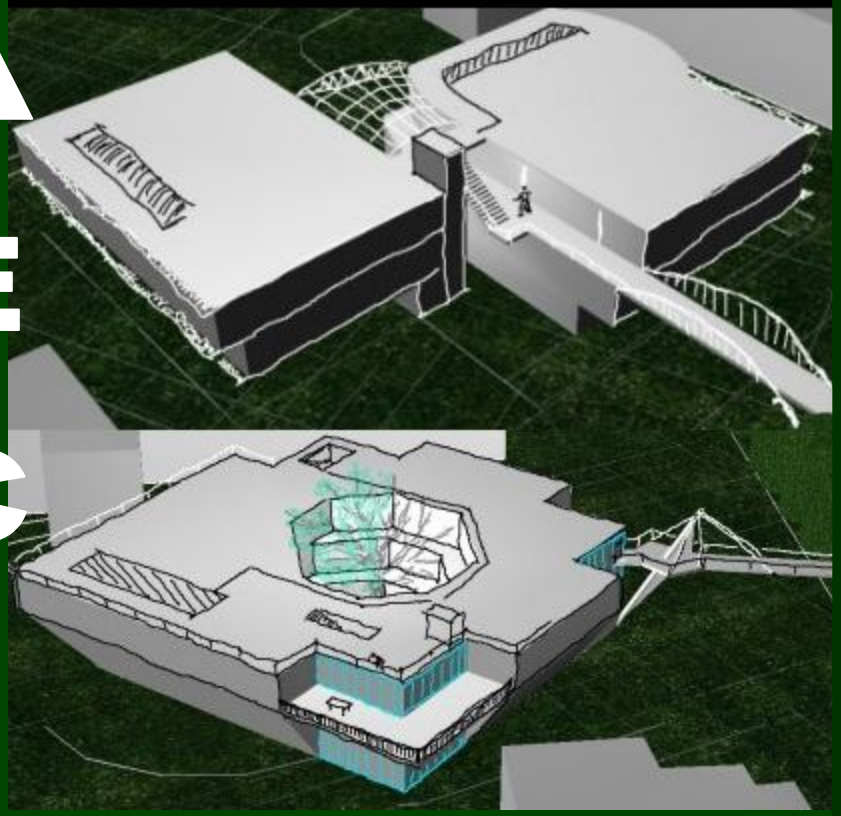
A

E

C



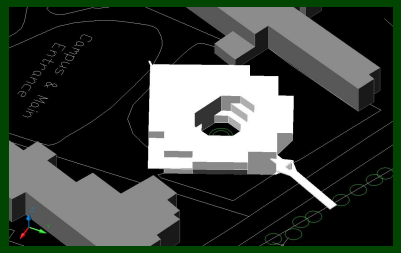
Bauhaus-Universität Weimar

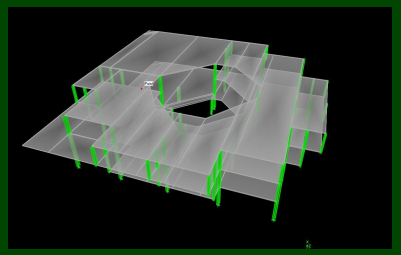
Architect

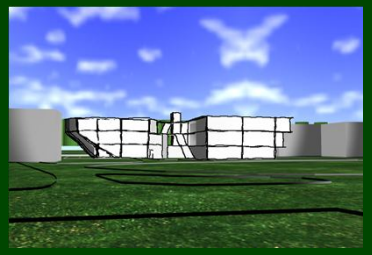
Engineers

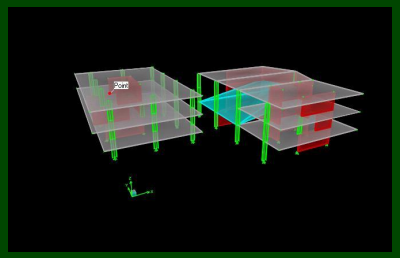
CM

Owner



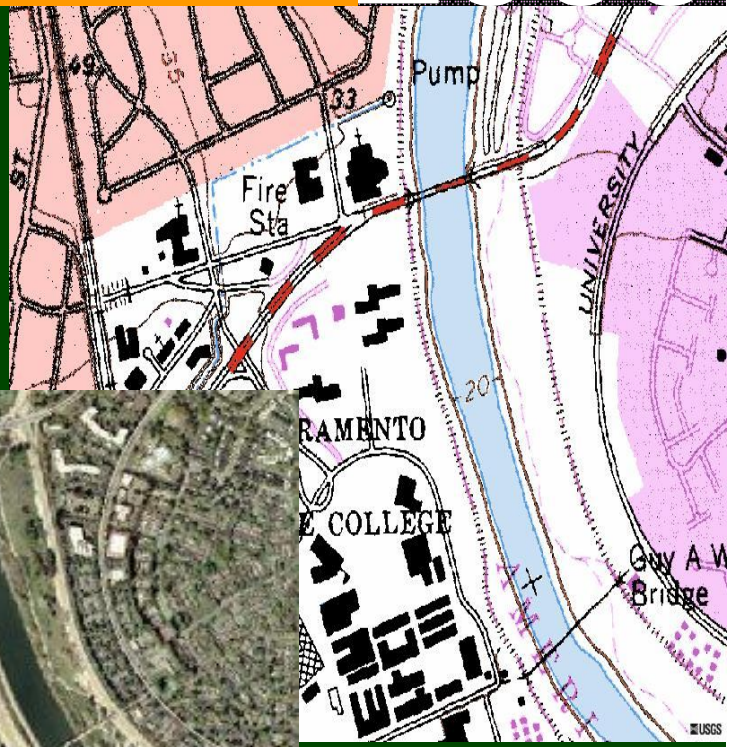


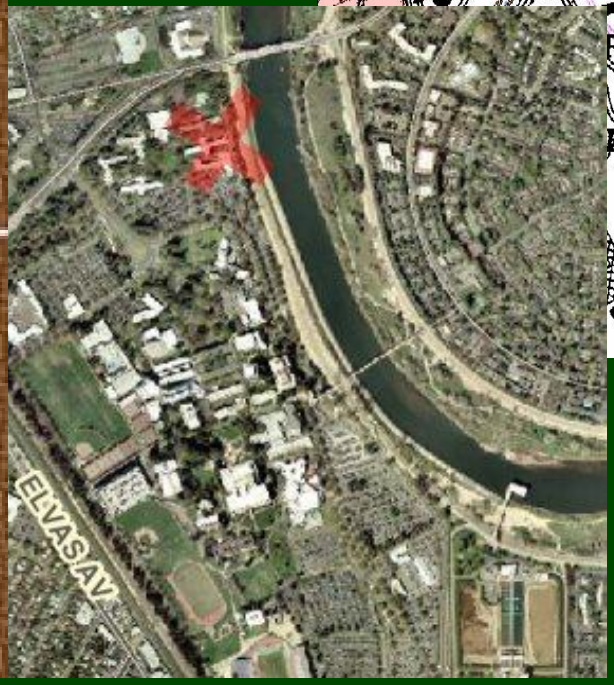




Site Conditions

RIVER 2003





A/E/C TEAM

Site Evaluation

RIVER 2003

A

- Proximity to the River – Fluid Element
- Existing Buildings

E

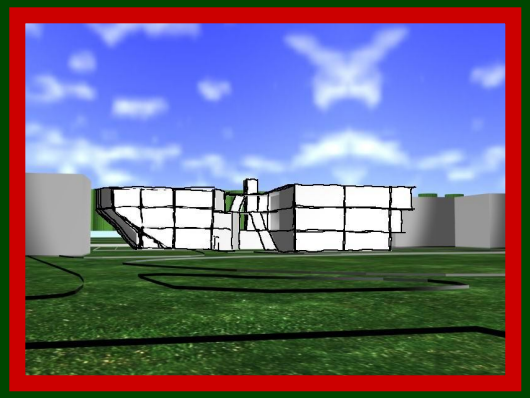
- Loose Compressible Soil
- High Water table
- California Seismicity

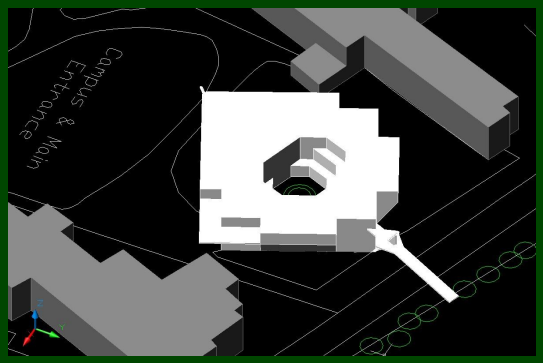
C

- Accessible, Spacious
- Subcontractor and Materials Availability

Decision Matrix

RIVER 2003





A	+	Circulation, Spaces	+	Shapes, Atrium
E	+	Straightforward system	-	Uncertainties
C	+	Faster, Economic	-	Complexity

Research

RIVER 2003

Green Buildings

Efficient Design

Innovative materials

Intelligent methods

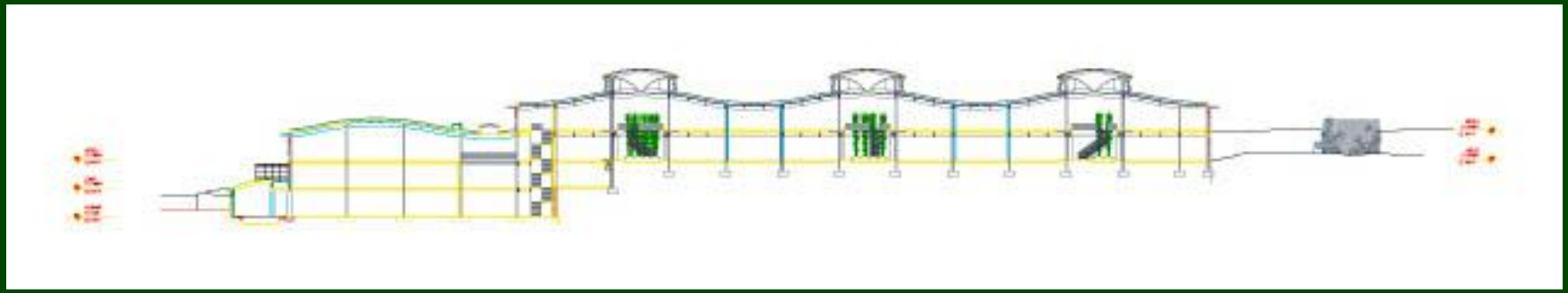
Case Study:

GAP headquarters
San Bruno, CA

Architect : William Mc Donough
Engineering: Ove Arup
Contractor: Swinerton

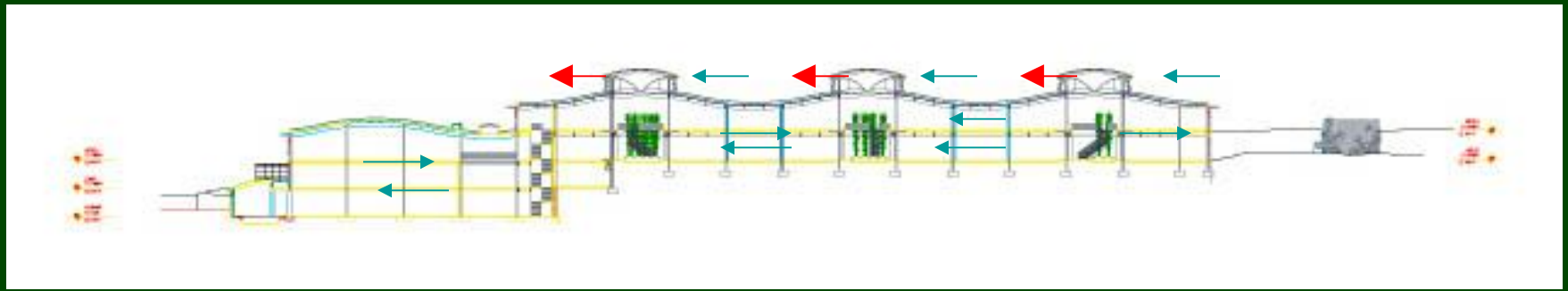
Efficient design: Passive methods

RIVER 2003



Section
GAP headquarters
San Bruno, CA

Efficient design: Passive methods



Section
Cross air circulation pattern

GAP headquarters
San Bruno, CA

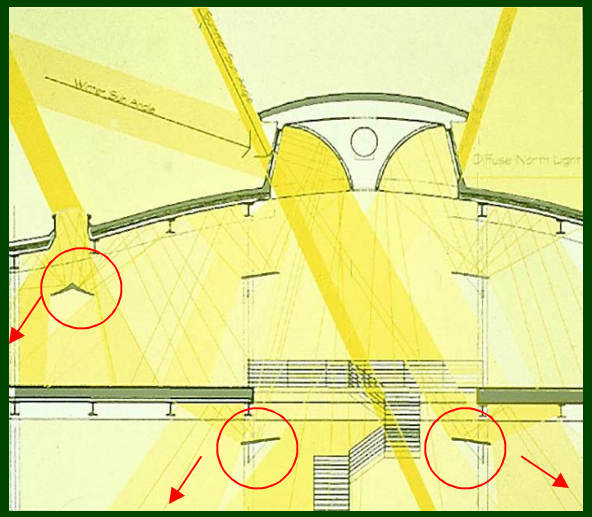
Efficient design: Passive methods





GAP headquarters
San Bruno, CA

Efficient design: Passive methods



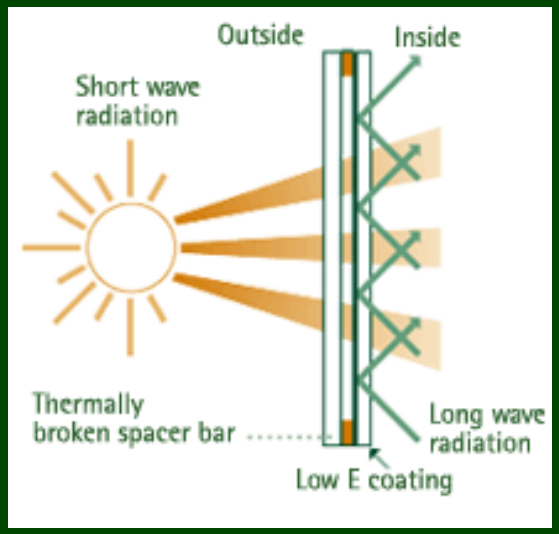
GAP headquarters
San Bruno, CA

William Mc Donough
AIA

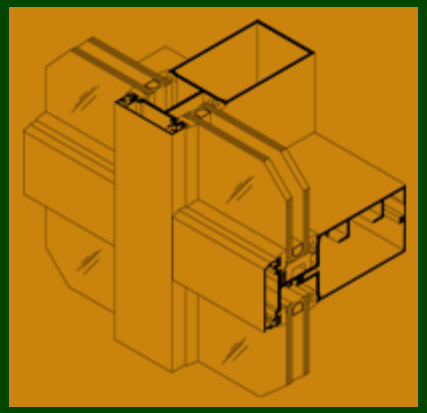
Daylighting Monitors :
broad light monitors above each atrium follow
east-west axis to maximize exposure to the southern sun
Occupancy Sensors:
-shut off lights when offices are empty

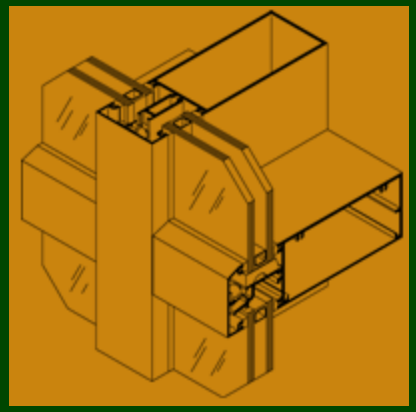
Innovative materials:
Manufacturing and construction

RIVER 2003



Low E emessivity windows

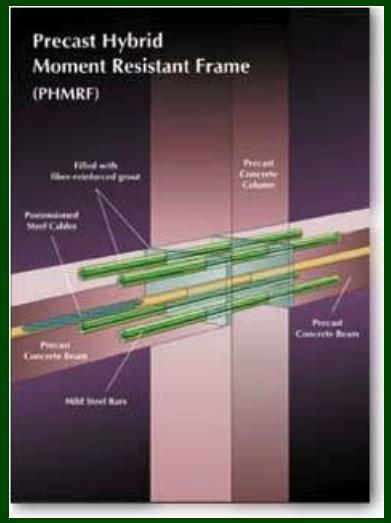




5 Times Square
New York City

Innovative materials:
New Technologies

RIVER 2003



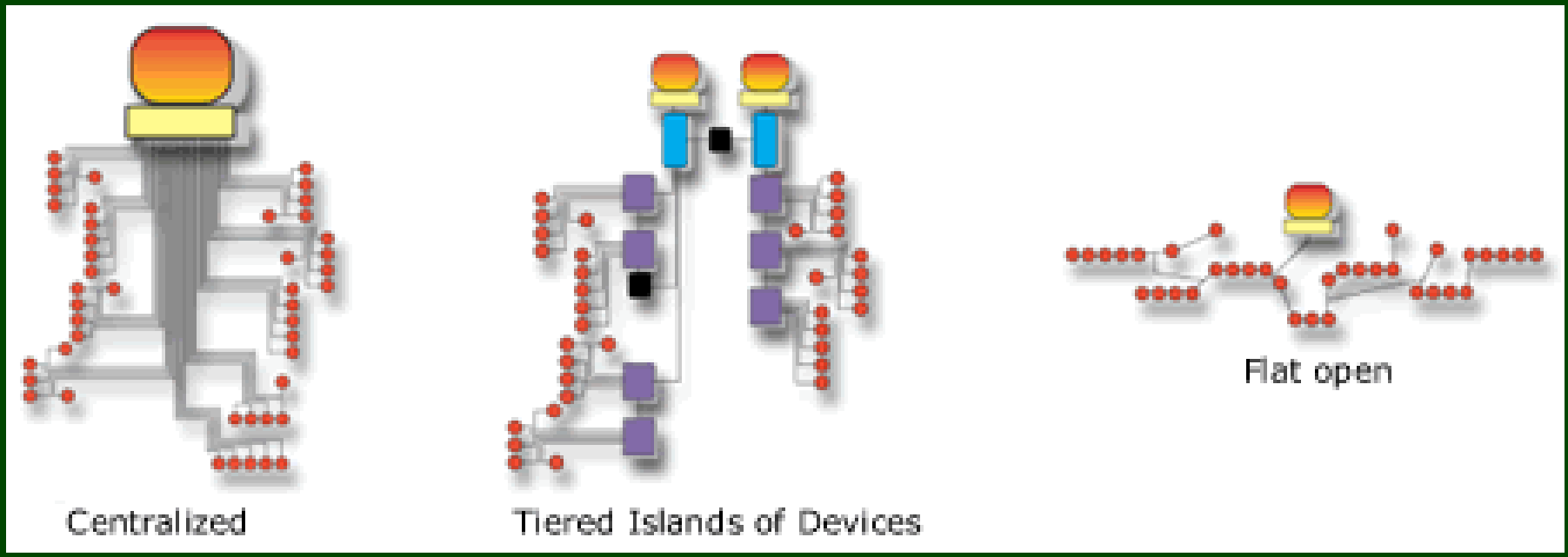
Traditional Materials

Passive energy sources

HVAC : Simulation

Intelligent methods:

- Computerized systems:



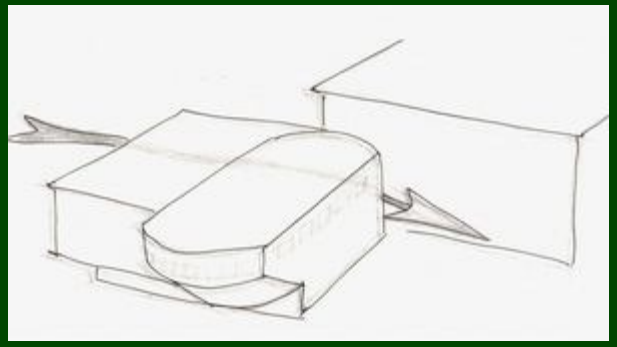
Automatic Meter Reading (AMR)
Centralized Systems

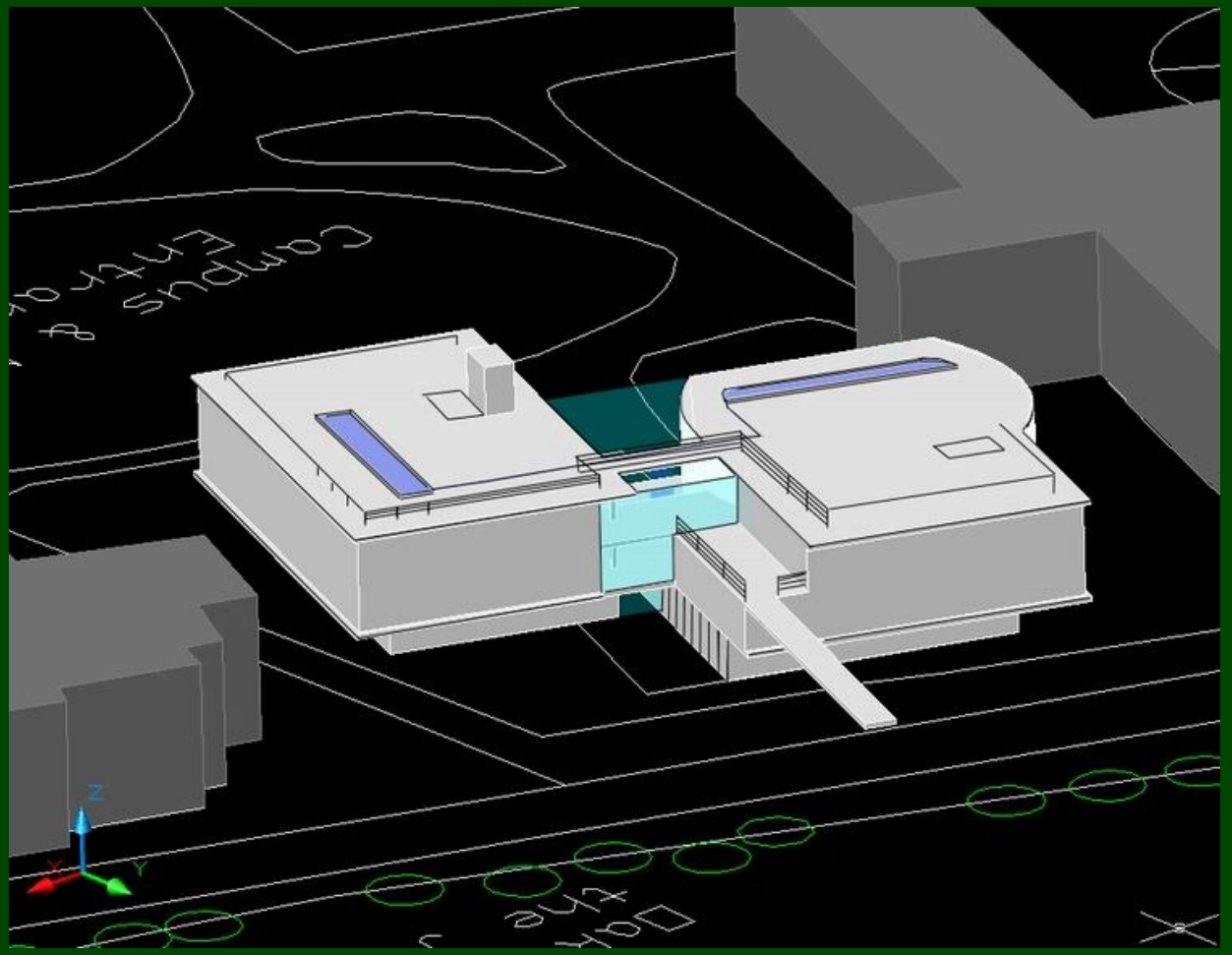
Intelligent methods:

RIVER 2003

Architecture

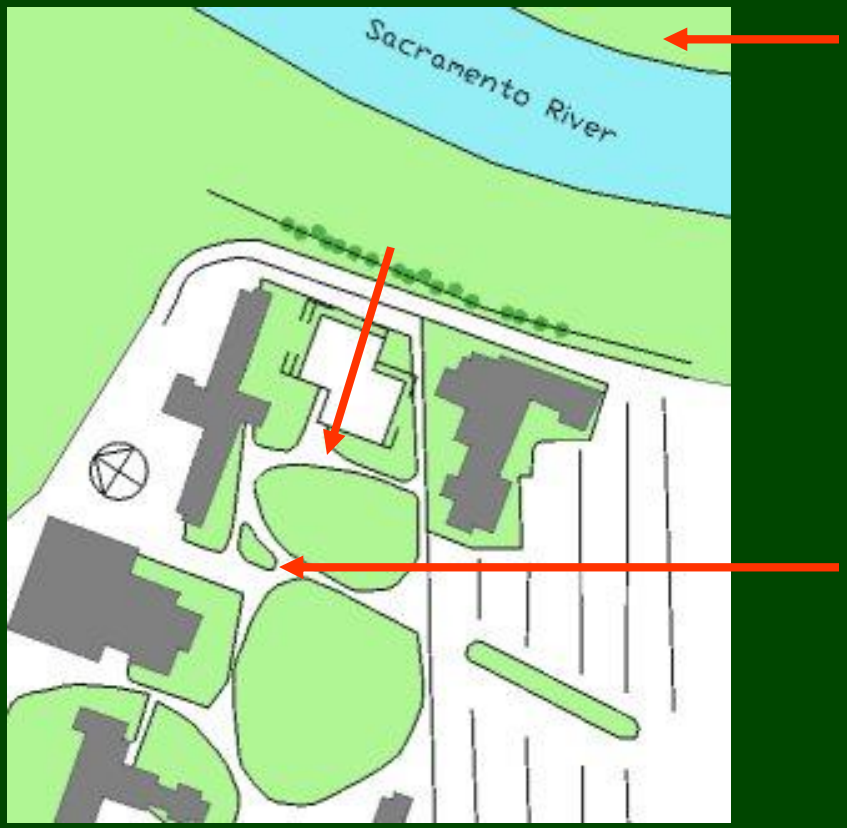
RIVER 2003





River and Campus

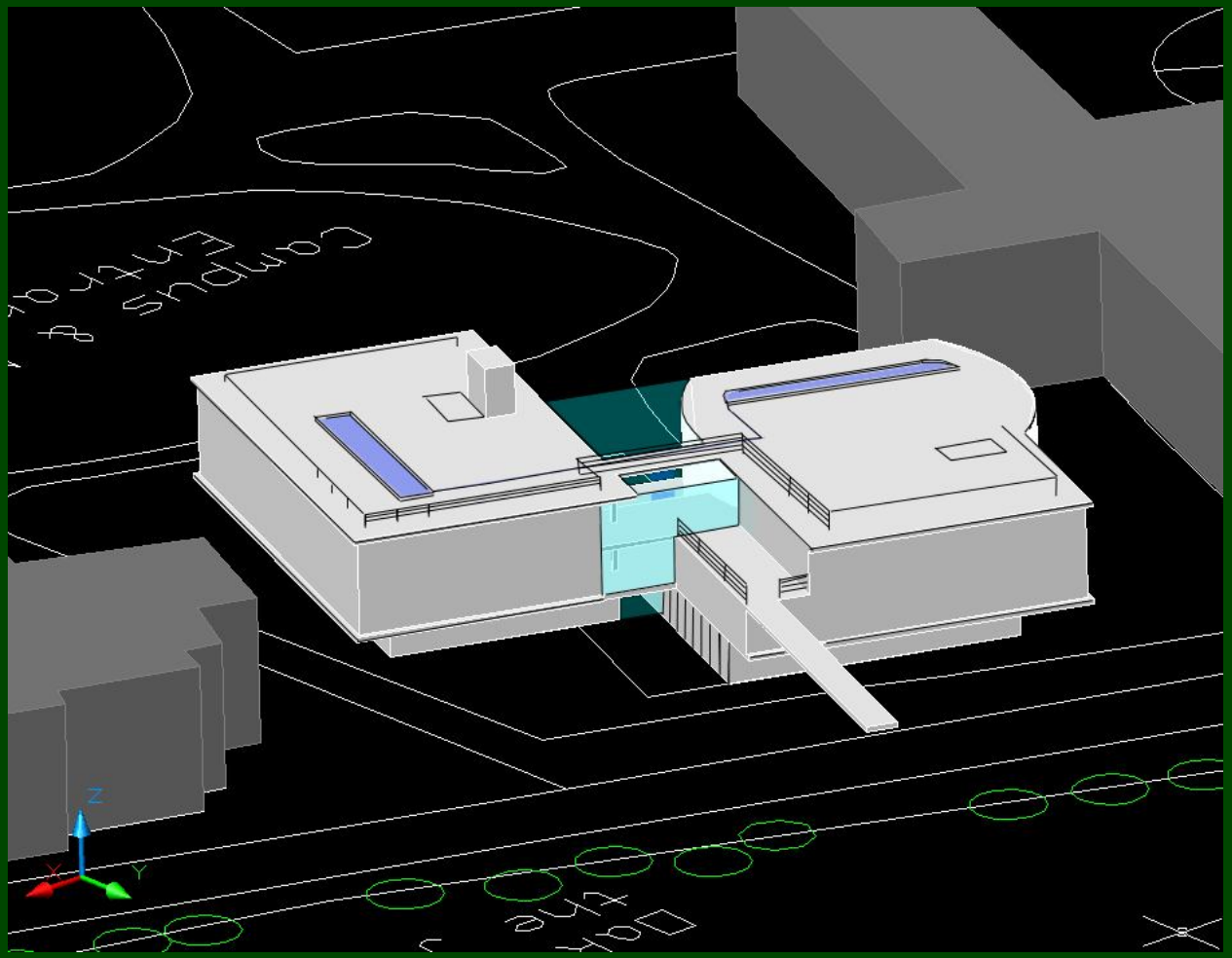
RIVER 2003

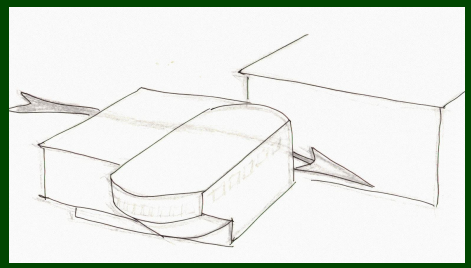


- connection - ecology - living symbiosis

Concept:
Extension of the River

RIVER 2003





- atrium
- stream
- rocky river bed
- rounded stone

Ground Floor Plan

RIVER 2003

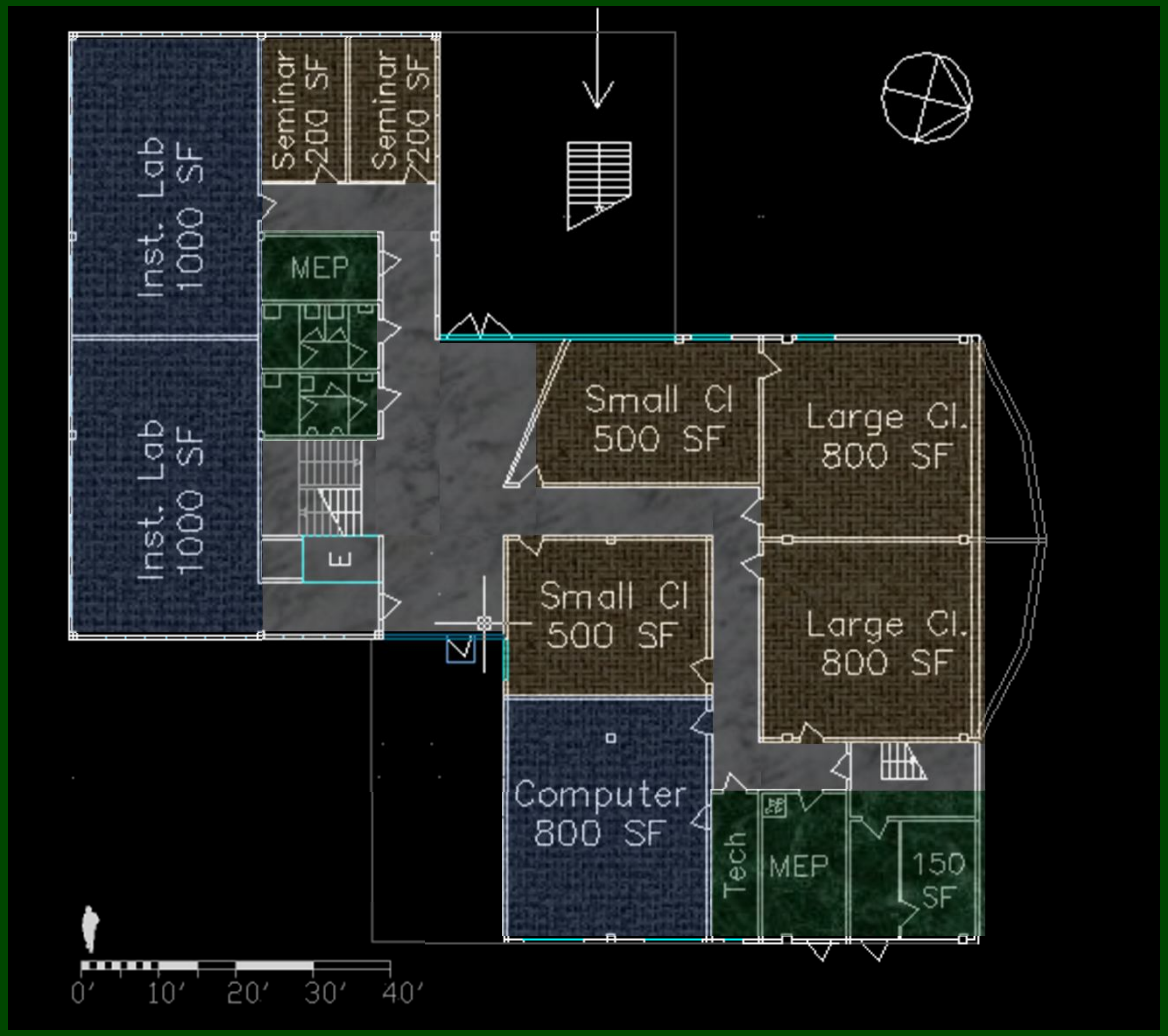
- curved wall
- majestic staircase
- symbiosis
- Circulation river

Laboratories

Teaching

Circulation

MEP - WC



ARCHITECTURE

Second Floor Plan

RIVER 2003

- center
- communication
- office views
- interaction

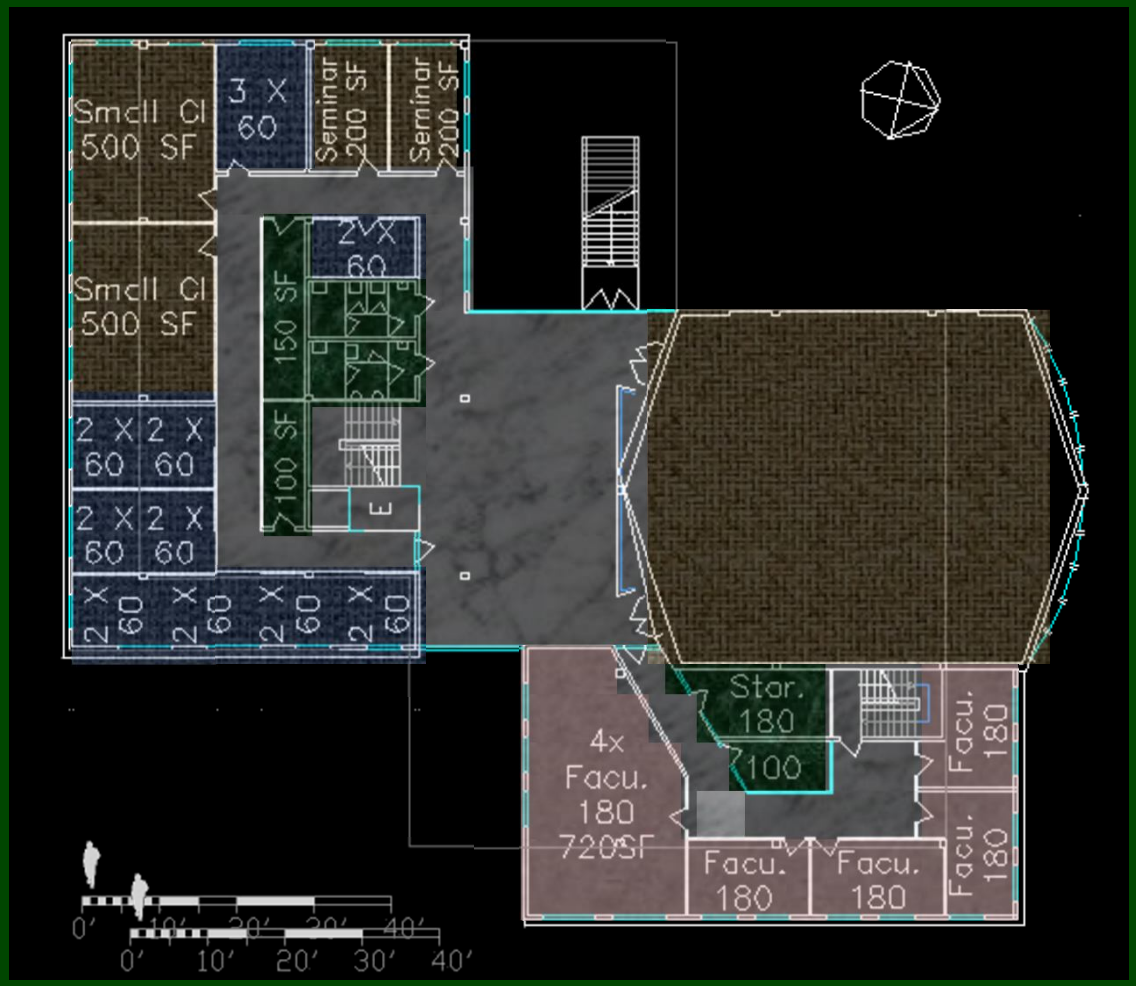
Student off.

Teaching

Faculty off.

Circulation

WC - Storage



ARCHITECTURE

Third Floor Plan

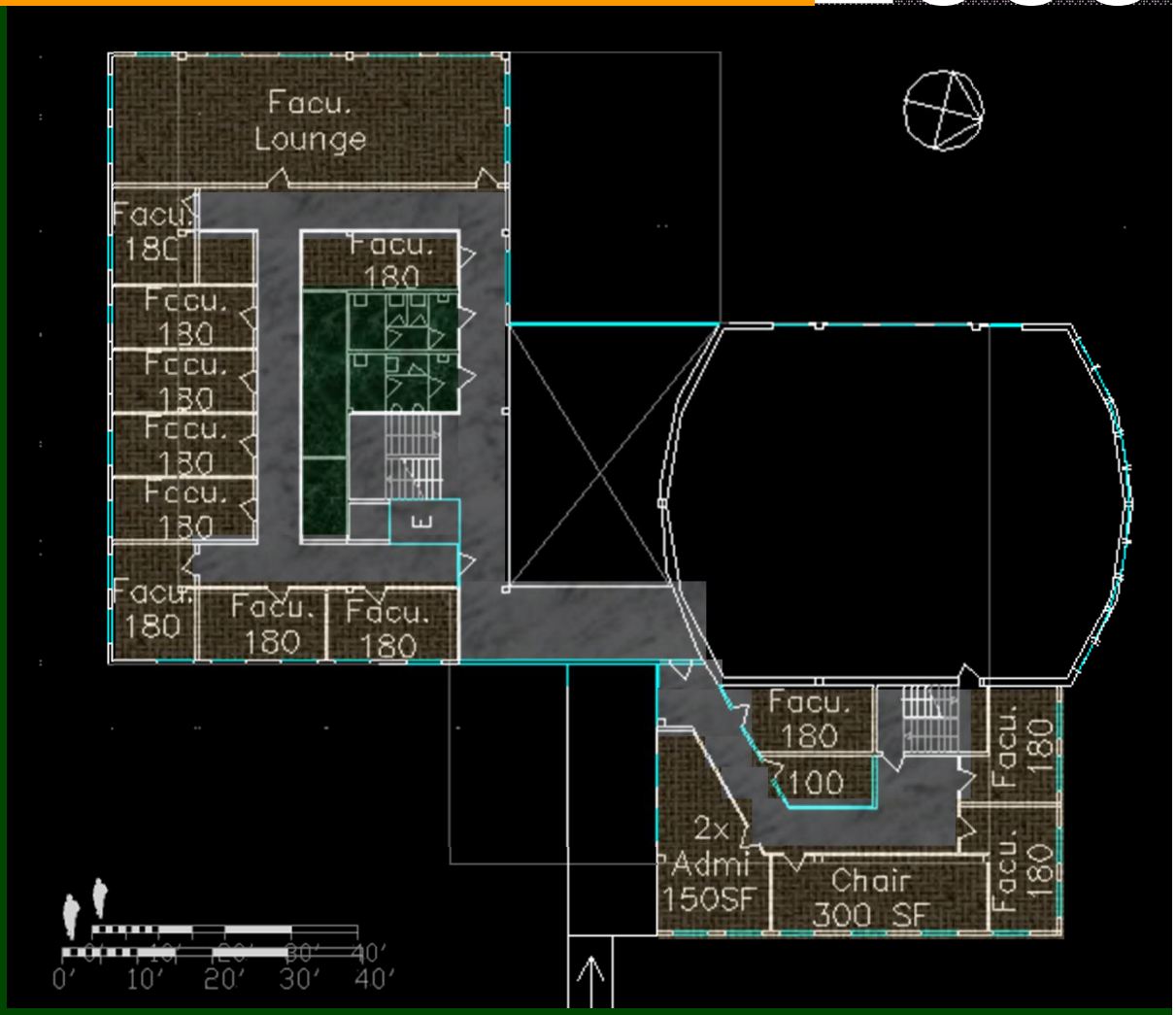
RIVER 2003

- 2nd entrance
- views

Faculty – Chair

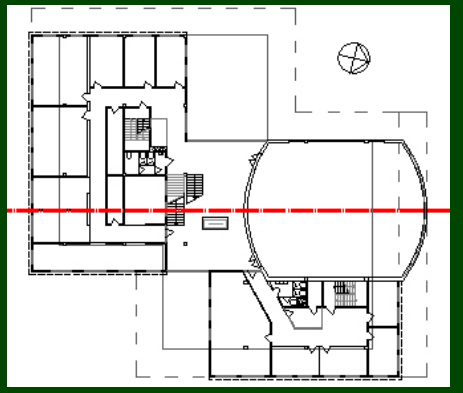
Circulation

WC - Storage



Section

RIVER 2003



- open MEP
- exposed rivers of the building

Facade

RIVER 2003

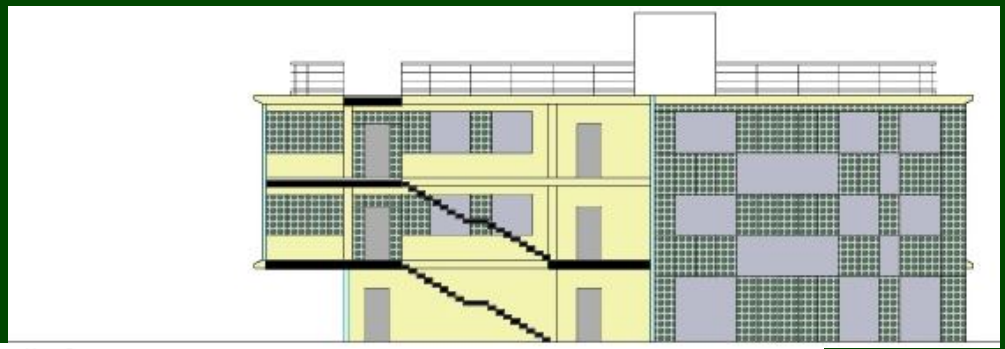
- future 2015: photovoltaic facade systems (?)

- genius loci of the location

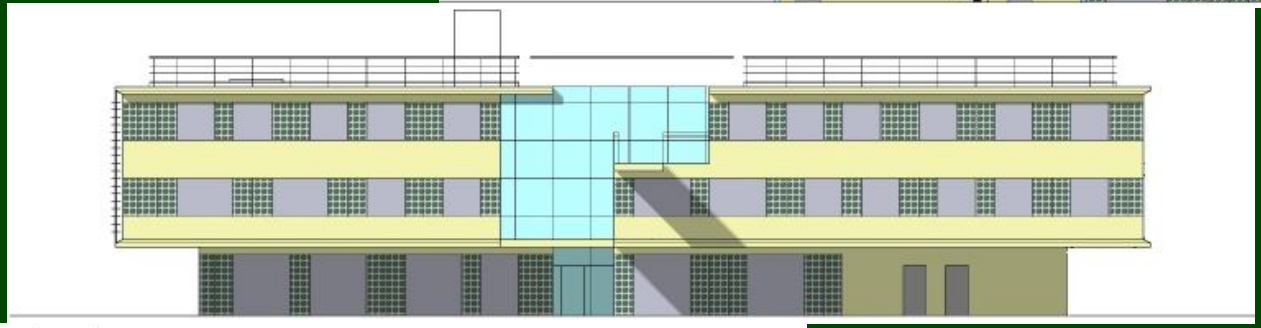
Elevations
South Part of the Building

RIVER 2003

- inner north elevation / section



- east elevation from the river with bridge



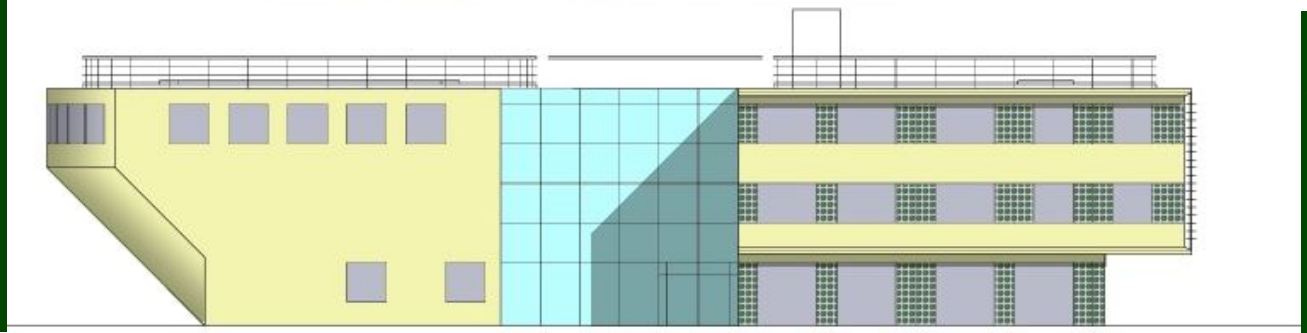
- south elevation with horizontal PV-lamellae for extra sun protection

Elevations
North Part of the Building

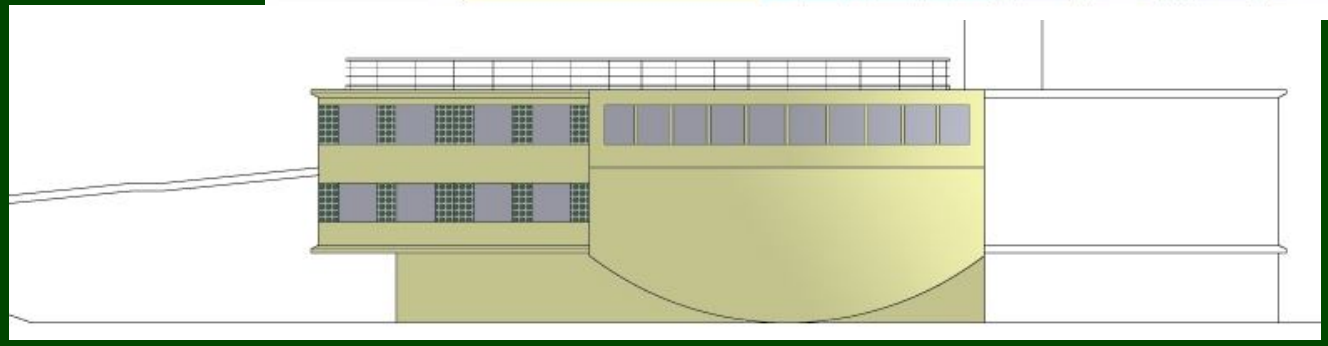
RIVER 2003

- inner south elevation

- west elevation from campus

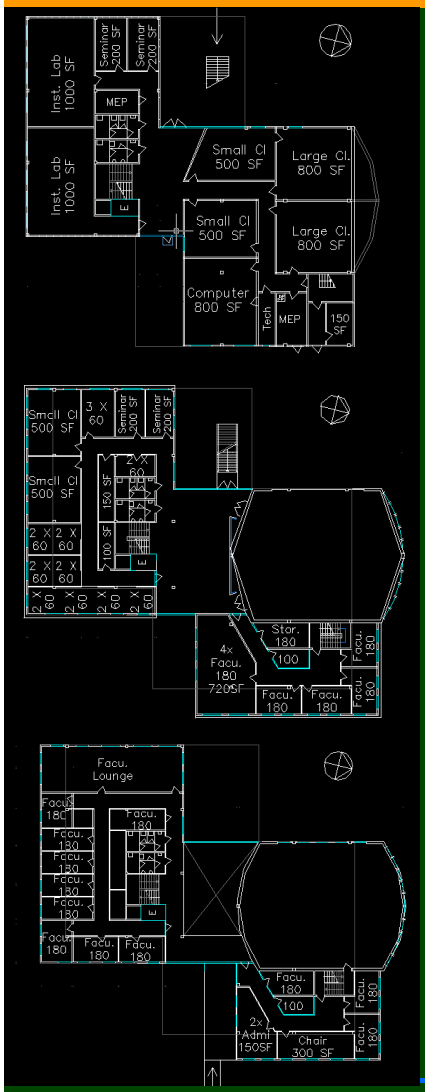


- north elevation



Architectural Performance

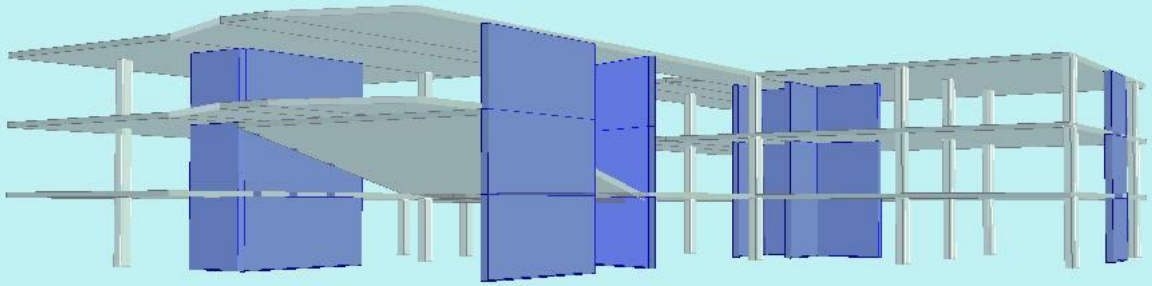
RIVER 2003



Function	SF required	SF provided	%
Faculty office	3600	3421	95
Chair's office	300	327	109
Senior Admin. office	300	339	113
Secretaries	300	300	100
Faculty lounge	1000	1017	102
Student's office	1200	1306	109
Auditorium	3000	2873	96
Large classrooms	1600	1536	96
Small classrooms	2000	2067	103
Seminar rooms	800	794	99
Instructional labs	2000	1862	93
Computer machine room	800	779	97
Technical support	100	106	106
Storage	1000	918	92
Total assignable SF	18000	17645	98
Gross total SF	30000	26946	90

Engineering Solutions

RIVER 2003



Materials

- Concrete:
  - f'_c=4000psi
- Mild steel:
  - Grade 60
- PT steel:
  - f_p=270ksi

Gravity Loads

RIVER 2003

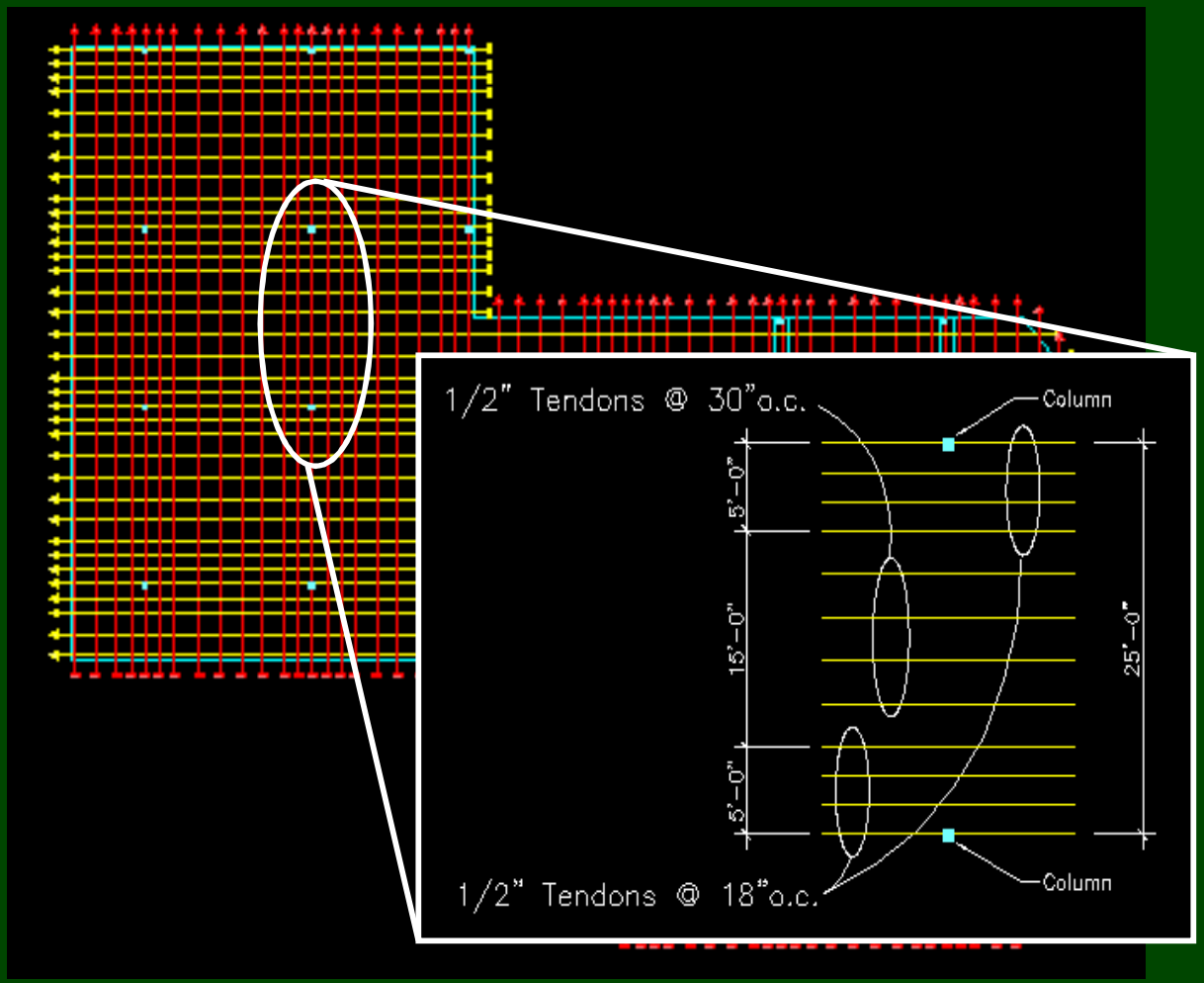
FLOOR DEAD LOAD

- Concrete Slab 97 psf
- Interior Partitions 20 psf
- MEP Overhead Systems 10 psf
- Cladding 15 psf

FLOOR LIVE LOAD [1997 UBC, Table 16-A]

- Office 50 psf
- Restrooms 50 psf
- Storage (light) 125 psf
- Classrooms 40 psf
- Auditorium (fixed seating) 50 psf
- Auditorium (stage area) 125 psf
- Exit Facilities 100 psf

Typical Slab



Tendons:

½" @75%

Spacing:

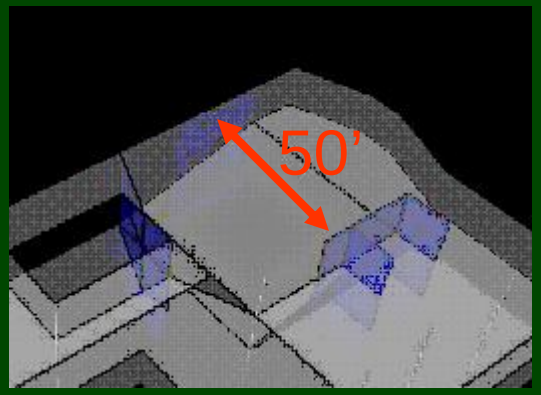
Within 5' of Col.

@18"

Between Columns

@ 30"

Auditorium Slab



Ribs:

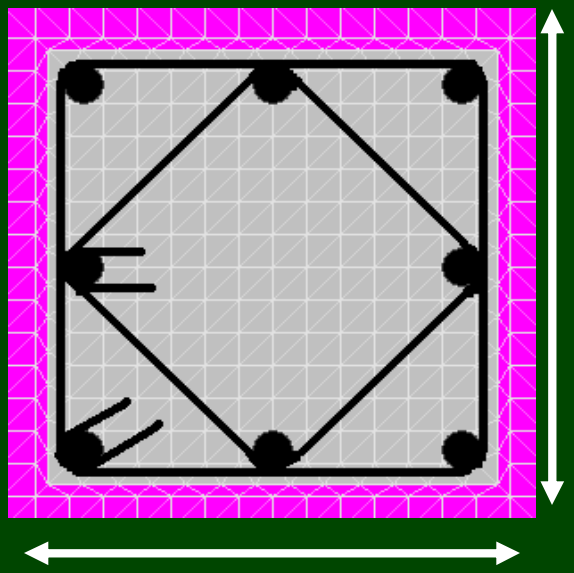
18” deep x 8” thick @ 36”

Tendons:

Draped @ max eccentricity

¾” @75%

Columns

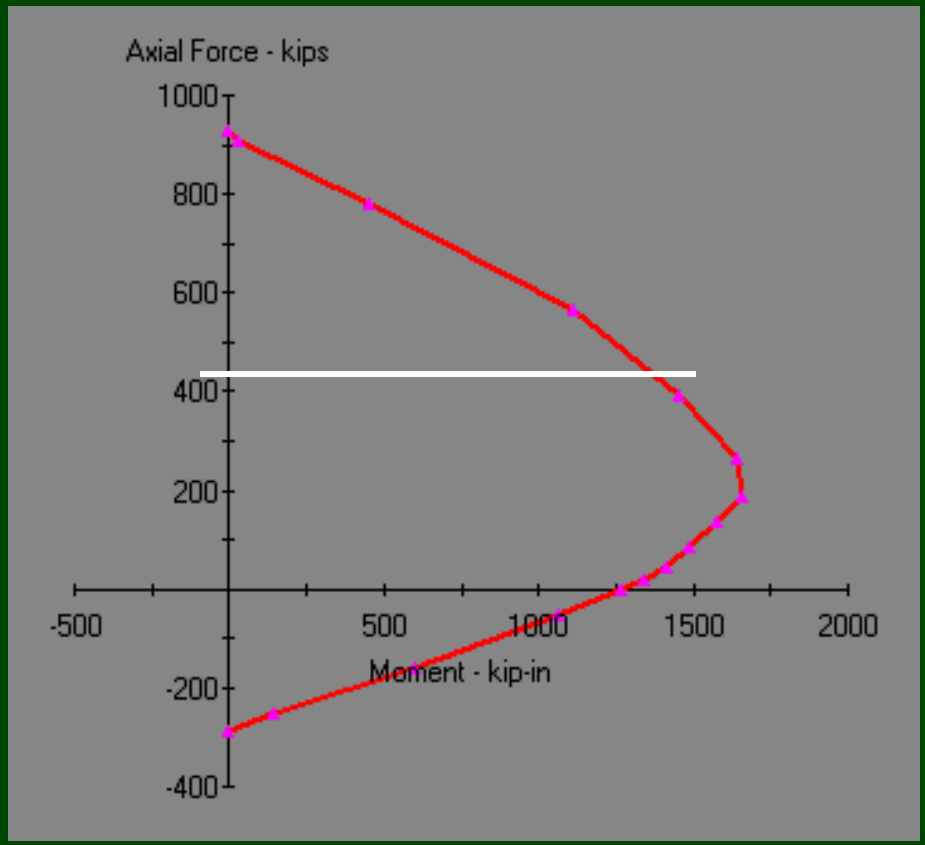


12”

12”

8 #7 longitudinal bars

#3 @4” double hoop



Lateral Resistance

RIVER 2003

- Philosophy
- System ← Constrained
- Loads
- Analysis
- Verification
- Design
- Verification

Earthquake Philosophy

RIVER 2003

- “I only know one thing,
  That I don’t know anything!”

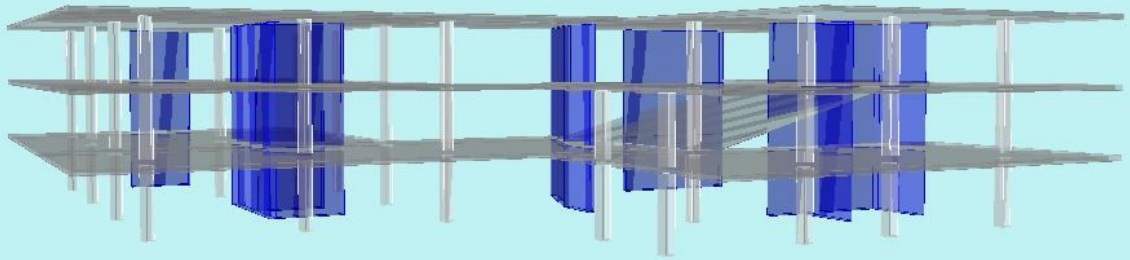
  Socrates

- “If you ‘re not sure,
  Wear both belt and suspenders!”

  Helmut Krawinkler

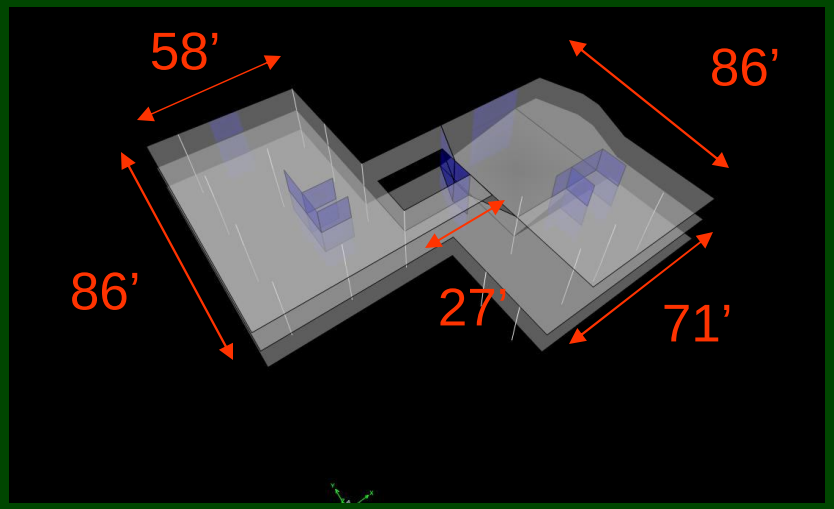
Lateral Resistance System

RIVER 2003

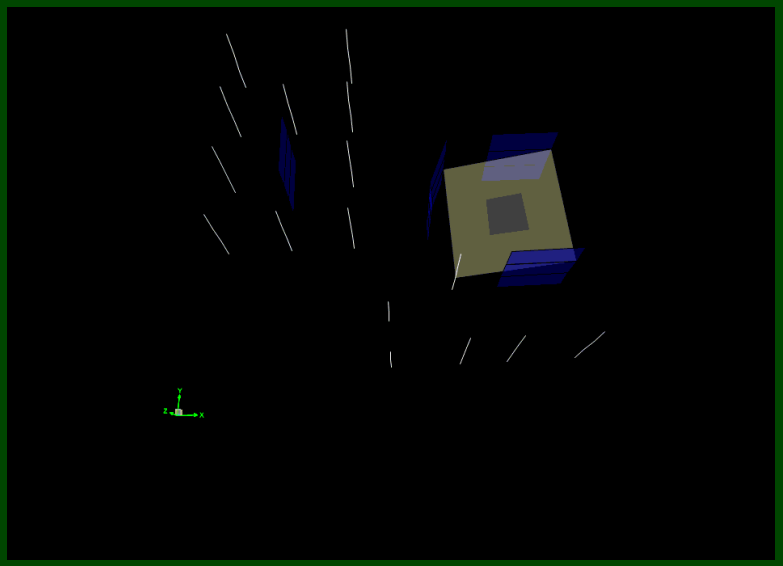


ENGINEERING

Lateral Resistance System



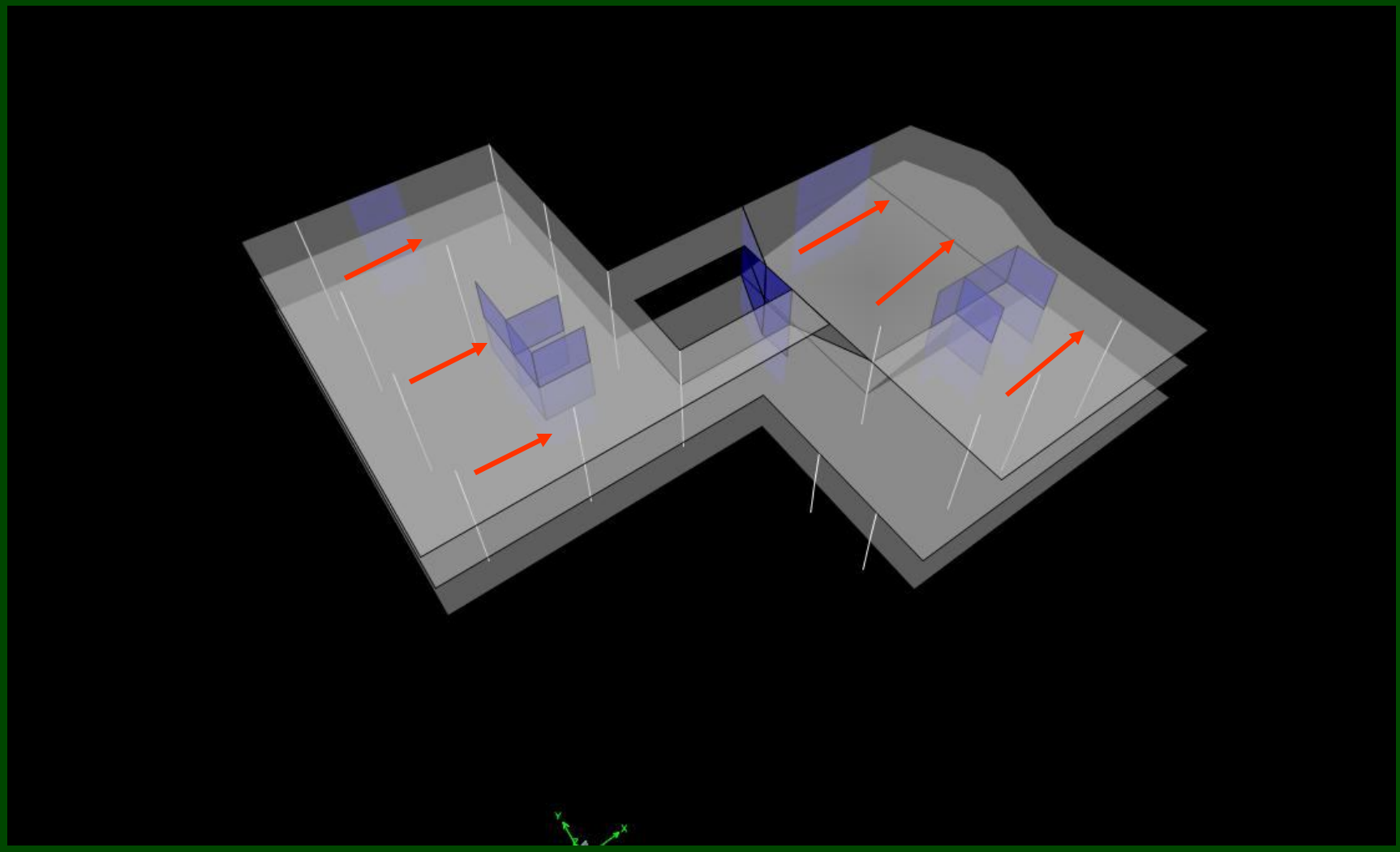
- Concrete Shear Walls
  - 2 (squat) walls in each direction



- Very stiff
- Not very redundant
- Not very symmetric

Lateral Load Path

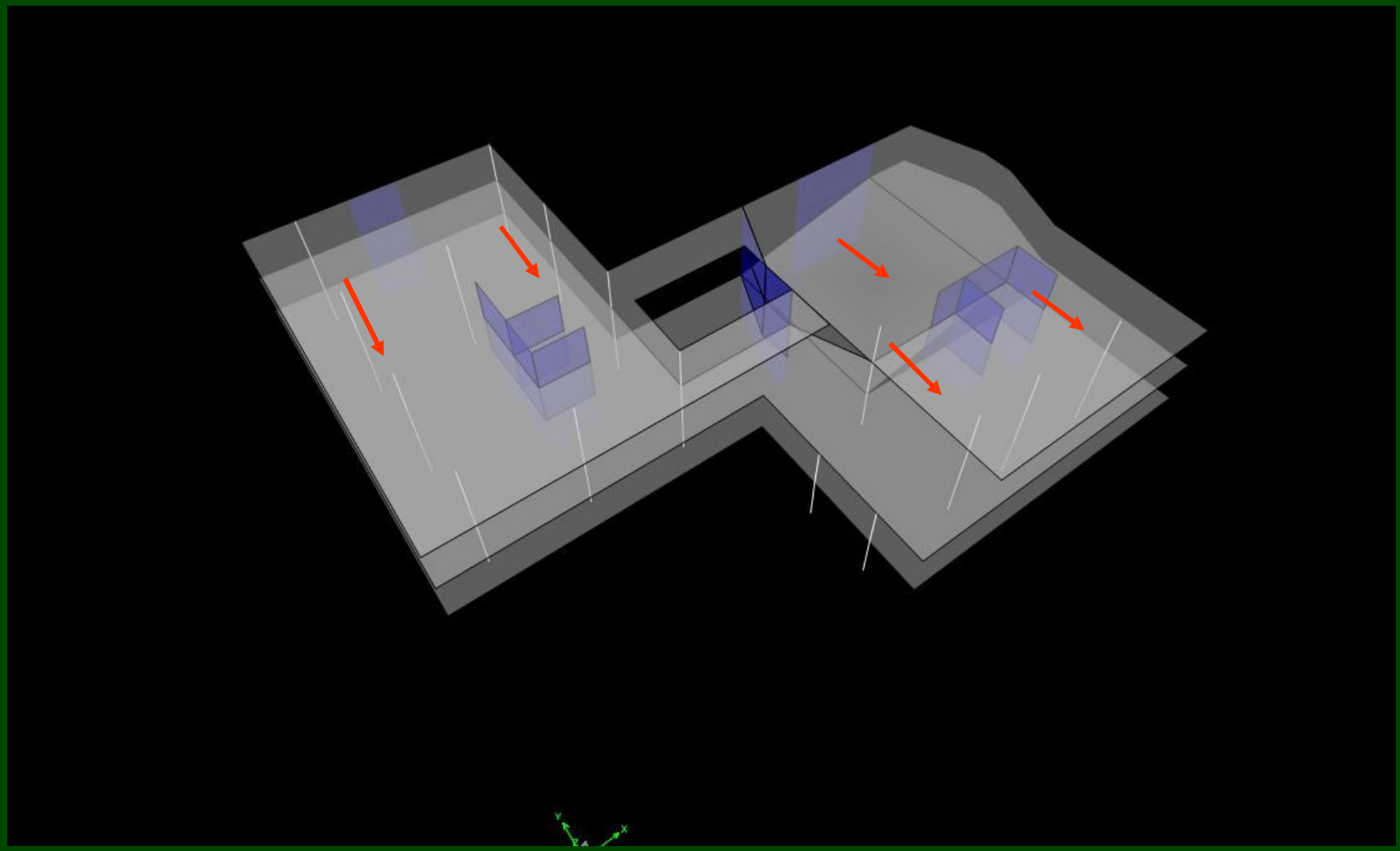
RIVER 2003



ENGINEERING

Lateral Load Path

RIVER 2003

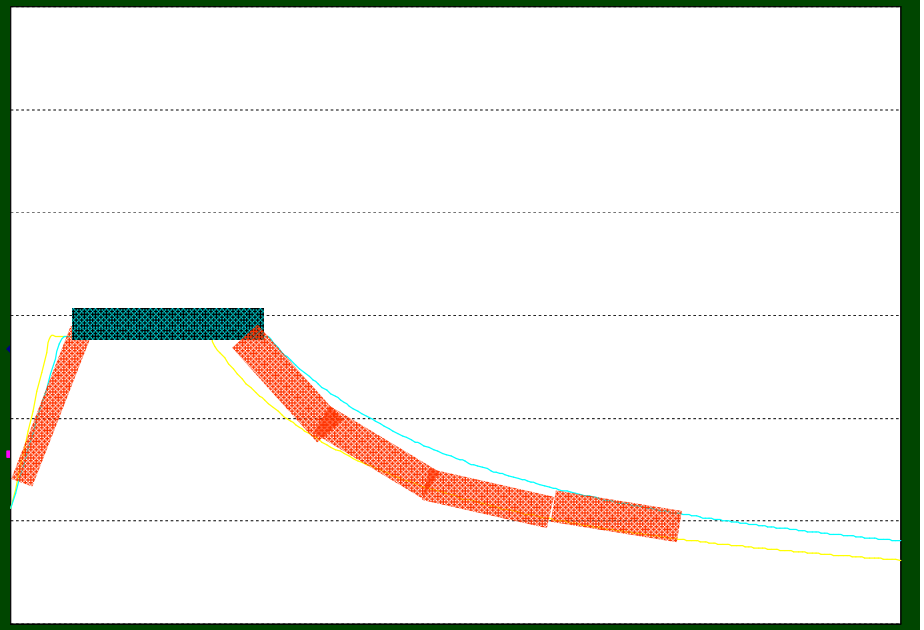


ENGINEERING

Seismic Loads

RIVER 2003

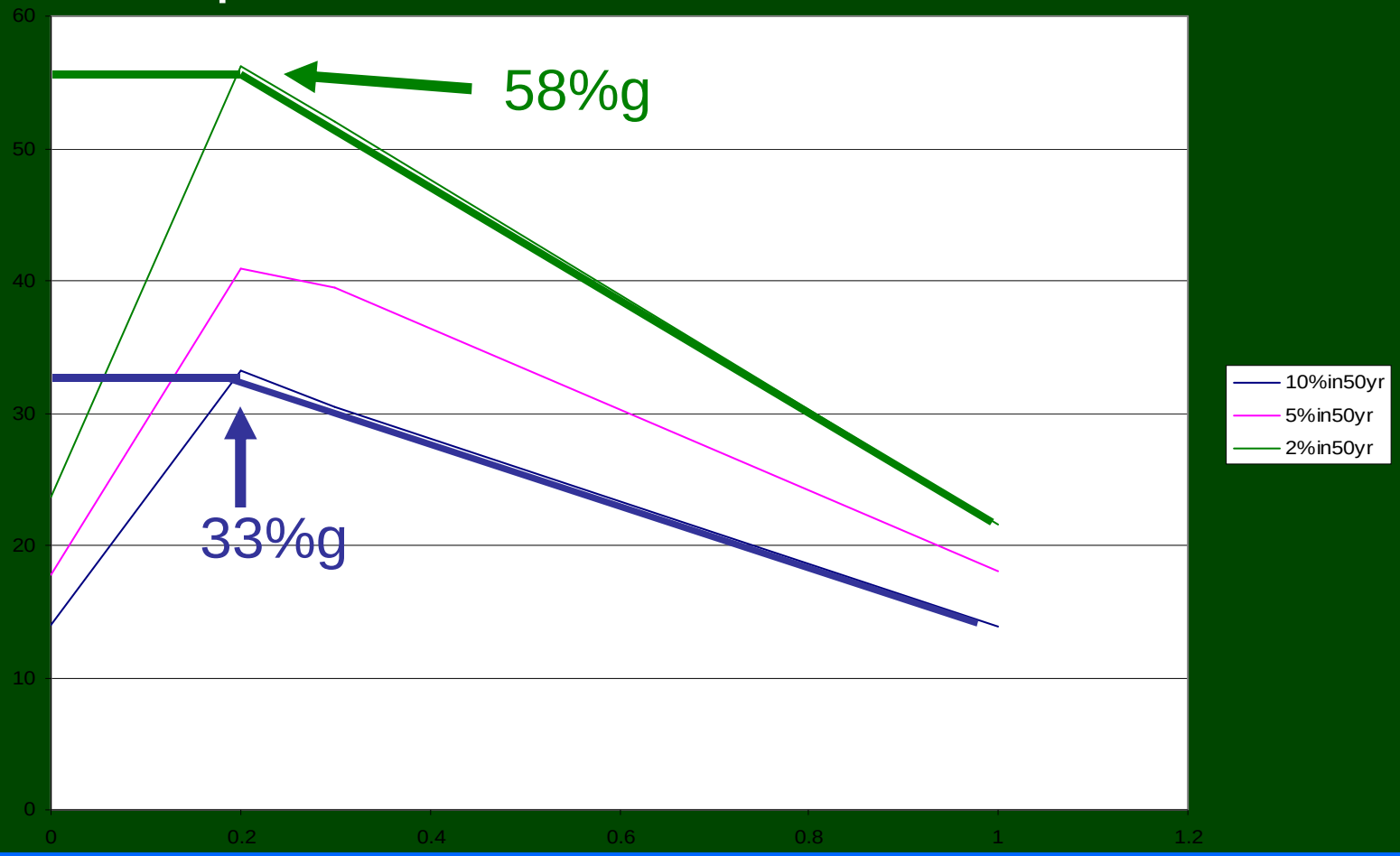
- 2000 IBC
- PERFORMANCE?
  - 2% in 50 yrs (2475)
  - 10% in 50 yrs (475)



Seismic Loads

RIVER 2003

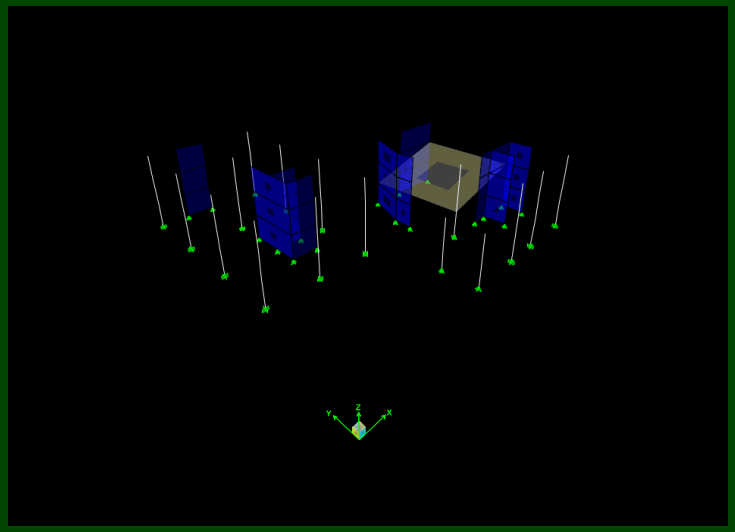
- USGS probabilistic seismic hazard

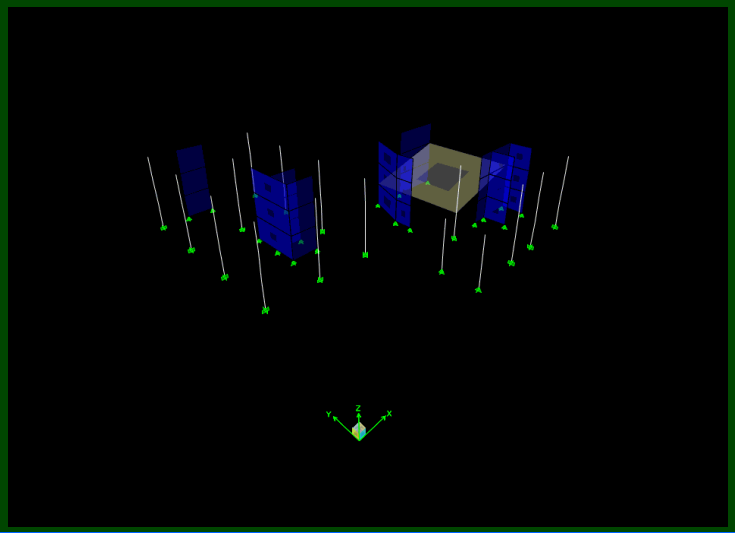


Analysis

RIVER 2003

- ETABS8 Non-Linear:
  - Modified USGS spectra
  - Equal results for both principle directions





Analysis

- ETABS8 Non-Linear building output:

- 2475 yrs EQ, R=4.5:
  - V_b=350kips
  - M_{ot}=8200kip-ft
  - Δ_{max}=0.08in
  - $\Delta_{int\text{-}s}$=0.04%

- 475 yrs EQ, R=1.0:
  - V_b=930kips
  - M_{ot}=21800kip-ft
  - Δ_{max}=0.05in
  - $\Delta_{int\text{-}s}$=0.02%

Analysis Verification

RIVER 2003

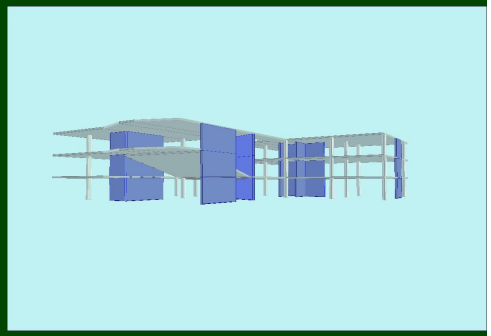
- 58%*145*30000*(8/12)/4.5=(very close to) 350
- 33%* 145*30000*(8/12)=(very close to) 930
- Since ETABS gives reasonable results, we trust it and proceed

Analysis

- Behavior governed by the four big walls
- Aspect ratio: 1.2
- Shear behavior
- Distribute story shears to individual walls:

  “in proportion to the area of the walls”

- Get demands on each element

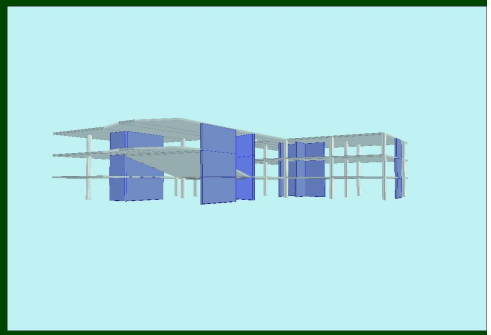


Shear Wall Design: V

RIVER 2003

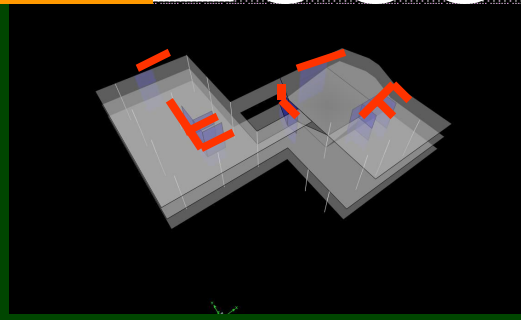
- thickness : t_w=8’’
- Web Reinforcement:

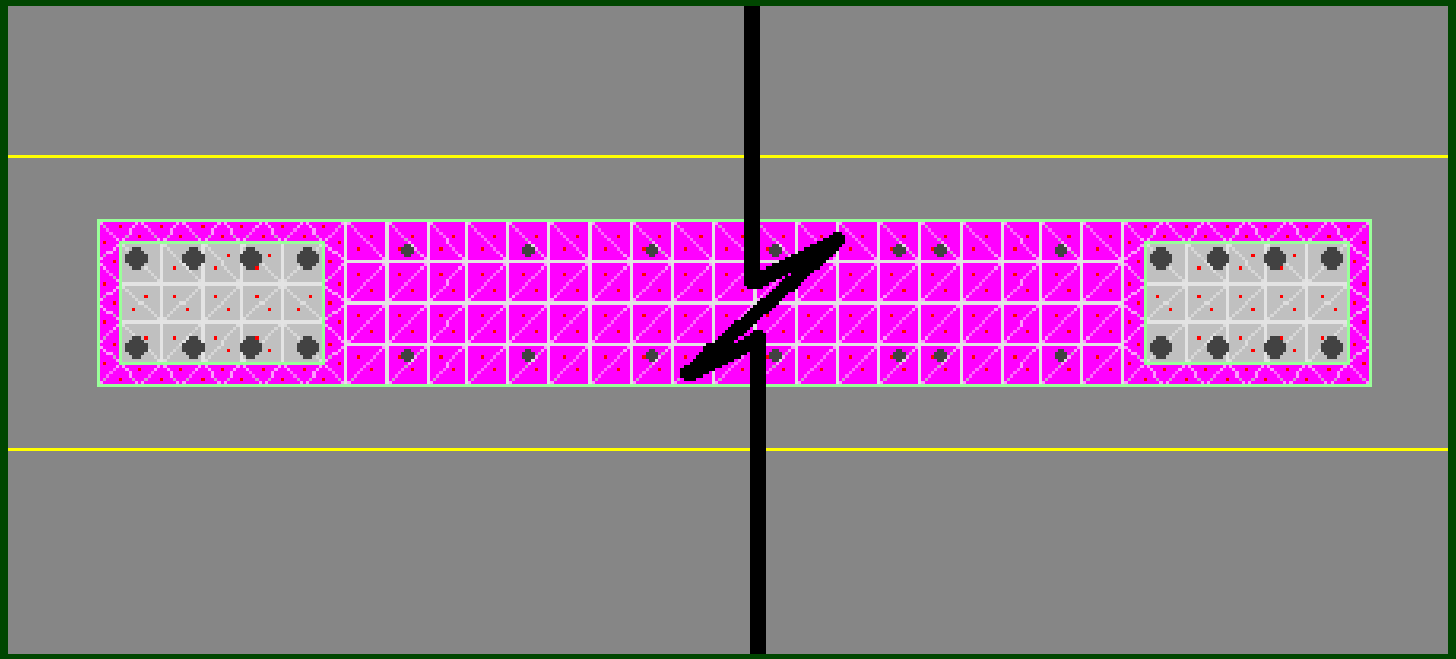
  #4@6’’ both directions, both sides
- ϕ=0.6 (assume shear failure)
- SF=2.7



Shear Wall Design: M – N

- Create 12’’ long boundary zones
- 8 #7 longitudinal bars in each B.Z.
- Double closed hoops #3@4’’ B.Z.





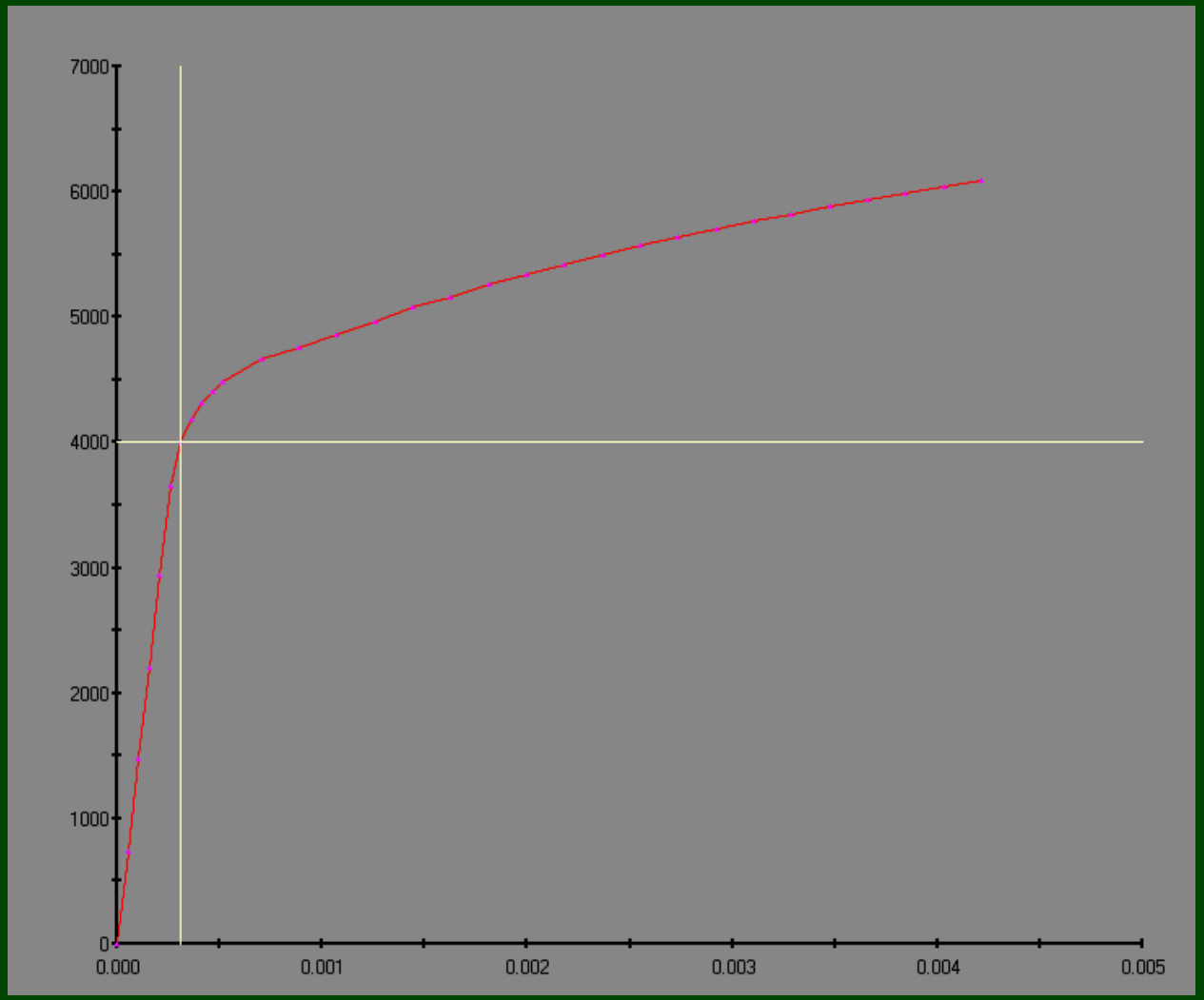
Shear Wall Bending Capacity

RIVER 2003

- Cross section analysis XTRACT
- Modified material properties
  - Mander confined concrete (strength, crushing strain)
  - Strain hardening steel

Shear Wall Bending Capacity

RIVER 2003



ENGINEERING

Design check

- And…

  "Because we must never use the output of a computer program without using our judgment":

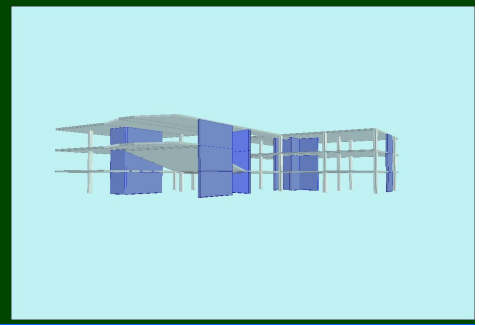
- The bending capacity provided ONLY by the B.Z. steel is:

  $10*60*8*\pi*(7/8)^2/4=3000$ kip-ft

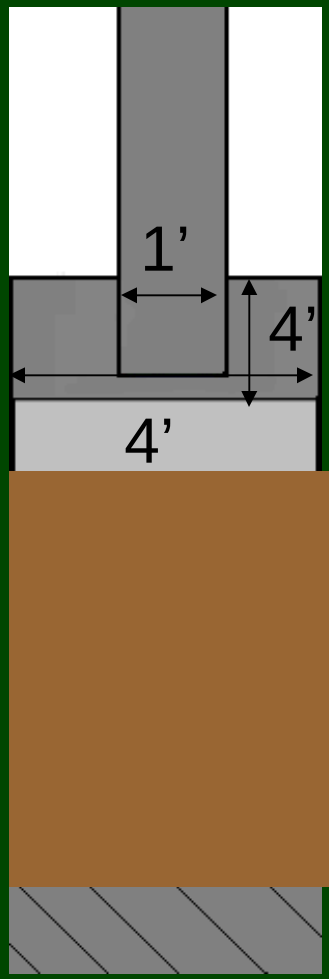
Design:

RIVER 2003

- 8’’ thick walls
- Web:
  - #4@6’’ both directions both sides
- Boundary:
  - 12’’ long boundary zones
  - 8 #7 bars in each
  - Double closed hoops #3@4’’



Foundation



30’ of soft clay - Bedrock

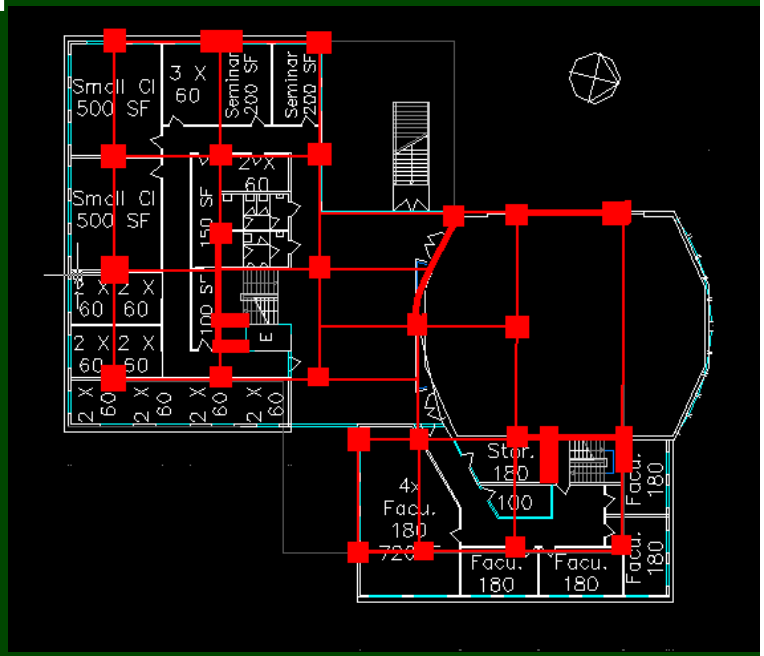
~~φ=0 c=20kPa~~

Capacity Design: 900kips

4 piles 8’’d

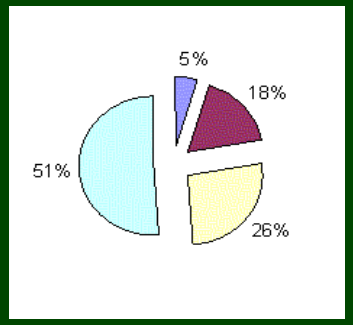
½’’ steel casing

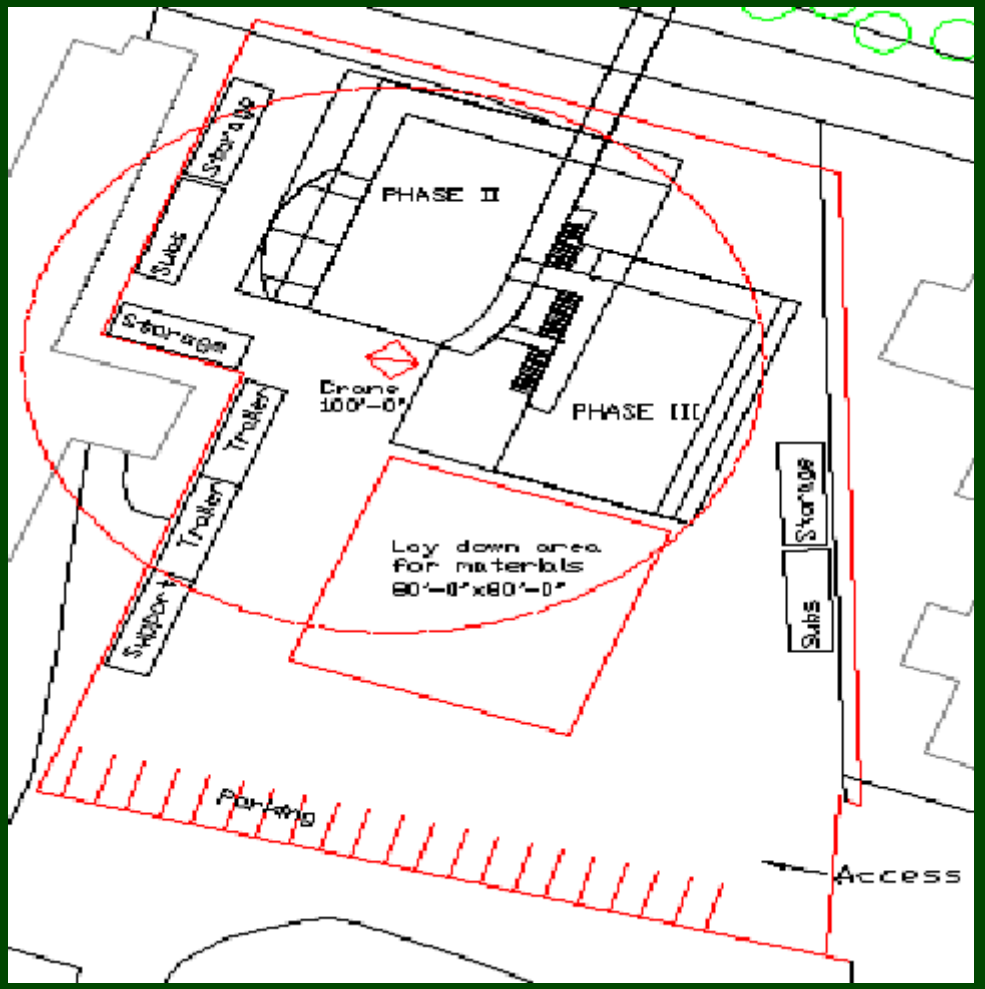
Concrete fill



Construction Management

RIVER 2003





Research: Projects in Sacramento State U.

RIVER 2003

- Regional and Cont. Education building:
  - 33,932 sq/ft
  - Classrooms
  - Office and administrative space
  - Budget: $7.1 million
  - Completed June 2002

- Modoc Hall:
  - 79,440 sq/ft
  - Classrooms
  - Office and administrative space
  - Conference space
  - Laboratories
  - Budget: $15.7 million
  - Occupancy of building: fall 2003

CONSTRUCTION MANAGER

Estimates: **Comparisons**

RIVER 2003

ORDER OF MAGNITUDE:

Mohoc hall

area	79440.00
cost	$15,700,000.00
total cost per sq/ft	$197.63

Regional /Continuing Education building:

area	33932.00
cost	$7,100,000.00
total cost per sq/ft	$209.24

Average costs:

average price per sq/ft	$203.44

Riverbank Project:

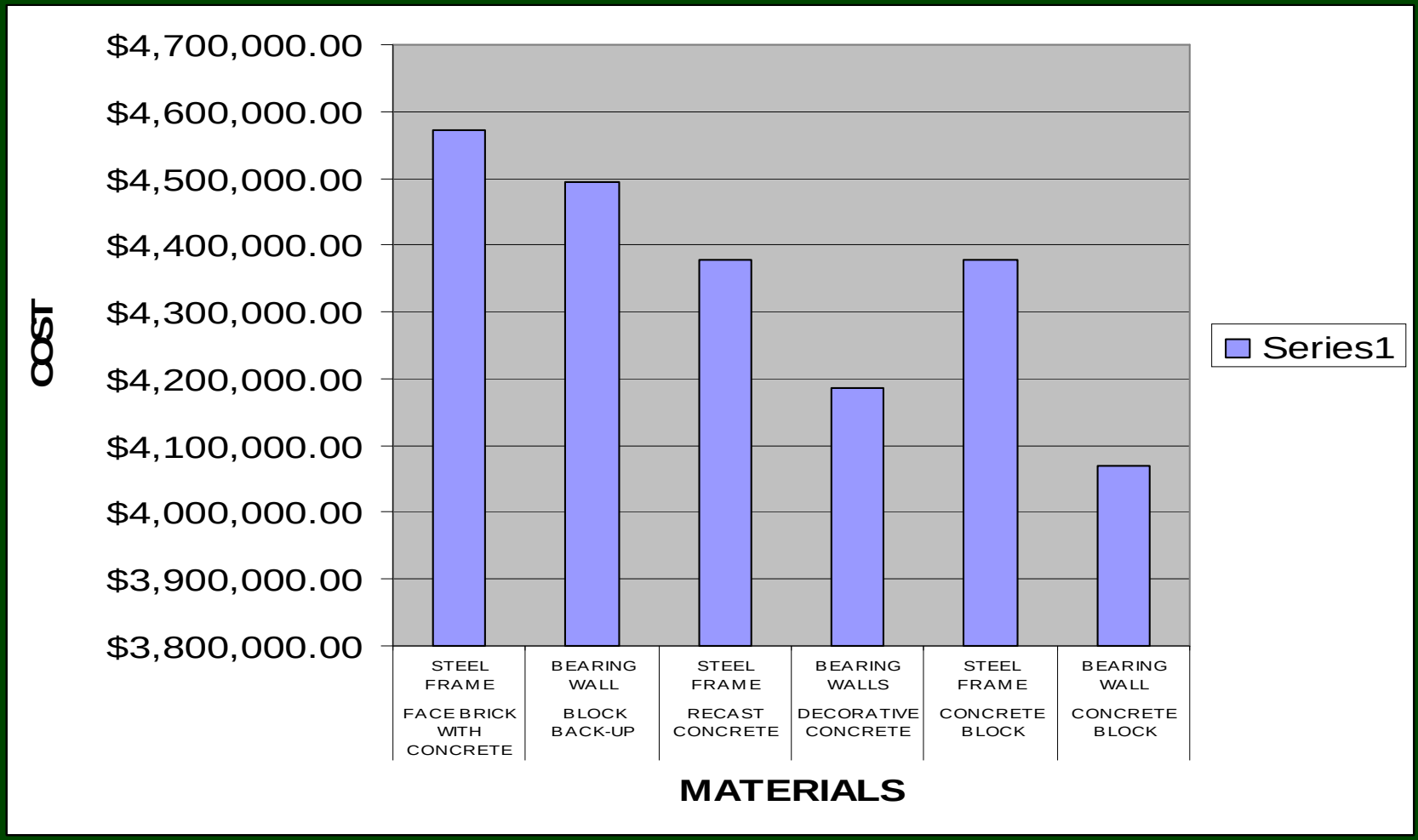
Total gross area	30000.00
Possible estimate	$6,103,131.71
Actual budget	$5,500,000.00

Possible deficit **$603,131.71**

11%

Estimates: **Building Systems comparisons**

RIVER 2003



CONSTRUCTION MANAGER

Estimates: Auditorium per Sq. Ft.

Exterior Wall: precast concrete Structure: steel frame

RIVER 2003

AUDITORIUM

HARD COSTS

		UNIT	UNIT COST	COST PER S/F	AUDITORIUM 4200 SQ/FT % OF SUBTOTAL
A. SUBSTRUCTURE					
	STANDARD FOUNDATIONS		0.99	0.99	
	SLAB ON GRADE		4.27	4.27	
	BASEMENT EXCAVATION		0.12	0.12	
	BASEMENT WALLS		94	2.51	
					9.10%
B. SHELL					
	SUPERSTRUCTURE				
	FLOOR CONSTRUCTION		14.48	1.81	
	ROOF CONSTRUCTION		5.54	5.54	
					8.50%
	EXTERIOR ENCLOSURE				
	EXTERIOR WALLS		16.95	8.68	
	EXTERIOR WINDOWS		30	3.94	
	EXTERIOR DOORS		2605	1.31	
					16.10%
	ROOFING				
	ROOF COVERINGS		3.81	3.81	
	ROOF OPENINGS		0.11	0.11	
					4.50%
C. INTERIORS					
	PARTITIONS		6.3	2.52	
	INTERIOR DOORS		541	1.35	
	FITTINGS				
	STAIR CONSTRUCTION		6300		
	WALL FINISHES		7.85	0.79	
	FLOOR FINISHES		7.24	3.14	
	CEILING FINISHES		2.87	7.24	
				2.87	20.60%
D. SERVICES					
	CONVEYING				
	ELEVATORS AND LIFTS		58800	2.45	
	ESCALATORS				
	BRIDGES				
	RAMPS				
					2.80%
	PLUMBING				
	PLUMBING FIXTURES		2464	3.08	
	DOMESTIC WATER DISTRIBUTION		0.26	0.26	
	RAIN WATER DRAINAGE		0.66	0.66	
	RIVER DRAINAGE				
					4.60%

HVAC				
	ENERGY SUPPLY	-		
	HEAT GENERATING SYSTEMS	-		
	COOLING GENERATING SYSTEMS	14	14	
	TERMINAL % PACKAGE UNITS	-		
	OTHER HVAC SYSTEMS	-		
	PHOTOVOLTAIC SYSTEMS	-		
				16.10%
FIRE PROTECTION				
	SPRINKLERS	1.86	1.86	
	STANDPIPES			
				2.10%
ELECTRICAL				
	ELECTRICAL SERVICE AND DISTRIBUTION	1.52	1.52	
	LIGHTING AND BRANCH WIRING	8.47	8.47	
	COMMUNICATIONS AND SECURITY	2.43	2.43	
	OTHER ELECTRICAL SYSTEMS	1.02	1.02	
				15.50%
SUBTOTAL			86.75	

SOFT COSTS

E. EQUIPMENT AND FURNISHINGS			
	COMMERCIAL EQUIPMENT	-	
	INSTITUTIONAL EQUIPMENT	-	
	VEHICULAR EQUIPMENT	-	
	OTHER EQUIPMENT	-	
			0.00%
F. SPECIAL CONSTRUCTION			
	INTEGRATED CONSTRUCTION	-	
	SPECIAL FACILITIES	-	
			0.00%
F. SPECIAL SITEWORK			
	N/A		
FEES	CONTRACTOR FEES (Gen. Req.: 10%, Overhead:5%, Profit 10%)	21.6875	25.00%
	ARCHITECT FEES	4.3375	5.00%
	CONSULTANTS	3.47	4.00%

TOTAL 160

TOTAL AREA: 4200SQ.FT $672,000.00

SACRAMENTO LOCATION FACTOR 11%

TOTAL ESTIMATE $745,920.00

CONSTRUCTION MANAGER

Estimates: Classrooms and Labs per Sq. Ft

Decorative concrete block – bearing walls

RIVER 2003

CLASSROOM

HARD COSTS

A. SUBSTRUCTURE	UNIT	UNIT COST	COST PER S/F	CLASSROOM 25800 SQ.FT. % OF SUBTOTAL
STANDARD FOUNDATIONS		0.99	0.45	
SLAB ON GRADE		3.57	1.79	
BASEMENT EXCAVATION		0.19	0.10	
BASEMENT WALLS		85	1.75	
				4.70%
B. SHELL				
SUPERSTRUCTURE				
FLOOR CONSTRUCTION		9.98	4.99	
ROOF CONSTRUCTION		5.38	2.69	
				8.80%
EXTERIOR ENCLOSURE				
EXTERIOR WALLS		11.29	2.22	
EXTERIOR WINDOWS		30	3.18	
EXTERIOR DOORS		3450	0.41	
				6.70%
ROOFING				
ROOF COVERINGS		3.78	1.89	
ROOF OPENINGS		-	-	
				2.20%
C. INTERIORS				
PARTITIONS		10.3	5.15	
INTERIOR DOORS		541	2.71	
FITTINGS		3.6	3.60	
STAIR CONSTRUCTION		6300	1.26	
WALL FINISHES		5.72	2.86	
FLOOR FINISHES		3.56	3.56	
CEILING FINISHES		3.74	3.74	
				26.30%
D. SERVICES				
CONVEYING				
ELEVATORS AND LIFTS		52750	2.11	
ESCALATORS				
BRIDGES				
RAMPS				
				2.40%
PLUMBING				
PLUMBING FIXTURES		4459	9.80	
DOMESTIC WATER DISTRIBUTION		0.58	0.58	
RAIN WATER DRAINAGE		1.1	0.55	
RIVER DRAINAGE				
				12.60%

HVAC				
ENERGY SUPPLY	-	-		
HEAT GENERATING SYSTEMS	-	-		
COOLING GENERATING SYSTEMS	14.3	14.30		
TERMINAL % PACKAGE UNITS	-	-		
OTHER HVAC SYSTEMS	-	-		
PHOTOVOLTAIC SYSTEMS	-	-		
				16.40%
FIRE PROTECTION				
SPRINKLERS	1.36	1.36		
STANDPIPES				
				1.60%
ELECTRICAL				
ELECTRICAL SERVICE AND DISTRIBUTION	2.97	2.97		
LIGHTING AND BRANCH WIRING	8.9	8.90		
COMMUNICATIONS AND SECURITY	3.55	3.55		
OTHER ELECTRICAL SYSTEMS	0.54	0.54		
				18.30%
SUBTOTAL			87.01	

SOFT COSTS

E. EQUIPMENT AND FURNISHINGS				
COMMERCIAL EQUIPMENT	-			
INSTITUTIONAL EQUIPMENT	-			
VEHICULAR EQUIPMENT	-			
OTHER EQUIPMENT	-			
				0.00%
F. SPECIAL CONSTRUCTION				
INTEGRATED CONSTRUCTION	-			
SPECIAL FACILITIES	-			
				0.00%
F. SPECIAL SITEWORK				
N/A				
FEES CONTRACTOR FEES (Gen. Req.: 10%, Overhead:5%, Pr			21.75	25.00%
ARCHITECT FEES			4.35	5.00%
CONSULTANTS			3.48	4.00%
TOTAL PER SQ. FT.			**$200.00**	
TOTAL AREA: 25,800.00 SQ.FT			**$5,160,000.00**	
SACRAMENTO LOCATION FACTOR			11%	
TOTAL ESTIMATE:			**$5,727,600.00**	

CONSTRUCTION MANAGER

Estimates: Entire Building

RIVER 2003

HARD COSTS COSTS		3 STORIES - 10' STORY HEIGHT - 25,800 SQ. FT.		1 STORY BUILDING, 20'' STORY HEIGHT, 4200 SQ. FT.	
A. SUBSTRUCTURE		4.70%	$242,520.00	9%	$61,152.00
B. SHELL		17.70%	$913,320.26	29%	$194,880.00
SUPERSTRUCTURE	8.80%	$454,080.00		8.5%	
EXTERIOR ENCLOSURE	6.70%	$345,720.00		16.0%	
ROOFING	2.20%	$113,520.00		4.5%	
C. INTERIORS		26.30%	$1,357,080.00	20.6%	$138,432.00
D. SERVICES		51.30%	$2,647,080.00	41.1%	$276,192.00
ELEVATORS / LIFTS	2.40%	$123,840.00		2.8%	
PLUMBING & HVAC	12.60%	$650,160.00		4.6%	
HVAC	16.40%	$846,240.00		16.1%	
FIRE PROTECTION	1.60%	$82,560.00		2.1%	
ELECTRICAL	18.30%	$944,280.00		15.5%	

SOFT COSTS

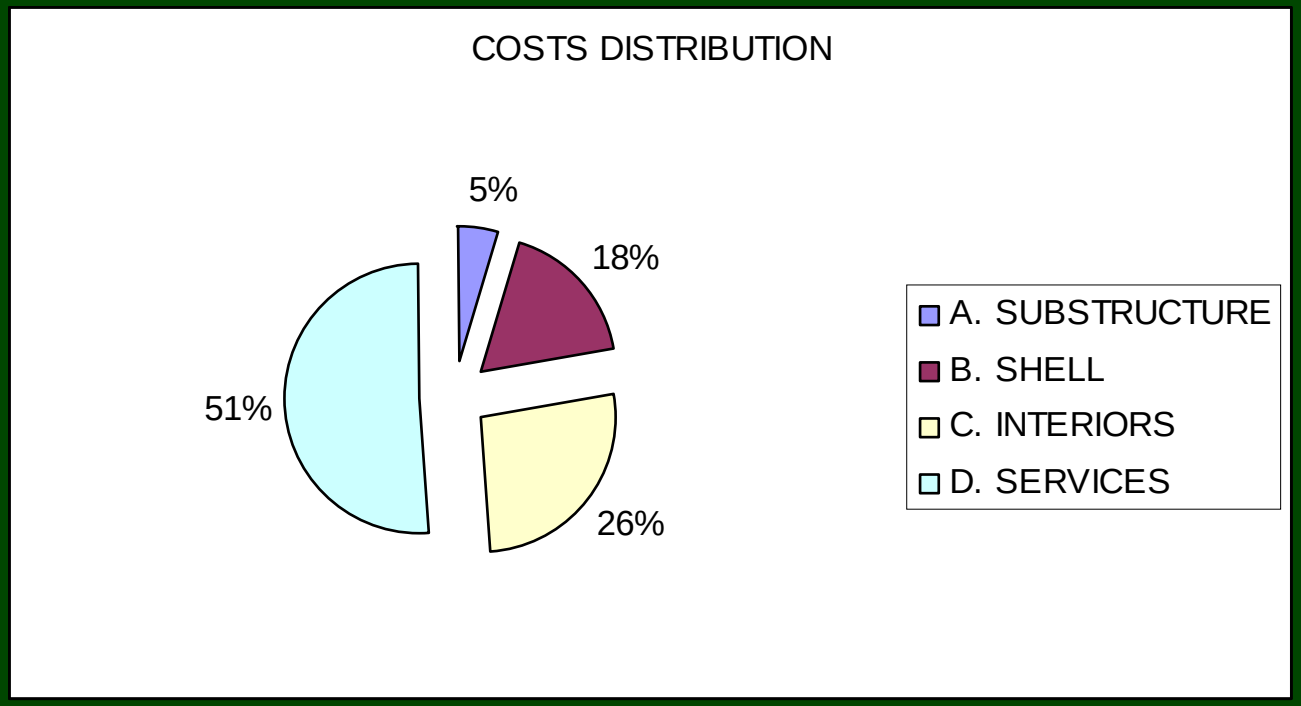
E. EQUIPMENT AND FURNISHI	0.00%			0.00%	
F. SPECIAL CONSTRUCTION	0.00%			0.00%	
G. SPECIAL SITEWORK					
FEES	25.00%			25.00%	
	5.00%			5.00%	
	4.00%			4.00%	
TOTAL AREA: 25,800.00 SQ.FT		**$5,160,000.00**			**$670,656.00**
TOTAL PER SQ. FT.		**$200.00**			**$160.00**
SACRAMENTO LOCATION FACTOR		**11%**			**11%**
TOTAL ESTIMATES:		**$5,727,600.00**			**$744,428.16**

TOTAL ESTIMATE : $6,472,028.16

CONSTRUCTION MANAGER

Estimates: Costs Distribution

RIVER 2003



A. SUBSTRUCTURE	$304,184.00	4.70%
B. SHELL	$1,145,544.00	17.70%
C. INTERIORS	$1,702,136.00	26.30%
D. SERVICES	$3,320,136.00	51.30%
TOTAL ESTIMATE	$6,472,000.00	100.00%

Estimates:
Costs Distribution by unit price

RIVER 2003

RULES OF THUMB:

TOTAL COST	$100/SF
HVAC	$8/SF
FIRE PROTECTION	$2.5/SF
PLUMBING	3$/SF
ELECTRICAL	$7/SF
5-10% OF SUBTOTAL	3.00%
BUILDING PERMIT ALLOWANCE	2.50%
FEE	5.00%
CONTINGENCY	10.00%

Estimates:
Costs Distribution by unit price

RIVER 2003

ACTIVITY	AMOUNT	PERCENTAGE
SITE DEVELOPMENT AND PREPARATION	$86,796.25	1.27%
LANDSCAPING	$51,941.06	0.76%
FOUNDATIONS	$166,758.14	2.44%
SUBSTRUCTURE	$299,344.53	4.38%
SUPERSTRUCTURE	$2,148,719.64	31.44%
EXTERIOR SKIN	$625,343.03	9.15%
MOISTURE PROTECTION	$258,338.43	3.78%
DOORS, FRAMES, HDWE	$90,896.86	1.33%
INTERIOR FINISHES	$569,984.79	8.34%
SPECIALTIES	$128,485.78	1.88%
ELEVATORS	$111,399.91	1.63%
PLUMBING	$325,998.50	4.77%
FIRE PROTECTION	$159,923.79	2.34%
H.V.A.C.	$327,365.37	4.79%
ELECTRICAL	$623,292.72	9.12%
MISCELLANEOUS EXPENSE	$34,855.19	0.51%
JOB EQUIPMENT	$48,523.89	0.71%
SUBTOTAL DIRECT COSTS	**$6,057,967.84**	**88.64%**

Estimates:
Costs Distribution by unit price

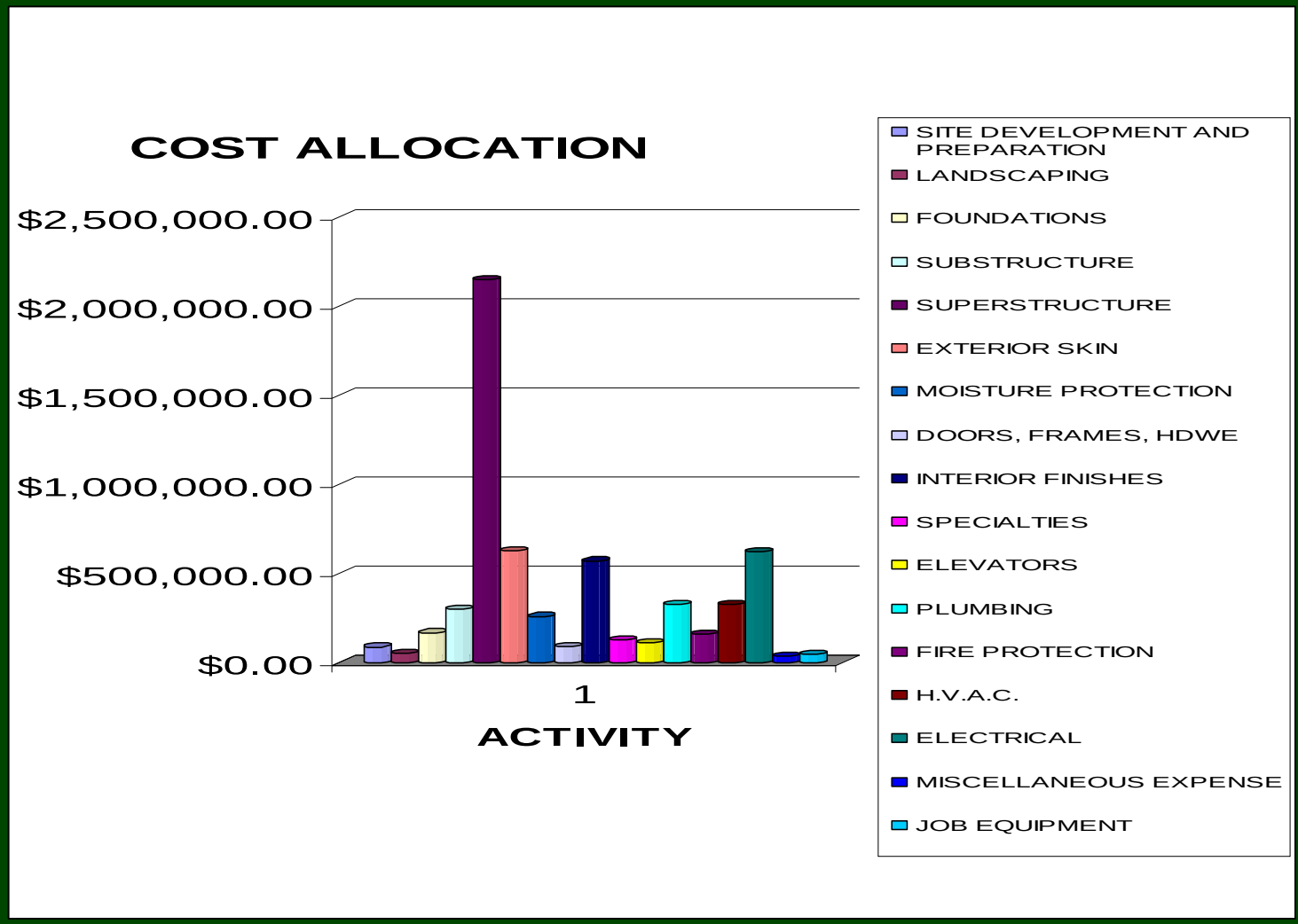
RIVER 2003

SUBGUARD	$12,301.83	0.18%
GENERAL CONDITIONS	$299,344.53	4.38%
PRECONSTRUCTION SERVICES	$7,517.79	0.11%
GENERAL CONTRACTOR'S CONTINGENCY	$191,361.80	2.80%
NET SUBTOTAL	$510,525.95	7.47%
SUBTOTAL	**$6,568,493.79**	**96.11%**
BUILDER'S RISK INSURANCE - BY OWNER	$0.00	0.00%
PL/PD INSURANCE	$64,926.33	0.95%
DATA PROCESSING	$8,884.66	0.13%
SUBTOTAL	**$6,642,304.77**	**97.19%**
CONTRACTOR OVERHEAD	$95,680.90	1.40%
CONTRACTOR FEE	**$96,364.34**	**1.41%**
TOTAL	**$6,834,350.00**	**100.00%**

CONSTRUCTION MANAGER

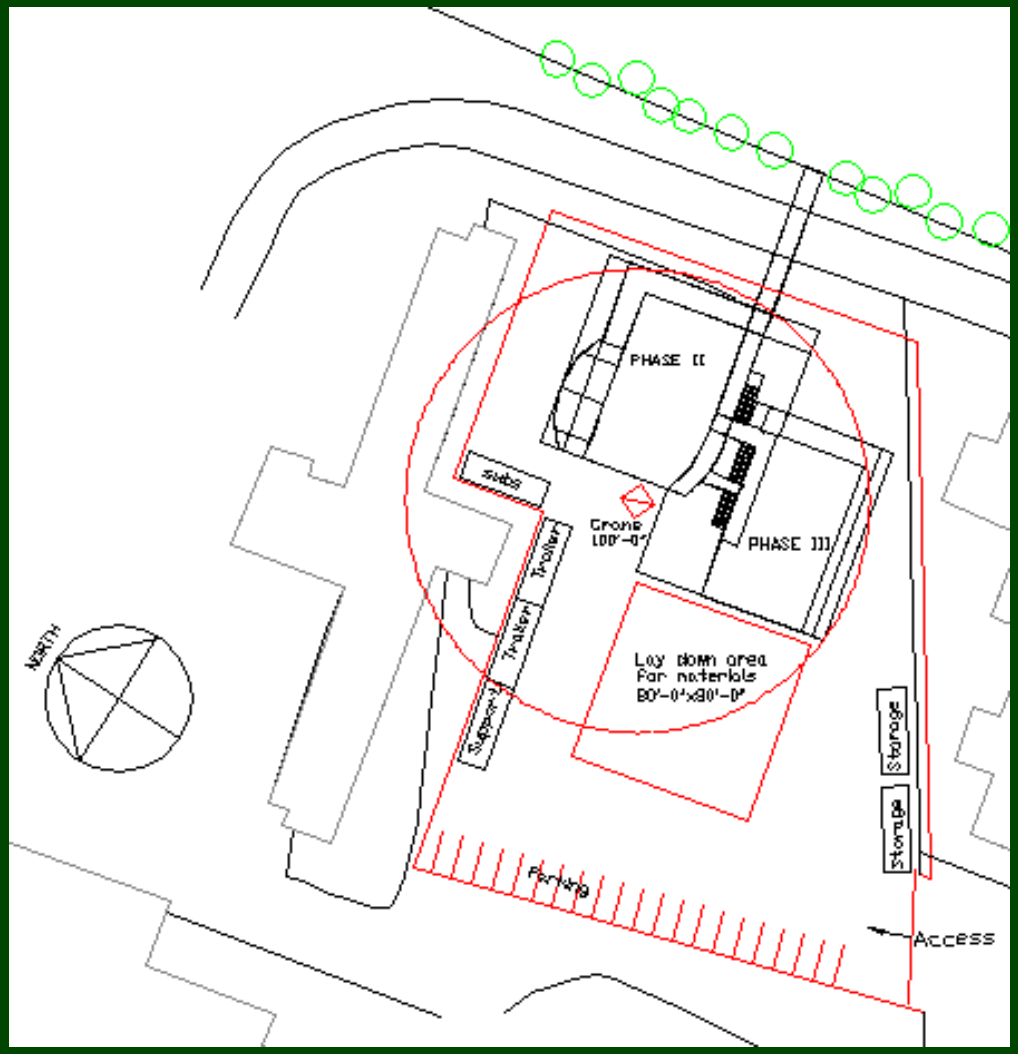
Estimates:
Costs Distribution by unit price

RIVER 2003



Site layout: **Design option 1**

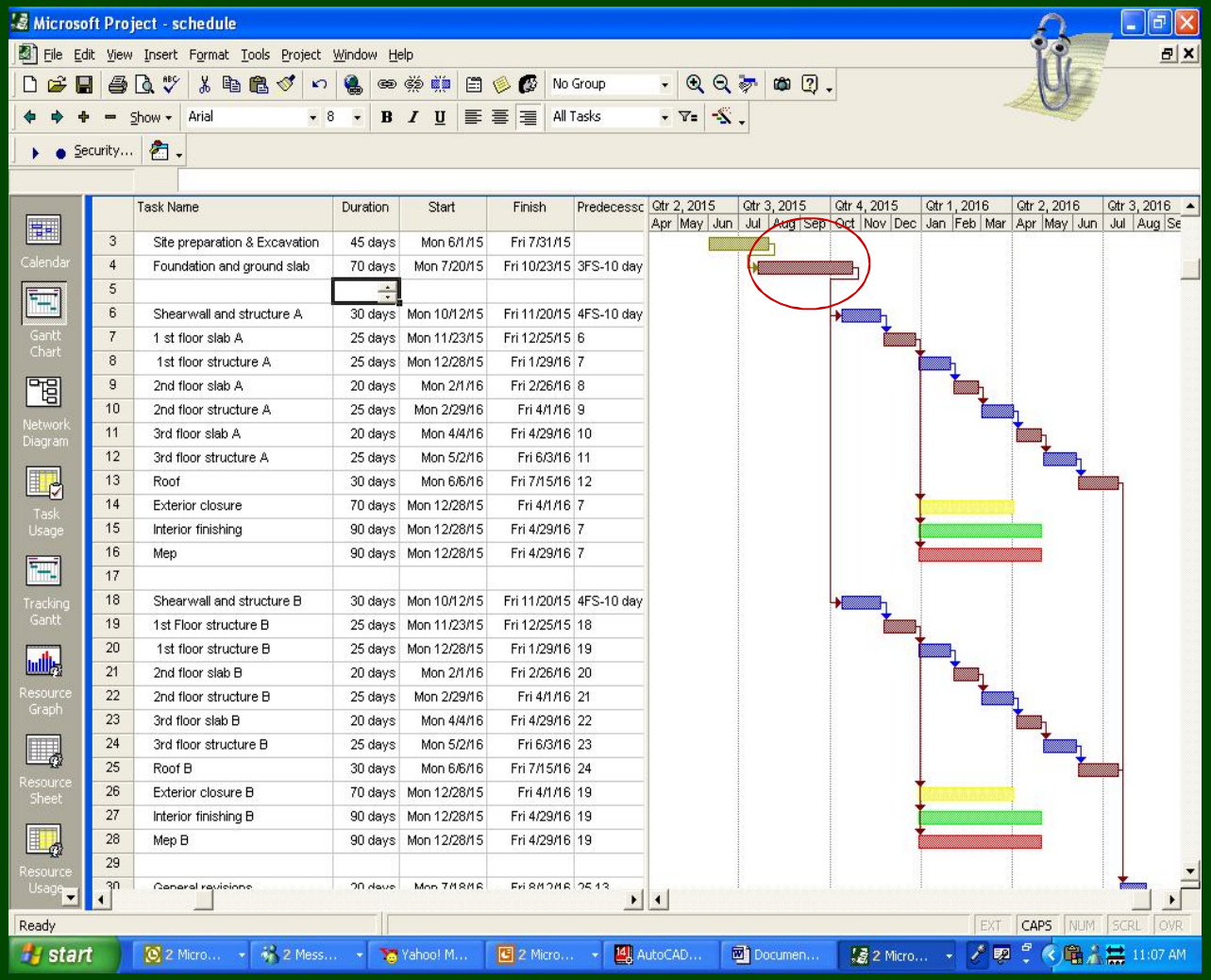
RIVER 2003



- Maximize:
  - Operations efficiency
  - Productivity
  - Schedule performance
  - Safety
- Reduce:
  - Travel distances
  - Interference
  - Disruptions

Schedule and sequences

RIVER 2003



- Previous one:
- Start: 6/1/2015
- Finish: 6/17/2016
- Milestone:

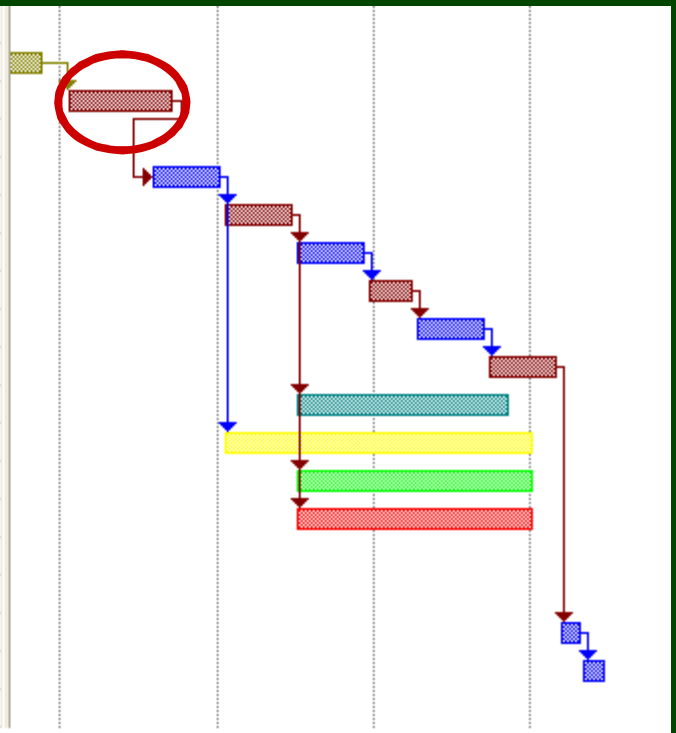
  Foundation: 9/11/15
- Parallel sequences
  - Two buildings
  - Efficiency
- Maximize:
  - Prefabricators
  - Subcontractors
  - Logic of activities
  - Safety

CONSTRUCTION MANAGER

Schedule and sequences

RIVER 2003

Site preparation & Excavation	15 days	Mon 6/1/15	Fri 6/19/15	
Foundation and ground slab	45 days	Mon 7/6/15	Fri 9/4/15	3FS-10 day
	1 day?	Fri 2/28/03	Fri 2/28/03	
Shearwall and structure A	30 days	Mon 8/24/15	Fri 10/2/15	4FS-10 day
1 st floor slab A	30 days	Mon 10/5/15	Fri 11/13/15	6
1st floor structure A	30 days	Mon 11/16/15	Fri 12/25/15	7
2nd floor slab A	20 days	Mon 12/28/15	Fri 1/22/16	8
2nd floor structure A	30 days	Mon 1/25/16	Fri 3/4/16	9
Roof	30 days	Mon 3/7/16	Fri 4/15/16	10
Non-bearing walls	90 days	Mon 11/16/15	Fri 3/18/16	7
Exterior closure	130 days	Mon 10/5/15	Fri 4/1/16	6
Interior finishing	100 days	Mon 11/16/15	Fri 4/1/16	7
Mep	100 days	Mon 11/16/15	Fri 4/1/16	7
General revisions	10 days	Mon 4/18/16	Fri 4/29/16	11
Cleanup	10 days	Mon 5/2/16	Fri 5/13/16	18



New schedule:

Start: 6/1/2015
Finish: 6/5/2016

Foundation:
9/11/15
One building
Milestone: river flooding

CONSTRUCTION MANAGER

Concept 2 - Equipment

RIVER 2003

VS.

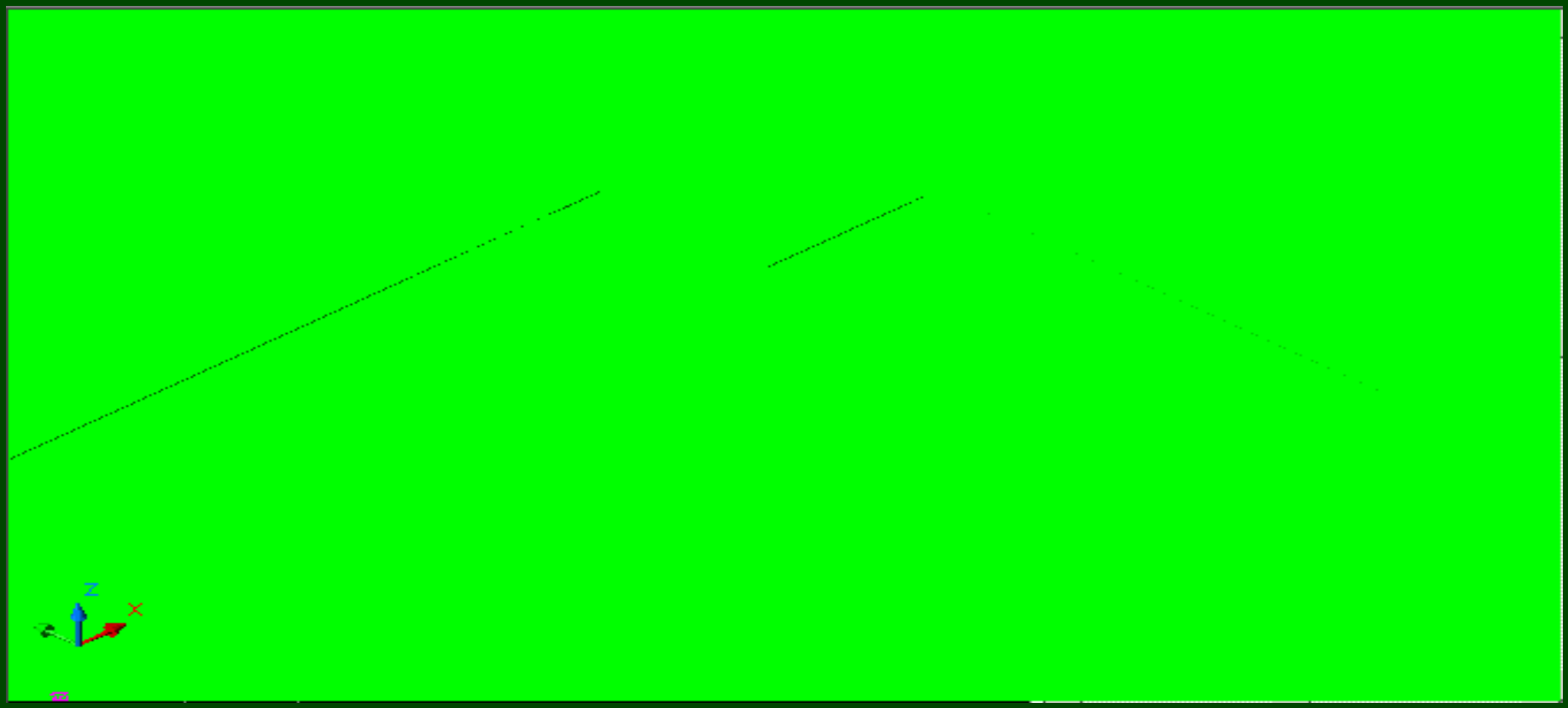
CONSTRUCTION MANAGER

Concept 2 - Equipment

RIVER 2003

Construction Sequence

RIVER 2003

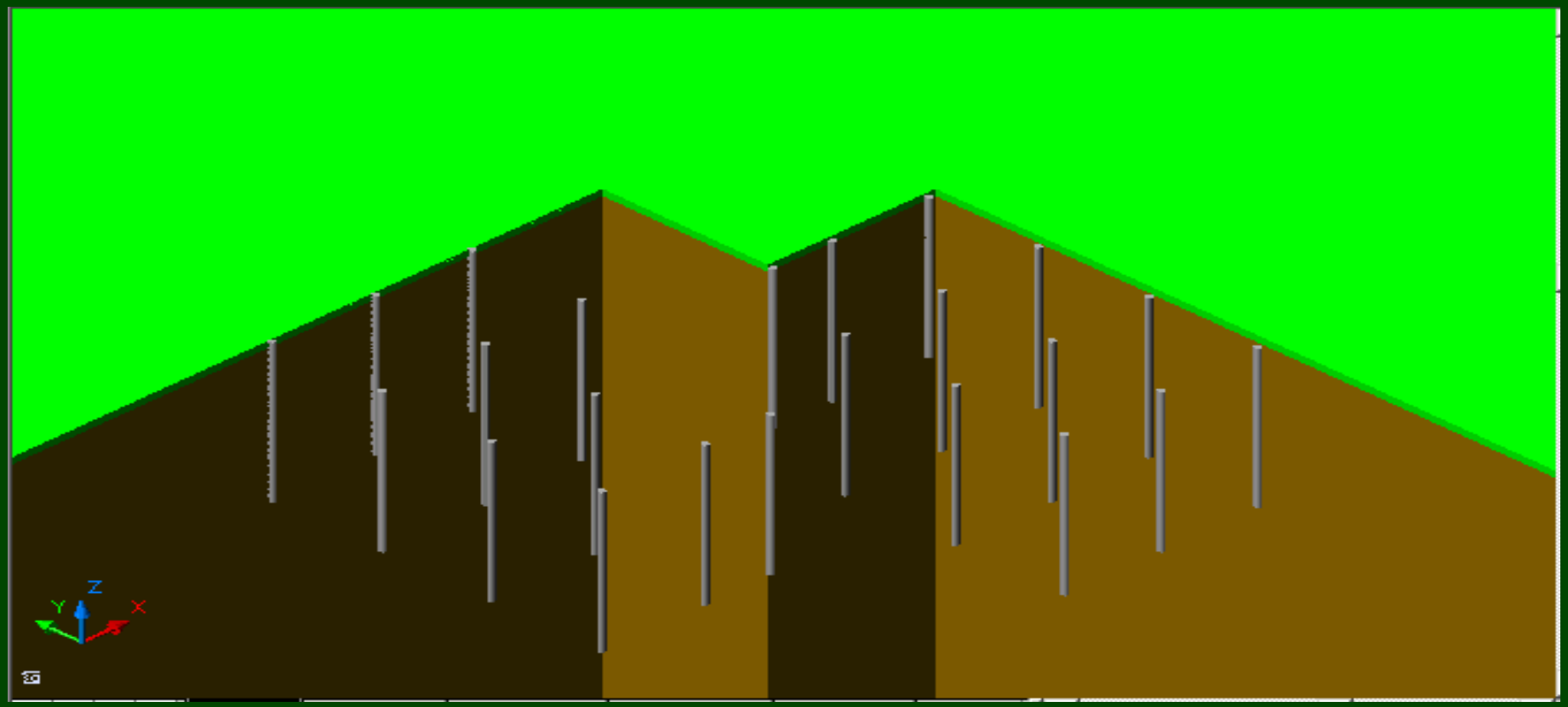


6/1/2015

$0

Construction Sequence

RIVER 2003

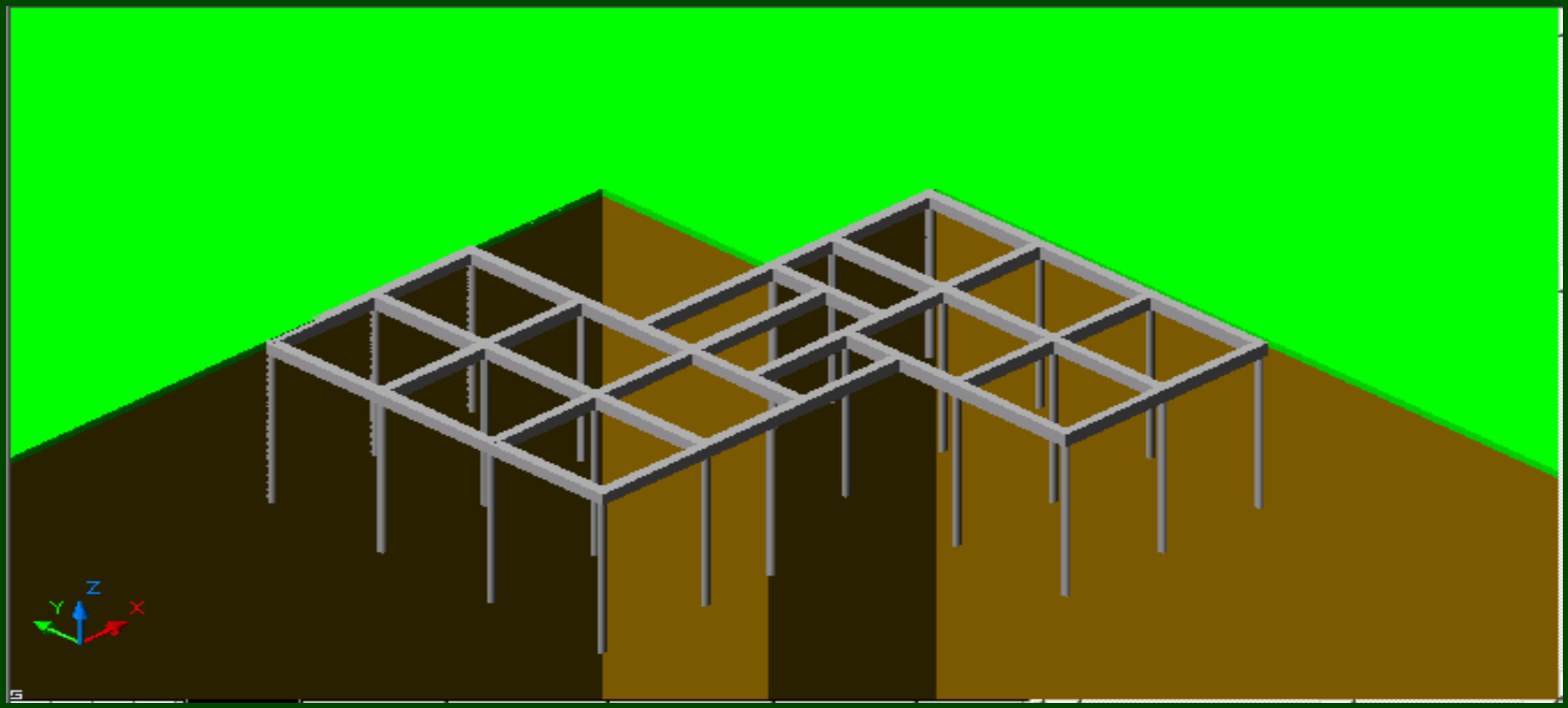


6/22/2015

$171,000

Construction Sequence

RIVER 2003

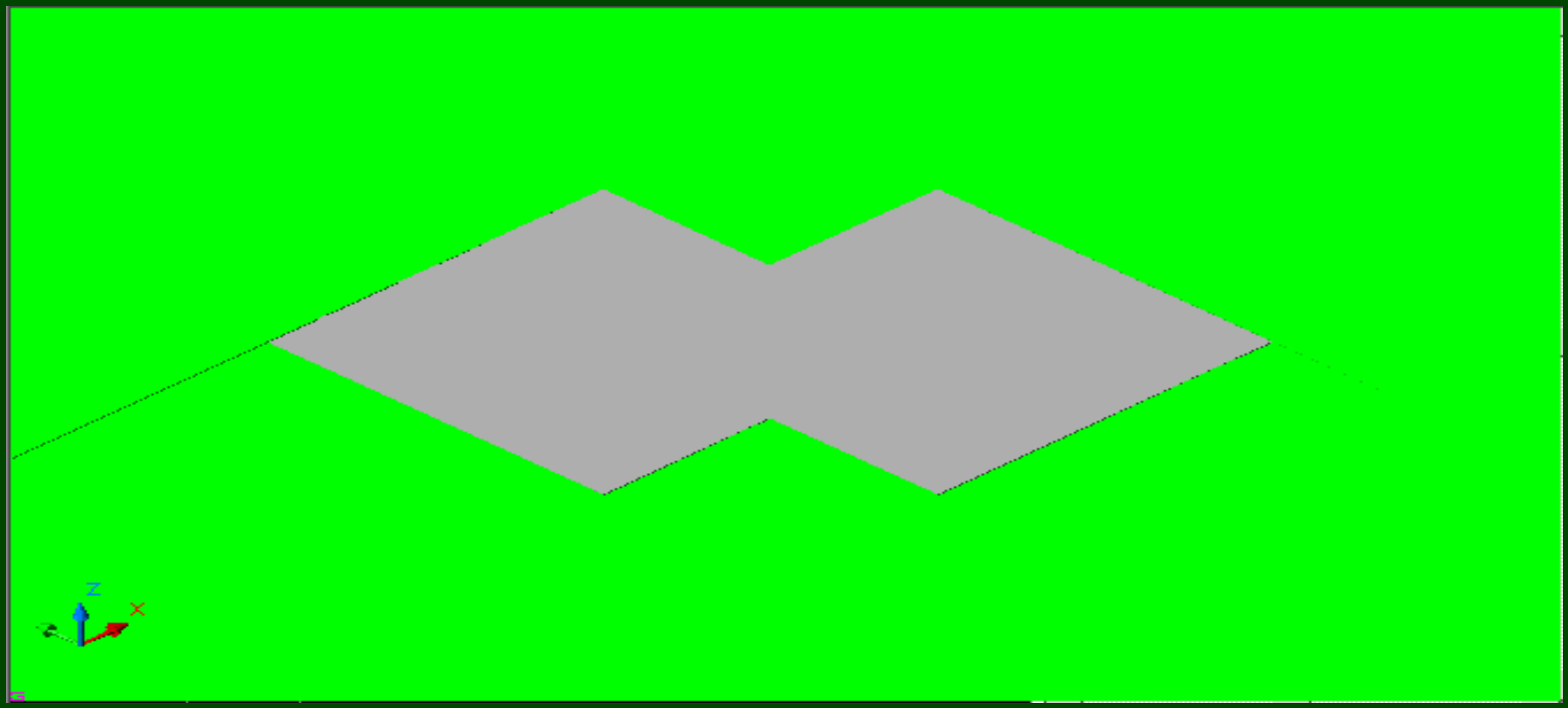


7/8/2015

$253,553

Construction Sequence

RIVER 2003

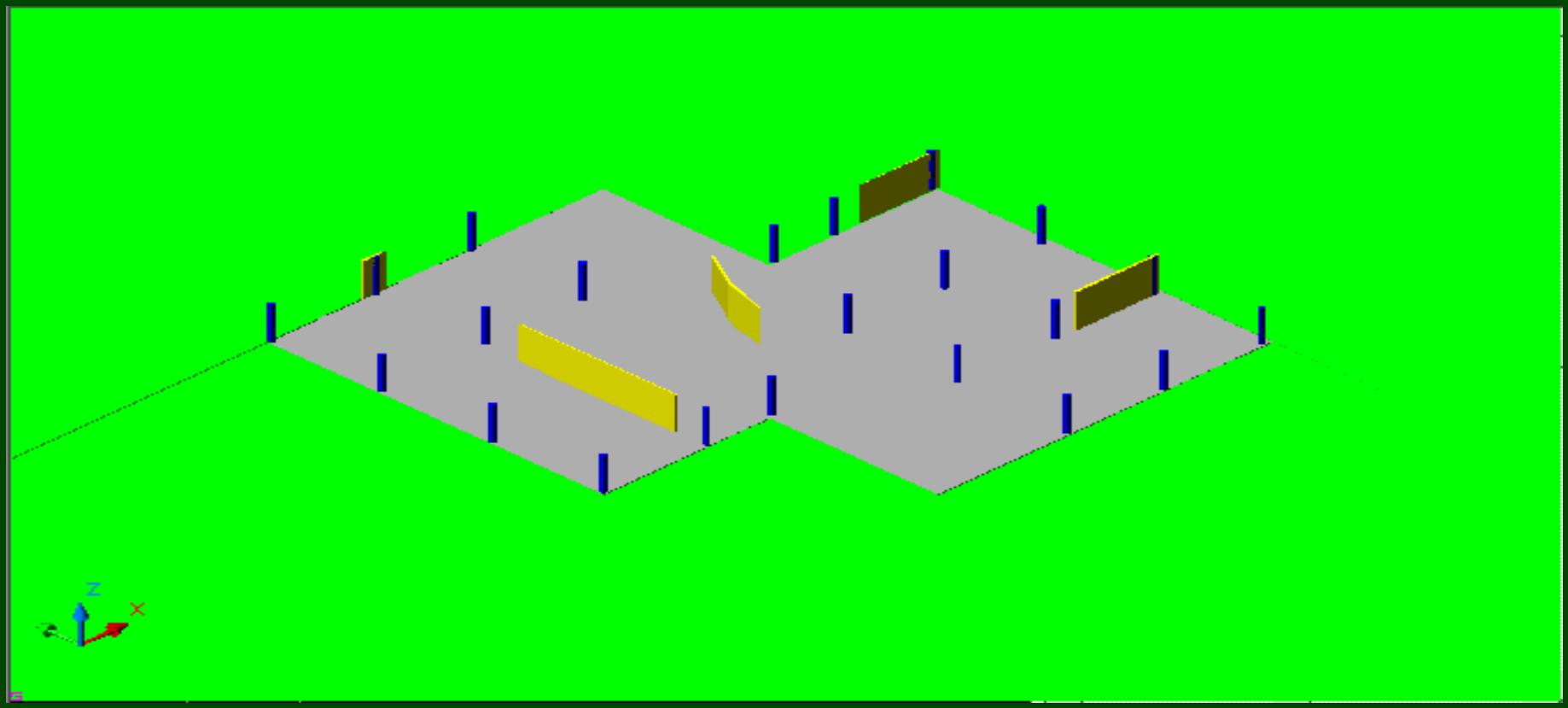


9/14/2015

$552,879

Construction Sequence

RIVER 2003

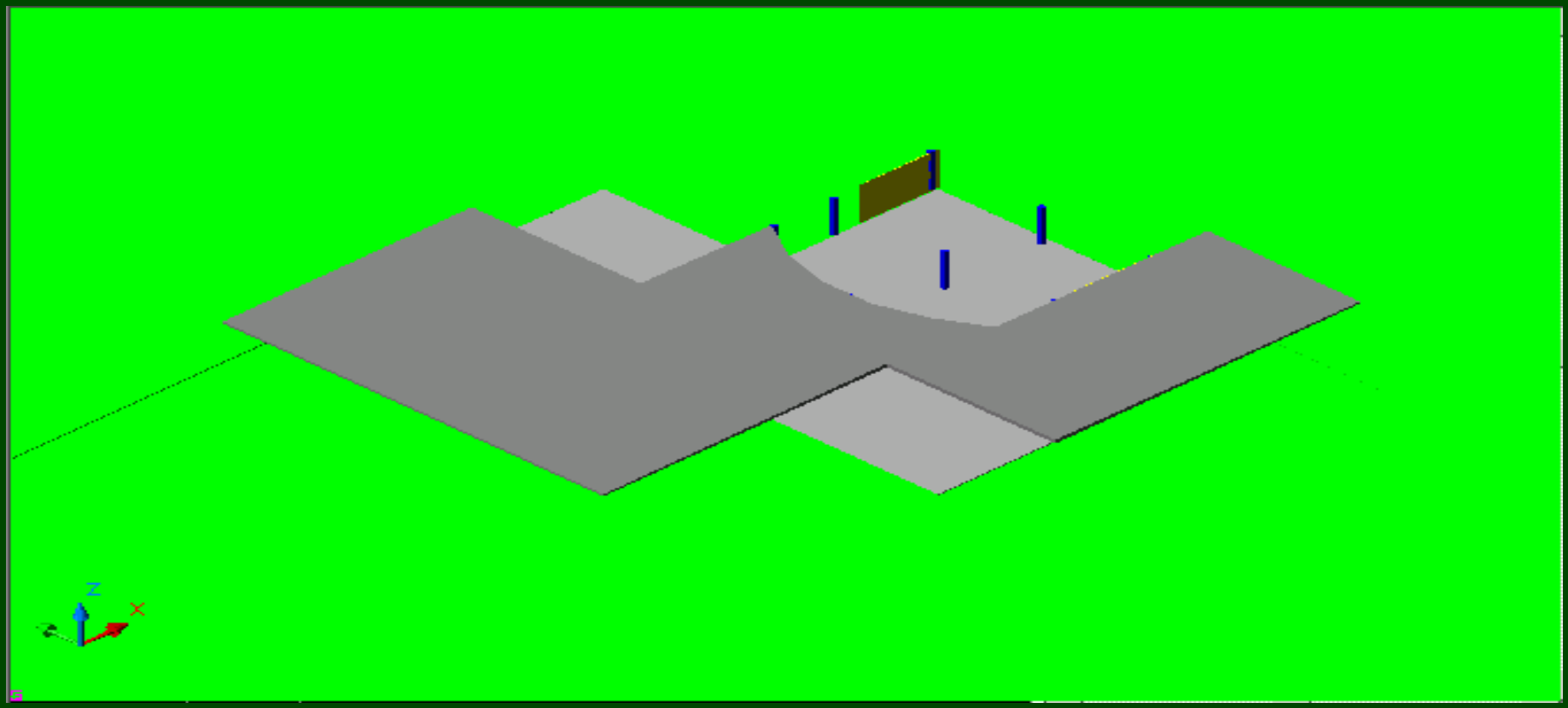


10/2/2015

$ 910,998

Construction Sequence

RIVER 2003

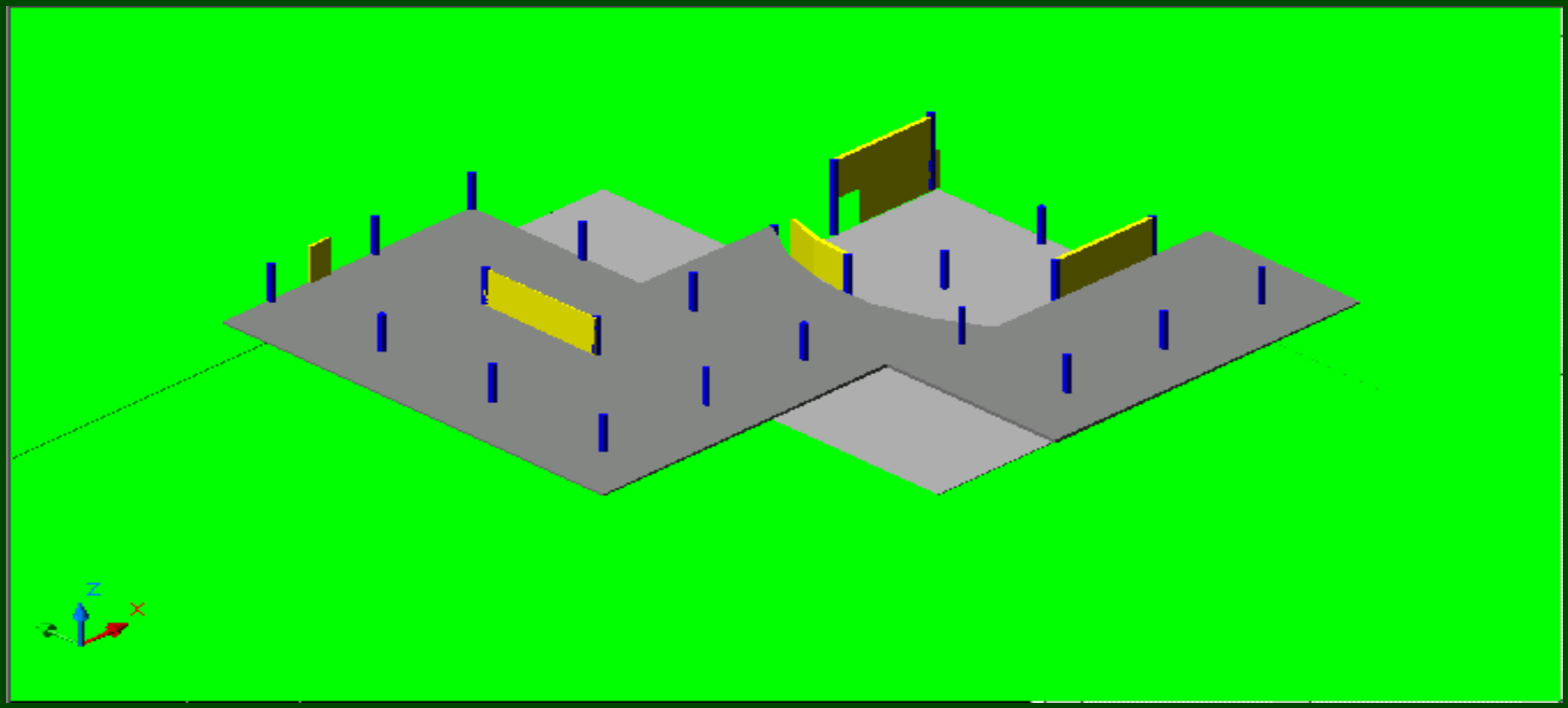


10/28/2015

$1’269,117

Construction Sequence

RIVER 2003

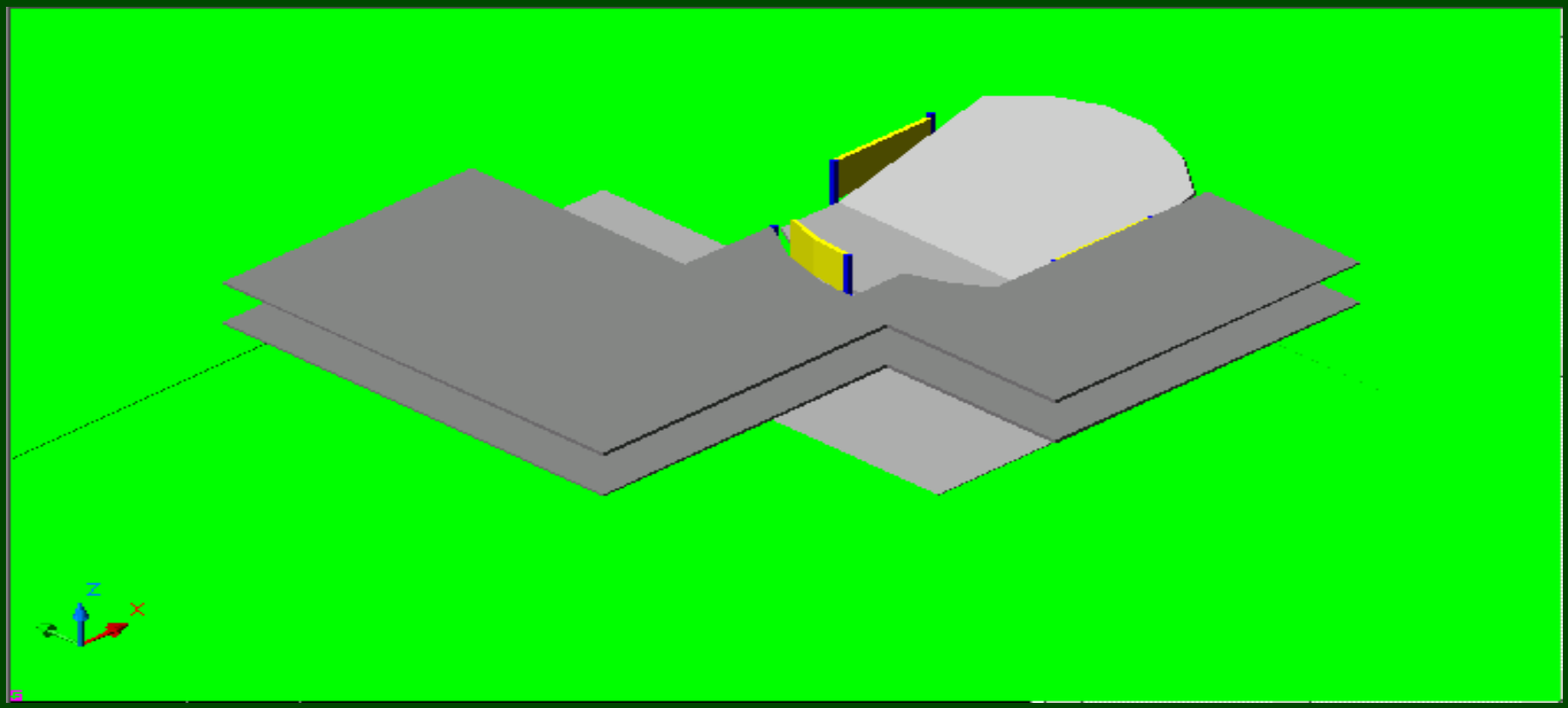


11/25/2015

$1’627,236

Construction Sequence

RIVER 2003

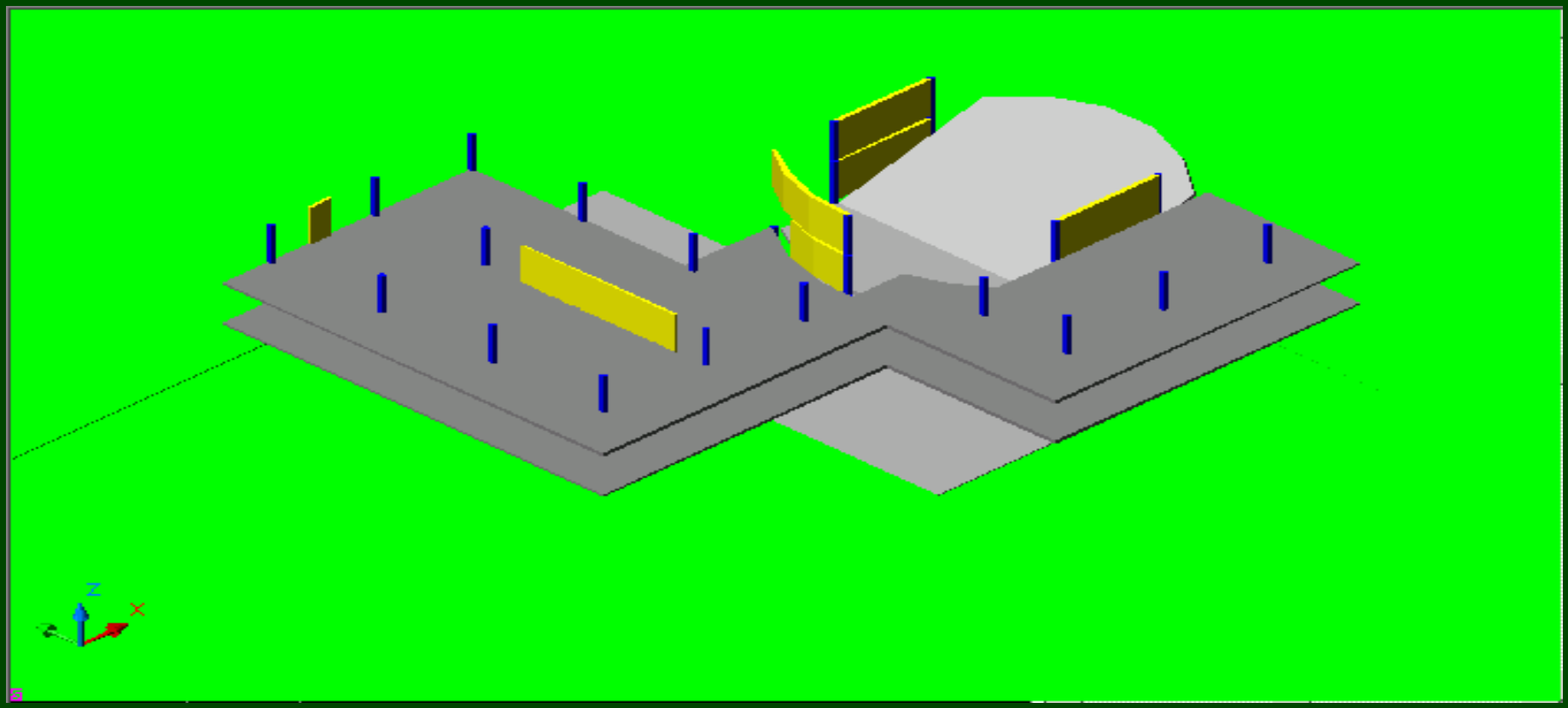


12/18/2015

$2’181,077

Construction Sequence

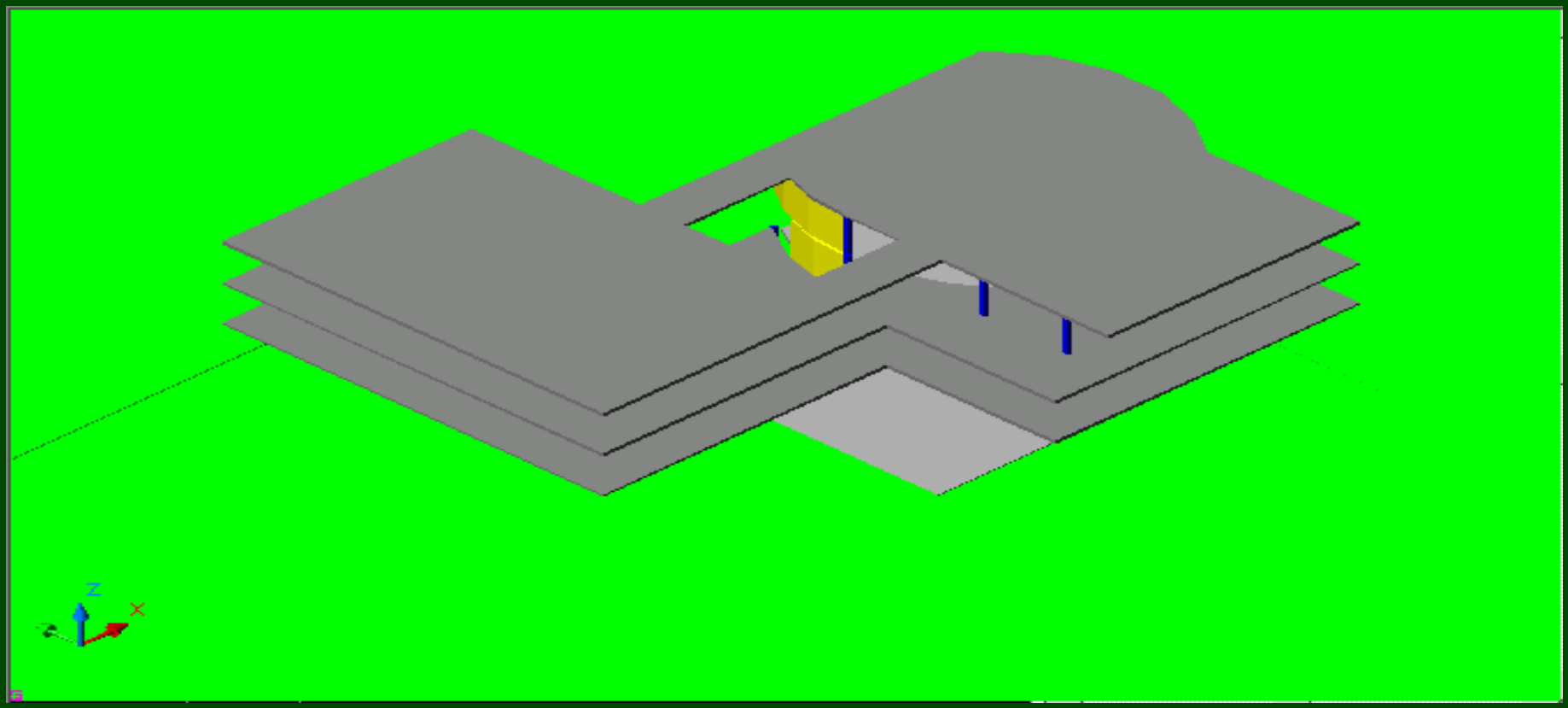
RIVER 2003



1/08/2016

$2’734,918

Construction Sequence

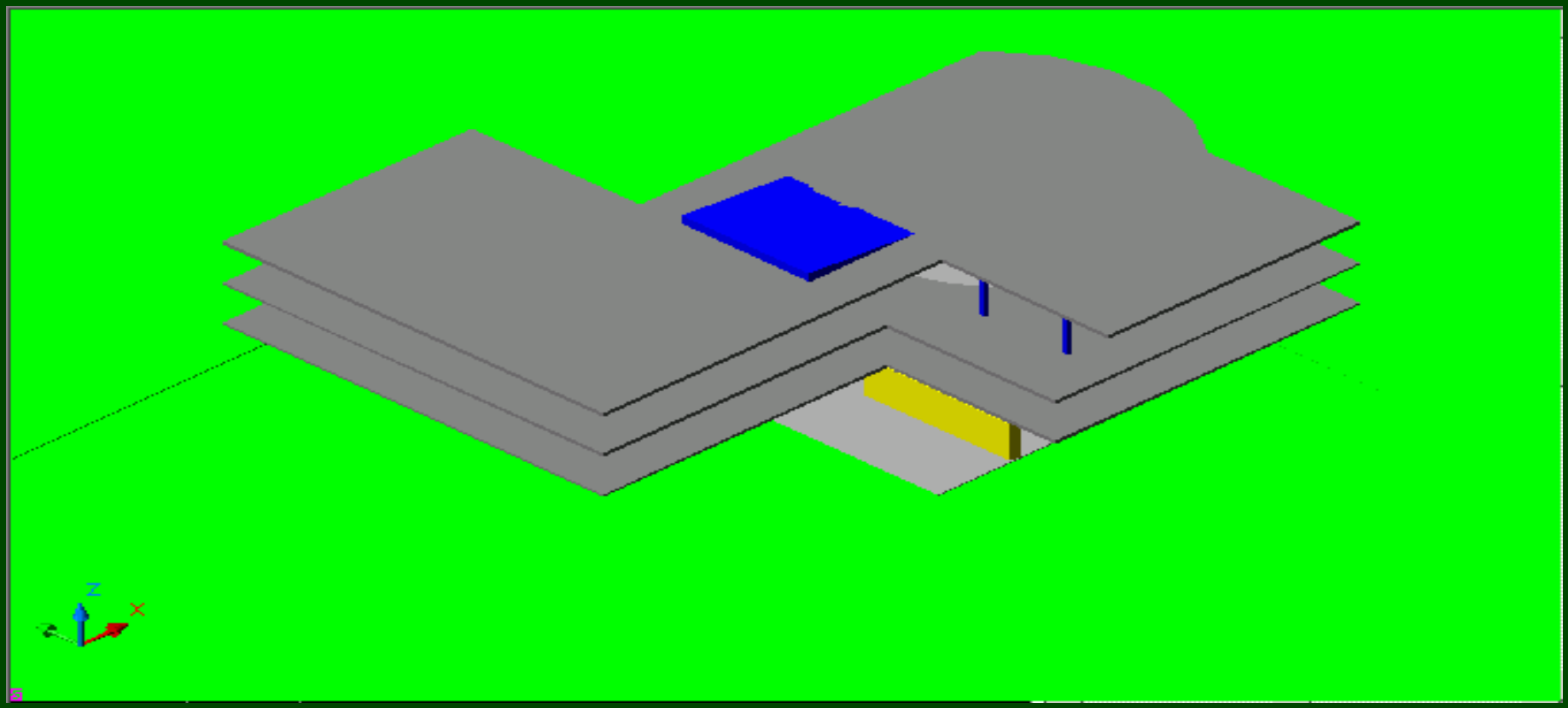


2/03/2016

$3’288,759

Construction Sequence

RIVER 2003

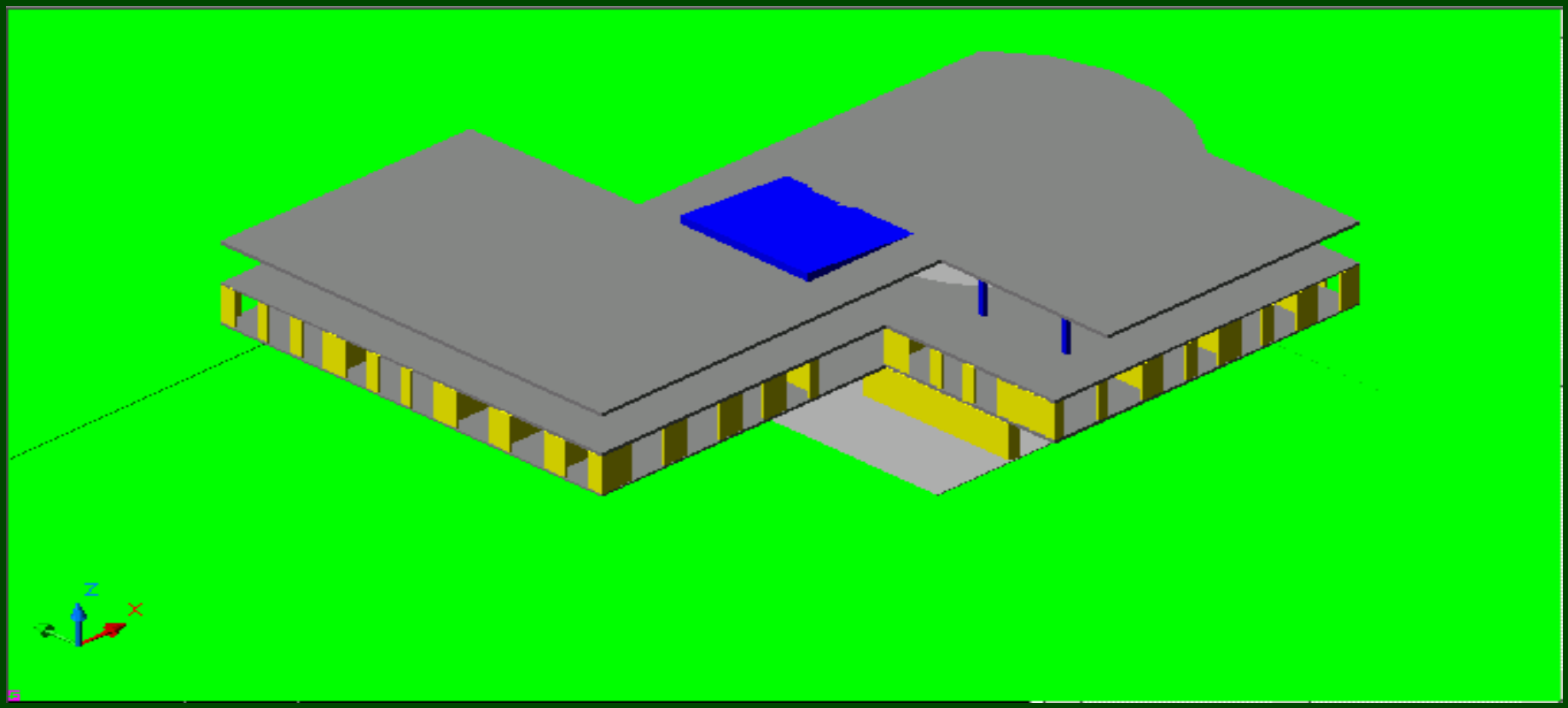


2/26/2016

$3’842,600

Construction Sequence

RIVER 2003

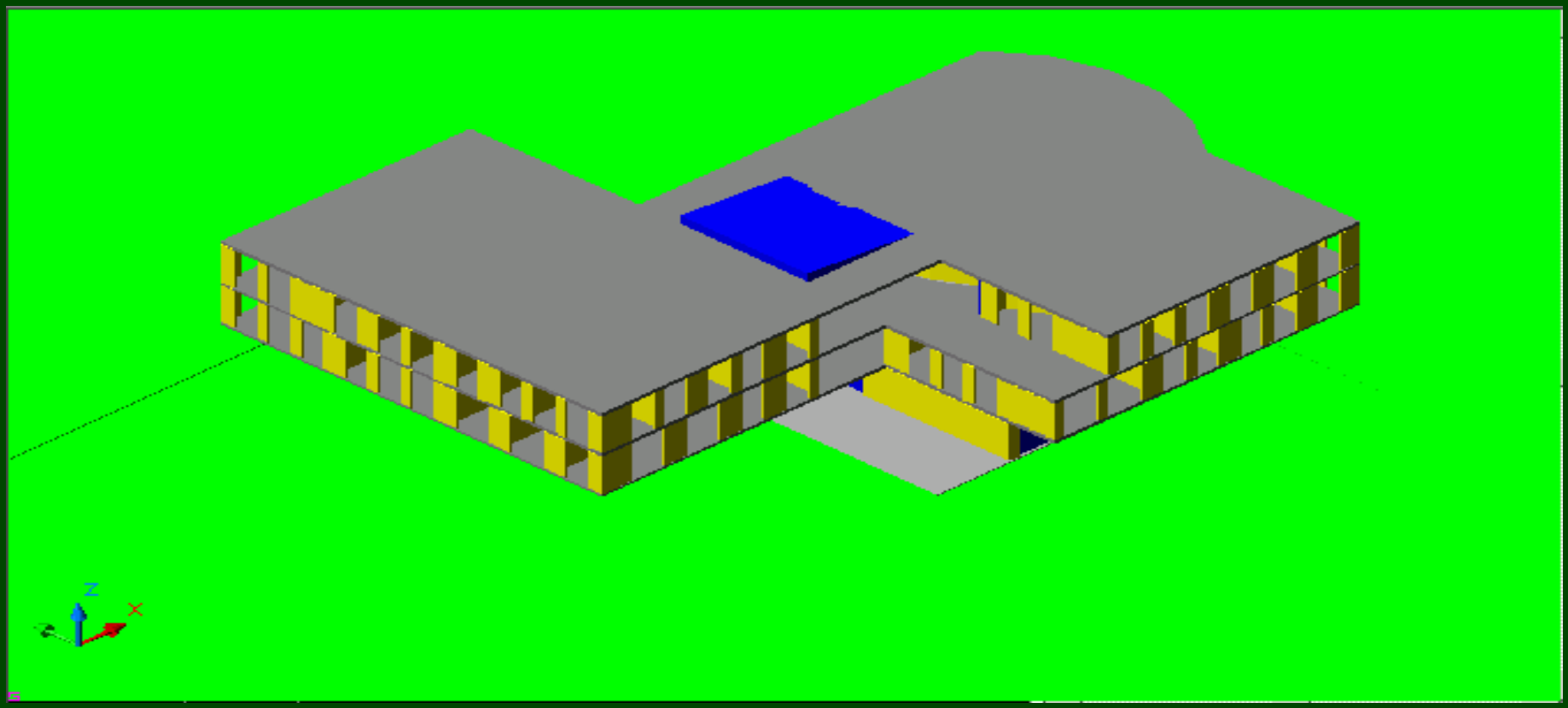


3/19/2016

$4’396,441

Construction Sequence

RIVER 2003

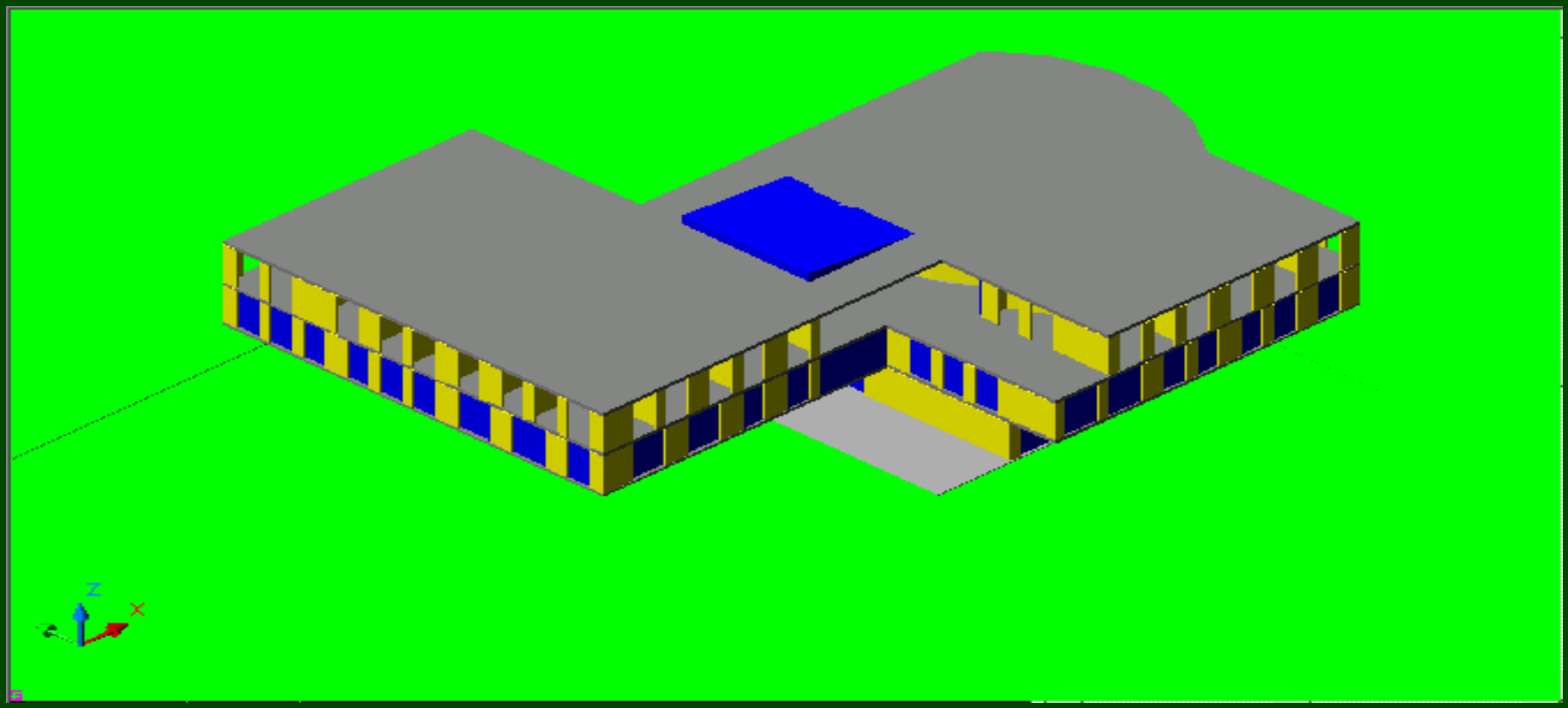


3/28/2016

$4’950,282

Construction Sequence

RIVER 2003

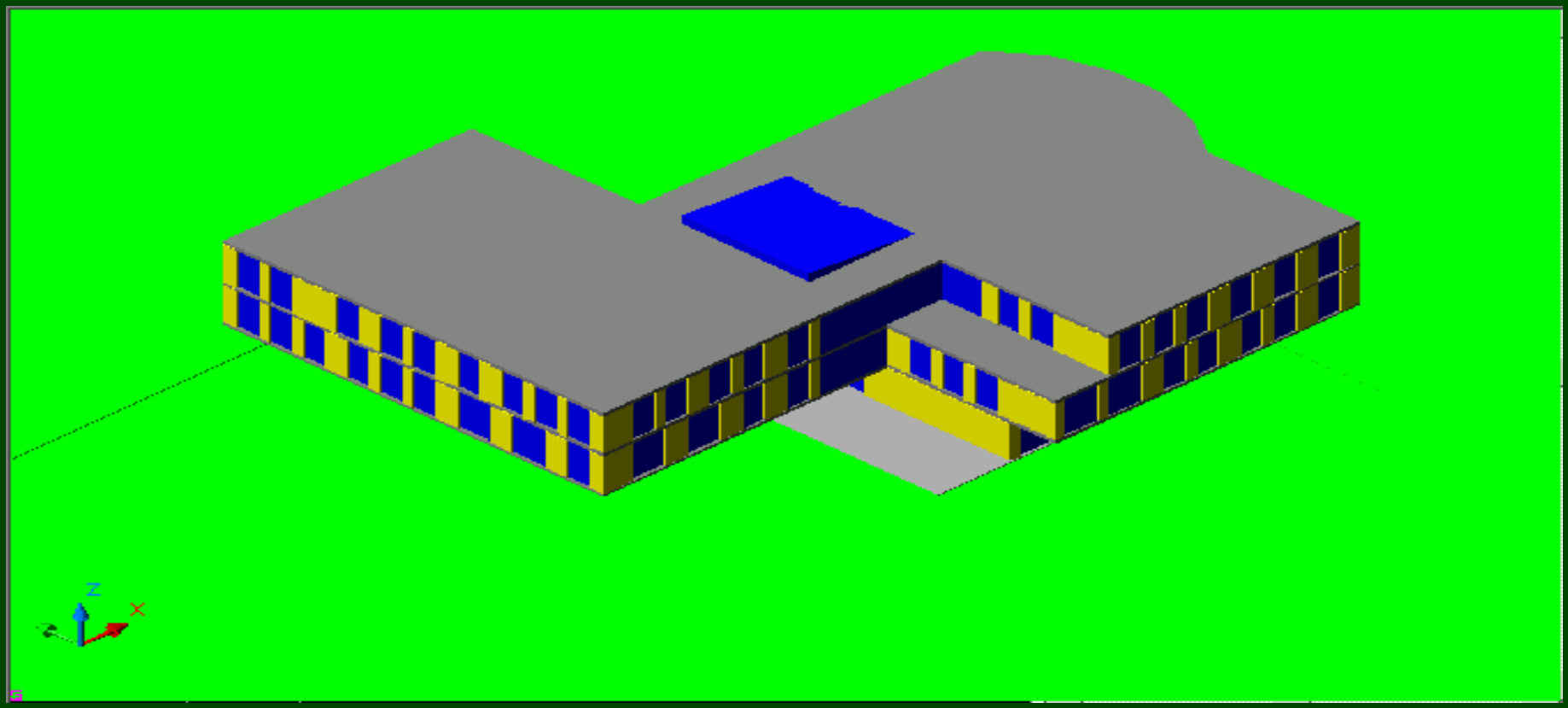


4/14/2016

$5’504,123

Construction Sequence

RIVER 2003

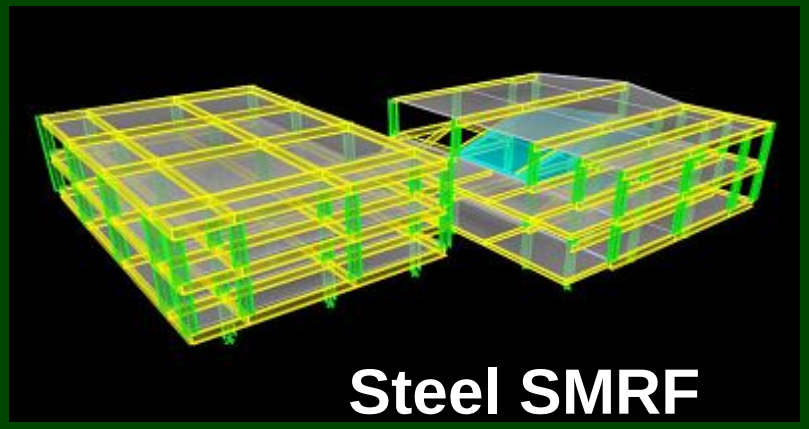


5/2/16

$6’057,964

Team Dynamics

RIVER 2003



Steel SMRF

Problems:

Building is too tall. 30’ max.

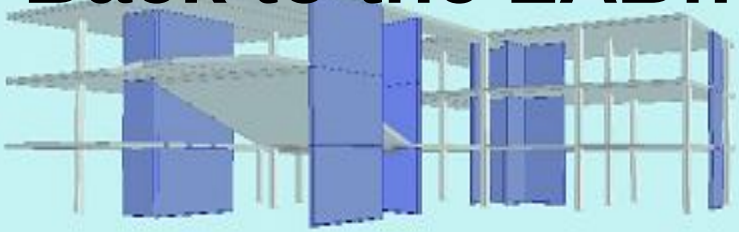
Need to reduce interstory height

Need more room for MEP

Solution:

Convert from Steel SMRF to Concrete Flat Slab with Shear Walls

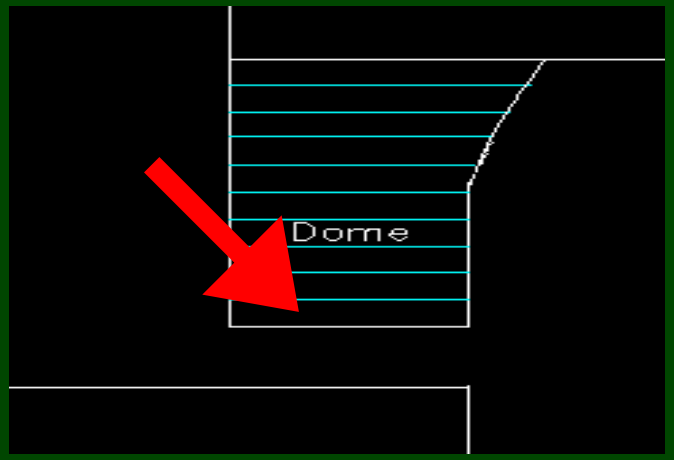
Back to the LAB!!!



Conc. w/ Shear Walls

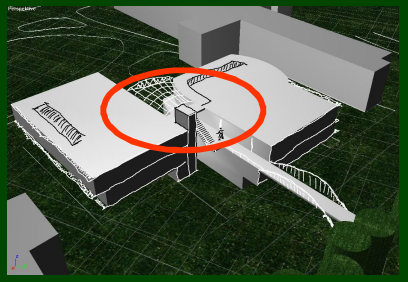
Team Dynamics

RIVER 2003

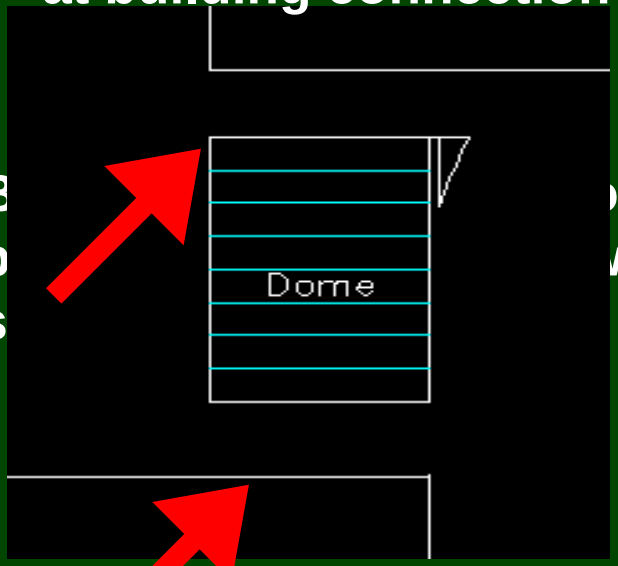


Original roof design at building connection

Original design - separate lateral system for each building



Revised roof design at building connection

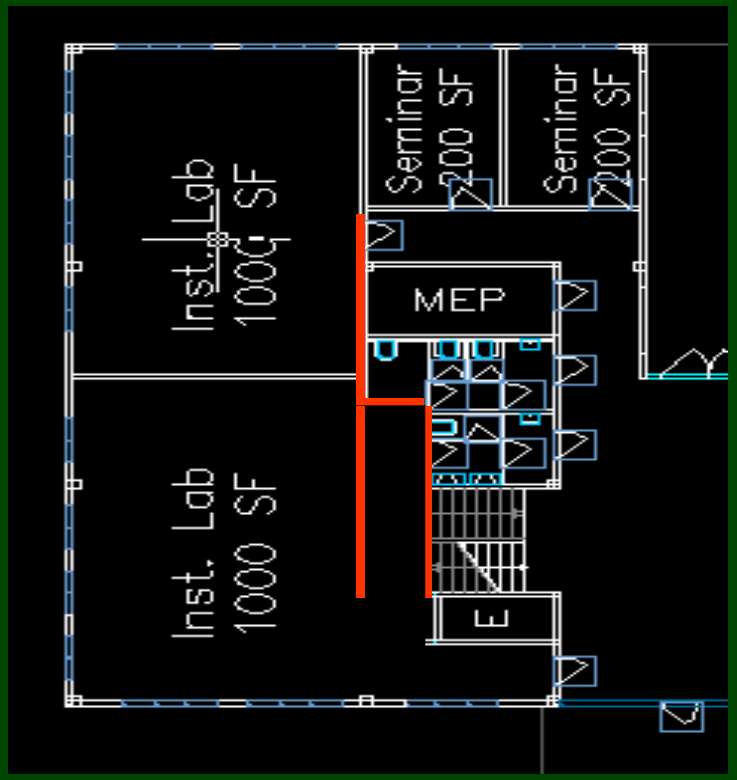


Use two 10’ wide slabs to connect the roof diaphragms to make one building

A/E/C TEAM

Team Dynamics

RIVER 2003



Problem:

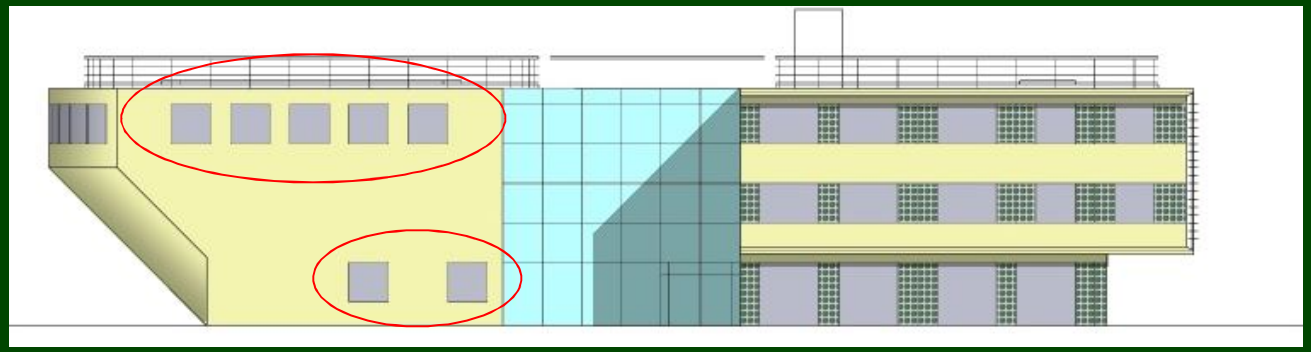
I need a shear wall…
Make it straight!

Solution:

Reconfigure layout

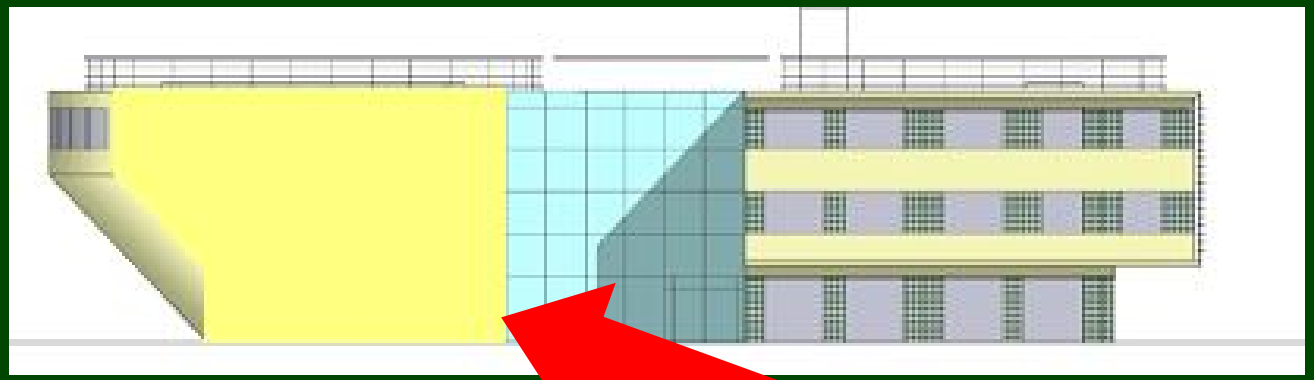
Team Dynamics

RIVER 2003



Problem:

Function
Increase Heat
Need Shear Wall



Solution:

Eliminate
Windows

A/E/C TEAM

LESSONS LEARNED

RIVER 2003

- Learned to appreciate all of the disciplines involved
- Technology allows us to make accurate cost estimates using unit prices.
- The importance of discipline coordination grows as the design progresses into more detail
- Using a consistent software platform for drawings across the disciplines saves time by minimizing rework.
- The more you get involved in the project, the more you love it…

TEAM IMPROVEMENTS

RIVER 2003

- Meetings became very efficient
- The sharing of thoughts, ideas, and comments improved through the use of instant massaging and e-mail
- Relationships between the team members grew stronger
- All members have a better understanding of the other disciplines' needs

APPRECIATION

RIVER 2003

Classmates

Owner

Mentors

Renate

THOUGHTS?

RIVER 2003

A/E/C TEAM