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PART 5

STRUCTURAL

TABLE OF CONTENTS

	TITLE	PAGE
SECTION I	Criteria	2
SECTION II	Applicable Technical Manuals, Engineering Technical Letters, and Publications	2
SECTION III	General	2
SECTION IV	Structural Submittals	2
SECTION V	Structural Narrative	6
SECTION VI	Structural Design Analysis	6
SECTION VII	Structural Drawings	8
SECTION VIII	Specifications	8
SECTION IX	Miscellaneous	8

I. CRITERIA: Technical Instructions TI 800-01 from CEMP-E, dated 20 Jul 1998 (and all current changes), are to be used replacing Architect Engineering Instructions (AEI) for all U.S. Corps of Engineers designs except medical facilities which are governed by AEI, Medical Design Standards. These TI are available at the U.S. Army Corps of Engineers TECHINFO web address: <http://www.hnd.usace.army.mil/techinfo/index.htm>.

II. APPLICABLE TECHNICAL PUBLICATIONS: In addition to TI 800-01 and its referenced publications, the following publication shall be used for general structural design and construction criteria for most military construction projects.

American Association of State Highway and Transportation Officials (AASHTO)

III. GENERAL:

A. A structural design submittal is required for all new projects, all additions to existing projects and all modifications, alterations and upgrading of existing projects that:

1. Change the use of the existing facility
2. Change the loading requirements of the existing facility
3. Increase the life span of the existing facility

B. Structural engineering shall be coordinated with other disciplines to avoid interference or conflicts. Terminology shall be kept consistent for all disciplines and between plans and specifications.

IV. STRUCTURAL SUBMITTALS:

A. The structural design submittals shall contain the following items:

1. A structural narrative
2. A structural design analysis
3. A seismic design analysis as required
4. Structural drawings as required

5. Technical specification as required

B. The structural requirement for the various phases of design for Military Construction are as follows:

1. Budget Design - The structural submittal at this design stage is only to the extent necessary to recommend the best suitable framing system, to evaluate the loading of columns and/or walls, and to determine the type of foundation - such as piles, caissons (drilled piers), or mat-type foundations and to furnish data (such as the total length of piling required) so that the costs of special foundations will be accounted for in budget estimate.

2. Concept Design - This design stage has two main objectives; first, to define the project in sufficient detail to permit the using agency to review it for functional adequacy, and second, to develop a valid cost estimated to insure that the project can be constructed within the budgeted funds. The structural submittal at this stage of design is to determine the structural system which will be utilized for the project. Generally, no structural drawings are prepared during this stage. However, a concept design analysis is prepared and shall contain the following items:

- a. Structural narrative
- b. List of design criteria used
- c. Dead load calculations
- d. Live load calculations
- e. Wind load calculations
- f. Seismic values
- g. Design calculations for typical structural elements
- h. List of guide specifications to be used
- i. Economic justification for the structural system selected (such as structural steel framing versus reinforced concrete framing)

j. Sketches as required, (showing the framing for a typical bay) may be furnished to enable "take-off" quantities for use in preparation of the concept estimate.

3. Preliminary Submittal (if required) The preliminary submittal shall consist of the following:

a. All comments and responses from the concept submittal.

b. The preliminary design analysis which accompanies the submittal will be substantially complete for all the major structural features of the principle structures. The preliminary design analysis will include all the information and calculations previously provided in previous submissions revised, corrected and updated together with additional design analysis to more adequately cover the more complete design effort. Checking of the design analysis will not be required for this submittal; this submittal will also not normally include the design of lesser related structures such as utility vaults, tanks, retaining walls, tank hold down pads, or similar exterior work. The design analysis will include but not be limited by the following:

1. Calculations of snow, wind, seismic loads for final design to include distribution of these loads to the load resisting elements. Also temperature, vibration, uplift and any other significant load or stress.

2. Design calculations for roof decks, beams, joists, girders, and columns as applicable.

3. Design calculations for floor deck, slab, beams, joists, girders, and columns as applicable.

4. Design calculations for horizontal diaphragms and bracing to include shear transfer connections.

5. Design calculations for exterior cladding (masonry steel, or precast concrete) for bearing, deflection, flexure, shear, and overturning as appropriate.

6. Design calculations for shear walls and bracing.

7. Design calculations for foundations based on bearing values determined by analysis of borings, or test loads, will be complete except for design of reinforcing.

c. The preliminary drawings shall show:

1. Foundations plans, framing plans for each floor, and roof plans for buildings Grid lines on center lines of columns shall be indicated on the plans for buildings framed with columns and beams. In framing plans consisting of repetitive bays, only a typical bay need be detailed to indicate the proposed type of framing. Design live loads, soil bearing pressures, and working stress for the various materials incorporated in the design should be shown on the applicable drawings.

2. Layout of floor joints in slabs on grade. Layout of construction, control and expansion joints in foundation, floor, and roof framing.

3. Typical sections through foundations, floors, and roof framing for buildings. Sections need not be completely detailed at this submittal.

4. Plans and sections of structures other than buildings.

5. Additional sections and details as required to illustrate any special items or methods of framing for which approval is sought.

6. All modifications to existing construction.

4. Final Design - The final structural design submittal shall consist of the following:

a. Structural narrative

b. All comments and responses from the previous submission

c. Final design analysis containing complete structural calculations and references to verify the structural adequacy of the structure shown on the drawings.

d. Final drawings, usually the completion of the preliminary drawings (plus additional drawings, if necessary, to complete the details), or complete structural drawings (plans, schedules and details) developed from an approved concept design.

e. Specifications - the specifications, in conjunction with the final drawings, must contain sufficient information to permit a contractor to bid and construct the project. The structural submittal is responsible for, but not limited to, the following technical sections (or portions thereof) of the specifications: Concrete, Masonry, Structural Steel, Open Web Steel Joists, Rough Carpentry, Roof Decking and Pre-engineered Metal Buildings.

5. Responses to Comments: One word responses, i.e., "Concur" or "Complied" are not to be used. The response shall indicate how the comment will be incorporated, or if not, the reason for not incorporating the comment.

V. STRUCTURAL NARRATIVE: The structural narrative shall describe how the structural system is to function and trace the vertical and lateral loads as they are transferred from the various load resisting elements to the foundation. This paragraph should also briefly describe the foundation system and explain why that system was chosen. Also discuss mutual influences and interactions with adjacent existing and/or planned structures and utilities.

VI. STRUCTURAL DESIGN ANALYSIS:

a. The structural design analysis shall include a thorough and complete structural investigation and show complete calculations for:

1. All design loads.
2. Stresses, including moments, shears and deflections for all structural members and all other members that will be subjected to loads.
3. Sizing of foundations, structural members and connections.
4. Stability and uplift.

b. The design analysis shall also include a brief description of the project and give the following:

1. Background data, statements of authority and requirements
2. Design Provisions

3. Economic Analysis
4. Users Information
5. Design criteria, sources and references for:
 - a. Loads and load factors
 - b. Allowance for future loads
 - c. Level of blast or radiation, when applicable
 - d. Allowable stresses and factors of safety
 - e. Deflections
 - f. Foundation characteristics
 - g. Spans and bracing system
 - h. Sound and vibration control

c. The design analysis shall be completed and all sheets checked and initialed by the preparer and the checker.

d. Load factors:

1. The snow load exposure factor "Ce" shall not be less than 1.0 unless prior approval has been given.

2. Wind load Exposure Categories A or B shall not be used unless prior approval has been given.

e. Seismic analysis:

The seismic analysis shall include but not be limited to the following:

- a. A statement of site seismicity
- b. A description of the structural system selected and discussion of the reason for its selection.
- c. All appropriate seismic factors.
- d. Complete calculations for seismic loads.

VII. STRUCTURAL DRAWINGS: Structural drawings shall contain a location plan plus plans of all roof and floor areas and necessary elevations to clearly locate and define extent of work covered. The plans and elevations shall be supplemented with sections and details necessary for itemized estimating and sufficient clarity necessary for the preparation of shop drawings and/or construction.

VIII. SPECIFICATIONS: The structural specifications shall be prepared and submitted. The current COE Guide Specification will be used as a guide to each technical section for the construction specifications. As a general policy, the use of trade names, proprietary items and the drafting of a specification by adopting a manufacturer's description of a commercial article will be avoided.

IX. MISCELLANEOUS: There is a moratorium on the use of load bearing cold formed steel members. These members shall not be used to resist either vertical or lateral loads with the exception of the following:

a. Non-load bearing interior partitions.

b. Non-load bearing masonry veneer/steel stud wall systems designed only to support its selfweight and to resist out-of-plane lateral loads due to wind and seismic forces.

END