

# INFILL SYSTEMS SOLUTIONS

<http://www.infillsystemsus.com>

Infill Systems US LLC (ISUS) offers consulting services for the design of “open” buildings prepared for long-term value and flexibility. ISUS also offers building products designed for efficient and customized interior fit-out, in new construction and in upgrading and converting existing buildings. ISUS architectural services provide the know-how to design flexible (and thus sustainable) real estate assets. ISUS products include CABLESTUD for flexible cable management in interior partitioning, and the MATRIX TILE SYSTEM for pipe management, the use of which allows free space and equipment planning of demised spaces.

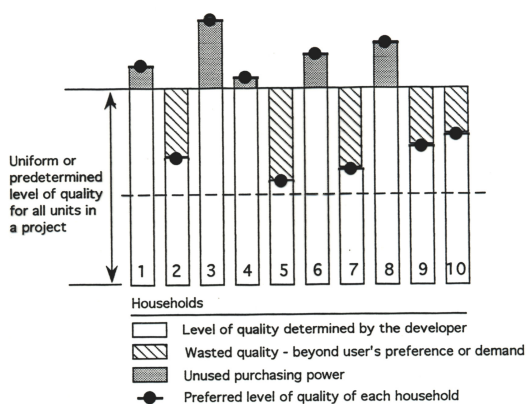
## THE ISUS SOLUTIONS

In the real estate industry, decision flexibility regarding building use – specifically, variable floor plans for individual occupant spaces in multi-tenant buildings - offers good return on investment and value to occupants, and extends the useful life of the building. These opportunities are significantly reduced in current practice, particularly in multi-floor and multiple occupancy buildings with plumbing fixtures distributed across a floor plate – that is, not concentrated in a central “core.” Normally, floor plan and equipment decisions in a given occupancy are entangled with those same decisions made for occupancies above and below. This causes conflict during planning, design and construction and over the life of the building when circumstances necessitate the change of floor plans. This conflict is also evident in the medium and long term when the investor or owner/occupant seeks to change the size of demised spaces, and to customize floor plans to meet varied and changing preferences and investment priorities.

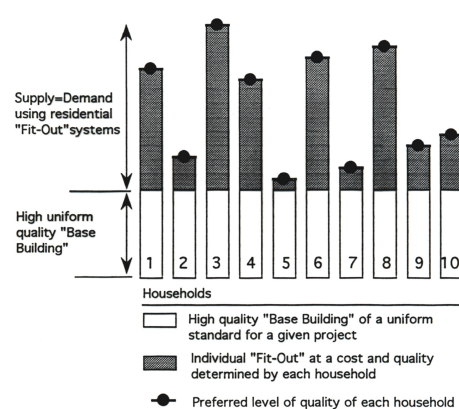
ISUS provides training to design/build teams in achieving optimum “open building design,” both in new buildings and in the “activation” of older buildings, ready to be prepared for an extended period of usefulness.

This assures that:

- Investors can achieve sustainable assets with long-term use-value;
- Decisions on sizes and floor plans of units of occupancy can be made independently;
- Reduction of conflict between tenant spaces one above the other when floor plan changes are made.
- A better match with market variety (initially and over time)



A Conventional Project:  
Mismatch Between Supply and Demand



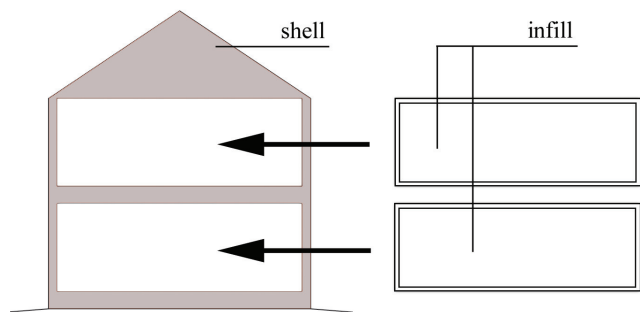
An Open Building Project:  
Matching Supply and Demand Exactly

Typically, multi-tenant buildings produce a mismatch between supply and demand when designed conventionally

In “open building” projects, this is avoided because each unit’s FIT-OUT is decided per occupant. (Source: Karel Dekker)

## Decision flexibility and long-term real estate asset value are enhanced by:

- 1) A clear separation of the BASE BUILDING (Shell) from the FIT-OUT (TI or Infill), enabling the production of FIT-OUT systems independent of specific projects. FIT-OUT components can be true mass-produced products like those found in building supply companies or showrooms;
- 2) The use of FIT-OUT systems, which offer developers decision flexibility and users choice, improves quality control, and saves time and labor on-site, thus reducing time to market and investor risk;
- 3) FIT-OUT systems, which can be improved over time and new ones can be installed in older buildings to give higher performance, because their use does not disturb the more permanent architectural infrastructure;
- 4) Several FIT-OUT companies, because competition will drive down prices and offer greater choice to decision-makers, including users;
- 5) The use of FIT-OUT systems, meaning that installation of individualized floor plans is just as easy as installing uniform floor plans, using advanced design and logistics software;
- 6) Disentangling individual units of occupancy, so that each can be changed quickly and improved over time with minimal disturbance to other spaces;
- 7) FIT-OUT systems that can be financed separately from the BASE BUILDING, with different financing instruments, interest rates and payback periods.



Separation of the more permanent part from the more changeable part



Diagram of this approach in a townhouse scheme

## At least three design problems need to be solved to deliver “open buildings:”

**First**, proper positioning of vertical MEP (mechanical, electrical and plumbing) shafts enables a sensible variety of occupant spaces, and also enables unit size and layout decisions on one floor to be independent of those on floors above or below.

**Second**, floor plates must be designed to enable optimum variety of demised spaces. Within each demised space, a variety of layouts should be possible, all respecting the need for natural light and ventilation in occupied spaces. Usually we start with floor plans and make a building design. When the floor plans are not known at the beginning, design decisions must be made on other criteria, called scenarios of use.

**Third**, horizontal drain lines must be handled within the demised space they serve, not in the ceiling of spaces below. This means that no floor penetrations can be accepted except at the common pipe shaft serving all floors within a given “zone” of the floor plate.

The design method applied to solve this problem is called CAPACITY ANALYSIS. This is a process of proposing a base building design, tentatively laying out units of occupancy of various sizes, and studying floor plans within these varied unit sizes. These studies normally indicate that certain features, proportions or dimensions of the proposed base building should be adjusted. This iterative process continues until agreement is reached that the proposed base building has suitable “capacity.”

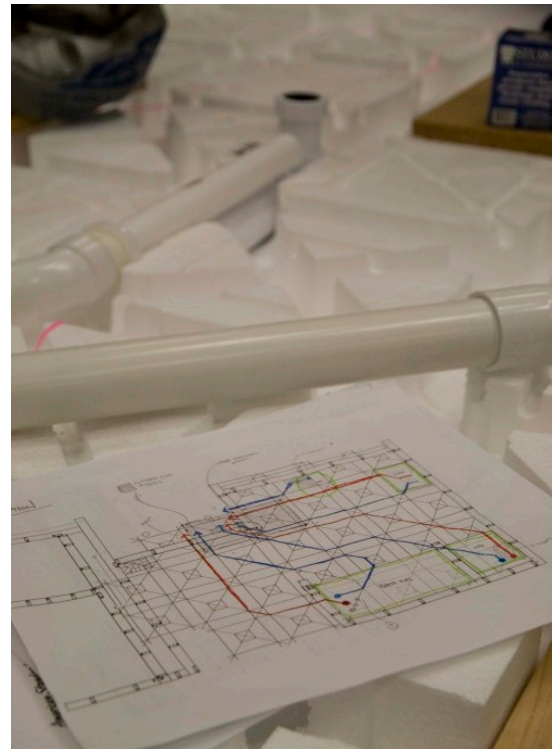
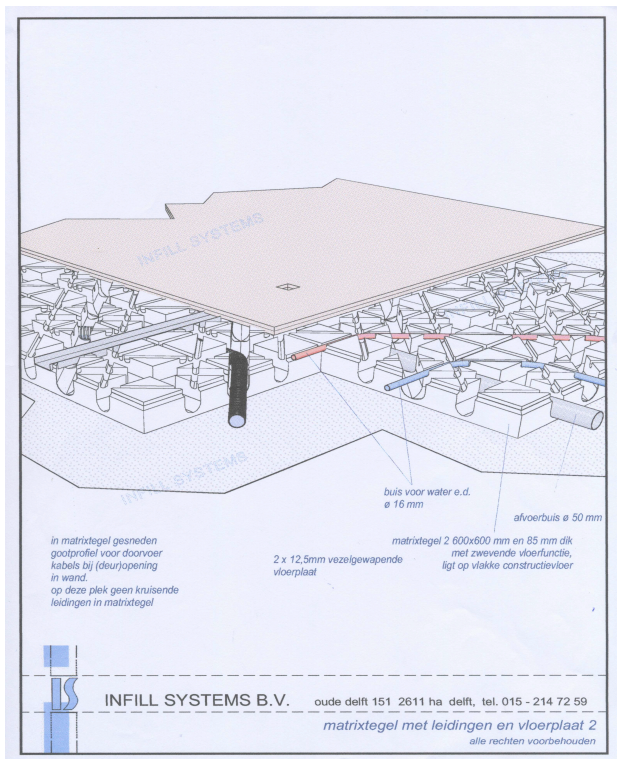
# ISUS PRODUCT SOLUTIONS

ISUS offers two solutions to facilitate “open building” processes. They are the **MATRIX TILE SYSTEM** and **CABLESTUD**. These products were developed in the Netherlands and have been and are being used there. They are invisible – like the INTEL microchip – and improve efficiencies in pre-construction project phases and during fit-out installation. They also offer positive ROI over short, medium and long-term cycles of churn, including adaptive reuse of old, previously rigid buildings. These are backbone products for full, slab-to-slab fit-out systems, but are also effective as stand-alone solutions.

## MATRIX TILE SYSTEM

The **MATRIX TILE SYSTEM** uses a standard, injection-molded 4” thick medium density polystyrene “tile” (36” square) applied on top of a leveled base building floor. Grooves of various sizes - located in several horizontal “zones” formed in the top of the tile - allow the secure placement, without interference, of lines or conduits for various services. These include hot and cold water, gray-water drainage (0-slope), hot water piping to radiators, floor heating, flat ventilation ducts, gas pipes and so on. A fireproof floor layer is laid to “close” the floor after pipes and other utility services are installed. Non-loadbearing partitions are erected on this floor covering, along with any finish floor material.

This system is officially certified in the Netherlands and Germany, and has been applied in more than 100 residential units, both in new construction and in the “one-unit-at-a-time” upgrading of 1960’s era apartment buildings. No problems have been reported after more than 15 years in service.



Matrix Tile System drawing shows water pipes (red and blue) “home-run” pex piping; 0-slope gray-water drainpipes are shown in the drawing in black and gray - standard schedule 40 PVC pipes and fittings.

Costs for the installed US MATRIX TILE SYSTEM is projected to be no more than conventional practice, all things considered. The Matrix Tile cost will be in the range of \$2.25/sq. foot. Evidence in Europe is that the added materials cost is offset by added acoustical and thermal performance; by the avoidance of floor penetrations with associated issues of quality control; by reduced coordination; reduced disturbance of other occupancies; and by enhanced decision-flexibility.

The MATRIX TILE SYSTEM is a superior solution because it avoids several problems:

1. **In conventional practice, floor plans must be decided and technically fixed well in advance of the project going to market.** The resulting rigidity – both technically and in terms of sale or lease options – increases the risk that the project will not deliver a good return on investment. This risk can be caused by other nearby developments getting to market first with similar floor plans or unit mixes; by the need to adjust the marketing plans, rental or sale prices at a late stage of construction due to cost overruns or other factors outside the developer’s control; or discovering the dissatisfaction of the end user - who (in for-sale projects) was never asked to help make the space plan decisions in the first place. In conventional ways of building, none of these problems is easily corrected without losing time and money.
2. **In conventional practice, rigid buildings become less attractive in the future, due to mismatch with living standards, changes in demographics or shifts in household life-styles, because they are very difficult to significantly upgrade unit-by-unit as they become vacant.** When multi-unit properties are unable to adapt unit-by-unit (as cells regenerate in an organism), they can become financial liabilities. Normally, an entire building (or an entire floor of a building) is allowed to decline in quality, forcing the building to be vacated for total upgrading, or demolition.

## CABLESTUD

**CABLESTUD** is a small CLASS-A plastic construction accessory that facilitates the routing and connection of electrical and low-voltage cables at the bottom of non-loadbearing metal or wood-stud partitions, behind a removable baseboard. By using CABLESTUD, the installation, addition or relocation of switches, electrical outlets or data ports is straightforward. Thanks to CABLESTUD, all wires disappear inside the partition in known locations, but are immediately accessible. The product can be specified for use in both combustible and non-combustible construction. It is especially useful in “hard-lid” or “no-lid” projects (vs. “soft-lid” or access - ceiling projects)

Electrical or low-voltage boxes are wired and the pigtails are dropped down inside the hollow wall, with connections made behind CABLESTUD’s removable baseboard (one side of the wall only). Standard connection boxes can be used or, for example, MOLEX’s self-contained connector and tap product (approved only for use when accessible). Where NM (non-metallic) cables are not permitted, MC (metal clad) cables can be installed. A CABLESTUD version is also available for wood-frame construction. Low-voltage wiring (CAT 6, fiber optic or cable-TV) is installed in the upper portion of the CABLESTUD, and 110/220 power cables are installed in the lower portion. The current design of the CABLESTUD for the US market has capacity for 6 NM or 3 MC cables passing at each stud. Careful planning is required, and where cable density is high, sub-breaker panels (e.g. in the kitchen) may be used.

Innovations such as quick-connect cable connectors (e.g. Wieland and Wago) and low-voltage wall heating systems (such as ACTIVE WALL - <http://www.tue.nl/en/publication/ep/p/d/ep-uid/269039/>) are mutually compatible with CABLESTUD.

CABLESTUD offers:

• **Flexibility in the building process:**

- Quick adaptations of electrical and low-voltage terminations are possible during the building process in response to changes in user requirements or the developer’s marketing projections;
- The location of most power outlets, data ports, switches, thermostats, sensors and lighting fixtures can be decided just before final installation (after gypsum board is installed) using “rework” boxes with connections behind the removable baseboard;
- Electrical/low-voltage installers will be on site less frequently (simplified building logistics/coordination).

• **Flexibility in use of the space:**

- Allows for quick (and much less expensive) adaptation to new requirements.
- Adaptation without ripping open the wall and destroying finishes.
- No unsightly and unsafe cables such as plug strips and extension cords.

CABLESTUD replaces conventional practice.

- Conventional methods result in installations where no one knows where cables are after drywall and finishes are installed. Conventional installation practice also means that decisions about where to locate convenience outlets, switches, wall lights, and data ports must be made early, sometimes before preferred equipment and furniture specifications are known. Burying cables and outlets in walls makes changes costly and disruptive.
- Later, during the period of occupancy, it is often the case that users want to add or move equipment or furniture, which can lead to moving, adding or upgrading cabling and devices. In current practice, making these changes during occupancy (or at change of occupancy or function) is expensive and destroys wall finishes.

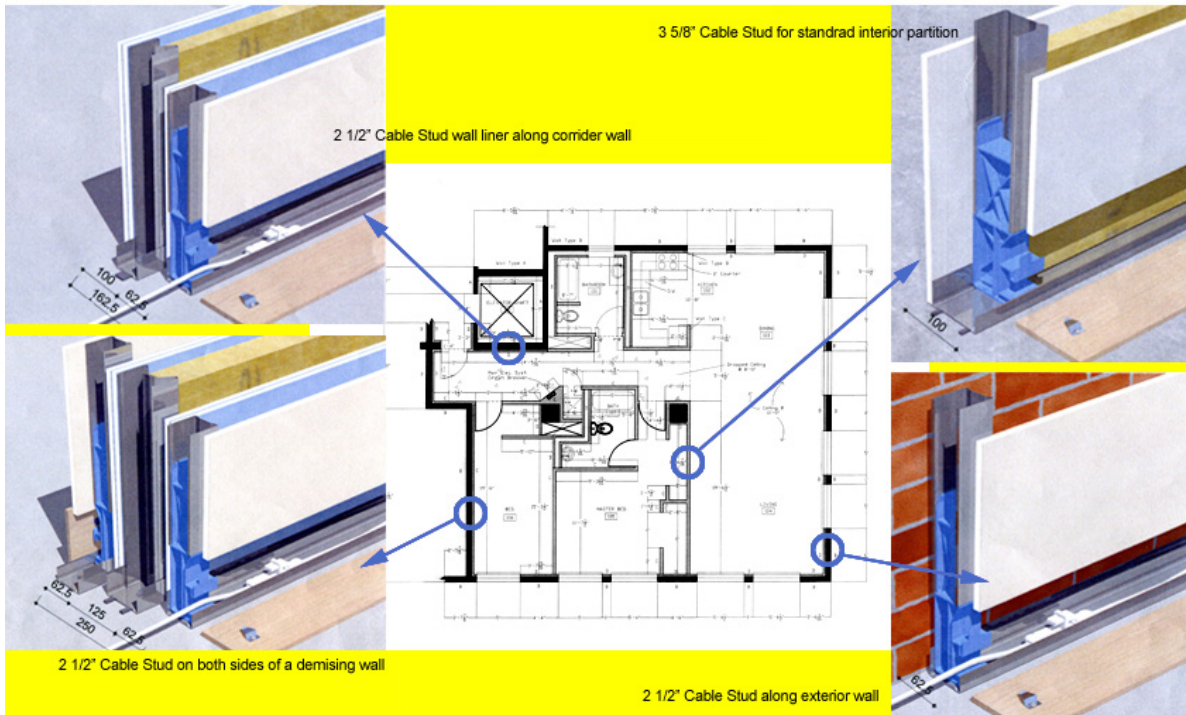
**JUSTIFICATION OF EXTRA COST:**

- Use of CABLESTUD (adds +/- \$10.00 per stud) reduces electrician costs during initial installation.
- Use of CABLESTUD reduces change orders.
- Use of CABLESTUD significantly reduces electrician costs when changes are made later (the cost of moving or adding one outlet can cost between \$200.00 - \$500.00).

CABLESTUD is in the market in the Netherlands and Belgium under the GYPROC label, and in France under the PLACOPLATRE label. These are companies in the Saint Gobain family. Since metal studs are of different dimensions in different markets, the CABLESTUD is designed to fit each markets' metal studs.



CABLESTUDS (white products) slip into the bottom of each metal stud. The mock-up on the left shows the use of Molex's self-contained connector and tap with NM cable. The baseboard clips are visible on the back of the baseboard lying flat. Any baseboard style can be used. The mock-up on the right shows the wood-stud version of CABLESTUD.



CABLESTUD can be applied in a variety of wall types – in partitions separating rooms within an office or apartment; as “wall-liners” against demising or separation walls between units; as wall liners against exterior walls. (Source: GYPROC)

## SUMMARY

**CABLESTUD market** opportunities include:

- DIY market (perhaps jointly marketed by MOLEX);
- Professional market (high-end residential market; panelized home-builders; office market where “systems furniture” is too expensive but where decision flexibility in wiring is important; office buildings with horizontal band windows at the perimeter, making closely spaced cable drops difficult; medical office buildings; schools and universities)

**MATRIX TILE SYSTEM market** opportunities include:

- Slab-on-grade residential construction (provides improved thermal isolation and more accuracy of piping placement vs. conventionally crude sub-slab pipe layout methods);
- New-construction of multi-story/multifamily residential and laboratory buildings (providing added acoustical isolation and eliminating floor penetrations at showers and bathtubs – rear discharge WC’s should be used in any case vs. bottom discharge WC’s);
- Renovation of older buildings where variety of layouts is desirable, and where floor penetrations at fixtures (showers and bathtubs) is problematic.

***ISUS has an exclusive agreement with Infill Systems BV (located in Delft, the Netherlands and owner of the intellectual property) to bring both the MATRIX TILE SYSTEM and CABLESTUD into the U.S. market. These products are game changers. While they are disruptive of many conventional practices, they are part of inexorable shifts in the way the building industry operates. The building industry and its clients will inevitably learn to handle variety, sustainability, and efficiency as a matter of conventional practice. We are part of that transition and are therefore especially interested in discussions with lead users of both ISUS consulting services and products, resulting in early adoption of these services and products with advantageous conditions.***

(April 2016) / Philadelphia, PA, USA