Ministerial Regulation
B.E. 2538 (1995)
Issued pursuant to the Energy Conservation Promotion Act B.E. 2535 (1992)

By the virtue of section 6 and section 19 of the Energy Conservation Promotion Act B.E. 2535 (1992), the Minister of Science, Technology and Environment, with the recommendation of the National Energy Policy Council, hereby issues the Ministerial Regulation as follows:

Chapter I
Scope of the Enforcement

Clause 1 This Ministerial Regulation shall be enforced on designated building under the Royal Decree on Designated Building B.E. 2538 (1995).

Clause 2 In this Ministerial Regulation,

"Old building" shall mean a building with complete construction or with ongoing construction or have not been constructed but already apply for the permit to construct before the Royal Decree designate such building as designated building under section 18 has come into force.

"New building" shall mean a building that apply for the permit to construct after the Royal Decree designate such building as designated building under section 18 has come into force.

Chapter II
The overall thermal transfer value

Clause 3 The overall thermal transfer value of the building or part of the building that has air-conditioning.

(1) The overall thermal transfer value of the building roof, both old and new building, shall not exceed 25 watts per square meter of the roof.

(2) The overall thermal transfer value of the building exterior wall or part of the building that has air-conditioning shall be as follows:

(a) For new building, shall not exceed 45 watts per square meter of the exterior wall.

(b) For old building, shall not exceed 55 watts per square meter of the exterior wall.

(3) The overall thermal transfer value of the building exterior wall or part of the building that has air-conditioning shall be calculated from weighted average of the total of area of each exterior wall or those of part of the building that has air-conditioning.

Chapter III
Energy Utilization in the Building

Clause 4 Use of light in the building, excluding such use in parking space.

(1) The use of light in the building, the light intensity for certain job shall be sufficient as in accordance with engineering acceptable criteria and method.

(2) Equipment used as light source in the building, excluding such use in parking space, electrical power used shall not exceed the following.

Building type [1]	Maximum light intensity (watts per square meter of working area)
(a) Office, Hotel, Educational institution and Hospital/Nursing home	16
(b) Convenient store, supermarket, or shopping mall [2]	23

[1] Building that has several uses shall use the value in the table according to type of working area.

[2] Including electrical light that use for product advertisement, except those used in product show case.

Clause 5 Standard of air-conditioning in the building

Air-conditioning system installed in the building shall have electrical power per ton cool air at full load or actual load not exceed the following value.

(1) air chiller using water as heat transfer media

Type of cooling part/chiller	New Building	Old Building
	Kilowatts per ton cool air	
a. centrifuge chiller		
not exceed 250 ton cool air	0.75	0.90
250 – 500 ton cool air	0.70	0.84
more than 500 ton cool air	0.67	0.80
b. reciprocating chiller		
not exceed 35 ton cool air	0.98	1.18
more than 35 ton cool air	0.91	1.10
c. package unit chiller	0.88	1.06
d. screw chiller	0.70	0.84

(2) air chiller using air as heat transfer media

Type of cooling part/chiller	New Building	Old Building
	Kilowatts per ton cool air	
a. centrifuge chiller		
not exceed 250 ton cool air	1.40	1.61
more than 250 ton cool air	1.20	1.38
b. reciprocating chiller		
not exceed 50 ton cool air	1.30	1.50
more than 50 ton cool air	1.25	1.44
c. package unit chiller	1.37	1.58
d. window/split type chiller	1.40	1.61

Chapter IV
Estimation of the thermal transfer value, light intensity in the building, and capacity of the air-conditioning equipment

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Clause 6 The following method shall be used to calculate the thermal transfer value of construction material.

(1) Heat transfer coefficient (k)

Heat transfer coefficient of materials shall be in accordance with those prescribed by the Ministry of Science, Technology and Environment.

(2) Heat conduction (C)

Heat conduction of material is ratio of heat transfer coefficient to the material thickness which can be calculated using the following equation.

$$C = \frac{k}{\Delta x}$$

Where Δ x = material thickness, meter

C = heat conduction, watts per square meter – degree Celsius

(3) Heat resistance (R)

Heat resistance of material is the reciprocal of heat conduction which can be calculated using the following equation.

$$R = \frac{1}{C} or \frac{\Delta x}{k}$$

Where R = heat resistance, square meter – degree Celsius per watts

(4) Heat resistance of air film

Heat resistance of air film can be divided into 3 categories

(a) Heat resistance of air film at the exterior surface of the building (R_o)

(b) Heat resistance of air film at the interior surface of the building (R_i)

(c) Heat resistance of air film within the air gap of roof wall and ceiling (R_a)

Heat resistance of air film that will be use in determination of heat resistance of wall or roof materials shall be in accordance with those prescribed by the Ministry of Science, Technology and Environment.

(5) The total heat resistance (R_T)

The total heat resistance of wall, roof and ceiling (R_T) which consists of different material n types can be calculated using the following method.

(a) in case the building wall consists of n material types

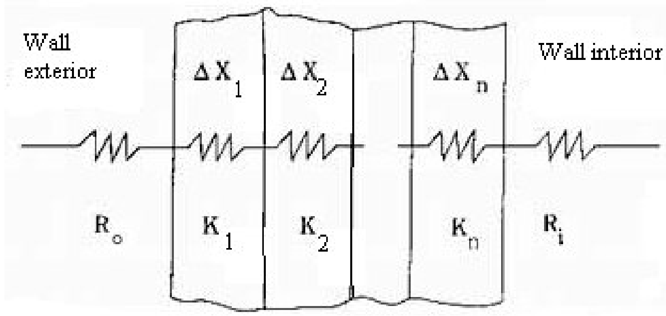

Figure 1: Heat conduction through building wall consisting of n material types

$$R_T = R_0 + \frac{\Delta x_1}{k_1} + \frac{\Delta x_2}{k_2} + \frac{\Delta x_3}{k_3} + ... + \frac{\Delta x_n}{k_n} + R_i$$

where $\Delta x_1, \Delta x_2, \Delta x_3, \ldots, \Delta x_n$ = thickness of wall material types 1,2,3,…, n, respectively

$k_1, k_2, k_3, \ldots, k_n$ = heat transfer coefficient of material types 1,2,3,…, n, respectively

R_0, R_i = heat resistance of air film at exterior surface and interior surface of the building wall, respectively

(b) in case the building wall has air gap.

The total heat resistance of roof wall and ceiling (R_T) which consists of different material n types and building wall has air gap can be calculated using the following method.

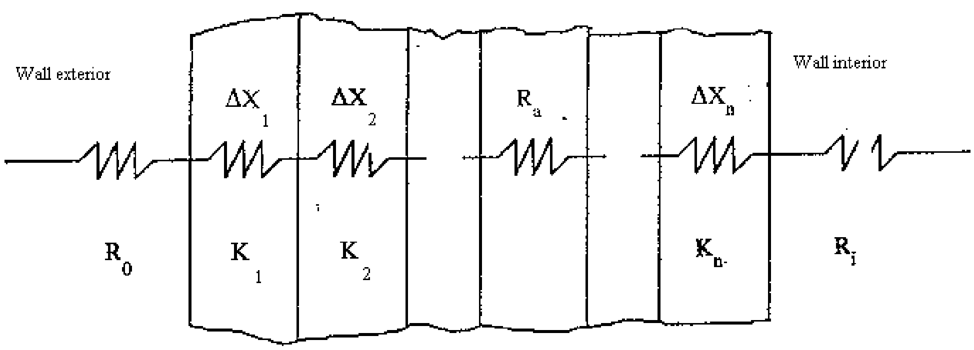

Figure 2: Heat conduction through building wall consisting of n material types and have air gap.

$$R_T = R_0 + \frac{\Delta x_1}{k_1} + \frac{\Delta x_2}{k_2} + \frac{\Delta x_3}{k_3} + ... + R_a + ... + \frac{\Delta x_n}{k_n} + R_i$$

where R_a = heat resistance of air film within the air gap

(6) Total heat transfer coefficient (U)

Total heat transfer coefficient is the reciprocal of total heat resistance which can be calculated as follows:

$$U = \frac{1}{R_T}$$

Clause 7 The total heat transfer of the building can be calculated using the following methods.

(1) Overall thermal transfer value of each exterior wall ($OTTV_i$) can be calculated from the following equation.

$$OTTV_i = (U_W)(1 - WWR)(TD_{eq}) + (U_f)(WWR)(\Delta T) + (SC)(WWR)(SF)$$

where $OTTV_i$ = overall thermal transfer value of the wall of interest, watts per square meter

U_W = total heat transfer coefficient of solid wall, watts per square meter – degree Celsius

WWR = ratio of area of light transparent window and/or area of light transparent wall to total area of the wall of interest

TD_{eq} = temperature different equivalent between outside and inside of the building, including the absorption of solar ray by solid wall, unit in degree Celsius, as prescribed by the Ministry of Science, Technology, and Environment

U_f = total heat transfer coefficient of mirror or light transparent wall, watts per square meter – degree Celsius

ΔT = temperature difference between outside and inside the building as prescribed by the Ministry of Science, Technology, and Environment

SC = window shading coefficient which can be calculated in accordance with criteria prescribed by the Ministry of Science, Technology, and Environment

SF = solar factor passing through light transparent window and/or light transparent wall in watts per square meter, as prescribed by the Ministry of Science, Technology, and Environment

(2) Overall thermal transfer value of all exterior wall (OTTV) is weighted average of total heat transfer of each exterior wall ($OTTV_i$) which can be calculated from the following equation.

$$OTTV = \frac{(A_{0_1})(OTTV_1) + (A_{0_2})(OTTV_2) + \ldots + (A_{0_i})(OTTV_i)}{A_{0_1} + A_{0_2} + \ldots + A_{0_i}}$$

where A_{0i} = area of the wall of interest, including area of solid wall and window or light transparent wall, square meter

$OTTV_i$ = overall thermal transfer value of the wall of interest, can be calculated from 7(1)

(3) Total heat transfer of roof can be calculated from the following equation.

$$RTTV = (U_r)(1 - RSR)(TD_{eq}) + (U_{rf})(RSR)(\Delta T) + (SC)(RSR)(SF)$$

where RTTV = roof thermal transfer value of building roof of interest, watts per square meter

U_r = total heat transfer coefficient of solid roof, watts per square meter – degree Celsius

RSR = ratio of area of light transparent channel at the roof to total area of the roof of interest

TD_{eq} = temperature different equivalent between outside and inside of the building, including the absorption of solar ray by solid roof, unit in degree Celsius, as prescribed by the Ministry of Science, Technology, and Environment

U_{rf} = total heat transfer coefficient of light transparent channel at the roof, watts per square meter – degree Celsius

ΔT = temperature difference between outside and inside the building as prescribed by the Ministry of Science, Technology, and Environment

SC = window shading coefficient light transparent channel at the roof which can be calculated in accordance with criteria prescribed by the Ministry of Science, Technology, and Environment

SF = solar factor passing through light transparent channel at the roof in watts per square meter, as prescribed by the Ministry of Science, Technology, and Environment

Clause 8 Estimation of electricity utilization in the building

(1) Use of light in the building, excluding such use in parking space.

Maximum light intensity installed in the building is average installed light intensity per unit building area, excluding parking apace area, which can be calculated from the following equation.

$$PD = \frac{LW + BW}{GR}$$

where PD = average installed light intensity per unit building area, watts per square meter

LW = summation of light installed capacity of light bulb installed in the building, watts

BW = summation of total heat loss of ballast installed in the building, watts

GR = total working area in the building

(2) Standard of air-conditioning in the building.

(a) For new building,

Air chiller using water as heat transfer or using air as heat transfer can be calculated the capacity of the chiller installed in the building as follows:

(a.1) centrifugal chiller, reciprocating chiller, or screw chiller

$$ChP = \frac{KW}{TON}$$

where ChP = capacity of chiller, watts per ton cool air

KW = utilized electrical power of chiller at full load, kilowatts, the tested or approved value by manufacturer or legitimate testing institute can be used

TON = ability to cool air at full load, ton cool air, the tested or approved value by manufacturer or legitimate testing institute can be used

(a.2) package unit or window/split type

$$ChP = \frac{KW}{TON}$$

where ChP = capacity of unit, watts per ton cool air

KW = utilized electricity power of unit at full load, kilowatts, the tested or approved value by manufacturer or legitimate testing institute can be used

TON = ability to cool air at full load, ton cool air, the tested or approved value by manufacturer or legitimate testing institute can be used

(b) For old building,

The criteria, method and condition for determination of capacity of air-conditioning equipment of air chiller either one using water as heat transfer media or one using air as heat transfer media for the old building shall be as same as those for the new building, except when there is no test result or approved value of utilized electricity power of air chiller at full load and capacity of air cooling at full load by manufacturer or legitimate testing institute, the following method can be used.

(b.1) for centrifugal chiller, reciprocating chiller, or screw chiller, the following equation can be used to determine capacity of installed chiller in the building.

$$ChP = \frac{KW}{TON}$$

where TON = ability to cool air at full load, ton cool air, determined from TON = (F x ΔT) / 50.40

F = amount of cooling water passing through chiller, liters per minute, using the reading value from flow meter installed in cooling system

ΔT = temperature difference between cooling water flowing in and out of chiller, degree Celsius

KW = utilized electricity power of chiller at full load, kilowatts, using the reading value from electricity meter (b.2) package unit or window/split type, the following equation can be used to determine capacity of installed chiller in the building.

$$ChP = \frac{KW}{TON}$$

where TON = ability to cool air at full load, ton cool air,
determined from TON = 5.707 x 10^{-3} CMM x ΔH

CMM = amount of cooling air passing through air chiller, cubic meters per minute, using the measured value of average wind velocity of air chiller multiplied by average cross section area of such air chiller

ΔH = enthalpy difference between air flowing out of air chiller and reverse air, kilo Jules per kilogram

KW = utilized electricity power of air-conditioning system, kilowatts, using the reading value from electricity meter

Given on the 3rd day of November B.E. 2538 (1995)
Signed Yingphan Manasikarn
(Mr. Yingphan Manasikarn)
Minister of Science, Technology and Environment

(Published in the Government Gazette, Vol. 112, Part 46a, dated 15th November B.E. 2538 (1995))

Remark: The reason for the enactment of this ministerial regulation is that the owner of designated building shall conserve energy, audit and analyze energy utilization in his building in accordance with the standard, criteria and method as prescribed in the Ministerial Regulation under section 21 of the Energy Conservation and Promotion Act B.E. 2535 (1992); it is therefore necessary to issue this ministerial regulation