



## Project Teams

Occupant  
Yale University

Architect  
Kieran Timberlake Associates LLP

Structural  
CVM Engineers

C/M/E Engineer  
BVH Integrated Services

Lighting  
Arup Lighting

Landscape  
Andropogon Associates

Parking  
Tim Haahs and Associates, Inc.

Code  
Bruce Spiewak

Environmental  
Atelier Ten

Signage  
Strong Cohen

Elevator  
Van Duesen and Associates

## Building Statistics

Occupant Type  
Education/Parking/Gallery  
155,828 SF

Construction  
March 2006 - June 2007

Schedule  
\$36 Million USD

Cost  
Design-Bid | Fast Tracked

Delivery Method

The Yale Sculpture Building consists of three connecting buildings. The Main Sculpture Building is a four story, 55,000 sq. ft. building for the Sculpture Department of the Yale School of Art. The second building is a double-height single floor gallery for exhibition of student work. The last structure is a five level parking garage. The garage has up to 288 parking spaces and contains a 9,000 sq.ft. area for retail and office space.

## Sculpture Building

100ft 4 floors, Basement  
Steel frame, double-skin, naturally ventilated curtain wall system

Parking Garage  
88ft 5 levels  
Vine Planter System

Photo Courtesy of Kieran Timberlake Associates LLP



## YALE SCULPTURE BUILDING AND PARKING GARAGE New Haven, Connecticut

### Structural System

Sculpture Building and Gallery  
-Steel Frame and Concrete Slab  
-10" Shear Wall / 8" CMU Shaft  
-12" Foundation Walls with Footings every 20'

Parking Garage  
-Post-Tension construction  
-18.5 k/ft Uniform Post Tension force  
-12'-18" Reinforced concrete foundation walls

### Lighting | Electrical System

Fluorescent Lighting Used Throughout Buildings  
1200A 408Y/277V 3 phase Main Switchboard  
200KW Emergency Generator  
31 208Y/120 Panelboards  
9 480Y/277 Panelboards  
Individual Metered Retail spaces  
13 Step-down Transformers  
125 HP 3P 480V Fire pump

### HVAC

Radiant Heating System  
Displacement Air Ventilation System  
Recycled Water System with Zentex Ozone disinfection

### Other Systems

Green Roof System  
Active Curtain Wall System  
Solar Hot Water System

# KHA N. DANG

ARCHITECTURAL ENGINEERING - LIGHTING | ELECTRICAL  
<http://www.arche.psu.edu/thesis/eportfolio/2007/portfolios/IKND107>



ELECTRICAL



ARCHITECTURE



LIGHTING



GREEN



ENGINEERING

“ While great efforts have been taken to provide accurate and complete information on the pages of this report, please be aware that the information contained herewith is considered a work-in-progress for this 2007 thesis project. Modifications and changes related to the original building designs and construction methodologies for this senior thesis project are solely the interpretation of **Kha N Dang**. Changes and discrepancies in no way imply that the original design contained errors or was flawed. Differing assumptions, code references, requirements, and methodologies have been incorporated into this thesis project; therefore, investigation results may vary from the original design. ”

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## ■ EXECUTIVE SUMMARY

This Yale Sculpture Building is a three part building that serves as the edge of the Yale Campus and the residential sector. The primary focus of the design of this structure is sustainability. The building contains classrooms, offices, retail spaces, studios, parking areas and a Gallery.

This report contains a redesign of the lighting and electrical (partial) systems. The following pages will discuss the criteria for the newly designed systems and contain an in-depth (case-studies) study for four (4) spaces. These spaces are Dean's Office, Studios, Gallery and Exterior/ Landscape.

Since the lighting system will be changed, the mechanical system will need to change to correspond to the new heating and cooling loads. The main focus of the mechanical redesign will be to downsize equipment to increase rentable space and decrease initial cost.

In my redesign of the fourth (4th) floor studio, a clerestory was added to decrease the use of electrical lighting. The addition of the clerestory warrants an investigation of the stability of the existing structure.





## ■ BUILDING STATISTICS

### GENERAL INFORMATION

Building Name	Yale Sculpture Building
Location	New Haven, Connecticut
Building Occupant	Yale University
Occupancy Type	Education   Gallery   Parking
Size [SF]	155,828 SF
Height	Sculpture Building - 100 FT Gallery - 64 FT Parking Garage - 88 FT
Construction Schedule	March 30, 2006 - June 30, 2007
Approximate Cost	\$36 Million USD
Delivery Method	Design-Bid   Fast Tracked
Sponsor	Steven Johns Kieran Timberlake Associates

### PROJECT TEAMS

Architect	Kieran Timberlake Associates LLP
Structural	[ Removed by Request ]
C/M/E Engineer	[ Removed by Request ]
Lighting Design	[ Removed by Request ]
Landscape	[ Removed by Request ]
Parking	[ Removed by Request ]
Code	[ Removed by Request ]
Environmental	[ Removed by Request ]
Signage	[ Removed by Request ]
Elevator	[ Removed by Request ]





## ■ GENERAL DESIGN SUMMARY

### ARCHITECTURE

The Yale Sculpture Building is composed of three connected buildings. The main Sculpture Building is a four story, 55,000 square feet building. This section will briefly house the architecture department and will be permanently occupied by the Sculpture department of the Yale School of Art. The building contains loft-like studios, classrooms, shop space, faculty and administrative offices, and storage throughout its occupancy. Adjacent to the main building, the parking garage can accommodate 288 vehicles. The first level of the garage contains a 9,000 square foot space for retail and office space. The last structure is the Gallery which is connect to the other buildings via a underground tunnel. This structure supports a green roof and is designated for student exhibition.

### ZONING

2005 Connecticut State Building Code (CSBC)

2005 Connecticut State Fire Safety Code (CSFSC)

Connecticut State Amendments to IBC, IMC, IECC and ANSI 117.1 2003

2003 International Building Code (IBC)

2003 International Residential Code

2003 International Plumbing Code

2003 International Mechanical Code

2003 International Energy Conservation Code

2003 International Fire Code

NFPA 70 National Electric Code

221 Standard for Fire Walls and Fire Barriers Walls

2003 ICC Performance Code

2003 ICC/ANSI A117.1



## HISTORICAL REQUIREMENTS

Zoning was a slight issue on the site since it was composed of several properties. A particular problem was a structure that was considered to be a “Historically Reserved Building.” The problem was resolved when research showed that the building in question was not actually registered as a historical site.

## BUILDING ENVELOPE | ROOFING SYSTEM

The Sculpture Building is an exposed steel frame structure with a glass, double-skin, naturally ventilated curtain wall system. The south facade features a full length shade system that is designed to decrease glare and heat gain through the curtain wall system. The roof system is composed of a steel grid of W beams and sloped concrete slab.

The Gallery is a stone clad, steel frame building with a sub-grade connection tunnel to the Sculpture Building. The roof of the Gallery contains a green garden that is supported by a grid of hollow structural shapes (HSS) and W beams.

The Parking Garage is a post-tension concrete structure that is supported by concrete columns. The North and South facades will have full length vine planters .

## CONSTRUCTION PROCESS

The project's delivery method was design-bid that was fast tracked. The total cost of the Yale Sculpture Building was approximately \$36 million USD. Construction started in March 2006 and is planned to be completed in June 2007.

## ELECTRICAL SYSTEM

The electrical system for Yale Sculpture Building is composed of three separated secondary electrical services from the primary transformer. The main switchgear in the Sculpture Building is rated at 1200A, 480Y/277 volts with a short circuit rating of 100,000A. This supplies power to both the main building and the Gallery. The lighting and receptacles in the main building are powered by a 112.5KVA step transformer off the main switchgear. One of the secondary supplies is connected to a fire protection system that consists of a fire pump and fire cabinet. The fire cabinet is rated at 1200A and connects to a 3 phase, 125HP, 460V fire pump. The last electrical supply feeds into the Parking Garage. Level One of the structure contains areas for offices and retail shops which is metered by a commercial switchboard. The emergency power system is connected to the electrical system via three automatic transfer switches that feed to a 200KW power generator.



## LIGHTING SYSTEM

### **Sculpture Building**

The lighting system in the main Sculpture Building operates on a 480Y/277 system. Linear fluorescent luminaires are used throughout the building for energy conservation and easy maintenance. These fixtures use a three lamp, tandem wiring configuration. Daylight and occupancy sensors control lighting levels on all floors. Accent lighting for the lobbies are compact fluorescent downlights. The utility areas such as storage and electrical rooms have industrial type fluorescent fixtures.

### **Gallery**

The lighting system in the Gallery is based on a track grid for flexibility in lighting levels and angles. The space is controlled by two occupancy sensors.

### **Parking Garage**

The Parking Garage is evenly illuminated by a grid of 150W surface mounted area flood lights.

## MECHANICAL SYSTEM

The Yale Sculpture Building utilizes a radiant heating system. One rooftop air handling unit circulates air in the building. The system contains three boilers and two variable flow controllers. One boiler and one variable flow controller are on standby.

## PLUMBING

The Yale Sculpture building utilizes a recycled water system. The system is intended to supply recycled water to the water closets of the Sculpture Building at a capacity and pressure to properly operate the plumbing fixtures at their maximum capacity. The recycled water system also supplies the irrigation system. Zentex Ozone generators and control panels are used to disinfect each system. The recycled water is colored dye in the water closet and clearly labeled "RECYCLED NON-POTABLE WATER".

## STRUCTURAL

The Main Sculpture Building and Gallery structural systems are steel framed construction. The foundation of the Sculpture building consists of primary 6'-6" x 10'-6" x 2'-0" and 6'-6" x 8'-0" x 2'-0" footings spaced 20'-0" around the perimeter and 8'-0" x 8'-0" x 2'-6" footings spaced 28'-0" in the interior section of the building. The foundation walls are typically 12" concrete walls. The steel frame of the building is typically composed of W16x31 steel beams that span 28'-0". The beams are supported by W24x55 girders that span 20'-0". A 10" shear wall is common on all levels along with an 8" CMU shaft. The shear wall encloses a stairwell and utility core. The concrete slab varies from a 2.5" – 3" thick normal weight concrete on composite metal floor deck. The foundation of the Gallery consists of footings ranging from 6'-0" x 6'-0" x 1'-6" to 24'-0" x 10'-0" x 2'-0". The thickness of the reinforced concrete walls are from 12" to 18" thick. The concrete slab is 3" thick normal weight concrete on 3" deep composite metal floor deck. The roof construction is a grid of HSS 12x4x1/4 beams that is supported by W24x62 girders.

The Parking Garage's structural system is a post-tension construction. The typical slab thickness is seven inches with an approximately 18.5 k/ft uniform post tensioning force required. Concrete columns are approximately spaced 60 feet apart North/South and 23 feet apart East/ West. Shear walls surround the stairwells and central utility core.



## FIRE PROTECTION

The Yale Sculpture building uses a system of sprinklers for fire protection. The Main Sculpture building and Gallery utilize a wet pipe system that has a Fire Department connection. Sprinkler heads are provided with a maximum of 130 square feet range with additional sprinkler heads below and around duct work, piping, conduits, equipment and as required insuring proper floor coverage as regarded in NFPA #13. Sprinkler wire guards are provided where mechanical damage might occur.

## TRANSPORTATION

The transportation system consists of two hydraulic elevators. The first is classified as a 3000 lbs capacity passenger that runs on a 480V 3 phase power supply. The second elevator is a type Class "A" freight loading that has a 12,000 lbs capacity.