Twinning « Improvement of the Energy Efficiency in Turkey »

Comparison of the Thermal Insulation Standard for Buildings TS 825 and International Energy Building Code

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ANSI/ASHRAE/IESNA Standard 90.1

Purpose :

To provide minimum requirements for the energy-efficient design of buildings except low-rise residential buildings.

Why is Standard 90.1 important?

- It is the reference standard for the 2001 IECC
- It is also the commercial energy reference in NFPA's family of codes.

Contents Standard 90.1

Contents Standard 90.1

Section 9 - Lighting

Section 10 - Other Equipment

Section 11 - Energy Cost Budget Method

Section 12 - Normative References

Appendices A-D - Mostly envelope related

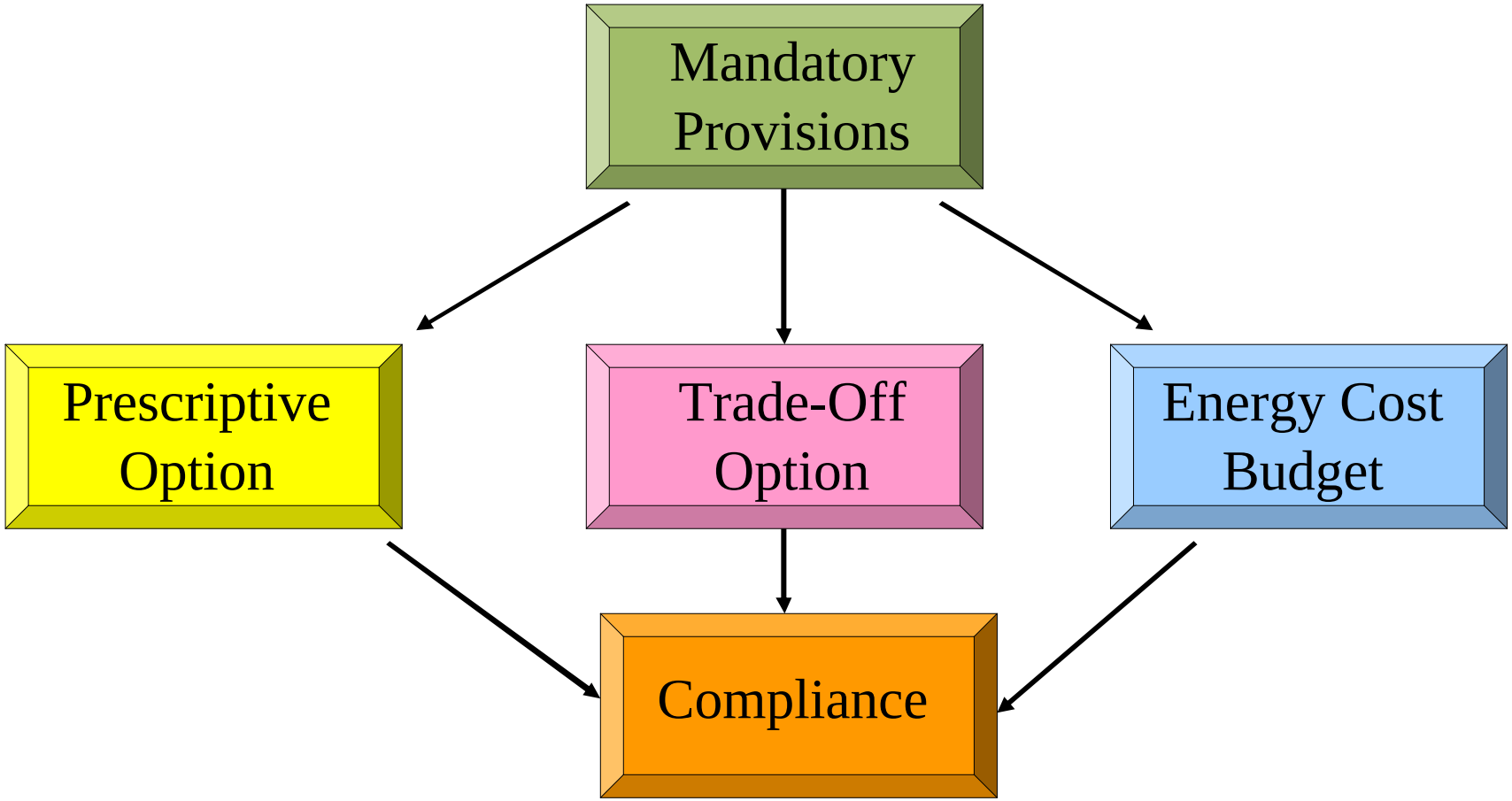
Appendix E - Informative References

Appendix F – Addenda Description Information

Mains features

- Contains separate envelope, HVAC, SWH, and lighting provisions.
- Includes envelope tradeoff software (ENVSTD).
- Contains an energy cost budget tradeoff method.

Envelope Compliance Methods *(Section 5.1.2)*



Climate
CDD and HDD

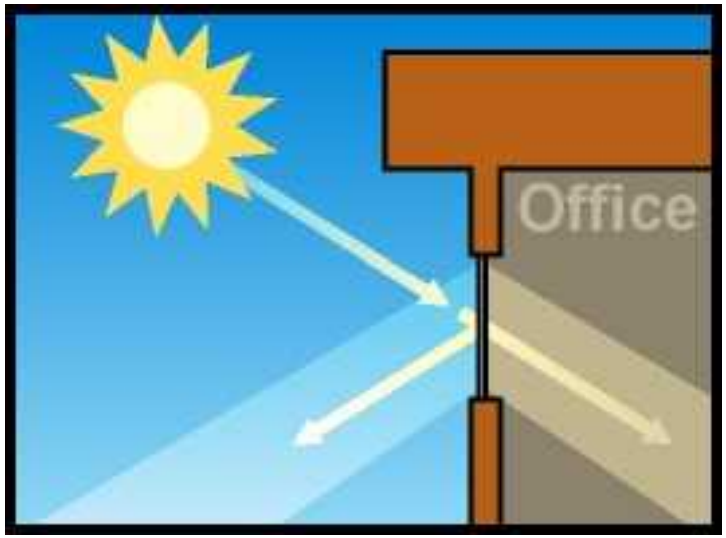
- Bins based on CDD50 and HDD65

- CDD50 = for any one day, when the mean temperature is > 50F (10 °C), there are as many degree-days as degrees F temperature difference between mean temperature and 50F. Annual cooling degree days (CDD) are the sum of the degree-days over a calendar year.

- HDD65 = for any one day, when the temperature is < 65F (18.3 °C), there are as many degree-days as degrees F temperature difference between mean temperature and 65. Annual heating degree-days (HDD) are the sum of the degree-days over a calendar year.

Solar heat gain coefficient SHGC

- The glazing's effectiveness in rejecting solar heat gain
- Part of a system for rating window performance
- Gradually replacing shading coefficient (SC) in product literature and design standards



Mandatory Provisions

Fenestration

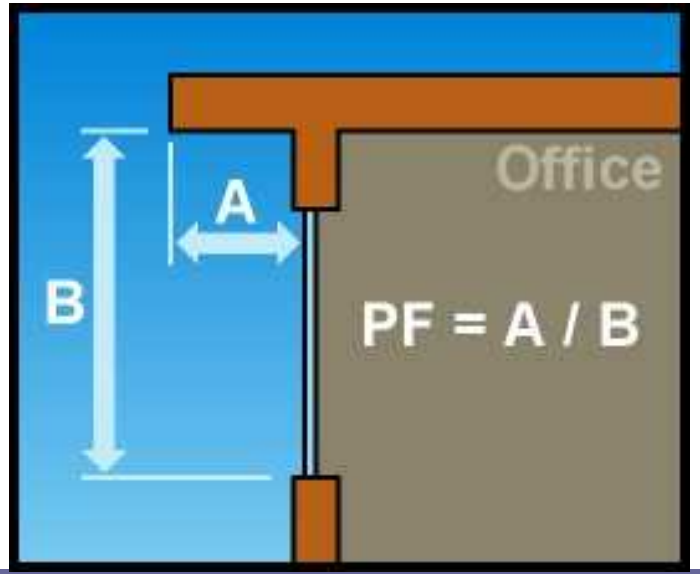
(Section 5.2.2)

- U-factors
- SHGC

  Solar Heat Gain Coefficient
- "No SHGC requirements for semiheated spaces or for buildings in climates > 10800 HDD65" (5982 DD18 °C).
- Visible Light Transmittance
  - When building envelope trade-off option is used.

Overhangs

- Standard credits permanent overhangs by adjustment to SHGC
- Size of overhang is determined by projection factor



Prescriptive Building Envelope Option *(Section 5.3)*

WWR # 50% of gross wall area
Skylight-roof ratio # 5% of roof area
Each envelope component must separately meet requirements

- 26 criteria sets for different climate types
  - Set = single page that summarizes all prescriptive requirements
    - Insulation levels for roofs, walls floors
    - Fenestration criteria

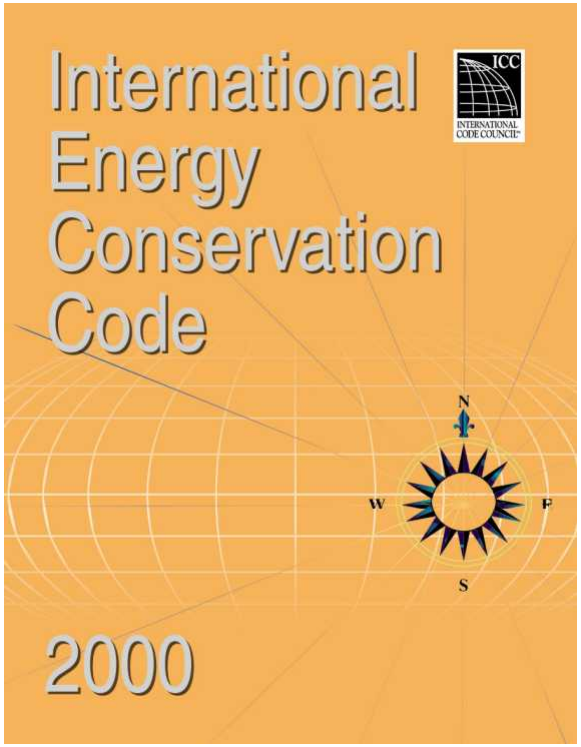
Designers

- Specify
  - R-values for walls, floors, and roofs
  - U-factors for opaque doors
  - U-factor and SHGC for fenestration **OR**
- Use
  - Pre-calculated assemblies from Appendix A

Energy Cost Budget

- Hourly annual energy use simulation to demonstrate that the proposed building uses equal or less energy compared to a “standard” building.
- Usually done through complex software analysis (DOE.2).
- Includes credit for renewable energy.

What is the IECC?

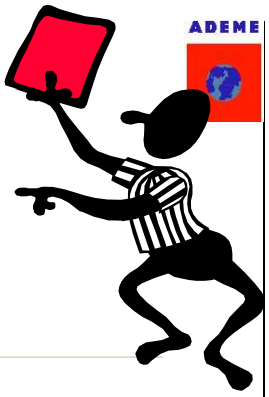


A REQUIRED MINIMUM LEVEL OF ENERGY EFFICIENCY IN NEW CONSTRUCTION

- Enables effective use of energy in new building construction
- Regulates the design and selection of the
  - building envelope
  - mechanical systems
  - electrical systems
  - service water heating systems

Requirements and Compliance Approaches

- Building envelope requirements *(Section 502.1)*
- Building mechanical systems and equipment *(Section 503)*
- Service water heating *(Section 504)*
- Electrical power and lighting *(Section 505)*
- *Design of Buildings Utilizing Renewable Energy Sources* ”



Mandatory Requirements

- Moisture control
- Recessed lighting fixtures
- Air leakage
- Fenestration solar heat gain coefficient

Mandatory Requirements

Air Leakage

(Section 502.1.4)

- Moisture Control
- Recessed lighting fixtures
- **Air leakage**
- Fenestration SHGC

- Window and door assemblies
  - Exception
    - Site-constructed windows and doors
- Caulking and sealants
  - All penetrations to the building envelope shall be sealed, caulked, gasketed, weatherstripped or covered with moisture vapor-impermeable house-wrap

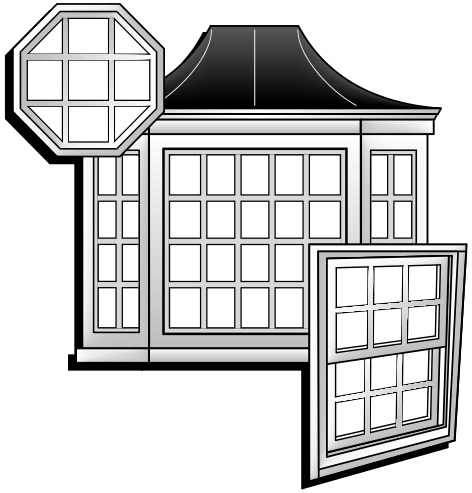
Areas for Air Leakage

Mandatory Requirements

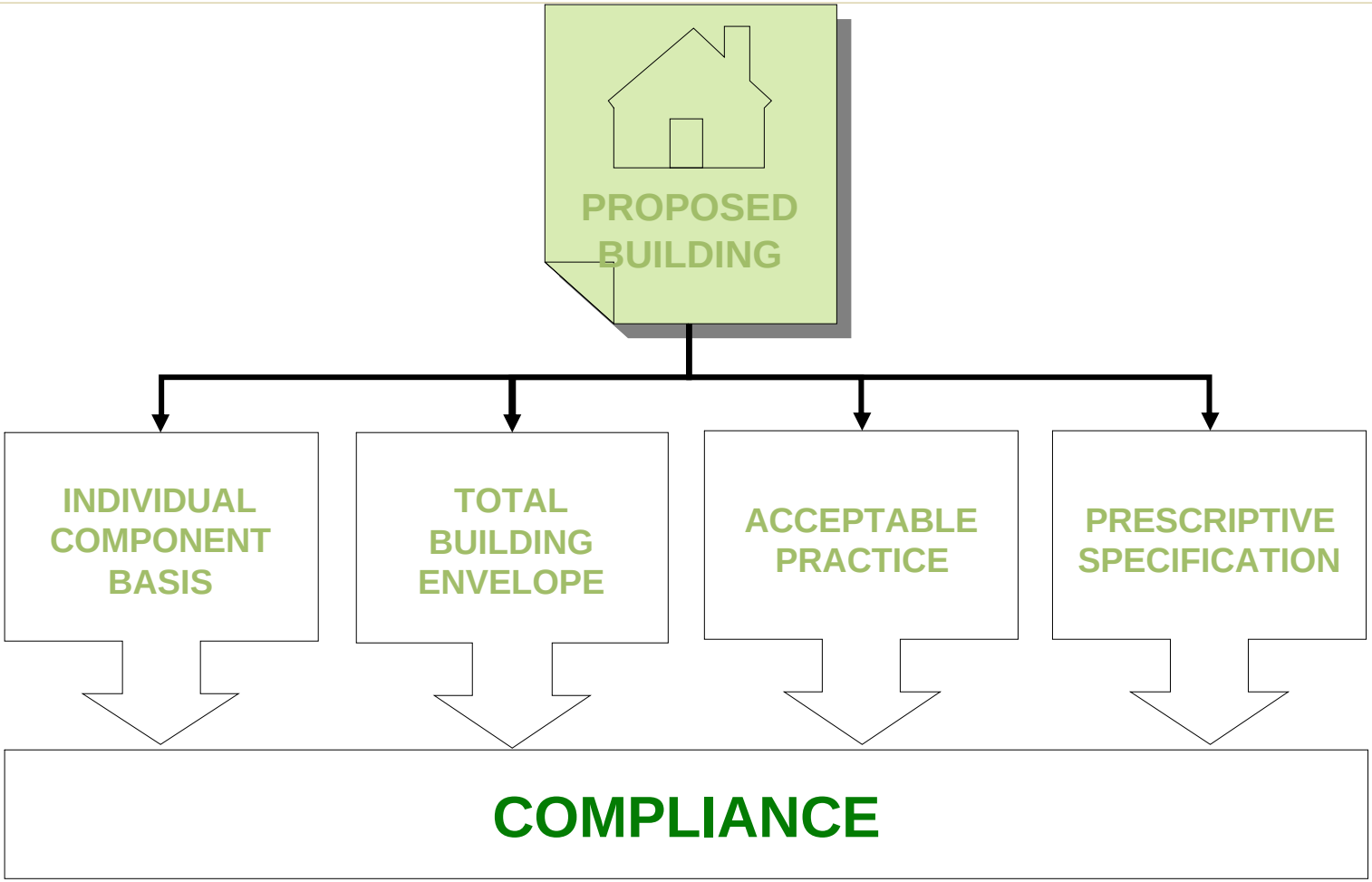
Fenestration Solar Heat Gain Coefficient *(Section 502.1.5)*

- Moisture Control
- Recessed lighting fixtures
- Air leakage
- **Fenestration SHGC**

- Locations with heating degrees days (HDD) < 3,500, the combined solar heat gain coefficient (SHGC) must be < 0.4



Heating and Cooling Criteria
(Section 502.2)



INDIVIDUAL COMPONENT BASIS

Compliance by Performance on an Individual Component Basis

- **Individual Component Basis**
- Total Building Envelope
- Acceptable Practice
- Prescriptive Specification

- Each component of the building envelope shall meet the provisions of Sections 502.2.1.1 through 502.2.16
  - Walls
  - Roof/ceiling
  - Floors over unheated spaces
  - Slab-on-grade floors
  - Crawl space walls
  - Basement walls

Walls
(Section 502.2.1.1)

- **Individual Component Basis**
- Total Building Envelope
- Acceptable Practice
- Prescriptive Specification

- Maximum U-factor from Figure 502.2(1)
- Includes windows
- Steel stud framed walls
  - Require a correction calculation
  - Exception:
    - System tested by approved laboratories
- Mass walls (Tables 502.2.1.1.2(1)-(3))

TOTAL BUILDING ENVELOPE

Total Building Envelope Performance
(Section 502.2.2)

- Individual Component Basis
- **Total Building Envelope**
- Acceptable Practice
- Prescriptive Specification

- The building envelope design is permitted to deviate from U-factors and R-values determined in the “Compliance by Performance on an Individual Component Basis” section provided the total thermal transmittance does not exceed that determined in that section.

Materials and Equipment
(Section 601.3)

- Compliance
- **Materials and equipment**
- Building envelope thermal performance criteria
- Fenestration requirements
- Mechanical systems
- Service water heating

- Insulation
  - R-value must be visible on all insulation or a certification of the R-value(s) by the insulation installer.
  - Blown or Sprayed Walls
    - Certification of installed density and R-value
  - Blown or Sprayed Roof/Ceiling
    - Certification of initial installed thickness, settled thickness, coverage area and # of bags installed
    - Insulation depth markers every 300 ft^2

This Attic Has Been Insulated To

INSULATION CONTRACTORS ICAA ASSOCIATION OF AMERICA

R- ☐

By A Professional Insulation Contractor

The insulation in this attic was installed by a qualified professional Contractor to the R-value stated above

CIMA

Energy INSULATION

INSULATE TODAY SAVE TOMORROW

Certificate of Insulation

BUILDING ADDRESS:

_____

_____

_____

Installation Date: _____

CONTRACTOR:

_____

_____

_____

License #: _____

Area Insulated	R-Value	Installed Thickness	Settled Thickness	Installed Density	No. Bags	Sq. Ft.
Attic						
Walls						
Floors						

I, _____, (print name) certify that this residence/building has been insulated to the stated R-value and that the installation is in conformance with all applicable codes, standards, regulations and specifications.

Authorized Signature: _____ Date:_____

Thermal Performance Criteria

Exterior Walls

(Section 602.1.1)

- The sum of the cavity and insulating sheathing shall meet the minimum required R-value (no credit for air films, drywall, siding, etc.)
- Mass Walls
  - Mass walls with exterior or integral insulation must meet Table 602.1.1.1(1)

French Thermal Regulation for Buildings RT2000

French Thermal Standards

- **A set of French thermal standards was first established in 1974 for residential buildings and in 1976 for non-residential, updated in 1988, in 2000 and in 2005. It is mandatory and focus on thermal insulation, heating, hot water, thermal solar use and air-conditioning of buildings in different climatic zones of France.**

Evolution of Requirements

Isolation des murs	**Notice du CSTB**		**Ancienne réglementation**		**RT 2000**		
	1958	1970	1974	1982	1988	U(Uref)	Umax
Kg	2,50	2,00	1,15	0,70	0,60	X	X
Isolation extérieure	2,00	1,75	1,05	0,65	0,50	0,40 à 0,47	
Isolation répartie			0,9	0,9	0,4		0,47
Isolation intérieure			0,8	0,45	0,3		

Performance Regulation RT2000

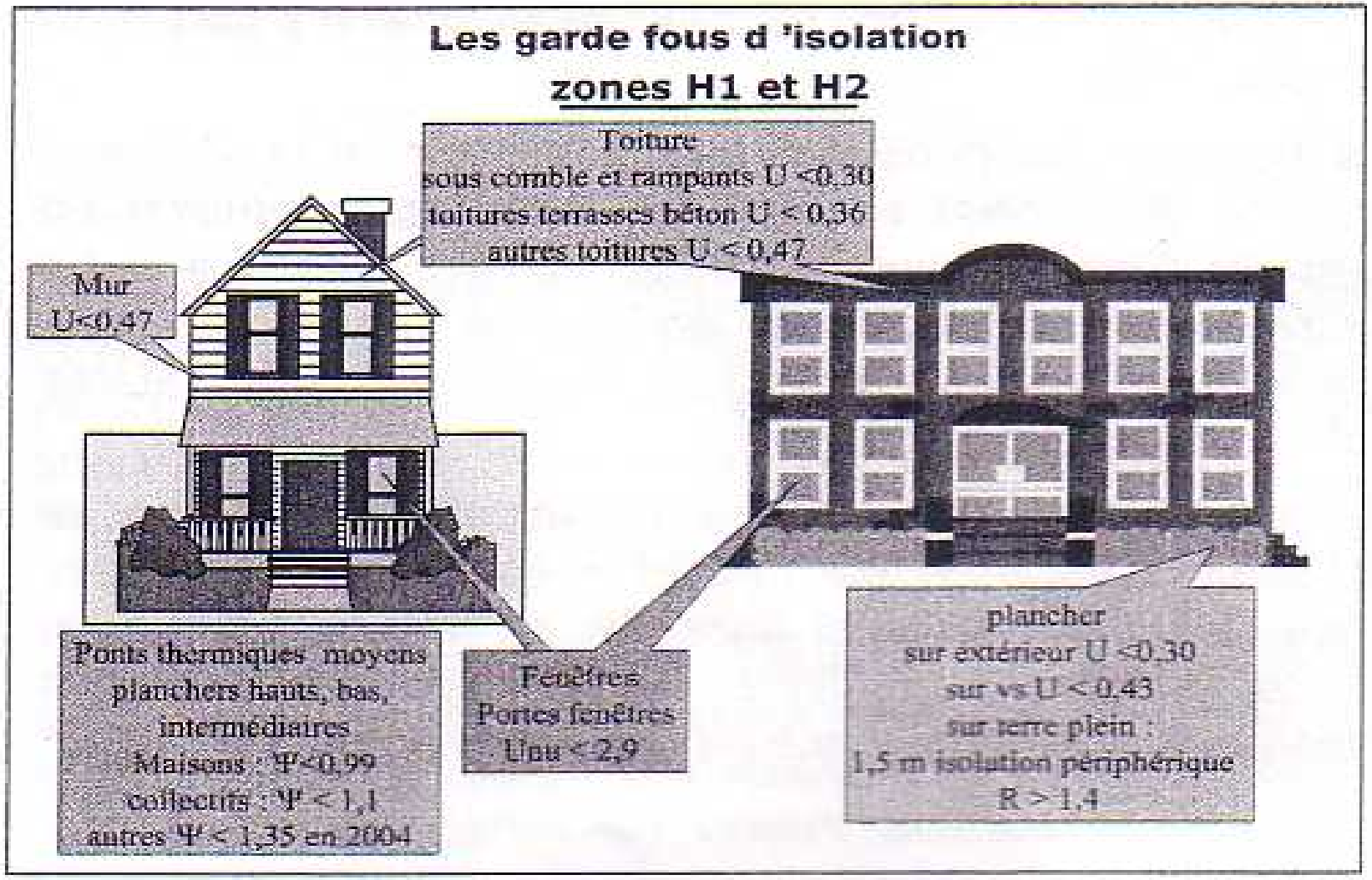
- Enables effective use of energy in new building construction
- Regulates the design and selection of the
  - building envelope
  - mechanical systems
  - service water heating systems
  - Thermal Solar Energy

Performance approach

Performance approach is taken to determine the acceptance criteria for RT2000 :

- **Performance approach - It sets a maximum allowable energy consumption level without specification of the methods, materials processes to be employed to achieve it, but with a statement of the requirements, criteria and evaluation methods.**
- **It specifies for each building component and system (heating, air conditioning, Hot water, ventilation) the minimum requirements to satisfy the regulation “garde-fous” (such as minimum insulation levels).**

« Garde-fous » of insulation



Performance approach

Energy Consumption C ≤ Cref

C(kwh) = C(heating)+(Cclim)+C(shw)+C(lighting)+Caux

RT2000 specifications :

- **The methods, materials processes to be employed to achieve calculation of C et Cref « Règles de calcul TH-C » (EN 832)**
- **The minimum required (garde-fous).**

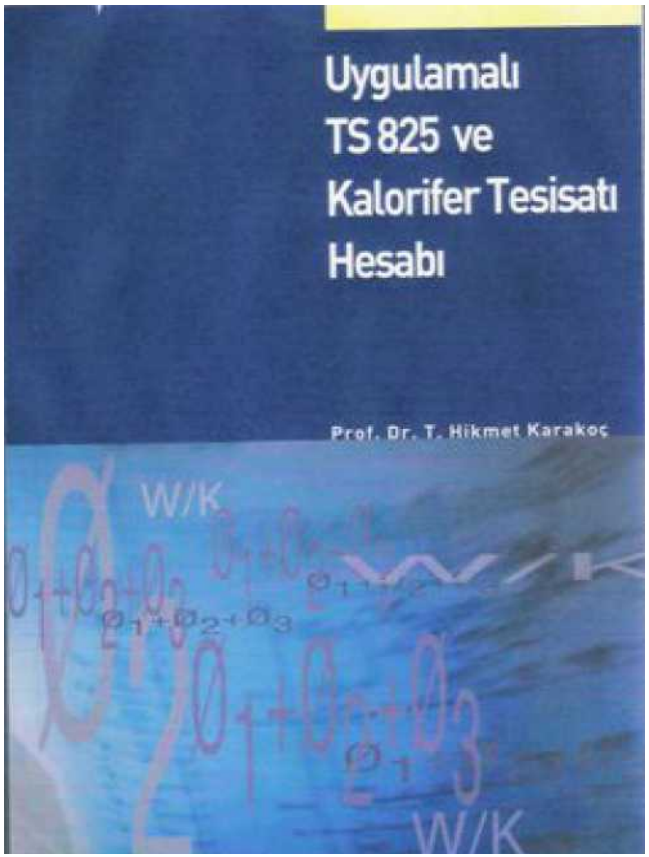
Summer Confort

Interior Operative Temperature without cooling
Tic≤ Ticref
(average on 3 hours)

RT2000 specifications :

- **The methods, materials processes to be employed to achieve calculation of** Tic≤ Ticref **« Règles de calcul TH-E »**
- **The minimum required (garde-fous)** Ticref ≤26°C

What is the TS 825?

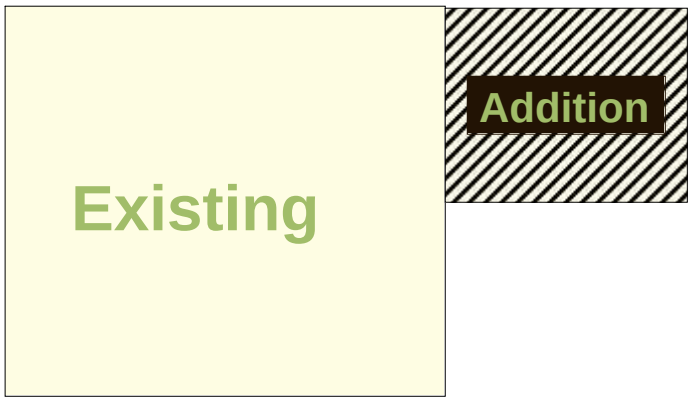


This standard is related with rules of calculation of the heating energy requirements of buildings and the determination of the maximum heating energy allowed

- Regulates the design and selection of the:
  - building envelope (Yes)
  - mechanical systems (No)
  - electrical systems (No)
  - service water heating systems (No)

New Buildings and Additions

- It sets thermal insulation for new buildings and at renovations of existing buildings with 15% ratio or more.

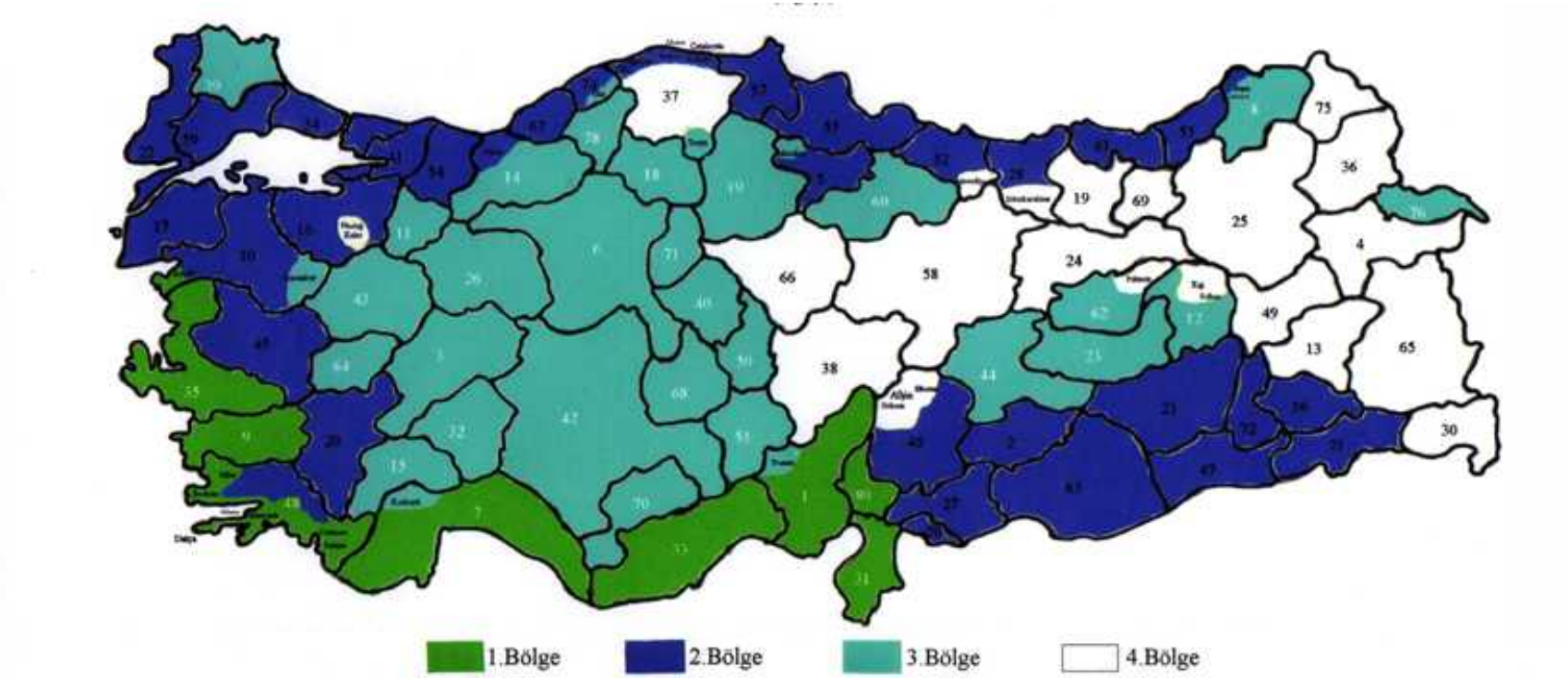


>15%

scope

- This standard sets forth the rules for the calculation methods of the heating energy requirements and the determination of highest heating energy permitted.
- Energy needs for other purposes are outside the scope of this standard.
- It divides Turkey into four climatic zones (depending on average temperature and degree-days of heating).
- Its mandatory application started in June 2000.

Climatic zones of Turkey



SINGLE ZONE CALCULATION FOR ANNUAL SPACE HEATING NEEDS

- Total annual heating energy requirement is calculated by adding the monthly heating energy requirements in the heating period.
- The annual heating requirement ($Qy_l l$) is calculated by subtracting the solar ($\phi g,ay$) and internal gains ($\phi i,ay$) from the total heat losses H(Ti internal temp – T outside temp.).

$$Qy_l l=\Sigma Qay$$

$$Qay=[H(Ti-Td)-\eta ay\ (\phi i,ay + \phi g,ay)]\ .\ t$$

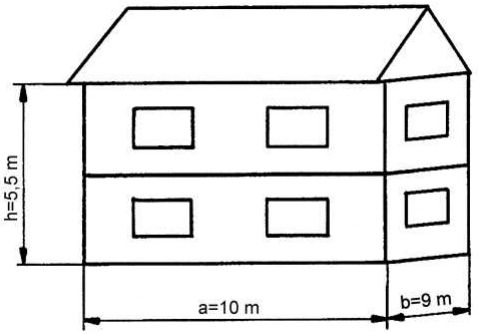
SINGLE ZONE CALCULATION FOR ANNUAL SPACE HEATING NEEDS

$$\Sigma AU = UDAD + Up.Ap + 0,8\ UT.AT + 0,5\ UtAt + UdAd + ...$$

Özgül ısı kaybı ; $H = HT + Hv$

İletim ve taşınım yoluyla gerçekleşen ısı kaybı ;

$$HT = \Sigma AU + l\ Ul$$



Havalandırma yoluyla gerçekleşen ısı kaybı

$$Hv = 0,33 . n_h . Vh$$

Maximum annual space heating needs according to(A/V)ratios

	A/V ≤ 0.2	A/V ≥ 1.05	
$Q'_{1.DG}$ =	27 19.2	66 56.2	kWh/m²
	8.5 6.2	21 18.2	kWh/m³
$Q'_{2.DG}$ =	48 38.4	104 97.9	kWh/m²
	14.7 12.3	33 31.3	kWh/m³
$Q'_{3.DG}$ =	64 51.7	121 116.5	kWh/m²
	20.4 16.5	39 37.3	kWh/m³
	104 67.3	175 137.6	kWh/m²
$Q'_{4.DG}$ =	33.4 21.6	56 44.1	kWh/m³

Q: Space heating need of building, DG: Degree days (4Regions) A: floor area of building, V: Volume of building

Draft Revision

Calculation of space heating for regions according to(Atop/Vbut) ratios

A_N related	$Q^l_{1.DG}$ =	46,62 44.1	A/V	+	17,38 10.4	[kWh/m²]
$V_{brüt}$ related	$Q^l_{1.DG}$ =	14,92 14.1	A/V	+	5,56 3.40	[kWh/m³]
A_N l related	$Q^l_{2.DG}$ =	68,59 70.0	A/V	+	32,30 24.4	[kWh/m²]
$V_{brüt}$ related	$Q^l_{2.DG}$ =	21,95 22.4	A/V	+	10,34 7.80	[kWh/m³]
A_N related	$Q^l_{3.DG}$ =	67,29 76.3	A/V	+	50,16 36.4	[kWh/m²]
$V_{brüt}$ related	$Q^l_{3.DG}$ =	21,74 24.4	A/V	+	16,05 11.7	[kWh/m³]
A_N related	$Q^l_{4.DG}$ =	82,81	A/V	+	87,70 50.7	[kWh/m²]
$V_{brüt}$i related	$Q^l_{4.DG}$ =	26,5	A/V	+	28,06 10.3	[kWh/m³]

Draft Revision

Recommended U values for Regions

	U_D (W/m²K)	U_T (W/m²K)	U_t (W/m²K)	U_P (W/m²K)
1. Region	0.80 0.70	0.50 0.45	0.80 0.70	2.80 2.4
2. Region	0.60	0.40	0.60	2.80 2.4
3. Region	0.50	0.30	0.45	2.80 2.4
4. Region	0.40	0.25	0.40	2.80 2.4

U: heat transfer coefficient

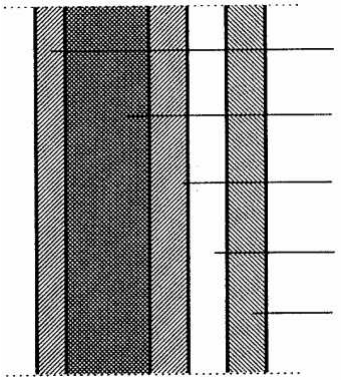
U_D : Wall, U_T : Roof, U_t : Floor ,U_p : window

Draft Revision

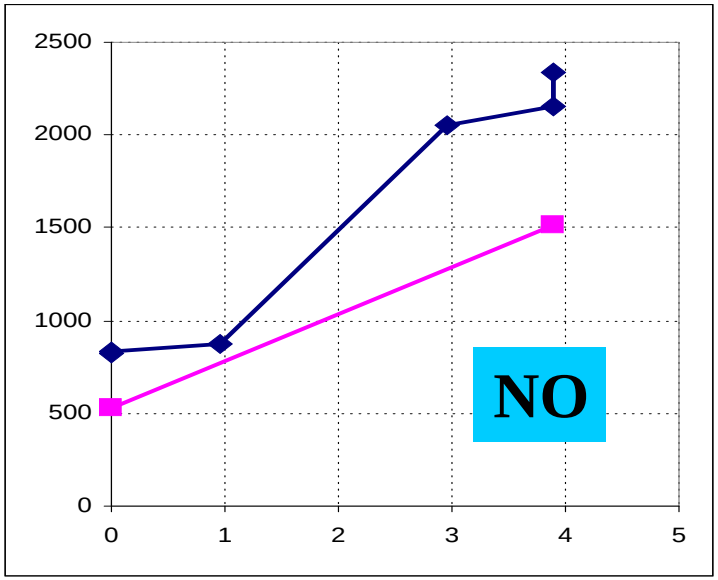
Recommended U values for Regions usually not respected

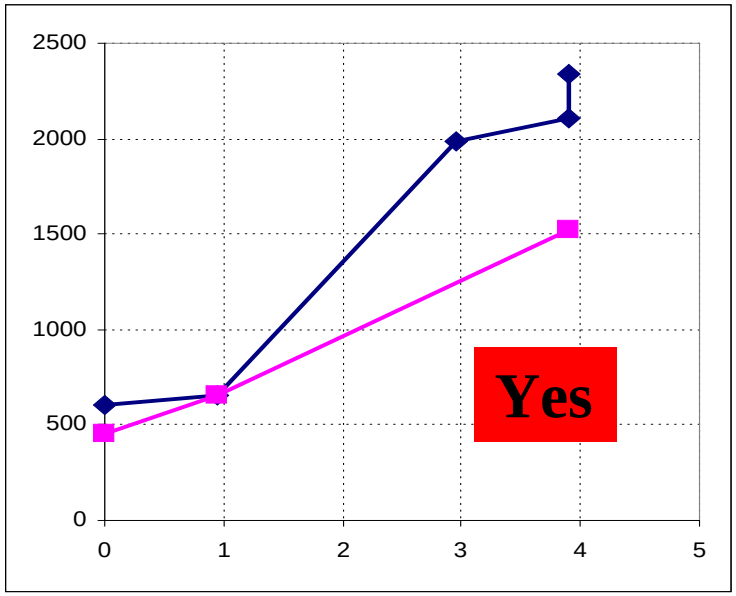
Limiting the Diffusion of Water Vapour Through The Construction and Insulation Materials

The risk of water vapour condensation in the building elements should be checked and permissible limits are specified in the standard



Risk of vapor condensation



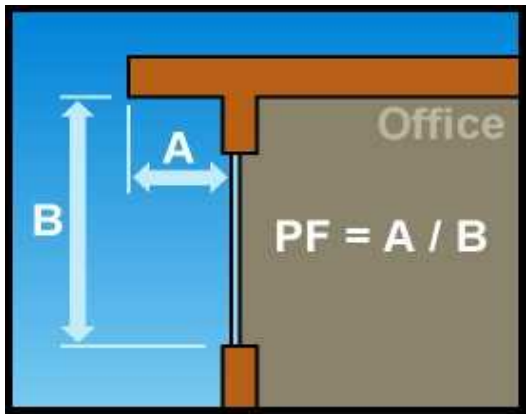


Analysis of the Thermal Standard for Building TS 825

Artificial air conditioning, which absorbs a growing portion of energy in the buildings, in particular in the coastal zone, is not dealt with in an in-depth analysis

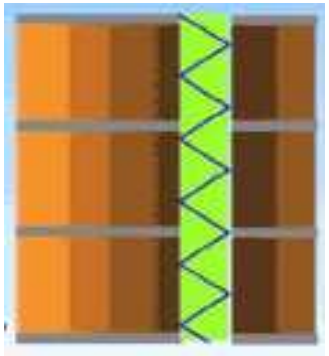
Analysis of the Thermal Standard for Building TS 825

The protection of windows against direct solar radiation is an important limiting factor for the thermal inflows to air-conditioned buildings. The standard gives no indication on how these protections should be implemented.



Analysis of the Thermal Standard for Building TS 825

- **The standard gives no indication on how to reduce thermal bridges.**
- **No precisions are given on the position of insulation material in the wall and its impact on the inertia class (to avoid overheating risks in summer)**



Analysis of the Thermal Standard for Building TS 825

There is no reference to summer conditions, which are very diverse according to the construction location, taking into account the geographic and topographic configurations of Turkey.

Analysis of the Thermal Standard for Building TS 825 : Conclusion

Knowing that the means to mobilize in order to ensure thermal quality are the following:

- **insulation of roof, walls and openings,**
- **relation with sun, position, orientation, dimensions and nature of openings, protection of openings, wall reflexivity,**
- **level of inertia of the building**
- **ventilating system and its modalities of use,**

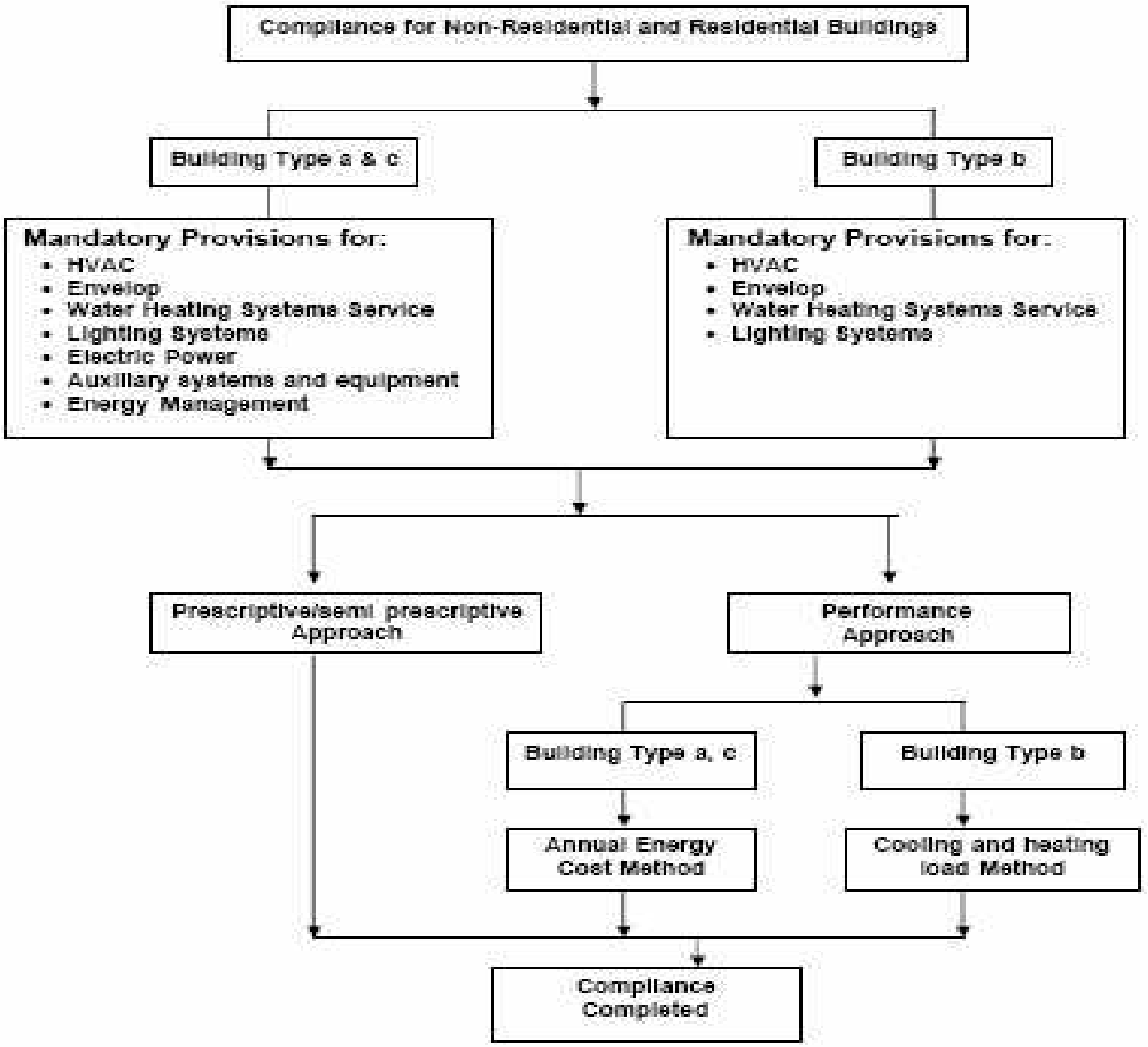
The standard only deals with the thermal insulation. Relations with sun radiation are not sufficiently dealt with.

The performances of devices such as lighting, air conditioning or heating equipment, service water heating systems are not dealt with in the standard (the performances of equipment are an important factor in the energy balance of the building).

Recommendations for the revision of the TS 825

- **It appears necessary to define a climatic zoning** (for summer and winter).
- **Indication on the outside base reference conditions to be taken into account for the dimensioning of heating and air conditioning equipment should be included in the revised TS.**
- **Relations with sun radiation should be developed.**

FROM THERMAL STANDARD FOR BUILDINGS IN TURKEY TO ENERGY BUILDING CODE



Thank you

Questions ?