

## METHODS AND SYSTEMS OF INSTALLING MECHANICAL AND ELECTRICAL MODULAR ASSEMBLY UNITS IN BUILDINGS

### FIELD OF INVENTION

[001] The present invention concerns modular multi mechanical and electrical (M&E) services, methods of installing such modular assembly units in buildings and subject matter ancillary thereto and use of coordinated lifting machines to lift connected modular multi mechanical and electrical services units within a building site.

### BACKGROUND OF THE INVENTION

[002] Mechanical and electrical (M&E) systems act as vital organs to a commercial building, providing power, heating, ventilation and air conditioning, fire protection, water and drainage and other important elements that keep the commercial building such as a hospital, data center or factory running efficiently and safely.

[003] It is known practice in the building industry to erect feed lines in the ceiling of buildings for supply of mechanical and electrical systems to various parts of the building facility. Traditionally these lines are laid successively by different tradesmen which can result in inefficient use of space. Improvements to the traditional method of erecting feed lines have since been introduced. In particular, modular building construction methods reduce on-site labour cost and shorten on-site building construction time for the installation of M&E services.

[004] Although various improvements have since been made in respect of the M&E service modular assembly units, limited improvements have been introduced to the assembly and installation methods of such units. Such units are still being lifted to the soffit using chain blocks. This requires an initial step of installing chain blocks at every lifting point. Another problem with such lifting method is that the installed chain block occupies a certain amount of ceiling space and the M&E service modular assembly units cannot be lifted above the lowest most point of the chain block. This results in a 'dead space' in the ceiling after the M&E service modular assembly units has been installed and correspondingly a reduction in head room space. Clearance height below 2.4m (8 ft) can create discomfort to building occupants.

[005] Because chain blocks are independently controlled, each modular assembly unit is separately lifted up and installed to the soffit. This is relatively unsophisticated lifting and

installation method thus requires adjoining modular assembly units to be coupled after they have been installed to the soffit. Using such methods, work men are required to work at elevated height to couple the modular assembly units. This presents a safety risk to the work men and also requires repeated use of man lifts such as scissor lifts to facilitate the work men's duties. There is also a limited area of movement when the work men are on a man lift. More time and effort will be required to complete the coupling modular assembly units as compared to working at ground level where movement is less restricted. Inspecting the quality of the coupling also requires significant effort and entails risks due to the elevation of the modular assembly units.

[006] M&E service lines erected along common corridors supplies M&E services to individual rooms of a building or for example to an array of factory machines. These service lines typically extend horizontally over a considerable distance. For greater efficiency, the length of a modular assembly unit for such M&E services is designed to be up to 6m for convenient transport by standard transportation vehicles. Depending on the size and the number of services assembled in the modular assembly unit, each unit can weigh over 1,000kg. Installation methods of such modules are limited due to the size and weight of each module and restrictive passage of the corridor.

[007] It can thus be seen that there exists a need for a safe and efficient method of installation of M&E service modular assembly units along common corridors. Desirably, the method reduces the time required for work men to work at elevated height, maximises the head room space available after installation, reduces the number of lifts required to bring all the modular assembly units along the corridor to installation height, reduces the total time to install the entire length of adjoining modular assembly units which should lead to an improvement in the quality of coupling connections between adjoining modular assembly units.

#### SUMMARY OF THE INVENTION

[008] The following presents a simplified summary to provide a basic understanding of the present invention.

[009] In the present invention, a method of connecting and installing mechanical and electrical (M&E) service modular assembly units is disclosed. The use of coordinated lifting

machines, optionally with lifting tables to simultaneously lift a section of coupled modular assembly units is also described.

[0010] The method comprises the steps of:

Fabricating a plurality of adjoining M&E service modular assembly units at a fabrication site, each assembly unit comprising a selection of mechanical and electrical service lines housed in a supporting frame;

Transporting the plurality of M&E service modular assembly units to an installation site;

Coupling the M&E service modular assembly units by connecting the supporting frames and service lines of adjoining M&E service modular assembly units at a level assessable to the work men working at the floor level of the installation site;

Lifting the coupled M&E service modular assembly units together to an elevation required for installation; and

Installing and securing the coupled M&E service modular assembly units to the building.

[0011] Since the connecting of the supporting frames and services lines are performed at a level assessable to the work men working at the floor level of the installation site, such method advantageously allows for more freedom of movement, reduces the time required for work men to work at elevated height which translates to higher quality of work, productivity and reduction in risk to the work men. Inspection of the quality of the connection can also be easily performed. Lifting of the coupled units is performed only once on-site as compared to multiple lifts that have to be made, one for each M&E modular assembly unit based on current practice.

[0012] Prior to transporting the plurality of M&E service modular assembly units to the installation site, a trial coupling of the modular assembly units may be performed at the fabrication site to check and rectify alignment and other issues.

[0013] The modular assembly units are rested on a series of lifting machines placed on the floor of the installation site, the lifting machines are centrally controlled to lift the modular assembly units after they have been coupled, in synchrony to the required level for installation to the building. By lifting the coupled modular assembly units in synchrony, no strain is exerted on the

connections between the adjoining units thus preserving the quality of the connections. Such lifting method also avoids the 'dead space' that comes with the use of chain blocks.

[0014] In another aspect of the invention, the modular assembly units are rested on and secured to support tables before the modular assembly units are coupled. The tables allow the work men at the floor level of the installation site to connect the supporting frames and services lines at ergonomic height (approximately 1.2m above floor level). By using such support tables, readily available hydraulic lifting machines that are not designed to directly lift objects to ceiling height, such as car hydraulic lifts may be used to lift the modular assembly units.

[0015] The connected assembly units and support tables are lifted together by a series of lifting machines that are coordinated to lift loads in synchrony.

[0016] In another aspect of the invention, the support tables are adapted to raising its table surface to installation height for the connected modular assembly units.

[0017] After installing the connected modular assembly units to the building, the support tables are disengaged with the modular assembly units and lowered back to floor level to receive further batches of M&E service modular assembly units.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0018] This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

[0019] FIG. 1 is a perspective view of a M&E service modular assembly unit installed to a building soffit.

[0020] FIG. 2 is a plan view of a commercial building showing all planned M&E service lines.

[0021] FIG. 2 is a set of drawings showing the main steps of connecting and installing a series of adjoining M&E service modular assembly units.

[0022] FIG. 4 illustrates a method of connecting and installing a series of adjoining M&E service modular assembly units in a building.

[0023] FIG. 5 illustrates another method of connecting and installing a series of adjoining M&E service modular assembly units in a building.

## DETAILED DESCRIPTION

[0024] One or more specific and alternative embodiments of the present invention will now be described with reference to the attached drawings. It shall be apparent to one skilled in the art, however, that this invention may be practiced without such specific details. Some of the details may not be described at length so as not to obscure the invention. For ease of reference, common reference numerals or series of numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0025] FIG 1 is perspective view of a standard M&E service modular assembly unit **100** of dimensions 6000mm:L x 3000mm:W x 3000mm:H designed to be installed below the soffit **10** of a building. M&E services such as water pipes, dry riser pipes, electric and telecommunication cables and cable trays are segregated in three separate levels and supported by a steel frame **30**. The modular assembly unit is installed below the soffit by connecting the supporting frame **30** to hanger rods **20** that have been pre-installed to the soffit. The space between the soffit **10** and the services located on the upper level of the modular assembly unit is a 'dead space' which ideally is minimised for maximum head room space. Depending on the dimensions and number of services housed in the unit, the weight of one modular assembly unit may be more than 1,000kg.

[0026] FIG 2 is a plan view of a commercial building with complicated M&E service lines. A main M&E service line can be seen running horizontally across the center part of the building with two major straight sections, the first section of the corridor is 16m length and the second is 16m length. Based on the dimensions of the M&E service modular assembly unit as described in FIG 1, 3 modular M&E service assembly units are needed to form the M&E service line for the first corridor section and 3 units are required for the second section.

[0027] Presently, M&E service providers will install each module individually and couple the installed modules at soffit level. The lifting of each modular assembly units is achieved by the use of chain blocks.

[0028] Referring to FIGs 3 and 4, a new method of installation is presented. By analysing the plan view of a building, sections of the building suitable for installing M&E service lines according to the present invention are identified. Typically, corridors or any other sections where M&E services extend over significant distance can benefit from use of the present method.

[0029] Based on the length of an identified section of the building, the number of M&E service modular assembly units needed are determined and fabricated off-site at a fabrication site. To check for proper alignment and other connection issues, a trial coupling of the modular assembly units is performed at the fabrication site. After uncoupling of the units, they are individually transported by conventional transport vehicles to the construction site.

[0030] As shown in FIG 3, a series of lifting machines **50** are strategically arranged along both sides of a corridor directly below the installation point of the construction site, defining a space for receiving the modular assembly units **100**. The modular assembly units **100** are arranged in order, positioned in the defined space and coupled together at floor level. Thereafter, the lifting machines are activated to lift the coupled modular assembly units **100** in synchrony to the necessary height to be installed to the soffit.

[0031] Due to the size and weight of the coupled modular assembly units, a number of the lifting machines **50** are used at the same time to lift the coupled modular assembly units. Ideally at least a pair of lifting machines are used to lift each modular assembly unit as shown in FIG 3. The lifting machines **50** are centrally controlled to ensure simultaneous lifting across all lifting machines. Lifting machines **50** may be hydraulic lifts such as commonly available mobile column lifts.

[0032] If the maximum reach of the lifting machine **50** is insufficient to raise the coupled modular assembly units to a level suitable for installation to the soffit, the lifting machine **50** may still be used in combination with support tables to bridge the height difference. Referring to FIG 5, after the modular assembly units have been delivered to the installation site, each unit is placed on and secured to a support table. The support table may have wheels so that the modular assembly unit can be wheeled from the building access point to the actual installation location. For example, if the soffit is 4m from the floor, the height of a modular assembly unit is 2m and the maximum lifting height of the lifting machine **50** is 1.7m, a support table of 1.2m can be used. Since the modular assembly units are rested on the tables, coupling of the units is performed at ergonomic height.

[0033] The support tables and coupled modular assembly units are lifted together by the series of lifting machines **50** to the necessary height for fixing to the soffit. This method advantageously allows the user to make use of commercially available lifting machines such as

car hydraulic lifts e.g. Redline's two post automotive lift MODEL: TLT-240SB to lift the coupled modules.

[0034] Optionally, the height of the support table may be adjustable. Lifting of the coupled modular assembly units is thus simply achieved by the support tables, without use of lifting machines **50**. The modular assembly units are first individually placed on the support tables by use of cranes or manual lifting device and arranged in order for coupling. After coupling, the height of the support tables is raised simultaneously to lift the coupled modular assembly units to the height required for installation to the soffit. The support tables may be centrally controlled to ensure simultaneous lifting across all tables.

[0035] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the present invention. For example, the invention may also be performed on modular assembly units that are smaller and lighter. The coupled modular assembly units may not necessary form a straight line.

## CLAIMS

1. A method of connecting and installing a plurality of mechanical and electrical (M&E) service modular assembly units to a building comprising the steps:

fabricating a plurality of adjoining M&E service modular assembly units at a fabrication site, the assembly unit comprising a selection of mechanical and electrical service lines housed in a supporting frame;

transporting the plurality of M&E service modular assembly units to an installation site;

coupling the M&E service modular assembly units by connecting the supporting frames and service lines of adjoining M&E service modular assembly units at a level assessable to the work men working at the floor level of the installation site;

lifting the coupled M&E service modular assembly units together to an elevation required for installation; and

installing and securing the coupled M&E service modular assembly units to the building.

2. The method of claim 1, whereby the coupling of the M&E service modular assembly units is performed at the floor level of the installation site.
3. The method of claim 1 or 2, whereby lifting machines are used to lift the coupled M&E service modular assembly units.
4. The method of claim 3, whereby the lifting machines are hydraulic lifts.
5. The method of claim 3 or 4, whereby the lifting machines are centrally controlled for synchronised lifting of the coupled M&E service modular assembly units.
6. A method of connecting and installing a plurality of mechanical and electrical (M&E) service modular assembly units to a building comprising the steps:

fabricating a plurality of adjoining M&E service modular assembly units at a fabrication site, the assembly unit comprising a selection of mechanical and electrical service lines housed in a supporting frame;

transporting the plurality of M&E service modular assembly units to an installation site;

resting and securing the M&E service modular units on support tables;

coupling the M&E service modular assembly units by connecting the supporting frames and service lines of adjoining M&E service modular assembly units at a level assessable to the work men working at the floor level of the installation site;

lifting the coupled M&E service modular assembly units and the support tables together to an elevation required for installation; and

installing and securing the coupled M&E service modular assembly units to the building.

7. The method of claim 6, whereby lifting machines are used to lift the coupled M&E service modular assembly units and the support tables together.
8. The method of claim 7, whereby the lifting machines are selected from a range of lifting machines with maximum lifting height less than the height required to lift the coupled modular units to a level suitable for installation.
9. The method of claim 7 or 8, whereby the lifting machines are hydraulic lifts.
10. The method according to claims 7-9, whereby the lifting machines are centrally controlled for synchronised lifting of the coupled M&E service modular assembly units and the support tables together.
11. A centrally controlled system of lifting machines for performing methods of claim 1-10.