CHAPTER 8
STRUCTURAL AND SEISMIC CRITERIA

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1. SELECTION OF STRUCTURAL SYSTEMS AND MATERIALS.

a. System Considerations. The structural systems and materials to be selected for the design of buildings and facilities at Army installations will be suitable for permanent-type construction, capable of carrying the required loads, compatible with fire protection requirements, and achieving architectural and functional concepts. Materials may be of any of those listed in table 8-1, or any combination, selected for desirability, economy, general availability, low maintenance costs over the design life of the building or facility, and resistance to fire.

TABLE 8-1

STRUCTURAL DESIGN METHODS AND STRESS ALLOWANCES

Materials	Codes or Specifications
Aluminum	The Aluminum Association (AA), "Specifications for Aluminum Structures"
Concrete	American Concrete Institute (ACI), "Building Code Requirements for Structural Concrete"
Masonry	ACI, "Building Code Requirements for Masonry Structures"
Precast-Prestressed Concrete	Prestressed Concrete Institute (PCI), Manuals
Steel	American Institute of Steel Construction (AISC), "Load and Resistance Factor Design Specification for Structural Steel Buildings" and "Manual of Steel Construction"
Steel Joists	Steel Joists Institute (SJI), "Standard Specifications and Load Tables, Open Web Steel Joists and Longspan Steel Joists," and similar publications covering deep longspan steel joists.
Steel, Light Gage	American Iron and Steel Institute (AISI), "Specifications for the Design of Cold-Formed Steel Structural Members"
	Steel Deck Institute, "Design Manual" and "Diaphragm Design Manual"
Welding	American Welding Society (AWS) Codes, Standards and Specifications
Wood	National Forest Products Association (NFPA), "National Design Specifications for Stress Grade Lumber and its Fastenings"

b. Design Considerations. It is required at the inception of the design that the structural system layout be concurrently developed with the architect to assure an overall effective plan.

c. Cost Considerations. The type of construction used for specific projects will be established by an economic study (see chapter 1) as indicated below. In selecting the type of structural system, the total facility should be considered, since the choice will influence the cost of such features as heating, ventilating, air-conditioning, lighting, electrical distribution, architecture, functional concepts, and utility requirements.

d. Structural Materials. When choosing structural materials for a specific project, consideration will be given to:

(1) Availability of labor and materials.

(2) Design life of the facility and maintenance costs over this period.

(3) Experience of inspection personnel.

(4) Experience and skill of prospective contractors.

(5) Feasibility of preassembling or precasting major structural elements.

(6) Site environment, including accessibility, climate, seismic hazard, subsurface conditions, and wind velocity.

2. DESIGN REQUIREMENTS.

a. Design Codes. Design methods and stress allowances or load factors for the various structural materials will be according to the current editions of the codes and specifications listed in table 8-1, except where these codes and specifications are modified or expanded by other published Corps criteria.

b. Design Criteria. Structural design criteria and guidance for military facilities are contained in the following documents:

TI 809-01 to TI 809-25 - Design Criteria

TI 809-01 Load Assumptions for Buildings
TI 809-02 Structural Design Criteria for Buildings
TI 809-03 Structural Design Criteria for Structures Other Than Buildings
TI 809-04 Seismic Design for Buildings
TI 809-05 Seismic Evaluation and Rehabilitation for Buildings (being prepared)
TI 809-06 Masonry Structural Design for Buildings
TI 809-07 Design of Loadbearing Cold-Formed Steel Systems

TI 809-26 to TI 809-50 - Guidance

TI 809-26 Welding - Design Procedures and Inspections
TI 809-27 Concrete Floor Slabs on Grades Subjected to Heavy Loads
TI 809-28 Design and Construction of Reinforced Ribbed Mat Slabs
TI 809-29 Structural Considerations for Metal Roofing
TI 809-30 Metal Building Systems

TI 809-51 to TI 809-99 - Commentary

TI 809-51 Seismic Screening and Evaluation Procedures for Existing Military Buildings
TI 809-52 Commentary on Snow Loads
TI 809-53 Selection Considerations for Roofing Systems

c. Seismic Design.

(1) New facilities and additions or extensions of existing facilities will be designed to provide the level of seismic protection required by TI 809-04, "Seismic Design for Buildings".

(2) Alteration, renovation, or improvement of existing facilities must include a seismic screening and evaluation as required by AR 415-15, "Army Military Construction Program Development and Execution" and AR 420-70, "Facilities Engineering Buildings and Structures."

3. DESIGN DEVELOPMENT OF NEW FACILITIES.

a. Building Design. All Army buildings must have complete lateral force resisting structural systems. The structural systems shall be capable of withstanding design earthquake ground motion while, (1) remaining within prescribed limits of strength and deformation and (2) providing adequate energy dissipation capacity. Structural design and siting considerations may conflict with functional considerations in building design. For instance, shear walls may limit horizontal flexibility and diaphragms may limit vertical circulation. Faults or soil instability may preclude the use of sites that would be otherwise acceptable. Therefore, for all major or complex buildings, including, but not limited to, large administrative buildings, command centers, communications centers, and other similar facilities, and for installation master plans; concept studies at the start of design will include seismic considerations as well as functional, flexibility, and siting considerations so all requirements may be optimally integrated. Where necessary, trade-off studies based on life cycle costing will be made to determine the optimum building design. In such studies, the cost of lost efficiency through less than desirable functional design and the risk cost of less than ideal seismic design will be included if quantification of such costs is feasible.

b. Building Configuration. Seismic considerations may require limits on the height of structures and design configurations. Consolidation of several small facilities, possibly serving widely different functions, may be desirable in limiting structural and foundation costs. Since different functions in the same building may be of different critically (some required to operate post-earthquake, and some not), functions must be studied during design to group those of greater critically. It must be noted that the building configuration plays an important role in the performance of the structure when subjected to seismic ground motion. To obtain optimal seismic resistance and performance, a symmetrically configured structural framing system with effectively and efficiently place lateral resisting elements (shear walls and braced frames) must be considered. Further, the nonstructural elements must be seismic resistant in order to maintain the expected capability (against collapse or post-earthquake operations).

c. Siting. Structures will not normally be sited over active geological faults, in areas of instability subject to landslides, where soil liquefaction is likely to occur, or in areas subject to tsunami damage. Site specific studies are recommended for major or essential buildings in areas where the design spectral response acceleration at short periods (S_{DS}) is equal to or greater than 0.75. Geotechnical reports are required for all major projects.

d. Climatic Considerations. Wind loads, snow loads, and frost penetration will be carefully established for each structure and including local climatic conditions when appropriate.

e. Design for Typhoon and Hurricane Areas. Structures to be constructed in typhoon and hurricane areas will be designed so structural integrity and continuity are provided from the foundation to the roof, irrespective of the materials selected for the facility. All components of the structure must be tied positively together to establish an overall integrated resistance to high wind effects. In designing drag sensitive structures, such as guyed towers, stacks, or suspended pipelines, the effect of maximum wind forces, including pulsating forces on structures, must be considered.