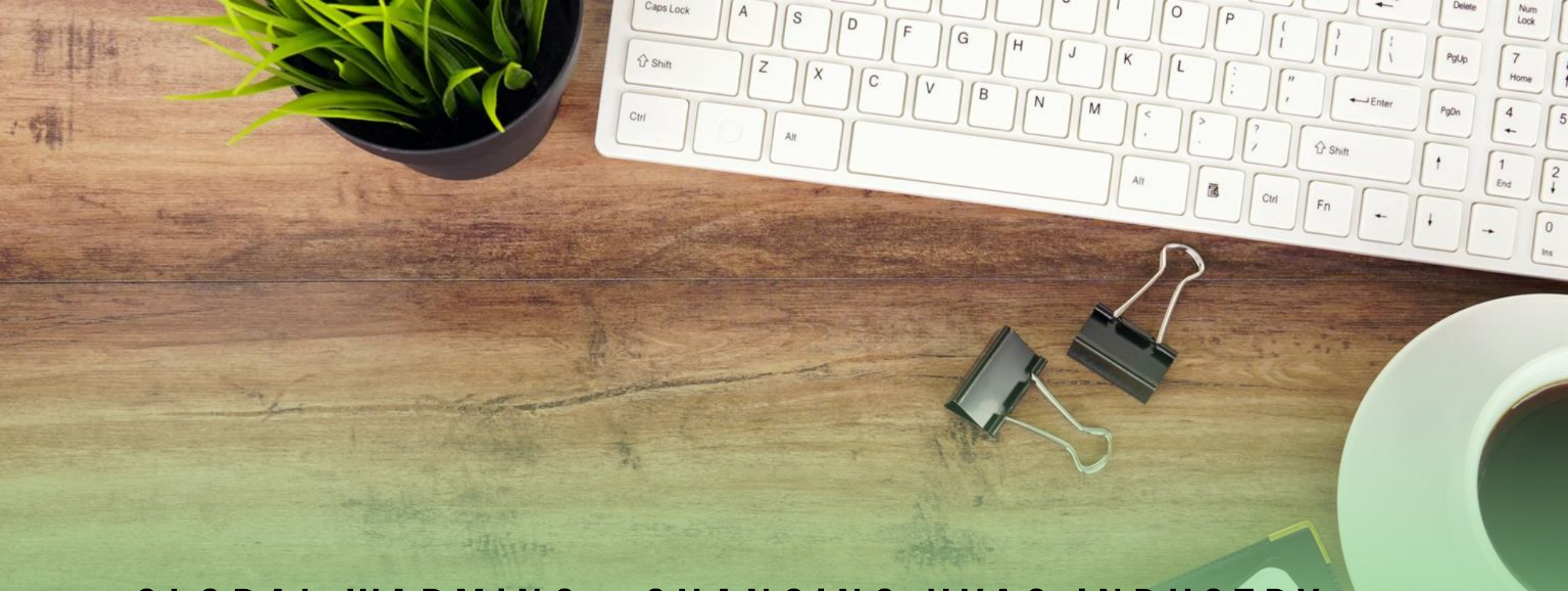


GLOBAL WARMING : CHANGING HVAC INDUSTRY

Need is mother of all inventions. Sustainable HVAC & Buildings

https://www.youtube.com/watch?v=JZV3zvN1I7k

TAKE STOCK OF SITUATION

HTTPS://WWW.TED.COM/TALKS/VANCE_KITE_URBANIZATION_AND_THE_EVOLUTION_OF_CITIES_ACROSS_10_000_YEARS?LANGUAGE=EN

- Since the Industrial Revolution, human activities have released large amounts of carbon dioxide and other greenhouse gases into the atmosphere, which has changed the earth's climate.
- Burning fossil fuels, cutting down forests and farming livestock are increasingly influencing the climate and the earth's temperature. This adds enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming.
- **How does HVAC affect the environment?** Most air conditioners are fueled by electricity and use refrigerant, which produces gaseous emissions that contribute to global warming and ozone layer depletion. Some studies predict that by 2050, roughly 25 percent of global warming will be caused by air conditioning.
- The researchers calculated air conditioning is responsible for the equivalent of 1,950 million tons of carbon dioxide released annually. Of that figure, 531 million tons comes from energy used to control the temperature and 599 million tons used for removing humidity.

WHAT NEXT?

- HVAC is a necessity; we can not remove / shun it. However, we can improve or minimize its use.
- An improved HVAC is nothing but EFFICIENT HVAC: meaning a HVAC system that is energy efficient.
  Less energy consumption mean less Carbon di-oxide and CFC released to atmosphere.
- Efficient HVAC is a HVAC using renewable energy such as
  - Solar energy powered HVAC system
  - Geothermal HVAC system
  - ABSORPTION technology-based HVAC system
- Minimizing the space for airconditioning and closing of dampers / grills for areas where airconditioning is not required.

IMPROVED HVAC FOR TOMORROW

- Use of CCHP is most beneficial

  Combined Cooling Heating and Power [CCHP] – using Gas to electricity generator to generate electricity and its by product to generate Chilled or HOT water for airconditioning or industrial process.

- Use of water-cooled HVAC system – replace Condenser/Cooling tower with Geothermal source such as Lake water or underground condenser coil. We can use underground water too.
- If Aircooled HVAC is only option, power it using Solar PV.
- Also use of natural refrigerant such as Ammonia is recommended:
  - It has Zero GWP, Zero ODP
  - COP is much better than CFC based chillers.

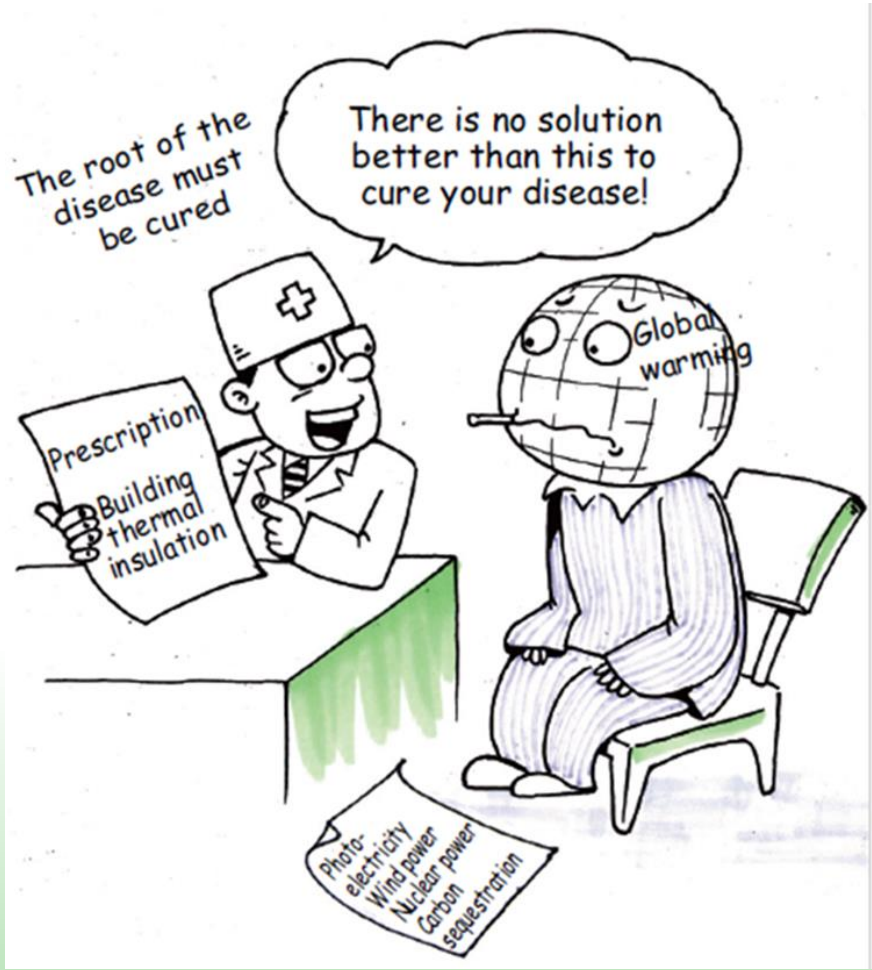
MINIMIZE HVAC IS TOMORROW

- Minimize Airconditioning space

  to minimize electrical consumption

  is next level.

- It has much improved /better results.
- https://youtube.com/clip/UgkxIrMapwFq0cqjX1iM73HMNR4VUVfyJ8A-



BUILDING CONTRIBUTE 40% OF TOTAL GLOBAL CO2 EMISSION

- An effort toward reducing carbon emission will help humanity in multiple ways.

A) We can reduce recurring energy expense 40% to 80% as well as

B) stop damage to forests and Ozone layer.

This is the future world needs.

Cold winter and hot summer areas like New York, Shanghai

uninsulated wall, single-paned window → CO_2

5 cm insulated wall, double-paned window → CO_2

20 cm insulated wall, triple-paned window, external solar shading, heat recovery fresh air → CO_2

IMPORTANT STEPS TOWARDS REDUCING AIRCONDITIONING LOAD OF A BUILDING:

It is similar to pipe insulation in HVAC

Exterior wall Insulation

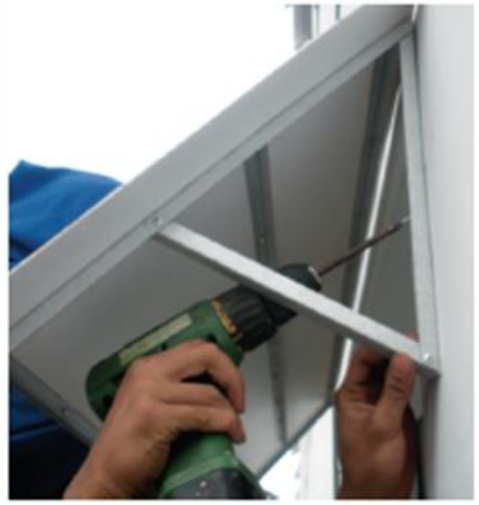
a. **Thickness of polystyrene foam board: 150 mm**
b. **Heat transfer coefficiency:0.24 W/m2 K**
c. **(Original wall without insulation:2.1 W/m2 K)**
d. **Thickness of polystyrene foam board: 150 mm, heat transfer reduces 8 times better than no insulation.**

IMPORTANT STEPS TOWARDS REDUCING AIRCONDITIONING LOAD OF A BUILDING:

2. Triple paned plastic frame windows

a. **Heat transfer co-efficiency: 1.65 W/m2 K**
b. **(Original single-paned aluminium window: 13 W/m2 K)**
c. **Reduces heat transfer 8 times better.**

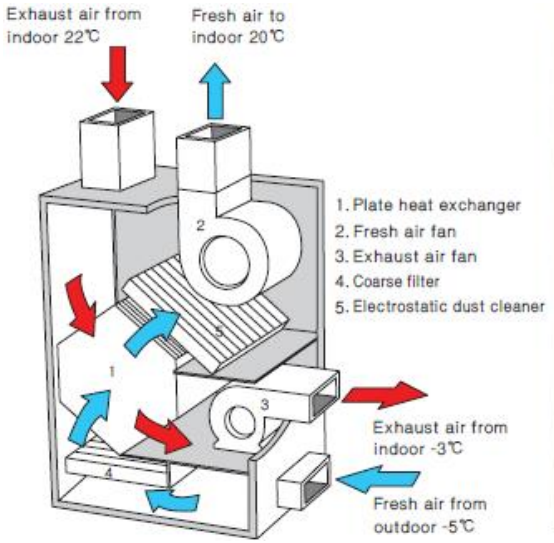
IMPORTANT STEPS TOWARDS REDUCING AIRCONDITIONING LOAD OF A BUILDING:



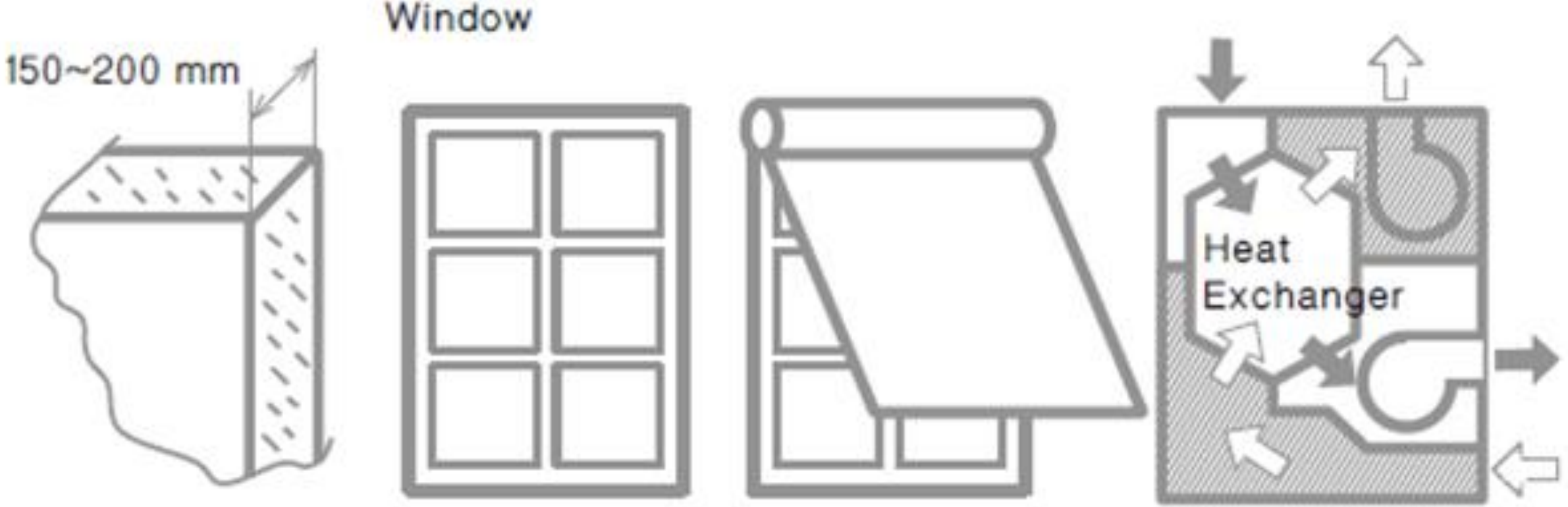
3. **External solar shading**
   a. **Effective solar shading time: 677 hrs/a**
   b. **Annual energy saved: 355 kWh**

https://youtube.com/clip/Ugkx85k6QRDGToZJGb0e0-uDP9cPLa-feQCm

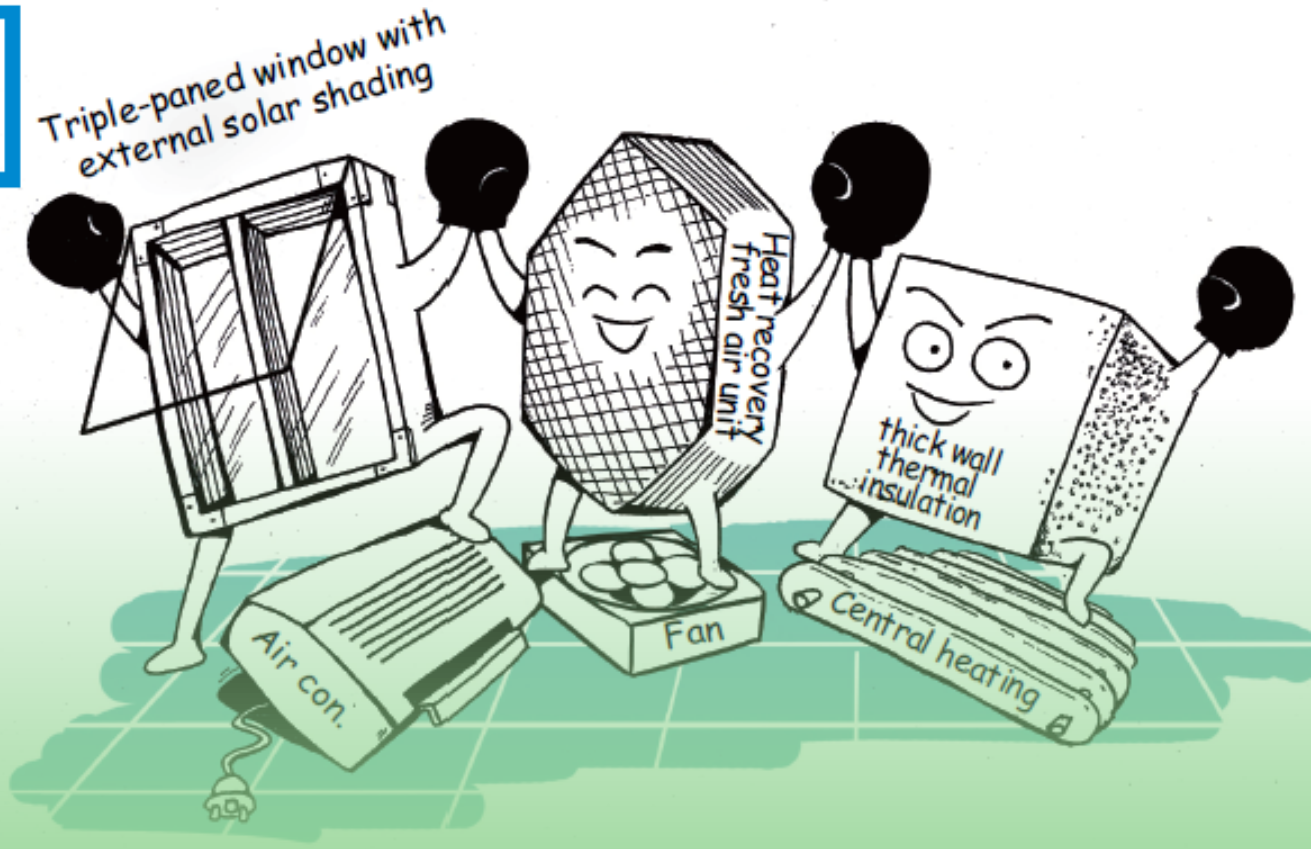
IMPORTANT STEPS TOWARDS REDUCING AIRCONDITIONING LOAD OF A BUILDING:



1. **Fresh Air Heat recovery system**
   a. **Heat exchanging time: 2,700 h/a**
   b. **Enthalpy difference: 10 W/m3 [Heat recovery]**
   c. **Approx. 70% in summer, 90% in winter**
   d. **Air purification efficiency: 99%**


150~200 mm
Window
Heat
Exchanger

TECHNO-LOGY	Very Simple	We learn and practise on-site, design and construct by ourselves → Everyone can learn well
ECONOMY	Very Cost -effective	All retrofitting investments can have a 3-year payback
EFFECT	Very Striking	80% energy can be saved (air quality can also be improved drastically)
QUALITY	Indoor environment is much more comfortable than before	



- BROAD Town is located on the outskirts of Changsha, South China. Changsha (N 28° , E113°), has 4-5 cold months and 5-6 hot months, the lowest temperature is -10℃ and the highest 43℃. Only 1-3 months in a year can be free from air conitioning. This kind of climate is very typical globally, as in Shanghai, Osaka, Washington, D.C., Rome, etc.

CHANGING LIFESTYLE

TRADITIONAL BUILDINGS

Buildings we live in:

1. Concrete building: a fixed structure. Each building is unique design thus need civil, mechanical, electrical and IT engineering to be done.
2. Time and capital intensive.
3. Weather affect it thus Airconditioning is used
4. Life span is 50 to 60 years.

HOLON BUILDING'S IMPROVEMENT TO BUILDING ASSETS: MAKES HUMAN ASSETS A GENERATIONAL LEGACY

- Holon Building are complete buildings. It is a "stainless steel factory-made building". The floor slab is made of BROAD's original "stainless steel B-Core slab", and the columns and beams are made of section stainless steel.
- It is the world's first stainless steel building. Thanks to the "super-strong and ultra-light" characteristics of stainless-steel B-Core slabs which can cut steel consumption drastically, what's more, the efficient stream- line production converted expensive stainless-steel buildings into economically acceptable ones.
- Importantly, the life span of a Holon Building structure can reach 1,000 years. Even if it were demolished, the steel could be recycled, making it possible to become a generational legacy.

MODULAR BUILDINGS-
BIGGER PICTURE

- Only through standardization, it can be possible for the general public to live in high quality buildings.
- [the automobile industry is standardized and is the most successful industry in modern times.]
- Holon Building comprehensively draws on the experience of the automotive industry by implementing the “5 Principles" of:

    1. **systematization** of research and development,
    2. generalization of parts,
    3. **modularization** of parts,
    4. automation of production and
    5. simplification of ordering.

Standardized construction products with high quality and low price that "meet the fundamental needs of customers" to meet the needs of 70% of the world's middle-income people.

Notes: photos are real scenes of Holon Building

floor slab:
BROAD stainless steel
B-CORE slab(thickness: 150)
panel:51.5
core tube:Φ51x0.3

The whole building is of stainless steel structure inclusive column, beam, floorslab, balcony,window frame,stairs, rooftop and guardrail

The thickness of columns and beams are configurated per height requirements column 84~624

ceiling
long beam
hot water tank
air conditioner
fresh air system

fixed floor and fixed beam

long beam
□270x220

The floor slabs and beams are folded during transportation. Room width will be doubled on site after installation

floor height 3000±2
clear height 2700
floor height 3000±2

small column
C360x180

large column
C360x360

2438 during transportation
2438 during installation
4876 ±1

transport lifting hole (disassembled before onsite installation)

folded during transportation

during transportation

Note: Each building module is shipped as a standard 40ft container (actually no container is needed)

during installation

Building module is 100% prefabricated in the factory before delivery. For clarity,this drawing does not showcase the wall, door & window, fire-protection, MEP and finishes

Rooftop can be equipped with swimming pool, water tank, planting, exercising (load 0.7t/m2)

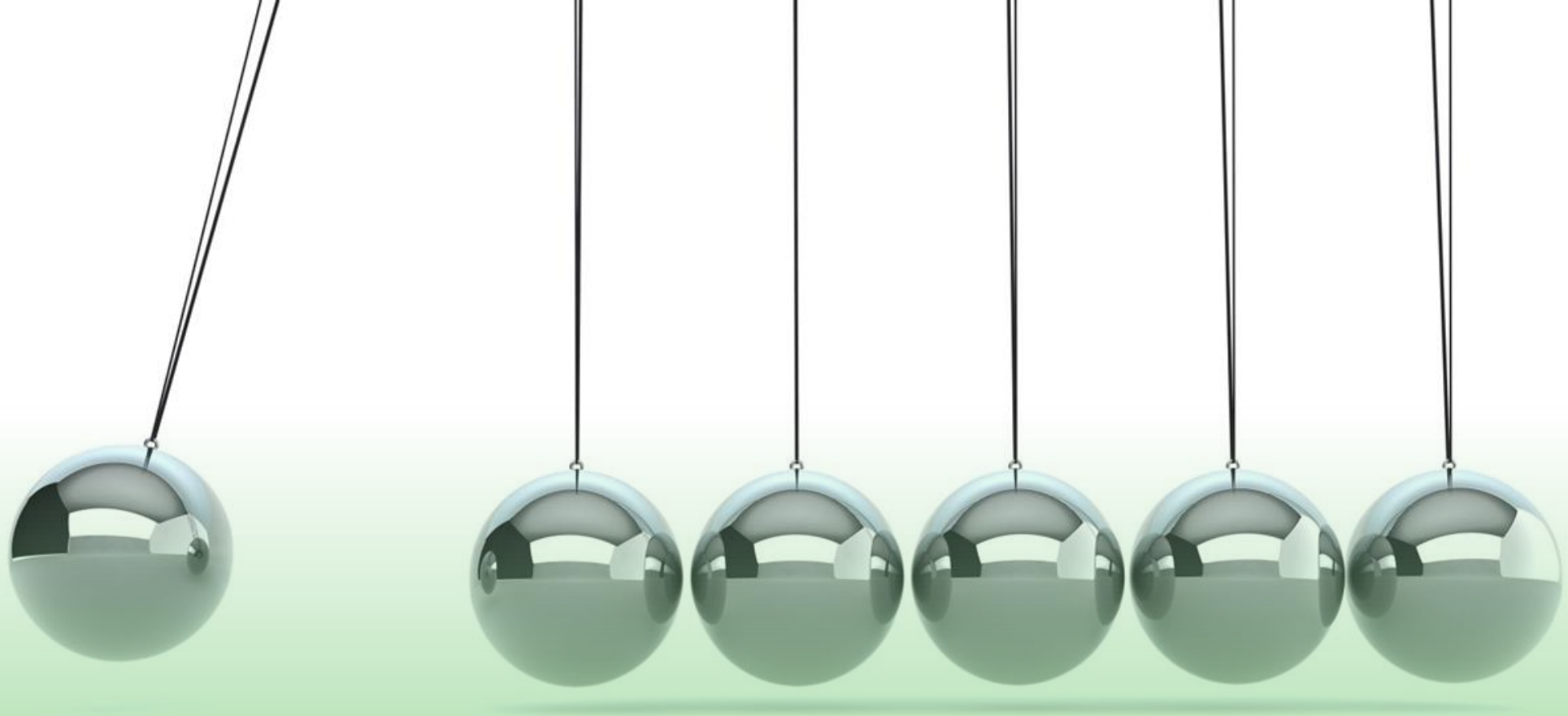
solar guardrail

after installation

Note: construction, finishes and MEP all done, turnkey project

Holon VS Traditonal

Holon		Traditonal
Factory made Quality is assured; zero pollution during construction; short construction time , 3F/ day	Method	**Site work** Hard to control quality; heavy construction pollution ; Long construction period; the delivery time is hard to control
Stainless steel 1000-year life span, a generational legacy recyclable after disposal. Ductile materials, strong earthquake resistance	Structure	**Reinforced concrete** 50-year life span,waste family assets and human resources, The earth is stuffed with construction waste after buildings are disposed . Brittle materials, buildings collapse easily in case of earthquakes
Flexible Large space of non-load bearing structure (11.7x4.8m), walls, doors and windows can be removed or revised after completion	Space	**Fixed** Limited space of non bearing structure (The length and width: generally less than 4m) no alteration allowed after walls, doors and windows are completed
More comfort, lower consumption "Nearly Zero Energy Building Standard" and "Passive House Standard" are adopted 90% higher energy efficiency (A/C noise level reduced by 90%)	Comfort & energy efficiency	**Less comfort, higher energy consumption** Poor thermal insulated exterior wall, A/C high energy consumption, very noisy
100 times cleaner than outdoors air When BROAD Clean Fresh Air Machine is used,100% fresh air, filtering PM2.5 by 99.9%	Air quality	**Air can be worse than outdoor air** Normal ventilation by windows, When A/C is on, windows are usually closed, indoor air quality is poor
Complete isolation 4-paned glass windows, 22cm rock wool for exterior walls. Ventilation through fresh air machine isolates outdoor noise from outside	Outdoor noise	**Transfer into building** Poor sound isolation of windows, Ventilation by windows can't isolate the indoor noise from outside



BENEFITS

HOLON – a unit complete in itself, still a part of bigger unit. [true sustainability]

1. Few varieties, modular size (like a 40 ft container).
2. **Stainless steel is 30 times more corrosion resistant** than carbon steel, and its lifespan exceeds one thousand years. It can be recycled after being discarded.
3. Stainless steel structure with high ductility. Elongation≥ 20%. No matter how strong the earthquake.
4. Small space occupied by columns and load-bearing walls and high space utilization efficiency.
5. Large indoor space, flexible configuration
6. Structural materials can be recycled
7. There are local standards for structure and fire safety.
8. Holon may deform but will never collapse.
9. The construction, electromechanical and decoration are 100% completed in the factory. The on-site installation only needs to screw bolts and glue.
10. https://www.youtube.com/watch?v=jL-iRjrZDic

1. **90% less energy consumption** than that of conventional buildings.
2. Construction waste is almost ZERO.
3. **Indoor air 100 times** cleaner than that of outdoors.
4. 100% fresh air, no recycled air.
5. The number of floors can easily be increased/decreased. (up to 12 floors can be built using the base level structural strength of standard modules).
6. The position of the interior walls and doors can easily be changed.
7. Flexible arrangement of housing type and room type
   - After completion, it can be easily removed, relocated and rebuilt.
   - Can be transported like an standard 40 ft container.
8. After installation, the room size will be doubled.
9. The weight of the building is light, **10 times lighter** than that of the reinforced concrete building, and the earthquake damage is also 10 times less.

CONCLUSION

- Modular factory built and tested units are more efficient and reliable.
- Easy to use.
- Last long.
- https://youtu.be/you-BV35B9Y

- HOLON building has shown that a buildings HVAC / electrical requirement can be reduced to 20% or less.
- In other words, if a building's HVAC+Electrical demand is 1000 kW, if build with HOLON technology will need 200 kW.
- Generational legacy, its life span is 1000 years.

- Future is here. https://youtu.be/77d2iDsRxaM