

A reconstruction of an ancient airwell of earth

Hauke Haupts
Architect Norway

The aim of this research

is to point out the message of vernacular ancient earthen architecture to modern constructions of earth concerning advantages in thermodynamics and sustainable low energy use technology for the extraction of drinking water and natural cooling in coastal desert zones.

What is an airwell?

Explanation by examples of different types of condensers.

Physics: Thermodynamic, thermal radiation and state of aggregation (hydrogen)

Which kind of historical airwells do we know?

Examples of reconstructions and original constructions.

Which cycles in nature follow the same physical laws?

1. Soil
2. Plants
3. Animals

Some basic conditions to succeed in extracting water out of air

Condition of place: high humidity (close to sea), short wave thermal radiation (sun), Thermal (warm day - cold night)

Condition of construction: protection of the condenser against warming up by short wave radiation of the sun, material: high thermal mass and low long wave radiation, form and design: supporting a strong downdraught and a large smooth inside surface.

Today the International Organization For Dew Utilization in Bordeaux, France researches this field scientifically. (<http://www.opur.u-bordeaux.fr/index.htm>)

There are climatic historical constructions of airwells in different climate zones

1. In the moderate climate zone of central Europe we find so called dew, cloud or fog ponds (Great Britain)
2. In the climate zone of the Mediterranean and the black sea special heaps of stones are described
3. In the coastal desert zones of Africa, South America and the Arabian Peninsula we know about earthen buildings and walls to extract water of air
4. Airwells build on the principle of the morning dew on leaves. These systems are based on the mass factor of thin materials with high long wave thermal radiation.

Vertical sails are placed on hillside towards the sea extracting the water out of morning fog by surface condensation.

All historical reconstructions of **type 2** failed or never lived up to the expectations. Vernacular historical constructions of **type 1** are in use. **Type 4** functioned as long as the material withstands destruction by UV radiation of the sun. **Type 3** is documented in vernacular architecture in ancient time and the Middle Ages. Similar systems based on the same physical law are in use in vernacular and modern architecture (examples: Hassan Fathy) No reconstructions of an earthen airwell have been tried yet.

Literary sources describing earthen airwells:

Maimonides, philosopher, physician (1135-1204) visited such a construction in Palestine and narrates about it in his works.

Legends and folktales from Arabia and Africa describe this phenomenon.

German chemist Wolf Klaphake (1900- 67) researched this field in the 1920s finding literary sources describing earthen walls and buildings. (Practical Methods for Condensation of Water from the Atmosphere Victoria /AU 1936)

Airwell as earthen building

Modern use of thermodynamic advantages of vernacular earthen architecture:

Natural acclimatization and cooling in **Hassan Fathi**: Natural Energy and Vernacular Architecture: Principles and Examples, With Reference to Hot Arid Climates, Chicago 1986.

Presentation of similar constructions to airwells:

Historical air-cooling systems: 1.The Claustum 2. The Malgaf 3.The Badgir

Physical laws behind the phenomenon

Cooling by vaporisation based on the unique humidity transfer in massive earthen constructions. Referring to Morony: *Adobe and Latent Heat; A Critical Connection* 2004 and Hapts: *Thermal radiation and earthen constructions* 2005)

Final drawing/ sketch: A reconstruction of an ancient airwell of earth as part of an oasis with agriculture.

Conclusions

1. The construction of the badgir is to be considered most similar to an ancient airwell. The storing of water is part of the extraction process. The inside wall have to be water proof and smooth. A lime plaster is to be considered the necessary surface material: a vernacular historical plaster called Tadelakt may have been used. The building material earth functions as protection against sunrays and inside cooling by vaporisation.
2. Such an airwell of earth is a sustainable affordable alternative to expensive high-energy use constructions like the pilot project of the aqua society in Saudi Arabia.
3. By reactivating these old traditions self-made constructions can be build and supply small communities with drinking water and natural cooling.

4. Research on prototypes can support more knowledge about the thermal conditions of earth as a building material (thermal balance). Welches moderne System baut auf diesem Prinzip auf?

Wie kann die Speicherung des Wassers durchgeführt worden sein?

Ist ein alleiniges Versorgen mit (Trink)wasser durch einen Luftbrunnen realistisch?

Wie kann die Kuppelform ausgesehen haben?

Wie ist die Position zur Sonne und zum Relief der Landschaft gewesen?

Wie sind die Kanäle angeordnet wie groß die Öffnungen die form ?

Wie ist der verlauf der Luftströme kalt warm wo und wann findet die abgabe des Kondenswassers statt ?