Regional Climate Analyses and Design Data

The House Beautiful

CLIMATE CONTROL PROJECT

X. BOSTON AREA

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Regional Climate Analysis and Design Data X. Boston Area

BECAUSE of the human tendency to remember unpleasant extremes it is difficult to accept the "hypothetical typical day" set up by statistical studies of the Boston climate:

"... it would be a very clear, dry, rather calm day when the sun brings up the temperature sharply during daylight hours, & radiation into the clear sky at night drops the temperature abruptly, as is the customary procedure in desert areas."

It would be unfair to omit the author's immediate qualification ("which of course Boston is not").

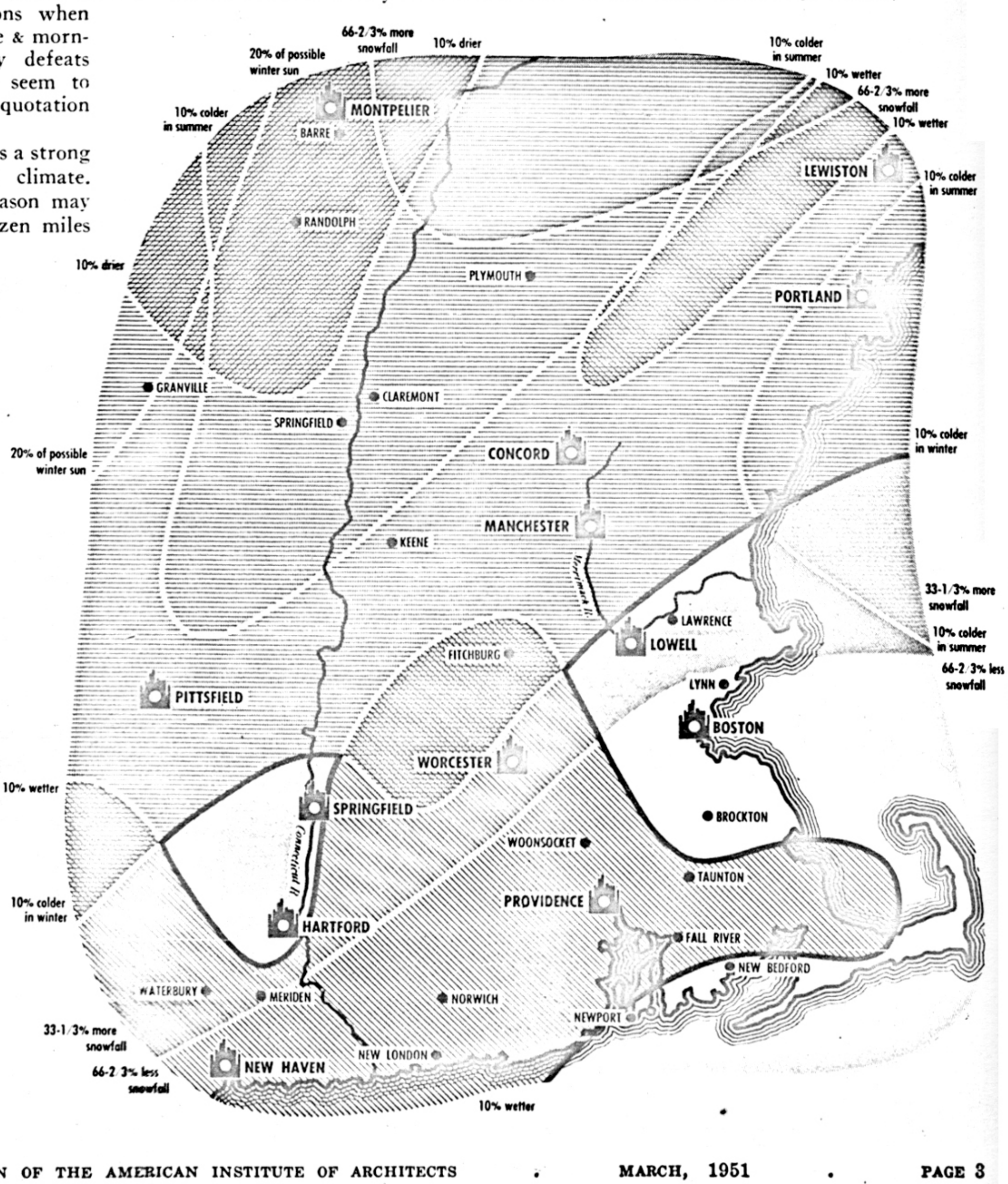
A nor'easter roaring in off the Atlantic & spraying snow on walls as if it were acoustical plaster, that outdoor wind-tunnel they call the Mass Avenue Bridge, August afternoons when brick sidewalks incandesce & mornings when the humidity defeats your shower all would seem to make our climatologist's quotation a dreamy fiction.

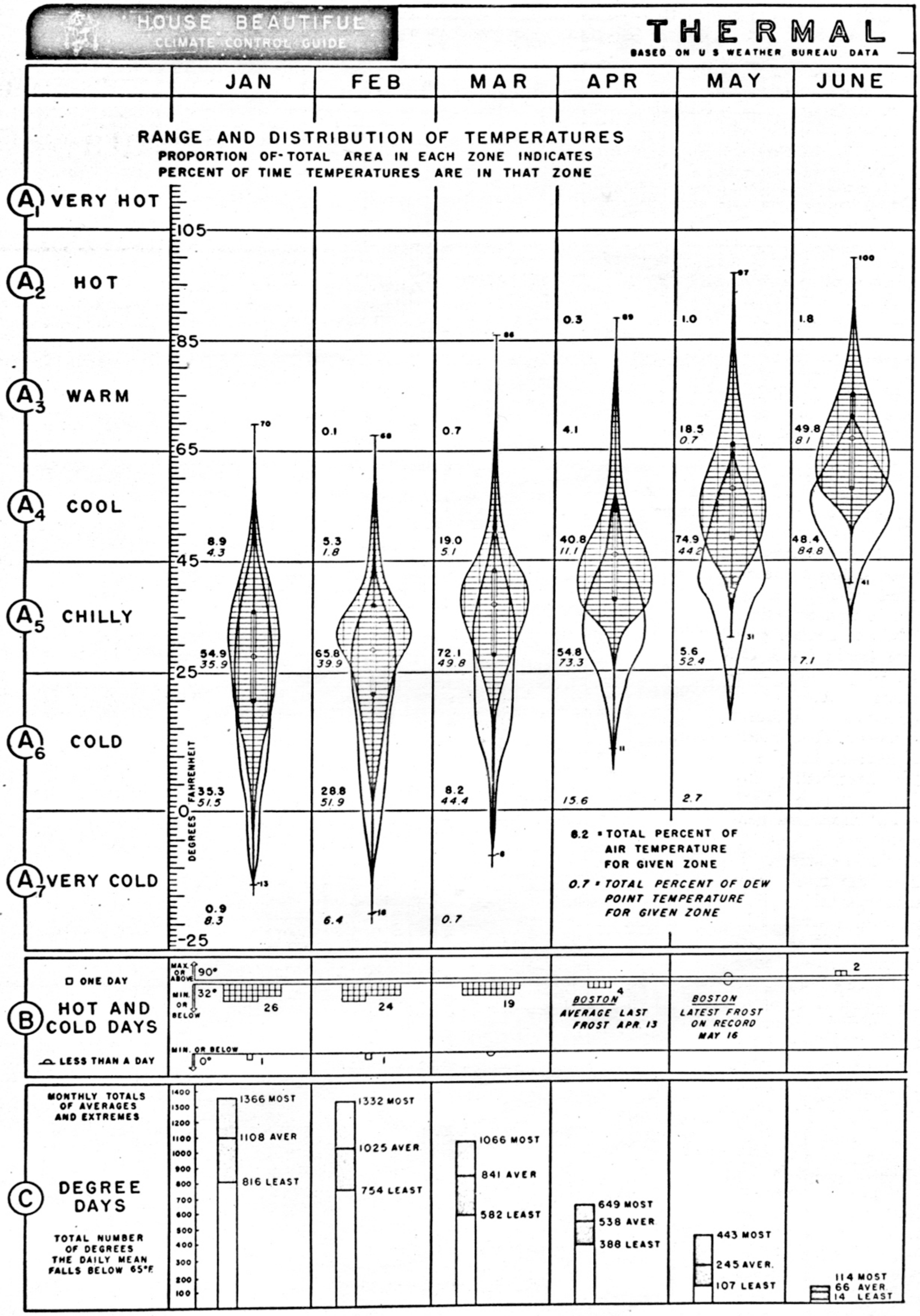
The Atlantic Ocean has a strong influence on the Boston climate. The average growing season may be 40 days shorter a dozen miles west. Storm & average wind velocities exceed Chicago conditions. Thermal & vapor pressure graphs (A & O) are long & thin, indicating rather wide ranges & frequent changes of these indices of comfort. In spite of the hypothetical dry day, Boston is accurately classed as generally wet in winter & humid in summer. It does have much more winter sunshine than most other areas of its latitude. Three times as much consideration should be given to heating period as to open-door period. Humidification is indicated for 56% of year & solar heating is practicable for over 75% of year.

These typical data indicate a compact plan taking all possible advantage of winter sun, better-than-average insulation & vapor-sealing, winter humidification (summer dehumidification if it can be afforded) & mandatory good site drainage.

Rough & rolling topography, varied vegetation & water areas should prepare us for extreme variety of microclimates in this region. Regional climate criteria must always be adjusted for actual site & neighboring land characteristics.

Hugh Stubbins, Jr., AIA, kindly furnished notes on local conditions.





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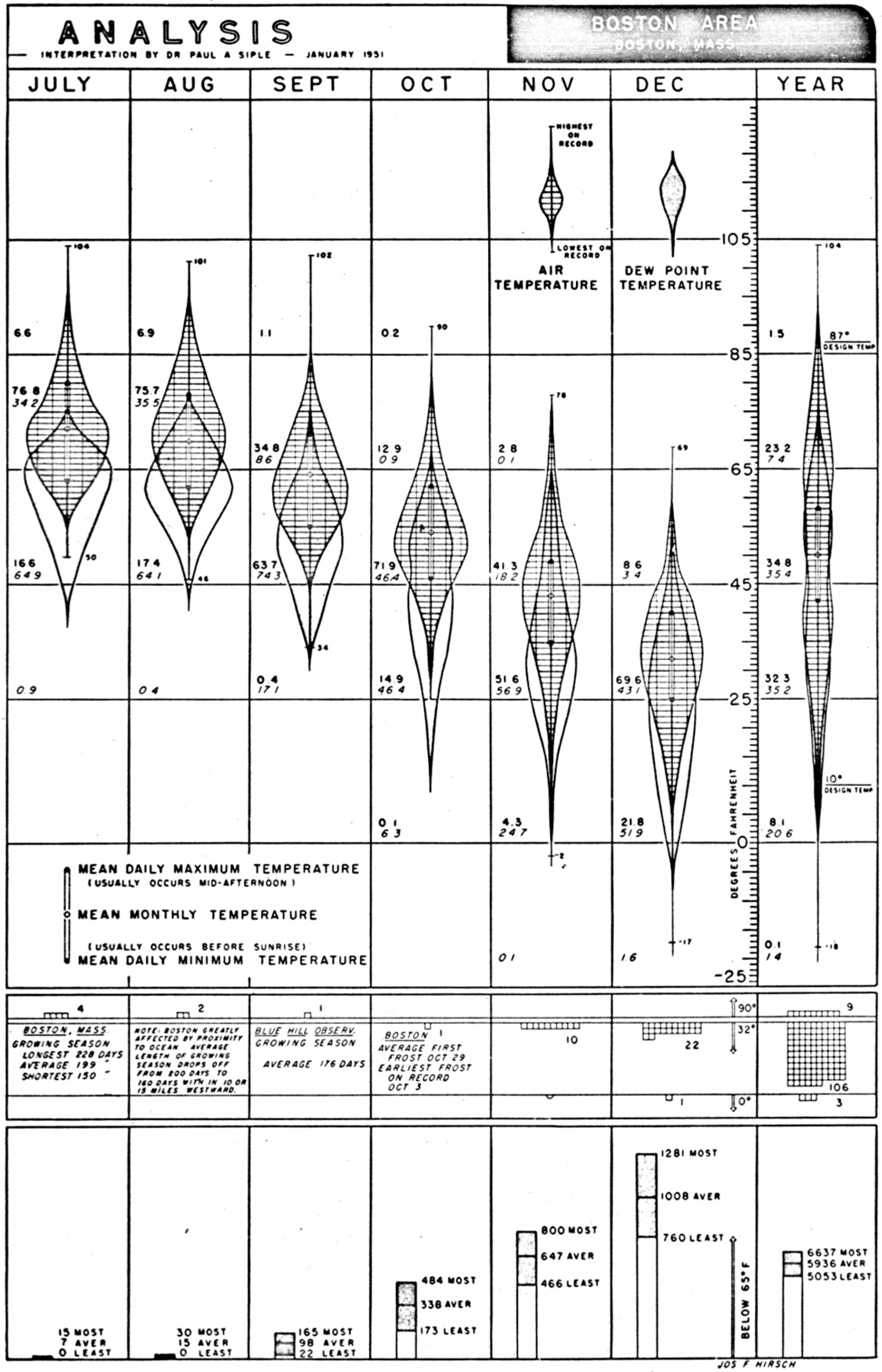

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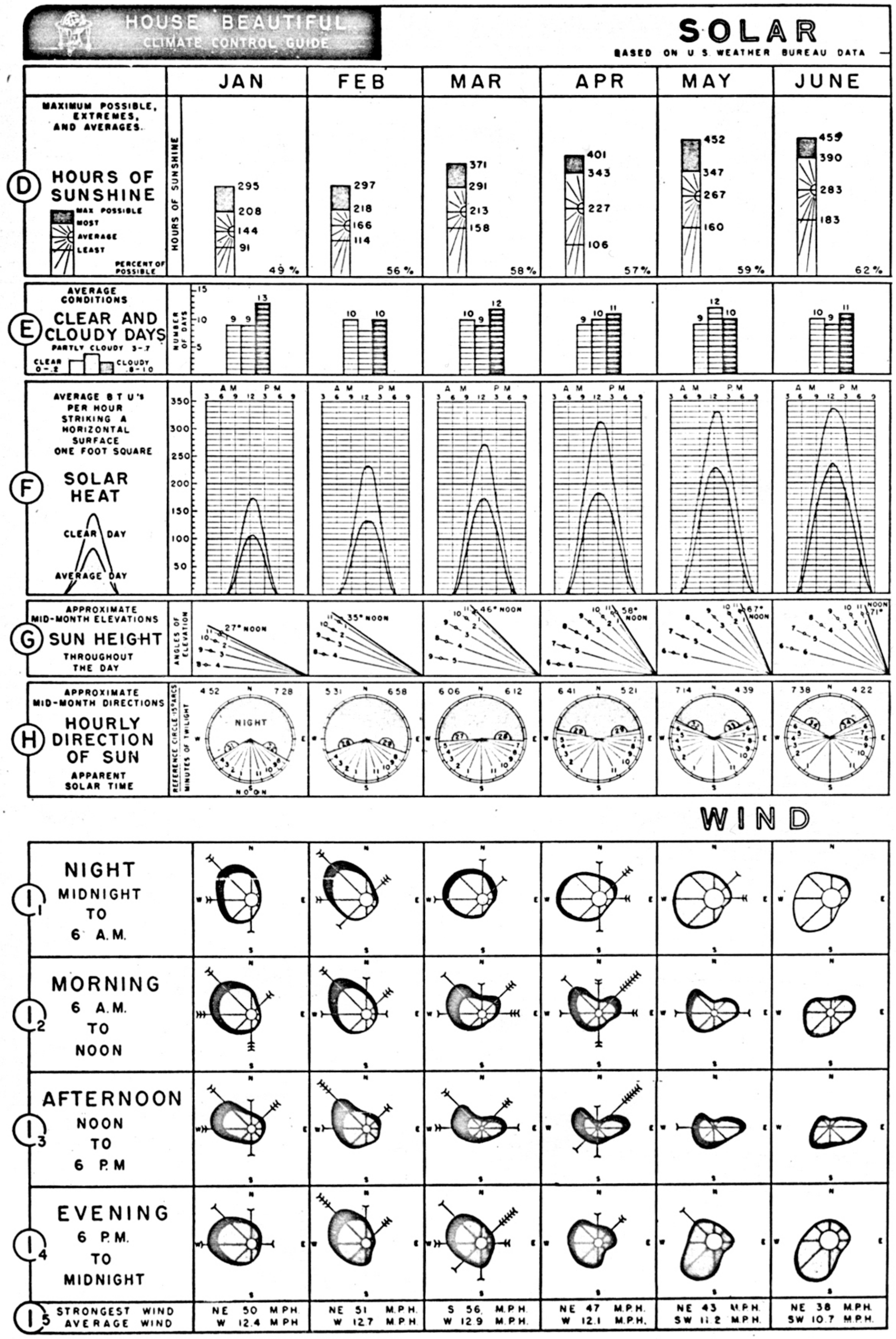
DESIGN DATA BASED

ZONE	GENERAL INTERPRETATION	SITE AND ORIENTATION PLANTING	INTERIOR PLAN
A1 VERY HOT A2 HOT	In general, design emphasis cannot be for summer conditions because of greater demands for winter protection. Highest temp zone—above 105°—never reached in Boston area. Significant only in Jul & Aug. Only 1.5 hrs/yr reach this zone, generally on unusually hot afternoons. Air temps never remain in this zone through 24-hr period. Recommended max design temp is 87°.	Avoid summer sun-pockets & radiation glare from pavements & nearby buildings. Shading should be used with caution if tending to exclude winter sun. Shade not also serving as winter windbreak should be deciduous.	Relying on normal temp lag & by keeping doors & windows closed during heat of day, interior need never reach higher thermal ranges.
A3 WARM	Typical of Jul & Aug, also of daytime hrs in May & Sep & hottest hrs of Apr, May & Oct—about 2055 hrs or 88 days in all. About 23% of yr in this zone of open-door, outdoor living.	Porches & terraces desirable for outdoor living in warm zone.	In this range adequate ventilation may ordinarily be obtained by opening windows & doors. When x-ventilation is not positive, artificial circulation is desirable. Avoid stagnant air pockets. Moistureproof & mothproof storage closets recommended.
A4 COOL	For nearly 35% of yr, design emphasis will be on low heat requirement & indoor living. Typical spring & fall weather, May & Oct & daylight hrs in Apr & warmer days of Nov. Total 3050 hrs or equivalent of 127 days. Humid conditions frequent.	Gardening may begin in Apr with planting completed by May. Blooming period Jun-Sep. Min shading desirable in this period to allow full solar impact. Solar nooks usable in this zone.	Interior comfort in this range depends upon control of drafts to bring air movement down to about 20 fpm. RH indoors in this zone in buildings maintained at a comfortable 70° F without specific moisture control mechanisms will fluctuate within reasonable limits even if outside humidity goes to 100%.
A5 CHILLY	Over 32% of hrs represent major winter climate with frequent frosts, freeze-thaw, wet snow, & mud. Typical of Mar & Dec, of daytime in Jan & Feb, nights in Apr & Nov, occasional nights in May, Sep, Oct. Total 2830 hrs or about 118 days. Outdoor humidity likely to be high.	Hardy evergreens recommended for winter landscape, placed appropriately for windbreaks (see wind analysis). Generous use of well-drained gravel or paving recommended for mud control in walks, play space, clothes-drying space, etc.	Protect entrance against tracking in of snow & mud. Facilities for storing wraps & overshoes should be ample. Make provision to restrict drafts & internal air movement. On extremely cold days it should be possible to cut off less-used parts of house.
A6 COLD A7 VERY COLD	About 8% of yr classed as cold. Typical of nights in Dec, Jan, Feb, & occasionally in Nov & Mar. Weather tends to be clear, calm & dry. Total about 710 hrs or equivalent of 30 days. Only 0.1% or equivalent of about 19 hrs/yr fall in this extreme range.	Frost penetration 2.5 to 3 ft. Emphasize planting & orientation to protect house from coldest winds.	Compact, two-story design favored over rambling design for fuel saving & winter comfort. Indoor laundry-drying facilities desirable.
B HOT & COLD DAYS	Only 9 days/yr likely to go over 90°, mainly in Jul & Aug. About 106 days when temp is at or below 32° (10 in Nov, 22 in Dec, 26 in Jan, 24 in Feb, 19 in Mar, & as many as 4 in Apr). Only 3 days likely to be at or below 0°. Av growing season 199 days, range 150 to 288 days.	Tender perennials should not be exposed before middle of May—max safe growing season 200 days with climax before Oct. Shallow-rooted plants should be well covered Nov to Mar.	
C DEGREE DAYS	Daily temp ranges between high in mid-afternoon to low at dawn about 16° on av. Actual range in summer may be 35° to 50° & in winter from 50° to 85°. Caution in use of degree days is urged because they neglect important factors in house cooling (RH, wind & solar radiation) each of which can create considerable variation from basic values. Degree days furnish indicator of conditions but may mislead by as much as 50%.		

ON THERMAL ANALYSIS

ROOF	WALLS	OPENINGS	FOUNDATIONS & BASEMENT	MECHANICAL
Roof & wall temps may rise to 160° depending upon reflectivity, conductivity & thermal capacity—results in excessive drying stress. Building materials subject to direct sun should withstand repeated cycles of 4-hr continuous temps as high as 160° & rapid reduction of as much as 100°. Insulation against radiant heat should be adequate to withstand thermal gradient of 85° to maintain approx 75° on inside of roof & walls under max stress conditions. Roof & west wall most affected. Light color roof & walls, former with at least 4" insulation & air space. Shade all sun-struck walls in this zone.		Glazed openings should be protected with awnings or blinds during hot days. Windows should have overhang to permit ventilation during rain.	**Summer basement temp likely to remain around 60°. Therefore all air entering basement having higher vapor pressure than that of floor & walls** will bear enough moisture to cause condensation. All windows should be kept closed & basement made proof against exterior vapor pressure. Low heat, by solar or other means, desirable. **Exterior ventilation usually not good means for drying basement in summer.**	Attic exhaust fan useful for creating interior circulation on hot days. Special ventilation desirable to exhaust humid air from kitchen and bathroom. Elaborate air-conditioning & dehumidification devices not ordinarily justified for house installation. Room circulating fans useful.
		Solar windows to S beneficial in this range. Efficiency greatest in Apr, May, Oct, & Nov.	Humidity usually not high enough in this range to cause basement condensation.	**Heat production by household appliances, fireplace, solar heating will be sufficient in this range. Optimum zone for solar heating.**
Substantial insulation required to reduce heat-loss in winter thru roof & walls. Thermal gradient Dec, Jan, Feb between external air temp & internal air temp will av approx 40° F. Often greater. Set min design temp for wall insulation in this area at 10° F, giving differential of approx 60° thru wall. Not more than 3½ days/yr will exceed this gradient. Surface materials (roof & walls) should be test-proofed down to at least −18° F (absolute min record). Avoid materials affected by freeze-thaw action & avoid construction leaving water pockets. Surface materials damp most of winter because of frequent rains, wet snow, little sun & low evap rate. Avoid absorptive materials on exterior or provide protective coating. Vapor-proof inner surfaces of walls & roof to permit raising internal humidity to higher vapor pressure than outside during this period.		Large windows desirable for winter light & solar effect but should be double-glazed or have storm sash.	Underground walls should be waterproofed on exterior, especially near grade.	Means of humidity production should be provided to hold indoor RH at 50%.
		Orient to receive max solar heat. Coldest days are sunniest. Weather-strip openings, provide curtains for evening insulation.	Water & sewer pipes should be at least 4' deep.	Heating system must be quick to respond to sudden temp changes.
Full impact of heating degree days greatly reduced by good quality insulation & airtightness of roof, walls & openings.				**In spring & fall degree days can be fairly well cancelled out by solar heating.** **780 hrs/yr air conditioning on basis of high dewp temps & high dry bulb in A2 Hot Zone.** **1405 hrs/yr no heat or cooling required.** **3050 hrs low heat (fireplace, aux heat sources, low central heat or solar). Av daily degree day 10.** **2830 hrs med heat requiring central heat. Av daily deg day 30.** **710 hrs high central heat. Av daily deg day 50.** **10 hrs max heat all facilities. Av deg day 75.**



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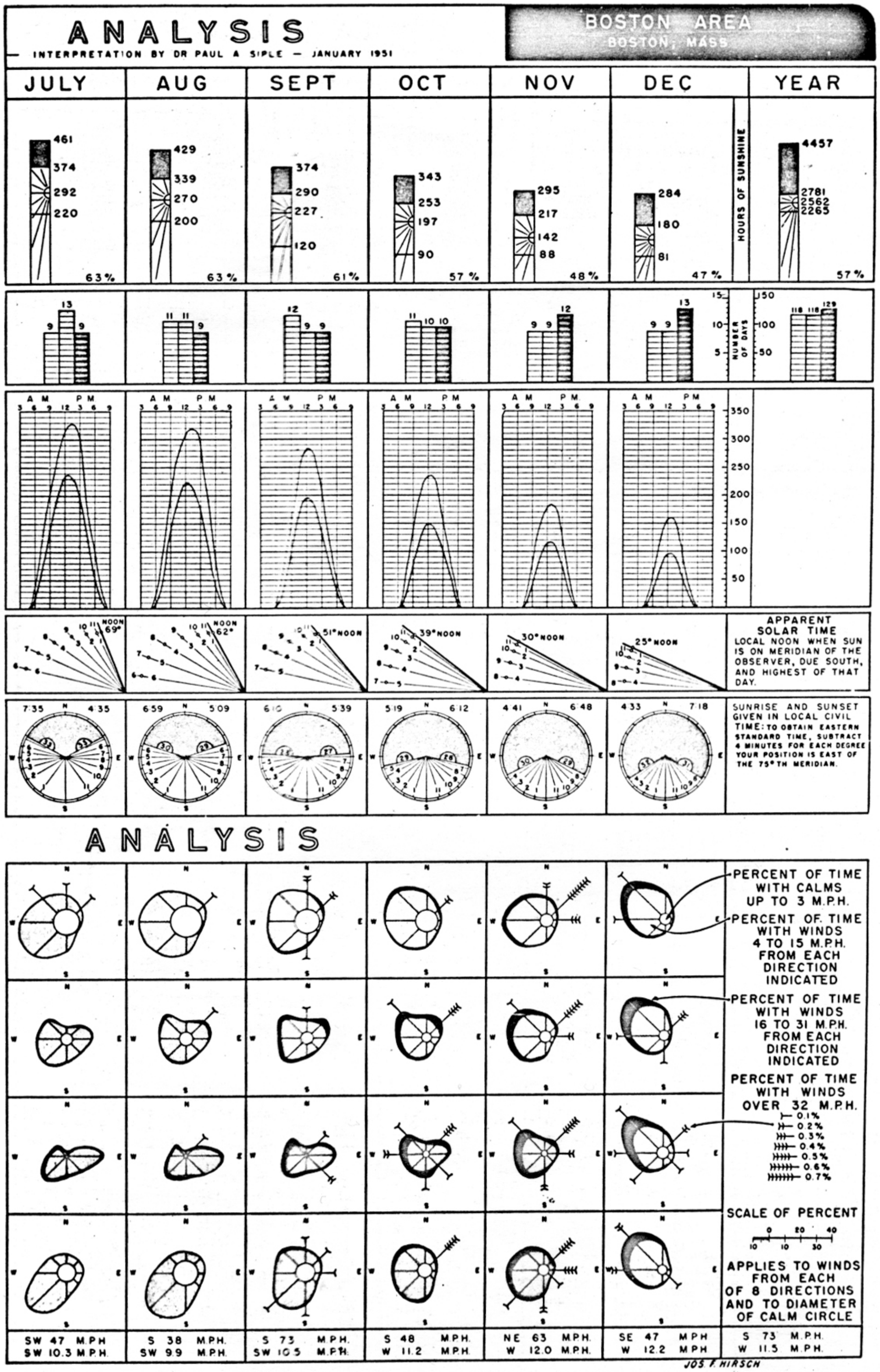
ANALYSIS
INTERPRETATION BY DR PAUL A SIPLE — JANUARY 1951
BOSTON AREA
BOSTON, MASS.
JULY
AUG
SEPT
OCT
NOV
DEC
YEAR
461
374
292
220
63%
429
339
270
200
63%
374
290
227
120
61%
343
253
197
90
57%
295
217
142
88
48%
284
180
81
47%
HOURS OF SUNSHINE
4457
2781
2562
2265
57%
NUMBER OF DAYS
APPARENT SOLAR TIME
LOCAL NOON WHEN SUN IS ON MERIDIAN OF THE OBSERVER, DUE SOUTH, AND HIGHEST OF THAT DAY.
SUNRISE AND SUNSET GIVEN IN LOCAL CIVIL TIME: TO OBTAIN EASTERN STANDARD TIME, SUBTRACT 4 MINUTES FOR EACH DEGREE YOUR POSITION IS EAST OF THE 75°TH MERIDIAN.
ANALYSIS
PERCENT OF TIME WITH CALMS UP TO 3 M.P.H.
PERCENT OF TIME WITH WINDS 4 TO 15 M.P.H. FROM EACH DIRECTION INDICATED
PERCENT OF TIME WITH WINDS 16 TO 31 M.P.H. FROM EACH DIRECTION INDICATED
PERCENT OF TIME WITH WINDS OVER 32 M.P.H.
0.1%
0.2%
0.3%
0.4%
0.5%
0.6%
0.7%
SCALE OF PERCENT
APPLIES TO WINDS FROM EACH OF 8 DIRECTIONS AND TO DIAMETER OF CALM CIRCLE
SW 47 M.P.H.
SW 10.3 M.P.H.
S 38 M.P.H.
SW 9.9 M.P.H.
S 73 M.P.H.
SW 10.5 M.P.H.
S 48 M.P.H.
W 11.2 M.P.H.
NE 63 M.P.H.
W 12.0 M.P.H.
SE 47 M.P.H.
W 12.2 M.P.H.
S 73 M.P.H.
W 11.5 M.P.H.
JOS F. HIRSCH

DESIGN DATA BASED ON

FACTOR	GENERAL INTERPRETATION	SITE AND ORIENTATION PLANTING	INTERIOR PLAN
D **HOURS OF SUNSHINE**	**About 57% of hrs/yr when sun is above horizon, weather is sunny. No great variation from yr to yr altho variation between corresponding months may be great. Relatively poor distribution of sunshine —least in winter, most in summer, but better distribution than most cities in same latitude.**	Shading desirable about 60% of hrs sun is above horizon Jun-Sep, primarily on W.	**Protect interiors from sun penetration during bright, hot periods** **Kitchen preferably on E or S.**
E **CLEAR & CLOUDY DAYS**	**About equal distribution between clear, partly cloudy & cloudy days. Av clear days about 9 to 10/mo, except in early fall when number rises to 11 or 12. Sep clearest month. Fewest cloudy days in summer—av 12 to 13.**	Full shading beneficial about 1 of 3 days. Avoid overshading for greater design emphasis on winter conditions.	Long periods of cloudiness in winter make interior gloomy. Light colors recommended in decoration.
F **SOLAR HEAT**	**When sun is at highest in Jun & Jul, solar radiation amounts to about 235 Btu's/sf/hr for av day & 333 Btu's/sf/hr for clear day. In Dec & Jan av radiation/hr drops to 110 Btu's & for clear day 165 Btu's.**	Sun is major factor in determining house orientation. S sun important in winter months.	
G & H **SUN HEIGHT & HOURLY DIRECTION**	**Use these two graphs together to determine height & direction of sun at any hour of day. Correct data to local civil or daylight time for precise shadows. Assume house plan placed at foci of lines or transfer angles by protractor. Use with Wind Analysis to plan orientation for wind & sun factors together. In summer, sun shines for av of 15 hrs/day (Jun-Jul) reaching max elevation of 70° at noon. In winter (Dec-Jan), day is reduced to less than 9½ hrs with av noon elevation of 26°.** **Total daily accumulation of heat/sf horizontal surface for each month is as follows (Btu's/sf/day):** **Av: Jan 365; clear day: 922 | Av: Jul 1937; clear day: 2728** **Feb 873 1364 | Aug 1737 2433** **Mar 1206 1770 | Sep 1443 1954** **Apr 1455 2286 | Oct 974 1438** **May 1890 2655 | Nov 702 955** **Jun 1941 2802 | Dec 525 811**	Houses on N-S streets, with main rooms facing E or W will miss much winter sun, particularly if placed close together.	
I **WIND**	**Boston relatively windy because normal westerly winds are intensified by lower pressures over ocean, especially in winter. Because of irregularity of landscape, considerable local variation in wind direction & velocity. Wind velocities are greater near ocean, with more tendency to land-sea breeze variation than farther inland. Check local conditions.** **Prevailing breeze in summer is from SW. Prevailing breeze in winter from W, with breeze during coldest part of winter nights from NW. Little winter wind from E & SE. Summer axis for cross ventilation primarily SW-NE. Gales up to 75 mph (of at least 5 min duration) have been recorded. Highest velocity to be expected at roof level, however, not greater than 50-60 mph & during summer only about 25 to 30 mph.** **Afternoons are windiest part of day. Evening & night tend to be calmest period, creating problem of ridding house of daily heat accumulation in summer. Winter is much windier than summer. Mar is windiest month, Aug least windy.**	**Wind almost as important as sun in determining house orientation.** Windbreaks should be placed to W & NW. Porches receive best NE-SW crossdraft in summer if placed on SE corner. If on S, they get cornering SW & W winds & E crossdraft but miss prominent summer NE wind. W porches receive W winds head-on but are shielded from E & NE summer breezes. If glazed, they act as W windbreak. They have added disadvantage of more heat & glare. N porches receive good E & W crossdraft but miss some of SW, receive no insulation in winter & serve only as minor windbreak. E porches get E winds head-on but get no crossdraft because N-S is least windy axis in summer. They receive early am sun & are shaded in pm, distinct summer benefit. If glazed for winter they receive only fractional sunshine & are poor windbreak since, except in spring & fall, cool period is characterized by low velocity winds from E.	Plan should permit taking advantage of SW-NE ventilation axis in summer, & to block NW-SE axis in winter.

SUN AND WIND ANALYSIS

<table>
<tr><th>ROOF</th><th>WALLS</th><th>OPENINGS</th><th>FOUNDATIONS & BASEMENT</th><th>MECHANICAL</th></tr>
<tr><td colspan="2">Select wall & roof materials to withstand extremes of dryness & continued dampness—resistant alike to desiccation & fungus.
Roof should control solar heat with insulation capable of resisting inward heat flow of 330 Btu's/sf/hr on horizontal surface.</td><td>Glare control by means of blinds desirable in summer. Blinds & sash should be arranged to avoid heat trap between glass & blind.</td><td>Consider extension of basement to admit max sunlight, making it more cheerful & partially controlling dampness, fungi, etc.</td><td></td></tr>
<tr><td colspan="2"></td><td>Oversize windows for winter daylighting not desirable because of excessive heat loss.</td><td></td><td>Provide ample electric outlets for adequate interior & exterior lighting.</td></tr>
<tr><td colspan="2">Vertical surfaces receive more heat than flat roof in winter & less in summer. Steep-pitched roof counteracts adverse summer-winter solar condition.
Solar screens shielding outer walls eliminate or capture sun at certain seasons & provide compromises with winter winds or summer breeze control.</td><td>S orientation for largest glass areas (more easily controlled).
Protect all windows from summer sun & permit max winter sun to penetrate as deeply as possible.</td><td>Solar heating of basement in spring & fall helps heat entire house, in summer can act as moisture control.</td><td>Solar heating devices most advantageously mounted on vertical wall or steep-pitched roof.</td></tr>
<tr><td colspan="2">Orientation of vertical walls is extremely critical. E-facing wall, receiving much heat early, receives no heat during pm. Therefore an E-facing wall receives about 75% as much heat as a horizontal surface would receive in winter in the course of a day & only 50-60% as much in summer. A S-facing wall receives twice as much as horizontal surface during Jan & Dec, 1½X as much in Feb & Nov, & approx same as horizontal in May, Jun & Jul. S-facing wall is somewhat selfshading in summer when sun is high but gains more than twice as much as an equal area of ground or flat roof in winter.</td><td></td><td></td><td></td></tr>
<tr><td>Roof should be shaped to minimize turbulence around house, especially in winter. Avoid pockets where leaves & snow will collect.</td><td>Wall & roof insulation advisable, particularly on N & W.</td><td>Choice location for entrances is on SE, second choices on E, N, or S. Avoid entrances on N, E, W, or NW.
Entrances should have vestibule or storm doors, & be recessed or otherwise protected against cross winds in winter. Avoid unnecessary windows or large windows on windward sides in winter (W & NW).</td><td>Provide wind deflecting devices or easy method of cleaning snow & leaves from basement window wells & entrances.
Summer ventilation usually not effective means of drying out basements in this region.</td><td>Exhaust fans should be located so as not to face into prevailing summer breeze from W & SW.</td></tr>
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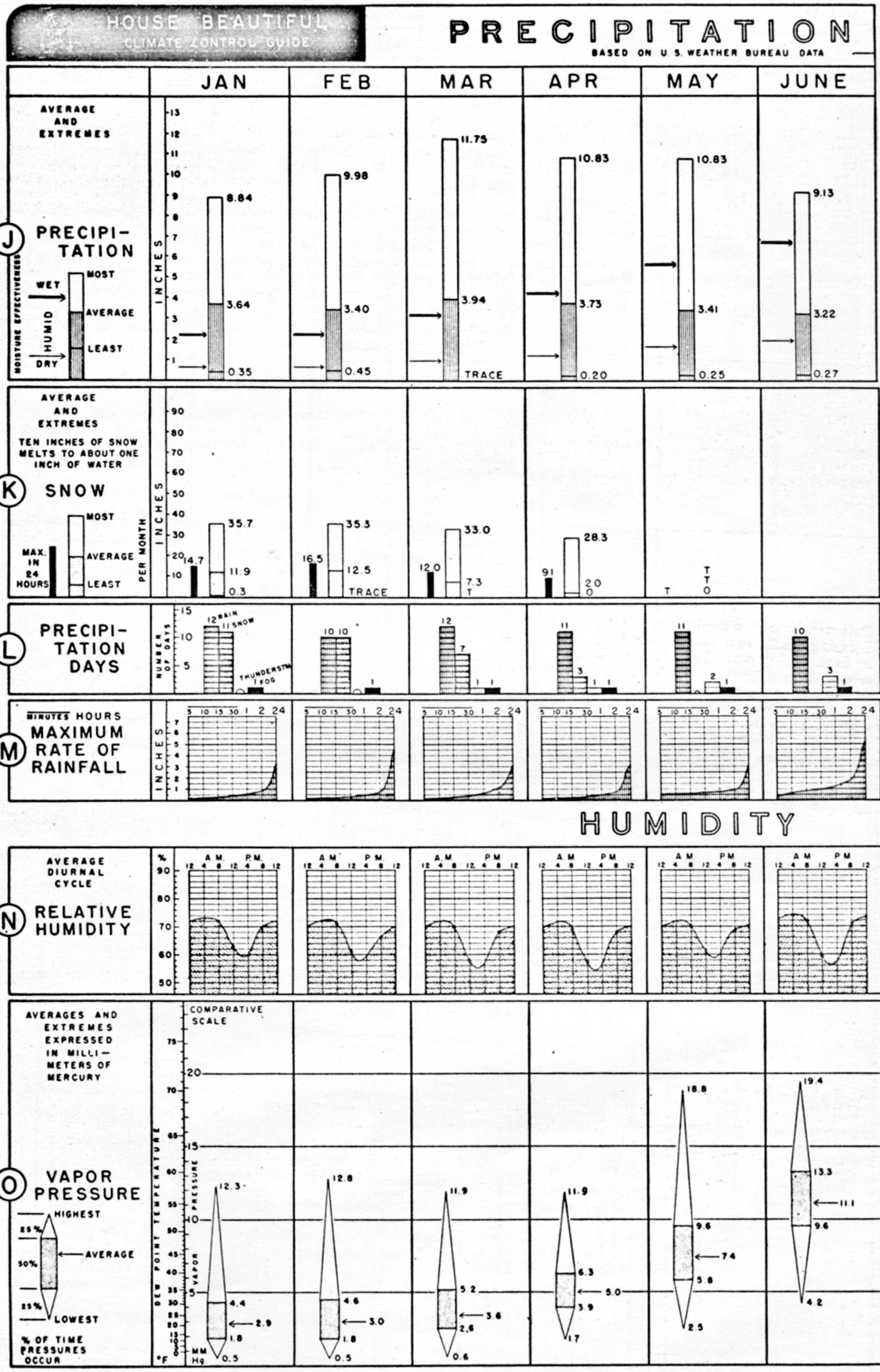

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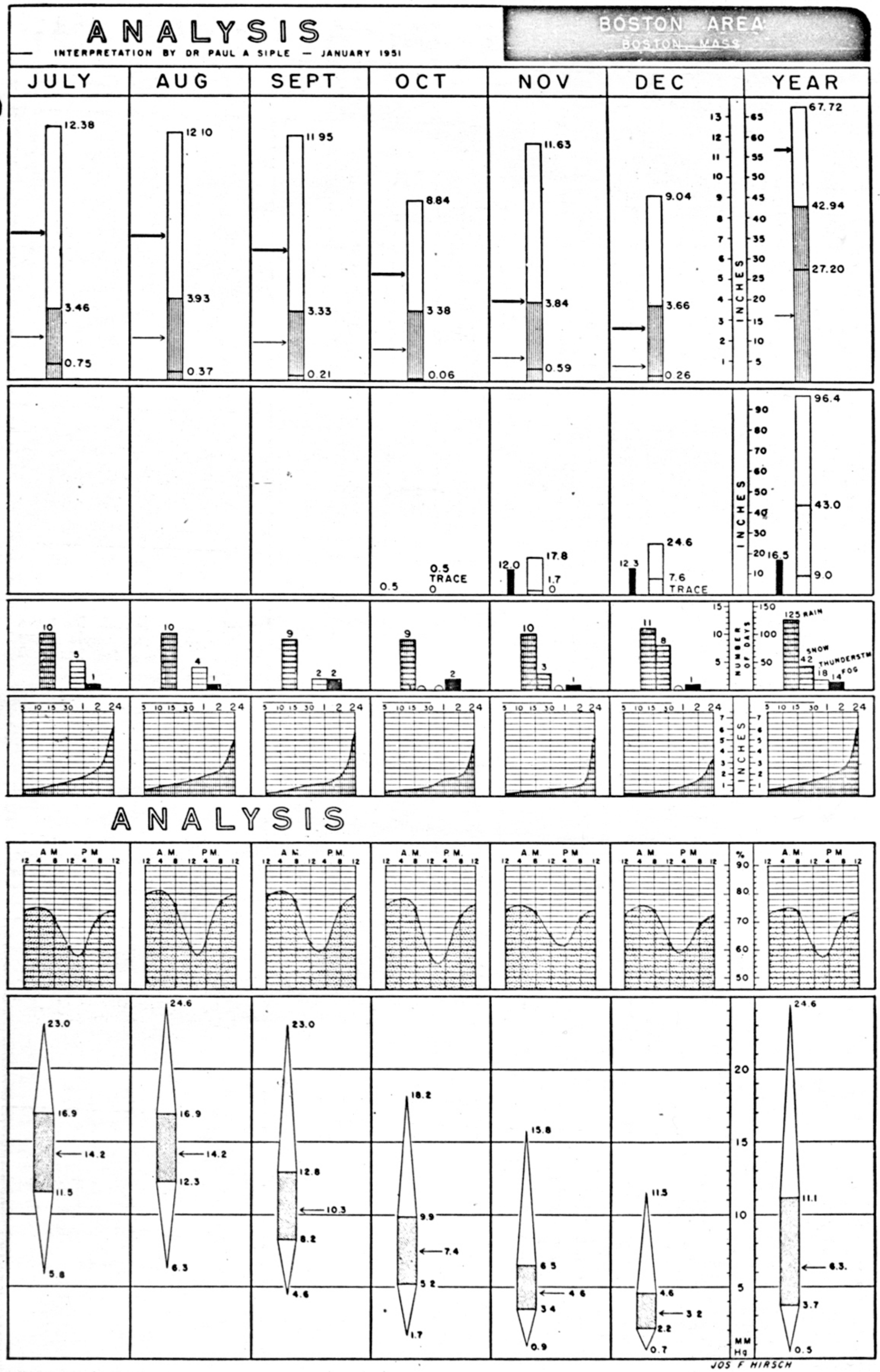

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DESIGN DATA BASED ON

FACTOR	GENERAL INTERPRETATION	SITE AND ORIENTATION PLANTING	INTERIOR PLAN
J PRECIPITATION	Av annual rainfall about 43", rather uniformly distributed throughout yr, but with considerable variation from yr to yr—annual range 27.2" to 67.7" normal av 3.2 to 3.9"/mo. Late spring & fall tend to have less rain than winter & summer. Brief heavy showers characteristic of summer, long, light rains in winter. Evaporation after rain rapid in summer, slow in winter creating sustained muddy conditions. From Dec thru Mar av rainfall is in Wet Zone of moisture effectiveness scale. In Humid Zone during warm season. In some yrs some months may be in Dry Zone (not indicated in av data shown in charts).	Normally ample rainfall for planting without irrigation, although occasional dry months will require it. Good drainage required. Areaways must be well drained. Well drained sub-base required under all paving to prevent frostheave. Storm sewers must be able to carry 6" of rain/day at max rate of about 1"/½ hr. Porches should be protected from driving rain by overhangs or shutters. Sheltered terraces desirable.	Vestibule desirable as protection to entrance from summer rain & mud & winter slush & cold.
K SNOWFALL	Av annual snowfall about 43", with great variations yr to yr—range 9 to 96.4". Jan & Feb av about 12" each, tending to accumulate from snow to snow. In Dec & Mar snowfall is lighter & tends to melt between storms. Heaviest snowfall in 24 hrs was 16.5".	Avoid long, steep or complicated driveways & walks which will be difficult to clear of snow.	
L PRECIPITATION DAYS M MAXIMUM RAINFALL	Av of 125 rainy days/yr. Traces of snow have fallen on av of 42 days/yr. Thunderstorms common only in warmer period reaching max of about 5/mo in Jul. Under worst conditions, 1" of rain has accumulated in 10-15 min. Max rate over 1.8"/hr. Heaviest 2-hr rain has accumulated only 2.5", & 6" in 24 hr. Heaviest single rains occur in summer.		Provide space outside for mats, mudscrapers, etc, ample entry & heated closets for heavy & bulky clothing.
N RELATIVE HUMIDITY	RH highest in cool of night, lowest in heat of day. Highest av RH in late summer & early fall, avg 60-80%. Greatest variation in winter, least in summer.	Generous use of evergreens is desirable for winter landscaping but avoid planting so dense as to create permanently damp areas near structures.	Assuming maintenance of 76° interior temp in summer, indoor RH will range from 25% to 100%, with av about 72%—sufficiently high to cause discomfort. Moderate air movement essential. In winter interior will be excessively dry, averaging 15% without supplemental moisture. Seal up storage closets in summer to avoid moisture pickup.
O VAPOR PRESSURE	Vapor pressure expresses force exerted by molecules of water vapor in atmosphere as well as those escaping or accumulating in process of evaporation or condensation. Vapor pressure above 15 mm creates discomfort even in sedentary occupations. Occurs only on hot, humid days in Jul, Aug, Sep. Av Jul & Aug pressure only 14.2 mm. Consequently more than half of summer has pleasant RH condition. Vapor pressure in winter extremely low, causing flow of moisture from indoors to outdoors & sensation of chilliness even at room temps in 70's.		

MOISTURE ANALYSIS

ROOF	WALLS	OPENINGS	FOUNDATIONS & BASEMENT	MECHANICAL
Avoid absorbent surface materials. Because of industrial waste in atmosphere, exterior materials should also be resistant to staining. Care should be taken to prevent formation of icicles, particularly over entrances. Flashing should be carried well up to prevent back-up moisture penetrating structure in winter. Avoid surfaces that show dirt near ground. Gutter & downspout capacity should handle 1" of rain in 15 min or 2"/hr. Overflow outlets in parapet walls must be protected against clogging with leaves & ice.		Overhangs desirable to permit ventilation during rainy weather.	**Artificially high water-table may form in early spring due to frozen substrata.** Drainage should be away from basement walls & positive drainage must be provided when doorsills are near grade.	Provide ample hose bibbs for summer dry spells. Keep turned off & drained from late Oct thru middle Apr.
Max snow load not likely to exceed 25-30 psf & will av under 10 psf even in extreme conditions. All joints should be well caulked or flashed to prevent snow penetration.		Consider winter views thru picture windows. Often insufficient snow to beautify site.	Areaways on S may be glazed to keep out snow & provide cold-frame space.	Snow-melting equipment for walks & driveways may be desirable (expensive).
Normally, period between rains is very brief but sufficient to permit general drying out of materials. This results in many wet-dry cycles during yr, which are extremely hard on surface materials.		Rains so frequent that all entrances should be well sheltered from above & to windward.	**Impervious cement apron or walk around house will** serve as wet-weather walk & keep excessive dampness from basement walls. (Consider heat & glare potentials on S & W.)	Indoor drying facilities required in winter.
Moisture absorptive materials on roof or walls exposed to solar radiation may have daily range from 5-100% RH, creating swelling, shrinking & desiccating stresses.		**In winter, temp of windowpanes should be kept** up to 52° to prevent condensation. Doors & windows should be vapor-sealed in winter **with** weatherstripping, **double glazing or storm doors & sash.**	Heat is most successful basement dampness control. Keep basement sealed up if it must be cool, otherwise atmospheric moisture will condense.	**Enclosed portions of house, such as poorly insulated attics under roof exposed to solar heat should have positive ventilation to prevent excessively low RH in summer,** causing damage to building materials & articles in storage. In winter, artificial humidification will be beneficial. **System should be used from early Oct through May. Artificial dehumidification may be used to advantage during summer in basement. Low heat, however, equally satisfactory.**
If, during summer, indoor temp is held at 76° F with RH at 50% (Jul & Aug), higher vapor pressure in atmosphere outside will try to pass thru walls into interior about 75% of time. In winter however, there are 8 months when over 75% of the time vapor pressure will be forcing its way out thru walls from inside if indoor temp is kept at 72° F & RH at 50% (comfortable winter conditions). This explains importance of vaporseal on inside of roof & walls. Without it, comfortable interior RH in winter may pass thru to insulation, condense & cause wet condition that may result in serious deterioration. This moisture will also cause a serious heat loss.				

Summer Weather Data
J. C. Albright, Editor, The Morley Co., Kansas City, Kansas, 1934.

Summer Weather Data and Sol-Air Temperature—Study of Data for Lincoln, Neb.
C. O. Mackey, ASHVE Research Report No. 1268, *ASHVE Trans.*, Vol. 51, 1945, p. 93.

Summer Weather Data and Sol-Air Temperature—Study of Data for New York City
C. O. Mackey and E. B. Watson, *ASHVE Trans.*, Vol. 51, 1945, p. 75.

Sunlight
British Standard Code of Practice. London, Codes of Practice Committee, British Standards Institute, SP 5, 1945.

Sunshine and Shade in Australasia
R. O. Phillips, Australia, Commonwealth Experimental Building Station. (Duplicated Document, No. 23, May 1948.)

Surface Treatment of Steel Prior to Painting
Rolla E. Pollard and Wilbur C. Porter. BMS 44, April 8, 1940.

Survey of Roofing Materials in the North Central States
Hubert R. Snoke and Leo J. Waldron. BMS 75, National Bureau of Standards.

Survey of Roofing Materials in the Northeastern States
Hubert R. Snoke and Leo J. Waldron. BMS 29, National Bureau of Standards.

Survey of Roofing Materials in the South Central States
Hubert R. Snoke and Leo J. Waldron. BMS 84, National Bureau of Standards.

Survey of Roofing Materials in the Southeastern States
Hubert R. Snoke and Leo J. Waldron. BMS 6, National Bureau of Standards.

Test House Heated Only by Solar Heat
Dr. Maria Telkes, residence, Dover, Mass. *Architectural Record,* Vol. 104, p. 136-137, March 1949.

The Thermal Characteristics of Model Structures, Investigations to March 1948
J. W. Drysdale. Australia, Department of Works and Housing, Commonwealth Experimental Building Station. (Duplicated Document No. 26) April 1948.

Tornado Effects on Structure in Three Recent Storms
S. H. Ingberg, *Engineering-News Record,* Vol. 79, p. 733-736, October 18, 1917.

Transmission of Solar Radiation Through Flat Glass Under Summer Conditions
G. V. Parmelee, *Heating-piping* Vol. 17, p. 562-573, October-November 1945.

REFERENCES ON CLIMATOLOGY

Conclusion of bibliography from proceedings of Research Correlation Conference on "Weather and the Building Industry" conducted by The Building Research Advisory Board in Jan., 1950.

For previous installments see BULLETINS *for July, September and November, 1950*

Use of Climatological Data in Heating and Cooling Design
H. E. Landsberg, *Heating, Piping and Air Conditioning,* Vol. 19, No. 9, Sept. 1947, p. 121-125.

The Use of Degree Day Calculations in the Retail Coal Industries
A. F. Duemler. Transactions of the First Annual Anthracite Conference of Lehigh University, pages 145 to 156 (1938).

Variations in the Total and Luminous Solar Radiation with Geographical Position in the United States
H. H. Kimball, *Monthly Weather Review,* Vol. 47, No. 11, Nov. 1919.

Water Permeability and Weathering Resistance of Stucco-Faced Gunite-Faced, and "Knap Concrete Unit" Walls
C. C. Fishburn, U. S. Bureau of Standards, BMS 94. 1942.

Water Vapor Transfer Through Building Materials
F. A. Joy, E. R. Queer, R. E. Schreiner, *Penn. State College Engineering Experiment Bulletin* 61. December 1948.

The Weathering of Natural Building Stones
Great Britain Department of Scientific and Industrial Research. 1932. Building research special report No. 18, reprinted 1949.

Weathering of Soft Vulcanized Rubber
J. Crabtree and A. R. Kemp, *Industrial and Engineering Chemistry,* Vol. 38, p. 292-296, March 1946.

Weathering Machine Correlation in the Cleveland Club
Cleveland Paint and Varnish Production Club, *Paint Oil and Chemical Review,* Vol. 110, p. 32-34, November 27, 1947.

Weathering Tests on Asbestos-Cement Roofing Materials
F. E. Jones, 1947. Great Britain Department of Scientific and Industrial Research. Building research technical paper, No. 29.

Weathering Tests on Filled Coating Asphalts
O. G. Strieter. RP 1073 in U. S. Bureau of Standards, *Journal of Research,* Vol. 20, No. 2, p. 159-171, February 1938.

Weather Profits in Building
V. L. Sherman. *National Builder,* Vol. 65, p. 26-27, August 1922.

Weather Resistance of Cellulose Ester Plastic Compositions
L. W. A. Meyer and W. M. Gearhart. *Industrial and Engineering Chemistry,* Vol. 37, p. 232-239, March 1945.

Weather Resistance of Porcelain Enamels Exposed for Seven Years
W. N. Harrison and D. G. Moore. National Bureau of Standards. *Journal of Research,* Vol. 42, p. 43-56, January 1949. Same *American Ceramics Society, Journal* Vol. 32, p. 15-25, January 1, 1949.

We Beg to Present—Florida
Journal of the A.I.A., April 1946.

Weekly Mean Values of Daily Total Solar and Sky Radiation
I. F. Hand, U. S. Department of Commerce, Weather Bureau, Technical Bulletin No. 11, Washington, 1949.

What Climate Control Means to the Building Industry
T. S. Rogers, New York, *House Beautiful,* 1949.

Where to Live
D. Brunt, Royal Institute of Evening Lectures, 1947.

Windowed vs Windowless Buildings
The Architectural Forum, New York. Vol. 74, p. 333. May 1941.

Windows in Modern Architecture
Geoffrey Baker and Bruno Funaro, The *Architectural Forum,* New York. Vol. 89, p. 120. December 1948.

Wind-Pressure on Buildings: Experimental Researches
J. O. V. Irminger and Chr. Nokkentved. 1930-36.

New Reference

THE CLIMATE NEAR THE GROUND, by Rudolf Geiger (rev 2nd ed trans by M. N. Stewart & others) Harvard University Press 1950 482p diagrams, graphs, tables, photographs, bibliography 5¾ x 8¾ $5.

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