



PIPE LINE CONSTRUCTION

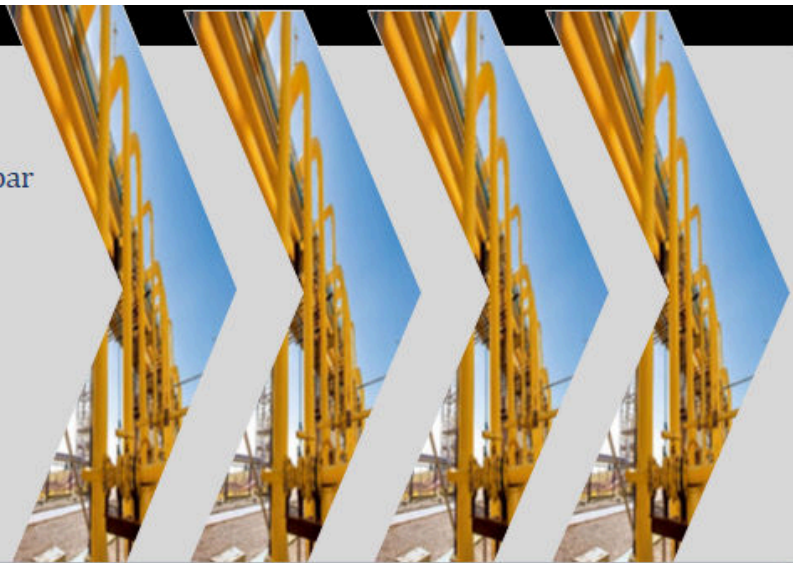
**CIVIL TECHINICAL REQUAIREMENTS FOR PIPELINE
CONSTRUCTION**

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PIPELINE CONSTRUCTION

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1- INTRODUCTION:

The scope of this technical report is to define the minimum criteria for earth works related to all civil activities (foundations, underground pits, trenches for pipes & cables etc.). And site preparation for the "Project".

2- ABBREVIATIONS

EIA	Environmental Impact Assessment
ROW	Right Of Way
IP	Intersection Point
U/G	Underground Utilities
NOC	No objection certificate
PTW	Permit to work
KM	Kilometer
HT	High-tension
LT	Low-tension
CP	Cathodic Protection
AC	Alternate current
MDD	Maximum dry density
NDT	Non Destructive Test
OHL	Overhead Transmission Line
FOC	Fiber Optic Cable

3- SITE PREPARATION

i. General

During construction all protection measures shall provide for existing utilities and services as may be required by the construction operations. Permanent protection of certain items, if any, shall be defined.

In addition to the requirements as specified herein, the following requirements shall comply.

1. Use all necessary precautionary and protective measures required to maintain existing utilities, services and appurtenances that must be kept in operation. In particular adequate measures shall take to prevent undermining of utilities and services presently in service.
2. Protect existing or new utilities and services where required with responsibility for bracing and supporting utilities and services to prevent settlement, displacement or damage.
3. Follow the slope stability requirement as per recommendations in "Geotechnical Survey Report".

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ii. PRE - CONSTRUCTION ACTIVITIES

Prior to any construction work, a pre-construction survey activities necessary to proceed with the construction. The pre-construction survey activity as a minimum shall include the following:

- Investigation of pipe route with reference to EIA and compiling environmental management plan and procedures for implementation of the EIA requirements.
- Geotechnical and Topographical investigations of pipe route
- Investigation of pipe route with reference to ROW (Right of way) conditions, constraints, verification of U/G utilities and associated construction activities and compiling pre-construction survey report.
- Identification of necessary access roads to be established newly, and subjected to approval.
- Approval process for access to site, including but not limited to gaining clearance (NOCs) from governmental authorities, land owners and operators of identified 3rd party lines.
- Preparation of Method Statements and Procedures and subjected to approval.
- Conduct kick-off meeting with all concerned parties at construction site.
- Establishment of pipe & Materials Tracking and Traffic Management System and subjected to approval. Familiarize with and implement the (PTW) system of any stakeholder while approaching and working near or within existing facilities. These operations shall only be performed after obtaining prior approval.

4- RIGHT OF WAY (ROW)

i. Topographic and Geotechnical Survey of Pipeline Corridor

Topographical and geotechnical surveys shall perform during the basic engineering stage of the Project and a Right of Way (ROW) corridor should establish. The route shall be further finalized in appropriate level of detail during the pre-construction phase of the project, based on the information that will be gathered regarding land acquisition in coordination with liaison with local authorities. Therefore the route shall indicate in alignment sheet and shall be used as a guideline for the detailed pipeline route pre-construction survey. Due to dynamic activities in and around the Pipeline Corridor, all survey activities carried out have to be coordinated with the construction management as well as any other party of ongoing or proposed activities.

The scope of work specified in this section shall include, but not be limited to the following:

- Carrying out detailed route survey work along the specified pipeline route.
- Carrying out soil surface visual classification along the proposed pipeline route including crossings.
- Pipeline alignment shall be surveyed and marked taking 50m on either side of the pipeline route.
- Supply and installation of the survey markers (staking) as per requirements.
- Carrying out cadastral survey covering areas 50 meters on either side of centreline of the pipeline along the entire proposed pipeline route. Other maps as well as forms required for carrying out this

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survey shall be arranged. Marking the pipeline route on maps with all existing facilities and details i.e. as listed below.

- Houses and any other concrete or brick structure
- Fences and walls
- Retaining walls and slope protections
- Crossings
- Archaeological sites
- Vegetation
- Any other relevant obstacles or installations

This information shall be adequate in all respect for ROW acquisition as appropriate.

- Presentation of route survey data in a form and highlighting the available working strip (i.e. available ROW width) along the route and the accessibility and constructability of the line along the route;
- Carrying out detailed geotechnical survey and verify soil properties and ground water table conditions;
- Identify high water table sections along the route.

ii. Equipment and Definitions

➤ Equipment

- Shovel
- Grader
- Bulldozer
- Excavator
- Surveying equipment

➤ Definitions

Here are a number of definitions:

- Transit area: that portion of land made available along the length of the pipeline and within which all work must be performed; the right-of-way must be prepared within the transit area
- Right-of-way: that strip of land normally assigned to pipeline installation operations and made available for the movement of personnel and normal work vehicles and for performing work activities; it may coincide with the transit area;
- Strip available for excavation: that part of the right-of-way reserved for excavation operations;
- Strip available for installation: that part of the right-of-way reserved for pipeline installation operations.

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iii. Clearing & Marking of Working Strip

The width of the graded Right-of Way and the working strip shall be as per approved drawings. The side shall select, which side of pipe system is to be the working side for the construction of each pipeline. In areas where the construction activities require a greater width, prior approval shall obtain from Authorities having jurisdiction before commencing any clearing operation. Prior to any cleaning operation, necessary familiar with all provisions on the land required using best endeavours to comply with such provisions and to avoid damage to property, and other pipeline facilities on or adjacent to the ROW.

The Working Strip shall be cleared over its entire width, unless restricted by the terrain or other features. All operations shall carry out within the limits of the Working Strip and shall not operate within 10 meters from any existing pipe lines without prior approval.

The cutting or removal of trees and plantation is strictly prohibited, unless prior approval from Authorities has been obtained. All debris, timber, dislodged and similar material, rock particles etc., shall be removing from the ROW and dispose it off in a manner and method satisfactory to Government Authorities having jurisdiction over the areas concerned. Contractor shall be responsible for all surplus material disposals, if any, arising out of clearing and grading operations.

In order to make the route visible for subsequent activities involving opening of the right-of-way, special marker posts with progressive kilometers markings shall be driven into the ground. If this operation cannot be performed due to the geological conditions of the terrain, alternative-marking methods shall be employed.

Survey crews shall indicate (KM) signs indicating the kilometre change. This shall be completed before any heavy vehicle operation on site.

Stakes shall be positioned at every (IP) and additional at intervals of at least 100 m or, in poorly visible terrain at closer intervals. Stakes shall be positioned at least 1KM in front of the (ROW) construction team. Each (IP) stake shall be safeguarded by two markers in line with the (IP), perpendicularly to the upstream direction, in appropriate equal distance (outside of the working strip) from the (IP), left and right. The (IP) stakes and the markers shall be surveyed separately and documented in a surveying sketches and shall handed over to the construction management

Stakes at the edge of the working strip shall be positioned at intervals of 50m or, in poorly visible terrain, at closer intervals in order to mark the working strip limits.

Any boundary markers or survey points touched by the working strip and in vicinity of up to 10 m from the working strip shall be surveyed by an officially authorized surveyor, respecting the relevant regulations in law. If boundary markers or survey points have to remove during construction they have to be re-instated after construction in co-ordination with the owners and the authorized surveyor.

Markers shall be of material and type as to serve their purpose. Contractor shall be responsible for the maintenance and replacement of the reference line markers until the permanent pipeline markers are placed and the as-built drawings are submitted and approved.

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iv. Surface Stripping

In cultivated land the topsoil shall be stripped from the working strip, except for the area to be utilized for stacking topsoil, over a width specifically agreed with local authorities. The topsoil shall be stripped to a depth as agreed with local authorities and stacked separately from subsoils and care shall be taken to avoid mixing topsoil and subsoil.

Stripped topsoil shall be stacked on one side of the right-of-way and kept free from the passage of vehicles and plant.

Topsoil stacks shall be placed to ensure that they are free draining. Gaps shall be left in the topsoil stack to permit reasonable access across the right-of-way and at low areas where surface water may be held against the stack.

Topsoil from adjacent undisturbed areas outside the ROW shall not be used for the covering of disturbances inside the ROW. The importation of additional topsoil shall be subject to approval.

Topsoil shall not be handled during excessively wet conditions or at times when the ground or topsoil is frozen.

v. Grading of ROW

Removing sharp high points during grade the ROW, to minimize bending and to maximize laying within the limits permissible for elastic bending. All dunes and sharp inclines shall be smoothed to avoid sharp bend and try to use as much as possible the natural elasticity of the pipe and the minimum radius of bends.

Where the construction ROW passes through or along roads, tracks, electric lines, plantations or any other improved or confined areas, shall grading only the width of the ROW necessary for digging the pipeline trench.

Preserve survey reference points (already staked on ground) such as Bench Marks and Intersection/Turning Points until the construction is completed shall maintaining. In case of any missing bench marks, re-establishing them are required, to carry out levelling work during laying or as-built survey of the pipeline.

The clearing of the ROW shall be carried out in conjunction with the construction of the access roads in the ROW's. After clearing the ROW and when grading has been performed so as to allow passage of loaded trucks and equipment without undue wear and tear thereon. All existing underground utilities must be identified prior to clearing and grading and precautions shall be taken so as not to interfere with any of the existing utilities.

Grading works shall always be carried out after the completion of clearing works. Earth movement resulting from grading of the ROW shall be minimized as far as practicable.

All necessary precautions to prevent outbreak of fire in the ROW and adjacent areas, where combustible materials, vegetation and plantations may be found shall be taken.

If any explosive ordinance is found in the course of the works, competent authorities shall be notified without delay.

The explosive ordinance found in or in the vicinity of the working width will be only removed by authorized and qualified personnel and companies.

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In general grade the whole of the working strip, but a narrower width may be allowed, depending on ground conditions such as rock or other material which cannot be graded off with ordinary grading equipment. All necessary grading at road or water crossings and at any other location, required to permit the passage of construction equipment which may require the construction of temporary bridges. No ditches, swales or drains shall be filled, bridged or otherwise obstructed without written approval of Authorities having effective control over such watercourses.

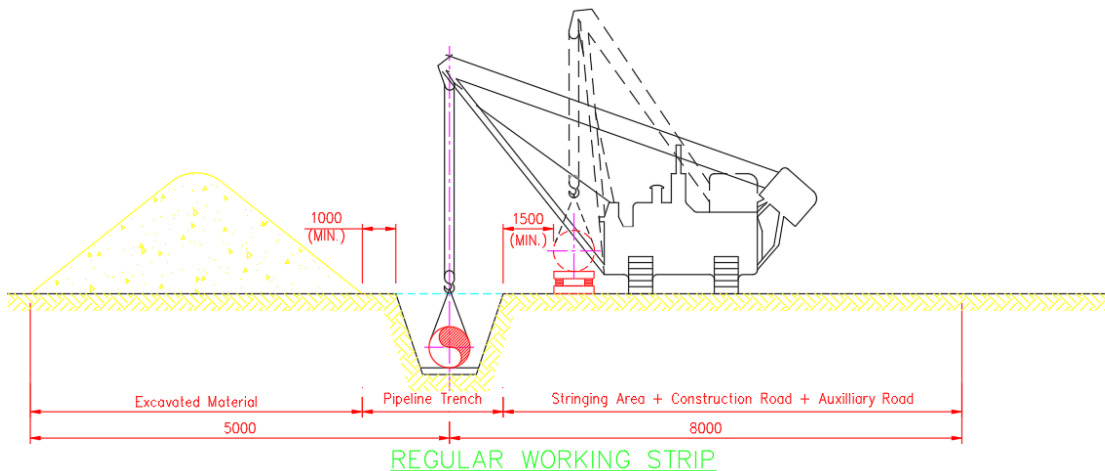
The profile of the graded ROW shall generally follow the profile of the natural terrain with some minor alterations to enable proper construction of the pipeline and ensure safe bending and laying of the pipeline. While grading, necessary cutting of high peaks shall be done based on geotechnical investigation results and considering consistency. The cut material shall be generally spread on the sides of the ROW and filling of low areas shall be minimized.

Below some typical details for:

- 1) Regular and Reduced working strip Detail NO: 01.
- 2) Final Right of way's width Detail NO: 02

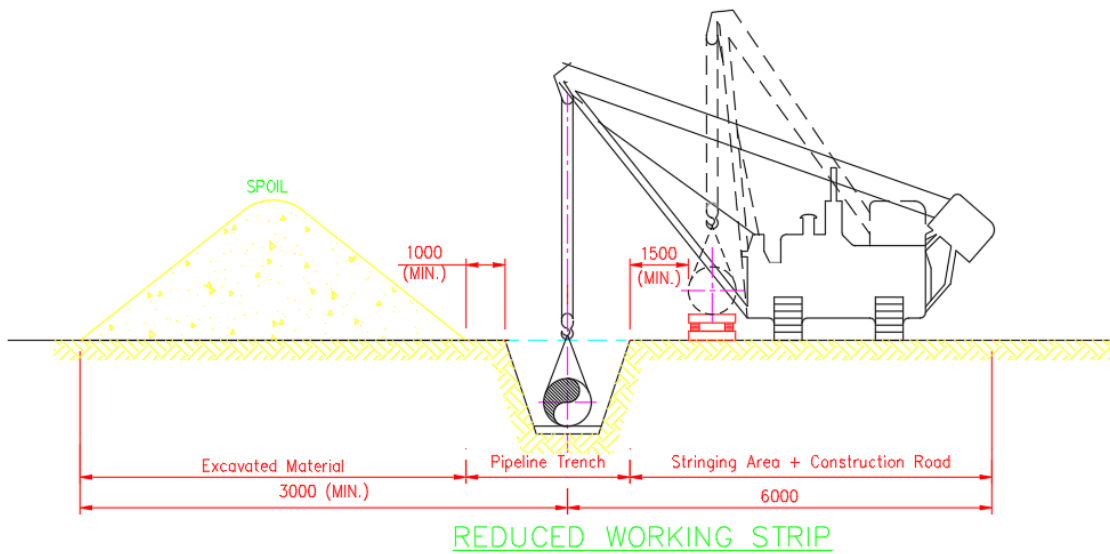
Notes:

1. All dimensions in MILLIMETERS
2. 300 mm Compacted Material, Maintenance road erected after backfilling

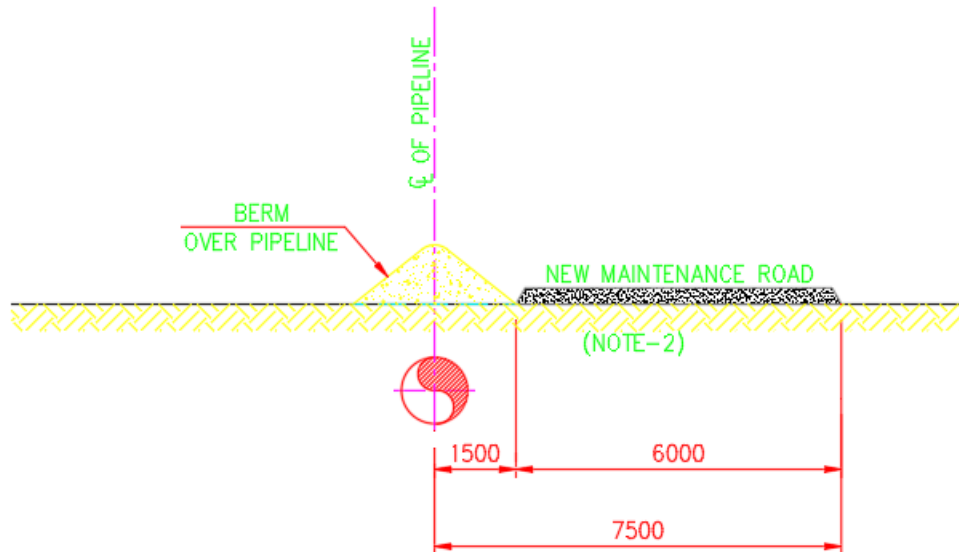


DETAIL NO: 01

PIPELINE CONSTRUCTION



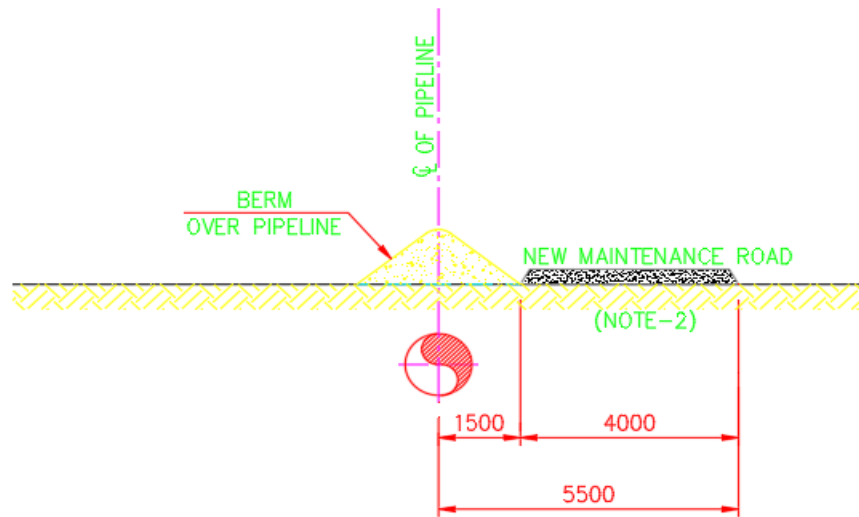
DETAIL NO: 01



FINAL RIGHT OF WAY FOR FLAT TERRAIN

DETAIL NO: 02

PIPELINE CONSTRUCTION



FINAL RIGHT OF WAY FOR SLOPES TERRAIN

DETAIL NO: 02

vi. Construction in Hill / Slope area

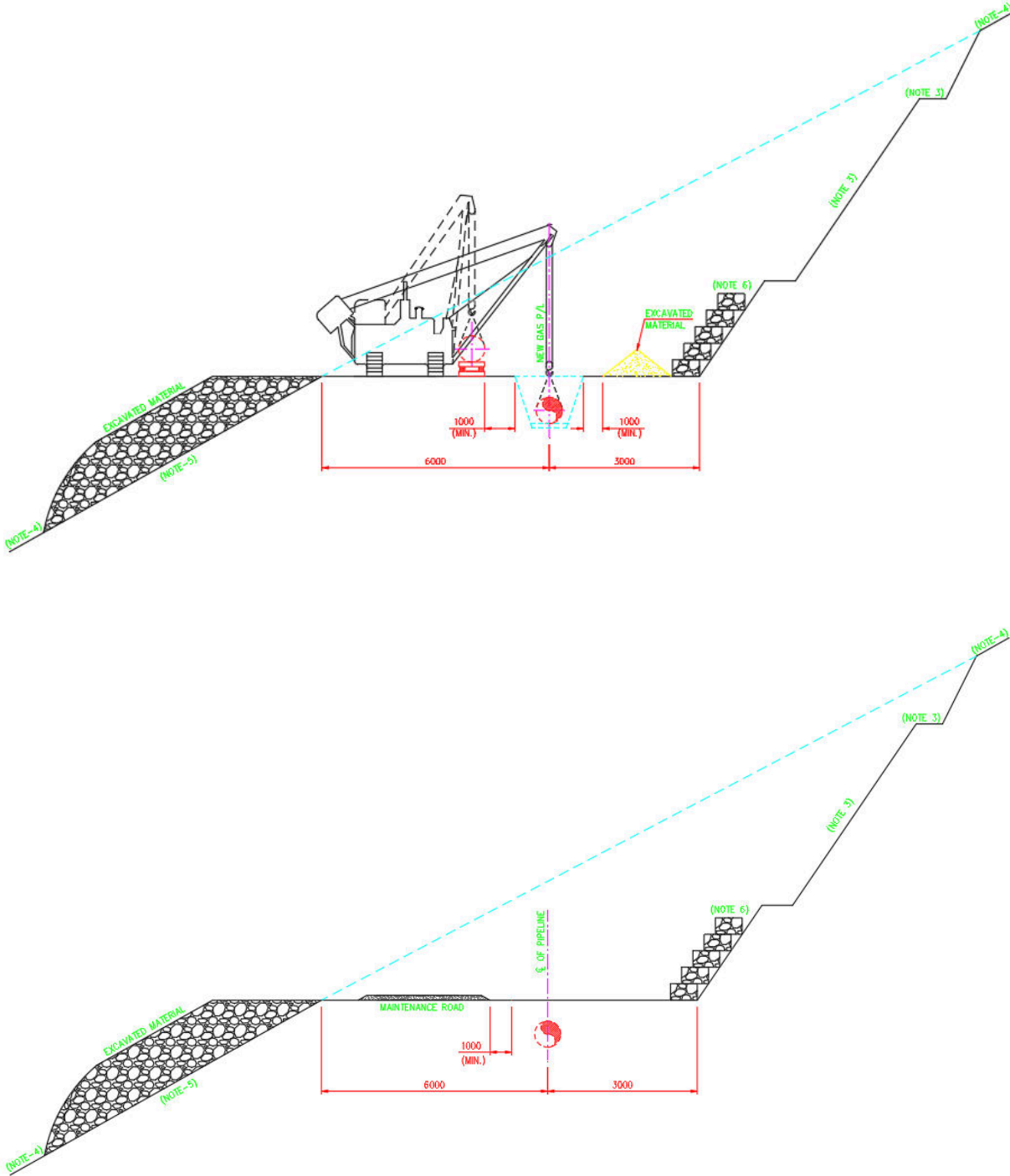
Contractor shall carry out all necessary grading in hilly areas/mountains/ridges inroute of the pipeline for passage of construction equipment and installation of pipeline. Contractor shall address all potential risk arising from loose rocks or rock fall in mountain slope area and clear the same to ensure safe working condition. All mountain slopes/rock face slopes will have protection installed to prevent surface erosion. The resulting slopes shall be step cut and required slope breakers/gabion mattress shall be installed to safe guard from erosion.

Detail NO: 03 shows Pipeline construction in side slope

Notes:

1. All dimensions in MILLIMETERS
2. 300 mm Compacted Material, Maintenance road erected after backfilling
3. Construction contractor shall cut the slope to sufficient angle to ensure that all slopes and bank is stable safe.
4. Risk of rock fall to be addressed
5. Even levelling of excavated material to be done along the (ROW) and ensure it is not impacted third party.
6. Gabions to be installed to restrain soil falls required by site conditions

PIPELINE CONSTRUCTION



DETAIL NO: 03

PIPELINE CONSTRUCTION

5- ACCESS ROADS

Obtaining access to the Working Strip from existing road where such roads cross the Working Strip required or via access roads constructed between existing roads and the Working Strip at other locations. Such access roads shall be agreed with authorities having effective control prior to commencement of Right-of-Way preparation, and shall be sign posted.

Existing pipeline ROW if available may only be used for access to the Working Strip after obtaining written permission from the owner. Contractor shall be responsible for repair of all damages caused to the existing roads and facilities due to his construction activities. An existing road/track used by local community may either lie in the ROW or could be used by Contractor for construction of pipeline. In such cases an alternate road/track shall be constructed by Contractor outside the ROW so as to connect with unused sections of the road/track.

All necessary arrangements shall be made such as ramps, temporary bridges, etc., to the extent necessary for crossing existing tracks/roads with men and machinery. No existing crossings shall be filled or otherwise obstructed without approval of the Authority having effective control over such crossings.

All access roads to be used shall be surveyed, in advance of use, in order to assess risks to project vehicles, for example, low overhead power lines, telephone cables, bridges, bicycle paths, utility poles near the travelled surface, schools and presence of children at specific times during the day, etc. Documentation of these road access risk assessments shall be maintained in the site office. All drivers involved on the project shall be aware of that survey.

Roads, foot paths, bicycle paths and paved ways shall be kept regularly clean in the course of the works in accordance with weather conditions, and by means of using water trucks keep dust levels down on roads used for the works.

The construction of the temporary roads could be directly on top of the topsoil (on the first layer) or on top of the second layer after topsoil stripping. They shall be prepared with sufficient care so that no works come to unnecessary stop because of lack of construction roads in wet weather conditions.

In general, prior to commencing the work. Contractor shall arrange temporary culverts/drainage or any other temporary detours required to ensure un-obstructed passage of vehicle and traffic at any point of time.

These Construction Roads shall be maintained during the entire duration of the construction works until the removal and restoration of such roads requested by land owners.

6- IDENTIFYING EXISTING U/G UTILITIES

Details of underground utilities, as available, will generally be indicated on the pipeline construction drawings. However, Contractor shall obtain plans and full details of all existing underground services from the relevant Local Authorities and Facility Operators. Identify and locating all existing buried/ above ground pipelines, cables, HT and LT overhead power lines, water mains, sewers and other utilities within a distance of 50m on either side of the pipeline alignment including those not shown on the construction drawings, crossed or at close proximity with the

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pipeline by contact with relevant Authorities carrying out appropriate surveys with the help of pipeline / cable locators or other suitable instruments and exposing them, if necessary, by hand excavation.

Once located, the underground facilities crossed by the pipeline route or running parallel to it, within the ROW, shall be clearly marked by approval method.

Precautions to be taken for avoiding or damaging existing pipelines, electrical lines and cables, walls, fences, roads, drainage, and any other existing above or below ground structures, or property, adjacent to or crossing the pipeline being constructed.

7- TRENCHING

Once the Right-of-way has been created, in order to define the most appropriate working method and sequence of work phases, on the basis of dimensions of the trench to be excavated, width of the right-of-way, topographic and hydrographic nature of the areas crossed and general and/or detailed work schedule, the most appropriate work vehicles and equipment for excavation operations (bulldozers, bucket excavators, mechanical shovels, trenchers, etc.) Shall be selected.

Before trenching, buried foreign utilities, and above-ground facilities or utilities, crossing or parallel the ROW, shall be duly investigated, uncovered/excavated and marked. If the pipeline route crosses the catchments areas of public or private wells, appropriate action to be taken and to be agreed with the local authorities, to ensure that the functioning of such wells is only impaired slightly and that any detrimental impact is limited to the actual duration of construction work

I. Excavation:

Excavation activities shall not start until the centreline of pipeline has been approved to prevent damage/deterioration to existing facilities. Excavation of the pipeline trench on the cleared and graded ROW using any approved method. Care shall be exercised to ensure that fresh material recovered from trenching operations, intended to be used for backfilling over the pipe in the trench or at the berms (wherever applicable), is not mixed with loose debris or foreign material. Trenching operations shall keep maximum 2 km ahead of welding and stringing operations, but the length of total open trench shall not exceed a maximum distance of 4 km.

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II. Trench Dimensions:

The trench shall be excavated to a minimum width so as to provide, on both sides of the installed pipeline, a clearance as indicated in the typical drawings and to a depth sufficient to provide the minimum covers specified below. The cover shall be measured from the top of the coated pipe, after it has been laid in the trench or placed on the formation level, to the level of the original ground.

The excavation and grading of the trench shall be done sufficiently deep and wide to provide space for 150- 200 mm of bedding and padding material after compaction all around the laid pipe and for the continuous length of the pipeline. The side slope for trench shall be less than the angle of repose for the soil type to avoid collapse of trench sides. Bell holes shall be dug at each tie-in weld location, the bottom of the trench and sides shall permit visual inspection of entire joint. Suitable measures shall adopt for protection of excavated trench by means of suitable temporary barriers etc.

Trench grading shall ensure continuous support of the entire pipe string over their whole length preventing hollow spaces and minimize the amount of bending (field and factory bends). Changes in direction or elevation where possible shall utilise elastic bending of pipeline. Bends shall be made in the pipe at significant changes in grade of the trench.

It is desired to reduce to a minimum the required number of cold field bends to lay the pipe to conform to the general contour of the ground and maintain a normal cover. This can be accomplished by cutting the trench slightly deeper at the crest of ridges and by gradually deepening the trench in approaches to road crossings and small water courses.

It is intended that there will be a minimum of hand grading of the trench bottom. To achieve this, shall digging the bottom of the trench as square as possible with equipment and shall do such hand work in the trench as is necessary to free the bottom of the trench from loose rock and hard lumps of material.

Trench alignment shall be maximum $\pm 0.2\text{m}$ from designed pipeline centreline. However in specific space constrained sections or at sections where pipeline runs parallel to existing pipelines, the deviation can be $\pm 0.5\text{m}$ maximum; any larger deviations are unacceptable unless prior approval.

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IV. Trench in Farm Land / Vegetation Area

Pipeline depth of cover in the area of farming shall be 1.5 m as a minimum.

V. Trench in Rocky Area

Wherever rocky terrain is encountered Pipeline depth of cover in rocky area and mountains shall be 1.0 m as a minimum. Rock shield installation requirements in rocky terrains. Unless otherwise provided, rock is generally classified as follows:

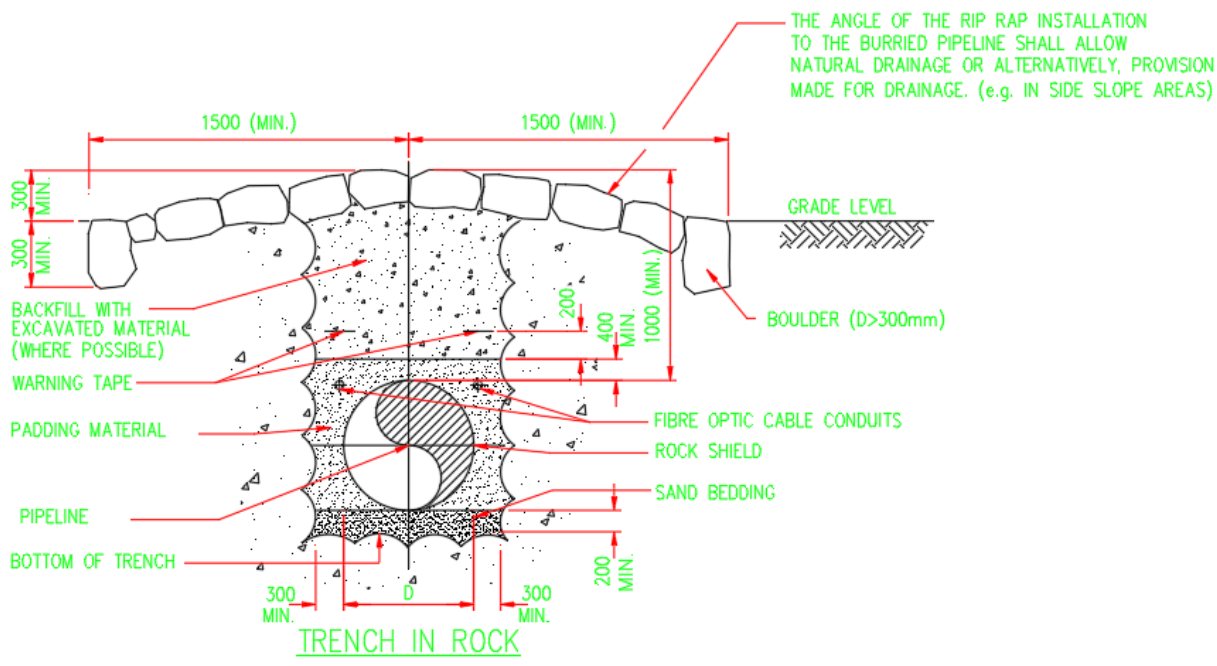
- ☐ Soft rock: rock that may be demolished using a pick miner weighing approx. 2,500 kg with a grip at least 80 cm long;
- ☐ Medium-hard rock: rock that may be demolished using a hand-held hammer pick equipped with a flat chisel;
- ☐ Hard and very hard rock: rock that may be demolished only using explosive material or hammer pick equipped with a pointed rock bit that may either be hand-held or mechanically driven (e.g., pneumatic hammers).

The use of any explosive material, especially with regard to its storage, transport and handling, must be performed in accordance with applicable legislated restrictions and with the express authorisation of the Client.

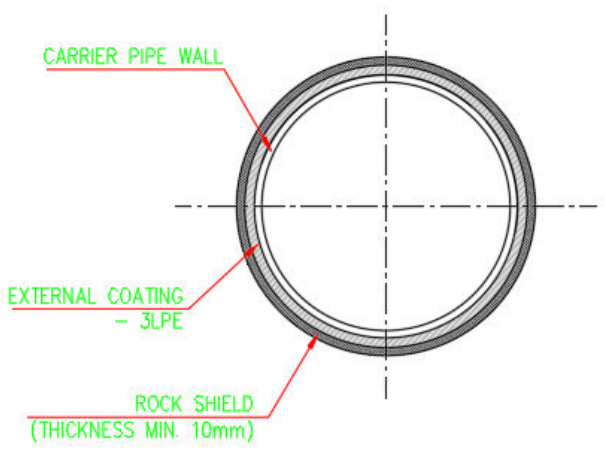
All precautions must be taken to avoid rolling and falling of rock outside the transit area and to prevent any possible damage to existing plant and property inside and outside the transit area.

“Erratic blocks” (isolated rocky masses, etc.) encountered during trench excavation must be removed and/or demolished using the most appropriate vehicles and equipment. Detail NO: 05

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DETAIL NO: 05



ROCK SHIELD DETAIL

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8- PROTECTION OF THIRD PARTY LINES

Excavation to additional depth shall be done where the pipeline approaches and crosses other pipelines, sewers, drain pipes, water mains, electrical cables, telephone conduits, and other underground structures. The pipeline shall be laid with at least 1 meter (or minimum pipeline cover) free clearance from the obstacle. If greater minimum distances are required by authorities and 3rd party line operators having jurisdiction, those distances shall be maintained. Implementation requirements necessary for protecting existing facilities during construction.

Where the pipeline crosses areas whose easements specifically require greater than normal depths of cover, the trench shall be excavated to extra depth as required.

All excavations/open trenches near third party lines shall be adequately protected by means of suitable temporary barriers and regular surveillance.

Prior to start of any work, as per with the location of the underground utilities to be hand excavated in the presence of owner's representative. Particular care will be taken to support properly the existing lines during the construction phases. Excavation activity shall start only after obtaining approval from third party facility owner.

If, despite all precautions, any damage should occur to any services and/or structures etc., the Contractor shall immediately contact the applicable owner. Replacement/Repair and reinstatement of the damaged service and/or structure shall be carried out by the Contractor at his expense under the direction and the satisfaction of the owner.

9- CROSSINGS

Where the pipeline crosses other underground utilities/structures, first manually excavations shall be done to uncover such utilities/structures, and clearly mark their location on as-built drawings i.e. types, diameter, horizontal and vertical location and angle relative to the new pipeline.

Temporary underpinning or any other supports and other protective devices necessary to protect the structure from damage shall be provided by the Contractor at his own cost.

Crossed structures/utilities above and/or below ground supporting necessary to prevent any damage.

I. Road and Track Crossings

In all cases where the trench has been cut across access roads/tracks etc., install substantial temporary bridge work to the full width of the roads/tracks, of adequate strength, properly constructed to ensure the safety of the traffic with minimum inconvenience and interruption and / or a suitable alternate route. The Contractor shall obtain the permission of the appropriate authorities, in writing, before commencing work and shall ensure that all regulations and requirements of the authority, having jurisdiction over such track/road are complied with. Proper safety barriers and warning signs shall be placed and maintained until such crossings are open. Construction of crossings shall include all necessary clearing, grading, excavating, shoring, de-watering, trenching, welding, coating, lowering, backfilling, clean up, restoration and any further work required. Testing, insulators, seals, casing pipes, etc. shall also form part of the work. If such crossings are open at night, warning lights shall provide and use of a type approved by the responsible authorities. Actual installation of crossings shall comply with the drawings issued for construction. Open cut crossings to be organized and executed such as to minimise interruption of traffic.

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To avoid settlement in open-cut crossings, the pipe shall have firm bearing on the bottom of the trench for a distance of not less than five meters beyond each side of the crossing ROW limits. This shall be accomplished by compacting the bottom of the trench.

Asphalt road crossings as identified in construction drawings or as required by concerned road authority shall be completed using one of three crossing techniques:

- 1- Thrust bore
- 2- Micro Tunnelling
- 3- Horizontal Directional Drilling

Controlling of horizontal and vertical accuracy of pipe positioning shall ensure as well as road settlement by surveying during boring operation. Concrete casing pipe shall not be used. The coated pipe shall be subjected to full visual inspection in the reception pit. Detail NO: 07

General Notes Regarding to Detail NO: 07

- All dimensions are in METERS. Backfilling and compaction of materials must be carried out in layers of 200mm each. Re-instatement is to be done by backfilling and the excess backfilling materials shall be removed.
- Roads and surrounding area shall be returned to its original condition
- D=pipe Diameter
- Crossing sign in accordance with road authority requirements.
- Thickness of line pipe at crossing shall be indicated.
- Pipeline shall cross the road or Truck between 60° to 90°.
- All open pits and excavations at road crossings shall be barricaded.
- The crossing length. Minimum cover. Spacing of barriers from road edge shall be as per approval of the relevant road authority.
- Pipe to be laid across track without bending.
- Identification slab shall be placed above the padding materials.

CROSSING OF ROADS-OPEN CUT

SAFETY BARRIER SEE DETAIL-A

EDGE 0.5M

ROADWAY

EDGE 0.5M

WARNING TAPE

CONCRETE IDENTIFICATION SLAB

2.0M (MIN.)

5.0M (MIN.)

NEW PIPELINE

FIBER OPTIC CABLES IN HDPE CONDUIT

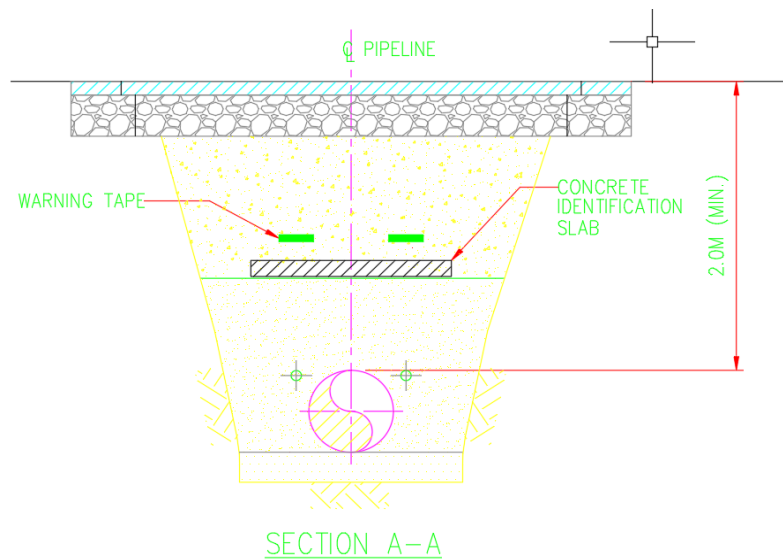
PIPELINE MARKER

1.0M (MIN.)

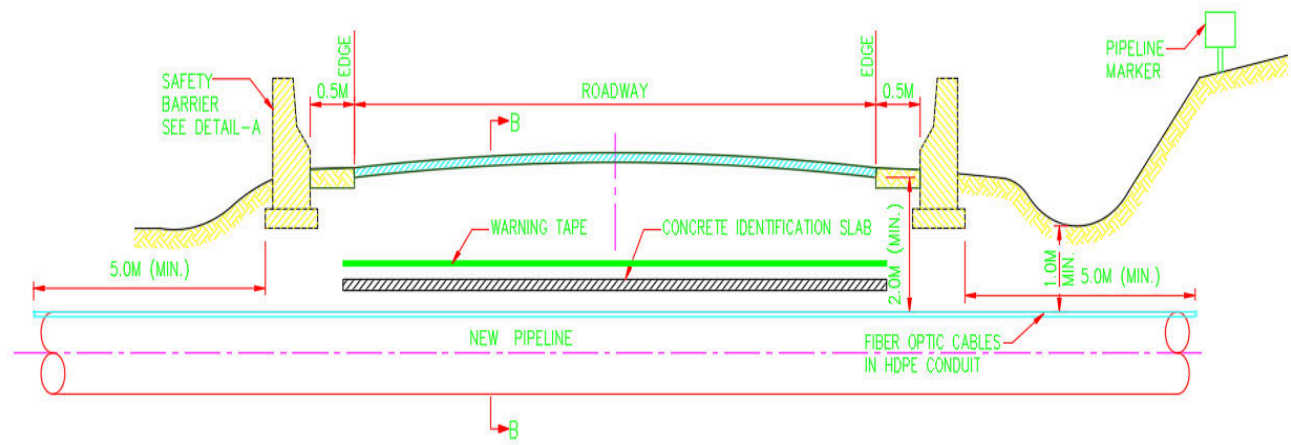
5.0M (MIN.)



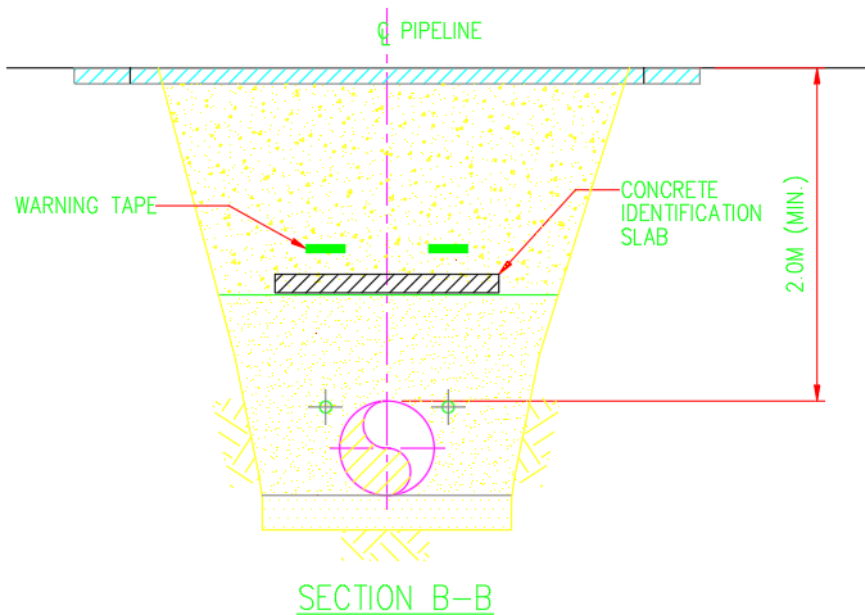
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Detail NO: 07/ Road Crossing



PIPELINE CONSTRUCTION



Detail NO: 07/ Track Crossing

II. Watercourse Crossings

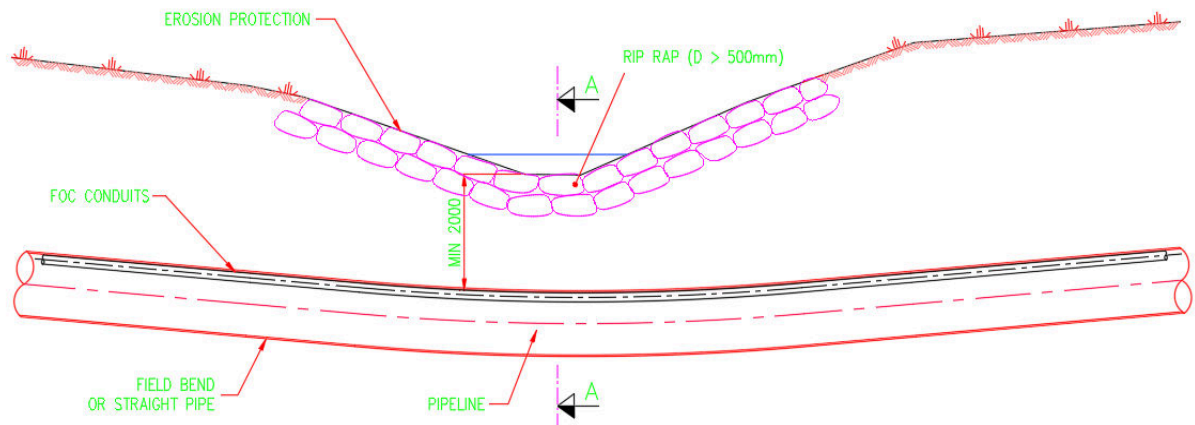
The pipeline route may cross several watercourses which are normally dry but could be temporarily flowing following rain or from melting snow. In addition, maybe there are few drain channels that flow throughout the year. Adequate protection measure shall be taken to cover installation of pipeline in the watercourse sections. The trench shall be dewatered and made dry prior to installation of the pipeline section. In no case pipeline shall be installed with water filled trench. To avoid up lift of pipeline in water filled sections, anti-buoyancy measures like concrete coating or saddle weight installation shall be taken up. A method statement shall be prepared detailing the suggested method of anti-buoyancy measure for approval. All installation works shall be carried out according to approved method statement.

Detail NO: 08

PIPELINE CONSTRUCTION

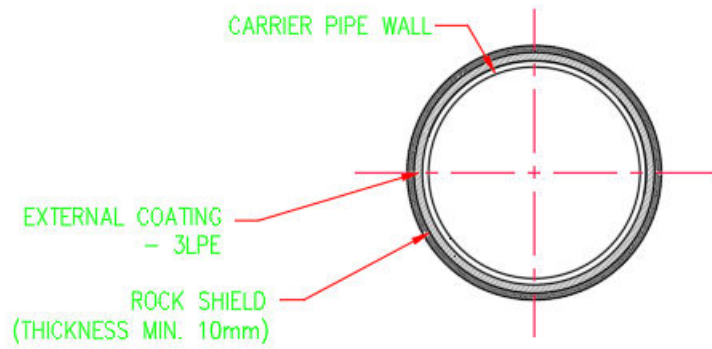
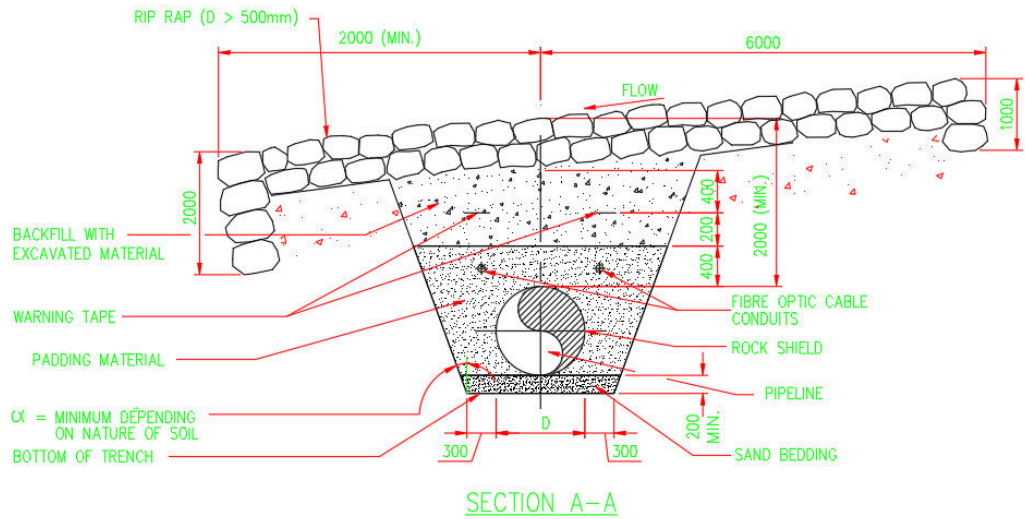
General Notes Regarding to Detail NO: 08

- All dimensions in MILLIMETER
- Erosion protection has to be applied as a minimum on entire width of working strip.
- The minimum cover of 2000mm includes the cover for scouring.
- Fibre optic cable in HDPE conduits.
- Stoned have to be placed according to their shape that they interlock properly avoiding bigger gaps.
- D =pipe diameter



Detail NO: 08

PIPELINE CONSTRUCTION



ROCK SHIELD DETAIL

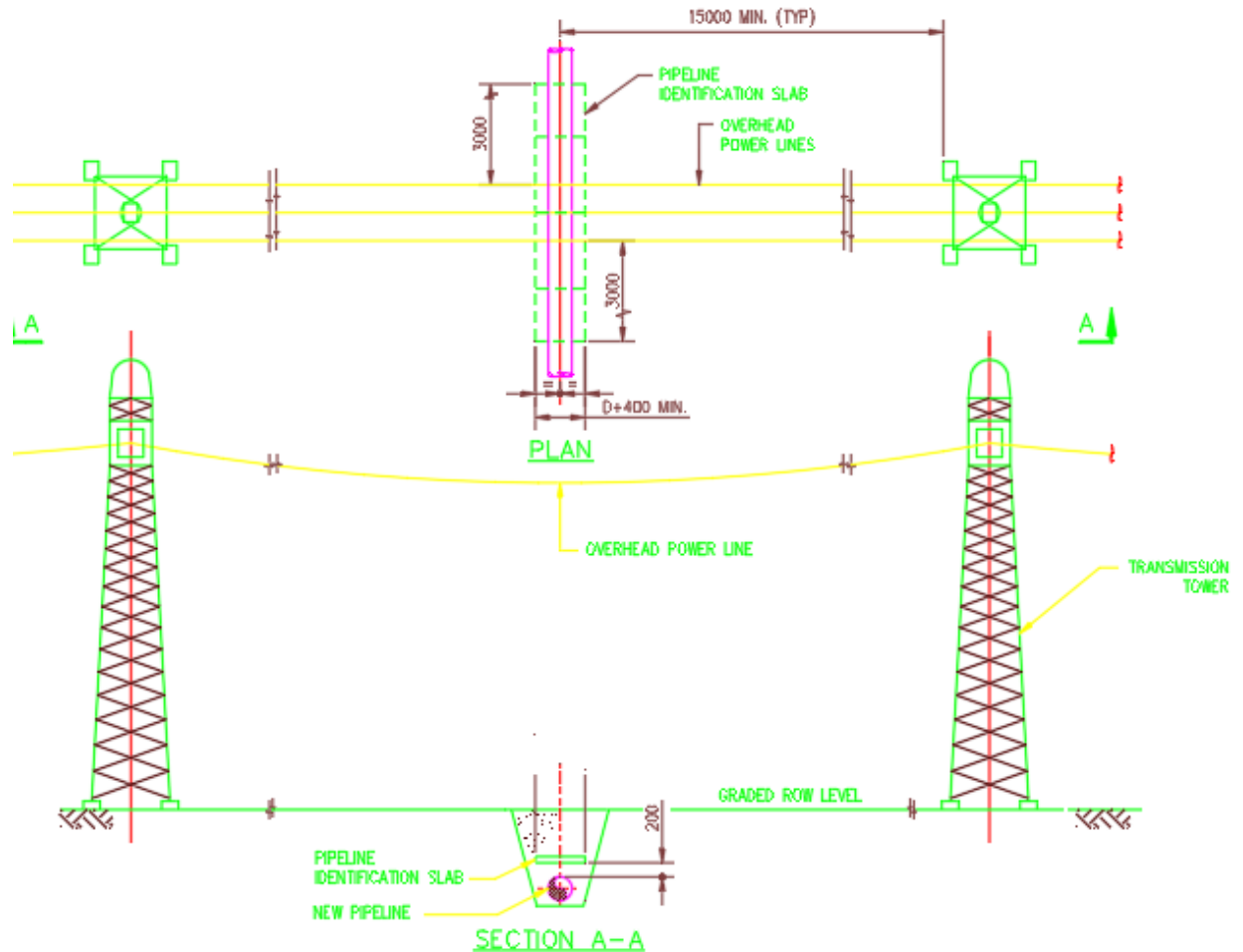
Detail NO: 08

PIPELINE CONSTRUCTION

III. Trench in Area between Over Head Power lines (OHL Crossing)

Extra care shall exercise while performing excavation between overhead pipelines. Pipeline depth of cover in this area shall be 1.0 m as a minimum. Suitable measures shall be taken for the protection of the line and security of personnel. Zinc earthen electrodes to be installed at all crossing and parallelisms with overhead AC line greater than 11kv in accordance with approved CP design.

Permanent warning signboards shall be installed on the pipeline ROW on either sides of the overhead power line crossings at a distance of 20 meters from the centre of crossing. Minimum ground clearance shall be check at each overhead power line crossing span measurement shall be made to lowest conductor at maximum temperature in still air.
Detail NO: 09



Detail NO: 09

PIPELINE CONSTRUCTION

IV. Crossing of Buried Services

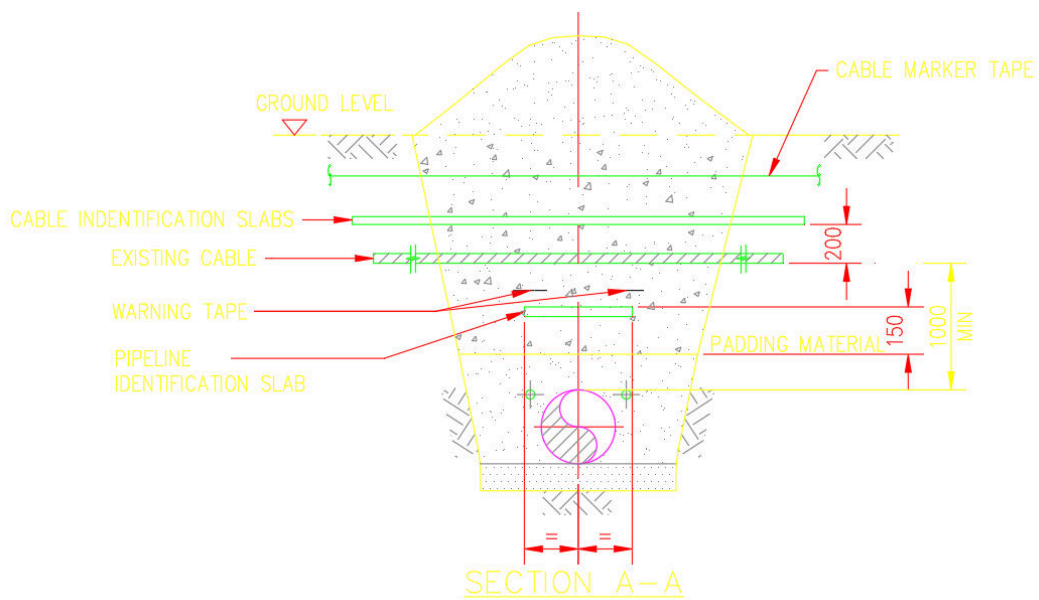
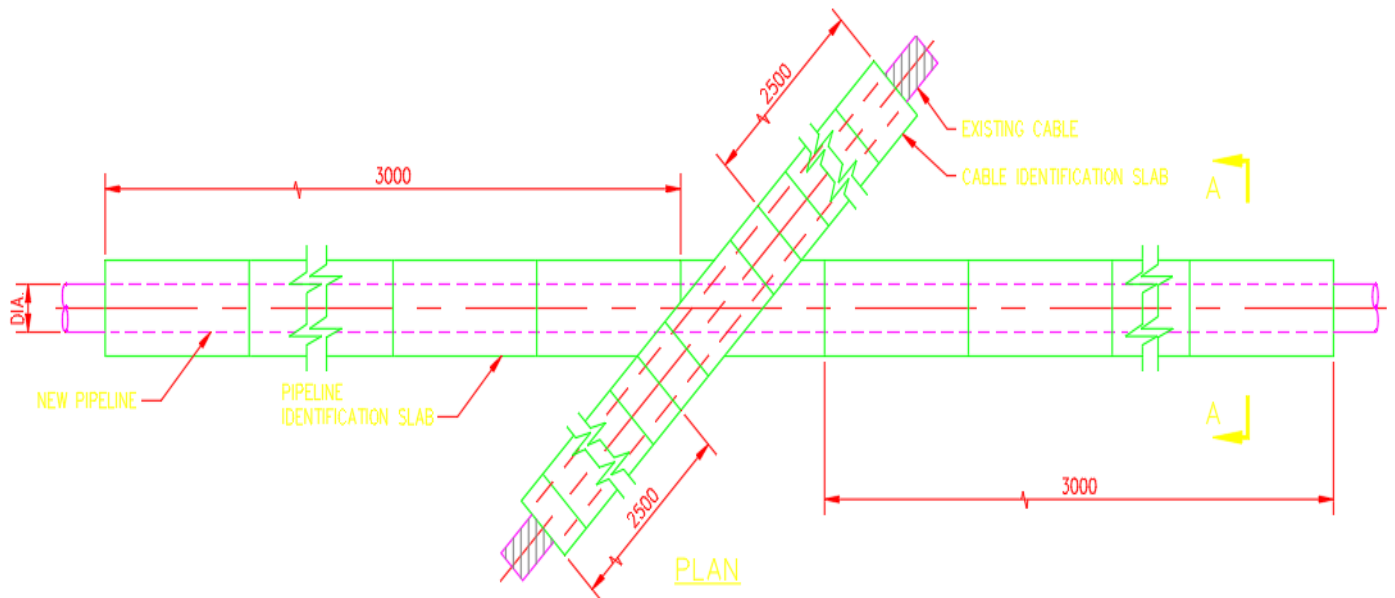
The pipeline under construction is to pass below existing buried facilities such as pipelines, cables, and conduits, where the construction activity shall be approved in writing by the authorities and is subject to approval. Type of crossing shall be such that a minimum depth of cover as required by the drawings and specifications is guaranteed. The minimum clearance required between pipeline and the existing facility shall be 1000 mm or as agreed by 3rd party line operator. Identification concrete slabs shall be provided. The pipeline shall cross under the existing services unless permitted to cross from top side by the authority having the jurisdiction.

Contractor shall safeguard the buried facilities while crossing them in the ROW. The required protecting precaution shall be executed as required and approved by the owners of the buried services. Detail NO: 10

General Notes Regarding to Detail NO: 10

- All dimensions in MILLIMETERS unless otherwise noted.
- Suitable CP bonding shall be provided between crossing pipeline.
- The owner of existing pipeline shall be notified in sufficient time to witness excavation or installation.
- Prior to excavation, all existing pipeline shall be exactly located and exposed by hand tools.
- Crossing with existing under ground pipe shall be 90° as far as possible and in no case the crossing angle be less than 60°.
- Prior to transit over existing utilities with any equipment appropriate protection measure shall be agreed up on the relevant authorities.
- If the burial depth of the utility is less than 600 mm it's required to built up the grade elevation at the point of crossing to archive minimum 1000 mm cover.
- Only sand shall be used as bedding/padding material.
- The warning tape shall be of any suitable thermoplastic(PE or PP)
- Backfill material shall be thoroughly compacted to 90% MDD.
- Concrete Identification slab to extend 2.5 Meters either side of third party cable and 3.0 Meters on top of both existing and new pipelines.
- D=pipe diameter
- Cable crossing to be Re-instated according to owner's requirement.

PIPELINE CONSTRUCTION



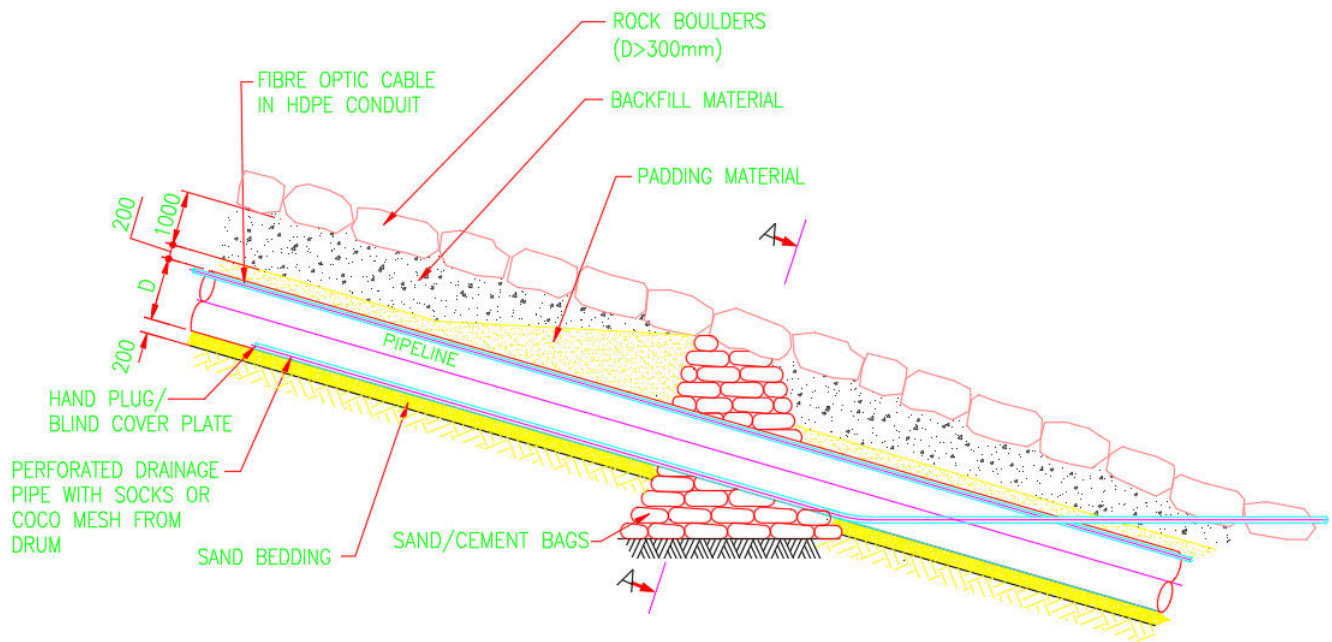
Detail NO: 10 / Existing underground cable crossing

PIPELINE CONSTRUCTION

10- EROSION PROTECTION WITH SAND / CEMENT BAGS

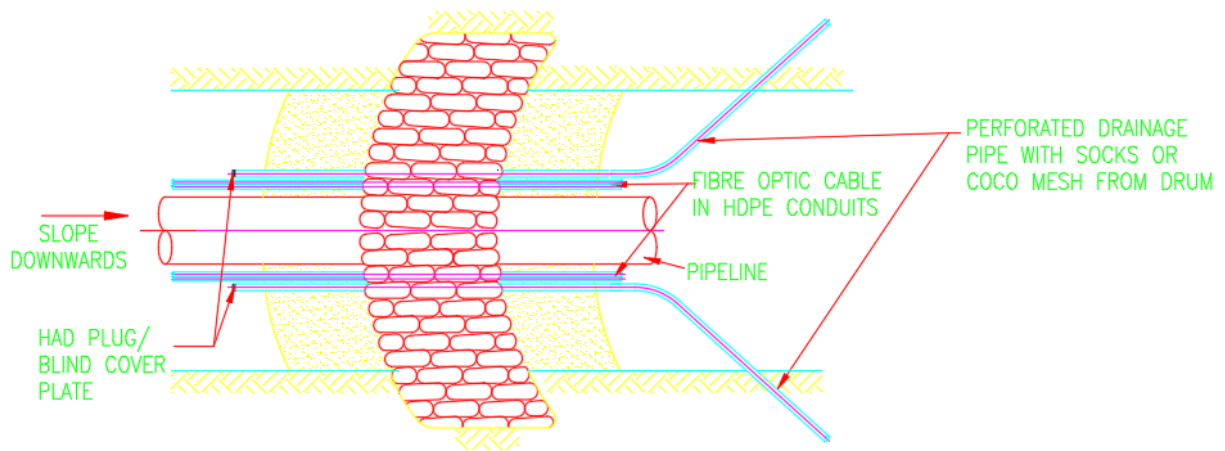
In general, Sand-Cement-Bags (sand/Cement mix or Bentonite) are to be used for all breaker locations. Sand/Cement ratios 10:1.

Length and outlets to be agreed and located on site. Additional trench and slope protection to be excuted as required by site condition. Detail NO: 11

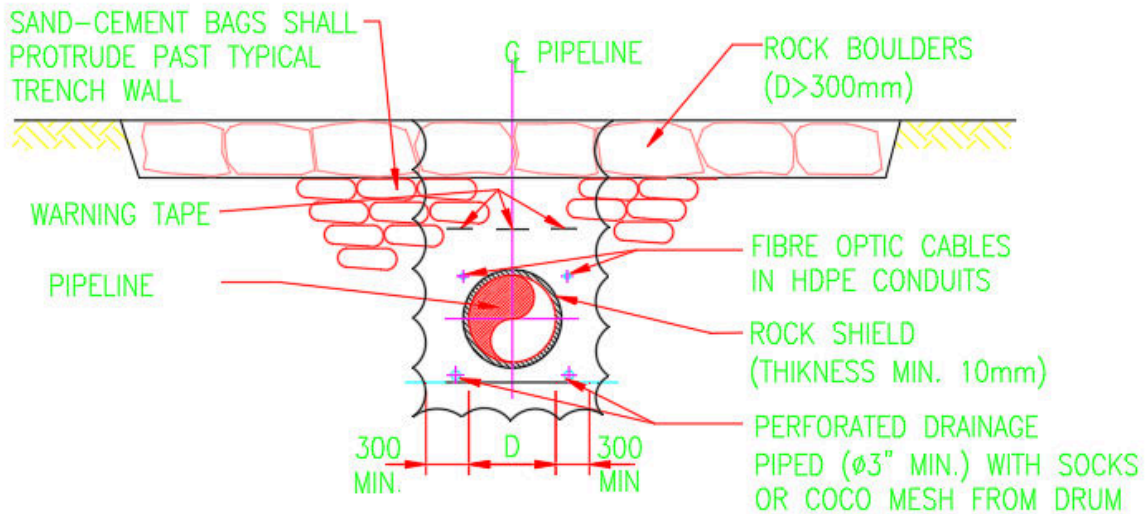


PIPE INSTALLATION IN STEEP SECTION

PIPELINE CONSTRUCTION



TOP VIEW



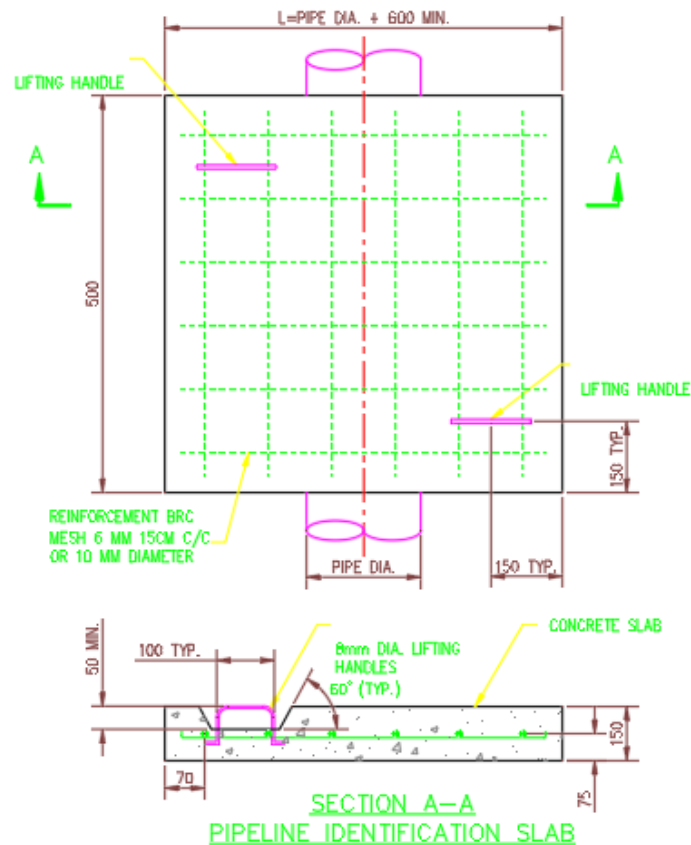
SECTION A-A

Detail NO: 11

PIPELINE CONSTRUCTION

11- IDENTIFICATION SLAB

Pipeline Identification slabs shall be constructed with minimum C20 concrete and ASTM A615 Grade 60 reinforcement and provided with 2.0 NOs of lifting hooks. Lifting handle shall be galvanized and shall be sunk in to the slab (Not protruding type) to allow stacking of slabs for storage and transportation. Identification slab shall be protected and painted by approval protective layer. Detail NO 12



Detail NO 12

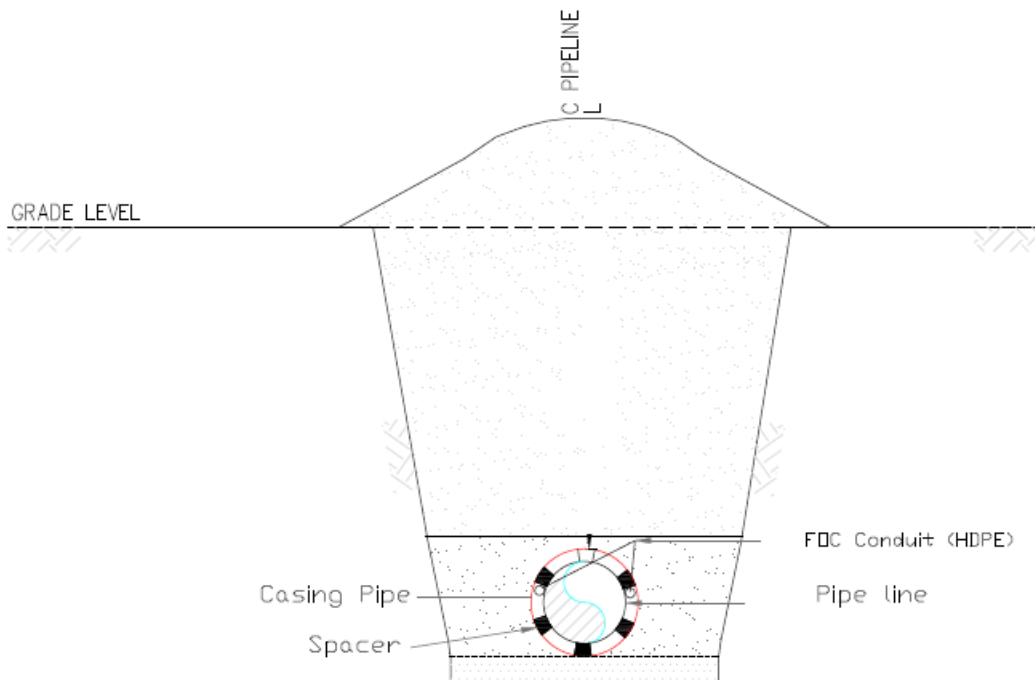
PIPELINE CONSTRUCTION

12- CASING INSTALLTION

Casing shall be positioned in the bottom of the trench right on the sand bedding. In order to avoid any obstacles in the path of the future carrier pipe, plates shall be tacked on the end of the casing in order to avoid any dirt/other substances entering.

Casing is a pipe with greater diameter that shall extend for at least 1.5m from each side of the crossing. Extra length is taken into account in order to leave open section on which the carrier pipe will enter. Pipeline depth of cover in this case shall be more than 1.0 m .The FOC shall be installed in the casing and not in separate FOC conduits. A metal wire will be installed inside the FOC conduits to allows bulling the FOC cable inside the conduit

Carrier pipe will then be prepared with all the spacers installed on 1m space interval. FO cables shall be secured against the carrier pipe and strapped in such a manner not to be pressed between the spacers and the casing wall. Pipe will then be installed using excavator/sideboom to hold and then push the future carrier pipe into the casing. Detail NO: 13



Detail NO: 13

13- HORIZONTAL DIRECTIONAL DRILLING

These work instructions regulate horizontal directional drilling activities will perform on the basis of project documentation provided by the customer and/or, In order to satisfy contractual requirements as well as the customer's needs and expectations. Actual work begins with the transport of drilling rigs and related equipment to the previously set-up rig site. Before this can happen, in order to select the crossing point, a number of tests, comparisons and evaluations are necessary.

The pipelines installed utilizing HDD technology serve to transport:

- Crude oil
- Gas
- Petrochemical products
- Refinery products
- Water
- Waste water
- Hot water for remote heating
- Methane.

Often protective pipes for lying of electrical cables or fibre-optic conductors are also laid. Important fields of application are crossings under:

- rivers and bodies of water
- all types of roads
- rail lines
- airplane runways
- Biotopes
- inaccessible areas
- Surfaces necessitating protection

Among other things, it must be kept in mind that heavy equipment must be transported to both ends of the drilling and, for this, special accessroads are required. It is not uncommon for the strip of pipeline route under construction to be the only possible access route.

Horizontal directional drilling also makes it possible to install a very large filtration route in shallow sub-soil water conductors, thus avoiding a series of traditional vertical pits while nonetheless maintaining the same level of productivity. To-date, using the HDD technique, drilling lengths of 1,800 m has been reached. Pipes with a diameter of up to 56" (DN1400) have been inserted successfully. Both these data represent extreme cases and should not be considered together as a technical standard.

PIPELINE CONSTRUCTION

Pipes with diameters between 36" (DN 900) and 48" (DN 1200) have been laid with optimal construction soil conditions, up to a length of approx. 1,000 m.

As with most construction work, it is also an advantage with HDD technology to have as much space as possible. The minimum amount of space required depends on the size of the drilling rig and other equipment required.

However, many of the components of drilling equipment can be placed in various ways and this makes it possible, in a given setting, to adapt site equipment to the specific conditions found there.

Optimal conditions include flat terrain, solid foundation and freedom of construction above ground-level (for example, no overhead lines).

At the drilling pipe-site, there must be enough space to set-up the entire pipe section directly aligned with the drilling route. The width of this assembly strip corresponds to that of normal open pipeline trenches.

Once the rig-site and pipe-site of horizontal drilling have been determined, the soil shall be measured with precision and it is advisable to draw up detailed construction plans.

With respect to conventional methods adopted for the construction of pipeline, the HDD technique offers a series of major advantages:

- Minimum impact of construction activity on the environment and surrounding area;
- Minimum breaking up of terrain surface
- No detriment to the circulation of naval, rail, air or automobile traffic
- Soil excavation/moving reduced to a minimum
- Large-scale earth coverage is possible
- A large distance from the obstacle to be crossed can be maintained
- Pipe protection from anchor casting or excavation works is guaranteed
- Generally no protection from pipe uplift pressure is necessary
- No danger of pipe flushing following erosion in water
- Reduced construction times
- Weather conditions and water levels have little influence.

In many cases, Horizontal Directional Drilling technique is also less costly than alternative construction methods. These work instructions will cover the following topics:

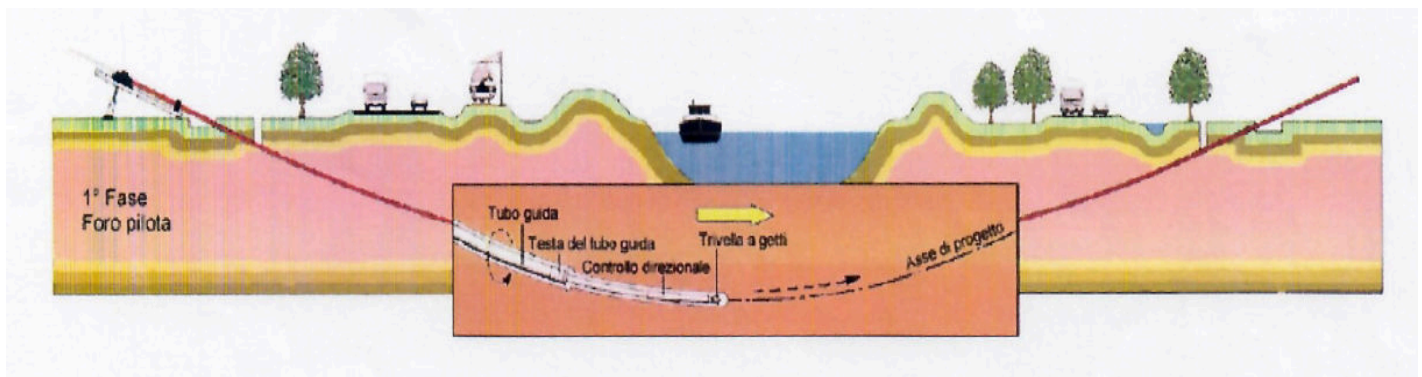
PIPELINE CONSTRUCTION

- Definition of main drilling operations
- Recording of control parameters
- Verification of the preconditions for performing HDD
- Regulation of soil tests
- Updating of documentation.

Within the context of horizontal directional drilling, there are three basic phases:

1. Creation of the pilot bore hole
2. Pre-reaming
3. Pipeline pull-in

Creation of the pilot bore hole:



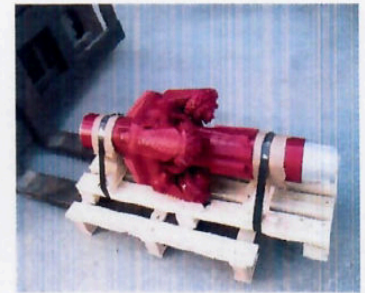
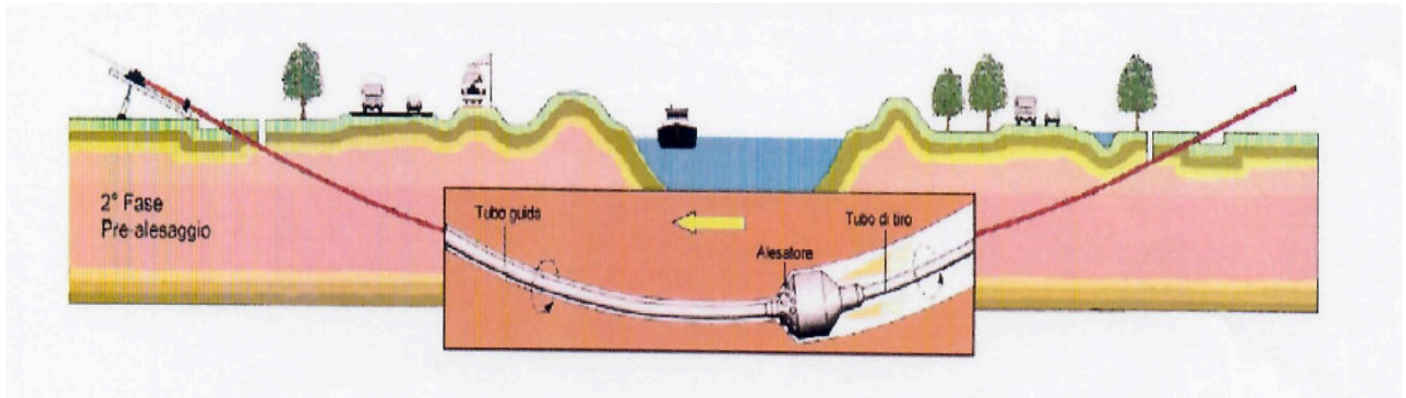
The pilot bore hole shall be drilled along the pre-set drilling line between the entrance point (in front of the drilling equipment) and an exit point on the opposite end of the obstacle. The pilot bore hole shall be created using a drilling head of the proper size also suitable for subsequent operations.

The first component of the bottom hole assembly shall be the bit and its purpose is to loosen the soil to be worked. Depending on the type of soil, a jet-bit shall be used for primarily hydraulic loosening operations or a rock-bit with mud- motor for hydraulic-mechanical loosening operations. Both types of bits will have a diameter slightly greater than the external diameter of the drilling rod that is to be subsequently inserted.

Pre-reaming

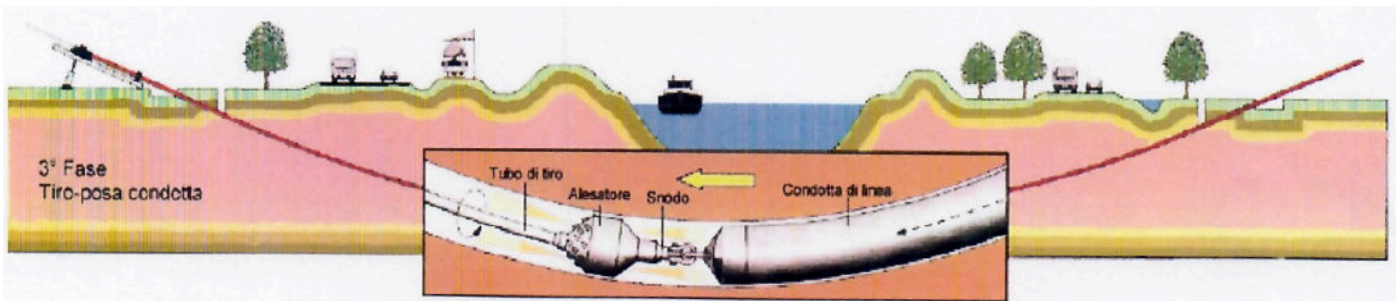
PIPELINE CONSTRUCTION

The second operation in horizontal directional drilling is the widening of the pilot bore hole (pre-reaming). To do this, a special drilling device is assembled on the drilling exit side (reamer). Depending on soil conditions, this could be a barrel reamer (normally for soft soil), fly-cutter (normally for medium soil) or hole-opener (normally for hard Soil). To sustain the work of mechanical loosening through teeth or rollers attached to the reamer, wash liquid shall be pumped through the drilling rod under high pressure and it shall exit from the jets on the reamer. Normally, the diameter of the bore hole is 1.3-1.5 times greater than the diameter of the pipe to be inserted.



PIPELINE CONSTRUCTION

Pipeline pull-in



As the final operation in performing horizontal directional drilling, the prepared pipeline shall be inserted in the widened bore hole (pull-back). As the initial part of the pull-back equipment, a reamer shall be screwed onto the drilling rod in the bore hole. This is followed by a swivel through the aid of which torsion transmission to the pipeline will be suppressed. This swivel shall be connected to the pull head using highly-resistant connectors.

The pull head is an end-cap for the pipeline to be inserted. The pull head is welded to the pipeline and comes with the possibility of attaching connecting pieces (e.g., handle) to the front end.

14- HAULING AND STRINGING OF PIPE

The Pipe shall be unloaded from the stringing trucks and lowered on to the ground by means of side booms, or other suitable approved equipment.

Pipe shall be strung alongside the trench on supports properly spaced with the pipe clear of the ground at a suitable and constant distance from the centreline of the trench. The stringing of pipe along the ROW shall be done in such a manner as to cause the least interference with the normal use of access by trucks, excavation equipment etc. Gaps shall be left at intervals or wherever requested by other users to permit the passage for traffic or equipment across the ROW or along public roads or highways. Pipe stringing shall be done in such a manner as not to cause a hazard or possible damage by traffic.

All coated pipe strung on the ROW shall be supported in such a manner that the pipe is free from contact with the ground at all times. Approval sand bags are permissible for use as pipe supports except in wet areas. In wet areas, skids with wood pads shall be used.

The pipe numbers shall be record, steel heat numbers, pipe lengths, wall thickness and location of each piece of pipe, as strung. These records shall be amended "as laid" subsequently after welding to include the weld numbers, the welding operator's identification numbers and as built co-ordinates, the stringing of pipes at site shall be minimized and shall not exceed more than 1 month. Pipe ends shall be protected with hook-able end caps to prevent sand from entering the pipe while the pipe is strung along the ROW. After the pipe has been strung on the ROW, it shall be inspected visually by the representatives of Contractor and Company jointly. Defective pipe lengths shall be repaired or rejected. Below some photos shows stringing of pipeline

PIPELINE CONSTRUCTION



Stringing of pipeline

PIPELINE CONSTRUCTION

15- LOWERING OF PIPE

Laying shall be carried out under safe conditions so as to avoid unacceptable stresses and temporary deformations which may cause damage to the pipeline itself and to the coating. In localized points where the right-of-way is restricted to less than the minimum necessary for the transit of mechanical equipment, the laying shall be carried out using other suitable means. Lowering of pipeline shall be done after the pipeline passed all NDT and inspection tests.

The pipe shall be placed on the trench bottom without jerking, falling, and impact and without inducing undue stresses. In particular, care must be taken that the deformation caused during the raising of the pipe work from the supports does not exceed the values for the minimum allowable radius of elastic curvature, so as to keep the stresses on the steel and on the coating within safe limits. The portion of the pipeline between trench and supporting skids shall be supported by as many side-booms as required.

A method statement shall be prepared and submitted for approval, proving the calculations that the pipe is not being over stressed beyond the specified limits during lowering the pipe in to trench. Method statement shall indicate that the minimum number of side-booms considered for lowering operation.

Lowering of pipe shall not start before the pipe trench and the pipe bedding are inspected and approved.

Laying the pipeline shall ensure that it fits the excavation and laying bed. The pipeline must be laid without interruption for the whole or the length of section considered for lowering. Where water is present, no laying shall be permitted until the ditch has been drained to the extent and for the time necessary to make visual inspection possible of the bed on which the pipe is to be laid.

The length of pipeline lowered in the trench shall be backfilled in same working day. In no case the lowered in pipe length can be allowed to leave without backfill. The Contractor shall estimate the lowering length with due consideration of weather, bedding and padding capabilities etc. Lowering of pipes shall only be commenced after inspection and approval.

I. Requirements Before Lowering

Lowering can start only after removal (from trench bottom) of all cut offs, pipe supports, stones, debris, stakes, rock projections below the underside of pipe and any other rigid materials which could lead to perforation or tearing of the coating. The bedding shall ensure that the lowered pipe shall rest firmly on bedding without hollow sections.

The soft bedding material shall be free of rock, metal parts, roots, clods, etc. and without sharp edges. Base materials from which the bedding material is produced shall be obtained from approved sources. It shall be Contractor's responsibility to obtain suitable bedding material.

Lowering shall follow as soon as possible, after the completion of the joint coating of the pipeline. Immediately before the lowering-in operation commences, the coating shall be **holiday detected** and if necessary repaired to the satisfaction of Company. (A **holiday test** is a non-destructive test method applied on protective coatings to detect unacceptable discontinuities such as pinholes and voids. Holiday testing involves checking an electric

PIPELINE CONSTRUCTION

circuit to see if current flows to complete the circuit. This testing is used to find coating film discontinuities that are not readily visible).

Before lowering-in, short completed sections of the pipeline shall be cleaned in order to remove all dirt, etc. from the inside of pipe sections.



The above photos shows Holiday Testing

PIPELINE CONSTRUCTION



Some photos shows Lowering in process



PIPELINE CONSTRUCTION

II. Method and Time of Lowering Pipe

Wide non-abrasive slings or belts shall be used in all lowering-in operations and care shall be taken when removing slings from around the coated pipe after it has been lowered into the trench. Any damage caused to the pipe and coating during lowering operations shall be repaired before backfill commences. Lowering-in using standard pipe cradles may be permitted if pipe coating is not damaged.

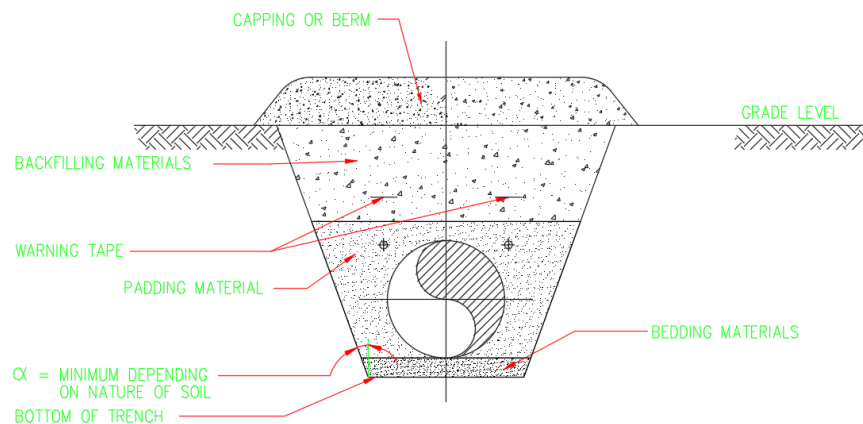
The trench shall be maintained in a dry condition during lowering-in and backfill operations.

The pipe shall restrain in the trench by means of 'plugging', i.e. placing soil on top and around the pipe at regular intervals away from the weld seam. The work shall plan such way that the lowering in and 'plugging' operations take place in close succession during the hottest part of the day. The bedding for trench shall be such that the maximum allowable elastic bend radius for the pipeline is not exceeded.

The time of the lowering-in operation and the amount of pipe to be lowered in shall take into account the required backfilling operation in the event of unstable ditch walls or inclement weather. The lowering in operation may be stopped if the required backfilling operation cannot keep up.

16- BEDDING, PADDING & BACKFILLING

The thickness of the compacted bedding/padding shall not be lesser than 150 mm in the trench unless specified otherwise. The trench shall be of sufficient depth and evenly and sufficiently padded to keep the pipe, when in place, at least 150 mm above bottom of excavated trench. The pipeline must always be covered with an initial layer of soft material (at 20 to 40 cm above the top of the pipe) that contains no stony material with sharp corners or whose size and amount could damage the pipeline coating with necessary padding of 20 cm. Detail NO: 14



Detail NO: 14

PIPELINE CONSTRUCTION

Material for backfill in trench shall not contain gravel or rock over 150 mm in dimension. The material to be used for backfilling must be that generated through trench digging free of any rock and/or stone. Material must be procured from borrow pits and then transported to the work site only if and when it is not available at the site or when provided for in contract documents or on specific request from the Client. Excavated material shall not be washed into the trench nor should any liquefied soil be installed in the trench. Backfill material shall be distributed and compacted around the pipeline and the conduits (if any) using equipment fit for the purpose. The backfilling operation shall follow as closely as practical to the lowering in of the pipe, on the same day so as to securely position the pipe in the ground and to prevent damages from any third party interference and avoiding long exposure of the coating to high temperatures, harmful actions of adverse weather conditions and hazards associated with the caving in of the trench walls. In agricultural areas, the trench shall be backfilled with a layer of at least 20 cm stone free soil, fit for the intended vegetation, and fit for use below the topsoil. Backfilling of all riverbed and/or overbank sections at waterway crossings must be performed using all precautions aimed at guaranteeing that laying height is maintained as well as the stability and safety of the pipeline. In sections on a steep slope in which pipeline backfilling could be washed away by subsequent atmospheric precipitation (especially rain), when backfilling has been completed, suitable drainage ditches and/or canals must be created running crosswise and starting from the trench, in any case, the maximum interval between lowering in and partial backfilling shall not exceed 24 hours. Backfilling shall commence upon completion of the as-built survey of top of pipeline.

17- BERM (WHEREVER APPLICABLE)

For the pipeline laid in normal terrain, where specified in the construction drawings the backfilled trench shall be provided with a berm formation as shown on the typical drawings NO: 14. The minimum height of the berm above the undisturbed ground level shall be 1 m. Following the compaction of the backfill material, additional excavated material shall be placed over the pipeline trench and backfilled slightly. Such material shall be piled to a berm (be at least 30 cm) of height sufficient to ensure that no depression is left when the backfill material in the pipeline trench has settled. Construction of berm is not envisaged in the farmland or where cultivation is supposed to be taken place.

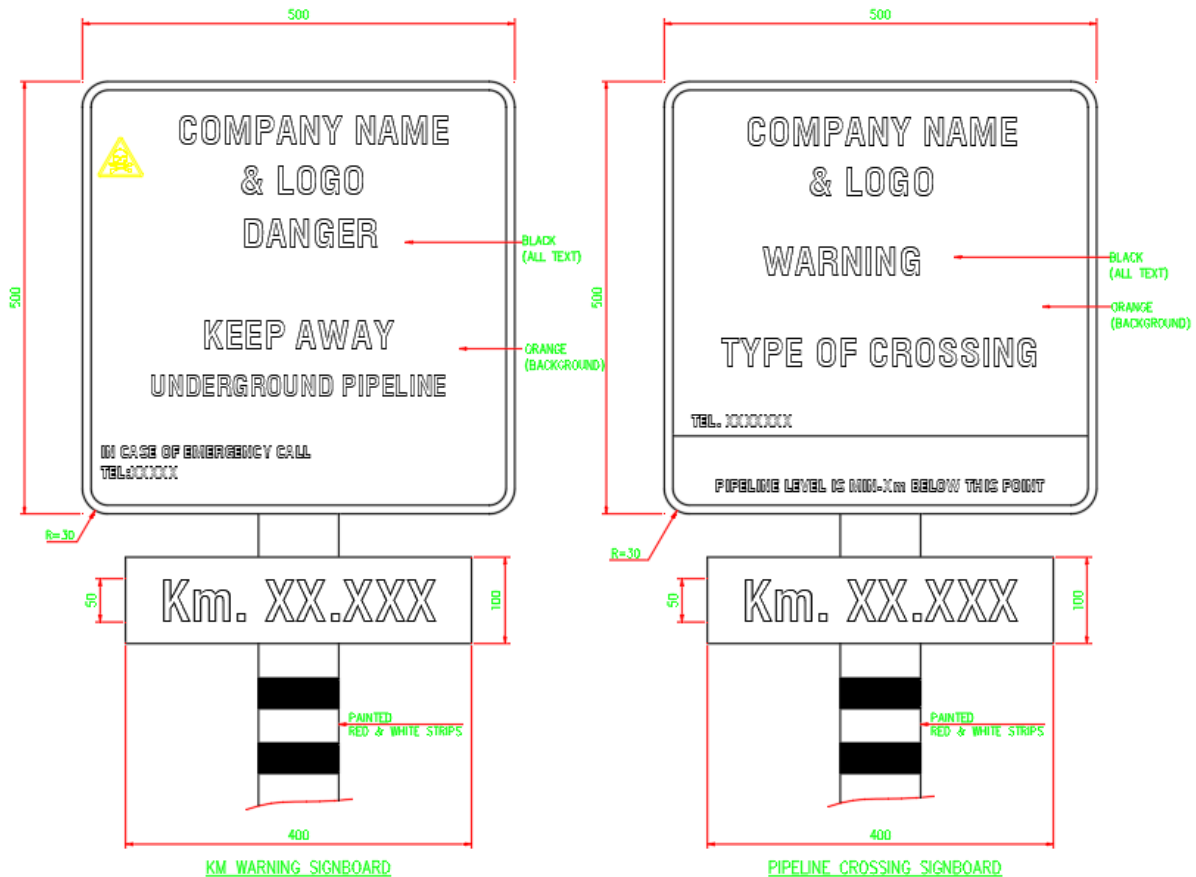
PIPELINE CONSTRUCTION

18- PIPELINE MARKERS

Pipeline markers shall be installed at an interval of 1000m on normal terrain, but only stakes posts placed at farmlands and vegetation area to indicate the existence of pipeline route.

In populated areas, additional warning signs shall be installed at every 250M interval. Additional warning signs shall be installed at locations specified in the alignments sheets.

Pipeline markers shall also be installed at all crossings (road/ track crossings, water crossings, third party crossings) and the places where deemed necessary as per the actual site conditions. Detail NO: 15



Detail NO: 15

19- ROW CLEAN-UP AND REINSTATEMENT

Following pipeline backfilling and covering operations, the right-of-way used for the installation of the pipeline shall be cleaned-up and reinstated to its original pre-work status. All other areas involved in work activities must be restored to their pre-existing conditions.

Before beginning this activity, all foreign matter still present on the right- of- way (e.g., pieces of electrodes, reels of welding wire, abrasive disks, cartons, wrapping material, wood stocks, sacks, etc.) must be removed.

These materials must be transported and disposed of as provided for by law. The following materials:

- Large-sized pieces of stony matter that is not to be utilized.
- Excess excavation spoils material.
- Any other natural material.

Must be collected and, if necessary, removed in accordance with instructions received from the customer on a case -by- case basis.

In particular, the following must be performed:

- De-stoning of all areas designated for cultivation.
- Recovery of soil previously deposited downhill during the creation of drift sections.
- Removal of everything installed to provide right-of-way continuity (e.g., platforms, pipes for ditches, trench ducts, etc.).

In all sections where during opening of the right-of-way it was requested that the layer of top soil be set aside and preserved, the soil must be put back in place taking care to respect pre-existing agricultural conditions.

All slopes, waterway shores and embankments partially or totally demolished during work activities must be properly reconstructed, reinforced and placed in working condition. Provisional roadwork must be rendered permanent as quickly as possible.

In particular, reinstatement of paving due to work activity or any damage must be performed on the basis of instructions provided by the bodies involved or, in their absence, using the same methods and materials as the pre-existing situations. Areas where terracing and drainage of any sort was created must be fully restored.

In addition, dry masonry and other types of walls, canals and irrigation systems as well as other structures demolished during work activities must be restored. Fencing that was cut must be repaired, temporarily leaving open only those passageways required for work still pending.

In the presence of steep slopes and where there is a strong risk of landslide of replaced soil, all works required in the project and/or ordered by the customer to stabilise the terrain shall be created.

PIPELINE CONSTRUCTION

All access points to the right-of-way created during work operations must be eliminated and the areas restored to their original status, except for those that the customer requests be maintained. Preferred obtaining a release statement from the owners signed by the parties involved that relieves the customer of any related expense.

20- QUALITY ASSURANCE / QUALITY CONTROL

Quality Management Systems shall comply with the applicable requirements of ISO 9001-“Quality Management Systems – Requirements”. Which shall have been in effect at all times, a QA programme, which clearly establishes the authority and responsibilities of those responsible for the quality system. Persons performing quality functions shall have sufficient and well-defined authority to enforce quality requirements that they initiate or identify and to recommend and provide solutions for quality problems and thereafter verify the effectiveness of the corrective action.

Quality System and Quality Control requirements shall be identified and included in the Contractor's Purchase documentation. Based on these requirements the Contractor will develop a QA/QC programme which shall be submitted to the Clint for review and concurrence. The Contractor's QA/QC programme shall extend to Sub-Contractors, Vendors and/or Sub-Vendors. Clint reserves the right to inspect materials and workmanship standards at all stages of construction and to witness any or all tests.

21- NOTES

After finishing bedding process and before lowering of pipes started there are several activities that shall be done as clarified below:

- ❖ WELDING WHICH CONSIST OF FOLLOWING
 - Pipe cleaning and Gauging
 - Pipe defects and repair
 - Bevelling
 - End caps
 - Pipe welding
- ❖ NON-DESTRUCTIVE TESTING
- ❖ FIELD JOINT COATING
 - Field Joint Coating
 - Material storing and applicability
 - Qualification of the Field Joint Coating Application Procedure & Applicator
 - Surface Preparation
 - Care in Handling of Coated Pipe
 - Coating Inspection and Repair
- ❖ HYDROTESTING
 - Safety
 - Cleaning Pig Runs
 - Gauging Pig Runs
 - Hydrotest

