

# SOLAR STRATEGY IN FAVOR OF ARCHITECTURAL DESIGN – CONVECTIONAL LOOP CASE

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## **Abstract**

The pattern of convectional loops (CL) is especially interesting among all the fifth main current Solar design strategies\*. Below one can find recommendations, specially referred for architectural design. They are illustrated, summarised and interrelated with the laws of physics, in this paper.

## **1. Introduction**

In this paper the authors present the meaning of convectional loops (CL) both as contributing to the microclimate of the houses as well as a considerable factor in the form creating processes for architectural composition and even aesthetics of the buildings. The exteriors and interiors are both influenced by the CL. Some references and recommendations for architectural design are in the conclusions of the paper, as far only the architects could find proper form composition of solar requirements. To derive conclusions for the future the authors rely on a survey of bulgarian historical construction tradition that had been presented at SWC 2007 [2]. Architects are for ages responsible to sequence many different requiremets, incl. solar ones in the projects. Recommendations are formulated on the ground how the elements conducting convection are situated in any house– (courtyard, lobby), atriums, verandahs, balconies, loggia, awnings, shelters, eaves, well etc). All these elements are consequently analyzed – about their inclination, surface, relief, materials, position etc. and some conclusions about the form creating role of convectional loops in architectural design are defined.

## **2. Holistic approach**

There are numerous examples of Bulgarian renaissance architecture revealing the remarkable environmental knowledge and skill of the anonymous constructors and how they used natural energy to reduce energy costs. Most of the solar requirements (depending on simple physics principles) are also applied in this type of architecture. (Fig.1) It is a rewarding experience to investigate how regional

climatic data interact with urban structure and how the air flows approach the houses.



Fig 1. Map of Bulgarian traditional houses' spread in regions

Most of the ancient architects have always applied the following five tools , direct and indirect gains, sun spaces, chimney effect and convectional loops ( CL ). The first four are major preconditions for CL. CL is not an independent phenomenon but the result. It could be called as most favorable effect of them. They are always interrelated. The way the house is oriented is the initial condition, the main premise whether a house could answer the climate or solar requirements or not, whether in it will be settled enough active CL and at the end whether the house will have solar/renewable gains from CL or no.

Below are some examples of how air flows interact with connected urban and architectural spaces. These will demonstrate that if they are propely oriented they could benefit any building and avoid expensive climatic devices by using CL to create different contours in different spaces.

We are going to analyze a series of building elements which could be implemented to favor the above mentioned strategy for the benefit of an optimal microclimate process in different houses. Another major benefit is to reduce the owner's expenses and energy bill

## **2.1. Urban context prerequisite**

The starting point of the analysis of the urban structure is the mapping of airflow patterns. If such flows are not intentionally caught by fence enclosures or by openings in the house itself they could not affect the courtyard or house interior at all. The example at Fig.2. demonstrates the rising flows, streaming the house elevations and penetrating to its courtyard and interior spaces.



Fig. 2. Veliko Tarnovo house



Fig.3 Koprivstiza, Oslekov house

## 2.2. Court yards

Courtyards are the next item to consider. Bulgarian gardens are grown with different shrubs, flowers and trees to create aromatic odors to freshen the incoming air. Opening different windows and doors in the morning and then in afternoon and will establish unique microclimates , solar and shadow access to the interiors. The courtyards that connect town streets and house rooms serve as filters between them.

### 2.2.1. Stream, river or well in vicinity

The house microclimate could also be enriched by fresh air flows directly from near by rivers, wells , subterranean canals or drains. Such flows could be enforced and then set strongly if they are on the way of existing air flows. We find them at the Georgeady house in Plovdiv exactly in such a place. Beside the staircase and main door entrance to the house is the well vent. In this example are we see where CL are strenghten by two simultaneously active flows, a combination of nature ventilation combined with natural cooling by evaporation from the well. (Fig 4)

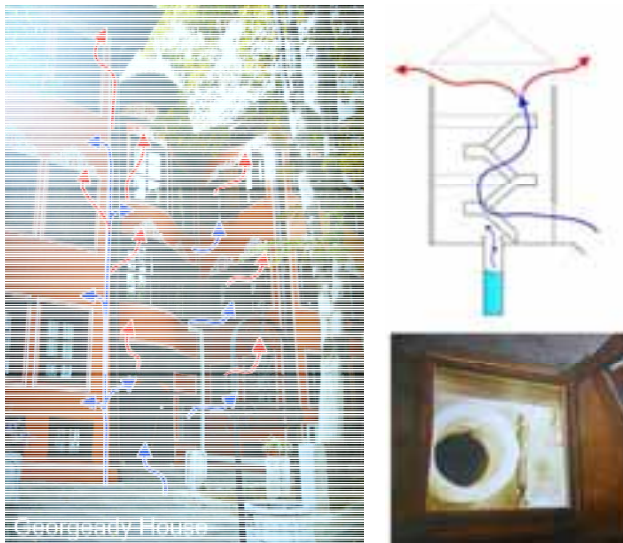


Fig.4. Georgeady house (now a historical museum and trap door to original well, 11 m depth.), Plovdiv

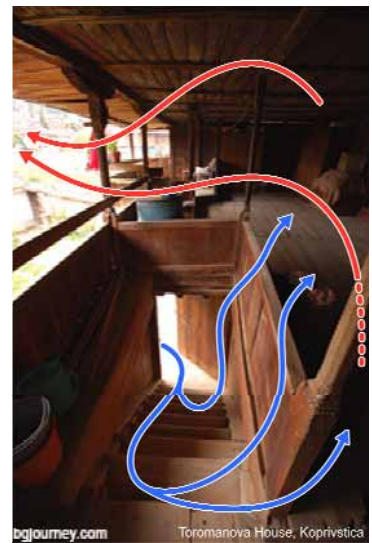


Fig.5. Toromanov House, Koprivstizza

### 2.2.2. Staircase effects

One of the functions of a staircase is very similar. Based on the chimney effect for the foyer and all adjacent rooms. Lobby with staircase anyway, is of special interest with its diversity of aesthetical interior decisions. (Fig.5.) Energy advantage due to energy gains and  $T^\circ$  comfort could be added to this.

### 2.3. Verandahs, balconies, loggia

Between the courtyard and interior there may be various balconies, verandas or loggia. They act as entrance points for the CL fresh air access to the interior spaces. (Fig.6)

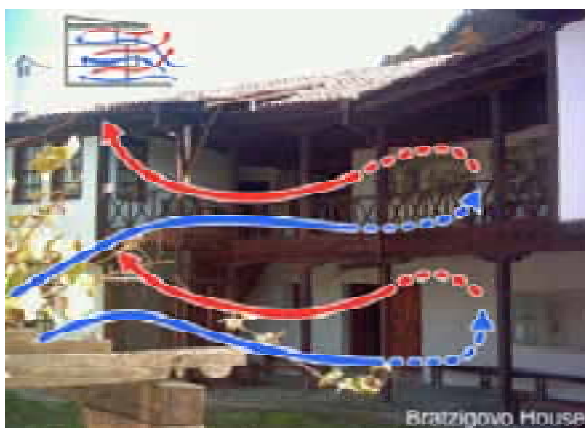


Fig.6. Bratzigovo house

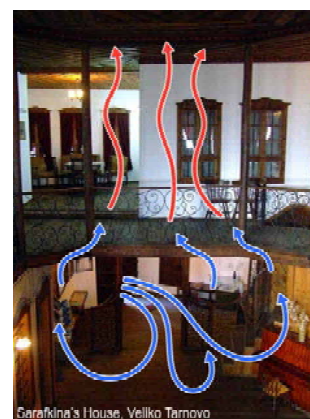


Fig. 7. Veliko Tarnovo hotel

## 2.4. Atriums

### 2.4.1. Sheltered atriums

Fig. 7 shows the application of simple natural ventilation of a hotel lobby based on chimney effect.

### 2.4.2. Open air atriums

Fig. 8. presents a house with 'II' form, open to the predominant wind direction. This guarantees natural ventilation of the courtyard as well favorable conditions for ventilation of the adjacent rooms

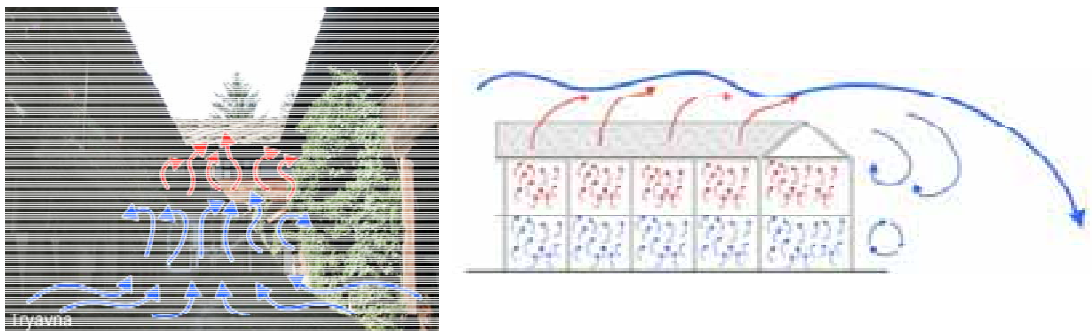


Fig. 8. Tryavna inn – courtyard

## 3. Conclusion

This presentation reveals the ingenious use of CL principles by anonymous Bulgarian architects and builders who during centuries have created, honed and carried on those bioclimatic architectural traditions.

CL as a tool for designing and constructing new buildings or renovating old ones.

CL reduces energy consumption by using natural tool for better air conditioning or ventilation.

It is easily applicable in the every day routine of architectural design work without any devices at all. The authors' conclusions in this paper could serve to save a lot of investment in air conditioning.

Using a holistic approach to the elements of housing design with respect. to spaces in which air flows act, town to street to courtyard to balconies to sheltered air to rooms and back to courtyard to street to town. This approach could provide the necessary energy savings and make visible the traces of the pragmatic aims of energy efficiency and the art of architectural form.

CL derive motivation and proof of precision of the architectural form.

CL could motivate the oval shape of edges in the interior of rooms and buildings. The presentation reveals architectural use of natural energy.

CL investigation could motivate other colleagues to reveal similar patterns particularly in other national tradition and thus to enrich the international RE design guidelines and knowledge, still lacking anywhere in architectural regulation.

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## **References**

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