where the anti-ram bollard is completely retained in the groove 2

The operational position of the anti-ram bollard is restricted to a position perpendicular to the groove 2 by above-mentioned location of the upper supporting structure 3. The non-operational position of the anti-ram bollard is restricted to a position where the anti-ram bollard 1 is horizontally retained in the groove 2 by above-mentioned location of the lower supporting structure 4. When the anti-ram bollard is in the operational position, both the upper supporting structure 3 and the lower supporting structure 4 should have one side disposed proximately against the anti-ram bollard.

The above-mentioned structure, where the upper supporting structure 3 and the lower supporting structure 4 are disposed on different side of the foldable anti-ram bollard (or spaced apart transversely), can have the following functions:

1. Restrict the movement of anti-ram bollard; i.e. when it is retained inside the groove 2 and in the non-operational position (see position b in FIG. 1), the lower supporting structure 4 can support the anti-ram bollard. When the anti-ram bollard is moved to a position close to the upper supporting structure 3, it is in the operational position (see position a in FIG. 1).

2. Provide supporting force; when the anti-ram bollard is in the operational position, the

upper supporting structure 3 can provide a supporting force. Thereby when an impact strikes the anti-ram bollard on the side opposite the upper supporting structure 3, both the upper supporting structure 3 and the lower supporting structure 4 provide a supporting and resisting force to prevent the anti-ram bollard from tilting and from eventually toppling.. The lower supporting structure may be disposed inside the groove below ground level, and juxtaposed against another portion of the foldable anti-ram bollard below the pivoting point when it is in operation. This other portion may be at an end portion of the anti-ram bollard that is disposed near the bottom of the groove. The lower supporting structure is to provide another part of supporting force to resist possible tilting of the fixed end portion of the anti-ram bollard. According to the lever principle, it can provide a supplementary supporting force and thereby maintain the anti-ram bollard in the operational/upright position.

The upper and the lower supporting structures are disposed spaced apart along the length of the anti-ram bollard (or vertically spaced apart) so that when the anti-ram bollard is folded and retained in its groove under the ground level (i.e. in a non-operational position), the upper and the lower supporting structures are not affected.

According to above-mentioned structure, the upper supporting structure and the lower supporting structure can resist the impact load together with the anti-ram bollard.

The connecting mechanical device 5 including, but not limited to, a pivot pin can movably engage the foldable anti-ram bollard to the groove. The connecting mechanical device provides a pivoting point about which the bollard is allowed to move between at least two positions, e.g. an operationally upright position to receive impacts, and a non-operationally horizontal position to be stored. In certain embodiments, the connecting mechanical device does not require electrical power to operate and thereby moving the foldable anti-ram bollard between the two positions does not depend on the availability of electrical supply.

A matched detachable cover 6 is to conceal the groove 2 for the safety and aesthetic value of surrounding grounds.

In operation, the groove 2 is secured in a fixed foundation. It has a recess suitably dimensioned to at least retain the anti-ram bollard in a non-operational/relatively horizontal position. The groove should also retain suitably disposed upper supporting structure and lower supporting structure.

According to the above-mentioned structure design, this invention provides a foldable anti-ram bollard system that can be used as anti-ram barriers for buildings and the like, with the advantage that it can perform anti-ram function in the operational position after being

installed and the anti-ram bollard can be folded down to the non-operational position at any time when needed. In addition, it has the advantages of a removable anti-ram bollard as it can avoid transportation and storage off site. More particularly, operating this foldable bollard system may be manual without a need for hoisting equipment. Further, Embodiments of the invention may be installed in shadow trenches without a need for deep excavations that may disrupt various utility lines buried in the ground. In one embodiment, the depth of such trenches may be about 0.5 m. However, the trench depth may differ in other embodiments depending on requirements. Even with the shallow footing, the anti-ram rating (i.e. maximum impact loading) of the anti-ram bollard system may be improved over conventional bollards of similar installations due to the design and structure of the groove.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a cross-sectional view (inner structure view) of a foldable anti-ram bollard system according to one embodiment of the invention.

FIG. 1B illustrates the operational state of the foldable bollard system upon receipt of an impact.

FIG. 2A is a sectional view of the foldable bollard system taken along the line A-A in FIG. 1A.

FIG. 2B is a sectional view of the foldable bollard system taken along the line B-B in FIG. 1A.

FIG. 3 is a sectional view of the system taken along the line C-C in FIGs. 2A and 2B. (Y is the Ground Elevation)

FIG. 4 is a detail of the horizontal section at the pivoting level. .

FIG. 5 is a sectional view of FIG. 4 taken along the line E-E in FIG. 4.

BEST MODE

Reference is made to FIG.1 to FIG. 5, the present invention provides a foldable anti-ram bollard system comprising:

an anti-ram bollard 1 pivoting between an operational position and a non-operational position;

a groove 2 that can retain the anti-ram bollard in the non-operational position;

An upper supporting structure 3 and a lower supporting structure 4 which are fixed on

the groove 2 in parallel with the foldable bollard 1 in the operational position and spaced apart vertically and transversely, providing supporting forces to the anti-ram bollard upon receipt of an impact at the anti-ram bollard;

and a connecting mechanical device 5 movably linked to the anti-ram bollard.

5 The connecting mechanical device 5 movably linked one end of the anti-ram bollard 1 to the inside or one end of the groove 2 with a pivot pin. The connecting mechanical device provides a pivoting point about which the anti-ram bollard is allowed to move between operational and non-operational positions. The anti-ram bollard 1 is completely retained in the groove 2 when it is in the non-operational position (see position b in FIG. 1); The movable
10 end of the anti-ram bollard pivots out of the groove 2 to resist impact when it is in operational position (see position a in FIG. 1). In certain embodiments, the connecting mechanical device does not require electrical power to operate and thereby moving the foldable anti-ram bollard does not depend on the availability of electrical supply. FIG. 1A is a cross-sectional view of a foldable anti-ram bollard system according to one embodiment of the invention. FIG.
15 1B illustrates the operational state of the foldable bollard system upon receipt of an impact. FIG. 4 is a plan view of the anti-ram bollard when it is in operational position. FIG. 4 shows the foldable anti-ram bollard coupled to the groove via a connecting mechanical device, e.g. pivot pin. FIG. 5 is a cross-sectional view of FIG. 4 taken from line E-E illustrating an foldable anti-ram bollard movably or pivotally engaged to groove.

20 The upper supporting structure 3 and the lower supporting structure 4 are disposed on each side of the anti-ram bollard respectively, spaced apart by the pivoting point of the anti-ram bollard in both directions parallel with and perpendicular to the groove. Thereby the movement of the anti-ram bollard is restricted between the operational position when the movable end of the anti-ram bollard pivots out of the groove 2 and the non-operational
25 position when the anti-ram bollard is completely retained in the groove 2. The operational position of the anti-ram bollard is restricted to a position perpendicular to the groove 2 by the location of upper supporting structure 3 and lower supporting structure 4. The non-operational position of the anti-ram bollard is restricted to a position where the anti-ram bollard 1 is horizontally retained in the groove 2 by the location of lower supporting structure 4. When the
30 anti-ram bollard is in the operational position, both the upper supporting structure 3 and the lower supporting structure 4 should have one side juxtaposed proximately against the anti-ram bollard.

In order to ensure the anti-ram capability of the foldable anti-ram bollard system, both the upper supporting structure 3 and the lower supporting structure 4 have one side juxtaposed

proximately against the anti-ram bollard when the anti-ram bollard is in the non-operational position. The upper supporting structure 3 and the lower supporting structure 4 can support the anti-ram bollard respectively when it is in the non-operational position.

The supporting structures (i.e., upper supporting structure 3 and lower supporting structure 4) are designed to resist the impact load with a room for anti-ram bollard on site. The upper supporting structure is proximately below the ground level and juxtaposed against a portion of the anti-ram bollard when the anti-ram bollard is in an operational position. The upper supporting structure may be disposed generally along a path expected of an impact but opposite the side of the anti-ram bollard system receiving the expected impact. For example, as indicated in FIG. 1B, if an impact is expected from a direction X towards one side of the foldable anti-ram bollard system, the upper supporting structure may be disposed on the opposing side of the system and generally along direction X. The upper supporting structure is to provide a first supporting force in response to an oncoming impact in the direction X. More particularly, when an impact strikes the anti-ram bollard along direction X, there is a tendency for the anti-ram bollard to tilt in the direction of the impact. The upper supporting structure thereby provides a supporting and opposing force to prevent the foldable bollard from tilting and from eventually toppling.

The above-mentioned structure, where the upper supporting structure 3 and the lower supporting structure 4 are disposed on different side of the foldable anti-ram bollard (or spaced apart transversely), can have the following functions:

1. Restrict the movement of anti-ram bollard; i.e. when it is retained inside the groove 2 and in the non-operational position (see position b in FIG. 1), the lower supporting structure 4 can support the anti-ram bollard. When the anti-ram bollard is moved a position close to the upper supporting structure 3, it is in the operational position (see position a in FIG. 1).

2. Provide supporting force; when the anti-ram bollard is in the operational position, the upper supporting structure 3 can provide a supporting and opposing force. Thereby when an impact strikes the anti-ram bollard on the side opposite the upper supporting structure 3, the upper supporting structure 3 provides a supporting and opposing force to prevent the anti-ram bollard from tilting and from eventually toppling. The lower supporting structure may be disposed inside the groove below ground level, and juxtaposed against another portion of the foldable anti-ram bollard below the pivoting point when it is in operation. This other portion may be at an end portion of the anti-ram bollard that is disposed near the bottom of the groove. The lower supporting structure is to provide a second supporting force to restrict possible tilting of the end portion of the anti-ram bollard. According to the lever principle, it can

provide a supplementary supporting force and thereby maintain the anti-ram bollard in the operational/upright position.

Reference is made to FIG. 1B illustrating an example of the operation of the foldable bollard system upon receipt of an impact. In this example, an impact force P_F is received by the anti-ram bollard along direction X and at a distance L_F from the upper supporting structure. The upper supporting structure provides a first supporting force P_1 at a distance L_1 from the pivoting point of the foldable anti-ram bollard system. The lower supporting structure provides a second supporting force P_2 at a distance L_2 from the pivoting point. The equation below illustrates a force-distance relationship which allows the foldable bollard system to effectively resist an impact:

$$P_F(L_F+L_1) \leq P_1L_1+P_2L_2.$$

the upper and the lower supporting structures are disposed spaced apart along the length of the anti-ram bollard (or vertically spaced apart) so that when the anti-ram bollard is folded and retained in its groove under the ground level (i.e. in a non-operational position), the upper and the lower supporting structures are not affected.

According to the above-mentioned structure, the upper supporting structure and the lower supporting structure can resist impact load together with the anti-ram bollard.

A matched detachable cover 6 is to conceal the groove 2 for the safety and aesthetic value of surrounding grounds. In operation, the groove 2 is secured in a fixed foundation. It has a recess suitably dimensioned to at least retain the anti-ram bollard in a non-operational/relatively horizontal position. The groove should also retain suitably disposed upper supporting structure and lower supporting structure.

FIGs. 2A and 2B are plan views of foldable anti-ram bollard system as viewed respectively from lines A-A and B-B of FIG. 1A. As illustrated, the upper supporting structure is disposed proximately to the ground level and juxtaposed against an intermediate portion of the anti-ram bollard. The lower supporting structure is not visible in FIG. 2A as it is disposed spaced apart and remote from the ground level but is shown in FIG. 2B. FIGs. 2A and 2B also illustrate covers, e.g. steel covers, overlaying the groove that stores the anti-ram bollard, to provide a substantially flush surface with the ground level. FIG. 3 is a sectional view of FIG. 2 taken from line C-C. However, in FIG. 3, the foldable anti-ram bollard is in an operational/relatively vertical position. Further, a cover, e.g. steel cover, is provided to overlay the recess to provide a substantially flush surface with the ground level so that the groove would not be visible.

A general method of installing the foldable anti-ram bollard system at a site is described

as follows. The site is prepared by excavating a trench for accommodating the lower supporting structure and groove. Dimensions of the trench would depend on height required for the foldable bollard system, spacing between adjacent grooves as well as the dimensions of the lower supporting structure and groove. In one embodiment, the depth of such trenches may be about 0.5 m. However, the trench depth may differ in other embodiments depending on requirements. An illustrative range of the depth of a trench may range from about 0.4 m to about 1.0 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 lower supporting structure 4 and groove 2. Subsequently, a plurality of the foldable bollard systems may be arranged in the trench and separated by a predetermined distance. Optionally, a small amount of concrete may be used at this stage to set the groove in position. The plurality of grooves is arranged such that the foldable bollard systems are oriented to resist an impact expected from a predetermined direction. The installation is completed by overlaying the groove with a cover 6.

After the completion of installation and during the operation, a cover is first removed to reveal the foldable anti-ram bollard from a non-operational position. The foldable bollard 1 is manually lifted to an upright position where it is at rest in its vertical position. Since a pivot pin mechanism 5 is designed for lifting the anti-ram bollard by rotating about the pin, the anti-ram bollard can be very easily and quickly installed. This will significantly reduce installation time. The cover is placed back to level the ground and hide the groove. The foldable bollard system is now in an operational position.

According to the above-mentioned structure design, this invention provides a foldable anti-ram bollard system that can be used as anti-ram barriers for buildings and the like, with the advantage that it can perform anti-ram function in the operational position after being installed and the anti-ram bollard can be folded down to the non-operational position at any time when needed. Further, it has the advantages of a removable anti-ram bollard as it can avoid transportation and storage off site and the foldable anti-ram bollard may be concealed. More particularly, operating this foldable bollard system may be manual without a need for hoisting equipment. Further, Embodiments of the invention may be installed in shadow trenches without a need for deep excavations that may disrupt various utility lines buried in the ground. Even with the shallow footing, the anti-ram rating (i.e. maximum impact loading) of the anti-ram bollard system may be improved over conventional bollards of similar installations due to the design and structure of the groove.

APPLICATION

This invention provides a foldable anti-ram bollard system that can be used as anti-ram barriers for buildings and the like, with the advantage that it can perform anti-ram function in the operational position after being installed and the anti-ram bollard can be folded down to the non-operational position at any time when needed. Further, it has the advantages of a removable anti-ram bollard as it can avoid transportation and storage off site and the foldable anti-ram bollard may be concealed. More particularly, operating this foldable anti-ram bollard system may be manual without a need for hoisting equipment.

In addition, embodiments of the invention are also advantageous as a foldable bollard system may be installed in shadow trenches without a need for deep excavations that may disrupt various utility lines buried in the ground. Even with the shallow footing, the anti-ram rating (i.e. maximum impact loading) of the bollard system may be improved over conventional bollards of similar installations due to the design and structure of the groove.

CLAIMS

1. A bollard system comprising:

an anti-ram bollard 1 movable between an operational position and a non-operational
5 position;

groove 2 for retaining the anti-ram bollard in the operational position and the
non-operational position;

an upper supporting structure 3 and a lower supporting structure 4 secured to the
groove and disposed to juxtapose the anti-ram bollard in the operational position, wherein the
10 upper and the lower supporting structures are vertically and transversely spaced apart to
provide supporting forces to the anti-ram bollard upon receipt of an impact at the anti-ram
bollard; and

a connecting mechanical device 5 movably engaging the anti-ram bollard between the
operational position and the non-operational position.

15 2. The foldable anti-ram bollard system of claim 1, wherein the connecting mechanical
device 5 movably linked one end of the anti-ram bollard to the inside or one end of the groove
2; the connecting mechanical device provides a pivoting point about which the movable end
of anti-ram bollard 1 is allowed to move, thereby the anti-ram bollard 1 can be completely
retained in the groove 2 and the movable end of the anti-ram bollard can move out of the
20 groove 2.

3. The foldable anti-ram bollard system of claim 1, wherein the upper supporting
structure 3 and the lower supporting structure 4 are disposed on different side of the anti-ram
bollard respectively, spaced apart by the pivoting point of the anti-ram bollard in both
directions parallel with and perpendicular to the groove, thereby the movement of the anti-ram
25 bollard is restricted between the operational position when the movable end of anti-ram
bollard pivots out of the groove 2 and the non-operational position when the anti-ram bollard
is completely retained in the groove 2.

4. The foldable anti-ram bollard system of claim 1, wherein the connecting mechanical
device 5 includes a pivot pin.

30 5. The foldable anti-ram bollard system of claim 3, wherein the operational position of
anti-ram bollard is restricted to a position perpendicular to the groove 2 by the location of
upper supporting structure 3.

6. The foldable anti-ram bollard system of claim 3, wherein the non-operational
position of anti-ram bollard is restricted to a position where the anti-ram bollard 1 is

horizontally retained in the groove 2 by the location of lower supporting structure 4.

5 7. The foldable anti-ram bollard system according to any one of claim 1 to claim 6, wherein both the upper supporting structure 3 and the lower supporting structure 4 have one side disposed proximately against the anti-ram bollard, when the anti-ram bollard is in the operational position.

8. The foldable anti-ram bollard system according to any one of claim 1 to claim 6, wherein both the upper supporting structure 3 and the lower supporting structure 4 have one side disposed proximately against the anti-ram bollard, when the anti-ram bollard is in the non-operational position.

10 9. The foldable anti-ram bollard system according to any one of claim 1 to claim 6, wherein the groove 2 is coupled with a matched detachable cover.

10. The foldable anti-ram bollard system of claim 7, wherein the groove 2 is coupled with a matched detachable cover.

15 11. The foldable anti-ram bollard system of claim 8, wherein the groove 2 is coupled with a matched detachable cover 6.

12. A method of installation of the foldable anti-ram bollard system of claim 1, wherein the bottom of the groove 2 is secured under the ground.

13. The method of claim 12, wherein the depth of the groove is between 0.4 m to 1.0 m below the ground.

20 14. The method of claim 12 or claim 13, wherein the ground surface, where the groove is located, is overlaid by a cover.

25