Energy Efficiency Policies in Morocco: Analysis and Comparison of Code Requirements for Buildings: A Morocco – Netherlands Case Study

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Abstract

This study gives an overview of the different energy efficiency policies present in Morocco along with a case study of a Moroccan house to which the building thermal regulations of both Morocco (RTCM) and the Netherlands (Bouwbesluit) are applied to compare their output and conclude the discrepancies between the two and come up with recommendations to the Moroccan policy makers.

Term	Description
Décret (Decree)	A decree is a legal act issued by the executive branch of the government. It is a type of regulation that is used to implement laws, set policies, or make decisions. Decrees have the force of law and are binding on those who are subject to them. They do not require approval from the legislature.
Loi (Law)	A law is a legal act passed by the legislature of a country. It is a type of regulation that is used to establish rules and regulations that govern society. Laws are binding on everyone, including individuals, businesses, and the government. They require approval from the legislature and may require additional approval from the executive or judiciary branches of the government.
Projet de loi (Draft Law)	A draft law is a proposed law that has not yet been enacted. It is a legal act that is introduced by a member of the legislature or the executive branch of the government. Draft laws must be approved by the legislature before they become law. They are often subject to debate and amendment before they are enacted.

Table 1: Analysis of the difference between Decree, Law and Draft Law

The table above is used to describe the different types of policies present in the Moroccan regulations and the main differences between them.

Methodology

The study begins with a meteorological analysis of the location of the house: "Zaouiat Sidi Abdelsalam" and a comparison with the weather in Amsterdam.

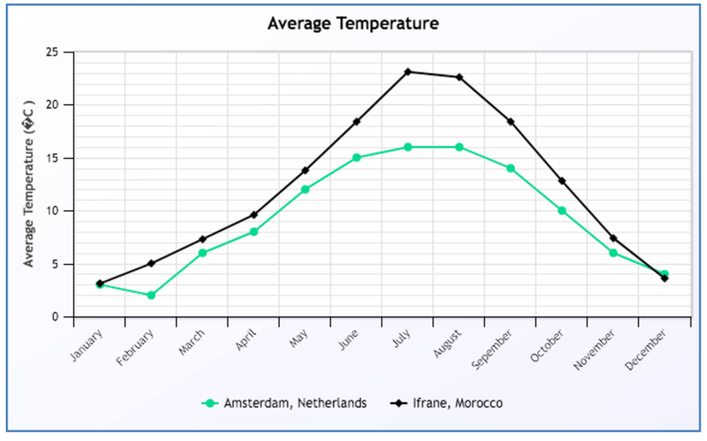

Figure 1: Temperature comparison between Ifrane and Amsterdam

Study of the house

This part shows the house used for the analysis along with the material used as it is shown below .

	Material	Thickness (mm)	Thermal Conductivity (W/m*K)	Cp (J/kg*K)	Density (kg/m3)
External walls (0.534W/m2*K)	Cement plaster	15	0.42	1000	1800
	Air layer	100	0.714	1012	1
	Brick wall	70	0.34	1000	1800
Roof (0.446W/m2*K)	Clay Tile	1200	1.40	1000	2500
	Mortar layer	450	0.42	1000	1800
	Reinforced concrete	400	2.30	1000	2350
Glazing area	Double Glazing U=1.960 W/m2*K				

Table 2: House Material Properties

All the material used was chosen in order to satisfy the (RTCM) requirement for the climatic zone 4.

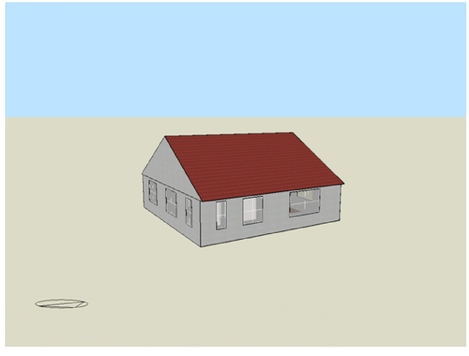

Figure 2: Design of the house in DesignBuilder

The house was designed with the same dimensions as our experimental House located in "Zaouiat Sidi Abdelsalam" in order to get accurate data about the heating and cooling demand of this residential building.

Equations Used

Equation Used in Design Builder

The DesignBuilder software utilizes the building information modeling (BIM) concept to enable a comprehensive simulation of both the building and HVAC systems, as well as natural and artificial lighting. The thermal model employed in the software primarily relies on heat transfer balances and is specifically tailored for the outdoor wall surface and is represented by the following equation:

$$q''_{solr} + q''_{LWR} + q''_{conv} - q''_{k_o} = 0$$

- q" solar : is the direct and diffuse solar (short wavelength) radiation heat flux.
- q"LWR : is the net long-wave (thermal) radiation flux exchange with the air and surroundings.
- q" conv : is the convective flux exchange with outdoor air.
- q"K0 : is the conduction heat flux into the outdoor wall.

Annual Energy Demand

In order to calculate the BECth: The annual energy demand related to the thermal comfort of a building (in kWh/m2· year) we used the following formula:

$$BECth = \frac{BECh + BECref}{STC}$$

With: BECh: The annual heating energy demand (kWh/year) and BECref: The annual cooling energy demand (kWh/year).

Recommendations to the Moroccan Government

1. Update the Theramal regulation in Morocco (RTCM) to cover a set of other part of building efficiency like: Air Infiltration and natural ventilation.
2. Building envelope: Buildings should be designed and constructed with a high-performance building envelope that minimizes air leakage, controls moisture, and provides thermal insulation to reduce energy consumption for heating and cooling.
3. Make incentives and subsidies to promote the energy efficiency for buildings in all climatic zones of the country.
4. HVAC systems: Heating, ventilation, and air conditioning (HVAC) systems should be designed to use energy-efficient technologies that reduce energy consumption, such as high-efficiency air conditioning units and heat pumps.

Conclusion

In conclusion, the policies and measures that Morocco has adopted to promote energy efficiency have the potential to make a significant impact in reducing energy consumption and greenhouse gas emissions. However and as the study showed, a lot of improvement has to be made to have energy efficent building in Morocco.