

METHOD AND SYSTEM OF CONSTRUCTION OF INTER TERRACE HOUSING

FIELD OF THE INVENTION

The invention relates to a method and system of construction of an Inter Terrace Housing using a new hoisting system to install customised Pre Cast Beams and Columns, Pre Cast Walls and Floors and other Pre Cast pieces and Prefabricated Prefinished Volumetric Construction Modules to build the Inter Terrace Housing.

BACKGROUND OF THE INVENTION

Since land is scarce in Singapore, many developers and house owners would take over an existing house such as inter terrace house (alternatively referred to as "Inter Terrace") and re-build it, creating more living space for the home owner. Whenever there is a requirement for Alteration and Addition or a complete demolition and re-development of a inter terrace house, developers face some constraints due to the existence of adjoining terrace houses, which may not be demolished and are still occupied and in use. These constraints faced by developers and construction companies include limited manoeuvrability of construction equipment needed for the re-construction project due to tight open spaces, noise pollution, environmental concerns and traffic obstruction to road users due to movement of construction machinery and equipment, to re-build the Inter Terrace, which due to the said constraints have to be carried out manually.

Since one inter terrace property is involved, most developers would rely heavily on workers to carry out a "piece meal" construction and would also be heavily reliant on manual labour method to demolish and then re-construct the inter terrace house, in accordance to the architect's plans. Since the Alteration and Addition works of an Inter terrace are carried out next to houses which are occupied, it is also difficult and also not practical to use heavy machinery or cranes due to tight space constraints and complaints of noise and environmental pollution. Therefore, such Alteration and Addition works for an Inter Terrace property usually take a long time. These constraints would result in delays, resulting on long construction time and therefore have to be factored into the project costs of an Alteration and Addition or re-development of an inter-terrace house. Since land costs are high, the Alteration and Addition costs for an Inter Terrace house would contribute another significant amount to the total costs of purchase of an Inter Terrace house.

The supply of such inter terrace houses in land-scarce Singapore is also relatively high. The

Singaporean dream is therefore owning a piece of landed property in the form of an inter-terrace house as these are still affordable by many Singaporeans. However, even though the purchase costs of inter terrace house is a significant sum, purchasers of such inter terrace houses would also have to spend another significant sum on Alteration and Addition. The purchaser may also wish to make Alterations and Additions or even demolish the present house structure and re-build the inter terrace to meet the family's use requirements. The costs of Alteration and Addition would add on to the costs of such purchases, thus pushing the costs of owning an inter-terrace house up.

Construction costs in Singapore is the 2nd highest in the world, after Tokyo, according to a Report by Turner & Townsend CBRE Research August 2022. While property prices are based on a number of factors such as supply and demand, the country's economic situation as well as global economic conditions, it would be good if the costs of Alteration and Addition could be controlled and even lowered, through innovation.

DISCUSSION OF PRIOR ART

The prior art discussion given herein is to provide an overview of methods of house construction.

While the problems faced in Singapore are quite unique, there have been patent applications for inventions covering house construction methods. However, these prior patent applications are not concerned over the unique problems of Alteration and Addition to an Inter Terrace or Demolition of an existing Inter Terrace and re-construction of a new Inter Terrace in the same site as faced in Singapore.

CN211114091 for an invention entitled "NOVEL PREFABRICATED ASSEMBLY TYPE STEEL STRUCTURE HOUSE CONSTRUCTION SYSTEM" describes prefabricated assembly type steel structure house construction system. The house building system comprises a house building system main body, assembled prefabricated plates, an adjustable ceiling frame and an interior wall, an assembled prefabricated plate which is fixed to the top end of the house construction system body.

KR1018958030000 for an Invention entitled "HOUSE CONSTRUCTION METHOD" describes a house construction method, comprising: a step of constructing a base floor; a step of installing a wall panel on the base floor; a step of installing a flat deck between floors and an upper end of the wall panel; and a step of casting concrete in a connection part between the

wall panels and the flat deck, wherein concrete is simultaneously casted in each of a joint portion of the wall panel and the flat deck so as to simultaneously build a wall, a slab, and a roof of a house. Therefore, construction of an additional mould is not required such that construction cost can be reduced and waste caused by the construction can be suppressed, thereby providing an environmentally friendly construction method. In addition, a process of the house construction method is simple such that construction period and manpower can be reduced, and worksite accidents can be prevented.

JP2005105537 for an invention entitled "HOUSE CONSTRUCTION METHOD" describes a house construction method for a house module made transportable by a ship, having flexibility in combination as a dividing unit of a house, in particular, enabling setting of a total floor area corresponding to Japanese housing condition and preventing or prohibiting positional deviation of wall panels to be attached to respective modules.

WO2006095266 for an Invention for "METHOD OF CONSTRUCTING STRUCTURES USING PREFABRICATED MATERIALS" describes a method of constructing insulated structures using prefabricated building materials using panels made of insulated material such as polyurethane or polyisocyanurate that is sandwiched between two sheets of fibre boards. The method including the steps of lining a base flooring with a channel attached thereon for defining a floor outline, inserting a prefabricated corner panel vertically into the channel at a corner of the floor outline, and placing an insulated body panel with its bottom end inserted into the channel and its side end attached to the corresponding side of the corner panel by using the tongue and groove coupling. Further panels in likewise manner are added to form an outer wall for the building. A roofing panel is attached to the top ends of the panels for covering the top of the outer wall.

None of the prior innovations may be used or practised in Singapore singly or in combination and none of the prior innovations could be adapted to re-construct Inter Terrace house in Singapore.

PROBLEM TO BE SOLVED

Currently any Alternation and Addition or even demolition and re-construction of a house in any landed property is carried out in a "piece meal" method with much reliance on manual labour since the works on an Inter terrace are carried out next to houses which are occupied. It is also not practical to use heavy machinery or cranes due to tight space constraints and complaints of noise and environmental pollution. Since land costs are high, the Alteration and

Addition costs for an Inter Terrace house would contribute another significant amount to the total costs of purchase of an Inter Terrace house.

5 The inventor has realised that the unique method of prefabrication of housing modular structures as practised in construction of modern apartments using prefabricated modular structures may be modified and used for re-building the housing structure of an inter terrace house. While the use of such prefabricated modular structures is known, the problem of fast installation of such prefabricated modular structures would be defeated if each piece has to be lifted and then fitted to form the designed housing structure. A computerised system of
10 identifying an unique module, locating its precise location for installation and moving and installing said module in the unique location and in a correct sequence would be advantageous. Also, there is the constraint of tight working spaces in Alteration and Additions to an Inter Terrace Housing structure since such properties are in between other housing units which are inhabited. In order to overcome the constraints in bringing cranes to lift such
15 prefabricated modular structures, and operating such cranes in tight spaces and ever mindful to ensure there is no traffic obstruction nor noise pollution, the inventor has proposed a method and system of building a housing structure using customised pre cast beams and pre cast columns and other pre cast pieces to build a Super Structure which can then allow a lifting device to be temporarily installed to pick, move and install these customized Pre Cast pieces
20 and prefabricated customised modules to build a house structure.

As for the problem of picking, moving and installing such heavy Pre Cast pieces and modular pre fabricated prefinished volumetric construction modules, the inventor has proposed
25 installation of a temporary lifting system on a super structure, said lifting device movable along rails at the top level to pick and install these modules at their designated locations in a sequenced manner.

30 Use of a temporary on-site lifting device which is movable along the length of the site of the inter terrace housing structure and installing these Pre Cast pieces and Pre fabricated customised modules in a predetermined sequence, would not only result in the building of the entire inter terrace structure speedily but with less congestion and obstruction to the residents in the vicinity.

35 The invention could be implemented for the Alteration and Addition of Inter Terrace house and even to demolition and re-construction of a new Inter Terrace. Time could be saved and noise and dust pollution avoided if most of the parts for the construction of an Inter Terrace housing structure could be made off-site. Furthermore, if these parts are made as modular Pre cast

pieces, these may be further designed to fit into each other, creating strength and rigidity for the entire housing structure. Consequently, the entire re-built inter terrace house would not only be built faster and higher than the adjacent inter terrace units but at a lower cost.

5 The use of the inventive method and system to construct an Inter Terrace housing structure offers these advantages:-

10 ■ Installation of a Super Structure of a vertical matrix of customized Pre Cast Beams and Columns which would allow a lifting device to be installed on rails on top of the beams, thus allowing programmed and sequenced construction of the Inter Terrace, ensuring completion of the Alteration and Addition in a faster yet safer manner.

15 ■ Use of Pre Cast Modules and Prefabricated Prefinished Volumetric Construction modules would ensure the housing structure is completed faster thus enabling interior works to be carried out sooner.

20 ■ Use of a lifting system using a programmed sequence to pick up a designated prefabricated module and customized precast piece, move the item to a designated position in a back to front and bottom to top sequence would ensure the housing structure of an Inter Terrace is efficiently carried out and speedily completed.

25 ■ Completion of the Alteration and Addition or Construction of a new Inter Terrace house could be achieved in a shorter time and with less noise pollution and inconvenience to adjacent and neighbouring homeowners.

SUMMARY OF INVENTION

A 1st object of the invention is a method of constructing an inter terrace house on a land located between two terrace houses comprising the steps of:

- 30 (i) clearing the land to form a site in which the terrace house having a front end and a back end is to be built;
- (ii) computing dimensions and construction requirements of the inter terrace house for prefabrication of customized pieces of Pre Cast beams, columns and other Pre Cast pieces and Pre Fabricated Prefinished Volumetric Construction (PPVC) modules;
- 35 (iii) assigning each customized Pre Cast piece and PPVC module an unique identifier and a designated location for installation in the inter terrace house;

(iv) installing a super structure with lengths to hold a lifting device on each length of the super structure; wherein the lifting device is moveable along the length of the super structure; and wherein the lifting device picks the customized Pre Cast piece and PPVC module in a sequenced manner to construct the inter terrace house.

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A 2nd object of the invention is a method of constructing an inter terrace house on a land located between two terrace houses comprising the steps of:

- (i) clearing the land to form a site in which the terrace house is to be built;
- (ii) installing Pre Cast Beams and Pre Cast Columns along each length of the inter terrace
10 house to form a super-structure;
- (iii) installing a track having a length on the Pre Cast Columns along each length of the super structure;
- (iv) assembling and installing a lifting device moveable along the length of the track;
- (v) programming the lifting device to identify, pick up, move a designated customized Pre
15 Cast piece or a PPVC module according to a programmed sequence being installed at a designated location thereof;
- (vi) picking up and installing each customized Pre Cast piece and the PPVC module in accordance with the programmed sequence, from one end of the land to another end of the land, and from one level upwards to another level, until both levels are completed; and
- 20 (vii) repeating step (vi) until the structure of the inter terrace house is completed.

Preferably the customized Pre Cast pieces and PPVC modules being employed are based on detailed requirements thereof, including the weight of the inter terrace house, designated location of installation, sequence of installation which are individually programmed for
25 fabrication, pick up by the lifting device and installation at the designated location thereof.

Preferably the construction is programmed and sequenced beginning from a 1st level and from the back end of the inter terrace house.

30 Preferably the customized Pre Cast pieces and PPVC module are planned and manufactured based on the planned dimensions of the inter terrace, and each customized Pre Cast piece and PPVC module is assigned an unique identifier and the specific designated location in the inter terrace being constructed.

35 Preferably each customized Pre Cast piece and PPVC module are identified by the unique identifier thereof, picked up from place of manufacture, transported to the site and placed in a specific designated location in the inter terrace being constructed.

Preferably a lifting device is installed on guide rails placed along the length of the Pre Cast beams of the super structure, and are movable along said guide rails.

- 5 Preferably the lifting device is equipped with cameras and sensors for remote operation of identifying, picking each customized Pre Cast piece or PPVC module, and moving the picked up piece to the designated location thereof, in accordance to a programmed sequence for construction and installation.
- 10 Preferably after completion of the installation of all the customized Pre Cast pieces and PPVC modules, the lifting device is dismantled and the guide rails are removed.

A 3rd object of the invention is a system of constructing an inter terrace house on a site, wherein the system computes the dimensions and construction requirements and building programme
15 for the construction of an inter terrace,

said construction requirements then further work out into a plurality of customized Pre Cast pieces, including Pre Cast Beams, Pre Cast Columns, Pre Cast Walls, Pre Cast Floors and Pre fabricated Prefinished Volumetric Construction ("PPVC") modules and each Pre
20 Cast piece and PPVC module is assigned an unique identifier and a designated installation location;

said customized Pre Cast pieces and PPVC modules are being made and delivered to the site of the inter terrace house being constructed, in accordance to a building programme;
25 and

said customized Pre Cast pieces and PPVC modules are identified by a lifting device, picked up and installed in a designated installation location in accordance to a building programme;
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wherein the customized Pre Cast pieces and PPVC modules are installed in a sequence starting from a first level upwards and from the back of the site, until all the customized Pre Cast pieces are installed in the designated installation location thereof, creating a structure of the inter terrace house.
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Preferably the dimensions and construction requirements of the inter terrace are computed for the prefabrication of customized Pre Cast beams, columns, Pre Cast Walls and Pre Cast floors and Pre fabricated Prefinished Volumetric Construction ("PPVC") modules, each customized Pre Cast Beam and Pre Cast Column, Pre Cast Wall and Pre Cast Floor and

PPVC Module assigned an unique identifier and a programmed designated location for its installation in the inter terrace, said system comprising the following:-

a Super Structure of customized Pre Cast Beams and Pre Cast Columns along each length
5 of the inter terrace;

a track on the customized Pre Cast Beams along the length of the super structure;

a lifting device movable along said track;

a plurality of customized Pre Cast Walls, Pre Cast Floors, Pre Cast Columns and Pre Cast
10 Beams and PPVC modules;

each customized Pre Cast Column, Pre Cast Beam, Pre Cast Wall and Pre Cast Floor and
15 PPVC module is prefabricated according to the computed dimensions and construction requirements of the inter terrace;

each customized Pre Cast Column, Pre Cast Beam, Pre Cast Wall and Pre Cast Floor and
PPVC module transported to the site and picked up by the lifting device according to a
20 programmed sequence based on the assigned unique identifier and designated location in the inter terrace; and

each customized Pre Cast Column and Pre Cast Beam, Pre Cast Floor and Pre Cast Wall and
PPVC module installed in its programmed designated location;

wherein the system works out the quantities of pieces of customized Pre Cast Beams, Pre
Cast Columns, Pre Cast Floor, Pre Cast Wall and PPVC modules required to be prefabricated
for the construction of the inter terrace, the timing of delivery of each customized piece,
arranging their delivery and pick up the lifting device, until each piece is installed in its
30 designated location.

Preferably, the lifting device is remotely controlled by an operator on the site.

Preferably, the lifting device moves along the track on each side of the customized Pre Cast
35 Beams in the site.

Preferably the lifting device is programmed to pick a customized Pre Cast piece or a PPVC module in a programmed sequence based on the assigned unique identifier and programmed designated location in the inter terrace.

- 5 Preferably, the lifting device is mounted with one or more video cameras and sensors of the lifting device to enable the operator to identify and pick a customized Pre Cast piece or a PPVC module in accordance to the programmed sequence of installation and guide the movement of the customized Pre Cast piece or PPVC Module picked up to the designated location for installation.

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Preferably the lifting device is powered by one or more electrical batteries or by electrical cables from an electrical source.

- 15 Preferably each customized Pre Cast pieces or PPVC module is provided with an unique identifier which contains a designated installation location within the inter terrace house.

Preferably each unique identifier is a QR code, bar code or any other identification code.

- 20 Preferably, each unique identifier further contains an unique designated installation location thereof in the inter terrace.

A 4th object of the invention is a lifting device as used with the method and system of any of the preceding claims.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig 1.0 shows the structure of an existing inter terrace house which is to be demolished and flattened.

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Fig 2.0 shows the site of the new inter terrace house structure to be built after demolition of the existing inter terrace house.

Fig 3.0 shows the super structure of customized Pre Cast Beams and customized Pre Cast Columns put in place along the opposite lengths of the inter Terrace.

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Fig 3.1 to Fig 3.9 illustrates the steps in the installation of the super structure of customized Pre Cast Beams and Pre Cast Columns to designed approved heights.

Fig 3.1 shows the site of the new Inter Terrace to be built.

Fig 3.2 shows the construction of the customized Pre Cast Columns to designed approved heights along the lengths of the Inter Terrace site.

Fig 3.3 shows the construction of the first level of customized Pre Cast Beams being added to the customized Pre Cast Columns.

Fig 3.4 shows the construction of another level of customized Pre Cast Columns upon completion of the installation of the customized Pre Cast Beams and Columns at the first level.

Fig 3.5 shows the construction of the 2nd level with the addition of customized Pre Cast Beams to the customized Pre Cast Columns(now at the height of the second level).

Fig 3.6 shows the construction of another side of the construction of the 2nd level of customized Pre Cast Columns and Pre Cast Beams.

Fig 3.7 shows the completion of the 2nd level of the Super Structure.

Fig 3.8 shows the construction of another (3rd level of customized Pre Cast Columns upon completion of the installation of the 2nd level of customized Pre Cast Columns and Pre Cast Beams.

Fig 3.9 shows the construction of the 3rd level with the addition of customized Pre Cast Beams to the 3rd level customized Pre Cast Columns, showing the outline of the Super Structure.

Fig 4.0 shows the laying of guide rails on the top most level of customized Pre Cast beams, for the installation of a movable lifting device.

Fig 4.1 shows a close-up representation of the guide rails.

Fig 5.0 to Fig 5.5 shows the installation of a lifting device, mounted on two guide rails laid on the beams of the super structure.

Fig 5.0 and Fig 5.1 shows the installation of a first part of the lifting device.

Fig 5.2 shows the installation of a second part of the lifting device.

Fig 5.3 shows the completion of the lifting device on the guide rails.

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Fig 5.4 shows the addition of a hoist in the lifting device, which would be used to pick up Pre Cast walls and other pieces as well as PPVC modules, in a programmed sequence for the construction of the new Inter Terrace.

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Fig 5.5 shows the completion of the lifting device with hoist on the guide rails.

Fig 6.0 – 6.11 shows the programmed sequence of the construction of an Inter Terrace House using the inventive building method and system.

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Fig 6.0 shows the lifting device at the commencement of the programmed building sequence. Each module, whether it is a PPVC or Pre Cast Wall or Pre Cast Floor has been assigned a unique identifier in the Inter Terrace, at the time of planning and development. When the order to manufacture the said module, the same unique identifier would be assigned and tracked using a computer system.

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Fig 6.1 shows a close-up view of the lifting device after installing a customized Pre Cast piece.

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Fig 6.2 is a close-up view of the lifting device after installing a customized Pre Cast Floor on the 3rd level. Some customized Pre Cast Floor pieces in the second level and first level which has been installed, in accordance to the programmed sequence are also shown.

Fig 6.3 is a close-up view of the lifting device installing a customized Pre Cast Ceiling for the 3rd level. It may be seen that some customized parts in the second level and first level have been installed, in accordance to the programmed sequence.

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Fig. 6.4 shows the programmed and sequential installation of customized Pre Cast stairs and a customized Pre Cast “House Shelter” on the 1st level.

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Fig 6.5 shows the next sequence in the programmed construction with the laying of a customized Pre Cast Beam after the installation of customized Pre Cast Stairs.

Fig 6.6 is a close-up of a customized Pre Cast Beam.

Fig 6.7. shows the commencement of the sequenced programmed construction of customized Pre Cast floor and stairs for the second level.

Fig 6.8. shows the sequenced programmed construction of customized Pre Cast Floors and Pre Cast Stairs for the first, second and third levels.

Fig 6.9. shows the sequenced programmed construction of roof level.

Fig 6.10 shows the programmed sequenced construction of the first, second and third level of the Inter Terrace, beginning from the back of the Inter Terrace, from the 1st level, up each level and then moving forward, in accordance to the programmed sequence of installation.

Fig 6.11 now shows the construction of the Inter Terrace now at the front of the Inter Terrace.

Fig 7.0 – 7.2 shows the completion state of construction of the Inter Terrace.

Fig 8 shows representations of different customized Pre Cast pieces used in construction of an Inter Terrace using this inventive method and system.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Detailed descriptions of the preferred embodiment (variations) are provided herein. It is to be understood, however, that the present invention may be embodied in various forms. Therefore, specific details disclosed herein are not to be interpreted as limiting, but rather as a basis for the claims and as a representative basis for teaching one skilled in the art to employ the present invention in virtually any appropriately detailed system, structure or manner.

The invention is suitable for Alteration and Addition of an existing Inter Terrace House or rebuilding of a new Inter Terrace House. Typically, an Inter Terrace house in Singapore has a frontage of between 6 Metre to 8 Metre but its length may vary. As a result of such land area, use of customised prefabricated (pre-designed and pre-casted) modules is possible. Most inter-terrace houses come in these two plot sizes: -

Parameters	Terrace Type 1 (Intermediate)	Terrace Type 2 (Intermediate)
Plot size and width (minimum)	Size : 150 sq. m Width : 6m	Size : 80 sq. m Width : 6 m

Parameters	Terrace Type 1 (Corner)	Terrace Type 2 (Corner)
Plot size and width (minimum)	Size: 200 sq. m Width: 8 m	Size: 80 sq. m Width: 8 m

The inventive method and system of construction is described using an example wherein the entire inter terrace is demolished and a new inter terrace house is built from scratch. The method and system of construction may also be used in the case where part of the Inter Terrace is re-built i.e. for major Alterations and Additions, involving the structure of the Inter Terrace.

While the steps of the inventive method and system of construction are described with reference to the embodiments using Terrace Type 1 and Terrace Type 2, which are the most common type of Inter Terrace Housing Structure found in Singapore, the inventive method and system would also be applicable to Inter Terrace Housing structures with different dimensions to those of Terrace Type 1 and Terrace Type 2, with appropriate adjustments to the number of customized modules used. Therefore, the discussion using the example of Terrace Type 1 and Terrace Type 2 are not construed to be limiting.

Definitions

Before the inventive method and system is described in detail, the scope and meaning of some terms used herein are explained.

Customized Pre Cast

Most Inter Terraces (alternatively mentioned herein as “Inter Terrace Houses”) have approximately frontage of between 6 Metre to 8 Metre, but its length may vary. As such, the Invention proposes the use of customised prefabricated (pre-designed and pre-casted) modules to construct the Inter Terrace.

“Customized Pre Cast” refers to customized Pre Cast Beams, Pre Cast Columns, Pre Cast Floors and Pre Cast Walls, Staircase, House Shelter and Structure Wall and other Pre Cast pieces which are manufactured or fabricated to fit the dimensions of the Inter Terrace. Each customized Pre Cast is assigned an unique identifier during the planning stage by the system. This unique identifier would be programmed with details of its location to be installed in the

Inter Terrace and details on sequence of installation.

“Customized Pre Cast” and “Customized Pre Cast piece” refers to any or all of the customized Pre Cast Beams, Pre Cast Columns, Pre Cast Floors and Pre Cast Walls, Staircase, House Shelter and Structure Wall and other customized Pre Cast pieces used in the invention.

The concept of Prefabrication in construction industry is well known. Basically, instead of building a house or even an entire apartment building piece by piece, prefabrication would enable the builder to make modules or units of the apartment building, assemble these large sections of the building to form the building structure, thereby saving time.

In the case of using the Inventive Method of constructing an Inter Terrace House, the Inventor has found that most Inter Terrace houses fall under two general dimensions described as Terrace Type 1 and Terrace Type 2. By proposing various quantities of customized Pre Cast pieces such as Pre Cast Walls, Pre Cast Floors, Pre Cast Staircase, Pre Cast Household Shelter, the Alteration and Addition or construction of an Inter Terrace is made faster and simpler. The use of customized Pre Casts must still be mechanised and programmed for the installation sequence in order to speed up the construction process, to solve the problems associated with the current methods .

These customized Pre Cast pieces are prefabricated off-site are assigned unique identifiers containing their identity within the planned construction drawings and assigned location within the Inter Terrace. These customized Pre Cast pieces are brought to the site in accordance to the programme sequence of construction.

As for customized Pre Cast pieces, the quantities are computed based on calculations of the requirements of the particular property, be it Terrace Type 1 or Terrace Type 2. However, if the particular property is different in dimensions from either Terrace Type 1 or Terrace Type 2, appropriate adjustments could be made to suit the physical dimensions of that particular property.

Again, Pre Cast method of fabrication or manufacture is known to the construction industry and therefore not described in great detail herein. However, the customized Pre Casts pieces would include customized Portion of Walls, Floors, Structure Walls, Staircase and House Shelter. By working out exact number of customized Pre Casts of each type, the requirements to build an entire house structure could be computed. The computer systems would then assign an unique identifier to each customized Pre Cast which would contain its exact location

to be installed and their installation sequence.

These customized Pre Casts are manufactured in accordance to the programmed worked out by the computer and transported to the property by 20-foot trailers for installation. The lifting device would then pick up each piece (in an arranged sequence, beginning with the installation of the modules at the back of the property and from first level upwards). The lifting device would move along the tracks laid on top of the beams lengthwise) and placing the particular Pre Cast in its designated position. The lifting device would then pick the next Pre Cast and the sequence of placement is repeated. When all the customized Pre Cast pieces are installed, the lifting device is disassembled and remove from site.

The quantities of each type of customized Pre Cast are calculated at the commencement of the construction project. Each customized Pre Cast is assigned to specific designated locations in the construction plans. For example, only specified numbers of say, customized Pre Cast staircase are made off site. After manufacture in accordance to their specifications including their design dimensions, each staircase is brought to the site, picked up by the lifting device and placed in their designated location. The method and system of construction and placement of each customized Pre Cast piece is based on the approved plans for the construction of the Inter Terrace. This would ensure all the different customized Pre Cast pieces are made, delivered and installed in their designated position in a timely manner so that every Pre Cast piece fits precisely into its assigned designated location in the housing structure.

In using the customized Pre Cast Beams and Pre Cast Columns to build the Super Structure of an Inter terrace, the work flow is not only made faster but with less noise and dust and lesser inconvenience to the people living in the adjacent and neighbouring houses. It is the combination of these individual features which make the method and system of construction of an Inter Terrace house not only new but inventive.

Pre fabricated Pre finished Volumetric Construction ("PPVC") Modules

The concept of Prefabrication in construction industry is well known. Basically, instead of building a house or even an entire apartment building piece by piece, prefabrication would enable the builder to make modules or units of the apartment building, assemble these large sections of the building to form the building structure, thereby saving time.

In the case of using the Inventive Method of constructing an Inter Terrace House, the Inventor

has found that by proposing various dimensions of PPVC modules, such as Prefab toilet and Prefab Kitchen, the Alteration and Addition or construction of an Inter Terrace is completed even faster and simpler. However, the use of PPVC modules must still be mechanised to speed up the construction process, in order to solve the problems associated with the current methods. The use of a lifting device in this invention would also enable the picking, moving and installation of these PPVC Modules just as in the case of the customized Pre Cast pieces.

PPVC is known to the construction industry and therefore not described in great detail herein. Again, the PPVC modules could be installed easily, using the lifting device, in a back to front sequence.

Site

This refers to the Inter Terrace which is to be built or undergo Alteration and Addition.

Super Structure of Pre Cast Beams and Columns

This inventive method and system of construction of an Inter Terrace housing structure relies on the use of customised Sub Structure Elements such as Pre Cast Beams and Columns to build the sub structure of the Inter Terrace House. These customized Pre Cast Beams and Columns are installed on both sides (lengths) of the perimeter of the Inter Terrace House to form a strong Super Structure, to enable the temporary installation and use of a lifting device but also to provide a strong and rigid structure and support for the Inter Terrace (when completed).

The installation of the customized Pre Cast Beams and Pre Cast Columns would be by use of conventional methods, known to the building and construction industry and therefore not discussed herein.

The installation of Pre-Cast Beams and Columns to form an integrated and strong Super Structure is important to this inventive Method as this allow the assembly and installation of a temporary lifting device which would move along a track laid on the Pre Cast Beams. Once the lifting device is installed, the lifting device is load tested to comply this lifting device meets all safety and weight load calculations.

The customized Pre Cast Beams and Columns are made off-site according to technical specifications and transported to the site and installed on the property after the foundation is

laid. Use of customized Pre Cast Beams and Columns to form a Super Structure for the Inter Terrace structure not only ensure faster construction but these Pre-cast Beams and Columns would meet safety and other regulatory requirements.

5 The quantities of each type of customized Pre Cast Beams and Columns are calculated at the commencement of the construction project. Each customized Pre Cast Beam and Column are assigned specific designated locations to be installed in the construction plans. After manufacture in accordance to their specifications including their design height, these pre-casted beams and columns are then installed in the property accordingly. During delivery to
10 the site, each customized Pre Cast Beam and Pre Cast Column would be transported and then installed according to their specific designated location.

Lifting Device movable along tracks

15 The lifting device is installed temporarily on top of the Super Structure for the purpose of picking each Pre Cast piece or PPVC module, such as customized Pre Cast Wall or Pre Cast Floor or any other PPVC module, on a pre-programmed sequence for the installation of each customized Pre Cast piece, from the back of the Inter-Terrace to the front, and from the 1st
20 level upwards, according to the specific location of the particular customized Pre Cast piece or PPVC module.

The Lifting Device may be a motorised gantry crane or any motorised crane and hoist system.

25 The Lifting device moves along two rail guides installed on top of the beams of the super structure.

The lifting device is equipped with cameras and sensors for the remote operation of identifying, picking each customized Pre Cast piece or PPVC module, and moving the picked up piece to its designated location, in accordance to a programmed sequence for construction and
30 installation. It may be powered by electrical batteries or powered directly from an electrical source. It may be manually operated by an operator on site or semi-automatic, identifying each customized Pre Cast piece based on its unique identifier, picking the precast piece and installing the piece according to its programme and sequence of installation.

35 It must also be noted that as used herein and in the appended claims, references to procedures and steps in undertaking Alteration and Addition or demolition and re-construction of an Inter Terrace House are known to those skilled in the art, and would not be discussed in

detail herein. An example of the step taken is preparation of the site. Whether the project is for Alteration and Addition or demolition of the existing house and re-construction of a new house on the same property, the requirements for getting approval from relevant statutory bodies for the works to be carried out must be followed, including preparation of plans for the project, submission of plans for the project and approval of plans for the project.

Detailed Discussion of Method and System of construction

Before the present method and system of construction of an Inter Terrace is further described, it is to be understood that these are not limited to the particular sequence and procedures described, as these may vary. It is also to be understood that the terminology used in the description is for the purpose of describing the particular versions or embodiments only, and is not intended to limit their scope which will be limited only by the appended claims.

With the explanation on use and features of the customized Pre Cast pieces, and starting with the building of a Super Structure for installation and use of a Lifting device, the inventive method is described with reference to the Drawings.

There are at least five (5) phases or stages in the method of construction :-

1st Phase – Demolition and flatten land, preparation of site

2nd Phase – Installation of customized Pre Casts Beams and Columns to build the Super-Structure

3rd Phase – Install tracks on beams for installation of the lifting device

4th Phase – Install customized Pre Casts such as Pre Cast walls, Pre Cast floors and use of Prefabricated Prefinished Volumetric Construction (PPVC) Modules using the lifting device in a programmed sequence, beginning from the back of the super structure, and from the first level up.

5th (Final) Phase – carry out Mechanical and Electrical works and complete interior finishes in the interior, so that the new Inter Terrace may be ready for hand over to the owner.

The method and system of construction of an Inter Terrace would be described with reference to the Drawings.

Fig 1.0 shows the structure of an existing inter terrace house which is to be demolished and flattened. This super structure of the inter terrace house would be constructed in accordance with site conditions and would meet the requirements of various regulatory and building authorities.

The methods for demolition and preparation of the land for the construction of the new Inter Terrace house using the inventive method are known and are not described herein.

Fig 2.0 shows the site (12) of the new inter terrace house (10) to be built after demolition of the existing inter terrace house.

Fig 3.0 shows the super structure of customized Pre Cast Beams (20) and Columns (21) put in place along the opposite lengths of the inter Terrace (10).

The construction of the super structure (22) would be carried out in accordance to the technical and safety requirements imposed by the various building authorities.

Fig 3.1 to Fig 3.9 illustrates the steps in the installation of the super structure of customized Pre Cast Beams and Columns to designed approved heights.

Fig 3.1 shows the site (12) of the new Inter Terrace to be built.

Fig 3.2 shows the construction of the customized Pre Cast Columns (21) to designed approved heights along the lengths of the Inter Terrace site.

Fig 3.3 shows the construction of customized Pre Cast Beams (20) being added to the customized Pre Cast Columns (21), creating the first level of customized Pre Cast beams (20) and Pre Cast columns (21).

Fig 3.4 shows the construction of another level of customized Pre Cast columns (21) upon completion of the installation of the customized Pre Cast beams (20) and Pre Cast Columns (21) at the first level.

Fig 3.5 shows the construction of the 2nd level with the addition of customized Pre Cast Beams (20) to the customized Pre Cast columns (21) which is now at the height of the second level.

Fig 3.6 shows the construction of another side of the construction of the 2nd level of customized Pre Cast Columns (21) and Pre Cast Beams (20).

Fig 3.7 shows the completion of the 2nd level of the Super Structure (22).

Fig 3.8 shows the construction of another (3rd level of customized Pre Cast Columns upon completion of the installation of the 2nd level of customized Pre Cast Columns and Pre Cast Beams.

Fig 3.9 shows the completion of construction of the 3rd level with the addition of customized Pre Cast Beams to the 3rd level customized Pre Cast Columns, showing the outline of the Super Structure.

The step of construction of a super structure (22) in this inventive method of installation comprises creation of a matrix of customised pre-casted beams and columns along each length of the Inter Terrace. This super structure (22) would bear the weight of the entire inter Terrace with all occupants and household items when completed. The super-structure (22) would also bear the weight of a lifting device and weight of each customized Pre Cast and PPVC module used for the construction of the Inter Terrace. The building of the Super Structure (22) would thus enable the identifying, picking and lifting of each customized Pre Cast piece and PPVC module delivered to the site and moving it to its final designated location within the Inter Terrace to be installed. These customised Pre Cast pieces and PPVC modules are prefabricated and then moved to the site based on the approved plan and the timing of delivery worked out by the system based on the sequenced programme of installation.

Fig 4.0 shows the laying of guide rails (23) on the top most level of customized Pre Cast Beams (20), for the installation of a movable lifting device.

The lifting device may consist of a crane and hoist or some similar system. It is movable along guide rails installed on the top of the Pre Cast beams running along the length of the super structure.

Fig 4.1 shows a close-up representation of the guide rails (23).

The lifting device and guide rails are temporary structures installed for the purpose of enabling the invention to be carried out, smoothly and efficiently. Once the structure of the Inter Terrace has been completed, the lifting device, and guide rails would be disassembled and removed

from the site.

Fig 5.0 to Fig 5.5 shows the installation of a lifting device, mounted on two guide rails laid on the beams of the super structure.

Fig 5.0 and Fig 5.1 shows the installation of a first part of the lifting device (30). A first side of the lifting device (30) is initially propped up against an opposite side of the super structure (22).

Fig 5.2 shows the installation of a second part of the lifting device (30). The second part of the lifting device is also propped up, against the opposite side of the super structure (22).

Fig 5.3 shows the completion of the lifting device (30) on the guide rails. The lifting device (30) is completed when the two sides of the lifting device are joined.

Fig 5.4 shows the addition of a hoist (31) in the lifting device (30), which would be used to pick up customized Pre Cast Walls and other pieces as well as PPVC modules, in a programmed sequence for the construction of the new Inter Terrace. The lifting device may be equipped with a motor to enable it to move along the guide rails and to enable it to lift heavy items such as the customised Pre Casts and PPVC Modules. The lifting device would then move along the guide rails to the back of the super-structure with each customized Pre Cast piece for installation. This lifting device then moves back along the guide rails to pick up another customized Pre Cast piece in accordance with the programmed sequence of installation.

Fig 5.5 shows the completion of the lifting device (30) with hoist (31) on the guide rails. The lifting device (30) would be programmed to identify, pick and move each customized Pre Cast pieces and PPVC module in accordance to the programmed sequence – to the correct location in the on-going construction of the structure of the Inter Terrace, beginning with the first level and from the back of the Inter Terrace.

Various embodiments of lifting devices have been proposed. The lifting device would move along the tracks or rails installed on the beams. Preferably, the lifting device may be controlled using Radio Control or WIFI or direct cable by an operator. The lifting device may also be fitted with cameras to offer the operator a bird's eye view of the lifting operations to be carried out when the lifting device is in operation. The lifting device would identify and pick up a customized Pre Cast piece or PPVC module and move along the tracks until the designated position for the placement of that selected item. The transportation to the site, identifying of

each customized Pre Cast piece or PPVC module, its picking and installation into its designated position and sequence of installation would be programmed so as to avoid mistakes such as picking up a customized Pre Cast and installing it in a wrong location.

5 The lifting device may be equipped with a system to identify that the correct customized Pre Cast piece and PPVC module is picked up, and in the correct sequence and then placed in its designated position. This is carried out by the use of the unique identifier, so that the customized Pre Cast piece and PPVC modules are installed in its designated position. This would also allow the next customized Pre Cast piece and PPVC Module to be picked and
10 positioned and installed, in a correct sequence, beginning with a back to front sequence and from the 1st level upwards, level by level.

The lifting device would therefore pick up the customized Pre Cast pieces and PPVC module from the 20 footer trailer, then the lifting device would move each item to the designated
15 location, with the lifting device moving each item along the length of track.

All temporary supporting structures used for the installation of the lifting device would be removed. After installation, the lifting device is tested and load tested to ensure the lifting device meets the professional calculations and endorsements. It would be then certified for
20 use, thus allowed to be used for the construction of the Inter Terrace.

Fig 6.0 – 6.11 shows the programmed sequence of the construction of an Inter Terrace House using the inventive building method and system.

25 Fig 6.0 shows the lifting device (30) at the commencement of the programmed building sequence. Each customized Pre Cast piece such as Pre Cast Floor, Pre Cast Wall or PPVC module, has been assigned an unique identifier in the construction programme of the Inter Terrace, at the time of planning and development. When the order to manufacture the said module, the same unique identifier would be assigned and tracked using a computer system.
30

The construction programme would also work out the sequence of manufacture, to enable the customized Pre Cast pieces and PPVC modules to be made, delivered to the site and installed, based on the specific location where the piece is to be installed in the Inter Terrace. The installation begins at the back of the super structure (being the back of the Inter Terrace).
35 The installation would also begin at the first level, then to the second level and then to the third level (as in the present example). This sequence would have been worked out and programmed so that the lifting device would be able to identify each piece, pick it up, move it

and install it according to the programmed sequence and location, in order for the next piece to be picked and installed.

Fig 6.1 shows a close-up view of the lifting device (30) with hoist (31) after installing a customized Pre Cast piece. Customised Pre Cast Floors (40), Pre Cast Beams (20) and Pre Cast columns (21) may be seen in this Figure.

Fig 6.2 is a close-up view of the lifting device (30) after installing a customized Pre Cast Floor (40) on the 3rd level. It may be seen that some customized Pre Cast Floor pieces (40) in the second level and first level which has been installed, in accordance to the programmed sequence are also shown.

Fig 6.3 is a close-up view of the lifting device (30) installing a customized Pre Cast ceiling for the 3rd level. It may be seen that some customized parts in the second level and first level have been installed, in accordance to the programmed sequence. It may be seen that some structures in the first level had also been installed and that only the floors and walls of the second level and third level have been installed. It can be seen that the lifting device is in the process of installing the ceiling. Again, it may be seen that the installation of the customized Pre Cast pieces must be in accordance to a programmed sequence else it would not be possible to fit a customized Pre Cast piece if it has been missed out.

Fig 6.4 shows the programmed and sequential installation of Pre Cast Stairs (42) and a customized "House Shelter" (43) on the 1st level. Other customized Pre Cast pieces such as customized Pre Cast Beams (20), Pre Cast Columns (21) and Pre Cast Stairs (42) are seen installed in accordance to the programmed sequence of installation.

Fig 6.5 shows the next sequence in the programmed construction with the laying of a customized Pre Cast Beam (20) after the installation of customized Pre Cast Stairs (42) and Pre Cast Wall (41). In the background, customized Pre Cast House Shelter (43) and Pre Cast Stairs (42) and a PPVC Module for Kitchen (46) is also shown.

Fig 6.6 is a close up of a customized Pre Cast Beam (20). In the background, the customized Pre Cast Floor (40) is shown as being laid on the level below.

Fig 6.7 shows the commencement of the sequenced programmed construction of customized Pre Cast Floor (40) and Pre Cast Stairs (42) for the second level. In the foreground, a house shelter (43) may be seen.

Fig 6.8. shows the sequenced programmed construction of customized Pre Cast Floors (40), Pre Cast Walls (41) and customized Pre Cast Stairs (42) for the first, second and third levels. The construction of the Inter Terrace at this stage may be at the 30 to 40 per cent mark. It may be seen that some Pre Cast Walls have been installed.

Fig 6.9. shows the sequenced programmed construction of roof level.

Fig 6.10 shows the programmed sequenced construction of the first, second and third level of the Inter Terrace, beginning from the back of the Inter Terrace, from the 1st level, up each level and then moving forward, in accordance to the programmed sequence of installation.

Fig 6.11 now shows the construction of the Inter Terrace now at the front of the Inter Terrace. At this stage, construction of the Inter Terrace would be almost 90 percent completed.

Fig 7.0 – 7.2 shows the completion state of construction of the Inter Terrace.

Fig 7.0 shows the front portion of the Inter Terrace being completed. At this stage, the lifting device may be removed. Since the construction starts from the back of the proposed Inter Terrace and programmed sequentially from the first level (back) to highest level (back), internal works could be commenced, and all electrical and other household fittings installed. With the housing structure completed at this stage, most of the works leading to the completion of construction of the Inter Terrace house would be done within the interior of the new house. These include installation of windows, interior finishing, electrical wiring and installation of lights and so on.

The use of customized Pre Cast pieces and PPVC modules would also allow the faster installation of electrical and other types of cables. The use of customized Pre Cast pieces and PPVC modules would also lead to more time and costs savings and less noise even during the completion stage.

Fig 7.1 shows the installation of a car porch, bringing the construction to a completion.

Fig 7.2 shows the new Inter Terrace in the midst of the existing row of terrace housing.

Customized Pre Cast Pieces and PPVC Modules

Fig 8 shows representations of different customized Pre Cast pieces such as Pre Cast Beams (20), Pre Cast Columns (21), Pre cast Walls (41), Pre Cast Floors (40), Structural Walls (44), Pre Cast Stairs (42) and House Shelter (43) for one size of Inter Terrace. These Pre Cast pieces shown are not to limit the type of Pre Cast pieces used for this invention. Since the average dimensions of an Inter Terrace are generally known, it is possible to combine different modular pieces to complete, for example a side. Due to different requirements of the owner of each Inter Terrace, the layout may be suitably and creatively planned with these customized Pre Cast pieces. These requirements are also programmed into the system and instructions for the layout including picking of specific modules in a particular sequence and designated installation location in the Inter Terrace house are given to the lifting device and construction personnel. All these information for each Pre Cast piece would be kept in the unique identifier assigned to each Pre Cast piece.

An example of how the customised prefabricated Pre Cast Beams and Columns and PPVC modules are calculated and customised are illustrated by the example of an Inter Terrace house type shown in Fig 6.0 to Fig 6.11. In this example, the construction company would order the following pieces of customized Pre Cast Columns and Beams and PPVC modules:-

1.	COLUMN (650 x 300 x 4000)	34 Nos
2.	BEAM (650 x 300 x 4000)	17 Nos
3.	WALL (200 x 4000 x 3800)	26 Nos
4.	FLOOR (150 x 4500 x 6000)	12 Nos
5.	STRUCTURAL WALL (150 x 650 x 3200)	12 Nos
6.	STAIRCASE	4 Nos
7.	HOUSE SHELTER	1 Nos

In this example, the construction of the Inter Terrace would require 34 units of customized Pre Cast Columns and 17 units of customized Pre Cast Beams to be used. As for the other Pre Cast pieces, the requirements are 26 units of Pre Cast Walls, 12 units of Floors, 12 units of Structure Walls, 4 units of Staircases and 1 unit of House Shelter.

The quantities are worked out based on the dimensions of the Inter Terrace to be constructed. Firstly, all Pre Cast Beams, Pre Cast Columns, Pre Cast Walls and Pre Cast Floors are made in accordance to the technical specifications, quantities and even their specific locations for

installation are worked out by both the Architect and Civil Engineer.

The customized Pre Cast pieces and PPVC modules such PPVC Toilet (45) and PPVC Kitchen (46) are likewise worked out based on the layout and dimensions as worked out by the Architect in consultation with the Civil Engineer. Their dimensions, weights and locations to be placed in the structure of the Inter Terrace to be built are all worked out and programmed into the Inter Terrace construction system.

Sequence of Construction Method

When the customized Pre Cast Beams and Columns are delivered to the site, these are then installed in accordance to the plan. Once the customized Pre Cast beams and Columns are in place, a temporary track is built on each length of the perimeter of the property on the Pre Cast Beams. A lifting device is then assembled onto the tracks, so as to move back and forth along the temporary tracks to lift and place the customized Pre Cast pieces.

Once the temporary tracks and lifting device are tested and confirmed to meet weight and power requirements, the lifting device would be ready to pick a customized Pre Cast piece or PPVC module for installation in its designated location. Since the lifting device is designed to move length-wise along the sides (length) of the property, the lifting device is programmed to lift each piece according to the programmed sequence and designated position for installation at the designated position, beginning from the back of the Inter Terrace. The installation would also have to be done in sequence, floor by floor. Therefore, the customized Pre Cast pieces and PPVC modules have to be made and delivered to the site in accordance to the lifting and installation programme worked out for the lifting device.

It may be seen that this inventive method and system allows the property owner to own not only a landed property but a house which is now new but built at a lower construction cost, and in faster time, besides being aesthetically pleasing.

The main problems associated with Alteration and Addition to an Inter Terrace or construction of a new Inter Terrace in the midst of a row of Inter Terrace houses such as :-

- Limited manoeuvrability of heavy machinery and construction materials
- Noise pollution created by movement of heavy equipment
- Tight spaces for loading/unloading of construction materials

would be overcome by using this inventive method and system of construction.

With the outer housing structure of the Inter Terrace being completed, the construction would quickly move inside for the Mechanical and Electrical installation, finishing of the interior as well as fitting of external structures such as windows, readily and with less noise and delay.

Lifting Device

The method of construction requires a systematic approach to construction using the customized Pre Cast walls and floors and PPVC modules which must be installed in a sequence from 1st floor upwards and from the back of the proposed Inter Terrace.

The designated position of each customized Pre Cast piece such as wall or floor and PPVC module would have been worked out during the construction planning stage and assigned an identifier. Order for manufacture of customized Pre Cast piece and PPVC modules would also be issued before construction of the Inter Terrace begins. The Pre Cast pieces and PPVC modules would be assigned their unique identifier at time of manufacture or pre fabrication.

As the construction of the Inter Terrace begins, the first lot of customized Pre Cast pieces would be delivery of Pre Cast Beams and Pre Cast Columns to form the Super Structure. The Super Structure would allow the installation of the lifting device. After that, other Pre Cast pieces such as Pre Cast walls and Pre Cast floors and PPVC modules for the 1st level and back of the proposed Inter Terrace would be transported to the site.

The lifting device would be programmed to identify each piece of Customized Pre Cast; pieces and PPVC module and pick up each piece in accordance to the programmed installation sequence. Each piece would then be installed in their designated position within the Inter Terrace structure.

The type of identifiers which may be used are various and known, including RFID or bar code or QR code or any other known method of identification. The lifting device would be equipped with a sensor to identify each piece, in accordance to the programmed sequence and install the piece in its designated position.

The lifting device would identify and pick up each selected customized Pre Cast piece, and move it along the guide rails to a position to be able to allow installation of the Pre Cast piece. The installation may require on site supervision to ensure smooth operation of the device and

efficient and correct installation. Alternatively the lifting device may be operated remotely and with use of on-board cameras and sensors, enabling installation of each Pre Cast piece and PPVC module without any manual intervention.

5 The lifting device may be controlled using Radio Control or WIFI or direct cable by an operator. The lifting device would also be fitted with cameras to offer the operator a bird's eye view of the lifting and installation operations to be carried out using the lifting device.

10 The lifting device would be disassembled after the completion of the outer housing structure and re-installed in another project for the alteration and addition or construction of a new Inter Terrace housing unit elsewhere. Various embodiments of lifting devices have been proposed. The lifting device would move along the tracks installed on the beams.

15 Savings in time and costs of construction

The Inventor has estimated the inventive method and system of construction of an Inter Terrace could result in significant savings as follows:-

	Work Items	Conventional Construction	Inventive Method & System
1	Concrete Casting	\$560,000	\$150,000
2	Man-Day (Duration) Est: \$150/day/man)	Est : 6 months (Based on 6 Man/21 work days) \$113,400	Est : 2.5 months (Based on 6 Man/21 work days) \$47,250

20 Conventional costs for structural costings based on \$1400/M²

Total Savings (estimation): \$476,150 per housing unit

\$ 410,000 from material costs

\$ 66,150 from 3.5 months' time saving

Estimates exclude: Pre cast bathroom and Pre Cast Kitchen.

25 The use of the inventive method and system would result in saving of at least 3 months. The time saving of this inventive method arise from the combination of these factors:-

- 30 ■ Use of customized Pre Cast Beams and columns to build the housing Super Structure

- use of customized Pre cast pieces including walls, floors, staircase and Prefabricated Prefinished Volumetric Construction (PPVC) modules to complete the housing structure.

- use of the lifting device to lift the customized Pre Cast pieces and PPVC modules as planned and programmed, for fast installation of the structure of the Inter Terrace.

- Use of Customized Pre Cast pieces and PPVC allows some construction works such as fabrication of these pieces to be carried out off site, thus contributing to faster construction period.

Since the Pre-Casted pieces and PPVC Modules are made off-site and are then transported to the site and then hoisted by the lifting device and quickly arranged according to plan, the result is less noise and dust pollution (form use of various handheld tools) as well as movement of heavy trucks and operation of other construction equipment and machinery.

Application of Method and System of construction to other types of housing

Although the invention is of great use and advantage to the construction of Inter Terrace houses, the method and system of construction could also be used for other types of houses.

ADVANTAGEOUS EFFECTS OF THE INVENTION

Costs and Time savings

The inventive method and system therefore would allow the Alteration and Addition or construction of a totally new Inter Terrace house in a faster time than using conventional methods and at a lower cost.

Reduction of noise and dust pollution and complaints of congestion

Through the use of a mechanised system of construction to a single site, there would be a reduction in noise and dust pollution besides avoidance of congestion at the site causing inconvenience to the people living in adjacent and opposite houses.

The most important feature of this invention is the home owner is able to obtain a pleasant and modern intern terrace with a costs savings of approximately half a million dollars and

would be able to enjoy the new property in a faster time of approximately 4 months.

All parties would benefit from the invention

The home owner gets a new house faster

The method lowers costs of construction

The neighbours would be happier.

CLAIMS

1. A method of constructing an inter terrace house on a land located between two terrace houses comprising the steps of:

- 5 (i) clearing the land to form a site in which the terrace house having a front end and a back end is to be built;
- (ii) computing dimensions and construction requirements of the inter terrace house for prefabrication of customized pieces of Pre Cast Beams, Pre Cast Columns and other Pre Cast pieces and Pre Fabricated Prefinished Volumetric Construction (PPVC) modules;
- 10 (iii) assigning each customized Pre Cast piece and PPVC module an unique identifier and a designated location for installation in the inter terrace house;
- (iv) installing a super structure with lengths to hold a lifting device on each length of the super structure; wherein the lifting device is moveable along the length of the super structure; and wherein the lifting device picks the customized Pre Cast piece and PPVC module in a
- 15 sequenced manner to construct the inter terrace house.

2. A method of constructing an inter terrace house on a land located between two terrace houses comprising the steps of:

- (i) clearing the land to form a site in which the terrace house is to be built;
- 20 (ii) installing Pre Cast Beams and Pre Cast Columns along each length of the inter terrace house to form a super-structure;
- (iii) installing a track having a length on the Pre Cast Columns along each length of the super structure;
- (iv) assembling and installing a lifting device moveable along the length of the track;
- 25 (v) programming the lifting device to identify, pick up, move a designated customized Pre Cast piece or a PPVC module according to a programmed sequence being installed at a designated location thereof;
- (vi) picking up and installing each customized Pre Cast piece and the PPVC module in accordance with the programmed sequence, from one end of the land to another end of the
- 30 land, and from one level upwards to another level, until both levels are completed; and
- (vii) repeating step (vi) until the structure of the inter terrace house is completed.

3. The method of constructing an inter terrace house as set forth in Claim 1 or Claim 2, wherein the customized Pre Cast pieces and PPVC modules being employed are based on

35 detailed requirements thereof, including the weight of the inter terrace house, designated location of installation, sequence of installation which are individually programmed for fabrication, pick up by the lifting device and installation at the designated location thereof.

4. The method of constructing an inter terrace house as set forth in any of the preceding claims, wherein the construction is programmed and sequenced beginning from a 1st level and from the back end of the inter terrace house.

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5. The method of constructing an inter terrace house as set forth in any of the preceding claims, wherein the customized Pre Cast pieces and PPVC module are planned and manufactured based on the planned dimensions of the inter terrace, and each customized Pre Cast piece and PPVC module is assigned an unique identifier and the specific designated location in the inter terrace being constructed.

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6. The method of constructing an inter terrace house as set forth in any of the preceding claims, wherein each customized Pre Cast piece and PPVC module are identified by the unique identifier thereof, picked up from place of manufacture, transported to the site and placed in a specific designated location in the inter terrace being constructed.

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7. The method of constructing an inter terrace house as set forth in Claim 1 or Claim 2, wherein a lifting device is installed on guide rails placed along the length of the Pre Cast Beams of the super structure, and are movable along said guide rails.

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8. The method of constructing an inter terrace house as set forth in Claim 5, wherein the lifting device is equipped with cameras and sensors for remote operation of identifying, picking each customized Pre Cast piece or PPVC module, and moving the picked up piece to the designated location thereof, in accordance to a programmed sequence for construction and installation.

25

9. The method of constructing an inter terrace house as set forth in Claim 5, wherein after completion of the installation of all the customized Pre Cast pieces and PPVC modules, the lifting device is dismantled and the guide rails are removed.

30

10. A system of constructing an inter terrace house on a site, wherein the system computes the dimensions and construction requirements and building programme for the construction of an inter terrace house,

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said construction requirements then further work out into a plurality of customized Pre Cast pieces, including Pre Cast Beams, Pre Cast Columns, Pre Cast Walls, Pre Cast Floors

and Pre fabricated Prefinished Volumetric Construction ("PPVC") modules and each Pre Cast piece and PPVC Module is assigned an unique identifier and a designated installation location;

- 5 said customized Pre Cast pieces and PPVC modules are being made and delivered to the site of the inter terrace house being constructed, in accordance to a building programme; and

said customized Pre Cast pieces and PPVC modules are identified by a lifting device, picked up and installed in a designated installation location in accordance to a building programme,

10

wherein the customized Pre Cast pieces and PPVC modules are installed in a sequence starting from a first level upwards and from the back of the site, until all the customized pre cast pieces are installed in the designated installation location thereof, creating a structure of the inter terrace house.

15

11. The system of constructing an inter terrace house on a site as set forth in Claim 10, wherein the dimensions and construction requirements of the inter terrace house are computed for the prefabrication of customized Pre Cast Beams, Pre Cast Columns, Pre Cast Walls and Pre Cast Floors and Pre fabricated Prefinished Volumetric Construction ("PPVC") modules, each customized Pre Cast Beam and Pre Cast Column, Pre Cast Wall and Pre Cast Floor and PPVC module assigned an unique identifier and a programmed designated location for its installation in the inter terrace house, said system further comprising the following:-

20

- 25 a Super Structure of customized Pre Cast Beams and Pre Cast Columns along each length of the inter terrace house;

a track on the customized Pre Cast Beams along the length of the Super Structure;

- 30 a lifting device movable along said track;

a plurality of customized Pre Cast Walls, Pre Cast Floors, Pre Cast Columns and Pre Cast Beams and PPVC Modules;

35

each customized Pre Cast Column, Pre Cast Beam, Pre Cast Wall and Pre Cast Floor and PPVC Module is prefabricated according to the computed dimensions and construction requirements of the inter terrace house;

each customized Pre Cast Column, Pre Cast Beam, Pre Cast Wall and Pre Cast Floor and PPVC Module transported to the site and picked up by the lifting device according to a programmed sequence based on the assigned unique identifier and designated location in the inter terrace; and

5

each customized Pre Cast Column and Pre Cast Beam, Pre Cast Floor and Pre Cast Wall and PPVC Module installed in its programmed designated location;

wherein the system works out the quantities of pieces of customized Pre Cast Beams, Pre
10 Cast Columns, Pre Cast Floor, Pre Cast Wall and PPVC Modules required to be prefabricated for the construction of the inter terrace house, the timing of delivery of each customized piece, arranging their delivery, pick up and installation by the lifting device, until each piece is installed in its designated location.

15 12. The system as set forth in claim 11, wherein the lifting device is remotely controlled by an operator on the site.

13. The system as set forth in claim 11, wherein the lifting device moves along the track on each side of the customized Pre Cast Beams in the site.

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14. The system as set forth in claim 11, wherein the lifting device is programmed to pick a customized Pre Cast piece or a PPVC Module in a programmed sequence based on the assigned unique identifier and programmed designated location in the inter terrace.

25 15. The system as set forth in Claim 11, wherein the lifting device has one or more video cameras and sensors to enable the operator to identify and pick a customized Pre Cast piece or a PPVC Module in accordance to the programmed sequence of installation and guide the movement of the customized Pre Cast piece or PPVC Module which has been picked up to its designated location for installation.

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16. The system as set forth in Claim 11, wherein the lifting device is powered by one or more electrical batteries or by electrical cables from an electrical source.

35 17. The system as set forth in Claim 10 or Claim 11, wherein the customized Pre Cast pieces or PPVC Module is provided with an unique identifier which contains a designated installation location within the inter terrace house.

18. The system as set forth in Claim 17, wherein said unique identifier is a QR code, bar code or any other identification code.

19. The system as set forth in Claim 17, wherein said unique identifier further contains a
5 unique designated installation location thereof in the inter terrace.

20. A lifting device as used with the method and system of any of the preceding claims.