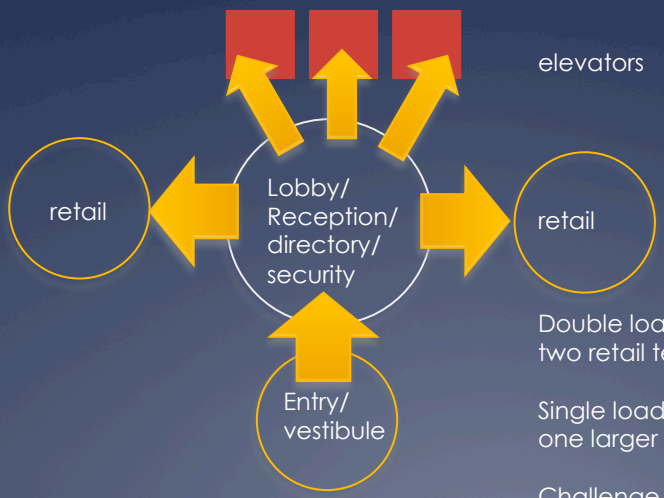
Building Planning… Part II

Core strategies

Example, multi-tenant office bulding

- Key issues
  - Return on investment
  - High net to gross ratio (what's that?)
  - Clear circulation/wayfinding
  - Maximize value of perimeter glass/views
  - Allow for street level retail

Public/employee sequence dominates… but doesn't locate



Double loaded lobby allows two retail tenants

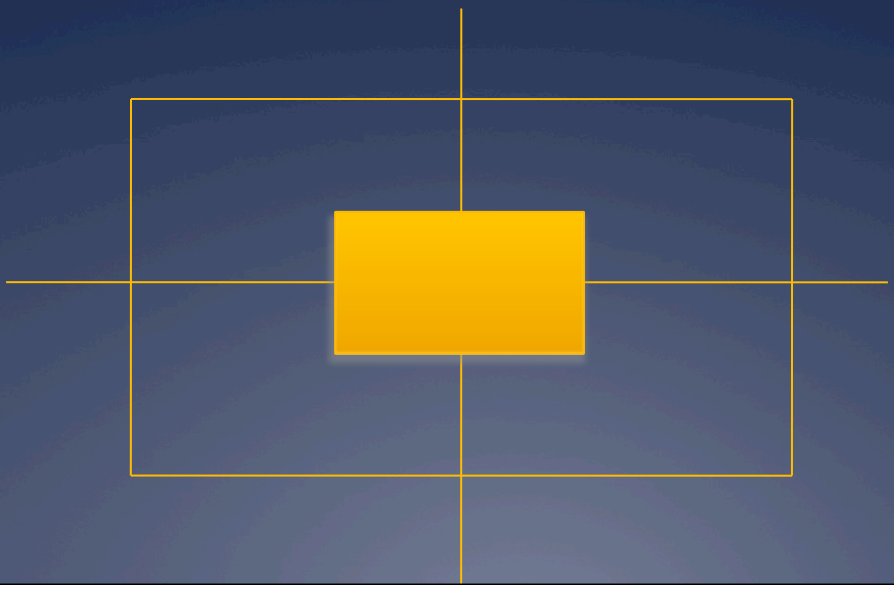
Single loaded would allow one larger tenant

Challenge might be identity

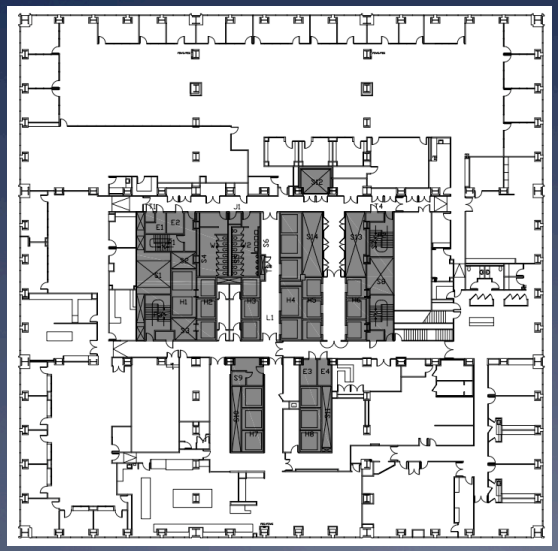
Other core responsibilities

- Besides housing egress, access, toilets and HVAC, cores often act as the primary space definition elements on a floor.
- They also are often used for lateral bracing of the structural frame, with walls reinforced to be shear diaphragms or with "X" bracing or chevron bracing concealed within their enclosing walls

Core location…always center?



Willis Tower, Chicago



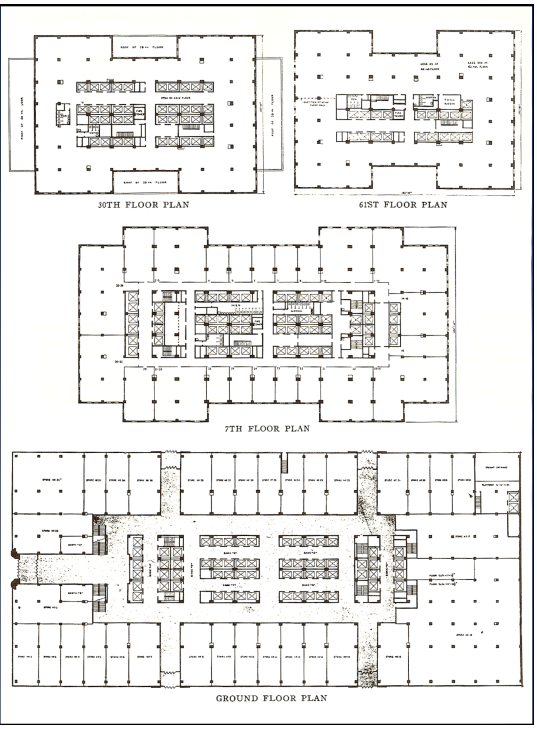
53,000 net rentable s.f.

Empire State Designed for Rapid-Building

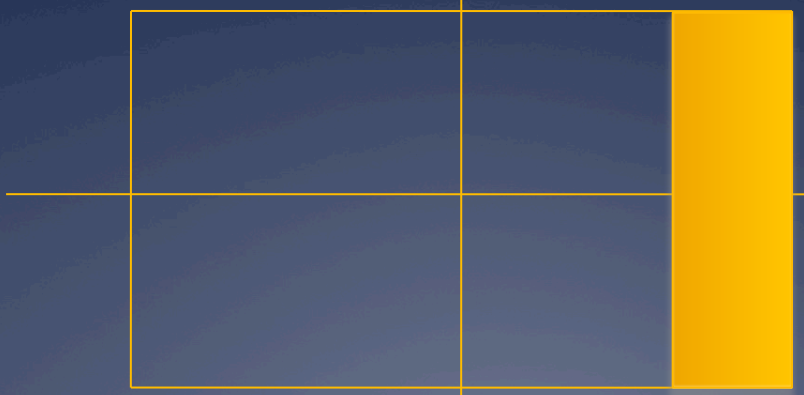
- … 2,768,591s.f. in 410 days?
  6,752 s.f. per day!
- Standard Bay sizes
- Standard Mullion spacing
- Stone sizes fit to milling equipment
- Steel sizes fit to transport/lifting equipment

Setbacks change floor plates

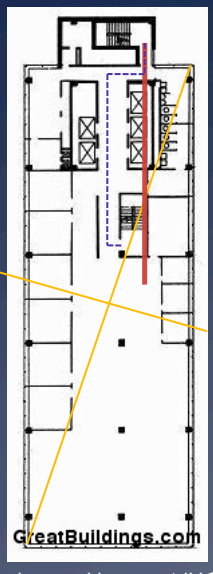
- Meeting zoning required stepping back the building, reducing the number of repeated floors
- Upper floors consumed by elevators (73 total)



End Core location responds to local conditions

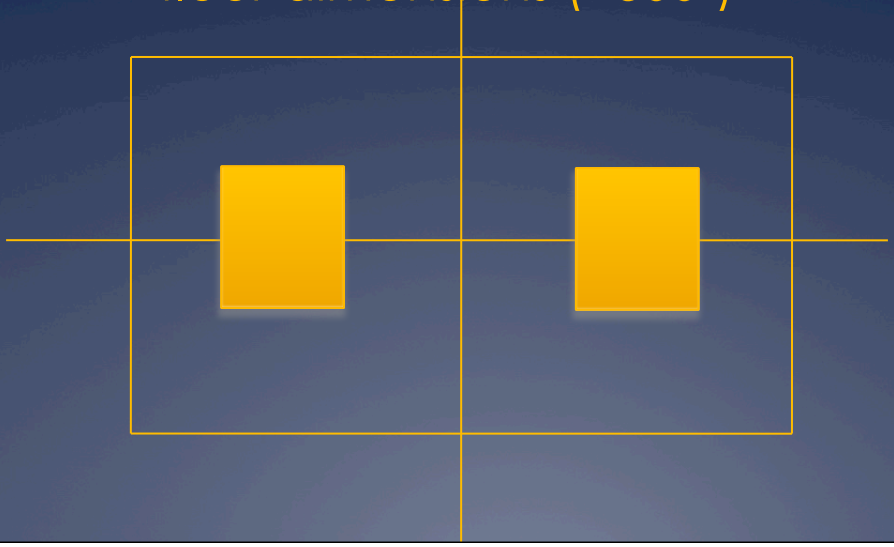


What looks problematic?

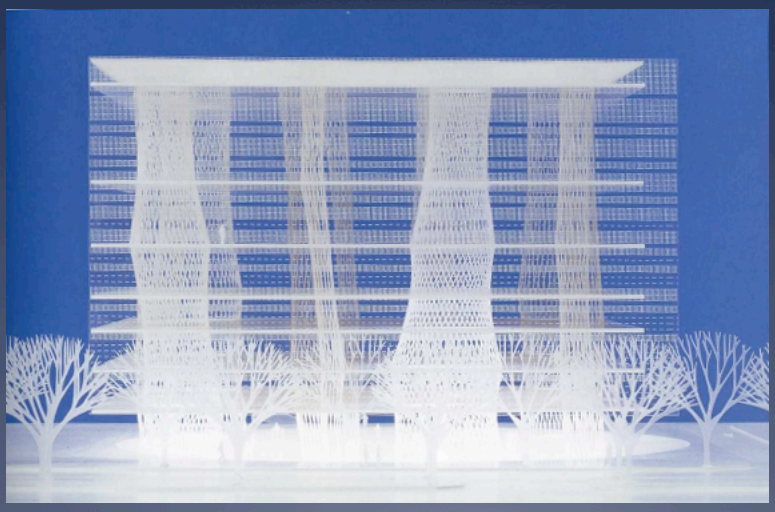


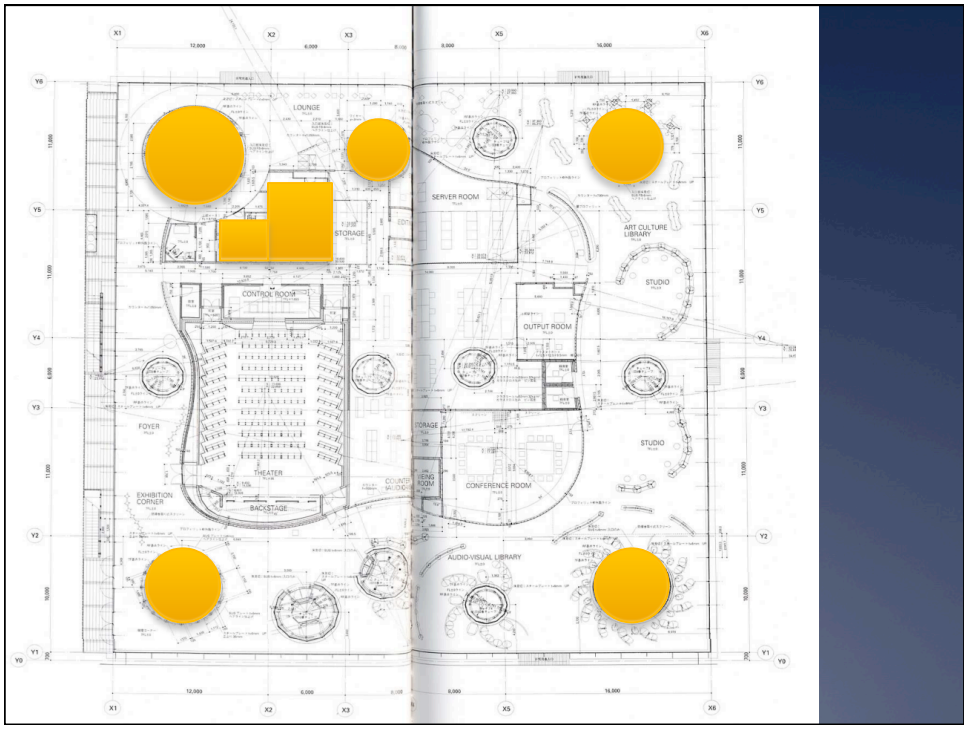
Lever House, NYC,
Gordon Bunshaft, 1952

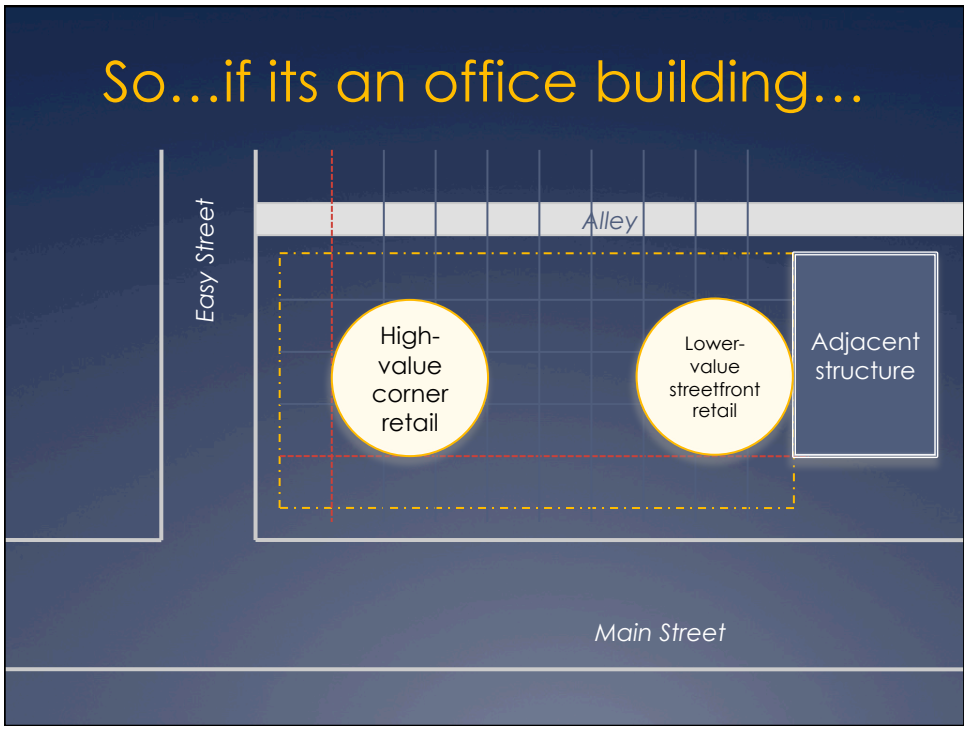
Multi Core placement for large floor dimensions (<300')



Sendai Mediateque, Ito atomizes the core




LOUNGE
SERVER ROOM
STORAGE
ART CULTURE LIBRARY
STUDIO
CONTROL ROOM
OUTPUT ROOM
FOYER
THEATER
STUDIO
EXHIBITION CORNER
BACKSTAGE
CONFERENCE ROOM
AUDIO-VISUAL LIBRARY


So…if its an office building…
Easy Street
Alley
High-value corner retail
Lower-value streetfront retail
Adjacent structure
Main Street

…but the tail can't wag the dog

- The corner retail will produce higher rental costs, but will it compromise the 15 floors of building above it?
- The street-front retail will tolerate more spatial disruption due to its lower rents, but how much can we intrude on it?

Time to consider the cores

- coreS?...not just one?
  - Every floor will need
    - Elevator access
    - 2 means of egress (elevators won't count)
    - Toilets for each gender
    - Some electrical/telecom space
    - Some space for ventilation/hvac
      - Could be a shaft
      - Could be a fan room

A midrise building core

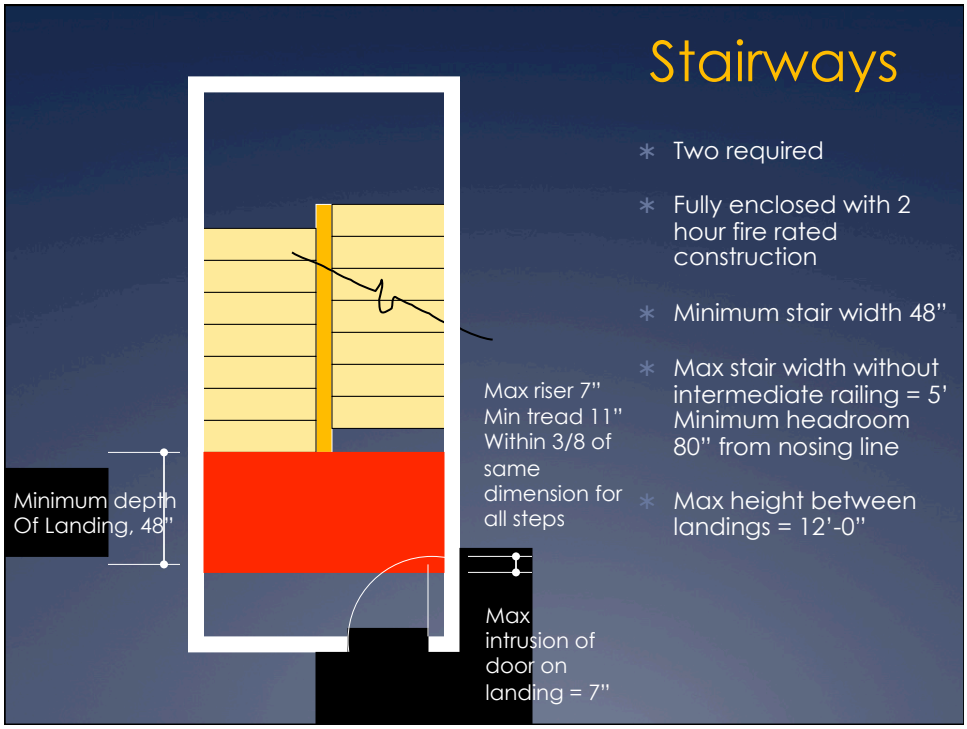
MULTI - TENANT CORE LAYOUT

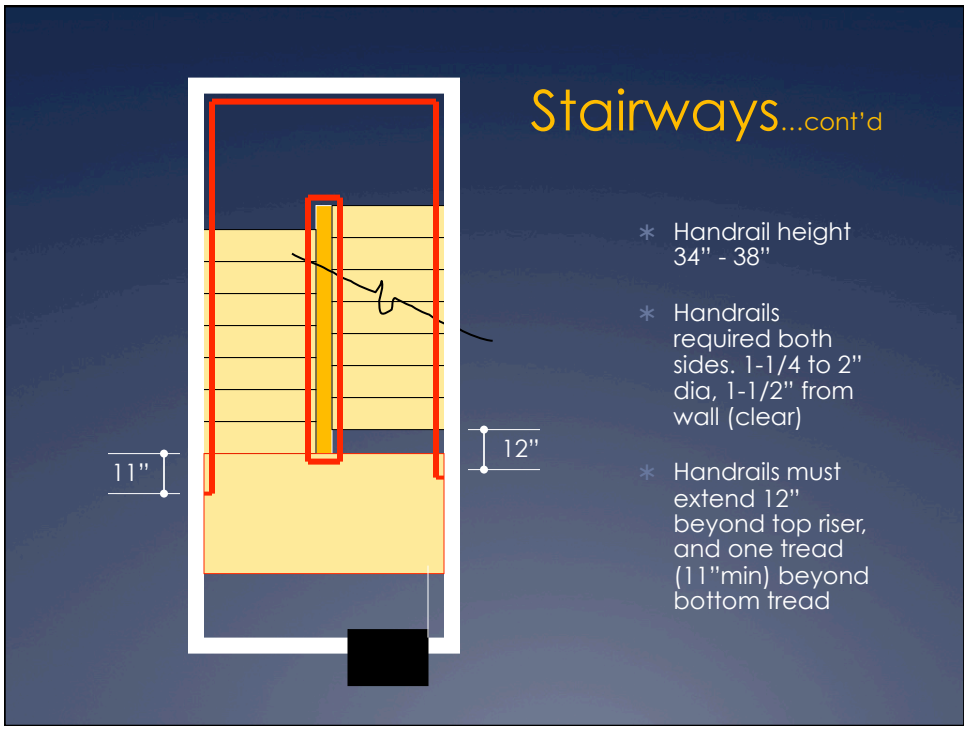
Stairwell Corridor _ 1
Stairwell _ 2
Men's Room _ 3
Women's Room _ 4
Janitorial _ 5
Cargo Elevator _ 6
Tenant Storage _ 7
Elevator Lobby _ 8
Janitorial _ 9
Telecom _ 10
Electrical _ 11
Mechanical _ 12

Will Paton, final study F2011

A minimal stair

- 48 inches between handrails
- 1.5" handrails (each side) that are 1.5" from the walls
- So a single run of stairs is 54" wide
- If the stair runs between 12 foot floors,
  - 12x12=144" of rise
  - divided by max riser 7.0 = 20.5 risers, say 21 at 6.8" or just over 6 and ¾ inches.
  - always one less tread than riser so 20 risers at min dimension of 11 inches so 20x11inches = 220 inches or 18 feet 4 inches of horizontal run, add 6-5 foot landings at the top and bottom if doors open into the stairs) (and, not counting the ARA), the overall inside of the straight run stair is 31'2" x 5'4" wide.

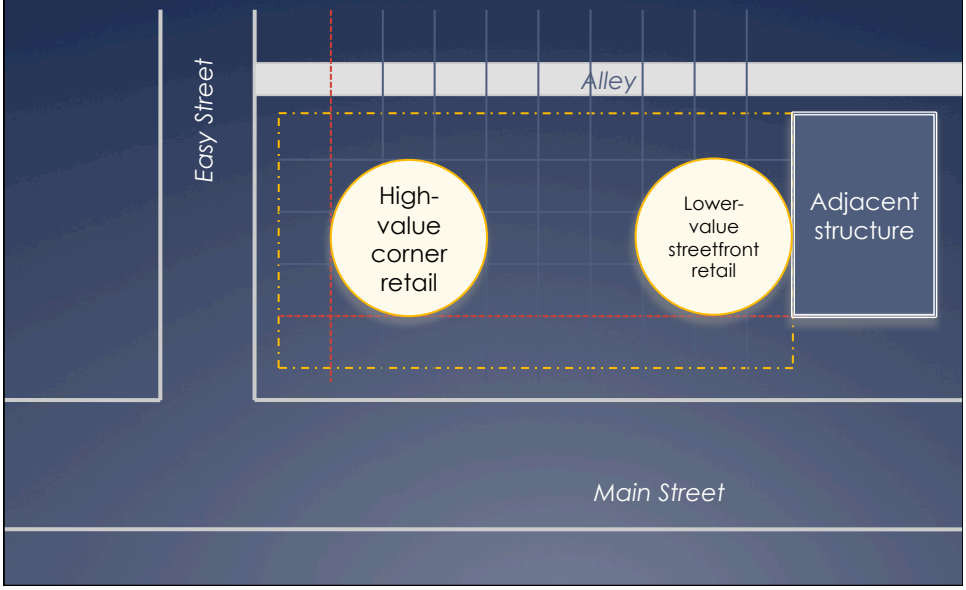

Stairways
Two required
Fully enclosed with 2 hour fire rated construction
Minimum stair width 48"
Max stair width without intermediate railing = 5'
Minimum headroom 80" from nosing line
Max height between landings = 12'-0"
Max riser 7"
Min tread 11"
Within 3/8 of same dimension for all steps
Minimum depth Of Landing, 48"
Max intrusion of door on landing = 7"


Stairways...cont'd
Handrail height 34" - 38"
Handrails required both sides. 1-1/4 to 2" dia, 1-1/2" from wall (clear)
Handrails must extend 12" beyond top riser, and one tread (11"min) beyond bottom tread
11"
12"

Other core responsibilities

- Besides housing egress, access, toilets and HVAC, cores often act as the primary space definition elements on a floor.
- They also are often used for lateral bracing of the structural frame, with walls reinforced to be shear diaphragms or with "X" bracing or chevron bracing concealed within their enclosing walls

Considering cores…



Chicken or the egg?

What sets the core-to-skin distance?

MULTI - TENANT CORE LAYOUT

Stairwell Corridor _ 1
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Tenant Storage _ 7
Elevator Lobby _ 8
Janitorial _ 9
Telecom _ 10
Electrical _ 11
Mechanical _ 12

How far is it from the core to the skin?

MULTI - TENANT CORE LAYOUT

Stairwell Corridor _ 1
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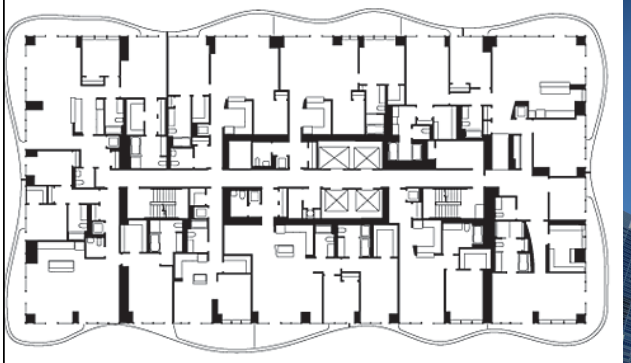
Know your typology ...what's that mean?



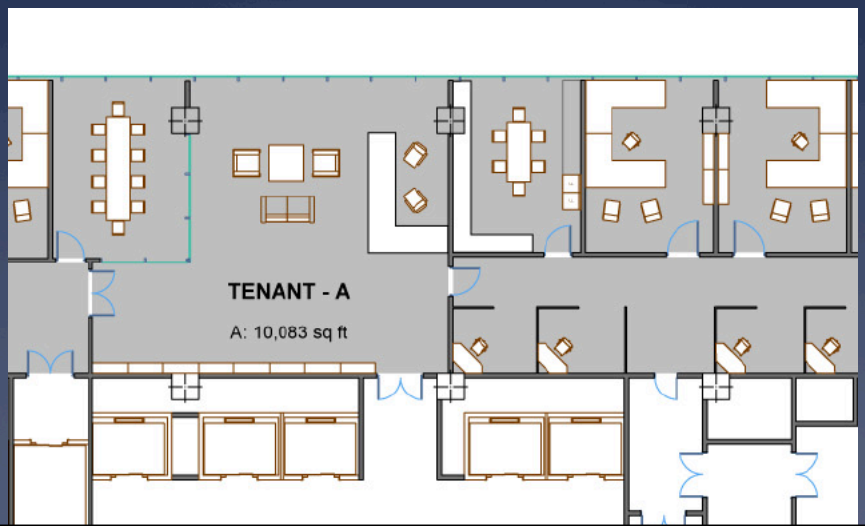
typology meets client culture… meets market…

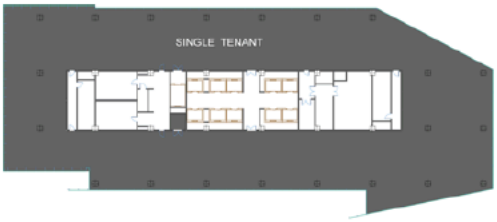
MULTI - TENANT FLOORPLATE

Tenant A - 10,083 sf
Senior-level Executive Suites - 6
Mid-level Executive Suites - 8
Junior Associates - 31
Conference Rooms - 2
Breakroom / Reception
Total Workforce - 45
SF / Employee - 224 sf

Tenant B - 9,092 sf
Senior-level Executive Suites - 6
Mid-level Executives Suites - 5
Junior Associates - 22
Conference Rooms - 2
Breakroom / Reception
Total Workforce - 35
SF / Employee - 260 sf

Client Culture, Organization, and Form





Single Tenant
Tenant- 20,520 sf
Employees: 87 (actual)
Efficiency: 224 sf/capita

Market needs inform

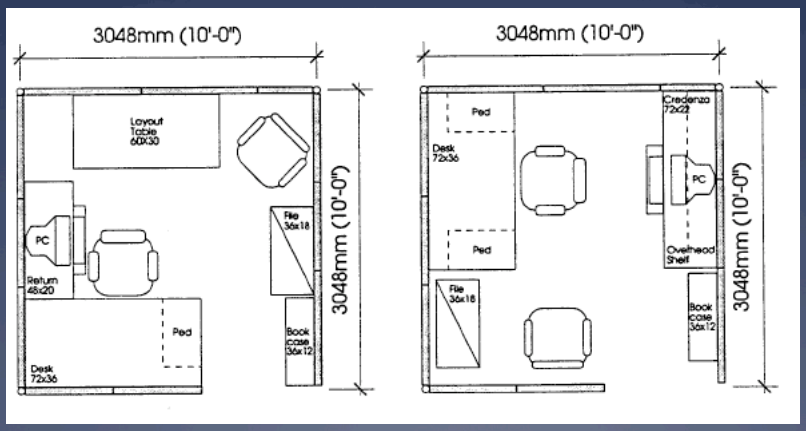
Dual Tenant
Tenant_A- 10,083 sf
Tenant_B- 9,092 sf
Employees: 34/45 (actual)
Efficiency A: 297sf/ capita
Efficiency B: 202 sf/capita

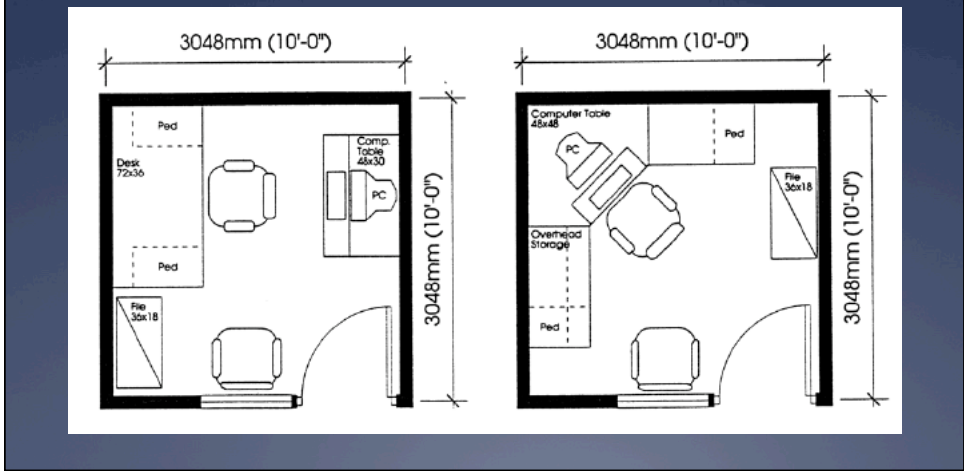
Triple Tenant
Tenant_A- 4,945 sf
Tenant_B- 7,146 sf
Tenant_C- 5,602 sf
Employees: 24/18/19 (actual)
Efficiency A: 206 sf/capita
Efficiency B: 397 sf/capita
Efficiency C: 295 sf/capita

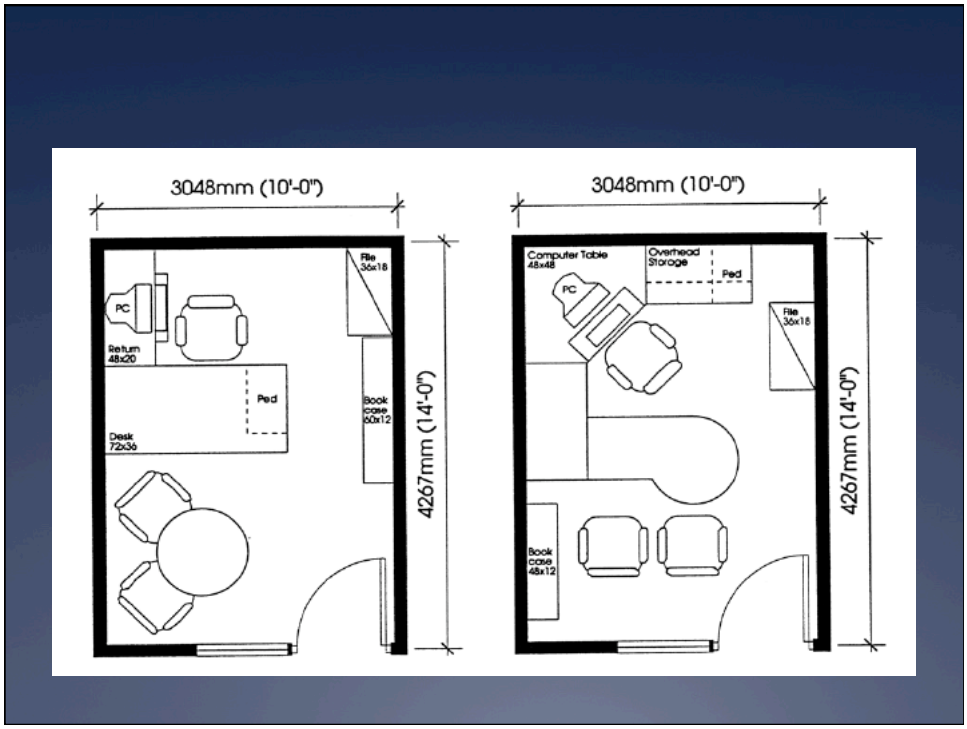
Modularity…common denominators…

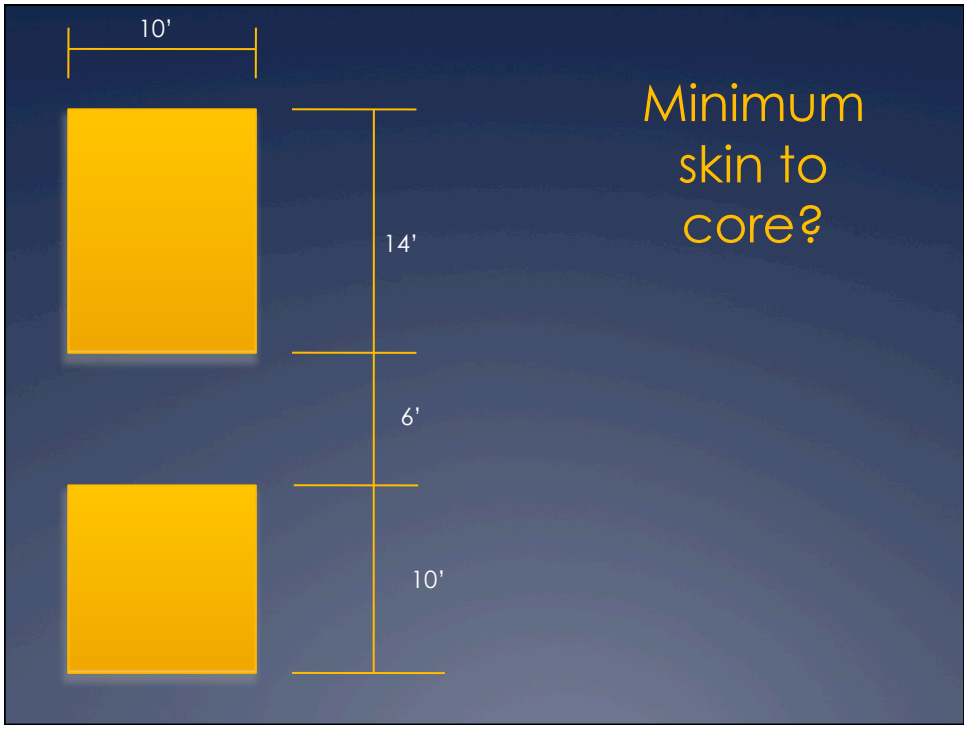
- Planning grids
- Structural grids
- Lighting grids
- Power grids
- Mechanical grids

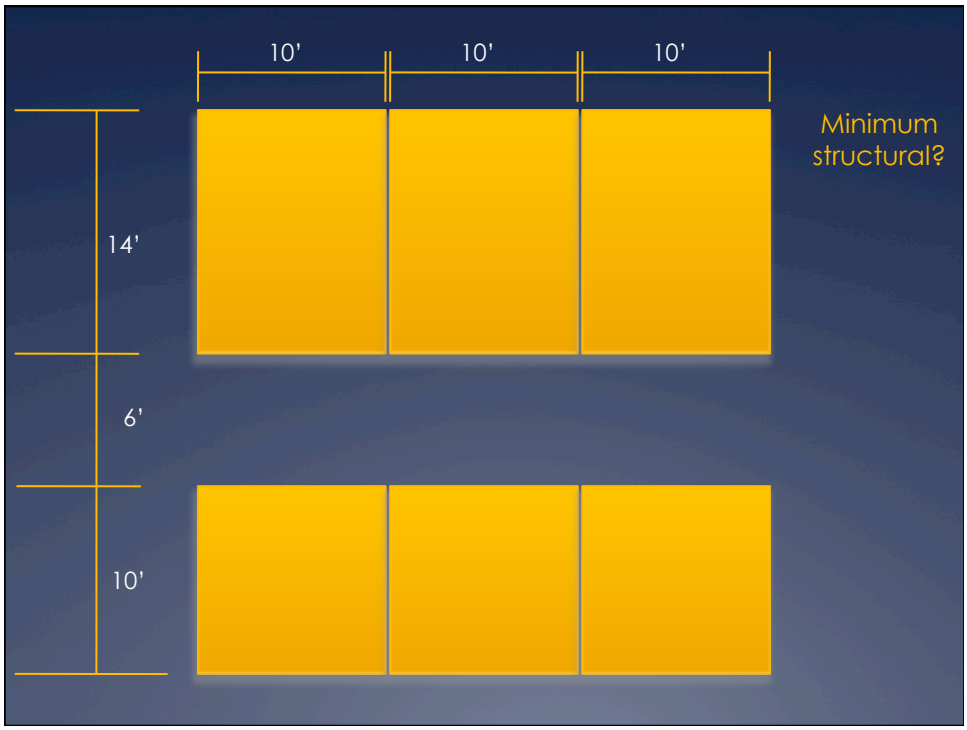
Built from the most common… and smallest acceptable unit of space




3048mm (10'-0")
Ped
Desk
72x36
Comp.
Table
48x30
PC
Ped
File
36x18
3048mm (10'-0")
3048mm (10'-0")
Computer Table
48x48
PC
Ped
File
36x18
Overhead
Storage
Ped
3048mm (10'-0")


3048mm (10'-0")
File
36x18
PC
Return
48x20
Ped
Desk
72x36
Book
case
60x12
4267mm (14'-0")
3048mm (10'-0")
Computer Table
48x48
Overhead
Storage
Ped
PC
File
36x18
Book
case
48x12
4267mm (14'-0")


10'
14'
6'
10'
Minimum skin to core?


10'
10'
10'
14'
6'
10'
Minimum structural?

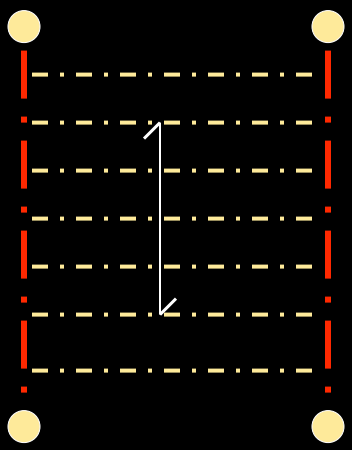
Check structural capability

Steel Frame

Cast-in-Place Concrete Frame

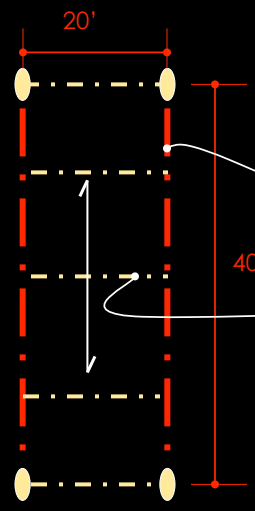
Precast Frame

Steel R.O.T. p.356



Depth of Girders = 1/15 span
(width=1/3 to 1/2 depth)
Depth of Beams 1/20 span
(depth of slab included in composite structures)
Depth of bar joists 1/20 span
(spacing 2 to 10 feet depending on decking / concrete thickness)
Depth of decking and concrete for floors 1/24th of span (2 1/2 to 7 inches typical)
Depth of decking for roof 1/40 th of span (1 to 4 inch decking available)

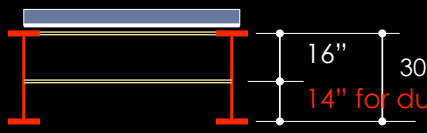
Bay proportions…are long girders better?



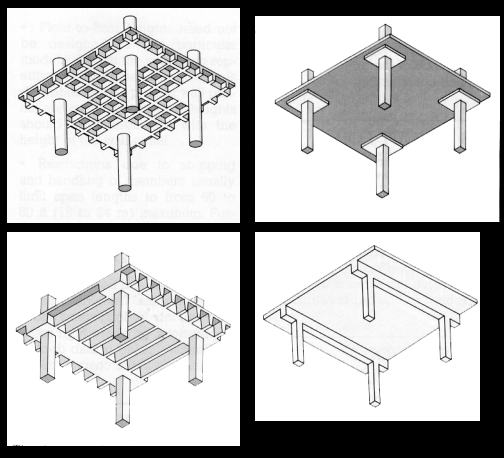
Here the girders are spanning 40' and are framing into the columns and carry the secondary floor beams.

This requires
W30x108 girders
And
W16x26 beams

With a 5 1/4" slab over the beams that's 6,400 pounds of steel in this bay



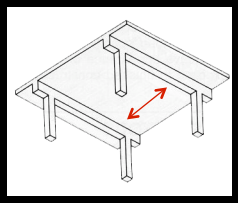
Site-Cast-Concrete Systems…Basic flavors



- Basically, there are 4 types of slabs an architect chooses from when considering a system for a project.
- Slabs are usually flat, can be reinforced to span one way or two ways. Their span usually depends on their depth, but there is a point where the extra concrete in the depth works against the slab due to its weight.
- Joist slabs usually can span farther and carry heavier loads because they eliminate concrete not contributing to the slabs strength. (hence the joists)

All diagrams from Allen "Architects Studio Companion"

One way flat slabs…will it work?

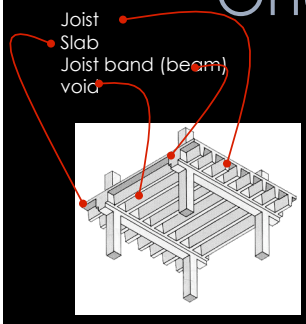


Span min6'
Span max 18'
R.O.T. Slab depth
1/22th of span
Postten rot Slab depth
1/40th of span

Min thick for 2hr = 5"
Min thick for 3hr = 6 1/2"

- The one way slab spans between beams or columns. It requires a structural bay (spacing between columns in both directions) that is within 20% of being square.
- It is usually used for light loading applications where it's thin structural depth gives a low floor to floor height.
- When heavily loaded it requires the beams below the slab, It is more desirable to NOT have these beams as they take additional labor to form and pour.
- Costs
  - 25x25 6" 40psf load about $13.80 per sq.ft.
  - 25x25 6" 125psf load about $17.20 per sq.ft.

One way joist slabs

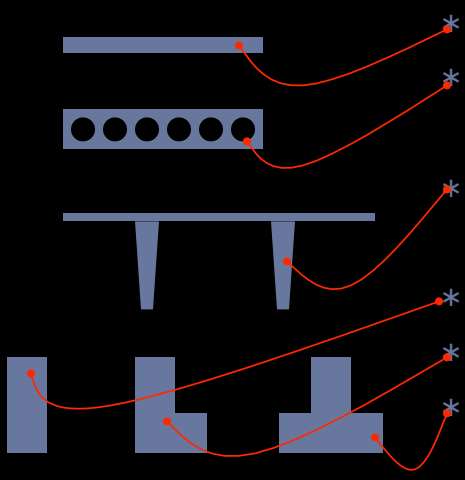


Span min12'
Span max 45'
R.O.T. Slab depth
1/18th of span
Postten rot Slab depth
1/36th of span

Min thick for 2hr = 5"
Min thick for 3hr = 6 1/2"

- To address heavier loading conditions, its necessary to remove the concrete that's acting as dead weight - working against the slab that comes along with an increase in the uniform thickness of a slab.
- This one way joist slab does just that, using prefab formwork set on a plywood deck voids are formed between the joists which make the slab lighter, and stiffer.
- The joists bear into beams (called ***bands***) spanning from column to column. These ***bands*** give this system the ability to move columns off the grid, (as long as they still fall under the ***bands***) allowing for more plan flexibility.
- Costs
  - 25x25 12" 40psf load about $14.10 per sq.ft.
  - 25x25 12" 125psf load about $16.50 per sq.ft.

Standard Spanning elements



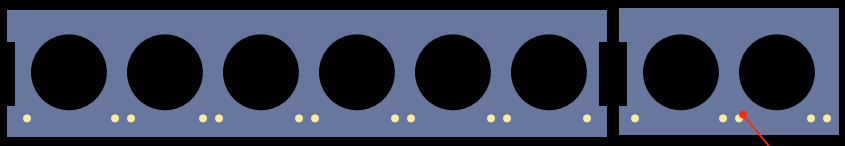
- Solid slabs
- Hollow core slabs
- Double tees
- Rectangular beam
- "L" beams
- "T" beams

- Each piece is numbered for location according to the shop drawings.
- This producer also dates each piece to be certain only fully cured components are installed

Castellated joint

Hollow Core slabs

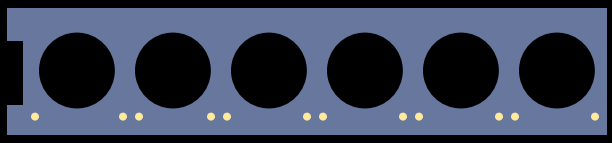
* Like sitecast slabs, when the depth of a solid slab increases past a certain point, the extra weight of the concrete works against the spanning member.
* In precast, the hollow core slab, removes unemployed concrete increasing the structural efficiency of the slab.



Unlike the solid slab, the hollow core slab is reinforced with prestressing strands in the top and bottom of the slab.

Spanning

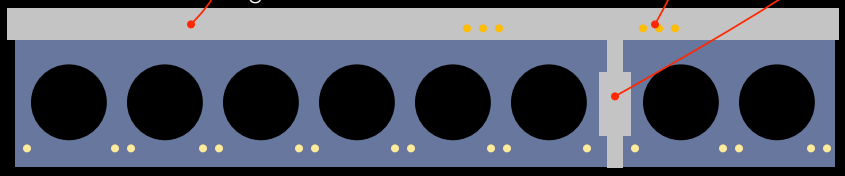
* The hollows are made in different ways by different companies. Some have expanding air cylinders, some use pea gravel laid in the bottom half of the pour.



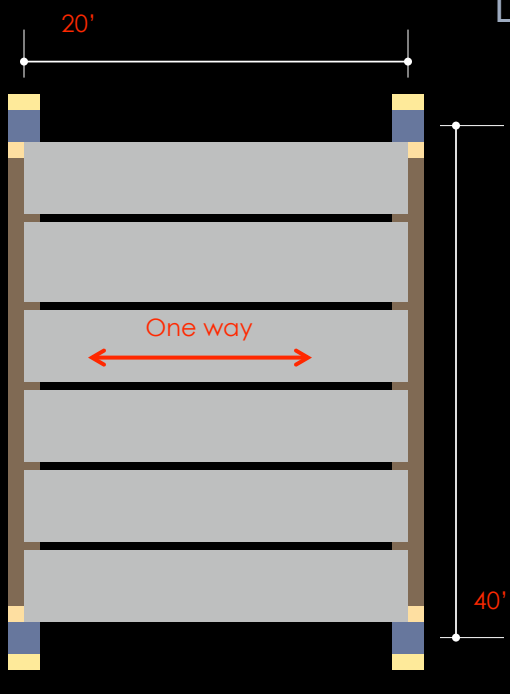
Span max 45'
Widths 2'-0", 3'-4", 4'-0", 8'-0"
Span / Depth ratio 1/40
Min produced depth 6" (2" increments)
Max produced depth 12"
Cost per s.f. topped $12.50
Cost per s.f. untopped $10.50

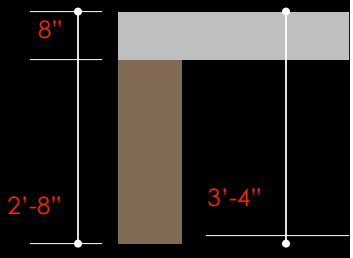
aka the plank

- Like the solid slab, the hollow core slab (***also known as the hollow core plank***) has castellated joints to form shear keys when filled with grout.
- This helps the planks work together and increases structural efficiency.
- Like other precast systems when used as floors, the hollow core plank needs a topping slab (2" or so) to level out the camber differences, make a diaphragm for lateral resistance, and make a place for electrical and hot water heating utilities.

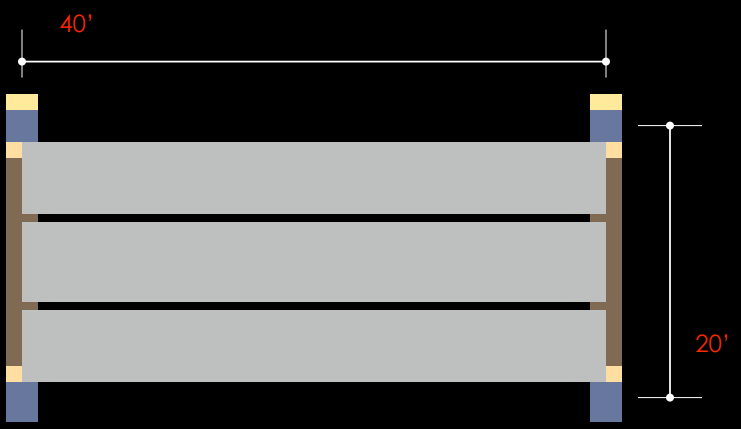


Long beams, short planks or long planks short beams?



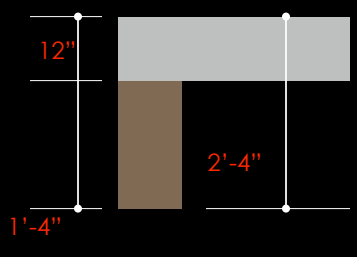


- The longer a beam spans, the deeper it must be. While the plank stays pretty much the same. (the number of prestensioned strands increases)
- In this example, say the beam span is 20 feet, the rule of thumb of d=1/15 s gives 20/15=1'-4" deep. The plank spans 40 feet here and which gives an 12" plank. This makes a 2'-4" deep structural sandwich



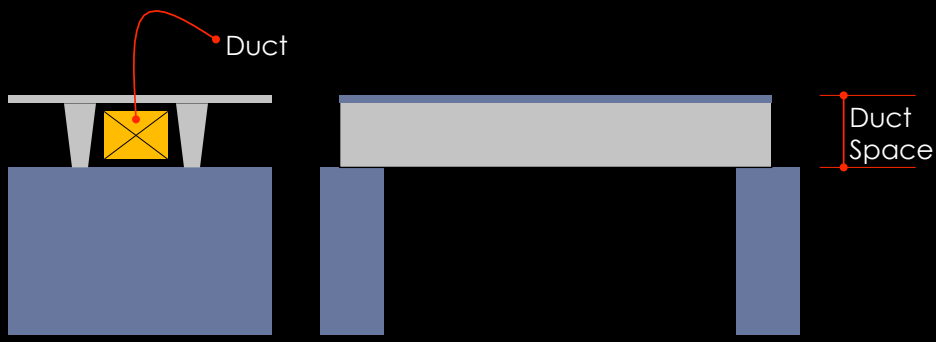
That's a FOOT thinner! In a 8 story building it gives the owner an extra floor for *FREE*!

So bay size has a LOT to do with structural depth, which has a significant impact on the projects economics!



Beams & floor to floor heights...look familiar?

- Supporting the spanning member on top of the beam adds to the floor to floor height, but, if the spanning member on top of the beam is a single or double tee, the space between the top flange and bottom of the stem is available for ductwork to pass **over** the beam with no conflict!

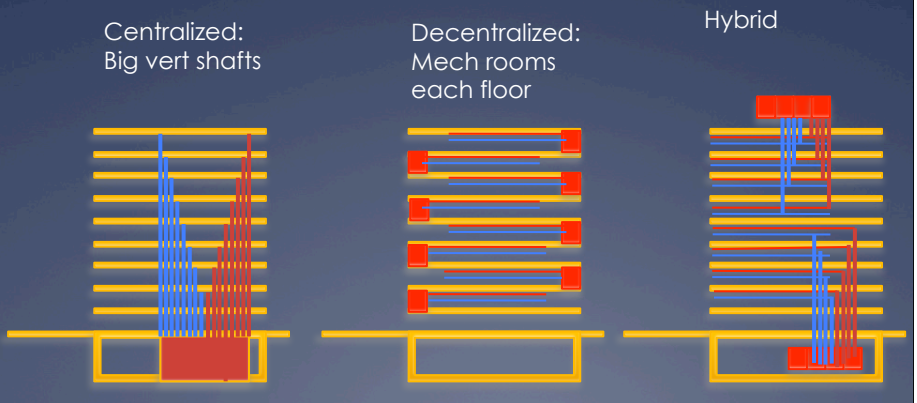


Mechanical Planning

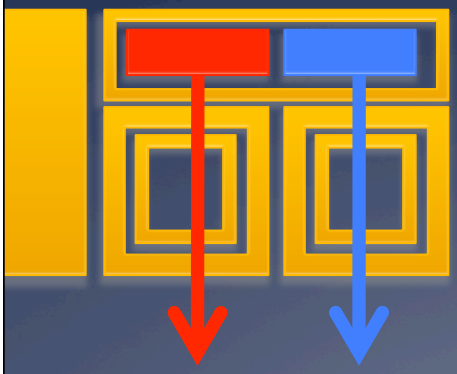
Is mostly about providing ventilation ...and cooling

...with big...noisy...machines

You can choose to Centralize or Decentralize the air handling machinery in the building



If Shafts…plan for trunks



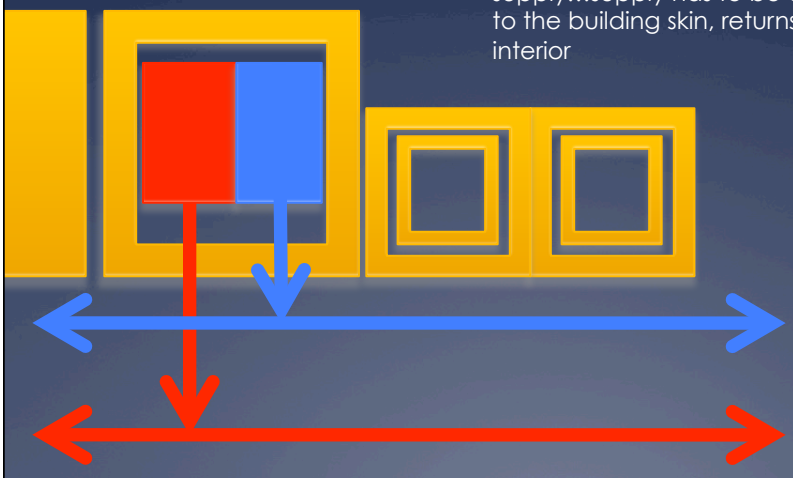
Trunk ducts are the main ducts that emerge from the shafts

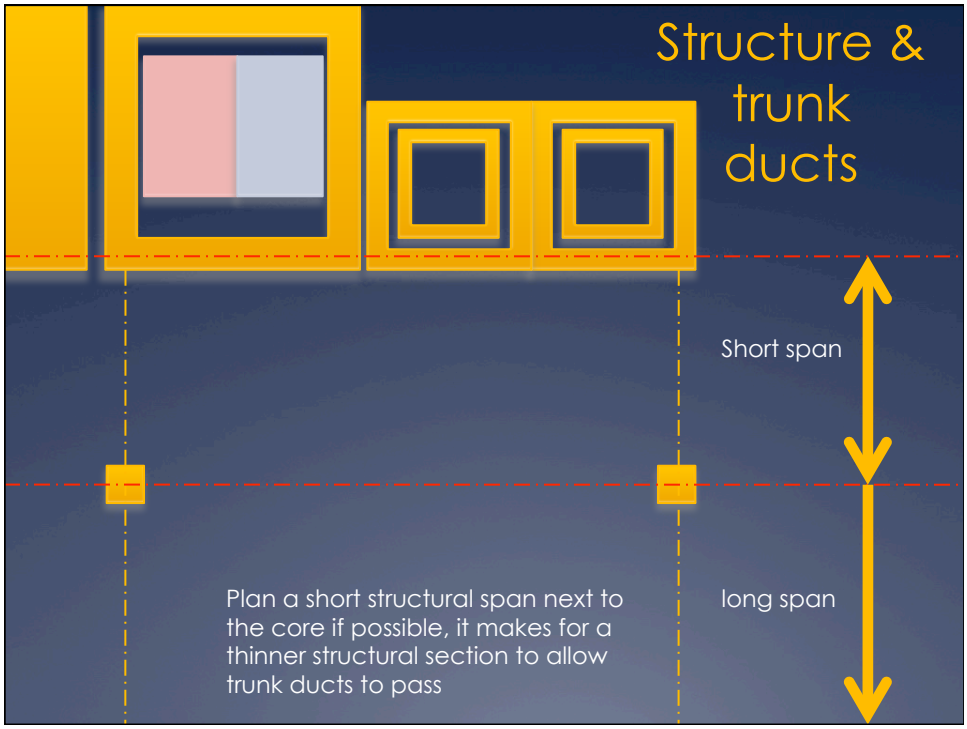
Since they serve large areas of floorspace, they contain lots of air and are bigger than distribution ducts

Don't trap shafts behind elevators and stairs

If Shafts…plan for trunks

Plan return ducts to run inboard of supply…supply has to be delivered to the building skin, returns can be interior




Structure & trunk ducts
Short span
long span
Plan a short structural span next to the core if possible, it makes for a thinner structural section to allow trunk ducts to pass