Why in High School Latin?

Mid-18th Century

Initiation of

Formal Thinking in Building

Italy

St. Peter’s Basilica, Rome

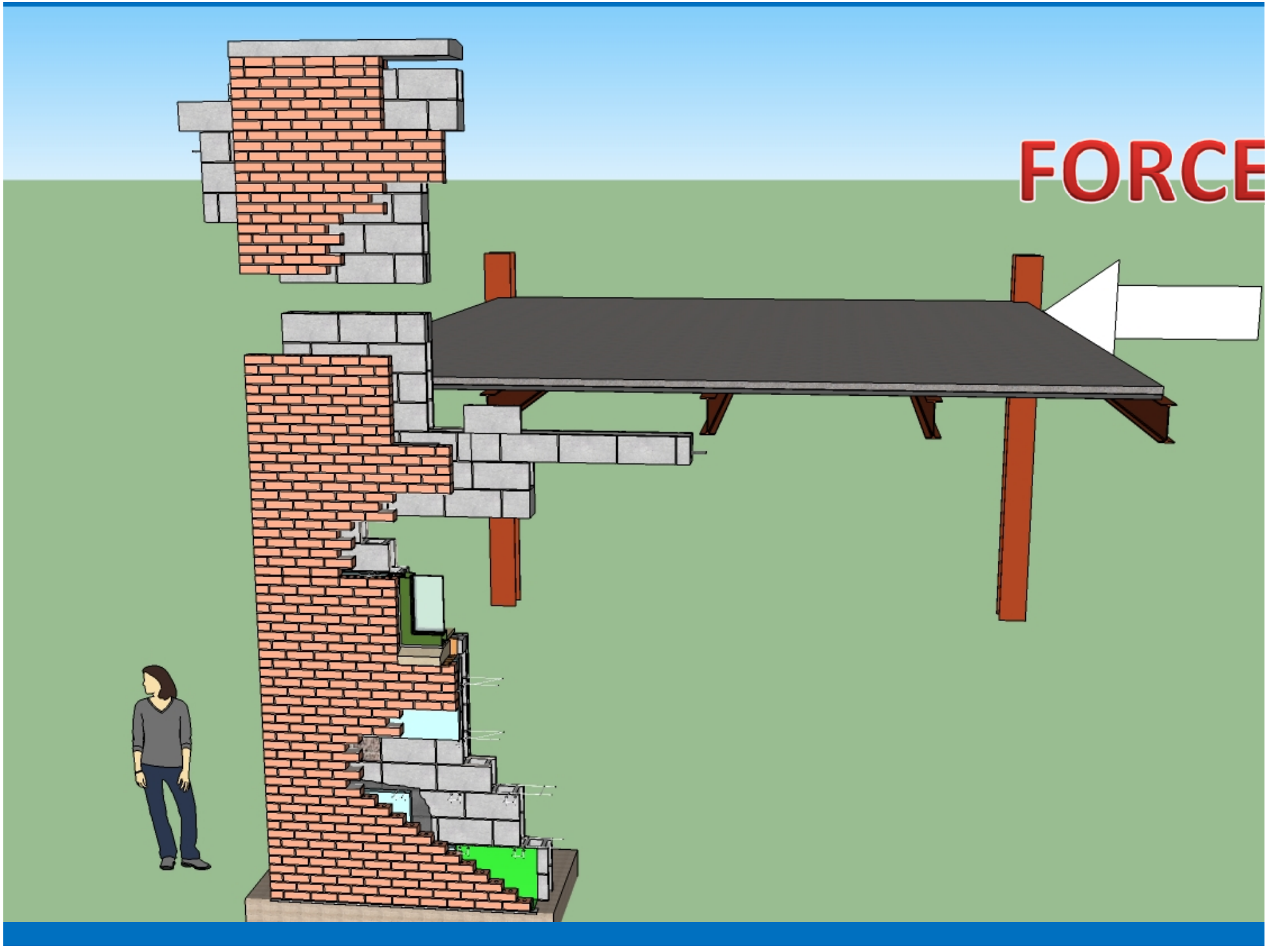
Early 20th Century

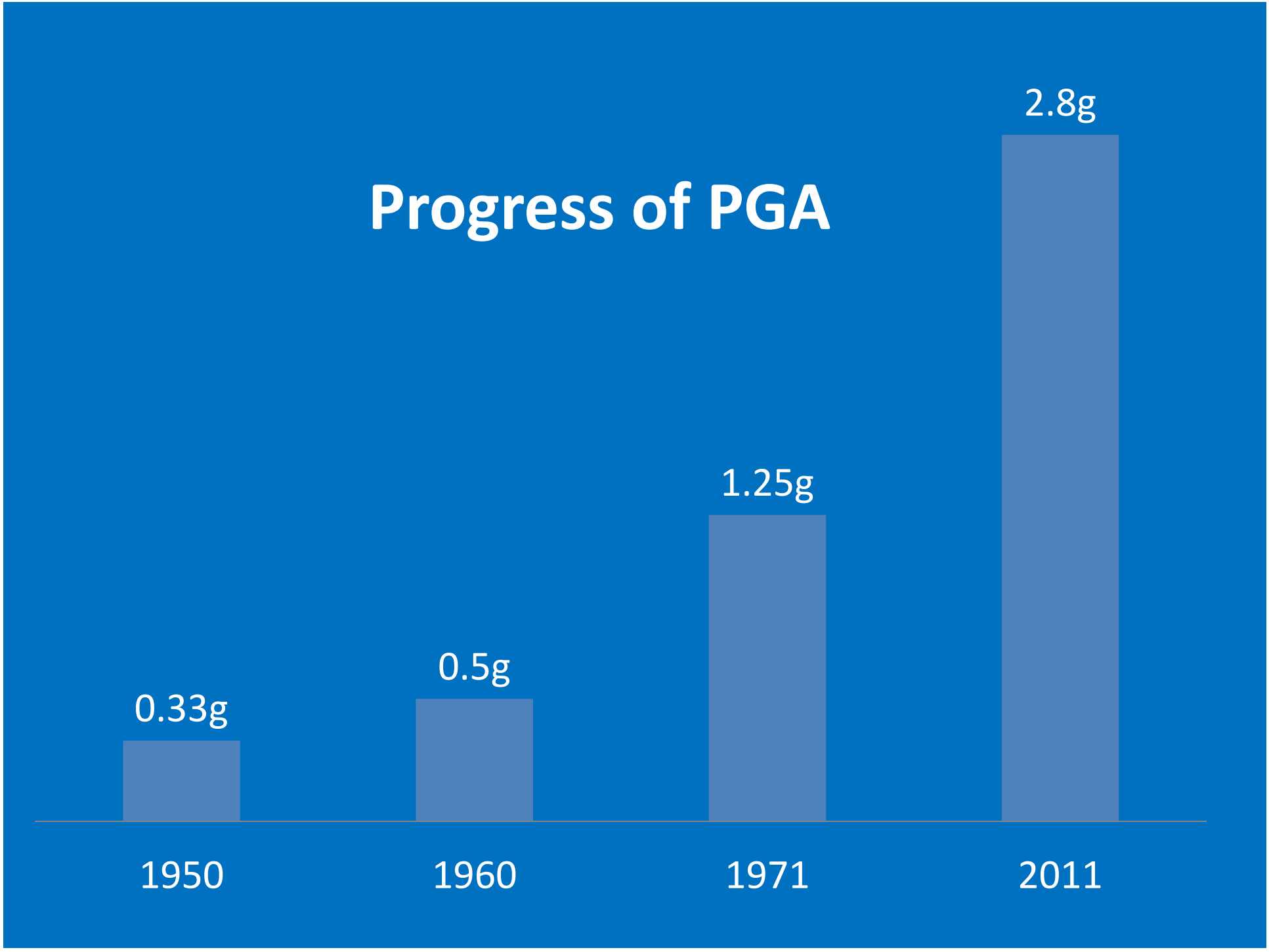
Initiation of

Formal Thinking in Structural Resistance to Earthquake

Italy

Messina, 1908


FORCE


Progress of PGA
0.33g
0.5g
1.25g
2.8g
1950
1960
1971
2011

Factor J

Overturning Moment * J

$J = 1/(2*T^{1/3})$

$J>1/3$ & <1.0

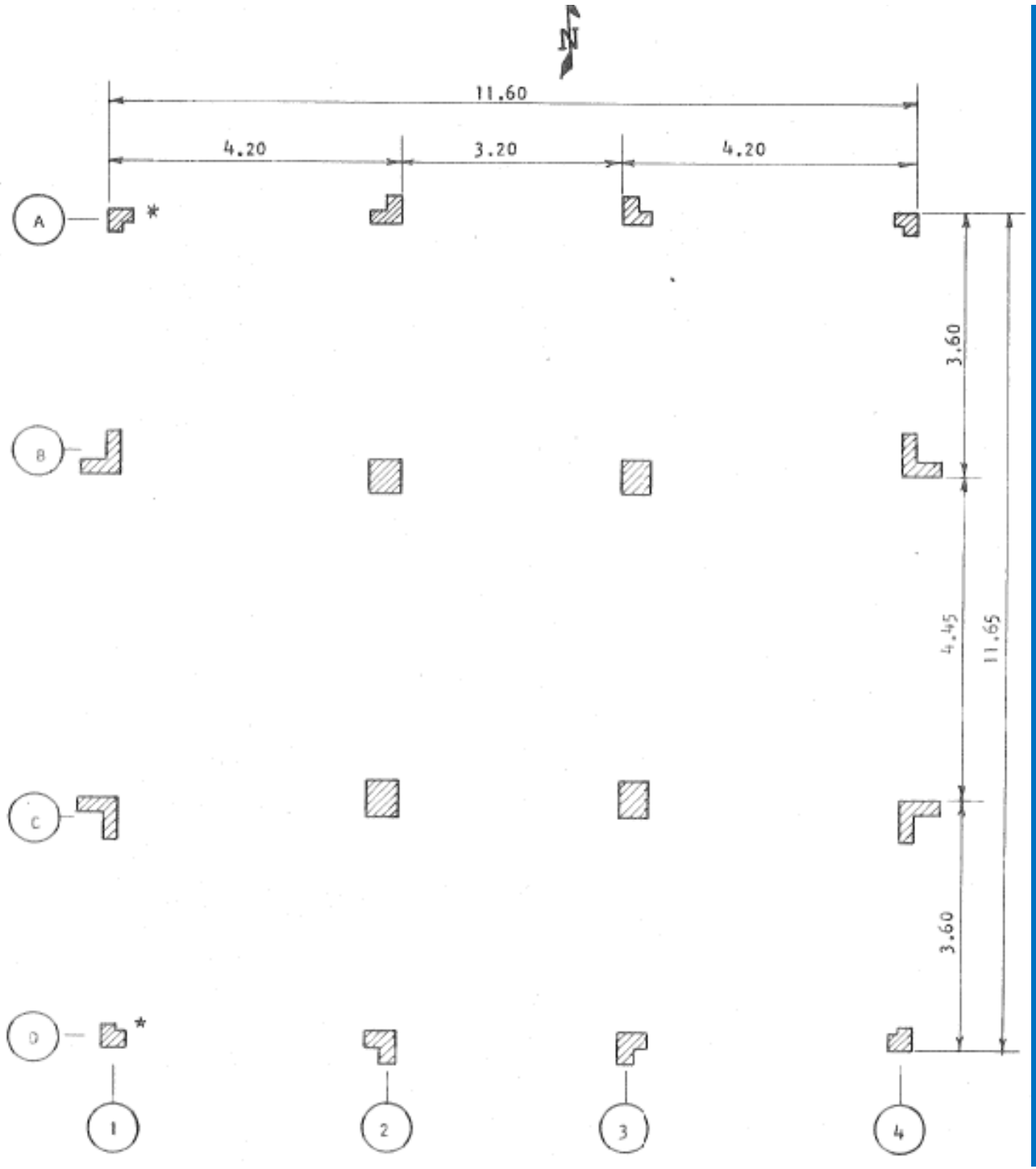
Recommended Lateral Force 1959

$$\frac{V_{.base}}{W} = \frac{2}{3} \cdot \frac{1}{20} \cdot \frac{1}{2}$$

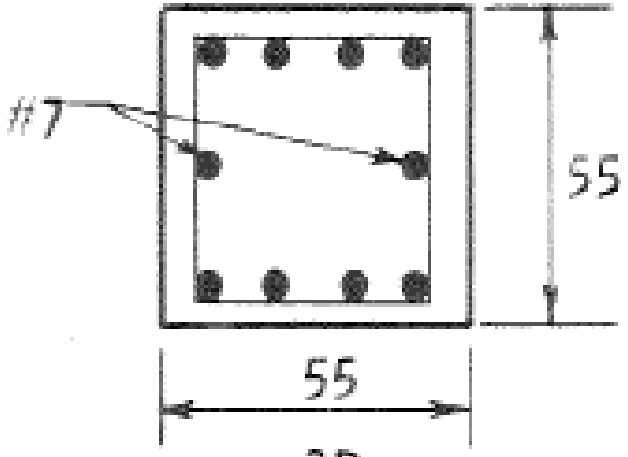
Frame
Working Stress
T=1 sec

Caracas 1967


FARMACIA
SAN ISIDRO

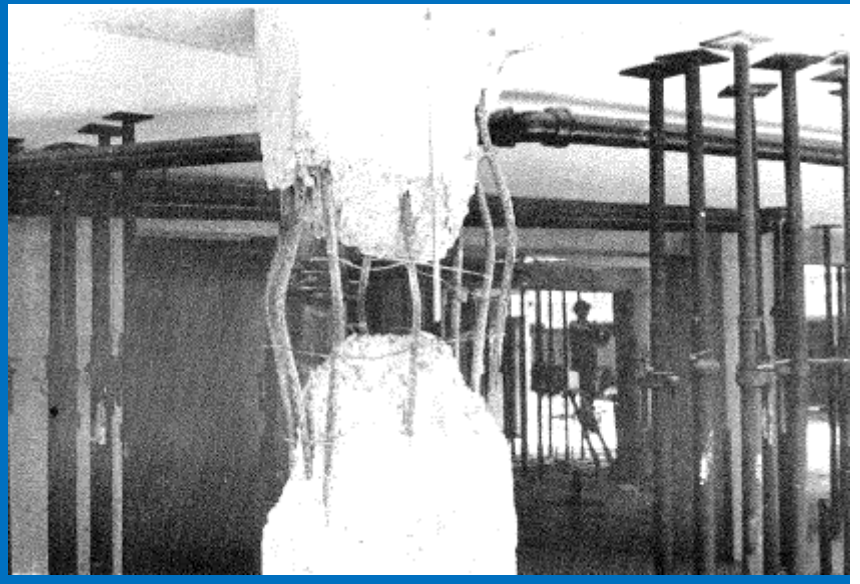

N
11.60
4.20
3.20
4.20
A
B
C
D
*
*
3.60
4.45
11.65
3.60
1
2
3
4

8 No. 8 Bars
2 No. 7 Bars
No. 3 ties at 20 cm

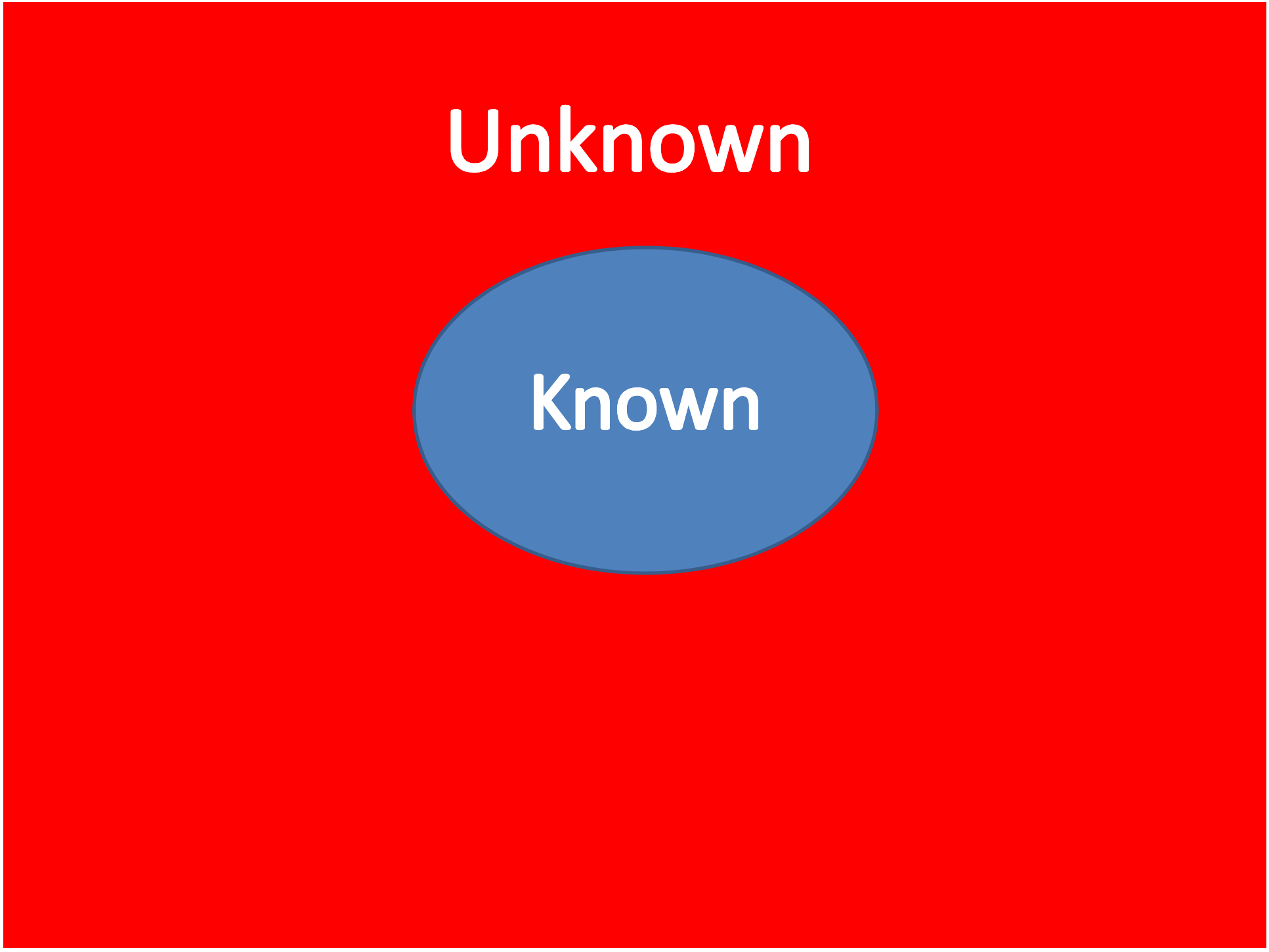


3B

0.55 m square



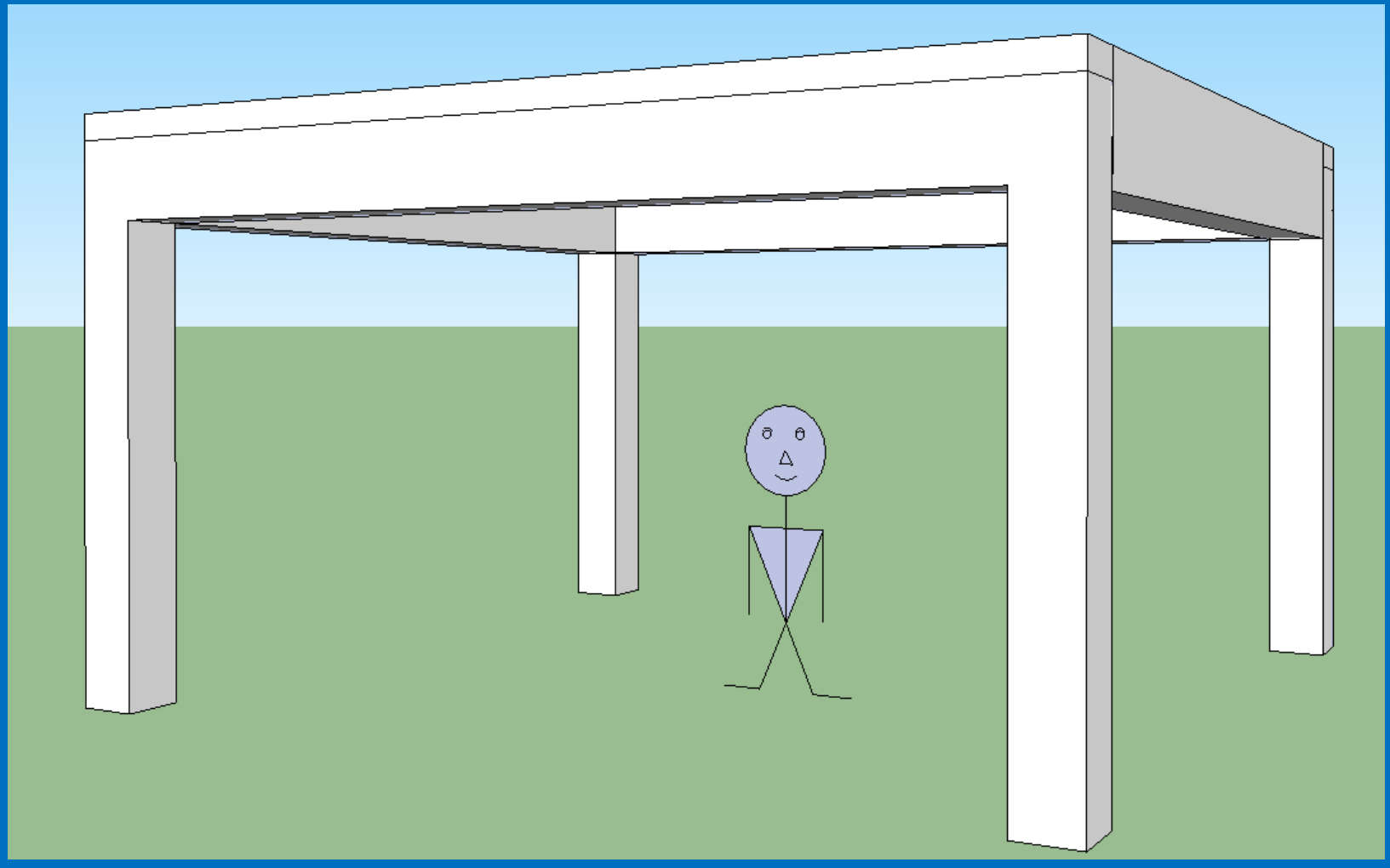
Unknown


Unknown
Known

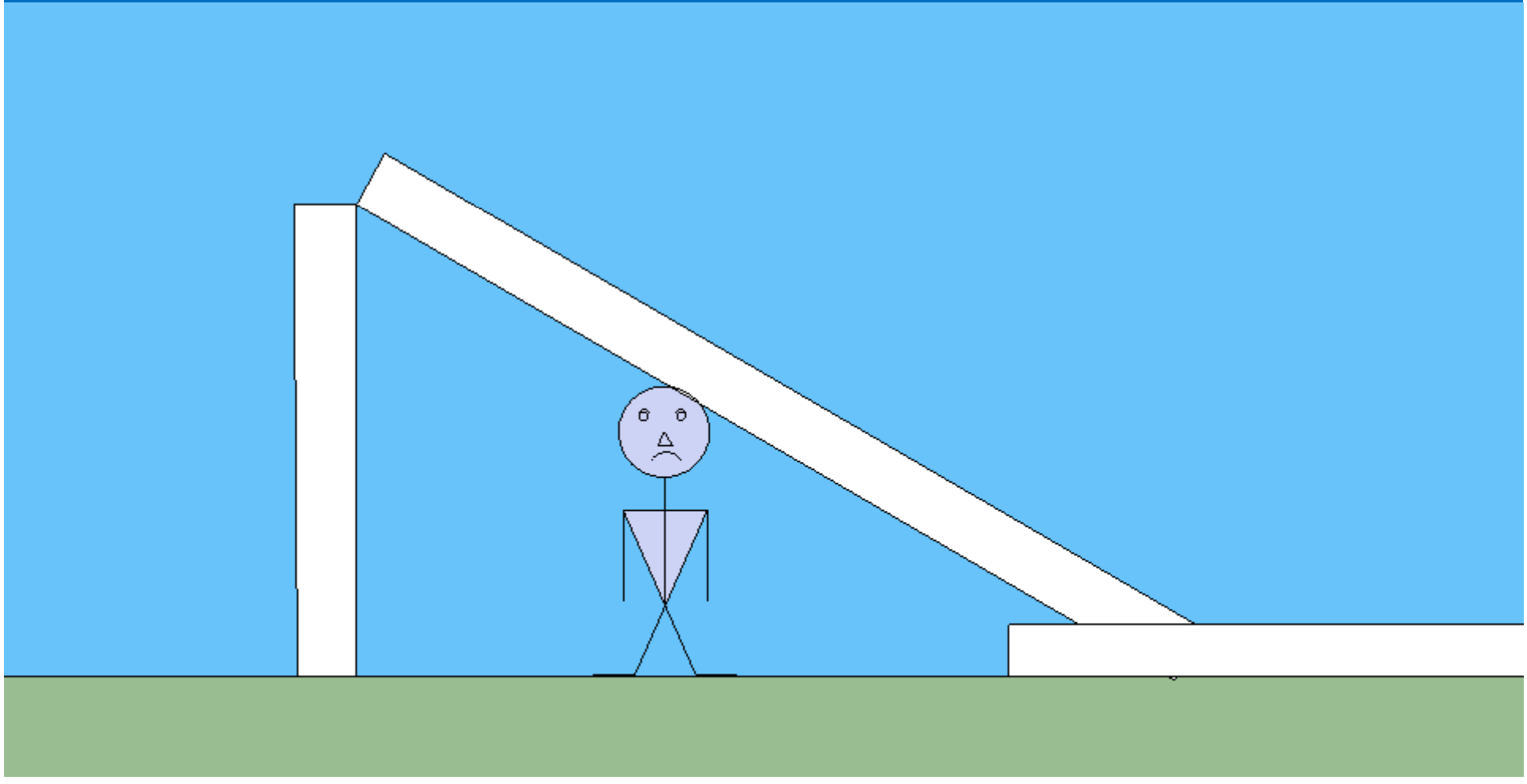
If we are going to be wrong anyway,
We should be wrong the easy way.

Two Simple and Direct Rules for Earthquake-Resistant Structures

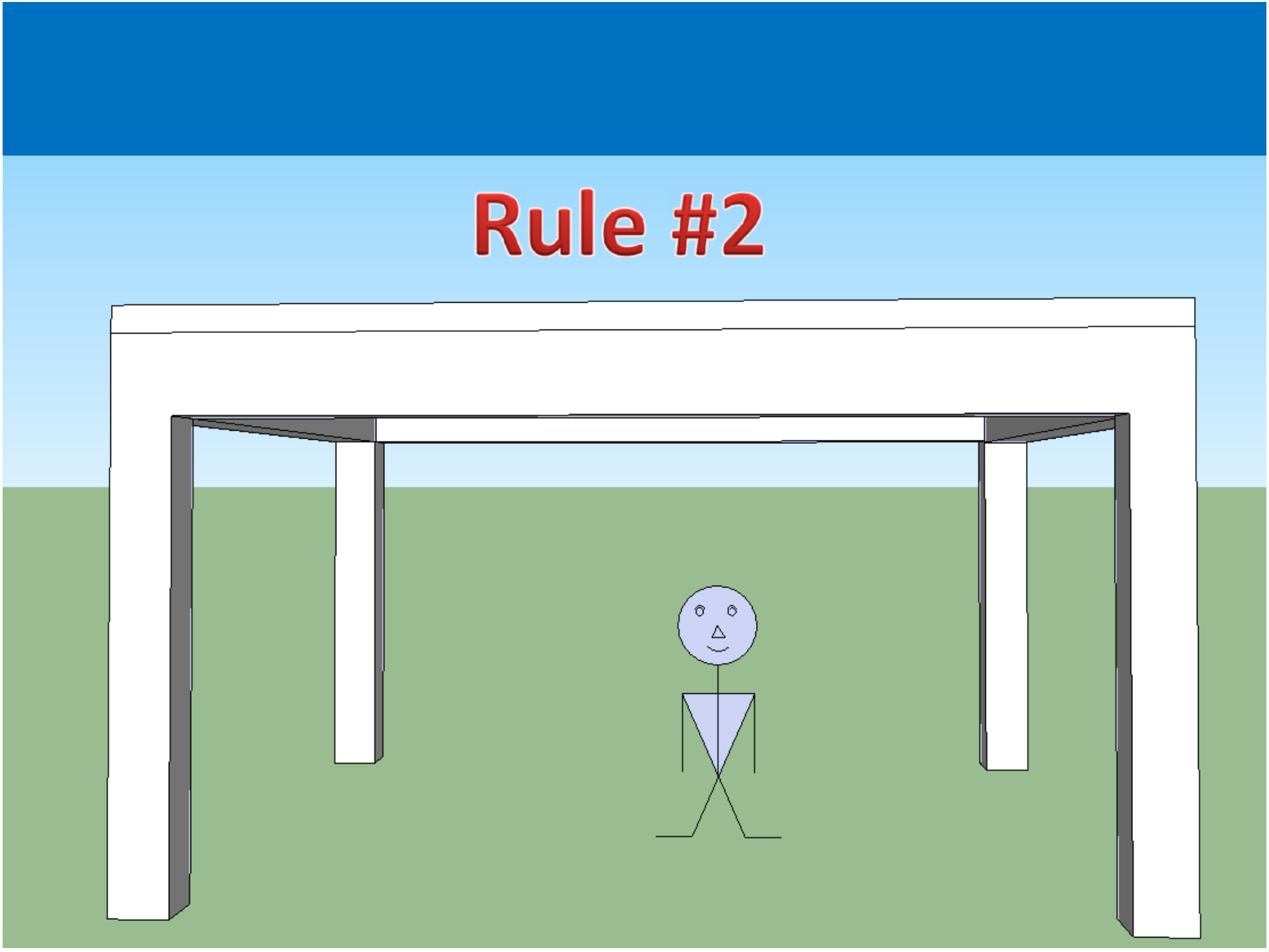
Rule # 1



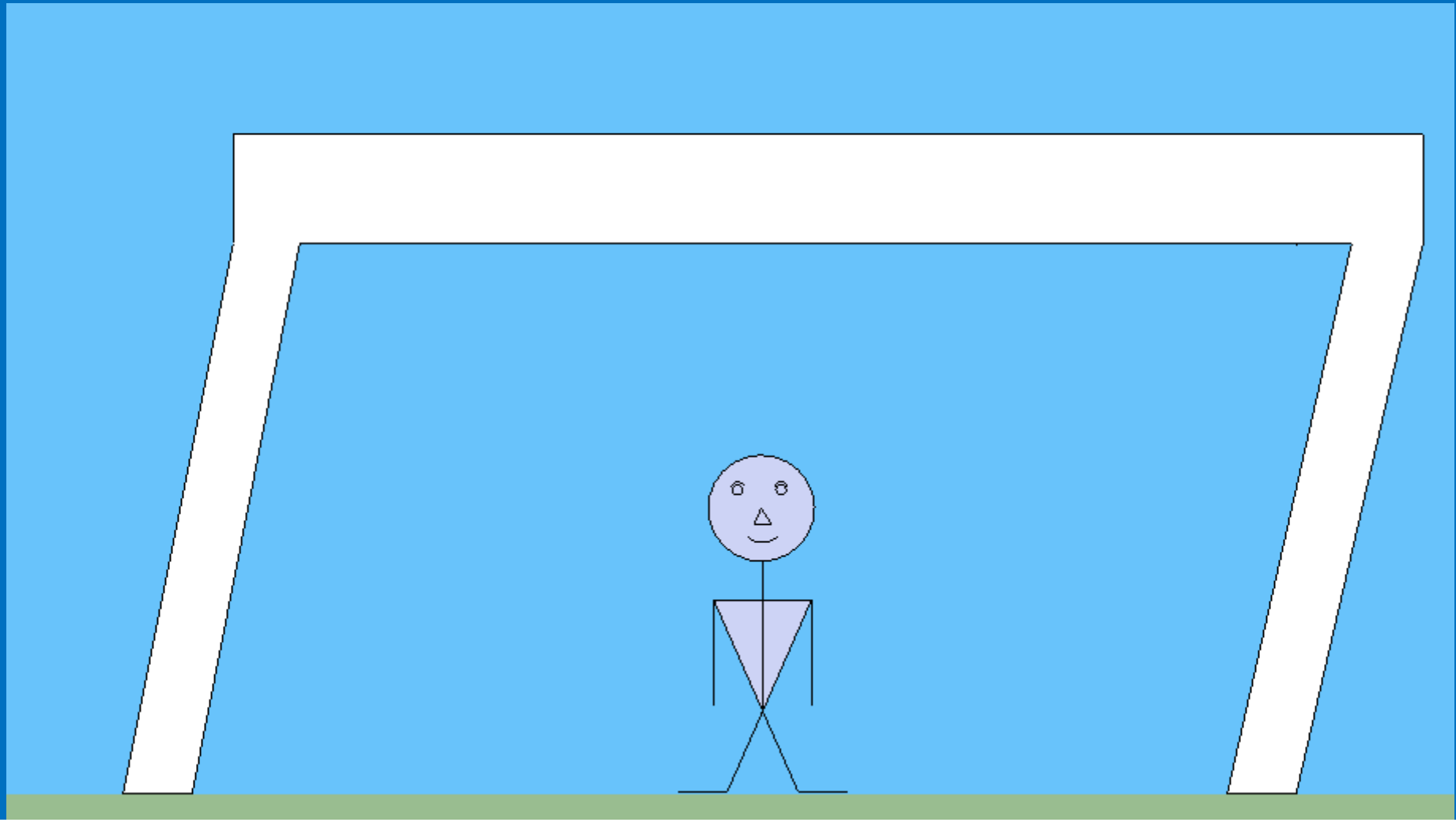
Rule # 1
Maintain Elevation



Rule #2



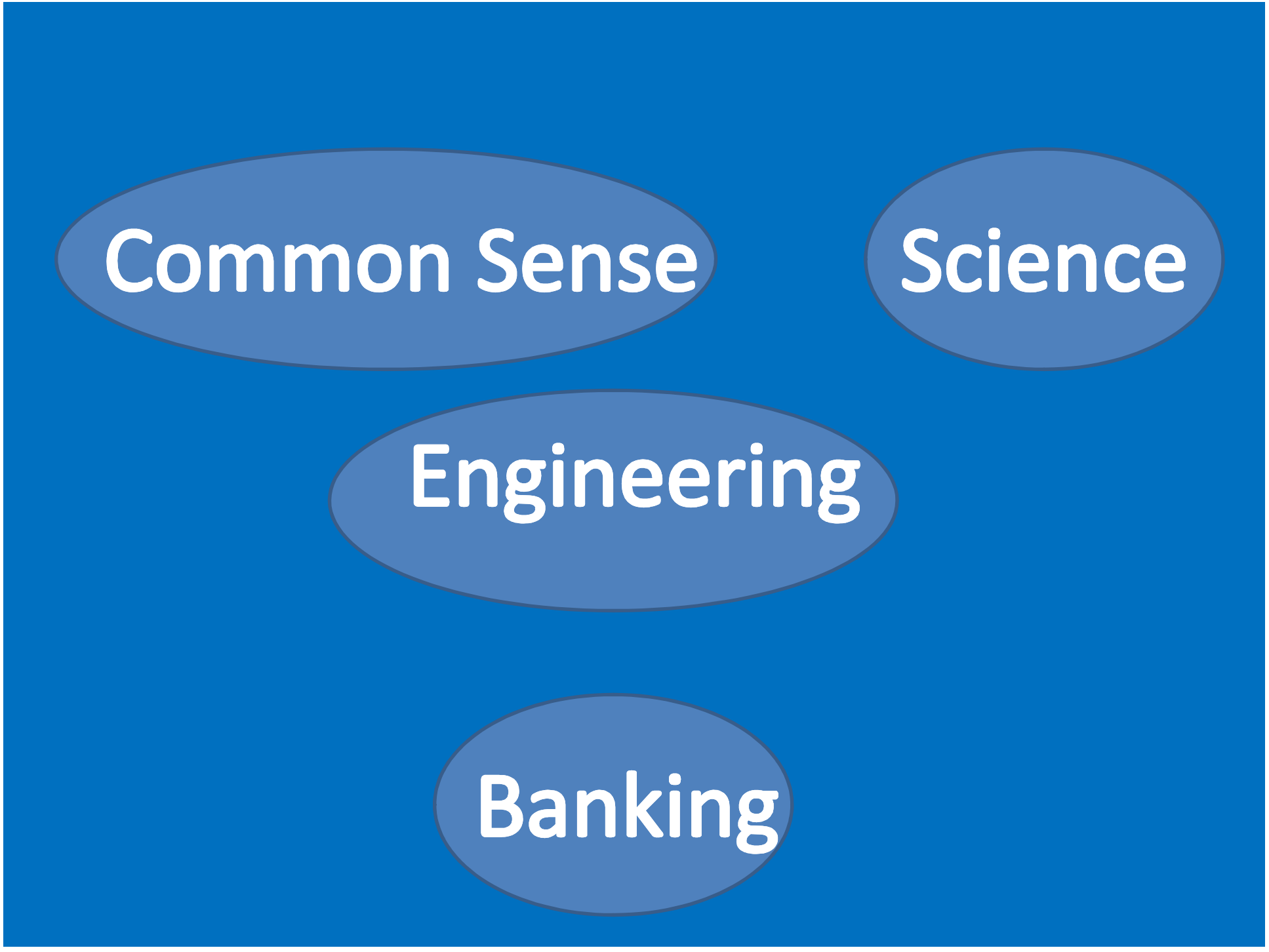
Rule #2
Maintain Shape



OBSERVED IN VAN 2012

Inadequate anchorage for main reinforcement

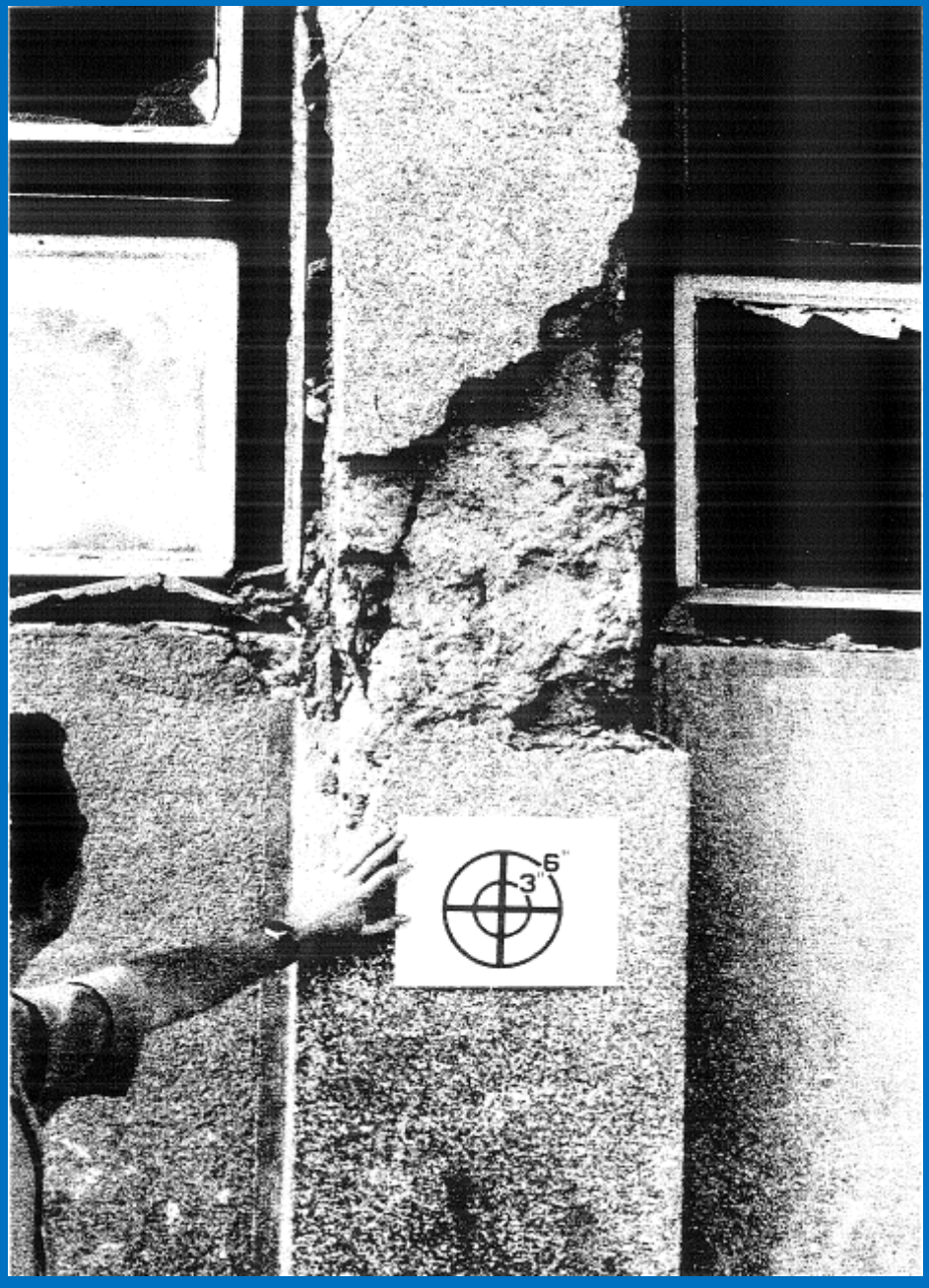
Hoops inadequately anchored in shell concrete

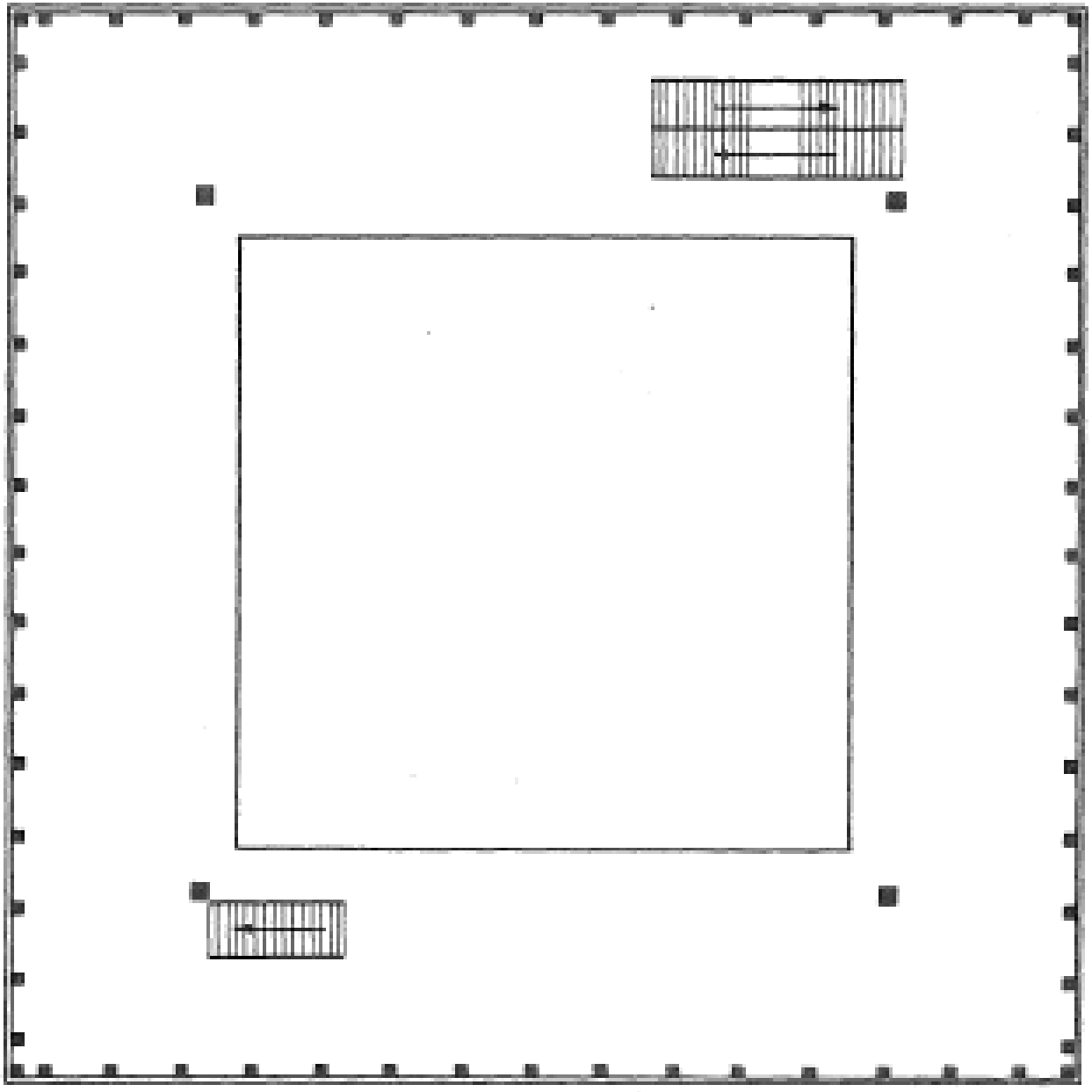

Common Sense
Science
Engineering
Banking

OBSERVED IN VAN 2012

Bottom bars not anchored at supporting column

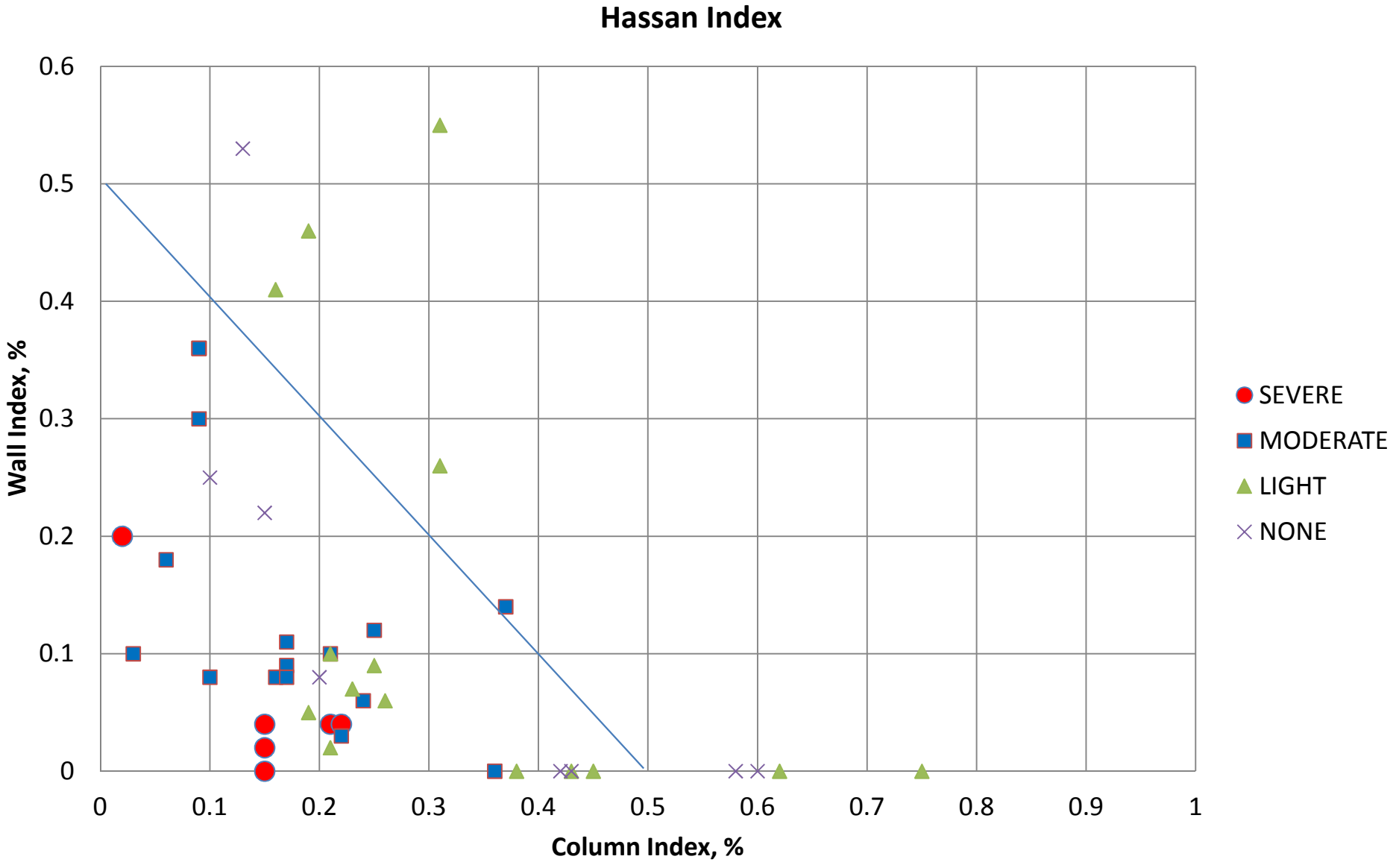
Top bars extended into joint outside column bars

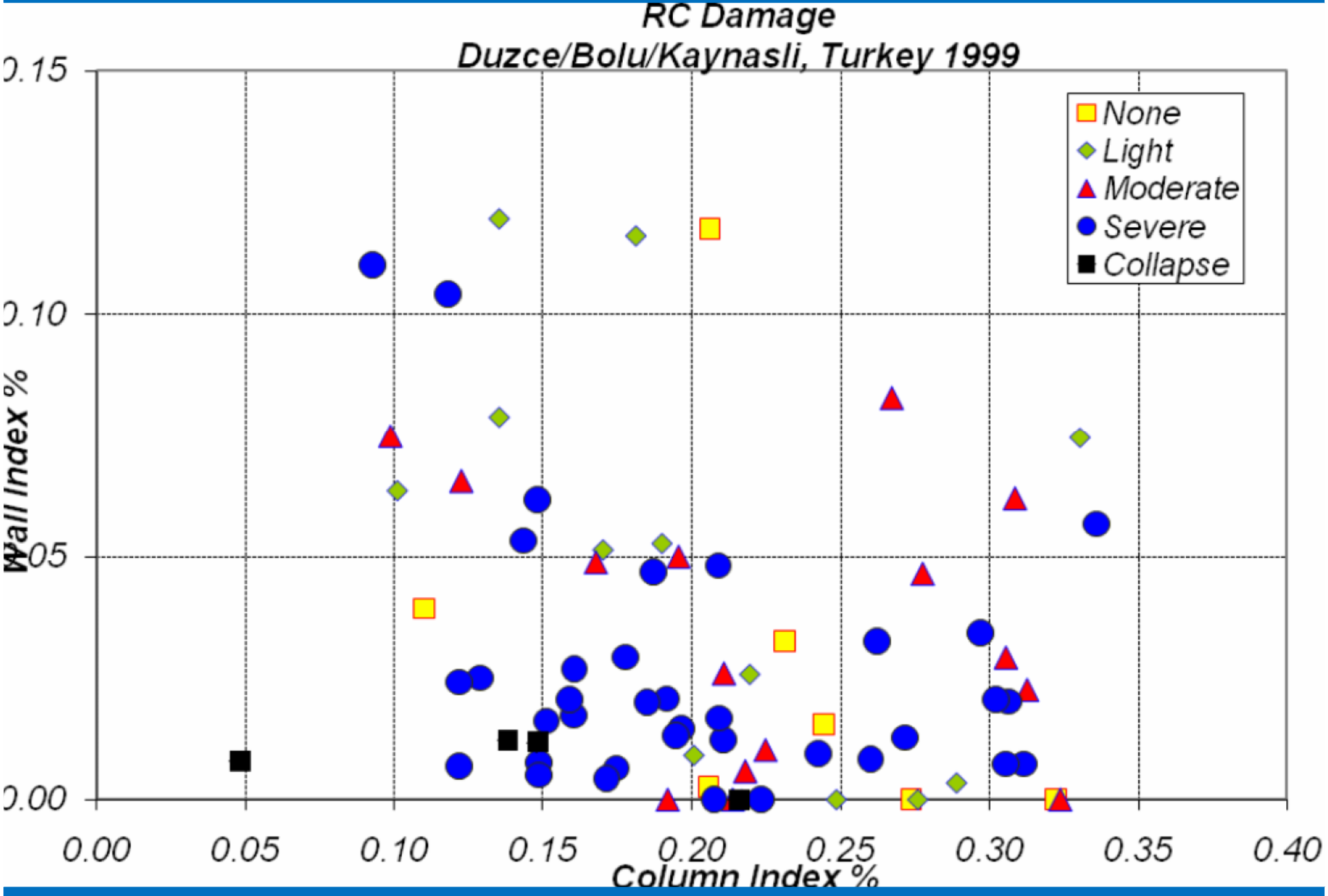

3"
6"



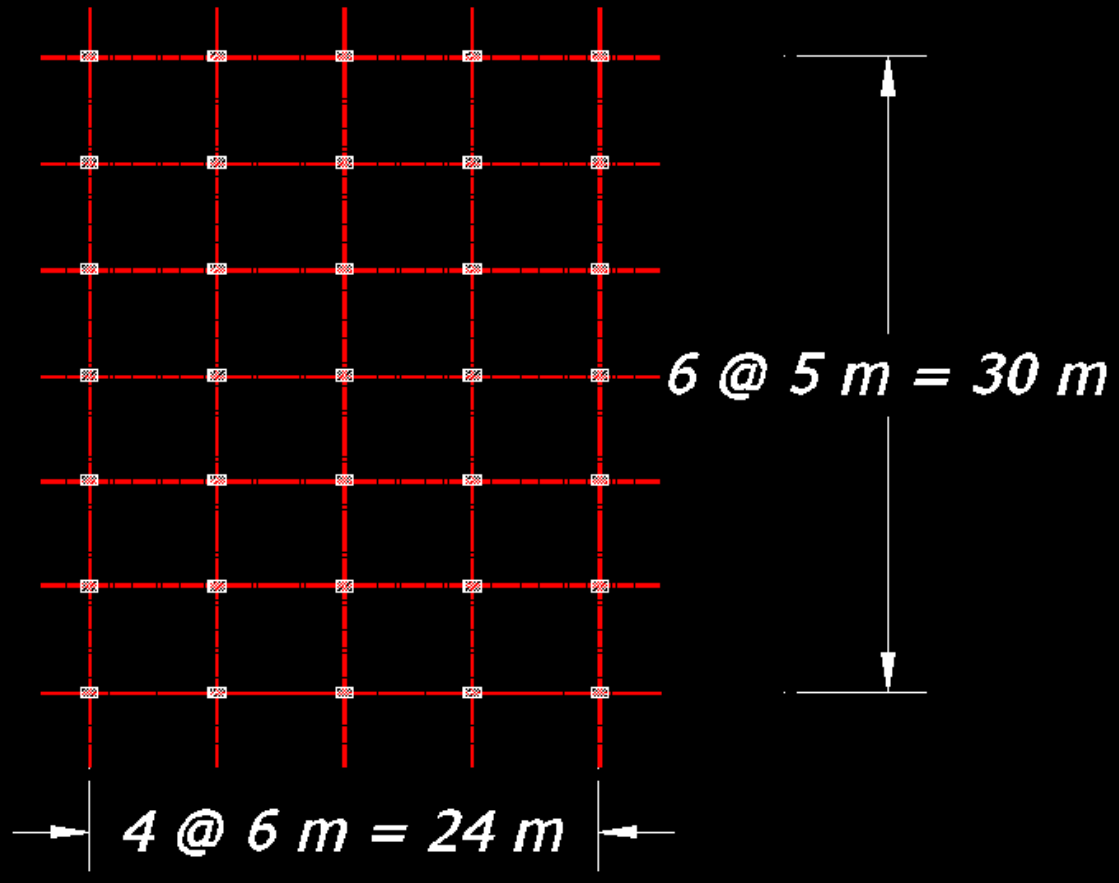
GALLERY FLOOR PLAN

A Simple Method for Simple Buildings


Hassan Index
Wall Index, %
Column Index, %
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
SEVERE
MODERATE
LIGHT
NONE


RC Damage
Duzce/Bolu/Kaynasli, Turkey 1999
None
Light
Moderate
Severe
Collapse
0.15
0.10
0.05
0.00
Wall Index %
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Column Index %

Plan of 5-Story Structure



Floor Area 720 m2

Total Floor Area ~ 3600 m2

Total Column Area

2*Total Floor Area/500

2*Total Floor Area/500/35

Ac = 0.4 m2

“Design” of Columns

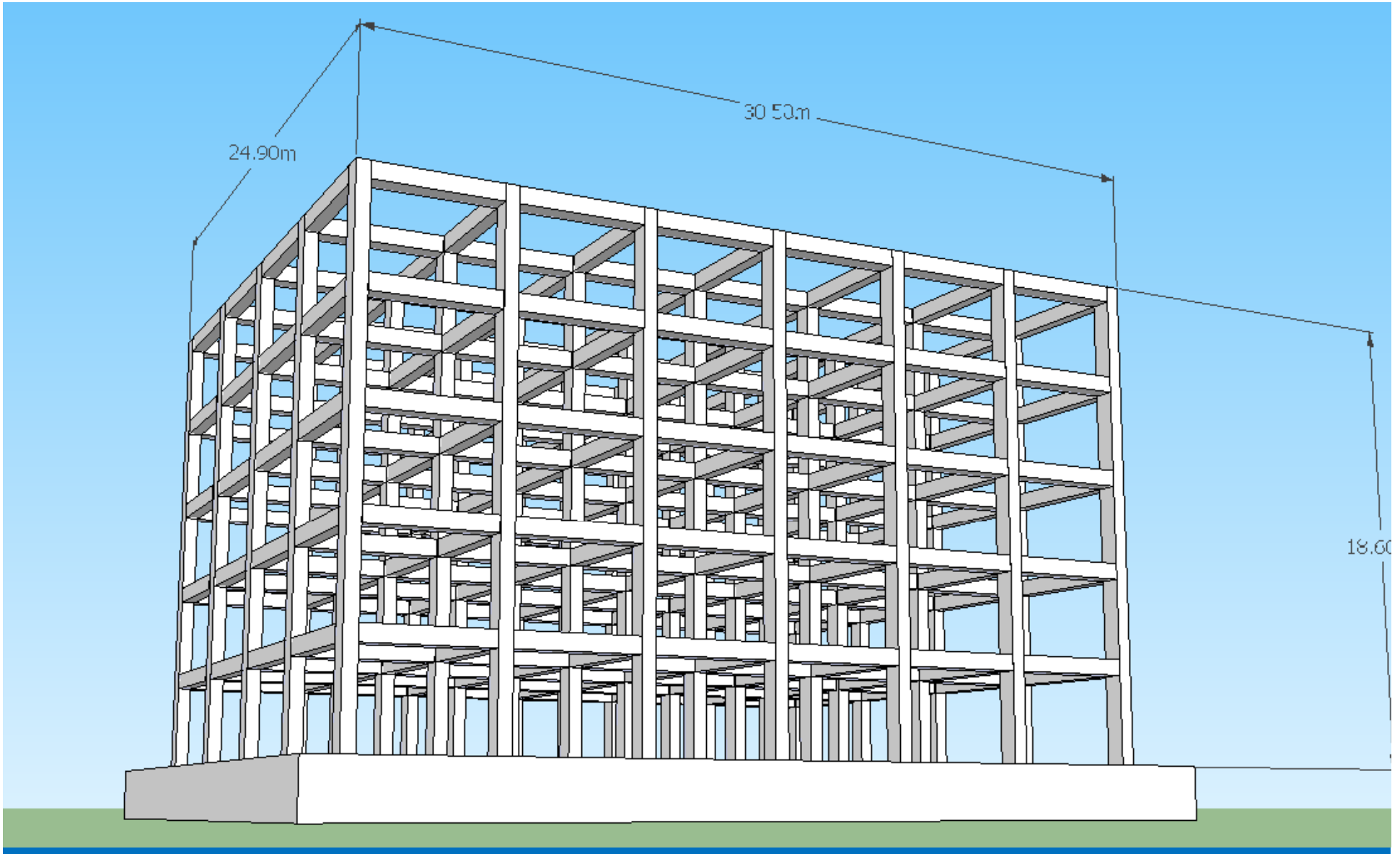
Width = 0.5 m
Depth = 0.8 m

0.65 m sq is an option

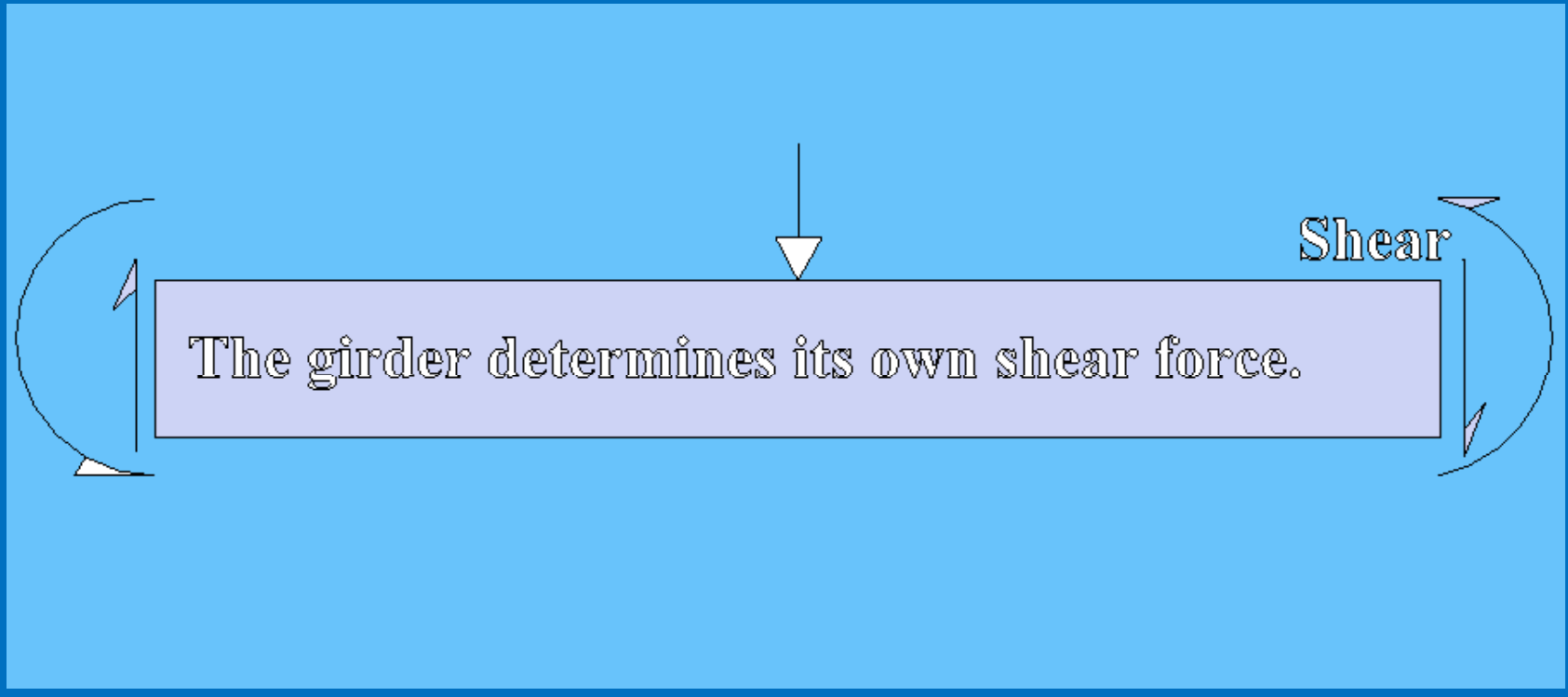
“Design” of Girders

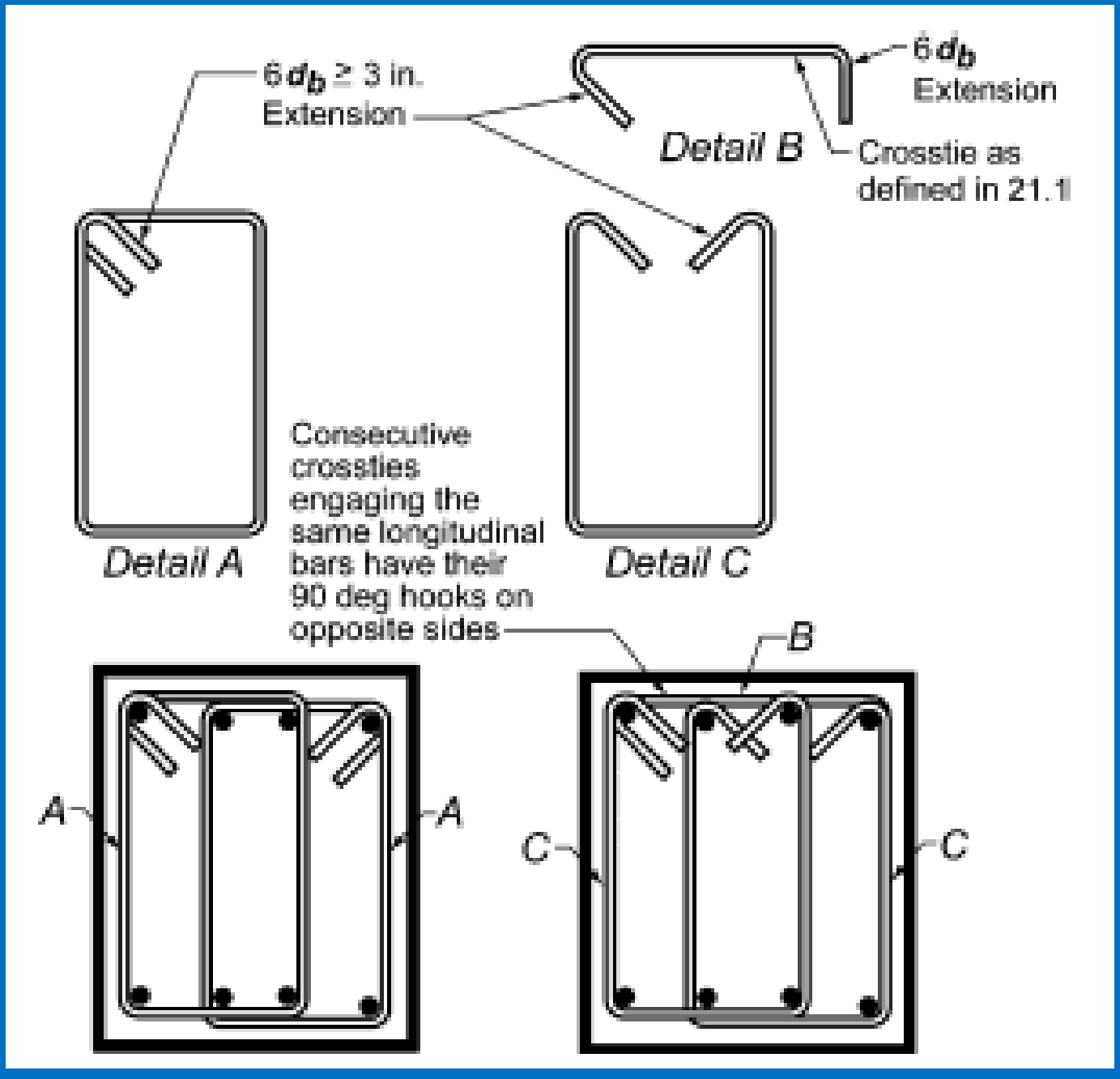
Height = Span/10

Height = 0.6 m



Framing

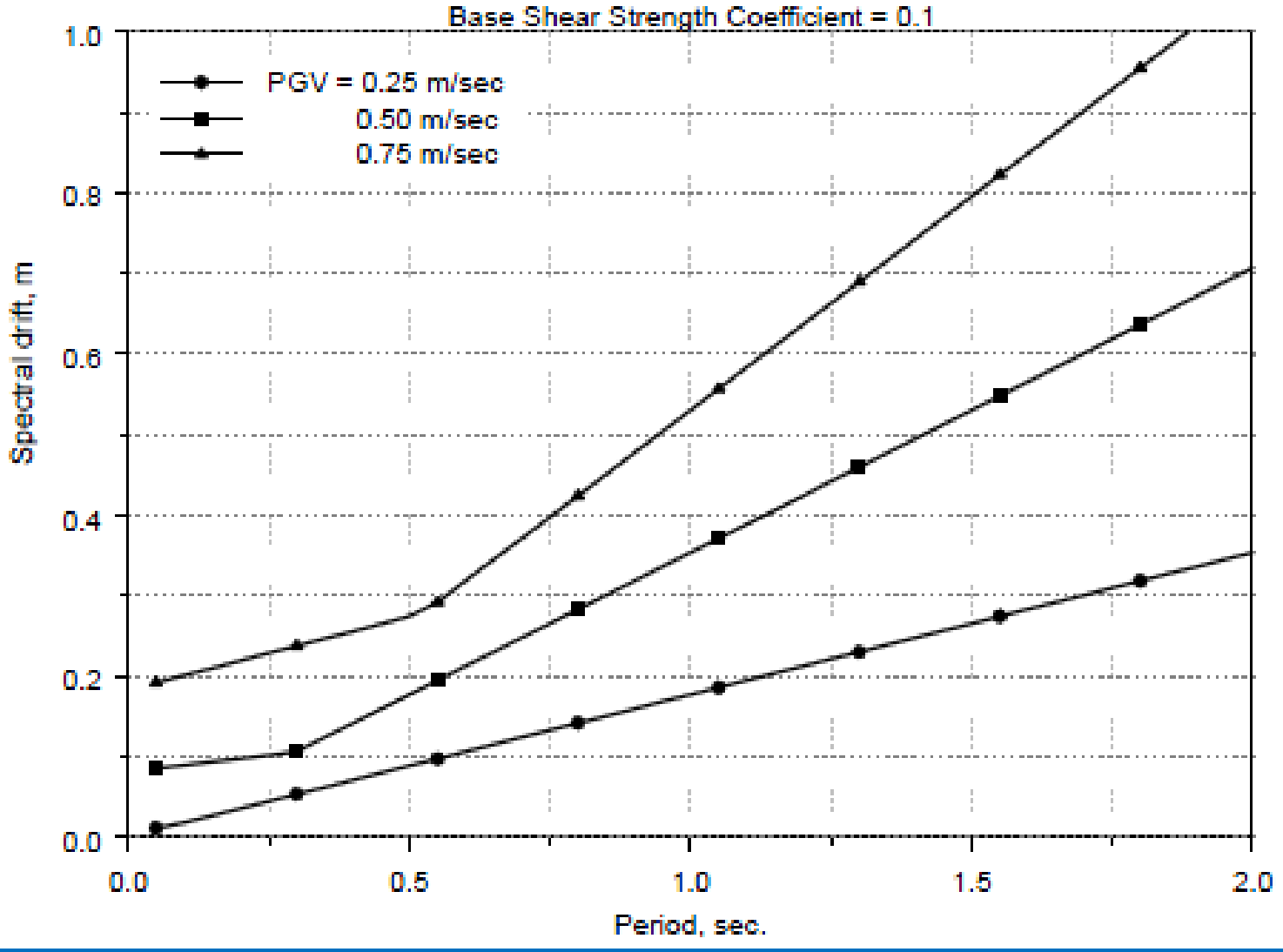

Shear
The girder determines its own shear force.


$6d_b \geq 3$ in. Extension
$6d_b$ Extension
Detail B
Crosstie as defined in 21.1
Detail A
Detail C
Consecutive crossties engaging the same longitudinal bars have their 90 deg hooks on opposite sides
A
A
B
C
C

Level	Mass	Assumed Δ	Related Force	Shear	Stiffness	Change	Drift	Shape
5	100,000	1	100,000				6.6	1.0
				100,000	149	0.67		
4	100,000	0.8	80,000				6.0	0.9
				180,000	149	1.21		
3	100,000	0.6	60,000				4.8	0.72
				240,000	149	1.61		
2	100,000	0.4	40,000				3.2	0.47
				280,000	149	1.88		
1	100,000	0.2	20,000				1.3	0.19
				300,000	235	1.28		
Base		0.0	0				0	0

Rayleigh
Kinetic En. -Potential En. = 0

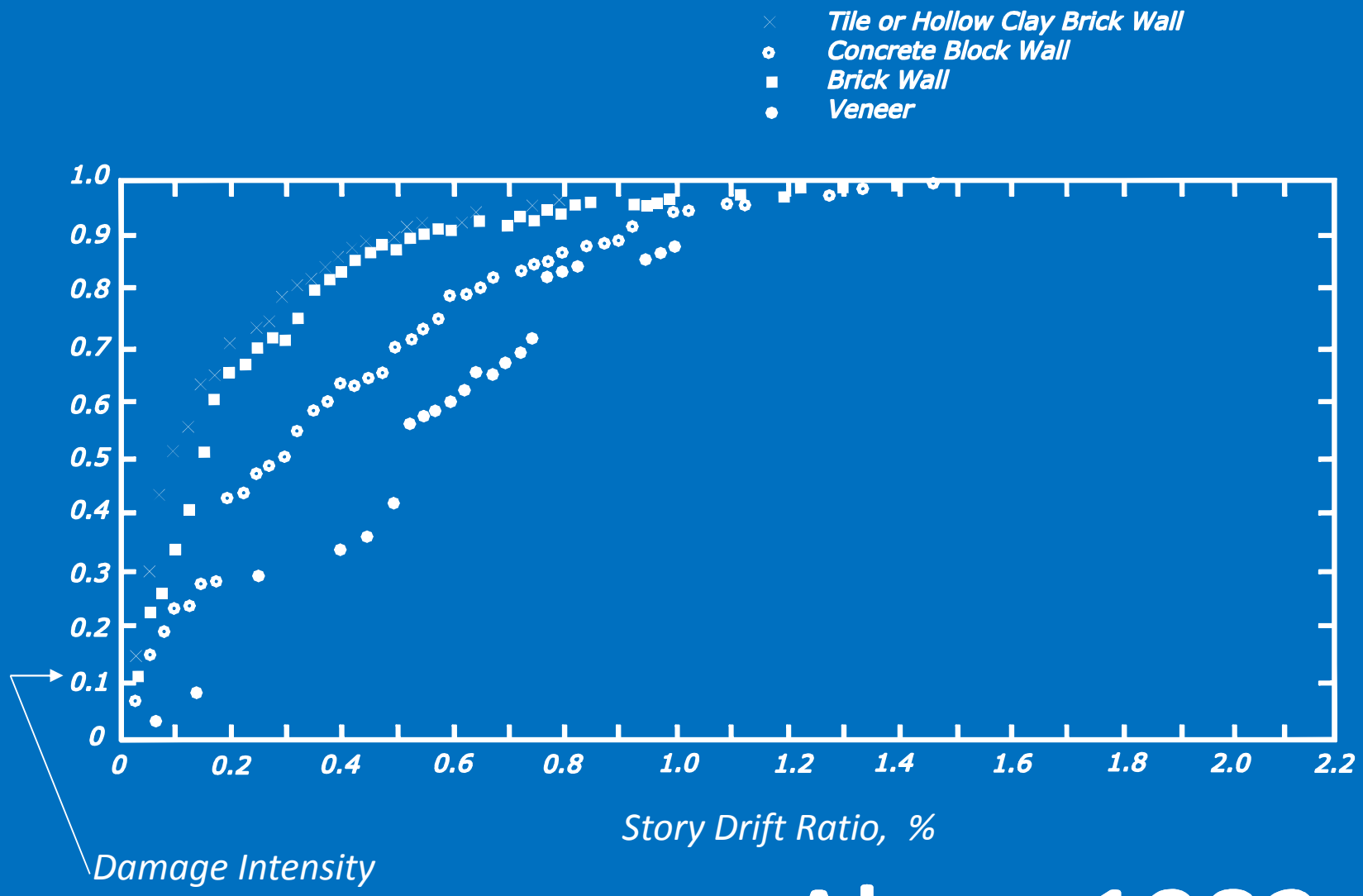
Period ~ 0.4


Base Shear Strength Coefficient = 0.1
PGV = 0.25 m/sec
0.50 m/sec
0.75 m/sec
Spectral drift, m
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Period, sec.

Őztűrk 2003

DRIFT, m	Story Drift, m	Ratios, %
0.25		
	0.02	0.6
0.21		
	0.04	1.1
.16		
	0.06	1.7
.1		
	0.06	1.7
0.04		
	0.04	1.1
0.0		

Maximum Estimated Story-Drift Ratio ~2 %


Tile or Hollow Clay Brick Wall
Concrete Block Wall
Brick Wall
Veneer
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
Story Drift Ratio, %
Damage Intensity

a

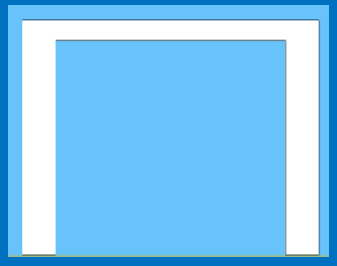
Algan 1982

CROSS

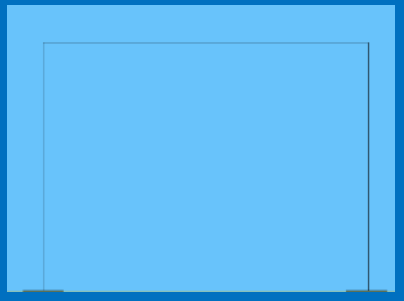
All analyses are based on some assumptions which are not quite in accordance with the facts.

From this, however, it does not follow that the conclusions of the analysis are not close to the facts.

It



Approximate Model of It



Exact Analysis of the Approximate Model of It

Is the Exact Analysis of the Approximate Model of

It

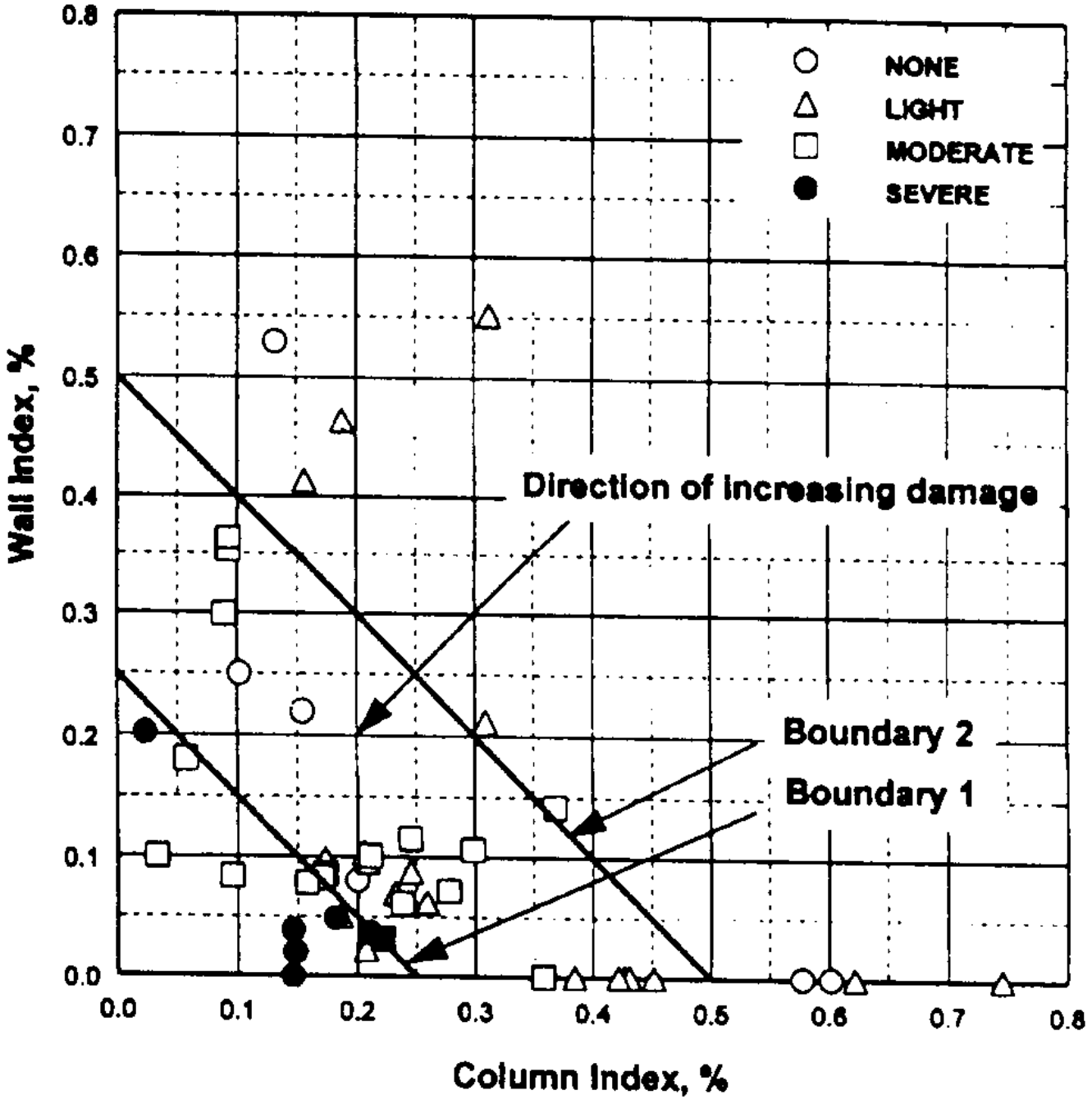
good enough to serve

as an approximate analysis of it?

Level	Mass	Assumed Δ	Related Force	Shear
5	100,000	1	100,000	
				100,000
4	100,000	0.8	80,000	
				180,000
3	100,000	0.6	60,000	
				240,000
2	100,000	0.4	40,000	
				280,000
1	100,000	0.2	20,000	
				300,000
Base		0.0	0	

Level	Mass	Assumed Δ	Related Force	Shear	Stiffness	Change	Drift
5	100,000	1	100,000				6.6
				100,000	149	0.67	
4	100,000	0.8	80,000				6.0
				180,000	149	1.21	
3	100,000	0.6	60,000				4.8
				240,000	149	1.61	
2	100,000	0.4	40,000				3.2
				280,000	149	1.88	
1	100,000	0.2	20,000				1.3
				300,000	235	1.28	
Base		0.0	0				0

Level	Mass	Assumed Δ	Related Force	Shear	Stiffness	Change	Drift	Shape
5	100,000	1	100,000				6.6	1.0
				100,000	149	0.67		
4	100,000	0.8	80,000				6.0	0.9
				180,000	149	1.21		
3	100,000	0.6	60,000				4.8	0.72
				240,000	149	1.61		
2	100,000	0.4	40,000				3.2	0.47
				280,000	149	1.88		
1	100,000	0.2	20,000				1.3	0.19
				300,000	235	1.28		
Base		0.0	0				0	0


NONE
LIGHT
MODERATE
SEVERE
Direction of increasing damage
Boundary 2
Boundary 1
Wall Index, %
Column Index, %
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8