STATE OF MICHIGAN
STATE OFFICE BUILDING

MINIMUM *DESIGN* STANDARDS

PART 1 - SITE DEVELOPMENT .....

PART 2 - ARCHITECTURAL SYSTEMS .....

PART 3 - STRUCTURAL SYSTEMS .....

PART 4 - FIRE PROTECTION SYSTEMS .....

PART 5 - MECHANICAL SYSTEMS .....

PART 6 - ELECTRICAL SYSTEMS .....

PART 7 - COMMUNICATIONS AND DATA SYSTEMS .....

PART 8 - SPECIAL SYSTEMS .....

PART 9 - APPENDICES .....

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
PART 1 - SITE DEVELOPMENT			
1.1 GENERAL APPROACH			

Site Development:
Harmony among *site elements* and *between site and its surroundings* constitute the *hallmark of a well planned project*
Three *characteristics* distinguish *State Buildings*:
▫ *Longer life span*
▫ *Changing occupancies*
▫ Use of *life cycle cost approach* to determine *overall cost*
The *State* typically will *own buildings longer* and will *perform alterations* in an ongoing fashion. Accordingly, Building and Site must:
▫ Use systems of *higher level of durability* (Site structures, utilities, etc.)
▫ Accommodate *periodic renovation* with use of *flexibility of access* and *staging areas*

1.2	**CODES AND STANDARDS**			
A.	Building Code			
	1. State construction code pursuant to 1972 P.A.230, and all other applicable codes.			
B.	Zoning			
	1. Adhere strictly to local zoning ordinances and regulations related to setbacks, height, massing, signage and site design requirements.			
	2. Local landscaping ordinances to be regarded as minimum requirements.			
C.	Local Regulations			
	1. Adhere strictly to local regulations including, but not limited to:			
	a. Storm water runoff.			
	b. Erosion control.			
	c. Sanitary and storm sewers and drains.			
	d. Natural gas systems.			
	e. Electrical power and communications systems.			
	f. Emergency vehicle access.			
	g. Roads and bridges.			
D.	Standards for Site Planning / Landscape Design			
	1. Adhere to local design standards.			
	2. American Association of Nurserymen ANSI Z60.1			
E.	Storm water detention			
	1. State of Michigan Soil Erosion and Sedimentation Act P.A. 1972 and 347 P.A. as amended.			
1.3	**SITE ANALYSIS**			
A.	On-site Investigation of existing conditions is required prior to any design.			
B.	Site survey required.			
C.	Environmental geotechnical investigations required and are responsibility of Lessor and Architect/Engineer.			
1.4	**GENERAL SITE PLANNING CRITERIA**			

General Site Planning Criteria
Preserve existing trees and other natural resources
Avoid *negative effects* of air, noise, smoke or dust *pollution* by:
▫ Using *natural terrain*
▫ Using *existing vegetation*
▫ Modifying *building orientation*
▫ Using *berms* and plant *buffer strips*
Promote *energy conservation* by:

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

▫ Taking advantage or *solar orientation*
▫ Using *coniferous trees* for *windbreaks and shade*
▫ Using *deciduous trees* for *shade in summer* and *heat gain in winter*
▫ Increasing amount of *green space*

1.5	**GRADING**			
A.	Slopes			
	1. Planted areas:			
	a. Must permit easy maintenance.			
	b. Turf areas: Between 3:1 and 1 percent (2 percent desirable).			
	c. Steeper than 3:1 requires ground cover or other erosion control.			
	d. Steeper than 2:1 not acceptable.			
	e. Terracing OK if access for lawn equipment provided.			
	2. Grassy swails and drainage ways: ≥ 1 percent			
	3. Walkways: ≤ 5 percent			
	a. If must exceed 5 percent, provide ramps for disabled.			
	b. Steps discouraged – where required, provide check walls enclosing treads and risers.			
	4. Cross slopes: ≤ 2 percent.			
	5. Parking areas / entrance plazas: ≥ 1 percent, ≤ 5 percent.			
B.	Miscellaneous			
	1. Parking lot drives should not be crowned.			
	2. Provide areas for piling of snow.			
	3. Provide drains at parking entrance ramps.			
C.	Storm water detention			
	1. Provide if required by local codes.			
	2. Detention must decrease runoff flow and improve water quality of runoff.			
	3. Consider for areas where existing system at or near peak capacity.			
	4. Rooftop detention not allowed.			
1.6	**SITE UTILITIES**			
A.	General			
	1. Architect / Engineer contact utility companies re rates, rebates, system capacity, etc.			
	2. Above-ground utility elements to be screened or integrated into building design.			
B.	Water Distribution			
	1. Follow local codes.			
	2. Coordinate service line with local authority.			
	3. Locate water lines			
	a. Behind curb lines			
	b. In unpaved areas, if possible.			
	c. Under sidewalks, if not in unpaved areas.			
	4. Do not locate water lines under foundations, streets, drives or other access areas.			
	5. Size according to fixture units and fire protection requirements.			
	6. Provide post indicator valve for fire service.			
	7. Fire hydrants to be placed:			
	a. Less than 300 ft. from all points on building façade.			
	b. Within 5 ft. of fire truck access road.			
	c. Within 100 ft. of building siamese connection.			
	d. Coordinate thread sizes with fire department.			
	8. Detector Check Valve			
	a. Provide at service entrance.			
C.	Sanitary Sewer System			

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				Yes	No	N/A
	1.	Follow regulations of local authority.				
	2.	Locate water lines				
		a.	In unpaved areas, if possible.			
		b.	At least 10 ft. from potable water lines.			
			1) Reduce to 6 ft. if bottom of water pipe is at least 12” above top of sewer pipe.			
		c.	Where crossing water pipe, encase in concrete or in pressure pipe extending 10 ft. either side of water line.			
	3.	Manholes				
		a.	Provide at:			
			1) All intersections.			
			2) Changes in pipe size.			
			3) Changes in gradient.			
		b.	Maximum spacing:			
			1) Pipe less than 18”: 300 ft.			
			2) Pipe ≥ 18”: 400 ft.			
		c.	Drop manholes			
			a) Provide where entering pipe is more than 18” above effluent line invert.			
		d.	Manhole connecting pipes			
			a) Straight, non-curved lines.			
			b) Connect to manholes with flexible gasketed joints.			
	4.	Service line connections				
		a.	Less than 100 ft. long: Use “Y” connection at main.			
		b.	More than 100 ft. long: Use manhole.			
	5.	Cleanouts				
		a.	Provide at:			
			1) Service lines, 5 ft. from building.			
			2) At all line bends where manholes not used.			
D.	Storm Drainage System					
	1.	Provide separate system even if connecting to dual service main.				
	2.	Use minimum of 10 yr. Storm frequency.				
	3.	Use piped, gravity flow systems (No open ditches, etc.)				
	4.	Locate in unpaved areas.				
	5.	Offset inlets from main trunk lines.				
1.7	**SITE CIRCULATION DESIGN**					

Site Circulation Design
Design can vary:
▫ *Tight urban* setting
▫ More *open suburban* setting
As a minimum, site *design must segregate*:
▫ Pedestrian access
▫ Vehicular access / parking
▫ Service vehicle access

A.	Service Drive must:				
	1.	Be from alley or site circulation drive.			
	2.	Have sufficient maneuvering space.			
	3.	Be screened as much as possible.			
	4.	Be separate from parking access.			
	5.	Be of one-way design.			

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		Yes	No	N/A
B.	Public Transportation			
	1. Provide bus stop for urban setting if appropriate.			
C.	Drop-off			
	1. Provide vehicular drop-off on street nearest main entrance.			
D.	Bike Racks			
	1. Provide 10 space rack			
	a. No less than 25 ft. from entry			
	b. Visible from entry.			
E.	Entrance Drives			
	1. Follow local codes.			
F.	Surface Parking Lots			
	1. Stall size: 9 ft. by 20 ft.			
	2. Use 90 deg. Parking where possible.			
	3. At least 10 percent total area for plant islands.			
	4. Curbs around perimeter and islands.			
	5. Maximum combined gradient: 5 percent.			
G.	Walkways			

Walkways:
Should be an *integral part* of *landscape design*.
Should *provide pleasant* and reasonably *direct route* to *building entrance.*
Can widen into *sitting areas* or *plazas*
Can link to *exercise trails*

	1. To be at least 5 ft. wide.			
	2. To be minimum 2'-6" from parking.			
	3. To include 5 ft. wide planting strips when next to drives.			
	4. Should incorporate handicapped provisions to avoid need for added ramps. etc.			
H.	Pavements and Curbs			
	1. Materials			
	a. Design for ease of maintenance.			
	b. Design for minimum glare (especially South side).			
	2. Textures			
	a. Change texture / pattern for pedestrian crossings / building entrance areas.			
	b. Textures to be only rough enough to not be slippery when wet.			
	3. Curbs			
	a. No precast concrete curbs allowed.			
	4. Drives			
	a. Follow local codes.			
	b. Use decorative bollards when bordering on pedestrian spaces.			
	5. Service areas			
	a. Truck passage areas to have concrete paving.			
	6. Pavement markings			
	a. Follow local codes.			
	7. Signage for roads and parking lots			
	a. Use minimum number of signs possible.			
1.8	**LANDSCAPE DESIGN**			

Landscape Design:
Unifies the *built areas* of the site
Should create a *pleasant*, *dynamic experience* for *staff* and *visitors*

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

Should be *appealing* from *inside* as well as *out*
Functions as a *setting for the building* as seen from *off-site by passing motorists / pedestrians*
Maintainability must be *investigated prior to design*

A. General Principals			
1. Category I Areas			
a. Definition: High visibility areas with highly developed designs.			
b. Comprised of:			
1) Building entrance.			
2) Courts.			
3) Plazas.			
4) Spaces between sidewalks and building.			
5) Eating / sitting areas.			
6) Parking lots at front of building.			
c. Design features:			
1) Integration into building architecture.			
2) Higher maintenance level.			
3) Planters.			
4) Landscape lighting.			
2. Category II Areas			
a. Definition: Lower visibility areas with simpler designs.			
b. Comprised of:			
1) Side and rear parking lots.			
2) Maintenance areas			
3) Loading docks.			
4) Other outlying areas.			
c. Design features:			
1) Lower maintenance level.			
2) Simpler plantings:			
a) Grasses.			
b) Deciduous trees.			
c) Ground covers.			
3. Total maintenance capability at site will determine proportions of the categories.			
4. Maintenance plan must be submitted with Final Concept Submittal.			
B. Landscape Elements			
1. Courts / Plazas			
a. Provide with:			
1) Capability of both sun and shade.			
2) Protection from winds.			
3) Pleasant views.			
4) Comfortable seating areas that accommodate large or small groups.			
5) Eating areas if appropriate.			
6) Separation from public areas using planters or walls.			
b. Smoking areas must be minimum 25 ft. from building.			
2. Planters			
a. Use large planters vs. small to protect plants more effectively.			
3. Rocks / Boulders			
a. Do not use lightweight or synthetic stones.			
1.9 IRRIGATION FOR LANDSCAPING			
A. System Design			
1. General criteria			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
		a.	Water plants only when needed.			
		b.	Water plants in infrequent, deep fashion (vs. frequent, shallow fashion).			
		c.	Use drip irrigation if feasible.			
		d.	Use only materials that are:			
			1) Durable			
			2) Readily available			
			3) Relatively maintenance free			
		e.	Allow for system expansion in design.			
	2.	Metering				
		a.	Meter separately from domestic water.			
	3.	Zoning				
		a.	Zone criteria:			
			1) Zones to be able to be timed differently.			
			2) Use same head / nozzle types in a zone.			
			3) Assign same vegetation types to a zone.			
	4.	Controls				
		a.	Controls criteria:			
			1) Provide for automatic control.			
			2) Provide for timed day or night watering.			
			3) Provide sensors as follows:			
			a) Rain or soil moisture sensors.			
			b) Freeze sensors.			
B.	Maintenance Considerations					
	1.	All components to be in protected, accessible locations.				
	2.	Manual and remote control valves to be in protected boxes.				
	3.	Controllers / remote sensing stations to be in vandal-proof enclosures.				
	4.	Above-ground components (backflow preventers, e.g.) to be in unobtrusive locations.				
	5.	Quick coupling valves to be:				
		a.	Two-piece body design.			
		b.	Installed at enough locations to facilitate wash down.			
	6.	Drain valves to be:				
		a.	Installed at enough locations to facilitate system draining.			
	7.	Provide connection for compressed air blowdown.				
1.10	**LANDSCAPE LIGHTING**					

Landscape Lighting:
Enhances *safety* and *security* on the *site*
Provides *illumination* for *nighttime activities*
Highlights site features
Should be *unobtrusive*
Should be unaffected by “spilled” lighting from parking lots or building

A.	Color					
	1.	Maintain single color throughout site.				
B.	Fixtures:					
	1.	Must complement other site elements (Matching bollards, e.g.).				
	2.	Must be recessed at retaining walls / check wall steps.				
	3.	Must have light source not directly visible to persons.				
	4.	Must be positioned so heat output will not harm plants.				
	5.	Must be resistant to vandalism.				
	6.	Must be replaceable from local sources.				

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			Yes	No	N/A
C.	Control				
	1.	Activated by building automation system.			
1.11	**SITE SIGNAGE**				
A.	Design Requirements:				
	1.	Use as few signs as possible.			
	2.	Signs must clafify:			
		a. Multiple entrances.			
		b. Parking areas.			
		c. Building entrance.			
		d. Building address.			
		e. Building identification.			
		f. Traffic directional signals.			
	3.	Signs must be consistent with interior signage and building architecture.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

SITE DEVELOPMENT							COMMENTS
X.1	A.	1.	a.	1)	a)	Reference Key	

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	Yes	No	N/A
PART 2 - ARCHITECTURAL DESIGN			
2.1 GENERAL APPROACH			

STATE BUILDING *Design* must:
▫ Demonstrate *Distinction* and *Quality*
▫ Reflect the *Dignity* and *Stability* of the *State Government*
▫ Embody the *Finest in Contemporary Architectural Thought*
STATE BUILDINGS Interiors must:
▫ Express quality of *Permanence* and *Elegance* consistent with building exterior
▫ Be *perceived as "First-Class"* by the Public and Employees
▫ Give employees sense of Pride and ability to Perform to the best of their abilities
STATE BUILDINGS must be:
▫ *Efficient*
▫ *Functional*
▫ *Flexible*
▫ *Technologically State-of-the-Art*
▫ Designed assuring *requirements of all disciplines* are *integrated* into the architectural *design*

2.2	**CODES AND STANDARDS**			
A.	The following design standards apply to various Architectural criteria outlined in this section:			

Category	Standard
Roofing	National Roofing Contractor's Association: Roofing and Waterproofing Manual
Concrete / Masonry	National Concrete Masonry Association: NCMA-TEK
Concrete / Masonry	Precast Concrete Institutes: Architectural Precast Concrete Second Edition
Brick / Masonry	Brick Institute of America (BIA) Technical Notes on Brick Construction
Limestone Veneer	Indiana Limestone Institute of America Handbook on Indiana Limestone
Metals	Association of Architectural Metal Manufacturers: AAMA Standard 101
Metals	National Association of Architectural Metal Manufacturers: NAAMM Standard SW-1
Sheet Metal	SMACNA Architectural Sheet Metal Manual
Communications	Electronic Industries Association/ Tele-communications Industry Association (EIAMA) 569: Commercial Building Standard for Telecommunication Pathways and Spaces
Elevators	ANSI Standard A17.1
Acoustics	ASHRAE Handbook of Fundamentals
Windows	ANSI/AAMA Standard 101-85 (Only Optical Performance Classes may be used)
Condensation	AAMA 1502.7 Voluntary Test Method for Condensation Resistance of Windows, Doors, and Glazed Wall Sections
Doors	Hardware - BOCA Building Code
Doors	Fire Rated - Chapter 5 ANSI/NFPA 101
Doors (Steel)	SDI Recommended Erection Instructions for Steel Frames
Ceilings	Suspension Systems - ASTM C.635 and C.636
Metal Stud Systems	ASTM C754
Drywall Systems	ASTM C840
Window Washing	OSHA Standard 29 CFR 1910.66 Subpart F - Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms
Window Washing	ANSI Standard A120.1 Safety Requirements for Powered Platforms for Building Maintenance
Window Washing	ANSI Standard A39.1 Safety Requirements for Window Cleaning
Graphics / Signage	Americans with Disabilities Act

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	Yes	No	N/A

Category	Standard
Graphics / Signage	Underwriters Laboratory (UL) Illuminated Signs Standard
Graphics / Signage	Occupational Safety and Health Administration (OSHA) Standards for Safety Signs
Graphics / Signage	Federal Standard 795 for signs indicating accessibility to the handicapped

2.3	**BUILDING PLANNING**					
A.	Basic Configurations and Core Placement					
	1.	Optimum depth of occupiable space between window wall and core is 40 ft.				
B.	Core Placement and Circulation Patterns					
	1.	Cores consist of elevators and lobbies, stairs, toilets, janitor closets, mechanical / electrical equipment spaces / shafts.				
	2.	Core types are:				
		a.	Centralized (One core in center of floor plate).			
			1)	Most efficient operationally (Travel distance, functional efficiency).		
			2)	Allows less contiguous space for open office areas.		
			3)	Practical for up to 15,000 SF floor area.		
		b.	Diffused (Two or three core areas within length of long floor plate).			
			1)	Less efficient than Centralized operationally (Travel distance, larger amount of main circulation).		
			2)	Allows for larger floor plates in excess of 15,000 sf.		
		c.	Exterior Perimeter (Core at perimeter of the floor)			
			1)	Maximizes contiguous usable space.		
			2)	Allows for large rooms in any configuration.		
		d.	Modular (Multiple cores in configuration suitable for floor expansion).			
			1)	Similar to diffused cores - multiple cores, longer travel distance, etc.		
			2)	Higher cost due to multiple cores.		
			3)	Circulation patterns can be X-shaped, racetrack, or H-shaped.		
C.	Placement of Core Elements and Distances					
	1.	Elevators.				
		a.	Banks of at least two.			
		b.	Maximum distance to work station = 200 ft.			
	2.	Stair				
		a.	As directed by code			
	3.	Toilets				
		a.	Maximum distance to work station = 200 ft.			
		b.	Fixtures as directed by floor area served.			
	4.	Electrical Closets				
		a.	Stack vertically			
		b.	Maximum wiring run distance = 100 ft.			
		c.	Shallow secondary closets (off corridors) allowed if max. run exceeds 100 ft. and additional riser is unjustifiable.			
	5.	Communication Closets				
		a.	Stack vertically			
		b.	Maximum wiring run distance = 290 ft.			
2.4	**SELECTING CONVEYING SYSTEMS**					
A.	Elevator Classifications					
	1.	Passenger Elevator				
		a.	Conveys persons and small carts			
	2.	Freight Elevator				
		a.	Required for buildings over 2 stories in height.			
		b.	Must be separate and remote from Passenger Elevator.			

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				Yes	No	N/A
			c. Should have 12 ft. ceiling.			
			d. Must have capacity to transport mechanical replacement equipment (compressors, motors, small tanks, etc.)			
			e. Shall go to Mechanical Penthouse.			
		3.	Shuttle Elevator			
			a. Transport passengers from parking levels to main lobby.			
			b. Required for buildings with parking.			
	B.	Elevator Design				
		1.	Separate traffic analysis must be done for passenger, freight, and combination passenger freight elevators.			
		2.	Loading: 80% rated load capacity during peak-up period.			
		3.	Number stops: Commensurate with type of building occupancy - Multi-tenant will have fewer than single tenant.			
		4.	Elevator population: Based on 150 sf/per, with 8-10% occupants not needing elevator service.			
			a. In multi-elevator bank buildings, apportion population calculation results according to functions of surrounding areas.			
		5.	Average intervals at peak capacity: ≤ 30			
		6.	Handling capacity: ≤ 20%			
		7.	Passenger elevator capacity: 3,500 - 5,000 Lb.			
		8.	Use Low Rise (First 15 floors), Mid Rise (Next 15 floors), and High Rise (Beyond 30 floors) for buildings greater than 15 floors.			
	C.	Elevators				
		1.	General			
			a. Lockout provided for all floors served by passenger / freight elevators.			
			b. Capability of overriding lockout key locks, card readers or coded key pads integral with elevator control panel.			
			c. Elevator alarm should annunciate at building security system monitoring panel.			
			d. Provide emergency telephone in cab (with auto dialing to local emergency response number), and telephone junction box in elevator equipment room.			
			e. Provide trap doors and hoists at machine rooms where room not served by freight or service elevator.			
		2.	Hydraulic Elevators			
			a. Must use moisture-proof and electrolysis-proof cylinder containers.			
			b. Insulated couplings or equivalent in oil supply lines.			
			c. No metal-to-metal contact at cylinder head support.			
			d. Use non-toxic biodegradable hydraulic oil.			
		3.	Elevator Machine Rooms			
			a. Environmentally controlled.			
			b. Low humidity.			
			c. Temperature ≤ 90 deg. F.			
			d. Hoistways provided with fresh air.			
		4.	Escalators			
			a. Use only to supplement elevators to accommodate large unpredictable public traffic volume.			
			b. Use only where absolutely necessary due to high maintenance.			
			c. Use when first floor too small to contain high public traffic so elevator interval can be calculated with accuracy.			
			d. Shall not be substituted for stairs.			
			e. Comply with the following:			

Criteria for Escalator Design		
Escalator Width (Inches)	Capacity (Persons per Hour)	Capacity (Persons per 5 Minutes)
32	3000	250

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				Yes	No	N/A

48	4000	400

2.5	**PLANNING MODULE**					
A.	General					
	1.	Is an imaginary 2'-0" by 2'-0" (or other size, if justifiable) grid that prescribes locations of repetitive elements - columns, partitions, ceiling panels, lights, diffusers, sprinklers, and electrical outlets.				
B.	Structural Bays.					
	1.	Sizing commensurate with building configuration, architectural expression, seismic zone, structural frame material, functional efficiency, and cost.				
	2.	Large bays give more planning flexibility, small bays may be more cost effective.				
	3.	Bay sizes:				
		a.	Buildings with no parking in structure: 24 by 32 foot or 20 by 40 foot.			
		b.	Buildings with parking in structure: 30 by 30 foot.			
		c.	Where increased layout flexibility is desired: 36 by 36 foot (though initial cost / flexibility tradeoff must be defined).			
C.	Column Placement within Planning Module.					
	1.	Two edges of concrete columns must line up with grid.				
	2.	Steel column furrings should align with future walls.				
	3.	Round columns not recommended.				
D.	Perimeter Column and Plan Layout at Exterior Wall.					
	1.	Case 1 - Structural elements, columns, and spandrel beams external to building skin (good flexibility but costly).				
	2.	Case 2 - Some (minimal) intrusions by structural elements (Mechanical risers / perimeter units can be incorporated).				
	3.	Case 3 - entire structure within exterior wall system (Lower flexibility).				
	4.	Floor-To-Floor Heights and Vertical Building Zoning.				
		a.	Ceiling heights: 10 foot (Office), 12 foot (Non-Office).			
		b.	Raised access floor preferred for electrical and communications systems (other distribution systems must be life cycle cost analyzed).			
		c.	Floor cavity contains power, data and telephone, placed in groups of three at fixed intervals.			
		d.	Ceiling cavity contains, top to bottom, layers for sprinkler, ductwork, and lighting, with ample space to rearrange lighting fixtures.			
2.6	**SECURITY DESIGN**					
A.	General					
	1.	No mazes of hallways / hidden corners.				
	2.	Exterior doors readily visible.				
	3.	Controlled Access to entire building and Individual floors.				
B.	Lock Systems					
	1.	Card access management system capable of:				
		a.	Tracking Issue and Revocation of Access Cards			
		b.	Generating reports of all access made to the building			
		c.	Utilizing proximity scan cards with employee ID and photo ID.			
	2.	Card access Lock locations:				
		a.	All building entrances			
		b.	Loading Dock			
		c.	Interior doors (Other than offices, toilets, conference and normal public accessible rooms.			
	3.	Central Data Base Computer:				
		a.	Connects all access locations.			
		b.	Equipped for stand-alone operation upon power failure.			
		c.	Programmed for Automatic locking / unlocking of building doors.			
		d.	All scheduling / access instruction in the English language.			

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				Yes	No	N/A
C.	Site Design					
	1.	No cars able to drive into lobby. Use bollards / concrete planters.				
D.	Building Entrances					
	1.	Small Buildings:				
		a.	One entrance for staff / visitors / public.			
	2.	Large Buildings:				
		a.	One entrance for staff / visitors / public			
		b.	Additional entrance for employees only.			
		c.	Egress / Service Doors allowable, if not used as entries.			
E.	Building Lobby					
	1.	Divided into Secure / Non-Secure.				
		a.	Turnstiles			
		b.	Metal detectors			
	2.	Secure side:				
		a.	Space for baggage checkpoint and control desk.			
F.	Mechanical Electrical Systems / Spaces:					
	1.	None to pass from Non-Secure to Secure.				
	2.	Secure / Non-Secure to have different HVAC zones.				
	3.	Access from inside building only, located on secure side of lobby.				
	4.	Keyed access of secured area is limited.				
G.	Elevators					
	1.	General				
		a.	Elevators serving upper levels must be visible from lobby.			
		b.	No elevators allowed between Parking and upper levels.			
	2.	Secure Lobby Side:				
		a.	One car able to be dedicated to future Secure traffic.			
		b.	Future Secure Elevator accessible from Secure lobby side only.			
	3.	Non-Secure Lobby Side:				
		a.	Shuttle elevators from parking end at Non-Secure Lobby side.			
	4.	Control Panels:				
		a.	Must have lockout provisions for all floors (Passenger and freight).			
		b.	Have built-in card readers for after-hour employee usage.			
H.	Mechanical and Electrical Spaces					
	1.	Access from inside building only, located on secure side of lobby.				
	2.	Keyed access of secured area is limited.				
2.7	**SPACE PLANNING**					
A.	Office Space					
	1.	Floor / Ceiling Grids				
		a.	Walls and ceiling high partitions must center on planning grid.			
		b.	Raised floor grid must be offset 3 inches both directions from planning grid.			
		c.	Ceiling grid offsets floor grid one foot both directions.			
	2.	Utility Placement				
		a.	General office space requires power, telephone, data, HVAC supply and return, sprinklers, public address system, and lighting. See "Planning Module" section for component locations.			
		b.	HVAC grilles should be in regular staggered pattern.			
		c.	Sprinklers should be in corner of tile, 3 inches from edge.			
	3.	Ceiling Height: Constant.				
	4.	Doors: 3 feet by 7 feet.				
	5.	Groups of Training / Major Conference Rooms as close to ground floor as possible.				
	6.	Minimize use of internal corridors.				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
B. Public Spaces			
1. Entrances and Vestibules:			
a. General			
1) Convenient, clearly visible and distinctive.			
2) Serve visitors and employees.			
3) Handicapped accessible.			
b. Canopy, portico, or arcade to be used for weather protection / identification.			
c. Approaches			
1) Well lighted			
2) Grade level preferred vs. elevated.			
3) Day / night design consideration.			
4) Clear attractive graphics.			
5) Landscape feature enhancements.			
d. Vestibules / Revolving Doors			
1) Vestibule or revolving doors required.			
2) Vestibule preferred: ease of handicapped access, temperature control.			
3) Doors offset to mitigate drafts.			
4) No raised thresholds.			
e. Sliding Doors			
1) Desired at main entrances.			
2) Adequate clearances required related to cross traffic.			
3) Sliding preferred vs. swinging.			
4) Vestibule preferred: ease of handicapped access, temperature control.			
2. Entrance Lobby			
a. Lobby clearly visible from outside, day and night.			
b. Contains information facility, waiting area(s), elevator access.			
c. High pedestrian traffic load.			
d. Proximity point for cafeterias, auditoriums, exhibition halls.			
e. Designed to accommodate future security station with:			
1) Bag check			
2) Identity check			
3) Metal detector			
4) Turnstiles, Queuing space into future non-secure side of lobby.			
f. Mechanical, electrical, communications systems:			
1) Mechanical grilles concealed.			
2) Lighting integrated into Lobby architecture.			
3) Indirect / spot lighting used when possible.			
4) Incandescent limited to accent lighting.			
g. Provide directional graphic system. Criteria:			
1) Clearly visible			
2) Easily understood			
3) Consistent with interior design.			
4) Incorporates Agency emblems, exhibit stands, artwork, and indoor landscaping as appropriate.			
3. Atria			
a. Appropriate where:			
1) Building has multi-level entrances.			
2) High level of traffic between lobby and levels above and below.			
3) Building is in prominent location.			
4) Building is 250,000 sf or more.			
5) Building has exceptional views.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
		b.	When used, use of monumental stairs / escalators allowed if justified by high traffic within affected levels.			
	4.	Elevator / Escalator Lobbies				
		a.	Minimum width between elevator banks: 10 feet.			
		b.	No elements requiring queuing close to elevator / escalator landings.			
		c.	Lobby close to and visible from main entrance.			
	5.	Stairways				
		a.	Monumental - serve high pedestrian traffic areas.			
			1) Lower risers and wider treads than normal stairs.			
		b.	Communicating - Connects departments within the building.			
			1) Design to be consistent with departments served.			
		c.	Egress			
			1) Combine with Communicating if possible.			
			2) Egress only have minimum architectural treatment.			
	6.	Public Corridors - allow public access to agency reception areas.				
		a.	Significantly and clearly different than departmental corridors.			
		b.	Connect lobbies / areas having different finishes:			
			1) Entrance lobby: Highest quality of finish / detail.			
			2) Main elevator / escalator lobbies match design of entrance lobby			
			3) Upper floor elevator lobbies less detailed than other lobbies but design has similar features.			
		c.	Desirable to increase corridor width over what code requires for ease of pedestrian traffic.			
		d.	Long corridors should be broken up by alcoves, light coffers, ceiling projections, banners, or sectional wall / floor patterns.			
		e.	Should have as much natural light as possible.			
C.	Building Support Spaces					
	1.	Toilet Rooms				
		a.	One men's and one woman's per floor.			
		b.	One men's and one woman's next to cafeteria.			
		c.	Travel distance: = 200 ft.			
		d.	Screen from view without double door vestibules at entrance.			
		e.	Must have facilities for disabled, including door power operators.			
		f.	Should be grouped (and stacked) to minimize plumbing runs.			
		g.	Minimize circulation space, while still maintaining enough for high load areas (Assembly, conference / training, etc.)			
	2.	Custodial Spaces				
		a.	Storage rooms			
			1) Space suitable for items stored.			
			2) Access doors / aisles suitable for item removal.			
		b.	Janitor's closets			
			1) Centrally located at core.			
			2) Space sufficient to house all cleaning items required.			
			3) 24" mop basin.			
			4) Wall mounted mop rack.			
			5) 6 ft. long 10" shelf.			
	3.	Mechanical and Electrical Rooms				
		a.	Equipment Spaces			
			1) Designed with adequate space / aisling for access / maintenance.			
			2) Hoists, rails, etc. if heavy equipment present.			
			3) Reasonably comfortable environment.			
			4) Doors / corridors to exterior adequate for equipment replacement.			

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				Yes	No	N/A
		5)	Ceiling height: = 12ft.			
		6)	Special fire protection as mandated by code.			
		7)	Control noise transmission to adjacent spaces.			
		8)	Floating floors required for major mechanical spaces.			
	b.		Electrical spaces			
		1)	Completely away from toilets, janitor closets, and other sources of water.			
		2)	Basement switchgear spaces must have provisions for removing water.			
	c.		UPS spaces			
		1)	UPS and asssociated lead acid batteries must be in separate rooms.			
		2)	Allow space for storage of safety equipment (goggles, gloves, etc.)			
	d.		Battery Rooms			
		1)	Floor structure suitable for weight.			
		2)	Acid waste system.			
		3)	Negative pressurization.			
		4)	Entrance width.			
		5)	Ceiling height to accommodate HVAC equipment.			
	e.		Electrical Closets			
		1)	Stack vertically			
		2)	Minimum 18' deep			
		3)	No extraneous floor area (storage temptation)			
	f.		Communication Closets			
		1)	Stack vertically			
		2)	Adequate space for racks, frames, and workspace.			
		3)	Plywood board for telephone equipment.			
	g.		Vertical Shafts			
		1)	Adjacent to core areas.			
		2)	Straight vertically with no offsets.			
		3)	Sized to accommodate expansion.			
		4)	Closed at top and bottom for noise control.			
		5)	Special fire protection as mandated by code.			
4.			Loading Docks			
	a.		Separate from main entrance.			
	b.		Convenient to freight elevator.			
	c.		Able to accommodate all service vehicles needed by building functions.			
	d.		Where appropriate, provide:			
		1)	Dock levelers			
		2)	Edge guards			
		3)	Dock bumpers.			
		4)	Dock seals at loading bays.			
	e.		Dock manager office placed for view of entire dock and building entrances / exits.			
	f.		Not allowable to use dock area for building egress.			
	g.		Adequate snow removal or melting for ramped docks.			
	h.		Weather protected Staging area adjacent to dock, clear of building egress.			
5.			Trash Rooms			
	1)		Adjacent to loading dock / service entrance.			
	2)		Sized for trash equipment and storage of three days' worth of packaged trash.			
	3)		Space for paper, glass and metal recyclables.			
	4)		Minimum one loading berth for trash.			
6.			Building Engineer's Space			

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				Yes	No	N/A
		a.	Houses Building Automation consoles and security / fire alarm readout panels.			
	7.	Security Control Center				
		a.	Adjacent to main lobby.			
		b.	Have clear view of lobby, but be inconspicuous from lobby.			
		c.	Houses security guard(s) and current / future equipment.			
		d.	Minimum 225 sf.			
	8.	Food Service Areas				
		a.	Storage areas adjacent to food service loading dock.			
		b.	Dumbwaiter if dock / food service areas on different levels.			
		c.	Dining entrances visible from main circulation path but clear of lobby traffic.			
	9.	Dining Areas				
		a.	Use natural light / outside eating areas as appropriate.			
		b.	Serveries laid out to minimize waiting.			
D.	Structured Parking					
	1.	Parking Layout				
		a.	2-Way drive aisles with 90 degree vehicle parking stalls on each side.			
		b.	Placement of entrances addresses traffic flow, queuing space, and security.			
	2.	Drive Aisles				
		a.	2-Way aisles minimum width 23 feet.			
		b.	One-way aisles unacceptable.			
	3.	Vehicle Stalls				
		a.	9 feet by 20 feet			
		b.	No special "compact car" spaces.			
		c.	Stall dimensions unintruded by columns.			
		d.	Columns located no less than 2 feet from aisle, unless aisle has no stalls perpendicular to it.			
		e.	Each stall has aisle access.			
	4.	Ramps				
		a.	Maximum incline: 12%.			
		b.	Maximum breakover angle at change of plane: 6%.			
		c.	Maximum incline on ramp floor garages: 5%.			
		d.	Entry and exit ramps protected from snow / ice build-up.			
		e.	Snow melting should be considered.			
	5.	Stairs and Elevator Lobbies				
		a.	Should be glazed.			
		b.	Capable of being observed from public street.			
	6.	Walkways				
		a.	Must have curbs, bollards or low walls for protection from traffic.			
		b.	Identify with signage and striping.			
2.8	**SPECIAL DESIGN CONSIDERATIONS**					
A.	Acoustic Design Criteria for Building Spaces					

DEFINITIONS:
Ambient Noise Level: sound level within the space.
▫ Too high and too low are both undesirable.
▫ Measured in Noise Criteria (NC) Curves
Noise Isolation: Amount of noise escaping perimeter of space.
▫ Barriers have STC (Sound Transmission Class) ratings, with the higher ratings best at isolating sound.
Noise Isolation Class: classification (ASTM E-336) for determining noise isolation between spaces.
▫ Modified rating "Speech Privacy Noise Isolation Class" (NIC) is used to rate ceiling tile and open office space dividers.

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	Yes	No	N/A

DEFINITIONS:
Reverberation Control: Amount and direction of sound reflected from a given material.
▫ Harder surfaces produce reflected noise level.
▫ Soft surfaces absorb sound and reduce ambient noise levels.
▫ A material's ability to absorb sound in measured by its Noise Reduction Coefficient (NRC)
BACKGROUND MASKING:
Can improve speech privacy and reduce perceived level of random noise.
People generally more comfortable with low frequency sounds (rustling leaves, gentle surf).
Sounds can be reproduced through loudspeakers at a uniform and unobtrusive volume level.
System must be coordinated with mechanical system sound patterns.
System design should be by acoustical specialist.

1.	Class A Spaces - Critical Noise sensitive spaces (Auditorium, Court Room)			
	a. Must be programmed / designed by acoustical professional.			
2.	Class B1 Spaces - Meeting spaces (Conference rooms, training rooms, etc.)			
	a. Ambient Noise Level ≤ NC 30.			
	b. Enclosing Partitions STC ≥ 45.			
	c. Doors gasketed.			
	d. Ceiling NRC ≥ 0.55 (space carpeted) or 0.65 (space not carpeted).			
	e. No background masking.			
3.	Class B2 Spaces - Spaces where likelihood of speech levels being higher than normal exists, and/or presence of noisy equipment (ADP rooms, copy areas, dining rooms, etc.)			
	a. Ambient Noise Level ≤ NC 40.			
	b. Enclosing Partitions STC ≥ 45.			
	c. Doors gasketed.			
	d. Ceiling NRC ≥ 0.55 (space carpeted) or 0.65 (space not carpeted)			
	e. If background masking used, NRC levels do not apply.			
4.	Class C1 Spaces - Enclosed Office Spaces			
	a. Ambient Noise Level ≤ NC 35.			
	b. Enclosing Partitions and ceiling assembly STC ≥ 40.			
	c. Floors should be carpeted, unless unusual circumstances exist.			
	d. Ceiling NRC ≥ 0.55 (space carpeted) or 0.65 (space not carpeted)			
	e. If background masking used, NRC levels do not apply.			
5.	Class C2 Spaces - Open Office Spaces			
	a. Ambient Noise Level ≤ NC 35.			
	b. Noise Isolation at least NIC 20.			
	c. Ceiling NRC ≥ 0.55 (space carpeted) or 0.65 (space not carpeted)			
	d. If background masking used, NRC levels do not apply.			
6.	Class D Spaces - Spaces where speech privacy is not a significant concern (Corridors, stairs, file rooms, etc.)			
	a. Ambient Noise Level ≤ NC 35.			
	b. Ceiling NRC ≥ 0.55 (space carpeted) or 0.65 (space not carpeted)			
	c. If background masking used, NRC levels do not apply.			
7.	Class E Spaces - Public and support spaces (Lobbies, atria, toilets, locker rooms)			
	a. Ambient Noise Level ≤ NC 40.			
	b. Locate as far away from quiet areas.			
	c. Treatment to certain surfaces in large lobbies to eliminate reverberation.			
8.	Class F Spaces - Warehouses, parking garages and fire stairs.			
	a. Ambient Noise Level ≤ NC 50.			
	b. Locate as far away from quiet areas.			
9.	Class X Spaces - "Noisy" spaces (Mechanical / Electrical / Communications rooms,			

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				Yes	No	N/A
			elevator machine rooms, trash rooms, etc.).			
		a.	Ambient Noise Level ≤ NC 60.			
		b.	Enclosing Partitions and ceiling assembly STC ≥ 45.			
		c.	Sound isolations floors required for mechanical rooms above occupied spaces.			
	10.		Sound Isolation From Exterior Noise Sources			
		a.	Buildings near high noise level areas (airports, etc.) must have special glazing / gasketing systems designed by an acoustical consultant.			
B.			Building Substructure			
	1.		Ground Water Control			
		a.	Foundation drains: drainage mat and soil filter from 4" below grade to 6" below top of drain.			
		b.	Piping: Rigid PVC.			
		c.	Pipe slope: ≥ 1:200			
		d.	Discharge to storm drain, by gravity if possible.			
	2.		Waterproofing			
		a.	See "Codes and Standards Section".			
	3.		Underslab Insulation - Required where:			
		a.	Slabs are heated.			
		b.	Slabs support refrigerated structures.			
C.			Building Exterior Closure			
	1.		No Carbon Steel Products allowed in exterior construction unless coated with 1.5 oz. Per sf galvanized zinc coating.			
	2.		Exterior Wall Construction			
		a.	See "Codes and Standards Section".			
		b.	Use vapor barrier where dew point exists within wall structure.			
	3.		Exterior Soffits			
		a.	Resist displacement / rupture due to wind uplift.			
		b.	Avoid housing equipment systems, but provide access where equipment is enclosed.			
		c.	Moisture resistant.			
		d.	Provide expansion / control joints at edges and within, spaced and configured per material manufacturer.			
		e.	No weather sensitive equipment systems inside soffits.			
		f.	Where insulation required at floor above soffit:			
			1) Attach to underside of floor.			
			2) Ventilate soffit.			
	4.		Exterior Windows			
		a.	See "Codes and Standards Section".			
		b.	Use fixed windows in environmentally controlled buildings.			
		c.	Operable windows allowed where they provide for window washing - must be able to be washes from either side.			
		d.	Operable windows must be key operated.			
		e.	Aluminum window frames must have thermal barriers.			
		f.	Mullions shall not preclude abutment of interior partitions.			
	5.		Glazing			
		a.	Choose double or triple pane according to climate conditions.			
		b.	Use reflective only when external glare not a problem.			
		c.	Condensation Resistance - See "Codes and Standards Section".			
	6.		Exterior Doors			
		a.	Entrance Doors: one of the following:			
			1) Stainless steel			
			2) Anodized aluminum			
			3) Heavy duty glass construction			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
b. Unglazed doors / frames:			
1) Steel construction, per requirements of SDI grade HI			
2) With G-90 galvanic zinc coating			
c. Automatic doors:			
1) Sliding type preferred.			
2) Push plate / motion detector activation (No mat actuation).			
d. Revolving doors:			
1) Minimum leaf size: 36"			
e. Loading Dock doors			
1) Overhead coil type preferred.			
2) Provide at least one companion personnel door.			
7. Door Hardware			
a. Exterior doors			
1) Hinges, hingepins and hasps secured against removal with spot welds or peened mounting bolts.			
2) Provide automatic closers.			
3) Provide exterior side with lock guard or astragal to prevent latch jimmying.			
4) Provide for perimeter doors:			
a) Locks with five-pin tumblers.			
b) 1" deadbolt (except egress doors)			
5) Hardware design / installation:			
a) Made to blueprint template.			
b) Supplied through Architectural Hardware Consultant responsible for handling, detailing and servicing.			
6) Provide hinges with:			
a) Stainless steel pins			
b) Oil impregnated bronze bushings			
c) Concealed ball bearing units			
7) Swingout doors to have non-removable pins.			
8) Interior doors to have 18" high kick plate which protects within 1" of bottom and sides.			
9) Locksets			
a) Heavy duty cylindrical type, minimum 2-3/4" backset, 9/16" throw latchbolt.			
b) Lock cylinders: Best Lock Corporation, "9K Varsity Series", unable to be grasped by wrench.			
10) Handles / knobs			
a) Heavy duty handles, except on doors to hazardous areas.			
b) Hazardous area doors: knurled knobs.			
c) Knobs to have stainless steel finish.			
d) Knobs to be minimum .50" thick.			
e) Cylinder cones and keys provided by state.			
11) Exit devices			
a) Steel (dull chrome US26D finish), UL approved.			
b) Fire rated door devices: UL listed as "fire exit hardware".			
c) Outside trim fastened with concealed lugs and through-bolts to active case.			
12) Closers			
a) To have key valves for back check, speed and latching.			
b) Degree of opening to be maximum without damage to door / trim.			
c) To be lockable in full-open position.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
d) To be fastened to door with sex bolts.			
13) Opening force requirements			
a) Fire doors: force as required by Fire Marshal.			
b) Other doors: No more than 8.5 lb. to open or close.			
14) Handicap requirements			
a) Main and employee entry doors and restroom doors to have Gyro Tech System 500 electric push-button operators.			
b) Push switch plates: 6-1/4" diam. With embossed wheel chair symbol.			
15) Exterior doors (other than main entrance, employee entrance, and receiving): Provide audible alarm-type hardware.			
16) Receiving double doors: Provide tamper-proof astragal and vertical deadbolts at top and bottom (verify Fire Marshal requirements).			
17) Construction locks			
a) Provide construction locks in cylinder cores on all exterior doors.			
b) Convert to cores for tenant use after control turned over to State.			
b. Other doors			
1) Lockable interior doors			
a) Provide with cylinder locks master keyed to exterior doors (State to provide keying plan).			
b) Special keying for computer room			
c) Provide two keys per lock and six master keys.			
2) Toilet room doors			
a) Provide door closers and ball bearing type hinges.			
b) Maximum closer lateral force: 5 lb. at handle or push plate.			
3) Security room doors			
a) Steel door / frame.			
b) Interior hinges or heavy duty hinges with non-removable pins			
c) Separately keyed with no master key (Lessor to supply two keys per lock)			
8. Roofing			
a. See "Codes and Standards Section".			
b. Roof Membrane			
1) Inverse membrane 4 ply coal tar pitch system with 20 year guarantee.			
c. Roof Drainage			
1) No level roofs allowed.			
2) Roof drains and scuppers only allowable low points.			
3) Minimum slope to drain is .25" per foot.			
d. Access to Roof			
1) Provide permanent interior stair.			
e. Roof Mounted Equipment			
1) Locate in penthouse or behind screen wall.			
2) Design of penthouse, screen walls and other non-screened equipment (antennae, lightning rods, flagpoles, etc.) must integrate into building design.			
3) Provide roof walkways to equipment.			
a) Provide handrails where walkways are within 3 ft. of vertical drop greater than 1ft.			
D. Building Interior Construction			
1. Partitions			

Partitions:
Should be chosen based on *space type* and *activity*:

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	Yes	No	N/A
▫ Volume and activity of people.			
▫ Type, size weight and function of space equipment (mail carts, forklifts, etc.).			
▫ Free standing, moveable or wall mounted equipment that impose lateral loads.			
Wall Systems:			
Should be chosen based on:			
▫ Structure, backing, finish and protection factors			
▫ Simplicity of construction			
▫ Availability			
▫ Cost			
a. See "Codes and Standards Section".			
b. Where metal stud systems are used, provide adequate tolerance where partition meets structure to allow for deflection and long term "creep"			
c. Partitions adjacent to humidified rooms to have vapor barrier.			
2. Doors			
a. See "Codes and Standards Section".			
b. Interior doors in tenant spaces to be flush, solid-core wood.			
c. Provide matching-edge veneers for transparent finished wood doors.			
d. Wood door frames only in specially designed areas.			
3. Ceiling suspension systems			
a. See "Codes and Standards Section".			
4. Access flooring			
a. Uniform load: 250PSF			
b. Point Load: 1250 PSF			
c. Concrete filled metal or concrete			
d. Pedestal and stringer systems are acceptable			
1) Use stringer systems for heavy cart traffic areas.			
e. Coordinate design with underfloor electrical and communications systems.			
f. System to be bolted construction suitable to withstand frequent tile removal.			
E. Building Specialties			
1. Window washing equipment			
a. Provide suitable engineered systems to accommodate equipment, lifts, platforms, etc., that will be used by Window Washing Contractor.			
b. See "Codes and Standards Section".			
2. Waste Removal equipment			
a. Facility must provide:			
1) Access for waste handling equipment from building areas to the pick-up station.			
2) Housing of on-site containers.			
3) Collection vehicle maneuvering space.			
4) Separate containers for recyclables:			
a) Glass			
b) Paper			
c) Metals			
5) Screening, doors, and gates around container area.			
3. Toilet Compartments			
a. Toilet partitions to be ceiling hung.			
b. Material: High density polyethelene.			
c. Plastic Laminate partitions not allowed.			
4. Toilet Accessories			
a. Stainless steel preferred.			
b. Integrate into toilet room design.			

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				Yes	No	N/A
		c.	Recessed / multi-function devices are desirable.			
	5.	Flagpoles				
		a.	Provide (2) 35 ft. flagpoles.			
	6.	Telephone Enclosures				
		a.	Provide public telephone enclosures:			
			1) In main lobby.			
			2) Near Cafeteria.			
			3) Near Auditorium.			
			4) In other spaces serving the public.			
	7.	Drinking Fountains				
		a.	Provide public drinking fountains:			
			1) At each floor near toilets.			
			2) Near Auditorium.			
	8.	Window Blinds				
		a.	Provide in all offices and conference rooms.			
F.	Graphics					

Graphics and Signage must be:
Clear and *simple*
Pleasing and *comprehensible*

	1.	Graphics and Signage				
		a.	Provide standardized system to ensure easy identification of:			
			1) Building entrance.			
			2) Parking.			
			3) All tenant agencies and services.			
		b.	Must be adjustable without damage to walls during tenant moves and changes.			
		c.	State must be provided with equipment supplies to make future signage changes.			
		d.	See "Codes and Standards" Section.			
	2.	Lobby Directory				
		a.	Provide video display directory and computer control system at:			
			1) Main entrances			
			2) Lobbies			
			3) Conference facility(ies).			
2.9	**INTERIOR FINISHES**					

General:
Finishes should be chosen for *quality, durability*, and *cost*.
Finishes are an important *expression of overall building quality.*
Designer is responsible for achieving *highest quality level of floor, ceiling and wall finishes*, within budget parameters.
State Minimum Standards:
The State has Minimum Standards for finishes in offices, ADP areas, conference / training rooms, and internal corridors. Architect is encouraged to select materials that *exceed State Minimum Standards* if project budget allows.
***Color* Considerations**
Light / Neutral Colors as Standard
Accent Colors to Highlight
Subtle Color differences to distinguish between Departments
Must be *commensurate with* type of *space lighting*
Medium tone colors hide *dirt and stains* more easily.

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

***Texture* Considerations:**		
Absorbency	*Minimum Reflectance Values:*	Ceilings: 80%
Space *non-slip* requirements		Walls: 50%
Space *cleanliness* requirements		Floors: 20%

A.	General Office Spaces (Open and Enclosed)			
	1. Floors			
	a. Carpet required.			
	b. Carpet tiles vs. broadloom except in permanent rooms (auditoriums, conference).			
	c. No resilient flooring.			
	2. Carpet for Raised Floor			
	a. Carpet tiles required (Loose-laid or carpet adhered to tile).			
	b. Preferred: Loose-laid carpet tile covering joints in access floor.			
	3. Walls			
	a. Conventional drywall systems.			
	b. Tenant partitions - demountable system using metal studs.			
	4. Ceilings			
	a. Suspended acoustical tile systems.			
	b. Grid size consistent with building planning module (2 ft. by 2 ft. recommended).			
	c. No inaccessible ceilings.			
	d. Standardize throughout building.			
	5. Doors			
	a. Wood veneer only.			
	b. Glass for Suite entrances only.			
B.	Training / Conference Rooms:			
	1. Provide tackable wall panels and rails.			
C.	Internal Corridors:			
	1. Same treatment as offices.			
	2. Consider color changes to assist orientation.			
D.	Entrances / Vestibules			

Entrances / Vestibules:
Integrate *Interior and Exterior* Building *Design.*
Use *durable*, *moisture resistant materials* due to exposure to weather.

	1. Floors			
	a. Provide mat and drainage system, surrounded by hard surface similar to lobby.			
	2. Walls			
	a. Glazed adjoining lobby, with similar lobby surfaces.			
	3. Doors			
	a. Glazed			
E.	Entrance Lobbies / Atria			

Entrance Lobbies / Atria:
are *Focal Point* of Building
are *landmark* to which other *spaces relate*
Extension of *exterior* and transition to *interior*
Have high level of *visibility*, thus warranting *high degree of finish*
are *Focal Point* of Building
are subject to *heavy use,* mandating materials that *age well*

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	1.	Floors			
		a. Hard surface (stone, brick, etc.).			
		b. No carpet.			
		c. Non-slip surfaces.			
	2.	Walls			
		a. Materials durable due to high use.			
		b. No paint unless special circumstances.			
	3.	Ceilings			
		a. Accessible required.			
		b. Combination drywall cove / lay-in recommended.			
F.	Elevator and Escalator Lobbies				

Elevator / Lobbies:
Need *similar finishes* as *Entrance Lobby*
Should have *color schemes / patterns* that can be *repeated at upper floors*.

	1.	Floors			
		a. Similar surface throughout the building.			
	2.	Walls			
		a. Materials durable due to high use.			
		b. Finishes compatible with elevator door / frame.			
	3.	Ceilings			
		a. Special treatments to visually distinguish lobby.			
		b. Accessible required.			
G.	Elevators				

Elevators:
Passenger elevators receive *highest traffic*.
Are *Focal point* for *Building's anterior Design*
Finishes must be both *durable* and of *highest Architectural Design*

	1.	Floors			
		a. Passenger Elevators			
		1) Durable or easily replaceable.			
		2) No brick, tile or stone (cab floors unstable).			
		3) Low pile height / high density carpet OK.			
		b. Freight elevators			
		1) resilient sheet vinyl or vinyl tile.			
	2.	Walls			
		a. Materials durable due to high use.			
		b. Removable panels (maintenance and renewal of finishes).			
	3.	Ceilings			
		a. Replaceable			
		b. Lighting - Recessed downlight or indirect lighting.			
	4.	Doors			
		a. Passenger Elevators			
		1) Scratch resistant.			
		2) Easily replaced / refinished.			
		3) Finishes coordinated with adjacent inside and outside surfaces.			
		b. Freight elevators			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
1) Durable / easily cleaned.			
2) Stainless steel walls / doors.			
3) Recessed ceiling light fixtures protected from possible damage.			
H. Closed Stairways			

Closed Stairways:
Finishes consistent with those of connecting spaces.
Avoid highly reverberant surfaces
Partial / Minimal finishes for egress-only stairs is acceptable

1. Floors			
a. Must provide acoustical control			
b. Use carpet or resilient materials			
c. Use tread non-slip nosing.			
2. Walls			
a. Drywall substrate with paint or wall covering.			
b. Highly finished / heavily textured finishes OK only if design statement is appropriate.			
c. Painted or unfinished in utility / egress stairs.			
3. Ceilings			
a. Absorptive material for acoustics.			
b. Painted gyp board soffits in stair runs.			
4. Doors			
a. Match adjacent doors.			
b. Identical interior and exterior finishes.			
c. Painted metal in utility / egress stairs.			
I. Open Stairways			
1. Finishes match adjacent finishes.			
J. Public Corridors			

Public Corridors:
Emphasis on *brightness*
Colors / textures should *open* and *widen* the areas
Provide features to *add visual interest* or *break up long spaces*
▫ Portals / Shifts
▫ Modified materials / lighting
Avoid finishes / treatments that *emphasize linear nature* of corridor
Use *glazing* if appropriate to *visually enlarge* space

1. Floors			
a. Use absorptive material for acoustical control unless finish determined by adjacent space(s).			
2. Walls			
a. Drywall substrate with wall covering.			
3. Ceilings			
a. Absorptive material for acoustics.			
b. Accessible system.			
4. Doors			
a. High quality to match			
b. Identical interior and exterior finishes.			
c. Painted metal in utility / egress stairs.			
K. Pedestrian Tunnels / Bridges			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

PEDESTRIAN TUNNELS / BRIDGES:
Similar to *Public Corridors*
Since they are longer, they must be bright and visually generous
Introduction of daylight should be a goal

	1.	Floors		
		a. Carpet similar to adjoining public corridors.		
		b. Resilient flooring or sealed concrete similar to adjoining service corridor.		
	2.	Walls		
		a. Drywall substrate with wall covering.		
		b. Use glazed openings.		
	3.	Ceilings		
		a. Absorptive material for acoustics.		
		b. Accessible system.		
	4.	Windows		
		a. Extension of building window system.		
L.	General Use Toilets			
	1.	Long-lived fixtures / finishes.		
	2.	Moderate to heavy use areas: Ceramic tile floors.		
	3.	Light use areas: Ceramic tile floors or other less costly moisture resistant materials.		
	4.	Lavatories - Continuous vanity made of:		
		a. Stone or artificial stone.		
		b. Tile.		
		c. Plastic laminate.		
	5.	Large continuous mirror above lavs.		
M.	Equipment Spaces / Maintenance Shops			
	1.	Wall coverings painted.		
	2.	Communications rooms - resilient flooring.		
	3.	Floors in Mechanical Rooms / Maintenance Shops: Sealed and waterproofed.		
	4.	Seal all exposed concrete flooring.		
N.	Staff Locker Rooms / Custodial Spaces			
	1.	Storage rooms - minimum finishes		
	2.	Janitor Closet :		
		a. Minimum finishes.		
		b. Rooms with sinks - Ceramic tile floor / base.		
	3.	Staff locker rooms - dry areas		
		a. Resilient flooring and vinyl wall covering.		
	4.	Staff locker rooms - wet areas		
		a. Ceramic floor tile and walls.		
O.	Building Engineer Office / Security Control Center			
	1.	See office spaces		
P.	Cafeteria / Kitchen Services			
	1.	Finishes governed by:		
		a. Health regulations		
		b. Concessionaire		
Q.	Dining Areas			
	1.	Graphic Designs		
	2.	Glazing at entrance		
	3.	Doors wood / glass combination (Upper half glazed)		
2.10	FURNISHINGS			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
A.	Lobby				
	1.	Finishes consistent with building quality			
	2.	100 sf information desk			
	3.	Lobby video display system			
	4.	Artwork			
	5.	Seating			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

ARCHITECTURAL DESIGN							COMMENTS
X.1	A.	1.	a.	1)	a)	Reference Key	

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
PART 3 - STRUCTURAL DESIGN			
3.1 GENERAL APPROACH			

Structural Systems:
Three *characteristics* distinguish *State Buildings*:
▫ *Longer life span*
▫ *Changing occupancies*
▫ Use of *life cycle cost approach* to determine *overall cost*
The *State* typically will *own buildings longer* and will *perform alterations* in an ongoing fashion. Accordingly, Structural systems must:
▫ Be of *higher level of durability* (Higher live load than code may require, e.g.)
▫ Accommodate *periodic renovation* by allowing some *increased floor loading*, ease of *cutting of new vertical openings*, etc.

3.2 CODES AND STANDARDS			
1. See separate articles.			
3.3 LIVE LOADS			
A. Use 100 pounds per square foot (PSF) for entire office floor.			
B. Design spaces with greater than office type loading according to the greater of actual load or code live loading.			
C. Do not reduce live load for horizontal framing members / columns or Load bearing walls supporting top floor or roof.			
3.4 STRUCTURAL SYSTEMS			
A. Steel Framing Systems			
1. Unshored Composite Beams			
a. Beams deflect during placement of slabs.			
b. Must add concrete to level floor.			
c. Must account for added dead load in calculations.			
2. Shored Composite Beams			
a. Beams do not deflect during placement of slabs.			
b. Is less costly in steel and concrete, but adds shoring cost.			
c. Floor deflects when shoring removed.			
d. Resulting floor is not as level as with unshored beams.			
3. Cambered Composite Beams And Girders			
a. Cambered composite beams and girders produce most level floors.			
b. Use camber for beams longer than 25 ft.			
1) Camber to be equal to deflection due to wet concrete, steel deck and steel beams.			
2) Exclude superimposed dead and live loads in calculation.			
4. Design Procedures			
a. Load Resistance Factor Design (LRFD)			
1) Use for small or large building structures.			
b. Allowable Stress Design (ASD)			
1) Use for small building structures only.			
B. Concrete Framing Systems			
1. Cast-in-Place Systems			
a. Systems having fewer limitations in cutting future openings are preferred.			
2. Precast Systems			
a. Do not use unless adaptability to future relocating of major walls or equipment is demonstrated.			
b. Are appropriate for low-rise structures: Parking decks, Industrial buildings, Storage / Maintenance facilities.			
3. Pre-tensioning and Post-tensioning			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
		a.	Do not use unless adaptability to future relocating of major walls or equipment is demonstrated.			
		b.	Posttensioned beams allowed where code allows in beams.			
3.5	**STABILITY AND SERVICEABILITY CRITERIA**					
A.	Progressive Collapse					
	1.	Building to not be subject to progressive collapse as defined by building code.				
	2.	Beam or slab failure shall not affect system below or in adjacent bays.				
	3.	Column failure shall affect only bays supported by that column.				
B.	Drift					
	1.	Lateral deflection of building under lateral load to be limited to wind and earthquake requirements.				
	2.	Wind induced motion and sway must also be limited.				
C.	Vibration of Floor Systems					
	1.	Transient vibration induced by passing traffic or footfall shall be minimized.				
D.	Corrosion Protection					
	1.	General				
		a.	Provide positive corrosion protection means for structures in salty environments:			
			1) Concrete foundations exposed to ground water.			
			2) Parking decks.			
			3) Bridges / pavements subject to use of de-icing salts.			
			4) Structures exposed to salt-laden air.			
	2.	Steel				
		a.	Steel exposed to elements to have protective coating.			
		b.	For small isolated steel elements, use one of the following:			
			1) Hot dipped, galvanized zinc coating.			
			2) Coal tar epoxy paint.			
		c.	For larger exposed steel elements (such as in parking areas) use two coat system:			
			1) Coat 1: Organic zinc rich urethane or epoxy primer shop applied over blast cleaned surfaces			
			2) Coat 2: Field applied finish coat.			
	3.	Concrete				
		a.	Provisions to be made for crack control, using any or all of the following (depending on severity of the condition):			
			1) Epoxy coated reinforcing bars.			
			2) Concrete surface sealers.			
			3) Corrosion inhibiting concrete additives.			
			4) Microsilica concrete used in lieu of additives.			
	4.	Concrete in Parking Structures				
		a.	For concrete in parking structures, use one of the following:			
			1) Corrosion inhibiting additives and cathodic protection			
			2) Epoxy coated reinforcing bars and surface sealer.			
		b.	Use epoxy coated reinforcing bars in the following:			
			1) Top bars of the concrete beam and slab.			
			2) Stirrups of beams and spandrel beams.			
		c.	Do not use epoxy coated reinforcing bars in the following:			
			1) Bottom bars in beams.			
			2) Column or wall reinforcement.			
E.	Construction Tolerances					
	1.	Measure in accordance with ASTM EI 155				
	2.	Comply with ACI 117: Standard Specification for Tolerances for Concrete Construction and Materials.				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
3.6	**FOUNDATION CONSIDERATIONS**					
	1.	Protection of Adjoining Property				
		a.	Take protective measures to eliminate effect on adjoining buildings, both during and after construction.			
	2.	Sheeting, Shoring and Underpinning				
		a.	Any sheeting, shoring and underpinning related to protecting excavation / adjacent buildings to be responsibility of construction contractor.			
	3.	Footings shall not extend outside property lines.				
3.7	**ATTACHMENTS OF NON-STRUCTURAL ELEMENTS**					
	1.	Exterior Cladding				
		a.	Provide connections and joints that provide movement between stories.			
		b.	Connections to have sufficient ductility and rotation capacity to preclude brittle failure in connection welds or concrete fractures.			
		c.	Concrete inserts to be attached to or hooked around reinforcing steel.			
		d.	Use slotted or oversized holes at cladding connections.			
		e.	Window frames:			
			1) Positively anchor frames to resist lateral loads.			
			2) Provide clearance and flexible mountings to permit thermal movement.			
	2.	Partitions				
		a.	Non-structural, rigid partitions must adequately supported so as to not inadvertently become load bearing.			
		b.	Masonry walls to be isolated from floor above by a gap, and restrained in one of the following ways:			
			1) Intermittent or continuous steel angles on both sides at wall top.			
			2) Steel straps extending into the wall grout.			
		c.	Metal stud partitions do not require in-plane lateral isolation from structure, if the design story drift ratio multiplied by 3(R/8) is less than 0.0025.			
		d.	Top of stud in full height walls to be separated from track.			
		e.	Building expansion to be carried through crossing partitions.			
	3.	Ceiling Systems				
		a.	Suspended Grid Ceilings			
			1) Ceilings must support all fixtures not independently supported.			
			2) Ceilings, including diffusers, lights, and speakers, to be braced according to seismic code provisions.			
			3) Ceilings must be isolated from walls extending to structure..			
		b.	Monolithic Ceilings			
			1) Fasten with large head screws.			
			2) Carry building expansion joints through monolithic ceilings.			
	4.	Mechanical and Electrical Equipment				
		a.	Equipment Anchorage			
			1) Equipment to be anchored to prevent movement due to lateral loads::			
			a) Air handling units			
			b) Battery racks			
			c) Boilers			
			d) Chillers			
			e) Control panels			
			f) Cooling Towers			
			g) Emergency Generators			
			h) Heat Exchangers			
			i) Motors			
			j) Panelboards			
			k) Pumps			
			l) Tanks			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
m) Switchgear			
n) Transformers			
o) Uninterruptable Power Supplies			
p) Vessels			
2) Use building code provisions for lateral loads.			
b. Compressed Gas Cylinders			
1) Anchor using straps, bars, or chains, at top and bottom.			
c. Batteries			
1) Strap or anchor to racks.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

STRUCTURAL DESIGN							COMMENTS
X.1	A.	1.	a.	1)	a)	Reference Key	

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
PART 4 - FIRE PROTECTION SYSTEMS					
4.1	**FIRE PROTECTION CODES AND STANDARDS**				
A.	Building Codes:				
	1.	The facility must comply with the requirements of the local building codes per 1972 P.A. 230.			
B.	Local Building Codes and Zoning Ordinances:				
	1.	Local fire protection officials will be given the opportunity to review and comment on State projects for compliance with local regulations and for compatibility with local fire fighting practices.			
	2.	Design professionals are required to meet with local fire authorities during the early stages of design and incorporate local requirements or NFPA '96 fire codes, whichever more constrained under the life safety design standards.			
C.	Comply with the following codes' standards which are mandatory guidelines for design (When referenced as such in the text of the Chapter):				
	1.	National Fire Protection Association (NFPA): National Fire Codes and Fire Protection Handbook			
	2.	Factory Mutual Engineering and Research Corporation (FM): Loss Prevention Data Sheets			
	3.	Underwriter's Laboratories, Inc. (UL) Directories			
	4.	Fire Protection Equipment Directory			
	5.	Building Materials Directory			
	6.	Fire Resistance Directory			
	7.	Electrical Construction Materials Directory			
	8.	Society of Fire Protection Engineers (SFPE)			
	9.	Fire Protection Engineering Handbook			
D.	Emergency Vehicle Access				
	1.	Roads, fire lanes and turnarounds must be designed for the weight and turning radius of fire trucks.			
	2.	At a minimum, one of the long sides of every building must be accessible to fire department equipment. Local fire departments may require additional access for large, unsprinklered buildings.			
E.	Water Supply				
	1.	All buildings must be supplied form a dependable public water main system or adequately sized water tower.			
F.	Potable Water				
	1.	It is not required that the water supply for fire protection be potable.			
	2.	When non-potable water can be used by the fire department, a backflow preventer must be incorporated in the potable water supply, including the sprinkler system.			
	3.	If there is any connection between the non-potable fire protection water system and the public water supply, requirements of water supply local authority must be followed.			
G.	Building Occupancies.				
	1.	All building occupancies of State buildings must comply with the local building code referenced by local jurisdiction.			
	2.	High Severity Occupancies are permitted only in fully sprinklered buildings.			
	3.	Unlimited floor area is permitted in single story warehouse buildings of Type 1 or Type 2A construction if the storage does not include archives, records, library stacks, flammable liquids or other items of high value or high hazard.			
	4.	Otherwise, the floor area is restricted to 40,000 square feet or less.			
	5.	Spaces which present a higher hazard than the general building occupancy must be separated by fire-resistant construction as specified by the national code.			
	6.	Fire control center area must be separated from entrance lobby and egress corridors by one-hour fire resistant construction.			
H.	Fireproofing:				
	1.	General Requirements.			
		a. The fire resistance ratings of structural elements and construction assemblies must be determined in accordance with the local building code per 1972 P.A.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
230.			
2. Sprayed-on Fireproofing shall not be used with return air plenum concepts.			
3. Exposed Fireproofing.			
a. The required physical characteristics of exposed fireproofing for density, bond strength, hardness and compressive strength are determined with consideration given to the environment and exposure to vibration, humidity and physical damage.			
b. The additional requirements are the same as those listed under sprayed-on fireproofing.			
4.2 MECHANICAL REQUIREMENTS			
A. Special Requirements for Air-Conditioning Systems:			
1. Cooling Towers.			
a. Cooling towers over 2,000 cubic feet in size built with combustible fill must be provided with automatic sprinkler systems, as defined by NFPA 214 (this requirement applies to single towers).			
b. Combustible castings are acceptable in cooling towers provided the fill and drift eliminators are non-combustible.			
1) Polyvinyl chloride and fire retardant treated fiberglass reinforced plastic are classified as combustible.			
2. Main Shut-off of Air Handling System			
a. In buildings that have a Fire Control Center, it must be possible to shut down the air handling system manually, overriding automatic controls.			
b. This shut-off switch must be located in the Fire Control Center.			
3. Duct Smoke Detectors			
a. Provide smoke detectors in the supply and return air ducts.			
b. Smoke detectors should be placed in the air handling unit supply duct downstream from final filters and prior to return fan in return air duct and be designed to shut down the individual air handling unit if smoke is detected in its system.			
c. Like all smoke detectors, duct smoke detectors must be connected to the building fire alarm system.			
4. Special Ventilation Systems			
a. Special ventilation systems must be designed in accordance with these standards:			

Option Description	NFPA
Spaces generating combustible or explosive vapors, dust, fumes	91
Cooking equipment that produces smoke or grease	96

5. Heating Equipment.			
a. Comply with the following standards which apply to the design and installation of heating equipment:			

Option Description	NFPA
Gas fired	54, 85A, 85B
Liquid petroleum gas fired	58
Liquid natural gas fired	59A

6. Gas Piping design and installation must meet the requirements of NFPA 54, 58, 59A, 85A and 85B.			
B. Smoke Exhaust Systems:			
1. The smoke control requirements stated in the local building code used apply.			
2. In buildings where smoke exhaust systems are necessary, the systems must be designed to be simple, effective, fail-safe, and reliable.			
3. Groups of on-off systems are acceptable, but, automatically dampered relief/exhaust ducts integrated with HVAC air systems are preferred.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
	4.	Smoke management systems should be supervised by the building fire alarm system.				
	5.	For simplicity and enhanced reliability, control dampers should be located only at the air handling units controlling outside and return air.				
	6.	Multi-floor zones, up to a maximum of five floors per zone, are permitted to allow integration of smoke control with the building's HVAC system.				
	7.	In high-rise construction, exit stair shafts and elevator shafts should be pressurized.				
	8.	The pressurization should be automatic upon activation of the fire alarm system.				
	9.	It should be supervised by the fire alarm control panel.				
	10.	In existing buildings, stair and elevator shaft pressurization should be provided.				
C.	Fire Suppression Systems:					
	1.	Water Supply and Standpipes and Automatic Sprinkler Systems.				
		a.	The water supply for standpipes and automatic sprinkler systems must meet the requirements of NFPA 13 or local building code per 1972 P.A. 230.			
	2.	Automatic Sprinkler Systems.				
		a.	Automatic sprinkler protection must be provided in all State operated space.			
		b.	Generally, all sprinkler systems must be of wet pipe design.			
		c.	Dry pipe systems may be used in areas subject to freezing; pre-action systems may be used with special State approval.			
		d.	Deluge systems may be used to protect cooling towers and transformer vaults.			
		e.	Where high voltage equipment (greater than 600 V) is involved, automatic fire protection must be designed in accordance with NFPA 15.			
		f.	Antifreeze loops are permitted off wet pipe systems for small areas subject to freezing, such as loading docks.			
	3.	General Sprinkler System Requirements.				
		a.	Automatic sprinkler systems must be a hydraulic design and must comply with NFPA 13 and the following supplemental requirements intended to meet the special needs of State Property Management.			
		b.	Fully Sprinklered Buildings.			
			1) All building areas must be protected with automatic sprinklers, including stairs (on each level), telephone rooms, telephone frame rooms, boiler rooms and mechanical rooms.			
			2) Branch sprinkler piping should always be located 3 inches off the ceiling grid line and sprinkler heads should be placed in the corner of the ceiling tiles.			
		c.	Sprinkler Zones			
			1) A sprinkler zone may not extend to more than one floor of a building.			
			2) Each zone must have a water flow alarm capable of transmitting a signal to the fire alarm control panel.			
		d.	Quick Response Sprinklers			
			1) Quick response sprinklers must be used throughout except where their use is prohibited by their use is prohibited by their listing for the specific space.			
		e.	Concealed and Recessed Sprinklers.			
			1) The use of concealed and recessed sprinklers is strongly discouraged.			
		f.	Sprinkler Flow and Coverage			
			1) Sprinkler flow and coverage is defined in NFPA 13.			
			2) High hazard and other specialized occupancies must be protected by hydraulic systems calculated at densities and areas of coverage required by the applicable NFPA standards.			
		g.	Temperature Ratings			
			1) All sprinkler heads should have an ordinary temperature rating (135° to 170°F) unless the ambient temperature of the protected area exceeds 100°F.			
		h.	Sprinklers in Spaces Housing Electrical Equipment			
			1) Provide annunciation and shut-off valves in elevator machine rooms, top and pit of hoistways, electrical switchgear rooms and transformer areas.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
	2)	Water flow signals are to be individually annunciated for rooms containing high voltage electrical systems or elevator machine rooms.				
	3)	Where appropriate, the sprinkler zone at the top to the elevator shaft may be combined with the machine room zone.				
	4)	Sprinklers in spaces housing electrical equipment, including electrical closets, must be equipped with a sprinkler head guard to provide protection against accidental damage.				
i.	Inspector's Test Connections					
	1)	Inspector's test connections must be provided for all zones, so that the water flow switch for each zone can be tested.				
	2)	Connections must have at least a ½-inch outlet discharging to a location that will accept full flow from the connection (This can be a sink, sanitary drain line or an express drain for multi-story buildings).				
	3)	Test connections to be provided adjacent to the sectional control valves.				
	4)	In single story buildings locate at hydraulically remote points.				
	5)	Any connection to a sanitary drain should be provided with a check valve conforming to the national mechanical code used or the local plumbing code.				
j.	Chemical Fire Extinguishing Systems					
	1)	The system must be designed so a pressure switch shuts off all associated power and send an alarm signal to the fire alarm control panel upon chemical discharge.				
k.	The following acceptance test procedures should be incorporated into project specifications when dry chemical extinguishing systems are used:					
	1)	Dry Chemical System Acceptance Tests				
		a)	After installation, mechanical and electrical equipment is to be tested to verify proper operation.			
		b)	A full discharge test must be conducted after the mechanical and electrical equipment has been fully tested.			
		c)	Plastic or cotton bags must be attached to each nozzle and the system must be activated.			
	2)	Cooking appliance nozzles must discharge at least 2 pounds; duct or plenum nozzles must discharge at least 5 pounds. Pre-engineered systems that fail to discharge these amounts are considered unsatisfactory and must be replaced.				
	3)	Wet Chemical System Acceptance Tests.				
		a)	After installation, mechanical and electrical equipment is to be tested to verify proper operations.			
		b)	The distribution piping must be pneumatically tested at 25 PSI for two hours.			
		c)	The installer must certify in writing that the piping has been pneumatically tested and that the pressure after two hours is a minimum of 23 PSI.			
		d)	A discharge test should be performed at the design pressure and must be conducted after the mechanical and electrical equipment has been fully tested.			
		e)	Replace the extinguishing agent container with one containing pressurized water prior to testing.			
		f)	Pre-engineered systems that fail to perform all the required functions will be considered unacceptable and must be replaced or repaired.			
l.	Gaseous Extinguishing Systems					
	1)	The installation of Halon 1301 or Halon 1211 systems or other systems using halogenated hydrocarbons is prohibited.				
	2)	Gaseous is a most recently used fire protection system for small computer areas that require non-wet fire protection systems.				
	3)	Evaluate and provide gaseous system for all zones of less that 2,500 feet squared with tenant requirement of non-wet protection system for the area.				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
4.3	**ELECTRICAL REQUIREMENTS**					
A.	Elevator Systems:					
	1.	General Requirements				
		a.	All elevator systems must be designed, installed and tested in accordance with ANSI/ASME Standard A17.1 and the following supplemental requirements.			
	2.	Shunt Trip				
		a.	When rooms containing elevator control equipment are protected with automatic sprinklers, activation of the waterflow device must simultaneously shunt-trip all power to the elevator controller and notify the fire alarm system of the condition and of the location of the waterflow.			
		b.	Heat detectors and interlocks must not be used.			
B.	Fire Alarm System:					
	1.	General Requirements				
		a.	Fire alarm systems should be installed in all buildings.			
		b.	All fire alarm systems must be designed, installed and tested in accordance with NFPA standards and local building code per 1972 P.A. 230, including applicable appendices.			
		c.	Alarm receipt and signaling must be capable of operating during a single open or single ground fault condition.			
		d.	All strobes, audible alarms and manual pull stations shall be specified and installed in accordance with ADA.			
		e.	Fire alarm systems must be electronically supervised to indicate a break or ground fault condition in all alarm initiating circuits, all alarm indicating circuits and in the circuit from the fire alarm panel to the central station or fire department.			
		f.	Alarm initiating circuits must receive alarms in maximum of 15 seconds.			
		g.	Trouble and supervisory signals must be received in a maximum of 200 seconds.			
		h.	At a minimum, systems must b horizontally zoned by floor and the control panel must indicate the location by floor (or by other more detailed zoning) of any alarm or supervisory or trouble signals received.			
		i.	Fire alarm systems should be provided with a battery backup power supply in accordance with NFPA 72 local building code per 1972 P.A. 230.			
		j.	Alternate power sources must be approved by the fire protection authority having jurisdiction.			
	2.	Integration of Systems				
		a.	Fire alarm systems must be self contained, stand-alone systems able to function independently of other building systems.			
		b.	However, a supervised interface must exist between the fire alarm and the controls of elevators, air handling systems and other building systems that are designed to change their operation in a fire.			
	3.	Special Fire Alarm System Requirements.				
		a.	Buildings of 12 or more stories must be provided with an emergency telephone system for use by building fire wardens and fire fighters.			
		b.	The emergency telephone system must be installed in exit stairways and at all elevator lobbies.			
		c.	The fire alarm is required to have both audible (non-coded) and visible appliances meeting NFPA 7G and local building code per 1972 P.A. 230 requirements.			
		d.	The concept of indirect, primary appliances photometrics (use of reflected light) should be applied to visual alarms to the extent practical.			
		e.	Fire alarm circuits and emergency communications circuits must be installed entirely in metal conduit or electrical metallic tubing (EMT), with a minimum inside diameter of ¾ inch, or a system having equal protection against damage by trades workers doing repair over the life of the equipment must be shown.			
		f.	All fire alarm systems should have at least one remote annunciator.			
		g.	The remote annunciator shall be placed at the main entrance of the building.			
		h.	The remote annunciator shall indicate, at a minimum, the location and severity			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
			of alarm.			
		i.	Some buildings may require more than one remote annunciator.			
4.	Manual Fire Alarm Stations					
	a.		Each fire alarm system must accommodate input from manual fire alarm stations located in exit corridors or in public corridors that are adjacent to a stairway or exit discharge from the building.			
	b.		Additional alarm stations may be provided at any location where there is special risk.			
5.	Water Flow Switches					
	a.		Water flow switches must be provided for each floor or fire area that is protected by wet pipe sprinkler systems.			
	b.		Pressure switches must be used to signal water flow for dry sprinkler systems.			
6.	Heat and Smoke Detectors					
	a.		Automatic heat or smoke detectors must be installed.			
	b.		Heat and smoke detectors must be designed and installed to meet NFPA 72E and local building code per 1972 P.A. 230.			
	c.		Smoke detectors must be installed in essential electronics equipment facilities, record centers, air handling units and all elevator lobbies.			
	d.		Other areas requiring detection, such as special purpose or high risk areas, may be identified by the future tenant during design development review.			
7.	Supervisory Signals.					
	a.		Supervisory signals must be transmitted under the following conditions:			
		1)	By tamper switches, when control valves are closed either two full turns of a valve wheel or upon 10 percent closure of the valve, whichever is less.			
		2)	This applies to control valves in the supply or distribution lines of automatic sprinkler systems, fire pumps, standpipe systems or interior building fire main systems.			
		3)	Operation of emergency generator.			
		4)	Condition of fire pump and power supply for the pump.			
		5)	Loss of primary power to a fire alarm system, fire pump or extinguishing system.			
		6)	Low and high air pressure for a dry-pipe or pre-action sprinkler system.			
		7)	Low water level in pressure tanks, elevated tanks or reservoirs.			
		8)	Low temperature (freezing) conditions in exterior reservoirs, water tanks or dry pipe valve enclosures.			
		9)	Abnormal operation signals for emergency generators and fire pumps, such as failure to start automatically, low oil pressure, high cooling water temperature, shutdown from overspeed and low battery condition or battery charger failure.			
	b.		All separate control panels for special extinguishing systems that receive a supervisory signal from the equipment they monitor must, in turn, send a single supervisory signal to the main fire alarm control panel.			
8.	Trouble Signals					
	a.		Trouble signals must be transmitted under the following conditions:			
		1)	Failure of central processing unit or peripheral equipment in a multiplex system.			
		2)	Wiring faults on supervised circuits, including open, short and ground fault conditions.			
		3)	Loss of DC (battery) back-up or charging.			
		4)	Detector faults for detectors capable of generating a trouble signal.			
	b.		All separate control panels for special extinguishing systems that receive a trouble signal from the equipment they monitor must, in turn, send a single trouble signal to the main fire alarm control panel.			
9.	System Output					
	a.		The output from the fire alarm control panel must be appropriate to the type of input (alarm) received, as described below. In all buildings, primary alarms			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
		transmitted to the building occupants and to the fire department and other critical signals for emergency equipment operation must function automatically and not depend on the action of a human being.			
	b.	Any action that is performed automatically by the fire alarm control panel (such as elevator recall or smoke control) must also be possible by manually overriding the automatic sequence from a fire control center or from the control panel of the fire alarm system.			
	c.	When an engineered smoke control system is provided, the fire control center or the fire alarm control panel must have the capability of manually canceling or altering the automatic system response.			
10.	Operation of Manual Fire Alarm, Heat Detector and Water Flow Alarm				
	a.	In addition to the requirements stated in the national building code used, operation of a manual fire alarm pull station, heat detector or a water flow alarm switch must result in the following automatic actions:			
	b.	Operations of the building fire (evacuation) alarms.			
	c.	Partial or selective evacuation may be necessary in high-rise buildings.			
	d.	Operation of other auxiliary features such as door holder release, unlocking of alarmed (locked) doors, fan shutdown or damper actuation (when directly connected to the main fire alarm control panel).			
	e.	Activation of a visual indicator at the fire alarm control panel and/or at the remote annunciator panel of the exact zone or device (if alarm annunciation is so detailed) in alarm.			
	f.	Independent waterflow for the elevator control room must also activate the elevator control power shunt trip and shut off all power to the elevator controller as well as smoke exhaust activation.			
11.	Operation of Smoke Detectors				
	a.	The activation of a smoke detector connected directly to the main fire alarm panel must cause operation of an audiovisual alarm at the individual detector, if so equipped, and at the main fire alarm control panel and/or remote annunciator panel.			
	b.	Building evacuation shall not be initiated by audible fire alarm activation.			
12.	Operation of the Supervisory System				
	a.	Receipt of a supervisory signal, either from an individual device or from a special extinguishing system control panel, must result in the activation of an audiovisual device at the main fire alarm control panel and/or the remote annunciator.			
	b.	The nature (location) of the signal must be indicated to the maximum extent permitted by the degree of zoning or sophistication of the control panel.			
13.	Operation of the Trouble System				
	a.	Receipt of a trouble signal, either from and individual device or from a special extinguishing system control panel, must result in the activation of an audiovisual device at the main fire alarm control panel and/or at the remote annunciator.			
	b.	The location of the signal must be indicated to the maximum extent permitted by the degree of zoning or sophistication of the control panel.			
14.	Fire Department Notification				
	a.	The fire department must be notified of the fire alarm activation. Signal transmission must not take longer than 90 seconds after initiation of an alarm.			
	b.	Transmission should indicate, at a minimum, alarm signals (detector-activated fire signal, a manual station, a water flow signal) or a supervisory/trouble signal without regard to location in the building.			
	c.	The signal must be reported through:			
	d.	A transmitter listed by a nationally recognized testing organization.			
	e.	The transmitter should be connected to a similarly recognized, listed, privately operated central station that has a protective signaling system.			
	f.	Automatic telephone dialers are not permitted; however; digital alarm communicator transmitters are allowed when telephone service provides timed-release disconnect.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	g.	A supervisory condition must transmit to a central station a signal that is different from and alarm signal. A single supervisory signal is sufficient for an entire building.			
	h.	An auxiliary tripping device connected to a municipal fire alarm box, to notify the local fire department as described in NFPA 72.			
	i.	A direct, supervised circuit between the building and the local fire alarm headquarters or a constantly manned fire station as stated in NFPA 72.			
15.	Operations of Evacuation Alarms				
	a.	Generally, the fire alarm should sound throughout the building to alert all occupants to evacuate.			
	b.	In high-rise buildings over 12 stories, the time needed for complete evacuation may be excessive.			
	c.	In that case, partial evacuation of the immediately affected areas should be announced by alarms which sound on the fire floor and on selected other floors, such as the floor(s) above and the floor below the fire floor.			
	d.	Such selective evacuation is permitted only in fully sprinklered buildings. Coded alarm systems are not acceptable.			
16.	Operation of Voice Communication Systems				
	a.	If selective evacuation is used, only the occupants on the fire floor, the floor(s) above and on the floor below must receive the message to relocate or evacuate automatically.			
17.	Power Supply Source				
	a.	Conductors of the power supply circuit must be connected on the line side of the main commercial service to the building.			
	b.	The connection must be on a dedicated circuit.			
	c.	A circuit disconnect device with overcurrent protection must be installed in a location that is accessible only to authorized personnel.			
	d.	The circuit disconnect must be next to the point of connection to the commercial service and must be clearly marked “Fire Alarm Circuit Control.”			
	e.	Any special extinguishing system control panels must have battery backup. In buildings with emergency generators, the fire alarm and any special extinguishing system control panels must be connected to emergency power in addition to the required battery backup.			
18.	Survivability				
	a.	Fire alarm systems must be designed to operated during any single fire emergency.			
	b.	The capability to simply report supervised conditions and circuit troubles in a fire is not considered sufficient.			
	c.	Wiring for the fire alarm and for the emergency telephone system must be shielded cable installed in metal conduit or EMT.			
	d.	At least two vertical cable risers must be installed as remote as possible from each other.			
	e.	The second riser must be separated from the first riser by at least a 1 hour rated firewall, not common to both risers.			
	f.	One wire should be used as the feed and other as the return.			
	g.	The wiring must be installed so that loss of one riser does not prevent receiving or sending an alarm signal or recorded message to or from any floor.			
	h.	Speakers, if used, must be installed so that a break or ground fault does not prevent operation of more than approximately one half of the speakers within a communication zone.			
	i.	They must be alternately connected to two separate circuits feeding each zone, and must be run in separate risers.			
	j.	The speakers must be connected to a return loop running to each zone in one riser and returning in a separate riser.			
19.	Testing				
	a.	All fire alarm systems must be maintained and tested in accordance with NFPA 72H and local building code per 1972 P.A. 230 requirements.			
C.	Fire Suppression Systems:				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
	1.	Water Demand				
		a.	The calculation for total water demand must include the sprinkler demand, hose streams form interior hose connections and exterior hydrants.			
		b.	A demand of 500 GPM should be assumed for interior hose streams for a duration of 2 hours.			
	2.	Fire Pumps				
		a.	Fire pumps, where provided, must start automatically.			
	3.	Automatic Sprinkler Systems				
		a.	Automatic sprinkler systems must be provided for all storage facilities.			
		b.	They should be designed in accordance with NFPA 231 and local building code per 1972 P.A. 230.			
		c.	Large-drop sprinkler heads rated at 286°F are recommended for record centers and may also be installed in facilities with other types of storage			
		d.	Installations should have a spacing of not more than 100 square feet per sprinkler.			
		e.	Alternate sprinkler designs may be used if approved by the fire protection engineer of the local authority having jurisdiction.			
D.	Fire Detection Systems:					
	1.	Detectors				
		a.	Smoke and heat detectors must be installed.			
		b.	In record storage where, heat or smoke detectors are not usually required to supplement the sprinkler system, smoke detectors may be used in special areas within record centers.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

FIRE PROTECTION SYSTEMS							COMMENTS
X.1	A.	1.	a.	1)	a)	Reference Key	

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
PART 5 - MECHANICAL SYSTEMS DESIGN			
5.1 GENERAL APPROACH			

Mechanical Systems:
Three *characteristics* distinguish *State Buildings*:
▫ *Longer life span*
▫ *Changing occupancies*
▫ *Use of life cycle cost approach to determine overall cost*
The *State* typically will *own buildings longer* and will *perform alterations* in an ongoing fashion. Accordingly, Mechanical Systems must:
▫ Be of a *higher level of durability* and *lower level of maintenance:*
- Central absorption or electrical centrifugal chillers
- Central hot water or steam boilers
▫ Accommodate *periodic renovation* by using systems that:
▫ Have capacity for increased localized load increases
▫ Allow modifications to be made with minimum impact on surrounding areas.
Fire Protection, HVAC And Plumbing Systems should:
▫ Be *"invisible" to occupants*
▫ Provide a *safe, clean, comfortable* and *healthy environment* for the *occupants*
▫ Be *designed* to respond to the *local climate*
▫ Make the best use of *natural resources*
▫ Be *sophisticated ("State of the Art")* while not *sacrificing reliability* and *maintainability*
Energy Considerations:
▫ *Energy savings* must be a *main factor in HVAC system* selection
▫ A computer-based *building automation system (BAS)* to monitor / control lighting, elevators, heating, ventilating and air conditioning *is required*
▫ Lessor shall provide the latest *technology / integration* of building automation systems available
▫ *Fire alarm* and *Security* systems must function as *stand-alone systems* with an interface to the BAS

5.2	**MECHANICAL CODES AND STANDARDS**			
A.	The following codes' standards are mandatory guidelines for design (When referenced as such in the text of the Chapter):			
	1. American Society of Heating, Refrigeration and Air Conditioning Engineers: '89 ASHRAE Handbook of Fundamentals and ASHRAE Standards 15, 55, 62, 100.3. 100.5. 100.6 ASHRAE 90 Air Use Standards is mandatory for compiling of building HVAC design criteria.			
	2. American National Standards Institute			
	3. American Society of Mechanical Engineers			
	4. BOCA Mechanical and Plumbing Code (amended by State of Michigan)			
	5. National Fire Protection Association (NFPA)			
	6. Sheet Metal and Air Conditioning Contractors' National Association, Inc.			
	7. Electronic Industries Association/Telecommunications Industry Association			
	8. Uniform Building Code (Lansing City proper)			
5.3	**MECHANICAL SPATIAL PLANNING**			
A.	General			
	1. In order to achieve system flexibility and thorough integration between building architecture and engineering systems, a concept for the distribution of mechanical systems must be established during the architectural schematic design.			
	2. The locations of vertical and horizontal mechanical elements should be established before the architectural concept is finalized.			
B.	Vertical Zoning of Floor-to-Floor Space.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	1.	Floor and ceiling spaces must be laid out to provide distinct zones for the placement of different utilities. The depth of the ceiling and floor space must be determined early in the design, in order to arrive at the floor-to-floor height of the building.			
	2.	The ceiling space should be layered, with the plumbing and sprinkler piping zone near the underside of the structure, or possibly through it if steel joists are used, the HVAC duct zone in the middle and the lighting zone immediately above the ceiling level.			
	3.	Enough space must be left between the HVAC and lighting zones to accommodate future lighting moves and changes without moving other components.			
C.	Vertical Riser.				
	1.	Risers for ducts and hydraulic piping should be combined with other core elements to form compact groups and maximize usable floor space.			
	2.	The number and size of risers will depend on the systems chosen, and future flexibility should be an important criterion in the vertical layout as well.			
	3.	Wet columns (domestic cold water, waste and vent) should be placed in each core and distributed in general office space at an approximate distance of 120 feet on center.			
	4.	Ductwork and plumbing piping should be run in separate chases to eliminate cross contamination of water, sewer, storm and building air transfer ducts.			
	5.	Water piping must not be placed in exterior columns and above ornamental ceilings.			
	6.	If valves for hydraulic piping cannot be avoided above inaccessible ceilings, ceiling access panels must be provided at each location. If placed in the exterior wall, it must be located on the inside of insulation and vapor barrier.			
	7.	Extended runs should be avoided in unheated garage space.			
	8.	Gas piping shall be low pressure (<7"W.G.) and not be placed in unventilated spaces (trenches / unventilated shafts), where leaked gas could accumulate and explode.			
5.4	**UTILITY DESIGN CRITERIA**				
A.	Energy Usage.				
	1.	Energy use by building environmental control systems shall be minimized so that average lease rates charged to the state departments for occupancy is justifiable for space use. However, energy conservation goals must be realistic.			
	2.	Energy usage must not be designed so conservatively that good design practices, such as make-up air, pressurization, proper ventilation and comfort conditions are compromised.			
B.	Water Conservation.				
	1.	Strategies to reduce water consumption such as water saving valves used in plumbing fixtures, electronic self-flushing, low volume flush toilets and self-closing metered valves shall be evaluated during the design process.			
	2.	Sewer utilities shall conform to all current municipality code constraints and standard tie-in procedures to site sewer connection.			
	3.	Electrical power for the facility shall be coordinated with Lansing Board of Water and Light for distribution feed, transformer data, metering requirements and standard connection procedures to local utility power grid.			
C.	Value Engineering Analysis.				
	1.	In buildings not yet constructed, Mechanical system which best serves the facility shall be selected based upon a value engineering analysis method. See Appencices for Value Engineering Analysis requirements.			
5.5	**SIZING AND OPERATING STANDARDS FOR EQUIPMENT / SYSTEMS**				
A.	The sizing of components of mechanical systems is a complicated process of balancing present building loads, reliability and potential future demand.				
B.	The overriding criterion of any sizing decision is that mechanical systems must operate efficiently at partial and at full load both at the time of building occupancy and over 30 years into the future.				
C.	State of the art mechanical components shall be required that keep the building HVAC systems energy use for space conditioning competitive.				
D.	This does not mean that all equipment necessary to satisfy potential future demand must be installed at the time of initial construction.				
E.	Often it may be more prudent to dedicate space in a mechanical room for future installation of additional equipment.				
F.	Careful consideration must be given to how the future equipment will integrate with installed systems. Examples:				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	1.	If space and accessibility is left for a future chiller, the piping header needs to be sized for the ultimate flow and variable speed application to the chilled water header shall be required to add pump horsepower.			
	2.	Providing an oversized housing for an air handling unit that would permit the later addition of fans and coils with the blower having variable speed drive to increase CFM and capacity in the future.			
	3.	Electrical service size and expansion potential must be considered.			
G.	Reliability is another factor to be considered in sizing equipment.				
	1.	The selection of multiple units of even or uneven size ensures added reliability because either component can carry at least a partial load if one unit breaks down.			
	2.	Multiple units also permit scheduling of equipment running times, e.g., 100 hours for unit 1 then 100 hours for unit 2, which lengthens equipment life (this is termed an alternative duty cycle).			
	3.	This type of control shall be programmed into the BAS and preventative maintenance schedule.			
H.	It is not always necessary to double equipment to achieve reliability.				
	1.	Often there is a possibility of tying units together that serve different areas of the building under normal conditions with additional ductwork paths and motor operable, diverting air flow dampers that redirect central station air handlers supply air to other zoned areas of the building.			
I.	Operation and Maintenance Considerations.				
	1.	Generally, State of Michigan employee buildings are open for operation form 8:00 a.m. until 5:00 p.m. Monday through Friday, except for holidays.			
	2.	In some cases, buildings or parts of buildings may need to operate on 24-hour schedules, such as central data processing, security, maintenance and dock delivery.			
	3.	Operating conditions will have a large impact on the choice of the building management system and other equipment maintenance considerations.			
	4.	The engineer is, thus required to evaluate the planned maintenance provisions for each type of HVAC system modeled in the design phase of this project.			
5.6	**HVAC DESIGN CRITERIA**				
A.	General				
	1.	Outdoor Design Criteria			
		a. Outdoor air design criteria must be based on Lansing weather data tabulated in the latest edition of the '89 ASHRAE Handbook of Fundamentals.			
		b. Winter design conditions must be based on the 97-1/2 percent column dry-bulb temperature in the ASHRAE table.			
		c. Summer design conditions must be based on the 97-1/2 percent column dry-bulb temperature with its corresponding mean coincident wet-bulb temperature.			
		d. Where critical spaces require temperature and humidity to be maintained to 1.5% or less tolerances, cooling loads must be based on the 1-percent column dry-bulb temperature with its corresponding mean coincident wet-bulb temperature for exterior envelope.			
	2.	Indoor Design Temperatures and Relative Humidity			
		a. Comply with Indoor design temperatures and relative humidity as stated in Table 2.			
		b. The office design conditions are set at the middle of the comfort range stated in the '89 ASHRAE Handbook of Fundamentals.			
		c. The actual operating conditions may be adjusted for local space use per the State Property Management Division.			
	3.	Outside Air and Ventilation Criteria.			
		a. Outside air and total ventilation rates must comply with the latest edition of ASHRAE Standard for occupancy code.			
		b. Outdoor air and exhaust of occupied areas must flush the space with a minimum of 20 cfm per person.			
		c. The following spaces must be kept under negative pressure relative to surrounding building areas:			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
1) toilets, showers, locker rooms, custodial spaces, battery charging rooms and kitchens and cafeteria.			
2) The air from these spaces must also be exhausted at 100 percent and makeup supply air set at 50% inlet air.			

Table 2 - Indoor Design Conditions					
	Summer			Winter	
Type of Area	DB[1]	RH[2]		DB[1]	RH[2]
General Office		75		70	30
ADP Rooms	75	35		70	40[4]
Corridors		75		70	35
Building Lobbies		75			70
Toilets, Lockers		75			70
Electrical Closets	75			70	
Tunnels, Bridges	75			70	
Mechanical Spaces	90			65	
Electrical Switchgear	90[5]			65	
Elevator Machine Room	90[5]				
Emergency Gen Room		104			
Transformer Vaults	90				
Stairwells				65	
Comm/Tel Frame Room	75[7]			70[7]	35
Storage Room		90			70
Conference Room	75			70	35
Computer Room	75	55		72	55

NOTES:
1 Temperatures are degrees Fahrenheit, to be maintained at +/- 2°F.
2 Relative humidity is minimum permissible, stated in percent.
3 Dry bulb and relative humidity are to be maintained 6" to 6' above the floor.
4 Relative humidity shall be maintained at +/- 5% in ADP spaces.
5 Maximum temperature. Space to be mechanically cooled if necessary.
6 Room must not exceed temperature with generator running.
7 Must comply with EIA/TIA Standard 569.
8 Minimum temperature in the building must be 65 even when unoccupied.
9 Relative humidity shall be maintained at +/- 1% in computer room.

4. Indoor Air Quality				
a. Virtually all building materials and furnishings in the internal areas of buildings give off some particulates and/or gases.				
b. Common office supplies and equipment have been found to release chemicals, especially duplicators and copiers; even bulk paper has been found to release formaldehyde.				
c. Exterior façade outdoor air intake shall be at a high penthouse elevation to avoid exhaust fumes, dock air contaminants or other outside air exposure to air contaminants or other outside air exposure to air contaminants beyond control of Property Management Division.				
d. Proximity of exhaust air discharge stream shall be a minimum of 25'' away from outside air intake and at a higher stack elevation downstream of prevailing winds if appropriate.				
e. When a building is new, volatile compounds can be released in large quantities from materials, such as adhesives, vinyls and carpets.				
f. A purge cycle of 100 percent outside air is recommended to run for one month				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
			prior to occupancy.			
		g.	Smoke exhaust systems for positive pressurization of egress routes are required and shall recognize the importance of adequate ventilation to maintain indoor air quality.			
		h.	The outside air and ventilation rates of ASHRAE Standard 90.1 are the minimum acceptable in all new State of Michigan facility buildings. Where occupancy requirements are likely to generate high levels of airborne particles, special air filtration shall be provided on the return air system.			
B.	Internal Heat Gain:					
	1.	Occupancy Levels				
		a.	The average density of the occupiable floor are of a State office building is one person per 200 square feet.			
		b.	Within areas of workstations, the occupancy load can be as dense as one person per 50 square feet.			
		c.	Block loads and room loads shall be calculated accordingly.			
		d.	Sensible and latent loads per person should be based on the latest edition the '89 ASHRAE Handbook of Fundamentals.			
		e.	In addition to normal office interior heat gains, each person shall have 1PC and monitor and .25 printer value for internal gain assumption.			
		f.	For dining areas, auditoria and other high occupancy spaces, occupancy loads should represent the number of seats available.			
		g.	Areas not normally occupied, such as storage rooms or mechanical rooms, do not have occupancy loads. Exhaust systems designed for these high occupancy areas must be sized to discharge an equal or greater amount of make-up of fresh air required for each specific space.			
		h.	Pressurization criteria of contaminate areas shall be negative and specifically controlled by the separate exhaust system for that environment to ensure no cross contamination of soiled air.			
	2.	Lighting Levels				
		a.	IES (Illumination Engineering Society Standards) shall be used for energy model.			
		b.	They must be consistent with the general building lighting concept, which may consist of overhead lighting, task lighting or both.			
		c.	Assign room loads and return air heat gain accordingly.			
		d.	For special areas such as conference rooms or lobbies where unique or accent lighting may be provided, appropriate additional load should be used and coordinated with electrical engineering in the preliminary heat gain load calculations and energy use analysis.			
C.	Zoning Criteria for HVAC Systems:					
	1.	Interior control zones must not exceed 3000 square feet per zone for open office areas or a maximum of three offices per zone for closed office areas.				
	2.	Corner offices should be a dedicated zone due to double exposure or configured as a stairwell, closet, electrical or telecommunications so as to have no occupancy.				
	3.	Independent zones shall be provided for spaces such as conference rooms, entrance lobbies, atria, kitchen areas, dining areas, child care centers and physical fitness areas.				
	4.	It may be assumed that up to 20 percent of the floor plan will be occupied by closed offices. HVAC zoning should be designed to adapt to this criteria.				
	5.	Separate HVAC systems shall be designed to serve areas expected to operate on widely differing operating schedules or design conditions.				
	6.	Separate systems are also recommended for buildings where perimeter zones have heating and/or cooling loads very different from interior zones.				
	7.	When a single system serves a large floor, provisions should be made to shut off or set-back the heating and cooling to each area independently.				
	8.	Multiple air handlers or floor by floor systems shall be considered. Where practical, a cooling/heating loop dedicated to operation after hours shall be considered.				
	9.	Spaces with relatively constant and weather-independent loads should be served with systems separate from those serving perimeter spaces.				
	10.	Areas with special temperature or humidity requirements, such as automated data				

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				Yes	No	N/A
			processing rooms, should be served by separate supplementary or auxiliary systems.			
	11.		The supply of zone cooling and heating should be sequenced to prevent the simultaneous operation of heating and cooling systems for the same space.			
	12.		Where sequencing is not possible due to ventilation or air circulation requirements, air quantities should be reduced as much as possible before reheating, recooling, or mixing hot and cold air streams.			
	13.		Finally, supply air temperature should be reset to extend economizer operations and to reduce reheating, cooling or mixing.			
	14.		Economizer systems shall be enthalpy based, digitally controlled and limited to 80% outside air intake during summer conditions.			
D.	Public Service HVAC and Plumbing Requirements:					
	1.	Entrance Vestibules				
		a.	Sufficient heating and cooling should be provided to offset the infiltration of the space. Where heating degree bins of 5° increments require full load space heating and wind speed averages more than 15 miles per hour, air curtains shall be considered. Dock areas shall have direct steam heater or natural gas infrared units to offset infiltration.			
	2.	Mechanical Rooms				
		a.	All mechanical rooms must be forced air ventilated. Water lines should not be located above motor control centers or disconnect switches. Mechanical rooms must have floor drains and combustion air may be forced or free draft in design application, but must meet all governing codes and local jurisdiction requirements.			
	3.	Kitchens and Dishwashing Areas				
		a.	Kitchens with cooking ranges and dishwashers shall be provided with separate exhaust hoods/exhaust systems and shall meet or exceed State of Michigan '96 Health Department criteria. Floor drains must exist and be interconnected with grease trap collection device.			
	4.	Toilet Rooms				
		a.	All toilet rooms shall have floor drains. A minimum exhaust system criteria of 2.5 cfm per square foot of floor area shall be required.			
	5.	Electrical Equipment Rooms				
		a.	No water lines are permitted in electrical rooms. HVAC supply and exhaust criteria shall be defined by equipment manufacturer heat gain value and suggested operating temperature of <90oF.			
	6.	Communications Closets				
		a.	Communications closets must be ventilated and cooled similar to occupied offices. Communications closets shall meet the requirements of EIA/TIA Standard 569.			
	7.	Elevator Machine Room				
		a.	In climates where heating and/or cooling of the elevator machine room may be required, ventilation louvers should be equipped with motorized dampers (normally open) that close when the heating or cooling system is in operation and that open when the fire alarm is actuated. Cooling or heating must be provided to maintain room conditions required by equipment manufacturer specifications. Heating and ventilating units shall be within the building and not roof mounted on the elevator penthouse.			
	8.	Emergency Generator Rooms				
		a.	Rooms must be ventilated sufficiently to remove heat gain from equipment operation. In remote areas, exhaust fan run time shall be controlled by an indirect acting space thermostat. The air supply and exhaust shall be located so air does not short circuit.			
		b.	Generator exhaust must be carried up to roof level in a flue or exhausted by way of a vault located away from any building wall. Horizontal exhaust through the building wall is not permitted.			
	9.	UPS Battery Rooms				
		a.	Battery rooms must be equipped with eye wash, emergency showers and floor drains. The exhaust for battery rooms must be connected to the emergency			

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				Yes	No	N/A
			power system. Battery rooms must be exhausted at five air changes per hour minimum, with 50% makeup air for proper ventilation and negative pressurization with respect to adjacencies.			
	10.	Data Processing/Computer Center				
		a.	Computer rooms require 24 hour conditioning with separate cooling and year round heat rejection equipment operations. Equipment for cooling, reheat and humidification shall be "stand alone" operation with temperature control separate from occupied adjacencies.			
5.7	**HEATING SYSTEMS**					
A.	Steam Heating:					
	1.	The State of Michigan Property Management Division prefers not to generate steam in new buildings or major renovations because of the high operational cost resulting from system maintenance.				
	2.	If steam is furnished to the building, such as under a district heating plan, it shall be converted to hot water with a heat exchanger near the utility corridor into the building.				
	3.	Steam distribution piping shall be minimized within the building.				
	4.	No steam piping, with operating pressure greater than 30 psig, shall be allowed within the building.				
	5.	Underground PRV station vault is most practical for steam utility service.				
B.	Hot Water System:					
	1.	Normally, hot water heating systems will be low temperature hot water.				
	2.	This is an efficient, easily controllable system for supplying heat to the perimeter and interior zones of a building.				
	3.	High temperature hot water should be limited to campus distribution systems where heat is supplied from a central plant and should be converted to low temperature water near the utility corridor into the building.				
	4.	Temperature and Pressure Drop				
		a.	Supply temperatures for forced hot water heating and corresponding temperature drops must correspond to the rated temperature drops on which equipment sizes are based.			
		b.	Total system temperature drop shall not exceed 30°F.			
		c.	Design water velocity in piping should not exceed 6 feet per second and design pressure differentials in piping systems should not exceed 30% of the overall system operating pressure.			
		d.	Operating and unoccupied idle modes of control should be provided.			
	5.	Piping				
		a.	Series loop piping is permitted only for terminal or branch circuits.			
		b.	Main distribution piping shall be a two pipe system, reverse return in conjunction with primary secondary pumping.			
		c.	Temperature control and pressure drop at terminal units should be evaluated and chosen within tolerances established by ITT Institute guidelines as well as minimizing cost of material assembly prior to selection.			
		d.	Reverse return piping systems for both hot and chilled water secondary loops are required because it provides the best overall control and reliability.			
		e.	It supplies the same temperature water to each terminal unit, minus negligible line losses, and distributes the proper flow of water in each pipe because all loops are the same length.			
		f.	Pressurized vessel expansion tanks are mandatory.			
		g.	Hot water systems must automatically bleed accumulated air.			
		h.	Automatic bleed valves shall only be used in accessible spaces in mechanical rooms where they can be observed by maintenance personnel.			
		i.	They must be piped directly to open drains.			
		j.	Use manual valves at terminal units and other accessible high points in the system.			
		k.	Diameter change in piping runs shall utilize eccentric fittings.			
	6.	Freeze Protection				
		a.	Propylene glycol shall be used to protect hot water systems from freezing,			

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				Yes	No	N/A
			where runs of piping are exposed to weather, where heating operations are intermittent or where coils are exposed to large volumes of outside air.			
		b.	Concentrations of propylene glycol shall not exceed 25 percent to limit the decrease in heat exchange efficiency.			
		c.	Glycols should not be used in boilers, because of corrosion caused by the chemical breakdown of this type of media.			
	7.	Electric Resistance Heat				
		a.	Electric resistance heat in coils or baseboards shall not be used.			
	8.	Radiant Heat				
		a.	Radiant heating systems (hot water or gas fired in open dock areas) may be overhead or underfloor type.			
		b.	They should be considered in lieu of convective or all-air heating systems in areas that experience infiltration loads in excess of two air changes per hour at design heating conditions.			
		c.	Radiant heating systems may also be considered for loading docks.			
C.	Boilers and Heat Exchangers:					
	1.	Boilers.				
		a.	Boilers for hydraulic hot water applications should generally be low pressure (up to 250°F at less than 60 psig).			
		b.	Package units, with all components and controls in a preassembled unit, are preferred.			
		c.	Controls and relief valves to limit pressure and temperature must be specified separately.			
		d.	Boiler sequences are temperature actuated and duty cycle digitally controlled with outdoor air reset algorithms within a Honeywell “Excel” protocol of standard facility DDC control and BAS systems.			
		e.	All boilers with ratings higher than 100 million BTU/hour are subject to stack discharge testing by MIDSHA and EPA operation guidelines.			
	2.	Heat Exchanger.				
		a.	Steam-to-water heat exchangers should be used in situations where district steam is supplied and a hot water heating system has been selected for the main heating of fresh air and periphery radiation.			
5.8	**COOLING SYSTEMS**					
A.	Chilled Water Systems:					
	1.	General				
		a.	Chilled water systems include chillers, chilled water pumps, piping and cooling towers, chiller/heaters and all compressorized unitary systems.			
		b.	The chilled water temperature differential should be selected to minimize energy use of the system.			
		c.	Larger temperature differentials will reduce pumping and piping costs but may increase coil sizes.			
		d.	Generally, chilled water systems should have a 12°F temperature differential, with a design supply water temperature of 45°F.			
	2.	Chillers				
		a.	Chillers should be specified in accordance with Air conditioning and Refrigeration Institute (ARI) ratings procedures and ASHRAE 90.1.			
		b.	They shall be centrifugal absorption, or screw type with electric or steam energy media.			
		c.	Water cooled refrigeration heat rejection systems are preferred over air cooled due to lower KW/ton part load conditions.			
		d.	Microprocessor-based controls must be used.			
		e.	They shall have self-diagnostic capability, set point displays, run time, and input/output (KW/ton) information and integrate with DDC automated building systems.			
		f.	Centrifugal chiller systems must consist of multiple machines.			
		g.	Plants over 300 tons each should have at least three machines.			
		h.	Generally, machines should be of equal size and be controlled via the lead-lag			

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				Yes	No	N/A
			"alternate" duty cycle control strategy.			
		i.	No single machine should run for more than 160 consecutive hours without maintenance check and purge cycle if run time errors found in diagnostics.			
		j.	The number of machines should be selected such that the loss of one in an emergency in peak cooling season will not allow the average space temperature to rise over the stipulated model design temperature assuming that the remaining machines may be run 24 hours a day.			
		k.	Part load efficiency must be considered in the operating features of the design.			
		l.	Efficiencies shall be as listed in ARI's application part load value increments to match expected site performance.			
		m.	Screw type electrical driven machines with water-cooled heat rejection offer least KW/ton performance criteria in loads less than 200 ton capacity.			
		n.	Steam absorption units have lower KW/ton performance in loads greater than 250 ton capacity.			
	3.	Environmental Protection.				
		a.	The design of refrigeration machines must comply with Clean Air Act amendment Title VI: Stratospheric Ozone Protection and Code of Federal Regulations (CFR) 40, Part 82: Protection of Stratospheric Ozone.			
		b.	No chlorofluorocarbon (CFC) refrigerants are permitted in new chillers.			
		c.	Hydrochlorofluorocarbon (HCFC) refrigerants 123 and 22 and hydrofluorocarbon (BFC) refrigerant 134a are acceptable.			
		d.	Other acceptable non-CFC refrigerants are listed in EPA regulations implementing Section 612 (Significant New Alternatives Policy (SNAP)) of the Clean Air Act, Title VI Stratospheric Ozone Protection.			
		e.	Refrigeration machines must be equipped with isolation valves, fittings and service apertures as appropriate for refrigerant recovery during servicing and repair, as required by EPA regulations implementing Section 608 of the Clean Air Act, Title VI.			
		f.	Protection systems including low electrical voltage or loss of one phase shall be provided.			
		g.	Chillers must also be easily accessible for internal component inspections and cleaning.			
		h.	Mechanical equipment rooms must be designed in accordance with the requirements of AS Standard 15, Safety Code for Mechanical Refrigeration.			
		i.	Chiller leak detection purge and remote alarming should be connected to the building automation system installed.			
		j.	Alarm condition shall signal Property Management personnel on or off site, depending upon Phase 300 schematic programming constraints.			
	4.	Chilled Water Pumps				
		a.	Pumps shall be selected to operate at 1750 RPM.			
		b.	Both partial load and full load must fall on the pump curve.			
		c.	The number of primary chilled water pumps shall correspond to the number of chillers, and a separate pump should be designed for each condenser water circuit.			
		d.	Secondary variable speed pumps shall be incorporated for future load and adjustable for 30 to 50% future capacity of loop piping installed.			
	5.	Piping				
		a.	Reverse return piping is required for secondary piping systems with many terminal units of similar pressure drop.			
		b.	For all systems, proper consideration must be given to location of balancing valves.			
		c.	All chilled water piping systems shall have rolled/grooved Schedule 40 black steel piping with victaulic couplings with insulated runs in return air plenums and shafts.			
		d.	Condenser Water.			
			1) Condenser water circuits must always be recirculating systems.			
			2) Once-through applications using domestic water are not permitted.			
			3) Cooling tower, open or closed loop systems shall have design criteria of			

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			Yes	No	N/A
		10-12oF differential with 96oF/76oF DB/WB ambient condition.			
6.	Water Treatment				
	a.	Water available in many parts of Michigan will cause corrosion and/or scaling recirculating systems, such as chillers, condensers and hot water systems.			
	b.	Water analysis and appropriate treatment shall be included to minimize corrosion in all open or closed loop systems.			
	c.	A complete water analysis is essential to the proper design of corrective measures.			
	d.	Since improper addition of chemicals to make-up water is likely to be more harmful than leaving the water untreated, water treatment for all hydraulic systems should be designed by a qualified specialist.			
	e.	Data required by this engineer shall be requested from the local municipality having jurisdiction.			
7.	Cooling Towers				
	a.	Cooling tower sizes should be based on the 97-1/2 percent column of the wet bulb temperature of ASHRAE weather data.			
	b.	Multiple cell towers and isolated basins are required to facilitate operations and maintenance.			
	c.	Piping should be manifolded to allow for any combination of equipment use.			
	d.	Cooling towers should have ladders and platforms for ease of inspections and replacement of components.			
	e.	Open or closed loop systems shall be considered.			
	f.	Variable speed fans shall be considered.			
	g.	Induced draft or forced draft systems with multiple fan arrangement towers shall run continuously to avoid short-circuiting.			
	h.	Induced draft towers must have a clear distance equal to the height of the tower on the air intake side(s) to minimize air recirculation.			
	i.	Clean-outs for sediment removal and flushing from basin and piping should be provided.			
	j.	Closed loop fluid cooler and/or indoor sump shall be considered in the energy analysis and incremental payback analysis as applicable to the system models chosen by the engineer for schematic program presentation.			
	k.	Indoor sumps for water collection are preferred over outdoor sumps with electric heater due to the Michigan winters.			
	l.	Cooling towers should be placed on the site so as not to interfere with the appearance of the building.			
	m.	Screen wall and planting may be used to conceal the penthouse tower.			
	n.	Cooling towers should also be located to prevent drift or plume fogging of the building façade or surrounding buildings.			
	o.	The effect of large equipment start/stop noise and radiated noise on occupied spaces in the vicinity must also be considered.			
	p.	Start/stop noise can be mitigated by utilization of A/C invertors for tower fan speed control.			
	q.	Wet bulb fan speed control optimization control strategies shall be utilized.			
	r.	The foundation tower construction and connections should be designed for a 80 MPH wind design load.			
	s.	Cooling towers should be constructed of corrosion resistant materials, particularly in high humidity areas.			
	t.	It the cooling tower is located on the building structure, vibration and sound isolation must be provided.			
	u.	Supports should be designed to permit re-roofing under the tower if located exterior to an enclosed penthouse.			
	v.	Special consideration shall be given to deicing cooling towers if they have free cooling option such as reversing fan rotation and are to operate in the sub-freezing weather.			
	w.	A manual shutdown for the fan should be provided.			
	x.	If cooling towers operate intermittently during sub-freezing weather, provisions should be made for draining all piping during periods of shutdown.			

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				Yes	No	N/A
			y. For this purpose, design of indoor drain down sumps are mandatory in lieu of heated wet basins at the cooling tower base.			
	8.	Air-Cooled Condensers				
			a. Air-cooled condensers are not recommended for this facility.			
B.	Special Cooling Applications:					
	1.	Water-Side Economizer Cycle.				
			a. In certain climate conditions cooling towers are capable of producing condenser water cold enough to cool the chilled water system without chiller operation.			
			b. These options should also be considered in energy analysis comparisons of water-cooled, electrical gas or steam driven chillers.			
			c. Also, air side economizer operation in Northern Great Lakes are by modulation o.a./r.a. dampers and exhaust systems tend to produce lower operating costs during spring and fall occupancy hours and shall be considered as any energy conservation measure.			
			d. Water-side economizer cycles are particularly cost effective in the low humidity climates.			
	2.	Computer Room Air-Conditioning Units.				
			a. Mainframe computer rooms may be cooled by self-contained units for loads up to 30 tons.			
			b. These units are specifically designed for this purpose and contain compressors, filters, humidifiers, reheat elements and controls.			
			c. They should be sized to allow for 50 percent redundancy, either two units at 75 percent load or three units at 50 percent load for these systems.			
			d. For continuous loads above 30 tons, chilled water air handling systems must be used.			
			e. A group of dedicated chillers is preferred, unless other parts of the building also require 24-hour cooling.			
			f. It should consist of three chillers, each capable of handling 60 percent of the sensible load.			
			g. Connection provisions should be made available and header primary flow volumes should be sized for the future addition of a fourth unit.			
			h. Heat rejection should be of water-cooled recirculating type, such as cooling towers or evaporative condensers.			
			i. Closed loop, ground heat exchanger systems design is encouraged for investigation SF alternative heat rejection methods, due to the free thermal cooling capability of the earth and relatively inexpensive installation.			
			j. Pond spraying is another free cooling method available for heat rejection if thermal pollution does not exceed EPA recommended guidelines.			
			k. Use of once-through domestic eater drained to sewer or ground injection is prohibited.			
5.9	**VENTILATION AND AIR DISTRIBUTION**					
A.	Pressurization.					
	1.	In general, a positive pressure should be maintained in a building with respect to the outdoor environment.				
	2.	In areas where exhaust systems are used, a negative pressure should be maintained relative to surrounding spaces by exhausting 20 percent more air than the supply air to the space, or by negative pressurization control.				
B.	Special Ventilation Requirements:					
	1.	Toilets.				
			a. Toilet areas must have segregated exhausts.			
			b. They should be under negative pressure during occupied and unoccupied periods.			
	2.	Food Service Areas.				
			a. Kitchen areas should be under negative pressure relative to dining rooms.			
			b. Make-up air should be introduced at the kitchen hood for up to 75 percent of exhaust air.			
			c. Duct air velocity should be not less that 2,000 FPM to hold particulates in			

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				Yes	No	N/A
			suspension.			
		d.	Dish washing areas must be under negative pressure relative to the kitchen or food prep areas, food prep area is negative to eatery and the eatery is slightly negative to entrance vestibule or egress corridor so as to maintain odor control from clean to progressively more contaminated waste areas.			
5.10	**AIR DISTRIBUTION SYSTEMS**					
A.	Constant Volume Systems:					
	1.	Single Zone Systems.				
		a.	Single zone air handlers may be considered for systems with relatively constant loading.			
		b.	Single zone units can be shut down individually without affecting conditions in adjacent spaces.			
	2.	Multi-zone and Dual Duct Systems.				
		a.	Multi-zone and dual duct systems are usually considered for constant volume systems with fluctuations in loading.			
		b.	They should be evaluated with caution, as they can be high-energy users due to reheating a cold air stream.			
	3.	Multi-zone Systems.				
		a.	Multi-zone systems often are an appropriate choice for small buildings.			
		b.	They achieve many of the advantages of dual duct systems at a much smaller initial cost.			
		c.	Multi-zone units should be of energy use considering the three deck type to minimize reheat size of this building.			
		d.	Reheat permits close control of temperature and moisture levels but it is a high energy consumer.			
		e.	Its use should therefore be limited to tightly environmentally controlled spaces.			
	4.	Dual Duct Systems.				
		a.	Conventional dual duct systems use high reheat and thus are high energy consumers.			
		b.	Where dual duct designs are used, two supply fans, one for the hot deck and one for the cold deck, are recommended.			
		c.	The design should allow all return air to pass through the hot deck where it recovers heat from internal loads for heating.			
		d.	The heating coil should operate only when additional heat is required.			
		e.	Outside air should pass through the cold deck.			
		f.	This configuration limits energy consumption for both heating and cooling, while maintaining excellent temperature and humidity control.			
		g.	Michigan Energy Code has limited the use of dual duct systems due to reheat energy required.			
		h.	This reheat energy must be adequately represented in the options study if dual duct constant volume system is proposed as a viable option for this facility.			
B.	Variable Air Volume (VAV) Systems:					
	1.	General				
		a.	Simple VAV systems provide cooling only.			
		b.	Any heating requirement is handled by a separate perimeter system.			
		c.	The supply fan is designed for the largest block load, not the sum of the individual peaks.			
		d.	VAV systems offer temperature control for multiple zones and a large degree of flexibility.			
		e.	They are particularly well adapted to subdivisions and rearrangements into new zones as building occupancy needs change.			
		f.	Operating costs are saved by running fans at reduced volume and matching refrigeration and heating to the diversity of cooling or heating loads.			
		g.	Simple VAV without reheat is generally appropriate for interior zones of office buildings that require year-round cooling.			
	2.	Perimeter Zones.				
		a.	Designers are encouraged to consider the use of an entirely separate perimeter			

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			Yes	No	N/A
		system, which may be central air or hot water or radiant heating type.			
3.	Volume Control.				
	a.	VAV systems depend on volume modulation to achieve the required ventilation and temperature, which makes volume control critical to the successful operation of the system.			
	b.	Room loads must be calculated accurately to avoid excessive throttling of air flow due to oversized fans and terminal units.			
	c.	Diffusers should be high entrainment type (3:1 minimum) to maximize air velocity at low flow rates.			
	d.	Also, the minimum volume setting should equal the larger of the following: a) 30 percent of the peak supply volume; or b) 0.4 CFM/FT^2 of conditioned zone area; or c) 20 cfm/person occupied in each zone are for minimum ventilation.			
	e.	VAV terminal units must never be shut down to zero when the system is operating.			
	f.	Also the fresh air requirements must be maintained under minimum flow conditions.			
	g.	It should be noted that simple VAV systems sometimes cannot meet these requirements during the heating season, particularly in colder climates.			
	h.	To maintain air circulation it may be necessary to raise the air supply temperature by resetting the discharge temperature of the cooling coil or heating at the central unit or at terminal units.			
	i.	A recommended alternative is the use of individual recirculating fans in each zone that blend room air with supply air to maintain minimum air circulation.			
	j.	Fans at the terminal unit increase noise levels in the space but provide for greater air recirculation and more stable space temperature control.			
	k.	Of the two types available, parallel fans are preferred over series fans.			
	l.	In VAV systems, the fans will remain shut down in the morning as long as the room temperature stays below the cooling set-point.			
	m.	This results in unacceptable temperatures and/or stagnant air during the first hour of occupancy.			
	n.	To counteract this problem, fan controls should be designed to run full speed for a warm-up period prior to occupancy.			
	o.	Systems should also be designed so the full air volume is supplied during morning warm-up in the heating season.			
	p.	In buildings where simultaneous heating and cooling are required (heating in some zones and cooling in others), two separate systems may be considered.			
4.	Terminals.				
	a.	VAV terminals should be pressure dependent unless there is a compelling reason to use pressure independent units.			
	b.	Terminal ceiling diffusers or booted-plenum slots should be specifically designed for VAV air distribution.			
	c.	Booted plenum slots should not exceed 4 feet in length unless more than one source of supply is provided.			
	d.	“Dumping” action is reduced air volume and sound power levels at maximum CFM delivery should be minimal.			
5.	Noise Control in VAV Systems.				
	a.	System sound levels need to be checked at maximum flow.			
	b.	Variable speed drive assembly or in flight vane pitch actuator shall be utilized on all VAV air handlers to modulate fan speed and thus volume of supply air to the space with positive duct static pressure control.			
	c.	Duct noise control shall be limited to NC of 40 within the open ceiling plenum and attenuation be achieved by controlling air velocity and by the use of sound attenuates.			
	d.	Comply with Table 3 which shows recommended duct velocities downstream from terminal unit based on noise generation as the controlling factor.			

Table 3 - Low Pressure Recommended Duct Velocities	
Application	Controlling Factor Noise Generation (Main duct Velocities - fpm)

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

Private Offices, Conference Rooms, Libraries	1,200
Theaters, Auditoriums	800
General Offices	1,500
Cafeterias	1,800
Main. Med. PSI Duct	<3,000

C.	Air Handing Units:			
1.	General			
a.	The air handling units described here consist of mixing boxes, filters, fans and heating and/or cooling coils.			
b.	Air handling units shall be factory fabricated in accordance with Figure M-4 horizontal draw-through air handling unit.			
2.	Unit Types.			
a.	The blow-through unit design allows air to be drawn through the filter section and blown through the heating an cooling coils into the supply duct.			
b.	This type of air handler is used for dual duct systems with hot and cold deck air flows supplied by common fan housing.			
c.	Draw-through units consume less fan energy and provide positive control of pressure in the main duct distribution system.			
d.	VAV system air handling shall be draw-through type in base option energy analysis.			
e.	A separate return air fan with VAV tracking control shall be specified in the base option for each air handling system for smoke exhaust system integration.			
3.	Horizontal Arrangement Air Handlers.			
a.	Horizontal units occupy more floor space than vertical air handling units.			
b.	Air flow through the coils is more uniform because the air does not have t turn before it enters the coil.			
c.	Discharge arrangements allow lower duct losses since elbows after the fan discharge can be located farther downstream.			
d.	A preference is given to horizontal draw-through arrangement air handling equipment for this project.			
4.	Air Delivery Capacity.			
a.	Recommended air delivery capacity is 26,000 CFM per air handling unit, with 52,000 CFM being the maximum.			
b.	This recommendation is based on examining operational flexibility for systems and tenants and minimizing energy use during after-hour operation.			
c.	Units should be sized to serve no more than one smoke zone or fire protection area per floor.			
d.	Casings and coils of air handling units should be sized so that the volume capacity can be increased in the future 20 percent by replacing the fan.			
e.	Initial fan selection, however, should be governed optimum efficiency for performance.			
f.	Outdoor air intake shall be sized for at least 80% volume for 80/20 economizer systems.			
5.	Return Air or Exhaust Fan.			
a.	Discussion			
1)	It regulates pressure in the air handling unit, particularly with economizer cycle operation.			
2)	Return air fans can also be used for negative pressurization as well as smoke exhaust.			
3)	They are recommended for all air systems with smoke exhaust integration control with the BAS.			
4)	The return fan should be sized at less CFM than the supply fan to maintain a slightly positive pressure in the building.			
5)	In high-rise buildings a static pressure regulator should be considered for the air return to counteract the stack effect.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
			6) This type of fan should be a vane axial fan equipped with variable speed controller for integration with building smoke exhaust systems.			
		b.	Systems Installed:			
			1) This building has return fans? If not, describe in comments.			
			2) Return fans are centrifugal? If not, describe in comments.			
	6.	Mixing Boxes.				
		a.	Mixing dampers should be placed across the full width of the air handling unit.			
		b.	Thorough mixing of outdoor and return air is essential for good coil performance and to prevent chilled water coils from freezing.			
		c.	Provide blender.			
	7.	Filtration.				
		a.	Air filtration should be provided in every air handling system.			
		b.	Each air handling unit should have a disposable pre-filter and a final filter.			
		c.	Filter media should be rated in accordance with ASHRAE 82.			
		d.	Pre-filters should be 30 percent to 35 percent efficient.			
		e.	Final filters should be 80 percent to 85 percent efficient and housed in a factory-fabricated frame with a maximum bypass leakage of 0.5 percent.			
		f.	Filters should be sized at 500 FPM maximum.			
		g.	Filter media shall be fabricated so that fibrous shedding does not exceed levels prescribed by ASHRAE 52.			
		h.	The filter housing shall not be lined with fibrous insulation.			
		i.	Double wall or an externally insulated sheet metal housing is acceptable.			
		j.	The filter change-out pressure drop must be used in determining fan pressure requirements.			
		k.	Differential pressure gauges should be placed across filter banks to allow quick and accurate assessment of filter dust loading as reflected by air pressure loss through the filter and the differential pressure sensor shall allow for digital control sensing of filter replacement for preventative maintenance programming in the BAS.			
	8.	Cooling Coils.				
		a.	The preferred configuration consists of no more than six row coil with eight fins per inch, which allows for easy coil cleaning.			
		b.	If higher cooling performance is required, a second cooling coil should be installed, leaving a clear distance of 3 feet between coils.			
		c.	The two coils can be piped in parallel configuration for optimum cooling performance in zones where humidity control is required.			
	9.	Heating Coils.				
		a.	As with cooling coils, heating coils with no more than eight fins per inch are preferred.			
	10.	Humidification.				
		a.	Humidification should be limited to building areas requiring special conditions.			
		b.	General office space shall not be humidified where sever winter conditions are likely to cause indoor humidity to rise above 25 percent.			
		c.	Where humidification is necessary, atomized hot water, steam or ultrasound may be used.			
		d.	Systems using electrical resistance heat are discouraged.			
		e.	Humidifiers should be centered on the air stream to prevent stratification of the moist air.			
		f.	Where humidification is provided, vapor barriers should be provided and the dew point of walls and windows must be documented.			
	11.	Supply Air Fans.				
		a.	Discussion			
			1) Vane-axial fans are efficient but are more costly than centrifugal fans.			
			2) Vane-axial fans are efficient but are more costly than centrifugal fans.			
			3) In-flight, vane pitch control actuation is very popular and minimizes duct noise and maintenance.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
4) Fans should be selected on the basis of horsepower as well as sound power level ratings at full load and at part load conditions, including variable speed application.			
5) Recommended selection of van-axial fans should be considered with in-flight pitch controller for duct static pressure control with a follower signal to vary-speed drive controller of return fan for smoke exhaust system integration.			
6) Since fan sound power level increases as an exponent of static pressure, it is essential that the total system static pressure be kept small.			
7) Fan motors should be sized so they do not run at overload anywhere on their operation curve.			
8) Fan operating characteristics must be checked for the entire range of flow conditions, particularly for forward curved fans.			
b. Systems Installed:			
1) This building has Centrifugal supply fans? If not, describe in comments.			
12. Noise Control in Air Handling Unit.			
a. Though variable-speed drives are the most costly, they are the most energy efficient at part-loading conditions and contribute the least to system noise level if they modulate fan speed within manufacturer's performance limitations.			
b. Variable blade pitch control is slightly noisier than variable speed drives but significantly less noisy than variable inlet vanes, particularly in low frequency bands.			
c. Though either option is available to the engineer to provide the most cost effective and noise free solution, variable-speed drives are recommended.			
13. Air-side Economizer Cycle.			
a. An air-side economizer cycle reduces cooling costs when outdoor air temperatures are below a preset high temperature limit, usually 60oF to 70oF, depending on the humidity of the outside air.			
b. Enthalpy economizer controls are recommended because they re-calibrate easily and may save energy.			
c. Economizer cycles should not be used for humidified spaces due to moist climate conditions.			
d. If economizer cycles are used in conjunction with heat reclaim chillers, care must be taken in the controls design to avoid having one concept defeat the effectiveness of the other.			
e. If an economizer cycle is used with the cold deck of a dual duct system, temperature set points may need to be adjusted downward.			
14. Computer Room Air Handling.			
a. Recommendation for Large Rooms			
1) In large computer installations it is recommended to segregate cooling of the sensible load (computer load) and control of ventilation and relative humidity by using two separate air handling units.			
2) This unit is regulated by a room thermostat.			
3) The second unit provides the required number of air changes and humidifies in response to a humidistat.			
4) The scheme avoids the common problem of simultaneously humidifying and dehumidifying the air.			
b. Recommendation for Smaller Rooms			
1) Single unit(s) with dehumidification and humidification capability.			
D. Ductwork:			
1. Ductwork shall be designed in accordance with ASHRAE: Handbook of Fundamentals, Chapter 33, and constructed in accordance with ASHRAE: HVAC Equipment, Chapter 1.			
2. Generally, Ductwork with the lowest possible aspect ratio and the fewest transitions will result in the lowest construction cost.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
3. Insulated double wall flat oval duct is recommended for VAV supply, but rectangular is acceptable.			
4. Extreme aspect ratios may also increase the fan power required.			
5. Maximum aspect ratio of low-pressure return duct is 4 to 1 for rectangular shape.			
E. Supply and Return Ductwork:			
1. Ductwork Pressure.			
a. Comply with Table 4 which illustrates recommended maximum air velocities for Ductwork up to 4 inches W.G. and minimum velocities for Ductwork of pressure ratings above 3 inches W.G.			
1) Note: The stated static pressures do not include the fan static pressure.			

Table 4 - Ductwork Classification		
Static Pressure	Air Velocity	Duct Class
0.5 in W.G.	2000 FPM DN Dual Duct	Low Pressure
1.0 in W.G.	2500 FPM DN Dual Duct	Low Pressure
2.0 in W.G.	2500 FPM DN Dual Duct	Low Pressure
3.0 in W.G.	4000 FPM DN VAV	Medium Pressure[1]
+4.0 in W.G.	2000 FPM DN VAV	Medium Pressure[1]
+6.0 in W.G.	2000 FPM DN VAV	Medium Pressure[1]
+10.0 in W.G.	2000 FPM DN VAV	High Pressure
[1]Spiral or flat oval		

b. Pressure loss in ductwork should be minimized.			
c. This can be accomplished by using smooth transitions and elbows with a 5-gore radius of at least 1-1/2 times the radius of the duct.			
d. Where mitered elbows have to be used, double thickness airflow turning vanes to be provided.			
e. Mitered elbows are not permitted where duct velocity exceeds 2500 FPM.			
f. Supply and return air ducts should be designed to allow no more than 3 percent leakage of total airflow in systems up to 3 inches W.G. in systems from 3.1 inches W.G through 10.0 inches W.G. ducts should be designed to limit leakage to 0.5 percent of the total airflow.			
2. Sizing of Ductwork.			
a. Supply Ductwork should be sized using the static pressure regain method, while return duct can be designed using the equal friction method.			
b. The static pressure regain method saves energy and ensures a relatively stable entering static pressure at the terminals in VAV systems.			
c. Duct pressurization control shall be energized VAV inflight pitch algorithm.			
d. Ductwork should be sized to permit a reasonable amount of relocation of air diffusers in the future.			
e. In buildings with large areas of open plan office space system, airflow diversity shall be sizing criterion.			
f. Full diversity can be taken at the air handling unit and the factor decreased the farther the Ductwork is from the source until no air flow diversity is taken into account.			
3. Ductwork Construction.			
a. Generally, Ductwork should be fabricated from galvanized sheet metal.			
b. Flex duct may be used for low pressure Ductwork downstream of the terminal box in office spaces.			
c. The length of the flex duct should not exceed the distance between the terminal box and the diffuser plus 20 percent to permit relocation of diffusers in the future while minimizing replacement of Ductwork.			
d. Flex duct runs to not exceed 8 feet nor contain more than two bends.			
e. Joint sealing tape for all connections must be of reinforced fiberglass backing material with field-applied mastic.			
f. Pressure sensitive tape to not be used as the primary sealant.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
	4.	Insulation.				
		a.	All supply ducts must b insulated, in accordance with ASHRAE Standard 90.1.			
	5.	Ceiling Plenum Supply.				
		a.	Plenum supply does not permit adequate control of and cleanliness of supply air and shall not be used.			
	6.	Plenum and Ducted Returns.				
		a.	A plenum return is a very attractive option in office space because it facilitates future reorganization of the space considerably.			
		b.	With a return plenum, care must be taken to ensure that the air drawn through the most remote register actually reaches the air-handling unit.			
		c.	The horizontal distance from the farthest point in the plenum to a return duct should not exceed 150 feet.			
		d.	No more than 3,000 CFM should be collected at any one return grille.			
		e.	All return risers must be ducted.			
	7.	Noise Control.				
		a.	The generation of noise at duct fittings on low-velocity under 2,000 FPM systems is usually not critical.			
		b.	However, a doubling of velocity increases the sound power level of fittings by approximately 15 dB.			
		c.	In high-velocity systems, fittings can become a significant noise source.			
		d.	High-velocity systems should avoid components such as mitered elbows, conventional and acoustical turning vanes, bullhead tees, balancing dampers and splitters.			
		e.	Air-foil UL rated smoke dampers shall be used instead of in stream fire dampers.			
		f.	Connections between central fans and supply ducts should be with fireproof fiber cloth sleeves without offset between fan outlet and duct.			
F.	Exhaust Duct Systems:					
	1.	All exhaust Ductwork should comply with the duct leakage provisions stated above for supply and return air.				
	2.	No exhaust duct shall exist in the building, which is under positive pressure.				
	3.	Kitchen exhaust duct systems: must comply with the building code and NFPA 96.				
		a.	Exhaust Ductwork should be of welded stainless steel construction.			
		b.	Ducts must be provided with drains at low points.			
		c.	For large kitchen hoods, auxiliary air intakes, which supply outside air directly to the hood, should be considered.			
	4.	For areas of negative pressurization control, variable speed drives and reference pressure datum controls shall be included in the design requirements for each fan.				
	5.	Smoke exhaust system mode shall be preprogrammed, digitally controlled remote function for these units.				
5.11	**SPECIAL SYSTEMS**					
A.	Heat Recovery:					
	1.	Discussion				
		a.	Heat recovery utilizes heat generated by internal loads or mechanical equipment within a building to the fullest extent possible before rejecting it.			
		b.	Heat Reclaim Chillers.			
			1) Heat recovery chillers should be considered for buildings that will require cooling year round.			
			2) If used in conjunction with airside economizer cycles, a careful controls design is required to prevent the two strategies form working against each other.			
	2.	Systems Installed:				
		a.	This building has heat recovery systems? If so, describe in Comments section.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
B.	Thermal Storage:					
	1.	Discussion				
		a.	Thermal storage systems use off-peak manufactured ice to produce chilled water rather than running chillers on demand.			
		b.	Their major advantage lies in the ability to control time of day electrical demand.			
		c.	Thermal storage should be considered on all building projects with large cooling loads.			
		d.	It can be an important operating cost consideration if the power company employs demand charges, ratchet clauses and/or time of use charges.			
		e.	With thermal storage, refrigeration machinery can be run at the time the lowest electrical rates are in effect.			
		f.	With refrigeration running at night and fans and pumps during the day, power usage is evened out.			
		g.	In the evaluation of this cooling option, a detailed comparison of rate structures is in order.			
		h.	Thermal storage also provides flexibility for the future as rate structures change.			
		i.	Some power companies will pay for an engineering feasibility study of thermal storage in an effort to encourage demand side management of large customers.			
		j.	Thermal storage systems also have operational advantages.			
		k.	The refrigeration equipment in thermal storage systems can operate at full load conditions most of the time, rendering it more efficient than conventional chillers. In addition, since the system typically operates at night, when outdoor air temperatures are cooler, condenser heat rejection in improved.			
		l.	Thermal storage permits use of smaller, less costly refrigeration compressors, whose reduced electrical load can result in lower-cost power distribution system. In addition, when ice is used as the storage medium, lower supply water temperature and a large temperature differential cab be employed.			
		m.	Although low temperature air distribution is sometimes used in conjunction with thermal storage, the impact on room air distribution may be a problem. This can be overcome with face and bypass air handling units or fan powered VAV boxes.			
		n.	In most buildings, conventional cooling considered a nonessential load and, thus, is not connected to standby power generation equipment. The relatively small on-peak load imposed by the fans and pumps of a thermal storage system storage may make it possible to connect critical areas to emergency power, which would ensure continued cooling during power outages.			
	2.	Systems Installed:				
		a.	This building has thermal storage systems? If so, describe in Comments section.			
5.12	**PLUMBING SYSTEMS**					
A.	Storm water Drainage System:					
	1.	Storm water drainage should be designed as a system separate from the sanitary sewer throughout the building and the site.				
B.	Sanitary Sewer System:					
	1.	Automatic Sewerage Ejectors				
		a.	Sewage ejectors to only be used where gravity drainage is not possible			
		b.	When they are required, only the lowers floors of the building should be			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
			connected to the sewage ejector; fixtures on the upper floors should use gravity flow to the public sewer.			
		c.	Sewage ejectors should be non-clog, screen less duplex pumps, with each discharge not less than 4 inches in diameter			
	2.	They should be connected to the emergency power system.				
C.	Domestic Water:					
	1.	Pressure Reducing Valves				
		a.	Pressure reducing valves to be installed where water pressure exceeds 70 PSI			
		b.	A valved by-pass should be provided			
		c.	Booster pump for domestic cold water service to a multi-story building shall be provided for			
		d.	A minimum of 3 parallel multiple capacity pumps with alternate duty cycle controls and high-pressure limit shall be provided in design activity.			
	2.	Exterior Wall and Yard Hydrants				
		a.	Unless the site is provided with a sprinkler system for landscape watering, wall and yard hydrants should be provided			
		b.	They should be located so every area can be reached with a 100-foot hose			
		c.	The hose should not have to cross the walkway to the building entrance			
		d.	Yard hydrants must be freeze proof and drainable			
		e.	Each wall and yard hydrant should be equipped with a vacuum breaker.			
D.	Domestic Hot Water:					
	1.	General				
		a.	Both hot and cold water should be supplied to lavatories			
		b.	Single temperature faucets are not permitted at lavatories			
		c.	Hot water taps should maintain water temperature at not less than 140°F to prevent bacterial growth unless some other technique is used for this purpose.			
		d.	Kitchen equipment should be supplied with high temperature water (180°F) from a separate heating system.			
	2.	Hot Water Heating				
		a.	Rejected heat should be used to preheat domestic hot water systems wherever feasible.			
		b.	Instantaneous type heaters are not recommended because of the difficulty of adequate temperature control.			
		c.	With indirect systems, careful attention must be given to the potential of leaks from the heat exchangers into the domestic hot water			
		d.	Double-wall vented tubing is recommended			
		e.	Water heaters should be sized in accordance with Michigan Department of Public Health 1996 standards.			
	3.	Recirculation				
		a.	Recirculation piping shall be provided for all hot water systems.			
		b.	A check valve should be provided in the main return to prevent temporary reversal of flow.			
E.	Plumbing fixtures:					
	1.	General				
		a.	Plumbing fixtures shall be commercial grade based on American Standard or Kohler			
		b.	Water conserving fixtures should be used.			
		c.	Fixtures designated for use by the handicapped must comply with the requirements of Federal Standard 795: Uniform Federal Accessibility Standards and the requirements of the Title III Standards for the Americans with Disabilities Act.			
	2.	Drinking Fountains				
		a.	Drinking fountains should supply 55°F water, either from standard packaged electric water coolers or from a central supply			
		b.	The use of CFCs for refrigeration is not permitted.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

						Yes	No	N/A
F.	Natural Gas Systems:							
	1.	Service Entrance						
		a.	Gas piping entering the building must be protected from accidental damage by vehicles, foundation settlement or vibration					
		b.	Where practical, the entrance should be above grade and provided with a self-tightening swing joint prior to entering the building					
		c.	All gas piping shall be low-pressure (<7"WC) service within occupied areas.					
	2.	Gas Piping within Building Spaces						
		a.	Gas should not be piped through confined paces, such as trenches or ventilated shafts.					
		b.	All spaces containing gas-fired equipment, such as boilers, chillers and generators, should be mechanically ventilated					
		c.	Vertical shafts carrying gas piping should be ventilated at top and bottom to prevent leaked gas from accumulating.					
5.13	**PUMPING SYSTEMS**							
A.	Hydraulic, Closed Loop systems:							
	1.	General						
		a.	Closed piping systems are unaffected by static pressure, therefore pumping is required only to overcome dynamic friction.					
		b.	Pumps used in closed loop hydronic piping should be designed to operate to the left of the peak efficiency point on their curves (high head, less flow) - This compensates for variances in pressure drop between calculated and actual valves without causing pump overloading.					
		c.	Do not use pumps with steep curves due to limiting of system flow rates.					
	2.	Variable Flow Pumping						
		a.	General					
			1)	Variable flows occur when control valves are used to modulate heat transfer				
			2)	The components if a variable volume pumping system include pumps, distribution piping, control valves and terminal units, and will also include boilers and chillers unless a primary secondary arrangement is used				
			3)	All components of the system are subject to variable flow rates				
			4)	It is important to provide a sufficient pressure differential across every circuit to allow design flow capacity at any time.				
			5)	Variable flow pumping must be designed carefully. Package systems should be used, with pumps and controls supplied by the same manufacturer.				
			6)	Chillers and boilers may experience flow related heat exchange problems if flow not maintained above a minimum rate.				
		b.	Flow may be varied by variable speed pumps or staged multiple pumps.					
		c.	Pumps to operate at no less than 75 % efficient for their performance curve.					
		d.	If minimum flows are required, use separate, constant flow primary water pumps, and variable flow secondary systems.					
	3.	Primary/Secondary Pumping						
		a.	In this application, primary and secondary circuits are separate, with neither having an effect on the pumping head of the other. The primary circuit usually serves the source equipment (chiller or boiler,) while the secondary circuit serves the load.					
		b.	It is easier to control flows in the secondary circuit because the pressure differential across control valves is a larger percentage of the pump head requirements which is comparable to a primary pump system arrangement, On the primary side it is possible to tie the system into a campus distribution loop.					
		c.	Primary/Secondary systems are recommended for larger buildings.					
5.14	**PIPING SYSTEMS**							
A.	All Piping systems should be designed in accordance with ASHRAE handbook of							

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
	Fundamental and the ASHRAE Handbook on HVAC equipment, Chapter 34					
B.	Cathodic Protection					
	1.	Need for metal protection for underground piping must be evaluated by sold resistivity test as described in the Geotechincal Report.				
	2.	As required, provide cathodic protection or other means of preventing pipe corrosion.				
C.	Piping Material					
	1.	Comply with Table 5 regarding commercial standards to be used for piping material.				
D.	Isolation of Piping at Equipment					
	1.	Isolation valves, shut off valves, by-pass circuits and unions should be provided as necessary for piping at equipment to facilitate equipment repair and replacement				
	2.	Equipment requiring isolation includes boilers, chillers, pumps, coils, terminal units and heat exchangers				
	3.	Valves should also be provided for zones off vertical risers.				
E.	Piping System Identification					
	1.	All pipes in mechanical rooms, shafts, ceilings, and other spaces accessible to maintenance personnel must be identified with color-coded bands indication type of material piped and direction of flow				
	2.	Gas piping and sprinkler lines must be identified as prescribed by NFPA.				
	3.	Valves and other operable fittings must be tagged.				
5.15	**VIBRATION ISOLATION, ACOUSTICAL ISOLATION AND SEISMIC DESIGN FOR MECHANICAL SYSTEMS**					
A.	Noise and vibration Isolation:					
	1.	General				
		a.	Isolate all moving equipment in the building under dynamic loading			
		b.	Flexible connections for piping / ductwork equipment terminations shall be used.			
	2.	Mechanical Room Isolation				
		a.	Floating isolation floors shall be provided for major mechanical rooms located in penthouses or at intermediate levels in mid-rise and high-rise construction.			
	3.	Mechanical Chases				
		a.	Mechanical chases should be closed at top and bottom, as well as the entrance to the mechanical room			
		b.	Any piping and ductwork should be isolated as it enters the shaft to prevent propagation of vibration to the building structure			
		c.	All openings for ducts and piping must be sealed, except that shafts dedicated to gas piping must be ventilated.			
	4.	Isolators				
		a.	Isolators should be specified by type / deflection, not by isolation efficiency			
		b.	See ASHRAE Guide for Selection of Vibration Isolators for types and minimum deflections			
		c.	Specifications should be worded so that isolation performance becomes the responsibility of the equipment supplier.			
	5.	Concrete inertia Bases				
		a.	Inertia bases should be provided for reciprocation and centrifugal chillers, air compressors, all pumps, axial fans above 800 RPM and centrifugal or vaneaxial fans above 25HP.			
	6.	Ductwork				
		a.	Reduce fan vibrations immediately outside any mechanical room wall by acoustically coating or wrapping the duct.			
	7.	Piping Hangers and Isolation				
		a.	Isolation hangers to be used for all piping in mechanical rooms and adjacent spaces, up to 12-foot distance from vibrating equipment			
		b.	The pipe hangers closest to the equipment to have the same deflection characteristics as the equipment isolators.			
		c.	Positioning hangers to be specified for all piping 8 inches and larger .			
		d.	Spring and rubber isolators are recommended for piping 2 inches and larger			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
hung below noise sensitive spaces.			
e. Floor supports for piping may be designed with spring or rubber pad mounts			
f. For pipes subject to large amounts of thermal movement, plates of Teflon or graphite to be installed above the isolator to permit horizontal sliding.			
g. Anchors and guides for vertical pipe risers usually must be attached rigidly to the structure to control pipe movement			
h. Flexible connectors to be designed into the piping before it reaches the riser.			

Table 5 - Commercial Standards for Piping Material

Standard Piping Material	Use	Comments
ASTM Schedule 40	Chilled water up to 12 inch diameter Condenser water up to 12 inch diameter.	150 psi fittings. Standard weight pipe over 12 inch diameter.
	Hot Water	Test to 300 psig.
	Natural gas	Weld and test to 300 psig.
ASTM Schedule 80	Steam over 15 psig	Test to 500 psig
Copper tubing	Chilled water, Condenser water	Builders option. Use type K below ground and type L above.
	Domestic water	Lead free solder connections.
	Refrigeration	Type ACR.
Cast Iron	Sanitary, waste and vent	
PVC	Storm	Below grade only.

5.16	**LAYOUT OF MECHANICAL SPACES**			
A.	Vertical Clearances			
1.	Mechanical equipment rooms to have a clear ceiling of not less than 12 feet.			
2.	Catwalks to be provided for all equipment that cannot be maintained from floor level			
3.	Where maintenance requires the lifting of heavy parts (200 lb. or more), provide hoists.			
B.	Horizontal Clearances			
1.	Mechanical rooms to be laid out with clear aisles and access to all equipment.			
2.	Chillers to be placed to permit pulling of unit tubes (Clearance = tubes + 2'-0")			
3.	Air handling units to have a min. clearance of 2'-6" on all sides, except coil / filter sides.			
4.	The clearance on that side shall equal the length of the coil plus 2'-0".			
C.	Lighting to be laid out so as not to interfere with equipment.			
D.	Housekeeping pads to be 3 inches wider than mounted equipment on all sides.			
E.	Piping to be laid out to leave space between piping and structure.			
F.	Ductwork to be laid with minimum bends and to preserve piping access			
G.	Operation and Maintenance Manuals			
1.	Documentation on all the building systems shall be provided for the guidance of the building engineering staff			
2.	This should show the actual elements that have been installed, how they performed during testing, and how they operate as a system in the completed facility.			
3.	The building staff should be provided with the following:			
a.	Record drawings and specifications.			
b.	Operating manuals with a schematic diagram, sequence of operation and system operating criteria for each system installed.			
c.	Maintenance manuals with complete information for all major components in the facility.			
H.	Posted instructions			
1.	Posted operation instructions are required for manually operated mechanical systems			
2.	They must consist of simplified instructions and diagrams of equipment, controls, and operation of the systems, including boilers, refrigeration equipment, HVAC controls, hot and chilled water distribution and hot and cold domestic water.			
3.	Instructions to be framed and posed adjacent to the major equipment of the system.			
I.	Operating Instructions			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
	1.	Operating instructions should be provided for maintenance staff at the time of commissioning the mechanical systems				
	2.	The amount of instruction time provided should be commensurate with the complexity of each system.				
5.17	**CONTROL SYSTEMS**					
A.	Automatic Temperature and Humidity Controls:					
	1.	General				
		a.	Control Systems and strategies should be kept as simple as possible to minimize first cost, improve reliability and simplify operation of the systems			
		b.	More sophisticated control strategies which can be shown to save energy or reduce life cycle costs should be considered but only applied where not detrimental to the overall system reliability and maintainability.			
	2.	Controls				
		a.	Pre-programmed single or multiple loop PLC controllers should be used to control all HVAC and plumbing subsystems.			
	3.	Temperature Controls				
		a.	Heating and cooling energy in each zone should be controlled by a DDC thermostat located in that zone			
		b.	Independent perimeter systems must have at least one thermostat for each zone of the building.			
		c.	Heating and cooling to spaces should be sequenced and not necessarily provided simultaneously			
		d.	Use 2°F dead band between heating and cooling operations where applicable			
		e.	Night set-back controls for the heating season and for summer conditions must be provided for all comfort conditioned spaces, even if initial building occupancy plans are for 24-hour operation			
		f.	Morning warm-up must be part of the control system.			
B.	Temperature Reset Controls:					
	1.	Air Systems				
		a.	Systems supplying heated or cooled air to multiple zones must include controls that automatically reset supply air temperature by representative building loads or by outside air temperature			
		b.	Temperature should be reset by at least 10 percent of the design supply-air to room air temperature differential			
		c.	Zones that are expected to experience relatively constant loads, such as interior zones, may be designed for the fully reset supply temperature.			
	2.	Hydraulic Systems				
		a.	Systems supplying heated and/or chilled water to comfort conditioning systems to have supply water temperature reset by outside air temperature.			
C.	Testing And Balancing Equipment And Systems					
	1.	Testing Stations				
		a.	Permanent or temporary testing stations to be provided to permit testing of building systems. Connections should be designed so that temporary testing equipment can be installed and removed without shutting down the system.			
		b.	Airflow measuring grids are required for all central air handling units			
		c.	Measuring grids should be provided at the supply duct and the return duct			
		d.	Airflow measuring grids must be sized to give accurate readings at minimum flow. It may be necessary to reduce the duct size at the station to permit accurate measurement.			
		e.	Water flow measuring devices are required for each refrigeration machine and for chilled water lines serving computer rooms and outleased spaces.			
		f.	Provide water flow totaling devices at boiler / hot water lines to outleased spaces.			
	2.	Thermometers and Gauges				
		a.	Each measuring point should have instrumentation to verify capacities, temperatures, flow rates and any other critical parameters.			
		b.	Thermometers and [pressure gauges are required on the suction and discharge			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
			of pumps, chiller, boilers, heat exchangers, cooling coils, heating coils, and cooling towers.			
		c.	Duct static pressure gauges should be provided for the air supply fan or in individual duct runs, if multiple pressure measurement is used.			
		d.	Pressure gauges to be placed on both sides of filters in the air handling unit.			
		e.	A static pressure gauge to be provided to measure building pressure.			
		f.	An outdoor temperature gauge is required as well as enthalpy and zero pressure reference data.			
5.18	**BUILDING AUTOMATION SYSTEM (BAS)**					
A.	General					
	1.		The primary reason for using a Building Automation System (BAS) is the anticipated lower operating cost over the 100 year life of the building			
	2.		Programmable controllers direct building systems to minimize overall power and fuel consumption; monitor systems such as elevators, security controls and fire alarms; cycle equipment for preventative maintenance and maintain parts inventories			
	3.		The BAS to be integrated with the basic building controls system.			
	4.		A BAS is mandatory for the building.			
B.	Level of Integration					
	1.		It is possible to combine controls for practically all building systems – HVAC, lighting, emergency power and elevators – into a single-CPU operating unit. Since the advent of the microcomputer BAS systems, it has been tempting to integrate as many systems as possible to reduce hardware requirements.			
C.	Software					
	1.		All BAS systems come with preprogrammed software			
	2.		Programming shall use open end protocol and be easily made compatible with existing State property management BAS campus controls.			
D.	Energy Conservation					
	1.		The best targets for energy conservation in building systems are the HVAC system and the lighting system			
	2.		Provide HVAC programs including optimized duty cycles for chillers and boilers and feed-forward controls based on predicted weather patterns or histograms of building HVAC systems performance data.			
	3.		Provide Optimal start/stop which calculates the earliest time systems can be shut down prior to the end of occupancy hours and the latest time systems can start up in the morning minimizing equipment run time without letting space conditions drift outside comfort set points.			
	4.		Provide weather prediction programs that store historic weather data in the processor memory and use this information to anticipate peaks or part load conditions			
	5.		Programs to also run economizer cycles and heat recovery equipment.			
E.	Preventative Maintenance Scheduling					
	1.		Programs to be considered are those that switch pumps and compressors from operating equipment to stand-by on a scheduled basis			
	2.		Likewise, there are programs that provide maintenance schedules for equipment in every building system, including information on what parts and tools are needed to perform each task			
	3.		A preventative maintenance integrated into the BAS is required for this facility.			
F.	System Design Consideration					
	1.		Building automation systems measurements at key points in the building system and must be capable of part-load operation recognition and be capable of part-load operation recognition and be equipped with controls to match system capacity to load demands			
	2.		Controls cannot correct inadequate source equipment, poorly selected components, or mismatched systems			
	3.		Energy efficiency requires a design that is optimized by realistic prediction if loads, careful systems selection, an full control provisions.			
	4.		In new buildings, the BAS should have approximately 20 percent spare point capacity for future expansion			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	5.	The system must provide for stand-alone operation of subordinate components.			
	6.	No matter how sophisticated, the BAS systems must be easy to understand and manipulate by State Property Management maintenance staff.			
G.	Energy Measurement Instrumentation				
	1.	The capability to allow building staff to measure energy consumption and monitor perform and us critical to the overall success of the system			
	2.	Electrical values, such as V, A, KW, KVAR, KVA, PF, KWH, KVAH, Frequency and Percent TDH should be measured.			
5.19	**FIRE PROTECTION SYSTEMS**				
A.	See "FIRE PROTECTION SYSTEMS" Section.				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

MECHANICAL SYSTEMS DESIGN							COMMENTS
X.1	A.	1.	a.	1)	a)	Reference Key	

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
PART 6 - ELECTRICAL SYSTEMS DESIGN			
6.1 GENERAL APPROACH			

Electrical Systems:
Electrical and communications systems in State of Michigan buildings provide the infrastructure for an efficient work environment for the occupants:
These systems must support the many types of equipment used in a modern office setting in a reliable fashion.
Three *characteristics* distinguish *State Buildings*:
▫ *Longer life span*
▫ *Changing occupancies*
▫ Use of *life cycle cost approach* to determine *overall cost*
The *State* typically will *own buildings longer* and will *perform alterations* in an ongoing fashion. Accordingly, *Building Electrical Systems* must:
▫ Accommodate *periodic renovation* by using systems that:
- Have capacity for increased localized load increases
- Allow modifications to be made with minimum impact on surrounding areas.

6.2	**CODES AND STANDARDS**			
A.	Model codes and standards adopted by State of Michigan are governed by local building code.			
B.	All electrical systems must meet or exceed the requirements of the National Electric Code (NEC).			
C.	The standards listed below are intended as guidelines for design only, and are mandatory only where referenced as such in the text of the chapter (The list is not meant to restrict engineers from using additional guides or standards as desired):			
	1. Electronic Industries Association/Telecommunications Industry Association (EIA/TIA) Standard 569:			
	2. Commercial Building Standard for Telecommunication Pathways and Spaces.			
	3. Illuminating Engineering Society of North America (IES) Lighting Standards			
	4. Institute of Electrical and Electronic Engineers (IEEE) Standards.			
	5. Federal Information Processing Standard 5-91.			
	6. National Electrical Manufacturers' Association (NEMA) Standards.			
	7. Insulated Power Cable Engineers' Association (IPCEA) Standards.			
	8. Certified Ballast Manufacturers' Association (CBMA) Standards.			
	9. National Fire Protection Association (NFPA).			
	10. Rules and regulations of local utility companies.			
6.3	**PLACING ELECTRICAL SYSTEMS IN BUILDINGS**			
A.	General			
	1. In order to achieve system flexibility and thorough integration between building architecture and engineering systems, a concept for the distribution of electrical and communications systems must be established during the architectural schematic design.			
	2. The locations of vertical and horizontal elements of electrical and communications distribution equipment must be established before the architectural concept is finalized.			
B.	Electrical Closets.			
	1. Electrical and communications closets must be stacked vertically and located so that the length of branch circuitry does not exceed 100 feet.			
	2. Shallow, secondary closets off permanent corridors may be used for receptacle panel boards where the distance between the riser and the farthest workstation exceeds 100 feet and a separate riser is not warranted.			
	3. Electrical closets should be designed to contain adequate wall space and clearances.			
	4. Environmental cooling of these closets shall require heat gain value of 10 watts/ft^2.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
C.	Planning Grid, Floor Grid and Ceiling Grid.					
	1.	A common 2' x 2' planning module is to be used in all State of Michigan buildings.				
	2.	The relationship of this module to wall placement, ceiling grids and location of mechanical and electrical elements is a spatial standard.				
	3.	Electrical and communications elements in floors and ceilings – lights, power, telephone and data – are given approximate locations based upon a 2' x 2' plan gird.				
D.	Floor and Ceiling Grid					
	1.	The centerlines of walls and ceiling height partitions always fall on the planning grid.				
	2.	Under floor utilities – power, telephone and data – are always offset 50 percent of the grid line spacing.				
	3.	In all cases where raised access flooring is used, the pedestals of the access floor are offset from the planning grid by 3 inches in both directions.				
	4.	Horizontal Distribution of Power and Communications.				
		a.	In areas with access flooring, power circuits should be provided via conduit, modular wire distribution boxes and modular wire cable sets to flush floor receptacles.			
		b.	Communication cables can be laid exposed directly on the slab and grouped together in alternate rows 6 feet on center.			
		c.	Light switches should be located near columns and the walls of fixed core elements.			
		d.	Flat conductors, poke-through or power poles are not to be used in new construction.			
		e.	These criteria apply to all occupiable area or net usable space in a State of Michigan office building but not to public spaces or support spaces, which can be considered housing fixed elements and are not subject to frequent changes.			
	5.	Vertical Zoning of Floor-to-Floor Space.				
		a.	Floor and ceiling spaces must be laid out to provide distinct zones for the placement of different utilities.			
		b.	The floor zone, usually the space under a raised access floor, is reserved for power, telephone and data cabling.			
		c.	The ceiling space shall be layered, with the sprinkler-piping zone near the underside of the structure, or possibly through it, if steel joists are used, the HVAC duct zone in the middle and the lighting zone immediately above the ceiling level.			
		d.	The depth of the ceiling and floor space must be determined early in the design, in order to arrive at the floor-to-floor height of the building.			
		e.	It needs to be based on preliminary estimates of systems designs.			
		f.	Enough space must be left between the HVAC and lighting zones to accommodate future lighting moves and changes without moving other components.			
		g.	The under floor zone should be as deep as the sum of all the required crossovers plus 2 inches for leeway.			
		h.	The minimum total depth, including the 2-inch deep floor panels, is 10 inches.			
	6.	Vertical Distribution.				
		a.	Risers for normal power, emergency power and communications should be combined with other core elements to form compact groups and maximize usable floor space.			
		b.	The number and size of risers will depend on the systems chosen, but future flexibility should be an important criterion in the vertical layout as well.			
		c.	Electrical closets should have two capped spare sleeves through the structural floor for future flexibility.			
		d.	Communications closets should also have two capped spare sleeves in each closet.			
6.4	**GENERAL DESIGN CRITERIA**					
A.	Energy Conservation.					
	1.	Code requirements for energy conservation are per local building code.				
	2.	The largest factor in the energy consumption of a building is lighting.				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	3.	The overall efficiency of the lighting system depends both on the individual components and on the interaction of components in a system.			
	4.	A good controls strategy that eliminates lighting in unoccupied spaces and reduces it where day lighting is available can contribute significantly to energy conservation.			
B.		Equipment Grounding Conductor.			
	1.	All low voltage power distribution systems should be supplemented with a separate, green insulated equipment-grounding conductor.			
C.		Lightning Protection.			
	1.	Lightning protection should be evaluated in accordance with NFPA 78.			
	2.	Buildings in the "moderate to severe" category of exposure and higher should be equipped with a UL listed lightning protection system.			
	3.	The system should be carefully designed to ensure that static discharges are provided with an adequate path to ground.			
	4.	Surge arresters on the main electrical service should also be considered.			
D.		Cathodic Protection.			
	1.	The need for corrosion protection for conduits and for all other underground piping and buried metals on the project must be evaluated through soil resistivity and pH testing.			
	2.	Testing for soils resistivity shall be part of the Geotechnical Report.			
E.		Operations and Maintenance Considerations.			
	1.	Generally, State office buildings are open for operation from 8:00 a.m. until 5:00 p.m. Monday through Friday, except for holidays.			
	2.	In isolated cases, buildings or parts of buildings may need to operate on 24-hour schedules.			
	3.	Operating conditions will have a large impact on the choice of the BAS and on equipment maintenance considerations.			
	4.	The engineer is encouraged, therefore, to evaluate the planned maintenance provisions for this project.			
6.5		**ELECTRICAL LOAD ANALYSIS**			
A.		General			
	1.	In establishing electrical loads for State of Michigan buildings it is important to look beyond the immediate requirements state in the project program.			
	2.	Even if floor layout remains unchanged, equipment loads may become denser.			
	3.	Future moves and changes have the effect of redistributing electrical loads.			
	4.	The minimum connected receptacle loads multiplied by appropriate demand factors, and with spare capacity added, should be used for obtaining the overall electrical load of the building.			
B.		Standards for Sizing Equipment and Systems.			
	1.	To ensure maximum flexibility for future systems changes, the electrical system must be sized as follows: secondary distribution panel boards for branch circuits must be sized with 50 percent spare capacity, main distribution panels and main switchgear with 25 percent spare capacity.			
	2.	All panel boards shall be 42-circuit minimum with 6 spare minimum and all breakers shall be bolt on type, 115% load rated, and 600 volt with isolated ground bus as required.			
6.6		**UTILITY COORDINATION**			
A.		Power Company Coordination.			
	1.	Shall be standards of Consumers Power or per Lansing Board of Water and Light.			
	2.	Utility requirements based upon site location.			
	3.	Electrical load estimates need to be prepared in conjunction with utility company discussions to establish the capacity of the new electrical services.			
	4.	The service entrance location for commercial electrical power should be determined concurrently with the development of conceptual design.			
	5.	Space planning documents and standards for equipment finished by utility companies should be incorporated into the concept design.			
	6.	Locations for transformers, vaults, meters and other utility items must be coordinated with the landscape design to avoid long secondary utility runs or detraction from the building's appearance.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	7.	The main building electrical service method can vary, depending on a number of factors (building size, local utility capabilities, etc.):			
		a. The utility company furnishes power at the main utilization voltage, as 480Y/277V, 3/phase, and 4 wire service.			
		b. State of Michigan purchases primary power and owns and maintains primary transformers.			
		1) Single-ended substation.			
		2) Double-ended substation with automatic transfer switch.			
	8.	In the case of large buildings or buildings with large footprints, it may be necessary to have more than one service.			
	9.	In large office buildings and in campus situations, it may also be necessary to distribute medium voltage power.			
B.	Communications.				
	1.	All communications systems within the building are designed, installed and operated under the State of Michigan Property Management.			
	2.	The engineers involved in the building design must coordinate their work with them as well as with the telecommunications vendor or telephone company.			
6.7	**SITE POWER DISTRIBUTION**				
A.	General				
	1.	Exterior distribution systems shall be direct buried conduit.			
	2.	Cable route selection should be based on all aspects of cable operation and the installation environment, ambient heat, pulling tensions and potential mechanical abuse.			
B.	Direct Buried Conduit.				
	1.	Direct buried PVC, coated intermediate metallic conduit (IMC) or rigid galvanized steel (RGS) is appropriate for the distribution of branch circuits.			
	2.	Direct buried cable shall not be used.			
	3.	Buried BUS duct rated for outdoor usage shall not be used.			
	4.	Conduit routes should be selected to balance maximum flexibility with minimum cost and to avoid foundations of other buildings and other structures.			
	5.	Conduit should be provided with a cover of at least 18 inches. Routes under roads should be encased or sleeved.			
	6.	Stub-ups into electrical equipment may be installed with manufactured elbows.			
	7.	Where it is necessary to run communication cables along-side power conduit, two separate systems must be provided with separate manhole compartments.			
	8.	The same holds true for normal and emergency power cables.			
	9.	Combined conduits in parallel path should be spaced at least 18 inches apart.			
	10.	Electrical and communication conduit to be kept clear of all other underground utilities.			
C.	Manholes.				
	1.	Manholes / access ports to be spaced no farther than 500 feet apart for straight runs.			
	2.	The distance between the service entrance and first manhole not to exceed 100 feet.			
	3.	Double manholes or access ports should be used where electric power and communication lines follow the same route. Separate manholes should be provided for low and medium voltage systems.			
	4.	Manholes should have clear interior dimensions of no less than 6 feet in depth, 6 feet in length, and 6 feet in width with an access opening at the top of not less than 30 inches in diameter.			
	5.	Smaller manholes or access port may be used for low voltage feeders, branch circuits or communications circuits.			
	6.	They should be not less than 4 feet in depth, 4 feet in length, and 4 feet in width with a standard manhole cover and sump of the same type provided for manholes.			
	7.	Generally, at least four racks should be installed.			
	8.	Where more than two splices occur, a manhole may be more appropriate.			
	9.	Where splicing or pulling of low-voltage or communication cables requires an access point, but the volume provided by a smaller manhole is unnecessary, pullboxes may be more suitable for the installation.			
6.8	**PRIMARY DISTRIBUTION**				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
A.	General				
	1.	The selection of a primary distribution system, i.e., radial, loop, primary selective, secondary selective, network, etc., should be evaluated on a case by case basis, with consideration given first to safety, then to longevity, cost and reliability.			
	2.	Generally, radial or loop systems are preferred, due to double ended service feed for primary power.			
	3.	The primary distribution system design should be based on the estimated demand load plus 25 percent spare capacity.			
B.	Medium Voltage Switchgear.				
	1.	When required, medium voltage service switchgear may be provided with air, vacuum or SF5 circuit breakers or fused air interrupter switches.			
	2.	Provide voltmeter, ammeter and watt-hour meter with demand register.			
	3.	Meters should be pulse type for connection to the Building Automation System.			
C.	Conductors.				
	1.	Conductors should be insulated with cross-linked polyethylene (XLP) or ethylene propylene rubber (EPR).			
	2.	133 percent insulation should be provided.			
	3.	Conductor size should not exceed 500 MCM.			
D.	Transformers.				
	1.	Substation transformers may be dry type with epoxy resin cast coils.			
	2.	Liquid filled transformers free of PCBs may be used.			
	3.	Substations should be located at least 100 feet from communications frame equipment to avoid radio frequency interference.			
	4.	Provide lightning arresters o the primary side of all transformers.			
	5.	Consider surge suppression on the secondary and/or downstream busses.			
	6.	All main service transformers shall have copper windings.			
6.9	**SECONDARY DISTRIBUTION**				
A.	Main Switchboards.				
	1.	The 208V and 480V service switchboards as well as substation secondary switchboards should be provided with a single main service disconnect switch.			
	2.	The main switch shall be insulated case or power air circuit breaker, individually mounted, draw-out type.			
	3.	Insulated case and power air circuit breakers should be electrically operated.			
	4.	The meter section should contain a voltmeter, ammeter and watt-hour meter with demand register.			
	5.	Meters should be pulse type for connection to the Building Automation Systems.			
	6.	Feeder devices of switchboards 2,000 AMPS and larger shall be insulated case or power air circuit breakers, individually mounted, draw-out type and electrically operated.			
	7.	Feeder devices of switchboards 2,000 AMPS and smaller may be group mounted, molded case circuit breakers.			
	8.	Switchboards should be front and rear accessible.			
	9.	In smaller switchboards, front access only is acceptable if space is limited.			
	10.	Copper bus elements shall be used.			
B.	Grounding.				
	1.	Power distribution system grounding must be in accordance with Article 250 of the National Electrical Code.			
C.	Ground Sources.				
	1.	The ground source for the electrical power systems must have a maximum resistance to ground of 5 ohms.			
	2.	The grounding design must be based on a soils resistivity test and ground resistivity calculations.			
	3.	Below grade connections should be exothermically welded.			
	4.	A wall-mounted, ¼-inch by 2-inch copper ground bus should be provided in each electrical room housing medium voltage switchgear, motor control center or substations.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	5.	The ground bus should be located in the rear access aisle of the room and should extend at least 3 feet.			
	6.	It should be interconnected with the ground electrode and ground bus in the switchgear or switchboard.			
D.	Power Factor Correction.				
	1.	If the utility rate structure has a power factor penalty, non-PCB centralized automatic power factor capacitors shall be connected at the main electrical service on the load side of the utility metering.			
	2.	Power factor capacitors should be designed to automatically correct a lagging power factor to a value that will avoid penalty charges.			
	3.	Switching circuits shall be specifically designed to prevent electrical noise from entering the electrical power distribution system.			
E.	Motor Control Centers.				
	1.	Grouped motor controls shall be used where more than six starters are required in an equipment room.			
	2.	Motor control center construction shall be NEMA Class I, Type B with magnetic starters and either circuit breakers or fuses.			
	3.	Minimum starter size should be size 1 in motor control centers.			
	4.	Each starter shall have three overload relays.			
	5.	Control circuit voltage should be 120V connected ahead of each starter via control transformer as required.			
	6.	Copper BUS elements shall be used.			
	7.	In the design of motor control centers on emergency power, time delay relays should be considered to reduce starting KVA on the generator.			
F.	Elevator Power.				
	1.	Elevators should be powered from a shunt trip circuit breaker located in the elevator machine rooms.			
	2.	Electrical design standards in elevator standard ANSI A17.1 must be followed.			
	3.	Freight and passenger elevators shall meet all constraints for ANSI A17.2 Inspector's Manual for Elevators and Escalators and ANSI A117.1 – Buildings and Facilities/Providing Accessibility and Usability for Physically Handicapped people.			
G.	Secondary Distribution Systems				
	1.	Secondary electrical power distribution systems in the building are classified as normal, emergency and uninterruptable.			
		a. Normal power serves the general power and lighting loads in the building.			
		b. Emergency power is distributed to life safety and critical loads.			
		c. Uninterruptable power is required for critical loads that cannot be interrupted.			
	2.	Bus Duct.			
		a. Where plug-in bus duct is used, it should have an integral ground bus, sized at 50 percent of the phase bus to serve as the equipment-grounding conductor.			
		b. All copper BUS elements, 600 volt or larger shall be required.			
	3.	Conductors.			
		a. Copper conductors are required for motor windings, transformer windings, switchgear bussing, switchboard bussing and bus duct, where the conductor is purchased as part of the equipment.			
		b. Copper conductors shall be used for cables; primary and secondary branch circuits.			
	4.	Power Distribution Panels.			
		a. Power distribution panelboards shall be circuit breaker type.			
	5.	Lighting and Receptacle Panelboards.			
		a. Lighting and receptacle panelboards shall be circuit breaker type.			
		b. Lighting panel boards shall have 5 percent spare circuit breakers (minimum 3 – 20/1) plus 20 percent space (minimum 6 poles) for future circuit breakers.			
		c. Minimum 42 circuit breaker panel configuration.			
		d. Receptacle panelboards should have 10 percent spare circuit breakers (minimum 6 - 20/1) plus 15 percent space (minimum 6 poles).			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
			e. All power panels shall be capable of accepting a minimum of 42 single pole circuit breakers.			
	6.	Panelboards Serving Electronic Equipment.				
			a. Electronic equipment panelboards serving personal computers, computer terminals or dedicated workstations should have an isolated ground bus.			
			b. The service to the electronic panelboard should be supplied from an isolation transformer.			
			c. Equipment should be sized with consideration given to higher harmonic currents in the neutral wire.			
			d. For initial planning purposes, the number of receptacle circuits may be estimated by assuming 120 square feet per dual 20 amp circuits, one task light and on isolated ground circuit.			
6.10	**WIRING DEVICES**					
A.	General					
	1.	In State office buildings, general wiring devices must be specification grade.				
	2.	Emergency receptacles must be red.				
	3.	Isolated grounding receptacles must be orange.				
	4.	Special purpose receptacles must be brown.				
	5.	The color of standard receptacles and switches should be coordinated with the architectural color scheme.				
	6.	Building standard receptacle must be duplex, specification grade NEMA 5-20R.				
	7.	Special purpose receptacles should be provided as required.				
	8.	Device plates should be plastic, colored to match the receptacles.				
B.	Placement of Receptacles					
	1.	Corridors.				
			a. Receptacles in corridors should be located 50 feet on center and 25 feet from corridor ends.			
	2.	Office Space.				
			a. Receptacles for housekeeping shall be placed in exterior walls and walls around permanent cores or corridors.			
	3.	Raised Access Floor.				
			a. All wiring beneath a raised access floor should be routed in metal conduit or cable to underfloor distribution boxes.			
			b. Flush mounted access floor service boxes should be attached to the underfloor distribution boxes by means of a plug-in modular wiring system to facilitate easy relocation.			
	4.	Electrical and Communications Closets.				
			a. Electrical closets require one emergency power receptacle; communications closets require two.			
			b. Uninterruptable power is required in communications closets.			
			c. Main mechanical and electrical equipment rooms should each have one emergency power receptacle for uninterruptable service.			
6.11	**EMERGENCY POWER SYSTEMS**					
A.	General					
	1.	All facilities must have an emergency power system for life safety as required by code.				
	2.	It must be designed in accordance with local building code per 1972 P.A. 230 and NFPA 1 10, Emergency and Standby Power Systems.				
B.	Batteries:					
	1.	Fire alarm and security systems must be provided with individual battery back up, separate from the emergency generator or UPS.				
C.	Generator Systems:					
	1.	General				
			a. The system should consist of a central engine generator and a separate distribution system with automatic transfer switch, distribution panels, and 480V/277V lighting panels with dry-type transformers feeding 208V/120V power panels as required.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
2. Service Conditions.			
a. If the unit is to be installed outdoors, it should be provided with a walk-in enclosure and have provisions to ensure reliable starting in cold weather.			
b. Diesels are particularly susceptible to slow starting when cold; however, starting aids such as jacket-water heaters can be specified to improve reliable starting capability.			
c. When installed at high altitudes or in higher-than-rated ambient temperatures, the unit must be derated in accordance with manufacturers' recommendations.			
d. Operation of starting batteries and battery chargers must also be considered in sizing calculations.			
e. IN humid locations heaters can reduce moisture collection in the generator windings.			
f. Silencers are required for all generators.			
g. Acoustical treatment of the generator room should also be considered, if spatial location is in proximity of occupied areas.			
h. Generators should be located at least 100 feet from communications frame equipment to avoid radio frequency interference.			
i. Radiators should be unit mounted if possible.			
j. If ventilation is restricted in indoor applications, remote installation is acceptable.			
k. Heat recovery and load shedding shall not be considered.			
3. Capacity.			
a. The engine generator should be sized to approximately 110 percent of design load; ideally it should run at 50 percent to 80 percent of its rated capacity after the effect of the inrush current declines.			
b. When sizing the generator, consider the inrush current of the motors that are automatically started simultaneously.			
c. The initial voltage drop on generator output due to starting currents of loads must not exceed 15 percent.			
d. Generator must run at full load capacity for a 24-hour period and pass a 4-hour full load test prior to building occupancy.			
4. Emergency Power Leads.			
a. Emergency power should be provided for the following functions:			
1) Epm and exit lighting			
2) Fire alarm system			
3) Generator auxiliaries			
4) Smoke control systems			
5) Night lighting			
6) Telephone switch			
7) Security systems			
8) Mechanical control systems			
9) Building automation system			
10) Elevators (passenger only)			
11) Sump pumps			
12) Sewage ejector pumps			
13) Exhaust fans removing toxic, explosive or flammable fumes			
14) Uninterruptable power systems serving computer rooms			
15) Exhaust fan in UPS battery rooms			
16) Power and lighting for Fire Control Center and Security Control Center			
*NEC '96 requires direct power from double end substation in lieu of emergency generator power.			
5. Distribution System.			
a. The distribution system should be designed so that emergency and auxiliary power sources cannot backfeed energy into the de-energized normal voltage systems under normal, emergency or failure conditions.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	6.	Generator Derangement Alarms.			
		a. Generator derangement alarms must be provided I the generator room.			
		b. All malfunctions should be transmitted to the BAS.			
		c. In buildings without BAS, a generator alarm annunciator should be located in the lobby next to the fire alarm panel.			
	7.	Automatic Transfer Switches.			
		a. Automatic transfer switches serving motor loads should be dual motor operated (adjustable time delay neutral position) or have in-phase monitor (transfer when normal and emergency voltages are in phase) to reduce possible motor damage caused by out of phase transfer.			
		b. They may also have pre-transfer contacts to signal time delay relays in the emergency motor control centers.			
		c. In order to reduce possible nuisance tripping of ground fault relays, automatic transfer switches serving 3-phase, 4-wire loads should have 4-pole contacts with an overlapping neutral.			
		d. Automatic transfer switches should include a bypass isolation switch that allows manual bypass of the normal or emergency source to insure continued power to emergency circuits in the vent of a switch failure or required maintenance.			
	8.	Load Bank.			
		a. Generally, generators should be run with the actual load connected.			
		b. In selected applications where critical loads cannot tolerate a momentary outage, load banks may be considered.			
	9.	Paralleling.			
		a. For major computer centers and other critical facilities, generator paralleling should be considered.			
6.12	**UNINTERRUPTIBLE POWER SYSTEMS**				
A.	General				
	1.	In some facilities computer room back-up systems may be designed by the State agency. If this is the case, shell space and utility rough-ins should be provided.			
	2.	In facilities where UPS systems are to be provided as part of the building construction, they should be designed as described in this section.			
	3.	An uninterruptable power supply (UPS) consists of one or more UPS modules, batteries and accessories.			
	4.	The UPS isolates critical technical loads from normal and emergency power sources, supplies “clean” power to these loads and, in the event of a power interruption, provides continuous power from its batteries for a specified period (normally 2 hours – 15 minutes).			
	5.	When serving computer loads, the UPS must be properly grounded to preclude setting up ground loops through the protected equipment.			
B.	Electrical Service and Bypass Circuits.				
	1.	Three separate electrical services should be provided: one to the UPS rectifier circuit, one to the inverter bypass circuit and one to a maintenance by-pass circuit.			
C.	Electrical Service Size.				
	1.	A UPS system should be sized with 25 percent spare capacity.			
D.	Critical Technical Loads.				
	1.	The nature, size and locations of critical loads to be supplied by the UPS will be provided in the program.			
	2.	The UPS system should serve critical loads only.			
	3.	Non-critical loads should be served by separate distribution systems supplied from either the normal or electronic distribution system.			
E.	System Status and Control Panel.				
	1.	The UPS should include all instruments and controls for proper system operation.			
	2.	The system status panel should have an appropriate audio/visual alarm to alert operators of potential problems.			
	3.	It should include the following monitoring and alarm functions: system on, system bypassed, system fault, out of phase utility fault, closed generator circuit breaker.			
	4.	It should have an audible alarm and alarm silencer button.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	5.	Since UPS equipment rooms are usually unattended, an additional remote system status panel must be provided in the space served by the UPS.			
	6.	The alarms should also be transmitted to the BAS.			
F.	UPS Environment Status Panel.				
	1.	The environmental status of the UPS and battery rooms should also be monitored by panel in the computer center and by the BAS.			
G.	UPS and Battery Room Requirements.				
	1.	Design the battery room in accordance with Article 480 of National Electrical Code.			
	2.	Provide emergency lighting in both spaces.			
	3.	Provide a telephone in or adjacent to the UPS room.			
H.	Battery Racks.				
	1.	Provide 20-year life batteries.			
	2.	Racks should be two tier with bracing and connections to match seismic conditions of the site.			
	3.	In laying out the battery room, consider that excessive cable lengths result in high voltage drop, which could reduce the power available from the battery.			
I.	Paralleling.				
	1.	Provide paralleling for solid-state UPS of 500 KVA and above.			
6.13	**COMPUTER CENTER POWER DISTRIBUTION**				
A.	Power distribution shall be provided and designed for all computer and data centers according to the criteria in this section.				
B.	Power Distribution Units (PDUs).				
	1.	PDUs with internal or remote isolation transformers and output panelboards should be provided in all computer centers.			
C.	Non-linear Loads.				
	1.	Non-linear loads generate harmonic currents that are reflected into the neutral service conductors.			
	2.	Engineers should exercise caution when designing circuits and selecting equipment to serve non-linear loads, such as automated data processing equipment in computer centers.			
	3.	It is recommended to size neutrals at twice the size of the phase conductor.			
	4.	PDUs with internal or remote isolation transformers should also be derated for non-linear loads.			
	5.	The transformer rating must take the increased neutral size into account.			
D.	Computer Center Grounding.				
	1.	To prevent electrical noise from affecting computer system operation, a low frequency power system grounding and a high frequency signal reference grounding system should be provided.			
	2.	The design of the computer room grounding system should be discussed with the computer center staff.			
E.	Low Frequency Power System Grounding.				
	1.	The primary concern is to provide a safe, low frequency, and single point grounding system, which complies with Article 250 of the National Electrical Code.			
	2.	The single point ground must be established to ground the isolation transformer or its associated main service distribution panel.			
	3.	A grounding conductor should be run from the PDU isolation transformer to the nearest effective earth-grounding electrode as defined in Article 250 of the NEC.			
	4.	AD circuits serving Automated Data Processing (ADP) equipment from a PDU should have grounding conductors equal in size to the phase conductors.			
F.	High Frequency Power System Grounding.				
	1.	In addition to the low frequency power system grounding, a high frequency signal reference grounding system for radio frequency noise is required (with the two systems bonded together at one point).			
	2.	A grid made up of 2-foot squares will provide an effective signal reference grounding system.			
	3.	The raised floor grid may be used if it has mechanically bolted stringers.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
	4.		Alternatively a grid can be constructed by laying a mesh (2-foot squares) of braided copper strap or 16 gauge (0.051 inch) by 2-inch copper strip directly o the structural floor below the raised access floor.			
	5.		Data processing equipment should be connected to the reference grid by the most direct route with a braided copper strap.			
G.	Common Mode Noise Reduction.					
	1.		The reduction of common mode noise is particularly important for the proper operation of computer based; distributed microprocessor based systems, i.e., building automation systems, electronic security systems, card access control systems, and local area networks.			
	2.		The following guidelines should be considered to reduce common mode noise:			
		a.	Avoid running unshielded metallic signal or data lines parallel to power feeders.			
		b.	Where metallic signal or data lines must be routed in noise prone environments, use shielded cables or install wiring in ferrous metal conduit or enclosed cable trays.			
		c.	Locate metallic signal or data lines and equipment at a safe distance from arc producing equipment such as line voltage regulators, transformers, battery chargers, motors, generators, and switching devices.			
		d.	Provide isolation transformers, electronic power distribution panel boards or power conditions to serve critical electronics equipment loads.			
		e.	Provide isolated grounding service on dedicated circuits to critical data terminating or communicating equipment.			
		f.	Replace metallic data and signal conductors with fiber optic cables where practical.			
H.	Emergency Power Off (EPO) Systems.					
	1.		EOP pushbutton should be provided in data processing center at exits and at PDU's.			
	2.		Upon activation of push button or local fire alarm system, all power to the room and to the HVAC system for the room should be disconnected per National Electric Code, Article 645 and NFPA 75, Protection of ADP Equipment.			
6.14	**LIGHTING**					
A.	General					
	1.		Lighting should be designed to enhance both the overall building architecture as well as the effect of individual spaces within the building.			
B.	Interior Lighting:					
	1.		Consideration should be given to the options offered by direct lighting, indirect lighting, downlighting, uplighting and lighting from wall or floor-mounted fixtures.			
	2.		Illumination levels.			
		a.	For lighting levels for interior spaces see the values indicated in Table 1.			
		b.	For those areas not listed in the table, the IES Lighting Handbook shall be used as a guide.			
	3.		Energy Efficient Design.			
		a.	Lighting design must comply with ASHRAE/IES 90.1 as modified by Appendix 6.A. Power allowances for normal system receptacles include task lighting.			
		b.	Power isolated ground for maximum of four cubicles on typical 20-amp circuit of #12 wire plus ground.			
		c.	Lighting calculations should show the effect of both general and task lighting assuming that task lighting.			
		d.	Comply with Table 1 foot-candle illumination levels for specific areas:			

Table 1 - Illumination Levels

Area	**Nominal Illumination level in Foot-candles**
Office Space	
Normal work station space, open or closed offices	70
ADP Areas	55
Conference Rooms	55
Training Rooms	55

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

Internal Corridors	55
Auditoria	70 (adj)
Public Areas	
Entrance Lobbies, Atria	55
Elevator Lobbies, Public Corridors	55
Ped. Tunnels and Bridges	15
Stairwells	15
Support Spaces	
Toilets	15
Staff Locker Rooms	15
Storage Rooms, Janitors' Closets	15
Electrical Rooms, Generator Rooms	15
Mechanical Rooms	15
Communications Rooms	15
Maintenance Shops	70
Loading Docks	15
Trash Rooms	15
Specialty Areas	
Dining Areas	70
Kitchens	100
Structured Parking, General Space	5
Structured Parking, Intersections	10
Level assumes a combination of task and ceiling lighting where systems furniture is used.	

	4.	Light Sources.			
		a. Generally, interior lighting should be fluorescent.			
		b. Downlights should be compact fluorescent; high bay lighting shall be high intensity discharge (HID) type.			
		c. HID can also be an appropriate source for indirect lighting of high spaces.			
		d. However, it should not be sued in spaces where instantaneous control is important, such as conference rooms, auditoria or courtrooms, whereas incandescent presents a more appropriate fixture selection.			
		e. Dimming can be accomplished with incandescent, fluorescent or HID fixtures, although HID and fluorescent dimmers should not be sued where harmonics constitute a problem.			
		f. Incandescent lighting should be sued sparingly. It is appropriate where special architectural effects are desired.			
C.	General Lighting Fixture Criteria:				
	1.	Lighting Fixture Features.			
		a. Lighting fixtures and associated fittings shall always be of standard commercial design.			
		b. Custom designed fixtures should be avoided.			
		c. Offices and other areas using personal computers or other VDT systems should use indirect or diffuser-shielded tube-type ceiling fixtures.			
		d. Diffusers or lenses should be non-combustible acrylic.			
	2.	Baseline Building Fixture.			
		a. The fixture to be used for baseline cost comparisons for office space is a 2-foot X 4-foot fixture utilizing T-8 lamps and electronic ballasts.			
	3.	Fixture Ballasts.			
		a. Electronic, energy saving ballasts shall be used as required for all fluorescent, HID and MH fixture.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
		b.	Grouping ballasts shall be considered where applicable.			
		c.	Sound ratings of ballasts shall be AF NC level <30 with ceiling tile removed.			
		d.	Sound ratings of open lighting fixture ballasts shall be at NC level <30 within a 12-foot radius.			
D.	Lighting Criteria for Building Spaces:					
	1.	Office Lighting.				
		a.	Office lighting is generally fluorescent lighting.			
		b.	A lighting layout with a fairly even level of illumination is desirable.			
		c.	Modular (plug-in) wiring for fluorescent lighting fixtures should be used for office areas to facilitate changes.			
		d.	In open office areas with systems furniture partitions, the coefficient of utilization must be reduced to account for the light obstruction and absorption of the partitions.			
		e.	Task lighting will be used in situations, such as areas of systems furniture, where the general lighting level would be insufficient for the specific functions required.			
	2.	ADP Areas.				
		a.	Generally, ADP areas shall have the same lighting as offices.			
		b.	If the area contains special workstations for computer graphics, dimmable incandescent lighting may be required.			
		c.	If a large ADP area is segregated into areas of high and low personnel activity, switching to be used when areas are not being worked in.			
	3.	Conference Rooms and Training Rooms.				
		a.	These spaces to have a combination of fluorescent and dimmable incandescent lighting.			
	4.	Lobbies, Atria, Tunnels and Public Corridors.				
		a.	Special lighting design concepts are encouraged in these spaces.			
		b.	The lighting design should be an integral part of the architecture.			
		c.	Wall fixtures or combinations wall and ceiling fixtures may be considered in corridors and tunnels to help break the monotony of a long, plain space.			
	5.	Mechanical and Electrical Spaces.				
		a.	Lighting in equipment rooms will be equipped with industrial type fluorescent fixtures.			
		b.	Care should be taken to locate light fixtures so that lighting is not obstructed by tall or suspended pieces of equipment.			
	6.	Dining Areas and Serveries.				
		a.	Ample daylight is the illumination of choice in dining areas, assisted by fluorescent fixtures.			
		b.	Limited incandescent lighting for accents is acceptable.			
	7.	Structured Parking.				
		a.	Fixtures for parking areas to be fluorescent strips with wire guards or diffusers.			
		b.	Care must be taken in locating fixtures to maintain the required vehicle clearance.			
		c.	Enclosed fluorescent or high intensity discharge (HID) fixtures should be considered for above-grade parking structures.			
	8.	High Bay Lighting.				
		a.	Lighting in docks or storage areas with ceilings above 16-feet shall be metal halide.			
	9.	Supplemental Emergency Lighting.				
		a.	Partial emergency powered lighting must also be provided in main mechanical, electrical and communications equipment rooms; UPS, battery and ADP rooms; security control centers; fire control centers and the room where the Building Automation System is located.			
E.	Lighting Controls:					
	1.	General				
		a.	All lighting must be provided with manual, automatic, or programmable			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
			microprocessor lighting controls.			
		b.	The application of these controls and the controlled zones will depend on a number of space factors: frequency of use, available day lighting, normal and extended work hours and the use of open or closed office plans.			
	2.	Lighting Configuration Benefits.				
		a.	An appropriate lighting configuration can benefit the State office function.			
		b.	Reduction in operating costs can be achieved liming operation after working hours as well as taking advantage of natural light during the daytime working hours and facilitation the subdivision of spaces.			
	3.	Enclosed Space Lighting Controls.				
		a.	Enclosed space lighting controls shall include switches, multi-level switching, occupancy sensors, light level sensors or microprocessors.			
		b.	The lights can be zoned by space or multiple spaces.			
		c.	If microprocessor controls are used to turn off the lights, a local means of override should be provided to continue operations when required.			
		d.	The following design guidance is provided for enclosed areas:			
			1) Photoelectric sensors that reduce lighting levels in response to day lighting are recommended for small closed spaces with glazing.			
			2) Occupancy sensors should be considered for small closed spaces with glazing.			
			3) Microprocessor control, programmable controller or central computer control are recommended for multiple closed spaces or large zones.			
	4.	Open space Lighting Controls.				
		a.	Open space lighting controls shall include switches, multi-level switching, and light level sensors for spaces adjacent to glazing and microprocessor controls for zones within the space.			
		b.	If microprocessor controls are used to turn off the lights, a local means of override should be provide to continue operations during abnormal conditions.			
	5.	Occupancy Sensor Lighting Controls.				
		a.	Infrared or ultrasonic sensors should be considered for small, enclosed office spaces and toilet areas.			
		b.	Each Occupancy sensor should control no more than 12 fixtures.			
		c.	A label in identifying the panel and circuit number should mark each occupancy sensor.			
		d.	Occupancy sensors should not be used in open office areas, spaces housing heat producing equipment or corridors.			
	6.	Ambient Light Sensor Controls.				
		a.	Photoelectric sensors should be considered for fixtures adjacent to glazed areas and for parking structures.			
F.	Exterior Lighting:					
	1.	General				
		a.	Exterior luminaries must comply with local zoning laws.			
		b.	Lighting levels for exterior spaces should be the values indicated by the IES Lighting Handbook.			
	2.	Parking and Roadway Lighting.				
		a.	Parking and roadway lighting should be HID and should not exceed a 10 to 1 maximum to minimum ratio and a 4 to 1 average to minimum ratio.			
		b.	Parking lots should be designed with high efficiency, pole mounted luminaries.			
		c.	Metal halide lamps are preferred but consideration should be given to existing site illumination and the local environment.			
		d.	Emergency power is not required for parking lot lighting.			
	3.	Entrances.				
		a.	Lighting fixtures should be provided at all entrances and exits of major structures.			
	4.	Loading Docks.				
		a.	Exterior door lighting should be provided at loading docks.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
		b. Fixtures for illumination of the interior of trailers should be provided at each truck position.			
	5.	Controls.			
		a. Photocell and a time clock controller to include both all-night and part-night lighting circuits should control exterior lighting circuits.			
6.15	**LAYOUT OF MAIN ELECTRICAL ROOMS**				
A.	Separate electrical rooms may be provided for medium voltage and low voltage switchgear assemblies.				
B.	Vertical Clearances.				
	1.	Main electrical equipment rooms shall have a clear height to the underside of the structure above of at least 10 feet to allow for a radius for conduit entering from the top.			
	2.	Where maintenance or equipment replacement requires the lifting of heavy parts, hoists should be installed.			
C.	Horizontal Clearance.				
	1.	Electrical equipment rooms should be planned with clear circulation aisles and adequate access to all equipment.			
	2.	Layout should be neat, and the equipment rooms should be easy to clean.			
D.	Lighting.				
	1.	Lighting in equipment rooms shall be configured so as not to interfere with equipment.			
	2.	Switched emergency lighting must be provided in main electrical rooms.			
E.	Housekeeping Pads.				
	1.	Housekeeping pads should be at least 3-inches larger than the mounted equipment on all sides.			
F.	Operation and Maintenance Manuals.				
	1.	As-built documentation on all building systems is mandatory and shall be provided for the guidance of the building engineering staff.			
	2.	This should show the actual elements that have been installed, how they performed during testing, and how they operate as a system in the completed facility.			
	3.	The building maintenance staff should be provided with the following:			
		a. Record Drawings and specifications.			
		b. Operating manuals with a schematic process and instrument diagram sequence of operation and systems operating criteria for each system installed.			
		c. Maintenance manuals with complete information for all major components in the facility.			
G.	Posted Instructions.				
	1.	Posted operating instructions are required for manually operated electrical systems.			
	2.	They should consist of simplified instructions and diagrams of equipment, controls and operation of the systems, including selector switches, main-tie-main transfers, ATS by-pass, UPS by-pass, etc.			
6.16	**FIRE ALARM AND ELEVATOR SYSTEMS**				
A.	See "FIRE PROTECTION SYSTEMS" Section.				

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

ELECTRICAL SYSTEMS DESIGN							COMMENTS
X.1	A.	1.	a.	1)	a)	Reference Key	

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

PART 7 - COMMUNICATIONS AND DATA SYSTEMS DESIGN

COMMUNICATIONS AND DATA SYSTEMS - GENERAL

All information contained in this section is typical. Each facility requires design review by the State of Michigan, Department of Information, Telecommunication Services organization.

7.1	**SCOPE**			
A.	The State of Michigan requires a building to be built and furnished with state of the art infra structures and communications products to support voice and data systems.			
B.	The electronic equipment to operate these system will be furnished and installed by the State of Michigan personnel will maintain this total system.			
C.	All communication items incorporated in this building project shall adhere to EIA/TIA and BICSI Standards.			
D.	The detailed specification for voice and data may override the EIA/TIA and BICSI Standard in some areas.			
E.	In addition to the EIA/TIA and BICSI Standards all applicable building standards must be incorporated.			
F.	This building infrastructure is to include a communications grounding system as set forth in the EIA/TIA standards as described in section 607 of that standard.			
G.	Telephone and Data closets are to be located adjacent to one another, with common wall.			
H.	Following is a description of building spaces, pathways and equipment that will be provided by the building Lessor under construction contract.			
7.2	**BUILDING CONDUIT, PATHWAYS AND SPACE REQUIREMENTS**			
A.	Building Entrance Conduit			
	1. Four (4) conduits having a four (4) inch diameter are required to facilitate building entrance of outside cables.			
	2. These conduits are to originate at the property line and terminate in a hand hole just outside the landscape area adjacent to the building.			
	3. Also, there are to be four (4) – four (4) inch conduits placed which connect the hand hole to the Main Telephone Equipment Room.			
	4. The placement of underground conduits, as far as location on the property line, is to be coordinated with the State of Michigan, Department of Information Technology, Telecommunications division.			
	5. Specifics for the building entrance conduits are as follow:			
	a. All conduits are to be 4” rigid steel			
	b. If bends in total length of conduit from property line to hand hole exceed one hundred eighty (180) degrees, an access box is to be installed at the point where adding another bend would exceed the one hundred eighty (180) degree limit.			
	c. This is to be done for each length of conduit where bends would exceed one hundred eighty (180) degrees.			
	d. All bends will have a sweeping radius.			
	e. No sharp 90 degree bends are allowed.			
	f. All ends of steel conduits will be reamed and bushed.			
	g. Hand hole will be a minimum of three four (4) feet by four (4) feet and eighteen (18) inches in depth.			
	h. Conduits are to be placed at least twenty-four (24) inches below finished grade.			
	i. Conduits placed underground are to be painted with a corrosion inhibitor paint.			
	j. All ends of the conduits are to be sealed thereby blocking the entrance of debris and water into the conduits.			
	k. Conduits placed from the outside hand hole to the Main Telephone Equipment Room shall be 4” in diameter.			
	l. All bends will be made with a sweeping radius.			
	m. No sharp 90 degree bends are allowed.			
	n. If bends totaling more than one hundred eight (180) degrees are required a junction box measuring at least three four (4) feet by four (4) feet will be placed			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
		at each point where the addition of a bend would result in that length of conduit having total bends in excess of one hundred eighty (180) degrees.			
		o. Conduits within the building are to be bonded and grounded.			
	6.	Any standards pertaining to building entrance conduits not addressed in this building entrance conduit section shall comply with, but not limited to, EIA/TIA and BICSI standards.			
B.		Building Main Communication rooms			
	1.	The Communication System for this building requires a Main Communication Room for Telephone (voice) and Data (see Figure C-1).			
	2.	These rooms are to be located above grade and, in the center of the building and share a common wall.			
	3.	This placement will minimize the size and length of the vertical cable and length of the horizontal distribution systems.			
	4.	Considerations for off-loading and moving the equipment to the equipment rooms along with availability of elevators, passageways and loading docks are to be kept in mind.			
	5.	These equipment rooms are to be established using, but not limited to, EIA/TIA and BICSI standards.			
	6.	The specific items listed below are requirements that must be met.			
	7.	Floors in main equipment rooms must accept loading of one hundred fifty pounds (150) per square inch.			
C.		Specifics for Telephone (voice) Main Equipment Room (switchroom)			
	1.	Size of telephone equipment room is to be twenty five (25) feet by twenty (20) feet.			
	2.	Door is to be three (3) feet wide and eighty (80) inches tall minimum and swing outward.			
	3.	Telephone equipment room shall be environmentally controlled seven (7) days a week, twenty four (24) hours a day. Environmental equipment is to be redundant within the main telephone equipment room.			
	4.	Temperature range 75 – 78 ± 1.5%.			
	5.	Humidity range 55% ± 1.5% variance.			
	6.	Heat dissipation 750 – 5,000 BTUs per hour per cabinet.			
	7.	The amount of equipment placed will be dependent the number of occupants the facility is designed to house. ~~Three (3) cabinets will be placed originally~~.			
	8.	Hazardous elements such as water, steam, gas pipes and explosive or corrosive atmosphere must be excluded from the telephone equipment room.			
	9.	The telephone equipment room shall contain the Main Telephone Ground Bar.			
	10.	A 208V 200A power panel, connected to emergency power generator and uninterrupted power supply, is required in telephone equipment room.			
	11.	The telephone equipment room, at a minimum, shall have three (3) 20A 110V circuits distributed on duplex wall plugs. It is highly possible that additional power will be required.			
	12.	All circuits within the main telephone equipment room, including lighting circuits, are to be connected to the emergency power			
	13.	AC outlets being served by emergency power are to be orange in color.			
	14.	The telephone equipment room shall contain two (2) 15A 110V circuits (for test equipment) distributed on duplex wall plugs.			
	15.	A minimum of One 15A duplex receptacle is to be located on each wall.			
	16.	This telephone equipment room requires the A.C. power to be dedicated branch circuits and have isolated grounds. Power circuits within this main telephone equipment room are to be protected using TVSS (Transient Voltage Surge Suppression) within the electrical panels supplying power to this room.			
	17.	Gaseous fire extinguishing equipment is required in this equipment room.			
	18.	Two adjacent walls are to be covered with fire retardant plywood with painted finish.			
	19.	Plywood is t reach from two (2) inches above floor to 8'-2" vertically.			
		a. Plywood is to be clear grade			
		b. Plywood is to be ¾" in thickness			
	20.	This telephone equipment room's floor covering is to have vinyl tile and the tile is to be			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
		treated with a anti-static sealer or wax.			
	21.	Local exchange carrier requirements are to be taken into consideration for telephone equipment room requirements.			
	22.	All lighting in this main telephone equipment room is to be Emergency lighting.			
	23.	The lighting when measured at floor level must have a uniform intensity of 50 FC.			
	24.	Light fixtures are to be fused separate from those that provide service to the equipment or other electrical circuits in the equipment space.			
	25.	There shall be 4" conduit sleeves placed between the "stacked" closets and/or "stacked" equipment room for the purpose of providing a pathway for the riser cable system.			
	26.	The number of 4" sleeves will depend on the riser cable design.			
	27.	At a minimum two (2) sleeves are required.			
	28.	If more than one sleeve is required to accommodate the riser cable system then an additional empty sleeve shall be placed.			
	29.	This means that upon completion of this communication system installation, a vacant 4" sleeve between stacked closets will exist.			
	30.	All metal conduits and/or metal sleeves are to be reamed and bushed on both ends. Metallic sleeves are to be grounded.			
	31.	It is required that 3 each 7200 pair double sided main frames be installed in the equipment room .			
	32.	These frames must be bolted to the floor, and grounded to the communications ground as required by the N.E.C.			
	33.	The 7200 pair double-sided frames will be equipped with wire management brackets.			
	34.	Sufficient 300 pair 110 A connecting blocks will be mounted on the 7200 pair frame to satisfy the termination of the building riser cable.			
	35.	It will be necessary to coordinate all 110A block locating on the frame with the State of Michigan, Telecommunications Division, prior to terminating the cables.			
	36.	Any standards not addressed in detail within this data equipment room section shall comply with, but not limited to, NEC, BOCA, EIA/TIA and BICSI standards.			
D.	Specifics for Data Main Equipment Room				
	1.	Size of data equipment room is to be twenty five (25) feet by twenty (20) feet.			
	2.	Door is to be three (3) feet wide and eighty (80) inches tall minimum, and open outward.			
	3.	Data equipment room is to be located on raised floor.			
	4.	Data equipment room shall be environmentally controlled seven (7) days a week, twenty four (24) hours a day. Environmental equipment is to be redundant within the main telephone equipment room.			
	5.	Temperature range 75 - 78° ± 1.5%			
	6.	Humidity range 55 ± 1.5% variance			
	7.	Heat Dissipation 750 – 5,000 BTUs per hour per cabinet			
	8.	The amount of equipment placed will be dependent the number of occupants the facility is designed to house.			
	9.	Hazardous elements such as water, steam, gas pipes and explosive or corrosive atmosphere must be excluded from the data equipment room.			
	10.	The data equipment room shall be placed in line with the stacked data closets located o each of the other floors.			
	11.	The data equipment room shall contain a Telephone Ground Bar.			
	12.	A 208V 200A power panel connected to emergency power is required in data equipment room.			
	13.	The data equipment room shall have, at a minimum, three (3) 20A 110V circuits distributed on duplex wall plugs. It is highly possible that additional power will be required.			
	14.	All circuits within the data equipment room, including lighting circuits are to be connected to the emergency power.			
	15.	AC outlets being served by emergency power are to be orange in color.			
	16.	The date equipment room shall contain two (2) 15A 110V circuit (for test equipment) distributed on duplex wall plugs.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	17.	One 15A duplex receptacle is to be located on each wall.			
	18.	This data equipment room requires the A.C. power to be dedicated branch circuits and have isolated grounds. Power circuits within this main data equipment room are to be protected using TVSS (Transient Voltage Surge Suppression) within the electrical panels supplying power to this room.			
	19.	Gaseous fire extinguishing equipment is required in this equipment room.			
	20.	This data equipment room is to have vinyl tile raised floor and the tile is to be treated with a anti-static sealer or wax.			
	21.	All lighting in this data equipment room is to be Emergency lighting.			
	22.	The lighting measured at floor level must have a uniform intensity of 50F.C. LM/Ft².			
	23.	Light fixtures are to be fused separate from those that provide service to the equipment or other electrical circuits in the equipment space.			
	24.	There shall be 4" conduit sleeves placed between the "stacked" closets and/or "stacked" equipment room to provide a pathway for the riser cable system.			
	25.	The number of 4" sleeves will depend o the riser cable design.			
	26.	At a minimum two (2) sleeves are required.			
	27.	If more than one sleeve is required to accommodate the riser cable system then an additional empty sleeve shall be placed.			
	28.	This means that upon completion of this communication system installation, a vacant 4" sleeve between stacked closets will exist.			
	29.	All metal conduits and/or metal sleeves are to be reamed and bushed on both ends. Metallic sleeves are to be grounded.			
	30.	Any standards not addressed in detail within this data equipment room section shall comply with, but not limited to, NEC, BOCA, EIA/TIA and BICSI standards.			
E.	Backbone Pathways				
	1.	A pathway must be installed which will allow for the placement of continuous riser communication cables from the voice equipment room to each of the voice and data communication closets.			
	2.	All voice and data closets are to be stacked one above and/or one below the other. If more than one voice and/or data closet is required per floor the additional closets are to be stacked above and/or below one another and a minimum of one four (4) metallic conduit is to be placed between closets on the same floor.			
	3.	Close attention to ANS/TIA/EIA – Commercial Building Telecommunications Cabling Standards, Section 5 for planning required pathways.			
F.	Horizontal Pathways				
	1.	Voice and Data			
		a. The cable management system will allow the placement of voice and data cable from the serving closets to the workstation.			
		b. The cable management system must be non-metallic and designed with no sharp edges, which could damage the cable.			
		c. The cable management system will have break out slots, which will allow the cable to change directions from the main flow of cables.			
7.3	**COMMUNICATION CLOSETS**				
A.	Telephone (voice)				
	1.	Each floor shall have at least one telephone (voice) closet.			
	2.	The telephone close will house, at a minimum, voice information outlet terminations and terminations for the riser cabling.			
	3.	Maximum length of data cable run from closet is two hundred ninety (290) feet .			
	4.	Provide added closet if maximum length would be exceeded.			
	5.	The telephone closets shall be "stacked", one above the other on adjacent floors.			
	6.	Specifics for generic telephone closet are as follows:			
		a. Size of closet is to be twelve feet by six feet.			
		b. Door is to be three feet wide and eighty inches tall minimum.			
		c. Door is to swing outward			
		d. Two adjacent walls are to be covered with fire retardant plywood with paint finish.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

				Yes	No	N/A
		e.	Plywood is to be placed 2” above floor and extend vertically to 8’-2” above floor.			
		f.	Plywood is to be clear grade.			
		g.	Plywood is to be ¾” thickness			
		h.	Two 20A 110V circuits are required in each communication closet. Each circuit is to have two duplex receptacles. One duplex receptacle is to be placed on each wall. For example, circuit “A” could have a duplex receptacle on the north and south walls and circuit “B” could have a duplex receptacle on the east and west wall. These circuits are to have isolated ground and TVSS protection.			
		i.	There shall be 4” conduit sleeves placed between the “stacked” closets for the purpose of providing a pathway for the riser cable system.			
		j.	The number of 4” sleeves will depend on the riser cable design.			
		k.	At a minimum two (2) sleeves are required.			
		l.	If more than one sleeve is required to accommodate the riser cable system then an additional empty sleeve shall be placed.			
		m.	This means that upon completion of this communication system installation, a vacant 4” sleeve between stacked closets will exist.			
		n.	All metal conduits and/or metal sleeves are to be reamed and bushed on both ends. Metallic sleeves are to be grounded.			
		o.	The floor is to be vinyl tile and the tile is to be treated with a anti-static sealer or wax.			
		p.	There are to be no electrical cabinets, transformers, water pipes, steam pipes, etc. within the telephone closets.			
		q.	The telephone close is to have a Telephone Ground Bar (TGB).			
		r.	This TGB is to meet EIA/TIA standards.			
		s.	All riser cables will be terminated on 110A – 300 pair connection blocks which are to be mounted on the backboard.			
		t.	The lighting measured at floor level must have a uniform intensity of 50FC.			
	7.		Any standards not addressed in detail within this data equipment room section shall comply with, but not limited to, EIA/TIA and BICSI standards.			
B.	DATA					
	1.		Each floor shall have at least one Data closet located in the center of the floor, and adjacent to telephone closets serving each floor.			
	2.		The Data close will house, at a minimum, information outlet terminations and terminations for the fiber optic riser cabling.			
	3.		Maximum length of data cable run from closet is two hundred ninety (290) feet .			
	4.		Provide added closet if maximum length would be exceeded.			
	5.		The data closets shall be “stacked”, one above the other on adjacent floors.			
	6.		Specifics for a generic data closet are as follows:			
		a.	Size of closet is to be twelve feet by six feet			
		b.	Door is to be three feet wide and eighty inches tall minimum.			
		c.	Door is to swing outward			
		d.	Two adjacent walls to be covered with fire retardant plywood with paint finish.			
		e.	Plywood is to be placed 2” above floor and extend vertically to 8’-2”			
		f.	Plywood is to be clear grade			
		g.	Plywood is to be ¾” thickness			
		h.	One 15A 110V duplex receptacle is to be located on each wall.			
		i.	Purpose of these outlets are for plugging in test gear, etc.			
		j.	Two (2) 20A 110V circuits are to be provided in this closet.			
		k.	They shall be distributed on four (4) duplex outlets along the long wall that is covered with plywood.			
		l.	Electrical circuits serving the data **closet** are to be connected to the emergency power source.			
		m.	AC outlets being served by emergency power are to be orange in color.			
		n.	There shall be 4” conduit sleeves placed between the “stacked” closets for the purpose of providing a pathway for the fiber optic riser cable system. Metallic			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
sleeves are to be grounded.			
o. The number of 4" sleeves will depend on the riser cable design.			
p. At a minimum two (2) sleeves are required.			
q. If more than one sleeve is required to accommodate the riser cable system then an additional empty sleeve shall be placed.			
r. This means that upon completion of this communication system installation, a vacant 4" sleeve between stacked closets will exist.			
s. All metal conduits and/or metal sleeves are reamed and bushed on both ends.			
t. The floor is to be vinyl tile and the tile is to be treated with a anti-static sealer or wax.			
u. There are to be no electrical cabinets, transformers, water pipes, steam pipes, etc. within the telephone closets.			
v. The data closet is to have a Telephone Ground Bar (TGB).			
w. This TGB is to meet EIA/TIA standards.			
x. The lighting measured at floor level must have a uniform intensity of 50 FC.			
y. Data closets require ventilation that will maintain temperatures and humidity the same as office space.			
z. Any standards not addressed in detail within this data closet section shall comply with, but not limited to, EIA/TIA and BICSI standards.			
C. Communication Systems			
1. General			
a. A certified structured building cable system will be utilized in this building. The certified building cable system will contain materials and labor that are warranted by one manufacturer. Each communication channel will consist of media that is manufactured by the structured building cable system manufacturer and no one else.			
b. The data portion of the certified building cable system will be certified to operate at 622 Mbps and the voice portion will be certified to operate at EIA/TIA category III levels.			
c. This cable system shall possess a fifteen year warranty.			
d. The warranty is to cover both labor and materials and is to be provided by the equipment manufacturer.			
2. Riser Systems			
a. Voice			
1) To establish the size of cable required in each riser closet, which must be home run to the equipment room, use the following formula: Cable Pair = Floor Area (sf) X .0075			
2) All cable pairs will be terminated on 110 type 300 pair connecting blocks on both ends.			
3) When the pairs required is greater than the manufactured cable size, use the next larger size cable.			
4) It will be required to install 3 each 7200 pair stand alone frames in the MDF for termination of the riser cables.			
b. Data			
1) A fiber optic cable riser system will be required.			
2) It will be required to place one 12 strand fiber optic cable from each data closet on each floor of the building, home run to the voice equipment room.			
3) The fiber optic cable shall be riser rated 62.5/125 um multimode fiber.			
4) All fiber optic strands shall be terminated in Light Guide Interface Units (LGUI) with ST type connectors mounted in 19" X 7' racks.			
5) All racks will be supplied by the vendor and bolted to the floor.			
6) Appropriate grounding is required to the racks as per N.E.C. standards.			
7) Each fiber strand will be tested at in both directions using an OTDR.			
8) The db loss must not be greater than industry standards for fiber at that			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
		length.			
	9)	Records must be provided to the State of Michigan, which express the test results of each strand.			
	10)	At the voice equipment room, all fiber riser cables will terminate in LGIU's which are mounted in 19" X 7' stand alone racks.			
	11)	All connections will be made with ST type connectors.			
	12)	An additional 60 strand fiber optic cable will be placed from the Data equipment room to the voice equipment room.			
	13)	In the voice equipment room the fiber optic cable strands will terminate on ST type connectors in a LGIU located in the same rack with the riser fiber connectors.			
	14)	IN the data room it will be required to install one 19" X 7' equipment rack for installation of sufficient LGIUs to terminate all 60 strands of fiber on ST type connectors.			
D.	Horizontal Cable Systems				
	1.	The horizontal cabling system will adhere, but not limited to, EIA/TIA and BICSI standards.			
	2.	The voice cable will be category III and the data cable will be enhanced category V.			
	3.	The cable will be run within the cable paths as described in the section titled pathways.			
	4.	All data cables will be certified to operate at 622 Mbps and all voice cabling will be certified to operate at level III.			
	5.	The specific items listed below are the requirements that must be met in addition to the requirements stated above.			
E.	Specifics for Horizontal Voice and Data Cabling				
	1.	Telephone closet voice terminations will be made on wall field.			
	2.	Voice wall field will consist of 110A type distribution blocks.			
	3.	Data closet data cable (enhanced cat V) terminations will be made on equipment rack mounted patch panels that will support the 622 Mbps data rate.			
	4.	Horizontal cable will be of the non-plenum type			
	5.	Telephone closet wall field is to incorporate cable management system			
	6.	Data closet equipment racks are to be equipped with a cable management system.			
	7.	Equipment racks mounted in the data closets are to be arranged with clearances as prescribed in BICSI standards.			
	8.	Both voice and data cables are to terminate on RJ45 jacks which will be installed in the duplex surface mount information outlet boxes.			
	9.	The CAT III voice jack will be ivory in color.			
	10.	The enhanced Cat V data jack will be orange in color.			
	11.	The Cat VE data cable is to be blue in color.			
	12.	The Cat III voice cable is to be white in color.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

COMMUNICATIONS AND DATA SYSTEMS DESIGN							COMMENTS
X.1	A.	1.	a.	1)	a)	Reference Key	

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
PART 8 - SPECIAL SYSTEMS DESIGN					
8.1	**VITAL RECORDS VAULT**				
A.	General				
	1.	Vault will house State's vital records.			
	2.	Vault is occupied throughout the day.			
B.	Architectural				
	1.	Size: Approximately 5,500 sf			
	2.	Entire vault must be located on one floor.			
	3.	Perimeter walls to be concrete block providing a 3-hour fire rating.			
	4.	Shelving Capacity: Approximately 11,000 lf of shelving. Baked enamel steel shelves required.			
C.	Structural				
	1.	Provide floor slab / supported floor designed to support the applied load, 200 psf minimum.			
D.	Mechanical				
	1.	Media Temperature: 68/F These conditions should not vary more than 2-3% during any 24 hour period.			
	2.	Relative Humidity: 55% These conditions should not vary more than 2-3% during any 24 hour period.			
	3.	Some filtration system to reduce dust. Workers can get "library lung" from the paper dust. They did not know the specific requirement, except that it can be a problem.			
	4.	Must be located in an area that will not flood, with no active piping directly above the stacks.			
	5.	Chemical fire suppression system.			
E.	Electrical				
	1.	Limited key access or access code security into the vault area.			
	2.	Vault must contain security cameras and motion sensors.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A

SPECIAL SYSTEMS DESIGN							COMMENTS
X.1	A.	1.	a.	1)	a)	Reference Key	

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

	Yes	No	N/A
PART 9 - APPENDICES			
9.1 VALUE ENGINEERING ANALYSIS FOR MECHANICAL SYSTEMS			
A. Value Engineering Analysis.			
1. In buildings not yet constructed, Mechanical system which best serves the facility shall be selected based upon a value engineering analysis method.			
2. Regarding small incidental pieces of equipment that do not warrant a full-fledged analysis, alternatives shall still be compared, taking into account flexibility and maintenance.			
3. In modeling the major equipment components and HVAC scheme, an annual energy cost, installation cost and operational maintenance cost shall be calculated using system parameters and typical occupied office hours for a base option.			
4. The base option shall be a mulitzone VAV system with perimeter heat with central absorption or centrifugal chiller and boiler.			
5. A minimum of two other HVAC system options shall be proposed.			
6. System descriptions that qualify as options for consideration are listed below for suggestion to steer the developer and architect/engineer.			
a. Constant volume with reheat and perimeter heat using central chiller and boiler.			
b. Floor by floor VAV multizone with integral water cooled compressor and fluid cooler.			
c. Dual duct-multizone with perimeter heat using central chiller and boiler and cooling tower.			
7. The value engineering analysis shall compare incremental complex pay back and discounted cash flow rate of return on investment calculated for each option presented.			
8. Results of the payback comparison shall be used to illustrate justification of the HVAC system recommended.			
9. The table summarizing each options data of annual figures for energy savings, operational and maintenance cost and interest on capital expenditures shall be included for State review.			
10. The table shall resemble the following:			

Table 1 - Option Cost Comparison

Option Description	First Cost	Annual Energy Savings	Annual O&M Costs
1. VAV with perimeter heat	X	X	X
2. Constant volume w/reheat	X	X	X
3. Multizone	X	X	X

11. A yearly cash flow shall be based upon the following parameters:			
a. The life cycle of air handlers and chiller equipment are near 30 years. Thus, the cash flow analysis will be for 30 years.			
b. Energy costs for electricity shall escalate at 3% per year.			
c. The initial rate of electrical energy shall be $.055/kwh + demand value.			
d. The initial rate of steam use shall be $.66/therm of med. Psi. steam and shall escalate at 3% a year.			
e. Operational and maintenance cost shall escalate at 5% per year.			
f. Interest value on first cost investment capital equals to 10% per year.			
g. Rate of natural gas shall be $.60 per therm at escalation rate of 1% per year.			
h. Base energy use of building proposed is $1.30/ft^2. Energy savings of the second option is defined as base option 2 or 3.			
12. A spreadsheet representing this payback is represented on the following page. This format makes the complex payback calculation procedure less cumbersome and easier to represent. The engineer is encouraged to utilize this or any other style of spreadsheet procedure.			
13. In the spreadsheet matrix, the first column represents the cash flow year. The last column “H” represents the principle balance of each year, similar to an amortization schedule in a home mortgage loan.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

			Yes	No	N/A
	14.	The year of cash flow, in which the principle balance column becomes a negative number, signifies the complex payback year. The HVAC option, which has the least payback, is the best option to choose.			
	15.	In each year's cash flow summary, Column "G" is defined as the "principle difference" and is found by subcontracting costs and interest form energy savings each year. Column "F" is the interest charge to investment. Column "E" is the annual operational and maintenance cost and Columns "B" , "C" and "D" represent differential energy savings of the HVAC option being studied for electricity, steam and gas. The equation of Column "G" for the principle difference matrix would be ("B" + "C" + "D")-("E" + "F") and repeated for each cash flow year. The year's principle balance in Column "H" is found by adding the principle difference to the previous year's principle balance.			
	16.	Note that a utility annual rate fluctuation or O&M cost and interest can be modeled throughout the life cycle by assigning an annual, compounded percent value to a dependent matrix for each column of savings and costs. This allows for yearly increase in electricity, steam, gas or O&M cost sensitivity to be studied over the life cycle.			
	17.	Systems, which must be selected based on a lower complex payback in a value engineering analysis, are the main heating, cooling and air handling systems for each building. At least three options for HVAC systems should be analyzed. Tow (or more) options may be of the developer's choosing, but they must be compared to a base system, which has been established for State buildings. The base system shall be a variable air volume system combined with a central cooling and heating system and a separate perimeter fin tube radiation system. All alternate systems shall include perimeter fin tubes.			
B.	Energy Analysis.				
	1.	The energy analysis is an important predictor of the energy costs of building operations.			
	2.	The chosen program must be capable of accepting the following input parameters:			
		a. Lansing weather data			
		b. fuel data of Lansing Board of Water and Light			
		c. building orientation			
		d. building width and length			
		e. building mass			
		f. number of stories			
		g. exterior wall construction			
		h. roof construction			
		i. glazing in walls			
	3.	It should also be able to compare all appropriate mechanical systems options in terms of their different effects on space conditioning of the environment and use of internal gain to offset perimeter heating loss during winter months.			
C.	Heat Balance Analysis.				
	1.	This calculation identifies the breakeven temperatures of a building for various energy loads and the maximum heating and cooling requirements at outdoor design limits.			
	2.	It is the basis for a diversity of heat distribution within buildings with heavy thermal loads.			
	3.	Many State operated buildings have sufficient internal heat gain to offset the need for heating perimeter zones by nearly 70% during periods of occupancy if air heat transfer can be accomplished within the building.			
	4.	The parameters to use in heat balance calculations include:			
		a. ventilation load			
		b. skin loads			
		c. light and power load			
		d. occupancy load			
		e. loads from heat producing equipment.			
D.	Selecting Fuel Sources.				
	1.	The primary fuel should be selected based on system value engineering analysis and must be in compliance with local laws.			

*Fill In **Yes**, **No**, or **Not Applicable (NA)** In All Shaded Line Items. Add **Comments** As Desired In Table At End of Section.*

		Yes	No	N/A
2.	It should be readily available and free of supply restrictions.			
3.	Where district heating and/or cooling systems are available, they should be considered, taking into account :			
	a. service reliability			
	b. downtime consideration			
	c. potential future expansion needs of the project.			
4.	Lansing Board of Water & Light, or other local utility, steam and power costs shall be utilized in energy model.			
5.	Emergency generator shall be provided for necessary elements of fire, security and mandatory operational elements of the tenants space.			
6.	In evaluating fuel costs, actual costs, including demand charges, at the project site should be used.			
7.	Lansing Board of Water and Light, or other local utility, steam and power costs in addition to Consumer Energy natural Gas rates for central boiler and/or gas fired builder/heater shall be used.			

STATE DMB OFFICE - ANNUAL % INCREASES	
ELECTRICAL	5%
STEAM	3%
GAS	1%
O&M COST	3%
LOAN INTEREST	10%

FINANCIAL INCENTIVE ANALYSIS								
	Column A	Column B	Column C	Column D	Column E	Column F	Column G	Column H
PROJ. YEAR	FIRST COST ($1000)	SAVINGS ELEC. ($1000)	SAVINGS STEAM ($1000)	SAVINGS GAS ($1000)	O&M COSTS ($1000)	LOAN INTEREST ($1000)	PRIN. DIFF. ($1000)	PRIN. BALANCE ($1000)
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

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ARCHITECTURAL SPECIFICATIONS

00001 - INTRODUCTORY INFORMATION

1.1 Scope: It is the purpose of these outline specifications format to set forth the minimum general requirements for the completed facility as well as to clarify points of particular interest to the Lessee.

A. Actual design, construction, and performance of the building, building systems, site and ground utilization, etc. are the responsibility of the Lessor.

B. The Lessor shall obtain the services of an independent architect/engineer to provide the construction drawings and specifications pursuant to the Lessee's requirements.

C. The architect/engineer shall be responsible for presiding over and generating periodic progress meetings, minutes of meetings, and periodic on-site construction inspections to verify the provisions of the drawings and specifications.

1.2 Construction Documents: the Lessor shall submit to the Department of Management and Budget, Office of Facilities, Real Estate Division (DMB), and the Property Management Division three (3) sets of complete construction drawings and specifications bearing the seal of a licensed architect or engineer in the State of Michigan, for review and approval.

A. While the approved drawings and specifications will become a part of the Lease, in the event there is a discrepancy between these outline specifications and the Lease, and the approved construction drawings, the outline specification and the written Lease document shall prevail.

B. The Construction Documents shall be approved by the Lessee before remodeling or new construction is started.

C. Approval of these documents does not waive the Lessor's responsibility to comply with the provisions of the Lease and Outline Specifications.

D. Construction drawings shall include a complete architectural site plan indicating boundary and/or topographic surveys, demolition, erosion plan, grading, lighting, utilities, building location, sidewalks, parking lot, drives, curbs, fences, signs, landscaping, and other site considerations.

E. Construction specifications shall follow the AIA/CSI format and shall p provide details and data not provided in the Outline Specifications.

F. All design considerations shall be based on the Lessor's knowledge of the intended use of the Leased premises. The Lessee's process of plans and specifications review and subsequent approval does not relieve the Lessor from any responsibility to provide an end product that is safe, comfortable and functionally satisfactory to serve as an office facility for the Lessee.

G. The Leased premises shall be designed in such a manner as to insure an economical and efficient use of space, adequate natural light, ventilation, circulation patterns and code compliance.

01000 - PROJECT SUMMARY

1.1 Project Name and Location

New Office building

State of Michigan

A. The project is a building for State of Michigan in Lansing, Michigan to be located on a site proposed by the Lessor receiving the award. The building will be a new or fully renovated facility including offices, training and conference.

B. Special Requirements:

1. Owner - Furnished and State- Installed Items:

a. Coordinate installation (by State) of State supplied furniture and other furnishings with base building construction schedule.

1.2 Permits

A. The Lessor or its representative shall obtain all necessary building, zoning, and other permits as required for the complete construction of the Leased premises.

1. Final Construction Documents

a. Prior to start of construction the Lessee shall be furnished free of charge, Five (5) copies of prints of the final approved drawings and specifications from the Lessor at the usual charge for reproduction and handling.

2. Compliance:

a. Construction shall be done in strict accordance with approved plans and specifications. The Lessee reserves the right to make periodic inspections of the construction to ascertain whether construction and workmanship are as represented by approved drawings, and that the Leased premises is also representative of practices of construction that are reasonable and customary in the industry.

b. To facilitate inspections of critical items, a certain reasonable number of special inspections will be identified as required at a Pre-Construction Meeting, to be chaired by an authorized representative of the Lessee. Construction of the item(s) to be inspected will not proceed until the Lessee has inspected and approved the work to that point. These must be given at least two (2) work days notice of when special inspections will occur and inspection will be made within one (1) work day; otherwise, construction can proceed as planned. The Pre-Construction meeting will be called by the Real Estate Division Property Analyst and moderated by an authorized representative of the Office of Facilities.

c. Periodic site inspections will be made by the Lessee or by a licensed architect/engineer hired by the Lessee for this purpose. This does not relieve the Lessor from providing architect/engineer inspections during the construction phase.

d. If any materials or workmanship provided are other than as indicated on drawings, or specified, the Lessee may direct that the portion of the work that is not satisfactory be removed and replaced or otherwise corrected, at no additional cost to the State.

e. Any reference to a specific brand and/or model is intended to establish quality, operating characteristics, or type are acceptable. The entire burden of establishing equality of alternate brands, types, sizes, etc., shall rest with the Lessor and the Lessor shall provide proof of "equal or better" upon request by the State.

1.3 Testing

A. Testing Agency: Independent testing agency engaged and paid for the Contractor, after the t4esting agencies qualifications have been submitted to and written approval obtained from the State of Michigan.

1.4 Coordination:

A. Coordination of site work, utilities, and building construction is required throughout construction.

1.5 Progress Schedule and Subcontractors:

A. Within ten (10) days after the Preconstruction Meeting, the Lessor shall submit to the Lessee a copy of a proposed CPM chart construction schedule, a list of all subcontractors, and shop drawings and catalogues specified below.

B. The Progress Schedule shall include the following:

1. The anticipated date of commencement and completion of the various operations to be performed under the Lease, including submission of samples and other information requiring prior approval of the Lessee, which directly control the key operations.
2. The estimated time required for fabrication or delivery, or both, of controlling materials and equipment required for the work.
3. The "schedule" shall be predicated on the completion of all the work on or before the date specified.
4. After being accepted by the Lessee as satisfactory, the schedule shall be strictly adhered to by the Lessor, subject to approved change order(s) to the Lease.

1.6 Field Engineering:

A. Underground Utilities: Verification and location of underground utilities, facilities, and equipment.

B. Layout: Layout for site improvements, utilities, and structures.

1.7 Project Meetings:

A. Regularly scheduled construction Progress Meetings shall be held at the job-site or a mutually agreed upon location between the Lessor, and the Lessee.

B. The Lessor shall include general contractors and sub-contractors as necessary.

C. A first meeting shall be held prior to commencement of actual construction (a Preconstruction Meeting referenced above) and held monthly thereafter until the Leased premises is completed.

D. The meeting schedule may be altered when mutually agreeable between the Lessor and the Lessee.

E. The Architect/Engineer retained by the Lessor shall record minutes of meetings and coordinate distribution of submittal, etc.

1.8 Required Submittals:

A. Prior to commencement of construction, the Lessor shall submit two copies of all Shop Drawings and Manufacturers' Catalogue information for all construction items proposed for use by the Lessee's authorized representative.

1. These drawings shall include complete schedules for finishes, doors, floors, ceilings, hardware, plumbing fixtures and accessories, HVAC equipment and accessories, etc.
2. Shop Drawings and Manufacturer's Catalogue information shall be checked and approved by the Lessor's Architect/Engineer.

B. Monthly written Construction Progress Reports and site inspection approvals shall be prepared by the Lessor's Architect/Engineer and copies submitted to the Lessee.

C. Construction tests such as soil borings, concrete mix designs, and other pertinent field verifications shall be submitted to the Lessee prior to construction.

D. Upon Substantial Completion of construction within 30 days, the Lessor shall submit to the Lessee the following:

1. Two complete sets of reproducible (Mylar) As-Built Drawings corresponding to the approved construction drawings.
2. Two copies of the final approved Floor Plans in the form of a computer disc(s) compatible with AutoCAD software.
3. Two complete sets of permanent operations manuals, instructions, and manufacturers' repair and maintenance information for all systems and equipment. These items shall be bound in a ring binder.
4. One reduced size composite floor plan (11"x17") designating all emergency valves, switches, controls, locations of equipment that will require periodic maintenance, etc. Provide the Lessee's designee with training to understand and familiarize occupants with building controls and systems locations/operations, etc.

1.9 Temporary Facilities:

A. New temporary utility services shall be obtained and paid for by the contractor.

B. Temporary construction office, material storage yard, office for State of Michigan use, support facilities, and security measures for all facilities shall be provided by the contractor.

1.10 Change Order and Field Bulletin Procedures:

A. Any changes in construction requirements that occur after the final approval of design and construction documents shall be initiated by a bulletin from the Lessor's architect/engineer requesting prices for changes proposed. Either the Lessor or the Lessee may make requests for changes consistent with Article III of the Lessee.

B. Requests for bulletin change shall be complete with drawings and/or other supporting documentation.

C. The Lessor shall submit a detailed breakdown of costs to Lessee through DMB's Real Estate Division, after review and approval by the Lessor's architect/engineer.

D. The Lessee, through DMB's Office of Facilities, will review and recommend the adequacy of pricing only to DMB/Real Estate Division and the Lessee.

E. The Lessee will advise DMB's Real Estate Division in writing: (1) if it wants the changes made, and (2) that it has the funds to pay for the proposed changes.

F. All changes are to be included in the as-built drawings regardless of whether the request is initiated by the Lessor or by the Lessee and regardless of whether a cost is associated with the change.

G. All changes or deletions which result in a change of construction expense shall be provided on the basis of an itemized breakdown of the actual cost plus 20% for overhead and profit for work done by the Lessor or its general contractor. On work performed by a subcontractor, the Lessor or prime contractor is allowed a 7-1/2% handling charge. The subcontractor will then receive the 20% addition for overhead and profit.

H. Payment for such changes, additions or deletions shall be made as a lump-sum adjustment with the first monthly rental payment.

I. All change orders shall be issued in writing by the DMB's Real Estate Division, on a construction change order notice all as required by Article III of the Lease. The Lessor will be responsible for the cost of any unauthorized changes.

1.11 Contract Close Out:

A. The Lessor shall notify the Lessee when the work will be Substantially Complete and ready for inspection and preparation of a list of minor replacement, correction, adjustment and touch-up items.

1. All concerned parties shall attend the Substantial Completion.
2. The Lessor shall complete all work required by the date set for final acceptance by the Lessee.
3. Provide a pest control application for the elimination and/or control of insects and rodents one-week before opening.

B. Final Clearing:

1. The Lessor shall remove from the Leased premises all surplus building material and rubbish; clean or re-clean entire work to normal level for "first class" maintenance/cleaning of building projects of a similar nature; and remove non-permanent protection and labels, polish glass, clean exposed finishes, touch up minor finish damage, clean or replace filers of mechanical systems, remove debris and broom clean non-occupied spaces, sanitize plumbing/food service facilities, clean light fixtures and replace burned out/dinned lamps, sweep and wash new paved areas, police yards and grounds, and perform similar cleanup operations needed to produce a "clean" condition.

2. No payments will be authorized until final cleanup is accomplished and inspection is made by the Lessee.

02100 - SITE PREPARATION

1.1 Protection of existing trees, vegetation, landscaping materials, and site improvements not scheduled for clearing, which might be damaged by construction activities.

1.2 Trimming of existing trees and vegetation as recommended by arborist for protections during construction activates.

1.3 Clearing and grubbing of stumps, vegetation, debris, rubbish, designated trees, and site improvements.

1.4 Topsoils stripping and stockpiling.

1.5 Materials used for erosion and sedimentation controls shall meet the requirements as set forth by code and local governing agencies.

1.6 Temporary protection of adjacent property, streets, sidewalks, curbs and gutters also any benchmarks, and monuments.

1.7 Watering of trees and vegetation during construction activities.

1.8 Removal and legal disposal of cleared materials.

1.9 Tree protection, erosion control, siltation control, and dust control material suitable for site conditions.

02110 - SITE CLEARING

1.1 General

A. Remove surface debris.

B. Remove paving and curbs.

C. Clear site of plant life and grass.

D. Remove trees and shrubs

E. Remove root system of trees and shrubs.

F. Verify that existing plant life and features designated to remain are tagged or identified.

G. Protect utilities that remain, from damage.

H. Protect trees, plant growth, and features designated remain as final landscaping.

I. Protect benchmarks and existing structures from damage or displacement.

02140 - DEWATERING

1.1 Dewatering equipment suitable for site conditions.

02150 - EXCAVATION SUPPORT SYSTEM

1.1 Steel Piling: Steel piling suitable for project requirements.

02211 - ROUGH GRADING

1.1 Topsoil: Fertile, natural excavated material (if acceptable), graded, free of roots, rocks larger than 1 inch, subsoil, debris, and large weeds. PH range 5.3 to 6.0.

A. Topsoil: Excavated material, graded, free of lumps larger than 6 inches, rocks larger than 3 inches, and debris.

B. Granular Fill: See 02223.

02218 - FINISH GRADING

1.1 Topsoil: Reuse stockpiled topsoil, if acceptable; or, use imported soils.

A. Topsoil: Imported, friable loam; free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter, acidity range (pH) of 5.3 to 6.0; containing a minimum of 4 percent and a maximum of 25 percent organic matter.

02222 - EXCAVATION

1.1 Excavation

A. Underpin adjacent structures, which may be damaged by excavation work, including utilities and pipe cases as required.

B. Excavate subsoil required to accommodate building foundations, slabs-on-grade, paving, and site structures, construction operations, and utilities.

C. Excavate to working elevations. Dewater if required. Excavation may require unacceptable material to be removed.

D. Machine slope banks to angel of repose or less, until shored as required.

E. Excavation cut not to interfere with normal 45 degree bearing splay of foundation.

F. Grade top perimeter of excavation to prevent surface water from draining into excavation.

G. Stockpile excavated material in area designated on site and remove excess unacceptable material not being reused, from site.

1.2 Field Quality Control

A. Field inspection will be performed.

B. Provide for visual inspection of bearing surfaces, and compaction tests of all virgin and fill areas.

02223 - BACKFILLING

1.1 Acceptable Fill Materials Are:

A. Type A - Dense graded aggregates: Per MDOT-22A.

B. Type B - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; graded in accordance with ANSI/ASTM C136, to the following:

1. Minimum Size: ¼".
2. Maximum Size: 5/8".
3. Use pea gravel around building foundation drainage system around site utility trenches where designated.

C. Type C - Sand: Natural river or bank coarse sand; free of clay, lumps and soft or flaky material. Type 2NS per MDOT 8.02-4.

D. Type D - Native Subsoil: Free of organic material, gravel over 2" size, and debris; subject to conditions outlined in Soils Report.

E. Type E - Natural Granular Material: Meeting requirements of MDOT 8.02-3, Class III.

1.2 Accessories

A. Geotextile Fabric: "Miramot" No. 1800 by Mirafi, Inc.

1. Use Mirafi's #600X woven geotextile ground stabilization fabric where designated under all paved areas and area where proper compaction cannot be achieved without extensive excavation and backfilling.
2. Use Mifafi's #500X woven stabilization fabric under slabs-on-grade; in order to acquire proper compacted granular fill base.
3. Use Mifafi's #140 N non-woven filter fabric around footing drain lines, and around drain pipe in below slab drainage system.

1.3 Schedule

A. Interior Slab-On-Grade:

1. Types A or C fills, depth as specified by Soils Report; compacted to 95 percent modified proctor.
2. Coordinate with Division 7 for moisture and thermal protection.

B. Exterior Side of Foundation Walls and Over Granular Filter Material and Foundation Perimeter Drainage:

1. Subsoil Type D fill, to subgrade elevation, each lift, compacted to 90 percent modified proctor. Compact to 95% modified proctor where paving or other new construction occurs above.
2. Type B fill around drain tile and field tile under slab.

C. Fill Under Grass or Landscaped Areas:

1. Subsoil, Type D fill, to 6" below finish grade, compacted to 90 percent modified proctor.

D. Fill Under Asphalt or Concrete Paving:

1. Type A fill, depths as required per drawings, compacted to 95 percent modified proctor.

E. Fill to Correct Over-Excavation:

1. Type A, C, D, or E fill depending on required thickness, flush to required elevation, compacted to 95 percent modified proctor. Coordinate with project engineer.

02368 - DRIVEN PILES

1.1 Steel H-Piles: Hot-rolled carbon steel structural shapes and plates, ASTM A36.

1.2 Precast Piles:

A. Concrete, ASTM C96, 500 psi, 28 day minimum compressive strength and maximum aggregate size of ¾".

B. Reinforcing steel, ASTM A615, Grade 60 deformed bars, and ASTM A82, plain cold-drawn steel wire.

C. Prestressing tendons, ASTM A416, Grade 250, seven-wire, uncoated, stress-relieved steel strand.

02380 - CAISSONS

1.1 Concrete Mix Design: ASTM C94, 4000 psi, 28 day minimum compressive strength.

1.2 Portland Cement: ASTM C150, Type I or Type II.

1.3 Reinforcing Bars: ASTM A615, Grade 60.

1.4 Casings: Steel pipe, ASTM A252, grade 2 or ASTM A36.

02511 - ASPHALTIC CONCRETE PAVING

1.1 Materials

A. Asphalt Cement: ASTM D946, AC-5, 120-150; 5 percent of mixture by weight.

B. Aggregate for Binder Course Mix: State of Michigan Highway Standard, 20A;per MDOT 1100L mix.

C. Aggregate for Topping Course Mix: State of Michigan Highway Standard, 20AAA per MDOT 1300T mix.

D. Fine Aggregate: Coarse sand, State of Michigan Highway Standard.

E. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.

1.2 Accessories

A. Primer: Homogeneous, medium curing, liquid asphalt, MDOT Standards of MC-30, MC-70, or MS-OP.

B. Tack Coat: Homogeneous, medium curing, liquid asphalt, MDOT Standards of SS-1H, or CRS-1; 0.05 to 0.10 gallons per square yard.

C. Seal Coat (Paving): Asphalt Institute Manual S-4, sand slurry type; similar to "Jennite" by Neyra Industries, "J-16: by Maintenance, Inc.; or, other approved equivalent.

1.3 Asphalt Paving Mix

A. Use drive material to avoid foaming. Mix uniformly.

B. Binder Course: 4.5 to 6 percent of asphalt cement by weight in mixture in accordance with Asphalt Institute Manual MS-4, MS-13, and State of Michigan Highway Standard.

C. Surface Course: 5 to 7 percent of asphalt cement by weight in mixture in accordance with Asphalt Institute Manual MS-4, MS-13, and State of Michigan Highway Standard.

02515 - UNIT PAVERS

1.1 Brick Pavers

A. Class: ASTM C902, Weather Class SX for use subject to freezing application.

B. Traffic Type: ASTM C902, Traffic Type II for exterior commercial walkways use.

C. Application: ASTM C902, Application Type PS for general application.

D. Concrete Pavers: Solid concrete interlocking paving units, STM C936, normal weight aggregates.

02520 - PORTLAND CEMENT CONCRETE PAVING

1.1 Concrete: ASTM C150, Type I, Portland Cement; ASTM C33, normal weight aggregates; potable water.

1.2 Design Mix: ASTM C94, 4000 psi, 28 day minimum compressive strength.

1.3 Slump Limits: 8" minimum with superplasticizer, 3" otherwise.

1.4 Air content: 6 percent.

1.5 Broom finish

1.6 Wire Mesh: Welded plain steel wire fabric, ASTM A185.

1.7 Reinforcing Bars: Deformed steel bars, ASTM A615, Grade 60.

1.8 Fabricated Bar Mats: Steel bar or rod mats, ASTM A184, using STM A615, Grade 60 steel bars.

1.9 Joint Dowel Bars: Plain steel bars, ASTM A615, Grade 60.

1.10 Hook Bolts: ASTM A307, Grade A threaded bolts.

1.11 Liquid-membrane Forming and Sealing Curing Compound: ASTM C309, Type I, Class A.

1.12 Bonding Compound: Polyvinyl acetate or acrylic base.

1.13 Epoxy Adhesive: ASTM C881.

1.14 Minimum 6" sand-gravel sub-base MDOT 23A.

1.15 Stripping System: Water borne acrylic paint.

02660 - WATER SERVICE

1.1 Ductile Iron Pipe, 4 Inches and Larger: AWWA C151, Class 50 minimum.

1.2 PVC Pipe 4 Inches and Larger: AWWA C900, Class 150.

1.3 Fiberglass Pressure Pipe 2 Inches and Larger: AWWA C950, type I filament wound or Type II centrifugally cast; Grade 1 or 2; fiberglass fittings, AWWA C950, RTRP, 200 psi minimum pressure rating.

1.4 Copper Water Tube 2 Inches and Smaller: ASTM B88, Type K seamless, annealed temper; ANSI B16.22 wrought-copper, 50/50 solder-joint copper fittings.

1.5 PVC Pipe 3 Inches and Smaller: ASTM D1785, Schedule 40; Schedule 40 socket-type PVC fittings or elastomeric gasketed joint.

1.6 Polyethylene Pipe and Tubing 3 Inches and Smaller: AWWA C901; barbed insert type copper alloy or nylon fittings.

1.7 Couplings: ASTM A126, gray iron sleeve assembly with followers, rubber gaskets, bolts, nuts, and enamel paint finish.

1.8 Valves:

A. Nonrising stem gate, valves 3 inches and larger, AWWA C500.

B. Rising stem gate valves 3 inches and larger, AWWA C500 or AWWA C509.

C. Nonrising stem gate valves 2 inches and smaller, MSS SP-80.

D. Valve Accessories: Cast-iron valve boxes, curb stops, and service boxes for curb stops.

E. Tapping sleeve and tapping valve for new connections larger than 2 inches.

F. Service clamps and corporation stops for new connections 2 inches and smaller.

1.9 Anchorages:

A. Clamps, Straps, and Washers: ASTM A506, steel.

B. Rods: ASTM A575, steel.

C. Rod Couplings: ASTM A197, malleable iron.

D. Bolts: ASTM A307, steel.

E. Cast-Iron Washers: ASTM A126, gray iron.

F. Concrete Reaction Backing: ASTM C150, Type I Portland cement for 3000 psi, 28 day minimum compressive strength.

1.10 Yard Hydrants: Sanitary type.

1.11 Valve Pits and Meter Pits: Reinforced concrete with ladder and cat-iron manhole frame and cover.

1.12 Water Meter: Utility company approved water meter.

1.13 Meter Box: Cast-iron body and cover with lettering.

1.14 Identification: Metallic-lined plastic underground warning tapes.

1.15 Fire Service Main Accessories:

A. Hose House: 16 gauge steel with red baked enamel finish, hoses, and nozzles.

B. Alarm Devices: UL 753 and FM approved including water flow indicators, supervisory switches, and pressure switches.

1.16 Schedule:

A. Valve, Hydrant and Water Meter Schedule: Provide hydrants at 100 spacing at exterior walls of all buildings. Provide separate meters for domestic water, cooling tower water, and irrigation system. Provide storm and sewer cleanout every 50 to 100 feet along main route to site discharge into municipality.

02710 - FOUNDATION DRAINAGE

1.1 Drainage Pipe

A. Perforated PVC pipe, ASTM D2729 with socket joints.

1.2 Subsurface Drainage Mat for Vertical Surfaces: Composite non-woven geotextile filter fabric of polypropylene or polyester fibers and plastic material to conduct water to drainage at maximum soil pressure.

02720 - STORM AND SANITARY SEWERAGE

1.1 Pipe and Fittings

A. Hub and Spigot Cast-Iron Soil Pipe and Fittings: ASTM A74, gray cast iron for compression gasket joints, class of service as required.

B. Ductile Iron Pressure Pipe: AWWA C151, Class 50 for push-on joints.

C. Ductile-Iron Culvert Pipe: ASTM A716 for push-on joints.

D. Ductile-Iron Sewer Pipe: ASTM A746, Class 50, for push-on type or mechanical joints.

E. Reinforced Concrete Sewer Pipe and Fittings: ASTM C76, Class III, Wall B, for rubber gasket joints.

F. Ductile-Iron Pipe Encasement: AWWA C105, polyethylene film tube.

G. Couplings: Rubber or elastomeric compression gasket.

H. Gaskets" Compatible with pipe materials joined.

1.2 Manholes

A. Precast Concrete Manholes: ASTM C478.

B. Manhole Steps: Ductile iron or cast aluminum cast in concrete by fabricator.

C. Manhole Frames and Covers: ASTM A536, Grade 60-40-18, heavy-duty ductile iron with lettering.

1.3 Cleanouts

A. Cast-iron, brass or bronze.

1.4 Catch Basins for Strom Sewerage System

A. Precast Concrete Catch Basins: ASTM C478 or ASTM C858.

B. Catch Basin Steps: Cast aluminum, cast in concrete by fabricator.

C. Catch Basin Frames and Grates: ASTM A536, Grade 60-40-18, heavy-duty ductile iron.

D. Curb Inlets: precast concrete, stone, or brick conforming to utility standards.

1.5 Outfalls or Swale for Strom Sewerage System.

A. Cast-in-place reinforced concrete pipe, head wall apron, tapered sides, and rip rap or similar erosion protection.

B. Dry Wells for Strom Sewerage System: ASTM C858, precast reinforced perforated concrete rings with cast-in-place concrete floor and lift-off concrete cover.

C. Trench Drains for Strom Sewerage System: Interlocking precast polymer concrete modular units with grates, channel caps, and related accessories.

D. Identification: Metallic-lined plastic underground warming tapes.

028000 - SITE IMPROVEMENTS

1.1 Benches: Cast-iron and wood type.

1.2 Trash Receptacles: Precast concrete type.

1.3 Bicycle Racks: Galvanized steel.

1.4 Picnic Tables: Wood with attached seating.

1.5 Entry Bollards: Precast concrete with integral lighting.

1.6 Site Lighting: Pole mounted fixtures.

02810 - IRRIGATION SYSTEMS

1.1 Pressure Pipe: Galvanized steel pipe for pipe 3 inches and larger: ASTM A53, Schedule 40; copper water tube for pipe under 3 inches, ASTM B88, Type K.

1.2 Circuit Pipe: PVC plastic pipe, ASTM D1785, Schedule 40, Phillips Petroleum, Drisco polyethylene thermal fusion bond or equal.

1.3 Pipe Fittings for PVC Pipe: ATM D2466 socket fittings.

1.4 Valves with Cast Bronze Bodies:

A. Manual Circuit Valves: Globe Valves.

B. Key Operated Valves: Manual valves fitted for key operation.

1.5 Backflow Preventer: Cast bronze.

1.6 Sprinklers

A. Flush surface type with fixed pattern.

B. Bubbler type with fixed pattern.

C. Shrubbery type with fixed pattern.

D. Pop-up spray type with fixed pattern.

E. Pop-up rotary spray type, gear drive.

F. Pop-up rotary impact type, impact drive.

G. Above-ground rotary impact type, impact drive.

1.7 Valve Box: Precast concrete.

1.8 Valve Cover and Frame: Cat iron, lockable.

1.9 Automatic Control System

A. Interior control enclosure.

B. Low voltage transformer.

C. Circuit control.

D. Timing device.

E. Rain gauge/detector.

02831 - CHAIN LINK FENCES AND GATES

1.1 Fabric

A. Material: Galvanized steel, ASTM A392, Class 2 finish.

B. Size: 2 inch mesh, 9 gauge steel.

1.2 Framework: Galvanized steel, ASTM F1083.

1.3 Gates: Swinging type at walkways. Cantilevered sliding type at vehicle entrances,

1.4 Framing and Fittings

A. End, corner, and pull posts, 2" IPS.

B. Line and intermediate posts, 1/12" IPS.

C. Gate post, 6" IPS

D. Top rail 1/12" IPS.

E. Tension wire.

F. Tie wires.

G. Bottom rail 1 ½" IPS

H. Post and line caps.

I. Barbed wire supporting arms, 15" 3 strands.

J. Barbed wire.

02900 - LANDSCAPE WORK

1.1 Plant Materials

A. Deciduous trees

B. Deciduous shrubs.

C. Coniferous and broad leafed evergreen trees and shrubs.

D. Ground cover.

E. Plants.

1.2 Lawns

A. Sod locally grown.

1.3 Seed Mixture (a combination of the following)

A. Fawn tall fescue.

B. Annual rye.

C. Perennial rye.

D. Kentucky Blue grass.

E. Creeping Red Fescue.

F. No toxic weed seeds permitted.

1.4 Topsoil: From site stockpile with additional fertile, friable topsoils form local source.

1.5 Soil Amendments:

A. Lime: Dolmitic limestone.

B. Aluminum Sulfate: Commercial grade.

C. Peat Humus: Finely divided peat.

D. Superphosphate: 20 percent available phosphoric acid.

E. Sand: Clean, washed sand.

F. Perlite: NBS PS 23.

G. Sawdust: Rotted sawdust free of chips and stones.

H. Manure: Rotted stable manure.

I. Commercial Fertilizer: Neutral character for plant materials and lawns.

J. Mulch: Ground or shredded pine bark mulch.

1.6 Landscape Materials:

A. Gravel: Water-worn gravel.

B. Anti-Erosion Mulch: Seed-Free salt hay or threshed straw.

C. Anti-Desiccant: Emulsion type, film-forming.

D. Plastic Sheet: Black polyethylene, 8 mils.

E. Filtration Fabric: Water permeable fiberglass or polypropylene fabric.

F. Wrapping: Tree-wrap tape.

G. Stakes and Guys: New hardwood, treated softwood, or redwood.

H. Metal Edging: Commercial steel edging.

I. Wood Headers and Edging: All heart redwood or pressure treated southern yellow pine.

03300 - CAST-IN-PLACE CONCRETE

1.1 Concrete Design Mixes, ASTM C94, 28 day compressive strength.

	Fc, psi at 28 days	Max WC Ratio	Max Slump (Inches)	Total Air Content (+/- 1-1/2%)
Cast-in-place concrete:				
Footings	4000	0.45	4	no test
Grade beams	4000	0.45	3*	7
Utilities	3000	0.45	3*	7
Slab on grade	3500	0.45	3*	7

Stairs, landings, lobbies	5000	0.40	3*	7
Pour strips, topping	5000	0.40	3*	7
Paving	4000	0.45	3*	7
All other	4000	0.45	3*	7
Other concrete concrete:				
Columns base drypack	8000		0	no test
Masonry wall grout fill	3000		8	no test
N.S.N.S grout	8000		0	no test

***** Prior to adding superplaticizer.....

03350 - CONCRETE TOPPINGS

Standard Aggregate Toppings

A. Portland cement: ASTM C150, Type 1 or Type III

B. Standard aggregate: ASTM C33.

C. Design mix: ASTM C94, 3500 psi, 28 day compressive strength.

D. Reinforcement: Welded steel wire fabric, ASTM A185.

1.2 Heavy-Duty Aggregate Toppings

A. Portland cement: ASTM C150, Type I or Type II.

B. Heavy-duty aggregate: Crushed or natural taprock, quartz, granite or corundum.

C. Design Mix: ASTM C94, 5000 psi, 28 day compressive strength.

D. Reinforcement: Welded steel wire fabric ASTM A185.

1.3 Heavy0Duty Metallic Floor Topping: Iron aggregate and cement topping, 10200 psi, 28 day compressive strength; 1428 psi flexural strength.

03355 - SPECIAL CONCRETE FINISHES

1.1 Abrasive Blast Finish

A. Brush Cut: Face of fine aggregate exposed, no reveal.

B. Light Cut: Fine aggregate exposed, maximum 1/16” reveal.

C. Medium Cut: Coarse aggregate exposed, ¼; reveal.

D. Heavy Cut: Coarse aggregate exposed to maximum projection of 1/3 diameter; 3/8” to ½”; reveal.

E. Acid Cleaning: Weak acid wash after blasting and neutralization of acid.

1.2 Bushhammer Finish

A. Finish: Depth of cut and aggregate exposure matching control samples.

B. Acid Cleaning: Weak acid wash after blasting and neutralization of acid.

1.3 Scrubbed Finish

A. Finish: Wire brush scrubbed finish producing uniform exposure of aggregate.

B. Acid Cleaning: Weak acid wash after blasting and neutralization of acid.

03415 - PRECAST HOLLOW CORE PLANKS

1.1 Materials:

A. Materials: ACI 318.

B. Tensioning Steel Tendons: ASTM A416, Grade 250K or 270K, of sufficient strength commensurate with member design.

C. Reinforcing Steel: STM A615, deformed steel bars.

D. Grout: Non-shrink, non-,metallic, minimum yield strength of 10,000psi at 28 days.

1.2 Accessories

A. Connecting and Supporting Devices: ASTM A36 carbon steel plates, angles, items cast into concrete, or items connected to steel framing members, inserts, conforming to PCI NML-123; prime painted. Do not paint surfaces in contact with concrete or surfaces requiring field welding.

B. Core Hole End Plugs: Cardboard insert and concrete fill.

C. Hanger Tabs: Galvanized steel, designed to fit into grouted key joints, capable of supporting 500 pounds dead load, predrilled to receive hanger.

D. Bearing Pads: High density plastic 1/8” thick, smooth both sides.

E. Sill Seal: compressible glass fiber strips.

03450 - ARCHITECTRUAL PRECAST CONCRETE

1.1 Design Mix: 5000 psi, 28 day compressive strength, 4 to 6 percent total air content.

1.2 Formwork: Plywood or metal panel formwork sufficient for structural and visual requirements, set with block-outs for reveals and other panel articulation.

1.3 Concrete Materials.

A. White Cement: Portland cement, ASTM C150, Type I.

B. Fine Aggregate (in approved color) for Facing Mixes: ASTM C33.

C. Coarse Granite Aggregate for Facing Mix: ASTM C33.

D. Pigments: Nonfading lime resistant pigments.

03520 - INSULATING CONCRETE DECKS

1.1 Perlite Aggregate Design Mix.

A. Wet Density at Placement: 38-40 pcf, ASTM C138.

B. Oven Dry Density: 24 to 30 PCF, ASTM C495.

C. Compressive Strength: Minimum 125 psi, ASTM C495.

1.2 Vermiculite Aggregate Design Mix

A. West Density at Placement: 44 to 60 pcf, ASTM C.

B. Oven Dry Density: 22 to 28 pcf, ASTM C495.

C. Compressive Strength: Minimum 125 psi, ASTM C.

04200 - UNIT MASONRY

1.1 Face Brick

A. Size: Standard, 3-5/8” x 2-1/4” x 8”.

B. Size: Utility 3-5/8” x 3-5/8” x 11-5/8”.

C. Grade: ASTM C216, Grade SW, severe weathering type.

D. Special Shapes: As required by building configuration.

E. Bond Pattern: Running bond.

1.2 Concrete Masonry Units

A. Hollow Load-Bearing Concrete Masonry Units: ATM C90, 1900 psi compressive strength, normal weight.

B. Size: Face dimension of 7-5/8” x 15-5/8”.

C. Concrete Building Brick: ASTM C55.

D. Special Finish: As selected by architect.

E. Special Shapes: As required by building configuration.

F. Bond Pattern: Running bond.

04270 - GLASS UNIT MASONRY

1.1 Hollow Glass Block: Non-loadbearing glass block with partial vacuum interior.

A. Pattern: Translucent, light-diffusing prismatic design.

B. Edge Coating Color: White

C. Shape: Square, nominal 8 inches square.

D. Corner Unit: Preformed.

E. Joint Width: ¼ inch.

04402 - INTERIOR STONEWORK

1.1 Granite

A. Building Stone Standard: 24” x 24” minimum typical stone panel size: ASTM C615.

B. Finish of Veneer: Polished and/or flamed thermal finish.

C. Finish of Flooring, Steps and Risers: Flamed thermal finish, with limited polished finish accents.

D. Type: As selected form samples.

E. Joints: Grout joints.

F. Veneer Thickness: ¾ minimum.

G. Stone Tile Thickness: ¾ inch minimum.

1.2 Marble:

A. Building Stone Standard: 24” x 24” minimum typical stone panel size: ASTM C503.

B. Classification: Calcite, Dolomite, Serpentine or Travertine marble.

C. Finish of Veneer: Honed finish.

D. Finish of Flooring, Steps, and Risers: Honed very flat or lightly bush hammered finish, with limited polished accents.

E. Type: Group A, Marble Institute of America as selected from samples.

F. Joints: Grout joints.

G. Veneer Thickness: ¾ inch minimum.

H. Stone Tile Thickness: ¾ inch.

1.3 Limestone

A. Building Stone Standard: 24” x 24” minimum stone panel size.

B. Finish Veneer: As selected.

C. Type: As selected from samples.

D. Joints: Grout joints

E. Veneer Thickness: 1-inch minimum.

04405 - EXTERIOR STONEWORK

1.1 Granite

A. Building Stone Standard: ASTM C615.

B. Finish: Polished and thermal.

C. Finish of Paving, Steps and Risers: Thermal.

D. Type: Color as selected by architect.

E. Joints: Mortar, ASTM C270, Type S.

F. Cladding Thickness: 1/14” plus or minus 1/8”.

1.2 Limestone

A. Building Stone Standard: 24” x 24: minimum stone panel size.

B. Finish Veneer: Polished finish.

C. Finish of Flooring, steps and Risers: As selected.

D. Type: As selected from samples.

E. Joints: Mortar joints

F. Veneer Thickness: 1 ¼” plus or minus 1/8”.

05120 - STRUCTURAL STEEL

1.1 Steel Materials

A. Structural Steel Shapes, Plates, and Bars: ASTM A36 Fy=36 Ksi or ASTM A572 Fy=50 Ksi.

B. Cold-Formed steel Tubing: ASTM A5090, Grade b.

C. Hot-Formed Steel Tubing: ASTM A501.

D. Steep Pipe: ASTM A53, Type E or S, Grade B; or ASTM A501.

E. Steel Castings: ASTM A27, grade 65-35.

F. Headed Stud-Type Shear Connectors: ASTM A108, Grade 1015 or 1020.

G. Anchor Bolts: ASTM A307, nonheaded type.

H. Unfinished Threaded Fasteners: ASTM A325 or ASTM A490, as applicable.

05220 - STEEL JOISTS AND JOIST GIRDERS

1.1 Steel Materials:

A. Type: K, LH, or DLH-series open web steel joists.

B. Steel: SJI specifications for chord and web s.

C. Steel Bearing Plates: ASTM A36.

05310 - STEEL DECK

1.1 Steel Floor and Roof Deck Units

A. Acoustical deck multiple-pan cellular units.

B. Non-composite steel form deck.

C. Cellular metal deck units, double-cell units.

D. Composite steel deck.

1.2 Standards: AISI, specification for the design of cold-formed steel structural members; and SDE design manual for composite decks, form decks and roof decks.

A. Approvals: UL label and FM listing.

1.3 Steel Materials and Finish

A. Type: Steel for galvanized metal deck, ASTM A446.

B. Steel Shapes: ASTM A36 Fy=36 S=KSI or ASTM A572 Fy=36 KSI or ASTM 572 Fy=50 Ksi.

C. Shear Connectors: Headed stud type, ASTM A108.

D. Sheet Metal Accessories: ASTM A526, commercial quality, galvanized.

E. Galvanizing: ASTM A525, G60.

F. Galvanizing Repair: ASTM A780.

1.4 Auxiliary Materials

A. Metal cover plates.

B. Metal closure strips.

C. Roof sump pans.

D. Flexible Closure strips.

E. Acoustic sound barrier closures.

05400 - COLD FORMED METAL FRAMING

1.1 Cold-Formed Metal Framing Materials.

A. Stud Type: C-shaped load bearing steel studs.

B. Joist Type: C-shaped steel joists.

C. Units 16 gauge and heavier: ASTM A446, A570, or A611, yield point 40 ksi.

D. Units 18 gauge and lighter: ASTM A446, A570, or A611, yield point 33 ksi.

E. Finish: Galvanized, ASTM A525, G60.

0500 - METAL FABRICATIONS

1.1 Metal Fabrications

A. Metal stairs.

B. Steel pipe railings.

C. Ladders for elevator pit.

D. Ladders and safety cages.

E. Ship's Ladders.

F. Nosings.

G. Cast treads and thresholds.

H. Loose bearing and leveling plates.

I. Loose steel lintels.

J. Framing and supports for overhead doors.

K. Framing and supports for suspended toilet partitions.

L. Framing and supports for suspended folding partitions.

M. Framing and supports for suspended operable partitions.

N. Prefabricated building columns.

O. Miscellaneous steel trim.

P. Shelf and relieving angles.

Q. Structural steel door frames for overhead doors.

R. Metal bar gratings.

S. Expanded metal gratings.

T. Floor plate and supports.

U. Tread plate and supports.

V. Pipe bollards.

W. Elevator entrance sill angles.

X. Rough hardware.

1.2 Ferrous Materials:

A. Steel Plates, Shapes and Bars: ASTM A36.

B. Rolled Steel Floor Plates: ASTM A766.

C. Steel Bars for Gratings: ASTM A569 or A36.

D. Wire Rod for Grating Cross Bars: ASTM A510.

E. Steel Tubing: ASTM A 500 or A 501.

F. Uncoated Structural Steel Sheet: ASTM A611 or A570.

G. Uncoated Steel Sheet: ASTM A 366 or A 569.

H. Galvanized Steel Sheet, Structural Quality: ASTM A526, G90.

I. Galvanized Steel Sheet, Commercial Quality: ASTM A526, G90.

J. Steel Pipe, Black Finish: ASTM A53.

K. Steep Pipe, Galvanized Finish: ASTM A53.

L. Gray Iron Castings: ASTM A48, Class 30.

M. Malleable Iron Castings: ASTM A47, grade 32510..

N. Reinforcing Bars: ASTM A 615, Grade 60.

O. Brackets, Flanges, and anchors: Cast of formed metal.

P. Concrete Inserts: Threaded or wedge type.

Q. Welding Rods and Bare Electrodes: AWS specifications.

R. Zinc-Coating: Hot-dip galvanized coating for materials in exterior assemblies or exterior walls.

1.3 Stainless Steel Materials

A. Bar Stock: ASTM A276, Type 302 or 304.

B. Plate: ASTM A167, Type 302 or 304.

1.4 Aluminum Materials:

A. Extruded Bars and Shapes: ASTM B221 aluminum alloy.

B. Rolled Tread Plate: ASTM B 632 aluminum alloy.

C. Rivets: ASTM B 316, aluminum alloy.

D. Sheet for Expanded Aluminum Grating: ASTM B209.

E. Fasteners: ASTM A 153.

F. Finish: Clear anodized.

1.5 Fasteners:

A. Bolts and Nuts: Hexagon head type, ASTM A307, Grade A.

B. Lag Bolts: Square head, FS, FF-B-561.

C. Machine Screws: Cadmium plated steel, FS FF-S92.

D. Wood Screws: Flat head carbon steel, FS FF-S-111.

E. Plain Washers: Round carbon steel, FS FF-W-92.

F. Drilled-In Expansion Anchors: FS FF-S-325.

G. Toggle Bolts: Tumble-wing type, FS FF-B-588.

H. Lock Washers: Spring type carbon steel, FS FF-W-84.

I. Zinc-Coating: Fasteners in exterior assemblies or exterior walls.

05521 - PIPE AND TUBE RAILINGS

1.1 Aluminum Pipe and Tube Railing Systems:

A. Extruded Bar and Tube: ASTM B221, alloy 6063 T5/T52.

B. Extruded Structural Pipe and Tube: ASTM B429, alloy 6063 T5/T52.

C. Drawn Seamless Tube: ASTM B210, alloy 6063 T832.

D. Plate and Sheet: ASTM B209, alloy 6061 T6.

E. Die and Hand Forgings: ASTM B247, alloy 6061 T6.

F. Castings: ASTM B26, alloy A356 T7.

G. Finish: Clean anodized.

1.2 Stainless Steel Pipe and Tube Railing Systems:

A. Tubing: ASTM A554, Grade TP304 or TP 316.

B. Pipe: ASTM A312, Grade TP304 or TP316.

C. Casting: ASTM A743, Grade CF8 or CF20.

D. Plate: ASTM A167, Type 304 or 316.

E. Finish: AISI No. 4 bright directional polish.

1.3 Steel Pipe and Tube Railing Systems:

A. Steel Pipe, Black Finish: ASTM A53.

B. Steel Pipe, Galvanized Finish: ASTM A53.

C. Steel Tubing: ASTM A500 or A501.

D. Steel Plates, Shapes and Bars: ASTM A36.

E. Gray Iron Castings: ASTM A48, Class 30.

F. Malleable Iron Castings: ASTM A47, Grade 32510.

G. Finish: Galvanized.

05580 - SHEET MEAL FABRICATIONS

1.1 Sheet Metals:

A. Steel Sheet, Galvanized: ASTM A526 or A527, G90.

B. Steel Sheet, Zinc-Coated: ASTM A591, Class C.

C. Steel Sheet, Uncoated: ASTM A366, Class I.

D. Stainless Steel Sheet: ASTM A167, Type 302 or 304.

E. Aluminum Sheet: ASTM B209, alloy 5005 H15.

1.2 Auxiliary Materials:

A. Sound Deadening Insulation: Unfaced miner fiber batt.

B. Welding Electrodes and Filler Metal: AWS specifications.

C. Fasteners, Anchors, and Inserts: Noncorrosive.

D. Gaskets: Flexible cellular neoprene, ASTM D1056.

E. Bituminous Paint: Asphalt mastic, SSPC-Paint 12.

05720 - ORNAMENTAL HANDRAILS AND RAILINGS

1.1 Stainless Steel:

A. Tubing: ASTM A554, Grade MT301, 302, or 304.

B. Pipe: ASTM A312, Grade TP304.

C. Castings: ASTM A743, Grade CF8 or CF20.

D. Plate: ASTM A167, Type 301, 302 or 304.

E. Finish: AISI No. 7, satin reflective directional polish.

1.2 Steel and Iron:

A. Steel Tubing: ASTM A500 or A501.

B. Steel Plates, Shapes, and Bars: ASTM A36.

C. Gray Iron Castings: ATM A48, Class 30.

D. Malleable Iron Castings: ASTM A47.

E. Finish: Galvanized and shop primed.

1.3 Glass Components:

A. Tempered Glass: ASTM C1048, Kind FT, Condition A.

B. Glass Color: Transparent

05810 - EXPANISION JOINT COVER ASSEMBLIES

1.1 Assemblies:

A. Type: Metal assembly with flat cover plates.

B. Performance: Based on building use.

1.2 Expansion Joint Cover Materials:

A. Aluminum: ASTM B221, alloy 6063 T5 for extrusions: ASTM B209, alloy 6061 T6 for sheet and plate.

B. Bronze: ASTM B455, alloy C38500 for extrusions; alloy C28000, Muntz metal for plates.

C. Brass: UNS alloy C26000 for half hard sheet and coil.

D. Stainless Steel: ASTM A167, Type 304 for plates, sheet, and strips.

E. Preformed Seals: ATM D2000 rubber extrusions.

F. Elastomeric Sealant: ASTM C920, Use T. Extrusions.

G. Seismic Seals: ASTM D2000 rubber extrusions.

H. Fire Barriers: Based on fire performance standards.

1.3 Finishes:

A. Aluminum Finish: Clear anodized.

06100 - ROUGHT CARPENTRY

1.1 Dimension lumber.

A. Light Framing: Stud, No. 3 or standard grade.

B. Structural Framing: Select structural No. 1 grade.

C. Species: Any species of grade indicated.

D. Exposed Framing: Appearance grade.

1.2 Boards:

A. Exposed Boards: 15% moisture content.

B. Concealed Boards: 19% moisture content.

1.3 Miscellaneous Lumber:

A. Moisture Content: 19%.

B. Grade: Standard grade light framing.

1.4 Particleboard:

A. Underlayment: ANSI A208.1, grade 1-M-1, grade marked.

B. Subflooring: ANSI A208.1, grade 2-M-W (waferboard) or Grade 2-M-3.

1.5 Gypsum Sheathing:

A. Material: Glass-fiber-surfaced-gypsum sheathing board.

B. Type: Type X fire-resistant ASTM C79.

1.6 Plastic Board Sheathing:

A. Material: Polyisocyanurate, FS HH-I-1972/1 for Class 2.

1.7 Lumber Standards and Grade Stamps: PS20, American Softwood Lumber Standard and inspection agency grade stamps.

1.8 Preservative Treatment: AWPA C2 for lumber and AWPA C9 for plywood; noncorrosive type.

1.9 Fire Retardant Treatment: AWPA C20 for lumber and AWPA C27 for plywood; non-corrosive type.

06402 - FINISH CARPENTRY

1.1 Interior Standing and Running Trim and Rails:

A. Species for Transparent Finish: Rift sawn red oak or comparable quality.

B. Grade: Premium.

1.2 Interior Wood Casework:

A. Species for Transparent Finish: Rift/sawn/cut red oak or comparable quality.

B. Grade: Premium.

C. Face Style: Flush

D. Frame Fabrication: Face Frame

E. Grain Matching: Vertical.

F. Veneer Matching of Leaves: End.

G. Veneer Matching in Panel Face: Slip.

1.3 Interior Laminate-Clad Casework:

A. Laminate: High pressure decorative laminate, NEMA LD-3.

B. Grade: Premium.

C. Face Style: Flush

D. Frame Fabrication: Face Frame.

1.4 Casework Hardware and Auxiliary Materials:

A. Hardware Standard: ANSI/BHMA A156.9.

B. Hardware Finish and Base Metal: Satin stainless steel.

C. Glass: Clear Tempered glass, ASTM C1048.

1.5 Interior Ornamental Items:

A. Species for Transparent Finish: Rift sawn red oak or comparable quality.

B. Grade: Premium.

06420 - PANEL WORK

1.1 Flush Wood Paneling:

A. Species for Transparent Finish: Rift Sliced red oak or comparable quality.

B. Grade: Premium.

C. Core: Particleboard.

D. Veneer Matching of Leaves: End.

E. Veneer Matching in Panel Face: Balance.

F. Panel Matching Method: Premanufactured sets.

1.2 Factory Finishing:

A. Transparent Finish: Premium grade with stain with dull satin sheen.

B. Opaque Finish: Custom grade with bright rubbed semi-gloss sheen.

1.3 Fire-Retardant Treatment:

A. Lumber: AWPA C20, non-corrosive interior type.

B. Plywood: AWPA C27, non-corrosive interior type.

C. Particleboard: ASTM E84 flame spread 20 or less, smoke developed 25 or less.

07110 - SHEET METAL MEMBRANE WATERPROOFING

1.1 Modified Bitumen Sheet Waterproofing: Modified bitumen sheets, 1/8" thick, tensile strength 1400 psi, ASTM D412.

1.2 Flashing Materials and Protection Board: Compatible with membrane waterproofing.

1.3 Drainage Fabric: Woven filter fabric glued to gridded plastic drainage mat.

07130 - BENTONITE WATERPROOFING

1.1 Bentonite Panels, Kraft Board Type: Kraft board panels 3/16" thick containing 1.0 pound per square foot of bentonite.

1.2 Granular Bentonite: Dust-free bentonite granules, packaged in moisture proof bags.

1.3 Plastic Bentonite: Hydrated bentonite gel, minimum 3/16" thick at surfaces and 3/8" thick at construction joints.

1.4 Protection Board: Compatible with bentonite waterproofing.

07160 - BITUMINOUS DAMPPROOFING

1.1 Hot Applied Coal-Tar Dampproofing:

A. Materials and Application: Coal tar primer, ASTM D43, and coal tar bitumen, ASTM D450, Type II or III; 2 coat, total 60 mils.

B. Protection Course: compatible with dampproofing.

07175 - WATER REPELLENTS

1.1 Water Repellents

A. Appearance: Clear, non-gloss, non-yellowing.

B. Vapor Transmission: Breathing type, non vapor barrier.

C. Penetrating Sealers (not visible): Solvent-based siloxane.

D. Application Rate: Suitable for substrate and project conditions.

07190 - VAPOR AND AIR BARRIERS

1.1 Sheet Materials.

A. Sheet Barrier, Type 1: Black polyethylene film for above grade application, 10 mil.

B. Sheet Barrier, Type 2: Black polyethylene film reinforced with glass fiber square mesh.

1.2 Sealants

A. Butyl Sealant, Type A: FS TT-S-001657, butyl rubber base, single component, solvent release, non-skidding, shore "A" hardness range of 10 to 30; black color.

B. Polysulphide Sealant, Type B: FS TT-S-00230, Type II Class A; single component, chemical curing, capable of continuous water immersion, non-sagging type, black color.

07210 - BUILDING INSULATION

1.1 Board Insulation:

A. Type: Extruded polystyrene ASTM C578 compressive strength minimum 25 psi, water absorption per ANSI/ASTM D2842, 0.15 percent.

B. Vapor Retarder: Integral vapor retarder as required for application.

1.2 Blanket/Batt Insulation:

A. Type: Glass fiber or mineral slag fiber, ASTM C665, Type I (unfaced).

B. Type: Glass fiber or mineral slag fiber, ASTM C665, Type III (foil-scrim-kraft vapor-retarder membrane).

1.3 Acoustical Insulation:

A. FS-HH-I-521, preformed mineral wool friction fit, thickness and density as required, for STC rating.

1.4 Loose Fill Insualtion:

A. Type: Losse granular vermiculite, ASTM C516, Type II.

1.5 Vapor Retarder (not integral with insulation).

A. Type: Reinforced 2-ply polyethylene, 6 to 8 mils.

07250 - FIREPROOFING

1.1 Concealed Sprayed-On Fireproofing:

A. Type: Cellulose Insulation, 2 pounds per cubic foot dry density, ASTM D1622.

B. Auxiliary Materials: Primers, adhesive, lath, and reinforcing fabric.

1.2 Exposed Sprayed-On Fireproofing:

A. Type: High density cementitious fireproofing, cement-aggregate or mineral-fiber formulation.

B. Auxiliary Materials: Primers, adhesive, lath, and reinforcing fabric.

C. Sealer for Mineral-Fiber Fireproofing: Clear-drying protective coating for nondusting applications.

1.3 Mineral Fiber Board Fireproofing:

A. Type: Semi-refactory fiber board, faced.

B. Auxiliary Materials: Anchorage assemblies required for fire rating and attachment.

07270 - FIRESTOPPING

1.1 Through-Penetration Firestopping of Fire-Rated Construction:

A. Systems or devices listed in the U.L. Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and tht the system be symmetrical for wall applications. Systems or devices must be asbestos free.

1. Additional Requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the U.L. system or device, and designed to perform this function.
2. Acceptable manufacturers and products.
   a. Those listed in the U.L. Fire Resistance Directory for the U.L. system involved.
3. All Firestopping products must be from a single manufacturer.
   a. All trades shall use products from the same manufacturer.

1.2 Construction-Gap Firestopping of Fire-Rated Construction.

A. Firestopping at construction gaps between edges of floor slabs and exterior wall construction.

B. Firestopping at construction gaps between tops of partitions and underside of structural system.

C. Firestopping at construction gaps between tops of partitions and underside of ceiling or ceiling assembly.

D. Firestopping of control joints in fire-rated masonry partitions.

E. Firestopping expansion joints.

F. Acceptable manufacturers and products: Those listed in the U.L. Fire Resisitance Directory for the U.L> system involved.

1.3 Smoke Stopping at Smoke Partitions:

A. Through-Penetration Smoke Stopping: Any system complying with the requirements for through-penetration firestopping in fire rated construction, as specified in this , is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistnace may be disregarded.

B. Construction Gap Smoke Stopping: Any system complying with the requirements for construction gap firestopping in fire rated construction, as specified in this , is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resisitance may be disregarded.

1.4 Materials:

A. Firestopping Material: Single or multiple component silicone elastomeric rubber type foam compound, formulated compound mixed with incombustible non-asbestos ceramic fibers.

B. Primer: Type recommended by firestopping manufacturers for specific substrate surfaces.

07411 - MANUFACTURED ROOF PANELS

1.1 Manufactured Roof Panels:

A. Sheet Materials: Aluminum-zinc alloy coated steel sheet, ASTM A792, with Class AZ-50 coating, 24 gauge.

B. Panel Core: Polyisocyanurate board insulation.

C. Finish: Fluoropolymer, Kynar 500.

1.2 Panel Supports and Anchorage:

A. Roof Purlin: C or Z shaped s, 16 gauge steel, shop painted.

B. Eave Struts: C shaped s, 16 gauge steel, shop painted.

C. Flange and Sag Bracing: 16 gauge steel, shop painted.

D. Base and Sill Angles: 14 gauge galvanized steel.

E. Secondary Structural Members: 14 gauge galvanized steel.

07512 - BUILD-UP COAL TAR ROOFING

1.1 Built-Up Coal Tar Roofing:

A. Type: Inverted roof membrane, 4 ply, 20 year warranty.

B. Felt: Asphalt/glass-fiber felts.

C. Deck Type: Insulated deck.

1.2 Auxiliary Materials:

A. Vapor Retarder: Bituminous vapor retarder.

B. Insulation: Polyisocyanruate foam board.

C. Surfacing Aggregate: Crushed stone.

D. Walkway Protection Boards: Compatible with system.

E. Sheet Metal Accessories: SMACNA and NRCA recommendations.

07600 - FLASHING AND SHEET METAL

1.1 Sheet Metal Flashing and Trim:

A. Lead Coated Copper: ASTM B370, 16 ounces per square foot.

1.2 Fabricated Units: Compliance with SMACNA Architectural Sheet Metal Manual.

07700 - ROOF SPECIAL TIES AND ACCESSORIES

1.1 Roof Hatches:

A. Lid: Insulated metal lid.

B. Framing: Zinc-coated steel.

C. Curb Type: Insulated double wall curb.

D. Size 2'-6" x 5'-0".

1.2 Verticle- Type Gravity Ventilators:

A. Type: Curb-mounted verticle-type gravity ventilators.

B. Materials: Sheet Aluminum.

C. Dampers: Manual operaton.

D. Screens: Insect screens.

1.3 Curb and Equipment Support Units:

A. Type: Designed for roof type and equipment.

B. Materials: Steel, 14 gauge, baked enamel finish.

1.4 Curb-Set Roof Expansion Joints:

A. Type: Prefabricated expanision joints for installation on rasied curbs.

B. Materials: Extruded aluminum with waterproof bellows.

07710 - MANUFACTURED ROOF SPECIALTIES

1.1 Fascia Systems:

A. Type: Standard modular panels, trim, closure strips, and accessories.

B. Materials: Extruded aluminum panels, 0.050" thick.

1.2 Fascia and Gravel Stops: Aluminum sheet, 0.050" thick interlocking with 26 gauge formed zinc-coated steel water dam/hold down clip, compression clamp, compression pad, and expansion covers.

1.3 Metal Fascia Panel Support Systems: Horizontal girts and verticle framing members sized for required wind pressure loading.

1.4 Aluminum Copings: Interlocking multi-part coping system, 0.50" thick aluminum sheet, 24 gauge zinc-coated steel anchor plate, and formed aluminum gutter.

1.5 Elastic Roof Expansion Joint Covers: Metal flanged elastic-sheet bellows-type joint system, membrane, and metal flanges compatible with substrate.

1.6 Finishes:

A. Aluminum Finish: Fluoropolymer, Kynar 500 or equivalent.

B. Application: Factory-applied.

07900 - JOINT SEALERS

1.1 Silicone Elastomeric Joint Sealants:

A. Type and Applications: One-part nonacid-curing silicone sealant, aSTM C920, for vertical and horizontal joints, modules as required for applicaton, exterior and interior use.

1.2 Polysulfide Elastomeric Joint Sealants:

A. Type and Application: Two-part nonsag polysulfide sealant, ASTM C920, for vetical joints, exterior and interior.

1.3 Compression Seals:

A. Type: preformed hollow neoprene gasket, ASTM D2628.

B. Application: Wide exterior joints in vertical surfaces.

1.4 Fire-Resistive Joint Sealers:

A. Type: Foamed-in-place fire-stopping sealants.

B. Application: Penetrations in fire-rated floor and wall assemblies.

1.5 Speciality Sealants:

A. Type of Application: Synthetic rubber acoustical sealant at concealed joints.

1.6 Paving Joint Fillers:

A. Type: Bituminous fiber.

B. Application: Filler for exterior paving joints.

08111 - STANDARD STEEL DOORS AND FRAMES

1.1 Steel Doors:

A. Door Type: Flush steel doors with hollow or composite construction.

B. Interior Doors: ANSI/SDI-100, Grade II, heavy-duty, minimum 16 gauge cold-rolled steel, 1 ¾" thick.

C. Exterior Doors: ANSI/SDI-100, Grade III, extra-heavy-duty, minimum 16 gauge galvanized sheet steel, 1 ¾" thick insulated core.

D. Accessories: Sightproof stationary louvers and glazing stops.

E. Finish: Factory primed and field painted.

1.2 Steel Frames:

A. Interior Frames: Welded type, 16 gauge sheet steel, mitered or coped corners.

B. Exterior Frames: Welded type, 16 gauge galvanized sheet steel, mitered or coped corners.

C. Accessories: Door silencers and plaster guards.

D. Finish: Factory primed and field painted.

08211 - FLUSH WOOD DOORS

1.1 Interior Solid Core Doors:

A. Grade: Premium grade.

B. Construction: 5-ply or 7-ply construction with particleboard or glued-block core.

C. Finish: Satin as selected and transparent finish on rift-cut red oak (or comparable quality) faces, factory or field applied.

08305 - ACCESS DOORS

1.1 Access Doors:

A. Frames: 16 gauge sheet steel with flange suitable for adjacent material.

B. Doors: 14 gauge sheet steel.

C. Door Type: Recessed panel to accept ceiling finish material.

D. Locking Deveices: Cylinder locks.

E. Provide access doors for fire rated assembly as required.

08330 - OVERHEAD COILING DOORS

1.1 Overhead Coiling Doors:

A. Type: Insulated standard service door.

B. Door Curtain: Galvanized steel.

C. Slat Profile: S-configuration.

D. Operation: Electric door operator - 3 button.

E. Steel Finish: Galvanized finish with field applied paint.

F. Fire Rated Assemblies: NFPA-80.

08360 - OVERHEAD DOORS

1.1 Sheet Steel: ANSI/ASTM A526 galvanized to 1.25 oz/sq ft., roll formed with v-groove for ribbed effect.

1.2 Metal Primer Paint: Zinc chromate type.

1.3 Insulation: polyurethane; same thickness as core framing members, bonded to facing.

1.4 Glazing: Wire glass or Polycarbonate, ¼ inch thick.

1.5 Weatherstripping: Resilient neoprene strip.

1.6 Panels: Flush steel construction; outer steel sheet of .016 thick, v-grooved profile; inner steel sheet of .016 gage thick, flat profile.

1.7 Galzed Lights: Glaszing for multiple glazed lights per door; set in place with resilient glazing channel.

1.8 Track: 13 gauge thick; inch wide rolled high rise steel track, continuous, verticle mounted; galvanized steel mounting brackets.

1.9 Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel.

1.10 Safety Edge: At bottom of door panel, full width, pneumatic sensitized type, wired to reverse door upon striking object; hollow neoprene covered to weatherstrip seal.

1.11 Jamb Weatherstripping: Formed metal retainer fitted full height of jamb with integral resilient weatherstripping in moderate contact with door panels.

1.12 Lift Mechanism: Torsion spring on cross head shaft, with braided steel life cables.

1.13 Electric Operator: NEMA Type 1 motor, side mounted on cross head shaft, adjustable safety friction clutch, gear driven limit switch, magnetic cross line reversing starter, mounting brackets and hardware.

1.14 Control Station: Standard three button open-close-stop type, separate control for each electric operator, surface mounted.

1.15 Steel: Manufacurer's standard paint.

08410 - ALUMINUM ENTRANCES AND STORE FRONTS

1.1 Aluminum Entrances and Storefront:

A. Door Style: Narrow stile and rail doors.

B. Aluminum Members: ASTM B221, B209 and B211.

C. Steel Reinforcement: ASTM A36, ASTM A611, and ASTM A570.

D. Glass and Glazing: Insulating glazing.

E. Glazing Color: type and color to match windows.

F. Door Hanging Devices: Center pivot sets.

G. Closers: Concealed, head mounted.

H. Closer Operation: Singe acting closers.

I. Aluminum finish: Fluropolymeer, Kynar 500, 2-coat system.

08450 - ALL GLASS ENTRANCES

1.1 All Glass Entrances:

A. Glass: Tempered safety glass, aSTM C1048, kind FT.

B. Glass Color: Clear.

C. Door Fittings: Stainless steel cladding, ASTM A167, alloy 302 laminated to aluminum extrusions.

D. Hardware: Concelaed closers, push-pull sets, locks.

E. Threshold: Matching door fittings.

F. Stainless Steel finish: AISI No. 7, high-reflective, directional polish.

G. Accessory fittings for overhead door stop, transom bracket, sidelight fittings.

H. Electric-strike release.

I. Exit devices.

J. Deadbolts.

08460 - AUTOMATIC ENTRANCE DOORS

1.1 Automatic Entrance Doors:

A. Door Operation: One-way swing or sliding doors.

B. Door Style: Narrow stile and rail doors.

C. Door Control: Push button automatic control.

D. Operator: Hydraulic operator.

E. Aluminum Members: ASTM B221, B209 and B211.

F. Steel Reinforcement: ASTM A36, ASTM A611, and ASTM A570.

G. Glass and Glazing: Insulating glazing.

H. Glazing Color: To match windows.

I. Closers: Concealed mounting.

J. Aluminum Finish: Fluropolymer, Knar 500, 2 coat.

K. Guide rails.

L. Push/pulls; door stops and deadlocks.

M. Weatherstripping and thresholds.

08520 - ALUMINUM WINDOWS

1.1 Materials.

A. Extruded aluminum: ANSI/ASTM B221; 6063-T5 aluminum alloy.

B. Sheet Aluminum: ASTM B209; aluminum alloy.

C. Steel s: ANSI/ASTM A36; shapes to suit mullion s.

D. Touch-Up Primer for Galvanized Surfaces: FS TT-P-641.

1.2 Fabricated Components

A. Frames: thickness as noted on drawings; thermally broken with interior portion of frame insulated from exterior portion, flush applied glass stops of snap-on type.

B. Sills: 125" thick, extruded aluminum; sloped for positive wash; slope depth for under sash leg to ½" beyond wall face; one piece full width of opening; jamb angles to terminate sill length.

C. Fasteners: Stainless steel.

08710 - DOOR HARDWARE

1.1 Door Hardware:

A. Quality Level: Heavy duty commercial type.

B. Locksets and Latchsets: Mortise type, heavy duty lever handle.

C. Lock cylinders shall be type: Best Lock Corporation "9K Varsity Series."

D. Keying: Owner's requirements keying and key control system, with master and grand master keying.

E. Hinges and butts: Full-mortise type with nonremovable pins at exterior doors.

F. Closers, Door Control, and Exit Devices: High frequency and barrier-free type.

G. Pivots: Offset or center-hung type.

H. Push/Pull Units: Through-bolted type.

I. Hardware Finsihes: Polished stainless finish on exposed surfaces.

J. Door Trim Units: Kickplates, edge trim, and related trim.

K. Stops and overhead door holders.

L. Soundstripping.

M. Weatherstripping and thresholds.

N. Electromagnetic hold-open devices.

O. Card-operated opening devices.

P. Push button operators.

08720 - POWER DOOR OPERATORS

1.1 Power Door Operators:

A. Power Units: One-way sliding type.

B. Operator: Electromechanical operator.

C. Automatic Door Control: Push button automatic controls.

D. Manual Door Control: Rail-supported switch.

E. Guide rails.

F. Wall push-plate switch.

08800 - GLASS AND GLAZING

1.1 Glass:

A. Primary Glass Procucts: Clear float and tinted float glass, ASTM C1036.

B. Heat-Treated Glawss Products: Heat-strengthened, tempered, coated, and spandrel glass, ASTM C1048.

C. Laminated Glass Units: Polyvinyl butyrl interlayer.

D. Sealed Insulating Glass Units: ATM E774, Class A, low "E."

E. High-Performance Coatings: Low E (low emissivity) type.

F. Mirrors: Silvering and protective coatings.

1.2 Glazing Schedule:

A. Storefront: 1" thick insulating unit, low E glass to match windows.

B. Entrances: 5/8" thick insulating unit, low "E" tempered glass.

C. Curtain Wall: 1" thick insulating unit, tinted glass or reflective coating on second or third surface, low "E."

D. Handrails: ½" tempered safety glass (non-structural).

E. Mirror: ¼" plate glass.

F. Doors: Tempered or wire glass.

G. Security Glazing: Laminated glass.

08921 - GLAZED ALUMINUM CURTAIN WALLS

1.1 Glazed Aluminum Curtain Walls:

A. Primary Components: Extruded aluminum framing, internal reinforcement, insulated spandrel panels, trim, and filler units, sealants, and gaskets.

B. Glazing: Insulating glass.

C. Glazing Color: Tinted or reflective glass, low "E."

D. Construction: thermal break type.

E. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or galvanized steel.

F. Aluminum Finish: Fluropolymer, Kynar 500, 2 coat for exterior and interior.

08925 - STRUCTURAL SEALANT GLAZED CURTAIN WALLS

1.1 Structural Sealant Glazed Curtain Walls:

A. Primary Componenets: Extruded aluminum framing, internal reinforcement, insulated spandrel panels, trim, and filler units, sealants, and gaskets.

B. Glazing: Insulating glass.

C. Glazing Color: Tinted or reflective glass, low "E."

D. Construction: Thermal-break type.

E. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or galvanized steel.

F. Aluminum Finish: Fluoropolymer, Kynar 500, 2-coat for exterior. Fluropolymer, Kynar 500, 2-coat or baked enamel for interior.

09200 - LATH AND PLASTER

1.1 Portland Cement Plaster:

A. Application: 3 coats over metal lath, 3 coats over concrete unit masonry and 2 coats over concrete unit masonry type.

B. Base and Finish Coat Cements: Portland cement, ASTM C150, Type I or II.

C. Finish Coat: Job-,ixed finish coat.

D. Finish: Floated finish.

1.2 Lath and Plaster Support Systems:

A. Metal Supports for Suspended and Furred Ceilings: ASTM C1063, for portland cement plaster installations.

B. Steel Studs and Runners, Non-Load (Axial) Bearing: ASTM C645, 20 gauge steel studs, 2 ½ and 3 5/8" typical depth.

C. Verticle Metal Furring: Channel furring and braces, Z-furring members, and furring brackets.

D. Expanded Metal Lath: ASTM C847, self-furring diamond mesh or rib lath.

09215 - VENEER PLASTER

1.1 Gypsum Base for Veneer Plaster:

A. ASTM C588, regular, foil-backed, and fire-rated types, 5/8" typical thickness.

B. Installation Standard: ASTM C844.

1.2 Veneer Plaster:

A. Type: ASTM C587, one-component veneer plaster, regular type.

B. Joint Reinforcing Materials: ASTM C587.

C. Installation Standard: ASTM C843.

09250 - GYPSUM DRYWALL

1.1 Gypsum Board:

A. Gypsum Wallboard: ASTM C36, regular, foil-backed, and fire-rated types, 5/8" typical thickness.

B. Water-Resistant Gypsum Backing Board: ASTM C630, regular and fire-rated types 5/8" typical thickness.

C. Joint Treatment: ASTM C475 and ASTM C840, 3-coat system.

D. Installation Standard: ASTM C840.

1.2 Cementitious Backer Units:

A. Type: ANSI A108.1, cement-coated portland cement panels.

B. Thickness: 5/8" nominal.

1.3 Trim Accessories:

A. Material: Metal or plastic trim.

B. Types: Cornerbead, edge trim, and control joints.

09270 - GYPSUM BOARD SHAFT WALL SYSTEMS

1.1 Cavity Shaft Wall Assembilies:

A. Shaft wall Board Thickness: Not less than 1".

B. Studs: C-H or double E type studs, not less than 20 gauge.

1.2 Gypsum Board Shaft Wall Materials:

A. Steel Framing: ASTM C645.

B. Gypsum Shaft wall Board: ASTM C442, Type X.

C. Gypsum Wallboard: ASTM C36, Type X.

D. Gypsum Wallboard Joint Treatment Materials: ASTM C475 and ASTM C840.

E. Studs and Tracks: ANSI/ASTM C645 galvanized sheet steel, 25 gauge "C" shape.

09300 - TILE

1.1 Interior Tile:

A. Wall tile over gypsum wallboard.

B. Wall tile over tile backer board at wet areas.

C. Floor tile over concrete slab.

1.2 Tile Materials: ANSI 118 series standard specifications.

1.3 Tile Installation: ANSI 108 series standard specifications and Tile Council of America, Handobook for Ceramic Tile Installation.

1.4 Unglazed Ceramic Mosiac Tile:

A. Type: Porcelain factory-mounted flat tile with abrasive admixture.

B. Size 2" x 2" minimum.

C. Thickness: ¼" nominal.

D. Face: patterned face with cushion edges.

1.5 Galzed Ceramic Mosiac Wall Tile:

A. Type: Interior type body, flat tile.

B. Face: 2" x 2: minimum.

C. Thickness: ¼" nominal thickness.

D. Face: Plain face with cusion edge.

1.6 Tile Schedule:

A. Toliet Room Walls: Glazed ceramic mosaic tile over gypsum drywall wit organic adhesive and latex-portland cement grout.

B. Toliet Room Floors: Unglzed ceramic mosaic tile over concrete slab with latex portland cement mortar and latex-portland cement grout.

09331 - QUARRY TILE FLOOR FINISH

1.1 Tile Materials

A. Quarry Tile: ANSI/TCA A137.1, conforming to the following:

1. Moisture Absorption: .....0 to 0.5
2. Size:.....
.....6 x 6 x ½"
3. Edge:.....
.....Square
4. Surface Finish:.....
.....Non-slip
5. Color:.....
.....As selected

B. Quarry Paver Tile: ANSI/TCA A137.1, conforming to the following:

1. Moisture Absorption; .....0 to 0.5
2. Size:.....
.....6 x 6 x ½"
3. Edge:.....
.....Square

4. Surface Finish:.....Non-slip
5. Color:.....As selected

C. Base: Match quarry or quarry paver tile for moisture absorption, surface finish, and color, conforming to the following:

1. Length:.....6”
2. Height:.....4”
3. Top Edge:.....Bullnosed
4. Internal Corner:.....Coved

1.2 Adhesive Materials

A. Epoxy Adhesive: ANSI/TCA A118.3, ANSI/TEC A108.6; thinset bond type.

1.3 Mortar Materials

A. Mortar Materials: ANSI/TCA A118.1, ANSI/TCA A118.3; Portland cement, sand, later additive, and water.

B. Color Admixture: Color as selected.

1.4 Grout Materials

A. Grout: Cementitious type, resistant to shrinking.

09440 - TERRAZZO

1.1 Materials

A. Epoxy Binder: Two componenet resin and epoxy hardener, non-volatile, thermo-setting, mineral filler, and color pigment.

B. Polyacrylate Binder: Resinous composition, non-volatile, for modifying cement, containing color pigment.

C. Polyester Binder: Two componenet resin and hardener, thermo-setting, mineral filler, and color pigment.

D. Portland Cement: ASTM C150, Type 1; color as selected; modified to NTMA higher compressive strength requirements.

E. Surface Aggregate: Crushed marble or granite, No. 0-1 size in accordance with NTMA chip size for standard gradation, uniform coloration.

F. Non-Slip Aggregate: Aluminm oxide of size and color to match surface aggregate chips.

G. Divider Strips: Zinc top strip; zinc coated steel bottom strip; neoprene filler strip between side strips, with anchoring features.

H. Control Joint Strips: Zinc top strips; zinc coated steel bottom strip; neoprene filler strip between side strips, with anchoring features.

I. Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.

J. Base Caps, Base Divider Strips, and Separator Strips: Match divider strips with projecting base.

K. Non-Slip Inserts: Zinc or Brass, 20 gauge dove-tail shaped channels, with anchors, filled with aluminum oxide non-slip filler.

L. Cleaner: Neutralizing liquid type, pH of 7.

M. Sealer: Colorless, penetrating liquid type to completrely seal matrix surface; not detrimental to terrazzo components.

N. Wax: Colorless, liquid type.

O. Subfloor Filler: Latex type.

P. Mixes

1. Topping: three parts aggregate chip; one part aggregate dust; one part matrix binder and hardener.

Q. Floor Colors

1. Matrix Binder: Color as selected.
2. Surface Aggregate: NTMA.

R. Base and Border Colors

1. Matrix Binder: Color as selected.
2. Surface Aggregate: NTMA

S. Stair Tread, Landing, and Stringer Colors

1. Matrix Binder: Color as selected.
2. Surface Aggregate: NTMA.

09512 - ACOUSTICAL TILE CEILINGS

1.1 Mineral Base Panels, Water Felted: Equal to Beveled Teglar Cirrus as manufactured by Armstrong Contract Interiors.

A. Type, form and Finish: ASTM E1264, Type III, form 2 with painted finish.

B. Pattern and Sound Transmissuion Class: Perforated and fissured pattern with NRX of .55 to .65 or greater.

C. Edge Detail: Beveled, kerfed and rabbeted joints.

D. Size: 24 by 24 by ¾”.

1.2 Ceiling Suspension Systems, Non-Fire-Resistance Rated: Equal to Silhouette 9/16" bolt slot system, grid face flush with panel (1/4" "T"-bolt recess), with mitered corner for trim grid interface, as manufactured by Armstrong Contract Interiors, or equal.

A. Type: Direct hung double-web intermediate-duty system, ASTM C635.

B. Suspension System Accessories: Attachement devices and hangers, ASTM C635.

09517 - METAL LINEAR CEILING SYSTEM

1.1 Materials

A. Steel Sheet: ANSI/ASTM A446, Grade A, galvanized with 1.25 oz/sq ft coating with surface paint finish.

B. Aluminum Sheet: ASTM B209, with surface paint finish.

C. Aluminum Extrusions: ASNI/ASTM B221, mill finish.

D. Insulation: FS HH-I-521 preformed mineral wool, with black plastic facing.

E. Suspension Wire: Steel, annealed, galvanized finish, 9 gauge diameter.

1.2 Components

A. Linear Panels: Channel shaped 1 x 3 inch bullnosed edges; of equal lengths.

B. Suspension Members: formed steel or aluminum s, with integral attachment points; galvanized finish.

C. Internal and External Corners: Of same material, thickness, and finish as exposed members; of profile to match system; preformed to required angles. Back brace internal corners.

D. Space Closures: Recessed: extruded vinyl s, snap fit between exposed members.

E. Expansion Joints: Of same material, thickness, and finish as exposed members.

F. End Caps: Formed metal, of same color and finish as exposed members.

G. Edge Molding: Of same material, profile, and color as exposed members.

H. Splices: Of same material, profile, and color as exposed members.

I. Accessories: As required to complete the system; color and finish of exposed to view surfaces, same as system.

1.3 Finishes

A. Exposed Surface Finish: Enamel finish of color from manufacturer's standard range.

09650 - RESILIENT FLOORING

1.1 Tile Flooring:

A. Vinyl Composition Tile: ASTM F1066, composition 1, nonasbestos formulated, Class 2, 12" by 12" by 1/8" thick.

B. Wall Base: Vinyl wall base 4" height, 1/8" thick.

C. Resilient Stari Threads, Risers, and Skirtings: Vinyl or rubber accessories.

D. Edge strips and terminations.

09680 - CARPET

1.1 Carpet Materials:

A. Pile Yarn Content: Staple filament or continuous filament branded by a fiber producer such as Allied, Dupont, Monsanto, BASF, of soil hiding nylon or wool nylon blends.

B. Carpet Pile Construction: Level loop, textured loop, level cut pile, or level cut/uncut pile.

C. Pile Weight: 26 ounces per square yard is the minimum for level loop or textured loop construction. 32 ounces per square yard is the minimum for level-cut/uncut construction.

D. Secondary Back: Jute or synthetic fiver for glue down installation.

E. Desity: 100% nylon (loop and cut pile) - minimum of 4000; other fibers, including blends and combinations - minimum of 4500.

F. Carpet Tile: Shall be 100% nylon, 28 ounce pile weight and with fiberglass reinforced vinyl backing. (Equal to Interface Flooring System, Inc. Fusion Bonded Carpet Tiles). Option 1 - shall be equal to Moire Plus 2, a tip sheared product, modified loop carpet tile as manufactured by Interface Flooring System, Inc. Option 2 - shall be equal to Impression Plus, a cut pile carpet tile as manufactured by Interface Flooring System, Inc.

1.2 Carpet Cushions:

A. Type: Sponge rubber cushion.

B. Service: Heavy traffic.

1.3 Auxiliary Materials:

A. Edge guards.

B. Adhesives, cements and fasteners.

1.4 Carpet Installation Method:

A. Direct glue down installation, without pad, where shown on finish schedule.

B. Tackless mounting with carpet cusion is typical installation.

1.5 Carpet Tile Installation Method: Partial glue-down installation.

09900 - PAINTING

1.1 Products:

A. First-line commercial-quality products for all coating systems.

1.2 Exterior Paint Schedule:

A. Concrete, stucco, and Masonry (except concrete masonry units) to Receive Lusterless Acrylic Latex Finish: 2 coats exterior polyvinyl acetate emulsion.

B. Concrete Masonry Units to Receive Lusterless Acrylic Finish: 1 coat latex block filler, 2 coats exterior acrylic emulsion.

C. Ferrous Metal to Receive Full-Gloss Alkyd Enamel Finish: 1 coat synthetic rust-inhibiting primer, 2 coats alkyd gloss enamel.

D. Zinc-Coated Metal to Receive High-Gloss Alkyd Enamel Finish: 1 coat galvanized metal primer, 2 coats alkyd gloss enamel.

1.3 Interior Paint Schedule:

A. Concrete and Masonry (except concrete mansonry units) to Receive Lusterless Latex Finish: 2 coats latex-based interior flat paint.

B. Concrete Masonry Units to Receive Semigloss Alkyd Enamel Finihs: 1 coat high-performance latex block filler, 1 coat interior enamel undercoat, 1 coat interior semigloss ordorless alkyd enamel.

C. Gypsum Drywall to Receive Lusterless Emuision Finish (ceilings): 1 coat latex-based interior primer, 1 coat latex-based interior flat paint.

D. Gypsum Drywall to Receive Semigloss Alkyd Enamel Finish (walls): 1 coat interior latex-based primer, 2 coats interior semigloss odorless alkyd enamel.

E. Gypsum Drywall to Receive Primer Only (at areas to receive wallcovering): 1 coat interior latex-based primer.

F. Plaster to Receive Lusterless Latex Finish: 1 coat latex-based interior flat pain, 1 coat interior flat odorless alkyd paint.

G. Woodwork and Hardboard to Receive Full-Gloss Enamel Finish: 1 coat interior enamel undercoat, 2 coats alkyd gloss enamel.

H. Stained Woodwork to Receive Stained-Varnish Rubbed Finish: 1 coat oil-type interior wood stain, 1 coat cut shellac. 1 application paste wood filler, 2 coats oil rubbing varnish.

I. Ferrous Metal to Receive Full-Gloss Enamel Finish: 1 coat synthetic Rust-inhibiting primer, 1 coat interior enamel undercoat, 1 coat exterior alkyd gloss enamel.\

J. Ainc Coated Metal to Receive Full-Gloss Enamel Finish: 1 coat galvanized metal primer, 1 coat interor enamel undercoat, 1 coat exterior alkyd gloss enamel.

09950 - WALL COVERINGS

1.1 Vinyl Wall Covering:

A. Type: FS CCC-W-408 Type II medium duty in offices and Type III heavy duty wall covering in all other places.

B. Stain Resistance: Factory applied polyvinyl fluoride or polymer coating.

1.2 Wall Covering Schedule:

A. Patterns: Stipples, fabrics or wovens in color selected.

10100 - VISUAL DISPLAY BOARDS

1.1 Markerboards:

A. Materials: Porcelain enamel face for liquid-type markers, core material, and backing.

B. Operation: Hinged conference units.

C. Trim: Wood frame and tray.

10155 - TOILET COMPARTMENTS

1.1 Type:

A. Toilet compartment shall be ceiling hung, with noncorrosive doors, panels and pilasters similar and equal to Poly-Mar HD®, or Poly-Granite HD® compartments.

B. Panels, doors, and pilasters shall be fabricated from High Density Polyethylene (HDPE) containing a minimum of 10% recycled material manufactured under high pressure forming a single component which is waterproof, nonabsorbent, and has a self-lubricating surface that resists marking with pens; pencils, or other writing utensils. All panels, doors and pilasters to arrive at job site with special protective plastic covering.

1.2 Characteristics

A. Dual component compression molded High Density Polethylene (HDPE) of solid Poly-Mar HD® virgin resin materials in colors that extend throughout the surface; the panels, doors, and pilasters shall have combined recycled and/or virgin material (HDPE) as the core material.

B. Doors, panels, and pilasters shall be a minimum of 1” thick and all edges machined to a radius of .250” and all exposed surfaces to be free of saw marks.

1.3 Fabrication

A. Dividing panels shall be 55” high and mounted at 14” above finished floor.

B. Doors shall be 55” and mounted at 14” above finished floor.

C. Pilasters shall extend from the finished ceiling to a point 14” above the finished floor. (Maximum length not to exceed 9’-0”.)

D. Finish of doors, panels, and pilasters shall be similar and equal to Santana Products, Inc. “Plastic-Glaze 280” color of doors, panels, and pilasters to be selected from the standard Poly-Mar HD®, Poly-Marble HD®, or Poly-Granite color range.

E. Aluminum edging strips to be fastened to the bottom edge of all doors and panesl using vandal-proof stainless stell fasteners.

F. Color to be selected from full range of manufacturer’s products.

G. Coat hooks on inside of each door.

10200 - LOUVER AND VENTS

1.1 Aluminum Louvers:

A. Aluminum Extrusions: ASTM B221, alloy 6063-T5 or T52.

B. Blade Type: Horizontal drainable sightproof blades.

C. Finish: Flouropolymer, Kynar 500 or equal.

1.2 Louver Accessories:

A. Bird screens.

B. Insect screens.

1.3 Wall Vents:

A. Material: Extruded aluminum.

B. Blade Type: Adjustable

10270 - ACCESS FLOORING

1.1 Access Flooring Assemblies and Materials:

A. Type: Bolted pedestals understructure with bolted stringers all secured to concrete floor with adhesives.

B. Lightweight-Concrete-Filled Steel Pan Panels: Zinc-coated steel pan filled with reinforced lightweight concrete. This panel shall have no cut-outs.

10350 - FLAGPOLES

1.1 Flagpoles:

A. Shape: Cone tapered.

B. Type: Vertical pole; length as specified.

1.2 Aluminum Flagpoles:

A. Material: ASTM B241, alloy 6063-T6. seamless tubing, minimum wall thickness 3/16 inch.

B. Finish: Clear anodized.

1.3 Fittings: External halyard, finial eagle, double trucks and cleats, and lockable box.

10416 - DIRECTORIES AND BULLETIN BOARDS

1.1 Directories:

A. Type: Internally illuminated.

B. Frame: Reveal-type frame and cover design.

C. Glazing: Tinted glass.

D. Message Strips: Film type message strips for rear illumination.

10425 - SIGNS

1.1 Panel Signs:

A. Type: Unframed.

B. Material: Plastic.

C. Copy: Raised lettering in compliance with ADA requirements.

1.2 Dimensional Letters and Numbers:

A. Type: Cast.

B. Material: Stainless steel.

1.3 Cast Plaques:

A. Material: Bronze castings.

10436 - EXTERIOR POST AND PANEL SIGNS

1.1 Panels

A. Type: Hollow box-type panels

B. Copy: Applied.

C. Material: aluminum.

D. Frame: Extruded aluminum.

E. Cosntruction: Fixed signage message.

F. Illumination: internal illumination.

1.2 Posts:

A. Material: structural aluminum tubing, 6063-T5 alloy.

B. Mounting: Permanent direct-burial.

C. Shape: Square.

1.3 Finishes:

A. Aluminum Finish: Color anodized.

10500 - METAL LOCKERS

1.1 Lockers:

A. Type: Wardrobe lockers, sheet steel, 24 gauge back and sides, 16 gauge top, bottom and doors.

B. Tier: Double-tier lockers.

C. Face: Solid with punched louvers.

D. Locking: Padlock type.

E. Tops: Sloped.

F. Mounting: On 4” high elevated base.

G. Number plates.

H. Locker room benches, wood seat, 5’-0” in length, bolted to floor.

I. Filler strips

10522 - FIRE EXTINGUISHERS AND CABINETS

1.1 Fire Extinguishers:

A. Type: Multipurpose dry chemical type.

B. Rating: Sized for project requirements.

C. Public, Office and work Areas Mounting: Flush mounted in recessed wall cabinet.

D. Warehouse and Storage Area Mounting: Metal brakets, surface mounted.

1.2 Cabinets:

A. Mounting: Recessed.

B. Trim: Trimless.

C. Doors: Aluminum, baked enamel finish.

D. Door Style: Vertical duo glass panel with concealed

E. Accessories: Glass breaker or fire handle.

10550 - POSTAL SPECIALTIES

1.1 Mail Collection Boxes:

A. Loading: Front loading type.

B. Materials: Aluminum, satin anodized finish.

10605 - WIRE MESH PARTITIONS

1.1 Wire Mesh:

A. Partition type: Heavy duty, 6 gauge crimped steel wire, 2” diamond mesh.

B. Railing Insert Type: 10 gauge crimped steel wire, 1-1/2’ diamond mesh.

C. Framing: Cold-rolled channels.

D. Hinged door with lock and hardward.

E. Service window.

F. Service window shelf.

G. Line posts

10652 - FOLDING PANEL PARTITIONS

1.1 Folding Panel Partitions:

A. Panel Type: Individual panels, side stacked STC50.

B. Overhead track suspended partition

C. Operation: Manual or electric

D. Frame: Steel reinforced aluminum.

E. Finish: Vinyl fabric.

10750 - TELEPHONE SPECIALITIES

1.1 Telephone Enclosures:

A. Interior type: Wall-mounted, shelf-type telephone enclosures, ADA and handicapped accessible.

B. Telephones: combination coin/credit card operated

C. Accessories: Telephone directory shelf units.

D. Accessories: Enclosure lighting.

1.2 Materials:

A. Aluminum Extrusions: ASTM B221, alloy 6063-T5.

B. Aluminum Sheet: ASTM B209, alloy 5005-H15.

C. Stainless Steel: ASTM A167, AISI Type 302 or 304.

D. Bronze Plate: Muntz metal.

E. Sheet Steel: ASTM A366 or ASTM A568.

F. Plastic Laminate: NEMA Standard LD-3, Grade GP50.

G. Glass: Tempered, ASTM C1048, transparent.

10800 - TOILET AND BATH ACCESSORIES.....

1.1 Toilet

A. Toilet tissue dispensers, dual roll, cast aluminum, non-restricted flow.

B. Combination towel dispenser/wast receptacle units, stainless steel, fully recessed, large capacity dispenser and waste.

C. Grab bars, 1-1/2” round stainless steel, one per stall.

D. Sanitary napkin disposal units, stainless steel, one per stall.

E. Seat Cover dispensers - one per stall.

F. Feminine napkin dispenser, stainless steel, fully recessed type, allowing coin or free operations, one per toilet room.

G. Soap dispenser, deck mounted, 7" spout, one per lavatory.

H. Mop and broom holders, two per janitor closet.

1.2 Mirrors and Frames:

A. One per sink in utilitarian toilet rooms, of height sufficient for ASDA and handicap use and for use without stooping by tall individuals.

B. Glazing: Mirror glass, ¼" thick, SATM C1036.

C. Frames: Stainless steel

1.3 Materials and Finishes:

A. Stainless Steel: AISI Type 302 or 304, No. 4 polished finish.

1.4 All products must be supplied by one manufacturer, and have coordinated keying provided.

11132 - PROJECTION SCREENS

1.1 Front Projection Screens:

A. Operation: Electric.

B. Mounting: Recessed mounting at ceiling.

C. Viewing Surface: Matte white surface.

D. Edge Treatment: without black masking borders.

1.2 Rear projection Screens:

A. Glazing: Clear float glass with optical coating.

B. Frame: Site-framed.

11160 - LOADING DOCK EQUIPMENT

1.1 Dock Bumpers:

A. Type: Molded or extruded rubber.

B. Mounting: Horizontal and vertical.

1.2 Dock Levelers:

A. Type: Hydraulic recessed in dock.

B. Rated Capacity: 30,000 pounds.

C. Controls: Remote control station.

1.3 Dock Light

A. Swing type next to overhead door.

1.4 Dock Seal

A. Rigid translucent cover.

B. Armor pleated curtain on treated wood frame.

12372 - BREAK ROOM CASEWORK

1.1 Casework:

A. Materials: Plastic laminate, CP28 thickness.

B. Face Style: Flush overlay.

C. Frame Fabrication: Face

D. Frame Finish: Paint.

E. Frame Finish Application: Factory-finished.

1.2 Counters:

A. Materials: Plastic laminate, GP50 thickness with particleboard substrate.

B. Countertop Front Profile: Rolled.

C. Countertop Cove Profile: Cove molding.

D. Countertop Backsplash: Square edge with scribe.

12500 - WINDOW TREATMENT

1.1 Vertical Blinds:

A. Slats: Prefinsihed aluminum.

B. Stal Width: 1”.

C. Operation: Titlting and lifting mechanisms, with top-lock and tilt-lock features.

1.2 Drapery Tracks:

A. Track System: Single channel, ball-bearing carriers.

B. Material: Steel with baked enamel finish.

12680 - VESTIBULE MATS

1.1 Foot Grilles:

A. Type: Extruded aluminum with top-surfaced tread rails.

B. Finish: Aluminum with clear anodized finish.

C. Top Surface: Nylon carpet insert.

1.2 Frame:

A. Material: Extruded aluminum, ASTM B221, alloy 6063-T5

B. Type: Recessed.

14210 - ELECTRIC TRACTION ELEVATORS

1.1 Passenger Elevators

A. Features and Components:

1. Type: D.C. worm geared traction type.
2. Control Systems: Group automatic elevator controls.
3. Cab: Custom design with front swing returns.
4. Door Panels: Stainless steel, AISI No. 4 satin finish.
5. Hoistway Entrances and doors: Stainless steel, AISI No. 4 satin finish.
6. Main lobby and machine room color CRT elevator status display monitors.

B. Auxiliary Operations and Controls:

1. Service panel for switch controls (car light, fan, access, etc.)
2. Alarm button and emergency stop key switch.
3. Digital hall and car position and direction indicators.
4. Audible and visual signals.
5. Automatic 2-way leveling.
6. Programmable security for elevator acess and egress.
7. Door nudging device with full door opening scanner protection.
8. Liner blanket hooks.
9. Emergency power operation.
10. Hoistway access switches.
11. Ergonomic car and hall button stations.
12. Automatic and maual fire recall.
13. Indpendent service feature.
14. Autodial care telephones.
15. Main and auxiliary car stations.

1.2 Freight Elevator

A. Features and Components

1. Type: Worm geared traction type.
2. Control Systesm: Selective collective automatic operation.
3. Cab: Custom design with swing front return.
4. Door Panels: Stainless steel, AISI No. 4 satin finish.
5. Hoistway - Entrances: Stainless steel, AISI No. 4 satin finish.
6. Floor: Non-slip steel.

7. Main lobby and machine room color CRT elevator status display monitors.

B. Auxiliary Operations and Controls:

1. Service panel for switch controls (car light, fan, access, etc.)
2. Alarm button and emergency stop key switch.
3. Digital hall and car position and direction indicators.
4. Audible and visual signals.
5. Automatic 2-way leveling.
6. Programmable security for elevator access and egress.
7. Full door opening scanner protection.
8. Liner blanket hooks and blankets.
9. Emergency power operation.
10. Hoistway access switches.
11. Vandal resistant car and hall button stations.
12. Automatic and manual fire recall.
13. Independent service feature.
14. Timed freight loading switch in car station.
15. Autodial car telephones.

14310 - ESCALATORS

1.1 Materials

A. Rolled Steel s, Shapes, Rods: ANSI/ASTM A36.

B. Structural Tubing: ANSI/SATM A500, Grade B, A501.

C. Sheet Steel: ANSI/ASTM A446, Grade B, zinc coated to G90.

D. Stainless Steel: ANSI/ASTM A167, Type 304, No. 4 finish.

E. Aluminum: ANSI/ASTM B221, extruded 6063 alloy with T6 temper finish.

F. Bolts, Nuts, and Washers: ANSI/ASTM A325, A490.

G. Bolts, Nuts, and Washers: ANSI/ASTM A325 A490.

H. Welding Materials: ANSI/AWS D1.1: type required for materials being welded.

I. Touch-Up Primer for Galvanized Surfaces: Zinc rich type.

1.2 Components

A. Structural Steel Components: Truss frame and end bearing plates, tracks, drive wheel trolleys, attachment brackets, anchors and fittings.

B. Cast Aluminum Components: Ribbed moving treads with ribbed risers and comb plate thresholds.

C. Deck Cover: Stainless steel; non-slip surfacing.

D. Handrails: Molded neoprene, steel mesh reinforced to minimze stretch.

E. Balustrades and Skirt Panels: Stainless steel with reinforced backing.

F. Operating Equipment: Motor and transmission drive, endless step drive chains; handrail drive; governor, brake, safety devices, and drip pan to meet system criteria.

G. Electrical components: Controller, switches, conduit and conductors; UL approved.

H. Special Illumination for comb Plates, Riser, Handrails: Flush incandescent downlight.

I. Grease Fittings: For lubricating bearings requiring periodic lubrication.

1.3 Finishes

A. Metal Surfaces concealed from view: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.

B. Galvanized Surfaces: Clean with neutralizing solvent; prime one coat.

C. Baked Enamel on Steel: Clean and degrease metal surface; apply one coat of primer sprayed and baked; two coats of enamel sprayed and baked; color as selected.

D. Handrail: Black.

E. ANSI/IEEE C1 - National Electrical Safety Code.

F. ASTM C1048 - Heat-treated flat glass - Kind HS Kind FT coated and uncoated glass.

G. AWS A2.0 - Standard welding symbols.

H. AWS D1.1 - Structural welding code.

I. SSPC - Steel structures painting council.

1.4 System Description

A. Characteristics of each escalator as follows:

1. Rated Net Capacity: As selected.
2. Rated Speed: 120 ft/min.
3. Vertical Rise (nominal): As designed.
4. Nominal Tread Width: Per code.
5. Control: One way.

1.5 Operation

A. Operation: Constant speed under light to heavy load conditions, quiet operation, transit speed of handrail same as treads.

B. Switching: Key operated “On/Off” control and emergency”Stop” buttons located at each end of unit.

C. Machine and Drive: Direct motor, transmission, chain sprocket drive, electromagnetic brake, crank for hand drive during servicing, drive chain tension adjustment.

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16000- ELECTRICAL SYSTEMS DESCRIPTION

1.1 Specification includes

A. Electrical systems for the following applications: Refer to individual speciation sections following for detailed requirements.

1. Power and distribution.
2. Packaged equipment definitions.
3. Lighting, including exit and emergency lighting.
4. Emergency generator.
5. Fire alarm and life safety.
6. Security.
7. Lightning protection.
8. Telephone.
9. Computer / local area network.
10. Empty conduit system.
11. Power connections for HVAC and plumbing equipment.
12. Power connections for specialty equipment.

B. Products

1. Systems, products, and standards are listed in individual specification sections, which follow.

16010 - ELECTRICAL BASIC REQUIREMENTS

1.1 Specification

A. General requirements specifically applicable to Division 16, in addition to Division 1 provisions.

B. Division 15 lists requirements for motors, pressure switches, solenoid valves, motorized valves, damper operators and other devices, which may be furnished under division 15, but installed, connected and tested under Division 16.

1.2 Quality Assurance

A. ANSI/NFPA 70-1996 National Electric Code.

B. ANSI/ IEEE C2 - National Electrical Safety Code.

C. Local Codes.

D. The 1996 BOCA National Building Code.

E. MIOSHA.

F. NECA - Standard of Installation.

G. NEC

H. NEMA

I. ANSI

J. IPCEA

K. ASTM

L. American Standard Safety Code for Elevators.

M. Lansing Board of Water and Light Utility Service Standards

N. MEC

O. HEW (Dept. of Health, Education and Welfare)

P. EPA, NES

Q. DNR

R. UL (United Laboratory)

1.3 Products

A. Furnish and install products, acceptable to the authority having jurisdiction as suitable for the use intended, from Square D, Cutler Hammer, G.E. or Westinghouse manufacturers having a history of successful installation and operation of the equipment proposed.

B. Manufacturer's Nameplates: Aluminum or type 304 stainless steel not less that 20 gauge thick, permanently engraved or punched, riveted or bolted to all equipment.

C. Field Nameplates: Provide engraved melamine plastic, 1/8" thick engraved in block capitol lettering to expose white lettering on black face.

1.4 Packaged Equipment

A. Packaged equipment shall be defined as architectural, mechanical, civil, or other trades equipment specified in other divisions of this specification, which shall be furnished and installed complete up to power source wiring connections, provided by this contractor.

B. Packaged equipment shall include but not be limited to control wiring, control deice, fused switch, combination magnetic starter control transformer, interlocks, relays, conduits, wiring and device identification for all integral device, to leave ready for operational start-up except for single incoming power service by this contractor under the provisions of Division 16000 of these specifications.

C. Any special work to be provided under this division outside the package equipment definition shall be noted on the contact drawings accompanying these specifications.

D. Packaged equipment shall be defined as follows:

1. Elevators, passenger and freight.
2. Escalators.
3. Man-lifts.
4. Dock levelers.
5. Hoists.
6. Cranes or winches.

7. Automatic or motor operated doors.
8. Incinerators.
9. Temperature controls.
10. Kitchen and laboratory equipment.
11. Chemical water treatment
12. Water softeners, water booster pumps
13. Building and control air compressors and dryers
14. Refrigeration units, compressors or self-contained air conditioner.
15. Fire and jockey pumps
16. Boilers, boiler feed and condensate pumps
17. Penthouse air handling units, return and exhaust fans
18. Walk -in coolers, refrigerator freezers.
19. Fire extinguishing systems
20. Drinking fountains.
21. Traffic signal equipment.
22. Aircraft warning and signal equipment.

16110 - RACEWAYS, CABLE TRAYS, AND BOXES

1.1 Project Includes

A. Electrical conduit, tubing, embedded raceways, wireways, cable trays, boxes, and cabinets for electrical power and signal distribution.

1.2 Products

A. Wiring Methods:

1. Exposed Indoor Wiring: Electrical metallic duct below finished floor; galvanized steel conduit in plenum, 10’ - 0’ above finished floor.
2. Concealed Indoor Wiring: Electrical metallic tubing except that all feeder circuits shall be installed in rigid galvanized conduit.
3. Exposed Outdoor Wiring: Galvanized rigid steel conduit. If local environmental conditions are not suitable for exposed galvanized steel, rigid non-metallic or PVC coated rigid steel conduit may be considered.
4. Concealed Outdoor Wiring: Provide same as required for exposed outdoor wiring.
5. Underground Wiring, Single Run: Rigid nonmetallic conduit.
6. Underground Wiring, Grouped: Rigid nonmetallic conduit. Utility service, or conduits below roads, grouped or single shall be encased in concrete with not less than 3” thickness beyond conduit wall. Steel reinforced under drives and parking lot.
7. Connection to Vibrating Equipment: Flexible metal conduit, liquid tight at exterior.

B. Metal Conduit and Tubing:

1. Rigid steel Conduit ANSI Conduit: ANSI C80.1.
2. PVC Externally coated Rigid Steel Conduit and Fittings: ANSI C80.1 and NEMA RN1.
3. Electrical Metallic Tubing (EMT) and fittings: ANSI C80.3.

4. PVC Externally Coated Electrical Metallic Tubing and Fittings: ANSI C80.3 and NEMA RN 1.
5. Flexible Metal Conduit: UL1 zinc-coated steel.
6. Liquid tight Flexible Metal Conduit and Fittings: UL 360.

C. Nonmetallic Conduits and Ducts:

1. Electrical Nonmetallic Tubing (ENT): NEMA TC 13.
2. Rigid Nonmetallic Conduit (RNC): NEMA TC2 and UL 651, Schedule 40 or 80 PVC.
3. Underground PVC and ABS Plastic Utilities Duct: NEMA T6, Type I for encased burial in concrete, Type II for direct burial.
4. PVC and ABS Plastic Utilities Duct Fittings: NEMA TC9.
5. Liquid tight Flexible Nonmetallic Conduit and Fittings: UL 1660.

D. Raceway Accessory Materials:

1. Conduit Bodies: NEC Requirements.
2. Wireways: NEC requirements
3. Surface Raceways, Metallic: Galvanized, painted steel, with snap-on covers.
4. Sub-surface raceways metallic, under floor, junction boxes, support couplers, service fittings: galvanized or enamel painted steel with snap on covers.
5. Surface raceways, Nonmetallic: Rigid PVC, UL 94.

E. Cable Trays:

1. Materials: Mill galvanized steel, hot-dip galvanized steel or aluminum.
2. Configuration: Ladder type, trough-type, solid bottom type, channel type.
3. Covers: solid type, louvered type, and ventilated-hat type.

F. Boxes and Fittings:

1. Cabinet boxes: UL 50, sheet steel, NEMA 1.
2. Pull and junction boxes: UL 50, steel boxes.
3. Metal Outlet, Device and Small Wiring Boxes: UL 514A and OS 1.
4. Nonmetallic Outlet, Device and Small Wiring Boxes: NEMA OS 2.

16118 - UNDERFLOOR RACEWAYS

1.1 Project Includes:

A. Pathways with the upper being galvanized steel duct or plastic under floor raceway similar to the “panduit”, under floor system. Top layer grouped in runs of 3 each (telephone communications and data) spaced on 6’-0’ centers and set in floor mounted j-box of the type which allow communications, data and telephone outlets to be installed in separate assembly. The lower level shall be closed conduit or trench duct having a junction box with removable covers installed on the floor surface at each 6’-0’ intervals for clean and dirty power. at each quad-plex junction box with isolated ground.

1.2 All open Office Area Shall Utilize Raised Access Flooring:

A. All ducts, cells, and trenches shall be sized to allow a spacing of up to one work station per each 120 SF with each work station requiring (for planning purposes) one 4-pair telephone cable, one four pair data cable, two general power duplex receptacles and one dedicated circuit isolated ground duplex receptacle for clean power. The engineer shall provide electrical load calculations to justify wire capacity of the under floor distribution system.

1.3 Products:

A. Under floor Raceway Components

1. Flat-Top Underfloor Raceway: Steel or galvanized 1-1/2" deep welded.
2. Trench-Type Underfloor Raceway: Steel bolt on or welded, with removable steel covers that will not permanently deflect under normal traffic loads.
3. Service Fittings: Flush, preset inserts, power outlets, communications outlets in modular pattern.

16119 - UNDERGROUND DUCTS AND UTILITY STRUCTURES

1.1 Specifications include:

A. Underground conduits and ducts, duct banks, pull boxes and hand holes, manholes, and other underground utility structures.

B. Primary service transformer shall be utility owned and serviced, oil filled, outdoor with double ended service or per Landing Board of Water and Light grid connection standards.

1.2 Products:

A. Underground duct applications:

1. Electrical Utility Service: Plastic PVC utilities duct encased in concrete.
2. Electrical Feeders: Direct buried rigid PVC plastic conduit.
3. Telephone Utility Service: Plastic utilities duct encased in concrete.
4. Communications Circuits: Plastic underground conduit encased in concrete.

B. Conduit and Duct:

1. Rigid Steel Conduit: ANSI C80.1, galvanized.
2. Plastic-Coated Rigid Steel Conduit and Fittings: NEMA RN 1.
3. Rigid Plastic Conduit: NEMA TC 2, Schedule 40 PVC.
4. PVC Conduit and Tubing Fittings: NEMA TC 3.
5. Rigid Plastic Underground Conduit: UL 651A, Type A PVC.
6. Rigid Plastic Underground Conduit: UL 651A, Type EB PVC.
7. Rigid Plastic Underground Conduit: High-density polyethylene, Schedule 50.
8. Rigid Plastic Underground Conduit: Fiberglass-reinforced epoxy.
9. Plastic Utilities Duct: NEMA TC 6.
10. Plastic Utilities Duct Fittings: NEMA TC 9.
11. Plastic Communications Duct and Fittings: NEMA TC10.

C. Pull Boxes and Hand holes:

1. Cast Metal Boxes: Cast aluminum with gasketed cover with nonskid finish.
2. Fiberglass Hand holes: Molded fiberglass with weatherproof cover with nonskid finish.

D. Precast Concrete Utility Structures:

1. Precast Units: Interlocking, mating sections.
2. Structural Design and Fabrication: ASTM c 857, class as applicable.

E. Accessories:

1. Duct Supports: Rigid PVC.
2. Frames and covers: Cast iron with cast-in legend.
3. Sump Frame and Grate: FS RR-F-621, Type VII for frame and Type I for cover.
4. Components: Pulling in eyes in walls, pulling and lifting irons in floor, cable stanchions, arms and cable support insulators, ladder.

16120 - WIRES AND CABLES

1.1 Specification Includes:

A. Wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts and less.

B. S.E.R. cable shall not be used for any other direct burial wiring system. All underground power and communications shall be in PVC conduit, encased in concrete for protection.

1.2 Quality Assurance:

A. Compliance: National Electrical Code: UL 4, 83, 486A, 486B, 854; NEMA/ICEA WC-5, WC-7, WC-8; IEEE 82.

1.3 Products:

A. Wire Components:

1. Conductors for Power and Lighting Circuits: Solid conductors for No. 10 AWG and smaller; stranded conductors for No. 10 AWG and smaller; stranded conductors for No. 8 AWG and larger.
2. Conductor Material: Copper.
3. Insulation: THHN/THWN for conductors size 500MCM and larger and No. 8 AWG and smaller; THW, THHN/THWN or XHHW insulation for other sizes based on location.
4. Insulation Voltage Rating: 600 volts.
5. Jackets: Factory-applied nylon or PVC.

B. Cables:

1. Metal-Clad Cable (prefabricated wiring systems) from Raceway Outlet Boxes to Lighting Fixtures: UL Type MC.
2. Control/Signal Transmission Media: Single conductor coaxial type with polyethylene core; twisted pair, aerial, plenum and video types.
3. Fiber Optic Cables: Single Channel low-loss glass type, fiber optic multi-mode graded-index cables, including connectors, couplers, transmitters, receivers, sources and detectors.

C. Connectors: UL listed solder less metal connectors with appropriate temperature ratings.

D. Color Coding:

1. All No. 12 and No. 10 conductors shall have continuous insulation colors as follows:
   280Y/120Volts, 3ph, 4W 480Y/277 Volts, 3 ph, 4W
   Phase A - Black
   Phase A - Brown
   Phase B - Red
   Phase B - Orange
   Phase C - Blue
   Phase C - Yellow
   Neutral - White Neutral - Gray
   Equipment Ground - Green
   Equipment Ground - Green
2. All Phase conductors larger than No. 10 shall be taped with corresponding colors in panel-board gutters, pull boxes and at load connections or any connection points.
3. Where prefabricated wiring systems are used, wiring shall be color coded to match above.

16140 - WIRING DEVICES

1.1 Specification Includes:

A. Wiring devices for electrical service.

1.2 Quality Assurance:

A. Compliance: National Electric Code, NEMA WD 1, UL.

1.3 Products:

A. Wiring Devices and Components:

1. Receptacles: UL 498, NEMA WD 1 and FS W-C 596. Receptacles shall be specification grade rated for the load supplied, however no receptacles less than 20 ampere rating shall be used on the project. General convenience receptacles shall be NEMA 5-20R configuration. Receptacles connected to emergency systems shall have red bodies, receptacles for computer service shall be provided with isolated grounds and have an orange body, general use receptacles may be architects choice use of colors.
2. Ground Fault Interrupter (GFI) Receptacles: Each ground-fault type receptacle shall be specification grade having an independent ground-fault interrupter unit with integral duplex receptacle having an NEMA 5-20R configuration.
3. Snap-Switches: UL 20, NEMA WD 1 and FS W-S 896, AC switches shall be quiet type, toggle handle, specification grade, rated 20 amperes, 120-277 volt. Motor starter switches, rated for motor starting loads may be used for motor loads under ½ HP.
4. Dimmer Switches, Incandescent Lamps: NEMA WD 1, solid state modular dimmer switches, 120 volts, 60 Hertz, adjustable rotary or slide type.

5. Dimmer Switches, Fluorescent Lamps: Full wave modular type AC dimmer, electronic type, with electronic filters.
6. Wall Plates: Single and combination types, stainless steel of plastic type plate with integral color. Where color plates are used, color may be architects choice except that where used with receptacles having a special color requirement, plates shall match the color of the receptacle.
7. Occupancy Sensors: Provide passive infrared, ultrasonic or dual technology sensors that are required for the best operations in the space controlled. All sensors shall have LED indicators, adjustable sensitivity and adjustable time of 30 seconds to 30 minutes. All occupancy sensors shall have at least a five-year warranty and shall be provided by a manufacturer who has been making sensors for a period of five or more years.
8. Provide timers, special devices or specific purpose receptacles as required for the project having quality similar to the above.

16400 - SERVICE AND DISTRIBUTION

1.1 Specification Includes:

A. Electrical service and distribution including service entrance, switchboards, low-voltage power switch gear, grounding, transformers, bus ways, panel boards, over current devices, and motor controllers.

B. Service ad Distribution Requirements: An Adequate underground service shall be provided at 480Y/277 volts to supply the building maximum demand plus at least 25% spare capacity above maximum demand. Should local conditions make a service at another voltage, or above ground, appear more appropriate for installation, a different voltage may be considered after receipt of written justification for the change and after written approval by the state.

1.2 Products

A. Service Entrance:

1. Circuit Breakers: Air circuit breakers, current limiting circuit breakers, molded-case circuit breakers, solid state trip circuit breakers, or insulated case circuit breakers. Where service entrances are 2,000 amperes or larger, main and feeder circuit breakers of the main switchboard shall be draw out construction with electrically operated air circuit breakers, or electrically operated insulated case circuit breakers.
2. Meter Sockets: Provided for the local utility company for contractor installation. Pulse meter required for interconnection to BAS

B. Switchboards:

1. Switchboard type: Front and rear accessible section for draw out or fixed main device, branches and sections.
2. Enclosure: NEMA 1, indoor.
3. Utility Metering Compartment: Acceptable to local utility company.

4. Buses and Connections: Three-phase four-wire type, uniform capacity entire length of switchboard, copper only.
5. Over Current Protective Devices: (Circuit Breakers): Ratings, characteristics and settings suitable for use. Provide two levels of ground fault protection.
6. Circuit Control and Protective Devices: Provide surge arrestors.
7. Instrument Transformers: NEMA EI 21.1, IEEE C57.13.
8. Ratings: Nominal system voltage, continuous main bus amperage, short-circuit current rating suitable for use.
9. Instrumentation: Provide solid state instrumentation on each main breaker to show digital readings of phase to phase to neutral voltages, phase amperage, KVA, power factor, KW and accumulative KWH. Instrumentation shall also provide for remote indication through the building automation system.

C. Low-Voltage Power Switchgear:

1. Low Voltage Switchgear Assemblies: IEEE C37.20.1 and UL 1558. Nominal system voltage, main continuous amperage suitable for use. Short-time and short-circuit-current ratings same as highest rated circuit breaker in switchgear assembly. Provide copper only construction materials.
2. Low Voltage Draw out Power Circuit Breakers: IEEE C37.13 and UL 1066. Continuous current, interrupting, and short-time current ratings for each circuit breaker suitable for use. Voltage and frequency rating same as switchgear.
3. Provide other features similar to that required for switchboards.

D. Grounding:

1. Grounding Equipment: UL 467; copper conductors; NEC table 8 wire and cable conductors; connectors.
2. Grounding Electrodes: Copper clad steel ground rods minimum 10 ft length.

E. Transformers:

1. Dry Type Transformers: NEMA ST 20, copper windings, 2 winding type; enclosure type, insulation class, insulation temperature rise suitable for use; Sound level ratings shall not be greater than allows by NEMA TR-27. For electronic and computer loads, transformers shall be rated K-13 or greater as required by the load and shall be provided with electrostatic shielding.
2. Drive Isolation Transformers: NEMA ST 1, UL 506, self-cooled, two winding dry type; continuous duty rating; enclosure type, insulation class suitable for use.
3. Buck-Boost Transformers: NEMA ST 1, UL 506, self-cooled, two-winding dry type; continuous duty rating.

F. Busways:

1. Busways: Feeder and plug-in type, ANSI/UL 857, NEMA BU 1, enclosed, non-ventilated, suitable for indoor installation, copper conductors with ground bars and 10% neutrals.
2. Plug-In Devices: Circuit breaker plugs and combination started plugs; compatible with connected busway.

G. Panelboards:

1. Panelboards: NEMA PB 1, UL 50, 61, with bolted on circuit breakers and enclosure suitable for use, copper bus, compression type main and neutral lugs.
2. Panelboard Type: Load-center-type panelboards; lighting and appliance branch circuit panelboards; distribution panelboards. Minimum of 20% spare capacity.
3. Panelboards serving electronic and computer loads shall be rated for non-linear loads, have neutrals rated at 100% of the phase current rating and shall be provided with an insulated isolated ground bus in addition to the equipment grounding bus. Minimum of 10% spare breakers of each size in panelboards.

H. Over Current Protective Devices:

1. Over Current Protective Devices:
   a. Integral to panelboards, switchboards, and motor control centers.
   b. Fused Power Circuit Devices: UL 977, operation suitable for use; open fuse trip device; minimum fault current rating suitable for use.
   c. Molded Case Circuit Breakers: UL 489, NEMA AB 1; combination circuit breaker and ground fault circuit interrupters type; current limiting circuit breaker type, integrally fused circuit breaker type; solid-state trip device circuit breaker type; rating suitable for use.

I. Fuses:

1. Cartridge Fuses: ANSI/IEEE FU 1, noninterchangeable type.
2. Spare Fuse Cabinet: Wall-mounted 18 gauge steel unit.

J. Motor Controllers:

1. Manual Motor Controllers: Quick-make, quick-break toggle action.
2. Magnetic Motor Controllers: Full-voltage non-reversing, across the lie, magnetic controller, multi-speed type, NEMA size 1 or larger.
3. Multi-Speed Motor Controllers: Full-voltage non-reversing, across the line, magnetic controller multi-speed type, NEMA size 1 or larger.
4. Reduced-Voltage Motor Controllers:
5. Star Delta magnetic type or part winding magnetic type or solid-state type.
6. Solid State, Variable Speed Motor Controllers: Variable speed control for NEMA Design B, 3 phase induction motor; ratings, control interfaces, internal adjustability, multiple motor capability, motor circuit protection features suitable for use.
7. Combination Controller/Disconnect: Provide with motor controllers as described above and having circuit breaker type disconnects (thermal/magnetic or MPCs) suitable for use.

16482 - MOTOR CONTROL CENTERS

1.1 Specification Includes

A. Motor control center for use on AC circuits rated 600V or less. Provide where five or more motors are grouped near each other.

1.2 Products

A. Motor control center (MCC) Components:

1. MCC Features: Modular motor controllers with motor circuit protectors or thermal magnetic circuit breakers, control devices, Over Current protective devices, transformers, panelboards, instruments, indicating panels, blank panels and accessory items mounted in MCC compartment.
2. MCC Wiring Classification: Class I, Type B
3. MCC Enclosure: NEMA Type I.
4. Buses: Plated copper only, ampacity rating AIC rating as required for the project.

16515- INTERIOR LIGHTING

1.1 Specification Includes

A. Interior lighting fixtures, lamps, ballasts, emergency lighting units, and accessories.

1.2 Quality Assurance

A. Compliance: NFPA 70 "National Electrical Code"

1.3 Products

A. Interior Lighting Components:

1. Florescent Fixtures: Fixtures UL 1570; ballasts UL 935, high frequency electronic type with ballast factor of 89% or greater, harmonic distortion less than 20%, and shall maintain full voltage light output at plus or minus 5% of standard with less than 5% flicker at cold start. Provide for both standard and dimming ballasts; lamps, T8, rare earth phosphor, 3500°, CRI 75 or greater; air handling fixtures at 35% minimum return air volume.
2. High Intensity Discharge (HID) Fixtures: UL 1572; blasts, UL 1029; instant restrike device.
3. Incandescent Fixtures: UL 1571.
4. Fixtures for Hazardous Locations: UL 844.
5. Track Lighting Systems: UL 1574.
6. Exit Signs: UL 924, LED type.
7. Emergency Lighting Units: UL 924.
8. Emergency Fluorescent Power Supply: UL 924.
9. Lamps: ANSI standards, C78 series.
10. Suspended fixture support Components: Stem, rod, and hook hangers. Provide seismic bracing if seismic conditions of project warrant this construction.

16525 - EXTERIOR LIGHTING

1.1 Specification includes

A. Exterior lighting fixtures: Fixtures, UL 1570; ballasts, UL 935, high frequency electronic types.

1.2 Quality Assurance

A. Compliance: NFPA 70 "National Electrical Code"

1.3 Products

A. Exterior Lighting Components:

1. Fluorescent Fixtures: Fixtures, UL 1570; ballasts, UL 935, high frequency electronic types.
2. High Intensity Discharge or Metal Halide (HID) Fixtures: UL 1572; ballasts, UL 1029; instant restrike device.
3. Incandescent fixtures: UL 1571.
4. Lamps: ANSI Standards, C78 series.
5. Fixture Support Poles, Mast Arms and Brackets: Steel or Aluminum.

16620 - PACKAGED ENGINE GENERATOR SYSTEMS

1.1 Specification Includes

A. Packaged diesel engine generator system.

B. Generator facility to be exterior to occupied office building.

1.2 Quality Assurance

A. Compliance: NFPA 110.

1.3 Products

A. Packaged Engine Generator System Characteristics:

1. Type: Standby rated automatically started diesel engine coupled to an AC generator unit.
2. Ratings: Voltage, frequency, and power output output ratings suitable for use.
3. Maximum Transfer Time to Assume Full Load: 10 seconds.
4. Fuel Supply: 72 hours of operation. Above ground storage

B. Packaged Engine Generator System Components:

1. Engine: NFPA 37.
2. Engine Fuel: Diesel fuel oil grade DF-2.
3. Cooling System: Closed Loop, liquid cooled, radiator mounted on generator set base with coolant heater for cold weather start.
4. Fuel Supply System: NFPA 30, 37; day tank for 4 hours full load, redundant high level fuel shut off, fuel piping and storage tank, dual redundant pumping.
5. Engine Exhaust System: Critical Rated muffler, suitable for use.
6. Combustion-Air Intake System: Filter type air intake silencer, intake duct and connections.
7. Starting System: DC electric with negative ground. Provide heavy duty diesel starting batteries (minimum of two) and suitable adjustable charge with full wave rectifier, current limiting, dual rate, float/equalize, DC voltmeter and ammeter, alarms for charger failure and low battery voltage including signals fir remote monitoring by BAS,
8. Control and Monitoring: Operation and safety indications, protective devices, basic system controls, engine gauges. Provide a fill option remote monitoring panel.
9. Generator, Exiter, and Voltage Regulator: NEMA MG 1, direct drive.

10. Governor: Solid State isochronous type to maintain engine speed within plus or minus 0.25 HZ, with recovery to steady state within 2 seconds following sudden load changes.
11. Outdoor Generator Set Enclosure: Weatherproof steel housing, wall-in enclosure, louvers, dampers and miscellaneous equipment included.
12. Transfer Switches: Automatic, 4 poles, applicable to service required.

16660 - GROUND FOUALT PROTECTION SYSTEMS

1.1 Specification Includes

A. Ground fault sensing, relaying, tripping and alarm devices for installation in distribution switchboards and panelboards rated 600 volts and less.

1.2 Products

A. Ground Fault Sensing Devices:

1. Outgoing Circuit Current Sensors: Current transformer with circuits requiring outgoing circuit sensing method.
2. Ground Return Current Sensors: Current transformer for encircling main bonding jumper connection.
3. Short Circuit Rating: 200,000 amperes RMS symmetrical.
4. Outputs: Compatible with relay inputs.

B. Ground Fault Relay: Solid State type without external electrical power supply required for relay. Provide two levels of ground fault protection.

C. Monitor Panels: Ground fault indicators, test and reset buttons.

16670 - LIGHTING PROTECTION SYSTEMS

1.1 Specification Includes

A. Lightning Protection Systems for buildings and associated structures.

1.2 Quality Assurance

A. Compliance: NFPA 78; UL 96; Provide a UL master Label System.

1.3 Products

A. Lightning Protection Systems Components:

1. Metal Type: Copper or Aluminum, with solid air terminals.
2. Air Terminals: Copper or Aluminum points.
3. Ground Rods: Copper clad steel.
4. Accessory Components: Bonding plates, conductors, connectors, conductor straps, fasteners, grounding plates, rod clamps, fasteners, grounding plates, rod clamps, splicers. All underground cables shall be copper and all underground connections shall be made with

an exothermal welding process. Down conductors shall be installed in non-metallic conduit concealed within the building.

16721 - FIRE ALARM SYSTEMS

1.1 Specification includes

A. Zoned, non-coded, addressable, microprocessor-based fore detection and alarm system with manual and automatic alarm initiation, analog addressable smoke detectors, and automatic alarm verification for alarms initiate by designated smoke detector zones.

B. Note: If the building proposed is not a high rise building, a basic fire alarm system will be required including horns, strobes, graphic enunciator and other control equipments, If the building proposed is classified a high rise building, a communications/firefighters alarm voice telephone system with CRT monitors and printer shall be provided ad the equipment shall be housed in a console installed in a building command center placed on the ground floor for speedy access by the local fire department.

1.2 Quality Assurance

A. Compliance: NFPA 70, 71, 72, 72E 72G, 72H.

1.3 Products

A. Fire Alarm System Characteristics:

1. Signal Transmission: Dedicated multiplex signal transmission.
2. Audible alarm indication: Horns and bells for basic system, tone signals and voice alarm messages on fire system rated speakers for high rise systems.
3. Visual Alarm Indicator: Strobe lights.
4. Interface: Smoke Removal systems' smoke dampers, air handling units control, elevator recall system, fire door holders, door locks.
5. Reporting and Annunciation: sound and LED LCD visual indication on main panel and remote annunciator panel with off-site reporting of alarms and trouble for basic system. Sound and CRT with keyboard and with a local and remote hard copy printer, along with displayed floor plans with off-site reporting of alarms and trouble for high rise systems.

B. Fire Alarm System Components:

1. Manual pull Stations: Red single action type, metal. Restoration of the unit shall require removal of the front cover with a tool or replacement of a broken glass or plastic rod.
2. Smoke Detectors: UL 268, self-restoring type with visual indicator, photoelectric type.
3. Thermal Detectors: Fix temperature and rate of rise type.
4. Flame Detectors: Ultraviolet type with delay.
5. Fire Alarm Bells: electric vibrating under-dome type.
6. Fire Alarm Horns: Electric vibrating polarized type.
7. Visual Alarm Devices: Xenon strobe lights having an intensity of 100 candela minimum with a flash rate of 1 HZ to 3 HZ. Provide with a clear plastic lens with the word "FIRE" in red letters on the lens.

8. Voice/Tone Speakers: UL 1480 type with 25 volt line matching transformer for each unit with taps a ¼ watt, ½ watt, 1 watt, 2 watts and 5 watts. Provide a minimum sound rating of 82dbA at 10 feet when tapped at 1 watt. Provide one amplifier for each speaker circuit with a minimum of two speaker circuits per floor. Speakers shall be wired and shielded in conduit such that every other speaker is on a different circuit, such that failure of a single circuit can only affect half the speakers on a floor, but the entire area of the floor will still be covered.
9. Fire Fighters Telephones: Red telephone handset dedicated supervised communication lines. Handsets shall have separate speaker and microphone coils. Provide ten standard telephone handsets with 6 foot coiled retractor cords stored in a flush mounted cabinet with hinged transparent door. Provide a fixed emergency telephones in code required locations at each three floor levels in each stairwell consisting of a telephone set in a cabinet with a hinged door, plainly marked an emergency telephone.
10. Device location Indication Lights: System voltage indication lights.
11. Magnetic Door Holders: Wall or floor mounted type.
12. Fire Alarm Control Panel: UL 864 with lockable steel enclosure and alphanumeric display ad system controls.
13. Graphic Annunciator: LED indicator on graphic building floor plan.
14. System Printers: Ink jet or laser jet type with standard EIA RS 232 ports. The unit shall receive standard paper widths abd length up to 14” wide. Each unit shall include an adjustable tractor feed. Character set shall be the standard ASCII set. Line width shall be 128 characters, minimum.
15. Transmitter: auto dialer type.
16. Emergency Power Supply: Battery operated, 24-hour operation capacity, complete with battery charger.
17. Line Voltage and Low Voltage Circuits: Solid copper conductors with rated insulation, color-coded. Signal circuits shall be shielded in cable format.
18. Conduit; The entire fire alarm system wiring shall be in rigid steel conduit that is painted red after installation.
19. CRT: The CRTs shall be packaged in a standard enclosure with only the CRT screen and keyboard visible. The CRT shall have a nonglare screen with 24 display lines. The diagonal dimension of the screen shall not be less than 12 inches. The CRT shall operate on EIA RS-232-C or current loop interfaces using ASCII encoded transmission.
20. Keyboard: The CRT shall be provided with a keyboard and shall be the main machine interface to the CPU. The keyboard shall include the full 129 ASCII character set, including control functions. The keyboard shall also include one special function key for the purpose of acknowledging alarms and cursor control keys.

16724 - SECURITY SYSTEMS

1.1 Specification includes:

A. Intrusion detection system including sensors, signal equipment, controls, and alarm displays.

1.2 Quality Assurance:

A. Compliance: UL 609, 681, 1023, 1076, 1641, FM approval as applicable.

1.3 Products.....

A. Intrusion Detection System Components:
   1. Surge Protection: UL 1449.
   2. Interference Resistance: Not affected by radiate radio frequency interference and electrical as applicable.
   3. Tamper Protection: Tamper protection switches.
   4. Intrusion Detection Deices: Types, features, accessories and mounting conditions as applicable.
   5. Alarm Contact Arrangement: Single pole, double throw type.
   6. Door Switches: UL 634.
   7. Space Intrusion Detection Devices: UL 369, passive infrared, microwave, acoustical, glass break, vibration, and dual technology devices as applicable.
   8. System Control Panel: UL compliance for type of unit.
   9. Annunciator: Visual display and audible alarm.
   10. Secure Access Control Stations: Keypad, display module, and key operated switch.
   11. System Printer: Dot matrix type with NRTL label.
   12. Wire and Cable: Stranded copper.

16740 - TELEPHONE AND COMMUNICATION SYSTEMS

1.1 Specification Includes:

A. Telephone and communication service entrance raceway.

B. Equipment and terminal backboards.

C. System Requirements: Provide conduit-encased raceway for telephone system from backboards to individual set outlet boxes. It is envisioned that much of the telephone distribution within the building will utilize an underfloor distribution system. Where wall mounted outlets are required, outlet boxes will cover plates shall be provided with conduit run in walls and overhead and voice/data with plenum rated cabling back to the telephone closet on each floor.

D. Raceway types:
   1. Surface raceways consisting if base cover, couplings and elbow surface mounted directly on floor feeding comm..blocks at approximate 6”-0” centers, providing a continuous “daisy chain” or modular pathway. Telecommunication modular outlets are multiport wire blocks by vendor located in 6’-0” centers along the raceway.
   2. Multi-channel raceway provides perimeter pathways for different systems such as telephone, data fire, BAS and security. Ensure that the same relative location of each channel is maintained for each system throughout the building. Within multichannel raceways, dividers separating compartments shall be bonded to ground.

1.2 Quality Assurance

A. Compliance: FCC Regulations.

1.3 Products

A. Telephone termination Backboards: Fire resistant plywood, sized at 4”-0” x 8’-0” x ¾” thick. Dual sheets required for multiplex systems.

B. Digital switches, MDF and all voice/data equipment shall conform to EIA/TIA 568 standards.

C. “Panduit” or equal raceway cable management systems shall conform to BICSI standards as applicable to open office area.

16780 - TELEVISION SYSTEMS

1.1 Specification Includes

A. Closed circuit television system (CCTV) for building surveillance and imaging applications.

1.2 Products

A. CCTV System Components:

1. Cameras: Silicon target, monochrome, CCD imaging type with ½” pickup tube capable of producing usable video images, resolving all 10 shades of gray of EIA resolution chart, using F/1.4 lens with subject illumination ranging from .5 lux to 100,000 lux.
2. Lenses: Fixed lenses f/1.4 adjustable to f/22; motorized remote controlled zoom lenses.
3. Camera Supporting Equipment: Minimum safety factor of 2.0; 100 mph wind for exterior units.
4. Pan Units: Motorized automatic scanning units.
5. Pan and Tilt Units: Motorized units for remote controlled aiming of camera panning rotation 0 to 355 degrees with adjustable stop, 90 degree tilt movement, 12 degrees per second speed.
6. Accessories: Mounting brackets, steel dustproof housings for fixed cameras.
7. Monitors: Monochrome, metal cabinet units designed for continuous operation.
8. Visual Tape Recorder: Industrial time lapse type for continuous operation, video cassette tape format ½” using industrial grade T120 cassettes, minimum 400 lines resolution.
9. Manual Switch Bank: low loss, high isolation multiple video switches.
10. Sequential Switches: Automatically sequence outputs of multiple cameras, continuously adjustable, 5 to 20 seconds with manual override.
11. Pan, Tilt, and Zoom Controls: Arranged for multiple camera control with selector switches.
12. CCTV Master Control Station: Heavy-duty, freestanding, modular metal furniture with wiring to other building systems including telephone, communications, fire alarm, and other systems.
13. CCTV Coaxial Cable Connectors:
14. Type BNC, 75 ohms.

16915 - LIGHTING CONTROL EQUIPEMNT

1.1 Specification Includes

A. Lighting controls Equipment:
   1. Manual modular dimming systems.
   2. Integrated mulit-preset modular dimming systems
   3. Multichannel remote controlled dimming system
   4. Programmable lighting control system

B. Products
   1. Lighting Control Equipment Components:
      a. Manual Modular Dimming System: Factory prefabricated, 1 to 4 channels of manual dimming control; common on off switching, single flush wall plate.
      b. Integrated Multi preset Dimming System: Microprocessor based, solid state system, automatically changes variable dimmer settings of different groups of lights when push button is operated; control panel to adjust dimmer channel settings of different groups of lights when push button is operated; control panel to adjust dimmer channel settings; times cross-fading action when one preset scene is switched to another.
      c. Multi-channel Remote Controlled Dimming System: Microprocessor based, sold sate system and low voltage control signals to change variable dimmer settings of different groups of lights from one preset scene to another; control panels adjust dimmer channel settings and command change; plug in type dimmer modules; power failure memory feature.
      d. Programmable Lighting Control System: UL 916, microprocessor based, solid-state 365-day timing and control unit with output circuits individually programmable.
      e. Surge Protection: UL 1449 solid state, line voltage equipment surge protection.
      f. Dimmers: UL 508.
      g. Contactors and Relays: NEMA ICS 2, electrically operated and mechanically held devices; pilot lights.
      h. Time Switches and Sensors: Solid State, electromechanically dial type time switches, UL 917. UL 773A photoelectric relays, solid state, with SPDT dry contacts for relay of contactor control, with time relay to prevent false operation.
      i. Occupancy Sensors: UL listed, Class 2, ultrasonic, infrared or combination technology ceiling mounted, motion detection type, with sensing head.

End of Specifications

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15000 - MECHANICAL SYSTEMS DESCRIPTION

1.1 Fire Protection Systesm: Refer to individual specification s following for detailed requirements

A. Sprinkler systems.

B. Standpipes. (For structures greater than three floors.)

C. Fire protection service per local code conforming to NFPA.

1.2 Plumbing Systems and Specialties: Refer to individual specification s following for detailed requirements.

A. Domestic water service and distribution.

B. Sanitary waste and vents

C. Storm water

D. Compressed air

E. Foodservice requirements conforming to MDPH.

F. Natural gas.

G. Lawn irrigation system.

1.3 HVAC Piping Systems: Refer to individual specifications s following for detailed requirements.

A. Hot water distribution systems.

B. Steam and condensate systems.

C. Regrigerant systems.

D. Chilled water systems.

E. Condenser water systems.

1.4 Heat Generation Systems: Refer to individual specifaction s follwoign for detiled requirements.

A. Boilers

B. Heat exchangers.

C. Heaters.

D. Feedwater equiment and accessories.

E. Chimneys, breechings, and stacks.

1.5 Heat Rejection Systems: Refer to individual specification s following for detailed requirements.

A. Chillers.

B. Cooling towers.

C. Condensers

1.6 Heat Transfer Systems: Refer to individual specifaction s following for detailed requirements.

A. Package units.

B. Air to air heat exhange coils

C. Humidifiers.

D. Terminal heating and cooling units.

1.7 Ventilation Systems: Refer to individual specification s following for detailed requirements.

A. Fans.

B. Ducts.

C. Terminal devices.

D. Exhaust systems for food service, kitchens and specialty areas.

1.8 HVAC Control Systems: Refer to individual specification s following for detailed requirements.

A. Direct digital control systems.

B. Electric control systems.

15050 - BASIC MECHANICAL MATERIALS

1.1 Specification Includes:

A. Basic mechanical materials including valves, pipe expansion joints, meters and gauges, supports and anchors, motors, mechanical identifcation, noise and vibration control.

1.2 Products:

A. Pipe, Fittings, and Specialties: Refer to individual piping systems specifications for materials and installation requirements.

B. Steel pipe coforming to ASTM120, A53-90b; cast iron ASTM C564-70; steel, seamless or galvanized, ASTM A120-73 ANSI B125.2 1985; copper ASTM B88-792 ANSI H23.7-1985; ductile iron, ANSI A21.52, contract, C-75 Class 5. Fittings shall conform to code regulations as stated: Cast iron ASTM A74-72, ANSI A112.5.1-1985; CI, screwed, ASME B16.3-85; copper sweat, ASME B16.22-89; welded, ASTM A234, ANSI B125.1-1985; ductile ron, ANSI A21.1. Joining types of connections: Bell joints ASTM C425-75 “Wedgeloc”. Bell joints (C.1.) Oakum and lead pack. No-hub FTG; AISI No. 301, 305 stainless with neoprene gasket. Ductile Iron; mechanical joint ANSI-A21.

1. Screwed: NPT American Standard tapered thread with compound.
2. Solder: 50/50 tin lead, 95/5 tin/antimoly solder or silfos brazing.
3. Flanged: ASME 125#-150# C.I. with gasket.

C. Valves: General duty valves, bronze, and brass, fabricated to comply with Manufactureres Standarization Society (MSS) classification listed. Gate, globe, ball, and plug valves for shutoff duty; globe, and ball for throttling duty.

1. Gate valves, 2” and smaller for condenser water, chilled water, domestic hot water, cold water, heating hot water and low pressure steam: MSS SP-80, Class 150, cast bronze, threaded or solder ends based on service. Milwaukee, Apollo or Lunkenheimer.
2. Gate valves, 2-1/2” and larger: MSS SP-70, Class 125, iron body, flanged ends. Walworth, Jamesbury, Lunkenheimer.
3. Ball valves, 1” and smaller: Rated for 150 psi saturated seam pressure, 400 WOG pressure, 3 piece construction, bronze body, threaded or solder ends based on service. Lunkenheimer, Apollo, Milwaukee.
4. Ball valves, 1-1/4” to 2”: Rated for 150 psi saturated steam pressure, 400 WOG pressure, 2 piee contruction, bronze body, threaded or solder ends based on service. Milwaukee, Appollo, Lukenheimer.
5. Plug valves, 2” and smaller: Rated at 150 psi WOG, bronze body, threaded ends. Lunkenheimer, Jamesbury, Milwaukee.
6. Plug valves, 2-1/2” and larger: MSS SP78, rated at 175 psi WOG, semi-steel body, flanged ends. Lunkenheimer, Jamesbury, Walworth.
7. Globe valves, 2” and smaller: MSS SP-80, Class 125 or 150 based on system pressure, cast bronze, threaded or solder ends based on service. Lunkenheimer, Vogt, Milwaukee.
8. Globe valves, 2-1/2” and larger: MSS SP85, Class 125, iron body, flanged ends. Lunkenheimer, Jamesbury, Walworth.
9. Butterfly valves, 2-1/2” and larger: MSS SP-67, rated at 200 psum cast iron body, field replaceable sleeve, stainless steel stem, lug or wafer type based on service. Lunkenheimer, Jamesbury, Walworth.
10. Swing check valves, 2” and smaller: MSS SP-80, Class 124# or 150# based on system pressure, cast iron body and cap, threaded or solder ends based on service. Watts, Apollo, Milwaukee.
11. Swing check valves, 2-1/2” and larger: MSS Sp-71, Class 150# (Class 175# FM for fire protection piping systems), cast iron body and cap, flanged ends. Lunkenheimer, Jamesbury, Walworth.
12. Wafer check valves: Class 250, cast iron body, to open with on foot differential pressure. Lunkenheimer, Jamesbury, Walworth.
13. Lift check valves, 2” and smaller: Class 125, cast bronze body and cap, threaded ends. Milwaukee, Apollo, Lunkenheimer.

D. Expansion Joints for Piping Systems: Joints shall provide 200 percent absorption capacity of piping expansion between anchors. ADSCO, Flexstee, Flexonics.

1. Packless expansion joints.
2. Slip joints.
3. Flexible ball pipe joints.
4. Mechanical grooved fittings.
5. Fabricated expansion loops.
6. Stainless steel flexible convolute joiner.

E. Meters and Gauges: Temperature and indicator ranges for services required. Accuracy of thermometers plus or minus 1 percent. Tretice, Dwyer, Gauge.

1. Mercury-in-glass thermometers: Die cast, aluminum finished, glass front, mercury filled tube with magnifying lens.
2. Direct mount filled system dial thermometers: Vapor actuated, universal angle, drawn steel or cast aluminum case with glass lens.
3. Remote-reading filled-system dial thermometers: Vapor actuated, drawn steel or cast aluminum case with glass lens.
4. Thermometer wells: Brass pressure rated to match piping system design pressure.
5. Pressure gauges: General use, ASME B40.1, Grade A, phosphor bronze bourdon-tube type, drawn steel or brass case, glass lens.
6. Pressure gauge accessories: Brass tubing straight coil siphon; brass snubber with disc suitable for fluid served and rated pressure.
7. Wafer orifie-type flow elements: Differential pressure type, cast iron body, brass valves with integral check valves and caps.
8. Venturi type flow elements: Differential pressure type, for installation in piping, bronze or cadmium plated steel with brass fittings.
9. Pilot tube type flow elements: Differential pressure pilot tube-type design with inserted stainless steel probe.
10. Window type flow meters: Designed for installation on hydronic piping, measure flow directly ingpm, bronze body and impact tube, integral self-closing valve with indicator valve, plus or minus 5 percent accuracy.
11. BTU meters: Turbine wheel flow meter, temperature sensors, PLC calculations with integral battery backup, bronze housing, plus or minus 1 percent accuracy.
12. Test plugs: Nickel plated brass body, self-sealing valve type core inserts.

F. Supports and Anchors: Hangers and support components: MSS SP-58, pipe and equipment hangers and supports including clamps, hanger rod attachments, saddles and shields, spring hangers, pipe alignment guides, and anchors.

G. Motors: NEMA Mg 1 motors with phase, frequency rating, voltage rating, and capacity suitable for use.

H. Mechanical Identification: ASME A13.1 as applicable, color coded, of the following types: Standard stencils, snap-on plastic pipe markers, pressure-sensitive pipe markers, plastic duct markers, plastic tape, valve tags, valve tage fasteners, access panel markers, valve schedule frames, engraved plastic laminate signs, plastic equipment markers, plastized tags suitable for use.

I. Noise Control: All mechanical equipment shall not exhibit noise beyond 80 dba levels within occupied office environment.

1. Air distribution devices at less than 24 NC.
2. Duct noise attenuators for 5db or greater low frequency reduction.
3. Inertial bases for chillers, A405 and pumps at 2 times operating weight of equipment for low frequency reduction.
4. Spring type isolators maintaining .075” deflection for medium and high frequency reduction.

J. Vibration Control: Fiberglass pads and shapes, neoprene pads, vibration isolation springs, pad type isolators, plate type isolators, double plate type isolators, all directional anchors, neoprene

mountings, free standing spring isolators, housed spring isolators, vertically restrained spring isolators, thrust restraints, equipment rails, fabricated equipment bases, inertia base frames, roof curb isolators, isolation hangers, riser isolators, flexible pipe connections suitable for use.

15250 - MECHANICAL INSULATION

1.1 Specification Includes

A. Pipe insulation, equipment insulation, and external duct and plenum insulation.

1.2 Products

A. Mechanical Insulation Types:

1. Pipe Insulation: Glass fiber; cellular glass; flexible elastomeric cellular; calcium silicate; type. John/Mansville or equal.
2. Equipment Insulation: Glass fiber; cellular glass; flexible elastomeric cellular; calcium silicate: type. John/Mansville or equal.
3. Duct and Plenum Insulation: Glass fiber; cellular glass; flexible elastomeric cellular; calcium silicate blanket; type. John/Mansville or equal.

B. Mechanical Insulation Materials:

1. Glass Fiber Insulation: Inorganic glass fibers bonded with thermosetting resin; board type, ASTM C612, Class 2, semi rigid jacketed board; blankete type, ASTM C553, Type II, Class F-1, jacketed flexible blankets; preformed pipe insulation; ASTM C547, Class 1, rigid pipe insulation, jacketed.
2. Cellular Glass insulation: Inorganic, foamed or cellulated glass, annealed, rigid hermetically sealed cells, incombustible, ASTM C921, Type I facing; blocks, ASTM C552, Type I; boards, ASTM C552, Type IV; preformed pipe, ASTM C552, Type II, Class 2 (jacketed); special shapes, ASTM C552, Type III.
3. Flexible Elastomeric Cellular Insulation: Flexible expanded closed cell structure with smooth skin on both sides; tubular materials, ASTM C534, Type I; sheet materials, ASTM C534, Type II.
4. Calcium Silicate Insulation: ASTM C533, Type I, inorganic, hydrous calcium slicate, non-asbestos fibrous reinforcement, incombustible, molded.
5. Fire Performance: Flame spread smoke value less than 30 per ASTM84.
6. Vapor Barrier: Fabric or plastic, 7 mil minimum thickness, porosity at zero value, type suitable for service.
7. Insulation Accessories: Insulting cements, adhesives, jackets, glass cloth and tape, bands, wire and sealing compounds suitable for service and exposure.

15320 - FIRE PUMPS.....

1.1 Specification Includes

A. Fire pumps and pressure maintenance pumps to supply water for fire protection systems.

B. Fire suppression control and Alarm annunciation to local authority per Division 16000.

1.2 Quality Assurance

A. Compliance: ASME B31.9 for piping; NFPA 20 for centrifugal fire pumps.

B. NFPA Guidelines and FM, UL approved controls manufacturer shall establish performance quality standards.

1.3 Products

A. Fire Pump System Components:

1. Fire Pumps, General: UL 448, base-mounted, factory assembled, factory-tested, separately housed.
2. Axially-Split-Case Fire Pumps: Centrifugal, on siet, separately coupled, bronze-fitted, labeled for fire service, horizontally mounted, single stage, double suction type. Peerless, ITT-AC, United or equal.

B. Fire Pump System Motors and Controllers:

1. Electric Motors: Open drip proof, squirrel cage, induction motor type, NFPA 20 and NFPA 70, suitable for type of fire pump.
2. Full-Service, Electric-Motor-Drive Fire Pump Controllers: Combined automatic and nonautomatic operation, UL listed and FM approved, UL 508, UL 1008, type suitable for use.

C. Fire Pump System Accessories:

1. Alarm Panels: NEMA Division 2 ICS 6, Type 1 remote wall-mounting-type.
2. Horizontal Fire Pump Accessory Fittings: Automatic air release valve, casing relief valve, suction and discharge pressure gauges, reducers, hose valves, discharge cone.
3. Equipment Bases: 4000 psi concrete, reinforced.
4. Flow Measuring Systems: FM approved with sensing element and flow meter.

D. Pressure Mainenance Pumps (Jockey Pumps)

1. Pumps: Base mounted, factory assembled, factory tested regenerative turbine pressure maintenance pumps.
2. Controllers: Combined automatic and nonautomatice operation, UL listed, UL 508, NEMA Division 1, Class 2, ICS 6, Type 2, wall mounted enclosure.
3. Accessories: Casing relief valve, suction and discharge pressure gauges.

15325 - STANDPIPE AND SPRINKLER SYSTEMS

1.1 Specification Includes

A. Sprinkler System: Combined dry pipe and preaction system with automatic sprinklers.

B. Standpipe and Hose System (for structures greater than three stories):

1. Wet type with water supply valve open and pressure maintained.

2. NFPA 14 Class I classification for use by trained personnel and in compliance with local code jurisdiction.

1.2 Quality Assurance

A. Compliance: NFPA 13 for sprinkler system, NFPA 14 for standpipes; UL listed and labeled; FM approved.

B. Calculations: Hydraulic computer generated procedure for pipe sizing utilizing scheduled pipe values or hardy cross interactive method of velocity pressure and most remote nodal flow and pressure delivery.

1.3 Products

A. Pipes and Fittings:

1. Steel Pipe: ASTM A53, Schedule 50 in sizes 6 inches and small, Schedule 30 in sized 8 inches and larger, black and galvanized or copper tube: ASTM B88, Type L and M.
2. Fittings: Suitable for service 175# class and piping type; threaded, grooved-end, pressue seal types.
3. Joining Materials: Welding and gasket materials suitable for design temperatures and pressures. Victaulic materials and couplings are approved.

B. Valves and Accessories:

1. General Duty Valves: Gate valves, swing check valves.
2. Specialty Valves: Alarm check valves, dry-pipe valves suitable for system use.
3. Control Panels: NEMA ICS 6 Type 1 enclsoure per Division 16000.
4. Water Meters: AWWA C700 series as applicable.
5. Backflow Preventers: ASME, sized for maximum flow rate and maximum pressure loss.
6. Fire Department Connections: UL405, exposed, wall type unit, connections and finish suitable for use.
7. Pressure Gauges: UL 393.

C. Sprinklers, Hose Racks and Accessories:

1. Automatic Sprinklers: Fusible link type; upright pendant, and sidewall styles; concealed, flush, and recessed styles; wall-mounted sprinkler head cabinet and wrench, suitable for service required.
2. Sprinkler Fittings: UL listed and FM approved, UL 213.
3. Nonadjustable Hose Valves: UL 668.
4. Pressure Regulating Hose Valves: UL 1468.
5. Hose Racks and Hoses: Shall be provided as required by local jurisdiction.
6. Fire Hose: Shall not be installed.

15410 - PLUMBING PIPING AND SPECIALTIES

1.1 Specification Includes

A. Plumbing piping systems within the building including the following:

1. Potable water distribution, including cold and hot water supply and hot water circulation.
2. Drainage and vent systems, including sanitary and storm
3. Engineered drainage systems including combination waste and vent systems; copper piping single-stack systems; cast iron piping single stack system; reduced size venting systems; and controlled flow storm drainage system.

B. Plumbing specialiteis for water distribution systems; soil, waste, and vent systems; and storm drainage systems.

1.2 Quality Assurance

A. Compliance: ASME B31.9.

1.3 Products

A. Piping System Working Pressure Ratings:

1. Water Distribution Systems, Below Ground: 150 psig.
2. Water Distribution systems, Above Ground: 125 psig.
3. Soil, Waste, and Vent Systems: 10 foot head of water pressure withheld at joinings of fittings.
4. Sanitary Sewage, Pumped Piping Systems: 125 psig.
5. Storm Sewage, Pumped Piping Systems: 125 psig.

B. Pipes and Tubes:

1. Hard Copper Tube: ASTM B88, Types K, L, and M, water tube, drawn temper.
2. Soft copper Tube: ASTM B88, Types K and L, water tube, annealed temper.
3. Copper Drainage Tube: ASTM B306, Type DWV, drawn temper.
4. Steel Pipe: ASTM A53, Type S, Grade A, Schedule 40, galvanized, plain ends.
5. Ductile Iron Pipe: AWWA C151, Classes 50 and 51, mechanical joint and push-on joint, with AWWA C104 cement-mortar lining.
6. Flanged Ductile Iron Pipe: AWWA C115, ductile-iron barrel, Class 150 or 300 iron-alloy threaded flanges, with AWWA C104 cement-mortar lining.
7. Hub and Spigot, Cast Iron Soil Pipe: ASTM A74, service class.
8. Hubless, Cast Iron Soil Pipe: CISPI 301.
9. ABS Plastic Pipe: ASTM D2661, Schedule 40, pain ends.
10. ABS Cellular Core Plastic Type: ASTM F628, Schedule 40, plain ends.
11. CPVC Plastic Pipe and Tube: ASTM D2846, SDR 11, plain ends.
12. CPVC Plastic Pipe: ASTM F441, Schedules 40 and 80, plain ends.

C. Fittings and Valves:

1. Pressure and Drainage Fittings for Pipe and Tubes: Suitable for working pressure, pipe, tube, and service.
2. Joining Materials: Solder, brazing and welding filler metals; couplings.
3. Valves: Gate, globe, ball, butterfly, and check valves suitable for service.

D. Plumbing specialties:

1. Water Meters: AWWA C700-C710 series; type as required for service, register in gallons or cubic feet as required.
2. Backflow Preventers: ASME reduced pressure principle backflow preventers for flow rate and maximum pressure loss required, 150 psig minimum working pressure.
3. Water Pressure Regulators: ASME 1003, initial working pressure 150 psig minimum.
4. Water Filters: Cartridge-type with housing fittings, cartridges, end caps, suitable for potable water.
5. Thermotstatic Water Mixing Valves: ASME 107, manually adjustable.
6. Water Tempering Valves: Manually adjustable, thermostatically controlled.
7. Miscellaneous Piping Specialties: Strainers, hose bibs, wall hydrants, post hydrants, sanitary hydrants, hose-end drain valves, stop and waste darin valves, water hammer arresters, trap seal primer valves, horizontal backwater valves, drain outlet backwater valves, air-admittance valves, stack flashing fittings, vent caps, vent terminals, roof flashing assemblies.
8. Cleanouts: Cast iron cleanouts, ASME A112.36.2M.
9. Floor Drains: Cast iron Floor darins with bronze heel proof grate, ASME A112.21.1M; cast iron trench drains, ASME A112.21.1M; cast iron open drains; cast iron deep seal traps; related fittings.
10. Roof Drains: Cast iron body, ASME A112.21.2M with combination flashing ring and gravel stop.
11. Interceptors: Grease, grease recovery, oil, and solids types suitable for service.
12. Sleeve Penetration Systems: UL 1479, through penetration firestop assembly.

15440 - PLUMBING FIXTURES

1.1 Specification Includes

A. Plumbing fixtures and trim, fittings, and related accessories and appliances.

1.2 Quality Assurance

A. Compliance: ANSI A117.1; applicable accessibility regulations.

1.3 Products

A. Plumbing Fixtures:

1. Water Closets: Minimum consumption per flush cycle, vitreous chine material, elongate bowl type, wall hung mounting, flush valve type, trim suitable for service required. American Standard or equal.
2. Urinals: Minimum consumption per flush cycle material, wall hanging type, trim suitable for service require. American Standard.
3. Lavatories: Vitreous chine material, wall and counter top mounting, fittings without pop-up and accessories suitable for service required. American Standard or equal.
4. Conference Room Sinks: Material, self rimming type, counter top mounting type, fittings and accessories suitable for service required. American Standard or equal.

5. Service Sinks: Material of enameled cast iron, trap standard or floor mounting, fittings suitable for service required. American Standard or equal.
6. Mop Basins: Cast stone materials and fittings suitable for service required.
7. Drinking Fountains: Stainless steel material, type, wall hung, conforming to ADA standards, fittings suitable for service required. Hausley Taylor or equal.
8. Water Coolers: ARI 100, ADA conforming type, capacity, and fittings suitable for service required.
9. First Aid Room Emergency Equipment: Eyewash and shower stations as required for special function.
10. Toilet Seats: Compatible with water closet and conform to ADA standards. Olsenite.
11. Flushometers: Electronic or infrared annunciated, for water closet and urinal types. Sloan.
12. Commercial Faucets: Cast brass faucets.
13. Fittings, Except Faucets: Supplies, stops, traps, continuous wastes, and escutcheons. Delta or equal.
14. Supports: ASME A112.6.1M, categories and types as required for fixtures required, including wall reinforecemnt, carriers, miscellaneous structural elements.

15450 - PLUMBING EQUIPMENT

1.1 Specification Includes

A. Water storage tanks for use in plumbing water supply system.

B. Commercial water softeners for use in building water supply system dependent on water analysis.

C. Commercial water heaters for potable water heat systems.

1.2 Quality Assurance

A. Compliance, Storage Tanks: ASME 125# code; AWWA standards for pressure tanks.

B. Compliance, Water Softeners: ASTM Code; NSF 44.

C. Compliance, Water Heaters: UL 174, 732, 778, 1261, 1453; NSF 5; ASME code compliance.

1.3 Products

A. Water Storage Tanks and Accessories:

1. Water: Potable.
2. Pressure Rating: 125 psig.
3. Plain Steel, Pressure Water Storage Tanks; Horizontal, steel construction tank of suitable size and capacity.
4. Steel, Pre-charged Water Storage Tanks: Butyl rubber bladder operation, ASTM code steel construction of suitable size and capacity.
5. Construction: Nontoxic welded joints; interior lining suitable for service.
6. Accessories: Manholes, tappings, valves, gauges, controls, compression stops, concrete base.
7. Insulation for energy conservation and anti-sweat.

B. Water Softener Equipment:

1. Softener Tanks; 316 stainless steel tanks, hydrostatically tested at 150 psig; 50 percent freeboard for backwash expansion.
2. Softener Tank Distribution Systems: Single point upper distribution system of schedule 40 galvanized steel pipe and fittings; lower distribution of Scheudle 40 PVC pipe with PE strainers.
3. Chemicals: High-capacity exchange resin of sulfonated polystyrene; high purity pellet salt.
4. Brine Tanks: Double brine measuring and dry salt storage tank for maximum 4 regenerations at full salting.
5. Controls: automatic multiport main operating valve meter, meter controls.
6. Accessories: Pressure gauges, sampling cocks, position indicator, concrete base.
7. Water Testing Sets: Complete for harness tests, wall mounted.

C. Water Heaters:

1. Natural Gas Fired Boilers or Self Contained, Gas Fired, Water Heaters: Automatic type with 150 psig rated storage tank, integral controls, relief valve. Lochinvar, Bradford White.
2. Accessories: Valves, gauges, concrete base, Type B flues, drains relief, circulation pump and aquastat..

15453 - PLUMBING PUMPS

1.1 Specification Includes

A. Centrifugal pumps for water distribution systems for recirculating or boosting pressure, and sump pumps for drainage water piping systems.

B. Hot water recirculation for instantaneous end of main fixture service.

1.2 Quality Assurance

A. Compliance: UL 778, AWWA and FM approved for style and service.

1.3 Products

A. Plumbing Pumps:

1. Base Mounted, Separately coupled, End Suction Pumps: Centrifugal, single stage, all bronze, radially split case type. ITT, Bell & Gosset, Gould, Peerless.
2. Submersible Sump Pumps: Simplex, vertical centrifugal, direct connected, end suction, single stage, bronze fitted with integral inlet strainer, controls and sump cover. Weil, Gould, Peerless.
3. Inline Pump: Close coupler casing volute type, vertically split, impeller; single open end sing suction, statically balanced. Mechanical seal, carbon and ceramic face, viton seal, Type 316 stainless steel. Machined fit adaptor motor; explosion proof, TEFC. All wetted parts shall be 316 stainless steel materials of construction.
4. Water Pressure Booster: Factory tested, skid mounted, multiple pumps and pressure control package B&G or equal.

15488 - NATURAL GAS SYSTEMS

1.1 Specification Includes

A. Natural gas systems within the building

1.2 Quality Assurance

A. Compliance: NFPA 54.

1.3 Products

A. Piping System Working Pressure:

1. Low Pressure Natural Gas Piping Systems: 1 psig or less will be allowed within the structure.
2. Natural Gas Service: 60 psig as defined by utility.

B. Pipe, Fittings and Specialties:

1. Steel Pipe and Tubes: ASTM A53, Type E welded or Type S seamless, Grade B, Schedule 40, black.
2. Fittings and Valves: ANSI B31.16, ASTM Class 150# for piping type and service class.
3. Gas Meter and Pressure Regulator: Diaghragm type meter and single stage gas pressure regulator if not provided by gas supplier; pressure regulator at device for less than 7" w.c. supply.
4. Piping Specialties: Flexible connectors, strainers.
5. Protective Coating: Corrosion resistant polyethylene for use in corrosive atmosphere.

15510 - HYDRONIC PIPING

1.1 Specification Includes

A. Piping Systems for hot water heating, chilled water cooling, condenser water, makeup water, and drain piping.

1.2 Quality Assurance

A. Compliance: ANSI and ASME code, ASME B31.9

1.3 Products

A. Pipes and Fittings:

1. Steel Pipe: ASTM A53, Schedule 40, black steel pipe.
2. Fittings: Suitable for piping type and service class.
3. Joints: Solder, gaskets and fittings suitable for service.
4. Copper Pipe: Type K or L with 50-50 solder or victaulic fitting coupling.
5. Grooved mechanical joints and fittings suitable for this service for chilled water and condenser water systems <145°F temperature range.

B. Valves:

1. General Duty Valves: Gate, globe, check, ball and butterfly valves suitable for use.

2. Special Duty Valves: Calibrated plug valves, pump discharge valves, pressure reducing valves, safety relief valves, combined pressure/temperature relief valves, automatic flow control valves, and triple duty discharge valves.

C. Specialties:

1. Manual Air Vents: Bronze body, nonferrous internal parts.
2. Automatic Air Vents: Float principle air vent, bronze body, nonferrous internal parts.
3. ASME 125# Steel Compression Tanks: Suitable for working pressure and operating temperature, pressure tested.
4. Air Separator; Welded black steel.
5. Pump Suction Diffusers: Cast iron Body, threaded or flanged. Connections for working pressure required.
6. Chemical Feeder: Bypass type chemical feeder, welded steel construction.
7. Diverting Fittings: Cast iron body.
8. Y Pattern and Basket Strainers: Cast iron body, ASTM A126, Class B.

15540 - HVAC PUMPS

1.1 Specification Includes

A. Centrifugal pumps used in hot and chilled water systems.

B. Condensate pumps and receiver sets.

C. Condenser pumps for heat rejection system.

D. Chemical feed water pumps for boiler or cooling tower service.

E. Primary circulation pump for heating boilers.

1.2 Quality Assurance

A. Compliance: UL778; Hydraulic Institute standards, ITT B&G equipment specification performance criteria.

1.3 Products

A. HVAC Pumps and Accessories:

1. Base Mounted, Separately coupled, Double Suction Pumps: Centrifugal single stage axially split case design, cast iron casings, balanced closed overhund double suction impeller, replaceable wear rings, steel pump shaft and sleeve bearings, mechanical seals, flexible pump couplings, frame mounted motor, ITT B&G, Gould, Peerless.

B. Condensate Pumps and Receiver Sets:

1. Pump: Close coupled, vertical design, permanently aligned, bronze fitted, with enclosed bronze case ring and mechanical shaft seal, and drip proof motor. ITT, B&G, peerless.
2. Receiver: Cast iron with externally adjustable 2 pole float switch.
3. Accessories: Gauges, strainer, float switch, control panel.

15555 - BOILERS AND ACCESSORIES

1.1 Specification includes

A. Boilers and accessories for HVAC systems.

B. Boilers for potable water heating.

1.2 Quality Assurance

A. Compliance: NFPA 54; ASME Code; factory mutual insurance criteria

1.3 Products

A. Fire Tube Hot Water Boilers:

1. Packaged Firetub Boilers: Gas and propane burners, factory-assembled and tested, packaged, multipass, horizontal firetube boilers for wet back type and accessories, capacity suitable for use. Lochinvar, Cleaver Brooks, Johnston.

B. Boiler Accessories

1. Boiler Valves: Stop and check valves; Y type blowdown valves.
2. Safety and Relief Valves: Steam safety valves; water relief valves.
3. Boiler control package with “fire eye” safety controls, UL and FM approved, factory mounted and tested.

C. Breechings, Chimneys, and Stacks:

1. Double Wall Metal Vents, Oil or Solid Fuel Appliances: Stainless steel inner jacket, aluminum coated steel outer jacket. Selkirk, metalbestos.
2. Accessories: Barometric dampers, cleanout doors, thermally actuated vent dampers.
3. Common breeching sized according for single roof penetration.

D. Boiler Water Treatment Systems:

1. Systems: Boiler water treatment to inhibit scale, corrosion and biological growth in hot water boiler system, steam boiler system, boiler blowdown system.
2. Equipment: Shot feeder, chemical treatment controller, chemical feeder pump, chemical solution reservoir, test kits, chemicals.

15670 - CONDENSING UNITS

1.1 Specification Includes

A. Condensing units for airconditioning systems.

1.2 Quality Assurance

A. Compliance: ARI 210, 360, ASHRAE 15; ASME code.

1.3 Products

A. Condensing Units:

1. Water Cooled Condensing Units:

a. Factory assembled, ASME 150# pressure vessel nickel-chrome tubes, dual access port headers, ASTM 31.B16 steel welded shell for refrigerant and water service. Trane or equal.

B. Accessories:

1. Discharge line muffler.
2. Gauge panel
3. Elecrtic solenoid unloading.
4. Control circuit transformer.
5. Pumpdown relay package.
6. Crankcase coverplates with equalizer connections.
7. Tube end 150# threaded, flanged or grooved connections.

15680 - CHILLERS AND ACCESSORIES

1.1 Specification Includes

A. Chillers and accessories for use with air conditioning systems.

B. Electrical or steam absorption type.

1.2 Quality Assurance

A. Compliance; ASHRAE 15, UL 465.

1.3 Products

A. Water Cooled Centrifugal Chillers:

1. Packaged Water Cooled Hermetic Centrigual Water Chillers: Factory assembled and tested, compressors, compressor motors, motor starters, evaporator, condenser, unit controls, capacity suitable for use. Trane, McQuay , Hitachi.

B. Reciprocating Chillers:

1. Water Cooled Reciprocating Chillers: Factory assembled and tested, compressors, condenser, evaporator, thermal expansion valve, unit controls, capacity suitable for use, Trane or equal.
2. Condenserless Reciprocating Chillers: Factory assembled and tested, compressors, evaporator, thermal expansion valve, unit controls, capacity suitable for use. Trane or equal.

C. Free cooling cycle with chillers shall be provided in conjunction with cooling tower and indoor sump for energy savings.

D. Absorption Chillers:

1. Trane or equal.
2. Absorption chiller shall be of two-stage lithium bromide concentrator configuration with floating tube support allowing controlled tube expansion eliminating stress cracking of tubes, longitudinal tube in shell construction, ASME 150# pressure vessel construction.

Condenser and evaporator tube bundle exposed to regrigerant shall be cupronickel materials of construction for longevity of operation.

3. Modular control elements of packaged chiller shall incorporate a positive concentration limiting crystallization of media during loss of power. This allows operating personnel to determine power loss caused without first decrystalizing machine.
4. ASME 150# raised face flanges for the evaporator condenser generator and absorber water connections.
5. NEMA and standard controls package shall include PID control strategy for stable, efficient, optimal chilled water supply temepereature and complete range of standard safety controls including pump motor protection, low refrigerant water temperature cutout, low leaving water temperature cutout and interstage high pressure cutout. Controls package shall be compatible and fully interated into a specific facility management system.
6. Pump and motor assemblies shall be self-contained, hermetically sealed with refrigerant pump lubricated and cooled by pump media. Pump assembly capable of being serviced without removal of bromide or refrigerant charge with service life expectancy of greater than 50,000 hours. Purge system shall protect concentrator against reentry of non-condensable gases by use of pump discharge valve.

15710 - COOLING TOWERS AND ACCESSORIES

1.1 Specification includes

A. Cooling towers for rejecting condenser heat from water cooled air conditioning systems or process cooling water.

B. Evaporative closed circuit cooler approved in applicable systems.

1.2 Products

A. Factory Fabricated Cooling Towers:

1. Induced draft, propeller fan, crossflow cooling towers: Factory fabricated, casings, galvanized collection basin and sump, wetted surface fill, drift elinators, louvers, water distribution system, basin covers, discharge dampers, inlet screens, discharge hoods, sound attenuators, basin heaters, rails, stain in instead of ladders, water level control, flow control valves, fans drives, motors, vibration cutouts, capacity suitable for use. Marley or equal..

B. Liquid coolers:

1. Contrifugal fan, blow through, counterflow or crossflow liquid coolers: Factory assembled and tested units, pans, fans, motors and drives, coils, water distribution unit, pumps, elminators, corrosion protection, sound attenuator, water heaters, capacity control dampers, screens, vibration isolators, discharge hoods, capacity suitable for use.
2. Axial flow fan, blow through, counterflow or corssflow liquid coolers: Factory assembled and tested units, pans, fans, motors and drives, coils, water distribution unit, pumps, eliminators, corrosion protection, sound attenuator, water heaters, capacity control

dampers, screens, vibration isolators, discharge hoods, capacity suitable for use. Evapco, Baltimore Air Coil.

15810 - HUMIDIFIERS

1.1 Specification Includes

A. Piped air humidifcation equipment for use in central air systems.

1.2 Quality Assurance

A. Compliance: ARI 610, 620, 630.

1.3 Products

A. Self-Contained Steam Humidifiers: Nortec, Armstrong or equal.

1. Steam Generator: Electrode type.
2. Distribution: Stainless steel duct distribution pipes and hose.
3. Distribution: Fan distribution unit.
4. Humidistat: Sold state electronic sensor controller.
5. Cartridge: Replaceable

B. Evaporative Pan or Elctrostatic Humidifiers: Stultz, Armstrong or equal.

1. Pan: Stainless with float controlled water level.
2. Fan: Direct drive centrifugal blower.
3. Humidistat: Solid state electronic 2 position humidistat.
4. Duct Connections: Stainless steel boot and fan inlet duct collars.

15830 - TERMINAL HEAT TRANSFER UNITS

1.1 Specification Includes

A. Terminal heat transfer units for heating and cooling.

1.2 Products

A. Unit Heaters: Trane, Sterling or equal.

1. Heating Medium: Hot water.
2. Horizontal Unit Heaters: Phosphatized steel casing with baked enamel finish; motor mounted panel minimum 18 gauge steel; casing to enclose coil, louvers and aluminum fan blades.
3. Vertical Unit heaters: Phosphatized steel casing with baked enamel finish; casing to enclose fan, motor and coil, aluminum fan blades.
4. Coils; Plat type aluminum fins mechanically bonded to copper tubes.

B. Unit Ventilators; Nesbitt, Trane, Sterling or equal.

1. Heating Medium: Hot water.
2. Cooling Medium: Chilled water cooling.

3. Cabinets; 14 gauge furniture steel with removable front, baked enamel finish.
4. Dampers: Dual blade mixing dampers for modulation of return and outside air.
5. Fan Board Assembly: Fans, fan housings, bearings, fan shaft.
6. Motors: Split phase start, capacitor run constant speed motors.
7. Coils: 5/8" copper tubes with plate type aluminum fins.
8. Refrigeration: Direct expansion coils of two row copper tubes and aluminum fins, ARI 210, expansion valve, refrigerant filter/dryer, holding charge.
9. Accessories: Throwaway filters, condensate pan, wall louvers, unit shelving, crossover piping, auxialiary radiation.

C. Fan Coil Units: Trane, Sterling or equal.

1. Heating Medium: Hot water.
2. Cooling Medium: Chilled water cooling.
3. Chassis: Galvanized steel with flanged edges.
4. Insulation: Faced heavy density glass fiber.
5. Cabinet: 18 gauge steel removable panels, 16 gauge front, insultion over entire coil .
6. Coils: 5/8" seamless copper tubes mechanically bonded to configured aluminum fins.
7. Auxiliary Heating Coils: 7/16" seamless copper tubes mechanically bonded to configured aluminum fins.
8. Drain Pans: Stainless steel, insulated.
9. Fans: Centrifugal forward curved double width wheels in galvanized steel fan scrolls.
10. Motors; Integral thermal overload protection type.
11. Filters: Throwaway type.
12. Dampers: 18 gauge steel damper blades.
13. Accessories: Wall boxes, discharge grille panels, sub bases, extended oilers, recessing flanges.

D. Fin Tube Radiation: Vulcan, Sterling, Trane.

1. Heating Medium: Hot water heating.
2. Cabinets: 18 gauge cold rolled steel full backplate, 16 gauge front.
3. Elements: Copper tube and aluminum fins, with tube mechanically expanded into fin collars.
4. Accessories: End panels, inside and outside corners, enclosure extensions, access panels, factory mounted dampers, sill extensions, mullion channels, pilaster covers.

15850 - AIR HANDLING

1.1 Specification Includes

A. Fans, ventilators, air handling units, and air filters for building mechanical systems

1.2 Products

A. Centrifugal Fans: Trane, Chicago, Woods, Twin City.

1. Centrifugal Fans for Indoor Installations: Belt driven with housing, wheel, fan shaft, bearings, motor and disconnect switch, A/C inverter motor capability drive.

2. Tubular or vaneaxial Fans: Tubular or vaneaxial inline belt driven with housing, whell, outlet guide vanes, fan shaft, bearings, drive assembly, motor, mounting brackets, A/C inverter motor capability accessories.
3. Inline Centrifugal Fans: Inline belt driven with housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, accessories.

B. Power Ventilators: Penn, Greenheck, Acme.

1. Centrifugal Roof Ventilators: Belt driven or direct drive types, centrifugal type with housing, wheel, fan shaft, bearings, motor and disconnect switch, A/C inverter motor capability drive assembly, curb base, accessories.
2. Centrifugal Wall Ventilators: Belt driven or direct drive, centrifugal fans with housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, accessories.
3. Utility Set Centrifugal Ventilators: Belt driven fans with housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, accessories.

C. Central Station Air Handing Units: Trane, Mamoth, or Heat Transfer Specialities.

1. Variable Air Volume, Central Station Air Handling Units for Indoor Installations: ARI 4430, NFPA90A; draw through type.
2. Components: Motors, coils, dampers, steam humidifiers, and filters.

D. Air Filters:

1. Air Filters: ASHRAE 89, ARI 850, NFPA 90A, 90B.
2. Replaceable (Throwaway) Panel Filters: Flat panels, interlaced glass fiber media, 20 gauge galvanized steel frame, 20 gauge galvanized steel duct holding frame for 10% through 25% filtration.
3. Cleanable Panel Filters: Flat panels electroplated steel, 18 gauge galvanized steel duct holding frames.
4. Extended Surface Disposable Panels Filters: Fibrous material media in deep pleats, galvanized steel frame, holding frames for 30% to 45% filtration.
5. Extended Surface Non-Supported Media Filters: Fibrous material with flexible internal supports, galvanized steel frame, duct holding frames.
6. Front and Rear Access Filter Frames: Aluminum framing members, prefilters, access doors, sealers.
7. Filter Gauges: Diaphragm type with suitable filter gauge range, manometer type filter gauge or Dwyer pressure transmitter each side of filter pack for DDC preventative maintenance controls.

15890 - AIR DISTRIBUTION

1.1 Specification Includes

A. Air distributions systems including ductwork, duct systems, HVAC casings, duct accessories, air outlets and inlets, and air terminals.

1.2 Quality Assurance

A. Compliance: NFPA 90A, 96. ASHRAE89 medium velocity pressure ratings, SMACNA guidelines for medium pressure class ductwork.

1.3 Products

A. Metal Ductwork: United Sheet Metal

1. Types: Rectangular, spiral, and flat-oval metal ducts and plenums for HVAC systems in pressure classes from negative 2" to positive 4" water gauge.
2. Galvanized sheet Steel: Lock forming quality, ASTM A527 G90, spiral wound or longitudinal seam.
3. Duct Liner: Ductliner shall not be used. Insulate duct on outside of duct.
4. Sealing Materials: Joint and seam sealants, tapes and mastics.
5. Firestopping: Fire resistant sealant.
6. Hangers and Supports: Concrete inserts, powder actuated fasteners, structural steel fasteners suitable for use; galvanized sheet steel hangers; duct attachments; trapeze and riser supports.
7. Fabrication: SMACNA HVAC duct construction standards for medium pressure class system velocity of 2500-3500 FPM.

B. HVAC Casings: Trane, United Sheet Metal, Titus.

1. Types: Field erected sheet metal casings used as equipment enclosures and plenums.
2. Plenum Equipment Casings: Double wall insulated, pressurized type, galvanized steel exterior shell, solid or perforated galvanized steel interior shell.

C. Duct Accessories: Greenheck, Louvers and Dampers, AWV.

1. Backdraft Dampers: Galvanized steel frame, blades, blade seals, and axles.
2. Manual volume control Dampers: Galvanized steel standard volume, low leakage volume, and high performance volume control dampers; galvanized steel jackshaft; damper control hardware.
3. Fire Dampers: UL555 with galvanized steel frame, mounting sleeve, blades, horizontal dampers, fusible link.
4. Ceiling Fire Dampers: UL listed and labeled galvanized steel frame, volume control adjustement, replaceable fusible link.
5. Smoke Dampers: UL555 and UL555S, galvanized steel frame, blades and mounting sleeve, replaceable fusible link.
6. Acuators: Damper motors for smooth modulating or 2 position action.
7. Turning Vanes: Manufactured and acoustic turning vanes.
8. Duct mounted access doors and panels.
9. Flexible Connectors: UL181, Class 1, flame retardant or noncombustible fabrics.
10. Flexible Ducts: UL181, Class 1 insulated types. Uninsulated type shall not be used.
11. Accessory Hardware: Instrument test holes, splitter damper accessories, flexible duct clamps, adhesives.

D. Air Outlets and Inlets: Tittus, Kreugar, Metalaire

1. Ceiling Air Diffusers: Diffuser faces, mountings, patterns, dampers, accessories, and finishes suitable for service, use, and location.
2. Wall Registers and Grilles: Materials, faces, patterns, dampers, suitable for service, use, and location as selected.

E. Air Terminals:

1. Central Air Terminals: Materials, dampers, heating coils, remote diffuser air outlets, hardward suitable for use.
2. Integral Diffuser Terminals: Galvanized steel lined plenum with extruded aluminum or sheet steel diffuser, with fixed or variable geometry suitable for use.
3. Fan Powered VAV Terminals: Galvanized steel plenum, heating coils and filtration suitable for use.

15970 - HVAC CONTROL SYSTEMS

1.1 Specification Includes

A. Direct digital control systems used for building HVAC lighting, fire, security and other environmental control systems. Fire and security are stand alone systems and not fully integrated.

B. Control System Operation: Temperature control contractor shall provide project specific piping and instrumentation diagrams as well as AHU flow and control diagrams.

C. Chilled water flow and control diagram shall indicate clearly all valves, pipe sizes, flow meters, 4-way reversing valves, pumps, flex connectors, isolation valves, expansion tank, makeup water, pressuer switches, pressure sensors, pressure gauges, flow switches, thermometers, temperature sensors, strainers, bypass valves, differential pressure sensors/switches, gauge cocks, check valves, all actuators, control system transmitters, control system transducers, pot-type chemical feeders, blancing valves, air separate, all air vents, and miscellaneous control items.

D. Condenser water flow and control diagram shall indicate clearly the quipment specified and the design of the system. Diagram should indicate flow meteres, check valves, pumps, strainers, isolation valves, flex connectors, triple duty or balancing valves, differential pressure sensors/switches, temperature sensors, control system transducers, all actuators, water meters, overflow piping, draining piping, makeup water piping, chemical injection tanks and chemical injectors.

1.2 Work Scope Definition:

A. Contractor shall design, furnish, install, commission and train the owner and representatives on the complete installation of a direct digital control and energy use monitoring system for new multistory office facility.

1.3 Quality Assurance:

A. Temperature control contractor shall be well versed in DOC installations of similar type, have factory trained technicians with minimum five year experience in comparable installation, fully

competent to provide instruction and routine maintenance and emergency on site within 24 hours upon receipt of request.

1.4 Electrical Interlock Requirements:

A. All wiring and devices incidental to the control system shall be furnished and installed by the control contractor. All terminations shall be numbered in orderly fashion and shall correspond to piping and instrumentation diagrams and be in agreement with specified sequence of operations.

1.5 Guarantee

A. The direct digital control system designated on the drawings and plans and specified herein shall be warranted and guaranteed free from defect in both material and workmanship for a period of two heating or cooling seasons, whichever comes first.

1.6 Acceptable Manufactureres:

A. Honeywell Excel DDC

B. Johnson Controls Metasys Systems

C. Barbara Coleman DDC

D. Landis Gyr/Powers

1.7 Products:

A. Acceptable Manufacturers:

1. Honeywell
2. Johnson Controls
3. Barbara Coleman
4. Landis Gyr/Powers

B. Central Hardward:

1. Building front end EMS shall consist of latest state-of-the-art personal computer with 133 megahertz clock speed, 32 megabyte RAM and advanced Pentium processor based with building graphics and all P.I.D. layouts superimposed on floor plans and equipment layouts for a self-diagnostic system wide preventative maintenance program development by the building owner.

C. General Conditions:

1. The direct digital control system shall be fully integrated and installed as a complete package of temperature controls and instrumentation. The DDC system shall function as a stand along unit or by addition of communication board, be interfaced to ahost computer by modem for integrated facility management. The facility management EMS programming shall incorporate direct digital control, energy mangement functions, state-of-the-art technology, simple operation, high reliability and modular construction.

D. Logic Control Functions:

1. Scheudled time of day start/stop
2. Duty cycle optimization

3. Lead-lag sequencing
4. Event initiated command
5. Time-based command
6. Equipment restart
7. Analog and digital base control
8. PI&D closed control looop
9. Direct and indirect (reversed) action
10. Square root and error squared control
11. Cascade and feed forward control
12. Enthalpy economizer optimization
13. Occupied/unoccupied setback and dead band
14. Temperature, humidity and O.A. setpoint reset
15. Heat/cool differential control and lockout
16. Status indication on/off, temperature, humidity, pressure
17. Manual override transfer
18. Deviation alarm
19. Smoke evacuation and pressurization/exhaust zone control.

E. Control Panels and Field elements:

1. Premanufactured elements shall meet all NEMA Class 2, Divion 2 standards of construction with all power terminations, transformations and dead end connections meeting 1996 NEC requirements and local code jurisdiction.

15990 - TESTING, ADJUSTING AND BALANCING

1.1 Specification includes

A. Total testing, adjusting, and balancing for mechanical systems to meet design specifications.

B. Complete commissioning of air and water systems' balance with impartial third party balance report issued to architect/engineer for review prior to owner acceptance

1.2 Quality Assurance

A. Compliance: Associated Air Balance Council (AABC) requirements; National Environmental Balancing Bureau (NEBB) requirements.

1.3 Products

A. Systems for Testing:

1. supply air systems, all pressure ranges; including variable volume and double duct systems.
2. Return air systems
3. Exhaust air systems
4. Hydronic systems
5. Steam distribution systems
6. Condenser systems
7. DDC temperature control system

8. Domestic water pressure and temperature

End of Specifications