# Engineering Specification for

## The Design, Construction and Testing of Civil and Structural Works – Part 12: Protection Works Over Steel Pipelines

# GD/SP/CE/12

**Issue Date: July 2019**

*This document is a reference document within the company Safety Case, all changes to this document shall be notified to the Head of SHES before any changes are initiated.*

## Version Control

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Disclaimer

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Mandatory & Non-Mandatory requirements:

In this document:

**Shall:** Indicates a mandatory requirement.

**Should:** Indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment must be completed to show that the alternative method delivers the same, or better, level of protection

**The Company:** Any reference in this document to 'The Company' shall be taken to mean Cadent Gas Ltd.

## Document History

| Description | Date | Reference |
|---|---|---|
| Editorial update for National Grid re-branding | October 2005 | T/SP/CE/12 |
| Revised and re-issued | December 2008 | T/SP/CE/12 |
| Revised and amended to align with Structural Eurocode Implementation & inclusion of PE Slab Materials | April 2014 | T/SP/CE/12 |
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## Contents

# Document Summary

## Purpose

This work procedure was approved by the Head of Engineering, in July 2019 for use throughout The Company.

**Users should ensure that they are in possession of the latest edition and related bulletins by referring to the document library of Safety and Engineering documents available on the company Infonet.**

Compliance with this safety and engineering document does not confer immunity from prosecution for breach of statutory or other legal obligations.

This "Engineering Specification for The Design, Construction and Testing of Civil and Structural Works – Part 12: Protection Works Over Steel Pipelines" is part of the suite of Specifications noted below:

| | | |
|---|---|---|
| GD/SP/CE/1 | General - Specification | Specification |
| GD/SP/CE/1 | Appendix A | Specification |
| GD/SP/CE/2 | Geotechnical, ground works and foundations | Specification |
| GD/SP/CE/3 | Fencing - Specification | Specification |
| GD/SP/CE/4 | Equipment enclosures and pit covers | Specification |
| GD/SP/CE/12 | Pipeline protection slabs | Specification |
| GD/SP/CE/13 | Technical Security Specification for Integrated Security Sites and Alarm Receiving Centre | Specification |
| GD/SP/CE/14 | Horizontal Directional Drilling (HDD) | Specification |

## Responsibilities

This document applies to all those working directly for Gas Distribution e.g. employees, or under the direction of The Company, e.g. contractor mate working in a direct labour team.

# 1. SCOPE

## 1.1. Introduction

1.1.1. The “Specification for the design, construction and testing of civil and structural works” is made up of a suite of seven separate Specifications. It provides design and construction requirements for all new works and modifications to existing assets which include the structural design of buildings and civil engineering works, as well as geotechnical aspects.

1.1.2. The structural Eurocodes require certain parameters/approaches/choices to be specified or determined on a project-specific basis. The Designer shall ensure that appropriate Eurocode parameters are selected for applicable sections where choice is permitted by the Eurocodes. Specific Company requirements and guidance are given in Appendix A of GD/SP/CE/1.

1.1.3. Any deviation to the Design, including non-adherence to the Specifications and drawings, or, use of innovative products where no recognized publications exist, shall be recorded, approved and appraised in accordance with GD/PM/GR/2: “Procedure for the technical assessment of deviations, concessions and variants”.

## 1.2. Scope

1.2.1. This Specification is part of a set of documents covering the design and construction of Pipeline Protection Works for use over steel gas pipelines at maximum operating pressures *up to 94 barg* and defines the minimum requirements for design, materials, workmanship and testing of the works. It is intended for use only within the United Kingdom except N. Ireland.

1.2.2. This Specification shall be read in conjunction with the appropriate parts of the CE series Specifications. In particular, the general requirements, design, materials, workmanship and testing requirements of GD/SP/CE/1 shall be applied to the design and installation of protection works over steel pipelines.

This Specification includes a number of “Standard Designs” for the following:

- Impact protection slabs
- Temporary & permanent crossing point slabs
- Haul roads (crossing points)

which, provided the application criteria are met, obviate the need for further analysis.

1.2.3. The Specification excludes any additional measures that may be required to reduce the risk of damage from earthquakes. The Company seismic policy shall be applied and any additional measures arising from the seismic policy shall either, by preference, be instructed in the project brief, or alternatively agreed with The Company as a Deviation to this Specification.

## 1.3. References

1.3.1. Reference to other documents including European, British and International Standards are made in GD/SP/CE/1. Unless otherwise specified at the time of Tender, the latest editions of such documents, including all addenda and revisions, current at the date of the Tender issue shall apply.

1.3.2. Company documents are revised, when necessary, by the issue of new editions. Users shall ensure that they are in possession of the latest edition by referring to the Gas Documents Library available on infonetUK (company intranet). Company documents shall take precedence over any other documents other than statutory or legal requirements.

1.3.3. Compliance with this Document does not confer immunity from prosecution for breach of statutory or other legal obligations.

1.3.4. It shall be the responsibility of the Designer to check the validity of this Specification in relation to the requirements of the specific projects' and propose any variations through the Deviation process.

## 1.4. Material Product Specifications

1.4.1. Material and product specifications used in the design of pipeline protection works shall comply with the requirements of GD/SP/CE/1 as supplemented by the specific requirements given in Section 7 of this specification.

## 1.5. Definitions

1.5.1. For the purpose of this Specification the following definitions shall apply:

1.5.2. **Abnormal Indivisible Load (AIL) –** a load that cannot without undue expense or risk of damage be divided into two or more loads for the purpose of being carried on a road, and that owing to its dimensions or weight cannot be carried on a motor vehicle or trailer or a combination of such vehicles that complies in all respects with Part 2 of the Road vehicles (Construction and Use) Regulations

1.5.3. **Artificial fill -** designed compressible fill e.g. polystyrene or similar.

1.5.4. **Californian Bearing Ratio (CBR) test –** a standardised soil test procedure begun by California State Highways Department in 1929 for comparing the strengths of base courses of roadways to determine the suitability of the soil with respect to its strength stiffness and moisture content. See the appropriate British or European Standard.

1.5.5. **Characteristic value of an action –** the main representative value of an action specified as a mean value, an upper or lower value, or a nominal value.

1.5.6. **Contractor:** The person or organisation who undertakes installation, inspection, testing and commissioning activities as well as purchasing of materials and services to undertake these activities.

1.5.7. **Crossing point slabs -** those pipeline protection slabs initially installed at, or close to, the ground surface and intended to spread the load of vehicles crossing above the pipeline thereby providing a designated crossing point. Such slabs may also be required to provide impact protection.

1.5.8. **Design:** The set of drawings, calculations and associated documentation required to achieve the objectives of the Design Brief (a descriptive statement which outlines the project-preferred solution).

1.5.9. **Design Output Package (DOP):** The set of 'checked' and 'approved' documents required for the specification and construction of the asset. DOP includes the design specifications, drawings, calculations and associated documentation.

1.5.10. **Deviation -** A one off change from the requirements of an Engineering Standard. The original requirements of the standard shall be adhered to until a deviation is approved. Deviations shall be managed in accordance with Clause 1.1.3.

1.5.11. **Dynamic amplification factor –** a factor by which the characteristic value of a traffic loading is multiplied to take account of its dynamic effect.

1.5.12. **Haul road -** a designed and constructed crossing point e.g. bog/excavator mats, road plates, stone roads or similar.

1.5.13. **Heavy Goods Vehicle (HGV) –** a goods carrying vehicle over 3,500 kilograms design gross weight.

1.5.14. **Impact protection slabs -** pipeline protection slabs buried above a pipeline and whose primary function is to reduce the likelihood of third party damage to the pipeline e.g. from excavators in compliance with the requirements of IGEM/TD/1.

1.5.15. **Lateral encroachment -** the horizontal dimension between the edge of the slab and the face of the pipe.

1.5.16. **Load Model 1 (LM1) -** Concentrated and uniformly distributed loads covering most of the effects of the traffic. The characteristic values and the adjustments factors for LM1 are derived from BS EN 1991 "Actions on structures. Part 2: Traffic loads on bridges" and the National Annex. Dynamic amplification is included in the characteristic values.

1.5.17. **Load Model 2 (LM2) -** A single axle load applied on specific tyre contact areas covering the dynamic effects of the traffic on short structural members. Its characteristic value and the adjustment factor are derived from BS EN 1991 "Actions on structures. Part 2: Traffic loads on bridges". Dynamic amplification is included in the characteristic value.

1.5.18. **Load Model 3 (LM3) SV -** A set of assemblies of axle loads representing special vehicles simulating vertical effects of different types of Special Types General Order vehicles (SV80, SV100, SV196) as indicated in the National Annex to BS EN 1991 "Actions on structures. Part 2: Traffic loads on bridges". In determining the load effects of SV vehicles, the basic axle loads shall be multiplied by the appropriate dynamic amplification factor as indicated in the National Annex to BS EN 1991-2.

1.5.19. **Load Model 3 (LM3) SOV -** A set of assemblies of axle loads simulating vertical effects of Special Order Vehicles (SOV), as indicated in the National Annex to BS EN 1991 "Actions on

structures. Part 2: Traffic loads on bridges".

1.5.20. **Nominal design trench width -** the trench width given in Table 1 of this Specification and adopted as the clear span in the standard slab designs in referred to in Section 6.

1.5.21. **Permanent actions -** the self weight of the slab and any soil and road construction materials over the slab.

1.5.22. **Pipe cover -** the thickness of material (including concrete protection slab and road construction where present) from the pipe crown to the finished ground level.

1.5.23. **Reinforcement cover -** the thickness of any concrete between the outermost reinforcing bar and the nearest face of the concrete member.

1.5.24. **Road Vehicles Construction and Use (C&U) Regulations 1996 as amended -** primary legislation for the construction and maximum dimensions for vehicles.

1.5.25. **Slab cover -** the thickness of material from the top surface of the slab to the finished surface level.

1.5.26. **Slab length -** the dimension of the slab parallel to pipe longitudinal axis.

1.5.27. **Slab width -** the dimension of the slab transverse to the pipe longitudinal axis.

1.5.28. **Special Order Vehicles (SOV) -** vehicles types representing the largest and heaviest vehicles permitted to move on the highway network, characterised by gross weights over 150 tonnes. They are governed by Section 44 of the 1988 Road Traffic Act.

1.5.29. **Special Types General Order (STGO) vehicles -** vehicles types characterised by gross weights of 150 tonnes or less. They are governed by the Road Vehicles (Authorisation of Special Types – General) Order 2003 No.1998, i.e. STGO Regulations.

1.5.30. **Support width -** the width of each bearing strip on which the slab is supported.

1.5.31. **Surcharge loading -** loading other than vehicles, applied above the existing or proposed pipe cover e.g. stacked materials or further soil over and above that already placed or proposed.

1.5.32. **Traffic loading -** variable action arising from the passage of vehicles or construction equipment which includes, when relevant, dynamic effects and centrifugal, braking and acceleration actions and actions for accidental design situations. The characteristic action value for a given vehicle or item of construction plant shall be taken as that given in the Manufacturers' Data Sheets including any payload.

## 1.6. Drawings

1.6.1. Drawings produced for the project shall be prepared in accordance with GD/SP/RE/3: "Management Procedure for Engineering Drawing Records"

1.6.2. For protection slabs the drawings shall include the following details

- location of slab over pipeline.
- general arrangement and cross section drawings showing slab dimensions and relative position to the pipeline, setting out points of the slab, grid North sign.
- reinforcement drawings and bar bending schedules.
- drawings should make reference to GD/SP/SSW/22 and list all residual risks.

## 1.7. As built drawings and documents

1.7.1. The Contractor shall provide on completion of siteworks all as-built drawings and other documents including delivery notes, material certificates and manufacturing, operating and maintenance instructions, if relevant, covering the components of the completed construction, and, shall identify all changes from the construction issue drawings and documents.

## 1.8. Personnel undertaking design, construction and testing

1.8.1. Personnel undertaking or supervising designs, investigations, construction and testing shall be competent, experienced and qualified in the specific area of works.

## 1.9. Design life

1.9.1. The minimum design life expectancies of all permanent pipeline protection works shall be 100 years.

1.9.2. The Designer shall propose a design life for temporary pipeline protection works, based on the anticipated duration of the temporary condition and the likelihood of this being extended due to unforeseen circumstances.

## 1.10. Design and Construction

1.10.1. The Designer and / or Contractor shall comply with the procedure described in GD/PM/G/17: "Management procedure for the management of new works, modifications and repairs" and with the requirements of the Construction (Design and Management) Regulations (CDM Regulations) with due consideration given to full life cycle of project.

1.10.2. Any changes to the specifications, designs or drawings proposed or due to changes to the basis of the design shall be immediately brought to the attention of the Designer. The Designer shall consider such changes and recommend acceptance, modification or rejection of the design change process in accordance to the procedure described in GD/PM/G/17.

1.10.3. The design and construction of the works shall take due cognizance of the geo-environment, other infrastructure and watercourses and include due allowance for the effects of the geo-environment, climate and time upon the ground and the resultant interaction of the assets with the ground to enable the integrity, durability and performance of the works to meet the above requirements. The respective design and construction method statement submissions shall contain all relevant details necessary to demonstrate that the above requirements shall be met, including any details of monitoring and action trigger levels and subsequent actions proposed to ensure that the execution of the work complies with the design analysis or that departures from such design predictions remain tolerable.

1.10.4. Temporary works required during construction, modification or maintenance of the works shall be managed in accordance with GD/PM/SHE/103 ‘Control of Temporary Works’, which defines the roles and responsibilities of the different people and organisations involved, as well as the key appointments which shall be made and key procedures which shall be followed.

# 2. DESIGN

## 2.1. General Requirements

2.1.1. Prior to deciding to install a pipeline protection slab over a new or existing pipeline, consideration should be given to its necessity, any risks involved in its installation and whether any alternatives exist. A Soil Pipeline Interaction Analysis (SPIA) shall be carried out to confirm the need for a pipeline protection slab.

2.1.2. Reference should be made to GD/PM/SSW/2 “Management Procedure for safe working and development in the vicinity of gas pipelines and associated installations – Requirements for The Company” and GD/PM/SSW/22 “Specification for safe working in the vicinity of Cadent high pressure gas pipelines and associated installations – Requirements for third parties” as appropriate.

2.1.3. Pipeline protection can take the form of:

- impact protection slabs – see Section 3.
- stream and ditch crossing slabs – see Section 3.6.
- temporary access solutions - see Section 4.2.
- construction of a haul road – see Section 4.3.
- temporary crossing point slabs – see Section 4.4.
- permanent crossing point slabs – see Section 5.

2.1.4. Where pipeline protection is required to reduce the stress or strain in the pipe, reference shall be made to GD/SP/GM/1, the “Procedure for the protection of pipelines from ground movement and external loading. External loading on Steel Pipelines”.

## 2.2. Design requirements for protection slabs

2.2.1. Protection slabs shall be designed in accordance with the relevant parts of the Structural Eurocodes including the basic requirements of BS EN 1990, the actions from BS EN 1991, the geotechnical provisions of BS EN 1997.

2.2.2. The analysis of the stresses and strains arising in the pipeline shall take into account the requirements of GD/SP/GM/1, the Procedure for “The protection of pipelines from ground movement and external loading. External loading on Steel Pipelines” and the effects of the proposed slab designs. This shall take into account the maximum and minimum temperatures at the location of the crossing relative to the tie-in temperature.

2.2.3. Also, where the slabs are installed within 3 pipe diameters of forged bends which have a bend radius of 5 pipe diameters or less, a specific assessment of the pipeline integrity shall be undertaken, taking into account the stress concentration effect on the bends.

## 2.3. Slab requirements

The length of the slab should be extended for at least 1.0m beyond the kerbline or the road boundary. This should be agreed between the third party and Cadent.

## 2.4. Protection against removal of slab

2.4.1. If the slab is ever likely to be removed, the requirements of Section 3.4 to protect against impact from handheld jackhammer shall be complied with. This requirement applies to all temporary protection slabs (including pre- cast slabs since there is a possibility these may be removed by breaking up on-site).

## 2.5. Pre-cast concrete

2.5.1. Pre-cast concrete slabs may be used for ease of placing or to enable removal for maintenance. Pre-cast concrete slabs shall be fitted with permanent lifting eyes and shall be designed for the effects of lifting and placing. The design shall specify the capacity and position of the lifting eyes to ensure they are capable of lifting the slab. Lifting eyes shall be designed and installed in accordance with Manufacturers' instructions, taking account of the temporary load concentrations at the lifting points.

## 2.6. In-situ concrete

2.6.1. Slabs may be designed for in-situ concrete. Where in-situ concrete slabs are to be adopted, the Designer shall consider the requirements for joints (if required) and shall define the details and positions of all, expansion, contraction and construction joints required by the design. The details and positions of any joint shall comply with Manual of Contract Documents for Highway Works (MCHW) Volume 3.

2.6.2. It is not envisaged that protection slabs will be of such length as to require contraction, expansion or construction joints, but in the event of the Contractor or The Company, considering that any situation requires them (including where slab length is greater than 15m), the joint design shall be produced by a competent Civil Designer andcomply with the requirements of Highway Works (MCHW) Volume 3.

## 2.7. Age at time of loading

2.7.1. The design of a concrete slab shall take account of its age and hence strength at the time when loads may be applied. The minimum strengths of concrete prior to the application of any loads shall be clearly stated on the drawings. If this strength is required prior to the 28 days following casting, then sufficient additional concrete compressive strength test samples shall be taken to provide verification that this required strength has been achieved before loading is applied. See also the appropriate sections in the CE series Specifications.

## 2.8. Artificial Fill

2.8.1. If the loads from the pipeline permanent crossing point slab cause the pipeline to be overstressed, a layer of compressible material can be provided immediately below the slab to reduce the stresses.

2.8.2. The material, type, grade and thickness of artificial fill required shall be designed to take account of the calculated settlement of the slab. The minimum thickness of the artificial fill should be 150mm and the grade should be expanded polystyrene Grade EPS 70 to BS EN 13163:2012.

2.8.3. The minimum clearance between the pipeline and any artificial fill material shall be 150 mm. Both these clearance dimensions are to prevent the presence of the slab having an adverse effect on the pipeline's cathodic protection system.

## 2.9. Nominal trench width

2.9.1. The nominal design trench width shall not be taken as less than that shown in Table 1 unless special measures are, or have been taken to ensure a lesser trench width. Where it is known that the actual trench width is greater, this greater dimension shall be used for the design of the slab, or the material up to the level of the slab on which the slab rests shall, where practical, be compacted to the standard required by the design. Where such material cannot be compacted to the desired standard, it shall be removed and replaced with imported granular material as specified in Section 7.2 and compacted to the requirements of Section 8.5.

| Nominal Pipe Size (mm) | Nominal Design Trench Width (mm) |
|---|---|
| Up to 300 | 700 |
| 450 | 900 |
| 500 | 950 |
| 600 | 1050 |
| 750 | 1200 |
| 900 | 1350 |
| 1050 | 1700 |
| 1200 | 1850 |

**TABLE 1: Nominal design trench width**

## 2.10. Piling

2.10.1. Where the compaction requirements cannot be achieved, consideration may need to be given to supporting the slab on piles. Where piles are to be used, consideration shall be given to both the possibility of additional temporary loading applied to the pipe from the piling rig and the vibration effects during the piling works. Reference shall be made to GD/SP/GM/4 "Specification for the protection of steel pipelines operating at pressures above 7 bar subjected to vibrations caused by blasting, piling or demolition".

## 2.11. Soil-structure interaction

2.11.1. When designing permanent crossing point slabs, account should be taken of the stiffness, or lack of stiffness, of the soil support on which the slab rests. If a manual calculation approach is adopted, the span of the slab, should not be taken as the nominal design trench width, but should be increased. The span multiplying factor to be used should be chosen by the Designer, but for guidance, a factor of less than 1.5 is typically considered insufficient.

In addition to the span moment, a hogging moment should be calculated to allow for a wheel load on the edge of the slab, unless wheel loading at the edge of the slab is prevented (e.g. by appropriate fencing).

## 2.12. Actions

2.12.1. Protection slabs shall be designed to support the following actions where applicable, ensuring that the most onerous combination of actions for the relevant design situation is taken:

- permanent actions, represented by the self weight of the slab and the soil load above the slab including road construction, etc.
- variable actions, including traffic and surcharge loading.

## 2.13. Self weight of slab

2.13.1. The self-weight of concrete slabs shall be in accordance with BS EN 1991-1-1.

## 2.14. Soil loading

2.14.1. The loading imposed by soil onto a buried slab shall be derived in accordance with the principles of BS EN 1997.

## 2.15. Traffic and surcharge load models

2.15.1. The Designer shall establish the type of vehicles which may feasibly apply loading onto the protection slab. This may include, as appropriate:

- Traffic permitted to use public highways.
- Abnormal loads.
- Agricultural plant.
- Tracked vehicles.
- Construction plant (including cranes, quarrying vehicles and equipment).
- Railway traffic.
- Aircraft.

2.15.2. The Designer shall establish an appropriate load model which adequately represents the loading applied by the vehicles onto the protection slab. The load model shall represent the effects of:

- Global effects (overall loads).
- Local effects (such as concentrated loading due to wheel loads or outriggers).
- Statistical variation of actual vehicle weights.
- Size of trafficked area.
- Dynamic amplification effects (e.g. due to vehicle suspension and surface roughness).
- Surcharge to buried elements.
- Horizontal loads where applicable (e.g. due to traction, braking, skidding).
- Accidental effects where applicable.

2.15.3. Values of traffic loads appropriate to the post-construction stage of the installation may be determined from various sources relevant to the land use of the surface above the pipeline

protection slab. (Note that construction equipment used to complete the installation may however provide the critical design condition).

The sections below give load models which may be used in particular cases:

- Public Highways
- Agricultural land
- Private traffic load routes

2.15.4. Where alternative load models to these are proposed, the load models shall include definitions of the following:

for wheeled vehicles:

- maximum wheel loads.
- axle spacing.
- number of wheels on each axle.
- wheel contact patch centres.
- tyre pressures or contact patch areas.

for tracked vehicles:

- track width.
- track length in contact with ground surface.
- track spacing.
- track contact pressures.

2.15.5. Similarly, should the pipeline or slab be subjected to loading from crane outriggers or other concentrated load, the following is required:

- contact areas.
- shape and size.
- contact pressures.
- position/centres of outriggers relative to pipeline.

## 2.16. Application of load models

2.16.1. Traffic loads shall be applied to protection slabs and the slabs shall be designed in accordance with the relevant parts of the Structural Eurocodes including the basic requirements of BS EN 1990, the actions from BS EN 1991 and the geotechnical provisions of BS EN 1997. This includes the use of relevant partial and combination factors and verification at applicable limit states.

2.16.2. Where traffic loads need to be used in a stress analysis of the pipeline, this shall be carried out in accordance with GD/SP/GM/1. This will require selection of a traffic load model which is consistent with the assumptions underpinning the pipeline stress analysis and which provides an appropriate overall factor of safety.

2.16.3. Where alternative load models (to the ones provided in this specification) are used, characteristic wheel load values shall be multiplied by an impact factor to take account of the dynamic effects of moving loads. Table 2 provides the appropriate impact factors to be used for the design of slabs and for analysis of stresses in the pipe.

| Type of vehicle | Impact Factor | |
|---|---|---|
| | For design of slab | For analysis of stresses in pipe |
| LM1, LM2, LM3 taken from BS EN 1991-2 | 1.00 | 1.5 |
| Traffic on private traffic routes | 1.00 | 1.5 |
| Traffic on agricultural land | 1.25 | 2.0 |
| Wheeled vehicles other than construction equipment | 1.00 | 1.6 |
| Tracked vehicles | 1.25 | 2.0 |
| Construction plant | 1.25 | 2.0 |
| Vibratory construction plant | 2.50 | 4.0 |
| Railway | To be established by the Designer | |
| Aircraft runway | | |

**TABLE 2: Impact factors**

## 2.17. Load dispersal

2.17.1. Where loads due to traffic or surcharge are applied over a permanent crossing point slab and such loads are applied over a finite contact area, dispersion of such loads through any soil (including the thickness of any road construction) placed over the slab, may be considered in the design. Such dispersion may be assessed by:

- the dispersal rules given in BS EN 1991-2, or
- the use of recognised load dispersion theories (e.g. such as the Boussinesq equation).

## 2.18. Traffic loadings on public highways

2.18.1. For a pipeline protection slab below a public highway, the representative values of traffic actions, their application on notional lanes and their combinations shall be determined according to BS EN 1991 “Actions on structures. Part 2: Traffic loads on bridges” and the UK National Annex. The traffic models for design should be appropriate for the location of the pipeline and the class of traffic. The following load models should be applied where appropriate:

- For pipelines under or adjacent to public highways: LM1, LM2 and LM3 (with the LM3 vehicles appropriate to the type of highway, as required by the Highway Authority), which gives a maximum axle load of 400kN;
- For pipelines that are remote from public highways but are subject to traffic loading that Cadent have little or no control over: LM3 (based on SV100 vehicles), which gives a maximum axle load of 165kN;
- For pipelines that are remote from public highways and subject to traffic loading that is controlled to vehicles that are permitted to use the highway without special authorisation: 0.685 × LM3 (based on SV100 vehicles), which gives a maximum axle load of 113kN.

## 2.19. Traffic loading on private traffic routes

2.19.1. The landowner or Tenant should be consulted to determine the types of vehicles that use or are expected to use the route. From this and any other relevant information, the Designer shall determine the appropriate traffic loading upon which the slab design is to be based. In cases of doubt guidance should be sought from the Competent Design Authority (CDA).

2.19.2. In situations where the types of vehicle using the crossing can be controlled, and where all vehicles are within the scope covered by The Construction and Use (C&U) Regulations 1996 as amended (i.e. abnormally large or heavy vehicles cannot use the crossing), then the following load model may be used:

- Factored 0.685 x SV100 vehicle taken from the National Annex to BS EN 1991-2, which produces a maximum axle load of 113kN, applied as a LM3 in accordance with BS EN 1991-2.

2.19.3. In situations where the types of vehicle using the crossing are unknown or cannot be controlled, then the full loading applicable to a public highway shall be used, using the SV80, SV100 and SV196 models for LM3.

2.19.4. In situations where abnormal vehicles can reasonably be expected to use the crossing (e.g. approaches to quarries) then the Designer shall select and apply an appropriate load model which may include some of the SOV vehicles from the National Annex to BS EN 1991-2 or other appropriate heavy-load models.

## 2.20. Traffic loading on agricultural land

2.20.1. For pipeline protection slabs in agricultural land, the minimum characteristic value of traffic loading shall be taken as two wheels on a single axle, at 1.6 m c/c, each with a wheel load value of 30 kN. The assumed contact area shall be taken as 385 mm square or 437 mm diameter.

# 3. IMPACT PROTECTION SLABS

## 3.1. General

3.1.1. Impact protection slabs should be installed to provide additional protection as required by IGEM/TD/1 “Steel pipelines for high pressure gas transmission” to reduce the likelihood of pipeline damage by mechanical plant.

3.1.2. In cases where temporary or permanent crossing point slabs also need to provide impact protection, the temporary or permanent crossing point slabs shall be designed to incorporate the requirements from this section for impact protection slabs.

3.1.3. Impact protection slabs should:

- not be considered as ‘loadbearing’ but should not fragment when subjected to loading by traffic, or excavating machinery including surface scrapers and telegraph pole augers.
- not be used in designated temporary or permanent traffic routes.
- not adversely affect the stress state in the pipeline.
- be installed within 1.2 m of surface ground level
- be marked with “HP GAS” on top surface e.g. concrete slabs should be laid with plastic marker tape along the concrete slab edges.

3.1.4. Where for any reason the standard impact protection slabs are not used, a case-specific slab shall be designed by the Proposer/Developer/Contractor and full details, including calculations, specifications and method statements submitted to Cadent as appropriate for approval in accordance with the procedures given in Section 1.10.

3.1.5. For general third party damage protection, consideration may be given to installing impact protection slabs made from other materials e.g. plastic, but if they are used the following should be taken account of, in addition to the above:

- stiffness of material so that it is obvious that it is there for a purpose.
- strength so that it does not bend or fragment under the impact of an excavator.
- colour – preferably yellow, so that it is associated with gas.

## 3.2. Standard Impact protection slabs

3.2.1. Standard impact protection slabs shall comply with Figure 1.

3.2.2. They may be constructed of in-situ or pre-cast concrete.

3.2.3. Figure 2 in this Specification provides an indicative arrangement of an alternative method. A full design analysis shall be carried out by the Developer/Contractor for this alternative.

3.2.4. Where non-standard impact protection slabs are required, the slab width, thickness and reinforcement may require to be increased.

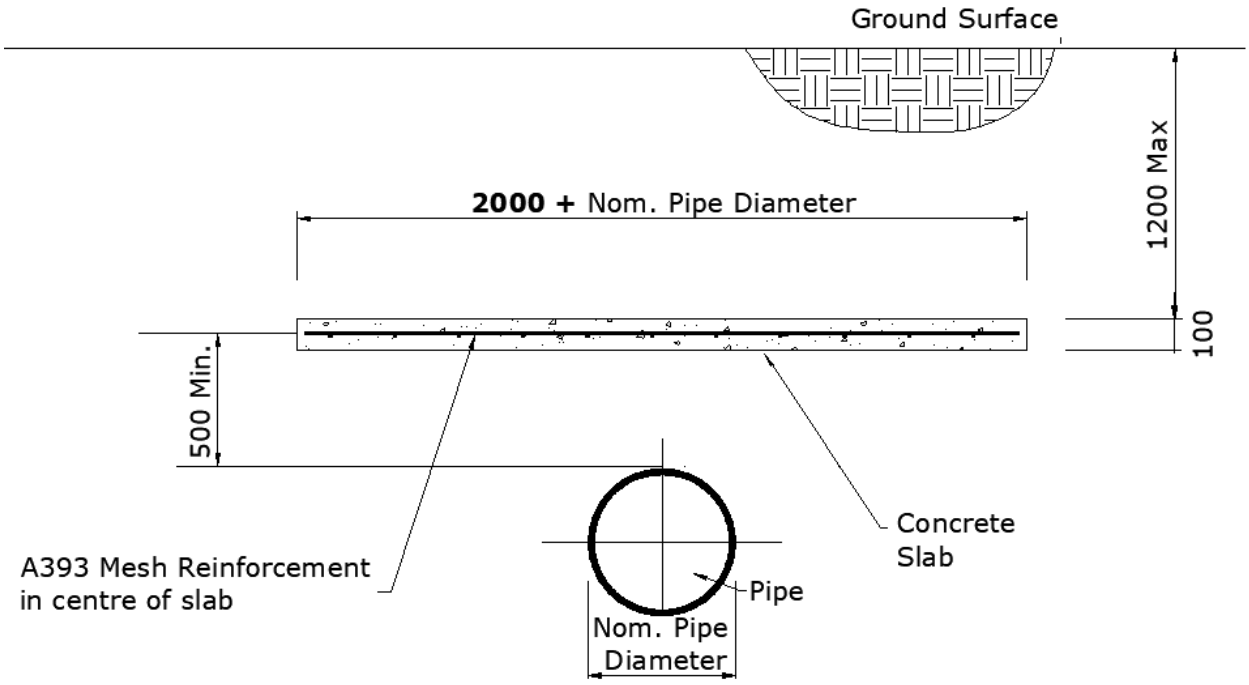



**FIGURE 1 Standard impact protection slab**

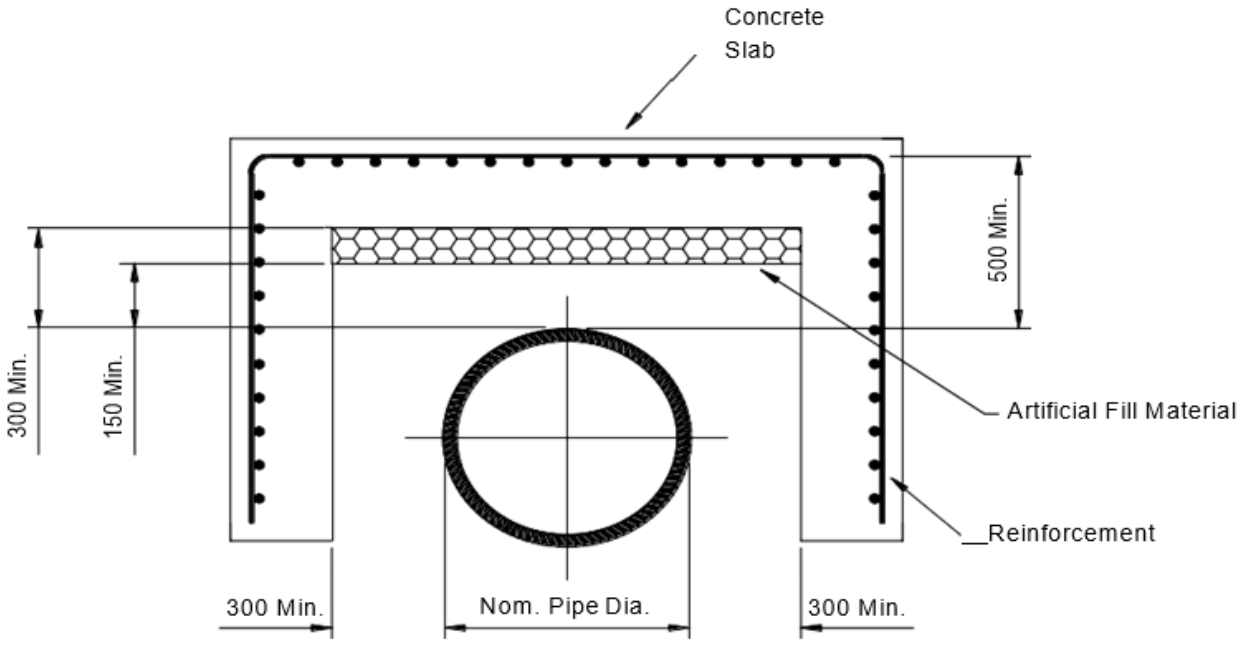



**FIGURE 2 Arrangement of slab with side support over pipeline - Indicative only**

## 3.3. Protection against lateral encroachment

3.3.1. The overall width of the pipeline protection slabs should be adequate to guard against lateral encroachment of excavating machinery. Where the slab is used as in Figure 1, the horizontal distance between the edge of the slab and the face of the pipe should be a minimum of 1.0 metre. Where a Risk Analysis shows that the probability of damage to the pipeline or its coating due to lateral encroachment of excavating machinery is acceptably low, then this can be reduced, but an analysis of the stresses in the slab, supporting soil and the pipe shall be carried out. Where the pipeline is located in areas where large types of excavating machinery are likely to operate, e.g. quarries and open-cast mining, the Designer should consider the need to increase the 1.0 metre dimension accordingly. Such modifications should be stated in the Design Output Package.

## 3.4. Clearance between pipeline and slab

3.4.1. The clearance between the top of the pipeline and the highest layer of reinforcement in the impact protection slab shall be a minimum of 500 mm to avoid possible damage by a hand-held pneumatic jackhammer. The clearance between the top of the pipeline and the underside of any concrete shall be a minimum of 300 mm. This clearance dimension is to prevent the presence of the slab having an adverse effect on the pipeline's cathodic protection system.

3.4.2. Where the clearance between pipeline and the underside of the impact protection slab is 1000 mm or more, consideration should be given to increasing the protection against lateral encroachment as Section 3.3 above. In cases of doubt reference shall be made to the Competent Design Authority (CDA).

## 3.5. Cover to impact protection slabs in agricultural land

3.5.1. Where impact protection slabs are laid in agricultural land, consideration shall be given to the cover required to avoid damage during drainage works or other agricultural operations. GD/SP/P/10 "Specification for General pipelining designed to operate at pressures greater than 7 barg" provides the minimum cover to the pipeline. This cover should also be adopted for the cover to pipeline protection slabs unless otherwise agreed as a Deviation with the Project Manager who shall consult and agree the proposal with the landowner and occupier.

## 3.6. Stream and ditch crossings

3.6.1. Where it is decided that an impact protection slab is required at a watercourse, trench, ditch or culvert, it shall comply with the following:

- GD/SP/P/10
- the pipeline protection slab should extend at least 500 mm beyond both sides of the watercourse.
- for the following criteria, standard impact protection slabs (as Section 3.2) may be used:
    - ditch width no greater than 2 metres.
    - tracked excavator greater than 20 tonne gross vehicle weight shall not be permitted in the vicinity.

- wheeled excavator greater than 9 tonne gross vehicle weight shall not be permitted in the vicinity.

3.6.2. Where the above criteria cannot be complied with, a case-specific design shall be prepared for the slab by the Developer/Contractor.

## 3.7. PE Impact Protection Slabs

Consideration should be given to installing impact protection slabs made from PE material. The criteria listed in Section 3.1 should be taken account of.

A PE slab should have the following dimensions:

- Minimum width (i.e. across the pipe) of 2.0 metres.
- Maximum length (i.e. along the pipe run) of 1.5m to ensure easy manhandling. Lifting arrangements should take account of the maximum 25kg weight that can be lifted by one person.
- Minimum slab thickness (i.e. depth) of 15mm.

Alternative dimensions, if used, shall be supported by written justification.

Where drainage is an issue of concern, drainage holes may be considered as long as the strength of the slab is maintained. It is recommended that drainage holes should not exceed a diameter of 30mm, account for no more than 0.6% of the surface area of the slab and be evenly spaced across the surface of the slab.

PE material specification shall comply with the requirements of Section 7.7 of this document.

There shall be marking along the widths of the slab to continuously read ‘Danger High Pressure Gas’ in black lettering.

PE slabs should be positioned central to the pipe. It is recommended that PE slabs are overlapped slightly to prevent any gaps between slabs. Where proprietary PE slabs are used, these should be installed, including overlaps and fixings, in accordance with the Manufacturers’ instruction. Standard PE impact protection slabs shall comply with Figure 3.

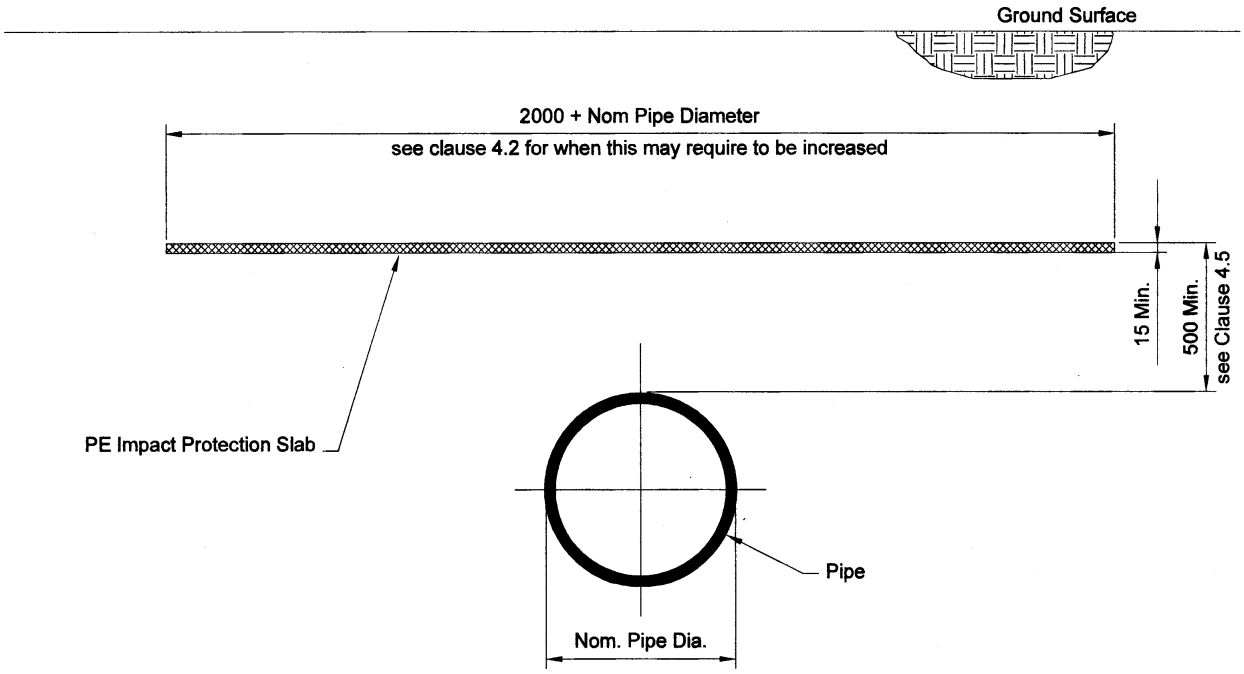



**FIGURE 3: Standard PE Impact Protection Slab (Dimensions in mm)**

# 4. TEMPORARY CROSSING POINT METHODS

## 4.1. General

4.1.1 Where it is necessary for vehicles only to temporarily cross a pipeline, and the vehicle loading has not been otherwise recognised within the pipeline design (e.g. by increasing the wall thickness), the point of crossing should be controlled and where necessary, protection to the pipe shall be provided.

Temporary crossings shall:

- be at right angles to pipeline.
- be fenced denoting the existence of the pipeline to ensure all traffic uses the crossing point (as Figure 4).
- have signs attached to the fence denoting the pipeline that the crossing point is located over.
- be regularly inspected and maintained in good condition.

4.1.2 Temporary crossing point slabs shall be removed under supervision of the Cadent Responsible Person. Consideration shall be given to the vibration during its removal and where practical the slab should be cut into manageable sections and removed from the vicinity of the pipeline before it is broken up – Information including:

- dimensions of slab.
- reinforcing in slab.
- clearance between pipeline and slab.
- method statement.

should be made available to the supervisor prior to the removal commencing.

4.1.3 Prior to slab design, the location and the depth of the pipeline shall be identified by trial pits at least at two locations, supervised by the Cadent Responsible Person.

## 4.2. Temporary Access Solutions

4.2.1 A number of alternative temporary access solutions are available, including:

- temporary protection slab.
- free-standing bridges (pre-fabricated modular steel or pre-cast concrete, bridges).
- proprietary access roadways.
- haul roads – (including hardcore, sleepers, steel plates or a combination).

4.2.2 Where the resulting stress state in the pipeline has not already been checked (i.e. standard slab designs and haul roads contained in this specification), it shall be checked for the direct load or the effects of the support loads (for bridges) where appropriate, in accordance with Section 2.2 and GD/PR/GM/1 prior to work commencing.

4.2.3 Where proprietary units are proposed to be used as crossing points, rental of the units may be possible. In general terms where the period of installation exceeds 3 months, purchase of the units or the installation of a concrete slab or haul road may be more cost effective.

4.2.4 Where proprietary access systems are proposed, the analysis of the system should be carried out, considering:

- axle loads and tyre or track patch dimensions of vehicles or plant that may use the roadway.
- strength of system and joining/interconnecting methods.
- suitability of the soil to support the system i.e. allowable ground bearing pressure.

4.2.5 Depending on the proprietary system proposed, panel properties may be available to the Designer from the Manufacturer, or it may be necessary to submit details to the Manufacturer or the Plant Hire Company for them to carry out the Design. Whatever method is chosen, the stresses in the pipeline shall also be checked.

## 4.3. Haul Road

4.3.1 Where it is desired to install a temporary haul road over a pipeline, the design below, should be used where the following conditions apply:

- Use Table B2 in Appendix B to determine the maximum allowable cover depth for various pressures, pipe cover dimensions and temperature difference from tie-in. For pipelines which do not comply with these allowable criteria, material grade and wall thickness, the pipe stresses resulting, require to be checked in accordance with GD/SP/GM/1 prior to the construction of a haul road.
- maximum axle load 10.5 tonne road legal vehicles.
- maximum 1000 'standard axles' to use haul road during its lifetime (44 tonne 5 axle HGV in full, out empty is approx. 10 standard axles) – where the life of the road exceeds this, it shall be re-constructed.

4.3.2 Prior to construction, consideration should be given to removal of topsoil and any possible reduction in the pipe cover. Construction shall consist of a minimum of:

- Separation member – layer of geotextile material to Section 7.6 of this specification.
- Roadbase – Type 1 granular material to Section 7.2, laid and compacted in accordance with Section 8.5 to the compacted thickness shown in Table 3 below dependant on the bearing resistance value of the soil on which the haul road is to be constructed (see Section 6.3):

| Bearing Resistance ($kN/m^2$) | Thickness of hardcore (mm) |
|---|---|
| 59 | 620 |
| 74 | 470 |
| 88 | 400 |
| 100 | 350 |
| 112 | 310 |
| 135 | 290 |

**TABLE 3 Hardcore thickness for haul road**

***Note:*** *For Bearing Resistance value of the soil on which the haul road is to be constructed, see Section 6.3*

4.3.3 Where the subgrade is frost susceptible and the hardcore road thickness is less than 450 mm, the possibility of damage caused by frost should be considered. This consideration may require the road construction to be increased to 450 mm.

4.3.4 Where a haul road is required that does not comply with the above, the resulting stress state in the pipeline shall be checked in accordance with GD/SP/GM/1 prior to work commencing.

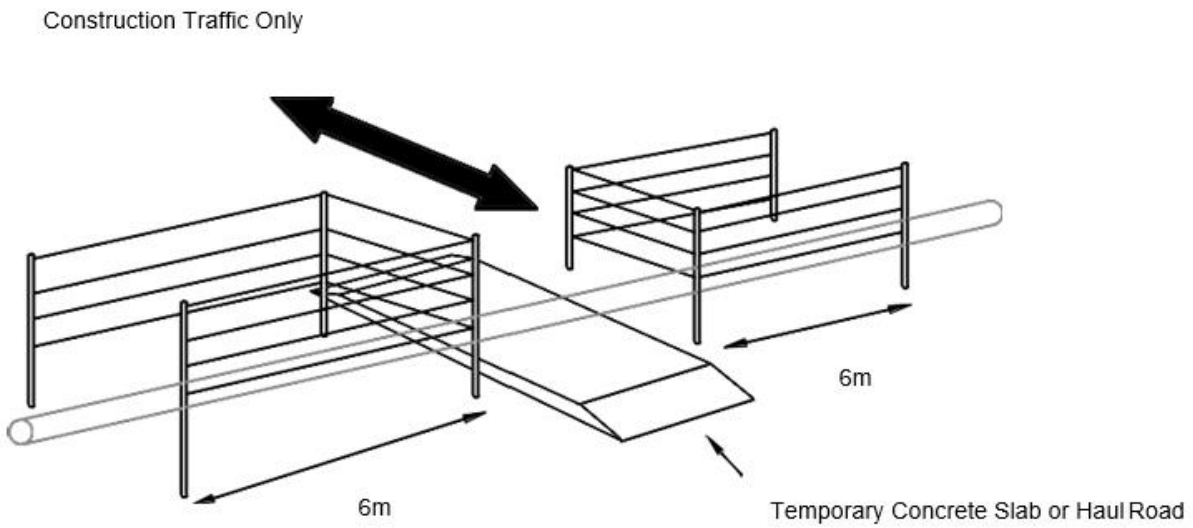



**FIGURE 4 Temporary Crossing Points**

## 4.4. Temporary Crossing Point Slabs

4.4.1 Temporary crossing point slabs as Figure 5 below:

- should be designed to bridge the pipe trench.
- should not adversely affect the stress state in the pipeline.
- are not intended to provide impact protection, although in some cases they may do so. Where they are required to provide impact protection, consideration should be given to their adequacy.
- are designed to be removed within 1 year of installation. Where their life expectancy extends beyond 1 year, an assessment should be made of their continued suitability.

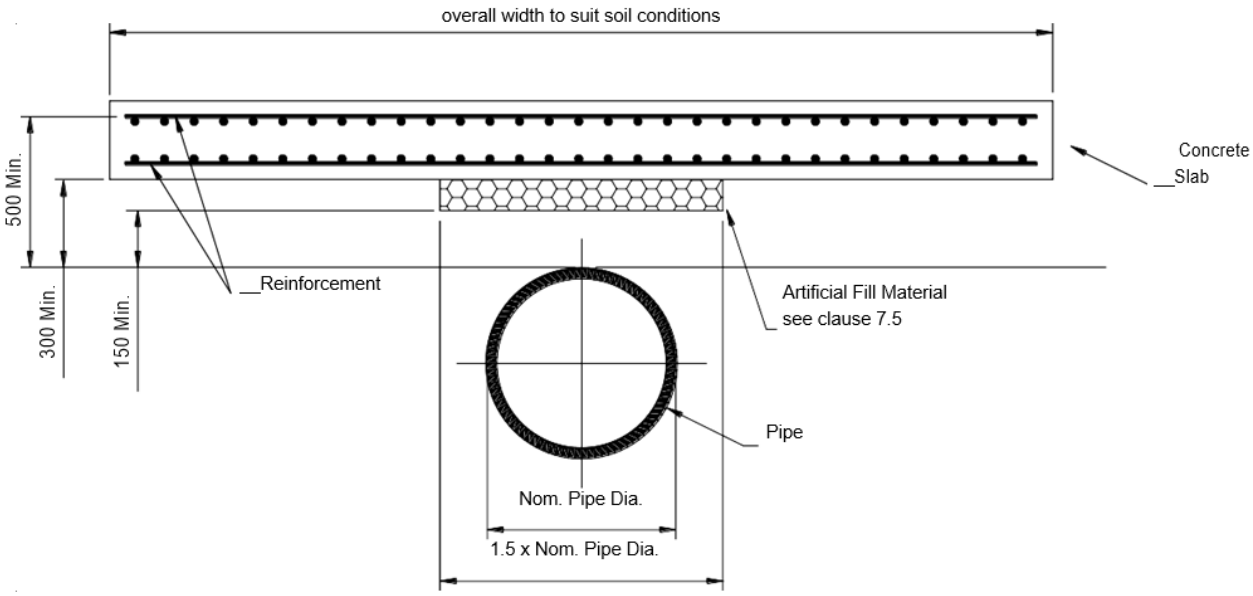



**FIGURE 5 Arrangement of crossing point slab over pipeline**

## 4.5. Standard designs for temporary crossing slabs

4.5.1 Standard designs which may be applicable for temporary crossing point slabs are provided in Section 6. The Contractor shall verify that the site conditions allow for the application of a standard design and that the assumptions which underpin the standard design are met, prior to installation of the standard design for the crossing point slab.

4.5.2 Where the site conditions differ and do not allow the application of the ‘Standard Designs’ below, a ‘Case Specific Design’ shall be produced.

# 5. PERMANENT CROSSING POINTS

## 5.1. General

5.1.1 Where it is necessary for a permanent road or access way to be constructed over an existing pipeline and a pipeline protection slab is required to provide one or more of the following:

- reduce the stress in the pipeline.
- protection of the pipeline during road or access construction work above.
- impact protection of the pipeline as required by IGEM/TD/1 – If this is the only purpose, refer to Section 3.

this shall be designed by the Proposer/Developer/Contractor and full details, including calculations, specifications and method statements submitted to The Company for approval.

## 5.2. Site Specific Minimum Functional Specification

5.2.1 Where a permanent crossing point slab is required, a 'Minimum Functional Specification' (MFS) should be produced and included in the Design Output Package. This MFS should include:

- The purpose of the slab and whether it is required to provide 'impact protection' as required by IGEM/TD/1.
- Diameter and wall thickness of pipeline it is over.
- Position of slab relative to forged pipe bends – see Clause 2.2.3.
- Maximum and minimum temperatures in pipeline at the proposed location see Clause 2.2.2.
- Existing cover dimensions of pipeline at each end of the slab and the proposed final roadway or ground levels.
- Required length of the slab, or if not known, the defining conditions of beginning and end of slab.
- Minimum and maximum permissible vertical dimensions from the pipeline. If these are not known and not included in MFS, it will be up to the Designer to establish what is acceptable. If required to provide impact protection, refer to Section 3.
- Minimum and maximum depth of cover to slab and details of any road construction above.
- All loading conditions that may be applied to the slab during its full life cycle. This shall include:
    - Temporary construction traffic loading and any reduced cover to the slab whilst this loading is in place.
    - Final loading condition(s) and if it is below a highway, these should be stipulated by the Highway Authority.
- A requirement for a concrete Specification suitable for the installation to be produced.
- A requirement to establish soil conditions (e.g. contamination, soil strength) that may influence the design or construction (e.g. concrete specification).

## 5.3. Standard designs for permanent slabs

5.3.1 Standard designs which may be applicable for permanent crossing point slabs are provided in Section 6. The Contractor shall verify that the site conditions allow for the application of a standard design and that the assumptions which underpin the standard design are met, prior to installation of the standard design for the crossing point slab.

Where the site conditions differ and do not allow the application of the 'Standard Designs' below, a 'Case Specific Design' shall be produced.

5.3.2 The standard designs as per Section 6 may be used as a permanent crossing only for the traffic loadings indicated in Table 4, providing the crossing point is not affected by any of the following conditions;

- Final cover depth to pipeline not to exceed 3 .5 metres
- Pipeline contains defective Girth Welds or Girth Welds of unknown quality. (Reference GD/PR/P/18)
- Ground movement or ground subsidence
- Vehicle loading in excess of Load Model 3 SV.
- Public road crossing or high density traffic.
- Bearing Resistance of the supporting soil less than 135kN/$m^2$.
- Area susceptible to flooding.

# 6 STANDARD DESIGNS OF CROSSING POINT SLABS FOR P/2 PIPELINES

## 6.1 Assumptions for Standard Designs of crossing point slabs

6.1.1 Standard crossing point slabs contained within this Specification:

- take account of the self-weight of the slab (assuming normal weight aggregates).
- pipeline welds comply with Standard GD/SP/P/2 “Specification For Welding Of Land Pipelines And Installations Designed To Operate At Pressures Greater Than 7 Bar”.
- do not allow for the special-order vehicles represented by the Load Model 3 SOV and those loads incurred by vehicles normally found in quarries and opencast sites.
- do not allow for adjacent services located in the slab bearing area.
- are designed for different traffic loadings up to normal public highway traffic.
- are designed to have 300mm to 500 mm cover to the slab (i.e. cast between 300mm and up to 500 mm of road construction over).
- are designed to be cast in-situ (pre-cast concrete will be case-specific designs).
- are designed for 0.9 m to 3.5 m pipe cover for nominal pipe diameter up to 1200mm – where greater cover exists, case-specific designs will be required.
- stresses in pipelines have been checked for loading defined above, taking account of:
    - nominal pipe diameters from 100 mm to 1200 mm.
    - wall thicknesses as shown in the Appendix B Tables.
    - maximum operating pressures up to 94 bar, and
    - are designed to rest on a soil with a bearing resistance of 135 kN/m2 assuming a total settlement of 25mm under the bearing areas.

## 6.2 Non-standard designs

6.2.1 Where the conditions for the Standard crossing point slabs are NOT met, a case specific design shall be produced by Developer/Contractor.

6.2.2 For permanent crossing points a ‘Minimum Functional Specification’ shall be produced as per Section 5.2 above.

## 6.3 Soil support / bearing material

6.3.1 The soil on which the slab rests should be capable of adequately resisting the applied loads. For the application of a crossing point slab design covered in this section, a bearing resistance of 135 kN/$m^2$ or higher is required from the soil which supports the slab. Where the bearing resistance is less than 135 kN/$m^2$, the material shall be removed and replaced with imported granular material complying with Section 7.2 and compacted to the requirements of Section 8.5.

6.3.2 Prior to slab Construction, the Contractor shall confirm the minimum bearing capacity used in the design can be achieved at the proposed slab formation level under bearing areas.

## 6.4 Nominal trench width

6.4.1 The nominal design trench widths used in the “standard slab designs” are in accordance with Clause 2.9.1 and Table 1.

6.4.2 Where the actual width of the pipe trench is greater than the nominal design trench width given in Table 1, the material up to the level of the slab on which the slab rests shall, where practical, be compacted to the standard required by the design. The required performance of the soil bearing is specified in Clause 6.3.1. Where such material cannot be compacted to the desired standard, it shall be removed and replaced with imported granular material as specified in Section 7.2 and compacted to the requirements of Section 8.5.

## 6.5 Pipe criteria

6.5.1 Provided the pipe criteria stated in this Section and in Appendix B are met, it is not necessary to carry out further checks on the integrity of the pipe.

6.5.2 All pipes of outside diameter (OD) between 114 and 1219 mm and wall thickness as detailed in GD/SP/DAT/6 have been checked for maximum allowable cover depth of 3.5 m. Where the allowable pipe stresses for this cover depth are exceeded, the cover depth requires to be reduced, as shown in Table B.1 in Appendix B. For all other cases, the maximum allowable cover depth of 3.5 metres applies. The standard designs also allow for a temperature difference between -20°C to + 40°C as shown in Table B.1.

## 6.6 Traffic loading used for “standard slab designs”

6.6.1 Standard crossing point slab designs provided in this specification have been designed for :

- Load Model 1 and Load Model 2 (max axle load 400 kN)
- the normal traffic under SV100 Loading (max. axle load 165 kN).

6.6.2 Where traffic loadings greater than Eurocode traffic loading (LM1, LM2, LM3) or concentrated point loads e.g. crane outriggers are anticipated, the standard designs shall not be used and a case-specific design shall be produced.

6.6.3 Equating the loading effects of actual vehicles to the Eurocode traffic loading (LM1, LM2, LM3), is complex and is dependent on the tyre and track size, wheel and axle spacing, impact factor and depth of cover to the pipeline crossing-point slab. In general terms, normal road vehicles i.e. Heavy Goods Vehicles, wheeled cranes (travelling, NOT lifting), and heavy construction vehicles, light construction and agricultural vehicles generally fall within the Eurocode traffic loading (LM1, LM2, LM3).

6.6.4 Very heavy construction vehicles exceed Eurocode traffic loading (LM1, LM2, LM3). If in doubt, appropriate calculations should be carried out for the actual vehicle or plant, which may cross the pipeline crossing-point slab at the depths of cover, which will apply.

6.6.5 Abnormal Indivisible Load (AIL) may exceed the vehicles represented by Eurocode traffic loading (LM1, LM2, LM3). In this case, Load Model 3 SOV may be considered for calculation in accordance with the National Annex to BS EN 1991-2, where appropriate.

6.6.6 AIL should be checked and if necessary a case-specific design as Section 6 should be produced by Developer/Contractor.

## 6.7 Artificial Fill

6.7.1 "Standard crossing point slab designs" include a requirement for the provision of an artificial fill material immediately below the slab to ensure that excessive loads from the slab are not passed to the pipeline. This should be placed centrally over the pipeline axis on a width of 1.5 times the pipeline nominal size, with a minimum required width of 300mm to account for small diameter pipelines. If the clearance between the crown of the pipe and the underside of the slab exceeds the width of the artificial fill, consideration may be given to omitting the artificial fill, provided that the Designer demonstrates that such action does not cause unacceptable load to be concentrated on the crown of the pipe.

6.7.2 The material shall be as defined in Section 7.5 of this Specification.

## 6.8 Drawings for "standard slab designs"

6.8.1 For standard crossing point slabs the drawings provided overleaf shall be used. The Designer shall ensure that the drawing selected is appropriate for the pipe diameter and applied traffic loading for the site situation.

6.8.2 A summary of the standard crossing point slabs for different nominal pipe diameters and traffic loadings is shown in Table 4.

6.8.3 Prior to selecting a standard pipeline protection slab, reference should be made to Appendix A for the information that should be collated or considered

| Traffic loading | Max axle load [kN] | Nominal Pipe Diameter [mm] | Slab thickness [mm] | Drawing reference |
|---|---|---|---|---|
| Standard Eurocode loading (LM1, LM2) | 400 | Up to 750 | 300 | No.001 |
| | | 900-1200 | 300 | No. 002 |
| LM3 (Based on SV100 Loading) | 165 | Up to 750 | 300 | No. 003 |
| | | 900-1200 | 300 | No. 004 |

**TABLE 4: Standard Temporary crossing point slab (bearing resistance over 135 kN/m$^2$)**

**Notes**

i. In order to use the standard design, it shall be ascertained that for the specific location of the slab, the maximum traffic loading the slab will be required to sustain during the operational life of the pipeline, will be within the traffic loadings indicated in Table 4.

ii. The soil on which the slab rests has values of bearing resistance over 135 kN/m$^2$ and a total settlement of 25 mm.

iii. The Temporary crossing point slabs to the standard designs are acceptable for a slab cover dimension between 300mm and 500 mm.

iv. Where the pipeline soil cover is greater than 3.5 metres, the pipe stresses should be checked in accordance with GD/SP/GM/1.

v. For pipelines of wall thickness not less than the minimum in GD/SP/DAT/6, the pipeline is not overstressed by the presence of the pipeline protection slab, the maximum soil cover as shown in Table B.1 in Appendix B and appropriate traffic loading.

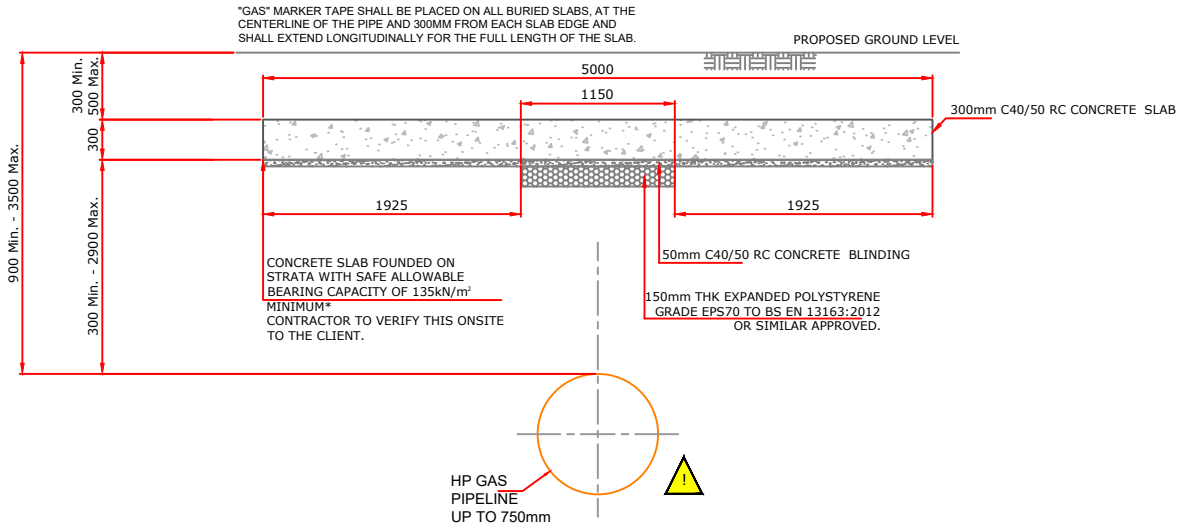
vi. Standard pipeline protection slab designs assumes welds comply with Standard GD/SP/P/2 “Specification For Welding Of Land Pipelines And Installations Designed To Operate At Pressures Greater Than 7 Bar”.

vii. Where existing or proposed services lie within a zone of influence below the pipeline protection slab, the effects of the increase in pressure on the service should be checked prior to the installation of the pipeline protection slab.

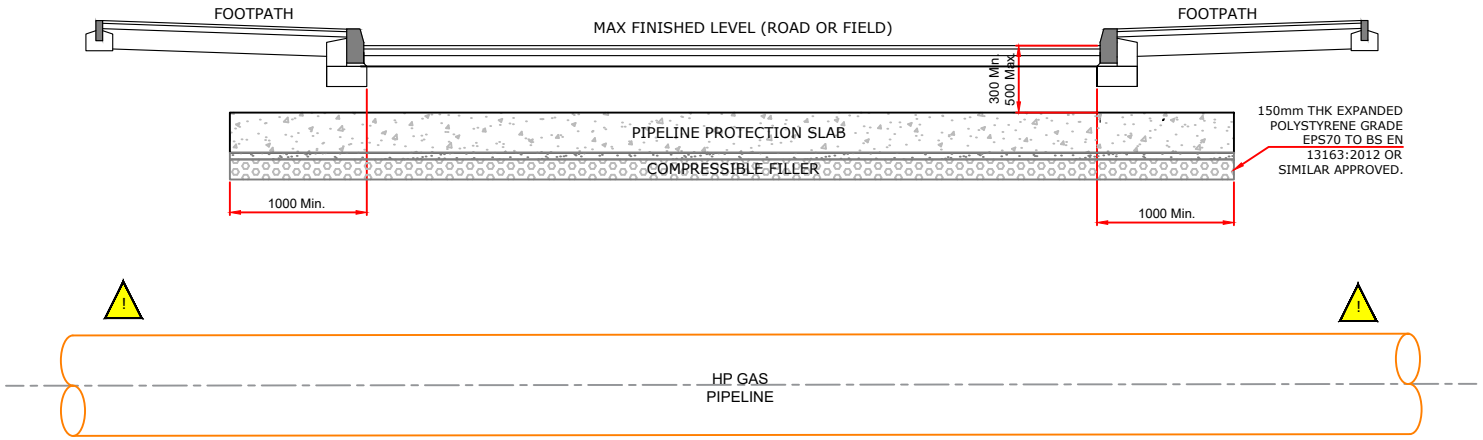
viii. This zone of influence shall be taken as a minimum of:

- an area bounded by the plan dimension of the slab plus a spread at an angle of 30 degrees to the vertical from the perimeter of the slab and
- a depth above a level at which the maximum increase in pressure due to the presence of the slab, does not exceed 10% of the pre-existing overburden pressure at the level under consideration.

ix. Slabs shall be constructed in accordance with the specification notes on the drawings.




## TYPICAL CROSS-SECTION OF CROSSING POINT SLAB OVER PIPELINE
## NOT TO SCALE




## TYPICAL CROSS SECTION ALONG PIPELINE
## NOT TO SCALE
## (TYPICAL ROAD LAYOUT SHOWN)

## 1.0 GENERAL NOTES:

1.1 ALL UNITS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.

1.2 THIS DRAWING SHOULD READ IN CONJUNCTION WITH 001 SHEET 2 OF 2 REV.0.

1.3 GAS PIPELINE LOCATION IS TO BE CONFIRMED BY TRIAL PITS, AT SUPERVISION OF CADENT.

1.4 ALL WORKS ARE TO BE CARRIED OUT IN ACCORDANCE WITH HSG 47 AND CADENT'S SPECIFICATIONS GD/SP/CE/12, GD/SP/SSW/22, AND WORKMANSHIP IN ACCORDANCE WITH GD/SP/CE/1.

## 2.0 MINIMUM FUNCTIONAL SPECIFICATION

2.1 THE MODEL SLAB DESIGNS ASSUME THE FOLLOWING:

- PIPELINES FALL WITHIN THE REQUIREMENTS OF CADENT GAS SPECIFICATION T/PM/P/2.
- PIPELINE WALL THICKNESS COMPLIES WITH THE MINIMUM IN T/SP/DAT/6.
- SLABS TO BE 300mm TO 500mm BELOW FINISHED GROUND LEVEL (I.E. CAST AT 300mm AND UP TO 500mm OF ROAD CONSTRUCTION OVER).
- TO BE CAST IN-SITU (PRE-CAST CONCRETE WILL BE CASE-SPECIFIC DESIGNS).
- 0.90m TO 3.5m PIPE COVER - WHERE GREATER COVER EXISTS, CASE-SPECIFIC DESIGNS WILL BE REQUIRED.
- THE MAXIMUM OPERATING PRESSURES FOR THE PIPELINE ARE UP TO 94 BAR.
- THE SLAB RESTS ON A SOIL WITH A SAFE ALLOWABLE BEARING PRESSURE OF AT LEAST 135kN/m² - THIS IS TO BE CONFIRMED ON SITE BY THE CONTRACTOR.
- THE PROPOSED SLAB IS FOR THE PROTECTION OF 1NO. OF HP PIPELINE ONLY, AND SHOULD NOT BE APPLICABLE TO MORE THAN 1 NO. PIPELINE PROTECTION.

2.2 300mm/500mm SHOULD BE MEASURED FROM THE HIGHEST POINT OF THE ROAD WHERE IS SLABBED.

## 3.0 EXCLUSION

3.1 THIS MODEL SLAB DESIGN SHALL NOT BE USED IN THE FOLLOWING CONDITIONS:

- FOR SPECIAL ORDER VEHICLES REPRESENTED BY THE LOAD MODEL 3 SOV AND THOSE LOADS INCURRED BY VEHICLES NORMALLY FOUND IN QUARRIES AND OPENCAST SITES.
- WHERE ANY ADJACENT SERVICE IS LOCATED IN THE SLAB AREA.
- INSTALLED WITHIN 3 PIPE DIAMETERS OF FORGED BENDS WHICH HAVE A BEND RADIUS OF 5 PIPE DIAMETERS OR LESS.
- SURFACE SLABS.
- PILED SLABS.
- PRE-CAST SLABS
- AREAS SUBJECT TO FLOODING.

## 4.0 RESIDUAL RISKS:

4.1 POTENTIAL FOR EXISTING UNDERGROUND SERVICES.

4.2 WORKING IN THE VICINITY OF A HIGH PRESSURE GAS PIPELINE.

4.3 POTENTIAL FOR CONTAMINATED GROUND.

| Rev No | Date | Drn by | Chk by | App by | Description |
|---|---|---|---|---|---|
| 0 | 28/03/19 | JWB | XHC | RMA | Incorporating Appraiser's comments |
| C | 21/03/19 | JWB | XHC | RMA | Incorporating Cadent's comments |
| B | 05/02/19 | JWB | XHC | RMA | G19 Approval |
| A | 05/12/18 | JWB | XHC | RMA | Internal Review |

Cadent
Your Gas Network

DNV·GL

GL Industrial Services UK Ltd trading as DNV GL
Holywell Park, Ashby Road, Loughborough, Leicestershire, LE11 3GR

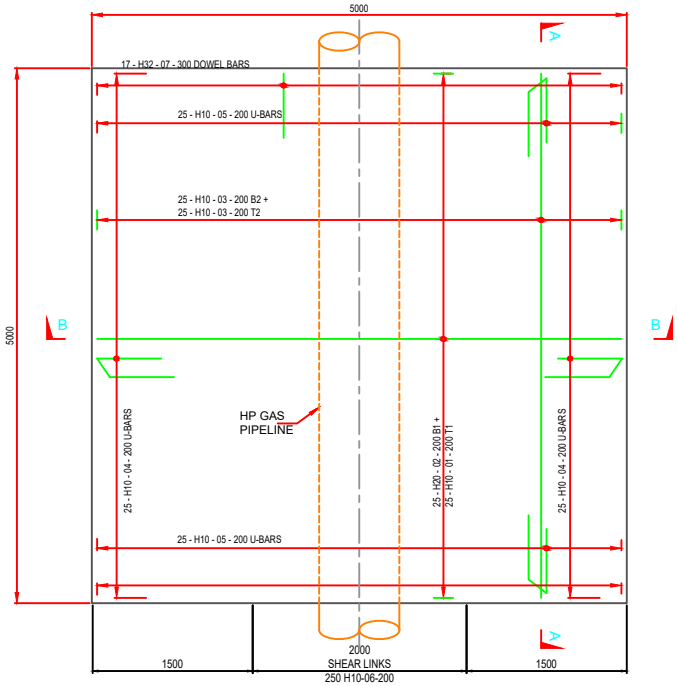
Title:
Nominal Pipe Diameter up to 750mm
Full Traffic Loading (BS EN 1991-2 LM1, LM2)
Slab Details

Client
Cadent

Contract
Standard Protection Slab for HP Gas Pipeline (P/2)

| | | Date | Drawing No | Rev |
|---|---|---|---|---|
| Drawn By | JWB | 05/12/2018 | 001 Sheet 1 of 2 | 0 |
| CAD Check by | XHC | 05/02/2019 | Sheet 1 of 1 | Sheet Size A3 |
| ENG Check by | DJ | 05/02/2019 | Scale As Shown | Project No 10122205 |
| Approved by | RMA | 05/03/2019 | | |

"GAS" MARKER TAPE SHALL BE PLACED ON ALL BURIED SLABS, AT THE CENTRELINE OF THE PIPE AND 300MM FROM EACH SLAB EDGE AND SHALL EXTEND LONGITUDINALLY FOR THE FULL LENGTH OF THE SLAB.




## PLAN

SCALE 1:50

## 1.0 CADENT REQUIREMENTS:

1.1 ALL WORKS ARE TO BE CARRIED OUT IN ACCORDANCE WITH HSG 47 AND CADENT'S SPECIFICATIONS GD/SP/CE/12, GD/SP/SSW/22, AND WORKMANSHIP IN ACCORDANCE WITH GD/SP/CE/1.

1.2 ALL WORKS ARE TO BE MONITORED BY CADENT GAS LIMITED SAFE CONTROL OF OPERATIONS (CADENT SCO) REPRESENTATIVE AT ALL TIMES. SETTING OUT OF THE GAS PROTECTION SLABS AND TOP OF PIPE LEVELS MAY VARY. VARIANCE OF SETTING-OUT LEVELS MUST BE REPORTED TO DESIGNER FOR REVIEW AND APPROVAL.

1.3 MECHANICAL EXCAVATORS MUST BE FITTED WITH TOOTHLESS BUCKET.

1.4 MECHANICAL EXCAVATORS AND ANY OTHER POWERED MECHANICAL PLANT SHALL NOT BE SITED OR MOVED ABOVE THE PIPELINE UNLESS WRITTEN AUTHORITY HAS BEEN GIVEN BY CADENT RESPONSIBLE PERSON.

1.5 MECHANICAL EXCAVATORS AND ANY OTHER POWERED MECHANICAL PLANT SHALL NOT DIG ON ONE SIDE OF THE PIPELINE WITH THE CAB OF THE EXCAVATOR POSITIONED ON THE OTHER SIDE.

1.6 MECHANICAL EXCAVATORS, AND OTHER POWERED MECHANICAL PLANT, AND OTHER TRAFFIC SHALL BE POSITIONED FAR ENOUGH AWAY FROM THE PIPELINE TRENCH TO PREVENT TRENCH WALL COLLAPSE.

1.7 BACKFILL COMPACTION METHOD SHOULD USE DEAD LOAD COMPACTION ONLY.

## 2.0 CONSTRUCTION:

2.1 FOR LONG SLAB, CONTRACTION JOINT LOCATION SHALL BE DETERMINED ON THE BASIS OF THE DESIGN MANUAL FOR ROADS AND BRIDGES, VOLUME 7,SECTION 2, PART 3 (HD26/06).

2.2 EVERY 3RD JOINT IS EXPANSION JOINT.

2.3 REINFORCEMENT SHALL BE CONTINUOUS ACROSS CONSTRUCTION JOINTS.

| Bar Mark | Type and Size | No. of Groups | No. in each Group | Total number | Length of each bar | Shape Code | All bending dimensions are in accordance with BS 8666 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A* mm | B* mm | C* mm | D* mm |
| 01 | H 10 | 1 | 25 | 25 | 4850 | 00 | 4850 | | | |
| 02 | H 20 | 1 | 25 | 25 | 4850 | 00 | 4850 | | | |
| 03 | H 10 | 1 | 50 | 50 | 4850 | 00 | 4850 | | | |
| 04 | H 10 | 1 | 50 | 50 | 1150 | 21 | 500 | 180 | 500 | |
| 05 | H 10 | 1 | 50 | 50 | 1130 | 21 | 500 | 150 | 500 | |
| 06 | H 10 | 1 | 250 | 250 | 570 | 99 | 150 | 200 | 75 | 145 |
| 07 | H 32 | See Note | 17 | 17 | 600 | 00 | 600 | | | |

Note: Bar Mark 07 only required if Contraction/Expansion Joints are provided.

## 3.0 CONCRETE NOTES

3.1 DO NOT SCALE FROM THIS DRAWING - USE ONLY VALUES OF STATED DIMENSIONS.

3.2 MINIMUM COVER TO REINFORCEMENT TO BE 50mm TO ALL FACES UNLESS NOTED OTHERWISE.

3.3 STEEL REINFORCEMENT SHALL BE GRADE B500B RIBBED BARS OF 500MPa CHARACTERISTIC YIELD STRENGTH TO BS 4449:2005, CUT AND BENT IN ACCORDANCE WITH BS8666: 2005.

3.4 BAR REFERENCES TO BE INTERPRETED THUS:-

24 H12 - 19 - 200 - T1

- 24 — NUMBER OF BARS
- H — TYPE OF STEEL
- 12 — BAR DIAMETER
- 19 — BAR MARK
- 200 — SPACING / BAR CENTRES (mm)
- T1 — LOCATION

3.5 BAR LOCATIONS AS NOTED BELOW:-

T1 = TOP FACE OUTER LAYER
T2 = TOP FACE INNER LAYER
B1 = BOTTOM FACE OUTER LAYER
B2 = BOTTOM FACE INNER LAYER

3.6 UNLESS NOTED OTHERWISE ALL BAR RANGES ARE CALLED UP WITH BAR CENTRELINE MEASURED PERPENDICULAR TO THE REINFORCEMENT BARS.

3.7 THIS SLAB HAD BEEN DESIGNED IN ACCORDANCE WITH BS EN 1990, BS EN 1991, BS EN 1992 AND BS EN 1997 AND THE REQUIREMENT OF GD/SP/CE/12.

3.8 CONCRETE SPECIFICATION INCLUDING MASS CONCRETE AND BLINDING TO BE A DESIGNED MIX AS BELOW AND TO COMPLY WITH BS 8500-1:2015 AND CONFORM TO BS 8500-

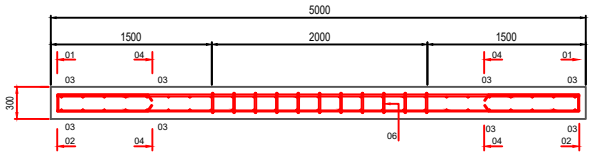
- GRADE - C40/50;
- MAXIMUM W/C RATIO 0.35;
- MINIMUM CEMENT CONTENT IS 380 kg/m$^3$;
- MAXIMUM AGGREGATE SIZE 20mm;
- CONSISTENCE CLASS S3;
- ACEC CLASS AC-4;
- DESIGN SULFATE CLASS FOR CONCRETE TO BE DS-4.

3.9 CONTRACTOR TO ENSURE THE SLAB IS NOT LOADED EARLIER THAN 28 DAYS. CONTRACTOR SHALL TAKE SAMPLE TEST CYLINDERS AND TEST AT 28 DAYS TO ENSURE THAT THE CONCRETE REACHES A CYLINDER STRENGTH OF 40N/mm$^2$ AT 28 DAYS.

3.10 CENTRELINE OF SLAB IN SPAN DIMENSION MUST COINCIDE WITH CENTRELINE OF PIPELINE. THE CONTRACTOR IS RESPONSIBLE FOR SETTING OUT AND FOR ENSURING THAT THE PIPELINE ALIGNMENT IS CORRECTLY IDENTIFIED.

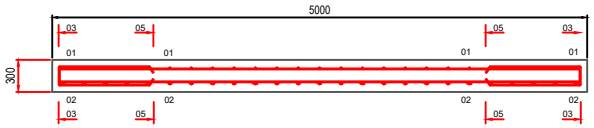
3.11 CONTRACTOR IS TO PROVIDE PROPRIETARY SPACERS BETWEEN TOP AND BOTTOM OF REINFORCEMENT LAYERS.

3.12 THESE REINFORCEMENT DETAILS APPLY TO DRAWING 001 SHEET 1 OF 2 REV. 0.



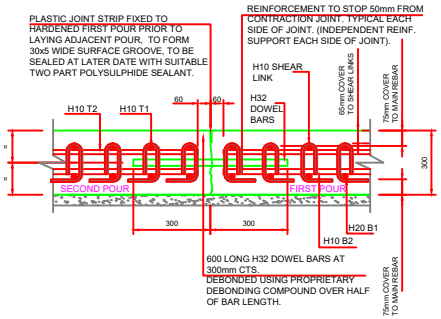

## SECTION B-B

SCALE 1:50




## SECTION A-A

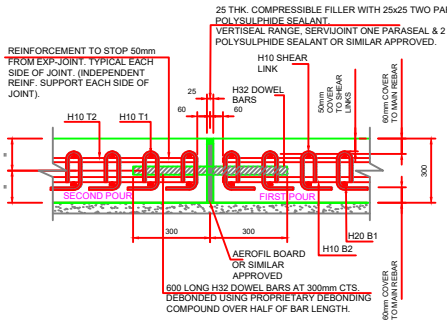
SCALE 1:50




## CONTRACTION JOINT DETAIL

SCALE 1:25

(COMPRESSIBLE FILLER IS NOT SHOWN FOR CLARITY)




## EXPANSION JOINT DETAIL

SCALE1:25

(COMPRESSIBLE FILLER IS NOT SHOWN FOR CLARITY)

| Rev No | Date | Drn by | Chk by | App by | Description |
|---|---|---|---|---|---|
| 0 | 28/03/19 | JWB | XHC | RMA | Incorporating Appraiser's comments |
| C | 21/03/19 | JWB | XHC | RMA | Incorporating Cadent's comments |
| B | 05/02/19 | JWB | XHC | RMA | G19 Approval |
| A | 05/12/18 | JWB | XHC | RMA | Internal Review |

Cadent — Your Gas Network

DNV·GL

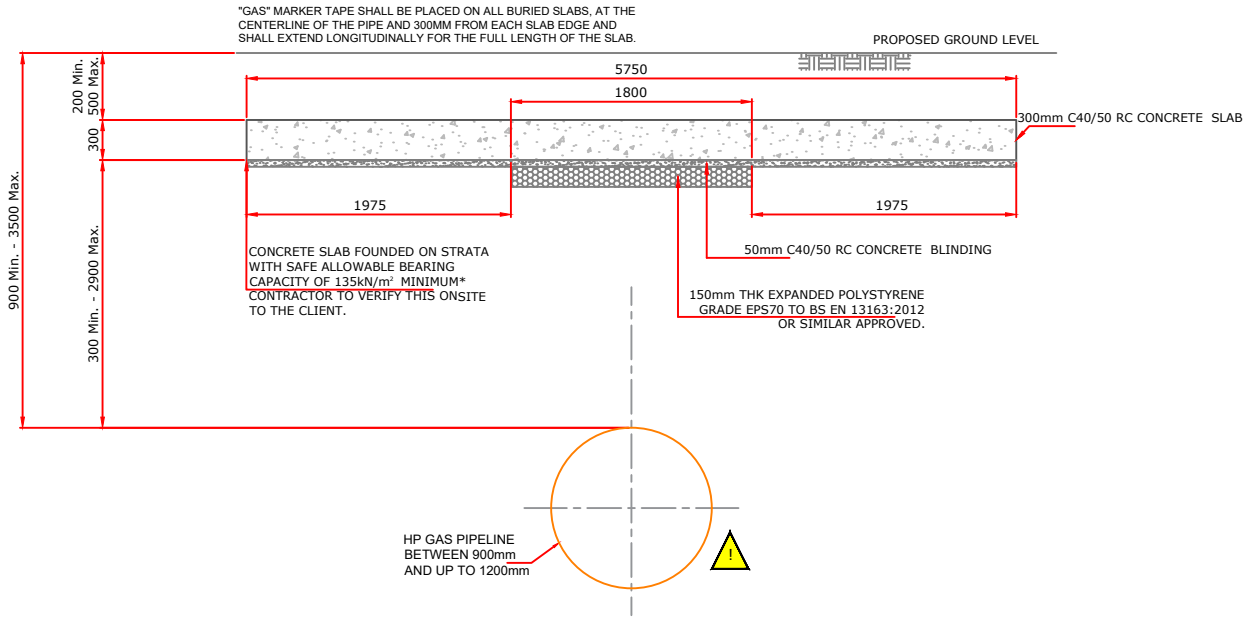
GL Industrial Services UK Ltd trading as DNV GL
Holywell Park, Ashby Road, Loughborough, Leicestershire, LE11 3GR

Title:
Nominal Pipe Diameter up to 750mm
Full Traffic Loading (BS EN 1991-2 LM1, LM2)
Slab Reinforcement and Joints Details

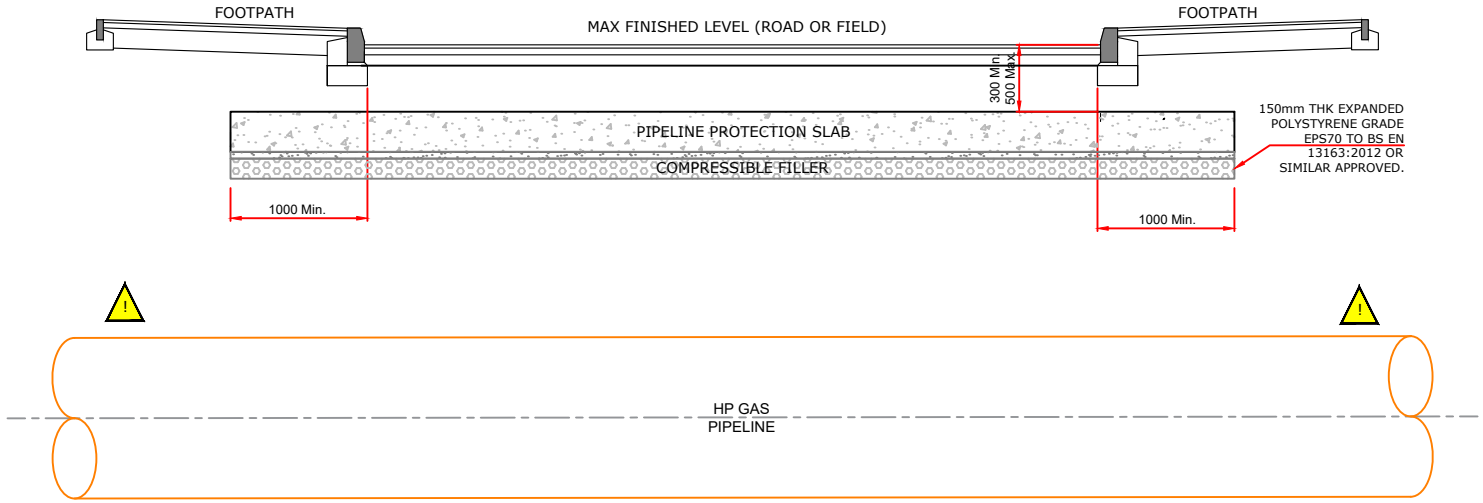
Client
Cadent

Contract
Standard Protection Slab for HP Gas Pipeline (P/2)

| | | Date | Drawing No | Rev |
|---|---|---|---|---|
| | | | 001 Sheet 2 of 2 | 0 |
| Drawn By | JWB | 10/12/2018 | | |
| CAD Check by | XHC | 05/02/2019 | Sheet 1 of 1 | Sheet Size A3 |
| ENG Check by | DJ | 05/02/2019 | | |
| Approved by | RMA | 05/03/2019 | Scale As Shown | Project No 10122205 |




TYPICAL CROSS-SECTION OF CROSSING POINT SLAB OVER PIPELINE
NOT TO SCALE




TYPICAL CROSS SECTION ALONG PIPELINE
NOT TO SCALE
(TYPICAL ROAD LAYOUT SHOWN)

## 1.0 GENERAL NOTES:

1.1 ALL UNITS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.

1.2 THIS DRAWING SHOULD READ IN CONJUNCTION WITH 002 SHEET 2 OF 2 REV. 0.

1.3 GAS PIPELINE LOCATION IS TO BE CONFIRMED BY TRIAL PITS, AT SUPERVISION OF CADENT.

1.4 ALL WORKS ARE TO BE CARRIED OUT IN ACCORDANCE WITH HSG 47 AND CADENT'S SPECIFICATIONS GD/SP/CE/12, GD/SP/SSW/22, AND WORKMANSHIP IN ACCORDANCE WITH GD/SP/CE/1.

## 2.0 MINIMUM FUNCTIONAL SPECIFICATION

2.1 THE MODEL SLAB DESIGNS ASSUME THE FOLLOWING:

- PIPELINES FALL WITHIN THE REQUIREMENTS OF CADENT GAS SPECIFICATION T/PM/P/2.
- PIPELINE WALL THICKNESS COMPLIES WITH THE MINIMUM IN T/SP/DAT/6.
- SLABS TO BE 300mm TO 500mm BELOW FINISHED GROUND LEVEL (I.E. CAST AT 300mm AND UP TO 500mm OF ROAD CONSTRUCTION OVER).
- TO BE CAST IN-SITU (PRE-CAST CONCRETE WILL BE CASE-SPECIFIC DESIGNS).
- 0.90m TO 3.5m PIPE COVER - WHERE GREATER COVER EXISTS, CASE-SPECIFIC DESIGNS WILL BE REQUIRED.
- THE MAXIMUM OPERATING PRESSURES FOR THE PIPELINE ARE UP TO 94 BAR.
- THE SLAB RESTS ON A SOIL WITH A SAFE ALLOWABLE BEARING PRESSURE OF AT LEAST 135kN/m² - THIS IS TO BE CONFIRMED ON SITE BY THE CONTRACTOR.
- THE PROPOSED SLAB IS FOR THE PROTECTION OF 1NO. OF HP PIPELINE ONLY, AND SHOULD NOT BE APPLICABLE TO MORE THAN 1 NO. PIPELINE PROTECTION.

2.2 300mm/500mm SHOULD BE MEASURED FROM THE HIGHEST POINT OF THE ROAD WHERE IS SLABBED.

## 3.0 EXCLUSION

3.1 THIS MODEL SLAB DESIGN SHALL NOT BE USED IN THE FOLLOWING CONDITIONS:

- FOR SPECIAL ORDER VEHICLES REPRESENTED BY THE LOAD MODEL 3 SOV AND THOSE LOADS INCURRED BY VEHICLES NORMALLY FOUND IN QUARRIES AND OPENCAST SITES.
- WHERE ANY ADJACENT SERVICE IS LOCATED IN THE SLAB AREA.
- INSTALLED WITHIN 3 PIPE DIAMETERS OF FORGED BENDS WHICH HAVE A BEND RADIUS OF 5 PIPE DIAMETERS OR LESS.
- SURFACE SLABS.
- PILED SLABS.
- PRE-CAST SLABS
- AREAS SUBJECT TO FLOODING.

## 4.0 RESIDUAL RISKS:

4.1 POTENTIAL FOR EXISTING UNDERGROUND SERVICES.

4.2 WORKING IN THE VICINITY OF A HIGH PRESSURE GAS PIPELINE.

4.3 POTENTIAL FOR CONTAMINATED GROUND.

| Rev No | Date | Drn by | Chk by | App by | Description |
|---|---|---|---|---|---|
| 0 | 28/03/19 | JWB | XHC | RMA | Incorporating Appraiser's comments |
| C | 21/03/19 | JWB | XHC | RMA | Incorporating Cadent's comments |
| B | 05/02/19 | JWB | XHC | RMA | G19 Approval |
| A | 05/12/18 | JWB | XHC | RMA | Internal Review |

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Holywell Park, Ashby Road, Loughborough, Leicestershire, LE11 3GR

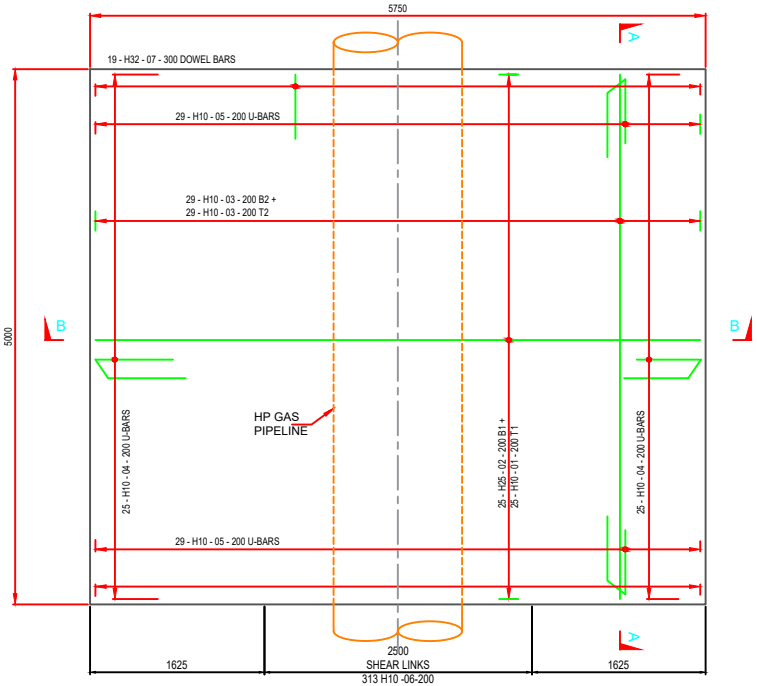
Title:
Nominal Pipe Diameter between 900mm and up to 1200mm
Full Traffic Loading (BS EN 1991-2 LM1, LM2)
Slab Details

Client
Cadent

Contract
Standard Protection Slab for HP Gas Pipeline (P/2)

| | | Date | Drawing No | Rev |
|---|---|---|---|---|
| Drawn By | JWB | 05/12/2018 | 002 Sheet 1 of 2 | 0 |
| CAD Check by | XHC | 05/02/2019 | Sheet 1 of 1 | Sheet Size A3 |
| ENG Check by | DJ | 05/02/2019 | Scale As Shown | Project No 10122205 |
| Approved by | RMA | 05/03/2019 | | |

"GAS" MARKER TAPE SHALL BE PLACED ON ALL BURIED SLABS, AT THE CENTRELINE OF THE PIPE AND 300MM FROM EACH SLAB EDGE AND SHALL EXTEND LONGITUDINALLY FOR THE FULL LENGTH OF THE SLAB.




## PLAN

SCALE 1:50

## 1.0 CADENT REQUIREMENTS:

1.1 ALL WORKS ARE TO BE CARRIED OUT IN ACCORDANCE WITH HSG 47 AND CADENT'S SPECIFICATIONS GD/SP/CE/12, GD/SP/SSW/22, AND WORKMANSHIP IN ACCORDANCE WITH GD/SP/CE/1.

1.2 ALL WORKS ARE TO BE MONITORED BY CADENT GAS LIMITED SAFE CONTROL OF OPERATIONS (CADENT SCO) REPRESENTATIVE AT ALL TIMES. SETTING OUT OF THE GAS PROTECTION SLABS AND TOP OF PIPE LEVELS MAY VARY. VARIANCE OF SETTING-OUT LEVELS MUST BE REPORTED TO DESIGNER FOR REVIEW AND APPROVAL.

1.3 MECHANICAL EXCAVATORS MUST BE FITTED WITH TOOTHLESS BUCKET.

1.4 MECHANICAL EXCAVATORS AND ANY OTHER POWERED MECHANICAL PLANT SHALL NOT BE SITED OR MOVED ABOVE THE PIPELINE UNLESS WRITTEN AUTHORITY HAS BEEN GIVEN BY CADENT RESPONSIBLE PERSON.

1.5 MECHANICAL EXCAVATORS AND ANY OTHER POWERED MECHANICAL PLANT SHALL NOT DIG ON ONE SIDE OF THE PIPELINE WITH THE CAB OF THE EXCAVATOR POSITIONED ON THE OTHER SIDE.

1.6 MECHANICAL EXCAVATORS, AND OTHER POWERED MECHANICAL PLANT, AND OTHER TRAFFIC SHALL BE POSITIONED FAR ENOUGH AWAY FROM THE PIPELINE TRENCH TO PREVENT TRENCH WALL COLLAPSE.

1.7 BACKFILL COMPACTION METHOD SHOULD USE DEAD LOAD COMPACTION ONLY.

## 2.0 CONSTRUCTION:

2.1 FOR LONG SLAB, CONTRACTION JOINT LOCATION SHALL BE DETERMINED ON THE BASIS OF THE DESIGN MANUAL FOR ROADS AND BRIDGES, VOLUME 7,SECTION 2, PART 3 (HD26/06).

2.2 EVERY 3RD JOINT IS EXPANSION JOINT.

2.3 REINFORCEMENT SHALL BE CONTINUOUS ACROSS CONSTRUCTION JOINTS.

| Bar Mark | Type and Size | No. of Groups | No. in each Group | Total number | Length of each bar | Shape Code | All bending dimensions are in accordance with BS 8666 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A* mm | B* mm | C* mm | D* mm |
| 01 | H 10 | 1 | 25 | 25 | 5600 | 00 | 5600 | | | |
| 02 | H 25 | 1 | 25 | 25 | 5600 | 00 | 5600 | | | |
| 03 | H 10 | 1 | 58 | 58 | 4850 | 00 | 4850 | | | |
| 04 | H 10 | 1 | 50 | 50 | 1150 | 21 | 500 | 180 | 500 | |
| 05 | H 10 | 1 | 58 | 58 | 1125 | 21 | 500 | 145 | 500 | |
| 06 | H 10 | 1 | 313 | 313 | 570 | 99 | 150 | 200 | 75 | 145 |
| 07 | H 32 | See Note | 19 | 19 | 600 | 00 | 600 | | | |

Note: Bar Mark 07 only required if Contraction/Expansion Joints are provided.

## 3.0 CONCRETE NOTES

3.1 DO NOT SCALE FROM THIS DRAWING - USE ONLY VALUES OF STATED DIMENSIONS.

3.2 MINIMUM COVER TO REINFORCEMENT TO BE 50mm TO ALL FACES UNLESS NOTED OTHERWISE.

3.3 STEEL REINFORCEMENT SHALL BE GRADE B500B RIBBED BARS OF 500MPa CHARACTERISTIC YIELD STRENGTH TO BS 4449:2005, CUT AND BENT IN ACCORDANCE WITH BS8666: 2005.

3.4 BAR REFERENCES TO BE INTERPRETED THUS:-

24 H12 - 19 - 200 - T1

- LOCATION
- SPACING / BAR CENTRES (mm)
- BAR MARK
- BAR DIAMETER
- TYPE OF STEEL
- NUMBER OF BARS

3.5 BAR LOCATIONS AS NOTED BELOW:-

T1 = TOP FACE OUTER LAYER
T2 = TOP FACE INNER LAYER
B1 = BOTTOM FACE OUTER LAYER
B2 = BOTTOM FACE INNER LAYER

3.6 UNLESS NOTED OTHERWISE ALL BAR RANGES ARE CALLED UP WITH BAR CENTRELINE MEASURED PERPENDICULAR TO THE REINFORCEMENT BARS.

3.7 THIS SLAB HAD BEEN DESIGNED IN ACCORDANCE WITH BS EN 1990, BS EN 1991, BS EN 1992 AND BS EN 1997 AND THE REQUIREMENT OF GD/SP/CE/12.

3.8 CONCRETE SPECIFICATION INCLUDING MASS CONCRETE AND BLINDING TO BE A DESIGNED MIX AS BELOW AND TO COMPLY WITH BS 8500-1:2015 AND CONFORM TO BS 8500-

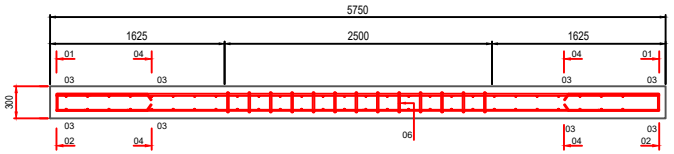
- GRADE - C40/50;
- MAXIMUM W/C RATIO 0.35;
- MINIMUM CEMENT CONTENT IS 380 kg/m$^3$;
- MAXIMUM AGGREGATE SIZE 20mm;
- CONSISTENCE CLASS S3;
- ACEC CLASS AC-4;
- DESIGN SULFATE CLASS FOR CONCRETE TO BE DS-4.

3.9 CONTRACTOR TO ENSURE THE SLAB IS NOT LOADED EARLIER THAN 28 DAYS. CONTRACTOR SHALL TAKE SAMPLE TEST CYLINDERS AND TEST AT 28 DAYS TO ENSURE THAT THE CONCRETE REACHES A CYLINDER STRENGTH OF 40N/mm$^2$ AT 28 DAYS.

3.10 CENTRELINE OF SLAB IN SPAN DIMENSION MUST COINCIDE WITH CENTRELINE OF PIPELINE. THE CONTRACTOR IS RESPONSIBLE FOR SETTING OUT AND FOR ENSURING THAT THE PIPELINE ALIGNMENT IS CORRECTLY IDENTIFIED.

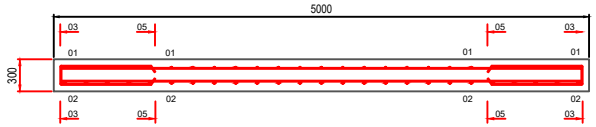
3.11 CONTRACTOR IS TO PROVIDE PROPRIETARY SPACERS BETWEEN TOP AND BOTTOM OF REINFORCEMENT LAYERS.

3.12 THESE REINFORCEMENT DETAILS APPLY TO DRAWING 002 SHEET 1 OF 2 REV. 0.



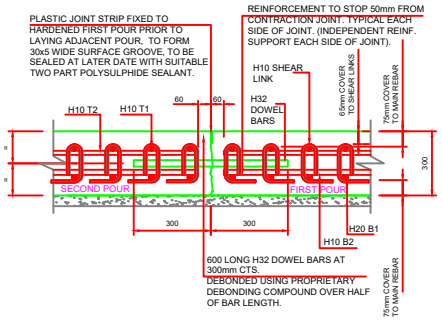

## SECTION B-B

SCALE 1:50




## SECTION A-A

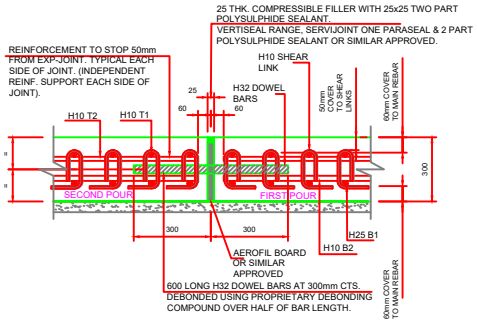
SCALE 1:50




## CONTRACTION JOINT DETAIL

SCALE 1:25

(COMPRESSIBLE FILLER IS NOT SHOWN FOR CLARITY)




## EXPANSION JOINT DETAIL

SCALE1:25

(COMPRESSIBLE FILLER IS NOT SHOWN FOR CLARITY)

| Rev No | Date | Drn by | Chk by | App by | Description |
|---|---|---|---|---|---|
| 0 | 28/03/19 | JWB | XHC | RMA | Incorporating Appraiser's comments |
| C | 21/03/19 | JWB | XHC | RMA | Incorporating Cadent's comments |
| B | 05/02/19 | JWB | XHC | RMA | G19 Approval |
| A | 05/12/18 | JWB | XHC | RMA | Internal Review |

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DNV·GL

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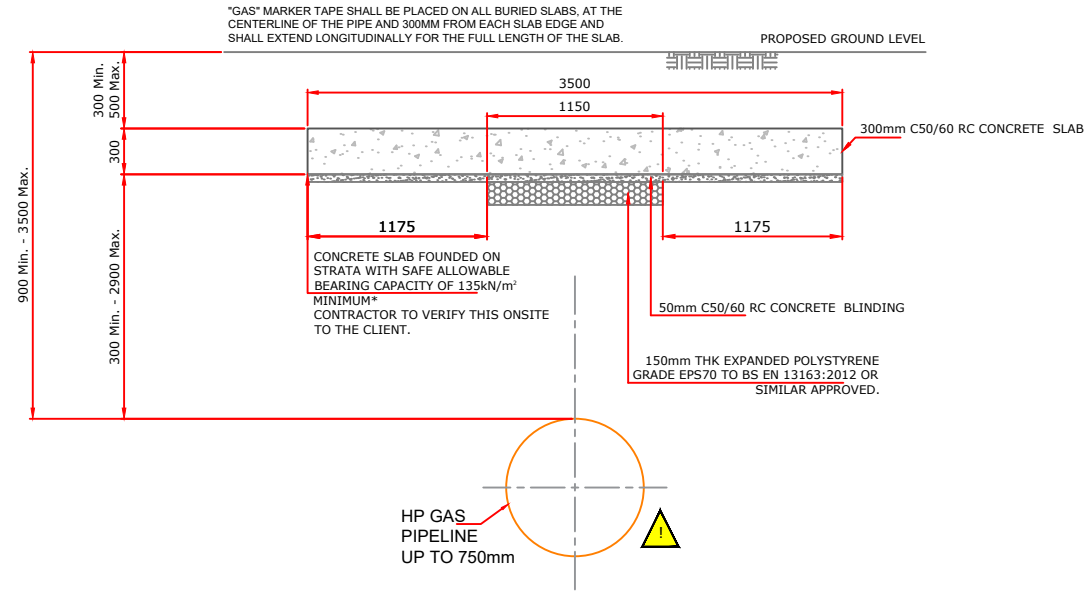
Holywell Park, Ashby Road, Loughborough, Leicestershire, LE11 3GR

Title:
Nominal Pipe Diameter between 900mm and up to 1200mm
Full Traffic Loading (BS EN 1991-2 LM1, LM2)
Slab Reinforcement and Joints Details

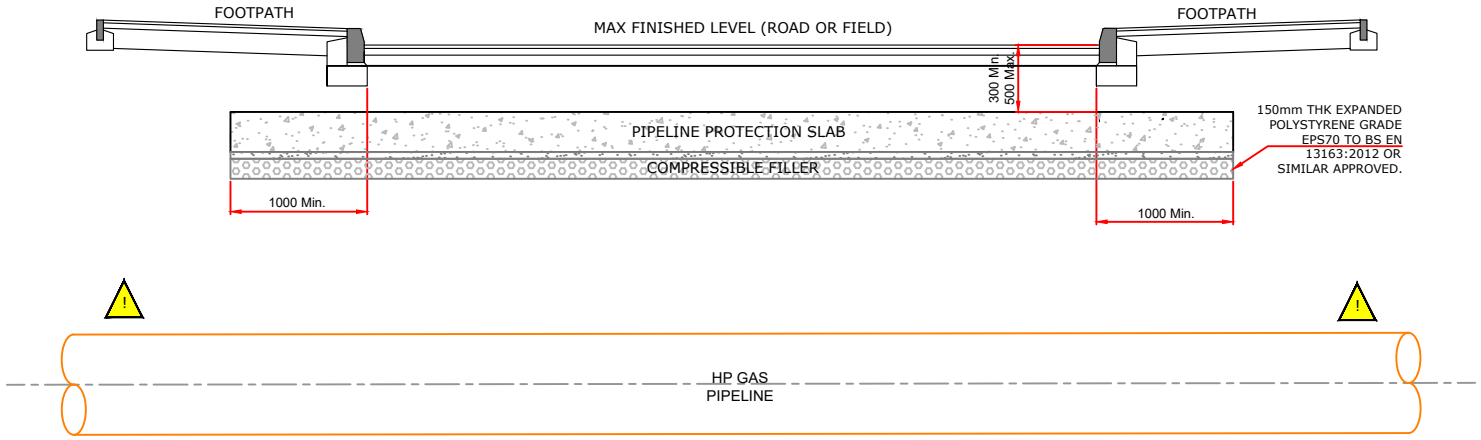
Client
Cadent

Contract
Standard Protection Slab for HP Gas Pipeline (P/2)

| | | Date | Drawing No | Rev |
|---|---|---|---|---|
| | | | 002 Sheet 2 of 2 | 0 |
| Drawn By | JWB | 11/12/2018 | | |
| CAD Check by | XHC | 05/02/2019 | Sheet 1 of 1 | Sheet Size A3 |
| ENG Check by | DJ | 05/02/2019 | | |
| Approved by | RMA | 05/03/2019 | Scale As Shown | Project No 10122205 |




## TYPICAL CROSS-SECTION OF CROSSING POINT SLAB OVER PIPELINE
## NOT TO SCALE




## TYPICAL CROSS SECTION ALONG PIPELINE
## NOT TO SCALE
## (TYPICAL ROAD LAYOUT SHOWN)

## 1.0 GENERAL NOTES:

1.1 ALL UNITS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.

1.2 THIS DRAWING SHOULD READ IN CONJUNCTION WITH 003 SHEET 2 OF 2 REV. 0.

1.3 GAS PIPELINE LOCATION IS TO BE CONFIRMED BY TRIAL PITS, AT SUPERVISION OF CADENT.

1.4 ALL WORKS ARE TO BE CARRIED OUT IN ACCORDANCE WITH HSG 47 AND CADENT'S SPECIFICATIONS GD/SP/CE/12, GD/SP/SSW/22, AND WORKMANSHIP IN ACCORDANCE WITH GD/SP/CE/1.

## 2.0 MINIMUM FUNCTIONAL SPECIFICATION

2.1 THE MODEL SLAB DESIGNS ASSUME THE FOLLOWING:

- PIPELINES FALL WITHIN THE REQUIREMENTS OF CADENT GAS SPECIFICATION T/PM/P/2.
- PIPELINE WALL THICKNESS COMPLIES WITH THE MINIMUM IN T/SP/DAT/6.
- SLABS TO BE 300mm TO 500mm BELOW FINISHED GROUND LEVEL (I.E. CAST AT 300mm AND UP TO 500mm OF ROAD CONSTRUCTION OVER).
- TO BE CAST IN-SITU (PRE-CAST CONCRETE WILL BE CASE-SPECIFIC DESIGNS).
- 0.90m TO 3.5m PIPE COVER - WHERE GREATER COVER EXISTS, CASE-SPECIFIC DESIGNS WILL BE REQUIRED.
- THE MAXIMUM OPERATING PRESSURES FOR THE PIPELINE ARE UP TO 94 BAR.
- THE SLAB RESTS ON A SOIL WITH A SAFE ALLOWABLE BEARING PRESSURE OF AT LEAST 135kN/m$^2$ - THIS IS TO BE CONFIRMED ON SITE BY THE CONTRACTOR.
- THE PROPOSED SLAB IS FOR THE PROTECTION OF 1NO. OF HP PIPELINE ONLY, AND SHOULD NOT BE APPLICABLE TO MORE THAN 1 NO. PIPELINE PROTECTION.

2.2 300mm/500mm SHOULD BE MEASURED FROM THE HIGHEST POINT OF THE ROAD WHERE IS SLABBED.

## 3.0 EXCLUSION

3.1 THIS MODEL SLAB DESIGN SHALL NOT BE USED IN THE FOLLOWING CONDITIONS:

- FOR SPECIAL ORDER VEHICLES REPRESENTED BY THE LOAD MODEL 3 SOV AND THOSE LOADS INCURRED BY VEHICLES NORMALLY FOUND IN QUARRIES AND OPENCAST SITES.
- WHERE ANY ADJACENT SERVICE IS LOCATED IN THE SLAB AREA.
- INSTALLED WITHIN 3 PIPE DIAMETERS OF FORGED BENDS WHICH HAVE A BEND RADIUS OF 5 PIPE DIAMETERS OR LESS.
- SURFACE SLABS.
- PILED SLABS.
- PRE-CAST SLABS
- AREAS SUBJECT TO FLOODING.

## 4.0 RESIDUAL RISKS:

4.1 POTENTIAL FOR EXISTING UNDERGROUND SERVICES.

4.2 WORKING IN THE VICINITY OF A HIGH PRESSURE GAS PIPELINE.

4.3 POTENTIAL FOR CONTAMINATED GROUND.

| Rev No | Date | Drn by | Chk by | App by | Description |
|---|---|---|---|---|---|
| 0 | 28/03/19 | JWB | XHC | RMA | Incorporating Appraiser's comments |
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DNV·GL

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Holywell Park, Ashby Road, Loughborough, Leicestershire, LE11 3GR

Title:
Nominal Pipe Diameter up to 750mm
Reduced Traffic Loading (BS EN 1991-2 SV100 Loading)
Slab Details

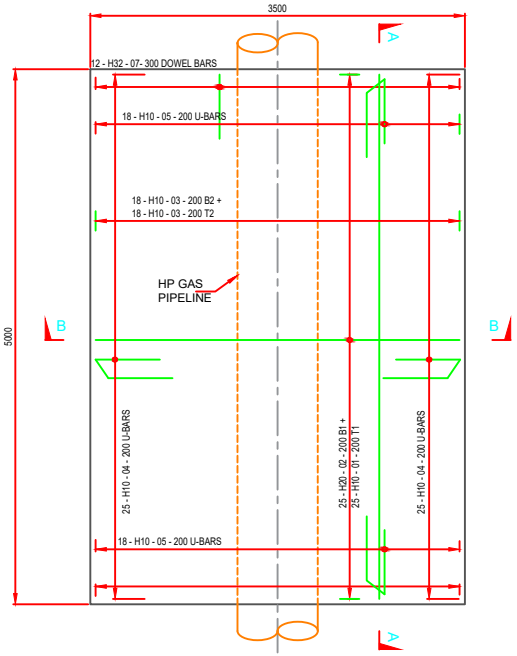
Client
Cadent

Contract
Standard Protection Slab for HP Gas Pipeline (P/2)

| | | Date |
|---|---|---|
| Drawn By | JWB | 05/12/2018 |
| CAD Check by | XHC | 05/02/2019 |
| ENG Check by | DJ | 05/02/2019 |
| Approved by | RMA | 05/03/2019 |

| Drawing No | Rev |
|---|---|
| 003 Sheet 1 of 2 | 0 |
| Sheet: 1 of 1 | Sheet Size: A3 |
| Scale: As Shown | Project No: 10122205 |

"GAS" MARKER TAPE SHALL BE PLACED ON ALL BURIED SLABS, AT THE CENTRELINE OF THE PIPE AND 300MM FROM EACH SLAB EDGE AND SHALL EXTEND LONGITUDINALLY FOR THE FULL LENGTH OF THE SLAB.




PLAN

SCALE 1:50

## 1.0 CADENT REQUIREMENTS:

1.1 ALL WORKS ARE TO BE CARRIED OUT IN ACCORDANCE WITH HSG 47 AND CADENT'S SPECIFICATIONS GD/SP/CE/12, GD/SP/SSW/22, AND WORKMANSHIP IN ACCORDANCE WITH GD/SP/CE/1.

1.2 ALL WORKS ARE TO BE MONITORED BY CADENT GAS LIMITED SAFE CONTROL OF OPERATIONS (CADENT SCO) REPRESENTATIVE AT ALL TIMES. SETTING OUT OF THE GAS PROTECTION SLABS AND TOP OF PIPE LEVELS MAY VARY. VARIANCE OF SETTING-OUT LEVELS MUST BE REPORTED TO DESIGNER FOR REVIEW AND APPROVAL.

1.3 MECHANICAL EXCAVATORS MUST BE FITTED WITH TOOTHLESS BUCKET.

1.4 MECHANICAL EXCAVATORS AND ANY OTHER POWERED MECHANICAL PLANT SHALL NOT BE SITED OR MOVED ABOVE THE PIPELINE UNLESS WRITTEN AUTHORITY HAS BEEN GIVEN BY CADENT RESPONSIBLE PERSON.

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1.7 BACKFILL COMPACTION METHOD SHOULD USE DEAD LOAD COMPACTION ONLY.

## 2.0 CONSTRUCTION:

2.1 FOR LONG SLAB, CONTRACTION JOINT LOCATION SHALL BE DETERMINED ON THE BASIS OF THE DESIGN MANUAL FOR ROADS AND BRIDGES, VOLUME 7,SECTION 2, PART 3 (HD26/06).

2.2 EVERY 3RD JOINT IS EXPANSION JOINT.

2.3 REINFORCEMENT SHALL BE CONTINUOUS ACROSS CONSTRUCTION JOINTS.

| Bar Mark | Type and Size | No. of Groups | No. in each Group | Total number | Length of each bar | Shape Code | All bending dimensions are in accordance with BS 8666 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A* mm | B* mm | C* mm | D* mm |
| 01 | H 10 | 1 | 25 | 25 | 3350 | 00 | 3350 | | | |
| 02 | H 20 | 1 | 25 | 25 | 3350 | 00 | 3350 | | | |
| 03 | H 10 | 1 | 36 | 36 | 4850 | 00 | 4850 | | | |
| 04 | H 10 | 1 | 50 | 50 | 1175 | 21 | 500 | 200 | 500 | |
| 05 | H 10 | 1 | 36 | 36 | 1150 | 21 | 500 | 170 | 500 | |
| 07 | H 32 | See note | 12 | 12 | 600 | 00 | 600 | | | |

Note: Bar Mark 07 only required if Contraction/Expansion Joints are provided.

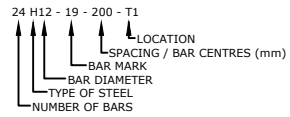
## 3.0 CONCRETE NOTES

3.1 DO NOT SCALE FROM THIS DRAWING - USE ONLY VALUES OF STATED DIMENSIONS.

3.2 MINIMUM COVER TO REINFORCEMENT TO BE 50mm TO ALL FACES UNLESS NOTED OTHERWISE.

3.3 STEEL REINFORCEMENT SHALL BE GRADE B500B RIBBED BARS OF 500MPa CHARACTERISTIC YIELD STRENGTH TO BS 4449:2005, CUT AND BENT IN ACCORDANCE WITH BS8666: 2005.

3.4 BAR REFERENCES TO BE INTERPRETED THUS:-




3.5 BAR LOCATIONS AS NOTED BELOW:-

T1 = TOP FACE OUTER LAYER
T2 = TOP FACE INNER LAYER
B1 = BOTTOM FACE OUTER LAYER
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3.6 UNLESS NOTED OTHERWISE ALL BAR RANGES ARE CALLED UP WITH BAR CENTRELINE MEASURED PERPENDICULAR TO THE REINFORCEMENT BARS.

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3.8 CONCRETE SPECIFICATION INCLUDING MASS CONCRETE AND BLINDING TO BE A DESIGNED MIX AS BELOW AND TO COMPLY WITH BS 8500-1:2015 AND CONFORM TO BS 8500-

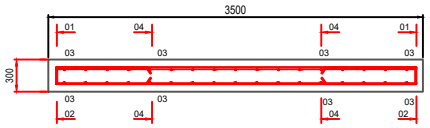
- GRADE - C50/60;
- MAXIMUM W/C RATIO 0.35;
- MINIMUM CEMENT CONTENT IS 380 kg/m$^3$;
- MAXIMUM AGGREGATE SIZE 20mm;
- CONSISTENCE CLASS S3;
- ACEC CLASS AC-4;
- DESIGN SULFATE CLASS FOR CONCRETE TO BE DS-4.

3.9 CONTRACTOR TO ENSURE THE SLAB IS NOT LOADED EARLIER THAN 28 DAYS. CONTRACTOR SHALL TAKE SAMPLE TEST CYLINDERS AND TEST AT 28 DAYS TO ENSURE THAT THE CONCRETE REACHES A CYLINDER STRENGTH OF 50N/mm$^2$ AT 28 DAYS.

3.10 CENTRELINE OF SLAB IN SPAN DIMENSION MUST COINCIDE WITH CENTRELINE OF PIPELINE. THE CONTRACTOR IS RESPONSIBLE FOR SETTING OUT AND FOR ENSURING THAT THE PIPELINE ALIGNMENT IS CORRECTLY IDENTIFIED.

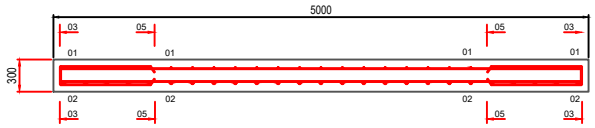
3.11 CONTRACTOR IS TO PROVIDE PROPRIETARY SPACERS BETWEEN TOP AND BOTTOM OF REINFORCEMENT LAYERS.

3.12 THESE REINFORCEMENT DETAILS APPLY TO DRAWING 003 SHEET 1 OF 2 REV. 0.



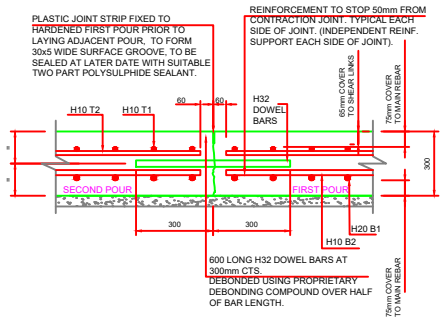

SECTION B-B

SCALE 1:50




SECTION A-A

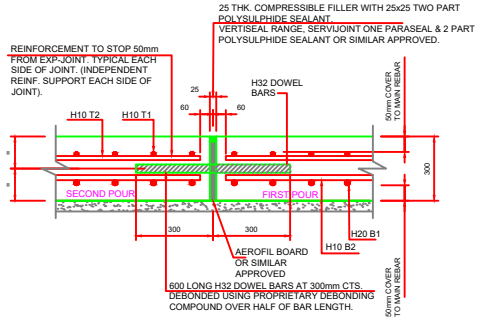
SCALE 1:50




CONTRACTION JOINT DETAIL

SCALE 1:25

(COMPRESSIBLE FILLER IS NOT SHOWN FOR CLARITY)




EXPANSION JOINT DETAIL

SCALE1:25

(COMPRESSIBLE FILLER IS NOT SHOWN FOR CLARITY)

| Rev No | Date | Drn by | Chk by | App by | Description |
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| 0 | 28/03/19 | JWB | XHC | RMA | Incorporating Appraiser's comments |
| C | 21/03/19 | JWB | XHC | RMA | Incorporating Cadent's comments |
| B | 05/02/19 | JWB | XHC | RMA | G19 Approval |
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Cadent Your Gas Network

DNV·GL

GL Industrial Services UK Ltd trading as DNV GL
Holywell Park, Ashby Road, Loughborough, Leicestershire, LE11 3GR

Title:
Nominal Pipe Diameter up to 750mm Reduced Traffic Loading (BS EN 1991-2 SV100 Loading) Slab Reinforcement and Joints Details

Client
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Contract
Standard Protection Slab for HP Gas Pipeline (P/2)

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Drawing No: 003 Sheet 2 of 2
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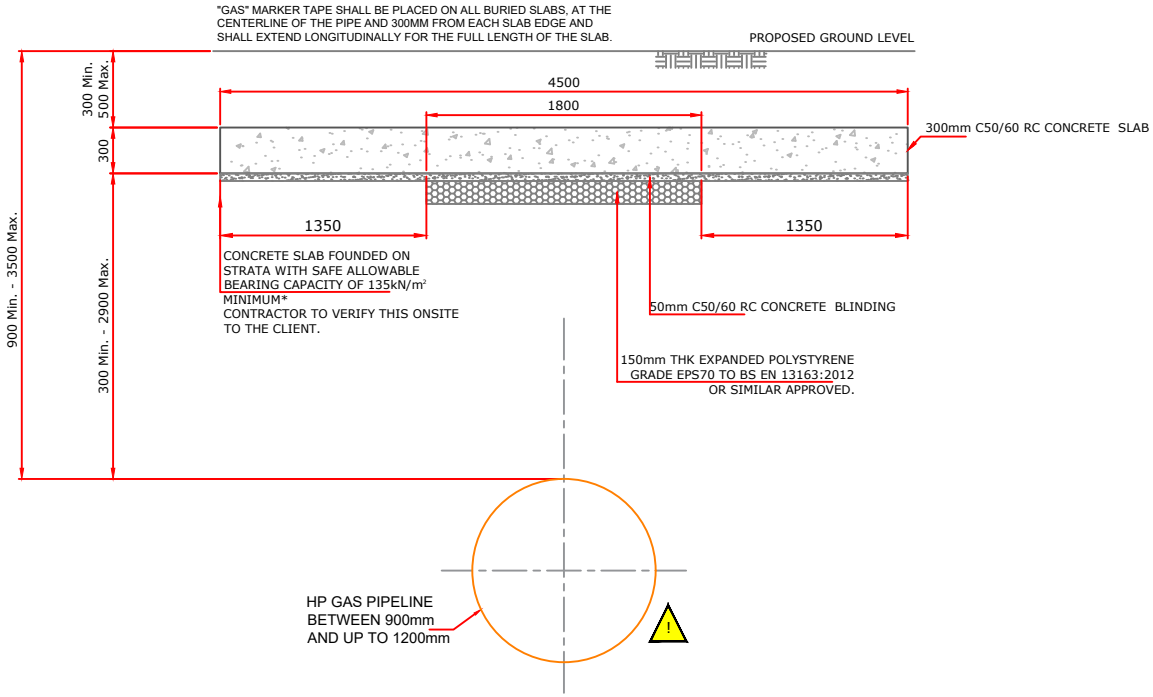
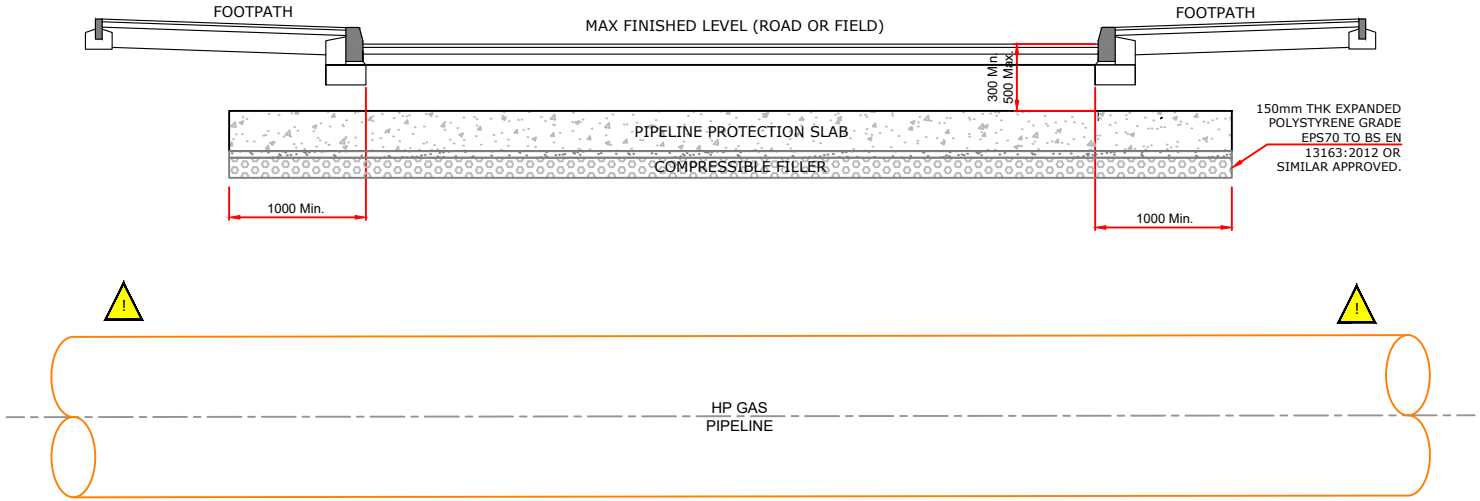



TYPICAL CROSS-SECTION OF CROSSING POINT SLAB OVER PIPELINE
NOT TO SCALE




TYPICAL CROSS SECTION ALONG PIPELINE
NOT TO SCALE
(TYPICAL ROAD LAYOUT SHOWN)

## 1.0 GENERAL NOTES:

1.1 ALL UNITS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.

1.2 THIS DRAWING SHOULD READ IN CONJUNCTION WITH 004 SHEET 2 OF 2 REV.0.

1.3 GAS PIPELINE LOCATION IS TO BE CONFIRMED BY TRIAL PITS, AT SUPERVISION OF CADENT.

1.4 ALL WORKS ARE TO BE CARRIED OUT IN ACCORDANCE WITH HSG 47 AND CADENT'S SPECIFICATIONS GD/SP/CE/12, GD/SP/SSW/22, AND WORKMANSHIP IN ACCORDANCE WITH GD/SP/CE/1.

## 2.0 MINIMUM FUNCTIONAL SPECIFICATION

2.1 THE MODEL SLAB DESIGNS ASSUME THE FOLLOWING:

- PIPELINES FALL WITHIN THE REQUIREMENTS OF CADENT GAS SPECIFICATION T/PM/P/2.
- PIPELINE WALL THICKNESS COMPLIES WITH THE MINIMUM IN T/SP/DAT/6.
- SLABS TO BE 300mm TO 500mm BELOW FINISHED GROUND LEVEL (I.E. CAST AT 300mm AND UP TO 500mm OF ROAD CONSTRUCTION OVER).
- TO BE CAST IN-SITU (PRE-CAST CONCRETE WILL BE CASE-SPECIFIC DESIGNS).
- 0.90m TO 3.5m PIPE COVER - WHERE GREATER COVER EXISTS, CASE-SPECIFIC DESIGNS WILL BE REQUIRED.
- THE MAXIMUM OPERATING PRESSURES FOR THE PIPELINE ARE UP TO 94 BAR.
- THE SLAB RESTS ON A SOIL WITH A SAFE ALLOWABLE BEARING PRESSURE OF AT LEAST 135kN/m$^2$ - THIS IS TO BE CONFIRMED ON SITE BY THE CONTRACTOR.
- THE PROPOSED SLAB IS FOR THE PROTECTION OF 1NO. OF HP PIPELINE ONLY, AND SHOULD NOT BE APPLICABLE TO MORE THAN 1 NO. PIPELINE PROTECTION.

2.2 300mm/500mm SHOULD BE MEASURED FROM THE HIGHEST POINT OF THE ROAD WHERE IS SLABBED.

## 3.0 EXCLUSION

3.1 THIS MODEL SLAB DESIGN SHALL NOT BE USED IN THE FOLLOWING CONDITIONS:

- FOR SPECIAL ORDER VEHICLES REPRESENTED BY THE LOAD MODEL 3 SOV AND THOSE LOADS INCURRED BY VEHICLES NORMALLY FOUND IN QUARRIES AND OPENCAST SITES.
- WHERE ANY ADJACENT SERVICE IS LOCATED IN THE SLAB AREA.
- INSTALLED WITHIN 3 PIPE DIAMETERS OF FORGED BENDS WHICH HAVE A BEND RADIUS OF 5 PIPE DIAMETERS OR LESS.
- SURFACE SLABS.
- PILED SLABS.
- PRE-CAST SLABS
- AREAS SUBJECT TO FLOODING.

## 4.0 RESIDUAL RISKS:

4.1 POTENTIAL FOR EXISTING UNDERGROUND SERVICES.

4.2 WORKING IN THE VICINITY OF A HIGH PRESSURE GAS PIPELINE.

4.3 POTENTIAL FOR CONTAMINATED GROUND.

| Rev No | Date | Drn by | Chk by | App by | Description |
|---|---|---|---|---|---|
| 0 | 28/03/19 | JWB | XHC | RMA | Incorporating Appraiser's comments |
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Drawing No: 004 Sheet 1 of 2
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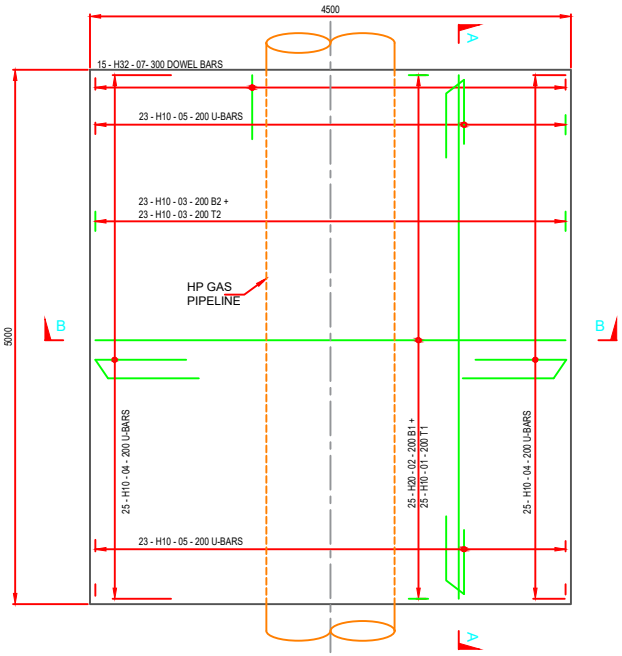
"GAS" MARKER TAPE SHALL BE PLACED ON ALL BURIED SLABS, AT THE CENTRELINE OF THE PIPE AND 300MM FROM EACH SLAB EDGE AND SHALL EXTEND LONGITUDINALLY FOR THE FULL LENGTH OF THE SLAB.




PLAN

SCALE 1:50

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A* mm | B* mm | C* mm | D* mm |
| 01 | H 10 | 1 | 25 | 25 | 4350 | 00 | 4350 | | | |
| 02 | H 20 | 1 | 25 | 25 | 4350 | 00 | 4350 | | | |
| 03 | H 10 | 1 | 46 | 46 | 4850 | 00 | 4850 | | | |
| 04 | H 10 | 1 | 50 | 50 | 1175 | 21 | 500 | 200 | 500 | |
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| 07 | H 32 | See Note | 15 | 15 | 600 | 00 | 600 | | | |

Note: Bar Mark 07 only required if Contraction/Expansion Joints are provided.

## 3.0 CONCRETE NOTES

3.1 DO NOT SCALE FROM THIS DRAWING - USE ONLY VALUES OF STATED DIMENSIONS.

3.2 MINIMUM COVER TO REINFORCEMENT TO BE 50mm TO ALL FACES UNLESS NOTED OTHERWISE.

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3.4 BAR REFERENCES TO BE INTERPRETED THUS:-

24 H12 - 19 - 200 - T1
- 24 — NUMBER OF BARS
- H — TYPE OF STEEL
- 12 — BAR DIAMETER
- 19 — BAR MARK
- 200 — SPACING / BAR CENTRES (mm)
- T1 — LOCATION

3.5 BAR LOCATIONS AS NOTED BELOW:-

T1 = TOP FACE OUTER LAYER
T2 = TOP FACE INNER LAYER
B1 = BOTTOM FACE OUTER LAYER
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- GRADE - C50/60;
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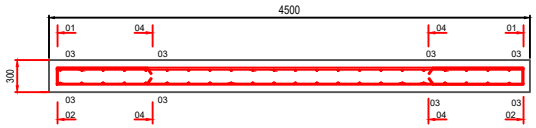
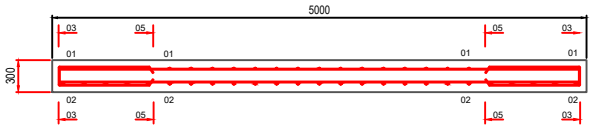


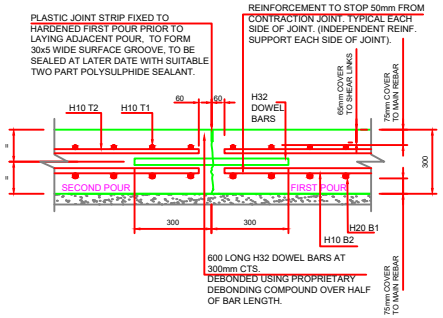

SECTION B-B

SCALE 1:50




SECTION A-A

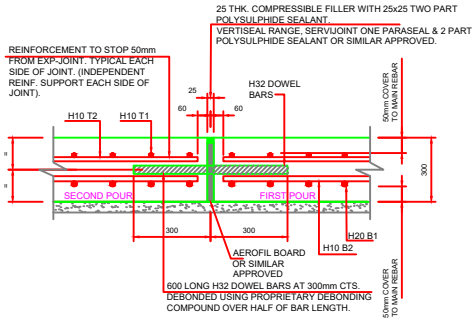
SCALE 1:50




CONTRACTION JOINT DETAIL

SCALE 1:25

(COMPRESSIBLE FILLER IS NOT SHOWN FOR CLARITY)




EXPANSION JOINT DETAIL

SCALE1:25

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Drawing No: 004 Sheet 2 of 2
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# 7 MATERIALS

Materials for pipeline protection works shall comply with the requirements of the CE suite of documents, supplemented by the following requirements;

## 7.1 Fill and capping materials

7.1.1 Fill and capping materials shall comply with the relevant Sections of GD/SP/CE/2.

## 7.2 Unbound Mixtures

7.2.1 Type 1 and Type 2 unbound mixtures shall comply with specification for Highway Works Volume 1 Series 803 and 804 respectively.

## 7.3 Concrete

7.3.1 This section provides a suitable concrete specification for 'standard slabs'. Alternatively, a competent Civil Design Engineer should be consulted and an appropriate concrete specification produced and included in the Design Output Package.

7.3.2 Concrete designation shall be C40/50 and C50/60 (See Drawings for details). Refer to GD/SP/CE/1 for more information.

7.3.3 The Designer shall determine the sulphate classification in accordance with BRE Special Digest No. 1: "Concrete in aggressive ground based upon specific ground and groundwater sulphate test results". Where the previous land use is unknown and no testing has been undertaken, the classification shall be specified as a minimum of DS-4 for the design sulphate class and ACEC Class AC4. Where ground conditions are found to be contaminated to a greater level, or there are any durability concerns in a particular situation, the concrete mixes specified above may require to be modified. Details of any modifications shall be provided by a competent Civil Design Engineer.

7.3.4 The concrete specified in this section is suitable for loading at 28 days following casting.

7.3.5 Where it is desired to load the slab at 7 days after casting, the contractor shall

- confirm that the concrete cylinder strength of the cast concrete is equal to or greater than 70% of the design cylinder strengths noted in clause 7.3.2.

and

- the applied maximum axle load of the vehicle shall not exceed 113KN, applied as an LM3 vehicle in accordance with BS EN 1991-2.

## 7.4 Steel reinforcement

7.4.1 Steel reinforcement used in the construction of pipeline protection slabs shall comply with the relevant sections of the CE suite of documents.

## 7.5 Artificial fill

7.5.1 Artificial fill used to minimise the load transferred from the slab to the pipeline shall be chosen to carry out the requirements of the design as required by Section 6.7 of this Specification.

7.5.2 Artificial fill used shall be a compressible material that prevents the transfer of load from the slab to the pipeline. It shall be solid, retain its rigidity and restrict the passage of gas or water.

7.5.3 For Standard Slab Designs provided in Section 6**,** expanded polystyrene of Grade EPS70, shall be used complying with BS EN 13163:2012+A2:2016 “Thermal insulation products for buildings. Factory made expanded polystyrene (EPS) products”.

## 7.6 Geotextiles

7.6.1 Geotextiles required as part of the permanent work to separate Type 1 or Type 2 granular material from subgrade shall be:

- manufactured from durable synthetic polymers.
- in the form of thin permeable membranes.
- woven or non-woven construction.

7.6.2 Geotextiles shall provide the mechanical properties required by the design and site conditions.

7.6.3 Where geotextiles are used as part of a haul road as Section 4.3, the geotextile adopted shall have a minimum mean peak tensile strength of 10 kN/m tested in accordance with the appropriate European or British Standard.

## 7.7 PE Slab Materials

Material used for the manufacture of PE Impact Protection slabs shall be Ultra High Weight Polyethylene (UHMWPE) with the following minimum test requirements:

- Elongation at Break Point, A% = 300% tested and proven in accordance with the requirements of the relative parts of BS EN ISO 527.
- Modulus of Elasticity, E = 800 MPa tested and proven in accordance with the requirements of the relative parts of BS EN ISO 527.
- Impact Resilience, Kcv = 2 J/cm2 tested and proven in accordance with the requirements of the relative parts of BS EN ISO 179.
- Colour to be Yellow within the range 10 E 50, 10 E 53 and 10 E 55 of BS 5252. The appearance of the slab shall be uniform in colour and opacity (refer to PL/2).

All polymer materials used shall be virgin material and as such the use of reconstituted materials shall not be permitted.

All material Manufacturers shall hold a current BS EN ISO 9001 Quality Management Systems Accreditation.

# 8 INSTALLATION OF PIPELINE PROTECTION WORKS

## 8.1 General

8.1.1 The safety of the pipeline is of prime importance therefore, prior to commencing work on any pipeline protection works, the following shall be complied with:

- The Construction (Design and Management) Regulations.
- GD/PM/SCO/1 Management Procedure for Safe Control of Operations.
- GD/PM/SSW/2 Management procedure for safe working and development in the vicinity of gas pipelines and associated installations – Requirements for The Company.
- GD/PM/SSW/22 Specification for safe working in the vicinity of high pressure gas pipelines and associated installations – Requirements for third parties.

Included in the above documents are requirements for:

- Risk assessments.
- Method Statements.
- Company supervision/presence.

## 8.2 Testing

8.2.1 With the exception of soils, it is not generally expected that any other materials will normally require testing. However testing is required for:

- Type 1, Type 2 or any other approved granular material used for fill below a crossing point slab, or the construction of a haul road that does not have documentation showing compliance with series 800 of the Specification for Highway Works.
- Concrete obtained from plants that do not have an approved quality assurance scheme.
- Any other materials that the project manager or supervisor deems should have a certificate
- Concrete where slabs may need to be loaded before 28 days.

8.2.2 Where documentation is not available, the supervisor should require testing of the material to show compliance with the specification.

## 8.3 Pipeline survey

8.3.1 Prior to the commencement of the installation of any protection works over a pipeline, a Close Interval Potential Survey or a Coating Defect Survey shall be carried out to the satisfaction of Cadent.

## 8.4 Soil

8.4.1 Soil on which any load-bearing pipeline protection works rest shall be tested in accordance with Clause 6.3.1. to confirm compliance with the criteria used in the design. The particular type and

frequency of testing shall be specified by the Designer.

## 8.5 Fill materials

8.5.1 Workmanship for fill materials, including preparation of the level on which the slabs will be bedded, shall be in accordance with the relevant sections of the CE suite of documents.

## 8.6 Concrete

8.6.1 The workmanship provided in the relevant sections of the CE suite of documents shall also apply to the construction of all concrete crossing and impact protection slabs.

## 8.7 Slab identification

8.7.1 Pre-cast concrete slabs shall be painted on the top surface with the word ‘GAS’, a reference as appropriate to identify the permissible use of the slab and the maximum pipe diameter for which the slab is applicable.

8.7.2 ‘GAS’ marker tape shall be placed on all buried slabs, at the centreline of the pipe and 300 mm from each slab edge and shall extend longitudinally for the full length of the slab.

## 8.8 Emergency construction joints

8.8.1 Emergency construction joints are only to be used in the event of concrete mixing plant failure.

8.8.2 In the event of this occurring, the joint shall be formed at right angles to the direction of pour and shall be straight and vertical. Prior to recommencing the pour, this face shall be prepared in accordance with the requirements of the appropriate European or British Standard and the relevant Sections of the CE suite of documents.

# 9 DESIGN PRINCIPLES OF CROSSING POINT SLABS FOR P/18 PIPELINES

## 9.1 General

This Section sets out the general principles for designing crossing point slabs over pipelines which fall within the requirements of T/PM/P/18.

## 9.2 Artificial Fill Length and Slab Span

9.2.1 As the pipeline contains girth welds of unknown quality, the amount of the surface loading transmitted to the pipeline will need to be reduced. In order to achieve this, the slab will need to ensure loads from the slab bearing areas are not transferred directly to the pipeline. This can be achieved by considering a 45 degree zone of influence from the slab bearing area towards the pipeline (this is shown indicatively in Figure 6 below). The length of compressible fill will be determined.

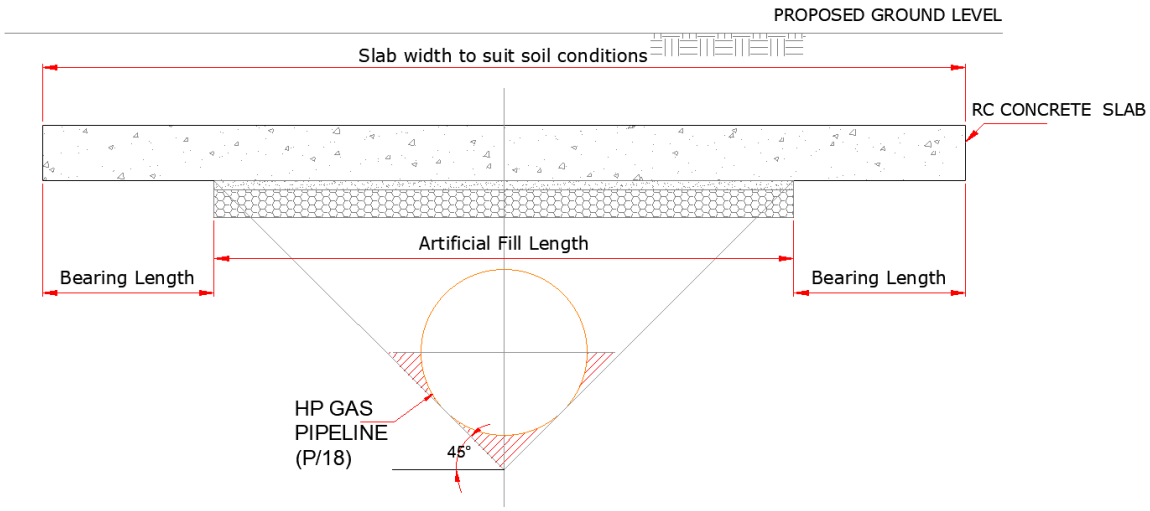


**FIGURE 6 Determination of slab width**

9.2.2 The soil on which the slab rests should be capable of adequately resisting the applied loads, which will determine the length of the bearing area. Typically, the bearing resistance of the ground should be estimated assuming a total settlement of 25 mm or less under the bearing areas.

9.2.3 In order to achieve the required bearing resistance, in some cases, the bearing area may need to extend to a point below the centre of the pipeline. In this instance, additional exclusion zone of 600mm shall be provided as shown in Figure 7 below.

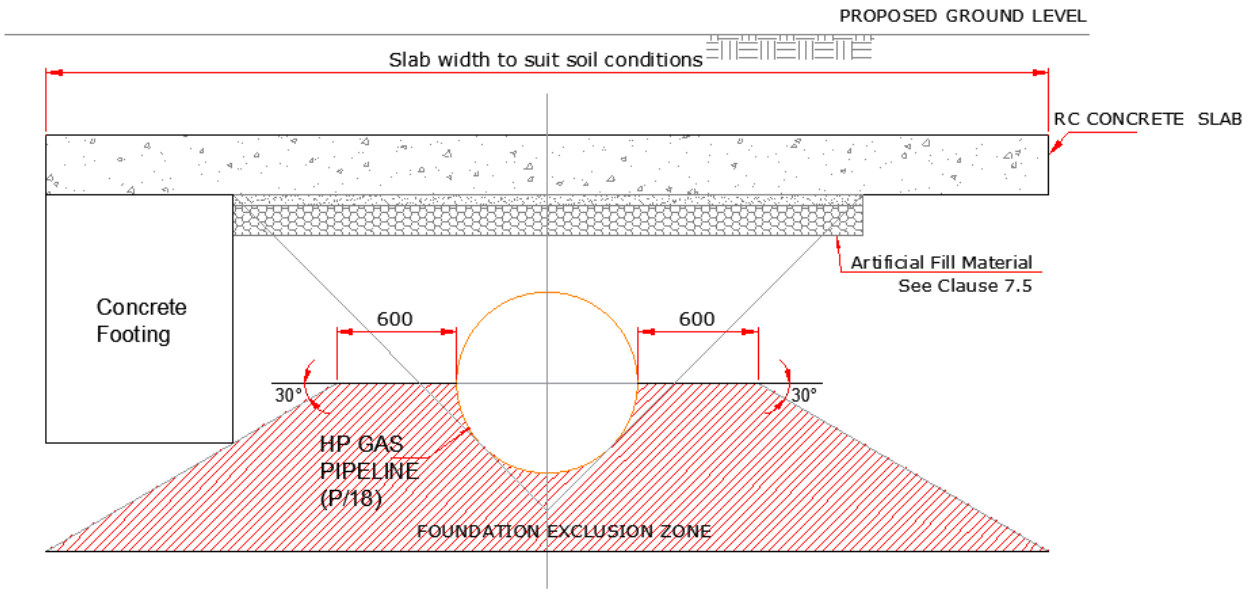


**FIGURE 7 Foundation Exclusion Zone for P/18 gas pipeline**

9.2.4 Prior to slab Construction, the Contractor shall confirm the minimum bearing resistance used in the design can be achieved at the proposed slab formation level under bearing areas as noted in 9.2.2 above.

9.2.5 For cohesive soils which are susceptible to heave and elastic rebound, specialist advice may be required for determining the concrete slab formation levels.

## 9.3 Standard concrete slab design for P/18 Pipeline

For standard protection slabs suitable for P/18 pipelines, please refer to the G19 Model Design G19/D/131 (Standard CE12 protection slabs for P/18 pipelines).

# APPENDIX A - INFORMATION TO BE COLLATED PRIOR TO SELECTING OR DESIGNING A PIPELINE CROSSING POINT SLAB

**Form A1**

The following Form, lists information that may be required to enable selection, design and appraisal of a crossing point slab.

| No. | Item | Information |
|---|---|---|
| 1 | Project Title | |
| 2 | Site Identification | |
| 3 | Pipe diameter | |
| 4 | Pipe wall thickness | |
| 5 | Pipe grade | |
| 6 | Pipe MOP | |
| 7 | Estimated temperature of pipe at time of tie-in | |
| 8 | Maximum operating temperature (including future) | |
| 9 | Are the pipe welds subject to the requirements of P18? | |
| 10 | Requirements for access to pipe in the event of an emergency arising. | |
| 11 | Existing pipe cover | |
| 12 | Planned pipe cover | |
| 13 | Planned cover to pipeline crossing point slab | |
| 14 | Trench width | |
| 15 | CBR of soil on which the pipeline crossing point slab will rest | |
| 16 | Type of plant which may be used over the pipeline crossing point slab during construction | |
| 17 | Gross vehicle weight of plant | |
| 18 | Size of load patch i.e. wheel patch or track size. | |
| 19 | Load on patch or track | |
| 20 | Type of traffic which may be used over the pipeline crossing point slab after construction | |
| 21 | Gross vehicle weight of vehicle | |
| 22 | Number of axles | |
| 27 | Any other information | |

## APPENDIX B - MAXIMUM ALLOWABLE PIPE COVER FOR TEMPORARY CROSSING POINT SLABS AND HAUL ROADS

For standard temporary crossing point slabs over pipelines with a maximum incidental pressure (MIP) as shown below, the Table B1 below gives the maximum allowable cover depth to the pipeline where it is less than 3.5 metres.

### Table B1 Maximum allowable cover depth to pipe (metres) where it is less than 3.5 metres

All pipes of diameter between 114 and 1219 mm OD and wall thickness as detailed in GD/SP/DAT/6 have been checked for maximum allowable cover depth of 3.5 m. Where the allowable pipe stresses for this cover depth are exceeded, the cover depth requires to be reduced, as shown in this Table. For all other cases, the maximum allowable cover depth of 3.5 metres applies.

| Pipeline Maximum Incidental Pressure | Pipe OD | Nom. wall thickness | Maximum temperature difference from tie-in (°C) | | | | |
|---|---|---|---|---|---|---|---|
| bar | mm | mm | 0 | +/- 10 | +/- 20 | + 30 | + 40 |
| **Surface Slabs** | | | | | | | |
| 70 - 85 | 610 | 9.5 | | | | 3 | 1.5 |
| | 762 | 11.9 | | | | 3 | 1.5 |
| | 1067 | 14.3 | | | | | 3 |
| 85 - 94 | 610 | 9.5 | | 3 | 2 | 1 | N/P |
| | 762 | 11.9 | | 3 | 2 | 1 | N/P |
| | 914 | 12.7 | | | | 2.5 | 1.5 |
| | 1067 | 14.3 | | | 3 | 2 | 1 |
| | 1219 | 15.9 | | | | | 3 |
| 94 - 100 | 324 | 7.1 | | | | | 2.5 |
| | 508 | 11.1 | | | | | 2.5 |
| | 610 | 9.5 | 2 | 1 | N/P | N/P | N/P |
| | 762 | 11.9 | 2 | 1.5 | 1 | N/P | N/P |
| | 914 | 12.7 | | 3 | 2 | 1.5 | N/P |
| | 1067 | 14.3 | 2.5 | 2 | 1.5 | 1 | N/P |
| | 1219 | 15.9 | | | | 2.5 | 1.5 |
| **Buried Slabs** | | | | | | | |
| 85 - 94 | 610 | 9.5 | | | | | N/P |
| | 762 | 11.9 | | | | | N/P |
| 94 - 100 | 610 | 9.5 | | | | N/P | N/P |
| | 762 | 11.9 | | | | N/P | N/P |
| | 914 | 12.7 | | | | | N/P |
| | 1067 | 14.3 | | | | 1.5 | N/P |

N/P – Not Permitted

## TABLE B2. Maximum allowable cover depth to pipe (metres) where it is less than 3.5m for haul roads

All pipes of diameter between 114 and 1219 mm OD and wall thickness as detailed in GD/SP/DAT/6 have been checked for maximum allowable cover depth of 3.5 m. Where the allowable pipe stresses for this cover depth are exceeded, the cover depth requires to be reduced, as shown in this Table. For all other cases, the maximum allowable cover depth of 3.5 metres applies.

| Pipeline Maximum Incidental Pressure | Pipe OD | Nom. wall thickness | Maximum temperature difference from tie-in (°C) | | | | |
|---|---|---|---|---|---|---|---|
| bar | mm | mm | 0 | +/- 10 | +/- 20 | + 30 | + 40 |
| 0 - 70 | 1067 | 14.3 | | | | | 3 |
| 70 - 85 | 324 | 9.5 | | | | | N/P |
| | 610 | 9.5 | | | | 1 | N/P |
| | 762 | 11.9 | | | | 1 | N/P |
| | 1067 | 14.3 | | | | | 2.5 |
| 85 - 94 | 273 | 6.4 | | | | | N/P |
| | 324 | 7.1 | | | | N/P | N/P |
| | 508 | 11.1 | | | | | N/P |
| | 610 | 9.5 | 3 | 1 | N/P | N/P | N/P |
| | 762 | 11.9 | 3 | 1 | N/P | N/P | N/P |
| | 914 | 12.7 | | | | 1 | N/P |
| | 1067 | 14.3 | | 3 | 1 | N/P | N/P |
| | 1219 | 15.9 | | | | | 1 |
| 94 - 100 | 219 | 6.4 | | | | | N/P |
| | 273 | 6.4 | | | | | N/P |
| | 324 | 7.1 | | | N/P | N/P | N/P |
| | 508 | 11.1 | | | | 3 | N/P |
| | 610 | 9.5 | N/P | N/P | N/P | N/P | N/P |
| | 762 | 11.9 | N/P | N/P | N/P | N/P | N/P |
| | 914 | 12.7 | 3 | 2 | N/P | N/P | N/P |
| | 1067 | 14.3 | 1 | N/P | N/P | N/P | N/P |
| | 1219 | 15.9 | | | 2.5 | N/P | N/P |

N/P – Not Permitted

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