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Test reference year (TRY) for comparative energy study

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Abstract

The ASHRAE procedure for selecting a Test Reference Year (TRY) has been adopted to find an appropriate test reference year for Hong Kong. Weather data in the test reference year could be used as a standard for comparing the performance and energy efficiency of different air-conditioning systems in a building. The original concept of the ASHRAE approach based on dry bulb air temperature has been extended to consider wet bulb temperature and global solar radiation. Different TRYs have been selected, and possible applications have been suggested.

Introduction

The Government has commissioned a study on Overall Thermal Transfer Value (OTTV), and is considering, among other measures, the possibility of legislative control for more energy-efficient building design. The OTTV method only considers the design of the building envelope[1]. In addition to the building envelope, it would be important for designers to compare the performance and energy efficiency of different air-conditioning systems, particularly during the initial design stage.

Effective air-conditioning very much depends on building and building services system design, and the dynamic interaction between various components. Comparison of the performance of different air-conditioning systems in a particular geographical area requires consideration of the effects of the local prevailing climatic conditions and other weather-oriented factors.

In the 1970s, a task group was established by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) to investigate energy requirements for air-conditioning in buildings. Research projects were initiated to quantify typical weather data and climatic information for use in building energy calculations and analysis[2]. Together with the US National Bureau of Standard and the National Oceanic and Atmospheric Administration (NOAA), ASHRAE developed the concept of Test Reference Year (TRY) and compiled TRY weather data tapes for several locations in US.

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
1990	14	15.9	14	16.2	14	18.5	18	21.4	19	24.6	10	27.9	6	29.0	1	29.5	7	27.8	10	25.1	8	22.1	3	18.8
1989	15	15.7	12	16.6	13	18.6	13	22.0	16	25.1	14	27.5	8	28.8	5	28.9	4	28.1	10	25.1	12	21.5	11	17.8
1988	1	17.9	13	16.3	25	16.8	22	20.8	7	26.6	3	28.6	6	29.0	15	27.8	9	27.6	16	24.4	23	19.9	12	17.7
1987	4	17.3	3	18.3	1	21.3	14	21.9	47	25.0	14	27.5	7	28.9	8	28.6	12	27.3	4	25.7	10	21.8	17	16.8
1986	14	15.9	22	14.7	22	17.6	9	22.6	10	25.9	9	28.0	11	28.5	4	29.0	7	27.8	11	25.0	20	20.5	12	17.7
1985	17	15.4	17	15.8	26	16.7	24	20.5	5	26.8	17	27.2	12	28.4	13	28.0	17	26.8	3	25.8	5	22.4	14	17.2
1984	26	14.1	24	14.5	19	18.0	18	21.4	19	24.6	10	27.9	6	29.0	11	28.2	12	27.3	8	25.3	8	22.3	15	17.0
1983	20	15.0	21	14.8	23	17.1	6	23.2	9	26.0	3	28.6	2	29.4	4	29.0	3	28.3	1	28.4	12	21.5	17	16.8
1982	8	16.9	16	15.9	10	19.2	21	20.9	14	25.3	17	27.2	10	28.6	10	28.3	10	27.5	3	25.8	6	22.3	18	16.7
1981	10	16.3	7	17.6	4	20.6	1	24.2	15	25.2	19	26.9	12	28.4	3	29.1	13	27.2	13	24.8	22	20.3	20	16.4
1980	7	16.6	27	14.0	6	19.8	12	22.1	19	24.8	5	28.4	9	28.7	6	28.8	12	27.3	6	25.5	6	22.3	9	18.1
1979	3	17.6	2	18.9	9	19.3	15	21.7	20	24.4	19	26.9	4	29.2	14	27.9	14	27.1	14	24.7	21	20.4	5	18.6
1978	14	15.9	15	16.0	18	18.1	14	21.9	17	25.0	5	28.4	7	28.9	11	28.2	6	27.9	19	24.0	16	20.9	5	18.6
1977	29	13.7	27	14.0	5	19.9	1	24.2	3	27.8	1	28.8	9	28.7	4	29.0	7	27.8	4	25.7	18	20.7	1	19.4
1976	16	15.6	7	17.6	17	18.2	20	21.1	10	25.9	15	27.4	15	28.1	14	27.9	17	26.8	12	24.9	26	19.1	13	17.3
1975	13	16.0	8	17.5	14	18.5	1	24.2	7	26.6	15	27.4	13	28.3	16	27.7	7	27.8	9	25.2	22	20.3	25	14.5
1974	12	16.1	26	14.3	21	17.7	13	22.0	7	26.6	15	27.4	9	28.7	7	28.7	9	27.6	8	25.3	16	20.9	12	17.7
1973	13	16.0	1	19.2	3	20.8	2	24.0	5	26.8	14	27.5	17	27.9	17	27.6	12	27.3	13	24.8	16	20.9	19	16.6
1972	15	15.7	22	14.7	8	19.5	17	21.5	17	25.0	12	27.7	8	28.8	18	27.5	8	27.7	5	25.6	5	22.4	11	17.8
1971	25	14.2	18	15.7	15	18.4	7	23.1	10	25.9	4	28.5	8	28.8	12	28.1	6	27.9	17	24.2	17	20.8	13	17.3
1970	21	14.9	6	17.7	29	15.8	19	21.2	11	25.8	5	28.4	3	29.3	10	28.3	12	27.3	14	24.7	12	21.5	8	18.2
1969	6	16.9	25	14.4	24	16.9	20	21.1	6	26.7	18	27.1	6	29.0	7	28.7	1	29.0	9	25.2	19	20.6	16	16.9
1968	27	14.0	29	9.6	30	15.3	26	18.9	22	23.9	22	25.4	19	27.3	20	26.3	19	25.7	21	22.5	21	20.4	1	19.4
1967	24	14.5	23	14.6	12	18.7	12	22.1	2	28.0	6	28.3	1	29.7	9	28.5	11	27.4	13	24.8	4	22.5	24	15.4
1966	2	17.7	4	18.0	4	20.6	4	23.5	12	25.7	17	27.2	12	28.4	5	28.9	5	28.0	3	25.8	1	23.1	4	18.7
1965	8	16.5	5	17.8	13	18.6	17	21.5	16	25.1	19	26.9	10	28.6	7	28.7	14	27.1	7	25.4	2	22.9	10	18.0
1964	13	16.0	26	14.3	21	17.7	2	24.0	11	25.8	13	27.6	6	29.0	12	28.1	11	27.4	2	25.9	14	21.1	13	17.3
1963	25	14.2	18	15.7	11	18.8	8	22.7	1	28.2	8	28.1	16	28.0	7	28.7	2	28.5	11	25.0	3	22.7	6	18.4
1962	26	14.1	12	16.6	17	18.2	24	20.5	6	26.7	14	27.5	5	29.1	2	29.2	10	27.5	11	25.0	20	20.5	12	17.7
1961	19	15.1	19	15.5	16	18.3	13	22.0	14	25.3	2	28.7	13	28.3	14	27.9	15	27.0	3	25.8	6	22.3	5	18.6
1960	11	16.2	9	17.4	2	21.2	16	21.6	14	25.3	16	27.3	7	28.9	12	28.1	11	27.4	13	24.8	10	21.8	16	16.9
1959	18	15.2	10	17.2	15	18.4	10	22.5	11	25.8	8	28.1	16	28.0	15	27.8	16	26.9	9	25.2	9	22.0	3	18.8
1958	19	15.1	23	14.6	7	19.7	3	23.7	8	26.4	15	27.4	11	28.5	16	27.7	11	27.4	18	24.1	18	20.7	9	18.1
1957	13	16.0	28	12.6	27	16.6	12	22.1	16	25.1	18	27.1	11	28.5	11	28.2	15	27.0	20	23.7	10	21.8	6	18.4
1956	26	14.1	18	15.7	20	17.8	5	23.3	13	25.4	10	27.9	10	28.6	14	27.9	6	27.9	14	24.7	25	19.2	21	16.2
1955	28	13.8	11	16.7	5	19.9	14	21.9	10	25.9	18	27.1	18	27.7	17	27.6	4	28.1	15	24.5	24	19.7	11	17.8
1954	5	17.1	16	15.9	28	16.0	18	21.4	7	26.6	7	28.2	9	28.7	12	28.1	11	27.4	16	24.4	13	21.4	22	16.1
1953	15	15.7	14	16.2	17	18.2	26	18.9	21	24.2	11	27.8	8	28.8	8	28.6	18	26.6	4	25.7	11	21.6	12	17.7
1952	9	16.4	14	16.2	15	18.4	12	22.1	4	26.9	10	27.9	13	28.3	17	27.6	17	26.8	13	24.8	7	22.2	23	15.6
1951	23	14.7	16	15.9	29	15.8	25	20.3	18	24.7	21	26.2	15	28.1	16	27.7	9	27.6	8	25.3	15	21.0	9	18.1
1950	1	17.9	20	15.4	12	18.7	23	20.7	18	24.7	20	26.3	12	28.4	16	27.7	7	27.8	6	25.5	16	20.9	24	15.4
1949	22	14.8	12	16.6	11	18.8	18	21.4	9	26.0	12	27.7	14	28.2	19	27.4	12	27.3	13	24.8	15	21.0	7	18.3
1948	18	15.2	11	16.7	8	19.8	11	22.3	10	25.9	15	27.4	17	27.9	12	28.1	13	27.2	14	24.7	25	19.2	2	19.2

Table 1 Measured Monthly Average Dry Bulb Air Temperature (in Deg. C) (1948 – 1990)

Notes : 1. Ranking is shown in shaded column.
2. TRY is shown in shaded row.

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
1989	10	13.8	13	14.0	17	15.9	10	20.4	15	23.4	9	25.3	7	25.9	3	26.1	5	25.0	14	21.6	12	18.0	10	15.0
1988	2	15.5	10	14.4	22	15.3	26	18.3	4	24.9	5	25.7	3	26.3	6	25.8	10	24.5	15	21.5	21	16.0	14	14.3
1987	6	14.4	3	16.0	1	19.8	11	20.3	13	23.6	11	25.1	2	26.4	4	26.0	10	24.5	3	23.2	4	19.3	23	12.8
1986	17	12.5	20	12.5	19	15.7	6	20.8	10	23.9	4	25.8	5	26.1	3	26.1	12	24.2	14	21.6	14	17.6	9	15.1
1985	14	13.1	9	14.5	24	15.0	24	18.5	6	24.6	11	25.1	10	25.6	4	26.0	9	24.6	7	22.6	3	19.4	16	13.9
1984	24	10.9	21	12.3	16	16.0	15	19.9	21	22.5	2	26.0	7	25.9	7	25.7	7	24.8	12	21.8	7	18.8	18	13.9
1983	18	12.8	16	13.4	21	15.5	5	21.4	9	24.0	4	25.8	2	26.4	1	26.3	2	25.4	2	23.4	18	16.6	20	13.1
1982	9	13.9	12	14.1	7	17.6	22	18.7	17	23.2	14	24.6	5	26.1	5	25.9	5	25.0	5	22.8	2	19.6	21	13.0
1981	15	13.0	5	15.6	4	18.7	2	22.2	19	22.7	15	24.2	9	25.7	1	26.3	8	24.7	12	21.8	15	17.5	25	12.4
1980	8	14.0	22	12.2	5	18.1	12	20.2	19	22.7	4	25.8	4	26.2	2	26.2	14	23.9	10	22.0	8	18.7	15	14.2
1979	1	15.6	2	16.6	5	18.1	14	20.0	19	22.7	12	25.0	3	26.3	5	25.9	10	24.5	27	19.6	22	15.9	5	15.7
1978	14	13.1	15	13.7	8	17.1	9	20.5	17	23.2	4	25.8	8	25.8	4	26.0	5	25.0	23	20.5	12	18.0	7	15.5
1977	20	11.7	25	11.1	9	16.9	4	21.7	1	25.4	1	26.4	1	26.5	2	26.2	11	24.4	6	22.7	19	16.3	2	16.6
1976	19	12.0	6	15.2	14	16.3	19	19.2	12	23.7	9	25.3	8	25.8	7	25.7	13	24.0	9	22.2	25	15.0	13	14.4
1975	10	13.8	7	15.1	10	16.8	3	21.9	5	24.8	8	25.4	8	25.8	6	25.8	3	25.2	7	22.6	17	17.0	28	11.2
1974	13	13.2	24	11.6	21	15.5	13	20.1	7	24.4	11	25.1	9	25.7	10	25.4	6	24.9	11	21.9	14	17.6	8	15.2
1973	10	13.8	1	17.5	4	18.7	1	22.4	2	25.2	4	25.8	5	26.1	7	25.7	4	25.1	18	21.0	16	17.1	27	11.6
1972	14	13.1	17	13.1	11	16.7	17	19.5	12	23.7	7	25.5	4	26.2	7	25.7	4	25.1	6	22.7	2	19.6	11	14.9
1971	25	10.5	17	13.1	18	15.8	8	20.6	14	23.5	3	25.9	5	26.1	9	25.5	9	24.8	26	20.0	22	15.9	13	14.4
1970	18	12.1	7	15.1	27	14.4	25	18.4	12	23.7	3	25.9	5	26.1	5	25.9	5	25.0	16	21.4	14	17.6	7	15.5
1969	3	15.4	18	12.7	23	15.2	20	19.1	8	24.3	13	24.9	2	26.4	5	25.9	4	25.1	17	21.1	19	16.3	22	12.9
1968	12	13.5	27	9.7	20	15.6	21	18.9	10	23.9	11	25.1	4	26.2	3	26.1	12	24.2	21	20.7	5	19.1	1	18.9
1967	23	11.0	21	12.3	12	16.6	12	20.2	3	25.1	9	25.3	1	26.5	5	25.9	13	24.0	23	20.5	6	19.0	27	11.6
1966	5	15.1	4	15.9	3	18.8	3	21.9	22	22.3	10	25.2	7	25.9	8	25.6	15	22.4	12	21.8	8	18.7	4	15.8
1965	13	13.2	4	15.9	18	15.8	16	19.7	23	22.2	13	24.9	8	25.8	9	25.5	13	24.0	8	22.3	1	19.8	8	15.2
1964	7	14.3	19	12.6	21	15.5	2	22.2	16	23.3	12	25.0	7	25.9	6	25.8	8	24.7	4	23.1	20	16.2	18	13.3
1963	28	8.9	20	12.5	13	16.4	10	20.4	6	24.6	10	25.2	11	25.5	4	26.0	1	25.6	19	20.9	1	19.8	10	15.0
1962	27	10.0	15	13.7	19	15.7	23	18.6	7	24.4	6	25.6	3	26.3	4	26.0	4	25.1	6	22.7	15	17.5	17	13.8
1961	19	12.0	16	13.4	12	16.6	14	20.0	18	22.9	3	25.9	6	26.0	6	25.8	7	24.8	13	21.7	4	19.3	7	15.5
1960	14	13.1	12	14.1	2	19.4	18	19.4	16	23.4	11	25.1	8	25.8	6	25.8	7	24.8	18	21.0	2	19.6	16	13.9
1959	21	11.5	4	15.9	15	16.2	10	20.4	12	23.7	3	25.9	8	25.8	7	25.7	11	24.4	22	20.6	10	18.3	3	15.9
1958	16	12.8	23	12.1	6	17.9	4	21.7	11	23.8	13	24.9	8	25.8	11	25.1	8	24.7	25	20.1	18	16.6	12	14.6
1957	10	13.8	26	10.9	25	14.9	12	20.2	15	23.4	11	25.1	6	26.0	6	25.8	14	23.9	25	20.1	12	18.0	6	15.6
1956	22	11.2	14	13.9	15	16.2	6	20.8	12	23.7	7	25.5	7	25.9	10	25.4	12	24.2	20	20.8	24	15.1	19	13.2
1955	26	10.2	11	14.3	5	18.1	18	19.4	13	23.6	11	25.1	10	25.6	10	25.4	2	25.4	24	20.2	23	15.4	13	14.4
1954	4	15.3	14	13.9	28	13.6	12	20.2	8	24.3	4	25.8	6	26.0	7	25.7	12	24.2	20	20.8	13	17.9	24	12.5
1953	14	13.1	8	14.6	11	16.7	27	17.1	20	22.6	6	25.6	4	26.2	1	26.3	10	24.5	1	23.6	9	18.5	10	15.0
1952	11	13.7	10	14.4	8	17.1	7	20.7	4	24.9	4	25.8	5	26.1	8	25.6	8	24.7	14	21.6	8	18.7	26	12.2
1951	16	12.8	12	14.1	26	14.7	21	18.9	20	22.6	14	24.6	8	25.8	7	25.7	8	24.7	12	21.8	11	18.1	15	14.2

Table 2. Measured Monthly Average Wet Bulb Temperature (in Deg. C) (1951 – 1989)

Notes : 1. Ranking is shown in shaded column.
2. TRY is shown in shaded row.

TRY consists of hourly weather data for a selected year in a particular area to be used by designers to compare, in energy terms, the performance of different air-conditioning systems in the same building or in different buildings.

ASHRAE selection procedure

The principle of the selection procedure developed by ASHRAE[3] is to eliminate, in order of importance, those years in the period of record containing months with extremely high or low air temperatures until only one year remains. Extreme months are arranged in order of importance for energy comparisons. Hot Julys and cold Januarys are assumed to be the most important. All months are ranked by alternating between the warm half (May to October) and the cold half (November to April) of the year, with the months closest to late July or late January given priority. If it is assumed that hot summer months or cold winter months are more important than cool summer or mild winter months, then the order of extreme months will be from "Hottest July" to "Coolest April" (left column) and then from "Coolest July" to "Warmest April" (right column) as shown below :

Hottest July	Coolest July
Coldest January	Mildest January
Hottest August	Coolest August
Coldest February	Mildest February
Hottest June	Coolest June
Coldest December	Mildest December
Hottest September	Coolest September
Coldest March	Mildest March
Warmest May	Coolest May
Coolest November	Warmest November
Warmest October	Coolest October
Coolest April	Warmest April

The first step in the selection process is to mark all 24 extreme months. Continue marking months starting with the next-to-the-hottest July, then next-to-the-coldest January and so on down the first column and then down the second column until only one year remains without any marked month. If two or more years remain without any marked months, the process is repeated with the third, forth, etc, hottest or coldest extremes until only one year remains without any marked month. The remaining year is the Test Reference Year (TRY).

TRY for Hong Kong

Measured monthly average dry bulb air-temperatures for the period 1948-1990 (43 years of record) have been obtained from annual publications by the Royal Observatory Hong Kong (eg, [4]), and are summarized in Table 1. For a particular month, say January, the 43 monthly average air temperatures have been ranked in descending order, that is number 1

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
1990	25	8.1	26	7.5	11	12.6	25	9.6	17	15.0	24	13.9	21	17.6	16	17.1	24	13.7	14	16.2	23	10.8	11	12.4
1989	26	8.0	7	13.0	10	13.4	27	9.1	24	12.4	17	15.7	16	18.5	21	15.9	19	14.9	23	13.9	18	12.5	26	9.7
1988	14	11.6	20	9.4	25	6.6	23	10.5	21	13.5	11	17.0	13	19.4	28	13.6	14	16.2	27	12.7	16	12.7	12	12.2
1987	13	11.9	12	11.7	22	8.1	17	12.5	26	11.7	19	15.1	26	15.8	6	19.4	22	14.0	25	13.5	25	9.6	14	12.0
1986	9	13.4	19	9.6	20	9.2	18	12.1	16	15.2	15	16.0	23	17.2	20	16.3	11	17.1	21	14.4	22	11.3	22	10.8
1985	22	9.3	29	5.2	21	8.5	22	11.1	11	17.2	26	12.3	20	17.9	22	15.4	25	13.5	17	14.9	14	12.9	18	11.3
1984	22	9.3	25	7.9	22	8.1	28	8.2	23	13.3	17	15.7	6	21.9	23	15.3	17	15.4	20	14.6	15	12.8	27	8.9
1983	28	6.8	30	4.1	27	4.8	26	9.3	27	11.5	14	16.3	14	19.2	19	16.6	18	15.3	31	11.5	7	15.1	19	11.2
1982	17	11.2	27	7.3	18	9.9	19	11.8	20	13.9	25	13.7	28	15.0	21	15.9	20	14.4	29	12.1	25	9.6	23	10.7
1981	14	11.6	23	8.5	20	9.2	20	11.4	22	13.4	20	15.0	27	15.4	14	17.3	27	12.6	26	13.2	24	10.7	13	12.1
1980	23	9.0	24	8.3	19	9.5	24	10.4	25	12.1	9	17.2	25	16.1	17	16.8	21	14.2	25	13.5	19	12.4	20	11.1
1979	19	10.8	16	9.9	26	6.5	21	11.2	24	12.4	16	15.9	7	21.6	25	14.5	15	15.9	3	19.8	21	11.4	13	12.1
1978	13	11.9	14	11.2	24	6.9	17	12.5	15	15.4	4	20.0	4	22.5	5	19.7	4	19.7	16	15.6	6	15.3	4	14.1
1977	24	8.2	12	11.7	6	14.1	12	13.6	5	18.6	10	17.1	24	16.7	10	18.5	18	15.3	14	16.2	8	14.6	16	11.5
1976	10	13.2	15	11.1	17	10.2	15	12.9	14	15.6	17	15.7	22	17.5	11	18.3	19	14.9	24	13.8	9	14.0	21	10.9
1975	21	9.4	9	12.2	23	7.8	13	13.3	19	14.2	22	14.4	18	18.3	27	14.2	11	17.1	30	11.8	16	12.7	17	11.4
1974	11	12.1	11	11.9	14	12.0	10	14.0	10	17.3	23	14.3	12	19.8	9	18.6	19	14.9	28	12.5	20	12.2	25	10.3
1973	18	11.1	9	12.2	4	14.3	18	12.1	14	15.6	18	15.6	29	14.6	26	14.3	23	13.9	18	14.8	17	12.6	3	14.7
1972	5	15.3	17	10.4	1	20.2	16	12.7	15	15.4	2	21.6	9	20.9	12	18.2	5	19.4	5	18.1	14	12.9	11	12.4
1971	6	15.1	10	12.1	8	13.8	7	15.3	18	14.9	12	16.5	22	17.5	7	19.1	4	19.7	4	19.3	1	19.7	10	12.8
1970	15	11.5	4	15.7	20	9.2	4	17.0	13	16.0	8	17.8	8	21.5	13	18.0	16	15.7	22	14.2	26	9.2	8	13.6
1969	27	7.0	21	9.3	16	10.9	7	15.3	7	18.3	7	17.6	15	19.0	2	22.7	4	19.7	10	16.9	5	15.5	8	13.6
1968	8	14.1	22	8.6	12	12.3	5	16.4	12	16.9	9	17.2	10	20.6	16	16.7	7	18.3	8	17.7	8	14.6	25	10.3
1967	16	11.4	14	11.2	7	13.9	9	14.5	3	19.9	3	21.3	1	23.9	14	17.3	6	18.8	9	17.5	12	13.2	15	11.7
1966	14	11.6	6	13.5	15	11.0	3	17.4	2	22.0	20	15.0	12	19.8	4	21.3	1	22.3	7	17.8	6	15.3	23	10.7
1965	2	17.1	8	12.6	2	15.6	17	12.5	4	19.5	13	16.4	5	22.1	1	23.4	8	18.2	13	16.5	10	13.4	24	10.4
1964	22	9.3	16	11.0	5	14.2	1	20.1	6	18.5	12	16.5	3	23.0	15	17.2	12	17.0	19	14.7	2	17.6	2	15.0
1963	1	17.3	2	16.5	6	14.1	2	18.1	1	24.5	8	17.4	13	19.4	3	22.5	2	20.1	11	16.8	11	13.3	5	13.9
1962	3	16.5	3	16.4	3	14.7	11	13.9	8	18.0	21	14.6	11	20.3	8	18.9	3	19.9	6	17.9	20	12.2	1	15.6
1961	4	16.1	13	11.3	2	15.6	6	15.6	2	22.0	1	24.1	8	21.5	22	15.4	26	12.7	1	22.0	3	15.8	7	13.7
1960	7	15.0	1	21.3	11	12.6	14	13.1	16	15.2	6	17.4	2	23.4	24	14.8	10	17.8	15	15.7	13	13.1	9	13.0
1959	12	12.0	28	5.5	9	13.5	8	14.6	6	18.5	20	15.0	17	18.4	17	16.8	9	17.9	2	21.9	2	17.6	6	13.8
1958	20	9.6	5	15.3	13	12.1	2	18.1	9	17.7	5	18.3	19	18.0	9	18.6	13	16.3	12	16.7	4	15.7	7	13.7

Table 3. Measured Monthly Average of Daily Global Solar Radiation (in MJ/SQ.M) (1958 – 1990)

Notes : 1. Ranking is shown in shaded column.
2. TRY is shown in shaded row.

for the highest temperature, number 2 for second highest temperature, and so on. If two or more months have the same mean temperature, they are given the same number and are marked together in the elimination process.

From Table 1, between 1948 and 1990, July 1967 is the hottest July (ranked number 1) with an average air temperature of 29.7 °C, and is the first month marked. The second month to be marked is the coldest January (ie, January with the lowest ranking or highest number), which has been found to be January 1977 with an average air temperature of 13.7 °C (ranking 29). The third month is the hottest August (ie, August 1990), and so on; until all 24 extreme months have been marked.

After marking of the first 24 extreme months, it has been found that there are 27 years remaining without any marked months. The marking process is then repeated with the 2nd, 3rd, etc extremes until only one year remains without any marked month, which is 1989 in this case.

The original concept of TRY and selection procedure developed by ASHRAE has been extended in the present study to cover two other important climatic variables - wet bulb temperature and global solar radiation.

Wet bulb temperature

Similar to dry bulb air temperature, measured monthly average wet bulb temperatures for the period 1951 - 1989 have been obtained and are shown in Table 2. The same ranking and selection process for dry bulb air temperature has been applied to wet bulb temperature. It has been found that, after marking the first 24 extreme months, there are 23 years remaining without any marked month. The marking process is then repeated with the 2nd, 3rd, etc extremes until only one year remains without any marked month, which has been found to be 1978.

Global solar radiation

The Royal Observatory Hong Kong has published measured data of solar radiation in Hong Kong since 1958. Measured monthly global solar radiation between 1958 and 1990 is shown in Table 3. Similar to dry and wet bulb temperatures, extreme months have been marked until the year 1976 remains with no marked month. There are 16 years remaining after marking the first 24 extreme months.

Discussion and conclusion

The prevailing climatic conditions affect the performance and energy efficiency of a building and its air-conditioning system. Measured weather data for three climatic variables - dry bulb air temperature, wet bulb temperature and global solar radiation have been analysed in the present study. Out-

Climatic Variable (Years of record)	TRY for HK	Suggested Application
Dry Bulb Air Temperature (1948 - 1990)	1989	General Comparison of Different Air-Conditioning Systems
Wet Bulb Temperature (1951 - 1989)	1978	Latent Load
Global Solar Radiation (1958 - 1990)	1976	Effect of Solar Heat Gain

Table 4. Summary of TRYs and Suggested Applications

door dry bulb air temperature affects the sensible cooling and heating loads, and hence energy consumption due to heat conduction, infiltration and fresh air requirement; whereas outdoor wet bulb temperature determines the latent cooling and heating loads due to infiltration and fresh air requirement. Solar radiation signifies solar heat gain, which is one of the major contributors to building cooling load in Hong Kong.

Based on the ASHRAE TRY determination method, which considers dry bulb air temperature as the determining variable, the TRY for Hong Kong has been found to be the year 1989. The ASHRAE procedure for selecting TRY has also been applied to wet bulb temperature and global solar radiation. It has been found that based on wet bulb temperature, the TRY is 1986; and based on global solar radiation the TRY is 1978 (see Table 4).

In the present study, it is suggested that the year 1989 should be selected as the TRY for Hong Kong; and the measured hourly weather data for 1989 could be used for more general comparative studies on the energy performance of different air-conditioning systems in the same or in different buildings in Hong Kong. For specific studies where only latent load (or only the effect of solar radiation) is to be assessed and emphasized, measured hourly weather data for 1978 (or 1986) should be used. Different TRYs and their suggested applications are summarized in Table 4. It is recognized that the TRY can provide a simple approach for determining weather data for use in building energy calculation and analysis.

Last but not least, it should be borne in mind that the weather data of TRY is only a selected standard to be used primarily for comparing different air-conditioning systems. It does not necessarily represent the long-term mean. When used in detailed building energy simulation, it is considered not sufficiently typical or representative enough to give reliable estimates of average energy consumption over a long period of time span. For more accurate and reliable estimates of long-term average energy consumption in buildings, the use of Typical Meteorological Year (TMY) or Weather Year for Energy Calculation (WYEC) is recommended. Both TMY and WYEC are made up of typical calendar months selected from the entire recorded span of weather data. The determination of TMY and WYEC is more complicated than that of TRY because of the details and the statistical techniques involved. A joint research project on TMY has been initiated by the Building Energy Conservation Unit (BECU) in the Department of Building And Construction, City Polytechnic of Hong Kong and Royal Observatory Hong Kong. It is envisaged that measured hourly weather data would be selected and compiled so as to formulate a set of TMY weather data for Hong Kong for use in building energy simulation and analysis[5].

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