

# CalorSTA, software for design and audit of evaporative cooling systems in poultry houses

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Evaporative cooling of livestock buildings, associated with ventilation, is one of the means used to reduce mortality of intensive livestock herds during hot periods. Such systems will continue to develop because of expected climate changes (Turnpenny et al, 2001) and new areas of intensive breeding. The rules used to design natural ventilation and evaporative cooling are not based on present knowledge. For example in a recent paper, Mutaf et al (2004) calculated natural ventilation only according to the temperature gradient while it was demonstrated that the moisture gradient should also be taken into account (Souloumiac and Itier, 1989) and most of the heat produced by the animals is emitted as water vapor during hot periods (CIGR, 1984, 2002). Our objective was to sum up useful knowledge for the study of evaporative cooling systems and to organize its use into an open model.

The software we developed in an Excel® sheet uses simple choices as inputs (Fig. 1). These choices can be adapted in more detail by the user when necessary. Three types of needs were treated: (i) the design of systems and their adaptation to the climate, the animals, and the farmer (Fig. 2), (ii) the simulation of a regulation scenario during a hot week (Fig. 3) in order to check if ventilation reduction does improve temperature control (Hassouna et al, 2005), (iii) the audit of a correct functioning in the building (Fig. 4). In the example presented we can see that either the actual ventilation and cooling rates are lower than expected, or there are significant unexpected warm air inputs. In order to improve the practice of ventilation and cooling design and the scientific knowledge of temperature control in animal houses during hot periods, an international network of scientists and engineers will be useful.

## References

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Lisez-moi ! **CalorSTA**  
Design and Audit of Evaporative Cooling Systems in Poultry Houses

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Choose an animal type Choose a building type

Animals : Poulets Standard VJ/Ross Building : Lanterneau (pente forte)

density : 18 animals/m<sup>2</sup>  cooling installed

animal initialization  building initialization

Climate : Ext 1 (40.0°C ; 25%HR) Int 1 (30.0°C ; 70%HR)

climate initialization

**Design of ventilation and cooling rate**

[Exit](#) [Initialize](#)

Figure 1 Initial choices for the cooling and ventilation design

**CalorSTA**  
Design of Evaporative Cooling Systems [Exit](#)

**Outside Climate** **Searched Inside Climate** [back to home page](#)

Outside Temperature: 40,0 °C Outside Relative Humidity: 25,0 %

Inside Temperature: 30,0 °C Inside Relative Humidity: 70,0 %

(outside enthalpy = 69,8 kJ/kg dry air) (inside enthalpy = 78,0 kJ/kg dry air)

**Data**

<b>Animals</b>	Standard Broiler (VJ/Ross)
number of days	39 days
weight (kg)	1,93 kg/an.
density (an./m <sup>2</sup> )	18 an./m <sup>2</sup>
stocking rate (kg PV /m <sup>2</sup> )	34,7
1st slaughter day	40 days
last slaughter day	60 days
%left after first slaughter day (heavy)	100 %
%present animals	100 %

**Results**

Air flow rate	224000 m <sup>3</sup> /h.building (5,39 m <sup>3</sup> /h.kg live weight)
Opening size	1,11 m
Cooling rate	1,35 m <sup>3</sup> /h.building (32,5 g eau/h.kg live weight)
inside T obtained	29,9 °C
inside RH obtained	69,0 %

[calculate](#)

**Building** **Natural vent. (high roof slope)**

surface	1200 m <sup>2</sup>
insulation	1,58 W/°C.m <sup>2</sup>
heat inputs (Troof-Tair)	5 W/m <sup>2</sup>
cooling	10 °C
	yes

Figure 2 Results of the design: air and water rate, static openings.

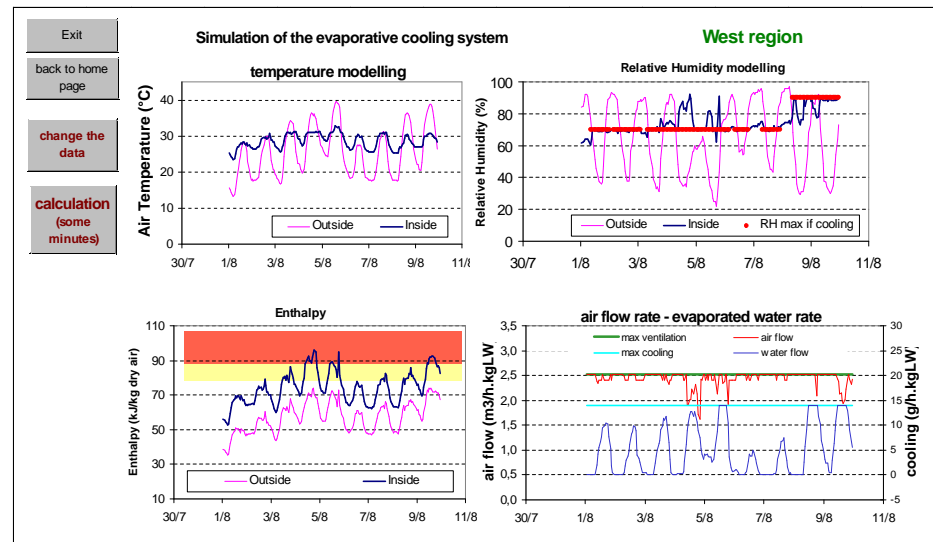


Figure 3 Results of the regulation simulation during a hot week

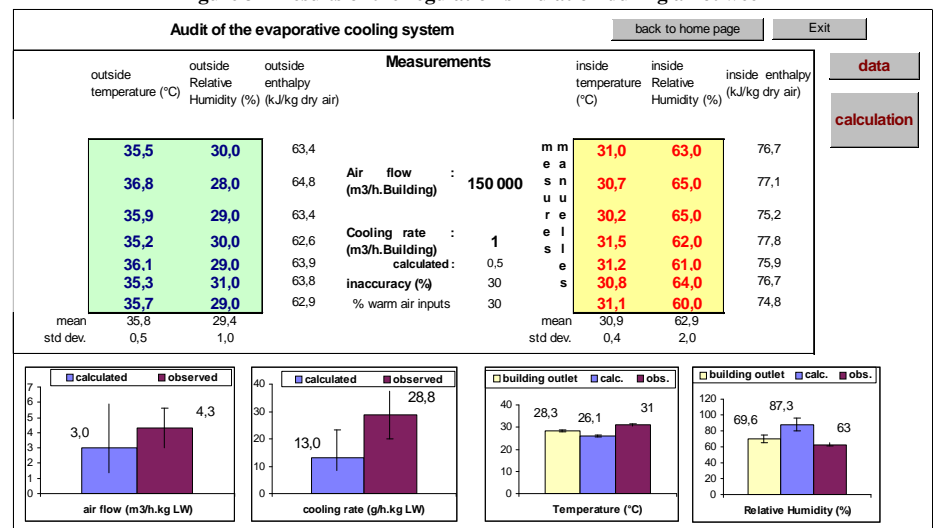


Figure 4 Results of the cooling and ventilation audit