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BEST PRACTICES FOR CONSERVATION OF ELECTRICITY AND WATER

Prepared by Conservation & Energy Effeciency Dept.

CONTENTS

PREFACE

The purpose of the document "Codes and Best Practices in Electricity & Water Conservation" is to provide a comprehensive & instant reference on codes and best practices for Electricity & Water Conservation as applicable to the state of Qatar

The document summarizes the aspects related to conservation from the following regulations

1. Regulations of Internal Water Installations & Connection Works- May 2009
2. Regulations for the Installation of Electrical Wiring, Electrical Equipment and Air conditioning Equipment – Dec 2010.
3. Further to that other best practices in Electricity & Water conservation are also detailed in the following areas
    - HVAC System & Controls
    - Lighting System & Controls
    - Motors
    - Plumbing fixtures
    - Irrigation

We trust "Codes & Best Practices in Electricity & Water Conservation" shall be good reference for all professionals in construction sector.

ELECTRICITY & WATER CONSERVATION

KAHRAMAA have stipulated regulations for conservation of Electricity and Water. The regulations were stipulated for the following areas of a utility

- Lighting
- Motor loads
- Air-conditioners
- Lighting control
- A/C control
- Thermal Insulation for buildings
- Low flow faucets/aerators in public/private buildings
- Water efficient flush tanks
- Alternative Energy sources for plumbing applications.

From among the above areas of the utility, regulations for motor loads is mainly applicable to the industrial sector, all other items are applicable to all sectors.

The regulations stipulated for the above areas are listed below

LIGHTING

USED ENERGY EFFICIENT LAMPS (CFL, HALOGEN, FLUORESCENT, LED & HIGH INTENSITY DISCHARGE) IN ALL BUILDINGS INSTEAD OF TRADITIONAL INEFFICIENT LAMPS. THEY ARE MORE VISIBLE, CUT COSTS & CO2E & CAN LAST MORE THAN TRADITIONAL ONES.

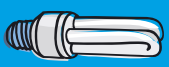
5-10%

GENERAL SAVINGS EXPECTED

GENERAL LIGHTING

LIGHTING REGULATION NUMBER (709.7) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

- The following types of energy efficient lamps (Some Or All As Applicable) shall be used in all buildings :
    - Compact Fluorescent Lamps (CFL) instead of Incandescent Lamps.
    - Halogen Lamps with Dimming System.
    - Linear or Circular Fluorescent Lamps.
    - Light Emitting Diode (LED) type Lamps.
    - High Intensity Discharge like High Pressure Sodium Vapor Lamps and Metal Halide Lamps.
- Use of CF Lamps are not insisted in premises where lighting and architectural features should provide aesthetics or good color rendering properties like theatres, ball rooms, television studios etc. However measures for energy conservation shall be explored in design stages.
- CFL should not be used in areas like toilets where the lights are frequently switched on and off.
- Electronic Ballasts shall be used instead of Magnetic Ballasts in fluorescent luminaire switching circuits.
- Luminaires with energy efficient T5 lamps to be considered during lighting design stage for interior lighting wherever applicable.
- Sodium Vapor Lamps and Metal Halide Lamps shall be used in luminaires for external lighting. Timers or Photocells with manuel override facility shall be used for external lighting controls as envisaged under clause 701.1 as per MENTIONED IN Regulations for the Installation of Electrical Wiring, Electrical Equipment and Air conditioning Equipment – Dec 2010.
- Under no circumstances, the external lighting shall be kept operational between 7 am to 4.30 pm during day time.
- Halogen Lamp Luminaires with dimmers shall be used for suitable interior task lighting.
- LED type exit lighting luminaires shall be used for egress indication illuminated signs and other feasible applications.
- Good quality CF Lamps shall be used in order to avoid or minimize the effects of harmonic currents, better power factor and superior lamp life.

TYPICAL COMPARISON OF INCANDESCENT LAMPS AND CFL		
CHARACTERISTICS OF LAMP	INCANDESCENT LAMPS 	COMPACT FLUORESCENT LAMPS 
Lamp Wattage -Typical	60 W	13 W
Average Luminous Flux In Lumens	890	900
Lamp Life	750 - 1000 Hrs	6000 - 20000 Hrs
Range Of Efficacy	8 - 17 Lumens Per Watt	60 - 72 Lumens Per Watt

TYPICAL EXAMPLES FOR PROJECTED SAVINGS IN LIGHTING(ONE LAMP) BY IMPLEMENTATION OF REGULATION

ENERGY SAVING AND PROJECTED REDUCTION IN CO_2 FOR TYPICAL ENERGY SAVING LAMPS			
TYPE OF LAMP	ANNUAL SAVING IN KWHR FOR 8HRS OPERATION COMPARED TO EQUIVALENT INCANDESCENT LAMP OF 60W FOR ONE LAMP	SAVINGS COM- % PARED TO BASE CASE	ANNUAL CO_2 REDUCTION PROJECTED IN KG
CFL LAMP 13 W	137	78.00%	74
HALOGEN 42 W	52	30.00%	28
LED 12 W	140	80.00%	75

2-15%

GENERAL SAVINGS EXPECTED

LIGHTING CONTROL

PIR SENSOR (OCCUPANCY SENSOR) SAVES 9855 KWHR OF ENERGY FOR 15 HR OPERATION/ DAY & 5312 KG OF CO_2 WHILE TIMER FOR EXTERNAL LIGHTS SAVES 7884 FOR 12 HOURS OPERATION/DAY & 4249 KG OF CO_2.

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LIGHTING CONTROL SYSTEMS

REGULATIONS FOR LIGHTING CONTROL SYSTEMS (709.7) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

- For building with large built up area, presence detectors /occupancy sensors are to be used in common areas like corridors and lobbies, to control switching of lighting depending on the occupancy of respective area.
- Presence detectors should not control the emergency egress illumination luminaires or egress direction indicators. All emergency lights to be switched on in the event of an emergency, as required by relevant saftey regulations.
- Access key cards or key tags used for hotel rooms, are to be used for electrical control activation in respective rooms thereby the room utilities will be switched off, when the occupant leaves the room.
- Depending on the layout of large hallways and office areas, local switching of luminaires shall be provided.
- All automated lighting and AC controls shall have manuel control / by pass facility for specific customised operations.

PROJECTED SAVINGS BY USING LIGHTING CONTROL

ENERGY SAVING AND PROJECTED REDUCTION IN CO_2 FOR TIMERS / PRESENCE DETECTORS		
ENERGY SAVING MEASURE	ANNUAL SAVING IN KWHR FOR ONE CIRCUIT OF 18 LAMPS@100W/LAMP (DIRECT SAVING)	ANNUAL CO2 REDUCTION PROJECTED IN KG
PIR SENSOR (Occupancy sensor)	9855 (For 15 Hours operation per day)	5312
Timer or Photoelectric control for External lights	7844 (For 12 Hours operation per day)	4249

FLOOD LIGHTING

REGULATIONS FOR FLOOD LIGHTING (710) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

Areas of application of flood lighting are gymnasiums, sports arena, ware houses, large public areas, football stadiums, outdoor activity areas, roadways, parking lots and pathways.

For flood lighting applications requiring good color rendering properties, luminaries with high intensity discharge lamps or high pressure gas discharge lamps (Example - Metal Halide Lamps) shall be used for energy saving and also to achieve good color rendering properties.

For applications requiring moderate colour rendering properties, luminaries with LED lamps shall be used.

For applications such as street lights and security lighting where faithful color rendition is considered unimportant, sodium vapour lamps (HPS And LPS) shall be used.

For sporting event applications, the lighting level parameters to be considered for design purposes Viz. LUX level, uniformity ratio, colour rendering index etc, shall be as per the relevant international norms.

NOTE :

Specific brands of HID or high pressure gas discharge lamps having poor color rendering properties shall not be used for applications where color rendition is of prime importance. Colour rendering index from 80 to 100 are considered ideal.

Lamps with higher luminous efficacy to be selected for energy saving ,as applicable.

(Example : Low Pressure Sodium Vapour Lamps Render Better Efficacy Upto 200 Lumens / Watt.).

25-30%

GENERAL SAVINGS EXPECTED

A/C CONTROL

AIR CONDITIONERS OF CAPACITY 5 TONNE AND ABOVE USED FOR LARGE OFFICES AND COMMERCIAL ESTABLISHMENTS SHALL BE CONTROLLED BY PROGRAMMABLE TIMERS.

AC CONTROL SYSTEMS :

REGULATIONS FOR AC CONTROL SYSTEMS 709.7 AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

- Air Conditioners of capacity 5 tonne and above used for large offices and commercial establishments, shall be controlled by programmable timers. The Air Conditioners for IT room /server rooms and their controls or any other rooms operational for 24 Hours a day, shall be segregated.
- The use of AC timer controls is optional for residential flats and villas.

AIR-CONDITIONERS

THE MORE THE AC EER VALUE, THE BETTER THE AC: LESS POWER CONSUMPTION, LESS CO2E, & LESS ELECTRICITY SYSTEM PEAK LOADS. AN EER OF 9.0 CAN SAVE YOU 17% OF YOUR BILL ANNUALLY WHILE EER OF 10.0 CUTS 25% ANNUALLY OFF YOUR BILL & AN EER OF 11.0 SAVES YOU ANNUALLY ALMOST 32% OF YOUR BILL.

15-20%

GENERAL SAVINGS EXPECTED

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HEATING, VENTILATION AND AIR CONDITIONING

General Guidelines given below are applicable to Heating ,Ventialtion and Air conditioning (HVAC) services for All new Buildings and additional to existing building applications.

SECTION 13 OF REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

MINIMUM EQUIPMENT EFFICIENCY(13.2)*

Cooling equipment shall meet or exceed the minimum efficiency requirements mentioned in the table (13.1)* to (13.3)* Equipment not listed here shall comply with ASHRAE 90.1 - 2007, 6.4.1 **(*AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.)**

The efficiency shall be verified through certification under an approved certification program or if no ceritification program exist the equipment efficiency ratings shall be supported by data furnished by the manufacturer.

WINDOW/SPLIT AIR CONDITONERS MINIMUM EFFICIENCY

EQUIPMENT TYPE	MINMUM EER (BTU/WH) AT OUTSIDE AIR TEMPERATURE 35 °C	MINMUM EER (BTU/WH) AT OUTSIDE AIR TEMPERATURE 46 °C	TEST STANDARD
Window / Split AC All Capacities	8.5	6.0	ASHRAE Standard 16/37

PACKAGE AIR CONDITONERS MINIMUM EFFICIENCY

EQUIPMENT TYPE	MINIMUM EER (BTU/WH)	RATING OUTDOOR CONDITION	TEST STANDARD
Single Package Air Conditioners < 19.05 kW (5.41 Tons)	9.0	35 °C (95 °F) DB	ARI 210/240
Single Package Air Conditioners 19.00 and < 39.56 kW (5.41 and < 11.25 Tons)	8.9	35 °C (95 °F) DB	ARI 340/360
Single Package Air Conditioners 39.56 kW (11.25 Tons)	8.6	35 °C (95 °F) DB	ARI 390

CHILLERS MINIMUM EFFICIENCY

EQUIPMENT TYPE	MINIMUM COP	MINIMUM IPLV	TEST STANDARD
Air Cooled Chiller All Capacities	2.80	3.05	ARI 550/590
Centrifugal Water Cooled Chiller < 530 kW (150 Tons)	5.00	5.25	ARI 550/590
Centrifugal Water Cooled Chiller ≥ 530 and < 1050 kW (≥ 150 and < 300 Tons)	5.55	5.90	ARI 550/590
Centrifugal Water Cooled Chiller ≥ 1050 kW (300 Tons)	6.10	6.40	ARI 550/590
Reciprocating Compressor Water Cooled Chiller All Capacities	4.20	5.05	ARI 550/590
Rotary Screw And Scroll Compressor Water Cooled Chiller < 530 kW (150 Tons)	4.45	5.20	ARI 550/590
Rotary Screw And Scroll Compressor Water Cooled Chiller ≥ 530 kW and < 1050 kW (≥ 150 and < 300 Tons)	4.90	5.60	ARI 550/590
Rotary Screw And Scroll Compressor Water Cooled Chiller ≥ 1050 kW (300 Tons)	5.50	6.15	ARI 550/590

NOTE: For centrifugal chiller operates at temperatures different from the ARI 550/590 rating condition, refer ASHRAE 90.1- 2007/6.4.1.2

Minimum Equipment efficiencies are required to met by all HVAC equipments .HVAC checklist and HVAC compliance forms (see appendix 02) shall show all the data and features of the air conditioning equipment and systems in sufficient detail to permit the KAHRAMAA engineer to verify that building complies with energy conservation part of the regulations. While specifying equipment models, designer can make alternatives for a particular equipment.

THE ENERGY SAVINGS BY USING HIGHER EER VALUE WINDOW /SPLIT AIR CONDITIONER WITH REFERENCE TO THE BASE CASE IS TABULATED BELOW			
EER	ANNUAL ENERGY CONSUMPTION (KW HR)	SAVING IN KW HR WITH REFERENCE TO BASE CASE (% SAVING)	REDUCTION IN CO_2 EMISSION (KG) WITH REFERENCE TO BASE CASE
8.5 (Base Case)	6,414		
9.0	6,057	357(6%)	192
9.5	5,739	675 (11%)	364
10.0	5,452	962(15%)	519
10.5	5,192	1,222(19%)	659
11.0	4,956	1,458(23%)	786

COOLING EQUIPMENT CONTROLS

ALL COOLING SYSTEMS SHALL BE CONTROLLED BY A TIME CLOCK THAT :

- Can start and stop the system under different schedules for three different day types per week.
- Is capable of retaining programming and time setting during loss of power for a period of at least 10 hours.
- Include an accessible manual override that allows temporary operation of the system for up to 2 hours

Exception to 13

OUTSIDE AIR AND EXHAUST DAMPER CONTROL

Outdoor air supply and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces are not in use.

Exception to 13.4.2 : Gravity dampers (Non Motorized) are acceptable in residential buildings and systems with design outdoor air intake or exhaust capacity of 141 L/s (300 cfm) or less.

NOTE:

The purpose of the damper control is to reduce the infiltration of hot air in to the building when ventilation systems are off or not required. Infiltration will increase the cooling load during off hours and thereby increase energy use .

COOLING TOWER FAN CONTROL

All cooling towers shall have either two speed motors, pony motors or variable speed drives.

ENERGY RECOVERY

ENERGY RECOVERY VENTILATION SYSTEM (13.5) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

Energy recovery ventilation systems shall be provided where individual fan systems with design supply air capacity of 2360 L/s (5000 cfm) or greater and have minimum outdoor air supply of 70% or greater of the design supply air quantity. Energy recovery systems shall have at least 50% recovery effectiveness.

- Laboratory systems, systems exhaust toxic, paint or corrosive fumes or dust, commercial kitchen hoods.
- Exhaust air flow rate is less than 75% of the design outdoor air flow.

NOTE:

Regulation explains exhaust air energy recovery as the process of exchanging sensible /latent heat between exhaust and outdoor air systems. This requirement generally apply to 1) Central full fresh air handling systems 2)Occupancies where high requirements for ventilation air (eg Schools,Hotels,conference hall etc)

LOAD CALCULATION

COOLING LOAD CALCULATION (13.6) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

The designer must make cooling load calculations before selecting and sizing the equipment. Cooling load shall be calculated using " Engineering standards and handbooks acceptable to the KAHRAMAA Engineer " or any computer method utilizing ASHRAE certified computer routines

NOTE:

Accurate Cooling Load calculations make helps to ensure that equipment is correctly sized .ie not undersized or oversized. Oversized equipments will increase the first cost and operates less efficiently than properly sized equipment. Undersized equipment makes poor temperature control in extreme weather conditions and also increase energy usage in other times.

SYSTEM SELECTION (13.7) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

The Air coniditioning system for the main cooling plant shall be selected in such a way that total power input for A/C equipment should be minimum

MOTOR LOADS

ENERGY EFFICIENT MOTORS HAVE HIGHER PERFORMANCE DUE TO KEY DESIGN IMPROVEMENTS AND MORE ACCURATE MANUFACTURING TOLERANCES. IT CAN REDUCE ELECTRICAL LOSSES & LOWER ENERGY CONSUMPTION. THEY'RE GENERALLY APPLICABLE IN INDUSTRIAL SECTOR.

2-6%

GENERAL SAVINGS EXPECTED

ENERGY EFFICIENT MOTORS

REGULATIONS FOR ENERGY EFFICIENT MOTORS(803.2) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

Poly phase motors which are not part of packaged unit equipment and having continuous rating and intended for long period of usage shall be energy efficient motors, tested to relevant international standards like IEEE 112 - 2004 or IEC60034 - 2 - 1.The efficiency class of the motors to be used shall be of minimum IE2 (High Efficiency) as detailed in IEC 60034 - 30.

NOTE :

Energy efficient motors have higher performance due to key design improvements and more accurate manufacturing tolerances. Lengthening the core and using lower electrical loss steel, thinner stator laminations reduce electrical losses. Improved bearings and a smaller more aerodynamic cooling fan further increase the efficiency (2 to 8% More Efficient than Standard Motors).

This regulation for energy efficient motors is generally applicable to the industrial sector

PROJECTED SAVINGS FOR MOTORS BY USING HIGH EFFICIENT MOTORS

ENERGY SAVING AND PROJECTED REDUCTION IN CO2 ENERGY EFFICIENT MOTORS 4 POLE 50 HZ				
MOTOR RATING IN KW	% EFFI-CIENCY FOR STANDARD MOTOR	% EFFICIENCY FOR HIGH EFFICIENCY MOTOR	ANNUAL SAVING USING HIGH EFFICIENT MOTOR IN KWHR FOR 12 HOURS OPERATION	ANNUAL CO2 REDUCTION PROJECTED IN KG
2.2	79.7	84.3	659	355
5.5	84.7	87.7	973	524
30	90.7	92.3	2511	1353

PERCENTATGE EFFICENCIES ARE INDIACTIVE ONLY AND MAY VARY FOR DIFFERENT MANUFACTURERS

POWER FACTOR

THE AMENDED VALUE OF THE POWER FACTOR (PF) FOR INSTALLATIONS IS 0.9 LAG OR BETTER. ALL INSTALLATIONS MUST FOLLOW THE VALUE 0.9.
JOIN HANDS TOWARDS ENERGY CONSERVATION AND HELP MITIGATE THE EFFECT OF GREENHOUSE GAS EMISSIONS BY HAVING A HIGHER PF.

0.3-1%

GENERAL SAVINGS EXPECTED

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POWER FACTOR

POWER FACTOR CORRECTION (SECTION 09) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

Regulation 901 as per mentioned in Regulations for the Installation of Electrical Wiring, Electrical Equipment and Air conditioning Equipment – Dec 2010 is stipulating the power factor, this is being amended and the amended version will be shortly published in the regulations

NOTE:

- The amended value of the power factor for installations is 0.9 lag or better.
- All installations are advised to follow the value 0.9 for design purpose.

THERMAL INSULATION FOR BUILDINGS

10-15%

GENERAL SAVINGS EXPECTED

REDUCE COOLING LOADS AND CORRESPONDING ELECTRICAL DEMAND BY SUITABLE SELECTION OF BUILDING MATERIALS, PROPER INSULATION FOR EXTERNAL WALLS AND ROOFS, PROPER WINDOW WALL RATIO ACCORDING TO WALL AND ROOF ASSEMBLY MAXIMUM U VALUE & WINDOW REQUIREMENTS INDICATED BY KAHRAMAA.

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THERMAL INSULATION OF BUILDINGS

All necessary Provisions were made to reduce the cooling loads and the corresponding electrical demand by suitable selection of building materials,proper insulation for external walls and roofs,proper window wall ratio etc in order to achieve energy efficient design. All air conditioned new buildings and addition to existing building should provide insulation requirement as below.

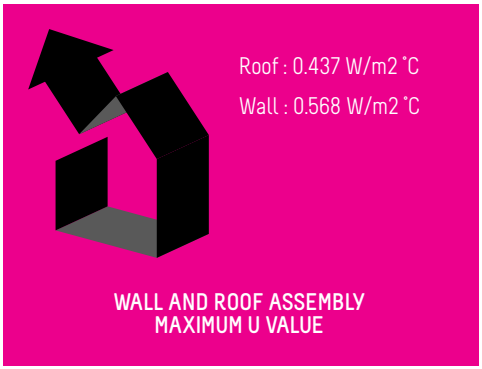
SECTION 12 OF REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

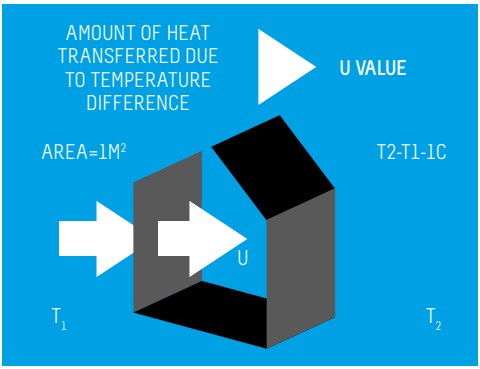
WALL AND ROOF ASSEMBLY MAXIMUM U VALUE (12.2) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

The Overall heat transfer coefficient value (U Value) for the building roof/ external wall must not exceed

Roof	: 0.437 W/m2 ˚C (0.077 Btu/h ft2 ˚F)
External Wall	: 0.568 W/m2 ˚C (0.100 Btu/h ft2 ˚F)

U value mentioned are maximum permitted values, designer to reduce the overall heat transfer coefficient values by properly selecting materilals, in such a way that materials should be available in the State of Qatar. Building materials resistence value shall be determined as per ASHRAE Fundmametals Handbook or approved lab test result data published by the manufacturer.





WINDOW REQUIREMENTS (12.3) AS PER MENTIONED IN REGULATIONS FOR THE INSTALLATION OF ELECTRICAL WIRING, ELECTRICAL EQUIPMENT AND AIR CONDITIONING EQUIPMENT – DEC 2010.

The total glass area in the building shall be reasonable to minimize the heat transmission and solar gain through the glazing. For different Window Wall ratio, overall U Value and Shading Coefficient of the glass assembly does not exceed the following values.

WINDOW WALL RATIO(WWR)	MAXIMUM U VALUE- W/M2 C (BTU/FT2H F)	MAXIMUM SHADING COEFFICIENT (SC)
5 - 40 %	3.30 (0.58)	0.40.
Above 40 %	2.10 (0.36)	0.35.

For the showroom building, double galzing shall be used with maximum U value 2.10 (0.36) W/m2 °C (Btu/ft2h F), maximum SC 0.6 and with minimum Visible Transmittance 0.3
U value shall be calculated in summer as per ASHRAE specifications. U Value and Shading Coefficient shall be certified by the manufacturer or other responsible party.

EXPLANATORY NOTES :

For the showroom building glazing type, the given U value and shading coefficient Values are maximum permitted values and in any case should not exceed from the value.

WATER CONSERVATION

Section 7 of Regulations of Internal Water Installations and Connection Works 2009 details the conservation measures

The regulations stipulated are as listed below

WATER CONSERVATION GUIDELINES: SECTION 7 OF REGULATIONS OF INTERNAL WATER INSTALLATIONS & CONNECTION WORKS- MAY 2009

Considerable amount of energy is consumed to deliver and treat the water we are using every day. By reducing the water use by efficient means will reduce the energy required to supply and treat public water. In designing plumbing systems, utilize new techniques and options that can lead to maximum water efficiency.

The guidelines that must be considered while designing the plumbing system for new and addition to existing buildings by all consultants, customers and developers, are as follow:

LOW FLOW FAUCETS AND TAPS IN ALL PUBLIC BUILDINGS :

Low flow faucets and taps (Automatic / Sensor Operator / Electronic / Pressed) shall be used in all public use buildings. The maximum flow rate shall not exceed 2.0 gallons per minute (gpm) (7.5 Liters / Minute L / Min.) at a pressure of 80 Pounds per Square Inch (PSI) at the inlet when water is flowing, and the minimum flow rate shall not be less than 0.8 gpm (3.0 L / Min.) at a pressure of 20 PSI at the inlet, when water is flowing.

LOW FLOW FAUCETS/AERATORS IN PUBLIC/PRIVATE BUILDINGS

10-12%

GENERAL SAVINGS EXPECTED

AERATORS SHALL BE INSTALLED IN BATHROOMS AND KITCHEN OF ALL PRIVATE AND PUBLIC BUILDINGS. THE MAXIMUM FLOW RATE FROM AERATORS SHALL NOT EXCEED 8.32 LITERS/ MINUTE. IT CUTS WATER CONSUMPTION BY ALMOST HALF IN COMPARISON TO TRADITIONAL FAUCETS.

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FAUCET AERATORS (WATER FLOW REDUCERS) IN ALL PUBLIC AND PRIVATE BUILDINGS:

Aerators shall be installed with conventional faucets and taps in bathrooms and kitchen of all private and public buildings. The maximum flow rate from aerators shall not exceed 2.2 gallons per minute (gpm) (8.32 liters per minute L / min)

LOW VOLUME FLUSH TANKS IN TOILETS IN ALL PUBLIC AND PRIVATE BUILDINGS:

The maximum volume of water that may discharged from flush tank shall not exceed the following amount :

For single flush tanks : 1.68 gallons (6.4 liters) / flush.

For dual flush tanks : 1.40 gallons (5.3 liters) / flush in reduced flush mode and 2.0 gallons (7.6 liters) / flush in full flush mode.

DUAL FLUSH OPERATION

NOTE:

In All Buildings, The Urinal System Must Be Flushed Only After Usage, Either By Manually Or Electronic Type Only.

15-20%

GENERAL SAVINGS EXPECTED

WATER CLOSETS

AN EFFICIENT WATER CONSUMPTION CLOSETS (OF 5 TIMES USES/DAY) HAS A FLOW RATE OF 4.9 L/FLUSH CONSUMES 25 LITRES IN COMPARISON TO A NON-COMPLIANT CLOSET OF 7.6 L/FLUSH AND CONSUMES 38 LITRES.

BEST PRACTICES IN WATER CONSERVATION

1. FAUCETS/WASH BASINS/KITCHEN SINKS

The flow rates of the faucets shall not exceed the maximum flow rate as stipulated in table below

SL.NO.	DESCRIPTION	MAXIMUM ALLOWABLE FLOW RATE
1	Wash Basins- Residential Occupancy	3.8 L/min or 1 gpm
2	Wash Basins- Non Residential Occupancy	1.9 L/min or 0.5 gpm
3	Wash Basins – Mechanical or Electronic Metered Faucet(suitable for public facilities like Mosque, School, Park etc)	3.8 L/min or 1 gpm
4	Kitchen Sinks	5.7L/min or 1.5 gpm

2. WATER CLOSETS/ TOILETS

The flow rates of the toilets shall not exceed the maximum flow rate as stipulated in table below

SL.NO.	DESCRIPTION	MAXIMUM ALLOWABLE FLOW RATE
1	Single Flush Toilets	4.9 L or 1.28 gpf /flush
2	Dual Flush Toilets – Full Flush Dual Flush Toilets – Half Flush	6 L or 1.6 gpf /flush 3.8 L or 1 gpf / flush

3. SHOWERS

The flow rates of shower head or hand held showers shall not exceed 7.6 L/min or 2 gpm

4. IRRIGATION

- Select native species of plants which consume less water
- Use drip irrigation
- Use non potable water for irrigation
- Sub-meter and monitor water consumed for irrigation to detect any possible leaks in the irrigation system
- Use moisture sensors and weather based controls to reduce the water consumption for irrigation

SL.NO.	FIXTURE & USAGE	WATER CONSUMPTION BY A NON COMPLIANT FIXTURE	WATER CONSUMPTION BY A COMPLIANT FIXTURE	WATER CONSUMPTION WHEN BEST PRACTICES ARE ADAPTED
1	Faucet/ occupant uses for 10 minutes per day (average)	Flow rate: 9.5 liters per minute Consumption: 95 liters	Flow rate: 8.4 liters per minute Consumption: 84 liters	Flow rate: 3.8 liters per minute Consumption: 38 liters
2	Water Closet/ occupant uses for 5 times per day (average)	Flow rate: 7.6 liters per flush Consumption: 38 liters	Flow rate: 6 liters per flush Consumption: 30 liters	Flow rate: 4.9 liters per flush Consumption: 25 liters
3	Showers/ occupant uses for 5 minutes per day (average)	Flow rate: 9.5 liters per minute Consumption: 48 liters	Flow rate: 9.5 liters per minute Consumption: 48 liters	Flow rate: 7.6 liters per minute Consumption: 38 liters
Total Water Consumption per person per day		181 liters per person per day	162 liters per person per day	101 liters per person per day
Water Savings per person per day			19 liters per person per day	80 liters per person per day
CO_2 Emission reduction per person per day @8.2 of kg of CO_2/m3			160 kg of CO_2 per person per day	660 kg of CO_2 per person per day

WATER SAVINGS & ENVIRONMENTAL BENEFITS OF ADOPTING BEST PRACTICES

BEHAVIORAL PRACTICES

This part of the document provides practical behavioral measures to reduce electricity and water consumption

AIR- CONDITIONING

- Switch off AC appliances during unoccupied hours
- Set AC temperature to 24 C or above.
- Increase the thermostat set point above 26 C in less frequently used spaces like store room and other unoccupied areas
- Select lower air speed on contrl units of the AC fan
- Avoid humidity by vapor generation in conditioned spaces
- When the AC is on, make sure windows are closed to reduce the infiltration of unconditioned air. This is the simplest way to keep your cooling efficient.
- Clean the Air conditioning filters frequently, at least once in a month.

LIGHTING

- Use natural light whereever possible. Ensure windows are clean and encourage staff to open blinds before thinking of switching on lights.
- When installing new lighting, provide seperate control for less frequently used areas, so that the same can be switched on and off independently of other lights.
- Ensure that light switches are clearly labeled, and the use of colored themes on the switches to indicate priority of switching off lights is always useful.
- Install presence detector lighting controls in places that are not in constant use (like the toilets, or photocopying room).
- Always switch off your office lights as you leave.
- Energy efficient light bulbs may be more expensive initially, but they will save in the long run.
- Clean light fittings regularly to ensure they are used to the maximum.

OFFICE EQUIPMENT

- Do not leave any office equipment ON overnight
- Share printers as much as possible, avoiding printers sitting idle.
- When you switch off devices make sure you switch off the electricity socket as well.
- Provide motivational slogans in conspicious locations to practice conservation
- Do not use screen savers, it is far more efficient to use the standby mode settings available, or to encourage staff to switch off their computer and/or monitors when away from their desks.
- When leaving the office avoid leaving any equipment on 'stand by' mode, it will still use energy and should be switched off instead.
- Ensure that equipment purchased has Energy Efficiency Labeling following international standards which will minimize energy consumption.
- Make sure to activate any power saving features in your devices because often it is set up as being disabled.
- Run photocopiers in batches to ensure that the photocopier does not spend more time than needed switching between high power and sleep modes.

WATER

- Dual flush toilets needs to have a clear poster on top of it to demonstrate its usage
- Water taps should not be opened in full
- Water leaks in toilets or elsewhere should be reported and fixed immediately.
- Provide motivational slogans in conspicious locations to practice water conservation
- Housekeeping and kitchen staff should be educated on how to use the minimum amount of water during cleaning or washing the cups and be penalized if caught wasting.
- Run appliances like washing machines and dishwashes at full load.
- Choose water efficient fixtures and appliances on new purchases

TRAINING

- Facilities management staff should have up-to-date training on energy & water conservation, this will not only help to promote the concept of energy efficiency but will reduce operational cost of the building. The following subjects would be helpful for energy management.
- Calculating your Carbon Footprint
- Introduction to Energy& Water Regulations and Standards
- Energy & Water Auditing in Practice
- Planning and Costing of Energy & Water Conservation Projects
- Small Scale Renewable Energy Sources
- Metering, Monitoring and Targeting

USE ALTERNATE ENERGY SOURCE :

It is preferable to specify renewable energy source like solar energy for plumbing applications, such as, solar water heater.

The consultants must provide the fixture information of each typical installed fixture type in drawings, like fixture model, flush rate in gallons, water flow rate, for KAHRAMAA, CSD, for approval during BP stage.

GLOSSARY

BP: Building permit

CSD: Customer Services Department

CFL: Compact fluorescent lamps

COLOR RENDERING: Expression for the effect of an illuminant on the color of an object in conscious comparison with their color as seen under a reference illuminant (daylight).

COLOR RENDERING INDEX (CRI) is a measure of the effect of light on the perceived color of objects. A low CRI indicates that some colors may appear unnatural when illuminated by the lamp.

COEFFICIENT OF PERFORMANCE (COP) : The ratio of net refrigeration effect to the rate of energy input .The numerator and denominator should be in same units.

ENERGY EFFICIENCY RATIO (EER) : It is the ratio of net cooling capacity in Btu/h to the total rate of electric input in Watts under designated operating conditions. The total input power shall include power input to the compressor(s) and fan(s) plus controls and other items included as part of the designated model.

INTEGRATED PART - LOAD VALUE (IPLV) : A single number figure of merit based on part load E E R,COP,or kW/ton expressing part load efficiency for air conditioning equipment on the basis of weighted operation at various load capacities of the equipment.

LED: Light Emitting diode

LUMEN: Unit of luminous flux; the flux emitted within a unit solid angle by a point source with a uniform luminous intensity of one candela. One LUX is one lumen per square meter.

LUX: This is the metric unit of measure for illuminance of a surface. Average maintained illuminance is the average of LUX levels measured at various points in a defined area. One LUX is equal to one lumen per square meter.

LUMINOUS EFFICACY: Quantity of light (lumen) emitted for each unit of electrical power (watt) consumed. The unit is 'lumen/watt' (lm/W).

LUMINAIRE: A luminaire is a complete lighting unit, consisting of a lamp or lamps together with the parts designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply.

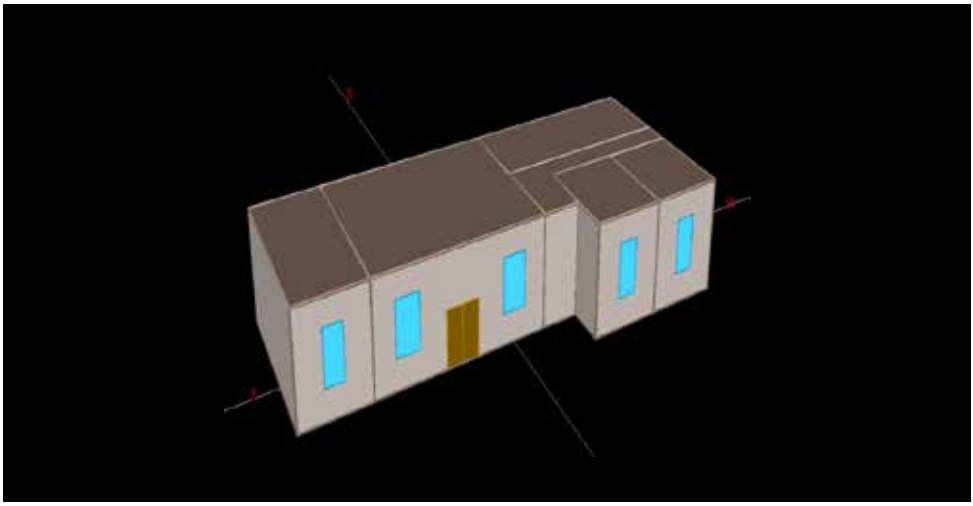
SHADING COEFFICIENT (SC): The ratio of solar heat gain at normal incidence through glazing to that occurring through 1/8 in thick clear double strength glass.

U VALUE (OVERALL HEAT TRANSFER COEFFICIENT): Heat transmission in unit time through unit area of material of construction and the boundary of air films, induced by unit temperature difference between the environments on each side. Units of U are W/m2 ^{0}C (Btu/h.ft2 ^{0}F).

VISIBLE TRANSMITTANCE (VT): It is the fraction of visible light transmitted through the glazing material

WINDOW WALL RATIO (WWR): The window wall ratio is the ratio of vertical fenestration area to gross exterior wall area. The fenestration area is the rough opening ie it includes the frame, sash and other nonglazed window components. The gross exterior wall area is measured vertically from top of the floor to bottom of the roof.

APPENDIX 1:
ENERGY SIMULATION CASE STUDY



ENERGY SIMULATION OF SINGLE STOREY VILLA

To analyze the effectiveness of conservation measures ,consider a single storey villa having an area of 208 m2.

In the first stage, building is analyzed without any energy conservation measures (Base Case) ie No wall/ roof insulation ,single glazing and air conditioned by Low efficient split AC unit .Then various single effect conservation measures are added to the base case and simulations are performed using Equest software . Simulations are performed for Doha climatic conditons. Results of the simulations are detailed below.

	DETAILS OF SIMULATION	TOTAL COOLING LOAD (TR) (% SAVINGS FROM BASE CASE)	ELECTRIC PEAK LOAD (KW) (% SAVINGS FROM BASE CASE)	ANNUAL ELECTRIC CONSUMPTION (KWH) (% SAVINGS FROM BASE CASE)	CO_2 EMISSION REDUCTION IN KG FROM BASE CASE
BASE CASE	NO ENERGY CONSERVATION MEASURE Floor Area -208 m2 Window Area -26.5 m2 Wall Area -245 m2 Single Glazed Window A/C EER – 7.5	12.0	32.0	115,688	
CASE -1 ADDING INSULATION TO WALL ONLY.	WALL U VALUE =0.363 W/ m2 C	8.0 (32 %)	23.0 (27 %)	92,296 (20 %)	12,608
CASE -2 ADDING INSULATION TO ROOF ONLY	ROOF U VALUE =0.380 W/ m2 C	10.0 (15 %)	28.0 (13 %)	102,417(11 %)	7,153
CASE -3 ADDING DOUBLE GLAZING TO WINDOW ONLY	WINDOW U VALUE=2.850 W/ m^{2C}, Shading Coefficient=0.27	(% 4) 11.5	(% 3) 31.0	(% 3) 111,679	2,161
CASE -4 HIGH EFFICIENT AC ONLY	E E R = 10 NOS SU -5	12.0	(% 25) 24.0	(% 20) 92,449	12,526
CASE -5 EFFICIENT LIGHTING ONLY	LIGHTING & POWER DENSITY W/m^2 6.5=	(% 4)11.5	(% 9)29.0	(% 11)102,667	7,018
CASE -6 COMBINING ALL ENERGY CONSERVATION MEASEURE -CASE-1,2,3, 4, & 5	WALL U VALUE =0.363 W/ m^{2C} ROOF U VALUE =0.380 W/ m^{2C} WINDOW U VALUE=2.850 W/ m^{2C} E E R = 10, Lighting Density = 6.5 W/m2	(59%) 5.0	(% 61) 12.0	(60%) 45,856	37,639

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