


## THE FORENSIC MEDICAL CENTER



KEENAN S. YOHE – STRUCTURAL OPTION  
DR. ALI M. MEMARI – FACULTY ADVISOR  
APRIL 15, 2008

---

---

---

---

---

---


---

---

## BUILDING OVERVIEW

KEENAN S. YOHE – STRUCTURAL OPTION      THE FORENSIC MEDICAL CENTER

- Building Statistics
  - State-of-the-Art Lab
  - Chief Medical Examiner
  - 121,000 square feet
  - 5 stories
  - \$45 million project



---

---

---

---

---

---

---

---


## BUILDING OVERVIEW

KEENAN S. YOHE – STRUCTURAL OPTION      THE FORENSIC MEDICAL CENTER

- Building Functions

Ground Floor:

- Parking Garage
- Drive-thru Delivery
- Main Entrance



---

---

---

---

---

---

---

---


### BUILDING OVERVIEW

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

▪ Building Functions

Second Floor:

- Autopsy Rooms
- Autopsy Support
  - Coolers
  - Freezers
  - Storage
- BSL 3 Laboratory



---

---

---

---

---

---

---

---


### BUILDING OVERVIEW

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

▪ Building Functions

Third Floor:

- Laboratories
  - Histology
  - Toxicology
  - Neuropathology
- Instrument Storage
- Record Storage



---

---

---

---

---

---

---

---


### BUILDING OVERVIEW

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

▪ Building Functions

Fourth Floor:

- Public Reception
- Pathology Exhibit
- Investigations Suite
- Photography Suite
- Training Rooms



---

---

---

---

---

---

---

---


### BUILDING OVERVIEW

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Building Functions

Fifth Floor:

- Administrative Offices
- Medical Records
- Conference Room
- Medical Examiners' Offices



---

---

---

---

---

---

---

---

### BUILDING OVERVIEW

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Existing Conditions
  - 11"-thick, two-way, flat plate concrete slab
  - 24" x 24" Concrete Columns
  - Dual Lateral System
    - Concrete Shearwalls
    - Concrete Moment Frame

---

---

---

---

---

---

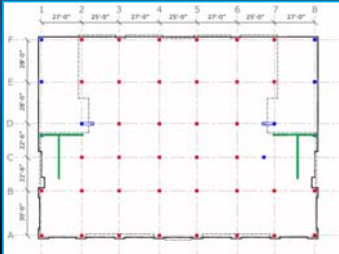
---

---

### BUILDING OVERVIEW

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Existing Conditions



---

---

---

---

---

---

---

---

### THESIS GOALS

KEENAN S. YOHE - STRUCTURAL OPTION      THE FORENSIC MEDICAL CENTER

- Structural Feasibility of a Composite Steel System
- Cost and Schedule Implications of a Steel System
- Cost and Planning of an Alternative Care Facility

---

---

---

---

---

---

---

---

### STRUCTURAL DEPTH STUDY

KEENAN S. YOHE - STRUCTURAL OPTION      THE FORENSIC MEDICAL CENTER

- Changes
  - Two-Way Concrete Slab to Composite Steel
  - Concrete Columns to Steel Columns
  - Concrete Shearwalls to Steel Braced Frames

---

---

---

---

---

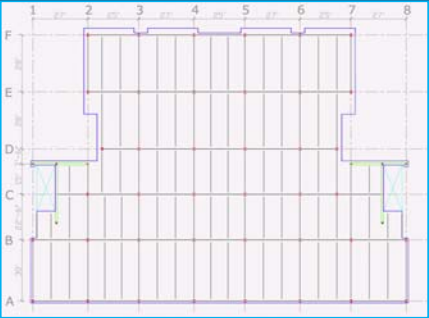
---

---

---

### STRUCTURAL DEPTH STUDY

KEENAN S. YOHE - STRUCTURAL OPTION      THE FORENSIC MEDICAL CENTER



---

---

---

---

---

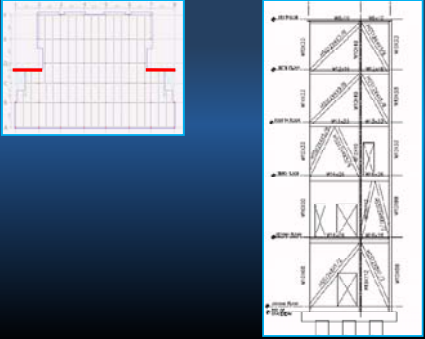
---

---

---

### STRUCTURAL DEPTH STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER



---

---

---

---

---

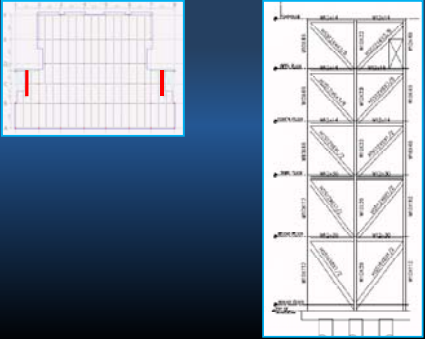
---

---

---

### STRUCTURAL DEPTH STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER



---

---

---

---

---

---

---

---

### STRUCTURAL DEPTH STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Vibration Considerations
  - Fifth Floor Medical Examiner Offices
  - Sensitive Microscopes
  - "Class A" Criteria – 2,000  $\mu$  in / sec
- No accepted method for concrete

---

---

---

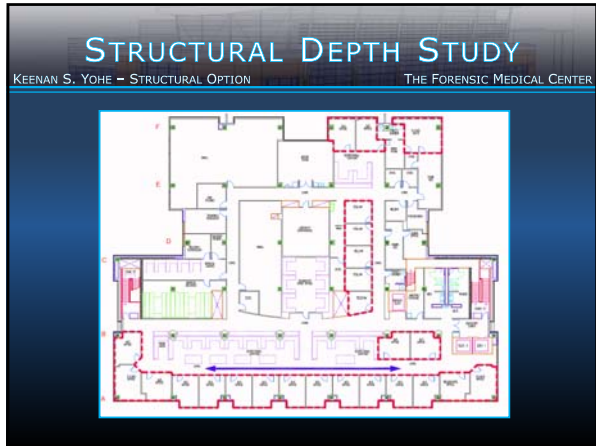
---

---

---

---

---



---

---

---

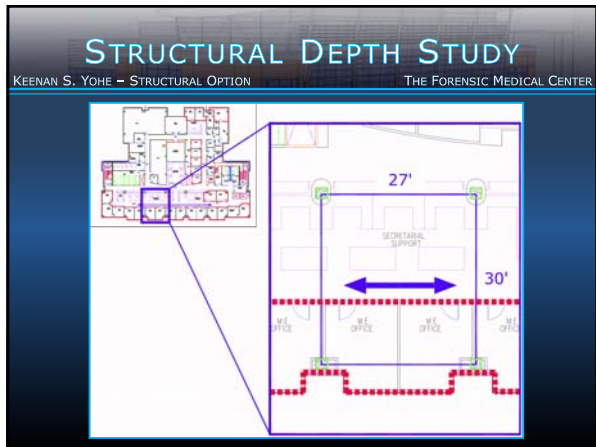
---

---

---

---

---



---

---

---

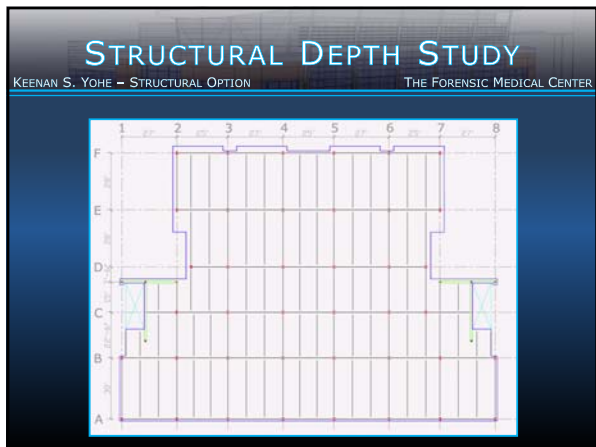
---

---

---

---

---



---

---

---

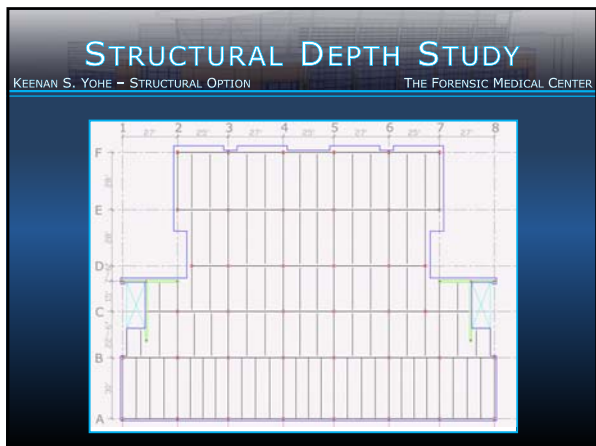
---

---

---

---

---



---

---

---

---

---

---

---

---

- ### STRUCTURAL DEPTH STUDY
- KEENAN S. YOHE - STRUCTURAL OPTION      THE FORENSIC MEDICAL CENTER
- Results
    - Framing
      - Typically W16 beams framing into W18 girders
      - W27 beams and W30 girders in vibration critical areas
    - Columns
      - W10 and W12 columns
    - Braced Frames
      - HSS12x4 to HSS16x8 braces

---

---

---

---

---

---

---

---

- ### THESIS GOALS
- KEENAN S. YOHE - STRUCTURAL OPTION      THE FORENSIC MEDICAL CENTER
- ✓ Structural Feasibility of a Composite Steel System
  - Cost and Schedule Implications of a Steel System
  - Cost and Planning of an Alternative Care Facility

---

---

---

---

---

---

---

---

### CONSTRUCTION MANAGEMENT STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Material Takeoffs
  - Existing System
    - From Contractor's Estimates
  - Steel Redesign
    - From RAM Structural System

---

---

---

---

---

---

---

---

### CONSTRUCTION MANAGEMENT STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Material and Labor Costs
  - R.S. Means - 2008
  - PSU AE Technical Discussion Board
    - Cost of Steel - \$0.44 / lb

---

---

---

---

---

---

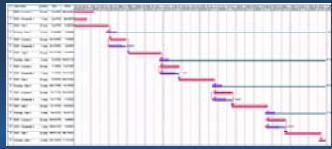
---

---

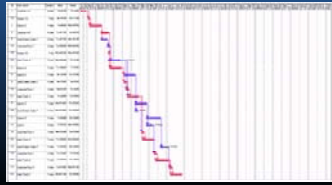
### CONSTRUCTION MANAGEMENT STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

Concrete



Steel



---

---

---

---

---

---

---

---



### CONSTRUCTION MANAGEMENT STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Scheduling
  - Concrete: 135 Days
  - Steel: 69 Days
  - Savings of 66 Days
  - 3.3 Months @ \$60,000 / mo. = \$198,000 Savings

---

---

---

---

---

---

---

---

### CONSTRUCTION MANAGEMENT STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Results:

C-I-P Concrete – Existing Conditions		Composite Steel – Redesign	
Materials:	\$1,536,749	Materials:	\$1,171,959
Labor:	\$1,507,128	Labor:	\$669,128
Equipment:	\$49,500	Equipment:	\$20,700
<b>TOTAL:</b>	<b>\$3,093,377</b>	<b>TOTAL:</b>	<b>\$1,861,855</b>

Savings of \$1.2 million

---

---

---

---

---

---

---

---

### CONSTRUCTION MANAGEMENT STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Conclusions
  - Total Savings: \$1.4 million
  - Additional Savings
    - Earlier Move-In, Foundations
  - Disadvantages of Steel
    - Lead Time, Increase in height, Staging Area

---

---

---

---

---

---

---

---

**CONSTRUCTION MANAGEMENT STUDY**  
KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Conclusions
  - Composite Steel is viable
  - Further investigation recommended

---

---

---

---

---

---

---

---

**THESIS GOALS**  
KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- ✓ Structural Feasibility of a Composite Steel System
- ✓ Cost and Schedule Implications of a Steel System
- Cost and Planning of an Alternative Care Facility

---

---

---

---

---

---

---

---

**ALTERNATIVE CARE FACILITY STUDY**  
KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- What is an Alternative Care Facility?
  - Temporary triage unit
  - Used for local catastrophic events
  - Provides intermediate care
  - Prevents overburdening of hospitals

---

---

---

---

---

---

---

---

### ALTERNATIVE CARE FACILITY STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

- Architectural Requirements
  - Quick set-up time
  - Decontamination area (Warm Zone)
  - Non-contaminated area (Cold Zone)
  - Separation of the zones
  - Storage

---

---

---

---

---


---

---

---

### ALTERNATIVE CARE FACILITY STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER



The floor plan shows a central area with several rooms and corridors. Key areas include a 'MAIN LOBBY' on the right, a 'RECEPTION' area, and various 'OFFICE' spaces. There are also 'RESTROOMS' and 'STORAGE' areas. The plan is color-coded to show different zones and structural elements.

---

---

---

---

---

---

---

---

### ALTERNATIVE CARE FACILITY STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER



This floor plan is similar to the one above but features different room labels. It includes a 'DECONTAMINATION AREA' on the left, a 'RECEPTION' area, and 'OFFICE' spaces. The layout and color-coding are consistent with the previous plan, showing a central area with surrounding rooms and corridors.

---

---

---

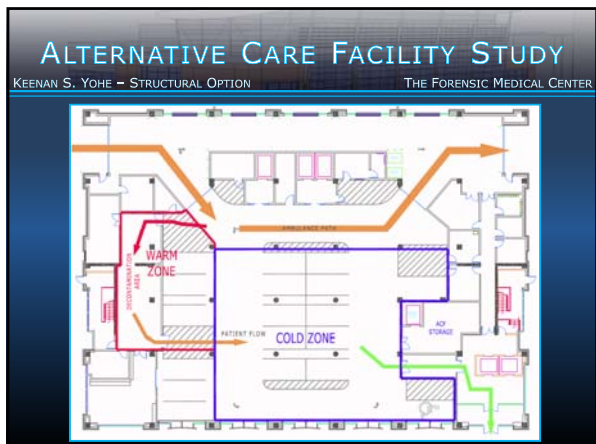
---

---

---

---

---



---

---

---

---

---

---

---

---

- ### ALTERNATIVE CARE FACILITY STUDY
- KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER
- Mechanical Requirements
    - Heating and Cooling
      - 800,000 BTU/hr is <5% of heating capacity
      - 42 Tons is 5.8% of cooling capacity
    - 100% Outdoor Air
  - Existing System meets requirements
  - Additional Ductwork needed

---

---

---

---

---

---

---

---

- ### ALTERNATIVE CARE FACILITY STUDY
- KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER
- Lighting Requirements
    - Additional luminaires to provide 50 fc
  - Add (45) suspended semi-direct HO luminaires
    - (4) F48T8/HO lamps
    - (2) Ballasts per luminaire
- 

---

---

---

---

---

---

---

---

## ALTERNATIVE CARE FACILITY STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

---

▪ **Cost Estimate**

ACF COST ESTIMATE				
Arch:	Barriers:	\$	10,000 per overhead door	
		x	7 required	= \$70,000
HVAC:	Ductwork:	\$	700,000 for existing 4 floors	= \$175,000 per floor
Lighting:	Luminaires:	45 @	\$100 =	\$4,500
	Lamps:	180 @	\$17 =	\$3,060
	Ballasts:	90 @	\$100 =	\$9,000
	Installation:		=	\$4,000
				= \$20,560
Electrical:	Wire, etc.	\$	1,500,000 for 101,000 SF	= \$15 per SF
			x 104' x 75' = 7800 SF	= \$117,000
<b>TOTAL:</b>				<b>\$382,560</b>

---

---

---

---

---

---

---

---

---

---

---

---

## ALTERNATIVE CARE FACILITY STUDY

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

---

▪ **Conclusions**

- Estimated Cost: \$400,000
  - Architecture, HVAC, Lighting/Electrical
  - Not Included: Plumbing, Supplies, Equipment
- System is feasible...
  - Owner must decide if it is worth the cost

---

---

---

---

---

---

---

---

---

---

---

---

## CONCLUSIONS

KEENAN S. YOHE - STRUCTURAL OPTION THE FORENSIC MEDICAL CENTER

---

- ✓ **Structural Feasibility of a Composite Steel System**
  - Vibration Criteria met according to Design Guide 11
  - Increased Floor Thickness, Less Uniformity
- ✓ **Cost and Schedule Implications of a Steel System**
  - Savings of \$1.4 million and 3 months
  - Disadvantages of steel construction
- ✓ **Cost and Planning of an Alternative Care Facility**
  - Feasible system in suitable location
  - Expensive and may never be used

---

---

---

---

---

---

---

---

---

---

---

---

## CONCLUSIONS

KEENAN S. YOHE - STRUCTURAL OPTION      THE FORENSIC MEDICAL CENTER

- ✓ Structural Feasibility of a Composite Steel System  
    Further investigation warranted
- ✓ Cost and Schedule Implications of a Steel System  
    Further investigation warranted
- ✓ Cost and Planning of an Alternative Care Facility
  - Owner's decision, based on cost and utility

---

---

---

---


---

---

---

---

## THE FORENSIC MEDICAL CENTER



QUESTIONS?

---

---

---

---

---

---

---

---