

The Use of Traditional Materials in Modern Houses: Case Study- Alqassim- Saudi Arabia

Introduction to Alqassim Region

Al-Qassim is located at the heart of the Kingdom of Saudi Arabia (KSA) in the Central region. It is located 26.33 latitude and 43.97 longitude and it is situated at elevation 606 meters above sea level. Buraidah is the capital of Al-Qassim. The region is known for its agricultural value to the KSA. Traditional oasis products of dates, oranges and other fruits are still important.



Contemporary Construction Materials

Modern construction materials might be divided into seven group: Reinforced concrete slab, beams and columns, hollow block, gypsum board.

Conventional Construction Materials

Traditional construction materials might be divided into eight group:

1. **Dried mud brick:** Used for wall construction.
2. **Mud layers:** Clay lump used to form a layer.
3. **Stone:** Used for foundations and columns.
4. **Wood:** Tamarix aphylla used to construct roof.
5. **Coral:** Used as a construction materials.
6. **Reed:** Used as a building materials.
7. **Gypsum:** Used in plastering houses surfaces.
8. **Palm leaves:** Used in roof construction.



Northern region Materials used



1, 2, 3, 4 and 8

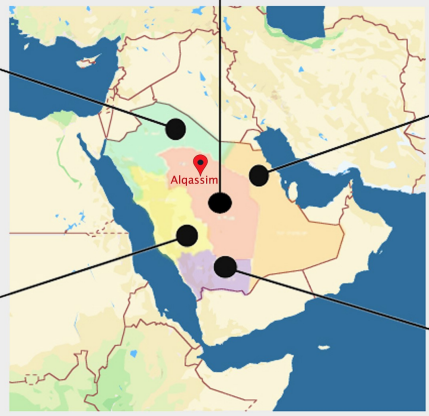


1, 3, 5 and 7

Western region Materials used

Central region Materials used

1, 2, 3, 4, 7 and 8



Eastern region Materials used



1, 2, 4, 3, 5 and 8

Southern region Materials used



3, 4, 6, 7 and 8

Pros and Cons of Modern Buildings



Pros and Cons of Conventional Building



Training to Build from Scratch



Simulation input:

A comparison study of the performance of both, modern and traditional construction materials used in Alqassim City is presented here in form of simulation results.

Different envelope systems and different construction materials were tested in this research. The construction materials used are shown in the next tables.

Location:

A guest house in Alqassim City-Central Saudi Arabia- was chosen as a case study. The houses consist of a sitting room, a kitchen, and a bathroom. The house has rectangular shape with total area of 60.452m (6.5mX9.3m).

Methodology:

Software simulation using Design Builder to understand the performance of a guest house in Alqassim City in Central Saudi Arabia.

Table.1. modern construction materials

| Materials | Thickness (m) | Conductivity (W/m-K) | Density (Kg/m ³) | Specific heat (J/kg-K) | Notes |
|-------------------------------|---------------|----------------------|------------------------------|------------------------|--------------|
| concrete block (Medium) | 0.54 | 0.5100 | 1400 | 1000 | Wall |
| Concrete mortar | 0.025 | 0.7200 | 1760 | 840 | Wall plaster |
| Concrete cast-lightweight Dry | 0.3 | 0.2200 | 720 | 840 | Roof |

U-Value (wall): 0.747 (W/m²-K) U-Value (Roof): 0.665 (W/m²-K)

Table.2. traditional construction materials

| Materials | Thickness (m) | Conductivity (W/m-K) | Density (Kg/m ³) | Specific heat (J/kg-K) | Notes |
|------------------|---------------|----------------------|------------------------------|------------------------|-------------------|
| Mud bricks tiles | 0.2 | 0.8469 | 800 | 750 | Roof |
| Palm leaves | 0.09 | 0.0800 | 100 | 1400 | Insulation (roof) |
| Mud with straw | 0.2 | 0.1800 | 800 | 750 | Wall |
| Mud with ash | 0.02 | 0.6905 | 800 | 750 | Wall plaster |

U-Value (wall): 0.743 (W/m²-K) U-Value (Roof): 0.666 (W/m²-K)

Results and discussion

Operative temperature
The results of the annual, summer and winter operative temperature are showed in the figures below.

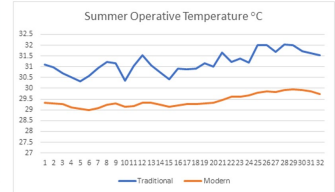
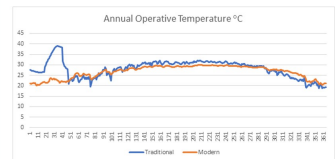


Table.3. Operative Temperature in Summer

| Envelope type | Summer Average Operative Temperature °C |
|---------------|---|
| Modern | 29.42 |
| Traditional | 31.16 |

Table 4. Net Energy Source

| Envelope type | Energy consumption (kWh) |
|---------------|--------------------------|
| Modern | 11955.69 |
| Traditional | 20585.58 |

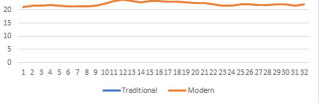


Table 4. Operative Temperature in Winter

| Envelope type | Winter Average Operative Temperature °C |
|---------------|---|
| Modern | 22.23 |
| Traditional | 33.44 |

Site and Source Energy

A comparison of the Values gathered over 8760.00 hours for both traditional and modern houses are showed in the figures below.

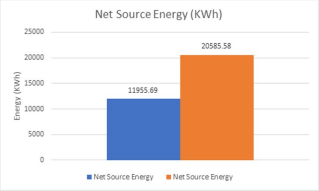


Table 5. Heating and Cooling loads

| Cooling (kWh) | |
|---------------|-------------|
| Modern | Traditional |
| 7345.07 | 9614.8 |
| Heating (kWh) | |
| Modern | Traditional |
| 843.34 | 2492.35 |