DESIGNING MEP SYSTEMS AND CODE COMPLIANCE IN THE MIDDLE EAST GCC REGION

BUROHAPPOLD ENGINEERING

17th December 2014

YOUR PRESENTERS

ChewPieng Ryan
BSc(Hons) CEng MCIBSE MIEI

ChewPieng Ryan is BuroHappold Engineering's MEP Group and Discipline Director for the Middle East region. Her passion for integrated design, makes her an invaluable asset to the practice. ChewPieng has extensive experience in the field of building services design, working on some of the most iconic projects across the globe. Her portfolio includes integrated design, tall buildings, healthcare campuses, education campuses, retail and commercial buildings. ChewPieng encourages those around her to grasp opportunities for a more effective, efficient building on every level and is passionate about broadening our reach, adopting new technologies and ensuring that the environment of a building meets the highest sustainability standards at all times. ChewPieng's deep understanding of clients' needs and ability to apply elegant solutions to complex problems has fuelled her success in the specialism for the last 27 years.

She is an active member of the CIBSE UAE committee and is the current Vice Chair.

Catherine Elliott-Scott
BScEng(Hons) MIET CEng MSLL P

Cathy is a Chartered Engineer with IET and an Associate with BuroHappold Engineering based in the Middle East. She has worked on a wide variety of projects in the UK, Ireland, Italy, Russia, Saudi Arabia, Oman, Kuwait, Syria, India, Azerbaijan and the UAE. Cathy has been involved with sustainability assessments including the use of BREEAM, LEED, QSAS and the Estidama rating system. Cathy is a qualified Estidama PQP for buildings and villas and has provided technical and expert support for the production of Estidama Guidance.

BUILDING SERVICES CHALLENGES IN THE GCC AND THE INTERACTION OF PROFESSIONAL CODES & STANDARDS

- Introduction
- Key Challenges for MEP in the GCC
- Extreme Climate
- MEP Design Codes in the GCC
- Sustainability Codes
- Opportunities for Technology
- CIBSE ASHRAE in Middle East

Al Faisaliyah Complex, Riyadh, ©Joe Poon

INTRODUCTION

- Gulf Cooperation Council (GCC)

Construction & expansion throughout the region
Source: Flickr/Omar Chatriwala

GCC Map

GCC Logo

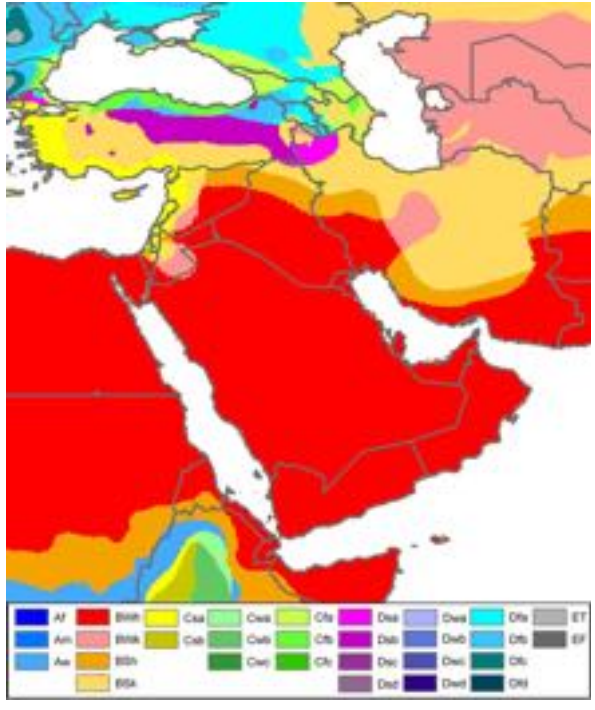
MEP CHALLENGES IN THE GCC

Extreme environmental conditions

- Heat
- Humidity
- Intense UV radiation
- Sand erosion
- Dust, haze, and fog

- Other notable challenges
  - Poor facilities maintenance
  - Seismic requirements
  - Lightning protection

Köppen-Geiger climate classification



GCC EXTREME CLIMATE

Fog

Floods

Sand storms

Extreme heat

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GCC EXTREME CONDITIONS

Lightning

Dust & humidity

Seismic joints

Aviation warning

HOW DO WE HARNESS THE EXTREME FOR THE GOOD OF SOCIETY?

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HOW DO WE HARNESS THE EXTREME FOR THE GOOD OF SOCIETY?

- High Humidity & Fog

The Louvre, Abu Dhabi
© AJN

Typical morning condensation in the UAE, here at the Beach Rotana Hotel

Condensation on some packing tape left on the Louvre site. The surface has a low ‘wetability’ and so the droplets are near spherical.

HOW DO WE HARNESS THE EXTREME FOR THE GOOD OF SOCIETY?

- Flooding

Wadi Hanifah, Riyadh, KSA
Winner of the Aga Khan Award for Architecture 2010
® ADA

The project has restored and enhanced the natural systems

DESIGN CODES IN THE GCC

- Mechanical
- Electrical
- Public health
- Fire engineering
- Sustainability

Mechanical Codes used in the GCC

ASHRAE CODES

ASHRAE Handbook

- Fundamentals
- System and Equipment
- Application
- Refrigeration

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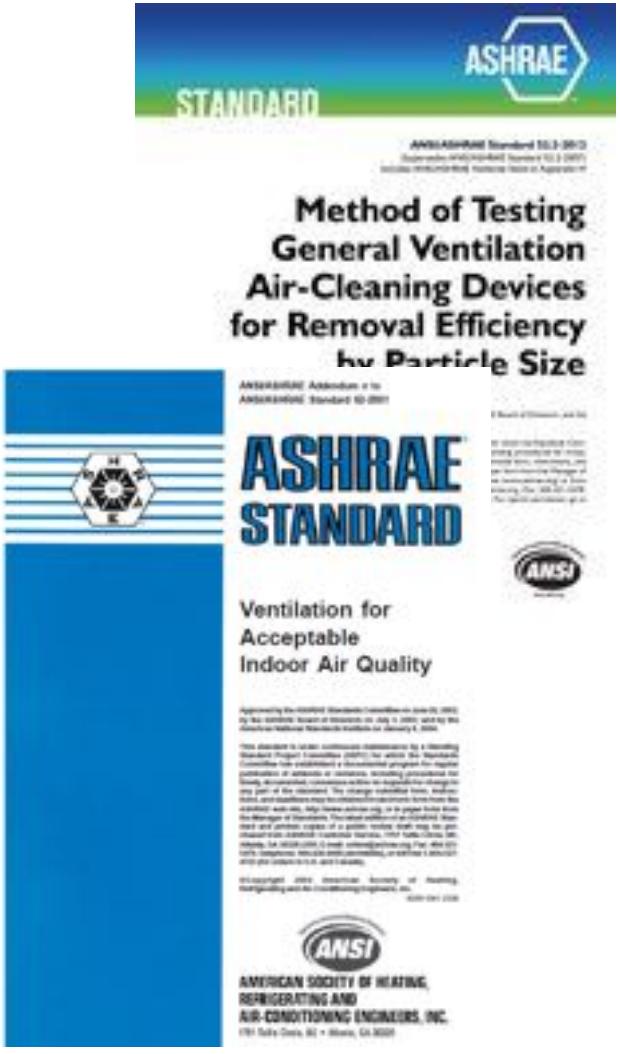
ASHRAE CODES

- ASHRAE 52.2- 2012
- ASHRAE 55 – Thermal Environmental Conditions for Human Occupancy
- ASHRAE 62 – 2007, SMACNOT APPLICABLE 1035 – HVAC Duct Construction Standards
- Standard 62.1-2013 Ventilation for Acceptable Air Quality
- Standard 62.2-2013 Ventilation for Acceptable Air Quality in Low Rise Residential Buildings
- Standard 90.1-2013 (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings
- Standard 90.2-2007 Energy Efficient Design of Low-Rise Residential Buildings
- Standard 189.1-2014 User's Manual



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CIBSE CODES

- Commissioning Codes
  - A: Air Distribution Systems
  - B: Boilers
  - C: Automatic Controls
  - L: Lighting
  - M: Management
  - R: Refrigeration
  - W: Water Distribution Systems
- CIBSE Guide D: Transportation systems in Buildings
- CIBSE Guide H: Building Control Systems
- CIBSE Guide M: Maintenance Engineering & Management

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CIBSE TM04 - MAY 2014
BUILDINGS FOR EXTREME ENVIRONMENTS: ARID

- Building envelope
- Daylight and solar gain
- Building orientation
- Intelligent façade design
- Wind movement
- Urban heat island effect
- U-Values

CIBSE TM04: GENERAL DESIGN PHILOSOPHY FOR ARID ENVIRONMENTS

1. **Sound basis of design**

   Consider geographical, local climatic, commercial, legal and social conditions and requirements.

2. **Climate problems**

   Anticipate problems due to high temperature and humidity, exposure to dust, sand and intense solar radiation, salty atmosphere, brackish water supplies and irregularity of supplies: both in system design and equipment/material selection.

3. **Simplicity**

   Avoid unnecessary design complications and over-design (unjustifiable safety margins, over-engineering through specifications and detailing). Do not experiment or use unproven techniques without undertaking a proper due diligence.

CIBSE TM04: GENERAL DESIGN PHILOSOPHY FOR ARID ENVIRONMENTS

4. **Local Resources and Experience**

   Take full advantage of local experience, expertise and resources including local fully trained engineers and technicians capable of applying Western technology in building services.

5. **Specialist Plant Commissioning**

   If the design includes specialist plant, such as chillers, sewage treatment plant and incinerators, allow for the manufacturer, specialist engineer or representative to supervise, set to work and commission as necessary.

6. **Packaged equipment**

   The use of packaged equipment that involves a minimum amount of specialised site installation work should be encouraged.

Fire Fighting & Plumbing Codes used in the GCC

PUBLIC HEALTH CODES

- International Plumbing Codes
- International Mechanical Codes
- Municipality Codes
- ADDC/DEWA Local codes
- ASTM – Material Testing

ASTM INTERNATIONAL

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BUILDING & FIRE FIGHTING CODES

- NFPA - Active Fire Fighting
- International Fire Code
- International Building Code
- The Building Regulations 2010
- British Standards
- Building Construction Safety Code

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Electrical Codes used in the GCC

ELECTRICAL CODES IN THE GCC

ELECTRICAL CODES IN THE GCC

IEC 60364

- Majority based on IEC 60364
- Some “loosely based” on superseded IEE 14th edition
- Local experience & opinions
- Trial & Error


IEC

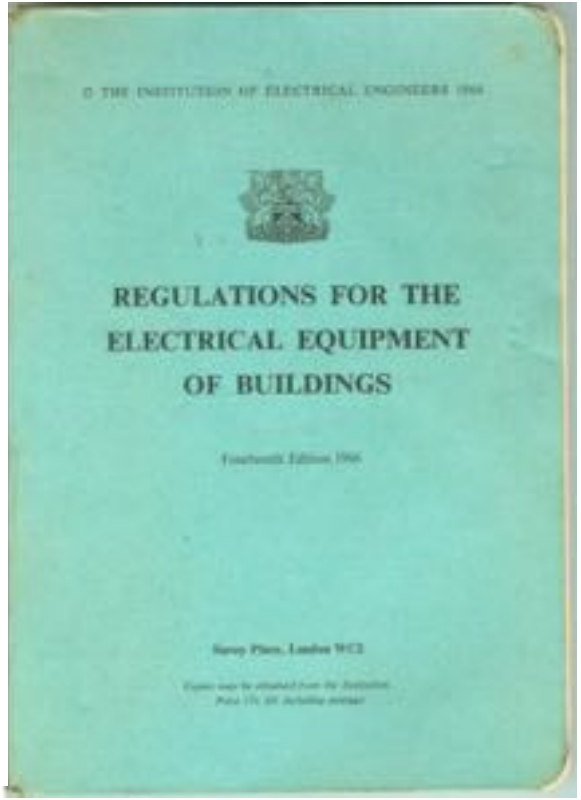
IEC 60364-1

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Low-voltage electrical installations –
Part 1: Fundamental principles, assessment of general characteristics, definitions

Installations électriques à basse tension –
Partie 1: Principes fondamentaux, détermination des caractéristiques générales, définitions


REGULATIONS FOR THE ELECTRICAL EQUIPMENT OF BUILDINGS

ELECTRICAL CODES IN THE GCC

Summary

- Design LV systems to IEE wiring regs
- Check for local variances (e.g. split load boards, max 14way TPN, PF >0.8, additional derating factors)
- Check what local forms used for submittals
- Submittals in person at a counter with multiple hard copies
- Local consultants apply on your behalf
- Online submittals
- Other approvals to be in place for submittal

GCC CLIMATE IMPACT ON ELECTRICAL EQUIPMENT

- Outdoor building services equipment must be dust proof to prevent premature failure of switchgear, control gear and machines.
- ANSI/IEC 60529-2004 *Degrees of Protection Provided by Enclosures* (IP Code) (National Electrical Manufacturers Association, 2004) outlines the sealing effectiveness of enclosures of electrical equipment.
- Using this classification system, external control panels and switchboards should be rated between IP53 and IP64.
- Local shading to provide protection of electrical components
- Humidity: Anti-condensation precautions should be undertaken to ensure continuous operation of electrical distribution and control systems.

SAND, DUST AND ELECTRICAL EQUIPMENT

- Fine wind-blown sand/dust invades devices
- Devices fail in energised state, supply remains energised
- CPDs fail to function as designed in a fault – risk of shock and fire
- Specification, regular testing and maintenance

ELECTRICAL CODES IN THE GCC

KSA

- **Saudi Electricity Company**
- Own wiring regulations (IEC 60364)
- Contractor does all application/liaison

Qatar

- **KAHRAMAA**
- Several own codes
- Own wiring regulations (IEC 60364)

ELECTRICAL CODES IN THE GCC

Kuwait

- **Ministry of Electricity & Water**
- Own wiring regulations (IEC 60364)
- Additional derating factors
- Power Factor 0.8
- ATS not permitted
- Lighting levels included in wiring regs
- Local consultant required for application

Oman

- **Ministry of Electricity & Water**
- Own wiring regulations (IEC 60364)
- Local consultant required for application

Bahrain

- **Electricity & Water Authority**
- Own wiring regulations (IEC and Kuwait)

ELECTRICAL CODES IN THE GCC

Dubai

- **Dubai Electricity & Water Authority**
- Own wiring regulations (IEC 60364)
- Green Building Specification
- Online application for supply
- UAE Fire and Life safety code
- Contractor led after contract awarded

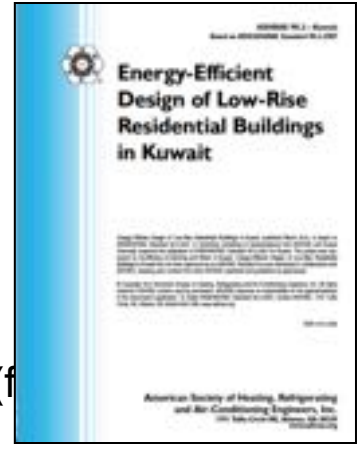
Abu Dhabi

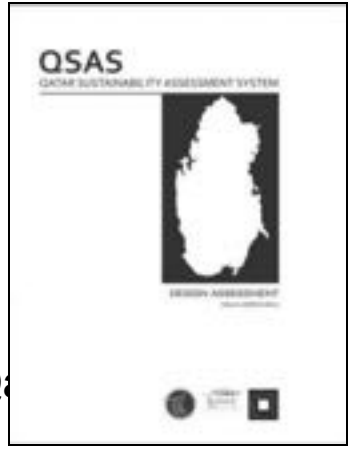
- **Abu Dhabi Distribution Company**
- Own wiring regulations (IEC 60364)
- Estidama Pearl Rating System
- Online application for supply
- UAE Fire and Life safety code
- ADM codes
- AAM codes
- DMA codes
- ADCD codes

Sustainability Codes used in the GCC

SUSTAINABILITY CODES IN THE GCC

- CIBSE, ASHRAE, LEED, BREEAM
- Estidama Pearl Rating System (Abu Dhabi)
- ASHRAE 90.2 Kuwait
- Dubai Green Building Regulations (Dubai)
- Global Sustainability Assessment System (GSAS) (f Q
  Sustainability Assessment System, QSAS)

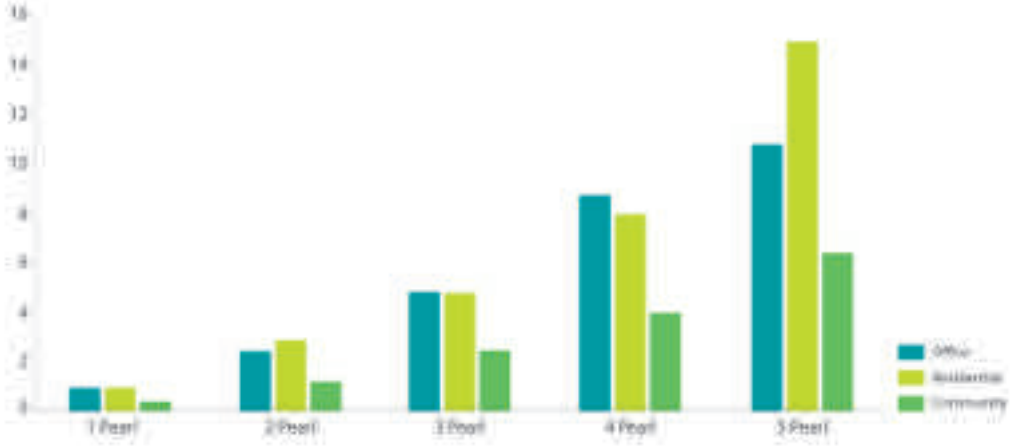




ESTIDAMA PEARL RATING SYSTEM AND THE INFLUENCE OF CIBSE AND ASHRAE

- Based upon ASHRAE Standards 90.1 and 62.1
- Section IDP-R3: Basic Commissioning
- Estidama U-value Calculator v1.1 – CIBSE Guide A, App 3.A7:Properties of materials
- Estidama PQP certification and Estidama Commissioning Agent approves professional qualification if member of CIBSE
- RE:R2 Energy Monitoring & Reporting – Refers to CIBSE TM39 2009: Building Energy Metering

COST : BENEFITS OF ESTIDAMA



Source: Brothers (p16)

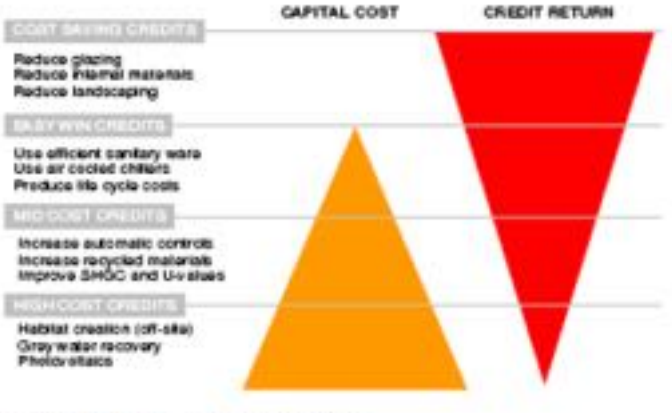


Diagram 7.1 Capital Cost investment profile

Source: Davis Langdon (2010c, p.10)

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LEED IN THE GCC

- October 2010: 26 LEED-certified projects in the GCC (623 projects registered for LEED certification)
  UAE: 25
  Saudi Arabia: 1

- October 2014: 1,236 LEED-certified projects in the GCC
  UAE: 828
  Qatar: 190 projects (16%)
  Saudi Arabia: 158 projects (13%
  Kuwait, Bahrain and Oman: 49

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UAE on list of Top 10 green building nations

Emirates has "cool" buildings that are more liveable and energy-efficient, says US-based council

Staff Report

Published: 21:20 May 2, 2014

Nation	GSM of LEED-certified space (million)	Total GSM of LEED-certified and registered space (millions)	Total number of LEED-certified an registered project
Canada	17.74	58.66	4,066
China	14.30	96.22	1,838
India	11.64	66.22	1,657
South Korea	3.84	16.61	242
Taiwan	2.98	8.97	114
Germany	2.90	7.32	365
Brazil	2.85	23.24	629
Singapore	2.16	3.86	91
United Arab Emirates	1.82	47.16	650
Finland	1.45	3.56	148

LEED rating 2014

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DUBAI MUNICIPALITY PUBLICATION: MANUAL OF GREEN BUILDING MATERIALS

401	Chapter 1: Ventilation and Air Quality
401.01	**Minimum Ventilation requirements for Adequate Indoor Air Quality**
	Applicable Materials & Systems
	Not Applicable
	Applicable Standards / Regulations
	ASHRAE 62 - 2007
	Availability of Testing Facility
	Dubai Central Laboratory Location & Contact Details Zabeel Road Next to Central Post Office Post Box # 67 Dubai Tel. 04 302 7007 Fax: 04 336 2696

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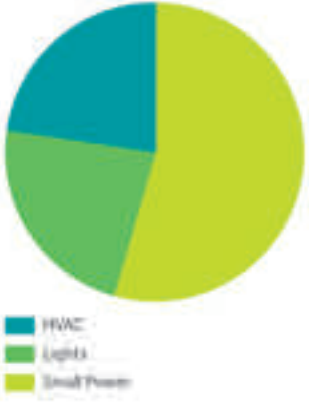
COMMISSIONING CODE STANDARDS

- LEED, GSAS, Estidama, Dubai Green Building Regulations (DGBR)
- *Systems Manual by ASHRAE (e.g.* Empower's ASHRAE District Cooling Guide)
- *Building Log Book by CIBSE TM31*

- 20%: Maximum energy efficiency improvement of commissioned buildings over those which are not
- 35%: Potential commissioning program value achieved from LEED Fundamental Cx
- 65%: Potential commissioning program value achieved from Estidama

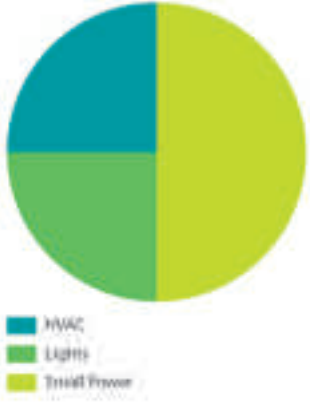
BUILDING ENVELOPE

Figure 31: Basic energy breakdown for a nominal building with poor U-values



U-value (walls and roof) = 1.0W/m²K
U-value (windows) = 5.9W/m²K
Solar heat gain coefficient (SHGC) = 0.61
Glazing ratio = 50%
Internal gains = 10W/m²
Lighting gains = 10W/m²
Occupancy density = 11m² per person
Outside air (OA) = 8.5 litres per person
Total plant coefficient of performance (COP) including fans and pumps

Figure 32: Basic energy breakdown for a nominal building with good U-values



U-value (walls and roof) = 0.35W/m²K
U-value (windows) = 1.8W/m²K
Solar heat gain coefficient (SHGC) = 0.28
Glazing ratio = 30%
Internal gains = 10W/m²
Lighting gains = 10W/m²
Occupancy density = 11m² per person
Outside air (OA) = 8.5 litres per person
Total plant coefficient of performance (COP) including fans and pumps

Figure 33: Breaking of cooling loads by source for a nominal building with poor U-values

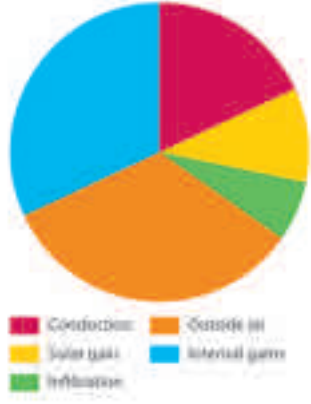
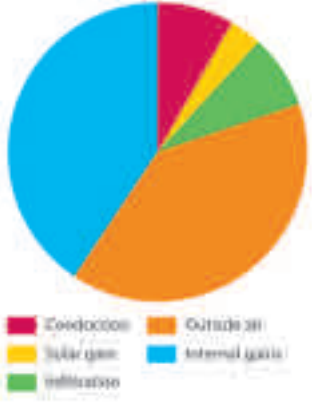


Figure 34: Breaking of cooling loads by source for a nominal building with good U-values



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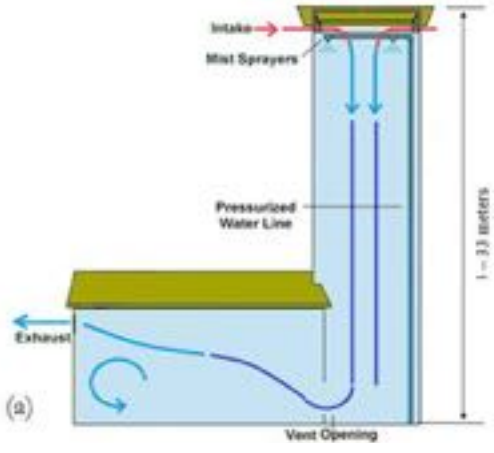
Opportunities for Technology in Arid Climates

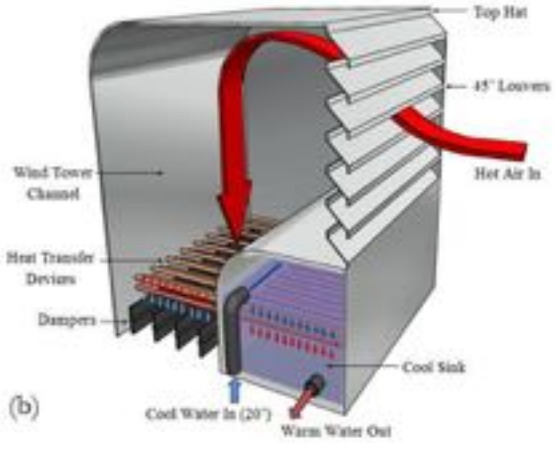
PASSIVE COOLING: WIND TOWER

Integration and Application of Passive Cooling Within a Wind Tower

John Kaiser S. Calautit; Ben Richard Hughes, PhD; Saud Abdul Ghani, PhD

- Structure cooling inadequate
- Heat transfer devices in wind tower
- Reducing the air temperatures by up to 12°C





Minimal restriction in the external air flow stream

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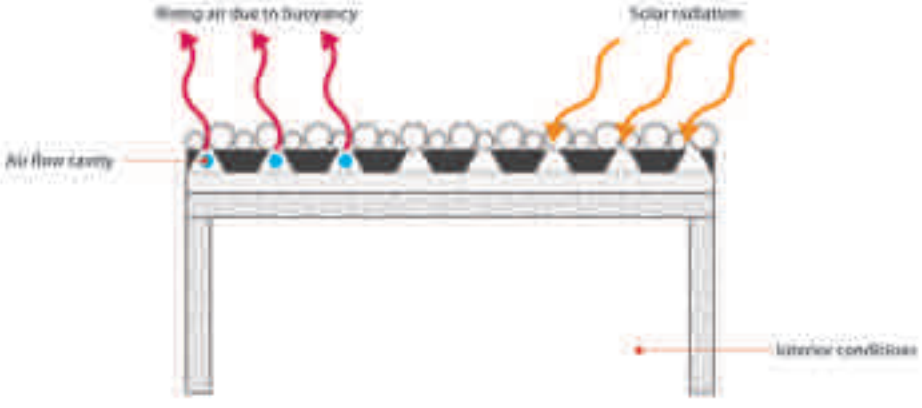
ROOF SYSTEM DESIGN

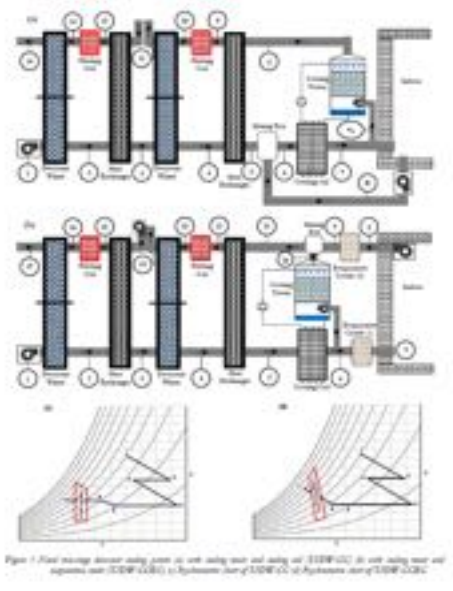
- Ballasted assemblies with river-washed gravel
- Drainage mat increases ventilation between voids



DESICCANT COOLING

A study on the performance of conventional and novel desiccant cooling systems in hot and humid climates

Hadi Pasdarshahri, PhD; Samira Haghshenaskashani, MSc; Ghassem Heidarinejad, PhD



- Liquid desiccant removes water from the air
- Cost effective when solar energy is available to regenerate the desiccant
- Improved indoor air quality (IAQ) due to greater humidity control
- Large desiccant cooling systems can be constructed at relatively low cost

Design Watchpoints

ELECTRICAL DESIGN WATCHPOINTS

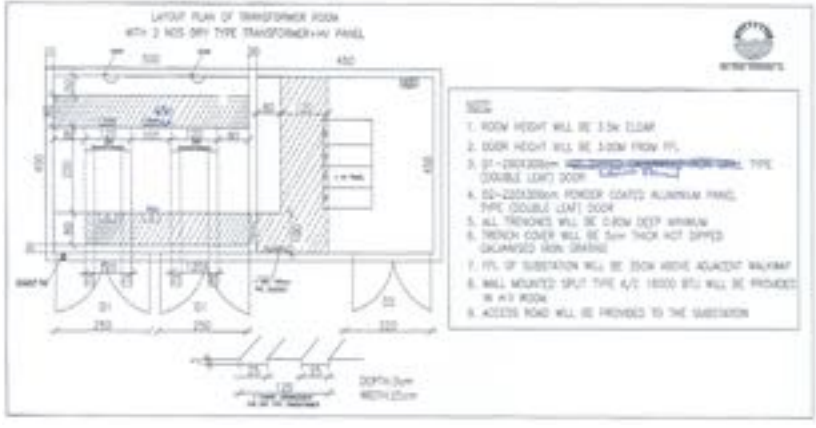
Redundancy

- N+1 recommended by DEWA
- N+N (50% loading)
- Generator back-up life safety
- Generator back-up business continuity
- Generator back-up VAC

ELECTRICAL DESIGN WATCHPOINTS

Space requirements

- Each has own requirements
- Typically bigger than European supply authority requirements
- Discussion and approvals necessary



ELECTRICAL DESIGN WATCHPOINTS

Electrical Plant Item	**Heat dissipation of plant item**
LV ACB Cubicle (each)	600W
LV Multi Outgoing Feeder cubicle	1kW
PFC Panels	Approx 8W per kVAR
2000kVA cast resin transformer	23kW
MV Panel Cubicle	1.8kW

All rooms containing electrical plant must be provided with cooling

CIBSE ASHRAE in the MIDDLE EAST

ASHRAE FIRST INTERNATIONAL CONFERENCE ON ENERGY AND INDOOR ENVIRONMENT FOR HOT CLIMATES IN DOHA –FEB 2014

Topics from keynote presenters:

- **Traditional Technology for Modern Problems: Re-energizing Wind Towers**
- **Solar Cooling in Hot Climates**
- **Integrating Indoor Air Quality and Energy Efficiency in Buildings**

ASHRAE Shaping Tomorrow's Built Environment Today

Presentation Topics:

- **Modeling Building Load**
- **HVAC System Operation**
- **Sustainable Buildings**
- **HVAC Technology**
- **Thermal Comfort**
- **Renewable Energy Technologies**
- **Systems for Improving Indoor Environmental Quality**
- **Building Envelopes**
- **HVAC System Performance**
- **Unique Applications**
- **Refrigerant Performance**
- **Healthy Indoor Environments**

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CIBSE-ASHRAE

CIBSE and ASHRAE play pivotal roles in the Middle East built environment for quality in construction with their Standards, Codes, Guidance and Technical Manuals

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