SHELL & CORE: LABORATORY

Definition

Laboratory building shell and core unit costs include the building structure, envelope, vertical circulation, public spaces, physical plant support spaces, and site improvements that constitute the facilities to house the laboratory suites of tenant agencies. Specifically, the Laboratory building shell and core includes the following:

- Site improvement allowance adequate to comply with life safety and other zoning set-backs, including: grading, drainage, irrigation, roadways, walkways, ground cover, shrubbery, trees, fencing and screening, lighting, signage, site furniture, and security systems;
- Base structure, including: foundation, beams, columns, floor slabs and roof structure that includes additional floor loading, special structural bay spacing and floor to floor heights required to accommodate typical 10'- 0" ceiling height laboratories;
- Building envelope, including: insulated exterior walls, exterior glazing, and roof;
- Building standard finished ceiling and ambient lighting;
- Gypsum wallboard (GWB) on exterior perimeter walls and interior core walls; Common corridor stud walls including GWB on public sides;
- Common areas, including: entrance vestibule, main lobby, public elevator lobby, fire egress stairways and corridors, mechanical and electrical equipment rooms, communication equipment rooms, public and service elevator shafts and elevator equipment rooms, and public waiting areas;
- Public toilets;
- Electrical and mechanical systems, including: central heating, ventilation, and air conditioning systems, chiller plant, cooling tower, emergency generator and Building Automation System (BAS);
- Combination fire standpipe/sprinkler system and central fire alarm;
- Utilities distribution, either through accessible shaft space or interstitial plenum space for distribution of services, including six nominal utility piping systems; These systems may include potable domestic water riser, high-purity distilled water, steam, special gases such as nitrogen and oxygen, natural gas, vacuum, service sanitary drain, sanitary vent, acid waste and vent system, solvent waste and vent system, electrical power distribution panels and circuit breakers in an electrical closet, designated connection point to the central fire alarm system, and a distribution backboard within a wire closet; All services will provide for connection to extensions to the tenant demised areas (Note that the nominal six gas/utility systems provide a budgetary allowance, and do not specifically entitle tenants to exactly six systems);
- Exhaust manifold collection system and discharge treatment system for fume hoods;
- The security level for U.S. Laboratory buildings is Level B, with costs added as a special item for security upgrades to the appropriate level determined for the specific project.

The following are special costs not included in the Laboratory building shell and core unit costs and may include:

- Interstitial service plenum with walkways or structural ceiling deck;
- Additional utility systems and infrastructure;
- Special structural systems for vibration and additional floor loads;
- Clean room mechanical systems.

Building shell and core features associated with interior (basement) parking will be considered part of the parking unit costs and excluded from the Laboratory building shell and core unit costs. These features include additional structural frame, structured floor above, basement perimeter walls, additional stair flights, additional public/restricted elevator stops or shuttle elevator, ventilation, drainage, lighting, additional perimeter security and access roadways.

References and Design Standards

The unit costs incorporate the following references and design standards:

- Facilities Standards for the Public Buildings Service;
- International Building Code;
- GSA Public Buildings Service Pricing Desk Guide, Edition No. 2.

Building Classification and Fire Resistance

Business Occupancy B2. For the purposes of this study assume:

- Sprinklered Type IB;
- Construction 2 hr structural frame, 2 hr exterior bearing walls, 2 hr interior bearing walls, 1 hr exterior non-bearing walls, 2 hr floor construction, 1 hr roof construction;
- GSA Acoustical Class B1 for laboratory spaces, Class C1 for enclosed offices, and Class C2 for open offices.

Example Program

The Laboratory building shell and core unit costs are based on the following representative building programs.

LABORATORY BUILDING SHELL & CORE

Tenant Assignable Spaces	USF
Laboratory Wet	47,520
Office	21,600
General Storage	2,140
SUBTOTAL USF	71,260
Parking	16,129
TOTAL USF	87,389

Construction Area Summary

The following tables provide the construction area summaries for the Laboratory building shell and core upon which the unit costs are based and are representative of typical laboratory building programs.

LABORATORY BUILDING
BUILDING AREA

FLOOR	USF Storage	USF Office	USF Wet Lab	USF Parking	**USF SUB-TOTAL TENANT SPACE**	USF Public Space	USF Common Space	USF Wall Thick-ness	**USF SUB-TOTAL NON-TENANT SPACE**	GSF TOTAL NON - PARKING AREAS	GSF Inside Parking	TOTAL BUILDING GROSS AREA
BASEMENT				16,129	**16,129**	2,340	11,515	856	**14,711**	14,711	16,129	30,840
1ST FLOOR	380	7,200	15,840		**23,800**	3,216	3,348	856	**7,420**	30,840		30,840
2ND FLOOR	880	7,200	15,840		**24,800**	2,976	3,088	856	**6,920**	30,840		30,840
3RD FLOOR	880	7,200	15,840		**24,800**	2,976	3,088	856	**6,920**	30,840		30,840
~~TOTAL~~	~~2,140~~	~~21,600~~	~~47,520~~	~~16,129~~	~~**87,389**~~	~~11,508~~	~~21,039~~	~~3,424~~	~~**35,971**~~	~~107,231~~	~~16,129~~	~~123,360~~
TOTAL ROUNDED	2,100	21,600	47,500	16,100	**87,400**	11,500	21,000	3,400	**36,000**	107,200	16,100	123,400

STRUCTURAL AREA

FLOOR	SLAB ON GRADE	OFFICE / CR SUP. SLAB	ROOFING	TOTAL STRUCT.
BASEMENT	30,840			30,840
1ST FLOOR		30,840		30,840
2ND FLOOR		30,840		30,840
3RD FLOOR		30,840		30,840
ROOF			30,840	30,840
~~TOTAL~~	~~30,840~~	~~92,520~~	~~30,840~~	~~154,200~~
TOTAL ROUNDED	30,800	92,500	30,800	154,200

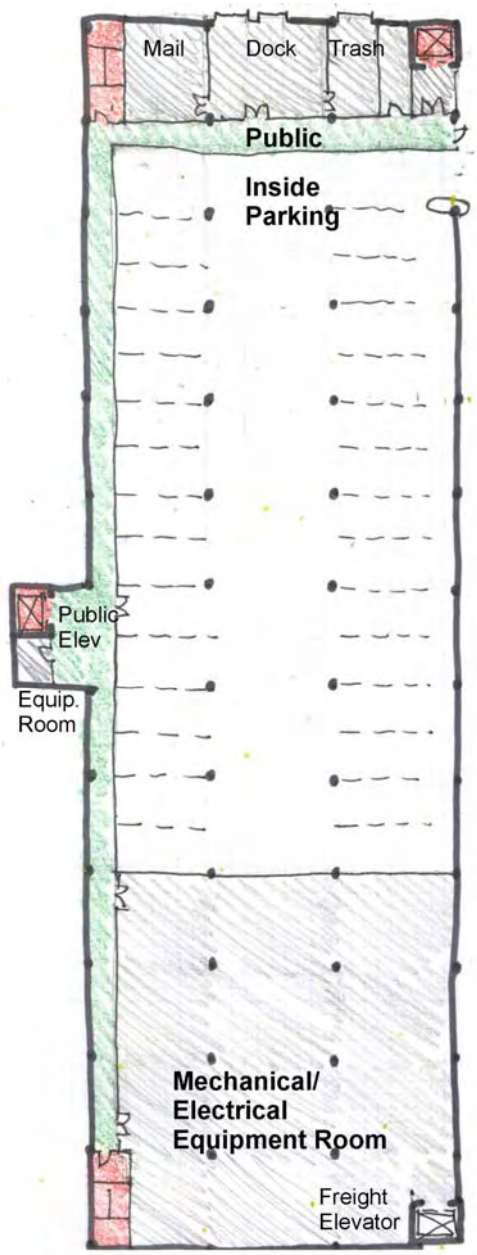
SKIN AREA

SKIN AREA	HT	EXTERIOR PERIM	EXTERIOR TOTAL	1.25 X EXTERIOR TOTAL*
BASEMENT	16.00	856	13,696	17,120
1ST FLOOR	16.00	856	13,696	17,120
2ND FLOOR	14.00	856	11,984	14,980
3RD FLOOR	14.00	856	11,984	14,980
SUBTOTAL			51,360	**64,200**
FOUNDATION			13,696	**17,120**
TOTAL FINISHED SKIN			37,664	**47,080**

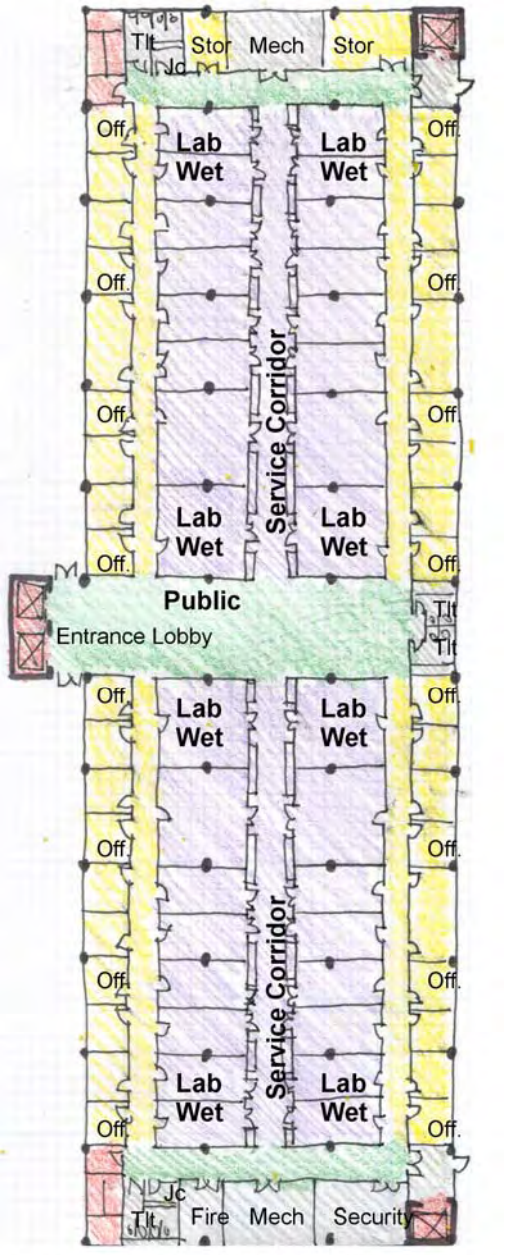
*1.25 Factor to account for the articulation of the exterior wall.

Example Plans

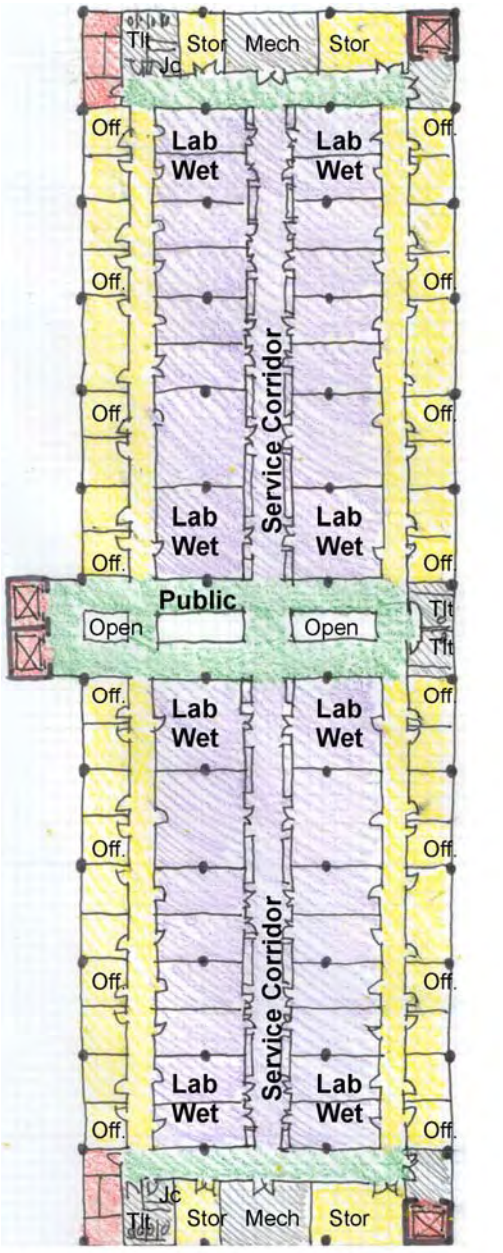
The following diagrams illustrate the design upon which the unit costs are based and are representative of typical laboratory building plans.



Laboratory Building Shell Type
Basement Floor Plan
0 10'-0" 20'-0" 60'-0"



Laboratory Building Shell Type
Ground Floor Plan
0 10'-0" 20'-0" 60'-0"



Laboratory Building Shell Type
Levels 2-3 Floor Plan

0 10'-0" 20'-0" 60'-0"

Construction Criteria

The unit costs for Laboratory buildings are based on the construction quality and design features in the following table. This information has been generally organized under Uniformat headings. Items marked with a ☒ indicate features required by government mandate for which there is "no market comparable."

Category	
Substructure Foundation	
Standard Foundation	■ Allowable soil bearing pressure of 2 tons/SF assumed for spread footings ■ Reinforced concrete spread footing 80 PSF concrete and 2.5 PSF reinforcing
Substructure Envelope	
Basement Excavation	■ 16'- 0" excavated one subgrade floor level and elevator pits
Basement Walls	■ 16'- 0" (h) by 1'- 0" (thick) reinforced concrete wall resting on spread footings
Slab on Grade	■ 4000 PSI 6" concrete slab with welded heavy wire mesh (20-25% fly ash) ■ Moisture barrier ■ Gravel base and compacted fill ■ Sealant at joints and wall junctures
Shell Superstructure	
Floor Construction	■ Poured-in-place reinforced concrete floor slab ■ The laboratory floor framing consists of one-way concrete joists and concrete beams on the column lines ■ Joists are 24½" (d) with 6" (w) ribs spaced 36" OC; beams are 24½" (d) ■ Volume of concrete for columns is 1 cubic yard per 400 SF floor area ■ Column reinforcement is 1.0 PSF floor area ■ Total tonnage of reinforcement for the floor (slabs + beams) is 8.0 PSF ☒ Spandrel beams along long sides of the building with column spacing 20'-0" are 24½" (d) with additional 30 lbs. per linear foot of reinforcing at all floors ☒ Spandrel beams along short sides of building with column spacing of 30'-0" are 36" (d) with additional 40 lbs. per linear foot of reinforcing at all floors ■ 150 lbs/SF floor load at lab modules ■ 150 lbs/SF storage and receiving areas
Roof Construction	■ Poured-in-place reinforced concrete frame with joist slab
Elevators	■ 6" CMU shaft
Fire Egress Stairs	■ 6" CMU stairs

Category	
Shell Exterior Closure	
Exterior Wall	■ Insulated metal panel curtain wall system on metal stud backup ■ Metal stud backup with $^{5}/_{8}$" GWB on inside ■ Batt insulation in metal stud cavity with vapor barrier on cold side ■ 24" parapet with stainless steel cap and metal stud backup wall
Corner Stone	■ Cast stone
Exterior Glazing	
Fenestration	■ 40% glazing/60% skin [for all]
Curtain Wall System	■ Aluminum framing with 3-coat baked painted finish ■ Glass to be insulated double glazed units with annealed coated low-e glass; U-factor for glazing = 0.32; shading coefficient for glazing = 0.35
Window System	■ Aluminum frame punched window system ■ Glass to be insulated double glazed units with annealed coated low-e glass; U-factor for glazing = 0.32 shading coefficient for glazing = 0.35 ■ Sill at 30" above floor
Exterior Doors	
Entrance Vestibule	■ Double set of automatic sliding doors including track, operator, jamb and door panels ■ Overhead concealed electrical linear operator ■ 7"- 0" (w) by 7'- 0" (h) ■ Sliding panel to be aluminum frame glass panel with intermediate rail; door panel to swing out 90 degrees for emergency egress ■ Glass to be safety tempered glass ■ Provide keyed lock with panic release and automatic access control via card reader system
Emergency Egress Doors	■ Hollow metal 1¾" insulated door 3'- 0" (w) by 7'- 0" (h) ■ 16 gauge steel frame with thermal break ■ Keyed lever lockset with panic release bar on inside and automatic access control via card reader system ■ Automatic closers
Fire Doors	■ Overhead coiling fire doors ■ Concealed overhead installation ■ 20 gauge metal interlocking slats ■ Nylon smoke seals ■ Visual and audio (strobe) anunciator to warn of operation

Category	
Coiling Overhead Dock Doors	■ Concealed overhead coiling door ■ 26 gauge flat metal slats ■ Motor operation ■ Bottom lock ■ Weather seals at the bottom, guides, and hood
Vents and Areaways	■ Architectural drainable steel louvers with 6" (d) adjustable blades with rain gutter
Shell Enclosure Roof	
Roof Covering	■ EPDM, single-ply membrane roofing system ■ Gravel ballast
Insulation	■ Two layers 2" (thick) closed cell polystyrene rigid insulation
Roof Access	■ Interior permanent stair extending up from emergency egress stairs with standard exterior metal door
Smoke Hatch	■ 14 gauge painted steel hatch and curb unit
Interior Construction	
Partitions	
Entrance Vestibule, Public Lobby and Exit Corridors, Tenant Demising Partitions, Public Toilets, Security Office, Vending/Concession Areas, Building Maintenance, Loading Dock, Mail Room	■ Structural slab-to-slab ■ $^{5}/_{8}$" GWB on metal studs at 24" OC ■ Acoustical insulation filling the GWB wall cavity
Mechanical and Electrical Equipment Rooms	■ Structural slab-to-slab ■ 1 hr fire rated ■ 55 STC ■ Two layers ½" GWB both sides on metal studs 16" OC ■ Acoustical insulation filling the wall cavity

Category		
	Fire Command, Janitor Closets, Electrical Closets, Telephone Closet, Trash Room, General Storage	■ Structural slab-to-slab ■ $^{5}/_{8}$" GWB on metal studs at 24" OC
	Ventilation, Plumbing, and Vertical Backbone Shafts	■ 2 hr fire rated ■ 50 STC ■ Type X GWB shaft wall system with one layer 1" channel mounted GWB and one layer ½" GWB outside face
	Emergency Egress Stairs and Elevator Shaft	■ 6" CMU with and one layer ½" GWB on metal furring outside face
	Doors	
	Public Toilets, Security Office, Vending/Concession Area, Fire Command, Janitor Closets, Electrical Closets, Telephone Closets	■ Solid core 1¾" hardwood veneer doors 3'- 0" (w) by 7'- 0" (h) ■ Doorframes will be a minimum 14 gauge metal frame construction ■ Hardware to be locksets with levers ■ Key locks
	Building Maintenance, Loading Dock, Mail Room, Trash Room, and General Storage	■ 1" ABS plastic clad wood core double service doors 5'- 0" (w) by 7'- 0" (h) ■ 250 degree cam hinge system ■ Acrylic view window ■ Impact plates and cart bumpers
	Mechanical and Electrical Equipment Rooms	■ Hollow metal 1¾" double doors 6'- 0" (w) by 7'- 0" (h) ■ 16 gauge welded metal frames ■ Hardware to be locksets with levers ■ Key locks
	Emergency Egress Stair Doors	■ Fire-rated solid core 1¾" hardwood veneer doors 3'- 0" (w) by 7'- 0" (h) ■ 16 gauge welded metal frames ■ Hardware to be panic release with levers opposite side ■ Automatic closers
Specialties		
	Specialties – Handrail	
	Emergency Egress Stairs	■ Welded pipe handrail

Category	
Specialties – Toilet Accessories	■ Stainless steel ceiling hung partitions ■ Toilet paper holder ■ Feminine napkin disposal (female toilets only) ■ Feminine napkin dispenser (female toilets only) ■ Paper towel dispenser combination waste receptacle ■ Soap dispenser ■ Mirror with stainless steel edging ■ ADAAG compliant toilet grab bars
Fire Extinguisher Cabinets	■ Fire extinguisher cabinets in storage rooms and equipment rooms
Signage	
Building Directory	■ Touch-screen computer monitor programmed building directory ■ Stone veneer pedestal case
Great Seal	■ Cast plaster 24” diameter
Interior United States Flag	■ Cantilever pole aluminum mounted ■ Manual operated
Dedication Plaque	■ Bronze 4 SF with raised letters
Floor Identification	■ Dimensional letters mounted on wall covering with ADAAG compliant tactile Braille signage
Emergency Egress	■ Etched on plastic laminate signage system panel with ADAAG compliant tactile Braille signage
Room Identification for Major Public Spaces	■ Room identification signage to be raised plastic letters mounted beside the door with ADAAG compliant tactile Braille signage
Room Identification	■ Signage system to be modular vinyl lettering on plastic laminate signage frame system with ADAAG compliant tactile Braille vinyl signage modules
Telephone Enclosure	■ Stainless steel dividers with stainless steel shelf and perforated interior face with acoustical material
Interior Finishes	
Walls	
Main Lobby, Main Elevator Lobby	■ 5’- 0” (h) stone wainscot with Type II vinyl wall covering above
Upper Floor Elevator Lobby, Public Corridors	■ Type II vinyl wall covering with hardwood base
Public Toilets	■ $^{3}/_{8}$” textured porcelain tile base and wainscot with paint above

Category		
	Vending/Concession Area, Copier Area	■ Low VOC paint with vinyl cove base
	Security Office, Egress Corridors	■ Low VOC paint with vinyl cove base
	Building Maintenance, Loading Dock, Mail Room, Trash Room, General Storage	■ Low VOC paint with vinyl cove base ■ Vinyl chair rail guard and vinyl corner guards
	Mechanical and Electrical Equipment Rooms, Fire Command, Janitor Closets, Electrical Closets, Telephone Closet	■ Low VOC paint with vinyl cove base ■ Steel corner guards
	Floors	
	Entrance Vestibule	■ Entrance to have 1” terrazzo floor tile 12” by 12” with mastic base ■ Drained entrance grid with structural aluminum rails, drain pan, and carpet tread inserts of monofilament solution died nylon fusion bonded to backing
	Main Lobby, Main Elevator Lobby	■ Terrazzo tile
	Upper Floor Elevator Lobby	■ Terrazzo tile
	Public Corridors, Security Office	■ Broadloom carpet ■ 32 oz face weight ■ Yarn dyed color ■ Fourth generation nylon yarn ■ Bonded construction with cushioned back
	Public Toilets	■ $^{3}/_{8}$” textured porcelain tile
	Vending/Concession Area, Copier Area	■ Vinyl composition tile
	Building Maintenance, Mail Room, Trash Room, General Storage, Janitor Closets, Fire Command	■ Vinyl composition tile

Category		
	Loading Dock Mechanical and Electrical Equipment Rooms	■ Sealed concrete
	Electrical Closets, Telephone Closets	■ Vinyl composition tile
	Ceiling	
	General	■ Suspended 24” (w) by 24” (l) acoustical tile ceiling
	Entrance Vestibule	■ Plaster
	Main Lobby, Main Elevator Lobby, Upper Floor Elevator Lobby	■ Low VOC painted GWB
	Upper Floor Public Corridors	■ Suspended 24” (w) by 24” (l) acoustical tile ceiling
	Public Toilets	■ Suspended 24” (w) by 24” (l) acoustical tile ceiling ■ Soffit over counter areas
	Vending/Concession Area, Security Office	■ Suspended 24” (w) by 24” (l) acoustical tile ceiling
	Egress Corridors	■ Suspended 24” (w) by 24” (l) acoustical tile ceiling
	Building Maintenance Office, Mail Room, Fire Command	■ Suspended 24” (w) by 24” (l) acoustical tile ceiling
	Building Maintenance Shop Area, Trash Room, General Storage, Loading Dock, Mechanical and Electrical Equipment Rooms, Janitor Closets, Electrical Closets, Telephone Closets	■ Exposed structure above

Category	
Conveying Systems	
Elevators	
Public Elevators	■ Holed hydraulic elevator ■ Elevator cab allowance: $31,500/per cab (Oct '00 dollars)
Service Elevators	■ Holed hydraulic elevator ■ Elevator cab allowance: $5,000/per cab (Oct '00 dollars)
Plumbing	
Utility Service: Domestic Water Supply	■ Two domestic cold water services shall be provided connecting to the public utilities in the adjacent streets ■ Domestic cold water services shall be metered in accordance with local requirements ■ Domestic water services shall be equipped with reduced pressure type backflow preventors located on the first level above grade
Utility Service: Storm Drainage and Sewerage Systems	■ Multiple sanitary and storm water (primary and secondary) house drain services shall be provided from the building and connect to public utilities in adjacent streets
Utility Service: Natural Gas	■ A natural gas service shall be extended into the building and be metered in accordance with local requirements ■ Shut-off valve at gas service entry point
Public Toilets	■ Porcelain sink inset in counter ■ Cold and hot water supply ■ Lever faucet ■ Porcelain floor mounted flush-valve water closet ■ Floor drain with primer
Domestic Cold Water System	■ Each system shall be pressurized by a factory prefabricated tri-plex constant pressure pumping system ■ Provide independent domestic cold water systems for general building and for laboratories ■ All domestic water connections to non-potable sources shall be provided with suitable backflow preventors ■ Provide non-freeze hydrants around the base of the building located on each side of main entrance and spaced approximately 100'-0" OC around building
Domestic Hot Water System	■ Provide independent domestic hot water systems for general building and for laboratories ■ Domestic hot water for each system shall be generated by multiple gas-fired storage type water heaters with water heater flues to be extended through main roof ■ A multi-zone central domestic hot water distribution system with supply and recirculation piping shall be provided to serve all fixtures and equipment requiring hot water; recirculation shall be provided to any fixture located greater than fifty-feet from a circulated main or riser

Category		
	Sanitary Drainage Systems	■ All areas below grade shall be provided with duplex sewage ejector stations; each ejector pump shall be sized for 100% capacity and be provided with emergency power
	Vending/Concession Area	■ Cold water supply with shut-off at connection
	Drinking Fountains	■ Wall-mounted fountain with chiller
	Laboratory Utility Systems	■ Six nominal piping systems ■ Central distribution for distilled water system with high purity dual bed deionized water feed with polypropylene piping ■ Central distribution for central natural gas supply with medical grade copper tubing ■ Central distribution and service for special gas supply systems including O_2, N_2, He, CO_2 with medical grade copper tubing ■ Central distribution, pumps and reservoir for central vacuum of 18”- 22” of mercury in medical grade copper tubing; discharge to have solvent stripper recovery unit followed by carbon filters ■ Central collection risers and mains for acid waste and vent with polypropylene piping with treatment system consisting of limestone chip acid neutralization tank discharged to the sanitary sewer system ■ Central collection risers and mains for solvent waste and vent with glass piping passed through solvent stripper/recovery unit of vacuum condensing type with waste discharged to acid waste system
	Mechanical Room, UPS Battery Rooms	■ Floor drain with primer ■ Emergency eye wash and deluge shower
HVAC		
	General	■ All HVAC systems and equipment shall at minimum comply with the energy performance criteria within the “Facilities Standards for the Public Buildings Service” supporting an assigned energy performance goal ■ System and equipment selections indicated below are for the purposes of this unit cost study only; alternate system and equipment options should be investigated on a specific building project for improved efficiency of operation, and enhanced life cycle economic performance
	Design Conditions and Loads	■ Outdoor design conditions shall be as per GSA Standards ■ Indoor design conditions shall be as required ■ Ventilation rates shall meet or exceed all required codes and standards, including ASHRAE-62, but in no case be less than 20 CFM of outside air per occupant ■ Space-heating boilers have been sized assuming a design load of 30 Btu/h per GSF of building ■ Central cooling equipment has been sized on the basis of 1 ton of refrigeration per 300 GSF for unit cost purposes; However, designers shall minimize cooling capacity to the degree possible while also satisfying all design criteria

Category		
	Energy Supply	■ A complete fuel oil pumping system shall be provided for the emergency generators and boilers and shall include fuel oil storage tanks, piping, valves, duplex fuel oil pump and day tank ■ Tanks to be buried underground double-walled fiberglass tanks with leak detection system ■ See Plumbing–Utility Service: Natural Gas for criteria
	Heat Generating System	■ Heating system shall be hot water type generated by dual fuel boilers (natural gas and #2 fuel oil); provide oil storage tank ■ Hot water shall be distributed to perimeter fan coil units and perimeter fan powered VAV boxes with heating coil ■ Heating water shall be distributed by two hot water pumps through two pipe reverse return system; hot water to glycol heat exchanger with two pumps (one standby) to be provided ■ For unit cost purposes, two space-heating boilers are assumed with each rated at approximately 67% of peak heating load; boiler capacities used in this study are as follows: two boilers at 65 HP each [capacities shown are in BHP (boiler horsepower where 1 BHP = 33,475 Btu/h)] ■ Pumps to be horizontal split case ■ Provide mechanical seals for all water pumps
	Cooling Generating Systems	■ Refrigeration machines shall be electrically driven chillers ■ For unit cost purposes, chillers are sized for 50%, 50%, and 20% of the peak cooling load; chiller capacities used in this study are as follows: 2 at 175 Tons and 1 at 70 Tons ■ Plate-and-frame heat exchanger provided for free-cooling application ■ Cooling towers to be forced draft type steel frame with fireproof fill
	Air Distribution System	
	Air Supply, VAV	■ Variable air volume (VAV) terminal reheat system with pre-filters and after-filters for 95% efficiency with terminal humidifier and with make up air handling unit with pre-heat and prefilter unit ■ Laboratory modules to have positive pressure relative to other spaces; no return air from laboratories to other spaces
	Air Handling Units	■ Provide a minimum of one unit for every floor and a separate unit for every 25,000 CFM of capacity ■ The air handling system(s) to consist of recirculating variable air volume air conditioning units providing conditioned air on each floor for space cooling and ventilation; each unit to consist of a supply air fan, filters, chilled water coil, sound attenuation and controls ■ Fan motors shall be driven by Variable Frequency Drives (VFD) for efficient electrical operation ■ Minimum outside air for each fan room will be supplied from a central outside air fan system which includes filters, cooling coil, heating coil and humidifier
	Materials	■ Sheet metal work for gauges and bracing shall conform to ASHRAE and SMACNA standards ■ Pipe for chilled water, condenser water, steam and hot water piping to be schedule 40 standard with steel ASTM A53 lap welded or seamless black steel

Category		
		■ Valves to be furnished and installed as necessary for the control and easy maintenance of all piping and equipment ■ Expansion loops to be provided for all piping systems ■ Grilles, registers and diffusers to be provided as required ■ Dampers to be provided as required for proper balancing of systems and all fire and fire/smoke dampers required by code ■ Fans (centrifugal) to be airfoil type with adjustable sheaves below 50 HP ■ Air filters to be 25-30% efficiency prefilters and 80-85% efficiency final filters for each AHU ■ Insulation for sheet metals to be provided in all medium pressure supply air ductwork from fan discharge to pressure reducing device (including flexible connections) and low-pressure ductwork; all supply, return, spill, outside air intake and exhaust plenums to be insulated
	Exhaust Air	■ Toilets to be provided with 100% exhaust operated by time clock or building management system ■ Ducted ceiling exhaust ducts with economizer exhaust and connections to individual fume hoods ■ Provide ducted exhaust system from laboratory modules for fume hood and safety cabinet exhausts ■ Provide dry trap for condensing solid material, one bubbler for reduction of post-reactions initiated by the presence of oxygen with caustic scrubbing liquid, a nitrogen purge, and a charcoal trap to remove unreacted toxic gases ■ Provide flexible exhaust duct “snorkel” connection—1 per laboratory module ■ Emergency generator vertical exhaust ■ UPS battery room to have 100% direct exhaust
	Controls	■ Building Automation Systems: all building systems shall be monitored or controlled or interfaced through the Building Automation System (BAS) which BAS consists of an Energy Management System (EMS), Security System and Fire Protection System; system selection shall be expandable and allow communication with other automation systems ■ The EMS will have Central Processing Unit (CPU), monitor, local permanently mounted alphanumeric keyboard, printer, control, and feedback functions; software programs will be used for control; all systems will be provided with redundant backup ■ The EMS shall utilize Direct Digital Controls (DDC) for system control; monitoring the systems will be accomplished with a central terminal in the BAS office; control systems shall be pneumatically actuated ■ Alarm to be the BAS system shall notify the operator of equipment failures and high/low operating conditions in all systems
Fire Protection		
	Service	■ Two services connecting to public utilities in adjacent streets ■ Fully metered in accordance with local requirements ■ Equipped with reduced pressure type backflow preventors located on the first level above grade
	Fire Suppression	■ Combination fire standpipe/sprinkler system throughout the building pressurized by automatic electric fire pump and jockey pump ■ Fire pump shall be supplied with normal and emergency power and an automatic transfer switch

Category		
		■ Automatic wet pipe sprinkler system throughout except areas subject to freezing where a dry pipe system shall be used ■ Recessed automatic glass bulb quick response type sprinkler heads; provide one sprinkler head for every 100 SF of finished space ■ Elevator machine room, elevator shafts and electrical switchgear rooms with sprinkler systems; cooling towers with deluge type sprinkler system ■ Fire department hose valves at stairways shall consist of a hose valve within the stair and an additional valve on the corridor side of the stairwell ■ Siamese connections ■ Tamper switches on all fire protection control valves ■ Each sprinkler floor system connection to standpipe riser and main provided with OS&Y gate valve with tamper switch, check valve, water flow alarm, inspectors test and drain, drain with sight glass ■ Multipurpose ABC dry chemical fire extinguisher in storage rooms and equipment rooms
	Fire Alarm System	■ Addressable type, electronic fully supervised multiplexing type employing high frequency carrier applied to dedicated wires for the distribution of its multiplex coded signals ■ Fire safety system command center in room on lobby level with direct access for fire fighters; command center to receive local alarms; remote annunciator panels located in engineer's control room ■ Fire protection alarm system devices shall be located in accordance with the following: manual fire alarm pull station adjacent to exit door on each floor; space smoke detectors (analog type) in all elevator lobbies, electrical switchgear, transformer vaults, and telephone exchanges; intercom (warden) stations on each floor and in each mechanical room; duct smoke detectors (analog type) in air handling systems in excess of 2000 CFM; waterflow detectors in sprinkler piping; tamper switches on valves in sprinkler piping; automatic control (stopping) of air handling systems in response to signal from the fire protective alarm system and automatic starting of smoke exhaust and pressurization fan systems; manual control of fans from the fire command center; combination voice evacuation speaker and visual devices throughout the floors, visual device in each toilet; elevator recall to ground floor
	Smoke Evacuation	■ Ceiling hatches in stairwells ■ Automatic opening ventilation louvers at stairwell bases ■ System actuated ventilation fans
Electrical		
	Electrical Service	■ Suitable for receiving low-tension power at the $^{480}/_{277}$ volt level from facilities provided by the utility company
	Service and Distribution Equipment	■ Include all the elements necessary to conduct electricity in an approved safe manner to all lighting fixtures, air conditioning equipment, heating equipment, plumbing equipment, sanitary equipment, elevators, special electrical systems, receptacle and appliance outlets, and signal and communications equipment ■ Single supply connection main switchboards ■ All required subsidiary panelboards (power, distribution, lighting, and appliance) ■ Automatic power factor correction equipment for each switchboard to maintain a 90% power factor ■ Incorporate copper busses and copper wiring throughout ■ 480 volts, three phase for all motors ½ horsepower and larger

Category		
		■ 277 volts single phase to all fluorescent (and other discharge type lamp) lighting fixtures ■ Power conditioning and transient suppression (PCTS) devices for each main switchboard, main emergency distribution panelboard, and each $^{120}/_{208}$ appliance panelboard ■ Three phase dry type 115° C transformers (480-$^{120}/_{208}$) for all normal power requirements ■ Three phase dry type K-13 rated transformers (480-$^{120}/_{208}$) for all panelboards serving office automation equipment and work stations ■ $^{120}/_{208}$ volt appliance panelboards serving office automation (electronic) equipment shall be suitable for 'harmonic rich' line to neutral loads ■ Grounding to consist of a series of driven ground rods and cable with connections to grounding electrodes ■ Provide master labeled UL96 lightning protection system ■ Plug-in buss duct risers will be utilized for distributing normal power to each of the floors
	Emergency Power	
	Generator Unit	■ Diesel-driven emergency generator unit with paralleling switchgears for multiple generators; provide 500 KW unit ■ Automatic transfer switches (by-pass isolation type) arranged to maintain the emergency power distribution system energized from the normal utility company source or the generating set ■ Remote emergency alarm panel for each generator located at the building control center
	Uninterruptible Power Systems	■ Provide separate uninterruptible power systems complete with UPS modules with 30-minute battery backup, maintenance bypass switchgear, and interconnecting circuitry for the computer/data and communications systems, life safety (egress lighting systems, and security systems
	Electrical Outlets	
	General Areas	■ Wall mounted duplex outlets every 50'- 0" OC
	Corridors and Lobby Spaces	■ Wall mounted duplex outlets every 50'- 0" OC ■ Provide a dedicated line duplex electrical outlet at the public lobby for metal detector and x-ray security screening equipment ■ Provide recessed duplex wall receptacle for clock in each lobby and corridor
	Vending/Concession Area	■ One quadplex counter splash mounted electrical outlet ■ One duplex wall outlet for each vending machine
	Electrical and Communication Closets	■ Two dedicated duplex outlets on emergency power plus additional outlets for every 6'- 0" of wall space ■ A separate 120-volt panel with master switch and five 20-amp circuits to be included for each telephone and LAN system for each separate agency
	Maintenance Shop, Mail Room	■ Provide counter plug mold strips with outlets at every 18" OC
	Public Toilets	■ Ground fault electrical duplex outlet

Category		
	Lighting	
	Entry Vestibule	■ Recessed down lamps one per every 10 SF
	Main Lobby, Main Elevator Lobby, Upper Floor Elevator Lobby	■ Metal halide uplighting
	Public Corridors, Egress Corridors	■ Parabolic fluorescent 24” (w) by 48” (l) recessed ceiling fixtures with two T-8 lamps and electronic ballasts located every 80 SF (or T-5 equivalent)
	Public Toilets	■ Recessed fluorescent light fixture located in the soffit above the lavatory and the toilet
	Vending/Concession Area, Security Office	■ Parabolic fluorescent 24” (w) by 48” (l) recessed ceiling fixtures with two T-8 lamps and electronic ballasts located every 80 SF (or T-5 equivalent)
	Building Maintenance Office, Mail Room, Fire Command	■ Parabolic fluorescent 24” (w) by 48” (l) recessed ceiling fixtures with two T-8 lamps and electronic ballasts located every 80 SF (or T-5 equivalent)
	Building Maintenance Shop Area, Trash Room, General Storage, Loading Dock, Mechanical and Electrical Room, Janitor Closets, Electrical Closets, Telephone Closets	■ Suspended fluorescent 24” (w) by 48” (l) recessed ceiling fixtures with two T-8 lamps and electronic ballasts located every 80 SF (or T-5 equivalent)
	Telephone and Communication Outlets	■ Conduit, power, and mounting/telephone boards for telephone and data communications system are provided as part of the building shell and core unit costs; equipment and wiring provided by tenant
	Public Lobby	■ Conduit and boxes for telephone connections for security screening post provided as part of the building shell and core unit costs; equipment and wiring provided by tenant ■ Conduit and boxes for public pay telephone connections provided as part of the building shell and core unit costs; equipment and wiring provided by tenant ■ Conduit and boxes for one data connection for electronic building directory provided as part of the building shell and core unit costs; equipment and wiring provided by tenant
	Security Office, Building Maintenance Office, Mail Room	■ Conduit and boxes for one telephone line provided as part of the building shell and core unit costs; equipment and wiring provided by tenant ■ Conduit and boxes for one LAN connection provided as part of the building shell and core unit costs; equipment and wiring provided by tenant

Category		
	Telephone Room	■ Four 4" vertical conduits between floors provided as part of the building shell and core unit costs ■ Conduit and boxes for one telephone line provided as part of the building shell and core unit costs; equipment and wiring provided by tenant ■ Conduit and boxes for mounting board for telephone and LAN switch connections provided as part of the building shell and core unit costs; equipment and wiring provided by tenant
	Mechanical Room	■ Conduit and boxes for one telephone line provided as part of the building shell and core unit costs; equipment and wiring provided by tenant ■ Conduit and boxes for one LAN connection for BAS computer provided as part of the building shell and core unit costs; equipment and wiring provided by tenant
	Security Devices	
	General	■ Exterior intrusion detection system, including door position detectors and lock keeper detectors on all exterior doors, glass break sensors on all exterior glazing, and volumetric motion sensors outside each door ■ For interior security, conduit, power and mounting support for interior security devices including x-ray baggage and walk through metal detectors provided as part of the building shell and core unit costs
	Entry Vestibule, Entry Door from Restricted Parking, Dock Man Door and Cargo Overhead Door	■ Card reader access control system ■ Intrusion detection system, with door position detector and lock keeper detector and glass break sensors ■ Intercom and duress alarm ■ Closed circuit television monitor ■ Volumetric motion sensor
	Emergency Egress Doors	■ Intrusion detection system with door position detector and lock keeper detector ■ Glass break sensors ■ Closed circuit television monitor
	Building Perimeter	■ Glass break sensors ■ Closed circuit television monitor
	Public Lobby	■ Closed circuit television monitor ■ Glass break sensor ■ Metal detector ■ X-ray baggage inspection equipment
	Security Office	■ Monitors for intrusion detection systems, duress alarms, intercoms, closed circuit television cameras, fire alarms, and card access controls
	Mail Room	■ X-ray package inspection system
	Elevator	■ Remote floor recall override to stop elevators on floors away from threats

Category	
Commercial Equipment	
Window Washing Equipment	■ Davit only ■ Allowance: $15,000 (Oct '00 dollars)
Dock Loading Equipment	■ One dock leveler with electro-hydraulic operation for building services provided as part of the building shell and core unit costs; additional docks will be tenant assignable space and associated levelers and dock equipment will be a special cost to the tenant
Furnishings	
Casework	
General	■ All millwork to be AWI custom grade plastic laminate veneer panels with stainless steel
Public Toilets	■ Cantilevered plastic laminate counter with splash
Public Lobby, Security/Information Desk	■ Wood veneer construction with transaction surface of polished granite and worksurface of plastic laminate
Vending/Concession Area, Security Office	■ Painted metal base and upper cabinets ■ Plastic laminate counter with splash
Building Site Work	
General	■ Site work allowance carried in estimate to cover such items as: roadways, walkways and plazas, vegetation, site lighting, and site utilities ■ Site allowance is based on a site area to GSF ratio of 75%
Flagpoles	■ 30'- 0" (h) aluminum pole with internal halyard and spread footing base for U.S. flag
Roadways	■ Concrete 12'- 0" (w) lanes with curbs
Walkways and Plazas	■ Concrete walkways
Fountains	■ Round fountain in entrance plaza
Vegetation	■ Grass ground cover ■ Accent annual flowerbeds and flowering shrubs along entrance paths ■ Perimeter indigenous trees
Site Lighting	■ Metal halide high mast general lighting ■ Metal halide building security flood lighting