

# THE REAL NUMBERS

## UNDERSTANDING SQUARE FOOTAGES AND BUILDING MULTIPLIERS THAT WORK

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*Shepley Bulfinch Richardson & Abbott*



- Square Feet and Building Multipliers
  - Definitions
  - Relationships / Calculations
    - Drivers
  - Common Problem Areas
- Key Rules of Thumb
- Escalation



**Capital Cost → Construction (Space)**

**Operational Cost → Staff (Efficiency)**



# Why it matters

*The Real Numbers*

- Program sets square footage
- Square footage sets estimated cost
  - very easy to be off by 10-15% on area
  - very difficult to recover from bad numbers



- General agreement on square footage definitions
- Divergent methods of measurement, application
- Significant issue of absence of evidence:
  - measured construction drawings should be basis for calculations
  - unwillingness to admit to larger multipliers



$$NSF \times A = DGSF$$

$$DGSF \times B = BGSF$$

$$[NSF \times AB = BGSF]$$



**NSF to BGSF**

*The Real Numbers*

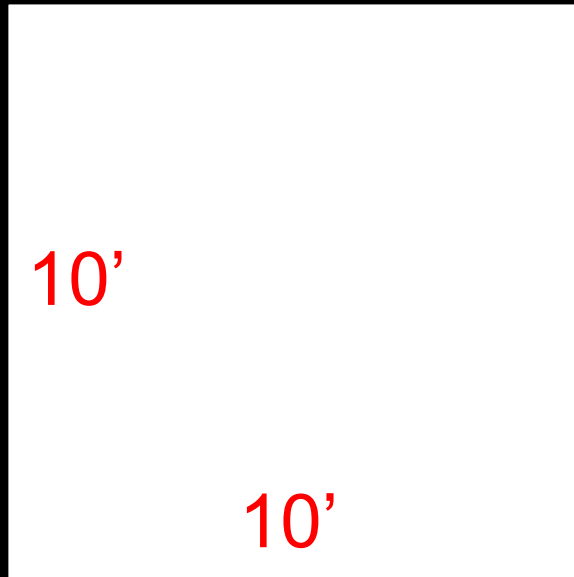
**AB =**

**2**



# Net Square Feet (NSF)

*The Real Numbers*



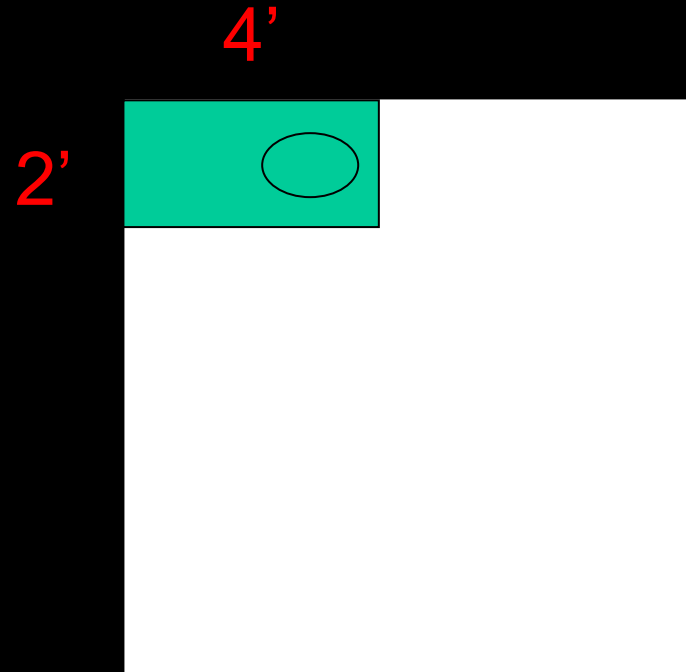
NSF = Area of a room

$$10' \times 10' = 100 \text{ NSF}$$



# Clear Square Feet

*The Real Numbers*



$$\begin{array}{r} 100 \text{ NSF} \\ - 8 \text{ NSF} \\ \hline 92 \text{ NSF} \end{array}$$

8%

100 NSF



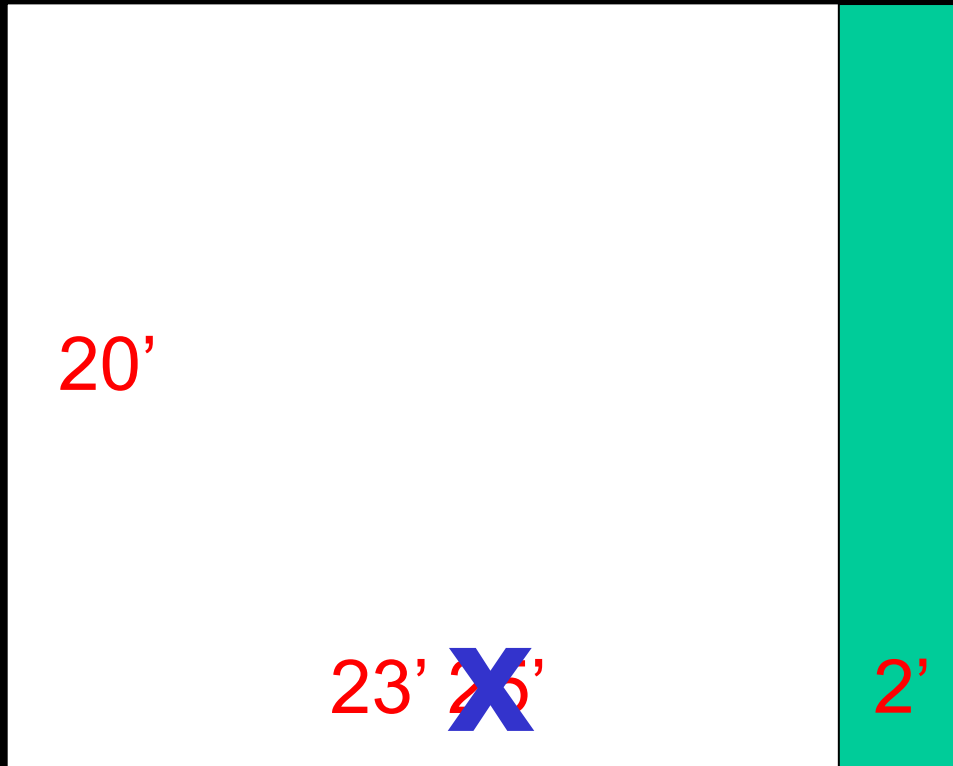
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# Clear Sq Ft: OR @ 500 NSF

*The Real Numbers*



500 NSF  
- 40 NSF  

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460 NSF

8%

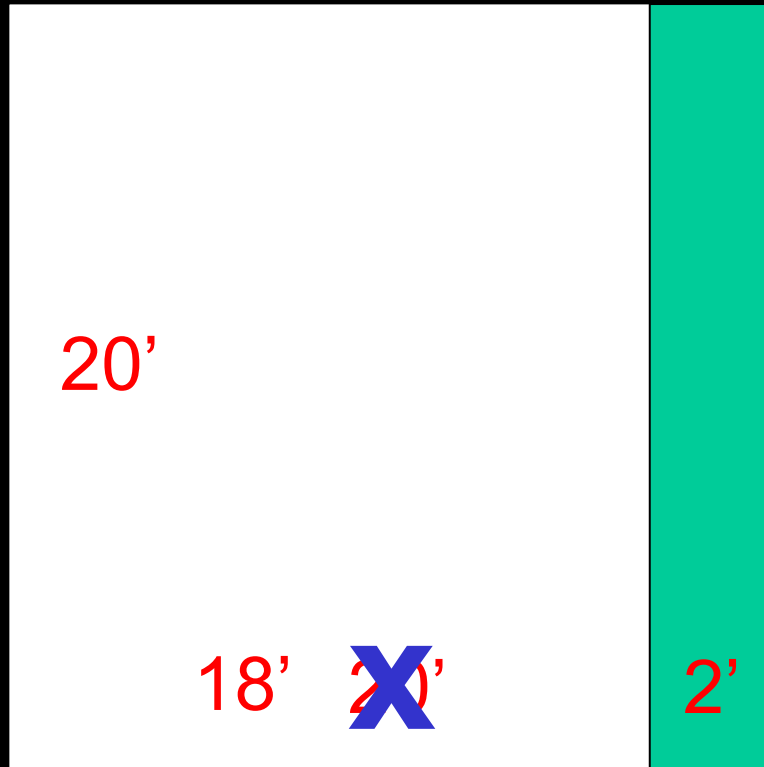
$20' \times 25' = 500 \text{ NSF}$

$20' \times 23' = 460 \text{ NSF}$



# Clear Sq Ft: OR @ 400 NSF

*The Real Numbers*



$$20' \times 20' = 400 \text{ NSF}$$

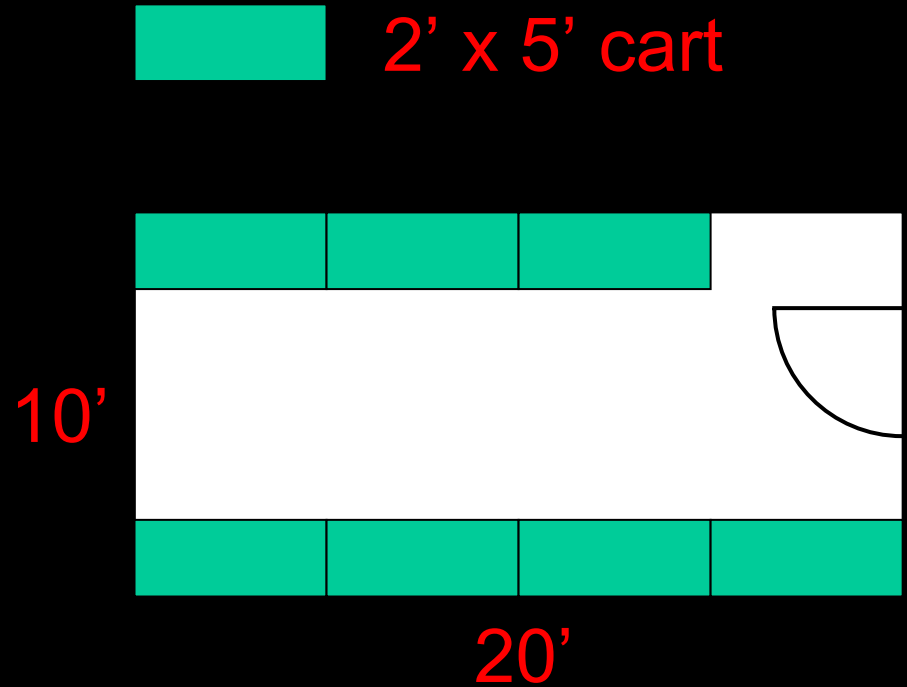
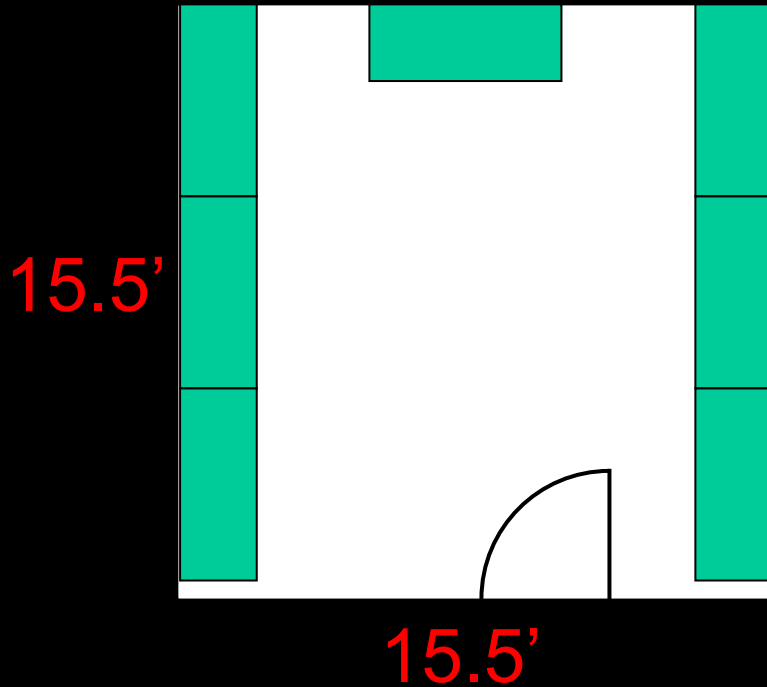
OR will no longer  
meet *AIA Guidelines*

$$20' \times 18' = 360 \text{ NSF}$$



# Proportion

*The Real Numbers*



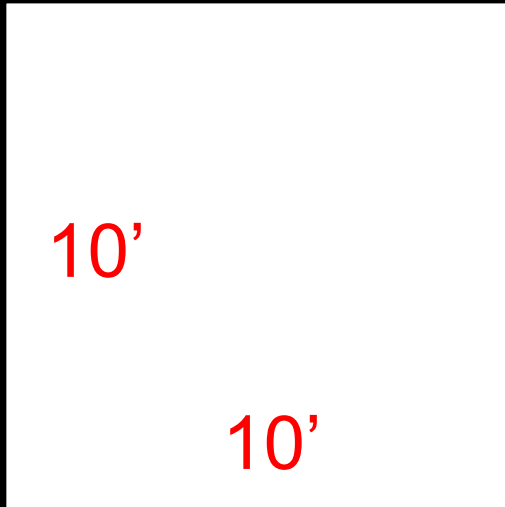
$$15.5'^2 = 240 \text{ NSF} < 10' \times 20' = 200 \text{ NSF}$$

*< means less efficiency*



# Proportion

*The Real Numbers*



10' x 10' = 100 NSF;  
40' Perimeter

5' x 20' = 100 NSF;  
50' Perimeter



# Departmental Gross Sq Ft (DGSF) *The Real Numbers*



DGSF = Area **within** a department

Sum of NSFs + interior partitions  
+ columns + departmental  
circulation (circulation required  
to get to all areas of the  
department)

$$\text{NSF} \times A = \text{DGSF}$$

$$A = 1.3 \leftrightarrow 1.7$$



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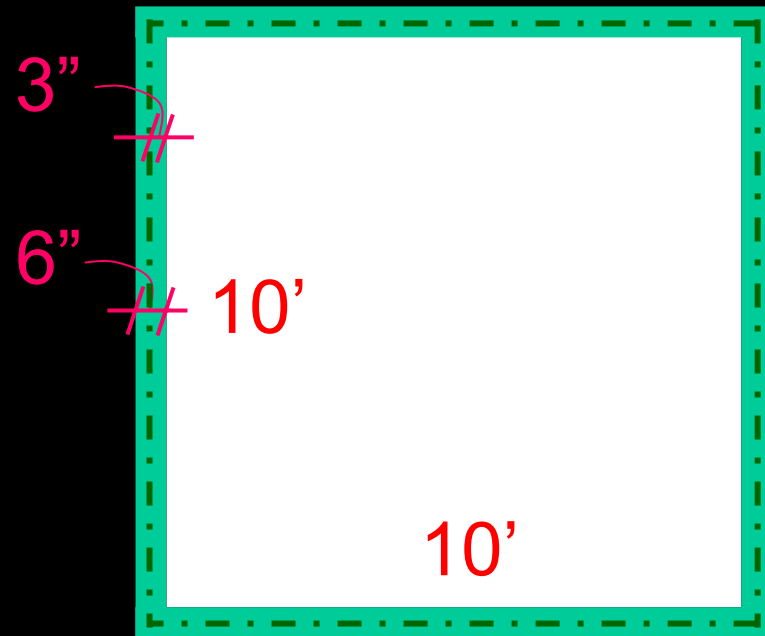


# DGSF: Interior Partitions

*The Real Numbers*

$$\begin{aligned} \text{Perimeter} &= 40' \\ 40' \times .25' &= 10' \\ 10/100 &= 10\% \\ &= 1.1 \end{aligned}$$

Room size a factor in  
partition contribution;  
larger room → smaller  
partition percentage



$$10' \times 10' = 100 \text{ NSF}$$



# DGSF: 5' Corridor

*The Real Numbers*

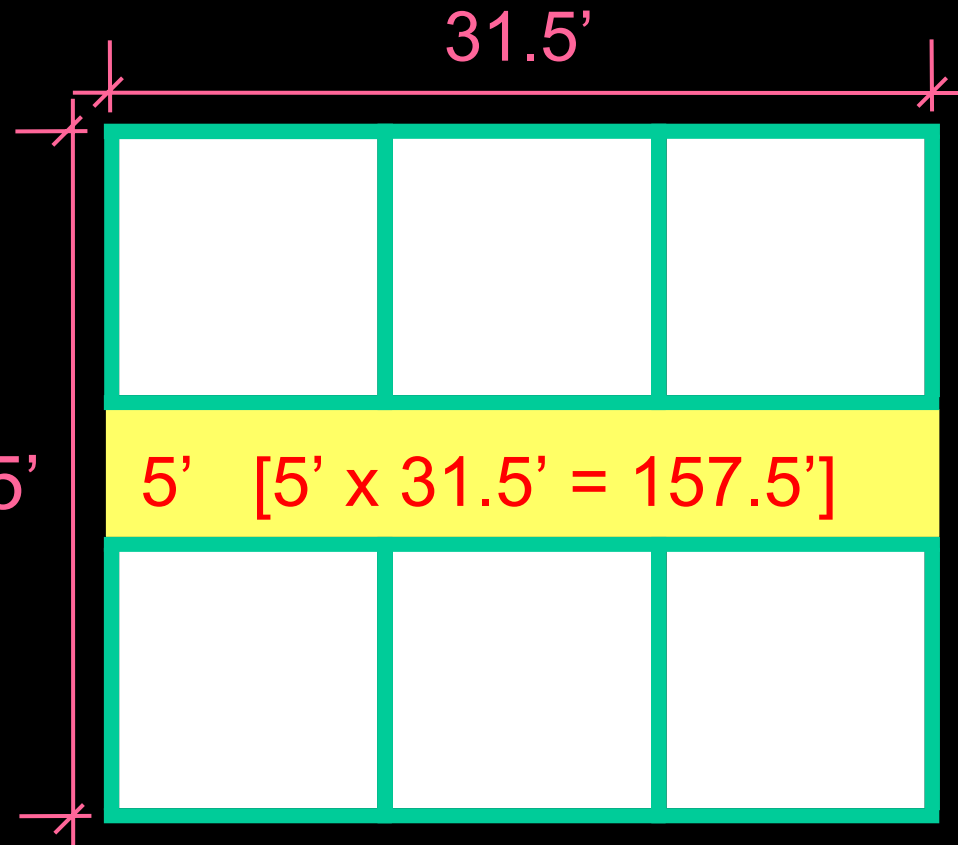
$$\text{NSF} \times A = \text{DGSF}$$

$$A = 1.3 - 1.7$$

$$600 \times A = 835$$

$$A = 1.39$$

$$\begin{aligned} \text{Efficiency} &= \text{NSF} / \text{DGSF} \\ &= 72\% \end{aligned}$$



**Measured DGSF = 835**



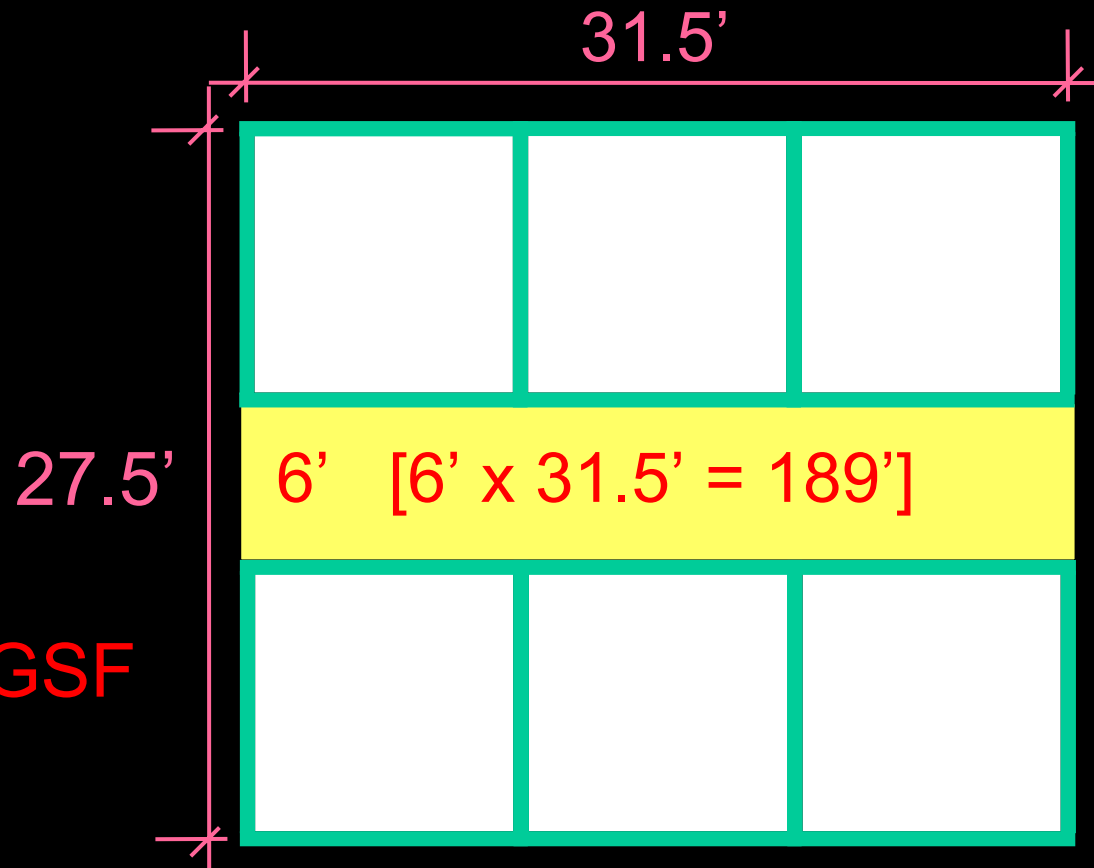
# DGSF: 6' Corridor

*The Real Numbers*

$$600 \times A = 866$$

$$A = 1.44$$

$$\begin{aligned} \text{Efficiency} &= \text{NSF} / \text{DGSF} \\ &= 69\% \end{aligned}$$



**Measured DGSF = 866**



# DGSF: 8' Corridor

*The Real Numbers*

$$600 \times A = 929$$

$$A = 1.55$$

$$\begin{aligned} \text{Efficiency} &= \text{NSF} / \text{DGSF} \\ &= 65\% \end{aligned}$$

29.5'

31.5'

8' [8' x 31.5' = 252']

Measured DGSF = 929

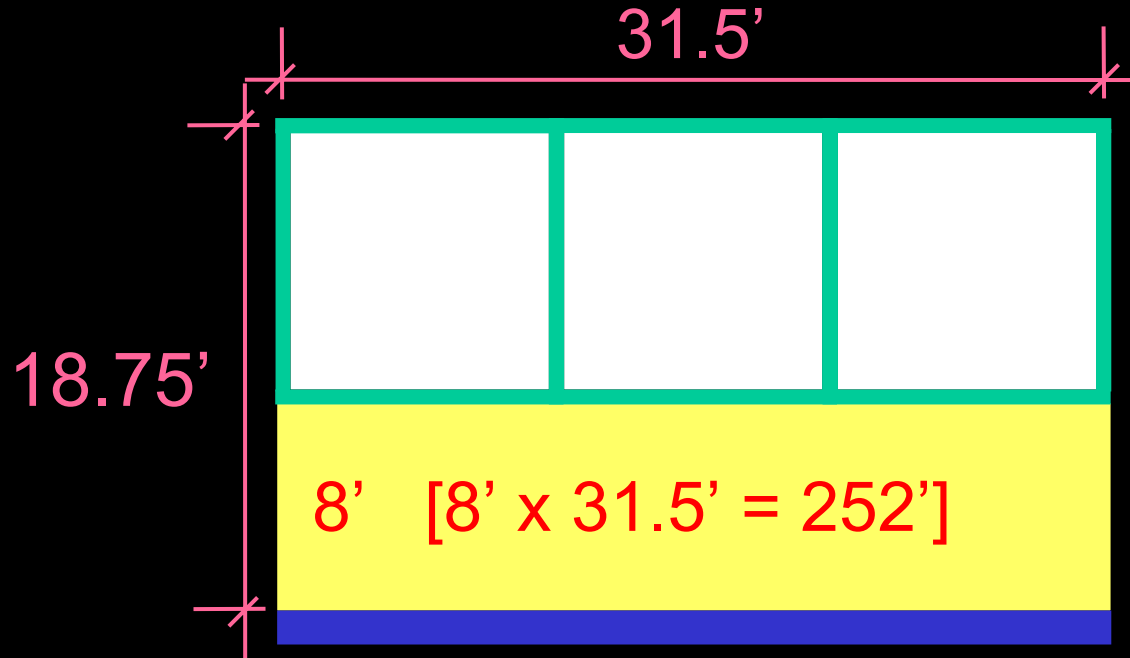


# DGSF: 8' Corridor, Single Loaded

*The Real Numbers*

$$300 \times A = 591$$

$$A = 1.97$$



$$\text{Efficiency} = \text{NSF} / \text{DGSF} \\ = 51\%$$

**Measured DGSF = 591**



# DGSF: 8' Corridor + BIG Rooms

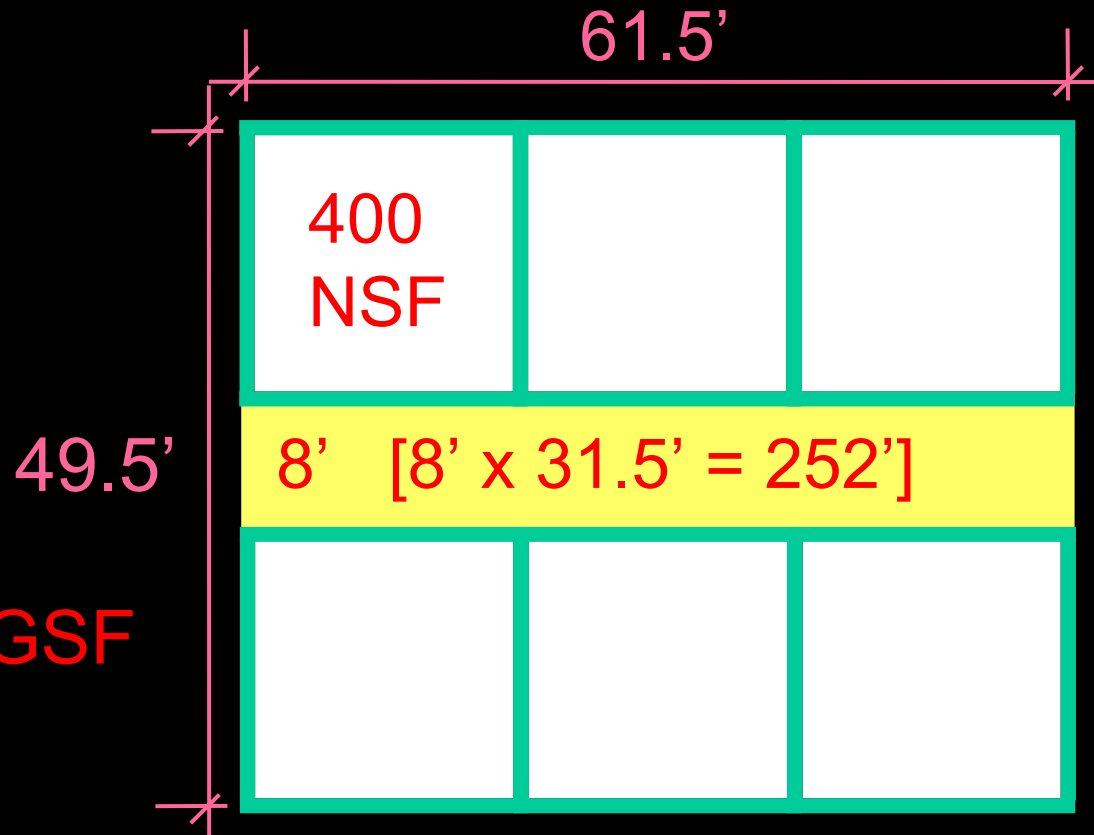
*The Real Numbers*

$$6 \times 400 = 2,400$$

$$2,400 \times A = 3,044$$

$$A = 1.27$$

$$\begin{aligned} \text{Efficiency} &= \text{NSF} / \text{DGSF} \\ &= 79\% \end{aligned}$$



**Measured DGSF = 3,044**



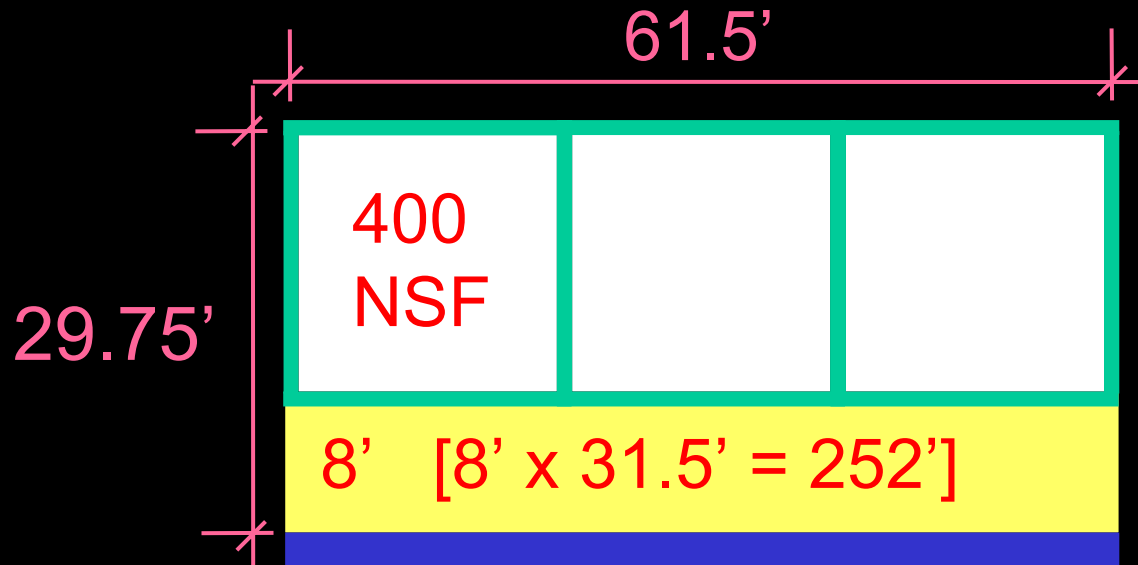
# DGSF: 8' Corridor + BIG Rooms

*The Real Numbers*

$$3 \times 400 = 1,200$$

$$1,200 \times A = 1,830$$

$$A = 1.53$$



$$\begin{aligned} \text{Efficiency} &= \text{NSF} / \text{DGSF} \\ &= 66\% \end{aligned}$$

**Measured DGSF = 1,830**



# Actual DGSF: Bronson

*The Real Numbers*



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# Actual NSF : DGSF Multiplier

*The Real Numbers*



1.50

Emergency Department: 20,446 DGSF



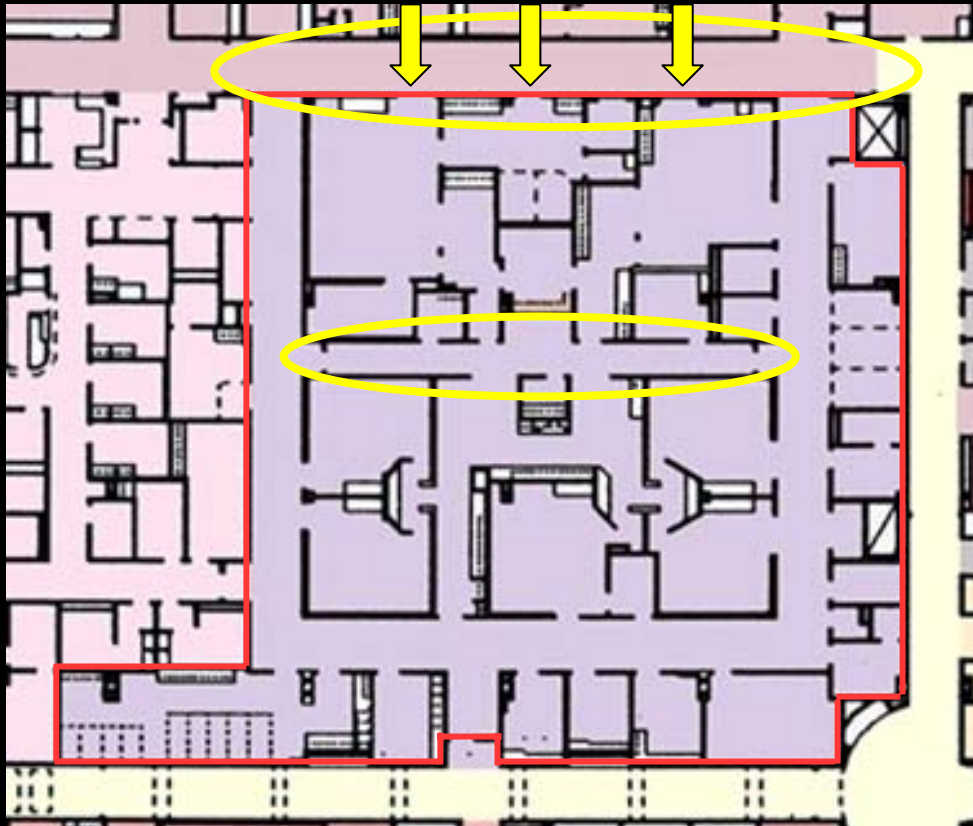
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# Actual NSF : DGSF Multiplier

*The Real Numbers*



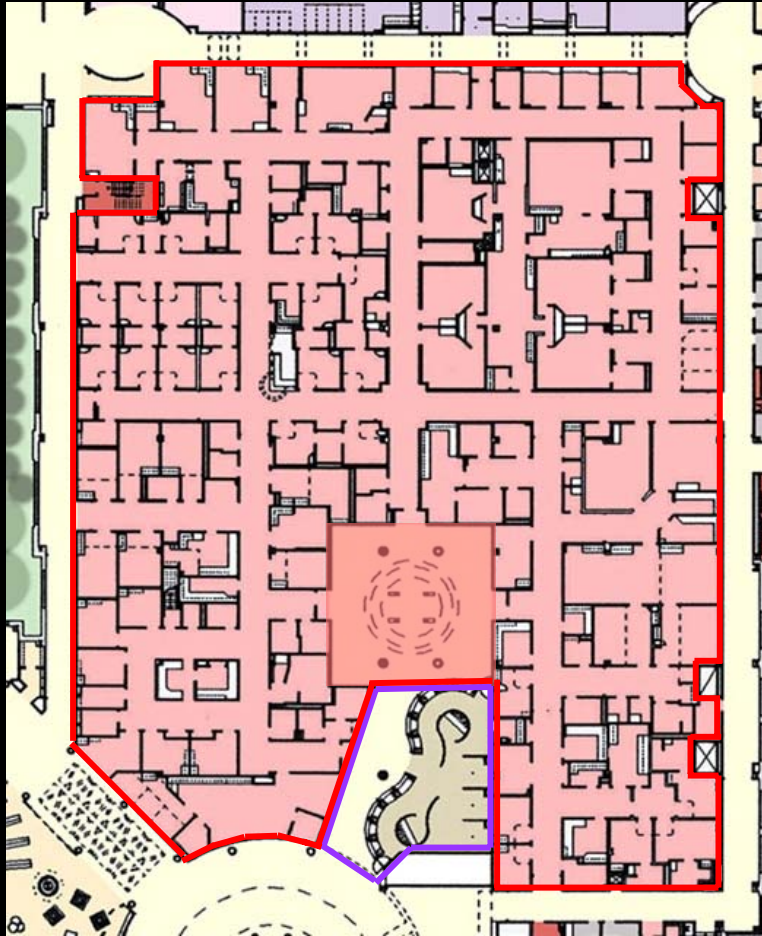
~~1.49~~  
~~1.58~~  
1.65

Radiology (Inpatient): 10,913 DGSF



# Actual NSF : DGSF Multiplier

*The Real Numbers*



1.49

Multi-Specialty  
Diagnostics (Outpatient):  
38,952 DGSF



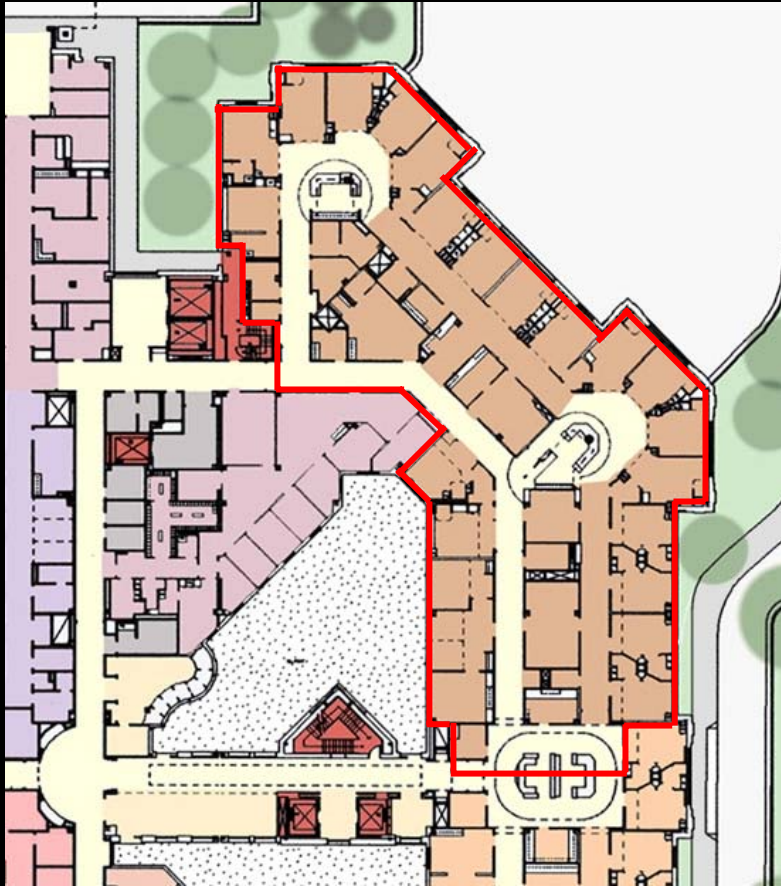
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# Actual NSF : DGSF Multiplier

*The Real Numbers*



1.57

Nursing Unit:  
13,004 DGSF



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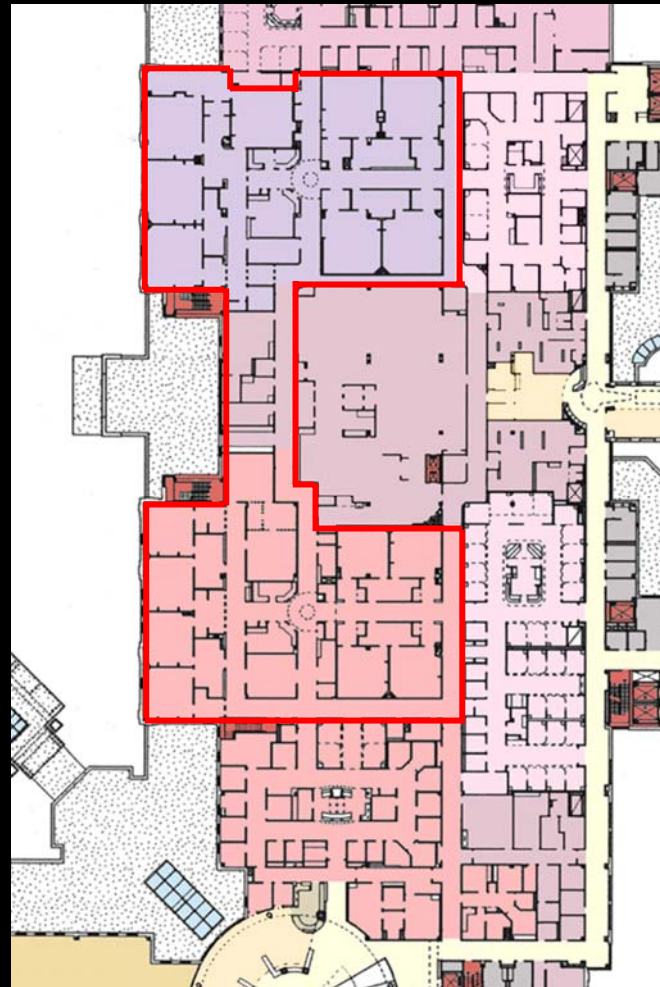


# Actual NSF : DGSF Multiplier

*The Real Numbers*

1.74

Operating Rooms:  
40,328 DGSF



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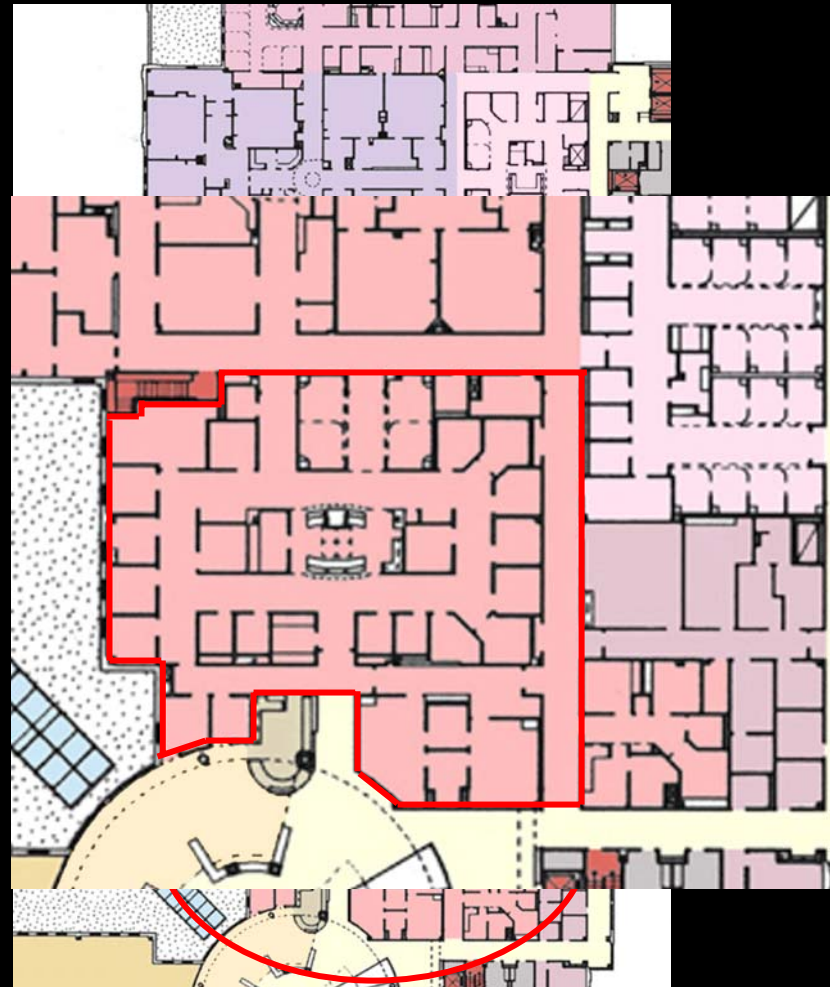


# Actual NSF : DGSF Multiplier

*The Real Numbers*

1.87

OR Prep/Minor  
Procedure (OP):  
5,227 DGSF



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# Actual NSF : DGSF Multiplier

*The Real Numbers*

1.70

NSF : DGSF  
Multiplier

Recovery  
(OP: Phase I, II):  
6,214 DGSF

Facility  
Efficiency  $\neq$   
Operational  
Efficiency



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# Common Problem Areas

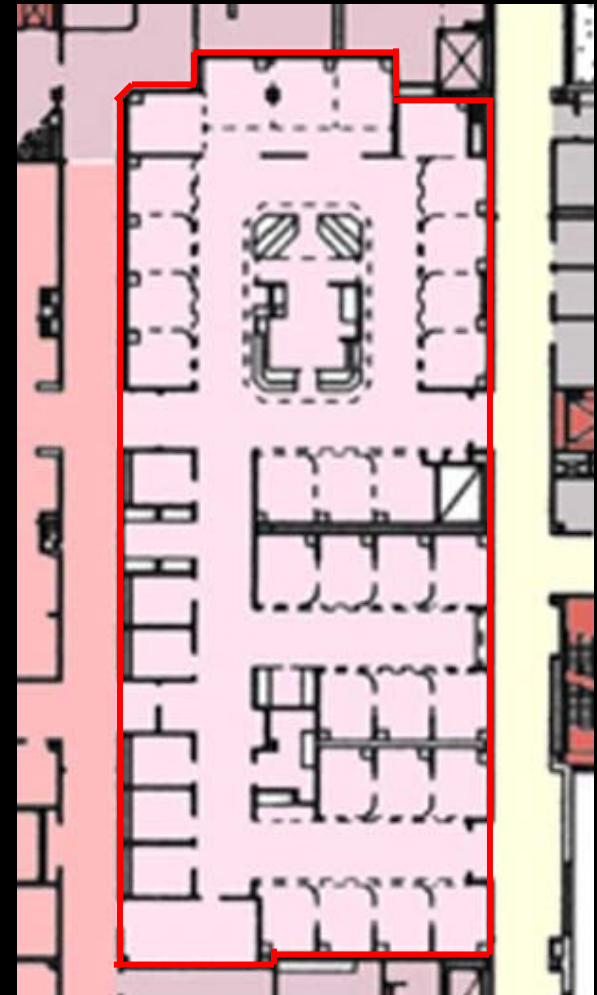
*The Real Numbers*

## Multiple-bay Room

- No circulation w/i room, i.e., 4 bays @ 80 NSF: 320 NSF

## Locker Rooms (Changing)

- Incomplete/inaccurate program, i.e., type and number of lockers, number of toilet fixtures, modesty vestibules, scrub storage...



# Common Problem Areas

*The Real Numbers*

## Acute Care Nursing Unit DGSF Multiplier

- Suggest same multiplier as critical care (1.5 vs 1.6); major difference is in NSF, not multiplier

## Ambulatory DGSF Multiplier

- Under-estimated; narrow corridors inappropriate?  
Allowed by code?



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# Common Problem Areas

*The Real Numbers*

## Control Rooms

- Proportion of imaging room governs size more than function

## Nurse/Work Station

(Centralized @ ICU, ED)

- Operational requirements (visualization) unrecognized in NSF



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# Building Gross Sq Ft (BGSF)

*The Real Numbers*



BGSF = Building Area

Sum of DGSGFs + exterior walls + mechanical + public and non-departmental circulation (including elevators and stairs)

$$\text{DGSGF} \times B = \text{BGSF}$$

$$B = 1.2 \leftrightarrow 1.4$$



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“Paved or finished covered areas, such as open porches and similar spaces, shall have the architectural area multiplied by an area factor of 0.50.”

*AIA Document D101, The Architectural Area and Volume of Buildings – 1995 Edition*



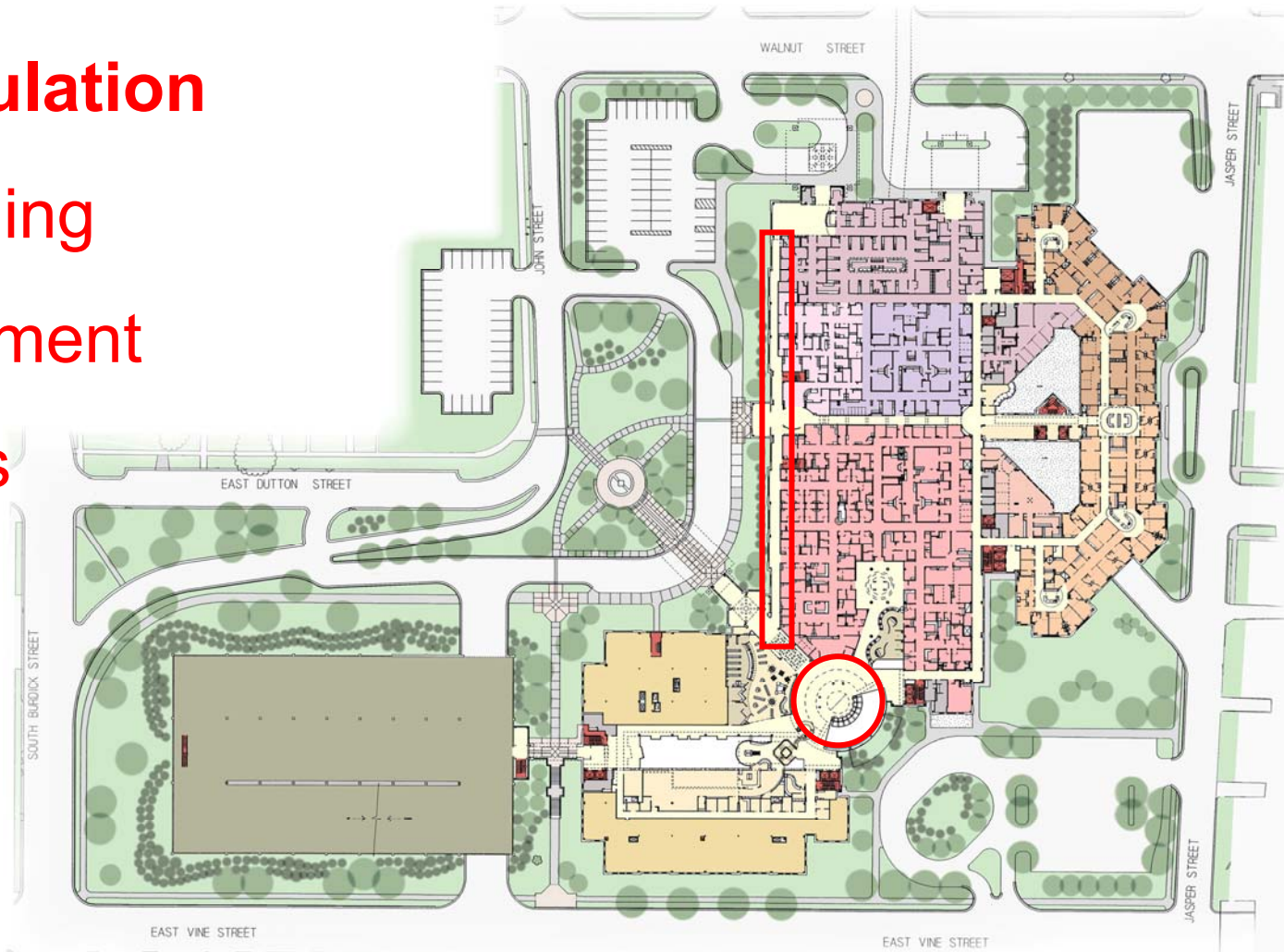
## Mechanical = 10 to 15%

- Enclosed (included) vs Exposed (excluded)  
-- may capture costs more accurately,  
obscures comparison
- Increasingly more mechanical area due to  
equipment and technology requirements
- Spatial implications of new mechanical  
systems, such as geo-thermal, may not be  
recognized/understood



### Public Circulation

- Wayfinding
- Environment
- Campus



# BGSF Multipliers

*The Real Numbers*

## Public Circulation



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## Other factors:

- Separation of public, (in)patient and service  
-- additional corridors, additional elevators
- Larger elevators
- ADA



# Basic Formula (“Avg” Values)

*The Real Numbers*

$$\text{NSF} \times 1.5 = \text{DGSF}$$

$$\text{DGSF} \times 1.35 = \text{BGSF}$$

$$[\text{NSF} \times 1.5 \times 1.35 = \text{BGSF}]$$

$$[\text{NSF} \times 2.025 = \text{BGSF}]$$



# Basic Formula: Pay Now or Later *The Real Numbers*

$$100,000 \times 1.5 = 150,000 \text{ DGSSF}$$

$$150,000 \text{ DGSSF} \times 1.35 = 202,500$$

Or:

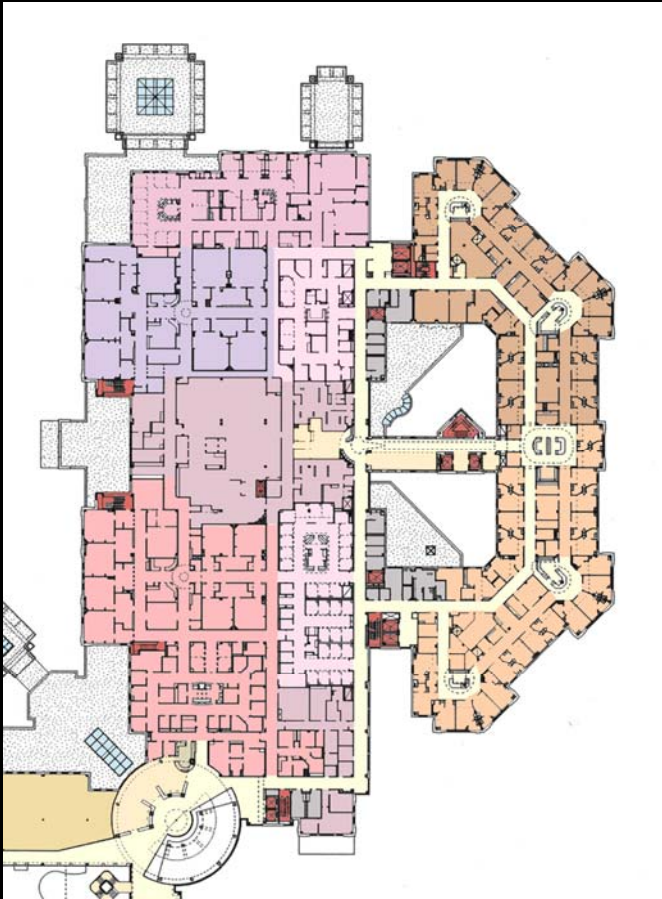
$$100,000 \times 1.55 = 155,000 \text{ DGSSF}$$

$$155,000 \text{ DGSSF} \times 1.3 = 201,500$$



# Floor Gross Square Feet (FGSF)

*The Real Numbers*



FGSF = Area of a floor

Sum of DGSFs + exterior walls + public and non-departmental circulation (including elevators and stairs)

**“Floor Fit” calculation:**  
**DGSFs x 1.15 - 1.2 =**  
**FGSF**



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# Academic Med Centers: U of Michigan Cardiovascular Center

*The Real Numbers*

1.39 NSF : DGSF  
1.59 DGSF : BGSF  
2.21 NSF: BGSF



# Academic Med Centers: Yale-New Haven Hospital

*The Real Numbers*

1.50 NSF : DGSF  
1.45 DGSF : BGSF  
2.18 NSF: BGSF



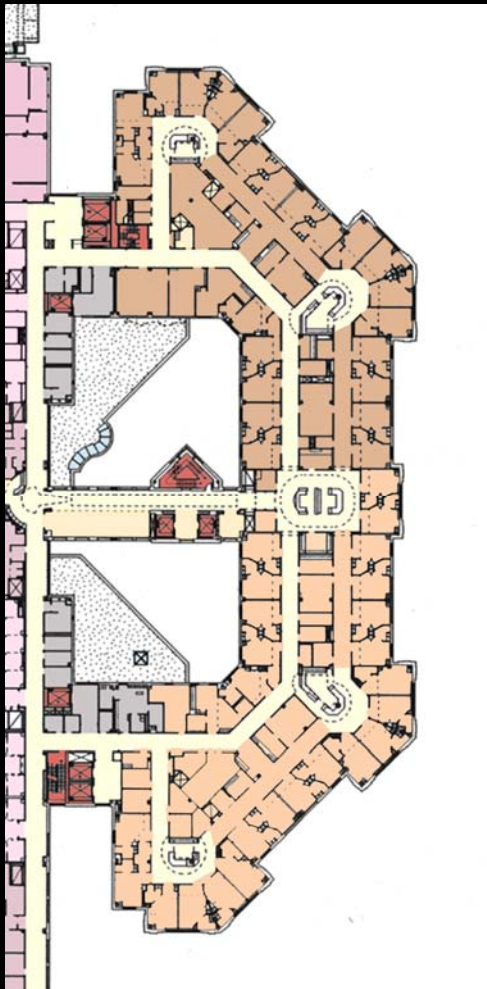
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# Rule of Thumb: Bed Fit/Floor

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1,000 FGSF / Bed

- All singles
- ~ 30 Beds/Floor (consider scale: fewer beds/larger FGSF ratio; more beds/smaller FGSF ratio)



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# Rule of Thumb: OR, Cath/EP

*The Real Numbers*



2,500 – 3,500 DGSF/OR, Lab

- Includes Recovery
- Likely to increase due to larger ORs/labs (equipment) and more private recovery rooms
- Central (sterile) core?

D&T rules of thumb very approximate due to variety of operational models



# Escalation: Rule of Two

*The Real Numbers*

## AREA:

Every square foot **programmed** (1 NSF) will require 2 square feet in **construction** (2 BGSF)

[NSF x 2 = BGSF]

## COST:

As a conservative rule of thumb, every **\$1** of construction cost may become **\$2** to cover project costs, financing, and inflation.



# Escalation: Rule of Two $\approx 2 \times 2$

*The Real Numbers*



AREA: 100 NSF

200 BGSF

COST:  
[\$300/SF] \$30,000



\$60,000

2 x 2: 100 NSF



\$120,000 =  
\$1,200/SF



### Skimping may ultimately be more costly:

- Minimally sized rooms unlikely to provide flexibility over time
- Renovation likely to be increasingly expensive
- Customer expectations regarding environment unlikely to become less demanding
- Balance facility efficiency with operational efficiency



# Summary

## *The Real Numbers*

- Size matters
- Scale matters
- Proportion matters
- Construction estimates and costs cannot be reasonably accurate without understanding square footage and building multipliers
  - Definitions: NSF, DGFSF, BGFSF and FGFSF
  - Relationships / Calculations: 2 and 2 x 2

