

A CAISSON BOX STRUCTURE

TECHNICAL FIELD

This invention relates generally to a caisson box structure.

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Background

Cryogenic vessels and the like pressurized vessels are typically transported and used on-site without adequate precautions for blast hazards. Specifically when they are used on-site or in an environment or setting which increases the risk of blast occurrence or pose danger to people in close proximity, there is always a need for measures to mitigate such risks. One approach is to construct a fortification to contain hazards, for example a blast, from the vessels. However, constructing such fortification becomes impractical in as it is difficult to determine the size of the fortification due to uncertainty in the number of vessels required. Further, such fortification disables the use of the huge space it occupies and is impossible to relocate and difficult to modify should the need arise, for example, from the need to use more or less of the vessels or to relocate the vessels due to the relocation of equipment that the vessels supplies to. Therefore, there exists a need for a system for addressing the foregoing issues.

Summary

In accordance with a first aspect of the invention, there is disclosed a caisson box structure comprising a concrete base, a plurality of concrete walls extending from adjacent the periphery of the concrete base to terminate at a free end for defining an opening to a compartment defined by the plurality of concrete walls and the concrete base, the compartment being shaped and dimensioned for receiving at least one insulative storage vessel therein, and at least one attachment structure formed with at least one of the plurality of concrete walls wherefrom weight of the plurality of concrete walls. The concrete base and the at least one insulative storage vessel can be supported for enabling mobility and transport of the caisson box structure.

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In accordance with a second aspect of the invention, there is disclosed a caisson box structure comprising a concrete base defining four edges, four concrete walls extending from adjacent the four edges of the concrete base to terminate at a free end for defining an opening to a compartment defined by the four concrete walls and the concrete base, the compartment
5 being shaped and dimensioned for receiving at least one insulative storage vessel therein, and a cage structure adapted for being received in the compartment and shaped and dimensioned for receiving the at least one insulative storage vessel, the cage structure for interposing the plurality of concrete walls and the at least one insulative storage vessel when received in the compartment to thereby substantially isolate movement of the at least one insulative storage
10 vessel in the compartment when the caisson box structure is being transported. The caisson box structure further comprises at least one attachment structure formed with at least one of the plurality of concrete walls wherefrom weight of the plurality of concrete walls, the concrete base and the at least one insulative storage vessel can be supported for enabling mobility and transport of the caisson box structure. Wherein each of the concrete base and
15 the plurality of concrete walls is formed from high strength concrete being adapted and shaped and dimensioned for forming a substantially blast and penetration resistant structure.

Brief Description of the Drawings

20 FIG. 1 shows an exemplary perspective view of a caisson box structure comprising a cage structure and a plurality of insulative storage vessels in accordance with an aspect of the invention;

FIG. 2 shows an exemplary perspective view of the caisson box structure of FIG. 1 without
25 the cage structure and the plurality of insulative storage vessels;

FIG. 3 shows an exemplary perspective view of the cage structure of FIG. 1 with the plurality of insulative storage vessels; and

30 FIG. 4 shows an exemplary perspective view of the cage structure of FIG. 1 without the plurality of insulative storage vessels.

Detailed Description

An exemplary embodiment of the present invention, a caisson box structure 20, is described hereinafter with reference to FIGS. 1 to 4. The caisson box structure 20 comprises a concrete base 22, a plurality of concrete walls 24 extending from adjacent the periphery of the concrete base 22 to terminate at a free end forming an edge 26. The edges 26 of the plurality of concrete walls 24 are preferably congruent to one another for defining an opening 28 to a compartment 30 defined and shaped by the plurality of concrete walls 24 and the concrete base 22. The compartment 30 is shaped and dimensioned for receiving at least one insulative storage vessel 32 therein. The caisson box structure 20 further comprises at least one attachment structure 34 formed with at least one of the plurality of concrete walls 24 wherefrom weight of the plurality of concrete walls 24, the concrete base 22 and the at least one insulative storage vessel 32 received in the compartment 30 can be supported for enabling mobility and transport of the caisson box structure 20.

Preferably, each of the concrete base 22 and the plurality of concrete walls 24 are prefabricated from reinforced concrete. The reinforced concrete can be high strength concrete being adapted and shaped and dimensioned for forming a substantially blast and penetration resistant structure. Further, the reinforced concrete being reinforced with at least one of steel rebars, synthetic fibers and natural fibers.

The at least one attachment structure 34 comprises at least one exposed rebar being adapted with one of a loop shape and a hook shape. Alternatively or additionally, the at least one attachment structure 34 is one of at least one recess and at least one hole formed in at least one of the plurality of concrete walls 24. The at least one attachment structure 34 may be formed during prefabrication of the caisson box structure 20, for example as exposed portions of a rebar mesh, or after fabrication of the plurality of concrete walls 24 via coupling of the at least one attachment structure 34 thereto or routing for forming of the at least one hole or recess.

Each of the concrete base 22 and the plurality of concrete walls 24 can be substantially planar. The concrete base 22 may have a rectilinear shape or a curvilinear shape based on the configuration of the at least one insulative storage vessel 32, or multiple items thereof, to be received in the compartment 30. Based on the shape of the concrete base 22, the plurality of
5 concrete walls 24 may be planar or curved to, preferably, conform to the shape of the periphery of the concrete base 22.

Preferably, the caisson box structure 20 further comprises a cage structure 36 adapted for being received in the compartment 30 and shaped, dimensioned and adapted for receiving the
10 at least one insulative storage vessel 32. The cage structure 36 is for interposing the plurality of concrete walls 24 and the at least one insulative storage vessel 32 when received in the compartment 30 to thereby substantially isolate movement of the at least one insulative storage vessel 32 in the compartment 30 when the caisson box structure 20 is being transported or moved.

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Preferably, the cage structure 36 comprises an external frame 38 for substantially shape matching the compartment 30 and at least one internal frame 40 for shape matching and accommodating the at least one insulative storage vessel 32. In some implementations, the at least one internal frame 40 is coupled directly with the external frame 38. The at least one
20 internal frame 40 can comprise at least one plate, preferably planar and made of metal, which couples directly to the external frame 38 and has at least one circular hole shaped for passage of the corresponding one of the at least one insulative storage vessel 32 therethrough. In other implementations, the at least one internal frame 40 is coupled to the external frame 38 by a plurality of braces which extends between the external frame 38 and the at least one
25 internal frame 40 to isolate movement of the at least one internal frame 40, and the at least one insulative storage vessel 32 held thereby, relative the external frame 38. Preferably, the cage structure 36 is formed from a plurality of metallic channels.

Preferably, the at least one insulative storage vessel 32 is at least one cryogenic storage
30 dewar having one of less than 3000 litres and substantially 210 litres in storage capacity.

Each of the concrete base 22 and the plurality of concrete walls 24 has a thickness of between 50mm and 500mm. Further, each of the plurality of concrete walls 24 has a height of between 1 meter to 3 meters and a width of between 0.3 meter and 5 meters. The at least one insulative storage vessel 32 is for storing gas, for example liquefied natural gas and is for discharging vaporized natural gas through the use of an internal vapourizer or an external vapourizer.

In one implementation of the caisson box structure 20, the concrete base 22 has a rectangular in shape with four of the concrete walls 24 extending therefrom to form the compartment 30. The cage structure 36 has a rectangular-shaped external frame 38 and receptacles forming four internal frames 40 for receiving up to four of the insulative storage vessel 32. The cage structure 36 can be releasable couplable to the four concrete walls 24 with the insulative vessels 32 being removably securable to the cage structure 36 by, for example, latches, fasteners and straps. Four loops forming the at least one attachment structure 34 are located at four corners of the opening 28 to provide four lifting points for lifting and transporting the caisson box structure 20. Hence, the caisson box structure 20 can comprise the insulative storage vessels 32.

The caisson box structure 20 can further include legs 58, which may be formed during fabrication of the caisson box structure 20, for elevating the concrete base 22 off the ground or off a surface on which it stands. As the concrete base 22 and the plurality of concrete walls 24 are waterproof, leakage of liquid from the compartment 30 and the introduction of water from outside the compartment 30 thereinto, for example via weathering, is impeded or substantially controlled. The plurality of concrete walls 24 allows any cryogenic, blast and fire hazards from the at least one insulative storage vessel 32 and its content to be substantially contained and buffered by the plurality of concrete walls 24 with only the opening 28 to the compartment 30 functioning as a vent. This benefit is made mobile through the portable construction of the caisson box structure 20 which may be suspended from the at least one attachment structure 34 for transport with or without the at least one insulative storage vessel 32 and with or without the cage structure 36.

Aspects of particular embodiments of the present disclosure address at least one aspect, problem, limitation, and/or disadvantage associated with existing box structures. While features, aspects, and/or advantages associated with certain embodiments have been
5 described in the disclosure, other embodiments may also exhibit such features, aspects, and/or advantages, and not all embodiments need necessarily exhibit such features, aspects, and/or advantages to fall within the scope of the disclosure. It will be appreciated by a person of ordinary skill in the art that several of the above-disclosed structures, components, or alternatives thereof, can be desirably combined into alternative structures, components,
10 and/or applications. In addition, various modifications, alterations, and/or improvements may be made to various embodiments that are disclosed by a person of ordinary skill in the art within the scope of the present disclosure, which is limited only by the following claims.

Claims

1. A caisson box structure comprising:
 - a concrete base;
 - 5 a plurality of concrete walls extending from adjacent the periphery of the concrete base to terminate at a free end for defining an opening to a compartment defined by the plurality of concrete walls and the concrete base, the compartment being shaped and dimensioned for receiving at least one insulative storage vessel therein; and
 - 10 at least one attachment structure formed with at least one of the plurality of concrete walls wherefrom weight of the plurality of concrete walls, the concrete base and the at least one insulative storage vessel can be supported for enabling mobility and transport of the caisson box structure.
- 15 2. The caisson box structure as in claim 1, each of the concrete base and the plurality of concrete walls are prefabricated from reinforced concrete.
3. The caisson box structure as in claim 2, the reinforced concrete further being high strength concrete being adapted and shaped and dimensioned for forming a
 - 20 substantially blast and penetration resistant structure.
4. The caisson box structure as in claim 2, the reinforced concrete being reinforced with at least one of steel rebars, synthetic fibers and natural fibers.
- 25 5. The caisson box structure as in claim 1, the at least one attachment structure comprising at least one exposed rebar being adapted with one of a loop shape and a hook shape.

6. The caisson box structure as in claim 1, the at least one attachment structure being one of at least one recess and at least one hole formed in at least one of the plurality of concrete walls.
- 5 7. The caisson box structure as in claim 1, each of the concrete base and the plurality of concrete walls being substantially planar.
8. The caisson box structure as in claim 1, further comprising:
 10 a cage structure adapted for being received in the compartment and shaped and dimensioned for receiving the at least one insulative storage vessel, the cage structure for interposing the plurality of concrete walls and the at least one insulative storage vessel when received in the compartment to thereby substantially isolate movement of the at least one insulative storage vessel in the compartment when the caisson box structure is being transported.
- 15 9. The caisson box structure as in claim 8, the cage structure having an external frame for substantially shape matching the compartment and at least one internal frame for shape matching and accommodating the at least one insulative storage vessel.
- 20 10. The caisson box structure as in claim 8, the cage structure being formed from a plurality of metallic channels.
11. The caisson box structure as in claim 1, the at least one insulative storage vessel being at least one cryogenic storage dewar having one of less than 3000 litres and
 25 substantially 210 litres in storage capacity.
12. The caisson box structure as in claim 1, each of the concrete base and the plurality of concrete walls having a thickness of between 50mm and 500mm,
 30 wherein each of the plurality of concrete walls having a height of between 1 meter to 3 meters and a width of between 0.3 meter and 5 meters.

13. A caisson box structure comprising:

a concrete base defining four edges;

four concrete walls extending from adjacent the four edges of the concrete base to terminate at a free end for defining an opening to a compartment defined by the four concrete walls and the concrete base, the compartment being shaped and dimensioned for receiving at least one insulative storage vessel therein;

a cage structure adapted for being received in the compartment and shaped and dimension for receiving the at least one insulative storage vessel, the cage structure for interposing the plurality of concrete walls and the at least one insulative storage vessel when received in the compartment to thereby substantially isolate movement of the at least one insulative storage vessel in the compartment when the caisson box structure is being transported; and

at least one attachment structure formed with at least one of the plurality of concrete walls wherefrom weight of the plurality of concrete walls, the concrete base and the at least one insulative storage vessel can be supported for enabling mobility and transport of the caisson box structure,

wherein each of the concrete base and the plurality of concrete walls is formed from high strength concrete being adapted and shaped and dimensioned for forming a substantially blast and penetration resistant structure.

14. The caisson box structure as in claim 13, the high strength concrete being reinforced with at least one of steel rebars, synthetic fibers and natural fibers with each of the concrete base and the plurality of concrete walls having a thickness of between 50mm and 500mm,

wherein each of the plurality of concrete walls having a height of between 1 meter to 3 meters and a width of between 0.3 meter to 5 meters.