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TRNSYS validation of a study on building's energetic evaluation in north of morocco

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Abstract

The study is done on an apartment of 85 m2, located in Tangier. A south facing façade receives a continuous sunshine all day. The outer walls are hollow brick Double skin spaced from an air knife (10 cm), the inside walls consist of simple dividers, while the ceiling and floor are concrete 30 cm thickness.
The aim of this study is to evaluate the hygro-thermal behavior of a multi-zone apartment located in northern Morocco by using the TRNSYS16 software, and compares its results with those from a study with CODYBA software and to estimate the heating load in January and the air conditioning load for the month of august.
Meteorological data and building materials properties are those used in the north of Morocco.

Peer-review under responsibility of the scientific committee of ICOME 2015 and ICOME 2016.

Keywords: Energy simulation, comfort heat, air temperature

1. Introduction

Morocco is poorly endowed with energy resources and imports over 96% of the energy it consumes. 36% of the overall energy consumption goes to the residential and tertiary sector, the housing sector emits more than 30% of greenhouse gas (GHG) emissions responsible of global climate on global warming. The increasing of the standard of living, and the availability of heating and air conditioning equipment at low prices, thus everyone has the possibility

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of heating in winter and cooling in summer. While the majority of existing electrical networks in some urban areas are not designed for these power calls, which weakens them.

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In addition, the demand for electricity could quadruple by 2030. The aim of this study is to compare the simulation results of two TRNSYS16 and CODYBA software. The study is to make a hydrothermal simulation of a local multi-zone and estimate the heating load for the month of January and the air conditioning load for the month of August.

2. Parameters used

2.1. Description of the local studied

The study is done on a flat in the city of Tangier in northern Morocco, with an area of 85m². A south-facing façade receives a continuous sunshine throughout the day; the plan of the apartment is on (figure1)

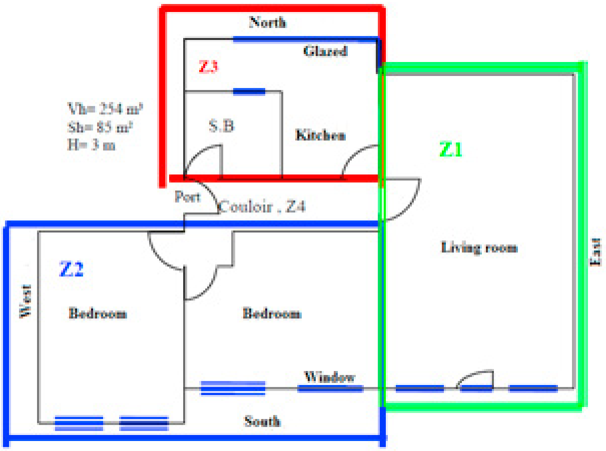

Figure1: Plan of the apartment studied

The exterior walls are brick Hollow double skin spaced from an air knife (10 cm), the interior walls are consisted of simple dividers, while the ceiling and the floor are concrete 30 cm of thickness. The structure construction in northern Morocco exterior walls appears on (figure2).

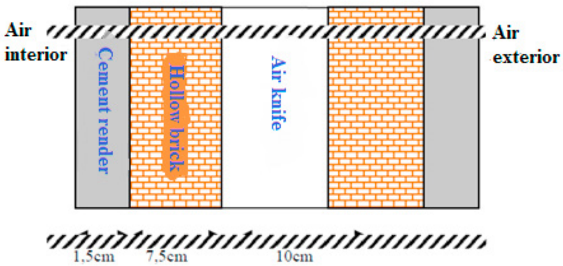

Figure2: Structure of an external wall

2.2. Weather data

Meteorological data were measured on the Tangier weather site over the two years 2003 and 2004.

2.3. Building materials used in northern Morocco

There is no reference to access the average values of thermo-physical characteristics of the materials used in Morocco. In our case, we take the thermo-physical properties of construction materials used in the north from the library TRNSYS16 software that is very rich.

2.4. Hygrothermal modeling of the apartment

TRNSYS is a particularly suitable for dynamic simulation software system, the thermal behavior of multi-zone buildings and associated systems. Because of its modular structure, it can describe complex systems with many components (types) included in its library. The TRNSYS environment comprises two sub-programs:

- TRNSYS Simulation Studio, host structure for both the development of new numerical models and implementation of dynamic simulations,
- The TRNBUILD interface, which defines the building envelope structure.

Modeling assumptions
Conditions considered for the simulations are as shows in Table 1, the air change rate is represented in table2.

Modeling in multi-zones:
In order to have a more detailed model of a house in function of their use, the studied apartment is divided into four climatic zones.
These areas are the following (figure 1)
Zone 1: The living room (Z1)
Zone 2: Bedroom 1 and 2 (Z2)
Zone 3: Kitchen and bathroom (Z3)
zone4: Hallway (Z4)

Table1: Internal loads of the apartment

Entity	Nb	power (w / unit)	unoccupied scenario
occupants	4	130	from 8h to 12h and from 14h to18h
equipment	4	60	from 23h to 6h, 8h to12h, and from 14h to 18h.
lamps	4	40	from 00h to 18h

Table2: The air change rate of apartment

	volume flow rate (m3/h)	scenario of operating
living room	90	From 8h to 14h and from 17h to 20h.
Bedroom 1and 2	100	From 8h to 12h and from 14h to 18h.
kitchen	80	From 7h to 12h and from 14h to 22h.

3. Results and discussion

4. All the results for different parameters characterizing the atmosphere of the studied apartment (the interior temperature and humidity) will be presented as graphics and will be compared to those of the study by CODYBA. We determine the evolution of these indicators over time, which will allow us to estimate the annual consumption for heating and air conditioning of the local.

4.1. Evolution of temperature:

The figures 3 and 4 show the evolution of temperatures for the months of January (01/01 to 15/01).
We got changes in temperature in the various local areas. We observed changes in these two parameters of a zone to the other, it's caused by radiation received via glass surface of this areas. However, the development of Zone 3 is higher, considering its operation. There is a bit difference in the half of the months that caused by the difference between method of calculation for each software. There is a similarity between temperatures in different zones with TRNSYS16 and CODYBA.

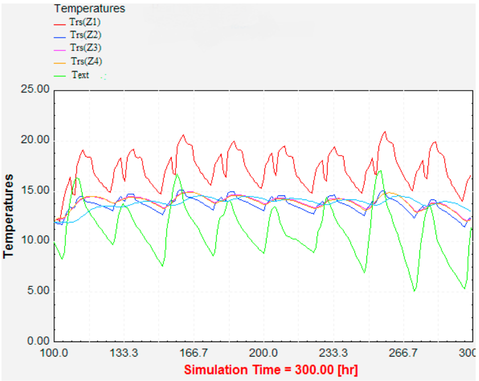

Figure3: Resulting temperature with TRNSYS 16

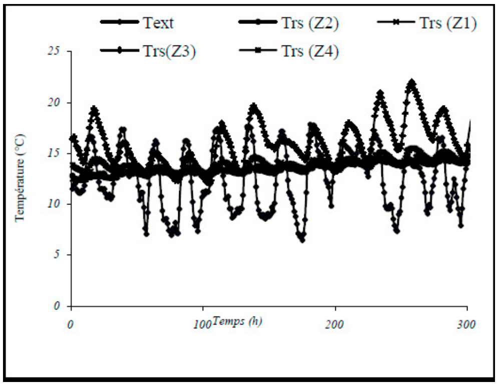

Figure4: Resulting temperature with CODYBA

For the months of august as shown in figure 5 there is a similitude between temperature results with TRNSYS16 and CODYBA for all zones.
The figures 5 and 6 show the evolution of temperatures for the months of august (01/08 to 15/08).

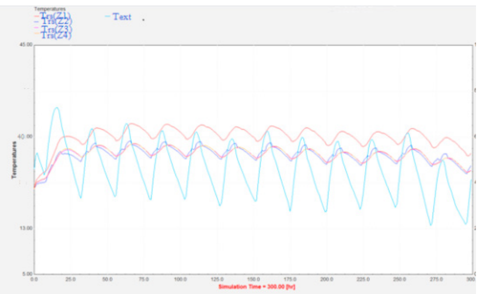

Figure5: Resulting temperature of the apartment With TRNSYS16

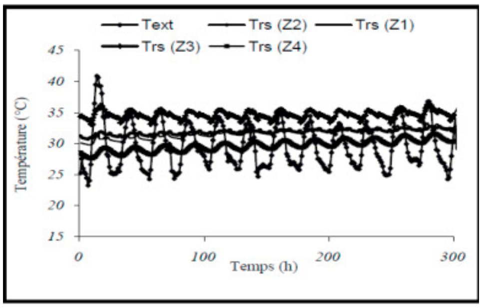

Figure6: Resulting temperature of the apartment with CODYBA

4.2. Evolution of humidity

The figure 7 and 8 show the evolution of temperatures for the months of January (01/01 to 15/01).
We got changes in relative humidity in various local areas; it presents a variation from one to another zone in multi-zone modelisation. The humidity is maximum in zone 1 and 2 because of the ventilation. It is minimum in the zone

3 and 4 because they are regularly ventilated. we find the same values for both software. For the months of august we have same comments as the months of January. The advantage of this software is to perform simulations of the evolution of different parameters characterizing the internal atmosphere of the building.

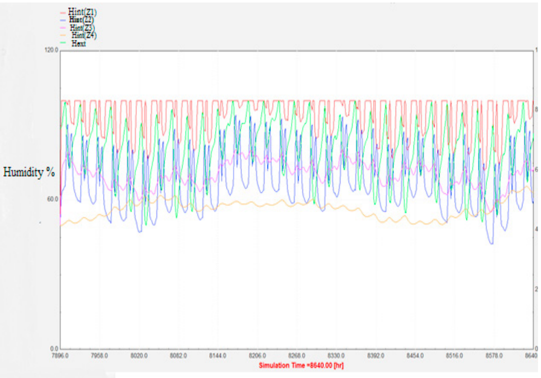

Figure7: Resulting humidity of the apartment with TRNSYS16.

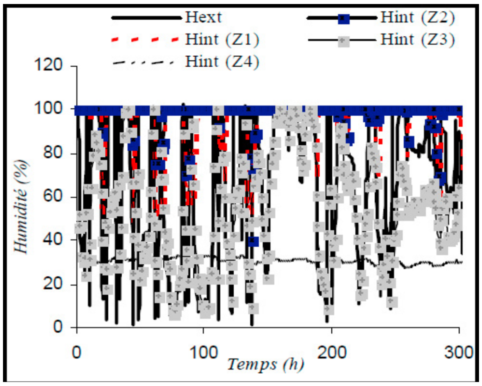

Figure8: Resulting humidity of the apartment With CODYBA.

The figure 9 and 10 show the evolution of temperatures for the months of august (01/08 to 15/08).

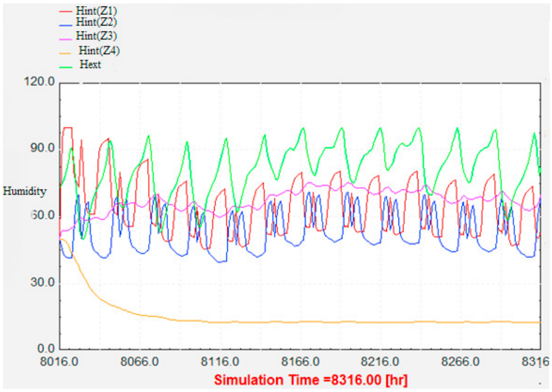

Figure9: Resulting humidity of the apartment with TRNSYS16.

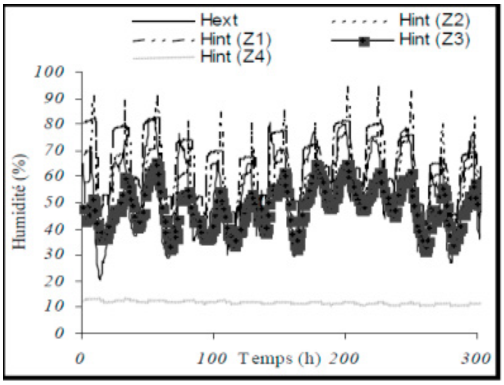

Figure10: Resulting humidity of the apartment With CODYBA.

5. Conclusions

TRNSYS 16 allowed us to model the building in dynamic regime.
All simulations results helped us to estimate the power of heating and cooling during winter and summer periods.
To dimension an air conditioning system adequate; in January, we need around 160kwh of heating energy to keep the temperature at 18°C (winter comfort), wish is higher than what they estimate with CODYBA software. And 540kwh of cooling energy to keep the temperature at 25°C (summer comfort) wish is higher than what they estimate with CODYBA software.
This difference in results is due to the calculation methods of the two software.
the calculation method of TRNSYS is to make the heat balance on all sides, unlike the software that CODYBA considered as the rays that come through, the window to the floor and is reflected to the other walls.
This software help to gain valuable time, an improving the reliability of the results in the study and the design of the thermal insulation, heating and air conditioning of a housing, and a study of the thermal behavior of the building.

6. References

[1] BABBAH. S, and DRAOUI. A, 2004, Evaluation Energétique des bâtiments au Nord du Maroc, Projet de Stage de Recherche, DESA, Transferts Thermiques et Energies Renouvelables, FST de Tanger, décembre.

[2] BOUSSAID. S, 1990, Caractérisation physico chimique Thermo-physique et mécanique de la terre utilisée en Construction au Nord du Maroc", Thèse de 3ème Cycle, Faculté des Sciences, Tétouan Maroc.

[3] CABIROL. T, FAURE. D and ROUX. D, 1982, Chauffage de l'habitat et énergie solaire, tome 1: Confort thermique et techniques de chauffage, Charly-Yves, Edisud.

[4] EL BAKKOURI. A, 1990, Caractéristique Thermo-physique et mécanique de quelques matériaux locaux utilisés dans l'isolation et la construction au Maroc: Le plâtre, le liège et la brique creuse, Thèse de 3ème Cycle, Faculté des Sciences, Tétouan Maroc.

[5] WERNER.K, and PAUL.S, 2005 TRNSYS Manuel, For Simulation Studio 4.0.

[6] .J.Noël, J, and J.Roux, 2004 CoDyBa Manuel d'utilisateur, Rev.1.00/Nov.

[7] Fanger P.O,1982, Thermal comfort. Robert E. Kreiger publishing company. Malabar Florida.

[8] Réglement thérmique 2000, centre téchnique des industries aérauliques et Thermiques.