Passive Venting of Radon From Concrete

What are the mitigation choices?

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Condominium Building near Miami Florida had elevated radon levels

Six Stories tall

12 years old

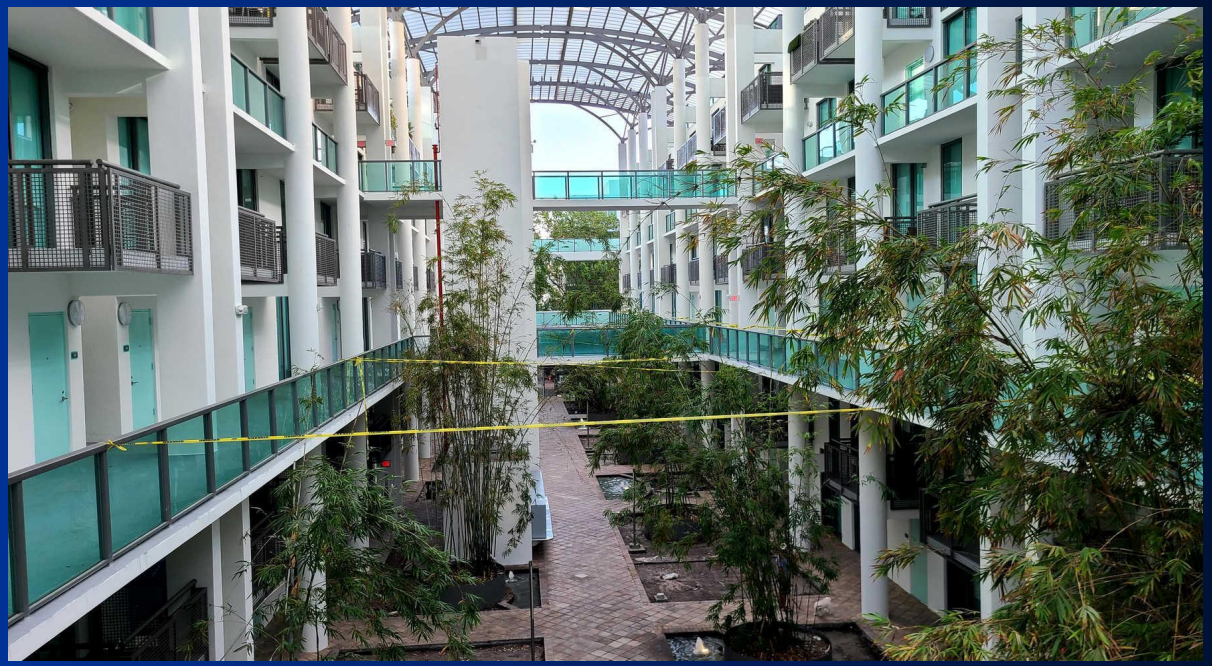
117 units

Each unit is two stories tall

Garage under all units and central courtyard

No windows only sliding doors

Nine units averaged 6 to 10 pCi/l



Entrance to each unit is from interior open air walkway

All units have 2x2 ft marble tile floors

All units have an HVAC closet with air handler

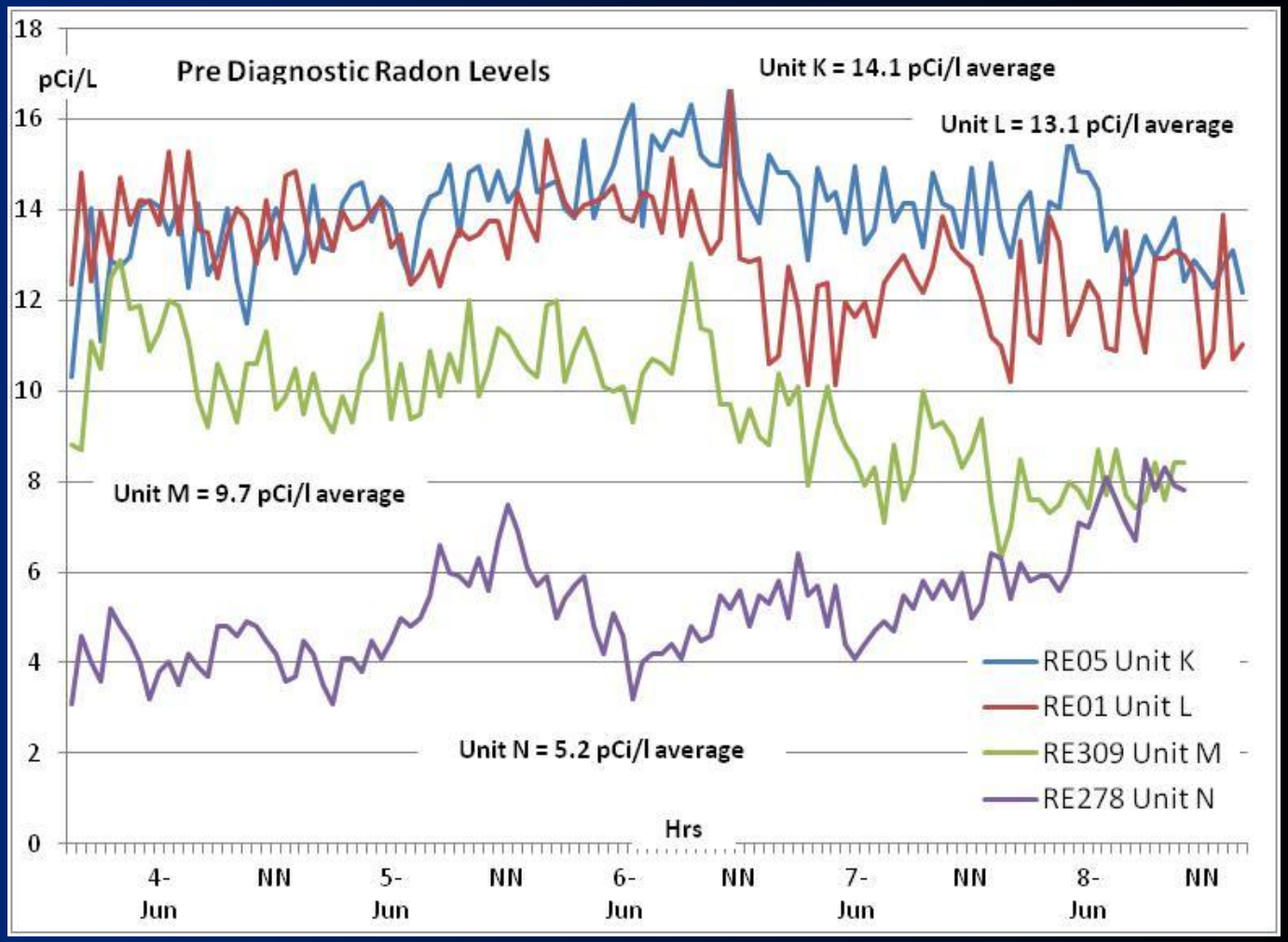
Return air is by a grill in HVAC closet

Reason WPB was hired

1) Design an effective radon mitigation system
2) Reduce system installation cost
3) Minimizes occupant disruption during construction
4) Minimizes disturbing system operating noise
5) Minimize loss of storage space
6) Minimize yearly maintenance & operating cost
7) Minimize increased humidity
   and possible mold growth.

Four units were studied. Radon levels were measured for 5 days before ventilation was added

The pre diagnostic radon levels were 4 to 14 pCi/l

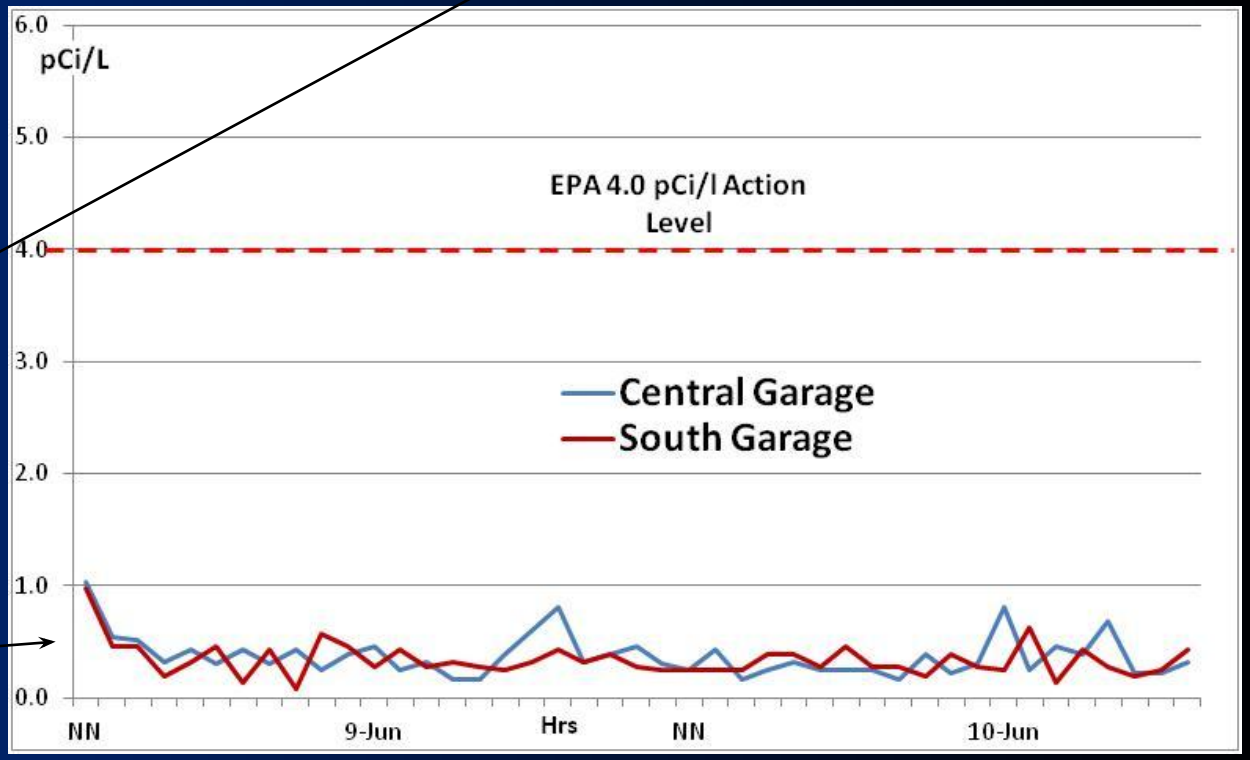


Garage was under the entire building except the office

Spaces around plumbing pipes could not be determined if they were sealed

Five exhaust fans maintained a negative pressure in the garage

Garage Radon measured 0.5 pCi/l



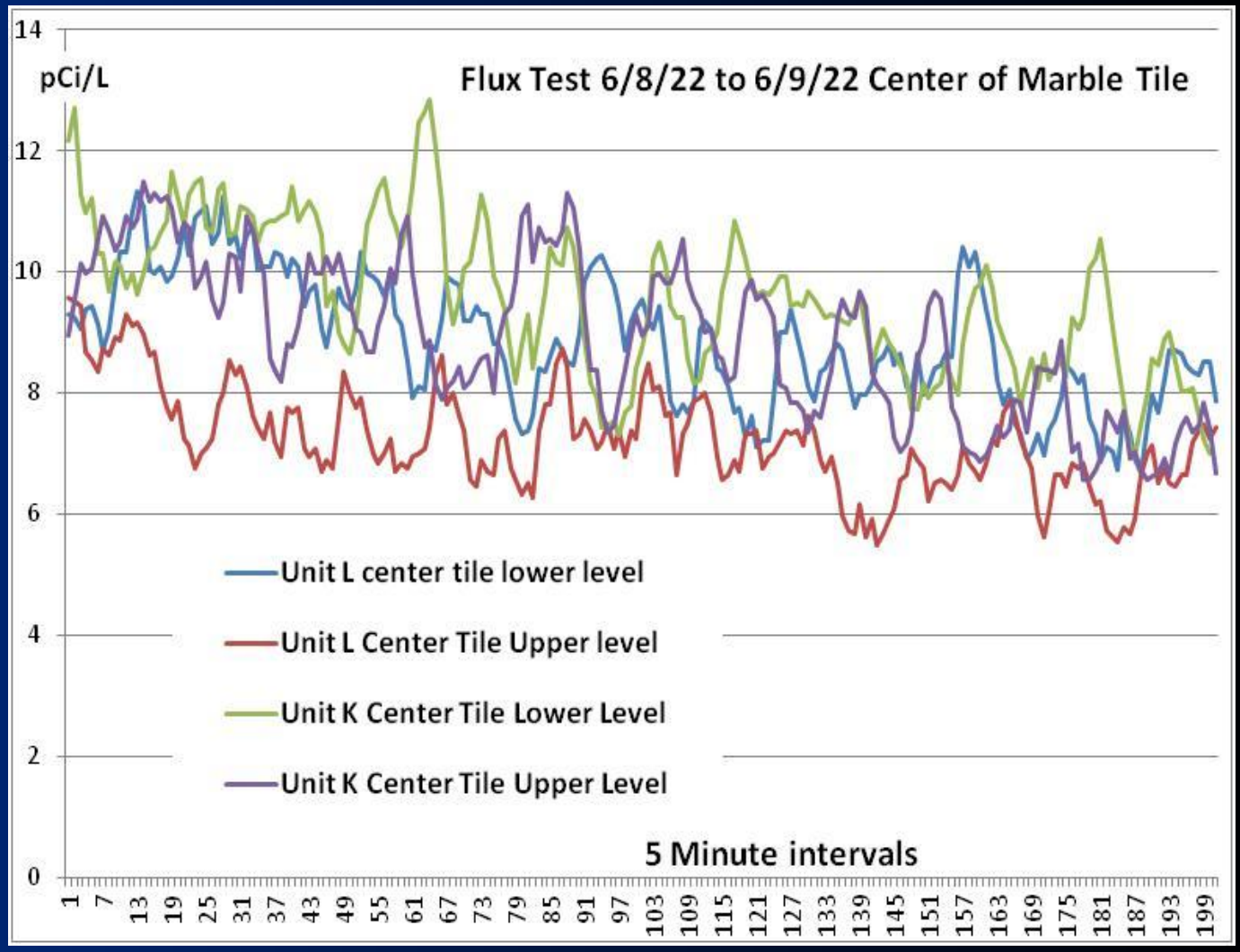
Slab Flux Testing was done with an EcoTracker or RadonEye under a 3 liter bowl

Flux test was done
in center of 2x2 marble tile

or

Flux test was done
over cross grout joints

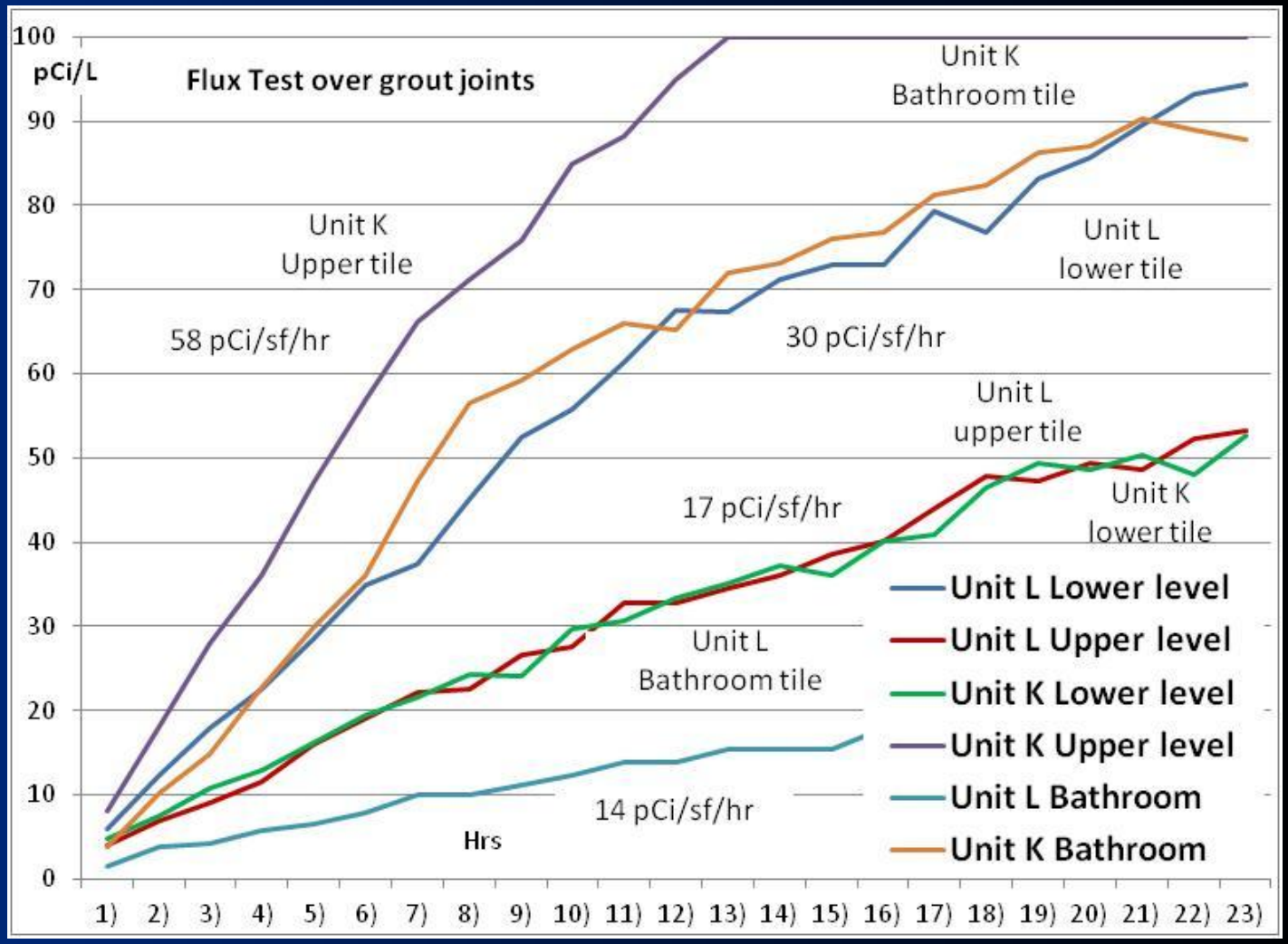
Flux test done in the center of marble tile showed no ingrowth



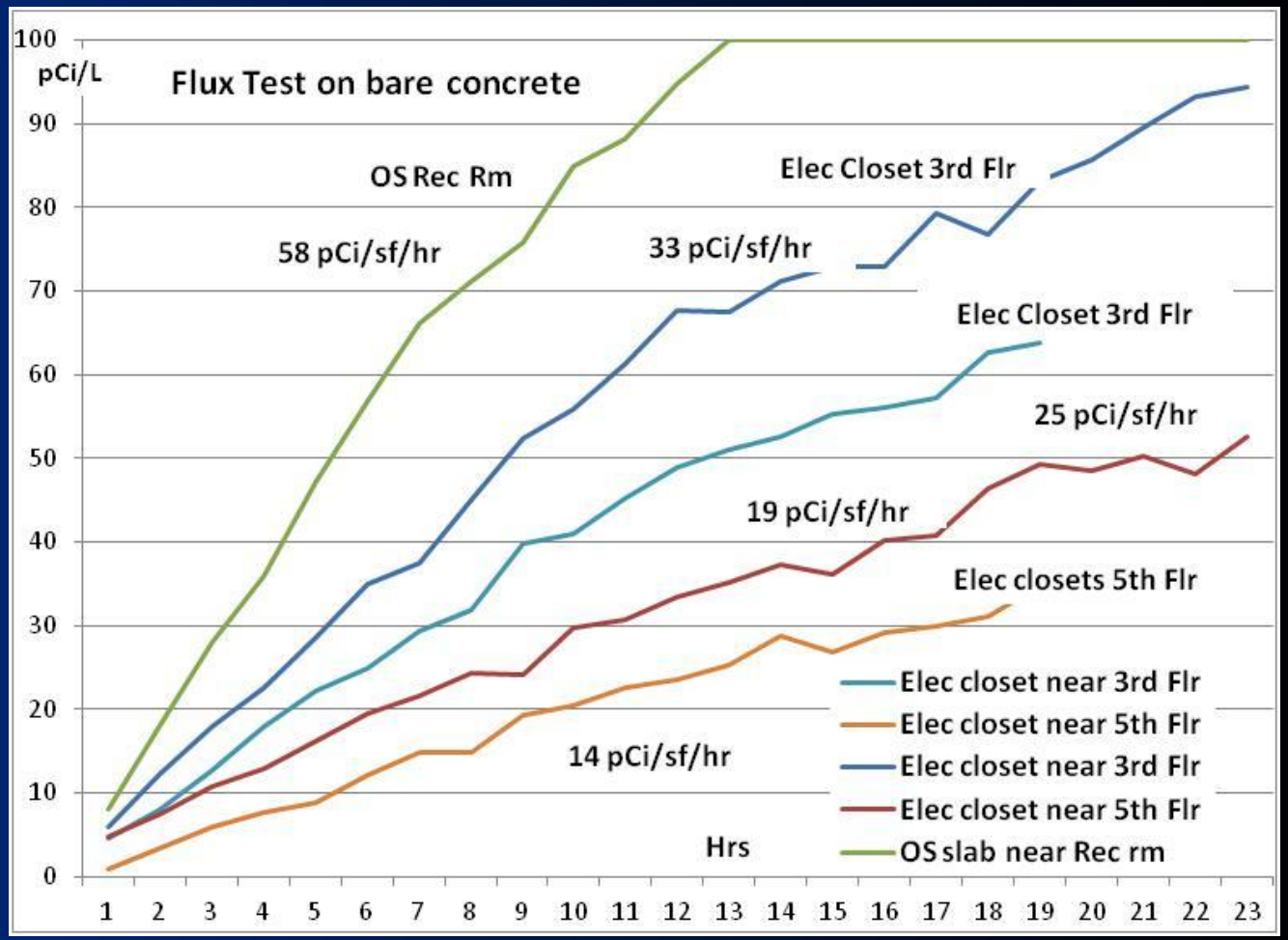
Flux testing over grout joints had measureable but varying flux rates

All these tests were done over intersecting grout joints

Flux test results varied from 14 to 58 pCi/sf/hr



Flux tests over bare concrete also had variation from 14 to 58 pCi/sf/hr flux



35 to 40 CFM of outdoor air was added to each unit

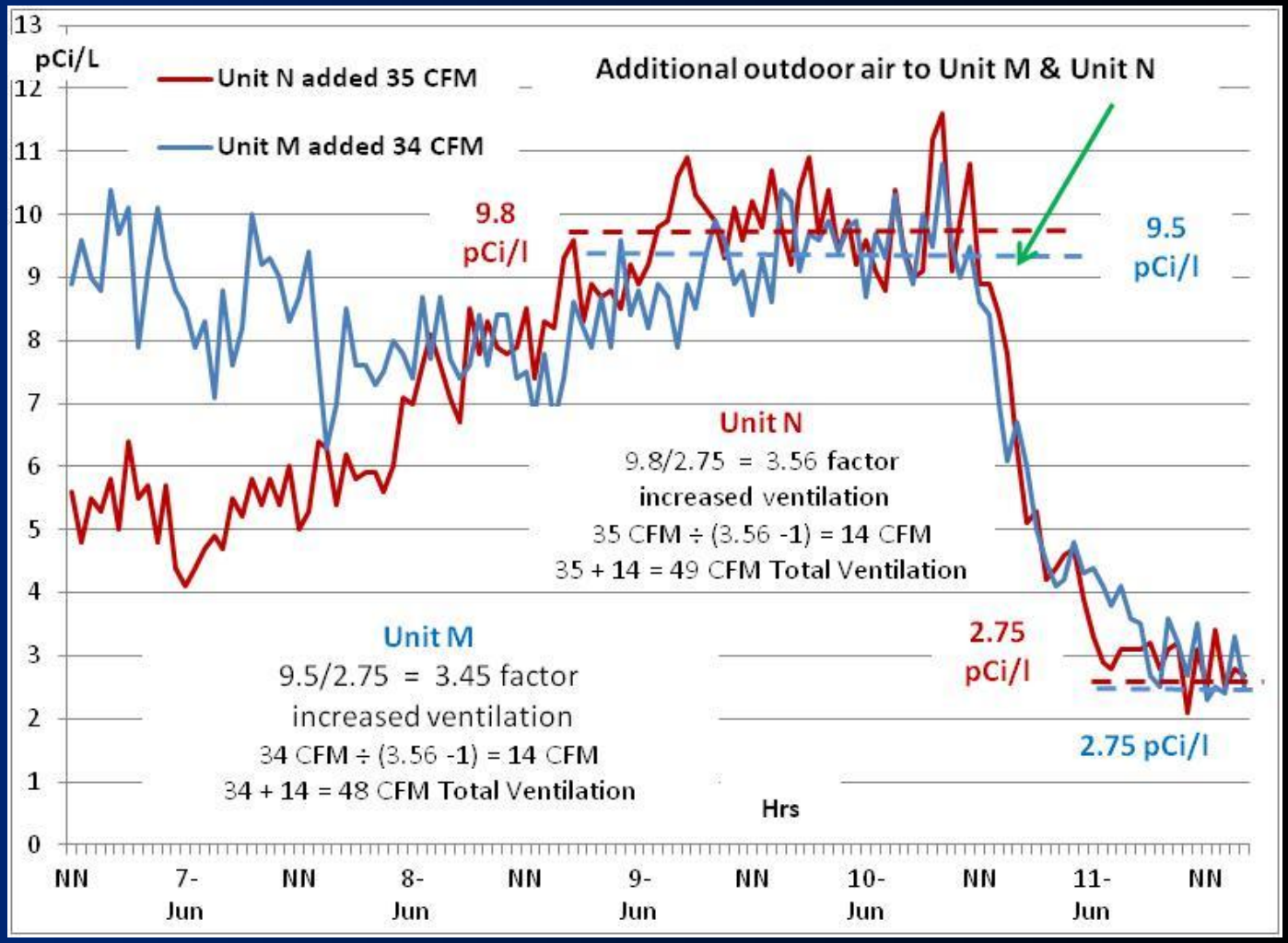
A five inch flow grid was placed in line to measure airflow

Airflow was adjusted using a speed controller

Formula for determining natural ventilation is included in the paper

Both of these Units calculated to 14 CFM of natural ventilation

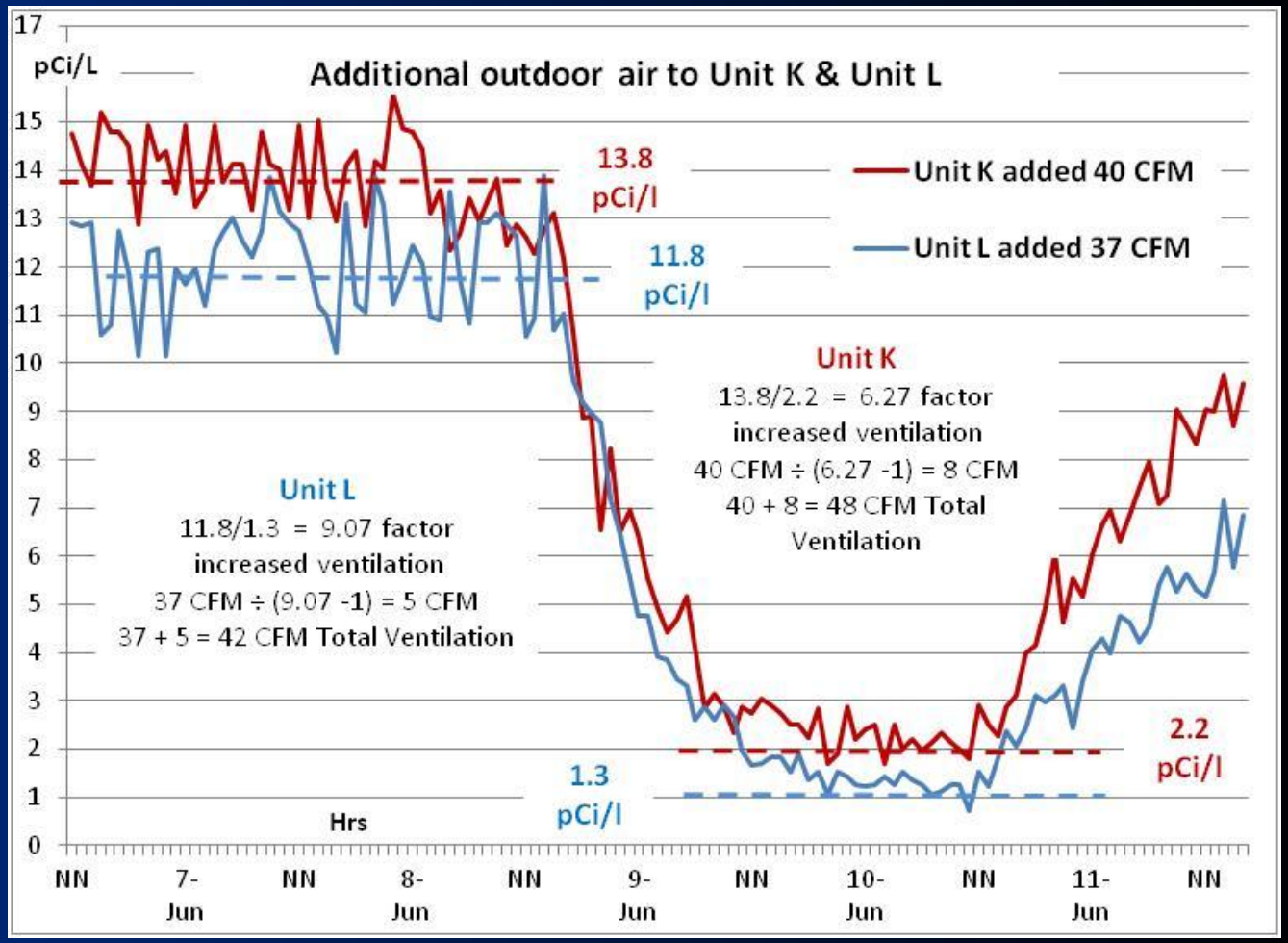
The change in radon levels is used to calculate the natural ventilation rate



Two of the units calculated to extremely low ventilation rate

One Unit calculated to 8 CFM of natural ventilation

Other Unit calculated to 5 CFM of natural ventilation



Results of Ventilation Testing

Unit #	Natural CFM	Natural ACH	Initial Radon	Added CFM	Total CFM	New Radon	0.35 ACH	Required CFM	Final Radon
K	8	0.03	13.8	40	48	2.2	100	92	1.1
L	5	0.02	11.8	37	42	1.3	87	82	0.6
M	14	0.06	9.5	34	48	2.75	87	73	1.2
N	14	0.05	9.8	35	49	2.75	100	86	1.4

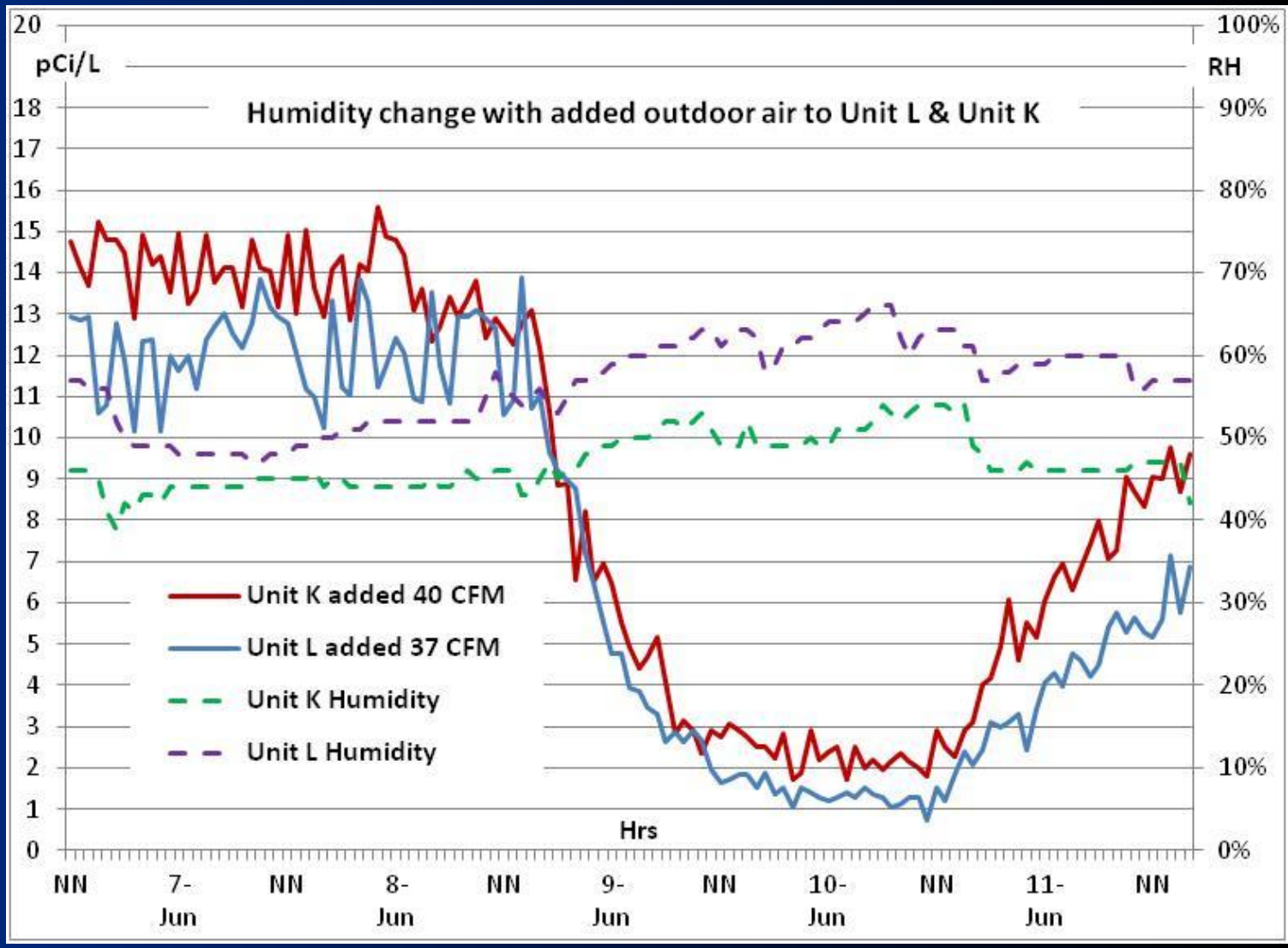
ASHRAE generally recommends about
0.35 ACH for residential homes
The four condo's varied from 0.02 to 0.06 ACH

Additional CFM ranged from 73 to 92 CFM to meet 0.35 ACH

Both units were unoccupied

40 CFM in Unit K increased humidity 45% RH to 55%RH

37 CFM in Unit L increased humidity 55% RH to 65%RH



Three methods of adding Ventilation in Florida Condo's

Whole Building Ventilation

Commercial Roof Top Unit

100% conditioned supply air

Main duct from roof to each unit

Most expensive

Best air quality

Least interior work

Heat Recovery Ventilator

Can have humidity recovery

Uses closet space

Two duct runs to outdoors

Supply duct runs

Bi yearly maintenance

Most interior construction

Direct Fan Ventilation

Least costly

One duct to outside

Simple timer

Mold buildup if HVAC is not operating regularly

Takes up some closet space

HVAC Closet Negative Pressure

An open grill was installed in Unit N causing low – 9.8 pascal pressure

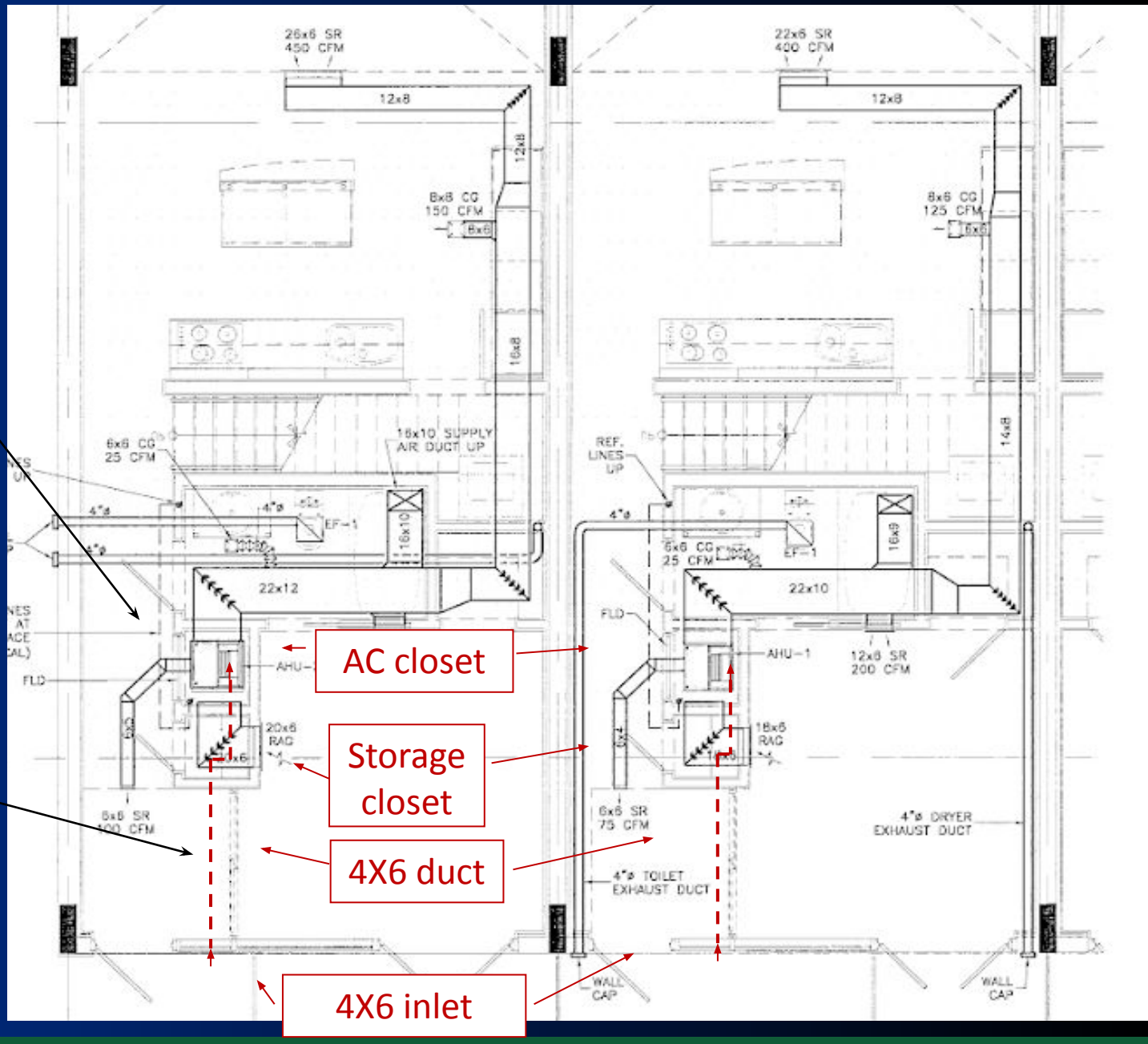
When the air handler was running the closets were 10 to 53 pascals negative

Negative pressure moved 46 to 100 CFM in a 4” pipe

Unit #	AC to Room	Box to Room	CFM
K	-53 pascals	-33 pascals	100
L	-42 pascals	-18 pascals	75
M	-25 pascals	-16 pascals	68
N	-9.8 pascals	-7.5 pascals	46

A 4x6 damper in HVAC closet could control airflow

Single 4” X 6” duct could be installed from HVAC closet to outside wall



Study Conclusions:

1) Residential condominiums in Florida are extremely air tight
2) Concrete floors and walls in air tight homes cause elevated radon
3) Adding mechanical ventilation easily reduces radon from concrete
4) Untreated mechanical ventilation in Florida raises humidity
5) Homeowners and condominium associations want inexpensive solutions
6) Passive radon venting brings in significant amount of air but only when HVAC is operating
7) A passive vent system can be modified in the future to include a fan that cycles with the HVAC operation.
8) The efficiency of this method and it's affect on humidity needs further studies.