

Materials And Workmanship Specification

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1 CONCRETOR

1.1 GENERAL

The Preliminary and General Clauses of this Specification shall be read in conjunction with and shall form part of this Section.

1.2 STANDARDS

The following Standards, together with their amendments and other related Standards, form part of this Specification. In the event of this Specification being at variance with any provision of these Standards, the requirements with this Specification take precedence over the provisions of the Standards.

NZS 3104	:	2003	-	Specification for concrete production
NZS 3109	:	1997	-	Concrete construction
NZS 3112 (Parts 1 – 4)	:	1986	-	Methods of test for concrete
NZS 3121	:	1986	-	Specification for water and aggregate for concrete
NZS 3122	:	1995	-	Specification for Portland and blended cements
NZS3101	:	2006	-	Concrete structures standard

1.3 SCOPE

The work includes the concrete work to all footings, foundation, floor slabs, columns, beams, concrete gutters, stairs, ramps, nibs, pads, pre-cast units, inspection chambers, beams, etc., as specified herein and shown on the Drawings.

1.4 WORKMANSHIP

All work in this section shall be carried out by tradesmen skilled in the mixing and placing of concrete to the satisfaction of the Structural Engineer.

1.5 FORMWORK

1.5.1 GENERAL

In this section 'forms' shall mean that part of the formwork in direct contact with the concrete. "Formwork" shall include the forms and all supports.

The Contractor shall be entirely responsible for the sufficiency of the whole of the formwork and shall give at least 24 hours' notice to the Architect or Consulting Structural Engineer when it is ready for inspection.

Formwork shall be such as to produce concrete to the shapes, lines, levels, grades and dimensions required by the Contract Documents within the tolerances specified. All discrepancies between the Contract Documents shall be referred to the Architect for decision before proceeding with the work.

Fillets and chamfers shall be used on all corners, unless particularly noted otherwise on the drawings.

1.5.2 TREATMENT FORMS

All form linings shall be treated prior to placing of concrete with a suitable release agent.

Sufficient evidence of tests shall be provided to ensure that no reaction which will affect the concrete surface will occur between any concrete additives, release agents, form surface coatings or curing compounds.

1.5.3 CLEANING OF FORMS

All dust, debris and rust, or other staining, shall be removed from the interior of the forms before the concrete is placed.

In order to facilitate the removal of major debris and to allow inspection immediately before the placing of concrete, certain of the forms shall be readily removable. Minor debris, dust, etc. shall be removed by vacuum cleaning, compressed air or the equivalent.

1.5.4 JOINTS IN FORMS - LOCATION AND TYPE PATTERN

Where form joints have been shown on the Contract Drawings, these shall be incorporated in the formwork design. All other joints shall be shown on the Formwork Shop Drawings and shall be approved for type and location before incorporation in the construction.

All forms joints shall be mortar tight and any indication in the finished concrete that this was not achieved will render that concrete liable for rejection.

1.5.5 BOLT HOLES

Bolt holes will be featured as part of the design. Circular - recessed bolt holes are envisaged. The Contractor is to liaise with the Architect regarding the number, type and location of the bolt holes.

1.5.6 FORMWORK WORKMANSHIP

Formwork shall be such as to produce concrete to the shapes, lines, levels and dimensions required by the Contract Documents within the tolerances specified. Work which does not comply or is defective shall be removed and remedied, as directed by the Structural Engineer.

1.5.7 STABILITY

Forms shall be constructed from sound material properly supported and braced or tied to maintain position and shape during and after the placing of concrete.

Vertical loads shall be supported in a manner which will prevent settlement.

Before pouring, all formworks shall be checked for the tolerances specified.

Should be formwork be displaced during concreting or within the period specified for its retention, the concrete shall be removed between such limits as the Structural Engineer may determine, construction joints formed and the section of the work reconstructed to the satisfaction of the Structural Engineer.

1.6 TOLERANCES

Unless otherwise stated, deviations from the lines, grades and dimensions of the concrete shall not exceed the following:

1.6.1 Variation from the Plumb

- i.) In the lines and surfaces of columns, piers, walls and in arrises:

In 3.000m	6mm
In any storey or 6.000m maximum	10mm
- ii.) For exposed corner, columns, control joint groove and other conspicuous lines:

In any bay or 6.000m maximum	6mm
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1.6.2 Variations from the Level, Line or Grade indicated on the Drawing

- i.) In floors, ceilings, beam soffits and arrises:

In 3.000m	6mm
In any bay or 6.000m maximum	10mm
- ii.) For exposed lintels, cills, parapets, horizontal grooves and other conspicuous lines:

In any bay or 6.000m maximum	6mm
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These levels, lines and grades will be checked before the removal of forms.

- 1.6.3 Variation of the building lines from established position in plan and related position of columns, walls and partitions:

In any bay or 6.000m maximum	12mm
In 12.000m or more	25mm

In no case shall the building extend beyond the site.

- 1.6.4 Variation in the location of sleeves, floor openings and wall openings:

Minus	6mm
Plus	6mm

- 1.6.5 Variation in size of sleeves, floor openings and wall openings:

Minus	0mm
Plus	12mm

- 1.6.6 Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls.

Minus	6mm
Plus	12mm

1.7 FOOTINGS

- (a) Variation in dimensions in plan:

Minus	12mm
Plus	50mm

- 1.7.1 Misplacement of eccentricity 2% of the footing width in the direction of misplacement but not more than 50mm.

- 1.7.2 Reduction in thickness of not less than 5% of specified thickness

1.8 PRECAST MEMBERS

The onus is on the Contractor to study the drawings, and to advise the Supervising Officer, before construction begins, if he considers he will not be able to meet the tolerances inherent in the details shown in the drawings. In this connection, his attention is drawn to the fact that the total tolerance indicated by a detail may have to be achieved by the co-operation of several trades [eg. Precast Concrete Sub-Contractor for fixings in precast work, Metalworker for brackets and the like and Concretor for cast-in-situ fixings].

Should the Contractor wish to do so, he may submit an alternative scheme using precast members to the Supervising Officer for approval. The submission, in duplicate, should include all calculations and drawings for scrutinising by the Supervising Officer.

The Supervising Officer reserves the right, at his absolute discretion, to reject any proposed alternative he considers will not meet his requirements.

1.9 SURFACE FINISH

1.9.1 GENERAL

Surface finish and truth of line in all concrete work is required to be of a high order, attained by a high standard of formwork, placing of concrete, and composition of concrete.

1.9.2 VISIBLE SURFACES

All formed surfaces visible on completion on the works shall be free from surface blemishes, entrapped air bubbles of over 3mm diameter, and ridges and surface displacements greater than 3mm at joints.

The general appearance of these surfaces must be neat and uniform, with an approved regular, joint pattern.

Formwork shall have structural backing and taped joints.

Special care shall be taken to compact concrete very carefully at these surfaces. The Contractor shall ensure that for such surfaces he uses a mix entirely suited to the finish required.

1.10 HIDDEN SURFACES

Reasonable care must be taken with these surfaces, and the structural dimensions shall not be less than shown on the Drawings.

1.11 SURFACE BLEMISHES

Should defective areas exist, the Contractor shall at once inform the Architect and shall under NO circumstances undertake any remedial measures without the express approval of the Architect. Surface plastering or cement washing to cover up poor workmanship will not be permitted. Defective areas shall be explored as directed by the Architect to determine the exact scope, depth, and nature of the defect. The Architect reserves the right to reject any defective work back to the next construction joint and to have it removed and replaced. The Architect may, however, order remedial works to be carried out. All work repaired by the use of the new materials shall be properly cured in place, as specified.

Unformed surfaces, which include all slab surfaces to be covered by bonded concrete topping, lightweight concrete screeds or cement mortar beds, shall receive a screeded finish. The finishing operations shall consist of sufficient levelling and screeding the concrete to produce a uniform plane surface, surplus concrete being struck off by a straight edge immediately after compaction. Surface irregularities shall be within the tolerances specified.

Unformed surfaces, such as tops of walls, copings, planters and other members exposed to weathering, surfaces of beds and slabs to receive thin flexible coatings, and tile paving bedded in adhesive, shall receive a hard smooth steel-trowelled finish. Trowelling shall not commence until the moisture film has disappeared and the concrete has hardened sufficiently to prevent excess laitance from being worked to the surface. The surfaces shall be trowelled under firm pressure and left free from trowel marks.

1.12 SURFACE TYPE

Surface types shall be constructed as follows:-

Type A "Rough"

- (a) Face texture not uniform, not to pattern, rough levelled at joints.
- (b) Joints not specially treated.
- (c) All arrises finished with fillet or square only.
- (d) Stripping agent not to be oily.
- (e) After stripping only boniness patched.

Type B "Smooth suppressed joint"

- (a) Face texture uniform but not to pattern but with make up pieces of large size and accurately levelled at joints.
- (b) Joints, plastic taped or filled or fitted. Pouring breaks handled by means of a removable key.
- (c) Arrises finished with selected fillet or square.
- (d) Stripping agent to approval.
- (e) After stripping, boniness only to be treated, remainder not to need treatment.

1.13 FACE FORMS

The number of re-uses and face and edge conditions shall be consistent with the concrete surface type specified, but generally for Types B, face forms shall be subject to the Structural Engineer's Approval at each stage of forming.

1.14 CLEANING OF FORMS

All debris shall be removed from the interior of the forms before the concrete is placed and the surfaces which are to be in contact with concrete shall be cleaned and thoroughly wetted or alternatively treated with a suitable composition. Any such composition shall be approved before use by the Structural Engineer and shall be applied before the placing of the reinforcing steel.

1.15 INSPECTION OPENINGS

Temporary openings shall be provided at the bases of column and wall forms and at other points where necessary to facilitate cleaning and inspection immediately before the placing of the concrete.

1.16 STRIPPING

1.16.1 GENERAL

Forms shall not be disturbed until the concrete in contact with them has hardened sufficiently to withstand such action without damage.

1.16.2 TIMING

Unless directed otherwise by the Structural Engineer, stripping times may be determined as follows, provided the construction on it does not exceed 1 kN/m^2 .

Vertical Surface	2 days
Bottom forms of beams and slabs upto 3.0m span	7 days
3.00m to 4.500m span	12 days
4.50m to 7.500m span	14 days
Over 7.500m span	28 days

Alternatively stripping times may be based on the concrete having attained the strength designated in the following Table 'A'

1.16.3 TABLE 'A'

Element	Surface Design Span (m)	% of F'c (28 day value)			
		Proportion of Design Element at stripping			
		Load [DL + LL] on slab			
		1/4	1/2	3/4	1
Beams	1.50m and less	50	60	75	100
	3.00m and less	55	65	80	100
And	4.50m and less	55	70	85	100
	6.00m and less		80	85	100
	7.50m and less		90	85	100
Slabs	Above 7.50m		95	95	100
Height (m)					
Walls	7.50m and less				30
Beams, Slabs and Columns	3.00m and less				40
	Above 3.00m				50

1.16.4 BOTTOM FORMS

Removal of bottom forms between bearers or props prior to the removal of supports may be permitted by the Engineer, provided the formwork has been designed to allow such removal without disturbance of the supports.

1.16.5 PERMANENT LOADS

Neither walls nor any permanent loading shall be erected or any part of the structure while it is still supported by formwork.

1.17 REINFORCEMENT

1.17.1 MATERIALS

Reinforcing bars and wire shall be free from loose mill scale, loose rust, mud, oil, grease and other coating which may reduce the bond between concrete and reinforcement shall comply with the following Standards:

NZS3109: 1997 : Concrete Construction
AS/NZS 4671: 2001 : Hot Rolled Bars for Reinforcement

The Contractor shall furnish evidence of compliance when and if required.

1.18 FABRICATION

1.18.1 BENDING

Reinforcement shall be bent or straightened in the manner that will not damage it. It shall generally be bent cold except that, when approved by the Structural Engineer, it may be bent at a cherry red heat [1550 °F]. Bars bent shall not be cooled by quenching.

1.18.2 SPLICING

Where not specifically shown, length of splice shall be at least 56x bar diameter for grade 430 deformed bars. The length of splice shall be at least 40x bar diameter for grade 300 deformed bars.

1.18.3 WELDING

Reinforcement shall not be welded without the approval of the Structural Engineer.

1.18.4 TOLERANCES

Reinforcement shall be cut and bent to the following tolerances:

Cutting to length	+/- 25mm
Hooked or coggd bars (out to out)	+/- 25mm

Cranked bars:

Overall length	+/- 25mm
Overall height or depth	+/- 25mm
Stirrups and ties, spirals (out to out)	+/- 12mm

1.19 PLACING

Reinforcement shall be placed within the tolerances listed below:

Cover distance	-0mm / +10mm
Lateral spacing	- Beams & Columns +/- 10mm
	- Slab & Walls +/- 20mm

1.20 SUPPORTS

Supports for reinforcement shall take into account construction traffic. Special care shall be given to the support of reinforcement where concrete is placed against ground and to light gauge material.

Reinforcement shall be securely held in position by using spacers or stools made of metal, concrete, plastic or by metal hangers, or other approved means.

1.21 FIXING

Reinforcement shall be fixed in strict accordance with the Contract Drawings and within the tolerances specified. The Contractor shall notify the Structural Engineer at least 24 hours before the reinforcement is ready for inspection and shall allow a further two hours for such inspection and approval.

Reinforcement which does not comply with the Specification shall be rejected, or the defects shall be remedied as directed by the Structural Engineer.

1.22 COVERS

Concrete cover to reinforcement bars, unless otherwise specified shall be measured to the stirrups or reinforcement which is closest to the surface of the member and shall strictly conform to the following:-

Foundations

- Beams, Pads
 - 75mm bottom (50mm when cast against DPC)
 - 50mm top and sides
- Ground Slab
 - 30mm top

Elsewhere

- Columns and Beams
 - 40mm generally
- Suspended Slabs and Stair
 - 20mm generally

1.23 CONCRETE

1.23.1 GENERAL

Concrete shall be made with Portland Cement coarse aggregate, fine aggregate, water and any admixture that may be specified or approved.

1.23.2 MATERIALS

(a) Ordinary Portland Cement conforming to NZS 3122 shall be used.

(b) Coarse aggregate shall conform to NZS 3111 and have the following grading:

Nominal Maximum Size (mm)	% Passing each sieve by lot					
	50mm	40mm	25mm	20mm	10mm	4mm
40mm	100	95 - 100	100	35 - 70	10 - 30	0 - 5
20mm	100	100	100	90 - 100	20 - 55	0 - 10

(c) Fine aggregate shall be clean river sand conforming to NZS 3111 and have the following grading:

Standard Sieve Size		% Passing by lot
B.S.S.	A.S.T.M.	
20mm	10mm	100
4mm	4mm	95 - 100
No. 7	No. 8	75 - 90
No. 14	No. 16	50 - 80
No. 25	No. 30	25 - 55
No. 52	No. 50	10 - 28
No. 100	No. 100	2 - 8

The permissible organic content shall not exceed that which will give a darker colour than standard solution No. 3 when subjected to a colour test in accordance with NZS 3111.

(d) Water shall be potable water from the supply mains.

(e) Admixture shall not be used except with the approval of the Structural Engineer.

1.24 STORAGE OF MATERIAL

Cement shall be stored in weather-tight buildings, bins or silos which will provide protection from dampness and contamination.

Bags of cement shall be stacked and used in rotation to prevent deterioration.

Aggregate stockpiles shall be arranged and used in a manner which will prevent excessive segregation or any contamination with other materials or with other sizes of aggregates.

Sand shall be allowed to drain until it has reached a uniform moisture content before it is used.

1.25 CONCRETE QUALITY

1.25.1 GENERAL

The Contractor shall be responsible for obtaining concrete of the specified compressive strength for the various parts of the work. This strength, represented by the symbol f_c will be based on the comprehensive strength of standard cylinders 150mm diameter and 300mm axial length at the age of 28 days as specified later under "Sampling and Testing".

1.25.2 MIX PROPORTION

The proportions of aggregate and cement shall be such that when mixed with an amount of water, will produce a mix which will work readily into corners and angles of the forms and around reinforcement, without segregation or excessive free water to collect on the surface.

The resultant concrete will be sound, dense, durable and of the required strength and other properties.

1.25.3 WORKABILITY

Slump shall be the measure of workability. The slump for various parts of the work shall be as follows:

Description	Slump
Blinding concrete	60 mm
Foundation	50 mm
Columns, beams	50 mm
Slab stair	40 mm
Masonry Infill	75 mm

In all cases the permitted deviation shall be ± 12 mm.

1.25.4 CONCRETE GRADE

The grade of concrete to be used for various parts of the work shall be as follows:

Grade	Max. Agg. Size	F_c	Location
A	20 mm	25 MPa	General
B	40 mm	25 MPa	Foundation
C	20mm	25 MPa	Ground Floor Slab
D	20 mm	17 MPa	Block cavities
E	20 mm	10 MPa	Blinding

1.26 CONCRETE MIXING

1.26.1 GENERAL

Concrete to be used may be site mixed or ready mixed obtained from an approved manufacturer. In either case, relevant sections of the specification shall apply.

1.26.2 SITE MIXED CONCRETE

Weight batching procedure in accordance with NZS 3108: 1983 or similar equivalent standard specification shall apply. The Contractor shall in good time [at least 14 days] at his own expense, have prepared and tested by an approved laboratory trial mixes for approval by the Engineer before producing it for use.

1.26.3 READY MIXED CONCRETE

Ready mixed concrete shall comply with relevant sections of the specification and produced in accordance with the requirements of Section 16 and 19 of NZS 3104. Transport from the supplier's plant to the site shall be by an agitating truck. When ordering ready mixed concrete, the Contractor shall give the following information to the supplier in accordance with the requirements:

- (a) Slump specified
- (b) Maximum aggregate size
- (c) Compressive strength [F'c] specified
- (d) Quantity
- (e) Structural elements being poured
- (f) The ordered F'c and slump.

1.27 CONCRETE PLACING

1.27.1 GENERAL

The concrete shall be placed in strict accordance with requirements and within the specified tolerances. Any concrete which does not comply shall be rejected or shall be remedied as directed by the Structural Engineer.

1.27.2 INSPECTION

The Structural Engineer shall be notified 24 hours prior to the pouring of concrete so that reinforcement and formwork may be inspected.

1.27.3 TRANSPORTATION

The concrete shall be transported from the site mixing plant or the ready mixed truck to its final position by clean vehicles, skips, containers or chutes as rapidly as possible so that segregation or loss of materials does not occur.

1.27.4 SUPERVISION

Concrete shall be placed under the direct supervision of a capable foreman experienced in reinforced concrete construction.

1.27.5 NON-CONFORMING CONCRETE

Concrete with measured slump outside the specified limits or suspected to be non-conforming in any way shall not be placed.

Concrete shall not be placed at a time or under such conditions which will not permit it to attain the specified standard.

Concrete shall be placed in such a manner as to avoid segregation. For thin walls and lifts in excess of 1.200mm in height, it may be necessary to pour the concrete through enclosed chutes or access hatches. When used, the chutes should be kept as vertical as possible.

1.27.6 CONTINUITY

Concreting shall be carried out continuously between construction joints and in such a manner that a 'wet' edge is maintained.

1.27.7 CONSTRUCTION JOINTS

Where shown, construction joints shall not be eliminated or relocated without the approval of the Structural Engineer.

Where not shown, construction joints shall be located as approved by the Structural Engineer.

1.27.8 HARDENED CONCRETE

Before fresh concrete is laid against hardened concrete as construction joints, the joint surfaces of the hardened concrete shall be thoroughly roughened and cleaned to remove all loose or soft material, all foreign matter and all laitance.

Coat the joint surfaces with a layer of neat cement slurry brushed into the joint surfaces immediately before the fresh concrete is placed. The slurry layer shall not be allowed to harden before the fresh concrete is laid.

1.27.9 COMPACTION

The concrete shall be thoroughly compacted by means of mechanical vibrators and hand methods and carefully worked around the reinforcement and embedded fixtures and into all corners of the formwork, in such a way that all air or stone pockets which may cause honey-combing, pitting or places of weakness are eliminated.

The coarse aggregate shall be worked back from the form so as to bring a full surface or mortar against the form, without the formation of excessive voids.

1.27.10 SURFACE FINISH

(a) Tolerances

The surface of the concrete shall be finished as specified to the following tolerances:

Class A - True plane within 3mm in 3.000m as determined by a 3.000m straight-edge placed anywhere on the slab in any direction.

Class B - 6mm in 3.000m as above.

Class C - 6mm in 0.600m using 0.600m straight-edge as above.

Type A - Brushed, Broom or Scratched Finish

After the concrete has been placed, struck off, consolidated and levelled to a Class C tolerance, the surface shall be roughened with stiff brushes or raked before final set.

Type B - Floated Finish

After the concrete has been placed, struck off, consolidated and levelled and mix stiffened sufficiently, the surface shall be floated with wooden trowels. Trueness shall now be re-checked and adjusted for Class B tolerance and the slab re-floated to a uniform smooth, granular texture.

Type C - Trowelled Finish

The procedure shall be as for Type B finish. Trueness however, shall be checked and adjusted for Class A tolerance and the slab re-floated with steel trowels and worked to give a surface uniform in texture and appearance free of trowel marks.

(b) Surface Finish

The required surface finishes are as follows:-

Element	Finish Type	Tolerance
Stair Tread	B	3 mm
Floor Slabs	B	3 mm

1.28 SAMPLING AND TESTING

1.28.1 GENERAL

All sampling and testing shall be carried out in strict accordance with NZS 3112.

All costs for sampling and testing, including any expense arising out of re-checking or rejected concrete, shall be borne by the Contractor.

1.28.2 NUMBER OF SAMPLES

A slump test and three standard cylinders shall be made from each sample. Sampling shall be distributed evenly throughout the pour, which is defined as an operation involving the continuous placing of concrete between construction joints.

The number of samples shall be as follows:-

(a) For concrete to be placed in columns, bearing walls and footings:

Site Mixed Concrete
1 sample per 4m³

Ready Mixed Concrete
1 sample per truck

(b) For concrete to be placed in other structural elements:

Site Mixed Concrete

- Up to 4m³ - 1 sample
- Over 4m³ to 16m³ - 2 samples
- Over 16m³ to 32m³ - 3 samples
- Over 32m³ to 64m³ - 4 samples
- Each additional 32m³ - 1 sample

Ready Mixed Concrete

- 1 truck - 1 sample
- 2 - 5 trucks - 2 samples
- 6 - 10 trucks - 3 samples
- 11 - 20 trucks - 4 samples
- Each additional 10 trucks - 1 sample

The number of samples, etc. specified shall be regarded as the minimum required. The Contractor shall allow for additional sampling where the source of supply or the specified quality changes during the pour.

1.28.3 TREATMENT OF CYLINDERS

1.28.3.1 IDENTIFICATION

Each cylinder shall be properly identified as to Job Site; date and time; sample taken; concrete supplier; delivery docket or batch number; method used; location of sample; cylinder number; location of concrete placed and slump.

1.28.3.2 RESTING PERIODS

For the 24 hours after moulding, the moulds shall be kept undisturbed on a rigid and approximately horizontal surface. At the end of the 24 hour period, the cylinders shall be removed from the mould, wrapped in three layers of wet newspaper, placed in the plastic bag which shall be air-sealed by a rubber band and placed in a protective cardboard carton. The cylinders shall be so kept for a further 48 hours and then transported to the testing laboratory as soon as possible and in the manner to avoid excessive jarring and movement.

1.28.4 TEST RESULTS

The laboratory's endorsed Test Certificate or a true copy shall be forwarded to the Engineer immediately after it is received by the Contractor.

The results of the tests shall be kept in a tabulated form in a suitable book kept on the Site by the Clerk of Works.

1.28.5 ACCEPTANCE

The concrete represented by the sample shall be deemed to comply with the specified compressive strength requirements when the test strength of the sample is greater than F'c. The test strength of each sample shall be the average of the strength of the test cylinders.

Where the strength of one cylinder differs from the overall average by greater than 10%, it shall be disregarded and the test strength shall be the average of the strength of the remaining two.

Where the individual strength of any two cylinders differ more than 10% from the overall average, the Structural Engineer may require the concrete represented by the sample to be re-checked for strength.

1.28.6 REJECTION

Hardened concrete shall be liable to rejection at the site if:

- (a) It is porous, segregated or honeycombed;
- (b) A construction joint has been made at a location and in a manner not in accordance with the specification;
- (c) If the reinforcing steel has been disturbed;
- (d) The construction tolerances have not been met;
- (e) The surface finish required has not been achieved;
- (f) The test strength is below f'c;

(g) The concrete does not meet other requirements of this specification.

1.29 CONCRETE CURING AND PROTECTION

1.29.1 GENERAL

The Contractor shall be fully responsible for the proper curing and protection of the concrete. Curing methods which do not conform to this Specification, shall be rejected.

Freshly laid concrete shall be protected from premature drying and excessive hot temperatures to enable the concrete to maintain a reasonable constant temperature with minimum moisture loss for the curing period.

1.29.2 INITIAL CURING

Initial curing shall commence not more than 2 hours after the finishing operation has been completed and the concrete shall be kept continuously moist at least 3 days by one of the following methods:

- (a) Ponding or continuous sprinkling of water
- (b) The use of an absorbitive cover kept continuously wet.
- (c) The use of approved curing compounds in the recommended manner.

1.29.3 FINAL CURING

Immediately following the initial curing and before the concrete has dried, additional curing shall be commenced by one of the following methods:

- (a) Continuing the initial curing method
- (b) The use of approved waterproof paper
- (c) The use of other approved moisture retaining covering.

If (b) or (c) is adopted, the covering material shall be so arranged and firmly held as to exclude air circulation at the concrete surfaces. Forms shall be kept wet.

Final curing shall continue for seven days. Rapid drying out at the end of the period shall be prevented.

1.29.4 PROTECTION

All concrete shall be protected from damage, especially during the curing period, due to over stresses, heavy shocks and excessive vibration. Finished surfaces shall be protected from damage caused by construction equipment, materials, workmen and by rain and running water.

2 STRUCTURAL STEELWORKER

2.1 GENERAL

The Preliminary and General Clauses of this Specification shall be read in conjunction with and shall form part of this section.

2.2 SCOPE

The work required under this section of the specification comprises the supply, fabrication and erection of all steelwork indicated and inferred by the drawings and includes surface treatment, storage, delivery to the site, steel to steel connection and their fastenings, miscellaneous attachments, holding down bolts, hook bolts, tie rods and hangers etc, erection, bolting, field welding, connection to anchor and holding down bolts, permanent grouting and repairs to surface treatment.

The work shall be carried out in strict accordance with the Drawings and this Specification and other relevant plans and details.

2.3 INSPECTION OF SITE

It shall be the Tenderer's responsibility to visit the site before tendering and fully inform himself of all existing conditions. Claims arising from failure to take this precaution will not be allowed.

2.4 TYPE AND GRADE OF STEEL

Unless otherwise shown on the Drawings, all steel shall comply with AS/NZS 3679.1 or AS 1163. Other types and grades of steel shall not be used without approval. The product shall be clearly and legibly identified or tagged (for bundles) as follows:

- a. The manufacturer's name or mark, or both.
- b. The grade of steel
- c. The product to be identified with AS/NZS 3679.1
- d. The product to be traced to the batch of steel from which it was made.
- e. The nominal size and shape.

Where identification is by means of die-stamping, low-stress stamps shall be used for impact tested grades.

2.5 STANDARDS GOVERNING THE WORK

Structural steelwork shall conform with the current relevant Codes, as follows:-

Steel:

AS/NZS 3679.1	Hot-rolled bars and sections
AS/NZS 3679.2	Welded I sections
AS 3678	Hot-rolled plates, floorplates and slabs
AS 1227	General requirements for supply of hot-rolled steel plates, sections, piling and bars for structural purposes [Metric Units]
NZS 3404	Steel Structures Standard
AS 1163	Structural Steel Hollow Sections
	Stainless Steel Hollow Sections (Austenitic Grade 304)

Welding:

AS/NZS 1553	Covered electrodes for welding
AS/NZS 1554	SAA Structural Steel Welding Standard

2.6 BOLTS, NUTS AND WASHERS

AS/NZS 1111	ISO Metric hexagon commercial bolts and screws
AS/NZS 1112	ISO Metric hexagon nuts, including thin nuts, slotted nuts and castle nuts.
AS/NZS 1252	High strength steel bolts with associated nuts and washers for structural engineering

Stainless Steel Bolts

Washers -

For Bolts specified above:

AS 3410 Metal washers for general engineering purposes.
 Stainless Steel Washers

Workmanship -

AS/NZS 1554 Structural Steel Welding Code.
AS 1796 Certification of Welders and Welding Supervisors
AS 2214 Structural Steel Welding Supervisors Certification Code

Surface Preparation -

AS/NZS Guide to the protection of structural steel against atmospheric corrosion by the use of protective
2312:2002 coatings
AS 1627 Preparation and pre-treatment of metal surfaces prior to protective coating.
(Pt. 1 to 9)

Galvanised Metals

With the prior agreement of the Architect, the following alternative galvanizing may be adopted:

- (a) All mild steel to be pickled [by submerging in bath].
- (b) All mild steel to be phosphated [by submerging in bath].
- (c) All welded and mild steel sections to be cold galvanized.
- (d) Prime immediately after galvanizing process - refer painter section.
- (e) Second and finishing coats to be in accordance with the painting specification.

2.7 DISCREPANCIES

Discrepancies shall be reported to the Structural Engineer and or Architect immediately they are found and an instruction obtained before continuing with the affected portion of the work.

2.8 WEIGHT OF STRUCTURAL STEEL

When the Contractor provides for variations to the Contract by supplying a rate per unit weight of structural steel, such weight shall mean net theoretical weight unless otherwise noted. This weight shall be as given in AS/NZS 3679.1 and shall exclude additional weight such as wastage, rolling margin, bolts and welding. The rate shall be considered to include any expense associated with such additional weight.

2.9 SUPPLY AND SUBSTITUTION

The Contractor shall be responsible for the ordering of all steel and the Tender shall be based on assured sources of supply and date of delivery.

Substitution of structural section shall not be made and members shall not be made of short lengths without approval.

2.10 TESTING

The contractor shall verify all dimensions and be responsible for their accuracy.

2.11 TESTING

Manufacturer's Certificate in accordance with AS/NZS 3679 shall be available for inspection.

2.12 SHOP DETAILS

The Contractor shall prepare and submit, free of charge, three copies of all shop drawings for approval and shall obtain an approved copy before commencing fabrication.

The Drawings shall show, in standard engineering drawing manner, clear and complete details of each assembly, component and connection in the work, together with all information relative to their fabrication, surface treatment and erection.

The Contractor shall verify that all members can be erected properly and, should this require variations to the Structural Engineer's Drawings, they shall be referred to the Architect.

Unless otherwise arranged, the drawings shall be submitted progressively and so as to allow the Structural Engineer at least seven clear working days for checking.

The Structural Engineer's approval will be required for member sizes, surface treatment and soundness of structural connections. Approval will not include dimensions or holes and cleats to suit other trades. Drawings not approved shall be corrected and resubmitted and approved before fabrication.

2.13 INSPECTION

All material and work is subject to inspection and the Contractor shall provide the necessary access and facilities. All steelwork is subject to final inspection in-situ.

Where steel has been inspected at the shop before being delivered to the site, such inspection does not relieve that Contractor of his responsibility to carry out the work in accordance with the Drawings and the Specification.

If, in the opinion of the Structural Engineer, the material or workmanship is defective, he may require the Contractor to carry out additional tests. If these tests show the material or workmanship to be unsatisfactory, all costs associated with testing and making good shall be borne by the Contractor. Costs of such tests shall be allowed for in the Preliminary and General Section.

2.14 WORKMANSHIP

Workmanship and finish shall be equal to the best general practice.

Where portions of the work are exposed to view and form part of the architectural treatment, special attention shall be given to the finish. Shearing, flame cutting and chipping shall be done carefully and accurately. Sharp corners and edges that are marred, cut or roughened in handling or erection shall be faired by grinding or other approved means.

Steelwork exposed to view shall have welds ground smooth.

2.15 CLEARANCES AND TOLERANCES

The end clearances shown on the Structural Engineer's Drawings shall not be exceeded; where these are not shown, the Contractor shall ascertain the clearances used in the design of the connections.

Structural members consisting primarily of a single rolled section shall, after fabrication, unless otherwise specified, conform to the appropriate tolerances allowed by AS/NZS 3679.1. Built up structural members, unless otherwise specified, shall conform to the tolerances stated in NZS3404 and AS/NZS 3679.2.

Completed members shall be free from twists, bends and open joints. Sharp kinks or bends shall be cause for rejection.

The above tolerances shall not result in a cumulative error over the whole or any part of the building.

2.16 CONNECTIONS

Where end cleats, brackets and other connections are not specifically detailed on the Structural Engineer's Drawings, they shall be of a type and proportion to suit the location and reaction shown thereon. As a minimum a 10mm thick cleat with 2-M20 8.8/S bolts or 6mm fillet weld of the connecting members shall be allowed for where not specifically detailed on the Structural Engineer's Drawings.

2.17 BOLTING

Bolts in bearing shall be of such lengths that no threaded portion shall be within the thickness of the parts joined.

At least one washer shall be placed under the bolt head or nut, whichever is to be rotated. Tapered washers shall be used where the part under the bolt head or nut is not perpendicular to the centre-line of the bolt.

Nuts or bolts subject to severe vibration and vertical bolts in tension, shall be locked in position by an approved method.

At least one and a half threads shall project beyond the nut after the latter is securely tightened.

Dimensions and tolerances of the bolt and nut shall comply with AS 1111 and AS 1112. Round holes for a bolt shall be in compliance with NZS 3404. Hand flame cutting of a bolt hole shall not be permitted except as a site rectification measure for holes in column baseplates.

High strength bolts shall be installed in lengths to exclude threads from the shear plane.

2.18 WELDING

Manual welding and semi-automatic or automatic welding shall be in accordance with AS/NZS 1554. The extent of non-destructive examination of welds shall be in accordance with table 7.4 of AS/NZS1554.1:2004.

Unless other stated welds shall be continuous generally of 6mm thickness.

A full strength weld is one which will give a resulting strength at least equal to the tensile strength of the smaller of the two parts being joined by welding.

Unless approved otherwise all butt welds shall be of the complete penetration type. Butt welds exposed to view shall be ground smooth.

2.19 MISCELLANEOUS ATTACHMENTS

The Tenderer shall allow for the drilling and cleats indicated on the Supervising Officer's Drawings and necessary to support and connect the architectural finishes.

2.20 SURFACE TREATMENT

2.20.1 GENERAL

Steelwork without surface treatment shall be free of all loose rust, loose mill scale, dirt, oil and grease.

All steel bolts, washers and nuts shall be hot dip galvanised to AS1214 to achieve 375g/m² average material protection. Brackets and cleats shall be hot dip galvanised in accordance with AS/NZS 4680 to achieve 600g/m² average material protection. Exposed brackets and cleats shall receive compatible paint coatings in addition to hot dip galvanising..

No treatment other than thorough wire brushing, removal of loose rust, loose mill scale, dirt, oil and other contaminants shall be needed for steelwork encased in concrete.

No treatment needed for stainless steel bolts and washers.

Those parts to be field welded, and contact surfaces in friction type joints, shall be kept clear of specified finish. Upon completion of welding or bolting the finish shall be applied to give complete coverage.

2.20.2 BLAST CLEANING

Abrasive blast clean to AS 1627.4 - 1997. Non metallic abrasive containing silica is acceptable. Class 2.5 "Near White" - blast cleaning standard of surface preparation shall be attained. Blast to achieve at least 50 micron angular profile. Remove abrasive residue or dust from surface and immediately apply first coat of primer/paint.

2.20.3 PRIMING

Unless otherwise specified, all steelwork shall be thoroughly wire brushed, and loose rust, loose mill scale, dirt, oil and other contaminants removed in accordance with AS 1627 and shall receive the appropriate paint system as specified in section 2.20.4. Steel surfaces shall be dry on application of paint.

2.20.4 PAINTING

Paint selection shall be in accordance with AS/NZS 2312 for the particular atmospheric corrosion category. The number of years to first maintenance as stated in clause 1.6 of AS/NZS 2312 shall be in the “Long term” range (10 to 15 years) or better. Areas of the structure inaccessible after erection shall be provided with a paint system not requiring maintenance for the service life of the structure.

The Contractor shall make a submittal on the paint systems to be used to achieve the above stated years to first maintenance using guidelines given in AS/NZS 2312. This submittal should be certified by the paint manufacturer/supplier.

2.21 MARKING

Every separate member shall be plainly and permanently marked with paint to show position and direction necessary for easy identification and correct placing.

Loose pieces for connections shall be attached to their respective members.

Bolts, where not in holes, shall be metal tagged, each type and size in a separate container.

Connections which are to be made by High Strength Bolts shall be given a 75mm wide distinctive flash of colour clear of holes for easy identification.

The extent and size of all fillet welds which are to be made in the field shall be clearly marked.

Where welds are to be made between dissimilar steels, they shall be given a distinctive flash of colour.

2.22 HANDLING DELIVERY TO SITE AND STORAGE

Steelwork shall be handled and stored by methods and appliances that will not over-stress or deform components. Members bent or buckled from handling or storing shall be liable to rejection.

Members shall be stored above the ground surface.

Bolts, nuts and washers shall be supplied in grit-free containers and stored in water-tight premises.

Burred, damaged, corroded or otherwise unserviceable bolts shall not be used.

2.23 PLANT AND EQUIPMENT

The suitability and capacity of all plant and equipment used for erection shall be to the satisfaction of the Structural Engineer.

2.24 SETTING OUT

The positioning and levelling of all steelwork and the placing of every part of the structure with accuracy shall be in accordance with the approved drawings and to the satisfaction of the Structural Engineer.

2.25 SECURITY DURING ERECTION

During erection, the work shall be securely bolted or otherwise fastened and if necessary, temporarily braced so as to make adequate provision for all erection stresses and conditions, including those due to erection equipment and its operation. Neither riveting, permanent bolting nor welding shall be done until proper alignment has been obtained.

2.26 PAINTING AFTER ERECTION (Refer also to Painting Specification)

Before painting of steel, all surfaces to be painted shall be dry and thoroughly cleaned from all loose scale and rust.

The specified protective treatment shall be completed after erection. All rivet and bolt heads and site welds after de-lagging shall be cleaned. Damaged or deteriorated paint surfaces shall first be made good with the same type of paint as the shop coat. Where specified, surfaces which will be in contact after site assembly shall receive a coat of paint [in addition to any shop priming] and shall be brought together while the paint is still wet.

Where the steel has received a metal coating in the shop, this coating shall be completed on site so as to be continuous over any welds and site rivets or bolts, but subject to the approval of the Structural Engineer, protection may be completed by painting on site. Bolts which have been hot dip galvanised or similarly treated are exempted from this requirement.

Surfaces which will be inaccessible after site assembly shall receive the full specified protective treatment before assembly.

Site painting should not be done in inclement weather or when humidity is such as to cause condensation on the surface to be painted.

3 BLOCKLAYER

3.1 GENERAL

The Preliminary and General Clauses of this Specification shall be read in conjunction and shall form part of this section.

3.2 STANDARDS

The following Standards shall form part of this Specification except as modified herein:-

NZS	3102P	:	Concrete Masonry Units
NZS	3112 Part 4	:	Methods of Test for Concrete Tests Relating to Grout
NZS	4210P	:	Masonry Buildings: Materials and Workmanship.

3.3 SCOPE

The works includes the construction of all blockwalls, complete with reinforcing bond beams, lintels, grout, openings, etc., as shown on the Drawings and specified herein.

3.4 MATERIALS

- Blocks : Steam-cured Grade "A" modular units of nominal 100mm, 150mm and 200mm thickness. Use appropriate units of shapes and sizes to suit location.
- Mortar : One part cement to three parts sand mixed thoroughly with water to give an even and easily workable consistency.
- Grout : Grade 'C' concrete.
- Plaster : One part cement to three parts washed and screened sand mixed thoroughly with water to give an even and easily workable consistency.

3.5 REINFORCING

Reinforce as detailed on Drawings. Where no specific details are shown, blockwork shall be reinforced as follows:-

<u>Horizontal</u>	<u>100</u>	<u>150</u>	<u>200</u>
(General) every 3rd course	1-D12	1-D12	1-D16
Sill	1-D12	1-D12	1-D16
Lintel upto 1200mm	1-D12	1-D12	1-D16
Top Band	1-D12	1-D12	1-D12
Vertical Jamb, corner junction	1-D12	1-D12	1-D16

Horizontal reinforcement shall be securely fixed in Bond Beam Blocks and vertical bars in block cavities. Lap bars 32x diameter where necessary or required.

3.6 GROUTING

Bond beam and block cavities containing reinforcement shall be grouted with Grade 'C' concrete in accordance with relevant provisions under "Concreting".

Ensure that cavities are free of rubbish and debris and that in the vertical direction there is present an uninterrupted shaft of 100mm x 75mm minimum dimensions in the case of 150mm and 200mm blocks and 100mm x 50mm in the case of 100mm blocks. Stop lift 25mm below course line to provide key for the subsequent pour.

3.7 PLASTERING [Where applicable]

Horizontal surfaces to be plastered shall have Type "A" finish and vertical surfaces shall have a splash coat of plaster to provide key.

Allow splash coat to harden before rendering.

Render reveals to windows and other openings to Type "B" Floated finish with Class "A" Tolerances as specified under Section "Concretor".

3.8 CUTTING OF BLOCKWORK

Note that where blocks are required to be cut they shall only be cut with a suitable masonry saw. Holes and openings in face blockwork shall be neatly cut to the required shape and size.

4 CARPENTER

4.1 GENERAL

The Preliminary and General Clauses of the Specification and those under Preservative Treatment, Grading and Moisture Content shall be read in conjunction with and shall form part of this Specification.

4.2 MATERIALS

Timber for structural purposes including plates, studs, noggings, beams, truss members, ties and purlins shall comply with the National Grading Rules for Fijian Timbers 1986 unless otherwise described.

4.3 SPECIES

Hardwoods as shown on the drawing shall be Heart Local Dense Hardwood.

All other framing timbers to be: Radiata Pine produced by Tropik Pine.

No substitution without approval.

4.4 ORDERING TIMBER

Timber orders shall be placed by the contractor at an early stage in order to ensure delivery on time.

Delays to the Contract caused by short supply due to late ordering shall not be allowed.

Jointing of timbers are allowed only where shown on drawings and in accordance with an approved detail.

Any jointing of timbers caused by unavailability of timbers in length as shown on the drawings shall be at no extra cost and at the Architect's prior approval.

4.5 MECHANICAL FASTENERS

4.5.1 GENERAL

All fasteners to be made to resist all forces in accordance with the design loading.

4.5.2 PROPRIETARY OR PATENT FASTENINGS OR FIXINGS

To be selected and installed in strict accordance with the manufacturer's written instructions.

4.5.3 FASTENERS FOR STRUCTURAL TIMBER FRAMING

As detailed in the Structural Engineers Drawings.

4.5.4 WOOD SCREWS

Steel with anti-corrosive finish or non-ferrous.

4.5.5 NAILS, SPIKES, BRADS, STAPLES

Steel with anti-corrosive finish or non-ferrous.

4.5.6 FINISH

All ferrous metals such as nails, bolts and accessories and light metal fastenings shall be electro-galvanised.

4.5.7 BOLTS

Bolts shall either be from stock and cut to exact length on site, or manufactured to the exact length. No visible bolt should project beyond the face of the nut and no metal surface should be ungalvanised. All site cut surfaces shall be painted in accordance with the relevant section of Painter.

All bolt heads and nuts which bear against the face of the timber members shall be provided with metal washers at both ends, in accordance with N.Z.S. 3603.

All bolts and nuts shall be primed before fixing with an approved anti-corrosive primer, including galvanised items. All in accordance with the relevant sections of the Painter Specification.

4.6 WORKMANSHIP

4.6.1 MANUFACTURER'S RECOMMENDATIONS

Handle, store and fix all components in accordance with their Manufacturer's written instructions.

Workmanship and details of construction not specifically stated or shown shall be of a nature that, in the opinion of the Architect, conforms to good trade practices.

4.6.2 GENERALLY

A first class finish is required on all work. It is recommended that the contractor ensures that only skilled and experienced tradesmen are engaged for this scope of the works in particular finished work that is exposed. Further, particular attention shall be observed for fixings as well as jointings of such exposed areas of work.

All framing timbers, unless otherwise specified, shall be Fiji Pine as produced by Tropik Wood Industries Ltd, Private Mail Bag, Lautoka.

Timber sizes shown are finished rough sawn sizes, and profiles. Timber sizes obtained by ripping larger size timbers shall match profiles and finish of factory supplied members from Tropik Woods.

All timber framing shall be securely fastened to resist all forces likely to be encountered during construction and during the expected life of the building in accordance with the design loading.

All proprietary or patent fasteners and fixings shall be installed in strict accordance with the manufacturers written instructions.

Nailed joints shall, as far as possible, be so fixed that the nails are loaded in shear i.e. laterally.

Nails to laps and scarfs of framing timber shall be 25mm longer than the total timber thickness and the ends clinched at right angles to the grain.

Lead holes shall be drilled for screw fixing with the lead hole diameter for the thread not greater than the core diameter, and for the shank not greater than the diameter of the shank of the screw to be used.

Slots in wood members for metal plate cleats etc., shall be 1.5mm wider than the metal.

All timber which would otherwise be in contact with blockwork concrete or plaster shall be separated by a damp proof course.

Purlins or battens shall be set out in accordance with the Structural Engineers Drawings.

Discrepancies between Engineer's drawings and Architect's drawings shall be brought to the attention of the Architect prior to commencement of the works.

The mismatch at the abutting ends of purlins or battens shall not exceed 2mm.

5 EXCAVATOR

5.1 GENERAL

The Preliminary and General Clauses of the Specification shall be read in conjunction with and shall form part of this section.

5.2 SCOPE

The scope of this Section includes the supply of all materials, equipment, plant and labor and the performance of all work necessary to execute all levelling, setting out, excavation, filling and sundry related work required for the satisfactory completion of the works. Some excavation is also covered in the Siteworks & Stormwater Drainage section of this specification.

Bulk excavation for the works has already been carried out to levels and profiles shown on Site plan. The Contractor is advised to familiarize himself with conditions existing on site and make necessary allowances for making good platform and other excavated areas which may have been covered up through silting etc.

5.3 SITE ESTABLISHMENT

Clear only the whole area to be occupied by the new buildings, and other related siteworks. Remove and stockpile topsoil separately from other material, and where directed for later use. Excess excavated material shall be carted away.

Remove from the site trees, shrubs, stumps and root systems thereto which are immediately within all trees, other than those which are nominated by the Architect for removal must be left undisturbed and protected from damage and scarring. The Contractor shall recognise that all trees on this site have an aesthetic and material value for the employer and shall ensure that, for the entire duration of the contract, remaining trees shall be protected from impact damage by vehicles, plant, etc. from malicious damage by persons on site and shall prohibit the use of trees for the support of power cables, telephone cables, lighting systems, scaffold supports, etc.

Should any of the existing trees be removed without the Architect's express written approval or a tree severely damaged or mutilated then the Contractor shall be required to replace the affected tree with a mature tree of a similar size and species to the Architect's approval.

5.4 EXISTING SERVICES

The underground services lines have already been installed as shown on the "as built" drawings

It may be necessary during the progress of the works to disconnect, seal or divert, as directed, any services encountered on the site which are not otherwise specified to receive some particular treatment. Such disconnection, sealing, or diversions shall be allowed for and carried out to the complete satisfaction of the Architect and of any authority having jurisdiction over the services involved.

5.5 SETTING OUT

The site has been set out and excavated to levels shown on the "as built" drawings. However, the Contractor shall be responsible for the accurate setting out of all the siteworks and excavations as necessary for the job.

On completion of the setting out, but prior to commencement of any excavation, the Contractor shall advise the Architect of any discrepancy that may exist between the As-Built drawings and his setting out.

The work shall be set out to confirm with the plans and to observe by-laws.

Relative levels relating to the finished ground floor level shall be set out properly and profiles left in position for inspection by the Architect or his agent and approval obtained prior to commencement of any permanent work.

The Contractor shall employ and pay all charges of a qualified registered Surveyor. Refer Preliminary Section of this specification.

The final graded surface of the earthworks shall be within a level tolerance of plus or minus 10mm from the design levels.

5.6 EXCAVATIONS

5.6.1 SCOPE

Excavate for strip footings, steeped footings, isolated pad footings, slab thickenings, service trenches, bulk regrading and other site works items and all other subgrade elements required.

Open areas have been excavated to levels shown on "as built" drawings. Final trimming and/or filling shall be done in accordance with the Architectural Drawings.

5.6.2 FOUNDATION DEPTH

Excavate for foundations, to the levels shown. The minimum depth shall be in accordance with the Structural Drawings, into solid ground and should satisfactory bearing not be found at this depth then excavation shall be carried further down until in the opinion of the Structural Engineer satisfactory ground is reached.

5.6.3 KEEPING EXCAVATIONS DRY

Excavations being prepared when rain is imminent shall have the last 25mm of the excavation left, this material being removed immediately prior to placing.

Excavations shall be dry before placing of concrete, and any areas damaged by water shall be additionally excavated and made good at the Contractor's expense. It is the Contractor's responsibility to keep the excavations free of water during the building operations. Excavations shall be kept dry and clear of water at all times by pumping, bailing, drainage or other means.

5.6.4 SERVICES TRENCH EXCAVATION

When services trenches run parallel to and below structural footings the base of the footings shall be extended if and as required to provide for adequate foundation bearing. The base of the footings shall be located at the greater of the following depths:

- i) as nominated by the Structural Engineering drawings; or
- ii) a 45 degree line from the closest and lowest point of the trench.

5.6.5 MAINTENANCE OF EXCAVATIONS

Properly timber, plank and strut, shore or sheet pile where necessary to maintain all excavation during the period necessary to keep excavation open and clear of debris and fallen material.

Remove all temporary planking, strutting, etc. when such provisions are no longer required.

5.7 HARDFILL

5.7.1 SCOPE

Return and fill in selected clean excavated material around footings and at backs of walls etc. up to original ground level or as required or as shown in layers not exceeding 200mm thick and carefully ram and consolidate with the addition of water if required or directed.

Consolidate with a vibrating roller where total depth of backfill exceeds 500mm.

Backfilling shall be done until the concrete footings etc. have been inspected and approved.

5.7.2 HARDCORE

Hardcore fill under ground floor slab, including linkways, shall be material approved by the Structural Engineers.

Under concrete ground floor slabs and paving slabs shall be laid a 150mm thick layer of approved graded crushed stone [20mm to 40mm] thoroughly rammed and consolidated and blinded with a 50mm layer of sand in readiness for the waterproof membrane where this is required.

When compacting adjacent to walls, around beams, drains or other services the Contractor shall exercise all care to avoid any displacement of structure, services or waterproofing membrane. Where necessary, the Contractor shall temporarily strut masonry walls against lateral pressures exerted during compaction.

The Contractor shall be responsible for taking such measures as may be necessary to ensure that no damage occurs and he shall promptly make good any damage to the entire satisfaction of the Structural Engineer and Architect before concreting commences.

Edges, corners and other inaccessible areas shall be carefully hand tamped.

5.8 OBSTRUCTIONS AND ARTIFACTS

Should any unforeseen obstruction other than services be encountered, the Contractor shall inform the Architect and obtain his instruction before proceeding.

Should artifacts be encountered during excavation the Contractor shall immediately cease work in the immediate vicinity of such items and notify the Architect forthwith. Afford all protection and do everything prudent to leave the items[s] undisturbed until inspected. Obtain and carry out the Architect's instructions before proceeding.

5.9 LEVELS AROUND BUILDINGS

On completion of the building operations, and unless otherwise instructed by the Architect, the distribution of stockpiled topsoil shall be coordinated with the requirements of the Landscaping Sub-Contractor.

Any surplus material shall be disturbed on the site or removed from site as directed by the Architect and at the Contractor's expense.

6 GLAZING

6.1 DESIGN WIND SPEED

The regional wind speed (V_{500}) for design of cladding and glazing shall be taken to be 65.8/s. The builder shall provide a producer statement confirming glazing, mullions, transoms and the connections between each of these and to the structure shall be capable of resisting the design wind speed.

6.2 IMPACT RESISTANCE

The windows, doors and cladding shall be shown to be capable of resisting impact loading equivalent to a 4kg piece of timber of 100mm x50mm cross-section, projected at 15m/s at any angle. Alternatively shuttering capable of resisting the above mentioned impact shall be provided. The builder shall provide certified producer statements indicating the impact resistance of the glazing or shuttering.