Chapter 3
DESIGN ANALYSIS REPORT

301 - GENERAL

A. The Consultant shall develop and maintain a Design Analysis Report for the project. The intent of Design Analysis is to present a clear, complete and concise picture of the design of the facilities and systems. This “as-designed” record is analogous to the construction contractor’s as-built record.

302 - SUBMITTALS

A. Submittal of the Design Analysis Reports shall be required as indicated in the Consultant’s Contract. If not defined in the Consultant’s Contract, the Consultant shall submit Design Analysis reports as defined in this Chapter and Chapter 33.

B. Format: Material shall be presented in 8 1/2” x 11” format, bound in three ring binders with front face and end panel sleeves for binder identification. The binder(s) carry identification including: Volume Number, Project Name, Number, Consultant Name, Consultant Contract Number, and date of submittal, and the name of the Design Phase the submittal addresses. Submittals shall be assembled into a single volume if possible.

C. The Table of Contents and subsequent division tabs shall divide the reports into the sections outlined in this chapter. Further subdivisions are at the discretion of the Design Consultant.

D. Sheets larger than letter size folded to the prescribed size may be used when reduction is not feasible. All side, top, and bottom margins shall be .75 inch minimum to permit side binding and head to head duplication. Folded sheets larger than 11” x 17” shall be placed in PAPER jackets and bound into each report. Material in 11” x 17” format may be folded in half and back-folded to allow binding.

E. Confer with Project Manager and reference Chapter 33 SUBMITTALS for quantities.

303 - DESIGN ANALYSIS SUBMITTALS DURING DESIGN PHASES

A. The Design Analysis shall be submitted at each phase of the design process. Drawings and specifications delivered without an updated and current Design Analysis may not be accepted.

B. The Consultant shall maintain and update the Design Analysis on a continuous and on-going basis to serve as a record suitable for evaluation of design process and progress not only at milestones, but at any time during the project.

C. At the beginning of Schematic Design, the Consultant shall prepare a Preliminary Design Analysis Report addressing all of the items noted in Section 304 below to the extent known following the pre-design meetings at the beginning of the project. Confer with the Project Manager to set the schedule for submittal and level of completion expected for each item.

D. The Schematic Design Analysis Report describes all design criteria, assumptions, design calculations, design coordination, cost estimates, schedules, and other items as itemized below. Appropriate backup material; i.e., product data, drawings, test data shall be included.

E. The Design Development Design Analysis Report contains the design criteria, assumptions, relevant design calculations, a list of any deviations from the CSU Design Standards or building code requirements, design coordination items with technical study reports and appropriate back-up materials, including but not limited to, catalogue cuts, product data sheets, specifications data,
systems performance data, and other data or information used to prepare the Design Development Documents. This Report shall include a list of utilities and their maximum capacities, the capacities of these utilities that will be required to supply each Project, Project systems or equipment and the horizontal and vertical locations where the utilities should enter each Project.

F. The Construction Document Design Analysis Report contains all information from the project inception to the final design of the project. The report summarizes the conclusions of the design, completing and updating design calculations, costs, O and M data, projected Operating and Maintenance cost impacts, and other information presented in the previous reports. It is part of the Final Review Submittal due at the end of the Contract Documents Phase. The content of each section shall be itemized by discipline, i.e., civil, architectural, structural, mechanical, plumbing, fire suppression, electrical power, electrical lighting, access control, teledata systems.

G. At conclusion of the Bid Phase, the Consultant shall provide revision sheets to update the previously submitted report with changes made as a result of final review, amendments and addenda during advertising or bidding. In cases of extensive addenda and changes, the Project Manager may require resubmittal of the entire Design Analysis Report as a conformed document.

304 - CONTENTS AND ORGANIZATION OF THE DESIGN ANALYSIS REPORT

The Design Analysis Report shall contain the following information, organized as follows:

304.1 Preface

A. Title Page

B. Table of Contents

C. Participants: List project participants, including Consultant, University, CMGC, etc.

D. Certification of Standards Compliance: Written certification that all deliverables under this Agreement conform to the CSU Standards. Identify any elements that the Consultant recommends variance from the CSU Design Standards. Include a formal request for variance.

E. Program Statement: Summarize the needs and analysis of the project. Include program conclusions, recommendations, ideas and strategies to accommodate the needs.

F. Diagrams: Logic programs, decision matrices, associative diagrams, functional diagrams, etc.

G. Interviews and Meetings: Meeting minutes of all interviews. Minutes shall be reviewed by the Project Manager prior to incorporation into the manual.

H. Description of Services: Describe engineering services such as geotechnical surface and subsurface investigations, vibrations analyses, acoustical studies, lighting studies, seismic analyses, line-of-sight studies, vehicular and pedestrian traffic studies, surveys and other technical studies required to design the Project.

I. Limits of Consultant Work: After consultation with the Project Manager, describe agreed-upon limits of the Consultant’s Scope of Work. Describe any work by other design Consultants in areas adjacent to, affected by or interfacing with the Consultant’s Work.

J. Project Limits: Define the limits of construction and any interface with other projects. Include records of correspondence involving coordination with other Consultants, utility agencies and code agencies. Provide a project layout including site plan, improvements, and general sections identifying the scope of the project and limits of work. Include approximate area calculations.
K. **Design and Construction Schedule:** Provide design schedule and construction schedules for the Projects in a format accepted by the Project Manager. See Chapter 32 Construction Schedule by A/E.

L. **Summary of Actions:** Provide a summary of the required actions, acceptances, permits or additional information from the CSU Facilities Management Department, user groups, University, governmental entities and private entities which the Consultant will require to complete its Scope of Work and the University or construction contractor will require to complete each Project.

M. **Budget and Funding:** Summarize the overall project budget and list funding sources.

N. **Bid and Procurement Packaging:** Consultant's recommendations for construction contract bid packaging for each of the Projects. The University may require the Consultant to prepare a separate bid packages to achieve the anticipated project delivery budget and schedule.

### 304.2 Design Requirements

The Design Analysis Report shall include a written discussion of design solutions, phasing, materials, risk assessment, compatibility with building systems, all building systems, design interfaces, equipment, performance criteria, maintenance considerations, operational compatibility, alternatives, construction scheduling, cost estimates, construction operation, special conditions and other construction issues.

The Consultant shall present factors considered and provided in the design of the project and project components, with supporting justification, i.e., design calculations, cost estimates and other data.

A. **General Narrative:** Describe facilities and systems designed by the Consultant in relation to user needs, codes, standards and other functional criteria.

1. Major project criteria, including funding sources and budget.
2. Interpretation of the major project criteria
3. Site plan selection factors, including utility availability and capacity
4. Spaces, areas, adjacencies and other relationship requirements
5. Existing components, systems and/or furnishings, with capacities and required modifications.
6. Exterior materials
7. Structural systems
8. Mechanical systems
9. Electrical systems
10. Energy and resource conservation strategies
11. Area summary (gross, net assignable and maintenance/custodial space)
12. Cost of construction and economic factors, initial and life cycle costs influencing design choices
13. Schedule

B. **Design Criteria:** List general criteria pertaining to all disciplines used in the design, including prescribed criteria, specific studies and minutes of pre-design conference meetings. Specific criteria used by each particular discipline shall be completely documented in the text of that discipline.

C. **Design Alternatives:** Provide design alternatives with recommendations and impact on project budget and schedule.

D. **Sustainable Design Strategies:** List and describe sustainable design strategies to conserve resources and protect the environment. Compare benefits and costs to incorporate or eliminate each strategy, and discuss alternatives. Prepare USGBC - LEED scorecard for the project. For projects seeking LEED certification, report status of USGBC process. See Chapter 29, Energy & Sustainable Design Documentation.
E. **Major Components:** List major components of the project and interfaces with larger systems of the University, City of Fort Collins, utility companies and other entities.

F. **Code Analysis:** Complete code analysis of the project including occupancy types and impacts on adjacent uses. Include compliance options. Include plan drawing(s) of pedestrian exiting diagrams with contributory loads of various occupied areas, paths of egress with load factor, vertical egress paths with load factors, and opening/corridor size factors.

G. **Life Safety, Security, and Communications Systems:** Identify all life safety, security systems and communications systems with relationship to existing systems and capacity requirements.

H. **Systems Load Requirements:** Identify design load requirements by listing all of the systems associated with a project and their proposed calculated demand and contributing loading requirements. These systems shall include but not be limited to grey water, potable water, storm water (surface and piped), dirty water, fire suppression water, sewage conveyance, heating, cooling, ventilation, electrical power, natural gas, communications, dedicated information technology power & cooling, fire alarm, access control, security, lightning protection, cathodic protection, roadways, parking, exit corridors, etc. The support data and calculations for this summary shall be located in a separate section or volume of the design analysis.

I. **Energy Conservation Requirements:** Identify energy loads and calculation factors. Discuss which energy design method is recommended for the project and explain why it is preferred (International Energy Conservation Code, ASHRAE Energy Design Guidelines, Appendix G Cost-Based Energy Modeling, etc.)

J. **Utility Incentive Programs:** Identify applicable incentive programs of Fort Collins Utilities, Poudre River Power Authority, Xcel Energy and other resource utilities. Identify contact information and program requirements and submittal schedule. Identify the specific type of documentation required and related deadlines.

K. **Aesthetic Guidelines:** Describe how the design complies with the CSU Aesthetic Guidelines, defining how the project integrates into the University Master Plan, participates in shaping public space and identifying specific elements that respond to the intent of the guidelines.

L. **Design Alternatives:** Define alternatives for improvements to the design and allowances for future growth, expansion or upgrade.
   1. Alternatives in layouts, sizes, locations, geometry
   2. Alternatives in materials, with varying sizes and properties
   3. Alternatives in operation and maintenance requirements
   4. Alternatives in design requirements, i.e. codes standards and loading criteria
   5. Opportunities to provide initial rough-in or substrate for future changes
   6. Alternatives in sustainable design strategies
   7. Cost analysis of alternatives, including life-cycle and return on investment

M. **Costs and Budget:** Provide cost estimates for the construction project. See Chapter 31 Cost Estimates. Account for discrepancies and propose design and budget alternatives to reconcile differences between cost and budget. List and explain selection of cost data sources.

N. **Area Tabulation:** Indicate Net Assignable Square Feet (NASF) and Gross Square Feet (GSF) of all spaces. Indicate amount by which programmed space exceeds or falls short of program. Complete the Building Maintenance and Custodial Space Report (see Chapter 34).

O. **Value Engineering:** Assist the Project Manager in completing value engineering studies as required to evaluate design alternatives by comparing performance criteria with initial and operating costs, scheduling and load evaluations.
P. **Operations and Maintenance Criteria (O&M):** List design provisions that enhance and reduce the time and cost of operating and maintaining the facility when completed.

1. Describe the Operation and Maintenance requirements of the design.
2. Describe the inspections, monitoring, testing, maintenance and security processes.
3. Identify O&M critical activities most critical to satisfactory operations.

Q. **List of Equipment and Long Lead Items:** List all long-lead-time equipment, fixtures, systems, software or accessories for which procurement activity must be accelerated. If long-lead procurement is planned to begin before completion of Contract Documents, the Consultant shall prepare procurement specifications, exhibits, schedules and contract procurement documents.

R. **Critical Construction Activities:** Prepare a list of critical construction and manufacturing activities that the Consultant will observe and monitor during the Construction Administration Phase (Chapter 8). These activities shall be identified in the Contract Documents.

S. **Independent Testing Laboratory Report:** Provide a matrix indicating the type, quantity and quality of tests to be performed by an independent testing laboratory. The matrix rows shall correlate to CSI MasterFormat 2004 divisions of work. The matrix columns shall identify from left to right the following: CSI Division, CSI Division Title, System or material to be tested, type of test and quantity of tests. The quantity of tests shall be identified as actual number of tests, not as a percentage of the work. For each test, recommend whether the ITA should serve as the quality assurance agent of the Owner or the quality control agent of the Contractor. This information shall also be incorporated in the Consultant Cost estimate (see Chapter 31).

T. **Contract Data Submittal Report (CDSR):** The Contract Data Submittal Report (CDSR) is a spreadsheet of all submittals required by the project specifications. This document is not part of the Bid Documents. The CDSR shall be provided initially no later than the 60% Construction Document Submittal and amended for subsequent document submittals including the Issue For Construction. The CDSR shall identify each submittal and acceptance required during the duration of the work from construction notice-to-proceed to final completion. The Report format shall include the following in columns from left to right: Contract Specification Section Number, Paragraph Number, Submittal Description, Related Sections, Number of Copies, Format of contractor's submittal.

U. **Cut Sheets:** Bind a set of the specifications in three ring binder(s) with cut sheets of all specified items and alternates at the end of each section. Annotate at the top right of each cut sheet the paragraph in the specification section where the cut sheet is applicable. The cut sheets shall be for items currently available on the market during that specific design phase. The Consultant shall be responsible and verify that the items specified are readily available up to the date of the Contract Documents as Issued for Bid.

### 304.3 Design Calculations

A. Provide copies of all calculations from which design decisions were made. Identify design, demand and contributory loads. Provide engineering load requirements, design criteria and assumptions made to determine sizes, capacities, etc. for all systems.

B. Divide this section by design discipline. Identify each page with the project title and location. Present calculations in clear and legible form with a table showing all design loads and conditions, formulas, and references. Explain all assumptions, cross-references and conclusions.

C. Indicate the software and version used for design analysis by computer. Include description of the analytical method, assumptions, theories, and technical formulas. Source code or other proprietary
D. If a standard design or other design is being site-adapted and a design analysis exists, the analysis for the new project shall include the material from the original analysis that was site-adapted, in addition to the revised analysis.

E. Describe all major civil and building systems, including but not limited to: stormwater, traffic, mechanical, electrical, communications, structural, foundations, plumbing, life safety, fire suppression, security, fire alarm, fiber optics, communications, signage and any other required systems.

1. Infrastructure support systems: geometry, loads, and schedules
   a) Pedestrian and vehicle traffic patterns and volumes, emergency access, traffic controls
   b) Utilities – electrical power, gas, sanitary, storm, water, gray water, communications
   c) Life Safety – fire department access
   d) Security – monitoring and police access
   e) Egress during emergencies, egress loads contributed to other areas and systems

2. Civil systems
   a) Landscaping area, irrigation loads and controls
   b) Storm water flow, snow removal / storage, erosion control, ground water quality, environmental controls

3. Building systems
   a) Occupancy and area calculations
   b) Structural load requirements by code
   c) Hazard area diagrams and calculations
   d) Code Analysis – include plan drawings indicating new and existing occupancy types, occupancy numbers, exiting directions and load tabulations, egress widths and ratings of separations. This document shall be incorporated in the drawings.
   e) Soils and structural support analysis
   f) Structural systems analysis - including vibration analysis
   g) Mechanical systems analysis - including energy, noise and vibration analysis
   h) Electrical systems analysis including cathodic protection of utilities, heat gains, harmonics where necessary
   i) Plumbing systems analysis – including roof drainage
   j) Fire suppression systems analysis
   k) Communications systems analysis
   l) Conveyance systems

F. Each calculation shall include a list of the basic criteria, including design assumptions, applicable codes, standards and references. List sources for major equations and computer programs. Show the source of formula, equation, input data or assumption and derivation of all uncommon calculations. The applicability of existing solutions to new problems will be explained in writing before they are adopted.

G. Calculations shall be orderly and complete with enough sketches and notes so that the work can be understood. Diagrams indicating data (such as loads, flows, voltages and dimensions) shall be included along with adequate details for nonstandard conditions.

H. The calculation sheets shall be numbered in sequence. When a revision alters the total number of the sequence of pages, they shall be renumbered. Before renumbering, a copy of the affected pages
shall be filed in a "Superseded" binder. The originating engineer shall prepare a calculation cover sheet before calculations are submitted for checking and review.

1. Lettering by hand must be legibly printed with sufficient contrast for photocopying.

2. Calculations shall be made on standard 8-1/2" x 11" calculation sheets. The heading of each sheet in the set of calculations shall be completely filled in with the date, designer's name or initials, checker's name or initials, CSU project name, CSU project number, Consultant job number, calculation set and sheet number and subject of calculation.

3. Computer printouts should be cross-referenced to their corresponding set of calculations. Printouts shall be labeled in the same manner as the hand calculations.

4. The calculation package for a standard computer program shall consist of a completed cover sheet and a complete outline of the problem, including sketches, if applicable.

I. Calculation Quality Control: Maintain a calculation quality control program that includes checking by a design professional whose qualifications are sufficient to originate the calculation. The checker shall not be the originator of the calculations.

1. Check calculations against the design drawing to verify whether they conform to specified configurations, dimensions, and materials.

2. Check calculations for assumptions, analytical methods, mathematical accuracy, completeness, compliance with design criteria, and the adequacy of design.

3. Initial and date each page of the original calculations after they are completely checked and all necessary corrections have been made. Attach initialed alternate calculations, if used.

4. When checking computer calculations, the checker shall check:
   a) Both the calculation package accompanying the printout and the computer printout.
   b) Project-specific programming for assumptions, program theory, compliance with the flow diagram and overall correctness.
   c) Applicability of standard programs and the assumptions made for setting up the calculation.
   d) All input data for correctness, as well as the application of output data.

J. Revisions: All parts of the calculation that are dependent on the revision shall be checked. Review the complete original calculation to determine which parts are dependent. It is not necessary to recheck parts that are independent of the revision. Results of calculation revisions shall be distributed to all parties affected by the change.

K. Maintain records of original calculations that were revised by crossing them out and marking "SUPERSEDED" on the page. Prepare new calculation sheets for all superseding calculations, except for minor changes where the designer may authorize a cross-out, initials the change and identifies it with a revision number on the calculation cover sheet. Original calculations shall be kept in each discipline's section of the project calculation file in the Design Analysis Report. Calculations shall be separated into groups: Preliminary, Final and Superseded and provided with an index.

L. The responsible designer shall review all design calculations prepared by his group for technical adequacy and conformance with design requirements. Preliminary calculations shall be reviewed and initialed by the responsible designer and clearly marked "PRELIMINARY". Final calculations, including computer calculations, shall carry the stamp, seal, and signature of the respective Consultant. The Consultant is liable for the constructability and the function of the system designed.

304.4 Appendix
A. Provide each appendix with a title page and table of contents (index) and number pages consecutively for each appendix. Explain all assumptions, cross-references and conclusions.

1. Cost estimates
2. Outline specifications
3. Data reports
4. Product data
5. Conference minutes and correspondence relative to the design and referenced in other sections.

END OF CHAPTER 3