1. What is Open Building?

1.1 A tradition in non-residential building

- The terms "base building" and "fit-out" are conventional in multi-tenant buildings - both retail and office.
- It is normal for one party to order a base building and other parties to independently determine the fit-out of individual spaces.
- This distinction is made real by the tax laws concerning depreciation, and the separation of professional roles, as well as the evolution of new fit-out technology.
- The practice of open building is independent of architectural style, climate and urban setting.
- The stock of office buildings constructed only 30 years ago is not able to adjust to new social and technical realities, a mistake we do not to have to repeat.

1.2 A future for residential construction

- Market pressure is increasing for customized dwelling units in multifamily buildings.
- Changes in demographics and life styles often make older dwelling types and sizes obsolete.
- In the design and development process, developers want to defer - and alter - unit design decisions as long as possible without loosing control or money.
- Time pressure - to build quickly and sell or lease units quickly - is in conflict with the demand for customized units and the complexity of building processes and systems. Present design and building practices put variety and efficiency in conflict.
- The increased number and complexity of mechanical systems in multi-family and single family residential construction is a cause of reductions in quality and increases in cost. In addition, future modifications are more difficult because of systems and trade entanglement.

2. Principles of Open Building

2.1 Five Basic Concepts

- **Working on levels**
  Examples are:
  - > tissue level (urban design)
  - > base building or support
  - > fit-out or infill
  - > furnishings and equipment

- **Adaptability**
  This means changeability - according to changing preferences and technical advances.

- **Variety with efficiency**
  This requires the use of IT, design for assembly, and advanced production technology.

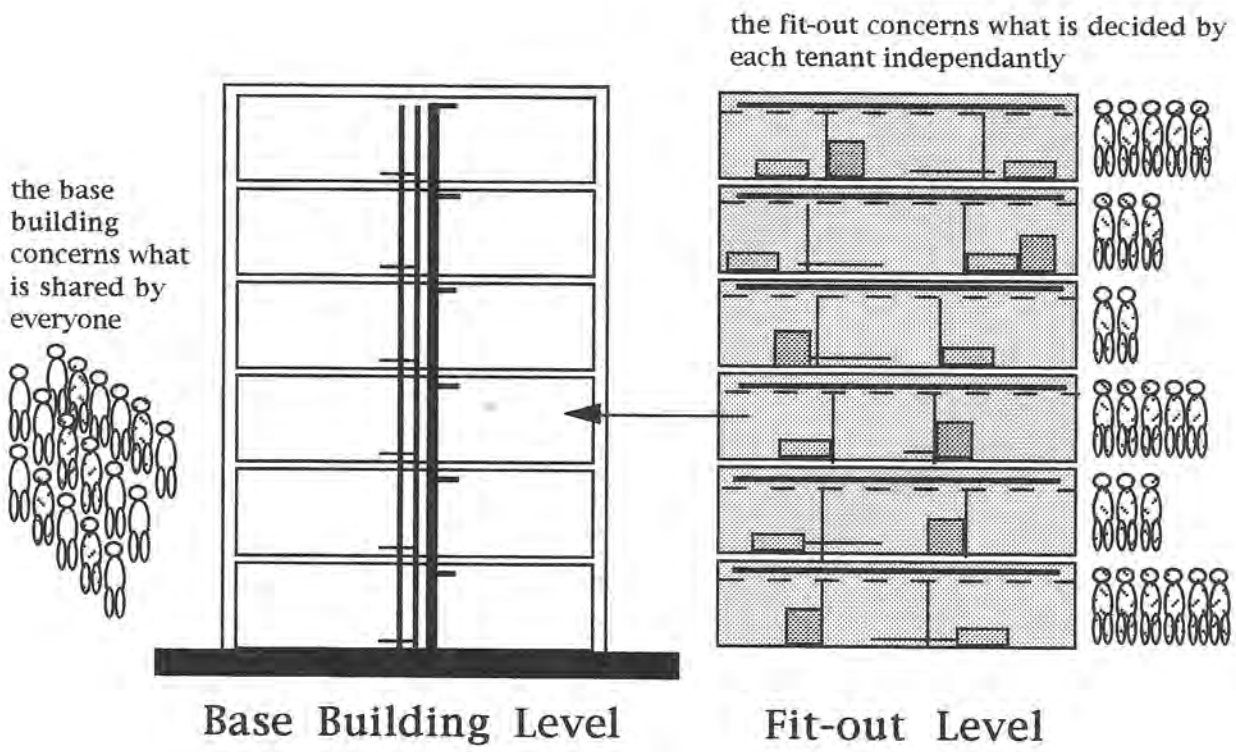
- **Subsystems disentanglement**
  This is important to decrease conflict and facilitate change of parts.

- **Sustainability**
  This means to invest according to life-cycle, to lengthen the useful life of buildings, reduce the use of throw-away products, and increase the use of recycled products.

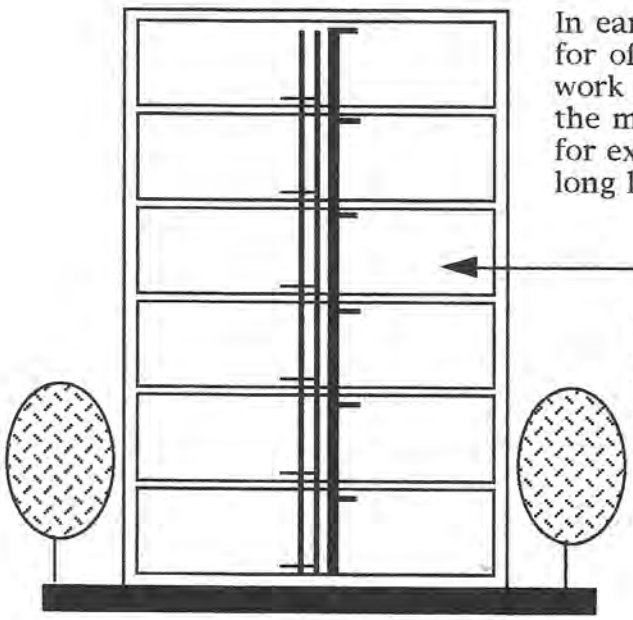
2.2 Specifying Open Building Projects

- Open building projects are specified according to the levels concept.

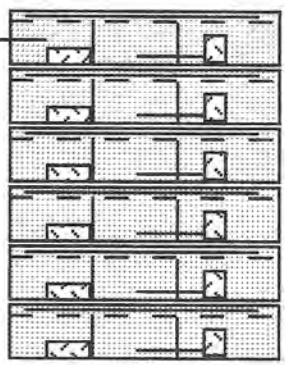
  First, a basic picture of the evolution of the distinction between base building and fit-out:



1955 - 1975



In early examples of Open Building architecture for office buildings, investment in base building work exceeded that for fit-out. Most components of the mechanical systems were in the base building, for example. Buildings were expected to have a long life, and so all parts were integrated to last.



Further, fit-out tended to be uniform in both layout and hardware. The state of the art at the time limited the ability to make variety efficient.

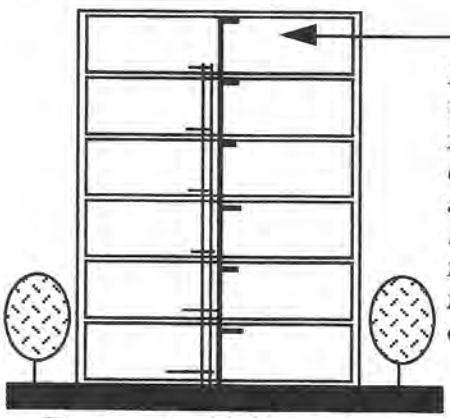
Base Building Level

Fit-out Level

1975 - 1995

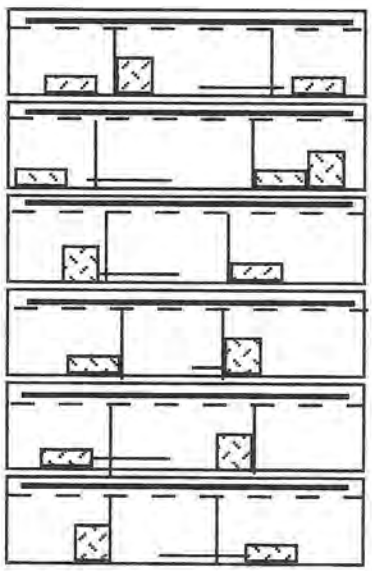
Within the past decades, investment in the fit-out level has increased. Further, many buildings constructed only 10 years ago are being completely altered inside and out, with only the structural frame remaining from its original state. But some buildings cannot have a future because their base buildings had no capacity for change: e.g. their floor to floor dimensions are too small.

Fit-out work now outpaces base building work among designers, builders and product manufacturers. In addition, the range of variety in fit-out space planning and technology has increased dramatically. In the best projects,variety is not more expensive than making uniform plans and technology.



Base Building Level

It is still the case that the various subsystems in a fit-out installation are controlled by specialized subcontractors. The benefits of multi- skilled installation teams have not yet entered the construction industry.



Fit-out Level

"Open Building: A Better Way to Build"
Stephen Kendall, PhD, AIA

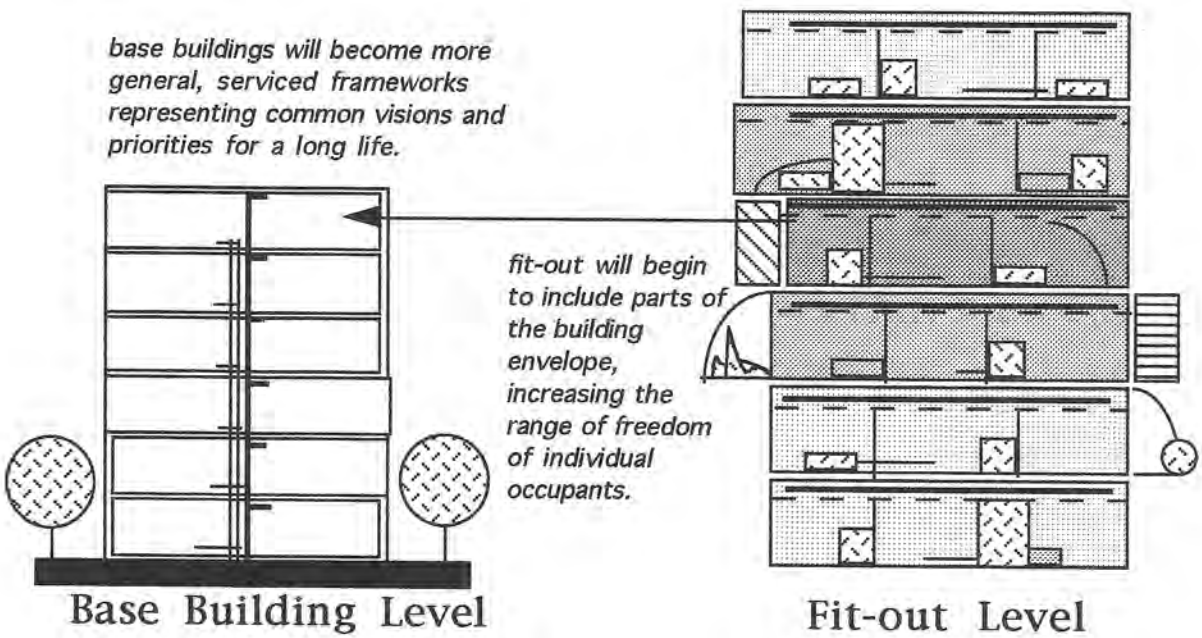
In the coming decades, base building architecture will become increasingly free of the particular and changing requirements of the fit-out, while offering improved capacity for change and individual preferences of occupants. The distinction between urban residential and non-residential architecture will be less pronounced, enabling a more healthy mix of uses.

New fit-out technology will be developed, and new organizational skills will emerge to manage the design, fabrication and installation of advanced, comprehensive infill or fit-out systems.

Specialization among all the players will continue to be molded to the principles of Open Building. These principles include:

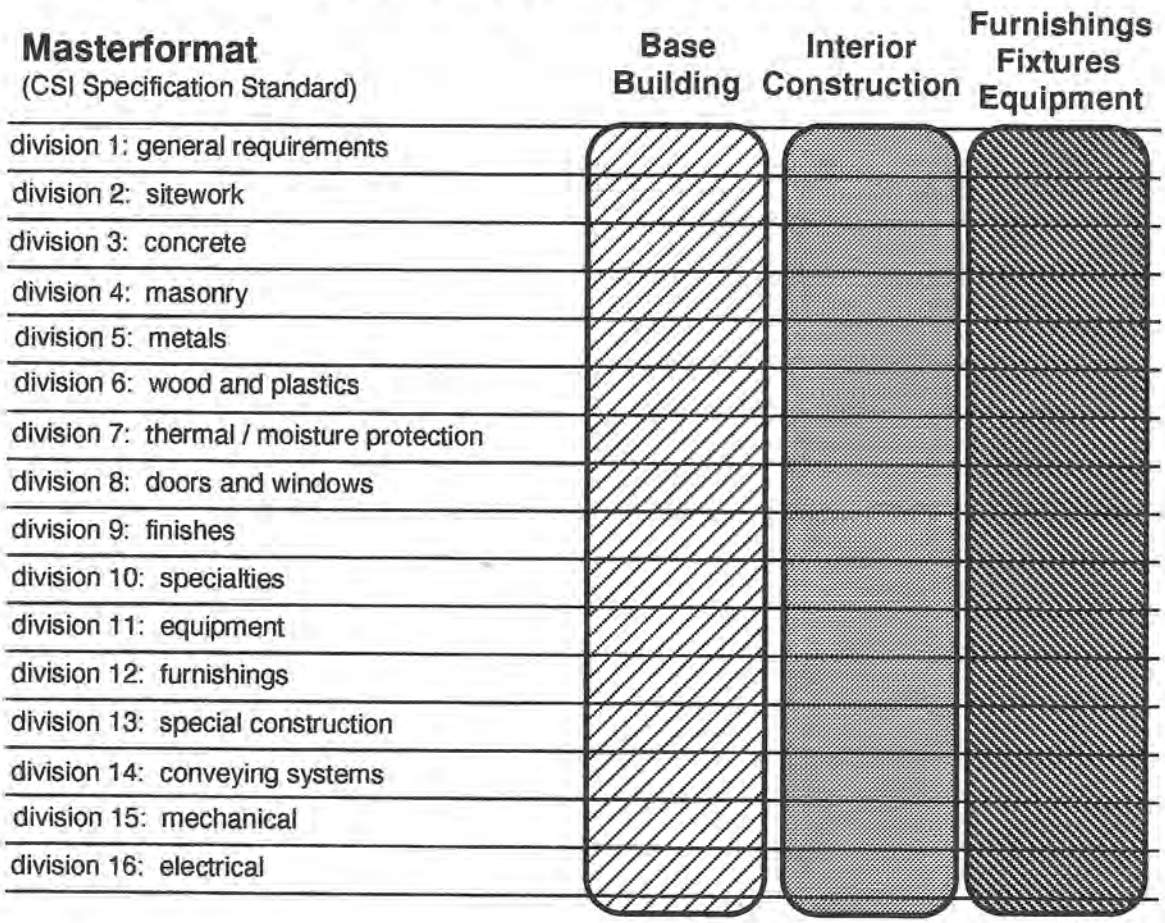
1. ordering and combining subsystems so that interference between them - and the parties controlling them - is minimized. This allows for more efficient building and the replacement or redesign of subsystems or parts with others performing the same function, without having to redesign or rebuild the whole.

2. organizing buildings according to levels. In the levels approach, there is stability and coherence at the higher level (e.g. base building) while adjustments can occur at the lower level (e.g. fit-out) with reduced conflict and confusion, improving efficiency and economic value. It also enables control to be distributed to all levels including that of building users without fear of unintended and unsafe consequences. These principles also apply at other levels in the built environment.



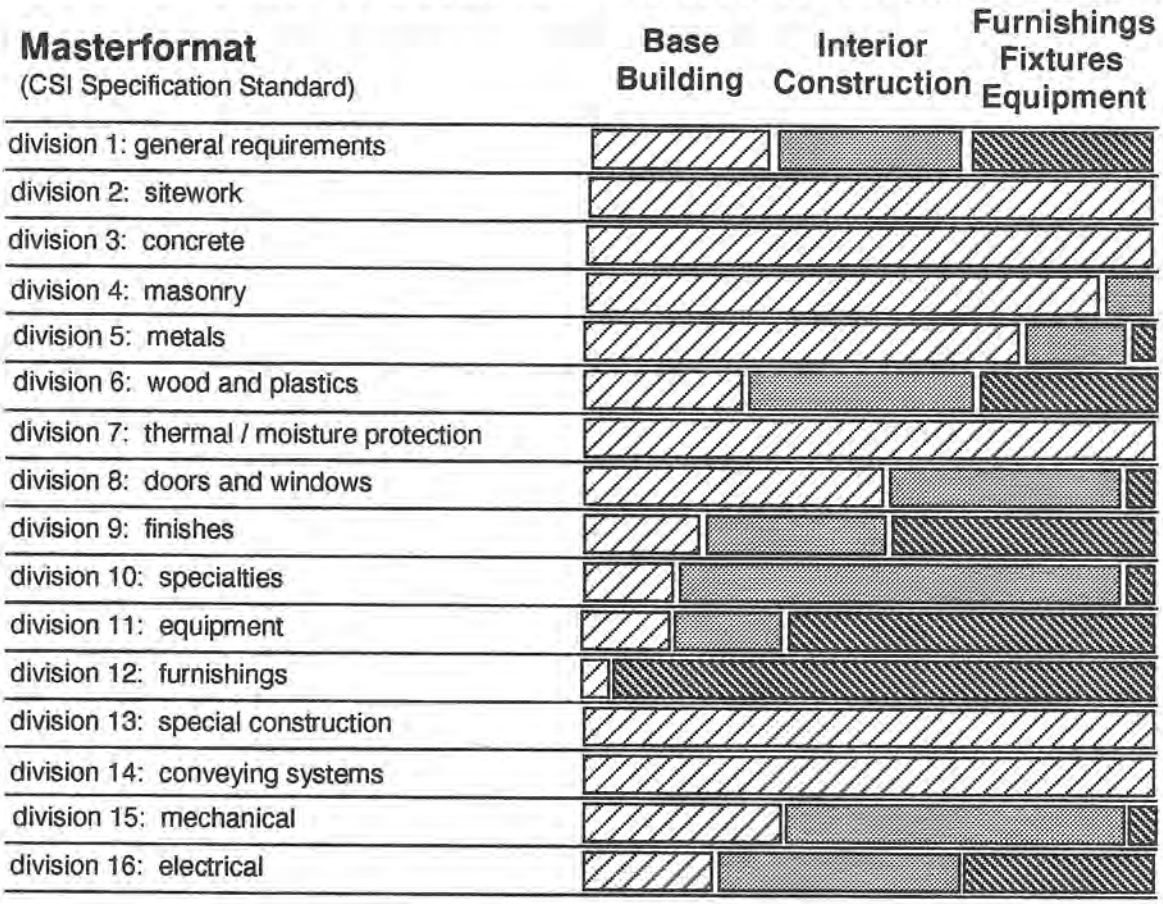
In the US, Open Building practice follows the Construction Specifications Institute Standard Specifications format in a special way.

Three Tier Model of Control Distribution



This diagram presents a basic three tier model of decisions. Later diagrams give examples of its use to describe actual (or hypothetical) situations in which control is distributed in a particular way. It also allows technical interfaces to be identified, as later diagrams show.

Three Tier Model of Control Distribution



In this diagram, each "tier" of responsibilities is adjusted according to the value of work-in-place for an hypothetical project. Some work - e.g. concrete - is entirely in the base building , while in other cases - e.g. finishes - work is distirbuted between all three tiers, but most is in the FF&E tier.

Another project will have a different diagram because, while it shares the same divisions of parts and products, work - investment - will be distributed differently. For example, it may have more interior construction and less base building work and very little if any FF&E work. This may be a project with built-in furniture and few finishes. Another project may have very little interior construction and most work distributed between the base building and FF&E work.

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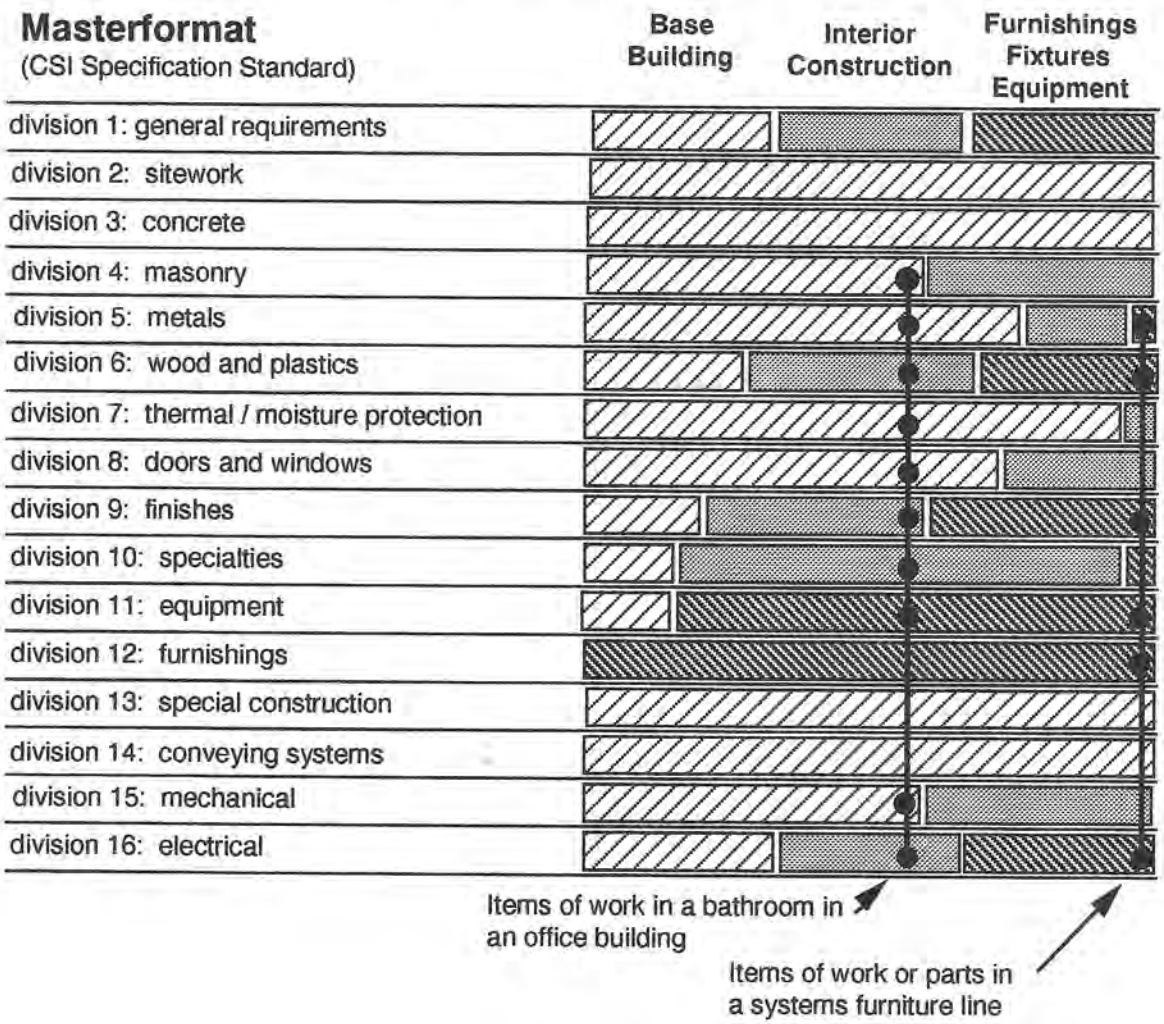
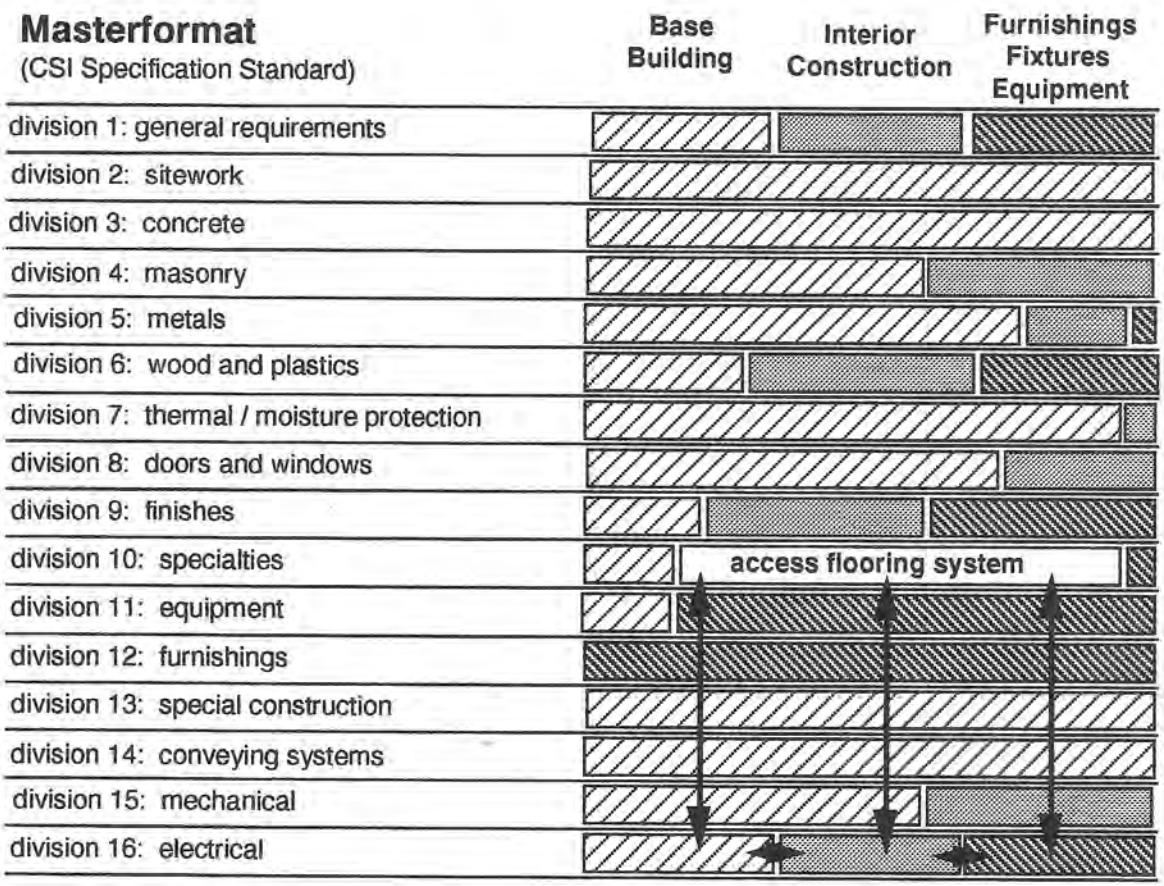


In this diagram, we can identify the divisions that are associated with any particular part (a systems furniture system's components) or space (e.g. a bathroom in an office tower's core).

Three Tier Model of Control Distribution



In this diagram, an indication is given that access flooring has a technical interface with the cabling of all three tiers, and that the cabling of all three tiers also have interfaces.

In this way, we can systematically identify parts, spaces and products according to their technical interfaces and the parties controlling them.

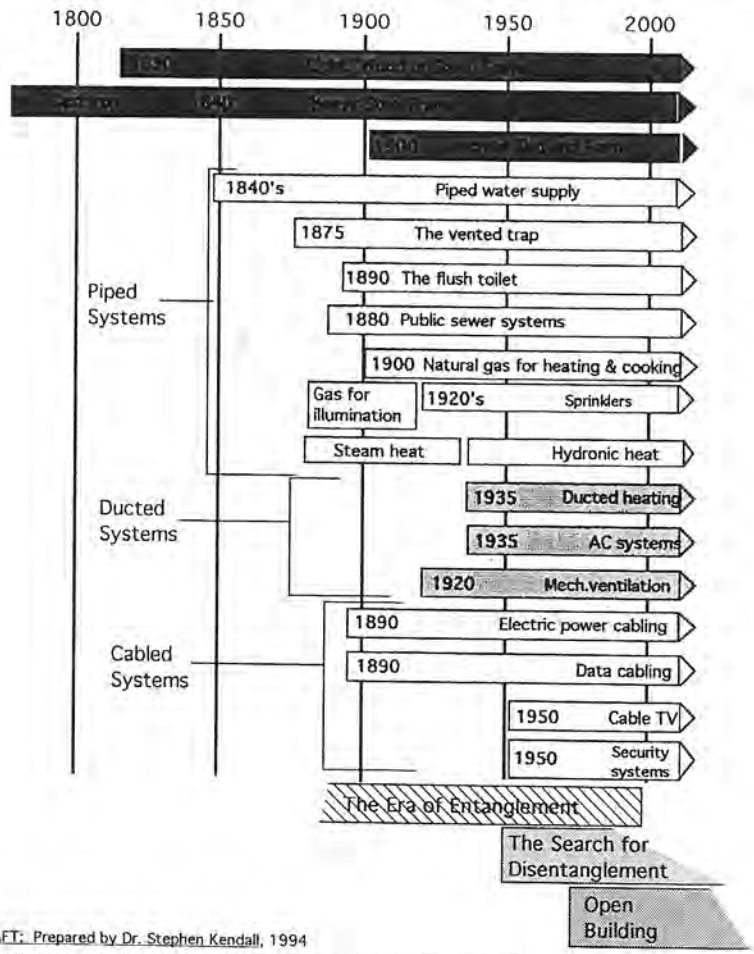
The identification of control can further be distinguished in different phases of a project: during design, one control pattern may be identified which is different from the distribution of control during installation or construction, and different still during use and subsequent alterations or renovation.

Use of these diagrams makes it possible to consider the interplay of parts and people in complex projects involving many players and many parts.

3. Why Open Building has Emerged

3.1 Physical Systems Evolution

- For centuries, buildings were predominantly composed of structural and enclosure elements. Only in the past 150 years have other kinds of systems entered the field: piped, ducted and cabled systems.



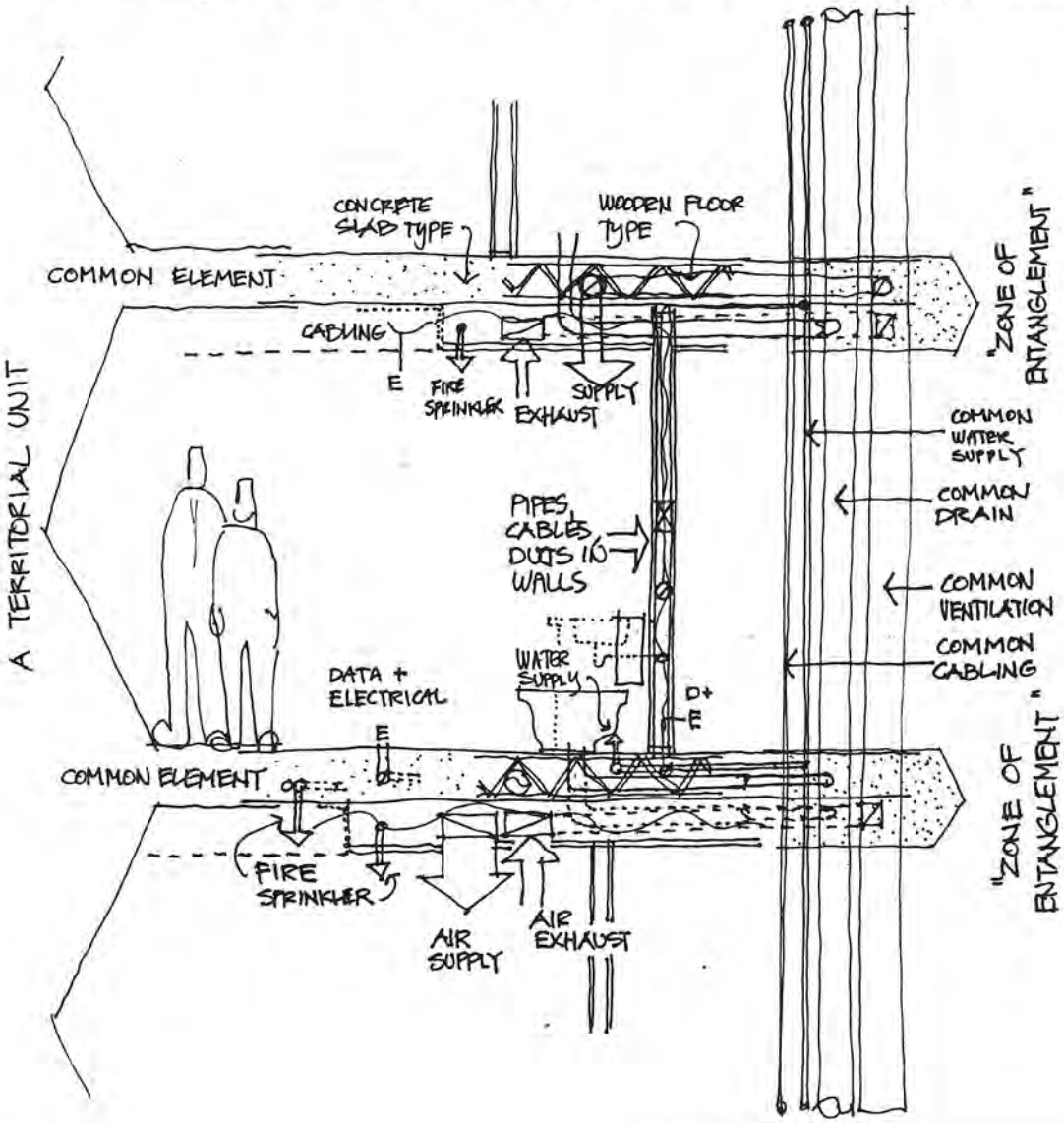
DRAFT: Prepared by Dr. Stephen Kendall, 1994

ref: Nielson, Louis, Standard Plumbing Engineering Design, McGraw-Hill, 1963
Nye, David, Electrifying America: Social Meaning of a New Technology, MIT Press, 1991
Condit, Carl, American Building, The University of Chicago Press, 1082
Forrest Wilson, Emeritus Professor, Catholic University, Washington, DC

3.2 Physical Systems Entanglement

- The relatively recent introduction of these systems - and the increasing dependence on them - means that the industry is still learning how to manage them.

Four Images of The Movement toward Disentanglement



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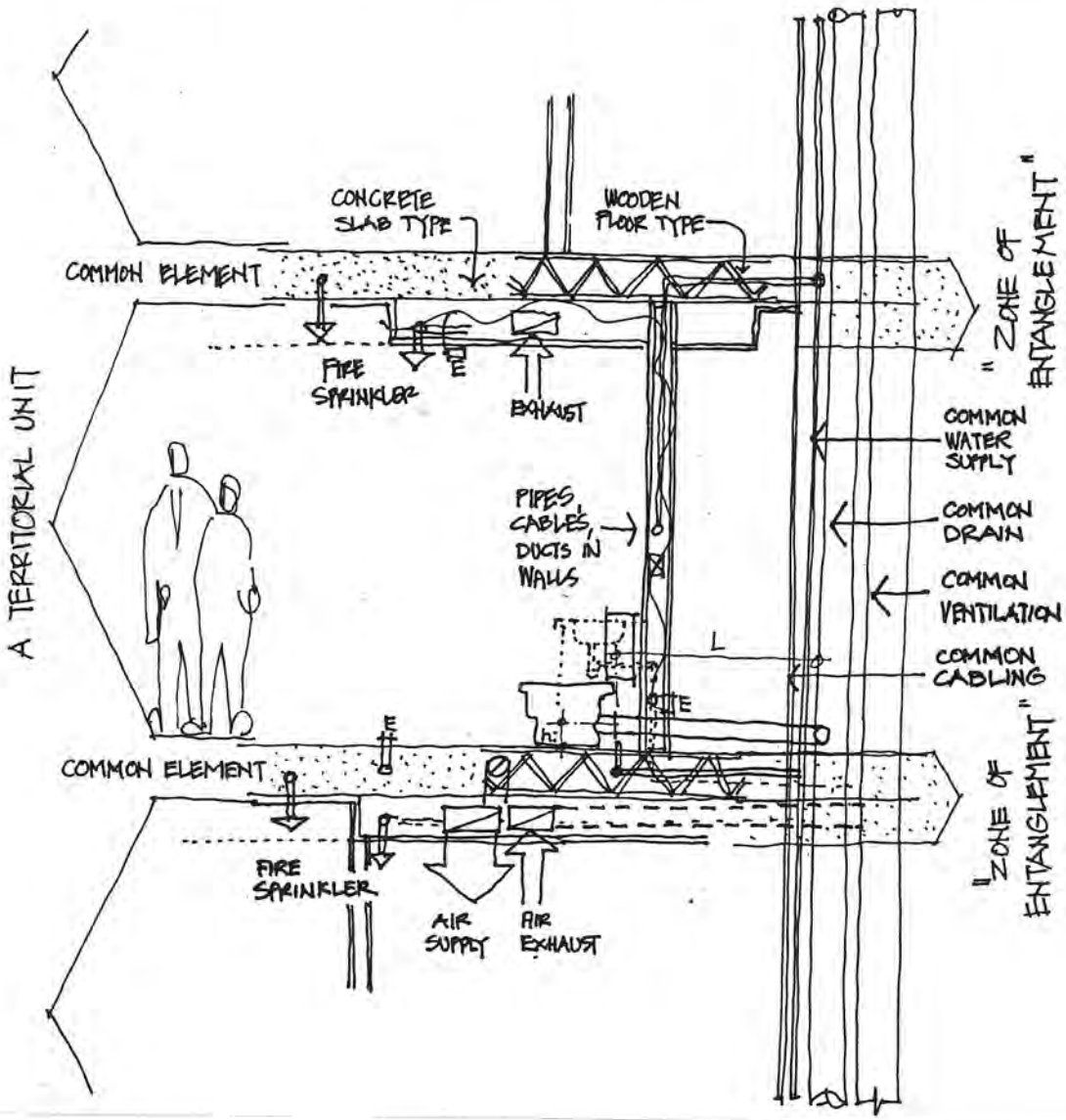

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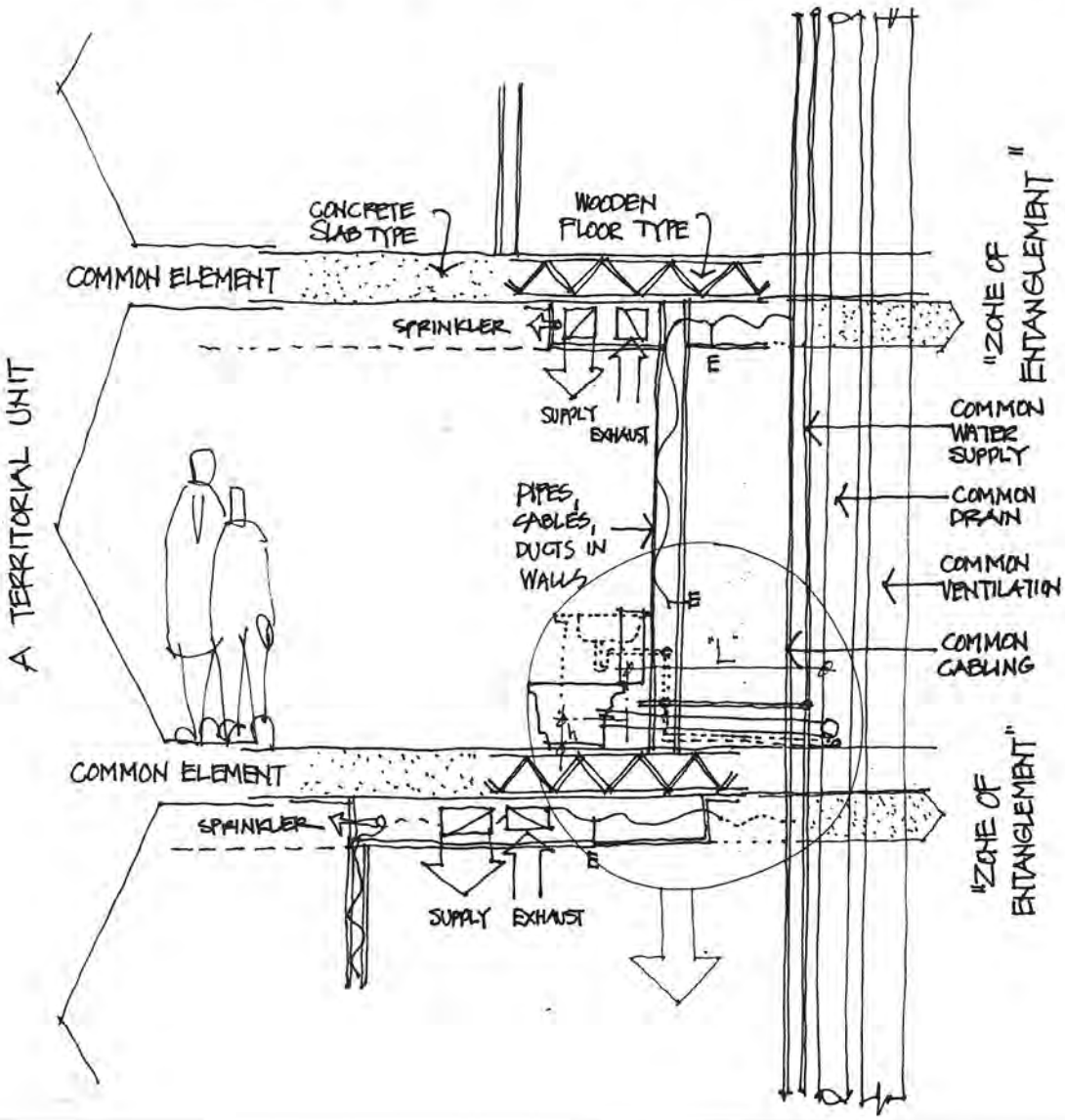

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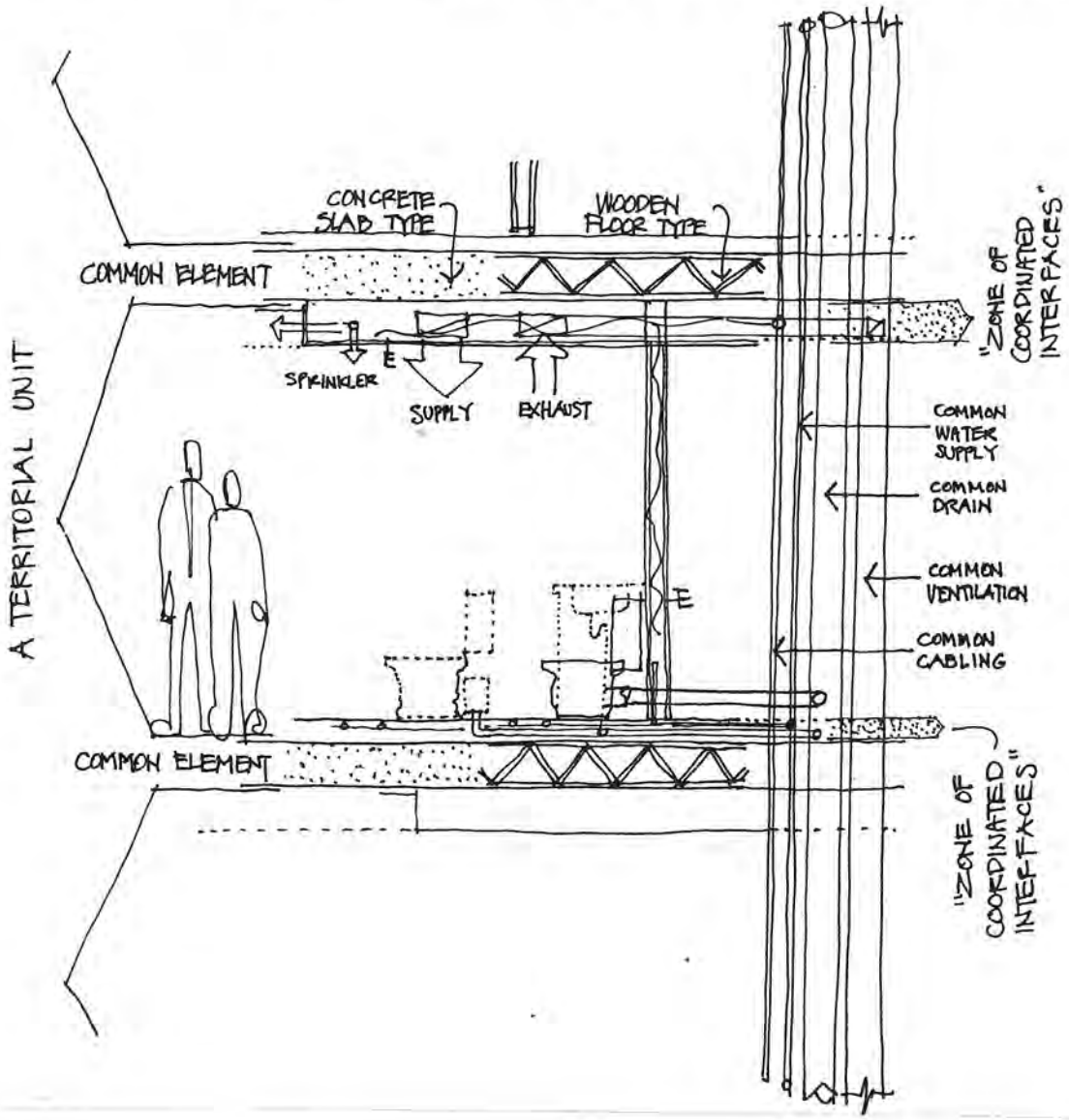

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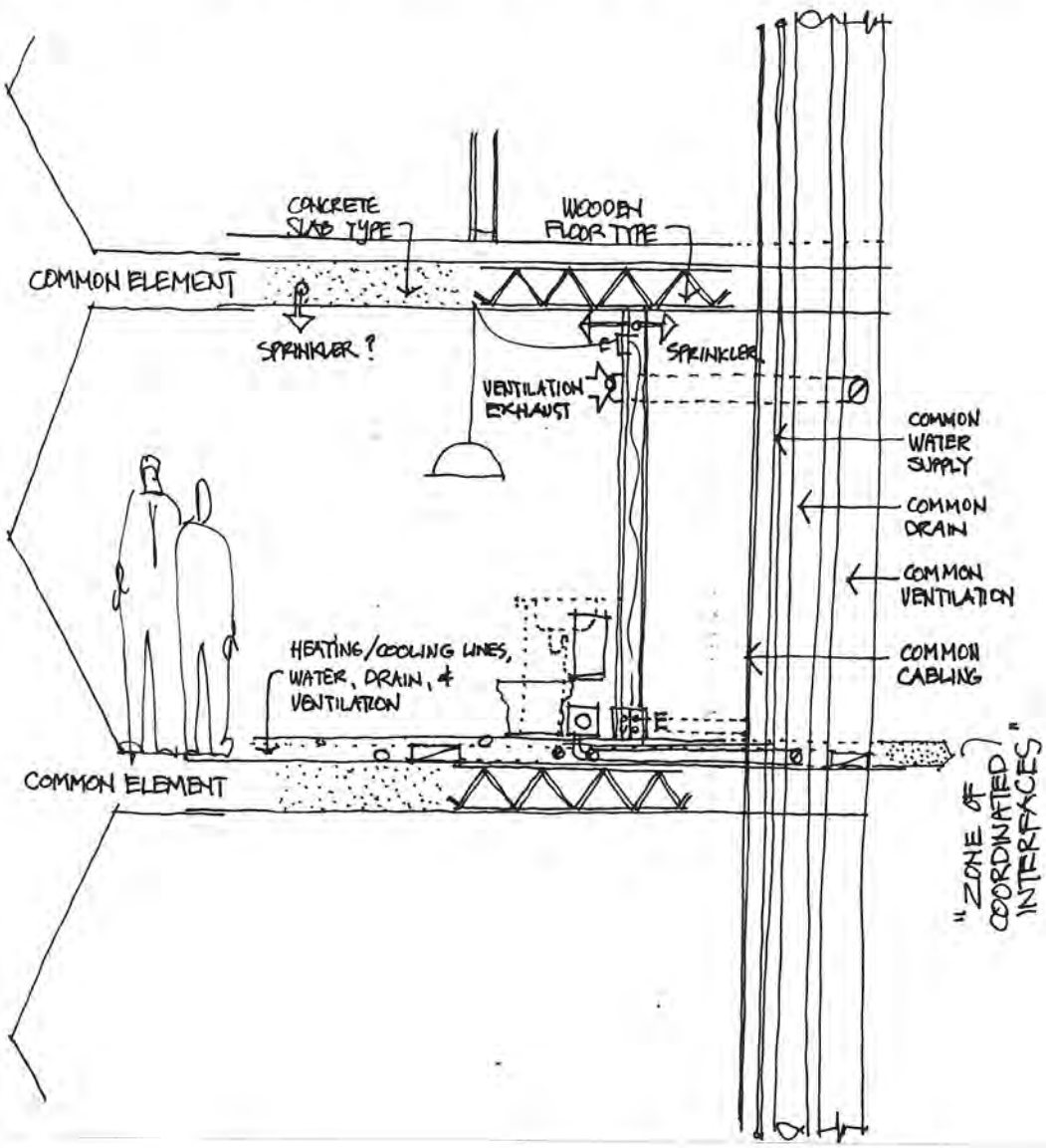

Kinds of Moves Toward Disentanglement

A. Adjustments in management techniques:

- We have been living in an era of increasing systems entanglement, including all parties in increasing conflict. Efforts to overcome these conflicts can be found in such concepts as DESIGN/BUILD; Partnering; Construction Management, and so on, which focus on organizational adjustments without fundemental design and product adjustments.

B. Reordering the Physical Organization of Parts

- Practitioners of Open Building recognize the reality of systems entanglement - related directly to organizational conflict - and advocate a particular set of tools and methods to solve these problems.

- Advocates of Open Building also suggest radical rethinking of the spatial ordering of physical systems, to reduce interfaces and reduce propogation of effects when one part is changed.

3.3 Changes in Demand and Supply

A. Non-residential Construction

- In the US non-residential building market, the rapid changes in the nature of office work has forced all parties to find new business alliances and new products.

- Much of this change in the work environment comes as a result of computers and communications technology, and the revolution in information management that results from their use.

- The decline in investment in buildings vs equipment as a % of the GNP, first documented in an article by Ventre in 1982, seems to be continuing. Over a building's life, investments in fitting-out and then changing interior environments far outstrips investments in base buildings.

- Now, the category called "equipment" is expanding to include the products of the multi-billion dollar systems furniture and access floor companies, as well as the cabling that connects computers together.

B. Residential Construction

- Demand for residential construction remains predominantly single-family in the US. But, the demand for attached single family (townhouses) is increasing. Multifamily remains about 20% of total starts.

- Changes in population demographics is an important factor in projecting future construction practices.

- There will be a sharp decline in the demand for small, non-luxury units as the US population ages. At the same time, there will be an increase in demand for housing for singles and elderly couples.

- At the same time, investments in improvements to existing housing units will increase to equal or exceed investment in new construction.

- Open Building suggests constructing base buildings which do not determine the units inside them. This allows decision flexibility during initial planning, and long term adjustability to suit changing technology and consumer demand.

- Open Building is one important strategy to meet the goals of sustainable development and construction.

4. The Emergence of an Infill Industry

4.1 Principles of Infill

4.2 Non-Residential Infill

4.3 Residential Infill

5. Examples of Open Building

5.1 Non-Residential

5.2 Residential

6. Why The Open Building View Matters

- Design and Building practice advances in complex, often invisible ways. The reality is difficult to describe.
- Giving the name "Open Building" to this reality can help.
- The idea of working on levels is not new. Levels is not an invention but an outgrowth of how people want to organize themselves to build.
- Giving a name to this interplay of technology and practice makes improvements possible.