

REQUIREMENTS FOR PROJECT DESIGN CALCULATIONS

Submittals:

In addition to the results of required project design calculations, submit to the Owner all design assumptions and inputs to the calculations that were used to derive those results.

Design Parameters:

The design parameters shall be noted on the Drawings and shall comply with the applicable requirements of the International Building Code for construction document submittals. Include at a minimum the following:

1. The use and occupancy classification for each building/area.
2. Gross square footage for each floor and for the entire building.
3. The designated construction type as derived from the International Building Code.

Occupancy Calculations:

The PSC shall provide the calculation for space utilization including the occupancy calculations with full-time equivalent employees.

Controlled Storm Water Discharge Policy:

The PSC shall prepare and submit calculations which compare the peak storm water characteristics of the construction site before the construction begins to the peak storm water runoff characteristics of the site after the construction is complete. The PSC must also prepare and submit plans detailing the retention/detention method chosen to reduce the peak storm water runoff to that which existed on the site prior to construction. The results of the storm water modeling and detention shall also be submitted. See the *Storm Water Drainage Systems* section within these *Standards* for more information.

Structural Loads:

The PSC shall indicate deflection limits, Live Load PSF, Dead Load PSF, Earth Loads, Roof Live Loads, Snow Loads,

Equipment Loads, Wind Loads, and Seismic Loads including Seismic Design criteria, including earthquake loads when applicable. All codes used with respective references shall be included.

The PSC shall consider the effects of demolitions and additional loads to the floors from renovations, including but not limited to: floor toppings, change in use, new walls, and new equipment.

Seismic Load Design:

The PSC shall indicate all seismic design criteria and assumptions in compliance with an executive order issued by the Governor of Illinois in 1990, the design and construction of all new state facilities shall be in accordance with seismic load design and construction standards provided in the current edition of the International Building Code adopted by the University.

Energy Model:

Facilities & Services receives funds from the State of Illinois each year to pay for the utilities and the operation and maintenance of campus buildings. The PSC shall design all new and remodeled buildings on campus to minimize the cost of operation, maintenance and utilities. The PSC shall provide the Energy Model results and file in accordance with ASHRAE 90.1.

Life Cycle Cost (LCC) Analysis:

The PSC firm(s) shall design a least life cycle cost facility. LCC Analyses shall be utilized to select energy related options on any project as deemed by the Scope or Program Statement and at a minimum, all projects 25,000 GSF or larger.

Comment: Campus building energy and maintenance costs must be evaluated in the context of the total building. Life Cycle cost comparisons should consider the effects of only one measure at a time.

The PSC is encouraged to discuss options with the U of I prior to calculating LCC. Life expectancies used in the LCC Analyses shall be consistent with the system life

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expectancies stated in these *Standards*. Note, that LCC Analysis results are required to be submitted with a variance request that has the potential to affect the life cycle cost of the facility. The Life Cycle Cost (LCC) Analysis method may be chosen by the PSC but the analysis should be accepted as a recognized method by the industry. Note that regardless of the method used, all inputs and outputs of the LCC should be submitted for review along with the results of the analysis. These include, but are not limited to: initial costs, replacement costs, annually recurring maintenance costs, non-annually recurring maintenance costs, energy costs, water costs, system life expectancies, etc.

Energy Values for the LCC will vary. Contact the U of I for the most current values.

Proof of Compliance with Energy Standards:

The PSC firm shall design the building envelope and building systems to maximize energy performance within the U of I Design Guidelines. The PSC shall use a computer simulation model to assess the energy performance and identify the most cost effective energy efficiency measures. Quantify energy performance as compared to a baseline building.

Provide documentation to demonstrate the design meets the applicable revision of *ASHRAE 90.1*. See the *Energy Conservation* general guideline within these *Standards* for energy reduction requirements.

Hydraulic Analysis for MEP Designs:

The PSC shall indicate provide all hydraulic analyses for water supply and building water, waste/sanitary, and fire protection / sprinklers.

Harmonic Analysis Report for Variable Frequency Drives (VFD's):

The PSC shall demonstrate compliance to IEEE 519-1992 (Guide for Harmonic Control and Reactive Compensation for Static

Power Converters). Based on the Design Engineering Firm's harmonic analysis report for each particular Project, additional steps may have to be taken to assure compliance to IEEE 519-1992.

1. The PSC report shall contain Total Harmonic voltage and current Distortion (THD) caused by the VFD's as well as other known non-linear loads. The results shall be based on a computer-aided circuit simulating the actual system.

2. The total harmonic voltage distortion shall be less than 5%. If the voltage THD exceeds 5%, additional equipment shall be required to reduce the voltage THD to an acceptable level.

Emergency Generator Load Calculations:

The PSC shall submit emergency generator load calculations to verify that the appropriate loads described as follows will be powered upon transfer. The engine generator set shall be three-phase and shall power all code-required loads including egress lighting. In addition, systems critical to building operation and department research shall be provided with emergency power. Typical building critical loads include: sump pumps; ejector pumps; perimeter heating system pumps where applicable, Communications Equipment Rooms (CERs) and other appropriate loads. The elevator starting current requirements shall be included in the design of the emergency power system to allow the emergency generator adequate starting capacity to operate the elevator upon transfer. The generator shall be designed with a minimum of 20% additional capacity for future loads. See *Section 26 32 00 – Generator Assemblies* within these *Standards*.

Extensions of Primary Electrical Distribution:

The PSC shall submit extensions of the primary distribution system as a part of the building design. The U of I shall review conceptual designs before allowing the project to proceed. Special instructions will be supplied to govern this type of design.

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(Transformer) Review Load Calculations:

Review the load calculations data and transformer KVA capacities with the U of I before proceeding with final design layouts.

Short Circuit (Fault) Analysis & Extensions of Primary Electrical Distribution:

The PSC provide calculations of the extensions of the primary distribution system as part of the building design. The U of I shall review conceptual designs before allowing the project to proceed. Special instructions will be supplied to govern this type of design.

Electrical Systems:

1. The PSC shall submit the total connected and running electrical load as well as the anticipated diversified load for each branch panel, motor control center, distribution panel, transformer/unit substation as well as for the building as a whole.

2. The PSC shall submit a short-circuit (fault) analysis for the building electrical system during the design phase at the 50% submittal. Analysis should be based on the electrical system design and equipment selection up to the 50% design level; assumption can be introduced for the equipment not yet shown in the design. Final short-circuit (fault) analysis should be submitted after all equipment is approved. Analysis shall be based on actual equipment rating.

3. The PSC shall submit a summary of breaker/fuse coordination analysis for the building electrical system(s). (Entire analysis should be made available upon request.)

4. The PSC shall submit a summary of harmonic analysis for any building electrical system that incorporates non-linear loads in excess of 15% of the total load. (Entire analysis should be made available upon request.)

Lighting Systems:

1. Exterior Lighting Calculations: PSC shall submit one copy of point-by-point calculations indicating designed lighting levels in compliance with IESNA recommendations. Areas where these calculations are required include walkways, plazas, parking lots and athletic facilities.

2. Interior Lighting Calculations: PSC shall submit one copy of point-by-point calculations indicating designed lighting levels for each typical space use (office, classroom, corridor, etc). Point-by-point calculations may not be required for every room in the project.

3. Interior Lighting / Energy Usage Calculations: PSC shall submit one copy of installed lighting power density calculations (output from COMcheck software or similar format) indicating that total installed lighting power is in conformance with applicable energy codes.

Telecommunications:

The commissioned Project PSC shall provide floor plans that meet the requirements of *Section 27 00 00 – Communications*. New construction and major remodeling or renovation projects will require the services of a BICSI Registered Communications Distribution Designer (RCDD) Telecommunications Engineer. At the Urbana campus, the Technology Services will assist the commissioned Project PSC in this regard by providing this service for a fee consistent with U of I policy. Minimum qualifications for the Telecommunications Engineer are as listed in *Section 27 00 00*.

HVAC:

With submitted calculations, include PSC's assumptions regarding the following:

1. Summer and winter outdoor climatic design conditions for heating and cooling in terms of dry bulb temperature, mean coincident wet bulb temperature and directional wind velocity.

2. Summer and winter outdoor climatic design conditions for evaporation in

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terms of wet bulb temperature and mean coincident dry bulb temperature.

3. Summer and winter indoor environmental design conditions for various space types and modes of operation in terms of dry bulb temperature and relative humidity.

See project specific *Required Phases & Minimum List of Deliverables and Project Submittal Requirements* for a complete list of deliverables required for each project phase.

Fire Protection & Plumbing Systems:

With submitted calculations, include PSC's assumptions regarding the following:

1. Identification of sprinkler zones and corresponding hazard classifications.
2. Domestic water flow test data indicating individual hydrant identification numbers with corresponding elevations, flow and pressure readings.
3. Indicate the number of male and female occupants per floor/area for determining the appropriate number of restroom fixtures.
4. Indicate rainfall data for roof drain and storm water retention system design.
5. Summary of storm water retention analysis for the building site. (Entire analysis should be made available upon request.)

Primary Building Automation Systems:

The PSC shall include calculations for:

1. HVAC instrumentation and controls (sensors and input devices)
2. Fire Alarm and systems calculations (voltage drops)
3. Telecommunications
4. Security
5. And other technologies required by the project.

Calculations shall be sufficient to establish quantity, location, and quality.

Reference: