

## Green Building Regulation GB - 6.0

### Warehouses & Industrial development

(For projects with building permit obtained prior to DBC implementation)

PCFC- Entity (Business Unit) Name	:	Trakhees – Ports, Customs & Free Zone Corporation
Department Name	:	Civil Engineering Department (CED)
Section Name	:	Permit Section (Green Buildings/ Sustainability)
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## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
<b>A: GENERAL REQUIREMENTS</b>							
1	Integrated Design Approach for achieving energy savings	<b>MANDATORY</b>	To encourage a collaborative and integrative process for designing, constructing and operating the warehouse building.	Where evidence demonstrates that ALL the key stakeholders comprising ALL of but not limited to developer / client, designers and contractors have effectively participated in the design process.	KEY stakeholders comprising all of but not limited to designers and builders should be part of integrated design development process wherein important aspects are deliberated.  The process should include discussions on envelope, hvac options, lighting schemes, innovative day lighting technologies, renewable technologies, commissioning, ease of operations & maintenance etc. as applicable for the project.	1.Minutes of meeting of the integrated design process.  2.Date stamped photograph.  3.A briefing note on what has been accomplished.	<b>NONE.</b>
2	<u>Post Contract Green Briefing.</u>  Sustainability Kick-off ( During commencement of construction )	<b>MANDATORY</b>	To seek full support, cooperation and commitment from the stakeholders during the construction phase of the project.	Where evidence provided demonstrates that a program is in place to ensure commitment from all stakeholders for site level compliance of green building design..  The scope and the deliverables of KEY stakeholders from the point of view of "Green Building Regulatory Compliance" is discussed and conveyed during this Kick Off meeting.	A project specific green building presentation should be made to all the stakeholders.  The presentation has to be a part of the agenda during formal "Project Kick-off" meeting.  The key stakeholders should comprise ALL of but not restricted to Civil and MEP contractors, project architect and consultants, client representative and product and technology suppliers.	1.Extract of the tender documents / specification confirming the requirement of a <u>project specific</u> green building presentation during the project kick-off meeting.  2.A formal letter from the client / developer confirming that a Green brief presentation would be a part of the Project Kick-off.-	1.Copy of the Green building presentation / briefing made during the project kick-off to specifically address the green design and to assign roles various stakeholders.  2.Minutes of Meeting (MOM) to confirm attendance.  3.Date stamped photograph.

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

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<b>B: ENVELOPE &amp; ENERGY</b>							
1	<p>Compliance with <u>Thermal Insulation System and Best Practices Energy conservation methods</u></p> <p>[For both Air-conditioned and Non Air-Conditioned buildings.]</p>	<b>MANDATORY</b>	<p>To reduce/control the solar heat gain through windows.</p> <p>To reduce conductive heat gain through opaque elements into the occupied space</p> <p>To encourage Warehouse Developments to achieve increased levels of performance. Sound design principles focusing on the insulation minimizes the environmental impact and thereby CO2 emissions associated with their operational energy consumption.</p> <p>Excessive heat gain increases the temperature within the space causing discomfort to the occupants. It also Increases the capacity of the HVAC equipment required to cater to this additional heat load being added to the space. Alongside, equipment sized higher consumes greater energy during their operations and may require greater maintenance.</p>	<p>Where evidence provided demonstrates an improvement in the energy efficiency of the building's fabric and services and therefore achieves lower building operational related CO2 emissions. The envelope addresses the following</p> <p>1) Roofs 2) Walls 3) Slab 4) Door 5) Vertical Glazing 6) Skylight</p>	<p>All Warehouses should be designed to achieve the environmental parameters (U-values, Solar heat gain coefficients, etc.) for various components of the building Fabric/ Envelope as mentioned in Table-1 of the Annexure that is part of the Regulation.</p>	<p>1. Specification documents stating types of glazing, roof and wall insulation.</p> <p>2. Calculations demonstrating average U-values and other thermal characteristics specified for the project.</p> <p>3. Typical sections of the envelope for both conditioned and non-conditioned spaces.</p> <p>4. These Envelope values must be used in the heat load estimation and sizing of the AC Equipment. Accordingly the heat load estimate should demonstrate these inputs.</p> <p>5. The Envelope details MUST be confirmed by filling the envelope commitment sheet of part of the <b>GBF-11 submission booklet</b>.</p>	<p>1. As-Built envelope details i.e. glazing, roof and wall to confirm compliance to design values. These must be reflected in the submission booklet</p> <p>2. Contractor's material data sheets for the envelope elements.</p> <p>3. Date stamped photographic evidence as applicable.</p> <p><i>NOTE: For specific situations, the compliance to these specific requirements may be required to be physically verified during the final check.</i></p>

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2	Limiting / Reversing Thermal Bridges  [Continuous Insulation / Associated Strategies]	MANDATORY	<p>To minimize the thermal bridges and maximize the Insulations' effectiveness between the enclosed space (Interior) and external (ambient) space through careful design and good construction practices.</p> <p>Heat flow through conductive components in an otherwise well-insulated assembly, results in disproportionately significant heat gain into the space.</p> <p>Thermal Bridges in a building can be expensive and cost prohibitive besides causing excessive heat gain and in some cases condensation as well.</p>	<p>Where evidence provided demonstrates that continuity of the thermal insulation is achieved to the practical extent possible</p> <p>Where thermal bridges do occur, care should be taken to minimize their effects right at the design stage through proper design review.</p>	<p>All Insulating building components must be designed and installed to work in unison and create a <u>continuous barrier</u> to heat flow in the building envelope. The insulation should be reviewed in relation to</p> <ul style="list-style-type: none"> <li>• Its location within the walls and Roofs</li> <li>• Its interface / connectivity with surrounding or penetration materials</li> <li>• Connectivity within and between insulating components.</li> </ul>	<p>1. Statement on strategies adopted to reduce Thermal bridging.</p> <p>2. Supporting documents such as drawings / extract of specifications to demonstrate such strategy.</p>	<p>1. As Built drawings showing the strategies followed on site for limiting the thermal bridging.</p> <p>2. Date stamped site photographs where relevant.</p>

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3	<p>Envelope Tightness (Prescriptive based)</p> <p><u>THERMAL IMAGING TECHNIQUE</u></p> <p>[Only for Air Conditioned Spaces]</p>	<b>MANDATORY</b>	<p>To discover defects in the Building Envelope and rectify them on time prior to operations so as to avoid loss of precious energy through leakages in the envelope (flow of air through gaps and cracks in the fabric of a building). To eliminate the air leakage paths through the fabric except through intentional openings.</p> <p>To ascertain if there are any inadequacies hidden in and around walls, ceilings, windows, doors and air ducts of the development as these are potential areas for wastage of energy and raising the energy costs of the proposed facility.</p> <p>Thermal Imaging This principle is used to ascertain the continuity of the insulation in accordance with the construction drawing and to identify patterns of heat loss from the property that are invisible to the naked eye.</p> <p>It is conducted by a qualified thermographer using infrared cameras which is able to determine the pattern of heat loss through the fabric of the building and HVAC systems.</p>	<p>Where evidence provided demonstrates that the project has</p> <ol style="list-style-type: none"> <li>Carried out interior <u>Thermal Imaging for the Air-Conditioned / climate controlled spaces</u> to identify the building defects caused by cracks, poor insulation or shoddy construction.</li> <li>Used the results of the above Thermal Imaging exercise to improve the energy efficiency of the facility by appropriate corrective actions to locate and fix the leaks and gaps identified.</li> <li>The tests and the reports should comply with specific conditions. Details as per Table-2 of Annexure</li> </ol>	<ol style="list-style-type: none"> <li>The envelope tightness should be ascertained by thermal imaging being carried out by a qualified thermographer.</li> <li>The thermography report should highlight the leakage spots noticed in the space and provide recommendations for rectifications</li> <li>The defects in the building envelope as detected and reported by the thermographer should be rectified.</li> <li>Note The types of issues that are usually found are improperly insulated access panels, air leaks at room corners and around windows and door frames, missing or compacted wall insulation, air infiltration at lighting fixtures and a host of other energy-wasting defects</li> </ol>	<ol style="list-style-type: none"> <li>Extract from the specification highlighting this requirement.</li> <li>Specification documents stating the strategy proposed to be deployed for checking the tightness of the envelope and the description of the system.</li> <li>Detailed Method statement for the proposed works before and after the test.</li> </ol>	<ol style="list-style-type: none"> <li>Report of the thermography test undertaken clearly tabulating the identified inconsistencies / leakage areas in the envelope.</li> <li>Report of corrective actions undertaken to rectify the defects. Thermal image should be provided to demonstrate compliance (before and after rectification).</li> <li>Copy of the contract with the specialist, providing a definitive time frame for completing all the sub elements. It also becomes legally binding on their part to submit the report on or before the committed date</li> <li>Date stamped photographs</li> </ol>

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4	Envelope Tightness (Performance based)  <u>BLOWER DOOR TEST TECHNIQUE</u>	VOLUNTARY	<p>To discover defects in the Building Envelope and rectify them on time prior to operations so as to avoid loss of precious energy through leakages in the envelope (flow of air through gaps and cracks in the fabric of a building)</p> <p>To ascertain if there are any inadequacies hidden in and around walls, ceilings, windows, doors and air ducts of the development as these are potential areas for wastage of energy and rising energy costs of the proposed facility.</p> <p>Subjecting the development to blower door testing which is a diagnostic tool to measure how much infiltration is occurring in the built facility.</p>	<p>Where evidence provided demonstrates that the building / facility</p> <ol style="list-style-type: none"> <li>has installed an airtight envelope;</li> <li>has taken the measures to identify the defects / leakages in the envelope by subjecting it to door blower test</li> <li>The air leakage is contained within maximum of 10m<sup>3</sup>/hr /m<sup>2</sup> @ 50 Pascal.</li> <li>Details as per <b>Table-2</b></li> </ol>	<p>The principal contractor accounts for the door blower test within the programme of works and this comprises at a minimum the following tasks:</p> <ol style="list-style-type: none"> <li>Setting up the blower door.</li> <li>Preparing the building for the Pre blower door test.</li> <li>Performing the blower door test.</li> <li>Recording the results on performance testing form</li> <li>Reporting the result to the contractor.</li> </ol> <p>These test need to be conducted with the use of a blower door to measure the amount of leakage of an object (thereby ascertaining the envelope tightness) which can in turn be extended with the use of techniques such as thermography and smoke simulations to locate any excessive leakages.</p>	<ol style="list-style-type: none"> <li>Specification documents stating the strategy proposed to be deployed for checking the tightness of the envelope, the description of the system and the numerical values proposed to be met.</li> <li>Detailed method statement by the appointed specialist</li> <li>Copy of the contract / purchase order to support the appointment of the specialist for the subject work</li> </ol>	<ol style="list-style-type: none"> <li>Test Report demonstrating compliance / corrective actions undertaken to seal the envelope. The report should include all of but not limited to the following <ol style="list-style-type: none"> <li>Executive summary of the air tightness test</li> <li>Test objective</li> <li>Test Methodology</li> <li>Test details</li> <li>Formal test Report – Positive pressurisation test</li> <li>Test Envelope description and Fan diagram</li> <li>Date stamped Photographs as evidence.</li> </ol> </li> <li>Copy of the contract with the specialist, providing a definitive time frame for completing all the sub elements. It also becomes legally binding on their part to submit the report on or before the committed date.</li> </ol>

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5	Efficient SIZING of the HVAC systems	MANDATORY	<p>To encourage optimum use of resources by an Engineering approach to <u>sizing and selection</u> of HVAC equipment and systems.</p> <p>To Reduce Cooling loads and Energy use of the facility.</p>	<p>Where evidence provided demonstrates that the equipment and systems have been selected after carrying out proper engineering calculation in line with the internationally accepted practices.</p>	<p>Heat load calculations should be carried out for all the conditioned areas of the building and the <u>results of these calculations should be used</u> as the basis for selecting the Air-conditioning equipment.</p> <p>Where heat recovery units are being used, a proper ventilation calculations should be carried out (areas such as kitchen, toilet etc. requiring ventilation) and the results of such calculations should be used for sizing the fresh air systems, exhaust systems and Energy Recovery Units etc.</p>	<ol style="list-style-type: none"> <li>Heat load calculations for conditioned area incorporating the right envelope thermal characteristics ( as confirmed in point 1)</li> <li>Fresh air / ventilation calculation.</li> <li>Schedule of equipment with the capacities</li> <li>Confirmation of air balance for energy recovery system</li> </ol>	<ol style="list-style-type: none"> <li>Technical submittals / material data sheets for the installed equipment.</li> <li>Date stamped photograph.</li> </ol>
6	Central air conditioning units equipped with Energy Recovery Units and regulated air intake system (Where Applicable)	MANDATORY	<p>To prevent loss of energy brought about by exhausting conditioned air from the space to the outside and to reuse it for productive purposes.</p> <p>To encourage good design principles in optimizing energy where appropriate and feasible.</p>	<p>Where evidence demonstrates that the project has incorporated strategies to avoid energy loss brought about by exhausting conditioned air to the atmosphere.</p>	<p>Energy recovery systems should be used in all combined supply &amp; extract air handling units <u>where applicable and found practical</u> in terms of</p> <ol style="list-style-type: none"> <li>Quantity of air extracted.</li> <li>Availability of ERV systems for that capacity.</li> <li>Assessment of the benefits.</li> </ol>	<ol style="list-style-type: none"> <li>Extract from specifications on the of heat recovery units.</li> <li>Schedule of equipment</li> <li>Design drawing highlighting the layout of heat recovery units.</li> </ol>	<ol style="list-style-type: none"> <li>Approved material data sheets / technical submittals for the installed equipment.</li> <li>Date stamped photograph of the installed units.</li> </ol>

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7	Selection of A/C unit with HIGH Energy Efficiency Ratio (EER)	MANDATORY	To optimize the energy consumption of Air Conditioning units proposed to be used in the project.	Where the evidence provided demonstrates that the energy efficient AC equipment has been procured for the project.  NOTE. The selected unit should be consistent with the capacities indicated in the Point no 5 under "Efficient Sizing of the HVAC system"	All Air Conditioning units should meet the <u>Minimum Energy Efficiency Ratio (EER)</u> as mentioned in <b>Table-3</b> of the Annexure.  For those units that do not find mention in the Table-3, the Energy Efficiency Ratio (EER) should follow the requirements set out in ASHRAE 90.2/ASHRAE 90.1 as applicable for the project.	<ol style="list-style-type: none"> <li>1. Extract from Specification highlighting the requirements on EER.</li> <li>2. Schedule of AC equipment alongside committed EERs.</li> <li>3. Confirmation by filling the EER table in part 5 the submission booklet</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material data sheets / technical submittals for the installed equipment.</li> <li>2. Confirmation by filling the EER table in part 5 the submission booklet</li> <li>3. Date stamped photograph of the installed units. This should include the nameplate of units which covers type refrigerant used, total Kw &amp; refrigerant charge.</li> </ol>
8	Energy Efficient Auxiliary Systems of HVAC systems- Blowers and Pumps	MANDATORY	To encourage selection of high-efficiency auxiliary equipment of the HVAC systems especially fans and pumps. (Applicable to Air Handling Units (AHUs), Fresh Air Handling Units (FAHUs), chilled water pumps etc.)	Where the evidence provided demonstrates that the project team has selected the most energy efficient fans and pumps as applicable for the project.	The AHU, FAHU and other centrifugal fans proposed to be used for the project must be selected so as to have the lowest bhp/1000 cfm.  The Pumps proposed to be used for the HVAC system must be selected for the highest efficiency	<ol style="list-style-type: none"> <li>1. Copy of relevant section of the specification confirming the compliance</li> <li>2. Schedule of equipment indicating the power and efficiency levels of the fans and pumps respectively.</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material datasheet with the performance curve / selection point.</li> <li>2. Date stamped photograph of the installed equipment.</li> </ol>



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9	INTERIOR LIGHTING LEVELS	MANDATORY	To optimize the energy consumption of Interior Lighting in order to reduce the lighting energy use as well as cooling loads for the conditioned spaces such as offices, warehouses etc.  Note Even If the areas are not climate controlled, the comfort level would be enhanced by eliminating / reducing unnecessary lighting.	Where evidence demonstrates that the interior lighting levels are improved and NOT exceed those limits prescribed by Table-4.	The Interior lighting levels (both warehouse and office areas) should comply with the limits specified in the Table -4 of the Annexure.  For those units that do not find mention in the table, the lighting levels specified should be at least 20% lesser than those levels prescribed in ASHRAE90.1 - 2007	<ol style="list-style-type: none"> <li>Proposed specifications on the lighting levels.</li> <li>A comparative table with the LPD values for Trakhees case and the proposed case scenario for various areas of the project including the overall savings achieved.</li> </ol>	<ol style="list-style-type: none"> <li>As built calculations to confirm the design values / lighting values required in the regulation</li> <li>As built drawings.</li> <li>Date stamped photos of the installation</li> </ol>
10	EXTERIOR LIGHTING LEVELS	MANDATORY	To optimize the energy consumption of exterior Lighting in order to reduce the total lighting related energy use of the warehouse facility.	Where evidence demonstrates that the exterior lighting levels are improved and NOT exceed those limits prescribed by Table-4.	The Exterior lighting levels in the warehouse development should comply with the limits specified in the <b>Table -4</b> of the Annexure of the Regulation.  For those units that do not find mention in the table, the lighting levels specified should be at least 20% lesser than those levels prescribed in ASHRAE90.1 - 2007	<ol style="list-style-type: none"> <li>Proposed specifications on the lighting levels.</li> <li>A comparative table with the LPD values for Trakhees case and the proposed case scenario for various areas of the project including the overall savings achieved.</li> </ol>	<ol style="list-style-type: none"> <li>As built calculations to confirm the design values / lighting values required in the regulation.</li> <li>As built drawings.</li> <li>Date stamped photos of the installation</li> </ol>
11	Use of Renewable sources of energy for domestic heating	MANDATORY	To encourage use of renewable power and reduce dependence on grid power for domestic heating purposes, thereby obviating environmental impacts (carbon emissions and atmospheric pollution) associated with fossil fuel.	Where evidence provided demonstrates that a feasibility study for solar thermal system has been carried out and the results implemented so as to achieve reductions in the building's CO2 emissions	Solar water heating (Solar thermal) technology shall be employed for domestic hot water requirements.  The solar hot water heating system must incorporate measures for efficient distribution system, pipe insulation and use of energy efficient electric hot water system (which is normally used as backup).	<ol style="list-style-type: none"> <li>Details of the solar system proposed i.e. power generated, heating capacity etc.</li> <li>Extract of specification about the system</li> <li>Plumbing drawings and schematics incorporating the above.</li> </ol>	<ol style="list-style-type: none"> <li>Approved material data sheets / technical submittals</li> <li>Date stamped Photographic evidence</li> <li>Commissioning report</li> <li>As-built plumbing / water supply layout showing the installed solar water heating system.</li> </ol>

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12	Use of Renewable sources of energy for power	VOLUNTARY	To encourage use of renewable power and reduce dependence on grid power for a proportion of the energy (lighting) demand, thereby obviating environmental impacts (carbon emissions and atmospheric pollution) associated with fossil fuel.	<p>Where evidence provided demonstrates that a feasibility study considering for renewable power generated at site has been carried out and the results implemented so as to achieve reductions in the building's CO2 emissions.</p> <p><u>Note</u> Considering the recent DEWA policy that permits grid connected solar systems, all efforts should made be towards maximising the benefits and discouraging the use of batteries for energy storage.</p> <p>This should however be upon approval in writing by DEWA.</p>	Solar PV system shall be utilized to generate power and cater to select loads of the development such as external security lighting loads, security lamps and any other lighting requirements specific to the project.	<ol style="list-style-type: none"> <li>1. Renewable report comprising energy calculations and minimum kW of renewable energy proposed to be generated in the project</li> <li>2. Details of the Solar PV system proposed.</li> <li>3. Extract of specification containing the PV system.</li> <li>4. Electrical drawings / layout incorporating the scheme.</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material data sheets / technical submittals</li> <li>2. Date stamped Photographic evidence</li> <li>3. Commissioning report</li> <li>4. As-built plumbing / water supply layout showing the installed solar water heating system.</li> </ol>

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13	Energy Sub-Metering	MANDATORY	<p>To recognise and encourage monitoring of operational energy consumption through sub-metering and monitoring strategy. To develop the infrastructure to capture system level energy use</p> <p>The provision of such a metering mechanism would pave the way for subsequent benchmarking of a facility and would also enable the individual facilities to compare their environmental performance against their peer groups or their branches elsewhere, thereby providing an opportunity to raise the bar of the facilities.</p>	<p>Where evidence demonstrates that clearly labelled and easily accessible energy sub meters have been provided to collate and track the energy consumption of major building systems at regular intervals.</p> <p>The systems to be considered at the <u>basis level</u> are:</p> <ol style="list-style-type: none"> <li>1. Air conditioning and Mechanical ventilation systems.</li> <li>2. Lighting and small power systems</li> </ol> <p>Sub-meters should be duly labelled for easy identification and tracking.</p> <p><u>Note</u> The criterion for this credit is for a basic sub metering infrastructure and a monitoring program; It does NOT imply any advanced metering through system such as BMS.</p>	<p>Develop a sub-metering and monitoring strategy to account for a minimum of 90% of the proposed building's incoming energy source (Electricity) so that it can be assigned to end uses such as cooling, lighting etc.</p> <p>Provide separate metering facility ( i.e. check meters ) for the following types of loads.</p> <ol style="list-style-type: none"> <li>1. Air conditioning and Mechanical ventilation systems that include both the high side and low side mechanical and electrical equipment.</li> <li>2. Lighting and small power systems</li> </ol> <p>The individual meters should be easily accessible and distinctly labelled.</p> <p><b>In case</b> the facility is contemplating a BMS / Automatic controls, these meters should be capable of providing the required outputs and integration.</p>	<ol style="list-style-type: none"> <li>1. Electrical Single Line Diagrams (SLD) showing the type, location and the designation of the meters.</li> <li>2. Technical specifications of the meters</li> <li>3. Schedule of Sub-meters in a tabular format providing details of sub meters, location and loads / areas being served by the sub meters.</li> </ol>	<ol style="list-style-type: none"> <li>1. As built Electrical Single Line Diagrams (SLD) showing the type, location and the designation of the meters.</li> <li>2. As installed Schedule of Sub-meters in a tabular format providing details of sub meters, location and loads / areas being served by the sub meters.</li> <li>3. As Built drawings showing the locations of the meters.</li> <li>4. Date stamped photographs of the sub meters.</li> </ol>
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14	Commissioning	MANDATORY	To encourage and recognize commissioning and handover initiatives that ensure that all building services of the proposed facility (office, warehouse and associated developments) can operate to optimal design potential.	Where evidence demonstrates that the project team has made provisions for carrying out the commissioning activities and transferring the required best practice expertise to the client / owner / operator of the facility.	Undertake comprehensive in accordance with ASHRAE Commissioning Guideline for mechanical services that includes at a minimum <ol style="list-style-type: none"> <li>HVAC</li> <li>Domestic water systems</li> <li>Renewable energy systems.</li> <li>Lighting system including checking of the levels</li> </ol> A design intent report has to be developed for commissioning.  Provide training of building management / FM staff so as to transfer the project knowledge to the project owner and his team.	<ol style="list-style-type: none"> <li>A copy of the relevant clauses of specification and/or marked-up M &amp; E drawings confirming the need for commissioning works.</li> <li>A copy of the relevant clauses of specification confirming the need for Training requirement.</li> </ol>	<ol style="list-style-type: none"> <li>Detailed Commissioning report for the building services.</li> <li>A copy of the Training session / MOM /Handing over report demonstrating necessary training and transfer of best practices to the client team.</li> <li>A Firm letter of commitment on the proposed commissioning</li> </ol>
15	FOR AIR-CONDITIONED SPACES MORE THAN 2000 SQ.M  BUILDING ENERGY SIMULATION ENERGY MODELING	MANDATORY	To encourage a computer based analytical process that helps designers and building owners to evaluate the energy performance of the building and make it <b>MORE</b> efficient by incorporating and factoring necessary modifications in the design BEFORE the building is tendered out and constructed.  To Maximize the energy saving by addressing the Energy Conservation Measures(ECMs) and calculating the net impact of engaging those measures.  Assist in taking informed decisions on the choice of the ECMs based on the feasibility.	Where evidence provided demonstrates that Energy simulation using KEY INPUTS has been carried out to evaluate the performance of the building and the results of the simulations have been effectively used for specifying the Equipment / Materials / Technologies.  Where evidence provided demonstrates an improvement in the energy efficiency of the building's fabric and	The predicted Annual Energy Consumption / CO2 emissions are calculated from the design information using an appropriate modelling software package. The modelling software package must be capable of carrying the requirements as set out in ASHRAE / equivalent  The Energy Modelling should be carried out by <u>Trakhees prequalified Green Building GB consultant.</u>  The results of the above are to be used in selecting the right equipment and envelope features.	<ol style="list-style-type: none"> <li>A copy of the Energy simulation report detailing all the details for base case and proposed case.</li> <li>A copy of the software output from the energy simulation software such as visual DOE used for the modelling</li> <li>Energy statement as required on part 6 of the submission booklet.</li> </ol>	<ol style="list-style-type: none"> <li>'As built' / As -Installed energy modelling report taking into consideration any changes during the construction phase</li> <li>A copy of the software output from the energy simulation software such as visual DOE used for the modelling</li> <li>Filled-up energy Statement sheet as per part 6 of the submission booklet.</li> </ol>

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				services and therefore achieves lower building operational related CO2 emissions. The improvement should be 20% compared to ASHRAE 90.1 -2007 in ENERGY Terms.			
16	FOR AIR-CONDITIONED SPACES MORE THAN 2000 SQ.M  INDEPENDENT COMMISSIONING AGENT	MANDATORY	To encourage and recognize the involvement of an Independent Commissioning Agent to ensure an effective commissioning process all through the project stages.  To stress / highlight the critical role played by proper commissioning in the overall performance of the building's facilities.	Where the evidence provided demonstrates that an Independent Commissioning Agent prequalified by Trakhees has provided the required services for the facility during design development, construction, commissioning and handover.	The project should seek the services of an independent commissioning Agent to advise, monitor and verify the commissioning of the nominated building systems throughout the tendering, construction and commissioning phases.	<ol style="list-style-type: none"> <li>1. Letter of appointment of the Commissioning specialist with the detailed scope of works of commissioning.</li> <li>2. A copy of the specification clause stating and confirming the standards and codes of practice for the commissioning.</li> <li>3. Proof of works carried out up to tender stage by the commissioning specialist i.e. OPR, BOD etc.).</li> <li>4. List of activities proposed to be carried out during by the specialist during construction and commissioning phases.</li> </ol>	<ol style="list-style-type: none"> <li>1. Commissioning report confirming the monitoring actions carried out by the specialist during the construction and completion phases..</li> <li>2. Where final commissioning works are yet to be carried out (for want of permanent power), a letter of undertaking highlighting specific timeframe for Cx, performance testing and handover period has to be submitted.</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
<b>C: LIGHTING</b>							
1	GENERAL	VOLUNTARY	To recognize the role day lighting plays in enhancing the quality of the environment while at the same time saving energy and reducing the Green House Gas (GHG) emissions.	Where evidence provided demonstrates that the project has explored the possibility and accordingly incorporated day lighting technologies.	The project should seek to embrace a judicial mix of solar day lighting systems i.e. systems/technologies and Architecture manifested in one of the following: ways  1. Daylight optimized building foot print 2. Skylights (Passive or Active) 3. Tubular day lighting devices 4. Daylight redirection devices 5. Solar Exterior shading and control devices. 6. Reflectance of room surfaces 7. Others	1. Copy of the relevant clause of the specification detailing the day lighting.  2. Architectural drawings highlighting the skylight.  3. Lighting levels - calculations in support of the decisions.	1. As-Built drawing.  2. Date stamped site photograph of the day light installation  3. As Built lighting calculations.
	Use of Solar Day lighting Technologies						
2	OFFICE PORTION	MANDATORY	To recognize and encourage the use of Energy efficient Lighting technology for the lighting systems of the project in lieu of the conventional lighting system.	Where evidence demonstrates that the development has proposed to use Efficient lighting system.	Use of Energy efficient technologies for Lighting requirements such as 1. Compact Fluorescent Lamp (CFL) 2. Light emitting diodes (LEDs) 3. Induction lamps where relevant and possible  The Project should adopt efficient lights systems with <u>dedicated fittings</u> to accommodate the above lamps.	1. Extract of specification necessitating energy efficient lighting systems.  2. Design lighting drawing / layout highlighting the lamps and the ratings.	1. Approved material datasheets / technical submissions.  2. As Built lighting layout  3. Date stamped site photographic evidence.
	Usage of energy saving high performance lamps						
3	Usage of Electronic Ballast	MANDATORY	To reduce energy losses from magnetic ballasts	Where evidence demonstrates that the ENTIRE development has used efficient electronic ballasts for the lighting systems.	All lighting ballasts should be electronic and NOT magnetic.	1. Copy of the relevant clauses of the specifications detailing electronic ballasts.  2. Design lighting layout highlighting electronic ballasts in the legend section.	1. Approved material datasheets / technical submissions for ballasts.  2. As Built lighting layout  3. Date stamped site photographic evidence.

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

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4	WAREHOUSE PORTION	MANDATORY	To recognize and encourage the use of Energy efficient Lighting technology for the lighting systems of the project in lieu of the conventional lighting system for the warehouse and industrial areas.	Where evidence demonstrates that the development has explored the possibility of different lighting systems prior to finalization of the lighting design and has arrived at the most efficient lighting system for the subject project.	<p>Use of Energy efficient technologies for Lighting requirements such as</p> <ol style="list-style-type: none"> <li>1. Fluorescent Lamp T5/T8/HO</li> <li>2. Light emitting diode (LED)</li> <li>3. Induction lamp</li> <li>4. Others</li> </ol> <p>For areas with specific needs as governed by the manufacturing processes, a thorough Energy Analysis / study should be carried out in relation to</p> <ol style="list-style-type: none"> <li>a) Storage / product criteria</li> <li>b) Products and</li> <li>c) Inside temperature</li> <li>d) Lumen outputs, Efficacy, Colour rendering index required for the space before arriving at the optimum lighting design.</li> </ol> <p>3) The Project should adopt efficient lights systems with dedicated fittings to accommodate the above lamps.</p>	<ol style="list-style-type: none"> <li>1. Copy of the lighting energy analysis report if relevant to the space</li> <li>2. Copy of the relevant clauses of the specifications detailing warehouse lighting.</li> <li>3. Design lighting layout highlighting location and types of the lamps and the ratings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Statement from the contractor confirming that installation followed the specification provided at the design stage.</li> <li>2. Approved Material Submissions / catalogues</li> <li>3. Photographic evidence where applicable.</li> </ol>
	Usage of energy saving high performance lamps						
5	Usage of Electronic Ballast	MANDATORY	To reduce energy losses from magnetic ballasts	Where evidence demonstrates that the ENTIRE development has used efficient electronic ballasts for the lighting systems.	All lighting ballasts should be electronic and NOT magnetic.	<ol style="list-style-type: none"> <li>1. Copy of the relevant clauses of the specifications detailing electronic ballasts.</li> <li>2. Design lighting layout highlighting electronic ballasts in the legend section.</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material datasheets / technical submissions for ballasts.</li> <li>2. As Built lighting layout/.</li> <li>3. Date stamped site photographic evidence.</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

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<b>D: CONTROL SYSTEMS</b>							
1	Use of programmable thermostats for HVAC system	MANDATORY	<p>To prevent the Air Conditioning units from operating during non-essential hours, thereby saving wastage of energy and the environmental impact from unnecessary operation of the units.</p> <p>To encourage and use meaningful Control strategies coupled with sound operational policies that reduce energy use.</p>	Where the evidence provided demonstrates that the project has incorporated the required strategies for efficient control and operation of the units.	<p>All thermostats linked to air conditioning or comfort cooling systems should be fitted with programmable thermostat which at the basic level provides on/off controls (timer controls) at a minimum level. Temperature control functionality is encouraged as it provides additional savings.</p> <p>The control should be simple and capable of operating independently without the need for BMS or any advanced integrations.</p> <p>The programmable thermostat unit shall be installed on an interior wall, away from heating or cooling vents and other sources of heat or drafts (doorways, windows, skylights, direct sunlight or bright lamps) which may potentially influence their functioning.</p>	<ol style="list-style-type: none"> <li>Specification of thermostat incorporating the programming functionality.</li> <li>Electrical Layout showing locations of controls for the thermostats.</li> </ol>	<ol style="list-style-type: none"> <li>Approved material data sheets</li> <li>As built layout clearly indicating the thermostat location.</li> <li>Date stamped photograph of installed timer unit (s).</li> </ol>



## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

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2	Control of External lights	MANDATORY	To prevent /avoid the operation of the external lighting systems during non-essential times and reduce the environmental and economic impact by unnecessary use of energy during such operations.	where evidence demonstrates that the external lighting systems have incorporated strategies to switch on <u>based on the needs / specific timings</u> etc.	Switching external lighting (or specific circuits of the lighting system <b>as per the project needs</b> ) by any of the following ways: <ol style="list-style-type: none"> <li>1. Photocell sensors (for precise switching and control of lights based on day light availability).</li> <li>2. Control motion control devices, occupancy sensors (if relevant to the project).</li> <li>3. Timer control for operation at pre-set times.</li> <li>4. Any other suitable means</li> </ol>	<ol style="list-style-type: none"> <li>1. Copy of relevant clause of the specification confirming the design strategy proposed for external lighting.</li> <li>2. Electrical layout / drawings highlighting the control strategy.</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material data sheets of the external lighting controls used in the project</li> <li>2. As built layout clearly indicating the thermostat location.</li> <li>3. Date stamped photograph of installed timer unit (s).</li> </ol>
3	Interlock of Toilet / Bathroom fans	MANDATORY	To prevent the operation of extract fans of bathrooms / toilets when they are not occupied (Not being used) thereby reducing the environmental and economic impact caused by unnecessary use of energy.	Where evidence demonstrates that suitable strategies have been employed to prevent operation of these fans and lights when the bathrooms / toilets are not being used.  <i>Where there are practical limitations alternative compliance path can be proposed to prevent the fans and lights from needless operations.</i>	Switching & controlling of bathroom extract fans through the lighting switch / Timers/Sensors or synchronizing light sensors as relevant for the project, with associated extract fans.	<ol style="list-style-type: none"> <li>1. Copy of relevant section of the specification confirming the control &amp; interlocking strategy for the bathroom extract fans / lights.</li> <li>2. Electrical drawings indicating the controls.</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material data sheet of the electrical interlock used in the project</li> <li>2. As built layout clearly indicating the thermostat location.</li> <li>3. Date stamped photograph of installed timer unit (s).</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

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4	Use of Occupancy Sensor / Motion Sensor for internal lighting devices	MANDATORY	To prevent the operation of the Internal lighting system of certain areas where applicable during non-essential times and thereby save energy.	Where evidence demonstrates that select internal lighting systems have incorporated strategies to switch on based on the needs / specific timings etc.  <b>NOTE</b> Task lighting if applicable can potentially be engaged as one of the strategies to fulfil the requirements of this credit	Switching lighting circuits of internal areas <u>where applicable and relevant for the project</u> , using occupancy sensors/motion sensors.  The Occupancy sensors <u>after due consideration</u> shall be provided for the following areas within the facility  1. Areas within warehouse if relevant and appropriate 2. Dining Room. 3. Pantry Worker's changing room. 4. Prayer room. 5. Corridor / passage. 6. Ablution 7. Corridor 8. Other areas if found suitable	1. Relevant clause of the specification highlighting this strategy along with the details of the control scheme.  2. Electrical drawings indicating the above strategy.	1. a
5	AUTOMATIC DAYLIGHT DIMMING CONTROLS  (Warehouse areas > than 2000 m <sup>2</sup> )	MANDATORY	To avoid usage and thereby consumption of precious electrical energy for lighting purposes when the daylight harvesting strategy included in the facility is able to provide the desired lighting levels in the facility.	Where evidence provided substantiates the provision of daylight dimming controls in the facility.	Indicate the spaces where automated day lighting controls are included, and verify these were modelled in the simulation program.	1. Description of the areas provided with the dimming controls.  2. Relevant clause of the specification highlighting this strategy along with the details of the control scheme.  3. Electrical drawings indicating the above strategy.	1. Approved material data sheet.  2. Date stamped photographic evidence.  3. Relevant documents such as as-built drawings.

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
<b>E: WATER</b>							
1	Usage of Sewage Treatment Plant (STP) for treating Grey Water and reuse of treated water in flushing toilets and other usage <u>not involving human direct contact.</u>	<b>VOLUNTARY</b>	To encourage the collection and re-use of waste water to meet toilet flushing needs and reduce the demand for potable fresh water.	Where evidence provided demonstrates the specification of systems, that collect, store and, where necessary treat Grey water for WC and urinal flushing purposes	The use of grey water for toilet flushing should be explored and <u>if feasible</u> considered.	<ol style="list-style-type: none"> <li>Feasibility study exploring the possibility and ruling out the use of grey water recycling; <b>OR</b> Description and specifications of grey water recycling system.</li> <li>Design drawings / layout showing the treatment system.</li> </ol>	<ol style="list-style-type: none"> <li>Approved material data sheet of the grey water recycling system.</li> <li>Date stamped photographic evidence of the installation.</li> <li>As-built drawings of the recycling system.</li> </ol>
2	Performance Requirements for Sanitary fittings ( <u>Low Flow / Low Flush Fittings</u> )	<b>MANDATORY</b>	To minimize the consumption of potable water in sanitary applications by encouraging the use of low water use fittings	Where evidence provided demonstrates that the specification includes taps, urinals, WCs and showers that consume less potable water in use than standard specifications for the same type of fittings.	The FLOW and FLUSH fixtures used in the project should conform to the flow rates specified in the <b>Table-5</b> of the Annexure.	<ol style="list-style-type: none"> <li>Relevant extract of the specification detailing the sanitary fittings.</li> <li>Plumbing drawings highlighting the flow / flush rates of the fixtures.</li> </ol>	<ol style="list-style-type: none"> <li>Approved material data sheet of flow / flush fixtures installed.</li> <li>Date stamped photographic evidence of the fixtures.</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
3	<p><u>Water efficient landscaping and irrigation systems</u></p> <p>Drip irrigation methods for vegetation according to climate and seasonal conditions.</p>	MANDATORY	To reduce the consumption of potable water for ornamental planting and landscape irrigation in the development.	Where evidence provided demonstrates that a low-water irrigation strategy/system has been installed.	<p>All irrigation should be delivered by drip irrigation systems together with other strategies such as moisture sensors, landscape zoning, timers, controllers and self-closing nozzles.</p> <p>For those Warehouse developments where irrigation is proposed with sprinklers, a combination of high efficiency sprinkler with timer switch controls should be utilized.</p> <p>Use of native plants is encouraged</p>	<ol style="list-style-type: none"> <li>1. Marked-up site plan showing all landscaped areas to be irrigated.</li> <li>2. Specifications of irrigation systems to be installed.</li> <li>3. Details of the Native plants proposed to be used.</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material data sheet of the irrigation equipment.</li> <li>2. As-built landscaping drawing.</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

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4	<p><u>Water efficient landscaping and irrigation systems</u></p> <p>Eliminate potable water use or irrigation</p>	VOLUNTARY	To eliminate the consumption of potable water for ornamental planting and landscape irrigation	Where evidence provided demonstrates that no potable water is being used for irrigation or the irrigation has been totally eliminated	<p>The following demonstrates compliance:</p> <p>The irrigation system specified for internal or external planting and/or landscaping uses <b>ONLY</b> the following</p> <p>a) captured Rain water b) Recycled waste water c) Non potable water treated by a public agency d) The only planting specified is restricted to species that thrive in hot and dry conditions. e)The system uses reclaimed condensate water from air conditioning systems f) combination of the above</p> <p>2) Where a sub-surface drip feed irrigation system or a system using reclaimed condensate water is installed for external areas, a facility or mechanism to prevent the irrigation system from activating during the day must be present</p>	<ol style="list-style-type: none"> <li>1. Relevant clause of specification on the irrigation strategy.</li> <li>2. Proposed site plan, marked up to illustrate the scope of the irrigation specified including controls..</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material data sheet of the irrigation system components where relevant.</li> <li>2. Date stamped photographic evidence of the installation</li> <li>3. As-built drawings of the landscaping and irrigation system.</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
<b>F: ENVIRONMENT &amp; INTERNAL AIR QUALITY</b>							
1	Building internal ventilation and Minimum Indoor Air Quality (IAQ)	<b>MANDATORY</b>	To recognize the provision of adequate fresh air rates by establishing minimum IAQ performance in order to maintain a healthy indoor environment, thus contributing to the comfort and well-being of the occupants.  This also includes Pantry/ Kitchen, and stores besides the office areas.	Where evidence provided demonstrates that each space within the development achieves recommended minimum fresh air rates as stated in the regulation	Meet the minimum requirement of ASHRAE 62.1-2007, Ventilation for acceptable indoor air quality (IAQ) and design ventilation systems to meet /exceed the rates.  Mechanical ventilation systems shall be designed using the Ventilation Rate Procedure or the applicable code whichever is stringent  Naturally Ventilated buildings shall comply with ASHRAE 62.1 2007 STANDARDS.	<ol style="list-style-type: none"> <li>1. A copy of the relevant clauses of specification on the ventilation system.</li> <li>2. Fresh air calculations in the tabular form for all the areas.</li> <li>3. Schedule of the ventilation air quantity along with the flow rate of ventilation being provided.</li> <li>4. Where energy recovery wheel is used, the total fresh air quantity should bear relevance to the sizing of ERV.</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material data sheet of the fresh air fans / systems.</li> <li>2. Date stamped photographic evidence of the installation</li> <li>3. As-built drawings of the fresh air system.</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
2	Control of Environmental Tobacco Smoke	MANDATORY	<p>To minimize the risk to health from passive smoking</p> <p>To reduce the risk to health associated with poor indoor air quality and provide capacity for ventilation system monitoring to sustain occupant control and wellbeing.</p>	Where evidence demonstrates that there will be a smoking ban in effect within the building and necessary precaution taken if smoking is permitted in the development.	<p>The following demonstrates compliance:</p> <p>There will be a smoking ban in place covering all public and staff only areas of the building.</p> <p>“ No Smoking” signs should be located in appropriate areas, i.e. common areas, offices and building entrances so that they are clearly visible to all occupants.</p> <p><u>OPTION-2</u></p> <p>Where smoking is permitted this should be in dedicated smoking rooms only with a ventilation rate of at least 32 liters per second per person. This must be achieved through mechanical means and the room must also be separated from all other occupied spaces by lobbies and serviced by separate ventilation systems to prevent re-circulation. Smoking rooms must be directly exhaust to the outdoors and must effectively contain, capture and remove ETS from building.</p>	<p>A copy of the relevant clauses of specification confirming " The smoking ban"</p> <p>Copy of the relevant clauses of specification and/or marked-up drawings confirming " The presence of appropriate signage indicating that there is a smoking ban"</p> <p><u>OPTION-2</u></p> <p>A copy of the relevant clauses of specification and/or marked-up M&amp;E drawings confirming:</p> <ol style="list-style-type: none"> <li>1) Scope of the ventilation system</li> <li>2) The flow rate of ventilation being provided</li> <li>3) Separation of smoking room</li> </ol>	<p>OPTION-1 Building/site inspection confirming that the SMOKING BAN NOTICE is in effect.</p> <p>OPTION-2 Commissioning data or Building/site inspection and photographic evidence confirming the ventilation flow rate and presence of adequate separation of smoking room</p>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
3	Low Emitting Paints, Coatings, Adhesives and Sealants	MANDATORY	<p>To recognize and encourage a healthy internal environment through the specification of internal finishes and fittings with low emissions of volatile organic compounds (VOCs).</p> <p>Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of the installers and occupants.</p>	Where evidence provided demonstrates that the emissions of VOCs and other substances from key internal finishes and fittings comply with best practice and internationally accepted levels.	<p>All adhesives and sealants used on the interior of the building (defined as inside of the weatherproofing system and applied on-site) must comply with the requirements as mentioned in the <b>Table-6</b> of the Annexure that has been aligned to LEED Reference Guide.</p> <p>All paints and coatings used in the project shall have Volatile organic compounds (VOCs) that are within the limits as prescribed in the <b>Table-6</b> of the Annexure, which has been aligned to LEED Reference Guide.</p>	A copy of the relevant specification clause confirming that the VOC content of the relevant specified product types will comply with the standards specified above.	<p>1. Provide list of each indoor adhesive sealant, primer product, aerosol adhesive and indoor paint and coating including manufacturer, product name, VOC data and corresponding allowable VOC from the reference standard.</p> <p>2. Copy of the manufacturer's literature / approval sheets.</p> <p>3. Date stamped photographic evidence.</p>
4	Usage of Ozone friendly materials in Air Conditioning equipment, thermal insulation, foam & fire fighting equipment.	MANDATORY	To reduce the potential for long-term damage to the Earth's stratospheric ozone layer through the accidental release of ozone depleting substances to the atmosphere	Where all refrigerant types in use have an ozone depletion potential (ODP) of ZERO or where there are no refrigerants present.	<p>CFCs should <b>NOT</b> be used in the project</p> <p>HVAC and Refrigeration systems should use Non-CFC refrigerants and must have Zero Ozone Depleting Potential (ODP). <b>Use of R22 is discouraged.</b></p> <p>All thermal insulation and fire suppressants should have zero Ozone Depleting Potential (ODP) substances.</p>	<p>1. Specifications showing the substances used for each of these items and supporting technical documentation confirming zero ODP.</p>	<p>1. Approved material datasheet</p> <p>2. Date stamped photographic evidence of the units where applicable along with the name plates of installed units</p>



## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

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<b>G: Sustainable Site &amp; Management</b>							
1	Sustainable Site and Management	MANDATORY	Reduce pollution from construction site by controlling air borne dust generation, soil erosion, etc.	Where the Evidence provided demonstrates that an elaborate construction Erosion / sedimentation control plan is put in place by the contractor in line with the Best practice policies in respect of  a) Air (dust) pollution arising from the site. b) Water (ground and surface) pollution occurring on site.	Provide erosion and sedimentation control plan to prevent 1) Loss of soil 2) Prevent air pollution from dust 3) Prevent sedimentation of storm sewer	1. Submission of Erosion and sedimentation control plan required as part of the specification.  2. Copies of drawings to document erosion / sedimentation control plan.	1. Proof of training on ESC implementation  2. Date stamped photos of ESC implementation.
2	Heat Island Effect Non-Roof	MANDATORY	Reduce heat islands to minimize impact on micro climate and human and wildlife inhabitants.	Where the evidence provided demonstrates that the design incorporates technology and materials to reduce the heat island effect brought from NON-ROOF COMPONENTS	The Site hardscape comprising the paving and parking sheds should incorporate one or more of the following strategies: 1) Paving materials with Solar Reflective index (SRI) of minimum 29.  2) Open Grid Paving system with 50% perviousness and /Or SRI of minimum 29  3) Parking spaces under cover with SRI of 29  OPEN Grid Pavers for Non-Traffic areas are encouraged.	1. Specification of the materials, SRI etc.  2. Drawings of the site plan identifying the site hardscape elements.	1. Approved material data sheet of the Non roof components  2. Date stamped photograph of the installation.  3. As-built drawings / layout clearly highlighting the SRI value of the non-roof components

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
3	Heat Island Effect Roof (Use of light and heat reflective colours on roofs)	MANDATORY	Reduce heat islands to minimize impact on micro climate and human and wildlife inhabitants.	Where the evidence provided demonstrates that the design incorporates technology and materials to reduce the heat island effect brought from <u>ROOF COMPONENTS</u>	Use roofing materials with SRI as mentioned under for minimum 75% of the roof area: a) Low slope 78 b) High slope 29	<ol style="list-style-type: none"> <li>1. Specification of the materials, SRI etc.</li> <li>2. Drawings of the site plan identifying the site hardscape elements.</li> <li>3. Elevation showing roof angle</li> </ol>	<ol style="list-style-type: none"> <li>1. Approved material data sheet of the roof components</li> <li>2. Date stamped photograph of the installation.</li> <li>3. As-built drawings / layout clearly highlighting the SRI value of the roof components</li> </ol>
<b>H: Operational Sustainability</b>							
1	Recycling facility -Storage and collection of Recyclables	MANDATORY	<p>To recognize the provision of dedicated storage facilities for the Warehouse development's <b>operational-related recyclable waste streams</b> and</p> <p>Facilitate the reduction of waste that is generated by the building occupants, being hauled to and disposed of in the landfills.</p> <p>Through this requirement, such wastes are diverted from landfill or incineration.</p>	Where a central, dedicated space is provided for the storage of the building's recyclable waste streams.	Recycling facilities should be provided in each warehouse development. This should be in the form of a bin with at least three separate compartments, clearly labelled for recycling.	<ol style="list-style-type: none"> <li>1. Specification requiring installation of bins.</li> <li>2. Marked up plan showing proposed location within unit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Date stamped photo of installed recycling facilities.</li> <li>2. Letter of commitment from the Recycling agencies about their involvement in the operations.</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
2	Energy Efficient equipment (White Goods)	MANDATORY	To encourage the provision or purchase of energy efficient white goods / Appliances, thus reducing the CO2 emissions and environmental impacts from appliance use in the proposed development.	<p><b>Case 1.</b> Where Energy efficient goods are provided within the project scope for the proposed facility</p> <p>OR</p> <p><b>Case 2.</b> Where relevant information is provided relating to the provision of energy efficient white goods in the development so that it can be used as a reference guide for future procurements.</p>	<p><b>Case 1:</b> Where white goods are provided as part of the project scope, they should be Energy Star / Equivalent Rated and should be applicable for</p> <p>a) Refrigerators b) Washing machines c) Driers d) Dish washers e) All other eligible equipment/goods</p> <p><b>Case 2:</b> Where <b>NO</b> white goods / Appliances are provided as part of the project scope.</p> <p>A) Information on the Energy Start rating scheme / EU labelling scheme along with the list of goods complying with them should be provided to the client to facilitate informed procurement decisions.</p>	<p><b>Case 1:</b></p> <ol style="list-style-type: none"> <li>1. Extract from specification highlighting the white goods requirement or a formal letter from the developer giving the specific undertaking for white goods.</li> <li>2. Make and model of all white goods to be provided.</li> <li>3. A copy of the Energy star / Equivalent rating for all the goods provided.</li> </ol> <p><b>Case 2:</b></p> <ol style="list-style-type: none"> <li>1. A copy of the Energy star / Equivalent rating scheme for the appliances / white goods.</li> <li>2. Extract from specification mentioning that the information on white goods has to be provided to the Owner / Client.</li> </ol> <p><b>OR</b></p> <p>Letter of undertaking</p>	<p><b>Case 1:</b></p> <ol style="list-style-type: none"> <li>1. Manufacturer's literature confirming the Rating for all the installed white goods / appliances.</li> <li>2. Site Inspection report OR Copies of Purchase orders / receipts for ALL the white goods supplied for the project and confirmation of their installation</li> </ol> <p><b>Case 2:</b></p> <ol style="list-style-type: none"> <li>1. Copy of the information on the energy efficient goods that have been provided to the client as a part of the Building / Utility user guide.</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Item	DESCRIPTION	TYPE	AIM / INTENT	REQUIREMENT / CRITERIA	COMPLIANCE REQUIREMENTS	EVIDENCE REQUIRED AT DESIGN STAGE NOC-BP	EVIDENCE REQUIRED AT POST-CONSTRUCTION STAGE NOC-BCC
3	Building user Guide	MANDATORY	<p>To Promote Awareness to the clients / operators on sustainable warehouses and facilities</p> <p>To recognize and encourage the provision of guidance for the non-technical building user so they can understand and operate the building efficiently.</p> <p>To ensure the Preventive Maintenance of all equipment are carried out as per maintenance schedule.</p>	Where evidence provided demonstrates the provision of a simple guide that covers information relevant to the tenant/occupants and non-technical building manager, on the operation and environmental performance of the building and sustainability of the environment	<p>A Building / Facility Owner's Manual should be provided that include all of but not limited to the following:</p> <ol style="list-style-type: none"> <li>1. A maintenance schedule for all installed mechanical equipment.</li> <li>2. Details of controls, interlocks and sequence of operations for the installed MEP systems.</li> <li>3. Details of internal and external recycling facilities.</li> <li>4. Guidance on the purchase of energy efficient lighting and appliances.</li> <li>5. Details of local public transport facilities.</li> </ol>	<ol style="list-style-type: none"> <li>1. Proposed Facility Owner's Manual with indicative structure and contents. The manual should be perfectly aligned with the nature of the project addressing the specific issues relevant to the development</li> <li>2. Letter of undertaking that client awareness program would be carried out prior to handing over of the apartment.</li> </ol>	<ol style="list-style-type: none"> <li>1. Completed Building / Facility owner's manual prepared specifically to the project needs.</li> <li>2. Evidence that a walk through training program has been conducted for the owner &amp; the building users to understand the energy efficient features installed in the building.</li> <li>3. Date stamped photographs of the facility walk through.</li> </ol>
4	Facility / Building Services Tuning	MANDATORY	To encourage and recognize tuning initiatives that ensure that building services can continue to operate to optimal design potential after handover. Such an initiative serves as a strong mechanism for operational sustainability, reduced emissions and savings for the client in terms of reduced utility expenses.	Where evidence provided demonstrates that the project has developed the infrastructure for fine tuning of the facility after 12 months after handover of the systems / commencement of operations date.	A Tuning report has of the essential building services of the facility comprising the HVAC, Renewable and Lighting systems and other systems if relevant has to be submitted after 12 months of the operations date	<ol style="list-style-type: none"> <li>1. A copy of the relevant clause of the specification incorporating the said requirement.</li> </ol>	<ol style="list-style-type: none"> <li>1. A Letter of undertaking by the client and the commissioning company.</li> </ol>

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

### ANNEXURE

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

**Table-1**

### **Building Envelope**

Building Element	Parameter	Requirements
<b>Warehouse Structure (NON Conditioned Space)</b>		
External Walls	U – value ( <b>Max</b> )	0.08 Btu/hr-ft <sup>2</sup> -°f 0.45 W/m <sup>2</sup> -°c
Roof	U – value ( <b>Max</b> )	0.074 Btu/hr-ft <sup>2</sup> -°f 0.42 W/m <sup>2</sup> -°c
<b>Warehouse Structure (Conditioned Space)</b>		
External Walls	U – value ( <b>Max</b> )	0.055 Btu/hr-ft <sup>2</sup> -°f 0.3123 W/m <sup>2</sup> -°c
Roof	U – value (Max)	0.045 Btu/hr-ft <sup>2</sup> -°f 0.2555W/m <sup>2</sup> -°c
Floors	U – value (Max)	0.1 Btu/hr-ft <sup>2</sup> -°f 0.57 W/m <sup>2</sup> -°c
<b>Office Structure</b>		
External Walls	U – value ( <b>Max</b> )	0.05 Btu/hr-ft <sup>2</sup> -°f 0.28 W/m <sup>2</sup> -°c
Roof	U – value (Max)	0.045 Btu/hr-ft <sup>2</sup> -°f 0.2555W/m <sup>2</sup> -°c
Floors	U – value (Max)	0.1 Btu/hr-ft <sup>2</sup> -°f 0.57 W/m <sup>2</sup> -°c
<b>OTHERS (Common to both)</b>		

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

Building Element	Parameter	Requirements
Fenestration	U – value (Max)	0.30 Btu/hr-ft <sup>2</sup> -°f 1.7 W/m <sup>2</sup> -°c
	Shading Coefficient (Max)	0.29
	SHGC (Max)	0.252
	VLT (Min)	25 %
<b>Glass</b> (for Skylights architecture)  Note This is not applicable to GRP skylights	U – value (Max)	0.335 Btu/hr-ft <sup>2</sup> -°f 2.15 W/m <sup>2</sup> -°c
	Shading Coefficient (Max)	0.70
	SHGC (Max)	0.61
	VLT (Min)	60 % to 70%
<b>NOTE</b> All glazed fenestration to have a maximum Solar Heat Gain Coefficient (SHGC) as specified in the table		

### Notes

- a) The values indicated above are applicable to the full development comprising warehouse, offices and associated areas.
- b) Compliance to the above should be demonstrated by submitting relevant sections with Calculations.

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

### Table-2

## Air Tightness / Envelope Tightness Guidelines

### INFRARED THERMOGRAPHY

#### Eligibility Requirements of Thermographers

1. The thermographer should be suitably qualified / trained / certified – Level 1
2. Affiliated to ATTMA / BINDT
3. Minimum 2 years of demonstrable experience
4. The testing technician should be competent enough to do the test according to the proper procedure and should be able to locate any leakages as well
5. The technician should be equipped with sensitive and calibrated equipment to test the building according to the procedure

CV should be submitted to Trakhees-CED (Green Building section) for review and approval

#### Test Conditions

The conditions (measurement circumstances) should follow the protocol of the referenced standard and should further ensure the following requirements are fulfilled

1. Atmospheric circumstances and the temperature difference
2. Wind speed and direction relative to the building.
3. An evenly distributed pressure across the area

#### Reporting

The report should be comprehensive and of good quality that helps the professionals to make use of the information for proper corrective measures. It should follow the protocols of the standards and as a minimum comprise the following

1. Background to the objective and principles of the test
2. Location, orientation, date and time of survey
3. Brief description of the construction of the building based on drawings or other available documentation
4. Type(s) of surface material(s) used in the structure and the estimated value(s) of emissivity of this (these) material(s).
5. A unique identifying reference
6. Thermographer's name, affiliation and qualifications
7. Type of construction
8. Weather conditions, wind speed and direction, last precipitation, sunshine, degree of cloud cover.
9. Ambient temperatures inside and outside before, at the beginning of the survey and the time of each image. Air temperature and radiant temperature should be recorded



## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

10. Inside air temperature and air temperature difference across the envelope during the examination
11. Inside Relative Humidity data and outside Relative Humidity data for the duration of the test
12. Precipitation, direction of the wind, and velocity of the wind during the examination.
13. Statement of any deviation from relevant test requirements
14. Sketches and / or photographs of the building showing the positions of the thermographs
15. Specification of the equipment used, including make, model and serial number , last calibration date, any known defects.
16. Thermographs indicating temperature levels obtained from the test, showing parts of the building where thermal anomalies have been detected, with indications of their respective positions, and the position of the IR camera with respect to the measurement target, and with comments on the appearance of the thermal images, if possible with reference to parts of the building envelope with acceptable performance
17. Date and signature and professional seal
18. Type, extent and position of each observed defect
19. Results of any supplementary measurements and investigations

### BLOWER DOOR TESTING

#### Eligibility Requirements of testing company

1. A blower door testing training certificate provided by an ATTMA /BINDT Certified testing organization of suitable Level required for undertaking the tests
2. Minimum 2 years of demonstrable experience  
The testing technician should be competent enough to do the test according to the proper procedure and should be able to locate any leakages as well. CV should be submitted to Trakhees for review and approval
3. The technician should be equipped with sensitive and calibrated equipment to test the building according to the procedure

#### Test Conditions

1. The ambient atmospheric conditions (measurement circumstances) should be measured before and after the tests and should follow the CIBSE TM23 - "Testing of buildings for air leakage" protocol and the referenced standard. Measurements taken for following are to be within acceptable limits as described in the CIBSE TM23 guidelines
  - a. Temperature
  - b. Humidity
  - c. Wind speed
  - d. Barometric pressure
2. 2 Bias pressure readings to be taken before and after test and averaged as described in the CIBSE TM23 guidelines

#### Reporting

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

The report should be comprehensive and of good quality that helps the professionals to make use of the information for proper corrective measures. It should follow the protocols of the standards and as a minimum comprise the following

1. Background to the objective and principles of the test
2. Location, orientation, date and time of the test
3. Brief description of the construction of the building based on drawings or other available documentation
4. Description of the activities, measurement conditions and if applicable any notes about closed or opened doors etc.
5. Presentation of the measurement-results as well as any digital (visual) images of the object
6. In case the building doesn't pass the test: evidence of leakage provided with the use of visual or thermal images.
7. Conclusions and recommendations

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

**Table-3**

### **Minimum HVAC system performance criteria (EER)**

#### **SPLIT AND PACKAGED UNITS**

S.No	Capacities	EER (Minimum)
1	Less than 2.5TR	11.8
2	Less than 5.4 TR	11.8
3	≥ 5.4 TR and < 11.4 TR	11.5
4	≥ 11.4 TR and < 19.8 TR	11.3
5	≥ 19.8 TR and < 63.4 TR	10.5
6	≥ 63.4 TR	10.0

#### **CASSETTE TYPE UNITS      EER    ≥ 11.5**

#### Notes

1. The above table stipulates the minimum HVAC energy efficiency requirement (system performance and has taken into consideration the minimum requirements of ASHRAE 90.1 stipulated vide its Table 6.8.1A and the high energy optimization needs of the jurisdiction. This also reiterates that under no circumstances would the EER be less that the ASHRAE stipulated values.
2. It is a well-known fact that HVAC systems consume up to 75% of the building energy consumption especially during summer. These basic EER requirements in conjunction with integrated design principles and other adequate green measures taken during design and construction stages of the project would greatly enhance the operational sustainability of the facility through efficient performance of the HVAC systems.

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

**Table-4**  
**Recommended Light Power Densities**

### Internal Lighting

S.no	Area / Zone	Light Power Density(LPD) Watt / Ft2
1	Open Offices	0.8
2	Reception / Lobby	0.7
3	Warehouse	0.4
4	Storage	0.5
5	Corridor / Passage	0.5
6	Pantry	0.9
7	Gym	0.7
8	Toilet / wash area	0.5
9	Dining Room	0.7
10	Prayer Room	0.6
11	Changing Room	0.5
12	Ablution	0.4 to 0.5
13	Staircase	0.5
14	Guard Room	0.8
15	Security Room	0.8

### External Lighting

Synod	Area / Zone	Light Power Density(LPD) Watt / Ft2
1	Canopies and overhangs	0.5

### Notes

- The light power densities indicated above are improvements over those levels mentioned in ASHRAE 90.1-2007.
- Submissions should comprise LPD tables for the project comprising the proposed values in relation to Trakhees specified values for different areas

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

**Table-5**

### **Minimum performance criteria for sanitary wares**

Fixture Type	Requirements	REMARKS
Water Closets	3/6 l/flush	Dual flush type
Urinals	2.0 l/flush or waterless	Sensor based urinal systems are also acceptable.
Wash Basin Mixture/ Faucets / Sink Mixer / Bath Mixer	6.0 l/min.	At 413.7 Kpa reference pressure
Hand Showers	8.0 l/min.	At 551.6 Kpa reference pressure
½'Water Tap	6.0 ~ 9.0 l/min.	At 413.7 Kpa reference pressure
½'Shattaf	None	

#### Notes

1. The table provides an outline / guidance on the flow and flush fixture requirements to be used in the project. This however does not stop a project from seeking higher efficiencies.
2. It should be ensured that laundry equipment , dish washers etc. that have not been mentioned in the above table are selected from energy star / equivalent accredited products for achieving maximum water savings

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

**Table-6**  
**VOC Limits**

**PAINTS:**

**Interior Coatings:**

Coating Type	VOC weight in grams/liter of product minus water
Non-flat	150
Flat	50

**Exterior Coatings:**

Coating Type	VOC weight in grams/liter of product minus water
Non-flat	200
Flat	100

**ANTI-CORROSIVE PAINTS:**

Coating Type	VOC weight in grams/liter of product minus water
Gloss	250
Semi-Gloss	250
Flat	250

**CLEAR WOOD FINISHES:**

Coating Type	VOC weight in grams/liter of product minus water
Varnish	350
Lacquer	550

**FLOOR COATINGS: 100g/l**

**SEALERS:**

Coating Type	VOC weight in grams/liter of product minus water
Waterproofing sealers	250
Sanding sealers	275

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

All other sealers	200
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### SHELLAC:

Coating Type	VOC weight in grams/liter of product minus water
Clear	730
Pigmented	550

### STAINS: 250g/l

Architectural Applications	VOC Limit (g/L less water)	Specialty Applications	VOC Limit (g/L less water)
indoor carpet adhesives	50	PvC welding	510
Carpet pad adhesives	50	CPvC welding	490
wood flooring adhesives	100	aBs welding	325
rubber floor adhesives	60	Plastic cement welding	250
subfloor adhesives	50	adhesive primer for plastic	550
Ceramic tile adhesives	65	Contact adhesive	80
vCt and asphalt adhesives	50	special purpose contact adhesive	250
Drywall and panel adhesives	50	structural wood member adhesive	140
Cove base adhesives	50	sheet applied rubber lining operations	850
Multipurpose construction adhesives	70	top and trim adhesive	250
structural glazing adhesives	100		
Substrate Specific Applications	VOC Limit (g/L less water)	Sealants	VOC Limit (g/L less water)
Metal to metal	30	architectural	250
Plastic foams	50	Nonmembrane roof	300
Porous material (except wood)	50	roadway	250
wood	30	single-ply roof membrane	450
fiberglass	80	other	420
Sealant Primers	VOC Limit (g/L less water)		
architectural, nonporous	250		

## Regulations GB – 6.0: Green Building Regulations (Warehouses & Industrial Development)

architectural, porous	775		
other	750		

### NOTES

- The above tables provide prescriptive criteria through which a development is expected to comply with the minimum requirements specified therein.
- While the table indicates the minimum level, it does not discourage / restrict the stakeholder in seeking higher levels of performance.
- It is strongly suggested the consultants undertake building energy simulation to demonstrate improvement in building performance by optimizing various factors.
- It is inherent that significant importance is to be attached to the performance of the villas based on the actual utility and requirement which exceeds the basic requirement set by the prescriptive approach.