SPAN

Suruhanjaya Perkhidmatan Air Negara

UNIFORM TECHNICAL GUIDELINES
WATER RETICULATION AND PLUMBING

First Edition │February 2014

ISBN 978-983-44456-7-6

Publish by:

Suruhanjaya Perkhidmatan Air Negara (SPAN)

Prima Avenue 7, Block 3510

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Selangor Darul Ehsan

Malaysia

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NOMENCLATURE

ABS	Acrylonitrile Butadiene Styrene
AC	Alternating Current
ACB	Air Circuit Breaker
AMR	Automatic Meter Reading
ARI	Annual Rainfall Intensity
AWA	Aluminium Wire Armoured
BEM	Board of Engineers Malaysia
BOMBA	Jabatan Bomba Dan Penyelamat Malaysia
BS	British Standards
BSI	British Standards Institution
BWL	Bottom Water Level
CA	Certifying Agency
CCF	Capital Contribution Fund
CIRIA	Construction Industry Research and Information Association
COC	Certificate of Compliance
CP	Code of Practice
CPVC	Chlorinated Polyvinyl Chloride
CT	Current Transformers
DB	Distribution Board
DC	Direct Current
DCA	Department of Civil Aviation
DE	De-energized
DLP	Defect Liability Period
DMZ	District Meter Zone
DO	Development Order
DOE	Department of Environment
DOL	Direct on line
DOSH	Department of Occupational Safety and Health
EC	Energy Commission
ELCB	Earth Leakage Circuit Breaker
ELR	Earth Leakage Relay
FAC	Free Available Chlorine
FL	Facilities Licensee
FRP	Fibre Reinforced Plastic
g	Gram
G.I.	Galvanized Iron
GPRS	General Packet Radio Services
GRP	Glass Reinforced Plastic
GSM	Global System for Mobile Communication
HDPE	High-Density Polyethylene Pipe
HGL	Hydraulic grade line
HL	Head Loss
hr	Hour
HRC	High Rapture Capacity (Fuse)
HSL	Highest Supply Level
HT	High Tension (11 kV)
HV	High Voltage
HWC	Hazen William Coefficient
Hz	Hertz
ID	Internal Diameter
IDMT	Inverse Definite Minimum Time
IEC	International Electrochemical Commission

IEE	Institute of Electrical Engineers, UK
IEEE	Institute of Electrical and Electronics Engineers
IEM	Institution of Engineers Malaysia
IES	Illuminating Engineering Society (of North America)
IP	Ingress Protection
ISO	International Organization of Standardization
JAS	Jabatan Alam Sekitar
JKKP	Jabatan Keselamatan dan Kesihatan Pekerjaan
kA	Kilo ampere
l	Litre
LED	Light Emitted Diode
LPU	Light Protecting Unit
LV	Low-Voltage
m	Meter
mA	Milliampere
M&E	Mechanical and Electrical
MCB	Miniature Circuit Breaker
MCCB	Moulded Case Circuit Breaker
MV	Medium Voltage
Mld	Million Litres per Day
mm	Millimeter
mm^2	Square Millimeter
MMi	Man-Machine Interface or User Interface
MS	Malaysian Standards
MSB	Main Switchboard
m^2	Square meter
m^3	Cubic meter
NPSH	Net Positive Suction Head
O&M	Operation and Maintenance
ODL	Ordinance Datum Level
PE	Professional Engineer
PL	Plug in – Light Bulb
PLC	Program Logic Controller
PP-R	Polypropylene Random Copolymer
PRV	Pressure Reducing Valve
PT	Potential Transformers
PVC	Polyvinylchloride
RBE	Report By-Exception
RC	Reinforced Concrete
RCCB	Residual Current Circuit Breaker
RCD	Residual Current Device
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SL	Service License
SMS	Short Messaging System
SON	Sodium (for types of lamps)
SPAN	Suruhanjaya Perkhidmatan Air Negara
SSB	Sub-Switchboard
ST	Suruhanjaya Tenaga
SWA	Steel Wire Armoured
SWL	Safe Working Load
TM	Telekom Malaysia Berhad
TNB	Tenaga Nasional Berhad
TWL	Top Water Level

UPVC	Unplasticized Polyvinyl Chloride
UTG	Uniformed Technical Guidelines
VCB	Vacuum Circuit Breaker
VSD	Variable Speed Drive
WC	Water Closet
WDL	Water Distribution Licensee
XLPE	Cross-Link Polyethylene

FOREWORD

Suruhanjaya Perkhidmatan Air Negara (or the Commission) is desirous that uniform technical guidelines be prepared to streamline the planning and design of water distribution system encompassing supply mains, pump stations, service reservoirs, external reticulation systems and water fittings (internal plumbing systems) throughout the States of Peninsular Malaysia, and the Federal Territories of Kuala Lumpur, Labuan and Putrajaya. The intention being to standardize the implementation of these water distribution facilities by developers, consultants, contractors, plumbers and Water Distribution Licensees (WDL). The concept of standardization does not preclude deviations from the norm to suit particular circumstances that may arise at a localized level. However, any significant departures from the standard criteria stated in this manual shall be justified, and deviations shall not lead to imposing adverse technical or financial implications on the WDL, developer or consumer.

The standardization of technical guidelines shall promote expedient approvals of water distribution plans and designs; lead to more consistent development of water distribution facilities exhibiting sustainability, robustness, durability and energy efficiencies; and enable more effective operation and maintenance of built facilities by the WDLs.

These Uniform Technical Guidelines (UTG) shall apply particularly to specific components of a total water supply value chain as highlighted in **Figure F.1**. In this regard the Uniform Technical Guidelines (UTG) establishes the general planning and design principles that should be applied in the development of new external reticulation (distribution) systems, inclusive of metering, control, monitoring and surveillance facilities (Refer to **Figure F.2)**. The specific components of the water distribution system include suction tanks, pumping stations, pumping mains, rising mains and falling mains (gravity mains), service reservoirs, supply mains, external reticulation network systems, sampling stations, district meters, valves, off-take ferrules/tee connections, communication pipes, bulk meters, sub-meters, service pipes, internal storage tanks, distribution pipes, flow control valves and particular fittings and appliances located within buildings. The water supply system encompassing the above components shall convey and distribute potable water to various categories of end users including residential, commercial, institutional, industrial and social and religious premises.

The standards and design parameters quoted in this document are meant to guide developers, competent persons, qualified persons and planners to prepare and submit technically acceptable plans and designs to the Commission. Nevertheless this Document, and its contents, do not relieve any person or entity of their responsibilities to exercise professional judgment, and apply sound engineering principles in the design, execution and completion of water distribution systems so as to meet Malaysian Codes of Practices and Standards. International Standards and Code of Practices may be adopted in the absence of equivalent Malaysian Standards.

The planning and design criteria, and operational responsibilities, pertaining to water fittings (or internal plumbing systems) associated with landed residential premises and multi-storey buildings are also addressed by these UTG. The scope of coverage in this case is depicted in **Figure F.3**.

The standards, criteria and parameters specified in the Uniform Technical Guidelines are subject to change or revision as deemed fit by the Commission. All planning and design efforts shall also conform with the general and particular provisions, and conditions,

specified in **the Water Services Industry Act of 2006, and the Water Services Industry (Water Reticulation and Plumbing) Rules 2014**. Planners, competent persons and permit holders are required to refer to these two publications when planning, designing and implementing water distribution systems.

This Uniform Technical Guideline is structured into Nine (9) parts, and three (3) Appendices, viz:

Part A : INTRODUCTION

Part B : PLANNING AND DESIGN OF SUPPLY MAINS, EXTERNAL RETICULATION SYSTEMS AND APPURTENANCES

Part C : PLANNING AND DESIGNS OF PLUMBING SYSTEMS

Part D : MECHANICAL DESIGNS FOR PUMPING STATIONS

Part E : ELECTRICAL DESIGNS FOR PUMPING STATIONS

Part F : INSTRUMENTATION AND CONTROL SYSTEMS

Part G : WATER CONSUMPTION METERING

Part H : PARTICULAR CONSTRUCTION AND COMMISSIONING SPECIFICATIONS

Part I : REQUIREMENTS FOR HANDING OVER OF WATER SUPPLY SYSTEM

Appendix A : APPLICABLE CODES AND STANDARDS

Appendix B : APPLICATION FORMS

Appendix C : STANDARD DRAWING FOR EXTERNAL RETICULATION SYSTEMS AND SUPPLY MAINS

These Uniform Technical Guidelines are applicable for water supply distribution systems operated by either an Individual or Class Licensee. However, these Guidelines do not address all aspects pertaining to water distribution for fire fighting purposes; except for hydrants installed on a public main.

Competent and qualified persons, planners, developers, water distribution licensees and permit holders should make reference to these Uniform Technical Guidelines for the preparation of plans and designs, and execution of construction works, related to water supply distribution systems defined in **Figure F.1** with the specific aim of delivering potable water to individual consumers at reliable, safe, efficient and sustainable levels.

Any person who is not clear on the general intent and specifications of this UTG may contact the Commission for clarification.

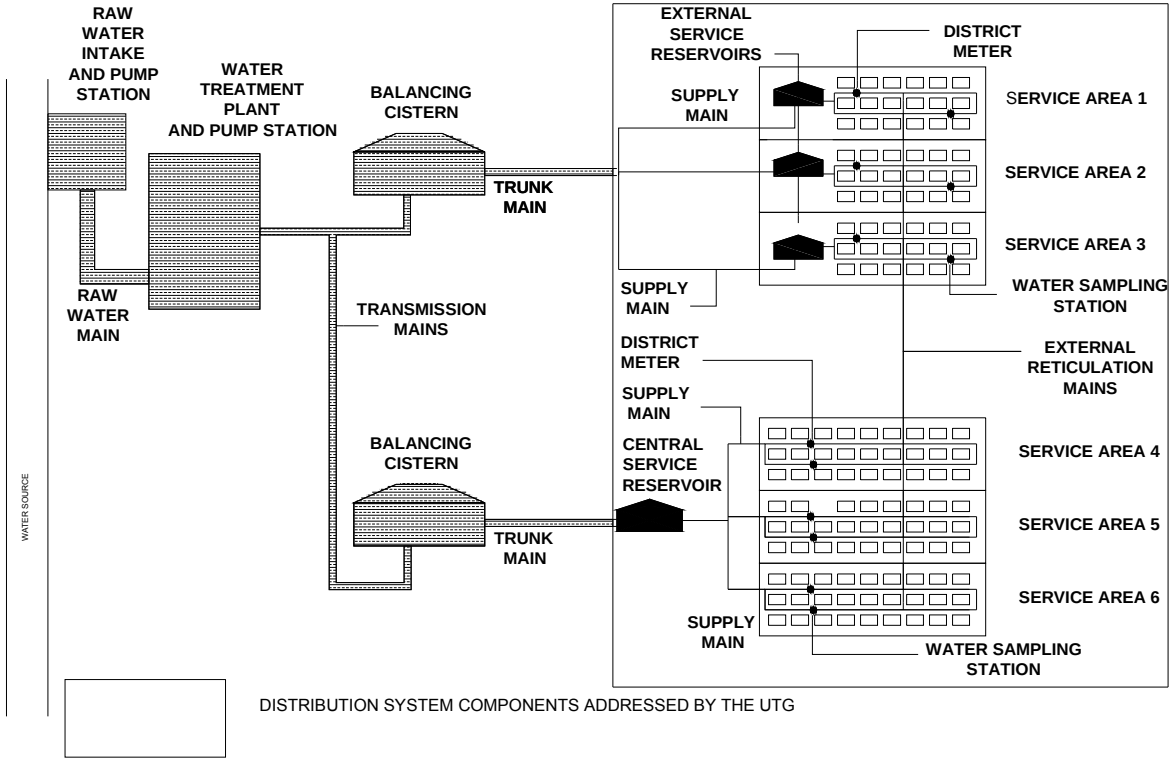


FIGURE F.1
WATER SUPPLY FACILITIES ADDRESSED BY THE UNIFORM TECHNICAL GUIDELINES (UTG)

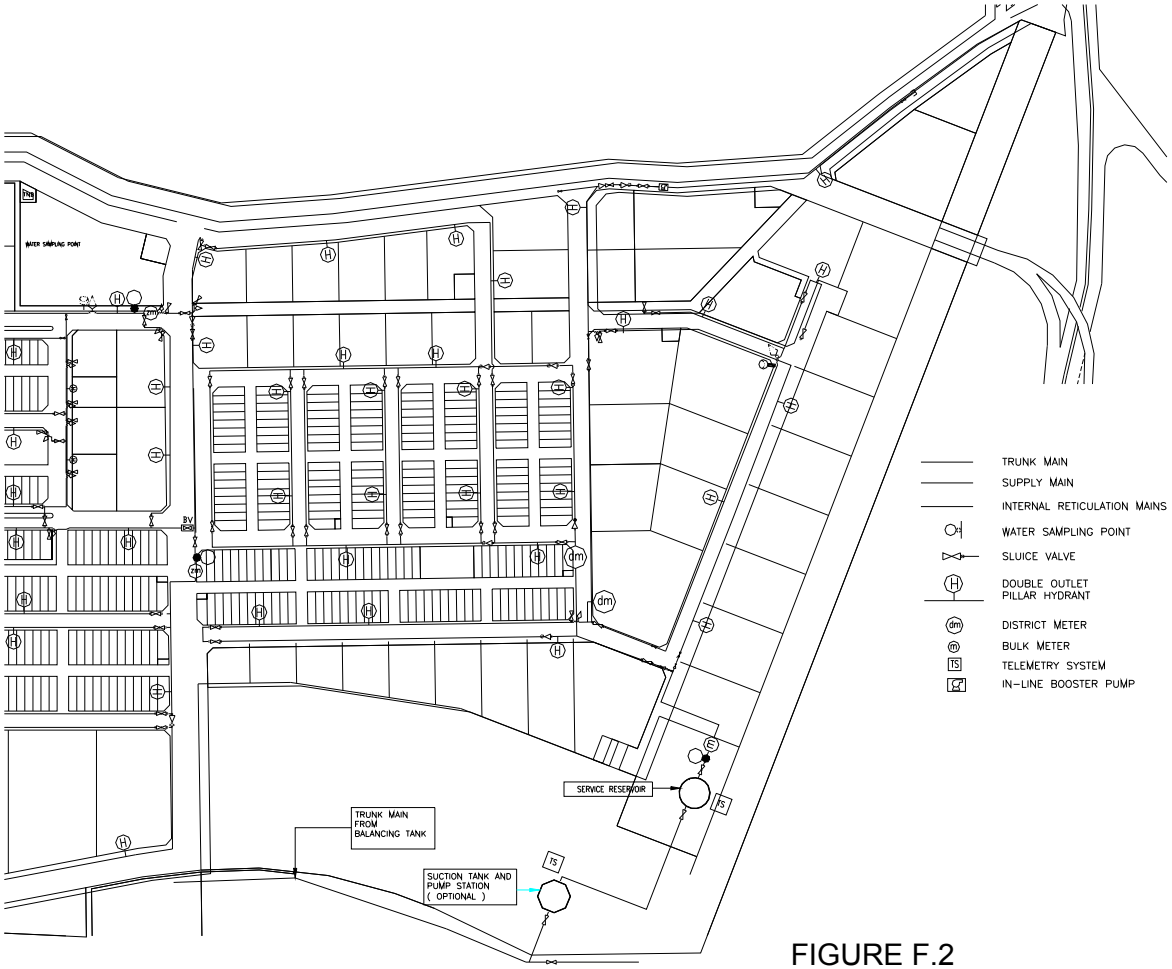
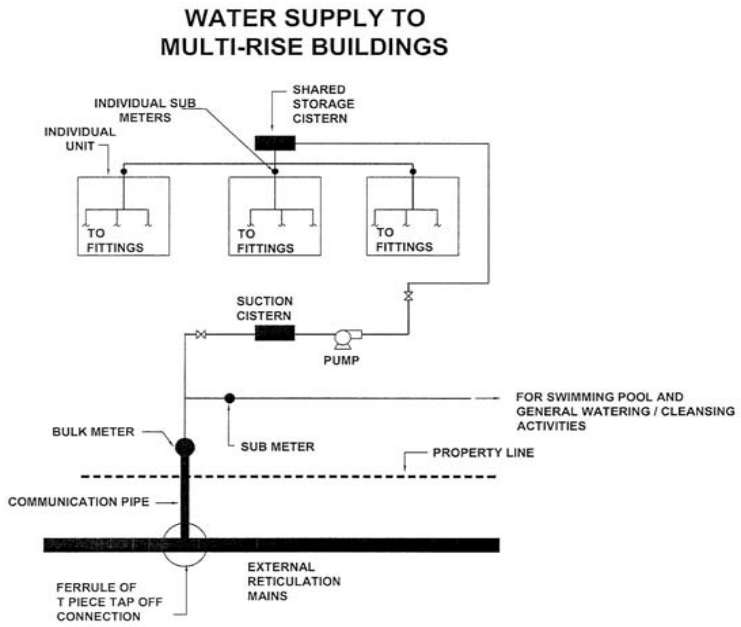
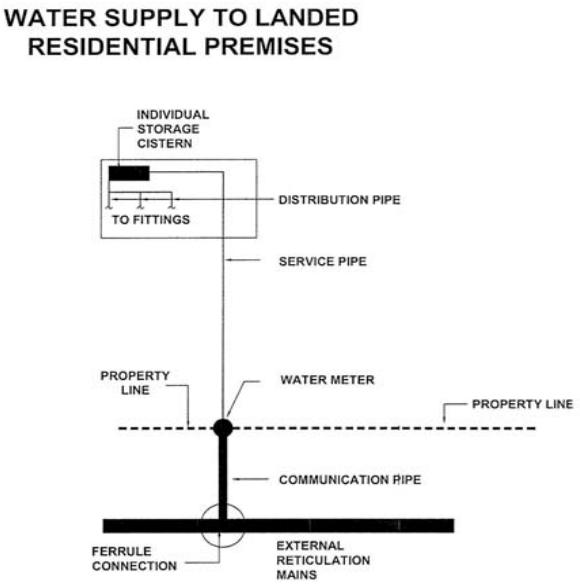


FIGURE F.2
TYPICAL EXTERNAL RETICULATION
SYSTEM FOR A SINGLE DEVELOPMENT AREA





NOTES:

1. Responsibility for maintenance of all facilities downstream of the water meter shall be borne by the premise owner in the case of landed properties; and by the management corporation in the case of multi-rise buildings.

2. Position of individual and bulk meters shall be decided by the Water Distribution Licensee

FIGURE F.3
THE SCOPE OF WATER FITTINGS ADDRESSED BY THE UNIFORM TECHNICAL GUIDELINES(UTG)

Part A:

Introduction

PART A : INTRODUCTION

A.1 PREAMBLE

Part A identifies, inter-alia, the particular responsibilities of developers and water distribution licensees (WDL) in implementing water distribution facilities; describes procedures for applying and obtaining approvals for design, construction and handing over of water distribution facilities to the WDL; identifies persons who are eligible to submit applications for approval of water distribution plans and designs, and to seek permission from the WDL to carry out the testing and commissioning of distribution system components, as well as to take over built systems; and identifies charges payable for submitting particular applications to the WDL. Pertinent terms expressed in the UTG are defined in this Part.

A.2 DEVELOPMENT RESPONSIBILITIES

In accordance with **Part III (Rules 6, 29 and 30) of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014**, the developer of any development area shall be responsible for the planning, design, construction, installation, testing and commissioning, and handing over, of all parts of an external reticulation system; as well as supply mains and associated pumping systems, which are required to connect a development area to an existing public main identified by the WDL as a source of water supply for the development. The developer shall undertake such duties and responsibilities in accordance with the Water Services Industry (Water Reticulation and Plumbing) Rules 2014, the Water Services Industry (Water Services Deposits, fees and Charges) Regulations 2014 and these Uniform Technical Guidelines.

Nevertheless the Water Distribution Licensee (WDL) may, in accordance with **Rule 7 of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014**, notify a developer of their decision to implement a supply main and centralized service reservoir to provide water to the developer's development area. If so notified, the developer shall no longer be responsible for the construction of a supply main and service reservoir serving their development area. The WDL shall in this case recover the cost of implementing the supply main and centralized service reservoir from the developer through imposition of an additional Capital Contribution Fee as *specified* in the **Water Services Industry (Water Services Deposits, Fees and Charges) Regulation 2014**.

A developer shall consult the WDL as to which party shall be responsible for implementing the supply main and the service reservoir prior to submitting his application to the State Authority for a planning permission (PP) to implement his proposed development.

In either case, the approval of the Commission is required for all planning and design submissions before any construction work may commence. Construction works must commence within two (2) years of issuance of the Commission's approval of design submissions, or otherwise fresh applications need to be resubmitted for the same scope of works.

A.3 PROCEDURES ASSOCIATED WITH IMPLEMENTATION OF SUPPLY MAINS, EXTERNAL RETICULATION SYSTEMS FOR INDIVIDUAL DEVELOPMENTS

The principal procedural steps which Developers / Owners of premises need to be conversant with for the successful and expedient implementation of water supply distribution systems for individual developments, or for individual buildings, are summarized as follows and further elaborated in **Appendix B**:

Stage 1 : Allocation of Reserves for Water Supply Facilities

WDLs shall be consulted on whether a centralized service reservoir and common supply mains shall be provided by the latter, or whether dedicated facilities have to be built by a developer / owner, to serve a proposed development. Land area reserves for siting of water supply facilities shall be incorporated in submission plans to the Local Authority as part of the process for the application of a Planning Permission (PP). The UTG provides specific criteria to assist in the estimation of daily water demand rates, and thereby assist in determining the functional capacity of specific facilities. Such information shall assist in determining areal requirements for siting of specific facilities (Refer to **Table B.1** and **Section B.1.2.2** of the UTG).

Stage 2 : Application for Water Supply Source

On issuance of a Planning Permission (PP) by the Local Authority, developers may proceed to apply for an external source of public water supplies from the WDL.

In the case of individual premise owners, a competent person is engaged to prepare a communication pipe and tapping point plan for submission to the WDL; which shall also represent a formal application for tapping water supplies from the nearest public main.

Stage 3 : Submission of Conceptual and Detailed Design Proposals

Upon confirmation of a water supply source, conceptual and detailed designs pertaining to supply mains (if required), external reticulation systems, on-site suction cisterns, pump stations, and service reservoirs (if required), shall be prepared by a competent person engaged by a developer. All designs shall conform to minimum standards specified under the **Water Services Industry (Water Reticulation and Plumbing) Rules 2014**, and to design criteria standards and guidelines specified in this Uniform Technical Guidelines (UTG). All designs shall be submitted to the Certifying Agency for approval, together with the prescribed Deposits, Fees and Charges [Refer to **Water Services Industry (Water Services Deposits, Fees and Charges) Regulations 2014**].

In the case of internal plumbing systems, a competent person shall be engaged by the Premise Owner to undertake the detailed design of an internal plumbing system; all such designs shall conform with the minimum standards specified under the **Water Service Industry (Water Reticulation and Plumbing) Rules 2014**, and with the design criteria and guidelines specified in these Uniform Technical Guidelines. The competent person shall be fully accountable for the proper design

of internal plumbing systems (or water fittings) downstream of the meter point in accordance with the Uniform Building By-Law's self regulation process. A copy of the general plans and specifications shall be lodged with the Commission and Local Authority for information purposes only.

In addition the Developer / Owner shall pay to the WDL the first installment (10%) of a Capital Contribution Charge determined in accordance with Regulation 16(2)(a) of the Water Services Industry (Water Services Deposits, Fees and Charges) Regulations 2014.

Stage 4 : Construction of Facilities

Upon obtaining design approvals from the Certifying Agency for external reticulation systems, suction tanks , pump stations and supply mains (if required), developers can proceed to engage a Permit Holder to carry out the construction of their water distribution facilities.

In the case of internal plumbing systems, once the plans, designs and specifications have been lodged by the competent person with the Commission for information only, with a copy extended to the Local Authority, construction activities may commence.

Stage 5 : Handing Over / Taking Over of Built Facilities and Systems

On successful commissioning of the external reticulation system, on-site suction cisterns, pumping stations, supply mains and service reservoirs (if required), and after that all relevant information and documentation related to the transfer of land areas on which water supply facilities are built to the State Authority has been completed by the Developer and submitted to WDL. Nevertheless the Developer is committed to rectify all defects over a two year period.

As for plumbing systems, the premise owner takes over the care and operation and maintenance of plumbing systems once the competent person and the permit holder jointly certify the successful construction and commissioning of the works according to forms G5 (Staged Certification: Internal Plumbing of CCC system) .

A.4 SUBMISSION OF PLANS AND DESIGNS

Developers, or individual premise owners, shall engage the following persons to, inter-alia, prepare and submit water distribution development plans and proposals; prepare and submit conceptual and detailed designs of water distribution and internal plumbing systems (including associated reports); construct water distribution and plumbing systems; supervise the construction and commissioning of water supply and plumbing systems; provide co-ordination during the Defects Liability Period; and co-ordinate the handing over of water supply systems to WDLs:

(a)	Planning of Water Supply Facilities	:	Competent Person
(b)	Application for Water Source	:	Competent Person
(c)	Concept and Detailed Design Submissions	:	Competent Person

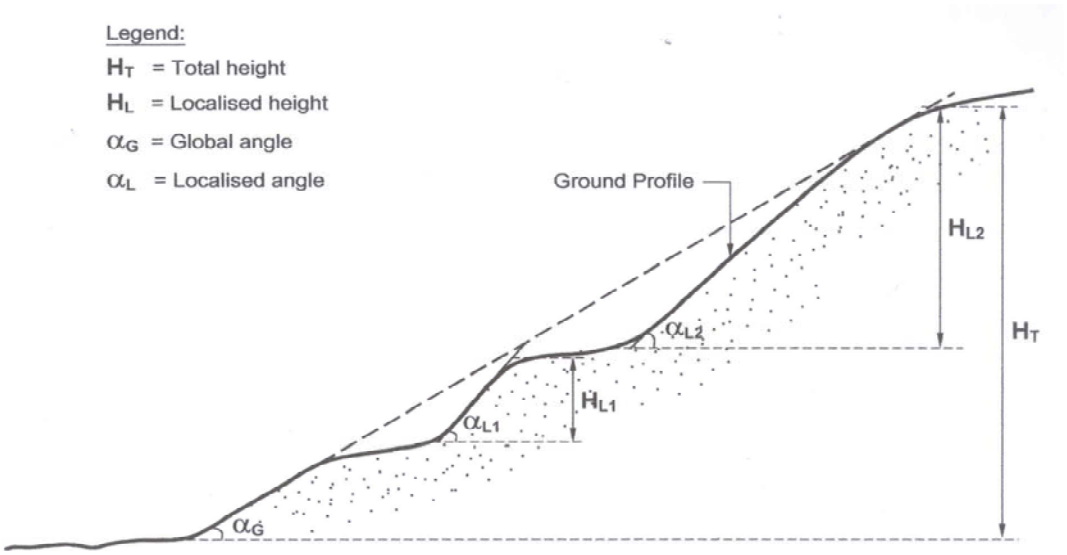
(d)	Construction of External Reticulation System and Internal Plumbing System	:	Permit Holder / Competent Person
(e)	Commissioning of External Reticulation Systems and Plumbing Systems	:	Permit Holder and Competent Person
(f)	Handing over of Built Water Supply System	:	Competent Person

Design of Geotechnical works shall be carried out by a Professional Engineer (PE) who shall have the relevant expertise and experience to undertake the analysis, design and construction supervision of foundations, earth retaining structures (including deep excavation support systems) or cut and fill slopes on hillsides. Slopes are classified in accordance with the risk of landslides (see **Table A.1**). The requirements for design proposals shall depend on the classification of slopes:

- Class 1 Slopes (Low Risk)
  - Existing legislations and requirements of Local Authority shall be followed whereby a PE shall endorse all applications.
- Class 2 Slopes (Medium Risk)
  - In addition to fulfilling the requirements for Class 1 Slopes above, a geotechnical design report shall be prepared and submitted by the PE who shall have the relevant expertise and experience in the analysis, design and construction supervision of slopes, retaining structures and foundations on hillsides.
- Class 3 Slopes (High Risk)
  - In addition to the requirements for Class 1 and 2 Slopes above, the owner shall engage an Accredited Checker who is registered with the Board of Engineers Malaysia (BEM) to audit the design.

Table A.1 : Classification on Risk of Landslide on Hillside Development

Class	Total Height (H_T)	Global Angle (α_G)	Localised Height (H_L)	Localised Angle (α_L)
CLASS 1 (Low Risk)	$\geq$ 15m	< 19	< 3m	< 27
	6m - 15m	< 27	< 3m	< 30
	< 6m	-	-	< 34
CLASS 2 (Medium Risk)	>15m	19 - 27	-	-
		-	$\geq$ 3m	27 - 30
	6m - 15m	$\geq$ 27°	-	-
		-	$\geq$ 3m	$\geq$ 30
	< 6m	-	$\geq$ 3m	$\geq$ 34
CLASS 3 (High Risk)	>15m	$\geq$ 27	-	-
		-	$\geq$ 3m	$\geq$ 30



Source: Policies and Procedures for Mitigating the Risk of Landslide and Hill Side Development : Institution of Engineers Malaysia, 2000

A.5 CHARGES FOR DESIGN AND CONSTRUCTION APPROVALS

In accordance with **Rules 6, 7 and 29** of the **Water Services Industry (Water Reticulation and Plumbing) Rules 2014**, an owner or a developer who wishes to construct an external water reticulation system / supply main within their development shall pay to the Commission specific charges for design approval and site inspections, respectively, during the design and construction stages. The quantum of charges shall be in accordance with **Rules 9 and 10** of the **Water Services Industry (Water Reticulation and Plumbing) Rules 2014**.

A.6 STANDARDS AND SPECIFICATIONS

All materials associated with the construction and installation for water fittings, external reticulation systems, centralised service reservoirs, and supply mains, or in the construction of any of the works identified in this Uniform Technical Guidelines, shall comply with the requirements specified in the latest edition of any applicable recognised standard (refer to the Appendix of this UTG), and to specifications issued by the Commission from time to time.

In case there is any discrepancy between the recognised standard and specifications and those issued by the Commission, the latter should take precedence.

A.7 PRINCIPAL OBJECTIVES OF THE UNIFORM TECHNICAL GUIDELINES

Every technical proposal for water supply distribution to developments and individual premises shall comply with the following underlying objectives of these Uniform Technical Guidelines i.e.:

- Sustainability
- Reliability
- Durability

- Ease of Operations and Maintenance
- Quality of Work
- Energy Efficiency
- Economic Viability

In these Uniform Technical Guidelines, the term "shall" when used in reference to standardise designs or technical parameters or other requirements means mandatory compliance to the stated norms. Departures may be granted on a case to case basis based on sound justifications which have to be accepted by the Commission.

The terms "should" or “may” when used in reference to recommended designs or technical parameters, or other requirements stated in this Uniform Technical Guidelines, indicates norms which the Certifying Agency may depart from, based on sound professional judgment. The competent person would be expected to justify such departures in terms of cost and improved engineering performance.

A.8 DEFINITIONS

The definitions of main terms expressed in these Uniform Technical Guidelines are summarized as follows:

“bulk-meter” includes any meter measuring water, all or part of which is subsequently measured by one or more sub-meters;

“capacity” in relation to a cistern means the volume of water stored between the invert of the distribution pipe outlet and the water line;

“centralised service reservoir” means any service reservoir constructed or to be constructed for the purpose of serving more than one developer’s development area;

“cistern” means fixed and vented container for storing water at atmospheric pressure;

“Commission” means Suruhanjaya Perkhidmatan Air Negara (SPAN) or any appointed agency by SPAN;

“communication pipe” means a part of the service pipe located between the public main and the meter, or if there is no main meter, a part of the service pipe located between the public main and the point where, in the opinion of the water distribution licensee, the main meter would be placed;

“competent person” means the person who is qualified to submit plans and issue certificate of compliance and completion with respect to the design, installation, construction or alteration of the water fittings, centralised service reservoirs, supply main or external reticulation system or any part thereof and more particularly set out in the **Second Schedule**; of the **Water Services Industry (Water Reticulation and Plumbing) Rules 2014**;

“consumer” means a person who is supplied with water from a water distribution licensee; or a person who has made a request to a water distribution licensee for a supply of water;

"corrosion resistance material" means any material which is highly resistant to any corrosive action to which it is likely to be subjected;

"developer" means the developer referred to under section 47(1) of the Act;

"development area" means any area to be developed or constructed thereon any buildings for residential, commercial, institutional, governmental or industrial purposes where the water supply system is to be handed over to the Water Distribution Licensee under Section 47 of the Act;

"distribution pipe" means any consumer's or class licensee's pipe conveying water from a storage or feed cistern, or a hot water apparatus supplied from a feed cistern, and is under pressure only from such cisterns, hot water apparatus or any in-line booster pump;

"district meter" means a meter that measures the total flow of water supplied to a defined area within an external reticulation system;

"external reticulation system" means a network of pipelines, excluding the service water and distribution pipes, within a developer's development area which is connected to the supply main and shall include –

(a) service reservoirs, suction cisterns, pumping stations, valves, hydrants, district meters, sampling stations, telemetry systems, communication pipes and any other appurtenances, equipment, devices and installations connected to such network; and

(b) the lands where such service reservoirs, suction cisterns, pumping stations, valves, hydrants, district meters, sampling stations, telemetry systems, communication pipes and any other appurtenances, equipment, devices and installations are located;

"Facilities Licensee (FL)" means a person who is licensed under the Water Services Industry Act 2006 to own a water supply system or any part of the water supply system;

"feed cistern" means any storage cistern used for supplying cold water to a hot water apparatus, a flushing cistern, any part of an air-conditioning system or any other plant or machinery;

"flushing cistern" means a cistern with a discharging apparatus for flushing a water closet pan, urinal, bidet drain, sewer or similar sanitary apparatus;

"high-rise building" means –

(a) any high-rise residential building;

(b) any multi-storey housing accommodation which is not intended to be subdivided under the Strata Titles Act 1985 [*Act 318*]; and

(c) any multi-storey building for commercial, institutional, governmental and industrial purposes,

but does not include any gated community;

"high rise residential building" means any multi-storey housing accommodation which has been subdivided or intended to be subdivided into parcels to be held under a separate strata title or which an application for subdivision has been made under the Strata Titles Act 1985 [Act 318];

"gated community" means any alienated land having two or more buildings held as one lot under final title (whether Registry or Land Office Title) which shall be capable of being subdivided into land parcels, each of which is to be held under a strata title or as an accessory parcel as prescribed under section 6(1A) of the Strata Title Act 1985 [Act 138];

"Highest Supply Level (HSL)" means the highest delivery level in a water supply system. It is the highest water draw-off level from a direct gravity or pumped supply discharging to a service reservoir or suction tank in a water distribution system; or discharging to the a storage cistern or suction cistern in an internal plumbing system;

"housing accommodation" includes any building which is wholly or principally constructed, adapted or intended for human habitation or partly for human habitation and partly for business;

"meter" means any appliance, equipment or device used for the purpose of measuring the amount of water supplied;

"meter stand" means the structure which supports the main-meter located above ground and at a position that shall be directed by the water distribution licensee;

"overflowing level" in relation to a warning or other overflow pipe of a cistern, means the lowest level at which water can flow into the overflow pipe from that cistern;

"non-potable water" means water other than that supplied from the public water supply and private water supply system;

"permit holder" means any person issued with permit IPA Type A, Type C or Type D under the **Water Services Industry (Permit) Rules 2007**;

"premise" means any building, land and any tent or structure;

"pressure tank" means a closed vessel capable of containing water under pressure greater than atmospheric pressure;

"private main" means any water pipe being part of a private water supply system maintained and controlled by the class licensee to which private service water pipes may be connected;

"private service water pipes" means any pipe used for supplying water from a private main to any premises which is subject to water pressure from the private main or would be so subject but for the closure of some taps;

"public main" means any water pipe maintained and controlled by the water distribution licensee to which service water pipes may be connected;

"pump delivery pipe" means any pipe which supplies water from a suction cistern to a storage cistern located higher than the suction cistern and connected within an intermediate pumping system;

"recognised standard" means the standards or a code of practice or specification as specified in the **First Schedule [Water Services Industry (Water Reticulation and Plumbing) Rules 2014]**;

"sampling station" means a device housed in an enclosure, which is attached to an external reticulation system in order to enable samples of water to be drawn for quality testing;

"Service Licensee (SL)" means a person who is licensed under the Water Services Industry Act 2006 to provide water supply services or any part of the water supply services;

"service pipe" means pipe for supplying water from a public main to any premises which is subject to water pressure from the mains, or would be so subject but for the closure of some taps;

"special" means any connecting length of pipe other than a straight pipe of uniform bore;

"storage cistern" means any cistern, other than a flushing cistern, from which water supplies from the public main or private main is delivered for use and stored otherwise than through a draw-off tap;

"stopvalve" means any device other than a draw-off tap, for stopping the flow of water in a pipe whenever necessary;

"sub-meter" means any meter which measures water which has already been metered since leaving the public main;

"suction cistern" means any cistern used for storing and supplying water to a pumping system;

"supply main" means the pipeline conveying water from either a centralized service reservoir or tapping point determined by water distribution licensee along an existing public main located outside a developer's development area to the external reticulation system, and the lands where the pipelines are located, and where required shall include an in-line booster pumping station;

"warning pipe" means an overflow pipe so fixed that its outlet is in an exposed and conspicuous position and where the discharge of water may be readily detected;

"watercourse" Includes rivers, streams and creek including any tributary, distributary or artificial deviation thereof, seas, lakes, ground water, dams, reservoirs, ditches, drains and passages, other than pipes, through which water flows for the supply of water to any premises;

"Water Distribution Licensee (WDL)" means a service licensee who holds an individual license to distribute and supply water to consumers by means of a public water supply system;

“water fittings” means pipes (other than the public mains), specials, taps, cocks, valves, ferrules, meters, sub-meters, cisterns, baths, water closets, hot water apparatus, and other similar apparatus or appliance used in connection for the supply and use of water;

“water kiosk” means any vending machine, connected to the water supply system, which filters or enhances the quality of water supplied from the public mains for public consumption;

"water line" means the highest operating water level in a cistern or tank at which a cistern or tank is designed to function;

“water supply distribution area” means an area within which a water distribution licensee is authorized to distribute and supply water;

“water supply system” means the whole of a system incorporating public mains, pipes, chambers, treatment plant, pumping stations, service or balancing reservoirs or any combination thereof and all other structures, installations, buildings, equipment and appurtenances used and the lands where the same are located for the storage, abstraction, collection, conveyance, treatment, distribution and supply of water;

“water supply services” means the treatment of water abstracted from watercourses and the distribution and supply of treated water to consumers and includes the operation and maintenance of the water supply system.

Part B:

Planning and Design of Supply Mains, External Reticulation Systems and Appurtenances

PART B

PLANNING AND DESIGN OF SUPPLY MAINS, RESERVOIRS, EXTERNAL RETICULATION SYSTEMS AND APPURTENANCES

B.1 PLANNING

In this Section, general principles for planning water supply systems within a particular development are described. These principles shall be applied to estimate water supply amounts to be provided by a WDL for a particular development; and to develop water supply needs information to be submitted to a WDL to apply for a public water source, and to obtain a Planning Permission for the proposed development.

B.1.1 Factors of Importance in Planning Water Supply Systems

Water supply planning for any development shall take into consideration the following pertinent factors:

a. The relevant provisions, and minimum standards, specified in **the Water Services Industry (Water Reticulation and Internal Plumbing) Rules 2014**.

b. Water Distribution Licensees' (WDL's) specific requirements to suit the local environment.

c. The estimated average daily water supply demand, which takes due cognizance of expected losses and leakages within distribution and storage systems as well as permitted non-metered use; and peak daily rates of flow.

d. The location, quantity and pressure of available source of water supply.

e. Requirement for on-site water service reservoirs or off-site centralised service reservoirs as instructed by the WDL (Refer to **Figure F.1**).

f. The need for pumping systems to deliver water to the development; as well as for distribution of water throughout an external reticulation network system located within development areas.

g. Optimizing life cycle costs.

h. Promoting energy efficiencies.

i. Monitoring and controlling distribution of water supply of an adequate quality.

B.1.2 Application For Planning Permission

The first stage of development planning is the application to the Local Authority for a Planning Permission. In this application, information on the water supply needs of the development are to be provided in terms of total daily demands. These are estimated based on the submitted Layout Plans, proposed types of physical developments envisaged, and unit rates of demand by various types of premises as listed in **Table B.1**.

Table B.1 : Tabulation of Estimated Water Demand Rate for Planning of External Water Reticulation System

Type of Premises/Buildings	Average Daily Water Demand (Litres)
Low cost terrace house / low cost flat	1100 / unit
Single storey terrace house / low cost house (less than RM25,000) / low medium & medium cost flats	1300 / unit
Double storey terrace house / high cost flat / apartment / town house	1500 / unit
Semi detached house / cluster	2000 / unit
Bungalow / condominium	2000 / unit
Wet market	1500 / stall
Dry market	450 / stall
Shop house (single storey) / low cost shop	2000 / unit
Shop house (double storey)	3000 / unit
Shop house (three storey)	4100 / unit
Shop house (four storey)	4550 / unit
Light industrial workshop	1500 / unit
Semi detached / bungalow workshops	1500 / unit
Building for heavy industry*	65,000 / hectare
Building for medium industry*	50,000 / hectare
Building for light industry*	33,000 / hectare
Office / complex / commercial (domestic usage)	1000 / 100 square metre
Community centres or halls	1000 / 100 square metre
Hotel	1500 / room
Education institutions (other than school and kindergarten)	100 / student
Day school / kindergarden	50 / student
Fully residential school/ institution of higher learning with hostels facilities	250 / student
Hospital	1500 / bed
Mosque or other place of worship	50 / person
Prison	250 / person
Army camp	250 / person
Bus terminal	900 / service bay
Petrol kiosk (with car washing bay)	50,000 / unit
Petrol kiosk (without car washing bay)	10,000 / unit
Stadium	55 / person

Type of Premises/Buildings	Average Daily Water Demand (Litres)
Golf course	1000 / 100 square metre
Warehouse	1500 / unit
Restaurant	25 / square metre
Airport	25 / passenger
Others	As per the estimated water demand by the developer or owner

Note: -
** As classified under the Piawaian Perancangan Kawasan Perindustrian issued by the Jabatan Perancangan Bandar dan Desa or its successor*

B.1.2.1 Service Reservoirs, Suction Cisterns and Pumping Stations

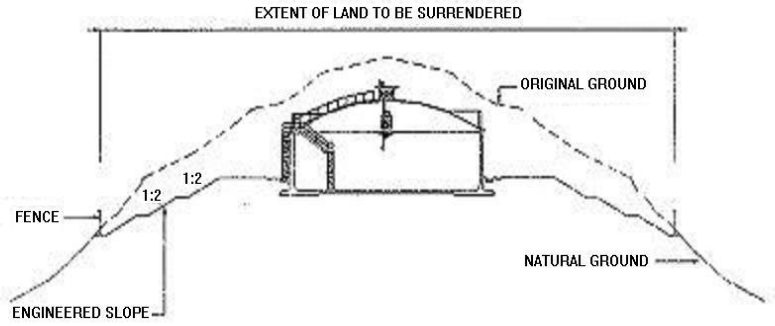
a. The WDL shall be consulted on the need for allocating land areas to accommodate a service reservoir and / or suction cistern and pumping stations within a development. Each WDL shall establish appropriate criteria for determining whether a service reservoir is required to be constructed within a development area. This information should be made readily available to a developer so that the latter can plan for allocating appropriate reserves to accommodate reservoirs, suction cisterns and pump stations in their development land use plans that are submitted to the Local Authority for application for a Planning Permission.

b. Sites for service reservoirs, pumping stations and suction cisterns shall be located at:-

- In the case of service reservoirs, they are to be positioned at lots capable of serving all premises within a single development area; or a number of discrete developments in the case of a centralized service reservoir.
- Level ground and not on slopes.
- Preferably within rectangular shaped lots.

c. Dedicated access shall be provided to service reservoirs, suction cisterns or pumping station sites.

All engineered slopes shall be designed so as to be located within the designated lot for a service reservoir, suction cistern or pumping station for ease of care and maintenance. This requirement shall also be applicable to natural slopes which are to be modified to create the platform for a particular facility. The responsibility for the safe design of engineered slopes, *and / or* modifications to existing slopes, shall lie with a competent person who in this case shall be a Professional Engineer (PE) experienced in the analysis and design of geotechnical works. The competent person designing such slopes shall take into consideration the long-term stability of the slopes, and shall also specify the frequency of slope inspections to be carried out taking into account weather conditions and surrounding land use.



d. Where extreme topographical conditions prevail within a development area, such as platform levels being greater than 30m in elevation, pressure zoning of distribution areas according to ground elevations may be necessary. Pressure reducing valves may be employed to connect high pressure to low pressure distribution zones; however their usage should preferably be restricted to within 20% of the maximum allowable pressure. The alternative concept of employing low level and high level service reservoirs to serve high and low pressure distribution zones respectively should also be considered. A decision on the best alternative system to adopt should be based on a life cycle cost analysis for the Certifying Agency's consideration.

B.1.2.2 **Land Reserves**

Land reserves required to accommodate service reservoirs, pumping stations and suction cisterns shall be adequately sized to provide for vehicular access, building setbacks and to allow for inspection and maintenance of the facilities. Reserves to be demarcated in Landuse Plans shall be based on relevant indicative areas specified in **Tables B.2**, **B.3, B.4** and **B.5**.

Table B.2 : Minimum site dimensions for the combination of suction cistern, pumping station and service reservoir

Water Demand (l/d)	Site Dimension (Minimum)
< 227,000	23 m x 54 m
227,001 – 454,000	27 m x 59 m
454,001 – 680,000	32 m x 63 m
680,001 – 900,000	32 m x 63 m
900,001 – 1,135,000	32 m x 68 m
1,135,001 – 2,270,000	36 m x 81 m
2,270,001 – 3,405,000	41 m x 90 m
3,405,001 – 6,810,000	45 m x 104 m
6,810,001 – 13,620,000	50 m x 130 m
>13,620,000	To be determined by Commission but subject to a minimum of 50 m x 150 m

Notes: Dimensions in the above table exclude areas of office, storeroom, toilet and quarters.

Table B.3: Minimum site dimension for construction of suction cistern and pumping station

Water Demand (l/d)	Site Dimension (Minimum)
< 227,000	18 m x 23 m
227,001 – 454,000	23 m x 27 m
454,001 – 680,000	23 m x 27 m
680,001 – 900,000	27 m x 32 m
900,001 – 1,135,000	32 m x 36 m
1,135,001 – 2,270,000	36 m x 41 m
2,270,001 – 3,405,000	41 m x 50 m
3,405,001 – 6,810,000	54 m x 59 m
6,810,001 – 13,620,000	68 m x 72 m
>13,620,000	To be approved by Commission but subject to a minimum of 81 m x 88 m

Note: Dimensions in the above table exclude areas for office, storeroom, toilet and quarters.

Table B.4 : Minimum site dimensions for service reservoir (square footprint)

Reservoir Capacity	Site Dimension (Minimum) in metres	
	Ground Reservoir	Elevated Reservoir
< 227,000	19 x 19	25 x 25
227,001 – 454,000	22 x 22	28 x 28
454,001 – 680,000	24 x 24	30 x 30
680,001 – 900,000	26 x 26	32 x 32
900,001 – 1,135,000	28 x 28	34 x 34
1,135,001 – 2,270,000	30 x 30	36 x 36
2,270,001 – 3,405,000	34 x 34	44 x 44
3,405,001 – 6,810,000	44 x 44	55 x 55
6,810,001 – 13,620,000	57 x 57	71 x 71
>13,620,000	Subject to setback 6.0 m (min) from edge of structural foundation for a ground reservoir and 9.0 m (min) for an elevated reservoir structure.	

Table B.5 : Minimum site dimensions for service reservoir (circular footprint)

Reservoir Capacity	Site Dimension (Minimum) in metres	
	Ground Reservoir	Elevated Reservoir
< 227,000	20 x 20	26 x 26
227,001 – 454,000	23 x 23	29 x 29
454,001 – 680,000	26 x 26	32 x 32
680,001 – 900,000	27 x 27	34 x 34
900,001 – 1,135,000	29 x 29	35 x 35
1,135,001 – 2,270,000	33 x 33	42 x 42
2,270,001 – 3,405,000	37 x 37	48 x 48
3,405,001 – 6,810,000	49 x 49	60 x 60
6,810,001 – 13,620,000	68 x 68	77 x 77
>13,620,000	Subject to setback 6.0 m (min) from edge of structural foundation for a ground reservoir and 9.0 m (min) for an elevated reservoir structure.	

B.1.2.3 **Additional Information**

If during the Planning Permission (PP) approval process, the Commission requires more information pertaining to a development, the Competent Person shall submit the following information, viz:

- Key Plan, Location Plan and Layout Plan
- Coordinates and bearings of the development boundaries
- Proper demarcation of the total development area, together with types and numbers of physical development units
- Contour plan, based on Survey Department's datum
- Location of Service Reservoir and Pumping Stations, and Access Roads, if applicable

B.1.3 **Application for Source of Water Supply**

Owners of individual premises and Developers shall engage a competent person to prepare documents to be submitted to the WDL for application for a water supply source. This exercise shall be performed once a Planning Permission has been obtained from the Local Authority. Documents and information to be provided together with the submission include:

- Copy of Planning Permission, together with the approved development layout plan from the Local Authority;

- Certified copy of competent person's appointment letter to perform as a consulting engineer for the developer/owner;

- Three (3) sets of Key Plan and Location Plan;

- Three (3) sets of Site Plan, of appropriate scale, indicating existing and proposed reticulation mains, service reservoirs, suction cistern and pumping

stations (if applicable), lot numbers (where available), number and type of premises and prominent landmarks;

- Three (3) sets of Layout Plan indicating proposed development platforms (in metres ODL);

- Water Demand and total water supply estimations (Refer to **Table B.1**).

All plans and drawings shall be in A1 size.

Applications shall be submitted to the appropriate WDL's office in the format presented in **Appendix B**.

B.2 CONCEPTUAL DESIGN SUBMISSIONS

B.2.1 Submission Criteria

Two sets of conceptual design documents outlining the proposed external reticulation system are required to be submitted to the Certifying Agency by a competent person for approval if:

- The total daily water demand for a development is greater than 4.5 million litres per day;

- The network system is to be developed in phases;

- Water Pumping Stations are to be located within the development;

- On-site service reservoirs are to be placed within the development.

B.2.1.1 External Reticulation Network *System*

This system shall be planned, designed and constructed by the developer. A competent person shall be engaged by the developer to be responsible for the concept design. The required information shall be provided in a Design Concept Report whose contents shall include:

- General description of the Development;

- Overall Layout Plan together with landuse profiles and physical development profiles and indicating clearly the phasing of development;

- Planned schedule for phased development;

- Daily water demand estimates, according to the phases of development, summarised in tabular form; and indicating timing of water supply requirements;

- General description of external reticulation network and related plans indicating nodal and pipe data;

- Hydraulic calculations for the overall external reticulation system concept;

All plans and drawings shall be submitted in A1 size.

B.2.1.2 Service Reservoirs, Pumping Stations and Suction Cisterns

These facilities shall normally be planned by the developer, unless otherwise instructed by the WDL. The developer shall co-ordinate and manage the design, construction and commissioning of facilities as detailed in **Part A** of the Uniform Technical Guidelines.

The WDL may undertake the design, construction and testing and commissioning of *common* supply mains and centralized service reservoirs to supply water to *more than one* development area.

In all cases a competent person shall be engaged by either the WDL, or a developer, to prepare conceptual designs for the respective facilities to serve water supply areas.

The competent person shall submit the following information to the Certifying Agency for approval:

General

- Key and Location Plans for each type of facility, including lot details (where applicable) demarcated on a representative revenue sheet/cadastral map.
- Surrounding land use profile.
- Site Plan indicating 5 metre contour levels (ODL) within and external to the principal lot.
- Access provisions to the facility and internal road systems.
- Basic earthwork plans for the facility site.
- Storm drainage systems within facility site and connection with external drain system.
- Principal external lighting arrangements.
- Control Systems, including telemetry.

Service Reservoir

- Type, size and material of construction of service reservoirs.
- Schematic drawings of piping arrangements located within the reservoir site (indicating inlet/outlet pipes and valves); and those to be positioned inside of the facility.
- Inlet, outlet, scour and overflow provisions for the reservoir, including access and drainage provisions for inspections, cleaning and repair of the reservoir.
- Top Water Level and Bottom Water Level details.

- Surveillance and security facilities.
- Control systems for the reservoirs.
- Plan and sections of reservoir and associated piping concepts.

Pumping Stations and Suction Cisterns

- Location and Site Plans of proposed pumping stations showing layout of earthworks planning, suction cisterns and basic infrastructural elements.
- Layout plan showing arrangements of pump sets and associated piping systems (suction pumping, header, delivery mains).
- Sectional and elevation views of the pumping station.
- Plan and sections of suction cistern and associated piping concepts including valves.
- Ventilation proposals.
- Mechanical and electrical installations.

Common and Dedicated Supply Mains

- Key and location plans.
- Location and details of tapping into public mains.
- Hydraulic profiles along the supply mains.
- Interfacing with pipelines within service reservoir sites, and for connection directly to a Development's external reticulation system.
- Location of scour and air valves.

B.3 DETAILED DESIGN SUBMISSIONS

B.3.1 General and Particular Submissions

Information submitted to the Commission / Certifying Agency shall cover civil, hydraulic, earthworks, structural, geotechnical, drainage, mechanical, electrical and telemetry system designs pertaining to external reticulation systems and associated appurtenances, service reservoirs, supply mains, pumping stations and storage cisterns and access roads where required. The submissions for mechanical and electrical works, and instrumentation and control systems, are described in **Parts D, E and F** of these Uniform Technical Guidelines respectively.

In addition to the three (3) sets of A1 size drawings, the submissions shall be accompanied by two (2) sets of a Detailed Design Report and a copy of Standard Technical Specifications that are to be applied. Where standard specifications issued or recognized by Commission / Certifying Agency are adopted, copies of these need not be submitted.

Drawings shall be submitted in AutoCad format and shall include one (1) compact disc containing electronic (soft) copy of all related drawings and calculations in word format.

Drawings, calculations and works specifications shall be endorsed by a competent person that is appointed by the owner, developer or WDL (in the case of the design of *common* supply mains and centralized service reservoirs only). Confirmation of appointment of the competent person shall be submitted to the Commission / Certifying Agency.

Basic information that should be supplied to the Commission / Certifying Agency includes:

- Definitions of standard symbols used in the Drawings.
- Layout plans for the external reticulation system, and its primary appurtenances.
- Layout plans and sectional details for pumping stations and associated suction cisterns.
- Layout plan and sectional details for Service Reservoirs.
- Plan and profile of supply mains.
- Copies of approval letters from the WDL relating to source of supply, and from the Commission / Certifying Agency with respect to conceptual designs.
- Standard Drawings other than those issued by the Commission / Certifying Agency.
- Hydraulic calculations pertaining to supply mains, pumping mains and reticulation networks.

The Detailed Design Report shall present the final criteria employed for hydraulic, civil, structural, geotechnical, road, drainage, mechanical, electrical and instrumentation designs.

All design submissions including layout plans for civil works, mechanical and electrical (M&E) and instrumentation systems can be submitted together to the Commission / Certifying Agency for approval.

For communication pipelines, the Competent Person shall submit location details of the tapping point, and the size and material of the approved public mains to which the communication pipes is to be connected. Furthermore the general layout and profile of the communication pipes, ferrule, valves and meter stands shall be provided. Submissions to the Commission / Certifying Agency shall comprise of three (3) sets of A1 size drawings, two (2) sets of a Design Report and a copy of Technical Specifications.

B.3.2 External Reticulation Networks

The technical submission for **external reticulation networks** shall comprise of the following as a minimum requirement:

- An outline description of the external reticulation system that is proposed to be implemented for a particular phase of development.
- Water demand table showing the types of development, corresponding number of units per development type, unit water demand rates for each type of development, and the sectoral and cumulative daily water demands.
- Calculations of external reticulation pipe design catering for peak flow, and for fire flow and average flow conditions.
- Justification for the selection of type of class of pipe based on imposed loads of backfill, depth of cover, pipe strength and bedding details.
- Detailed pipe layout plans pertaining to the external reticulation system that are coloured according to types and sizes of pipes.
- Hydraulic calculations for the reticulation system shall include the following information:

Pipe Details

Pipe No.	From Node	To Node	Length (m)	Dia. (mm)	HWC	HL (m)	HL/1000	Velocity (m/s)

Node Details

Node No.	Flow (l/s)	Elev (m.ODL)	HGL (m.ODL)	HSL (m.ODL)	Residual Pressure (m)

Where: -

HWC = Hazen William Coefficient
HL = Head Loss
HGL = Hydraulic Grade Line
HSL = Highest Supply Level

B.3.3 Service Reservoirs and Suction Cisterns

The detailed technical submissions for **service reservoirs** and **suction cisterns** shall include:

- Reservoir Location Plan.
- Justification for type and size of service reservoir including material selection and setting of Bottom Water Level (BWL) and Top Water Level (TWL).

- Detailed layout plan of reservoir or suction tank showing location, side views, top and sectional views, details of levels, incoming water pipe, outgoing water pipe, overflow and scour pipes, valve locations, level indicator, ventilation system, walk-up stairs, security fencing and water sampling stations.

- Structural design including the design calculations and design criteria for suction tank or service reservoir endorsed by the competent person.

- Design calculations to support layout and details of storm water drain size and *the* type *of* overflow or scour systems, and other drainage facilities that will be employed to evacuate excess waters from the reservoir site for discharge to an external main drain system.

- Design check to verify capability of external main drain system to accommodate evacuation of excess water from the facility site.

- Calculation and sizing of scour pipe for the reservoir or suction cistern.

- Detailed drawings for the proposed access road.

- Schematic drawings and telemetry components and overall system.

B.3.4 **Supply Mains**

- Brief description of proposed water source, location of tapping point and safe water pressure, as determined by the WDL, at the tapping point.

- Pipeline route from proposed tapping point to service reservoir / suction cistern. The A3 size (1:1,500 scale) drawings should also include information on the Top Water Level (TWL) and Bottom Water Level (BWL) and size of mains. Longitudinal sections shall be in scale of 1:1,000 (vertical) and 1:1,000 (horizontal).

- Location of all isolation, scour and air valves along the supply mains.

- Description of valve chambers, thrust blocks and drain and culvert crossings.

- Overall and phased water demand in tabulated form.

- Hydraulic calculations indicating available pressure along the pipeline route based on the pipeline conveying a peak flow equivalent to 1.2 times the estimated daily water demand.

B.3.5 **Pumping Stations**

The detailed technical submissions for pumping stations shall include:

- Location plan for the pumping station.

- Access roads and internal roads within site including parking bays if relevant.

- Floor plan, side and sectional views including all relevant reduced levels of pumping station showing the pump locations, arrangement of pumping system including suction pipe from suction cistern to pumps, pumping mains, pipe fittings, pipe trenches, motor, switchboard, surge suppression system and details of levels.

- Detailed drawing showing the supports and foundation arrangements for pump sets with base plate dimensions and the positions of all foundation bolts and pipe connection, chequered plate and all necessary information for a complete design.

- Design for storm drainage and connection to an external main drain; and design check to verify main drain system to accommodate storm flows from facility site.

- Schematic diagrams of telemetry components and systems.

B.3.6 Geotechnical Submissions Pertaining to Service Reservoirs and Pumping Stations

a. Design Proposals

The competent person shall perform and submit a detailed analysis of all major systems and/or structural components that are proposed for the project, including geotechnical and foundation components. Aspects of design and construction that depend on the subsoil and on groundwater conditions shall be reviewed and approved by a professional geotechnical engineer.

Each design proposal shall include but shall not be limited to the following submittals:

- **Site Investigation Report**

The Competent Person shall properly plan and specify the scope of site investigations to be carried out for the works after a desk study and site reconnaissance, including reviewing all available information pertaining to the site and adjacent areas. The methods of site investigation, and sampling for laboratory tests, must be adequately specified, and take into account the type of development to be undertaken and the prevailing ground conditions. Guidance for site investigations shall be as per MS 2038:2006 or any subsequent revisions to the standard, and in accordance with Circular No. 4/2005 entitled “Engineer’s Responsibility for Subsurface Investigation” issued by Board of Engineers, Malaysia.

- **Geotechnical Interpretative Report,** which shall contain:

  - References to desk study, factual and interpretative reports, and any other contractual document relating to the project.

  - An interpretation of the site geology including description of site and its surroundings and clearly indicating the subsoil, ground water and foundation conditions and flood plain elevations, etc.

- Engineering interpretation of the implications of ground conditions on the development of facilities identified in this sub-section.

- **Geotechnical Design Report,** which shall furnish:

  - Assumptions, data and methods of verifying the safety and serviceability of the geotechnical work (e.g. method of calculation).

  - Design values of soil and rock properties, including any necessary explanation for their selection.

  - Statements on any codes, design guides and standards used.

  - Engineering calculations for:

    - Shallow and/or deep foundations including bearing capacity calculations and settlement predictions.
    - Slope stability analysis including stabilization measures, if any.
    - Earth retaining structures.
    - Other geotechnical works including excavation support systems, ground improvement works, etc.

- Recommendations for slope stabilization and protection works, maintenance measures, earth-retaining structures and other geotechnical considerations.

- Engineering Plans, Drawings and Specifications which must be prepared, endorsed and signed by the Competent Person.

- Further testing requirements for design validation where necessary.

- Details of potential construction impacts such as anticipated loading and any imposed deformations.

B.4 DESIGN CRITERIA

The following design criteria shall be employed to prepare detailed designs of external reticulation and supply main pipelines, reservoirs and pumping stations; and for geotechnical related designs associated with these facilities.

B.4.1 External Reticulation Networks and Supply Mains

A. General Requirements for Pipeline Routing

The design of pipelines within an external reticulation system, or associated with supply mains, shall take into consideration the following factors:

- The selection of pipeline routes external to built-up areas shall take into consideration the cost of securing way leaves, as well as the difficulty of construction in rocky, waterlogged or compressible ground.

- Desk studies, surveys and site investigations shall be carried out to obtain adequate information concerning existing utilities lying adjacent to, or crossing, the line of the planned water pipeline trench. The sizes, locations and alignments of such utilities shall be inventorised. The same principle shall be employed when deciding on the routing of pipelines, and for the design and construction of trenching works

- Routing of supply mains and external reticulation networks shall be kept as far away as possible from the crest or toe of an engineered slope or retaining structure, especially if trench excavation is required. As a general rule, water-carrying buried pipelines should not be placed within a slope. Pipelines shall be located a minimum horizontal distance from the slope crest which is equal to the vertical height of the slope. If this condition cannot be met, measures shall be implemented to minimize possible adverse effects of leakage on slope stability.

- The pipes shall be buried with a minimum depth of cover of 1.0 meter measured above the crown of the pipe. The trench above the pipe shall be well compacted with suitable backfill materials, and all pipes shall be able to withstand the expected design traffic loads taking into consideration the standard of pipe bedding selected, as detailed in the **Standard Drawing No. SPAN/WS/STD/F/001.** If the minimum depth of cover cannot be achieved, additional measures to protect the pipe from damage due to traffic loads shall be incorporated in the design; such as employing steel pipe sleeves or other measures acceptable to the Commission / Certifying Agency. The top of the pipe sleeve shall not penetrate into the road sub-grade layer.

- Under all circumstances, water pipes shall not be laid below sewers. A minimum vertical clearance of 1.0 m shall be provided between the crown of a sewer pipe and the bottom of a water pipe. The horizontal clearance between sewer and water pipelines shall be 3.0 m where applicable. Also, where applicable, water pipes shall be installed on the opposite side of road carriageways or shoulders in relation to sewers installed along the same road.

- The pipes shall be laid a minimum of 600mm away from any other utilities, and also from drains.

- All pipes shall be laid at locations which are readily accessible for carrying out maintenance works; and where the repair and rehabilitation works can be carried out economically. Details of pipe markers to identify location of pipeline and specials are depicted in **Drawing No. SPAN/WS/STD/F/024 and 025**.

- Pipelines shall not be laid beneath a road pavement unless so permitted by the Commission / Certifying Agency. Exceptions to this requirement include pipeline crossings at road junctions, and when laying service pipes to serve individual buildings. It is preferable for pipelines to be laid within a utility reserve.

- All supply mains of nominal diameter greater than 900mm shall be installed within a water pipeline or utility reserve to facilitate repairs and maintenance,

and to minimize damage to property of third parties in the event of a pipe burst.

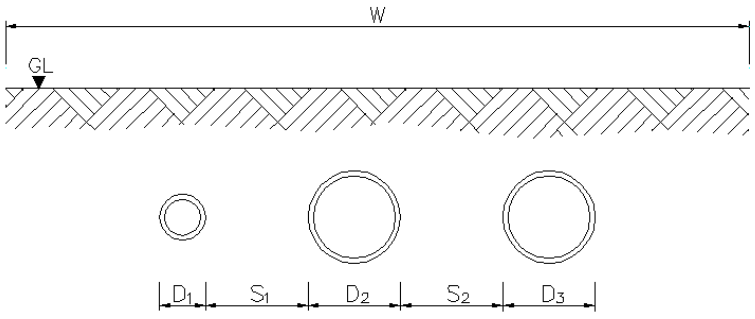
- Where the pipe is to be routed through a dedicated pipeline reserve, the width of the reserve shall allow for the access of maintenance vehicles and equipment. The width (W) of the pipeline reserve shall be determined in accordance with the following formula, but subject to a minimum width of five (5) metres:

$W = 3 + D_T + S_T$

Where D_T = Cumulative external diameter of pipes (in metres)

and S_T = Cumulative separation distance between pipes (in metres)

Notes:
1. The separation distance between any two pipes shall not be less than 1 metre.
2. $S_T = 0$ if there is only one pipe.
3. If any of the pipes are to be installed above ground, there shall be adequate space for access of maintenance vehicles on either side of the exposed pipe or pipes.
4. The reserve width shall exclude cut and fill slopes where such slopes are required. Additional land shall be provided.



In the above illustration, $D_T = D_1 + D_2 + D_3$
and $S_T = S_1 + S_2$

- All specials along the pipeline shall be suitably anchored to maintain stability against hydraulic forces. Typical details of thrust and anchor blocks to support bends, tees, end caps and reduces are depicted in **Drawing Nos. SPAN/WS/STD/F/010 to 012**.

- Hydrant pipelines shall be installed separately from water pipelines within the confines of any area accommodating apartments / condominiums, factories, office and commercial complexes, institutional buildings and schools. Separate water meters shall be provided for hydrant and domestic pipelines.

- All supply mains and external reticulation system pipelines shall cross above culverts with a minimum vertical clearance of 300mm from the top of the culvert, and where this is not possible, the crossing shall be by means of an "S-bend" configuration as depicted in **Drawing No. SPAN/WS/STD/F/018 to 020**. Typical drawings for different span lengths and crossing conditions are also depicted in the same referenced drawing.

  Pipe crossings can also be routed below the river or stream invert level, provided a suitable minimum clearance between the river / stream invert and the soffit of the pipeline structure is integrated into the design. Pipelines crossing beneath rivers / streams shall be surrounded by a concrete encasement. Jabatan Pengairan and Saliran shall be consulted when pipeline crossings are located below river beds and drainage structures before the Commission / *Certifying Agency* approves the pipeline crossings.

B. Pipe Materials

Pipe materials for supply mains and external reticulation pipelines shall be selected based on laying conditions, i.e. whether in corrosive soils or otherwise; under different terrain conditions; or if subjected to traffic loadings or not. The following Tables summarize the type of allowable pipe materials under different laying conditions:

Table B.6.1 : Materials for supply mains (without tapping)

Laying Conditions	Pipe Material
Non- corrosive soil	- Mild Steel (note 1) - Ductile Iron (note 2) - HDPE - ABS - GRP
Corrosive soil / coastal area	- HDPE - ABS - GRP - Ductile Iron (note 2)

Table B.6.2 : Materials for pumping mains

Laying Conditions	Pipe Material
Under roadways	- Mild Steel (note 1) - Ductile Iron (note 2) - HDPE, ABS, GRP with RC pipe sleeve
All pumping mains in undulating and sloping/hilly areas	- Mild Steel (note 1) - Ductile Iron (note 2)

Notes: -

1. Mild Steel pipe shall be internally lined with cement mortar / concrete and externally coated with bitumen. However, cathodic protection could be considered if the need arises.
2. The joints of Ductile Iron pipes shall be push-in type complete with or without tie bars depending on site conditions or flanged type. For corrosive soils DI pipes shall be PE wrapped.
3. All HDPE pipes shall be rated at PN12.5 and above; whilst uPVC and ABS pipes shall be rated at PN12 and above.
4. All pipes shall be registered by the Commission.
5. All pipeworks shall be as per Specifications approved by the Commission.
6. For the list of registered materials/manufacturers, please refer to www.span.gov.my.

Table B.6.3 : Materials for external reticulation pipelines

Laying Conditions/Location	Pipe Material
Corrosive soil, coastal area, ex-mining land, etc.	- HDPE - ABS - GRP - Ductile Iron (note 2) - Mild Steel (note 1) - uPVC (note 6)
Fully industrial areas	- Ductile Iron (note 2) - Mild Steel
Residential Area, flats, condominium and mixed developments, commercial and shop houses	- HDPE - ABS - GRP - Ductile Iron (note 2) - Mild Steel - uPVC (note 6)
Under roadways	- Mild Steel (note 1) - Ductile Iron - HDPE, ABS, uPVC and GRP with RC pipe sleeve

Notes: -

1. Mild Steel pipe shall be internally lined with cement mortar / concrete and externally coated with bitumen. However, cathodic protection could be considered if the need arises. Details of mild steel bends and tapers are depicted in **Drawing No. SPAN/WS/STD/F/015 and 017**.
2. The joints of Ductile Iron pipes shall be push-in type complete with or without tie bars depending on site conditions or flanged type (Refer to **Drawing No. SPAN/WS/STD/F/016**).
3. All HDPE pipes shall be PN12.5 and above; and uPVC pipes shall be rated at PN12 and above.
4. All pipes shall be approved by the Commission.
5. All pipe works shall be as per Specifications registered by the Commission.
6. UPVC pipes of nominal diameter up to 65mm shall be of PN15; for nominal diameter from 80mm to 300mm the pressure rating shall be PN12.5. Use of uPVC pipes is limited to a nominal diameter not greater than 300mm.
7. The use of uPVC is not allowed under the roadways subjected to traffic loads but may be considered under pedestrian walkways.
8. For the list of registered materials/manufacturers, please refer to www.span.gov.my.

The Commission shall have the right to decide on the final selection of pipe materials for different applications.

C. Hydraulic Requirements

The design of an external reticulation system and supply mains shall comply with the following boundary conditions, viz:

(i) convey peak flows in external reticulation networks (i.e. 2.5 times the average daily demand flow) and supply mains (i.e. 1.2 times the average daily demand flow) without incurring head losses greater than **2 m/1000m for gravity flow**.

(ii) convey a combination of average and fire flows without incurring head losses of greater than 15 m/1000m within external reticulation networks.

(iii) convey flows with a velocity of not less than 0.3 m/sec in order to reduce deposition of sediments; if this condition cannot be met justifications for lower flow velocities and related implication on maintenance to be submitted to Commission / Certifying Agency for consideration.

(iv) maximum flow velocities not to exceed 2.0 m/sec. However, flow velocities *along* pumping mains located within a pump station (i.e. header system) may exceed this value.

(v) the minimum pipe size in an external reticulation network system shall be 100mm.

(vi) the following residual pressures shall be maintained within an external reticulation system:

- During peak flow conditions the minimum residual pressure at each node shall be of such magnitude as to enable water to flow directly into a storage cistern located up to 15 metres above a building platform level without the need for pumping. The discharge residual pressure at the highest supply level (HSL) shall not be lower than 7.5 metres. This shall be applicable to a development area where the source of water is drawn directly from a supply main or from a service reservoir with the hydraulic calculations based on the bottom water level (BWL).

- During combined average flow and fire flow conditions the minimum residual pressure at each node shall be maintained at 7.5 meters above the building platform level.

- All pipelines within an external reticulation system shall operate within a static pressure not exceeding 30m at all flow conditions. Subject to the approval of the Commission /Certifying Agency, pressure reducing valves shall be provided where the static pressure exceeds 30m in a pipeline.

(vii) the static pressure at any point along a supply mains shall not exceed 50 meters head.

Both the Hazen Williams and Colebrook White hydraulic formulae may be employed to assist in determining the size of a pipeline. The friction factors, i.e. 'C' value, to be employed in the Hazen William formulae are summarized in **Table B.7**.

Table B.7 : Hazen-William Coefficient C for Various Pipe Materials

Type Of Pipe	Hazen-William Coefficient, C
Ductile Iron (cement lined)	100
Steel (cement lined)	100
HDPE/ ABS/ GRP/uPVC	120

In terms of sizing pipes targeted to convey fire flows within external reticulation networks, the minimum pressures required for fire fighting shall be given due consideration. Furthermore BOMBA shall be consulted with respect to fire flow requirements, and location and type of hydrants to be installed.

D. Valves

- For external reticulation network systems, isolating valves shall be provided at all junctions/ branches of pipelines. Isolating valves are to be judiciously placed within the external reticulation system in order to segregate the system into smaller zones for a number of purposes including achieving greater control over the distribution of water; for leakage detection and control purposes; for water quality monitoring; and for containment of a problem (such as pipe breakages) to small areas of the system so that supply to the entire network system is not compromised.

- All isolating/regulating valves shall be (a) of the flanged ended sluice type for pipe diameters less than 400mm; and (b) of the flange ended butterfly type for pipe diameters of 450 mm and above (Refer to **Drawing No. SPAN/WS/STD/F/004**). In-line valves located along supply mains shall be installed at intervals between 500m to 2000m and at every off-take point. Standard details of typical sluice valve chambers of different sizes are depicted in **Drawing No. SPAN/WS/STD/F/002**.

- The size of isolating valves shall be at least the size of the pipeline. However for pipe diameters 900 mm and above, the isolating valve can be one size smaller than the main pipe size.

- All pipe dead ends shall be connected to either a full-bore scour valve housed in an appropriate RC chamber, or to a pillar hydrant (Refer to **Drawing No. SPAN/WS/STD/F/023** for pillar hydrant details). Drained flows shall be conveniently discharged to streams or to surface drainage systems and shall take due consideration of the carrying capacity of the external drainage system.

- Scour valve locations and sizes shall be designed such that the pipelines can be drained of water within three (3) hours. Full bore scour valves shall be provided for an external reticulation system, and shall be of the flange ended sluice type. Recommended sizes of scour valves are indicated in **Table B.8**.

Table B.8 : Scour Valve Sizes

Pipe Size (mm)	Recommended Scour Valve Size (mm)
150 – 400	100
450 – 550	150
600 – 750	200
800 – 1000	250
1050 – 1200	300
1300 and above	450

Note : All scour valves shall be flange ended**.**

- Full bore scour valves shall be provided for supply mains at not greater than 5 km apart, and at low points near to streams/rivers/main drains. Discharge to these water courses shall be subject to the river/drain capacity. A self cleansing velocity of greater than 0.6 m/s shall be achieved during drain-off conditions.

- Scour valves shall be housed within a purpose fit chamber and placed at locations that are readily accessible for examination, repair and placement. Detail of a scour valve system complete with associated valve chamber is depicted in **Drawing No. SPAN/WS/STD/F /003**.

- Air valves shall as a minimum be provided at all peak points along a pipeline profile and where there are significant negative changes in pipeline gradient. Typical details of various types and sizes and layout of air valves are depicted in **Drawing No. SPAN/WS/STD/F/005**.

- For external reticulation pipelines with diameter of 200 mm and below, air insertion points shall be provided not greater than 1 km apart. The air valve shall be of the double orifice type incorporating a flange ended isolating valve. Sizes of the air valve required shall be in accordance with **Table B.9**.

Table B.9 : External Reticulation System Air Valve Sizes

Pipe Size (mm)	Air Valve Size (mm)
150 - 300	50
350 - 550	80
600 - 800	100
850 - 1200	150
1300 and above	200

Note : All air valves shall be double orifice type incorporating a flange ended isolating valve

- Constant flow valves may be installed on a service pipe discharging to the suction cistern located at factories, condominiums or apartments and at offices so as to limit the flow rate at levels sufficient to fill the suction tanks within a twenty hour period, whenever the residual head at the inlet of the cistern exceeds 15 meters; and at industrial establishments (if warranted by the WDL). The competent person shall submit the characteristic curve/chart of the constant flow valve to the Commission / Certifying Agency for approval.

- All valve chambers shall be covered by suitable lockable covers. Details of different types of covers are depicted in **Drawing Nos. SPAN/WS/STD/F/006 to 007**.

- Pipeline segments should be adequately jointed in order to prevent leakage, to maintain stability and to ensure integrity of the pipelines basic functions. Different permitted type of joints for various pipe materials are depicted in **Drawing Nos. SPAN/WS/STD/F/013 to 014**.

E. Water Sampling Stations (for new development areas)

- For new development areas, a water sampling station, incorporating a pressure gauge, shall be provided at every service reservoir or suction cistern outlet. A typical design of a water sampling station is depicted in **Drawing No. SPAN/WS/STD/F/008**. For safety reasons the door of the Station enclosure shall not face the road. The Ministry of Health shall be consulted on the numbers and location of water sampling stations to be provided within a defined external reticulation network system serving a specific development. As a general rule the number of water sampling stations required shall be in accordance with the criteria specified in **Table B.10**.

Table B.10 : Number of Water sampling stations required within an external reticulation system

Number of Connections (No.)	No. of Water Sampling Station
Below 300	Not Required
301 – 1,000	1
1,001 and above	Additional 1 no. of sampling station for every 1,000 connections

Note: Ministry of Health to be consulted on the appropriateness of the above criteria

F. District Meter Zones

- A District Meter Zone (DMZ) facility may be installed at the discretion of the WDL within an external reticulation system serving a particular development. The Water Distribution Licensee shall be responsible for determining whether a DMZ should be implemented within a Development Area based on a macro assessment of water metering systems within a larger or regional water distribution network system. The locations of DMZ within a particular development shall be decided

by the Water Distribution Licensee. DMZ facilities shall be constructed by the WDL.

- Typical plan and sections of a district flow meter facility is reproduced in **Drawing No. SPAN/WS/STD/F/009** Typical diameters for various sizes of DMZ are also displayed in this referred drawing.

B.4.2 Service Reservoirs

A. Storage Capacity

- A service reservoir shall be designed to store or contain within its storage compartment a maximum volume of water equivalent to a cumulative day's estimated total water demand from all types of premises located within its demarcated service area. The service area could either be a single development area or a number of development areas receiving water only from one reservoir. Estimation of stored water volume shall be based on the unit water demand rates pertaining to specific premise types (**Table B.1**), and the total numbers of each premise type located within the reservoir service area.

B. Hydraulic Requirements

- Design of external reticulation systems supplied from an service reservoir shall be based on (a) the reservoir's BWL, and (b) the minimum residual pressure available at the HSL of a premise shall be a minimum of 7.5 m.

- The following residual pressure requirements shall be satisfied at the service reservoir:

  - Minimum residual pressure at reservoir/ tank's Top Water Level (TWL) shall not be less than 4.5m, where the connection source of incoming main has no connection to any other reticulation main.
  - Minimum residual pressure at reservoir/ tank's Top Water Level (TWL) shall not be less than 7.5 m where the incoming main has direct connection to reticulation pipe.
  - Maximum residual pressure above HSL at any case shall not exceed 15 m for a gravity fed reservoirs/ tanks and 5 m for pumping fed reservoirs/ tanks.

- Reservoirs with storage capacities above 5 million litres shall be provided with compartments.

- Reservoirs shall be designed to permit the ingress and egress of air as the water level falls and rises. Appropriate ventilation systems shall be screened by non-corrosive mesh to prevent intrusion by insects, small animals, etc.

- There shall be proper circulation within reservoirs and suction cisterns. Inlets and outlets shall be located at the far side of each other. Inlets shall be placed at an angle to promote circulation.

- Outlets shall be designed in order to prevent pick up of sediments accumulated within the reservoir.

C. Boundary Setback

- Setbacks from the edge of structural foundations to the facility's boundary shall be flat all-round and shall be at least 6.0 m for ground reservoirs, suction cisterns and pumping station structures, and 9.0 m for elevated reservoirs. Minimum distance between two (2) structures shall be 3.0 m.

- Subject to the minimum setback condition as specified above, the competent person shall determine the distance between service reservoir and the toe or crest of a slope.

D. Materials and Measures

- All materials used in the construction of an service reservoir shall conform to those registered with the Commission.

- Service reservoirs and suction cisterns shall preferably be constructed from reinforced concrete. However, service reservoirs of other materials may be used in special cases such as where there are constraints in the available size or shape of the land, or when the reservoir needs to be completed within a short duration. The Commission/Certifying Agency shall have the right to decide on the final selection of reservoir construction materials for different applications.

- Service reservoirs with a capacity of more than 454,000 litres should be of reinforced concrete or of other materials registered with the Commission.

- Elevated service reservoirs of the reinforced concrete type, or storage cisterns, shall be limited to capacities of less than 4.54 million litres. The allowable capacity of elevated service reservoirs constructed from other materials shall be determined by the Commission.

- The effective water depth in service reservoirs built from reinforced concrete shall be limited to five (5) metres for capacities of less than 4.54 million litres, or seven (7) metres for capacities of 4.54 million litres and above. The water depth for non-reinforced concrete service reservoirs or storage cisterns shall not be more than five (5) metres.

- Inspection gallery with access door shall be provided for ground reservoirs of 4.54 million litres capacity, or more.

E. Pipelines located inside of Service Reservoirs and Storage Cisterns

- All pipes installed within service reservoirs or storage cisterns shall either be of stainless steel or ductile iron and coated with suitable anti-corrosion paint system or other materials as approved by the Commission.

- All vertical pipes shall be anchored and supported with stainless steel brackets and bolts and nut bolted into the wall of the reservoir.

- Overflow pipes shall be at least one size larger than the inlet pipe diameter.

- The scour pipe shall be designed to empty the full capacity of an service reservoir or storage cistern at least within six (6) hours.

- Generally, if water is supplied to a storage reservoir by gravity flow, the inlet pipe at the reservoir shall be of side or bottom inlet, whilst if water is supplied by forced pumping the inlet pipe shall be of top-inlet (bellmouth) type. The outlet pipe shall be of side or bottom outlet.

- Stainless steel strainer shall be installed at the outlet pipe of the reservoir or storage cistern. The invert level of outlet pipe shall be at least 150 mm above the floor of the reservoir.

F. Control Valves

- Water flowing by gravity into a suction cistern or service reservoir shall be controlled by a mechanical control valve; except in the case of pumped flows which shall be controlled by electrodes or level sensors.

- Inlet control valves shall be a one way flow full bore altitude valve complete with strainer and by-pass system installed in one common chamber, with butterfly valves introduced for isolating and by-passing water flows. This requirement is exempted when the incoming main is below 300mm and the inlet position is at the top end of a reservoir.

- By-pass pipes shall be provided and shall be of the same size as the incoming pipes.

- The altitude valve shall be of the diaphragm or piston type for sizes of less than 450 mm diameter, and only of the piston type for sizes of 450 mm diameter and above.

- The control valves shall be fitted with sluice valves/ butterfly valves for isolation and maintenance purposes.

- All valve chambers shall either be well drained, or equipped with an installed dewatering system.

G. Pipes Strainers

- All incoming mains to the suction cistern and gravity flow to service reservoirs shall be fitted with pipe strainers.
- A pipe strainer shall be fitted after the sluice valve and installed together in a common valve chamber. The size of the valve chamber shall be constructed to suit the fittings of the sluice valve and pipe strainer.
- The strainer shall be of 10 - 15 mm size of mesh stainless steel screen (net).

H. Miscellaneous

- Stairs placed external to an elevated or ground service reservoir shall be of reinforced concrete and shall be fenced complete with mild steel doors. All external walk up stairs for ground reservoirs shall have brick wall enclosure. Walk up stairs inside an service reservoir shall be of reinforced concrete or stainless steel (SS304). All walk-up stairs shall be fixed with hand railings.
- All service reservoirs or suction cisterns shall be fitted with 'Dial' type level indicators. The size of level indicator for ground type service reservoirs or cisterns, and for elevated reservoirs or cisterns shall not be less than 600 mm diameter and 900 mm diameter respectively. Only stainless steel grade cable (of tangle-free design) shall be permitted.
- Top water level, bottom water level and capacity of an service reservoir or suction cistern shall be printed on the reservoir or cistern wall.
- Water sampling stations shall be provided at every service reservoir outlet.
- All valve chambers shall protrude above the ground level by not more than 300 mm, and shall be tightly fitted with a suitable cover.
- Platform drainage, overflow drains and slope drainage shall be designed as per **Table B.11**. The type of slope drainage shall be reinforced concrete V-drain as shown in **Figure B.1**.

Table B.11 : Storm drainage system design requirements

Drain Type	Design Flow
General platform drainage	5 years ARI + check 100 years ARI
Overflow discharge drain to approved discharge point	5 years ARI + check 100 years ARI or 5 years ARI + Overflow whichever is the greater
Slope drainage	5 years ARI + check 100 years ARI

Note: ARI is an average recurrent interval

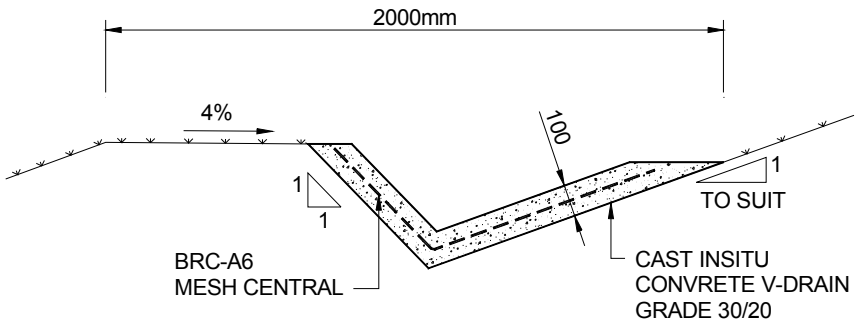


Figure B.1 : Typical Details of Slope Drainage

- Security fences for service reservoirs and/or suction cisterns and pumping stations shall be built along the boundary of the reserve (in accordance with the **Standard Drawing No. SPAN/WS/STD/035**), and the boundary shall be marked with boundary stones at 6 meter intervals.

- All level ground within an external service reservoir, suction cistern and pumping station compound shall be premixed in accordance with criteria specified in **Table B.12**.

Table B.12 : Premix road pavement structures

Pavement Structure	Thickness (mm)	
	Subject to traffic loads	Not subject to traffic loads
Road Base (crusher run)	250	150
Base / Binder Course Surfacing	60	60
Wearing Course Surfacing	40	40

- Dedicated access metalled roads servicing an service reservoir, suction cistern and pumping station site shall be at least 6 m wide with 1 m shoulder on both sides. The maximum gradient of an access road should not exceed 10%.

- Service reservoirs and cisterns shall be painted as per WDL's requirements.

- All markings on service reservoirs or suction cisterns and pumping stations shall be subject to the WDL's approval.

- All ferrous type saddles used shall have protective coating against corrosion.

- Saddles for High Density Polyethylene (HDPE) pipe should be of electro-fusion tapping.

- All bolts and nuts placed below ground shall be of stainless steel.

B.4.3 **Pumping Stations**

A. General

- Platform levels of pumping stations and suction cisterns shall be designed to be above the 100 years ARI flood level determined for the specific area in which the pumping station is located.

- Pumping stations shall be of reinforced concrete type, with non-load bearing walls constructed with bricks. Roofs may either be of reinforced concrete or be built with tiles. Roof tiles can only be used for pumping stations where the pumping capacity does not exceed 100 m^3/hr. If a roof truss is to be used, the truss shall be of the steel type.

- All pumping stations shall be equipped with toilets served by a sewerage system as approved by the Commission / Certifying Agency.

- Pumping stations with pumping capacity exceeding 50 m^3/hr shall be equipped with an office/store room.

- All windows shall be of the steel-casement type.

- Security grilles shall be provided on the inside of the pumping station windows.

- Heavy duty floor tiling shall be provided.

- Ceramic wall tiling shall be provided up to 1.5 m height.

- Pipe materials employed for suction and discharge piping, and for fittings, shall conform to **Table B.6.2**.

- Within a pumping station, pipes, valves and fittings may either be laid in trenches, as normally practiced, or otherwise. Exposed fittings shall incorporate additional features, such as working platforms, to avoid promoting obstructions inside the pumping station when operation and maintenance works are carried out.

- Where trenches are used, pipes shall be well-anchored within the trench. The minimum width of trenches shall be the size of pipe laid plus 300 mm clear spacing on either side of the pipes external wall. All trenches shall be well drained and covered with hot dipped galvanised grating or chequered plate. Trenches built below the drain level shall be provided with a pump sump and submersible pump complete with isolator point and earth leakage relay.

- All exposed pipes and fittings shall be painted as per WDL's requirements.

- Main switchboards shall be compartmentalized and located away from water pipes. Minimum clear distance between the main switchboards and an adjacent wall shall be 1.5 m.

- Minimum clear distance between two (2) pump sets shall not be less than 1.0 m.

- All pumping stations shall be provided with fire prevention and fire fighting system as per BOMBA requirements. First aid kits and safety procedures shall also be provided.

- The pumping station shall be painted and labelled as per WDL's specifications.

- Security fencing and an access gate, including guard house if required by the WDL, shall be provided as detailed in the **Standard Drawing No. SPAN/WS/STD/035**.

- For outside of designated industrial zones adequate acoustically designed pumping stations shall be provided to limit sound levels of less than 65 dB to be induced at the pump station boundary; whereas for inside of designated industrial zones shall be limited to maximum of 70 dB.

B. Pump Plinths

- Pumpsets shall be rigidly fixed in position on its foundation and shall be free from vibrations. The design of the foundation shall comply with the following criteria:

  - The pumpset foundation shall be sufficiently strong to support its load.
  - It shall be sufficiently strong and heavy for suppressing any vibrations.

- A good practice is to fix the pumpsets on concrete blocks, in reasonably good firm ground. The recommended standard heights of plinths for pumps with various power ratings are as follows:

  - 7.5 -15.0 kW : 200 mm to 250 mm
  - 15.0 -40.0 kW : 250 mm to 450 mm
  - 40.0 -55.0 kW : 450 mm to 600 mm
  - 55.0 -75.0 kW : 600 mm to 750 mm
  - 75.0 -100.0 kW : 750 mm to 1000 mm

- In practice, for pumps with power ratings above 75.0 kW, foundation plinths shall be specially designed based on the following standards:

  - For electric motor driven pumps, the weight of an independent foundation shall be at least three times more than the machine kerb weight of the pumpset.

  - When anti-vibration material such as rubber, spring etc; is placed between the common base plate (for pump and the prime mover), and the foundation, the weight of the foundation can be reduced to half of the standard weight.

  - Where any pipe of the pumping system passes through a building wall, an anti-vibration measure shall be provided to prevent the vibration from being transmitted to the building.

- Apart from depth, the size of foundation plinth shall have a minimum border of 100 mm to 150 mm all round while the top of the plinth shall be 100 mm to 150 mm above the floor. The concrete mix for the plinths shall be Grade 25.

B.4.4 **Geotechnical Considerations**

A. Foundation Design

Foundations shall be designed so that adequate bearing capacities can be mobilized within the serviceability limit states of the structure.

Where structures are located on or adjacent to slopes, due consideration shall be given to the interaction between the structure and the slope. The following criteria shall be considered:

- The influence of the adjacent slope on the bearing capacity, lateral capacity and settlement of the foundation.

- The effect the foundation will have on the stability of the slope during construction and during its working life.

B. Proximity to Existing Structures

The Competent Person shall take into consideration the proximity of existing structures when designing foundations for water supply facilities, in order to ensure that such foundations can be safely constructed.

C. Slope Stability Analysis & Design

- Slope stability analyses shall be carried out for all Class 2 and Class 3 Slopes (Refer **Table A.1**). The analyses must take into account all potential external loadings and ground water conditions.

- If initial analyses show that the stability of a proposed slope is inadequate, the Owner and Competent Person should first establish if

  the re-siting of a proposed structure or change in slope geometry (i.e. by reducing the height and/or slope gradient) is feasible, as this may be the cheapest solution. Otherwise, stability may be enhanced by provision of slope stabilization and protection measures including retaining structures, appropriate drainage systems, etc.

- Ground water levels observed during investigations do not normally represent the peak levels occurring during storm conditions. Therefore, estimation must be made as to the increase in water levels due to rainfall events or other factors such as leaking pipes. Where necessary, seepage analyses shall be carried out to determine the existing and worst credible ground water regime that shall be adopted in the design.

- For soil slopes, the analysis of its long-term stability shall be considered using effective stress parameters. The use of apparent cohesion in the calculation is not advised. If cementation is found to be present in the soil, rock mechanic principles should be adopted in the analysis.

- For newly formed slopes, the minimum factor of safety against failure shall be as follows:

  - 1.5 for normal groundwater conditions,
  - 1.4 for 10-year return period rainfall, and
  - 1.1 for worst ground water conditions.

- For slopes composed of well-graded, free-draining rock fill materials the above indicated factors of safety may not be appropriate, since these slopes are not normally subject to saturation or groundwater rise during rainfall. The Competent Person shall exercise due judgment in this respect.

- The stability of a slope may be affected by excavation for construction of foundations on or adjacent to the slope and the demolition of structures supporting the toe of slopes. These effects shall also be duly considered during design/analysis.

- Under no circumstance shall loosely placed fill material be used on slope and embankment. Fill slopes shall be designed using shear strength parameters obtained from tests on representative samples of the proposed earth fill material compacted to the specified requirements.

- For rock slopes, geological mapping and interpretation shall be carried out to analyze its stability. The potential failure modes of rock slopes such as wedge, toppling and/or plane failures shall be identified. Where necessary, appropriate rock slope stabilization measures shall be employed.

D. Slope Protection and Drainage Measures

Effective slope protection and drainage measures shall be provided to prevent erosion, limit rainfall infiltration via surface runoff, and to ensure that the ground water level will not exceed the design level. Due consideration shall be given to the following:

- Slope protection measures shall be suitably prescribed to prevent erosion and minimize rainwater infiltration. Vegetation / turfing, sprayed concrete and geosynthetic reinforcement solutions have been found to be effective in Malaysia. The Competent Person shall recommend the most optimum mitigation measures supported by appropriate analysis.

- Drains shall be provided at berms and at the crest of a slope. Where drains are used to intercept water flowing into the slope from infiltrations uphill, they shall be constructed up slope of possible failure surfaces to avoid creating tension cracks.

- Surface and subsurface drains and weep holes shall be considered on the slopes where:

  - The water bodies such as water catchment areas, sewers, drains and water mains are located above the slope.

  - The critical ground water level is uncertain or may likely exceed the adopted design value.

E. Lateral Soil Loads

For all yielding or non-yielding structural components, lateral soil loads shall be determined by using Active or Passive soil pressure conditions respectively, as indicated in the Geotechnical Design Report.

A minimum surcharge pressure equal to an additional 10 kPa shall be used for all structures adjacent to traffic loading conditions.

F. Recommended maintenance of sloped areas

- The long-term safety and stability of slopes and earth-retaining structures within and adjacent to the facility lot should be ensured by the owner, or the Local Authority/WDL if ownership of the land has been transferred to the State.

- The owner or Local Authority/WDL should implement the inspection plan for slopes to ascertain the need for maintenance of man-made items by identifying occurrences which may eventually lead to failure, such as:

  - Cracked/broken drains and concrete structures i.e. retaining walls, shotcrete surface and stone pitching.
  - Obstructions to weep-holes and drainage channels
  - Erosion and distress of slopes
  - Tension cracks at the crest of slopes

  - Heaving at toes of slopes
  - The inspection plan for slopes proposed by the Competent Person, who shall be a Professional Engineer experienced in the design of geotechnical works, should specify the frequency of inspections. Preferably slope inspection should be undertaken at least once a year; but the frequency of inspection should be increased during prolonged wet weather conditions. Where a slope failure could result in significant risk of losses to life or property, then the inspection intervals should be reduced accordingly

- Slope inspections should be carried out well before the onset of the wet season in Malaysia. Adequate time should be allowed for the construction of remedial works, if any.

- Reference may be made to CKC (2006a) and CKC (2006b) for further guidance on slope maintenance inspections works.

- All inspection records should be kept by the owner or Local Authority. Where necessary, the owner or Local Authority shall carry out works to maintain and/or restore the safety of a structure, and to prevent further deterioration.

B.4.5 **Communication Pipes**

- Pipe materials for communication pipes shall conform to the following types:

Type of Pipe	D< 100mm dia.	D ≥ 100mm dia.
Communication Pipe	Stainless Steel 304 / HDPE/ Composite Pipe as approved by the Commission.	Mild Steel lined with cement mortar / concrete and Ductile Iron lined with cement mortar / concrete

Notes: All stainless steel pipes shall be of Grade 304, except in coastal areas where Grade 316 shall be used.

- Communication pipes shall not be routed through contaminated soils, traverse along the inner faces of roadside drains, and shall not puncture through a roadside drain. Typical communication pipeline profiles are depicted in **Drawing No. SPAN/WS/STD/F/030**.

- Tap-off connection details between a communication pipe and reticulation pipelines made out of different materials is depicted in **Drawing Nos. SPAN/WS/STD /F/026 to 029**. For HDPE pipe, all joints shall be electro fusion type.

- Non-metallic & composite pipes which are laid cross drain or laid exposed shall be protected by steel pipe sleeves or by any other method permitted by the commission.

- Stop valves, including lockable types, shall be installed along the communication pipe upstream of the meter point so as to terminate flows to a premise, or to shut off flows during installation and reinstatement of meters.

- The size of the communication pipe shall be determined based on delivering a flow of 2.5 times the estimated premise average consumption rate.

B.4.6 Materials

A. All materials used in the construction of supply mains, service reservoirs, pumping stations, and external reticulation systems shall conform to those which are registered with the Commission. The Commission, CA or WDL reserves the right to inspect the materials to be used before installation. Unapproved materials/products, including those incorporated in completed works, shall be cleared from the site. Otherwise, the development will not be taken over by the WDL.

B. Approved materials for supply mains (without tapping) are as shown in **Table B.6.1**.

C. Approved materials for pumping mains are as shown in **Table B.6.2.**

Part C:

Planning and Designs of Plumbing Systems

PART C : PLANNING AND DESIGN OF PLUMBING SYSTEMS

C.1 PLUMBING SYSTEMS

The components of a plumbing system comprises of service pipes, distribution pipes, storage cisterns, feed cisterns, hot water apparatus, taps, valves, water closets, baths, sinks, wash basins, and other connected appliances that are normally installed within a building to distribute water supplied by the Water Distribution Licensee to various outlets for use by a premise owner. Schematic drawings describing the basic features of a plumbing system associated with a landed property, and with a high rise building are depicted in **Figures C.1 and C.2** respectively.

C.1.1 Rules and Regulations

a. This chapter on Plumbing Systems shall be read in conjunction with the following documents:

   i. Water Services Industry Act 2006.

   ii. Water Services Industry (Water Reticulation and Plumbing) Rules 2014.

   iii. Water Services Industry (Maintenance of Water Storage Tank in High Rise Residential Buildings and Gated Community) Rules 201X *(when the proposed subsidiaries law has enforce)*.

b. The provisions specified in the above Rules and Regulations are not necessary repeated in these Uniform Technical Guidelines.

c. Where there occurs a discrepancy between the Uniform Technical Guidelines and the above Rules and Regulations, the provisions stipulated in the Rules and Regulations shall prevail.

C.2 SUBMISSION OF PLANS

a. A competent person shall lodge one (1) set of plumbing plans of A1 size, together with one (1) no. Compact Disk containing the soft copy of the drawings in AutoCAD format, with the Local Authority and the Commission respectively. The purpose of submission is for record purposes only, and not for obtaining an approval.

   Installation and certification of plumbing systems shall be subject to the Certificate, Completion and Compliance process specified under the Uniform Building Bye Laws. This is a self regulatory process wherein the Principal Submitting Person shall design and certify plumbing systems in compliance with the Water Services Industry (Water Reticulation and Plumbing) Rules and other relevant written laws**.** A Permit Holder shall also certify construction of plumbing systems in accordance with the designs.

Plumbing plans submission shall include the following information:

i. Site plan of the Premise.

ii. Floor plan and cross sections of the building, including locating the position of meters, fittings, valves, pipeline layouts, etc.

iii. Sectional plans of building showing locations of storage cistern and pumping rooms (where applicable).

iv. Schematic diagram or single line schematic diagram of pipework layout.

v. Copy of approved letters issued by the WDL confirming permission to source water from an approved external water reticulation system, including location of tapping point.

b. Plumbing designs and drawings for buildings of 15 meters of height and below, and not equipped with pumping or central heating systems, can be submitted by either a competent person who can either be an architect, mechanical engineer, civil engineer; or by a registered building draftsman as stipulated in the second schedule of Water Services Industry (Water Reticulation and Plumbing) Rules 2014.

c. Submission of plumbing designs and drawings for buildings of above 15 meters, and which are equipped with pumping or central heating systems can be submitted by a competent person who shall be either a professional mechanical engineer.

d. All plans for fire fighting systems shall be separately submitted to BOMBA.

C.3 TECHNICAL REQUIREMENTS

C.3.1 General

a. Only Type A permit holders issued by the Commission shall be permitted to carry out plumbing works.

b. Tapping works shall only be conducted by a Type A2 permit holder.

c. Only pipes, valves, storage cisterns and other installations that have been registered by the Commission can be used.

d. Tap off to kitchen sinks shall be drawn directly from a service pipe. (Not applicable for development with central storage cisterns).

e. Draw off tap to kitchen sinks that draw water directly from service pipe shall be designed with an air gap to avoid contamination of the external water reticulation system. Such draw-off taps shall be so fixed that their outlets are at least 150 mm above the top edge of sink into which the water may discharge.

f. No draw of tap for the purpose of any activity performed within the boundary of the premises but external to building structure can be directly connected to a service pipe provided that a backflow preventer is installed between the tap and the service pipe.

g. Piping systems for domestic water supply, air conditioning, fire fighting systems and for distribution of non-potable water shall be separated from each other. No inter-connections are permitted.

h. The WDL may require a constant flow valve to be installed upstream of the meter for supply to commercial or industrial premises whose water demand exceeds 250m^3 per day.

i. Automatic flushing of urinals, other than controlled by a sensor mechanism, is not permitted.

j. Manual flushing, or a flush valve, shall be used for urinals.

k. All bolts and nuts placed below ground shall be of stainless steel.

C.3.2 Pipes and Valves

A. Pipes

a. The nominal size, type and class of pipes shall be specified in the drawings.

b. Minimum internal diameter of pipes for plumbing systems shall be 15 mm.

c. Use of Galvanized Iron (G.I.) pipes are not permitted for domestic internal plumbing systems.

d. Use of uPVC pipes shall be restricted to distribution pipes operating at low pressure heads installed within landed residential buildings only.

e. Non-metallic & composite pipes which are laid cross drain or laid exposed shall be protected by steel pipe sleeves or by any other method permitted by the commission

f. Types of pipes permitted, and their complying standards, for internal plumbing systems are described in **Table C.1**.and **Table C.2** respectively.

Table C.1 : Pipe Materials for Plumbing Systems

Type of Pipe	D< 100mm dia.	D ≥ 100mm dia.
Service Pipe (Downstream of Meter)	Stainless Steel / ABS / Polypropylene Random Co-Polymer (PPR) / Copper / Polybutelyne / Polyolefine Blend (POB) / GRP / Composite Pipe / CPVC (Chlorinated PVC) HDPE	Mild Steel / Ductile Iron / Stainless Steel / ABS / GRP / PPR / HDPE
All Pumping Mains (Pump Suction and Delivery Pipes)	Stainless Steel / Copper / Composite Pipe / Polypropylene Random Co-Polymer (PPR)	Mild Steel / Stainless Steel / Ductile Iron / Polypropylene Random Co-Polymer (PPR)
Distribution Pipe	Stainless Steel / ABS / Polypropylene Random Co-Polymer (PPR) / Copper / Polybutelyne / Composite Pipe / Polyolefine Blend (POB) / GRP / uPVC / HDPE	Mild Steel / Ductile Iron / ABS / HDPE / PPR / uPVC

Note:-

1. Only pipes registered with the Commission can be used.
2. Registered pipes and manufacturers are listed in the website of the Commission i.e. www.span.gov.my.
3. Ductile iron pipe for riser pipes shall be flange ended or push-in-jointed complete with restraint tie bars.
4. All plastic pipes shall be of PN 12 and above
5. All stainless steel pipes shall be of Grade 304, except in coastal areas where Grade 316 shall be used.

Table C.2 : Complying standards of pipes used in internal plumbing system

	Types of Pipe	Complying Standard
1.	Acrylonitrile-butadiene-styrene (ABS)	MS 1419:2007
2.	Polybutylene (PB)	MS ISO 15876- part 1,2 & 3: 2004
3.	Polyethylene (PE)	MS 1058-part 1&2: 2005 & part 3 : 2006
4.	Ductile Iron	MS 1919: 2006
5.	Copper	BS EN 1057:2006
6.	Stainless Steel	MS 1841: 2010
7.	High Density Poyethylene (HDPE)	MS 1058 Part 2:2005
8.	Unplasticised PVC (uPVC)	MS 628 : Part I 1999
9.	Polypropylene (PP)	ISO 15874:2003 (Part 1 to Part 4)
10	Chlorinated Polyvinyl Chloride (CPVC)	MS 2045:2007
11	Mild Steel Cement Line Pipe	BS 534:1990

Note: The Commission may from time to time permit other standards to be used. The Competent Person shall be responsible for adopting the latest revised or updated (version) edition of the standards listed under **Table C.2**

g. In the case of dropper pipes where the water pressure exceeds 30m head, pressure reducing valves or break cisterns shall be employed to reduce static pressures.

h. The distance between supports and hangers for different types of pipes shall be in accordance with **Section 6.1.7 (Table 12) of BS 6700:2006**.

B. Valves

a. Isolating valves (ball or stop cock type), shall be installed on:-

i. All inlet pipes to suction cisterns and shall be positioned at a minimum of **1.8 metres** above the floor level.
ii. All outlet pipes from suction cisterns, and shall be placed in an accessible position and located a maximum height of **1.8 metres** above the floor level.

iii. Scour pipes attached to storage cisterns.

b. Separate pipes shall be routed to each toilet compartment, and to fittings such as sinks, basins, water closets (WC) and urinals.

c. All valves employed in an internal plumbing system shall be made of brass, ductile iron or stainless steel. Valves made of thermoplastic materials shall not be used, except for valves of 15mm nominal diameter within landed residential premises.

d. The pressure rating of the valves used shall be adequate to withstand the operating pressure of the piping system, and also the expected pressure (1.5 times the maximum permissible working pressure) during the hydraulic pressure test of the piping system.

e. The valves used in the plumbing system shall comply with the requirements of applicable standards specified in **Table C.3**.

Table C.3 : Complying Standards for Valves

Valves	Nominal Bore (NB)	Complying Standard
Stopvalves	50mm and below	MS 1022:2005
Stopvalves	50mm and above	BS EN 1213:2001
Gate Valves	Various sizes	BS EN 12288:2003 (copper alloy valves) BS EN 1171:2002 (cast iron valves)
Butterfly Valves	100 mm and above	BS EN 593:2004
Check Valves	Various sizes	BS EN 12288:2003 (copper alloy) BE EN 12334:2001 (Cast Iron) BS EN 14341: 2006 (Steel)
Float Operated Valves	Various sizes	MS 1882:2005 BS 1212, Part 1, 2, 3,4 for valves and BS 1968 or BS 2456 for float.
Pressure Reducing Valves	Various sizes	BS EN 1567:2000

Note: The Commission may from time to time permit other recognised standards to be employed.

C.3.3 Storage Cistern Within Consumer Premises

The storage cistern within a consumer's premise serves several functions including (a) providing sufficient storage of water to safeguard against disruption of water supplies over a twenty-four hour period, (b) maintaining suitable pressures within the distribution piping system serving a building and (c) safeguarding against backflow of stored and used water to the external reticulation system. A schematic drawing illustrating the basic components of a storage cistern is depicted in **Figure C.3**.

a. Capacity

i. Generally, the effective capacity of a storage cistern (i.e. the maximum volume of water that can be drawn for use over a twenty-four hour period) shall provide for one day's water consumption needs of different types of premises. The minimum storage capacities for different types of buildings are specified in **Table C.4, Table C.5** and **Table C.6**.

Table C.4 : Minimum storage capacities for hospital, airport and particular industry

Type of Building	Minimum storage capacity for one day (liters)
Hospital	1500 / bed
Airport	25 / passenger
Heavy Industry	65000 / hectare
Medium Industry	50000 / hectare
Light Industry	33,000 / hectare
Light Industrial Workshop	1500 / unit
Wet Market	1500 / stall
Dry Market	450 / stall
Semi Detached / Bungalow / Workshops	1500 / unit

Table C.5: Minimum storage capacities for residential / shop premises

Type of Building	Minimum storage capacity for one day (liters)
Dwelling Houses (Rural)	800 / unit
Dwelling Houses And Flats With Individual Storage Cistern(Urban)	1300 / unit
Flats With Shared Storage Cistern	1000 / unit
Low Cost Houses (Rural And Urban)	800 / unit
Shop House (Single Storey) / Low Cost Shop	2000 / unit
Shop House (Double Storey)	3000 / unit
Shop House (Three Storey)	4100 / unit
Shop House (Four Storey)	4550 / unit

Table C.6: Minimum storage capacities for other types of buildings

Type of Building	Minimum storage capacity for one day (liters)
Hotels	270 / person
Hostels	180 / person
Day Schools / Kindergarden	30 / person
Boarding Schools	180 / person
Restaurants	14 / person
Mosque Or Other Place Of Worship	50 / person
Barrack (Army And Police)	250 / person
Office / Complex / Commercial (Domestic Usage)	1000 / 100 square metre
Community Centres Or Halls	1000 / 100 square metre
Education Institutions (Other Than School And Kindergarten)	100 / student
Institution Of Higher Learning With Hostels Facilities	250 / student
Prison	250 / person
Army Camp	250 / person
Bus Terminal	900 / service bay
Petrol Kiosk (With Car Washing Bay)	50,000 / unit
Petrol Kiosk (Without Car Washing Bay)	10,000 / unit
Stadium	55 / person
Golf Course	1000 / 100 square metre
Warehouse	1500 / unit
Others	As per the estimated water demand by the owner

ii. For premises where the population is transient and unknown the required storage cistern capacity may be estimated by the number of, and the types of, fittings installed as denoted in **Table C.7**.

Table C.7 : Estimation of Water Demand based on Types of Fittings

	Storage Capacity	Type of Fittings
1.	450-900 liters	Per Shower
2.	910 liters	Per Slipper Bath
3.	180 liters	Per Water Closet
4.	90 liters	Per Lavatory Basin
5.	90 liters	Per Sink
6.	180 liters	Per Urinal
7.	180 liters	Per Bed Pan Washer
8.	225 liters	Per Wash-Up Sink

iii. Storage cisterns for hospitals, airports and medium and heavy industries shall have a storage capacity of not less than two days water demand based on projected consumption pattern in accordance with **Table B.1**.

iv. Factories with future expansion plans shall allocate sufficient space for ultimate storage requirements.

v. Top Water Level (TWL) for suction cisterns and roof storage cisterns shall be referred to Ordnance Datum Level.

vi. Separate water storage cisterns and distribution pipes shall be provided for supplying water to food courts in buildings, and for kitchen and food and beverage outlets at hotels, hospitals and convention centre's.

b. Pipeworks and Materials

i. Water storage cistern with a capacity of 4,500 liters and below shall have an overflow pipe which shall function as a warning pipe and shall be installed at a visible location.

ii. The overflowing level of the warning pipe shall be set 50mm above the water line and not less than 50mm below the top edge of the cistern.

iii. Water storage cisterns with capacity of above 4,500 liters shall have separate overflow and warning pipes which shall be installed at a visible location so that visual detection of overflows can be made.

iv. Overflow pipes and scour pipes shall be one size larger than an incoming pipe and not smaller than the outlet distribution pipe.

v. Scour pipes shall be installed at the lowest point (underneath or side) of the cistern and channeled to the nearest floor trap, sump or drain at a visible location.

vi. Materials permitted to be used in the construction of water storage cisterns shall conform to the Commission's registered list or other permitted Recognised Standards.

c. Dedicated Water Storage Cisterns

i. These provisions shall be applicable for every dedicated storage cistern installed to serve a single consumer occupying any type of landed property, shop house, shop offices and flatted factory which is served by an individual meter.

ii. A hatch of not less than 600mm x 600mm shall be provided to access to the water storage cistern if the latter is placed within a roof truss area of a building.

iii. If the water storage cistern is placed other than within the roof truss area, it shall be shaded against the sun and be readily accessible for maintenance and replacement; provided that it may also be located in an unshaded area so long as the storage cistern is constructed from materials that are ultra violet resistant.

iv. The storage cistern shall be placed on flat platform which prevents distortion of the base of the cistern.

v. A professional structural engineer as stipulated in the second schedule of competent persons who shall certify that cistern and its support system is structurally sound and is safe.

vi. The storage cistern shall be placed in a position where the interior of the cistern may be readily inspected and cleaned. A clear space of not less than 375mm shall be provided between the top of the cistern and any obstruction.

vii. A stable platform of not less than 600mm wide shall be provided at least along three sides of a cistern for assisting in maintenance of the tank.

viii. The storage cistern shall be provided with a chlorine resistant cover which is dust and mosquito-proof. Such cover shall be provided with an opening of a size not less than 300mm diameter located directly above the float operated valve or inlet valve of the storage cistern to enable easy maintenance without having to remove the entire storage cistern cover.

d. Shared water storage cisterns

i. These provisions shall apply to a single storage cistern that serves more than one customer (e.g. parcel owners in a condominium, multi-story flats, high rise buildings, etc.).

ii. Secured access shall be provided for shared storage tanks. Persons entering secured storage tank areas shall be registered and their intent recorded in a Registration Booklet maintained by the Management Corporation or Owners of buildings.

iii. A storage cistern (including any tap fitted to the storage cistern) and its ancillary equipment shall be kept properly locked at all time.

iv. All roof storage cisterns shall be easily accessible with proper staircases located within the premise. Only spiral or walk up RC staircases shall be used and no cat ladder shall be allowed.

v. There shall be proper access and ancillary facilities provided for regular inspection and cleaning of the water storage cistern. A minimum head room of 900mm, and similar horizontal clearances, shall be provided on top of and around the storage cistern.

vi. The storage cistern shall be placed on a flat RC slab or RC plinth (as the case may be) completes with proper drainage system discharging to a conspicuous location, such as a scupper drain or floor traps.

vii. The base of the storage cistern shall be fully supported over its whole area by a durable, rigid, flat and level platform sufficiently strong to withstand the weight of the cistern without deflection when filled with water. For FRP / GRP panel storage cisterns and hot dipped galvanized storage cisterns, support or skids shall be provided between the cistern and the concrete plinth.

viii. Storage cisterns of 10,000 litres or more shall have internal compartments to facilitate maintenance of the cistern. Alternatively, multiple cisterns may be employed. An equalizing pipe shall be provided between each compartment or between each separate storage cistern supplying water to the same distribution pipe.

ix. Ladders to access the interior of the storage cistern shall be of stainless steel grade 316

x. All internal reinforcement (tie rods) if required for the storage cistern shall be of stainless steel grade 316.

xi. All internal bolts, nuts and washers shall be of stainless steel grade 316.

xii. Bolts, nuts and washers external to the storage cisterns and roof plate shall be hot dipped galvanized to MS 740 : 1981.

xiii. External ladders to access to the top of the storage cistern may be of stainless steel, aluminium or hot-dipped galvanized steel.

xiv. All storage cisterns constructed of concrete or steel panels for domestic water systems shall be lined with HDPE or other corrosion resistant material for ease of cleaning.

C.3.4 Supply Pressure

a. Landed Residential Premises

i. The residual pressure at any water fixture shall not be less than 2.0m head.

ii. Any section of the plumbing system shall not be subject to a pressure of more than 30m head, otherwise a pressure reducing valve shall be used to lower water pressures.

b. Multi-storey Buildings

i. The minimum pressure to be supplied shall be as follows:-

Location	Minimum Pressure
Parcel meters of residential units	10m head
Water Fixtures at commercial buildings (non-flush valves)	7m head
Flush valves	10.5m head

ii. All distribution pipes shall not be subjected to a pressure of more than 30m head, otherwise a pressure reducing valve shall be employed to lower water pressures.

c. Water for non potable purposes

i. The pressure of water supplied for non-potable use, e.g. for industrial process, cooling, washing, etc., shall conform with equipment manufacturer specifications.

ii. If pressures of more than 30m head are required, piping and fittings of a higher pressure rating to suit the specific requirement of a manufacturer shall be provided. If required, a separate localized pressure boosting pump set shall be employed to meet the required pressure levels.

C.3.5 Pumping System

a. Before commencement of any design work for a pumping system, the WDL shall be consulted on the minimum water pressure available at the identified tapping point along an existing public main. In this context application for a water pressure test may be made to the WDL to determine the pressure available at the proposed tapping point. Should the available pressure be inadequate to supply water to the elevated storage cistern; a pumping system shall be provided.

b. Duty and standby hydro-pneumatic pump sets, or variable speed pump sets, shall be provided to raise the pressure of water supply to the top two floors of high rise residential and commercial buildings. The pumps shall be fed with water from the elevated storage cistern.

c. Separate pumping systems shall be provided for non-potable distribution water systems.

d. Buildings of more than 70m (measured from the ground floor to the top of the last occupied floor) shall require multi-stage pumping. Similarly each stage of an intermediate pumping system shall be limited to 70m (physical height) measured from the base of the suction cistern to the delivery point of the break cistern.

e. The capacity of suction cistern should be from 30% to 70% of the total daily storage capacity required. The balance of the storage volume shall be provided at the elevated (roof top) cistern.

f. The capacity of the break cistern shall be equivalent to sustaining 1 hour of pumping of the transfer pump, or 11.5m^3, whichever is greater.

g. Minimum pumping rate for a duty pump shall be adequate to fill a commercial or office building elevated storage cistern in eight (8) hours; and a residential building storage cistern in sixteen(16) hours.

h. Pumping system operation shall be automated with the assistance of stainless steel electrodes located within both the suction cistern and storage cistern.

i. Selector switches shall be provided at the starter panel in order for pumps to be operated manually.

j. For pumping designs using a pressurized system, and where all of the storage of water is provided at the ground level storage cistern, the following shall apply:-

   i. The number of pumps on standby shall be 100% of the duty pumps.

   ii. Pumping system shall be of variable speed drive type.

   iii. The power supply shall be tapped from Tenaga National's power supply system and be backed up by a standby generator.

k. Alarm systems shall be provided to display a signal when the water level in the storage cistern is lower than the pump start level.

l. For buildings with multi-basements that are lower than the external road level, pumps and suction cisterns shall not be located at the lowest basement level in order to avoid water contamination, and damage to pumping equipment. For buildings with single basement, or where the lowest basement is above the road level (as in hill side developments), pumps and suction cisterns may be located at the lowest basement level, provided that proper drainage systems are installed to prevent flooding.

m. The design of the pumping system shall adopt measures to minimize the effect of water hammer. Available solutions, depending on the pumping head and pumping rate, are as follows:-

   i. Using multiple check valves at the header and riser.

   ii. Using surge anticipator valves and pressure relieve valves.

   iii. Use of hydro-pneumatic tanks (with motorized valve at the elevated storage cistern, and a pressure sensor positioned on the pump delivery header for pump control).

n. The manufacturer of the surge anticipator valve and pressure relieve valve shall be consulted when selecting the most suitable types to be used.

o. The types of pump sets permitted for raising water in a building system shall include either horizontal end suction pumps or vertical in-line pumps. Variable speed pumping systems, if introduced, shall be an integral unit complete with pumps, suction and delivery header pipes, variable speed drives and pump control systems all assembled by the pump manufacturer.

p. Thermoplastic pipes are permitted to be used in low pressure pumping systems associated with landed residential premises only.

q. The power supply to any pumping system, other than those located within landed properties, shall be backed up by a generator set.

r. Booster pumps of capacity lower than 10 m^3/hour (< 10 m^3/hr) shall have efficiencies of not less than 45%. Booster pumps of capacity exceeding 10 m^3 /hour (≥ 10 m^3/hr) but lower than 30 m^3/hour (< 30 m^3/hr) shall have efficiencies (pump side) of not less than 50%. The efficiency of all types of booster pumps of higher capacity shall meet the minimum requirements tabulated in **Table D.1**.

s. Compliance with EFF1 ratings for booster pump motors is voluntary. However, buildings conforming with Green Building Ratings should have pump motors complying with EFF1 rating.

C.3.6 **Hot Water System**

a. Hot water apparatus shall not draw water directly from a service pipe.

b. Hot water apparatus installed in landed residential properties, or other premises having dedicated storage tanks and served by a single water meter, can draw water directly from the storage cistern.

c. For high rise residential buildings, the supply to a hot water system shall be drawn from the distribution pipe located downstream of parcel meters measuring water use at individual dwelling units. Pumping system is only allowed downstream of the storage cistern.

d. In the case of high rise commercial buildings a separate feed cistern, supplied by water from a shared storage cistern through a distribution pipe, shall supply water to a hot water apparatus.

e. Cold water supplied to a heating apparatus shall be controlled by a stop valve, and shall be discharged within the heating apparatus at a level above the overflowing level of the apparatus (air gap provision). This condition may be waived in the case when the discharge from the heating apparatus is in open air or through a mixing valve.

f. Control valves shall not be fixed at the heater outlet pipe in the case of instant water heaters.

g. Hot water pressure tanks shall be constructed from corrosion resisting materials that are capable of withstanding twice the operating pressure of the tank.

h. Safety valves, whether in the form of vent pipes or pressure relief valves, shall be drained to the bathroom floor trap in the case of storage type water heaters. Vent pipes shall have nominal diameters exceeding 20mm.

i. Types of pipes permitted for use in hot water systems include stainless steel, copper, CPVC pipes and PPR pipes.

j. Hot water systems shall be designed to be energy efficient. In this respect all measures shall be taken to minimize heat losses from heating apparatus, storage tanks and transmission pumping. Pipelines conveying hot water should be lagged especially in cases where the distribution is extensive. The recommended distances between hot water apparatus and draw-off taps where pipe lagging is not required as a function of pipe size as summarized in **Table C.8** below. Pipe with hot water conveyance lengths greater than stated in **Table C.8** should be substantially lagged with appropriate insulation material.

Table C.8 : Pipe Lagging Requirement

Largest Nominal Diameter of Pipe	Length
Not exceeding 13mm	18m
Exceeding 13mm but not exceeding 19mm	12m
Exceeding 19mm but not exceeding 25mm	8m
Exceeding 25mm	3m

k. All un-insulated pipes conveying hot water in landed and high-rise residential premises (non centralized hot water system) shall as far as possible be concealed within a brick wall.

l. The outlet level of a pipe conveying cold water from a storage cistern to a hot water apparatus shall be at the same level or higher than cold water distribution pipe supplying water to water fixtures from the same cold water storage cistern.

m. The design of centralized hot water supply systems is beyond the scope of these Uniform Technical Guidelines. For the design of such systems, reference shall be made to CP 342-2, Code of Practice for Centralized Hot Water Supply – Part 2: Buildings Other Than Individual Dwellings.

n. Cold water supplies to a solar heater shall be from a distribution pipe discharging water from a storage cistern.

C.3.7 Public Swimming Pools

a. Pool capacity, turnover time, rate of water cycle, rate of filtration and make-up water volume, which consists of backwash, water displacement, evaporation loss and the details of filtration plant shall be stipulated in the design drawings to be lodged with the Local Authority and the Commission.

b. Detailed schematic drawings of swimming pool piping systems approved by the Principal Submitting Person shall be lodged with the Commission for record purposes only and a copy extended to the Local Authority.

c. The water inlet pipe shall terminate at least 225 mm above the overflow level of the balancing cistern which shall be secured and access made available to authorized personnel only.

d. Swimming pools shall be designed in order to be filled within one (1) day to three (3) days.

e. Water supplies to swimming pools shall be separately metered for condominiums and high rise buildings.

f. All public swimming pools shall be supplied from a dedicated communication pipe fitted with an independent meter. Draw-offs from service pipes serving individual landed properties is not permitted unless approved by the Commission. In the case of high rise buildings or condominiums, draw off from service pipes to serve swimming pools is permitted provided that the water is either discharged to a feed or building

storage cistern with an air gap of at least 225mm, or a backflow preventer is installed downstream of the connection with the service pipe but before any tap offs.

C.4 PRESERVATION OF WATER QUALITY

C.4.1 Prevention of Backflow

a. Air gaps between the level of water discharged and the water line of roof storage cisterns, suction cisterns, bath tubs, sinks and basins shall be designed and maintained at not less than 75mm.

b. A backflow preventer of the Dual Check Valve type shall be installed at an appropriate distance downstream of the water meter measuring water supplies to:-

- Agricultural, and horticultural premises and premises for processing general chemical;
- Factories using toxic chemicals and processing water other than potable water;
- Hospitals, mortuaries and veterinary clinics;
- Automated car wash centres.

b. A backflow preventer of the Dual Check Valve type shall be provided along the service pipe upstream of all point of entry water filters and water kiosks.

c. A Single Check Valve backflow preventer shall be installed upstream of a garden tap if the fixture is supplied with water from a service pipe.

d. A backflow preventer is not required if these appliances are supplied which public water supplies through a distribution pipe that is connected to an approved storage cistern.

C.4.2 Cleaning and Maintenance of Water Storage Cisterns

a. Shared water storage cisterns installed at high rise residential buildings and gated communities shall be inspected and if required cleaned and maintained in conformance with provisions specified under the Water Services Industry (Maintenance of Water Tank at High Rise Buildings and Gated Community) Rules 201X *(when the proposed subsidiaries law has enforce).*

b. Owner of other premises should take initiatives to inspect, clean and disinfect water storage cisterns at their premises at regular intervals on a voluntary basis.

C.4.3 Disinfection of Storage Tanks and Distribution Pipes

All buildings equipped with a shared water distribution plumbing system shall employ a permit holder to disinfect all new or altered water fittings after its installation but prior to its use. Individual landed residential properties and individual residential units within a multi-storey building are exempted from his condition.

C.5 WATER CONSERVATION

C.5.1 Water Conservation Measures

a. Water shall be used efficiently and effectively at all times. Consumers are encouraged to adopt water conservation measures in both non-domestic and domestic premises, and at construction sites, in order to lower the rate of consumption of water.

b. Installation of flow control valves and self closing delay action taps in high rise commercial, office, institutional, and industrial buildings is encouraged.

c. Installation of dual flush cisterns with the full flush discharging not more than 6 litres shall be installed in all new buildings. The partial flush shall not exceed 3 litres.

d. Owners of factories consuming a large amount of water shall study the feasibility of using recycle water for washing, cooling, and other non potable uses, and implement such measures if found to be economical.

C.5.2 Use of Non-Potable Water

a. Rain water harvesting system, if adopted by the consumer, shall be tailored to supply water for:-

   i. General washing and gardening.
   ii. Flushing water closets.

b. There shall be no cross connection between non-potable and potable water distribution systems within buildings.

c. Distribution pipes for supplying non-potable water shall be painted green along its entire barrel.

d. Taps and outlets for non-potable water shall be clearly identified as '**Not for Drinking Purposes'**.

e. The water storage cistern for potable and non-potable water shall be separated and shall not be inter-connected.

f. Any service pipe conveying potable water to top-up a rain water storage cistern containing non-potable water shall have a backflow preventer of the Dual Check Valve type; and the service pipe shall terminate at least 225 mm above the overflow level of the rain water storage cistern.

C.6 CERTIFICATION PROCESS

C.6.1 Certification during Construction

Principal submitting person or his representative at Site, and the Permit Holder, shall jointly certify all inspections and tests carried out during the construction of facilities.

C.6.2 Certification of Completion

The principal submitting person and the permit holder shall jointly certify in Form G5 that the plumbing installation has been constructed in accordance with the approved plan (current requirement in Form G5 which form part of the staged Certificate Forms over the CCC process).

C.6.3 Record Drawings and Calculations

The principal submitting person shall maintain as built record drawings and design calculation for a period of seven (7) years.

The premise owner shall maintain as-built drawings for future reference.

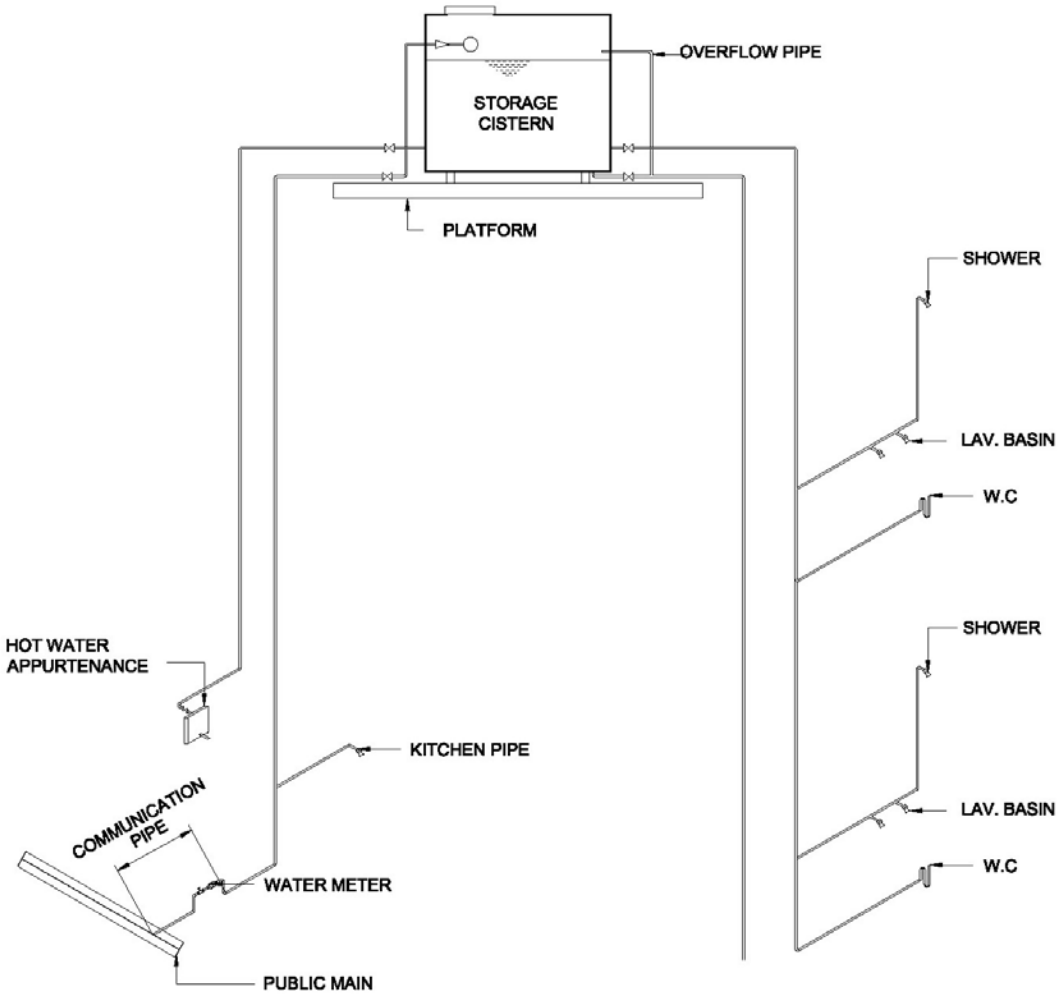


FIGURE C.1
SCHEMATIC DIAGRAM OF A WATER SUPPLY PLUMBING SYSTEM FOR TYPICAL LANDED RESIDENTIAL PREMISES

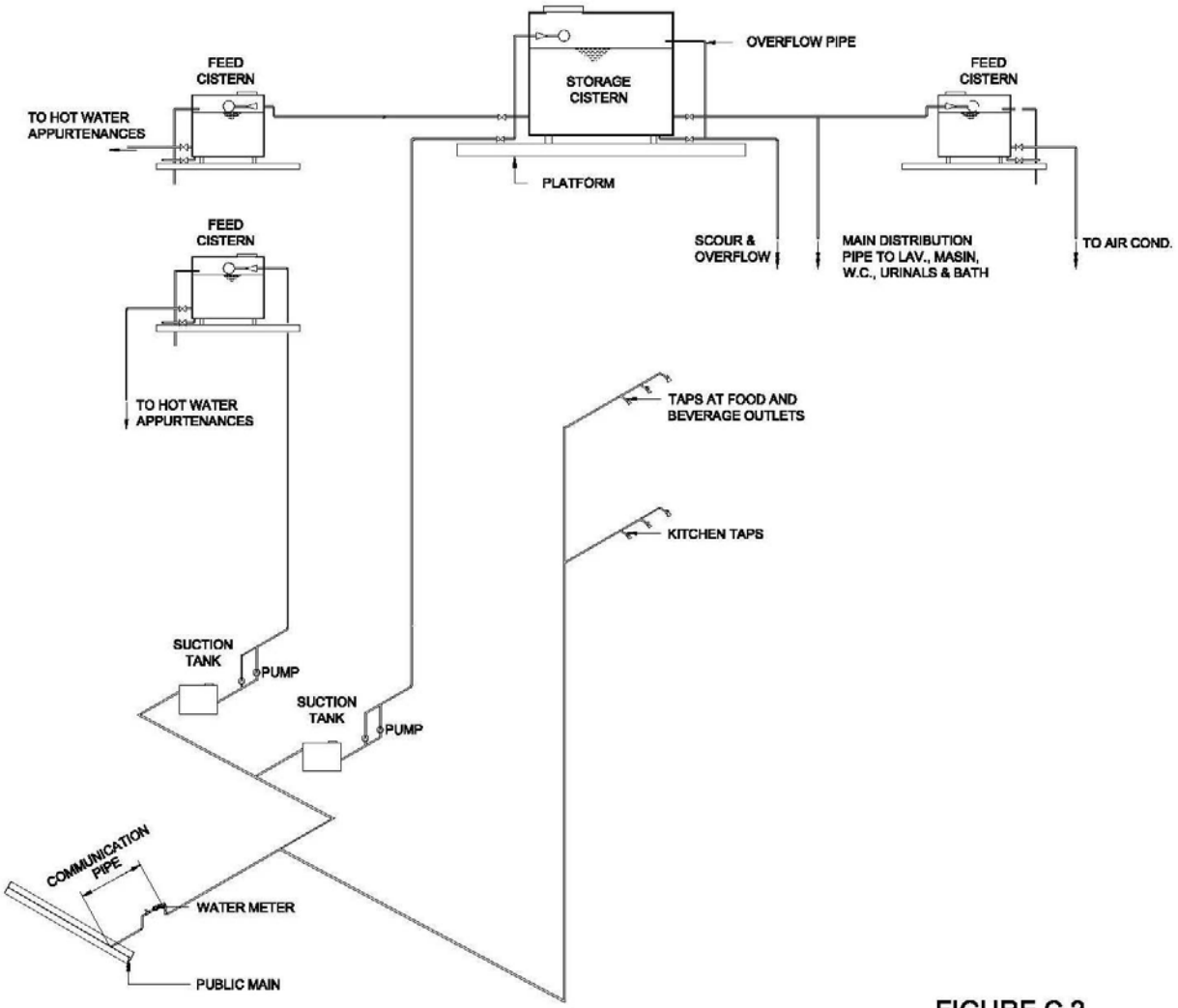
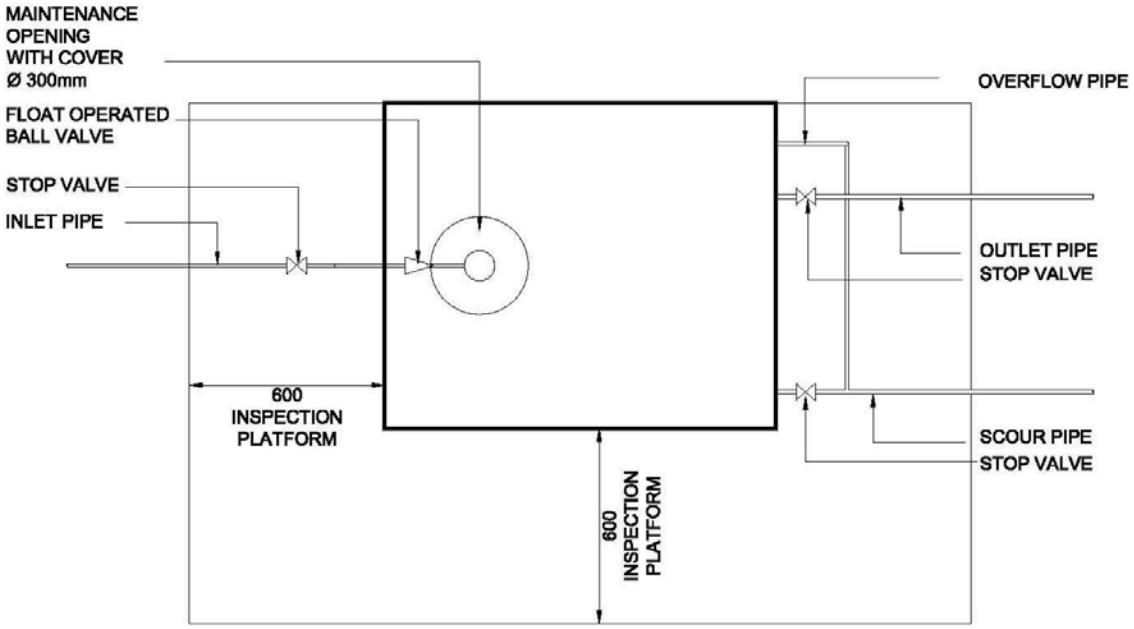
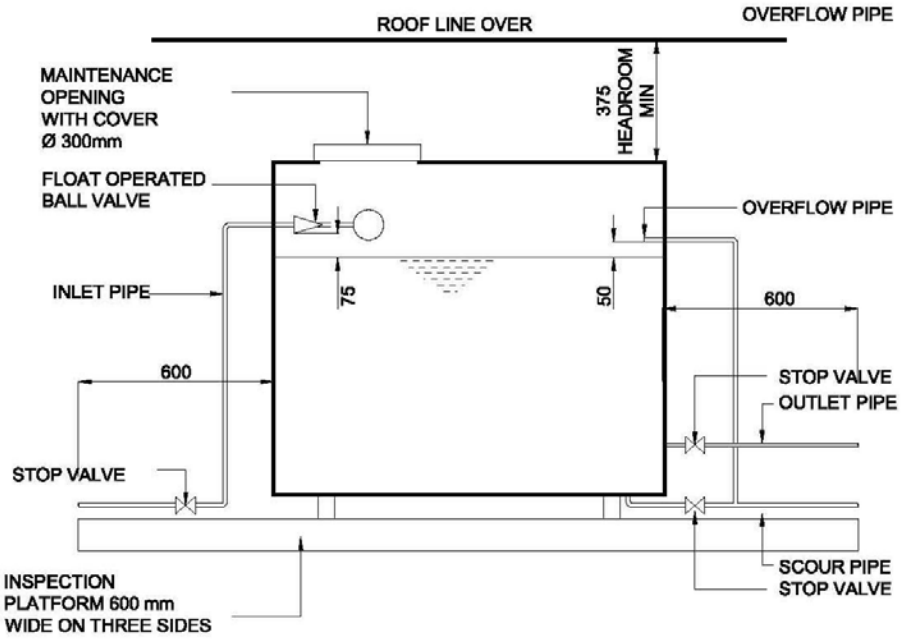


FIGURE C.2
SCHEMATIC DIAGRAM OF A WATER SUPPLY PLUMBING SYSTEM FOR LARGE HOTELS



PLAN VIEW



SECTIONAL VIEW

FIGURE C.3
TYPICAL DETAILS OF A STORAGE CISTERN

Part D:

Mechanical Designs for Pumping Stations

PART D : MECHANICAL DESIGNS FOR PUMP STATIONS

D.1 MECHANICAL SYSTEM

D.1.1 General

The design of pumping stations, and the selection of mechanical equipment, shall meet the following requirements:-

a. Pumping stations and associated equipment shall conform with Jabatan Keselamatan dan Kesihatan Pekerjaan's (JKKP) specific requirements concerning Occupational Safety and Health matters.

b. There shall be no objectionable noise and vibration emissions within the pumping station. Conformance with Occupational Safety and Health Act's (OSHA) work place noise and vibration limits shall be factored into the design of the pump station and selection of specific equipment.

c. The pump stations shall comply with Jabatan Alam Sekitar's (DOE) conditions pertaining to noise (65 dB at the building) and air pollution.

d. The design and the selection of equipment types shall take into consideration the life cycle cost of constructing, and operating and maintaining pump sets, piping and fittings.

e. Adequate headroom and horizontal clearances (minimum of 1 meter) shall be provided around all equipment (e.g. pump sets, compressors, etc.) and pipework for ease of maintenance, and for future replacement of any equipment and pipework.

f. Pumps and motors selected shall be of EFF1 type, i.e. high efficiency types, and shall comply with the current regulations with respect to energy efficiency.

g. Protection and safety devices shall be interlocked such that in times of failure of one part of the system, the system shall stop to operate thus preventing further damage to the rest of the system.

h. The degree of sophistication of a control system for the pumping station shall take into consideration the availability of persons with the required skills and competency level to operate and maintain the facilities.

i. Direct boosting, or boosting tapped from the main pipe, is generally not allowed. If this is unavoidable, detailed designs by a competent person shall be included in the design submission to the Certifying Agency.

j. The pumping system shall be designed to operate under positive suction heads; if this is not possible, self priming pumps or submersible pumps shall be used.

k. This chapter is applicable for pumping stations forming part of the external reticulation system or supply mains; and in general does not pertain to pumping systems installed within individual buildings. The requirements for pumping system serving a building are described in **Part C Planning and Design of Plumbing Systems**.

D.2 DETAILED DESIGN SUBMISSIONS

a. Detailed designs of mechanical and electrical works shall be carried out and endorsed by a competent person as specified in Second Schedule of the Water Supply Rules and submitted to a Certifying Agency for approval in two (2) specific stages (i.e. before and after tender award) as described in **Sections D.2.1 and D.2.2**.

b. All plans / drawings submitted shall be of A1 size.

c. All drawings shall be endorsed with the word “SUBMISSION DRAWING FOR APPROVAL”.

d. All drawings shall be approved before any construction is permitted to commence.

e. All fire fighting systems for pumping stations shall be as per Jabatan Bomba dan Penyelamat, Malaysia (BOMBA) requirement, and be separately submitted to BOMBA for approval.

D.2.1 First Stage (Design Stage before Tender Award)

Detailed designs submitted to the Certifying Agency, during the first stage process, shall incorporate the following specific information:

a. Submission of Mechanical & Electrical (M&E) designs shall be accompanied by a letter from the Certifying Agency formally approving the detailed design of associated civil works.

b. General arrangement drawings of pumping installation; including the arrangement of suction and discharge piping.

c. Design calculation for pumping system which shall include the pump curves; system curves; available Net Positive Suction Head (NPSH) calculation; pumping head calculation; sizing of suction pipe; headers and pumping mains; and sizing of prime movers.

d. Pump and prime mover (electrical motor or diesel engine) specifications and other relevant details.

e. Design calculation and layout of mechanical ventilation systems.

f. General layout of all mechanical handling systems.

g. General layout of generator set installation (as the case may be).

h. General layout drawings of a Surge Suppression System, if warranted, incorporating details on surge vessels or surge anticipator valves. The sizing of components of a surge suppression system shall be determined after a hydraulic surge analysis has been carried out.

i. Layout of fire fighting systems.

D.2.2 Second Stage (During Approval Stage of Equipment)

Upon confirming the specific details of equipment to be installed, the competent person shall submit to the WDL / CA the following information:-

a. Full details of equipment offered or proposed, together with copies of manufacturer's specifications to enable the nature, workmanship and functional characteristics of the equipment offered to be assessed.

b. The pump type, brand and manufacturing details for a minimum of three (3) brands of pumps for final selection by the Water Distribution Licensee.

c. Characteristic curves of the pump offered when operating singularly; describing the relationship between total dynamic head and rate of discharge; and superimposing on the system curve details on horsepower ratings, efficiency and Net Positive Suction Head (NPSH) requirements.

d. Duty point and efficiency of single pumps.

e. The scope and details of pump accessories to be provided.

f. Detailed specifications pertaining to the motor.

g. All pipework and valves; providing details on material specifications and sizes.

h. Surge suppression system complete with surge analysis calculation (including sizing of surge vessel) or sizing of surge anticipator valves.

i. Details of all components of mechanical handling equipment together with specifications.

j. Details on fire fighting system and equipment together with relevant specifications.

k. Details on proposed spare parts and tools to be provided.

l. All relevant shop drawings.

D.3 PLANNED PUMPING RATES AND NUMBER OF PUMP UNITS

Generally, the rates of water to be pumped, and the number of pump units required, shall be determined according to the following basic criteria:-

a. Flow of water to be pumped directly into an external reticulation system shall take into consideration the estimated average and peak water supply rates, and fire flow rates, to be conveyed within the reticulation system. Pumping water to a service reservoir shall be based on a rate of flow which is equivalent to 1.2 times of the average daily flow to be distributed to consumers within its service area over a period of 16 hours.

b. The number of pumps required shall be determined by the estimated rate of water to be pumped, as well as other criteria such as installation cost, operation and maintenance requirements, power consumption and level of redundancy required.

c. Standby pumps shall be provided in accordance with the design criteria for pump sets given in **Table D.1**. The number of standby pumps depends on the size of duty pumps, the locality of the pump station and the required factor of the redundency desired.

Table D.1 : Design Criteria for Pump sets

Pumping Rate Per Pump (m^3 / hr)	Number of Pump sets	Total	Pumping Hours	Minimum Pump Efficiency (%)	Maximum Pumping Head (m)	Maximum Speed (rpm)	
						Horizontal Split Casing Pumps	End Suction Pumps
>30 ≤100	On Duty = 1 Standby = 1	2	12	60	75	-	2900
>100 ≤ 300	On Duty = 1 Standby = 1	2	12	70	75	1500	2,900
>300 ≤1000	On Duty = 2 Standby = 2	4	12	75	75	1,500	-
>1000	On Duty = 4 Standby = 2	6	12	80	75	1,500	-

Notes:

i. Duty pump is the primary pump used for continuous operation in accordance with the WDL's operational programme to achieve their optimum operational objective.
ii. Standby pump is an additional pump used to alternate or serve as duty pump in case of any duty pump failure.
iii. All pumps shall be installed to operate under positive suction heads.

d. In the case where water demand fluctuates widely, such as for an in-line booster system, it is advisable to have a combination of different size pumps; or resort to the use of variable speed pumps.

e. The capacity and the number of pumps in a pumping station shall take into consideration the specified maximum number of starts / stops the pump motor can withstand.

D.4 PUMPSETS

D.4.1 Duties and Selection

a. Electric motor driven pumps shall operate below 2900 rpm.

b. The pump shall have a stable characteristic curve such that the pressure falls steeply and continuously from a closed valve position.

c. For economic operation, it is advisable to employ a single duty pump which operates constantly near the point of maximum efficiency. Larger pumps normally have better performance efficiencies.

d. The duty point of the pump supplied shall lie within a range of 20% below and not more than 20% above the best efficiency point of the characteristic curves associated with specific impellers which are selected to pump the required quantity of water.

e. The performance of the pumps shall be verified by tests conducted under controlled factory conditions, and subsequently at site, in accordance with BS EN ISO 9906 : 2000.

f. The material for pump shaft shall be of Stainless Steel of Grade 420 or better.

g. In the design of a pumping system, pumps should not operate more than twelve (12) hours continuously in a day. This requirement is distinct from the criteria for determining the rating of the duty pump to deliver the estimated daily quantity of water over a specific time period and each pump is rotated based on WDL's operating programme.

h. The total pumping head shall not exceed 75m for each pumping stage under normal circumstances. For pumping heads exceeding 75m but below 100m, prior consent from the Certifying Agency shall be obtained. This consent may be granted on case to case basis supported by an economic justification based on an analysis of the total life cycle cost of the pumping system.

i. All pumps with power ratings of 22.5 kW (or 30.0 water horsepower (HP)) and above shall be of the Horizontal Split Casing Pump type, with pump speeds of not more than 1500 rpm.

j. All pumps with power ratings below 22.5 kW (or 30.0 water horsepower (HP)) shall be either of the Horizontal Split Casing Pumps type (with pump speed of not more than 1500 rpm) or the End Suction Pump / Vertical Multi-Stage Pump type (with pump speeds of not more than 2900 rpm).

k. The minimum Factor of Safety (FS) in the sizing of motors shall be 1.1 times the motor power.

l. All pumps, parts and accessories shall comply with relevant Malaysian Standards, or equivalent international standards [such as ISO, British Standard (BS) or European Standard (EN)], and shall be manufactured or supplied from a supplier registered by the Commission.

D.4.2 **Horizontal Split Casing Pumps**

a. The pump casing shall be of axially split type, made of grey cast iron or ductile iron, and be fitted with high tensile steel shafts running on ball or roller bearings with suitable lubricating arrangements.

b. All impellers, neck rings, sleeves, gland, lantern ring and bushes shall be of zinc-free bronze or stainless steel.

c. Gland seals shall be of the silicon carbide or tungsten carbide mechanical seal type.

d. The pumps shall be supplied with all necessary air release valves, drain valves, and suction and delivery gauge mounting points.

e. The pumps shall be supplied complete with base plates and approved types of flexible couplings.

f. The combined base shall be fabricated according to the manufacturer's instruction.

g. The combined base plate and stool shall be supplied complete with all necessary holding bolts and lifting points.

h. On-line vibration and bearing monitoring system should be installed for pumps of capacity above 1000 m^3 / hr.

D.4.3 **End Suction Pumps**

a. A spacer piece and coupling shall be provided to facilitate removal of impeller without dismantling the connecting pipeworks.

b. Gland seals shall be of the silicon carbide or tungsten carbide mechanical seal type.

c. Pump impellers shall be of zinc-free bronze or stainless steel.

D.4.4 Vibration Isolation Material

a. The pump set shall be provided with vibration isolation mechanisms such as a rubber damper between pump set and pump plinth, flexible coupling for the suction pipe and expansion joints for the delivery pipes.

b. For pumps which are supported on ground, neoprene / rubber mount and structural steel base shall be employed for pumps with power ratings less than 4 kW; whereas steel springs and concrete inertia base shall be provided for pumps with power ratings larger than 4 kW.

c. For pumps which are supported on a suspended floor slab, only steel springs and concrete inertia base shall be used.

D.4.5 Bolt and Nuts

a. All exposed bolts and nuts in the construction for the pump shall be cadmium treated or hot dipped galvanized.

D.5 VARIABLE SPEED PUMPING SYSTEM

a. The objective of adopting a Variable Speed Pumping System is to maintain a near constant discharge pressure while delivering varying rates of water supply to a distribution network whose demand characteristics vary over time.

b. Due to the complexity of designing in-line variable speed booster pumping systems, a detailed engineering study shall be carried out to examine the technology and economic feasibility of selecting a VSD pumping system over other conventional constant speed pumping systems; focusing on the technical characteristics of individual components. If necessary a pump manufacturer shall be consulted during the selection process.

c. The design submission by the competent person for an in-line variable speed booster pumping system shall include a description of the control system, and a plot of pump performance curves at various operating speeds superimposed on the system curves that describes the range of flows to be pumped and the related total dynamic head requirements to be met. Pump efficiency trends shall also be included in the plot.

d. The type of pumps used, and the pump efficiency ratings at the maximum flow rate, shall comply with the requirements stated in **Table D.1**.

e. The redundancy policy for variable speed pumping systems shall be as follows:-

- Two standby pumps to backup a single duty pump.
- 100% standby pumps to backup two or more duty pumps.

f. Each pump shall be provided with an individual variable speed drive.

g. The power supply to the variable speed pumping system shall be backed up by a generator set capable of supplying the rated power needs.

D.6 PRESSURE GAUGES

a. The construction of pressure gauges shall comply with BS EN 837-1: 1998.

b. The gauge used shall be of the liquid filled type.

c. The entire gauge shall be calibrated, either in a single scale unit expressed in meter (head) or dual scale expressed in head of water.

d. The size of the dial gauge or face of the pressure gauge shall not be less than 100 mm in diameter for pump capacities of below 300 m^3 / hr; and 150 mm in diameter for pumping capacities above 300 m^3 / hr.

e. A pressure gauge shall be installed when measuring suction pressures.

f. The measuring range of a suction pressure gauge shall generally be between - 10m to 10m head of water, or 125% of the maximum pressure.

g. The gauge shall incorporate a micrometer zero adjustment pointer and restrictor screw.

h. The over pressure limit shall not be less than 1.30 x full scale dial. Suitable gauges shall be selected such that the working pressure ranges between 50% and 70% of the full scale dial.

i. The accuracy shall be +/- 1% full scale dial or better according to BS EN 837-1 : 1998.

j. A pressure gauge shall be installed at every suction pipe, every delivery pipe and at the common header pipe.

k. The location of all pressure gauges shall be indicated in the submission drawings.

l. The gauge shall be installed with the following necessary accessories to protect the gauge:-

   i. **Snubber** for protection of the gauge against sudden pressure change and fluctuation of pressurized fluid.

   ii. **Instrument isolating Valve (Needle Type)** for isolation of the gauge from the fluid in the pipework.

   iii. **Overload Protector (For pump discharge side)** for protection of pressure instrument from over pressure, exceeding the specified pressure range by sudden and excessive pressure fluctuation from surges or spikes.

D.7 SUCTION AND DELIVERY PIPES

The criteria to be adopted when designing suction and delivery pipes are as follows:-

a. Suction pipe shall be as short as possible. Push-on-spigot and socket type joints shall not be permitted for suction pipelines.

b. Bends shall be avoided, if possible, along a suction pipeline.

c. The minimum length of straight pipe located before the suction intake of pumps shall be at least 5 times the diameter of the suction pipe.

d. The clearance between the inlet end of the suction pipe, or strains, and the base level of the pumping cistern shall be a minimum of 0.5 to 0.8 times the pipe diameter.

e. The depth between the suction cistern inlet end of a suction pipe, or strainer, and the base level of the pump chamber shall be a minimum of 0.5 to 0.8 times the pipe diameter.

e. The distance between the inlet end of a suction pipe and the wall of the pump chamber shall be more than one and a half (1½) times the pipe diameter.

f. The distance separating adjacent suction pipes of equal diameter shall be more than three (3) times the pipe diameter.

g. For suction pipes of different diameters, the separation distance between pipes shall be more than three (3) times the largest diameter.

h. When sizing suction and delivery pipes within the pumping station, the velocity of flow shall not be greater than 1.5 m/s and 2.5 m/s respectively.

D.8 PIPEWORKS

a. All mild steel pipes shall be cement mortar / concrete lined, or lined by other approved materials internally, in accordance with approved specifications by the Commission.

b. All pipes and specials, and associated materials of construction, shall either be of mild steel or ductile iron conforming to the latest MS standards as imposed by the Commission.

c. All mild steel pipes and specials shall be painted with one (1) layer of zinc chromate and two (2) layers of gloss finish coating, whilst ductile iron pipes and specials shall be painted with two (2) layers of gloss paint externally.

d. All pipes laid above ground and located within a pump station shall be flange jointed, machined and drilled and conforming to BS EN 1092-1 : 2007, BS EN 1092-2 : 2007.

e. Coal tar coating or bitumen coating shall be applied on the external surfaces of all buried pipes.

f. Thrust blocks shall be designed to withstand the magnitude of thrust forces that are induced at bends, tees, wyes, etc.

D.9 VALVES

D.9.1 Sluice Valves

a. Sluice valves shall conform to the requirements of standards recognized by the Commission and the closing direction of the valve should generally be clockwise. Anti-clockwise closing of sluice valves shall be accepted by the Certifying Agency if adequate reasons are submitted to opt for such an alternative mode of operation.

b. The valve should be fitted with hand wheels with the direction of opening and closing cast marked thereon. Exceptions to this norm may be considered and approved by the Certifying Agency.

c. Sluice valves in pumping stations shall only be used for pipe sizes of 300 mm diameter and below.

d. Sluice valves with pressure rating of not less than PN 16 shall only be employed.

e. The sluice valves shall be coated with epoxy paint conforming to standards agreed by the Commission.

D.9.2 Butterfly Valves

a. All butterfly valves shall conform to the requirement of Standards recognized by the Commission and shall be used for pipe sizes above 300 mm diameter.

b. Butterfly valves with pressure rating not less than PN 16 shall only be employed.

c. For butterfly valves without a motorized gear, a suitable hand wheel on headstock shall be provided for manual operation.

d. Manual gearing actuators may be used for valves of 450 mm nominal diameter and below. For valves of 500 mm nominal diameter and above, only motorized actuators shall be used.

D.9.3 Non-slam Type Check Valves

a. Non-slam check valves employed shall conform to BS EN 12334 : 2001, and shall have high operating reliabilities and sustain minimum pressure losses.

b. The valve shall have metal to metal seating and shall be equipped with minimum wearing parts and in general shall require minimum maintenance throughout its operating life.

c. The non-slam type valve shall be designed for shock free closure, and may be installed in any position i.e. horizontal, vertical or inclined.

D.9.4 Altitude Valves

a. Float operated valves may be used for incoming pipe of up to 150mm diameter. For incoming pipes of 200mm diameter and above, altitude valves or other level control devices shall be used.

b. Altitude valves control the water level in a reservoir. It remains open when the reservoir is not full and closes when the tank reaches its maximum water line.

c. Strainers shall be installed before any altitude valve.

d. A by-pass pipe and isolation valve shall be installed to facilitate the repair and maintenance of an altitude valve.

e. The selection of altitude valves shall take into consideration the water pressure of the incoming pipe to ensure that the altitude valve shall be able to close without leaking when the high water level is reached. If this is not possible, alternative types of water level control valves which are permitted by the Commission shall be employed instead.

f. Level electrode systems may be used in lieu of altitude valves to control water delivered to a reservoir by pumps.

D.10 SURGE SUPPRESSION SYSTEMS

a. To counter water hammer, the following mitigating systems shall be used in pumping stations:-

   i. Adoption of pressurized surge vessel to prevent column separation, taking into consideration the incorporation of check valves as part of the surge vessel system.

   ii. Adoption of surge anticipating valves which open or close at specific preset values so as to lower surge pressures in the pipeline.

b. A surge analysis shall be carried out for a particular pumping system to profile the variation of induced pressures along the pipeline, and within a surge vessel.

c. The surge analysis shall elucidate the changes in air volume and pressures within the surge vessel after incorporating check valves as part of the overall suppression system.

d. A surge analysis shall also be carried out if surge suppression employing surge anticipator valves is to be adopted.

e. Manufacturers of surge vessels are required to submit complete sets of drawings, calculation and other required information to Jabatan Keselamatan dan Kesihatan Pekerjaan (JKKP) for approval. The Contractor shall be responsible for obtaining Permit Mesin Tekanan (PMT) certificates from JKKP.

f. The competent person shall submit appropriate documentation which describes the concept and functional characteristics of the overall surge suppression system, and provide design calculations supporting the sizing of components including duty and standby air compressors, as well as system drawings and test certificates as part of the O&M manuals.

g. If a surge anticipator valve is used, the water discharged from the surge anticipator valve shall be channeled back to the suction tank or otherwise be recovered without affecting the proper functioning of the surge anticipator valve. If this is not possible, a surge vessel should be used.

h. Other types of surge suppression system sanctioned by the Commission may be employed.

D.11 VIBRATION AND NOISE CONTROL

a. The noise level within a pumping station, and at its boundaries, shall comply with the requirements of JKKP and Jabatan Alam Sekitar (DOE) respectively.

b. Where required, suitable noise barriers or acoustic barriers, shall be installed to reduce the intensity of noise propagated from the noise source so that Jabatan Alam Sekitar's noise limits at the pump station boundaries can be complied with.

c. The design of the pumping system shall avoid intruding into pump operating regimes outside of the stable region of the pump performance curve.

d. The pump manufacturers shall submit a report, or provide evidence that the rotating components in the pumps are balanced in compliance with internationally accepted balancing standards.

e. The alignment of the pump and motor shall be performed by a trained and experienced person and the accuracy of alignment shall meet the specific requirement of the pump manufacturer.

f. The natural frequencies of the supporting floor elements, pump set, and the pipe support system shall be analysed. A structural engineer and the pump manufacturer shall be consulted in performing this analysis to avoid resonance effects taking place at the pump, pipework and supporting floor.

g. The manufacturer's technical catalogue shall be referred for selecting vibration isolators to be installed. In this respect the performance characteristics of vibration isolators shall be given due consideration in the selection process.

h. Where stipulated by JKKP, hearing protectors shall be provided for use by operating and maintenance personnel.

D.12 MECHANICAL HANDLING EQUIPMENT

a. Gantry crane with electrically operated hoisting equipment shall be installed for lifting loads exceeding 1,000kg.

b. Gantry crane with manually operated hoisting equipment shall be installed for lifting loads between 50kg and 1,000kg.

c. Monorail cranes shall be used for lighter lifting loads, and when the centre line of the equipment is inline with entry or exit provisions.

d. All cranes shall be suitably sized to lift 1.25 times the weight of the heaviest equipment.

e. Electrically operated cranes shall be required in large installations where individual equipment weighs more than 2,000 kg. Wire rope hoisting units shall be used in conjunction with electric operated cranes for lifting capacities more than 2,000 kg of safe working load.

f. Manufacturers shall endorse and submit all design calculations and drawings for cranes to JKKP, and apply for installation approvals.

g. The Contractor shall be responsible for obtaining a Permit Mesin Angkut (PMA) Certificate for the crane or monorail hoist from JKKP.

h. All required drawings, calculations and certificates shall be handed over to WDL during the first handing over inspection process.

D.13 DRAINAGE SYSTEM

a. Scupper drains shall be provided around the pumping equipment to drain any stagnant water which may accumulate to an external drain.

b. Where the pump chamber is located below grade, the scupper drain shall drain to a pit where a duty and a standby drainage submersible pump complete, with float switch for automatic operation, shall be provided to transfer the water accumulated to the external drain.

D.14 MECHANICAL SPARE PARTS

Developers are required to provide the following minimum mechanical spare parts together with any pumping stations:-

a. One (1) set of repair kit for Altitude Control Valves.

b. One (1) set of repair kit for Surge Anticipator Valves.

c. One (1) set of Mechanical Seals.

d. One (1) set of Complete Rotating Assembly for each type of pump

e. One (1) set of Pump and Motor Bearings.

f. One (1) set of impeller wear rings.

Part E:

Electrical Designs for Pumping Stations

PART E : ELECTRICAL DESIGN FOR PUMPING STATIONS AND RESERVOIRS

E.1 ELECTRICAL SYSTEM

The electrical design of a typical pumping station and reservoir should address fourteen (14) main topics, namely:-

a. Standards, Codes of Practice, Rules and Regulations
b. Power supply requirements
c. Medium Voltage (MV) installations
d. Low Voltage (LV) installations
e. Essential power supplies
f. Motor starter panel (Motor control centre)
g. Electric motors
h. Internal lighting and small power systems
i. Compound lighting
j. Lightning protection systems
k. Earthing systems
l. Electrical spare parts
m. Electrical As-built drawings
n. Testing and commissioning

E.2 STANDARDS, CODES OF PRACTICE, RULES AND REGULATIONS

a. All designs, materials, construction works and equipment installed shall conform to the relevant standards, regulations and by-laws imposed by authorities having jurisdiction over the installation of an electrical system. These include: -

   i. Pihak Berkuasa Tempatan
   ii. Suruhanjaya Tenaga (ST)
   iii. Tenaga Nasional Berhad (TNB)
   iv. Telekom Malaysia Berhad (TM)
   v. Jabatan Bomba Dan Penyelamat Malaysia (BOMBA)
   vi. Jabatan Alam Sekitar (JAS)
   vii. Jabatan Penerbangan Awam (DCA)
   viii. Jabatan Keselamatan dan Kesihatan Pekerjaan (DOSH)
   ix. All other relevant authorities having jurisdiction on the installations.

b. The following Act, Regulations and standards shall generally be applicable to the design of electrical systems:-

i. Electricity Supply Act 1990

ii. Electricity Regulation 1994

iii. Malaysian Standards (MS), where applicable.

iv. Other International Standards such as IEC, IES, IEEE, where applicable.

v. BS 7671: 2008 IEE Wiring Regulations for Electrical Installation, latest edition.

Where there is a discrepancy between standards, or differences in requirements specified in two or more documents, or between published specifications and the specific requirements of a local authority having jurisdiction, over electrical installations, Malaysian Standard (MS) shall be adopted.

E.3 DETAILED DESIGN SUBMISSIONS

a. The Competent Person shall submit the following information to the certifying agency for approval :-

i. Letter from the Certifying Agency on approving of external water supply system including the pumping station layout works.

ii. Catalogues for all materials/equipments where required by the Certifying Agency.

iii. Control circuit diagrams.

iv. All electrical conceptual drawings including single line diagrams and layout drawings as per items listed in Clause E.1.b. to E.1.k.

b. All electrical drawings shall be of A1 size.

c. All submission drawings shall be endorsed by a Competent Person (PE of electrical discipline as in schedule 2 of Water Services Industry (Water Reticulation and Plumbing) Rules 2014)

E.4 POWER SUPPLY REQUIREMENTS

a. The owner or developer shall apply to TENAGA NASIONAL BERHAD (TNB), through their appointed Competent Person, for electric power supply to the reservoir and/or pumping station.

b. The Competent Person shall liaise with TNB to confirm and obtain approval on the numbers, area of land required and locations of TNB substations as required.

c. The Competent Person shall apply on behalf of WDL for the most appropriate electricity tariff and intake voltage supply level from TNB.

d. The developer shall pay the electricity bill for the reservoir and/or pumping station before handing over of water supply system.

e. The developer shall be responsible for changing the TNB account name to WDL after handing over of water supply system.

E.5 MEDIUM VOLTAGE (MV) INSTALLATIONS

a. All 11 KV switchgears shall incorporate both Potential Transformers (PT) and metering Current Transformers (CT) for TNB to meter electricity usage by consumers.

b. The 11 KV circuit breakers shall be of the vacuum, gas insulation or modular distribution types.

c. A Vacuum Circuit Breaker (VCB) shall have a rated short circuit breaking current of 20 kA for 3 second minimum and rated impulse withstand of 75 kV.

d. Operation of the VCB shall be by a motor-wound spring assisted system. Both over current and earth fault protection via electronic relays shall be provided.

e. Integral earthing on the cable side shall be provided for outgoing feeders.

f. All MV design shall be subjected to the approval of the Certifying Agency.

g. MV cables shall be of cross linked polyethylene (XLPE) copper cables (with steel wire armoured protections). Size of cables shall meet the necessary fault level current associated with the switchgear.

h. Power transformers shall be of the cast resin or oil type, and shall comply with the requirements of BS EN 60076 and BS EN 50216.

i. A separate TNB metering panel shall be provided inside the Consumer MV switch room.

E.6 LOW VOLTAGE (LV) INSTALLATIONS

a. Low Voltage switchboards shall comprise of the following:-

   i. A floor standing cubicle shall be provided if the main incoming feeder has a running load of 250A and above.

   ii. Either a floor standing or wall mounted cubicle shall be provided if the main incoming feeder has a running load of less than 250A.

b. For Main Incoming of 800 A and above

   Air Circuit Breakers (ACB) complete with one (1) element earth fault IDMT relay, three (3) elements over current IDMT relay and all current

transformers for protection, shall be provided. IDMT shall be of the numerical or electro-mechanical type. Surge Protection devices complying with Zone 1 Protection as defined in IEC 61643-12 shall be provided.

c. For Main Incoming of less than 800 A

Moulded Case Circuit Breaker (MCCB) complete with one (1) element earth fault IDMT relay, three (3) elements over current IDMT relay and all current transformers for protection, shall be provided. IDMT shall be of the numerical or electro-mechanical type. Surge Protection devices complying with Zone 1 Protection as defined in IEC 61643-12 shall be provided.

d. For Main Incoming of less than 60 A only

A 60 A MCCB complete with shunt trip coil in series with a Zero Current Transformer (CT) and Earth Leakage Relay (ELR), complete with over current used at the incomer side, shall be provided. Electric Surge Protection devices complying with Zone 1 Protection as defined in IEC 61643-12 shall be provided.

e. Outgoing Breakers at Main Switchboards

All outgoing breakers from main switchboards to other parts of the electrical system (such as distribution boards and motor starter panels) shall be of the MCCB type, complete with shunt trip coil of appropriate rating. The rating of MCCB shall be 25% higher than the full load current.

f. Power Factor Correction

The power factor of the loads shall be corrected to not less than 0.90 lagging. The power factor correction capacitance shall be installed either at a central point, for example, at the MSB or in parallel with each individual starter panel.

g. Harmonics

Automatic harmonic current suppressors, capacitors and blocking reactors of appropriate ratings shall be installed in the main switchboards where harmonic generating equipment such as Variable Speed Drives (VSD) is installed.

h. Cable Types

Cable from main switchboard to distribution boards and motor starter panels shall be of XLPE insulated copper cables. For distribution of loads, XLPE or PVC insulated copper cables shall be used. For underground and surface mounted installations, the following cable shall be used:-

Multi-core cable of 25mm^2 and above	-	XLPE/SWA/PVC
Multi-core cable of 16mm^2 and below	-	PVC/SWA/PVC
Single core cable	-	XLPE/AWA/PVC

i. Cables for Fire Fighting Equipment

Dedicated cables to fire fighting equipment shall be of the fire resistance type approved by BOMBA.

j. Circuit Wiring

All sub-circuit and final circuit wiring shall be encapsulated by high impact uPVC conduits when concealed in false ceiling or walls, and by galvanised iron (G.I.) conduits when exposed or supplied to fire protection devices.

k. Cable Supports

All cable trunkings, trays, ladders shall be hot-dipped galvanised. Identification shall be provided for electrical trunkings and cable trays. The number of cables installed in trunking trays, conduits, and ladders shall be such that a space factor of 45% is not exceeded.

l. Materials for Switchboard and Distribution Board

The construction materials for switchboards and distribution boards (DB) shall be as follows: -

i. Main Switchboard

Constructed from electro-galvanised, or galvanised steel iron sheet, with minimum ingress protection conforming to IP42. Form 3B segregation requirement shall be met. Panel thickness shall be at least 2 mm, and painted in beige colour with a paint thickness of at least 75 micron on average.

ii. Sub-switchboard

Constructed from electro-galvanised or galvanised steel iron sheet, with minimum ingress protection conforming to IP42. Panel thickness shall be at least 2mm, and painted in beige colour, with a paint thickness of at least 75 micron on average.

iii. Distribution Board

Constructed from electro-galvanised or galvanised steel iron sheet, with minimum ingress protection conforming to IP42. Panel thickness shall be at least 1.5 mm, and painted in beige colour with paint thickness of at least 75 micron on average.

E.7 ESSENTIAL POWER SUPPLY

a. Essential back-up power supply systems, in the form of diesel standby generator sets, shall be provided for pumping stations transmitting a flow of more than 4.5 Mld.

b. For pumping stations transmitting flows less than 4.5 Mld, a manual change over switch shall be provided at the electrical switchboard to enable

switching over to back up supply from a mobile generator in the event of failure of power supply from TNB.

c. The essential backup power supply system shall be in compliance with Jabatan Alam Sekitar requirements with respect to limiting noise levels.

d. The fuel tank supplying a diesel generator shall have the required capacity to enable generator sets to continuously run for at for least 24 hours at full load.

e. The sizing of standby generators shall take into consideration the power ratings of all duty pumps running (N-1), and the starting of the last duty pump. (For example: sizing criteria for 3 duty pumps: 2 duty pump running + 1 duty pump starting)

E.8 MOTOR STARTER PANELS

a. All motor starter panels shall be of the floor standing cubicle type except for motors having loads of less than 250 A which can be of the floor standing or wall mounted type.

b. The motor starters shall either be integrated with the electrical switchboard, or it shall be a stand alone module with sub-main cables being fed from the main switchboard through circuit protective devices to its starter panel complete with earth fault relay and over current relay IDMT.

c. The motor starter panel shall have the following features:-

i. ACB/MCCB shall be provided for main incoming supply to its starter panel.

ii. The kA rating of the ACB/MCCB shall comply with the fault level of the motor starter panel.

iii. Direct On Line (DOL) starter contactors shall be rated to handle the full load current of the motor.

iv. Miniature circuit breaker (MCB) shall be provided for individual control circuits.

v. Motor heater circuits shall be equipped with motor heater switches and indicator lights.

vi. Panel heater circuits shall be equipped with MCB, heater switches, thermostat controls and indicator lights.

vii. The types of motor protection relays to be provided shall be dependent on power ratings as follows:

0 kW - 37 kW	-	Thermal Overload Relay with ERL
Above 37kW	-	Electronic micro processor or Electro-mechanical type of motor protection relay

viii. All motor starters shall be provided with phasing relays complete with MCB.

ix. The entire autotransformer and rotor resistance bank, complete with thermistors, shall be installed at the top compartment of a switchboard; and within the same vertical module of switchboard housing the motor circuit.

x. The main earth chamber shall be painted in green colour, and the proposed type to be employed shall be subject to the approval of the Certifying Agency.

xi. The motor can be operated by local manual control, automatic control or remote control mode via a SCADA/ Telemetry system.

xii. The automatic operation of motors shall be controlled by the level of water in the suction and elevated service reservoir tank, by floatless and control relays at the motor control centre, and by a 3-CORE (copper) PVC/SWA/PVC underground cable laid adjacent to the pumping mains. If the elevated service reservoir tank is located external to the compound of the pumping station, a controller which is coupled with a GSM/GPRS (SMS) system, conforming to WDL requirements, shall be provided. This shall be an independent system from the existing Telemetry system.

xiii. Cables for automatic operation shall be of 2.5 mm2 or above, and insulation shall be above 10M ohm.

xiv. All electrode sets shall be of 13 mm diameter, and of stainless steel make.

xv. The starter shall have a protection timer incorporated in the starting sequence.

xvi. All indicator lights shall be of the LED type.

xvii. Power factor shall be corrected to not less than 0.90 lagging.

xviii. All capacitor banks shall be rated at 440V and shall be protected by fuses.

xix. All outgoing cables to motors shall be of the armoured type, and shall be laid in trenches or concealed in G.I. conduits placed on the floor slab.

E.9 ELECTRIC MOTORS

a. All motors shall be of the induction type as specified below:-

i. All motors shall be of the High Efficiency Motor standard type, i.e. EFF1 CEMEP-EU standard, Class 1 as detailed in **Table E.1**. Motors of capacity greater than 90 kW shall have an efficiency of not less than 95.0%. Compliance to this Clause is mandatory for external

pumping stations.

ii. High Efficiency Motors of performance rating equals to or exceeding EFF1 class certified by other internationally recognized organizations may also be used subject to the approval by the Commission.

iii. Motor up to 10 horsepower / 7.5 kW shall be of squirrel cage motor with direct-on line starter.

iv. Motor of more than 10 horsepower / 7.5 kW and less than 150 horsepower / 110 kW shall be squirrel cage motor with autotransformer starter.

v. Motor of 150 horsepower / 110 kW and above shall be squirrel cage motor with soft starter or slip rings motor with rotor resistance starter.

vi. Autotransformer starters may be used for motors of rating higher than 150 horsepower / 110kW on the condition that a detailed calculation to verify that TNB's power supply system is not adversely affected by the starting of the pumps is approved by TNB.

b. In any case, the starting operation of a motor shall not have any undesirable effects on other electrical power consumers.

Table E.1 Class Definition for Electrical Motors

Motor Capacity (kW)	Motor Efficiency (%) for Class EFF1	
	2-Pole Motors	4-Pole Motors
1.1	≥ 82.8	≥ 83.8
1.5	≥ 84.1	≥ 85.0
2.2	≥ 85.6	≥ 86.4
3	≥ 86.7	≥ 87.4
4	≥ 87.6	≥ 88.3
5.5	≥ 88.6	≥ 89.2
7.5	≥ 89.5	≥ 90.1
11	≥ 90.5	≥ 91.0
15	≥ 91.3	≥ 91.8
18.5	≥ 91.8	≥ 92.2
22	≥ 92.2	≥ 92.6
30	≥ 92.9	≥ 93.2
37	≥ 93.3	≥ 93.6
45	≥ 93.7	≥ 93.9
55	≥ 94.0	≥ 94.2
75	≥ 94.6	≥ 94.7
90	≥ 95.0	≥ 95.0

E.10 INTERNAL LIGHTING AND POWER REQUIREMENTS

a. General lighting and power distribution inside the pumping station shall be fed from a distribution board equipped with a current operated Residual Current Device (RCD) and main switch. Separate Residual Current Device (RCD) shall be employed for delivering power to lighting fixtures and power switch socket outlets. The sensitivity of the RCD shall comply with the latest Suruhanjaya Tenaga's specifications for various applications.

b. The light fitting and illumination levels for common areas in pumping stations are stated in **Table E.2**.

Table E.2: Illumination Level

Area	Maintained Average Illumination (lux)
Office/Computer Rooms	400
Store	200
M&E Plant rooms and Pumping Station	250
Internal Corridors	100
Toilets	150

c. Control of lighting for the different areas of a pumping stations and reservoirs shall be achieved by the following methods, depending on type of area and usage:-

i. Partitioned areas : Individual switch

ii. Open areas : Switch centre

d. Lighting circuits shall be arranged as alternating circuits.

e. Lighting and small power circuitry / DB shall be provided with Earth Leakage Circuit Breaker (ELCB) complete with auto reset function for Reservoirs.

f. All light fittings shall be of energy efficient type.

g. The types of light fittings to be employed at different areas are described in **Table E.3**.

h. Exit lights ("KELUAR" SIGN) and self-contained emergency lights of fluorescent type, with minimum three hours of battery (rechargeable) reserve, shall be provided for all areas in accordance with BOMBA and UBBL requirements.

i. A "KELUAR" sign complete with arrow sign showing the exit direction shall be provided where appropriate.

j. Sufficient power points of a suitable type and rating shall be provided to serve the intended use of common areas or rooms, and for all equipment and plants to be installed including power points for all mechanical equipment requirements.

k. Each equipment shall have its own power point. No two (2) equipments shall share the same power point. Additional 13A switch socket outlets shall be provided for general use in all areas.

Table E.3: Type of Light Fitting

Area	Area Type of Light Fitting
Office/Computer Rooms	Fluorescent light fittings with aluminium reflector (Preferably using 28W T5 lamps)
Store	Bare channel fluorescent light fittings (Preferably using 28W T5 lamps)
M&E Plant rooms and Pumping Station	a. 5 m height and above - low bay metal halide (corrosion resistance type) b. Less than 5 m - wall mounted fluorescent light fittings complete with metal reflector (Preferably using 28W T5 lamps)
Internal Corridors	Fluorescent light fittings with aluminium reflector (Preferably using 28W T5 lamps)
Toilets	Compact fluorescent down light c/w electronic ballast

E.11 EXTERNAL LIGHTING INSTALLATIONS

a. External compound street lighting shall be provided for the pump stations and reservoirs. The compound / street lighting shall be mounted on 5 m high galvanized iron poles. Other types of compound / street lighting pole shall be subjected to the approval of the Certifying Agency. Wall mounted light fittings shall be used where pole mounted light fittings are not suitable. Generally, the spacing between the poles shall not exceed three times the mounting height of the pole. The lamps for the light fittings shall be of SON/energy saving type or equivalent. The illumination level on the ground road surface shall not be less than 15 lux.

b. Area floodlighting shall be provided where necessary, and SON type of floodlighting shall be provided with an average of 30 lux.

c. Suitable path lighting with SL or PL lamps shall be provided in the walk paths.

d. All linkways and covered walkways shall be illuminated using tamper proof luminaries with an average illuminating level of 30 lux.

e. Control of these various lighting systems shall be by local relays, time switches and photocells complete with contactors. Override facilities shall also be provided.

E.12 LIGHTNING AND SURGE PROTECTION SYSTEMS

a. Lightning protection system shall be provided for pumping stations, service reservoirs and suction cistern, especially for RC structures.

b. Lightning protection system for the building shall be of the Faraday cage type conforming to MS-IEC 61024-1 requirement. Other lightning protection

systems shall be subjected to the approval of the Certifying Agency.

c. For metal roofing, the metal structure shall be exothermically bonded with a copper tape or bare stranded G.I. cable. Otherwise roof conductors shall be installed.

d. The system shall comprise down conductors, non-radioactive air terminals, fixing, bonding, jointing, test clamps, earth clamps, earth electrodes, concrete and precast earth chambers, etc.

e. All exposed metallic protrusions on buildings shall be connected to the lightning protection system.

f. Lightning surge protection devices shall be provided for all power and data lines to ensure all equipment inside computer rooms, network equipment rooms and SCADA/ Telemetry control rooms are protected against lightning surges complying with Zone 1 Protection as defined in IEC 61643-12.

g. All down conductors shall be concealed in conduit within building structures to prevent the theft of the copper conductor.

h. Earth resistance value for lightning protection system shall not exceed 10 ohms.

E.13 EARTHING SYSTEMS

a. Earthing systems shall comprise several sets of earth electrodes, earth clamps, lug couplings, copper tape or bare stranded G.I. cable and concrete and precast earth chambers. More elaborate measures shall be proposed if earth resistance values could not be achieved.

b. An equipotential earthing system shall be provided to prevent dangerous voltage rise between different earthing systems. This involves tying together the various roof earthing systems for electrical, lightning protection, telecommunication and the building structure. All service metallic pipes and exposed metallic protrusions on the building shall be earthed together.

c. Earth resistance for electrical earthing, electronic and telecommunication (clean) earthing shall be of 1 ohm or less (separately measured for each system before interconnection).

E.14 ELECTRICAL SPARE PARTS

Developer/Contractor is required to provide the following electrical spare parts:-

a.	RCCB and MCB	-	5 nos. (each type)
b.	MCCB	-	1 no. (each type)
c.	Contactor	-	5 nos. (each type)
d.	Lamps	-	5 nos. (each type)

e.	HRC Fuses	-	5 nos. (each type)
f.	Indicating Lamps	-	5 nos. (each type)
g.	Voltmeter	-	1 no. (each type)
h.	Ammeter	-	1 no. (each type)
i.	Motor Protection Relay	-	1 no.
j.	Current and Voltage Transformer	-	1 no. (each type)

All proposed brands for spare parts shall be as per that installed at site.

E.15 ELECTRICAL AS-BUILT FITTED DRAWINGS

a. All electrical drawings shall be of A1 size and endorsed by a Competent Person.

b. Three (3) sets of electrical drawings and electrical load calculations and three (3) sets of key plan shall be provided and endorsed by the Competent Person on behalf of the developers / contractors where:-

   i. One (1) set of main single line diagram shall be framed and hung in the pumping station.

   ii. One (1) set shall be submitted to WDL Headquarters.

   iii. One (1) set shall be submitted to the District Office of WDL.

c. Three (3) sets of Operation and Maintenance Manual shall be provided by the Competent Person on behalf of the developers / contractors where:-

   i. One (1) set shall be kept in the pumping station and located at a wall mounted rack.

   ii. One (1) set shall be submitted to WDL Headquarters.

   iii. One (1) set shall be submitted to WDL District Office.

d. Two (2) electronic copies (in AutoCad Format) of the As-Built drawings and O&M Manual shall be handed over to the WDL.

E.16 TESTING AND COMMISSIONING

a. Two (2) sets of a testing and commissioning reports incorporating results that are endorsed by a Competent Person, shall be forwarded to the Water Distribution Licensee (WDL).

b. The developer's contractor shall carry out all testing and commissioning to verify the safe, reliable and satisfactory operation of the electrical supply and distribution system and equipment installed.

c. At least two months prior to testing or commissioning of any system, the developer's contractor shall furnish the following information for each system or process to the WDL for review.

   i. Testing procedure and details as well as the relevant report forms that will be submitted to the WDL for approval.

   ii. Type of testing instruments to be used

   iii. Valid calibration certificate by approved Authority

   iv. Complete schedule and programme of all testing and commissioning activities

d. The developer's contractor shall employ a team of competent and experienced personnel to carry out all testing and commissioning works. If it is the opinion of the WDL that the testing and commissioning of parts of a system or the whole system, have not been properly executed by the contractor's own staff, the contractor shall employ a qualified independent Testing and Commissioning Specialist to carry out necessary Works, when directed by the WDL. The cost of employing this Testing and Commissioning Specialist shall be borne by the contractor.

e. The developer's contractor shall provide all instruments, tests and labour necessary for testing and commissioning of the entire installation.

f. All instruments shall have been recalibrated within six months of the start of commissioning or testing. Calibration of all instruments shall be certified by the instrument manufacturers or an approved calibration agency.

g. Should the results of any test show that any plant, system or equipment fails to perform to the efficiencies or duties as given in the Specifications, the developer's contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance may be obtained.

h. Should it be necessary for the developer's contractor to modify or replace any item of plant as described above, he shall be responsible for the cost for making good of any damage or deterioration to the building or other services consequent to such modifications.

i. All equipment testing and commissioning shall be carried out by relevant engineers who has undertaking the similar system.

Part F:

Telemetry and SCADA Systems

PART F: TELEMETRY AND SCADA SYSTEMS

F.1 DETAILED DESIGN SUBMISSION

a. The submission requirements shall as per Clause E.3

b. The Competent Person shall submit the following information to the Certifying Agency for approval:-

i. Catalogues for Telemetry and Instrumentation Equipment.

ii. All SCADA/ Telemetry system drawings.

F.2 GENERAL

a. The purpose of Telemetry or Supervisory Control and Data Acquisition System (SCADA) systems are to enable real time measurements and data acquisition of operating parameters associated with water supply facilities located at remote (outstation) areas. In this context information such as water levels at suction tanks and reservoirs; flow rates and flow volume at outlet pipes of reservoirs; pump operating status (On / Off / Fault); pressure level at pump delivery pipes, and other such important operational parameters are required to be transmitted from an outstation facility to WDL's command centre.

b. SCADA, enables WDL personnel to operate and control the essential functions of water supply facilities at remote areas from their operating centres, in addition to recovering basic information (as in a Telemetry System).

c. Telemetry systems shall be planned, design and installed and paid for by Developers; whereas SCADA systems which build on Telemetry systems shall be installed by the WDL.

d. A Telemetry system shall comprise, inter-alia, transducers (sensors), local display panel / indicator panels, power supply units, Remote Terminal Units (RTU), all necessary cabling work and GPRS / GSM modems for transmission of data to the WDL's command centre. For water supply facilities located at areas where GPRS / GSM services are not available, the wireless communication shall be by radio link.

e. The developer's scope of work for the Telemetry system shall also include installing a termination block at the motor control centre to enable remote manual start / stop of the pumps when the Telemetry system is upgraded by WDL to a full fledged SCADA system.

f. All detailed drawings for RC chambers and covers for flow and pressure transmitters shall be submitted to the Certifying Agency (CA) for approval prior to construction. All chambers shall be design to protect it from becoming water logged.

g. The laying of power and signal cables (inclusive of protective covers, cable route markers and cable joint pillars (for underground cable joint, if any) shall be in accordance with the requirements of the WDL. All underground cables shall be of the Steel Wire Armoured (SWA) type.

h. All earthing points shall be of 1 ohm or less.

i. All equipment and instrumentation requirements and specifications shall comply with the requirements of the WDL.

j. All testing, commissioning and calibration of Telemetry and SCADA system shall be carried out by the supplier as authorized by the WDL.

F.3 HARDWARE REQUIREMENTS

F.3.1 General

a. State-of-the-art Telemetry equipment shall be provided, and shall incorporate the latest available solid-state designs which have successfully been tested in field operations, and are capable of giving satisfactory performance and be compatible with WDL's hardware and software requirements for a SCADA system.

b. The Telemetry system shall be modular in concept, leading to a system that can be easily expanded, modified or reconfigured. The system shall be expandable in order to cope with envisaged future requirements. The addition of outstations or MMIs in future shall be carried out without taking the system out of service and shall not jeopardize the continuous working of the rest of the system.

c. The system shall be designed for continuous fail-safe operation with minimum amount of maintenance. Failure in any part of the system shall be localized to that part only, and shall not cause damage to other parts of the system.

F.3.2 Outstations

a. The outstation equipment shall be provided in dust proof, industrial type fiber reinforced-polyester enclosures rated at IP66 for both indoor and outdoor installations. All outstation equipment including the GSM modem, antennae and back-up power batteries shall be installed within an enclosure, and shall not be directly exposed to the elements.

b. The outstation equipment furnished shall be designed for installation in a dusty, humid and tropical environment and shall operate satisfactorily in temperatures between 5 deg. C and 70 deg. C, and up to 95% relative humidity assuming no condensation will occur. Each outstation shall be a stand alone RTU, unit capable of performing data acquisition and control, independent of the master station. Each outstation shall be provided with the required number of inputs and outputs subject to the approval of the WDL.

c. All inputs shall be time-tagged and transmitted to the master station. The time-tag shall be the actual time of an event, and its accuracy and resolution shall be within 1 second.

d. Reservoirs at outstation locations shall communicate with the master station via a GPRS communication link. In the event of a GPRS connectivity failure, the reservoir outstations shall be able to operate a SMS to the Master Station and/or to respective pumping stations at outstation locations. The outstation RTUs shall incorporate a report-by-exception (RBE) feature, where only data from 110 points that have experienced a change in status shall .be reported back to the master station. For analogue input points, the user shall be able to set the percentage of change in the measured parameter that represents a change in status for reporting to the master station.

F.3.3 Remote Terminal Units

Remote Terminal Units (RTUs) shall be provided at outstation facilities in accordance with the related specification requirements and drawings. Two (2) types of RTU shall be used for different types of function. Both RTU types shall be equipped with a Pulse Counter function which can be assigned to any digital input (DI) point.

a. Type 1 : Designed for installations at remote sites without a permanent AC power supply source. The RTU shall be suitable for operation powered by a single phase supply with auxiliary supplies at 24VDC supply or 12VDC supply from a solar power system. Adequate quantity of solar panels shall be provided to fully restore battery power within 4 hours. Adequate quantity of batteries shall be supplied to provide power supply to the RTU and accessories for operations of up to 5 days without need for charging.

b. Type 2 : Designed for installations at pumping stations and any remote sites that require an expandable feature such as video surveillance features, door access system, and others.

Each type of RTU provided for the scheme shall be from the same manufacturer to provide standardization and interchangeability of equipment; in addition 20% active spares shall be provided for both types of RTU.

The communication protocol provided between RTU and control center (master center) shall be a minimum DNP 3.0; and the minimum standard of communication protocol between RTU and smart sensors shall be by Profibus PA or Profibus DP. The RTU shall be of low-power design. During active mode, the RTU shall consume no more than 1.2 watt. The RTU programming shall be compliant with IEC 61131-3 programming standard, and shall be supported with minimum ladder diagrams and structured texts. The analogue inputs shall have a 16-bit resolution with signal input accuracy of at least 0.05% of full-scale span.

F.3.4 GPRS/GSM Modem

a. GPRS / GSM modems shall be provided at each of the remote outstations for data communication. The modems shall come with a dual band feature, and be designed for data, fax, SMS and voice applications. The modems shall be compliant with GSM phase 2/2+ and allow control via AT commands. The modems shall support MS Class Band GPRS Class 8 for data transfer, and be suitable to operate in temperatures up to 55 deg. C. Modems at master stations shall be configured to send SMS to the selected authorized personnel and must be ready to receive SMS from existing metering zone sites. Modems at outstation areas shall be able to communicate with a broadband connection at the master station.

b. The outstations shall have a continuous GPRS link with the master station and upload any status change data to the master station. The master station shall not have to poll the outstations for data.

F.4 COMMUNICATION SYSTEMS

a. Outstation RTUs must be configured to use GPRS as a primary link to communicate with a master station, and must be able to switch to SMS mode in the event of GPRS connectivity failure.

b. In the event of GPRS connectivity failure, the data must be recorded, compressed and sent back to the Master Station via SMS at 4 hour intervals. Regardless of the failure of GPRS, all critical alarms shall be sent back in real time via SMS to the respective parties as specified by the WDLs.

c. Data transfer delay from RTU to Master Station and vice versa shall be within seconds.

F.5 REQUIREMENTS OF TELEMETRY SYSTEM FOR WATER SUPPLY FACILITIES

F.5.1 Introduction

a. Local RTUs shall transmit the relevant data including water levels, pressure, flow and other related information, for monitoring purposes via GPRS/GSM network to the WDL'S Master Station (Command Centre) as required in F.1 and F.2 above.

b. Additional features for the purpose of automatic operation, or SCADA, is beyond the scope of this Uniform Technical Guidelines.

F.5.2 Suction Tanks

a. One (1) no. pressure transmitter complete with pressure gauge and lightning surge arrestor shall be provided in a RC chamber located at the inlet pipe. The instrument shall be housed within a floor mounted weatherproof metal cabinet complete with high quality stainless steel padlock. Cable used shall

be of 4 Core (C) of 2.5 mm^2 PVC armoured copper cable applicable to both power and signal transmissions. An earthing system of less than 1 ohm shall be provided.

b. One (1) no. level instrument ultrasonic transmitter, complete with lightning surge arrestor, shall be provided at the suction cistern. The instrument shall be housed within a floor mounted weatherproof metal cabinet complete with high quality stainless steel padlock. Cables used shall be of 4C 2.5 mm2 PVC armoured copper cable applicable to both power and signal transmissions. An earthing system of less than 1 ohm shall be provided.

c. An overflow detection system and level instrument accuracy checker, complete with stainless steel electrodes mounted on a stainless steel bracket, and supported by floatless and auxiliary relays, shall be provided at the overflow chamber to detect any overflows. Armoured type copper cable shall be employed for power and signal transmissions. Overflow detection will induce an alarm upon detecting a dangerous high liquid level. An accuracy checker will compare the reading at the level sensor against a fixed level water point in the suction tank. Percentage of error shall not exceed 2%.

d. Copper tape complete with concrete earthing chamber shall be used for an external lightning protection system. All installations shall be concealed inside a slab wall, etc. Earthing systems of less than 10 ohm shall be provided.

e. A 600 mm diameter mechanical dial indicator, incorporating a stainless steel wire type, shall be provided. The range of measurement shall be from 0 - 10m.

F.5.3 **Pumping Stations**

a. One (1) no. magnetic flow meter with transmitter complete with two (2) nos. lightning surge arrestor shall be provided within RC chambers along the delivery pipes located within the pumping station compound. The flow meter shall be provided with a 25 mm dia. full bore tapping complete with ball valve. All instruments shall be housed in a floor mounted weatherproof metal cabinet complete with high quality stainless steel padlock. Cables used shall be of 4C 2.5 mm2 PVC armoured copper cable for both power and signal transmission (with 2 pairs of spare cables provided in each case). An earthing system of less than 1 ohm shall be provided.

b. A floor standing Remote Terminal Unit (RTU) instrumentation panel shall be provided complete with mimic diagram, one (1) no. RTU GSM System, time switch with contactor, all lightning surge arrestors, standby power supply system, relays, alarm annunciator, digital indicator, digital clock, indicating lights, siren and high quality stainless steel padlock. An earthing system of less than 1 ohm shall be provided.

c. One (1) no. pressure transmitter complete with pressure gauge and lightning surge arrestor shall be provided in a RC chamber at the pumping main. The instrument shall be housed in floor mounted weatherproof metal cabinet made of high quality stainless steel. Cables used shall be of 4C 2.5 mm2

PVC armoured copper cable (for both power and signal transmissions). An earthing system of less than 1 ohm shall be provided. A display shall be provided at the instrumentation panel for this sensor to indicate the pumping pressure when the pump is running. The signal will be converted to water level in the high reservoir tank when the pump casers to operate.

d. The outstation pumping station shall also perform pump cycling operations. After a particular pump has been on duty for a certain accumulated period of time, the outstation shall stop the pump and designate the next pump as the duty pump. The change in status of the pumps should be detected by the Telemetry system and reported to the master station.

F.5.4 **Reservoirs**

a. One (1) no. magnetic flow meter coupled to a transmitter and with two (2) nos. lightning surge arrestor shall be provided in RC chambers at the outlet pipe. The flow meter shall be provided with a 25 mm dia. full bore tapping complete with ball valve to incorporate the flow sensor. All instruments shall be housed in a floor mounted weatherproof metal cabinet complete with high quality stainless steel padlock. Cable used shall be of 4C 2.5 mm2 PVC armoured copper cables (for both power and signal transmission, with 2 pairs of spare cables provided). An earthing system of less than 1 ohm shall be provided.

b. One (1) no. level instrument ultrasonic transmitter complete with lightning surge arrestor shall be provided at the reservoir cistern. The instrument shall be housed in floor mounted weatherproof metal cabinet complete with high quality stainless steel padlock. Cables used shall be of 4C 2.5 mm2 PVC armoured copper cable (for both power and signal transmission). An earthing system of less than 1 ohm shall be provided.

c. An overflow detection system and level instrument accuracy checker, complete with stainless steel electrodes mounted on a stainless steel bracket, and provided with floatless and auxiliary relays, shall be provided at the overflow chamber to detect any overflows. Armoured type of copper cables (for both power and signal transmission) shall be employed. Overflow detection will induce an alarm upon detecting a dangerous high level. An accuracy checker will compare the reading at the level sensor against a fixed level water point in the reservoir. Percentage of error shall be not more than 2%.

d. Copper tape complete with a concrete earthing chamber shall be used in association with an external lightning protection system. All installations shall be concealed inside a slab wall. Earthing system of less than 1 ohm shall be provided.

e. One additional RTU GSM system shall be provided at the reservoir site if the reservoir location is outside both the pumping station and suction cistern compound. The panel shall be installed together with a high quality stainless steel padlock, time switch with contactor, all lightning surge arrestors, standby power supply system, and relays.

f. A 600 mm diameter mechanical dial indicator with stainless steel wire type shall be provided. The range shall be from 0 -10 m.

g. A pumping line and scouring line shall be connected to the relevant sensors for detection purposes through Telemetry system.

h. The outstation reservoir shall update the master station on the status of the field instruments and equipment on a Report-By-Exception (RBE) basis. This means that the outstation shall only report back to the master station on input / output points that have changed in status. For analogue signals the percentage change that represents a change in status shall be manually or automatically adjustable.

i. The Master Station located in the Command Centre shall be configured with the high and low levels of each ground and elevated reservoir. However, the need for the additional level configuration on alarms can be software generated.

j. Alarms generated shall be able to be viewed by a Crisis Operation Centre located at the office of WDL for appropriate action to be taken.

k. An earthing system of less than 1 ohm shall be provided.

F.5.5 Testing and Commissioning

a. The testing and commissioning shall be as per Clause E.16

b. All testing and commissioning works shall be carried out by the developer's SCADA/ Telemetry specialist.

F.5.6 Spare Parts

The following spare parts shall be provided with each Telemetry system:-

a.	Ultrasonic level transmitter	- 1 unit
b.	Category 2 Lightning Protection Unit (LPU)	- 1 unit
c.	Category 3 Lightning Protection Unit (LPU)	- 4 units
d.	Lead acid rechargeable battery	- 2 units
e.	Pressure transmitter	- 1 unit
f.	RTU with built in Programme Logic Controller (PLC) + modem	- 1 unit

Part G:

Water Consumption Metering

PART G : WATER CONSUMPTION METERING

G.1 METERING

G.1.1 General

a. Water supplies provided by Individual Licensee to all type of premises and areas shall be metered. The type and size of meter shall be determined by the WDL.

b. All supplies to fire hydrants and other fire fighting devices installed within a consumer's premise or within a premise compound shall be separately metered.

c. For high rise residential buildings and gated communities, water shall be supplied through bulk meters which measures the total volume of water abstracted from the public mains, including water consumed at individual parcels which is accounted for by parcel meters.

d. Individual metering shall be carried out for all multi-unit residential premises. However, the developer/Management Corporation shall sign an agreement with the WDL confirming that the developer/Management Corporation will operate and maintain the water supply system located downstream of the bulk meter, including storage and suction cisterns as required by the Commission, and shall pay for water supplies based on the difference between bulk meter consumption readings and the sum of water delivered to each residential unit as measured by individual parcel meters supplied by the WDL (Refer to Rules 83, 84, 85, 86 and 87 of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014).

e. For higher accuracy, and the need to transmit the flow data in electronic format, electro-magnetic meters may be used in lieu of the mechanical meter. The accuracy of the electro-magnetic meters at maximum flow, nominal flow and minimum flow shall comply with the requirements of BS EN 14154-1:2005 and ISO 4064:2005.

f. All meters shall be supplied and fixed by and remain the property of the water distribution licensee.

g. The consumer shall be solely responsible for the safe custody of the meter or meters which are sited within the boundary of the consumer's property and are fixed on the service water pipe or pipes supplying water to his premise.

G.2 LOCATION OF METERS

a. The location of a meter shall be determined by the WDL.

b. The meter shall be installed in such a position that it should be unobstructive and can be easily accessible for meter installation, meter reading, maintenance and for meter disconnections (Refer to Rules 73 and 74 of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014).

c. For shop houses and walk-up flats not further than 15 metres high, and where consumers are served by individual storage cisterns, meters registering water consumption by each consumer shall be installed at the ground floor, and arranged in stacks which clearly demarcates the floor level served. Individual meters will have attached address plates.

d. All bulk meters for apartments, flats, factories, condominiums and schools shall preferably be placed within the fenced compound area, and close to the guardhouse or entrance gate, or any other location as determined by the WDL.

e. Meters shall be centrally placed at each floor of a high rise building, or in front of individual parcels at locations which are easy to install, access, read and disconnect a meter. A meter should preferably be installed in a box recessed into the wall and shall not be positioned at the corridor in a manner that will affect movement along the corridors.

g. For meters placed in shafts, or boxed in chambers, sufficient natural light must be available for ease of reading. Alternatively, electrical lighting shall be provided.

G.3 SIZE OF METERS

The recommended criteria for selection of mechanical water meters are described in **Table G.1** below.

Table G.1: Criteria for selection of water meters

Reference	Meter Size (mm)	Recommended Continuous Flow (Q_n)		
		m3/hr	m3/month	m3 / two months
ISO 4064 Class C meters	15	1.5	1,080	2,160
	20	2.5	1,800	3,600
	25	3.5	2,520	5,040
	40	10.0	7,200	14,400
ISO 4064 Class B meters	50	15	10,800	21,600
	80	40	14,400	28,800
	100	60	43,200	86,400
	150	150	108,000	216,000
	200	250	180,000	360,000
	250	400	288,000	576,000
	300	600	432,000	864,000

G.4 AUTOMATIC METER READING SYSTEM (AMR)

a. The WDL may at its own discretion implement an AMR at premises. The use of AMR provides enhanced security, privacy, accuracy and timeliness in meter reading.

b. The WDL shall inform the developer during the design stage of any development of its intention to implement AMRs for the developer.

c. Developers shall ensure that all necessary provisions be allowed for in the development to facilitate installation of AMRs.

G.5 METER/SUB-METER STANDS

G.5.1 General

a. This section covers information on the dimensions and various material requirements for water meter / sub-meter stands connected to a public main.

b. Materials for meter / sub-meter stand shall be of stainless steel or rigid composite metallic pipe materials.

c. For each individual meter / sub-meter stand at high rise residential buildings, the meter shall be arranged in correct order and marked as per the requirements of WDL.

d. Meters in scripted with a symbol indicating upward flow of water are allowed to be placed vertically. Such meters shall be installed a minimum of 1.2m to 1.5m above the ground level.

e. Individual meters may be installed in a vertical position at high-rise residential buildings provided that the meters are designed for vertical installation and for ease of reading. The number of vertical meters that can be stacked one over the other shall be limited to five (5) numbers only.

f. Minimum size of meter shall be 15mm diameter.

g. Gap between meter / sub-meter stands shall be not less than 150mm.

h. A stop valve shall be placed immediately upstream of the meter.

i. A lockable stop valve may be installed by the WDL upstream of the meter.

j. Typical configuration of meter / sub-meter stands for single and multi-meters (up to 5 water meters) are as shown in the **Standard Drawing Nos. SPAN/WS/STD/F/031 and SPAN/WS/STD/F/033**, and **Standard Drawing Nos. SPAN/WS/STD/F/032 and 034** respectively. Typical meter stands for pipe sizes from 80mm to 200mm is depicted in **Drawing No. SPAN/WS/ STD/F/022**.

k. Meter / sub-meter stands should comprise the following components:-

   i. Stainless steel / approved composite metallic pipe material.

   ii. Outgoing pipe of 20mm or 25mm ID (depending on design).

   iii. Incoming pipes of 20mm ID for one-meter stands.

iv. Incoming pipes of 25mm ID for two-meter stands.

v. Incoming pipes of 50mm ID for three to five meter stands.

vi. Stop valve or ball valve (full bore) for two to five meter stands..

vii. If required backflow preventers shall be located a distance of at least 10 times the diameter of the service pipe downstream of meters installed in premises specified in the Water Services Industry (Water Reticulation and Plumbing) Rules 2014 [Refer Rule 40, Table 1].

viii. All nipples, couplings, elbows, jam nuts, tees etc. shall be of stainless steel.

ix. Saddles and ferrules shall be installed to tap water from the public mains.

x. All meter stands shall be anchored into a minimum 600mm x 300mm concrete slab reinforced with BRC of thickness not less than 50mm.

l. Other jointing combinations for single and multi-meter / sub-meter stands are as shown in the **Standard Drawings (SPAN/WS/STD/028 and SPAN/WS/STD/030)**.

G.5.2 Markings for Meter/Sub-Meter Stands

No markings are required for single meter / sub-meter stands. For two or more meter / sub-meter stands, identification markings of the unit number shall be provided in an engraved stainless steel plate permanently mounted on the wall, or otherwise be clearly painted on both sides of the meter / sub-meter stand itself, as per the requirements of the WDL.

Part H:

Particular Construction and Commissioning Specifications

PART H : PARTICULAR CONSTRUCTION AND COMMISSIONING SPECIFICATIONS

H.1 CONSTRUCTION OF PIPELINES

The following narrative is confined to trench excavations to lay water pipelines

H.1.1 General

Trenching works are steep temporary cuttings that are backfilled once a utility such as a pipeline has been laid.

- The design of trench excavation is normally the responsibility of the Contractor appointed for the works. The Contractor shall engage a Competent Person to undertake a safe and proper shoring design. No temporary works deemed unsafe shall be allowed.

- For excavations not exceeding 1.2m, shoring support may not be required if the ground is found to be self-supporting. If external loads are likely to be present, or if there is doubt as to the stability of the trench sides due to weak ground and/or high ground water table, especially in rainy weather, the trench sides should be supported even if the excavation depth is less than 1.2m.

- For excavations exceeding 1.2m, adequate support must be installed in a timely manner, and as far as practicable, ahead of any further excavation.

- The typical shoring details given in **Figure H.1** may be acceptable for depths up to 4.5m. Guidance on the design of shoring works can also be found in Construction Industry Research and Information Association, London (CIRIA) Report 97 on prescriptive design and Utilities Technical Liaison Committee (UTLC) (2003).

- All excavations must be properly designed, and Competent Person are required to take adequate precautions to ensure public safety. Specific designs with detailed drawings shall be prepared for excavations meeting the following criteria:

  i. Deeper than 4.5m and greater than 5m in length, and

  ii. Liable to affect any road, building, structure, slope steeper than 30˚, water main 75mm in diameter or greater, the affected area being defined as within 45˚ line up from the base of the excavation to the ground surface.

- It is also not desirable to have the whole length of a long trench opened up at any one time, even with support. Excavations should be in sections of shortest practical length, preferably not more than 100 meters long.

H.1.2 Technical Consideration

- The design and construction of trenching and shoring works shall consider the following failure mechanisms:

  i. The collapse of vertical sides of poorly supported trenches which may cause subsidence of the neighbouring ground or the death of workers in the trench.

  ii. Heaving or softening at base of excavation due to high ground water pressures which may adversely affect the foundation for pipe laying.

  iii. Heaving at base of excavation due to shear failure of the soil causing local subsidence inside the trench.

  iv. The erosive action of ground water, washing sand and silt into the trench and causing local subsidence.

  v. Consolidation of neighbouring compressible soils due to local reduction of ground water table which may cause settlement of adjacent foundations or the opening of sewer joints, etc.

- Consideration shall be given to loads imposed on the open trench such as vehicular loads and loads due to excavated spoil or stockpiling of materials near the excavated trench.

- Trenches located at the toe of a slope or earth-retaining structure can reduce its stability and should be avoided wherever possible. Where it is unavoidable, trench supports must be designed to ensure that the stability of the nearby slope or earth-retaining structure is not compromised by the trenching work. Stability analyses of the affected slope/structure may be required.

- Pipe trenches shall be backfilled with suitable materials and shall be properly compacted in accordance with the specifications.

H.1.3 Drainage Consideration

- Drainage measures shall be provided regardless of the excavation depth. This is especially important when trenches are located uphill or in close proximity to slopes and opened during the rainy season. Effective measures shall be implemented to:

  i. Minimise the ingress of surface run-off.

  ii. Control infiltration of rainwater and water runoff from an open trench into nearby slopes.

- Up-stands used together with trench covers have been found to be effective in dealing with surface runoff. Up-stands are provided on either side of the trench and can be made of compacted earth fill bunds cemented together. The height of the up-stand shall be determined by the designer but shall not be less than 10 cm.

- Pumping from small sumps shall be provided for all trenches located at slope crest, on slopes or in flood prone areas and opened up in the rainy season.

- High ground water table levels can be controlled by means a dewatering system. However, dewatering can cause the consolidation of neighbouring compressible soils and thus, the settlement of adjacent foundations and utilities, opening of sewer joints, etc. Where this risk arises, assessments should be carried out by a qualified Professional Engineer with appropriate experience to ensure the safety of adjacent structures/infrastructures.

H.1.4 **Shoring**

- Construction works shall be supervised by the Competent Person who is responsible for the Temporary Works design and who shall also ensure that trenches are constructed strictly in accordance to the design and contract specification, and safety requirements.

- Where the ground conditions are poor and have little “free-standing” time, the installation of sheeting, excavation and insertion of waling and struts shall proceed in stages until the full excavation depth is achieved.

- Under no circumstances should workers be permitted to work in an unsupported trench that is deeper than 1.2m.

- When removal of struts are required in order to give access during lowering of pipes, equipment or compaction of backfill, only the minimum practicable number of struts should be removed. The ground shall be adequately supported at all times while workers are in the trench.

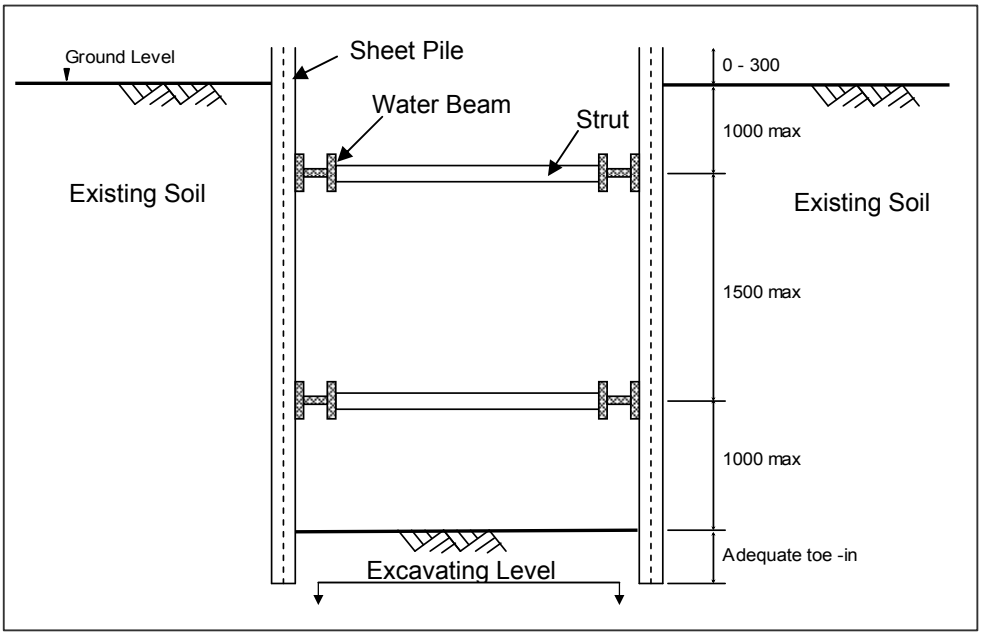


Figure H.1: Typical sheet pile shoring detail with steel struts and water beams

Notes:

1. All dimensions are in millimeters (mm).
2. The sizes of the structural members (e.g. sheet piles, struts and water beams) and spacing between struts shall be adequately prescribed based on actual excavation depth, ground conditions and other factors affecting loading on the shoring system.

H.2 INSPECTION, TESTING AND COMMISSIONING OF PIPELINES

H.2.1 Inspection

a. Prior to hydrostatic testing of pipelines, the installation inclusive of all testing equipment shall be inspected by the Competent Person or his representative at the Site.

b. The inspection of underground pipe shall focus on the following:-

i. Depth of trench, pipe bedding, pipe invert level, irregularity at joints, correct fitting of valves.

ii. Correct installation of thrust anchor/diaphragm blocks where applicable.

iii. Filling materials used shall comply with the specifications.

c. The inspection of the installation of any pipes in a building will focus on the following:-

i. All pipes to be securely fixed.

ii. All valves to be correctly installed

iii. All water storage cisterns to be properly supported and secured.

iv. All debris to be removed from water storage cisterns.

v. Clearance and headroom for maintenance to be provided it is not less than 375mm between the top of the cistern and any obstruction.

H.2.2 Hydrostatic Test

a. Plumbing System

i. The installation shall be tested with potable water. Water shall be filled slowly to allow air to be expelled from the system.

ii. The complete system shall be inspected for leaks.

iii. No part of concealed pipework shall be covered up until the installation has passed the hydrostatic test and clearance has been given by the Competent Person or his representative.

iv. The procedure for hydrostatic testing of plastic pipes within a building shall follow the guidelines as described in **Clause 6.1.12.3.5 of BS 6700:2006**.

v. The pipeline and installation within the buildings shall be tested to 1.5 times the working pressure for 1 hour.

vi. The completed system shall be inspected for leaks during the test. The pipe installation is considered to have passed the hydrostatic test if no visible leak and no drop in the pressure reading are observed during the test.

b. Testing of External Reticulation Mains

i. If the water for testing the underground pipe is obtained from the supply main, the supply main shall be disconnected or isolated before commencement of the test.

ii. To avoid risk of contamination, water for testing shall be obtained from the supply main.

iii. Water shall be filled slowly to allow air to be expelled from the system.

iv. Long pipelines should be tested in sections as the work progresses.

v. No part of the pipe trench should be backfilled until pipeline has passed the hydrostatic test and clearance has been given by the Competent Person or his representative.

vi. The external pipelines shall be subject to hydrostatic test (i.e. pressure test and leakage test) in accordance with established practices and / or particular requirements of the Certifying Agency.

H.2.3 Flushing and Disinfection

a. Flushing

i. Every new installation including water storage cisterns, service pipe, distribution pipes, hot water system and other appliance and any extension or modification of such installation shall be thoroughly flushed with potable water and thereafter disinfected before they are put into use.

ii. Under normal circumstances, single dwelling or premises undergoing minor alteration do not require disinfection after flushing, unless contamination is suspected.

b. Disinfection

i. After flushing, the installation shall be disinfected in the following cases:-

- In any new installations and pipelines with the exception of single private dwellings.
- Where major extension or alterations have been carried out.
- Where suspected contamination might have occurred.

ii. For safety reasons, the systems, or any parts of the systems shall not be used during the duration where disinfection is being carried out.

iii. The procedure for disinfection of piping system within a building shall be in accordance with **Section 6.1.10.4 of BS 6700:2006**.

iv. After flushing, water samples shall be taken from the selected fittings and sent for biological analysis by an accredited laboratory. The water quality shall conform to the guidelines published by the Ministry of Health.

H.3 GEOTECHNICAL RELATED PRACTICES

The following narrative is confined to geotechnical related works.

- Construction of geotechnical works shall be carried out by Contractors who are experienced and competent in the required works. The Contractor shall

construct the works in such a way that the intent of the design is not undermined.

- The Contractor shall assign suitably experienced personnel to supervise the construction works. This person shall examine the works to ensure that they are constructed as per construction drawings.

- Supervision of the construction works shall also be carried out by the Competent Person or their duly appointed representatives.

- Variations between the ground conditions encountered during construction and those assumed for design shall be brought to the attention of the Competent Person. If these variations are significant, designs shall be revised to suit actual site conditions. Where necessary, the Competent Person shall propose supplementary soil investigations.

- The Competent Person shall review and approve the Contractor's proposed method statement so as to maintain the integrity of existing structures or service lines, etc. on the adjacent sites.

Part I:

Requirements for Handing Over of Supply Mains, External Reticulation Systems and Appurtenances

PART I : REQUIREMENTS FOR HANDING OVER OF SUPPLY MAINS, EXTERNAL RETICULATION SYSTEMS AND APPURTENANCES

I.1 PRINCIPAL OVERALL REQUIREMENTS

In accordance with Section 47 of the Water Services Industry Act 2006, a developer of a new development, located within the service area of a Water Distribution Licensee, shall hand over a successfully completed External Reticulation System (ERS) Supply Mains and centralised service reservoir where applicable, or part thereof, to the WDL for operations and maintenance. The application forms for handing over and acknowledgement by the WDL are included in **Appendix B**.

The handing over can only be executed after the developer's appointed competent person has issued a certificate of compliance for the ERS Supply Mains and centralised service reservoir where applicable, which in essence confirms that these facilities have been constructed in accordance with the plans, designs, specifications and standards approved by the Certifying Agency. Furthermore the Works must have successfully passed all material inspections; leakage and pressure tests, disinfection procedures, mechanized and electrical system tests and testing and commissioning tests and procedures witnessed and attested jointly by the competent person, developer / permit holder, the WDL and Facility Licensee if required.

In addition, the handing over of an external water reticulation system and/or supply mains can only be deemed successful if the following procedures, steps and submission of pertinent information are satisfactorily completed to the satisfaction of the CA, WDL and Facility Licensee (FL), viz:

- The certificate of compliance is submitted to the Commission by the competent person once all procedures (i) to (vii) as listed under **Section I.1.1** have been satisfactorily completed. This application shall be accompanied by authenticated forms confirming that the pressure and leakage tests, disinfection processes, water tightness testing of the reservoirs, and inspections of materials employed in the construction of reservoirs, pump stations, pipelines, valves and other relevant appurtenances, have been successfully conducted in the presence of the WDL.

- The performance of all pumpsets and other equipments, where applicable, meets the specified duty requirements and a copy each of the test results shall be submitted to the WDL.

- Operation Manuals for M&E Works, including Telemetry System, if any, to be submitted to the WDL.

- A joint final inspection of the completed system has been carried out by the CA, WDL, FL, the competent person and the permit holder to confirm that external reticulation system, supply mains and centralised service reservoir have been constructed in conformance with design interest and details of which are accurately described in the As-Built Drawings..

- The competent person submits a list of outstanding defects that in his opinion must be carried out before a Certificate of Compliance can be issued for approval by the WDL and FL. This condition would apply to

external reticulation system, supply mains and centralised service reservoir where applicable.

- A successful application has been made to the WDL for connection of bulk supplies of public water from the approved water supply source to the Development.

- Tapping into public supply mains has been successfully completed.

- Successful completion of sterilization, flushing and water quality checks of the water reticulation system.

- Developer to comply with provisions under **Rules 28, 29 and 30** of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014 viz:

  - The developer provides the water distribution licensee with documentary proof evidencing that all the necessary steps or actions required under the National Land Code 1965 *[Act 56]* or any other legislations that need to be complied with, including for any approvals to be obtained and fees or duties payable thereunder, for the surrender to the State Authority of the land whereon the completed supply mains and external reticulation systems are located, have been taken by the developer.
  - Where the supply mains are constructed by the developer on private land, any way leave secured by the developer in relation to such land has been assigned in perpetuity to the water distribution licensee.
  - Payments of prescribed charges for connection works have been settled.
  - Ensure that all mechanical and electrical equipment are in working order and all associated spares as specified are provided.
  - As-built drawings, endorsed by the competent person, have been submitted and accepted by the WDL.
  - Developers shall lodge a guarantee as prescribed under Rule 30 of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014 with the WDL in the form of cash or bank guarantee which shall be valid for a period of twenty seven months from date of handing over of the external reticulation system. This sum is to provide the WDL the necessary funds to rectify defects not carried out by the developer during the defect liability period (DLP).
  - Complete the staged payment of Capital Contribution Fee mandated under **Regulation 16** of the Water Services Industry (Water Services Deposits, Fees and Charges) Regulations 2014.

I.1.1 Handing Over Steps

The developer or owner shall follow the following steps for effective and expedient taking over of water supply facilities by the WDL/Facility Licensee.

i. Testing and commissioning of components and systems witnessed by competent person, permit holder, developer, Facility Licensee (FL) and WDL.
ii. Final Inspection of built facilities jointly by competent person, permit holder, developer, FL and WDL.

iii. Temporary connection application for undertaking flushing, sterilization and water quality testing activities (if applicable) of built facilities.
iv. Issue of certificate of compliance for external reticulation system, supply mains and centralised service reservoirs where applicable.
v. Flushing and sterilization of external reticulation system, supply mains and centralised service reservoir by developer if facilities built by the latter.
vi. CCC issued under the Uniform Building Bye-laws for relevant water structures and reservoirs if applicable.
vii. Permanent connection of external reticulation system to the supply main; or supply mains built by the developer to a public mains identified by the WDL.
viii. Handing over of external reticulation system, supply mains and centralised service reservoirs if applicable.
ix. Twenty-four months defect liability period initiated upon date of handing over.

In the case where the WDL implements centralised service reservoirs and supply mains, the WDL shall be responsible for handing over completed facilities to the FL. The WDLs appointed competent person and permit holders shall be responsible for obtaining approvals for the design of systems, for issuing a COC and to organize and arrange for inspection materials, testing and commissioning of facilities and for preparation of a defects list to be rectified before a certificate of completion can be issued. The permit holder appointed by the WDL shall undertake the construction of facilities in accordance with the approved plans and designs, and shall prepare adequately for undertaking for disinfection, connection and testing and commissioning activities.

I.2 SPECIFIC CONDITIONS FOR HAND OVER OF PUMPING STATIONS

I.2.1 General

At the time of handing over, the competent person shall submit the following to WDL:

- Factory Acceptance Test Report (where applicable)
- PMT (for surge vessel) and PMA (for cranes & hoists) certificates from JKKP
- As-Built Drawings
- Operations and Maintenance Manuals
- Testing and Commissioning Reports
- Tools
- Spare Parts
- Warranty Certificates
- Relevant Catalogues
- Keys

Two (2) bound printed copies, and two (2) electronic copies of the O&M Manual, Reports and As-Built drawings, shall be handed over to the WDL.

I.2.2 The Contents and Requirements of Documentation

The contents, and requirements, for the above specified submissions are as follows:

Factory Acceptance Test Report for Pumps

Factory test report for the designated equipment shall contain the following information:

- Reference to specifications and internationally recognized standards.
- Extract of relevant sections of test standard.
- Description of procedures adopted in carrying out tests.
- List of calibrated measuring instruments and gauges.
- Calibration report for measuring instruments and gauges from recognised institute or laboratory.
- A plot of measured performance data against manufacturer's published performance curves.
- Signature of manufacturer's engineer who conducted the test.
- Signature of the Competent Person or his representative and the Licensee's representative who witnessed the tests (if applicable).
- Sketches, drawings or photographs showing the set-up of measuring instrument, gauges and equipment under test.
- Test certificate for the pumps tested.

As-Built Drawings

The as-built drawings shall include the following information:

- Plan view and section view for Mechanical Works showing the suction reservoir, arrangement of pumping equipment, drainage pumps (where applicable), suction and delivery pipes, surge protection equipment, and material handling equipment.

- Plan and sectional views for Electrical Works showing the lighting and small power systems, lightning protection system, electrical and control boards, incoming electrical cabling, etc.

- Tabulation of brand name, model no. and capacity / rating of major equipment and components for pumps and motors, electrical and control panels, Telemetry System.

- Mechanical schematic drawings describing the Pumping System, Surge Protection System and Pump Control Systems.

- Electrical schematic diagrams describing the electrical power supply routing systems to pumps, small power and lighting systems, Telemetry system and control systems.

- Two electronic copies of all information provided shall be in CD ROM or DVD ROM using latest version of Autocad software.

- Hard copy of relevant drawings to be bound in the O&M Manual.

- As-built drawings to be endorsed by the Competent Person (civil engineer or mechanical engineer for pumping systems, and electrical engineer for power supply systems).

Testing and Commissioning Reports

The testing and commissioning reports shall include:

- Table of Contents identifying the organization of the testing and commissioning reports in systematic and logical order.

- Approved testing and commissioning procedures adopted.

- Calibration reports pertaining to measuring instruments and gauges from recognized institutions and laboratories (including completion certificates).

- Sketches, schematic drawings and photographs showing the set-up of measuring instruments and gauges.

- Endorsed copy of testing and commissioning forms.

- Explanation of variance of final measured data and design values.

- Factory test report for pumps.

Operations and Maintenance Manuals

The complete O&M Manual shall comprise the following documents:

- Table of Contents identifying each section of the document.

- Emergency and agency notification procedures.

- Operating Manual containing information on:

  - Building / Equipment function
  - Building / Equipment description
  - Operating standards and logs
  - System description
  - Operating routine and procedures
  - Special procedures (if any)
  - Basic trouble shooting procedures

- Maintenance Manual containing

  - Equipment data sheet and list of suppliers
  - Information on warranties
  - Installation, operation and maintenance instructions
  - List of spare parts
  - Preventive maintenance actions to be adopted by WDL

- Test reports documenting set points, and observed performance during start up and commissioning.
- As-built drawings in printed form and electronic media.
- List of recommended spare parts.
- Manufacturers' technical literature comprising performance curves, technical catalogs and technical information.

I.2.3 Tools, Appliances and Test Equipment

Each tool, appliance and test equipment required to be supplied shall be marked clearly indicating its size and intended purpose and shall not be used in the installation of the plant.

Permit holder shall demonstrate to the WDL's staff, the use of the tools, appliances, test equipment, trouble shooting and maintenance procedures before taken over by the WDL. All tools and appliances shall be placed in appropriately labelled storage boxes and shall be supplied complete with accessories including probes and power leads.

I.2.4 Operations and Maintenance Training Program

Objective

The objective of the O&M training program is to provide the WDL staff with the knowledge to operate and maintain the Pumping System in accordance with design intent, manufacturers' recommendations, and procedures contained in the O&M Manual. Training Documentation (Lecture notes and Presentation Slides etc) shall be supplied for the training. The training shall be conducted by persons having specific expertise in each aspect of the Pumping System.

Scope of Training

The objective of the training program shall be to instill a thorough understanding of all equipment, components, systems, and their operation. The training program shall include the following topics.

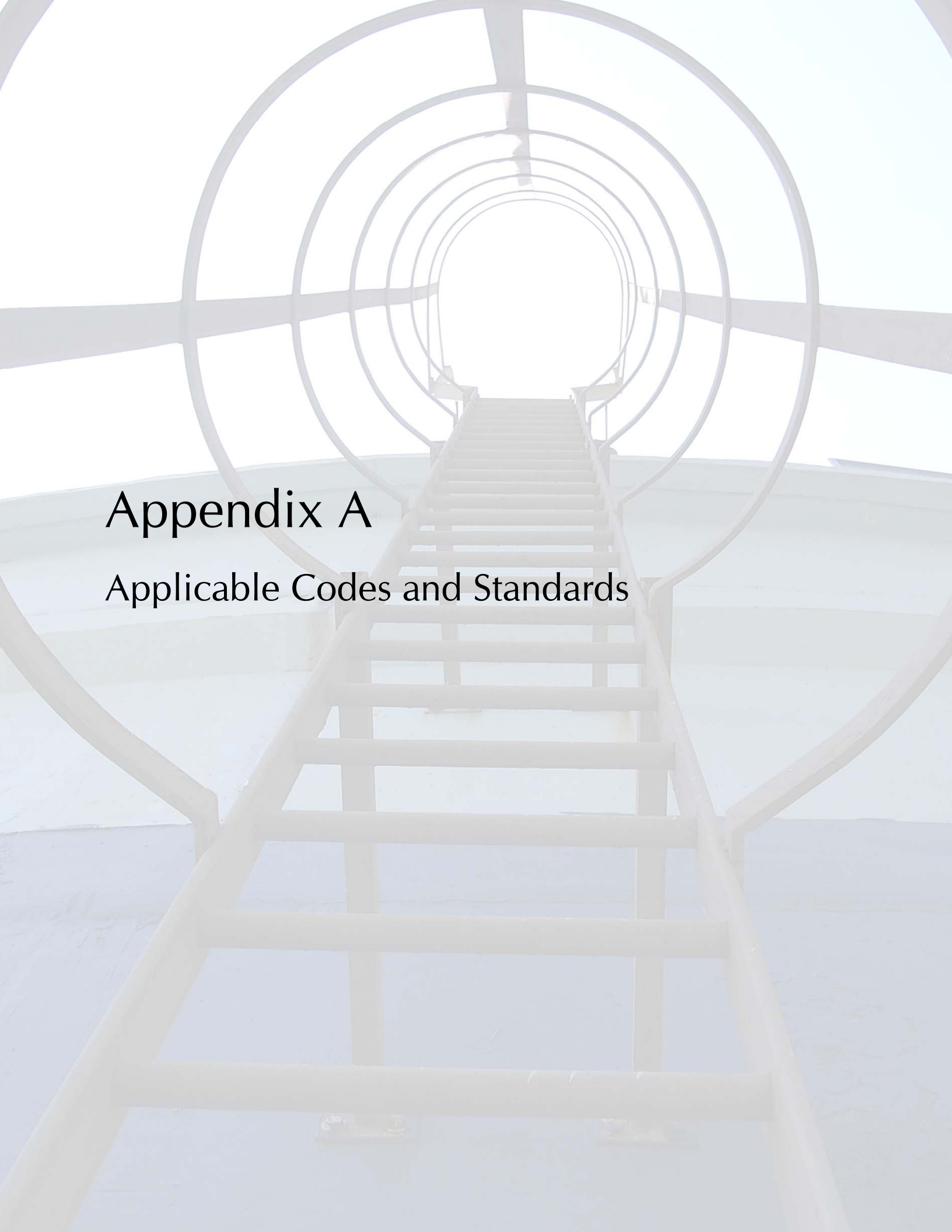
(a) Use of O&M Manual with an emphasis on:

- Design intent
- Description, capabilities, and limitations of the systems
- Operation procedures for all modes of operation
- Procedure for dealing with abnormal conditions and emergency situations
- Use of operation manuals
    1. Use of maintenance manuals

(b) Recommended procedures for collecting and interpreting specific performance data.

(c) Specialized manufacturers' training programs.

The use and maintenance of Telemetry and SCADA systems.



Appendix A

Applicable Codes and Standards

RECOGNISED STANDARDS FOR WATER SUPPLY PRODUCTS

Items	Standard Number	Standard Title
(A) Water Pipes		
(i) Polyethylene (PE) Pipes	MS 1058: Part 2: 2005	Specification for Polyethylene (PE) Piping Systems for Water Supply : Part 2 : Pipes (Forth Revision)
	ISO 4427–2 : 2007: AMD 1:2011	Plastics Piping Systems – Polyethylene (PE) Pipes and Fittings for Water Supply – Part 2 : Pipes
	DIN 8075 (2011 – 2012)	Polyehtylene (PE) Pipes – General Quality Requirements, Testing
(ii) PE-RT Pipes	ISO 22391-2:2009	Plastics Piping Systems for Hot and Cold Water Installations – Polyethylene of Raised Temperature Resistance (PE-RT) : Part 2 : Pipes
	MS 2508-2: 2012	Plastics Piping Systems for Hot and Cold Water Installations – Polyethylene of Raised Temperature Resistance (PE-RT) : Part 2 : Pipes (ISO 22391-2: 2009, MOD)
(iii) PE-RT/AL/PE-RT Pipes	BS EN ISO 21003 - 1: 2008	Multilayer Piping Systems for Hot and Cold Water Installation Inside Buildings. General
(iv) PE-X Pipes	MS 1736 : Part 2 : 2004	Plastic Piping Systems for Hot and Cold Water Installations – Crosslinked Polyethylene (PE-X): Part 2 : Pipes (ISO 15875-2:2002 MOD)
(v) PE-X/AL/PE-X Pipes	AS 4176 : 1994	Polyethylene / aluminium and cross-linked polyethylene / aluminium macro-composite pipe systems for pressure applications
(vi) PE Aluminium (PE-AL-PE) Pipes	ASTM F1282 – 03	Standard Specification for Polyethylene / Aluminium / Polyethylene (PE-AL-PE) Composite Pressure Pipes
(vii) Unplasticized Polyvinylchloride (uPVC) Pipes	MS 628: Part 1: 1999 AMD.1: 2001 & AMD.2: 2002	Specification for Unplasticised PVC (uPVC) Pipes for Water Supply : Part 1: Pipes (1st revision)
	BS EN ISO 1452-2: 2009	Plastics Piping Systems for Water Supply and for Buried and Above-Ground Drainage and Sewerage Under Pressure. Unplasticized Poly(vinyl Chloride) (PVC U). Pipes

Items	Standard Number	Standard Title
(viii) Solvent cement for UPVC piping system	MS 628 : Part 2 : Section 2.2 : 1999	Specification for Unplasticised PVC (UPVC) Pipes for Water Supply : Part 2 : Joints and Fittings for Use with Unplasticised PVC Pipes : Section 2.2 : Solvent Cement
(ix) Chlorinated Polyvinylchloride (cPVC) Pipes	MS 2045 : 2007	Chlorinated Poly (Vinyl Chloride) (PVC-C) Plastic Hot-and-Cold-Water Distribution Systems – Specification
	ASTM D2846 / D2846M – 09b	Standard Specification for Chlorinated Polyvinyl Chloride (cPVC) Plastic Hot and Cold Water Distribution System
	MS 1757 : Part 1 : 2008	Chlorinated Poly (Vinyl Chloride) (PVC-C) – Plastic Piping System – Part 1 : Specification for Schedule 40 & 80 Pipes
(x) Acrylonitrile-Butadiene-Styrene (ABS) Pipes	MS 1419: Part 1: 2007	Acrylonitrile-Butadiene Styrene (ABS) Piping Systems for Pressure Applications – Part 1: Specification for Compounds, Pipes and Fittings (First Revision)
	AS/NZS 3518 : 2004	Acrylonitrile Butadiene Styrene (ABS) Compounds, Pipes and Fittings for Pressure Application
(xi) Solvent cement for ABS piping system	MS 1419 : Part 3 : 1997	Specification for Acrylonitrilebutadiene Styrene (ABS) Pipes and Fittings for Pressure Applications Part 3 : Solvent Cement and Priming (Cleaning) Fluids for Use with ABS Pipes and Fittings
(xii) Polypropylene (PP) Pipes	MS 2286-2: 2012	Plastics Piping Systems for Hot and Cold Water Installations – Polypropylene (PP)- Part 2: Pipes (ISO 15874-2: 2003, AMD.1: 2007, MOD)
	ISO 15874: Part 2: 2003	Plastics Piping Systems for Hot and Cold Water Installations – Polypropylene (PP). Part 2: Pipes
	DIN 8078: 2008	Polypropylene (PP) Pipes – PP-H, PP-B, PP-R, PP-RCT – General Quality Requirements and Testing
(xiii) Polybutylene (PB) Pipes	MS ISO 15876-2 : 2004, AMD. 1: 2009	Plastics Piping Systems for Hot and Cold Water Installations – Polybutylene (PB) Part 2 : Pipes (ISO 15876-2:2003, MOD)
	AS/NZS 2642.2: 2008	Polybutylene (PB) Plumbing Pipe Systems – Polybutylene (PB) Pipe for Hot and Cold Water Applications

Items	Standard Number	Standard Title
(xiv) Glass Reinforced Plastic (GRP) Pipes	ISO 10639: 2004	Plastics Piping Systems for Pressure and Non-pressure Water Supply – Glass Reinforced Thermosetting Plastics (GRP) Systems Based On Unsaturated Polyester (UP) Resin
(xv) Steel Pipes	BS 534: 1990	Specification for Steel Pipes, Joints and Specials for Water and Sewage ***This standard is recognized for SPAN product listing until 31 May 2015 only*
	SPAN TS 21827:2013	Specification for Steel Pipes, Fittings and Joints for Water and Sewerage Part 1: Technical Delivery Requirements Part 2: Tube Requirements
	MS 1968 : 2007	Non-Alloy Steel Tubes and Fittings for the Conveyance of Aqueous Liquids Including Water for Human Consumption – Technical Delivery Conditions
	BS EN 10224 : 2002	Non-Alloy Steel Tubes and Fittings for the Conveyance of Water and Other Aqueous Liquids – Technical Delivery Conditions
(xvi) Stainless Steel (SS) Pipes - Industrial	MS 1841: 2010	Seamless, Welded and Heavily Cold Austenitic Stainless Steel Pipes – Specification (First Revision)
	ASTM A312/A312M-11	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
(xvii) Stainless Steel (SS) Light Gauge Tubes	MS 1988: 2007 (Confirmed :2011)	Welded Stainless Steel Tubes for the Conveyance of Water and Other Aqueous Liquids – Technical Delivery Conditions and Include Ammendment A1)
	BS EN 10312 : 2002	Welded Stainless Steel Tubes for the Conveyance of Aqueous Liquids Including Water for Human Consumption. Technical Delivery Conditions
	JIS G 3448: 2004	Light Gauge Stainless Steel Tubes for Ordinary Piping
(xviii) Ductile Iron (DI) Pipes	MS 1919: 2006	Ductile Iron Pipes, Fittings, Accessories and Their Joints for Water Pipelines – Requirements and Test Methods

Items	Standard Number	Standard Title
	BS EN 545 : 2010	Ductile Iron Pipes, Fittings, Accessories and Their Joints for Water Pipelines – Requirement and Test Method
(xix) Copper Tubes	BS EN 1057: 2006 + A1:2010	Copper and Copper Alloys. Seamless, Round Copper Tubes for Water and Gas in Sanitary and Heating Applications
(xx) Steel Pipe with Plastic Lining	CJ/T 137: 2008	Malleable Iron Threaded Fittings of Lining Plastic for Water Supply
(B) Water Fittings		
(i) Polyethylene (PE) Fittings	BS EN 12201-3:2011	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Fittings
	MS 1058: Part 3: 2006	Polyethylene (PE) Piping Systems for Water Supply – Part 3 : Fittings
	AS/NZS 4129: 2008	Fittings for Polyethylene (PE) Pipes for Pressure Applications
(ii) HDPE Joints Assemblies and Fittings	DIN 16963 : Part 5 : (1999-10)	Pipe Fittings and Joints and Assemblies for PE 80 and PE 100 Polyethylene Pressure Pipes-Part 5: General Quality Requirements and Testing
(iii) PE-X Fittings	MS 1736 : Part 3 : 2004	Plastics Piping Systems for Hot and Cold Water Installations – Crosslinked Polyethylene (PE-X): Part 3 : Fittings
(iv) PE-RT Fittings	ISO 22391 – 3 : 2007	Plastics piping systems for hot and cold water installations – Polyethylene of raised temperature resistance (PE-RT) – Part 3 : Fittings
	MS 2508-3: 2012	Plastics piping systems for hot and cold water installations – Polyethylene of raised temperature resistance (PE-RT) – Part 3 : Fittings (ISO 22391-3: 2009, MOD)
(v) PE-RT/AL/PE-RT Fittings	ISO 21003 – 3 : 2008	Multilayer piping systems for hot and cold water installations inside buildings – Part 3 : Fittings
(vi) PPO Fittings	ISO 4176 : 2000	Polyethylene/aluminium and cross-linked polyethylene/aluminium macro-composite pipe systems for pressure applications

Items	Standard Number	Standard Title
(vii) Nylon Joints and Compression Fittings for use with HDPE Pipes	BS 5114: 1975 (1981) Amd.2 – 1987	Specification for Performance Requirements for Joints and Compression Fittings for Use with Polyethylene Pipes
	ISO 14236: 2000	Plastics Pipes and Fittings – Mechanical-Joint Compression Fittings for Use with Polyethylene Pressure Pipes in Water Supply Systems.
(viii) Polypropylene (PP) Fittings	ISO 15874: Part 3: 2003	Plastics Piping Systems for Hot and Cold Water Installations – Polypropylene (PP) – Part 3 : Fittings
	DIN 16962-5: 2000	Pipe fittings and joint assemblies for polypropylene (PP) pressure pipes - Part 5: General quality requirements and testing.
	MS 2286-3: 2012	Plastics Piping Systems for Hot and Cold Water Installations – Polypropylene (PP) – Part 3 : Fittings (ISO 15874-3: 2003, FDAM 1:2009, MOD)
(ix) Polybutylene (PB) Fittings	AS/NZS 2642-3: 2008	Polybutylene Pipe Systems – Mechanical Jointing Fittings for Use with Polybutylene (PB) Pipes for Hot and Cold Water Applications
	MS ISO 15876 – 3 : 2004	Plastics Piping Systems for Hot and Cold Water Installations – Polybutylene (PB) Part 3 : Fittings
(x) Unplasticized Polyvinylchloride (uPVC) Joints / Fittings	MS 628: Part 2: Section 2.1: 1999	Specification for Unplasticised PVC (uPVC) Pipes for Water Supply : Part 2: Joints and Fittings for Use with uPVC Pipes: Section 2.1: uPVC Joints and Fittings
	BS EN ISO: 1452-3: 2010	Plastics Piping Systems for Water Supply and for Buried and Above-ground Drainage and Sewerage Under Pressure. Unplasticized poly (vinyl chloride) (PVC-U)Fittings
	BS 4346-1: 1969	Joints and Fittings for use with Unplasticized PVC Pressure Pipes. Injection Moulded Unplasticized PVC Fittings for Solvent Welding for use with Pressure Pipes, Including Potable Water Supply
	BS 4346-2: 1970	Joints and Fittings for use with Unplastisized PVC Pressure Pipes. Mechanical Joints and Fittings, Principally of Unplasticized PVC

Items	Standard Number	Standard Title
(xi) Chlorinated Polyvinylchloride (cPVC) Fittings	ASTM D2846 / D2846M – 09b	Standard Specification for Chlorinated Polyvinyl Chloride (cPVC) Plastic Hot and Cold Water Distribution System
	MS 1757 : Part 2 : 2008	Chlorinated Poly (Vinyl Chloride) (PVC-C) – Plastic Piping System – Part 2 : Specification for Schedule 40 Socket-type Pipe Fittings
	MS 1757 : Part 3 : 2008	Chlorinated Poly (Vinyl Chloride) (PVC-C) – Plastic Piping System – Part 3 : Specification for Schedule 80 Pipe Fittings
	MS 2045 : 2007	Chlorinated Poly (Vinyl Chloride) (PVC-C) Plastic Hot-and-Cold-Water Distribution Systems – Specification
(xii) Acrylonitrile-Butadiene-Styrene (ABS) Fittings	MS 1419: Part 1: 2007	Acrylonitrile-Butadiene Styrene (ABS) Piping Systems for Pressure Applications – Part 1: Specification for Compounds, Pipes and Fittings (First Revision)
	AS/NZS 3518: 2004	Acrylonitrile Butadiene Styrene (ABS) Compounds, Pipes and Fittings for Pressure Application
(xiii) Glass Reinforced Plastic (GRP) Fittings	ISO 10639: 2004	Plastics Piping System for Pressure and Non-pressure Water Supply – Glass Reinforced Thermosetting Plastics (GRP) Systems Based On Unsaturated Polyester (UP) Resin
(xiv) Steel Pipe Specials	BS 534: 1990	Specification for Steel Pipes, Joints and Specials for Water and Sewage ***This standard is recognized for SPAN product listing until 31 May 2015 only*
	SPAN TS 21827:2013	Specification for Steel Pipes, Fittings and Joints for Water and Sewerage Part 1: Technical Delivery Requirements Part 2: Tube Requirements
	MS 1968 : 2007	Non-alloy steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption – technical delivery conditions
(xv) Stainless Steel (SS) Threaded Fittings	ISO 4144: 2003	Pipework – Stainless Steel Fittings Threaded in Accordance with ISO 7-1
	MS 2495: 2012	Pipework – Stainless Steel Fittings Threaded in Accordance with MS 1989: Part 1 (ISO 4144:2003, MOD)

Items	Standard Number	Standard Title
(xvi) Stainless Steel (SS) Welded Fittings	MS 1842: 2010	Wrought Austenitic Stainless Steel Piping Fittings – Specification (First Revision)
	ASTM A403/A403M-10-13a	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
(xvii) Stainless Steel (SS) Press Fittings	SAS 322: 2003	Pipe Coupling Performance Standards for Stanless Steel Pipes for General Piping
(xvii) Ductile Iron Fittings	MS 1919: 2006	Ductile Iron Pipes, Fittings, Accessories and Their Joints for Water Pipelines – Requirement and Test Method
	BS EN 545 : 2010	Ductile Iron Pipes, Fittings, Accessories and Their Joints for Water Pipelines – Requirement and Test Method
(xix) Copper & Copper Alloys Fittings	BS EN 1254-1: 1998	Copper and Copper Alloys. Plumbing Fittings. Fittings with Short Ends for Capillary Brazing to Copper Tubes
	BS EN 1254-2: 1998	Copper and Copper Alloys. Plumbing Fittings. Fittings with Compression Ends for Use with Copper Tubes
	BS EN 1254-3: 1998	Copper and Copper Alloys. Plumbing Fittings. Fittings with Compression Ends for Use with Plastic Pipes
	BS EN 1254-4: 1998	Copper and Copper Alloys. Plumbing Fittings. Fittings Combining Other End Connections with Capillary or Compression Ends
(xx) Steel Fittings with Plastic Lining	CJ/T 136: 2001	Steel Pipes of Lining Plastic for Water Supply
(xxi) Variable Adapter	Spesifikasi JKR 20200-0045-99	JKR Standard Specification for Detachable Joints and Variable Adaptors for uPVC, Ductile Iron and AC Pipes
(xxii) Flange Adapter	Spesifikasi JKR 20200-0047-99	JKR Standard Specification For Flexible Couplings and Flange Adaptors
(xxiii) Flexible Coupling	Spesifikasi JKR 20200-0047-99	JKR Standard Specification For Flexible Couplings and Flange Adaptors

Items	Standard Number	Standard Title
(xxiv) Detachable Joint	Spesifikasi JKR 20200-0045-99	JKR Standard Specification for Detachable Joints and Variable Adaptors for uPVC, Ductile Iron and AC Pipes
(xxv) Ferrous Saddle	Spesifikasi JKR 20200-0044-99	JKR Standard Specification for Ferrous Saddles
(xxvi) Pillar Hydrant	Spesifikasi JKR 20200-0042-99	JKR Standard Specification for Ductile Iron Pillar Hydrants
	MS 1395: 2011	Pillar Fire Hydrants: Specification (First Revision)
(xxvii) Ductile Iron (DI) Strainer	Spesifikasi JKR 20200-0100-01	JKR Standard Specification for Ductile Iron Y and T Strainers (DN 50 to DN 600)
(xxviii) Swivel Ferrules	Spesifikasi JKR 20200-0174-04	JKR Standard Specification for Ferrules
(xxix) Under Pressure Vertical Ferrules	MS 1396: 2006	Ferrules – Specification (First Revision)
(xxix) Polypropylene (PP) Tapping Ferrules	Spesifikasi JKR 20200-0055-99	JKR Standard Specification for Polypropylene (PP) Tapping Ferrules to be used with Polyethylene (PE) and uPVC Pipes
(xxx) Manhole Cover	BS EN 124 : 1994	Gully Tops and Manhole Tops for Vehicular and Pedestrian Areas. Design Requirements, Type Testing, Marking, Quality Control
(C) Service Reservoir		
(i) Reinforced Concrete Reservoir	BS EN 1992-3 : 2006	Eurocode 2. Design of Concrete Structures. Liquid Retaining and Containing Structures
	BS 4449 : 2005+A2 : 2009	Steel for the Reinforcement of Concrete. Weldable Reinforcing Steel. Bar, Coil and Decoiled Product – Specification
(ii) Cylindrical Double Fold System	BS 5950-1:2000	Structural Use of Steelwork in Building Part 1 : Code of Practice for Design – Rolled and Welded Section

Items	Standard Number	Standard Title
(iii) Glass Coated / Glass Lined / Glass Fused / Epoxy Coated / Epoxy Lining	AWWA D103-97, AWWA D103-09	Factory-Coated Bolted Steel Tanks For Water Storage
	ISO 28765 : 2008	Vitreous and Porcelain Enamels -- Design of Bolted Steel Tanks for the Storage or Treatment of Water or Municipal or Industrial Effluents and Sludges
(D) Storage Cistern		
(i) Cylindrical Double Fold System	BS 5950-1:2000	Structural Use of Steelwork in Building Part 1 : Code of Practice for Design – Rolled and Welded Section
(ii) Glass Coated / Glass Lined / Glass Fused / Epoxy Coated / Epoxy Lining	AWWA D103-97, ANSI/AWWA D103-09	Factory-Coated Bolted Steel Tanks For Water Storage
(iii) PE / HDPE Tanks Storage Tank	MS 1225 : Pt 1 : 2007 AMD.1:2011	Polyethylene (PE) Tanks For Cold Water Storage; Part 1: Capacity up to 600G (Second Revision)
	MS 1225 : Pt 2: 2006 AMD.1:2011	Polyethylene (PE) Tanks For Cold Water Storage; Part 2: Capacity more than 600G (First Revision)
(iv) GRP/FRP Sectional Water Tank	MS 1390 : 2010	Glass-fibre Reinforced Polyester Panels and Panel Water Tanks - Specification (First Revision)
(v) Corrugated Steel Panel With Polyethylene-Lined Water Storage Tank	BS 1449 -1.1:1991	Steel Plate, Sheet & Strip. Carbon and carbon-manganese plate, sheet and strip general specification
	SS 245:1995 (Cl. 10.2.1 & Cl 10.2.2)	Specification for Glass Reinforced Polyester Sectional Water Tank
(vi) FRP One-Piece Water Tank	BS EN 13280 : 2001	Specification for glass fibre reinforced cistern of one-piece and sectional construction for storage above ground of cold water
	MS 1241 : 2011	One Piece Glass Fibre Reinforced Polyester (GRP) Water Tanks Nominal Capacity of 100 000 Litres and Below-Specification (First Revision)

Items	Standard Number	Standard Title
(vii) Pressed Steel Sectional Rectangular Tank Panel	BS 1564 : 1975	Specification for Pressed Steel Sectional Rectangular Tanks
(viii) Stainless Steel Storage Tank	JKR 20200-0041-99	Stainless Steel Water Tanks (With Effective Capacity Up to 15,000L)
(ix) Stainless Steel Storage Tank (Rectangular / Panel Tank)	CNS 9443 : 2000	Stainless Steel Storage Tanks
(E) Valves		
(i) Butterfly Valve	BS EN 593 : 2009 + A1:2011	Industrial Valves. Metallic Butterfly Valves
(ii) Air Valve	JKR 20200-0097-01	Ductile Iron Air Valves (Revised Edition 2001)
	JKR 20200-0043-99	Ductile Iron Air Valves (Revised Edition 1999)
	AWWA C512-07	Air Release, Air/Vacuum and Combination Air Valve for Waterworks Service
	BS EN 1074-4 : 2000	Valves for Water Supply. Fitness for Purpose Requirements and Appropriate Verification Tests. Air Valves
(iii) Gate Valve	MS 1049 : 1986	Specification for Double Flanged Cast Iron Wedge Gate (sluice) valves for waterworks purposes
	BS EN 12288 : 2010	Industrial Valves. Copper Alloy Gate Valves
	BS EN 1171 : 2002	Industrial Valves. Cast Iron Gate Valves
	JKR 20200-0077-00	Ductile Iron Type B Large Sluice Valves (DN700-DN1800)

Items	Standard Number	Standard Title
	BS 5163-1 : 2004	Valves for Waterworks Purposes. Predominantly key-operated cast iron gate valves. Code of practice
	BS 5163-2 : 2004	Valves for Waterworks Purposes. Stem Caps for use on isolating valves and associated water control apparatus. Specification
	BS EN 1074-2 : 2000	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Isolating valves
(iv) Check Valve	BS EN 12334 : 2001	Industrial Valves. Cast Iron Check Valves
	BS EN 14341 : 2006	Industrial Valves. Steel Check Valves
	BS EN 12288 : 2010	Industrial valves. Copper Alloy Gate Valve
	BS EN 1074-3 : 2000	Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Check valves
	AWWA C508 - 2009	Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
(v) Control Valve	BS EN 1074-5:2001	Valves for Water Supply – Fitness Purpose Requirements and Appropriate Verification Tests. Part 5 : Control Valve
	AWWA C530-07	Pilot-operated control valves
(vi) Stop Valve	MS 1022 : 2005	Stopvalves – Specification (First Revision)
	BS 6675 : 1986	Specification for servicing valves (copper alloy) for water services
	BS EN 1213 : 2000	Building Valves. Copper alloy stopvalves for potable water supply in buildings. Test & Requirements.

Items	Standard Number	Standard Title
	JKR 20200-0056-99	Specification of Mechanical Stopvalve for water supply usage
(vii) Ball Valves	BS 1212 : Part 1 : 1990	Float Operated Valves. Specification for Piston Type Float Operated valves (Copper Aloy Body)
	BS 1212 : Part 2 : 1990	Float Operated Valves. Specification for Diaphragm Type Float Operated Valves (Copper Alloy) (Excluding Float)
(viii) Landing Valve	MS 1210: Part 1: 1991 (Confirmed : 2011)	Specification for Fire Hydrant Systems Equipment – Part 1: Landing Valves for Wet Risers
	MS 1210: Part 2: 1991 (Confirmed : 2011)	Specification for Fire Hydrant Systems Equipment – Part 2: Landing Valves for Dry Risers
	BS 5041 : Pt 1 : 1987	Fire Hydrant Systems Equipment. Specification for landing valves for wet risers
	BS 5041 : Pt 3 : 1975	Fire Hydrant System Equipment. Specification for Inlet Breeching for Dry Riser Inlets
(ix) Mixing Valve (Manually Operated)	BS EN 1286 : 1999	Sanitary Tapeware. Low Pressure Mechanical Mixing Valves. General Technical Specification
(x) Float Operated Valve	MS 1882 : 2005	Piston Type Float Operated Valves – Specification
	JKR 20200-0059-99	Piston Type Float Operated Valves (Revised Edition 1999)
(xi) Pressure Reducing Valves	BS EN 1567 : 2000	Building Valves. Water Pressure Valves and Combination Water Reducing Valves. Requirements and Test
(xii) Plug Valve	AWWA C517 - 2009	Resilient-Seated Cast-Iron Eccentric Plug Valves
(xiii) Penstock	BS 7775 : 2005	Penstocks for use in Water and Other Liquid Flow Applications. Specification

Items	Standard Number	Standard Title
	JKR 20200-0108-01	JKR Standard Specification for Penstocks (Revised Edition 2001)
(F) Back Flow Preventer		
(i) Dual Check Backflow Preventer	BS EN 14454 : 2005	Devices to prevent pollution by backflow of potable water. Hose Union backflow preventer DN15 to DN32 inclusive. Family H, Type A
	AS/NZS 3500.1:2003/Amdt 2:2010	Plumbing and drainage - Water Services
(ii) Reduced Pressure Zone Assembly	BS EN 12729 : 2002	Devices to prevent pollution by backflow of potable water. Controllable backflow preventer with reduced pressure zone. Family B, Type A
	AS/NZS 3500.1:2003 /Amdt 2:2010	Plumbing and drainage - Water Services
(iii) Cast Iron Check Valves	BS EN 12334 : 2001	Industrial Valves. Cast Iron Check Valves
(iv) Steel Check Valves	BS EN 14341 : 2006	Industrial Valves. Steel Check Valves
(v) Copper Alloy Globe, Globe Stop, Check and Gate Valves	BS EN 12288 : 2010	Industrial Valve. Copper Alloy Gate Valve
(G) Meter		
Custody Transfer Meter		
(i) Electromagnetic / Ultrasonic Flowmeter	OIML R 49-1 (E) 2006)	Water Meters Intended for the metering of Cold Potable Water and Hot Water Part 1 : Metrological and technical requirement
(ii) Mechanical Water Meter	OIML R 49-1 (E) 2006	Water Meters Intended for the metering of Cold Potable Water and Hot Water Part 1 : Metrological and technical requirement

Items	Standard Number	Standard Title
	ISO 4064-1 : 2005	Measurement of Water Flow in fully charged closed conduits – Meters for Cold Potable Water and Hot Water – Part 1 – Specifications
	MS ISO 4064-1 : 2006	Measurement of Water Flow in fully charged closed conduits – Meters for Cold Potable Water and Hot Water – Part 1 – Specification (First revision) (ISO 4064-1:2005, IDT)
Non-Custody Transfer Meter		
(i) Mechanical Water Meter	ISO 4064-1 : 2005	Measurement of Water Flow in fully charged closed conduits – Meters for Cold Potable Water and Hot Water – Part 1 – Specification
	MS ISO 4064-1 : 2006	Measurement of Water Flow in fully charged closed conduits – Meters for Cold Potable Water and Hot Water – Part 1 – Specification (First revision) (ISO 4064-1:2005, IDT)
(H) Tap and Mixer		
(i) Bib Tap / Pillar Tap/ Faucet	BS EN 200 : 2008	Sanitary Tapware. Single Taps and combination Taps For Water Supply Systems of Type 1 and Type 2. General Technical Specification
	AS / NZS 3718 : 2005	Water Supply – Tap ware
	MS 1461 : 1999	Specification for draw off taps with metal bodies for water service
(ii) Mixer	BS EN 817 : 2008	Sanitary tapware. Mechanical mixing valves (PN 10). General technical specifications
	BS EN 1286 : 1999	Sanitary Tapeware. Low Pressure Mechanical Mixing Valves. General Technical Specification
(I) Water Closet		

Items	Standard Number	Standard Title
(i) Water Closet	MS 1522 : 2011	Vitreous China Water Closet Pans – Specification (Third Revision)
(J) Water Closet Flushing Cistern & Flush Pipes		
(i) Water Closet Flushing Cistern & Flush Pipes	MS 795-1 : 2011	WC Flushing Cisterns – Part 1: Specification (Second Revision)
(K) Flush Valve		
(i) Flush Valve	JKR 20200-0130-01	JKR Standard Specification For Flush Valve
	BS EN 12541 : 2002	Sanitary Tapware – Pressure Flushing Valves & Automatic Closing Urinal Valves PN 10
(L) Sanitary Appliances		
(i) Urinal bowls, Pedestal, Bidets, WC Pans	MS 147 : 2001	Specification for quality of Vitreous China Sanitary Appliances (First Revision)
(M) Urinals		
(i) Urinals	MS 1799 : 2008	Urinals - Specification
(N) Solar Water Heater		
(i) Solar Water Heater	MS 1367 : 1994	Specification for Domestic Solar Water Heater
(O) Lining / Coating / Waterproofing / Sealant / Adhesive		
(i) Lining / Coating / Waterproofing / Sealant / Adhesive	MS 1583 : Part 1 : 2003	Suitability of Non-Metallic Products for Use in Contact with Water Intended for Human Consumption with Regard to Their Effect on the Quality of the Water : Part 1 : Specification
	BS 6920 – 1 : 2000	Suitability of Non-Metallic Products for Use in Contact with Water Intended for

Items	Standard Number	Standard Title
		Human Consumption with Regard to Their Effect on the Quality of the Water : Specification
	AS/NZS 4020: 2005	Testing of Products for Use in Contact with Drinking Water

Appendix B

Application Forms

WATER SERVICES INDUSTRY ACT 2006

WATER SERVICES INDUSTRY (WATER RETICULATION AND PLUMBING) RULES 2014

APPLICATION FOR SOURCE OF WATER SUPPLY

Date: ……

To : Chief Executive Officer (of the relevant water distribution licensee)

Address: ……

……

……

1. We…… (Company No. :.....) hereby apply for a source of water supply for our proposed development.

2. Details of the proposed development:

   i. Name of development:

   ……

   ii. Address of site or premises:

   ……

   ……

   ……

   iii. Lot No.(s) of development area:

   ……

   iv. Area of land occupied by service reservoir: …… hectares

   v. Area of land occupied by pumping station: …… hectares

   vi. Area of land occupied by suction cistern: …… hectares

   vii. Address and lot number of any other land affected by the proposed external reticulation system:

   ……

   ……

   ……

3. The other required documents submitted herewith are as follows:

		Yes	No
i.	Certified copy of development order;	□	□
ii.	Certified copy of competent person's appointment letter;	□	□
iii.	Qualification of appointed competent person conforms with the Second Schedule of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014;	□	□
iv.	Three sets of key and location plan in A1 size;	□	□
v.	Three sets of site plan incorporating information specified in section B.1.3 of the Uniform Technical Guidelines in A1 size;	□	□
vi.	Three sets of layout plan indicating proposed development platform (meter ODL) in A1 size;	□	□
vii.	Water demand and total water supply estimate*;	□	□
viii.	Original copy of Power of Attorney confirming person appointed to sign on behalf of developer and premise owner.	□	□

……..

Signature of applicant/ authorized representative of the applicant

Name (in capital letters):.....

NRIC no.: .....

Address: .....

.....

.....

Telephone no.:.....

Fax No.: .....

Certification by competent person

I hereby certify that to the best of my knowledge and belief, the information and documents submitted herewith is/are true and complete in accordance with the requirements of the Act, Water Services Industry (Water Reticulation and Plumbing) Rules 2014, Uniform Technical Guidelines and other relevant laws and I accept full responsibility accordingly.

.....

Signature of competent person

Name of competent person (in capital letters):

.....

NRIC no.: .....

Address: .....

Telephone no: .....

Fax no: .....

Qualification and registration particulars:

.....

* *Competent Person shall refer to the Eighth Schedule of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014 in estimating water demands.*

FOR OFFICIAL USE ONLY

Date received: ..... Checked by:.....

Date replied: ..... Ref.No: .....

WATER SERVICES INDUSTRY ACT 2006

WATER SERVICES INDUSTRY (WATER RETICULATION AND PLUMBING) RULES 2014

APPLICATION FOR APPROVAL OF PLANS AND SPECIFICATIONS OF EXTERNAL RETICULATION WATER SUPPLY SYSTEM/ SUPPLY MAINS *

Date: .....

To : Chief Executive Officer, Suruhanjaya Perkhidmatan Air Negara

Address: ……

File No. : ……..

I/We (the undersigned)..... hereby apply to construct/modify/alter* the following extra reticulation system/supply mains* in accordance with Section 45 of the Water Services Industry Act 2006 as specified below:

Development title : .....

Description of works : .....

2. I / We hereby submit the following plans/designs /specifications* for the said external reticulation system/ supply mains for approval. I/We declare that all design particulars comply with the requirements specified under Sections B.2 and B.3 of the Uniform Technical Guidelines and to related provisions under the Water Services Industry Act 2006 and Water Services Industry (Water Reticulation and Plumbing) Rules 2014. In complying with rule 9 of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014, a prescribed payment is included for the sum of RM ..... in accordance with the Fourth Schedule of that Rules, for the Commission's review of the submitted plans/designs/specifications*.

……..

Signature of developer

Name of developer (in capital letters): ……..

NRIC no.: ……..

Address: ……..

Telephone no.: ……..

Fax no.: ……..

Certification by competent person

I hereby certify that such details and documents submitted herewith are in accordance with the requirements of the Water Services Industry Act 2006, Water Services Industry (Water Reticulation and Plumbing) Rules 2014, Uniform Technical Guidelines and other regulatory agencies requirements.

……..

Signature of competent person

Name of competent person (in block letters): ……..

NRIC No.: ……..

Address: ……

Telephone no.: ……..

Fax no.: ……..

Qualification and registration particulars:

……

*(*Please delete where appropriate)*

FOR OFFICIAL USE ONLY

Date received: …….. Checked by: ……..

Date replied: …… Reference no.: ……..

WATER SERVICES INDUSTRY ACT 2006

WATER SERVICES INDUSTRY (WATER RETICULATION AND PLUMBING) RULES 2013

APPLICATION TO TEST AND INSPECT THE EXTERNAL RETICULATION SYSTEM/ SUPPLY MAINS

Date: .....

To : Chief Executive Officer, Suruhanjaya Perkhidmatan Air Negara
Address : .....
File No. : .....
Development Title : .....

I/We refer to the approval of plans, designs and specifications for the implementation of an external reticulation system/supply mains* for the above named development as notified by Suruhanjaya Perkhidmatan Air Negara on .....

2. In accordance with rule 10 and the Sixth Schedule of the Water Services Industry (Water Reticulation and Plumbing) Rules 2013, I/We hereby apply for [material and pipe inspections, for pressure and leakage tests/for supervision of tapping connection, for sterilization, dewatering, flushing and water quality testing activities/for inspection, testing and commissioning of mechanical and electrical works/and final inspection for handover of facilities to the Water Distribution Licensee],* and we submit herewith a cheque for the sum of RM..... payable to .....(Name of Water Distribution Licensee) for ..... (Name of Water Distribution Licensee) to conduct the said inspections, supervisions and tests.

3. Notification shall be issued to your office when preparations to carry out the aforesaid inspection, supervisions and tests have been completed.

.....

Signature of developer

Name of developer (in capital letters):

……

NRIC no.: ……

Address: ……

Developer license no.: ……

Telephone no.: ……

Fax no.: ……

*(*Delete whichever is not appropriate)*

WATER SERVICES INDUSTRY ACT 2006

WATER SERVICES INDUSTRY (WATER RETICULATION AND PLUMBING) RULES 2014

APPLICATION FOR HANDING OVER OF EXTERNAL WATER RETICULATION SYSTEM / SUPPLY MAINS* TO A WATER DISTRIBUTION LICENSEE/ SERVICE LICENSEE IN ACCORDANCE WITH SECTION 47 OF THE ACT

To : Chief Executive Officer (of the relevant water distribution licensee)
Development : ……..
File No. : ……
Date : ……

We, …… (Company No: .....), the developer for the above development wish to inform that the construction of the external water reticulation system/supply mains* for the development has been completed, and successfully tested and commissioned as witnessed by the water distribution licensee's representative.

2. In accordance with section 47 of the Act and rule 29 of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014, we hereby apply to hand over the external water reticulation system/supply mains* to the water distribution licensee.

3. We hereby confirm that the external water reticulation system/supply mains* had been constructed in accordance with Approved Plan No(s): …… and the specifications and fittings/products are as recognised by the Commission in accordance with the requirements under the Act, Water Services Industry (Water Reticulation and Plumbing) Rules 2014 and any other conditions imposed by the Commission.

4. We attach herewith the following documents:

i. As built drawings of all components of the external water reticulation system/supply mains*;
ii. Copies of approval certificates pertaining to inspection of materials at site;
iii. Copies of final joint inspection reports and certificates;
iv. Copies of pressure and leak test of certificates of compliance and reports;
v. Documentation relating to surrender of the external water reticulation system/supply mains* to the relevant State/Federal* Authority under subrule 29(2) of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014;
vi. Testing and commissioning certificates of compliance relating to mechanical and electrical equipments and systems;
vii. Receipts of payments for capital contribution;
viii. Submission of required copies of operation and maintenance manuals;
ix. Approval certificates for connection of supply main to identified tapping point;
x. Copy of Bank Guarantee to cover against defects during defect liability period; and
xi. Original copy of the certificate of compliance issued by the qualified person under section 47 of the Act.

5. We take full responsibility for the design and construction of the external water reticulation system/supply mains* and undertake to rectify any defect within the defect liability period.

Thank you.

Applied by	:	Applied by	:.....
Qualified person	:	Developer	: .....
Name	:	Name	: .....
Designation	:	Designation:	.....
Date	:	Date	: .....

*(*Delete where appropriate)*

WATER SERVICES INDUSTRY ACT 2006

WATER SERVICES INDUSTRY (WATER RETICULATION AND PLUMBING) RULES 2014

ACCEPTANCE OF HANDING OVER OF EXTERNAL WATER RETICULATION SYSTEM / SUPPLY MAINS* FROM A DEVELOPER IN ACCORDANCE WITH SECTION 47 OF THE ACT

Development Title : ……..
Developer's Name : ……..
Address : ……..
File No. : ……..
Your Reference : ……..
Our Reference : ……..
Date : ……..

Sir,

We refer to the above named Development Title and to your application for the handing over of the external water reticulation system/supply mains* dated……

2. The accompanying documents submitted together with your application have been reviewed and found to be complete and are in compliance with the handing over rules and guidelines specified in the Water Services Industry (Water Reticulation and Plumbing) Rules 2014 and Uniform Technical Guidelines respectively. In addition, a joint inspection of the external water reticulation system/supply mains* was successfully conducted in the presence of the qualified person and representatives from the developer and water distribution licensee.

3. The list of defects to be rectified during the Defects Liability Period is approved and we acknowledge the receipt of a guarantee to carry out rectifications of such defects (Bank Guarantee) valid for a period of twenty-seven months from the date of handing over. Your obligations during the Defects Liability Period are specified in rule 30 of the Water Services Industry (Water Reticulation and Plumbing) Rules 2014.

4. We therefore confirm that pursuant to section 47 of the Water Services Industry Act 2006, the external reticulation system/supply mains* for the above named development has been handed over to the water distribution licensee on..... The Defects Liability Period shall come into operation from ..... to.....

Thank you.

……..

Chief Executive Officer of water distribution licensee

Name : ……

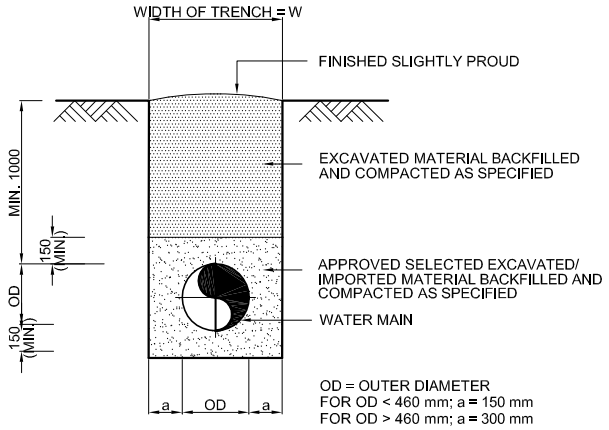
Date : ……

*(*Delete where appropriate)*

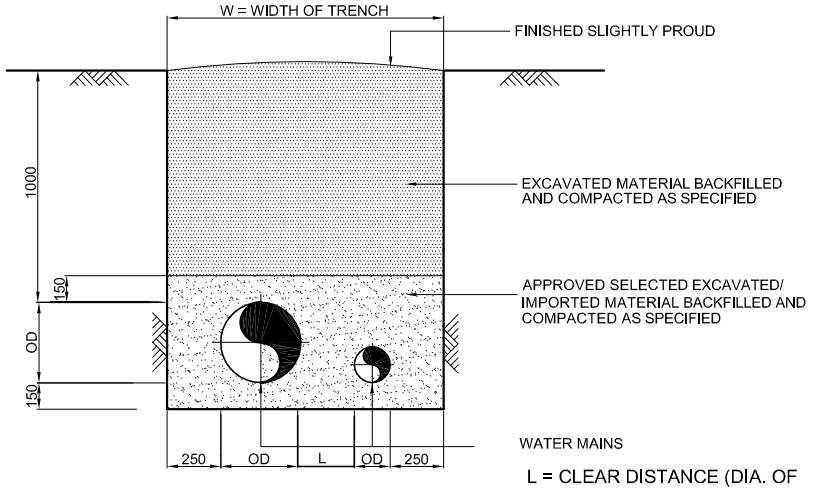
Appendix C

Standard Drawing for External Reticulation Systems and Supply Mains

	LIST OF DRAWINGS	
1	DETAILS FOR PIPE IN TRENCH	SPAN/WS/STD/F/001
2	TYPICAL DETAILS OF SLUICE VALVE AND SCOUR VALVE CHAMBER (SHEET 1 OF 2)	SPAN/WS/STD/F/002
3	TYPICAL DETAILS OF SLUICE VALVE AND SCOUR VALVE CHAMBER (SHEET 2 OF 2)	SPAN/WS/STD/F/003
4	TYPICAL DETAILS OF BUTTERFLY VALVE CHAMBER	SPAN/WS/STD/F/004
5	TYPICAL DETAILS OF AIR VALVE CHAMBER	SPAN/WS/STD/F/005
6	DETAILS OF STANDARD COVER CHAMBER (SHEET 1 OF 2)	SPAN/WS/STD/F/006
7	DETAILS OF STANDARD COVER CHAMBER (SHEET 2 OF 2)	SPAN/WS/STD/F/007
8	DETAILS OF WATER SAMPLING STATION	SPAN/WS/STD/F/008
9	DETAILS OF DISTRICT FLOW METER CHAMBER	SPAN/WS/STD/F/009
10	DETAILS OF CONCRETE THRUST BLOCK AND ANCHOR BLOCK (SHEET 1 OF 2)	SPAN/WS/STD/F/010
11	DETAILS OF CONCRETE THRUST BLOCK AND ANCHOR BLOCK (SHEET 2 OF 2)	SPAN/WS/STD/F/011
12	SCHEDULE OF THRUST BLOCK	SPAN/WS/STD/F/012
13	DETAILS OF JOINTS (SHEET 1 OF 2)	SPAN/WS/STD/F/013
14	DETAILS OF JOINTS (SHEET 2 OF 2)	SPAN/WS/STD/F/014
15	DETAILS OF MILD STEEL PIPES, BENDS AND TAPERS	SPAN/WS/STD/F/015
16	DETAILS OF DUCTILE IRON GUSSETED BENDS, PUSH-IN JOINT AND FLANGE	SPAN/WS/STD/F/016
17	DETAILS OF MILD STEEL TEES	SPAN/WS/STD/F/017
18	TYPICAL TYPE 1 CULVERT OR STREAM CROSSING	SPAN/WS/STD/F/018
19	TYPICAL TYPE 2 CULVERT OR STREAM CROSSING	SPAN/WS/STD/F/019
20	TYPICAL TYPE 3 CULVERT OR STREAM CROSSING	SPAN/WS/STD/F/020
21	TYPICAL TYPE 4 CULVERT OR STREAM CROSSING	SPAN/WS/STD/F/021
22	METER STAND (PIPE 80mm - 200mm)	SPAN/WS/STD/F/022
23	FIRE HYDRANT AND TANKER FILLING OPTION	SPAN/WS/STD/F/023
24	DETAILS OF STANDARD MARKER POST	SPAN/WS/STD/F/024
25	DETAILS OF REFLECTIVE 3M STICKERS	SPAN/WS/STD/F/025
26	DETAILS OF HDPE COMMUNICATION PIPE AND TAPPING FROM MILD STEEL RETICULATION PIPE	SPAN/WS/STD/F/026
27	DETAILS OF HDPE COMMUNICATION DUCTILE IRON / uPVC/AC / MILD STEEL RETICULATION PIPE	SPAN/WS/STD/F/027
28	DETAILS OF HDPE COMMUNICATION PIPE AND TAPPING FROM HDPE RETICULATION PIPE (SHEET 1 OF 2)	SPAN/WS/STD/F/028
29	DETAILS OF HDPE COMMUNICATION PIPE AND TAPPING FROM HDPE RETICULATION PIPE (SHEET 2 OF 2)	SPAN/WS/STD/F/029
30	TYPICAL COMMUNICATION PIPE TAPPING AND DETAILS	SPAN/WS/STD/F/030
31	METER STAND (PIPE 15mm - 50mm)	SPAN/WS/STD/F/031
32	METER STAND FOR MULTI METER CONNECTION	SPAN/WS/STD/F/032
33	METER STAND (PIPE 15mm - 50mm) - POLYSTEEL PIPE	SPAN/WS/STD/F/033
34	METER STAND FOR MULTI METER CONNECTION - POLYSTEEL PIPE	SPAN/WS/STD/F/034
35	FENCE AND GATE DETAILS	SPAN/WS/STD/F/035

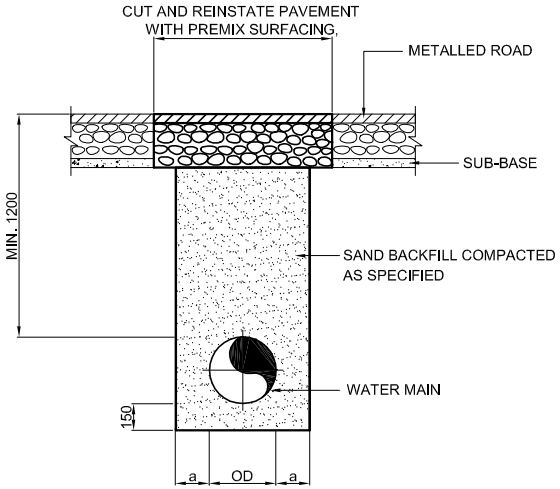


NORMAL TRENCH FOR SINGLE PIPE

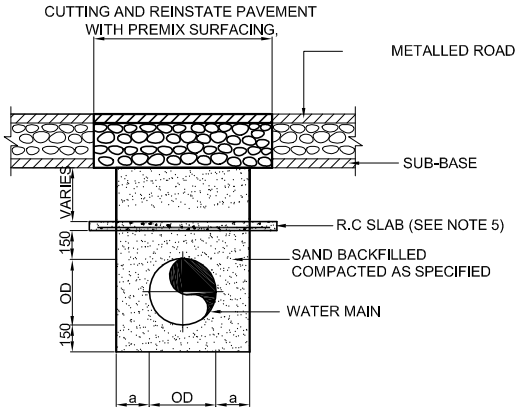


NORMAL TRENCH FOR TWIN PIPES

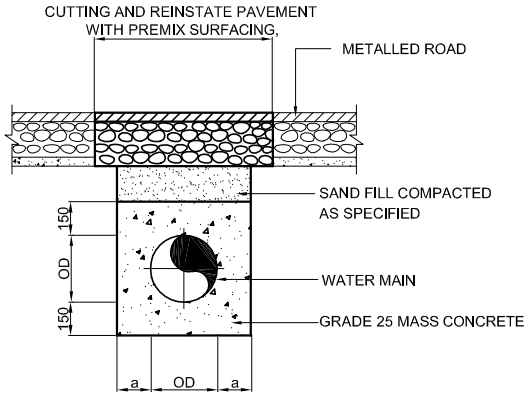
L = CLEAR DISTANCE (DIA. OF LARGE PIPE OR 600 mm WHICHEVER IS GREATER)



PIPE UNDER ROAD PAVEMENT OR TRACK



R.C SLAB FOR PIPE WITH INSUFFICIENT COVER, UNDER ROAD OR DRAIN



CONC. SURROUND FOR PIPE WITH INSUFFICIENT COVER, UNDER ROAD OR DRAIN

NOTES:–

1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.

2. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.

3. ALL REINSTATEMENTS SHALL BE SUBJECT TO LOCAL AUTHORITY/ COUNCIL'S TECHNICAL REQUIREMENTS AND APPROVAL CONDITIONS.

4. PAVEMENT SHOULD BE CUT SQUARE BY APPROVED CUTTER.

5. R.C SLAB SHOULD BE DESIGN BY APPROVED SUBMITTING PERSON THAT SHOULD MEET ALL TECHNICAL REQUIREMENTS IN TERMS OF PAVEMENT LOADINGS, PIPE SIZE AND MATERIAL.

SPAN

SURUHANJAYA PERKHIDMATAN AIR NEGARA
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

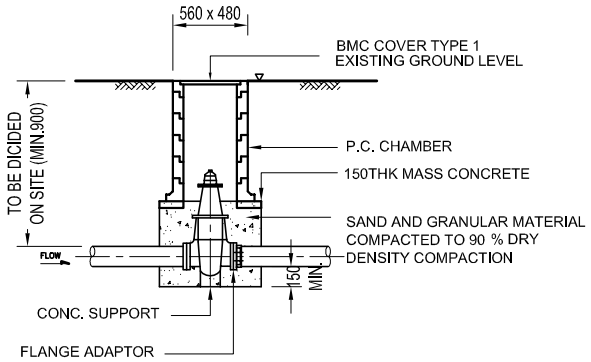
DRAWING TITLE :

DETAILS FOR PIPE IN TRENCH

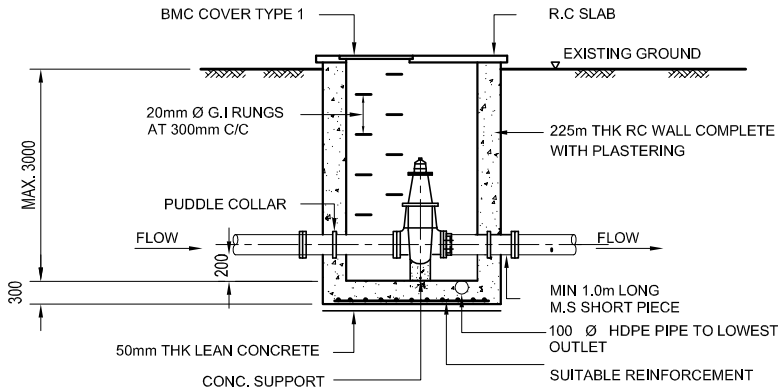
DRAWING NO:

SPAN/WS/STD/F/001

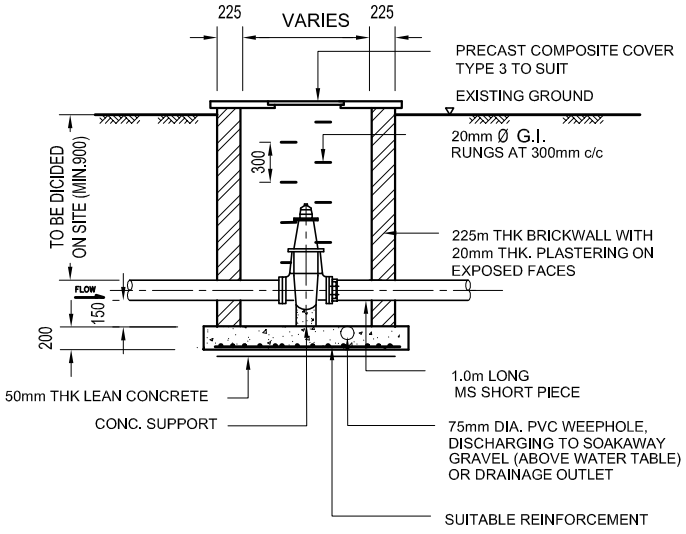
[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF001.dwg Wed, 26 Jun 2013 – 2:17pm



PC CHAMBER FOR SLUICE VALVE DEPTH LESS THAN 1.0m)



PC CHAMBER FOR SLUICE VALVE AND SCOUR VALVE (PIPE SIZE MORE THAN 600mm AND DEPTH MORE THAN 1.5m)



BRICK CHAMBER FOR SLUICE VALVE (FOR PIPE DEPTH 1m TO 1.5m)

NOTES:-

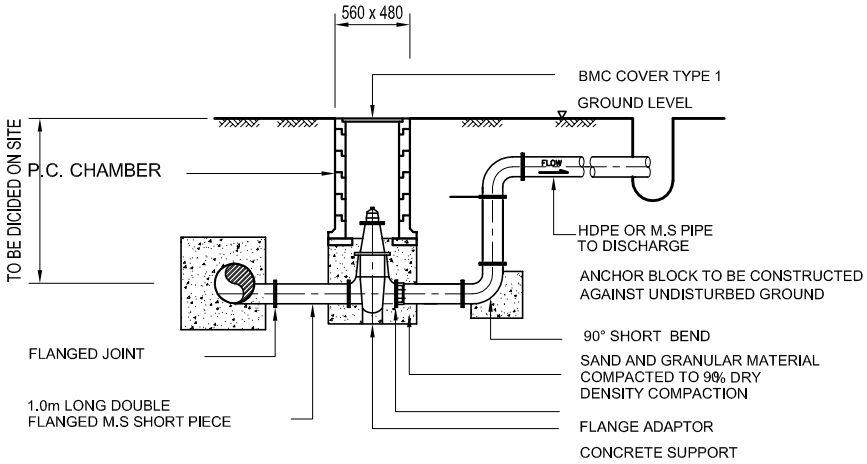
1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. ALL STEELWORK TO BE PAINTED WITH 2 COATS OF APPROVED ANTI CORROSIVE PAINT/EPOXY 325 MICRO DFT.
3. LEAN CONCRETE SHALL BE OF GRADE 15/20.
4. ALL VALVES SHALL BE OF DUCTILE IRON GRADE $\frac{500}{7}$ PN 16 TO SPAN APPROVAL.
5. FOR SLUICE VALVE CHAMBER LOCATED WITHIN THE ROAD SHALL USE RC COVER CHAMBER TO DETAILS.

SPAN
SURUHANJAYA PERKHIDMATAN AIR NEGARA
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

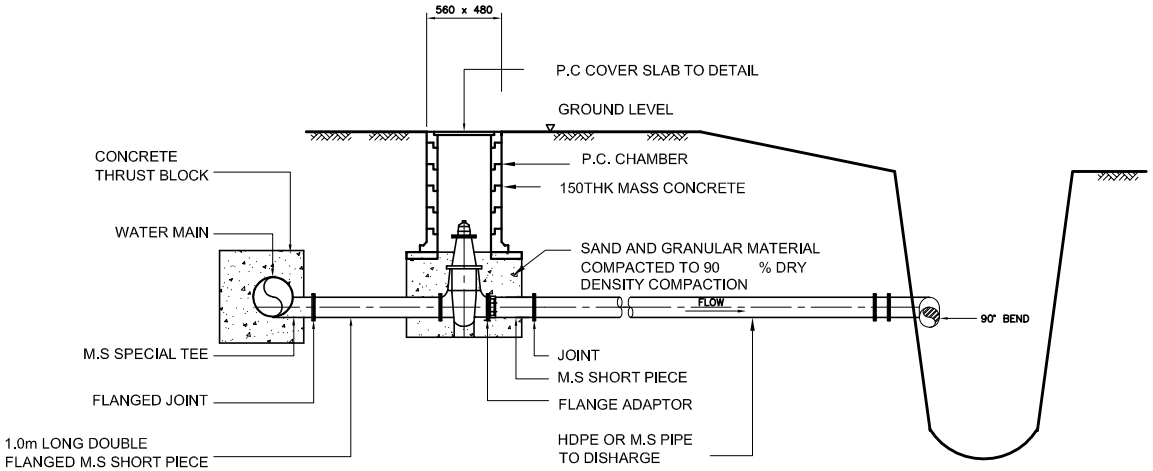
DRAWING TITLE :

TYPICAL DETAILS OF SLUICE VALVE AND SCOUR VALVE CHAMBER
SHEET 1 OF 2

DRAWING NO:
SPAN/WS/STD/F/002



PC CHAMBER FOR SCOUR
VALVE DEPTH 1m TO 1.5m



PC CHAMBER FOR SCOUR
VALVE DEPTH LESS 1m

NOTES:-

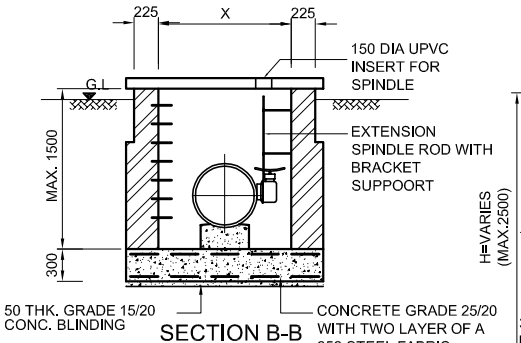
1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. ALL STEELWORK TO BE PAINTED WITH 2 COATS OF APPROVED ANTI CORROSIVE PAINT/EPOXY 325 MICRO DFT.
3. LEAN CONCRETE SHALL BE OF GRADE 15/20.
4. ALL VALVES SHALL BE OF DUCTILE IRON GRADE $\frac{500}{7}$ PN 16 TO SPAN APPROVAL.
5. FOR SLUICE VALVE CHAMBER LOCATED WITHIN THE ROAD SHALL USE RC COVER CHAMBER TO DETAILS.

SPAN
SURUHANJAYA PERKHIDMATAN AIR NEGARA
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

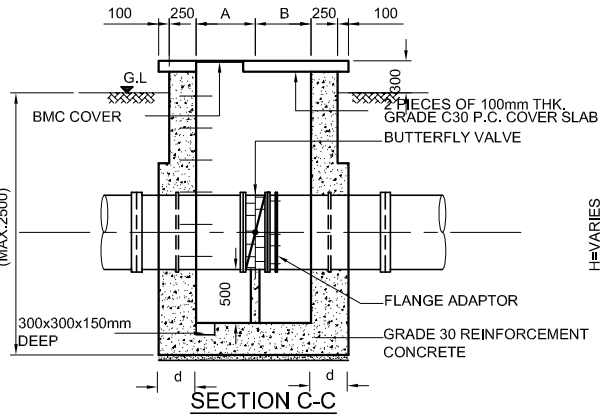
DRAWING TITLE :

TYPICAL DETAILS OF SLUICE VALVE AND SCOUR VALVE CHAMBER
SHEET 2 OF 2

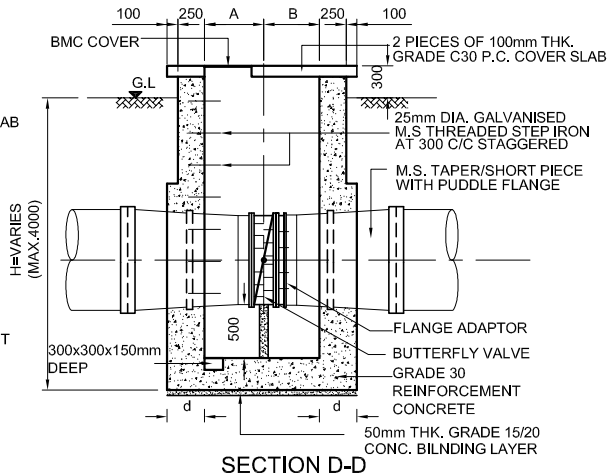
DRAWING NO:
SPAN/WS/STD/F/003



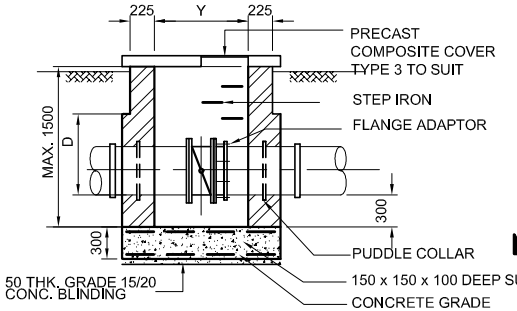
SECTION B-B



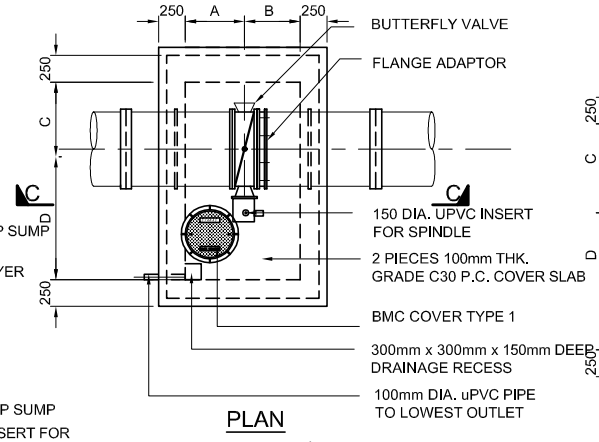
SECTION C-C



SECTION D-D

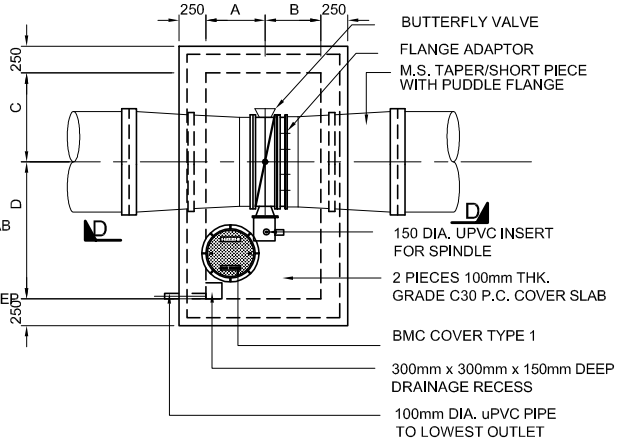


SECTION A-A

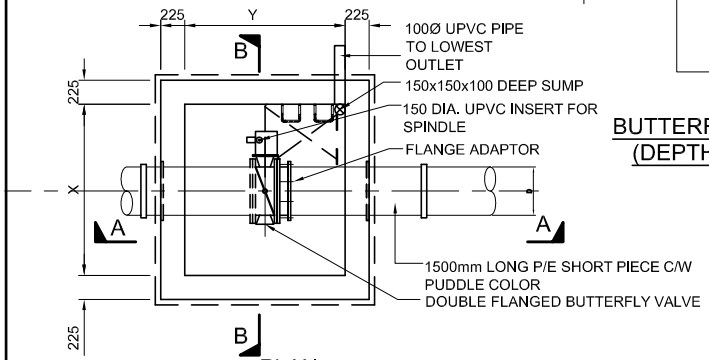


PLAN

BUTTERFLY VALVE CHAMBER TYPE 2
(DEPTH NOT EXCEEDING 2.5m)



BUTTERFLY VALVE CHAMBER TYPE 3
(DEPTH NOT EXCEEDING 4.0m)



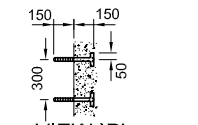
PLAN

DETAIL OF BUTTERFLY VALVE CHAMBER TYPE 1
(DEPTH NOT EXCEEDING 1.5m)

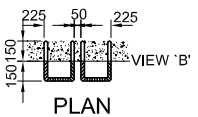
SHEDULE OF BUTTERFLY CHAMBER			
MAIN PIPE (mm N.D)	X (mm)	Y (mm)	T (mm)
BELOW 600Ø	1600	1500	250
≥ 600Ø BUT ≤ 900Ø	2500	1600	250

NOTE : "T" IS APPLICABLE FOR R.C CHAMBER ONLY

TYPE OF CHAMBER	DIA. OF BUTTERFLY VALVE (mm)	SIZE OF CHAMBER -INTERNAL (mm)				TYPE OF COVER	THICKNESS d (mm)	
		A	B	C	D		2.0 < H < 4.0m (mm)	4.0 < H < 5.0m (mm)
A	2100	1200	1600	1800	2800	2 PIECE OF 3500mm x 2650mm x 100mm THK COVER SLAB WITH 6mm THK. M.S CHEQUERED PLATE COVER OVER 900mm SQ. ACCESS OPENING	450	600
B	2000	1200	1600	1800	2800	2 PIECE OF 3500mm x 2650mm x 100mm THK COVER SLAB WITH 6mm THK. M.S CHEQUERED PLATE COVER OVER 900mm SQ. ACCESS OPENING	450	600
C	1000	600	900	900	1400	2 PIECE OF 2200mm x 1500mm x 100mm THK COVER SLAB WITH 6mm THK. M.S CHEQUERED PLATE COVER OVER 900mm SQ. ACCESS OPENING	450	600
D	600	600	900	600	1200	1 PIECE OF 2200mm x 2500mm x 100mm THK COVER SLAB WITH 6mm THK. M.S CHEQUERED PLATE COVER OVER 900mm SQ. ACCESS OPENING	450	600
E	450	600	900	600	1200	1 PIECE OF 2200mm x 2500mm x 100mm THK COVER SLAB WITH 6mm THK. M.S CHEQUERED PLATE COVER OVER 900mm SQ. ACCESS OPENING	450	600
F	400	600	900	600	1200	1 PIECE OF 2200mm x 2500mm x 100mm THK COVER SLAB WITH 6mm THK. M.S CHEQUERED PLATE COVER OVER 900mm SQ. ACCESS OPENING	450	600



VIEW `B'



PLAN

DETAILS OF THREADED STEP IRON

NOTES:-

1. ALL DIMENSIONS ARE IN MILLEMETRE UNLESS OTHERWISE STATED.
2. REINFORCEMENT CONCRETE 30/20
3. LEAN CONCRETE GRADE 15/20
4. ALL MS PLATE AND STEP IRONS TO BE HOT DIPPED GALVANISED TO BS 729.

SPAN

SURUHANJAYA PERKHIDMATAN AIR NEGARA

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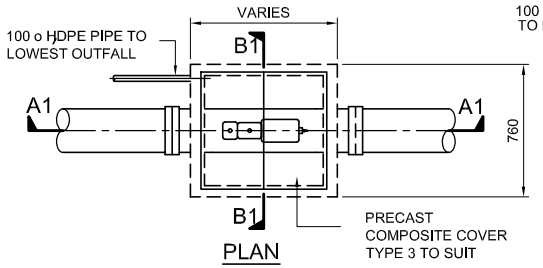
DRAWING TITLE :

TYPICAL DETAILS OF BUTTERFLY VALVE CHAMBER

DRAWING NO:

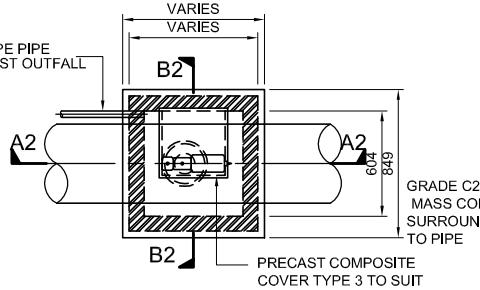
SPAN/WS/STD/F/004

[Infrastructure Div] 3414 C:\a_data\david c dwd3\SPAN\final drawings\span final print\ WSSTDF004.dwg Wed, 26 Jun 2013 - 2:22pm



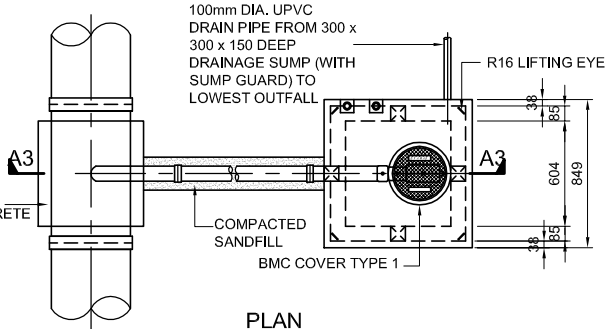
PLAN

PC CHAMBER FOR AIR VALVE : TYPE AV1
(FOR PIPE DEPTH LESS THAN 0.75m)



PLAN

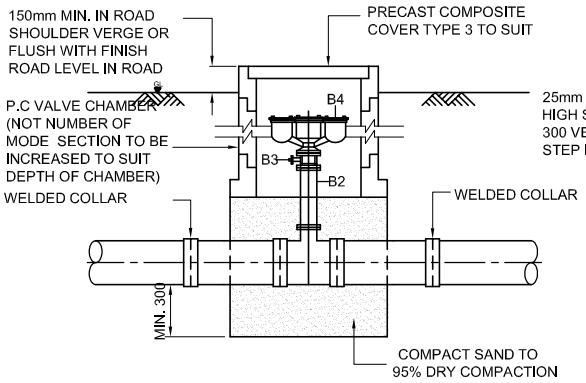
BRICK CHAMBER FOR AIR VALVE : TYPE AV2
(FOR PIPE DEPTH 1m TO 1.5m)



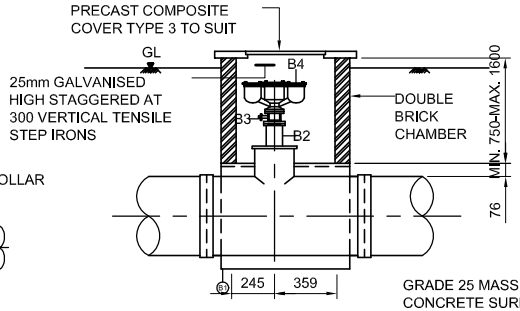
PLAN

RC CHAMBER FOR AIR VALVE CHAMBER : TYPE AV3
(FOR PIPE DEPTH MORE THAN 1.5m)

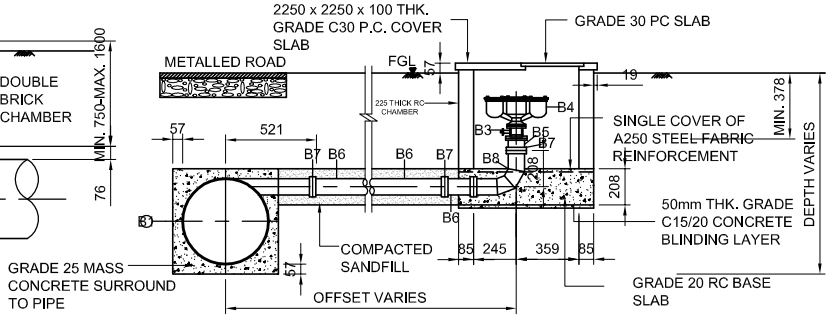
NOTE : THE ENGINEER SHALL DESIGN THE CONCRETE ENCASEMENT APPROPRIATELY FOR SL/WDL APPROVAL.



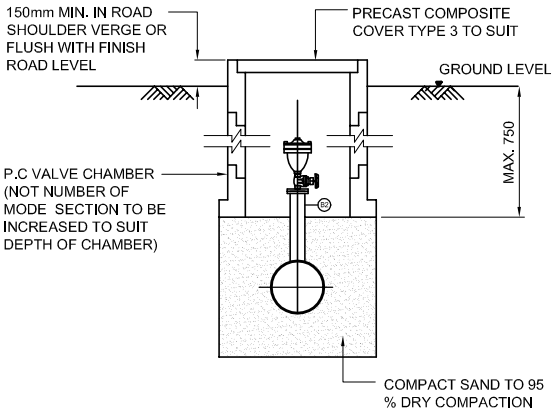
SECTION A1-A1



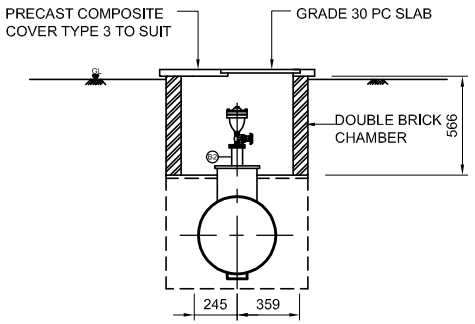
SECTION A2-A2



SECTION A3-A3



SECTION B1-B1



SECTION B2-B2

DESCRIPTION OF PIPES, FITTINGS AND VALVES	
ITEM NO.	DESCRIPTION
B1	CONCENTRIC TEE : X mm DIA. FLANGE ENDED BRANCH ON Ymm F.I.D. PLAIN ENDED BARREL
B2	Xmm DIA. x 250mm LONG WITH ONE END TO SUIT MS FLANGE PIPE
B3	Xmm DIA. DOUBLE FLANGED BUTTERFLY VALVE
B4	Xmm DIA. DOUBLE ORIFICE AIR VALVE
B5	Xmm DIA. x 450mm LONG P/FE SHORT PIECE FLANGED ENDED TO SUIT
B6	Xmm DIA. PLAIN ENDED SHORT PIPE (LENGTH TO SUIT SITE CONDITION)
B7	Xmm DIA. COLLAR WELD
B8	90° PLAIN ENDED BEND TO SUIT 300mm DIA. PIPE

NOTES:-
1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. ACTUAL LENGTH OF PE COMMUNICATION PIPES SHALL BE DETERMINED ON SITE.
3. THIS DRAWING SHALL BE READ IN CONJUNTION WITH DRAWING NO. SPAN/WS/STD/002.
4. THE ENGINEER SHALL DETERMINE THE APPROPRIATE DIMENSIONS FOR THE CHAMBER TO SUIT THE SIZE OF THE AIR VALVE.
5. THE SHOP DRAWINGS SHORT PIECES SHALL BE SUBMITTED FOR APPROVAL BEFORE MANUFACTURE.

SPAN

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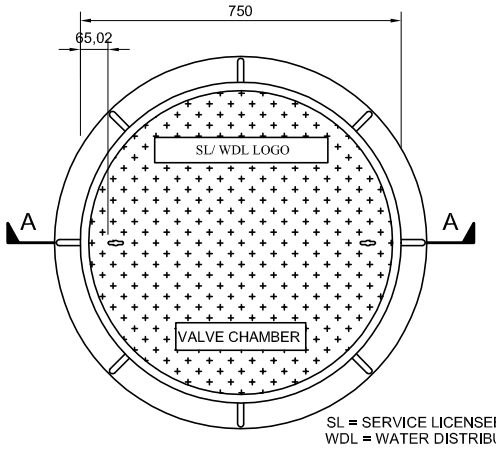
DRAWING TITLE :

TYPICAL DETAILS OF AIR VALVE CHAMBER

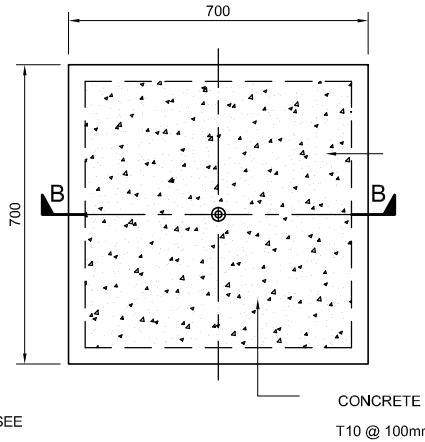
DRAWING NO:

SPAN/WS/STD/F/005

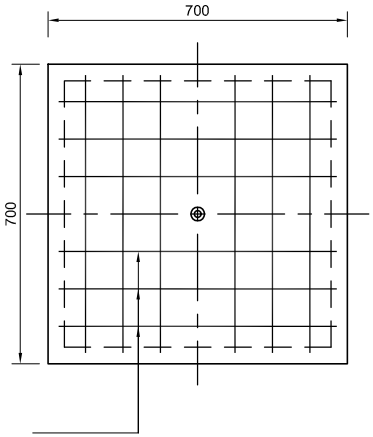
[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF005.dwg Wed, 26 Jun 2013 - 2:22pm



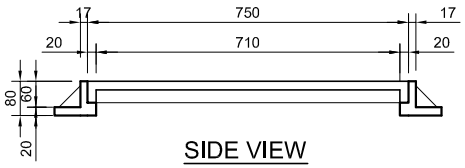
TOP VIEW
(COVER TYPE 1)



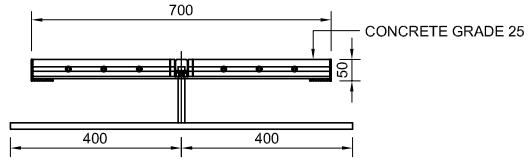
TOP VIEW
(LOCKABLE CONCRETE COVER (TYPE 2)



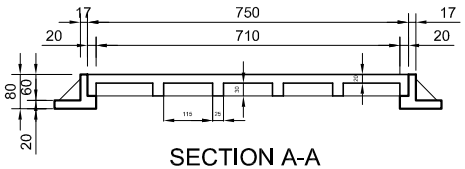
REINFORCEMENT DETAIL



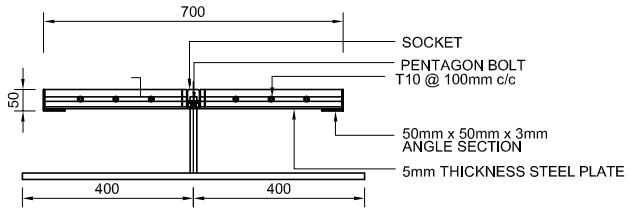
SIDE VIEW



SIDE VIEW



SECTION A-A



SECTION B-B

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.

2. THE COVER SHALL HAVE CAST ON STAMPED LETTERING/SERVICE LICENSEE/WATER DISTRIBUTION LICENSEE NAME.

SPAN

SURUHANJAYA PERKHIDMATAN AIR NEGARA

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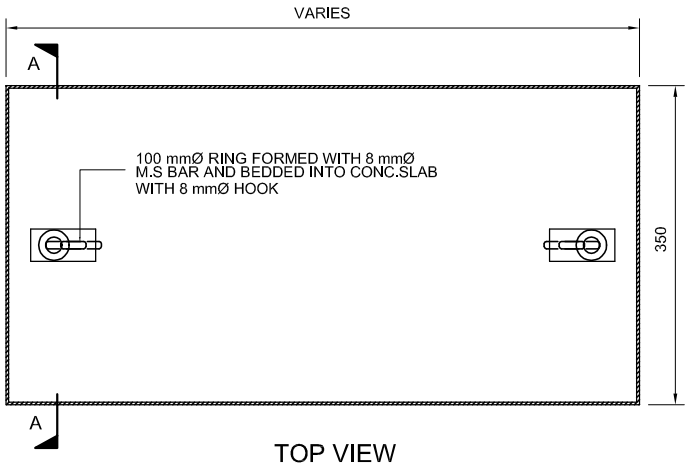
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

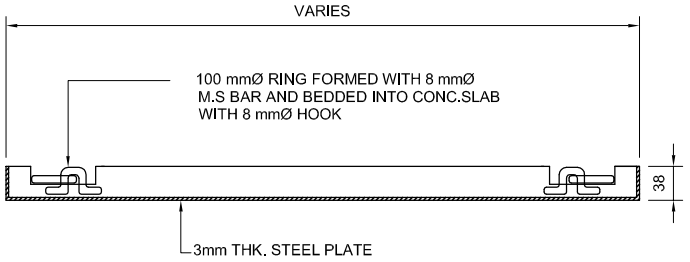
DETAILS OF STANDARD
COVER CHAMBER
(SHEET 1 OF 2)

DRAWING NO:

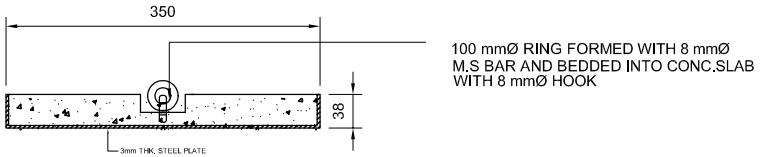
SPAN/WS/STD/F/006



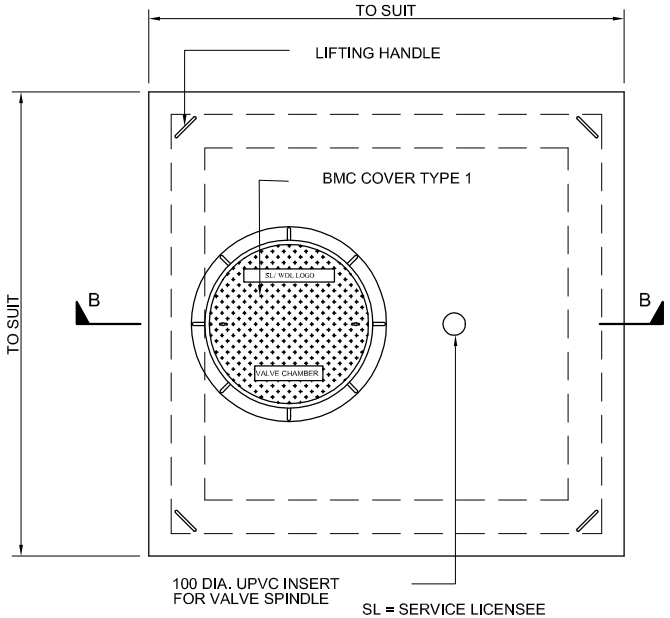
TOP VIEW
(PRECAST COMPOSITE COVER (TYPE 3)



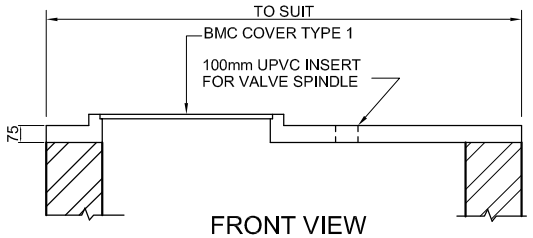
FRONT VIEW



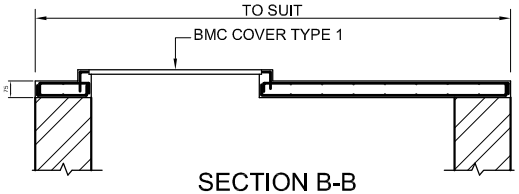
SECTION A-A



TOP VIEW
(RC SLAB COVER (TYPE 4)



FRONT VIEW



SECTION B-B

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.

2. THE COVER SHALL HAVE CAST ON STAMPED LETTERING/SERVICE LICENSEE/WATER DISTRIBUTION LICENSEE NAME.

SURUHANJAYA PERKHIDMATAN AIR NEGARA
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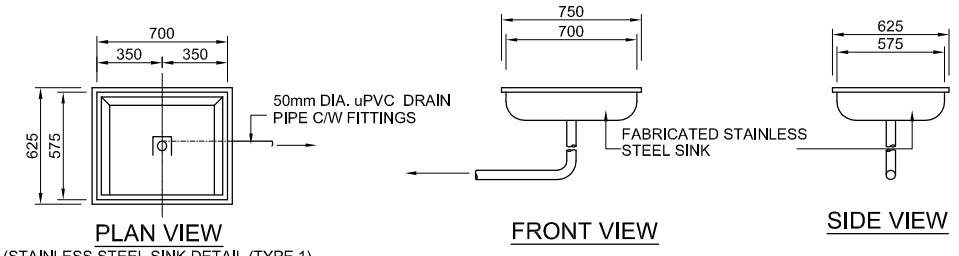
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

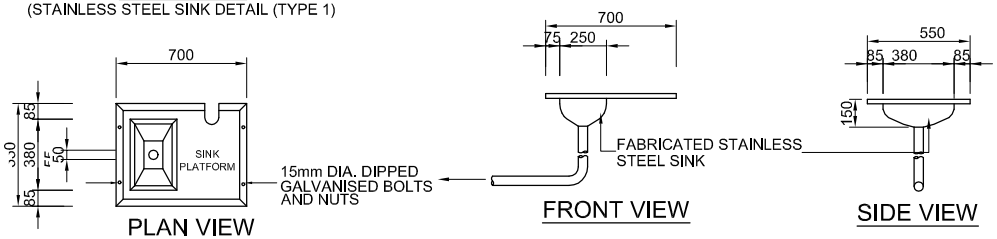
DETAILS OF STANDARD
COVER CHAMBER
(SHEET 2 OF 2)

DRAWING NO:

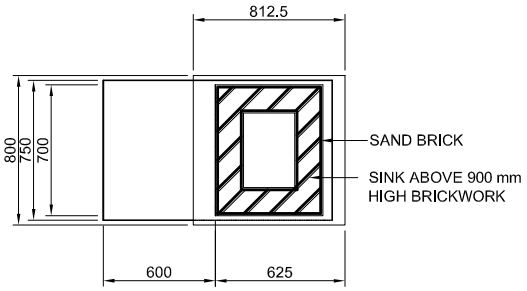
SPAN/WS/STD/F/007



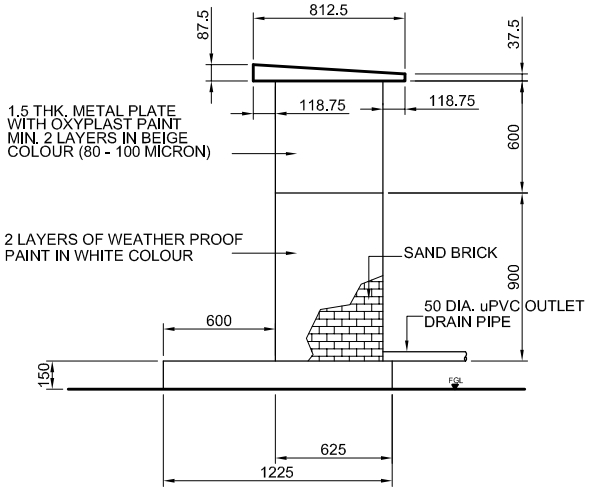
(STAINLESS STEEL SINK DETAIL (TYPE 1)



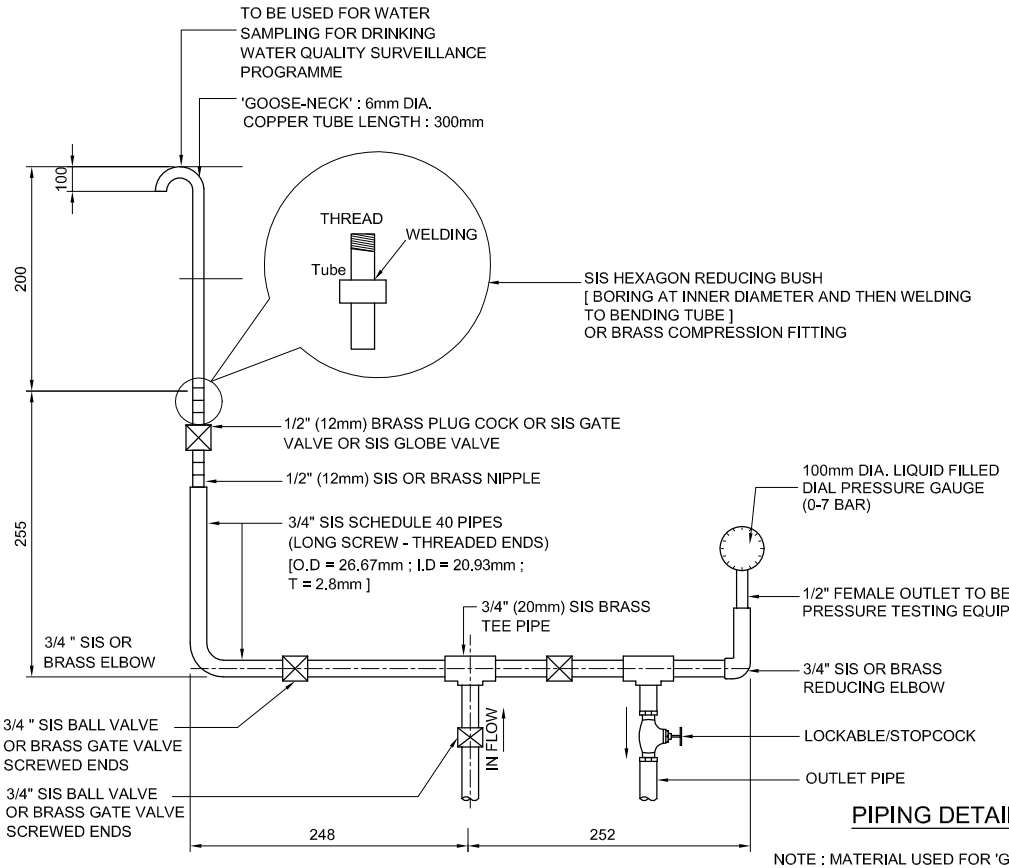
(STAINLESS STEEL SINK DETAIL (TYPE 2)



PLAN VIEW
SAMPLING STATION

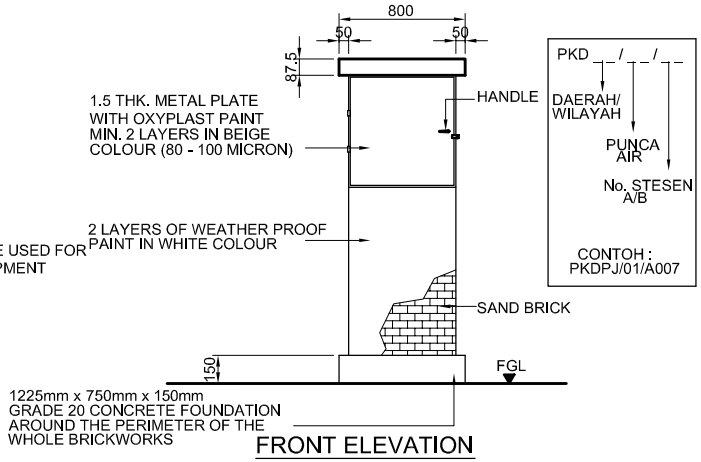


SIDE ELEVATION



PIPING DETAILS

NOTE : MATERIAL USED FOR 'GOOSE-NECK' TUBE MUST BE THE SAME AS THE REDUCING BUSH OR COMPRESSION FITTING



FRONT ELEVATION

NOTE:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.

SPAN

SURUHANJAYA PERKHIDMATAN AIR NEGARA
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
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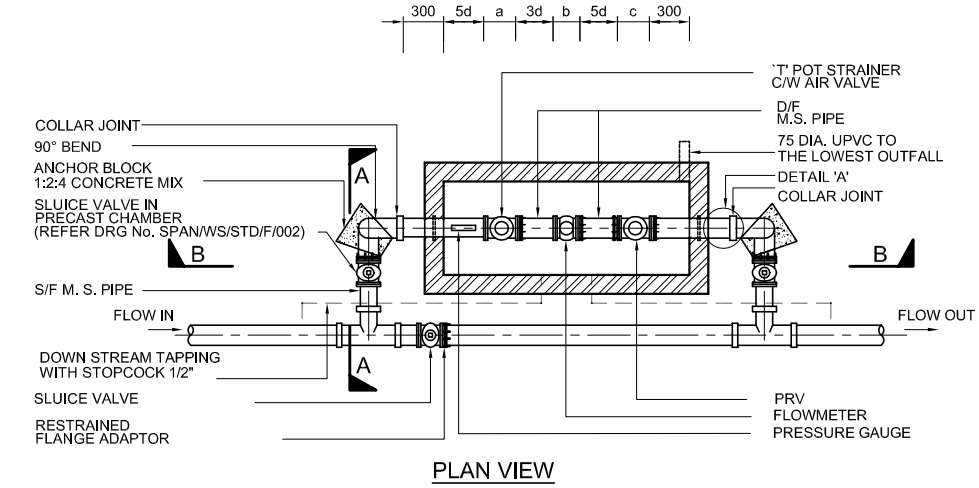
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

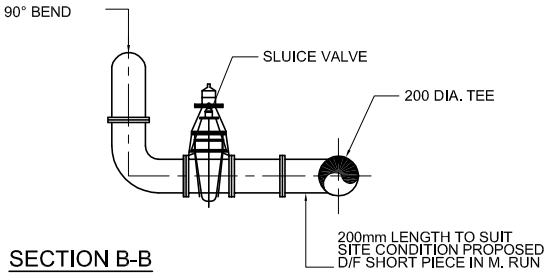
DETAILS OF WATER SAMPLING STATION

DRAWING NO:

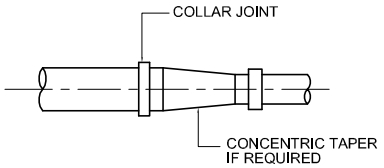
SPAN/WS/STD/F/008



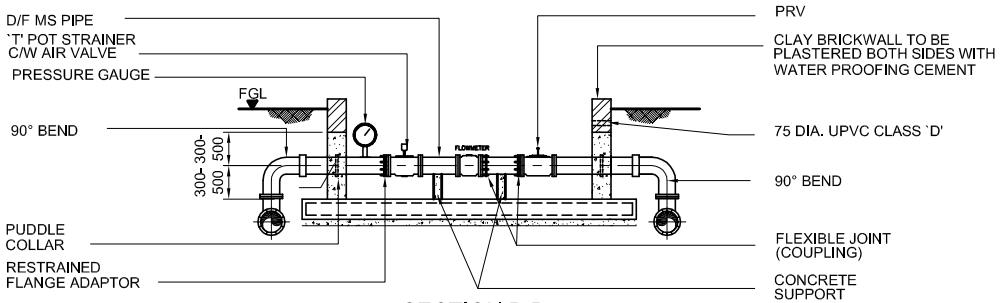
PLAN VIEW



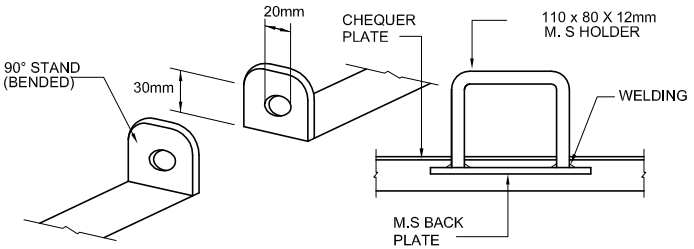
SECTION B-B



DETAIL `A'

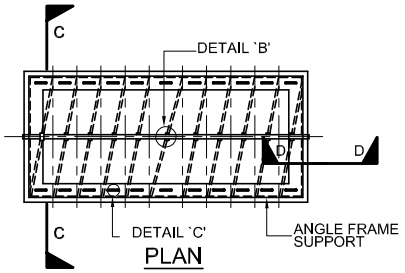


SECTION B-B

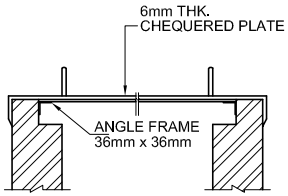


DETAIL `B'

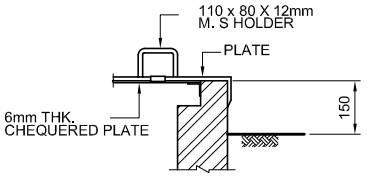
DETAIL `C'



PLAN



SECTION C-C



SECTION D-D

T-POT STRAINER	
SIZE	LENGTH = a
100mm	340mm
150mm	420mm
200mm	480mm

FLOWMETER			
SIZE	LENGTH = b	5d	3b
100mm	250mm	500mm	300mm
150mm	300mm	750mm	450mm
200mm	350mm	1000mm	600mm

PRESSURE REDUCING VALVE	
SIZE	LENGTH = c
100mm	368mm
150mm	473mm
200mm	560mm

NOTES :–

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. THRUST BLOCK TO BE CAST AGAINST UNDISTURBED GROUND.
3. FOR ALL STEEL PIPES, NO ALLOWANCE FOR INTERNAL LINING CUTBACK TO BE PROVIDED
4. ALL EXPOSED STEEL TO BE PAINTED WITH 2 PACK HIGH SOLIDS EPOXY PAINT TO MIN. 150mm.
5. THE DIMENSIONS ARE BASED ON 'WATTS' PRV, NVM FLOWMETER, LYE T–POT STRAINER.

SPAN
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Aras Bawah & Aras Satu
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Selangor Darul Ehsan, Malaysia

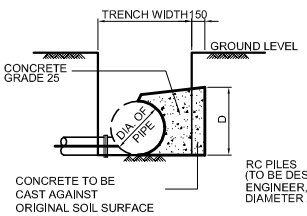
DRAWING TITLE :

DETAILS OF DISTRICT FLOW METER CHAMBER

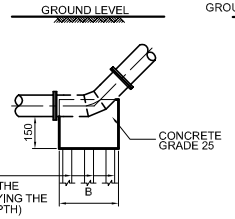
DRAWING NO:

SPAN/WS/STD/F/009

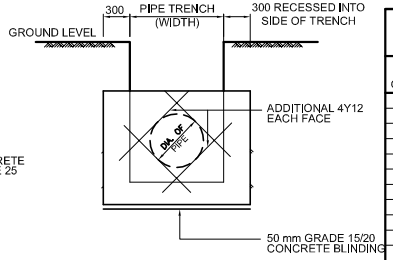
[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF009.dwg Wed, 26 Jun 2013 – 2:24pm



SECTION D-D



SECTION E-E



SECTION F-F

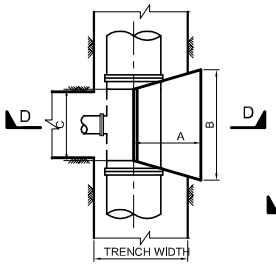
SCHEDULE OF CONCRETE THRUST BLOCK FOR BEND & TEE WITH WELDED JOINTS

NOMINAL DIA. OF PIPE (mm)	OUTER DIA. OF PIPE (mm)	GUSSETED BEND UP TO 30° A	B	C	D	OVER 30° TO 60° A	B	C	D	OVER 60° TO 90° A	B	C	D
100	121.9	450	700	300	300	450	800	500	500	450	1000	500	600
150	177.3	450	900	400	400	450	900	550	500	450	1400	600	600
200	232.2	450	1000	500	400	450	1200	700	500	450	1700	750	600
250	286.0	500	1000	500	500	500	1550	800	600	500	1900	800	700
300	345.4	500	1200	500	500	500	1700	800	600	500	2000	800	700
350	399.3	550	1500	600	500	550	1800	850	600	550	2600	900	700
375	426.0	600	1600	600	500	600	2100	900	700	600	3000	950	700
400	453.1	600	1700	700	500	600	2300	1000	700	600	3300	1100	700
450	507.0	650	1900	700	600	650	2900	1000	700	650	3500	1150	800
525	560.3	700	2000	800	700	700	3100	1050	800	700	3800	1250	900
600	667.0	800	2000	800	800	800	3400	1200	1000	800	4100	1300	1200
750	813.4	950	2500	900	1000	950	4000	1400	1200	950	4600	1300	1400
800	914.4	1000	2900	900	1100	1000	4300	1500	1400	1000	5500	1600	1600

NOMINAL DIA OF TEE (mm)	TEE/SCOUR TEE A	B	C	D
100 x 100	450	350	250	200
150 x 100	450	350	250	200
150 x 150	450	350	350	190
200 x 100	450	350	250	200
200 x 200	500	450	500	200
250 x 100	500	450	300	250
300 x 100	500	400	300	250
350 x 100	550	450	350	300
375 x 100	600	450	350	300
400 x 150	600	800	600	400
450 x 150	650	800	650	600
450 x 200	650	800	700	650
450 x 450	600	2100	650	650
525 x 150	700	800	700	650
600 x 150	800	800	750	650
600 x 200	850	1000	800	700
600 x 450	900	2500	900	900
600 x 600	950	2800	1500	1200

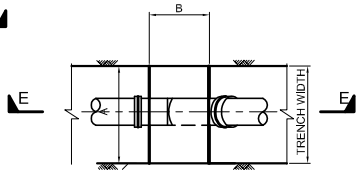
NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. MASS CONCRETE GRADE 20/25
3. ALLOWABLE BEARING PRESSURE = 75KN/M.
4. TEST PRESSURE FOR THRUST BLOCKS IS BASED ON 100mm HEAD OF WATER.
5. DIMENSIONS OF THRUST BLOCKS TO BE INCREASED IF ACTUAL BEARING PRSSURE IS FOUND TO BE LESS THAN 75 KN/M.
6. DIMENSIONS `A' OF THRUST BLOCK TO BE ADJUSTED BY THE S. O. IF NECESSARY TO SUIT TRENCH WIDTH.



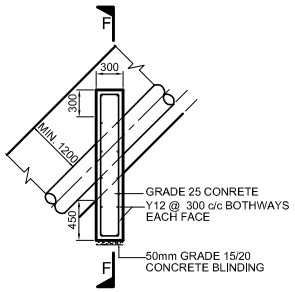
PLAN

DETAILS OF THRUST BLOCK FOR STEEL SCOUR TEE



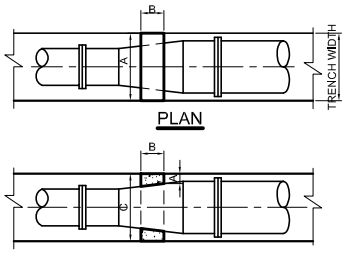
PLAN

DETAILS OF THRUST BLOCK FOR VERTICAL BEND



ELEVATION

ANCHOR BLOCK



PLAN

SECTION

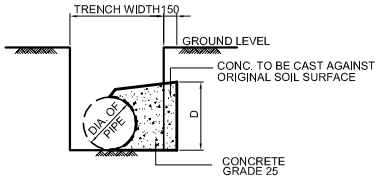
DETAILS OF THRUST BLOCK FOR TAPER

SCHEDULE OF VERTICAL CONCRETE THRUST BLOCK FOR WELDED JOINTS

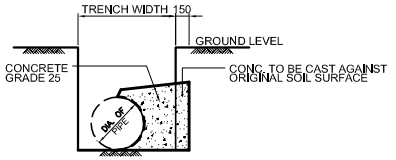
NOMINAL DIA OF PIPE (mm)	GUSSETED BEND 45°			30°		
100	450	600	350	450	550	100
150	450	700	400	450	600	150
200	450	950	400	450	700	200
250	550	1200	500	550	850	250
300	550	1200	500	550	900	250
350	600	1200	500	600	900	300
375	650	1200	550	650	900	300
400	700	1200	550	700	900	350
450	850	1250	600	850	1000	350
525	950	1400	700	950	1100	400
600	1200	1450	750	1200	1250	450
750	1350	2000	850	1350	1400	500
800	1450	2400	1000	1450	1700	550

SCHEDULE OF ANCHOR BLOCK

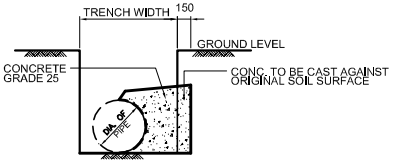
GRADIENT EXCEEDING	POSITION OF ANCHOR BLOCK
8% - 12.5%	EVERY 3RD. PIPE
12.5% - 20%	EVERY 2ND. PIPE
20% & ABOVE	EVERY PIPE



SECTION A-A



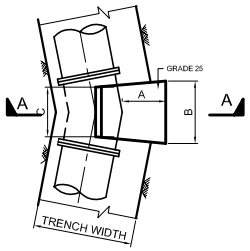
SECTION B-B



SECTION C-C

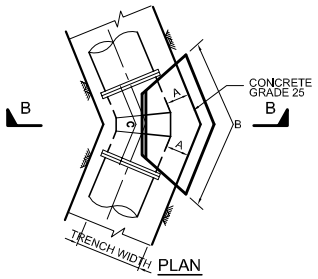
TABLE FOR THRUST BLOCK FOR TAPER

NOMINAL DIA. OF PIPE (mm)	A (mm)	B (mm)	C (mm)
150 x 100	500	300	500
200 x 100			
200 x 150			
250 x 150	600	300	600
250 x 200			
300 x 200	700	400	700
300 x 250			
350 x 200	800	400	700
350 x 250			
350 x 300			
400 x 200	900	500	800
400 x 250			
400 x 300	900	450	800
400 x 350			
450 x 300	1000	700	850
450 x 350			
450 x 400			



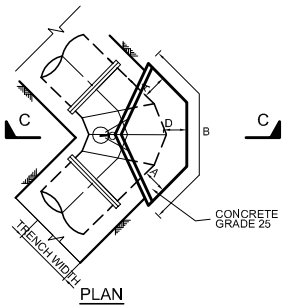
PLAN

DETAILS OF THRUST BLOCK FOR GUSSETED BEND UP TO 30°



PLAN

DETAILS OF THRUST BLOCK FOR OVER 30° - 60° STEEL GUSSETED BEND



PLAN

DETAIL OF THRUST BLOCK FOR OVER 60° TO 90° STEEL GUSSETED BEND

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Aras Bawah & Aras Satu
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Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

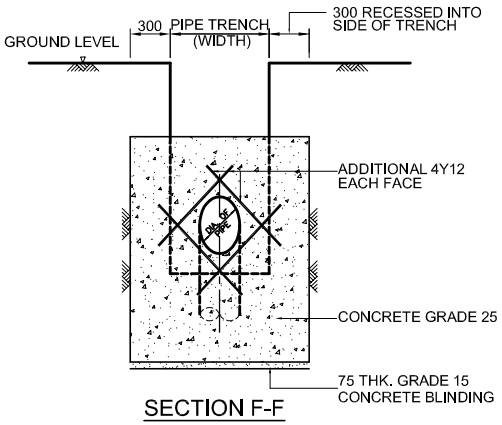
DRAWING TITLE :

DETAILS OF CONCRETE THRUST BLOCK AND ANCHOR BLOCK SHEET 1 OF 2

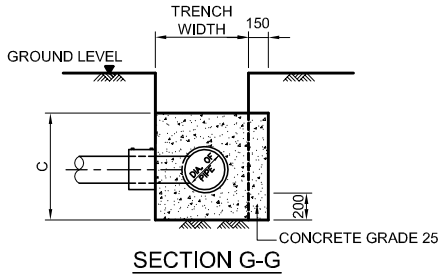
DRAWING NO:

SPAN/WS/STD/F/010

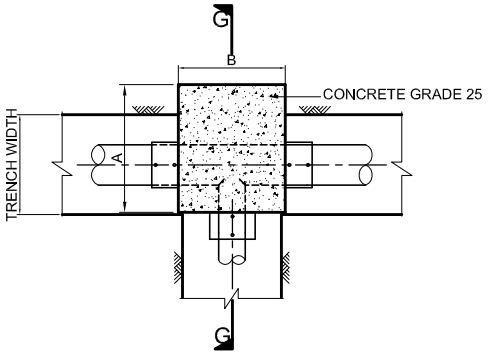
[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF010.dwg Wed, 26 Jun 2013 - 2:26pm



SECTION F-F

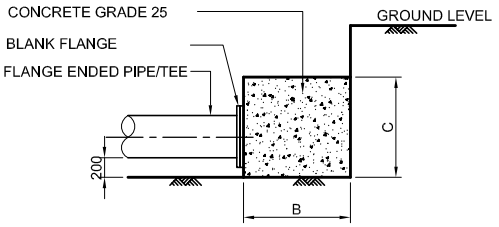


SECTION G-G

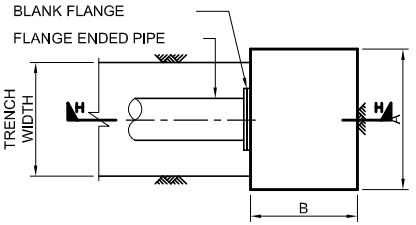


PLAN

DETAILS OF THRUST BLOCK FOR TEE

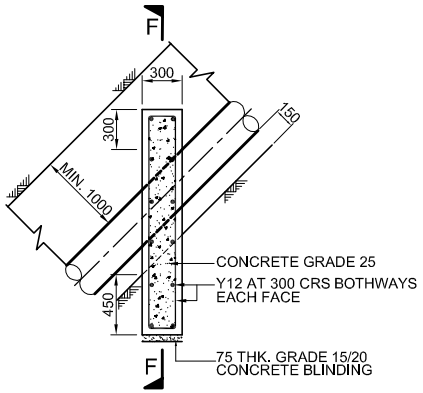


SECTION H-H



PLAN

DETAILS OF THRUST BLOCK FOR END CAP



ELEVATION

DETAILS OF ANCHOR BLOCK

TABLE FOR ANCHOR BLOCK	
GRADIENT EXCEEDING	ANCHOR BLOCK
1 : 12	EVERY THIRD PIPE
1 : 8	EVERY SECOND PIPE
1 : 5	EVERY PIPE

TABLE FOR CONCRETE THRUST BLOCK FOR TEE				
PIPE OD (mm)	PIPE ND (mm)	A (mm)	B (mm)	C (mm)
125 x 125	100 x 100	750	500	500
180 x 125	150 x 100	800	550	550
180 x 180	150 x 150	800	700	650
225 x 125	200 x 100	850	600	600
225 x 180	200 x 150	850	700	600
225 x 225	200 x 200	850	950	850
280 x 125	250 x 100	900	650	650
280 x 180	250 x 150	900	650	650
280 x 225	250 x 200	900	900	800
280 x 280	250 x 250	1000	1300	1000
355 x 125	300 x 100	950	700	700
355 x 180	300 x 150	950	700	700
355 x 225	300 x 200	950	850	800
355 x 280	300 x 250	950	1300	950
355 x 355	300 x 300	1100	1700	1100

TABLE FOR THRUST BLOCK FOR END CAP				
PIPE OD (mm)	PIPE ND (mm)	A (mm)	B (mm)	C (mm)
125	100	600	300	500
180	150	700	350	600
225	200	900	450	900
280	250	1250	650	950
355	300	1600	800	1000

NOTE:-

SPAN

SURUHANJAYA PERKHIDMATAN AIR NEGARA

Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

DETAILS OF CONCRETE THRUST BLOCK AND ANCHOR BLOCK
SHEET 2 OF 2

DRAWING NO:

SPAN/WS/STD/F/011

[Infrastructure Div] 3414 C:\a_data\david c dwd3\SPAN\final drawings\span final print\ WSSTDF011.dwg Wed, 26 Jun 2013 - 2:27pm

SCHEDULE OF CONCRETE THRUST BLOCK FOR PLAIN END TEE

NOMINAL DIA. OF BRANCH (mm)	NOMINAL DIA. OF BARREL (mm)	OUTER DIA. OF TEE (mm)	A	B	C	D
150	200	232.2	450	600	400	400
200	200	232.2	450	1000	600	400
250	250	286	600	1400	700	500
200	250	286	600	900	600	500
150	250	286	600	600	400	500
150	300	345.4	500	500	400	600
200	300	345.4	600	800	600	600
250	300	345.4	900	1200	900	600
300	300	345.4	1100	1700	900	600
150	350	399.3	450	600	400	600
200	350	399.3	500	600	500	600
250	350	399.3	900	600	900	600
300	350	399.3	1300	600	1000	600
350	350	399.3	1600	600	1100	600
150	400	453.1	500	450	300	700
200	400	453.1	600	700	400	700
250	400	453.1	700	1100	600	700
300	400	453.1	1200	1400	1100	700
350	400	453.1	1400	1900	1100	700
400	400	453.1	2100	2300	1100	700
150	450	507	500	400	300	700
200	450	507	600	700	400	700
250	450	507	700	1000	600	700
300	450	507	1000	1400	900	700
400	450	507	1900	2200	1100	700
450	450	507	2300	2700	1100	700
150	500	560.3	550	400	300	800
200	500	560.3	700	600	400	800
250	500	560.3	900	900	700	800
300	500	560.3	1100	1300	900	900
350	500	560.3	1600	1600	1100	800
400	500	560.3	1700	2100	1100	800
450	500	560.3	2400	2500	1100	800
500	500	560.3	2800	3000	1100	800
150	600	667	650	400	300	900
200	600	667	650	600	400	900
250	600	667	700	900	500	900
300	600	667	900	1200	800	900
350	600	667	1200	1500	1000	900
400	600	667	1500	1900	1100	900
450	600	667	1900	2300	1300	900
500	600	667	2400	2700	1400	900
600	600	667	3300	3600	1500	900

SCHEDULE OF CONCRETE THRUST BLOCK FOR HORIZONTAL BEND WITH WELDED JOINTS

NOMINAL DIA. OF PIPE (mm)	OUTER DIA. OF PIPE (mm)	GUSSETED BEND											
		UP TO 30°				OVER 30° TO 60°				OVER 60° TO 90°			
		A	B	C	D	A	B	C	D	A	B	C	D
200	232.2	400	700	400	400	400	1100	600	500	400	1600	700	500
250	286.0	500	900	500	400	500	1400	700	600	500	1800	800	600
300	345.4	500	1100	600	500	500	1600	700	600	500	2200	1000	600
350	399.3	500	1500	600	500	500	2000	700	600	500	2800	1000	600
400	453.1	600	1600	700	500	600	2200	800	700	600	3100	1000	700
450	507.0	600	1700	700	600	600	2600	800	750	600	3400	1100	800
500	560.3	800	1800	700	650	800	2800	800	850	800	3700	1100	900
600	667.0	800	1900	800	800	800	3100	900	1000	900	4500	1100	1100

SCHEDULE OF CONCRETE THRUST BLOCK FOR VERTICAL BEND (ACTING UPWARD)

NOMINAL DIA. OF PIPE (mm)	OUTER DIA. OF PIPE (mm)	GUSSETED BEND								
		UP TO 12°			UP TO 25°			UP TO 45°		
		A	B	C	A	B	C	A	B	C
100	122	300	300	300	200	400	350	200	400	350
150	177	350	350	350	300	450	400	400	450	500
200	232.2	400	400	400	350	550	450	600	600	550
250	286.0	500	450	500	500	700	500	800	800	600
300	345.4	600	500	600	650	850	550	1000	1000	650
350	399.3	700	500	700	800	1000	600	1200	1200	700
400	453.1	800	600	800	950	1150	650	1400	1400	800
450	507.0	900	700	900	1100	1300	700	1600	1600	900
500	560.3	1000	800	1000	1250	1450	800	1800	1800	1000
600	667.0	1200	900	1100	1400	1600	900	2000	2000	1100

SCHEDULE OF CONCRETE THRUST BLOCK FOR VERTICAL BEND (ACTING DOWNWARD)

NOMINAL DIA. OF PIPE (mm)	OUTER DIA. OF PIPE (mm)	GUSSETED BEND								
		UP TO 12°			UP TO 25°			UP TO 45°		
		A	B	C	A	B	C	A	B	C
100	122	350	250	250	400	200	200	350	200	200
150	177	450	300	300	450	200	200	450	250	200
200	232.2	500	300	350	500	250	250	500	350	250
250	286.0	600	400	400	550	350	250	550	500	300
300	345.4	700	500	450	600	450	250	600	650	400
350	399.3	800	600	500	650	550	300	700	750	400
400	453.1	900	700	550	700	900	350	900	1000	550
450	507.0	1000	800	600	800	950	350	1000	1100	600
500	560.3	1100	900	650	1100	900	400	1100	1200	650
600	667.0	1200	1100	700	1200	1100	450	1400	1350	750

NOTE:-
1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.

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63000 Cyberjaya
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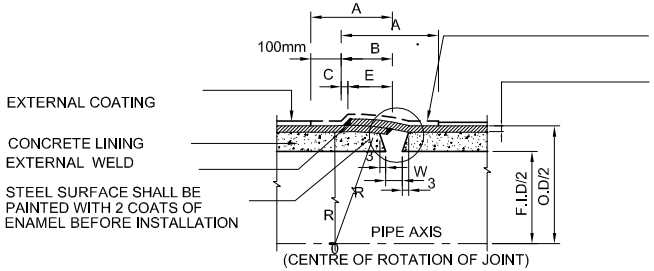
DRAWING TITLE:

SCHEDULE OF THRUST BLOCK

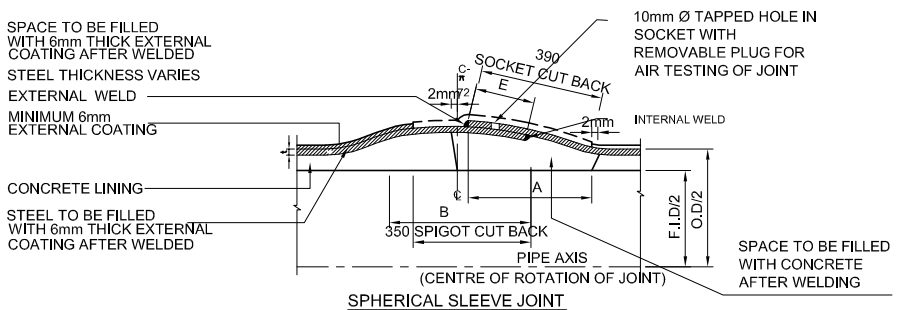
DRAWING NO:

SPAN/WS/STD/F/012

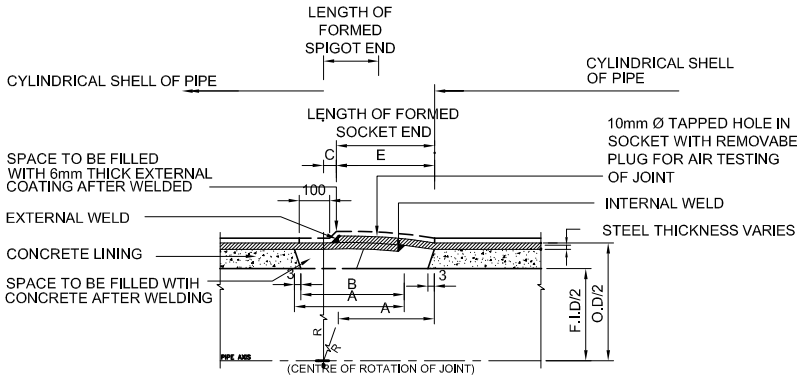
[Infrastructure Div] 3414 C:\a_data\david c dwd3\SPANfinal drawings\span final print\ WSSTDF012.dwg Wed, 26 Jun 2013 - 2:28pm



HEMI-SPHERICAL SLEEVE JOINT/SLIP JOINTS (FOR PIPES BELOW 700mm F.I.D.)

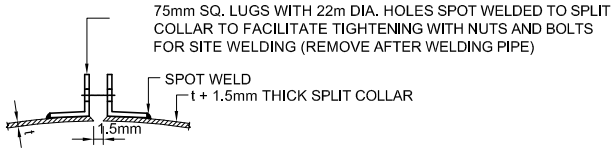


SPHERICAL SLEEVE JOINT (FOR PIPES 1400mm F.I.D. AND ABOVE)



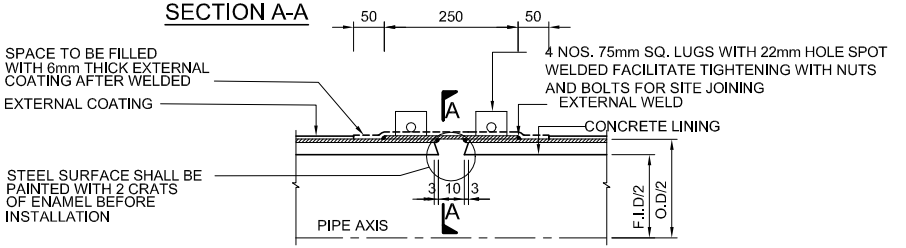
HEMI-SPHERICAL SLEEVE JOINT/SLIP JOINTS (FOR PIPES 700mm F.I.D. AND ABOVE)

SPHERICAL SLEEVE JOINT DETAIL								
PIPE F.I.D. (mm)	PIPE O.D. (mm)	RADIUS R (mm)	STEEL/ THICKNESS (mm)	ENGAGEMENT, E NORMAL 4t+$\frac{4t}{36}$ (mm)	ENGAGEMENT, E MINIMUM 4t (mm)	A (mm)	B (mm)	C (mm)
2200.0	2290.0	1190	15	164	60	335	538	50
2050.0	2138.0	1111	14	153	56	301	503	47
1800.0	1876.0	977	13	137	52	274	451	41
1400.0	1472.0	769	11	112	44	223	368	33

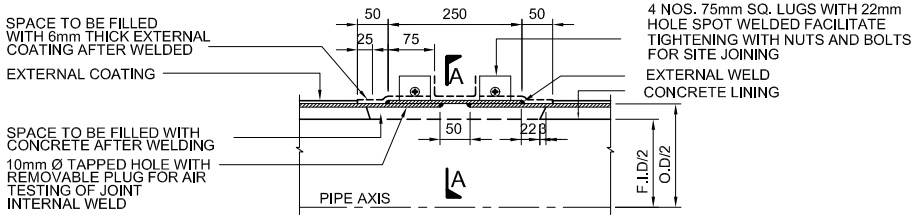


SECTION A-A

HEMI- SPHERICAL SLEEVE JOINT									
PIPE F.I.D. (mm)	PIPE O.D. (mm)	RADIUS R (mm)	STEEL/ THICKNESS t (mm)	ENGAGEMENT, E NORMAL 4t+c(mm)	ENGAGEMENT, E MINIMUM 4t(mm)	A (mm) B+100	B (mm) 4t+2c	C (mm) R/90	MAX. W (mm)
149.1	177.3	89	4.1	25	20	130	30	5	10
204.0	232.2	116	4.1	25	20	130	30	5	10
257.8	286.0	143	4.1	25	20	130	30	5	10
313.8	345.4	173	5.8	35	25	145	45	10	20
388.4	426.0	213	5.8	35	25	145	45	10	20
415.5	453.1	227	5.8	35	25	145	45	10	20
469.4	507.0	254	5.8	35	25	145	45	10	20
522.7	560.3	280	5.8	35	25	145	45	10	20
628.0	667.0	334	6.5	45	30	160	60	15	20
701.2	754.0	377	7.4	45	30	160	60	15	-
751.2	804	402	7.4	45	30	160	60	15	-
1050.0	1107.0	554	9.5	60	40	180	80	20	-
1200.0	1270.0	635	10.0	65	40	190	90	25	-



DETAILS OF WELDED COLLAR JOINT (FOR PIPE/FITTING BELOW 700mm F.I.D.)



DETAILS OF WELDED COLLAR JOINT (FOR PIPE/FITTING 700mm F.I.D. AND ABOVE)

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.

2. THE OUTSIDE DIAMETER OF PIPE SHALL MEAN THE EXTERNAL DIAMETER OF STEEL PIPE BEFORE COATING.

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Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

DRAWING TITLE:

DETAILS OF JOINTS
(SHEET 1 OF 2)

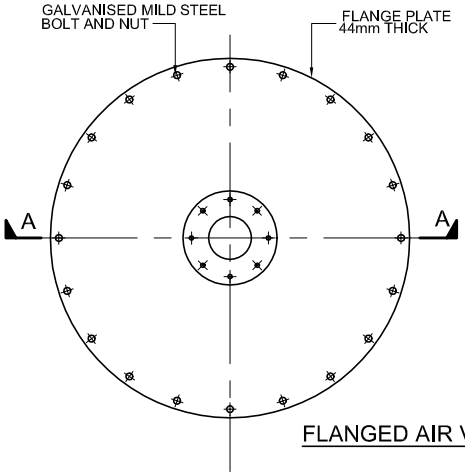
DRAWING NO:

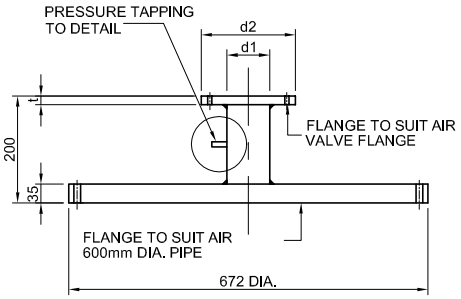
SPAN/WS/STD/F/013

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPANfinal drawings\span final print\ WSSTDF013.dwg Wed, 26 Jun 2013 - 2:29pm

d1 (mm)	d2 (mm)	t (mm)
100	220	20
150	280	22
200	340	24
250	406	26

DOUBLE FLANGE VALVE ADAPTOR

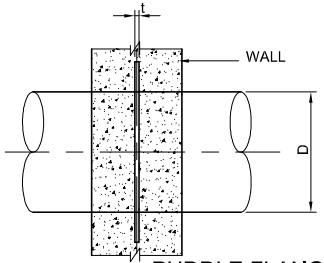




SECTION A-A

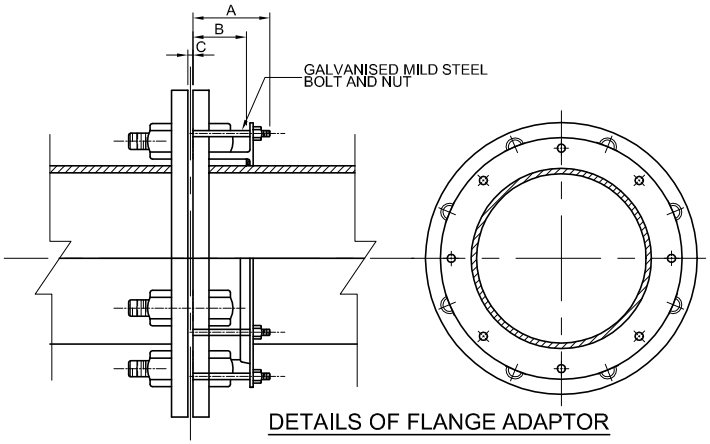
FLANGED AIR VALVE ADAPTORS

PUDDLE FLANGE DETAILS			
PIPE SIZE D	F.I.D (mm)		NOMINAL DIAMETER 450mm & BELOW
	2200 T0 750	710 TO 500	
THICKNESS OF PUDDLE FLANGE t	20mm	12mm	10mm
DIAMETER OF PUDDLE FLANGE	O.D OF PIPE + 125mm	O.D OF PIPE + 100mm	O.D OF PIPE + 75mm

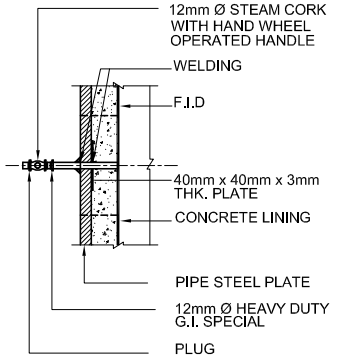


PUDDLE FLANGE DETAIL

SCHEDULE OF FLANGE ADAPTOR					
NOMINAL DIA. OF PIPE (mm)	FINISHED INTERNAL DIA. (F.I.D) OF PIPE (mm)	OUTER DIA. OF PIPE(O.D) (mm)	A (mm)	B (mm)	C (mm)
1200	1200	1270	180	125	38
1000	1000	1054	155	115	25
700	701.2	754.0	155	105	25
600	628.0	667.0	155	105	25
525	522.7	560.3	155	105	25
450	469.4	507.0	155	105	25
400	415.5	453.1	155	105	25
375	388.4	426.0	155	105	25
300	313.8	345.4	136	90	25
250	257.8	286.0	136	90	25
200	204.0	232.2	118	75	24
150	149.1	177.3	118	75	22
100	93.7	121.9	118	75	20



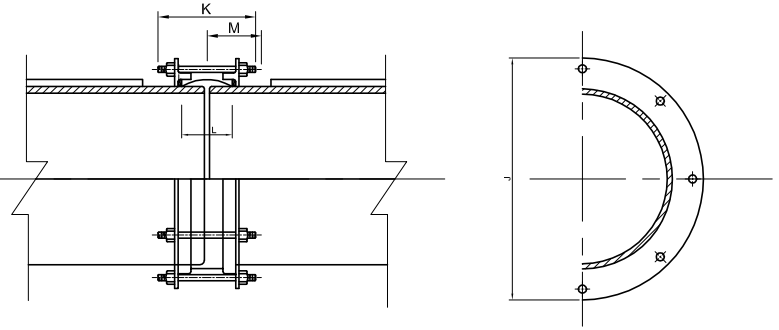
DETAILS OF FLANGE ADAPTOR



PRESSURE TAPPING

SCHEDULE OF MECHANICAL COUPLING									
NOMINAL DIA. OF PIPE (mm)	FINISHED INTERNAL DIA. (F.I.D) OF PIPE (mm)	OUTER DIA. OF PIPE(O.D) (mm)	J (mm)	K (mm)	SLEEVE L x THICKNESS (mm)	BOLTS			
						No.	DIA. (mm)	LENGTH (mm)	M (mm)
700	701.2	754.0	858	228	150 x 8	12	16	215	150
600	628.0	667.0	760	228	150 x 8	12	16	215	150
525	522.7	560.3	664	228	150 x 8	8	16	215	150
450	469.4	507.0	612	228	150 x 8	8	16	215	150
400	415.5	453.1	562	228	150 x 8	8	16	215	150
375	388.4	426.0	530	228	150 x 8	8	16	215	150
300	313.8	345.4	460	228	150 x 8	6	16	215	150
250	257.8	286.0	377	175	150 x 8	6	12	165	100
200	204.0	232.2	324	175	150 x 8	5	12	165	100
150	149.1	177.3	270	175	150 x 7	5	12	165	100
100	93.7	121.9	218	175	150 x 6	4	12	165	100

NOTE : LARGER SIZED TO BE DESIGNED BY THE CONSULTANT TO SERVICE LICENSEE/WATER DISTRIBUTION LICENSEE APPROVAL



DETAILS OF MECHANICAL COUPLING

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.

2. THE OUTSIDE DIAMETER OF PIPE SHALL MEAN THE EXTERNAL DIAMETER OF STEEL PIPE BEFORE COATING.

SPAN

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Selangor Darul Ehsan, Malaysia

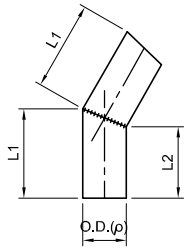
DRAWING TITLE :

DETAILS OF JOINTS
(SHEET 2 OF 2)

DRAWING NO:

SPAN/WS/STD/F/014

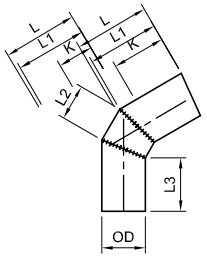
[Infrastructure Div] 3414 C:\e_data\david c dvd3\SPANfinal drawings\span final print\ WSSTDF014.dwg Wed, 26 Jun 2013 – 2:31pm



L1= L + (Ø Tan.Δ) / 2 / 2

L2= L - (Ø Tan.Δ) / 2 / 2

UP TO 30° BEND



K= L - R Tan. Δ/2

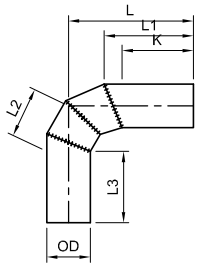
L1= K + (R + Ø/2) Tan.Δ/4

L2= (2R + Ø) Tan.Δ/4

L3= K + (R - Ø/2) Tan. Δ/4

L4= (2R - Ø) Tan.Δ/4

OVER 30° TO 60° BEND



K= L - R Tan. Δ/2

L1= K + (R + Ø/2) Tan.Δ/6

L2= (2R + Ø) Tan. Δ/6

L3= K + (R - Ø/2) Tan. Δ/6

L4= (2R - Ø) Tan. Δ/6

OVER 60° TO 90° BEND

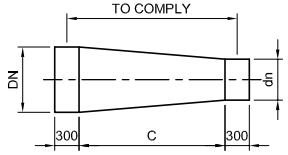
Δ UP TO 30° MILD STEEL BEND			
M.S. BENDS (NOMINAL DIA.)	OUTER DIA. (mm)	R (mm)	L (mm)
100	121.9	-	200
150	177.3	-	275
200	232.2	-	300
250	286.0	-	375
300	345.4	-	375
350	399.3	-	450
375	426.0	-	450
400	453.1	-	450
450	507.0	-	450
525	560.3	-	450
600	667.0	-	550
700	754.0	-	600
750	804.0	-	600
954	954.0	-	700
1000	1054.0	-	750
1050	1107.0	-	800
1150	1219.0	-	850
1200	1270.0	-	850
1400	1472.0	-	850
1800	1876.0	-	900
2050	2138.0	-	1000
2200	2290.0	-	1000

Δ UP OVER TO 30° TO 45° MILD STEEL BEND			
M.S. BENDS (NOMINAL DIA.)	OUTER DIA. (mm)	R (mm)	L (mm)
100	121.9	200	200
150	177.3	275	300
200	232.2	350	350
250	286.0	375	450
300	345.4	525	550
350	399.3	600	600
375	426.0	600	600
400	453.1	675	600
450	507.0	750	600
525	560.3	825	650
600	667.0	975	750
700	754.0	1125	850
750	804.0	1200	850
954	954.0		
1000	1054.0	1500	1100
1050	1107.0	1500	1100
1150	1219.0	1800	1200
1200	1270.0	1800	1200
1400	1472.0	2100	1300
1800	1876.0	2700	1500
2050	2138.0	3000	1600
2200	2290.0	3000	1700

Δ UP OVER TO 45° TO 60° MILD STEEL BEND			
M.S. BENDS (NOMINAL DIA.)	OUTER DIA. (mm)	R (mm)	L (mm)
100	121.9	200	250
150	177.3	275	300
200	232.2	300	400
250	286.0	375	500
300	345.4	525	600
350	399.3	600	600
375	426.0	450	600
400	453.1	450	600
450	507.0	500	600
525	560.3	600	750
600	667.0	650	750
700	754.0	750	850
750	804.0	800	850
900	954.0		
1000	1054.0	1000	1100
1050	1107.0	1000	1100
1150	1219.0	1200	1200
1200	1270.0	1200	1200
1400	1472.0	1400	1300
1800	1876.0	1800	1300
2050	2138.0	2000	1600
2200	2290.0	2200	1700

Δ UP OVER TO 60° TO 90° MILD STEEL BEND			
M.S. BENDS (NOMINAL DIA.)	OUTER DIA. (mm)	R (mm)	L (mm)
100	121.9	200	350
150	177.3	275	350
200	232.2	300	400
250	286.0	375	650
300	345.4	525	500
350	399.3	600	700
375	426.0	450	800
400	453.1	450	850
450	507.0	500	850
525	560.3	600	1000
600	667.0	650	1000
700	754.0	750	1100
750	804.0	800	1100
900	954.0		
1000	1054.0	1000	1500
1050	1107.0	1000	1500
1150	1219.0	1200	1700
1200	1270.0	1200	1700
1400	1472.0	1400	1900
1800	1876.0	1800	2200
2050	2138.0	2000	2500
2200	2290.0	2200	2600

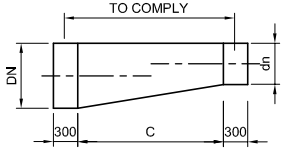
ENDS SUITABLE FOR WELDED COLLAR JOINTS OR FLANGE END TO COMPLY



CONCENTRIC TAPER

*PLATE THICKNESS FOR SECTION C SHALL BE THE SAME AS DN PLATE THICKNESS

ENDS SUITABLE FOR WELDED COLLAR JOINTS OR FLANGE END TO COMPLY



FLAT TAPER

*PLATE THICKNESS FOR SECTION C SHALL BE THE SAME AS DN PLATE THICKNESS

SCHEDULE OF STEEL PIPES/FITTINGS THICKNESS				
NOMINAL DIAMETER	FINISHED INTERNAL DIAMETER	OUTSIDE DIAMETER (mm)	THICKNESS OF STEEL PLATE (mm)	THICKNESS OF CONCRETE LINING (mm)
50	50.0	69.2	3.6	6.0
75	75.0	94.2	3.6	6.0
100	93.7	121.9	4.1	10.0
150	149.1	177.3	4.1	10.0
200	204.0	232.2	4.1	10.0
250	257.8	286.0	4.1	10.0
300	313.8	345.4	5.8	10.0
350	361.7	399.3	5.8	13.0
375*	388.4	426.0	5.8	13.0
400	415.5	453.1	5.8	13.0
450	469.4	507.0	5.8	13.0
525*	522.7	560.3	5.8	13.0
600	628.0	667.0	6.5	13.0
700	701.2	754.0	7.4	19.0
750	751.2	804.0	7.4	19.0
900	900	954	8.0	19.0
1000	1000	1054.0	8.0	19.0
1050	1050	1107	9.5	19.0
1150	1150	1219	9.5	25.0
1200	1200	1270	10	25.0
1300	1300	1372	11	25.0
1400	1400	1472	11	25.0
1800	1800	1876	13	25.0
2000	2000	2088	14	30.0
2050	2050	2138	14	30.0
2100	2100	2189	14.5	30.0
2200	2200	2290	15	40.0

* OUTSIDE DIAMETER OF PIPE SIZE 375mm DIA. AND 525mm DIA. ARE BASED ON A.D. PIPE CLASS C

TABLE FOR MILD STEEL TAPER			
DESCRIPTION	OUTER DIA. (DN) mm	OUTER DIA. (dn) mm	LENGTH OF TAPER (C) mm
2200 x 2100mm	2290.0	2189.0	600
2200 x 2000mm	2290.0	2088.0	1200
2050 x 2000mm	2138.0	2088.0	600
2050 x 1800mm	2138.0	1876.0	1500
1400 x 1200mm	1472.0	1270.0	1200
1150 x 1000mm	1219.0	1054.0	900
1050 x 1000mm	1107.0	1054.0	600
750 x 700mm	751.2	701.2	600
750 x 450mm	304.0	507.0	1800
600 x 525mm	667.0	560.3	450
600 x 450mm	667.0	507.0	900
450 x 375mm	507.0	426.0	450
450 x 150mm	507.0	177.3	1800
400 x 375mm	453.1	426.0	300
250 x 200mm	286.0	232.2	1500
250 x 150mm	286.0	177.3	600
200 x 150mm	232.2	177.3	300

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. THICKNESS OF TAPER AND BENDS SEE SCHEDULE OF STEEL PIPES/ FITTINGS THICKNESS.
3. FID REFERS TO FINISHED INTERNAL DIAMETER AFTER LINING.
4. MS PIPE SPECIAL ARE DESIGN IN ACCORDANCE TO BS EN 534 : 1990
5. ALL FLANGE ARE DESIGN TO PN 16 PRESSURE.

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Selangor Darul Ehsan, Malaysia

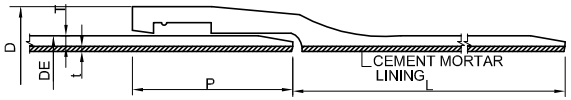
DRAWING TITLE:

DETAILS OF MILD STEEL PIPES, BENDS AND TAPERS

DRAWING NO:

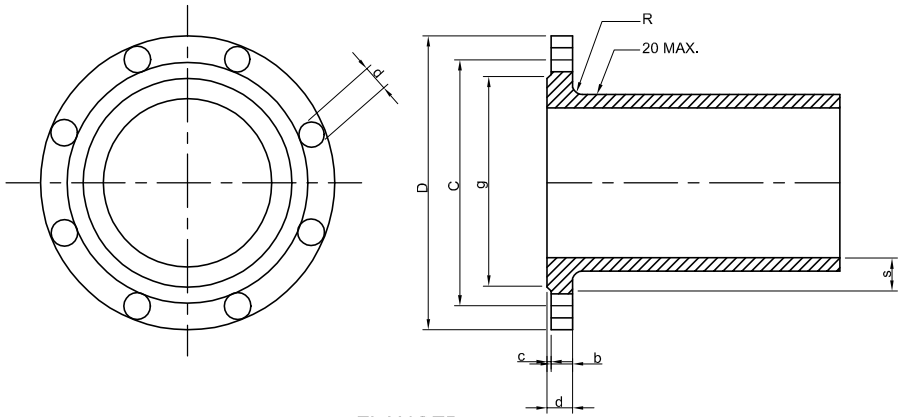
SPAN/WS/STD/F/015

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPANfinal drawings\span final print\ WSSTDF015.dwg Wed, 26 Jun 2013 - 2:32pm

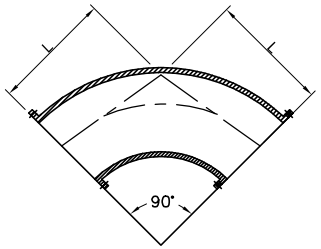


PUSH IN JOINT

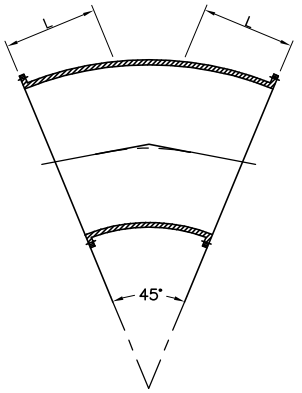
TABLE FOR PUSH-IN JOINT						
NOMINAL DIAMETER ND (mm)	NOMINAL OUTER DIAMETER DE (mm)	D (mm)	P (mm)	T(kg) (mm)	t (mm)	L (mm)
100	118	160	85	6.0	4.0	6000
150	170	215	90	6.0	4.0	6000
200	222	275	100	6.3	4.0	6000
250	274	325	105	6.8	4.0	6000
300	326	380	110	7.2	4.0	6000
350	378	445	110	7.7	5.0	6000
400	429	195	115	8.1	5.0	6000
450	480	550	120	8.6	5.0	6000
500	532	600	120	9.0	5.0	6000
600	635	710	120	9.9	5.0	6000



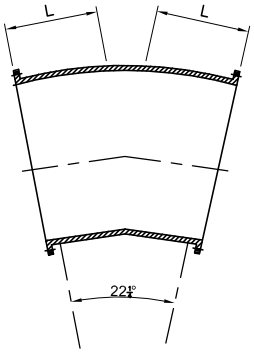
FLANGED



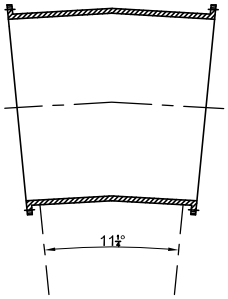
DOUBLE FLANGED 90° BEND



DOUBLE FLANGED 45° BEND



DOUBLE FLANGED 22½° BEND



DOUBLE FLANGED 11¼° BEND

TABLE FOR FLANGE												
NOMINAL DIAMETER ND (mm)	D	C	g	a	b	c	BOLT			MASS (kg)	S (mm)	R
							SIZE	No.	d			
100	220	180	156	19.0	16.0	3	M16	8	19	3	3	3
150	285	240	211	19.0	16.0	3	M20	8	23	3	3	3
200	340	295	266	20.0	17.0	3	M20	12	23	3	3	3
250	400	355	319	22.0	19.0	3	M24	12	28	3	3	3
300	455	410	370	24.5	20.5	4	M24	12	28	4	4	4
350	520	470	429	26.5	22.5	4	M24	16	28	4	4	4
400	580	525	480	28.0	24.0	4	M27	16	31	4	4	4
450	640	585	548	30.0	26.0	4	M27	20	31	4	4	4
500	715	650	609	31.5	27.5	4	M30	20	34	4	4	4
600	840	770	720	36.0	31.0	5	M33	20	37	5	5	5

TABLE FOR DOUBLE FLANGE BEND						
NOMINAL DIAMETER ND (mm)	OUTER DIAMETER OD (mm)	t PLATE THK. (mm)	90° L (mm)	45° L (mm)	22½° L (mm)	11¼° L (mm)
100	118	7.2	180	140	140	140
150	170	7.8	220	160	160	160
200	222	8.4	260	180	180	180
250	274	9.0	350	350	350	350
300	326	9.6	400	400	400	400
350	378	10.2	450	298	298	298
400	429	10.8	500	324	324	324
450	480	11.4	550	350	350	350

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. DESIGN STANDARD COMPLY WITH BS EN 545 : 2002.

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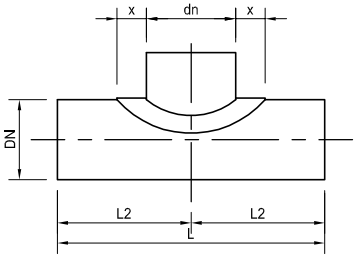
DRAWING TITLE :

DETAILS OF DUCTILE IRON GUSSETED BENDS, PUSH-IN JOINT AND FLANGE

DRAWING NO:

SPAN/WS/STD/F/016

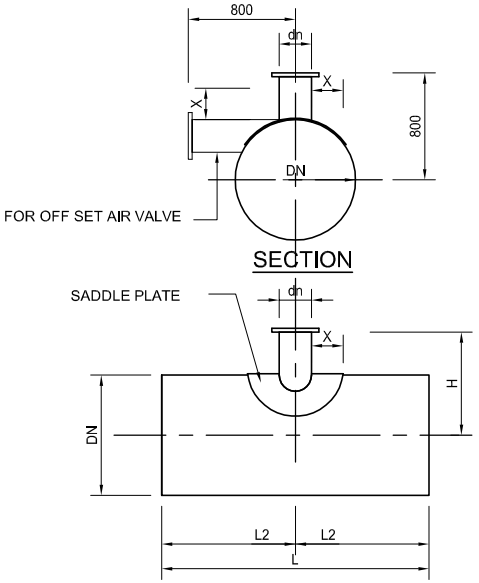
[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF016.dwg Wed, 26 Jun 2013 - 2:32pm



PLAIN ENDED TEE

SCHEDULE OF PLAIN ENDED TEE						
NOMINAL SIZE (mm)	BARREL O.D DN (mm)	BRANCH O.D dn (mm)	L (mm)	H (mm)	SADDLE PLATE	
					X (mm)	THICKNESS (mm)
600 x 600	667.0	667.0	2000	650	220	4.1
600 x 450	667.0	507.0	1550	650	180	4.1
600 x 200	667.0	232.2	700	600	100	4.1
600 x 150	667.0	177.3	700	550	75	4.1
450 x 450	507.0	507.0	1550	550	-	-
450 x 300	507.0	345.4	1050	500	-	-
450 x 250	507.0	286.0	850	500	-	-
450 x 200	507.0	232.2	700	500	-	-
450 x 150	507.0	177.3	550	450	-	-
400 x 400	453.1	453.1	1350	550	-	-
400 x 150	453.1	177.3	550	450	-	-
250 x 250	286.0	286.0	850	400	-	-
250 x 200	286.0	232.2	700	400	-	-
250 x 150	286.0	177.3	550	350	-	-
200 x 200	232.2	232.2	700	400	-	-
200 x 150	232.2	177.3	550	350	-	-
200 x 100	232.2	121.9	400	350	-	-
150 x 150	177.3	177.3	550	300	-	-
150 x 100	177.3	121.9	400	300	-	-

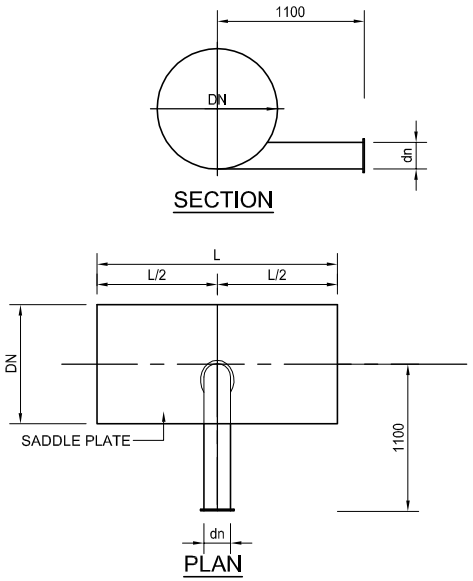
NOTE : LARGER SIZED TO BE DESIGNED BY THE CONSULTANT TO SERVICE LICENSEE/ WATER DISTRIBUTION LICENSEE APPROVAL.



STEEL AIR VALVE TEE

SCHEDULE OF P/E STEEL AIR VALVES TEES WITH FLANGED BRANCH						
TEE	BARREL O.D (mm)	BRANCH O.D (mm)	L (mm)	H (mm)	SADDLE PLATE	
					X (mm)	THICKNESS (mm)
100 x 25	121.9	44.2	550	150	-	-
150 x 25	177.3	44.2	600	180	-	-
200 x 50	232.2	69.2	750	210	-	-
250 x 50	286.0	69.2	850	230	-	-
300 x 50	345.4	69.2	900	260	-	-
350 x 50	399.3	69.2	1200	290	-	-
375 x 50	426.0	69.2	1200	290	-	-
400 x 75	453.1	94.2	950	310	-	-
450 x 75	507.0	94.2	1000	340	-	-
500 x 75	560.3	94.2	1050	370	-	-
600 x 100	667.0	121.9	1150	450	50	4.1
700 x 600	754.0	667.0	2000	760	220	4.1
750 x 600	804.0	667.0	2000	680	220	4.1
900 x 600	954.0	667.0	2000	800	300	4.1

NOTE : LARGER SIZED TO BE DESIGNED BY THE CONSULTANT TO SERVICE LICENSEE/ WATER DISTRIBUTION LICENSEE APPROVAL.



STEEL SCOUR TEE

SCHEDULE OF P/E STEEL TANGENTIAL SCOUR TEES						
TEE	BARREL O.D (mm)	BRANCH O.D (mm)	L (mm)	H (mm)	SADDLE PLATE	
					X (mm)	THICKNESS (mm)
100 x 100	121.9	121.9	550	750	-	-
150 x 100	177.3	121.9	600	800	-	-
200 x 100	232.2	121.9	750	825	-	-
250 x 100	286.0	121.9	850	850	-	-
300 x 100	345.4	121.9	900	875	-	-
350 x 100	399.3	121.9	1200	900	-	-
375 x 100	426.0	121.9	1200	900	-	-
400 x 150	453.1	177.3	950	925	-	-
450 x 150	507.0	177.3	1000	950	-	-
500 x 150	560.3	177.3	1050	975	-	-
600 x 150	667.0	177.3	1150	1000	75	4.1
700 x 200	754.0	232.2	1450	1050	100	4.1
750 x 200	804.0	232.2	1500	1100	100	4.1
900 x 200	954.0	232.2	1800	1100	125	4.1

NOTE : LARGER SIZED TO BE DESIGNED BY THE CONSULTANT TO SERVICE LICENSEE/ WATER DISTRIBUTION LICENSEE APPROVAL.

NOTES:–

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. O.D REFERS TO OUTER DIAMETER.
3. THICKNESS OF TEE AND BENDS SEE SCHEDULE OF STEEL PIPES/ FITTINGS THICKNESS.

SPAN

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63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

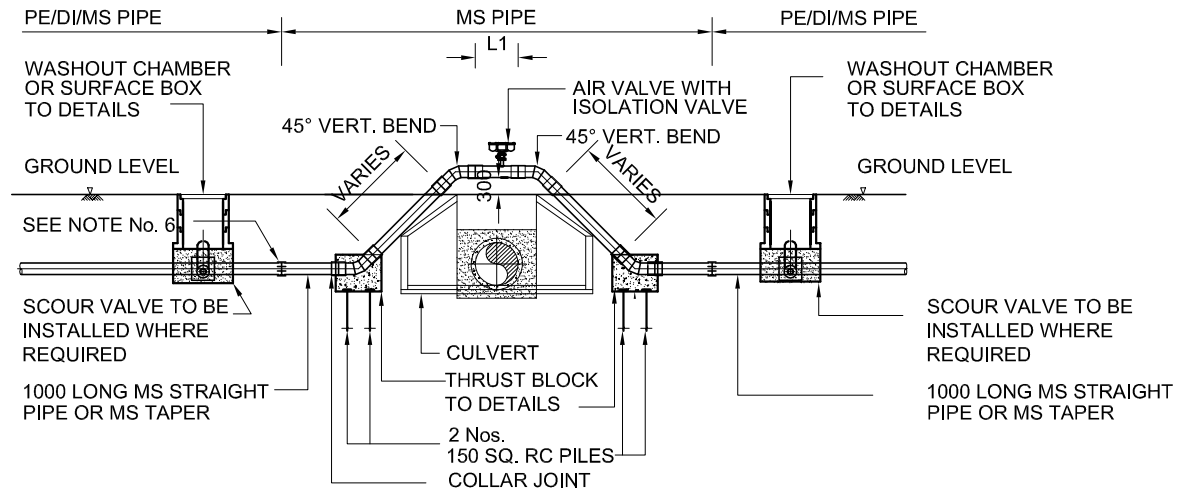
DRAWING TITLE :

DETAILS OF MILD STEEL TEES

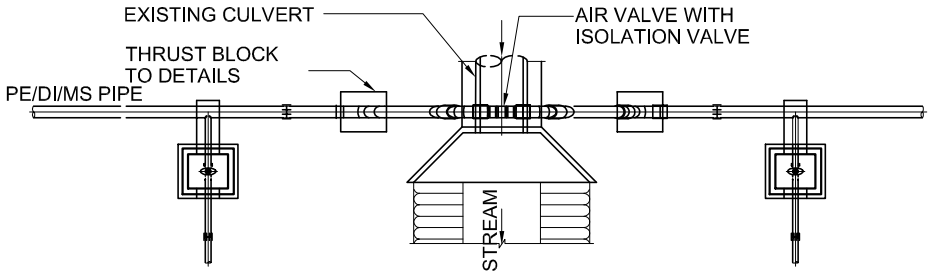
DRAWING NO:

SPAN/WS/STD/F/017

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF017.dwg Wed, 26 Jun 2013 – 2:33pm



SECTIONAL ELEVATION



PLAN

TYPICAL TYPE 1 CULVERT OR STREAM CROSSING

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. TYPE OF OVERCROSSING USED SHALL BE DETERMINE BY THE S. O. ; AND OVERCROSSING SHALL BE OF MILD STEEL.
3. COLLAR JOINTS SHALL GENERALLY BE USED IN ALL CROSSING.
4. 150 SQ. R.C PILES AT OVERCROSSING THRUST BLOCK WHERE NECESSARY AS DIRECTED BY THE S. O.
5. L1 IS THE LENGTH OF AIR VALVE TEE.
6. STEPPED COUPLING FOR JOINTING TO D.I PIPE/COLLAR JOINT FOR JOINTING TO M.S PIPE/ STUB END FOR JOINTING TO PE PIPE.
7. SPIKE GUARD TO BE PROVIDED FOR PIPE SIZES 250Ø AND ABOVE, IF SPAN EXCEEDS 5.0 METRES.

SPAN
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Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

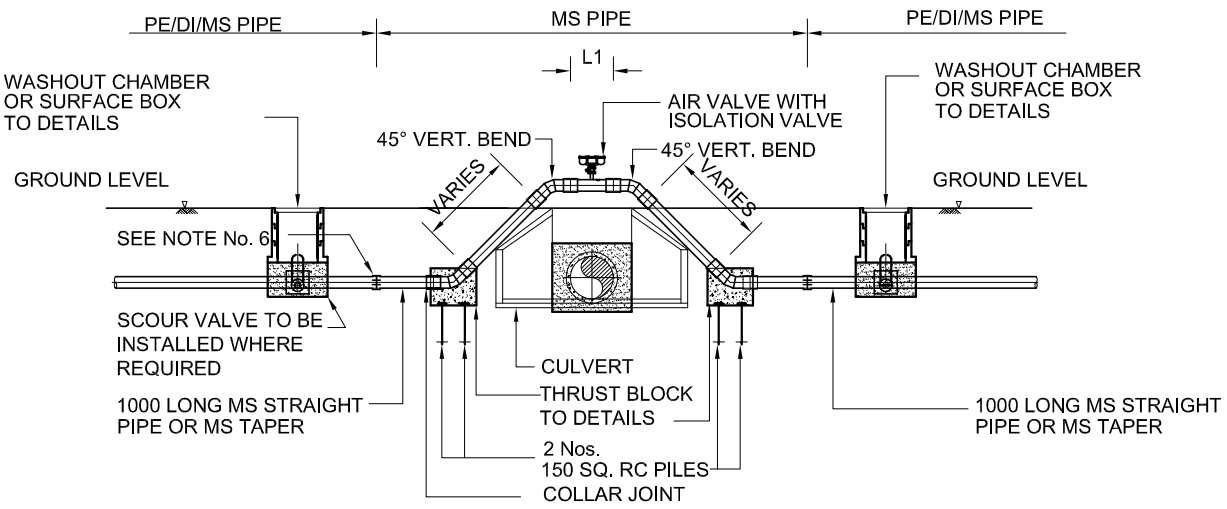
DRAWING TITLE :

TYPICAL TYPE 1 CULVERT OR STREAM CROSSING

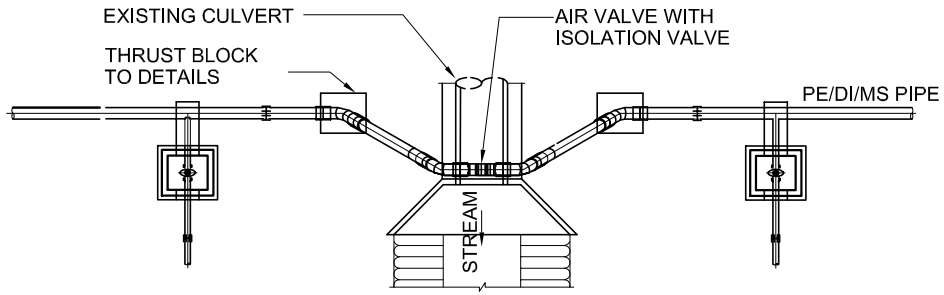
DRAWING NO:

SPAN/WS/STD/F/018

[Infrastructure Div] 3414 C:\o_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF018.dwg Wed, 26 Jun 2013 - 2:34pm



SECTIONAL ELEVATION



PLAN

TYPICAL TYPE 2 CULVERT OR STREAM CROSSING

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. TYPE OF OVERCROSSING USED SHALL BE DETERMINE BY THE S. O. ; AND OVERCROSSING SHALL BE OF MILD STEEL.
3. COLLAR JOINTS SHALL GENERALLY BE USED IN ALL CROSSING.
4. 150 SQ. R.C PILES AT OVERCROSSING THRUST BLOCK WHERE NECESSARY AS DIRECTED BY THE S. O.
5. L1 IS THE LENGTH OF AIR VALVE TEE.
6. STEPPED COUPLING FOR JOINTING TO D.I PIPE/COLLAR JOINT FOR JOINTING TO M.S PIPE/ STUB END FOR JOINTING TO PE PIPE.
7. SPIKE GUARD TO BE PROVIDED FOR PIPE SIZES 250Ø AND ABOVE, IF SPAN EXCEEDS 5.0 METRES.

SPAN

SURUHANJAYA PERKHIDMATAN AIR NEGARA

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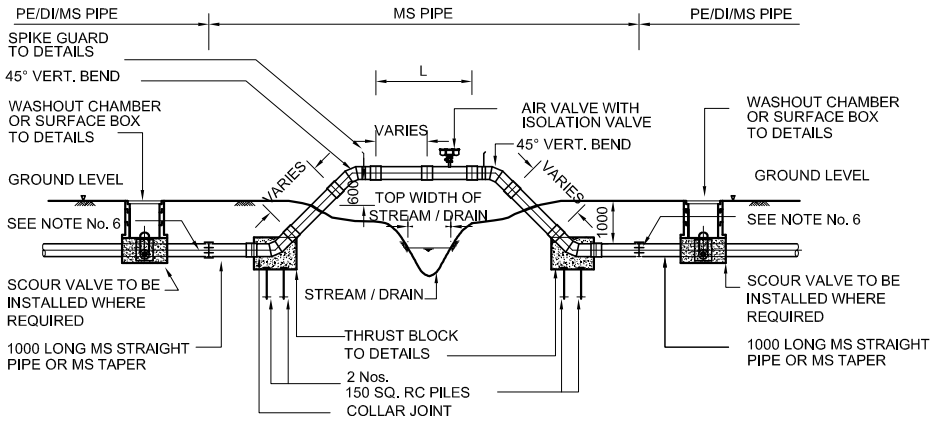
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

DRAWING TITLE:

TYPICAL TYPE 2 CULVERT OR STREAM CROSSING

DRAWING NO:

SPAN/WS/STD/F/019



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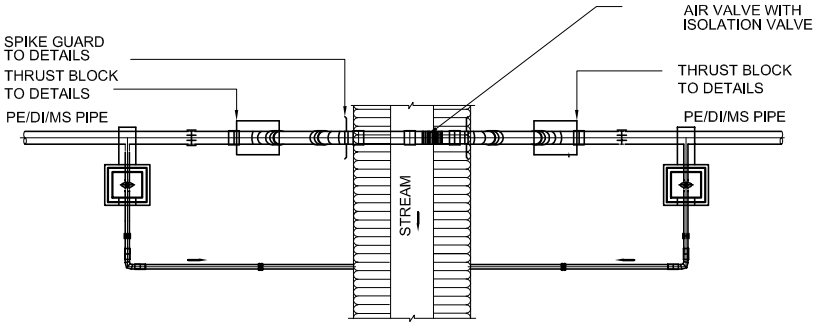

PLAN
TYPICAL TYPE 3 CULVERT OR STREAM CROSSING

TABLE FOR TYPE 3 CROSSING	
MS PIPE ND (mm)	SAFE SPAN L (m)
100	3.0
150	4.0
200	5.0
250	5.0
300	6.0
350	6.0
400	6.0
450	6.0
500	6.0
600	6.0

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. TYPE OF OVERCROSSING USED SHALL BE DETERMINE BY THE S. O. ; AND OVERCROSSING SHALL BE OF MILD STEEL.
3. COLLAR JOINTS SHALL GENERALLY BE USED IN ALL CROSSING.
4. 150 SQ. R.C PILES AT OVERCROSSING THRUST BLOCK WHERE NECESSARY AS DIRECTED BY THE S. O.
5. L1 IS THE LENGTH OF AIR VALVE TEE.
6. STEPPED COUPLING FOR JOINTING TO D.I PIPE/COLLAR JOINT FOR JOINTING TO M.S PIPE/ STUB END FOR JOINTING TO PE PIPE.
7. SPIKE GUARD TO BE PROVIDED FOR PIPE SIZES 250Ø AND ABOVE, IF SPAN EXCEEDS 5.0 METRES.

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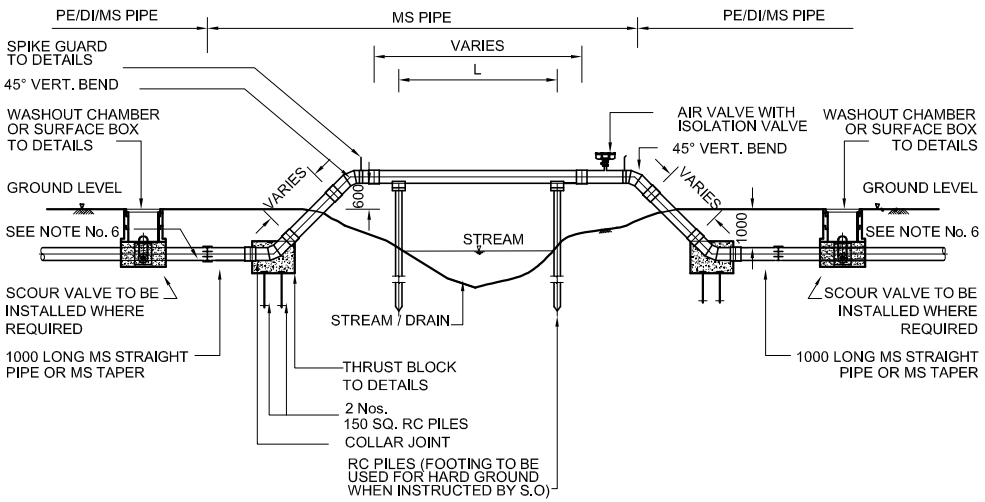
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

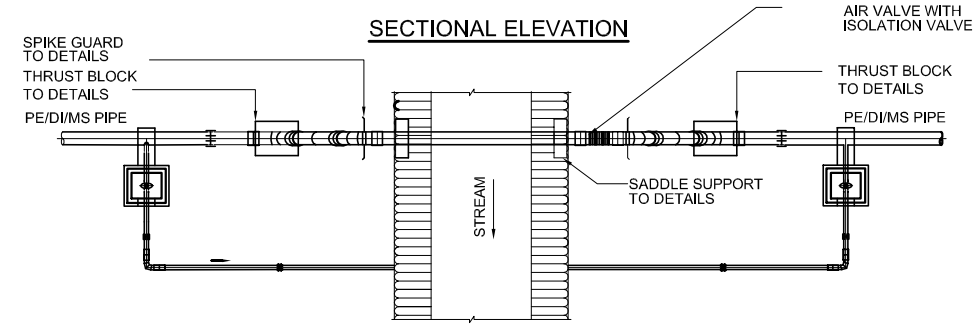
TYPICAL TYPE 3 CULVERT OR STREAM CROSSING

DRAWING NO:

SPAN/WS/STD/F/020



SECTIONAL ELEVATION



PLAN

TYPICAL TYPE 4 CROSSING ON PIPE SUPPORTS

TABLE FOR TYPE 4 CROSSING			
MS PIPE ND (mm)	SAFE SPAN L (m)	PILE SIZE	
100	6.0	150 SQ.	TWIN
150	7.5	150 SQ.	
200	8.5	150 SQ.	
250	9.5	150 SQ.	
300	10.0	150 SQ.	
350	10.0	200 SQ.	
400	10.0	200 SQ.	
450	11.0	250 SQ.	
500	11.0	250 SQ.	
600	11.5	250 SQ.	

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. TYPE OF OVERCROSSING USED SHALL BE DETERMINE BY THE S. O. ; AND OVERCROSSING SHALL BE OF MILD STEEL.
3. COLLAR JOINTS SHALL GENERALLY BE USED IN ALL CROSSING.
4. 150 SQ. R.C PILES AT OVERCROSSING THRUST BLOCK WHERE NECESSARY AS DIRECTED BY THE S. O.
5. L1 IS THE LENGTH OF AIR VALVE TEE.
6. STEPPED COUPLING FOR JOINTING TO D.I PIPE/COLLAR JOINT FOR JOINTING TO M.S PIPE/ STUB END FOR JOINTING TO PE PIPE.
7. SPIKE GUARD TO BE PROVIDED FOR PIPE SIZES 250Ø AND ABOVE, IF SPAN EXCEEDS 5.0 METRES.

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63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

TYPICAL TYPE 4 CROSSING ON PIPE SUPPORTS

DRAWING NO:

SPAN/WS/STD/F/021

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF021.dwg Wed, 26 Jun 2013 – 2:37pm

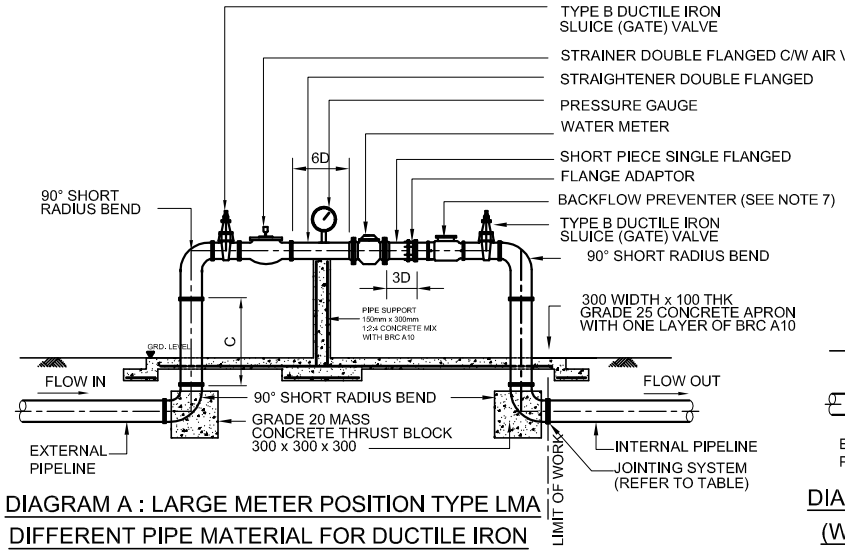


DIAGRAM A : LARGE METER POSITION TYPE LMA
DIFFERENT PIPE MATERIAL FOR DUCTILE IRON

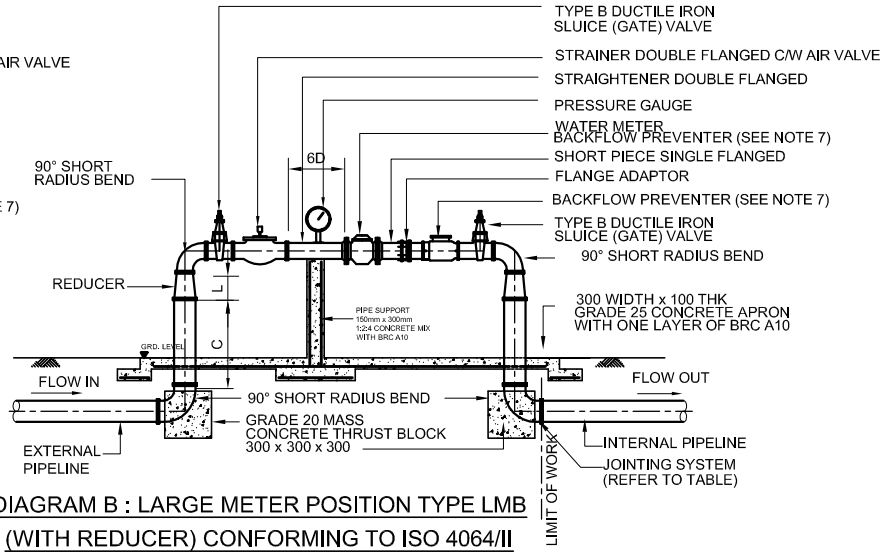
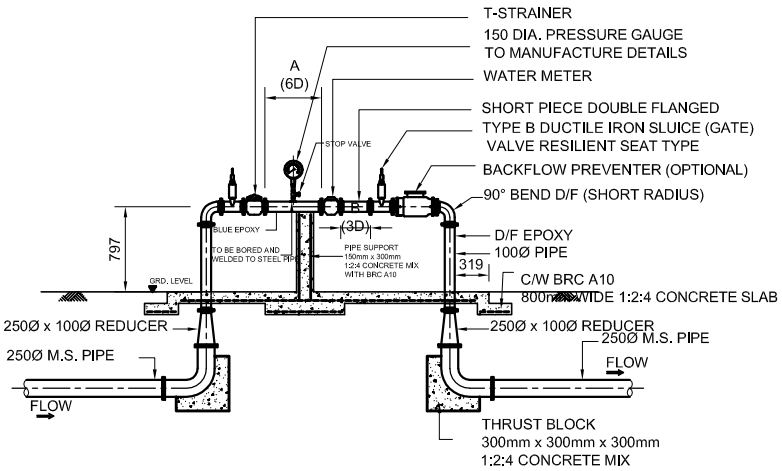


DIAGRAM B : LARGE METER POSITION TYPE LMB
(WITH REDUCER) CONFORMING TO ISO 4064/II



TYPICAL DETAIL OF 100Ø WATER METER

DUCTILE IRON FITTINGS COMBINATION	TYPE LMA C (mm)	TYPE LMB C (mm)
80 mm STRAIGHTENER 80 x 90° DOUBLE FLANGED BEND	820	-
100 mm STRAIGHTENER 100 x 90° DOUBLE FLANGED BEND	780	-
150 mm STRAIGHTENER 150 x 90° DOUBLE FLANGED BEND	710	-
200 mm STRAIGHTENER 200 x 90° DOUBLE FLANGED BEND	630	-
100 mm STRAIGHTENER 100 x 80 DOUBLE FLANGED TAPER 80 x 90° DOUBLE FLANGED BEND	-	610
150 mm STRAIGHTENER 150 x 80 DOUBLE FLANGED TAPER 80 x 90° DOUBLE FLANGED BEND	-	370
150 mm STRAIGHTENER 150 x 100 DOUBLE FLANGED TAPER 100 x 90° DOUBLE FLANGED BEND	-	450
200 mm STRAIGHTENER 200 x 100 DOUBLE FLANGED TAPER 100 x 90° DOUBLE FLANGED BEND	-	110
200 mm STRAIGHTENER 200 x 150 DOUBLE FLANGED TAPER 150 x 90° DOUBLE FLANGED BEND	-	370

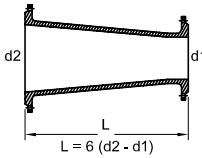
LENGTH OF STRAIGHTENER C

TYPE	INCOMING/ OUTGOING PIPELINE MATERIAL	TYPE OF JOINT
JOINT SYSTEM A	DI PIPE	FLANGED SOCKET
JOINT SYSTEM B	PE PIPE	STUB END
JOINT SYSTEM C	MS	FLANGE ADAPTOR

TYPE OF JOINT SYSTEM

SIZE OF METER D	STRAIGHTENER 6D (mm)	SHORT PIECE 3D (mm)
DN 80	480	240
DN 100	600	300
DN 150	900	450
DN 200	1200	600
DN 250	1500	750
DN 300	1800	900

LENGTH OF STRAIGHTENER 6D
AND SHORT PIECE 3D



REDUCER DIMENSION

NOTES:-

1. ALL DIMENSIONS ARE IN MILIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.
3. ALL FLANGE SHALL COMPLY WITH BS EN 1092-1:2002
4. ALL PIPEWORKS SHALL BE OF MILD STEEL TO BS EN 534 WITHOUT CONCRETE CUTBACK.
5. ALL DUCTILE IRON PIPEWORKS SHALL BE SOURCED FROM SUPPLIES/ MANUFACTURES APPROVED BY *SYABAS ONLY.
6. EXPOSED STEEL PIPES ARE TO BE INTERNALLY CONCRETE LINED AND EXTERNALLY PAINTED WITH 100 MICRON THICK PRIMER, 150 MICRON TWO PACK EPOXY AND FINISHED WITH 100 MICRON POLYURETHANE AFTER REPAIRING ALL DAMAGED PAINTWORKS.THE TOTAL PAINT THICKNESS SHALL BE 350 MICRON.
7. EVERY SERVICE WATER PIPE SERVING THE FOLLOWING PREMISES SHALL BE PROVIDED WITH THE APPROPRIATE TYPES OF BACKFLOW PREVENTER
   - i) INSTITUTIONAL PREMISES WITH LABORATORIES
   - ii) HOTELS
   - iii) WATER KIOSK
   - iv) WATER FILTER
   - v) SWIMMING POOL
   - vi) PUBLIC FOUNTAINS AND ORNAMENTAL POOLS
   - vii) AGRICULTURAL, HORTICULTURAL AND GENERAL CHEMICAL PROCESSES
   - viii) FACTORIES USING TOXIC CHEMICALS AND PROCESSING WATER OTHER THAN POTABLE WATER.
   - Ix) HOSPITALS, MORTUARIES AND VETERINARY CLINICS.
   - x) AUTOMATED CAR WASH CENTRES.
8. A SINGLE CHECK VALVE IS TO BE PROVIDED AT ALL GARDEN HOSE OUTLET FOR INDIVIDUAL PREMISES

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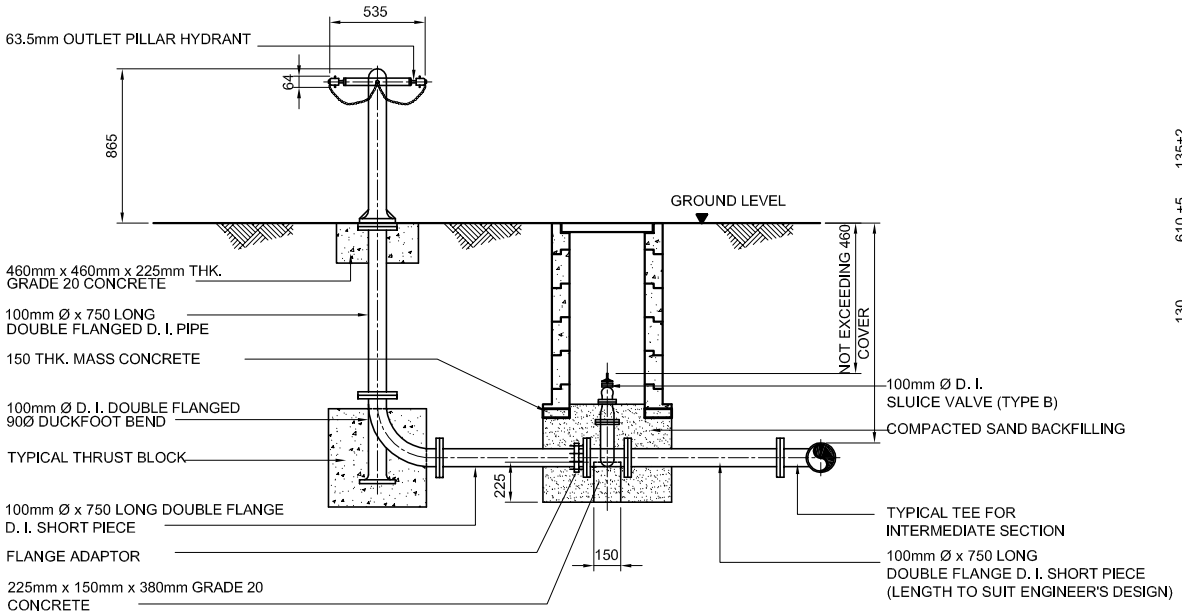
DRAWING TITLE :

METER STAND
(PIPE 80mm - 200mm)

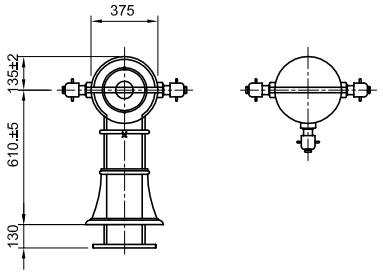
DRAWING NO:

SPAN/WS/STD/F/022

[Infrastructure Div] 3414 C:\a_data\david c dwd3\SPANfinal drawings\span final print\ WSSTDF022.dwg Wed, 26 Jun 2013 – 2:38pm

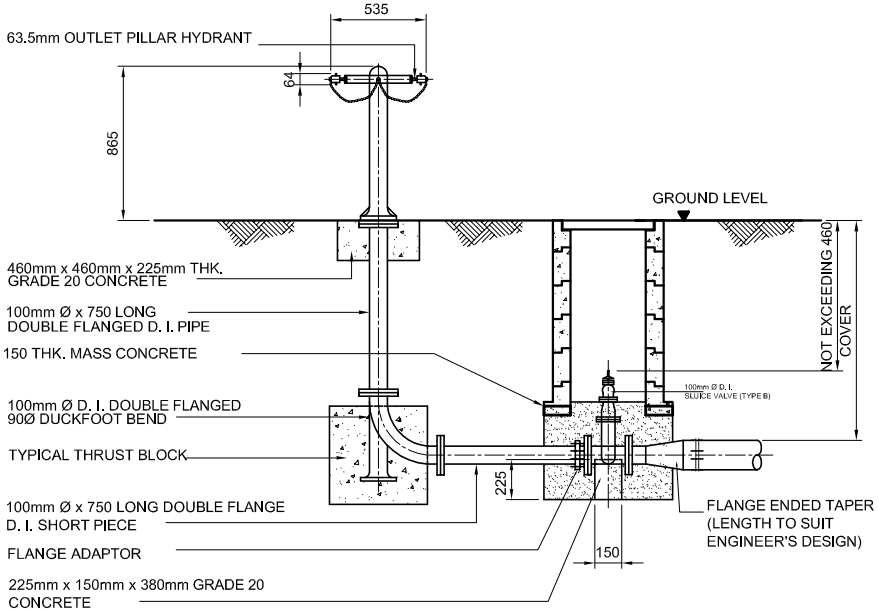


TYPICAL ARRANGEMENT OF 100mm Ø SLUICE VALVE AT 100mm Ø PILLAR HYDRANT WITH 63.5mm (2 .5") OUTLET (AT INTERMEDIATE LOCATION)

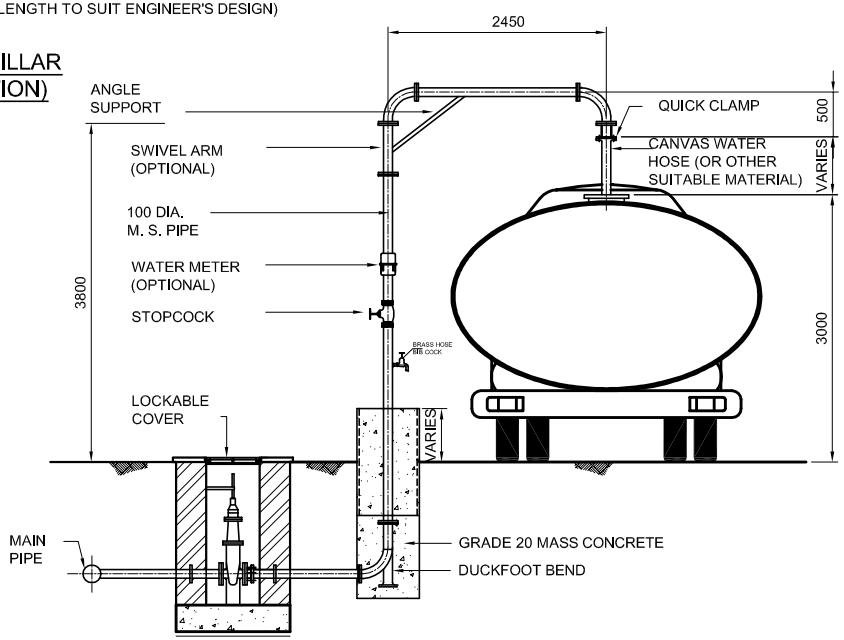


ELEVATION PLAN

3 WAY PILLAR HYDRANT



TYPICAL ARRANGEMENT OF 100mm Ø SLUICE VALVE AT 100mm Ø PILLAR HYDRANT WITH 63.5mm (2.5") OUTLET (AT DEAD END)



TANKING FILLING OPTION (ELEPHANT TRUNK TYPE)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.

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Selangor Darul Ehsan, Malaysia

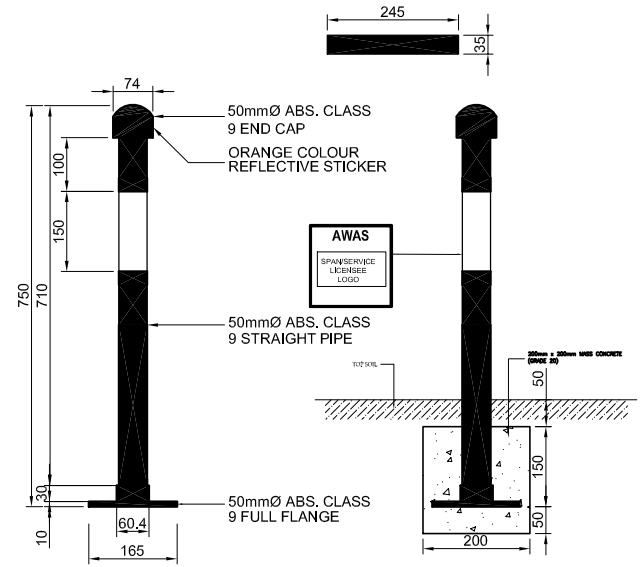
DRAWING TITLE :

FIRE HYDRANT AND TANKER FILLING OPTION

DRAWING NO:

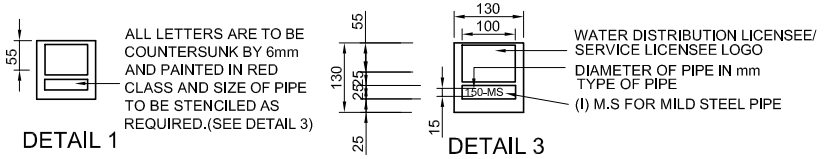
SPAN/WS/STD/F/023

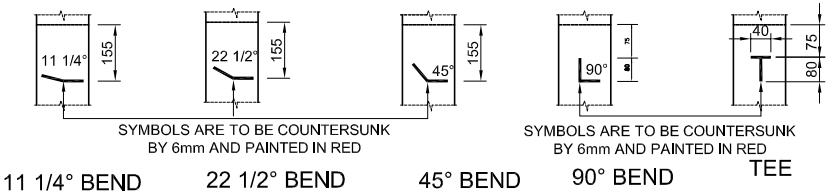
[Infrastructure Div] 3414 C:\o_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF023.dwg Wed, 26 Jun 2013 – 2:38pm



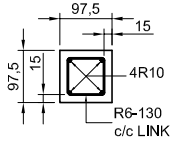
PIPES RESERVE MARKER DETAILS

INSTALLATION OF PIPE RESERVE MARKER

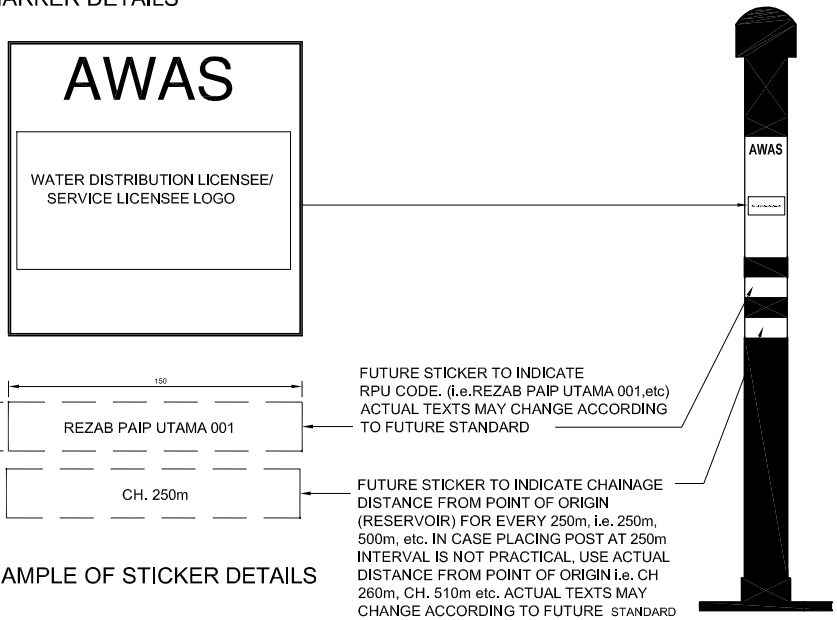




DETAIL 2

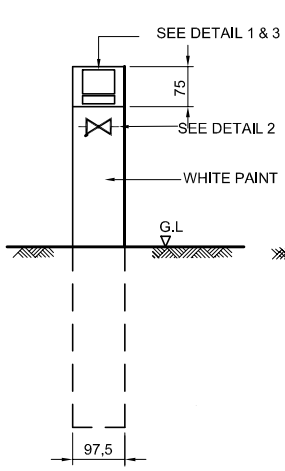


SECTION A-A

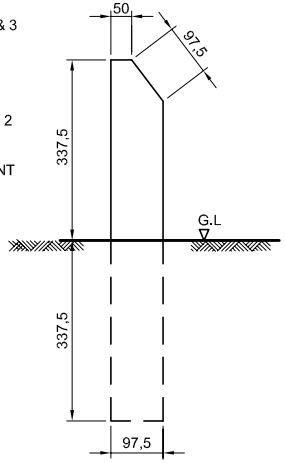


SAMPLE OF STICKER DETAILS

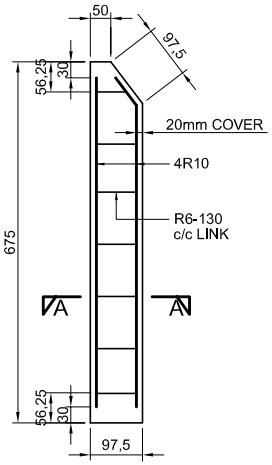
OPTION 1



FRONT ELEVATION



END ELEVATION



SECTION SHOWING REINFORCEMENT

OPTION 2

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.

2. STICKER SHALL BE OF 3M SCOTCH LITE REFLECTIVE STICKER.

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Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

DETAILS OF STANDARD MARKER POST

DRAWING NO:

SPAN/WS/STD/F/024

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF024.dwg Wed, 26 Jun 2013 - 2:39pm

150

TYPE 1

150

AWAS

WATER DISTRIBUTION LICENSEE/
SERVICE LICENSEE LOGO

x MM y

JIKA BERLAKU KEROSAKAN ATAU KEBOCORAN
SILA HUBUNGI

CONTACT NUMBER

TYPE 2

AWAS

WATER DISTRIBUTION LICENSEE/
SERVICE LICENSEE LOGO

z MM

JIKA BERLAKU KEROSAKAN ATAU KEBOCORAN
SILA HUBUNGI

CONTACT NUMBER

TYPE 3

AWAS

WATER DISTRIBUTION LICENSEE/
SERVICE LICENSEE LOGO

z MM

JIKA BERLAKU KEROSAKAN ATAU KEBOCORAN
SILA HUBUNGI

CONTACT NUMBER

TYPE 4

AWAS

WATER DISTRIBUTION LICENSEE/
SERVICE LICENSEE LOGO

z MM

JIKA BERLAKU KEROSAKAN ATAU KEBOCORAN
SILA HUBUNGI

CONTACT NUMBER

TYPE 5

AWAS

WATER DISTRIBUTION LICENSEE/
SERVICE LICENSEE LOGO

z MM

JIKA BERLAKU KEROSAKAN ATAU KEBOCORAN
SILA HUBUNGI

CONTACT NUMBER

TYPE 6

AWAS

WATER DISTRIBUTION LICENSEE/
SERVICE LICENSEE LOGO

PERCEROBOH AKAN DIDAKWA
SEPERTI YANG TERMAKTUB
DI BAWAH
UNDANG-UNDANG

SAMPLE OF STICKER DETAILS

STICKERS SCHEDULE FOR PIPES

SIZE OF PIPE (x)	TYPE OF PIPE (y)					
	MS	ABS	DI	HDPE	AC	uPVC
100	100	100	160	160	100	155
150	150	150	180	180	150	175
200	200	200	200	200	200	200
250	225	225	225	250	225	
300	250	250	250	300	250	
350	315	280	280	350	300	
400	355	315	315	400		
450	400	355	355	450		
500	450	400	400	500		
600	500	500	450	600		
650	560	600				
700	630					
750						
800						
850						
900						
950						
1000						
1050						
1100						
1150						
1200						
1300						
1400						
1500						
1600						
1700						
1800						

STICKERS SCHEDULE FOR VALVE

TYPE OF PIPE (y)			
SLUICE VALVE	BUTTERFLY VALVE	AIR VALVE	SCOUR VALVE
100	300	25	100
150	350	50	150
200	400	75	200
250	450	100	250
300	500	150	300
350	600	200	400
400	700	250	
450	800	300	
500	900		
600	1000		
700	1200		
750	1400		
800	1500		
900	1800		

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.

2. STICKER SHALL BE OF 3M SCOTCH LITE REFLECTIVE STICKER.

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SURUHANJAYA PERKHIDMATAN AIR NEGARA

Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

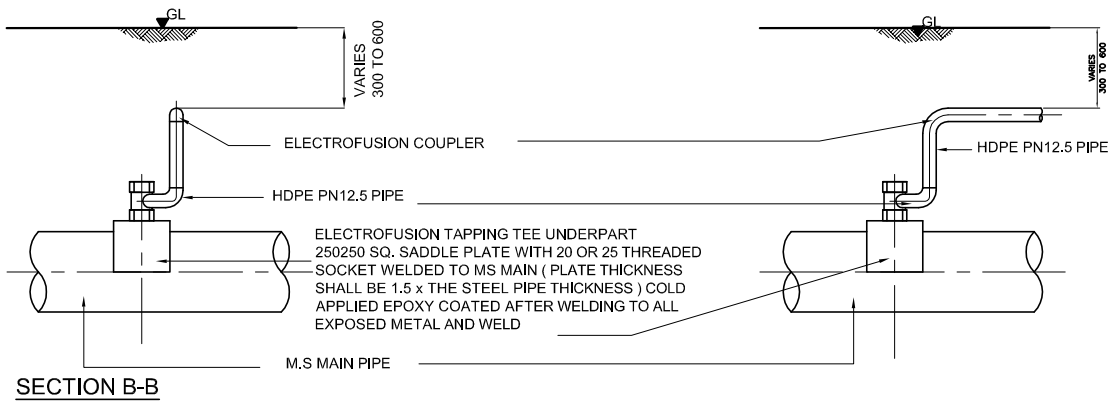
DRAWING TITLE :

DETAILS OF REFLECTIVE
3M STICKERS

DRAWING NO:

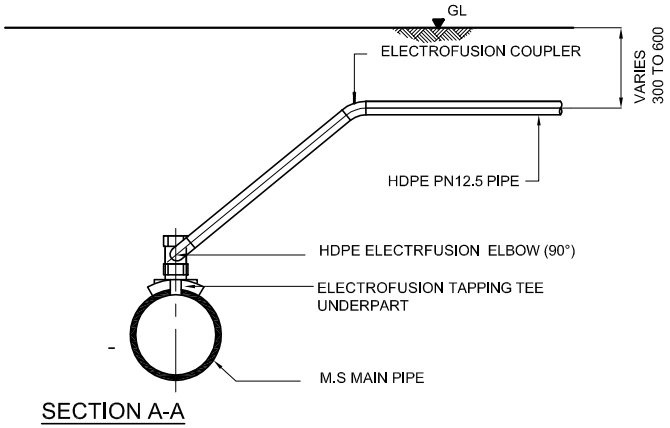
SPAN/WS/STD/F/025

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF025.dwg Wed, 26 Jun 2013 - 2:40pm

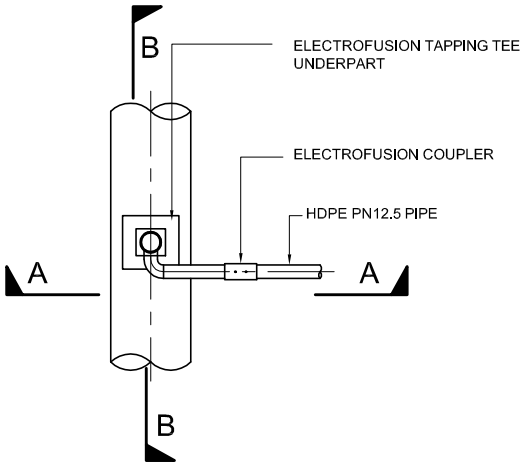


SECTION B-B

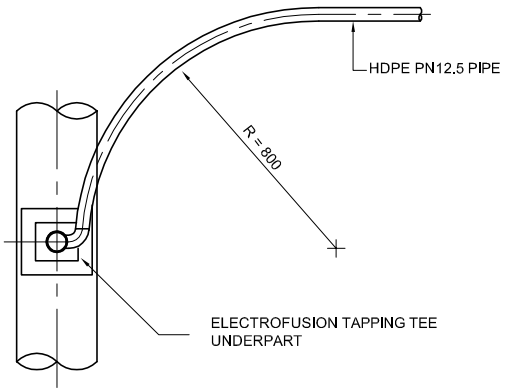
SECTION
TYPE 4



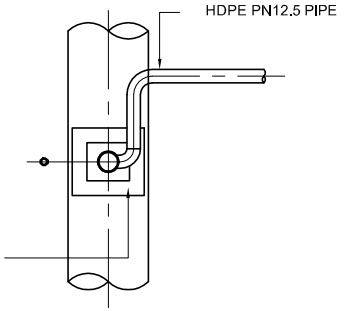
SECTION A-A



PLAN



PLAN
(TYPE `2')



PLAN
(TYPE `3')

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. ACTUAL LENGTH OF COMMUNICATION PIPE SHALL BE DETERMINED ON SITE.
3. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.

SPAN

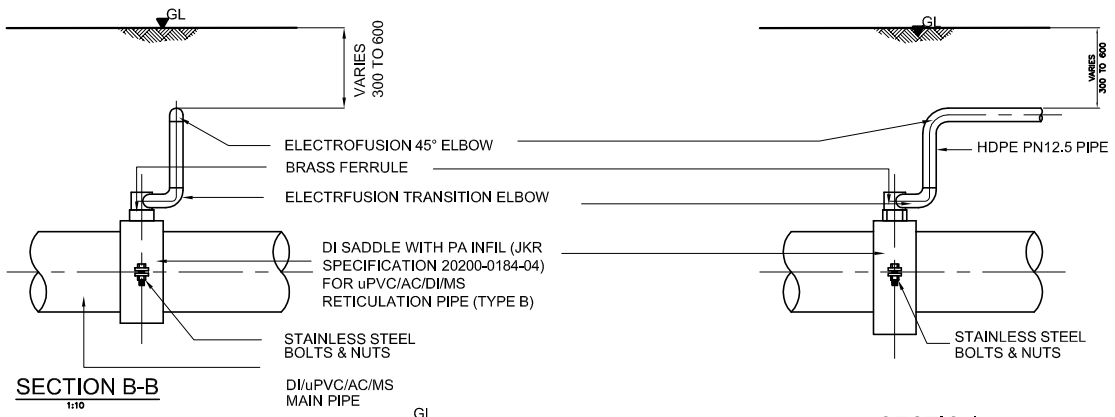
SURUHANJAYA PERKHIDMATAN AIR NEGARA
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

DETAILS OF HDPE COMMUNICATION PIPE AND TAPPING FROM MILD STEEL RETICULATION PIPE

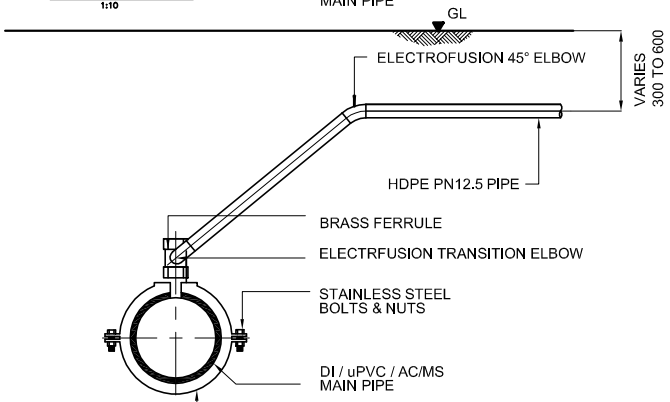
DRAWING NO:
SPAN/WS/STD/F/026

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF026.dwg Wed, 26 Jun 2013 - 2:40pm

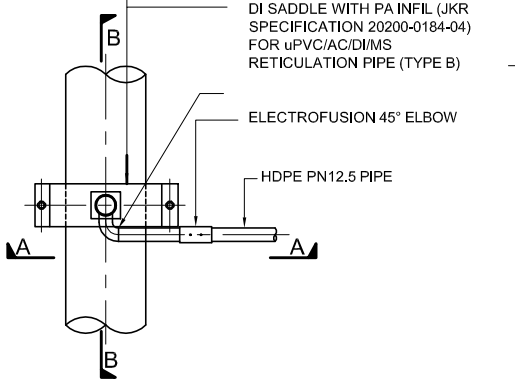


SECTION B-B
1:10

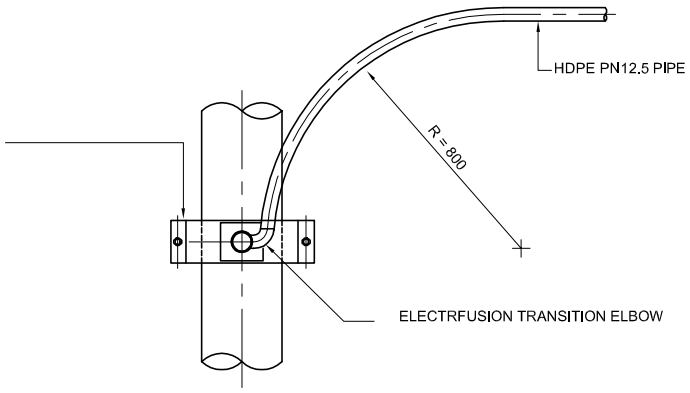
SECTION
TYPE 4



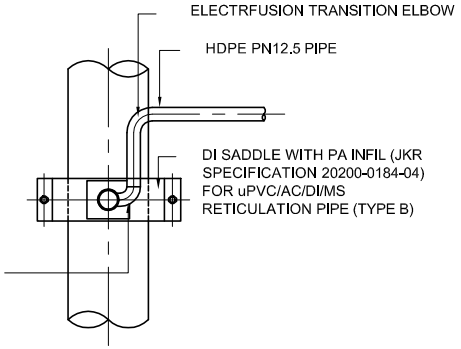
SECTION A-A



PLAN
(TYPE `1')



PLAN
(TYPE `2')



PLAN
(TYPE `3')

DI TAPPING SADDLE FOR DI/uPVC/AC/MS MAIN PIPE WITH HDPE COMMUNICATION PIPE

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. ACTUAL LENGTH OF COMMUNICATION PIPE SHALL BE DETERMINED ON SITE.
3. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.

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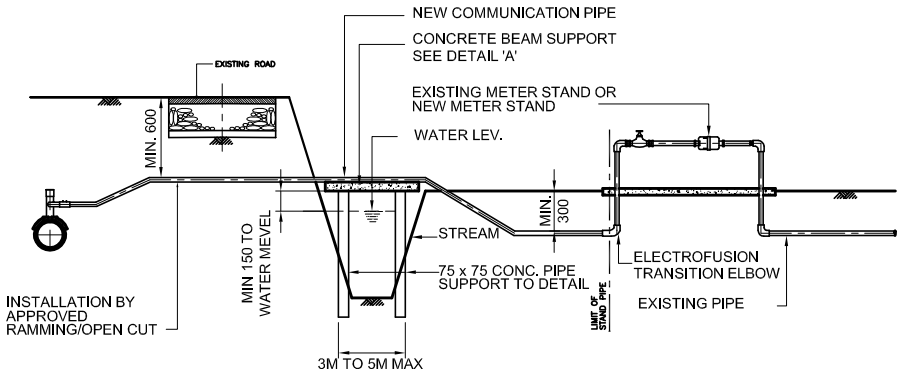
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

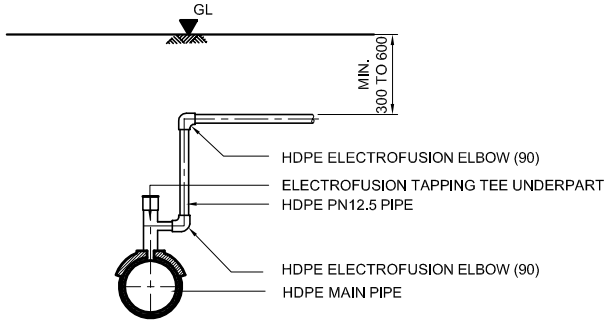
DETAILS OF HDPE COMMUNICATION DUCTILE IRON / uPVC/AC / MILD STEEL RETICULATION PIPE

DRAWING NO:
SPAN/WS/STD/F/027

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF027.dwg Wed, 26 Jun 2013 – 2:41pm

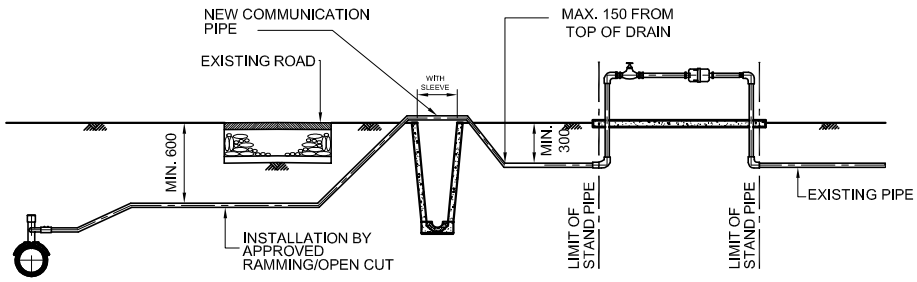


TYPICAL DETAIL FOR HDPE COMMUNICATION PIPE WITH STREAM CROSSING

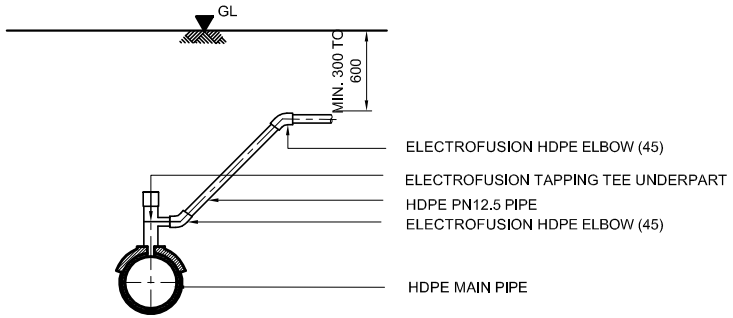


SECTION

TYPE 1 - HDPE TAPPING SADDLE FOR HDPE MAIN PIPE WITH HDPE COMMUNICATION PIPE FOR LOCATION WITH SPACE COSTRAINT

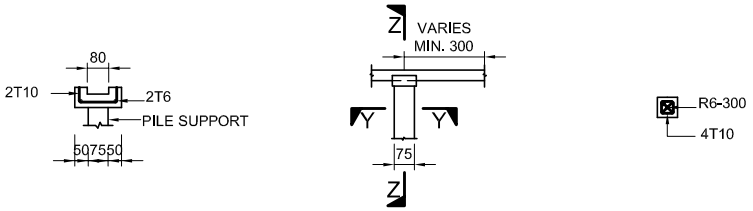


TYPICAL DETAIL FOR HDPE COMMUNICATION PIPE WITH DRAIN CROSSING

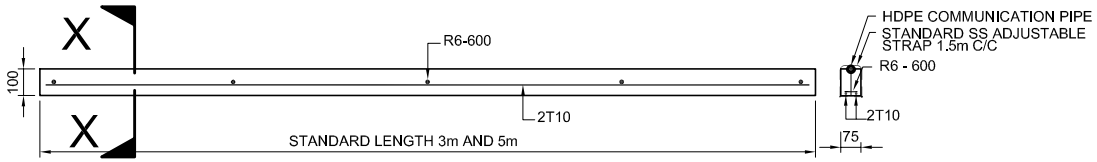


SECTION

TYPE 2 - HDPE TAPPING SADDLE FOR HDPE MAIN PIPE WITH HDPE COMMUNICATION PIPE FOR LOCATION WITH SPACE COSTRAINT



SECTION Z-Z DETAILS OF RC POLE SUPPORT SECTION Y-Y



DETAIL A

DETAIL OF PRECAST RC CONCRETE BEAM SUPPORT SECTION X-X

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. ACTUAL LENGTH OF COMMUNICATION PIPE SHALL BE DETERMINED ON SITE.
3. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.

SPAN

SURUHANJAYA PERKHIDMATAN AIR NEGARA
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

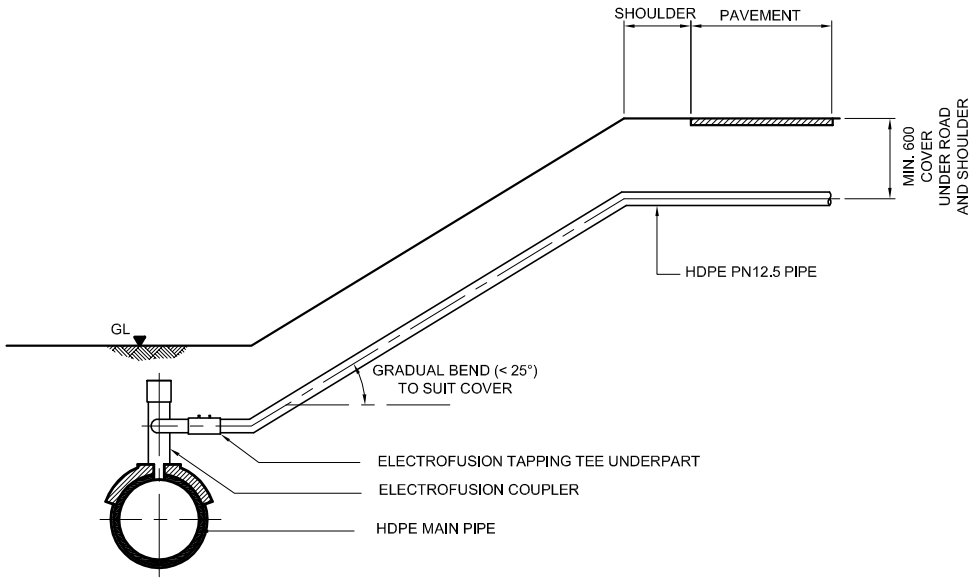
DRAWING TITLE:

DETAILS OF HDPE COMMUNICATION PIPE AND TAPPING FROM HDPE RETICULATION PIPE (SHEET 1 OF 2)

DRAWING NO:

SPAN/WS/STD/F/028

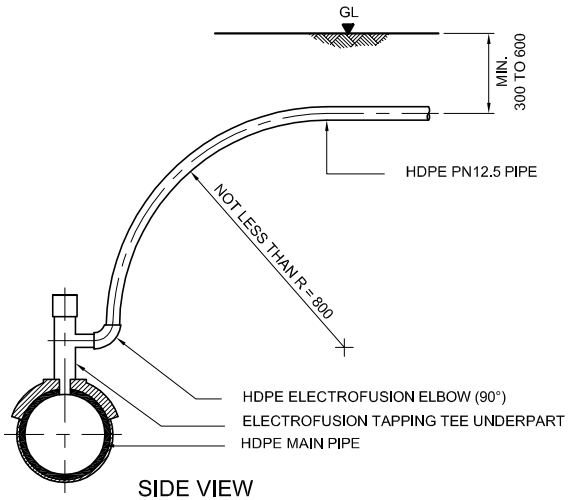
[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF028.dwg Wed, 26 Jun 2013 - 2:41pm



SECTION

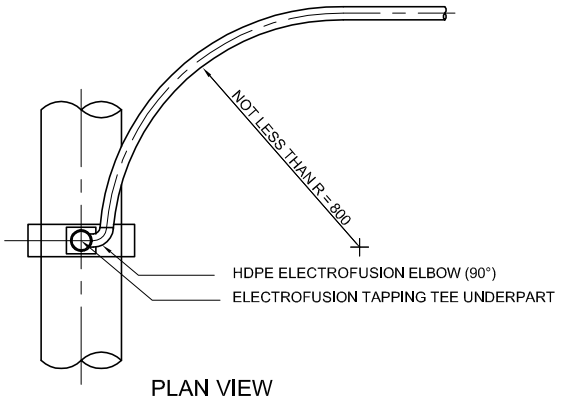
TYPE 3A - HDPE TAPPING SADDLE FOR HDPE MAIN PIPE WITH HDPE COMMUNICATION PIPE

1:20



SIDE VIEW

1:20



PLAN VIEW

1:20

TYPE 3A - HDPE TAPPING SADDLE FOR HDPE MAIN PIPE WITH HDPE COMMUNICATION PIPE

FOR LOCATION WITH AMPLE SPACE AND ROAD LEVEL HIGHER THAN SHOULDER

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.
2. ACTUAL LENGTH OF COMMUNICATION PIPE SHALL BE DETERMINED ON SITE.
3. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.

SPAN

SURUHANJAYA PERKHIDMATAN AIR NEGARA

Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

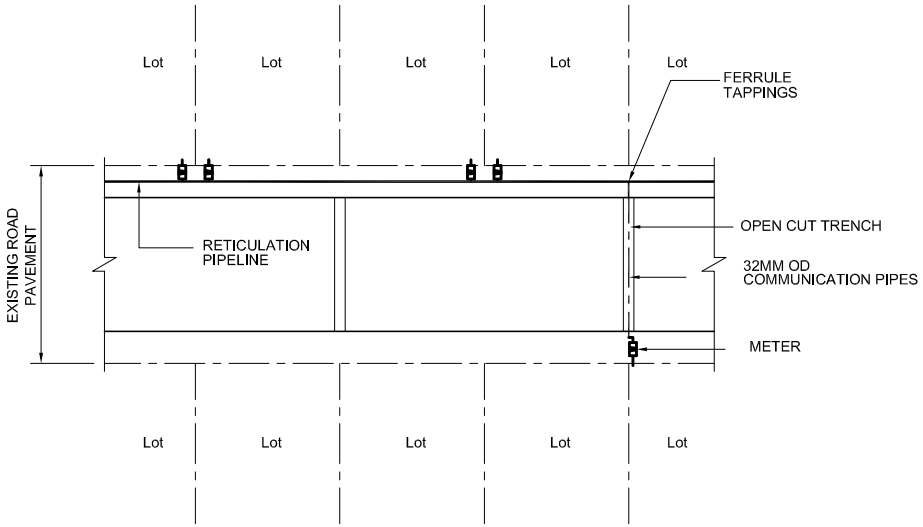
DRAWING TITLE :

DETAILS OF HDPE COMMUNICATION PIPE AND TAPPING FROM HDPE RETICULATION PIPE (SHEET 2 OF 2)

DRAWING NO:

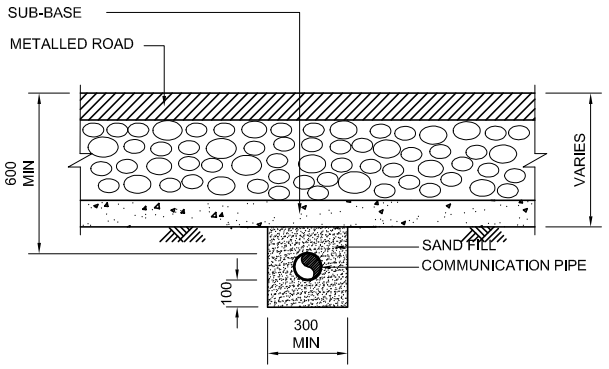
SPAN/WS/STD/F/029

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF029.dwg Wed, 26 Jun 2013 - 2:42pm

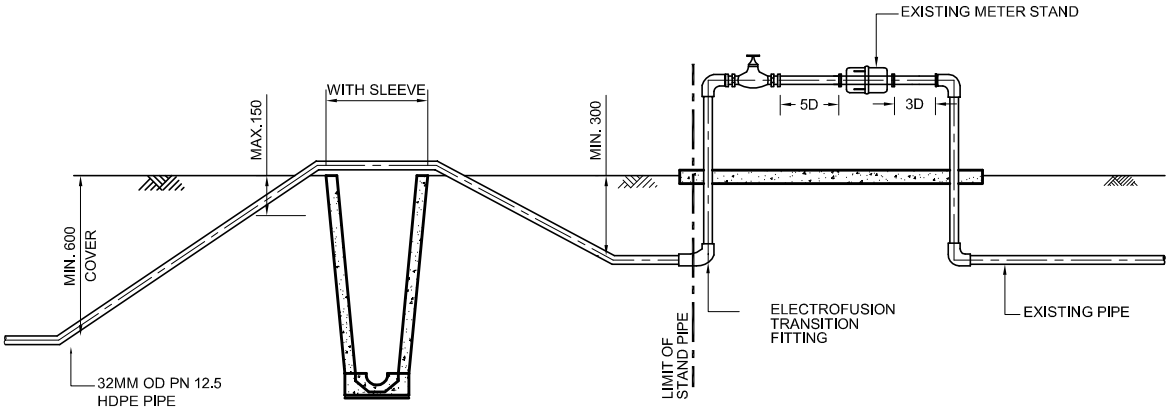


TYPICAL COMMUNICATION PIPES TAPPING ARRANGEMENT (OPEN CUT)

NOTE : IF INSTALLATION OF ROAD CROSSING IS BY APPROVED DIRECTIONAL HYDRAULIC RAMMING THERE IS NO REINSTATEMENT REQUIRED.

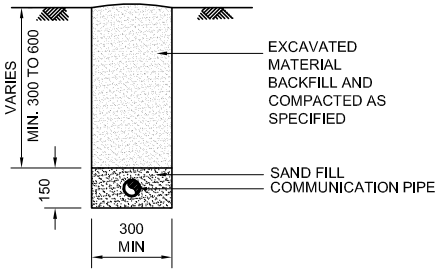


COMMUNICATION PIPE UNDER METALLED ROAD CROSSING



TYPICAL DETAILS FOR HDPE LIMIT OF WORKS

NOTE : IF METER NEED TO BE RELOCATED OUTSIDE PREMISES, A NEW METER STAND WILL BE INSTALLED AND METER TRANSFERED



NORMAL TRENCH FOR COMMUNICATION PIPE ON ROAD SHOULDER NOT UNDER METALLED ROAD

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. ACTUAL LENGTH OF COMMUNICATION PIPE SHALL BE DETERMINED ON SITE.
3. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.
4. ALL STAINLESS STEEL PIPES SHALL BE OF GRADE 304 TO SCHEDULES 40S.
5. ALL STAINLESS STEEL PIPES SHALL BE SOURCED FROM SUPPLIERS/ MANUFACTURERS APPROVED BY SPAN.
6. ACTION WILL BE TAKEN AGAINST PLUMBER/CONTRACTOR/CONSULTANT/ DEVELOPERS FOUND USING UNAPPROVED MATERIALS.

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SURUHANJAYA PERKHIDMATAN AIR NEGARA

Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

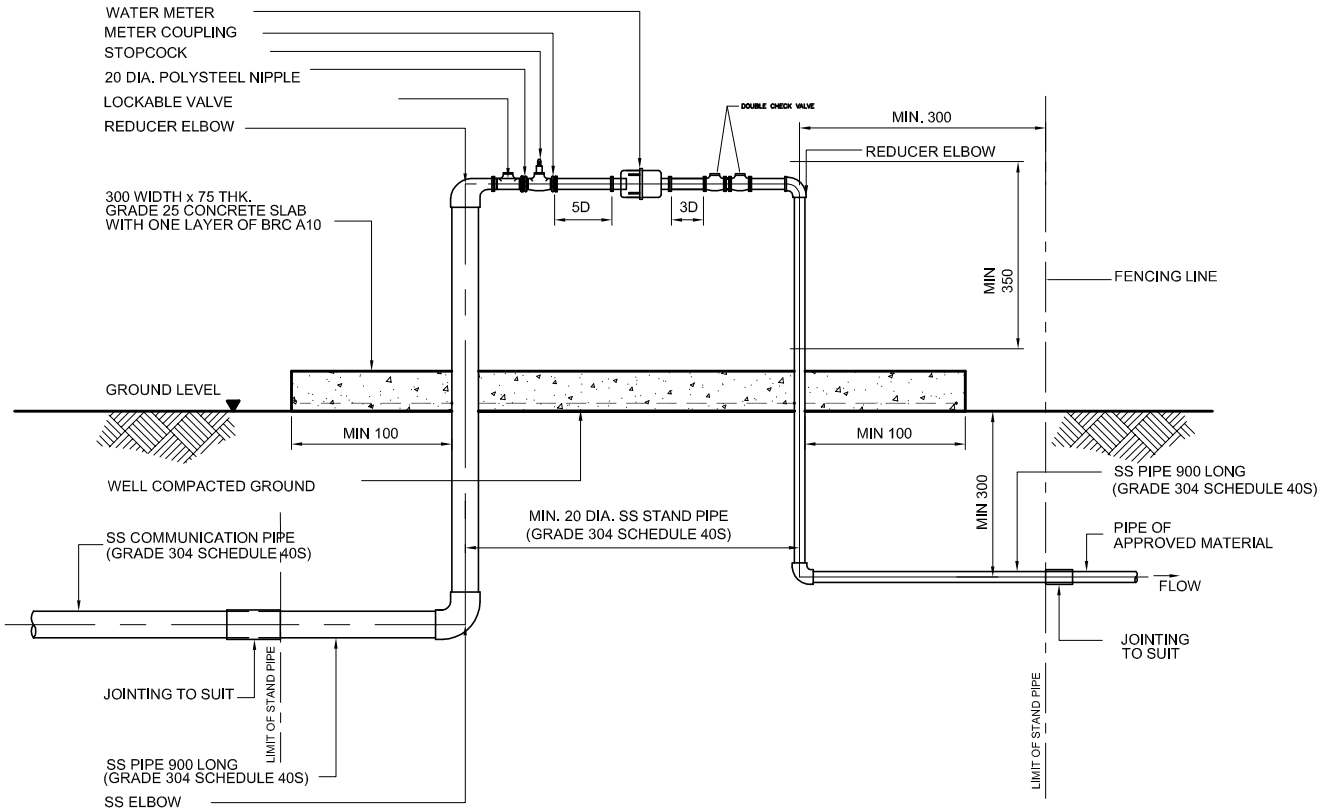
DRAWING TITLE :

TYPICAL COMMUNICATION PIPE TAPPING AND DETAILS

DRAWING NO:

SPAN/WS/STD/030

[Infrastructure Div] 3414 C:\e_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF030.dwg Wed, 26 Jun 2013 – 2:43pm



TYPICAL DETAILS OF STAINLESS STEEL METER STAND INSTALLATION FOR SINGLE METER SIZE 15 - 50 DIA. ~ TYPE A

PIPE DIAMETER (D) (mm)	5D (mm) MIN.	3D (mm) MIN.
15	75	45
20	100	60
25	125	75
50	250	150

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SURUHANJAYA PERKHIDMATAN AIR NEGARA

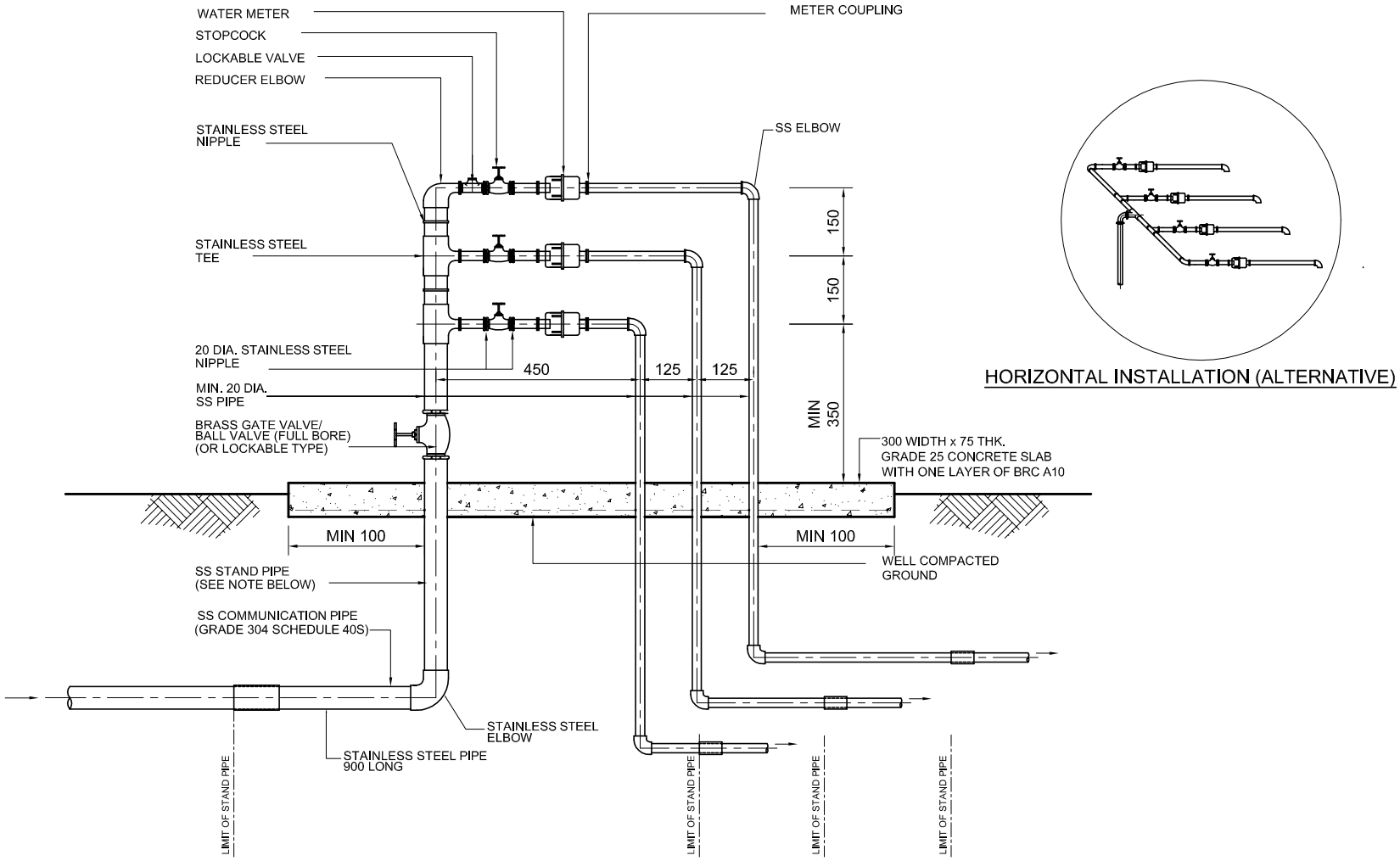
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

METER STAND
(PIPE 15mm - 50mm)

DRAWING NO:

SPAN/WS/STD/031



HORIZONTAL INSTALLATION (ALTERNATIVE)

NOTE :-
1. SS STAND PIPE SHALL BE :
   a.) 25 DIA. FOR 2 Nos. OF METERS OR
   b.) 50 DIA. FOR 3 OR MORE Nos. OF METERS

TYPICAL DETAILS OF STAINLESS STEEL METER STAND INSTALLATION FOR MULTI METER CONNECTION

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. ACTUAL LENGTH OF COMMUNICATION PIPE SHALL BE DETERMINED ON SITE.
3. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.
4. ALL STAINLESS STEEL PIPES SHALL BE OF GRADE 304 TO SCHEDULES 40S.
5. ALL STAINLESS STEEL PIPES SHALL BE SOURCED FROM SUPPLIERS/ MANUFACTURERS APPROVED BY SPAN.
6. ACTION WILL BE TAKEN AGAINST PLUMBER/CONTRACTOR/CONSULTANT/ DEVELOPERS FOUND USING UNAPPROVED MATERIALS.

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SURUHANJAYA PERKHIDMATAN AIR NEGARA
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

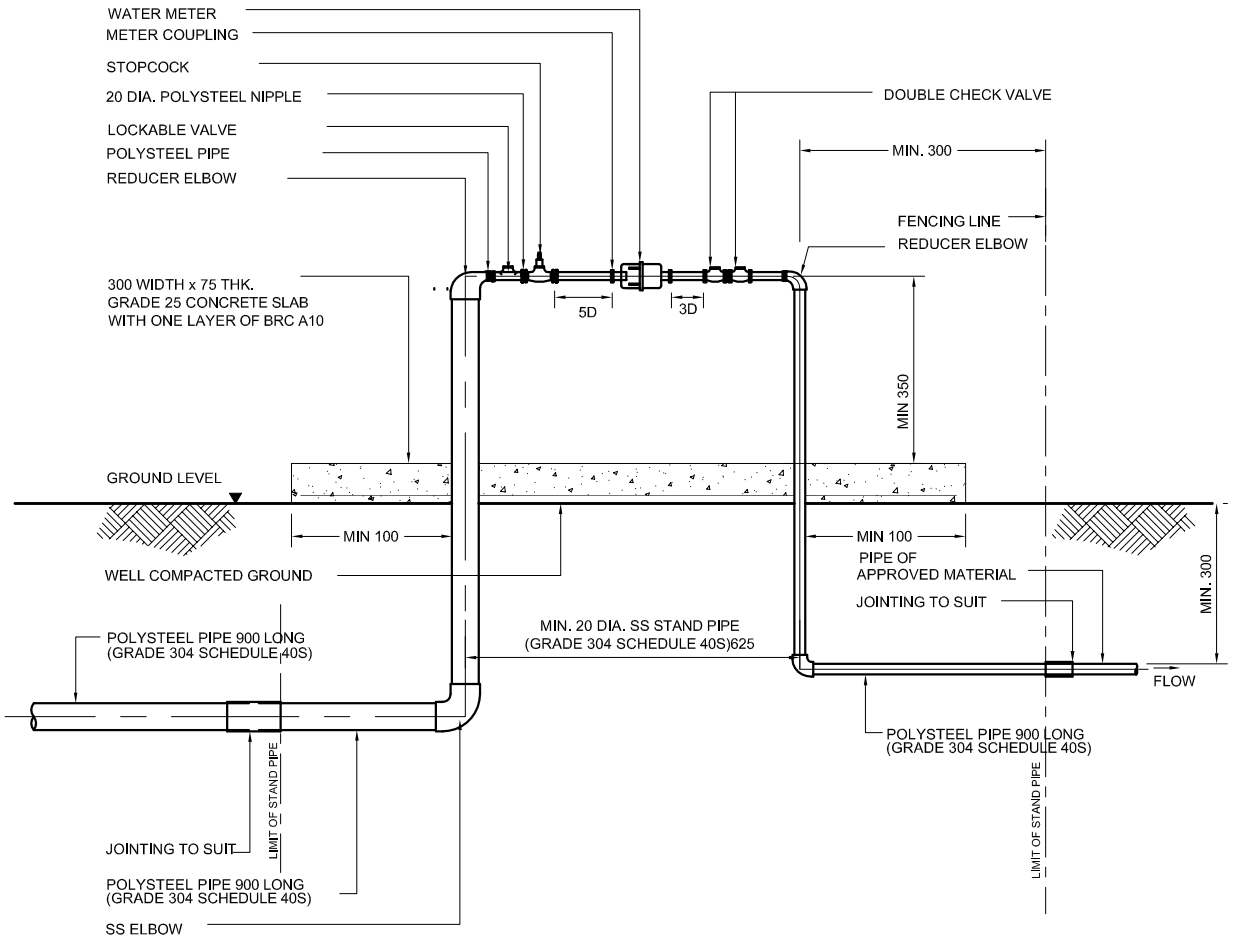
DRAWING TITLE:

METER STAND FOR MULTI METER CONNECTION

DRAWING NO:

SPAN/WS/STD/032

[Infrastructure Div] 3414 C:\e_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF032.dwg Wed, 26 Jun 2013 - 2:53pm



TYPICAL DETAILS OF POLYSTEEL METER STAND INSTALLATION FOR SINGLE METER SIZE 15 - 50 DIA. ~ TYPE A

PIPE DIAMETER (D) (mm)	5D (mm) MIN.	3D (mm) MIN.
15	75	45
20	100	60
25	125	75
50	250	150

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. ACTUAL LENGTH OF COMMUNICATION PIPE SHALL BE DETERMINED ON SITE.
3. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.
4. ALL STAINLESS STEEL PIPES SHALL BE OF GRADE 304 TO SCHEDULES 40S.
5. ALL STAINLESS STEEL PIPES SHALL BE SOURCED FROM SUPPLIERS/ MANUFACTURERS APPROVED BY SPAN.
6. ACTION WILL BE TAKEN AGAINST PLUMBER/CONTRACTOR/CONSULTANT/ DEVELOPERS FOUND USING UNAPPROVED MATERIALS.

SURUHANJAYA PERKHIDMATAN AIR NEGARA
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

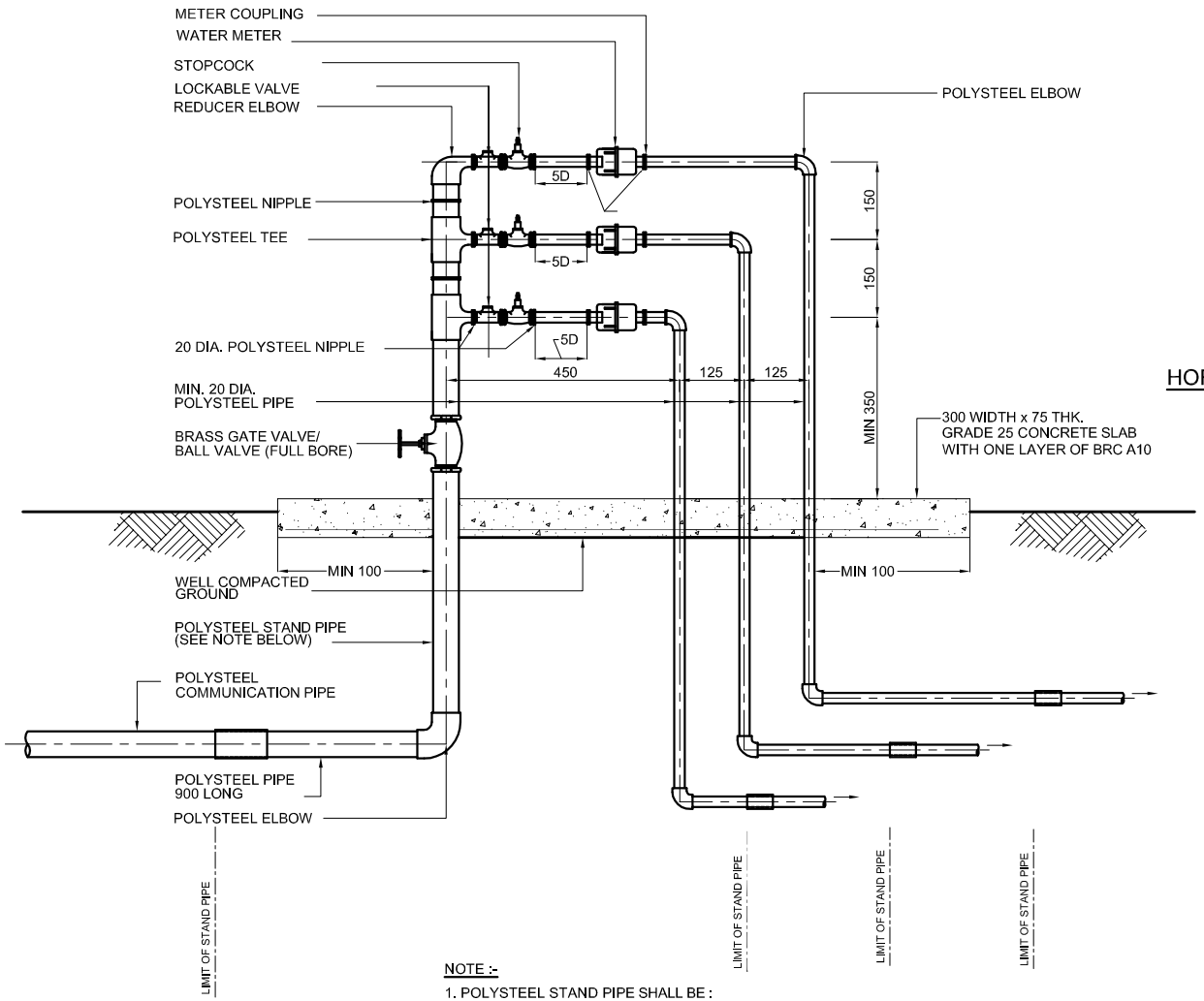
DRAWING TITLE:

METER STAND
(PIPE 15mm - 50mm)
- POLYSTEEL PIPE

DRAWING NO:

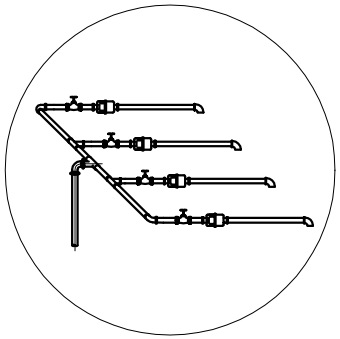
SPAN/WS/STD/033

[Infrastructure Div] 3414 C:\a_data\david c dvd3\SPAN\final drawings\span final print\ WSSTDF033.dwg Wed, 26 Jun 2013 - 2:56pm



NOTE :-

1. POLYSTEEL STAND PIPE SHALL BE :
   a.) 25 DIA. FOR 2 Nos. OF METERS OR
   b.) 50 DIA. FOR 3 OR MORE Nos. OF METERS



HORIZONTAL INSTALLATION (ALTERNATIVE)

TYPICAL DETAILS OF POLYSTEEL METER STAND INSTALLATION FOR MULTI METER CONNECTION

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS ARE IN METRE UNLESS OTHERWISE STATED.
2. ACTUAL LENGTH OF COMMUNICATION PIPE SHALL BE DETERMINED ON SITE.
3. ALL CONCRETE TO BE GRADE 25 UNLESS OTHERWISE STATED.
4. ALL STAINLESS STEEL PIPES SHALL BE OF GRADE 304 TO SCHEDULES 40S.
5. ALL STAINLESS STEEL PIPES SHALL BE SOURCED FROM SUPPLIERS/ MANUFACTURERS APPROVED BY SPAN.
6. ACTION WILL BE TAKEN AGAINST PLUMBER/CONTRACTOR/CONSULTANT/ DEVELOPERS FOUND USING UNAPPROVED MATERIALS.

SPAN

SURUHANJAYA PERKHIDMATAN AIR NEGARA

Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
Jalan Teknokrat 6,
63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

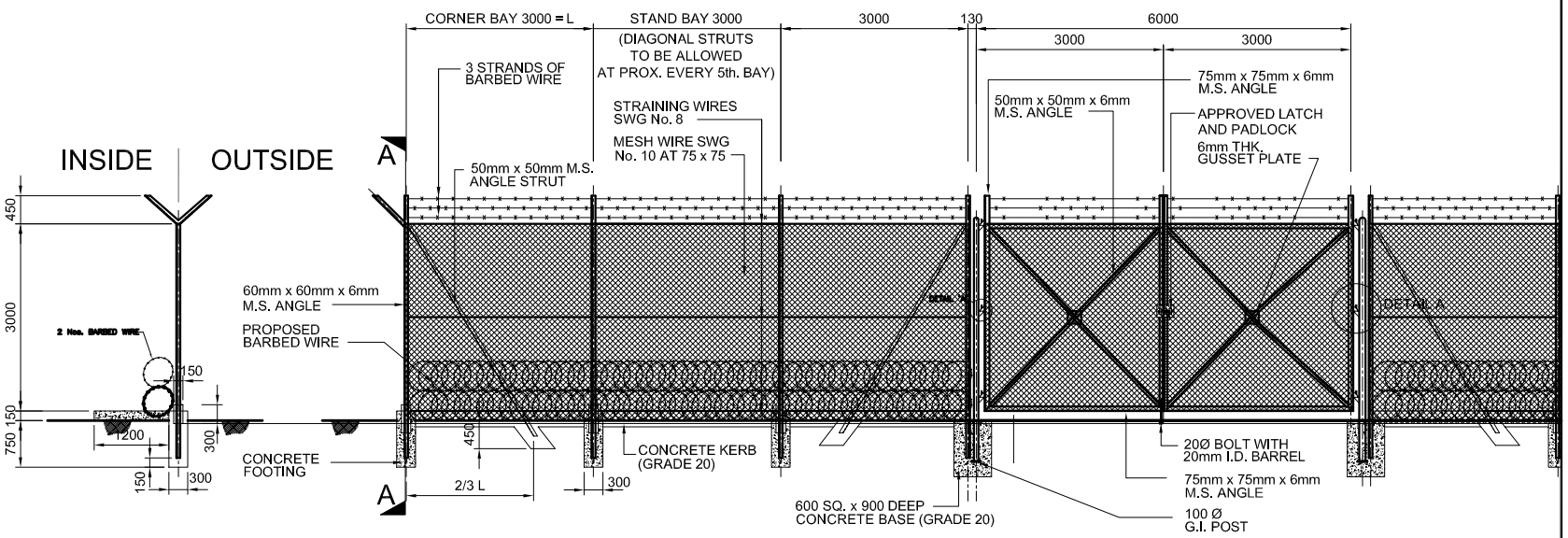
DRAWING TITLE :

METER STAND FOR MULTI METER CONNECTION - POLYSTEEL PIPE

DRAWING NO:

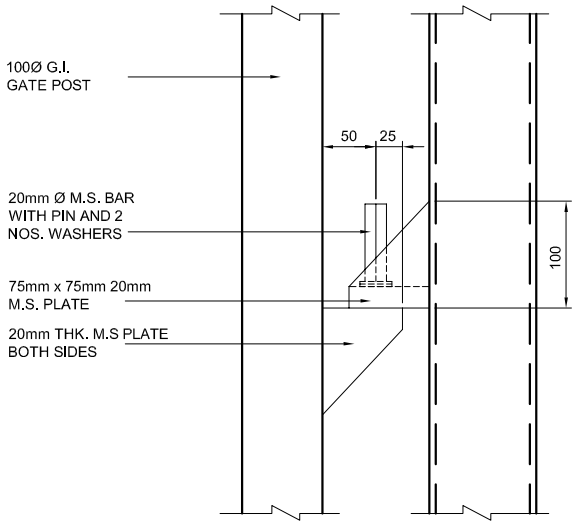
SPAN/WS/STD/034

[Infrastructure Div] 3414 C:\a_data\david c dwg3\SPANfinal drawings\span final print\ WSSTDF034.dwg Wed, 26 Jun 2013 – 2:57pm



SECTION A-A
1:40

TYPICAL DETAILS OF FENCING AND GATE
1:40



DETAIL `A'
1:5

NOTE:-
1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS OTHERWISE STATED.

SURUHANJAYA PERKHIDMATAN AIR NEGARA
Aras Bawah & Aras Satu
Prima Avenue, Blok 3510
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63000 Cyberjaya
Selangor Darul Ehsan, Malaysia

DRAWING TITLE :

FENCE AND GATE DETAILS

DRAWING NO:

SPAN/WS/STD/F/035

SPAN

Suruhanjaya Perkhidmatan Air Negara

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