



announcements 4/8/08

course website:

<http://courses.washington.edu/arch3431/index.shtml>

Course materials (readings, assignments, lectures, references and website links) are now posted and will be updated after every lecture.

lecture slides:

PowerPoint lecture slides are now posted on the course website following lecture. They will be posted as PDF documents in two versions: 6 slides per page (for printing); 2 slides per page for viewing on your computer.


A2: Climate Analysis and References

The second assignment, along with several useful references, is now available on the course website.

Thermal Building Types


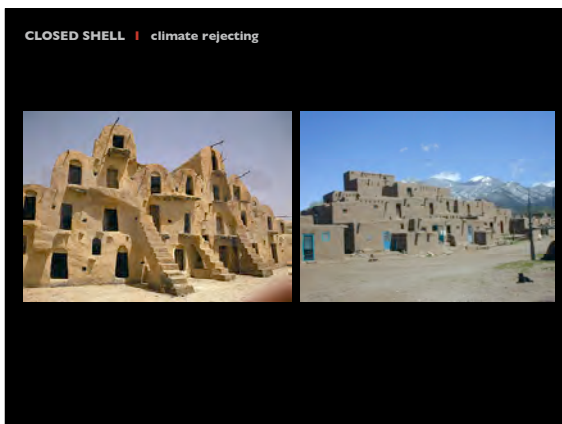
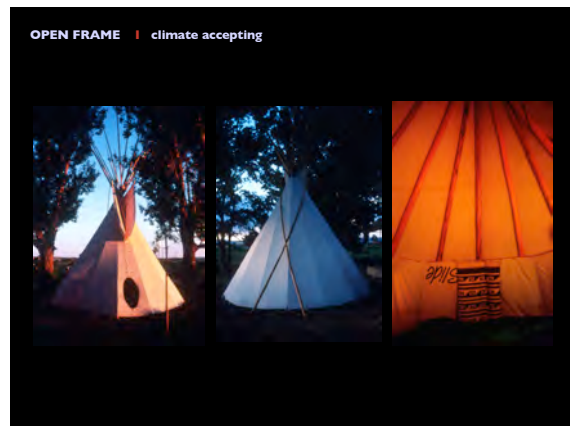
ENVELOPE DOMINATED

- typically small buildings
- low internal heat gains
- space heating determined by heat loss through the envelope.
- relatively high balance point temperature



INTERNAL LOAD DOMINATED

- typically larger buildings
- high internal heat gains
- space cooling requirements determined by heat gains from people, lights and equipment within the building
- relatively low balance point temperature

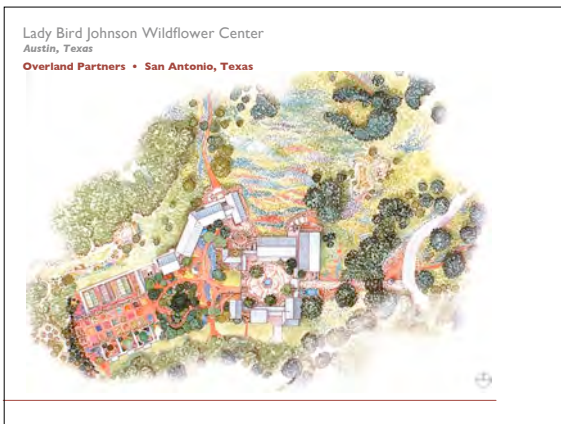
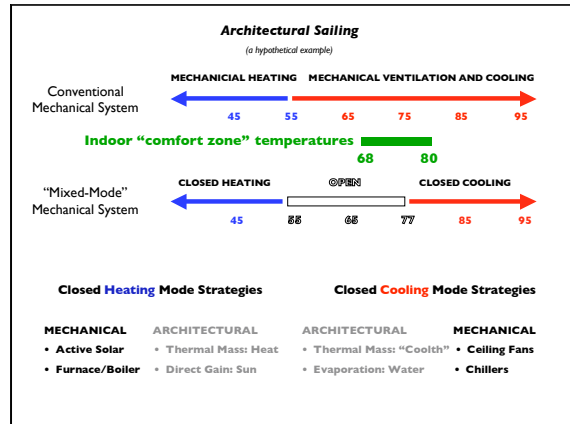
Mechanisms for Environmental Adaptation

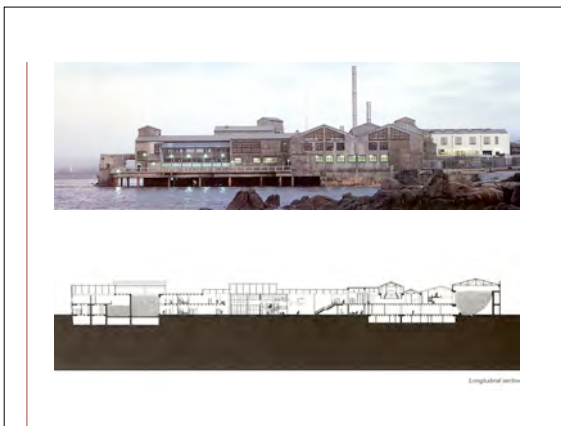
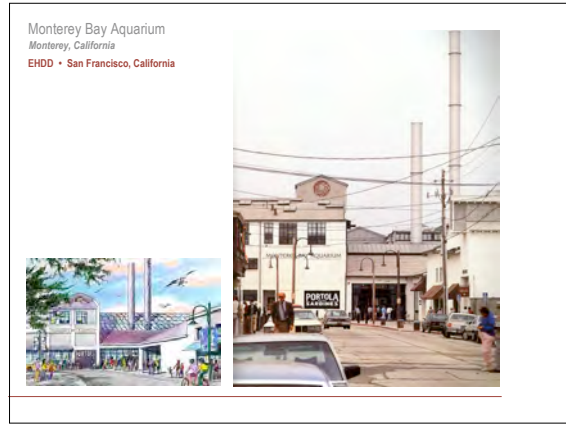
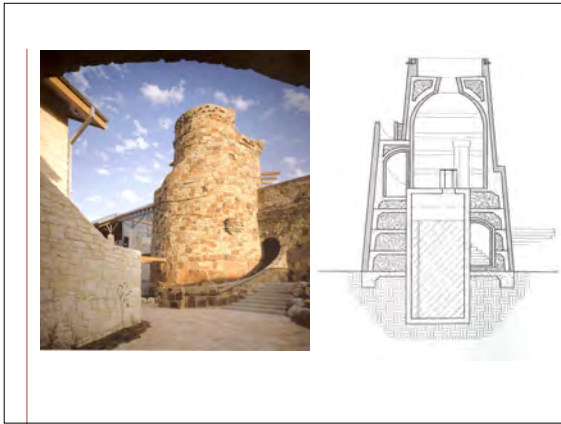
All things in nature respond to change and to transitions from one state of the environment to another. In nature, complex interactions between organisms and the environment are structured by various adaptive mechanisms. Plants and animals use specialized strategies adapted to the particular demands of a place to survive under a broad range of global environmental conditions.

The result of adaptation in recurring conditions in nature is a remarkable array of forms that can be characterized in both static and dynamic terms.

Mechanisms for Environmental Adaptation
 Reference: Ralph Knowles, *Sun Rhythm Form*

- 1. LOCATION**
 - orientation
 - juxtaposition
 - migration
- 2. FORM**
 - shape
 - surface-to-volume ratio (*susceptibility to environmental stress*)
 - envelope & openings
- 3. METABOLISM (chemical conversion)**
 - fire
 - evaporation





Climate Analysis

Ecological design begins with an intimate understanding of *Place*

When coming to an understanding of place, we should ask these questions:

- What is here?
- What will nature **allow** us to do here?
- What will nature **help** us do here?

1. Collect relevant climate, weather and solar data;

2. Analyze and articulate this information in clear, graphic form;

3. Synthesize a set of climate priorities and architectural strategies.

Climate Analysis
Global Climate: Cause and Effect

Uneven heating and cooling of the Earth's surface combined with rotation produce large scale wind, temperature and precipitation patterns

Climate Analysis
Global Climate: Classification Systems

Af, Am	BWh, BSk	Cfb, Cfc	Cw, Cwa, Cwb	Dfb	Dwb	EF
Aw	BK	Cs	Dfa	Dfd	Dwc	ET
BSk, BSh, Bsk	Cfa	Csa, Csb, sa	Dfb	Dwa	Dwd	H

Köppen World Climate Types

Simplified Climate Types

A	hot, tropical rainy	A	hot humid
B	dry	B	hot arid
C	temperate rainy	C	temperate
D	snowy forest	D	cold/variable
E	arctic/alpine		

A, C, D, and E differ by temperature.
B distinguished from others by low precipitation.


Climate Analysis
Climate Mechanisms: **Rain Shadow**

Climate Analysis
Climate Mechanisms: **Land-Sea Breezes**

Climate Analysis
Climate Mechanisms: **Valley Winds and Air Drainage**

Climate Analysis

Climate Mechanisms: **Biological Factors**



Climate Analysis

Objectives

I. Collection: Finding Relevant Climate Data
 Challenges:
 • finding temperature, relative humidity, wind speed and direction, and sky cover, for your location.

II. Analysis: Understanding & Graphic Articulation of the Data
 Challenges:
 • too much information; making sense of the data available, and selecting the most important, **architecturally relevant**, information;
 • effectively telling the story of the climate in your location in a clear graphic manner and a climate narrative in plain language.

III. Synthesis: Identifying Climate Priorities & Architectural Strategies
 Challenges:
 • correctly identifying what the most important priorities are for a particular building type and program in a particular place.

Climate Analysis

Obstacles to reliable site-specific climate data

- dependence on airport or agricultural data sets remote from actual building site
- not all data collected at every station
- topography and land cover are major determinants of local climate
- human impacts are changing climate

Climate Analysis

I. Data Collection for Architectural Design

- **Temperature:** monthly normal high & low
- **Relative Humidity:** monthly normal high & low
- **Wind:** normal monthly normal velocity and direction
- **Sky Conditions:** clear, partly cloudy, cloudy
- **Climate Narrative:** description of climate
- **Character/Sense of Place:** images
- **Solar Radiation:** energy incident on a surface

Climate Analysis

I. Data Collection for Architectural Design: **sources**

Reference
 Online Resources: *Climate Data & Analysis* (available on course website)

Western US:
 Western Regional Climate Center
www.wrcc.dri.edu/climsum.html

USA:
 NOAA
www.ncdc.noaa.gov/oa/ncdc.html

International:
 ICSMS *International Meteorological Data*


- Each instructor will have at least one CD.
- This disk runs only on PC's, and operates in DOS.
- Instructions are in A2: Climate Analysis, on the course website.

sources

MEEB 10th edition

Appendix B:
 Climate Conditions for the United States, Canada and Mexico

Appendix C:
 Solar Data


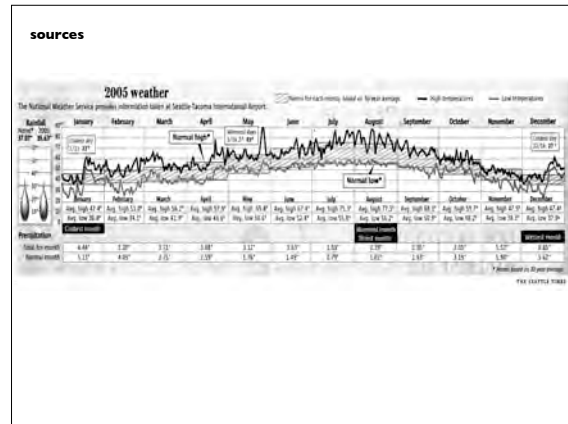


sources

MEEB 9th edition

Appendix A:
Climate Conditions for the United States, Canada and Mexico

Appendix B:
Solar Data

sources

CLIMATES OF THE STATES


National Oceanic and Atmospheric Administration
National Normals, Means, and Maxes
for Each State

Second Edition

Prepared by
James A. Miller

Volume 1
Ohio - Wyoming

Part of the U.S. Tropic of Cancer
Belt and Zone
The State Classification Program
1964-1965



NORMALS, MEANS, AND EXTREMES


SEATTLE, WASHINGTON SEATTLE-TACOMA AIRPORT PACIFIC 87° 27' W 122° 13' W 800 FT. 1617

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Normal High	48.0	52.0	57.0	62.0	67.0	71.0	75.0	78.0	75.0	68.0	60.0	52.0
Normal Low	32.0	35.0	39.0	43.0	47.0	51.0	54.0	57.0	54.0	47.0	39.0	32.0
Precipitation	4.8	3.2	2.5	2.8	2.2	1.8	1.5	1.2	1.0	0.8	0.7	0.6

Climate Analysis

I. Data Collection: **sources**

Western Regional Climate Center:
www.wrcc.dri.edu/summary/lcd.html



SAN FRANCISCO, CALIFORNIA, INTERNATIONAL AIRPORT

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Normal High	55.6	59.4	60.8	63.9	66.5	70.3	71.6	72.3	73.6	70.1	62.4	56.1
Normal Low	41.8	45	45.8	47.2	49.7	52.6	53.9	55	55.2	51.8	47.1	42.7
Precipitation	4.8	5.2	5.3	5.6	5.8	6.1	6.2	6.3	6.4	6.1	5.4	4.9

SAN FRANCISCO, CALIFORNIA, INTERNATIONAL AIRPORT

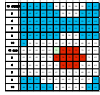
NORMALS, MEANS, AND EXTREMES

LATITUDE: 37 Deg. 37 Min. N. LONGITUDE: 122 Deg. 53 Min. W. ELEVATION: FT. GROUND: 600 TIME ZONE: PACIFIC WMAN: 21524

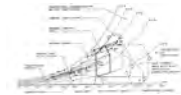
Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE (Deg. F)													
Normal High	55.6	59.4	60.8	63.9	66.5	70.3	71.6	72.3	73.6	70.1	62.4	56.1	65.2
Daily Maximum	41.8	45	45.8	47.2	49.7	52.6	53.9	55	55.2	51.8	47.1	42.7	49
Daily Minimum	48.7	52.2	53.3	55.6	58.1	61.5	62.7	63.7	64.5	61	54.8	49.4	57.1
Monthly													
NORMAL DEGREE DAYS													
Heating (base 65 Deg. F)	905	558	363	287	218	123	92	68	79	135	306	484	3016
Cooling (base 65 Deg. F)	0	0	0	5	0	16	21	28	64	111	0	0	145
MEAN NUMBER OF DAYS:													
Sunrise to Sunset	68	8.5	7.8	9.6	10.8	13.5	16.1	20.6	19	18.1	15.5	11.1	9.4
Clear	68	7.6	7.4	8.6	9.3	9.7	8.6	7.6	8.7	8.3	8.9	8.3	7.5
Partly Cloudy	68	14.9	13.1	12.9	9.9	7.8	5.3	2.8	3.3	3.6	6.5	10.6	14.1
Cloudy													
RELATIVE HUMIDITY (%)													
Hour 04	36	86	85	82	82	84	85	86	87	84	82	84	85
Hour 10 (Local Time)	36	79	76	71	65	64	63	65	67	66	68	72	77
Hour 16	36	67	65	63	60	60	58	59	61	59	59	63	67
Hour 22	36	81	79	77	77	79	80	82	83	80	77	77	80
PRECIPITATION (in.)													
Water Equivalent													
Normal	4.35	3.17	3.06	1.37	0.19	0.11	0.03	0.05	0.2	1.22	2.86	3.09	19.7
WIND													
Mean Speed (mph)	68	7.2	8.6	10.5	12.2	13.4	14	13.6	12.8	11.1	9.4	7.5	7.1
Prevailing Direction through 1964		WNW	WNW	WNW	WNW	W	W	NW	NW	NW	WNW	WNW	WNW

Climate Analysis
 II. Analysis and Graphic Articulation

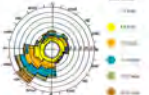
1. Temperature:
 2-hour temperature map



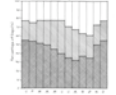
2. Temperature + Rel. Humidity:
 Psychrometric Chart



3. Wind Direction & Velocity
 Wind rose



4. Sun & Shade
 Sky Cover Chart



I. Temperature: 2-hour temperature map

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
12 midnight	37	40	42	45	50	56	60	60	56	49	42	38
2	37	39	40	43	49	54	58	58	54	48	42	37
4	36	38	39	42	47	53	56	57	53	47	41	36
6	35	37	38	41	46	52	55	56	52	46	40	35
8	36	39	40	43	48	54	57	58	54	47	41	37
10	41	44	47	51	57	62	67	67	62	54	46	41
12 noon	44	48	51	55	61	67	72	72	67	58	49	44
2	45	50	53	57	64	70	75	74	69	60	51	45
4	44	48	52	56	62	68	74	74	68	59	50	44
6	42	46	48	52	59	64	69	69	64	55	47	42
8	40	43	45	48	54	60	64	64	60	52	45	40
10	38	41	43	46	52	57	61	62	57	50	43	38

Seattle 2-hour temperatures
 Balance Point = 55° F
 Change-over Temperature = 75° F

Annotations:
 - CLOSED/Heating: 55%
 - OPEN/Sailing: 42%
 - CLOSED/Cooling: 3%