PROJECT LOCATION
PROJECT OVERVIEW
SITE CONTEXT

- Lake Merced
- Natural Surroundings
- High School
- Shopping center
- Site Slope
- SFSU Campus
- Seismic Zone

OPPORTUNITIES

- OPPORTUNITIES

CHALLENGES

- CHALLENGES

HAZARDS

- HAZARDS
SFSU CAMPUS CONTEXT
WIND ROSE - SAN FRANCISCO

- Prevailing wind from SW

SITE CONTEXT WATER

TEMPERATURE & PRECIPITATION - SAN FRANCISCO
-Moderate climate with low precipitation levels

SITE CONTEXT SUN PATH
SITE CONTEXT

STRUCTURAL

SEISMIC CONDITIONS
SITE CONTEXT STRUCTURAL

SOIL CONDITIONS & WATER TABLE

WELL SORTED MEDIUM SAND

BEARING CAP.
3500 PSF

14 ft
CRITERIA FOR DECISION MATRIX
# Alternatives Summary

<table>
<thead>
<tr>
<th></th>
<th>Box</th>
<th>Skeleton</th>
<th>Steel</th>
<th>Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Time</td>
<td>35 weeks</td>
<td>38 weeks</td>
<td>48 weeks</td>
<td>51 weeks</td>
</tr>
<tr>
<td>Early Occupancy Date</td>
<td>05/06/20</td>
<td>05/27/20</td>
<td>08/07/20</td>
<td>08/26/20</td>
</tr>
<tr>
<td>Construction Cost</td>
<td>$9.5 million</td>
<td>$9.2 million</td>
<td>$9.7 million</td>
<td>$9.9 million</td>
</tr>
<tr>
<td>GWP (kg CO2-eq)</td>
<td>4,754,854</td>
<td>5,636,275</td>
<td>4,363,543</td>
<td>9,733,475</td>
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<tr>
<td>Energy (MJ) 50 Years</td>
<td>153,297,052</td>
<td>190,309,656</td>
<td>138,696,681</td>
<td>359,159,061</td>
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<tr>
<td>Water (kgH2O-eq) 50 Years</td>
<td>288,529,904</td>
<td>289,336,838</td>
<td>290,754,462</td>
<td>297,310,083</td>
</tr>
</tbody>
</table>
SCHEDULE COMPARISON

- **35 WEEKS**
  - Prelim: 3 weeks
  - SubStruct: 10.5 weeks
  - Shell: 10.5 weeks
  - Interior: 7 weeks
  - Closeout: 4 weeks

- **38 WEEKS**
  - Prelim: 3 weeks
  - SubStruct: 11 weeks
  - Shell: 9 weeks
  - Interior: 11 weeks
  - Closeout: 4 weeks

- **48 WEEKS**
  - Prelim: 3 weeks
  - SubStruct: 8 weeks
  - Shell: 11 weeks
  - Interior: 14 weeks
  - Landscape & Façade: 5 weeks
  - Closeout: 5 weeks

- **51 WEEKS**
  - Prelim: 3 weeks
  - SubStruct: 10 weeks
  - Shell: 14 weeks
  - Interior: 14 weeks
  - Landscape & Façade: 5 weeks
  - Closeout: 5 weeks
DECISION MATRICES

EXPEDITE - BOX

EXPEDITE - SKELETON

EVOLVE - STEEL

EVOLVE - CONCRETE
DPR OCCUPANT WELL-BEING

OWNERS

PROJECT TEAM

SMART COMMISSIONING

MANUAL FOR THE
21st CENTURY OCCUPANT

OCCUPANT
SPACE-MATE FLEXIBLE SPACE

PROJECT REQUIREMENTS

EFFICIENT SPACE

OCCUPANT
BUILDING OCCUPANT WANTS

- Co-Work Spaces
- Private Office
- Social Spaces
- Study Space
- Cafe
- 21st Century Equipment
- Wayfinding

- Student
- Professor
- Visitors
- Commuters
- Building Manager
- Researcher

- Natural Light
- Storage Space
- Flexible Space
- Community Events
- Easy Operation
- Good Air Quality
BUILDING OCCUPANT NEEDS

LIGHT
AIR
MIND
INNOVATION
WATER
FITNESS
NOURISH
COMFORT
LEARNING L.A.B. - LIGHT, AIR QUALITY, BALANCE
EXPEDITE

SEP 2019  DEC 2019  MAR 2020  JUN 2020  SEP 2020

TRADITIONAL

SEP 2019  DEC 2019  MAR 2020  JUN 2020  SEP 2020

LIGHT  AIR QUALITY  BALANCE

DAYS SAVED

000
EXPEDITE FORMING
SITE CONTEXT
VIEW FROM SOUTH
LEVEL 2

INSTRUCTIONAL LABS
SMALL CLASSROOMS
SEMINAR ROOMS
STUDENT OFFICES

MEP SHAFT
STAIRS
RESTROOMS
SECTION B-B (north/south)
ELEVATIONS - WEST
ELEVATIONS - NORTH
ELEVATIONS - SOUTH
3D PLANS - 1st FLOOR
3D PLANS - 3rd FLOOR
ADJUSTABLE SPACE
ATRIUM VIEW

![Image of a person wearing a cardboard VR headset]

![QR Code]

46
SECOND FLOOR VIEW
SECONd FLOOR VIEW
EXPEDITE

SEP 2019
DEC 2019
MAR 2020
JUN 2020
SEP 2020

DAYS SAVED
000

TRADITIONAL

SEP 2019
DEC 2019
MAR 2020
JUN 2020
SEP 2020

OUTDOOR COURTYARD
ZONING
ACCOYA
FLEXIBLE ATRIUM

PUSH & PULL
CAFE
GREEN WALL
ATRIUM LIGHTWELL
CO-WORK SPACES
SUN MOVEMENT
SUN MOVEMENT
SUN PATH
EXTERIOR PANEL LAYERS

- Prefabricated Element - Sit on Slab
- Accoya Wood Rain Screen
- Curtain wall w/glazing & operable window
- Sliding whiteboards providing shading
- 8” Metal Stud Framing Insulation Waterproofing
D3. EXT. PANEL CONNECTION

Accessories wood (finish)
EPS, exterior insulation
air
air infiltration barrier (membrane)
plywood sheathing
metal studs
vapor retarder (membrane)
typural wall board (finish)
D1. conXtech column with panels

- plywood panel (finish)
- fireproof gypsum board
- sound insulation/wooden studs
- fireproof gypsum board
- plywood panel (finish)

- conXtech column collar perimeter
- conXtech steel column fireproof gypsum board

- Accoya wood (finish)
- EIFS, exterior insulation
- air
- air infiltration barrier (membrane)
- plywood sheathing
- metal studs
- vapor retarder (membrane)
- gypsum wall board (finish)
Component Log

Accoya wood (finish)...
EIFS, exterior insulation...
Air...
Air infiltration barrier (membrane)
Plywood sheathing...
Metal studs...
Vapour retarder (membrane)...
Gypsum wall board (finish)...

HPB | SHELL - reduction
HPB | SHELL -reduction
HPB | SHELL -reduction

![Graph showing percent reduction over iterations](image-url)
INTERIOR PANEL LAYERS

TYPE A

TYPE B
Panel layers:

- Plywood (finish) ½"
- Fireproof gypsum board ½"
- Wooden studs 4"x2"
- Insulation 4"
- Fireproof gypsum board ½"
- Plywood (finish) ½"
INTERIOR PANEL LAYERS

Type A

Type B
D2. Interior panel connections

- **Connection A**
  - Ready precast panel

- **Connection B**
  - Steel profile
  - Polyurethane cover

- **Connection C**
  - Steel profile
  - Concrete slab
  - Polyurethane covering

The steel profile is first mounted to the concrete slab, and later the panel is inserted.
STRUCTURAL DESIGN PROCESS
EXPEDITED

SEP 2019  DEC 2019  MAR 2020  JUN 2020  SEP 2020

DAYS SAVED

69

PUSH & PULL

OUTDOOR COURTYARD

ZONING

ACCOYA

FLEXIBLE ATRIUM

CAFE

GREEN WALL

ATRIUM LIGHTWELL

CO-WORK SPACES

NATURAL LIGHT

EXTerior PANELS

MOVEABLE SHADES

interior WOOD PANELS

SKELETON MODULAR

EXPERIENCE

0 1 3

TRADITIONAL
SITE CONDITIONS

SEISMIC CONDITIONS

SOIL CONDITIONS & WATER TABLE

WELL SORTED MEDIUM SAND

BEARING CAP. 3500 PSF

14 ft
**TYPICAL BUILDING LOADS**

### LIVE LOADS

<table>
<thead>
<tr>
<th>USE</th>
<th>UNIFORM LOAD (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offices</td>
<td>50</td>
</tr>
<tr>
<td>Faculty offices</td>
<td></td>
</tr>
<tr>
<td>Department Chair’s offices</td>
<td></td>
</tr>
<tr>
<td>Senior Administration Office</td>
<td></td>
</tr>
<tr>
<td>Student Offices</td>
<td></td>
</tr>
<tr>
<td>Administrative Assistants</td>
<td></td>
</tr>
<tr>
<td>Corridors (1st Floor)</td>
<td>100</td>
</tr>
<tr>
<td>Corridors (above 1st Floor)</td>
<td>80</td>
</tr>
<tr>
<td>Classroom</td>
<td>40</td>
</tr>
<tr>
<td>Large classrooms</td>
<td></td>
</tr>
<tr>
<td>Small classrooms</td>
<td></td>
</tr>
<tr>
<td>Seminar rooms</td>
<td></td>
</tr>
<tr>
<td>Stairs/Exits</td>
<td>100</td>
</tr>
<tr>
<td>Auditorium</td>
<td>60</td>
</tr>
<tr>
<td>Lobbies</td>
<td>100</td>
</tr>
</tbody>
</table>

### LATERAL LOADS

- 200 kips
- 900 kips
- 550 kips

Base shear = 1.650 kips

\[ T_n1 = 0.705 \text{ sec} \quad R = 8 \text{ (SMS)} \quad Cd = 5.5 \]

*Loads displayed are not reduced.*
STRUCTURAL SYSTEM

GRAVITY: ConXtech frame w/composite deck

LATERAL: Moment frame

FOUNDATION: Strap footings
SYSTEM LOAD PATH DIAGRAM

Gravity

Lateral
FOUNDATIONS PLAN

- 12’x12’ Footing
- 14’x14’ Footing
- 16’x16’ Footing
- 20’ Retaining Walls
FOOTING DETAILS

21#7

16ft

16ft

#7 rebar
RETAINING WALL DETAILS

Level 2: 0'-0"

Welded studs through deck to angle with studs at top of wall

Level 1: -18'-0"

Level 0: -22'-0"

Footing

12 in.

#4 @12 in.

#8 @24 in.

#8 @7 in.

#6 @8 in.
FOUNDATIONS SEQUENCE

Day 1: Footings w/ Retaining Walls
Day 2: Footings w/ Retaining Walls
Day 3: Footings w/ No Retaining Walls
Day 4: Interior Footings
EXPEDITED SOLUTION FOUNDATIONS

PREFAB REBAR CAGES

FAST FOOT
ConXL HSS (16 x 16 x 5/8")

ConXR HSS (8 x 8 x 5/8")

W30x90 conXtech girder
RBS: a = 14.875" b =25" c = 2.6"
12 Shear studs

W16x26 filler beams
(spaced @ 7.6 ft)

2VLI Composite steel deck
2" metal deck, 3.25" concrete
LW 3 KSI CONC.
¾" Studs
STRUCTURAL SECTION VIEW

- Roof: 26'-0"
- Level 3: 13'-0"
- Level 2: 0'-0"
- Level 1: -18'

Key Features:
- ConXtech Moment Frame
- Metal Deck Roof
- Concrete Fill
- Composite Floor
- Retaining Wall
STRUCTURAL SECTION VIEW

ConXtech Moment Frame

Metal Deck Roof

Roof: 26'-0"

Level 3: 13'-0"

Level 2: 0'-0"

Level 1: -18'

Concrete Fill

Composite Floor

Retaining Wall
GRAVITY CONNECTIONS

ISOMETRIC VIEW

PLAN VIEW
GRAVITY CONNECTION

SECTION CUT

SHOP

A325
\( \phi = \frac{3}{4}" \)
\( s = 3" \)

ON SITE

A325
\( \phi = \frac{3}{4}" \)
\( s = 3" \)
ROOF STRUCTURAL PLAN

- ConXL HSS (16 x 16 x 5/8")
- W21x90 conXtech girder
  RBS: a = 13.375"  b =18.250"  c = 2.1"
  # Shear studs
- W16x26 filler beams
  (spaced @ 7.6 ft)
- Lateral Bracing
- 1.5F20 Steel deck
  1.5" metal deck
ATRIUM BEAM SIZING

HSS 10 x 2-3/8
Max Deflection = 0.3 in
ATRIUM DISPLACEMENT
ROOF BEAMS ITERATION 1
ROOF BEAM DEPTH REDUCTION

ITERATION 1

ITERATION 2
ROOF BEAM DEPTH REDUCTION
ROOF BEAMS ITERATION 2
OUTDOOR COURTYARD
CAFE
GREEN WALL
ATRIUM LIGHTWELL
FLEXIBLE ATRIUM
CO-WORK SPACES
NATURAL LIGHT
MOVEABLE SHADES
INTERIOR WOOD PANELS
BEAM DEPTH REDUCTION
ACCOYA
SKELETON MODULAR
EXTerior PANELS
DAYS SAVED
0 5 3
D3. EXT. PANEL CONNECTION
Prefabricated Element - Sit on Slab

Accoya Wood Rain Screen

Curtain wall w/glazing & operable window

Sliding whiteboards providing shading

8" Metal Stud Framing Insulation Waterproofing
CLADDING DETAIL
ETABS Model
L/240 = 1.90"
STORY DRIFTS (%)
LOMA PRIETA EARTHQUAKE
TIME HISTORY ANALYSIS

SCALE FACTOR = 200
MEP STRATEGIES

- Orientation
- Synergy with Environment
- Building shape
- Building envelope

PASSIVE STRATEGIES
- HVAC systems
- Overhead mixed ventilation vs. Displacement ventilation
- Modular Bathroom

OPTIMIZATION STRATEGIES
MEP STRATEGIES

- PV PANELS

PRODUCTION STRATEGIES
STRUCTURAL DESIGN PROCESS
STRUCTURAL DESIGN PROCESS

A Design  Non load-bearing modules  Load-bearing modules  Simple frame & facade elements
STRUCTURAL SYSTEM
# Typical Building Loads

## Live Loads

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<th>Use</th>
<th>Uniform Load (PSF)</th>
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<tr>
<td>Auditorium</td>
<td>60</td>
</tr>
<tr>
<td>Lobbies</td>
<td>100</td>
</tr>
</tbody>
</table>

## Lateral Loads

- Base shear = 1.650 kips
- $T_{n1} = 0.705$ sec
- $R = 8$ (SMS)
- $C_d = 5.5$

*Loads displayed are not reduced.*
**STRUCTURAL SYSTEM**

**GRAVITY:** ConXtech frame w/composite deck

**LATERAL:** Moment frame

**FOUNDATION:** Strap footings
SYSTEM LOAD PATH DIAGRAM

Gravity

Lateral
FOUNDATION & RETAINING WALLS
FOUNDATIONS PLAN

12'x12' Footing
14'x14' Footing
16'x16' Footing
20' Retaining Walls
RETAINING WALL DETAILS

Level 2: 0'-0"

Welded studs through deck to angle with studs at top of wall

Level 1: -18'-0"

Level 0: -22'-0"

Footing

0' - 6"

0' - 8"

3' - 10"

12 in.

#4 @12 in.

#8 @24 in.

#8 @7 in.

18 in.

#6 @8 in.
Day 1: Footings w/ Retaining Walls
Day 2: Footings w/ Retaining Walls
Day 3: Footings w/ No Retaining Walls
Day 4: Interior Footings
EXPEDITED SOLUTION FOUNDATIONS

PREFAB REBAR CAGES

FAST FOOT
MEP STRATEGIES

- Orientation
- Synergy with Environment
- Building shape
- Building envelope
## Climate Conditions

### Comfort Criteria

<table>
<thead>
<tr>
<th>Concept</th>
<th>Calculation units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daylight factor criteria [DF]</td>
<td>[%]</td>
</tr>
<tr>
<td>Minimum-Maximum operative temperature range</td>
<td>[°C]</td>
</tr>
<tr>
<td>Fresh air supply- maximum CO2 concentration</td>
<td>[ppm]</td>
</tr>
</tbody>
</table>

### Energy Frame

<table>
<thead>
<tr>
<th>Concept</th>
<th>Calculation units</th>
<th>BR-15 Art. value</th>
<th>BR-20 Art. Value</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall insulation</td>
<td>(W/m2.K)</td>
<td>0.15</td>
<td>0.10</td>
<td>3.292</td>
<td>0.85</td>
<td>0.696</td>
<td>0.590</td>
<td>0.511</td>
<td>0.454</td>
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<tr>
<td>Floor insulation</td>
<td>(W/m2.K)</td>
<td>0.40</td>
<td>0.40</td>
<td>1.828</td>
<td>0.60</td>
<td>0.420</td>
<td>0.321</td>
<td>0.520</td>
<td>0.287</td>
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<tr>
<td>Roof insulation</td>
<td>(W/m2.K)</td>
<td>0.12</td>
<td>0.10</td>
<td>0.273</td>
<td>0.22</td>
<td>0.220</td>
<td>0.184</td>
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<tr>
<td>Groundfloor insulation</td>
<td>(W/m2.K)</td>
<td>1.40</td>
<td>0.80</td>
<td>2.840</td>
<td>2.27</td>
<td>1.990</td>
<td>1.990</td>
<td>1.820</td>
<td>1.820</td>
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<tr>
<td>Glazing U-factor</td>
<td>(%)</td>
<td>0.75</td>
<td>0.85</td>
<td>0.250</td>
<td>0.25</td>
<td>0.250</td>
<td>0.400</td>
<td>0.400</td>
<td>0.400</td>
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<tr>
<td>Visible Light Transmittance **</td>
<td>(%)</td>
<td>0.75</td>
<td>0.50</td>
<td>0.200</td>
<td>0.20</td>
<td>0.200</td>
<td>0.200</td>
<td>0.200</td>
<td>0.200</td>
</tr>
<tr>
<td>Daylight Factor</td>
<td>(%)</td>
<td>2.00</td>
<td>2.00</td>
<td>1.575</td>
<td>1.57</td>
<td>1.575</td>
<td>1.575</td>
<td>1.575</td>
<td>1.575</td>
</tr>
<tr>
<td>Leakage/infiltration</td>
<td>(m³/s.m²)</td>
<td>3.60</td>
<td>1.80</td>
<td>7.200</td>
<td>7.20</td>
<td>7.200</td>
<td>7.200</td>
<td>7.200</td>
<td>7.200</td>
</tr>
</tbody>
</table>

### Other Parameters ASHRAE

<table>
<thead>
<tr>
<th>Concept</th>
<th>Calculation units</th>
<th>BR-15 Art. value</th>
<th>BR-20 Art. Value</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting Power density</td>
<td>[W/m²]</td>
<td>8.800</td>
<td>8.800</td>
<td>8.800</td>
<td>8.800</td>
<td>8.800</td>
<td>8.800</td>
<td>8.800</td>
<td>8.800</td>
</tr>
<tr>
<td>Plug Load power density</td>
<td>[W/m²]</td>
<td>8.100</td>
<td>8.100</td>
<td>8.100</td>
<td>8.100</td>
<td>8.100</td>
<td>8.100</td>
<td>8.100</td>
<td>8.100</td>
</tr>
<tr>
<td>Heating setpoint</td>
<td>[°C]</td>
<td>19.000</td>
<td>19.000</td>
<td>19.000</td>
<td>19.000</td>
<td>19.000</td>
<td>19.000</td>
<td>19.000</td>
<td>19.000</td>
</tr>
<tr>
<td>Cooling setpoint</td>
<td>[°C]</td>
<td>22.000</td>
<td>22.000</td>
<td>22.000</td>
<td>22.000</td>
<td>22.000</td>
<td>22.000</td>
<td>22.000</td>
<td>22.000</td>
</tr>
<tr>
<td>Occupant density [person/14m²]</td>
<td>[p/m²]</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
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</tbody>
</table>

### HVAC Parameters

<table>
<thead>
<tr>
<th>Concept</th>
<th>Calculation units</th>
<th>BR-15 Art. value</th>
<th>BR-20 Art. Value</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Fan Power</td>
<td>[kW.s/m³]</td>
<td>8.30(9)</td>
<td>1.80</td>
<td>1.80</td>
<td>1.80</td>
<td>1.80</td>
<td>1.80</td>
<td>1.80</td>
<td>1.80</td>
</tr>
<tr>
<td>VAV (Variable Air Volume)</td>
<td>[kW.s/m³]</td>
<td>8.30(9)</td>
<td>2.10</td>
<td>2.10</td>
<td>2.10</td>
<td>2.10</td>
<td>2.10</td>
<td>2.10</td>
<td>2.10</td>
</tr>
<tr>
<td>Heating COP</td>
<td>COP</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
</tr>
<tr>
<td>Domestic heat pump</td>
<td>COP</td>
<td>3.60</td>
<td>3.60</td>
<td>3.60</td>
<td>3.60</td>
<td>3.60</td>
<td>3.60</td>
<td>3.60</td>
<td>3.60</td>
</tr>
<tr>
<td>Heat recovery &amp; Heat Pump</td>
<td>COP</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Cooling COP</td>
<td>COP</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Ventilation Rate</td>
<td>[L/s.m²]</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
</tr>
</tbody>
</table>

** Typical value inputted as no value provided
INDOOR CLIMATE CONDITIONS

PASSIVE HVAC Design Strategies

Comfort Target
PASSIVE HVAC Design Strategies

- Comfort Target
- Windows sun shading
- Thermal mass
- Internal heat gaining
- Passive solar direct gain
- Outdoor wind protection
- Heating
DAYLIGHT FACTOR - INITIAL

Passive HVAC Design Strategies
- Windows sun shading
- Internal heat gaining
- Passive solar gain
DAYLIGHT FACTOR - WINTER

Passive HVAC Design Strategies
- Windows sun shading
- Internal heat gaining
- Passive solar gain

3.65%
NEW DAYLIGHT FACTOR

Passive HVAC Design Strategies
- Windows sun shading
- Internal heat gaining
- Passive solar gain
ANNUAL RAINFALL: 504 g/ft²

ROOF AREA: 10,108 ft²

HARVEST POTENTIAL 13,940 g/day 5,087,975 g/yr
WATER HARVESTING - reduction
MEP STRATEGIES

- HVAC systems
- Overhead mixed ventilation vs. Displacement ventilation
- Modular Bathroom
HVAC DECISION MATRIX

DESIGN ASPECTS

- Aesthetics impact
- Noise & Vibration
- Design Flexibility
- Space impact /floor
- Space impact /ceiling
- Constructability /assembling & desassembling
- Synergy with Architecture/Weather /Site

INDOOR COMFORT ASPECTS

- Indoor Air Quality
- Particulate Control
- Temperature Control
- Exhaust Capability
- Humidity Control
Displacement Ventilation (DV)

Central DOAS (VAV + reheat) or roof DOAS (VAV + reheat)

Chiller plant +

Air-cooled condenser
Water-cooled condenser

Terminals:
DV diffusers + Return diffusers
MEP 3D MODEL
DV - LEVEL 1 PLAN

- Supply
- Return
- Centralized atrium exhaust
- Inlet
- Exhaust
- Vertical Duct
- MEP room/ shaft
DV - LEVEL 3 PLAN

- Supply
- Return
- Centralized atrium exhaust
- Inlet
- Exhaust
- Vertical Duct
EXPEDITE

SEP 2019  DEC 2019  MAR 2020  JUN 2020  SEP 2020

DAYS SAVED

0 5 3

TRADITIONAL

SEP 2019  DEC 2019  MAR 2020  JUN 2020  SEP 2020

OUTDOOR COURTYARD
ZONING
ACCOYA
FLEXIBLE ATRIUM
NATURAL LIGHT
EXTERIOR PANELS
SKELETON MODULAR
DV

PUSH & PULL
CAFÉ
GREEN WALL
ATRIUM LIGHTWELL
CO-WORK SPACES
MOVEABLE SHADES
INTERIOR WOOD PANELS
BEAM DEPTH REDUCTION
PREFABRICATED TOILETS
PREFABRICATED MEP RACKS
MEP STRATEGIES

- PV PANELS

PRODUCTION STRATEGIES
PV PANEL PLACEMENT
- ASHRAE - Building type: Secondary school

- Energy Use Intensity Target: 25 kBtu/sqft-yr
ENERGY STORAGE

12:00 AM - 8:30 AM: OFF-PEAK, $0.212 per kWh

NOON - 6:00 PM: ON-PEAK, $0.263 per kWh
STV - RESULTS

<table>
<thead>
<tr>
<th>Impact</th>
<th>Target</th>
<th>Project</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon (kgCO2e)</td>
<td>3,714,897</td>
<td>2,864,250</td>
<td>77%</td>
</tr>
<tr>
<td>Energy (MJ)</td>
<td>120,509,807</td>
<td>40,329,748</td>
<td>33%</td>
</tr>
<tr>
<td>Water (kgH2O)</td>
<td>73,347,945</td>
<td>128,912,132</td>
<td>178%</td>
</tr>
<tr>
<td>Ozone (kgCFC11)</td>
<td>-</td>
<td>7.33E-02</td>
<td>-</td>
</tr>
</tbody>
</table>
STV EVOLUTION

1. Fishbowl
2. Concrete type
3. Energy 1st Iteration
4. Structure change
5. Displacement ventilation
6. Toilets with low water use
7. Interior wall changed
8. Exterior wall changed
9. PV Panels
10. Energy 10th iteration
SITE ACCESS: TRUCK ROUTE

NORTH

SOUTH
SUPPLIERS & CONTRACTORS

Site
Concrete Batch Plant
Lumber Supplier
Steel Supplier
Building Trades Council (Union Labor)
Equipment Rental
ConXTech
HVAC Contractor

10 MILES
20 MILES
40 MILES
RAIN CHALLENGE

- **Start**: 9/2/19
- **Enclosed**: 11/15/19
- **Finish**: 2/10/19
1 Site Trailers
2 Material Laydown
3 Recycling
4 Toilets
5 Concrete Pumps
6 Truck Entrance
7 Truck Exit
EQUIPMENT SELECTION (EXTERIOR)

- Putzmeister 31Z-Meter Concrete Truck
- GEHL DL7-44
- 6CuYd Excavator
- RIDING TROWEL
1 Site Trailers
2 Material Laydown
3 Recycling
4 Toilets
5 Crane
6 Truck Entrance
7 Truck Exit
EQUIPMENT SELECTION (INTERIOR)

RIDING TROWEL

SCISSOR LIFTS
SITE PROGRESSION

1 Site Trailers
2 Material Laydown
3 Recycling
4 Toilets
5 Crane
6 Truck Entrance
7 Truck Exit
Crane Selection: Link-Belt 3140

- Radius of >160ft
- Capacity of 21 kips
- Mobile
4D SIMULATION
# TVD Winter to Spring

## ESTIMATE AND TARGET VALUE - SUMMARY

<table>
<thead>
<tr>
<th></th>
<th>ESTIMATED VALUE</th>
<th>TARGET VALUE</th>
<th>VALUE DELTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>$9,219,508</td>
<td>$10,355,000</td>
<td>$1,135,492</td>
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<tr>
<td>A Substructure</td>
<td>$500,000</td>
<td>$635,107</td>
<td>$135,107</td>
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<tr>
<td>B Shell</td>
<td>$2,200,000</td>
<td>$2,510,225</td>
<td>$310,225</td>
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<tr>
<td>C Interiors</td>
<td>$1,600,000</td>
<td>$1,729,285</td>
<td>$129,285</td>
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<tr>
<td>D Services</td>
<td>$2,700,000</td>
<td>$2,588,750</td>
<td>$(111,250)</td>
</tr>
<tr>
<td>E Equipment and Furnishing</td>
<td>$900,000</td>
<td>$750,736</td>
<td>$(150,736)</td>
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<tr>
<td>F Specialty Construction</td>
<td>$840,000</td>
<td>$936,265</td>
<td>$96,265</td>
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<tr>
<td>G Building Sitework</td>
<td>$490,000</td>
<td>$562,287</td>
<td>$72,287</td>
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<tr>
<td>H General Conditions</td>
<td>$950,000</td>
<td>$664,042</td>
<td>$(285,958)</td>
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</tbody>
</table>

## TVD - TARGETS BY CLUSTER

### Target Value

- **A Substructure**: $990,000
- **B Shell**: $2,200,000
- **C Interiors**: $1,600,000
- **D Services**: $2,100,000
- **E Equipment and Furnishing**: $400,000
- **F Specialty Construction**: $570,000
- **G Building Sitework**: $500,000
- **H General Conditions**: $460,000

### Estimated Value

- **A Substructure**: $635,107
- **B Shell**: $2,441,191
- **C Interiors**: $1,729,285
- **D Services**: $2,588,750
- **E Equipment and Furnishing**: $750,736
- **F Specialty Construction**: $936,265
- **G Building Sitework**: $552,287
- **H General Conditions**: $673,075

### Value Delta

- **A Substructure**: $354,983
- **B Shell**: $241,191
- **C Interiors**: $129,285
- **D Services**: $488,750
- **E Equipment and Furnishing**: $350,738
- **F Specialty Construction**: $366,265
- **G Building Sitework**: $52,267
- **H General Conditions**: $213,075
TRADITIONAL SCHEDULE

<table>
<thead>
<tr>
<th>Preconstruction</th>
<th>SUBSTRUCTURE</th>
<th>Superstructure</th>
<th>Exterior Shell</th>
<th>Interiors</th>
<th>Equipment/Furnishings</th>
<th>Building Sitework</th>
<th>Commissioning</th>
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<tbody>
<tr>
<td>SEP</td>
<td>OCT</td>
<td>NOV</td>
<td>DEC</td>
<td>JAN</td>
<td>FEB</td>
<td>MAR</td>
<td>APR</td>
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</table>
EXPEDITE TIME SAVINGS

<table>
<thead>
<tr>
<th>Component</th>
<th>Time Saved</th>
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<tbody>
<tr>
<td>PREFAB REBAR CAGES</td>
<td>1.5 WEEKS</td>
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<tr>
<td>FAST FOOTS</td>
<td>0.5 WEEKS</td>
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<tr>
<td>PREFAB PANELS</td>
<td>2 WEEKS</td>
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<tr>
<td>EXTERIOR PANELS</td>
<td>2.5 WEEKS</td>
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</table>
EXPEDITE TIME SAVINGS

TIME SAVES

CONXTECH

MECH CAGES

NO CONCRETE SHAFT

TIME SAVED

1 WEEKS

2 WEEKS

2 WEEKS

11.5 WEEKS
EXPEDITED SCHEDULE

<table>
<thead>
<tr>
<th></th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
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<th>FEB</th>
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<tr>
<td>SUBSTRUCTURE</td>
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<tr>
<td>SUPERSTRUCTURE</td>
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<tr>
<td>EXTERIOR SHELL</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>EQUIPMENT/FURNISHINGS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUILDING SITEWORK</td>
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<td>COMMISSIONING</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>
21st CENTURY SITE

- Report Hazards
- Blueprints and Plans
- Task Management

- Team Exercises
- Backup Plans
- Plan of the Day
CHALLENGES
EXPEDITE

SEP 2019  DEC 2019  MAR 2020  JUN 2020  SEP 2020

TRADITIONAL

SEP 2019  DEC 2019  MAR 2020  JUN 2020  SEP 2020

DAYS SAVED

000

DF  CO2 REDUCED  NEEDS MET
LEARNING L.A.B TIMELINE

PUSH & PULL

OUTDOOR COURTYARD

CAFE

ZONING

ACCOYA

DAYLIGHT

AIR QUALITY

BALANCE
LEARNING L.A.B TIMELINE

LIGHTWELL

FLEXIBLE ATRIUM

CO - WORK SPACES

NATURAL LIGHT

SHADES

DAYLIGHT

AIR QUALITY

BALANCE

#
TEXT JULIANNECRAW603 to 22333

VOTE
TEAM PROCESS
## TEAM PROCESS - PLATFORMS

<table>
<thead>
<tr>
<th>PLATFORM</th>
<th>USERS</th>
<th>PURPOSE</th>
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</thead>
<tbody>
<tr>
<td>TERF</td>
<td>All team, Renate, owners</td>
<td>Weekly meetings</td>
</tr>
<tr>
<td>SLACK</td>
<td>All team</td>
<td>Formal team communication</td>
</tr>
<tr>
<td>GOTOMEETING</td>
<td>All team</td>
<td>Team/subcommittee meetings</td>
</tr>
<tr>
<td>SPAN</td>
<td>All team</td>
<td>Process</td>
</tr>
<tr>
<td>REVIT</td>
<td>All team</td>
<td>Graphical documentation</td>
</tr>
<tr>
<td>A360</td>
<td>All team</td>
<td>BIM - Revit collaboration</td>
</tr>
<tr>
<td>GOOGLE DRIVE</td>
<td>All team, owners</td>
<td>Archive and documentation</td>
</tr>
<tr>
<td>BOX</td>
<td>All A/E/C teams, Renate</td>
<td>Course files &amp; deliverables</td>
</tr>
<tr>
<td>BIM360 GLUE</td>
<td>All team</td>
<td>Clash detection</td>
</tr>
</tbody>
</table>

**Platforms**

- **Communication**
- **Collaboration**
- **Coordination**
A/E/C COORDINATION

CLASH DETECTION

CLASH AVOIDANCE

CLASH RESOLUTION

CLASH DOCUMENTATION
TEAM DYNAMIC

10376 Slack notifications!!!

Could you move that 0.1mm to the left???

Let's focus!

Wind turbines!!!

No servers!!!