

Design Planning Manual for Buildings

Technical framework for minimum requirements
for infrastructure design

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UNOPS *Design Planning Manual for Buildings* is a living document and is intended to be a tool for learning and improving the quality of design of infrastructure work. Please send comments on this document, highlighting gaps, omissions and areas that need more development to design.review@unops.org

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Abbreviations

Abbreviations relevant to UNOPS

DP	Design Practitioner
MOSS	Minimum Operating Security Standards
MORSS	Minimum Operating Residential Security Standards
PM	Project Manager, UNOPS
SIPG	Sustainable Infrastructure Practice Group

Other Abbreviations

CRPD	Convention on the Rights of Persons with Disabilities
EA	Environmental Assessment
EIA	Environmental Impact Assessment
ER	Environmental Review
IBC	International Building Code
GHG	Green House Gas
FIP	Fire Indicator Panels
NGO	Non-Governmental Organization
PAHO	Pan American Health Organization
PEMP	Project Environmental Management Plan
SRF	Shatter Resistant Film
UXO	Unexploded Ordnance
WHO	World Health Organization

Executive summary

This is the first of a series of Design Planning Manuals to ensure that UNOPS delivers safe and functional infrastructure to the beneficiaries of its projects. A crucial factor in any infrastructure project is the quality of its design.

The UNOPS *Design Planning Manual for Buildings* applies to all UNOPS projects with a building component, including new constructions, alterations to existing buildings, and any reconstruction or associated works for buildings.

This document defines the responsibilities of Project Managers and Design Practitioners in delivering a design that complies with the mandatory minimum requirements contained herein.

The **Project Manager** must understand the contents to carry out the responsibilities with regard to:

- The engagement and performance of Design Practitioners
- The assessment of the level of risk involved in the design and implementation of infrastructure works. This determines the extent of review required
- The management of a Design Review to verify that the design solution proposed by the Design Practitioner meets performance requirements

Note: *The design reviewer must issue a Certificate of Design Review Compliance before procurement can issue tender documents for construction services.*

The **Design Practitioner** must:

- Demonstrate that the identified design solution has addressed UNOPS performance requirements for infrastructure design, and
- Rectify any design problems or inadequate documentation issues arising from Design Reviews

Statement on design liability

UNOPS shall accept design liability **only** when a design has been produced internally on behalf of UNOPS by UNOPS practitioners (i.e., staff or ICA) in accordance with this manual.

For designs provided by a **third party (e.g. a donor, a consultant)**, design liability shall rest with that third party. UNOPS shall not accept design liability in such cases. In this vein, UNOPS shall not make changes to such design either prior to, or during the construction phase, other than to the extent identified in SECTION B12.

The design review carried out under this manual, whether by a peer reviewer or a third party reviewer, shall not relieve the original designer from design liability. The latter shall remain responsible to implement appropriate modifications to the design until it meets the minimum requirements set out in this manual.

The design reviewer's liability shall be limited to evaluating the compliance of the design against the minimum requirements set out in this manual and shall not include any liability for the design itself, which shall remain with the original designer.

SECTION A

Introduction to the manual

A1 GENERAL INTRODUCTION

As the central UN resource for infrastructure, UNOPS has a responsibility to continually review and improve the quality of infrastructure works delivered to its partners. All infrastructure projects delivered by UNOPS should have a special focus on national capacity and sustainability, to contribute to the ability of countries to design, construct and maintain infrastructure, and to integrate and balance social, environmental and economic considerations in accordance with the *UNOPS Policy for Sustainable Infrastructure*. This is in line with UNOPS mandate¹, vision and high-level goals as outlined in *UNOPS Strategic Plan 2014-2017*.

A crucial factor in any infrastructure project is the quality of its design. This document sets out the approach Design Practitioners (DP) should follow to help ensure that quality design is consistently applied across all infrastructure projects. In the planning phase, DPs will need to take into account specific factors and constraints affecting each infrastructure project.

The Design Practitioner may be a national or international practitioner. By providing a sound design process to follow, this manual is intended to develop the ability of all personnel to deliver acceptable infrastructure solutions.

The UNOPS *Design Planning Manual for Buildings* applies **to vertical structures only** and not to civil works and other works. It applies to all new buildings, alterations to existing buildings and associated site works and services for buildings.

¹ On 20 December 2010 the United Nations General Assembly adopted a resolution which reaffirmed UNOPS mandate. The Assembly highlighted UNOPS role as a central resource for the United Nations system in procurement and contracts management as well as in civil works and physical infrastructure development, including the related capacity development activities.

Following this introductory section, the design protocols and technical content of the manual are set out in SECTIONS B and C. Later sections provide specific instructions and guidance to relevant parties. The whole of the document is laid out as follows:

Section A Introduction

This section explains the relationship of the Manual to *UNOPS Policy for Sustainable Infrastructure* and sets out the general provisions. These provisions detail how the manual should be used.

Section B Guidance and Protocols for the Design Process

A series of common issues that may affect infrastructure design are explored in SECTION B. For each issue a relevant protocol identifies the Design Practitioner's responsibilities and provides guidance towards a design solution.

Section C Technical Objectives, Functional Statements and Performance Requirements

The Technical Objectives, Functional Statements, and Performance Requirements that need to be considered in infrastructure design are outlined in SECTION C. These include fire safety, access and egress, structural integrity and health, among others.

Section D Instructions to Project Managers

SECTION D provides the risk assessment methodology and different risk categories for infrastructure, followed by the Design Review requirements for each risk category. The section also includes guidelines for special design cases and flow charts for the Design Review process.

Section E Instructions to Peer Reviewers

SECTION E provides instructions and guidance to Peer Reviewers.

Section F Instructions to Design Practitioners

SECTION F provides instructions and guidance to Design Practitioners. Included is a design checklist, detailing the requirements with which a proposed design must comply, and the standards of documentation to be submitted so that the proposed design can be evaluated against these requirements.

Section G Annexures

Environmental and technical annexures are supplied in SECTION G.

A2 GENERAL PROVISIONS

A2.1 Application

UNOPS *Design Planning Manual for Buildings* applies to all UNOPS projects with a building component. By extension, all design services implemented by or on behalf of UNOPS will follow the protocols, guidelines and mandatory design requirements set out in this document.

Design Practitioners (DP) must comply with the provisions stipulated in this document and:

- a. demonstrate that the identified design solution has addressed UNOPS performance requirements for infrastructure design, and
- b. rectify any design problems or inadequate documentation issues arising a Design Review

An implicit assumption in this manual is that it provides guidance on minimum requirements for design of UNOPS projects. There are many design projects in countries with well-established, sophisticated building codes and regulatory processes that far exceed these provisions. In such instances, the protocol in SECTION B2 defines the appropriate relationship between the minimum standards of this manual and national codes and regulations.

A2.2 Interpretation

This manual presents performance requirements, rather than mandatory prescriptions for a design solution, in order to suit the wide range of operational environments of UNOPS. Such an approach allows for greater flexibility and responsiveness on the part of project managers (PM), as they are best placed to identify a design solution that will work well in a particular context.

DPs may interpret the Performance Requirements in a manner that meets the aims and intent of Technical Objectives and Functional Statements. The relevant framework is outlined in the diagram and table in SECTION A3.

However, **all designs must comply** with the mandatory content set out in SECTION C. The documentation submitted for Design Review must include statements identifying how the DP has interpreted and met the provisions of SECTION C. If the design cannot be made to comply with a specific requirement, solid justification needs to be provided for any exceptions to be granted.

For further assistance in interpreting the contents of this manual, DPs should refer to SECTION F, or contact the UNOPS Project Manager.

A3 UNOPS POLICY FOR SUSTAINABLE INFRASTRUCTURE²

UNOPS Policy for Sustainable Infrastructure provides the policy framework for the delivery of infrastructure in a socially and environmentally acceptable manner. It defines the aspirational outcomes that all infrastructure projects should aim to accomplish.

This manual derives from and provides concrete guidelines to implement the *UNOPS Policy for Sustainable Infrastructure*. By following the contents of this manual, DPs minimize the risk of delivering low quality infrastructure projects and ensure that infrastructure design meets the minimum standards of safety and quality.

The *UNOPS Design Planning Manual* includes guidelines, mandatory minimum provisions, and performance requirements for infrastructure design. In addition to these design planning guidelines, Project Managers will refer to *UNOPS Infrastructure Project Implementation Manuals* during the implementation of infrastructure projects.

The conceptual framework for the *UNOPS Policy for Sustainable Infrastructure* is outlined in the following graphic and table.

² The *UNOPS Policy for Sustainable Infrastructure* is available [here](#) from the UNOPS website.

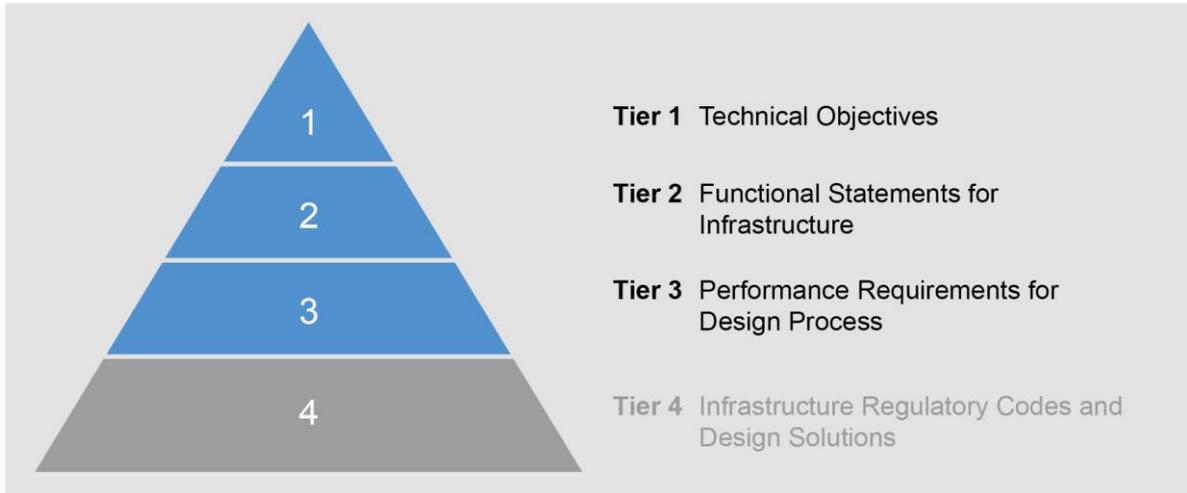


Figure 1: Conceptual framework for UNOPS Policy for Sustainable Infrastructure

Table 1: UNOPS Social Impact Policy for the Design and Implementation of Infrastructure

Tier 1	
Intent	Tier 1 defines high-level standards, benchmarks and aspirations for the design process relevant to the content of the <i>UNOPS Policy for Sustainable Infrastructure</i> .
Content	Technical Objectives of infrastructure design activities relevant to the applicable parts of the <i>UNOPS Policy for Sustainable Infrastructure</i> . This includes labour standards, gender equality, child labour, health & safety, environmental and social impacts, transparency and anti-corruption, etc.
Tier 2	
Intent	Tier 2 sets out the general terms of how a piece of infrastructure is expected to satisfy the Technical Objectives .
Content	Functional Statements identify the processes, actions or functional requirements for the specific category or element.
Tier 3	
Intent	Performance requirements and minimum expectations for design practitioners to meet the Functional Statements as defined in Tier 2.
Content	Performance Requirements set out the minimum level of performance and design standards, which must be met for the infrastructure to comply with the relevant Functional Statements and Technical Objectives .
Tier 4	
Intent	Tier 4 will provide statutory codes and regulations , as well as best practice guidance , but does not exist at present.
Content	Will be provided in the future.

SECTION B

Guidance and Protocols for the Design Process

INTRODUCTION

UNOPS infrastructure projects need fit-for-purpose design solutions that are appropriate for the partner and end users, and in line with *UNOPS Policy for Sustainable Infrastructure*. The intent of this section is to give Design Practitioners (DPs) the resources to make informed decisions during the design process.

Section B: Guidance and Protocols for the Design Process

- B0** Design process
- B1** Sustainable infrastructure
- B2** National design standards
- B3** Life safety
- B4** Design brief criteria
- B5** Services design and future maintenance
- B6** Services infrastructure on site
- B7** Green technology
- B8** Climate change adaptation and disaster risk reduction
- B9** Environmental imperatives
- B10** Design duty of care
- B11** Design review
- B12** Changes affecting design

For each issue, a relevant protocol identifies the DP's responsibilities and provides guidance toward a design solution. The DP's decisions should be recorded and justified, where necessary, to ensure that the basis for the design can be understood and approved by funding partners and stakeholders.

The designer may be a national or international professional. By providing a sound design process to follow, this manual is intended to develop the ability of all personnel to deliver acceptable infrastructure solutions.

In all cases, when the Design Practitioner encounters an issue that needs to be raised, or requires additional guidance or consultation, the appropriate contact point is the responsible Project Manager.

DESIGN PROCESS

By bringing UNOPS policy and processes in line with normal professional practice in design consulting, the *Design Planning Manual for Buildings* aims to ensure that UNOPS construction projects are consistently implemented and meet minimum requirements for safety and functionality.

The following figure provides an overview of the general risk management in the design process for UNOPS construction projects. More specific requirements will depend on the risk category of the infrastructure, and separate requirements may apply for renovation or repetitive works. Detailed guidelines and flow charts are located in SECTION D.

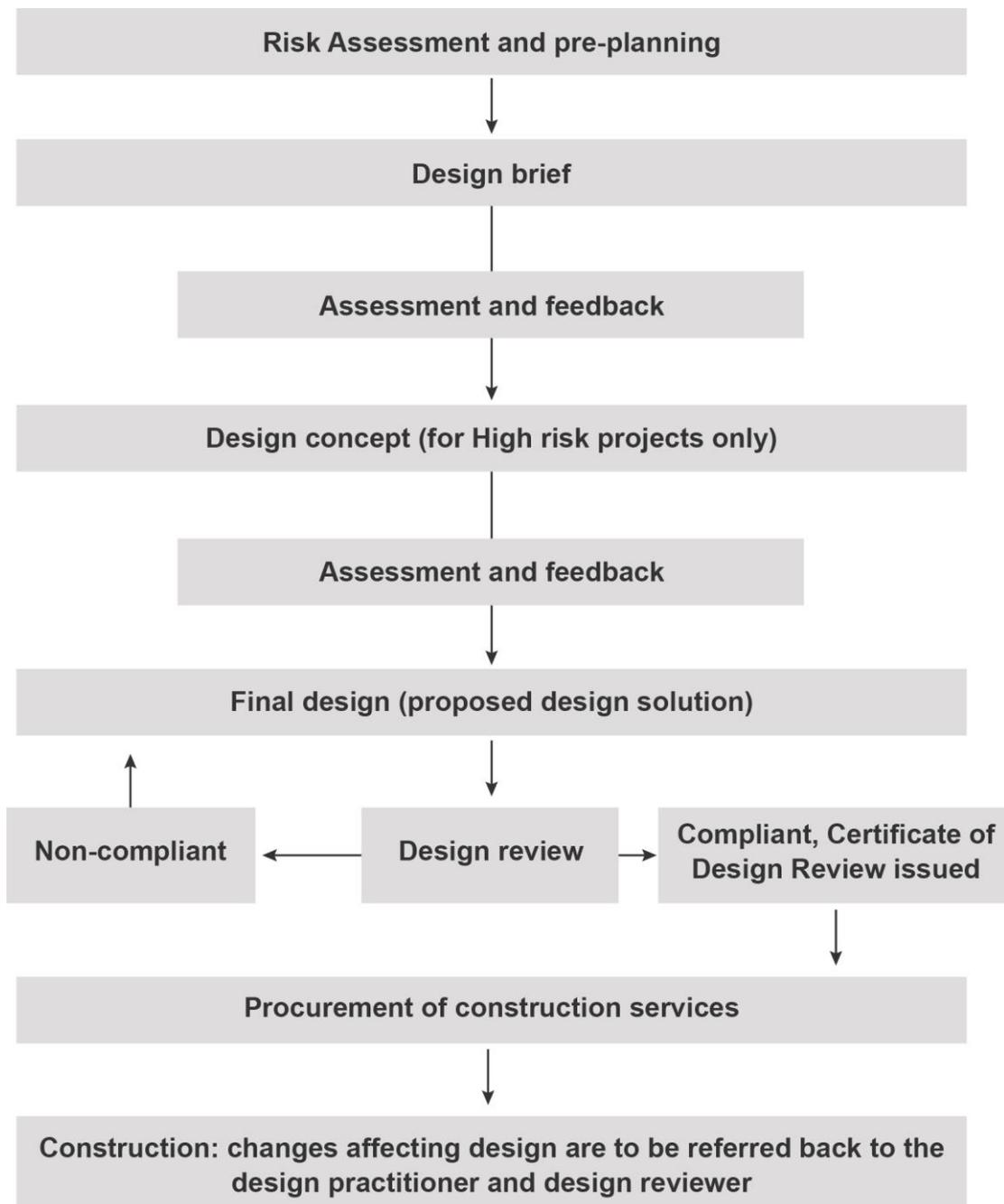


Figure 2: Design process

The design process³ begins with pre-planning, proceeds through various stages of design and review, continues through the construction phase and concludes with the hand-over of the building. Key stages are outlined briefly below, providing a framework for design management from the inception of the construction project through and until its delivery.

B0.1 Design brief

Once the business case for the project has been affirmed, establishing that the scope of the works is financially and legally viable, and the Design Practitioner has been identified by the UNOPS Project Manager, this stage of the design process helps identify project objectives, budget, and quality expectations.

Feasibility studies, site investigations, and environmental and risk assessments are all to be carried out in preparation of the initial design brief. At the same time, a communication strategy should be developed to continually correspond with and involve all stakeholders.

The time required to prepare the design brief will vary according to the size and complexity of the construction works. In all cases, however, a sound design brief is essential in providing a solid foundation for a successful completion of works.

For medium and high risk works (see the risk methodology in SECTION D) the design brief will be reviewed by a third party, to ensure that the above considerations are included and provide a sound basis to accomplish the project and quality objectives.

Note on usage: a design brief may be sometimes referred to as a design program or a design initiation document. In some cases, similar terminology is used to refer to general instructions to the designer. For UNOPS projects, however, a proper design brief must contain all of the below elements.

In preparation of the design brief and in consultation with stakeholders, the Design Practitioner must consider:

- Spatial requirements of the project (list of rooms and functions and the corresponding linkages between them)
- Scope of works
- Site information, based on site investigations and surveys, an environmental assessment, as well as all other necessary technical surveys (geotechnical, hydrographic, etc.)
- Budget

³ The UNOPS process draws on and is adapted in part from the Royal Institute of British Architects Plan of Work, 2013.

B0.2 Concept design (for high risk projects)

In addition to the design brief and the final design solution, high risk infrastructure also requires an intermediate concept design that will undergo a third party review.

The concept design develops from and expands upon the design brief to include preliminary cost information, outline proposals for structural design and building services and outline specifications.

Any additional, necessary site assessments and surveys that emerge as a result of the design brief submission, are carried out at this concept design stage.

Design Practitioners should also consider construction and sustainability strategies, maintenance and operational implications for services, and health and safety considerations.

In preparation of the concept design, the Design Practitioner must consider:

- Outline proposals for structural design
- Outline proposals for building services systems
- Outline specifications
- Preliminary cost information

B0.3 Final design solution

The final design develops from and expands upon the design brief and the design concept (in the case of high risk infrastructure only).

For the final design solution, the proposed design is fully developed. Final design documentation **requires a design review** to check for compliance against the requirements of this Design Planning Manual, before tendering documents can be issued for the construction of the building.

At this stage, all spatial coordination exercises have been completed, and architectural and building services and structural engineering information have been provided and aligned to the budget. Additionally, the design work of any specialists has been completed and incorporated into the proposed design solution.

Any necessary government and other external consultants will have been consulted at this point, and the concerns of relevant stakeholders incorporated into the final solution.

At this stage, except for design variations stemming from changes occurring during the construction stage, all aspects of design have been completed and incorporated, including services maintenance, operational implications, and health, safety and sustainability considerations.

In preparation of the final design, the Design Practitioner must consider:

- Drawing sets
- Schedules
- Specifications
- Computations
- Photographs
- Bill of quantities
- Standards, codes or guidelines
- Other reports

B0.4 Design review process

When a final design solution is proposed, a design review is required to check the design against the protocols and requirements of the Design Planning Manual and/or the agreed codes or standards. The level of review will depend on a number of risk factors (see the risk methodology in SECTION D), but even low-risk designs require at least a peer-review by a qualified professional.

After the design review is carried out, reviewers will send their comments to the Project Manager, who will bring them to the attention of the Design Practitioner (DP). The DP is then required to address the identified issues, amending the original design or otherwise responding to the questions raised. These responses and any revised documents are then submitted for a reassessment.

Note: In the case of any unresolvable issues between the designer, design reviewer and project manager, the matter should be referred to the Head of Design and Planning for conflict resolution.

More information on the Design Review process can be found in SECTION B11 and SECTION D. UNOPS Project Managers should also refer to the Book of Knowledge for further guidance.

B0.5 Construction

The building is constructed according to the specifications of the design. Variations that affect design may need to be referred back to the Design Practitioner, in accordance with the specific guidelines laid out in SECTION B12.

B0.6 Handover of buildings and defects notification period

The handover of the building occurs once the works defined in the construction contract are complete. To provide for the possibility of design defects, the design process continues through the expiration of the defects notification period, as specified in the construction contract.

B1 SUSTAINABLE INFRASTRUCTURE

Infrastructure projects must address all aspects of the *UNOPS Policy for Sustainable Infrastructure* as interpreted in this manual.

As per Organizational Directive No.40, UNOPS endeavours to design and implement infrastructure projects in a manner that respects the principle of social and environmental responsibility and sustainability, including preventing or mitigating adverse impacts on the environment and identifying opportunities for improved environmental performance.

Furthermore, UNOPS is committed to ensuring that the planning, design and implementation of infrastructure projects does not unfairly burden poor and vulnerable individuals, communities, and governments. Wherever feasible, UNOPS infrastructure projects must be designed to mitigate the risks of negative social and environmental impacts and maximize positive impacts of the same.

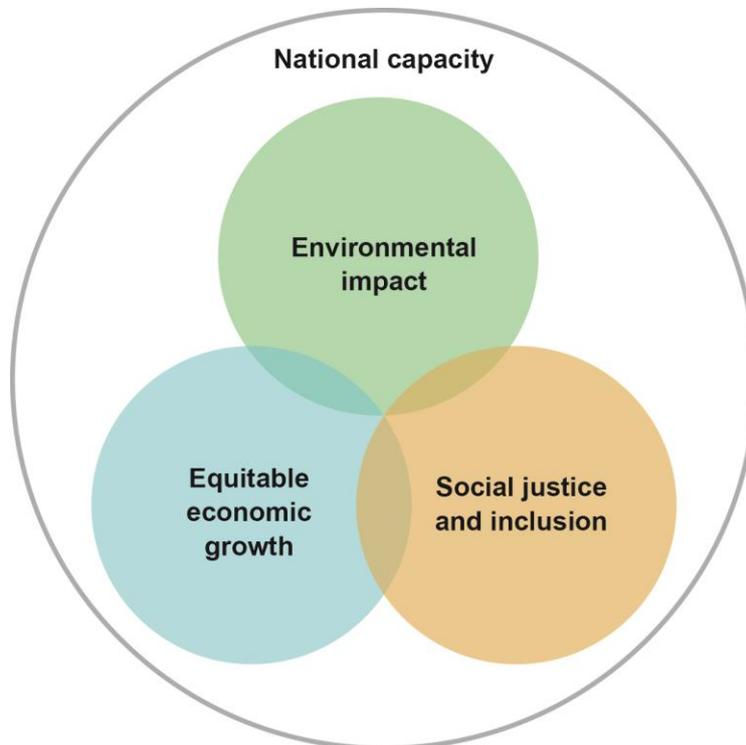


Figure 3: UNOPS Sustainability Dimensions

Protocol B1 Sustainable infrastructure

The Design Practitioner (DP) must ensure that the identified design solution has met the functional statements of SECTION C and is compliant with *UNOPS Policy for Sustainable Infrastructure*. If the DP identifies the possibility of negative social or environmental impacts, it is the DP's responsibility to raise this risk to the Project Manager.

B2 NATIONAL DESIGN STANDARDS

UNOPS implements infrastructure in a broad range of countries. Each country generally has a building code/regulations and an authority that reviews or approves building designs. Many of these codes are highly sophisticated documents with significant regulatory impact. While such regulations may far exceed the minimum requirements contained in this manual, there are other countries that have limited or no standard basis for design. In contexts where there are no national building codes, UNOPS minimum requirements as outlined in this manual may be the only guidelines available.

This manual is not intended to supersede existing building codes and guidelines. DPs need to be aware of existing standards in the relevant country and ensure that any design solution identified matches or exceeds the existing country standard. Where national building codes do not meet UNOPS stipulated minimum design provisions, this manual becomes the default standard for DPs to follow.

If a design is to comply with an agreed higher standard, such as the International Building Code (IBC), more detailed documentation is required than that laid out in SECTION F, which is sufficient only to assess the design against the requirements of this manual. In such a case, the DP should submit sufficient documentation to assess the proposed design against the requirements of the particular standard. For instance, compliance with the IBC requires a DP to submit specifications for every piece of piping, electric cables, etc.

Note: A statement claiming compliance with the International Building Code (IBC) implies that the infrastructure also complies with other parts of the International Code Council Suite of Codes, multiple ASTM and other recognised American Code or regulatory material, which could in total exceed 20,000 pages of cross-referenced material.

Note: The ability to comply with the codes of other countries. In many countries, it is not appropriate, cost-effective, practical or achievable to design and build in line with a particular code requirement from another country. This may be necessary on occasion, however, and UNOPS is committed to providing consistent quality in its design and implementation of infrastructure projects.

Protocol B2 National design standards

The UNOPS Design Manual and any national building code standards **MUST** be jointly applied, and compliance with the more stringent standard is required. Design Practitioners should crosscheck national and UNOPS standards in order to determine and, if necessary, provide reasoning for the appropriate standards to be used.

B3 LIFE SAFETY

UNOPS priority for building design is life safety. Protection of assets, while important, is a secondary concern. In line with the safe schools and safe hospitals agenda, special factors are to be considered in the design of these entities, in order to ensure that they are constructed to withstand the impact of hazards and remain functional in emergency situations.

The Final Design must consider the combination of many critical elements that impact life safety, such as, but not limited to building size, building capacity, firefighting and warning capability, choice of materials to be used, etc. The life safety mitigation measures may vary widely and the available options must provide flexibility in the design outcome.

The measures incorporated by the designer will vary from project to project. Some examples and case scenarios are provided in SECTION C below, but it is the DP's responsibility to determine the most appropriate solution to ensure an acceptable standard for life safety.

Example: According to the International Building Code (IBC), a building in the USA could require fire sprinklers due to its size, function, the materials used, construction type and number of people. However, the proposed site is in a country and location where it is not feasible to use sprinklers. In this context, the building will require other mitigation measures. These could include the installation of fire walls effectively dividing a large building into smaller ones for fireproofing purposes, an increased number of exits and/or fire detectors and/or additional fire extinguishers and/or fireproof materials to mitigate the risk.

Protocol B3 Life safety

The design solution must comply with and, in some cases, exceed national building codes which relate to life safety as per the requirements of Section B2. When a performance requirement is defined, the Design Practitioner must provide evidence of compliance.

B4 DESIGN BRIEF CRITERIA

The quality of the Design Brief provided to the Project Manager is a critical issue for the success of the Final Design. Any lack of understanding of specific requirements, functionality, linkages between spaces or functions, service requirements etc., will affect the quality of the design. It is therefore imperative that a clear Design Brief is prepared by the DP to ensure that all aspects of the design are effectively addressed.

The Design Brief must be approved by the donor, end user and other stakeholders before the design process commences. Many poor infrastructure outcomes can be avoided in this manner, but it should be recognized that it is necessary to provide adequate allowances for time and costs in preparation of the Design Brief. This is particularly critical for complex design works such as hospitals.

In addition to the actual physical space requirements and linkages, the design criteria used for engineering design also need consideration. These criteria may change, subject to the intended and potential future use of the facilities.

It is a common situation that the original information provided by the donor or end user in the formulation of the project is modified and augmented as a result of technical input during the design phase. This can affect the complexity of design, the budget, timelines for construction and quality requirements. The direct partner may also change the brief during the design documentation phase, significantly altering the intent of the building functionality and space allocation.

Example: Foundation and column/beam design criteria change if there is an intent to increase from a two storey building to add a further two storeys in future.

Example: Specific building types such as hospitals, for which functionality is critical, require a higher design load for earthquakes or high winds compared to housing in the same location.

Example: An end user requests a specific rate of air exchange that does not correlate with international expectations of performance in a hospital. If this could affect the health of occupants, any alterations to the rate should be discussed with the aim of improving the standard of health care provided. The resulting decision should be documented. A change in the design criteria could affect air conditioning equipment and ductwork size, cost, and ceiling void clearance requirements.

A comprehensive Design Brief and statement of requirements establish the basis for the design and should be in place to minimize the occurrence of significant changes to the scope of works. The PM, advised by the DP, plays a leading role in informing partners and end users of the implications associated with changing significant requirements and the ensuing alterations to design.

Protocol B4 Design Brief criteria

When the Design Brief is not provided by a third party, the DP is responsible for preparing this document. The DP is subsequently responsible for demonstrating that the design solution meets appropriate design criteria and has addressed all elements of the brief.

B5 SERVICES DESIGN AND FUTURE MAINTENANCE

It is understood that a design solution that is appropriate in one context might not be appropriate in another. Any services design must take into consideration the availability of construction materials and experienced labour sources in country. Another consideration is the availability of spare parts for services maintenance during the building's operational life and the availability of local connecting/supply services. These are critical factors in the safety and efficiency of infrastructure works and the DP should consider them in the development of a design solution. In many cases, reliable low-tech mitigation measures may be more realistic and preferred to high-tech measures. Incorporating these considerations helps ensure that the outcome is both manageable during the construction phase and practical for long term maintenance.

Example: *The design solution calls for the import of a specialist water pump that takes 16 weeks to deliver for construction and eight weeks for spares delivery. However, no services maintenance capacity in-country requires expensive 'fly in' support or replacement with locally available components that may not provide the same performance.*

Note: Project managers as well as stakeholders should be aware that the construction contractor is not responsible for normal building maintenance.

Protocol B5 Services design and future maintenance

The Design Practitioner is responsible for examining the possible alternatives, future maintenance implications and provision of recommendations for a design solution. The solution must meet the design criteria and partner and end user requirements in accordance with the local context.

B6 SERVICES INFRASTRUCTURE ON SITE

In some instances, local authorities may not be able to provide water supply, water treatment, solid waste management systems or electrical supply to the site. If, for example, a building needs access to its own water supply (not supplied by the local authority), the design will need to include such provisions.

Any planned urban renewal and extension of services should be considered during the design phase, as this will influence decisions concerning the design of services for the infrastructure. If it is envisaged that a building will eventually connect to local authority services, the design solution should reflect this expectation. This is particularly important if the extension will occur within a short to medium period of five to ten years. If the timing is more likely to occur in excess of ten years, then the eventual connection may not be as relevant.

Wherever possible the design should incorporate environmentally-sound practices including the reduction of power consumption, waste, water use and increased reliance on alternate sources of renewable water and power supply. This includes, for example, rain capture and recycling systems, renewable energy systems, the reuse and recycling of waste and the composting of biodegradable waste.

It is likely that some types of infrastructure—such as hospitals, storm shelters, or schools, which may be part of an evacuation shelter—should maintain a degree of independence from infrastructure services. This will permit uninterrupted services to be maintained in an emergency scenario. The DP must evaluate and confirm any requirements for ‘stand-alone’ capacity or ‘survivability’ for the building works and must incorporate these requirements into the design solution.

Example: A hospital might have its own generator for power, but if it does not have water storage or waste storage capacity, then its functionality in an emergency is limited.

Example: The project requires pit toilets constructed in high water table locations due to a lack of water supply. However, the users draw water from nearby wells, potentially resulting in illnesses and poor health. Alternatives may include roof water capture and re-use, composting, above ground toilets, above ground waste separation and disposal systems.

In some instances, the site will not have available services and the end users or donors may request a solution that is potentially harmful to users, public health or the environment. It is the responsibility of the DP to raise this issue to the PM and seek an alternative that is acceptable to all stakeholders.

There must also be awareness of possible issues arising from technological solutions that may be proposed. An onsite waste water treatment system may appear a sound solution but the cost and availability of spare parts, trained service personnel, environmental sustainability, long-term operational capacity, and cultural issues of waste disposal all must be assessed and agreed to, prior to its inclusion in the design solution.

Protocol B6 Services infrastructure on site

The Design Practitioner must demonstrate that the design solution is appropriate for the services infrastructure available or planned for the site. The design should also consider maintenance implications for services to maximize the potential design horizon and functionality of the infrastructure.

B7 GREEN TECHNOLOGY

Green technology in the design of infrastructure is the application of environmentally sound practices to promote energy efficiency, to reduce greenhouse gas emissions and to source and re-use locally available materials, as well as other sustainable construction practices. This may require compliance with National Energy Codes and guidelines, which must be understood by the Design Practitioner in order to develop a compliant solution. In instances where compliance with the codes or other requirements is not feasible, the DP is to provide the PM with all relevant information to enable an informed decision that is agreeable to all stakeholders, such as authorities, donors and end-users.

Protocol B7 Green technology

The Design Practitioner must demonstrate that appropriate solutions have been considered to reflect the intent of reducing energy consumption and greenhouse gas emissions during both construction and over the lifetime of the infrastructure. Particular attention should be paid to ongoing costs and periodic maintenance of the infrastructure services until the design horizon is reached.

B8 CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

Climate change adaptation in the design of infrastructure is interpreted by UNOPS in light of the Durban COP17 Climate Conference publication, *Promoting sustainable development by making communities and infrastructure climate resilient*⁴, released in December 2011. The intent is to make infrastructure more resilient and responsive to the anticipated effects of climate change. Some considerations are explored below.

Infrastructure should be designed in line with existing national, regional and international climate change adaptation and mitigation plans. This is to ensure that infrastructure is not designed and constructed in isolation from other development initiatives, but is in line with the host country's national sustainable development plans.

Due to the uncertainties associated with climate change, current codes and standards are not sufficient to reduce vulnerability. It is necessary to take into account engineering principles and promote safer construction practices to reduce vulnerability. A safety factor in one dimension may be catastrophic in another.

Example: If the design solution prepares the building for a greater amount of snowfall, the structural mass of the building could be increased to resist higher external variable loads through thicker slabs, girders, columns and reinforcement. However, buildings with more mass (especially in upper level floors) produce larger horizontal/seismic forces in the case of an earthquake. This could be catastrophic in a country where earthquakes are common.

Example: Current maximum rainfall intensity of 150mm/h may be expected to increase to 200mm/h, which will require larger capacity gutters and downpipes.

Disaster risk planning and mapping should be undertaken in preliminary discussions, to help inform local and national authorities and donors of the risk of adverse effects of climate change for the identified site. To make communities climate resilient, infrastructure needs to be designed and built with an integrated approach. The aim is not just for a single building in isolation to withstand the effects of a natural hazard but for the system to remain functional; therefore, considerations of the supporting infrastructure (i.e. access roads to site) are also relevant. For example, necessary operational plans and measures to ensure that people in need can access a hospital are equally important as the need for a hospital structure to resist the effects of an earthquake.

An analysis of disaster risk mapping of the proposed site may indicate that it is more practical, feasible and sustainable to construct in a different location. Infrastructure should be constructed in areas that are least vulnerable to the effects of climate change. If there is no alternative location available, or if the infrastructure works involve upgrading existing works in a location vulnerable to the effects of climate change, Design Practitioners must demonstrate that they have included climate change mitigation measures into their design solutions.

⁴ UNOPS publication "Promoting sustainable development by making communities and infrastructure climate resilient" is accessible at:
http://www.unops.org/SiteCollectionDocuments/Publications/Rio/UNOPSNexusPositionPaper_web.pdf

Given the long functional lifespan of infrastructure, infrastructure investment decisions can significantly impact the options and cost of future adaptation/disaster risk reduction (DRR) activities.

Example: Without consideration of the impact of flood water on the accessibility and services design, building a hospital in a flood prone area will reduce its functionality or stop it from functioning altogether in the event of a disaster.

Example: Many urban infrastructure systems largely rely on centralized, networked systems, such as fossil-fuel, grid-based energy systems. These systems and their supply chains can be extremely vulnerable to hazards. If service is disrupted or the system fails, it can result in power being cut off to millions of people for an extended period of time.

To improve the resilience of our infrastructure systems to future disasters, it is important to consider investment in decentralized systems that rely on renewable inputs, and can thus operate independently of central networks systems in case of their failure.

Protocol B8 Climate change adaptation and disaster risk reduction

The Design Practitioner must demonstrate that steps have been taken to identify the most suitable site available, preferably in a zone that is least vulnerable to the effects of climate change and natural hazards. When infrastructure development is planned in a vulnerable zone, or is restricted to a specific site, or entails works with existing building infrastructure, the Design Practitioner must demonstrate that adequate measures have been incorporated into the design solution to make the infrastructure as resilient as possible and practicable.

B9 ENVIRONMENTAL IMPERATIVES

The project should consider negative and positive effects that may potentially impact local communities and the surrounding environment.

In accordance with the UNOPS Environmental Management System, an environmental screening shall be conducted before the design process commences, in order to determine the need for an Environmental Assessment (EA) to assess the suitability of the site and identify any environmental impact from the construction of the project and the operation of completed facilities.

The EA should include or be followed up by the Project Environmental Management Plan and Site Environmental Management Plan that specify actions to eliminate, reduce, mitigate or control potential negative impacts and maximize possible positive effects. More information on the requirements for the Environmental Assessment can be found in the attached APPENDIX G1, which contains the Project Environmental Management Plan, to be filled out by the Project Manager based on the information provided by the Design Practitioner's analysis and input.

Each infrastructure project is required to identify the environmental impacts that can be addressed during the design. These may include the incorporation of integrated water management systems (recycled water, grey water, rainwater harvesting, reduced volume of water required by users), solid waste management systems (separation of waste into reusable, recyclable, biodegradable and residual waste, and safe disposal onsite or offsite of hazardous waste), energy efficient features and adaptation of the passive design principles for lighting and heating.

The use of high-energy embodied materials and imported materials should be kept to a minimum and the reuse of recycled materials available in-country should be considered in the design.

Protocol B9 Environmental imperatives

The Design Practitioner must demonstrate that due care has been exercised to assess the environmental impact of the project and that suitable measures have been put in place to respond to recommendations identified during the assessment, in accordance with the UNOPS Environmental Management System.

B10 DESIGNER DUTY OF CARE

As an UN organization, UNOPS has a duty to provide competent professional services to donors and beneficiaries. The designer duty of care and the design review process described in B11 are an integral part of UNOPS commitment to consistent quality in the services it provides. With regard to Design Practitioners, Designer Duty of Care is interpreted by UNOPS as follows:

- Duty to beneficiaries (end users of infrastructure)
- Duty to personal safety (and that of colleagues) within UN offices and on project sites

UNOPS and UNOPS personnel duty to beneficiaries

All external consultants and personnel involved in the design of infrastructure should have the knowledge, skills and experience to comply with the UNOPS *Design Planning Manual for Buildings*. The use of professional judgment is expected from all those working on the design of infrastructure. These personnel should be competent and have the necessary resources to complete their job satisfactorily (resources include time, equipment etc., as needed). It is UNOPS duty, as the employer, to request that personnel engaged to undertake design tasks have the necessary competence to do so. UNOPS should not ask Design Practitioners to accept tasks that they are not competent to execute.

Designers and contractors are duty bound not to endanger the safety of others. In addition to their duty to be competent and to maintain their competency, designers and contractors also assume additional duties:

- a. Duty of care to the public as stipulated by law of host nation
- b. Duty of care to the occupants of the building and associated site work
- c. Professional organizations (e.g. membership to recognized Architectural or Engineering Bodies)
- d. Terms of contract either with UNOPS or UNOPS direct partners

Example: A civil engineer with three years' experience is requested to design a health centre in a rural area. The design of this building requires the technical input of a professional architect with relevant background in health care facilities. It would not be appropriate, in this case, for an engineer to perform design tasks which clearly fall within the discipline of architecture professionals.

Duty to personal safety

It is the Design Practitioner's duty to respect their personal safety and that of their colleagues. This includes understanding and following UNOPS Organizational Directives and Administrative Instructions relevant to personal health and safety at work.

UNOPS is also committed to working with host governments and local design and engineering practices to harness local knowledge and to build architectural and engineering capacity in the host country. This is in line with UNOPS values for service to others, the promotion of excellence and national ownership and capacity in the design and implementation of infrastructure.

Protocol B10 Designer duty of care

Design Practitioners must only undertake design tasks that they are competent to fulfil. The Design Practitioner must comply with his/her professional obligations to UNOPS, professional organizations and the host country.

B11 DESIGN REVIEW

All infrastructure implemented by UNOPS must undergo a design review process as part of their quality and risk management plan. This is a normal design activity within all professional design organizations in order to limit the risk of infrastructure failure.

The design review process exists to address planning issues and establish whether the design solution meets the protocols and intent of SECTION B and the performance requirements as set out in SECTION C. The Design Review will check if the Design Practitioner has considered the main structural, architectural and functional elements in the design.

The extent of the Design Review is determined by the risk level of the infrastructure works, assessed by the Project Manager or a qualified engineer to whom the PM has delegated responsibility, and based on the potential risk implicit in the proposed building solution. Please refer to SECTION D1 'Risk assessment methodology' for further information.

Design reviews occur at key stages during the design process, as laid out at the outset of this SECTION B. These reviews should be carried out in a timely fashion; a review that is done too late may have cost implications, or result in lost opportunities for improved infrastructure outcomes.

Example: The Design Review might include confirming that the corridor space allocation is correct; that the relationship between different parts of the building is functional; that adequate access has been provided to persons with disabilities; and that fire escape routes have been allowed for. Entrances and exits to the buildings will be checked, as well as provisions for parking when appropriate.

Example: The design review may include an assessment of structural loads and other design elements concerning services and space allocation; whether the water supply system is adequate for the expected use; whether effluent systems have been sized correctly for the expected loads; and whether measures have been taken to avoid contamination and adverse effects downstream.

Depending on the host country regulations, an external design review and approval by the relevant authority may be needed before construction. This does not release the Design Practitioner and the Project Manager from the responsibility for complying with the requirements of this manual.

During project implementation and construction phases, contractor, donor, or end user requests for significant design changes, specification and alternative materials will be referred to the appointed DP for consideration and approval. See SECTION B12 'Construction changes affecting design' for the protocol on design variations and their implications with regard to the requirement for design review.

Finally, please note that a Design Review might imply changes in the scope and budget of the works. The DP is to assess these changes and inform the PM of their implications for further discussion with the donor, direct partner and relevant stakeholders, in order to reach an agreement before the changes are implemented. This discussion and agreement may be implemented with a formal change/control

management process to ensure that the changes are agreeable to all relevant stakeholders.

The final design documentation is to be checked and the approval of the design reviewer obtained prior to the construction or procurement of construction services.

Protocol B11: Design Review

The Design Practitioner must demonstrate that due care has been taken to meet the performance requirements as set out in SECTION C and that errors and omissions identified in the Design Review process are rectified and implemented as directed by the Project Manager.

B12 CONSTRUCTION CHANGES AFFECTING DESIGN

There is a risk associated with construction variations or substitutions required during the construction process. These variations may occur for various reasons and may affect the design as previously approved. Some may be substantial changes, while others are minor but may have major implications.

Example: The donor provides more funds and wants to add a staff dining facility to the roof slab of a three storey building. This could affect slab and foundation loading, fire escape provisions, water supply and drainage design.

Example: The documented size of reinforcement bars for concrete beams is not available and the contractor requests a different size as substitute. This may affect the total number of bars, their connection, cover to the reinforcement, which may affect the flexural strength, shear loading and other engineering design associated with columns and beams.

Example: The end user wants to move a column to fit a particular piece of equipment into a space. This affects the span of the beam overhead, potentially increasing deflection and causing wall issues on the floor above.

Example: The contractor in a cold climate country wants to replace clay based floor tiles with polished marble slabs on an outside deck and steps to 'make it look nicer'. If the PM approves, this could be a serious design risk due to the extreme slip hazard in wet, icy or snowy conditions.

The Project Manager should not approve and implement the sorts of changes in the above examples without reference to the Design Practitioner or other design support. Any changes that may potentially adversely affect the life safety of the occupants and other users, including all structural changes, must be approved by the DP or a third party reviewer as appropriate.

Other potential changes may be modifications of the original design with limited design impact.

Example: The contractor wants to substitute separate wall mounted taps with a combined mixer tap.

Example: The contractor wants to substitute acoustic ceiling tiles due to non-availability. Assuming the detail is provided for the alternative, and it matches the performance of the original, there is no reason to refuse the substitution.

The PM will consult with the DP for all variations that affect design outcomes. This is particularly critical in high risk infrastructure projects where design reviews have been undertaken. The DP and reviewer both are required to update the documentation and the Design Review report in light of alterations during the construction phase.

The Project Manager must consider any design implications associated with proposed construction variations and their impact on the design elements in SECTION C of this manual. These must be referred to Design Practitioners on the following basis:

- No requirement for referral of low risk infrastructure unless the risk associated with the proposed variation is high impact (for example, adding an additional story to a single story facility). The PM is responsible for any

design related change, however, so it is highly recommended to refer significant design changes to the DP.

- The PM is required to notify the Design Practitioner for comment for medium risk infrastructure and take any comments into consideration if the PM intends to approve the variation.
- The PM is required to notify the Design Practitioner and reviewer of proposed changes for high risk infrastructure. The PM is to seek written comments and approval of both parties for changes that affect compliance with the mandatory requirements in SECTION C of this manual.

The DP and the reviewer must recognize the time implications associated with delays in construction and respond in an expeditious manner to all requests. Variations may occur in budget allocation, timelines, and technical design modifications. The PM will evaluate the relative importance of these variations and any associated risks.

Protocol B12 Construction changes affecting design

If the proposed design changes constitute a significant change to the design intent of the building, and/or exceed the variation limits within the contract approval, and/or could potentially affect the risk category of the infrastructure, or constitute a structural change, the Project Manager must refer the changes to the Design Practitioner and the Design Reviewer.

SECTION B: GUIDANCE AND PROTOCOLS FOR THE DESIGN PROCESS

Code/ Protocol	Clause	Completed: Yes or n/a
B1 Sustainable infrastructure	The Design Practitioner (DP) must ensure that the identified design solution has met the functional statements of SECTION C and is compliant with <i>UNOPS Policy for Sustainable Infrastructure</i> . If the DP identifies the possibility of negative social or environmental impacts, it is the DP's responsibility to raise this risk to the Project Manager.	
B2 National design standards	The UNOPS Design Manual and any national building code standards must be jointly applied, and compliance with the more stringent standard is required. DPs should crosscheck national and UNOPS standards in order to determine and, if necessary, provide reasoning for the appropriate standards to be used.	
B3 Life safety	The design solution must comply with and, in some cases, exceed national building codes which relate to life safety as per the requirements of Section B2. When a performance requirement is defined, the Design Practitioner must provide evidence of compliance.	
B4 Design Brief	When the Design Brief is not provided by a third party, the Design Practitioner (DP) is responsible for preparing this document. The DP is subsequently responsible for demonstrating that the design solution meets appropriate design criteria and has addressed all elements of the brief.	
B5 Services design & maintenance	The Design Practitioner is responsible for examining the possible alternatives, future maintenance implications and provision of recommendations for a design solution. The solution must meet the design criteria and partner and end user requirements in accordance with the local context.	
B6 Services infra. on site	The Design Practitioner must demonstrate that the design solution is appropriate for the services infrastructure available or planned for the site. The design should also consider maintenance implications for services to maximize the potential design horizon and functionality of the infrastructure.	
B7 Green technology	The Design Practitioner must demonstrate that appropriate solutions have been considered to reflect the intent of reducing energy consumption and greenhouse gas emissions during both construction and over the lifetime of the infrastructure. Particular attention should be paid to ongoing costs and periodic maintenance of the infrastructure services until the design horizon is reached.	
B8 CCA & DRR	The Design Practitioner must demonstrate that steps have been taken to identify the most suitable site available, preferably in a zone that is least vulnerable to the effects of climate change and natural hazards. When infrastructure development is planned in a vulnerable zone, or is restricted to a specific site, or entails works with existing building infrastructure, the Design Practitioner must demonstrate that adequate measures have been incorporated into the design solution to make the infrastructure as resilient as possible and practicable.	
B9 Environmental imperatives	The Design Practitioner must demonstrate that due care has been exercised to assess the environmental impact of the project and that suitable measures have been put in place to respond to recommendations identified during the assessment, in accordance with the UNOPS Environmental Management System.	
B10 Duty of care	Design Practitioners must only undertake tasks that they are competent to fulfil. The Design Practitioner must comply with his/her professional obligations to UNOPS, professional organizations and the host country.	
B11 Design review	The Design Practitioner must demonstrate that due care has been taken to meet the performance requirements as set out in SECTION C and that errors and omissions identified in the Design Review process are rectified and implemented as directed by the Project Manager .	
B12 Changes affecting design	If the proposed design changes constitute a significant change to the design intent of the building, and/or exceed the variation limits within the contract approval, and/or could potentially affect the risk category of the infrastructure, or constitute a structural change, the Project Manager must refer the changes to the Design Practitioner and the Design Reviewer.	

SECTION C

Technical Objectives, Functional Statements and Performance Requirements

INTRODUCTION

This section contains the technical objectives, functional statements and performance requirements for meeting UNOPS minimum standards.

STATEMENT: This document includes all the specified requirements that the Design Practitioner is generally responsible for fulfilling. However, the Design Practitioner's Terms of Contract with UNOPS will identify the relevant scope of works for which the Design Practitioner has this responsibility.

Section C: Technical Objectives, Functional Statements and Performance Requirements

- C1** Site
- C2** Materials Selection
- C3** Structure
- C4** Fire Safety
- C5** Access and Egress
- C6** Health and Amenity
- C7** Services and Equipment
- C8** Security
- C9** Green Technology
- C10** Climate Change and Disaster Risk Reduction

With regard to each element, SECTION C is structured in the following manner:

- a. The relevant clauses of *UNOPS Policy for Sustainable Infrastructure* are referenced at the start of each element
- b. Relevant **technical objectives**, defining high-level standards, benchmarks and aspirations are referenced in relation to the *UNOPS Policy for Sustainable Infrastructure*.
- c. **Functional statements** identify the necessary processes, actions or functional requirements to satisfy the defined **technical objectives**
- d. **Performance requirements** set out the minimum level of performance and design standards, which must be met to comply with the relevant processes, actions or functional requirements for the specific category or element **functional statements** and **technical objectives**.
- e. The mandatory performance requirements are indicated throughout by the word '**MUST**' in bold, capital letters.
- f. At the end of each element, a checklist provides a handy reference for all the performance requirements for the corresponding section.

C1

SITE

C1 SITE

The site for any infrastructure project can give rise to numerous issues which have human rights, and social and environmental effects. Population displacement, livelihoods, cultural issues and biodiversity shall be considered carefully and measures taken to mitigate any negative impacts. It is strongly encouraged that site selection be addressed at the planning stage to reduce the negative impacts that the future infrastructure might have.

POLICY REFERENCES

- Item 4** **Purpose:** This policy provides the framework to ensure that the development and living conditions of all segments of society are not put at risk, but enhanced by the design and implementation of infrastructure projects. In particular, it enables the identification of opportunities for sustainable infrastructure activities, while simultaneously facilitating the detection of socially or environmentally detrimental impacts associated with the design, development and implementation of infrastructure projects and the creation of methods to eliminate or mitigate these impacts.
- Item 19** **Human rights:** Furthermore, UNOPS activities aim to prevent, mitigate or remedy adverse impacts on individuals, communities, and their environment resulting from the design and implementation of infrastructure projects and identify opportunities for positive impacts on individuals and communities and their environment in all UNOPS infrastructure activities.
- Item 26** **Public health, safety and security:** UNOPS strives to mitigate the exposure or spread of water-borne and vector-borne diseases associated with the design and implementation of infrastructure projects. Furthermore, UNOPS attempts to identify mechanisms to eliminate or minimize existing threats to communities from the exposure or spread of disease.
- Item 49** **Indigenous peoples:** The application of this section and relevant protections must be considered where a project directly or indirectly affects the dignity, human rights, livelihood systems, or culture of indigenous peoples or affects the territories or natural or cultural resources that indigenous peoples own, use, occupy, or claim as an ancestral domain or asset.
- Item 52** **Indigenous peoples:** Meaningful consultation with indigenous peoples is of particular importance where projects adversely affect land and resources under traditional ownership or customary use.
- Item 57** **Cultural heritage:** UNOPS strives to safeguard and ensure respect for the cultural heritage of communities, groups and individuals affected by infrastructure activities and to prevent any adverse impact on cultural heritage as a result of these activities.
- Item 62** **Involuntary resettlement and displacement:** UNOPS seeks to avoid involuntary resettlement wherever possible as a result of project activities and, where this is not possible, to minimize involuntary resettlement by exploring project site and design alternatives.
- Item 97** **The environment:** UNOPS endeavours to design and implement infrastructure projects in a manner that respects the principle of environmental responsibility and sustainability, including preventing or mitigating adverse impacts on the environment and identifying strategies for improved environmental performance.

- Item 100** **The environment:** UNOPS seeks to develop mechanisms to ensure sufficient recognition and protection of the right to water, wherever implicated by the design and implementation of infrastructure projects.
- Item 111** **Sustainable resource use:** When project activities reveal the potential for significant impacts on the environment or natural resources utilized by local communities, UNOPS endeavours to take reasonable steps to avoid or mitigate these effects, in collaboration with partners and third parties.
- Item 120** **Protection of biodiversity and prevention of land degradation:** In cooperation with partners, UNOPS strives to identify impacts on biodiversity, with particular attention to impacts on indigenous and local communities that are dependent on these resources, and to prevent, minimize and remedy adverse impacts, while recognizing opportunities for the protection, promotion and recovery of biodiversity.

TECHNICAL OBJECTIVES

- C1.TO 1** To develop infrastructure on the site that has a minimum negative impact on the site-related elements of the *UNOPS Policy for Sustainable Infrastructure*.
- C1.TO 2** To deliver, where possible, positive impacts on site-related elements of the *UNOPS Policy for Sustainable Infrastructure*.
- Example: Where a site has been contaminated by hazardous waste, the project may have the option of building on top of these grounds, or removing the contaminated soil first. The latter option would be a case of "positive impact", assuming that the contaminated soil is properly remediated and not dumped elsewhere. If building on top of the grounds, environmental, social and structural considerations would have to be incorporated due to disturbances of the soil and the nature of contamination.*

FUNCTIONAL STATEMENTS

- C1.FS 1** The social impact on communities on and around the site must be considered in the design of the infrastructure.
- C1.FS 2** The environmental impact of the infrastructure on and around the site must be considered in the design of the infrastructure.
- C1.FS 3** The DP should examine the site and carry out all research necessary to confirm any limiting factors which may affect the design of the infrastructure.

PERFORMANCE REQUIREMENTS

C1.PR 1 Rights of Way and Rights of Use (formal or informal)

- a. The DP **MUST** investigate existing Rights of Way, both formal and informal, where these cross all or part of the Site. These may entail implications to be considered in the social impact assessment.

Example: A right of way could allow access to a stream, and removal of this right of way could prevent local inhabitants' access to water, or could considerably increase the walking distance to the water source.

- b. Formal Rights of Way and Rights of Use should be shown on existing ownership documents for the land on which the Site is situated. Further research may be required in the Deeds Office of the national government so that accurate positions, coordinates etc., may be obtained. Should it be proven that formal rights of way exist, and these are to remain in force, positions of such rights of way and rights of use **MUST** be marked on the topographic survey drawings, and positions pegged on site.
- c. If it is possible to retain formal rights of way or rights of use, it may be necessary to design fences and gates to enhance security for the infrastructure occupants.
- d. If the removal of formal rights of way or rights of use is necessary, and this causes inconvenience to any sector of the local population, every effort should be made to find an acceptable alternative solution to compensate for the loss.
- e. Informal rights of way or rights of use should be identified by the DP, and UNOPS should notify the Direct Partner / Donor / Government of their existence, as well as negotiate with appropriate parties to assist in reaching solutions regarding these rights.
- f. If it is possible to retain informal rights of way or rights of use, it may be necessary to design fences and gates to enhance security for the infrastructure occupants.
- g. If the informal rights of way or rights of use cannot be retained, and this causes inconvenience to any sector of the local population, every effort should be made to find an acceptable alternative solution to compensate for the loss.

C1.PR 2 Displacement of people

Displacement of people on or adjacent to the site could occur as a result of people living on the site, or people using the site to earn their living, e.g. growing crops, grazing livestock. The PM should investigate the circumstances of such occupancy and bring this to the attention of the government authorities.

Where relevant, DPs **MUST** consider design solutions that enable continued use of the site. If this is not possible, the PM should make recommendations to the government authorities so that affected people are allocated suitable replacement land and/or acceptable alternative compensation.

C1.PR 3 Bio-diversity

DPs **MUST** make enquiries with relevant authorities such as national or international conservation bodies regarding the likelihood of any significant bio-diversity issues arising as a result of the infrastructure project, unless this process has been completed as part of an existing environmental assessment.

Example: The possibility exists that land allocated for a project may be the habitat of a rare species of flora or fauna. Note should be taken of land type, (urban, agricultural, natural state), surface area of site, proximity to water, etc.

Example: It is unlikely that a 0.1 hectare Site in a built-up area will present any significant bio-diversity issues, while a 5 hectare Site in an area of forest could well do so.

Example: Consideration may be needed for the breeding season of birds, which may entail implications for the timing of construction or delivery of services.

Should site investigations show that bio-diversity issues exist, the DP **MUST** report this to the PM, so that UNOPS can bring the issue to the Direct Partner / Donor / Government / national conservation bodies before any major design work is carried out.

C1.PR 4 Cultural heritage

DPs **MUST**:

- a. Enquire from appropriate authorities such as local municipalities, historical societies, UNESCO, into the possibility that any buildings on the site could be of cultural or historical significance.
- b. Research records and make enquiries locally as to whether the site could have been a burial ground, or other area of cultural or historic significance.

- c. Should investigations show that cultural heritage issues exist, DPs **MUST** report this to the PM, so that UNOPS can bring the issue to the Direct Partner / Donor / Government before any major design work is carried out.
- d. Should the government have any requirements regarding steps to be taken to protect culturally sensitive buildings or areas, such steps should be clearly stated in the approval documents from the government. The DP **MUST** ensure these are clearly identified and adhered to in the design documents.

If the appropriate authorities decide that a culturally sensitive building or area may be demolished or modified, the PM must obtain clear direction in writing from the relevant authorities, approving or instructing UNOPS to proceed. The PM should record details of such buildings or areas by means of a descriptive report containing photographs and, where possible, by the preservation of any artefacts or historical objects for handover to the relevant government department or cultural organisation.

C1.PR 5 Archaeological significance

DPs **MUST**:

- a. Enquire from appropriate authorities such as local municipalities, historical societies, UNESCO, into the possibility that the project Site is situated on land which could be of archaeological significance, as well as research the subject on internet sites or any other relevant information sources.
- b. Should investigations show that the Site is on land of any archaeological significance, DPs **MUST** report this to the PM, so that UNOPS can bring the issue to the Direct Partner / Donor / Government before any major design work is carried out. If any archaeological issues are not identified at an early stage, this could result in major delays and redesign costs.

Example: A piece of land was allocated by a government for the construction of a border post. When UNOPS' research determined the possibility that the site may be on a valuable archaeological area, the government was notified. Three ministries under whose auspices the Border Control Post project fell, instructed UNOPS to ignore this fact and continue with design. When UNESCO, and then the Ministry of Culture, were consulted, UNOPS were instructed that work would not be allowed to proceed on the site. New land was allocated some months later, the time schedule was affected and extra design costs were incurred.

Example: A UN agency was requested to build a new village over the buried ruins of a centuries-old city. Flat slab foundations with large surface area were designed to ensure the lowest possible bearing pressure on the ruins below; the intent was to excavate the ruins at some time in the distant future. This had considerable effect on the structural design.

C1.PR 6 Site environmental assessment

The PM, with the assistance of the DP, **MUST** identify any problems with the site and should allow for this in construction estimates. Such issues should be brought to the attention of the Direct Partner / Donor / Government as early as possible, before any major design work is carried out. Costs of environmental remediation could be high, and could affect the time schedule.

The DP **MUST** verify with the UNOPS PM whether any specific environmental remediation or control measures are required in the design documentation.

For further guidance and documentation, please refer to SECTION B9 and APPENDIX G1, Environmental Management Documentation.

Example: The site may have been a fuel filling station in the past, and hydrocarbon contamination could reach the water table.

Example: Existing untreated sewage contamination from external sources may need to be cleaned up before construction can commence.

Example: Buried rusting metal scrap could cause foundation difficulties, and could also cause contamination of the water table.

C1.PR 7 Site infrastructure services

DPs **MUST** consider the following in the initial planning phase:

- a. Any adverse impact on the site or local populations resulting from the design, and any issues identified in the environmental assessment.

Examples: 1. Pollution from untreated sewage.

2. Ponding of water caused by incorrect ground slopes (too shallow). This could result in an increase in breeding of mosquitoes, causing malaria and dengue fever.

3. Scour effects and erosion caused by incorrect ground slope (too steep).

4. Reduced water supply to local populations, if too much water is drawn off from a stream.

5. Deep wells drilled for water supply for the infrastructure could draw down the water table and render existing adjacent shallow well useless.

6. Sewage disposal by septic tank soak-away could contaminate adjacent shallow water wells.

- b. The potential for positive site impacts resulting from the design.

Example: Water can be collected from roofs and hardened areas and stored, reducing runoff from the site.

Example: A well can be installed so that surplus water can be supplied to the local population.

C1.PR 8 Demining

UNOPS often works in post conflict areas, where the presence of land mines and unexploded ordinance is a very real danger. Data for infrastructure design relies heavily on information gained from topographical and geological surveys; limited design work can take place before the above surveys have been completed. Before any physical work commences on the Site, including the above topographical and geological site surveys, the PM must investigate the possibility of mines or UXOs existing on such Site.

- a. The PM will refer to UN de-mining agencies and local de-mining NGOs for records and mapping which shows which areas have been mined, never mined, or mined and demined.
- b. Should research show that the Site has never been mined, or has been de-mined, the PM must have in their possession a clearance certificate to this effect.
- c. In the event that the Site has been mined, and mines could still exist on the Site, a licensed de-mining company must be contracted to carry out demining. On completion, the demining company will issue a clearance certificate to the PM.

The DP **MUST** not enter the site area until a clearance certificate has been issued and approval for access provided by the PM. The DP **MUST** document any areas that are off limits for the contractor due to demining issues.

C1.PR 9 Site ownership

Ownership of the site should be clarified prior to or early in the design phase due to potential impact on the design solution, project management costs and timelines.

Where possible, the Direct Partner, Donor or Government **MUST** provide an official deed / document showing ownership, signed and stamped by the relevant authorities. If possible, UNOPS should request to view the original of this document.

A site governed by informal ownership systems will affect the determination of site ownership. This is distinct from issues surrounding displacement or right or way/right of use. An agreement shall be reached by all stakeholders to determine site ownership for the purposes of the project in an informal ownership systems setting.

No work should commence on the Site until ownership has been established. The DP should ensure that the site plan identifies any issues with site ownership boundaries and considers any associated design implications.

C1.PR 10 Technical surveys and reports

DPs **MUST** obtain all technical surveys necessary to complete the design of the infrastructure. This could include, but are not limited to, the following:

- a. An Environmental Assessment (EA). The EA may be required, depending on the type and size of the project and requirements of the Direct Partner / Donor / Government. Refer to SECTION B9 for further clarification regarding the requirements of the Environmental Assessment.
- b. A Topographic Survey. This should show reference to existing horizontal and vertical control / benchmarks, levels, contours, positions and levels of existing services, walls, adjacent roads and properties, etc.
- c. A Geotechnical Survey Report. This should include all relevant data from test pits and boreholes to show the existing soils and geotechnical data of the site, and should include recommendations for foundation design, including footing levels and soil bearing pressures.

Other surveys which may affect the design process include social impact assessments, transport studies, and urban planning studies.

C1.PR 11 Site clearing

The DP **MUST** identify the full extent of any site clearing in the documents, if it forms part of the construction contract. Any site clearing **MUST** comply with the previously identified requirements from C1.PR 3 to C1.PR 6.

C1.PR 12 Demolition of existing structures

Building

If a building is to be demolished, the PM must establish/confirm ownership of the building. The building may have been constructed by others with the permission of a previous owner, and demolition could result in objections and delays on site.

The DP **MUST** identify the full extent of any demolition in the design documentation if it forms part of the construction contract. The DP **MUST** ensure that the demolition does not impact any other site infrastructure or adjacent infrastructure.

Materials

Demolition materials should be dealt with and disposed of in a responsible manner. The previous property owner may claim them, a third party could lay claim, or they could become property of the construction contractor depending on the terms of the contract. UNOPS should consider all eventualities.

The PM, with the aid of the DP, **MUST** identify the ownership of the demolished materials and ensure it is included in the technical documentation. Consideration should be given to the disposal of construction waste in a social and environmentally responsible manner.

Example: Culturally significant carved entry portals that were an entrance to previous building may not fit new entrance space or are now claimed by a third party who does not give permission for relocation.

It is encouraged that materials be reused in new constructions, and DPs should ensure that they are not contaminated and are fit-for-purpose.

Examples: Breaking of waffle slabs for rubble infill where waffle former is made of asbestos cement is NOT permitted.

Equipment

If specific equipment is to be reused, the PM must ensure that ownership is determined. The DP **MUST** determine the suitability of the equipment before the design is completed.

Example: A steam steriliser is considered too good to 'throw away' but services connections to proposed location need design to suit power and water supply requirement.

C1.PR 13 Vehicular access and car parking



DPs should consider:

- a. The integration of transport and land use planning to reduce transport needs and promote energy efficiency.
- b. The feasibility of alternative transport systems and/or locations of public transport terminus/stops with regard to reducing private vehicle transport and parking requirements.

DPs **MUST** check:

- a. That vehicle parking is sufficient on the site or on adjacent areas next to site area for the likely volume and size of vehicles.
- b. The effect of transport to and from the new infrastructure on the existing road system, when positioning entries and egress to and from the site. This could be through application to local municipalities or transport authorities.
- c. Turning spaces, wheel loads, clearing heights and accessibility for heavy vehicles (e.g., fire engines, flatbed delivery trucks, containerised transport, buses) accessing the site and any required parking spaces.

C1.PR 14 Accessible parking

Parking spaces for persons with disabilities **MUST** be provided in accordance with the table below.

Table 2: Parking facilities, based on the International Building Code

Total number of parking spaces provided in parking facility	Minimum number of required accessible parking spaces
1 to 25	1
26 to 50	2
51 to 75	3
76 to 100	4
101 to 150	5
151 to 200	6
201 to 300	7

- a. The minimum dimension for an accessible parking space shall be 4.0m width x 6.0m length. The spaces shall be located at the closest parking location to the building entrance.

The parking space shall be a maximum of 1:50 slope to ensure the safe transfer of persons from vehicle to wheelchair.

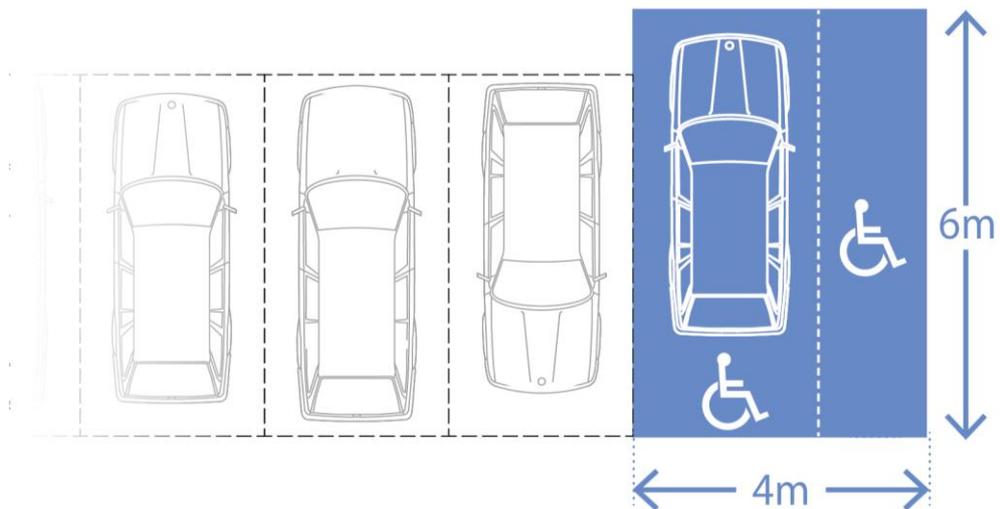


Figure 4: Minimum dimensions for an accessible parking space

- b. For rehabilitation and outpatient facilities for physical therapy, 1 in 5 patient and visitor parking spaces **MUST** be provided to serve patients whose mobility is affected.

Conditions that affect mobility include conditions requiring the use or assistance of a brace, cane, crutch, prosthetic device, wheelchair or powered mobility aid; arthritic, neurological or orthopaedic conditions that severely limit one's ability to walk; respiratory diseases and other conditions that may require the use of portable oxygen; and cardiac conditions that impose significant functional limitations.

- c. For residential facilities, parking spaces provided to serve the facilities **MUST** comply with the above table. Where at least one parking space is provided for each residential unit, at least one accessible parking space **MUST** be provided for each residential dwelling unit required to provide mobility features.

Site (C1)		Completed Yes or n/a
C1.PR 1 Rights of Way/ Rights of Use	The DP MUST investigate existing Rights of Way, both formal and informal, where these cross all or part of the Site. Positions of such rights of way and rights of use MUST be marked on the topographic survey drawings, and positions pegged on site.	
C1.PR 2 Displacement of People	Displacement could occur as a result of people living on the site, or people using the site to earn their living, e.g. growing crops, grazing livestock. Where relevant, DPs MUST consider design solutions that enable continued use of the site.	
C1.PR 3 Bio-diversity	<p>DPs MUST make enquiries with relevant authorities such as national or international conservation bodies regarding the likelihood of any significant bio-diversity issues arising as a result of the infrastructure project, unless this process has been completed as part of an environmental assessment.</p> <p>Should site investigations show that bio-diversity issues exist, the DP MUST report this to the PM, so that UNOPS can bring the issue to the Direct Partner / Donor / Government / national conservation bodies, preferably before any major design work is carried out.</p>	
C1.PR 4 Cultural heritage	<p>DPs MUST enquire into the possibility that any buildings on the site could be of cultural or historical significance.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C1.PR 5 Archaeological significance	<p>DPs MUST enquire into the possibility that the Site is situated on land which could be of archaeological significance.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C1.PR 6 Environmental assessment	The PM, with the assistance of the DP, MUST identify any problems with the site. The DP MUST verify with the UNOPS PM whether any specific environmental remediation or control measures are required in the design documentation.	
C1.PR 7 Site infrastructure services	<p>DPs MUST consider the following:</p> <p>a. Any adverse impact on the site or local populations resulting from the design, or any issues identified in the environmental assessment</p> <p>b. The potential for positive site impacts resulting from the design</p>	
C1.PR 8 Demining	UNOPS often works in post conflict areas, where the presence of land mines and unexploded ordinance is a very real danger. The DP MUST not enter the site area until a clearance certificate has been issued and approval for access provided by the PM. The DP MUST document any areas that are off limits for the contractor due to demining issues.	
C1.PR 9 Site ownership	Where possible, the Direct Partner, Donor or Government MUST provide an official deed / document showing ownership, signed and stamped by the relevant authorities.	
C1.PR 10 Technical Survey/Report	DPs MUST obtain all technical surveys necessary to complete the design of the infrastructure. This could include, but are not limited to, environmental assessments, topographical surveys, and geotechnical surveys.	
C1. PR 11 Site clearing	The DP MUST identify the full extent of any site clearing. Any site clearing must comply with previously identified requirements from C1.PR 3 to C1.PR 6.	
C1.PR 12 Demolition	<p>The DP must identify the full extent of any demolition in the design documentation if it forms part of the construction contract. The DP MUST ensure that the demolition does not impact any other site infrastructure or adjacent infrastructure.</p> <p>The DP MUST identify the ownership of the demolished materials. If specific equipment is to be reused, the DP MUST determine the suitability of the equipment before the design is completed.</p>	
C1.PR 13 Car access & car parking	The DP MUST consider the impact of vehicular access, car parking, and more on the adjacent road transport system. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
C1.PR 14 Accessible Parking	Parking spaces for persons with disabilities MUST be provided in accordance with the table in the relevant section. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	

C2 MATERIALS SELECTION

C2 MATERIALS SELECTION

The choices made for building elements and materials will critically influence the quality of the project. Choices shall be made that are sustainable, economical and fit-for-purpose. The context of the local situation shall be considered carefully to ensure that supply and execution are feasible in a manner that benefits the project in the long term. The building elements considered in this section are:

- Foundations
- Structural frame work
- Walls-load bearing and non-load bearing
- Roofs
- Floors
- Ceilings
- Heating and ventilation equipment
- Doors and hardware
- Windows and hardware
- Glass
- Sanitary ware and fittings
- Waterproofing and weatherproofing
- Insulation
- Plumbing and piping
- Electrical systems

POLICY REFERENCES

- Item 37** **Gender equality and the empowerment of women:** Infrastructure projects have the potential to create job opportunities and training for women, which enable women to reap the economic benefits associated with construction and maintenance projects.
- Item 43** **Persons with disabilities:** UNOPS seeks to ensure that roads, premises and facilities are designed and built with consideration for universal design standards and that these standards are integrated into the project cycle.
- Item 85** **Health and safety in employment:** UNOPS strives to maintain the highest health and safety standards for employment in the context of infrastructure projects, [...] in particular in connection to dangerous processes or substances.
- Item 96** **The environment:** Poor design and implementation of infrastructure projects may contribute to increased levels of pollution, poor air-quality, excessive resource consumption, climate change, socio-economic inequality, loss of bio-diversity and waste. However, incorporating appropriate safeguards into project design and implementation can avoid or minimize adverse impacts on the environment and contribute to the protection of the global climate for present and future generations.
- Item 97** **The environment:** UNOPS endeavours to design and implement infrastructure projects in a manner that respects the principle of environmental responsibility and sustainability, including preventing or mitigating adverse impacts on the environment and identifying strategies for improved environmental performance.
- Item 107** **Pollution prevention:** UNOPS seeks to ensure consideration of the life cycle impacts of materials used in construction activities; for example, the processes used in the creation of materials, the environmental impacts of materials during their use, and the reuse, recycling or disposal of the materials when they are no longer useful.
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Item 110 Sustainable resource use: UNOPS endeavours to support sustainable resource use in the context of all infrastructure activities. In this regard, UNOPS seeks to identify measures to improve resource efficiency by reducing energy and water use, using sustainable, renewable and low-impact resources instead of non-renewable resources wherever possible and with respect for the local context, and identifying methods of reusing or recycling resources used in project activities.

TECHNICAL OBJECTIVES

C2.TO 1 Where feasible, the choices of building elements and materials should deliver impacts that are positive as defined in *UNOPS Policy for Sustainable Infrastructure*.

FUNCTIONAL STATEMENTS

C2.FS 1 In integrating the building elements and materials DPs must strive to achieve a resulting infrastructure project which is sustainable, energy efficient, cost efficient, causes the least possible negative environmental and social impact, protects its users from impact of weather and other natural hazards, and allows the efficient functioning of the activity for which it is designed.



C2.FS 2 DPs should, in the choice of building elements, consider the balance between choices that favour local building practice, availability of skills and the potential for local capacity building with new solutions and/or technology. All social and environmental impacts of these choices, both positive and negative, must be included in the decision process.

C2.FS 3 Equally, in the choice of materials, DPs must consider local products and only specify imported materials where locally available materials either do not exist or are not suitable. UNOPS may encourage, directly or indirectly, the establishment of production facilities or the enhancement of existing facilities.

C2.FS 4 In the selection of materials, the DP must consider maintenance implications for local communities.

PERFORMANCE REQUIREMENTS

C2.PR 1 Fitness for purpose

The choice of building elements and materials **MUST** take into consideration that the materials fit the requirements as defined in C2.PR 2 to C2.PR 4.

Example: Lightweight timber with plastic sheeting may be fit for purpose in the construction of emergency shelters; it is not fit for purpose in the construction of a permanent building.

Example: Glass in a window shall be specified taking into consideration safety and security of the occupants and the availability of replacement. Ordinary thin glass sheet would not be fit for purpose in full height glazing.

Example: Door and window hardware and sanitary fixtures shall be robust and hardwearing. Cheap hardware which lasts only a short time is not considered fit for purpose.

C2.PR 2 Local sources

All selection of building elements and materials **MUST** be carried out on the basis of professional judgement of choices between locally available systems and materials, and systems that require either importation or the establishment or enhancement of a manufacturing facility.

Example: For safety reasons laminated glass is specified, but there is no local source and no commercial motive for starting production. In this case, importing laminated glass is unavoidable.

Example: A precast product manufacturer exists, but has no current competence in the manufacture of manholes. Encouragement may be given to invest in moulds, handling and curing facilities with a long term commercial motive.

Example: If a local manufacturer of good quality timber framed windows exists, using timber from a renewable managed source, it would be inadvisable to specify aluminium framed imported windows.

C2.PR 3 Life cycle

Other than services and equipment, building elements **MUST** be envisaged to have the required lifetime for the infrastructure project, an acceptable life cycle cost, and which can be recycled safely at the end of their useful life, where feasible.

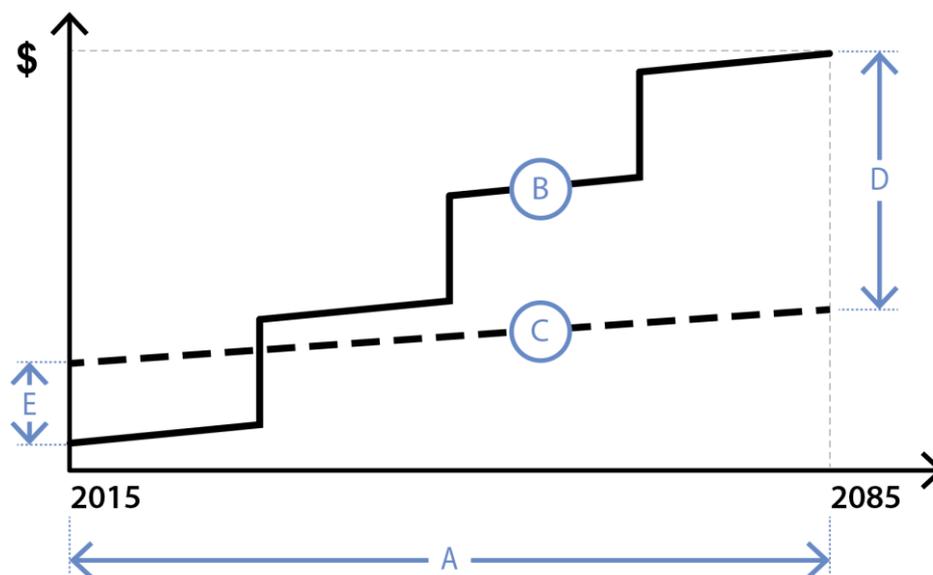


Figure 5: Life cycle cost
Over the lifetime (A) of a building, 'Component C' has a lower total life cycle cost (D) than 'Component B', although the initial investment (E) was higher.

C2.PR 4 Hazardous elements and materials

Elements and materials with known hazardous content **MUST** not be used. Appropriate precautionary measures are required for materials that may be hazardous only during construction activities.

Example: Do not reuse old roofing sheets or floor tiles containing asbestos.

Example: Do not use lead-containing paints or primers.

Example: Do not use epoxy paints and polyurethane lacquers without appropriate protective measures during their application.

C2.PR 5 Renewable materials

Preference may be given to elements with material content from renewable sources and lower embodied energy.

Example: Specify timber from certified managed forestry.

Example: Do not specify highly complex elements requiring long transport.

C2.PR 6 Composites

Composite elements should not be used where avoidable, due to the difficulty in recycling such materials.

Example: Precast concrete elements with polystyrene void filler.

Example: Glass fibre reinforced concrete facade elements with insulation of polyurethane.

C2.PR 7 Supplier social responsibility

Preference may be given to suppliers of building components or materials that have adopted a corporate social responsibility policy which adheres to the ten principles of the Global Compact⁵ or are prepared to commence a programme of adopting such a policy into their corporate strategy.

Example: A competent local manufacturer exists, but has no knowledge of the Global Compact, but is willing to join the Global Compact and commence a programme of incorporating the principles in its organisation.

C2.PR 8 Costs and functionality

Unnecessarily expensive elements and materials should be avoided and the DP should research alternatives with lower cost where possible.

Example: Prefabricated systems of internal non load bearing light weight partitions should only be specified if there is a firm prediction that frequent changes in user requirements will take place.

Example: Decorative stone cladding should be sourced locally in preference to specifying imported stone.

C2.PR 9 Termite treatment

Termite treatment **MUST** be specified in any zone that is infested with termites. The treatment is to be carried out during construction and must carry a guarantee of a minimum of ten years.

Failure to carry out termite treatment during construction may create the need for post construction treatment, which is not as efficient and may be more costly.

C2.PR 10 Insulation



The DP **MUST** carefully consider insulation, both thermal and acoustic, even in environments where local practice is to not insulate the buildings.

The use of alternative materials for solid walls should be included in the design choices as well as the design of brick or block walls with cavities and cladding or lining over timber or steel framed walls.

Example: Alternative materials may include straw bale, cob construction, compressed mud brick, log cabin, etc.

Radiant barriers that greatly improve the thermal performance of a building element may be a good choice in remote locations where transport of bulky materials is prohibitive.

⁵ The UN Global Compact's ten principles in the areas of human rights, labour, the environment and anti-corruption can be consulted in the following link:
<http://www.unglobalcompact.org/AboutTheGC/TheTenPrinciples/index.html>

The user benefits of properly insulated buildings can be significant, both from the point of view of comfort and energy efficiency.

C2.PR 11 Fire resistance

Fire resistance **MUST** be considered with reference to SECTION C4, including the contribution of materials to the spread of fire. Fire doors, walls and stops **MUST** be incorporated in the design where appropriate.

Element Materials Selection (C2)		Completed Yes or n/a
C2.PR 1 Fitness for purpose	The choice of building elements and materials MUST take into consideration that the materials fit the requirements as defined in C2.PR 2 to C2.PR 4	
C2.PR 2 Local sources	All selection of building elements and materials MUST be carried out on the basis that a balanced choice is made between locally available systems and materials, and systems that require either the importation or the establishment or enhancement of a manufacturing facility.	
C2.PR 3 Life cycle	Other than services and equipment, building elements MUST be envisaged to have the required lifetime for the infrastructure project, an acceptable life cycle cost, and which can be recycled safely at the end of their useful life, where feasible.	
C2.PR 4 Hazardous elements and materials	Elements and materials with known hazardous content MUST not be used. Appropriate precautionary measures are required for materials that may be hazardous only during construction activities.	
C2.PR 9 Termite treatment	Termite treatment MUST be specified in any zone that is infested with termites. The treatment is to be carried out during construction and must carry a guarantee of a minimum of ten years.	
C2.PR 10 Insulation	The DP MUST carefully consider insulation, both thermal and acoustic, even in environments where local practice is to not insulate the building.	
C2.PR 11 Fire resistance	Fire resistance MUST be considered with reference to SECTION C4, including the contribution of materials to the spread of fire. Fire doors, walls and stops MUST be incorporated in the design where appropriate.	

C3 STRUCTURE

C3 STRUCTURE

The objective of structural design is to deliver a building that will be structurally sound during its functional life. As every site is different, designs must be specific to the location where construction is planned. A structural design that is appropriate in one location cannot be simply applied to another.

Design, construction and inspection of structures are to be carried out by engineers and technicians with the necessary expertise and experience. The structural designer, working with the design practitioner, shall choose a structural system which does not diminish the quality of functional layouts and plans. The choice of structural system shall be influenced by the choice of locally available materials, construction practice and capacity and skills available.

The Project Manager should consider the implications for design sign-off by a recognized/registered engineer where sign-off is required for legal registration and/or authority approval.

POLICY REFERENCES

Item 22 **Public health, safety and security:** UNOPS endeavours to design and implement infrastructure projects in a manner that prevents or, where this is not possible, mitigates adverse effects to the health, safety and security of affected individuals and communities and their environment.

TECHNICAL OBJECTIVES

- C3.TO 1** To protect people from the effects of structural damage, failure and building collapse.
- C3.TO 2** To protect the property and other buildings from damage caused by structural damage or failure.

FUNCTIONAL STATEMENTS

- C3.FS 1** The structure must be designed to satisfy structural safety and serviceability requirements with sufficient technical guarantees, so that negative impacts are minimized and positive impacts are maximized.

Example: Loss of life as a result of bad design would be a severe negative impact, loss of use of the building less so. A hospital which is functioning after a serious natural event would be a positive impact – it can serve the community in times of disaster.

- C3.FS 2** Every building must be designed to withstand the ultimate limit state that can reasonably be foreseen in the location except for temporary short term solutions with clearly recognized performance characteristics.

Example: In an earthquake zone combine the seismic loads with snow load and/or wind load for permanent buildings. These combinations may be unlikely to apply in a temporary structure designed to last six months.

- C3.FS 3** Special considerations pertain for safe hospitals and schools, which are to remain operational if at all possible, as these structures provide essential public services in the wake of a disaster.⁶

⁶ For reference, DPs and PMs should refer to WHO's Hospital Safety Index and evaluation tools, available [here](#). Global Facility for Disaster Reduction and Recovery's [Guidance Notes for Safer School Construction](#) and [Hospitals Safe from Disasters](#) also provide useful guidance.

PERFORMANCE REQUIREMENTS

C3.PR 1 Codes

As per SECTION B2, the DP **MUST** comply with regional, national and/or international design codes appropriate to the country in which the structure is built. As a rule, codes are prescriptive and must be researched carefully. The DP will assess the national and UNOPS requirements and apply the stricter standard. Likewise, if no national code is in place, the DP will fulfil the relevant functional statements, technical parameters and performance requirements through the agreed codes and standards.

C3.PR 2 Progressive collapse

The structure **MUST** be designed so that if structural damage or failure occurs it will do so in such a way that time is allowed for occupants to evacuate the building prior to total collapse.

Example: A carefully designed level of robustness in the structure enables the building to progressively collapse. This gives warning and allows occupants to evacuate.

C3.PR3 Earthquake design

Structural design for earthquake zones **MUST** be undertaken only by professional structural engineers with specialist experience.

Establishing the seismic design parameters is a critical part of the designer's task and all information required **MUST** be obtained from national codes, seismic maps, or other worldwide sources.⁷

Beyond the minimum requirements of protecting human life, professional judgment is required to carefully balance the cost of additional safety measures against potential loss of safety to human life.

Special considerations apply to structures such as schools and hospitals, which should try to maintain functionality if at all possible.

Example: Buildings designed to prevent structural collapse could be offices or stores or buildings with a function similar to those. The consequences of loss of use for a period, whilst serious, are secondary to life safety considerations. The design should ensure that occupants can safely evacuate and the buildings may be repairable

Example: Buildings designed to remain functional will be critical infrastructure critical for the community especially in a disaster situation. A hospital must be able to continue to function when it is most needed.

⁷ For a comprehensive interactive map of natural hazards, see the National Geophysical Data Center map here: <http://maps.ngdc.noaa.gov/viewers/hazards/>

When choosing a structural system the designer, both engineer and architect, **MUST** give consideration to the strengths and weaknesses of different construction methods. Special attention to connection detailing and design for seismic forces/accelerations is essential. The designer **MUST** also give consideration to the use of energy absorbing design features, which are not costly when measured against the life-cycle cost of a building.

C3.PR 4 Deflections and deformations

The DP **MUST** check the design for deflections and deformations and ensure not only that the fluctuations are permitted within the relevant standard approved for use, but also that such deflections and deformations do not cause damage to other parts of the building or to installed equipment and fittings.

C3.PR 5 Neighbouring buildings

The DP **MUST** investigate the potential for neighbouring buildings and structures to be affected by the infrastructure works and any negative effects **MUST** be eliminated.

Example: Foundation excavation for the new structure may influence the bearing capacity in the vicinity of an existing building or cause earth movement or change the groundwater levels with detrimental effect.

Example: Clearance from adjoining buildings must allow for building movement in high/extreme wind conditions.

C3.PR 6 Calculations

In preparing the design calculations, the DP **MUST** use internationally recognized structural design software based on international standards or, if working manually, prepare neat and proper records of the design calculations.

The design record **MUST** be made available for third party reviews and checks at any time and **MUST** be handed over as part of the end users Taking-Over package along with as-built drawings. Design revisions and changes carried out during construction **MUST** be incorporated in the final design record.

C3.PR 7 Safety factors

The DP should carefully assess safety factors prescribed in codes, but may use professional judgment to increase these factors as a result of local circumstances; non-availability of materials with known quality; the level of skill and professionalism of local contractors and craftsmen.

Example: It is not uncommon in certain markets that mill certificates for steel are falsified and it may be difficult or impossible to obtain valid and proper certification.

Example: Timber may not be obtainable with strength and quality classification.

Example: Concrete may not be vibrated with power vibrators but only tamped with a piece of timber. Increased cover for reinforcement may be prudent.

C3.PR 8 Foundations

When designing foundations, careful analysis of the Geotechnical Investigation is required and all factors such as soil type and soil bearing capacity, water table, and potential for ground movement **MUST** be taken into consideration by the DP. The history of the site must be investigated, especially to discover if the site is filled and a cut and fill platform exists in the location proposed for the building.

*Example: If the Geotechnical Investigation reveals evidence of expansive soils the designer **MUST** take all precautions necessary to avoid foundation movements and resulting damage caused by expansion of the soil. Such precautions could take one of the following forms:*

- 1. Removal of expansive soil and replacement with compactable non-expansive materials or;*
- 2. Stabilization of the soil with, for example, lime or;*
- 3. Design of foundations and ground slabs so that they form a rigid structural unit which can withstand the forces exerted by the expansion without deformation and subsequent damage to the building.*

*Example: If underlying layers of gypsum are in evidence it may be necessary to relocate the structure to avoid these. Gypsum in the subsoil can cause 'sink-holes' when dissolved by water. If relocation is not an option then the foundations **MUST** be designed so that they have the structural strength to span potential settlement voids.*

C3.PR 9 Longevity of materials

Careful attention must be paid to the selection of materials to be used, and particularly the longevity of materials that may affect the structural strength of the building.

Example: This refers not only to reinforcement and structural steel with doubtful certification, but to concrete aggregates, cement, timber, bolts, nails, to name a few.

C3.PR 10 Construction details

The structural engineer and the architect together **MUST** design details that not only meet the structural requirements but are also not too complex. The local skill level and expected quality achievable **MUST** be considered so the construction details can be executed without compromising the design intent and can be supervised on site by the site engineer.

Example: Reinforcement-crowded junctions between beams and columns are to be avoided. It is better to increase the beam and column dimensions so that placing of concrete can be done even manually.

C3.PR 11 Existing buildings

In cases where an existing building is converted and/or renovated the load bearing structure **MUST** be subjected to a detailed investigation.

Historical records—design drawings and calculations and as-built drawings—should be consulted wherever they exist and, most importantly, a detailed examination of the structure should be carried out. This examination should make use of any method available to establish if the structure is built in accordance with the design. In cases where the design is not available the investigation must provide details sufficient for the DP to calculate the permissible load capacity of the building.

Example:

A residential building intended for renovation into new offices lacks adequate records in the form of design drawing or as-built drawings. Extensive on-site investigations are necessary to assess structural capacity. Such investigations should include both destructive and non-destructive methods and visual inspections to determine the quality of workmanship, such as in concrete placing, concrete and formwork related defects, and in the case of steel structures size of sections, connections and welding quality, etc. Timber structures should also be examined carefully for deterioration of timber and quality of joints assemblies, etc.

The results of the investigation must allow a structural determination to be carried out with confidence, and allow a decision to proceed with the project or not, prior to detailed designs and the tender process.

The cost of any structural analysis may well save considerable sums later, as the cost of fixing structural flaws rises exponentially once the works are underway.

Structure (C3)		Completed Yes or n/a
C3.PR 1 Codes	As per SECTION B3, the DP MUST comply with regional, national and/or international design codes appropriate to the country in which the structure is built. As a rule, codes are prescriptive and must be researched carefully. The DP will assess the national and UNOPS requirements and apply the stricter standard. Likewise, if no national code is in place, the DP will apply the relevant functional statements, technical parameters and performance requirements indicated in this manual.	
C3.PR 2 Progressive collapse	The structure MUST be designed so that if structural damage or failure occurs it will do so in such a way that time is allowed for occupants to evacuate the building prior to total collapse.	
C3.PR 3 Earthquake design	Structural design for earthquake zones MUST be undertaken only by professional structural engineers with specialist experience. Establishing the seismic design parameters is a critical part of the designer's task and all information MUST be obtained from national codes, seismic maps, or other worldwide sources. When choosing a structural system the designer, both engineer and architect, MUST give consideration to the strengths and weaknesses of different construction methods. The designer MUST also give consideration to the use of energy absorbing design features, which are not costly when measured against the life-cycle cost of a building.	
C3.PR 4 Deflections and deformations	The DP MUST check the design for deflections and deformations and ensure not only that the fluctuations are permitted within the relevant standard approved for use, but also that such deflections and deformations do not cause damage to other parts of the building or to installed equipment and fittings.	
C3.PR 5 Neighbouring buildings	The DP MUST investigate the potential for neighbouring buildings and structures to be affected by the infrastructure works and any negative effects MUST be eliminated.	
C3.PR 6 Calculations	In preparing the design calculations, the DP MUST use internationally recognized structural design software based on recognized standards or, if working manually, prepare neat and proper records of the design calculations. The design record MUST be made available for third party reviews and checks at any time and MUST be handed over as part of the end users Taking-Over package along with as-built drawings. Design revisions and changes carried out during construction MUST be incorporated in the final design record.	
C3.PR 8 Foundations	When designing foundations, careful analysis of the Geotechnical Investigation is required and all factors such as soil type and soil bearing capacity, water table, and potential for ground movement MUST be taken into consideration by the DP. The history of the site must be investigated, especially to discover if the site is filled and a cut and fill platform exists in the location proposed for the building.	
C3.PR 10 Construction details	The structural engineer and the architect together MUST design details that not only meet the structural requirements but are also not too complex. The local skill level and expected quality achievable MUST be considered so the construction details can be executed without compromising the design intent and can be supervised on site by the site engineer.	
C3.PR 11 Existing buildings	In cases where an existing building is converted and/or renovated the load bearing structure MUST be subjected to a detailed investigation.	

C4 FIRE SAFETY

C4 FIRE SAFETY

Fire safety is of paramount importance in any infrastructure project. It cannot be overemphasized that the designer must refer to existing fire regulations and consult with local fire authorities where available. Where professional fire engineering is not available, the DP must use professional judgment to ensure that the collective measures taken to mitigate fire risk to human life represents the best achievable design solution in the circumstances. The risk to infrastructure itself must also be considered, but this is secondary to life safety.

POLICY REFERENCES

- | | |
|----------------|--|
| Item 19 | Human Rights: UNOPS activities aim to prevent, mitigate or remedy adverse impacts on individuals, communities, and their environment resulting from the design and implementation of infrastructure projects and identify opportunities for positive impacts on individuals and communities and their environment in all UNOPS infrastructure activities. |
| Item 22 | Public health, safety and security: UNOPS endeavours to design and implement infrastructure projects in a manner that prevents or, where this is not possible, mitigates adverse effects to the health, safety and security of affected individuals and communities and their environment. |
| Item 43 | Persons with disabilities: UNOPS seeks to ensure that roads, premises and facilities are designed and built with consideration for universal design standards and that these standards are integrated into the project cycle. |
| Item 84 | Health and safety in employment: The right to safe and healthy working conditions is a fundamental human right. |

TECHNICAL OBJECTIVES

- C4.TO 1** To protect people from the threat of fire.
- C4.TO 2** To enable people to escape from a fire.
- C4.TO 3** To protect buildings and other property from damage caused by fire.

FUNCTIONAL STATEMENTS

- C4.FS 1** Every building must be designed:
 - 1. To minimize the likelihood, severity and spread of fire;
 - 2. To enable the rapid, safe evacuation of people from all floors of the building, and
 - 3. To limit the spread of fire to other buildings and properties.
- C4.FS 2** Technology-based solutions should only be considered where basic technical services such as water and electricity are assured at a high level of reliability.
- C4.FS 3** Every building is to include detection and notification devices, where feasible, to provide early warning of a fire. This includes associated external service elements within the site.
- C4.FS 4** Every building is to include passive fire management systems and active firefighting devices, where feasible, to provide firefighting protection in the event of a fire.

PERFORMANCE REQUIREMENTS

C4.PR 1 Structural integrity

All buildings **MUST** be designed so that their structural integrity is maintained during a fire to permit the evacuation of occupants and provide limited protection of firefighting personnel. The time taken to reach a state of collapse will be in nominal terms a minimum of:

1. **15 minutes** : lightweight timber or steel structures, including roofs
2. **One hour**: low rise (less than 3 story) masonry/concrete structure
3. **Two hours**: high rise (more than 3 story) masonry/concrete structure

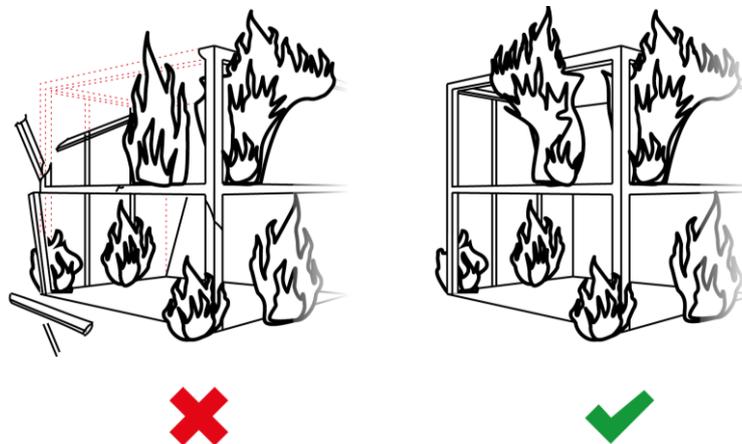


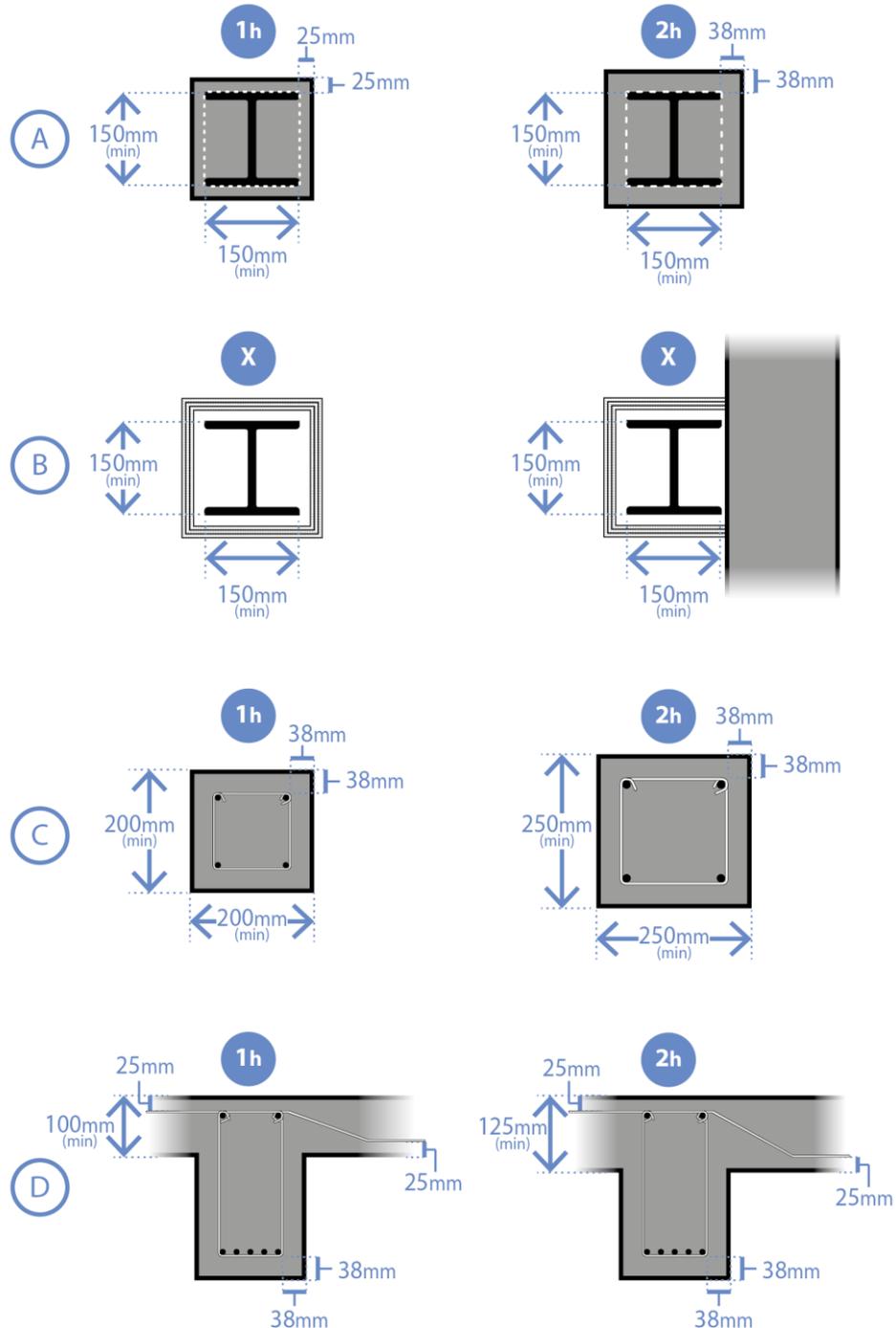
Figure 6: Structural integrity during fire

This nominal period can be modified by the DP, subject to approval by the design reviewer, and on the grounds of following criteria:

- | | |
|--------------------------------------|---|
| a. Building use risk | A school with 600 students has a different life safety risk compared to a warehouse with 5 occupants. |
| b. Fire hazard | There is a higher likelihood of fire in a vehicle workshop compared to an office building. |
| c. Fire load | Storage of significant volumes of paints or other flammable materials such as lubricants or chemicals affects fire load, intensity and duration of a fire. |
| d. Durability of available materials | The char rate of timber structures varies depending on timber type. The level of protection with render finishes to concrete beams, and concrete cover to reinforcement affects the integrity of concrete structures. |

Exception: Simple one or two room structures such as emergency shelters with less than 30 occupants are exempt from this requirement.

The following two figures (7 and 8) provide some prescriptive solutions to achieve one and two hour fire ratings, applying systems likely to be used in a UNOPS operational context. There are many other potentially suitable solutions. If alternatives are proposed, the DP should provide the necessary substantiation that the alternative meets the minimum requirements for structural integrity during fire.



*Figure 7: Min. dimensions for structural elements, 1 and 2 hour fire rating
Steel columns/beams, with spirally wound wire tie reinforcement and
caste-in-place concrete (A); steel columns/beams with proprietary light-weight
cladding system to achieve manufacturer's specified fire rating, X (B);
Reinforced concrete columns (C); Reinforced concrete beams and slabs (D).*

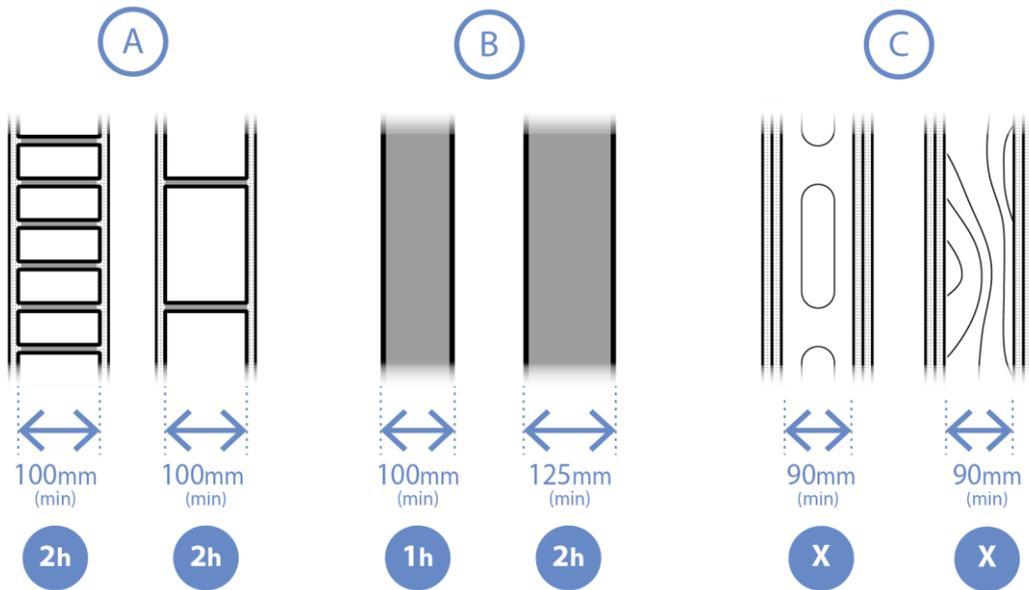


Figure 8: Min. dimensions for wall and partition assemblies, 1 and 2 hour fire rating
 Solid or hollow bricks wall/partition, and solid concrete block (A);
 solid concrete wall/partition (B); steel or timber frame wall/partition, with proprietary
 light-weight cladding system to achieve manufacturer's specified fire rating, X (C).

C4.PR 2 Evacuation and escape

All buildings **MUST** comply with the following interrelated requirements for evacuation and escape in the event of a fire.

a. Travel distance

A clearly marked exit door to the outside of the building or a stairwell from upper floors with a maximum travel distance of 40m from the furthest point on the floor.

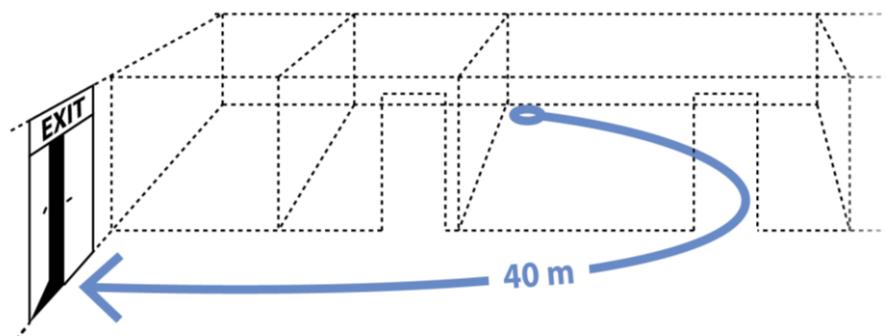


Figure 9: Maximum travel distance

b. Signage visibility

The exit sign is to be visible from within the corridor. Signage to be provided for guidance in corridors where the exit door is obscured from view.

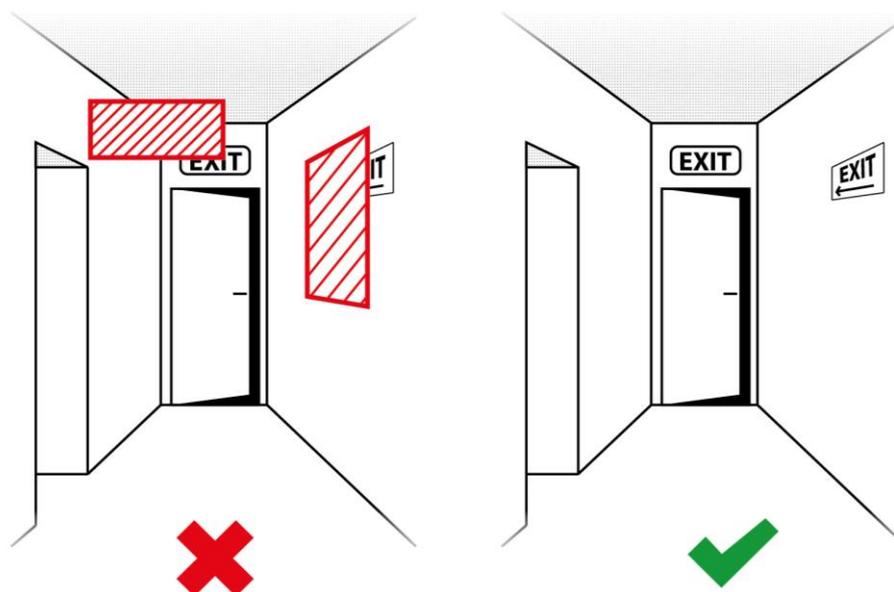


Figure 10: Signage visibility

c. Exits number

The minimum number of exits points per floor to be two (2) locations, widely separated to provide alternative escape points. Buildings occupied by more than 500 people per floor require 3 exits and more than 1,000 people per floor require 4 exits.

Exception: Small buildings that are less than 100m² and 20 occupants per floor, for a maximum two story building, may have one exit location.

d. Exits opening direction

A designated exit door is to be provided in all rooms that may be occupied by more than 20 people and must open in the direction of exit path. Other doors may still open inwards; if only one door is provided, it must open in the direction of the exit.

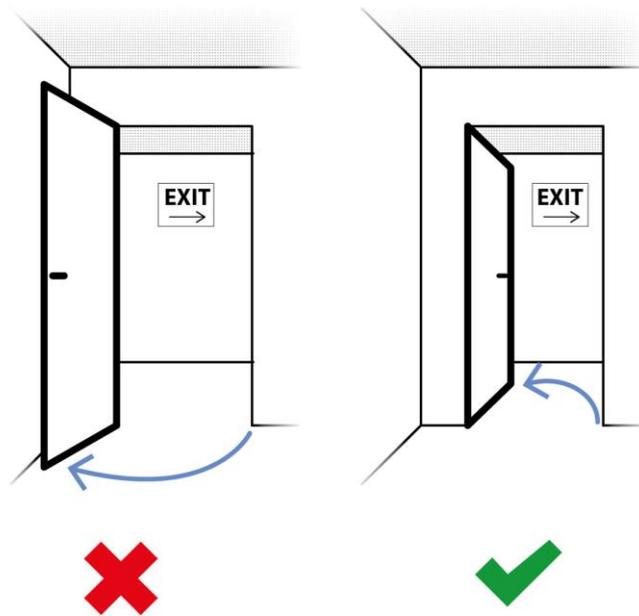


Figure 11: Exits opening direction

e. Exit door width

All exit door widths (or multiple door assemblies such as double swing doors) must be suitable for the expected numbers of people. The minimum clear width of a designated exit door is 900mm inside the frame. This applies to all doors in the exit path from the room egress door to the exit point from the building and ensures that all doorways are accessible to wheelchairs, preventing the door from being blocked in the event of an emergency.

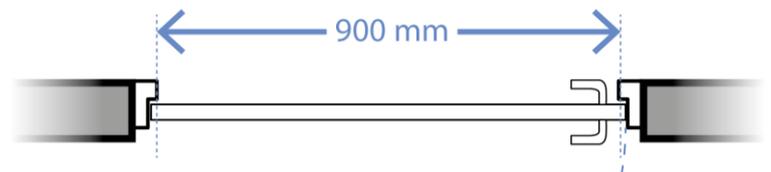


Figure 12: Exit door width

f. Width of corridors and stairs

All staircase and corridor widths must be suitable for the expected numbers of people. The minimum clear width of a corridor is 1,500mm and staircase is 1,200mm between wall faces. The projection of any doors into the clear width is not permitted. This provision also applies to external balcony access when these are the primary circulation used for egress.

Note: To maintain accessibility, all door openings must be designed as per SECTION C5.PR 6.

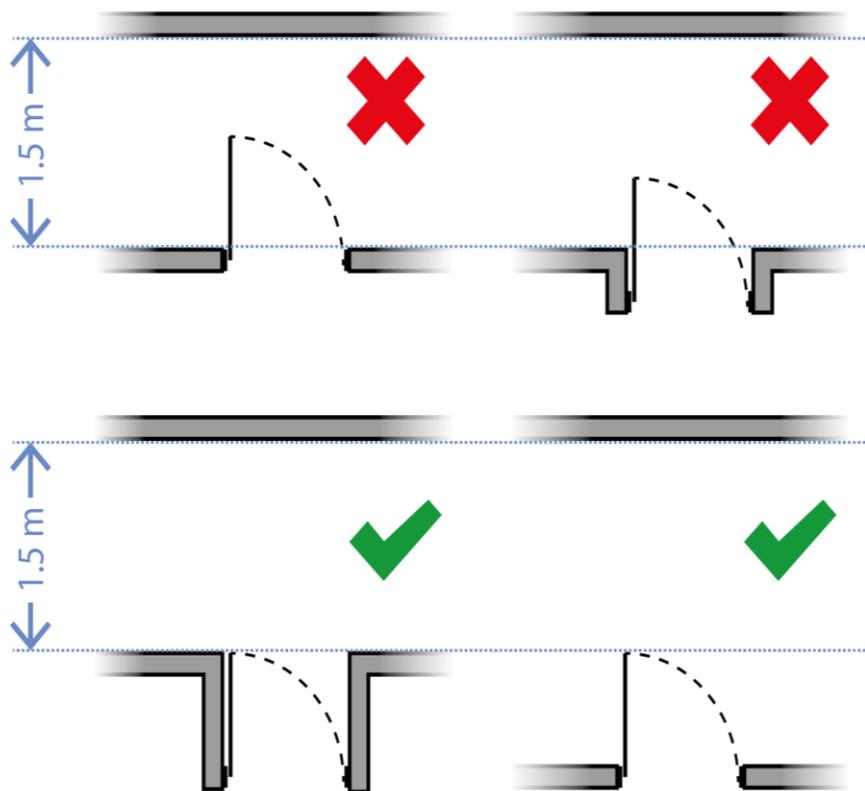


Figure 13: Minimum corridor width

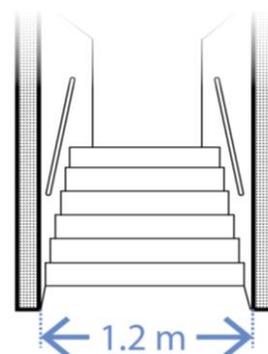


Figure 14: Minimum clear width of staircase

Exception: The only exception to the requirement for stair width is that stairs serving less than 50 occupants may be 900mm between wall faces.

g. Dead ends

Dead end corridors must be no more than 6m in length where they branch off from the main egress corridor.

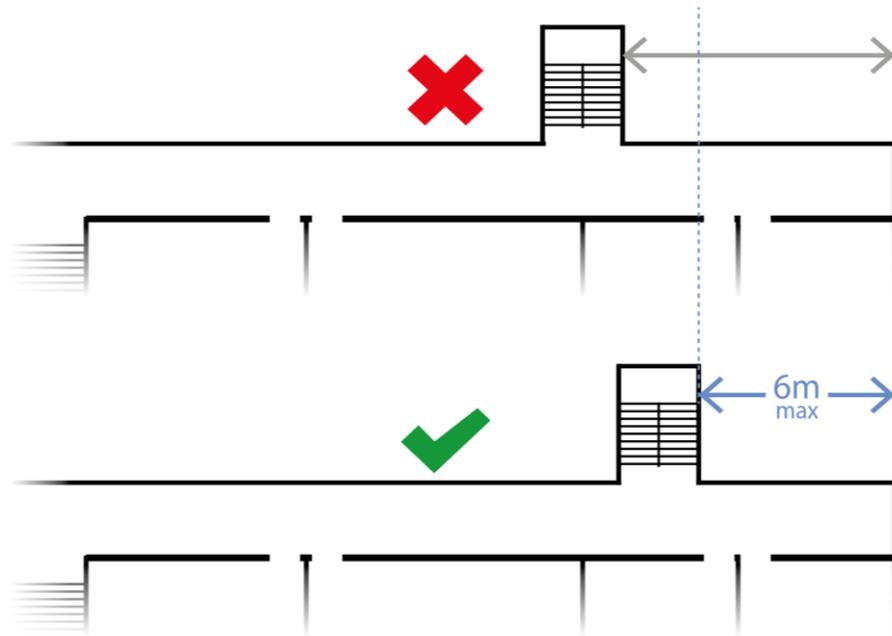


Figure 15: Dead end corridors

Exception: When one exit is required, this provision does not apply.

h. Fire isolated stairs

Where a building contains more than 3 upper floors, one of the exit stairs **MUST** be a fire isolated stair. This will be built with suitable construction techniques to achieve a minimum 2 hour fire rating inclusive of all doors, windows, wall and floor structure. The fire isolated stair exit at the ground floor must exit directly to the outside of the building or exit through a corridor which has a 2 hour fire rating.

i. Emergency lighting

All buildings **MUST** have emergency lighting with battery backup to ensure safe evacuation in the event of power failure, including lit exit lighting and other emergency fixtures located in strategic points in the travel path to the exit.

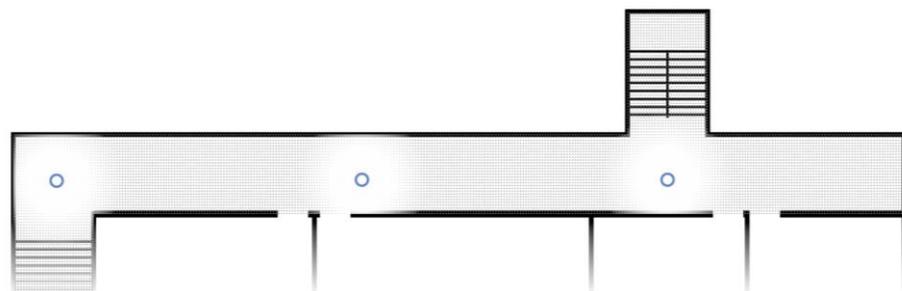


Figure 16: Emergency lighting

C4.PR 3 Fire exits

The number of fire exits required for each building is dependent on the numbers of people in the facility based on the floor area. The following table **MUST** be used for guidance in calculation of the maximum number of occupants within a building.

Table 3: Reference table for calculating the maximum number of occupants within a building⁸

Function of Space	Type of calculation	Floor area
Accessory storage areas, mechanical equipment room	Gross	25m ² /occupant
Agricultural building	Gross	25m ² /occupant
Aircraft hangers	Gross	45m ² /occupant
Airport terminal		
Baggage claim	Gross	1.8m ² /occupant
Baggage handling	Gross	25m ² /occupant
Concourse	Gross	9.0m ² /occupant
Waiting areas	Gross	1.4m ² /occupant
Assembly with fixed seats		See Note 3
Assembly without fixed seats		
Concentrated (chairs only – not fixed)	Net	0.7m ² /occupant
Standing space	Net	0.5m ² /occupant
Unconcentrated (tables and chairs)	Net	1.4m ² /occupant
Business and office areas	Gross	9.0m ² /occupant
Courtrooms (other than fixed seating areas)	Net	3.7m ² /occupant
Dormitories	Gross	4.0m ² /occupant
Educational		
Classroom area	Net	1.5m ² /occupant
Shops & other vocational room areas	Net	4.0m ² /occupant
Industrial, fabrication and manufacturing areas	Gross	9.0m ² /occupant
Institutional areas		
Inpatient treatment areas	Gross	18.0m ² /occupant
Outpatient areas	Gross	9.0m ² /occupant
Sleeping areas	Gross	9.0m ² /occupant
Kitchens, commercial	Gross	15.0m ² /occupant
Locker rooms	Gross	4.5m ² /occupant
Mercantile, general areas	Gross	5.0m ² /occupant
Storage, stock, shipping areas	Gross	25m ² /occupant
Residential	Gross	20m ² /occupant
Warehouses (bulk storage)	Gross	45m ² /occupant

⁸ Adapted from International Building Code (IBC)

Notes:

1. *Gross floor area refers to the entire floor space available within the particular space with the same function, not including walls.*
2. *Net floor area refers to the identified usage not including aisles or primary circulation spaces, or walls.*
3. *Fixed seating. For areas having fixed seats and aisles, the occupant load shall be determined by the number of fixed seats installed. The occupant load for areas in which fixed seating is not installed, e.g. waiting spaces and wheelchair spaces, shall be added to the number of fixed seats.*

For areas with fixed seating (without dividing arms) the occupant load shall not be less than the number of seats based on one person for each 450mm of seating length.

C4.PR 4 Assembly points

Designated assembly points should be identified by the DP on site plans for occupants evacuating the building. These must be far enough from the building to avoid injury from falling debris such as glass or masonry. Radiant heat and blast protection, as well as ventilation, should be considered in circumstances where these considerations may be required. Particular attention is required for secure compounds and protective shelters for personnel in circumstances where it may not be safe or desirable for people to leave the compound.

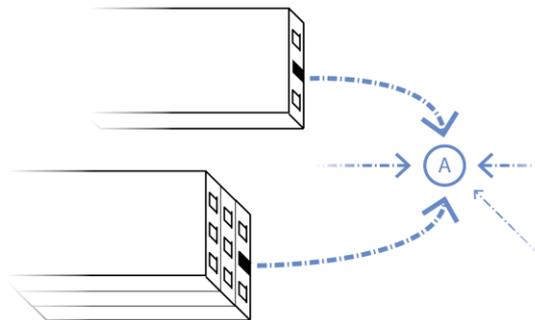


Figure 17: Assembly points

Example: UN compounds in high risk areas, higher security prisons excluding low security or open detention facilities, will require space for evacuation within the security perimeter.

Example: An evacuation point in a facility containing significant fuel storage or other inflammables may require an above ground bunker or protected facility, with its own ventilation system.

C4.PR 5 Smoke and fire separation

All buildings **MUST** comply with the following requirements for smoke and fire separation:

a. **Smoke separation**

Smoke separation is to be achieved with a smoke resistant barrier that completely separates different areas inclusive of ceiling void spaces. Self-closing doors have to be provided to corridors as needed to achieve the separation. This requirement does not apply to open balcony access buildings that permit the escape of smoke from the balcony.

The building requires smoke separation when it has an area exceeding 1000m², with the area divided as evenly as possible into zones as per the following table:

Table 4: Smoke and fire separation zones

0-1,000m ²	1 zone
1,000m ² – 2,000m ²	2 zones
2,000m ² – 3,000m ²	3 zones

b. **Internal fire separation**

Fire separation is to be achieved, at a minimum, with a 2 hour fire rated barrier that completely separates different areas. The barrier can be a horizontal barrier separating by floors with fire isolated stairs or a vertical barrier dividing the structure with a fire wall. All doors in the barrier are to be self-closing and certified to 2 hour fire rating inclusive of frames. No windows are permitted in the fire wall except for certified fire rated window assemblies. The building requires fire separation when it meets the following constraints:

1. Maximum floor area per zone of 3,000m², to limit the spread of fire in large buildings with common use;
2. Multiple occupancy buildings greater than 2,000m² where there is significant life safety risk between occupancies such as commercial kitchens and auditoriums;
3. Common boundary walls where the new building is on the boundary with an adjoining property.

c. **Fire separation on the same property**

All new buildings should be separated from existing buildings on the same site. Where one building contains windows facing blank walls on the other building the separation shall be 2.5m for a single story building and 1.0m more for each additional story. Where both the existing and new building contains windows facing each other, the separation distance shall be 3.5m for a single story building and 1.0m more for each additional story.

Exception: Where the new building is an extension or modification to an existing building, the separation of buildings does not apply. However, care should be taken to consider smoke and fire separation zones due to the increased floor area.

d. **Fire separation from adjoining property**

Fire separation between the new building and the side or back boundary of the property shall be a minimum of 2.5m for a single story building and 1.0m more of setback for each additional story, where the wall of the new building contains windows facing the boundary.

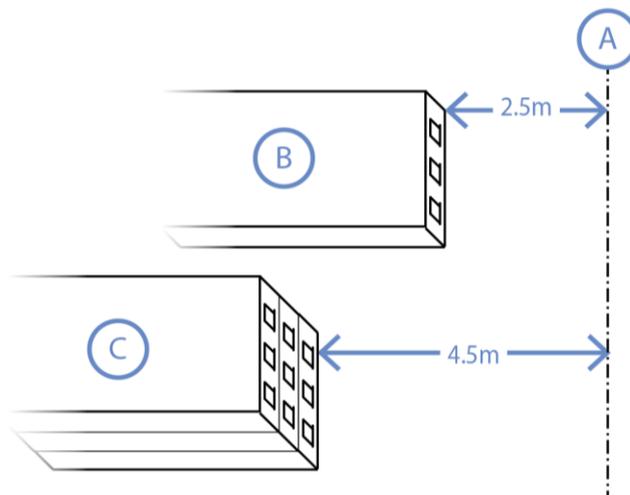


Figure 18: Fire separation from adjoining property
Boundary (A), Single Story Building (B), Example of three stories building (C)

If the setback is not achievable, the wall cannot contain windows facing the boundary and the wall face shall be of non-combustible construction. If the external wall contains a light well with windows at 90° to the boundary, these must have a minimum of 600mm separation wall of fire rated construction. There is no requirement for fire rating of the wall or windows where the external wall and any windows located at, or greater than, the minimum distance from the boundary wall.

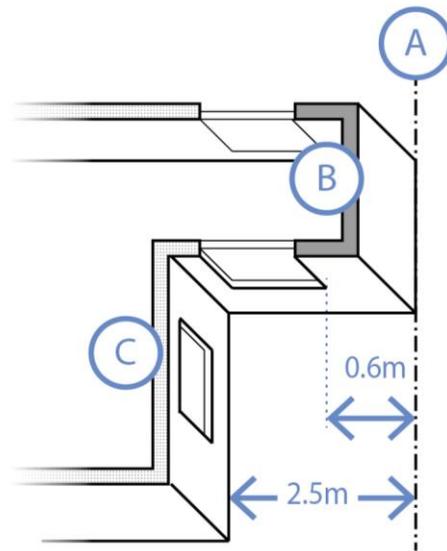


Figure 19: Fire separation and windows
Boundary (A), 2 hours fire wall (B), not fire rated wall (C)

C4.PR 6 Fire detection and protection systems

All buildings **MUST** comply with the following requirements for fire detection and protection systems:

a. **Alarms and detectors**

Fire detection systems are required for all buildings greater than 300m². The systems shall be smoke detectors permanently wired to an audible alarm. Thermal detectors are required to locations such as kitchens where smoke alarms may not be appropriate. If a wired system is not technically feasible, battery-powered detectors with individual alarm capacity shall be used.

b. **Zonal controls**

Zonal controls are needed in all buildings greater than 1,000m² in area. Fire indicator panels (FIPs) should be installed in the facilities that contain multiple detection zones. These will be located in readily accessible locations to assist with the firefighting response. If a connection to municipal fire brigade facilities is feasible, this is required for all buildings greater than 3,000m² in area.

c. **Fire extinguishers**

Portable fire extinguishers are required for all buildings as a first response method for a developing fire. These shall be located by the DP on building floor plans.

Table 5: Fire extinguisher types, based on British Standards

Class A Extinguisher	Generally water-based and suitable for ordinary combustibles.
Class B Extinguisher	Generally foam or powder-based suitable for flammable liquids.
Class C Extinguisher	Generally nonconductive foam or powder-based suitable for fires from electrical equipment.
Fire Blankets	Used in kitchen facilities as first response for pan fires.

The determination of the type of extinguishers required will be based on the anticipated use of the facility, number of occupants, and other fire protection systems, if any. Generally, Class A and B extinguishers will be located together at a common point, whilst Class C are located in high use IT rooms and rooms where electrical distribution boards and switching equipment are located ready for immediate use. Commercial kitchens should be equipped with a Class B extinguisher, in addition to fire blankets.

The maximum floor area per extinguisher is 500m². The maximum travel distance between extinguishers is 45m or 23m, if the building contains a single extinguisher.

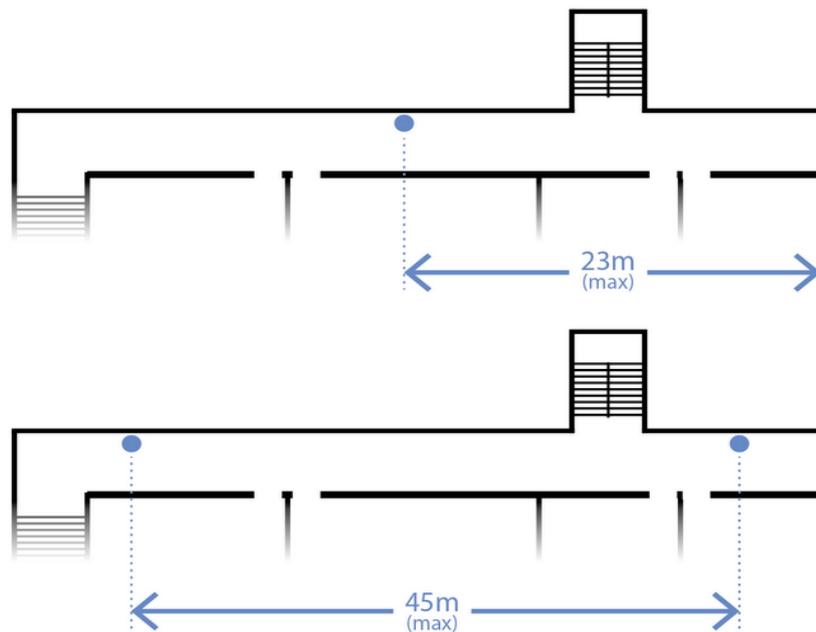


Figure 20: Travel distance between fire extinguishers

d. **Fire hose reels and standpipes**

Fire hose reels and standpipes are required for all buildings greater than 500m² for general firefighting response. These must comprise, as a minimum, a 30m long fire hose of 25mm diameter located on a

reel and a separate 38mm outlet capable of supplying 60l/min for a minimum of 30 minutes. The hose must be able to reach within 6m of the furthest portion of the building most remote from the reel location. The reel location shall be adjacent to an exit or exit stair from the building. A single reel may be used to service a 2 story building if the distance meets the above requirements.

The determination of the number of standpipes, hose reels and waters supply line will be based on the anticipated use of the facility, number of occupants and other fire protection systems.

If a hose reel and standpipe system is not technically feasible either due to insufficient water supply, electrical supply for fire pumps, or other factors caused by the remote location of the site or other factors, alternate risk mitigation techniques **MUST** be provided. The following mitigation techniques may be appropriate: smoke/fire separation parts with fireproof materials, additional fire exits/ fire escape routes/ fire doors/staircases/fire rated barriers/reduced fire loads, etc.

e. **Fire sprinkler systems**

The provision for automated fire sprinkler systems is generally a complex matter and technically sophisticated in both operational characteristics and design certification requirements. In locations where sprinkler systems are feasible, there are normally existing regulatory frameworks that govern their use and these **MUST** have precedence in this instance as per the protocol in SECTION B. If a sprinkler system is required, then the DP should seek expert guidance on its design and installation on a 'one-off' basis.

C4.PR 7 Signage

The DP **MUST** specify signage to be included in the design documentation.

In all buildings greater than 300m² of total floor area, signage **MUST** be provided in the local language to clearly identify all locations of fire extinguishers, hose reels, stand pipes adjacent to the equipment.

Each floor of a building **MUST** be displayed on a plan mounted on a wall near the entrance to each floor, and identifying:

- a. Exit points from the floor
- b. Fire extinguisher locations
- c. Hose reel and standpipe locations
- d. Location: "You are here" designated on the plan

C4.PR 8 Locks on exit points

All exit points and doors **MUST** not be lockable in the direction of escape. Door hardware schedules must comply with this requirement.

C4.PR 9 Emergency equipment

To ensure that emergency equipment is available for use at all times, access doors to hose reels or extinguisher cabinets **MUST** not be locked. If in the open, controls on the equipment **MUST** not be locked.

C4.PR 10 Inflammable liquids

All buildings that contain, or propose to contain, significant volumes of inflammable liquids, such as petroleum, oil or paint products, **MUST** have special provisions for storage. These provisions **MUST** apply to all storage requirements as follows:

- a. Less than 0.3m³ of material, no special provision.
- b. Between 0.3m³ and 1.5m³ of material, the room shall be fire isolated from adjoining spaces with a minimum of 1 hour fire rated enclosure inclusive of door. The room may contain a window to the exterior of the building and have high and low level vents to the exterior.
- c. Between 1.5m³ and 5.0m³ of material, the room shall be fire isolated from adjoining spaces with a minimum of 2 hour fire rated enclosure inclusive of door. The floor **MUST** contain a bund to ensure retention of contents in the event of leakage or a drum failure. The room **MUST** not have a window *and* **MUST** have high and low level vents to the exterior. Care must be taken for locations and accessibility of vents for spread of fire from inside or possible interference from outside. Total vent area is to be minimum 5% of floor area. Alternatively, the room may be free standing outside the building and located at a minimum of 6m from the nearest habitable building. Construction to be a minimum of steel framed and clad, with insulation as necessary for climatic conditions and containing a concrete slab floor with bund enclosure as above. There is no requirement for fire proofing and a window is permitted for this alternative. Ventilation grills as above are required.
- d. More than 5.0m³ of material, the room **MUST** be separate from the building located a minimum of 6m from the nearest habitable building. Construction as per c) alternative above. Where buildings such as warehouses contain significant volumes of inflammable goods or liquids, these **MUST** be designed to limit the potential spread of fire, contain any liquids, and have acceptable firefighting capacity.

- e. Spark proof switches, lights, ventilation fans (if used) are required for all storage capacities greater than 0.3m³. All storage shelving should be spark resistant such as concrete or timber rather than steel shelving.

C4.PR 11 Firefighting services

In those locations where externally provided governmental, municipal or city-based firefighting services exist, these **MUST** be consulted for confirmation of all fire protection measures and any requirements for:

- Firefighting vehicle access to the site
- Specific external hydrant locations, sizes and capacities
- Fire indicator panel (FIP) locations
- External communication links for detection alarm notifications

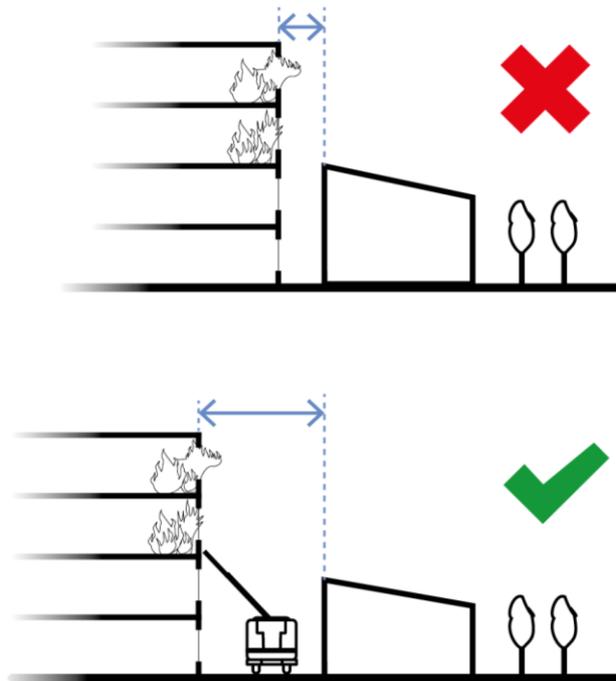


Figure 21: Firefighting vehicle access

Fire safety (C4)	Completed Yes or n/a
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C4.PR 1 Structural integrity	<p>All buildings MUST be designed so that their structural integrity is maintained during a fire to permit the evacuation of occupants and provide limited protection of firefighting personnel.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C4.PR 2 Evacuation & escape	<p>All buildings MUST comply with the following requirements for evacuation and escape in the event of a fire.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C4.PR 3 Fire exits	<p>The number of fire exits required for each building is dependent on the numbers of people in the facility based on the floor area. The table in this section MUST be used for guidance in calculation of the maximum number of occupants within a building.</p>	
C4.PR 5 Smoke & fire separation	<p>All buildings MUST comply with a number of requirements for smoke and fire separation, laid out in the relevant section.</p>	
C4.PR 6 Fire detection & protection systems	<p>All buildings MUST comply with a number of requirements for fire detection and protection systems, laid out in the relevant section.</p>	
C4.PR 7 Signage	<p>The DP MUST specify signage to be included in the design documentation. In all buildings greater than 300m² of total floor area, signage MUST be provided to clearly identify all locations of fire extinguishers, hose reels, stand pipes adjacent to the equipment. Each floor of a building MUST be displayed on a plan mounted on a wall near the entrance to each floor, and identifying elements laid out in the relevant section.</p>	
C4.PR 8 Locks on exit points	<p>All exit points, escape corridors, escape doors, MUST not be lockable in the direction of escape. Door hardware schedules must comply with this requirement.</p>	
C4.PR 9 Emergency equipment	<p>To ensure that emergency equipment is available for use at all times, access doors to hose reels or extinguisher cabinets MUST not be locked. If in the open, controls on the equipment MUST not be locked.</p>	
C4.PR 10 Inflammable liquids	<p>All buildings that contain, or propose to contain, significant volumes of inflammable liquids, such as petroleum, oil or paint products, MUST have special provisions for storage. These provisions are laid out in the relevant section.</p>	
C4.PR 11 Firefighting services	<p>In those locations where externally provided governmental, municipal or city-based firefighting services exist, these MUST be consulted for confirmation of all fire protection measures and requirements for firefighting vehicle access; specific hydrant locations, sizes and capacities; FIP locations; and external communication link for detection alarm notifications.</p>	

C5 ACCESS AND EGRESS

C5 ACCESS AND EGRESS

This section intends to ensure that building occupants are able to carry out the activity for which the building is designed, and that its function is not compromised by poor planning. This planning includes study of access to the site and building, circulation within it and egress from the building and site. All potential activities must be considered, including maintenance access and access for emergency vehicles and wheelchairs.

POLICY REFERENCES

- Item 22** **Public health, safety and security:** UNOPS endeavours to design and implement infrastructure projects in a manner that prevents or, where this is not possible, mitigates adverse effects to the health, safety and security of affected individuals and communities and their environment.
- Item 35** **Gender equality and the empowerment of women:** UNOPS endeavours to identify areas where project activities may adversely impact the quality of life of women and girls. In this regard, UNOPS will work with partners, governments and contractors to design and implement projects with full respect for the human rights and inherent dignity of women and girls.
- Item 39** **Persons with disabilities:** A significant barrier facing persons with disabilities is inadequate access to buildings, transportation and information. These barriers contribute to poorer health outcomes, lower educational achievements, less economic participation, higher rates of poverty, increased dependency and reduced societal participation. One method of reducing or eliminating these barriers is by ensuring that building projects and information and communication technology products include adequate access for persons with disabilities.
- Item 40** **Persons with disabilities:** Employing the concept of 'universal design' is one of the primary methods to guarantee accessibility. This concept, as defined in the Convention on the Rights of Persons with Disabilities, stems from the need to provide accessibility measures to persons with disabilities; however, universal design includes benefits for society as a whole, including the elderly, people with strollers and children. Employing universal design enhances access to services and economic opportunities and promotes the inclusion of those who have been traditionally marginalized due to their functional limitations.
- Item 50** **Indigenous peoples:** UNOPS strives to design and implement infrastructure projects in a manner that encourages full respect for the human rights, inherent dignity, livelihood systems and cultural identity of indigenous peoples.
- Item 84** **Health and safety in employment:** The right to safe and healthy working conditions is a fundamental human right.

TECHNICAL OBJECTIVES

C5.TO 1 To ensure equitable access for all in their use of the infrastructure.⁹

FUNCTIONAL STATEMENTS

C5.FS 1 The access, egress and circulation spaces must permit the unhindered movement of all occupants in the facility.

C5.FS 2 The access, egress and circulation spaces must address and recognize the implications for cultural and societal norms in particular where these affect gender equality.

⁹ For best practice guidance in accessibility refer to The Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines, available from http://www.wbdg.org/ccb/ASTAND/ada_aba.pdf

PERFORMANCE REQUIREMENTS

C5.PR 1 Circulation space

Each building **MUST** be designed to:

- a. Allow movement into and out of the building in a safe and unobstructed manner during normal use. This is particularly important with direction of door swings, ramps, steps at the door threshold, visibility approaching the doors, to avoid possible confusion, injury, trips and falls. The primary point of access **MUST** be clearly defined to enable simple access with signage or non-written visual means depending on the design circumstances.

Example: Visual cues such as canopies over entries, planter boxes, paving colour changes may emphasize the entry door without the need for obvious signage.

- b. Have sufficient circulation space within the building to enable its intended function in an efficient and smooth manner. This is particularly important for the movement of disabled persons and in specialized facilities with complex design issues, such as hospitals, where enough space must be allotted for manoeuvring sick beds.
- c. Ensure that circulation space includes common walkway spaces and likely access paths within rooms as well as corridors. This is an important consideration due to physical space necessary for the movement of people. The minimum width should be not less than 650mm for access paths between furniture. Where this is a primary movement route to a fire exit it must not be less than:
 - 1050mm for rooms containing less than 50 people
 - 1200mm for rooms containing more than 50 people

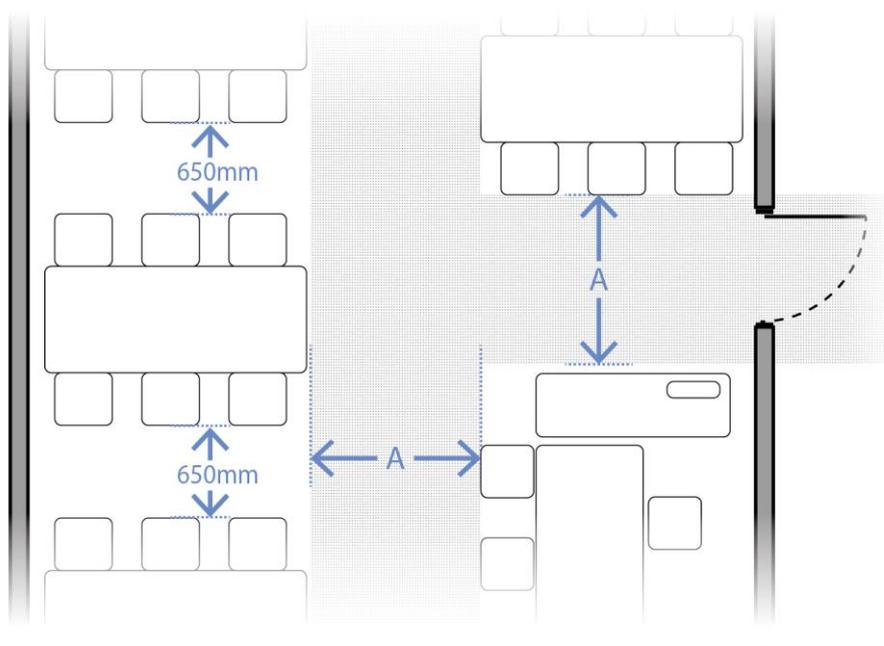


Figure 22: Circulation space
 If path is a primary route to fire exit (A), minimum widths are: 1050mm for rooms containing less than 50 people; 1200mm for rooms containing more than 50 people.

C5.PR 2 External steps

External steps leading to the entry/exit point of buildings **MUST** comply with the following requirements:

- a. Must provide capacity greater than the expected number of persons that may use them during a fire or emergency event.
- b. Must be consistent in step depth and riser for the full length and height.
- c. The maximum riser height is 180mm. Minimum riser height is 100mm. Minimum tread is 280mm.
- d. The potential slip hazard on tread surface in wet, icy or snowy conditions must be considered in material selection.
- e. The marking of the tread nosing in a different colour or texture to assist sight-impaired people must be considered.
- f. Handrails must be provided to one side of the stair when the width is less than 1,500mm; handrails must be provided on each side of the stairs where stair width is between 1,500mm and 3,000mm wide; if the stair width is greater than 3,000mm wide, intermediate handrails must be provided to the stair to assist safe movement.

The clear distance of the handrail from the wall or obstruction is to be between 50-75mm.

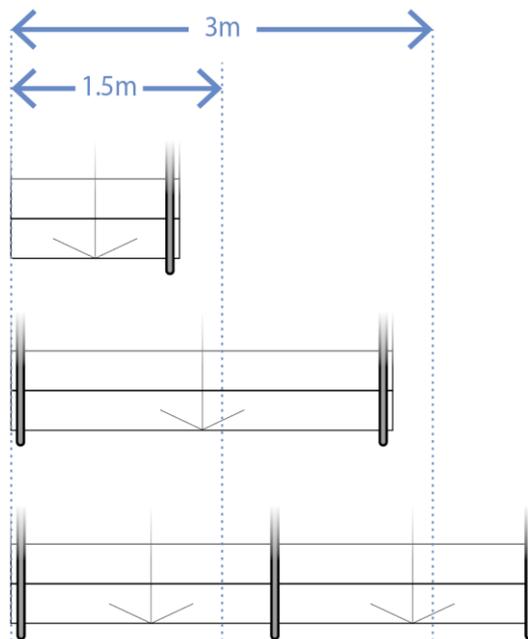


Figure 23: Quantity of handrails for external steps

- g. Handrails to be well secured and able to withstand all normal usage forces without obvious deflection, located 865mm-965mm to top of rail above step height.

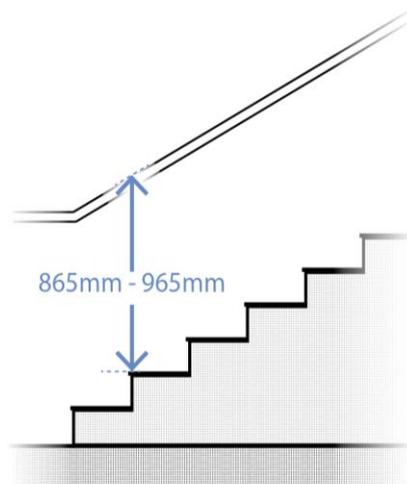


Figure 24: Handrail location

- h. Landings every 12 risers with a minimum length of 1,200mm between stairs.

Note: All staircases must comply with the fire safety considerations in SECTION C4.PR 2.

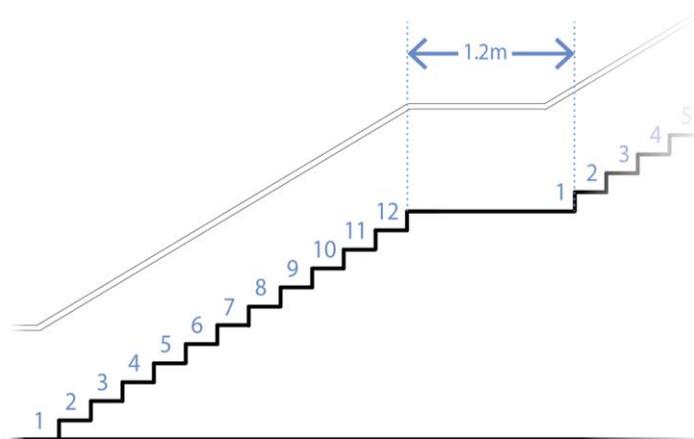


Figure 25: External stairs landings

Exception: If the external stair is a steel fire escape stair, it should comply with C5.PR 3.

C5.PR 3 Internal stairways

Internal stairways within buildings **MUST** comply with the following requirements:

- a. Must not be less than the minimum widths for escape as noted in SECTION C4.PR 3.
- b. Must be consistent in step depth and riser for the full length and height.
- c. The maximum riser height is 180mm. Minimum riser height is 100mm. Minimum tread is 280mm.
- d. The potential slip hazard on tread surface in wet, icy or snowy conditions must be considered.
- e. Hand rails must be provided to each side of the stairs where width is less than 2,400mm wide. If the width is greater than 2,400mm wide, intermediate hand rails must be provided to assist safe movement. The clear distance of the handrail from the wall or obstruction is to be between 50-75mm.

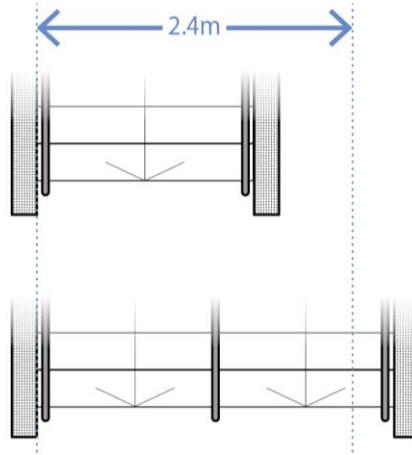


Figure 26: Quantity of handrails for internal stairs

- f. Hand rails are to be well secured and able to withstand all normal usage forces without obvious deflection, located 865mm-965mm to top of rail above stair height.

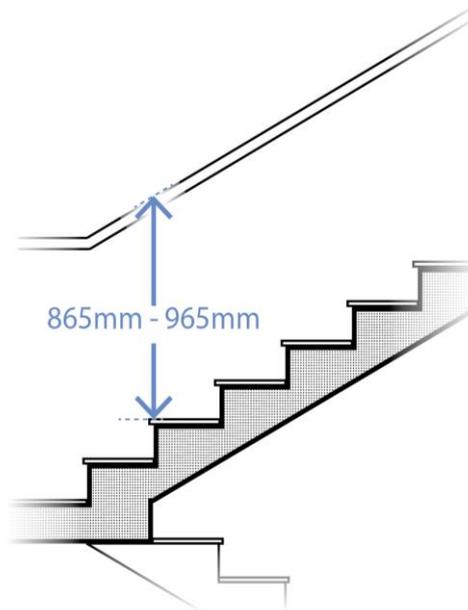


Figure 27: Height of handrails for internal stairs

- g. Landings every 16 risers with a minimum length of 1,200mm between stairs.

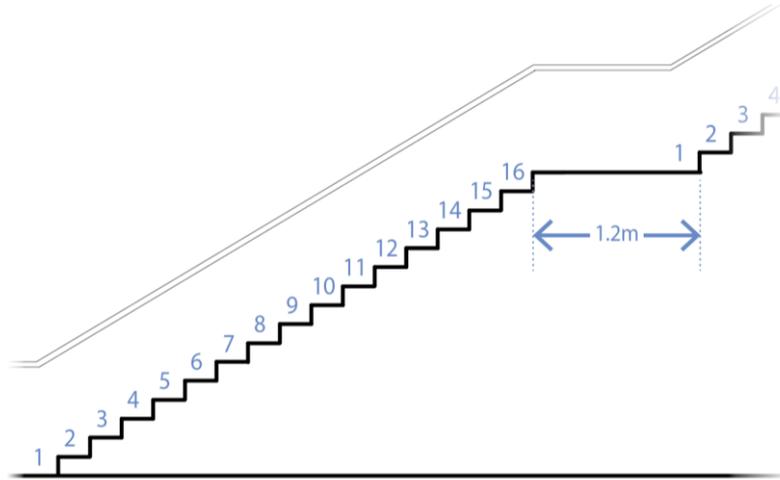


Figure 28: Landings for internal stairs

Note: All staircases must comply with the fire safety considerations in SECTION C4.PR 2.

C5.PR 4 Balustrade

Balustrade panels to balconies used as primary access **MUST** not be less than 1,000mm in height from floor level of balcony to top of panel. The infill between 150mm above floor level to 750mm above floor level **MUST** be either solid material or vertical bar, making it un-climbable for small children. Bar spacing to be maximum of 150mm centers.

Balustrade panels below handrails to external stairs, internal stairs and landings **MUST** contain infill as above.

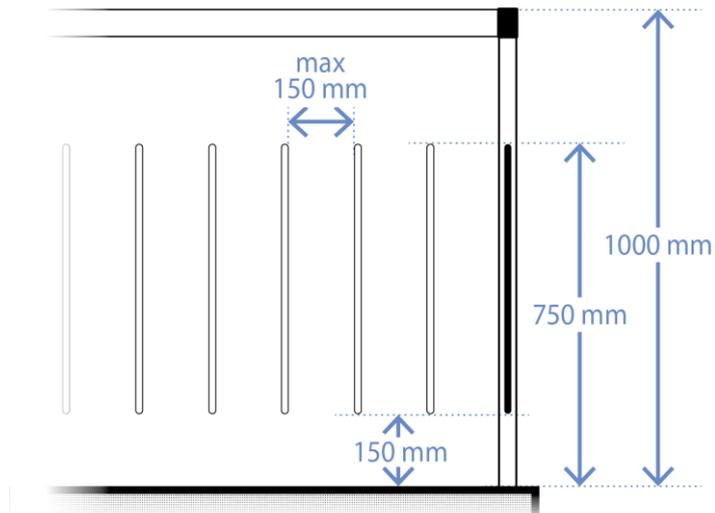


Figure 29: Balustrade panels to balconies

C5.PR 5 Ramps

Ramps **MUST** be provided for access to the main entrance/exit of all buildings. It is not acceptable to design for disabled access at a back or side access point unless it is physically impossible to achieve entry at the main entrance. Ramps **MUST** be used wherever possible inside the building to facilitate access to all parts of the building.

Where multi-story buildings are designed, lifts between floors or stair riser platforms may be the only sensible mechanism for access. If these are not feasible for economic, geographic or other constraints, the DP **MUST**:

- a. Ensure that inaccessible services or building functional spaces that may be used by disabled persons are on the ground floor, or duplicated on the ground floor.
- b. Ensure that toilet facilities are located in an accessible location.

Ramps **MUST** be constructed with the following elements:

1. Minimum width of 915mm between handrails.

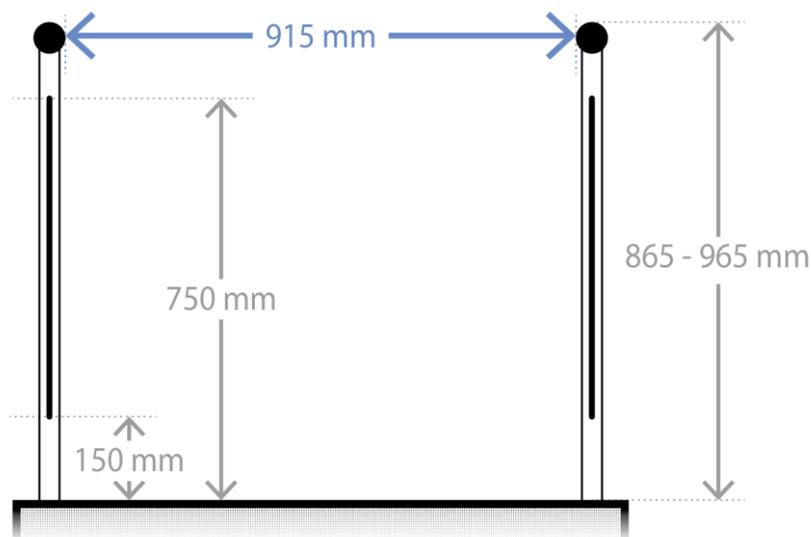


Figure 30: Ramp handrails minimum width

2. Maximum slope of 1:12, or 8.3%.

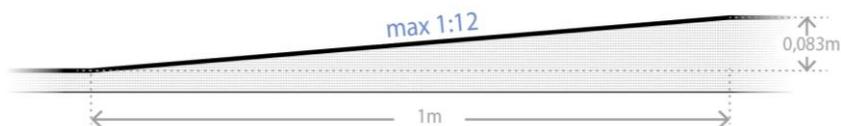


Figure 31: Ramps maximum slope

3. Horizontal landings at maximum of 8m length of ramp with landing a minimum of 1,525mm in length.

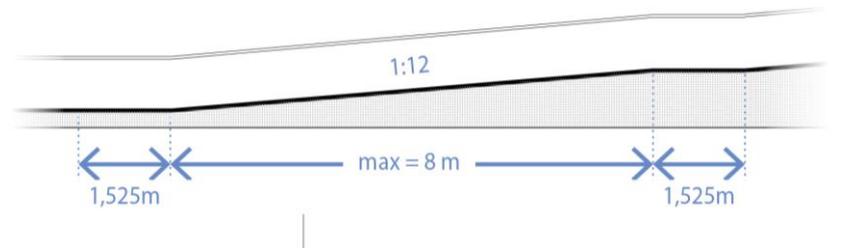


Figure 32: Ramps landings

4. Handrails to ramp sides at 865mm-965mm to top of rail above ramp.
5. Threshold ramps where used for maximum of a single 150mm rise may have a steeper slope of maximum 1:8.

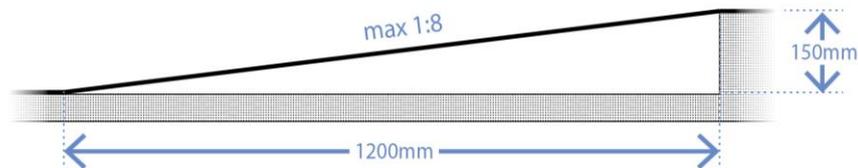


Figure 33: Threshold ramps maximum slope

6. Ramp surface finish must be considered for potential slip/slide hazard in wet, icy or snowy conditions.

Landings of suitable size must be provided at the top of a ramp to permit level access at the door opening. Note that if the door opens outwards, this space must be increased to enable circulation space for wheelchairs to clear the opening door edge.

C5.PR 6 Door openings

Accessibility at door openings is critical for the effective access of wheelchairs. The design of all spaces which have wheelchair access **MUST** comply with the following space requirements:

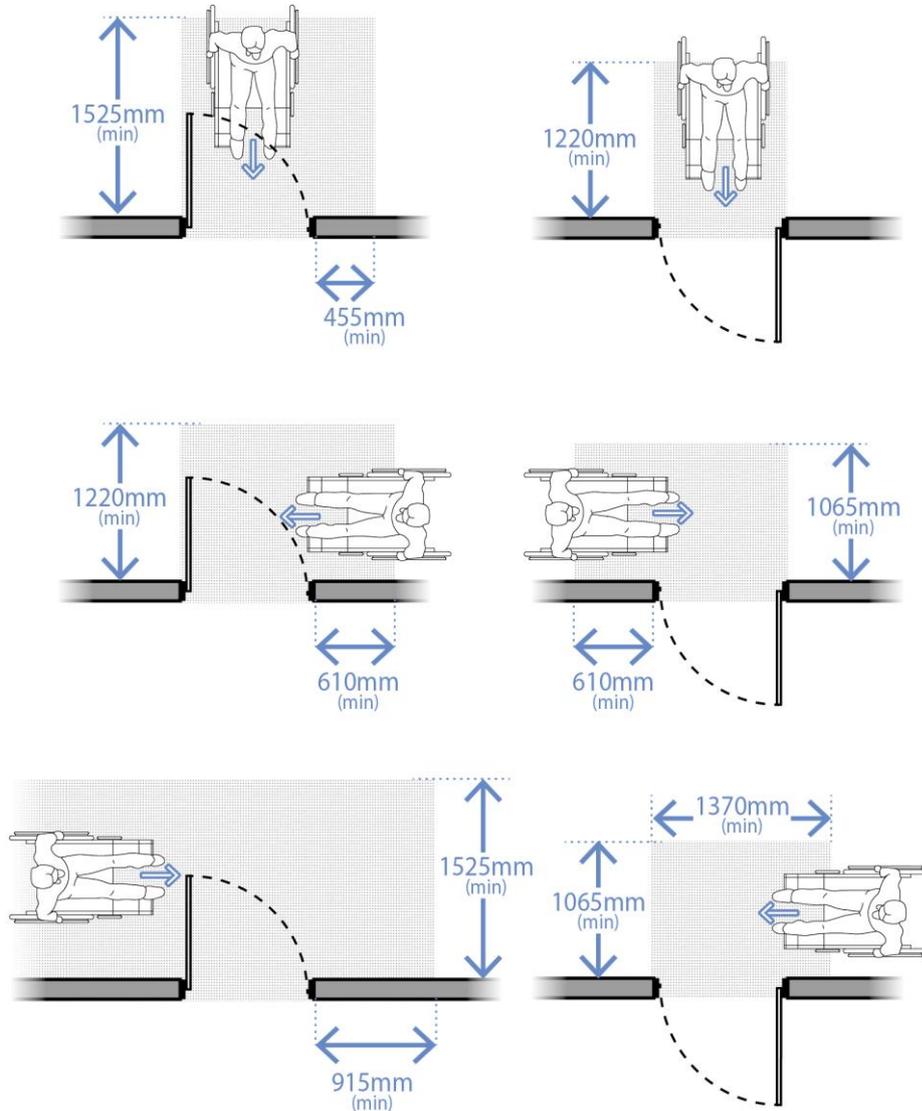


Figure 34: Accessibility at door openings

Note: To maintain accessibility, all staircase and corridor widths must be maintained, even when corridors are 1,500mm or less, as per SECTION C4.PR 2e.

C5.PR 7 Gender equality

Cultural and social norms regarding gender equality and access differ in the countries where UNOPS provides building infrastructure. It is imperative that the design process considers these issues in countries where females may not be allowed to use the same entrances and stairs or facilities as males. The Design Solution **MUST** demonstrate that cultural and social norms have been considered while ensuring that women and men have equal access to public facilities.

Indeed it may increase the quality of security and empowerment for females to have the separation of access and functions.

Example: In the Afghan context, solutions have included health centres with separate facilities and entrance for women and high perimeter walls around girls' schools to allow girls to freely play outside.

C5.PR 8 Equipment access

Equipment access for service, repair and replacement if necessary, has implications for circulation space, door opening widths, and general access to the building and roof. The DP **MUST** consider this aspect in the development of the design.

Roof mounted equipment on flat roofed structures should be readily accessible from internal stairwells for multi-story buildings or portable ladders, as a minimum, for single story buildings.

On roofs with a slope greater than 1:10, roof mounted equipment should have a horizontal maintenance platform space not less than 750mm wide and a walkway from the point of roof access not less than 450mm wide. The platform and walkway shall be mesh or with significant surface texture to be anti-slip in wet, icy or snowy conditions. Balustrade and infill panels can be substituted with a single horizontal rail at mid-height.

The platform should be provided to all sides of the equipment that may require maintenance. This is to facilitate safe access for maintenance personnel and reduce damage to the roof surface from maintenance activities.

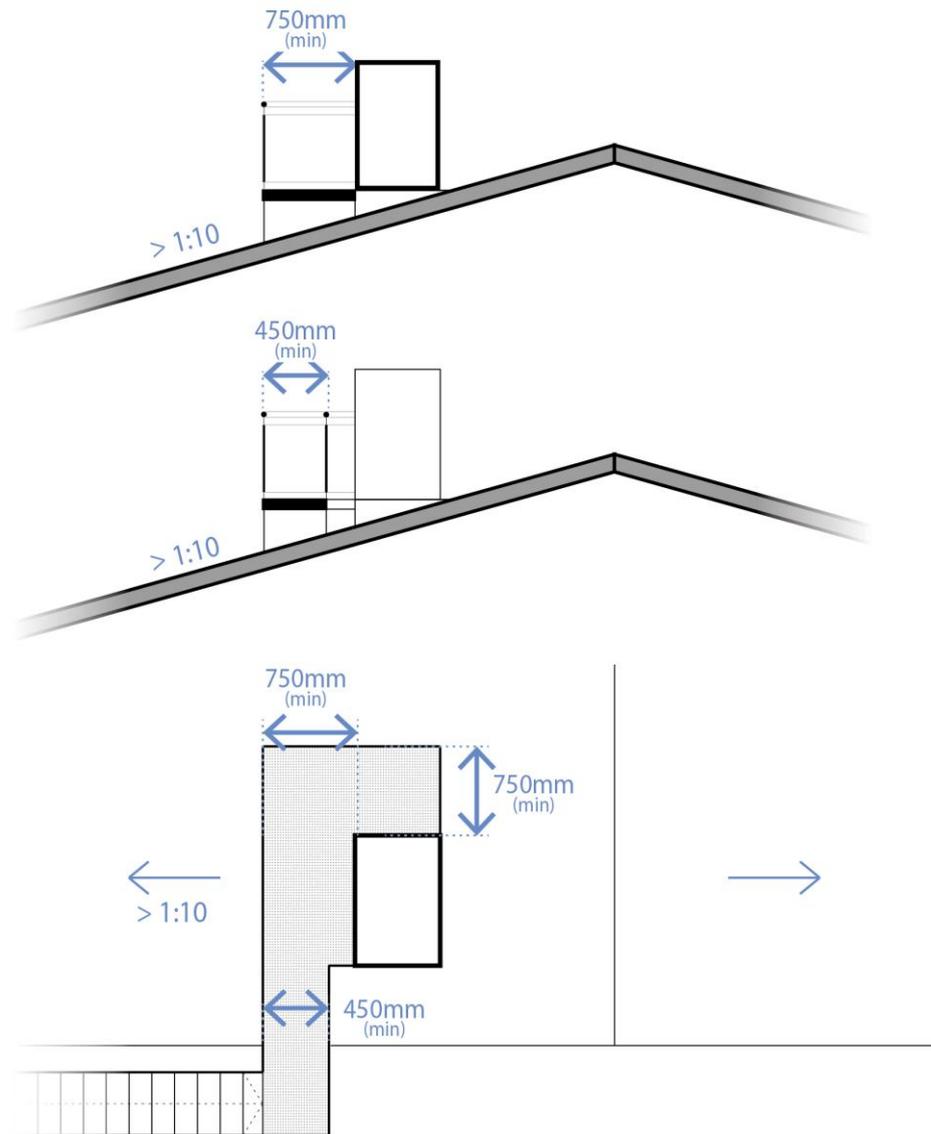


Figure 35: Roof maintenance platform

C5.PR 9 IT Systems

Communications and IT systems should be accessible to persons with disabilities where appropriate and necessary.

Access and egress (C5)		Completed Yes or n/a
C5.PR 1 Circulation space	<p>Each building MUST be designed to:</p> <p>a. Allow movement into and out of the building in a safe and unobstructed manner during normal use. The primary point of access MUST be clearly defined to enable simple access with signage or non-written visual means depending on the design circumstances.</p> <p>b. Have sufficient circulation space within the building to enable its intended function in an efficient and smooth manner.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C5.PR 2 External steps	External steps leading to the entry/exit point of buildings MUST comply with all of the requirements specified in the section.	
C5.PR 3 Interior stairways	Internal stairways within buildings MUST comply with all of the requirements specified in the section.	
C5.PR 4 Balustrade	Balustrade panels to balconies used as primary access MUST not be less than 1,000mm in height from floor level of balcony to top of panel. The infill between 150mm above floor level to 750mm above floor level MUST be either solid material or vertical bar, making it un-climbable for small children. Bar spacing to be maximum of 150mm centers. Balustrade panels below handrails to external stairs, internal stairs, and landings MUST contain infill as above.	
C5.PR 5 Ramps	<p>Ramps MUST be provided for access to the main entrance/exit of all buildings. Ramps MUST be used wherever possible inside the building to facilitate access to all parts of the building.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C5.PR 6 Door openings	Accessibility at door openings is critical for the effective access of wheelchairs. The design of all spaces which have wheelchair access MUST comply with the space requirements in the relevant section.	
C5.PR 7 Gender equality	The Design Solution MUST demonstrate that cultural and social norms have been considered while ensuring that women and men have equal access to public facilities.	
C5.PR 8 Equipment access	Equipment access for service, repair and replacement if necessary, has implications for circulation space, door opening widths, and general access to the building and roof. The DP MUST consider this aspect in the development of the design.	

C6 HEALTH AND AMENITIES

C6 HEALTH AND AMENITIES

The designer shall consider all aspects that may affect the health of occupants of the building. Primarily this entails the provision of light, clean air, heating or cooling, but also includes sanitary facilities and cooking facilities. Wherever possible, the designer shall make provisions to allow access for persons with disabilities to all parts of all buildings and their facilities.

POLICY REFERENCES

- Item 22** **Public health, safety and security:** UNOPS endeavours to design and implement infrastructure projects in a manner that prevents or, where this is not possible, mitigates adverse effects to the health, safety and security of affected individuals and communities and their environment.
- Item 26** **Public health, safety and security:** UNOPS strives to mitigate the exposure or spread of water-borne and vector-borne diseases associated with the design and implementation of infrastructure projects.
- Item 35** **Gender equality and the empowerment of women:** UNOPS endeavours to identify areas where project activities may adversely impact the quality of life of women and girls. In this regard, UNOPS will work with partners, governments and contractors to design and implement projects with full respect for the human rights and the dignity of women and girls.
- Item 40** **Persons with disabilities:** Employing the concept of ‘universal design’ is one of the primary methods to guarantee accessibility. This concept, as defined in the CRPD, stems from the need to provide accessibility measures to persons with disabilities; however, universal design includes benefits for society as a whole, including the elderly, people with strollers and children. Employing universal design enhances access to services and economic opportunities and promotes the inclusion of those who have been traditionally marginalized due to their functional limitations.
- Item 50** **Indigenous peoples:** UNOPS strives to design and implement infrastructure projects in a manner that encourages full respect for the human rights, inherent dignity, livelihood systems and cultural identity of indigenous peoples.
- Item 84** **Health and safety in employment:** The right to safe and healthy working conditions is a fundamental human right.
- Item 97** **The environment:** UNOPS endeavours to design and implement infrastructure projects in a manner that respects the principle of environmental responsibility and sustainability, including preventing or mitigating adverse impacts on the environment and identifying strategies for improved environmental performance.
- Item 110** **Sustainable resource use:** UNOPS endeavours to support sustainable resource use in the context of all infrastructure activities. In this regard, UNOPS seeks to identify measures to improve resource efficiency by reducing energy and water use, using sustainable, renewable and low-impact resources instead of non-renewable resources wherever possible and with respect for the local context, and identifying methods of reusing or recycling resources used in project activities.

TECHNICAL OBJECTIVES

- C6.TO 1** To provide healthy environmental conditions for people using the infrastructure.
- C6.TO 2** To provide suitable amenities for people using the infrastructure.

FUNCTIONAL STATEMENTS

- C6.FS 1**  The design of every building shall utilize daylighting and natural ventilation, where feasible, as a preferred design solution to artificial lighting and mechanical ventilation. The solution shall consider methods to achieve acceptable comfort conditions for all occupants and users.
- C6.FS 2** The design of every building shall include provision of toilet and bathing facilities appropriate to building use. The solution shall consider methods to achieve healthy sanitary outcomes for all occupants and users, with particular consideration for gender issues.
- C6.FS 3** The design of every facility shall consider provision of cleaning, cooking, sick room and other ancillary health and life support functions as appropriate to the function of the building or facility.

PERFORMANCE REQUIREMENTS

C6.PR 1 Lighting



The Design Practitioner **MUST** take into consideration the following elements in the design of lighting for each building:

a. **Daylight**

Use daylight as a primary means of lighting in all habitable rooms during daylight hours, unless security, privacy or other technical reasons preclude it. Habitable rooms are rooms occupied on a long-term basis such as offices, wards, bedrooms, meeting rooms, kitchens. Non-habitable rooms are rooms used on a short-term basis such as toilets, bathrooms, cleaners' storage rooms. Non-habitable rooms should have windows where feasible, but this is not essential to meet the minimum standard.

Example: A security control room may have ballistic rated glass for vision but may equally be required to be completely sealed and underground for security reasons, depending on the required protection level.

b. **Glazing impact**

Consider the climatic conditions, orientation, size, insulation and shading of windows to limit the negative impacts of glazing. This is particularly important in full wall glazing which may be in sunlight causing overheating, glare, or significant heat loss where no sun access occurs in a very cold climate.

Example: A full wall of single glazing with no sun protection facing west in a tropical climate country makes desks next to the wall almost unusable in late afternoons due to heat and glare. This could be improved by reducing the glass area, providing double glazing or external sun shading louvers or shutters.

Note that in many countries, the westernized glass box office is seen as an expectation of progress or a more modern design solution. Whether it is climatically or culturally appropriate is a broad subject with many views, however the DP **MUST** consider the glazing solution for any building to avoid significant heating and/or cooling issues which may affect both the health of occupants and service costs for the building.

c. **Daylight penetration**

Consider the maximum effective depth of daylight penetration into a building. A typical indication of maximum effective depth is 6-9m from the external wall, subject to many factors such as:

- Floor to ceiling height within rooms.
- Slope of ceiling and any high level lighting such as clerestory.

- Use of external light shelves to 'bounce' light into the room.
- Orientation of windows: full wall area or height relative to width.

Example: A window 2.4m high x 1.2m wide will give more daylight penetration than the same window 1.2m high x 2.4m wide.

- Glazing type affecting light transmission
- Sun-shading devices
- Surface texture and colour of finishes inside the building

d. **Artificial lighting**

Consider the extent of supplementary artificial lighting for all internal rooms, or spaces unable to be lit by daylight. The level of artificial lighting shall be sufficient to enable the effective functional use of the room or space.

To reduce energy use the preferred option is the use of low energy solutions, such as LED and compact fluorescence, and higher quality fluorescent tube fittings wherever possible and available.

Example: A 12m deep office space with access to windows on one side only requires lighting from 7m inside the room. The light level must be sufficient to carry out desk-based activities without eye strain or limitations on activity duration.

Example: An internal hallway without access to windows requires lighting as a minimum to enable safe travel in the hall. This may be a substantially lower level of light compared to office space, for example, but must be sufficient to avoid trip hazards, and to recognise signage etc.

C6.PR 2 Ventilation



Ventilation for each building **MUST** be designed to:

a. **Natural ventilation**

Facilitate natural ventilation to all habitable rooms where feasible and appropriate to do so. The minimum openable window area to the outdoors shall be 5% of the floor area in a room.

In locations where adjoining rooms without openings to the outdoors use 'borrowed' ventilation from a naturally ventilated room the common wall shall have an opening of a minimum of 10% of the unventilated room floor area.

Note: The 5% mentioned above is a minimum for moderate/temperate climates. In humid locations comfortable conditions may require ventilation areas that are two or three times as large, and permanently open.

Example: In certain circumstances, natural ventilation can be facilitated with openable windows and not fixed solutions.

- b. **Mechanical ventilation**
In cold climates, where temperatures are lower than 5°C, ensure that all rooms containing bathtubs, showers, spas and other bathing facilities shall be mechanically ventilated. This is to remove moisture laden air and prevent mould and other undesirable health hazards from occurring when natural ventilation may not be used.
- c. **Cross ventilation**
Enable cross ventilation where feasible and appropriate. This is particularly relevant in hot or humid climatic conditions and should be achieved with nominally equal areas of openable ventilation on opposite walls of the room or space.
- d. **Other measures**
Consideration should be given to other methods for natural ventilation such as stack or chimney design techniques to boost the impact of natural ventilation techniques where required. Other measures, such as large ceiling sweep fans, may be appropriate to increase comfort conditions by creating air movement.

C6.PR 3 Concealed spaces

Every building that contains concealed sub floor spaces, attic spaces or voids within wall cavities **MUST** be designed to inhibit or eliminate moisture migration or condensation issues. These issues may have serious effects directly on human health and/or the structure of the building ultimately affecting the building's strength and increasing future risk of injury. Specific mitigation measures include:

- a. Temperature variations and dew point locations relative to chosen building elements shall be assessed to avoid condensation in building cavities. Measures such as vapour retardant barriers are to be installed to walls and ceilings as needed to stop air borne water vapour migration and condensation.
- b. Roof void space ventilation is to be implemented by openings at the bottom and top of sloped roofs to ensure convection air movement. Gable vents are an alternative option, but in all cases the ventilation grille openings should have an area of 1/300 of the area to be ventilated. All ventilation air movement **MUST** be located on the outer face of insulation to ensure the effectiveness of the insulation is not compromised.
- c. Sub floor ventilation is required to be installed for voids between the underside of timber floor structures and the earth below. The vents shall be vermin proofed to prevent access into the crawl space and have an area of 0.7m² per 100m² of floor space. Openings should be

distributed to the perimeter to ensure cross ventilation of the under floor area. Minimum clearance for timber above ground is 300mm. Alternatively, if the floor level is raised, the perimeter can be open. Insulation to the floor structure is a consideration for cold climates.

C6.PR 4 Mechanical ventilation

Buildings or parts of buildings that require mechanical ventilation for exhaust **MUST** comply with the following requirements:

- a. Mechanical exhaust rates for air changes/hour will be a minimum of:
 1. Two air changes/hour for internal rooms or store rooms
 2. Five air changes/hour for bathing facilities, domestic style kitchens and cleaners' rooms
 3. Specific trade related exhaust requirements to be commensurate with acceptable levels prescribed for use by local authorities or bodies such as WHO.

Sophisticated heat exchange and mechanical systems may achieve lower air change rates. However, these are specialist installations requiring a sophisticated design for the building and ventilation system. Note that consideration of pre-heating incoming air to replace exhausted air may be required in cold climates where temperatures are lower than 0°C.

Example: Use of high volume commercial kitchen exhaust in a -10°C winter environment will require preheated incoming air to avoid sub-zero working conditions in the kitchen.

- b. Mechanical exhaust systems shall not discharge into roof void spaces or ceiling spaces. All exhaust shall discharge to the outdoors. Openable self-closing shutters or louvers should be used where feasible to limit drafts and reverse air exchange when the units are not in operation.
- c. Controls for exhaust systems may be linked to light switches for internal rooms or rooms without natural ventilation sufficient to ensure operation whilst the room is in use.
- d. Controls for trade related exhaust requirements may be manually controlled with automatic or emergency shutdown features as needed.

Example: Welding exhaust systems or vehicle maintenance exhaust systems may use manual controls. A commercial kitchen exhaust should have automatic or emergency shutdown in the event of fire in the cooking area.

C6.PR 5 Space heating



All habitable spaces within buildings **MUST** be provided with an acceptable method of space heating in cold climates. The lack of heating can directly affect human health and learning effectiveness in schools in addition to causing building damage with frozen pipes and other adverse effects. The heating system **MUST** be capable of sustaining a minimum temperature of 15°C and preferably 18°C at any location within the heated space during normal occupancy periods. This capability is to be available on the coldest anticipated day. Heating provided during the non-occupied periods should ensure that the temperature within the habitable spaces does not drop below 7°C.

The DP designing the spaces and building **MUST** consider the impact of extreme cold and provide insulation, air locks and other heat management design activities to minimize heat loss and fuel usage. All pipe work, tanks, valves, and other liquid-based circulation systems **MUST** be insulated and located appropriately to avoid freezing conditions. The DP should consider protective measures such as heating cables for vulnerable building elements in extreme winter conditions.

C6.PR 6 Air conditioning



Buildings or parts of buildings that are required to be air conditioned are potentially subject to a broad range of operational conditions and serviced by a wide variety of equipment.

Given the variability of conditions that affect power considerations, types of equipment, and spare parts availability, the DP should prepare a design solution that provides human comfort conditions within the following matrix.¹⁰

¹⁰ For a more comprehensive online tool, refer to <http://www.cbe.berkeley.edu/comforttool>.

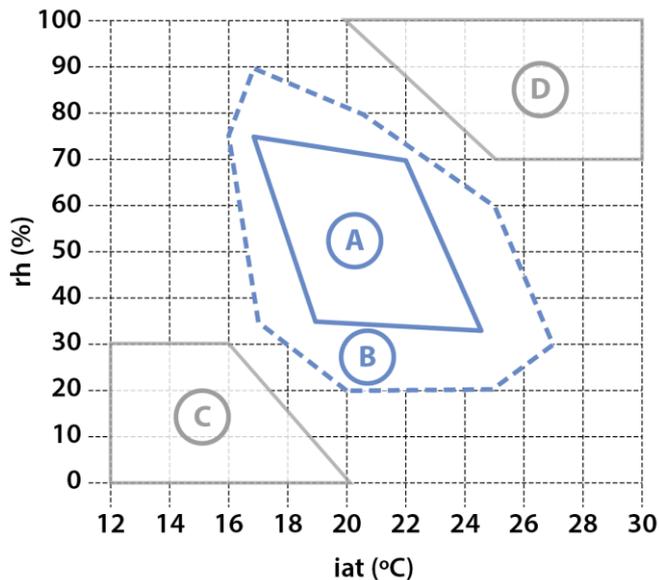


Figure 36: Matrix of human comfort conditions: comfortable (A), acceptable (B), uncomfortably dry (C), uncomfortably moist (D)¹¹

Note that this increases the potential range of operating conditions providing flexibility in use in comparison to many internationally accepted standards that use design temperatures such as a maximum of 22°C for heating and a minimum of 24°C for cooling.

Where there are opportunities to consider alternatives to full air conditioning, or reducing equipment size by improvements to the building design or its insulation, the DP **MUST** investigate these options prior to finalizing the design solution. Marginal increases in initial construction costs may be offset by considerable savings in long-term operational costs over the lifetime of the use of the equipment.

Concepts such as preconditioning of air, passive heat exchanges, evaporative cooling, chilled beam or panels and other best practice techniques should be explored to determine their applicability and potential to deliver green building solutions.

¹¹ The matrix is adapted from Victor Olgyay's "Design with Climate", and according to Interior Air Temperature (iat °C) and Relative Humidity (rh %).

C6.PR 7 Washroom facilities

The DP **MUST** ensure that adequate toilets, washing and bathing facilities areas are provided in all buildings or adjacent to the buildings, depending on cultural expectations, and employing a gender-based approach. These minimum requirements are identified in the table below:

Table 6: Minimum requirements for adequate washroom facilities

DESCRIPTION	Water closets (1)		Hand basins(1)	Bathtubs or Shower (1)	Cleaners sink and others (1)
	Male (2)	Female	Male/Female		
Assembly					
Theatres and other buildings for performing arts/cinema	1 per 125	1 per 65	1 per 200	(4)	1 sink/1000m ² building area
Restaurants, banquet halls	1 per 75	1 per 75	1 per 200	(4)	1 sink
Auditoriums without permanent seating, art galleries, exhibition halls, museums, libraries, gymnasiums	1 per 125	1 per 65	1 per 200	(4)	1 sink/1,000m ² building area
Passenger terminals and transportation facilities	1 per 500	1 per 500	1 per 750	(4)	1 sink/1,000m ² building area
Stadiums, grandstands, or arenas both indoor and outdoor	1 per 75 for first 1,500; 1 per 120 for the remainder over 1,500	1 per 40 for first 1,500; 1 per 60 for the remainder over 1,500	1 per 150	(4)	1 sink per 1,000m ²
Employees (3)	1 per 25		1 per 35	1 per staff change area	---
Business					
Buildings for the transaction of business e.g. merchandise, office buildings, light and industrial business	1 per 25 for the first 50; 1 per 50 for the remainder exceeding 50		1 per 40 for first 80; 1 per 80 for the remainder exceeding 80	(4)	1 sink/floor or 1 sink/750m ² building area
Educational					
Educational facilities	1 per 50		1 per 50	---	1 sink/750m ²
Employees (3)	1 per 25		1 per 35	1 per staff change area	---
Institutional					
Residential care	1 per 10		1 per 10	1 per 8	1 sink
Hospitals, nursing home patients	(up to 4 persons) 1 per room		(up to 4 persons) 1 per room	1 per 15	1 sink/floor
Visitors, other than residential care	1 per 75		1 per 100	---	---
Prisons, detention centres	(up to 4 persons) 1 per cell		(up to 4 persons) 1 per cell	1 per 15	1 sink/750m ²
Correctional centres	(dormitory up to 30 persons) 1 per 30		1 per 15	1 per 15	1 sink/750m ²
Employees (3)	1 per 25		1 per 35	1 per staff change area (4)	---
Mercantile					
Retail stores, service stations, shops, salesrooms, and markets	1 per 500		1 per 750	---	1 sink/750m ²
Residential					
Apartment house, one and two family dwellings	1 per dwelling unit		1 per dwelling unit	1 per dwelling unit	1 kitchen sink/ dwelling unit; clothes washing facilities
Storage					
Structures for the storage of goods, storehouse, warehouses, freight depots	1 per 100		1 per 100	(4)	1 sink per 750m ²

Notes:

1. The fixtures shown are based on one fixture being the minimum required for the number of persons indicated or any fraction. The number of occupants shall be based on the number identified in the table in C4.PR3.
2. Water closets may be replaced with urinals in each bathroom for not more than 50 percent of the required water closets.

*Example: Facility with 3 WC can substitute 1 urinal for 1 of the WC.
Facility with 4 WC can substitute 2 urinals for 2 WC facilities.*

3. Toilet facilities for employees **MUST** be separate from other users.
4. Shower or bathing facilities may be required subject to the type of activity and likelihood of requiring decontamination, cleaning and hygiene requirements. These shall be determined on a case by case basis, recognizing the importance of shift changeovers, work type, cultural expectations, and gender balance.

Note that consideration should be given to increasing all of these minimum requirements to allow for facilities that may be out of order, particularly in locations where spares and maintenance be limited.

C6.PR 8 Accessible toilets

The DP **MUST** provide at least one accessible toilet facility for persons with disabilities in all buildings.

The use of a unisex toilet facility is subject to confirmation of any gender and or cultural requirement and this provision may therefore prove not to be acceptable. In this instance separate male and female facilities are required.

Minimum requirements for accessible toilet facilities are identified in the table below:

Table 7: Accessible toilet facilities

Type of facility	Accessible water closet and hand basin	Accessible Showers
Assembly	1 per 400 occupants	
Business	1 per 200 occupants	
Educational	1 per 200 occupants	
Factory and Industrial	1 per 400 occupants	May be required subject to function
Residential care	1 per 20 residents	1 per WC required
Hospitals	1 per 5 patients	1 per WC
	1 per 200 staff	1 per WC
Prisons	1 per 100 inmates	1 per WC
Mercantile	1 per 400 occupants	
Dormitories/boarding houses	1 per 50 beds	1 per WC required
Apartment, House, One and Two family dwellings	1 per 25 dwellings	1 per WC required
Storage and Warehouses	1 per 400 occupants	

Exceptions:

1. Alterations to existing buildings where it is not feasible to provide the full extent of facilities. In this instance, at least 1 unisex facility suitable for disabled persons is required.
2. New buildings of less than 200m². In this instance, at least 1 unisex facility suitable for disabled persons is required.
3. New buildings containing less than 50 occupants. In this instance, at least 1 unisex facility suitable for disabled persons is required.

Minimum space requirements are shown below for separate facilities, and for toilet compartments within male or female toilet facilities.

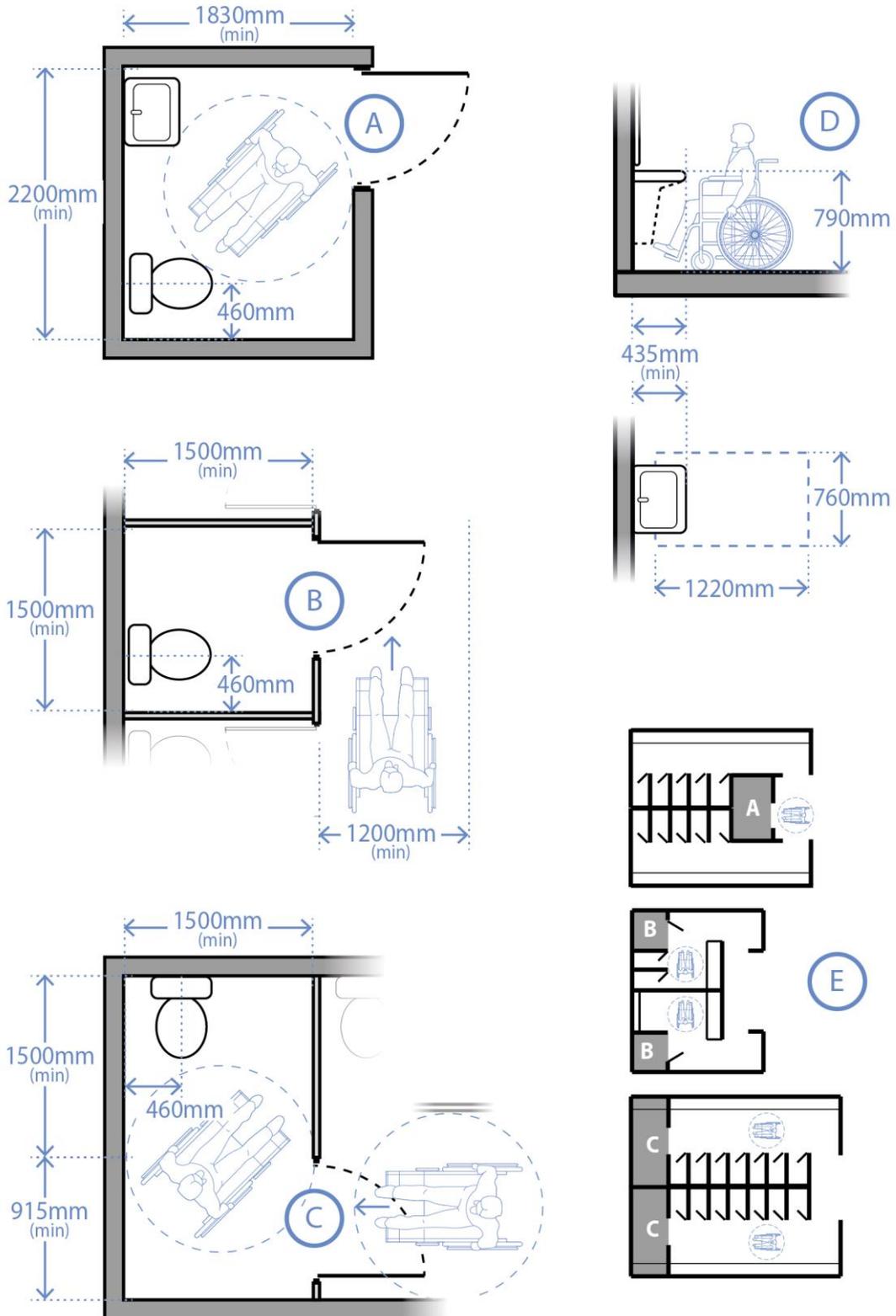


Figure 37: Minimum space requirements for accessible toilets: individual toilet room (A); standard compartment (B); end row compartment (C); minimum clearance space for lavatory (D); examples of public toilets configurations(E)

C6.PR 9 Accessible kitchens

All dwelling units that are configured for accessibility for disabled persons **MUST** contain a kitchen facility suitable for use by a person in a wheelchair. Reach and clearance spaces, under bench knee spaces and similar operational aspects **MUST** be included by the DP in the design of these facilities.

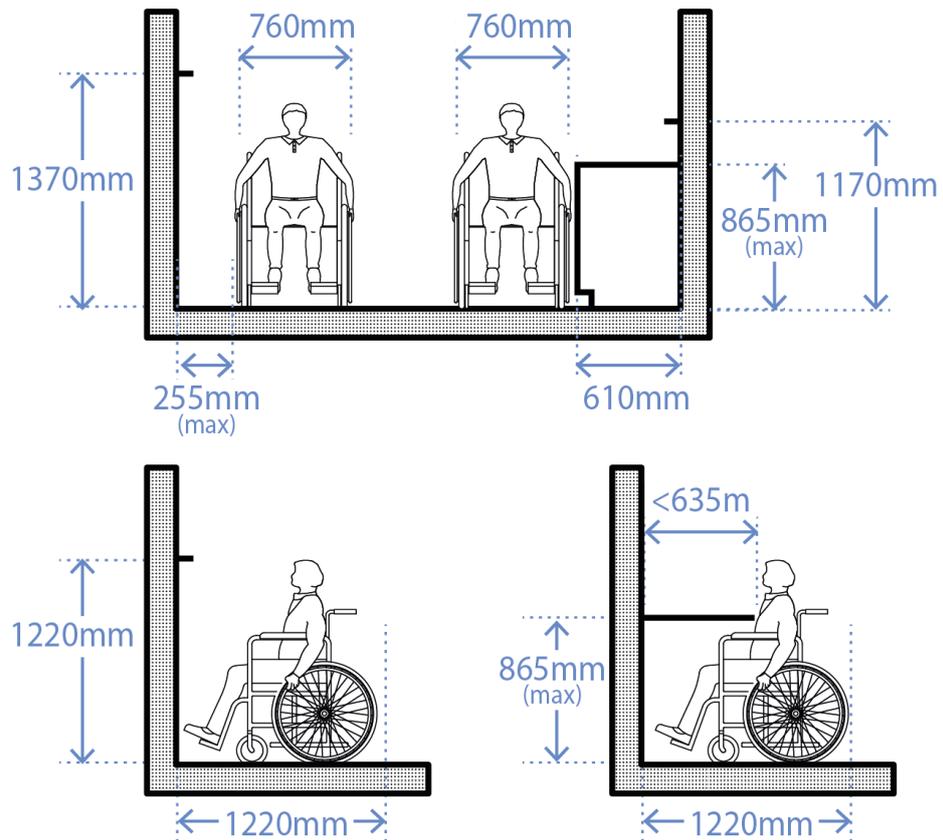


Figure 38: Reach and clearance space considerations for disabled persons

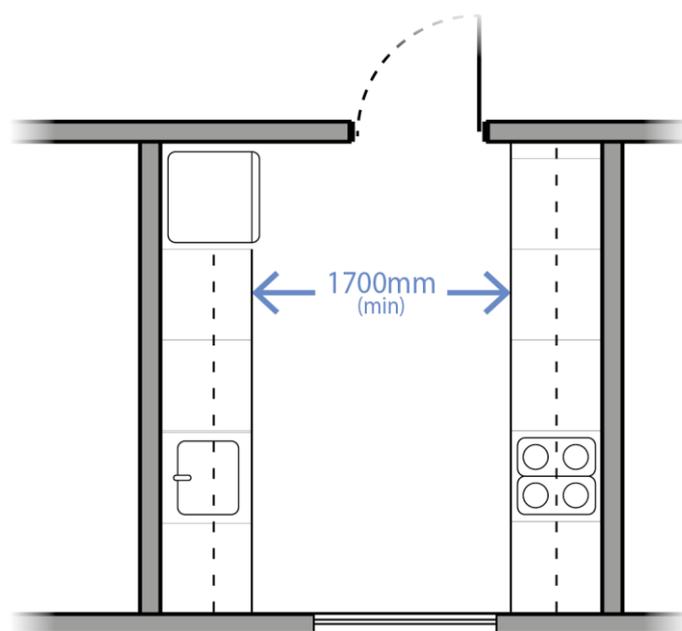


Figure 39: Example of a kitchen facility

C6.PR 10 Cleaners' sinks

Cleaners' sinks **MUST** be included in each building to ensure there are suitable facilities available for keeping the building clean and hygienic. These can be either deep sinks raised above floor with a separate floor drain, or a floor drain with a raised lip to control spread of water. In all cases, there must be a water supply to enable filling of buckets and dilution of cleaning liquids.

These sinks should be located in a dedicated room so that all cleaning supplies and equipment can be safely stored. A cleaners' cupboard containing the sink may be sufficient for small buildings.

C6.PR 11 Kitchen facilities

Food preparation facilities should be separate rooms and contain sufficient cupboards, sinks, ventilation and water supply to enable the hygienic preparation of drinks and food appropriate to cultural norms.

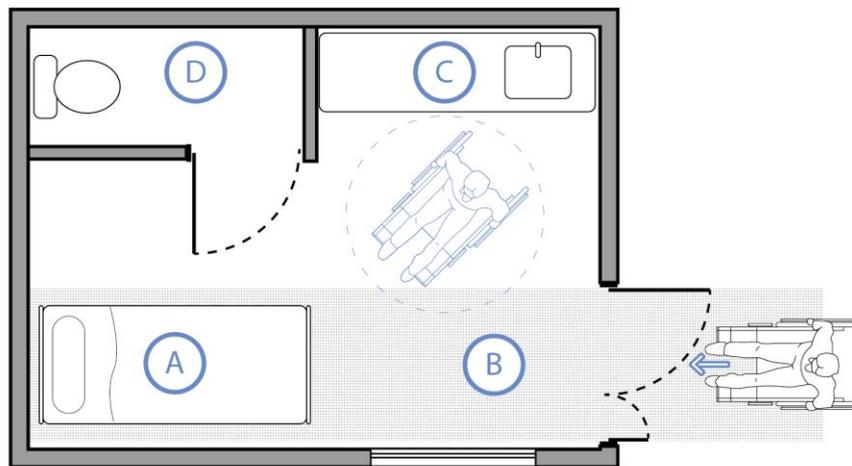
Cleaners' rooms **MUST** not be used for tea-making or food preparation.

C6.PR 12 First aid facilities

First Aid facilities should be considered for all buildings in the interests of emergency assistance for the occupants. These facilities may be simply a first aid box in an office, containing basic items such as bandages, gloves, thermometer, saline solution, antiseptic cream etc. Many countries, however, require 'sick' rooms as part of labour laws to provide a space for visiting doctors, first aid treatment and a quiet space for occupants who are unwell. In this instance, the room should contain space for a bed, hand basin for hand washing and separate toilet facilities.

These requirements, in addition to an extended range of medical supplies, are normally based on the numbers of employees in the facility. Given the resource-constrained locations of many UNOPS projects, the inclusion of a 'sick' room with associated facilities should be considered for all buildings greater than 1,000m² in area.

If the building is located in a conflict zone, then the provision of a 'sick' room as an emergency first aid room **MUST** be included for all buildings with an area greater than 300m².



*Figure 40: Minimum sick room
Bed area (A), circulation area (B), sink & cabinet area (C), toilet area (D)*

Health and amenities (C6)		Completed Yes or n/a
C6.PR 1 Lighting	Lighting for each building MUST comply with the requirements laid out in the relevant section.	
C6.PR 2 Natural ventilation	Ventilation for each building MUST comply with the requirements laid out in the relevant section.	
C6.PR 3 Concealed spaces	Every building that contains concealed sub floor spaces, attic spaces or voids within wall cavities MUST be designed to inhibit or eliminate moisture migration or condensation issues, in line with the requirements laid out in the relevant section.	
C6.PR 4 Mechanical ventilation	Buildings or parts of buildings that require mechanical ventilation for exhaust MUST comply with the requirements laid out in the relevant section.	
C6.PR 5 Space heating	All habitable spaces within buildings MUST be provided with an acceptable method of space heating in cold climates. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
C6.PR 6 Air conditioning	Given the variability of conditions that affect power considerations, types of equipment, and spare parts availability, the DP should prepare a design solution that provides human comfort conditions within the provided matrix. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
C6.PR 7 Washroom facilities	The DP MUST ensure that adequate toilets, washing and bathing facilities areas are provided in all buildings or adjacent to the buildings, depending on cultural expectations, and employing a gender-based approach. For a table of minimum requirements for adequate washroom facilities, please refer to the table in the relevant section.	
C6.PR 8 Accessible toilets	The DP MUST provide at least one accessible toilet facility for persons with disabilities in all buildings. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
C6.PR 9 Accessible Kitchens	All dwelling units that are configured for accessibility for disabled persons MUST contain a kitchen facility suitable for use by a person in a wheelchair. Reach and clearance spaces, under bench knee spaces and similar operational constraints MUST be considered by the DP in the design of these facilities.	
C6.PR 10 Cleaners' sinks	Cleaners' sinks MUST be used to ensure there are suitable facilities available for keeping the building clean and hygienic.	
C6.PR 11 Kitchen facilities	Cleaners' rooms MUST not be used for tea-making or food preparation.	
C6.PR 12 First aid	First aid facilities should be considered for all buildings in the interests of emergency assistance for the occupants. If the building is located in a conflict zone, then the provision of a 'sick' room as an emergency first aid room MUST be included for all buildings with an area greater than 300m ² .	

**C7 SERVICES
AND
EQUIPMENT**

C7 SERVICES AND EQUIPMENT

The design of building services and the selection of related equipment is of crucial importance when delivering a successful infrastructure project. Services such as water and drainage and waste collection systems have important influence on health aspects. Heating, ventilation and air conditioning play a vital role in making a building usable in whichever climate it is located. The designer must very carefully study each situation and make balanced choices between complex technology and what is practically and economically possible. Circumstances shall in each case be analysed (Refer to SECTION B7).

POLICY REFERENCES

- | | |
|-----------------|---|
| Item 22 | Public health, safety and security: UNOPS endeavours to design and implement infrastructure projects in a manner that prevents or, where this is not possible, mitigates adverse effects to the health, safety and security of affected individuals and communities and their environment. |
| Item 26 | Public health, safety and security: UNOPS strives to mitigate the exposure or spread of water-borne and vector-borne diseases associated with the design and implementation of infrastructure projects. |
| Item 50 | Indigenous peoples: UNOPS strives to design and implement infrastructure projects in a manner that encourages full respect for the human rights, inherent dignity, livelihood systems and cultural identity of indigenous peoples. |
| Item 84 | Health and safety in employment: The right to safe and healthy working conditions is a fundamental human right. |
| Item 97 | The environment: UNOPS endeavours to design and implement infrastructure projects in a manner that respects the principle of environmental responsibility and sustainability, including preventing or mitigating adverse impacts on the environment and identifying strategies for improved environmental performance. |
| Item 100 | The environment: In efforts to comply with the General Assembly's resolution, recognizing the right to water, UNOPS seeks to develop mechanisms to ensure sufficient recognition and protection of the right to water, wherever implicated by the design and implementation of infrastructure projects. |
| Item 104 | Pollution prevention: UNOPS strives to prevent the release of hazardous materials into the local environment in association with project activities. |
| Item 110 | Sustainable resource use: UNOPS endeavours to support sustainable resource use in the context of all infrastructure activities. In this regard, UNOPS seeks to identify measures to improve resource efficiency by reducing energy and water use, using sustainable, renewable and low-impact resources instead of non-renewable resources wherever possible and with respect for the local context, and identifying methods of reusing or recycling resources used in project activities. |

TECHNICAL OBJECTIVES

- C7.TO 1** Services installations are to be designed so that negative environmental impacts are minimized and positive impacts maximized.
- C7.TO 2** To select equipment which is fit for purpose in the operational context in which it is situated.

FUNCTIONAL STATEMENTS

- C7.FS 1** The design of the services installations must deliver a functional system which ensures a safe and healthy environment both in and around the infrastructure project.

Example: The water supply system is designed so that it delivers safe water to users without depriving others downstream.

Example: The electrical installation is safe, using the latest technology and codes, and has the facility of low consumption and use of renewable sources of power whenever practically possible.

Example: The effluent disposal system ensures the safe disposal of sewage. In the absence of a main sewer system the designer has provided for local treatment in a sustainable and safe manner.

- C7.FS 2** The equipment chosen to serve the infrastructure project must whenever possible be energy efficient, have low maintenance requirements, low cost, good manufacturer support and a proven long life span.



Example: A water pump with high quality stainless steel components may well have a much lower life cycle cost than a conventional cast iron housing and impeller pump.

PERFORMANCE REQUIREMENTS

C7.PR 1 Water supply system



- a. The water supply system¹² **MUST** deliver water which is safe for human consumption. Laboratory analysis and a treatment regime may be required to achieve the standard for safe drinking water as defined by WHO. Toilet flushing and similar non-drinking water applications may use lower qualities of water supply.

Example: It may be decided for reasons of economy to have two sources of water: one for all general requirements requiring little or no treatment and one for safe potable water, thereby reducing substantially the quantity treated to drinking water standard. Reference shall be made to the WHO Water Safety Plan Manual.

- b. The DP **MUST** research all water supply options including rain water harvesting.

Example: Water supply could be municipal but with limited pressure and intermittent availability, creating a need for design of onsite storage and pressure boosting.

- c. Water storage requirements **MUST** be determined on the basis of data collected about reliability of supply and estimated daily consumption. It is also necessary to have historic data about the power supply including length of time and frequency of power interruptions where electric pumps are used for pressurization, or movement of water to/from storage tanks.

Example: Daily consumption of water can vary widely depending on cultural practices and location. If intermittent supply issues are assessed as well, this can lead to storage requirements that may vary from 1m³ to 20m³ for the same size facility and number of occupants.

- d. Water requirements for firefighting **MUST** be determined and a separate storage provided if the municipal supply is inadequate and/or intermittent. Refer to C4.PR 6 for firefighting requirements.

Example: The water supply for firefighting may have to be independent of power supply. Therefore it may be necessary to use overhead storage to have security of supply for this purpose.

- e. Cold water reticulation **MUST** be designed so that adequate supply—a minimum of 5 l/min—is available at all discharge points. The possibility of frost damage **MUST** be considered and precautions taken to avoid frost damage in cold climates.

¹² WHO Water Safety Plan Manual is accessible through the following link:
http://www.who.int/water_sanitation_health/publication_9789241562638/en/

Example: Although many designers now choose small diameter pressurised systems it may be more appropriate to use larger diameters where frequent power outages are expected

Example: In a situation where a building is unheated insulation alone will not prevent frost damage. It may be necessary to provide a water circulation facility.

- f. Hot water reticulation: the same observations apply as for cold water, but insulation should be provided to avoid heat loss. Circulation systems should be considered to ensure short time lag at remote supply points. This would also prevent damage where pipes are in unheated spaces in cold climates.
- g. The design of the water heating and pipe system **MUST** be such as to prevent incubation of bacteria colonies, legionella in particular.

Example: Prevention of incubation of bacteria in a hot water system is achieved by designing the system so that the heating source achieves a temperature of 60°C and hot water at the remotest supply point achieves 55°C in the time of one minute or less.

Example: In situations where the users are elderly or children, consideration should be given to water tempering devices to ensure that scalding does not occur. This should reduce temperatures to 40°C for hot water supplied to showers, baths, or hand basins.

- h. The method of heating water **MUST** be considered by the designer. Sustainable and renewable sources of fuel, such as solar, straw, wood, wood pellets or wood chips should be considered in conjunction with oil, gas or electric power. Centralised heating should be compared with de-centralised heating in terms of initial cost and operating cost.

Example: In making a choice of heating method it is essential that the fuel chosen is available without interruption and at a reasonable cost.

Example: In a renovation situation decentralised heating of water may be a practical and economical solution. It saves a great deal of pipe work to have the heating source close to the point of use and less building fabric is affected by the installation.

C7.PR 2 Sewage and waste water

- a. Sewage and other waste water potentially present the most serious threat to health in any project. Given the particular context for the project, the DP **MUST** consider all available technologies to determine the most environmentally sustainable option.

Example: There are more than 15 common infections caused by exposure to untreated sewage and if these illnesses are untreated many afflicted people will die. Children are particularly vulnerable.

- b. Waste water from kitchens **MUST** pass through a grease trap before being discharged into the general waste water system. The grease trap **MUST** be engineered to suit volume and operating conditions for the system.
- c. Sewage systems, collection pipe work, manholes and treatment facilities **MUST** be designed with great attention to detail to ensure that any potential health hazard is mitigated. In particular possible groundwater contamination and infiltration into drinking water sources must be avoided.
- d. Neutralising tanks and plaster traps **MUST** be considered for waste systems for health clinics and hospitals and only deselected with good reason. Disposal systems for medical waste **MUST** be considered to ensure that any potential health hazard is mitigated.
- e. Connection to a municipal sewage system is clearly the preferred option subject to the capacity of the system to manage the discharge volume and frequency. The DP **MUST** confirm the capacity of the municipal system with the relevant authority.

In the absence of a public mains system, alternatives may include: holding tanks for regular emptying, septic tanks with soak-aways or drain fields or raised transpiration beds and ultimately a self-contained treatment plant.

Example: In a situation where no public system exists, a substantial infrastructure project may well justify the establishment of a treatment plant, which produces irrigation quality water.

Example: Soak-aways and drain-fields may only be established where they are a sufficient height (minimum one meter) above the groundwater table or a rock strata.

C7.PR 3 Stormwater management



Some countries have historically used combined stormwater/sewage systems, which may be subject to significant operational issues and health risks. As a result, these systems should be separated to improve waste management.

- a. Stormwater discharge systems **MUST** be designed so that they safely dispose of stormwater without causing scour, flooding or contamination. The disposal of storm water should not negatively affect neighbouring communities and property or agricultural activities in the vicinity.

Example: A storm water outlet into an adjacent waterway must be sufficiently protected so that scour of the bank of the waterway does not take place. Flooding of fields with possible damage to crops would be unacceptable.

- b. Water from roof drainage should, where practical, be harvested for use in the water supply to the infrastructure project or for site irrigation.

Example: A community centre in a remote location with no obvious water source may rely on roof water collection to enable its use. Consideration may be needed for water storage duration, filtration and possible animal/insect contamination.

- c. Water from hardened surfaces, parking and roads **MUST** be led through gross solid traps, silt and oil traps before either being stored for re-use in reservoirs or discharged safely into either a municipal stormwater drainage system or a waterway.
- d. The storm drains **MUST** be designed for agreed rainfall parameters determined from meteorological data. The design **MUST** be resilient against extreme situations to prevent serious failure.

C7.PR 4 Electrical systems



- a. Electric installations, if incorrectly designed or badly executed, are a major risk factor for human life safety. All electrical installations **MUST** result in a high degree of life safety and building safety for the project. The lifespan of the project should be considered in the design of electric installations. In the case that no such codes exist, see section B3.
- b. All earthing/grounding devices, including lightning rods, **MUST** be identified on electrical documentation, as incorrectly executed earthing may result in failure of safety devices and cause a fire and/or loss of life.

- c. The designer **MUST** research the local situation of power generation and distribution and establish to the greatest extent possible the reliability and capacity of supply.

Example: Knowing the history of supply and having some knowledge of future plans enables an educated decision to be made about standby power requirements.

- d. Consider means of reducing power requirements and smoothing out peak loads where possible. This may entail the removal of air conditioning units, electric ovens and substitution of conventional lighting. The use of low start load pumps may reduce peak loads.

Example: Solar heating of hot water supply is a very good alternative to electrical heating of water and units are now widely available.

- e. Alternative forms of power generation such as photovoltaic, wind power and micro hydro systems should be considered. The extent of their use for either primary power or supplemental power needs careful judgement.
- f. When choosing standby power diesel generators the following **MUST** be considered: availability of competent maintenance service; availability of spare parts; reliability of operation; fuel availability and consumption. Consideration of whether the facility requires full standby power, or if it can be limited to essential services only, can make a substantial difference to the generating capacity.

C7.PR 5 Communications and IT systems

- a. The designer should obtain the requirements for telecommunication services and consider the implications for the following types of services:
1. Fixed line connection
 2. Mobile network
 3. Internet service
 4. Number of extensions
 5. Private exchange
- b. The DP should research to which extent the requirements can be met locally in a conventional manner and, if required, propose alternatives such as:
1. Radio communications systems
 2. Satellite systems

- c. The IT requirements for server rooms, patch panel locations, PABX units **MUST** be defined, in cooperation with the end-user, in order to enable an acceptable level of security, operation and capability for the facility.

C7.PR 6 Security services

The DP **MUST** identify in the design brief and assist with provision of any specialist services infrastructure related to security needs for the operation of the building. It is not acceptable, except in extreme security circumstances, for these to be excluded from the design and installed later by separate contract outside the control or knowledge of the DP. Their integration with the overall design process will result in a better solution that is more able to meet operational and security related objectives. These services include:

- a. public address/intercom systems where these provide warning, communication or public message delivery for building occupants
- b. closed circuit TV systems for visual security at entry points, within buildings and grounds adjacent to buildings
- c. access control systems at entries and within buildings to secure facilities
- d. intruder alert alarm and active control systems

Refer to SECTION C8 Security for further guidance on security.

C7.PR 7 Evidence of research

The DP **MUST** provide evidence of research in the consideration of equipment to meet C7.TO 2 and C7.FS 2 for complex equipment design solutions. These choices are critical to the future performance, effectiveness, and maintenance of the design outcome. Every effort should be made to meet any design brief requirements with the least complex technical solution where possible. This requirement applies to:

- a. ventilation fans, filters, exhaust hoods, make up air supply systems
- b. heating equipment such as boilers, burners, duct heaters, radiant heat systems
- c. water pumps for distribution and/or pressurisation to sanitary facilities or for heating systems, fire hydrant/hose reel systems

- d. air conditioning systems comprising air, ground or water based split systems, packaged systems, conventional chiller/evaporator centralised systems, VRV and other technologically advanced systems

This requirement also applies to any alternative technology systems that replace the equipment identified above in the design solution.

C7-PR 8 Testing of equipment

In the design documentation, prior to the handover of the building to users, the DP **MUST**:

- a. Clearly identify those items of equipment to be tested and commissioned.
- b. Clearly identify the need for maintenance manuals for such equipment.
- c. Clearly identify any necessary training of occupants in the use of the equipment.

Services and Equipment (C7)		Completed Yes or n/a
C7.PR 1	Water supply system	
a.	The water supply system MUST deliver water which is safe for human consumption and other uses. Laboratory analysis and a treatment regime may be required to achieve the standard for safe drinking water as defined by WHO. Toilet flushing and similar non-drinking water applications may use lower qualities of water supply.	
b.	The DP MUST research all water supply options including rain water harvesting.	
c.	Water storage requirements MUST be determined on the basis of data collected about reliability of supply and estimated daily consumption.	
d.	Water requirements for firefighting MUST be determined and a separate storage provided if the municipal supply is inadequate and/or intermittent.	
e.	Cold water reticulation MUST be designed so that adequate supply--a minimum of 5 l/min--is available at all discharge points. The possibility of frost damage MUST be considered and precautions taken to avoid frost damage.	
f.	Hot water reticulation: the same observations apply as for cold water, but insulation is required to avoid heat loss.	
g.	The design of the water heating and pipe system MUST be such as to prevent incubation of bacteria colonies, legionella in particular.	
h.	The method of heating water MUST be considered by the designer. Sustainable and renewable sources of fuel, such as solar, straw, wood, wood pellets or wood chips should be considered in conjunction with oil, gas or electric power. Centralised heating should be compared with de-centralised heating in terms of initial cost and operating cost.	
C7.PR 2	Sewage and waste water	
a.	Sewage and other waste water potentially present the most serious threat to health in any project. Given the particular context for the project, the DP MUST consider all available technologies to determine the most environmentally sustainable option.	
b.	Waste water from kitchens MUST pass through a grease trap before being discharged into the general waste water system. The grease trap MUST be engineered to suit volume and operating conditions for the system.	
c.	Sewage systems, collection pipe work, manholes and treatment facilities MUST be designed with great attention to detail to ensure that any potential health hazard is mitigated. In particular possible groundwater contamination and infiltration into drinking water sources must be avoided.	
d.	Neutralising tanks and plaster traps MUST be considered for waste systems for health clinics and hospitals and only deselected with good reason. Disposal systems for medical waste MUST be considered to ensure that any potential health hazard is mitigated.	
e.	The DP MUST confirm the capacity of the municipal system with the relevant authority.	
C7.PR 3	Stormwater management	
a.	Stormwater discharge systems MUST be designed so that they safely dispose of stormwater without causing scour, flooding or contamination.	
b.	Water from roof drainage should, where practical, be harvested for use in the water supply to the infrastructure project or for site irrigation.	

c.	Water from hardened surfaces, parking and roads MUST be led through gross solid traps, silt and oil traps before either being stored for re-use in reservoirs or discharged safely into either a municipal stormwater drainage system or a waterway	
d.	The storm drains MUST be designed for agreed rainfall parameters determined from meteorological data. The design MUST be resilient against extreme situations to prevent serious failure.	
C7.PR 4	Electrical systems	
a.	Electric installations, if incorrectly designed or badly executed, are a major risk factor for human life safety. All electrical installations MUST result in a high degree of life safety and building safety for the project. The lifespan of the project should be considered in the design of electric installations.	
b.	All earthing/grounding devices, including lightning rods, MUST be identified on electrical documentation, as incorrectly executed earthing may result in failure of safety devices and cause a fire and/or loss of life.	
c.	The designer MUST research the local situation of power generation and distribution and establish to the greatest extent possible the reliability and capacity of supply.	
f.	When choosing standby power diesel generators the following MUST be considered: availability of competent maintenance service; availability of spare parts; reliability of operation; fuel availability and consumption. Consideration of whether the facility requires full standby power, or if it can be limited to essential services only, can make a substantial difference to the generating capacity.	
C7.PR 5	Communications and IT systems	
c.	The IT requirements for server rooms, patch panel locations, PABX units MUST be defined, in cooperation with the end-user, in order to enable an acceptable level of security, operation and capability for the facility.	
C7.PR 6 Security services	The DP MUST identify in the design brief and assist with provision of any specialist services infrastructure related to security needs for the operation of the building. For the equipment to which this requirement pertains, consult the relevant section.	
C7.PR 7 Evidence of research	The DP MUST provide evidence of research in consideration of the choice of equipment to meet C7.TO 2 and C7.FS 2 for complex equipment design solutions. These choices are critical to the future performance and effectiveness of the design outcome. For the equipment to which this requirement pertains, consult the relevant section.	

C8 SECURITY

C8 SECURITY

It is noted that this section may not be relevant for some projects. However, security is a major concern in many buildings implemented by UNOPS. Specialists may be required to assess the individual situations and propose measures to counter these risks. A detailed analysis of risks to security shall form the basis of measures taken against such risks. A forecast of how security risks might develop will play a useful role in mitigation of risk. The PM must assess whether it is preferable to make temporary precautions and measures that can be dismantled quickly and easily rather than permanent solutions.

POLICY REFERENCES

Item 22 **Public health, safety and security:** UNOPS endeavours to design and implement infrastructure projects in a manner that prevents or, where this is not possible, mitigates adverse effects to the health, safety and security of affected individuals and communities and their environment.

Item 28 **Public health, safety and security:** The development of infrastructure improves communication and accessibility to national territory, fosters trade and is a cornerstone of development; however, facilitating accessibility and communication can also lead to increased security risks for certain segments of the population, including marginalized and vulnerable groups. In this regard, UNOPS will consider the potential security risks of infrastructure development and seek to ensure that these activities do not increase security risks for affected populations.

TECHNICAL OBJECTIVES

C8.TO 1 Infrastructure must be constructed in a way that protects occupants and users against direct and indirect threats.

FUNCTIONAL STATEMENTS

C8.FS 1 Infrastructure must be designed in a manner that facilitates safe and secure operation, while maximizing life safety for occupants.

C8.FS 2 Entry and exit control facilities to buildings and compounds must be installed to increase the level of life safety for all staff and visitors within the facility.

PERFORMANCE REQUIREMENTS

C8.PR 1 Security levels

Security is the protection of people and property from physical circumstances and events that could cause losses, including loss of life. In the environments that UNOPS operates, the requirement for different levels of security will be encountered. These can be as a result of:

1. Crime
2. Terrorism
3. Warfare

The DP **MUST** design security elements and systems that are appropriate to the level or type of threat that can be reasonably anticipated. Security requirements will also vary with regard to the building use.

Examples:

1. Police training facilities, police stations, and prisons.
2. Customs and border control facilities, and government buildings.
3. Hospitals, pharmacies in hospitals, and health clinics.
4. Schools, training centres, laboratory buildings, and university buildings.

C8.PR 2 Codes

National codes and standards **MUST** be used for the design of security elements where such codes and standards exist. In the absence of these, applicable international codes should be used. Refer to SECTION B2 for further guidance.

C8.PR 3 UN buildings and compounds

United Nations Department of Safety and Security MOSS (Minimum Operating Security Standards) and MORSS (Minimum Operating Residential Security Standards) **MUST** be used for the design of all infrastructure for all UN buildings and compounds.

C8.PR 4 Atypical security considerations

Some atypical security considerations may apply for other types of buildings in exceptional circumstances, and these **MUST** be designed to an appropriate standard to mitigate the particular threat.

Example: The walls and roof of a hospital in a high-conflict zone are designed to mitigate the effects of rocket and mortar fire.

C8.PR 5 Physical security

There are three main components to physical security:

- a. **Delay**
Obstacles can be placed in the way of potential attackers, such as gates, fencing, razor wire, boundary walls, window bars etc., to prevent entry to the building or compound.
- b. **Detection**
Surveillance and warning systems can be put in place, such as lighting, heat sensors, smoke detectors, intrusion detectors, alarms, and cameras.
- c. **Apprehension and Protection**
Methods can be implemented to apprehend attackers and defend a building or compound from attackers (guard towers, defensive firing positions, safe rooms, bunkers, tee walls, HESCO barriers and other explosion protection devices, etc.)

It should be noted that all three of the above are required for a functional security system to operate. The DP **MUST** design all Delay, Detection and Apprehension and other physical aspects of security systems to meet the security requirement. This is subject to the agreed scope of work for the DP. Specialist consultants may be required for major projects, in which case the DP **MUST** liaise with the consultant to ensure all relevant content is provided in the design documentation.

C8.PR 6 Design considerations

The extent of security measures that should be considered in the design will depend on the level of threat, but should include:

- a. **Blast film (SRF: shatter resistant film)**
If the authentic material is specified, and applied to window glass correctly, this is an extremely effective measure against injury from flying glass as a result of explosion, and will also provide some protection against crime (break-ins, burglaries etc.).
- b. **Window frames**
Window frames should be sturdy and installed soundly to at least partially resist blast from explosions.
Example: Window frames with SRF protected window glass can be blown into a room in one piece if frames are not fixed correctly in the window opening.
- c. **Window bars / grilles**
Window bars / grilles should be securely fitted and fit for purpose.
Example: Window bars as burglar proofing - to keep intruders out.
Example: Window bars in prisons to keep prisoners in.

- d. **Ballistic resistant windows**
Ballistic resistant windows may also be required. Glazing materials and window fabrication details should be designed in line with the level of threat.
- e. **Ballistic resistant doors**
Ballistic resistant doors may be required. Construction materials and fabrication details should be defined, as a door required to resist attack from handguns will not be the same as a door required to resist attack from assault rifles.
- f. **Other doors**
Solid doors required to resist possible physical assault, should be designed with appropriate frames, hinges, dead bolts, door locks, peepholes, etc.
- g. **Walls**
Walls into which items b, c, d, e and f above are fixed, should be of suitable construction so that the wall does not become the weak point.
Example: Solid doors with suitably sturdy frames, hinges, locks and door furniture are installed in hollow block walls that can be demolished easily by attackers, so that the door assembly complete with frame can be pushed over.
- h. **Access control**
Access control should be designed to suit operation of the infrastructure (see C8.PR 7 and C8.PR 8 below.)
- i. **Alternate exits**
Alternate/emergency exits for personnel and/or vehicles may be required dependant on infrastructure layout and threat level.
- j. **Stand-off distance**
Stand-off distance is one of the most effective measures in protection against explosions and grenade attacks, and should be maximised where space / site layout allows. Specialist consideration may be required for roll-over blast effects and clearance spaces to buildings.

Stand-off distance can also play a part in delay and detection of attackers, where there is an open area between perimeter walls and the building.
- k. **Bunkers and safe rooms**
Bunkers or safe rooms may be necessary in some locations. Numbers of personnel to be protected should be carefully considered, and these facilities **MUST** be designed in accordance with recognized security standards and practices.

l. **Surveillance towers**

Surveillance towers may be required in some locations. These should be positioned to enable full visual coverage of the relevant area, and should provide protection to the guards occupying these structures according to the appropriate level of threat.

m. **Blast walls**

Reinforced concrete blast walls, HESCO walls and/or security fencing may be required in some locations. In some circumstances all of the above may be required. In such arrangements, layers of security walls provide protection from explosions, provides stand-off distance, and delays attackers attempting to breach the defences. All **MUST** be designed in accordance with recognized security standards and practices.

n. **Gates**

Gates, lifting vehicle barriers, and booms are to be designed to prevent unauthorised access, and **MUST** be strong enough to resist the assessed threat.

Example: Approaches to gates can be protected by staggered concrete barriers to prevent ramming by speeding vehicles.

o. **Security lighting**

Security lighting **MUST** be commensurate with security requirements. The DP **MUST** consider the power available, heights of light poles, area coverage, lights shining inside or outside, etc.

p. **Emergency communication systems**

Emergency communications systems such as satellite phones, radio communications, cellular phones etc. **MUST** be considered, and appropriate systems installed.

q. **Fire safety**

Fire extinguishers and fire alarms are discussed in SECTION C4 Fire Safety, and security factors may be a further consideration in this matter.

C8.PR 7 Access control

Access Control **MUST** be designed to prevent unauthorized access to the building or compound, and to intercept contraband (weapons, explosives, etc.), with the minimum impact to traffic flow through the access.

Access control facilities should be isolated from heavy concentrations of people where possible, to minimise the effect of any explosions or physical threat inside or adjacent to the access control area.

C8.PR 8 Exit control

Exit control **MUST** also be considered. Exit searches should focus on theft or unauthorised removal of vehicles, equipment, classified material, etc.

Exit gates should be as strong and secure as entry gates, as attackers could force entry through these facilities. Possible ramming of exit gates should also be considered and protection should be provided where necessary.

C8.PR 9 IT security

Security on IT networks should be investigated and appropriate systems installed. The DP may be required to install power, UPS and other support systems to assist this process.

Example: If e-mail and IT security is compromised, potential attackers could gain information on security systems for the building or compound. The loss of information, malicious damage or alteration may all affect security systems or general IT content.

C8.PR 10 Demining

For demining considerations, refer to SECTION C1.PR 8.

Security (C8)		Completed Yes or n/a
C8.PR 1 Security levels	The DP MUST design security elements and systems that are appropriate to the level or type of threat that can be reasonably anticipated.	
C8.PR 2 Codes	National codes and standards MUST be used for the design of security elements where such codes and standards exist. In the absence of these, applicable international codes should be used. Refer to SECTION B2 for further guidance.	
C8.PR 3 UN buildings and compounds	United Nations Department of Safety and Security MOSS (Minimum Operating Security Standards) and MORSS (Minimum Operating Residential Security Standards) MUST be used for the design of all infrastructure for all UN buildings and compounds.	
C8.PR 4 Atypical security considerations	Some atypical security considerations may apply for other types of buildings in exceptional circumstances, and these MUST be designed to an appropriate standard to mitigate the particular threat.	
C8.PR 5 Physical security	All three main components to physical security (delay, detection, and apprehension) are required for a functional security system. The DP MUST design all Delay, Detection and Apprehension and other physical aspects of security systems to meet the security requirement. For more information on the three components, consult the relevant section.	
C8.PR 6 Design considerations	Issues that MUST be considered in the design will depend on the level of threat, which the DP must research with care. For further guidance and specific requirements that MUST be met under certain security circumstances, consult the relevant section.	
C8.PR 7 Access control	Access Control MUST be designed to prevent unauthorized access to the building or compound, and to intercept contraband (weapons, explosives, etc.), with the minimum impact to traffic flow through the access.	
C8.PR 8 Exit control	Exit control MUST also be considered. Exit searches should focus on theft or unauthorised removal of vehicles, equipment, classified material, etc.	

C9 GREEN TECHNOLOGY

C9 GREEN TECHNOLOGY

The sustainable use and management of natural resources is essential to ensure their availability for future generations. Consequently, UNOPS infrastructure projects aim to support the sustainable use of resources in all of its activities. In the design solution, the DP should seek to identify measures to improve resource efficiency by reducing energy and water use, using sustainable, renewable and low-impact resources instead of non-renewable resources, and identifying methods of reusing or recycling resources used in project activities.

Throughout this manual, green technology measures have been embedded and marked with the icon:



POLICY REFERENCES

- | | |
|-----------------|--|
| Item 97 | Environment: UNOPS endeavours to design and implement infrastructure projects in a manner that respects the principle of environmental responsibility and sustainability, including preventing or mitigating adverse impacts on the environment and identifying strategies for improved environmental performance. |
| Item 109 | Sustainable resource use: The depletion and degradation of the world's natural resources is a growing concern. The sustainable use and management of natural resources is essential to ensure availability for future generations. Sustainable resource use should be incorporated into UNOPS infrastructure projects, at a minimum, within the following areas: energy efficiency; water conservation and availability; efficient use of materials; reducing resource requirements; and conserving ecosystems functions. |
| Item 110 | Sustainable resource use: UNOPS endeavours to support sustainable resource use in the context of all infrastructure activities. In this regard, UNOPS seeks to identify measures to improve resource efficiency by reducing energy and water use, using sustainable, renewable and low-impact resources instead of non-renewable resources wherever possible and with respect for the local context, and identifying methods of reusing or recycling resources used in project activities. |
| Item 111 | Sustainable resource use: When project activities reveal the potential for significant impacts on the natural resources utilized by local communities, UNOPS endeavours to take reasonable steps to avoid or mitigate these effects, in collaboration with partners and third parties. |
| Item 112 | Climate change: The United Nations Framework Convention on Climate Change expresses concern that human activities are significantly increasing the atmospheric levels of greenhouse gasses (GHG), resulting in adverse effects on the ecosystem and humankind. While the full impact of climate change is still unclear, it is becoming increasingly evident that the world's poor and marginalized communities are disproportionately affected by increases in natural hazards, changing disease patterns, severe droughts and deteriorating tropical forests. |
| Item 113 | Climate change: Considering that buildings are responsible for more than one third of the total energy use and GHG emissions in society, infrastructure activities have the potential to create a significant impact on the reduction of these emissions. Furthermore, designing infrastructure that is resilient to the effects of |

climate change will support efforts to protect the world's most vulnerable nations and communities.

Item 114 **Climate change:** UNOPS recognizes the nexus between climate change adaptation and mitigation efforts and infrastructure and communities and, on behalf of its partners, UNOPS helps implement climate change adaptation and mitigation activities. In this regard, UNOPS strives to design infrastructure projects to withstand climate change impacts, including more frequent and severe floods, droughts, storms and sea-level rise. The use of green design concepts, renewable energy and natural cooling and heating designs will also be incorporated into infrastructure design to reduce harmful emissions. Special attention should be paid to synergies between adaptation and mitigation measures, ensuring that infrastructure is both low carbon and climate resilient.

TECHNICAL OBJECTIVES

C9.TO 1 To design under the premise of minimizing the negative environmental impact of the infrastructure and increase the ecological, social, and economical positive impacts.¹³

FUNCTIONAL STATEMENTS

C9.FS 1 The DP must analyse and evaluate the cost-benefit of the potential environmental outcomes for the project.

C9.FS 2 The DP should strive to reduce energy consumption, promote the use of renewable energy sources and use bioclimatic design principles in their designs.

¹³ A forthcoming training course on green building design will provide project managers and design practitioners with best practice guidance on minimizing negative impacts and maximizing positive impacts related to green design and technology.

PERFORMANCE REQUIREMENTS

C9.PR 1 Design Elements



Green technologies **MUST** be considered by the DP in different design elements, such as:

1. Site location planning
2. Selection of environmentally preferable materials
3. Minimize greenhouse gas emissions
4. Minimize use of energy and supply with renewable sources
5. Water use
6. Sewage and graywater use
7. Solid waste handling
8. Indoor air quality, including thermal comfort, lighting quality and type of fitting
9. Building commissioning, its operation and maintenance
10. Mitigation of greenhouse gases

As a result, several of the performance requirements have already been included in previous sections.

These elements are to be applied taking into account the local climate, construction methodologies, material availability and societal values in the area where the building is to be constructed and used.

C9.PR 2 Building orientation and shape



DPs **MUST** consider building orientation and shape to reduce energy consumption and promote natural light and ventilation whenever possible.

Green technology (C9)		Completed Yes or n/a
C9.PR 1 Design elements	Green technologies MUST be considered by the DP in different design elements, such as: site location planning; selection of environmentally preferable materials; minimize greenhouse gas emissions; minimize use of energy and supply with renewable sources; water use; sewage and graywater use; solid waste handling; indoor air quality, including thermal comfort, lighting quality and type of fitting; building commissioning, its operation and maintenance; and mitigation of greenhouse gasses.	
C9.PR 2 Building orientation and shape	DPs MUST consider building orientation and shape to reduce energy consumption and promote natural light and ventilation whenever possible.	

**C10 CLIMATE CHANGE
ADAPTATION AND
DISASTER RISK
REDUCTION**

C10 CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

UNOPS recognizes that disasters have a severe impact on affected communities and that environmental degradation increases the frequency and severity of natural hazards. Disaster risk reduction is therefore a key component of efforts to achieve sustainable development and poverty reduction. In the design solution, the DP must consider the implementation of disaster risk reduction in all infrastructure activities.

POLICY REFERENCES

- Item 112** **Climate change:** The United Nations Framework Convention on Climate Change expresses concern that human activities are significantly increasing the atmospheric levels of greenhouse gases (GHG), resulting in adverse effects on the ecosystem and humankind. While the full impact of climate change is still unclear, it is becoming increasingly evident that the world's poor and marginalized communities are disproportionately affected by increases in natural hazards, changing disease patterns, severe droughts and deteriorating tropical forests.
- Item 113** **Climate change:** Considering that buildings are responsible for more than one third of the total energy use and GHG emissions in society, infrastructure activities have the potential to create a significant impact on the reduction of these emissions. Furthermore, designing infrastructure that is resilient to the effects of climate change will support efforts to protect the world's most vulnerable nations and communities.
- Item 114** **Climate change:** UNOPS recognizes the nexus between climate change adaptation and mitigation efforts and infrastructure and communities and, on behalf of its partners, UNOPS helps implement climate change adaptation and mitigation activities. In this regard, UNOPS strives to design infrastructure projects to withstand climate change impacts, including more frequent and severe floods, droughts, storms and sea-level rise. The use of green design concepts, renewable energy and natural cooling and heating designs will also be incorporated into infrastructure design to reduce harmful emissions. Special attention should be paid to synergies between adaptation and mitigation measures, ensuring that infrastructure is both low carbon and climate resilient.
- Item 122** **Environment and disaster risk reduction:** Disaster risk reduction is a key component of efforts to achieve sustainable development and poverty reduction. In 2005, the World Conference on Disaster Reduction adopted the Hyogo Framework for Action: 2005-2015, which focuses on increasing the resilience of nations and communities to disaster. The Hyogo Framework recognizes that disaster risks increase when hazards interact with environmental vulnerabilities. Subsequently, the General Assembly endorsed the Hyogo Framework, emphasizing the particularly harsh long-term social and economic consequences of disasters on developing countries, which impede the achievement of sustainable development.
- Item 124** **Environment and disaster risk reduction:** Disaster risk reduction is a cross-cutting issue within environmentally sustainable development practice. In particular, the frequency and severity of disasters are directly related to climate change, which causes variations in rainfall, temperature and weather patterns, and also to deforestation and desertification, which can lead to significant changes in rainfall and weather patterns. Many alterations in the environment associated with climate change, deforestation and desertification have a direct impact on the increased frequency and consequences of hazards such as droughts, floods, storms and heat waves.

Item 125 Environment and disaster risk reduction: UNOPS executes a range of crisis and disaster projects related to risk reduction and preparedness, emergency relief, and recovery and reconstruction. UNOPS is committed to exploring ways to decrease the risks associated with disasters for communities in need. UNOPS will make a particular effort to focus efforts on disaster risk reduction in all infrastructure activities.

TECHNICAL OBJECTIVES

C10.TO 1 To design resilient infrastructure systems that can better withstand and mitigate the effects of natural phenomena, a changing climate and man-made disasters.

FUNCTIONAL STATEMENTS

C10.FS 1 The potential impact of failure of the infrastructure in a natural hazard scenario should be mitigated to the highest practicable level within the context of the infrastructure purpose.

C10.FS 2 The localised implication for climate change should be researched and defined where possible, and an agreed level of mitigation measures prepared for the building and site.

PERFORMANCE REQUIREMENTS

Design of disaster and climate resilient infrastructure is achieved through risk assessment and the implementation of professional judgment in the different components of the design. These include site selection, building design criteria, materials and equipment selection. It is augmented by an understanding of additional mitigation measures to provide support to the community and end users in the event of a disaster.

C10.PR 1 Impact of natural hazards

The DP **MUST** consider principles and good practices in the design, thinking beyond codes and standards, to design infrastructure that reduces the impact that failure due to natural hazard could have for the use of infrastructure. The DP must identify all measures taken to consider these principles and practices in the design of infrastructure.

C10.PR 2 Climate change

The DP **MUST** design the facility with recognition of the increased impacts of climate change. The DP must identify all measures taken to consider these principles and practices in the design of infrastructure.

C10.PR 3 Safe health facilities

When designing health facilities, the Design Practitioner **MUST** incorporate specific measures for the services of the building to remain accessible and functional at maximum capacity and within the same infrastructure immediately following a disaster, in line with WHO's *Hospitals safe from disasters' programme*.¹⁴ As defined by the Pan American Health Organization (PAHO): "The term 'safe hospital' encompasses all health facilities, regardless of their level of complexity. A hospital is 'safe' when it enjoys the highest level of protection possible, when access routes to the health facility are open and when the water supply and electric power and telecommunications can continue supplying the health facility, thus guaranteeing continuity of operations and the ability to absorb the additional demand for medical care."¹⁵

C10.PR 4 Safe schools

When designing schools, the Design Practitioner **MUST** incorporate specific measures for the services of the building to remain accessible and functional at maximum capacity and within the same infrastructure immediately following a disaster, in line with the *Guidance Notes on Safer School Construction*¹⁶ developed by the Inter-Agency Network for Education in Emergencies and the Global Facility for Disaster Reduction and Recovery.

¹⁴ More information on "Hospitals safe from disaster" in <http://safehospitals.info/>

¹⁵ http://safehospitals.info/index.php?option=com_content&task=blogcategory&id=55&Itemid=192

¹⁶ https://www.gfdr.org/sites/gfdr.org/files/publication/Guidance_Notes_Safe_Schools.pdf

This document is also available in French, Spanish, and other languages at the INEE site: <http://www.ineesite.org/en/disaster-risk-reduction/safer-schools>

Climate change adaptation and disaster risk reduction (C10)		Completed Yes or n/a
C10.PR 1 Impact of natural hazards	The DP MUST consider principles and good practices in the design, thinking beyond codes and standards, to design infrastructure that reduces the impact that failure due to natural hazard could have for the use of infrastructure,	
C10.PR 2 Climate change	The DP MUST design the facility with recognition of the increased impacts of climate change.	
C10.PR 3 Safe health facilities	When designing health facilities, Design Practitioner MUST incorporate specific measures for the services of the building to remain accessible and functional at maximum capacity and within the same infrastructure immediately following a disaster, in line with WHO's "Hospitals safe from disasters' programme".	
C10.PR 4 Safe schools	When designing schools, the Design Practitioner MUST incorporate specific measures for the services of the building to remain accessible and functional at maximum capacity and within the same infrastructure immediately following a disaster, in line with the "Guidance Notes on Safer School Construction" developed by the Inter-Agency Network for Education in Emergencies and the Global Facility for Disaster Reduction and Recovery.	

SECTION D

Instructions for Project Managers

INTRODUCTION

The purpose of SECTION D is to describe the different risk categories for infrastructure and the corresponding requirements for design review. These activities are to be managed by the Project Manager.

*STATEMENT: It is important to note that **every reference to risk refers to the risk of each particular piece of infrastructure, not that of the project as a whole.** In other words, a risk assessment and a design review must be carried out for each individual building to be constructed as part of a large prison, for example.*

Section D: Instructions for Project Managers

- D1** Risk assessment methodology
- D2** Design review requirements
- D3** Infrastructure design special cases
- D4** Submitting design documentation
- D5** Design review flowcharts

SECTION D1 lays out the risk assessment methodology to identify risks for construction projects.

SECTION D2 specifies the design review requirements for low, medium, and high risk infrastructure projects.

SECTION D3 discusses special circumstances, such as renovation and repetitive works and projects of special significance, which may demand additional considerations in the design process.

SECTION D4 provides instructions on submitting design documentation to the internal management system, and so initiating the process of design review.

SECTION D5 provides flow charts for the design process in circumstances when the design is provided by a donor/client; a design practitioner is appointed to prepare a design; or when a design is provided by the supplier/contractor as in design/build contracts.

D1 RISK ASSESSMENT METHODOLOGY

To apply the appropriate measures of design review and risk management, UNOPS infrastructure will be assessed and categorized according to a number of risk factors.

This first assessment occurs at the lead stage of a project. Regional Infrastructure Leads or other SIPG staff will provide a preliminary risk assessment to allow the Project Manager to budget and plan for the design and review process. As more information become available, these preliminary assessments will be reviewed and re-evaluated by the Project Manager.

The risk assessment evaluates six elements of infrastructure risk, scoring each according to the points-based system detailed below. Once the evaluation exercise has been completed, each unit of infrastructure will fall into one of three risk categories according to the total of points allocated.

The categories are Low Risk, Medium Risk or High Risk:

Category	Risk level	Points
A	Low Risk	7 to 12 Points
B	Medium Risk	13 to 19 Points
C	High Risk	20 to 28 Points

Once the Project Manager has identified the building's risk level, the appropriate category will determine the extent of necessary Design Reviews and Design Checks. The Design Review requirements associated with low, medium and high risk design are contained in SECTION D2 below.

The risk category is the result of evaluating the following elements:

- Element 1a Life Safety - Structure
- Element 1b Life Safety - Occupancy
- Element 2 Social Impact
- Element 3 Environmental Impact
- Element 4 Complexity
- Element 5 Natural Phenomena
- Element 6 Estimated Total Construction Cost

Note: A building will automatically be rated as 'High risk' if a score of four (4) is allocated to any one of the above elements.

There is considerable scope for subjectivity in a system such as this and professional judgment must be applied. Any temptation to achieve a lower risk category should be resisted.

Element 1: Life safety

The most important aspect of any infrastructure project is life safety. Life safety is a factor in structural design, where a design error may result in infrastructure failure and a threat to the end users. In certain contexts, buildings are at high risk from blast impact or earthquakes. This context will affect the choice of materials, including glass, roofing and structural reinforcement. Challenging subsoil conditions will make foundation design critical. The purpose of the building, and its anticipated occupancy rate, is a factor in assessing the risk to end users, especially in the event of an emergency like fire or an earthquake. Please refer to SECTION C for performance requirements in the consideration of site, materials selection, structure and fire safety (SECTIONS C1, C2, C3 and C4).

Points allocation for Element 1A: Structure

Single story building , or a building of less than 200 m²	1 Point
Two story building , or total floor area between 201m² and 1,000 m²	2 Points
Three story building , or total floor area between 1,001m² and 5,000 m²	3 Points
Four stories and above , or total floor area more than 5,001 m²	4 Points

Points allocation for Element 1B: Occupancy*

A building occupancy of less than 50 people	1 Point
A building occupancy of between 51 to 150 people	2 Points
A building occupancy of between 151 and 500 people	3 Points
A building occupancy of 501 or more people	4 Points

Note: Occupancy in this context includes both people working in the building and visitors likely to be in the building.

Example: The design for a UN building with 80 people working in offices and meeting rooms capable of accommodating a further 80 people for conferences. Total occupancy is therefore potentially 160, so three points should be allocated for Element 1B, Occupancy.

Element 2: Social impact

The Project Manager, with the aid of the DP, must consider potential positive and negative social impacts of the proposed design solution. Refer to the relevant clauses of *UNOPS Policy for Sustainable Infrastructure* for UNOPS position on mitigating negative social impacts of its infrastructure projects.

Note: The International Association for Impact Assessment defines Social Impact Assessment (SIA) in the following manner:

"Social Impact Assessment includes the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions. Its primary purpose is to bring about a more sustainable and equitable biophysical and human environment."

In general terms, the objective of a social impact assessment is to determine how a project may affect the lives of people both local and distant and includes considerations for site selection, gender equality and accessibility and livelihood and displacement of communities.

Site selection

The choice of site may have a significant social impact; and the implementation of the project may have far reaching social implications. As far as possible, these should be identified and all negative social impacts should be mitigated.

Example: The proposed site may deprive the local community of their traditional/historical access and use of land. The PM and the DP should bring this concern to the host government, stakeholders and donors to seek a solution to this, possibly with the selection of a more suitable site.

Example: The site has cultural or historical significance. With the cooperation of all stakeholders, appropriate measures must be taken to mitigate the social impact in the use of the site.

Gender equality and accessibility

The design must consider gender equality in providing appropriate facilities for both sexes. The PM must observe national building design codes and should take into account requests of the end users regarding the segregation of facilities for men and women. The Final Design must consider accessibility issues for end users with disabilities, including persons who have hearing and sight impairments. This is of particular importance in government buildings, healthcare, education, sports and community facilities.

Livelihood and displacement of communities

Livelihood issues should be addressed in the project design. The DP should consider design solutions that benefit the community during construction and throughout the lifetime of the facility.

Some infrastructure projects will involve the resettlement of local communities. Projects that cause the displacement of population groups should include mitigation measures to address resettlement of people affected by the project.

Points allocation for Element 2: Social impact

Positive, little or no impact on local population , no threat to ethnic minorities or cultural aspects, historic or archaeological features	1 point
Some negative social impact , displacement, loss of livelihood and impact on future employment, disproportionate ethnic impact, gender equality impact	2 points
Moderate negative social impact , loss of livelihood, displacement and other negative factors, some loss of cultural heritage	3 points
Substantial to severe negative social impact , loss of livelihood for substantial population, loss of cultural heritage, displacement of substantial population	4 points

Element 3: Environmental impact

An environmental assessment is an important part of any project. The PM and the DP must consider both positive and negative aspects of the findings of the assessment.

Note: An environmental impact assessment is an assessment of the potential positive or negative impact that a proposed project may have on the environment, together consisting of the natural, social and economic aspects. The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts when deciding whether to proceed with a project.

The International Association for Impact Assessment (IAIA) defines an environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects—intended or not—of development proposals."

Positive impacts may arise from the opportunity to clean a site of hazardous waste, treating effluent previously allowed to cause pollution and creating eco-friendly systems to deal with waste, effluents and flue gases. Negative impacts could, for example, be the creation of new sources of undesirable effluent and discharge of gases if not dealt with in a professional and technically appropriate manner.

Examples: Septic tanks and soakaways need to be designed and located properly to ensure that no water source is contaminated with dangerous bacteria.

Where water pools and remains stagnant, a programme of elimination of mosquito populations should be implemented in situations where the spread of mosquito borne disease is an issue.

Points allocation for Element 3: Environmental impact

Positive impact or no impact	1 point
Minor impact , acceptable risk to ecosystems	2 points
Moderate impact with moderate risk to ecosystems	3 points
Substantial to severe negative environmental impact	4 points

Element 4: Complexity of design

Building complexity is a function of building use, size, and operational characteristics among other factors.

Low complexity buildings will require less input in pre-planning and design than more complex buildings. A highly complex project will involve comprehensive studies and planning. The PM should expect design fees to be higher for complex infrastructure as senior technical staff will be involved for longer periods of time. With highly complex projects, third party reviews are mandatory (refer to SECTION B11).

- Note:*
- Simple design** means basic and utilitarian without complicated design features, basic finishes and very simple structural, mechanical and electrical design.
 - Average design** means normal and conventional design requiring no special coordination or detailing with common structural, mechanical and electrical design.
 - Complex design** means above average complexity with a need for considerable coordination of structural, mechanical, electrical and plumbing design.
 - Very complex design** means added issues, such as security and complex systems creating an exceptional need for detailed and extensive coordination of structural, mechanical, electrical, and plumbing design.

In post-conflict and conflict contexts, external security risk is a factor contributing to increased design complexity. Security issues may impact the design process significantly and should be considered carefully. This includes security challenges during design (e.g. access to the site) and construction. Certain aspects of the permanent structure will need to be designed to protect occupants from security risks. Please refer to SECTION C for performance requirements relevant to Site (C1), Structure (C3) and Security (C8).

- Note:* *The security and protection of the end user is an important factor, particularly in buildings such as police stations, courthouses, drug rehabilitation centres, customs halls, prisons, hospitals, schools and domestic violence centres.*

Professional judgment should be exercised to determine the level of complexity of the planned facility. What may seem like a simple project may in fact be challenging, due to complex technical systems incorporated into the building or other factors.

Points allocation for Element 4: Complexity of design

Simple design (Storage building, small office)	1 point
Average design (Office, single story small school, low security detention centre, small customs facility, vaccination clinic. military barracks)	2 points
Complex design (Larger school, primary health clinic, detention centre, government offices, military training facility)	3 points
Very Complex design (Central hospital, high security prison, university buildings, airport, multi-transport customs facility)	4 points

Element 5: Natural phenomena

In many countries, national statistics and data gathering is well established. In some contexts, however, including post conflict and post disaster scenarios, there may be no independent verifiable data to assess the risk of future natural phenomena.

The Project Manager, in consultation with the Design Practitioner (DP) and local authorities and end users, should ensure that the best possible information is gathered before commencing the design process.

As a general rule, seismic activity presents one of most significant challenges. At the outset, the DP needs to establish what level of structural damage—if any—is acceptable. The DP should consider the ability of occupants to evacuate the building prior to eventual collapse of the structure, and refer to the minimum requirements outlined in SECTION C for Site (C1), Materials selection (C2) Structure (C3) and Fire safety (C4).

Other natural phenomena to be considered include flooding, land shifts, storms and hurricanes, and snow and frost, among others. It may be necessary to commission studies in the absence of historical records and reliable data for the proposed project site.

Natural phenomena and design parameters affected

- Earthquake Structural
- Flood Site location and planning
- Storm and hurricane Structural and orientation
- Tsunami Site location
- Landslide Geotechnical and structural
- Earth movement Geotechnical and structural
- Tornado Structural and architectural
- Hail Architectural and structural
- Rainwater ponding Roof drainage, site planning and public health
- Snow and frost Architectural, insulation, protection of services, loading
- Volcanic activity Location and structural
- Wild fires Planning, firefighting capacity, fire breaks, materials
- Wildlife Consider entry of undesirable animal life

Point allocation for Element 5: Risk resilience to natural phenomena

Minimal natural phenomena and/or comprehensive relevant design codes in place; low-level seismic risk zone	1 point
Moderate natural phenomena and/or some relevant design codes in place; moderate-level seismic risk zone	2 points
Some natural hazards acting together and/or very limited relevant codes in place; moderate to severe level seismic risk zone	3 points
Severe natural hazards acting together and/or no design codes in place; severe level seismic risk zone	4 points

Element 6: Estimated total construction cost

The preliminary budget is to be taken into account for the purposes of the risk assessment. Estimated total construction cost is to include fixed equipment cost, external site works and services related to the building infrastructure.

Example: A boiler house may cost \$150,000 to construct, but the equipment could cost \$400,000. The total cost of \$550,000 therefore elevates the project to a higher risk category.

If the project is intended to be bid in smaller work packages, the sum of the values of the work packages should be used to determine the correct risk category for the project.

Point allocation for Element 6: Estimated total construction cost

Up to US\$ 500,000	1 point
From US\$ 500,001 to US\$ 1,500,000	2 points
From US\$ 1,500,001 to \$ 3,000,000	3 points
More than US\$ 3,000,000	4 points

It is recognized that preliminary budgets have an accuracy margin of +/- 15%. Consequently the upper estimate should be considered for the purposes of this risk assessment. Furthermore, multiple phases of projects should be taken into account, particularly when there are several structures planned for a single site.

Case studies

Case study 1: Low Risk Category

TOTAL: 7 points

A single storey building of 100m² is commissioned as a guard hut/gate reception facility. A maximum of three guards are on duty at any time. The site is adjacent to an existing government facility and the proposed facility has no negative social impact associated with it. There is no environmental risk associated with the facility. It is a very simple structure with basic services, in a low-risk seismic category zone. The budget for construction is US\$ 150,000.

Element 1a	Element 1b	Element 2	Element 3	Element 4	Element 5	Element 6	TOTAL
1	1	1	1	1	1	1	7

Case study 2: Medium Risk Category

TOTAL: 13 points

The building is a low-security detention centre with an area of 250m² attached to a police station. It is a single storey building for maximum occupancy of 60 people. Some displacement of local community will occur as there is an informal settlement on the boundary of existing police station. The project includes a perimeter wall to separate detention centre from local community. There is no ecological risk and there is some flooding in the rainy season. The cost is an estimated US\$ 550,000.

Element 1a	Element 1b	Element 2	Element 3	Element 4	Element 5	Element 6	TOTAL
2	2	2	1	2	2	2	13

Case study 3: High Risk Category

TOTAL: 20 points

A three-storey school with an estimated 450 students and staff has been commissioned. It will include some displacement of the local population with a moderate impact to ecosystems as the site is located adjacent to a park, home to indigenous and threatened species of birds. It is a complex design as the building is on a high density urban plot. There is also a simultaneous risk of floods and hurricanes. The preliminary estimated budget is in the order to US\$ 2,000,000.

Although none of the risk elements merit an allocation of four points, the cumulative total of points puts this project in a high-risk category for design.

Element 1a	Element 1b	Element 2	Element 3	Element 4	Element 5	Element 6	TOTAL
3	3	2	3	3	3	3	20

Case study 4: Changing risk categories

A medium-sized health clinic in a semi-urban area needs expanding due to rapid urbanization both upstream and downstream. The design works are relatively simple, and include a boundary wall to mitigate annual flooding. The site is on a flood plain and the floods last month were the worst in 70 years. The preliminary budget estimate is US\$ 2,000,000, set by the donor. Two communities will be displaced by the planned expansion of the facility. Untreated medical waste and medications are currently dumped on an open dump site 1km away. There is intermittent electricity supply to the facility. The last earthquake was 30 years ago and caused substantial damage but no loss of life. The planned improvements to the facility will improve the quality of healthcare and public health in the neighbourhood. The communities affected are being relocated to a more suitable housing location 5 km away where it does not ordinarily flood. New housing is being provided to the displaced communities who currently live in informal settlements with no services.

A month into discussions, the donor allocates an additional US\$ 500,000 to the project to procure equipment for the facility, including a large incinerator and a four bed ward to treat drug resistant tuberculosis. Stronger than predicted rainfall in the north of the country threatens the flood plain where the project site is located.

This project originally rated in the category for medium design risk. It was upgraded to a high risk category as more information was received regarding worsening floods upstream and changes in the design brief to allow for an incinerator and the tuberculosis ward. Although the budget only rated as a medium risk, and there were positive social and environmental outcomes from this project, other factors contributed to upgrading the infrastructure design risk associated with the project.

Case Study 4: Health clinic facility in semi-urban area	
Risk Categories	Points allocated
Element 1a	2
Element 1b	2
Element 2	2
Element 3	3
Element 4	3
Element 5	3
Element 6	3
TOTAL	18 (MEDIUM CATEGORY RISK)
Changes in Scope to Project elevates the design risk of project as follows:	
Element 4	4 <i>Increase in design complexity due to incinerator and TB ward</i>
Revised Risk Score	19 (HIGH RISK CATEGORY)

Note: While the 19 point aggregate would place the health clinic in the medium risk category, the change in design complexity elevates the score of 'Element 4' to a four, automatically elevating the infrastructure to a high risk category.

D2 DESIGN REVIEW REQUIREMENTS

A different Design Review process will be applied according to the risk category. Separate requirements may apply for renovation or repetitive works and infrastructure of special significance, as detailed in SECTION D3.

These design review requirements refer only to the design reviews and checks necessary in the initial stages of the project and do not address design variations that occur once implementation starts. During project implementation and construction, any requests from the contractor for structural or significant design changes, specification and alternative materials, must be referred to the appointed DP for consideration and approval. Please see SECTION B12 for the protocol on design variations and their implications.

Note: All designs provided to UNOPS must be submitted to SIPG for third party review.

Category A, Low Risk: 7 to 12 points

Projects that fall in this category require only a peer review. The PM may seek assistance from a colleague with the necessary technical experience, from a local design consultant or from UNOPS Regional Infrastructure Leads if necessary, to identify and clarify any issues associated with the design work.

The process to follow is:

1. **PM** appoints Design Practitioner (DP)
2. **DP** prepares design brief in consultation with PM and stakeholders
3. **DP** prepares final design and all necessary documentation
4. **PM** sends documentation to design.review@unops.org and receives a unique identifier for the review
5. **PM** identifies a certified peer reviewer to carry out the review, and provides the peer reviewer with design documentation and the unique identifier
6. **Peer reviewer** approves design documentation and provides the PM with a signed and completed Certificate of Design Review Compliance
7. **PM** sends the certificate to design.review@unops.org, and attaches it to the design documentation sent to procurement
8. **PM and DP** refer to SECTION B12 in event of modification of design in construction phase

Category B, Medium Risk: 13 to 19 points

Projects that fall into this category are subject to a third party review of the design brief and the final design documentation.

The process to follow is:

1. **PM** appoints Design Practitioner (DP)
2. **DP** prepares design brief in consultation with PM and stakeholders
3. **PM** submits design brief documentation to design.review@unops.org
4. **Third party reviewer** reviews design brief and provides comments to PM
5. **DP** prepares final design and all necessary documentation
6. **PM** sends documentation to design.review@unops.org and receives a unique identifier for the review, initiating a third party review
7. **Third party reviewer** reviews final design documentation and provides comments to PM
8. **DP** reconciles third party review comments, modifies documentation as required, and submits revised design to the PM
9. **PM** submits revised design to design.review@unops.org
10. **Third party reviewer** approves final design for compliance
11. **SIPG** issues Certificate of Design Review Compliance
12. **PM** attaches the certificate to the design documentation and sends it to procurement
13. **PM and DP** refer to SECTION B12 in event of modification of design in construction phase

Category C, High Risk: 20 to 28 points

Projects that fall into this category are subject to a third party review of the design brief, concept design and the final design documentation. Additionally, a third party Design Check will check and confirm the structural calculations of the works at the final design stage.

The process to follow is:

1. **PM** appoints Design Practitioner (DP)
2. **DP** prepares design brief in consultation with PM and stakeholders
3. **PM** submits design brief documentation to design.review@unops.org
4. **Third party reviewer** reviews design brief and provides comments to PM
5. **DP** prepares concept design in consultation with PM and stakeholders
6. **Third party reviewer** reviews concept design and submits comments to PM and DP
7. **DP** prepares final design and all necessary documentation
8. **PM** sends documentation to design.review@unops.org and receives a unique identifier for the review, initiating a third party review
9. **Third party reviewer** reviews final design documentation and provides comments to PM
10. **DP** reconciles third party review comments, modifies documentation as required, and submits revised design to the PM
11. **PM** submits revised design to design.review@unops.org
12. **Third party reviewer** approves final design for compliance and
13. **SIPG** issues Certificate of Design Review Compliance
14. **PM** attaches the certificate to the design documentation and sends it to procurement
15. **PM and DP** refer to SECTION B12 in event of modification of design in construction phase

D3 INFRASTRUCTURE DESIGN SPECIAL CASES

There are additional elements of importance to consider in projects with renovation or repetitive works, and projects of special significance.

Renovation works

There are several steps in the implementation of renovation works. The first step is a competent condition assessment survey of existing structures, as per SECTION C3.PR11. This will establish whether there will be a demolition/renovation/reconstruction programme. The survey should be undertaken by a professional building surveyor guided by the PM in consultation with stakeholders.

Renovation works will carry a certain level of risk that needs to be addressed. A building or structure may have inherent safety issues that may be overlooked if the planned budget is only for a 'patch and paint' job. If a building or structure needs renovation work, UNOPS has a duty of care to ensure that it is subject to a structural safety review (see SECTION C3) and is analysed for fire safety (see SECTION C4) and existing hazardous materials such as asbestos. This is particularly relevant if the building purpose has changed from the original design brief, or if the building is now used by a greater number of people than was initially envisaged.

This includes, for instance, confirming that the corridor space allocation is correct, that the relationship between different parts of the building is functional, if adequate access has been provided to persons with disabilities and if fire escape routes have been allowed for. Access to and from the project buildings will be checked, as well as provisions for parking when appropriate.

The PM should present the client with any issues identified during the review to discuss the course of action to mitigate life safety risk.

Once the review findings have been discussed with the client, the DP should prepare a budget and outline specification to rectify any identified life safety issues. Once the client is in agreement and has agreed to fund this additional work, it should be included in the scope of renovation works.

If the client does not agree or does not wish to allocate funds for the additional work required, the PM must obtain a letter of exemption from the client, specifically stating that the works to be undertaken do not meet the minimum standards as outlined in the *UNOPS Policy for Sustainable Infrastructure* and this manual. This is to ensure that the client is fully aware of the decision not to follow advice on fire regulations and life safety for the building under renovation and to release UNOPS for any potential liability from undertaking works that do not meet the performance requirements laid out in this manual. The PM is strongly recommended to lobby with the client to carry out remedial works to improve the infrastructure, even if these works are not eventually carried out by UNOPS.

Repetitive works

Repetitive design projects that include low value works (such as emergency shelters, resettlement housing, customs posts, health clinics and multiple small police stations) should be handled as medium risk infrastructure, according to SECTIONS D1 and D2.

Although the cost of each individual element of works may be quite low, there is potential for repeating a design error many times over. Furthermore, the intended use of similar facilities on multiple sites may well entail substantially different site related factors. These include orientation, foundation conditions, differing social and environmental risks, and differing access to facilities. These multiple factors may adversely affect the outcome of the project and need to be considered carefully on a case by case basis.

Example: 100 schools are planned for remote rural areas. Some schools will be located in desert highlands, others in flood plains. Some will have access to local municipal services, others will rely on independent sources of energy, telecommunications and water. Although the basic two-classroom design will remain the same for each facility planned, a variety of factors will affect the suitability of the design in different locations.

Additional factors include:

- *Beneficiaries (age and sex of users, accessibility factors for physically-challenged users)*
- *Climate (snowy, icy conditions, areas prone to seasonal flooding)*
- *Access to services (electricity, piped water, sewerage systems, waste management systems)*
- *Orientation of site (insulation to conserve heat; measures to maximize ventilation)*
- *Capacity of local contractors and availability of appropriate construction materials*

Projects of special significance

Occasionally, for a variety of reasons, there will be projects of special significance that will require different considerations and associated costs than those outlined in this manual and the relevant Administrative Instruction.

These will be identified during the lead assessment and handled on an individualised basis. Appropriate measures for risk assessment and design review will be identified in the project documentation.

D4 SUBMITTING DESIGN DOCUMENTATION

As described in this section and SECTION B11, all UNOPS infrastructure works must undergo a process of design review.

For legal and quality management purposes, design documentation will be submitted, stored and tracked through an internal management system.

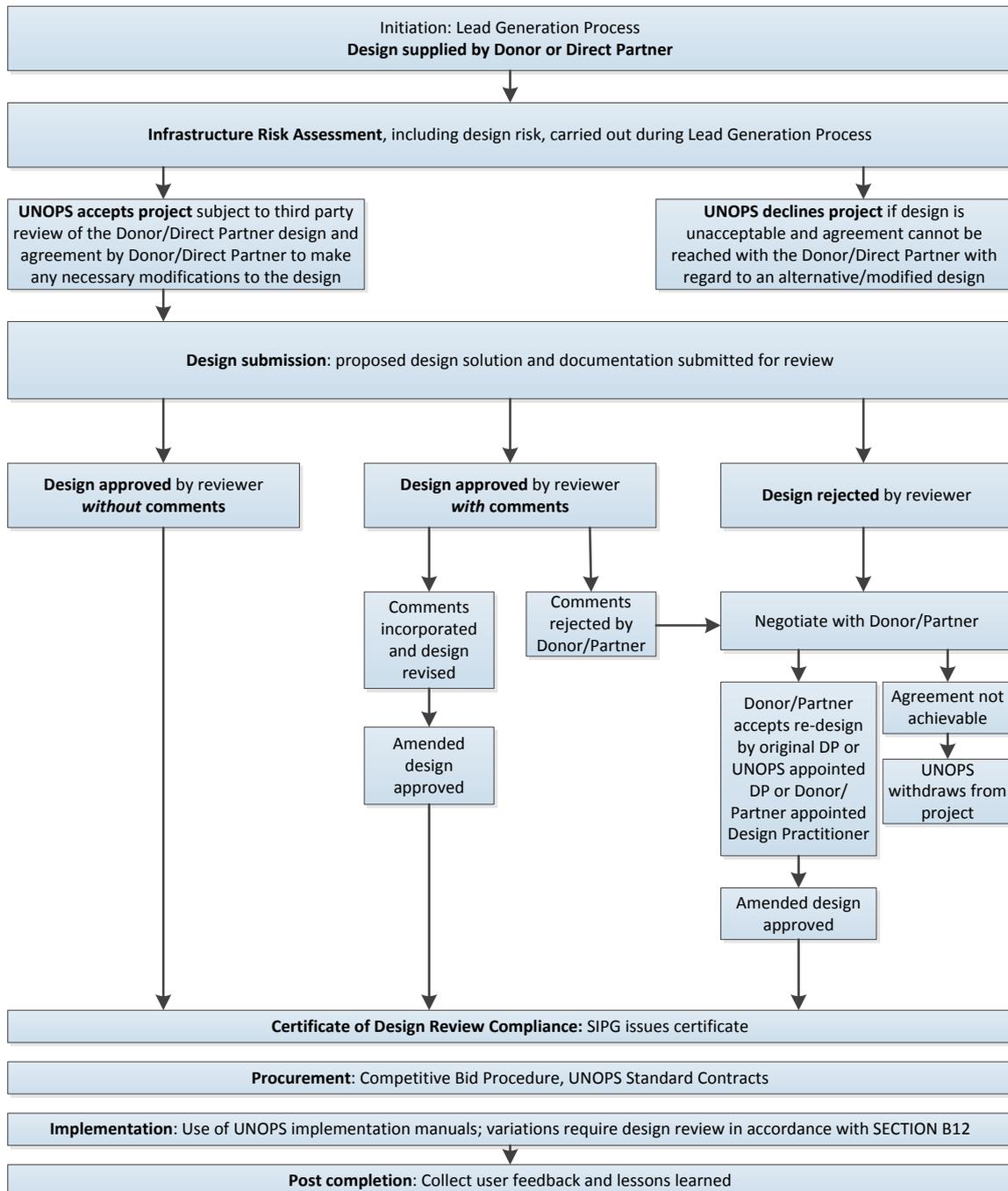
All design and review documentation should be submitted to design.review@unops.org.

In the subject line of the email, please be sure to provide the project's ATLAS ID and the risk level of the infrastructure. Please also provide a brief description of the infrastructure works.

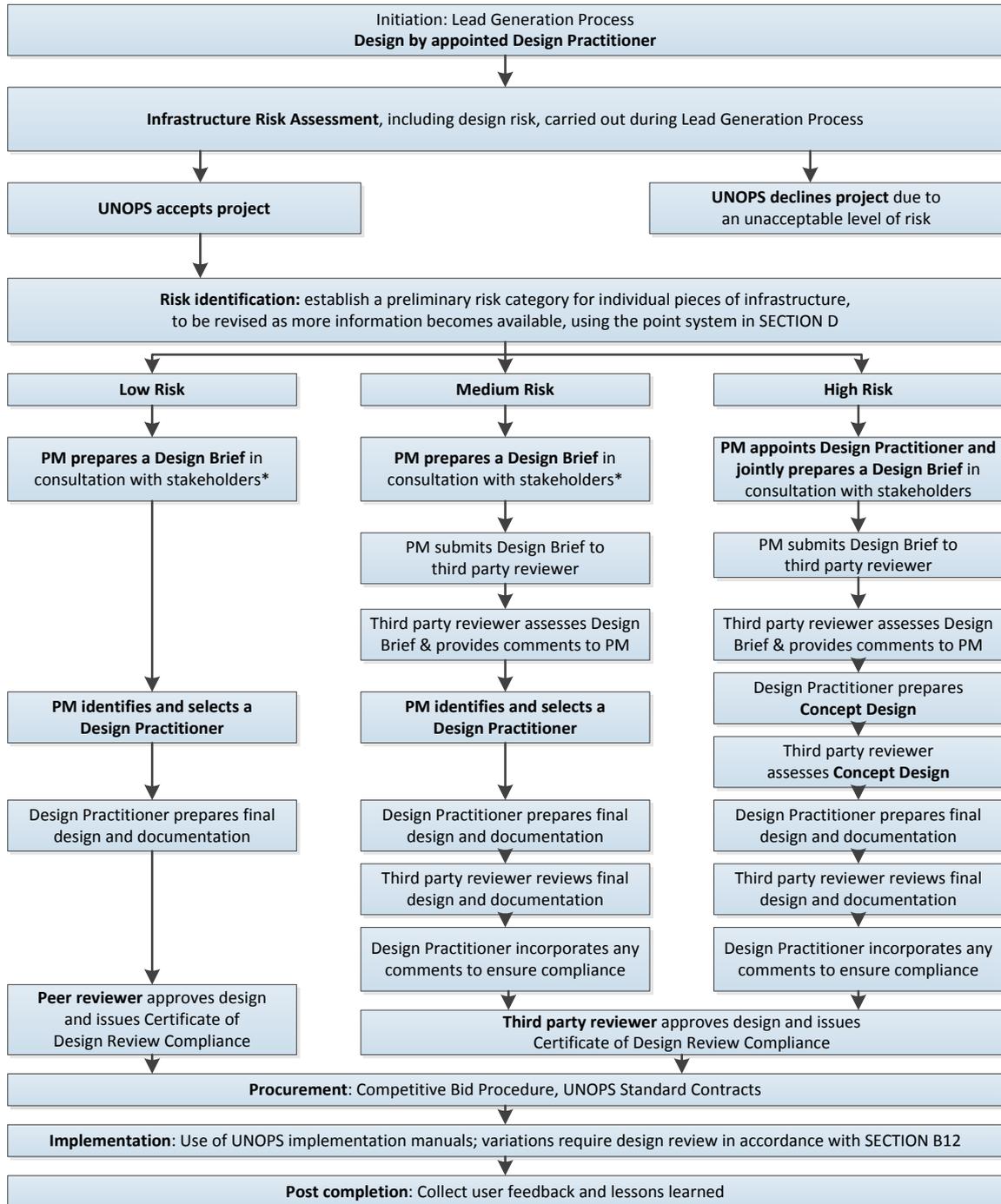
If the delivery of documents to the email address is not possible or impractical for any reason, an alternate delivery method may be used. These may include transfer via USB, a cloud storage service such as Dropbox, or another method of delivery that ensures the safe and reliable transfer of files.

D5 DESIGN REVIEW FLOW CHARTS

Design provided by Donor or Direct Partner

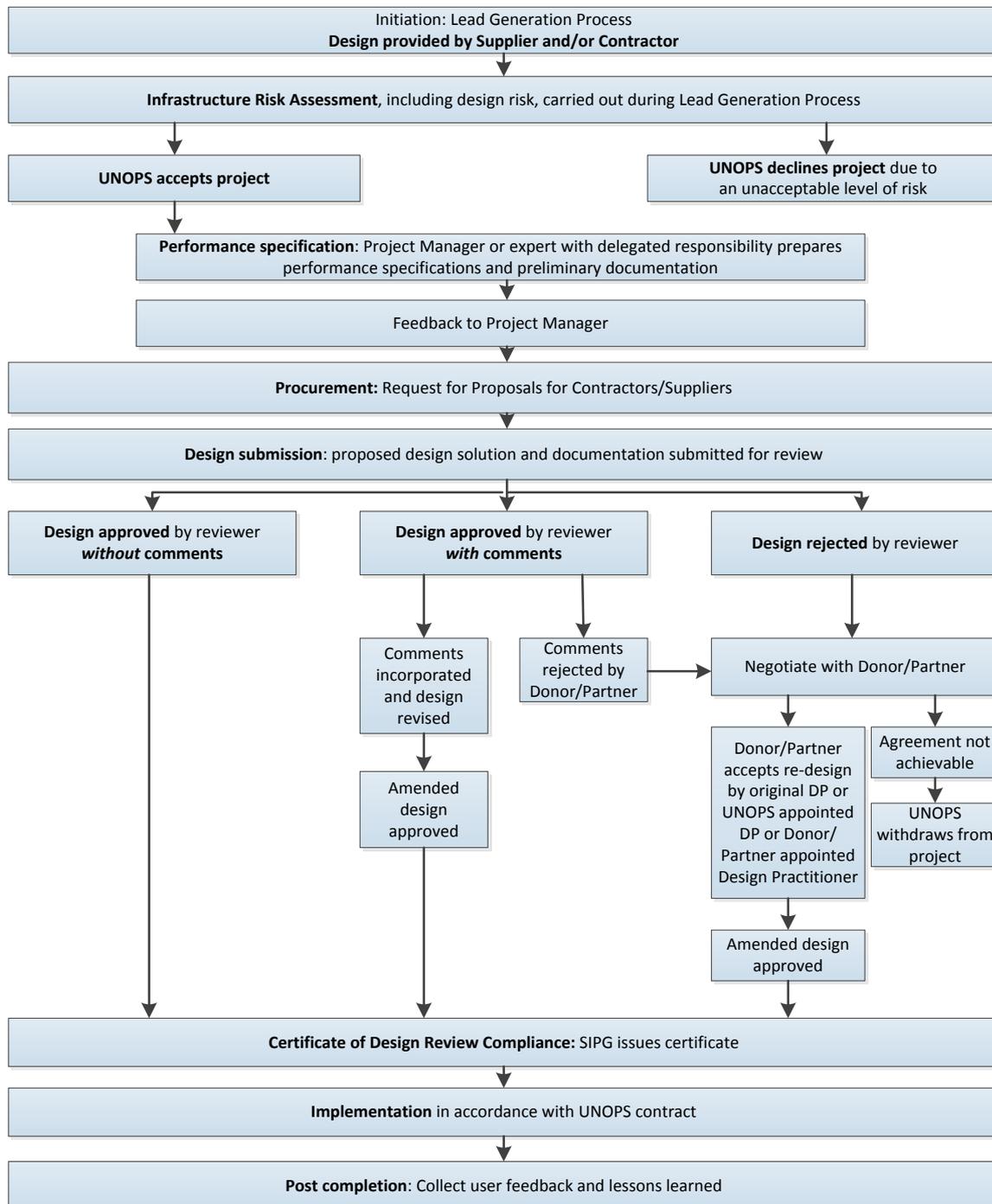


Design by appointed Design Practitioner (Internal or external)



Note: This flowchart describes the typical design process for designs by an appointed Design Practitioner (internal or external). However, for both the low and medium risk levels the Project Manager may select a Design Practitioner earlier, to help with the development of the Design Brief—the relevant stage is marked by an asterisk (*).

Design provided by Supplier and/or Contractor (Design/build)



SECTION E

Instructions for Peer Reviewers

GUIDANCE

While medium and high risk designs are carried out by a third party, low risk designs are peer reviewed by a qualified colleague, with the caveat that the Peer Reviewer must not have had any significant role in the development of the design.

Peer Reviewers are UNOPS personnel who have been trained and certified to review relatively simple, low risk designs. The necessary training is provided by SIPG as part of the rollout of this manual. After completing the training to understand the contents and implications contained in this manual, participants will be certified to review low risk designs for UNOPS projects.

As noted in the preliminary statement on design liability at the outset of this document, **all design liability rests with the original designer**. The Peer Reviewer is tasked with evaluating the design against the requirements of this manual—but the act of review neither indemnifies the original designer, nor assumes any liability on part of the Peer Reviewer.

Process

The peer review process is initiated by the Project Manager, who identifies and contacts a qualified colleague to carry out a review for a low risk design and provides the Peer Reviewer with a unique identifier for that review. Peer Reviewers **must not** accept any requests to review medium or high risk designs, which should instead be referred to a third party via SIPG.

Upon receiving final design documentation from the Project Manager, the Peer Reviewer should first assess whether the documentation submitted is sufficient to evaluate the review against the requirements of this manual.

After establishing that there is adequate basis to carry out the review, the Peer Reviewer shall proceed through the checklist provided in SECTION F3, evaluating the design against individual requirements and noting whether the requirement has been met. For any aspect of design that does not meet the minimum requirements or is insufficiently documented, the Peer Reviewer should notify the Project Manager, who is to liaise with the Design Practitioner. If a particular requirement is not deemed to be applicable, the Peer Reviewer should note so in the comment box.

The Certificate of Design Review Compliance is located on the following page and is also available on SIPG's intranet page. After confirming that the design complies with the minimum requirements of this manual, the Peer Reviewer fills out this form and returns it to the Project Manager. Construction works will not be able to proceed to tender until the Certificate of Design Review has been signed.

If you have any questions about the process of review and its associated requirements, please write to us at design.review@unops.org.

CERTIFICATE OF DESIGN REVIEW COMPLIANCE

To: UNOPS Procurement

Design Review
Unique Identifier

Designer details:

Name

Vendor #

Business Address

Phone Number

Email Address

Details of proposed work:

Project Number

Project Name

Project Manager Name & Contact Info

Type and Category of Work (e.g. school, new building; prison, alteration/addition/repair/other; health clinic...)

Design documents provided:

The following documents are used as a basis for this certificate:

Document description:

Drawing sets:	Prepared by:	Date:
Schedules:	Prepared by:	Date:
Specifications:	Prepared by:	Date:
Computations:	Prepared by:	Date:
Photographs:	Prepared by:	Date:
Bill of quantities:	Prepared by:	Date:
Other reports:	Prepared by:	Date:

Standards, codes or guidelines relied on in design process:

Any other relevant documentation:

Confirmation of Design Reviewer:

I confirm that the design meets the requirements laid out in the UNOPS Design Planning Manual for Buildings or/and other relevant codes.

Reviewer's Signature

Date

Name

Phone Number

Email Address

SECTION F

Instructions for Design Practitioners

INTRODUCTION

SECTION F provides a number of documents to assist the Design Practitioner in meeting the mandatory requirements for the safety, functionality, and sustainability of UNOPS projects. Some of these are provided for the Design Practitioner's reference; others are required to be submitted along with the proposed design solution.

Section F: Instructions for Design Practitioners

- F1** Quality checklist
- F2** Standards of design documentation
- F3** Design checklist (required)

SECTION F1 provides a quality checklist to help the Design Practitioner ensure that all the relevant considerations have been included in the design. This checklist is provided for the DP's reference and **need not be returned** to the Project Manager.

SECTION F2 provides instructions on the necessary standards of documentation to be submitted to the Project Manager for the design to be evaluated against the minimum requirements of this manual.

SECTION F3 is a checklist derived from the protocols, objectives and minimum requirements provided in the UNOPS *Design Planning Manual for Buildings*, which are aggregated at the end of each section. This checklist **must be filled out and provided to the Project Manager** at the final design stage, along with the other necessary documentation requested in SECTION F2.

Note: For additional quality control considerations, as well as for general engineering good practice, DPs can consult SECTION G2. The checklist in this section focuses on the riskiest and most significant aspects of design; measuring the proposed design against this checklist is not required but it is encouraged as a best practice that aids the Design Practitioner in confirming the soundness of crucial aspects of design.

F1 QUALITY CHECKLIST

- Have you reviewed and familiarized yourself with *UNOPS Policy for Sustainable Infrastructure*?
- Have you considered the implications of the chosen site for the works?
- Have you considered the functional use of the building?
- Does the design consider the entire lifespan of the works, such as maintenance implications?
- Have you applied the relevant national/international/UNOPS design standards?
- Have you considered accessibility issues for people with disabilities?
- Have you considered energy efficiency and green technology solutions to reduce greenhouse emissions in the construction of the works and over the lifespan of the building?
- Have you assessed the environmental impact of the design?
(See SECTIONS B9, C1.PR 6, and ANNEXURE G1)
- Does the design consider the implications of climate change, and take appropriate measures toward disaster risk reduction?
- Is the selection of materials economical, sustainable, and fit-for-purpose?
- Have all the performance requirements been followed and adhered to?
- Does the design consider gender implication and take appropriate measure to meet the functional, social and safety needs of both women and men?
- Has the Design Review been completed and does the design solution address and incorporate the proposed changes and recommendations?

F2 STANDARDS OF DESIGN DOCUMENTATION

Design Practitioners (DP) must provide sufficient documentation to allow the design to be evaluated against the requirements of the appropriate standard. If, in accordance with SECTION B2, the relevant standard exceeds the minimum requirements laid out in this manual, the DP must provide documentation that surpasses the standards of documentation laid out in this section.

Example: If the relevant standard is the International Building Code (IBC), the documentation must include technical specifications and calculations for every piece of piping, in order to evaluate the design against IBC standards.

Design brief

This stage of the design process helps identify project objectives, budget, and quality expectations.

Feasibility studies, site investigations, and environmental and risk assessments are all to be carried out in preparation of the initial design brief. At the same time, a communication strategy should be developed to continually correspond with and involve all stakeholders.

The time required to prepare the design brief will vary according to the size and complexity of the construction works. In all cases, however, a sound design brief is essential in providing a solid foundation for a successful completion of works.

Note on usage: a design brief may be sometimes referred to as a design program or a design initiation document. In some cases, similar terminology is used to refer to general instructions to the designer. For UNOPS projects, however, a proper design brief must contain all of the below elements.

The preparation of the design brief, in consultation with stakeholders, must consider and document the following:

- Spatial requirements of the project
(list of rooms and functions and the corresponding linkages between them)
- Scope of works
- Site information, based on site investigations and surveys, an environmental assessment, as well as all other necessary technical surveys (geotechnical, hydrographic, etc.)
- Budget
- Any specific design considerations, such as materials choices, compatibility with existing built environment, etc.

Concept design (for high risk projects)

In addition to the design brief and the final design solution, high risk infrastructure also requires an intermediate concept design that will undergo a third party review.

The concept design develops from and expands upon the design brief to include preliminary cost information, outline proposals for structural design and building services and outline specifications.

Any additional, necessary site assessments and surveys that emerge as a result of the design brief submission, are carried out at this concept design stage.

Design Practitioners should also consider construction and sustainability strategies, maintenance and operational implications for services, and health and safety considerations.

In preparation of the concept design, the Design Practitioner must consider and document:

- Concept drawings for architectural and structural design
- Concept drawings for building services systems
- Outline specifications
- Preliminary cost information
- Design Report including any other relevant matters that may affect the completion of the design process

Final design solution

The final design develops from and expands upon the design brief and the design concept. For the final design solution, the proposed design is fully developed.

At this stage, all spatial coordination exercises have been completed, and architectural and building services and structural engineering information have been provided and aligned to the budget. Additionally, the design work of any specialists has been completed and incorporated into the proposed design solution.

Any necessary government and other external consultants will have been consulted at this point, and the concerns of relevant stakeholders incorporated into the final solution.

At this stage, except for design variations stemming from changes occurring during the construction stage, all aspects of design have been completed and incorporated, including services maintenance, operational implications, and health, safety and sustainability considerations.

In preparation of the final design, the Design Practitioner must consider and document all building plans, and mechanical, plumbing and electrical aspects of the design, and document these in accordance with the checklists on the following pages.

BUILDING PLAN REVIEW DOCUMENTATION¹⁷

1. Complete architectural plans, structural plans and material specifications of all work
2. A site plan including the following information:
 - Size and location of all new construction and all existing structures on site, including all demolition works
 - Distances from lot lines and any existing buildings or structures
 - Established street levels and proposed finished levels
3. Architectural plans and specifications are to include:
 - Description of uses and the proposed occupancy group(s) for all portions of the building
 - Proposed type of construction of the building
 - Fully dimensioned drawings to determine building areas and height
 - Adequate details and dimensions to evaluated means of egress, including occupant loads for each floor, exit arrangement and sizes, corridors, doors, stairs, etc.
 - Exit signs/means of egress lighting, including power supply
 - Accessibility provisions
 - Adequate details to evaluate fire-resistive construction requirements, including data substantiating required ratings
 - Details of required fire protection systems
4. Structural plans, specifications, and engineering details are to include:
 - Soils report indicating the soil type and recommended allowable bearing pressure and foundation type
 - Signed structural design calculations which support the member sizes of the drawings
 - Local design load criteria, including: frost depth; live loads; snow loads; wind loads; earthquake design; other special loads
 - Details of foundations and superstructure
 - Applicable construction standards and material specifications
5. The Design Planning Manual Checklist, contained in SECTION F3

¹⁷ This checklist, as well as the following checklists on mechanical, plumbing, and electrical aspects of building design are adapted from the International Code Council's document, "Construction Documents Necessary for a Thorough Plan Review."

ELECTRICAL PLAN REVIEW DOCUMENTATION

- Plans and specifications of all electrical work
- Lighting floor plan including fixture locations, electrical circuits, circuit numbers, and panel locations
- Power floor plans including electrical circuits, wiring sizes, panel locations, working clearances and electrical room egress, disconnect switches, receptacle locations and required arc fault protected circuits
- Exit sign/means of egress lighting location and power supply
- Single line diagram and panelboard schedule including circuit breaker rating and available fault current and the calculated service load with a load distribution schedule
- Automatic changeover system design and essential service loads for diesel or other generator systems
- Details showing the grounding electrodes, bonding of the grounding electrode system and the size of all bonding and grounding electrode conductors
- Lighting protection system (if any)
- IT systems (if any), including fixture and patch panel locations, uninterruptable power supply, server and layouts
- Any systems specific to particular types of buildings (e.g. hospitals, laboratories)

MECHANICAL PLAN REVIEW DOCUMENTATION

- Plans and specifications of all heating, ventilation, and air conditioning work
- Complete information on all the mechanical equipment and materials including listing, labelling, installation and compliance with referenced material standards
- Details on the HVAC equipment including the equipment capacity, controls, equipment location, access and clearances
- Condensate disposal, routing of piping and auxiliary and secondary drainage systems
- Required exhaust systems, routing of ducts and termination to the exterior
- Details of all duct penetrations through fire-resistance rated assemblies including locations for all fire dampers and smoke dampers
- Boiler and water heater equipment and piping details including safety controls, gauges, valves and distribution piping layout
- Complete details on the gas piping system including materials, installation, valve locations, sizing criteria and calculations
- Diesel generator installations with associated filters, air intakes, fuel tanks and acoustic provisions
- Any systems specific to particular types of buildings (e.g. hospitals, laboratories)

PLUMBING PLAN REVIEW DOCUMENTATION

- Plans and specifications of all plumbing work
- The basis for the number of plumbing fixtures provided
- Site plan that indicates the routing of the sanitary, storm and water service with the burial depths for all sewers and water service
- Water supply and distribution piping plan showing the incoming water supply, distribution piping and pipe size
- Drainage system piping plan showing the layout of all piping, of plumbing fixtures and the location of cleanouts
- Riser diagram(s) of the drain, waste and vent piping including the building drain, all horizontal branches and the connections and layout of all fixtures
- The location of all indirect waste connections, standpipes, grease traps and separators
- Complete water heater details, temperature and pressure relief valve discharge and discharge piping
- Complete details of the method of draining storm water from the roof including calculations to verify pipe and/or gutter sizes, the location of all roof drains and the roof area that each group of roof drains is intended to serve
- Any systems specific to particular types of buildings (e.g. hospitals, laboratories)

F3 DESIGN CHECKLIST (REQUIRED)

DESIGN CHECKLIST FOR BUILDINGS		
<p>The following checklist is provided to help review the safety, functionality, and sustainability of UNOPS infrastructure projects. It is derived from the protocols, objectives and requirements provided in the UNOPS <i>Design Planning Manual for Buildings</i>, which lays out the minimum performance standards for UNOPS infrastructure.</p> <p>Design Practitioners are required to submit the following checklist with the final design documentation in order to demonstrate that the proposed design has addressed UNOPS performance requirements as laid out in this manual.</p>		
SECTION B: GUIDANCE AND PROTOCOLS FOR THE DESIGN PROCESS		
Code/ Protocol	Clause	Completed: Yes or n/a
B1 Sustainable infrastructure	The Design Practitioner (DP) must ensure that the identified design solution has met the functional statements of SECTION C and is compliant with <i>UNOPS Policy for Sustainable Infrastructure</i> . If the DP identifies the possibility of negative social or environmental impacts, it is the DP's responsibility to raise this risk to the Project Manager.	
B2 National design standards	The UNOPS Design Manual and any national building code standards must be jointly applied, and compliance with the more stringent standard is required. DPs should crosscheck national and UNOPS standards in order to determine and, if necessary, provide reasoning for the appropriate standards to be used.	
B3 Life safety	The design solution must comply with and, in some cases, exceed national building codes which relate to life safety as per the requirements of Section B2. When a performance requirement is defined, the Design Practitioner must provide evidence of compliance.	
B4 Design Brief	When the Design Brief is not provided by a third party, the Design Practitioner (DP) is responsible for preparing this document. The DP is subsequently responsible for demonstrating that the design solution meets appropriate design criteria and has addressed all elements of the brief.	
B5 Services design & maintenance	The Design Practitioner is responsible for examining the possible alternatives, future maintenance implications and selection of a solution that meets the design criteria and partner and end user requirements in accordance with the local context.	
B6 Services infra. on site	The Design Practitioner must demonstrate that the design solution is appropriate for the services infrastructure available or planned for the site. The design should also consider maintenance implications for services to maximize the potential design horizon and functionality of the infrastructure.	
B7 Green technology	The Design Practitioner must demonstrate that appropriate solutions have been considered to reflect the intent of reducing energy consumption and greenhouse gas emissions during both construction and over the lifetime of the infrastructure. Particular attention should be paid to ongoing costs and periodic maintenance of the infrastructure services until the design horizon is reached.	
B8 CCA & DRR	The Design Practitioner must demonstrate that steps have been taken to identify the most suitable site available, preferably in a zone that is least vulnerable to the effects of climate change and natural hazards. When infrastructure development is planned in a vulnerable zone, or is restricted to a specific site, or entails works with existing building infrastructure, the Design Practitioner must demonstrate that adequate measures have been incorporated into the design solution to make the infrastructure as resilient as possible and practicable.	

B9 Environmental imperatives	The Design Practitioner must demonstrate that due care has been exercised to assess the environmental impact of the project and that suitable measures have been put in place to respond to recommendations identified during the assessment, in accordance with the UNOPS Environmental Management System.	
B10 Duty of care	Design Practitioners MUST only undertake tasks that they are competent to fulfil. The Design Practitioner must comply with his/her professional obligations to UNOPS, professional organizations and the host country.	
B11 Design review	The Design Practitioner must demonstrate that due care has been taken to meet the performance requirements as set out in SECTION C and that errors and omissions identified in the Design Review process are rectified and implemented as directed by the Project Manager .	
B12 Changes affecting design	If the proposed design changes constitute a significant change to the design intent of the building, and/or exceed the variation limits within the contract approval, and/or could potentially affect the risk category of the infrastructure, or constitute a structural change, the Project manager must refer the changes to the Design Practitioner and the Design Reviewer.	
SECTION C: TECHNICAL OBJECTIVES, FUNCTIONAL STATEMENTS AND PERFORMANCE REQUIREMENTS		
Site (C1)		
C1.PR 1 Rights of Way/ Rights of Use	The DP MUST investigate existing Rights of Way, both formal and informal, where these cross all or part of the Site. Positions of such rights of way and rights of use MUST be marked on the topographic survey drawings, and positions pegged on site.	
C1.PR 2 Displacement of People	Displacement could occur as a result of people living on the site, or people using the site to earn their living, e.g. growing crops, grazing livestock. Where relevant, DPs MUST consider design solutions that enable continued use of the site.	
C1.PR 3 Bio-diversity	DPs MUST make enquiries with relevant authorities such as national or international conservation bodies regarding the likelihood of any significant bio-diversity issues arising as a result of the infrastructure project, unless this process has been completed as part of an environmental assessment. Should site investigations show that bio-diversity issues exist, the DP MUST report this to the PM, so that UNOPS can bring the issue to the Direct Partner / Donor / Government / national conservation bodies, preferably before any major design work is carried out.	
C1.PR 4 Cultural heritage	DPs MUST enquire into the possibility that any buildings on the site could be of cultural or historical significance. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
C1.PR 5 Archaeological significance	DPs MUST enquire into the possibility that the Site is situated on land which could be of archaeological significance. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
C1.PR 6 Environmental assessment	The PM, with the assistance of the DP, MUST identify any problems with the site. The DP MUST verify with the UNOPS PM whether any specific environmental remediation or control measures are required in the design documentation.	
C1.PR 7 Site infrastructure services	DPs MUST consider the following: a. Any adverse impact on the site or local populations resulting from the design, or any issues identified in the environmental assessment b. The potential for positive site impacts resulting from the design	

C1.PR 8 Demining	UNOPS often works in post conflict areas, where the presence of land mines and unexploded ordinance is a very real danger. The DP MUST not enter the site area until a clearance certificate has been issued and approval for access provided by the PM. The DP MUST document any areas that are off limits for the contractor due to demining issues.	
C1.PR 9 Site ownership	Where possible, the Direct Partner, Donor or Government MUST provide an official deed / document showing ownership, signed and stamped by the relevant authorities.	
C1.PR 10 Technical Survey/Report	DPs MUST obtain all technical surveys necessary to complete the design of the infrastructure. This could include, but are not limited to, environmental assessments, topographical surveys, and geotechnical surveys.	
C1. PR 11 Site clearing	The DP MUST identify the full extent of any site clearing. Any site clearing must comply with previously identified requirements from C1.PR 3 to C1.PR 6.	
C1.PR 12 Demolition	The DP must identify the full extent of any demolition in the design documentation if it forms part of the construction contract. The DP MUST ensure that the demolition does not impact any other site infrastructure or adjacent infrastructure. The DP MUST identify the ownership of the demolished materials. If specific equipment is to be reused, the DP MUST determine the suitability of the equipment before the design is completed.	
C1.PR 13 Car access & car parking	The DP MUST consider the impact of vehicular access, car parking, and more on the adjacent road transport system. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
C1.PR 14 Accessible Parking	Parking spaces for persons with disabilities MUST be provided in accordance with the table in the relevant section. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
Element Materials Selection (C2)		
C2.PR 1 Fitness for purpose	The choice of building elements and materials MUST take into consideration that the materials fit the requirements as defined in C2.PR 2 to C2.PR 4	
C2.PR 2 Local sources	All selection of building elements and materials MUST be carried out on the basis that a balanced choice is made between locally available systems and materials, and systems that require either the importation or the establishment or enhancement of a manufacturing facility.	
C2.PR 3 Life cycle	Other than services and equipment, building elements MUST be envisaged to have the required lifetime for the infrastructure project, an acceptable life cycle cost, and which can be recycled safely at the end of their useful life, where feasible.	
C2.PR 4 Hazardous elements and materials	Elements and materials with known hazardous content MUST not be used. Appropriate precautionary measures are required for materials that may be hazardous only during construction activities.	
C2.PR 9 Termite treatment	Termite treatment MUST be specified in any zone that is infested with termites. The treatment is to be carried out during construction and must carry a guarantee of a minimum of ten years.	
C2.PR 10 Insulation	The DP MUST carefully consider insulation, both thermal and acoustic, even in environments where local practice is to not insulate the building.	
C2.PR 11 Fire resistance	Fire resistance MUST be considered with reference to SECTION C4, including the contribution of materials to the spread of fire. Fire doors, walls and stops MUST be incorporated in the design where appropriate.	

Structure (C3)		
C3.PR 1 Codes	As per SECTION B3, the DP MUST comply with regional, national and/or international design codes appropriate to the country in which the structure is built. As a rule, codes are prescriptive and must be researched carefully. The DP will assess the national and UNOPS requirements and apply the stricter standard. Likewise, if no national code is in place, the DP will apply the relevant functional statements, technical parameters and performance requirements indicated in this manual.	
C3.PR 2 Progressive collapse	The structure MUST be designed so that if structural damage or failure occurs it will do so in such a way that time is allowed for occupants to evacuate the building prior to total collapse.	
C3.PR 3 Earthquake design	Structural design for earthquake zones MUST be undertaken only by professional structural engineers with specialist experience. Establishing the seismic design parameters is a critical part of the designer's task and all information MUST be obtained from national codes, seismic maps, or other worldwide sources. When choosing a structural system the designer, both engineer and architect, MUST give consideration to the strengths and weaknesses of different construction methods. The designer MUST also give consideration to the use of energy absorbing design features, which are not costly when measured against the life-cycle cost of a building.	
C3.PR 4 Deflections and deformations	The DP MUST check the design for deflections and deformations and ensure not only that the fluctuations are permitted within the relevant standard approved for use, but also that such deflections and deformations do not cause damage to other parts of the building or to installed equipment and fittings.	
C3.PR 5 Neighbouring buildings	The DP MUST investigate the potential for neighbouring buildings and structures to be affected by the infrastructure works and any negative effects MUST be eliminated.	
C3.PR 6 Calculations	In preparing the design calculations, the DP MUST use internationally recognized structural design software based on recognized standards or, if working manually, prepare neat and proper records of the design calculations. The design record MUST be made available for third party reviews and checks at any time and MUST be handed over as part of the end users Taking-Over package along with as-built drawings. Design revisions and changes carried out during construction MUST be incorporated in the final design record.	
C3.PR 8 Foundations	When designing foundations, careful analysis of the Geotechnical Investigation is required and all factors such as soil type and soil bearing capacity, water table, and potential for ground movement MUST be taken into consideration by the DP. The history of the site must be investigated, especially to discover if the site is filled and a cut and fill platform exists in the location proposed for the building.	
C3.PR 10 Construction details	The structural engineer and the architect together MUST design details that not only meet the structural requirements but are also not too complex. The local skill level and expected quality achievable MUST be considered so the construction details can be executed without compromising the design intent and can be supervised on site by the site engineer.	
C3.PR 11 Existing buildings	In cases where an existing building is converted and/or renovated the load bearing structure MUST be subjected to a detailed investigation.	
Fire safety (C4)		
C4.PR 1 Structural integrity	All buildings MUST be designed so that their structural integrity is maintained during a fire to permit the evacuation of occupants and provide limited protection of firefighting personnel. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	

C4.PR 2 Evacuation & escape	All buildings MUST comply with the interrelated requirements for evacuation and escape in the event of a fire. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
C4.PR 3 Fire exits	The number of fire exits required for each building is dependent on the numbers of people in the facility based on the floor area. The table in this section MUST be used for guidance in calculation of the maximum number of occupants within a building.	
C4.PR 5 Smoke and fire separation	All buildings MUST comply with a number of requirements for smoke and fire separation, laid out in the relevant section.	
C4.PR 6 Fire detection & protection systems	All buildings MUST comply with a number of requirements for fire detection and protection systems, laid out in the relevant section.	
C4.PR 7 Signage	The DP MUST specify signage to be included in the design documentation. In all buildings greater than 300m ² of total floor area, signage MUST be provided to clearly identify all locations of fire extinguishers, hose reels, stand pipes adjacent to the equipment. Each floor of a building MUST be displayed on a plan mounted on a wall near the entrance to each floor, and identifying elements laid out in the relevant section.	
C4.PR 8 Locks on exit points	All exit points, escape corridors, escape doors, MUST not be lockable in the direction of escape. Door hardware schedules must comply with this requirement.	
C4.PR 9 Emergency equipment	To ensure that emergency equipment is available for use at all times, access doors to hose reels or extinguisher cabinets MUST not be locked. If in the open, controls on the equipment MUST not be locked.	
C4.PR 10 Inflammable liquids	All buildings that contain, or propose to contain, significant volumes of inflammable liquids, such as petroleum, oil or paint products, MUST have special provisions for storage. These provisions are laid out in the relevant section.	
C4.PR 11 Firefighting services	In those locations where externally provided governmental, municipal or city-based firefighting services exist, these MUST be consulted for confirmation of all fire protection measures and requirements for firefighting vehicle access; specific hydrant locations, sizes and capacities; FIP locations; and external communication link for detection alarm notifications.	
Access and egress (C5)		
C5.PR 1 Circulation space	Each building MUST be designed to: a. Allow movement into and out of the building in a safe and unobstructed manner during normal use. The primary point of access MUST be clearly defined to enable simple access with signage or non-written visual means depending on the design circumstances. b. Have sufficient circulation space within the building to enable its intended function in an efficient and smooth manner. For further guidelines and specific parameters stemming from this requirement, please see the relevant section.	
C5.PR 2 External steps	External steps leading to the entry/exit point of buildings MUST comply with all of the requirements specified in the section.	
C5.PR 3 Interior stairways	Internal stairways within buildings MUST comply with all of the requirements specified in the section.	
C5.PR 4 Balustrade	Balustrade panels to balconies used as primary access MUST not be less than 1,000mm in height from floor level of balcony to top of panel. The infill between 150mm above floor level to 750mm above floor level MUST be either solid material or vertical bar, making it un-climbable for small children. Bar spacing to be maximum of 150mm centers. Balustrade panels below handrails to external stairs, internal stairs, and landings MUST contain infill as above.	

C5.PR 5 Ramps	<p>Ramps MUST be provided for access to the main entrance/exit of all buildings. Ramps MUST be used wherever possible inside the building to facilitate access to all parts of the building.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C5.PR 6 Door openings	<p>Accessibility at door openings is critical for the effective access of wheelchairs. The design of all spaces which have wheelchair access MUST comply with the space requirements in the relevant section.</p>	
C5.PR 7 Gender equality	<p>The Design Solution MUST demonstrate that cultural and social norms have been considered while ensuring that women and men have equal access to public facilities.</p>	
C5.PR 8 Equipment access	<p>Equipment access for service, repair and replacement if necessary, has implications for circulation space, door opening widths, and general access to the building and roof. The DP MUST consider this aspect in the development of the design.</p>	
Health and amenity (C6)		
C6.PR 1 Lighting	<p>Lighting for each building MUST comply with the requirements laid out in the relevant section.</p>	
C6.PR 2 Natural ventilation	<p>Ventilation for each building MUST comply with the requirements laid out in the relevant section.</p>	
C6.PR 3 Concealed spaces	<p>Every building that contains concealed sub floor spaces, attic spaces or voids within wall cavities MUST be designed to inhibit or eliminate moisture migration or condensation issues, in line with the requirements laid out in the relevant section.</p>	
C6.PR 4 Mechanical ventilation	<p>Buildings or parts of buildings that require mechanical ventilation for exhaust MUST comply with the requirements laid out in the relevant section.</p>	
C6.PR 5 Space heating	<p>All habitable spaces within buildings MUST be provided with an acceptable method of space heating in cold climates.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C6.PR 6 Air conditioning	<p>Given the variability of conditions that affect power considerations, types of equipment, and spare parts availability, the DP should prepare a design solution that provides human comfort conditions within the provided matrix.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C6.PR 7 Washroom facilities	<p>The DP MUST ensure that adequate toilets, washing and bathing facilities areas are provided in all buildings or adjacent to the buildings, depending on cultural expectations, and employing a gender-based approach.</p> <p>For a table of minimum requirements for adequate washroom facilities, please refer to the table in the relevant section.</p>	
C6.PR 8 Accessible toilets	<p>The DP MUST provide at least one accessible toilet facility for persons with disabilities in all buildings.</p> <p>For further guidelines and specific parameters stemming from this requirement, please see the relevant section.</p>	
C6.PR 9 Accessible Kitchens	<p>All dwelling units that are configured for accessibility for disabled persons MUST contain a kitchen facility suitable for use by a person in a wheelchair.</p> <p>Reach and clearance spaces, under bench knee spaces and similar operational constraints MUST be considered by the DP in the design of these facilities.</p>	
C6.PR 10 Cleaners' sinks	<p>Cleaners' sinks MUST be used to ensure there are suitable facilities available for keeping the building clean and hygienic.</p>	
C6.PR 11 Kitchen facilities	<p>Cleaners' rooms MUST not be used for tea-making or food preparation.</p>	

Services and Equipment (C7)		
C7.PR 1 Water supply system	For the guidelines and specific parameters related to this requirement , please see the relevant section.	
C7.PR 2 Sewage and waste water	For the guidelines and specific parameters related to this requirement , please see the relevant section.	
C7.PR 3 Stormwater management	For the guidelines and specific parameters related to this requirement , please see the relevant section.	
C7.PR 4 Electrical systems	For the guidelines and specific parameters related to this requirement , please see the relevant section.	
C7.PR 5 Comms and IT systems	For the guidelines and specific parameters related to this requirement , please see the relevant section.	
C7.PR 6 Security services	The DP MUST identify in the design brief and assist with provision of any specialist services infrastructure related to security needs for the operation of the building. For the equipment to which this requirement pertains, consult the relevant section.	
C7.PR 7 Evidence of research	The DP MUST provide evidence of research in consideration of the choice of equipment to meet C7.TO 2 and C7.FS 2 for complex equipment design solutions. These choices are critical to the future performance and effectiveness of the design outcome. For the equipment to which this requirement pertains, consult the relevant section.	
Security (C8)		
C8.PR 1 Security levels	The DP MUST design security elements and systems that are appropriate to the level or type of threat that can be reasonably anticipated.	
C8.PR 2 Codes	National codes and standards MUST be used for the design of security elements where such codes and standards exist. In the absence of these, applicable international codes should be used. Refer to SECTION B2 for further guidance.	
C8.PR 3 UN buildings and compounds	United Nations Department of Safety and Security MOSS (Minimum Operating Security Standards) and MORSS (Minimum Operating Residential Security Standards) MUST be used for the design of all infrastructure for all UN buildings and compounds.	
C8.PR 4 Atypical security considerations	Some atypical security considerations may apply for other types of buildings in exceptional circumstances, and these MUST be designed to an appropriate standard to mitigate the particular threat.	
C8.PR 5 Physical security	All three main components to physical security (delay, detection, and apprehension) are required for a functional security system. The DP MUST design all Delay, Detection and Apprehension and other physical aspects of security systems to meet the security requirement. For more information on the three components, consult the relevant section.	
C8.PR 6 Design considerations	Issues that MUST be considered in the design will depend on the level of threat, which the DP must research with care. For further guidance and specific requirements that MUST be met under certain security circumstances, consult the relevant section.	
C8.PR 7 Access control	Access Control MUST be designed to prevent unauthorized access to the building or compound, and to intercept contraband (weapons, explosives, etc.), with the minimum impact to traffic flow through the access.	
C8.PR 8 Exit control	Exit control MUST also be considered. Exit searches should focus on theft or unauthorised removal of vehicles, equipment, classified material, etc.	
Green technology (C9)		

C9.PR 1 Design elements	Green technologies MUST be considered by the DP in different design elements, such as: site location planning; selection of environmentally preferable materials; minimize greenhouse gas emissions; minimize use of energy and supply with renewable sources; water use; sewage and graywater use; solid waste handling; indoor air quality, including thermal comfort, lighting quality and type of fitting; building commissioning, its operation and maintenance; and mitigation of greenhouse gasses.	
C9.PR 2 Building orientation	DPs MUST consider building orientation and shape to reduce energy consumption and promote natural light and ventilation whenever possible.	
Climate change adaptation and disaster risk reduction (C10)		
C10.PR 1 Impact of natural hazards	The DP MUST consider principles and good practices in the design, thinking beyond codes and standards, to design infrastructure that reduces the impact that failure due to natural hazard could have for the use of infrastructure,	
C10.PR 2 Climate change	The DP MUST design the facility with recognition of the increased impacts of climate change.	
C10.PR 3 Safe health facilities	When designing health facilities, Design Practitioner MUST incorporate specific measures for the services of the building to remain accessible and functional at maximum capacity and within the same infrastructure immediately following a disaster, in line with WHO's "Hospitals safe from disasters' programme".	
C10.PR 4 Safe schools	When designing schools, the Design Practitioner MUST incorporate specific measures for the services of the building to remain accessible and functional at maximum capacity and within the same infrastructure immediately following a disaster, in line with the "Guidance Notes on Safer School Construction" developed by the Inter-Agency Network for Education in Emergencies and the Global Facility for Disaster Reduction and Recovery.	

SECTION G

Annexures

INTRODUCTION

SECTION G provides annexures to the *Design Planning Manual for Buildings*. Among these are environmental management documents, a best practice quality checklist for Design Practitioners, and glossaries of general and technical terms.

Section G: Annexures

- G1** Environmental management documents
- G2** Detailed checklist (for reference only)
- G3** Glossary of general terms
- G4** Glossary of technical terms

SECTION G1 contains environmental management documents to help identify and address environmental impacts of the planned infrastructure. Project Managers and Design Practitioners should also refer to SECTIONS B9 and C1.PR 6 for more guidance on environmental assessments.

SECTION G2 provides a checklist for the riskiest and most significant aspects of design; measuring the proposed design against this checklist is not required but it is encouraged as a best practice that aids the Design Practitioner in confirming the soundness of crucial aspects of design.

SECTION G3 contains a glossary of general terms used throughout this manual.

SECTION G4 contains a glossary of technical terms used throughout this manual.

G1 ENVIRONMENTAL MANAGEMENT DOCUMENTS

Note for Design Practitioners:

1. POTENTIAL IMPACTS OF THE PROJECT

The environmental aspects (meaning, how the project activities interact with the environment) and potential impacts should be identified for the project. Both negative and positive impacts should be identified.

Positive impacts alter the natural environment (physical, biological and/or socio-economic) to the benefit of the environment.

Negative impacts alter the natural state of the environment (physical, biological and/or socio-economic) to the detriment of the environment. These impacts should be eliminated or mitigated. There are two kind of negative impacts: direct and indirect.

The direct negative impacts result directly from any project activity.

Examples: Degradation of water quality due to waste produced by the construction works or to spills from machinery; depletion of natural resources (water, wood), used as construction material or for construction purposes

These impacts will require mitigation measures to be identified and implemented.

The indirect negative impacts may occur after completion of the construction works, once the object of the project is operational.

Examples: Land degradation, due to increase use of land for economic activities – resulting from the opening of a road; increased logging due improved access to the forest.

If some of these impacts can be mitigated during design stage of the project i.e. implementation of the green design principle, the review should identify such solution.

Once the impacts are identified, their significance needs to be assessed. For negative impacts that have been assessed with 'High' and 'Medium' significance, a mitigation measures **MUST** be put in place to address them throughout the project cycle. Some of the impacts can be mitigated during the design stage, others during the implementation/construction phase.

2. ANALYSIS OF ALTERNATIVES

Describe the possible alternatives to the project. This will generally include:

- 'No action' alternative
- Alternative(s) with variations to reduce environmental impact, such as site location, materials to be used, project products, product design, etc.
- The preferred alternative and justification for this option (generally the originally planned works and activities—however, the choice should be justified.)

Issues to consider	ASPECT description	Potential IMPACT (under normal, abnormal or emergency situations, as required)	Applicable Environmental Legislation,	Significance Rating	Action required / MITIGATION	Responsible party	Status of mitigation measures
<i>The list of impact types is not exhaustive and will vary between projects (see additional guidance on page 2 of this programme)</i>	How do the project activities interact with the environment in terms of the issues in the left hand column? <i>E.g. Debris from bridge repairs falls into river; or New road reduces congestion in town centre</i>	What change (impact) would this aspect of the activity have on the environment? Impacts may be positive(+) or negative(-) <i>E.g. Debris pollutes river; or Improved air quality, reduced noise</i>	List relevant environmental legislation and regulations, related requirements of the brief or contract and any relevant guidance	Low, Medium or High – see the Notes below	Identify whether the impact can be controlled or influenced by UNOPS and if so, what action is required <i>E.g. Erect shuttering to prevent debris falling into river, or incorporate green design, or to be managed by contractor on site according to REI</i>	Who is responsible, eg: <i>A named person within UNOPS or Contractor</i>	Sign off the aspect once proposed actions completed
Community and stakeholder issues (i.e. planning requirements)							
Landscape & visual impact							
Ecology (habitats, flora and fauna)							
Archaeology and cultural heritage							
Air quality (emissions and indoor air quality)							
Water (usage, discharges and risk of floods)							
Contamination							
Energy (usage, source, cost etc)							
Processes (production, chemical, mechanical, electrical)							
Materials (quantity and type used)							
Waste management							
Nuisance (noise, odour, dust vibration etc.)							
Transport (transport / traffic plans)							
Emergency Plan (Is a project one required?) Who would be							
Social							
Economic							
Other							

Significance rating:

Negative High	<ul style="list-style-type: none"> - High environmental risk - Client or legal requirement - Certain or frequent likelihood of occurrence 	Negative Medium	<ul style="list-style-type: none"> - Medium environmental risk - NOT a client or legal requirement - Probable or occasional likelihood of occurrence 	Negative Low	<ul style="list-style-type: none"> - Low environmental risk - NOT a client or legal requirement - Remote or improbable likelihood of occurrence 	Positive	<ul style="list-style-type: none"> Environmental opportunity
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PROJECT ENVIRONMENTAL OBJECTIVES

The project environmental objectives are presented in the table below. The objectives are aligned with the Donor/Beneficiary objectives for the project and UNOPS Environmental Management System objectives. Project Manager carries an ultimate responsibility for ensuring that these objectives are achieved. Progress on the achievements shall be reviewed on the quarterly basis and reported to the Regional Environmental Co-ordinator.

[Outline reporting requirements to the Donor/Beneficiary]

Environmental Objective	Target	Progress

To assist with the identification of the aspects and impacts for the project following guidelines can be used:

Community and stakeholder issues

- Consider any effects that the project may have on the stakeholders involved, including the local community, land owners, local societies in the project area. These may range from short-term effects such as noise and other inconveniences created by the project or long-term effects such as increase in the traffic in area.
- Is a community consultation exercise required?
- How might stakeholder views be integrated into the project or design?
- How close is the neighbourhood community to the construction site? What impact construction and operation of the facility will have on it?
- What is the impact of the construction of the site camp i.e. water supply, sanitation, waste disposal?

Landscape & visual impact

- Consider whether a potential direct or indirect impact of the project will be the obstruction of existing views or the destruction of a natural landscape area.
- Consider the extent and consequences of the impact from the point of view of the stakeholders and the potential repercussions that this will have on the project itself.
- Are there any conservation areas or locally designated landscape areas that may be affected by the project?
- How can the project be modified to reduce the impact on the character of the landscape/townscape?
- Is site sloped? What are the risks of landslide? What is the impact of construction – i.e. erosion of slope, slope stabilisation required?

Ecology (habitats, flora and fauna)

- Take into account flora and fauna that may be affected and in particular, any protected species.
- Consider the full ecological impacts of the project activities. E.g. draining a wetland will potentially affect several species of plants, animals and insects indirectly but this may not be immediately evident.
- Consider also the sensitivity of the affected environment. For instance damage to an ecologically important site regardless of its size will have significant consequences e.g. nesting and breeding habitats.
- Does the site have any ecological designations? Is consultation with local or national body required? Are specialists survey required?
- If new plantings are proposed will these be indigenous?

Archaeology and cultural heritage

- Will be archaeological, cultural, historical importance places affected by the project? It is important to prevent not only direct and immediate impacts on these sites, but also to ensure that the project does not contribute in any way to the diminishment of the prominence of sites of archaeological and/or cultural heritage.
- Indirect impacts (eg changing groundwater conditions) should also be considered.
- Are desk studies or surveys required?

Air quality (emissions and indoor air quality)

- A project may have detrimental effects on air quality through emissions and dust particles generated during the construction period or through the operation of a completed facility e.g. a project to build a road.
- Consider the impacts of emissions from site vehicles, earthworks, stockpiles, traffic generated by the development and its operations.

- How could design, construction and operation be changed to mitigate air quality impact?

Water (usage, discharges to surface water, groundwater and sewers)

- Consider water usage in terms of quantity as well as quality. For instance it may not be necessary to use drinking quality water for all operations at a site and there may be a potential for savings here.
- Will consumption of the water by the project impact on the water delivery to the neighbourhood.
- Is more water being used than is necessary on the project? Consider whether upon completion the project will ensure that water is efficiently used and appropriately discharged.
- Will construction involve working in or over water or affect any surface water or groundwater in any way? What consents are required?
- Can surface water runoff cause erosion? If yes, how it will be controlled?
- Can project cause siltation of the streams and drains? For example compaction of the soil and grading of the site may alter drainage patterns and water tables, changing access to water by animals, people and vegetation.
- Are there any water bodies in the vicinity of the construction site that can be affected?
- Is site located in vulnerable area such as wetland, slopes, area prone to flooding, landslides, heavy rain fall, earthquakes? Are there flood protection measures incorporated in design?
- Are sanitary facilities available or would they have to be constructed? Where sewage can be discharged? Would treatment be required?

Contamination

- Contamination may occur as a consequence of materials used during the life of a project. The potential for contamination should be considered on any site but in particular on a site where past development has occurred. Contamination may not be an immediate effect, but may result after years of degradation of structures and components. Examples include lead used in paints and the use of asbestos in buildings, which become exposed with gradual degradation.
- Are there any risks of disturbing or excavating contaminated land?
- Contamination may also result from accidental spillage of chemicals and other hazardous materials (solvents, paints, vehicle maintenance fluids (oil, coolant), diesel fuel) used and stored on a construction site. If washed into the ground or stream, may contaminate water and create hazard to people and ecosystems.
- Can project cause pollution of the ground and water?

Energy (usage, source, cost, etc.)

- Energy use has direct environmental impacts in terms of fuel consumption and emissions and can be a considerable construction or operational cost. Excessive energy usage should be avoided if possible and energy saving measures (low energy light bulbs; timed lighting; natural lighting; natural heating and district heating systems) may result in substantial cost savings. Consider the efficiency of the energy usage and the source of the energy both during the project life and after it is completed. Is energy being wasted?
- Will the end result of the project be as energy efficient as possible?
- Are renewable energy sources being used where possible?
- During operation what inputs are needed, including raw materials, water, or energy sources? Where will they come from?

Processes (production, chemical, mechanical, electrical)

- Civil engineering schemes, particularly those in the water industry, may involve complex and resource consuming processes, i.e. sheet piling can cause unpleasant

and undesirable vibration. Will your project involve these processes and if so can alternative processes be used that have less impact?

Materials (quantity and type used)

- Consider the quality and quantity of materials and their source. Some materials can be more environmentally friendly than others based upon their embodied energy, ability to bio-degrade, waste products or their direct impact on the environment in which they are used. Embodied energy is high in products like steel and cement because they require a large amount of energy in production.
- Where are the construction materials coming from - are they local or from a distant source? Products imported from overseas require energy for transportation. Local sourcing of goods and materials can help to support local businesses and communities.
- Is the material from a sustainable source? Can reused, recycled or renewable materials be used in place of virgin or non-renewable materials? Do new materials being used have the potential to be recycled? Does the material have high durability and a long life span so will not need substantial maintenance or need replaced as often?
- Does the design optimise the efficiency of materials used to reduce consumption and/or generation of waste in construction?
- Is quarrying required? Are borrow pits for earth fill needed? Where is wood coming from?

Waste management

- Will the project result in the production of waste?
- What are the opportunities to design out waste? There should be a waste management system in place to ensure that waste is reduced, recycled or re-used as far as possible and that waste is sorted for disposal by appropriate categories (e.g. wood, metal, green waste, hazardous waste).
- Hazardous wastes such as asbestos require special handling, permits etc.
- Consider the quantities of waste produced and the quality of the waste in terms of its potential for contamination.
- Look for opportunities for reuse: for example earth or construction rubble - noise or flood defence bunds or road sub-base can usually be made with low quality, locally sourced materials that cannot be used for other construction purposes and might otherwise be placed in landfill.
- If earth or vegetation is removed, what will be done with it?
- Can waste be 'out designed'?

Nuisance (noise, odour, dust vibration etc.)

- Nuisance is often perceived to be a problem during the construction period of a project. However, the end result of a project may also cause nuisance through its ultimate function. Nuisance can be noise, vibration, odour, dust, site appearance, tidiness, lighting etc but can also include the behaviour of site staff towards the general public or local residents.
- Are surveys required to establish baseline conditions and predict potential nuisance impacts? Are permissions required to manage those impacts before construction or operation commences?

Transport

- Consider whether the project will increase or decrease transport demand.
- What type of transport will be used during construction and operation?
- Is a transport assessment required? Will the traffic management plan be required during construction?
- Is construction of the haul road required – what impacts that will have?

Suppliers and subcontractors

- In order to ensure that all activities are carried out in a safe, ethical and environmentally responsible way, it is important to ensure that suppliers and subcontractors are governed by the same principles that govern our working methods (e.g. safety, quality and environmental management systems). In addition it must also be established that they are capable of the tasks to which they are assigned. Possible problems may result due to a lack of sufficient information on suppliers and subcontractors. It is pointless to operate an EMS and then use suppliers/subcontractors that do not adhere to similar principles. This is a risk to UNOPS reputation and project performance.

Emergency plan

- Certain activities may require planning for emergency situations to ensure that serious environmental damage or harm to environment, for instance, emergency containment procedures for spills of hazardous materials (fossil fuels, coolants, chemicals etc.). Consider whether any activity is likely require such procedures and if any are in place consider whether or not they are adequate.

Social

- Consider what will be the social impact of the project, both during construction and operation?
- Where is labour coming from? Is there a risk that construction schedule will compete with local crop harvesting?
- Will project require/result in relocation of local communities?
- Can project result in contributing to spreading disease – for example standing water in borrow pits may be source of disease-bearing insects.
- Is there potential for increased crime or violence? (e.g. by influx of workers)
- How distant is the site/facility form the intended users – is construction of the access road required? What are the impacts of such construction?
- Who are the intended beneficiaries of the project? Are there issues of discrimination with regard to accessibility to project products or services?
- Are there on-going conflicts in the area?
- Will the project have consequences for land ownership by local/indigenous communities? Will the project affect access to resources used by local/indigenous communities to support livelihoods?

G2 DETAILED CHECKLIST

(NOT REQUIRED, FOR REFERENCE ONLY)

Note: The checklist in this section focuses on the riskiest and most significant aspects of design; measuring the proposed design against this checklist is not required but it is encouraged as a best practice that aids the Design Practitioner in confirming the soundness of crucial aspects of design.

Project Title: _____

A

Design Programme Development

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Prepare cost & manpower allocation plan (in-office) coordinate with PM cash flow requirements					
02	Prepare schedule of key persons, addresses, phone nos. etc. Circulate. Verify all titles, firm names, spellings.					
03	Review check survey and other available site data; prepare list of additional detail information required. Submit to PM.					
04	Prepare detailed task list of all decisions requiring input by more than one consultant. Confirm team members responsible for each action.					
05	Review in detail client's brief; prepare detail list of additional information required. Submit to PM					
06	Confirm understanding with PM, end user & other consultants of all types of information flow. including procedures for transmittals					
07	File requests for site utilities data or confirm that the responsible consultant has done so.					
08	Obtain adjoining owners' consent for survey of adjoining properties.					
09	Check status of subsoil/structural data available & need (or additional data), with responsible consultant. Confirm to PM.					
10	Prepare drawings list & schedule re proposed uses for each building: gross floor area, all principal & ancillary uses.					
13	Verify that all critical decisions have been made and communicated as required in current period.					
14	Check against overall schedule; adjust as required.					

Tick '✓' where applicable

Project Title: _____

B

Surveys

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Confirm title particulars from check survey (A 03)					
02	Note planning and design constraints in Basements, party walls or covenants as identified in check survey (A 03)					
03	Specify detail for topographical survey, including contour interval, vegetation, existing works, soils etc					
04	Verify data for below-ground structures against site evidence.					
05	Record all relevant abuttal conditions, including overshadowing and overlooking, and required protection during demolition.					
06	After consultation with Structured Eng., prepare and issue plan and specification for soil borings and test pits to PM.					
07	Check survey requirements with planning, landscape and engineering consultants.					
08	Establish current ground water levels and probable highest seasonal ground water levels.					
09	Obtain from responsible authorities, where applicable, statutory certificates and advisory documents identifying all relevant planning controls.					
10	Document supporting information ref environmental impact: natural, social, economic, commercial, traffic and other utility systems where applicable.					
11	Carry out/commission existing conditions surveys of adjoining properties, if affected by works					
12	Identify responsible officers of all authorities and add to schedule of "key persons" (A 02).					
13	Identify owners, occupiers & title particulars for all other property likely to be materially affected including adjoining owners; advise PM					

Tick '√' where applicable

Project Title: _____



Renovations Survey

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Confirm with PM the complete purposes of the survey; prepare checklist of items to be documented					
02	Confirm permission and access details to building; confirm security: obtain complete set of keys if needed					
03	Obtain and study any existing drawings. Take copies to survey for comparison to actual conditions					
04	Determine whether any documentation of historic detail is required.					
05	Carry out photographic survey on site.					
06	For measuring of existing conditions, a party of 2 is minimum 1 to measure, 1 to record.					
07	Equipment check: (1) min. 30m tape, (1)6m tape, (2) torches with extra batteries, camera, clipboard, screwdriver.					
08	Check and note all external spaces, including roof					
09	Check and note all rooms on each floor in a clockwise manner. Note any alterations from existing drawings.					
10	Measure floor to-floor heights in stairwells; measure exterior wall heights by dropping tape line from roof, if possible					
11	Check and note carefully beams and structures					
12	Check and note carefully all exposed portions of foundation walls, noting any evidence of past movement, including stabilized movement.					
13	Note any evidence of insect infestation or dry rot. Use screwdriver as probe					
14	Note drain locations, position of drains, locations and size of water entry lines.					
15	Note electrical equipment and building service capacity.					
16	Note heating and cooling equipment; copy data from nameplates; note operating condition if known.					
17	Note history of additions, extensions and alterations as can be determined.					
18	Check conditions of all flashings, copings, damp courses windows, skylights, external grilles, intakes and exhausts; note and photograph defects,					
19	Check adequacy of crawl space ventilation; check all sub floor spaces, where accessible.					

Tick '✓' where applicable

Project Title: _____

C

Renovations Survey (continued)

No		Check Box			Initial	Date
		Yes	No	N/A		
20	Collect any drawings or photographs of the structure found during the survey.					
21	Prepare complete report promptly from notes.					
22	Prepare existing conditions drawings (if required); note taken dimensions; note check dimensions which do not appear to be correct.					
23	Revisit site and verify all doubtful dimensions, if possible.					
24	Incorporate survey reports from sub consultants, if any, and distribute complete report and survey drawings package.					
25	Review survey report against project brief; advise PM and other consultants of any modification indicated.					

Tick '√' where applicable

Project Title: _____

D

Schematic Design

No		Check Box			Initial	Date:
		Yes	No	N/A		
01	Develop list of questions affecting schematic design pertinent to each engineering discipline. Circulate with requested target date for answers.					
02	Verify progress to work plan in current period. Note deficiencies					
03	Prepare functional diagrams including relationship to existing structures; develop viable functional arrangement options; review with PM. Select preferred arrangement (s).					
04	Study siting options and climatic influences; develop massing models; evaluate relationships to site context.					
05	Test massing options against preferred functional arrangement and brief; review with PM. Select model.					
06	Evaluate provisional concepts for accommodation of economic structural systems with S Eng.					
07	Evaluate provisional concepts for accommodation of parking requirements.					
08	Evaluate engineering system options and select provisional systems (s)					
9	Prepare drawings & schedule re development: existing & proposed building envelope, landscaping, parking & access.					
10	Prepare drawings & schedule re urban design: elevations, materials, colours, shadows, signage, awnings etc					
11	Develop plan for presentation materials, renderings, models and written materials Confirm with PM.					
12	Prepare preliminary schedule of internal & external finishes; confirm with PM & submit to QS; request confirmation of any cost plan changes and costs for alternatives					
13	Check concept plans for conformity with fire and exit requirements					
14	Establish provisional lift shaft sizes, air duct sizes, raised floor requirements, plant room sizes and other mechanical requirements.					
15	Establish provisional beam depths, duct crossovers and floor-to-floor heights.					
16	Establish disabled access requirements					
17	Establish sanitary fixture requirements with types and numbers of each fixture per floor.					
18	Submit schematic design to Quantity Surveyor for review of preliminary cost plan.					
19	Review schematic design with PM and end user.					
20	Obtain client's approval of and sign-off on schematic design, or obtain authority to proceed to next stage.					

Tick '√' where applicable

Project Title: _____

E

Site Landscape and Environment

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Visit site and determine if any site trees and shrubs are to be retained; note on survey drawings.					
02	Determine temporary site access points and any easements required.					
03	Note retaining walls, outcroppings and any other site features to be conserved.					
04	Prepare/distribute report on site findings, recommendations, and plant materials suited to soils and climate.					
05	Determine which tasks are to be responsibility of Landscape Architect; prepare brief, engage LA as appropriate (NB; this list assumes tasks E 8 to E 17 are by LA).					
06	Establish solid waste disposal needs of building user.					
07	Determine access requirements and clearances for disposal service vehicles.					
08	Check preliminary landscaping plan; distribute for review.					
09	Check preliminary plant materials schedule.					
10	Confirm cost plan allowances for landscaping.					
11	Confirm coordination of hydrant, irrigation and drainage requirements with services engineer.					
12	Check final landscaping plan for conformity to brief and architectural design.					
13	Verify that areas of sodding, seeding and mulching are shown and noted.					
14	Check final plant materials schedule.					
15	Confirm appropriate planting season limitations.					
16	Confirm final landscape requirements with Quantity Surveyor					
17	Confirm provision of specification notes to specification writer.					

Tick '√' where applicable

Project Title: _____

F

Traffic and Parking

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Meet with authorities to discuss site access preference and restrictions. Confirm in report to PM.					
02	Establish statutory or other official parking limitations, and special site requirements.					
03	Confirm parking space requirements, minimum lane and turning dimensions, disabled person parking spaces.					
04	Confirm that proposed column spacing is compatible with parking requirements.					
05	Establish footpath elevations at all vehicle access points and proposed parking floor elevations. Determine ramp lengths needed.					
06	Prepare preliminary parking layouts; distribute to engineers for checking of conflicts.					
07	Check design development drawings for vehicle headroom.					
08	Confirm headroom requirements, turning radii, dock heights etc. at loading bays.					
09	Confirm location and type of drains with services engineer.					
10	Confirm fire separation ratings required and check against architectural drawings.					
11	Confirm that all ducts, piping and conduits are higher than entrance clearance.					
12	Confirm locations and type of all required signs. Advise specification writer.					
13	Confirm locations of all column guards, bollards and barriers. Advise architectural team.					
14	Final check all ramp grades and gradients.					

Tick 'v' where applicable

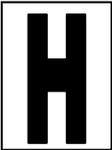
Project Title: _____


Design Development

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Compare each sub consultant's and other consultant's schematics to architectural, verify match.					
02	Verify that all questions from the schematic design brief relating to engineering disciplines have been resolved (D 01).					
03	Confirm any revisions to cost plan.					
04	Check preliminary internal and external Finishes Schedule; revise if necessary. Distribute (D 10).					
05	Verify progress to work plan in current period. Note deficiencies.					
06	Confirm lift shaft dimensions, overrun and pit requirements, plant room sizes etc.					
07	Confirm typical floor beam depths, maximum duct depth requirements, floor-to-floor heights.					
08	Test mechanical design against other criteria: confirm/amend provisional building services system selections; confirm that sanitary fixture count meets requirements.					
09	Establish location and provisional size of electrical substation if required: consult power supply authority.					
10	Establish location, and provisional size of emergency generator and other support infrastructure, if required.					
11	Confirm provisional dimensions of shafts and duct spaces, all levels; confirm plant room equipment layouts, tanks and other mechanical requirements.					
12	Evaluate vertical "creep" considerations (for tall structures).					
13	Confirm ceiling module dimensions with PM.					
14	Confirm all service utility entry points, sizes, and architectural requirements.					
15	Confirm fire rating requirements for all building elements.					
16	Submit design development drawings to Quantity Surveyor for review of cost plan.					
17	Obtain PM approval of and sign-off on design development, obtain authority to proceed to next stage.					

Tick '√' where applicable

Project Title: _____

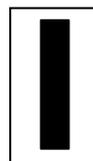


Documentation General

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Establish/distribute project drawing standards, preliminary schedule of drawings, numbering system & title information.					
02	Check progress to work plan in current reporting period. Note deficiencies.					
03	Establish documentation coordination procedures with all consultants, set regular meeting times, agenda format and minute procedure if applicable.					
04	Compare each sub consultant's and other consultant's design development drawings to architectural. Verify match.					
05	Review and confirm security system provisions with PM and specialist consultant as needed.					
06	Review and confirm communications and PA system provisions with PM and services engineer.					
07	Review and confirm cleaning, refuse and waste paper removal system provisions with PM and services engineer.					
08	Confirm if energy management system is to be employed; establish brief.					
09	Confirm final dimensions for all shafts and duct openings.					
10	Confirm final dimensions for all lifts.					
11	Confirm locations for firehose cabinets, fire extinguishers, sprinkler control valves, pumps and control panel.					
12	Confirm weights of all heavy equipment and special floor loading requirements; advise structural engineer.					
13	Obtain services' engineer report on acoustic and vibration characteristics of mechanical system, review with PM.					
14	Confirm grades at all building entry points with civil drawings; check disabled access requirements.					
15	Verify limits of site if required; compare property line dimensions on architectural against survey plan.					
16	Confirm overall thermal and other movement coefficients: check against movement joint provisions.					
17	Verify that all details are referenced to general documents.					
18	Submit drawings to Quantity Surveyor for possible adjustment to cost plan.					
19	Submit drawings, specification notes and product literature to specification writer.					
20	Obtain PM and end user approval and sign off for completed drawings and related documents at same time as detail documentation (I12).					

Tick '✓' where applicable

Project Title: _____

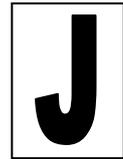


Documentation Detail

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Review all plans, elevations and sections; determine sections still needed to be prepared.					
02	Mark up complete set of general documents to show all locations where details are required.					
03	Assign number and sequence schedule for all details; confirm reference system is understood by general documenters.					
04	Prepare detail "library" of typical details from other projects anticipated to apply to this project. Provide to team.					
05	Check sizes of all column and beam sections for conflicts with ceilings or other elements, including equipment.					
06	Confirm design of grilles, diffusers and ducted skirting with services engineer.					
07	Coordinate lighting details with services engineer.					
08	Confirm security requirements; check against door and other details.					
09	Review tolerances established for all surfaces and materials; confirm they are achievable in practice; coordinate with specification writer.					
10	Confirm requirements for attaching of cladding systems to edge beams; check details, including fire rating requirements.					
11	Verify that details are drawn.					
12	Obtain PM and end user approval and sign off for completed drawings and related documents at same time as general documentation (H 20).					

Tick '✓' where applicable

Project Title: _____



Specifications

No		Check Box			Initial	Date:
		Yes	No	N/A		
01	Determine form of conditions of contact or obtain copy of conditions of contract.					
02	Review project file and determine any special conditions.					
03	Write preliminaries; check for compatibility with other parts of contract.					
04	Circulate proposed conditions of contract and preliminaries to PM for review.					
05	Confirm extent of information required by Quantity Surveyor for Bill of Quantities					
06	Review progress drawings and compile draft list of all specification sections and subsections likely to be required.					
07	Obtain all engineering specification sections, review and put into approved format.					
08	Request list of all contractors items from all consultants.					
09	Determine if any sections are likely to require performance specifications; confirm with client. If affirmative, agree on method of performance testing.					
10	Prepare draft list of Standards likely to be needed for reference.					
11	Confirm completion schedule for specification sections and related drawing groups.					
12	Review drawings as completed.					
13	Confirm specification of any required staging of construction; check against preliminary construction schedule.					
14	Check finishes schedule against specification index; confirm all finish materials are included.					
15	Confirm that final issue of drawings matches specified schedule of Drawings exactly.					
16	Verify all specification cross-referencing.					
17	Check all specification references to drawings ("as indicated", "as shown") and verify that drawing references to specifications are covered.					
18	Confirm schedule of provisional sums for contract, if any.					

Tick '✓' where applicable

Project Title: _____

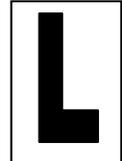
K

Civil Engineering Coordination

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Verify site dimensions against survey.					
02	Verify easements are indicated.					
03	Verify that proposed and existing grades are shown and keyed. Check against survey.					
04	Verify items of demolition, clearing limits and grading limits.					
05	Verify that new site construction does not interfere with existing features to remain including poles, pole guys, manholes, drain inlets, valve boxes.					
06	Cross check all new utilities for interference; verify invert levels, diameters and clearances at all crossings.					
07	Verify that underground utilities are shown on ground section drawings.					
08	Confirm requirements for retaining walls to suit design and gradients of roads, ramps and walkways.					
09	Confirm plan dimensions and profile dimensions match scaled dimensions for utility structures.					
10	Verify that indicated falls match invert levels and distances.					
11	Verify hydrant and utility pole locations.					

Tick '√' where applicable

Project Title: _____



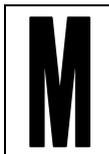
Structural Engineering Coordination

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Confirm that column coordinate numbering on structural matches architectural.					
02	Check set back lines and building location (to roof overhang lines, if so defined).					
03	Compare bottom of footing levels with water table					
04	Verify that all footings are on undisturbed bearing or that areas of compaction are shown; check bottom of footing elevations.					
05	Check perimeter slab dimensions against architectural; check perimeter offset from grid line.					
06	Verify all depressed/raised slabs & block outs are shown.					
07	Verify all slab profiles: check architectural and civil.					
08	Check dimensions of all grade beams and piers against architectural.					
09	Compare roof framing plan dimensions and coordinates against foundation plan coordinates.					
10	Check location of rooftop equipment supports against mechanical.					
11	Check location and sizes of all structural penetrations against building services.					
12	Check location of drains against architectural and hydraulics (for interior drains).					
13	Confirm that all columns and beams are listed in column and beam schedules.					
14	Verify that all structural sections are referenced to plans and elevations.					
15	Verify that all details referenced on plans and sections have been drawn and fit the conditions.					
16	Verify all movement joint details and locations against architectural.					
17	Check that any details identified as "typical" are in fact typical, with any major exceptions noted.					
18	Confirm that structural engineer has received final data on equipment weights and has sized footings as required by soil bearing capacity.					
19	Check for missing or incomplete drawing notes.					
20	Confirm that structural calculations have been submitted and approved where required by authorities.					

Tick '√' where applicable

Project Title: _____

Fire Protection and Hydraulics Engineering Coordination



No		Check Box			Initial	Date
		Yes	No	N/A		
01	Confirm size and location of all new utilities connections to existing services.					
02	Confirm that plumbing fixture, supply and drain locations match architectural.					
03	Confirm storm drainage locations and details against architectural.					
04	Check perimeter foundation drainage against architectural.					
05	Confirm supply size of any fixtures requiring special volume supply.					
06	Verify wall chases, recesses and ducts on architectural at vertical piping locations.					
07	Confirm that no wet piping is run in unheated spaces (freezing climate only).					
08	Confirm that all vents are shown on roof plan.					
09	Confirm that access panels are provided for all concealed valves.					
10	Confirm that all equipment items requiring electrical connections, such as pumps, water heaters and drinking fountains, are shown on electrical drawings.					
11	Check all plumbing fixtures against fixture schedule.					
12	Check all plumbing fixtures against specification.					
13	Check all taps and fittings against fixture schedule.					
14	Check for missing or incomplete drawing notes.					
15	Check fire protection hydraulics specification against fire protection and hydraulics drawings.					
16	Confirm calculations for gutter sizes; check box gutters for overflows.					
17	Check coordination of sprinkler heads/detectors with lighting and mechanical air diffusers on reflected ceiling plans.					
18	Check that drain has been provided for the fire sprinkler control valve set, air conditioning units, water heaters, etc.					
19	Check that provision (drain or open able window) has been made for performance testing of hydraulically least favorable hydrant or hose reel.					

Tick '√' where applicable

Project Title: _____

N

Mechanical Services Coordination

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Verify mechanical floor plans and space allocations against architectural.					
02	Verify that all sections and floor-to-floor heights match architectural and structural.					
03	Confirm that adequate ceiling height clearances exist at intersections of largest ducts, including construction tolerances.					
04	Confirm that largest ducts fit within clear height at raised floors.					
05	Check duct clearances at all deep beams.					
06	Verify locations of structural supports at all items of mechanical equipment; compare with structural.					
07	Verify that smoke and fire dampers are indicated where required.					
08	Check grilles and diffusers against reflected ceiling plans.					
09	Verify that all exhaust fans and relief vents are shown on roof plan.					
10	Verify that all wall air conditioners, fans, grilles and louvers are shown on elevations.					
11	Verify that all equipment will fit in space provided; check service clearances and accessibility.					
12	Verify clearance of installation path for equipment installed after walls are up.					
13	Verify door undercuts and door grilles against door schedule.					
14	Check all equipment items on plans against mechanical schedules.					
15	Verify that electrical connections are shown on electrical plans and schedules for all items requiring power connections.					
16	Verify locations of condensate drains on architectural.					
17	Check for missing or incomplete drawing notes.					
18	Confirm sizes and locations of all equipment plinths to be supplied by Contractor.					
19	Check and confirm that all building work required by mechanical services installation are included in architectural specification.					

Tick '✓' where applicable

Project Title: _____

0

Lifts Coordination

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Request list from services engineer of all critical decisions, and the deadlines for making them, to be made by others in order to meet the schedule for the lift design.					
02	Check lift details against structural drawings.					
03	Check sizes and heights of motor rooms and overruns against architectural.					
04	Confirm lead times for ordering of cars and equipment against construction schedule, including installation, availability of permanent power and testing.					
05	Check standard lift door opening details against architectural details.					
06	Confirm estimates for car interiors against cost plan allowances.					
07	Verify shaft way sizes, all levels and maintenance access requirements.					
08	Confirm security requirements for lifts (eg: after-hours use) and coordinate with communication system.					
09	Check loading dock details against drawings. Verify size, height and capacity requirements.					
10	Check stair lifter or similar platform lifts for disabled persons access requirements. Verify size, height and capacity requirements.					
11	Check for missing or incomplete drawing notes.					

Tick '√' where applicable

Project Title: _____

P

Electrical Services Coordination

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Confirm location, size, access and other details of substation, or other provision for power supply against architectural.					
02	Confirm power authority approval of power supply provisions.					
03	Verify electrical floor plans and dimensions against architectural.					
04	Confirm that all light fixtures are shown on architectural reflected ceiling plans.					
05	Verify that sufficient height exists for all recessed fixtures.					
06	Confirm that recessed fixtures are not in conflict with beams and ducts.					
07	Verify that all equipment items are connected.					
08	Verify location and space requirements of all electrical and telephone panel boards, check requirements for radius dimensions of large conduits.					
09	Check lighting fixture schedule against drawings and specification.					
10	Confirm space and equipment allocation for telecommunications.					
11	Verify electric strike releases, hold open devices and security switches with door schedule. Confirm provision for all other required security systems.					
12	Verify that suspended exit signs are clear of full height doors.					
13	Verify underground external wiring provision for building lighting is shown on site work drawings.					
14	Verify light switch positions against door swings.					
15	Verify that under-slab conduits for floor outlets are dimensioned to coordinates.					
16	Verify power wiring and provision for security systems; coordinate with client.					
17	Verify power wiring and provision for communications and IT system; coordinate with client.					
18	Confirm emergency power provisions, switchboard requirements and protocol for changeover switching.					
19	Check for missing or incomplete drawing notes.					

Tick '✓' where applicable

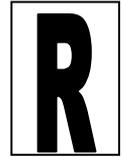
Project Title: _____


Architectural Check

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Verify that limits of existing and new work are clearly shown (additions and renovations only).					
02	Verify all structures elements and dimensions against structural drawings.					
03	Compare elevations to floor plans: check all features shown on both.					
04	Compare building sections to elevations and plans, check all features on both.					
05	Compare detail wall sections with building sections.					
06	Verify that all details referenced on plans, elevations and sections exist and are properly keyed.					
07	Verify that all details are referenced at least once to plans, elevations and sections.					
08	Verify rough openings for doors and windows against schedule and structural.					
09	Verify movement joint locations and cross-check with structural engineer requirements.					
10	Compare finish schedule with ceiling and wall finish notes.					
11	Check lighting fixture layout against electrical plan and schedules.					
12	Check diffusers, grilles and registers against mechanical plans.					
13	Check vent locations against reflected ceiling plans and elevations.					
14	Verify door schedule data including sizes, types, frame conditions.					
15	Verify ironmongery and door furniture schedule against door schedule and specification.					
16	Verify fire rated wall locations and details.					
17	Verify ratings of doors in fire rated walls.					
18	Check all dimension strings and totals.					
19	Verify fit of cabinets and items of equipment.					
20	Verify data on room finish schedule against all other drawings; check room names & nos, ceiling heights & finishes.					
21	Check detail of plan enlargements against small scale plans					
22	Where plan of one floor is on more than one drawing, check match of all meeting lines.					
23	Submit completed documents to PM for building approval where required					

Tick '√' where applicable

Project Title: _____



Renovations Check

No		Check Box			Initial	Date
		Yes	No	N/A		
01	Check all documents against Building surveys site-check any discrepancies.					
02	Check for details at all locations where new construction meets existing.					
03	Where appropriate, verify that all known services required to remain are shown on drawings.					
04	Verify that all remedial/repair work called for in site survey report is covered.					
05	Check for any new piping and conduit to be run in solid walls; check for sufficient furring or chase depth.					
06	Verify that chases in solid walls do not go through structural beams.					
07	Verify that "make good" notes are sufficiently precise to make clear the intended scope.					
08	Verify that historic/important detail to be conserved is properly identified and protection called for.					
09	Verify structural drawings and resolve all known structural deficiencies.					
10	Verify that access exists to run ducts and piping above suspended ceilings.					
11	Verify that vertical shafts on different floors actually line up.					
12	Confirm continuity of any required fire separation.					
13	Check specification carefully against all restoration detail.					
14	Verify provision for treatment where door hardware is to be removed/replaced.					
15	Check door and window schedules for remedial work required against each door and window on site.					

G3 GLOSSARY OF GENERAL TERMS

The phrases in italics below are defined as follows:

<i>Bill of Quantities</i>	A detailed statement of work, prices, dimensions and other details for the erection of a building by contract.
<i>Design Brief</i>	A Design Brief captures the functions and purpose of the infrastructure being commissioned and information about the end-user. A Design Brief can take the form of a report, or project brief, with supporting emails, meeting notes and background notes and should reference any technical requirements, standards, or codes to be applied. The Project Brief could also be included as an attachment for reference to the Design Brief.
<i>Design Check</i>	More comprehensive than a Design Review, a Design Check includes verification of calculations made by the Design Practitioner for the Design Solution. The function of the Design Check is to ascertain that comparable calculations are arrived at independently by the third party reviewer of the design. This is particularly relevant in structural calculations for infrastructure planned for high-risk seismic zones.
<i>Design Consultant</i>	Design professionals engaged by UNOPS as external consultants.
<i>Design Practitioner</i>	Design personnel (internal and/or external) delivering design solutions and inputs to Project Managers.
<i>Design Process</i>	Steps involved in the delivery of design for an infrastructure project, as laid out in SECTION B0.
<i>Design Review</i>	A stage in the design process that verifies proposed design parameters, documents and drawings, consistency between design specialties, and that the design solution is fit for purpose and meets the requirements of UNOPS partners and the <i>Design Planning Manual for Buildings</i> . The Review is undertaken to verify that the DP has used the correct parameters in the design solution for structural, architectural, functional, mechanical and electrical calculations. It does not involve verification of the calculations themselves, which is undertaken during the Design Check.
<i>Design Solution</i>	The Design Solution is the approved design and associated documentation that meets the requirements of the direct partner/end user/donor's Project Brief. Several design options may be presented to the partner in response to the Design Brief (this may vary by type of facility, location, site, functionality, operational services, orientation etc.) before an agreed Design Solution is possible.

<i>Donor</i>	The party(s) who fund(s) the engagement with UNOPS.
<i>Employer's Requirements</i>	The primary contract document which describes for the contractor the terms for the works that UNOPS wants implemented.
<i>End User</i>	The final intended beneficiary/user of the planned infrastructure facility.
<i>Functional Statement</i>	A functional statement identifies the processes, actions or functional requirements for a specific category or element.
<i>Infrastructure</i>	<p>For the purpose of this manual, infrastructure means the buildings and associated service infrastructure on the site related to buildings.</p> <p>In a different context it refers to the societal networks needed for the proper functioning of government, social and health services, judicial and correctional systems, education and training, sports and recreational facilities, and transport related facilities, airports, ports and rail and border facilities for emigration and customs.</p> <p>Infrastructure is also road systems, power distribution, water supply systems, effluent systems including treatment works, solid waste collection and disposal, recycling and all communication systems.</p>
<i>Partner</i>	The term encompasses direct partners as well as donors / funding sources.
<i>Performance Requirements</i>	These set out the minimum level of performance and design standards, which must be met for the infrastructure to comply with the relevant Functional Statements and Technical Objectives.
<i>Project Brief</i>	A Project Brief provides a full and firm foundation for the initiation of the project. It sets out the objectives of the infrastructure project with requirements stipulated by the direct partner and details of stakeholders, beneficiaries, timeline and budget. A project brief provides background information, project definition, outlines the business case and sets up project tolerances, customer's quality expectations, acceptance criteria and risks.

<i>Project Manager</i>	Refers to UNOPS personnel responsible to ensure that the project produces the required products within the specified tolerance of time, cost, quality, scope, risk and benefits. The Project Manager is also responsible for the project producing a result capable of achieving the benefits defined in the Business Case. In the particular case of infrastructure projects, UNOPS PM is therefore responsible for managing the design and implementation process.
<i>Schedules</i>	Includes Schedules of Contract Price & Payment, Site, Works, and Details, as defined in the contract documents.
<i>Scope of Works</i>	All the work to be performed during the construction phase, in accordance with the schedules and including temporary work and variation.
<i>Specifications</i>	Requirements or documents as listed in the Schedules, including Employer's requirements in respect to design to be carried out by the contractor.
<i>Technical Objectives</i>	Technical Objectives define high-level standards, bench marks and aspirations for the design process as related to UNOPS <i>Policy for sustainable infrastructure</i> .
<i>UNOPS Direct Partner</i>	The party(s) (Host Government, Agency, etc.) that UNOPS signs a legal agreement with for provision of services.

G4 GLOSSARY OF TECHNICAL TERMS

The phrases in italics below are defined as follows:

- Accessibility*
(C5.TO 1) Is the degree to which a product, device, service, or environment is available to as many people as possible. Accessibility can be viewed as the "ability to access" and benefit from some system or entity. The concept often focuses on people with disabilities or special needs and their right of access.
- Air Changes per Hour*
(C6.PR 4) Is a measure of how many times per hour the total volume of air within a defined space (normally a room or house) is replaced.
- Cross Ventilation*
(C6.PR 2) Wind-induced ventilation uses pressures generated on the building by the wind, to drive air through openings in the building. It is most commonly realised as cross-ventilation, where air enters on one side of the building, and leaves on the opposite side, but can also drive single sided ventilation, and vertical ventilation flows
- Daylight*
(C6.PR 1) Is the combination of all direct and indirect sunlight during the daytime. This includes direct sunlight, diffuse sky radiation, and (often) both of these reflected from the Earth and terrestrial objects.
- Dew Point*
(C6.PR 3) Is the temperature at which the water vapor in air at constant barometric pressure condenses into liquid water at the same rate at which it evaporates.
- Embodied Energy*
(C2.PR 5) Is the sum of all the energy required to produce any goods or services, considered as if that energy was incorporated or 'embodied' in the product/material/component itself.
- Fire Hydrant*
(C4.PR 11) Is an active fire protection measure, and a source of water provided in most urban, suburban and rural areas with municipal water service to enable firefighters to tap into the municipal water supply to assist in extinguishing a fire.
- Fire Isolated Stair*
(C4.PR 2.h) a stairway within a fire-resisting shaft and includes the floor and roof or top enclosing structure. Fire isolated stairs are an integral part in the safe evacuation process of a building.
- Fire Rating*
(C4.PR 2.h) A fire-resistance rating typically means the duration for which a passive fire protection system can withstand a standard fire resistance test. This can be quantified simply as a measure of time, or it may entail a host of other criteria, involving other evidence of functionality or fitness for purpose.
- Fire Sprinkler System*
(C4.PR 6) Is an active fire protection measure, consisting of a water supply system, providing adequate pressure and flow rate to a water distribution piping system, onto which fire sprinklers are connected. A fire sprinkler discharges water when the effects of a fire have been detected, such as when a predetermined temperature has been exceeded.

<i>Fire Wall</i> (C4.PR 5)	A wall or partition designed to inhibit or prevent the spread of fire.
<i>Fire fighting Devices</i> (C4.FS 4)	Passive systems attempt to contain fires or slow the spread, through the use of fire-resistant walls, floors, and doors (amongst other measures such as compartmentalization). Active systems are characterised by items and/or systems, which require a certain amount of motion and response in order to work.
<i>Fitness for Purpose</i> (C2.PR 1)	Equates quality with the fulfilment of a specification or stated outcomes. The term generally refers to something that is good enough to perform the task it was designed to do
<i>Glazing</i> (C6.PR 1)	Is a part of a wall, roof or window made of glass.
<i>Greenhouse Gas</i> (B 7)	A greenhouse gas is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone. Greenhouse gases greatly affect the temperature of the Earth; without them, Earth's surface would average about 33 C° colder than the present average of 14 °C.
<i>Hazardous content</i> (C2.PR 4)	Are substances that can cause harm or damage to the body, property, or the environment.
<i>Heat Loss</i> (C6.PR 5)	Is the transfer of heat from inside to outside by means of conduction, convection, and radiation through all surfaces of a space.
<i>High-tech</i> (B 5)	High technology is technology that is at the cutting edge: the most advanced technology available.
<i>Human comfort conditions</i> (C6.PR 6)	Human thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation. Thermal neutrality is maintained when the heat generated by human metabolism is allowed to dissipate, thus maintaining thermal equilibrium with the surroundings. The main factors that influence thermal comfort are those that determine heat gain and loss, namely metabolic rate, clothing insulation, air temperature, mean radiant temperature, air speed and relative humidity. Psychological parameters such as individual expectations also affect thermal comfort There are two main different models that can be used: the static model (PMV/PPD) and the adaptive model. The PMV model can be applied to air-conditioned buildings, while the adaptive model can be generally applied only to buildings where no mechanical systems have been installed. There is no consensus about which comfort model should be applied for buildings that are partially air conditioned spatially or temporally.
<i>Indoor Air Quality</i> (C9-PR 1)	Is a term that refers to the air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants. It can be affected by gases (including carbon monoxide, radon, volatile organic compounds), particulates, microbial contaminants

(mold, bacteria) or any mass or energy stressor that can induce adverse health conditions.

Insulation, acoustic
(C2.PR 10)

Also known as 'soundproofing', is any means of reducing the sound pressure with respect to a specified sound source and receptor.

Insulation, thermal
(C2.PR 10)

Is the reduction of heat transfer (the transfer of thermal energy between objects of differing temperature) between objects in thermal contact or in range of radiative influence.

Life Cycle Cost
(C2.PR 3)

Sum of all recurring and one-time (non-recurring) costs over the full life span or a specified period of a good, service, structure, or system.

Low-tech
(B 5)

Low technology, is simple technology, often of a traditional or non-mechanical kind, and unsophisticated.

Natural Hazard
(C10-FS 1)

is a threat of a naturally occurring event that will have a negative effect on people or the environment. Many natural hazards are interrelated, e.g. earthquakes can cause tsunamis and drought can lead directly to famine or population displacement.

Natural Ventilation
(C6.PR 2)

Is the process of supplying and removing air through an indoor space without using mechanical systems. It refers to the flow of external air to an indoor space as a result of pressure or temperature differences. There are two types of natural ventilation occurring in buildings: wind driven ventilation and buoyancy-driven ventilation.

Radiant Barrier
(C2.PR 10)

(or reflective barriers) inhibit heat transfer by thermal radiation. However, radiant barriers do not necessarily protect against heat transfer via conduction or convection.

Renewable Resources
(C2.PR 5)

A renewable resource is a natural resource, which can replenish with the passage of time, either through biological reproduction or other naturally recurring processes. Renewable resources are a part of Earth's natural environment and the largest components of its ecosphere.

Rights of Way
(C1.PR 1)

The legal right, established by usage or grant, to pass along a specific route through grounds or property belonging to another.

Safety Factor
(C3.PR 7)

Is a term describing the structural capacity of a system beyond the expected loads or actual loads. Essentially, how much stronger the system is than it usually needs to be for an intended load.

Seismic Acceleration
(C3.PR 3)

Unlike the Richter and moment magnitude scales, it is not a measure of the total energy (magnitude, or size) of an earthquake, but rather of how hard the earth shakes in a given geographic area (the intensity).

Serviceability
(C3.FS 1)

In civil engineering, serviceability refers to the conditions under which a building is still considered useful. Should these limit states be exceeded, a structure that may still be structurally sound would nevertheless be

considered unfit.

Soil Bearing Capacity
(C3.PR 8)

Is the capacity of soil to support the loads applied to the ground. The bearing capacity of soil is the maximum average contact pressure between the foundation and the soil, which should not produce shear failure in the soil. There are three modes of failure that limit bearing capacity: general shear failure, local shear failure, and punching shear failure.

Structural Deflections
(C3.PR 4)

In engineering, deflection is the degree to which a structural element is displaced under a load. It may refer to an angle or a distance.

Structural Deformations
(C3.PR 4)

In materials science, deformation is a change in the shape or size of an object due to: an applied force (the deformation energy in this case is transferred through work); or a change in temperature (the deformation energy in this case is transferred through heat).

Structural System
(C3)

Also called structural frame, in structural engineering refers to the load-resisting sub-system of a structure. The structural system transfers loads through interconnected structural components or members to the ground.

Termite treatment
(C2.PR 9)

One of several different chemical measures, preservatives and processes (also known as timber treatment, lumber treatment or pressure treatment) that can extend the life of wood, timber, wood structures or engineered wood. These generally increase the durability and resistance from being destroyed by insects or fungus, in this case termite.

Thermal Performance
(C2.PR 10)

The thermal performance of a building depends on a large number of factors. They can be summarised as (i) design variables (geometrical dimensions of building elements such as walls, roof and windows, orientation, shading devices, etc.); (ii) material properties (density, specific heat, thermal conductivity, thermal transmission, etc.); (iii) weather data (solar radiation, ambient temperature, wind speed, humidity, etc.); and (iv) a building's usage data (internal gains due to occupants, lighting and equipment, air exchanges, etc.)

Ultimate Limit State
(C3.FS 2)

The ULS is not a physical situation but rather an agreed condition that must be fulfilled, among other additional criteria, in order to comply with the engineering demands for strength and stability under design loads. A structure is deemed to satisfy the ultimate limit state criterion if all factored bending, shear and tensile or compressive stresses are below the factored resistances calculated for the section under consideration.

Vapour Barrier
(C6.PR 3)

Is often used to refer to any material for damp proofing, typically a plastic or foil sheet, that resists diffusion of moisture through wall, ceiling and floor assemblies of buildings. Technically, many of these materials are only vapour retarders as they have varying degrees of permeability.

