towards sustainable architecture

what's the problem? passive design! what does nature do? biomimicry!
what's the problem?
- 3,000 — Ancient Egyptian House
  (Sun worshipped, mass, sacred utilization)

- 2,000 —

- 1,000 — Ancient Chinese House
  (Flowing energy ‘qi’, connection to universe, peaceful design)

- 0 —

1,000 —

1,500 — Japanese House
  (Adaptable House)

Middle Eastern House
  (Utilizing Solar Power)

Ancient Egyptian House
  (Engineering features, pressure design, ventilation, underground heating)

Ancient Greek House
  (Adaptable rooms + shutters)

Solar Plugin House
  (Pressure solar design)

Ancient Egyptian House
  (Pressure solar design)

1,000 —

4,000 — Industrial Age

13,000 — Agricultural Age

2,000 —

4,000 — Industrial Age

Ancient Egyptian House
  (Adaptable House)

5,000 — Industrial Revolution

Ancient Egyptian House
  (Adaptable House)

10,000 — Industrial Revolution

Ancient Egyptian House
  (Adaptable House)

Population

Population

Population

Population
ancient civilisations - love, respect, worship of nature
1. Indigenous Australia Shelters _circa_ 80,000 BC
   The Australian aboriginal people lived sustainably for more than 80,000 years. Temporary adaptable shelters were constructed _typically_ of bark and tree limbs adjusted to suit the sun, wind and rain as required. (wikipedia_indigenous australian shelters)

2. Ancient Egyptian House _circa_ 2500 BC
   The ancient Egyptians worshipped the sun as the source of all life. High density courtyard housing was _traditional_ to provide shade in the hot and dry climate. Mud brick construction provided thermal mass with all high and low level windows to allow for night time ventilation and cooling. (wikipedia_ancient egyptian architecture)

3. Ancient Chinese House _circa_ 1000 BC
   The concept of ‘Qi’ a medium of energy connecting man, earth, and heaven “intrinsic life energy”. Courtyard dwellings were laid out in a hierarchy according room importance with relation to the _five elements_ (wood fire earth metal water) and solar orientation. (wikipedia_ancient chinese architecture)

4. Ancient Greek House _circa_ 500 BC
   Courtyard housing featuring adjustable devices such as shutters over windows and extendable cloth awnings to provide shade in summer. (wikipedia_ancient greek architecture)

5. Socrates Megaron House _circa_ 300 BC
   “Now in houses with a south aspect, the sun’s rays penetrate into the porticos in winter, but in summer the path of the sun is right over our heads and above the roof, so that there is shade. If, then, this is the best arrangement, we should build the south side loftier to get the winter sun and the north side lower to keep out the winter winds” (wikipedia_socrates)

6. Ancient Roman Housing _300 AD
   The Romans developed many engineering features such as sewage systems, piped water, underfloor heating, double glazing and concrete. Underfloor heating created a beautiful and effective heating separated from the pollution of the fire source. (wikipedia_ancient roman architecture)

7. Traditional Japanese House _circa_ 1000 AD
   Elaborated timber houses with _flexible interior spaces_ (sliding screens) to allow the occupants to open up the house to suit weather conditions and observe the beauty of nature from a raised platform. (wikipedia_traditional japanese architecture)

8. Middle Eastern House _circa_ 1,400 AD
   Courtyard housing in hot dry climate featuring an elevated ‘wind tower’ used to capture and cool prevailing breezes through mass, evaporative water features and gardens. ‘Masrabeja’ screens were also adjusted to control privacy, ventilation, shade, diffusing daylighting, evaporative cooling. (Wind Tower, Anne Coles & Peter...
middle eastern courtyard house, microclimate
screening - sun, wind, ventilation, privacy - expression of culture and local materials
industrial revolution, nature becomes to be seen as a limitless resource for man's consumption
50% of Earth's forests removed

50% of all animal life extinct by 2100

Modern civilisation

Mining

Pollution: air + land + sea

Global impact

Environmental damage
invention of a/c - arbitrary shape making, closed internalised boxes
unhealthy internalised interiors, disconnected from the natural world, psychologically damaging buildings are essentially all the same - appearance is generally arbitrary graphic design
passive design!
the foundation of good building design

re-connect our buildings with nature
(create openable smart buildings - integrated natural light, shade, ventilation, gardens)

remove over-reliance on technology
(don't create dumb closed buildings fully reliant on a/c)

make better buildings - that don't cost more to build!
(cost neutral - integrated passive design)
George Fred Keck_Passive Solar House (USA) _1940
Pioneered the modern passive solar house movement in the 1930’s discovering the glass house he constructed for the ‘house of tomorrow’ exposition was warm in winter.

Jean Prouve_Tropical House (Africa) _1951
Commissioned prototype to address housing shortage in French colonies in West Africa. Mobile modular pre-baricatered house in lightweight aluminium featuring adjustable shading to perimeter in the form of sliding perforated panels.

Le Corbusier_Ahmedabad Textile Millowner’s Association Building (India) _1954
Features integrated adhes and gardens on the west and east facades (vertical and horizontal elements) to shade, and, pre-cool and cleanse intake air.

Glenn Murcutt_Kempsey Farmhouse (NSW) _1975
House designed in response to its ‘place’. The idea of the house itself being an operable randah which enabled the occupant to ‘ail’ the building according to the movement of the sun and wind.

Ken Yeang ‘Mesiniaga Tower’ (Bio-Climatic Skyscraper) (Malaysia) _1995
Adapting ecological design principles to the high rise built form. Using rice areas to perimeter for shading and allowing natural ventilation.

Mick Pearce_Eastgate Centre (Zimbabwe) _1996
Inspired by the passive design (mass & ventilation) of termite mounds. Shopping centre passively cooled and uses only 10% of typical building. (wikipedia eastgate centre harare)

Foster + Partners_City Hall_2002
Local government building where building form is completely derived from solar design analysis.

Fosters + Partners_Gherkin (London) _2004
High rise commercial office building with naturally ventilated communal spaces by inducing an aerodynamic effect around the building.

Design Inc_K2 Apartments (Melbourne) _2007
Multi-residential designed where every apartment receives access to winter sun.

WOHA_The Met (Bangkok) _2009
High rise multi-residential tower designed for low wind tropical climate to accelerate breezes through the permeable form of the tower.

Elenberg Fraser_Lilli (Melbourne) _2011
Multi-residential building with effective natural ventilation of single dedicated apartment through integrated emphasis of pressure differentials across facade.

history of quality passive building designs
PASSIVE ENVIRONMENTAL ARCHITECTURE _ COLLECTIVE PERFORMANCE

CLIMATIC DATA
Passive Environmental Design must be Climate Specific. Refer to local and site specific climatic data to influence building design.

SUN - BUILDING PROPORTION & ORIENTATION
Building proportion & orientation is carefully considered to maximise natural light & shade.

SUN - PASSIVE SOLAR CONTROL (natural heating + cooling)
Vertical building elements (privacy screens) provide passive solar control.

SUN - NATURAL LIGHTING
Carefully considered apartment plan depth and proportion, maximised glazing area and building surface colour to reflect or absorb reflected light provides excellent natural lighting to the apartments.

WIND - BUILDING PROPORTION & ORIENTATION
Building proportion & orientation is carefully considered to maximise natural ventilation.

THERMAL COMFORT
Human Thermal Comfort is reliant more to Surface Temperatures, Humidity, & Air Movement rather than just Air Temperature (i.e. A/C in a poor passively design building does not create a comfortable environment).

SUN - PASSIVE SOLAR CONTROL (natural heating + cooling)
Horizontal building elements (balconies) provide passive solar control.

SUN - NATURAL LIGHTING
Carefully considered apartment plan depth and proportion, maximised glazing area and building surface colour to reflect or absorb reflected light provides excellent natural lighting to the apartments.

WIND - ENVIRONMENTAL WIND
Building form + solar helps to evenly distribute wind and minimise downwash at communal terraces and pedestrian level.

EARTH - BUILDING FABRIC (reduce energy consumption)
High performance building fabric stabilises internal temperatures i.e. high performance window and facade systems + reduces reliance on artificial heating/cooling systems.

EARTH - LANDSCAPE (microclimate + habitat)
Landscaping is integrated into building design with green roof areas to communal areas with benefits of amenity, natural cooling, insulation & habitat.

EARTH - THERMAL MASS (stabilise internal environment)
Exposed Thermal Mass Within The Apartments Creates A Thermal Lag Which Stabilises Internal Temperatures + reduces reliance on artificial heating/cooling systems.

WATER
Rainwater harvesting is used to irrigate landscaping. Grey water is recycled to provide toilet flush water. Fixtures and fittings are specified with high water efficiency to minimise consumption.

ACTIVE SYSTEMS
'Green' building technologies - maximise efficiency, on site power production + water recycling.
Passive Environmental Architecture: Collective Performance

Wind - Natural Ventilation (natural cooling + fresh air)
Natural ventilation to the apartments is significantly improved through the careful arrangement and detail of the balconies, balustrades, balcony screens and apartment windows.

Earth - Landscape (microclimate + habitat)
Landscaping is integrated into building design with green roof areas to communal areas with benefits of amenity, natural cooling, insulation & habitat.

Earth - Building Fabric (reduce energy consumption)
High performance building fabric stabilizes internal temperatures in high performance window and facade systems; reduces reliance on artificial heating/cooling systems.

Water
Rainwater harvesting is used to irrigate landscaping. Grey water is recycled to provide toilet flush water. Fixtures and fittings are specified with high water efficiency to minimise consumption.

Wind - Natural Ventilation Common Areas (natural cooling + fresh air)
Apartment lobbies are naturally ventilated through the use of passive thermal buoyancy and negative wind pressure shafts which operate through sun + wind energy.

Earth - Thermal Mass (stabilise internal environment)
Exposed Thermal Mass Within The Apartments Creates A Thermal Lag Which Stabilises Internal Temperatures; reduces reliance on artificial heating/cooling systems.

Earth - Materials / Fixtures / Finishes

Active Systems
‘Green’ building technologies - maximise efficiency, on site power production + water recycling.
le corbusier - india
The city grid is really an 88-storied increment, visually.

The city might or city has always been full of surprises!
Ken Yeang - Singapore

Ken Yeang architect
woha - the met bangkok
what does nature do?
seeing + studying nature’s design genius
the earth! a stunning integrated ecology
(solar powered, absorbs CO2, creates oxygen, varies with the seasons, stores water, provides habitat, flexible, design specific to place (never the same), natural cooling (transpiration), resilient, many trees together form a forest and ecosystem, they're beautiful!) a tree!
Imagine a building like a tree + our cities like a forest

where rather than striving to make each building ‘less bad’
each building could actually be good for the world!

through high performance passive design + renewable energy technology
buildings could produce more clean energy, water, air than they consume, provide valuable
habitat and biodiversity, and create beautiful healthy space for us to occupy and connect with
nature

every new building could actually help restore our planet and our lives!

*concept from cradle to cradle*

nature’s designs - everything has a purpose, nothing is there just for appearance!
termite mounds - stabilised temperatures in extreme climates through passive design!
passive solar design
shark skin - low friction through aerodynamics of denticles
tree bark - tough, flexible, breathable
snake skin - scales enable flexibility and toughness
falcon - high performance aerodynamics super lightweight
Biomimicry!

Passive design principles + inspiration from nature's genius = sustainable architecture?
“those who are inspired by a model other than nature, a mistress above all masters, are labouring in vain”

Leonardo da Vinci
eastgate centre harrare (mick pearce) - termite mound
eastgate centre harrare mick pearce - 90% less energy, healthy interior space
Biomorphic Design
Building Design Inspired by Nature

Concept Building (Elenberg Fraser) - Falcons Wing
Concept building - Falcons Wing - same $ construction cost as typical building

- Sun
  - Natural Light
    - Add effective natural light
    - Reduce artificial lighting
  - Passive Solar Design
    - Add passive solar design (balcony/roof)
    - Reduce A/C
- Wind
  - Environmental Wind
    - Add texture/roughness to facade
    - Reduce need for common wall
    - Reduce A/C
    - Add aerodynamic performance
  - Natural Ventilation
    - Add aerodynamic performance
    - Reduce A/C
- Earth
  - Public
    - Add exposed thermal mass
    - Reduce filling channels + lining
  - Gardens
    - Add climbing plants to common spaces
    - Reduce 'stone alone gardens'

Concept Tower
(Same cost - but better)
lilli apartments (elenberg fraser) - shark skin
timm angus architect

WIND AERODYNAMIC ARCHITECTURE

natural ventilation

lilli apartments - natural ventilation
multi-res melbourne (elenberg fraser) - biomorphic tree like forms creating microclimate
Introduction
The landscape is designed to achieve a vital and abundant appearance, promoting the affirming co-existence of nature with architecture. Vigorous climbing plants shooting up from the ground emphasise the upwards motion of the architectural features. Balcony plantings continue the greening of the building fabric to keep the occupants connected to the natural environment.

Biodiversity
The planting palette was compiled with local biodiversity as a priority, tempered with the species' suitability in urban cultivation. The palette consists primarily of species indigenous to the Hobsons Bay area with a focus on bird and insect attracting properties. A small number of Australian native species were added to this selection to achieve the design concept. The inclusion of a native species that has culinary value (Lemon Myrtle) allows an additional connection that the occupants will have with the landscape. The native climbers selected are able to both rigorously ascend the climbing frames, as well drape over the edge of the balconies.

Maintenance
The planting will be maintained for health but will be free to grow and spread in a natural manner without being rigidly clipped to unnatural forms. Maintenance of the ground floor landscape and the first floor above-lobby planting will be managed by the body corporate. The defects period will extend to 12 months to ensure that the planting establishes well, and that any plants that fail can be replaced. While all the planted areas throughout the building will be watered by an automated irrigation system (with a rain shut-off device), planting in the private balcony planters will be maintained by the owner/occuants.

multi-res melbourne - biodiversity
“study nature, love nature, stay close to nature, it will never fail you”

frank lloyd wright
concept multi-res (elenberg fraser) - snake skin - scales / bay windows - sun + wind
tim angus architect

Armsby Architects

a building inspired by Richmond's natural landscape

Armsby Architects

a green rooftop inspired by Richmond's grasslands

richmond multi-residential - a building as a 'living landscape' biomimicry of 'system'
tim angus architect

richmond green.... “a better way to live”

beautiful, healthy, low energy, naturally air-conditioned apartments

passive design overview

sun
- passive solar design
  the apartments are passively designed to let the winter sun IN, and to keep the summer sun OUT
  this is achieved through careful control of balcony overhangs, exterior wing walls and exterior window
  screening (refer to marketing imagery)

natural light
- the apartments are passively designed to provide an excellent quality of natural light with carefully
  proportioned and located windows combined with light coloured interior surfaces

wind
- natural ventilation
  the apartments are passively designed to provide excellent natural ventilation through carefully located
  and configured windows, vertical double hung casement windows provide for high and low level
  ventilation enabling excellent control of the breezeways
  entrance locations and carpark areas of the building are naturally ventilated creating healthy indoor
  spaces that do not have the high running costs associated with mechanical ventilation

earth
- building fabric
  windows, the apartments feature high performance double glazed windows providing excellent
  thermal efficiency and acoustic performance
  exterior walls, the apartments feature high performance exterior wall constructions providing excellent
  thermal efficiency and acoustic performance

- gardens
  rooftop gardens, the building features a residents rooftop garden and facilities with fantastic views
  across melbourne
  balcony gardens, custom made garden planters are available as a purchase upgrade to the apartment
  balconies, they are carefully located so that breezes can be drawn through the garden to pre-cool
  and cleanse the incoming air

- thermal mass
  exposed and insulated thermal mass within the apartments (living room ceilings + exterior walls to east/ west facades) greatly
  stabilises the interior temperatures, the interior finish to the exterior walls is
  a paint finish and has same appearance as traditional plaster/ board though with excellent durability

- materials
  all interior finishes and materials strictly adhere to the green building council of
  australia greenstar certification requirements ensuring only sustainably sourced and healthy products
  are used

- water
  water efficiency
  fixtures & appliances provided in the apartments strictly adhere to the green building council of
  australia greenstar certification requirements ensuring high energy and water efficiency

  rainwater harvesting
  a large capacity rainwater tank is provided in the basement to provide irrigation water to the rooftop garden
richmond multi-res - facade screen - tree bark
richmond multi-res - facade screen - geometry, bee hive structure
tim angus architect

richmond multi-res - sun + wind
Richmond Multi-Res - Sun + Wind, Integrated Garden, Thermal Mass - 9 Star Energy Rating
barrel cactus - self shading tower form
tim angus architect

cancept tower - barrell cactus, shading, views, aerodynamics
“you never change things by fighting the existing reality, to change something, make a new model that makes the old model obsolete”

buckminster fuller