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

17th December 2014
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.

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.

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

- Gulf Cooperation Council (GCC)

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

GCC Map

GCC Logo
Extreme environmental conditions

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

Other notable challenges

- Poor facilities maintenance
- Seismic requirements
- Lightning protection
GCC EXTREME CLIMATE

- Fog
- Floods
- Sand storms
- Extreme heat
GCC EXTREME CONDITIONS

Lightning

Dust & humidity

Seismic joints

Aviation warning
HOW DO WE HARNESS THE EXTREME FOR THE GOOD OF SOCIETY?
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
ASHRAE CODES

- ASHRAE 52.2- 2012
- ASHRAE 55 – Thermal Environmental Conditions for Human Occupancy
- Standard 62.1-2013 Ventilation for Acceptable Air Quality
- Standard 62.2-2013 Ventilation for Acceptable Air Quality in Low Rise Residential Buildings
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
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
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.
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
BUILDING & FIRE FIGHTING CODES

- NFPA - Active Fire Fighting
- International Fire Code
- International Building Code
- The Building Regulations 2010
- British Standards
- Building Construction Safety Code
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
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
Outdoor building services equipment must be dust proof to prevent premature failure of switchgear, control gear and machines.


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) (formerly known as Qatar 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 PQP certification and Estidama Commissioning Agent approves professional qualification if member of CIBSE
COST : BENEFITS OF ESTIDAMA

Source: Brothers (p16)
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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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.

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

Figure 33: Threading of cooling load by source for a nominal building with poor U-values.

Figure 34: Threading of cooling load by source for a nominal building with good U-values.

- HVAC
- Lights
- Small Power

U-value (walls and roof) = 1.00 W/m²K
U-value (window) = 1.50 W/m²K
Solar heat gain coefficient (SHGC) = 0.45
Glazing area = 30%
Total gain = 100 W/m²
Lighting gains = 10 W/m²

U-value (walls and roof) = 0.59 W/m²K
U-value (window) = 1.10 W/m²K
Solar heat gain coefficient (SHGC) = 0.33
Glazing area = 50%
Total gain = 100 W/m²
Lighting gains = 10 W/m²

Occupancy density = 15 ft² per person
Outside air (OFA) = 6.0 ft³ per person
Total plant capacity = 500000
Total plant capacity = 1000000

Figure 31 includes fan and pump.
Opportunities for Technology in Arid Climates
Integration and Application of Passive Cooling Within a Wind Tower

- 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
ROOF SYSTEM DESIGN

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

- LV ACB Cubicle (each)
- LV Multi Outgoing Feeder cubicle
- PFC Panels
- 2000kVA cast resin transformer
- MV Panel Cubicle

Heat dissipation of plant item

- 600W
- 1kW
- Approx 8W per kVAR
- 23kW
- 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

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