

قطر للبتروول  
Qatar Petroleum



**DEVELOPMENT PLANNING AND ENGINEERING DEPARTMENT  
PROJECTS & ENGINEERING DIVISION**

**Design Guidelines for Road Pavement**

**QGL-CE-009**

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## 1.0 OBJECTIVES

The objectives of this document are to set out the design guidelines for the construction of roads and to define the design loads at road crossing within both Ras Laffan Industrial City and Mesaieed Industrial City under QP Industrial Cities Directorate.

## 2.0 SCOPE

The guidelines cover the design parameters for the construction of industrial roads and module corridors within both Ras Laffan Industrial City and Mesaieed Industrial City under QP Industrial Cities Directorate (QP-IC).

The construction design guidelines for roads and road crossing are based upon the design loads and load distributions resulting from the transportation of heavy equipment, and include but are not limited to, the following:

- Road Pavement
- Road Bridges
- Box Culverts
- Duct Banks
- Direct Buried Pipe

It is the policy of QP-IC that:

- 1) All major roads, industrial roads, and roads in support areas will be constructed and maintained by QP-IC Directorate.
- 2) End-User access roads, providing direct access from industrial roads to individual industrial plots, shall be constructed and maintained by End-Users.

## 3.0 DEFINITIONS AND ABBREVIATIONS

### 3.1 Definitions

Definition	Description
Contractor	A party engaged by QP, QP-IC, Investor or End-User to perform work and/or services under a Contract or Service Order.
End-User	A Company or firm that uses services, facilities and occupies RLIC/MIC land for the purpose of manufacturing a product or providing a service to QP/QP-IC or other tenants within RLIC/MIC.
Industrial Roads	All roads excluding the module corridor roads within Industrial Cities including the perimeter roads are covered under this category.

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Definition	Description
Module Corridor	Module Corridor Roads have been constructed to withstand a repetitive high load-bearing capacity arising as a result of transportation of wide range of heavy equipment, machinery from Ras Laffan port to the End-User industrial plants.
Shall	A mandatory action
Should	A preferred course of action or activity

### 3.2 Abbreviations

Abbreviation	Definition
BS	British Standards
CE	Manager, Development Planning & Engineering department
CED	Head of Infrastructure Development
CEI	Assistant Manager, Projects & Engineering, Mesaieed
CEL	Assistant Manager, Projects & Engineering, Ras Laffan
CPW	Consolidated Permit to Work
MC	Module Corridor
MIC	Mesaieed Industrial City
QCS	Qatar Construction Specifications
QHDM	Qatar Highway Design Manual
QNG	Qatar National Grid
QNHD	Qatar National Height Datum
QP-IC	Industrial Cities Directorate
QTM	Qatar Traffic Manual
RAP	Risk Assessment Approval
RLIC	Ras Laffan Industrial City

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## 4.0 PROCEDURAL STEPS

### 4.1 Design Guidelines for Road Pavement

Roads are categorized into two types: Modules Corridor Roads and Industrial Roads.

#### 4.1.1 Module Corridor Roads

The pavement design for the Module Corridor (MC) had taken into consideration the repetitive heavy loads generated from the Ras Laffan port route. As such, the pavement of the MC was designed in accordance with the British Port Association “The Structural Design of Heavy Duty Pavement for Port and Other Industries”. The design of Module Corridor extensions may be in accordance with the Qatar Highway Design Manual (QHDM), and Qatar Construction Specification (QCS) and shall be subject to QP-IC’s approval

#### 4.1.2 Industrial Roads

Industrial roads shall be designed in accordance with either the Qatar Highway Design Manual (QHDM) or the latest Qatar Construction Specifications (QCS). At a minimum, a minimum pavement design classification of T3 based on subgrade type “S1” shall be considered (refer to QHDM) with 50mm of wearing course.

#### 4.1.3 Loads and Load Factors

Design loads, in pavement design, shall be as per Item 4.2.3 below. The effects of dynamic loading, due to cornering, accelerating and/or braking shall be taken into account, together with Proximity factors where applicable. Proximity factors shall be considered to account for the effect of overlapping of the stress distribution generated by wheels. This effect is a function of the CBR of the supporting sub grade. Refer to British Ports Association – The Structural Design of Heavy Duty Pavement for Ports and Other Industries.

### 4.2 Design Guidelines for Loads at Road Crossing

It shall be the responsibility of all End-Users and their road contractors to ensure that design and construction of road crossing infrastructure (i.e. concrete box culvert, concrete duct bank or direct buried pipe) under existing or future roads are done in accordance with the design basis and specifications mentioned below.

The design of road crossing shall take into consideration the following:

#### 4.2.1 Design Basis

1. The design life of road crossing shall be 40 years, with due note being taken of the dusty, hot, humid, salt-laden atmosphere of the State of Qatar, and the

proximity to the Arabian Gulf.

2. Site Conditions as set out below (see **Item 4.2.2** below)
3. Construction, Permanent and Live Loads shall be taken as the greater of design loads as given in this guideline or as specified in British Standard **BS 5400: Part 2**.
4. All applicable load combinations shall be as per British Standard **BS 5400: Part 2**.
5. For applicable loading that needs to be considered for the design such as dynamic effect, cornering, braking, acceleration etc. refer to **BS 5400: Part 2 and BS 5400: Part 4** for requirements.
6. Where reference is made to HA or HB loading it is considered to include a dynamic impact allowance of 25% (refer Cl. 6.1 and Appendix A, **BS 5400: Part 2**).
7. Dispersal of wheel loads shall be spread to depth ratio of 1 horizontally to 2 vertically through the surfacing and overburden.
8. Units of measurement shall be in accordance with SI standards. Refer to **BS ISO 1000** and **BS 350**.
9. Levels shall be related to Qatar National Height Datum (**QNHD**) and Co-ordinates shall be related to Qatar National Grid (**QNG**).

#### 4.2.2 Site Conditions

1. Type of soil where the road crossing will be constructed (i.e. Rock, Sabkha, desert fill, sand etc.).
2. Water table level at the location and the effect of buoyancy. Consider a minimum design water table level of +1.25 QNHD.
3. Method of transportation of equipment over the crossing.

#### 4.2.3 Design Loads

The design parameters for road and road crossing loading are as follows:

##### 4.2.3.1 Permanent Loads

- a) Dead load of concrete structure element, with  $\gamma_{\text{concrete}} = 25.0 \text{ kN/m}^3$
- b) Overburden dead load of fill material over the concrete structure, consider two cases for the design, 0.2m and 1.0 m thickness, with  $\gamma_{\text{soil}} = 20 \text{ kN/m}^3$ .
- c) Road Surfacing dead load, consider 0.25 m minimum thickness, with  $\gamma_{\text{road}}$

surface = 24kN/m<sup>3</sup>.

#### 4.2.3.2 Live Load

- 1) HB45 Abnormal Vehicle
  - a) Axle load of 45 Mton (inclusive of 25% dynamic impact allowance), with 4 wheels (at 1.0m centers) per axle and 1.8m spacing between axles (as defined for a HB vehicle in **BS 5400: Part 2**).
  - b) 112.5kN wheel load.
- 2) Abnormal Multi-Axle Trailer
  - a) Trailer assemblies, for transporting heavy equipment, typically comprise of a number of smaller axle-units, side-by-side, to form an axle-line in the transverse direction and axle rows in the longitudinal direction/travel direction. Each axle-unit typically consisting of 2 double-wheels (at 0.75m to 0.84m centers) per axle.
  - b) Design Axle-unit Loads shall be taken as 15 Mton per axle-unit (allowable axle load). Consider an additional 20% load increase for dynamic impact allowances.
  - c) 90kN double-wheel Load (75kN plus 20% impact i.e. 37.5kN allowable load per wheel)
  - d) A trailer assembly of 2 x axle rows with 10 axle-lines at 1.3m spacing between axle-lines is equivalent to a 30Mton Axle-line load, with an overall width 3.0 m. Maximum Allowable/ Minimum Design Payload shall be 300Mton.
  - e) A trailer assembly of 4 x axle rows with 12 axle-lines at 1.510m spacing between axle-lines is equivalent to a 60Mton Axle-line load with overall width of 6.24m. Maximum Allowable/ Minimum Design Payload shall be 720Mton.
  - f) A trailer assembly of 3 x axle rows with 16 axle-lines at 1.510m spacing between axle-lines is equivalent to a 45Mton Axle-line load with an overall width of 4.8m. Maximum Allowable/ Minimum Design Payload shall be 720Mton.
  - g) A Minimum Uniform Surcharge/Maximum Equivalent Uniformly Distributed load of **5-MTon/ m<sup>2</sup>** shall be considered in the design, for abnormal multi-axle trailers for transporting heavy equipment, applied over the “effective projected area”. Consider an additional 20% load increase for dynamic effect.



#### 4.2.3.3 Horizontal Loads

- a) Earth Pressures due to Surcharge load as per Section **4.2.3.2-2)-g)** above.
- b) A horizontal force of 5% of the total payload (inclusive of weight of trailer) of 720 ton for trailer assemblies, as per the above, shall be considered (with 4 driven axles) to overcome acceleration and gradients to start the movement and is to be allowed for in the design.
- c) Earth Pressures due to Surcharge load and horizontal loads to be considered for the design shall be as per **BS 5400** for HB45 vehicle.

#### 4.3 Road Crossing

All future road crossing shall be performed utilizing trenchless construction. Method Statements and Detail Drawings, incorporating the above requirement, must be submitted for QP-IC's review and approval. Deviation from the above will only be allowed in rare circumstances.

Spacing requirements with respect to the crossing of roads by any above or underground utilities, pipelines or cables are dealt with in **QGL-CE-001**– Guidelines for Corridors and Corridor Crossings.

### 5.0 RESPONSIBILITIES

This section highlights the responsibilities of the key parties directly involved in the process described by the document.

#### 5.1 QP Industrial Cities directorate

QP Industrial Cities directorate is responsible for:

- Updating information included in this document
- Providing, upon written request, up-to-date documents and drawings as referred to in section 6.

#### 5.2 End-Users

End-Users are required to adhere to these guidelines and requirements and to other stipulations, which may be imposed by other regulations, procedures and guidelines documents. QP-IC will work with End-Users to the mutual benefit of both parties.

Design of any work shall comply with the requirements of latest standards or code of practice of British Standards and/or Eurocodes. If the End-Users wish to use alternative standards, the End-Users shall demonstrate compliance with the specified

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standards and obtain QP-IC's approval prior to proceeding further. In case of conflict between standards or code of practice, the most stringent one shall apply, in concurrence of QP-IC.

## 6.0 REFERENCES

It is incumbent to End-User / contractor to confirm that the latest revision of the Documents / Regulations / Drawings is employed. Documents are available, upon written request, from QP-IC.

1. **SK-RLC-00518** – Road Network Drawing
2. Qatar Highway Design Manual (**QHDM**) (Latest revision)
3. Qatar National Height Datum (**QNHD**)
4. Qatar National Grid (**QNG**)
5. Qatar Construction Specifications (**QCS**) (Latest revision)
6. **BS 5400: Part 2** – British Standard, Specification for Loads
7. **BS 5400: Part 4** – British Standard, Code of Practice for design of Concrete Bridges.
8. British Ports Association – The Structural Design of Heavy Duty Pavement for Ports and Other Industries.
9. British Standard **BS ISO 1000**
10. British Standard **BS 350**
11. **QPR-RHT-REG-001** – Health, Safety and Environment Regulations
12. **QPR-CHR-001** – Risk Assessment Procedure
13. **QRG-DC-004** – Procedure and Regulation governing the requirements for Consolidated Permit to Work in QP Industrial Cities Common Areas.
14. **QGL-CE-001** – Guideline for Corridors and Corridor Crossings
15. **EQGL-RHS-101** – RLC Security Philosophy and Guidelines Summary
16. **QPR-DP-RHS-002** – Industrial Security Pass Guidelines for End-Users/ Main Contractors
17. **QP-MPR-004** – Heavy Lift and Over Dimensions Cargo Procedure

## 7.0 ATTACHMENTS

Not applicable.