UNIVERSITY of WASHINGTON

Overview of CEE 442

For Spring 2022

Instructors: Professor Dawn Lehman

Kelley Grabner, KPFF

CEE 442: Overview

- Design 4-6 story building in Seattle
- Use of tools and technologies from prior structural & geotechnical classes
- Students form a “company”. Company designs the building with real deliverables including (a) design report, (b) calculation package, (c) drawings and (d) presentations.
- Students meet with practicing engineers twice during the quarter to receive feedback on their designs and deliverables
- Many students bring their capstone projects to interviews. The class simulates an actual design project.

Problem Statement

- Each team is given a set of architectural plans
- Structural systems will be assigned by instructors
- All information needed for schematic design is in the drawings, ASCE 7 (loads) and design codes.
- Schematic design:
  - determine design loads and layout structural system to meet the geometry, functionality and demands (D, L, W, E)

PROJECT DATA

EGRESS DATA

OCCUPANT LOAD (PER TABLE 1004.1.2)
MAX. GROSS FLOOR AREA = 110685F
DESIGN OCCUPANT LOAD = 130SFGROSS/OCCUPANT
110685F/130SF = 85 MAX. OCCUPANT LOAD

EGRESS WIDTH (PER 1005.1)
MIN. STAIR WIDTH (PER 1005.1) = 44"
MIN. CORRIDOR WIDTH (PER 1014.2) = 44"
MIN. PROVIDED CORRIDOR WIDTH = 54"

EGRESS WIDTH PER TABLE 1005.1
(SUPERCEDED BY 1005.1)
MIN. STAIRWAY WIDTH = 85 x .2 = 17"
MIN. CORRIDOR WIDTH = 85 x .15 = 12.75

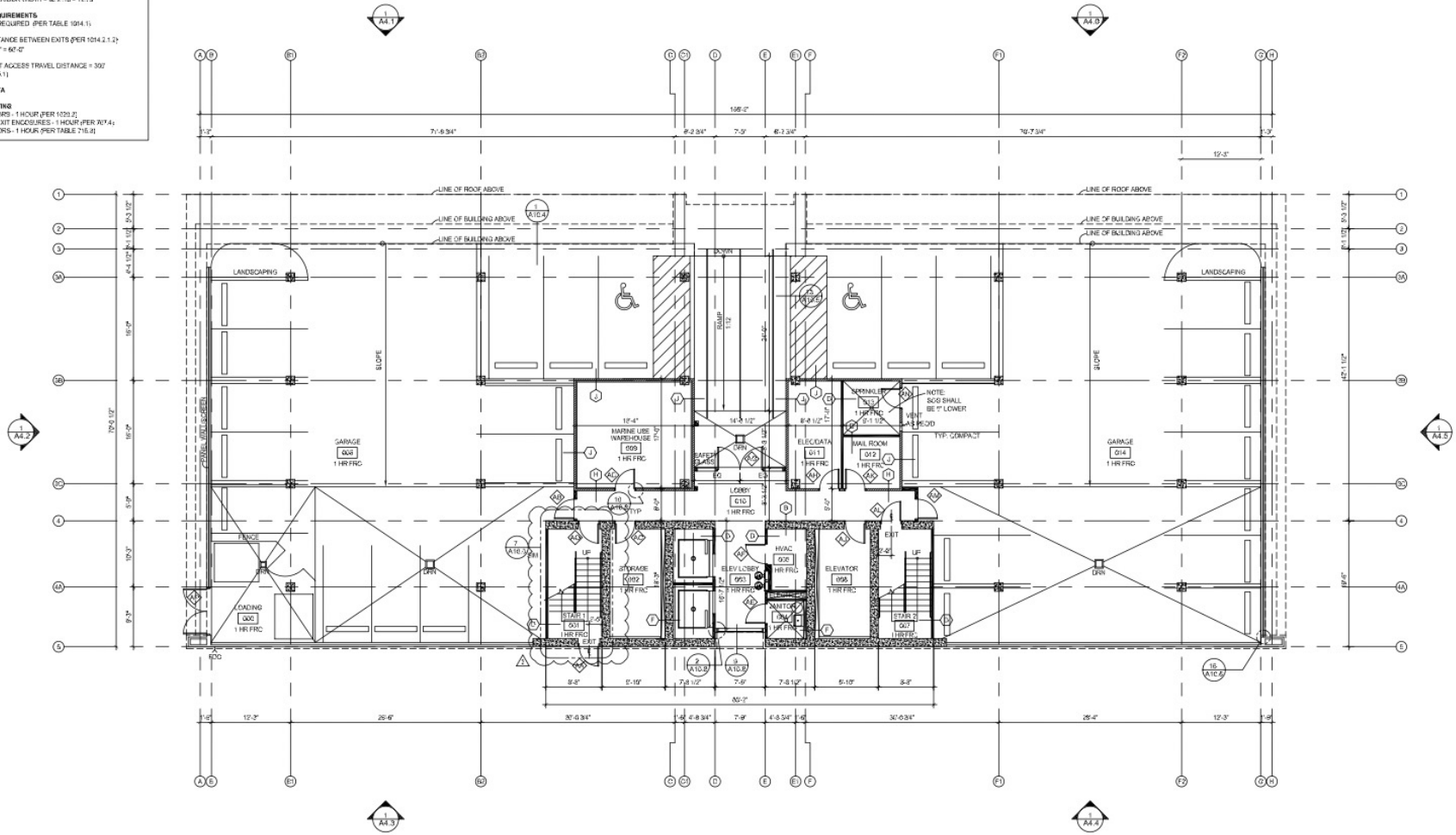
EXIT REQUIREMENTS
2 EXITS REQUIRED (PER TABLE 1014.1)

MIN. DISTANCE BETWEEN EXITS (PER 1014.2.1.2)
½ X 165'-0" = 82'-6"

MAX. EXIT ACCESS TRAVEL DISTANCE = 300'
(PER 1018.1)

FIRE DATA

FIRE RATING
CORRIDORS - 1 HOUR (PER 1020.2)
STAIRS/EXIT ENCLOSURES - 1 HOUR (PER 707.4)
FIRE DOORS - 1 HOUR (PER TABLE 716.3)



NOTE: GRADING MUST BE STABILIZED BY OCTOBER 31ST, AND NO EXCAVATION IS TO BE PERFORMED BETWEEN OCTOBER 31ST AND APRIL 1ST WITHOUT AN APPROVED 'DRY SEASON GRADING EXTENSION LETTER' FROM DPD.

1 GROUND FLOOR PLAN
Scale 1/8" = 1'-0"

NORTH

SYMBOL LEGEND

- DOOR TYPE, SEE A6.6
- WALL TYPE, SEE A9.0
- 001 ROOM NUMBER

Project Team = Engineering Company

- Project Team
  - 4-6 members (*depends on the class size*)
  - Name your company and develop a logo
  - Have at least 2 members who have taken 457.
  - Each member has a technical roles
    - **Gravity** (floor system & columns & connections)
    - **Lateral** (lateral system including connections)
    - SAP **analysis** (Lateral for steel/gravity for concrete)
    - **Foundation** (deep foundation upon request)
  - Also, one person will serve as lead communicator (this is ON TOP of the technical role)

Project Phases

- Project is approached as a professional project with multiple phases:

1. Request for Qualifications (RFQ)
2. Schematic Design including design criteria
3. Detailed Design

Deliverables

SHK East Design Engineers, Inc.

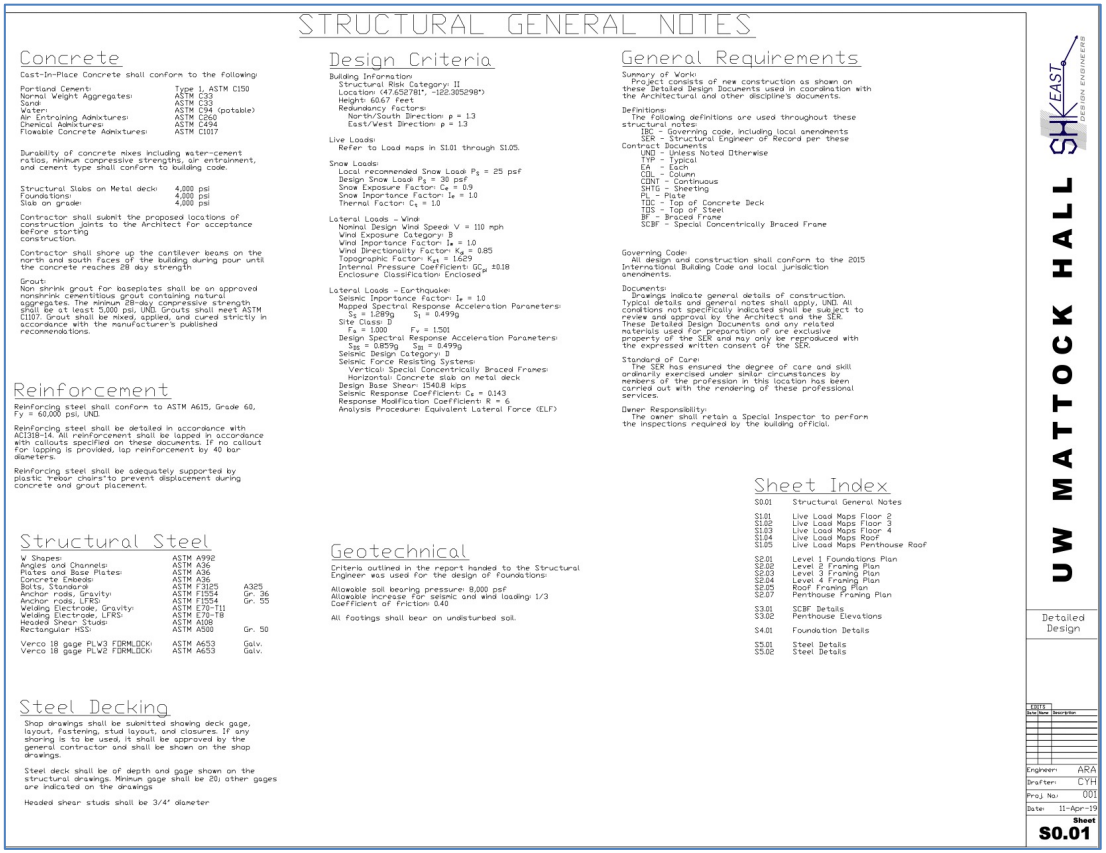
Design Report

University of Washington – Mattock Hall

SHK East Design Engineers, Inc.

Structural Calculations

University of Washington – Mattock Hall



STRUCTURAL GENERAL NOTES

Concrete

Cast-In-Place Concrete shall conform to the following:

Portland Cement:	Type I, ASTM C150
Normal Weight Aggregates:	ASTM C33
Sand:	ASTM C33
Water:	ASTM C94 (potable)
Air Entraining Admixtures:	ASTM C260
Chemical Admixtures:	ASTM C494
Flowable Concrete Admixtures:	ASTM C1017

Durability of concrete mixes including water-cement ratios, minimum compressive strengths, air entrainment, and cement type shall conform to building code.

Structural Slabs on Metal deck:	4,000 psi
Foundations:	4,000 psi
Slab on grade:	4,000 psi

Contractor shall submit the proposed locations of construction joints to the Architect for acceptance before starting construction.

Contractor shall shore up the cantilever beams on the north and south faces of the building during pour until the concrete reaches 28 day strength

Grout:
Non shrink grout for baseplates shall be an approved nonshrink cementitious grout containing natural aggregates. The minimum 28-day compressive strength shall be at least 5,000 psi, UNO. Grouts shall meet ASTM C1107. Grout shall be mixed, applied, and cured strictly in accordance with the manufacturer's published recommendations.

Reinforcement

Reinforcing steel shall conform to ASTM A615, Grade 60, Fy = 60,000 psi, UNO.

Reinforcing steel shall be detailed in accordance with ACI318-14. All reinforcement shall be lapped in accordance with callouts specified on these documents. If no callout for lapping is provided, lap reinforcement by 40 bar diameters.

Reinforcing steel shall be adequately supported by plastic 'rebar chairs' to prevent displacement during concrete and grout placement.

Structural Steel

W Shapes:	ASTM A992	
Angles and Channels:	ASTM A36	
Plates and Base Plates:	ASTM A36	
Concrete Embeds:	ASTM A36	
Bolts, Standard:	ASTM F3125	A325
Anchor rods, Gravity:	ASTM F1554	Gr. 36
Anchor rods, LFRS:	ASTM F1554	Gr. 55
Welding Electrode, Gravity:	ASTM E70-T11	
Welding Electrode, LFRS:	ASTM E70-T8	
Headed Shear Studs:	ASTM A108	
Rectangular HSS:	ASTM A500	Gr. 50
Verco 18 gage PLW3 FORMLOCK:	ASTM A653	Galv.
Verco 18 gage PLW3 FORMLOCK:	ASTM A653	Galv.

Steel Decking

Shop drawings shall be submitted showing deck gage, layout, fastening, stud layout, and closures. If any shoring is to be used, it shall be approved by the general contractor and shall be shown on the shop drawings.

Steel deck shall be of depth and gage shown on the structural drawings. Minimum gage shall be 20; other gages are indicated on the drawings

Headed shear studs shall be 3/4" diameter

Design Criteria

Building Information:
Structural Risk Category: II
Location: (47.6527781°, -122.3052998°)
Height: 60.67 Feet
Redundancy Factors:
North/South Direction: ρ = 1.3
East/West Direction: ρ = 1.3

Live Loads:
Refer to Load maps in S1.01 through S1.05.

Snow Loads:
Local recommended Snow Load: P_S = 25 psf
Design Snow Load: P_f = 30 psf
Snow Exposure Factor: C_e = 0.9
Snow Importance Factor: I_e = 1.0
Thermal Factor: C_t = 1.0

Lateral Loads – Wind:
Nominal Design Wind Speed: V = 110 mph
Wind Exposure Category: B
Wind Importance Factor: I_w = 1.0
Wind Directionality Factor: K_d = 0.85
Topographic Factor: K_{zt} = 1.629
Internal Pressure Coefficient: GC_{pi} ±0.18
Enclosure Classification: Enclosed

Lateral Loads – Earthquake:
Seismic Importance Factor: I_e = 1.0
Mapped Spectral Response Acceleration Parameters:
S_S = 1.289g S_1 = 0.499g
Site Class: D
F_a = 1.000 F_v = 1.501
Design Spectral Response Acceleration Parameters:
S_{DS} = 0.859g S_{D1} = 0.499g
Seismic Design Category: D
Seismic Force Resisting Systems:
Vertical: Special Concentrically Braced Frames:
Horizontal: Concrete slab on metal deck
Design Base Shear: 1540.8 kips
Seismic Response Coefficient: C_s = 0.143
Response Modification Coefficient: R = 6
Analysis Procedure: Equivalent Lateral Force (ELF)

Geotechnical

Criteria outlined in the report handed to the Structural Engineer was used for the design of foundations:

Allowable soil bearing pressure: 8,000 psf
Allowable increase for seismic and wind loading: 1/3
Coefficient of friction: 0.40

All footings shall bear on undisturbed soil.

General Requirements

Summary of Work:
Project consists of new construction as shown on these Detailed Design Documents used in coordination with the Architectural and other discipline's documents.

Definitions:
The following definitions are used throughout these structural notes:
IBC – Governing code, including local amendments
SER – Structural Engineer of Record per these
Contract Documents
UNO – Unless Noted Otherwise
TYP – Typical
EA – Each
COL – Column
CONT – Continuous
SHTG – Sheeting
PL – Plate
TOC – Top of Concrete Deck
TOS – Top of Steel
BF – Braced Frame
SCBF – Special Concentrically Braced Frame

Governing Code:
All design and construction shall conform to the 2015 International Building Code and local jurisdiction amendments.

Documents:
Drawings indicate general details of construction. Typical details and general notes shall apply, UNO. All conditions not specifically indicated shall be subject to review and approval by the Architect and the SER. These Detailed Design Documents and any related materials used for preparation of are exclusive property of the SER and may only be reproduced with the expressed written consent of the SER.

Standard of Care:
The SER has ensured the degree of care and skill ordinarily exercised under similar circumstances by members of the profession in this location has been carried out with the rendering of these professional services.

Owner Responsibility:
The owner shall retain a Special Inspector to perform the inspections required by the building official.

Sheet Index

SHK EAST DESIGN ENGINEERS

UW MATTOCK HALL

Detailed Design

Engineer:	ARA
Drafter:	CYH
Proj. No.:	001
Date:	11-Apr-19

Sheet S0.01

1. Report
2. Calculation Package
3. Drawings
4. Presentation(s)

Learning and Teaching Approach

- Few to no lectures.
- Students work in teams but must make and demonstrate individual contributions to all technical and communication aspects of project (drawings, report, and presentation).
- Students meet regularly with faculty members, and professional engineers acting as advisors and/or evaluators.

Example Project Calendar (442)

CEE 442 Spring 2018 Class Calendar				
Phase	**Week**	**Date**	**Class Lectures**	**Material Due**
RFQ	1	M 3/26/17	Syllabus, Intro Buildings, Design Progression, CAD/Bluebeam	
		W 3/28/17	Drawings/Calcs, Rules of Thumb, Outline SD & Expectations	
		F 3/30/17		RFQ Response
SD	2	M 4/2/17	Review of Framing and Loads	
		W 4/4/17	Review of Framing and Loads	
		F 4/6/17		Design Criteria, Progress Drawings
	3	M 4/9/17	Partially Composite Design, Foundations, Concrete Framing	
		W 4/11/17	Seismic Design and Lateral Systems	
		F 4/13/17		Column & LFRS Locations Drawings
	4	M 4/16/17	SD Presentations	
		W 4/18/17	SD Presentations	
		F 4/20/17		100% SD Package
DD	5	M 4/23/17	Outline DD & Expectations, Checkpoint / Work Session	
		W 4/25/17	KPFF Review	(Lehman out)
		F 4/27/17		
	6	M 4/30/17	Review of SD Documents	
		W 5/2/17	Review of SD Documents	
		F 5/4/17		50% DD Package
	7	M 5/7/17	Review of 50% DD Documents	
		W 5/9/17	Review of 50% DD Documents	
		F 5/11/17		
	8	M 5/14/17	Meetings as requested	
		W 5/16/17	KPFF Review	
		F 5/18/17		Progress Package
	9	M 5/21/17	Preview of DD Documents	
		W 5/23/17	Preview of DD Documents	
		F 5/25/17		
	10	M 5/28/17	Holiday - No Class	
		W 5/30/17	Final Checkpoint / Work Session / Presentation Review	
		F 6/1/17		
	11	T 6/5/17	DD Presentations	
		Th 6/7/17	DD Presentations	
		F 6/8/17		100% DD Package

Key

Informational Session
Group Meeting
Deliverable
Review by Engineers