A complete prefabricated mechanical and utility unit for residential or commercial use that includes all utilities and mechanics for servicing the adjacent uses. Once attached to utility supply lines the invention does not require work from skilled labor to operate. The unit has the ability to support satellite services as required.
Complete Prefabricated Mechanical & Utility System

Field of Invention

The present invention relates to a prefabricated system incorporating a complete mechanical and utility unit that can operate as a stand alone “closed system” with the possibility of elements being added on at the time of construction or at a later date.

Background

Traditional construction practices for constructing a building are not efficient and wasteful of time of skilled labor, materials and future resources to operate. One of the major expenditures of the overall cost of any project is skilled labor (e.g. Electricians, Plumbers, etc.). The skilled labor is also required to work at the job site which is not efficient in many ways. Two examples of this are: the skilled labor is required to travel to and from the site and the skilled labor must relocate all of their equipment throughout the project as the work is completed.

The common solution to this problem has been to prefabricate Modular buildings in part or whole. Current prefabrication techniques can be classified in those two groups but both have drawbacks. Whole fabricated buildings are difficult to transport to the site and erect. Partially fabricated units are not complete and must be assembled on site resulting in double the amount of structure (walls, slabs, etc.). Attaching said units also require a great amount of on site skilled labor to assemble the mechanical systems. The resultant joints between the units leave a potential for failure. These prefabricated buildings or modules provide limited design flexibility, allowing few configurations and not recognizing specific site or design conditions.

In current building techniques incorporation of the mechanical systems into the building can require unnecessary time, for example the electrician may be required to come to the site before the foundation pour to place electrical conduit, by limiting the required integration of the mechanical system into the other building materials it would greatly increase efficiency and reduce costs.

Often storage space is limited and difficult to secure on a construction site. Prefabrication offers a solution by not requiring raw materials to be stored on site waiting to be installed.

The idea of a grouping plumbing and mechanical walls creating a service core is not a novel idea, but rather it is a fundamental principle in the vertical organization of architecture. One solution proposed by past inventions have created prefabricated systems that can be stacked or assembled to create this service core, but the connections and structural intersections make these systems difficult to use in the field requiring special knowledge for installation and construction. These connections are also a point of failure in the systems.

Therefore devising building techniques that reduce skilled labor and increase efficiency are desired.

Summary of the Invention

I have discovered a novel construction system that would be a complete prefabricated mechanical and utility unit, herein referred to as “the unit”. The system would include all mechanical and utility systems for the building to operate. The Unit utilizes the most efficient method of building (prefabrication) for the most expensive part of construction (Mechanical & Utility Systems).

The system is comprised of multiple walls and floor diaphragms that provides structure while housing the mechanical & utility systems.

These units could be assembled on an assembly line similar to techniques used to manufacture automobiles.

Brief Description of the Drawings

Fig. 1 is a perspective view of the complete prefabricated mechanical & utility system

Fig. 2 is an axonometric view of the unit, installed as possible use

Fig. 3 is a perspective view of the unit, installed as possible use

Fig. 4 is a perspective view of the unit, installed as possible use

Fig. 5 is a perspective view of the unit, looking up a ceiling cavity

Fig. 6 is a perspective view of the unit, installed as possible use

Fig. 7 is a perspective view of the unit, installed as possible use

Fig. 8 is a perspective view of the unit, installed as possible use

Fig. 9 is a perspective view of the embedded mechanical systems

Fig. 10 is an axonometric view of the foundation

Fig. 11 is a diagram of the possible delivery system

Fig. 12 is a longitudinal elevation of the unit

Fig. 13 is a section through the unit

Fig. 14 is the exterior elevation

Fig. 15 is the interior elevation

Fig. 16 is a plan view of the roof top

Fig. 17 is a plan view of the Foundation

Fig. 18 is a plan view of the unit

Fig. 19 is an example first floor plan using the unit

Fig. 20 is an example second floor plan using the unit

Fig. 21 is a plan view of an example hotel use

Fig. 22 is a plan view of possible configuration

Fig. 23 is a plan view of possible configuration

Fig. 24 is a plan view of possible configuration

Fig. 25 is a plan view of possible configuration

Fig. 26 is a plan view of possible configuration

Detailed Description of the Invention

Embodiments of the invention can be used in the construction of buildings to reduce cost, improve efficiency, reduce construction time, and decrease a building's operational costs. The unit is prefabricated at a factory and is of a transportable size. The unit is transported to a site that is prepared for the installation of the unit. The unit would preferably be fabricated in an assembly line method.

The prepared site would preferably have foundation and all utility inlets in place. A premade form is used to cast the foundation and with ensure proper placement of utility inlets while reducing the cost and waste of additional formwork when pouring the foundation.

The invention is a part or whole of the mechanical and utility systems for a building. Once installed and inlets have been attached the system is able to operate. Additional
elements may be added at the site so that the unit can be customized to any situation. The ability to be customized makes the system extremely flexible and able to adapt to any situation, increasing its design flexibility.

[0040] The unit is built of traditional building materials so that no special knowledge is required to install, modify, or repair. Wood framing is shown in Fig. 1 but other materials may be used to satisfy structural or other limitations.

[0041] An advantage of prefabricating the mechanical system is that it can be inspected prior to installation. Problems can be addressed prior to the units being installed saving delays at the site. The units can also be tested in the factory prior to shipment ensuring high standard of quality. The automation system is pre-programmed at the factory reducing the site work of the automation technician.

[0042] The units contain all the meters to monitor and control all the services. External digital readouts can be placed anywhere on the exterior of the building as required by the utility services. The unit otherwise would be able to connect to the utility companies to report usages though wireless or data lines. Two way communication would be possible allowing the utility to communicate and control parts of the system as known in the art.

[0043] STRUCTURE—The vertical structural members (1) shows the frame of the unit to be of typical construction materials. The rim joist (2) shows the edge beam parallel to the long wall, thus creating a cavity between the edge beam and the longitudinal wall. The edge beam is able to support adjacent floor members. The structural sheathing (3) will allow the unit to remain rigid during transportation and may provide lateral resistance in the completed building. A pressure treated sill (4) or similar material that would allow the unit to be placed directly on the concrete foundation. Anchoring hardware (5) such as hold-downs that would securely fasten the unit to the foundation.

[0044] WEATHERPROOFING—The roof top waterproofing pan (8) is a one piece liner made of a durable impervious material such as plastic that lines the rooftop parapet area to waterproof it, and is connected to the scupper (9) that is incorporated into the Liner allowing water to exit the roof top mechanical area. An overflow scupper (10) located at a higher elevation allows water to escape if the main scupper becomes obstructed. All weatherproofing connectors and flashing may be also manufactured to ensure quality of construction.

[0045] WATER—The water supply is connected at the water meter (15) which is monitored by the automation system. All of the water supplied to the unit is filtered at the water treatment module (16). The potable water is then either sent into the cold water supply line (14) or sent to the tankless water heater (19). The hot water line (13) is supplied by the tankless water heater (19). The hot and cold water lines serve all the fixtures in the unit and have additional connections to service other fixtures.

[0046] WASTE LINES—The washer drain (6) is installed at a location that is ready for immediate use and is connected to grey waste line (11). An overflow pan (7) made out of metal or plastic prevents water leakage incase the washer fails and is connected to the grey waste line (11). The shower/tub drain (21) is placed in location for immediate use and is connected to the grey waste line (11). The Solid waste line (12) is installed in the unit that connects the Sewer lateral to the plumbing fixtures that can not produce grey water easily such as the toilets drain (22), kitchen sink (23), and dishwasher. The waste line vent (20) is connected to the grey waste line (11) and the solid waste line (12) to vent them through the parapet of the unit.

[0047] GAS LINES—All required inlets and outlets are installed for all gas appliances. The gas line (24) is connected at the Gas meter (25) which is controlled through the automation system. The gas line connects the equipment on the roof top such as the water heater (19), heat pump (26), and generator (34). The gas line is also connected to the clothes dryer (50) and to the stove connector line (54).

[0048] HVAC—The airconditioner/heatpump (26) is controlled by the automation system. The intake/exhaust grill (28) is made to resemble a traditional chimney cap. The thermostat (29) is controlled by the automation system.

[0049] ELECTRICAL—The electrical supply is connected at the electrical meter (30) which is controlled by the automation system. Conduit (33) connects the meter (30) to the Electrical panel (31). The use of conduit and the properties of its material could reduce the amount of EMF (Electrical Magnetic Fields) exposure to the user of the unit. The electrical panel (31) is connected to and controlled by the automation system (32). The generator (34) provides backup power if electrical service is interrupted. Lighting (35) is preinstalled in the unit. Electrical conduit (33) is located at the edge beam (2) that is connected to the electrical panel (31). This allows additional electrical fixtures to be placed outside the unit and the wires can be fed to the panel.

[0050] AUTOMATION SYSTEM—Automation Systems are known in the art but are currently expensive to install. The systems abilities are able to be expanded upon by incorporating it into a prefabricated system. The Unit does not require the use of an automation system but by using an automation system it eliminates the need for certain elements. Such elements are light switches, rather than skilled labor required to install the lights outside the unit, the lighting fixtures just need to be plugged into the automation system.

[0051] PRE-INSTALLED ELEMENTS—Elements are included in the system that allow future systems to be installed, but any of these additional items could be incorporated into the unit if desired. Such elements are a power converter (37) pre-installed so that photovoltaic panels can be mounted on the building and plugged into the unit. A solar water heater junction box (39) is also installed so that solar water heaters can be mounted on the building and plugged into the unit. A grey water holding tank (17) would store grey water to be used at the site where potable water is not required. A hydraulic pump (18) would provide required pressure to transport grey water from element (17) to outlet. An air handler (27) that can be placed at any location in the project works in conjunction with the compressor/heatpump (26) so all heating and cooling requirements can be met. Added photovoltaic panels (36) can be connected "plugged in" to power converter (37). Solar water heaters (38) connect to solar water heater junction box (39).

[0052] VENTING—Venting for all the equipment is installed in the unit terminating at the vent cap (43). Using the said vent cap reduces the amount of roof penetrations of the adjacent building reducing the chance of waterproofing failure, reducing the time of the roof installation and reduces the amount of trade coordination. The laundry dryer duct (40) is connected to the vent cap (43) and is ready for connection to the dryer. The Laundry make up air (56) is provided so that make up air is not required by additional means required for gas appliances. The Laundry make up air (56) may use means
to reduces air humidity such as pressurization to increase the efficiency of said dryer. The bathroom duct and fan (41) is installed, connected to the vent cap (43) and ready for use to meet required codes for ventilation of the said bathroom. The hood duct (44) is installed and connected to the vent cap (43) and is operable when connected to the Hood (45). The tankless water heater (19) is equipped a exhaust vent (46) and an intake air vent (47). The refrigerator vent (48) is provided to either exhaust the heat generated by the refrigerator coils or use the exhaust heat to assisting the tankless water heater (19) or the air conditioner/heatpump (26) and is controlled by the automation system. The roof top mechanical area may be equipped with ventilation as required by specific mechanical units. All or any of the ventilation ducts may be equipped with mechanical means of improving efficiency (i.e. fans).

[0053] SHOWER/TUB DRYER—The shower/tub dryer (50) is an element that provides force air from the room that it is located or outside air that is used to dry said area reducing humidity limiting the growth of mold and fungus. The shower/tub dryer is controlled by the automation system and may turn on or off when required to reduce moisture levels as required and is connected to the vent cap (43) via shower/tub duct vent (49).

[0054] DETECTORS—Detectors and sensors are placed throughout the unit to monitor for system or building failures. The gas detector (60) is located near the appliances that use gas or along parts of the unit that gas might accumulate. The water detector (57) are located along the floor and in the under floor vault, installed to monitor if sink/tub overflows, washer malfunctions or if a pipe in the walls rupture. A water sensor is also located in the roof equipment area to warn if the scuppers are blocked and the roof pan is filling with water. Fire detectors are provide including a Co² (58) detector and smoke detector (59). Security detectors (61) are ready for installation at typical locations i.e. (doors, windows). All detectors are controlled by the automation system. The automation system has the ability to shut off services (i.e. gas, water), turn of fans to vent (i.e. gas), to signal audible, visual, mechanical alarms or notify third party services such as the fire department, police department, a security company, etc.

[0055] ENERGY CONSERVATION—By combining all of the mechanical systems together it will be possible to greatly conserve energy by reclaiming “lost” energy by using heat transfer devices. In typical construction heat expelled from mechanical devices (i.e. clothes dryer, oven, refrigerator, or heatpumps) is considered “lost”. In the unit the excess heat would be collected though heat transfer devices known in the art and used by the unit to preheat or precool water or air to conserve energy. A geothermal tank system (63) is also incorporated as the automation system will use the ground temperature in combination with any of the other devices to conserve energy by cooling water, air, or mechanical coils to improve their efficiency. Exterior temperature coils are mounted on the exterior of the unit which allows the automation system to use extreme exterior temperature in hot or cold climates to assist in providing heating or cooling for any of the incorporated devices, increasing the efficiency of the unit as a whole.

[0056] The lifespan of all mechanical equipment is limited and dated. New technology will make old units obsolete. The ability to update a buildings entire mechanical system would allow the remaining building to be reused and preserved. The unit could be installed in such a manner that it is not an integral part of the structure allowing it to be removed and replaced with a new unit. The old unit could then be recycled.

[0057] A common problem with new or alternative building techniques is that it is difficult to incorporate the mechanical systems, at least the trades may provide resistance by increasing fees due to unknowns and unfamiliar conditions. By self containing the mechanical and utility systems it allows the use of alternative building techniques and materials. (i.e. straw bale, adobe, foam block)

DETAILED DESCRIPTION OF THE DRAWINGS

[0058] FIG. 2, FIG. 3, FIG. 4, FIG. 6, FIG. 7, and FIG. 8 show the unit installed with other elements. Element (45) shows the location of a hood for a stove. Element (52) shows the hotwater line installed on site connecting the unit to the kitchen sink. Element (53) is the cold waterline installed on site connecting the unit to the kitchen sink. Element (54) is the gas line installed onsite connecting the unit to the gas appliances. Element (55) is the Ventilation duct connecting Element (45) to the Unit.

[0059] FIG. 5 is a perspective view looking at the ceiling cavity of the unit. Element (42) is a fan unit connected to element (41) to (43). Element (50) is a dryer for the shower/tub.

[0060] FIG. 10 is an axonometric view of the prepared foundation. The foundation can be used with a slab or raised floor construction. The formwork (51) can be reused or made in mass such as plastic formwork. This would allow proper installation of site connections, structural and utility by precut holes and markings as required. The formwork may be removed to use again or left in place.

[0061] The obvious method of transportation for multiple units would be on a flatbed truck and craned into place. This method is preferred if multiple units are to be installed but FIG. 11 is a diagram of a possible alternative delivery system that would allow for a single unit to be transported and erected without the use of a crane. The trailer (62) could be towed behind any vehicle and brought to the site. Said trailer would have the ability to tilt up the unit while aligning it with the foundation using human or mechanical means.

VARIATIONS

[0062] Multiple variations are possible for the unit. Certain configurations may be more applicable than others depending on the intended use or specific site/project conditions. The unit may be a single story or multiple stories. The dimensions of the unit may very maintaining the unit is transportable. The unit could be constructed out of any construction material. The unit can be double loaded (as shown) or single loaded (example: the plumbing wall is the exterior wall). The unit may or may not structurally support the adjacent structure. The services can be located above, below or within the unit. The unit could also incorporate any mechanical or utility service, not only the specific ones described in this document.

[0063] The unit may control any data, utility, or service. Items such as cable, Ethernet, dsl, phone, satellite, wireless data, detectors, monitoring equipment, etc. shall be apart of this document.

[0064] An example of a variation of the unit is one with no plumbing on the exterior wall and the mechanical equipment underneath the unit may be more efficient in colder climates. The pipes could freeze in an exterior wall and the other
mechanical equipment would provide enough heat output to keep the mechanical vault from freezing.

[0065] Another variation is a unit that allows other units or other systems to be serviced by the Unit acting as a hub or core to the overall system.

[0066] The unit may also be used in the construction of multi-residential, hospitality and in healthcare projects due to the repetition of mechanical and utility systems. For hospitality the front desk could control the rooms systems from the front desk. For the healthcare application the nurses station could monitor all of the incorporated medical equipment.

[0067] The unit may be used for emergency housing for organizations such as FEMA. A single story simplified version of the unit that does not incorporate such elements as the automation system. Appliances and fixtures would be installed and ready for use. The structure would be made out of a material that could resist exposure to weather. The smaller size of this unit would allow for many more to be loaded on a transportation vehicle. This variation would allow for quick and efficient mechanical and utility support for emergency shelter. After the emergency use is no longer required the same units could be made available for reconstructing destroyed permanent housing.

What is claimed is:

1. A complete prefabricated mechanical and utility unit in the use of building construction comprising:
   (a) A structure with the ability to house and distribute all incorporated systems.
   (b) All building systems that will provide service the adjacent uses

2. Said building systems (1a) shall include multiple or all but not limited to: electrical, gas, potable water, grey water, cold water, hotwater, solid waste, grey waste, hvac, lighting, data, phone, cable, dsl, satellite, solar water, photovoltaic, water purification, automation, ventilation, and metering

3. The said unit is installed complete with the ability to provide outside systems with services.

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