

THE STRANGE AND SAD STORY OF QATAR'S FIRST PASSIVHAUS

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OVERVIEW

- the of the Passivhaus concept in the GCC region
- implications for construction
- research programme
- retrofitting the existing building stock

BARWA Real Estate
reviewed the Passivhaus
concept in 2012.
Immediately proceeded
with demo project to test
the Passivhaus concept in
hot, arid climate

The project was to coincide
with COP 18 and Qatar
Green Building Council
(**QGBC**) selected as the
**technical and scientific
partner** for the project

Partnership extended to
include **Kahramaa**
(electricity and water utility
providers in Qatar) and the
**Ministry of Municipalities
and Urban Planning**

PROJECT AIMS



Passivhaus villa to reduce annual **operational energy** consumption by **50%** compared with the BAU Villa



Passivhaus villa to achieve a **50%** reduction in annual **water consumption** compared with the BAU villa



Passivhaus villa to achieve a **50%** reduction in annual operational **CO₂e emissions** compared with the BAU Villa;



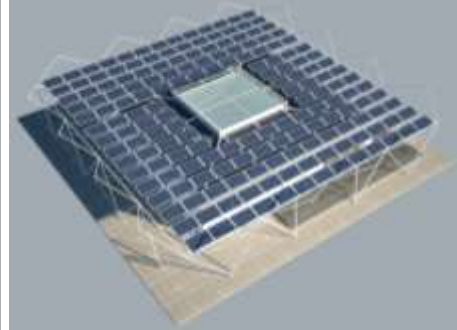
Additional **construction (capital) costs** of achieving the above performance in the Passivhaus villa is no more than **15-20%** of the capital cost of the BAU villa



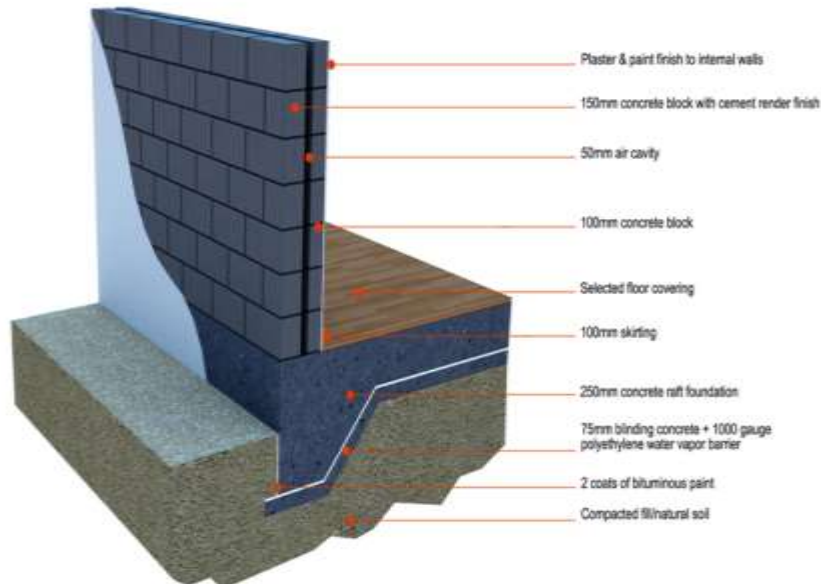
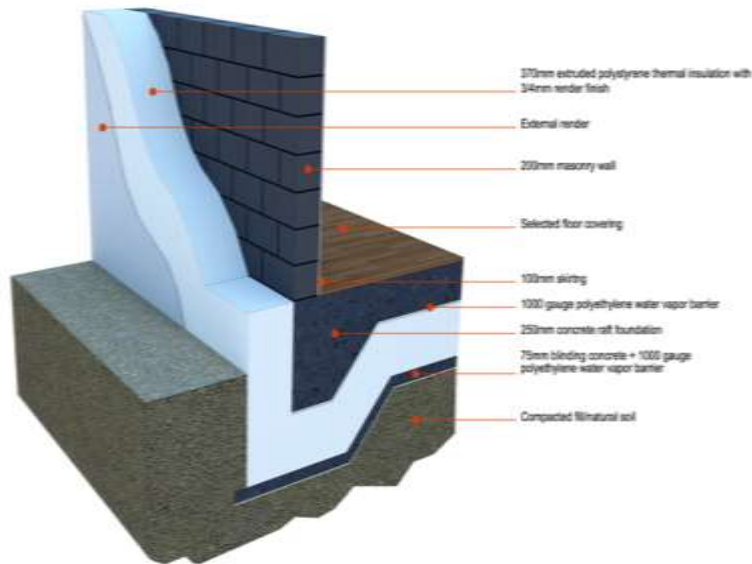
Passivhaus villa can be **certified** to have met the Passivhaus standards by the Passivhaus Institute

Passivhaus and 'ImPassivhaus'

- located in BARWA City the Passivhaus and a 'Business As Usual' villa (nicknamed the 'ImPassivhaus') that acted as a control for the experimental programme, were constructed;
- the intention after commissioning and installation of experimental equipment, was for the two villas to be inhabited by **researchers for a year**, so that all monitoring systems were calibrated and the 'base loads' of each villa established;
- after this was achieved, the intention was for **two similar families** with one or two young children to inhabit the villas be and monitored for up to 2 years.



PASSIVHAUS & 'ImPassivhaus' WALL SECTIONS



- 3 - 4mm external render finish;
- 370 mm extruded polystyrene insulation;
- 200 mm masonry wall
(compared to 150 mm external /100 mm internal concrete block with 50 mm air gap in BAU);
- triple glazed windows and doors;
- skylight in atrium with louvers that open/close with sun angle;
- PV array for daytime power;
- black and grey water recycling;

PASSIVHAUS BUILDING ENVELOPE

- walls, roof, and floor externally insulated to 0.1 W/m² K;
- low emissivity finish to external surfaces;
- thermal mass from external walls and roof/floor slab;
- triple glazing with g-value of ≤ 0.25 .

U-VALUES

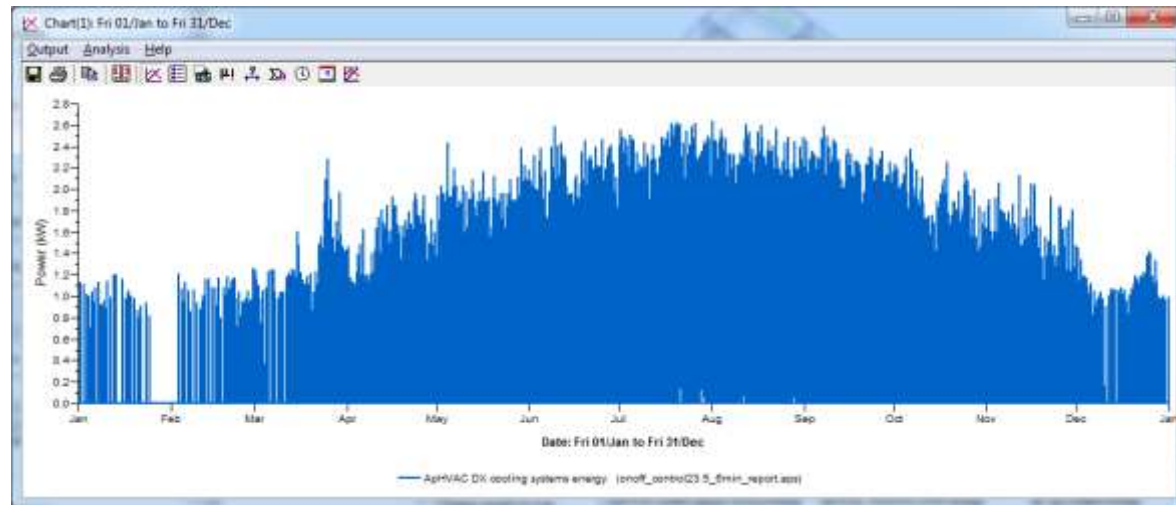
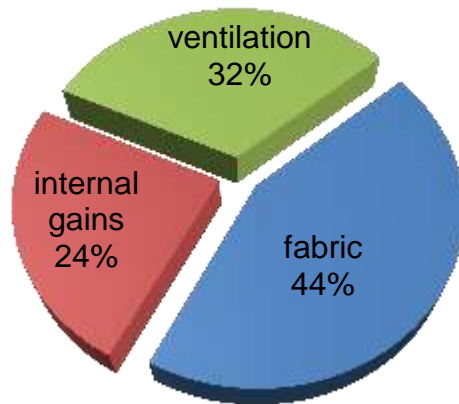
Passivhaus	ImPassivhaus House
Walls & roof – 0.09	Walls – 1.3
Floor – 0.1	Roof – 0.3
Glazing – 1.0	Floor – 0.5
	Glazing – 2.6

HVAC DESIGN

- space heating demand limit $\leq 15 \text{ kWh/m}^2$ per year
- air permeability $\leq 0.6 \text{ ac/hr}$ at 50Pa
- primary energy demand $\leq 120 \text{ kWh/m}^2$ per year
- whole house heat recovery unit providing $\sim 50 \text{ l/s}$ ventilation (ASHRAE 62.2)
- cooling provided by multi-split VRF system maintaining 24°C in bedrooms and living space
- ventilation and cooling operates continuously

analysis using IES simulation software

annual cooling demand



PASSIVHAUS: Experimental Programme

a vehicle for a number of experiments, most with industrial partners:-

1. 'carbon neutrality' feasible:- determine the amount of generated PV energy that can be fed back to the Kahramaa's power grid and calculate the total carbon emissions;
2. embodied carbon payback:- net energy exported compared with a detailed embodied carbon calculation to deliver a notional 'carbon payback period';
3. comparative performance of both houses without inhabitation and then after with;
4. PV array cleaning:- array split into three systems to allow for a control and two cleaning regimes to be assessed;
5. Bionest assessment:- efficacy of system system for recycling both black and grey water; *(a biological process consisting of an extended aeration submerged fixed film bioreactor)*
6. Polypipe Terrain:- assess new irrigation technique that delivers water to the root base of shrubs and trees reducing irrigation demand;
7. efficacy of shading by vegetation:- heat flux meters installed at 3 locations along the west wall, all at the same height, at equal spacing along the length of the wall at both Passive House and BAU house;
8. comparative analysis of GSAS and LEED building assessment systems;
9. various cost studies to determine the most cost effective means of reducing carbon;
10. efficacy of various solar reflective paints.



additional studies envisaged

- indoor air quality (IAQ):- assessment of reducing PM 2.5 particulates and other pathogens;
- impact upon regulation and new build construction;
- development of energy modelling software with IES
- solar hot water heating efficacy as compared to PV;
- building information modelling (BIM):- demonstration of responsible supply chain;
- UV treatment of wastewater to render TSE potable;
- sustainable economics:- costing externalities and opportunity costs; and
- **examination of possible economic instruments and incentives necessary for market transformation.**



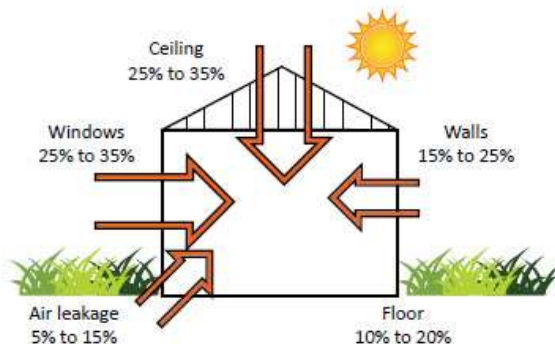
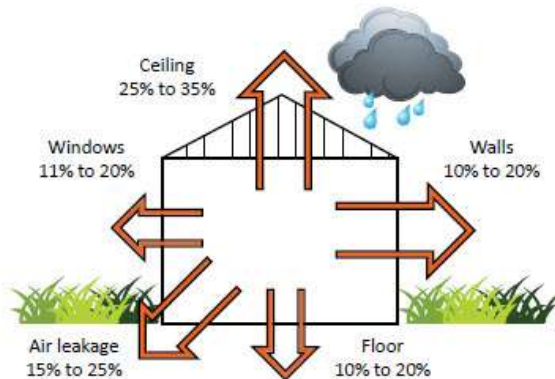
RETROFITTING THE EXISTING BUILDING STOCK



is there an elephant in
the room right now ?

RETROFITTING THE EXISTING BUILDING STOCK

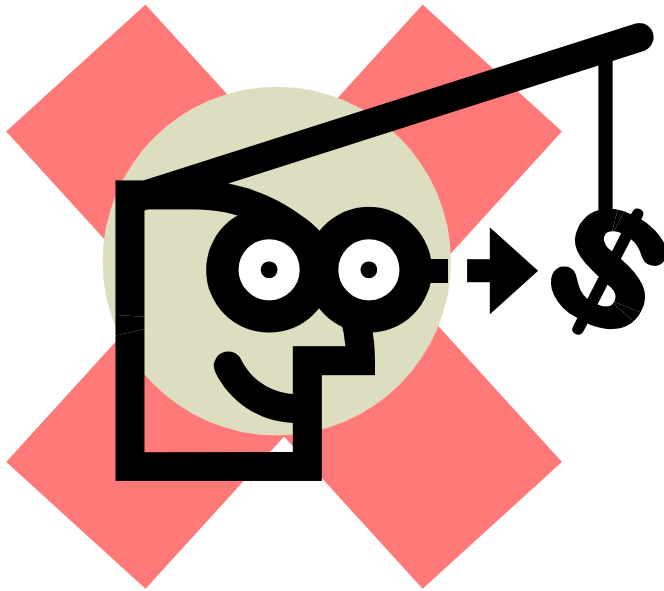
yes it's the existing building stock!
capital expenditure is required to upgrade its
energy performance if the construction sector
is ever going to deliver on its significant
potential to reduce carbon.
measures need to be applied such as:-



- externally applied insulation;
- double or triple glazed windows, doors etc.;
- external shading measures (e.g. external louvers);
- efficient well maintained AC systems;
- air-tightness measures;
- energy saving controls;
- thermal hot water systems;
- PV installations;
- behavioural education programmes; and
- many many more cost effective tried and tested solutions.

RETROFITTING THE EXISTING BUILDING STOCK

HOW CAN WE GIVE A VALUE TO CARBON?



- for some markets the energy price is so low that it provides no motivation for energy savings;
- Qatar's starting tariff for commercial buildings is $0.09\text{QR/kWh} = 0.025\text{\$/kWh}$ the U.S average is $0.1\text{\$/kWh}$;
- when energy prices fail to stimulate change an intervention is required;
- an alternative is to assign value to carbon savings.

RETROFITTING THE EXISTING BUILDING STOCK

STIMULATING THE RETROFIT MARKET

Needs incentives to introduce a retrofitting agenda (beginning with insulation and PV)



Markets, Economies of scale and Expertise develop (Construction Industry Responds)



Prices fall



Return on investment comes to a reasonable level (5-10 years)

thank you for your kind attention

any ?