

A FREIGHT CONTAINER STORAGE AND RETRIEVAL SYSTEM AND METHOD FOR CARRYING OUT THE SAME

TECHNICAL FIELD

[0001] The present invention relates to the field of storing freight containers. In particular, it relates to
5 a system for the storage and retrieval of freight containers and a method of carrying out the same.

BACKGROUND

[0002] Containerisation is a system of freight transportation based on the use of freight containers. The containers are built to standardised dimensions in order to provide cross-compatibility across the various transportation networks such as road, rail and sea, for example. An example of international
10 standards that are applicable to freight containers can be found in the International Standards Organisation (ISO) Handbook – Freight Containers (ISO 668:1995), which is hereby incorporated by reference.

[0003] The widespread use of ISO standards for freight containers has allowed freight containers to become the backbone of global supply chains. It is estimated that over 13 million freight containers
15 are currently in service around the world and conform to ISO standards. In order to cope with the phenomenal growth of the use of freight containers in global trade, systems and methods of optimising the storage and transportation of such freight containers have also rapidly developed. Such systems and methods extend to, but are not limited to, the following:-

- a. Ship design;
- 20 b. Transport methodologies; and
- c. Container loading, stacking and storage systems and facilities.

[0004] The ISO freight container is commonly twenty feet or forty feet in length. However, it is industry practice that the size of freight containers is often expressed in terms of twenty-foot equivalent units (TEU). PCT application published as WO 2010/087784 A1 ("**the Tan Patent**")
25 discloses that one TEU container is generally 20 feet (6.1m) x 8 feet (2.4m) x 8.5 feet (2.6m) (length x width x height) in size (refer to [0002], lines 12 – 13). In addition, there is a further type of freight container typically referred to as a "High Cube" freight container. The only difference between the dimensions of a TEU container as disclosed in the Tan Patent and the High Cube container is that the

height of a High Cube container is about 9.5 feet (approximately 2.9m). The High Cube containers are nevertheless also referred to as TEUs.

5 **[0005]** Accordingly, a forty-foot container, or 2 TEUs has a length of 40 feet (12.2m) with the width and height of the container remaining the same as that of a single TEU (refer to [0004], lines 4 – 6 of the Tan Patent). It is this uniformity in the dimensions of the freight containers, insofar as the width and height are concerned, that allows the ISO freight container to be used widely across transportation networks as mentioned above. It is also this uniformity in dimensions that allows the freight container to be stored in a relatively compact manner by employing the practice of stacking.

10 **[0006]** The Tan Patent also discloses that the freight containers are typically owned by a shipper, leasing lines, or a carrier (refer to [0005], line 13 of the Tan Patent). Often, after a freight container has been delivered to its destination and its contents unloaded, the freight container may not be required for further utilisation. In such instances, the freight container is sent to a container depot to be stored until required in the future. As container depots are shared facilities, i.e., several freight container owners share the storage facilities of the container depot, it is important that there is a proper management and tracking system in place to ensure that the location of each freight container is logged in order to facilitate any subsequent retrieval process in the event that the container is subsequently needed for use.

20 **[0007]** In addition, a container depot also provides services and facilities for the repair and maintenance of freight containers. This includes welding, cutting, spray jet cleaning, painting and metal treatment for the containers (refer to [0005], lines 16 – 18 of the Tan Patent). Other services provided include the inspection and testing of the freight containers.

[0008] Apart from the services and facilities described above, the main function of a container depot is still the storage and handling of unused freight containers. The Tan Patent sets out at [0006] – [0009] the main problems presently facing container depots as follows:-

- 25
- a. Freight containers are normally stored in open areas in a stacked fashion up to a limited height of 10 freight containers;
 - b. Storage area for freight containers only occupies 60% of the container depot space with the remaining 40% being used for operational purposes such as for access ways, freight container stackers, prime movers and trailers; and

- c. A freight container stacker's cabin is situated at or around the 3rd or 4th freight container in a stack, which results in difficulty for the operator of the container stacker when stacking freight containers above the height of the container stacker's operator's cabin, which in turn results in slower operations, when.

5 The invention of the Tan Patent is intended to address the above-mentioned problems faced by freight container depots. The invention of the Tan Patent provides a building structure with a roof that is used for the storage of freight containers. The roof is also described as having container handling equipment, such as a crane, mounted thereon to hoist and store freight containers on the rooftop. Other equipment to be placed there includes forklifts and other stacking equipment.

10 **[0009]** However, the invention of the Tan Patent has inherent drawbacks as well. First, by situating the container depot on the top surface of the roof, the load factor on the roof will be extremely high. The Tan Patent itself has disclosed that each TEU could potentially weigh about 2,400kg when empty. As such, if hundreds of freight containers are intended to be stacked, with each stack consisting of up to 10 containers, the cost of building a structure strong enough to withstand such a
15 load factor will be prohibitive and cause freight container depot costs to be substantially higher as well.

[0010] Second, the invention of the Tan Patent contemplates using a crane, such as an overhead crane to stack the freight containers on the roof. In so doing, the height to which containers may be stacked on the roof will be limited to the height of the overhead crane. In most cases, this will only
20 permit stacks of 6 – 9 containers to be arranged. This limitation further prevents the number of freight containers that may be stored on the rooftop of the freight container depot and therefore results in a less than optimal use of the freight container depot disclosed in the Tan Patent.

[0011] Third, placing a stack of up to ten containers on the rooftop is a safety hazard. This is because placing a stack of freight containers on a rooftop makes the stacked freight containers
25 vulnerable to the effects of wind shear, which can topple the stacked freight containers.

[0012] As such, despite the above-mentioned attempt by the invention in the Tan Patent to provide a solution to the storage of freight containers, there is clearly still a need for a system and method for storing and retrieving freight containers that is safe, provides better operational efficiency by making better use of area resources, and is cost – effective to implement. In this respect, a system and

method as described below, and as defined in the claims appended hereto, overcomes the difficulties of the Tan Patent whilst still providing the aforesaid stated benefits.

DESCRIPTION OF THE INVENTION

5 **[0013]** A first aspect of the present invention relates to a system for storing and retrieving ISO freight containers also referred to as a container storage and retrieval system ("CSRS"). The system includes at least one supporting structure. The at least one supporting structure has at least an upper portion that is a rooftop section. The at least one supporting structure extends vertically to a height at least substantially equivalent to the height of at least one ISO freight container. In one exemplary
10 embodiment, the supporting structure may extend to a height of about 85 metres or more in height depending on operational requirements.

[0014] The system also includes at least one freight container handling crane. The freight container handling crane is positioned such that its base legs are located on the rooftop section of the at least one supporting structure. Effectively, the freight container handling crane is positioned atop of the
15 rooftop section of the supporting structure.

[0015] In an embodiment of the invention, the at least one freight container handling crane may be a quayside crane having a boom. The base legs of the quayside crane may be positioned such that the boom of the quayside crane extends away from the periphery of the at least one supporting structure. In other words, the boom of the quayside crane would extend away from the supporting structure.

20 **[0016]** In another embodiment, the system may also include at least one cell-guide structure positioned in an area proximate to the at least one supporting structure. In this embodiment, the cell-guide structure would be positioned within the operational area or operational limits of the at least one freight container handling crane. The cell-guide structure includes a substantially right-angled rectangular frame dimensioned to be substantially similar to the dimensions of a base of an ISO
25 freight container. The rectangular frame is arranged substantially horizontal to the vertical axis of the at least one supporting structure. The length of the rectangular frame would lie substantially parallel to the upper portion of the at least one supporting structure. The rectangular frame has vertical guide

rails extending from each corner of the rectangular frame. Each vertical guide rail extends to a height at least substantially equivalent to the height of an ISO freight container.

[0017] The cell-guide itself includes a substantially right-angled rectangular frame as its base. The right-angled rectangular frame is preferably dimensioned to be substantially similar, or slightly larger than the dimensions of a base (length x width) of an ISO freight container. In one exemplary embodiment, the base rectangular frame of the at least one cell-guide structure may be dimensioned to be substantially similar to a twenty-foot freight container or alternatively, to that of a forty-foot freight container. The rectangular base is preferably arranged with its length substantially parallel to the upper portions of the supporting structures.

10 **[0018]** The cell-guide structure also has vertical guide rails extending from each corner of the rectangular base. Each vertical guide rail extends to a height at least substantially equivalent to the height of an ISO freight container. However, in exemplary embodiments where the supporting structures extend to higher heights, the vertical guide rails may also extend, such that the ends of the vertical guide rails are approximately coplanar with the upper portions of the first and second supporting structures.

[0019] In the exemplary embodiments where the vertical guide rails extended beyond the height of a single ISO freight container, the cell-guide structure may further include at least one more rectangular frame located further away from the base but along the vertical guide rails, such that the at least one more rectangular frame still connects with the vertical guide rails at its corners and is coincident with the base. In so doing, the additional rectangular frames may provide additional support and rigidity to the vertical guide rails that are extending vertically from the base rectangular frame. The additional rectangular frames may be evenly distributed along the length of the vertical guide rails to provide even support and uniform structural integrity to the cell-guide structure as a whole.

25 **[0020]** In a further exemplary embodiment, the cell-guide structure is adapted to be capable of receiving and guiding an ISO container being lowered by the crane. The crane would lift a freight container from its position on the upper portion of either the first and/or second supporting structure and position it over a rectangular frame of the cell-guide structure. In so doing, the freight container will be positioned such that it will be also be able to just fit within vertical guide rails as it is lowered by the crane. During the lowering process, the vertical guide rails will restrict any lateral or longitudinal

movement of the freight container and ensure that the freight container follows a substantially linear path towards the base rectangular frame of the cell-guide structure, such that the ISO freight container is finally placed on or within the base rectangular frame. If another container has already been placed on or within the base rectangular frame, the subsequent freight container is simply
5 stacked up in the cell-guide structure. In order to maximise the space available for storing containers in the cell-guide structure, where more than one cell-guide structure is employed, the plurality of cell-guide structures may be placed in a grid arrangement.

[0021] In yet another embodiment of this aspect of the invention, the container storage and retrieval system also includes at least one vehicular transit portion. The vehicular transit portion is adapted to
10 transport vehicles from the ground to any level of the supporting structures, and in particular, to the upper portions of the first, second and/or third supporting structures. In one exemplary embodiment, the vehicle transit portion is a vehicular lift or alternatively, a vehicular ramp, for example.

[0022] In one embodiment, the system may include a second supporting structure having an upper portion that is a rooftop section. The second supporting structure is separated from the at least one
15 supporting structure by a fixed distance. In another exemplary embodiment, the upper portion of the second supporting structure is at least substantially parallel to and directly opposite to the upper portion of the at least one supporting structure. In this exemplary embodiment, the second supporting structure extends vertically to a height at least substantially equivalent to the height of an ISO freight container, and typically to the same height as the at least one supporting structure.

[0023] In another embodiment, the system may include a third supporting structure having an upper portion that is a rooftop section. In an exemplary embodiment, the third supporting structure may be located between the at least one supporting structure and the second supporting structure. The location of the third supporting structure may be such that it connects to the at least one supporting structure and second supporting structures at their respective peripheries. In this embodiment, this
25 would result in at least a section of the upper portion of the third supporting structure being at least substantially perpendicular to the parallel sections of the upper portions of the at least one supporting structure and second supporting structure.

[0024] In the exemplary embodiment having a third supporting structure, the third supporting structure may be located such that its upper portion is at least substantially perpendicular to the upper

portions of the first and second support structures, in particular with the sections of the upper portions of the first and second supporting structures that are parallel to each other. In such an embodiment, the upper portion of the third supporting structure may also be coplanar with the upper portions of the first and second supporting structures. Thus, in this exemplary embodiment, the upper portions of the
5 supporting structures may be of substantially similar height and at least substantially coplanar with respect to each other.

[0025] In all the exemplary embodiments of this aspect of the present invention, the upper portions of the first, second and/or third supporting structures may be rooftop sections. The rooftop sections may be substantially horizontally planar. In yet another exemplary embodiment, the upper portions and/or
10 the supporting structures may be adapted to have structural strength to accommodate freight container handling trains, the movement and parking of trailers, prime movers or ISO freight containers on the upper portions of the supporting structures. In the exemplary embodiment having a third supporting structure, the upper portions of the first, second and third supporting structures may be constructed such that vehicular access is provided from one supporting structure to another via the
15 upper portions of the first, second and third supporting structures.

[0026] In any of the exemplary embodiments described above, the supporting structures may be multi-storey buildings. In the embodiments where the supporting structures are multi-storey buildings, at least one of the respective upper portions of the supporting structures may be adapted to function as an inspection and repair bay for trailers, prime movers and/or ISO freight containers. Alternatively,
20 any one or more of the levels in the multi-storey building may be used for the purposes of inspecting, washing and/or repairing trailers, prime movers and/or ISO freight containers.

[0027] In yet another exemplary embodiment of this aspect of the invention, the first, second and/or third supporting structures may be adapted, to protect against wind shear with respect to the volume of space located between the upper portions of the supporting structures and the bottom of the
25 supporting structures.

[0028] The system of the present invention also includes at least one freight container handling crane. The crane may be a quayside crane or any other suitable crane that may be situated on the upper portion of the supporting structure. The situating of the crane on the upper portion of the support structure should be such that the crane has an operational area proximate to the support

structure. In another exemplary embodiment of the invention, the base legs of the crane may adapted to traverse the whole or part of the length of the upper portion of the supporting structure on which the crane is situated. Where there is more than one crane being employed, the length of the upper portion may be sub-divided such that each crane is allocated to operate over a specific range of the upper
5 portion of the supporting structure.

[0029] In another embodiment of the invention, the system for storing and retrieving freight containers may also include a controller. The controller may be in the form of a computer device that is adapted to execute at least one computer programme. The controller may also include at least one database that is adapted to store the particulars of any ISO container deposited within the cell-guide
10 structure via the crane. In particular, the database may include the location of the freight container within the cell-guide structure by utilising a 3-dimensional coordinate system. The controller may also be in electronic communication with at least one other controller via a communication network.

[0030] In another embodiment, the CSRS may include a freight container handling crane that has an automatic gantry steering system (AGSS), position determination system (PDS) and radio data
15 system (RDS). In such an embodiment, the AGSS, the PDS and the RDS would typically be in electronic communication with the controller via the communication network. The AGSS, the PDS and the RDS are electronic systems that enable automatic steering of cranes that enable the automatic determination of the position of containers relative to the crane and allow for monitoring of the same.

[0031] Using AGSS, a crane can be reliably steered and directed into an appropriate position to
20 either deposit or retrieve a freight container. The PDS on the other hand is concerned with the tracking and positioning of freight containers that are to be deposited and retrieved from the container depot.

[0032] A second aspect of the present invention relates to a method for storing an ISO freight container based on any of the embodiments of the system as described above. This method includes
25 the following processes:-

- a. inputting a storing order for an ISO freight container from a haulier into the controller;
- b. allocating a position in the at least one cell-guide structure to the ISO freight container specified in the storing order; and

- c. transporting and storing the ISO freight container via the crane in its allocated location within the cell-guide structure.

[0033] One exemplary embodiment of this method may further include the process of inputting a receipt order for an ISO freight container from a customer into the controller *prior* to inputting the storing order from the haulier. By so doing, upon input of the storing order the controller may execute a computer programme to verify the storing order against the receipt order. This is a security feature to guard against ad-hoc depositing of containers which in turn would allow the system to better plan, coordinate and allocate its resources in advance of receiving any freight containers for storage.

[0034] The process of transporting and storing the ISO freight container may also include any one or more of the following processes:-

- a. Inspection of the freight container to be deposited and generation of a status report on the status of the freight container;
- b. Based on any issues identified in the status report, the freight container may be stored immediately, or may be subject to repairs and/or washing and cleaning;
- 15 c. Further inspection to confirm whether the issues identified in the status report have been addressed, following which, the freight container may be stored.

[0035] Where the freight containers are subject to any additional processes such as repairs, washing and cleaning, the controller, based on the report, informs the owners of the containers via the communication network. The controller is adapted to receive an authorisation from the owner of the freight container prior to the application of any additional processes to a freight container.

[0036] A third aspect of the present invention relates to a method for retrieving an ISO freight container based on any of the embodiments of the system as described above. This method includes the following processes:-

- a. inputting a release order for an ISO freight container from a haulier into the controller;
- 25 b. locating the position of the ISO freight container specified in the release order from the cell-guide structure; and
- c. retrieving the ISO freight container from its location in the cell-guide structure and releasing it to the haulier.

[0037] One exemplary embodiment of this method may further include the process of inputting a retrieval order for an ISO freight container from a customer (typically the owner of the freight container) into the controller prior to inputting the release order from the haulier. Upon input of the release order the controller executes a computer programme to verify the release order against the retrieval order. As above, this additional process is a form of security to guard against unauthorised deposition of containers. In a further exemplary embodiment of the third aspect of the invention, the method may further include a process of verifying the status of the ISO freight container released to the haulier for any restrictions or qualifications, and obtaining the concurrence of the haulier.

[0038] In either the storage or retrieval process, the allocated position or existing position of the freight container is always known to the controller. This allocated position or existing position can then be provided to the freight container handling crane via the AGSS, the PDS and/or the RDS since these systems are in communication with the controller.

[0039] Although various aspects and embodiments of the present invention have been described above, the following illustrations of exemplary embodiments and accompanying description serve to further aid in the understanding and clarity of those various embodiments of the invention. However, it should be noted that the scope of the invention is by no means limited to the exemplary embodiments described and illustrated hereafter, but rather, as set out in the claims that are appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040] FIGURE 1 is an illustrative embodiment of a system for freight container storage and retrieval according to the present invention;

[0041] FIGURE 2 is another view of the illustrative embodiment of FIGURE 1;

[0042] FIGURE 3 is yet another view of the illustrative embodiment of FIGURE 1 during the operation of the system for freight container storage and retrieval according to the present invention;

[0043] FIGURE 4 is a side view of an exemplary embodiment of the system of the present invention;

[0044] FIGURE 5 is a top view of an exemplary embodiment of the system of the present invention;

[0045] FIGURE 6 is a top view of another embodiment of the system of the present invention;

[0046] **FIGURE 7** and **FIGURE 8** are exemplary process flow diagrams of a method of storing containers using a system as illustrated in **FIGURES 1 – 5**; and

[0047] **FIGURE 9** is an exemplary process flow diagram of a method of retrieving containers using a system as illustrated in **FIGURES 1 – 6**.

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DETAILED DESCRIPTION OF THE DRAWINGS

[0048] **FIGURE 1** is an illustrative embodiment of a system for freight container storage and retrieval. In this illustrative embodiment, the system comprises of a first and second building support structures **12A** and **12B** (not shown). On the rooftop of the building **12A**, a loading and/or unloading area is present wherein prime movers and trailers are parked while either waiting to store or retrieve freight containers **1**. The prime movers access the rooftop of building **12A** via vehicular access ramp **18**. The vehicular access ramp also provides access to the lower levels of building **12A** wherein other services, such as the inspection, washing and cleaning and repair of freight containers **1** may take place. These services may also be carried out on the rooftop of the support structures themselves.

10 **[0049]** Also located on the rooftop of building **12A** is at least one crane **14**. In this embodiment, the crane **14** is a quayside crane and has a pair of base legs **14A**. The base legs **14A** are situated along a section of the rooftop of the building **12A** that is parallel and coplanar to a corresponding section on the second building support structure **12B**. The base legs **14A** are adapted to translate along the section of the building **12A**. The boom of the crane **14** extends at least substantially across the space
20 between both building support structures **12A** and **12B**. Essentially, the boom of the crane **14** is such that it extends substantially perpendicular from the section of the rooftop of the building **12A** that is parallel and coplanar to a corresponding section on the second building support structure **12B**.

[0050] Adjacent to the first building is an embodiment of the invention having a plurality of cell-guide structures **16**. In this illustrative embodiment, the cell – guide structures are located in-between the
25 building support structures **12A** and **12B**. In particular, the height of the cell-guide structures are limited to the sections of the rooftop of the buildings **12A** and **12B** that are parallel and coplanar to each other, i.e., along and within the operational range of the crane **14**.

[0051] During operations, once confirmation of the storing and/or retrieval process has been made, the prime move will proceed via the vehicular access ramp **18** and park in a waiting area on the

rooftop of the building support structure **12A**. If a storage process is to take place for example, the prime mover, with hitched trailer and freight container **1** mounted thereon enters into the operational range of the crane **14**. The crane **14** will pick up the freight container **1** from the trailer and position the freight container over an allocated cell-guide structure **16**. The crane **14** will then lower the freight
5 container **1** down the cell-guide structure **16** until the freight container **1** either rests on the ground, or on another freight container **1** already placed within the cell-guide structure **16** earlier on.

[0052] The top of the cell-guide structure **16** includes a rectangular frame that connects at its four corners to vertical guide rails. The dimensions of the rectangular frame of the cell-guide structure **16**, and the positioning of the vertical guide rails, is such that it is slightly larger than the dimensions of a
10 twenty-foot and/or forty-foot freight container, as the case may be. This is to allow the freight container **1** to be lowered into the rectangular frame while at the same time severely limiting the degree of lateral movement of the freight container **1** in or about any axis other than the vertical axis as the freight container **1** is being lowered down the cell-guide structure **16**.

[0053] **FIGURE 2** is another view of the illustrative embodiment of **FIGURE 1**. **FIGURE 2** shows a
15 view of the rooftop of the second building support structure **12B**. Although the rooftop of the second building support structure **12B** does not have any crane positioned thereon, the rooftop is structurally capable of having a crane, such as a quayside crane, installed. If such a crane were to be installed on the rooftop of the second building support structure **12B**, that crane would also be capable of translating along the rooftop. To aid this, a track **22** would also have to be laid such that the track **22**
20 is parallel to the sections of the building support structures. As mentioned above, and as shown in **FIGURE 2**, the cell-guide structure **16** is also located between the building support structures **12A** and **12B**, and within the operational range of the crane **14**. Where a crane is not installed on the rooftop of the second building support structure, the rooftop may be utilised as an inspection bay, repair bay, washing, trailer chassis parking area, warehouse storage, open yard storage, marshalling area,
25 covered storage, prime mover parking area, cleaning bay or for any other functional purpose.

[0054] **FIGURE 3** is yet another view of the illustrative embodiment of **FIGURE 1**. As can be seen, in this particular exemplary embodiment the vehicular access ramp **18** is a circular ramp that provides access to every level of the first building support structure **12A** (not shown) or to the second building support structure **12B**, as the case may be. In this illustrative embodiment, the crane **14** is shown to
30 be lowering a freight container **1** down into the cell-guide structure **16**. The cell-guide structure **16**

includes horizontal rectangular frames **32** that are connected at their corners (vertices) to vertical guide rails **34**. The base of the cell – guide structure **16** may have the rectangular frame **32** though it is not essential. The vertical guide rails **34** may extend until they are at substantially at the same height as the rooftops of either or both rooftops of the building supporting structures **12A** and **12B**.

5 The cell-guide structure **16** has rectangular frames **32** periodically distributed along the vertical guide rails **34**.

[0055] **FIGURE 4** is a side view of an exemplary embodiment of the present invention. **FIGURE 4** shows the first building support structure **12A** having a vehicular access ramp **18**. The ramp **18** allows prime movers with or without trailers (loaded or otherwise) access to the rooftop of the first building support structure **12A**. The illustrative embodiment of **FIGURE 4** also has a second building support structure **12B**. As can be seen from the side view, the first building support structure and the second building support structure **12A** and **12B** are parallel to each other.

[0056] A crane **14** is installed atop building support structure **12A**. The base legs of the crane **14A** are located proximate to the edge of the building support structure **12A**. In particular, the base legs of the crane **14A** are located along the section of the rooftop of the building **12A** that is parallel and coplanar to a corresponding section on the second building support structure **12B**. As shown in **FIGURE 4**, the crane **14** may pick up a freight container **1** from a trailer on rooftop **12A** and lower the freight container **1** down the cell-guide structure **16** to a predetermined position that has been allocated to the freight container by a controller.

20 [0057] The cell-guide structure **16** is located in between the first and second building support structures **12A** and **12B**. As illustrated, the cell-guide structure **16** is also located within the operational area of the crane **14**. The cell-guide structure **16** includes horizontal rectangular frames **42** that are connected at their corners to vertical guide rails **44**. The base of the cell – guide structure **16** in this embodiment does not have any rectangular frame. In other exemplary embodiments, the base of the cell-guide structure **16** may include a rectangular frame **42** from the four corners of which the vertical guide rails **44** extend from. The vertical guide rails **44** may extend until they are at substantially at the same height as the rooftops of either or both rooftops of the building supporting structures **12A** and **12B**.

[0058] The cell-guide structure **16** is adapted such that the dimensions of the rectangular frame **42** are slightly larger than and can accommodate either a twenty-foot or forty-foot freight container **1**. Given the slight variance between the dimensions of the base of a freight container **1** and the dimensions of the rectangular frame **42**, the freight container will have its movement restricted save
5 for its movement along the vertical axis or direction denoted by the arrow marked 'Y' as the freight container is lowered down along the cell-guide structure **16**.

[0059] **FIGURE 5** is a top view of another exemplary embodiment of the present invention. **FIGURE 5** shows the exemplary embodiment of the present invention having three support structures **12A**, **12B**, and **12C**. In this embodiment, building support structure **12C** connects support structures **12A**
10 and **12B** together in an integral fashion such that vehicular access across all three support structures is granted. From the top view, it can be seen that the upper portion of support structure **12B** may be utilised as a vehicular park, container open storage area **56**, washing area, repair bay and/or even as a trailer chassis parking area. Likewise for support structures **12A** and **12C**.

[0060] **FIGURE 5** also clearly illustrates a plurality of freight container handling cranes **14** operating
15 between support structures **12A** and **12B**. The base legs of the freight container handling cranes **14** are adapted to traverse along the tracks **22**. In between the support structures **12A** and **12B** is a plurality of cell-guide structures **16**. The cell-guide structures **16** are placed such that they are at all times within the operational range of at least one freight container handling crane **14**. In this particular embodiment, the support structures **12A** and **12B** both have a vehicular access ramp **18**. It should be
20 noted that depending on operational requirements cranes **14** may be installed on any of the building support structures **12A**, **12B** and **12C**.

[0061] **FIGURE 6** is a top view of another exemplary embodiment of the system of the present invention. In this embodiment, there is only a single support structure **12A**. The support structure **12A** has a vehicular access ramp **18** leading to the rooftop of support structure **12A**. The rooftop of
25 support structure **12A** may accommodate washing bays, repair bays and other related services **56**, as well as an area where prime movers having freight containers may park to unload the same.

[0062] The support structure of **FIGURE 6** also has a second vehicular access ramp **18** at its far end. This second ramp may serve as the exit ramp in order to ensure that traffic on the rooftop of the support structure **12A** only flows in a single direction to minimise congestion and confusion. A plurality

of cranes **14** are also shown to be installed on the rooftop of the support structure **12A**. Each crane **14** may be responsible for a portion of the cell-guide structure **16** in order to process multiple movements of freight containers concurrently.

[0063] **FIGURE 7** and **FIGURE 8** are exemplary process flow diagrams of a method of storing
5 containers ("the Storing Method") using a system as illustrated in any of the previously described exemplary embodiments. In the Storing Method, a customer of the container depot provides an advance order or notification that the customer intends to deposit a freight container for storage at the container depot ("the Storing Order"). The customer may provide this Storing Order manually, or by
10 via a world wide web (Internet) interface. The Storing Order may include any description or particulars of the container, such as its dimensions, serial or registration number and/or particulars of the customer's representative who is authorised to deposit the container in question with the container depot. The container depot, or more specifically, a controller thereat, will provide a confirmation of receipt of the Storing Order along with a specific reference identification number to the customer.

[0064] Subsequently, the authorised representative of the customer will arrive at the container depot
15 with the freight container in question. The representative will provide the reference identification to the controller which will then carry out a verification of the reference identification against the Storing Order received from the customer. Once the reference identification, the representative's identification and the Storing Order have been verified, the freight container to be stored undergoes an inspection.
20 The inspection will determine whether the container can proceed to be stored, requires cleaning and washing, and/or requires repairs to be carried out.

[0065] If the freight container obtains clearance that it can be stored, the controller immediately determines a location for the container within the cell-guide structure and allocates that location to the container. Concurrently, the customer's representative may then proceed to a waiting lane to wait for
25 a crane to pick up the freight container to deposit at the allocated slot.

[0066] However, if the inspection process determines that the freight container repairs to be carried out, the representative and the container are directed to a repair bay. Concurrently, the customer is informed of the results of the survey and a cost estimate for the repairs is provided to the customer. If the customer agrees to the cost estimate (either immediately or after a further joint inspection), a

Work Order is raised and repair works are then carried out on the freight container. Upon completion of the repairs, a second inspection is carried out to determine if the container is now suitable for storage and if so, the representative will proceed to the waiting lane to have the freight container picked up by a crane for storage in the cell-guide structure.

- 5 **[0067]** **FIGURE 9** is an exemplary process flow diagram of a method of retrieving containers ("the Retrieval Method") using a system as described in any of the previously described exemplary embodiments. In this embodiment of the Retrieval Method, a customer of the container depot would provide an advance order or notice that a container already at the storage at the depot would be retrieved. The customer may provide this order or notice manually, or by any electronic means,
- 10 including, but not limited to, fax, electronic mail, or a secure online notification via a world-wide-web (Internet) interface. The advance notice or order ("the Release Order") may include particulars of the container, such as its dimensions, serial or registration number and/or particulars of the customer's representative who is authorised to collect the container in question from the container depot. The container depot, or more specifically, the controller thereat, will provide a confirmation of receipt of the
- 15 Release Order along with a specific reference identification number to the customer.

- [0068]** Subsequently, the authorised representative of the customer, usually a haulier with a prime mover and trailer, will then report to the container depot. Upon reporting, the representative will inform the container depot of the reference identification number. Upon receiving the reference identification number, the controller will verify the reference identification number and the identification of the
- 20 representative against the Release Order provided earlier on by the customer.

- [0069]** Upon confirmation, the retrieval of the freight container will be authorised and the representative will be directed to drive the prime mover and trailer to a waiting lane. Concurrently, a crane will be directed to retrieve the particular freight container in question from the cell-guide structure and to deposit the freight container on the waiting trailer. Upon receiving the retrieved freight
- 25 container, the representative is to carry out a visual inspection to confirm that the retrieved freight container corresponds to the particulars of the freight container that was provided in the Release Order from the customer. Once it is confirmed that the retrieved freight container corresponds to the freight container in the Release Order, the controller will conduct a final check as to whether there are any restrictions on the freight container about to be released. Barring any restrictions, the container

depot will permit the customer's representative to exit the container depot's premises. Upon releasing the freight container to the representative, the Retrieval Method is concluded.

[0070] As mentioned earlier, the above description of the exemplary embodiments of the present invention merely serve to aid in the understanding of the underlying principle behind the invention.

- 5 The present invention is not to be construed as being limited to the illustrated embodiments but rather, to the extent as defined in the claims that follow.

CLAIMS

What is claimed is:

1. A system for storing and retrieving ISO freight containers at a container depot comprising:-

at least one supporting structure,

wherein the at least one supporting structure has at least an upper portion that is a rooftop section, said at least one supporting structure extending vertically to a height at least substantially equivalent to the height of at least one ISO freight container; and

at least one freight container handling crane positioned such that its base legs are located on the rooftop section of the at least one supporting structure.

2. The system according to claim 1, wherein the at least one freight container handling crane is a quayside crane having a boom, wherein the base legs of the quayside crane are positioned such that the boom extends away from the periphery of the at least one supporting structure.

3. The system according to claims 1 or 2, further comprising:

at least one cell-guide structure positioned in an area proximate to the at least one supporting structure such that the cell-guide structure lies within the operational area of the at least one freight container handling crane, wherein said at least one cell-guide structure comprises:-

a substantially right-angled rectangular frame dimensioned to be substantially similar to the dimensions of a base of an ISO freight container, said rectangular frame being arranged substantially horizontal to the at least one supporting structure and with the length of the rectangular frame being substantially parallel to the upper portion of the at least one supporting structure, and

vertical guide rails extending from each corner of the rectangular frame, each vertical guide rail extending to a height at least substantially equivalent to the height of an ISO freight container.

4. The system according to any of claims 1 – 3, further comprising a second supporting structure having an upper portion that is a rooftop section, wherein the second supporting structure is separated from the at least one supporting structure by a fixed distance, and where at least a section of the upper portion of the second supporting structure is at least substantially parallel and directly opposite to at least a section of the upper portion of the at least one supporting structure, with the second supporting structure extending to a height at least substantially equivalent to the height of an ISO freight container.
5. The system according to any of claims 1 – 4, further comprising a third supporting structure having an upper portion that is a rooftop section, wherein the third supporting structure is located between the at least one supporting structure and the second supporting structure such that it connects to the at least one supporting structure and second supporting structures at their respective peripheries, and wherein at least a section of the upper portion of the third supporting structure is at least substantially perpendicular to the parallel sections of the upper portions of the at least one supporting structure and second supporting structure.
6. The system according to claim 4, wherein the sections of the upper portions of the at least one supporting structure and the second supporting structure are of substantially similar height and at least substantially planar with respect to each other.
7. The system according to claim 5, wherein the sections of the upper portions of the at least one supporting structure, the second supporting structure and the third supporting structure are of substantially similar height and at least substantially planar with respect to each other.
8. The system according to any of claims 1 – 7, wherein the upper portion of the at least one supporting structure is adapted to have sufficient structural strength to support the freight container handling crane and withstand the movement and parking of trailers, prime movers and ISO freight containers.
9. The system according to any of claims 1 – 8, wherein the upper portion of the supporting structure is adapted to function as an inspection and repair bay for trailers, prime movers and/or ISO freight containers.

10. The system according to any of claims 1 – 9, wherein the supporting structures are multi-storey buildings.
11. The system according to any of claims 4 – 10, wherein the supporting structures are adapted to protect against wind shear with respect to the volume of space between the supporting structures.
12. The system according to any of claims 1 – 11, wherein the base legs of the at least one freight container handling crane are adapted to traverse the length of the upper portions of the at least one supporting structure.
13. The system according to any of claims 3 – 12, wherein the at least one cell-guide structure is arranged to form a regular grid.
14. The system according to any of claims 3 – 13, wherein the vertical rails of the at least one cell-guide structure extend to the height of the upper portions of the at least one supporting structure.
15. The system according to any of claims 3 – 14, wherein the at least one cell-guide structure further comprises at least one more rectangular frame located distal from the first rectangular frame and along the vertical guide rails, such that the at least one more rectangular frame is in a plane parallel to the first rectangular frame and connects with the vertical guide rails at its corners.
16. The system according to any of claims 3 – 15, wherein the at least one cell-guide structure is adapted to receive and guide an ISO container being lowered by the at least one freight container handling crane from the distal end of the vertical rails, vertically downwards.
17. The system according to any of claims 3 – 16, wherein the rectangular frame of the at least one cell-guide structure is dimensioned to be substantially similar to a twenty-foot freight container or a forty-foot freight container.
18. The system according to any of claims 1 – 17, further comprising at least one vehicle transit portion adapted to enable vehicles to access the upper portion.

19. The system according to claim 18, wherein the vehicle transit portion is a vehicular lift or a vehicular ramp.
20. The system according to any of the preceding claims, further comprising a controller, wherein the controller is a computer device adapted to execute at least one computer programme.
21. The system according to any of claims 3 – 20, wherein the controller comprises at least one database that is adapted to store the particulars of any ISO container deposited within the at least one cell-guide structure via the at least one freight container handling crane.
22. The system according to claim 20 or 21, wherein the controller is in electronic communication with at least one other controller via a communication network.
23. The system according to any of the preceding claims, wherein the at least one freight container handling crane further comprises an automatic gantry steering system (AGSS), position determination system (PDS) and radio data system (RDS).
24. The system according to claim 23, wherein the AGSS, the PDS and the RDS are in electronic communication with the controller via the communication network.
25. A method for storing an ISO freight container based on a system as defined in any of claims 21 – 24, said method comprising:-
 - inputting a storing order for an ISO freight container from a haulier into the controller;
 - allocating a location to the ISO freight container specified in the storing order; and
 - transporting and storing the ISO freight container in the allocated location.
26. The method according to claim 25, wherein the allocated location is provided to the at least one freight container handling crane via the AGSS, the PDS and/or the RDS.
27. The method according to claim 25 or 26, further comprising:

inputting a receipt order for an ISO freight container from a customer into the controller prior to inputting the storing order from the haulier, such that upon input of the storing order the controller executes a computer programme to verify the storing order against the receipt order.

28. A method for retrieving an ISO freight container based on a system as defined in any of claims 21 – 24, said method comprising:-

inputting a release order for an ISO freight container from a haulier into the controller;

locating the position of the ISO freight container specified in the release order from the cell-guide structure; and

retrieving the ISO freight container from its location in the cell-guide structure and releasing it to the haulier.

29. The method according to claim 28, wherein the location of the ISO freight container is provided to the freight container handling crane via the AGSS, the PDS and/or the RDS.

30. The method according to claim 28 or 29, further comprising:

inputting a retrieval order for an ISO freight container from a customer into the controller prior to inputting the release order from the haulier, such that upon input of the release order the controller executes a computer programme to verify the release order against the retrieval order.

31. A method according to claim 28 – 30, further comprising:

verifying the status of the ISO freight container released to the haulier for any restrictions or qualifications, and obtaining the concurrence of the haulier.