



DENVER FEDERAL CENTER BUILDING 48 MODERNIZATION

INTERAGENCY SUSTAINABILITY WORKING GROUP

BUILDING 48



B48 MODERNIZATION PROJECT

Full Building Modernization of a 1940's Ammunition Manufacturing Plant & Warehouse

- Complete adaptive reuse to office
- New mechanical, electrical, plumbing, life safety systems, etc.
- Site upgrades – paving, landscaping, parking
- New envelope

B48 MODERNIZATION GOALS:

High Performance Green Building

- Meet or exceed federal energy and water conservation goals and incorporate exceptional integration of architectural form and optimized building systems which provide excellent indoor environmental quality

High Performance Workplace

- Enhance all human factors including health, functional efficiency, productivity, space flexibility, air quality, and comfort in thermal, acoustical, and visual perspectives utilizing natural daylight.

Design, Construction, & Operational Excellence

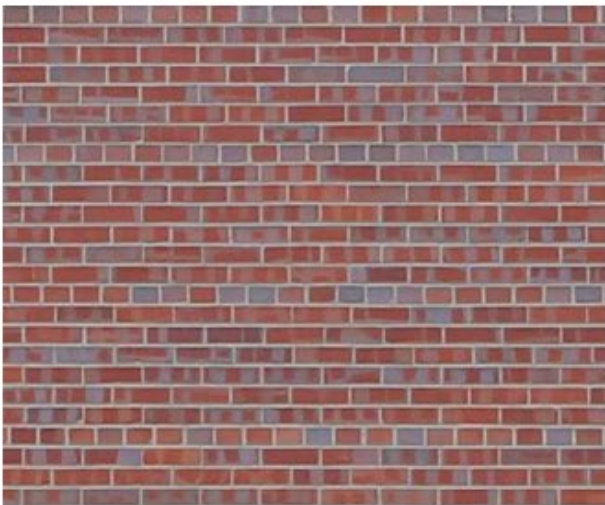
- Utilize best practices to design and construct an office of outstanding quality and value. Extending the service life of the building.

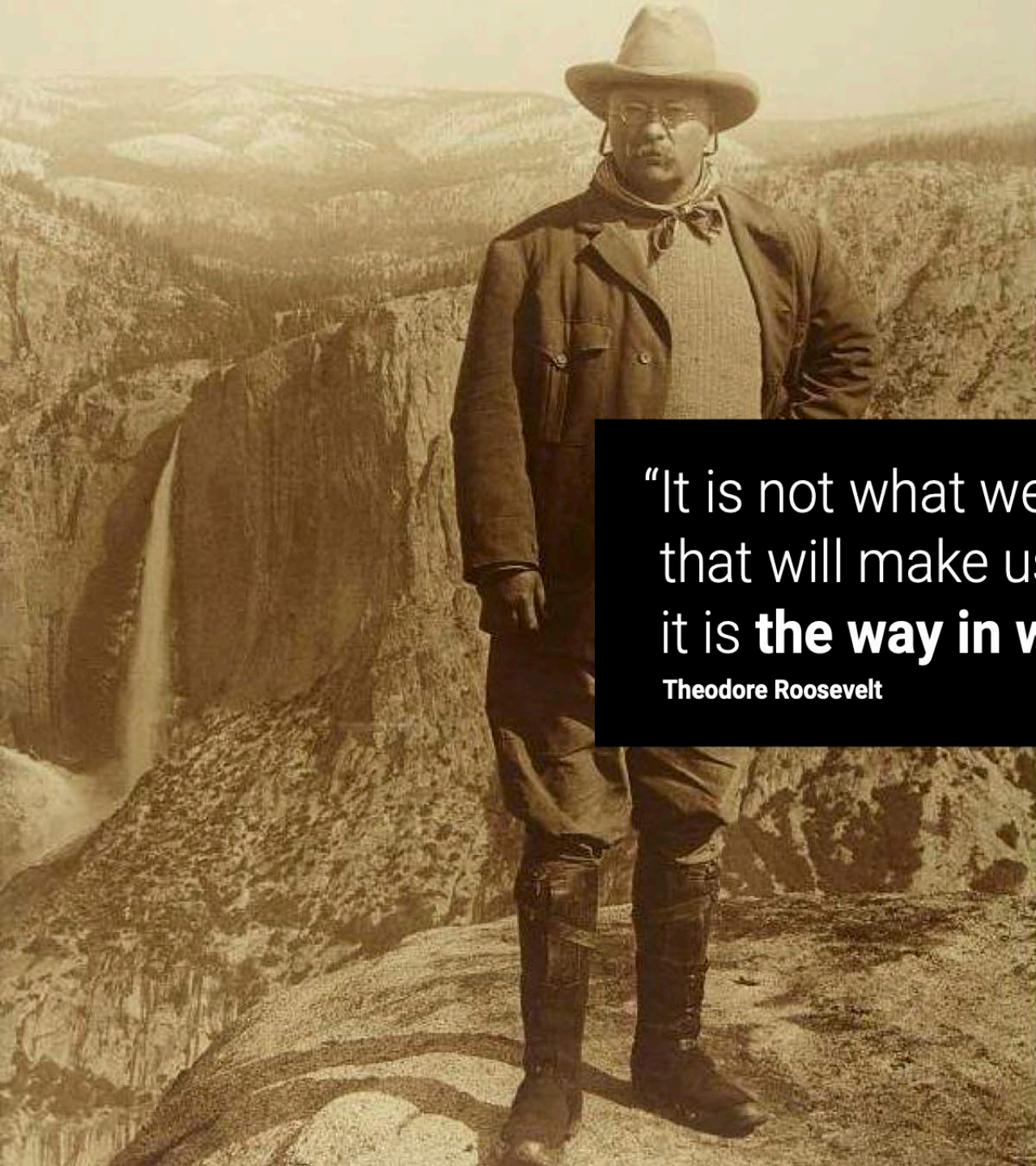
Space & Experience

- Provide spatial experiences for those working and visiting Building 48 connecting the outdoors and the indoors both spatially and visually.

Modern Office Environment

- Modernize and transform the building from its current state, meeting IBC's programmatic needs while creating a lasting impression.

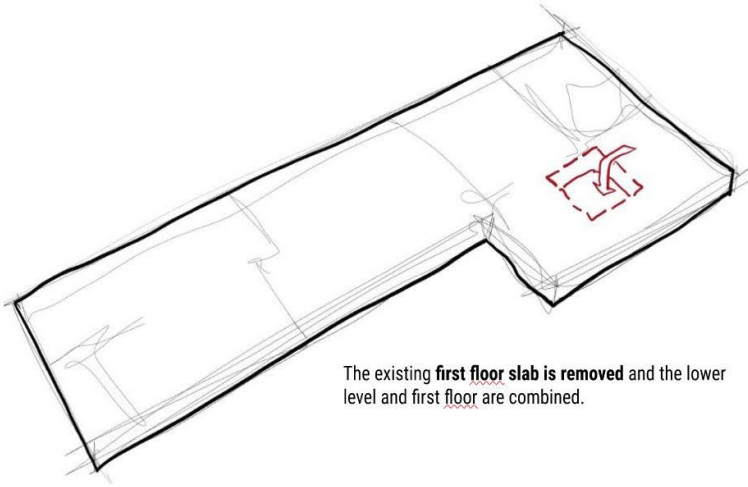




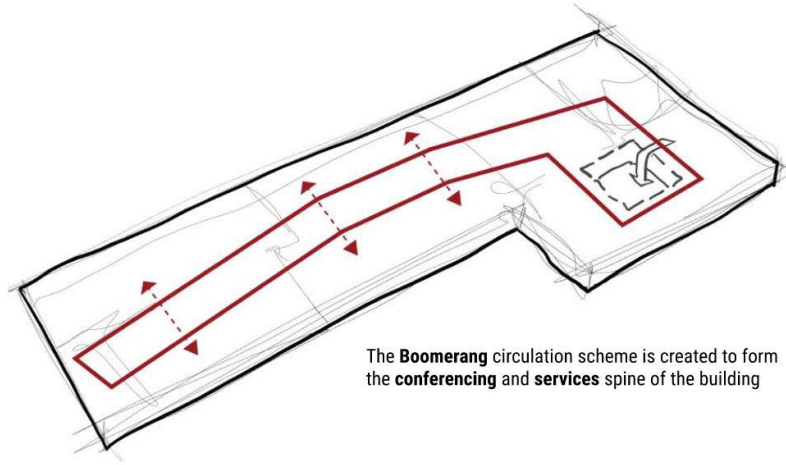
“It is not what we have
that will make us a great nation;
it is **the way in which we use it.**”

Theodore Roosevelt

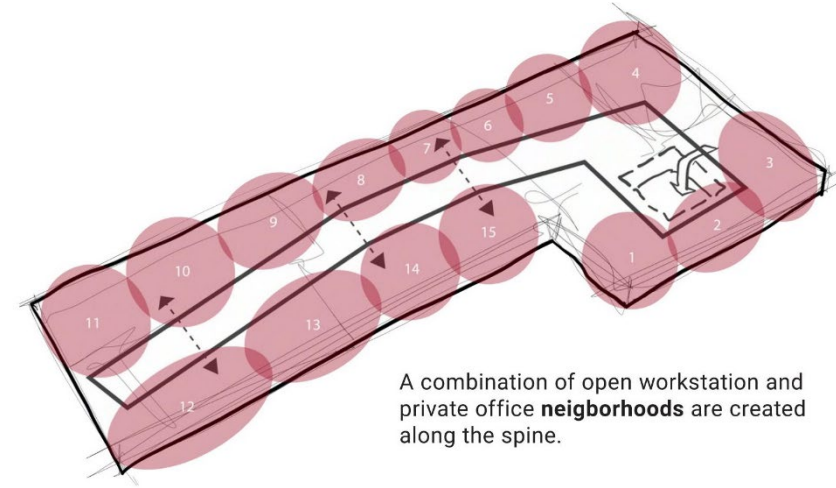




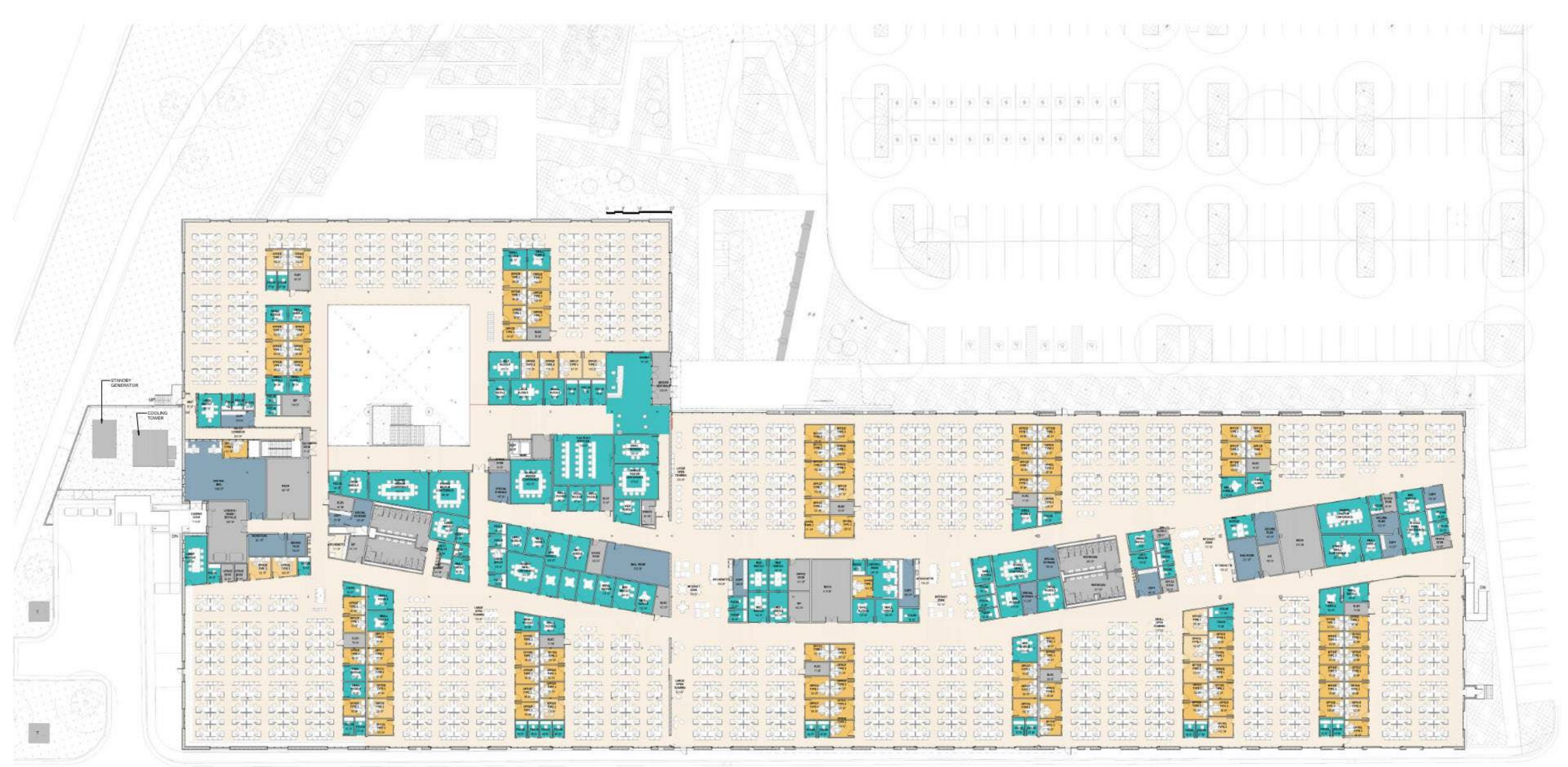
The existing **first floor slab is removed** and the lower level and first floor are combined.



The **Boomerang** circulation scheme is created to form the **conferencing** and **services** spine of the building



A combination of open workstation and private office **neighborhoods** are created along the spine.



True North

Grid North





EXISTING CONDITION







EXISTING CONDITION





EXISTING CONDITION





INTERIOR
BUSINESS
CENTER
U.S. DEPARTMENT OF THE INTERIOR











BLACK CANYON OF THE GUNNISON





ACHIEVEMENTS:

Lease Cost Avoidance

- Nearly \$6M in Annual Taxpayer Savings
- Taxpayer ROI < 9 Years | ROI w/ Rent Revenue < 5 Years

Addressing Climate Change + Human Health

- LEED Gold
- SITES Silver
- Net Zero Energy
- USGBC Net Zero Energy Certification
- All-Electric Building
- Net Zero Operational Carbon
- UL Design Guideline DG24480
Design Guideline for Promoting Circadian Entrainment with Light for Day-Active People
- 87% Embodied Carbon Avoidance
- Embodied Carbon Emissions Tracking for Future Baselines

Customer Business Improvement

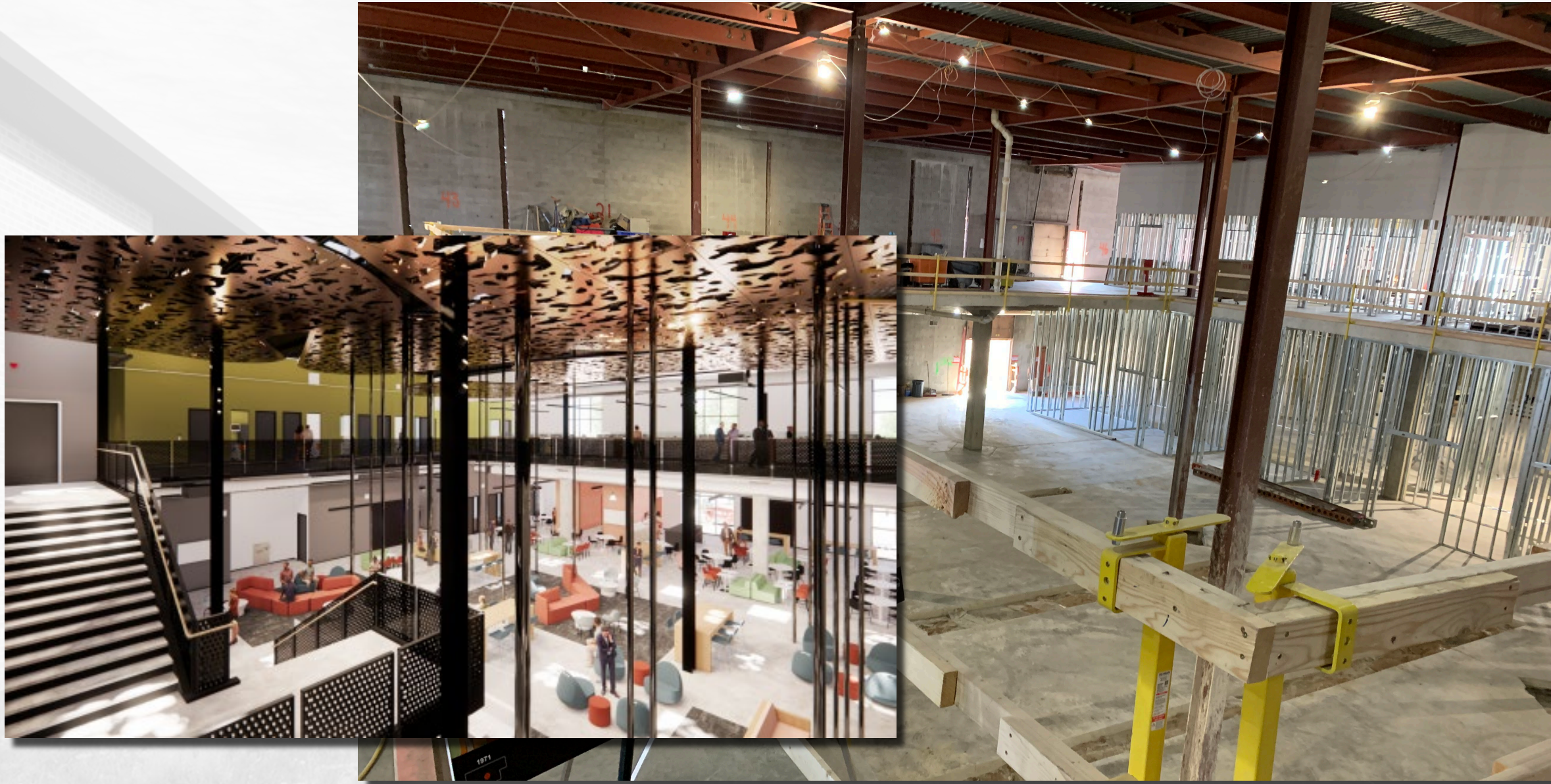
- Co-Location
- Improved Workplace
- Innovative Technology
- Modern Work Environment

Asset Performance

- Adaptive Reuse of an Underperforming Asset.

**ADAPTIVE REUSE
& EMBODIED
CARBON AVOIDED**





The most sustainable material is the material that already exists.

B48 COMPARED TO SIMILAR NEW CONSTRUCTION | WBLCA

**Baseline Case
New Construction**

100% New Materials

- Gross Floor Area
- Building Function
- Building Element Types Assessed
- Material Types and Volumes
- Industry Standard Environmental Data
- Location
- Orientation
- Energy Performance
- Service Life

**Design Case
B48 as Designed**

**Reused Materials
Newly Added Materials**

WBLCA | INCLUDED BUILDING ELEMENTS

Building Structure & Envelope

Foundation & Substructure

- Foundation & foundation walls
- Sub-surface structure
- Drilled piers & footings
- Basement & retaining walls

Horizontal Elements

- Roof materials
- Roofing decks / assemblies
- Horizontal beams
- Floor slabs
- Insulation

Vertical Elements

- External walls & façade
- Insulation
- Gypsum board & drywall of structural walls
- Columns & load-bearing structures
- Interior structural walls

Other Elements

- Doors
- Windows
- Stairs
- Ramps
- Other misc. structure and envelope items

Excluded Elements:

MEP and life safety systems
Site work, parking lots, and landscaping

Interior finishes (flooring, paint, tiling, acoustical panels, etc)
Interior non-structural walls

B48 COMPARED TO SIMILAR NEW CONSTRUCTION | WBLCA

Baseline Brand New
Building
~19.7 million kg CO₂e

87% Decrease in
Embodied Carbon
through Reuse Alone

Adaptive Reuse Design
~2.6 million kg CO₂e

The carbon savings from Building 48's adaptive reuse are equivalent to approximately:



43 million miles driven by an average gasoline powered passenger vehicle



3,300 homes' electricity use for 1 year

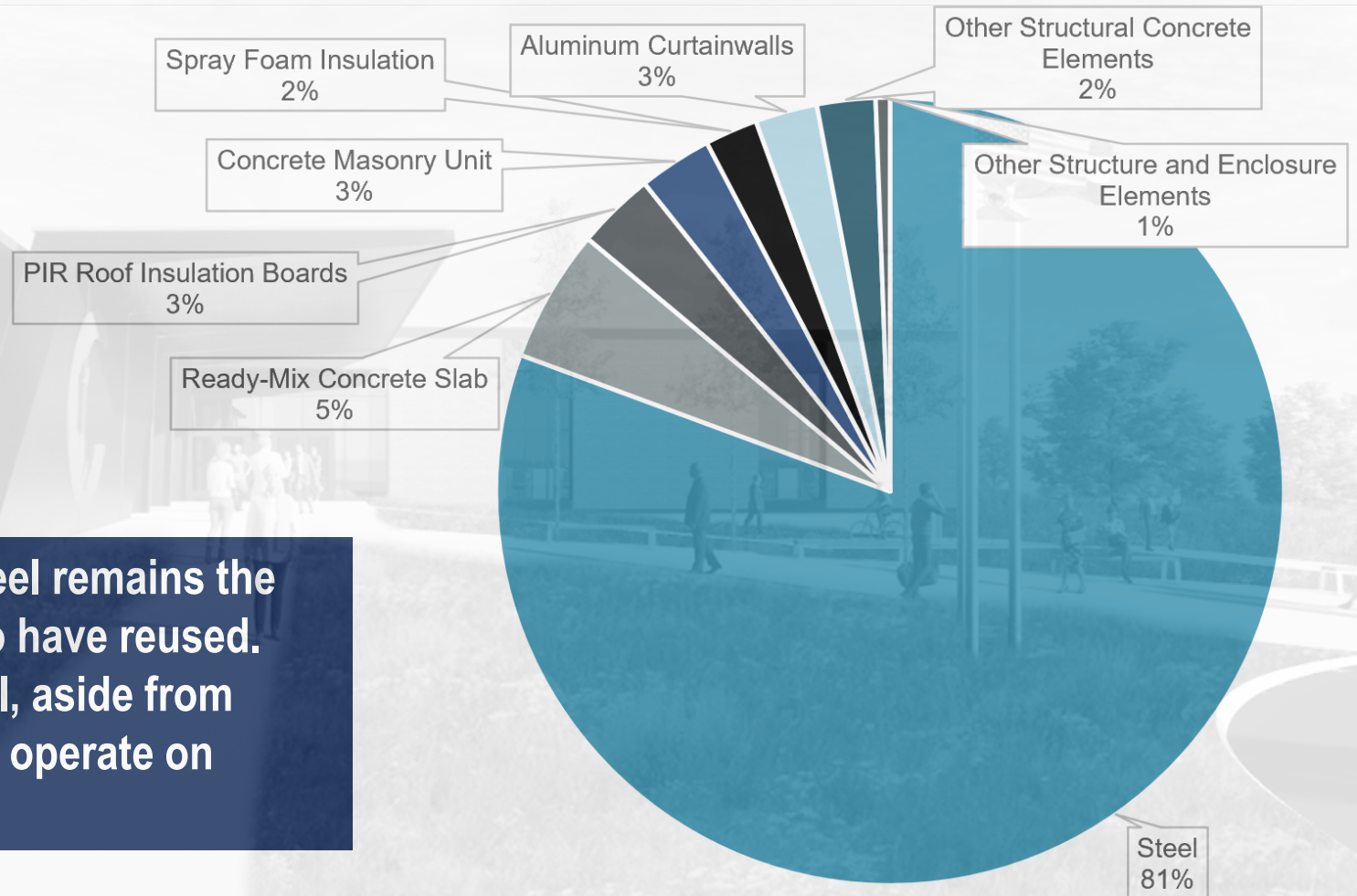


116 acres of U.S. forests saved from conversion to cropland

Source: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

This does not account for any improvements from material selection – both design and baseline used industry standard materials. This is the savings simply from using materials that were already there!

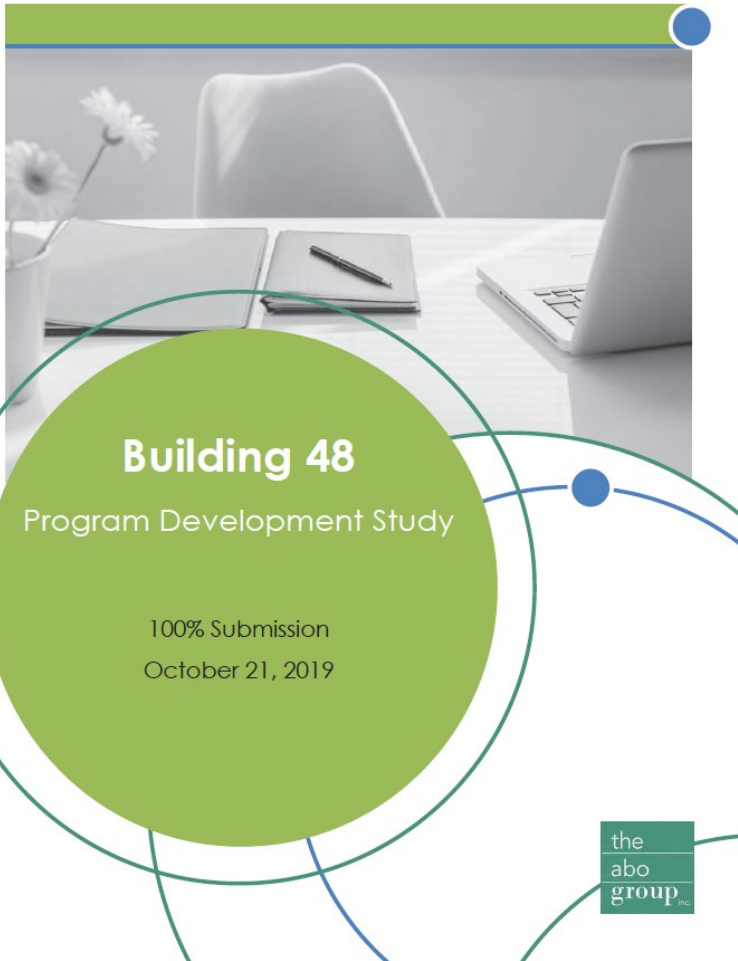
B48 WBLCA | MATERIAL IMPACT



Despite high recycled content, steel remains the most impactful material for B48 to have reused. The biggest opportunity with steel, aside from reuse, is to source from mills that operate on renewable energy sources.

**ELECTRIFICATION
& DESIGN-BUILD
PROCUREMENT**





Building 48

Program Development Study

100% Submission
October 21, 2019



PROGRAM DEVELOPMENT STUDY
TECHNICAL PERFORMANCE CRITERIA
MECHANICAL /PLUMBING SYSTEMS 04

DOMESTIC COLD WATER SERVICE

- Evaluate if the current 1" water service is adequately sized for the new office usage. It is possible that a larger service will be required if the building and an it required to serve tank
- Provide piping to all requiring cold water.
- Provide a reduced pressure preventer on the main where it enters the building.
- Provide a connector system (by others) if needed.

DOMESTIC HOT WATER

- Due to the size of the two new direct vent, type, domestic hot water at each end of the building they shall be approx each.
- Provide new gas pipe heaters.
- Provide combustion new heaters.
- Replace the existing distribution piping with new piping sized office use demand.
- Provide a hot water and pipe the lines etc as required by the IPC

PLUMBING FIXTURES

- Provide new low flow plumbing fixtures in the bathrooms (see LEED discussion).

DOVE DRAINS AND DRINKING

BUILDING 48 - DENVER FEDERAL CENTER

02 PLANNING & DESIGN

02.11 - ROOM TYPES

TYPE 1 OFFICE



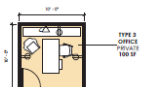
DESIGNATION: SR. LEADERSHIP
POWER: 3 DUPLEX OUTLETS
DATA: 2 DATA OUTLETS, WIF-I
CEILING: WALLS: 1 GLASS, 3 METAL STUD OR DEMOUNTABLE
DOOR: FLOORING:

TYPE 2 OFFICE



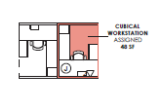
DESIGNATION: OFFICE
POWER: 2 DUPLEX OUTLETS
DATA: 2 DATA OUTLETS, WIF-I
CEILING: WALLS: DOOR: FLOORING:

TYPE 3 OFFICE



DESIGNATION: OFFICE
POWER: 2 DUPLEX OUTLETS
DATA: 2 DATA OUTLETS, WIF-I
CEILING: WALLS: DOOR: FLOORING:

WORKSTATION



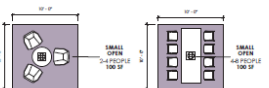
DESIGNATION: WORKSTATION
POWER: 2 DUPLEX OUTLETS
DATA: 2 DATA OUTLETS, WIF-I
CEILING: WALLS: DOOR: FLOORING:

NOTE: FURNITURE LAYOUT, DIMENSIONS AND EQUIPMENT SHOWN FOR ILLUSTRATION. REFER TO ROOM DATA MATRIX AND IT'S DETAILS FOR MORE DETAILS AND SCHEDULES.

BUILDING 48 - DENVER FEDERAL CENTER

02 PLANNING & DESIGN

SMALL OPEN COLLABORATION



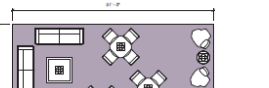
TECH: POWER: 2 DUPLEX OUTLETS
DATA: 2 DATA OUTLETS, WIF-I
CEILING: WALLS: DOOR: FLOORING: TABLE BOX
NICHE CARPET TILE

MEDIUM OPEN COLLABORATION



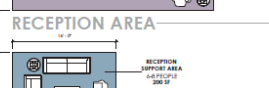
TECH: POWER: 4 DUPLEX OUTLETS
DATA: 4 DATA OUTLETS, WIF-I
CEILING: WALLS: DOOR: FLOORING: TABLE BOX
NICHE CARPET TILE

LARGE OPEN COLLABORATION



TECH: POWER: 4 DUPLEX OUTLETS
DATA: 4 DATA OUTLETS, WIF-I
CEILING: WALLS: DOOR: FLOORING: TABLE BOX
NICHE CARPET TILE

RECEPTION AREA



TECH: POWER: 3 DUPLEX OUTLETS
DATA: 3 DATA OUTLETS, WIF-I
CEILING: WALLS: DOOR: FLOORING: TABLE BOX
MATCH ADJACENT SUITE ENTRY CARPET TILE

PRESCRIPTIVE REQUIREMENTS

- Statement of Work & Owner's Project Requirements
- Functional requirements of the building and tenant space
- Deliverable requirements of the DB during each phase of the project



P100 FACILITIES STANDARDS FOR THE PUBLIC BUILDINGS SERVICE

October 2021

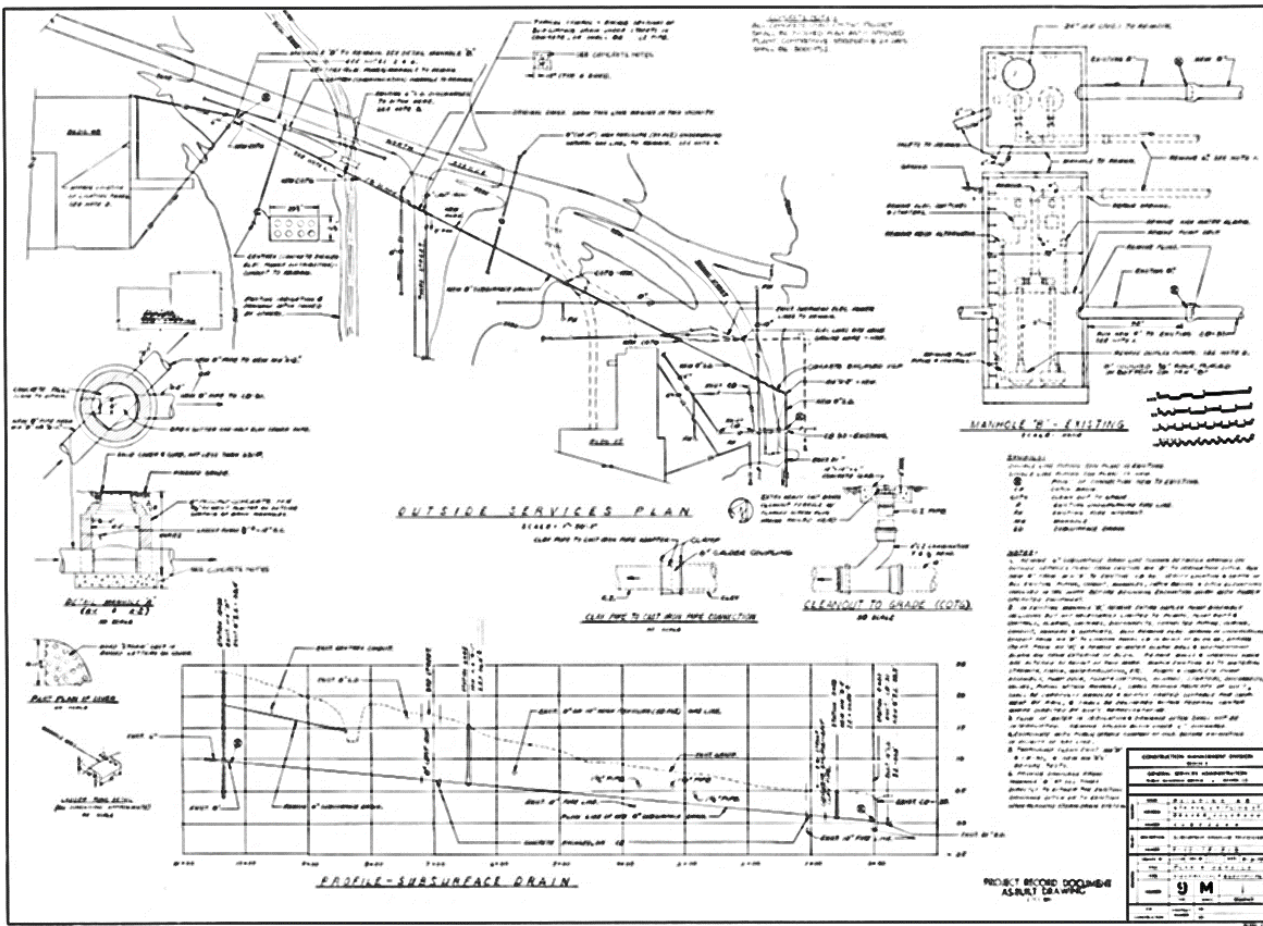
Energy	
Energy Net-Zero	
Baseline	Designs must be Energy Net-Zero ready on a source energy basis with onsite renewables that are designated on the plan for future installation including pathways, conduits, or other means of getting the power in the building.
Tier 1	Designs must be Energy Net-Zero ready with 25% onsite renewables installed and the remainder designated on the plan for future installation. At a minimum, comply with IgCC-2018 Section 701.4.1.1 (7.4.1.1) On-Site Renewable Energy Systems, however Exception 2 shall not apply.
Tier 2	Tier 1 + 50% onsite renewables installed.
Tier 3	Tier 1 + 100% renewables installed.
M & V	Report the projects ongoing energy performance in a sustainability benchmarking platform
Plans & Specs	Y
Calculations & Analysis	Provide 90.1 Appendix G energy model and calculations for proposed and installed renewable energy.
References	
Basis of Design	Show project is energy net-zero ready, on a source energy basis, and achieves actual annual delivered energy less than or equal to the on-site and/or proposed renewable exported energy.
Construction Verification	CX agent to confirm installed renewables supply the required power to meet the high-performance tiers.

Water	
Water Net-Zero	
Baseline	Meet current policy including EISA sec. 438.
Tier 1	Designs must be Water Net-Zero ready with 50% potable water returned to the original water source on site.
Tier 2	Designs must be Water Net-Zero ready with 75% potable water returned to the original water source on site.
Tier 3	Comply with IgCC-2018 Chapter 6, W (5.3.4.1) Projects on Greenfields.
M & V	Report the project's ongoing water p
Plans & Specs	Y
Calculations & Analysis	Provide calculations for water-use b water returned to the original water

2018 P100 Performance Matrix	Place an X for each requirement						Notes (Describe how design meets performance or any waivers from a requirement)
	Baseline	Tier1	Tier2	Tier3	N/A		
1.7.2 Sustainable Performance Requirements							
Energy							
Energy Net Zero	X	X	X	X			GSA allocated 1,067,817 kWh/yr of PV to the site. Design is net-zero ready based on source energy. Preliminary energy simulations show an additional 200 kW of PV is needed to achieve net zero energy.
Water							
Water Net Zero	X						EISA section 438 Stormwater Management goals are met in the baseline design by retaining rainfall from 95 th percentile event on site and infiltrating the rainwater through raingardens and porous pavers to soils below the parking lot.
High Performance Building Technologies							
GSA Proving Ground	X	X					Base design incorporates condensing boilers and LED fixtures.
Construction Personnel							
Green Credentialed	X						Tier 1-3 for Subcontractor credentials not feasible.

PERFORMANCE REQUIREMENTS

- Performance based goals focusing on the end result
- Baseline is the standard
 - Owner can specify a higher tier if desired
 - Proposals can be evaluated and higher scores can be provided for teams which exceed the baseline



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GEOTECHNICAL ENGINEERING STUDY
GSA BUILDING 48 MODERNIZATION
DENVER FEDERAL CENTER
LAKEWOOD, COLORADO

Prepared By:

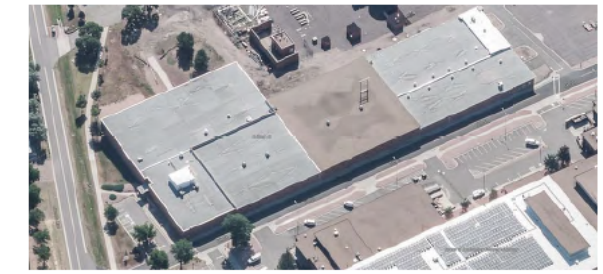
 Alan Velton, E.I.

Prepared For
 The Abo Gr
 12600 West Colfax Ave
 Lakewood,
 Attention: Mr. Ronal

Project No. 18-1-635

100% PDS - 10

ASBESTOS INSPECTION REPORT



DENVER FEDERAL CENTER
BUILDING 48
WEST 6TH AVENUE AND KIPLING STREET
LAKEWOOD, JEFFERSON COUNTY, COLORADO 80125

PREPARED FOR:
KUMAR & ASSOCIATES, INC.
 2390 SOUTH LIPAN STREET
 DENVER, COLORADO 80223

PROJECT #:
 18128.1
 DATED:
 JANUARY 31, 2019



SCHAFFER ENVIRONMENTAL CONSULTING, INC.
 10000 West Alameda Avenue, Suite 209
 Lakewood, Colorado 80126
 Phone: 303.988.8871 • Fax: 303.988.8873

100% PDS - 10.21.2019
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SUPPORTING DOCUMENTATION

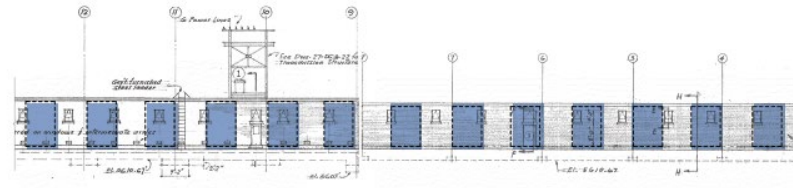
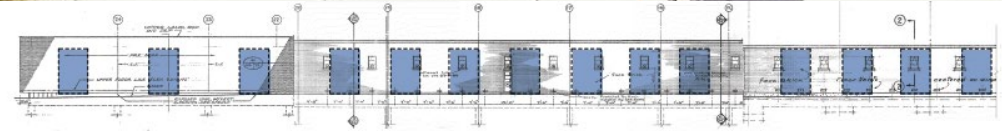
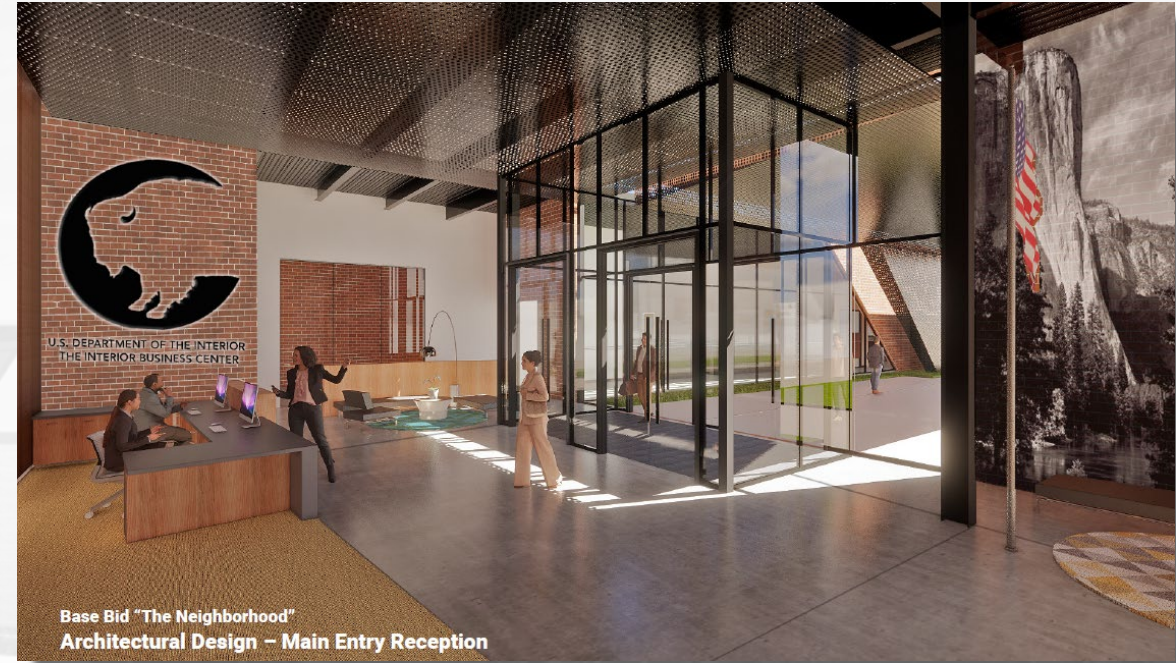
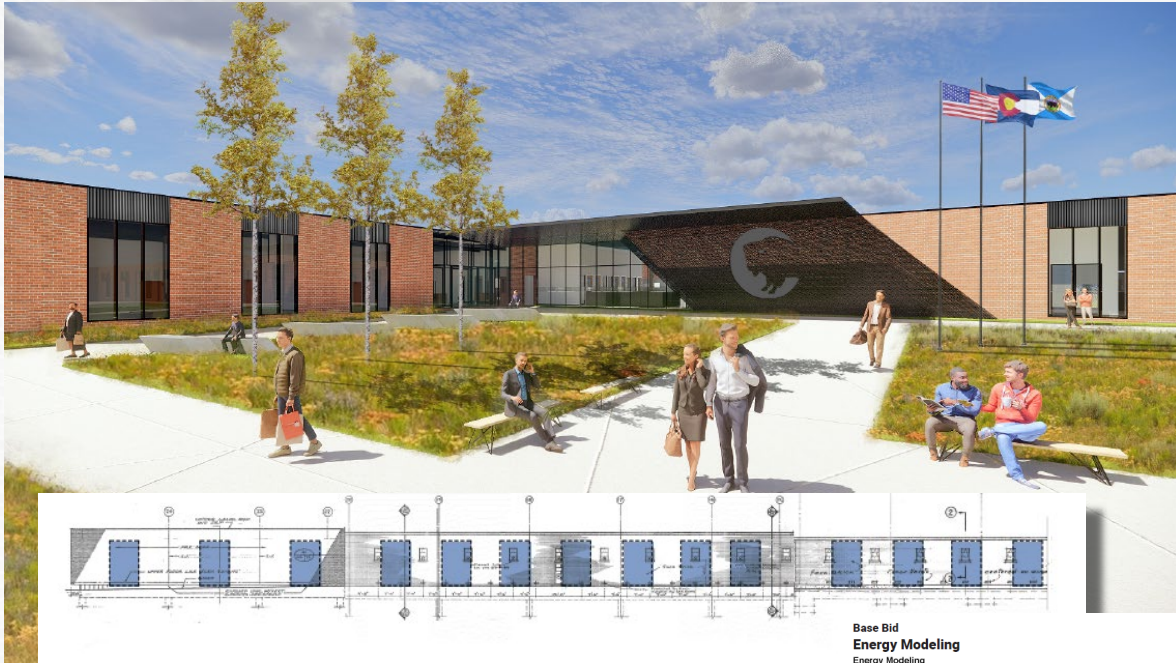
- Studies
- Hazardous materials reports
- As-Built Conditions

**ELECTRIFICATION
& DESIGN BUILD
PROPOSAL**



BASE PROPOSAL:

- Meets Performance and Prescriptive Requirements of the Proposal
- Combination of Narrative, Drawings, Cut Sheets, and Renderings

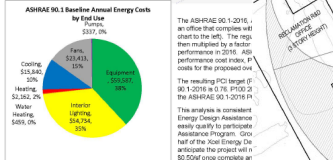


Base Bid Energy Modeling

The energy savings required under P100 2018 is 30% below ASHRAE 90.1-2016 as clarified in the responses dated May 15, 2020.

To evaluate energy efficiency strategies, we used the OpenStudio 2.9 interface for EnergyPlus 8.2 building energy simulation program for the energy analysis. OpenStudio performs a detailed analysis of all energy flows within, into, and out of a building, doing a separate calculation for each hour of the year. The model includes details of architectural, mechanical, and lighting systems, as well as all interior loads such as occupants and plug loads. Outputs are extensive and include hourly monthly and annual energy use, energy cost, and details of HVAC system performance. The software is developed by the Department of Energy, and is approved for building energy design assistance, energy code compliance and compliance with LEED's energy optimization credit.

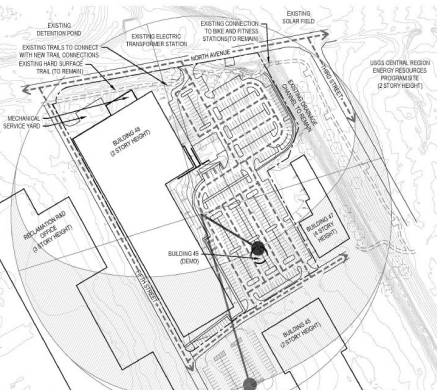
Our analysis followed ASHRAE 90.1-2016, Appendix G modeling protocol. The conditioned space is just under 100,000 sq ft including a gas furnace HVAC system defined by Appendix G as packaged variable air volume (VAV) reheat units with CO₂ control and gas-fired boilers. The minimum outside air needs that defined in ASHRAE 90.1-2016.



3-D rendering of the building exterior view as is



Rendering of floor plan



Base Bid Civil and Landscape: Solar Orientation Site Plan

LANDSCAPE LEGEND

- EXISTING TREE
- TWO-WAY VEHICLE CIRCULATION
- LIMIT OF WORKLINE
- EXISTING HAZE SURFACE TREATMENT
- SOIL POSITION (SUMMER SOLISTICE)
- SOIL POSITION (WINTER SOLISTICE)
- SOIL MANAGEMENT REGION WITHIN A YEAR

USGS CENTRAL REGION ENERGY RESOURCES PROGRAM SITE (EFORM16061)

The ASHRAE 90.1-2016, is an office that complies with about to the left. The region multiplied by a factor performance in 2019. ASH performance cost rate, P100 costs for the proposed out.

The resulting P100 larger P100 1-2018 is 0.78, P100 of the ASHRAE 90.1-2016 P100.

This analysis is consistent with the Energy Efficiency Assistance Program, CO2 cap of the job energy, DA anticipate the project will in 80,000 once complete an

BETTERMENTS:

- Empower the Design Build Team explore self proposed alternatives
- Design Builder breaks out cost information for each betterment



Betterment 2 "The Stack"
Architectural Design – Main Entry Exterior

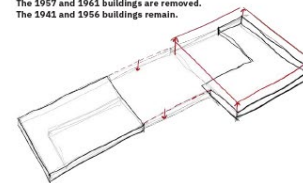


ZOOM IN
FOR DETAILS

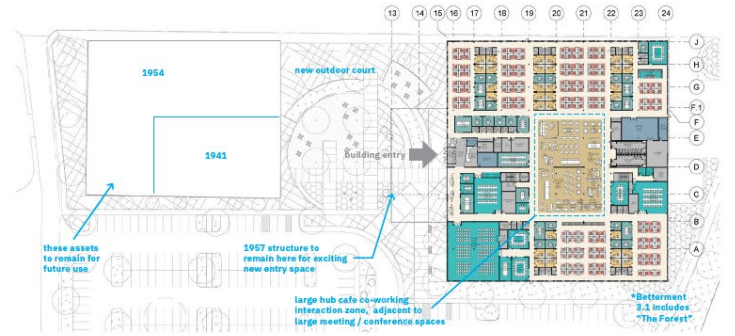
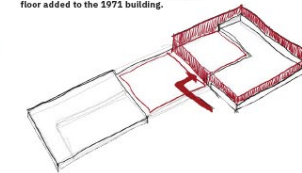
COMMENT 6/26

The Betterment 2 Program matrix has been updated to support the removal of ADQ from the project scope while floor plans and diagrams have not. The personal workstations can all be designed to fit on Floors 1 and 2 and the shared spaces located in the basement.

The 1957 and 1961 buildings are removed. The 1941 and 1956 buildings remain.



An outdoor court is created and a second floor added to the 1971 building.



LEVEL 01 PLAN



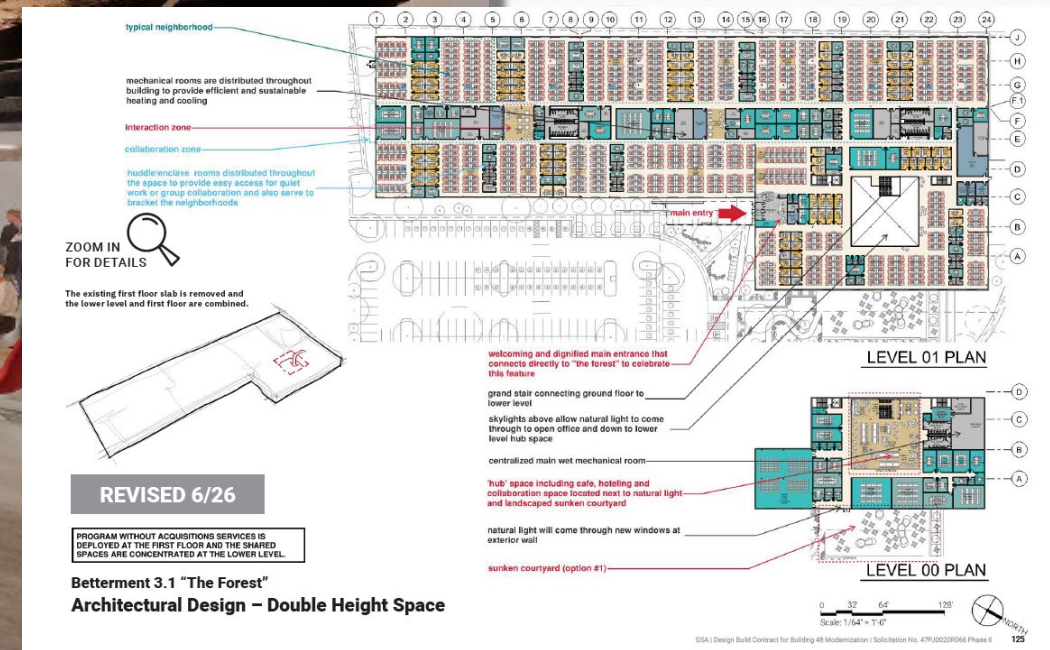
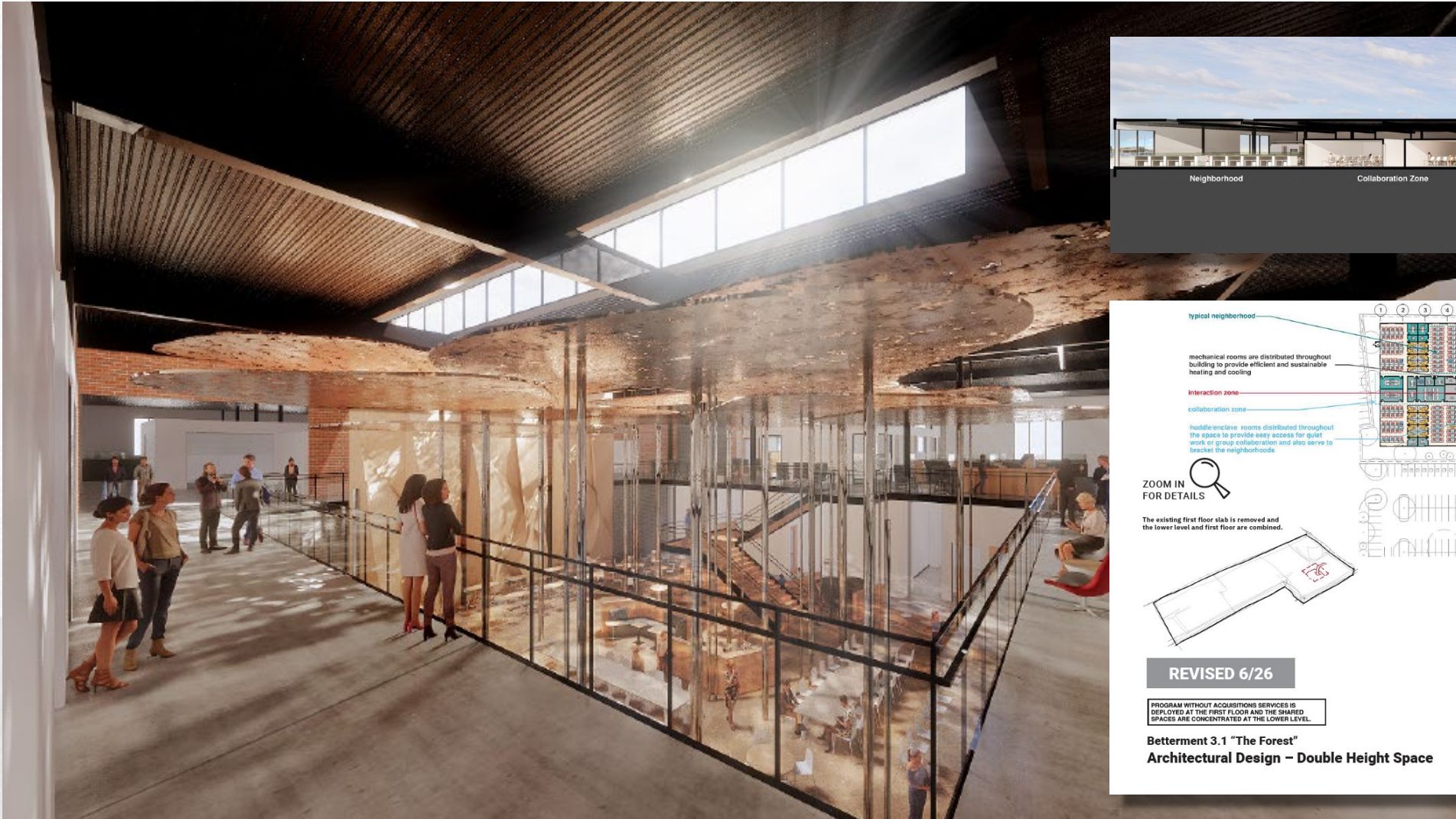
LEVEL 00 PLAN

Scale: 1/64" = 1'-0"

Betterment 2 "The Stack"
Architectural Design

BETTERMENTS:

- Empower the Design Build Team explore self proposed alternatives
- Design Builder breaks out cost information for each betterment



BETTERMENTS:

- Empower the Design Build Team explore self proposed alternatives
- Design Build Team breaks out cost & technical information for each betterment

Miscellaneous Betterments 3.2 to 3.7

Betterment 3.2: Covid Response Mechanical system

The design build team offers a betterment air handling system which is the same WSHP based system with a Displacement Ventilation distribution and dedicated outside air systems (DOAS). Displacement Ventilation delivers air at the floor, which pools and seeks out heat sources like people and equipment. This air is drawn to the heat source and rises in a plume, taking the heat from the source. This air naturally rises to the upper areas of the space, drawing further new air to the occupant, constantly flushing the breathing zone of contaminates with a generally unidirectional flow of air. (see following pages)

Betterment 3.3: Carbon net-zero on-site production mechanical system

The team has a betterment to provide three electric boilers in lieu of the modulating condensing natural gas boilers which would remove the need for natural gas to the building and reducing the building's site carbon footprint with no fossil fuels consumed on site. All other components and design points of the heating water system remain the same as the base bid. (see following pages)

Betterment 3.4: Demountable partitions

Betterment is for the Betterment-1 or Betterment-2 only and replaces the office fronts (Door/frame/hardware, Glass and Drywall) with DIRTT sliding doors, and office fronts.

Betterment 3.5: 200kw PV array on Roof

200kw Photovoltaic system on roof of buildings 1957 and 1961. Minor structural upgrades are included to the roof of the 1956, 1961, and 1971 buildings to accommodate the 200kw and future PV array expansion.

Betterment 3.6: Work Place Strategy - Change Implementation

Provide consulting services during construction to help IBC stakeholders make a successful transition into new ways of working. Supports the roll-out of the change strategy leading up to the occupancy of the new workplace. Key areas of focus include content creation and coordination of change network engagement. Anticipated duration is six months and will commence at least four months prior to move-in / occupancy, with at least two months post-occupancy change management support.

Betterment 3.7: Ultra Violet light system and HEPA

This system is to add HEPA filters and a UV light filtration system into the 4 main indoor AHUs providing all of the ventilation air to the space. Though this is not guarantee that contaminants such as viruses do not enter and/or get filtered in the air stream it assists in the removal of contaminants.

Common considerations for HVAC systems design and operation related to operating buildings during the COVID-19 pandemic include the following:

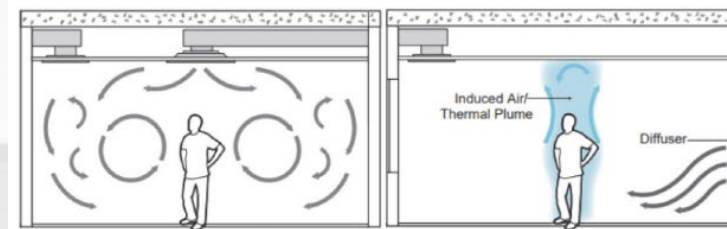
Passive filtration: ASHRAE has indicated that the use of MERV-13 filter media is effective in capturing the SARS-CoV-2 virus that causes the COVID-19 disease. This particular virus is large enough that it can be captured with conventional media. Upgrading to MERV-14 filter media would improve overall filter performance and capture rate.

The more efficient the filter media is, the higher will be the pressure drop associated with its use. It is possible to incorporate sufficient supply fan horsepower to account for the filters in new equipment and systems. The addition of improved filter media in existing systems will require evaluation of the impact on the existing supply fan and motor. Increasing the filter efficiency will increase energy usage for those fan systems. As part of the UVGI system (UV lights with filtration) betterment we have provided HEPA filters which have a higher filter efficiency than MERV-14.

Electronic filtration: ASHRAE documentation to date has indicated that UVGI (ultraviolet germicidal irradiation) systems can be used as an effective means of controlling the spread of the coronavirus. This type of electronic filter system using UV-C radiation can be installed in new equipment and retro-fitted to existing systems. It has been in use for many years for purification of both water and air systems. This has been provided as part of our UVGI system (UV lights with filtration) betterment.

Outdoor air control: Documentation from ASHRAE favors increasing the percentage of outdoor air that is delivered by an HVAC system into the occupied zone, in order to improve dilution. Central air handling systems with outdoor air economizer provisions already have this capability; however, the quantity of outdoor air that can be delivered will be limited by the heating and cooling capacity of the equipment and systems. The air handling units provided as part of our base bid have this capability. 100 percent outside air will be used only in cases where the outside conditions would not put excessive load on the system. This will help to mitigate excessive energy usage.

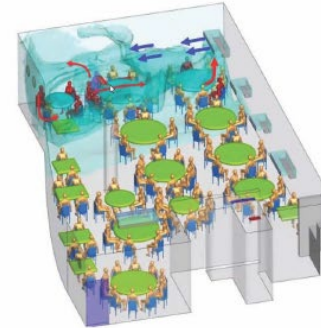
ASHRAE further has suggested disabling demand controlled ventilation, and running systems on a 24/7 basis, in order to increase the outdoor air circulation on a continuous basis. We have chosen not to provide this as it would more greatly affect our LEED criteria.



OVERHEAD MIXING VENTILATION

DISPLACEMENT VENTILATION

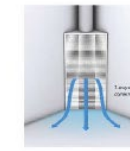
DISPLACEMENT VENTILATION WORKS BY LAYING A LOW VELOCITY BLANKET OF COOL AIR ON THE FLOOR. THIS COOL AIR STAYS LOW DUE TO NEGATIVE BUOYANCY, UNTIL IT FINDS A HEAT SOURCE, THEN CREATES A PLUME TO THE CEILING. THIS PLUME SWEEPS AWAY CONTAMINATES SUCH AS CO2, DUST, AND PATHOGENS



CFD MODEL OF THE SUSPECTED PATHOGEN VECTORS OF A COVID OUTBREAK IN GUANGZHOU CHINA. THE HVAC UNITS ARE SHOWN TO BE RECIRCULATING FAN-COILS (VRF OR SIMILAR).



BASIC DV WALL DIFFUSER



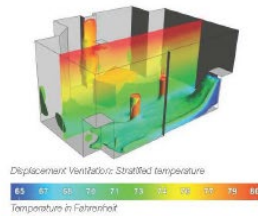
CORNER DV DIFFUSER



EXPOSED DV DIFFUSER



CEILING DIFFUSER IS POSSIBLE, NEED TO LOCATE WHERE PEOPLE ARE NOT FIXED IN PLACE TO AVOID DRAFTS



TYPICAL CFD MODEL OF TEMPERATURES IN A DV SUPPLIED ROOM. THE COOL AIR FLOWS AROUND FLOOR PLAN OBJECTS TO FIND A HEAT SOURCE.

ELECTRIFICATION



Considerations

- What is right for the building 'Beneficial electrification'
- Maintenance personal
- Scope of planned renovations
- Electrical rates and possible renewables
- Equipment layout



Hurdles

- Service size
- Electrical room space
- Spare capacity requirements



QUESTIONS

