

Handling Device and Loading Method Thereof and Testing System and Testing Process Thereof

Technical Field

[0001] A handling device arranged to transfer a concrete sample to be tested to a testing machine, a loading method using the handling device, a testing system arranged to test a concrete sample and a testing process arranged to test a concrete sample using the testing system. For example, a concrete sample handling device, a loading method using the concrete handling device, a concrete testing system and a concrete testing process using the testing system.

Background

[0002] Destructive testing of material to failure is constantly being carried out to ensure that the strength of the material is within safety or working range. Testing of concrete samples obtained during the construction of concrete structures are usually compulsory to find out about the characteristic of the concrete used for the building to ensure that the concreting works are properly carried out for the structure. Concrete sample can be in the form of a cube or cylinder or any other shapes suitable for testing.

[0003] Testing of concrete samples is usually performed in compression testing machines which measure the compressive strength of the material. Typically, a concrete sample is placed in the testing machine and the concrete sample is being compressed till failing point, i.e. when the concrete sample cracks. At this point, the force used to compress the concrete sample to failure is being recorded and calculation is done to determine the characteristics of the concrete sample.

[0004] Thereafter, the concrete sample on the testing machine which has been tested to failure (the 'previous concrete sample') is removed and another concrete sample is loaded. Prior to loading the concrete sample again, an operator would clear the testing machine from any debris left behind from the previous concrete sample.

[0005] The process of loading the concrete sample to the testing machine, cleaning the testing machine and re-loading the concrete sample to testing machine can be time consuming. In the long run, the cumulative time used to test concrete samples can be

substantial. In a highly competitive market, the loss in time can be translated to, for example, higher costs for testing or reduction in profit margins.

[0006] Therefore, it would be advantageous to reduce the time used for carrying out testing of the concrete samples.

Summary

[0007] According to various embodiments, there is provided a handling device arranged to transfer a concrete sample to be tested to a testing machine. Handling device includes a holder arranged to engage and hold the concrete sample to be transferred to the testing machine; a remover coupled to the holder, such that the remover is arranged to simultaneously remove a previous concrete sample from the testing machine when the holder is loading the concrete sample to the testing machine; a base such that the holder and the remover extend from the base; such that the remover includes a remover portion such that the remover portion is being actuatable between a blocking position to prevent the holder from engaging the concrete sample when the handling device is actuated toward the concrete sample and an unblocking position where the holder is able to engage the concrete sample when the handling device is actuated toward the concrete sample.

[0008] According to various embodiments, the remover can include a frame surrounding the holder.

[0009] According to various embodiments, the frame can include a gap arranged to allow the concrete sample therethrough to within the frame so as to allow the concrete sample to be held by the holder.

[0010] According to various embodiments, the remover portion can include a gate, such that the gate is pivotally connected to the frame. Gate can be operable between a closed position to cover the gap and an open position to expose the gap.

[0011] According to various embodiments, the handling device can include a cleaning element arranged to clean the testing machine before transferring the concrete sample to the testing machine.

[0012] According to various embodiments, the cleaning element can be attached to the remover portion of the remover.

[0013] According to various embodiments, the cleaning element can be an elongated brush extending along an edge of the remover portion.

[0014] According to various embodiments, the holder can include an engaging element extending from the base. Engaging element can be arranged to engage and hold the concrete sample.

[0015] According to various embodiments, the holder can include a clamp arranged to clamp the concrete sample.

[0016] According to various embodiments, the gap can be downstream of the holder along a loading direction, the loading direction being a direction the handling device actuates along to engage the concrete sample.

[0017] According to various embodiments, the present invention provides a testing system arranged to test a concrete sample. Testing system can include a testing machine arranged to receive the concrete sample to be tested; and a handling device according to various embodiments.

[0018] According to various embodiments, the testing system can further include a weighing device arranged to weigh the concrete sample.

[0019] According to various embodiments, the handling device can be arranged to transfer the concrete sample from the weighing device to the testing machine.

[0020] According to various embodiments, the testing system can further include a platform for holding the concrete sample to be tested.

[0021] According to various embodiments, the platform can be arranged to be orientated to a position to enable the handling device to hold the concrete sample.

[0022] According to various embodiments, the platform can be rotatable about a horizontal axis.

[0023] According to various embodiments, the handling device is mounted on a mechanical arm.

[0024] According to various embodiments, the mechanical arm is configured to provide the handling device three dimensions of motion.

[0025] According to various embodiments, the testing system further includes an incoming conveyor system arranged to deliver concrete samples to be tested to the testing machine.

[0026] According to various embodiments, the testing system further includes a barcode scanner arranged to identify incoming concrete samples for testing at the testing machine.

[0027] According to various embodiments, the testing system further includes a position sensor arranged to locate the position of the concrete sample in the testing system.

[0028] According to various embodiments, the testing system further includes a sensor array to determine dimensional measurements of a concrete sample for testing.

[0029] According to various embodiments, the testing system further includes a receiving system to receive a concrete sample from the testing machine after testing.

[0030] According to various embodiments, the testing system further includes an outgoing conveyor system arranged to receive concrete samples from the testing machine after testing.

[0031] According to various embodiments, the receiving system comprises an inclined chute to direct the concrete samples from the testing machine to the outgoing conveyor system.

[0032] According to various embodiments, the receiving system further includes a container arranged to receive a concrete sample for further processing.

[0033] According to various embodiments, the receiving system further includes an actuable slide arranged to move between a raised position allowing a concrete block to be received in the container and a lowered position allowing the concrete block to be received in the outgoing conveyor system.

[0034] According to various embodiments, the outgoing conveyor system comprises a delivery system configured to deliver the concrete samples after testing to a collection bin.

[0035] According to various embodiments, the delivery system is elevated above the collection bin.

[0036] According to various embodiments, the delivery system is mounted on a frame, the frame arranged to receive the collection bin under the frame.

[0037] According to various embodiments, the outgoing conveyor system comprises an inclined portion arranged to deliver concrete samples to the elevated delivery system.

[0038] According to various embodiments, wherein the delivery system is configured to actuate with respect to the inclined portion of the outgoing conveyor system.

[0039] According to various embodiments, the frame is configured to actuate with respect to the inclined portion of the outgoing conveyor system.

[0040] According to various embodiments, the testing system comprises a plurality of testing machines.

[0041] According to various embodiments, the testing machine can include a compression machine.

[0042] According to various embodiments, there is provided a loading method for loading a concrete sample using the handling device according to various embodiments. Testing method can include holding the concrete sample with the holder of the handling device; transferring the concrete sample to the testing machine; actuating the remover portion of the remover into a blocking position to prevent the holder from engaging the previous concrete sample when the handling device is actuated toward the testing machine; and loading the concrete sample to the testing machine and simultaneously removing the previous concrete sample from the testing machine by the remover.

[0043] According to various embodiments, the loading method can further include simultaneously cleaning the testing machine while removing the previous concrete sample from the testing machine.

[0044] According to various embodiments, there is provided a testing process arranged to test a concrete sample using the testing system according to various embodiments. Testing

process includes the loading method according to various embodiments to load the concrete sample to the testing machine; and testing the concrete sample with the testing machine.

[0045] According to various embodiments, the testing process further includes simultaneously cleaning the testing machine while removing the previous concrete sample from the testing machine.

[0046] According to various embodiments, the testing process can further include weighing the concrete sample.

[0047] According to various embodiments, the testing process can further include orientating the concrete sample to enable the handling device to hold the concrete sample.

[0048] According to various embodiments, the testing process can further include compiling measurement results for a concrete sample in a database.

[0049] According to various embodiments, the testing process can further include determining dimensional measurements for a concrete sample and compiling the dimensional measurements in the database.

[0050] According to various embodiments, the testing process can further include determining the weight of a concrete sample and compiling the weight in the database.

[0051] According to various embodiments, the testing process can further include identifying a concrete sample through barcode identification, and compiling the concrete sample identification in the database.

[0052] According to various embodiments, the testing process can further include providing a server-client access to the database.

[0053] According to various embodiments, the testing process can further include making test and measurement data available for client access through a web-based interface.

Brief Description of Drawings

[0054] Fig. 1 shows a handling device according to various embodiments of the present disclosure.

[0055] Fig. 2 shows another handling device according to various embodiments.

[0056] Fig. 3 shows a front view of the holder of the handling device of Fig. 2.

[0057] Fig. 4 shows a top view of the handling device of Fig. 2 loading a concrete sample.

[0058] Fig. 5 shows another handling device according to various embodiments.

[0059] Fig. 6 shows another handling device according to various embodiments.

[0060] Fig. 6A shows a perspective view of the handling device of Fig. 6.

[0061] Fig. 6B shows a front view of the handling device of Fig. 6.

[0062] Fig. 7 shows a testing system according to various embodiments.

[0063] Fig. 8 shows a platform of a pre-loading portion of the testing system according to embodiments.

[0064] Fig. 9 shows a loading method using a handling device according to various embodiments.

[0065] Fig. 10 shows a testing process using the loading method of Fig. 9.

[0066] Fig. 11 shows an automated testing system according to an embodiment.

[0067] Fig. 11A shows a close up perspective view of a testing module in the automated testing system of Fig. 11.

[0068] Fig. 12A and Fig. 12B shows a receiving system according to an embodiment in a first position and a second position respectively.

[0069] Fig. 13A and Fig 13B show a portion of an outgoing conveyor belt system according to various embodiments.

Detailed Description

[0070] Fig. 1 shows a handling device 100 according to various embodiments. Handling device 100 is arranged to transfer a concrete sample 10 to be tested to a testing machine 20 (not shown in Fig. 1). Handling device 100 includes a holder 110 arranged to hold the

concrete sample 10 to be transferred to the testing machine. Handling device 100 has a remover 120 connected to the holder 110, such that the remover 120 is arranged to simultaneously remove a previous concrete sample from the testing machine 20 when the holder 110 is loading the concrete sample 10 to the testing machine 20.

[0071] In other words, the handling device 100 is able to transfer the concrete sample 10 to be tested to the testing machine 20. Handling device 100 includes a holder 110 arranged to hold the concrete sample 10 so that handling device 100 is able to transfer the concrete sample 10 to the testing machine 20. Handling device 100 also has a remover 120 arranged to remove a previous concrete sample or a concrete sample that has been tested by the testing machine 20 before or at the time that the handling device 100 is loading the concrete sample 10. Handling device 100 includes a base 130 whereby the holder 110 and the remover 120 both extend from the base 130. To load the concrete sample 10 to the testing machine 20, the holder 110 holds the concrete sample 10 and transfers it to the testing machine 20. As the holder 110 loads the concrete sample 10, the remover 120 can simultaneously remove the previous concrete sample from the testing machine 20.

[0072] Fig. 2 shows a handling device 102 according to various embodiments. Referring to Fig. 2, the handling device 102 can include a base 130. Holder 110 can be connected to the base 130 and the remover 120 can extend from the base 130. Base 130 can include an elongated member 132 having a first end 134 and a second end 136 opposite the first end 134, a first side 137 and a second side 138 opposite the first side 137. Both the first side 137 and the second side 138 can extend from the first end 134 to the second end 136. Handling device 102 can have an engaging portion 139 disposed on the first side 137 of the base 130. First side 137 can be the side facing away from the concrete sample 10 and second side 138 can be the side facing the concrete sample 10 when the holder 110 is holding the concrete sample 10. Engaging portion 139 can be disposed between the first end 134 and the second end 136. Engaging portion 139 can be disposed equidistance from the first end 134 and the second end 136. Engaging portion 139 can be connected to an actuator (not shown in Fig. 2) arranged to actuate the handling device 102. The actuator can be a robotic arm, motorized shaft, etc.

[0073] Holder 110 can be disposed on the second side 138 of the base 130. Holder 110 can be disposed between the first end 134 and the second end 136. Holder 110 can be disposed equidistance from the first end 134 and the second end 136. Holder 110 can extend from the

base 130. Holder 110 can be arranged to lift the concrete sample 10. Holder 110 can slide below the concrete sample 10 and be actuated upwards to lift the concrete sample 10.

[0074] Holder 110 can include an engaging element 111 extending from the base 130. Engaging element 111 can be arranged to engage and hold the concrete sample 10. Engaging element 111 can extend from the base 130. Engaging element 111 can be arranged to change between an engaging configuration and a releasing configuration such that in the engaging configuration, the engaging element 111 can be arranged to engage the concrete sample 10 and in the releasing configuration, the engaging element 111 can be arranged to release the concrete sample 10.

[0075] Engaging element 111 can be a pair of arms 112. Pair of arms 112 can be arranged to move towards each other, from the releasing configuration to the engaging configuration, such that in the engaging configuration, the distance between the pair of arms 112 can be about the width or less than the width of the concrete sample 10. Clearly, when engaging the concrete sample 10, the distance between pair of arms 112 can only be as wide as the width of the concrete sample 10 when in the engaging configuration. Conversely, the pair of arms 112 can be arranged to move away from each other, from the engaging configuration to the releasing configuration, such that the distance between the pair of arms 112 is larger than the width of the concrete sample 10. In other words, the holder 110 can include a clamp arranged to clamp the concrete sample 10.

[0076] Holder 110 can include an actuating base 114 connected to the base 130. Engaging element 111 can be slidably attached to the actuating base 114 such that the engaging element 111 can move or slide between the engaging configuration and the releasing configuration (as shown by the arrows in Fig. 2). Each of the pair of arms 112 can include a rear arm 115 and a fore arm 116 extending perpendicularly from the rear arm 115. Each of the pair of arms 112 can be L-shaped such that the rear arm 115 forms the shorter limb of the L-shape and the fore arm 116 forms the longer limb of the L-shape. Each of the pair of arms 112 can be attached to the actuating base 114 by the rear arm 115 such that each of the pair of arms can be slidable along a longitudinal axis of the rear arm 115. Pair of arms 112 can be attached to a pinion and rack gears (not shown in Fig. 2) whereby the pinion can be actuated by a motor, solenoid motor, pneumatic motor etc. For each of the pair of arms 112, the width of the fore arm 116

can be thicker than the width of the rear arm 115. Fore arm 116 can be tapered at about one end opposite the end connected to the rear arm 115.

[0077] Fig. 3 shows a front view of handling device 103 according to various embodiments. Each of the arms 112 of engaging elements 111 can include a lifting lip 113 extending from the fore arm 116 and/or fore arm 116 of each of the pair of arms 112. Lifting lip 113 of the pair of arms 112 can extend towards each other. Each lifting lip 113 can extend along the rear arm 115 and/or the fore arm 116. In the engaging configuration, the lifting lip 113 can be inserted under the concrete sample 10 to engage the concrete sample 10. Pair of arms 112 can be actuated upwards such that the lifting lips 113 can lift the concrete sample 10 to enable the holder 110 to hold and move the concrete sample 10.

[0078] Referring to Fig. 2, handling device 102 has a base 130 such that the holder 110 and the remover 120 are extended from the base 130. Remover 120 has a remover portion 122, the remover portion 122 is actuatable between a blocking position 127 to prevent the holder 110 from engaging the concrete sample 10 and an unblocking position 128 such that the holder 110 is able to engage the concrete sample 10. The remover 120 can extend from the base 130 in a direction perpendicular a horizontal surface of the base 130. In embodiments, the remover 120 extends perpendicularly from the second side 138 of the base 130. Remover 120 includes a support portion 124 extending from the base 130.

[0079] Support portion 124 can be connected to the base 130 at a proximal end 125 and the remover portion 122 can be pivotally connected to the support portion 124 at a distal end 126, which is opposite the proximal end 125. Remover portion 122 of the remover 120 can be actuated at about the distal end 126 of the support portion 124 of the remover 120. Referring to Fig. 2, the remover portion 122 can be pivotally rotatable between a blocking position 127 and unblocking position 128 at about the distal end 126. Remover portion 122 can be pivotally rotatable along a plane formed between the base 130 and support portion 124.

[0080] In the blocking position 127, the remover portion 122 can be bent to an angle sufficient to prevent the concrete sample 10 from reaching the holder 110. As shown in Fig. 2, in the blocking position 127, the remover portion 122 can be bent to a direction perpendicular to the support portion 124. In the blocking position 127, the concrete sample 10 would not be able to be engaged by the holder 110 as the concrete sample 10 is blocked from reaching the holder 110. In the unblocking position 128, the remover portion 122 can be bent to an angle

sufficient to allow the concrete sample 10 to reach the concrete sample 10. In the unblocking position 128, the remover portion 122 can be parallel or aligned to a longitudinal axis of the support portion 124. In the unblocking position 128, the concrete sample 10 can be engaged by the holder 110 as the concrete sample 10 is allowed to reach the holder 110.

[0081] Referring to Fig. 4, the handling device 100 can be actuated to load the concrete sample 10 to the testing machine 20. As the handling device 100 is loading the concrete sample 10 to the testing machine 20, the remover portion 122 can be bent to the blocking position 127, which blocks the concrete sample 10 from accessing the holder 110. When the handling device 100 is holding the concrete sample 10, the remover portion 122 of the remover 120 can be actuated to a blocking position 127. In other words, when the handling device 100 approaches the testing machine 20, any concrete sample remaining in or on the testing machine, e.g. a previous concrete sample 12, would be pushed by the remover portion 122 of the handling device 100. Any broken portions of the previous concrete sample 12 which remain on the testing machine 20 after testing can be pushed off the testing machine by the remover portion 122 when the handling device 100 is loading the concrete sample 10 to the testing machine 20. Remover portion 122 can be actuated by an actuator (not shown in Fig. 4) to move from the unblocking position 128 to the blocking position 127.

[0082] Referring to Fig. 4, the handling device 100 can be actuated along a loading direction (as shown by arrow in Fig. 4) when the handling device is loading the concrete sample 10 to the testing machine 20. Loading direction can also be known as engaging direction as the handling device 100 is actuated along the same direction to engage the concrete sample 10.

[0083] Referring to Fig. 5, the holding device 104 can include a relay element 144. Relay element 144 can be attached to the remover portion 122. Relay element 144 can be centered at a rotational axis of the remover portion 122, whereby the rotational axis can be the axis of rotation when remover portion 122 is bent. Holding device 104 can include a motor 142 arranged to actuate the remover portion 122. Motor 142 can be attached to the base 130. Relay element 144 can be transmissionally connected to the motor 142 such that relay element 144 can be actuated when the motor 142 is operated. Relay element 144 can be connected to the motor 142 via a transmission member 146. Relay element 144 can be at least one of a wheel or a pinion gear. Transmission member 146 can be at least one of a belt, a

chain or a gear. Transmission member 146 can extend parallel to the support portion 124. Transmission member 146 can be adjacent the support portion 124.

[0084] Fig. 6 shows a handling device 106 according to various embodiments of the present disclosure. Remover 120 can include a frame 150 surrounding the holder 110. In embodiments, the frame 150 can form a part of the support portion 124. Frame 150 can extend from the base 130. Support portion 124 can include a first side element 152 extending from the support portion 124 and from the base 130. First side element 152 can extend from a proximal end 153 to a distal end 154. First side element 152 can be attached to the base 130 at the proximal end 153 of the first side element 152. First side element 152 can be an elongated member. Support portion 124 can include a second side element 162 extending parallel to the first side element 152. Second side element 162 can extend from a proximal end 163 to a distal end 164. Second side element 162 can be an elongated member. First side element 152 can have a length as long as the length of the second side element 162. First side element 152 and the second side element 162 can extend along a same plane.

[0085] Referring to Fig. 6, the frame 150 can include a gap 156 arranged to allow the concrete sample 10 (not shown in Fig. 6) therethrough to within the frame 150 so as to allow a concrete sample to be held by the holder 110. Gap 156 can be disposed between the distal end 154 of the first side element 152 and the distal end 164 of the side element 162. Concrete sample can enter the frame 150 via the gap 156 when the handling device 100 moves to engage the concrete sample. As shown in Fig. 6, the gap 156 can be downstream of the holder 110 along the loading direction (as shown by arrow in Fig. 6), the loading direction being a direction the handling device 100 travels along to engage the concrete sample 10.

[0086] Referring to Fig. 6, the remover portion 122 can include a gate 166, such that the gate 166 can be pivotally connected to the frame 150, the gate 166 can be operable between a closed position 167 to cover the gap 156 and an open position 168 to expose the gap 156 (as shown in Fig. 5). Gate 166 can be pivotally connected to the first side element 152. Gate 166 can be pivotally connected to the distal end 154 of the first side element 152. Gate 166 can be an elongated member. Gate 166 can be rotatable about the first distal end 154 and between a closed position and an open position. In other embodiments, gate 166 can be pivotally connected to the second side element 162. Gate 166 can be pivotally connected to the distal

end 164 of the second side element 162. Gate 166 can be rotatable about the second distal end 164 and between a closed position and an open position.

[0087] In the closed position, the gate 166 can be disposed perpendicularly and extends from the distal end 154 of the first side element 152 to the distal end 164 of the second side element 162. Gate 166 can extend from the distal end 154 of the first side element 152 towards the distal end 164 of the second side element 162 such that gate 166 would not contact the second side element 162. Vice versa, in other embodiments, the gate 166 can extend from the distal end 164 of the second side element 162 towards the distal end 154 of the first side element 152 without contacting the first side element 152. In the closed position 167, the gap 156 is blocked or closed such that the concrete sample 10 is blocked from entering the frame 150 when the handling device 100 travels along the loading direction towards the concrete sample 10 (not shown in Fig. 6). In the open position 168, the gate 166 can be disposed at an obtuse angle formed between the gate 166 and the first side element 152 or the second side element 162 as long as the gap 156 of the frame 150 is wide enough for the concrete sample 10 to enter. Gate 166 can be rotated to a direction parallel to the first side element 152 or the second side element 162, whichever the gate 166 is pivotally attached to. Gate 166 can be rotated about a plane parallel to the plane the frame 150 is in.

[0088] Relay element 144 can be attached to gate 166. Relay element 144 can be attached to the gate 166 along the rotational axis of the gate 166. Relay element 144 can be transmissionally connected to a motor 142 by a transmission member 146 such that relay element 144 can be actuated when the motor 142 is operated.

[0089] A compressed air blower 174 can be coupled to gate 166. Compressed air blower 174 is connected to rubber tubing 176 which delivers compressed air from compressor 178, which can be provided at or near the base 130 or the motor 142 of the handling device 106. Rubber tubing 176 can be secured to the sides of the handling device 106 in being attached to the gate 166 and the first side element 152 in extension from the compressor 178 to the blower 174. Other delivery apparatus can also be used. The compressed air blower 174 is configured to operate in conjunction with the cleaning element 170 of the remover portion 122. The cleaning element 170 generally is able to push or brush away the previously tested sample, including small pieces of concrete which may have fallen off the sample during testing. The compressed air blower 174 further cleans the testing machine 20 by blowing away even

smaller fragments or finer dust particles left behind by the testing on the previous concrete sample. The compressed air blower 174 can include a nozzle for the adjustment of air pressure and air outflow, to allow for better cleaning of the testing machine surface.

[0090] Fig. 6A shows a perspective view of the handling device 108 according to various embodiments. Referring to Fig. 6A, the handling device 100 can include a cleaning element 170 arranged to clean a portion of the testing machine 20. Cleaning element 170 can be attached to the remover portion 122 of the remover 120, or in other embodiments, cleaning element 170 can be the remover portion 122 of the remover 120. Cleaning element 170 can have an elongated profile. Cleaning element 170 can be attached along an edge of the remover portion 122. Cleaning element 170 can extend widthwise in a direction perpendicular to the loading direction. Cleaning element 170 can be an elongated brush 172 extending along an edge of the remover portion 122. Brush 172 can have bristles which extend perpendicularly to the plane of the frame 150. Bristles can extend in a downward direction (towards stage 26 as will be presented later). As clearly seen, the handling device 108 can in a single or consequent action remove a previous concrete sample, clean the testing machine 20 and load the concrete sample into the testing machine 20.

[0091] Fig. 6B shows a front view of the handling device 108, from the perspective shown indicated as A in Fig. 6A. It is also noted that A indicates a direction of movement in which the handling device 108 can actuate towards, especially in approaching towards a testing machine 20. Cleaning element 170 can be coupled to the remover portion 122 such that it extends vertically downwards and perpendicular to horizontal plane of the frame 150. It can be observed that as the handling device 108 actuates towards direction A or the loading direction, the cleaning element 170 can push away or aside any remaining concrete block debris.

[0092] In embodiments, the remover portion 122 can be coupled to the first side element 152 of the handling device 108 by the relay element 144. Relay element 144 is driven by the motor 142 through the transmission member 146 such as to pivotally actuate the remover portion 122 about a rotational axis formed vertically through the remover portion 122 and the first side element 152. The remover portion 122 can be pivotally actuated from a closed position and an open position.

[0093] Fig. 7 shows a testing system 200 according to various embodiments of the present disclosure. There is illustrated a handling device according to various embodiments loading a concrete sample for testing on to a testing machine. Testing system 200 can be arranged to test the concrete sample 10. Testing system 200 can include a testing machine 20 that is arranged to receive the concrete sample 10 to be tested. Testing system 200 can include a handling device according to any one of the above described embodiments, for example any one of handling device 100, 102, 104, or 106.

[0094] Testing system 200 can include a platform 180 for holding the concrete sample 10. Platform 180 can hold the concrete sample 10 for pick-up by the handling device 102, which subsequently delivers the concrete sample 10 to the testing machine 20. Concrete sample 10 can be delivered to the platform 180 from an incoming conveyer belt (refer to Fig. 11). Platform 180 can be arranged to be oriented to a position to enable the handling device 102 to conveniently pick up the concrete sample 10. Platform 180 can be rotatable about a horizontal axis 182. Platform 180 can be rotatable between a horizontal holding position 185 and a tilted dispatching position 186 at about the horizontal axis 182. Platform 180 can be rotated about another axis other than the horizontal axis 182. Platform 180 can be rotated about a vertical axis 184 perpendicular to the horizontal axis 182. Platform 180 can be rotatable to accommodate to the orientation of the handling device 102 when engaging and holding the concrete sample 10. Holding device 102 can be advanced towards the concrete sample from a horizontal direction. In other embodiments, holding device 102 can be manipulated with a mechanical arm (Fig. 11A), allowing holding device to advance towards the concrete sample from any other direction. In an embodiment, the mechanical arm can advance the holding device 102 toward the concrete sample 10 from a top-down diagonal direction, such as representatively shown in Fig. 7.

[0095] According to embodiments, the holding device 102 can be configured to deliver the concrete sample 10 to the testing machine 20 after pick up of the concrete sample 10 from the platform 180. The handling device 102 can be manipulated such that handling device 102 is laterally facing the testing machine 20, and a horizontal advance can be made for the concrete sample 10 to be deposited by the handling device 102 in the testing machine 20. In Fig. 7, the handling device 102 is representatively shown as ready to be horizontally actuated to the testing machine 20 in order to deliver the carried concrete sample 10 in the loading direction demarcated by the arrow, in loading the concrete sample 10 onto the stage 26.

[0096] The handling device 102 is then inserted laterally into the through hole 22 of the testing machine 20. In embodiments, as the handling device 102 is inserted into the through hole 22, the remover portion 122 of the handling device 102, arranged to be forward of the handling device 100 and perpendicular to the direction of advance of the handling device, is configured to push aside the previous concrete sample 12, which still remains on the stage 26 of the testing machine 20. The previous concrete sample 12 is arranged to be pushed through the opposing end of the through hole 22 from which the handling device 100 is advancing through.

[0097] Handling device 100 can be controlled to actuate the remover portion 122 into the blocking position 127 such that the remover portion 122 is arranged to prevent a concrete sample 10 from entering the frame 150. In the blocking position 127, when the handling device 100 is loading the concrete sample 10, any previous concrete sample on the stage 26 can be pushed by the remover portion 122 off the stage 26.

[0098] When the handling device 102 is above the stage 26, the cleaning element 170 can be in contact with the stage 26. Cleaning element 170 can be marginally pressed onto the stage 26 so as to prevent any gap between the cleaning element 170 and the stage 26. It can be appreciated that any gap between the cleaning element 170 and the stage 26 can allow debris from the previous concrete sample to remain on the stage 26. As the handling device 102 moves from a proximal edge of the stage to a distal edge opposite the proximal, the cleaning element 170 can “sweep” or push any debris off the stage 26. In embodiments, the holding device 102 can simultaneously clean the testing machine while removing the previous concrete sample from the testing machine 20. In other words, the handling device 102 can clean the testing machine 20, e.g. the stage 26, at the same time or just before the holding device 102 is loading the concrete sample 10 onto the testing machine 20, e.g. onto stage 26 of the testing machine 20.

[0099] The cleaning element 170 can also include an elongate brush 172 extending along a downward edge of cleaning element 170, and arranged to have bristles extending and sweeping a surface over which the handling device 100 moves. The cleaning element 170 is arranged to push the bulk of the previous concrete sample 12, while the brush 172 is arranged to sweep away debris which can fracture away from the previous concrete sample 12 during destructive testing. In embodiments, the handling device 102 can further include a

compressed air blower 174 which can project a stream of air onto the stage 26 when the handling device 102 moves over the stage 26 in cleaning it. The compressed air blower 174 can disperse smaller fragments or dust particles from the stage 26, so as reduce any disturbance to a following test to failure. According to embodiments, the handling device 102 can be inserted and retracted into the through hole 22 of the testing machine 20 multiple times prior to depositing the concrete sample 10 for testing. This allows for a more thorough cleaning of the stage surface 26. In embodiments, the handling device 102 is actuated back and forth over the stage surface 26 three times prior to placing the concrete sample 10 onto the stage 26.

[0100] As shown in Fig. 7, the testing machine 20 can be a compressing machine. Testing machine 20 can include a through hole 22 and a stage 26 for resting the concrete sample 20 to be tested. Testing machine 20 can include a piston 24 arranged to press onto the concrete sample 10 to compress it. The testing machine 20 can be oriented such that the hole 22 and stage 26 can face the handling device 102 to receive an incoming concrete sample 10, when the handling device 102 actuates towards the testing machine 20 to deliver the concrete sample 10.

[0101] When the handling device 100 is above the stage 26, the holder 110 can be actuated from the engaging configuration to the releasing configuration thereby releasing the concrete sample 10 from the holder 110 and onto the stage 26. Thereafter, the piston 24 can be activated downward to compress the concrete sample 10 against the stage 26. Concrete sample 10 can be tested to failure, i.e. the concrete sample 10 fractures. Readings of the compression test can then be recorded. In embodiments, the handling device 100 can remove the previous concrete sample just before the handling device 100 is loading the concrete sample 10 onto the testing machine 20, e.g. onto the stage 26 of the testing machine 20.

[0102] Further, the testing system 200 can include a receiving system 220 arranged to receive a previous concrete sample, which has already been tested to failure, and that is pushed off the stage 26. The previous concrete sample 12 is pushed out of the testing machine 20 by the incoming handling device 102, in particular, with the remover portion of the handling device 102. Receiving system 220 can be disposed at another end of the through hole 22 of the testing machine 20, which is opposite the end of the hole 22 where the handling device 102 enters the through hole 22 to clear the stage 26 and deliver the concrete sample 10.

[0103] Fig. 8 shows a top view of a platform 180 of a pre-loading portion of the testing system 200 according to various embodiments. Fig. 8 shows an initial portion of the automated testing system 200, where concrete block samples are prepared for loading and testing. Platform 180 can include a plurality of rods 188 arranged parallel to and spaced from each other. Platform 180 can be coupled to a conveyor system 202 such that the conveyor system 202 can transport the concrete sample 10 onto the platform 180.

[0104] Conveyor system 202 can originate from a sample loading module 230. At sample loading module 230, an operator or an automated loading module can load concrete samples for destructive failure testing into the sample loading module 230 in entering the testing system 200. Typically, each concrete sample loaded for testing includes a barcode sticker adhered to a side of the concrete sample block. The barcode sticker includes identification of the concrete sample, including details such as origin, batch of manufacture, date of manufacture, size, density, etc. Testing system 200 includes a plurality of barcode scanners 232 throughout the testing system, provided at different modules in the testing system, so as to identify and track the concrete samples as it undergoes testing. In loading concrete samples into the sample loading module 230, a user or an automated loading module can be configured to place the concrete sample such that the barcode sticker is notably visible, and in place for detection by the plurality of bar code scanners 232.

[0105] In an embodiment, after the concrete samples are loaded into the sample loading module 230, the concrete samples are arranged into position onto conveyor system 202. As concrete sample 10 departs the sample loading module 230, a barcode scanner 232 scans the barcode sticker adhered to a side of the concrete sample 10. A plurality of barcode scanners can also be provided to scan multiple areas of the passing concrete sample, if the concrete sample is not arranged to display the barcode sticker on a predetermined surface. The identification of the concrete sample 10 is then verified with a central system processor. In embodiments, the identification of the concrete sample as a correct sample for undergoing testing allows the concrete sample to move on towards the testing machine 20. If the concrete sample is identified as a sample which is not scheduled for destructive testing, the identified concrete sample is diverted into a holding area, for which an operator would undertake a review of the concrete sample for further processing.

[0106] According to embodiments, once the barcode scanner 232 scans the barcode sticker of a concrete sample 10, and identifies the concrete sample 10 as not scheduled for testing, a piston 234 activates, as the concrete block 10 moves adjacent the entrance to holding area 236. In embodiments, the holding area 236 is a ramp configured to hold the concrete blocks identified for further processing. The ramp can be a downward inclined ramp from the conveyor system 202. The ramp can include a friction-reduced surface, allowing for the concrete sample 14 to coast down the ramp. The friction-reduced surface can be formed by a plurality of rollers, or any other arrangements.

[0107] Concrete sample 10 can be carried by the conveyor system 202 toward the pre-loading portion of the testing system 200, in preparation of loading onto a holding device. Conveyor system 202 can include a transferring system 204 in which the transferring system 204 can be arranged to transfer the concrete sample 10 from the conveyor system 202 to the platform 180. A position sensor 238 can be provided to detect the position of concrete sample 10, and at the appropriate location, the transferring system 204 can activate a pusher 192 which can be arranged to push the concrete sample 10 from the conveyor system 202 onto the platform 180. Further, a second position sensor 240 can be provided to work in conjunction with the first position sensor 238 to obtain dimensional measurements of the concrete sample 10. In other embodiments, a sensor array can be provided to obtain dimensional measurements. Additional sensors can also be provided to obtain a full 3-dimensional analysis and confirmation of the dimensions of the concrete sample 10. Obtained measurements of the concrete sample are stored by the testing system 200 in a test database.

[0108] Transferring system 204 can include a complementing platform 190 which is arranged to complement the platform 180. Complementing platform 190 can include a plurality of rods 198 arranged parallel to and spaced from each other. Complementing platform 190 can be arranged to mesh with the platform 180. For example, the rods 188 of platform 180 and the rods 198 of the complementing platform 190 can be arranged side by side in an alternating sequence thereby forming an interlocked “combined” base for holding concrete sample 10. As shown in Fig. 8, the rods 188 of platform 180 and the rods 198 of complementing platform 190 can be disposed alternatively with each other. Rods 188 of the platform 180 can extend perpendicularly to the horizontal axis 182. When the concrete sample 10 has been transferred to the platform 180, platform 180 can be tilted at about the horizontal axis 182 to accommodate the handling device 100 in picking up the concrete sample 10. As the handling

device 102 actuates closer to the platform 180, the holder 110 in the handling device 102 can be arranged to pick up the concrete sample 10 quickly, and have the concrete block supported on lifting lips 113 in the holder 110.

[0109] Fig. 9 shows a loading method 1000 for loading a concrete sample 10 using the handling device according to various embodiments. Testing method 100 includes holding the concrete sample 10 by the holder 110 of the handling device 100 as shown in 1100, transferring the concrete sample 10 to the testing machine 20 as shown in 1200, actuating the remover portion 122 of the remover 120 into a blocking position 127 to prevent the holder 110 from engaging the concrete sample 10 as shown in 1300, and loading the concrete sample 10 to the testing machine 20 and simultaneously removing the previous concrete sample from the testing machine 20 by the remover 120 as shown in 1400.

[0110] Fig. 10 shows a testing process 2000 arranged to test the concrete sample 10 using the testing system according to various embodiments. Testing process 2000 can include the loading method 1000 according to various embodiments to load the concrete sample 10 to testing machine 20 and testing the concrete sample 10 by the testing machine 20 in 2100.

[0111] Fig. 11 illustrates perspective view of an automated testing system according to an embodiment of the present disclosure. Automated testing system 300 is shown, the automated testing system 300 including three testing modules 302, 304, 306 which carry out testing of concrete samples to destructive failure. In an embodiment, the testing modules 302, 304 and 306 include the same components and carry out the same functions. In other embodiments, the testing modules can include different components and can be configured to carry out destructive testing according to varying parameters or conditions. In embodiments, the automated testing system can include any number of testing modules, for example four modules, five modules or any other number.

[0112] An incoming conveyor system 202 can be provided to bring in concrete samples 10 into the testing modules 302, 304 and 306 for destructive testing, and an outgoing conveyor system 310 can be provided to receive tested concrete blocks from the testing modules 302, 304 and 306. The incoming conveyor system 202 can be coupled to a sample loading module for loading concrete samples for testing by the testing system 300. A plurality of testing modules can be coupled to each other via a conveyor belt 202 such that conveyor belt 202 can convey concrete samples 10 along the conveyor belt 202 to each of the plurality of testing

modules. The outgoing conveyor system 310 can be configured to remove concrete samples which have undergone a stress test to failure from the testing system 300 to a central collection bin which can handle the broken concrete blocks and debris.

[0113] Fig 11A shows a close up perspective view of a testing module 302 of Fig. 11. In testing module 302, a handling device 100 is coupled to mechanical arm 320, the handling device 100 arranged to carry a concrete sample 10 to a testing machine 20. In embodiments, a testing module can include a single handling device coupled to a mechanical arm, which can serve a plurality of testing machines.

[0114] According to an embodiment, the handling device 100 can be coupled to a hydraulically actuated mechanical arm 320. The mechanical arm 320 can provide for three dimensions of motion. The mechanical arm 320 can be multi-segmented, each segment allowing for an additional degree of motion, each segment mechanically coupled to another. The coupling within the mechanical arm segments can be rotatable couplings. The mechanical arm can be mounted onto a swivel base, allowing for a further degree of lateral rotation. The varying degree of motions of the mechanical arm 320 allows for the handling device to service more than one testing machine 20, which increases the productivity of the testing system 300.

[0115] In an embodiment, the handling device 100 coupled to the mechanical arm 320 is arranged to pick up a concrete block from a platform 180 after being driven off the incoming conveyor system 202 by a pusher (not shown). The platform 180 can be further tilted about a horizontal axis, so as to provide the handling device a better approach angle and direction to the concrete sample being supported on the tilted platform. The handling device 100 can be arranged to actuate the remover portion 122 from the blocking position 127 to the unblocking position 128. Motor 142 can be activated to actuate the relay element 144 so that the gate 166 can be rotated from the blocking position 127 to the unblocking position 128. At the same time, the holder 110 can be left in the releasing configuration or activated from the engaging configuration to the releasing configuration. In the unblocking position 128, the handling device 100 can move towards the concrete sample 100 to enable the concrete sample 100 to pass through gap 156 such that the holder 110 can engage the concrete sample 10. Holder 110 can be actuated from the releasing configuration to the engaging configuration to hold the concrete sample 10. In an embodiment, the holder 110 includes lifting lips 113, and the

holder 110 can be actuated upwards to lift the concrete sample 10 from the platform 180. Thereafter, the handling device 100 can be made to load the concrete sample 10 to the testing machine 20.

[0116] Testing system 300 can include a weighing device 210 arranged to weigh the concrete sample 10. The handling device 100 carrying the concrete sample 10 picked up from platform 180 can be manipulated by the mechanical arm 320 to position and place the concrete sample 10 onto the weighing device 210. Testing module 302 can include two (or more) weighing devices 210. Weighing device 210 can include a weighing scale. Weighing device 210 can measure the weight of the concrete sample 10 for purposes of testing the concrete sample 10. Similar to the dimensional measurements of the concrete sample 10, the weight of the concrete sample 10 can be stored by the testing system 300 in a test database. A density can be calculated based on the dimensional measurements and weight of the concrete sample 10.

[0117] Handling device 100 can be arranged to transfer the concrete sample 10 from the weighing device 210 to the testing machine 20 once the weighing measurement is complete, and where the testing machine 20 is ready to receive a new concrete sample for testing. In the illustrated embodiment, the testing module 302 includes two weighing devices 210 and two testing machines 20. Each testing machine 20 includes a piston (not shown) arranged to press onto the concrete sample under test 10 to compress it to failure. Under normal circumstances, the time to failure for a concrete block can take approximately half a minute. Having two sets of weighing devices 210 and testing machines 20 can allow the handling device 100 coupled to the mechanical arm 320 to concurrently prepare the concrete samples for pickup and weighing, whilst awaiting the completion of a compression test to failure of a present concrete sample, thereby providing for an improvement in productivity of the automated testing system 300.

[0118] In embodiments, each testing module 302 can include a processing system provided with the testing module 302. The processing system 330 can include processing capability and non-transitory memory modules for storing instructions which can be run to operate for example, the mechanical functions and operability of the mechanical arm 320, coordination with the overall testing system 300 for receiving concrete blocks for testing and delivering concrete blocks tested to destruction, operating the testing machine 20, carrying out and recording results of the testing process, etc. In embodiments, the dimensional measurement

results, the stress testing results are correlated to the concrete block under test, based on the barcode sticker adhered to each concrete block under test. The results can be stored on memory provided with the processing system 330. The results can also be compiled and delivered onto a web-hosted secure database correlated to the testing system 300 and arranged for hosting testing parameters and measurements in relation to concrete block testing. In embodiments, the database is coupled to a server which allows for client access through, for example, a client web-based interface, the client able to access real-time testing results for his batch of samples for testing.

[0119] Fig. 12A and Fig. 12B shows a receiving system according to an embodiment in a first position and a second position respectively. Testing machine 20 is provided with a receiving system 220, configured to receive a previous concrete sample 12, which is ejected from testing machine 20, or pushed off the stage of testing machine 20 by a handling system loading a next concrete sample for testing. Receiving system 220 can include a fixed chute 222 coupled to the testing machine 20, at a through hole opening 22 of the testing machine 20. The fixed chute 222 is arranged to be downward inclined, such that an ejected concrete sample can be directed into receiving system 220. The fixed chute 222 can be a tray with sides raised perpendicularly from a base of the tray, the sides allowing for the previous concrete sample or debris from the previous concrete sample to be received into receiving system 220. The fixed chute 222 can also include a width that corresponds to the width of the opening of the through hole 22.

[0120] The fixed chute 222 can also include a ledge 224 protruding from the fixed chute 222. The ledge 224 can be provided from a lower surface of the chute 222, the ledge 224 providing a support for an actuatable slide 226. A portion of the actuatable slide 226 can rest on the ledge 224 of the fixed chute 222 in a first lowered position 227. In the first lowered position 227, the fixed chute 222 and the slide 226 provide an open incline for an ejected concrete sample to be fall from testing machine 20 to conveyer belt system 310. Conveyer belt system 310 can include splash shields 314 extending out from belt 312, forming a gutter for which can receive and retain a concrete block descending from testing machine 20. The conveyer belt system 310 can be arranged to deliver the tested concrete blocks and debris to a central collection bin 318.

[0121] In a second raised position 228, the actuatable slide 226 is raised such that any concrete block ejected from the testing machine 20 and descending on fixed chute 222 would drop into a container 250. In carrying out a destructive stress test to failure on a concrete sample, the testing machine 20 is configured to analyze the failure patterns of the concrete sample under test. If the test fails to meet up to predetermined standards, the concrete sample is identified and will be set aside for further observation and/or analysis. When such a sample is identified, the testing machine 20 indicates the result to the processor system 330 which thereafter controls the actuatable slide 226 to be hydraulically raised, exposing the container 250 for receiving the sample identified as requiring further observation. In an embodiment, the slide 226 includes a stopping panel 252 arranged to stop concrete samples in tumbling down the fixed chute 222 and directing them into container 250. The stopping panel 252 can include a resilient surface to absorb impact from the concrete samples. Fig. 13A and Fig.13B show a portion of an outgoing conveyor belt system according to various embodiments. Outgoing conveyor belt system 310 can include a belt 312 laterally conveying concrete samples 12 received from testing machines 20, and which have completed stress testing to failure. As such, the concrete samples 12 have satisfied their purposes for testing as part of a manufactured batch of concrete, and can be considered broken concrete samples 12. The broken concrete samples 12 are delivered for disposal by the belt 312.

[0122] In an embodiment, outgoing conveyor system 310 can include an inclined portion 316. Inclined portion 316 is configured to carry the broken concrete samples 12 from belt 312 for disposal in a collection bin 318. Inclined portion 316 can include a conveyer belt provided at an inclined angle, the inclined portion 316 provided sufficiently long so as to elevate the broken concrete samples 12.

[0123] Inclined portion 316 can deliver the broken concrete samples 12 to a distribution apparatus 340. Distribution apparatus 340 is configured to receive broken concrete samples 12 for disposal from testing machines 20 through outgoing conveyer system 310. Distribution apparatus 340 is configured to dispose broken concrete samples 12 evenly into collection bin 318. Distribution apparatus 340 is configured to laterally actuate such that the broken concrete samples 12 can be disposed into collection bin 318 evenly from one side to another.

[0124] Distribution apparatus 340 can include a frame 342. Frame 342 is configured to support a delivery system 344, and is arranged to receive within the frame 342 and below the

delivery system 344 a collection bin 318. Frame 342 supports on it delivery system 344. Delivery system 344 includes a receiving portion 346, where broken concrete samples 12 are received from the inclined portion 316 of the outgoing conveyor system 310. Receiving portion 346 is coupled to the frame 342, and is stationary with respect to the distribution apparatus 340 and the inclined portion 316.

[0125] Fig. 13B illustrates a top-down perspective of the portion of the outgoing conveyor belt system according to Fig. 13A. In embodiments, a collection bin 318 is configured to be placed under frame 342. According to embodiments, the receiving portion 346 of the delivery system 344 can include a delivery belt 348. Delivery belt 348 can be a conveyor belt operating in a single direction. In an embodiment, the delivery belt 348 operates in a clockwise direction, with respect to observation from the inclined portion 316.

[0126] In an embodiment, the receiving portion 346 is mounted fixedly onto frame 342. Distribution apparatus 340 is configured to laterally actuate such that the broken concrete samples 12 delivered by inclined portion 316 can be disposed into collection bin 318 evenly from one side to another. In embodiments, the frame 342 is configured to laterally actuate from side to side, with respect to the stationary inclined portion 316 of the outgoing conveyor belt system 310. In such a way, the broken concrete samples 12 can be deposited onto receiving portion 346 of the distribution apparatus, and are carried away by delivery belt 348 in a predetermined direction. As such, all broken concrete samples 12 are deposited into collection bin 318 positioned under the frame 342 off the end 350 of the delivery system 344. The frame 342 can be actuated such that the collection bin 318 is evenly filled.

[0127] The above apparatus, method and/or system as described and illustrated in the corresponding figures, is not intended to limit an or any apparatus, method or system as according to an embodiment, and the scope of the present disclosure. The description further includes, either explicitly or implicitly, various features and advantages of the method or system according to the present disclosure, which can be encompassed within an apparatus, method or system according to the disclosure.

[0128] While embodiments of the disclosure have been particularly shown and described with reference to specific embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the disclosure as defined by the appended claims. The scope of the disclosure is

thus indicated by the appended claims and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced.

Claims

1. A handling device arranged to transfer a concrete sample to be tested to a testing machine, the handling device comprising:

a holder arranged to engage and hold the concrete sample to be transferred to the testing machine;

a remover coupled to the holder, wherein the remover is arranged to simultaneously remove a previous concrete sample from the testing machine when the holder is transferring the concrete sample to the testing machine;

a base wherein the holder and the remover extend from the base;

wherein the remover comprises a remover portion, the remover portion being actuatable between a blocking position to prevent the holder from engaging the concrete sample when the handling device is actuated toward the concrete sample and an unblocking position wherein the holder is able to engage the concrete sample when the handling device is actuated toward the concrete sample.

2. The handling device of claim 1, wherein the remover comprises a frame surrounding the holder.

3. The handling device of claim 1 or 2, wherein the frame comprises a gap arranged to allow the concrete sample therethrough to within the frame so as to allow the concrete sample to be held by the holder.

4. The handling device of claim 3, wherein the remover portion comprises a gate, wherein the gate is pivotally connected to the frame, the gate operable between a closed position to cover the gap and an open position to expose the gap.

5. The handling device of any one of claims 1 to 4, wherein the handling device comprises a cleaning element arranged to clean the testing machine before transferring the concrete sample to the testing machine.

6. The handling device of claim 5, wherein the cleaning element is attached to the remover portion of the remover.

7. The handling device of claim 5 or 6, wherein the cleaning element is an elongated brush extending along an edge of the remover portion.
8. The handling device of any one of claims 1 to 7, wherein the holder comprises an engaging element extending from the base, the engaging element arranged to engage and hold the concrete sample.
9. The handling device of any one of claims 1 to 8, wherein the holder comprises a clamp arranged to clamp the concrete sample.
10. The handling device of any one of claims 3 to 9, wherein the gap is downstream of the holder along a loading direction, the loading direction being a direction the handling device actuates along to engage the concrete sample.
11. A testing system arranged to test a concrete sample, the testing system comprising:
 - a testing machine arranged to receive the concrete sample to be tested; and
 - a handling device as claimed in any one of claims 1 to 10.
12. The testing system of claim 11, further comprising a weighing device arranged to weigh the concrete sample.
13. The testing system of claim 12, wherein the handling device is arranged to transfer the concrete sample from the weighing device to the testing machine.
14. The testing system of any one of claims 11 to 13, further comprising a platform for holding the concrete sample to be tested.
15. The testing system of claim 14, wherein the platform is arranged to be orientated to a position to enable the handling device to hold the concrete sample.
16. The testing system of claim 15, wherein the platform is rotatable about a horizontal axis.
17. The testing system of any one of claims 11 to 16, wherein the handling device is mounted on a mechanical arm.

18. The testing system of claim 17, wherein the mechanical arm is configured to provide the handling device three dimensions of motion.
19. The testing system of any one of claims 11 to 18, further comprising an incoming conveyor system arranged to deliver concrete samples to be tested to the testing machine.
20. The testing system of any one of claims 11 to 19, further comprising a barcode scanner arranged to identify incoming concrete samples for testing at the testing machine.
21. The testing system of any one of claims 11 to 20, further comprising a position sensor arranged to locate the position of the concrete sample in the testing system.
22. The testing system of any one of claims 11 to 21, further comprising a sensor array to determine dimensional measurements of a concrete sample for testing.
23. The testing system of any one of claims 11 to 22, further comprising a receiving system to receive a concrete sample from the testing machine after testing.
24. The testing system of claim 23, further comprising an outgoing conveyor system arranged to receive concrete samples from the testing machine after testing.
25. The testing system of claim 24, wherein the receiving system comprises an inclined chute to direct the concrete samples from the testing machine to the outgoing conveyor system.
26. The testing system of claim 25, the receiving system further comprising a container arranged to receive a concrete sample for further processing.
27. The testing system of claim 26, the receiving system further comprising an actuatable slide arranged to move between a raised position allowing a concrete block to be received in the container and a lowered position allowing the concrete block to be received in the outgoing conveyor system.
28. The testing system of any one of claims 24 to 27, wherein the outgoing conveyor system comprises a delivery system configured to deliver the concrete samples after testing to a collection bin.

29. The testing system of claim 28, wherein the delivery system is elevated above the collection bin.
30. The testing system of claim 29, wherein the delivery system is mounted on a frame, the frame arranged to receive the collection bin under the frame.
31. The testing system of claim 30, wherein the outgoing conveyor system comprises an inclined portion arranged to deliver concrete samples to the elevated delivery system.
32. The testing system of claim 31, wherein the delivery system is configured to actuate with respect to the inclined portion of the outgoing conveyor system.
33. The testing system of claim 32, wherein the frame is configured to actuate with respect to the inclined portion of the outgoing conveyor system.
34. The testing system of any one of claims 11 to 33, wherein the testing machine comprises a compression machine.
35. The testing system of any one of claims 11 to 34, wherein the testing system comprises a plurality of testing machines.
36. A loading method for loading a concrete sample using the handling device as claimed any one of claims 1 to 10, the loading method comprising,

holding the concrete sample with the holder of the handling device;

transferring the concrete sample to the testing machine;

actuating the remover portion of the remover into a blocking position to prevent the holder from engaging the previous concrete sample when the handling device is actuated toward the testing machine; and

loading the concrete sample to the testing machine and simultaneously removing the previous concrete sample from the testing machine by the remover.

37. The loading method of claim 36, further comprising simultaneously cleaning the testing machine while removing the previous concrete sample from the testing machine.
38. A testing process arranged to test a concrete sample using the testing system of any one of claims 11 to 35, the testing process comprising,

the loading method of claim 36 to load the concrete sample to the testing machine; and

testing the concrete sample with the testing machine.

39. The testing process of claim 38, further comprising simultaneously cleaning the testing machine while removing the previous concrete sample from the testing machine.

40. The testing process of claim 38 or 39, further comprising weighing the concrete sample.

41. The testing process of any one of claims 38 to 40, further comprising orientating the concrete sample to enable the handling device to hold the concrete sample.

42. The testing process of any one of claims 38 to 40, further comprising compiling measurement results for a concrete sample in a database.

43. The testing process of claim 42, further comprising determining dimensional measurements for a concrete sample and compiling the dimensional measurements in the database.

44. The testing process of claim 42 or 43, further comprising determining the weight of a concrete sample and compiling the weight in the database.

45. The testing process of any one of claims 42 to 44, further comprising identifying a concrete sample through barcode identification, and compiling the concrete sample identification in the database.

46. The testing process of any one of claims 42 to 45, further comprising providing a server-client access to the database.

47. The testing process of claim 46, further comprising making test and measurement data available for client access through a web-based interface.