

# Sustainable Materials Guidelines

Sustainability

ECD-SUS-GDE-0002 Revision 0

Prepared for

**Expo City Dubai LLC**

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مدينة إكسبو دبي  
**EXPO CITY DUBAI**

Expo City Dubai

Expo City Dubai Site

Expo Road

PO Box 2020

Dubai, UAE

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# Acronyms, Abbreviations, and Definitions

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## Acronyms and Abbreviations

Acronym/Abbreviation	Expansion
ATCM	Airborne Toxic Control Measure
BIM	Building Information Modelling
BREEAM	Building Research Establishment Environmental Assessment Method
CAP	Climate Action Programme
CARES	Certification Authority for Reinforcing Steels
CCA	Crushed Concrete Aggregate
CoC	Chain of Custody
DCL	Dubai Central Laboratories
ECVM	European Council of Vinyl Manufacturers
EMAS	Eco Management and Audit Scheme
EPD	Environmental Product Declaration
ECD	Expo City Dubai LLC - SO
FSC	Forest Stewardship Council
GGBS	Ground Granulated Blast-Furnace Slag
GHG	Greenhouse Gas
ICE	Inventory for Carbon and Energy
ISO	International Organisation for Standardization
IWBI	International WELL Building Institute
KPI	Key Performance Indicator
LVL	Laminated Veneer Lumber
LCA	Life Cycle Assessment
LEED®	Leadership in Energy and Environmental Design
MAFF	Ministry of Agricultural, Forestry and Fisheries
OHSAS	Occupational Health and Safety Management Systems
PEFC	Programme for the Endorsement of Forest Certification

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Acronym/Abbreviation	Expansion
PVC	Polyvinyl Chloride
USGBC	U.S. Green Building Council
VCM	Vinyl Chloride Monomer
VOC	Volatile Organic Compounds
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

## Definitions

Term	Definition
<b>BIM</b>	A process involving the generation and management of digital representations of physical and functional characteristics of places.
<b>Carbon Mitigation</b>	A project or action which reduces the embodied carbon, and which is accomplished by management or change of an emission source.
<b>Certification Authority for Reinforcing Steels (CARES)</b>	Independent, not-for-profit certification body to provide confidence to the users, purchasers and specifiers of construction steels through a regime of regulation, testing and inspection.
<b>Embedded Carbon</b>	Carbon and other Greenhouse gas (GHG) emissions, comprising embodied carbon and additional emissions released during transportation of materials from manufacturing facility to site and installation of the product.
<b>Forest Stewardship Council (FSC)</b>	The Forest Stewardship Council is an international not for-profit, multi-stakeholder organisation established in 1993 to promote responsible management of the world's forests.
<b>GHG Emissions</b>	The emission of greenhouse gases to the atmosphere. GHG are those compounds that absorb and emit radiation within thermal infrared range and contribute to climate change.
<b>Infrastructure</b>	The facilities and improvements needed to support the event with transportation, information technology and communications networks and utilities.
<b>KPI</b>	A means of measuring attributes vital to achieving a strategy.

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Term	Definition
<b>LEED®</b>	A voluntary, consensus-based, market driven program that provides third-party verification of green buildings administered by the U.S. Green Building Council.
<b>BREEAM Infrastructure</b>	BREEAM Infrastructure is one of the world leading sustainability assessment, rating and awards scheme for civil engineering, infrastructure, landscaping and public realm projects.
<b>WELL</b>	A performance-based system for measuring, certifying, and monitoring features of the built environment that impact human health and well-being, through air, water, nourishment, light, fitness, comfort and mind.
<b>Product Stewardship</b>	A product-centric approach to environmental protection that requires the associated parties involved in the product's life cycle to share responsibility for reducing the product's environmental impact.
<b>Programme for the Endorsement of Forest Certification (PEFC)</b>	The PEFC is an international non-profit, non-governmental organisation dedicated to promoting Sustainable Forest Management (SFM) through independent third-party certification.
<b>Sustainability</b>	Ability to maintain or support an activity or process over the long term.
<b>U.S. Green Building Council (USGBC)</b>	A U.S. based non-profit organisation committed to a prosperous and sustainable future through cost-efficient and energy-saving green buildings.
<b>World Business Council for Sustainable Development (WBCSD)</b>	CEO-led organisation of forward-thinking companies that galvanises the global business community to create a sustainable future for business, society and the environment.
<b>World Resources Institute (WRI)</b>	A non-governmental global research organisation which seeks to create equity and prosperity through sustainable natural resource management.

# Executive Summary

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Materials are a finite resource. The increase in earth's population and demand of goods has a direct effect on the life cycle of materials. Approximately 40% of global material use is for building and construction activities. The selection of sustainable materials conserves natural resources preserves biodiversity at the point of extraction and enhances environmental conditions within the constructed facilities.

The purpose of this document is to provide specific guidance to the Expo City Dubai programme that will support it in achieving sustainable material selection practices.

Sustainable material selection for the Expo City Dubai will be achieved by implementing the following practices:

- Adopting guidelines that account for embedded carbon.
- **Selecting materials with no impact on human health.**
- Promoting reused materials and those with a high recycled content.
- Encouraging responsible and regional sourcing of materials.
- Selecting materials that do not have a negative impact on indoor environmental quality.

The Sustainable Materials Procurement Guidelines provide direction on the following:

- Requirements associated with reporting project performance.
- Approaches to design that address the following:
  - Embedded carbon content and footprint.
  - Environmental impacts generated from material extraction, product manufacture, and transportation.
  - Sourcing of materials to improve local economies.
  - Indoor environmental quality, including health, wellbeing, and productivity.
  - Approaches to construction that address the use of recycled materials.

Specific material key performance indicators (KPIs), as well as sustainability certification criteria such as LEED®, & BREEAM Infrastructure, or WELL® in specific cases, will measure progress toward the fulfilment of programme-wide strategies and reporting requirements during design and construction stages.

- Completing the **design stage consultant's** sustainability data log demonstrates compliance with the Expo City Dubai requirements and presents compliance against the applicable Key Performance Indicators. For presenting compliance with Expo City Dubai requirements, all materials requirements in alignment with these guidelines shall be included in detailed manner within the Project Specifications.
- Completing the **monthly contractor's** sustainability data log demonstrates compliance with the Expo City Dubai requirements and presents compliance against the applicable Key Performance Indicators.

## 1.1 Objective

Selection and procurement of sustainable materials requires understanding and integration of multiple materials aspects, including recycled content, embedded carbon, health impact, and responsible sourcing. At times, conflicting requirements must be reconciled to deliver the most sustainable outcome.

This guideline focuses on reducing the negative environmental impact of all materials procured in the Expo City Dubai programme. Materials will be assessed against the following criteria:

- Socially and environmentally responsible sourcing.
- Recycled content.
- Regional material.
- Embedded carbon content.
- Life cycle cost and durability.
- Impact on the indoor environmental quality.
- Product declarations against Human Health.

Material specifications may also impact the achievement of other sustainability aspects, which will require an integrated approach when selecting and specifying materials. For example, a paving slab may have recycled content impacting the materials theme, and a solar reflectance contributing to urban heat island effect.

Implementation of sustainable material purchasing strategies, through the guidelines, will:

- Maintain the material specifications intent.
- Reduce embedded carbon.
- Consider the origin including the impact of manufacturing and production.
- Avoid adverse impacts on human health, well-being and the environment.
- Drive delivery of the sustainable economic legacy of the programme

Ultimately, the material purchasing process will support the development of a local supply chain that provides opportunities for local businesses and job creation in a socially responsible manner.

These Guidelines have been presented to the Dubai Municipality's Dubai Central Laboratories (DCL) division. DCL have confirmed alignment of the materials requirements stipulated in these guidelines, with Dubai's overarching approach to sustainable materials.

## 1.2 Sustainability Outcomes

Implementing the Sustainable Materials Guidelines across the programme will support the delivery of the sustainability outcomes as follows:

- Selection of materials with a lower embedded carbon content will reduce the embedded carbon footprint of the programme.
- Choosing responsibly sourced materials will minimise the environmental impacts associated with material extraction, product manufacture and transportation. Incorporating materials with recycled content can support the diversion of waste from landfill, reduce the demand for virgin materials, as well as potentially reduce embedded carbon.
- Incorporating sustainable materials requirements across the programme will enhance the awareness of designers and workers. By choosing environmentally and socially responsible suppliers when sourcing materials, employees of suppliers and people living in proximity to materials extraction and manufacturing facilities will be protected. In addition, the choice of low emitting materials and products will improve the indoor environmental quality with a positive impact to the occupants' health and wellbeing and productivity.
- Through implementing the guidelines to purchase materials, companies supplying the programme will be encouraged to consider the sustainability of products.

Implementation of these guidelines at programme and project level will facilitate:

- Promotion of environmentally and socially responsibly sourced materials with higher recycled content, lower embedded carbon and reduced impacts on indoor environment,
- Integrated consideration of all materials aspects during procurement
- Sharing of information across the programme on products available on the regional and global market, and
- Engagement with key stakeholders to encourage changes in regulations and building codes to allow the use of sustainable materials.

## 1.3 Compliance Demonstration Methodology

This document is provided as guidance for designers and contractors. The minimum compliance standard defined by the Expo City sustainability KPIs is that more than 90% by weight of the total weight of the material types listed in this document (concrete, steel, aggregate, timber, glass, aluminium and PVC) should comply with the requirements as set out for those materials in Appendix A. In addition, the monthly consultant sustainability data log materials tab should be completed to demonstrate compliance with this KPI and achieving the required Embodied Carbon reductions.

The compliance is for the totality of these material types, so individual material percentage compliance may go below 90% by weight, as long as the overall compliant weight of materials exceeds 90% of the total weight of these types of material. In practice, this means that the majority of the heavier materials, such as concrete and steel, should be compliant with the requirements listed in these guidelines.



## 2 Requirements

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Specific materials requirements, as well as sustainability certification criteria (as required by LEED, BREEAM International or WELL® as applicable to project-specific requirements), will help fulfil Expo City Dubai Sustainability Strategy and reporting requirements during design and construction stages.

The project team is required to embed these requirements into the project-specific Sustainability Management Plan. Materials selection for permanent, temporary, (event) built assets and operational are to be addressed. Design consultants are to identify the key materials on their project and define how they will reduce impacts, particularly carbon footprints, so that efforts on materials sustainability are focused on those few materials that have the largest sustainability impact.

Designers must ensure specified materials are considered in an integrated manner to determine the best overall sustainability outcome and align with sustainability KPIs. Similarly, contractors must ensure materials are procured and installed as per the specification and the sustainability KPIs, with any specific installation requirements captured and communicated to all relevant parties.

To track materials performance on each project, design consultants and contractors are to complete the design stage data reports and monthly materials data logs, respectively, and submit them to Expo City Dubai for collection and further analysis. Furthermore, any documentation on installed materials must be collated to support the delivery of the required monitoring and measuring and any third-party sustainability certification, such as LEED® and BREEAM Infrastructure or WELL as needed.

### 2.1 Calculating Embedded Carbon

Selection of materials with reduced embedded carbon, resulting from the use of lower carbon raw materials or more efficient processing techniques, supports the overall carbon commitment for Expo City Dubai. The intent of the guidelines is to estimate carbon emissions associated with material selection for the programme and meet the carbon aspirations for Expo City Dubai.

The acceptable compliance paths are detailed below.

#### 2.1.1 Performance Based

Design teams are to develop a baseline carbon model for the asset based on current local industry standard materials and dimensions. The basis of design for this model is to be discussed and agreed upon with Expo City Dubai at the start of Concept Design, and the model itself is to be reviewed with Expo City Dubai once prepared. All materials and their recycled content are as per Dubai Building Code 2021 Edition, which has minimum requirements for recycled materials, regional material and GGBS/Fly Ash within Portland Cement.

The baseline carbon model will be compared to a design carbon model, which uses as-designed materials and details. An overall reduction in embodied carbon, from baseline to design, needs to be aligned with the requirements of the relevant embodied carbon KPI OBJ1\_MAT\_01 & 02 as per the Expo City Dubai Sustainability Strategy. The design carbon model shall be maintained during the design and construction stages to track and monitor performance against the emission reduction target for the facility.

Total embedded emissions in key construction materials are defined as cradle-to-gate plus transport to the Expo City Dubai site. Material volumes are to be sourced either from the project Building Information Modelling (BIM) model or the project Bill of Quantities (BoQ).

Key construction materials are those accounting for the greatest proportion of the total embodied carbon footprint of the built asset.

For carbon factors for materials, see Section 2.1.3 Calculation Methodology.

#### 2.1.2 Compliance Based

Where performance-based modelling of baseline and carbon footprints is not practical, project teams shall specify and install materials that meet the technical requirements listed in Appendix A. If any of a project's key materials is not covered by Appendix A, e.g. aluminum, then the performance-based methodology shall be followed.

### 2.1.3 Calculation Methodology

Cradle-to-Gate emissions<sup>1</sup> shall be estimated for key construction materials. These emissions arise from:

- Extraction and any processing of raw materials or primary products
- Transportation of raw materials and primary products to site of final production
- Manufacturing processes.
- Maintenance required for the material or system installed.
- End of life weather it will be recycled or sent to landfill.

These emissions shall be estimated using the following sources:

Table 2-1. Embedded Carbon Calculation Sources

<b>Cradle-to-Gate Embodied Energy</b>	Suppliers' Environmental Product Declarations University of Bath Institute for Carbon and Energy Version 2.0 <sup>2</sup>
<b>Grid Emission Factors</b>	UAE: 2021: 0.4293 tCO <sub>2-e</sub> /MWh <b>2022: 0.4035 tCO<sub>2-e</sub>/MWh</b> <i>as per DEWA(PJSC) Sustainability Report 2022</i>
<b>Stationary Combustion Factors</b>	WRI GHG Protocol for Stationary Fuel Combustion
<b>Transportation Factors</b>	In the absence of more accurate data, Consultants can use the following emissions factors: Road (HGV): 62 gCO <sub>2-e</sub> /tonne-km Rail: 22 gCO <sub>2-e</sub> /tonne-km Sea (deep-sea): 8.4 gCO <sub>2-e</sub> /tonne-km Sea (short-sea): 11.5 gCO <sub>2-e</sub> /tonne-km Air (long haul): 602 gCO <sub>2-e</sub> /tonne-km

**Note:** Cradle-to-gate quantification is guided by The Greenhouse Gas Protocol Initiative Guidance for Calculating Scope 3 Emissions: Calculation Guidance for Implementing the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting.

## 2.2 Environmental Considerations for Materials

Decisions on which materials to use on a particular project will be taken based on an assessment of a range of factors, including:

- Whether the identified use is necessary or merely desirable, and the extent to which the use could be minimised or excluded.

<sup>1</sup> Materials will be sourced from various countries, each with their own mix of energy sources feeding the electricity grid. In addition, factories producing materials may employ onsite energy sources which would also influence the embodied energy of a material. Where embodied energy is not obtainable before procurement of materials, default emissions factors are sourced from Prof. G. Hammond & C Jones (2011) Inventory of Carbon & Energy (ICE) – version 2.0, University of Bath, UK, or by identifying similar material embodied carbon and their Environmental Product Declarations (EPD) directly by the suppliers or by databases such as this that is included within OneClickLCA.

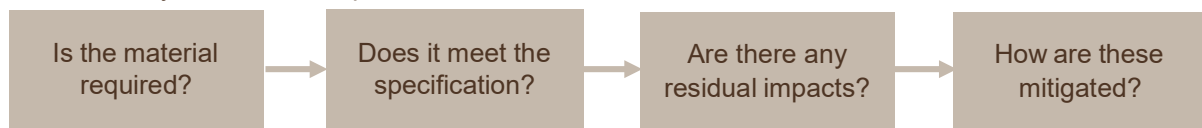
## Sustainable Materials Guidelines

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### Sustainability

- Suitability, such as structural integrity, ease of use, installation and dismantling, water-proofing, etc.
- Cost and value for money
- Environmental and social impacts across the whole life cycle, including:
  - The scope for potential harm to the environment and public health
  - The scope for recycling or re-use (with an emphasis on the importance of closed loop reuse and recycling options)
  - The percentage of recycled content
  - Embodied carbon
- Any wider implications or requirements affecting the use, such as the ability to print on, backlight and project onto a material
- Availability and suitability of substitute materials, each of which shall be evaluated on the same criteria

Schematically, this can be expressed as:



Assessments shall also take account of the possibility and desirability of using a mix of materials for the same or similar solutions, especially where this offers greater opportunity to promote sustainable procurement.

Where the balance of factors leads to the procurement of materials which carry potentially adverse environmental or social impacts, at any stage in the manufacturing, supply, usage or disposal processes, reasonable steps to mitigate these impacts are to be taken, such as through the use of method statements, for example.

## Sustainable Materials Guidelines

Sustainability

### 2.2.1 Concrete

Concrete has high thermal mass, is fire resistant, and long lasting. However, it has a high carbon footprint. The maximum embodied carbon footprints for different grades of concrete are listed in Appendix A. To achieve the goal of sustainability, there are certain strategies that can be employed, such as the use of Ground Granulated Blast Furnace Slag (GGBS) or Fly Ash. The Dubai Building Code 2021 Edition specifies a minimum requirement for concrete mixes, as well as green concrete combinations as per the Code paragraph F.6.2.3 and table F.3 presented below.

Substructures				
Options	Maximum w/c ratio	Minimum combination content (kg/m <sup>3</sup> )	Composition	
1	0.45	360	OPC with 66% to 80% GGBS	
2	0.40	380	OPC with 36% to 55% fly ash	
3	0.35	380	OPC with 36% to 65% GGBS or 26% to 35% fly ash	
Superstructures				
Options	Compressive strength (cylinder/cube) (N/mm <sup>2</sup> )	Maximum w/c ratio	Minimum combination content (kg/m <sup>3</sup> )	Composition
4	≥ C45/55	0.35	380	OPC with 26% to 35% GGBS
5	≥ C45/55	0.35	380	OPC with 16% to 20% fly ash
6	C40/50	0.35	380	OPC with 36% to 65% GGBS
7	C40/50	0.35	380	OPC with 26% to 35% fly ash
8	C32/40	0.40	380	OPC with 66% to 80% GGBS
9	C32/40	0.40	380	OPC with 36% to 55% fly ash
10	C32/40	0.45	360	OPC with 36% to 65% GGBS
11	C25/30	0.50	340	OPC with 66% to 80% GGBS
12	C25/30	0.50	340	OPC with 36% to 55% fly ash
13	Blinding concrete	0.55	202	OPC with 36% to 65% GGBS
14	Blinding concrete	0.55	202	OPC with 26% to 35% fly ash
NOTE 1: The specifications are based on the requirements of BS 8500-1.				
NOTE 2: The minimum cement/combination content specified is for 20 mm aggregate size.				
NOTE 3: OPC is ordinary Portland cement (CEM I).				

Table F.3 Green concrete combinations

### 2.2.2 Steel

Steel is a durable and low-maintenance material that can be recycled repeatedly without degradation or performance. For the maximum carbon footprint and other notes refer to Appendix A. Structural steel components and reinforcing bars in all applications and of any shape shall be certified to originate from a recognised responsible source.

### 2.2.3 Aggregate

Crushed Concrete Aggregate (CCA) can be used in the following applications provided it complies with the technical requirements described in Appendix A:

- Use of coarse CCA in base and sub-base: up to 90%
- Use of fine CCA in pavement surface: up to 15%
- Concrete production: up to 15%. This only applies to CCA generated at the batching plant from returned or unused concrete. Imported CCA or recycled aggregate is not approved for use in structural concrete on this project.

A lower limit is not provided due to limited availability, however use of CCA links to the carbon target.

### 2.2.4 Timber

All timber used on site, including formwork, is to carry sustainable forestry certification, specifically Forestry Stewardship Council (FSC) or Programme for the Endorsement of Forestry Certification (PEFC). Certified timber is increasingly available in this market and ample time is given for contractors to work on their supply chains to ensure supply.

When estimating carbon footprints for timber, Consultants should use the University of Bath's Inventory of Carbon & Energy (ICE) and Embodied Energy and Carbon in Construction Materials documents, with inclusions for transportation to site.

### 2.2.5 Polyvinyl Chloride (PVC)

Where Polyvinyl Chloride (PVC) is required for performance-based reasons, and it can be robustly demonstrated that no other more suitable, cost effective, alternative substance or material exists, mitigating measures must be pursued, including, but not limited to:

#### Manufacture

- The supplier must demonstrate that any PVC supplied has been manufactured in accordance with the European Council of Vinyl Manufacturers (ECVM) Industry Charter for the Production of Vinyl Chloride Monomer (VCM) and PVC.
- The supplier must confirm that:
  - The production of PVC does not result in effluent discharges exceeding established water quality standards, or vent gases exceeding European standards for waste incineration.
  - The production of PVC is conducted in a way that prevents fugitive emissions during manufacture and protects the health and safety of employees.
- The non-recycled content of PVC must not contain lead, mercury or cadmium stabilisers, and Expo City Dubai will challenge suppliers not to include older recycled content which may include lead, mercury or cadmium stabilisers.
- The Contractor must use reasonable endeavors to procure PVC with a recycled content of at least 30% unless this is specifically precluded by performance requirements, for example where a structural tensile membrane must be fully waterproof in which case new PVC (with 0% recycled content) may be acceptable.
- Where PVC proposed contains less than 30% recycled content, the contractor must ensure that the Engineer/Engineer representative is consulted and agree to its use in the specific instance.
- PVC is to be produced using non-phthalate plasticisers.

#### Supply and Disposal

- Where PVC is procured for temporary usage or where permanent usage is not assured, Contractors are to ensure that there is a take-back scheme that offers a closed loop reuse system or mechanical recycling system for post-consumer waste. Take-back schemes that specify incineration, land-filling or any form of disposal of PVC that does not include recycling or re-engineering options are not acceptable.
- Any additional costs for take-back schemes must be set out in the tender documentation so that budgetary impacts can be monitored.
- If a contractor believes that it has valid reasons why it cannot meet any of these conditions, then it must promptly raise this with the Engineer and provide a detailed justification for not meeting the condition(s).

#### Exclusions

- Where a product made from (or containing) PVC is to be hired but is already part of the hire market, and is due to be returned to that market after use, that product may be used at Expo City Dubai. However, contractors and operators are expected to use reasonable endeavors to work with the hire market to identify appropriate materials or products, meeting as many of the conditions as possible, including all the relevant environmental, health, safety, and regulatory conditions; and to choose suppliers which have responsible disposal and/or recycling policies and procedures in place.

### 2.2.6 Reused and Recycled Materials

The project teams must identify suitable opportunities in the design and construction stages to address the following material requirements:

Table 2-2. Reused and Recycled Materials

<b>Recycled Content</b>	Sourced from post-consumer and/or post-industrial recycled material (e.g. metals)
<b>Recycled Product</b>	Sourced from waste materials for another use (e.g. recycled aggregates)
<b>Reused</b>	Sourced from waste materials for direct use (e.g. components of existing buildings scheduled for demolition)
<b>Product Stewardship</b>	Manufacturer agreement to take back the product at the end of its service life for reuse, recycling or reprocessing

Project teams are required to consider the Table 2-2 requirements within the scope of required sustainability rating (e.g. LEED®, BREEAM Infrastructure) certifications and the embedded carbon reduction requirements.

It is a requirement that the material costs and the recycled content of any procured material are recorded to allow determination of the relevant materials information.

### 2.2.7 Material Reduction

Sustainability impacts can also be reduced by using less material. This could be achieved, for example, through additive manufacture of building elements, and such savings would be reflected in the carbon footprint models prepared under the performance-based methodology described above.

To ensure a baseline level of improvement over standard practice, Expo City Dubai requires design teams to demonstrate that the average utilisation of structure is a minimum of 70% or greater. The target value shall be based on a representative sample and inclusion of all primary structural elements. Secondary structures including façade supports and similar are excluded from this assessment. The evaluation process includes calculation of utilisation factors based on samples taken along the structure height and distributed uniformly over the footprint.

The calculation shall be based on a sample accounting for minimum of 5% of elements in each category: beams, columns, walls, slabs, and similar. The utilisation ratios for an individual element are to be calculated at the critical point and also considering the governing criteria, either strength or serviceability. These factors are to be calculated based on formula:

- **Strength Criteria:** applied force > 0.7 x member resistance  
Member resistance is calculated based on the adopted design standard/code. This may include but is not limited to resistance to: flexure, shear, axial and any other combination of member forces, and also includes stability effects.
- **Serviceability Criteria:** deformations > 0.7 x code permissible value  
Effects studied may include but not limited to: deflections of individual beams and slabs at one level, inter-story drift for wind or seismic, and similar.

The applied loads to the structure are assumed to be based on applicable codes and adopted for the project. Excluded from this representative calculation are members for which vibrations and fatigue are the governing design criteria.

## 2.3 Social Considerations for Materials

### 2.3.1 Responsible Sourcing

Sustainable construction considers and identifies products that minimise the potential harm that may occur to people and the environment through the extraction and manufacture of products. Such responsible sourcing identifies products whose manufacturers have implemented management systems to identify and minimise potential harm. Responsible sourcing also addresses ethical principles based but not limited to:

- Human rights
- Discrimination
- Fair pay
- Child labour
- Forced labour

Responsible sourcing shall align, as a minimum, with Expo City Dubai Vendor Code of Conduct for Vendors and procurement policies.

The project teams are to identify materials that comply with the accreditation requirements in Appendix A.

### 2.3.2 Healthy and Low Emissions Materials

Materials used in construction and operation that have a detrimental impact on indoor air quality, present risks to the health of the workforce and building occupants. Alternative materials that minimise or avoid such health risks are frequently available, and innovative sustainable alternative solutions may also be identified.

To avoid the use of materials with an unacceptable risk, and promote the selection of lower risk materials, three chemical lists have been developed (see Appendix B):

- A Banned Chemical List detailing chemical that must not be used, including where the chemical is a component of a product.
- A Restricted Chemical List detailing chemical that should be avoided where possible, and the use of which should be minimised.
- List of maximum Volatile Organic Compounds (VOC) levels for paints, adhesives, sealants and flooring systems, and formaldehyde emission limits for composite wood products.

The project teams are required to:

- Identify chemicals on the Banned Chemical List and the Restricted Chemical List as part of the material specification, selection, and procurement process.
- Ensure that no products containing components on the Banned Chemical List are incorporated into the specification and procured during construction.
- Minimise the specification and procurement of products containing components on the Restricted Chemicals List by undertaking an assessment of alternatives. Restricted chemicals are only to be used where no alternatives prove viable. Viability is to be based on analysis of systems which include the proposed chemicals, and options which include more sustainable alternatives. The analysis is to include:
  - Total system global warming potential.
  - Health Product Declaration (HPD), should this be available for the specific.
  - Other environmental impacts.
  - Total capital cost.
  - Total operational cost.
- Minimise the specification and procurement of products containing components on the VOC list and identify and propose opportunities for specification of alternative products.
- Minimise the specification and procurement of products containing components on the formaldehyde list and identify and propose opportunities for specification of alternative products.



## 2.4 Economic Considerations for Materials

### 2.4.1 Regional Sourcing

By considering material sourcing locality and considering the transportation methods, and hence transportation related carbon emissions, it is possible to reduce the embedded carbon associated with materials transport as well as support local businesses.

Project teams are required to consider regional sourcing within the scope of required sustainability rating and green certifications and the embedded carbon reduction requirements, where feasible.

### 2.4.2 Life Cycle Assessment

Life Cycle Assessment (LCA) considers the embedded impacts associated with a material, including water use and disposal, energy requirement, fossil fuel depletion, waste disposal, minerals extraction, from the point of creation to the point of disposal or reuse.

The Expo City Dubai programme supports the use of LCA approach to materials selection. Where innovative products are proposed, LCA may be required to address one or more aspects of the product performance.

## 2 Design Stage Review

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The following list details some of the key aspects that may be considered during the design stage reviews. Further aspects may be considered at the discretion of Expo City Dubai.

- Design efficiencies.
- Lightweight design.
- Modular design.
- Responsible sourcing (including timber).
- Key materials identified.
- Key challenges identified.
- Recycled materials.
- Reduce embedded carbon.
- High carbon items and substitution options.
- Healthy/low emission materials.
- Compliance of specifications with Banned Chemical List.
- Specifications of alternative products to minimise those on the Avoid Chemical List.
- Life Cycle Assessment.
- Innovative solutions.

# Appendix A

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## Materials Schedule

## Appendix A – Materials Schedule

Sustainability

Material	Compliance Element	Compliance Requirements	Submission Requirements
		Independently verified Environmental Product Declaration (EPD) to EN 15804 or equivalent showing the global warming potential, which is to be equal to World Steel average for the below. Alternatively, the consultant should provide an Employer-approved embedded carbon LCA showing that the overall building structure/envelope system beats a baseline by 20% as defined in section 2.1.1 of this document.	
		Carbon steel rolled sections, plates and bars for structural applications	EPD/LCA&CARES*
Carbon		Stainless steel sections	EPD/LCA&CARES*
		Hot and cold formed carbon steel tubular sections, corrugated plates and similar sections	EPD/LCA&CARES*
		Carbon bars for concrete reinforcement	EPD/LCA&CARES*
Steel		Stainless steel reinforcing bars for concrete	EPD/LCA&CARES*
		Any other structural steel materials not specified above	EPD/LCA&CARES*
		<p>BS EN ISO 14001 or EMAS accreditation or alternatively an Employer Approved Environmental Management System structured in compliance with best practice standards. This applies only to suppliers who manufacture the products they are supplying. Otherwise, the suppliers should source the evidence from their manufacturers showing compliance with this requirement.</p> <p>- BS OHSAS 18001 accreditation, or alternatively an Employer Approved Health &amp; Safety Management System structured in compliance with best practice standards. This applies only to suppliers who manufacture the products they are supplying. Otherwise, the suppliers should source the evidence from their manufacturers showing compliance with this requirement.</p> <p>* CARES certificate must include (Product Conformity Certification, SCS Sustainability, Certification, EPD Reporting (3rd Party Verified)</p>	

## Appendix A – Materials Schedule

Sustainability

Material	Compliance Element	Compliance Requirements	Submission Requirements										
		<p>Independently verified Environmental Product Declaration (EPD) to EN 15804 or equivalent standard which shows the global warming potential is equal or lower than the following values <math>\text{kgCO}_2/\text{m}^3</math>: Alternatively, the consultant should provide an Employer-approved embedded carbon LCA showing that the overall building structure/envelope system beats a baseline by 20% as defined in section 2.1.1 of this document.</p>											
		<table border="1"> <thead> <tr> <th data-bbox="534 750 662 795">Strength Grade</th> <th data-bbox="534 795 662 929">20MPa and lower</th> <th data-bbox="534 929 662 1064">30MPa</th> <th data-bbox="534 1064 662 1198">40MPa</th> <th data-bbox="534 1198 662 1366">50MPa and greater</th> </tr> </thead> <tbody> <tr> <td data-bbox="670 750 718 795">Concrete Supply (see notes)</td> <td data-bbox="670 795 718 929">215</td> <td data-bbox="670 929 718 1064">250</td> <td data-bbox="670 1064 718 1198">270</td> <td data-bbox="670 1198 718 1366">280</td> </tr> </tbody> </table>	Strength Grade	20MPa and lower	30MPa	40MPa	50MPa and greater	Concrete Supply (see notes)	215	250	270	280	
Strength Grade	20MPa and lower	30MPa	40MPa	50MPa and greater									
Concrete Supply (see notes)	215	250	270	280									
Concrete	Carbon	<p>Notes:</p> <p>Included in <math>\text{kgCO}_2/\text{m}^3</math> values above are the raw materials extraction production and transport, chemical admixtures, energy and auxiliary materials, and transport up to 15km from the plant.</p> <p>Excluded from <math>\text{kgCO}_2/\text{m}^3</math> values are items associated with the cast-in-place or pre-fabrication processes to construct the building, contribution from reinforcing and pre-stressing steel, and similar.</p> <p>Linear interpolation shall be used for concrete strengths other than the posted values.</p>	EPD/LCA										
		<p>One of the strategies to achieve the carbon requirements for concrete material supply may be replacement of Portland cement content with the following supplementary cementitious materials such as GGBS, Fly Ash and Silica Fume. See Dubai Building Code section F.6.2.3 maximum and minimum levels of cement replacement.</p>											
		<p>BS EN ISO 14001 or EMAS accreditation or alternatively an Employer Approved Environmental Management System structured in compliance with best practice standards. This applies only to suppliers who manufacture the products they are supplying. Otherwise,</p>											

## Appendix A – Materials Schedule

Sustainability

Material	Compliance Element	Compliance Requirements	Submission Requirements
		<p>the suppliers should source the evidence from their manufacturers showing compliance with this requirement.</p> <ul style="list-style-type: none"> <li>- BS OHSAS 18001 accreditation, or alternatively an Employer Approved Health &amp; Safety Management System structured in compliance with best practice standards. This applies only to suppliers who manufacture the products they are supplying. Otherwise, the suppliers should source the evidence from their manufacturers showing compliance with this requirement.</li> </ul>	
	Responsible Sourcing	<p>Forestry Stewardship Council (FSC) certification or Programme for the Endorsement of Forest Certification (PEFC) certification.</p> <p>Applies to all timber and wood products, including temporary works.</p>	Chain of Custody (CoC) certificate with codes or serial numbers
Timber	Restrictions	<p>The following are not permitted at Expo City Dubai, including in temporary works:</p> <ul style="list-style-type: none"> <li>- Meranti</li> <li>- Rosewood</li> <li>- Any other endangered tree species</li> <li>- Chromated copper arsenate-treated timbers</li> </ul>	
	Reuse	<p>Use of Crushed Concrete Aggregate (CCA) in <b>concrete production</b> shall conform to requirements of BS 8500 and accompanied standards considering concrete strength class and associated exposure. Alternatively, ACI 555R in conjunction with corresponding ASTM standards is acceptable.</p>	
Aggregate		<p>Properties of recycled concrete aggregates used for <b>road base course and other unbound mixtures</b> shall conform to requirements of AASHTO M 319-02(2010). Alternatively, BS EN 12403 can be used for this application. Maximum percent CCA is 90%.</p> <p>These requirements are summarised below, subject to RTA approval:</p>	

## Appendix A – Materials Schedule

Sustainability

Material	Compliance Element	Compliance Requirements	Submission Requirements
	<b>Parameter</b>	<b>Limit</b>	
	Loss by Abrasion Test AASHTO T096	40% maximum	
	Liquid Limit AASHTO T089 (ASTM D4318)	25% maximum	
	Plasticity Index AASHTO T090 (ASTM D4318)	4% maximum	
	Sand Equivalent AASHTO T176	35% minimum	
	California Bearing Ratio at 98% MDD – AASHTO T193	120% minimum	Lab test results
	Soundness (Magnesium) – AASHTO T104	15% maximum	
	Flakiness – BS 812	35% maximum	
	Elongation – BS 812	35% maximum	
	Sulphate Content – BS 812	2% maximum	
	Chloride Content – BS 812	2% maximum	
	<b>Foreign Material Type</b>	<b>%</b>	
	High density materials such as glass, brick, asphalt	10 maximum	
	Metallic items such as steel, aluminium, iron	1 maximum	
	Low density materials such as plastic, rubber, plaster, clay lumps and other friable material	1 maximum	Lab test results
	Wood and other vegetable or decomposable matter	0.2 maximum	

## Appendix A – Materials Schedule

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Compliance Element	Compliance Requirements	Submission Requirements																		
	<p><b>ASTM D2940 Sieve (mm)</b></p> <table border="1"> <thead> <tr> <th></th> <th>% Passing</th> </tr> </thead> <tbody> <tr> <td>50</td> <td>100</td> </tr> <tr> <td>37.5</td> <td>95-100</td> </tr> <tr> <td>19</td> <td>65-95</td> </tr> <tr> <td>9.5</td> <td>30-65</td> </tr> <tr> <td>4.75</td> <td>25-55</td> </tr> <tr> <td>2.00</td> <td>15-40</td> </tr> <tr> <td>0.425</td> <td>8-20</td> </tr> <tr> <td>0.075</td> <td>2-8</td> </tr> </tbody> </table>		% Passing	50	100	37.5	95-100	19	65-95	9.5	30-65	4.75	25-55	2.00	15-40	0.425	8-20	0.075	2-8	Field testing results by contractor
	% Passing																			
50	100																			
37.5	95-100																			
19	65-95																			
9.5	30-65																			
4.75	25-55																			
2.00	15-40																			
0.425	8-20																			
0.075	2-8																			
PVC	<p>Complies with ECVM Industry Charter for the Production of VCM and PVC, or Required:</p> <ul style="list-style-type: none"> <li>▪ Must not contain lead, mercury or cadmium stabilisers.</li> <li>▪ Must be produced using non-phthalate plasticisers.</li> <li>▪ Take-back scheme for temporary-use PVC preferred.</li> <li>▪ Has recycled content of at least 30% unless this is specifically precluded by performance requirements.</li> </ul>	<p>Certificate</p> <p>Product data sheet Product data sheet Written evidence</p> <p>Product data sheet</p>																		
	<p>BS EN ISO 14001 or EMAS accreditation or alternatively an Employer Approved Environmental Management System structured in compliance with best practice standards. This applies only to suppliers who manufacture the products they are supplying. Otherwise,</p>																			



## Appendix A – Materials Schedule

Sustainability

Material	Compliance Element	Compliance Requirements	Submission Requirements
		<p>the suppliers should source the evidence from their manufacturers showing compliance with this requirement.</p> <ul style="list-style-type: none"> <li>- BS OHSAS 18001 accreditation, or alternatively an Employer Approved Health &amp; Safety Management System structured in compliance with best practice standards. This applies only to suppliers who manufacture the products they are supplying. Otherwise, the suppliers should source the evidence from their manufacturers showing compliance with this requirement.</li> </ul>	
All materials	Responsible Sourcing	<ul style="list-style-type: none"> <li>- A valid ISO 9001 certificate, or an independent 3<sup>rd</sup> party certification pertaining to the product being supplied (i.e. manufacturing process, testing, conformity to the relevant standard, etc.).</li> <li>- Compliance with governing laws and regulations with regards to worker welfare, including accommodation standards and employment practices.</li> <li>- Compliance with Expo City Dubai Code of Conduct for Vendors</li> <li>- Compliance with WELL V2 standard Material category X01 Material restriction, X02 Interior hazardous Material Management, and X3 CCA and Lead Management (<i>only applicable to WELL Projects</i>)</li> </ul>	<p>Copy of certificate and/or management system manual, or documentation demonstrating compliance.</p> <p>Worker welfare compliance statement.</p> <p>Documentation demonstrating compliance with Expo City Dubai worker welfare policy.</p>
Cleaning Materials	Responsible Sourcing	<ul style="list-style-type: none"> <li>- Green Seal® Standard for Commercial and Institutional Cleaning Services, GS-42, operated by Green Seal Inc.18</li> <li>- GBAC STAR Service Accreditation Program, operated by ISSA.</li> <li>- ISO 14024-compliant (Type 1) Ecolabel,</li> <li>- Products labeled as disinfectants meet the following:               <ol style="list-style-type: none"> <li>1- Have all antimicrobial efficacy claims registered by a governmental office and stated in their label.</li> <li>2- Utilize only active ingredients only from the following list: citric acid, hydrogen peroxide, L-lactic acid, ethanol, isopropanol, peroxyacetic acid, sodium bisulfate, chitosan.</li> <li>3- Section 2 of the SDS does not contain the following GHS codes: H311, H312, H317, H334, H340, H350, H360, H372.</li> </ol> </li> </ul>	<p>3<sup>rd</sup> Party Test report</p> <p>TDS- Technical Data Sheet</p> <p>SDS- Safety Data Sheet</p>

# Appendix B

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## Chemical Lists

## Appendix B – Chemical List

Sustainability

### Banned Chemical and Martials List

This list does not comprise a full list of materials banned for use. All parties must comply in full with the UAE, Dubai and international legislation, however, the following chemicals shall not be used at Expo City Dubai.

### Annex III Chemicals and Chemicals Recommended for Listing

Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

2,4,5-T and its salts and esters	DDT	Octabromodiphenyl ether commercial mixtures
Actinolite asbestos	Dieldrin	Paraquat dichloride
Alachlor	Dinitro-ortho-cresol (DNOC) and its salts (such as ammonium salt, potassium salt and sodium salt)	Parathion
Aldicarb	Dinoseb and its salts and esters	Pentabromodiphenyl ether and commercial mixtures
Aldrin	EDB (1,2-dibromoethane)	Pentachlorophenol and its salts and esters
Amosite asbestos	Endosulfan	PFOS, its salts and PFOSF
Anthophyllite	Ethylene dichloride	Phosphamidon
Asbestos		
Azinphos-methyl	Ethylene oxide	Polybrominated Biphenyls (PBBs)
Benomyl	Fluoroacetamide	Polychlorinated Biphenyls (PCBs)
Binapacryl	HCH (mixed isomers)	Polychlorinated Terphenyls (PCTs)
Captafol	Heptachlor	Tetraethyl lead
Carbofuran	Hexachlorobenzene	Tetramethyl lead
CCA	Chromate Copper Arsenate	
Chlordane	Lindane (gamma-HCH)	Thiram
Chlordimeform	Mercury compounds, including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds	Toxaphene (Camphechlor)
Chlorobenzilate	Methamidophos	Tremolite
Chrysotile asbestos	Methyl-parathion	Tributyl tin compounds
Crocidolite	Monocrotophos	Tris(2,3 dibromopropyl)phosphate

## Appendix B – Chemical List

Sustainability

### Annex A, B and C Chemicals and Chemicals Proposed for Listing

Stockholm Convention on Persistent Organic Pollutants

Aldrin	Heptachlor	Pentachlorophenol
Alpha hexachlorocyclohexane	Hexabromobiphenyl	Perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride
Beta hexachlorocyclohexane	Hexabromocyclododecane	Polychlorinated biphenyls (PCB)
Chlordane	Hexabromodiphenyl ether and heptabromodiphenyl ether	Polychlorinated dibenzofurans (PCDF)
Chlordecone	Hexachlorobenzene (HCB)	Polychlorinated dibenzo-p-dioxins (PCDD)
Chlorinated naphthalenes	Hexachlorobutadiene	Short-chained chlorinated paraffins
DDT	Lindane	Technical endosulfan and its related isomers
Dieldrin	Mirex	Tetrabromodiphenyl ether and pentabromodiphenyl ether
Endrin	Pentachlorobenzene	Toxaphene

### Other Chemicals

The following chemicals are also banned from Expo City Dubai.

- Chlorofluorocarbons (CFCs)
- Methylene Chloride
- Perchloroethylene

### Restricted Chemical List

The following chemicals, which have high global warming potentials, shall only be used where analysis is submitted that shows no viable alternative exists.

- Hydrochlorofluorocarbons (HCFCs)
- Halons

## Appendix B – Chemical List

Sustainability

### Volatile Organic Compounds (VOC)

The contractor shall consider material finishes (internal applications), having lower than the following total VOC (TVOC) content limits:

Product Type (Paints, Varnishes and Coatings)	Max TVOC (g/L Ready to Use Product)
California Air Resources Board 2007 Suggested Control Measure for Architectural Coatings	As defined by the standard
South Coast Air Quality Management District Rule 1113	As defined by the standard

Product Type (Paints, Varnishes and Coatings)	Max TVOC (g/L Ready to Use Product)
European Decopaint Directive (2004/42/EC)	As defined by the standard
Canadian VOC Concentration Limits for Architectural Coatings	As defined by the standard
Hong Kong Air Pollution Control (VOC) Regulation	As defined by the standard
Walls and ceilings – interior gloss Trim – gloss, semi-gloss, satin, varnishes and woodstains	75
Walls and ceilings – interior semi-gloss, low sheen and flat washable	16
Ceilings - interior flat	14
Timber and binding primers	30
Latex primer for galvanised iron and zincalume	60
Interior latex undercoat and sealer	65

## Appendix B – Chemical List

Sustainability

Product Type (Carpets and Floor Coverings)	Max TVOC (g/L Ready to Use Product)
Carpets	4-PC (4-Phenylclohexene) 0.05mg/m <sup>2</sup> per hour
Floor coverings other than carpets (ASTM D5116 or ISO 16000)	5mg/m <sup>2</sup> /h at three days 0.5mg/m <sup>2</sup> /h at 28 days
Floor coverings other than carpets (ISO 10580)	0.5mg/m <sup>2</sup> /h at 24 hours

Product Type (Adhesives and Sealants)	Max TVOC (g/L Ready to Use Product)
South Coast Air Quality Management District Rule 1168	As defined by the standard
European Decopaint Directive (2004/42/EC)	As defined by the standard
Canadian VOC Concentration Limits for Architectural Coatings	As defined by the standard
Hong Kong Air Pollution Control (VOC) Regulation	As defined by the standard
Indoor carpet and carpet pad adhesive	50
Wood flooring and laminate adhesive	100
Rubber flooring adhesive	60
Sub-floor and cover base adhesive	50
Ceramic tile adhesive	65
Dry wall and panel adhesive	50
Structural glazing adhesive	100
Architectural sealants	250

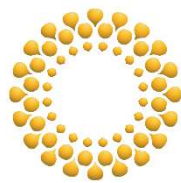
## Appendix B – Chemical List

Sustainability

### Formaldehyde

The contractor shall consider engineering wood products (including exposed and concealed applications), having lower content emissions for different testing protocols than the values in the table below:

Test Protocol	Emission Limit/Unit of Measurement
California Air Resources Board Airborne Toxic Control Measure (ATCM) for various composite wood applications	As defined by the standard
AS/NZS 2269:2004, testing procedure AS/NZS 2098.11: 2005 method 10 for Plywood	≤1mg/L
AS/NZS 1859:2004, Particle Board with use of testing procedure AS/NZS 4266.16: 2004 method 16	≤1.5mg/L
AS/NZS 1859:2004, MDF with use of testing procedure AS/NZS 4266.16: 2004 method 16	≤1mg/L
AS/NZS 4357:4, Laminated Veneer Lumber (LVL)	≤1mg/L
Japanese Agricultural Standard MAFF Notification No.701 Appendix Clause 3 (11) - LVL	≤1mg/L
JIS A 5908:2003 Particle Board and Plywood, with use of testing procedures JIS A 1460	≤1mg/L
JIS A 5905:2003 MDF, with use of testing procedures JIS A 1460	≤1mg/L
ASTM D5116	≤0.1(+/-0.0005) mg/m <sup>2</sup> hr
ISO 16000 part 9, 10 and 11 (also known as EN 13419)	≤0.1(+/-0.0005) mg/m <sup>2</sup> hr (at 3 days)
ASTM D6007	≤0.1(+/-0.0005) mg/m <sup>2</sup> hr (at 3 days)
ASTM E1333	≤0.12mg/m <sup>3</sup>
EN 717-1 (also known as DIN EN 717-1)	≤0.12mg/m <sup>3</sup>
EN 717-2 (also known as DIN EN 717-2)	≤0.12mg/m <sup>3</sup>



مدينة إكسبو دبي  
EXPO CITY DUBAI

Expo City Dubai  
Expo City Dubai Site  
Expo Road  
PO Box 2020  
Dubai, UAE