

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.

[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.

[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.

[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:-

- 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 a first supporting structure and a second supporting structure. Each supporting structure has at least an upper portion and is separated from the other by a fixed distance. At least a section of the upper portion of the first supporting structure is at least substantially parallel and directly opposite to at least
10 a section of the upper portion of the second supporting structure. Both supporting structures extend to a height at least substantially equivalent to the height of an ISO freight container. However, in an exemplary embodiment, the supporting structures may extend to a height of 85 metres in height.

[0014] The first supporting structure has an upper portion. Likewise, the second supporting structure also has an upper portion. The upper portion of the first supporting structure or at least a portion
15 thereof, is at least substantially parallel and directly opposite to the upper portion, or at least a portion thereof, of the second supporting structure. The portions of the upper portion of the first and second supporting structures that are parallel to each other may lie in substantially the same horizontal plane, for example.

[0015] In one exemplary embodiment, the system may also include a third supporting structure also
20 having an upper portion. In this exemplary embodiment, the third supporting structure may be located between the first and second supporting structures such that the third supporting structure connects to first and second supporting structures. The connection between the first and second supporting structures and the third supporting structures may be at the respective peripheries of the supporting structures.

25 [0016] Alternatively, the connection between the three supporting structures may occur at the respective peripheries of the various upper portions of the three supporting structures. 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 supporting structures may be of substantially similar height and at least substantially coplanar with
5 respect to each other.

[0017] In another exemplary embodiment of this aspect of the present invention, the upper portions of the first, second and/or third supporting structures may be rooftops. The rooftops may be substantially horizontally planar. In yet another exemplary embodiment, the upper portions and/or the supporting structures may be adapted to have structural strength to accommodate the movement and
10 parking of trailers, prime movers and 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 upper portions of the first, second and third supporting structures.

[0018] 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, any one or more of the storeys in the multi-storey building may be used for the purposes of
15 inspecting, washing and/or repairing trailers, prime movers and/or ISO freight containers.

[0019] 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 supporting structures.

[0020] The system of the present invention also includes at least one freight container handling crane. The crane includes a pair of base legs located at distal ends from each other. The base legs are connected by a supporting framework and a spreader between the base legs. The pair of base legs are positioned such that the supporting framework and spreader straddle across the fixed distance between the sections of the upper portions of both supporting structures in an at least
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substantially perpendicular orientation to the at least substantially parallel sections of the upper portions of both supporting structures..

[0021] In one exemplary embodiment, one of the pair of base legs of the at least one freight container handling crane may be situated at the section of the upper portion of the first supporting structure, and the other of the pair of base legs may be situated at the section of the upper portion of the second supporting structure. Again in this embodiment, the supporting framework continues to straddle across the fixed distance between the sections of the upper portions of both supporting structures in an at least substantially perpendicular orientation to the at least substantially parallel sections of the upper portions of both supporting structures.

10 **[0022]** In another exemplary embodiment, the pair of base legs of the at least one freight container handling crane may be situated at the fixed distance between the first supporting structure, and the second supporting structure. In other words, the pair of base legs in this embodiment will be located on the ground and adjacent to the respective supporting structures. Yet again in this exemplary embodiment, the supporting framework continues to straddle across the fixed distance between the sections of the upper portions of both supporting structures in an at least substantially perpendicular orientation to the at least substantially parallel sections of the upper portions of both supporting structures.

[0023] In all the exemplary embodiments of the invention, the base legs of the crane are adapted to traverse the length of the substantially parallel sections of the upper portions of the first and second supporting structures. Where there is more than one crane being employed, the parallel sections may be sub-divided such that each crane is allocated to operate over a specific range of the parallel sections of the upper portions of the first and second supporting structures.

[0024] The system also includes at least one cell-guide structure. The cell-guide structure is positioned in an area on the ground between the supporting structures. 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 parallel sections of the upper portions of the supporting structures.

[0025] 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.

[0026] 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.

[0027] 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 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.

[0028] 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 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.

[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 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 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 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 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;
- 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;
- 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;

[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**;

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

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

[0045] **FIGURE 6** and **FIGURE 7** are exemplary process flow diagrams of a method of storing containers using a system as illustrated in **FIGURES 1 – 5**; and

[0046] **FIGURE 8** is an exemplary process flow diagram of a method of retrieving containers using a system as illustrated in **FIGURES 1 – 5**.

DETAILED DESCRIPTION OF THE DRAWINGS

5 [0047] **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
10 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.

[0048] Also located on the rooftop of building **12A** is at least one crane **14**. The crane **14** has a pair of base legs **14A** and **14B** (not shown). The base leg **14A** is situated along a section of the rooftop of
15 the building **12A** that is parallel and coplanar to a corresponding section on the second building support structure **12B**. The base leg **14A** is adapted to translate along the section of the building **12A**. The framework and spreader of the crane **14** straddles both building support structures **12A** and **12B** 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**.

20 [0049] 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 building support structures **12A** and **12B**. In particular, 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**.

25 [0050] 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 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.

[0051] The top of the cell-guide structure **16** includes a rectangular frame that connects at its four
5 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 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 movement of the freight container **1** in or about any axis other than the vertical axis as the freight
10 container **1** is further lowered down the cell-guide structure **16**.

[0052] **FIGURE 2** is another view of the illustrative embodiment of **FIGURE 1**. **FIGURE 2** shows a view of the rooftop of the second building support structure **12B**. On this rooftop, as with the first building support structure **12A**, the crane **14** has its other base leg **14B** position along the section of the rooftop of the building **12B** that is parallel and coplanar to a corresponding section on the second
15 building support structure **12A**, as mentioned above. The base leg **14B** is also capable of translating along the section. To aid this, a track **22** is laid such that the track **22** is parallel to the sections of the building support structures. As mentioned above, 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**. The rooftop of the second building support structure may be utilised as an inspection bay, repair bay,
20 washing, trailer chassis parking area, warehouse storage, open yard storage, marshalling area, covered storage, prime mover parking area, cleaning bay or for any other functional purpose.

[0053] **FIGURE 3** is yet another view of the illustrative embodiment of **FIGURE 1**. As can be seen, the vehicular access ramp **18** is a circular ramp that provides access to every levels of the first building support structure **12A** or the second building support structure **12B**. This illustrative
25 embodiment also shows that a plurality of cranes **14** may be utilised 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**.

[0054] **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.

5 **[0055]** A crane **14** straddles both building support structures **12A** and **12B**. The base legs of the crane **14A** and **14B** are located towards the edge of the building support structures **12A** and **12B**. In particular, the base legs of the crane **14A** and **14B** 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** picks up a freight container **1** from a trailer on
10 rooftop **12A** and lowers the freight container **1** down a cell-guide structure **16** that has been allocated to the freight container by a controller.

[0056] 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
15 **42** that are connected at their corners to vertical guide rails **44**. The base of the cell – guide structure in this embodiment does not have rectangular frame though 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
20 structures **12A** and **12B**.

[0057] 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
25 for its movement along the vertical direction denoted by the arrow marked 'Y' as the freight container is lowered down along the cell-guide structure **16**.

[0058] **FIGURE 5** is a top view of an exemplary embodiment of the present invention. **FIGURE 5** shows the exemplary embodiment of the present invention having three support structures **12A**, **12B**, and **12C**. Support structure **12C** connects support structures **12A** and **12B** together 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 **12A** 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 **12B** and **12C**.

5 **[0059]** **FIGURE 5** also clearly illustrates a plurality of freight container handling cranes **14** straddling across support structures **12A** and **12B**. The base legs of the Freight container handling cranes **14** are adapted to traverse along the tracks **22**, which make a section of the upper portion of the support structures **12A** and **12B**. 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
10 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**.

[0060] **FIGURE 5** and **FIGURE 6** are exemplary process flow diagrams of a method of storing 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
15 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 any electronic means, including, but not limited to, fax, electronic mail, or a secure online notification 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
20 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.

[0061] Subsequently, the authorised representative of the customer will arrive at the container depot with the freight container in question. The representative will provide the reference identification to the
25 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. The inspection will determine whether the container can proceed to be stored, requires cleaning and washing, and/or requires repairs to be carried out.

[0062] 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 a crane to pick up the freight container to deposit at the allocated slot.

5 [0063] 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
10 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.

[0064] FIGURE 7 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
15 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, 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
20 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 Release Order along with a specific reference identification number to the customer.

[0065] Subsequently, the authorised representative of the customer, usually a haulier with a prime
25 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 representative against the Release Order provided earlier on by the customer.

[0066] 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 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.

[0067] 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. 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:-

a first supporting structure, and

a second supporting structure;

wherein each supporting structure has at least an upper portion and is separated from the other by a fixed distance, wherein at least a section of the upper portion of the first supporting structure is at least substantially parallel and directly opposite to at least a section of the upper portion of the second supporting structure, both supporting structures extending to a height at least substantially equivalent to the height of an ISO freight container;

at least one freight container handling crane having a pair of base legs located at distal ends from each other connected by a supporting framework and a spreader between the base legs;

wherein the pair of base legs are positioned such that the supporting framework and spreader at least substantially span across the fixed distance between the sections of the upper portions of both supporting structures in an at least substantially perpendicular orientation to the at least substantially parallel sections of the upper portions of both supporting structures.

2. The system according to claim 1, further comprising:-

at least one cell-guide structure positioned in an area between the at least substantially parallel sections of the upper portions of the supporting structures, 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 and with its length substantially parallel to the parallel sections of the upper portions of the supporting structures, 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.

3. The system according to claim 1 or 2, further comprising a third supporting structure having an upper portion, wherein the third supporting structure is located between the first and second supporting structures such that it connects to first and second supporting structures at their respective peripheries, and 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 first and second support structures.
4. The system according to any of claims 1 – 3, wherein one of the pair of base legs of the at least one freight container handling crane is situated at the section of the upper portion of the first supporting structure, and the other of the pair of base legs is situated at the section of the upper portion of the second supporting structure.
5. The system according to any of claims 1 – 3, wherein the pair of base legs of the at least one freight container handling crane are situated at the fixed distance between the first supporting structure, and the second supporting structure.
6. The system according to any of claims 1 – 5, wherein the sections of the upper portions are of substantially similar height and at least substantially planar with respect to each other.
7. The system according to any of claims 1 – 6, wherein the upper portions are the rooftop sections of the first, second and third supporting structures.

8. The system according to any of claims 1 – 7, wherein the upper portions and/or the supporting structures are adapted to have structural strength to accommodate the movement and parking of trailers, prime movers and ISO freight containers.
9. The system according to any of claims 1 – 8, wherein at least one of the respective upper portions of the supporting structures 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 1 – 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 are adapted to traverse the length of the upper portions of the first and second supporting structures.
13. The system according to any of claims 1 – 12, wherein the at least one cell-guide structure is arranged in a grid.
14. The system according to any of claims 1 – 13, wherein the vertical rails of the at least one cell-guide structure extend to the height of the upper portions of the supporting structures.
15. The system according to any of claims 1 – 14, wherein the at least one cell-guide structure further comprises at least one more rectangular frame located further away from the first

rectangular frame and along the vertical guide rails, such that the at least one more rectangular frame also connects with the vertical guide rails at its corners.

16. The system according to any of claims 1 – 15, wherein the at least one cell-guide structure is adapted to receive and guide an ISO container being lowered by the crane from the distal end of the vertical rails, vertically downwards.
17. The system according to any of claims 1 – 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 vehicular transit portion adapted to transport vehicles to the upper portions of the first, second and/or third supporting structures.
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 claim 20, wherein the controller comprises at least one database that is adapted to store the particulars of any ISO container deposited within the cell-guide structure via the 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 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 any of the preceding claims, 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 20 – 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 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 20 – 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.