ECO-STRUCTURES INTERNATIONAL presents: TERMO DECK®

INTERNATIONAL CONFERENCE FOR SUSTAINABLE CONSTRUCTION MATERIALS
Building the Future - Construction Technology of Tomorrow

Organized by Dubai Central Laboratory - Dubai Municipality

November 6 & 7, 2018, Conrad Hotel - Dubai
Zero Cost Strategy to Achieve Green Standards: TES Building Design

Air-Based Building-Integrated Thermal Energy Storage (BITES) HVAC System

Swedish/UK Technology: 20+ GCC, 400+ worldwide projects exceeding 2M m²

BITES HVAC known as “TermoDeck” for New Builds & Select Retrofits

Using Existing Products & Methods of Construction
Dr. Ghassan Al Nimry  
*Director, Eco-Structures*

As Founder of Eco-Structures International, Ghassan’s work is centred on low-cost, sustainable solutions for the region’s construction and infrastructure industries. With more than 25 years of experience in the region and internationally, Ghassan has advised on and developed projects in construction, oil & gas, telecommunications for several firms including BHP Billiton, Eskom and The Weir Group.

Ghassan completed high school at 14 to become the one of youngest doctoral engineering graduates at George Washington University, U.S.A., graduating at the top of his class.

Randa Mouammar  
*Chief Strategy Officer, Eco-Structures*

Randa Mouammar joined Eco-Structures in 2007, and now heads the marketing and communications strategy, applying her background in law, policy, and socio-economic development to the construction industry and company operations.

Randa studied at Osgoode Hall law school at York University and has a Masters in Political Science and Law degree from Western University with a focus on modern Middle Eastern socio-political systems and development studies.

She is a member of the Law Society of Ontario since 2005.
Learning Objectives

1. **Sustainable, Low Cost** Construction Achieved With Building Integrated Thermal Energy Storage (BITES) Technology, Commercially “TermoDeck”

2. **TermoDeck Designs Low Energy Buildings**

3. **TermoDeck is a Future Proof** Force Multiplier, Adaptable to Next Generation Technologies

4. **TermoDeck Provides Superior Indoor Environments & Health Benefits**

The purpose of this presentation is to convey technical knowledge to the conference participants.

The presentation also contains slides with text that summarises the content of the presentation and the main learning objectives.
Business-As-Usual: Expensive & Unsustainable.

Solution: Design & Build with TermoDeck Thermal Energy Storage HVAC in Concrete

- 10 percent of GDP or $160 bn/yr (Dhs 588 bn) spent on energy subsidy in the GCC
- 700 million metric tons of CO₂ emissions annually produced by AC systems worldwide
- 70 percent of GCC power capacity in the GCC (149 GW) is used purely for AC (103 GW)
- 600 million m³ forecasted GCC natural gas supply gap as cooling demand triples
- 70 GW ($140 billion) of new capacity needed for AC ($25-30bn/year of LNG)

TermoDeck® 50% Reduction of AC Capacity

Cores Absorb Coolth

TermoDeck Hollowcore Slab

TermoDeck In-Situ
Available: https://www.youtube.com/watch?v=HciN8QOJclc
Uses Existing Materials & Methods of Construction; Allows Individual Room Control.
Proven in GCC to Reduce Installed AC Capacity ~50% (>70% of all Power is for AC).
Lowers CapEx 3-6%; Build Faster; Reduces Height (30-40% less concrete, Less False Ceilings).

30-35% Lower Connected Electrical Load.
25-35% Lower Electricity Consumption; Cuts HVAC-related O&M >50%.
Offsets Energy Used to Build Structure; Slashes AC & Peak Power; Enables Solar-Power Off-Grid Homes.

Meet Sustainability Targets, Reduces Carbon Emissions and Greenhouse Gases.
Adapts to New Equipment Technologies; Protects Real Estate Investment: Marketability Improves with Heightened Awareness of High Energy Costs, Environmental Impact and Sick-Building-Syndrome.

Active/ Passive, Healthy Radiant Cooling; Stable Temperature; No Drafts; Quiet; High Fresh Air; Ventilation with No In-Room Recirculation; No Risk of Mold, Fungus, Bacteria.
Embedded ducts (In-situ slabs)

End-caps

Concrete Frame (in-situ or precast)

Metal Frame Flat Slab Design

Air Diffusers

Equivalent In-situ slab:
- h200 mm • Kg/m² 242
- h265 mm • Kg/m² 303
- h320 mm • Kg/m² 378
- h400 mm • Kg/m² 432
- h500 mm • Kg/m² 521

480 kg/m²
635 kg/m²
770 kg/m²
960 kg/m²
1,200 kg/m²
Entire slab cooled from within, coolth is absorbed and stored, radiated to evenly cool and ventilate occupants, comfortably and naturally, wherever they are in the room.
Air circulates in slab, enters room, exits via return grille, to main supply in corridor, then to AHU, is partly re-used, partly exhausted with heat exchanger, then mixed with fresh air, filtered, cooled and returns to main supply ducts to slabs in occupied spaces.

TermoDeck Has No Unnecessary Conduits/Mechanical Devices. Slab Cores = Conduits for Convective Cooling/Ventilation. Concrete = Provides Thermal Storage + Radiant Cooling. Floor-to-Floor Height Reduced.
Healthy Indoor Environment
Superior Indoor Air Quality (IAQ):
No Possibility of Bacteriological Growth

**Indoor Air Quality (IAQ) Test Conducted on a TermoDeck® Building in Dubai, UAE (Summer 2016).**

Office building built in 2000 (in operation for 17 years). Regular inspection of the hollowcore slabs showed them to be clean and thus not requiring any additional treatment. This air quality test measured the dust, mold and bacteria present on the cores' surfaces, and in the air exiting the cores into occupied spaces. Results were outstanding.

**Test: Respirable Particulate Matter (PM10) after passage of air through slabs**

<table>
<thead>
<tr>
<th>Method: Particulate Analyzer</th>
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</tbody>
</table>

**Test: Microbiological Activity (Bacteria, Mold, Fungus) after passage of air through slabs**

<table>
<thead>
<tr>
<th>Method 1: Swab Test</th>
<th>Method 2: Microbiological Air Sampling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swab test measured microbiological activity on the slab surface → &quot;Not Detected&quot;.</td>
<td>Air sampling measured quality of the air exiting the slab</td>
</tr>
<tr>
<td>Aerobic Colony Count</td>
<td>Total Bacteria</td>
</tr>
<tr>
<td>&lt;10</td>
<td>76</td>
</tr>
<tr>
<td>Mold</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Yeast</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Comments</td>
<td>negligible</td>
</tr>
</tbody>
</table>
1) **Acoustic Comfort**: Operates silently, no AC system noise (e.g. fans, fan-coil units, etc.)

2) **No Draft**: Slab (~20\(^\circ\)), air (~21\(^\circ\)), occupant temperature (~23\(^\circ\)) within 2-3 degrees.

3) **Consistent Temperature**: Well-mixed air system, difference in floor to ceiling temperature less than 1\(^\circ\)C.

4) **Healthier Radiant Cooling**: Radiant cooling more natural/comfortable compared with convective.

5) **No Recirculation**: All air is sent to AHU for partial exhaust/heat exchange, mixed with fresh air, filtered/cooled/dehumidified/etc. then returned to occupied space.

6) **Higher % of Fresh Air**: Air volume needed to cool is reduced, better maintaining or increasing the amount of fresh air.

7) **No Bacteriological Growth**: Highly alkaline inorganic concrete does not allow bacteriological growth on slab surfaces;

8) **No Refrigerants in Occupied Spaces**

9) **No Maintenance in Occupied Space**: With no equipment in occupied spaces, there is zero chance of leaking water pipes, damaged FCUs, overflowing drain pans, blocked pipes, moldy false ceiling, etc.

10) **Continues to Cool if Power Interrupted**: During power outages, coolth stored in slabs radiates cool for hours until power is restored.
## UK Government Study
Comparison: TermoDeck (Thermal Energy Storage TES) with Conventional AC

### TABLE ES1: COST COMPARISON TES AC / CONVENTIONAL AC

<table>
<thead>
<tr>
<th>AC System</th>
<th>Purchase and Installation Cost</th>
<th>Operating Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional AC</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Chilled Water Storage TES AC</td>
<td>185</td>
<td>106</td>
</tr>
<tr>
<td>Hollow Core BMTS TES AC</td>
<td>80</td>
<td>60</td>
</tr>
</tbody>
</table>

Source: ASA Consulting

### Note difference between **CapEx** and **OpEx** of conventional and TermoDeck AC

- **CapEx**
- **OpEx**

**Before TermoDeck**

**OpEx (30 years)**

- TD OpEx savings (at current tariff)
- TD OpEx savings (if tariffs increase over 30 years)

**OpEx over 30 years with TD**

- (incl. electricity)

**Approximate Scale of Capital and Operating costs**

OpEx is ~4-5 times greater than CapEx over 30 years.

TermoDeck lowers CapEx, significantly cuts OpEx.
Case Study: Window opens from 1:00 pm – 6:00 pm on 16-Aug. Outside temperature: 46°C.

As soon as the window opens, hot and humid air enters the room. Room temperature quickly rises from 23°C to 32°C.

Condensation does not take place because the temperature of the slab surface quickly rises from 23°C to 28°C, yet remains firmly above the dew point. Room dew point jumps from 11°C to 24°C.

In a conventionally air-conditioned room, condensation would immediately occur, as diffusers discharging at 14°C.
1,250 m² Villa (Riyadh): 15 TR (conventional AC: 40 TR)

“During the summer, I switch off the AC at 4am and switch it back on at 3pm, and the house remains very comfortable all day.” (July 2018)

1,450 m² Office (Dubai): 45 TR (Conventional AC: 90 TR)

40,000 m² School (Dubai): Connected load dropped from 7.4 to 4.9 MW

10,000 m² Office (Jeddah): “more than 50% reduction of active energy needed to cool a building”

20,000 m² Retail (Oman): 510 TR (Conventional AC: 1,020 TR)

30,700 m² Office (Jeddah): 750 TR (Conventional AC: 2,200 TR)

“During the summer, I switch off the AC at 4am and switch it back on at 3pm, and the house remains very comfortable all day.” (July 2018)

Project – Retrofit / Riyadh: Removed 24 TR, Installed 10 TR AC