TEAM CENTRAL
RYAN
USA
LCFM

NORAYR
GERMANY
CM

MANDY
GERMANY
SE

JAKOB
DENMARK
A
DECISION MATRIX

EPICENTER

- Functionality
- Earthquake resilience
- Consistence of big Idea
- Constructability
- Atmosphere
- Air quality
- Aesthetic
- GWP
- Costs

Epicenter Steel: 283
Epicenter Concrete: 271
DECISION MATRIX

LUNG

- Lung Steel: 264
- Lung Concrete: 241

- Functionality
- Earthquake resilience
- Consistence of big Idea
- Constructability
- Atmosphere
- Air quality
- Aesthetic
- GWP
- Costs
<table>
<thead>
<tr>
<th><strong>Birthe</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hours Per Week</strong></td>
<td>30-40 hours</td>
</tr>
<tr>
<td><strong>Frequented Area</strong></td>
<td>Classrooms, auditorium, collaborative spaces, cafe, office, lobby</td>
</tr>
<tr>
<td><strong>Known As</strong></td>
<td>Loud and late for class</td>
</tr>
<tr>
<td><strong>Provide Value</strong></td>
<td>Social student environment</td>
</tr>
<tr>
<td><strong>Most Important Thing</strong></td>
<td>Wayfinding, good learning environment, social spaces</td>
</tr>
<tr>
<td><strong>Desired Things</strong></td>
<td>High speed WiFi indoors and outdoors</td>
</tr>
<tr>
<td><strong>Expectations</strong></td>
<td>Access to facilities and possibility to buy food &amp; beverage</td>
</tr>
<tr>
<td><strong>Do Not Like</strong></td>
<td>Closed off, unwelcoming faculty offices/wing</td>
</tr>
<tr>
<td>Description</td>
<td>Details</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Eva</td>
<td><img src="image" alt="Eva" /></td>
</tr>
<tr>
<td>Hours Per Week</td>
<td>30-40 hours</td>
</tr>
<tr>
<td>Frequented Area</td>
<td>PhD office, desks, kitchen, faculty lounge, cafe</td>
</tr>
<tr>
<td>Known As</td>
<td>The nerdy PhD Student</td>
</tr>
<tr>
<td>Provide Value</td>
<td>All around user of the building</td>
</tr>
<tr>
<td>Most Important Thing</td>
<td>Own big table, office room with max. 10 students, daylight, a good chair</td>
</tr>
<tr>
<td>Desired Things</td>
<td>Kitchen in the lobby or cafe, wired connection at the table</td>
</tr>
<tr>
<td>Expectations</td>
<td>Good wifi connection</td>
</tr>
<tr>
<td>Do Not Like</td>
<td>Interruptions, Noise in the office, sit with the back to the door</td>
</tr>
<tr>
<td>Nicolaj</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>Hours Per Week</strong></td>
<td>30-40 hours</td>
</tr>
<tr>
<td><strong>Frequented Area</strong></td>
<td>PhD office, desks, kitchen, faculty lounge, cafe</td>
</tr>
<tr>
<td><strong>Known As</strong></td>
<td>Loyalty in the educational sector for the last 40 years</td>
</tr>
<tr>
<td><strong>Provide Value</strong></td>
<td>Quality over quantity</td>
</tr>
<tr>
<td><strong>Most Important Thing</strong></td>
<td>Productivity and high professional level</td>
</tr>
<tr>
<td>** Desired Things**</td>
<td>Private working space</td>
</tr>
<tr>
<td><strong>Expectations</strong></td>
<td>Good educational environment and equipment</td>
</tr>
<tr>
<td><strong>Do Not Like</strong></td>
<td>Too many students around the faculty offices</td>
</tr>
</tbody>
</table>
## COMMUNITY MEMBER

<table>
<thead>
<tr>
<th>Name</th>
<th>Hours Per Week</th>
<th>Frequented Area</th>
<th>Known As</th>
<th>Provide Value</th>
<th>Most Important Thing</th>
<th>Desired Things</th>
<th>Expectations</th>
<th>Do Not Like</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aleš</td>
<td>0-5 hours</td>
<td>Public spaces, cafe, auditorium</td>
<td>You can be a good neighbor only if you have good neighbors</td>
<td>Involvement of community</td>
<td>Silence</td>
<td>Better apartment, no flashy new houses in the street</td>
<td>New parking spaces for users of faculty</td>
<td>Vibrations from street and construction site and loud noises</td>
</tr>
</tbody>
</table>
### DISABLED PERSON

<table>
<thead>
<tr>
<th>Han</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hours Per Week</strong></td>
</tr>
<tr>
<td><strong>Frequented Area</strong></td>
</tr>
<tr>
<td><strong>Known As</strong></td>
</tr>
<tr>
<td><strong>Provide Value</strong></td>
</tr>
<tr>
<td><strong>Most Important Thing</strong></td>
</tr>
<tr>
<td><strong>Desired Things</strong></td>
</tr>
<tr>
<td><strong>Expectations</strong></td>
</tr>
<tr>
<td><strong>Do Not Like</strong></td>
</tr>
<tr>
<td>Melissa and Tawa</td>
</tr>
<tr>
<td>----------------------------------</td>
</tr>
<tr>
<td><strong>Hours Per Week</strong></td>
</tr>
<tr>
<td><strong>Frequented Area</strong></td>
</tr>
<tr>
<td><strong>Known As</strong></td>
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<td><strong>Most Important Thing</strong></td>
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<tr>
<td><strong>Desired Things</strong></td>
</tr>
<tr>
<td><strong>Expectations</strong></td>
</tr>
<tr>
<td><strong>Do Not Like</strong></td>
</tr>
</tbody>
</table>
AEC BRIEF REQUIREMENTS

Assignable SqFt

Strong privacy for faculty and chair’s offices

GROSS SqFt

Daylight to instructural labs

High security for chair’s office, instructural lab and serverroom

Include every program

Semi-privacy for student offices

Build inside footprint
AEC BRIEF REQUIREMENTS

- Views to outside/nature from every room
- Sloped classrooms
- 30’ max. building height
- Min. 1 elevator
- Low noise for classrooms
- Main entrance close to main access road
- Max. construction cost $10,000,000
- Building fits the site
DESIGN TEAM GOALS

Relation between exterior and interior
Linked area and smooth circulation
Innovative and attractive learning spaces
Exposed structure
Equipment room on each floor
Min. 400 SqFt technical room
Small window towards South-West
Central shaft
400 SqFt
DESIGN TEAM GOALS

Symmetry

Earthquake resilience

10’ min. ceiling height

Visible and central stair

Min. 4% daylight factor

Integration of solar panels

Shading

Air-intake from outside
DESIGN TEAM GOALS

- Utilizes prefabrication
- Standard elements
- Thermal comfort
- Water saving
- Blend into context
- Architecture and structure fit each other
- Regular MEP systems
- Constructability
PROJECT ASPIRATIONS

Consistency of BIG IDEA
High value for money
LEED PLATINUM
Innovative and attractive learning spaces

Win the challenges
UNIQUE OPPORTUNITIES

LA: THE MOST DIVERSE CITY IN USA

INTERSECTION OF COMMUNITIES

EARTHQUAKE ZONE
CENTER OF DIVERSITY
CLIMATE CONDITIONS & CHALLENGES

Temperature and precipitation

- 80°F
- 60°F
- 40°F
- 6 inch
- 3 inch
- 0 inch

Relative humidity

- 100%
- 70%
- 40%

Sun position

- Solstice
- Equinox
- Solstice

Wind speeds

- 55+ kph
- 55 kph
- 40 kph
- 30 kph
- 19 kph
- 16 kph
- 12 kph
- 7 kph
- 2 kph
Northridge earthquake 1994
Mw = 6.7
Damage $13-40 billion
Peak ground acceleration 1.82 g

Chino Hills earthquake 2008
Mw = 5.5
Peak ground acceleration 0.44 g

La Habra earthquake 2014
Mw = 5.1
Damage $10.8 million

Expected damage in next 10 years—California exceed $30 billion
CONCEPT EVOLUTION

30’ max. Building height

Build inside footprint

Main entrance close to main access road

Blend into context
L-shape placed on side defining the university borders
Adjusted to context
Pointing towards the community
Emphasizing the entrance
Minimize exposure from sun
Introducing green areas and air-cleaning facade system
30’ max. Building height

Build inside footprint

Main entrance close to main access road

Blend into context

DESIGN PROCESS
CONCEPT EVOLUTION
“So much more than just an educational building”
Linked area and smooth circulation

Strong privacy for faculty offices

Include every building program

Innovative learning spaces
BASIC BUILDING PROGRAM

ADMINISTRATION

PRIVATE

Faculty Office
Administration Office
Senior Admin. Office
Department Chair’s Office
Faculty Lounge

COMMON

Stair
Storage Room
MEP
Elevator
Tech. Support
Server Room
Restrooms

PRIVATE

EDUCATIONAL

Instructional Lab
Small Classroom
Student Office
Large Classrooms
Auditorium
OPTIMIZED BUILDING PROGRAM

PRIVATE

SEMIPRIVATE

PUBLIC

SEMIPRIVATE

PRIVATE

ADMINISTRATION

Faculty Office

Collaborative space

Administration Office

Senior Admin. Office

Restrooms

Restrooms

Faculty Lounge

Elevator

Lobby

Café

Large Classrooms

MEP

Storage Room

Restrooms

Tech. Support

Instructional Lab

Student Office

Auditorium

Collaborative space

Exhibition area

NEW

NEW

NEW

OUTSIDE
BUILDING PROGRAM

Assignable SqFt

Views to outside/nature

Min. 1 elevator

Visible and Central stair

GROSS Bath

Views to outside/nature

Min. 1 elevator

Visible and Central stair

Seamless indoor and outdoor

Legal area and interior

Innovative and advanced heating system

Perennial windows

Symmetry

Earthquake resistance

Miscellaneous options

Utility prequalification

Standard elements

Simplicity

Send interconnexion

Integration of solar panels

Small windows/windows

Heat distribution

Thermal comfort
VISUALIZATION OF FACULTY OFFICES
GROUND FLOOR

- Lobby
- Cafe
- Stair
- Elevator
- MEP

- Faculty Lounge
- Open Offices

- Meeting Rooms
- Senior Department Offices
- Administrative Offices
- Chair’s Department Offices
BASEMENT

- Student area
- Collaborative spaces
- Stair
- Elevator
- MEP
- Restrooms

- Technical Support
- Study Spaces

- Auditorium
- Instructional Labs
- Student Offices
VISUALIZATION OF STUDENT AREA
GROSS SqFt
Daylight to instructional labs
Semi-privacy for student offices
Low noise for classrooms
VISUALIZATION OF AUDITORIUM
BASEMENT

- Student area
- Collaborative spaces
- Stair
- Elevator
- MEP
- Restrooms
- Technical Support
- Study Spaces
- Auditorium
- Instructional Labs
- Student Offices
1st FLOOR

- Sky Lounge
- Stair
- Elevator
- MEP
- Restrooms
- Large Classroom
- Small Flexible Classrooms
VISUALIZATION OF SKY LOUNGE

A
<table>
<thead>
<tr>
<th>Earthquake resilience</th>
<th>Architecture and structure fit</th>
<th>Exposed structure</th>
<th>Standard elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️ 크게 하기</td>
<td>✔️ Building is soundproof</td>
<td>✔️kerja light</td>
<td>✔️At the top</td>
</tr>
<tr>
<td>✔️ Standard</td>
<td>✔️ Wall is suitable to</td>
<td>✔️ 30°</td>
<td>✔️ Inside view</td>
</tr>
<tr>
<td>elements</td>
<td>case form every room</td>
<td>✔️ 10 ft.</td>
<td>✔️ Inside view</td>
</tr>
<tr>
<td>✔️ Exposed structure</td>
<td>✔️ building height</td>
<td>✔️ 10 ft.</td>
<td>✔️ Inside view</td>
</tr>
<tr>
<td>✔️ High natural history</td>
<td>✔️ Visits the challenge</td>
<td>✔️ Building the city and</td>
<td>✔️ Inside view</td>
</tr>
<tr>
<td>✔️ Low-cost</td>
<td>✔️ Geotechnical quality</td>
<td>✔️ and sleep</td>
<td>✔️ Inside view</td>
</tr>
<tr>
<td>✔️ $10,000,000</td>
<td>✔️ Wins the challenge</td>
<td>✔️ Inside view</td>
<td>✔️ Inside view</td>
</tr>
<tr>
<td>✔️ High natural history</td>
<td>✔️ High-quality building</td>
<td>✔️ Inside view</td>
<td>✔️ Inside view</td>
</tr>
<tr>
<td>✔️ Inside view</td>
<td>✔️ Natural light</td>
<td>✔️ Inside view</td>
<td>✔️ Inside view</td>
</tr>
<tr>
<td>✔️ Inside view</td>
<td>✔️ Inside view</td>
<td>✔️ Inside view</td>
<td>✔️ Inside view</td>
</tr>
<tr>
<td>✔️ Inside view</td>
<td>✔️ Inside view</td>
<td>✔️ Inside view</td>
<td>✔️ Inside view</td>
</tr>
</tbody>
</table>
SITE CONDITIONS

Soil conditions

Bearing Capacity 5000 psf

Sandy soil

Water table: 15 feet

Seismic loads

USGS - Provided Output

\[ S_S = 2.245 \, g \quad S_{MS} = 2.245 \, g \quad S_{DS} = 1.479 \, g \]

\[ S_1 = 0.823 \, g \quad S_{M1} = 1.234 \, g \quad S_{D1} = 0.823 \, g \]
## BUILDING LOADS

<table>
<thead>
<tr>
<th>Use</th>
<th>Uniform (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>50</td>
</tr>
<tr>
<td>Classroom</td>
<td>40</td>
</tr>
<tr>
<td>Auditorium</td>
<td>100</td>
</tr>
<tr>
<td>Roof</td>
<td>40</td>
</tr>
<tr>
<td>Stairs</td>
<td>100</td>
</tr>
<tr>
<td>Corridors</td>
<td>100</td>
</tr>
</tbody>
</table>

Load combinations:
- 1.4 D
- 1.2 D + 1.6 L
- 1.2 D + 0.5 L + 1.0 E

Total Base Shear = 918 kips
LOAD PATH
Earthquake resilience

Architecture and structure fit

Exposed structure

Standard elements
BASEMENT - RETAINING WALL

12’

130’
**RETEAINING WALL**

Shear force \[ \text{min} = -63 \text{ kN/m} = -4.3 \text{ kip/ft} \]

Bending moments \[ \text{min} = -86.4 \text{ kNm/m} = -19.4 \text{ kip-ft/ft} \]
- Schöck BOLE software
- Punching force = 314 kip
- After the reinforcements is placed
Hilti software - Profis anchor
Earthquake resilience

Architecture and structure fit

Exposed structure

Standard elements
BUCKLING RESTRAINED BRACED FRAMES
Concept Development Design

Architect Approved Placement
BRB PLACEMENT EVOLUTION

Coordination in progress

Final Design
DISPLACEMENTS FOR EARTHQUAKE LOAD

Ss = 2.245 g
S1 = 0.823 g
Site Class D
FLOOR SYSTEM

Earthquake resilience

Architecture and structure fit

Exposed structure

Standard elements
GROUND FLOOR FRAMING

- Retaining Wall 12”
- Beams:
  - W12x26
  - W14x82
  - W12x58
  - W10x26
- Columns:
  - W14x109
  - W14x193
  - W14x159
  - W12x50
- Bracing:
  - BRBF $A_{core} = 9.5 \text{ in}^2$
- Slimdek engineered flooring system - Comflor 210
- Fire protection of the beam (2 Hr)
- Lightweight concrete
- Reduction of floor thickness
- Optimal spans 12’ to 36’
- Thicker web and flange
- Welded plate 16” x 2.5” under beam profile
- Slimflor Fabricated Beam (SFB)
Max 0.53”

Max 0.70”
Earthquake resilience

Architecture and structure fit

Exposed structure

Standard elements
FIRST FLOOR FRAMING

Beams:
- W12x26
- W12x58
- W12x58
- W10x26
- W21x93

Columns:
- W14x109
- W14x193
- W14x159
- W12x50

Truss Diagonals:
- W14x68

Bracing:
- BRBF $A_{core} = 9.5 \text{ in}^2$
Beams:
- Yellow: W12x26
- Red: W12x58
- Purple: W14x82
- Pink: W10x26
- Pink: W21x93

Columns:
- Green: W14x109
- Green: W14x159
- Pink: W14x193

Truss Diagonals:
- Blue: W14x68

Bracing:
- BRBF $A_{core} = 9.5$ in$^2$
CANTILEVER SUPPORT

Truss Members:
- W14x68

Bracing:
- BRBF $A_{\text{core}} = 9.5 \text{ in}^2$
CANTILEVER DESIGN

Earthquake resilience

Architecture and structure fit

Exposed structure

Standard elements
CANTILEVER SUPPORT

Truss Members:
W14x68

Bracing:
BRBF $A_{core} = 9.5 \text{ in}^2$
CANTILEVER EVOLUTION

1. Only diagonals  (Week 7)
   Max 2.22”

2. Added columns  (Week 8)
   Max 1.53 ”
3. Additional diagonal at the end (Week 11)

4. Architect protests → thicker beams W21 (Week 12)
HVAC DESIGN

Central Shaft

Min. 10’ ceiling height

Air-intake from outside

- Central Shaft
- Min. 10’ ceiling height
- Air-intake from outside
HVAC CONCEPT

UCLA cogeneration plant

- Heating
- Cooling
- Electricity
- Inlet
- Exhaust
- AHU
- MEP room

MEP room
FLOOR SANDWICH

100

A - SE - MEP

Rooms

Hallways

12'

10' 2"

9' 2"

12" 14"
13 kWh/ft²
GFA: 17000 ft²
346,000 kWh annually
ROUTING DESIGN

Min. 400 SqFt
Technical room

Regular MEP
System

Thermal Comfort
CLASH AVOIDANCE

Interference Check

Runs an interference check report, or shows the most recent report.

An interference check identifies elements that intersect one another within a project, or between the host project and a linked model. The report locates invalid intersections between elements of different types, whereas the Copy/Monitor tool monitors pairs of elements of the same type.

Press F1 for more help
CONSTRUCTION SITE

Max. constructions cost

Risk

Utilizes prefabrication

Constructability
SITE PLAN

Job Site

Car Parking

Emergency Area

Le Conte Ave

Gayle Ave
EQUIPMENT SELECTION

Mobile Crane
Grove TMC540
- Max Lift Capacity: 40 ton
- Boom Length: 102 ft (+26~45ft extension)

Concrete Pump
BPL2525-5KVM39X
- Boom Length: 128 ft
- Max Concrete Output: 210 cubic yards / hour

Excavator
John Deere G250LC
- Max Digging Depth: 25 ft
- Arm Digging Force: 25,224–25,628 lb

Scissor Lift
GS 3390RT
- Max Lift Capacity: 2500 lb
- Maximum Working Height: 39ft
SITE ADDITIONS

Sedimentation & Erosion Control Fence

Truck Wheel Wash

Recycling
Max. constructions cost

Risk

Utilizes prefabrication

Constructability
Start Construction
Mon 9/30/19

Superstructure complete
Mon 1/13/20

Site
Mon 9/30/19

Substructure
Mon 10/14/19 - Fri

Superstructure
Mon 11/18/19 - Mon 1/13/20

Interior
Mon 12/16/19 - Mon 4/6/20

Exterior
Fri 12/20/19 - Fri 3/13/20

Services
Fri 1/31/20

Equ. Mon
March 1 | April 1 | May 1 | June 1 | July 1 | 08/28/20

- CSM Move In
  Mon 4/27/20

- Equipment
  Mon 4/6/20 - Fri 5/8/20

- Finishes
  Mon 4/6/20 - Mon 5/25/20

- Site Improvement
  Fri 3/13/20 - Fri

- Building Close Out
  Mon 4/28/20 - Fri 7/17/20

- Project Complete
  Fri 7/17/20

- 6 weeks
SCHEDULE OPTION 1

Sequence

OA  OB  OC

1A  1B  1C

2A  2B  2C

(plus roof 3A, 3B)

11 Zones

Option 1 - 48 Weeks

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>09/30/2019</td>
</tr>
<tr>
<td>Structural completion</td>
<td>01/30/2020</td>
</tr>
<tr>
<td>Instructional lab delivery</td>
<td>05/04/2020</td>
</tr>
<tr>
<td>Completion</td>
<td>08/28/2020</td>
</tr>
</tbody>
</table>
SCHEDULE OPTION 2

Sequence

<table>
<thead>
<tr>
<th>OA</th>
<th>OB</th>
<th>OC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>1B</td>
<td>1C</td>
</tr>
<tr>
<td>2A</td>
<td>2B</td>
<td>2C</td>
</tr>
</tbody>
</table>

(plus roof 3A, 3B)
11 Zones

Option 2 - 42 Weeks

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>09/30/2019</td>
</tr>
<tr>
<td>Structural completion</td>
<td>01/13/2020</td>
</tr>
<tr>
<td>Instructional lab delivery</td>
<td>04/27/2020</td>
</tr>
<tr>
<td>Completion</td>
<td>07/17/2020</td>
</tr>
</tbody>
</table>
Max. constructions cost

Risk

Utilizes prefabrication

Constructability

$10,000,000
SITE LAYOUT

Site Work Completion

11/15/2019

1 Site Trailers
2 Material Laydown
3 Recycling
4 Toilets
5 Crane
6 Truck Entrance
7 Truck Exit
1 Site Trailers
2 Material Laydown
3 Recycling
4 Toilets
5 Crane
6 Truck Entrance
7 Truck Exit

Structural Completion
01/13/2020
SITE LAYOUT

Instructional Lab Delivery

04/27/2020

1 Site Trailers
2 Material Laydown
3 Recycling
4 Toilets
5 Crane
6 Truck Entrance
7 Truck Exit
INSTRUCTIONAL LABS EARLY DELIVERY

-1. Basement

CSM Accessible Area

Closed Off Area
4D Simulation
Max. constructions cost

Risk

Utilizes prefabrication

Constructability
PREFABRICATION

As much as Possible!

- Stairs
- Structural Steel
- Prosolve370e Facade Panels
- Glass Curtain Wall System
- Windows & Doors

CM
<table>
<thead>
<tr>
<th>Company</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star Seismic Group</td>
<td>BRBs</td>
</tr>
<tr>
<td>Paramount Inc</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Sun Pacific Glazing</td>
<td>Curtain Wall</td>
</tr>
<tr>
<td>Habitat Gardens</td>
<td>Green Roof &amp; Landscaping</td>
</tr>
<tr>
<td>Demcon Concrete</td>
<td>Concrete</td>
</tr>
<tr>
<td>Limbach Company</td>
<td>HVAC</td>
</tr>
<tr>
<td>Elegant Embellishments Limited</td>
<td>Prosolve 370e Facade</td>
</tr>
</tbody>
</table>
- Easy Installation!
- 3D Printing Panels
BASEMENT - WATERPROOFING

- Retaining wall
- Water table
- Waterproofing mortar
- Membrane
- waterproofing system

2’ excavated
12’
14’’
CANTILEVER CONSTRUCTION
CANTILEVER CONSTRUCTION
SAFETY

No hat
No boots
No vest
No job
No exceptions!

Personal Protective Equipment

Safety Incentive

Stretch “N” Flex

Stop men/women

Above OSHA Standards

Zero Tolerance for Accidents

Construction Fall Protection
COLLABORATION DURING CONSTRUCTION
CONSTRUCTION COST

Max. constructions cost

Risk

Utilizes prefabrication

Constructability
<table>
<thead>
<tr>
<th>Item</th>
<th>Estimated Value</th>
<th>Target Value</th>
<th>Value Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>$8,444,000</td>
<td>$8,840,000</td>
<td>$396,000</td>
</tr>
<tr>
<td>A Substructure</td>
<td>$437,000</td>
<td>$884,000</td>
<td>$447,000</td>
</tr>
<tr>
<td>B Shell</td>
<td>$2,402,000</td>
<td>$2,210,000</td>
<td>$(192,000)</td>
</tr>
<tr>
<td>C Interiors</td>
<td>$1,449,000</td>
<td>$1,326,000</td>
<td>$(123,000)</td>
</tr>
<tr>
<td>D Services</td>
<td>$2,484,000</td>
<td>$2,475,000</td>
<td>$(9,000)</td>
</tr>
<tr>
<td>E Equipment and Furnishing</td>
<td>$308,000</td>
<td>$619,000</td>
<td>$311,000</td>
</tr>
<tr>
<td>F Specialty Construction</td>
<td>$266,000</td>
<td>$265,000</td>
<td>$(1,000)</td>
</tr>
<tr>
<td>G Building Sitework</td>
<td>$399,000</td>
<td>$442,000</td>
<td>$43,000</td>
</tr>
<tr>
<td>H General Conditions</td>
<td>$699,000</td>
<td>$619,000</td>
<td>$(80,000)</td>
</tr>
</tbody>
</table>

**TVD - Targets by Cluster**

- **Target Value**
- **Estimated Value**
- **Value Delta**
COST EVOLUTION

<table>
<thead>
<tr>
<th>DATE</th>
<th>ESTIMATE</th>
<th>DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target</td>
<td>$8,840,000</td>
<td></td>
</tr>
<tr>
<td>RS Means</td>
<td>$9,983,000</td>
<td>$(1,143,000)</td>
</tr>
<tr>
<td>Origional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-Feb</td>
<td>$9,500,000</td>
<td>$(660,000)</td>
</tr>
<tr>
<td>23-Feb</td>
<td>$9,000,000</td>
<td>$(160,000)</td>
</tr>
<tr>
<td>2-Mar</td>
<td>$9,000,000</td>
<td>$(160,000)</td>
</tr>
<tr>
<td>9-Mar</td>
<td>$9,000,000</td>
<td>$(160,000)</td>
</tr>
<tr>
<td>16-Mar</td>
<td>$8,529,000</td>
<td>$311,000</td>
</tr>
<tr>
<td>23-Mar</td>
<td>$8,215,000</td>
<td>$625,000</td>
</tr>
<tr>
<td>30-Mar</td>
<td>$8,552,000</td>
<td>$288,000</td>
</tr>
<tr>
<td>6-Apr</td>
<td>$7,918,000</td>
<td>$922,000</td>
</tr>
<tr>
<td>13-Apr</td>
<td>$8,250,000</td>
<td>$590,000</td>
</tr>
<tr>
<td>20-Apr</td>
<td>$8,459,000</td>
<td>$381,000</td>
</tr>
<tr>
<td>27-Apr</td>
<td>$8,459,000</td>
<td>$381,000</td>
</tr>
<tr>
<td>30-Apr</td>
<td>$8,444,000</td>
<td>$396,000</td>
</tr>
</tbody>
</table>
WEEKLY COST/TVD UPDATE PROCESS

17-04-2016

24-04-2016

CM
WEEKLY COST/TVD UPDATE PROCESS

- Item 1
- Item 2
- Item 3
- Item 4
## COST INTEGRATION

### Max. constructions cost
- $10,000,000

### Risk
- Utilizes prefabrication

### Constructability
- Utilizes prefabrication
## COST INFORMATION INTEGRATION

Integrated cost information in architectural model

<table>
<thead>
<tr>
<th>Total Cost</th>
<th>33335.65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Price</td>
<td>48.85</td>
</tr>
</tbody>
</table>
COST INFORMATION INTEGRATION

Integrated cost information in structural model
MODEL ITEM BASED BOQ

All items in BOQ are visually trackable in BIM model

CM
MODEL ITEM BASED BOQ

All items in BOQ are visually trackable in BIM model
CROSS DISCIPLINE DECISION MAKING

Min. 4% daylight factor

Smaller windows towards south-west

Shading

Water saving
### REVISING FLOOR PLAN LAYOUT

<table>
<thead>
<tr>
<th>Structural</th>
<th>Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High live load on cantilever</strong></td>
<td><strong>OPTION 1</strong></td>
</tr>
</tbody>
</table>

#### Structural Diagram
- [High load on cantilever diagram]

#### Architecture Diagram
- **BLOCK DIVISION**
  - Common
  - Educational
  - Administration

- **LAYER DIVISION**

#### Options
- **OPTION 1**
- **OPTION 2**
### Revising Floor Plan Layout

<table>
<thead>
<tr>
<th>MEP</th>
<th>Construction</th>
<th>LCFM</th>
</tr>
</thead>
</table>
| High internal load  
High external load | Thicker beams and columns  
Difficult to construct  
Higher cost | Higher cleaning cost |
| High internal load  
Low external load | Smaller steel frame  
Less cost | Possibility of renting out classrooms on the cantilever (Sky Lounge) |
Exposed structure - Intumescent painting

Hidden structure - fire resistant plasterboards
Resolved all major clashes
End result: down to 48 “noise” clashes
Good Air Quality

- Good Air Quality

- Sunlight in tenant space
- Views to outside views from every room
- Served by multiple elevators
- 30 sq ft parking
- 10 sq ft balcony
- Air conditioning
- Desks for the city and work at home
- Conference facilities
- Wi-Fi throughout
- High natural light
- Water saving
- Air conditioned outside
- Air filtration system
- Equipment room on each floor
- Building's own hot water
- LED exit and emergency lighting
- Access to public transit
- Built in storage
- Symmetry
- Earthquake resistance
- High performance glass
- Privacy and security
- Utilizes daylighting
- Standard elements
- Simplicity
- Bend resistant
- Integration of solar panels
- Small windows/doors in south walls
- Thermal comfort
AIR QUALITY
AIR-CLEANING FACADE EVOLUTION

DOUBLE FACADE

SINGLE FACADE
QUALITATIVE COMPARISON OF IDEAS

Biodynamic Concrete Facade

Algae Farm

Prosolve 370e

Vacuum Brick Facade
<table>
<thead>
<tr>
<th>Function</th>
<th>Biodynamic Concrete Facade</th>
<th>Algae Farm</th>
<th>Prosolve 370e</th>
<th>Vacuum Brick Facade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filters CO2 from air</td>
<td>Produces oxygen from sunlight and CO2 via photosynthesis</td>
<td>Filters NOx (smog) from air Activated by sunlight</td>
<td>Filters particles from air</td>
<td></td>
</tr>
<tr>
<td>Implementation</td>
<td>Facade -- provides shading</td>
<td>Could be on facade or roof top park -- urban garden</td>
<td>Can be added as coating to the shading system</td>
<td>Facade -- provides shading</td>
</tr>
<tr>
<td>Architectural Synergy</td>
<td>Fits with architecture</td>
<td>Requires architectural creativity</td>
<td>Potential to fit with architecture</td>
<td>Requires coordination -- could be load bearing</td>
</tr>
<tr>
<td>Notable Features</td>
<td>Synergy = facade/shading + air purification</td>
<td>Produces algae for harvest -- potential for revenue or green electricity</td>
<td>Self cleaning Tile frame made of plastic -- no concrete emissions</td>
<td>Filters 100% of coarse particles and 30% of fine particles</td>
</tr>
</tbody>
</table>
FACADE FINAL SELECTION

Min. 4% daylight factor

Smaller windows towards south-west

Shading

Water saving
INTEGRATED ANALYSIS

AIR CLEANING SYSTEM
Prosolve 370e

Carbon output = 3,613,171 kgCO2e

LCC Cost = $ 9,500,000

Initial Cost = $ 384.654
INTEGRATED ANALYSIS

AIR CLEANING SYSTEM
Prosolve 370e

AIR CLEANING SYSTEM
Biodynamic Concrete
INTEGRATED ANALYSIS

AIR CLEANING SYSTEM
Biodynamic Concrete

Carbon output = 6,019,105 kgCO2e

LCC Cost = $11,195,907

Initial Cost = $67,374
<table>
<thead>
<tr>
<th></th>
<th>Prosolve 370e</th>
<th>Biodynamic Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TVD Initial cost</strong></td>
<td>$ 384,000</td>
<td>$ 195,286</td>
</tr>
<tr>
<td><strong>STV carbon output</strong></td>
<td>3,613,171 kgCO2e</td>
<td>6,019,105 kgCO2e</td>
</tr>
<tr>
<td><strong>LCC with facade</strong></td>
<td>$ 9,492,546</td>
<td>$ 11,195,907</td>
</tr>
<tr>
<td><strong>Air pollution cleaning</strong></td>
<td>NOx and VOC → CO2 and Water</td>
<td>NOx and VOC → CO2 and salt</td>
</tr>
<tr>
<td><strong>Material</strong></td>
<td>Liquid coat with a superfine titanium dioxide (TiO2) Plastic piles</td>
<td>highly fluid injectable cement mortar</td>
</tr>
<tr>
<td><strong>Structural implementation</strong></td>
<td>Lighter, more flexible and simple attachment</td>
<td>Heavier and stronger structural frame needed</td>
</tr>
<tr>
<td><strong>Additional information</strong></td>
<td>UV, selfcleaning, flexible usage, replacement of single piles</td>
<td>UV, replacement of whole pane</td>
</tr>
</tbody>
</table>
**SUSTAINABILITY**

- **Min. 4% daylight factor**
- **Smaller windows towards south-west**
- **Shading**
- **Water saving**
INPUT BUILDING DATA

02.01.02 - Epicenter - Struct - V1

Use Phase Impacts
Inventory and Impact Assessment
Team: Central

STV-03-11-2016

Carbon (kgCO2e)  Energy (MJ)  Water (kgH2O)
WATER CHALLENGE

Vacuum toilet

Water line to bowl

Vacuum motor

Waste discharge to holding tank

Vacuum switch

Vacuum body

Vacuum tank

Waste inlet

Waste discharge to vacuum generator

Carbon (kgCO2e)  Energy (MJ)  Water (kgH2O)

03-18-2016  03-25-2016  04-01-2016

Vacuum toilets
TEAM CENTRAL
62 Points
LIFE CYCLE MANAGEMENT

Value for money

Life Cycle

Cost
VALUE FOR MONEY

LC cost
Construction cost
Carbon output
Water
Energy
Materiality
Building shape
Integration of nature

Indoor
Outdoor
Maintenance of system
Indoor climate/thermal comfort
Space
Noise
Schedule
Simplicity
Site planning

Is the main idea well adapted into the building concept
Structural design
Level of damage in case of an earthquake
Flexible usage of the spaces
Ratio (assignable Area/Gross total)
Building program

A- SE- MEP - CM - LCFM
FLOW OF INFORMATION

- Revit
  - Quantity Takeoff
  - Room Schedule
  - TVD
  - STV
  - Cash Flow

- Rent

- Discussion

- Value

- Decision
TVD Winter = 8,45 million
TVD Fishbowl = 8,55 million
TVD Spring = 8,45 million

Rent Winter = 25 million
Rent Fishbowl = 24 million
Rent Spring = 22 million
EVOLUTION OF COSTS

Rent

Winter 25 Million

Spring 22 Million

Annual $892,000
LIFE CYCLE COST

Value for money

Life Cycle

Cost
OPERATION & MAINTENANCE COSTS

OPERATION
$ 4.7 Million

MAINTENANCE
$ 1 Million

REPLACEMENT
$ 1.2 Million
REPLACEMENT STRATEGY

Replacement Costs
$ 1.2 Million

Additional Credit
$ 400,000

Year 15  $ 300 T
Year 20  $ 300 T
Year 24  $ 200 T
Year 25  $ 400 T
CASH FLOW

Break Even Year 18

INCOME
$ 22.5 Million

OUTCOME
$ 19 Million

LCFM
I can’t come to the meeting at that time.

I can’t speak for the entire owner team.

I am not up to date.

I don’t feel engaged in the meeting.
WEEKLY UPDATE

DISTRIBUTE FINAL COPY

FEEDBACK & INFORMATION REQUEST

DISCUSSION PLATFORM

TEAM
**Team Process:**

**A:** Floor plans locked - based on selection from last owner meeting
Additional restrooms and emergency exit added.

**SE:** Ran Etabs analysis
Updated BRBF placement

**MEP:** Ran clash detection with MEP - SE - updated routing of ductwork
Updated STV

**CM:** Added 2 additional outside stairs ($28600), interior windows ($22524), floors ($27082), interior folding walls and outer walls ($49936)-- construction cost increased by $127,616
Construction zoning and Site changes

**LCFM:** Updated CF analysis (**A,SE,MEP,CM)**
SE - Column Placement Changes

- Coordination with architecture
- Moving auditorium columns from middle to outside wings
- Enabled BRB to be placed on farthest north wall for increased stability

STV Evolution

Construction Updates

New Strategies

- Extend site to one street lane for truck entrance and exit access
  - Slight increase in construction cost
- Remove site offices for more and safer space for the cantilever work
  - Possibly rent space nearby or use off-site emergency area
  - No cost impact

WEEKLY UPDATE

Life cycle cost: $456,000
Construction cost: $8,838,116

Costs

Materiality:
Building shape:
Integrations of nature:

A discussing for team meeting
Terrasse at the east inner corner:
Integration of a green wall in lobby

Indoor:
Outdoor:
Maintenance of system:

IAQ analysis being verified in IDA ICE
The shading facade in progress
Only one layer of the facade
Hey! We got good feedback, let's keep it up!

Hey! We have something to work on this week!
TEAM PROCESS
No Emails!

TEAM

Eva/Architect
Nicolaj/Architect
Ales/Structural
Melissa/Structural
Birthe/MEP
Tawa/CM
Han/CM
Weekly meetings in TERF

Stanford 9 AM PST
Leicester 5 PM GMT
Copenhagen 6 PM CET
TIMELINE

Week 1
Kick off

Week 2
Shared Grid
Merged ARCH and
STRUCT Revit
Model

Week 6
Peer Review

Week 8
TERF Walkthrough

Week 9
Winter presentation

TEAM
Consistency of

BIG IDEA

Win the challenges
FAVORITE MOMENTS

Singing happy birthday to Birthe in Terf, it was “perfect” :D and unharmonized!
Tawa let the milkshake fly!
Random visitor in our terf room (surely wasn’t Camilla from Island!)
Silly group pictures!

Volleyball Match

Cheesecake DINNER
**PROSOLVE 370e**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td></td>
<td>Plastic piles</td>
</tr>
<tr>
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</tr>
</tbody>
</table>
AIR QUALITY SUMMARY

- 120,000 GAL
  - Annual

- 150 Bikes

- 135,000 kWh.
  - Annual

- 220,000 kWh.
  - Annual

- 1,226 Cars
  - Emission cleaned today

- 225 Cars
  - Emission cleaned today

- Facade

- External shading
  - 10%
  - Energy saved

- Basement
  - 10%
  - Energy saved
CLIENT AFFINITY SUMMARY

WEEKLY UPDATE

SURVEY

USER GAME

ICON GOAL LINKING

ICONS - CROSS-DISCIPLINARY LANGUAGE

Costs

Value

30,000 Sqft
Most importantly, we had a lot of fun!

Aleš: “Calculating time for all possible time zones is not easy even at the end of the project”

Eva: “Even if you are saying the same thing, it doesn’t mean you mean the same thing”

Birthe: “Multidisciplinary design is one thing. Multicultural design is a whole other thing”

Tawa: “It’s not about the people on the team, it’s about the team and it’s people”

Han: “Should start interaction with other disciplines earlier and more actively”

Melissa: “Talk less, listen more, and always spend time preparing the agenda”

Nicolaj: “Rather ask three times than never”
THANK YOU

SUPER OWNER
Renate Fruchter

OWNERS
Jakob Feldlager
Norayr Badasyan
Mandy Bug
Ryan Coakley

MENTORS
Glenn Katz
Forest Olaf Peterson
Björn Wünsch
Tomo Cerovšek
David Bendet
Willem Kymmel
Humberto Cavallin
Josh Odelson
Erik Kneer
Eduardo Miranda
Greg Luth
Justin Schwaiger

MENTORS
Elizabeth Joyce
John Nelson
Ronnie Haagensen

TA
Flavia Grey
Maria Frank

And all the other Angels