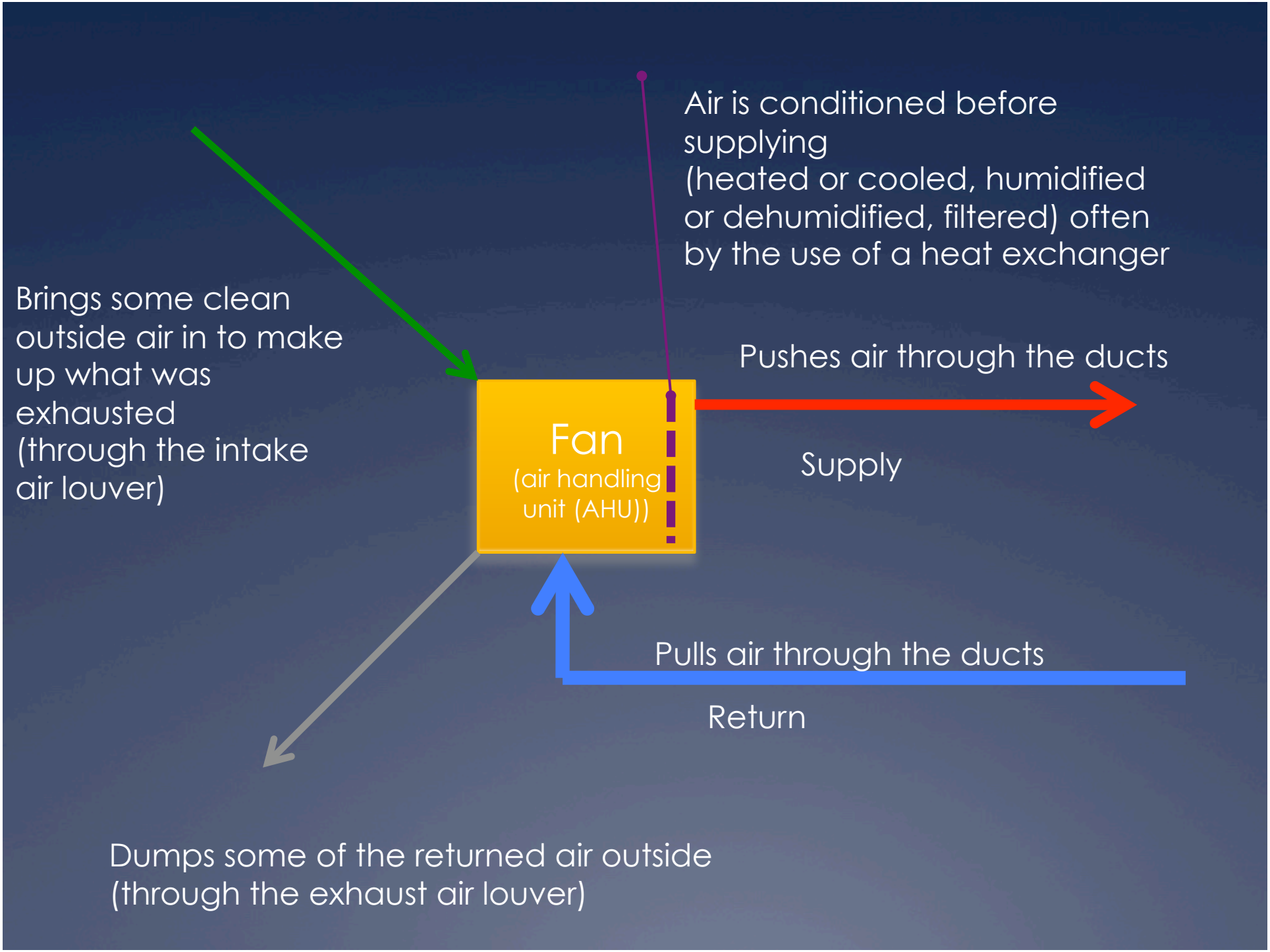
Getting your ducts in a row

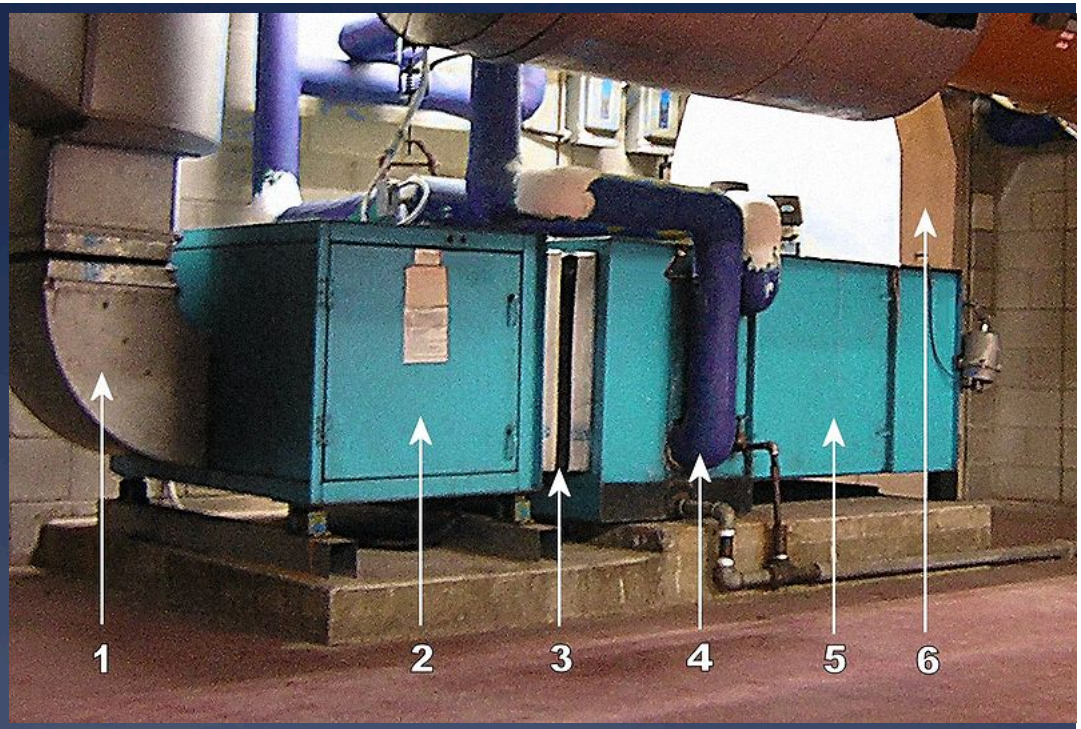
A rough guide to ductwork layout


Air is conditioned before supplying
(heated or cooled, humidified or dehumidified, filtered) often by the use of a heat exchanger
Brings some clean outside air in to make up what was exhausted
(through the intake air louver)
Pushes air through the ducts
Fan
(air handling unit (AHU))
Supply
Pulls air through the ducts
Return
Dumps some of the returned air outside
(through the exhaust air louver)

Air Handler

Air Handling Unit (AHU) basically it's a fan inside a box,

- usually a really big box, maybe the size of a dorm room,
- the fan blows air across a coil filled with a circulating fluid (water, glycol/water, freon)
- that is supplied at a temperature needed to raise or lower the temperature of the airstream as it departs the AHU.
- Air is returned to the AHU some is exhausted, and replenished with outside air, and then conditioned and supplied

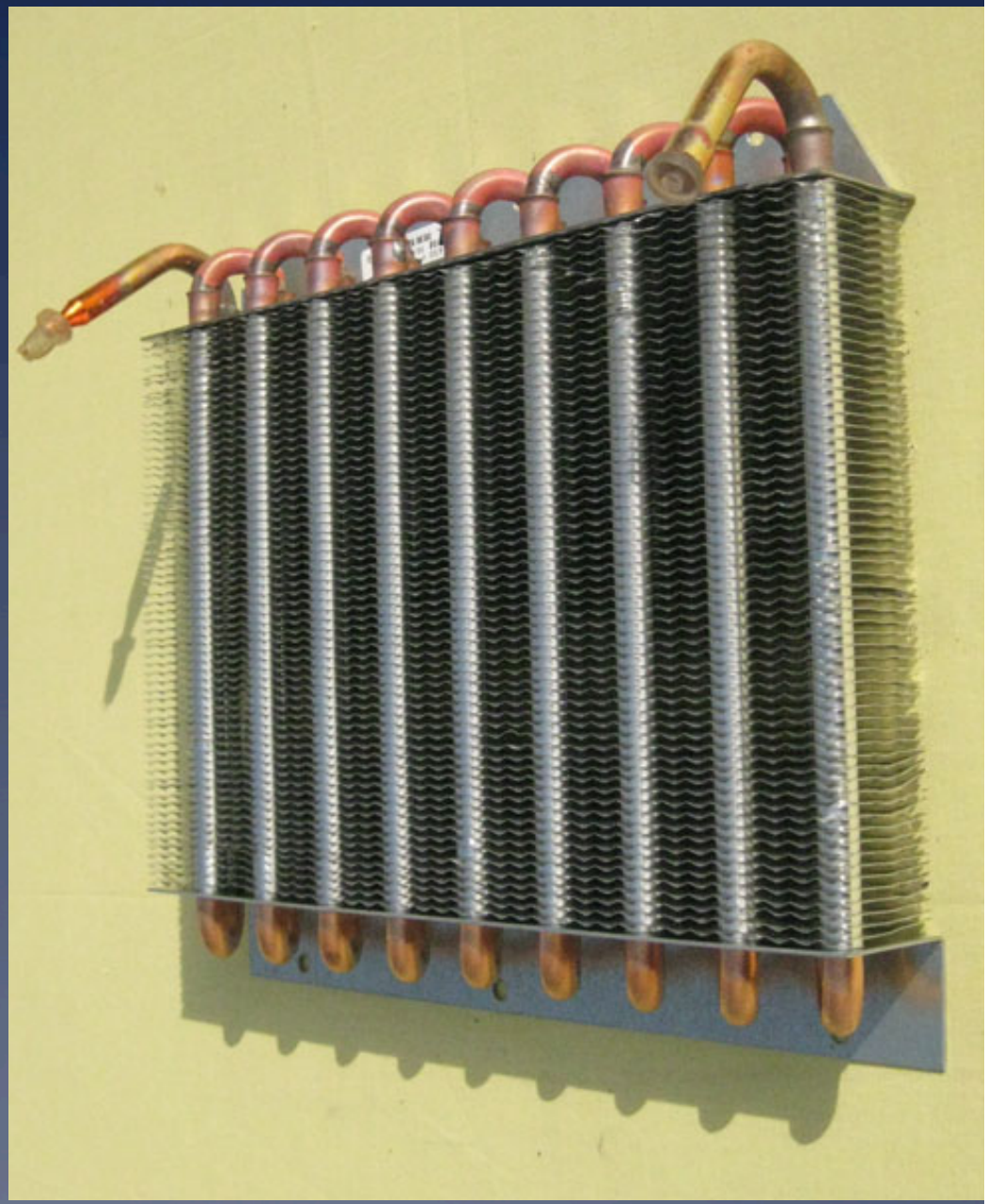


An air handling unit; air flow is from the right to left in this case. Some AHU components shown are:

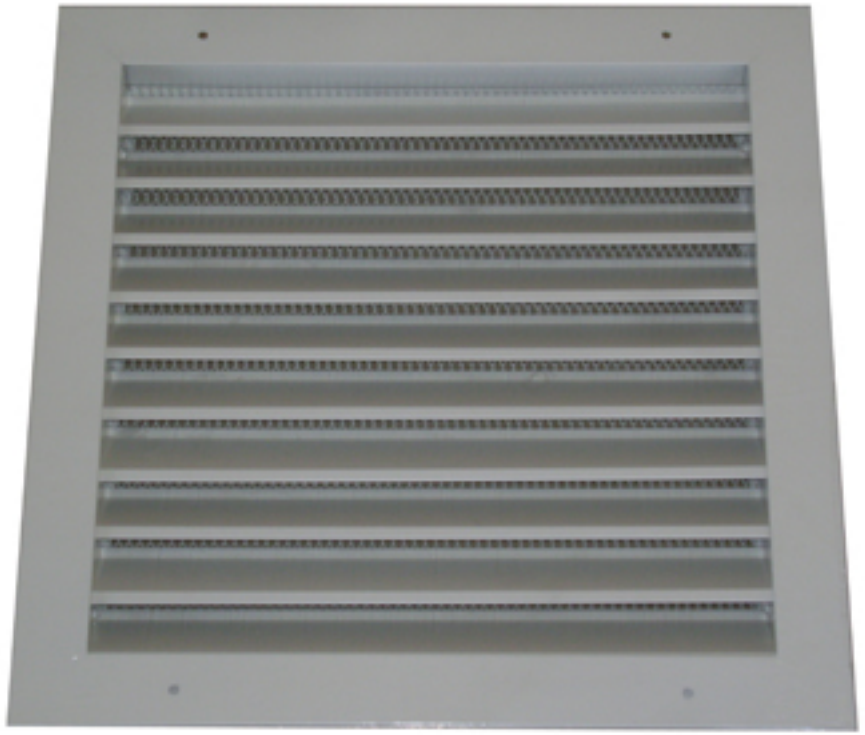
1 - Supply duct
2 - Fan compartment
3 - Vibration isolator ('flex joint')
4 - Heating and/or cooling coil
5 - Filter compartment
6 - Mixed (recirculated + outside) air duct

Heat Exchange Coil

Sits inside the air handler
Like a car radiator
..heated or cooled fluid enters
..(could be water, antifreeze, or freon)
..is circulated through pipes that are embedded in fins
.. Air is pushed over the fins by a fan
.. Which raises or lowers the temp of the air



Motorized damper



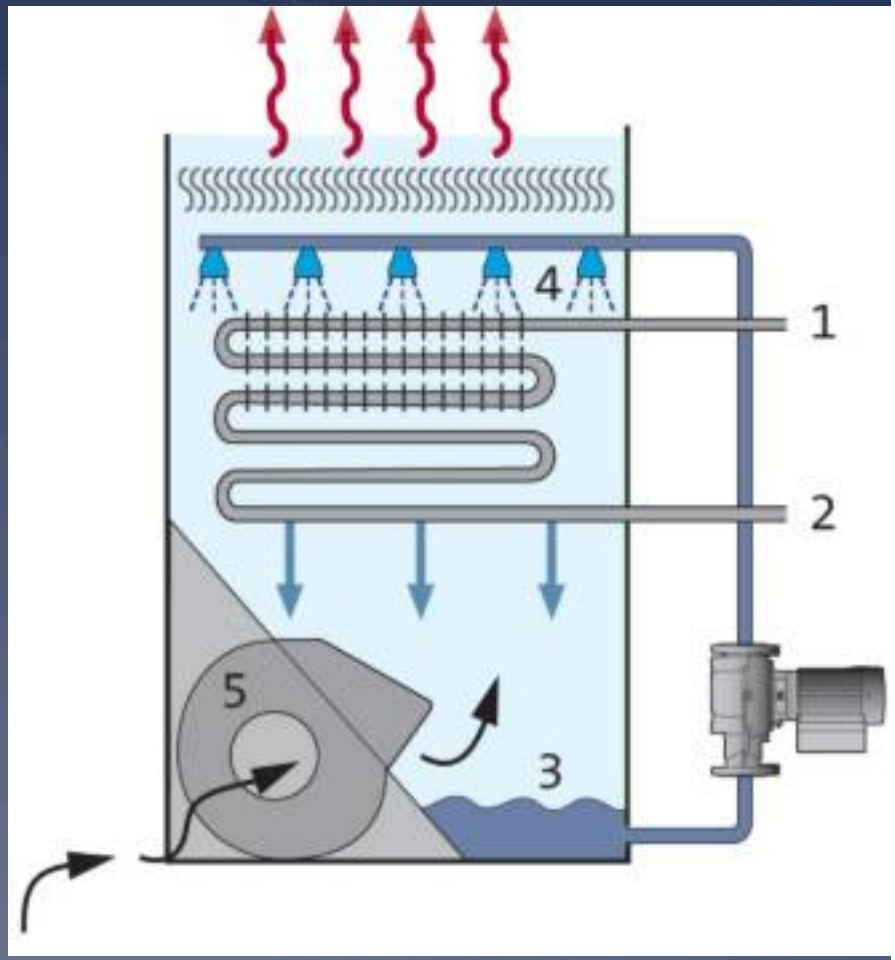
Once you've pushed warm air over a cool coil, you've warmed the water

Congratulations! You've moved heat from the air in the building to the fluid in the coil!

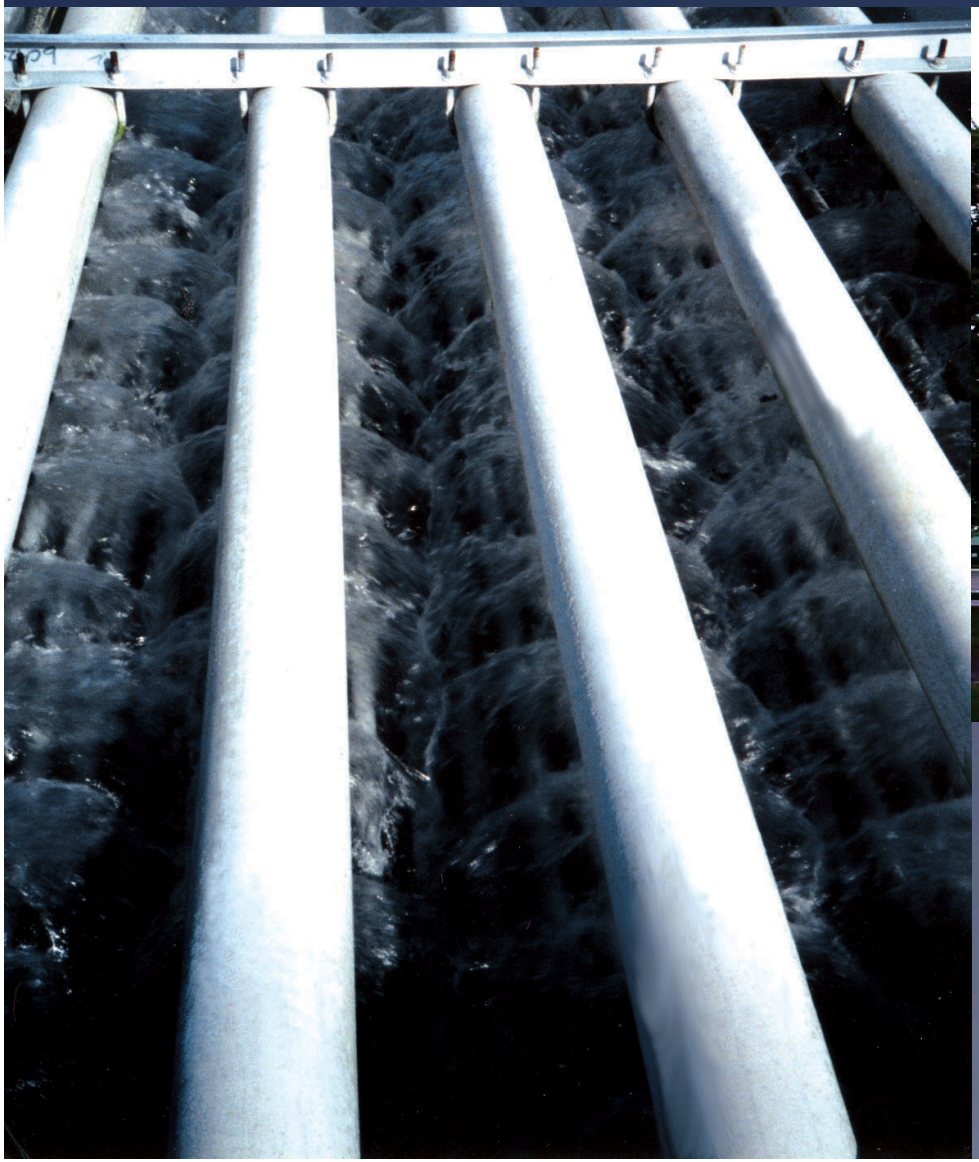
This warms the fluid and now we pump it outside to release heat from it.

This is done with a piece of equipment that sits outside the building, a cooling tower or condensing unit

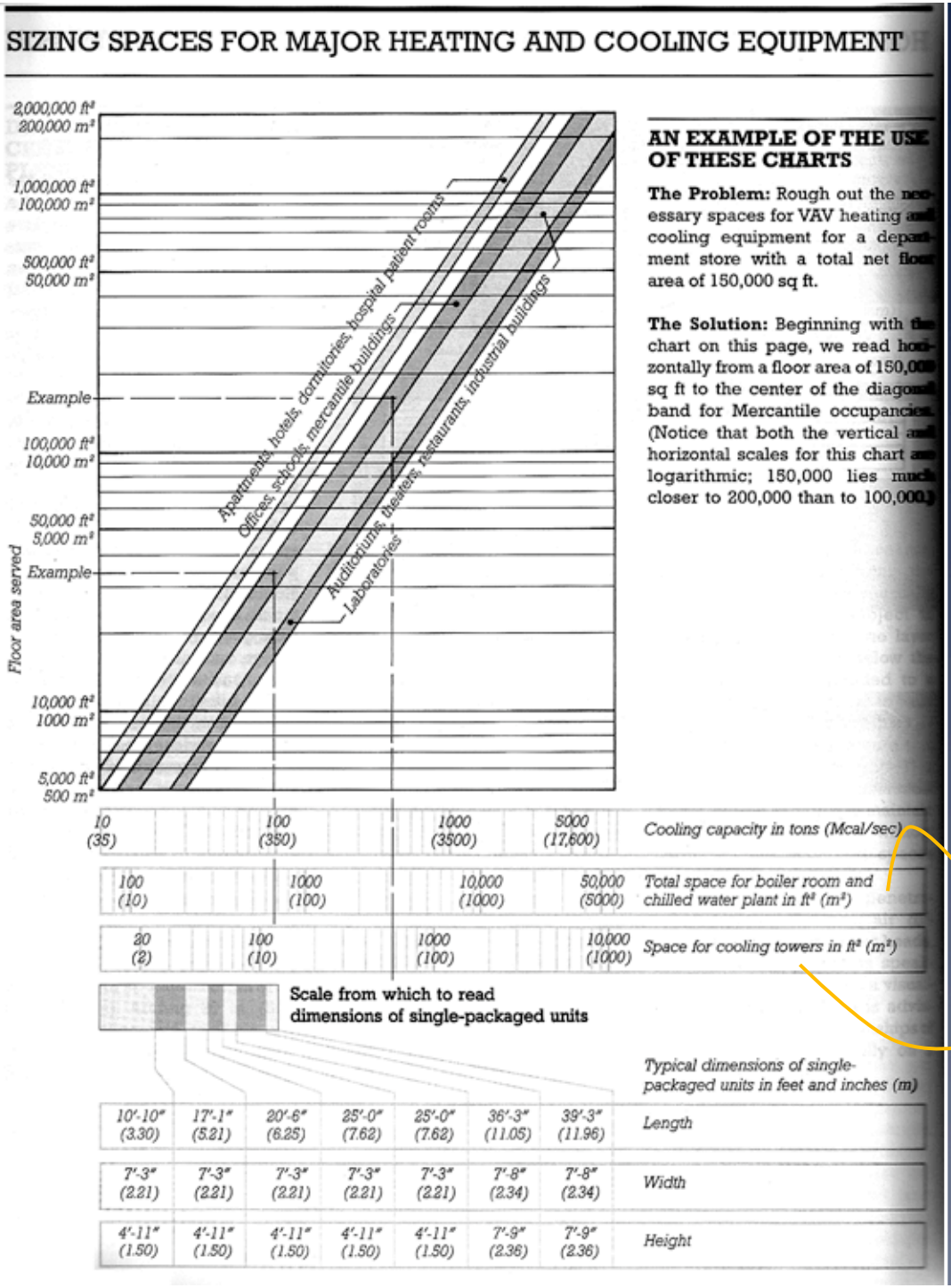
Watch out for legionella!



Spray water across the coils, some evaporates taking heat with it



Cooling tower



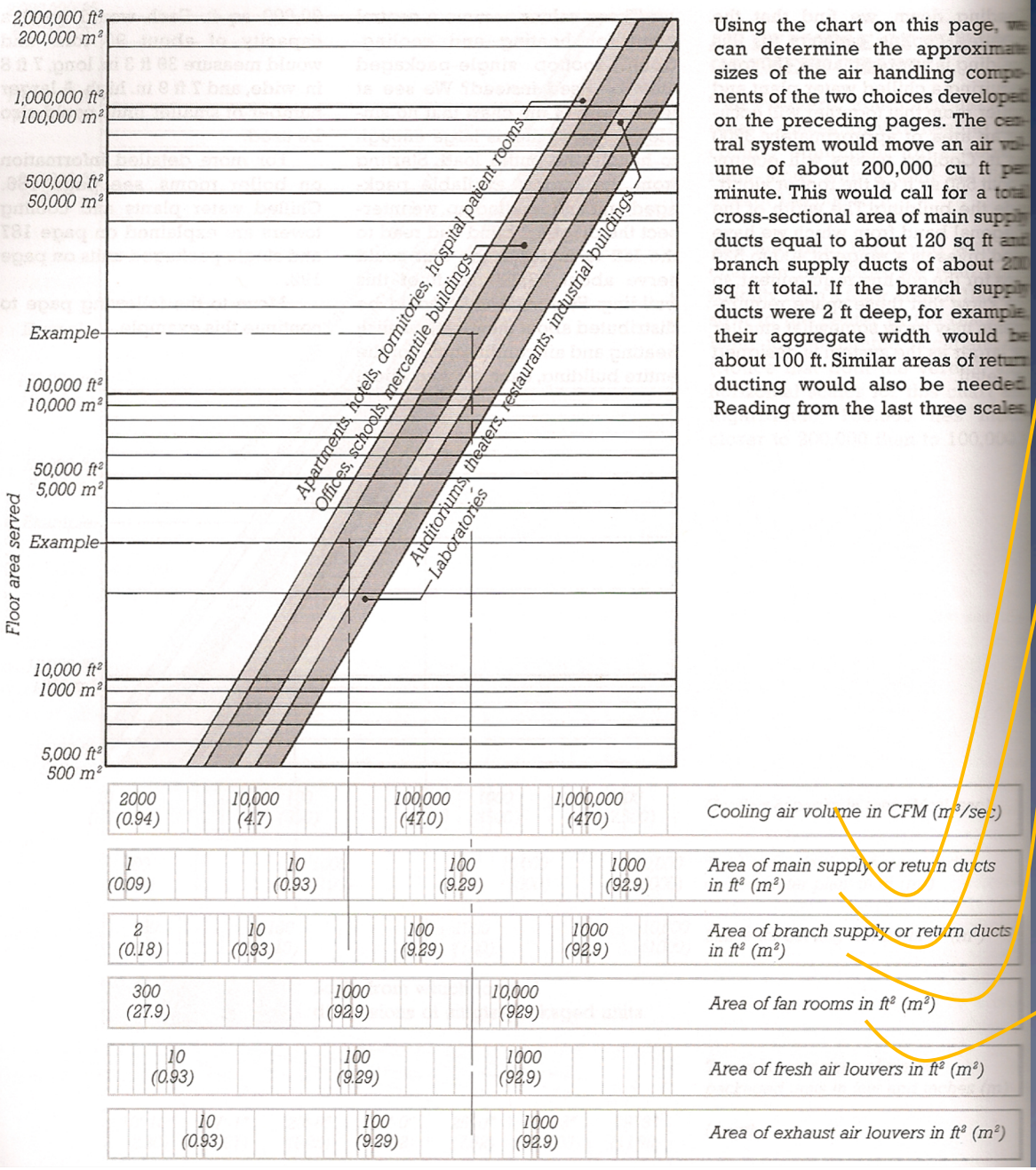
BUY THIS BOOK!

Architects Studio Companion written by Edward Allen

This is the floor are you need for boiler/chiller

This is the floor area outside you need for the cooling tower

SIZING SPACES FOR AIR HANDLING



Using the chart on this page, we can determine the approximate sizes of the air handling components of the two choices developed on the preceding pages. The central system would move an air volume of about 200,000 cu ft per minute. This would call for a total cross-sectional area of main supply ducts equal to about 120 sq ft and branch supply ducts of about 200 sq ft total. If the branch supply ducts were 2 ft deep, for example, their aggregate width would be about 100 ft. Similar areas of return ducting would also be needed. Reading from the last three scales

Reserve enough space

This is how much air you have to move each minute

This is how big the supply air ducts are coming from the machine or shafts

This is how big the return air ducts are coming from the machine or shafts

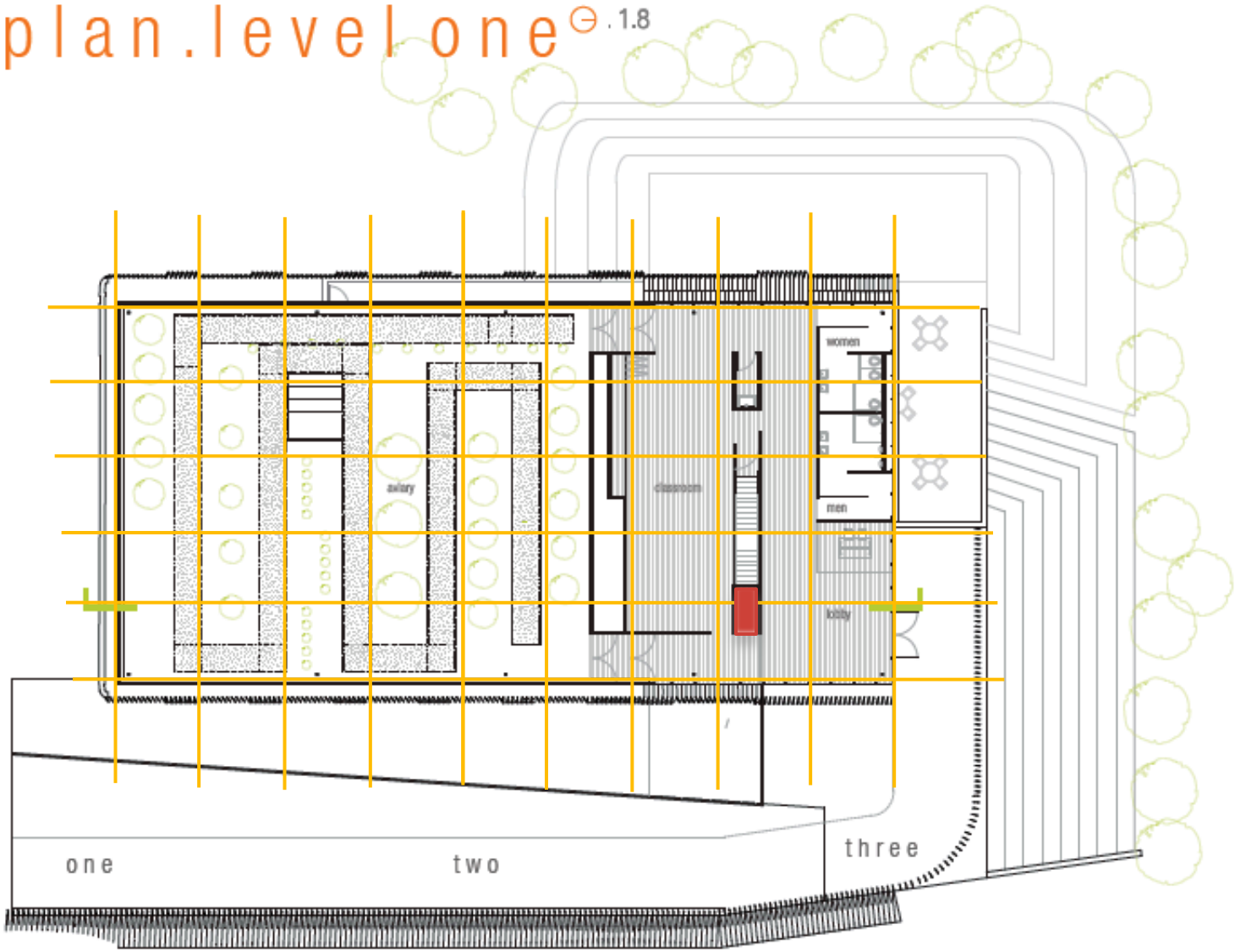
This is how big the branch ducts are from the shaft to the diffuser

This is how big the room has to be to hold the fan

Crude backsizing

floor area served		duct cross section area		duct diameter		**1:1 square**	1:2 rectangle		*1:4 short*	*1:4 rect long*
no of 235 s.f. areas served	furtherst 235 s.f. served from fan	28.26	area of	6	inch round	**5.316013544**	3.758989226	7.51797845	*2.658006772*	*10.6320271*
2	470	56.52	area of	8.485	inch round	**7.517978452**	5.316013544	10.6320271	*3.758989226*	*15.0359569*
3	705	84.78	area of	10.39	inch round	**9.207605552**	6.510760324	13.0215206	*4.603802776*	*18.4152111*
4	940	113.04	area of	12	inch round	**10.63202709**	7.517978452	15.0359569	*5.316013544*	*21.2640542*
5	1175	141.3	area of	13.42	inch round	**11.88696765**	8.405355436	16.8107109	*5.943483827*	*23.7739353*
6	1410	169.56	area of	14.7	inch round	**13.02152065**	9.207605552	18.4152111	*6.510760324*	*26.0430413*
7	1645	197.82	area of	15.87	inch round	**14.0648498**	9.945350673	19.8907013	*7.032424902*	*28.1296996*
8	1880	226.08	area of	16.97	inch round	**15.0359569**	10.63202709	21.2640542	*7.517978452*	*30.0719138*
9	2115	254.34	area of	18	inch round	**15.94804063**	11.27696768	22.5539354	*7.974020316*	*31.8960813*
10	2350	282.6	area of	18.97	inch round	**16.81071087**	11.88696765	23.7739353	*8.405355436*	*33.6214217*
11	2585	310.86	area of	19.9	inch round	**17.63122231**	12.46715685	24.9343137	*8.815611153*	*35.2624446*
12	2820	339.12	area of	20.78	inch round	**18.4152111**	13.02152065	26.0430413	*9.207605552*	*36.8304222*
13	3055	367.38	area of	21.63	inch round	**19.16715941**	13.5532284	27.1064568	*9.583579707*	*38.3343188*
14	3290	395.64	area of	22.45	inch round	**19.89070135**	14.0648498	28.1296996	*9.945350673*	*39.7814027*
15	3525	423.9	area of	23.24	inch round	**20.58883192**	14.55850267	29.1170053	*10.29441596*	*41.1776638*

plan.level one ⊖ .1.8

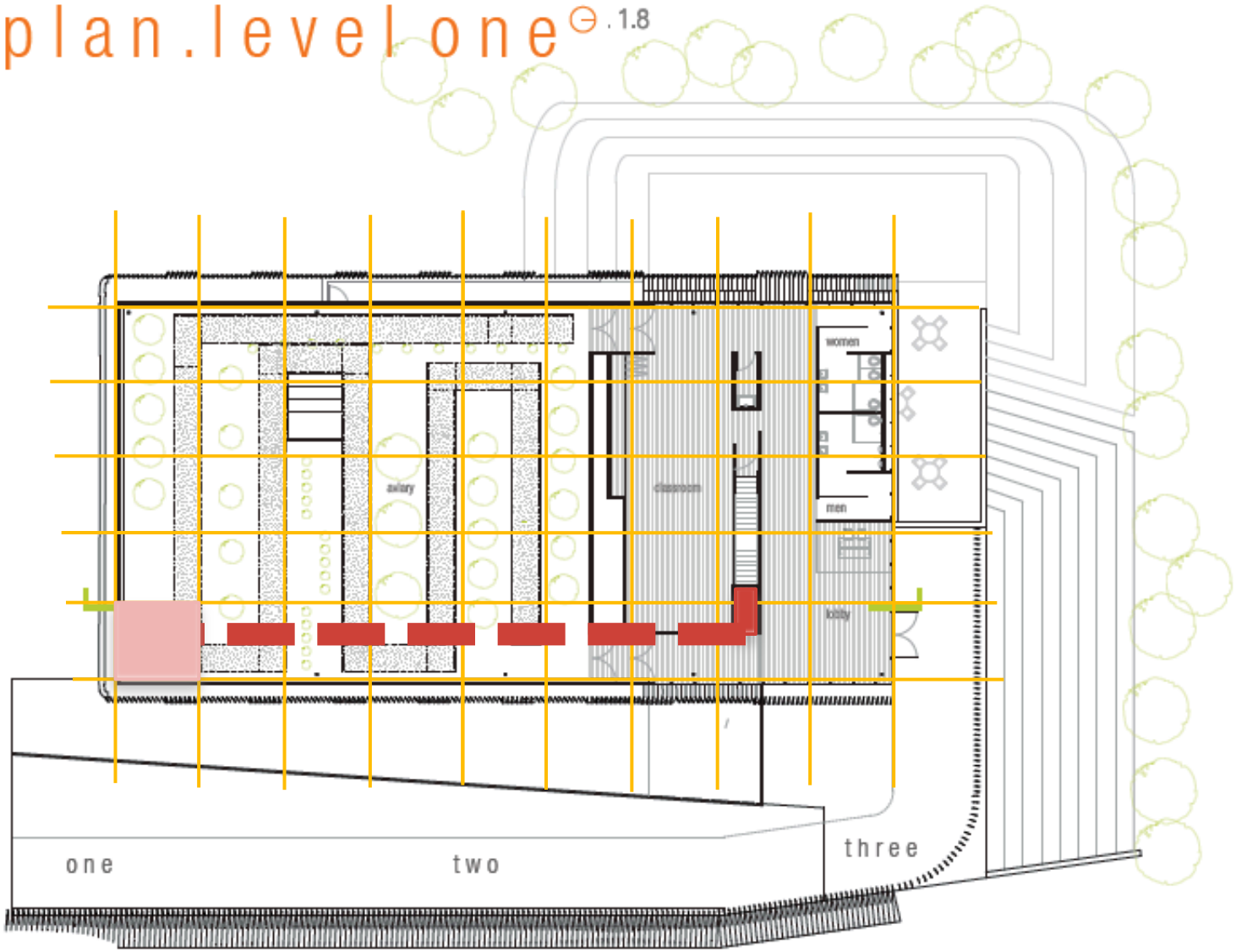


Divide your plan into 235 s.f. areas

Identify the location of the shaft or air handler

Count the number of areas and size according to the chart

plan.level one ⊖ .1.8



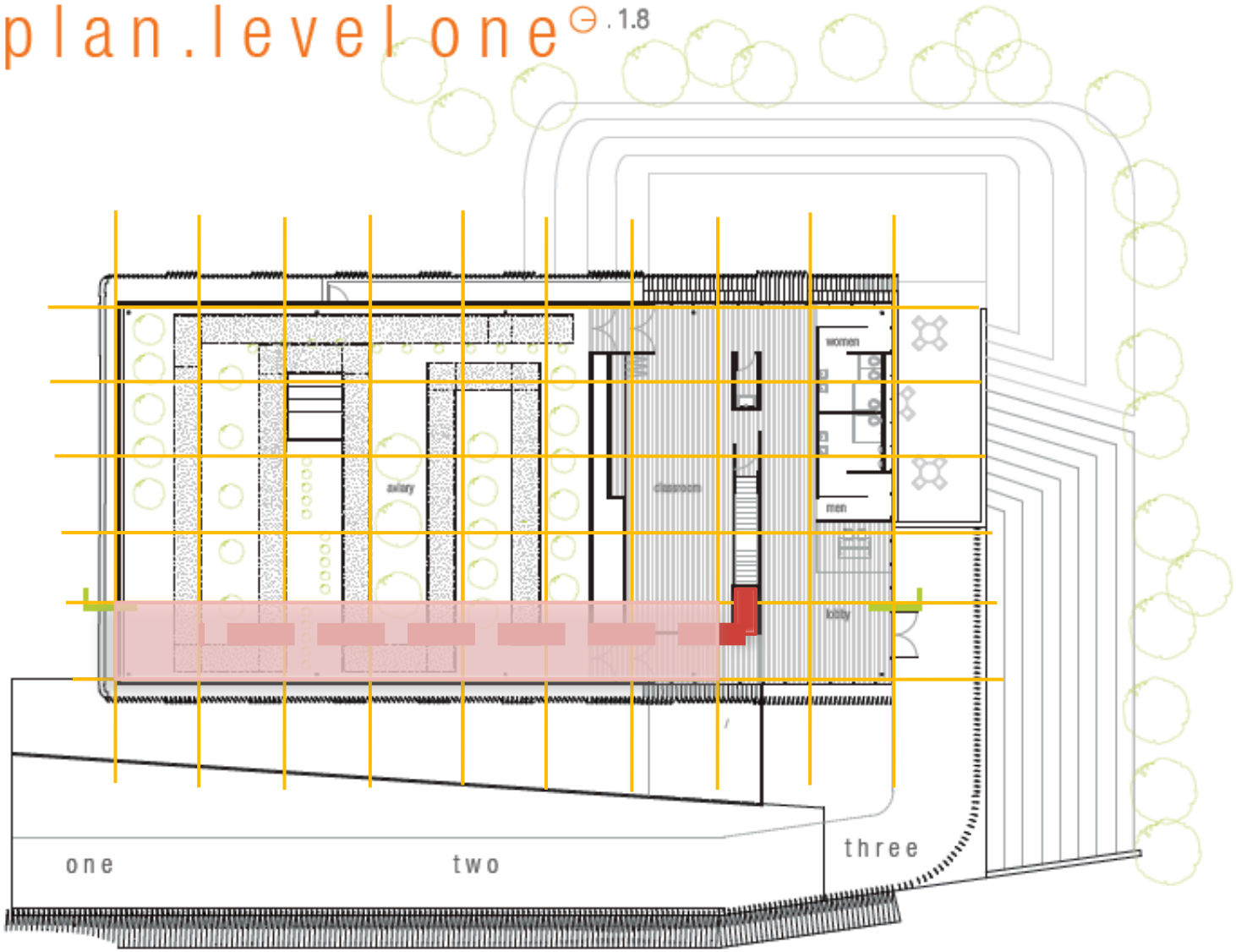
Trace a duct route

The duct at the very end only serves one-235 sf space.

A 6” dia duct serves 235 s.f.

rea erved		duct cross section area		duct diameter		**1:1 square**	1:2 rectangle		*1:4 short*	*1:4 rect long*
of 235 areas rved	furtherst 235 s.f. served from fan	28.26	area of	6	inch round	**5.316013544**	3.758989226	7.51797845	*2.658006772*	*10.6320271*
4	940	113.04	area of	12	inch round	**10.63202709**	7.517978452	15.0359569	*5.316013544*	*21.2640542*
5	1175	141.3	area of	13.42	inch round	**11.88696765**	8.405355436	16.8107109	*5.943483827*	*23.7739353*
6	1410	169.56	area of	14.7	inch round	**13.02152065**	9.207605552	18.4152111	*6.510760324*	*26.0430413*
7	1645	197.82	area of	15.87	inch round	**14.0648498**	9.945350673	19.8907013	*7.032424902*	*28.1296996*
8	1880	226.08	area of	16.97	inch round	**15.0359569**	10.63202709	21.2640542	*7.517978452*	*30.0719138*
9	2115	254.34	area of	18	inch round	**15.94804063**	11.27696768	22.5539354	*7.974020316*	*31.8960813*
10	2350	282.6	area of	18.97	inch round	**16.81071087**	11.88696765	23.7739353	*8.405355436*	*33.6214217*
11	2585	310.86	area of	19.9	inch round	**17.63122231**	12.46715685	24.9343137	*8.815611153*	*35.2624446*
12	2820	339.12	area of	20.78	inch round	**18.4152111**	13.02152065	26.0430413	*9.207605552*	*36.8304222*
13	3055	367.38	area of	21.63	inch round	**19.16715941**	13.5532284	27.1064568	*9.583579707*	*38.3343188*
14	3290	395.64	area of	22.45	inch round	**19.89070135**	14.0648498	28.1296996	*9.945350673*	*39.7814027*
15	3525	423.9	area of	23.24	inch round	**20.58883192**	14.55850267	29.1170053	*10.29441596*	*41.1776638*

plan.level one ⊖ .1.8

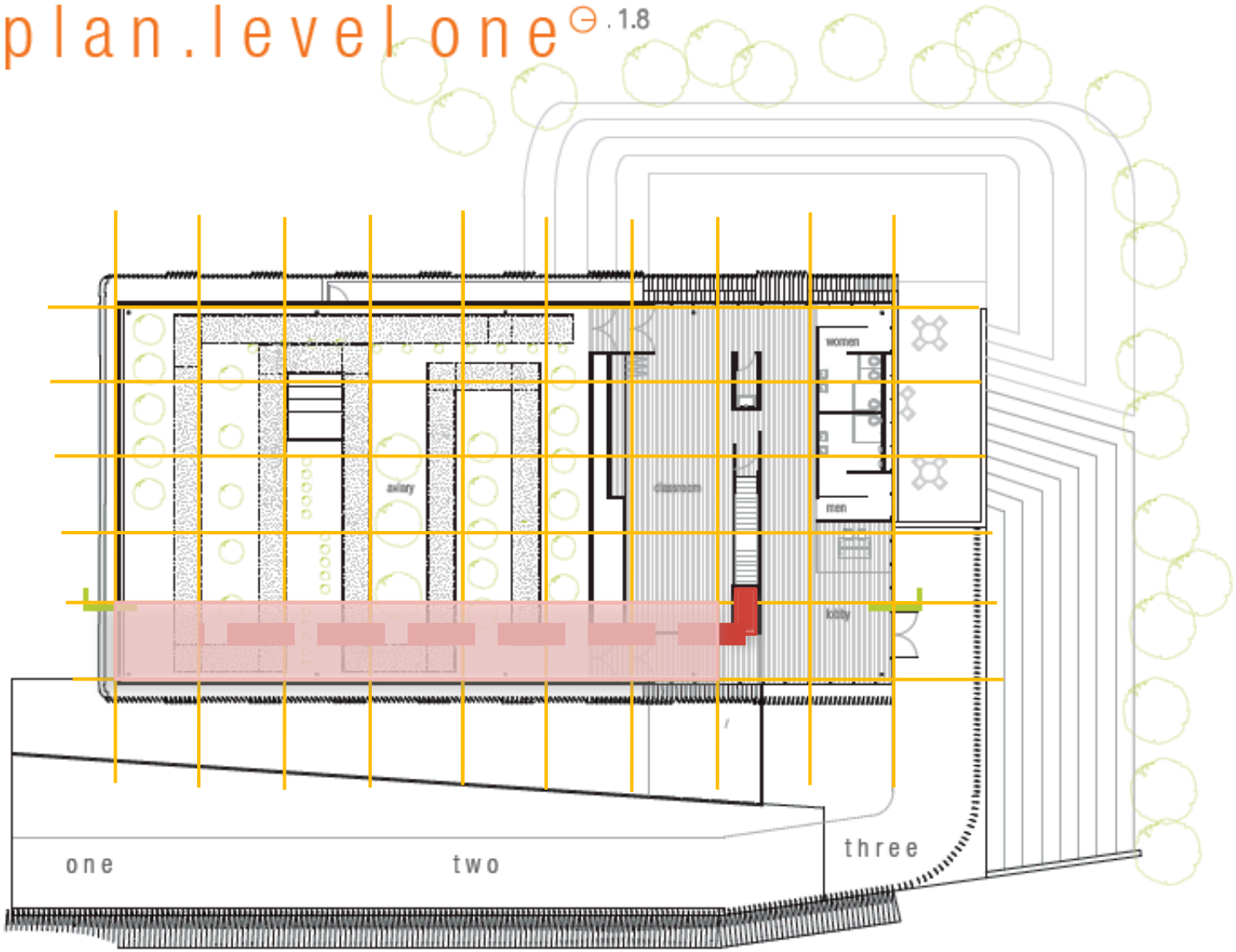


But this main duct coming from the shaft, serves 8-235 s.f. areas so…

To serve 8-235 s.f. spaces you need a 17" round duct

floor area served		duct cross section area		duct diameter		**1:1 square**	1:2 rectangle		*1:4 short*	*1:4 rect long*
no of 235 s.f. areas served	furtherst 235 s.f. served from fan	28.26	area of	6	inch round	**5.316013544**	3.758989226	7.51797845	*2.658006772*	*10.6320271*
2	470	56.52	area of	8.485	inch round	**7.517978452**	5.316013544	10.6320271	*3.758989226*	*15.0359569*
3	705	84.78	area of	10.39	inch round	**9.207605552**	6.510760324	13.0215206	*4.603802776*	*18.4152111*
4	940	113.04	area of	12	inch round	**10.63202709**	7.517978452	15.0359569	*5.316013544*	*21.2640542*
5	1175	141.3	area of	13.42	inch round	**11.88696765**	8.405355436	16.8107109	*5.943483827*	*23.7739353*
6	1410	169.56	area of	14.7	inch round	**13.02152065**	9.207605552	18.4152111	*6.510760324*	*26.0430413*
8	1880	226.08	area of	16.97	inch round	**15.0359569**	10.63202709	21.2640542	*7.517978452*	*30.0719138*
10	2350	282.6	area of	18.97	inch round	**16.81071087**	11.88696765	23.7739353	*8.405355436*	*33.6214217*
11	2585	310.86	area of	19.9	inch round	**17.63122231**	12.46715685	24.9343137	*8.815611153*	*35.2624446*
12	2820	339.12	area of	20.78	inch round	**18.4152111**	13.02152065	26.0430413	*9.207605552*	*36.8304222*
13	3055	367.38	area of	21.63	inch round	**19.16715941**	13.5532284	27.1064568	*9.583579707*	*38.3343188*
14	3290	395.64	area of	22.45	inch round	**19.89070135**	14.0648498	28.1296996	*9.945350673*	*39.7814027*
15	3525	423.9	area of	23.24	inch round	**20.58883192**	14.55850267	29.1170053	*10.29441596*	*41.1776638*

plan.level one ⊖ .1.8



This floor of the building has 45-235 s.f. areas

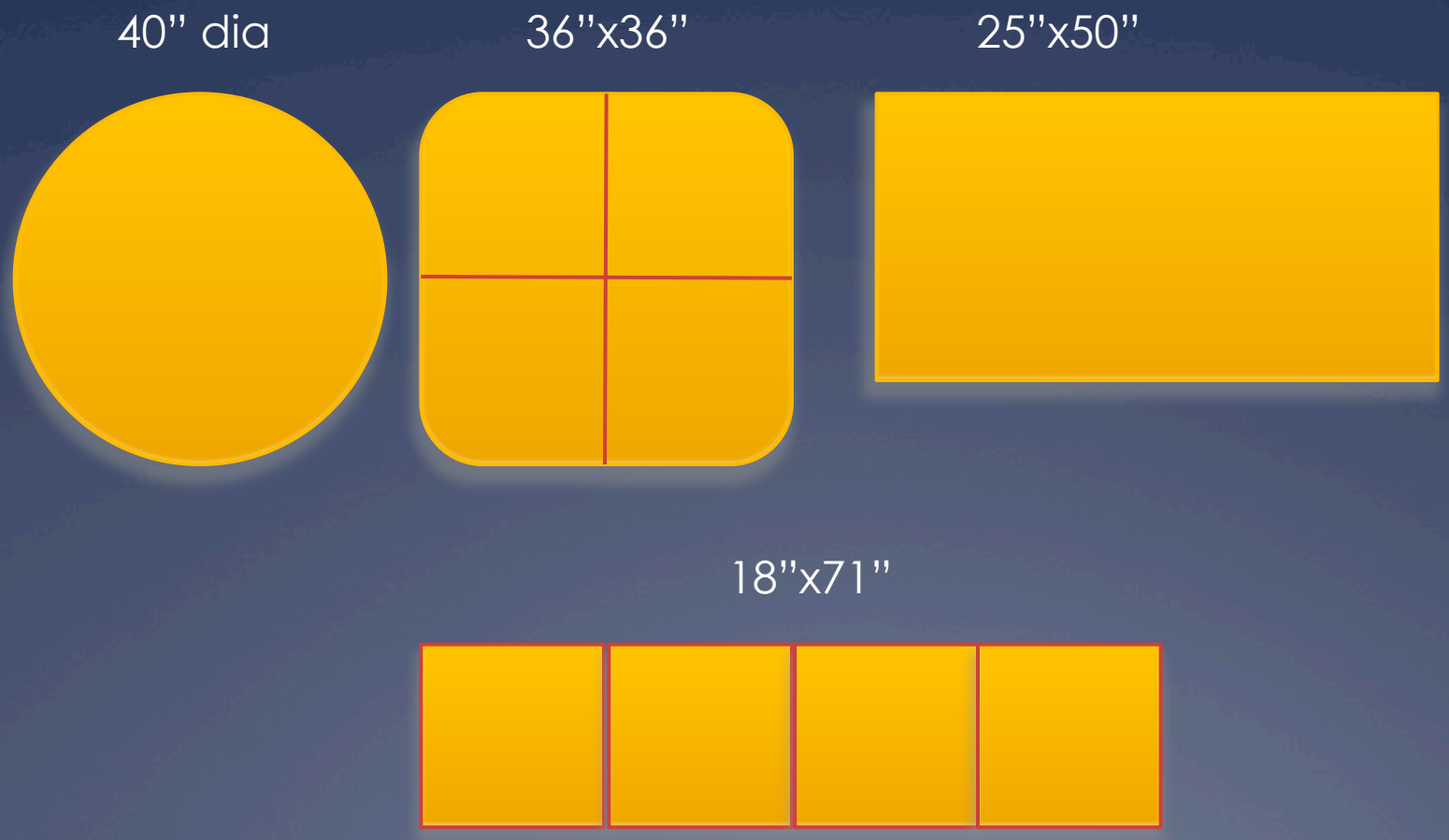
If that single shaft served all 45 it would need to be….

To serve 45 of those 235 s.f. spaces, you need a shaft that's 40" in diameter

floor area served		duct cross section area		duct diameter		**1:1 square**	1:2 rectangle		*1:4 short*	*1:4 rect long*
45	10575	1271.7	area of	40.25	inch round	**35.66090296**	25.21606631	50.4321326	*17.83045148*	*71.321805*
46	10810	1299.96	area of	40.69	inch round	**36.05495805**	25.49470533	50.9894107	*18.02747903*	*72.109916*
47	11045	1328.22	area of	41.13	inch round	**36.44475271**	25.77033178	51.5406636	*18.22237635*	*72.8895054*

…and you need a second one for return air!

Flattening ducts 1:1, 1:2, 1:4

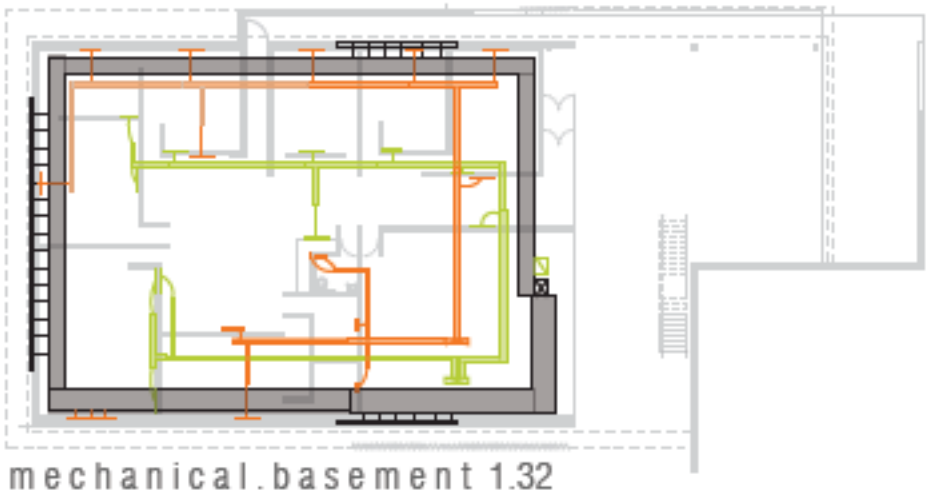


Route Supply and Return

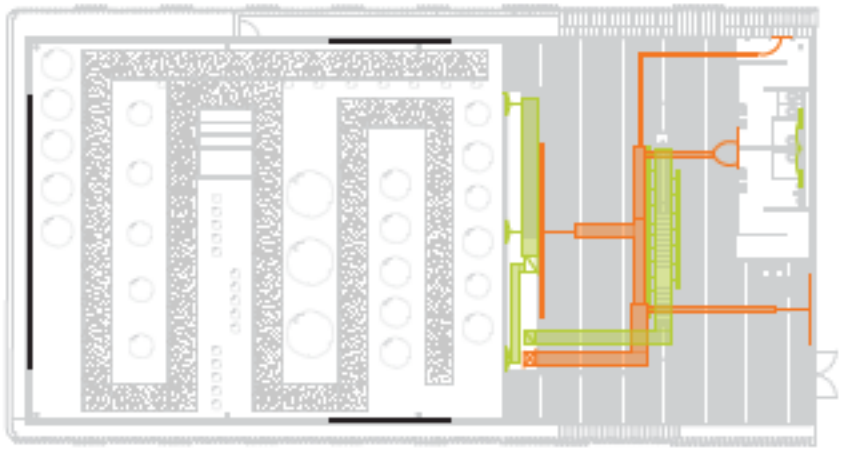
Supply to perimeter… the source or most losses and gains

Return from interior

No returns from toilets… exhaust those spaces!

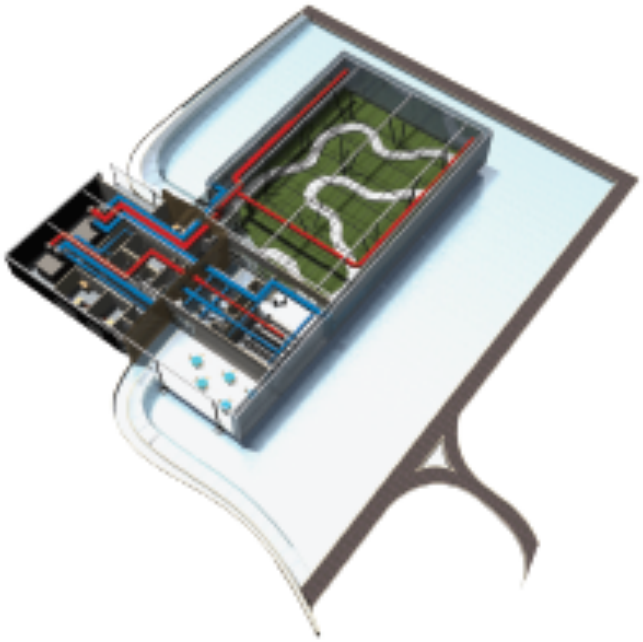


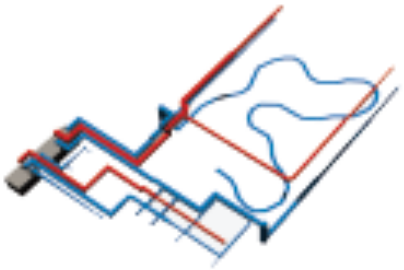
mechanical.basement 1.32

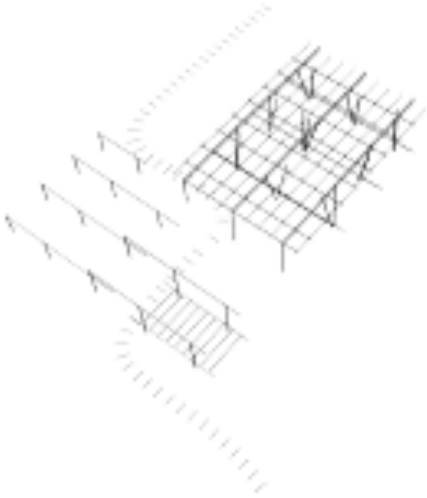


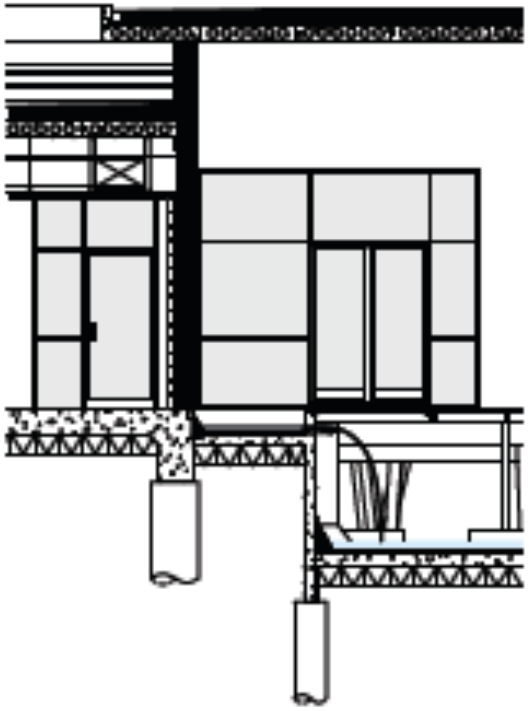
mechanical.level one 1.32

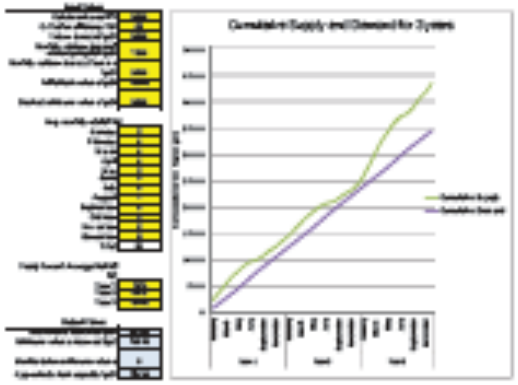
HVAC SYSTEMS

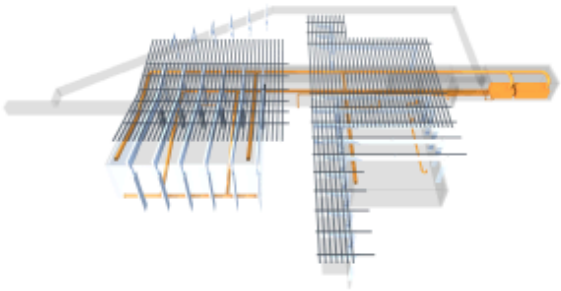


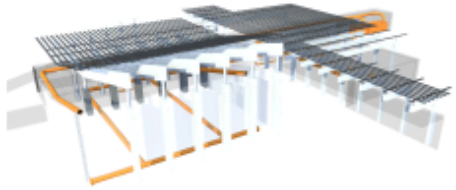


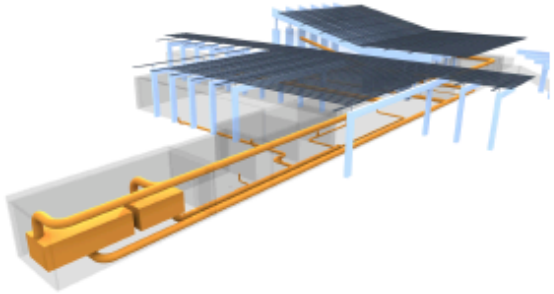






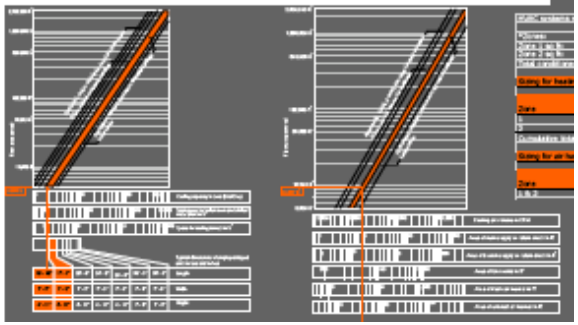






SIZING AND SPACING FOR MECH. SYSTEMS

SIZING AND SPACING FOR AIR HANDLING



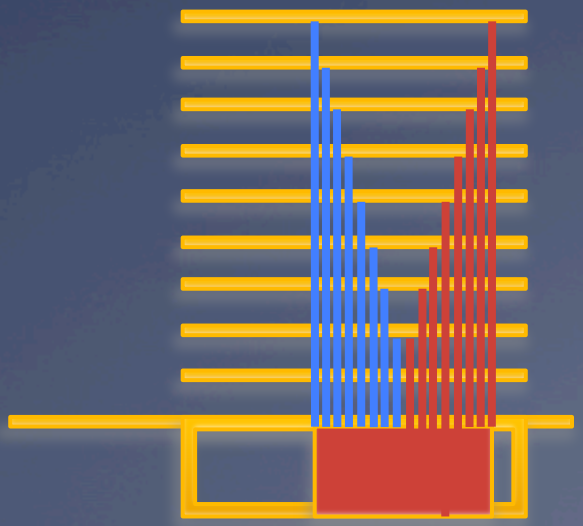
Mechanical Planning

Is mostly about providing ventilation
…and cooling

…with big…noisy…machines

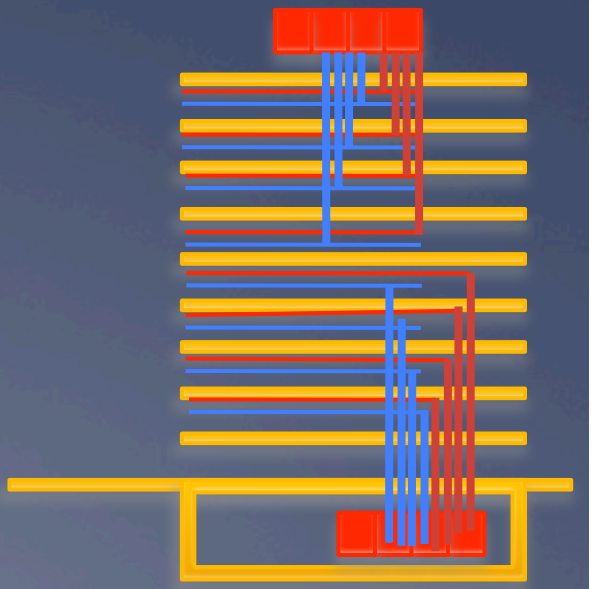
You can choose to Centralize or Decentralize the air handling machinery in the building

Centralized:
Big vert shafts

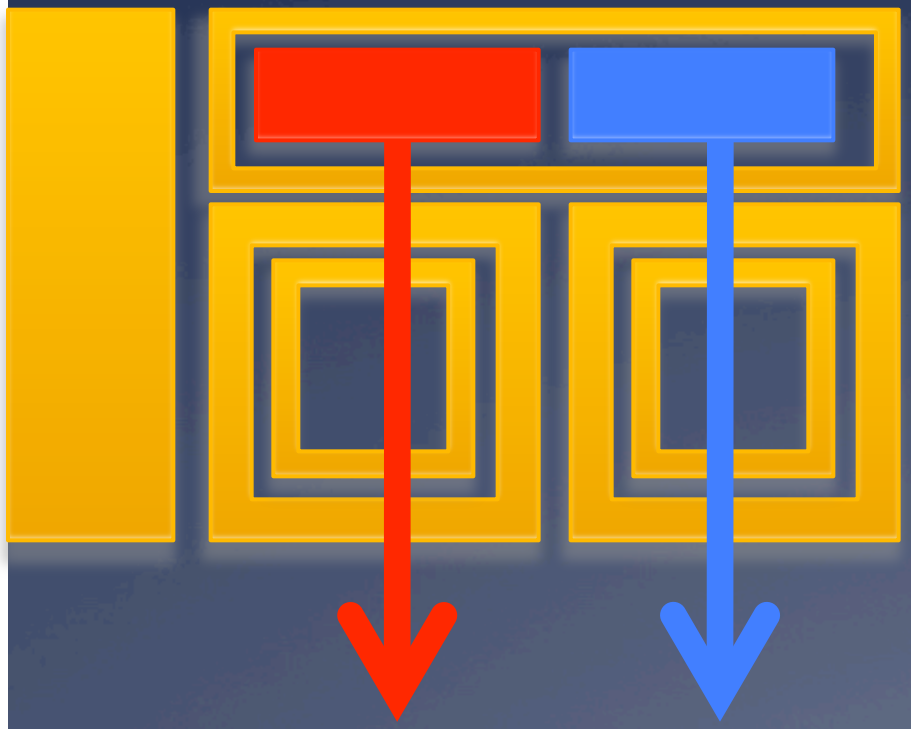


Decentralized:
Mech rooms
each floor

Hybrid



If Shafts…plan for trunks



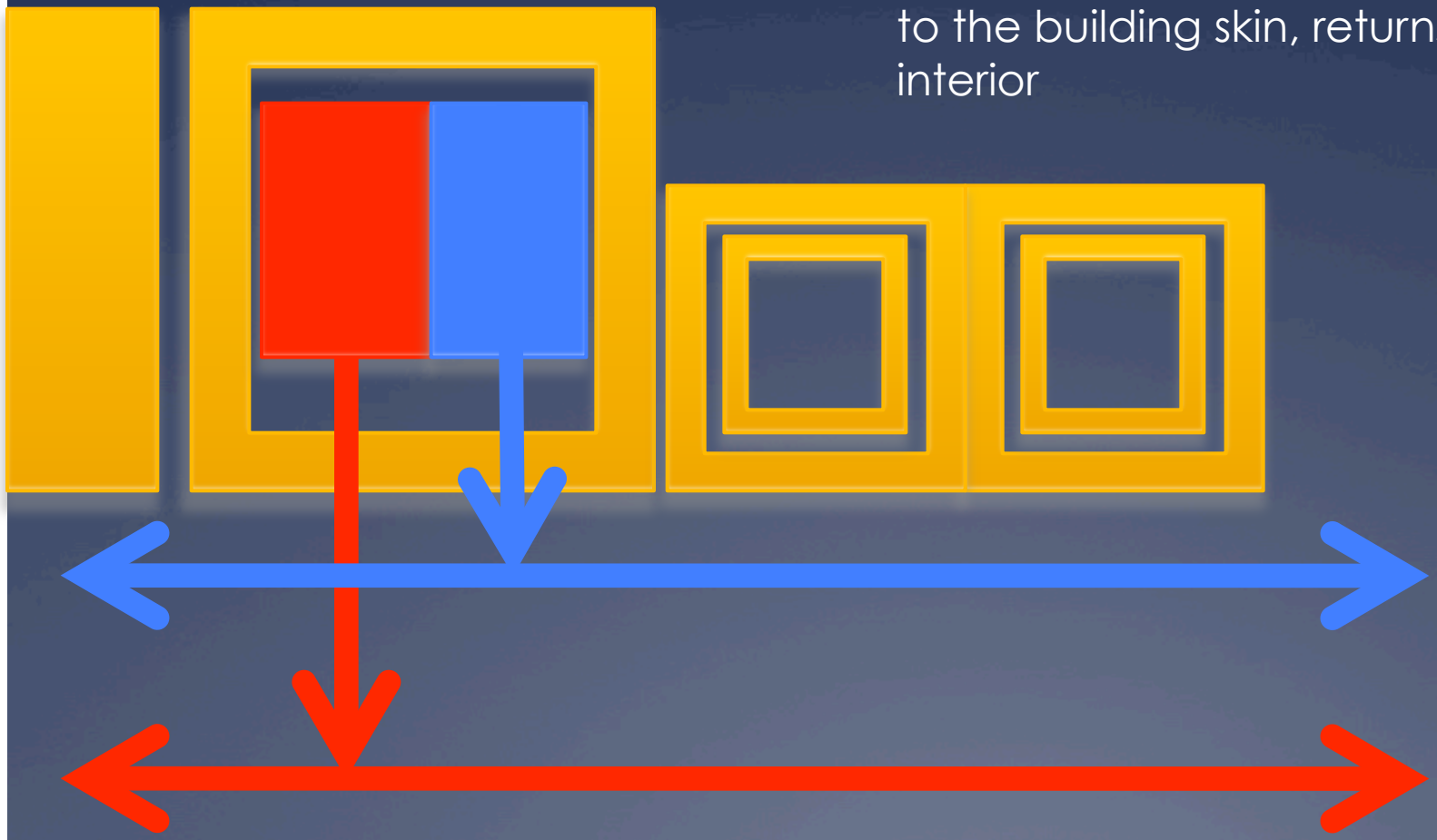
Trunk ducts are the main ducts that emerge from the shafts

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

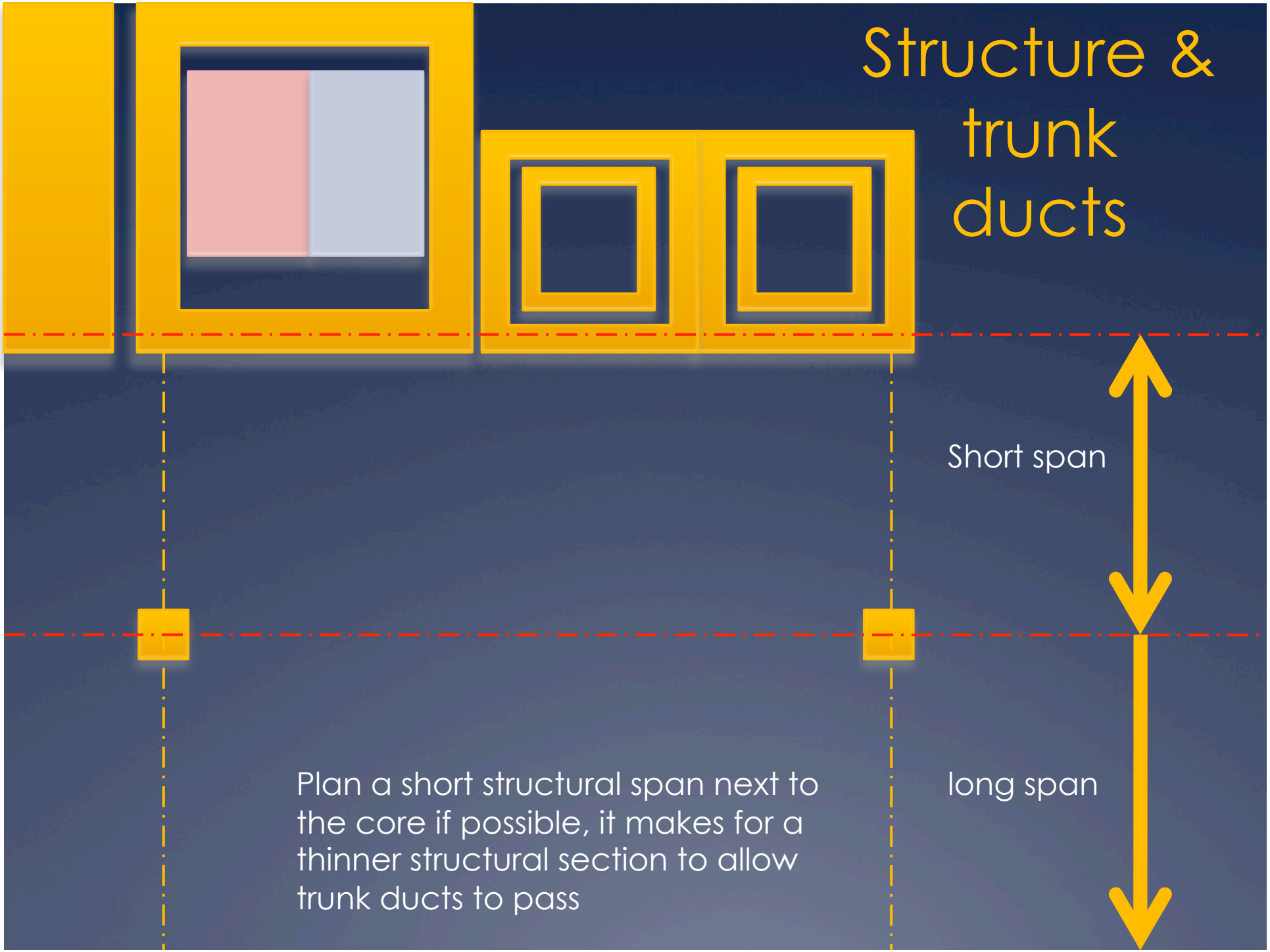
Don’t trap shafts behind elevators and stairs

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



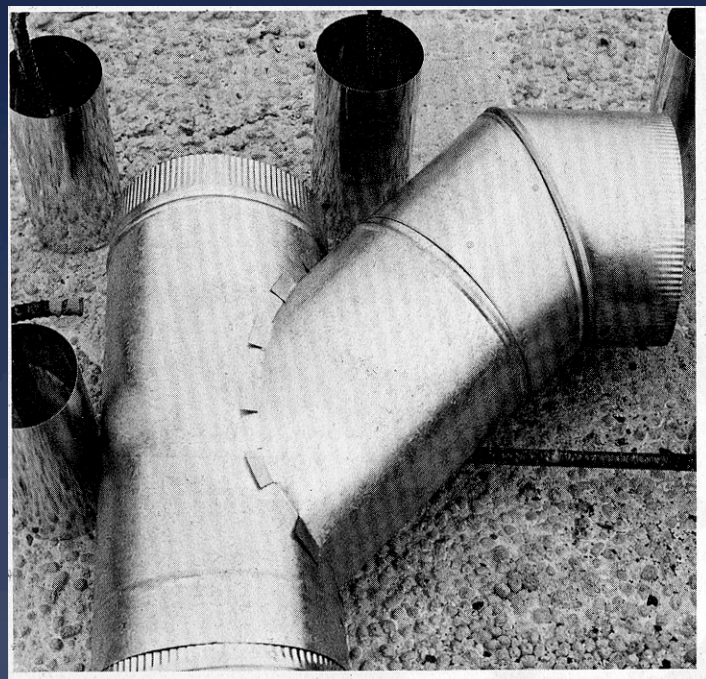
Structure & trunk ducts

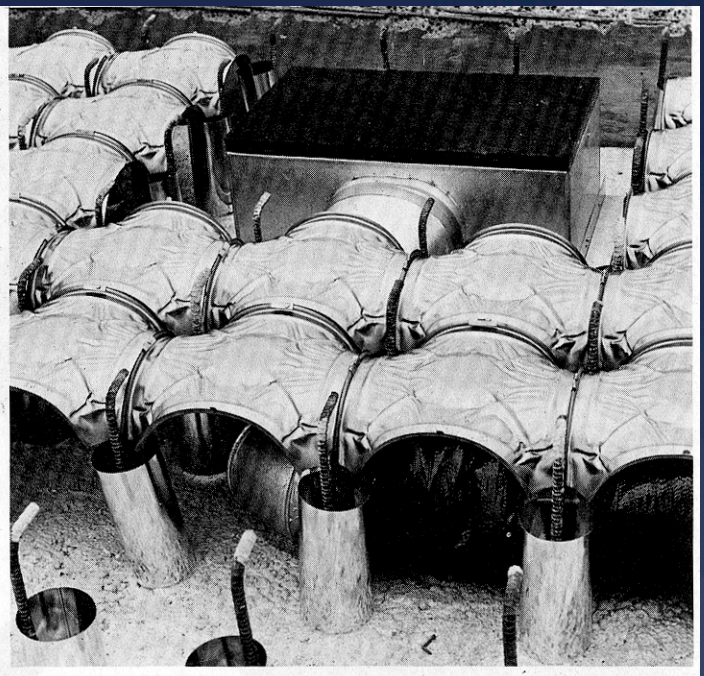


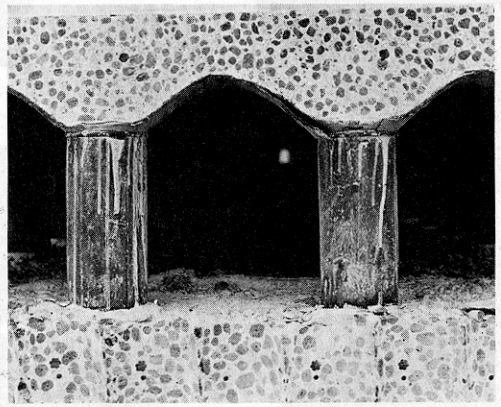

WARNING:
REMOVE ALL FAN PACKAGING
BEFORE RUNNING FAN
AVISO:
AVERTISSEMENT:
FAN UNIT
#4
044395BB0200
VAV-14-04


KRUEGER
FAN UNIT
KRUEGER
ARI
UP
#4
04413958B0200
KRUEGER
CAUTION:
ATTENTION:

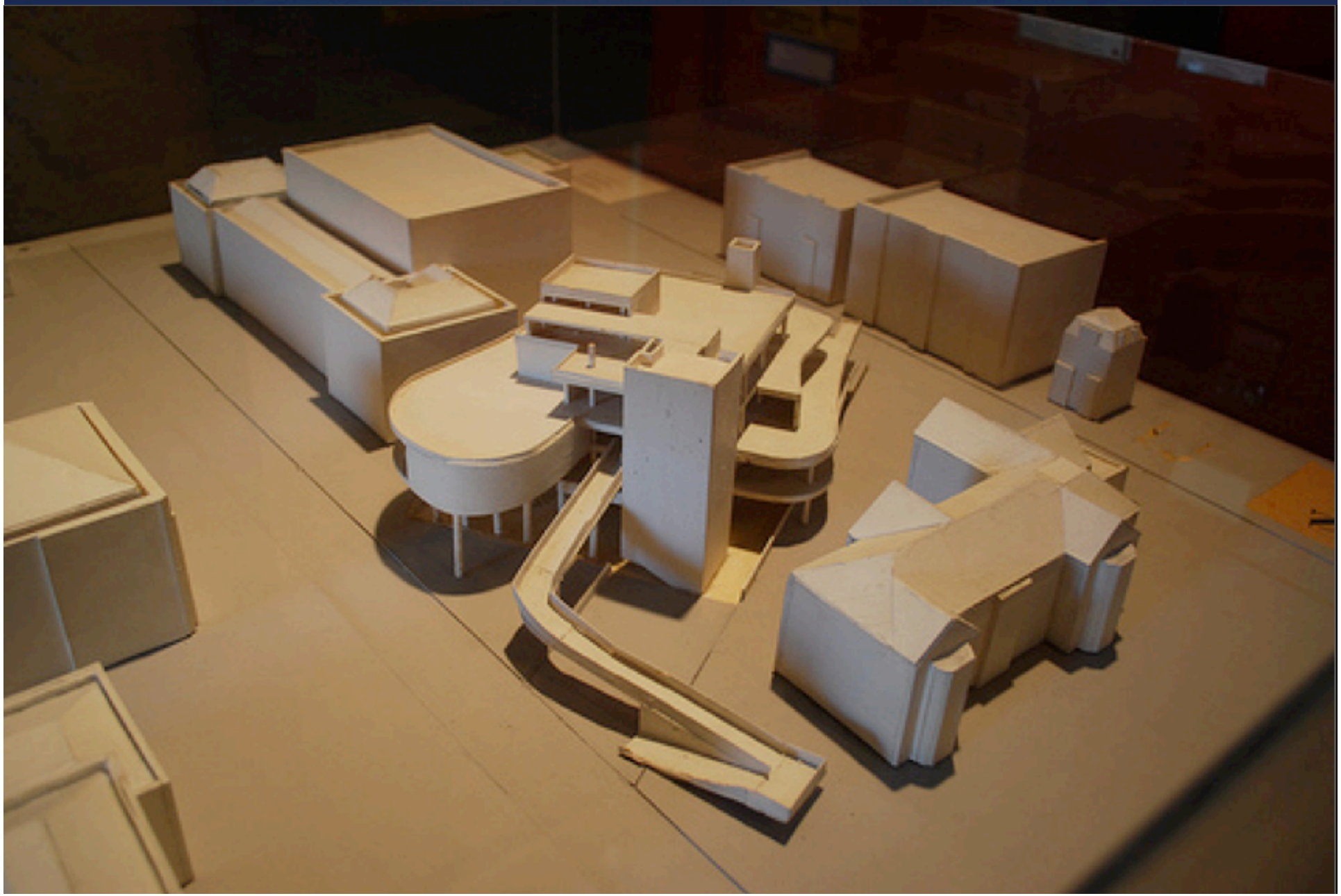
Where else do ducts go?







Hollow URBS floors enable ducts to extend in two directions. Ducts are laid on precast concrete bottom slab, arched forms are installed atop stub columns, and top slab is cast on them.



A spatial problem...

To keep the column from punching through the slab, shear heads are usually poured below the slab at the column head.

Corbu said no, the piloti must meet the slab in a pure way.

The engineers proposed casting the shear heads *above* the slab.

Usually shear heads never go above the slab because … ***people would trip on them!***

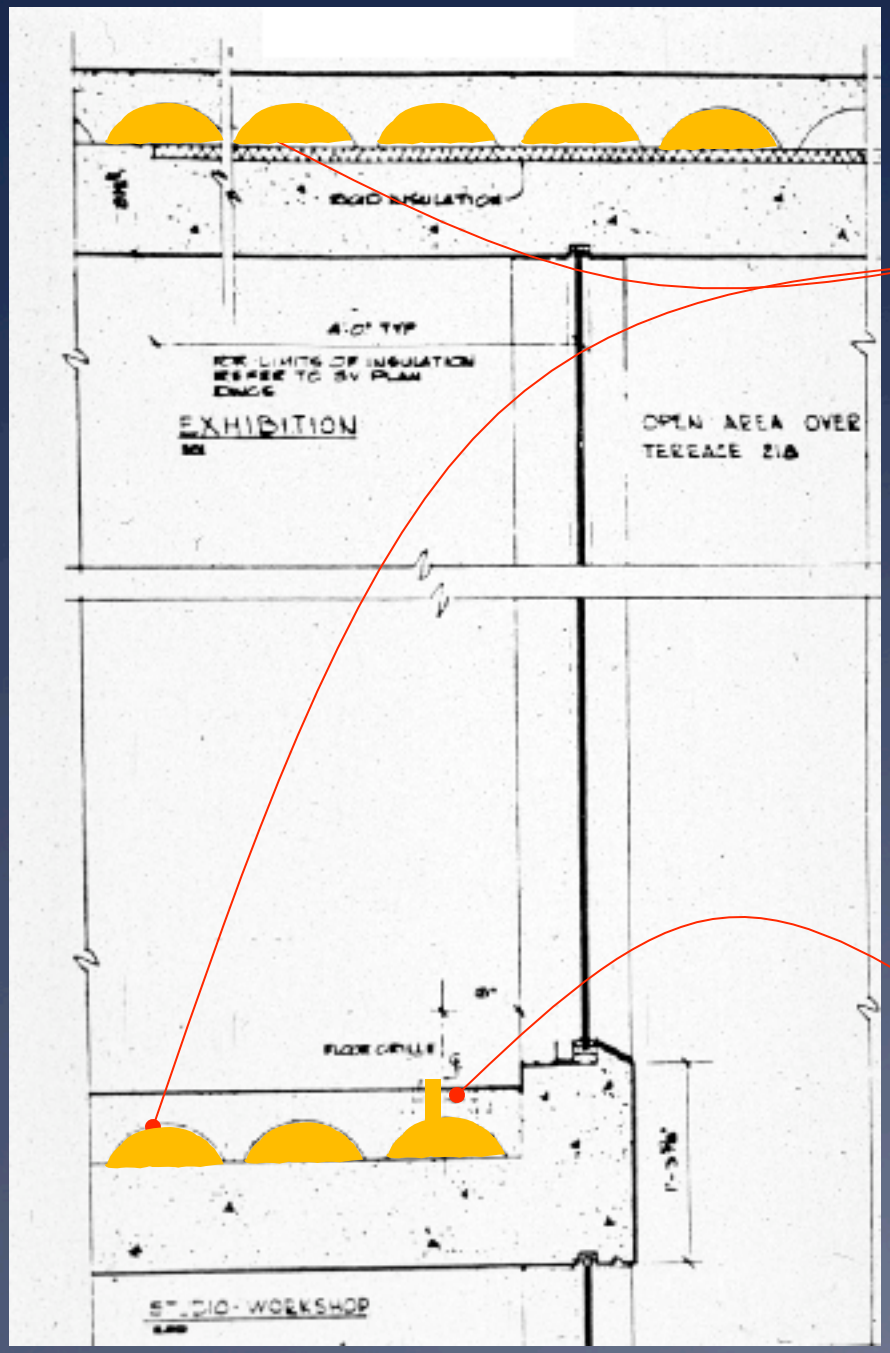
But Corbu's clarity of vision about the piloti and slab was also challenging the mechanical engineers….

He would accept ***no ductwork*** visible in the space!

Problem + Problem = solution!

The structural and mechanical engineers were in different firms, not in direct communication, they could only see their own problem…Corbu!

Sert's architects ***combined*** both problems and found the solution!



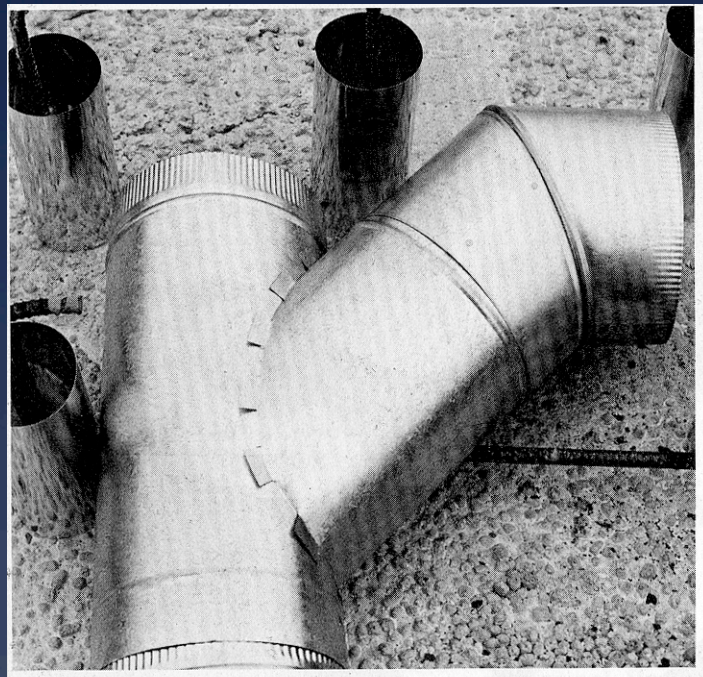
Air filled floors

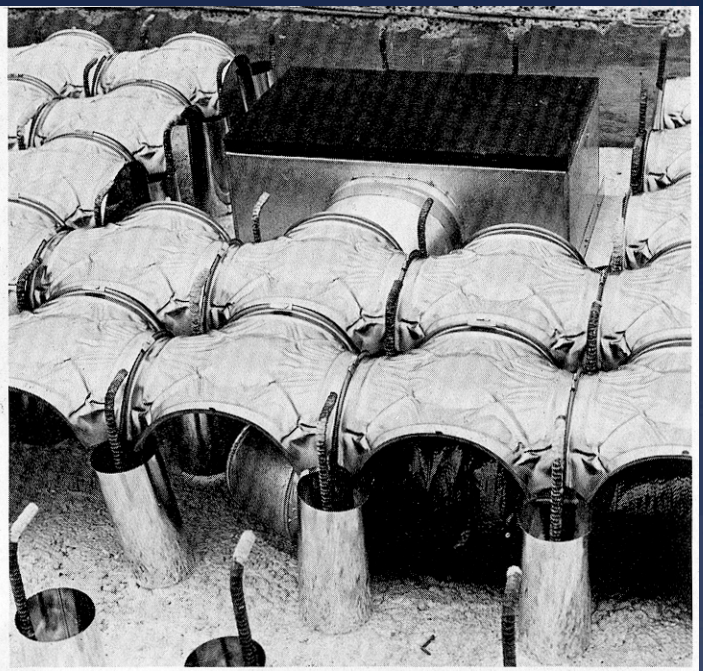
Supply air would be carried through a network of small voids beneath a floor slab poured ***on top*** of the structural slab!

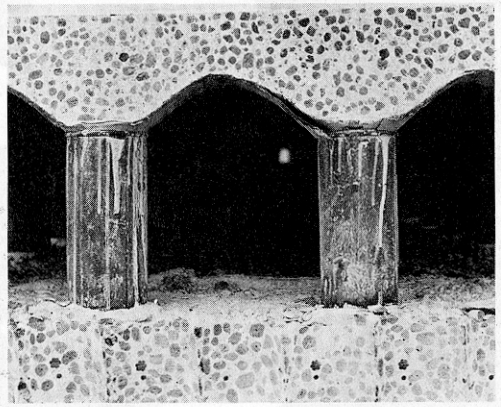
This ***Air Floor*** would cover up the shear heads so no tripping, no projections below the slab, no ducts…everybodies concerns are addressed.

The Air Floor product was '+' shaped plastic vaults set on the floor slab and connected to supply air ducts in the walls.

Where supply air was needed for in the room distribution, a slot was cut through the topping into the Air Floor to release supply air.



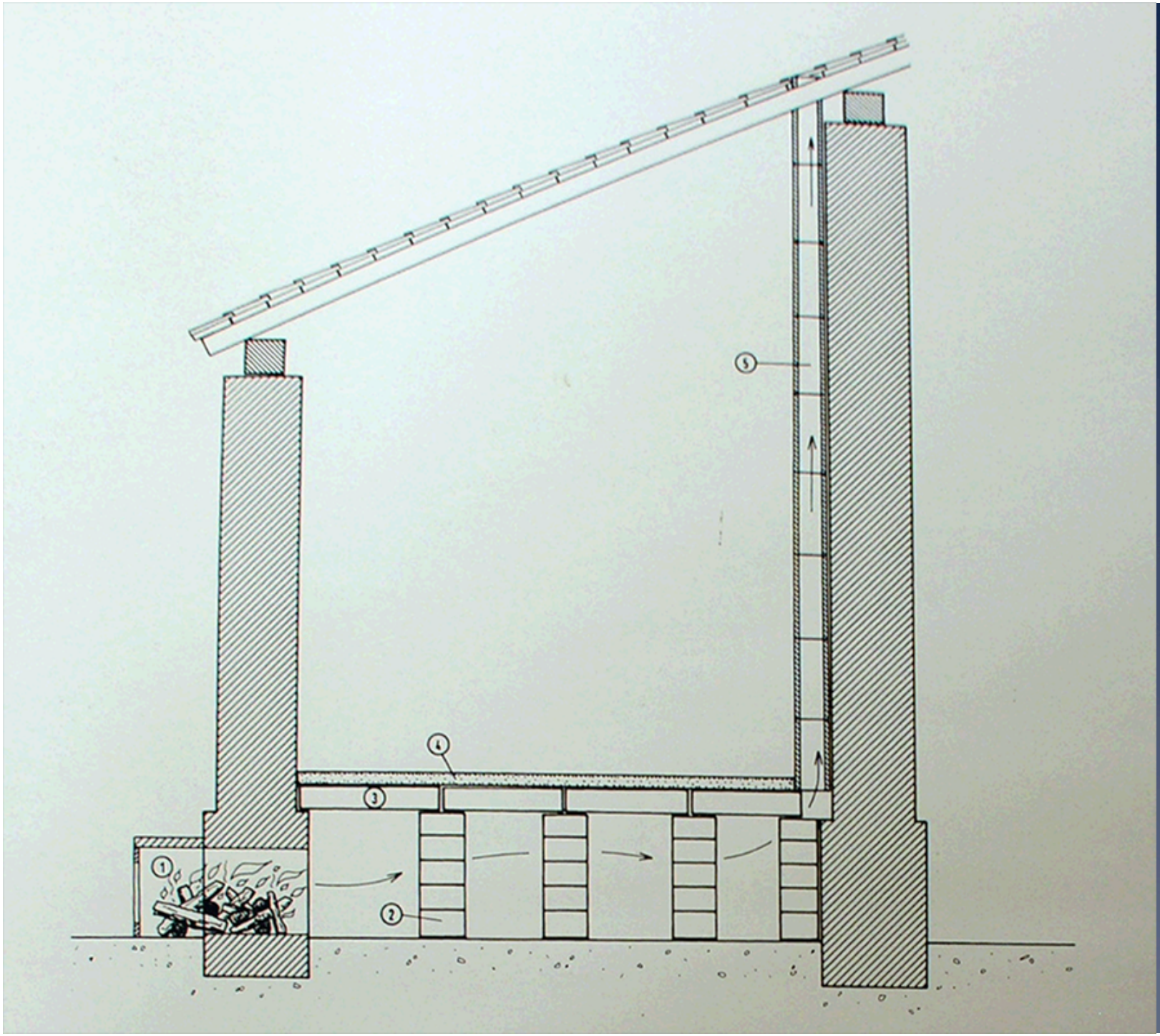




Hollow URBS floors enable ducts to extend in two directions. Ducts are laid on precast concrete bottom slab, arched forms are installed atop stub columns, and top slab is cast on them.

Floor ducts…a roman idea…

Roman builders would often route the smoke from the chimney through a labyrinth path *under* the floors, thus heating the floors.

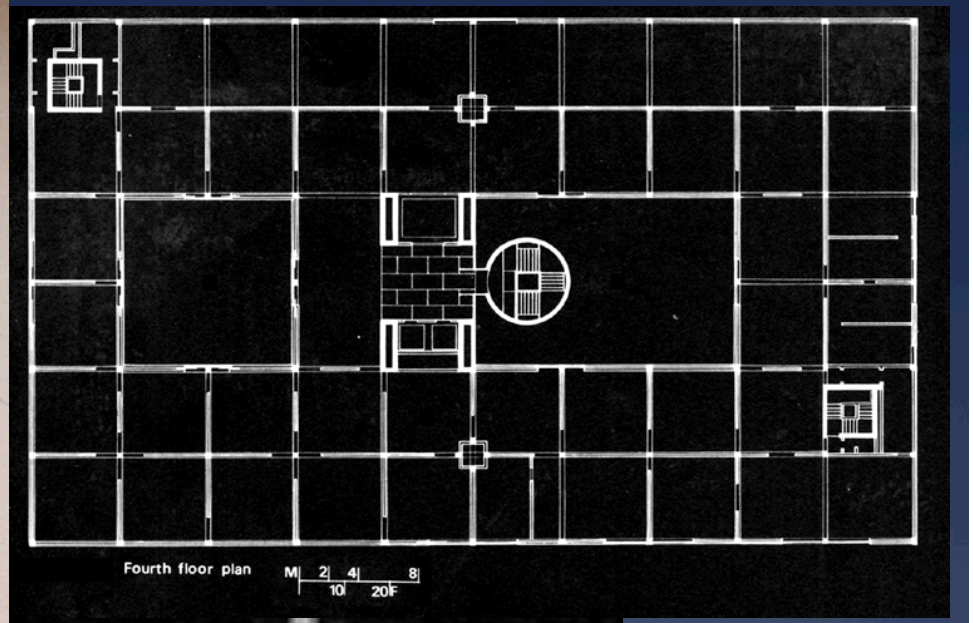

1
2
3
4
5

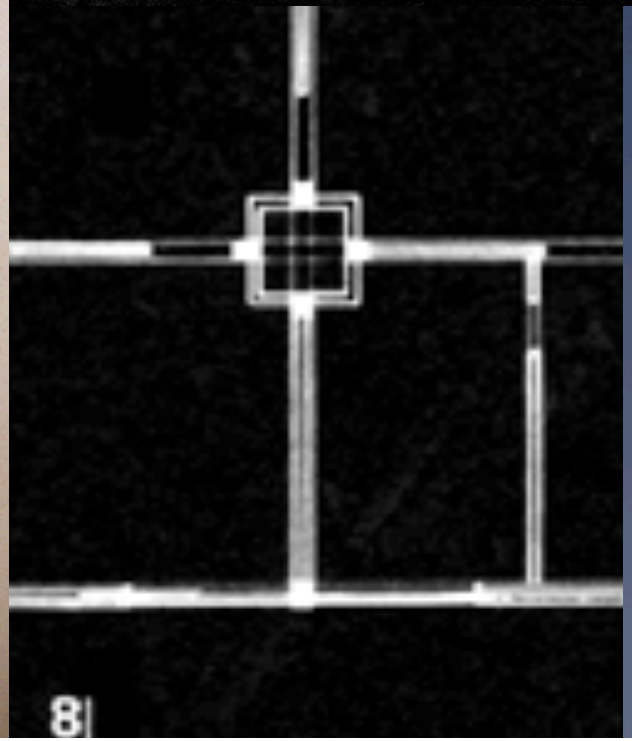
Underfloor ducting endures

Mellon Center for British Art, Louis Kahn

- See the smoke stains?
- Hypocaust!
- …covered by Zumthor in Chur

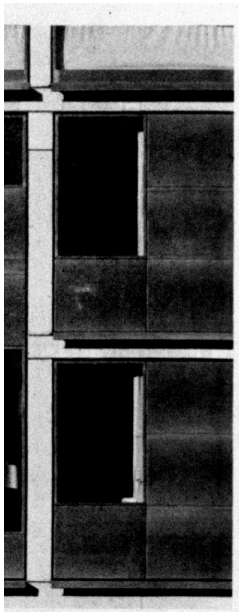
No room for a chase? Part the column!



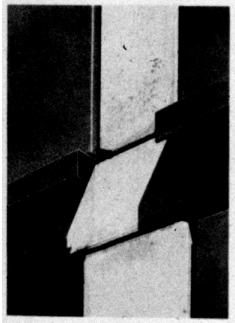


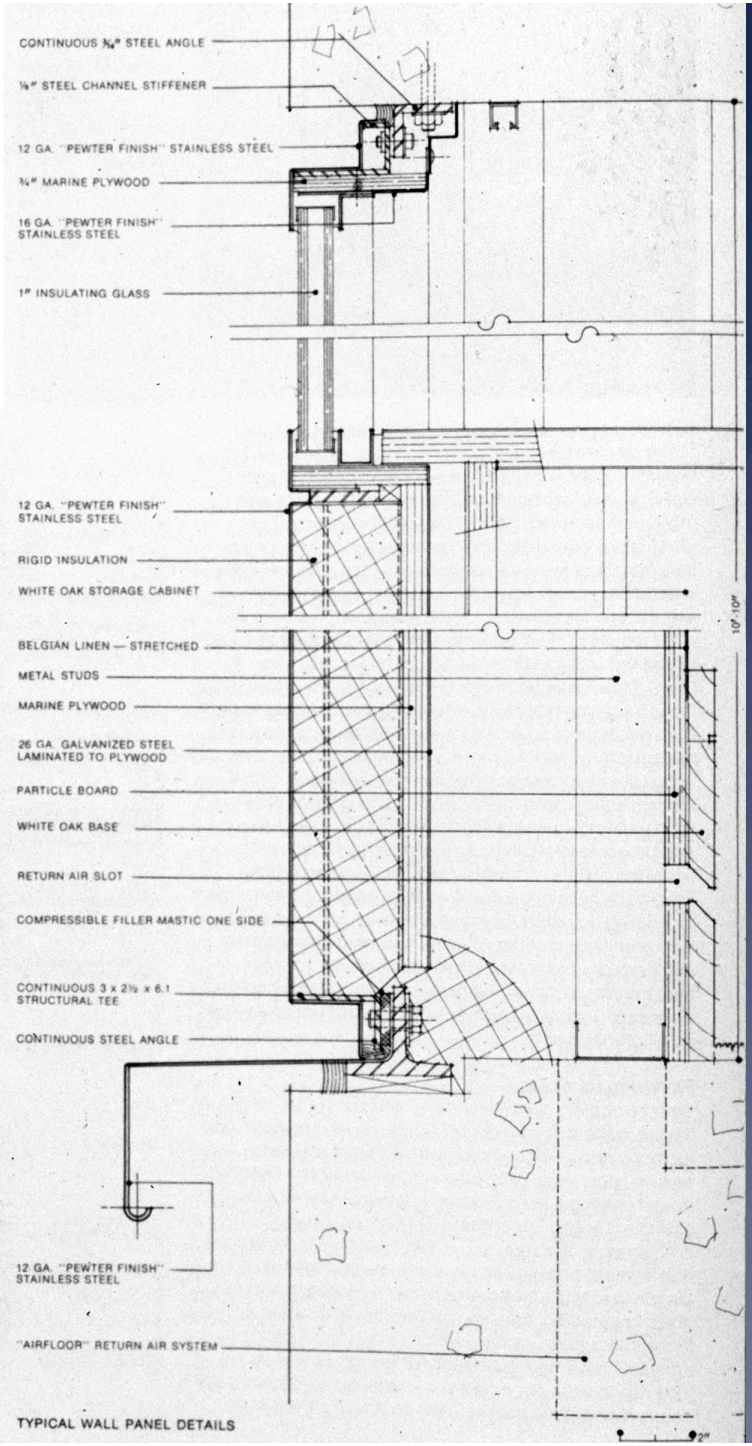
Supply High

Return low



on to expose the hollowness of
illustrated by details at drip
se of building (below). Panels
ed by Trio Industries.

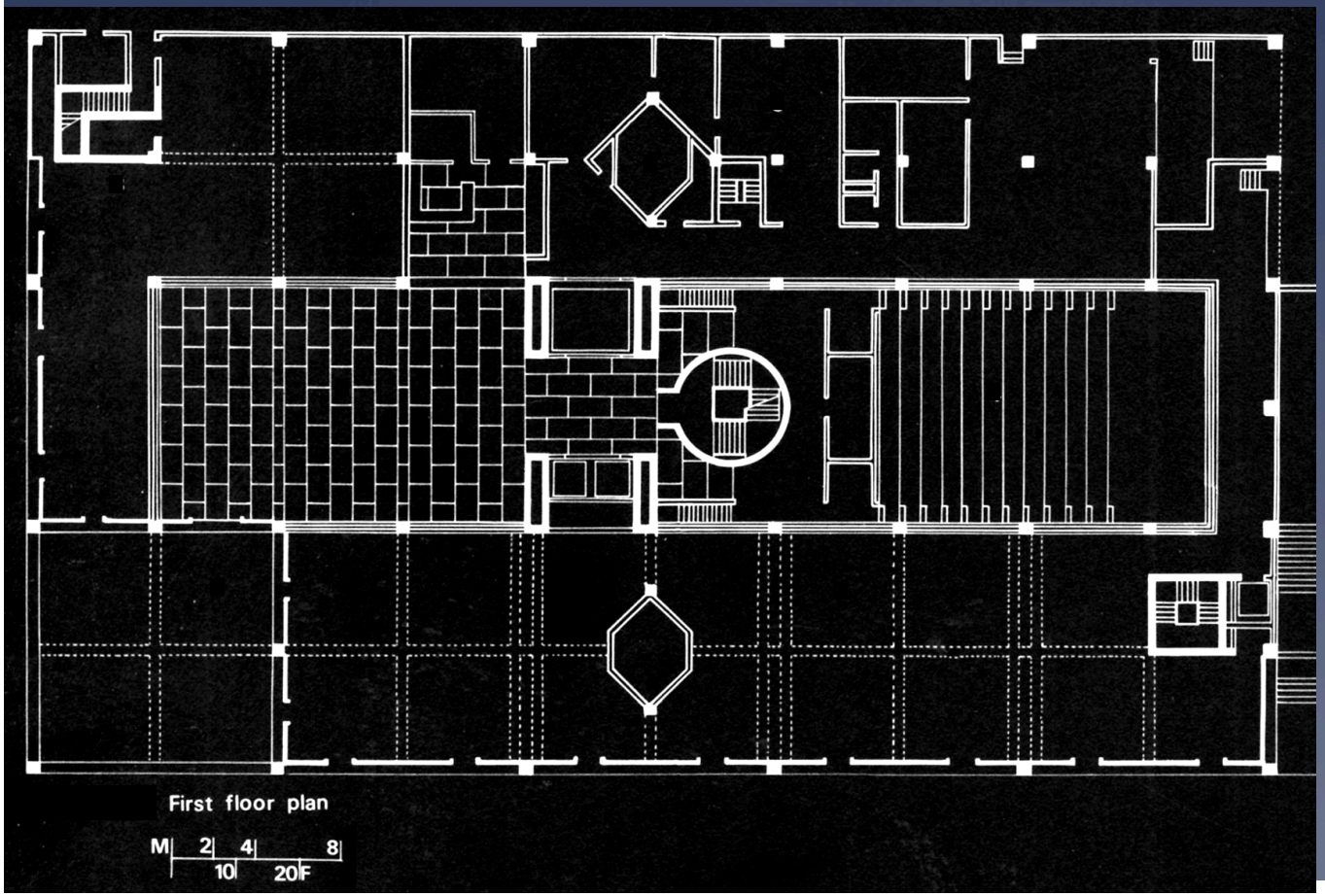


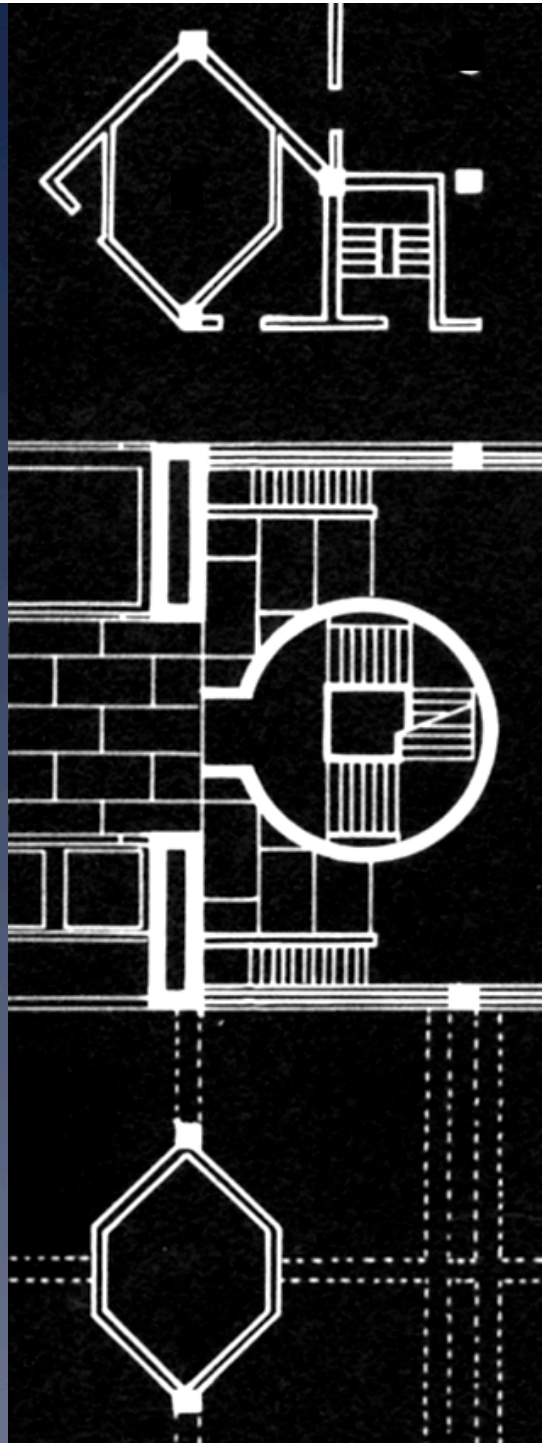


TYPICAL WALL PANEL DETAILS

Wall as duct

How many cores?

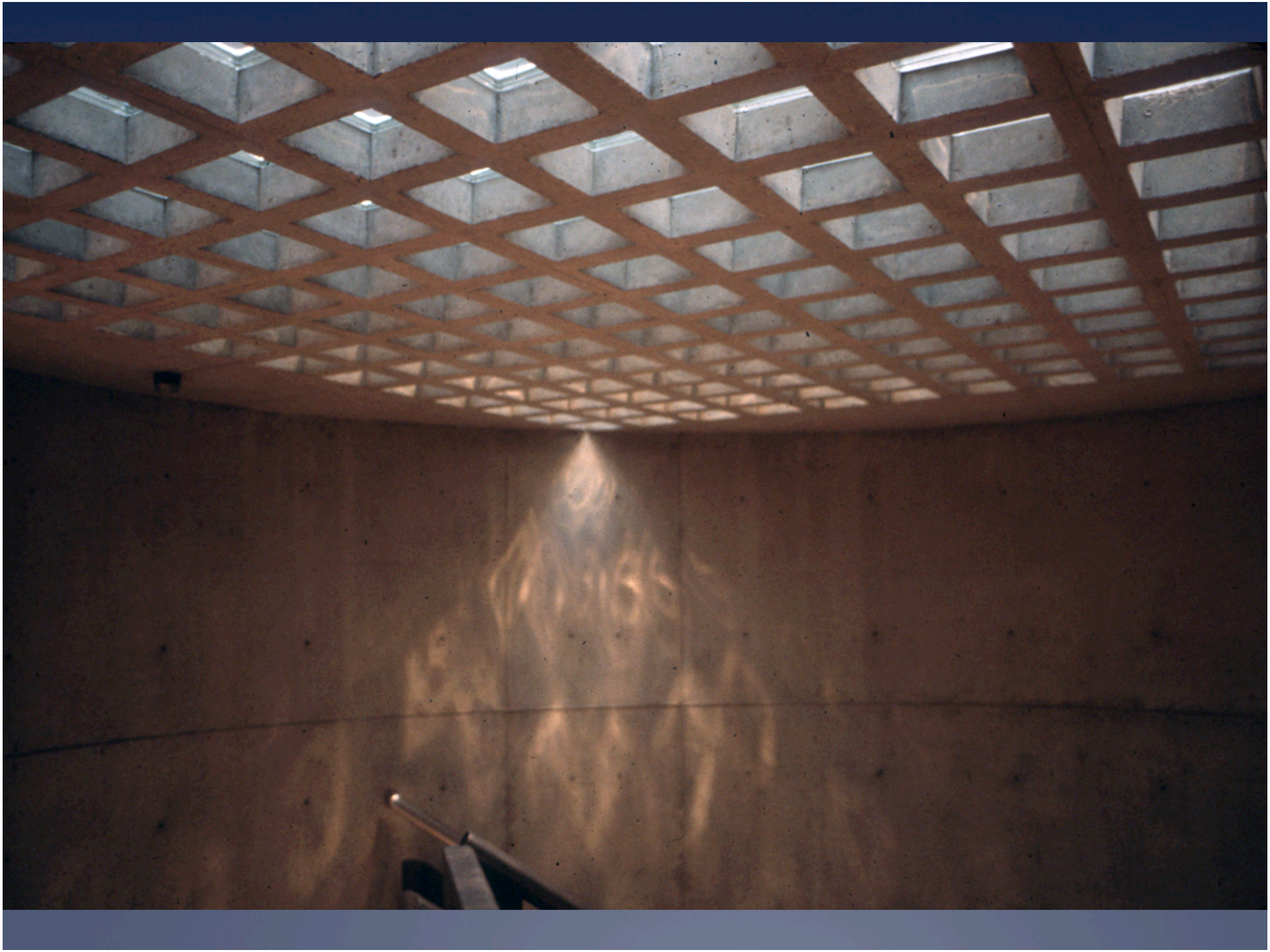


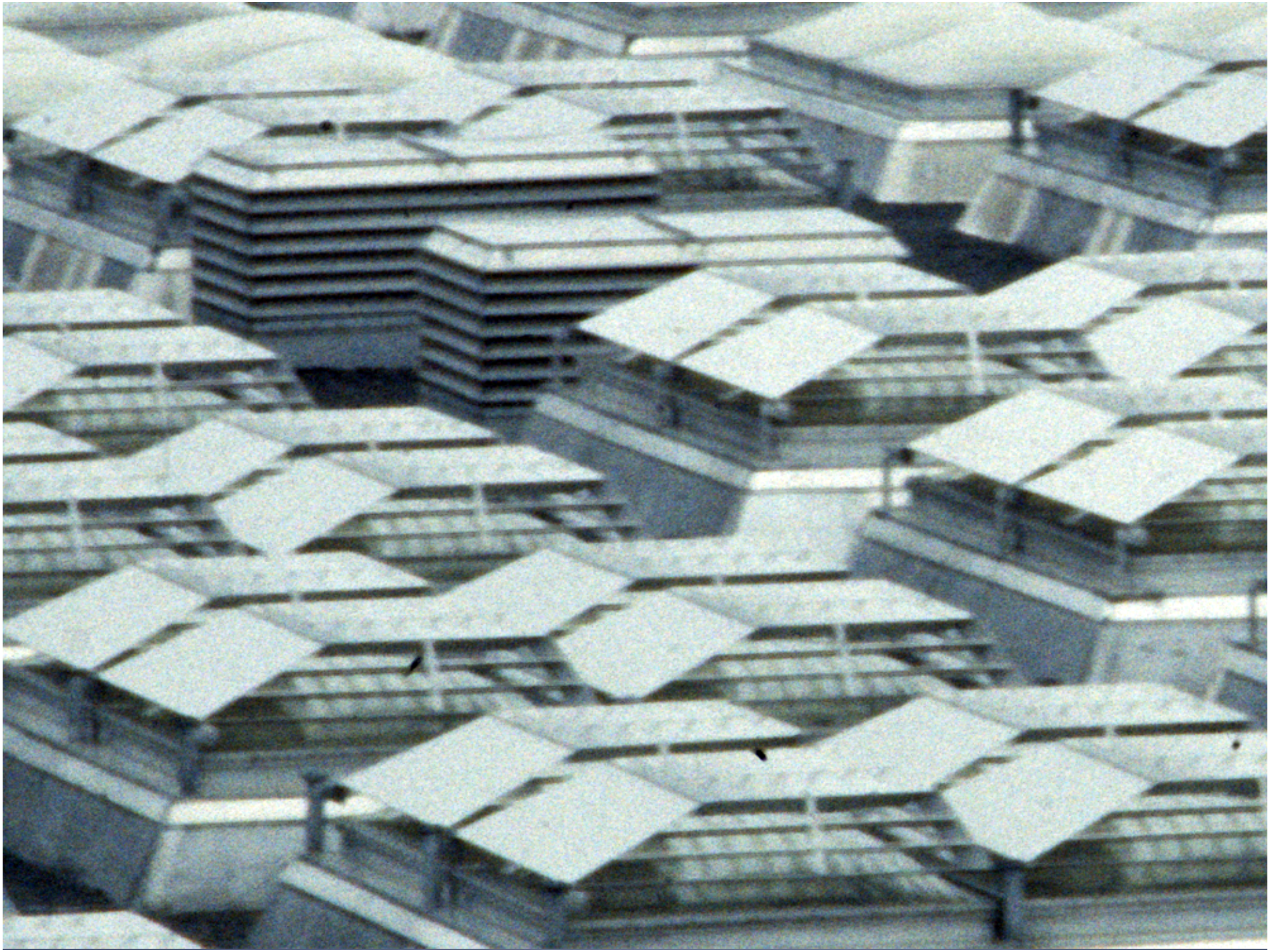


Drum roll…

Getting closer…

Perhaps the nicest fire stair in architecture?






NO
TURN
ON
RED

Underfloor ducting endures

Vanke Center, Steven Holl

Avoid conflicts with structure…ducts in the floor


KLD ACCESS FLOORING
KLD

Computer access floor