TECHNICAL SPECIFICATIONS
FOR
PROPOSED UPGRADE & EXTENSION
FOR
PUBLIC RENTAL BOARD
WESTERN BRANCH OFFICE
AT LOT 39, DP 4389,
HECTOR EYRE STREET,
NATOKAWAQA,
LAUTOKA

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1.0 INTRODUCTION

Public Rental Board is Proposing to **Upgrade & Extend the Public Rental Board Western Branch Office at Lot 39, DP 4389, Hector Eyre Street, Natokawaqa, Lautoka** within the estate. The construction of the proposed works features has been summarized as follows:

1. Pad & strip reinforced concrete foundations.
2. D10, D12, D16, D20 as reinforcement bars.
3. 200mm,100mm Blockwork structure where shown.
4. Epoxy methods on specified areas to be recommended by structural engineers.
5. 150 x 75 “C” Channels Rafter Purlins, Color bond Roofing Iron & Type 17 roofing screw.
6. Plumbing and stormwater disposal shall be provided.
7. All electrical works shall be provided.
8. All architectural works such as Floor plan, Elevations, Sections etc. are to be completed as per the drawings and specifications.
9. All onsite civil works and connections and liaison with the service providers are to be done by the Contractor.

2.0 TECH SPEC 1A: CLEAR & GRUB / TOPSOIL

2.1 SCOPE OF WORK

This specification covers the removal, stockpiling and eventual disposal of all organic and vegetable matter at present growing on the sites of the subdivision and the port access road. It also covers the recovery and stockpiling of the topsoil on the same areas.

2.2 CLEARING & GRUBBING OF VEGETATION

The entire areas of the site of the subdivision and the port access road shall be stripped of all vegetation (grass, shrubs, trees etc.) either by hand means or by light construction equipment.

Roots of all shrubs and trees shall be grubbed or otherwise excavated and treated in he same manner as other vegetation.

All products of this clearing operation shall be stockpiled on the site and progressively removed to waste as detailed in Clause 4.0.

2.3 EXTRANEOUS NON-ORGANIC RUBBISH

Any extraneous non organic rubbish uncovered during the clear and grub operation shall be stock piled separately and removed to waste as detailed in Clause 4.0.

2.4 REMOVAL OF UNWANTED MATERIAL

All products of the clear and grub operation, including the non-organic components, shall be removed to a dump area approved by the Suva City Council.

Care shall be taken during the transport of this rubbish to ensure that there is no spill from the trucks.

All loads shall be covered with securely tied tarpaulins or netting in such manner to ensure that no leaves, grass, branches etc. blow off the vehicle.

2.5 BURNING OF VEGETATION

Under no circumstances shall the vegetation be burnt, either on the site of the works or at the dump area.

THIS REQUIREMENT IS MANDATORY & NO DEVIATION WILL BE PERMITTED.

2.6 MULCHING OF VEGETATION

If desired, the Contractor shall mulch the organic component on site, prior to disposal.

In this case, disposal may be to an approval site where the mulch can be used as a soil supplement. Mulching shall break all vegetation to a maximum size chip of 30 x 5mm.

2.7 RECOVERY & STOCKPILING OF TOPSOIL

Top soil shall be recovered from the entire area down to the top of the clay sub-base.

Top soil shall be “riddled” to remove all sticks, stones, leaves etc. and stockpiled where directed on site.

2.8 DISPOSAL OF TOPSOIL

Following the replacement of topsoil on new berms and designated reserves, the balance of the topsoil shall be disposed of, off site, at the Contractors discretion. Surplus topsoil is considered to be the Contractors property

3.0 TECH SPEC 2A: EXCAVATION & BACKFILL TO FOUNDATIONS

3.1 GENERAL

This Technical Specification establishes the quality of materials and workmanship and defines how quality is measured for structural excavation and structural backfill. It applies to site facilities and buildings. Note that excavation and backfill for conduit and piping systems is specified in TECHSPEC 2B.

The Specification shall be read in conjunction with the drawings.

3.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings:

U.S.B.R.	U.S. Bureau of Reclamations Earth Manual
A.S.	Australian Standard
NZS	New Zealand Standard
NRB	National Roads Board (New Zealand)

3.3 CODES AND STANDARDS

3.3.1 Unless otherwise specified or shown on the drawings, the following codes and standards shall apply to the extent indicated herein.

NZS 4402 P Part 1: 1980 Methods of Testing Soils for Civil Engineering Purposes Part 1 Soil Classification and Chemical Tests.

Comprising:

NZS 4402 P Test 1	Determination of Water Content
NZS 4402 P Test 2	Determination of Liquid Limit
NZS 4402 P Test 3	Determination of Plastic Limit
NZS 4402 P Test 4	Determination of Plasticity Index
NZS 4402 P Test 7	Determination of Sand Equivalent
NZS 4402 P Test 8	Determination of Solid Density of Soil Particles
NZS 4402 P Test 9	Determination of the Particle Size Distribution
NZS 4431: 1978	Earthfill for Residential Development
BS 1377 Test 12	Density/water content relationship (Standard compactions test)
BS 1377 Test 14	Density/water content relation (Vibrating Hammer method)

BS 1377 Test 15 Insitu density test US Bureau of Reclamation's Earth Manual 1968 Edition. Test E -12.

3.4 SETTING OUT

The Contractor shall employ a registered surveyor to set out the work, to check that the work is being carried out to correct line and level and shall at all times be responsible for the setting out of the works. The setting of the foundation bolts shall also be checked by the surveyor.

3.5 STRUCTURAL EXCAVATION

Structural excavation includes all excavation required for the construction of footings, foundations and walls.

Pockets of unsuitable materials within the limits of excavation shall be removed from the site and wasted.

The method of excavation shall not weaken surrounding areas or damage structures or parts thereof that are completed or under construction.

Existing structures and utilities adjacent to excavations shall be protected and supported to prevent slip failure, settlement or loss of confined materials under existing floors and footings. Any damage to the existing buildings and services for the duration of the contract will be made good at cost to the Contractor.

Water encountered during excavation shall be controlled and removed by pumping to maintain excavations in a stable and dry condition suitable for the placing of concrete. Where necessary, the Contractor shall install at his own cost, a subsurface drainage system capable of maintaining a stable base and all depressions free of water.

Over-excavated areas adjacent to, or under footings, foundations or other bearing portions of the structure, shall be restored by back-filling to design levels with 17.5 MPa concrete.

Restoration of over-excavated areas outside the foundation areas shall be restored to provide bearing values at least equivalent to that previous to over-excavation but not less than 70% relative density.

Suitable excavated materials shall be utilised in backfills. Unsuitable or excess excavated materials shall be disposed of at waste locations. off site.

Suitable material is defined as materials free of organic and silt components, well graded sandy gravel able to be compacted to 70% relative density index at moderate compactive efforts.

In general, excavation for concrete slabs shall be extended to permit the placing and removal of forms. Unless otherwise shown, or specified, the extension for concrete slabs shall not exceed 300 mm except where substructure concrete is to be deposited directly against excavated surfaces and then the extension shall be 50 mm.

In general, excavation slopes shall be one half horizontal to one vertical. Excavations may be made to lines and slopes either steeper or flatter than those specified above except for those excavations where steep slopes are required to maintain the stability of existing foundations.

Areas being excavated and areas being backfilled shall be maintained in a clean condition free of trash and other debris.

3.6 STOCKPILING

Different classes of material shall be stockpiled separately.

Stockpiles and waste material shall be placed in such a manner to provide natural drainage and a stable embankment.

Stockpiles shall be constructed with a maximum height not exceeding 12 metres and shall be constructed in uniformly placed layers being placed in an orderly manner.

Compactive effort achieved by the operation of the construction equipment shall be the only compaction of stockpiled material required. The stability of heap shall be the Contractor's responsibility at all times.

3.6.1 PREPARATION OF SUBGRADE

Subgrade preparation shall include the fine grading and preparation of previously rough graded surfaces upon which floor, foundations and pavements are to be constructed, together with all excavating, filling, compacting, sprinkling, disposal of excess excavation, and borrow of fill material required to construct subgrades to the elevations shown on the drawings and/or established in the field.

Unless otherwise specified or shown the top 50 mm of subgrade shall be sand blinding compacted to 96% relative density. Hard tamping with pneumatic tampers will be permitted only in areas inaccessible to a roller. After rolling or tamping, the subgrade shall be tested with a template, straight edge, and/or level; all irregularities of level to a tolerance of plus and minus 5mm over a length of 3000 shall be corrected and, if directed, the subgrade shall be re-rolled or tamped after correcting levels.

Subgrades shall be accurately constructed to indicated levels with all high and low spots eliminated.

Soft spots not conforming to specified relative density shall be corrected, as directed by the Engineer.

3.6.2 BACKFILL MATERIALS

Backfill material shall be of the quality as defined in clause 5.6 and shall be placed as follows.

Backfill against concrete work shall be placed only when directed and shall be tamped backfill placed in uniform layers not exceeding 150 mm in depth and each layer shall be thoroughly compacted by vibrating rollers. Where backfill is to be placed on each side of members subject to bending, the backfilling shall be placed in equal layers of each side of the member.

3.6.3 SOURCES OF IMPORTED MATERIAL

The Contractor shall make his own arrangements to obtain sufficient quantities of imported sand and sandy gravel from the nominated offsite source.

The contractor shall allow for all costs associated with the royalties, purchase, excavations, loading and transportation to site of all suitable imported fill material.

3.6.4 FOUNDATION INSPECTION

Prior to concreting, all excavations shall be inspected and approved by the Engineer.

The Engineer shall be given 24 hours prior notice by the Contractor of any intended inspection.

3.6.5 BARRICADES AND LIGHTS

Where directed, or where required for protection of workmen or public safety, substantial barricades shall be erected and maintained.

Warning flares or lights shall be maintained on such barricades at night.

3.6.6 DISPOSAL OF SURPLUS MATERIALS

All excess material on completion of the contract shall be removed from the site to designated waste areas offsite.

The building site and surrounding construction laydown area shall be left in a neat and tidy condition with surface grades to shed water away from buildings towards drainage channels.

4.0 TECH SPEC 2B: EXCAVATION & BACKFILL FOR PIPING, CABLES ETC.

4.1 GENERAL

This Technical Specification establishes the quality of materials and workmanship and defines how quality is measured for excavation and backfill for underground piping and structures. It applies to plant site and offsite piping systems to the extent and limits shown on the drawings.

4.2 ABBREVIATIONS

The abbreviations listed below, where used in these Specifications, shall have the following meaning:

NZS	New Zealand Standard
BS	British Standard
USBR	United States Bureau of Reclamation

CODES AND STANDARDS

All work shall be performed in accordance with the relevant Codes and Standards listed below and as indicated by references therein and other statutory rules and regulations applicable to the works required to be performed in this Contract.

CODE No.	DATE	TITLE
NZS 4402 Pt 1	1980	Methods of Testing Soils for Civil Engineering Purposes.
NZS 4431	1978	Earth fill for Residential Development.
NZS 4452	1974	Construction of underground pipe sewers and drains.
BS 1377	1977	Methods of test for soil for Civil engineering purposes
USBR		Earth Manual
NZ Labor Department		Code of Practice for Excavation Work

4.3 EXCAVATION

The contractor shall be deemed to have satisfied himself as to the nature and difficulties resulting from all obstructions on or in the vicinity of the line and shall include these costs in his bid submission. Trenches shall not be excavated more than one day in advance of pipe laying. Open trenches shall be barricaded and lit at night as directed or according to statute. The excavation shall be performed by open trench with adequate side batters. Where necessary the ground shall be adequately braced and sheeted to ensure stability of vertical faces in compliance with the relevant statutory requirements. Suitable excavated materials shall be utilized in backfills. Unsuitable or excess excavated materials shall be disposed of at locations within the site perimeter as directed by the Engineer.

Pockets of unsuitable materials within the limits of trench excavation shall be removed to a depth of 600mm below bottom of structure (pipe) or those structures 600mm or more in height (Dia) and to a depth equal to the height (Dia) of structure for those structures less than 600mm in height. Such excavation shall be carried at least 300mm beyond the horizontal limits of the structure on all sides. The method of excavation shall not weaken surrounding areas or damage structures or parts thereof that are completed or under construction. Existing structures and utilities adjacent to excavations shall be protected and supported to prevent settlement. Work shall be conducted to avoid disturbance to existing utilities. Handwork shall be used in the vicinity of all known services. Care shall be exercised to avoid the cutting or breakage of water lines. Such lines, if broken, shall be restored promptly.

When active pipelines are cut in the trenching operations, temporary pipe supports and/or conduits shall be provided across the trench, while open, and the lines shall be restored when the backfilling has progressed to the original bedding lines of the pipeline so cut. Any damage by the Contractor to the existing buildings and services during the duration of the Contract will be made good at cost to the Contractor.

Notwithstanding the above, breakage in main lines shall require immediate notification to the Engineer. Connections to existing lines shall only be by prior arrangement with the Engineer and Local Authority.

Water in excavations shall be controlled and removed. Piping shall not be constructed or laid in a trench in the presence of water.

All water shall be removed from the trench sufficiently prior to the placing of piping to ensure a dry, firm bed on which to place the piping, and the trench shall be maintained in such unwatered conditions until all concrete and mortar is set.

Where necessary the Contractor shall install, at his own cost, a subsurface drainage system capable of maintaining a stable base and all depressions free of water.

Except as otherwise shown, grading tolerances shall be zero to minus 30mm for common excavation.

All excavations shall conform within the tolerance specified to the lines, grades, sections and elevations shown and shall be shaped on the bottom to the bedding details shown.

Excavated material shall be deposited at least 600mm from the edge of the trench. The size of heaps shall be limited to that which will not endanger the stability of trench wall. Soil shall be removed from all access ways. Surplus soil is to be removed not later than when the trench is backfilled.

Over-excavated areas in soil shall be restored to the designated grade by backfilling with weak concrete to a mix design approved by the Engineer. Generally, this shall be min strength concrete of 12Mpa 28 day strength. Restoration of over-excavated areas in soil shall provide uniform bearing values at least equivalent to that previously given by the excavation prior to the over-excavation.

Excavation for manholes, pump wells and pits shall be extended to permit placing and removal of forms. Unless shown otherwise, the extension for manholes, pump wells and pits shall be 600mm except where soil conditions permit concrete to be deposited directly against excavated surfaces and then the extension shall be 75mm.

Areas being excavated and areas to be backfilled, shall be maintained in a clean condition free from leaves, brush, sticks, trash and other debris.

4.4 STOCKPILING

Different classes of material shall be stockpiled separately.

Stockpile and waste material shall be placed in such a manner to provide natural drainage and a stable embankment.

Stockpiles shall be constructed with a maximum height not exceeding 2 metres.

4.5 BEDDING AND CONCRETE SURROUND

All pipes shall be bedded on a uniformly firm well compacted foundation in such a manner that the pipe is supported uniformly along its underside. The bed shall be so shaped that a minimum of 1/3 of the circumference is in contact with such a bed for the full length of the pipe (unless otherwise noted). Recesses shall be provided for joints so that pipes are supported along their full length of the pipe. To obtain these results the following types of bedding shall be used.

4.5.1 Ordinary Bedding

Ordinary bedding shall be used where the bottom of the trench is a firm material and where it is practical to hand trim the bottom of the trench to provide the bedding specified above.

When this form of bedding is used, the bottom of the trench should be left 50mm high by machine. This layer is then hand trimmed to provide the shaped bed for the pipe.

All trimming shall be done immediately prior to pipe laying to minimize the effects of ground water on the bed.

Should the contractor excavate deeper than as specified he shall provide backfill as specified in gravel bedding at his own expense.

4.5.2 Gravel Bedding

Gravel bedding shall be used where shown on the drawings or where the material at the bottom of the trench contains large stones or other material which makes hand trimming impractical or because of water saturation or above rock excavation.

The excavation shall be a minimum of 100mm below the underside of the pipe and backfilled with gravel of 6mm to 18mm size range.

Samples of material for gravel bedding shall be submitted to the Engineer for approval prior to placement.

The material shall be compacted in 100mm layers to minimum 75% relative density (USBR Earth Manual) and be in contact with the pipe for at least one third of its circumference.

4.5.3 Sand Bedding

Sand bedding shall be used where shown on the drawings or where directed by the Engineer.

The excavation shall be a minimum of 100mm below the underside of the pipe.

The grading shall be such that no more than 5 percent passes No 100 sieve.

The material shall be compacted in 100mm layers. Relative density sand bedding when tested shall be 75% (USBR Earth Manual).

Concrete Bedding

Concrete bedding shall be used as directed by the Engineer.

(a) where the pipe is laid in variable material or partly in fill.
(b) in some shallow conditions not subject to heavy load.

The trench shall be excavated to a minimum of 100mm below the underside of the pipe and the pipe shall be supported while concrete is poured. The cross section of concrete shall be as shown on the drawings.

The concrete shall be 20 MPa at 28 days and 75mm to 100mm slump when poured.

The concrete shall be carefully worked under the pipe from each side.

Construction joints shall be provided in the bedding at joints in the pipes. These joints shall have a key formed in them to allow for transfer of shear forces.

4.5.4 Concrete Surround

Concrete surround shall be used as directed by the Engineer.

(a) where the pipe is laid at excessive depths.

(b) where there is less than 900mm of cover on roads or where heavy loads are expected.

(c) under buildings or where buildings are expected to be built.

The concrete, laying procedure and construction joints shall be as for concrete bedding. The cross section shall be as shown on the drawings.

4.6 BACKFILL MATERIALS

Suitable excavated materials shall be used in backfills as shown on the drawings. Suitable materials shall be free from all deleterious substances such as rock, rubbish, inorganic, perishable or uncompactable material.

When required backfill materials, as shown on the drawings, are not available from excavations, imported gravel backfill shall be obtained from an approved source.

4.7 BACKFILL

Backfill shall not be placed until piping has been bedded and installed as shown on the drawings.

Backfill shall take place immediately after piping has been satisfactorily tested.

All backfill shall conform with the tolerances specified to the lines, grades, sections and elevations shown.

Except as otherwise shown grading tolerances shall be plus or minus 60mm for all exposed surfaces of backfill.

Backfills required for superstructures and foundations shall be placed after all forms have been removed and the concrete has attained at least 60% of the 28-day compressive strength or a minimum period of seven days after placement of concrete has expired.

The backfilling operations shall prevent equipment loads from surcharging foundations on substructures.

All excavations to receive backfill shall be cleaned of all trash and debris.

4.8 PLACING OF BACKFILL

Backfill unless otherwise shown shall be placed in layers, with the aid of mechanical plant, the full width of the trench to finished surface level. Care shall be taken to prevent the dumping of material in the trench.

Layer thickness shall be as follows:

(a) imported gravel backfill - not more than 150mm before compaction.

(b) ordinary backfill - not more than 150mm before hand compaction - not more than 300mm before mechanical compaction.

4.9 COMPACTING

Each layer of backfill shall be compacted as follows:

(a) cohesive backfill material shall be compacted to 90% of Maximum Dry Density except in the area up to 300mm above top of pipe and under all roadways and parking lots where compaction shall be 95% of Maximum Dry Density.

(b) cohesionless backfills shall be compacted to a relative density of 75%.

Special care shall be taken to secure thorough compaction of the materials placed under the haunches of the piping. All backfill below the top of the pipe shall be compacted mechanically.

Backfill below the top of pipes, pits, manholes, inlets or other structures shall be placed and compacted equally along both sides of the structure to prevent strain on or displacement of the structure.

Tests for specified compaction will be by Subcontractor in accordance with the following:

(a) Maximum density at optimum moisture content shall be determined in accordance with USBR Earth Manual.

(b) In place density shall be determined in accordance with the USBR Earth Manual.

(c) Determination of the minimum and maximum dry density of cohesionless material will be by USBR Earth Manual.

(d) Determination of the relative density of cohesionless material will be by USRB Earth Manual.

Where backfill material does not meet the specified compaction, it shall be reworked to achieve the specified density.

4.10 REINSTATEMENT

Where trenches and associated excavations are under metalled or sealed roads, after adequate compaction of lower layers, the top 900mm of backfill shall be approved gravel base course adequately compacted to the Engineer's satisfaction.

Any subsequent subsidence shall be rectified with the addition of extra gravel at the contractor's expense. Where the road is sealed the

reinstatement shall consist of the above work plus the addition of either 50mm minimum asphaltic plant mix or MC3 applied at 1.8/m^2 and spread with 10-15mm aggregate. The surfacing layer will match the existing.

4.11 TESTING OF PIPES & SERVICES PRIOR TO FINAL BACKFILLING

All pipes shall be tested to the heads and service condition required by TECH SPEC 44 - TESTING OF PIPING SYSTEMS prior to covering the pipe.

Electrical cables (both main feed cables and control cables) shall be fully tested for continuity, prior to backfilling.

The requirement for testing of all pipes, services and other utilities shall be considered part of the responsibility of the Contractor & Sub-Contractor responsible for the excavation and installation of the relevant service.

NO BACKFILLING SHALL BE UNDERTAKEN UNTIL WRITTEN APPROVAL OF THE TEST PROCEDURES AND TESTING IS APPROVED BY THE ENGINEER IN WRITING.

5.0 TECH SPEC 5: SUPPLY, FABRICATION & PLACEMENT OF REINFORCEMENT

5.1 GENERAL

This specification defines the requirements for furnishing, fabricating and placing reinforcing steel in reinforced concrete.

5.2 ABBREVIATIONS

The abbreviations listed below, when used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard

5.3 STANDARDS & CODES

Unless otherwise approved or shown, the following Standards and supplements thereof shall apply:

CODE No.	YEAR	TITLE
AS/NZS 4671	2001	Steel Reinforcing Materials
AS 3600	2001	Concrete Structures
NZS 4702	1982	Metal-arc Welding of Grade 300 Reinforcing Bar
AS 3735	2001	Concrete Structures for Retaining Liquids

5.4 MATERIALS

Reinforcing steel and accessories shall be new and shall conform to the following requirements, unless otherwise specified or indicated in the drawings.

Manufacturer's certificates will be required for all reinforcing steel supplied to the site or used in precast items manufactured off site.

Reinforcing bars, both plain and deformed, shall conform to AS/NZS 4671 and shall be Grade 500E for main steel and Grade 300E for stirrups & ties.

Reinforcing bar supports shall be either plastic rebar chairs of approved type (a sample of each type shall be submitted to the Project Engineer for inspection and approval) or shall be concrete biscuits cast on a timber base using 20 MPa

concrete correctly vibrated. Each biscuit shall have soft black steel tie wire cast in to firmly attach the biscuit to the rebar.

Tie-wire shall be 1.626mm (16 SWG) or equivalent black annealed wire.

5.5 FABRICATION

Fabrication of reinforcing steel shall, unless otherwise shown on the drawings, conform to the requirements of AS/NZS 4671.

All bars shall be bent cold and shall not be straightened or rebent in a manner that will injure the material. All bends shall be bent around the correct mandrels of the appropriate diameter for the bar size (see AS/NZS 4671). Bars with kinks or bars with bends not shown on the drawings shall not be used. Heating of bars will not be permitted except where approved in writing. All reinforcing steel as fabricated shall be free from defects, loose mill and rust scale, oil, grease and from dirt or other coatings that destroy or reduce the bond to the concrete.

Steel shall be stacked, both at the fabrication yard before delivery and on site after delivery, on approved racks that keep the bars off the ground, straight and free from sags and bends.

5.6 BUNDLING AND TAGGING

All reinforcing steel shall be bundled and tagged for identification at the jobsite. Tags shall show the steel grade, number of bars in the bundle, the diameter, length and mark number.

Tags shall be furnished of such material and shall be attached to the bundle in such a way that the markings shall not be destroyed by weathering or become detached from the bundle.

5.7 PLACING

Reinforcing steel shall be accurately placed in accordance with the drawings and shall be firmly secured to prevent displacement during the placement of the concrete or when placing other bars. If necessary, use planking or bridging to prevent displacement.

All bar intersections shall be tied with tie-wire and bars shall be supported by bar supports, either metal, plastic or concrete, spaced at sufficiently close intervals to maintain their correct positions but no greater than the following:

a. Beams and columns 160 main bar diameters
b. Walls 130 bar diameters
c. Slabs 100 bar diameters

Where portions of the supports will be exposed on concrete surfaces designated to receive a smooth finish, the supports shall be made of non-corrodible material.

The minimum center-to-center spacing between parallel bars shall be two bar diameters but in no case shall the clear spacing be less than 30mm.

Minimum cover of reinforcing shall be maintained to the dimensions shown on the drawings.

Prior to placement of concrete, all reinforcement shall be inspected and cleaned of all materials that would prevent effective bonding to concrete and to ensure that all supports and ties are in place. Grout coatings on rebar from previously placed concrete shall be removed before attaching additional lengths of reinforcing steel or embedding the reinforcing steel extensions in new concrete.

5.8 SPLICING

When splicing of reinforcing steel is necessary at points other than those indicated on the drawings or when lap-lengths are not dimensioned on the drawings, the splices shall be made by laps as specified herein:

a. In reinforcing bars, laps and splices shall be made in accordance with AS 3600. Unless special conditions apply, the length of straight lap for bars shall be not less than the lengths tabled below:

ALL LAPS SHALL CONFORM TO THIS TABLE UNLESS DETAILED OTHERWISE ON THE DRAWINGS. ALL DIMENSIONS IN MM.

BAR SIZE	ROUND	DEFORMED	ROUND H/T	DEF H/T
6	200	-	-	-
10	520	350	870	580
12	700	470	1050	700
16	930	520	1400	930
20	1200	810	1750	1160

b. Mechanical couplers shall not be used without prior approval by the Project Engineer.

5.9 WELDING OF REINFORCEMENT BARS

Unless detailed on the drawings, the welding of reinforcing bars or mesh shall not be permitted.

5.10 MISCELLANEOUS

Reinforcing steel furnished and fabricated shall include all chairs, bolsters and spacers required to properly secure the reinforcement in place during the placing of the concrete.

Placing reinforcement shall include all labor, transportation and supply required to deliver and stack all reinforcement to job site, to place reinforcement in accordance with drawings and to maintain reinforcement in place during placing of concrete. It shall also include furnishing any tie-wire, supports such as concrete blocks, metal or plastic spacers or chairs and any highchairs or supports for upper face rebar.

6.0 TECH SPEC 6: SUPPLY, FABRICATION & INSTALLATION OF FORMWORK

6.1 GENERAL

This Specification establishes the quality of the materials and workmanship and defines how quality is measured for the construction of the forms to shape, line and dimensions of the concrete sections shown so as to produce mortar tight joints and smooth even faces.

Construct forms of suitable material and as herein after specified. Construct forms to shape, line and dimensions shown on the drawings except where obviously not required, so as to produce mortar tight joints and smooth even faces. All forms shall be trued up immediately before concrete is deposited.

6.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS	New Zealand Specification
AS	Australian Specification
BS	British Specification

6.3 CODES AND STANDARDS

Unless otherwise specified or shown, the current editions and revisions of the following codes, standards, and references to other documents therein, shall apply.

NZS 3109: 1997	Concrete Construction
NZS 3114: 1987	Specification for Concrete Surface Finishes
AS 1509: 1974	Formwork Code

6.4 DESIGN AND CONSTRUCTION REQUIREMENTS

Forms shall be of sufficient rigidity and strength to prevent distortion due to pressure from the concrete, impact loads and all other loads incidental to construction operations including effects of vibration during placing of concrete.

All design loads shall be as shown in AS 1509 Clause 3.3 "Loads". Design forms so that the deflection of sheeting or main members is within the requirements of AS 1509 Clause 3.13 "Deflection Limits".

The design and construction of the formwork shall be such to facilitate the ease of stripping in the manner which assures the complete safety of the structure and precludes damage to the concrete.

Form ties and form accessories to be partly or wholly embedded in the concrete shall be commercially manufactured and to the approval of the Engineer. Wire
Is not acceptable. Construct the formwork so that bolts, form ties and other metal fittings used in formwork erection can be easily removed to a depth of 50mm from the surface of the concrete without injury to it and so that the cavities left by these accessories are of the smallest possible size.

6.5 RE-USE OF FORMS

The re-use of forms will be permitted provided they continue to comply with the requirements of this Specification. Thoroughly clean the surfaces of forms before they are re-used.

6.6 FORM RELEASE AGENTS

Coat the surfaces of all forms with a commercially available form release agent approved by the Engineer. The form release agent shall not adhere to the concrete or impair the adhesion of finishes and care shall be taken to ensure that it does not encounter reinforcing steel, embedded items or construction joints.

6.7 FORMWORK ERECTION

Positive means of adjustment (wedges or jacks) of shores and struts shall be provided, and all settlement shall be taken up during concrete placing operations. The shores and struts shall be securely braced against lateral deflection in both directions.

Formwork for slabs, beams etc. shall be adjusted to offset the estimated settlement and bedding of false work and formwork under the imposition of load from wet concrete and the concreting operations.

6.8 CLEANLINESS OF FORMS

Ensure that, immediately before concreting, all formwork is clean. Temporary openings shall be provided at the base of column and wall forms and at the ends of beam forms and at other points where necessary to facilitate this.

6.9 FAILURE OF FORMWORK

Concreting shall cease if at any time during pouring, settlement, bulging or other defects become apparent in the formwork.

6.10 REMOVAL OF FORMWORK AND STRIKING OF FALSEWORK

Remove formwork and strike false work in such a manner that the concrete is not damaged, or the structure, or any part thereof, over-stressed.

Formwork for beams, slabs and soffits and any other parts that support the weight of the concrete shall remain in place until the concrete has reached 80 percent of its specified 28 day strength.

Notwithstanding the requirements of Clause 10.2, the minimum time for the stripping of formwork shall be as set out in Table 4.2 of AS 1509, part of which is tabulated below:

MEMBER	EFFECTIVE SPAN (metres)	MIN. STRIP TIME (days)
Wall, column, beam side (non-load bearing)	0	2
Wall, column (load bearing)	0	5
Slab	Under 3	7
	3 to 6	10
	Over 6	14
Beam	Under 3	10
	3 to 6	14
	Over 6	21

(Note that table is for average air temperature during curing of 21^{o} C or greater. If colder or warmer than this, refer to the Engineer)

6.11 CONCRETE SURFACE FINISHES

Concrete surface finishes shall be classified in accordance with, and shall comply with, the requirements of NZS 3114: 1980 and the requirements given in the following clauses of this Specification.

Formed Concrete Surface Finish Type F1

This clause refers to the surface finish required on all cast in-situ concrete work which is to be unplastered, exposed to view and for water retaining structures.

Formed Concrete Surface Finish Type F2

This clause refers to the surface finish required on all cast in-situ concrete which is to be unplastered and painted or finished with a thin membrane coating. The surface of the concrete is to be finished dense, smooth and free from honeycombing etc.

Formwork used to produce this surface shall be arranged to form a regular pattern to the approval of the Engineer and all form joints shall be mortar tight.

Surface variations shall be no greater than 3mm gradual variation measured from a 1200mm straight-edge or appropriate profile board. No abrupt surface variation shall be permitted. The formwork shall be erected so that the finished concrete does not deviate from plumb or grade or from a true surface by more than 3mm.

Formed Concrete Surface Finish Type F3

This clause refers to the surface finish required on all cast in-situ concrete work that will be plastered or is not exposed to view. The finished concrete surface shall be dense and reasonably smooth and free from honeycombing. Any material may be used as formwork provided the forms are mortar tight.

Surface variations shall be no greater than 6mm gradual variation measured from a 1200mm straight-edge or appropriate profile board and with no more than 3mm abrupt variation. Concrete surface deviation from plumb or grade or from a true surface by more than 3mm.

Unformed Concrete Surface Finish Type U1

The concrete shall be carefully screeded to the final levels and grade or grades. After the moisture film has disappeared from the surface of the concrete, thoroughly compact the surface with a power compacting machine and float up the surface with a Kelly power float operated by a tradesman skilled in it's use to give a smooth, even, uniform dense finish. Hand trowelling with steel trowels is permitted provided it achieves the same surface finish.

The use of sand or cement (dryers) or water (dampener) is not permitted.

Surface variation shall be no more than 6mm gradual variation measured with a 3000mm straight-edge or profile board anywhere on the slab and no abrupt variation will be permitted.

Unformed Concrete Surface Finish Type U2

The concrete surface shall be uniform, smooth and to correct grades and levels. This finish can be produced by floating the surface with a wooden float after it has been carefully screeded. Surface variation shall be no more than 6mm gradual variation measured from a 1500mm straight-edge or appropriate profile board.

The concrete shall have a screeded finish with an even and uniform surface to grades as shown, to receive topping layers as required.

6.12 REPAIRS TO CONCRETE SURFACES

The Contractor shall repair all imperfections on the concrete surfaces as determined by the Engineer within 24 hours of removal of forms. Method of repairs proposed shall be subject to approval by the Engineer. Moist cure all repairs to concrete surfaces.

She bolts holes or any cavities left by form securing systems shall be filled with a dry mortar and this shall be caulked into the hole. Overfill the hole and dress the surface manually to provide the same surface texture as the rest of the surface.

Repairs to F2 finish shall be by patching mortar which shall have the mix formula determined by trial and error to obtain the same surface texture as the surrounding surface after the patch has been dressed manually.

Repairs to U1, U2 and F3 surfaces shall be carried out as determined by the Engineer, to meet the required tolerances of this Specification.

7.0 TECH SPEC 7: SUPPLY & INSTALLATION OF EMBEDDED ITEMS

7.1 GENERAL

This Specification covers the requirements for the furnishing, fabrication and placement of Anchor Bolts, Embedded Metalwork, etc.

7.2 ABBREVIATIONS

The abbreviations listed below, where used in this specification, shall have the following meanings.

NZS	New Zealand Specification
AS	Australian Specification
BS	British Specification

7.3 CODES AND SPECIFICATIONS

Unless otherwise specified or shown, the current editions of the following codes, standards and references to other documents therein, shall apply:

AS 1111: 1972	ISO Metric Hexagonal Commercial Bolts & Screws
AS 1112: 1972	ISO Metric Hexagonal Nuts, Slotted Nuts and Castle Nuts
AS 1237: 1973	Flat Metal Washers for General Engineering Purposes
AS 1650:	Galvanized Coatings
AS 3000:	SAA Wiring Rules
BS 4254:	Two Part Polysulphide Based Sealants for the Building Industry
NZS 1298: 1978	Flexible PVC Compounds

7.4 ANCHOR BOLTS

All anchor bolts, nuts and washers shall be as shown on the drawings and shall conform to the appropriate New Zealand or Australian Standards.

Anchor bolts shall be set and maintained plumb. Bolts shall be fitted and held in place with Engineer approved templates. Upon the completion of the concrete placing, the Contractor shall check all anchor bolts for correct locations and elevations.

In the event that the allowable placing tolerances are exceeded, the Contractor shall make all such corrections as are necessary in a manner acceptable to the Engineer. At completion of the alignment check and any corrections, the Contractor shall clean out all anchor bolt sleeves (if used), remove concrete from the projecting portion of all anchor bolts, wire brush the threads, thoroughly grease the threads and replace the washers and nuts. If anchor bolt sleeves are larger than the washers, the Contractor shall securely wire the washers to any such bolts.

7.5 GALVANISING

Anchor bolts, nuts, washers and assemblages shall be hot dip galvanized in accordance with AS 1650 and the following provisions.

Average minimum weight of zinc coating shall be 450 gms/sq.m. unless shown or specified otherwise.

Galvanizing procedures shall be such as to avoid distortion of the assemblies. Nuts shall be tapped oversize, after galvanizing, to the minimum diametral amounts specified in AS 1111 and shall be provided with an additional lubricant which shall be clean and dry to the touch. Nuts shall have a loose, free turning fit on the bolt threads after galvanizing.

TABLE 1 GALVANIZING WEIGHTS FOR ENBEDDED ITEMS

Item No.	a. Item	Galvanising Weight	Standard
1.	Holding Down Bolts & Holding Down Bolt Assemblages	450gm/m^2	AS 1650
2.	Fin Plats to support structural items.	600gm/m^2	AS 1650
3.	Kerb angles, sump support frames.	600gm/m^2	AS 1650
4.	Handrail support brackets	450gm/m^2	AS 1650
5.	Puddle Pipes for fixed pipe spools	600gm/m^2	AS 1650

7.6 DELIVERY

Bolts, nuts, washers and assemblages shall be bagged in suitable groupings and shall be securely tagged to indicate point of usage.

7.7 OTHER EMBEDDED ITEMS (OTHER THAN ANCHOR BOLTS)

7.8 Materials

Other embedded items such as kerb angles, pipe sleeves, eyebolts, expansion joints, water stops, grating supports etc. shall be of materials and finishes as detailed on the drawings. Where items are shown as GALVANISED, the coating weight shall be in accordance with Clause 5.0 of this Specification.

Fabrication

Unless otherwise specified, all fabrication shall be in accordance with the drawings and shall conform to the sizes and dimensions shown.

Pipe sleeves shall conform to BS 534 for pipe sizes up to 150mm and shall be fabricated to a length equal to the thickness of the concrete. Pipe sleeves shall have a 6mm thick plate anchor (puddle flange) at approximately the centre point of the sleeve. The minimum diameter of the plate anchor shall be the sleeve OD plus 100mm.

Kerb angles, grating supports, frames, beams and other embedded metal items shall have suitable anchors securely welded at not more than 1000mm centres with an anchor within 150mm of all ends and corners.

All joints, corners and splices shall be welded and exposed surfaces ground flush. All areas of embedded metal shall have all loose scale, rust, oil, grease and encrustations removed before galvanising.

Installation

All embedded sundry items shall be set true to line and level as shown on the drawings. All embedded items shall be securely fastened and braced to prevent displacement during concrete placement. All exposed field welds on kerb angles, frames and other embedded steelwork shall be made and ground flush prior to placing the concrete.

After completion of concrete placement, all embedded items shall have the exposed portions cleaned of concrete, oil or other foreign matter.

7.9 TOLERANCES

All embedded items shall be positioned with an accuracy of plus or minus 3mm in any direction. The item shall be supported securely to maintain this tolerance during the casting of the concrete.

7.10 CONDUITS & PIPES

Embedded conduits & pipes in structural concrete shall be installed in the structural member prior to filling the forms with concrete. Under no circumstance shall chasing out of the structural member to accommodate conduits or pipes be tolerated. All conduits for electrical reticulation to be installed in structural concrete shall be installed in accordance with the latest issue of AS 3000 SAA Wiring Rules and shall also be in accordance with the best practice of the trade.

7.11 EMBEDDED ITEMS - THIS CONTRACT

The following list gives the extent of, but is not limited to, the embedded items under this contract.

a. Fin plates to beam fixings
b. Anchor bolts to all structural members
c. Any other steel items to be embedded at time of concrete pouring

8.0 TECH SPEC 8: MANUFACTURE, PLACEMENT, CURING & TESTING OF CONCRETE

8.1 GENERAL

This Technical Specification establishes the quality of materials and workmanship and defines how quality is measured for the supply, testing, placing and curing of the concrete.

8.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS	-	New Zealand Standard
ASTM	-	American Society for Testing and Materials
AS	-	Australian Standard

8.3 CODES AND STANDARDS

Unless otherwise specified or shown, the current editions and revisions of the following codes, standards and references to other documents therein, shall apply.

NZS 3109 : 1997	Specification for Concrete Construction.
NZS 3113: 1979	Chemical Admixtures for Concrete.
NZS 3121: 1986	Water and Aggregate for Concrete.
NZS 3122: 1995	Portland Cement and blended cements (General and Special Purpose)
AS 1478.1: 2000	Chemical Additives for Concrete, Mortar and Grout
AS/NZS 4200	Pliable Building Membranes and Underlays

8.4 MATERIALS

It shall be the Contractor's responsibility to show that the materials used in the concrete comply with the requirements of the appropriate New Zealand, Australian or other approved Standard.

8.4.1 Cement

Cement shall be ordinary Portland Cement complying with the requirements of NZS 3122:1995. Rapid Hardening Portland Cement shall be used only with the Engineer's written approval. High Alumina Cement shall not be used under this Specification.

8.4.2 Aggregates

Fine and coarse aggregates shall comply with the requirements of NZS 3111 and 3121. The nominal maximum size of coarse aggregate shall not exceed 19mm for normal structural concrete or 10 mm for block filling.

Mixing Water

The mixing water shall be from the nearest public domestic supply or equal and shall be free or organic matter or other deleterious substances. If required, the Contractor shall drink a glass of the water to assure purity.

8.4.3 Additives

Concrete may contain an air entraining agent complying with ASTM C260-69T, and used strictly in accordance with the Manufacturer's instructions to produce a maximum of 4.5% entrained air.

The use of proprietary dispersing and plasticising agents which facilitate concrete placing and the production of the specified concrete surface finishes will be permitted subject to written approval by the Engineer.

8.5 PROPORTIONING CONCRETE

Proportioning of concrete shall be the responsibility of the Contractor. The Contractor shall establish the proportions, including the water-cement ratio and shall submit the mix designs to the Engineer for review prior to the initial manufacture of Concrete.

The specified slump may be changed only with prior consent. Slump shall be adjusted only by changing mix design and not merely by the water content.

Concrete shall be delivered to the placing point in the following grades designated by strength, coarse aggregate size and minimum cement content as shown in TABLE 1:

12 TABLE 1 - CONCRETE GRADE & COMPONENT DESIGNATIONS

Strength Mpa at 28 Days	Min Cement Content kg/m^3	Coarse Aggregate max size mm
20	265 (for salt water 340)	19
25	300	19
30	345	19
35	385	10 (for shotcrete)
17.5	260	19
17.5 (Conc block filling)	260	10

The concrete to be used in various positions on the project shall be as designated in TABLE 2

13 TABLE 2 - STRENGTHS OF CONCRETE REQUIRED IN THE PROJECT

Position of Concrete	Concrete Strength at 28 Days	Slump
Blinding concrete	17.5 MPa	100mm
Foundations to Buildings	30 Mpa	80mm
Pipe bedding	17.5 MPa	100mm
Pipe surrounds	17.5 MPa	100mm
Conc block filling	17.5 MPa	150mm * see note 1
Ordinary Structural Concrete (buildings etc.)	25 MPa	80mm
Floor Slabs	30MPa	80mm

Note 1: Super plasticiser may be used with permission of the Engineer.

8.6 PRODUCTION AND DELIVERY TO SITE OF READY MIXED CONCRETE

Concrete shall be manufactured and supplied to site by an approved and graded member of the Fiji Ready Mixed Concrete Association.

Alternatively the Contractor may establish his own batch plant subject to the Engineer's approval and in conformance to the requirements of the following clauses.

Batching, mixing and the quality control of Ready Mixed Concrete shall conform to NZS 3104: 2003 Concrete Production.

Concrete shall be either plant-mixed or truck-mixed. Plant-mixed concrete shall be transported to the delivery point either in a truck agitator or in a truck mixer operating at agitating speed. Both plant-mixer or truck-mixer plant shall conform to NZS 3104: 2003 Concrete Production.

The rate of hardening of concrete shall be retarded by using an Engineer approved retarding admixture when the average ambient air temperature on the project site during periods of concrete placement exceeds 25^{o}C.

The total elapsed time between the introduction of the cement to the concrete aggregate and depositing the completed mix at the delivery point shall not exceed one hour.

With each load of concrete delivered to the project work site, the Contractor shall submit delivery tickets in triplicate listing the following information:

a. Date
b. Name of ready-mixed concrete plant
c. Job location
d. Contractor
e. Type and brand name of cement
f. Class and specified cement content in kilograms per cubic metre of concrete
g. Type of concrete
h. Truck number
i. Time dispatched and time water introduced
j. Amount of concrete in load in cubic metres
k. Admixtures in concrete, if any specify
l. Maximum size of aggregate
m. Water added at job, if any.

8.7 TESTING AND EVALUATION OF MATERIALS AND CONCRETE

All testing of concrete shall be carried out in accordance with NZS 3112: 1986 Methods of Test for Concrete. All equipment used shall be subject to review by the Engineer.

The Contractor shall be responsible for the carrying out and for the arranging of all testing as specified herein and shall pay all testing costs and incidental expenses attached thereto. Tests on material and compression test specimens shall be carried out by an Authority approved by the Engineer.

The Contractor shall provide and permanently maintain on site in good order, sufficient testing equipment for Slump Cone Testing and the preparations of concrete cylinders for testing.

Concrete samples for slump, compressive strengths and air content tests shall be taken at the point of delivery.

Slump tests shall be taken for each batch of concrete produced and as required by the Engineer and maximum slump allowance shall be consistent with that specified.

The Frequency of Sampling for Compressive Strength Tests shall be in accordance with the following table:

TABLE 3 - FREQUENCY OF SAMPLE

Number of batches per day	Number of Samples
1	1
2 to 5	2
6 to 10	3
11 to 20	4

For each additional 10 batches, one additional sample shall be taken.

From each sample, three cylinders shall be made, one shall be crushed at 7 days and one at 28 days; the third to be kept in reserve for check testing to the Engineer's order.

Test cylinders shall be prepared by the Contractor at the site and shall be cured in standard laboratory conditions as provided by the Contractor complying with NZS 3112: 1974 and to the satisfaction of the Engineer.

The Engineer may direct that test cylinders be site cured in lieu of laboratory curing in order to determine stripping times.

Results of all tests shall be documented and submitted to the Engineer on the day of execution or within 24 hours of execution.

All technicians and workmen engaged on the operations of equipment by the Contractor for the testing of concrete shall be trained and experienced and shall be supervised by a qualified engineer, experienced in the taking of samples and laboratory techniques.

Concrete shall be suspect if the results of the seven (7) day tests of the laboratory cured cylinders indicate that the strength will be less than that specified in the tables of Section 5.3 of this Specification.

The Statistical appreciation of NZS 3109 :1997 shall be used to determine confirmation.

Should the tests show that the specified strengths have not been attained, the Engineer may direct the Contractor not to place any further concrete above the suspect concrete until the results of the twenty eight (28) day tests are known.

8.8 REJECTION OF FAULTY CONCRETE

Should the result of any twenty eight (28) day test on standard laboratory cured test cylinders indicate that concrete had failed to reach it's specified strength, the Engineer shall require the concrete covered by this particular test to be cut out and removed from the site and the work made good at the Contractor's expense.

Hardened concrete deemed not to comply may be further tested for compressive strength by an approved method of core sampling. The point from which the cores are taken shall be at the discretion of the Engineer and shall be representative of the whole of the concrete concerned, but in no case shall fewer than three cores to be tested.
All cores shall be tested dry unless the concrete concerned is more than superficially wet in service.

8.4

Should these test cores indicate the specified strength has not been achieved, the Engineer shall require the concrete be cut out and removed from site and the work made good at the Contractor's expense.

Should hardened concrete meet with specified strength criteria but in the opinion of the Engineer be insufficiently compacted or segregated during placing or fails to meet the specified surface finish, the concrete shall be replaced in accordance with this Specification.

8.9 HANDLING AND PLACING CONCRETE

A minimum of 24 hours prior notice shall be required from the Contractor before forms and reinforcing etc. will be inspected by the Engineer and approved for concreting. “A CONCRETE POUR SHEET” shown as *Appendix 1* is added to this Tech Spec for the information of the Contractor.

A concrete placing schedule showing the number, size and sequence of placements proposed shall be prepared and shall be subject to approval prior to starting concrete work.

Concrete for slabs shall be placed in a checkerboard pattern unless otherwise approved.

Prior to starting any concrete work, all equipment surfaces that will be in contact with fresh concrete shall be satisfactorily cleaned.

An approved means of communicating with the ready-mixed concrete supplier during placing operations shall be provided before starting any concrete placing.

The piping arrangements for pumping or pneumatic conveying of concrete shall not have branch lines unless a valve is provided at the branch point which will direct the flow into only one branch at a time.

Concrete may be placed during rain provided satisfactory protection is furnished to prevent rainwater from increasing mixing water or damaging fresh concrete surfaces.

Water shall be removed from excavations or forms before concrete is deposited, unless otherwise approved. Any flow of water into an excavation shall be diverted through proper side drains to a sump, or be removed by other approved methods which will avoid washing the freshly deposited concrete.

Concrete shall not be dropped through dense reinforcing steel which might cause segregation of the coarse aggregate. In such cases, spouts, flexible drop chutes or other satisfactory means shall be employed. In any event, concrete shall not be dropped free through a height of more than 2 metres unless otherwise approved.

Concrete shall be placed in EVEN HORIZONTAL LAYERS not exceeding 300 mm in thickness except where expressly permitted by the Engineer. Thoroughly compact each layer as specified below before placing further concrete. Place and compact each layer of concrete before the preceding layer has taken its initial set. If the preceding layer of concrete has taken it initial set, then further placing shall cease until the placed concrete is set. The Contractor shall then form, at his own expense, a construction joint.

Concrete shall not be allowed or caused to flow laterally a distance of more than 1.5 m from point of deposit.

Concrete which has not reached it's final position in forms within 15 minutes after discharge from the mixer or agitator truck shall be removed from the site.

Generally the placing of concrete to finished surface levels for vertical members, such as walls and columns shall be placed to a level approximately 25 mm above the soffit of the deepest beams, girders, tops of walls, or other superimposed construction and then struck off to true level after settlement has taken place. For construction joints to vertical members refer to clause 12.2 of this Specification.

Concrete shall be consolidated by mechanical vibrators. The vibrators shall be internal type and shall at all times be adequate in number of units and power of each unit to properly consolidate all concrete. The duration of vibration shall be limited to the time necessary to produce satisfactory consolidation without causing objectionable segregation. In consolidating each layer of concrete the vibrator shall be operated in a near vertical position and the vibrating head shall be allowed to penetrate under the action of its own weight and revibrate the concrete in the upper portion of the underlying layer.

Neither form nor surface vibrators shall be used unless specifically approved. Vibrators shall not be used to move or spread concrete. A ratio of not less than one spare vibrator in good working condition to each three vibrators required for satisfactory vibration of the concrete being placed shall be kept available for immediate use at the point of placing.

Auxiliary power to provide continuity of vibration in case of power failure from the principal sources shall be provided. Experienced and competent operators shall be provided for each vibrator being used.

Should the interval of time between the completion of the placing of one batch of concrete and the commencement of placing of a subsequent batch be greater than 60 minutes, then concrete placing shall cease. Should concrete have taken it's initial set or because the time between placing of adjacent batches has exceeded 60 minutes, then the Contractor shall form at his own expense, a construction joint as specified below.

Formwork shall not be jarred or strained after concrete has taken its initial set. Projecting reinforcement is to be securely braced so that movement is prevented.

Prevent spilling or splashing mortar on to reinforcing steel or boxing where it will become dry before being covered with concrete.

8.10 PROTECTION AGAINST WEATHER

In hot weather protect the concrete from the direct rays of the sun and from drying winds.

Concreting of beams and walls will be permitted when rain is falling provided that rainwater does not collect on the surfaces of fresh concrete either in the forms or during handling. Protect the top surface of the work against damage by rain.

Concreting of slabs shall not commence when rain is falling or threatening. Should rain commence during a pour, the Contractor shall adequately protect the work against damage, and provide shelter so that all finishing operations may be completed in the dry.

8.11 CURING OF IN-SITU CONCRETE

All in situ concrete shall be moist cured. Membrane curing compounds will not be permitted, unless there is no surface finish to be applied to the concrete and then the Engineer's approval is required.

After concrete has set sufficiently, all boxing and exposed surfaces shall be kept continuously moist for a period of at least 7 days with approved mist water sprays, lawn sprinklers etc. Hessian sheets and sand will not be approved.

8.12 JOINTS

Construction joints shall be located as shown on the drawings. Where construction joint locations are not shown, the Contractor shall obtain the prior written consent of the Engineer of proposed pouring sequence and joint locations.

Generally, construction joints, unless otherwise shown, shall be located at the 1/4 span point of the span and so that pours do not exceed 10 metres in either direction for beams and slabs.

Joints in columns and walls shall be at a point 25 mm above beam and slab soffits.

Vertical lifts of concrete shall not be less than 75 mm and shall not exceed 3000 mm unless approved by the Engineer.

Preparation of Construction Joints

The surface of the fresh concrete of horizontal and vertical construction joints shall be cut with either a high velocity air/water jet or an approved surface retarding agent to remove the laitance and to expose the larger aggregate. No undercutting will be permitted. The surface shall be protected from contamination after cutting.

The larger aggregate of vertical construction joints shall be exposed by coating the stop and before concreting with an approved surface retarding agent. Boxing shall be removed as soon as practicable after concrete has set hard and the retarded surface layer cut off. Ensure that all traces of retarder are removed from the joint.

Construction joints shall be kept continuously wet for 24 hours preceding the placing of fresh concrete.

All reinforcement shall be continued across the construction joints unless shown otherwise. Dowels at construction joints shall be as shown on the drawings.

Location and size of waterstops shall be as shown on the drawings. Installation shall be in accordance with the Manufacturer's recommendations.

Cleanliness

At the time of concreting, the joints shall be free of all foreign material, ie. sawdust, shavings, nails, tie wire, etc.

8.13 CONCRETE SURFACE FINISHES

TABLE 4 - SURFACE FINISHES

FLOOR AREAS	U1 (Lightly Broomed)
Floor areas to receive special surfaces	U2
Concrete exposed to view above ground floor level	F1

Concrete below ground floor level exposed to view	F2
Concrete foundations not exposed	F3
Concrete to be plastered	F3

Surface finishes and locations shall be as shown in Table 4.

8.14 FOUNDATION INSPECTION

Before any foundation concrete is poured, the Contractor shall ensure that the foundation has been inspected and approved by the Engineer.

8.15 BLINDING CONCRETE

Whenever the footing base cannot be maintained in a firm condition as established by the Engineer, the Contractor shall lay blinding concrete to a minimum thickness of 50 mm and screeded to the correct level.

In general, footings and slabs on grade will be cast without the use of blinding concrete, unless specifically required on the drawings.

8.16 GROUTING OF BASES AND BEARING PLATES

Machine and equipment bases, structural bearing places and other items requiring grout as shown shall be grouted after setting and levelling by others has been completed.

The concrete surface under the base or bearing plate shall be brought to the level shown and given a scratched finish.

Prior to the base or bearing plate being set, all defective concrete and laitance shall be removed from the concrete surface to be grouted by chipping or other approved means.

The resulting surface shall be rough and free of oil, grease, dirt and loose particles.

Temporary shims or wedges which are designated to be removed after grout has hardened shall be coated with a thin coat of grease to facilitate removal.

Prior to beginning grouting, the concrete surface shall be saturated with water for a minimum of 6 hours. Just before grouting, all free water shall be removed from the surfaces, keys and sleeves which are to be grouted.

Grouting procedures shall be placement of grout under entire surface of base or bearing plate and avoiding any possibility of air pockets or voids by sufficient compaction. Grouting procedures shall be subject to approval.

Grout shall be either standard cement-sand grout or non-shrink grout as specified and or detailed on the drawings.

Standard cement-sand grout shall be composed of one part Portland cement and two parts of well-graded concrete sand by volume, thoroughly mixed with just sufficient water to produce a mix that can be placed by hand. Freshly placed grout shall be protected and cured in the same manner as concrete in accordance with the provisions in Clause 11.0 hereinbefore.

Non-shrink grout shall be pre-mixed product of approved, standard manufacture or job mixed grout utilising an approved, expanding-type aggregate of standard manufacture.

Grout shall be mixed, placed and cured in accordance with the grout or aggregate manufacturer's instructions. Grout shall be non-staining and shall be suitable for the intended purpose.

8.17 MEMBRANE

All slabs on grade unless noted otherwise on the drawings shall require a waterproof membrane at the interface of concrete and compacted surface.

The membrane shall comprise of a black, high impact Polyethylene film manufactured in accordance with AS/NZS 4200.

The membrane laps and any tears shall be sealed with pressure sensitive tape approved by the film manufacturer.

8.18 LAYOUT OF THE WORK

The Contractor shall employ a Registered Surveyor to lay out his work from the base lines and bench marks, and shall be solely responsible for the location and accuracy of his construction. The following layout tolerances shall be used during construction of the plant facilities.

Tolerances for concrete work shall be in accordance with Table 5

TABLE 5 - TOLERANCES FOR CONCRETE WORK

ITEM	HORIZONTAL	VERTICAL
Concrete forms	± 3.0mm	± 3.0mm
Concrete Pedestals	± 3.0mm	± 6.0mm
Earthwork	± 30.0mm	± 30.0mm

Slab Subgrades	± 9.0mm	± 9.0mm
Slab Screed Boards	± 9.0mm	± 3.0mm
Piping, above ground	± 6.0mm	± 6.0mm
Piping, under ground	± 6.0mm	± 6.0mm
Precast concrete column and centre plate	± 6.0mm	± 6.0mm
Anchor Bolts		
Bolts less than 25mm diameter	± 3.0mm	± 6.0mm
Bolts greater than 25mm diameter	± 4.5mm	± 6.0mm

9.0 TECH SPEC 10: FABRICATION OF STRUCTURAL STEEL

9.1 GENERAL

This Specification establishes the quality of materials and workmanship and defines how quality is measured for furnishing, detailing, fabricating, and delivery of structural steel. It applies to structural steel and platework for structures, buildings and facilities.

9.2 ABBREVIATIONS

The abbreviations listed below, where used in these Specifications shall have the following meanings:-

N.Z.S.	New Zealand Standard
B.S.	British Standard
A.S.	Australian Standard
S.A.A.	Standards Association of Australia
A.I.S.C	Australian Institute of Steel Construction

9.3 CODES AND STANDARDS

Unless otherwise specified or shown, the current editions of the following codes and standards and others referenced therein shall apply to the extent indicated herein.

NZS 1900	Chapter 9.4 1977 "Steel"
NZS 1083-1965	"Steel Tubes for Mechanical, Structural Welders".
NZS 3404-1977	"Code for Design of Steel Structures (with commentary)".
BS 4360-1972	"Weldable Structural Steels".
BS 5135-1974	"Metal Arc Welding of Carbon and Carbon Manganese Steels".
BS 639-1976	"Covered Electrodes for the Manual Metal Arc Welding of Carbon and Carbon Manganese Steels".
BS 4397-1969	"Methods for Magnetic Particle Testing of Welds".

BS	638-1966	"Arc Welding Plant Equipment and Accessories".
BS	729-1971	"Hot Dip Galvanised Coatings on Iron and Steel Articles."
BS	499-1965	"Welding Terms and Symbols".
BS	2600	"Methods for radiographic examination of fusion welded butt joints in steel".
BS	638-1966	"Arc welding plant equipment and Accessories".
BS	4416-1969	"Method for penetrate testing of welded or brazed joints in metals".
AS	2207-1979	"Methods for Ultrasonic testing of Fusion Welded Joints in Steel".
NZS	3404-1992	" Steel Structures Standard"
AS	1111-1972	"ISO Metric Hexagon Commercial Bolts and Screws".
AS	1204-1972	"Structural Steels - Ordinary Weldable Grades (metric units)".
AS	1252-1973	"General Grade High-strength Steel Bolts with associated Nuts and Washers for Structural Engineering (ISO metric Series)
AS	1275-1972	"Metric Screw Threads for Fasteners".
AS	1112-1972	"ISO Metric Hexagon nuts, including thin nuts, slotted nuts".
AS	1237-1973	"Flat Metal Washers for General Engineering Purposes".
AS	1554-1974	"Rules for the Design and Application of Metal Arc Welding in Steel Building Construction".

9.4 MATERIALS

Structural steel and connection material shall be as defined in the appropriate standards referenced in Section 11 of this Specification and as shown on the drawings.

Certified copies of all mill test reports covering the chemical analysis and physical properties of the steel used in this work, as described in the relevant specifications referenced above, shall be submitted to the Engineer with the deliveries of fabricated members to jobsite.

9.5 CONNECTIONS

Connections shall be detailed for shop welding and field bolting using high strength friction grip bolts, unless otherwise shown or specified. Bolting procedures with design of connection strength shall be to AS 1511. High strength bolts shall be Grade 8.8 to AS 1552.

Commercial bolts ("black bolts") shall be used for field connections of grits, purlins, door and window framing and where designated, unless otherwise shown on the drawings. Strength grade of bolts shall be grade 4.6 to AS 1111.

All bolts, nuts and washers shall be galvanised where a paint system is specified by Technical Specification 22.

Field welded connections shall be provided as shown and shall be detailed for downhand welding unless unavoidable.

The tightening procedures shall be designated on the drawings by:

S = Snug
T = 1/2 Turn of Nut

The Faying face shall be designated by:

B = Bearing
F = Friction

9.6 HIGH-STRENGTH BOLTING

The design, installation and inspection of high-strength bolted joints shall be in accordance with AS 1511 and the following provisions.

The mode of action of the bolts, shall be friction type unless otherwise stated on the drawings.

Bolts shall be tightened by the "part turn of nut" method unless otherwise specified.

9.7 WELDING

9.7.1 General

All welding shall generally conform to the requirements of BS 5135 and BS 639, subject to the special requirements and provisions noted on the Drawings and in this Specification.

Welders
All welding shall be carried out by welders who are fully qualified and experienced. Qualification tests for manual metal arc welders shall be in accordance with NZ 4711. The Engineer will conduct initial acceptance tests on all welders and welding procedures. These acceptance tests may also be conducted by the Engineer periodically at intervals on all welders to ensure the quality of their workmanship on the actual works.

Both the initial acceptance test and the continuing periodic tests will be on test specimens similar to actual weldments and in similar positions as are to be carried out on the works. The nature of tests and acceptance or otherwise of the welders shall be entirely at the discretion of the Engineer.

Welders who have failed a repeat acceptance test shall not be permitte to weld. Welders who fail any periodic tests shall be given another test as soon as practicable, and shall be deployed on welding only after passing such a retest.

All labour and material costs for these tests shall be borne by the Contractor.

Welding Procedures
All welding procedures shall be the responsibility of the Contractor and shall be such as to minimise distortion or restraint. When required by the Engineer, the Contractor shall submit for review details of one or all welding procedures.

Pre-Heating
Pre-heating shall be carried out per BS 5135, and when the following conditions exist:

(a) Temperature of the parent metal is at or below 10^{o}C.
(b) All repairs.
(c) Any incomplete weld which has been allowed to cool.

For typical weldments the Contractor shall be required to carry out a qualification procedure on test pieces cut from the representative material to be used in the actual construction; this testing shall be at the Contractor's expense.

All welding shall be carried out in positions as close as practicable to the actual positions to be used in construction. Except where unavoidable, the "vertical position" shall not be permitted.

Acceptance of any procedure by the Engineer shall not relieve the Contractor of his responsibility for all the suitability of such welding

procedure and for the satisfactory execution of the work.

Transverse welds to form members of the required length shall be complete penetration butt welds.

9.7.2 Weld Quality

All welds shall be continuous unless shown otherwise on drawings and there shall be thorough fusion between weld metal and base metal between successive passes in the weld. All craters shall be filled to the full cross section of the weld. Undercutting is to be avoided.

Arc strikes outside the area of permanent welds shall be avoided. Crack or blemishes resulting from arc strikes shall be ground to a smooth contour and checked to ensure soundness.

Additional weld metal to compensate for deficiency in size of weld shall be deposited using an electrode preferably smaller than that used in making the original weld and preferably not more than 6 mm in diameter. The surfaces shall be thoroughly cleaned before welding.

9.7.3 Weld Testing

The Engineer will employ a supplier quality surveillance representative (hereinafter SQR) to carry out inspection of the welding. The name of the SQR to inspect the welding will be communicated to the Contractor. It shall be warranted by the Contractor that the SQR's decisions on weld qualities shall be binding upon him. The Contractor shall give all necessary assistance to such SQR to carry out their work of inspecting the welds.

The SQR will carry out visual examinations of the welding in progress and observe either radiographic examination in accordance with BS 2600 or ultrasonic testing in accordance with AS 2207, or magnetic particle testing in accordance with BS 4397 on completed works at random.

Such random examination could be as high as 5% of the total welding required to be carried out. However the SQR may vary the extent of examination when, in his opinion, the rejection rate becomes high.

In the case of failure of a test, the Engineer reserves the right to reject the whole member or assemblage or order such remedial measure to the Engineer's satisfaction. Where such remedial measures are ordered, a retest of the new welding shall be carried out. The Contractor shall be liable for the cost of all retests necessitated on account of the initial weld failing to pass the test. the Contractor shall also be liable for section lengths and welding required to replace a rejected member or assemblage on account of failure to pass the weld test and compliance with BS 5135.

Notwithstanding the random testing of welds and acceptance by the Engineer the Contractor shall be responsible for all defects in welding at any later date prior to the completion of the works and shall take necessary remedial action including replacement of any rejected member or assemblage which shall be at the cost of the Contractor and in compliance with BS 5135.

9.7.4 Welding Electrodes and Welding Plant

In addition to the requirements of BS 5135 and BS 639 low hydrogen electrodes shall be kept in their sealed packets until the time of actual welding.

Immediately after opening a new pack of electrodes they shall be transferred into a portable drying oven where they shall be kept at the temperature recommended by the Manufacturer.

Electrodes which have been exposed to weather and especially to atmospheric moisture’s shall be discarded.

9.7.5 General Procedure Prior to Start of Welding

In order to facilitate proper identification of members and/or asssemblages and assist in the testing and control of weld quality as specified in the preceding sections, the Contractor shall weld on to each member and/or assemblage an identifying numerical character of sufficient size which will be visible after painting for site erections. The Contractor shall provide the Engineer and the Welding Inspector a layout drawing indicating the location of the members and/or assemblages in his yard and his welding schedule.

Welding on any part of any crane runway beams and associated fittings is prohibited unless the location is approved in writing by the Engineer.

9.7.6 Testing Personnel

All radiographic, ultrasonic and magnetic particle testing shall be carried out by the Engineer's appointed authorities.

9.8 DETAILING AND FABRICATION

Unless otherwise specified or shown, fabrication of structural steel shall confirm to the requirements of AS 1250 and as stated below.

Before marking-off, steel entering the shop shall be checked for size and straightness and any distorted material corrected by mechanical means which will avoid damage to the steel.

Cambering of rolled steel member shall be achieved by mechanical means used in straightening or bending operations.

Cutting of steel shall be by shearing, cropping, sanding or flame cutting. The cut edges shall be free from burrs, gouges and other defects which would aversely affect the serviceability of the member. Any stress-raising notches must be removed. Re-entrant corners shall be notch free and suitably radiused to a minimum of 12 mm.

Holing shall be by drilling. Punching or flame cutting of a bolt hole shall not be permitted.

The Contractor shall supply mark plans and elevations clearly showing all members and member bearing on individual identification mark or marks (see 11.0 - Marking, below).

All working points, as indicated, shall be adhered to in the design and detailing of the work which shall generally conform with the recommendations of the Australian Institute of Steel Construction as given in their publication Standardised Structural Connections Parts A and B.

All members shall be prefabricated into sub-assemblies to facilitate field erection. Structures and components such as trusses, combined columns and beams shall be shop fabricated so as to form sub-assemblies of the largest practical size suitable for transpiration, handling and erection. The maximum size suitable for the sub-assembly shall be subject to approval.

Substitutions of structural steel sections or modifications of design details shall be made only when approved.

Holes shall be provided to suit future work and equipment mounting, where shown.

9.9 PLATEWORK

Platework shall be carried out to the highest standards ordinarily practised in the industry.

All plates shall be formed accurately to the proportions shown in the detail drawings either by roll-forming, spinning or break-pressing as appropriate.

9.10 TOLERANCES

The minimum dimensional accuracy required on structural members shall be as specified in AS 1250 and as tabled below:

Straightness

(a)	Struts	L/1000
(b)	Plates	b/200
(c)	Tubes	L/600

Limit for Twist

(a)	Box girders and heavy columns	L/1500
(b)	Other	L/1000

Where L is the length between effective lateral supports.

Length

The length of a member shall not deviate from the specified length by more than:

(a) Strut finished for full contact bearing	+ 1mm
(b) Any other member	
9000 mm long and under	+0 -3 mm
over 9000 mm long	+0 -5 mm

Camber

The deviation from a specified dimension of camber shall not be more than L/500 where camber is measured with the member flat on the floor with the web horizontal.

9.10.1 End of Members

For Beam to Beam and Beam to Column Connections where the abutting part are to be joined by butt welds, a reasonable deviation from the squareness of the ends shall be no greater than:

Beams 800 mm deep and under	2 mm
Beams over 800 mm deep	1 mm per 400 mm of depth to a maximum of 3 mm.

Where abutting parts are to be joined by bolting through cleats or end plates, the connections require the following maximum deviations:

Beams 800 mm deep and under	1 mm
Beams over 800 mm deep	1 mm per 800 mm of depth to a maximum of 2 mm.

9.10.2 Butt Joints

Where two abutting ends of a column are aligned to 1 in 1000 or columns are in contact with slab bases or cap plate, which have been designed for contact bearing, the following conditions must be met:

(a) Over 60% of the bearing surface, the clearance between the surfaces shall not exceed 0.25 mm.

(b) Over the remainder of the surface the measurable gap between the surfaces shall not exceed 0.50 mm.

Gusset plates, angles or channels which may be attached to the ends of columns shall be so made and assembled to ensure that the maximum amount needed to be machined from the end to provide a common finished bearing face does not exceed 2 mm.

Web stiffeners designed for full bearing shall have at least half of the stiffener in positive contact with the flange. The remainder of the contact face shall have a maximum gap of 0.25 mm.

9.10.3 Built-up Members

(a) When plates are stripped for built-up members, the overall deviation from the specified overall depth shall be:

For depths of 900 mm and under	±3 mm
For depths of 900 mm up to 1800 mm	±5 mm
For depths over 1800 mm	+8 mm -5 mm

(b) For Web Plates the allowable deviations from flatness in girder web plates given by AS 1250 shall be b/200.

Where b is the lesser dimension of the web panel.

(c) The combined tilt and warp of flange plates shall not exceed 1200 of the total width of the flange or 3 mm whichever is the smaller.

9.11 MARKING

Before shipment, all pieces shall be marked clearly with paint or substantial tags indicating the piece number and such other information as is required for ready identification. Long members shall be marked at both ends and at approximately 6 m intervals.

Marks shall not be cut into the steel surface. Marking shall permit overcoating with paint without the marks bleeding or showing through the paintwork.

9.12 DELIVERY TO SITE

All structural steel work shall be delivered to site by the supply/fabrication Contractor in a condition conforming to the requirements of this Technical

Specification.

Responsibility for steel work shall remain with the supply/fabrication Contractor until inspected and accepted on site by the Engineer.

Notwithstanding such acceptance by the Engineer from the supply/fabrication Contractor, the latter is not relieved in any way from his contractual responsibility for the accuracy of manufacture of all items.

9.13 SHEAR CONNECTORS

Flash welded studs shall be used where shown for shear connectors.

Steel used shall have a yield stress of not less than 300MPa and an ultimate tensile strength of not less than 500MPa, and is to be suitable for welding. The properties mentioned are those pertaining to the steel after manufacture of the stud.

9.14 GALVANISING

Structural steel which is designated as "galvanised" shall be hot-dipped galvanised after fabrication in accordance with BS 729. Thickness shall be in accordance with the requirements of Specification 7.

9.15 PAINTING

Painting of structural steel where required shall be in accordance with the painting schedule and requirements of Specification 22 – Painting

10.0 TECH SPEC 11: STRUCTURAL STEEL (ERECTION)

10.1 GENERAL

This Specification establishes the quality of materials and workmanship and defines how quality is measured for the manufacture and delivery to the fabricator of structural steel.

10.2 ABBREVIATIONS

The abbreviations listed below, where used below have the following meanings:

NZS New Zealand Standard
BS British Standard
AS Australian Standard

10.3 CODES AND STANDARDS

Unless otherwise specified or shown, the current editions of the following codes and standards and other references therein shall apply to the extend indicated herein.

NZS	3404 : 1992	Code for Design of Steel Structures
BS	4360 : 1972	Weldable Structural Steels
AS	1204 : 1972	Weldable grades (metric units).
AS	1252 : 1252	General Grade High Strength Steel bolts with associated Nuts & Washers

10.4 MATERIALS

All material shall conform to the requirements of BS4360: Grade 43A. The maximum allowable carbon content equivalent for steel shall be 0.41.

Alternatively material supplied may conform to the requirements of AS1204: 1972: Grade 250.

Certified copies of all mill test reports covering the chemical analysis and physical properties of the steel shall be submitted to the Engineer with the delivery of steel members and plates.

10.5 MARKING

Before shipment, all pieces shall be marked clearly with paint or substantial tags indicating the piece number and other such information as is required for

ready identification. Long members shall be marked at both ends and at approximately 6m intervals.

Marks shall not be cut into the steel surface. Marking shall permit overcoating with paint without the marks bleeding or showing through the paintwork.

10.6 HANDLING AND TRANSPORTATION

All members shall be handled in such a manner that no damage is caused to them at any stage. Any damage during transport or handling will be rejected by the Engineer. On such rejection by the Engineer the Contractor, at his cost, shall provide a new member to replace the damaged member.

When stored, members shall be fully supported to prevent permanent deformation.

10.7 QUALITY SURVEILLANCE

Mill test reports and quality surveillance actions planned for structural steel shall be in accordance with the contractors submittal made with the bid.

10.8 ERECTION & ERECTION TOLERANCES

All components shall be erected true to line & level and shall be positioned with a dimensional accuracy in accordance with Clause 15.3 of NZS 3404: 1992 Part 1.

10.9 BOLT TENSIONS

Table 1 - Minimum Bolts Tensions gives the minimum tensions that shall be applied to all bolts of Grade 8.8.

Table 1 - MINIMUM BOLT TENSIONS, GRADE 8.8 BOLTS

Normal diam of Bolt	Bolt Tensions, kN
M16	95
M20	145
M24	210
M30	335
M36	490

Where the drawings indicate that Grade 4.6 bolts are to be used they shall be tightened to “snug tight” condition.

10.10 GROUTING UNDER BASE PLATES

Machine and equipment bases, structural bearing places and other items requiring grout as shown shall be grouted after setting and levelling by others has been completed.

The concrete surface under the base or bearing plate shall be brought to the level shown and given a scratched finish.

Prior to the base or bearing plate being set, all defective concrete and laitance shall be removed from the concrete surface to be grouted by chipping or other approved means.

The resulting surface shall be rough and free of oil, grease, dirt and loose particles.

Temporary shims or wedges which are designated to be removed after grout has hardened shall be coated with a thin coat of grease to facilitate removal.

Prior to beginning grouting, the concrete surface shall be saturated with water for a minimum of 6 hours. Just before grouting, all free water shall be removed from the surfaces, keys and sleeves which are to be grouted.

Grouting procedures shall be placement of grout under entire surface of base or bearing plate and avoiding any possibility of air pockets or voids by sufficient compaction. Grouting procedures shall be subject to approval.

Grout shall be either standard cement-sand grout or non-shrink grout as specified and or detailed on the drawings.

Standard cement-sand grout shall be composed of one part Portland cement and two parts of well-graded concrete sand by volume, thoroughly mixed with just sufficient water to produce a mix that can be placed by hand. Freshly placed grout shall be protected and cured in the same manner as concrete in accordance with the provisions in Clause 11.0 here-in-before.

Non-shrink grout shall be pre-mixed product of approved, standard manufacture or job mixed grout utilising an approved, expanding-type aggregate of standard manufacture.

Grout shall be mixed, placed and cured in accordance with the grout or aggregate manufacturer's instructions. Grout shall be non-staining and shall be suitable for the intended purpose.

10.11 TEMPORARY BRACING

All the supply, install and maintenance all temporary bracing, struc, turfers, wire ropes, come-along etc. necessary to ensure that items are maintained in their correct positions while erection is continuing and that any wind, seismic, shock etc. loads shall not cause partial or complete collapse of the partly erected structure.

10.12 INSTALLATION OF PERMANENT BRACING

Permanent bracing shall be installed in a “no preload” condition, that is, no heat to expand or cooling to shrink shall be permitted. Bracing must NOT be force fitted, nor shall drifts be used to align bolt holes beyond ▯ of bolt diameter.

11.0 TECH SPEC 13: STRUCTURAL BLOCKWORK

11.1 SCOPE OF WORK

This specification covers the Supply of all materials, delivery, storage and fabrication of these to form the structural walls as shown on the drawings.

11.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

11.3 CODES AND STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

11.4 BLOCKWORK

11.4.1 QUALITY OF BLOCKS

All structural blockwork shall be from 200mm, 150mm concrete blocks (where shown on drawings) and non-structural walls of 100mm concrete blocks laid in running bond. Blocks shall be Grade A and shall be selected to ensure that blocks are free of defects such as chipped corners, dimensional intolerance etc.

It shall be clearly understood that inside and outside of the buildings will be plastered and painted.

11.4.2 LAYING OF BLOCKS

Blockwork shall be fair-face finished inside and outside. Blocks shall be laid by experienced tradesmen. Horizontal joints shall be truly horizontal and perpends vertical. Perpends on alternate courses shall be in line.

At door and window openings, use plain ended blocks.

Reinforcing to walls shall be as follows:

Vertical reinf	-	At every intersection.
	-	Beside all doors and windows.
	-	At every 600mm between the above.
Horizontal reinf	-	Bond beam at every 3rd course and lintels to doors and windows.
	-	Bond beams at top of wall.

Walls shall be constructed vertically and true to plane with a maximum variation in plane of 3mm when measured on a 3000 straight edge. No sudden discontinuity greater than 3mm will be accepted.

11.5 MORTAR

Mortar for blocks shall be standard mortar in accordance with NZS 3103:1991 and shall have correct proportions of sands, cement and lime. Lime may be replaced by a plasticiser of approved manufacture used strictly in accordance with the Manufacturer's instructions.

11.6 JOINTS

Mortar must be trowelled to give full mortar bed on each face including ends. Horizontal and vertical joints shall be maintained at 10mm, plus or minus 1mm. All joints, horizontal and vertical, shall be tooled with a 16mm dia tool to give a slightly concave surface.

11.7 DOORS & WINDOWS

In general, door and window frames shall be placed after completion of the blockwork but where these items are to be built-in they shall be set-out and fixed by the Carpenter. Frames MUST be protected from damage during subsequent operations by block layer.

11.8 CUTTING OF BLOCKWORK

When blocks are to be cut, a mechanical masonry saw shall be used. Cuts shall be neat and square to inner section of the block and shall be free of spalled or chipped edges. Cut-outs for electrical flushboxes etc. shall be neatly cut to the correct size and shape.

11.9 SERVICES IN BLOCKWORK

Under no circumstances shall blockwork be chased to accommodate electrical conduits, water pipes or drainage pipes.

Block layer shall allow to attend upon, and give notice to, the relevant trades to allow the installation and testing of services before filling. Allow to take special care when placing block fill to avoid damage to any services in the block walls.

11.10 COMPLETION

Following completion of all blockwork, blockfill etc, allow to rub down entire area of block walls, internal and external, with a carborundum stone to remove all

12.0 TECH SPEC 14A: STRUCTURAL TIMBER

12.1 SCOPE OF WORK

This specification covers the supply and fixing of all structural framing including beams, joists, purlins etc.

12.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

See also Clause 2.17 of Special Conditions of Contract.

12.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

12.4 STRUCTURALTIMBER - CARPENTRY

12.5 TIMBER GRADES & SIZES

MEMBER	CALL SIZE	GAUGED SIZE	TIMBER GRADE	MAX MOISTURE CONTENT
Rafters	200 x 50			24%
Purlins	100x50			24%
Beams 1				18%
Beams 2				18%

12.5.1 FRAMING TIMBER DPC PROTECTION

All framing shall be as shown on the drawings and shall be fixed strictly in accordance with the details shown on the drawings. All members that abut concrete or concrete blockwork shall be seated on 3 ply bituminous DPC 3mm wider than the seating member.

Where purlins or other structural members are fixed to gable walls they shall be similarly protected by 3 ply bituminous DPC.

12.6 NAILS, SCREWS, BOLTS & OTHER FIXINGS

All fixings for structural carpentry items shall be made with hot dipped galvanised steel fixings of appropriate length and gauge in accordance with TABLE 1

TABLE 1 - FIXINGS

Item		Galv Weight	Comment
1.	Bolts	450 gm/m^2	Bolts to be metric size bolts to sizes shown on dwgs. Where bolts are detailed as “coach bolts” the head shall be rounded and the shank immediately under the head shall squared.
2.	Nails	450 gm/m^2	All nails to structural members to be “jolt head”
3.	Washers to bolts	600 gm/m^2	Washer sizes shown on the notes on the dwgs
4.	Nail plates	450 gm/m^2	Nail plates are to be on BOTH sizes of the members
5.	Coach screws	600 gm/m^2	Coach screws shall be supplied with square head and a washer under the head of the screws
6.	Structural screws	450 gm/m^2	Screws shall be raised or countersunk head as the finishing description requires

12.7 GENERAL

All structural timbers shall be examined prior to installation and shall be installed with any integral bow upwards. Any members that are laterally bowed shall be straightened by the installation of suitable lateral blocking to ensure that the member, before loading, is straight.

The moisture content of all structural timbers shall be checked by the Engineer and any members found exceeding the values in the Table in Clause 4.1 above shall be removed by the Contractor and replaced with items complying with the specified standard.

13.0 TECH SPEC 14: CARPENTRY

13.1 SCOPE OF WORK

This specification covers the supply and fixing of all framing, linings, soffits, finishing timbers etc.

13.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

See also Clause 2.17 of Special Conditions of Contract.

13.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

13.4 CARPENTRY

13.4.1 TIMBER SPECIES & SIZES

MEMBER	CALL SIZE	SPECIES ALT 1	SPECIES ALT 2
Rafters	200 x 50	Damanu Treated	Tropik pine Treated H3
Ridge Board Where applicable	400 x 50	Damanu Treated	Tropik pine Treated H3
Barge Board Where applicable	400 x 32	Rosawa	Tropik pine Treated H3
Fascia Board	400 x 32	Rosawa	Tropik pine Treated H3

All framing timbers including purlins, shall be gauged to sizes shown, barge and fascia boards shall be dressed 4 sides to sizes shown and shall be Fiji-C-Select (No.1 Framing).

Finishing Timbers shall be Fiji-F-Select (No.1 Dressing).

13.5 ROOF FRAMING

All roof framing shall be as shown on the drawings and shall be fixed strictly in accordance with the details shown on the drawings. Rafters shall be seated on 3 ply bituminous DPC where this fix is to walls.

Where Purlins and ribbon plates, fix to gable walls, they shall be similarly protected by 3 ply bituminous DPC.

13.6 SOFFIT LININGS

Soffit linings shall be 10mm Hardies Villa Board fixed in accordance with the Manufacturers recommendations. Ensure that all sheet edges and inner faces are primed before erection.

Ensure that soffits are scribed to blockwalls as necessary to ensure that the joint is rain proof.

At fascia, fit quarter round bead (set in approved sealant) fixed with galvanised jolt head nails at max 300 c/c.

13.7 CEILINGS

These shall be lined with 10mm Gibraltar board, tapered edges fully stopped with plaster. Joints shall be taped with Gib. Tape. Fixings shall be by galvanised flatheads at 150c/c on edges of sheets, 250c/c in centre. Ensure sufficient dwangs so that Gib-board is supported at maximum 600c/c.

13.8 LININGS TO TIMBER STUD WALLS (WHERE REQ'D)

Where shown on the drawings and schedule of finishes line with 6mm Tempered hardboard for wall claddings. Joints shall be used butted and placed with a max.0.5mm gap between adjacent sheets.

13.9 ARCHITRAVES, SKIRTINGS, CORNICES

At all wall/floor, wall ceiling junctions and at all doors (all in timber framed walls) fit architraves/skirt/cornices of ex 50 x 25 bevel edged (one edge) timber moulding, mitred and scribed at intersections.

13.10 FOIL TO ROOF

Over entire area of building, supply and fit underlay to roofing of AHI grade 524 flamestop double sided aluminium foil, two way reinforced, supported on netting.

13.11 NETTING

Netting shall be 50 x 50 twist wire netting securely fixed to framing and tightened correctly with lacing wire.

13.12 HARDWARE

For Hardware, see TECH SPEC 17 HARDWARE

13.13 NAILS, SCREWS & OTHER PROPRIETARY FIXINGS

All fixings to carpentry items shall be made with hot dipped galvanised steel fixings of appropriate length and gauge.

Galvanising shall be hot dipped with a residual coating weight of 450 gm/m^2 minimum.

In general, nails shall have the following characteristics.

TABLE 1 - NAILS

Item	Description	Length & Diam	Head
1.	Timber Framing	100mm x 400mm galv.	Jolt or Flat
2.	Finishing Timbers	To suit but generally 50mm x 2.8mm galv.	Jolt or Flat
3.	9.5mm Gib B'd linings	38mm x 2,24mm galv	Flat
4.	6mm Temp H/B'd	16mm galv. panel pins	Jolt
5.	Wire Mesh	galv. 16mm staples	N/A

14.0 TECH SPEC 15: ROOFING

14.1 SCOPE OF WORK

This Section covers the supply of all roofing iron and its fasteners, the spoutings and downpipes and all roofing accessories required to complete the roofs on the proposed buildings.

14.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

See also Clause 2.17 of Special Condition of Contract.

14.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

AS1445 - Custom Orb Sheets

AS1397 - TRIMDEK Hi-Ten

14.4 MATERIALS

All roofing shall be TRIMDEK Hi-Ten, 0.42mm BMT with Colorbond treatment on both sides or similar approved.

All roofing shall be delivered to the site stacked flat on a pallet.

14.5 STORAGE OF ROOFING COMPONENTS

Roof sheeting shall be stored flat, undercover and on suitable wooden packers to ensure that the sheeting is adequately supported at no less than 750 c/c and to a slight fall to shed condensed liquid. Before stacking on site, the sheets shall be separated, allowed to sun dry and then re-stacked.

Nails, screws and roof accessories shall be stored undercover with adequate support.

14.6 ROOF FASTENERS

Screws shall be appropriate Hex Head self-drilling and tapping screws to suit rib fastening in the TRIMDEK. Screws shall be Type 17 cyclone assembly galvanised screws complete with neoprene gasket and folded galvanised steel washer. No nails shall be permitted.

14.7 FOOTWARE & WALK BOARDS

All workers on the roof shall wear soft non-metallic footware and walk boards shall be utilised to prevent damage to the roofing colour surface.

14.8 SPOUTINGS

Spoutings shall be standard Marley Gutter with size as shown on the drawings.

Spoutings shall be supported on custom made and supplied brackets at maximum 900c/c. Spoutings shall be fitted to give a minimum fall of 1 in 80 to downpipes. Fit 100mm outlets at downpipes, fully soldered to the spoutings.

14.9 DOWNPIPES

Downpipes shall be 100mm dia downpipes fitted up into spouting spigots with 75mm lap.

Downpipes shall be positioned where shown on the drawings and shall be fixed back to the supporting posts with galvanised holder-bats at the following position:-

a) 100mm below upper turn in
b) 150mm above discharge point at bottom of downpipes.
c) At midpoint between (a) & (b)

Holder-bats shall be of cast steel, fully hot dip galvanised to a coating weight of 450gms/m^2.

Clamp screws to holder-bats shall be brass or hot dip galvanised steel to a coating weight of 600gm/m^2.

14.10 BARGE & EAVES FLASHINGS

These shall be fabricated from 20gge galvanised colour bond coated steel to the dimensions shown on the drawings. Eaves flasher at high edge of roof

shall be fitted with a 19kg/m^2 (4 lbs/ft^2) edging dressed down into the troughs of the TRIMDEK.

Fasten barge and eaves flashings at max. 600c/c on both roof and the vertical face.

14.11 CLEANING UP OF ROOF AREA

Each night prior to leaving the site and at completion, sweep the entire area of the roof with a soft bristle broom to remove all drill swarf, clippings and other rubbish to prevent staining.

15.0 TECH SPEC 17: HARDWARE

15.1 SCOPE OF WORK

This specification covers the supply and fixing of all hardware to doors and joinery items. It does not include hardware to metal windows and doors.

15.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

15.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

15.4 HARDWARE

15.4.1 GENERAL

Allow to supply and fit hardware as scheduled in TABLE 1:

TABLE 1

ITEM	HARDWARE	FINISH
Internal Doors	• Brass Butt Hinges, as specified • Brass Spring Hinges to toilet door • 2- Coat hooks to Toilet Door • Double Acting Brass Spring Hinges to Kitchen door • Mortice deadlock with 2 keys • Wall mounted rubber eye door stop	Satin Chrome Plated
Main Entrance Doors	• Heavy Stainless Steel Hinges • Cylinder mortice locks • Wall mounted rubber eye door stop	
Vanity Bench	• "HETTICH" Concealed Hinges • "HETTICH" Plastic shelf support • Selected "D" Pull Handle	
Sink Bench	• "HETTICH" Concealed Hinges • "HETTICH" Plastic Shelf support • Selected "D" Pull Handle	
Overhead Kitchen Cupboard	• Latch bolt locks – short cylinder type • Selected 75mm "D" Pull Handle	Satin Chrome Plated
Drawer	• Selected Stainless D handles	
Kitchen Breakfast Bar Drawer Pulls	• Selected Door Knob	

15.5 WORKMANSHIP

Carefully mortice all locks, strike plates and other lock furniture to exact fits.

Door stops, drawer pulls and coat hooks shall be set truly level and plumb.

Head all screws so that driver slot is finished vertical.

Prior to hand-over carefully oil all locks and ensure that all hardware functions as intended

15.6 KEYS

Allow to supply all keys set on a 25mm key-ring complete with an engraved FORMICA tag 75 x 25mm labelled as follows:

Allow to supply two keys per lock, together with two master keys.

16.0 TECH SPEC 20: SOLID PLASTERING

16.1 SCOPE OF WORK

This section covers the solid plastering to internal and external faces of all block walls, shower cubicles, pointing to windows and foundation to buildings.

16.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

See also Clause 2.17 of Special Conditions of Contract.

16.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

16.4 PLASTER MATERIALS & WORKMANSHIP

Plaster shall be mixed from clean sharp sand, cement and either lime or a propriety plaster additive. Proportions shall be as dictated by the particular requirements. Mix plaster to a smooth, workable texture free from lumps and deleterious materials.

Slash coat shall be applied followed by main plaster and a finish coat with a higher proportion of lime/cement shall be used to form a hard, true, smooth surface.

16.5 SHOWERS

Plaster shower walls full height. Plaster shower base to centre waste with min fall of 20mm. Shower base and walls will be tiled.

16.6 CLEAN-UP

Following plastering, clean up all areas, remove all plaster dropping, rubbish etc. Brush down and leave all clean and tidy.

17.0 TECH SPEC 21: JOINERY

17.1 SCOPE OF WORK

This specification covers the supply of all materials, labour, delivery, fabrication and installation of the interior and exterior doors and trim. It also covers the supply, installation and fitting of fixed sink benches to the kitchen and vanity. Note that hardware is included in SPECIFICATION 17 - HARDWARE.

17.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

17.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

17.4 JOINERY

17.4.1 INTERIOR DOORS

Doors shall be constructed as semi-solid core doors fitted with lock rail and clashing strips on all four edges. All joinery shall be constructed in treated Damanu or Kauvula with all faces and edges dressed. Joinery shall be joined with glue and screwed joints. Cladding of doors shall be with paint quality 3 ply. All screws or nails used in door construction shall be galvanised.

Door frames shall be treated Damanu or Kauvula, minimum 50 thick with planted stops. Frames shall be of the same width as the wall in which they are fixed. Allow to supply and fit ex 75 x 25mm treated Damanu or Kauvula splay edge architrave on both sides of each door.

Hang all doors on 1½ pairs (3) 75mm brass butt hinges.

Frames shall be fixed into block opening with 3-M10 galvanised Dynabolts at each jamb and at head.
Overall door frame shall be not less than 20mm less than rough opening.

Packers at fixing bolts shall be of hardwood.

17.4.2 EXTERIOR DOORS

Exterior doors shall be solid timber, breed framed and ledged doors with T&G infill panels, generally as detailed on the drawings. Door frame shall be ex 200 x 75 treated Kauvula with rebated stops. (Planted stops shall not be allowed). All other details shall be as for Clause 4.1 INTERIOR DOORS.

Doors shall be hung on 3 heavy duty galvanised extended throw butt hinges checked into door and frame. Hinges shall be fixed with galvanised countersunk screws. Doors shall be capable of being opened out flat against the wall.

Fit other leaf with Lockwood dead lock, (brass heavy duty) supplied with 2 keys.

Fit each leaf of both single and double doors with heavy duty cabin hook. Cabin hooks to be minimum 6mm bronze brass or galvanised steel dependent on length. Coat hook to be fitted to fixed item on door leaf.

All items shall be capable of resisting full load on door of 120kg at outer edge of door leaf.

17.4.3 DOOR SIZES

Door openings shall be as in drawings and door schedule.

17.4.4 WINDOW SIZES

Window openings shall be as on drawings and window schedule and details.

17.4.5 VANITY BENCH

Vanity work bench shall be constructed generally in accordance with the details on the drawings.

Carcase is to be constructed of 75 x 50 framing and 100mm high toe space is to be allowed. An intermediate shelf at approximately ½ height is to be fitted. Intermediate and bottom shelves shall be fabricated from 19mm marine grade plywood.

Exposed edges of carcase with 20 x 3mm hardwood glued and nailed to plywood.

Bend top shall be 20mm marine grade plywood supported in front and rear longitudinal framing with intermediate transverse members at 500c/c.

Cover entire bench top and upstand with 2mm heavy duty vinyl sheet (in one piece). Colour shall be as selected. Allow to securely glue the vinyl to the substrate so that no air bubbles or “holidays” occur.

Allow to co-operate with plumber and electrician to fit pipes for taps and wastes and electrical GPO’s where required.

17.4.6 KITCHEN SINK BENCH

Allow to supply and install sink bench unit to kitchen. Details of this unit are generally as shown on the drawings.

17.4.7 KITCHEN OVERHEAD STORAGE CUPBOARD

Allow to supply and install wall mounted cupboard unit over kitchen sink bench. Details of this cupboard are generally as shown on the drawings.

18.0 TECH SPEC 22 : PAINTING

18.1 SCOPE OF WORK

This specification covers the supply of materials and labour to complete the painting of this contract.

18.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

18.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

18.4 PAINT SUPPLY

18.5 Supply of Paint

All paint specified is available from Dulux Fiji. Other paint suppliers and manufacturers may be offered but full details must be submitted to the Engineer for approval. Paint types must be of the same generic type.

18.6 ANCILLARY EQUIPMENT

Allow to supply all ancillary equipment such as scaffolds, brushes, rollers, thinners, throw sheets, masking tape, cleaning rags etc. required for execution of the work.

18.7 PROTECTION OF SURROUNDINGS

Allow to protect all adjacent surfaces from paint spots, drips etc. Allow to use throw sheets to floors, masking tape to window frames, door frames etc. Allow to remove G.P.O's, switches, door hardware etc. before painting and replace on completion.

18.8 GENERAL

Paint shall be applied by skilled brush hands. Painted surfaces shall be free of sags, runs, "holidays" etc. Where two colours meet, allow to cut in junction with a truly straight line.

Allow to prepare all surfaces by brushing down, sanding and washing where necessary.

In timberwork, ensure that all nails are punched and all screws countersunk. Fill all holes, cracks etc. with linseed oil putty and sand down to be flush with surrounding surface. Painting shall only be carried out when the surfaces are clean and dry. Allow for four different colours to painting.

18.9 CURING ITEMS

For plasterwork, concrete blockwork and concrete surfaces allow a minimum of 14 days between completion of the cement containing surface and the application of the first paint coat.

(This allows the lime salts to leach from the cement, plaster etc)

18.10 TINTING PAINTS BETWEEN SUCCESSIVE COATS

Where finishing coats are to be overcoated, tint first coat to a paler shade to ensure that coverage is correctly applied. Paint cans shall be marked to differentiate between initial and final colour coats.

18.11 COLOUR SCHEME

To be confirmed by Client.

18.12 PIPES AND SERVICES IDENTIFICATION

Refer to TECHSPEC 23 – SIGNWRITING for colour identification of pipes and services.

18.13 TABLE A – PREPARATION TYPES

	DESCRIPTION	NORMAL APPLICATION (SEE ALSO TABLE C)
P1	Sandblast to SA 2.5	New steelwork, major steelwork items
P2	Power wire brush to SA 3.5	Normal new steelwork
P3	Degrease with mineral turpentine, hose, scrub. Allow to dry	Galvanised steel, dirty existing steelwork
P4	Hose, scrub. Allow to dry	Between coats if elapsed time more than 48 hours or if shown in Table B
P5	Chip rust back to black steel using mechnical or hand chippers	Foe existing steelwork, followed by preparation P2

18.14 TABLE B - FINISH TYPES

FINISH TYPE REF	DESCRIPTION	THICKNESS DFT ((μ = microns)	RECOAT TIME
8.0 1	Dulux Universal Acrylic Undercoat	50μ DFT	4 – 6 hours
F2	Dulux Weathshield 100% acrylic	50μ DFT	4 – 6 hours
F3	Dulux Luxepoxy 4 White Primer	50μ DFT	Overnight
F4	Dulux Luxepoxy 4 Red Primer	50μ DFT	Overnight
F5	Dulux Luxathane RT Recoatable Urethane	50μ DFT	Overnight
F6	Dulux wood Pink Primer	50μ DFT	Overnight
F7	Dulux all purpose Undercoat	50μ DFT	Overnight
F8	Dulux High Gloss Enamel	50μ DFT	Overnight
F9	Dulux Durapon P14	75μ DFT	Overnight

	epoxy Zinc Phosphate		
F10	Dulux Durabild STE 400	50μ DFT	Overnight

18.15 TABLE C – PAINT FINSHES SCHEDULE

ITEM DESCRIPTION	BASE PREPARATION	1ST COAT (PRIME)	2ND COAT (UNDERCOAT)	3RD COAT (FINISH)	4TH COAT (FINISH)
Concrete blockwork	P4	F1	F2	F2	
Concrete	P4	F1	F2	F2	
Plastered surfaces	P4	F1	F2	F2	
Hardies Villa board (soffits)	P4	F1	F2	F2	
Hardies compressed Fibrous cement sheets	P4	F1	F2	F2	
Gutters, Spoutings & down pipes (galvanised steel)	P3	F3	F5	F5	
Galvanised roofing (any profile)	P3	P3	F5		F5
Laps to roofing, downpipes, gutters, spoutings . flashings, brackets for these	P3	F3	F5	F5	
Any other galvanised sheeting	P3	F3	F5	F5	

Timber trim (interior)	P4	F7	F8	F8	
Timber trim (exterior)	P4	F7	F8	F8	
Timber doors & windows	P4	F7	F8	F8	
Sundry metalwork (ungalvanised)	P2	F9	F3	F5	F5
Sundry metalwork (galvanised)	P3	F9	F3	F5	F5

ITEM DESCRIPTION	**BASE PREPARATION**	**1ST COAT (PRIME)**	**2ND COAT (UNDERCOAT)**	**3RD COAT (FINISH)**	**4TH COAT (FINISH)**
Structural steel (new)	P2	F9	F3	F5	F5
Structural steel 1 (existing)	P5, P1	F9	F3	F5	F5
Structural steel 2 (existing)	P5, P1	F10	F3	F5	F5
Pipework identification bands	P5, P1	F10	F3	F5	F5

19.0 TECH SPEC 24A : SEWER DRAINAGE

19.1 GENERAL

This Section covers the supply and installation of the sanitary sewerage reticulation and details the quantity of the work required.

19.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS	New Zealand
AS	Australian Standard
BS	British Standard

CODES & STANDARDS

CODE No.	DATE	TITLE
AS 1254		Unplasticised PVC (UPVC) Pipes & Fittings for Storm & Surface Water Applications
AS 1260	Parts 1 to 4	Unplasticised PVC (UPVC) Pipes & Fittings for Sewerage Applications
AS 1342		Precast Concrete Drainage Pipes
AS 1415	Parts 1 to 4	Unplasticised PVC (UPVC) Pipes & Fittings for Soil, Waste & Vent (SMV) Applications
AS 1462	Parts 1 to 12	Methods of Test for PVC (UPVC) Pipes & Fittings
AS 1646		Rubber Ring Joints
AS 2032		Installation of UPVC Pipe Systems

19.3 MATERIALS

19.3.1 Sewer Pipes

Sewer pipes shall be UPVC pipes to AS 1260 and shall be of the sizes shown on the drawings.

19.3.2 Fittings

Where fittings are used, such as inspection Y joints, end caps etc. They shall conform fully to AS 1260.

19.3.3 Rubber Rings

Rubber Rings used for jointing pipes shall conform fully to AS 1646.

19.3.4 Cast Iron Man Hole Covers

These shall be GATIC NONROG or similar approved circular light duty covers Product Code L185 (unfilled) 610mm dia.

19.3.5 Concrete to Manholes

Shall be as specified in TECHSPEC 8 - CONCRETE with a concrete strength of 20 Mpa at 28 days.

19.4 LAYING OF PIPES

19.4.1 Trenching, Bedding & Backfilling

This shall be as specified in TECHSPEC 2 - EXCAVATION & BACKFILL FOR PIPES, CABLES etc. But for the sewerage reticulation all pipes shall be bedded on a minimum of 100mm of approved bedding material.

Note that recesses are to be left at pipe joints to ensure that the pipe is supported for its full length. Trenches shall run straight and to correct grade between manholes.

19.4.2 Jointing

All jointing shall be by rubber ring joints carefully noted and placed. The technique to be used for jointing shall be demonstrated to the Engineer prior to commencing full laying.

19.4.3 Initial Backfilling

Prior to testing, backfill over pipe, leaving all joints clear, with approved material ad compaction to the requirements of TECHSPEC 2. This initial backfilling shall not exceed 200mm over the top of the pipe. Following testing, repair and retesting of necessary, the areas at the pipe joints shall be carefully hard filled initial backfill and compacted.

19.4.4 Testing of Pipe Sections

Testing of the sewerage piping shall be carried out as specified in TECHSPEC 44 - TESTING OF PIPING SYSTEMS and this shall take place prior to completion of backfilling.

19.5 MANHOLES

19.5.1 Manhole Construction

Manhole shall be constructed from 1200 dia precast concrete culvert pipe as shown on drawings.

Manholes shall be truly plumb and shall be fitted with a precast concrete led bedded on mortar. This precast lid shall be cast with a circular rebated hole to receive the GATIC manhole cover.

19.5.2 Haunching to Manhole Floor

Following completion of the manhole, from up haunching in the base with 17.5 mpa concrete to give smooth swept semicircular channels for the effluent.

This mortar to be sloped from the outer edge of the manhole to the channels with a minimum slope of 1 in 10.

19.5.3 Finished Ground Level

Top of manhole shall be set so that the finished top of the manhole cover is flush with the final ground level.

19.5.4 Filling of GATIC Cover

On completion of all work in the manhole, fill the GATIC NONROC cover with 17.5 Mpa concrete (using aggregate size 10mm) and trowel smooth.

19.6 SPURS

19.6.1 Inspection Y Junctions

Allow to supply and test inspection Y junction. Inspection Y to have inspection port on top face.

19.6.2 Spurs to Buildings

Allow to terminate 100mm dia. spurs with black removable cap.

19.7 AS BUILT DRAWINGS

Allow to prepare as-built drawings of all pipes, spurs, manholes, inspection Y's etc. As builts shall be presented on A3 sized reproducable paper and shall clearly show the following:

1. All manholes giving co-ordinates and invert levels
2. Positions of all I - Y's giving co-ordinates and invert levels
3. Positions of end of individual lot spurs giving co-ordinates & invert levels.

20.0 TECH SPEC 24B: STORMWATER DRAINAGE

20.1 SCOPE OF WORK

This section covers the supply of materials, labour, setting out and supervision required to complete the vee drains and all other ancillary items associated with the stormwater drainage.

20.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

20.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

20.4 SETTING OUT

All stormwater drainage components shall be out set out by a registered surveyor true to line and level and the surveyor shall be required to constantly monitor the work to ensure the compliance with the drawings.

20.5 DRAINS

Vee drains shall be constructed where shown on the drawings and to the details given. Vee drains shall be formed from precast reinforced concrete vee sections bedded on compacted filling and surrounded by approved compacted material. This compaction shall be by plate compactor's or "jumping jacks". Layers shall be limited to 75mm loose.

The vee drain depth shall be extended, where necessary and as shown on the drawings, by stone pitching set at a batter angle of ¼ : 1. Stone for the pitching shall be hard and durable and shall be placed in a concrete matrix with 17.5 Mpa concrete with max aggregate of 12.0mm.

21.0 TECH SPEC 24B: STORMWATER DRAINAGE

21.1 SCOPE OF WORK

This section covers the supply of materials, labour, setting out and supervision required to complete the vee drains and all other ancillary items associated with the stormwater drainage.

21.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

21.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

21.4 SETTING OUT

All stormwater drainage components shall be out set out by a registered surveyor true to line and level and the surveyor shall be required to constantly monitor the work to ensure the compliance with the drawings.

21.5 DRAINS

Vee drains shall be constructed where shown on the drawings and to the details given. Vee drains shall be formed from precast reinforced concrete vee sections bedded on compacted filling and surrounded by approved compacted material. This compaction shall be by plate compactor's or "jumping jacks". Layers shall be limited to 75mm loose.

The vee drain depth shall be extended, where necessary and as shown on the drawings, by stone pitching set at a batter angle of ¼ : 1. Stone for the pitching shall be hard and durable and shall be placed in a concrete matrix with 17.5 Mpa concrete with max aggregate of 12.0mm.

22.0 TECH SPEC 25 : PLUMBING

22.1 SCOPE OF WORK

This section details the supply and installation of plumbing and plumbing fittings for new building.

22.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

AS	Australian Standard
NZS	New Zealand Standard
AS/NZS	Joint Australian and New Zealand Standard

22.3 STANDARD SPECIFICATION

Relevant New Zealand and Australian Standard Specifications.

AS/NZS 3500	Parts 1 to 4	2003	Plumbing and Drainage
AS/NZS 1477		1999	PVC pipes and fittings for pressure applications
AS/NZS 4130		2003	Polyethylene (PE) pipes for pressure applications
AS/NZS 4129		2000	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 1260		2002	PVC-U Pipes & Fittings for Drain, Waste and Vent Applications
AS/NZS 2642	Part 2	1994	Polybutylene pipe systems –Polybutylene (PB) pipe for hot and cold water applications
AS/NZS 2642	Part 3	1994	Polybutylene pipe systems –Mechanical jointing fittings for use with polybutylene (PB) pipes for hot and cold water applications
AS 1432		1996	Copper tubes for plumbing, gasfitting and drainage applications
NZS 3501		1976	Specification for copper tubes for water, gas and sanitation

22.4 SCHEDULE OF PLUMBING FITTINGS

See Architectural Specifications.

22.5 COLD WATER PIPING

All piping within the building shall be 18mm minimum UPVC with 15mm UPVC piping branches to each fitting using preformed tees, elbows etc. Joints shall be solvent cement type. All piping shall be concealed in walls in accordance with AS/NZS 3500.1 Clause 5.5.

Note that both Clause 5.5.1 (b) and Clause 5.5.3 (d) of AS/NZS 3500.1 state "(Water) Service pipes shall not be embedded or cast into concrete structures."

Water pipes located in timber or metal framed walls shall be installed in accordance with clause 5.5.2, Table 5.1 and Figures 5.2 and 5.3 of AS/NZS 3500.1.

Water pipes located in concrete walls and floors shall be located in chases, ducts or conduits.

Water pipes located in masonry walls shall be located in ducts or conduits. Chases shall not be used.

Pipes in chases shall be continuously wrapped with an impermeable flexible material and ducts shall be fitted with removable covers. Conduits shall also be continuously wrapped with an impermeable flexible material.

Pipes located beneath concrete slabs on ground shall comply with the following:

Pipes shall be laid in a narrow trench on a bed of fine sand or fine-grained soil placed and compacted in a manner that will not damage the piping. There shall be a minimum distance of 75 mm between the pipe and the underside of the slab.

The pipe ends shall be crimped or capped prior to pouring of the concrete and measures shall be taken to protect the exposed pipe from damage.

Any pipework that penetrates the slab shall be at right angles to the surface of the slab and shall be lagged with an impermeable flexible plastic material of not less than 6 mm thickness for the full depth of the slab penetration.

The number of joints shall be kept to a minimum.

Terminate pipes in brass bracket elbows at fixture connections. Fix bracket elbows with min 2 brass screws.

22.6 HOT WATER PIPING

Hot water piping within the building shall be of 18mm minimum diameter with 15mm diameter piping branches to each fitting using preformed tees, elbows etc. Piping shall be either Type A, B or C copper in accordance with AS 1432, copper water pipes in accordance with NZS 3501 or polybutylene pipes and fittings in accordance with the relevant parts of AS/NZS 2642. Limitations on the use of polybutylene pipes shall be as listed in Clause 2.4.3 of AS/NZS 3500.4. Installation shall generally be in accordance with Section 4 of AS/NZS 3500.4. All piping concealed in walls shall be installed in accordance with AS/NZS 3500.4 Clause 4.6.

All hot water piping shall be insulated in accordance with Section 8 of AS/NZS 3500.4. For the purposes of Clause 8.2.2, Climate Region A shall be used to determine the insulation R-value to be achieved by the insulation. Acceptable insulation for all hot water pipes includes, but is not limited to 13 mm of closed cell polymer.

Note that Clause 4.6.1.2 (e) of AS/NZS 3500.4 states **"Service pipes shall not be embedded or cast into concrete structures."**

Hot water pipes located above ground shall be retained in position by brackets, clips or hangers in accordance with clause 4.5, and Table 4.1 of AS/NZS 3500.4.

Hot water pipes located in timber or metal framed walls shall be installed in accordance with clause 4.6, Table 4.2 and Figures 4.1 and 4.2 of AS/NZS 3500.4.

Hot water pipes located in concrete walls and floors shall be located in chases, ducts or conduits.

Hot water pipes located in masonry walls shall be located in ducts or conduits. Chases shall not be used.

Pipes in chases shall be continuously wrapped with an impermeable flexible material and ducts shall be fitted with removable covers. Conduits shall also be continuously wrapped with an impermeable flexible material.

Pipes located beneath concrete slabs on ground shall comply with the following:

Pipes shall be insulated in accordance with 6.2 above and laid in a narrow trench on a bed of fine sand or fine-grained soil placed and compacted in a manner that will not damage the piping. There shall be a minimum distance of 75 mm between the pipe and the underside of the slab.

The pipe ends shall be crimped or capped prior to pouring of the concrete and measures shall be taken to protect the exposed pipe from damage.

Any pipework that penetrates the slab shall be at right angles to the surface of the slab and shall be lagged with an impermeable flexible plastic material of not less than 6 mm thickness for the full depth of the slab penetration.

Soft-soldered joints shall not be permitted.

The number of joints shall be kept to a minimum.

Terminate pipes in brass bracket elbows at fixture connections. Fix bracket elbows with min 2 brass screws.

22.7 PIPING TO FIXTURES

From bracket elbow, supply water pipe to taps and other fixtures in copper pipe bent carefully to fit and fitted with crox fittings at either end. Pipe to be complete with chrome plated escutcheon plate at wall connections. Where specified in schedule, after fitting, remove pipe from wall and plate with heavy duty chrome plate before refitting.

22.8 SANITARY DRAIN PIPING

All sanitary drain pipework within the buildings shall be PVC-U pipes and fittings in accordance with AS/NZS 1260. Installation shall be carried out generally in accordance with AS/NZS 3500.2 and with the drawings.

22.9 TRAPS, WASTES ETC

Supply all fittings with wastes, traps etc. as required in AS/NZS 3500.2.

22.10 DRAINAGE OF FITTINGS

Basins and showers may drain to floor waste gullies, W.C's are to be direct connected to the drain.

22.11 VENTS

Vents shall be provided as necessary to avoid vacuum emptying of traps and in accordance with the requirements of AS/NZS 3500.2. Air admittance valves

(AAVs) may be used instead of trap vents and group vents in certain circumstances, in accordance with clause 6.9 of AS/NZS 3500.2.

The location of AAVs will be shown on the drawings.

22.12 TESTING OF SYSTEMS

Following completion of the work all systems shall be pressure tested in the presence of the Engineer. Testing shall be strictly in accordance with the requirements of TECH SPEC 44 – TESTING OF PIPING SYSTEMS.

Note that clause 16.3.1 of AS/NZS 3500.1 requires that the hydrostatic pressure test shall be performed on installed water piping prior to burial or concealment.

22.13 CLEAN-UP

Following completion and testing the entire area will be cleaned up, toilet bowls and basins properly cleaned and cistern wiped down. Remove all packing materials, rubbish etc. from site and destroy.

23.0 TECH SPEC 26 : ELECTRICAL

23.1 SCOPE OF WORK

The extent of work covered by this section includes but is not limited to the following:

(i) Supply and install at the position shown on the drawings all cabling between the main board and distribution board and to fittings.

(ii) Supply and installation of luminaries.

(iii) Supply and installation of G.P.O's.

23.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS New Zealand Standard
AS Australian Standard
BS British Standard

23.3 STANDARD SPECIFICATIONS

Relevant New Zealand and Australian Standard Specifications.

AS 3000 SAA Wiring Rules

23.4 CABLES GENERAL

Mains, submains, earthing and distribution and lighting cables shall be as follows:-

Cables shall be manufactured in accordance with Australian Specifications with 600/1000 volt designation with Stranded Copper Conductors.

Generally all cables shall be run inside orange coloured rigid PVC electrical conduits. Obtain Engineers approval prior to pouring concrete around conduits. Conduits must be concealed in walls wherever possible and on no account shall chasing back into new blockwork be allowed.

23.5 EARTHING

Supply and install all earthing in accordance with the requirements of the SAA Wiring Rules and the requirements of the Fiji Electricity Authority.
Allow to carry out earth resistance tests and continuity tests to show that the earthing complies with the requirements. For the main earth, supply and install driven earth rods suitably connected to the earth bar on the main switchboard. Run separate earth wire to the distribution boards.

23.6 MAIN SWITCHBOARD & DISTRIBUTION BOARDS

23.6.1 GENERAL

Allow minimum 20% spare circuits on distribution boards. The busbar shall be tinned. The distribution boards and particularly contactors shall be fully tropicalised.

The distribution boards shall be colour orange to standard colour identification charts.

Circuit breakers shall be Email Westinghouse or equal.

Where appropriate fuses shall be HRC or equal to approval.

All switchgear circuit interruptors etc. shall be Kraus & Naimer rotary switches or equal to approval.

23.6.2 MAIN SWITCH BOARD & DISTRIBUTION BOARD CONSTRUCTION

Boards shall be premade PVC from HPM or PDL casing and fitted with lockable doors. Main board shall be floor mounted and other boards shall be wall mounted, fixed by galvanised screws, bolts and shall comply in all respects to AS3000. All switchgear and circuit breakers shall be labelled and supplied with wiring diagram on approved paper print fitted in a container on compartment door. Labelling for each circuit shall be by GRAFOPLAST TRASP system for who the local agent is Trade Supplies of Walu Bay. All labels shall be screwed to board. Colour shall be white on black. All wiring shall be identified by tags on each end of run.

Main switch, fuse and breakers shall be approved type. Ensure that busbars are of generous size for allocated loads. Main incomer cable shall be provided with glands.

23.7 LIGHTING & POWER

23.7.1 LIGHTING

Allow to supply and install luminaries and lamps and associated wiring and switching as specified and as shown on the drawings.

Lighting to the buildings shall be as shown on the drawings. Generally all lighting cables shall be run tidily in electrical conduits generously sized. Switches shall be mounted in flush boxes cut into blockwork.

Control for the external under canopy lighting shall be by photo electric cell. The position of the cell shall be tested for operation at low light levels to give the required light level control prior to final fixing and shall be to the satisfaction of the Engineer.

23.7.2 GPO's

Allow to supply, install and wire up new general purpose outlets as shown on the drawings. G.P.O's shall generally be PDL 56 series or equal to approval and as shown on drawing. All shall be in flush boxes cut into blockwork.

23.7.3 TESTING & COMMISSIONING

Allow to fully test and commission the completed installations in stages as necessary to suit the requirements of the Principal.

24.0 TECH SPEC 44 : TESTING OF PIPING SYSTEMS

24.1 GENERAL

This Technical Specification covers the testing of piping systems for leaks. Pipes may be of various materials and this specification covers the testing of pipes used to convey raw water.

24.2 ABBREVIATIONS

The abbreviations listed below, where used in this Specification, shall have the following meanings.

NZS	New Zealand
AS	Australian Standard
BS	British Standard

24.3 CODES & STANDARDS

AS/NZS 2566.2:2002	Buried flexible pipelines – Installation
AS/NZS 3500	National Plumbing and Drainage

24.4 TIME OF TEST

Testing shall be carried out at a time that best suits the construction sequence with the general times as set out below:

	PIPING FOR	
1	Sewage, stormwater (non pressure applications)	In sections, testing after initial backfilling and prior to final backfill. All joints must be left exposed.
2	Water Pipes Untreated & potable (pressure application)	i. For underground pipes, as Item 1 above ii. For exposed piping (eg. In pumphouses), when the installation of plant and valving is completed.

24.5 NOTIFICATION OF TEST

It is a requirement of this specification that tests are carried out by the Contractor and all defects remedied prior to notification of full witnessed tests.

The following parties or Statuary Bodies shall be notified by fax or letter of the date & time of each test to be witnessed, notification shall arrive at a minimum time of 48 hours prior to the test.

ITEM	iii. NOTIFY
Sewage, Stormwater, untreated & potable water	Engineer

24.6 TEST PERSONNEL

Contractor test staffing shall consist of the following:-

- Contractors Authorised representative or foreman
- Sub Contractors authorised representative or foreman
- One journeyman experienced in the laying of the type of pipe to be tested.
- Sufficient other staff to service the testing.

24.7 EQUIPMENT FOR TESTING

The following equipment shall be supplied by either the Contractor or the Subcontractor concerned.

ITEM No.	TEST TO BE ON	APPLICABLE TO	EQUIPMENT REQUIRED
1.	Gravity Application	i. Sewerage ii. Water (untreated & potable) iii. Stormwater	a) Plugs, blank caps etc. To fit relevant pipe diameters b) Air Pump & gauges (100mm dia)
2.	Pressure Applications	i. Pump rising mains for sewer & stormwater ii. Water (untreated & potable) iii. Stormwater	a) Plugs, blank flanges etc. To fit relevant pipe diameters and resist pressure of test without movement or leak b) Gasket insertions c) Pressure gauges (100mm dia) d) Soap or soap solution e) Pump, either hand or powered f) Sufficient tees, reducers & valves to connect plugs g) Marking crayon h) Thermometer for air temperature i) Water

All test equipment shall be in good condition and repair, and in the case of pressure gauges, shall be complete with a calibration & certification certificate from a recognised testing authority.

Test certificate shall be no older than 6 months at the date of the test.

24.8 TEST PROCEDURE

24.8.1 Gravity Pipes

a) Section of pipe to be tested shall be visually examined to ensure all debris in the pipe is removed by flushing, that joints are clear, that pipe has sufficient backfill and anchoring to prevent “snaking”.

b) Section to be tested shall be blocked at both ends generally at the inlet to a manhole or at an inspection Y or inspection bend.

c) Air shall be introduced to the pipe and raised to a pressure of 34kPa (5psi)

d) The maximum allowable pressure loss after stabilisation at the test pressure shall be :-

Type of Pipe	Diam	Test Duration	Max Allowable Loss
UPVC	Drains within buildings & mains of 100 & 150	6mins	3kpa (0.5psi)
UPVC	225 & 300	9mins	3kpa (0.5psi)

(e) Mark any leaks, discontinue test and repair

(f) Retest until criteria above is satisfied

24.8.2 Pressure Pipe Applications

TEST PRESSURE SHALL BE 1.5 TIMES MAX WORKING PRESSURE, OR 1.25 TIMES PIPE PRESSURE RATING, WHICHEVER IS THE LESSER MEASURED AT THE LOWEST POINT IN THE PIPELINE

a) Section of pipe to be tested shall be visually examined to ensure all debris in the pipe is removed by flushing, that joints are clear, that pipe has sufficient backfill or connections to anchor blocks to prevent “snaking” and that all valves in the section are “open”

b) Section to be tested shall be blocked by use of blank flanges, valves etc,

c) At a convenient place, generally the lowest end, install reducing pipes, tees etc. to allow connection of pump and connect pump.

Ensure that there is a valve between the pump & the pipe and that there is an air bleed fitted to this system.

d) Fill pipe section with water up to and including pump. Allow to sit for 30 minutes.

e) Open all air valves on section to be tested to remove air. Close when water runs free. Top up with water as necessary.

f) Open valves to pressure gauge and raise the pressure to 40% of the test pressure & record pressure, air temperature and time. Retain that pressure for a period of 24 hours.

g) Read and record pressure every 30 minutes for 24 hours recording pressure, air temperature & time

h) If pressure has dropped, re-pump to 40% of the test pressure at each reading from (g).

i) Check pipe for leaks, using soap solution if necessary. Mark all leaks with crayon.

j) If a large leak (or a number of small leaks) exists after (g), lower pressure, empty line, repair, then repeat.

k) At the successful completion of the initial test, raise the pressure to the full test pressure. Test is complete when pressure drop does not exceed 5% of test pressure after 4 hours.

l) The pressure testing of a section can be considered to be satisfactory if:

1. There is no failure of any thrust block, pipe fitting, valve, joint or any other pipeline components.

2. There is no visible leakage

3. The measured rate does not exceed the permissible leakage rate as determined by the following formula

Q = 0.14 x D x L x H where

Q = Permissible make-up rate in Litres/hour

D = Nominal pipe diameter (m)

L = Length of pipe under test (km)

H = Average test head (m) over the test section

This permissible make-up allowance should not be interpreted as an allowance for leakage but as compensation for the normal expansion or movement of the pipe and joints under pressure and for the inevitable entrapment of small amounts of air within the test section. In bubble form, this air compresses and may pass in and out of solution at test pressures with significant volumetric changes.

24.9 TEST RESULTS RECORD

Test results shall be on a form similar to that attached to this TECHSPEC as FORM “A”

Every section of pipe tested shall be recorded on a separate form and shall be submitted to the Engineer following the test. Records on the form shall be made in permanent ink (biro or felt pen) marked in blue or black.
Test forms shall be signed in the relevant spaces and names of all witnessing personnel filled in.

Date Of Test .....

iv. PIPE TEST FORM

PROJECT NAME :..... CONTRACTOR: .....

SECTION TO BE TESTED: ..... SUBCONTRACTOR: .....

PIPE CARRYING:.....

ATMOSPHERIC PRESSURE APPLICATION ☐ Y ☐ N				PRESSURE PIPE APPLICATION ☐ Y ☐ N			
Pipe Diameter ..... Pipe Material.....				Initial Pressure, Pipe full, No pump			
Test Pressure	**Time**	**Test Pressure**	**Pressure After Tes**	**Test Pressure**	**Time**	**Pressure**	**Pressure Brought Back to Test Pressure Yes or No**
1st Reading				1st Reading			
2nd Reading				2nd Reading			
3rd Reading				3rd Reading			
4th Reading				4th Reading			
5th Reading				5th Reading			
6th Reading				6th Reading			
7th Reading				7th Reading			
8th Reading				8th Reading			

Test Carried Out By	Name	Signature	Company
Witnessed By			
Engineer			
Local Authority			
Client			