

Construction Method and System

The present invention relates to construction methods and construction systems. In particular, but not exclusively, the invention relates to construction methods and systems for buildings, and in particular to high-rise buildings.

- 5 High-rise buildings are typically constructed by first building a portion of a core of a building. The core is conventionally formed from steel rebar and concrete. The initial portion of core may be, for example, ten storeys high. An outer steel frame can then be built around the portion of core, with cladding and other materials being used to finish the building portion. The core can then be built upwards in stages, with the frame and
10 cladding similarly being added to in stages.

The components of the building, such as steel for the core and frame, may be lifted using cranes. The cranes may be external to the building, or may be supported by the core as it is constructed upwardly.

- This building technique is slow, which can lead to delays in the construction timeline, and
15 therefore fines imposed by the authorities.

As such, it is desirable to provide a construction method and system which allows for faster and more reliable construction of high-rise buildings. Such principles could also be used in other contexts, such as in the construction of temporary structures, for example when building music festival stages or similar.

- 20 The present invention seeks to provide a solution to these problems.

- According to a first aspect of the present invention, there is provided a construction method comprising: a) providing at least one first structural column secured relative to the ground; b) mounting a cable raising device to the first structural column; c) supporting a construction platform from the cable raising device via a cable; d) elevating the
25 construction platform via raising the cable with the cable raising device; e) supporting the construction platform with the first structural column or a supporting structural column under the first structural column via a platform supporting means which is different to the cable raising device; f) dismounting the cable raising device from the first structural column and securing a second structural column above the first structural column; g)

mounting the cable raising device to the second structural column; and h) supporting the construction platform from the cable raising device via the cable.

This allows for a tower of columns of a resulting building or structure to self-climb or ascend. The method may be a self-climbing or self-ascending construction method. In
5 other words, a tower of columns which are to form part of a building can be created without requiring an external lifting crane, for example. The cable raising devices mounted to the columns elevate the construction platform. The construction platform can then be supported directly on the columns without using the cable raising devices, to allow the cable raising devices to be dismantled and a new column to be inserted on
10 top. As such, the towers of columns are increased in height, and the cable raising devices can be re-mounted to the tops of the towers of columns.

This provides for a more efficient construction technique, reducing the risk of delays to construction, and therefore also reducing the risk of fines for late construction.

Preferably, the cable raising device may be a strand jack.

15 Advantageously, the platform supporting means may comprise a lateral protrusion on the first structural column or the supporting structural column under the first structural column, and a moveable support for supporting the construction platform on the lateral protrusion.

As such, the construction platform can be directly supported by the relevant column or
20 columns. Each column of the tower of columns may have its own lateral protrusion, and these may be aligned with each other. This creates a plurality of lateral protrusions along the height of the tower of columns. The spacing of the lateral protrusions is low, for example 3 m, although this may vary depending on architectural decisions and/or structural engineering requirements. Therefore, the possible distance that the
25 construction platform may fall due to failure of the cable raising devices is reduced. There may be multiple lateral protrusions to each column, such as a pair of lateral protrusions at opposite sides of each column.

Beneficially, the lateral protrusion has a sloped surface extending upwardly and away from the column and a seat at an upper surface thereof, the moveable support being
30 biased towards the column so that, as the construction platform moves upwardly, the moveable support moves along the sloped surface before seating on the seat. Optionally, the lateral protrusion may comprise a wedge.

The construction platform can therefore sit on the top of the seat, and be supported thereby. The cable raising devices can be demounted once the construction platform is supported by the lateral protrusion. The moveable support allows for the construction platform to freely move upwards, but be prevented from unintentionally falling below the lateral protrusion.

In a preferable embodiment, the moveable support may be biased by at least one spring.

Preferably, the method may construct a core of a building or a temporary structure.

According to a second aspect of the invention, there is provided a self-climbing construction system for a method according to the first aspect of the invention, the system comprising: at least one first structural column and at least one second structural column securable above the first structural column; a cable raising device mountable to the first structural column and to the second structural column; a construction platform; a cable configured to be raised by the cable raising device and to support the construction platform; and a platform supporting means which is different to the cable raising device and which is configured to support the construction platform the first structural column or the supporting structural column under the first structural column.

The system may be a self-climbing or self-ascending construction system.

According to a third aspect of the invention, there is provided a construction method comprising: a) providing at least one first structural column secured relative to the ground; b) mounting a cable raising device to the first structural column; c) supporting a construction platform from the cable raising device via a cable; d) elevating the construction platform via raising the cable with the cable raising device; e) supporting the construction platform with the first structural column or a structural column under the first structural column via a platform supporting means which is different to the cable raising device; f) dismounting the cable raising device from the first structural column and securing a second structural column above the first structural column; g) mounting the cable raising device to the second structural column; and h) providing at least one building storey at or adjacent to the ground, and raising said building storey from the construction platform using the or another cable raising device.

Such a method allows for each building storey to be premanufactured at or adjacent to ground level. The building storeys can then be raised to the relevant elevation. This provides for a rapid means for constructing a high-rise building. The term premanufactured is in reference to construction elements produced offsite. When onsite,

the premanufactured elements are assembled, or connected together and/or constructed on the ground level to form sections that are then connected to the erected grid for winching and gradually ascending into position.

Preferably, said raising of the building storey may comprise winching the building storey
5 from the construction platform.

According to a fourth aspect of the invention, there is provided a construction system for the method of the third aspect of the invention, the system comprising: at least one first structural column and at least one second structural column securable above the first structural column; a cable raising device mountable to the first structural column and the
10 second structural column; a construction platform; a cable configured to be raised by the cable raising device and to support the construction platform; a platform supporting means which is different to the cable raising device and which is configured to support the construction platform from the first structural column or a structural column under the first structural column; at least one building storey; and a raising means for raising the
15 building storey from the construction platform. The raising means and the cable raising device may be the same device, and so may not necessarily be separate.

According to a fifth aspect of the invention, there is provided an automatic fastening system for automatically fastening a first construction element to a second construction element, the automatic fastening system comprising: a fastener propelling means for
20 propelling at least one fastener for fastening the first construction element to the second construction element; a trigger means for triggering the fastener propelling means to propel said at least one fastener; a first support means for supporting the fastener propelling means from a first side of at least one of the first construction element and the second construction element; a fastener locking means for locking said fastener; and a
25 second support means for supporting the fastener locking means from a second side of at least one of the first construction element and the second construction element; the system configured so that, when the trigger means is triggered, the fastener propelling means propels said fastener from said first side and the fastener locking means locks said fastener at said second side to automatically fasten the first construction element to
30 the second construction element.

Such a system allows for the automatic fastening of construction elements, such as columns. As such, the requirement to use workers to fasten columns is reduced, increasing safety and construction speed, whilst reducing costs.

The fasteners are preferably propelled through at least one fastening plate, which is secured to and depends from an upper column, and through the lower column. There is here a fastening plate at either side of the columns. The plate from which the fastener is propelled may be a front plate, and the other plate may be a rear plate. The fastening
5 plates and the column have pre-formed apertures therethrough to allow the fasteners to pass therethrough.

Preferably, the system may further comprise the first construction element and the second construction element, the fastener propelling means supported from the first side of at least one of the first construction element and the second construction element via
10 the first support means, and the fastener locking means supported from the second side of at least one of the first construction element and the second construction element via the second support means.

Beneficially, the first construction element and the second construction element may be structural columns.

15 Advantageously, the fastener propelling means may comprise at least one spring positioned at the first support means and for being positioned at a fastener so that the spring is between the first support means and the fastener.

In a preferable embodiment, the fastener locking means may comprise a moveable locking element for being received in a hole of a portion of the fastener which protrudes
20 from the second side, the second support means configured to hold the locking element. The hole is here a groove formed in an end portion of each fastener.

Optionally, the moveable locking element may be configured to be in an unlocked position and a locked position, the moveable locking element being supported by a moveable support in the unlocked position, the moveable support being moveable by the
25 fastener so as to allow the moveable locking element to move to the locked position.

The moveable support is here a backer or cover, which covers the aperture in the lower structural column and/or the rear plate, and upon which the locking element sits. The cover is pushed away by the propelled fastener, which allows for the locking element to fall and site into the groove of the fastener. The locking element thereby bridges between
30 the fastener and an upper bracket to lock the fastener in position.

Additionally, the moveable support may be biased to support the moveable locking element via a biasing means. The biasing means is here a compression or coil spring, held between the support means and the moveable support.

According to a sixth aspect of the invention, there is provided a construction method comprising: a) providing a support and mounting a cable raising device to the support; b) providing a construction platform, and supporting the construction platform from the support via a cable secured to the cable raising device; c) raising the construction platform via raising the cable with the cable raising device; d) installing at least one first structural column; e) further raising the construction platform via raising the cable with the cable raising device; and f) installing at least one second structural column supported by and above the first structural column, the second structural column being installed from the construction platform.

In this way, a construction platform is not required to self-climb. Instead, it may be raised from a pre-constructed building portion, such as a core of the building. The construction platform installs a tower of columns as it ascends, which form part of the underlying structure of the wider building.

Preferably, the cable raising device may comprise at least one winch.

Advantageously, the support may be a core of a building.

Additionally, the system may further comprise a platform supporting means for supporting the construction platform from the first structural column or a structural column under the first structural column, the platform supporting means being different to the cable raising device. This may allow for the construction platform to be supported directly on the columns, and thereby permit the cable raising device to release the construction platform.

According to a seventh aspect of the invention, there is provided a system for supporting a construction platform relative to a building portion, the system comprising: a building portion having at least one lateral protrusion including a sloped surface extending upwardly and away from the support, and a seat at an upper surface thereof; a construction platform; and a moveable support for supporting the construction platform on the lateral protrusion, the moveable support being biased towards the building portion so that, as the construction platform moves upwardly, the moveable support moves along the sloped surface before seating on the seat.

This allows for the construction platform to be supported by a building portion. The construction platform may be for installing storeys of a building.

Preferably, the building portion may be a core of the building or a column of a building.

Advantageously, the building portion may have a plurality of lateral protrusions vertically spaced apart from each along the building portion, the moveable body being moveable to each of the lateral protrusions. As such, in the event that the construction platform is being winched or otherwise raised and there is an unlikely failure, the construction platform can be caught by the lateral protrusions, and only fall a minimal distance.

There may also be a set of lateral protrusions at a given elevation around the building. There may be a plurality of such sets spaced apart from each other along the height of the building.

According to an eighth aspect of the invention there is provided a supporting platform for supporting a construction platform relative to a building portion having at least one lateral protrusion including a sloped surface extending upwardly and away from the support and a seat at an upper surface thereof, the supporting platform comprising a moveable support for supporting the construction platform on the lateral protrusion, the moveable support being biased towards the building portion so that, as the construction platform moves upwardly, the moveable support moves along the sloped surface before seating on the seat.

In a preferable embodiment, the moveable support may be biased by at least one spring.

The invention will now be more particularly described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a first embodiment of a construction system in accordance with a second aspect of the invention for a construction method in accordance with a first aspect of the invention;

Figure 2 shows an enlarged view of the construction system of Figure 1;

Figure 3 shows a construction platform of the construction system of Figure 1 in an elevated condition compared to Figure 2;

Figure 4 shows the construction system of Figure 1, having constructed a portion of a core of a building;

Figure 5 shows a second embodiment of a construction system in accordance with the second and a fourth aspect of the invention, for a construction method in accordance with the first and a third aspect of the invention;

Figure 6 shows the construction system of Figure 5 lifting storeys of a building;

5 Figure 7 shows the construction system of Figure 5 having lifted storeys of the building to construct the building;

Figure 8 shows a third embodiment of a construction system for building a method in accordance with a sixth aspect of the invention;

10 Figure 9 shows an embodiment of an automatic fastening system in accordance with a fifth aspect of the invention;

Figure 10 shows the automatic fastening system of Figure 9 with fasteners having been propelled;

Figure 11 shows a reverse view of the automatic fastening system of Figure 9;

15 Figure 12 shows the view of Figure 11 with a moveable locking element in a locked condition;

Figure 13 shows an embodiment of a platform supporting means for supporting a construction platform;

Figure 14 shows a moveable support of the platform supporting means of Figure 13 below a lateral protrusion on a column;

20 Figure 15 shows the moveable support of the platform supporting means of Figure 13 above the lateral protrusion on a column;

Figure 16 shows an upper view of a cable attachment means for attaching the platform supporting means of Figure 13 to a cable;

Figure 17 shows a lower view of the cable attachment means of Figure 16;

25 Figure 18 shows a fourth embodiment of a construction system in accordance with a seventh aspect of the invention; and

Figure 19 shows a further view of the construction system of Figure 18 with components partially transparent for clarity.

Referring firstly to Figure 1, there is shown a first embodiment of construction system 10. The construction system 10 is for a first embodiment of a construction method, which is preferably for building a high-rise building, and most preferably for building a core of a high-rise building.

The construction system 10 comprises a plurality of structural columns 12 secured relative to the ground.

It may be necessary to provide a building foundation for the building for securing the lowermost columns 12 thereto. Any suitable conventional building foundation may be considered, and so details of the building foundation are omitted for conciseness.

There are here four towers of structural columns 12. Each tower of structural columns 12 comprises a lowermost column 12a which is secured to the foundation. A lower end of a further structural column 12b is secured to an upper end of each lowermost column 12a. Another structural column 12c is secured to each further structural column 12 in a corresponding manner. This process is continued to construct the tower of structural columns 12 to a desired height.

Whilst four towers of structural columns 12 are described, it will be appreciated that other numbers of towers of columns 12 may be considered, depending on the size of the building to be constructed. The towers are here arranged in a rectangular configuration, although it will be appreciated that other arrangements may be considered.

Each tower of structural columns 12 is only one column 12 wide, and so has a footprint of a single column 12.

Each structural column 12 may comprise metal, such as steel, and may be a beam, preferably having a substantially H-shaped or I-shaped cross-section. As such, each structural column 12 may be an H-beam or I-beam. As such, each beam may have a web which separates two flanges.

Each structural column 12 preferably includes at least one lateral protrusion 14, details and the purpose of which will be described subsequently.

The construction system 10 further comprises a construction platform 16. The construction platform 16 may have a base 18 and side guards 20. The base 18 may comprise a framework or grid of structural beams with a deck 22 placed thereacross for workers or robotic workers to move across. The deck 22 may be formed from non-slip
5 steel decking plates. The base 18 is for supporting the construction materials whilst the side guards 20, which are also framework, may be non-structural and may for safety purposes only, so may be omitted if necessary.

The base 18 is planar or substantially planar and is oriented or arranged horizontally or substantially horizontally. The base 18 is receivable around the tower of columns 12, and
10 therefore has a plurality of apertures for receiving one column 12 of the tower of columns 12 therethrough.

There is preferably a supply of structural columns 12 supported on the base 18. The supply of structural columns 12 is preferably stored upright in a holding frame 24 for ease of access. There may be a separate supply of columns 12 and holding frame 24 for each
15 tower of columns 12. There is preferably a rail per each supply of columns 12, the rail being for moving a column 12 to each tower of columns 12 via a pre-determined column-installation route. In addition to the supply of columns, there may be various other construction elements supported and/or stored on the base 18 of the construction platform 16. For example, there may be beams, fasteners, rebar, and/or façade
20 constituents.

The construction system 10 further comprises a cable raising device 26 which is mountable to the uppermost column 12d of each tower of columns 12. As such, there is preferably at least one cable raising device 26 for each tower of columns 12. The cable raising device 26 is preferably a strand jack, although it will be appreciated that other
25 cable raising devices may be considered, such as winches. A hydraulic jack used in a jack and pin method may be considered, instead of the strand jack. Additionally, a system of counterweights may be considered as an alternative to the strand jack.

The cable raising device 26 is releasably or demountably mountable to the uppermost column 12d. As such, it can be mounted and secured to the uppermost column 12d, and
30 then released or demounted from the uppermost column 12d for repositioning. As such, the cable raising device 26 may include a releasable column-mounting means, such as a clamp, for example.

The cable raising device 26 is also supportable by the construction platform 16, and is moveably supportable by the construction platform 16. In particular, the cable raising device 26 can be moved in a vertical direction relative to the construction platform 16, which allows for the cable raising device 26 to be demounted from a previously
5 uppermost column 12d, and remounted to a new uppermost column which has subsequently been secured to the previously uppermost column 12d.

Each cable raising device 26 is supported from the construction platform 16 via a movable support means. Here this takes the form of the cable raising device 26 being secured between two side walls 28 or posts. The posts may each include a rack, and the
10 cable raising device 26 may include corresponding pinions to allow the cable raising device 26 to move along the posts. This may be actuated via a motor, for example. The side walls 28 form part of a gantry 30. However, it will be appreciated that other methods of movable supporting the cable raising device may be considered.

The construction system 10 further comprises at least one cable 32 configured to be
15 raised by the cable raising device 26 and which is securable to the construction platform 16. The cable is an engineering load bearing cable. The loads of the construction system 10 are better spread than in conventional construction systems.

There is here at least one cable 32 per cable raising device 26. The securing of the cable raising device 26 to the construction platform 16 will be described in detail subsequently.
20 Lengths of cable 32 not currently being used are stored on the base 18 of the construction platform 16. For example, the cable 32 may spooled or wound. The portion of cable 32 actively being used is fed through the cable raising device 26.

For example, this may be fed via the top of the gantry 30. The cable 32 may be directed via a semicircular cable guide 34 mounted at the top of the gantry 30 so that the cable
25 32 can be directed from the base 18 of the construction platform 16 to the top of the gantry 30 and then vertically downwards through the cable raising device 26 and then at or adjacent to the tower of columns 12. The cable 32 may be received between flanges of the columns 12 and adjacent to a web of the columns 12. As such, the cross-sections of the columns 12 should be aligned to allow smooth passage of the cable 30.

30 The first embodiment of the construction system 10 may be used according to the first embodiment of the construction method which firstly comprises securing lowermost columns 12a relative to the ground, such as to a foundation plate via anchor bolts. The

construction platform 16 is then constructed around the columns 12a, and a cable raising device 26 is mounted to each column 12a. At least one supporting platform, which will be described in detail below, is positioned underneath the construction platform 16 and at or adjacent to each column 12a. The cables 32 are fed through their respective cable
5 raising device 26 and secured to respective supporting platforms. This supports the construction platform 16 from the cable raising devices 26.

Referring now to Figures 2 and 3, the construction platform 16 can then be raised via the cable raising devices 26.

The cable raising device 26 may at this point be positioned in a raised condition relative
10 to the construction platform 16. As such, the cable raising device 26 is elevated on the gantry 30. This is shown in Figure 2. The cable raising devices 26 raise their respective cables 32, which cause the supporting platforms to rise and push the construction platform 16 upwards. Since the construction platform 16 is moving upwards, and the cable raising devices 26 are in a fixed position since they are secured to the columns 12,
15 the cable raising devices 26 in effect move on their mounting to a lowered condition relative to the construction platform 16. This is shown in Figure 3.

Each cable raising device 26, which is a strand jack, may raise the building platform via incremental lifts of 400 mm, and may result in a lift speed of 16 metres per hour. The strand jack re-adjusts itself upon each incremental lift.

20 The supporting platforms can then be supported via the lateral protrusions 14 on the columns 12, details of which will be described subsequently. This allows for the cable raising devices 26 to be dismounted from the lowermost column 12a since the weight of the construction platform 16 is now being supported independently of the cable raising devices 26. As such, the cable raising devices 26 are dismounted and moved to the
25 raised condition relative to the construction platform 16. A new column 12 is then moved to and secured to each of the lowermost columns 12a, details of the securement of which will be described subsequently.

The cable raising devices 26 are then mounted to the top of respective new columns 12. The construction platform 16 can then be raised in the same way as previously
30 described, and then further new columns 12 secured. This process is repeated until the tower of columns 12 has reached a desired height.

Referring now to Figure 4, once the tower of columns 12 has reached the desired height, a building or building portion 36 can be constructed based on those columns 12. In this case, the core 36 can be constructed based on the tower of columns 12. For example, a steel framework or grid may be constructed around the columns 12, and concrete sections may be secured thereto or concrete poured into a mould.

To achieve the construction of the core, at least one sub-construction platform 38 may be secured to and below the construction platform 16. Here are there shown two such sub-construction platforms 38, each sub-construction platform 38 being supported from the construction platform 16 via cables 32. The cables 32 may be raised or lowered via cable raising devices 26 to allow relative movement between the sub-construction platforms 38 and the construction platform 16. As the height of the tower of columns 12 increases, the sub-construction platforms 38 can be raised by the construction platform 16 to allow building of the core 36 around the newly secured columns 12.

The building core 36 can thus be constructed. The building core 36 can be constructed in portions, as the construction platform 16 ascends and builds towers of columns.

Referring now to Figure 5, having constructed the core 36, the construction of the storeys or floors of the buildings can then be considered. To achieve this, a second embodiment of a construction system 110 can be provided and used according to a second embodiment of a method. A plurality of columns 12 are installed and secured relative to the ground, in a similar or identical way as described previously. There may be more lowermost columns 12a, to result in more towers of columns 12, than for the core 36. A building-storey construction platform 116 can then be built around the tower of columns 12 and around the building core 36. The building-storey construction platform 116 may be similar to the previously described construction platform 16, except that it is preferably significantly larger, being supported by more towers of columns 12. Supporting platforms may be positioned beneath the building-storey construction platform 116, and around each tower of columns 12. Cable raising devices 26 are initially mounted to each lowermost column 12a. The building-storey construction platform 116 can then be raised by the cable raising devices raising the supporting platforms, with new columns 12 inserted to allow the building-storey construction platform 116 to climb, in the same way as described for the construction platform 16.

Referring now to Figure 6, once the building-storey construction platform 116 has reached a pre-determined height, a building storey 40 or floor may be constructed at or

adjacent to ground level, around the tower of columns 12. The building storey 40 may be constructed on a loadbearing base, such as a steel framework. The building storey 40 is then secured to cables 32 from the building-storey construction platform 116. These may be the same cables 32 as which lift the supporting platforms, and thus the supporting
5 platforms may include strand jacks which receive the cable 32 to allow the same cable 32 to support both the building storey 40 and the supporting platforms. The building storey 40 may be secured to the cables 32 via supporting platforms positioned underneath. Alternatively, separate cables and cable raising devices may be used.

The cable raising devices 26 can then raise the cables 32 to lift the building storey 40.
10 The building storey 40 may be lifted to a desired height, for example at or adjacent to the building-storey construction platform 116, and then secured in place to the tower of columns 12. This process may be repeated for lower building storeys 40, with the cables 32 passing through the upper storeys. It may be possible to lift multiple building storeys 40 simultaneously, in which case upper building storeys 40 may be secured to the cable
15 32 via a strand jack, so that the same cable 32 can pass through and lift upper building storeys 40, as well as lifting the lower building storeys 40.

Once all the building storeys 40 have been lifted and secured into place, the building may be finished, as shown in progress in Figure 7.

At all times during mounting and dismounting of the cable raising devices 26 the cable
20 32 will be continually running through all the levels. It can be temporally disconnected from the building-storey construction platform 116 or building storey 40 when the supporting platform is seated on the lateral protrusion 14. The cable 32 runs all the way down through all the building stories 40, when winching a newly constructed story 40 from the ground upwards. The system will be able to incrementally adjust the
25 construction platform 116 or stories upwards 40, but only one at a time while always remaining connected to the cable raising device 26.

Referring now to Figure 8, a third embodiment of a construction system 210 and method may be provided. The third embodiment is for lifting building storeys 40 in a similar way as the second embodiment. However, in the third embodiment, the building-storey
30 construction platform 116 may be raised from the core 36 or another building portion 36 or support. As such, the core 36 may first be constructed, and then cables 32 may be secured from cable raising devices 26 mounted to the core 36, to the building-storey

construction platform 116 or underlying supporting platforms. The cable raising devices 26 may be winches.

As the building-storey construction platform 116 is raised by the winches, the building-storey construction platform 116 may build towers of columns 12 in the same way as previously described. However, the building-storey construction platform 116 is not required to use its own cable raising devices 26 to raise itself, since the building-storey construction platform 116 is being lifted by the winches. The columns may support the building-storey construction platform 116, although this may not be necessary since the weight of the building-storey construction platform may be held by the cable raising devices 26 of the building portion.

The building storeys 40 may then be lifted to the building-storey construction platform 116 in the same way as previously described, or via using the winches from the core 36.

Referring now to Figures 9 to 12, there is shown an embodiment of an automatic fastening system 42 for automatically fastening a first construction element to a second construction element. The automatic fastening system 42 is preferably used in the aforementioned construction systems 10, 110, 210 and construction methods for securing structural columns 12 together, preferably without requiring direct human intervention. In such an instance, the construction elements are, of course, structural columns 12 so the first construction element is a first structural column 12e, and the second construction element is a second structural column 12f.

Each structural column 12 has a fastening device 44 projecting downwardly from a lower end thereof. The fastening device 44 preferably projects from a web 46 of the structural column 12, and may, for example, be mounted to a lower end portion of the structural column 12 via fasteners 52, such as bolts.

The fastening device 44 preferably extends from each side of the web 46 of the given structural column 12, so that it may be received at each side of the web 46 of the column 12 to which it is to be fastened. For clarity of description, the given or upper structural column 12 is referred to as a first structural column 12e, and the column 12 to which the first structural column 12e is to be fastened, or lower column, is referred to as a second structural column 12f.

The fastening device 44 comprises a first plate 48 which projects downwardly from a first side of the web 46 of the first structural column 12e, and a second plate 50 which projects downwardly from a second side of the web 46 of the first structural column 12e. The first and second plates 48, 50 are preferably secured to the first and second sides of the first structural column 12e respectively through the use of bolts. The plates may be referred to as splicing plates.

The first plate 48 comprises at least one aperture, and preferably a plurality of apertures, for receiving a fastener 52. The apertures are in a projecting portion of the first plate 48. There is a fastener 52 at an outside side of the first plate 48, and which is at or in each aperture. Here there are six such apertures and fasteners 52, arranged in three rows of two apertures and associated fasteners 52.

A first bracket 54 extends across the or each fastener 52, and there is a first biasing element 56 between the bracket 54 and the fastener 52. There are preferably three such first brackets 54, each of which extends across a row of fasteners 52. Here the fasteners 52 are bolts, and the first biasing element 56 is a spring, such as a coil spring or compression spring. The coil spring is compressed in its initial state. Upon triggering by a triggering means, the bolts 52 are propelled or fired by the springs 56 through the apertures, as shown in Figure 10.

Here, the triggering means is the removal of a plate 57 which sits in front of each of the fasteners 52, distal to the springs, and prevents the fasteners 52 from being propelled until the plate 57 is moved.

The fasteners 52 each include a hole, such as a groove 58, in a distal end portion thereof.

Referring in particular to Figures 11 and 12, the second plate 50 comprises at least one aperture, and preferably a plurality of apertures, for receiving a fastener 52. The apertures are in a projecting portion of the second plate 50. The apertures are similarly arranged as those of the first plate 48.

There is preferably a cover 60 or backer, which covers each aperture of the second plate 50. There is also a second bracket 62 which overlies, but is spaced apart from, each cover 60. Between the cover 60 and the second bracket 62 is a second biasing element 64, such as a coil spring or compression spring.

There is additionally a locking element 66 positioned above and supported by each cover 60. The locking element 66 is supported in its position by a third bracket 68.

The fastening device 44 may comprise further plates which are attached to the first structural column 12e and project from a lower end thereof. For example, there may be
5 a plate 70 which attaches to an inside surface of each flange of the construction element, and projects from a lower end thereof. As such, these further plates 70 may lie up against an upper end portion of the inside surfaces of the flanges of the second structural column 12f. The further plates may include fastener receiving apertures therethrough to allow fastening with the second structural column 12f.

10 In use, the first structural column 12e is positioned above and aligned with the second structural column 12f. The first structural column 12e is then lowered so that the projecting portions of the first and second plates 48, 50 are received either side of the second structural column 12f. The end of the first structural column 12e preferably also abuts the end of the second structural. The further plates 70 may also lie up against the
15 second structural column 12f.

The second structural column 12f has fastener-receiving apertures which have an arrangement which corresponds to those of the first and second plates 48, 50. As such, the fastener-receiving apertures of the first plate 48, second plate 50, and second structural column 12f are aligned.

20 The triggering means is then triggered by the plate 57 being displaced from the fasteners 52 so that the fasteners 52 are free to move. The plate 57 automatically moves upwards as the first structural column 12e engages with the second structural column 12f. This allows the fasteners 52 to be fired or propelled via the first biasing element 56 through the apertures in the first plate 48, the second structural column 12f, and the second plate
25 50. The plate 57 may be able to automatically move up since it may be movably mounted or slidably mounted, for example on rails or sliders. The second structural column 12f may have a pin, protrusion, or other engagement element which may engage with the plate 57 as the plate 57 descends on the first structural column 12e. This engagement stops the plate 57 from moving, and so causes the plate 57 to move relative to the second
30 structural column 12f. This thereby allows the first biasing element 56 to propel the fasteners 52 through the apertures.

The fasteners 52 push the covers 60 against the second biasing elements 64, which acts against the second biasing elements 64. Since the second biasing elements 64 are coil springs, the coil springs are compressed.

5 The covers 60 are thus moved out from underneath the locking elements 66. Each locking element 66 thusly falls into the groove 58 of the projecting portion of the associated fastener 52. The locking element 66 may bridge or extend between the fastener 52 and the third bracket 68, to hold the fastener 52 in place. The fasteners 52 are thereby locked into position, which fastens the first structural column 12e to the second structural column 12f.

10 The automatic fastening system 42 may be pre-secured to the lower end of any and/or each structural column 12 of the aforementioned construction systems 10, 110, 210 and methods to allow convenient and automatic fastening of structural columns 12. This may be with the exception of the lowermost structural column 12, which may not require such interconnection. This allows for rapid construction of the tower of columns 12.

15 It will be appreciated that the automatic fastening system could also be applied to other elements, such as beams or when a façade is being installed onto a floor section.

Referring now to Figures 13 to 17, there is shown a supporting platform 72 and associated components for supporting the construction platform 16 of the aforementioned construction systems 10, 110, 210 and methods.

20 The construction platform 16 may be supported by multiple such supporting platforms 72. Each tower of columns 12 may have an associated supporting platform 72. The supporting platforms 72 are moveable up, and preferably also down, the tower of columns 12.

25 The supporting platform 72 may support the structural elements, such as the structural framework 74, of the construction platform 16. The structural framework 74 may sit and/or be supported on an upper surface of each supporting platform 72. The supporting platform 72 may include a plurality of receivers 76 for receiving the ends of beams of the structural framework 74 of the construction platform 16. There may be two such receivers 76 positionable between the flanges and at the web 46 of the structural column 12, and
30 two such receivers 76 positionable at the outside faces of the flanges. The cable 32 may be receivable through one such receiver 76, adjacent to the end of one of the beams.

At least one supporting platform 72 is received around each tower of columns 12, and therefore has an aperture 78 for receiving the tower of columns 12 therethrough.

The supporting platform 72 is supportable by the associated tower of structural columns 12 independently of the cable 32, and therefore this represents a platform supporting
5 means for the construction platform 16 which is different to the cable raising device 26.

To be supportable by the structural column 12, preferably each structural column 12 of the tower of columns 12 has at least one lateral protrusion 14. However, it will be appreciated that not all of the columns 12 may necessarily have a lateral protrusion 14, and only a selection of the columns 12 of a tower of columns 12 may have a lateral
10 protrusion 14.

The lateral protrusion 14 has a sloped surface 80 extending upwardly and away from the column 12. At an upper surface of the lateral protrusion 14 is a seat 82. The seat 82 is preferably flat or substantially flat. The lateral protrusion 14 may therefore be a wedge or wedge shaped. The sloped surface 80 is preferably straight, and may extend to the
15 surface of the structural column 12. The lateral protrusion 14 may be mounted to the outside surface of one of the flanges of the structural column 12. There may be a co-located pair of lateral protrusions 14, each preferably mounted to the outside surfaces of the flanges of the structural column 12. The or each lateral protrusion may be able to support 500 tonnes, for example.

20 The supporting platform 72 includes at least one moveable support 84. There may be two moveable supports 84, each at an opposing side of the supporting platform 72, and therefore the column 12. The supporting platform 72 is arranged so that each moveable support 84 is at one of the sides of the structural column 12 which has the lateral protrusion 14. In other words, the moveable supports 84 and lateral protrusions 14 are
25 co-locatable.

Each moveable support 84 is moveable towards and away from the column 12. As such, as the supporting platform 72, with the construction platform 16 supported thereon, moves upwardly, the moveable support 84 may move up the sloped surface 80 and away from the column 12. Once the moveable support 84 has reached the top of the protrusion,
30 it may move back towards the column 12 so as to overlie the seat 82 of the lateral protrusion 14. As such, the moveable support 84 may sit on the seat 82 and support the building platform from the structural column 12, via the seat 82.

The moveable support 84 is preferably moveable towards and away from the column 12 via a biasing element 86, which biases the moveable support 84 towards the column 12. The biasing element 86 may be one or more springs, such as coil springs or compression springs 86. The moveable support 84 may be movable mounted via a slider arrangement
5 or similar.

As the moveable support 84 engages the sloped surface 80 and moves upwards, the sloped surface 80 causes the moveable support 84 to move away from the column 12 and so works against the biasing element 86. In this case, the coil springs are compressed. When the moveable support 84 passes the top of the sloped surface 80,
10 the biasing element 86 causes the moveable support 84 to return towards the column 12. In other words, the springs relax, returning the moveable support 84 towards the column.

Such an arrangement is shown in Figure 14 which shows the moveable support 84 approaching the lateral protrusion 14, and Figure 15, which shows the moveable support
15 84 having passed the sloped surface 80 and rebounding, to overlie the lateral protrusion 14.

It will be appreciated that the supporting platform 72 may be considered to be a part or portion of the construction platform 16.

Figures 16 and 17 show how each cable 32 may be secured to each supporting platform
20 72, and therefore how the cables 32 from the cable raising devices 26 may be secured to the construction platform 16 to support and raise the construction platform 16.

The end of the cable 32 may have a cable stopper 88 or cable connecting device attached thereto. The cable stopper 88 may have a clamp for clamping, and thereby securing, to one end portion of the cable 32. However, it will be appreciated that the
25 cable stopper 88 may have other means for securing to the cable 32. The cable stopper 88 may also have keep 90 for receiving a locking bolt 92 or locking pin from the supporting platform 72.

The cable stopper 88 may first descend to the supporting platform 72 in a condition which is rotated 90 degrees compared to that shown in Figure 16. The cable stopper 88 may
30 be received between the flanges of the structural column 12.

The cable stopper 88 may then be turned 90 degrees to the condition shown in Figure 16 by a turning means. The turning means comprises a prod 92a or shaft which is moveable from a side of the cable stopper 88 towards the cable stopper 88 to engage and push the cable stopper 88 so that it turns. A leveller 92b may then move forwards to
5 level the cable stopper 88 in the orientation of Figure 16. The cable stopper 88 may then descend beneath the turning means to an underside of the platform, as shown in Figure 17.

The supporting platform 72 may have a bolt holder, not shown, for moveably holding a locking bolt 92 or locking pin. The bolt holder is preferably secured at an underside of
10 the supporting platform 72. The bolt holder is moveable to insert the locking bolt 92 into the keep 90 of the cable stopper 88. When the locking bolt 92 is received in the keep 90 of the stopper, the cable 32 is connected to the supporting platform 72, and thus the construction platform 16 may be raised by the cable 32 via the supporting platform 72.

The bolt holder may retract the locking bolt 92 from the keep 90 to disconnect the cable
15 32 from the supporting platform 72. The cable 32 may then, for example, be free to descend or ascend, to be connected to any lower or upper supporting platforms 72 if so required. The bolt holder may move the locking bolt 92 via an actuator, such as a hydraulic actuator.

The bolt holder may be received in and supported by framework structure 94 underneath
20 the supporting platform 72.

It will be appreciated that a similar or identical arrangement may be used to secure cables 32 to building-storey construction platform 116.

It will be appreciated that other means for securing the cable 32 to the construction platform 16 or building-storey construction platform 116 may be considered, such as the
25 use of a strand jack.

Referring now to Figures 18 and 19, there is shown a fourth embodiment of a construction system 310. In the fourth embodiment, a construction platform is supported relative to a building portion 36, in particular to a building core 36. This may be of particular use when raising the building-storey construction platform 116, having
30 constructed the building core 36.

The building-storey construction platform 116 may be constructed around the building core 36 as previously described. The building-storey construction platform 116 is at or adjacent to the building core 36.

5 The core 36 of the building may have a plurality of lateral protrusions 14 which are similar or identical to those previously described with reference to the columns 12. There is preferably at least one set of lateral protrusions 14 which are each mounted to the building core 36 at a given elevation. There are preferably a plurality of such sets, each having a different elevation so that each set is spaced apart from each other along the height of the core 36. Each protrusion 14 of a set may align with a protrusion 14 of
10 another set.

The building-storey construction platform 116 may have a plurality of moveable supports 184 mounted to an underside thereof. The moveable supports may be housed in a housing 96. The moveable supports 184 are preferably similar or identical to those previously described with reference to the supporting platform 72. As such, the moveable
15 supports 184 are moveable towards and away from the building core. The moveable supports 184 are biased towards the building core 36 via biasing means 186.

Each moveable support 184 of the building-storey construction platform 116 is preferably engageable with one lateral protrusion 14 of each set of lateral protrusions 14. As such, the moveable supports 184 of the building-storey construction platform 116 may be
20 moveable up the sloped surface 80 of a respective lateral protrusion 14, and may be seated on the seat 82 of said lateral protrusion 14.

This allows for the building-storey construction platform 116 to be supported from the building at various points during its ascent.

It will be appreciated that alternatives, or additions, to the disclosed platform supporting
25 means may be considered. For example, instead of, or in addition to, lateral protrusions and a moveable support, a lock and pin system may be considered. In such a case, the supporting platform may have a pin and the building portion, such as a column or core, may have a lock or receiver. The pin may be removably receivable in the lock. The supporting platform may be supportable from the building portion when the pin is
30 received in the lock or receiver. It will be appreciated that, alternatively, the supporting platform may have the pin, and the supporting platform may have the lock or receiver.

It will be appreciated that the systems, methods and devices described herein may be used, and adjusted if necessary, to build structures other than high-rise buildings. This includes temporary structures, such as stages for music festivals.

It is therefore possible to provide a construction system and method, particularly for
5 constructing high-rise buildings. A construction platform can be hung from the tops of towers of columns via cables secured to a cable raising device mounted to the top of each tower. The construction platform can be raised via the cable raising devices to allow for a building to be constructed around the towers of columns. The construction platform can then be supported directly from the columns to allow the cable raising device to be
10 dismantled and new columns to be attached to the top of the towers. The cable raising devices can be remounted to allow for the construction platform to be raised further.

Such a system can be used to raise building storeys. As such, a building core can first be constructed, before towers of columns are used to raise a building storey construction platform. The towers of columns ascend in a similar way, allowing for the ascent of the
15 building storey construction platform. The building storey construction platform can then be used to winch or otherwise raise at least partially completed building storeys.

It is also possible to provide an automatic fastening system comprising a firing means for firing fasteners to connect structural columns, and a locking means to lock the fasteners in position.

20 It is further possible to provide a system and method for raising a construction platform using a building core. The construction platform installs columns as it ascends to provide support for the construction platform.

It is additionally possible to provide a system and method for supporting a construction platform relative to a building core. The building core has at least one lateral protrusion
25 having a sloped surface and a seat at the top of the sloped surface. The construction platform has a moveable support which can track up the sloped surface, before seating on the seat so as to support the construction platform with the building core.

The words 'comprises/comprising' and the words 'having/including' when used herein with reference to the present invention are used to specify the presence of stated
30 features, integers, steps or components, but do not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention which are, for brevity, described in the context of a single embodiment, may also be provided separately or in
5 any suitable sub-combination.

The embodiments described above are provided by way of examples only, and various other modifications will be apparent to persons skilled in the field without departing from the scope of the invention as defined herein.

Claims

1. A construction method comprising:
 - a) providing at least one first structural column secured relative to the ground;
 - b) mounting a cable raising device to the first structural column;
 - 5 c) supporting a construction platform from the cable raising device via a cable;
 - d) elevating the construction platform via raising the cable with the cable raising device;
 - e) supporting the construction platform with the first structural column or a supporting structural column under the first structural column via a platform supporting means which is different to the cable raising device;
 - 10 f) dismounting the cable raising device from the first structural column and securing a second structural column above the first structural column;
 - g) mounting the cable raising device to the second structural column; and
 - h) supporting the construction platform from the cable raising device via the cable.
- 15
2. A construction method as claimed in claim 1, wherein the cable raising device is a strand jack.
- 20
3. A construction method as claimed in claim 1 or claim 2, wherein the platform supporting means comprises a lateral protrusion on said first structural column or the supporting structural column under the first structural column, and a moveable support for supporting the construction platform on the lateral protrusion.
- 25
4. A construction method as claimed in claim 3, wherein the lateral protrusion has a sloped surface extending upwardly and away from said column and a seat at an upper surface thereof, the moveable support being biased towards said column so that, as the construction platform moves upwardly, the moveable support moves along the sloped surface before seating on the seat.
- 30
5. A construction method as claimed in claim 4, wherein the lateral protrusion comprises a wedge.
- 35
6. A construction method as claimed in claim 4 or claim 5, wherein the moveable support is biased by at least one spring.

7. A construction method as claimed in claim 3, wherein the method constructs a core of a building or a temporary structure.
- 5 8. A self-climbing construction system for a method of any one of the preceding claims, the system comprising:
- at least one first structural column and at least one second structural column securable above the first structural column;
 - 10 a cable raising device mountable to the first structural column and to the second structural column;
 - a construction platform;
 - a cable configured to be raised by the cable raising device and to support the construction platform; and
 - 15 a platform supporting means which is different to the cable raising device and which is configured to support the construction platform from the first structural column or the supporting structural column under the first structural column
9. A construction method comprising:
- 20 a) providing at least one first structural column secured relative to the ground;
 - b) mounting a cable raising device to the first structural column;
 - c) supporting a construction platform from the cable raising device via a cable;
 - d) elevating the construction platform via raising the cable with the cable raising device;
 - 25 e) supporting the construction platform with the first structural column or a structural column under the first structural column via a platform supporting means which is different to the cable raising device;
 - f) dismounting the cable raising device from the first structural column and securing a second structural column above the first structural column;
 - 30 g) mounting the cable raising device to the second structural column; and
 - h) providing at least one building storey at or adjacent to the ground, and raising said building storey from the construction platform using the or another cable raising device.
- 35 10. A method as claimed in claim 9, wherein said raising of the building storey comprises winching the building storey from the construction platform.

11. A construction system for the method of claim 9 or claim 10, the system comprising:
- at least one first structural column and at least one second structural column securable above the first structural column;
 - a cable raising device mountable to the first structural column and the second structural column;
 - a construction platform;
 - a cable configured to be raised by the cable raising device and to support the construction platform;
 - a platform supporting means which is different to the cable raising device and which is configured to support the construction platform from the first structural column or a structural column under the first structural column;
 - at least one building storey; and
 - a raising means for raising the building storey from the construction platform.
12. An automatic fastening system for automatically fastening a first construction element to a second construction element, the automatic fastening system comprising:
- a fastener propelling means for propelling at least one fastener for fastening the first construction element to the second construction element;
 - a trigger means for triggering the fastener propelling means to propel said at least one fastener;
 - a first support means for supporting the fastener propelling means from a first side of at least one of the first construction element and the second construction element;
 - a fastener locking means for locking said fastener; and
 - a second support means for supporting the fastener locking means from a second side of at least one of the first construction element and the second construction element;
- the system configured so that, when the trigger means is triggered, the fastener propelling means propels said fastener from said first side and the fastener locking means locks said fastener at said second side to automatically fasten the first construction element to the second construction element.

13. An automatic fastening system as claimed in claim 12, further comprising the first construction element and the second construction element, the fastener propelling means supported from the first side of at least one of the first construction element and the second construction element via the first support means, and the fastener locking means supported from the second side of at least one of the first construction element and the second construction element via the second support means.
14. An automatic fastening system as claimed in claim 13, wherein the first construction element and the second construction element are structural columns.
15. An automatic fastening system as claimed in any one of claims 12 to 14, wherein the fastener propelling means comprises at least one spring positioned at the first support means and for being positioned at a fastener so that the spring is between the first support means and the fastener.
16. An automatic fastening system as claimed in any one of claims 12 to 15, wherein the fastener locking means comprises a moveable locking element for being received in a hole of a portion of the fastener which protrudes from the second side, the second support means configured to hold the locking element.
17. An automatic fastening system as claimed in any one of claims 16, wherein the moveable locking element is configured to be in an unlocked position and a locked position, the moveable locking element being supported by a moveable support in the unlocked position, the moveable support being moveable by the fastener so as to allow the moveable locking element to move to the locked position.
18. An automatic fastening system as claimed in any one of claims 17, wherein the moveable support is biased to support the moveable locking element via a biasing means.
19. A construction method comprising:
- a) providing a support and mounting a cable raising device to the support;

- b) providing a construction platform, and supporting the construction platform from the support via a cable secured to the cable raising device;
- c) raising the construction platform via raising the cable with the cable raising device;
- 5 d) installing at least one first structural column;
- e) further raising the construction platform via raising the cable with the cable raising device; and
- f) installing at least one second structural column supported by and above the first structural column, the second structural column being installed from the construction platform.
- 10
20. A construction method as claimed in claim 19, wherein the cable raising device comprises at least one winch.
- 15
21. A construction method as claimed in claim 19 or claim 20, wherein the support is a core of a building.
22. A construction method as claimed in any one of claims 19 to 21, further comprising a platform supporting means for supporting the construction platform from the first structural column or a structural column under the first structural column, the platform supporting means being different to the cable raising device.
- 20
23. A system for supporting a construction platform relative to a building portion, the system comprising:
- 25 a building portion having at least one lateral protrusion including a sloped surface extending upwardly and away from the support, and a seat at an upper surface thereof;
- a construction platform; and
- a moveable support for supporting the construction platform on the lateral protrusion, the moveable support being biased towards the building portion so that, as the construction platform moves upwardly, the moveable support moves along the sloped surface before seating on the seat.
- 30
24. A system as claimed in claim 23, wherein the building portion is a core of the building or a column of the building.
- 35

25. A supporting platform for supporting a construction platform relative to a building portion having at least one lateral protrusion including a sloped surface extending upwardly and away from the support and a seat at an upper surface thereof, the supporting platform comprising:

- 5 a moveable support for supporting the construction platform on the lateral protrusion, the moveable support being biased towards the building portion so that, as the construction platform moves upwardly, the moveable support moves along the sloped surface before seating on the seat.