

Reverse Stacking Cell Guide For Storing of ISO Shipping Containers

Field of the Invention

This invention relates to a method and system of stacking ISO (International Standards Organization) shipping containers in an unconventional method of reverse stacking.

Prior Art

ISO shipping containers are stacked one on top of the other. The bottom container is placed first on the ground and then the next container is placed on top of the first container by a lifting machine such as a crane. The third container is placed on top of the second container and so on. Since the containers are stacked via a lifting machine, the height of stacking is limited by the height to which the lifting machine can stack. Presently, the stacking height in the industry is generally up to 6 to 7 containers high.

Thus, those skilled in the art are constantly striving to design an improved system and method of storing ISO shipping containers, which will be easy and simple to handle and take less space.

Summary of the Invention

The above and other problems are solved and an advance in the state of art is made by a method and system for stacking ISO shipping containers in accordance with this invention. A first advantage of this method and system in accordance with this invention is that the method and system is not restricted by the height limitation to which lifting machine can stack. Hence, the stacking height of the ISO shipping containers can be increased and is not limited by the height to which the lifting machine is capable of stacking. A second advantage of this method and system in accordance with this invention is that, with the improved method and system of stacking ISO shipping containers, utilisation of available premium terminal space increases substantially.

In accordance with an aspect of the invention, a method for stacking up ISO shipping containers to a reverse stacking cell guide is provided in the following manner. A method for stacking ISO shipping containers to a reverse stacking cell guide comprising a plurality of angle bars arranged vertically to fit four corners of the ISO shipping containers and a plurality of secure pins provided proximate a bottom end of each of the plurality of angle bars, the method comprising: loading a first ISO shipping container on a lifting system; elevating the lifting system to a first height such that apertures of the first ISO shipping container are aligned with the plurality of secure pins; and moving the plurality of

secure pins of the reverse stacking cell guide to a locked position such that the first ISO shipping container is locked within the reverse stacking cell guide.

In accordance with an embodiment of this invention, the apertures of the first ISO shipping containers are provided at each of four pin lock block being engaged to
5 respective four bottom corner fittings of the first ISO shipping container.

In accordance with an embodiment of this invention, the method further comprises lowering the lifting system back to base level; loading a second ISO shipping container on the lifting system; elevating the lifting system to a second height such that a top surface of the second ISO shipping container is in contact with bottom surface of the four pin lock
10 block; moving the plurality of secure pins to an unlocked position such that the first ISO shipping container is movable within the reverse stacking cell guide; elevating the lifting system to the first height such that apertures of the four pin lock block being engaged to the second ISO shipping container are aligned with the plurality of secure pins; and moving the plurality of secure pins to the locked position locking the second ISO shipping
15 container within the reverse stacking cell guide.

In accordance with an embodiment of this invention, the method further comprises moving the plurality of secure pins to the unlocked position; lowering the lifting system to the second height; moving the plurality of secure pins to the locked position locking the first ISO shipping container; and lowering the lifting system to base level to unload the
20 second ISO shipping container.

In accordance with an embodiment of this invention, the apertures of the first ISO shipping containers are provided at each of the four bottom corner fittings of the first ISO shipping container.

In accordance with an embodiment of this invention, the method further comprises
25 lowering the lifting system back to base level; loading a second ISO shipping container on the lifting system; elevating the lifting system to a second height such that a top surface of the second ISO shipping container is in contact with a bottom surface of the first ISO shipping container; moving the plurality of secure pins to an unlocked position such that the first ISO shipping container is movable within the reverse stacking cell guide;
30 elevating the lifting system to the first height such that bottom end fittings of the second ISO shipping container are aligned with the plurality of secure pins; and moving the plurality of secure pins to the locked position locking the second ISO shipping container within the reverse stacking cell guide.

In accordance with an embodiment of this invention, the method further comprises
35 moving the plurality of secure pins to the unlocked position; lowering the lifting system to

the second height; moving the plurality of secure pins to the locked position locking the first ISO shipping container; and lowering the lifting system to base level to unload the second ISO shipping container

5 In accordance with another aspect of the invention, a reverse stacking cell guide for stacking ISO shipping containers is provided in the following manner. The reverse stacking cell guide comprises a plurality of angle bars arranged vertically to fit four corners of the ISO shipping containers; a plurality of secure pins provided proximate a bottom end of each of the plurality of angle bars adapted to lock and unlock a bottom most ISO shipping container; and a frame for supporting the plurality of angle bars such
10 that the bottom end of each of the plurality of angle bars is apart from a bottom of the frame forming a bottom entry for loading and unloading ISO shipping containers to the plurality of angle bars.

In accordance with an embodiment of this invention, the reverse stacking cell guide further comprises a lifting system. In accordance with an embodiment of this
15 embodiment, the lifting system is provided on a movable vehicle.

In accordance with an embodiment of this invention, the reverse stacking cell guide further comprises a plurality of pin lock blocks being adaptably engagable to corner fittings of an ISO shipping container.

20 In accordance with an embodiment of this invention, each of the plurality of pin lock blocks comprises a support block; and a dovetail twist lock extending from a top of the support block.

In accordance with an embodiment of this invention, the dovetail twist lock comprises: a dovetail twist lock head for engaging the corner fittings of the ISO shipping containers; and a twist lock handle, the dovetail twist lock head and twist lock handle
25 being arranged such that actuating the twist lock handle in a first direction causes the dovetail twist lock head to be engaged to the bottom corner fitting of the ISO shipping container and actuating the twist lock handle in a second direction causes the dovetail twist lock head to be disengaged from the bottom corner fitting of the ISO shipping container.

30 In accordance with an embodiment of this invention, a top aperture and a bottom aperture are provided on the support block, each of the top aperture and bottom aperture is adapted to receive one of the plurality of secure pins.

In accordance with an embodiment of this invention, the reverse stacking cell guide further comprises a processor; memory, and instructions stored on the memory and
35 executable by the processor to: load a first ISO shipping container on the lifting system;

elevate the lifting system to a first height such that top and bottom apertures of each of the pin lock blocks being engaged to bottom fittings of the first ISO shipping container are aligned with the plurality of secure pins; and move the plurality of secure pins to a locked position such that the first ISO shipping container is locked within the plurality of angle bars.

In accordance with an embodiment of this invention, the reverse stacking cell guide further comprises instructions to: lower the lifting system back to base level; load a second ISO shipping container on the lifting system; elevate the lifting system to a second height such that a top surface of the second ISO shipping container is in contact with bottom surface of the support block of each of the pin lock block being engaged to the first ISO shipping container; move the plurality of secure pins to the unlocked position where the first ISO shipping container is movable within the reverse stacking cell guide; elevate the lifting system to the first height such that top and bottom apertures of each of the pin lock blocks being engaged to bottom fittings of the second ISO shipping container are aligned with the plurality of secure pins; and move the plurality of secure pins of the reverse stacking cell guide to the locked position locking the second ISO shipping container within the reverse stacking cell guide.

In accordance with an embodiment of this invention, the reverse stacking cell guide further comprises instructions to: move the plurality of secure pins to the unlocked position; lower the lifting system to the second height; move the plurality of secure pins to the locked position; and lower the lifting system to base level to unload the second ISO shipping container.

In accordance with an embodiment of this invention, the reverse stacking cell guide further comprises a processor, memory, and instructions stored on the memory and executable by the processor to: load a first ISO shipping container on the lifting system; elevate the lifting system to a first height such that bottom end fittings of the first ISO shipping container are aligned with the secure pins; and move the secure pins to a locked position such that the first ISO shipping container is locked within the angle bars.

In accordance with an embodiment of this invention, the above process can be repeated to reverse stack up more ISO containers up to the allowable limit.

In accordance with an embodiment of this invention, the reverse stacking cell guide further comprises instructions to: lower the lifting system back to base level; load a second ISO shipping container on the lifting system; elevate the lifting system to a second height such that a top surface of the second ISO shipping container is in contact with a bottom surface of the first ISO shipping container; move the secure pins to the unlocked

position where the first ISO shipping container is movable within the reverse stacking cell guide; elevate the lifting system to the first height such that bottom end fittings of the second ISO shipping container are aligned with the secure pins; and move the secure pins of the reverse stacking cell guide to the locked position locking the second ISO shipping container within the reverse stacking cell guide.

In accordance with an embodiment of this invention, the reverse stacking cell guide further comprises instructions to: move the secure pins to the unlocked position; lower the lifting system to the second height; move the secure pins to the locked position; and lower the lifting system to base level to unload the second ISO shipping container.

Brief Description of the Drawings

The above and other features and advantages in accordance with this invention are described in the following detailed description and are shown in the following drawings:

Figure 1 illustrates a perspective view of a reverse stacking cell guide in accordance with an embodiment of this invention;

Figure 2 illustrates a plan view of one of the angle bars of the reverse stacking cell guide in accordance with an embodiment of this invention;

Figure 3 illustrates a side view of one of the angle bars of the reverse stacking cell guide in accordance with an embodiment of this invention;

Figure 4 illustrates a perspective view of one of the angle bars of the reverse stacking cell guide in accordance with an embodiment of this invention;

Figure 5 illustrates a perspective view of the reverse stacking cell guide without the frame in accordance with an embodiment of this invention;

Figure 6 illustrates a processing unit in accordance with an embodiment of this invention;

Figure 7 illustrates a process flow of loading an ISO shipping container to a reverse stacking cell guide in accordance with an embodiment of this invention;

Figure 8 illustrates a process flow of unloading an ISO shipping container to a reverse stacking cell guide in accordance with an embodiment of this invention;

Figure 9 illustrates an ISO shipping container loaded on a platform of the lifting system in accordance with an embodiment of this invention;

Figure 10 illustrates an ISO shipping container being elevated to a first height by the lifting system in accordance with an embodiment of this invention;

Figure 11 illustrates an ISO shipping container being elevated to a second height by the lifting system in accordance with an embodiment of this invention;

Figure 12 illustrates a number of reverse stacking cell guides being arranged in a 4 by 4 grid arrangement in accordance with an embodiment of this invention;

5 Figure 13 illustrates a side view the 4 by 4 grid arrangement in accordance with an embodiment of this invention;

Figure 14 illustrates a use of a movable lifting system in the 4 by 4 grid arrangement in accordance with an embodiment of this invention;

10 Figure 15 illustrates the movable lifting system moving in a first direction within the space below the entry point of the reverse stacking cell guides in accordance with an embodiment of this invention;

Figure 16 illustrates the movable lifting system moving in a second direction within the space below the entry point of the reverse stacking cell guides in accordance with an embodiment of this invention;

15 Figure 17 illustrates a perspective view of a reverse stacking cell guide implementing pin lock blocks in accordance with an embodiment of this invention;

Figure 18 illustrates a perspective view of the pin lock block in accordance with an embodiment of this invention;

20 Figure 19 illustrates a cross sectional view of box 1850 (as shown in figure 18) of the pin lock block in accordance with an embodiment of this invention; and

Figure 20 illustrates a cross sectional view of box 1860 (as shown in figure 18) of the pin lock block in accordance with an embodiment of this invention.

Detailed Description

25 This invention relates to a method and system of stacking ISO shipping containers in a reverse manner.

For purposes of this disclosure, the ISO shipping containers are in relation to shipping containers that have or would be published in the catalogue prepared by International Standards Organization.

30 Cell guides have been used in containerhips for many years but not so on land. In ships, the containers are lowered from top to bottom by shore cranes and have limitation up to about 10 containers one on top of the others. It is proposed that the cell guides are implemented on land in an arrangement such that ISO shipping containers can be stacked in a reverse stacking manner. In other words, instead of conventional

method of lowering an ISO shipping container from top down, the ISO shipping containers are stacked in a bottom up or reverse approach.

Figure 1 illustrates a reverse stacking cell guide 100. The reverse stacking cell guide 100 comprises mainly of four angle bars 110-113 arranged vertically to fit at four corners of an ISO shipping container 190. The four angle bars 110-113 are connected together via 2 sets of connecting bars 114-117, one at the top end 210 while the other proximate the bottom end 220 of the four angle bars 110-113. The four angle bars 110-113 are supported by a frame 120. The frame 120 comprises four vertical bars 121-124 extending from the ground to the top of the frame 120. Four sets of four connecting bars 125-128 are provided to connect the four vertical bars 121-124 together forming a quadrilateral. Four sets of four linking bars 129-132 are provided to link the edges of the quadrilateral to each of the four angle bars 110-113. One skilled in the art will recognise that other number of linking bars or connecting bars may be provided to form the frame and an exact number of linking bars or connecting bars is left to one skilled in the art.

The reverse stacking cell guide 100 further comprises a lifting system 150 and a processing unit (not shown). The lifting system 150 is any system for elevating the ISO shipping containers into and out of the reverse stacking cell guide 100. The processing unit is any computing system that executes instructions to control the lifting system 150, secure pins 410 and other systems such as container carriers or software applications such as inventory management program.

Figure 2 illustrates a plan view from the top of one of the four angle bars 110-113. Figure 3 illustrates a side view of a bottom end of one of the four angle bars 110-113. Figure 4 illustrates a perspective view of a bottom end of one of the four angle bars 110-113. At the bottom end 220 of each of the four angle bars 110-113 includes a reverse funnel shaped structure adapted for ease of introducing the ISO shipping containers from below. In particular, the reverse funnel shaped structure acts as a guide to align the ISO shipping container to a certain position so that a lifting system 150 is able to push the ISO shipping container 190 upwardly and within the four angle bars 110-113.

As shown in figure 5, the reverse stacking cell guide 100 is arranged at a certain height 510 away from the ground leaving a gap from the ground forming a bottom entry so that the container carriers can travel below and deliver the ISO shipping container to the bottom entry of the reverse stacking cell guide 100. Two secure pins 410 are provided proximate the bottom end of each of the vertical angle bars 100-113. The secure pins 410 are adapted to secure the bottom most ISO shipping container's bottom corner fittings to the reverse stacking cell guide 100 preventing the bottom most ISO shipping container

from falling off the reverse stacking cell guide 100. In another embodiment, an additional two secure pins 412 are provided further up each of the vertical bars 110-113 proximate to match with bottom most ISO shipping container's top corner fittings. One skilled in the art will recognise that any number of secure pins may be provided without departing from the invention. Further, one skilled in the art will recognise that the pair secure pins may be provided as a unitary piece. Still further, a processing unit may be provided with the secure pins to receive instructions to move the secure pins in the desired locations, namely lock or unlock positions. In yet another embodiment, a secure plate 420 may be provided proximate the bottom end of each of the vertical angle bars 100-113. The secure plate 420 is adapted to support the bottom most ISO shipping container's bottom corner fittings. The secure plate 420 acts as a failsafe in case the secure pins 410 give way.

As the secure pins 410 and the portion at the bottom end 220 of each of the four angle bars 110-113 are required to carry the weight of the ISO shipping containers stacked within the cell guide 100, the secure pins 410 and the portion at the bottom end 220 of each of the four angle bars 110-113 are made of material with a higher tensile strength than the rest of the cell guide. Alternatively, the cell guides 100 and frame 120 are made of the same materials with high tensile strength.

Briefly, to stack an ISO shipping container into the reverse stacking cell guide, a first ISO shipping container is pushed upwardly by the lifting system until the first ISO shipping container is within the reverse stacking cell guide 100 and the bottom end fittings of the ISO shipping container are aligned with the secure pins. Secure pins are provided to lock and secure the first ISO shipping container to prevent the first ISO shipping container from falling out of the reverse stacking cell guide 100. In an embodiment where secure plates 420 are used, the secure plates 420 are moved to the extended position where the bottom corner fittings of the first ISO shipping container is resting on the secure plates 420. When a second ISO shipping container is loaded onto the lifting system, the lifting system lifts the second ISO shipping container until a top surface of the second ISO shipping container is in contact with a bottom surface of the first ISO shipping container. In the embodiment where secure plates 420 are used, the secure plates 420 are moved to the retracted position, where the bottom corner fittings of the first ISO shipping containers are not resting on the secure plate, before the lifting system begins to lift the second ISO shipping container. The secure pins 410 are then removed before the lifting system continues to lift the second ISO shipping container upwardly until the bottom of the second ISO shipping container is aligned with the secure pins. The secure pins are then secured to the second ISO shipping container. The lifting system then lowers back to the base level for loading a third ISO shipping container. In the embodiment where secure

plates 420 are used, the secure plates 420 are moved back to the extended position. This process can be repeated to reverse stack up more ISO shipping containers up to the allowable limit.

5 The process of stacking and unloading ISO shipping containers into and out of the reverse stacking cell guide may be performed manually by instructions from a user or by a processing unit that is communicatively connected to the cell guide 100, lifting system 150 and other components required to work the invention.

Figure 6 illustrates an example of a processing system 600 in the processing unit. Processing system 600 represents the processing systems in the processing unit that
10 execute instructions to perform the processes described below in accordance with embodiments of this invention. One skilled in the art will recognize that the instructions may be stored and/or performed as hardware, firmware, or software without departing from this invention. Further, one skilled in the art will recognize that the exact configuration of each processing system may be different and the exact configuration of
15 the processing system executing processes in accordance with this invention may vary and processing system 600 shown in figure 6 is provided by way of example only.

Processing system 600 includes a processor 610, a radio transceiver 620, an image capturing device 630, a display 640, a keypad 650, a memory 660, an audio module 670, and an I/O device 690.

20 The radio transceiver 620, image capturing device 630, display 640, keypad 650, memory 660, audio module 670, I/O device 690 and any number of other peripheral devices connect to processor 610 are to exchange data with processor 610 for use in applications being executed by processor 610.

The radio transceiver 620 is connected to an antenna which is configured to
25 transmit outgoing voice and data signals and receive incoming voice and data signals over a radio communication channel. The radio communication channel can be a digital radio communication channel such as a CDMA, GSM or LTE channels that employs voice and/or data messages in conventional techniques.

The image capturing device 630 is any device capable of capturing still and/or
30 moving images such as complementary metal-oxide semiconductor (CMOS) or charge-coupled sensor (CCD) type cameras. The display 640 receives display data from processor 610 and display images on a screen for a user to see. The display 640 may be a liquid crystal display (LCD) or organic light-emitting diode (OLED) display. The keypad 650 receives user input and transmits the input to processor 610. In some embodiments,

the display 640 may be a touch sensitive surface that functions as a keypad to receive user input.

The memory 660 is a device that transmits and receives data to and from processor 610 for storing data. The audio module 670 may include a microphone, an earpiece and a headset. A microphone is a device that transmits audio data to processor 610. An earpiece is a device that receives audio data from the processor. The headset is a device that transmits and receives audio data to and from the processor 610.

Other peripheral devices that may be connected to processor 610 include a Bluetooth transceiver, a Wi-Fi transceiver, a Global Positioning System (GPS), a RFID transceiver, an ultra wideband transceiver and other positioning receivers.

The processor 610 is a processor, microprocessor, or any combination of processors and microprocessors that execute instructions to perform the processes in accordance with the present invention. The processor has the capability to execute various application programs that are stored in the memory 660. These application programs can receive inputs from the user via the display 640 having a touch sensitive surface or directly from a keypad 650. Some application programs stored in the memory 660 that can be performed by the processor 610 are application programs developed for iPhone, Android, Windows Mobile, Blackberry or other mobile platforms.

Figure 7 illustrates a process 700 performed by the processing unit to stack an ISO shipping container to the reverse stacking cell guide in accordance with this invention. In a default position, a platform of the lifting system 150 is on the base level awaiting ISO shipping container to be loaded onto the platform. Process 700 begins with step 705 by determining a load on the lifting system 150. In particular, if the lifting system 150 determines that an ISO shipping container is loaded onto a platform of the lifting system 150, the lifting system 150 sends a load signal to the processing unit. Figure 9 shows a loading ISO shipping container 191 being loaded onto the platform of the lifting system 150.

Upon receiving the load signal from the lifting system 150, the processing unit awaits a signal to stack the loading ISO shipping container 191 to the reverse stacking cell guide 100. The signal may be a trigger by an operator. Alternatively, a signal may not be required and the processing unit may transmit a first signal to the lifting system 150 to elevate the platform upwardly in the direction of arrow 1010 to a first height 1020 in step 710 as shown in figure 10. In particular, at the first height 1020, the top surface of the loading ISO shipping container 191 is in contact with the bottom surface of the bottom most ISO shipping container 192 in the reverse stacking cell guide 100. In an

embodiment where secure plates 420 are used, the first signal includes a signal to the reverse stacking cell guide 100 to move the secure plates 420 to the retracted position.

In step 715, process 700 sends a second signal to the reverse stacking cell guide 100 to move the secure pins to an unlock position. When the secure pins are in the unlock position, the weight of the ISO shipping containers in the reverse stacking cell guide 100 are transferred from the reverse stacking cell guide 100 to the top of the loading ISO shipping container 191. This means that the lifting system is supporting the weight of the ISO shipping containers within the cell guide.

In step 720, process 700 sends a third signal to the lifting system 150 to elevate the platform upwardly in the direction of arrow 1110 to the second height 1120 as shown in figure 11. In particular, at the second height, the platform is slightly above the bottom end of the four angle bars so that the top and the bottom end fittings of the ISO shipping container are aligned with the secure pins.

In step 725, process 700 sends a fourth signal to the reverse stacking cell guide 100 to move the secure pins to the lock position locking the loading ISO shipping container 191. When the secure pins are in the lock position, the loading ISO shipping container on the platform of the lifting system together with the ISO shipping containers above 190 and 192 are locked within the reverse stacking cell guide 150. Thereafter, the platform of the lifting system is lowered back to the default position. In the embodiment where secure plates 420 are used, the fourth signal includes a signal to the reverse stacking cell guide 100 to move the secure plates 420 to the extended position. Process 700 ends after step 725.

Figure 8 illustrates a process 800 performed by the processing unit to unload the bottom most ISO shipping container in the reverse stacking cell guide in accordance with this invention. Process 800 begins with step 805 where process 800 sends a first signal to the lifting system 150 to elevate the platform upwardly in the direction of arrow 1110 to the second height 1120 as shown in figure 11. In particular, at the second height 1120, the platform is slightly above the bottom end of the four angle bars and platform is in contact with the bottom surface of the bottom most ISO shipping container. In an embodiment where secure plates 420 are used, the first signal includes a signal to the reverse stacking cell guide 100 to move the secure plates 420 to the retracted position.

In step 810, process 800 sends a second signal to the reverse stacking cell guide 100 to move the secure pins to an unlock position. When the secure pins are in the unlock position, the bottom most ISO shipping container in the reverse stacking cell guide 100 rest on the platform of the lifting system 150.

In step 815, process 800 sends a third signal to the lifting system 150 to lower the platform downwardly in the direction of arrow 1030 to a first height 1020 as shown in figure 10.

In step 820, process 800 sends a fourth signal to the reverse stacking cell guide 100 to move the secure pins to the lock position locking the ISO shipping container. When the secure pins are in the lock position, the second bottom most ISO shipping container is locked within the reverse stacking cell guide 150.

In step 825, process 800 sends a fifth signal to the lifting system 150 to lower the platform to the default height as shown in figure 9. In the embodiment where secure plates 420 are used, the fifth signal includes a signal to the reverse stacking cell guide 100 to move the secure plates 420 to the extended position.

In step 830, process 800 awaits the ISO shipping container to be unloaded from the platform of the lifting system 150. After the ISO shipping container is unloaded from the platform of the lifting system 150, process 800 ends.

By similar operation, ISO shipping containers can be stacked up till the load on the lifting system 150 reaches the desired test load of the ISO shipping container. Based on ISO 1496-1 : 1990 (E) the desired test load is 192 tons. Table 1 below shows forces to be applied in stacking test.

Container designation	Test force per container (all four corners simultaneously)		Test force per pair of end fittings		Superimposed mass represented by test force	
	kN	lbf	kN	lbf	kg	lb
1A,1AA,1AX	3392	762550	1696	381275	192000	423290
1B,1BB,1BX	3392	762550	1696	381275	192000	423290
1C,1CC,1CX	3392	762550	1696	381275	192000	423290
1D, 1DX	896	201600	448	100800	50800	112000

Note – The test force of 3392kN per container is derived from the superimposed mass of nine-high stacking, i.e. eight containers stacked on top of one container, all being rated to 24000kg, and an acceleration force of 1,8g. [The corner posts of such containers are known to have been tested to 86400kg (190480lb)]

Table 1

From the test loads as shown in table 1, a general purpose container will be subjected to vertical force 192 tons with a factor of safety of 1.8g. Table 2 below shows the number of ISO shipping containers that can be stacked on top of each other based on desired test load of 192 tons.

5

S/N	Type	Theoretical stacking height of containers based on 192 ton of total weight of containers			
		20' container		40' container	
		WT (t)	HT (Tires)	WT (t)	HT (Tires)
1	Empty	2.3	83	3.75	38
2	Max Gross	32.5	6	32.5	6
3	Average weight of 8t/container	8	24	8	24
4	Average weight of 14t/container	14	13	14	13

Table 2

As shown in table 2, 83 20' empty ISO shipping container, each weighing 2.3 tons, can be stacked on top of each other, 6 20' ISO shipping container, each weighing 32.5 tons, can be stacked on top of each other, 24 20' ISO shipping container, each weighing 8 tons, can be stacked on top of each other, 13 20' empty ISO shipping container, each weighing 14 tons, can be stacked on top of each other. For a 40' ISO shipping container, 38 40' empty ISO shipping container, each weighing 3.75 tons, can be stacked on top of each other, 6 40' ISO shipping container, each weighing 32.5 tons, can be stacked on top of each other, 24 40' ISO shipping container, each weighing 8 tons, can be stacked on top of each other, 13 40' empty ISO shipping container, each weighing 14 tons, can be stacked on top of each other. It is uncommon that a ISO shipping container is loaded up to maximum gross weight of 32.5 tons. In fact, most ISO shipping containers are typically loaded up to half of the maximum gross weight.

Existing stacking practice is up to a maximum of 6 to 7 tiers. This limit is set by the limit to which the handling equipment is designed to stack up to, which is about 6 to 7 ISO shipping container tiers. High stacked empty containers are unstable in stormy condition when high wind is expected.

The reverse stacking cell guide 100 is able to secure the ISO shipping containers and prevent external conditions such as wind from unsettling the stack of containers. Hence, more containers can be stacked on top of each other. Thus, increasing the number of ISO shipping containers to form a stack based on maximum weight allowable

5 for each reverse stacking cell guide.

S/N	Type	Theoretical stacking height of containers based on 192 tonnes of total weight of containers			
		20' container		40' container	
		HT (Tires)	Advantage	HT (Tires)	Advantage
1	Empty	83	13 times	38	6 times
2	Max Gross	6	Same	6	Same
3	Average weight of 8t/container	24	4 times	24	4 times
4	Average weight of 14t/container	13	2 times	13	2 times

Figure 17 illustrates a second embodiment of a reverse stacking cell guide 100 where pin lock blocks 1710 are added. Various locking mechanisms are deployed to secure an ISO shipping container 190 via the corner fittings 195 of the ISO shipping container 190. Hence, the corner fittings 195 of the ISO shipping container 190 are typically subjected to substantive stress. In order not to apply further stress on the corner fittings 195 of an ISO shipping container 190, pin lock blocks 1710 are used instead. Particularly, instead of having secure pins 410 locking the corner fittings 195 of an ISO shipping container 190, the secure pins 410 are inserted into apertures of each of the pin lock blocks 1710 that is engaged to each of the four bottom corner fittings 195 of the ISO shipping container 190. By doing so, the bottom most ISO shipping container would be resting on the four pin lock blocks 1710 instead.

Figure 18 illustrates a perspective view of the pin lock block 1710 being engaged with a corner fitting 195 of an ISO shipping container 190. Figure 19 illustrates a cross sectional view of box 1850 showing the pin lock block 1710 from the angle as shown by arrow 1851. Figure 20 illustrates a cross sectional view of box 1860 showing the pin lock block 1710 from the angle as shown by arrow 1861.

The pin lock block 1710 includes a support block 1910 and a dovetail twist lock 1920. The support block 1910 and dovetail twist lock 1920 may be joined together by

welding. Alternatively, both support block 1910 and dovetail twist lock 1920 may be provided as a unitary piece. The dovetail twist lock 1920 comprises a twist lock handle 1921 and a dovetail twist lock head 1922, where actuating the twist lock handle 1921 in a first direction causes the dovetail twist lock head 1922 to be engaged to the bottom corner fitting of the ISO shipping container and actuating the twist lock handle 1921 in a second direction (which is opposing the first direction) causes the dovetail twist lock head 1922 to be disengaged from the bottom corner fitting of the ISO shipping container. The dovetail twist lock 1920 is commonly used for engaging the corner fittings of the ISO shipping containers. Hence, specific details of the dovetail twist lock 1920 are omitted for brevity. Importantly, support block 1910 extends below the dovetail twist lock 1920 for engaging the securing pins 410. Support block 1910 has a top aperture 1911 and a bottom aperture 1912 adapted to receive a top securing pin 410a (shaded) and bottom securing pin 410b (shaded). To secure and lock a pin lock block to the reverse stacking cell guide 100, a pair of secure pins 410 is inserted through the apertures of the angle bars 110-113 and top and bottom apertures of the support block 1910.

Every ISO container 190 will be fitted with four pin lock blocks 1710 before loading onto the reverse stacking cell guide 100. To implement this, the ISO shipping container may be stacked onto the reverse stacking cell guide 100 in the following manner. Four bottom corner fittings of a first ISO shipping container are each fitted with a pin lock block 1710. An example of fitting the pin lock block 1710 to the bottom corner fittings of a first ISO shipping container is by first arranging four pin lock blocks 1710 on the lifting system 150 at positions such that when the first ISO shipping container is loaded from the ship to the lifting system 150, the dovetail twist lock heads 1922 engages the bottom corner fittings of the first ISO shipping container. Further actuating the twist lock handle 1921 in a first direction, locks dovetail twist lock heads 1922 to the bottom corner fittings 195. The lifting system 150 then travels to the bottom entry of the reverse stacking cell guide 100 and lifts the first ISO shipping container until the first ISO shipping container is within the reverse stacking cell guide 100 and the top and bottom apertures of the pin lock blocks 1710 are aligned with the respective secure pins 410 at each of the four angle bars 110-113. The top and bottom secure pins 410a and 410b are then inserted to the top and bottom apertures of the four support blocks 1910 thereby locking and securing the first ISO shipping container to prevent the first ISO shipping container from falling out of the reverse stacking cell guide 100.

When a second ISO shipping container is loaded onto the lifting system, the lifting system lifts the second ISO shipping container until a top surface of the second ISO shipping container is in contact with the bottom surface 1913 of the support block 1910

that is engaged to the first ISO shipping container. The secure pins 410a and 410b are then removed before the lifting system 150 continues to lift the second ISO shipping container upwardly until the apertures of the pin lock blocks 1710 fitted to the bottom corner fittings of the second ISO shipping container are aligned with the respective
5 secure pins 410a and 410b at each of the four angle bars 110-113. The secure pins 410a and 410b are then inserted to the apertures of the four support blocks 1910 thereby locking and securing the second ISO shipping container to prevent the first and second ISO shipping containers from falling out of the reverse stacking cell guide 100. The lifting system then lowers back to the base level for loading a third ISO shipping container. This
10 process can be repeated to reverse stack up more ISO shipping containers up to the allowable limit.

To unload a ISO shipping container from the reverse stacking cell guide 100, the lifting system 150 elevates the platform until the platform is slightly above the bottom end of the four angle bars and platform is in contact with the bottom surface of the support
15 blocks that are engaged to the bottom most ISO shipping container. The secure pins 410a and 410b are then removed from the apertures of the four support blocks 1910, thereby unlocking the bottom most ISO shipping container. When the secure pins 410a and 410b are in the unlock position, the pin lock blocks 1710 that engage the bottom most ISO shipping container in the reverse stacking cell guide 100 rest on the platform of
20 the lifting system 150. The lifting system 150 then lowers the platform until the apertures of the pin lock blocks engaging the second bottom most ISO shipping container are aligned to the respective secure pins 410a and 410b at each of the four angle bars 110-113. The secure pins 410a and 410b are then inserted to the apertures of the four support blocks 1910 thereby locking and securing the second bottom most ISO shipping
25 container to prevent the second bottom most ISO shipping containers from falling out of the reverse stacking cell guide 100. The lifting system 150 then lowers the platform to the default height.

Thereafter, the lifting system 150 travels to unloading area for loading the ISO shipping container to a designated ship. To unload the ISO shipping container from the
30 platform of the lifting system 150, the twist lock handles 1921 are actuated in a second direction, unlocking the dovetail twist lock heads 1922 from the bottom corner fittings. Thereafter, the ISO shipping container can be unloaded from the lifting system 150.

Essentially, every ISO shipping containers will be fitted with four pin lock blocks at the four bottom corner fittings of the ISO shipping container as soon as the ISO shipping

container is unloaded to the terminal. The four pin lock blocks will only be removed when the ISO shipping container is about to leave the terminal.

Similar to the first embodiment, the process of stacking and unloading ISO shipping containers into and out of the reverse stacking cell guide 100 on the second embodiment may also be performed manually by instructions from a user or by a processing unit that is communicatively connected to the cell guide 100, lifting system 150 and other components required to work the invention.

Processes 700 and 800 may be modified to implement the second embodiment of the reverse stacking cell guide 100 that uses the pin lock blocks 1710 in the following manner. For process 700, in a default position, a platform of the lifting system 150 is on the base level with four pin lock blocks 1710 being arranged on the platform such that when a ISO shipping container is loaded from the ship and onto the platform, the dovetail twist lock heads 1922 engages the bottom corner fittings of the ISO shipping container. In step 705, process 700 determines a load on the lifting system 150. In particular, if the lifting system 150 determines that an ISO shipping container is loaded onto a platform of the lifting system 150, the lifting system 150 sends a load signal to the processing unit. Upon receiving the load signal from the lifting system 150, the lifting system 150 actuates the twist lock handle 1921 in a first direction locking dovetail twist lock heads 1922 to the bottom corner fittings. Thereafter, the processing unit awaits a signal to stack the loading ISO shipping container 191 to the reverse stacking cell guide 100. The signal may be a trigger by an operator. Alternatively, a signal may not be required and the processing unit may transmit a first signal to the lifting system 150 to elevate the platform upwardly to a first height in step 710 where a top surface of the ISO shipping container is in contact with the bottom surface 1913 of the support block 1910 that is engaged to the bottom most ISO shipping container 192 in the reverse stacking cell guide 100.

In step 715, process 700 sends a second signal to the reverse stacking cell guide 100 to move the secure pins to an unlock position. When the secure pins are in the unlock position, the weight of the ISO shipping containers in the reverse stacking cell guide 100 are transferred from the reverse stacking cell guide 100 to the top of the loading ISO shipping container. This means that the lifting system is supporting the weight of the ISO shipping containers within the cell guide.

In step 720, process 700 sends a third signal to the lifting system 150 to elevate the platform upwardly to the second height where the platform is slightly above the bottom end of the four angle bars so that the apertures of the support block of the loading ISO shipping container are aligned with the secure pins.

In step 725, process 700 sends a fourth signal to the reverse stacking cell guide 100 to move the secure pins to the lock position locking the loading ISO shipping container. When the secure pins are in the lock position, the loading ISO shipping container on the platform of the lifting system together with the ISO shipping containers
5 above are locked within the reverse stacking cell guide 150. Thereafter, the platform of the lifting system is lowered back to the default position. Process 700 ends after step 725.

Process 800 is modified as follows. Process 800 begins with step 805 where process 800 sends a first signal to the lifting system 150 to elevate the platform upwardly to the second height where the platform is slightly above the bottom end of the four angle
10 bars and platform is in contact with the bottom surface of the support blocks that are engaged to the bottom most ISO shipping container.

In step 810, process 800 sends a second signal to the reverse stacking cell guide 100 to move the secure pins to an unlock position. When the secure pins are in the unlock position, the pin lock blocks that engage the bottom most ISO shipping container
15 in the reverse stacking cell guide 100 rest on the platform of the lifting system 150.

In step 815, process 800 sends a third signal to the lifting system 150 to lower the platform downwardly in the direction of arrow 1030 to the first height where apertures of the pin lock blocks engaging the second bottom most ISO shipping container are aligned to the respective secure pins.

20 In step 820, process 800 sends a fourth signal to the reverse stacking cell guide 100 to move the secure pins to the lock position locking the second bottom most ISO shipping container. When the secure pins are in the lock position, the pin lock blocks that engage the second bottom most ISO shipping container are locked, securing the second bottom most ISO shipping container within the reverse stacking cell guide 150.

25 In step 825, process 800 sends a fifth signal to the lifting system 150 to lower the platform to the default height.

In step 830, process 800 awaits the ISO shipping container to be unloaded from the platform of the lifting system 150. To unload the ISO shipping container from the platform of the lifting system 150, the twist lock handles 1921 are actuated in a second
30 direction, unlocking the dovetail twist lock heads 1922 from the bottom corner fittings. Thereafter, the ISO shipping container can be unloaded from the lifting system. After the ISO shipping container is unloaded from the platform of the lifting system 150, process 800 ends.

Figure 12 illustrates a plan view of the first and second embodiments of the
35 reverse stacking cell guide 100 being implemented in a grid arrangement. In particular, 16

reverse stacking cell guides 100 are arranged in a 4 by 4 arrangement. Figure 13 illustrates a side view of the 4 by 4 arrangement where ISO shipping containers are stacked in the reverse stacking cell guides 100.

While the figures used in this disclosure show the reverse cell guides and frame using longitudinal bars, one skilled in the art will recognise that the reverse cell guides and frame may also be implemented in an enclosure or forms the foundation of a warehouse without departing from the invention.

One skilled in the art will also recognise that the grid arrangement shown in figure 12 is for illustrative purposes only and the grid arrangement can be arranged to any extent depending on the design requirement and space availability without departing from this invention.

Figure 14 illustrates another embodiment of the lifting system 150 where the lifting system 150 is movable. Particularly, the lifting system 150 is provided on a vehicle that is communicatively connected to the processing unit. The processing unit controls movement of the vehicles. This allows an operator to move the vehicle remotely. In the second embodiment, four cavities are provided on the platform of the lifting system 150. Each of the cavities is adapted to receive the support block of the pin lock block. Hence, prior to loading a ISO shipping container, the pin lock blocks are inserted to the four cavities such that when the ISO shipping container is loaded onto the platform, the dovetail twist lock head engages the four bottom corner fittings of the ISO shipping container. Further actuating the twist lock handle locks the pin lock block to the ISO shipping container.

Figures 15 and 16 illustrate that the positions and the spacing of the vertical angle bars 121 to 124 of frame 120 are such that at ground level the lifting system 150 can easily pass through the grid in both directions as shown by the routes 1310 and 1320.

The above is a description of exemplary embodiments of a reverse stacking cell guide for stacking ISO shipping containers in a bottom up approach in accordance with this invention. It is foreseeable that those skilled in the art can and will design alternative systems based on this disclosure that infringe upon this invention as set forth in the following claims.

Claims:

1. A method for stacking ISO shipping containers to a reverse stacking cell guide comprising a plurality of angle bars arranged vertically to fit four corners of the ISO shipping containers and a plurality of secure pins provided proximate a bottom end of each of the
5 plurality of angle bars, the method comprising:
loading a first ISO shipping container on a lifting system;
elevating the lifting system to a first height such that apertures of the first ISO shipping container are aligned with the plurality of secure pins; and
moving the plurality of secure pins of the reverse stacking cell guide to a locked
10 position such that the first ISO shipping container is locked within the reverse stacking cell guide.
2. The method according to claim 1 wherein the reverse stacking cell guide further comprises four pin lock blocks for each ISO shipping container and being adaptably
15 engagable to corner fittings of the ISO shipping container to form the apertures of each ISO shipping container.
3. The method according to claim 2 further comprising:
lowering the lifting system back to base level;
20 loading a second ISO shipping container on the lifting system;
elevating the lifting system to a second height such that a top surface of the second ISO shipping container is in contact with bottom surface of the four pin lock block;
moving the plurality of secure pins to an unlocked position such that the first ISO shipping container is movable within the reverse stacking cell guide;
25 elevating the lifting system to the first height such that apertures of the second ISO shipping container are aligned with the plurality of secure pins; and
moving the plurality of secure pins to the locked position locking the second ISO shipping container within the reverse stacking cell guide.
- 30 4. The method according to claim 1 wherein the apertures of the first ISO shipping containers are provided at each of the four bottom corner fittings of the first ISO shipping container.

5. The method according to claim 4 further comprising:
lowering the lifting system back to base level;
loading a second ISO shipping container on the lifting system;
elevating the lifting system to a second height such that a top surface of the second
5 ISO shipping container is in contact with a bottom surface of the first ISO shipping container;
moving the plurality of secure pins to an unlocked position such that the first ISO
shipping container is movable within the reverse stacking cell guide;
elevating the lifting system to the first height such that bottom end fittings of the
second ISO shipping container are aligned with the plurality of secure pins; and
10 moving the plurality of secure pins to the locked position locking the second ISO
shipping container within the reverse stacking cell guide.
6. The method according to claim 3 or claim 5 further comprising:
moving the plurality of secure pins to the unlocked position;
15 lowering the lifting system to the second height;
moving the plurality of secure pins to the locked position locking the first ISO
shipping container; and
lowering the lifting system to base level to unload the second ISO shipping container.
- 20 7. A reverse stacking cell guide for stacking ISO shipping containers comprising:
a plurality of angle bars arranged vertically to fit four corners of the ISO shipping
containers;
a plurality of secure pins provided proximate a bottom end of each of the plurality
of angle bars adapted to lock and unlock a bottom most ISO shipping container; and
25 a frame for supporting the plurality of angle bars such that the bottom end of each
of the plurality of angle bars is apart from a bottom of the frame forming a bottom entry for
loading and unloading ISO shipping containers to the plurality of angle bars.
8. The reverse stacking cell guide according to claim 7 further comprising a lifting
30 system.
9. The reverse stacking cell guide according to claim 8 wherein the lifting system is
provided on a movable vehicle.

10. The reverse stacking cell guide according to anyone of claims 7-9 further comprising a plurality of pin lock blocks being adaptably engagable to corner fittings of an ISO shipping container.
- 5
11. The reverse stacking cell guide according to claim 10 wherein each of the plurality of pin lock blocks comprises:
- a support block; and
 - a dovetail twist lock extending from a top of the support block.
- 10
12. The reverse stacking cell guide according to claim 11 wherein dovetail twist lock comprises:
- a dovetail twist lock head for engaging the corner fittings of the ISO shipping containers; and
- 15
- a twist lock handle, the dovetail twist lock head and twist lock handle being arranged such that actuating the twist lock handle in a first direction causes the dovetail twist lock head to be engaged to the bottom corner fitting of the ISO shipping container and actuating the twist lock handle in a second direction causes the dovetail twist lock head to be disengaged from the bottom corner fitting of the ISO shipping container.
- 20
13. The reverse stacking cell guide according to claim 12 wherein a top aperture and a bottom aperture are provided on the support block, each of the top aperture and bottom aperture is adapted to receive one of the plurality of secure pins.
- 25
14. The reverse stacking cell guide according to claim 13 further comprising:
- a processor; memory, and instructions stored on the memory and executable by the processor to:
 - load a first ISO shipping container on the lifting system;
 - elevate the lifting system to a first height such that top and bottom apertures
- 30
- of each of the pin lock blocks being engaged to bottom fittings of the first ISO shipping container are aligned with the plurality of secure pins; and
 - move the plurality of secure pins to a locked position such that the first ISO shipping container is locked within the plurality of angle bars.

15. The reverse stacking cell guide according to claim 14 further comprises instructions to:
- lower the lifting system back to base level;
- 5 load a second ISO shipping container on the lifting system;
- elevate the lifting system to a second height such that a top surface of the second ISO shipping container is in contact with bottom surface of the support block of each of the pin lock block being engaged to the first ISO shipping container;
- move the plurality of secure pins to the unlocked position where the first ISO
- 10 shipping container is movable within the reverse stacking cell guide;
- elevate the lifting system to the first height such that top and bottom apertures of each of the pin lock blocks being engaged to bottom fittings of the second ISO shipping container are aligned with the plurality of secure pins; and
- move the plurality of secure pins of the reverse stacking cell guide to the locked
- 15 position locking the second ISO shipping container within the reverse stacking cell guide.
16. The reverse stacking cell guide according to claim 15 further comprises instructions to:
- move the plurality of secure pins to the unlocked position;
- 20 lower the lifting system to the second height;
- move the plurality of secure pins to the locked position; and
- lower the lifting system to base level to unload the second ISO shipping container.
17. The reverse stacking cell guide according to anyone of claims 7-16 further
- 25 comprising:
- a processor; memory, and instructions stored on the memory and executable by the processor to:
- load a first ISO shipping container on the lifting system;
- elevate the lifting system to a first height such that bottom end fittings of the
- 30 first ISO shipping container are aligned with the plurality of secure pins; and
- move the plurality of secure pins to a locked position such that the first ISO shipping container is locked within the plurality of angle bars.

18. The reverse stacking cell guide according to claim 17 further comprises instructions to:
- lower the lifting system back to base level;
 - load a second ISO shipping container on the lifting system;
 - 5 elevate the lifting system to a second height such that a top surface of the second ISO shipping container is in contact with a bottom surface of the first ISO shipping container;
 - move the plurality of secure pins to the unlocked position where the first ISO shipping container is movable within the reverse stacking cell guide;
 - 10 elevate the lifting system to the first height such that bottom end fittings of the second ISO shipping container are aligned with the plurality of secure pins; and
 - move the plurality of secure pins of the reverse stacking cell guide to the locked position locking the second ISO shipping container within the reverse stacking cell guide.
19. The reverse stacking cell guide according to claim 18 further comprises instructions to:
- 15 move the plurality of secure pins to the unlocked position;
 - lower the lifting system to the second height;
 - move the plurality of secure pins to the locked position; and
 - lower the lifting system to base level to unload the second ISO shipping container.